

# **COMPENDIUM OF GFCS PROJECTS**

## COMPENDIUM OF GFCS PROJECTS

### Introduction

The Global Framework for Climate Services was established to enable communities across the globe to meet the challenge of vulnerability to climate hazards. The poorest countries are especially at risk from climate variability and climate change as they have the least capacities to cope.

There have been major advances in our understanding of climate, its variations and related impacts. The quality, coverage and accessibility of climate-related data and the research, modelling and prediction of climate and its impacts are all steadily improving. However much more needs to be done, particularly to take account of and meet the needs of users and to develop services to meet those needs. The situation varies widely across the globe – some countries have access to well-developed services while others have very little or even none. In some cases information is available but is not known to or accessed by users. Developing countries are particularly likely to suffer from shortcomings in capacity and their needs should be given a higher priority.

The central concept of the Global Framework for Climate Services is that it draws together all of the components necessary to ensure that climate information is produced and disseminated effectively and in a manner that lends itself more easily to practical action. This will lead to effective climate services that will enable user communities make climate-smart decisions that will reduce the impact of climate-related disasters, improve food security and health outcomes, and enhance water resource management, for example.

The Goals of the Framework are:

- (1) Reducing the vulnerability of society to climate-related hazards through better provision of climate information;
- (2) Advancing the key global development goals through better provision of climate information;
- (3) Mainstreaming the use of climate information in decision-making;
- (4) Strengthening the engagement of providers and users of climate services;
- (5) Maximizing the utility of existing climate service infrastructure.

It is clear that these goals are aligned well with the objectives of governments, UN agencies, and humanitarian organizations in that they seek to improve the safety and well-being of people by effective and sustainable action.

The development of the GFCS Implementation Plan has involved extensive consultation to ensure that the GFCS addresses current gaps and needs identified across the pillars and initial priority areas by stakeholders. Since the endorsement of the Draft Implementation Plan for the Global Framework for Climate Services by the Extraordinary Session of the World Meteorological Congress (Cg-Ext.(2012)) in October 2012, further consultation has taken place under the guidance of the GFCS Project Oversight Board and the involvement of several UN Agencies and other organizations. This process has led to the development of this initial Compendium of projects to help realize the goals of the Framework, building upon the further development of the Annexes to the Implementation Plan and of the Exemplars for the four initial priority sectors.

The projects contained in this initial Compendium are designed to give impetus to the Framework and to make a real difference to people on the ground by contributing directly to the achievement of the Framework goals. They encompass all five pillars of the Framework and include projects targeted at the four priority sectors of Agriculture and Food Security, Disaster Risk Reduction, Health and Water. For the most part, the initial projects focus on a two year horizon. Many of the

projects address the requirements to have a more systematic and coordinated system underpinned by communication between those involved in the development and provision of climate services and the users and potential beneficiaries of services, and to build capacity and remove gaps across all segments of climate services. In this way, a firm foundation will be laid for further success for the Framework and credibility will be built among users and governments.

The projects listed in this document, whilst not an exhaustive list of GFCS-related projects, present a major opportunity for investments to be made donors to invest in a coordinated, sustainable and replicable process that addresses one of the huge challenges facing global society by placing the emphasis on the user while applying the best scientific advances. They represent critical contributions that complement each other for the achievement of the overall goals of the Framework.

The structure of the Compendium is such that those projects which target the four priority sectors and user requirements in general are presented first. There follows a set of projects which contribute in many ways (through capacity development, research, observations, or climate information systems) to improving the quality, usefulness or availability of climate services.

The benefit of implementing the projects and activities contained in the Compendium is the firm foundation that will be laid enabling further success or gains to be made with additional activities under the Framework. This will bring real benefits to users who will have access to tailored climate information and services to support their decision-making processes.

## 1. Projects in the initial priority areas

These user-driven projects were developed based on the Exemplars of the initial four priority areas directly from the priority area Exemplars developed in consultation with relevant agencies, or were identified within other pillar Annexes that correspond to the pillars of the Framework as projects that could make a direct contribution to the priority areas.

### A. Agriculture and Food Security

**Project title: 1** - Improve agricultural performance through the World AgroMeteorological Information Service (WAMIS-DSS) by working to make agrometeorological products available to the global agricultural community.

**Goal:** Mainstreaming the use of climate information in decision-making

**Pillar:** UIP – Agriculture and Food Security sector

**Submitting Agency:** WMO

**Partners:** FAO, WFP

#### **Scope:**

The World AgroMeteorological Information Service Decision Support System (WAMIS-DSS) will offer a full suite of decision-support tools and resources to strengthen integrated and participatory early warning systems for sustainable agriculture and food security. The project will build on the current WAMIS activity which has the goal to make agrometeorological products issued by WMO members available to the global agricultural community on a near real-time basis. The WAMIS server hosts agrometeorological bulletins and advisories issued by WMO Members, aiding user evaluation of various bulletins and sharing insight into improving their own bulletins. Over 50 countries and institutions participate in this service. The current WAMIS servers are being coordinated and administered by WMO with the assistance of Italian Institute of Biometeorology (IBIMET) and the National Center for Agrometeorology (NCAM) in the Republic of Korea. The current WAMIS also host a tools and resources section, which includes data, information, dissemination, and feedback. These links include software, web portals, training resources, and tutorials.

#### **Objectives:**

The objectives will be to harness the power of Information Communication Technologies (ICT) to improve agricultural performance and to empower small holders to increase their productivity by facilitating the flow of accurate, timely and cost-effective information from agrometeorological and climate service providers to the user communities.

#### **Activities:**

The UIP will help establish effective communication between climate scientists, climate and agricultural researchers, agricultural extension services and the decision-making community, to ensure that application science meets operational needs of the user communities. The UIP will also promote development of information channels with the farming community (including farmer associations, NGOs, village leaders etc.) to help training and capacity development.

A comprehensive profile will provide an understanding of the different types of users. The profile will place emphasis on the quantitative understanding of the climate risks in which the users

operate, the nature of climate risk management strategies they currently use (if any), their access to inputs, and information on the nature of climate products and forecast information they need for management decisions. This comprehensive understanding will assist in categorizing the users into different groups based on their vulnerability to impacts of climate events, develop suitable climate products targeted to those who are in a position to benefit from them and decide on the best feedback mechanisms to be put in place to evaluate the products provided to them. An essential element in this process is user feedback from the beginning of this collaborative partnership at all levels.

WAMIS Application Servers, located in the selected African countries, such as Kenya and South Africa, for example, will serve as pilot projects in this study. These regional servers would link to the updated WAMIS-DSS servers in the United States, Italy and Republic of Korea that would offer a full-suite of demand-driven DSS tools to the WAMIS-DSS Application Servers. This proposed project builds on the successful operation of the current WAMIS servers across several institutions for almost 10 years. The new project will also involve the George Mason University (GMU) in the eastern United States.

Based on a needs assessment, deliverables from the WAMIS suite of services would be made available in a timely and user-friendly format in an ICT mode (radio, mobile phone) for appropriate decision-making. Promote train-the-trainer sessions following the first two pilot projects to expand the use of the pilot project activity in additional countries for greater operational use.

**Benefits:** Agricultural performance will be improved and small holders will be empowered to increase their productivity by facilitating the flow of accurate, timely and cost-effective information from agrometeorological and climate service providers to the user communities.

**Deliverables/Outcomes:**

WAMIS-DSS will be a demand-driven interactive computing platform that can access a library of resources to support a community-based agro-weather management and decision-support system. This system will deliver real-time agrometeorological advisory products and information to farmers, extension services and policy-makers by way of ICT as well as decision-support system (DSS) services to local and national decision-makers. Deliverables will include a suite of daily farm management decisions derived from such products as Agro-Climate from the Southeast Climate Consortium (SECC), based on local weather and climate data; or long-term planning indicators based on seasonal outlooks and climate forecasts. Output can be used for policy recommendations on crop yield projections and can alter crop risk management decisions.

**Indicators and assessment measures:**

The service will be driven by the needs of the user community; products are tailored for local use, and resources are based on collaboration and consultation with partners and stakeholders. Extension services are often the bridge between the scientific community and the agricultural users, and WAMIS-DSS can serve a vital role in strengthening this bridge. Farmers and agriculturalists need quality information and technical advice, and WAMIS-DSS offers a DSS computing platform for key decision-making. First, a needs-assessment workshop will be conducted in selected pilot project locations with all available stakeholders. On-going collaboration with stakeholders will be essential throughout the project implementation for feedback and verification. Online training modules will also be set up on the WAMIS.

**Risks:**

Critical to the project is stakeholder engagement throughout the process from initial planning to

operational implementation, and steps for capacity development.  
Collaboration between ministries, agencies and institutions involved with data, services, DSS resources, and capacity building activities is essential.

**Timeline:** 3 years

**Resource requirements:**

Year 1: (two proposed countries) - Application Servers (2): Hardware @ CHF 15,000 = CHF 30,000

WAMIS DSS Development (WMO:GMU/IBIMET/NCAM): CHF 75,000

ICT Development: CHF 50,000

Training & Capacity Building (Workshops/Seminars): CHF 75,000

Year 1 Total CHF 215,000

Total Costs: CHF 645,000

**Project title: 2** - Improving communications between the climate and agriculture and food security communities

**Goal:** Strengthening the engagement of providers and users of climate services

**Pillar:** UIP – Agriculture and Food Security sector

**Submitting Agency:** WMO

**Partners:** FAO, WFP

**Scope:**

Communication is a vital area of work necessary to maximize the uptake, translation, and partnerships for agriculture and available climate services. The Agriculture and Food Security priority actions for communications outline actions to support the agriculture and climate partners to communicate climate risks to agriculture, raise awareness of the availability and benefits of climate services, attain buy-in from agriculture users, advocate for partnership and sponsorship, and build trust amongst communities of practice. Investment in communication is essential to create demand for climate services from within the agriculture sector, and motivate engagement in dialogue. The Agriculture and Food Security activities will try to establish a four-way communication between climate scientists, climate and agricultural researchers, agricultural extension services and the decision-making community, to ensure that applied research is refined and expanded to meet community needs. The Agriculture and Food Security activities will develop information channels that the farming community (including farmer associations, NGOs, village leaders etc.) can easily understand and grow to trust.

To facilitate dialogue across disciplines to understand information requirements of the different users and to develop effective climate service applications, the User Interface Programme needs to facilitate an effective flow of information from weather and climate service providers to decision-makers in a timely manner for appropriate use. It will differentiate between the different types of decision-makers; recognizing that the needs and abilities vary amongst the farming community, research community, governmental bodies, private industry, and international agencies.

**Objectives:**

1. To support the agriculture and climate partners to increase participation and demand by communicating: climate risks to agriculture and food security, the availability and benefits of climate services for agriculture policy, planning and operations.
2. To build, maintain, and facilitate an active community of practice, and network of partners and experts supporting and implementing climate and agriculture activities.
3. To facilitate and support dialog and partnerships between agriculture and climate partners, which can build trust and success between disciplines.

**Activities:**

A comprehensive profile will be developed to provide an understanding of these different types of users. The profile will place emphasis on the quantitative understanding of the climate risks in which the users operate, the nature of climate risk management strategies they currently use (if any), their access to inputs, and information on the nature of climate products and forecast information they need for management decisions.

This comprehensive understanding will assist in categorizing the users into different groups based on their vulnerability to impacts of climate events, develop suitable climate products targeted to those who are in a position to benefit from them and decide on the best feedback mechanisms to be put in place to evaluate the products provided to them. An essential element in this process is user feedback from the beginning of this collaborative partnership at all levels

**Benefits:**

Communities and farmer organizations will benefit from knowledge obtained by using Information and Communication Technology; tools for communication will be extended by improving web-based storage of agricultural information and by increasing connectivity in rural communities.

**Deliverables/Outcomes:**

Collaborative partnerships between WMO, FAO, NGOs and other partner agencies, policy makers and NMHSs established and functional systems for disseminating information and evaluating the benefits; organization of roving seminars and farmer field days. The initial target region will be West Africa, with expansion to other African regions.

**Timeline: 6 years**

**Resource requirements:**

First three years: CHF 1.2M

Following three years: CHF 1.6M

**Project title: 3** - Climate services to enhance food security and resilience: Strengthening regional and national early warning systems for food security

**Goal:** Reducing the vulnerability of society to climate-related hazards through better provision of climate information

**Pillar:** UIP – Agriculture and Food Security sector

**Submitting Agency:** United Nations World Food Programme (WFP)

**Partners:** National governments, National Hydrometeorological Services, regional institutions, and other partners

**Scope:**

Through this project, WFP will work closely with partners to develop climate services through early warning systems at the national level in Ethiopia, and at the regional level in up to two regions. The experience gained in these activities will benefit similar initiatives in other regions.

*National food security early warning system - Ethiopia*

The Government of Ethiopia's Livelihoods, Early Assessment and Protection (LEAP) food security early warning system currently integrates long-term historical data and current climate trends to trigger a USD 200 million contingent finance scheme that allows the Government to scale up operations for the Productive Safety Nets Programme (PSNP).

*Regional food security early warning systems*

Evidence shows that climate-induced food security crises do not affect countries in isolation, but entire regions. Recognizing this challenge, the project will integrate a climate service component into up to two regional food security early warning systems. Tentative regions include East Africa.

**Objectives:**

The overall aim of the proposed programme is to improve the provision of climate services to help build resilience and enhance the food security of the most vulnerable households.

This aim will be achieved through the following objectives:

- ✓ Deliver and scale-up operational climate services in the food security sector;
- ✓ Develop capacity at community, national and international levels to implement and scale-up climate services for food security;
- ✓ Develop new tools and models for improved climate services;
- ✓ Strengthen the knowledge base on the effect of climate change on nutrition security and malnutrition and identification of adaptation needs linked to these effects;
- ✓ Develop mechanisms to provide climate services to selected communities for enhanced planning and decision making on resilience building efforts.

**Activities:**

*National food security early warning system*

LEAP brings the Ministry of Agriculture, National Meteorological Agency (NMA) and other key government stakeholders together in an operational climate service for food security. This

project will increase focus on long term capacity building for government partners, including further expanding the government's capacity for early warning, seasonal monitoring, and contingency planning for drought and other food crises.

The Government has identified a need to integrate seasonal-to-decadal climate information into LEAP. This project will support this process.

The project will also include a component to evaluate the cost-effectiveness of integrated climate services in the context of LEAP, and use this information to provide lessons for improved climate services.

Finally, this project will support pilot efforts to link the LEAP platform to the development of climate services for pastoral populations and the development of micro-insurance tools, further strengthening the user interface platform for food security climate services in the country.

*Regional food security early warning systems*

The project will focus on identifying the types of climate information that can help anticipate climate-induced food security crises at the regional level. This will be done with regional food security early warning platforms, such as the Regional Food and Nutrition Security Working Group in the Horn of Africa.

This activity will recommend types of climate services that could support and enhance delivery of climate information to decision-makers. Based on this information, the project will provide information to design innovative climate services to support the most food insecure people.

**Benefits:** Resilience will be enhanced as well as the food security of the most vulnerable households.

**Deliverables/Outcomes:** Operational climate services in the food security sector; and capacity built at community, national and international levels to implement and scale-up climate services for food security.

**Timeline:** 3 years

**Resource requirements:** CHF 720,000

**Project title: 4** - Climate services to enhance food security and resilience: Operationalizing climate services through the R4 Rural Resilience Initiative

**Goal:** Reducing the vulnerability of society to climate-related hazards through better provision of climate information;

**Pillar:** UIP – Agriculture and Food Security sector

**Submitting Agency:** United Nations World Food Programme (WFP)

**Partners:** Oxfam America, Swiss Re, and other partners

**Scope:**

The R4 Rural Resilience Initiative (R4) is a global strategic partnership between the United Nations World Food Programme, Oxfam America and Swiss Re which provides an innovative model for building climate resilience, using government safety nets to expand access to insurance and risk management services. R4 enables the most vulnerable people to purchase insurances with their own labour on projects that reduce climate risks, while relatively better-off farmers are able to purchase insurance in cash. This large-scale pilot aims to assist over 500,000 people in 4 countries by 2016. In Ethiopia, R4 reached a major milestone in 2012 when nearly 12,000 drought-affected households received an insurance payout of over US\$ 320,000. This insurance pay-out helped households absorb the shock, repay loans, and invest in agricultural inputs for the next season.

Overall R4 represents one of the largest scale efforts to help expand weather insurance to food insecure households globally. As a next step, R4 aims to operationalize climate services, to enhance food security and support the most vulnerable communities.

**Objectives:**

The overall aim of the proposed programme is to improve the provision of climate services to help build resilience and enhance the food security of the most vulnerable households in R4 pilot countries: Ethiopia, Senegal, and two other countries to be selected by 2015. The experience gained can be applied to other countries and regions.

This aim will be achieved through the following objectives:

- ✓ Deliver operational and innovative climate services in the food security sector;
- ✓ Develop capacity at community, national and international levels to implement and scale-up climate services for food security;
- ✓ Develop new tools and models for improved climate services;
- ✓ Strengthen the knowledge base on the effect of climate change on nutrition security and malnutrition and identification of adaptation needs linked to these affects;
- ✓ Develop mechanisms to provide climate services to selected communities for enhanced planning and decision making on resilience building efforts.

**Activities:**

As part of the R4 Rural Resilience Initiative, the proposed activities would develop user-oriented climate services to enhance climate change adaptation efforts and food security outcomes in

countries where R4 is being implemented (Ethiopia, Senegal, and two other countries to be selected by 2015). Such climate services may include, among others, project design, community planning, insurance design and capacity development.

*Planning and targeting.* Targeting in R4 projects is done through a robust analysis of food security, vulnerability and climate trends at the national, sub-national, and local levels. Working with National Hydrometeorological Services and other partners, this project will identify the types of climate services needed to enhance risk assessments and develop better climate risk management tools. *Key target audience: National Hydrometeorological Services, national partners, project management team (climate risk managers)*

*Local community planning.* A key element of R4 is rigorous local and community planning. Building on seasonal livelihood analysis and in close collaboration with national hydrometeorological agencies and other partners, this project will identify and develop the types of climate services required by communities. *Key target audience: Smallholder farmers and R4 project beneficiaries, hydrometeorological services*

*Insurance design.* Insurance as a transfer modality to support vulnerable communities is one of the key programme innovations being piloted under the R4 Rural Resilience Initiative. Different insurance mechanisms, including weather-based index insurance, will be designed and tested in R4 pilot countries. Working with insurers and reinsurers, national hydrometeorological agencies, research bodies, and international organizations, this project will identify and develop climate services to improve insurance design. This component of the project will also identify opportunities for directly linking the scale-up of micro-insurance tools for smallholders with the development and scale up of climate services. For example, in Senegal, R4 is working with the national hydrometeorological agency (ANACIM) to develop the climate and weather data required to operate weather index insurance programmes, including expanding the weather data infrastructure to food insecure areas that are poorly served. *Key target audience: Project management team (climate risk managers, insurance advisors), project implementation team, hydrometeorological services.*

*Capacity development.* The project will include a capacity development component to engage targeted communities and national governments in the development of climate services. (1) Communities will be involved in the design of climate services and will be trained to better interpret climate information and better prepare for climate risk. (2) The project will also support governments and will develop their capacity to identify options and implement country-driven risk management strategies that can support national development process such as the National Adaptation Plans. *Key target audience: Smallholder farmers, R4 project beneficiaries, government agencies, project management team (climate risk managers).*

**Benefits:** Resilience will be enhanced as well as the food security of the most vulnerable households.

**Deliverables/Outcomes:** Operational climate services in the food security sector; and capacity built at community, national and international levels to implement and scale-up climate services for food security.

**Timeline:** 2 years

**Resource requirements:** CHF 980,000

**Project title: 5** - Climate services to enhance food security and resilience: Strengthening context analysis on food security, nutrition and climate change

**Goal:** Reducing the vulnerability of society to climate-related hazards through better provision of climate information

**Pillar:** UIP – Agriculture and Food Security sector

**Submitting Agency:** United Nations World Food Programme (WFP)

**Partners:** National government agencies, communities, and other partners

**Scope:**

This project aims to support the global understanding of ways in which climate risks and climate change affect the determinants of nutrition security in different contexts. This project will also strengthen contextual analysis of nutrition security and climate change by examining pathways between health and climate change and between food security and climate change, and to further understand the extent to which these pathways may impact nutritional outcomes in different contexts.

**Objectives:**

The overall aim of the proposed programme is to improve the provision of climate services to help build resilience and enhance the food security of the most vulnerable households.

This aim will be achieved through the following objectives:

- ✓ Deliver and scale-up operational climate services in the food security sector;
- ✓ Develop capacity at community, national and international levels to implement and scale-up climate services for food security;
- ✓ Develop new tools and models for improved climate services;
- ✓ Strengthen the knowledge base on the effect of climate change on nutrition security and malnutrition and identification of adaptation needs linked to these affects;
- ✓ Develop cross-sector climate services that link food security, nutrition and health sectors;
- ✓ Develop mechanisms to provide climate services to selected communities for enhanced planning and decision making on resilience building efforts.

**Activities:**

This project will link climate services to food insecure communities following a twin track approach:

1. Using climate trend data and related information in community-based participatory planning work enhances decision-making at the community level to select resilience building interventions, particularly of women and vulnerable groups. Specific climate-related information informs the identification and selection of nutrition-sensitive programmes that further strengthen resilience building interventions supported by WFP food and nutrition assistance. WFP will work with local hydrometrological agencies and other partners to develop the climate information required for local level planning, and to

identify potential climate services that could be delivered to local communities to improve their food security and resilience.

2. The aggregation of climate-informed and nutrition sensitive community-based plans into district (or other) level plans will indicate which interventions would need to be taken to scale. This offers the opportunity to converge interventions of WFP and partners into mutually-reinforcing and complementary programmatic efforts to further increase resilience outcomes for communities and vulnerable groups.
3. Finally, WFP will formulate and incorporate nutrition-sensitive aspects into the existing methodological approach for community-based participatory planning and pilot this approach in a selected country or countries (e.g. Kenya or Zimbabwe). The community based planning approach will include nutrition-sensitive aspects aimed at: (i) sensitizing community members, and women in particular, on the nexus between climate risks, environmental degradation and malnutrition; and (ii) to support the selection of resilience building interventions that positively impact on nutrition as well as adaptation to climate risks.

WFP will build upon its relationship with local partners, communities and specific government institutions to build capacities and strengthen community and district-level planning that incorporates climate information and its relevance regarding programme activity areas such as nutrition, livelihood assets creation and preparedness work.

The tools developed under this activity will be mainstreamed into WFP's overall programme and planning guidance for Food Assistance for Assets (FFA) programmes, which reach 20 million people or more a year. Tools developed and lessons learned will also be made into available guidance to support partner efforts to mitigate the impacts of climate risk and change on the nutritional status of vulnerable groups.

**Benefits:** Resilience will be enhanced as well as the food security of the most vulnerable households.

**Deliverables/Outcomes:** Operational climate services in the food security sector; and capacity built at community, national and international levels to implement and scale-up climate services for food security.

**Timeline:** 3 years

**Resource requirements:** CHF 1,400,000

**Project title: 6** - Develop GFCS climate, food security and agriculture research strategy and set targets and priorities to support research at regional and national levels

**Goal:** Strengthening the engagement of providers and users of climate services

**Pillar:** Research, Modelling and Prediction; UIP

**Submitting Agency:** WMO

**Partners:** FAO, WFP, stakeholders in the sector

**Scope:**

The food dimension of life support is extremely complex and diverse. Agriculture requires data on processes and phenomena affecting plant growth (zone and season), health, and processes that affect them, such as erosion, soil and water quality, pests, conditions of harvest collection and storage, and ultimately processing and dissemination of food products that affect human health and security. Livestock is highly dependent on grazing conditions. Forestry is most vulnerable to fires and pests. Fisheries and aquaculture critically depend on a range of oceanographic, biogeochemical, and ecological conditions in the coastal zone, and, as an example, in the long run they may be interested in knowing how coastal upwelling systems will be affected by the climate change. All sectors of food production and distribution are vulnerable to storms and have well defined real-time weather prediction requirements. In terms of climate information, very significant value resides in combined long-term predictions of temperature and precipitation anomalies, and particularly of their extremes such as droughts. Corresponding requirements for climate information differ for regions, sub-regions, and nations.

**Objectives:**

Develop GFCS climate, food security and agriculture research strategy and set targets and priorities to support research at regional and national levels. Develop virtual forum on climate and food research

**Activities:**

At the initial phase of the GFCS implementation a detailed research agenda will be developed to guide global and national efforts in agricultural and food security research. Research activities will be aimed at improving the understanding of the impacts of climate change and extremes such as droughts on agriculture and food systems, developing capacity to assess the risks from climate change for agriculture and to implement effective response measures, promoting research in sustainable agriculture and a secure food supply in a changing climate, formulating climate information requirements to support climate and agriculture research in favour of agriculture-policy making, planning and operations, and building the economic and political case for the application of climate services to protect agriculture from climate-related risks.

**Benefits:** Research at regional and national levels will be supported.

**Deliverables/Outcomes:**

- Strategy as a document.

- Improved frameworks, communication and partnerships.
- Web-portal.
- Translation of strategic recommendations into regional and national research and development plans.
- Proposals on research Capacity Development.
- Active posts and exchange of views on the portal.
- Level of engagement with countries.
- Website monitoring.

**Indicators and assessment measures:**

**Inputs:**

Inputs will be required from FAO, Consultative Group on International Agricultural Research (CGIAR), WFP, WCRP, PROVIA, and from regional stakeholders

**Risks:**

Complexity of the task; inadequate knowledge of partner communities, divided interests between communities

**Timeline:** 2 years

**Resource requirements:** CHF 250,000

**Project title:** 7- Establish a coordination mechanism for collection, management, and exchange of climate and related food security data

**Goal:** Strengthening the engagement of providers and users of climate services

**Pillar:** Observations and Monitoring; UIP

**Submitting Agency:** FAO, CFS

**Partners:** World Meteorological Organization

**Scope:**

This project aims to engage the climate community and the agriculture and food security sector in coordinated efforts to address needs for climate and related food security data, consistent with the High Level recommendation to the Committee on World Food Security and Nutrition to “facilitate a dialogue on improved global data collection efforts for climate change and food security”. As indicated in the Exemplar on Food Security, effective delivery of climate services critically depends on the two communities working together and learning from each other.

**Objectives:**

Achieve enhanced, better coordinated collection and international exchange of climate and food security data and derived products, maximizing all possible synergies through the adoption of agreed data and metadata standards and improved data analysis and exchange capacities.

**Activities:**

**Benefits:**

This implementation activity addresses an identified need. It is responsive to GFCS Principles 1, 4, 6, and 8.

**Deliverables/Outcomes:**

High quality observations of the climate system, related socio-economic data and derived products are collected and exchanged, enabling the agriculture/food security sector to plan for and adapt to climatic variations, climatic extremes, and changes in climate.

**Indicators and assessment measures:**

**Inputs:**

Sustained high-level engagement and commitment by the climate and agriculture and food security communities to addressing the challenges associated with improving coordination between the sectors; Provision of adequate resources and expertise to develop and authority to implement an effective coordination mechanism.

**Risks:**

<b>Timeline:</b> 2 years
<b>Resource requirements:</b> CHF 100,000

B. Disaster Risk Reduction

**Project title: 8 - Climate Services for Disaster Risk Reduction (DRR)**

**Goal:** Reducing the vulnerability of society to climate-related hazards through better provision of climate information

**Pillars:** Climate Services Information System (CSIS); Research Modelling and Prediction (RMP); Observations and Monitoring (OBS); UIP; Capacity Development

**Submitting Agency:** WMO

**Partners:** IFRC, UNDP, UNISDR and WMO

**Scope:**

The Implementation Plan of the Global Framework for Climate Services (GFCS) is an ambitious attempt to significantly enhance the availability and use of tailored climate information and services to improve sustainable development and humanitarian outcomes in climate-sensitive contexts. It seeks to channel the vast amount of existing (and needed) climate-related expertise, data and information, in more relevant and useable form, into decision-making processes, starting within its four priority areas of disaster risk reduction (DRR), health, water, and agriculture and food security.

Implementing GFCS entails promoting more systematic and productive interaction between climate-service providers, and those engaged in various aspects of climate risk and impacts management, particularly at community and national levels.

As the vast majority of disasters involve extreme weather and climate-related events, there is a high level of demand for GFCS outputs in the priority area of DRR. Indeed, successful DRR depends on information about hazards and their impacts as a basis for measures to reduce societal exposure and vulnerability.

This project will provide an initial vehicle for GFCS engagement by countries and communities, committed to reducing disaster risk, that are seeking climate products and services to assist them. At the same time, it will serve as a means through which GFCS Project Oversight Board (POB) member organizations, key international organizations that are centrally involved in supporting high-risk countries to better manage disaster risks globally, can bring together the powerful networks and joint strengths of their institutions to help countries and communities access and use climate information. Regional and national activities emerging from this project will be closely coordinated and leveraged with existing and pipeline World Bank, Global Facility for Disaster Reduction and Recovery (GFDRR) and other multilateral bank investments, to maximize impact and mainstreaming into development, and to help ensure sustainability. This project also will provide links into DRR contexts and decision-making processes for other GFCS stakeholders focused on implementation of the GFCS Pillars. It will facilitate interaction among all these stakeholders to:

- Generate key outputs – better, timely, comprehensive and user-oriented climate information – in specific areas of DRR, as described in detail in the DRR Exemplar of the GFCS Implementation Plan.
- Apply these outputs to improve the management of climate-related risks in a set of high-risk contexts.

The project includes an outreach component (objective 3, below) which is specifically intended to promote widespread stakeholder engagement at all levels amongst relevant constituencies.

This project will work through existing national, regional and international DRR coordination and support mechanisms described in the Implementation Plan DRR Exemplar. At a country level, the project will build upon ongoing country DRR programmes and initiatives, as well as the leadership of the ministries and or multi-ministerial mechanisms responsible for coordinating the implementation of the national DRR programme and the National Meteorological and Hydrological Services (NMHS), with participation by other relevant stakeholders. Supporting partners will include other relevant UN agencies' country teams, National Red Cross and Red Crescent Societies, and the UN Resident Coordinator/Country Team and Humanitarian Coordinator/Country Teams. The regional representation and programmes of participating organizations, and their global technical assistance programmes, will be drawn on for additional support. The GFCS Secretariat and governance mechanisms will provide mechanisms for engaging stakeholders involved in establishing the GFCS Pillars, and for linking with the implementation of other Exemplars when required.

**Objectives:**

1. High climate-risk countries receive enhanced disaster risk reduction support through improved climate information and services.

This objective will prioritize countries that have evidenced a strong demand for disaster risk reduction by committing resources to DRR programmes; with a regional climate centre or a similar proximate source of support; and where national efforts are supported by a convergence of international and other regional initiatives (such as the Association of Southeast Asian Nations, or ASEAN). Two categories of countries will be considered to demonstrate ways in which climate-related capacities can be developed and applied to DRR decision-making:

- a. *Countries with existing resource and programme commitments to DRR, and some institutional capacities in place:* Activities in this category focus on high-risk contexts in which stakeholders are seeking to put in place comprehensive, multi-stakeholder support of a scale sufficient to achieve substantial reductions in disaster losses. The project will work through country-level institutional mechanisms in cooperation with the NMHS and the regional climate centre(s), supported by international/regional coordination mechanisms (such as Global Producing Centres) associated with CSIS as appropriate, to: exchange relevant data, identify needs, and develop and integrate climate information and services into decision-support mechanisms at the national level, to support DRR activities.
- b. *Countries with fragile or non-existing institutional capacities that can significantly benefit from climate information:* Under this category, national user interfaces for climate services will be defined through work with governments, building on the existing coordination and institutional frameworks (as available). Local and national needs and requirements for climate services will be identified through multi-stakeholder consultations. Relevant climate services will be developed with guidance from regional climate centres. Effective service delivery approaches will be created and capacity development and joint trainings will be implemented. All these activities will engage stakeholders to ensure that the institutional and infrastructure needs are accurately assessed, both for strengthening observing networks and climate services, and for sustaining them over time, so that they can be utilized in decision-making.

2. Enhanced DRR-related climate information and services are provided for initiatives on disaster

risk analysis, risk reduction and financial protection.

DRR-related products and services that can benefit from the GFCS Pillars are identified in the DRR Exemplar. A number of multi-agency initiatives to develop these products and services are already underway. Specific activities under this objective will:

- a. Enhance the standards, methodologies, guidelines and training materials generated by several planned multi-stakeholder initiatives focused on risk analysis through GFCS engagement. These initiatives focus on standardization of extreme event characterization, risk assessment and risk profiling at country level, and country-level implementation of databases that track disaster losses (loss data).
  - b. Incorporate GFCS outputs into Inter-Agency Standing Committee (IASC) and other relevant initiatives focused on early warning systems and humanitarian planning and preparedness for improved humanitarian response.
  - c. Identify and develop climate information products and services for financial protection through a multi-stakeholder UN, International Finance Institution and private-sector initiative focused on improved government and private financial planning and investment, risk financing and transfer of disaster risk.
  - d. Coordinate with projects of the other GFCS Exemplars to provide disaster risk reduction stakeholder inputs into GFCS sector-specific risk reduction projects being undertaken in the priority areas of agriculture and food security, water resources, and health.
3. Enhanced climate services for DRR are promoted through facilitation, basic training and capacity development, advocacy and outreach.

Achieving the two objectives above will entail a set of underpinning activities to inform DRR stakeholders about the GFCS and vice versa, and to conduct basic capacity development and training activities, and development of targeted promotional materials. These activities will be accomplished through the insertion of DRR- and GFCS-related messages and content into ongoing projects and processes. On the DRR side, these will emphasize outreach through existing networks and regional intergovernmental processes, as well as via the standing mechanisms of the ISDR system including the regional, national and the Global Platform for Disaster Risk Reduction, and the Inter-Agency Group, and through other mechanisms supported by the socio-economic groupings needed for effective stakeholder interaction, engagement and establishment of partnerships. On the GFCS side these will include the activities of the GFCS Secretariat, with implementing partners of the ISDR system, and other governing and implementing bodies.

**Activities:**

1. Coordinate identification of strategies for integrating enhanced climate information into stakeholder DRR processes in high-risk contexts; will include pilot initiatives and replication processes.  
  
Initialization of required climate information products and services.
2. Extreme climate event characterization for risk assessments and loss attribution.  
  
Incorporation of extreme climate event information into country-level risk profiling.  
  
Incorporation of extreme climate event information into country-level loss databases.
3. Outreach and advocacy.

Capacity development.

Programme Oversight Board management support.

**Benefits:** Disaster risk reduction support will be enhanced through improved climate information and services.

**Deliverables/Outcomes:**

1. GFCS implementation plans for DRR in specific high-risk contexts, incorporating comprehensive, multi-stakeholder international support.

GFCS implementation plans for DRR operationalized in specific high-risk contexts as part of comprehensive, multi-stakeholder international support.

2. Standards, guidelines, methodologies and training materials.

Outputs verified and refined through incorporation of enhanced climate information into risk profiles in specific countries.

Outputs verified and refined through incorporation of enhanced climate information into loss databases in specific countries.

3. Website content, publications, flyers and presentations.

Materials and capacity development delivery through existing programmes in support of objectives 1 and 2.

Project coordination and linkage to GFCS implementation and governance processes.

**Risks:**

As described above, the proposed activities will be undertaken through numerous multi-stakeholder and inter-agency processes, at differing geographic scales and in different regions of the world. Although some of these processes are well established, others, most significantly the GFCS itself, are in early stages of formation and therefore lacking in well-understood stakeholder groupings, procedures and norms. Working through these mechanisms and processes enhances the potential for widespread GFCS impact; however, GFCS engagement through them will tie GFCS and project implementation progress to circumstances outside project control. It also remains to be seen what capacities the GFCS Pillars and their implementing partners and partnerships will have for responding to DRR stakeholder demand and requirements for tailored climate information and services. Additionally, there is currently no single established platform or coordination mechanism for disaster risk analysis; therefore relevant activities will be undertaken through multi-stakeholder initiatives which, although they are the result of extensive planning, are nonetheless currently in a formative stage. National government and local authorities' ownership of the GFCS's implementation and commitment is also essential to its success. Finally, the mainstreaming of GFCS activities into the project partner organizations' existing intra-organizational processes as is required by the project is expected to be challenging, with uneven results.

**Timeline:** 2 years

**Resource requirements:**

Objective 1: CHF 6,000,000

Objective 2: CHF 2,000,000

Objective 3: CHF 2,000,000

**Total:** CHF 10,000,000

**Project title: 9** - Mechanisms to coordinate research on attribution and prediction of climate extremes and transfer of its outcomes to climate services for DRR sector, adaptation measures, and development of corresponding Early Warning Systems (EWSs)

**Goal:** Strengthening the engagement of providers and users of climate services

**Pillar:** Research, Modelling and Prediction

**Submitting Agency:** WMO

**Partners:** UNISDR, IFRC, WCRP and its affiliates, WCP, PROVIA, National Meteorological and Hydrological Services

**Scope:**

The need for climate services arises to a large extent because of the societal risks related to extreme hydrometeorological events. The risk is growing partly because the societal infrastructure is becoming more exposed to weather related risks as the global economy expands and population grows, and partly because of the climate change. Provision of information and warnings for high impact weather, air quality-related and health-hazards are high priority objectives for the emerging multi-hazard Early Warning Systems. The climate dimension of disaster risk reduction has two major sets of requirements. The first one is understanding (i.e. knowledge development) of the causes and enabling prediction of individual extreme climate events, such as long-term anomalies of temperature and precipitation, leading to droughts, floods, and storminess, especially with respect to tropical cyclones (typhoons, hurricanes) and extratropical storms. The second set of requirements is associated with information support for decision making, i.e. use of available knowledge, for example, of the climate defined as weather statistics. The probability distribution of weather events in a changing climate is non-stationary implying that the return periods of extreme events related to floods, avalanches, mud slides, drought, heat waves, wind, storm surges, weather related diseases, etc. are undergoing significant changes in many regions of the world. Due to the non-stationary character of current climate records, past climate information may be no longer representative for the future. The geographical distribution of environmental risks is uneven and there are areas of particularly high exposure to hazards, for example, low-lying deltas, and areas impacted by tropical cyclones and floods. It is essential therefore to ensure that climate information requirements for decision-making purposes in the DRR sector are identified in an interactive manner between the research community and users.

Exposure to hazards turns into vulnerability due to systemic socio-economic and political conditions, such as poverty, underdevelopment, lack of resources and inadequate infrastructure. It may be exacerbated by long- and short-term decision-making failures and even cultural factors affecting behaviour. Thus the target audience for climate services in the DRR sector should involve governance and development agencies, such as those responsible for land use and livelihoods planning.

Mechanisms to coordinate research on attribution and prediction of climate extremes and transfer of its outcomes to climate services for DRR sector, adaptation measures, and development of corresponding EWSs.

**Objectives:**

Mechanisms to coordinate research on attribution and prediction of climate extremes and transfer of its outcomes to climate services for DRR sector, adaptation measures, and development of

corresponding EWSs.

**Activities:**

In the DRR area, the climate science community will engage industries and interested communities into a wide discussion on climate variability and change aspects of hazard risk estimation and safety reinforcement in sectors with identified vulnerability. This communication should result in a broad programme of research activities on adaptation of the DRR sector to climate change and to inform risk assessment and reduction. Industry-specific engineering design criteria related to activities safety and insurability sectors will be reviewed. New civil engineering and safety standards will be proposed that take into account climate predictions and their inherent uncertainties. Internationally accepted guidance on climate information for construction and operation safety codes and related basis for insurance coverage will be a very important outcome of this initiative. The expertise of insurance and reinsurance industry will be invited and used to promote the timely adoption and implementation of new practices. This may include development of financial risk transfer products for climate risks (such as weather index insurance) for agriculture, water resource management, and natural disaster risk reduction sectors. In addition, availability of environmental information useful for identifying hazards induced by climate variability and change and preparation of related advisories and warnings should be reinforced in this process. The use of climate predictions in the disaster risk assessment practices, development of EWSs, and in support of safety precautions will be promoted.

**Benefits:** Attribution and prediction of climate extremes will be improved and its outcomes will be transferred to climate services for DRR sector.

**Deliverables/Outcomes:**

- Improved attribution and skilful prediction of extreme events and their statistics, guidance to users
- Publications on attribution of extreme events, increased percentage of predicted events and improved guidance on extreme events for decision-making
- Proposals on research capacity development
- Verification scores for meteorological variables associated with extreme events, insurance loss data

**Inputs:**

Inputs will be required from research groups affiliated with WCRP, especially CLIVAR and Global Energy and Water Cycle Experiment (GEWEX), WCP, National Meteorological and Hydrological Services. IRDR, PROVIA, and from regional stakeholders.

**Risks:**

Multi-disciplinary challenges, resources required to resolve tails of distributions.

**Timeline:** 2014 with subsequent continuation

**Resource requirements:** CHF 200,000

**Project title: 10** - Monitor coastal regions in support of adaptation and understanding of vulnerabilities

**Goal:** Reducing the vulnerability of society to climate-related hazards through better provision of climate information

**Pillar:** Observations and Monitoring

**Submitting Agency:** IOC

**Partners:** World Meteorological Organization

**Scope:**

The activity will contribute to addressing weaknesses in observational coverage of climatically-important Essential Ocean Variables (EOV) and Essential Climate Variables (ECVs) required for coastal region monitoring, thus responding to the requirements of the Framework for Ocean Observations in this regard. This will allow better understanding and prediction of changes in the coastal environment (e.g., sea level rise, coastal erosion) and natural disasters (e.g., storm surges, extreme waves, tsunamis) in order to benefit coastal communities and better protect peoples' lives and property.

**Objectives:**

Improve coastal region monitoring and related services by increasing the percentage completion of the initial global ocean observing system, as defined within the JCOMM Observations Programme Area Implementation Goals, from 62 to 80 percent. It addresses the identification of needs for strengthening the capacity for observations and monitoring to inform risk assessments in the DRR Exemplar.

**Activities:**

**Benefits:**

Benefits will be improved understanding of vulnerabilities, and prediction of changes and harmful events and disasters in coastal regions to help decision makers to adapt to such changes, and reduce related risks. GFCS Principles 4 and 7, in particular, are advanced through this project.

**Deliverables/Outcomes:**

Deliverables will include prioritized national and regional plans for achieving enhanced coastal regions monitoring, and in particular the collection, and exchange of the required EOVs and ECVs.

**Inputs:**

The understanding and prediction of changes, harmful events, and disasters is possible through appropriate monitoring of the coastal regions. This requires appropriate atmospheric, ocean, and climate models and computing infrastructure, together with the routine observation of ocean and atmospheric variables analyzed and assimilated in those models. As this activity only covers the observations part, prerequisites for this activity include: (i) commitment of IOC and WMO Members/Member States to undertake the necessary ocean observation programmes as

reflected in the JCOMM Observations Programme Area Implementation Goals; (ii) open data policy and international exchange of the required data in real-time; and (iii) parallel development (or improvement) of the required ocean, atmospheric, and climate models.

**Timeline:** Initial phase of 2 years

**Resource requirements:**

The project is expected to start with an initial phase of two years, costing about CHF 8M annually. The goal in this period will be to increase the percentage of completion of the initial global ocean observing system, as defined within the JCOMM Observations Programme Area Implementation Goals, from 62 per cent to 80 per cent. Future efforts will be to complete of the observing system.

C. Health

**Project title: 11** - Establish frameworks for climate services for health at the national level in developing countries

**Goal:** Strengthening the engagement of providers and users of climate services

**Pillar:** UIP with Health sector

**Submitting Agency:** World Meteorological Organization and WHO

**Scope:**

In 2010 and 2011, Regional Committees of the World Health Assembly endorsed climate and health work plans to guide the member Ministries of Health in all world regions toward priority actions for climate adaptation. The successful completion of actions within these agendas requires close collaboration and joint programming with National Met and Climate Services. Several climate and health working groups (CHWGs) have been established in Africa since 2008, supported by WMO and other partners, which serve as models to be expanded to meet this need. These CHWGs have proven to be a successful model to build national level capacity to respond to the tailored needs of the health community, while establishing structured mechanisms for collaboration.

Within 2 years, establish 3-5 national level climate and health working groups, in countries that have existing projects or plans that can benefit from Climate Services (i.e. expressed interest by the MoH in further development of health actions within UNFCCC NAPAs, National Communications, the conduct of Vulnerability and Adaptation assessments, or climate informed health emergency preparedness and management plans, or have existing climate adaptation projects). Work plans jointly developed by national health and climate sector actors will respond to nationally identified needs to enhance health activities with climate information, such as climate vulnerability assessments, or establishment of early warning systems. Global and regional level activities will support national actors with technical guidance, networking, and institutional capacity development that can establish structures to later support national actors at a wider scale. New working groups can benefit from guidance and lessons learned through existing WMO supported working groups, with the aim that activities reach beyond research to enhance policy and operations.

**Objectives:**

This activity aims to establish national mechanisms whereby the research and operational sections of the climate sector can interact with health actors, and build capacity in a learning-by-doing approach to the jointly identify, implement and evaluate the use of climate information services in support of and as direct inputs into improved health protection. It will serve as a model and help establish standard tools and references for the expansion of the model in other countries and regions.

**Activities:**

- Hold national workshops to identify partners, needs, and priorities for joint action
- Establish Working Group mechanisms
- Implement national activities, as oriented by existing priorities
- Develop Regional Climate Outlook Forums (RCOF) activities involving National Working Groups, to meet National Needs
- Training

- Communications tools
- Development of Operational and Policy Guidance

**Benefits:**

The capacity of both health and National Meteorological and Hydrological Service partners will be developed through training, linkages to international and regional experts, and via the structured mechanism for collaboration necessary for health actors to implement climate-informed policy, research, and practice. The capacity of national networks can be further strengthened by bridging national collaborators with each other through the RCOF processes (i.e. national to national working group) as well with regional and international experts.

**Deliverables/Outcomes:**

- Guidance on the establishment of National Institutional Mechanisms for collaboration between climate and health.
- Linkages made between National Working Groups, in West/East Africa.
- Development of applied sessions within RCOFs that cater to sectoral and national service needs.
- Link National WGs to RCOF processes as applied activities.
- Develop capacity for health and climate sector for applied.
- National activities to fulfil and implement UNFCCC processes (i.e. NC, NAPAs, V&A assessments) and climate-enhanced national emergency preparedness and management plans.
- Engagement of WHO and health partners at National and Regional levels and hospital preparedness (Latin America and the Caribbean).

**Indicators and assessment measures:**

- National Workplans shared.
- National WGs attend RCOFs and benefit from specific activities.
- Health activities held at RCOFs that address the needs of the national groups (emergency preparedness, infectious disease control).
- Guidance documents published.
- Public health preparedness plans routinely use climate information.

**Inputs:**

Receive input from WHO and WMO at Global, Regional, and National levels:

- Technical assistance and training from international climate and health partners.
- WHO engagement at National and Regional levels to identify and prioritize participating countries.

Linkages with other projects:

- Existing working groups in Madagascar, Kenya, and Ethiopia have experience in different models of CHWGs albeit with similar objectives and aims.
- WMO efforts to establish new WGs in Mali, Mauritania, Burkina Faso, and Niger
- WHO supports climate adaptation projects around the world which could all benefit from stronger and active partnerships with NMS, and RCOF services. Including: 7 country project (WHO/UNDP/GEF); (EUR) a German funded project in 7 Eastern European and Central Asia, Europe) countries, (WPR) 16 Pacific Islands developing adaptation plans, etc.

- Existing training networks and collaborating centres with capacity related activities exist in both developed and less-developed country contexts.

**Risks:**

- Sustainability of funding.
- Identification and engagement of international and regional partners to support activities .  
Motivation of local partners.

**Timeline:** Within 2 years 3 to 5 national level climate and health working groups established (subject to funding)

**Project title: 12** - Develop GFCS climate and health research and communication strategy and set targets and priorities to support health and climate research at regional and national levels

**Goal:** Strengthening the engagement of providers and users of climate services

**Pillar:** Research, Modelling and Prediction; UIP, links to CSIS

**Submitting Agency:** WMO

**Partners:** WHO

**Scope:**

Environmental determinants of human health include direct effects of climate conditions on health through, e.g. thermal stress (both due to heat and cold conditions), exposure to UV radiation, air pollution, etc., and a number of other factors. Nutrition, water availability, natural disasters also strongly affect the health sector. Adequate measures to address these issues should be initiated through the appropriate sector activities.

Many necessary research tasks to address the above issues require multidisciplinary guidance and oversight (e.g. in reviewing and periodically revising the global research agenda, or producing “best-practice” guidance for economic assessments on climate change and health), or technical projects (such as global assessments of the current and future burden of disease attributable to climate change). In order to ensure coherence, these processes should have access to relevant climate expertise.

**Objectives:**

Develop GFCS climate and health research and communication strategy and set targets and priorities to support health and climate research at regional and national levels. Develop virtual forum on climate and health research.

**Activities:**

An inventory and assessment of climate information, products, and services currently available to (and used by) the health sector, which can be optimized and improved, will be conducted. Based on this inventory and as well on the analysis of the gaps in current research agendas, an assessment will be made of what is optimally required for climate related risk management and adaptation to climate change in the health sector. In doing this, the positive experience of several initiatives in the climate and health sector that can serve as building blocks for future developments will be used. This includes, for example, the Meningitis Environmental Risk Information Technologies (MERIT) initiative, which has gained valuable experience in setting research strategies based on effective dialog between health researchers, practitioners, and their environmental counterparts. Existing practices and arrangements such as the Malaria Outlook Forum (MALOF) will also be used and strengthened as much as possible. The national level health Early Warning System and climate-sensitivity models will be evaluated to identify best and standard practices and cost-effectiveness. A systematic analysis will be conducted of current health actor capacity/readiness to make climate informed decisions and inventory of common approaches used, including case studies on benefits of health and climate service collaboration. Research will also be conducted to evaluate the cost-effectiveness and cost-benefit of climate informed health operations. Most of these activities will start at the initial stage of the GFCS

implementation and contribute to the development of the strategic implementation plan of research on climate services for the human health.

**Benefits:** Health and climate research will be supported at regional and national levels. Virtual forum on climate and health research will be developed.

**Deliverables/Outcomes:**

- The strategy as a document.
- Improved frameworks, communication and partnerships.
- Web-portal established.
- Translation of strategic recommendations into regional and national research and development plans.
- Proposals on research Capacity Development.
- Level of engagement with countries.
- Website monitoring

**Inputs:**

Inputs required from WHO, Global Environmental Change and Human Health (GECHH) and others. Also from WCP, CSIS, WCRP, WGRC, PROVIA, and from Early Warning Systems for air quality and their health implications

**Risks:**

The complexity of the project, and the dependence on regional and local levels of development that may be insufficient, are risks.

**Timeline:** 2 years

**Resource requirements:** CHF 250,000

**Project title: 13** - Establish best practices for air quality observations and monitoring in urban environments so as to address a major health concern.

**Goal:** Reducing the vulnerability of society to climate-related hazards through better provision of climate information

**Pillar:** Observations and monitoring

**Submitting Agency:** WMO

**Partners:** WHO, UNEP

**Scope:**

According to the World Bank (2008), to combat climate change, targeted research is needed at the city level to enable policy makers to understand the magnitude of the impacts and the alternatives to improve resilience of cities. In this project, case studies will be developed for understanding air pollution, health, and climate connections in large urban complexes in Africa, Asia, and Latin America. This will lead to the improvement and harmonization of air quality measurements and related modelling and to an international network of institutional partnerships to support air-quality related services.

**Objectives:**

To establish guidelines and networks of quality assured air quality measurement sites in order to provide accurate knowledge of pollution levels in cities to support decision making. The Health Exemplar cites “air quality, pollens and allergens, ultra-violet radiation, and their impacts on human health, especially in cities,” as a particular concern.

**Activities:**

**Benefits:**

The improved coverage and reliability of air quality observation systems will allow for better and more knowledgeable decision making, for instance, in order to take appropriate precautionary/mitigation measures to address pollution problems related to health. This will result in better management of chronic disease burden associated with poor air quality. The project will also assist in the mitigation of short lived climate pollutants (SLCPs), such as ozone and black carbon, and thus both improve air quality and mitigate climate change. This implementation activity is addressing identified gaps and is responsive to GFCS Principles 4 and 7.

**Deliverables/Outcomes:**

Starting with a few cities in different regions, harmonized measurements of air quality, information and data systems, and delivery will be developed. Environmental and air quality products and their dissemination will be improved. Guidelines will be developed based on this experience for the use of other institutes and authorities in the regions.

**Inputs:**

(i) Collaboration at the national level among institutes dealing with air quality, such as NMHSs and Environmental Agencies and Municipal Governments, and at the international level among WMO, WHO, UNEP; and (ii) provision of adequate funding and human resources.

**Timeline:** Initial 2 years: 2 meetings in each Asia, Africa, and Latin America.

**Resource requirements:** CHF 350,000 (including salary for a consultant to prepare the Guidelines).

D. Water

**Project title: 14** - Improved water resources management through the development and testing of a tool which links changes in climate averages and variability to changes in water resources availability

**Goal:** Mainstreaming the use of climate information in decision-making

**Pillar:** User Interface Platform – but also cross cutting – water related

**Submitting Agency:** WMO

**Partners:** UNESCO, Global Water Partnership (GWP), UN-Water agencies

**Scope:**

This project would involve the development of a tool (web-based) which identifies those aspects of their water resources management programme that are at most risk to the impacts of climate variability and change. The driver of the hydrological cycle is climate and variability and change in the climate can have widely varying impacts on the different elements of the hydrological cycle, including the amount of rainfall, the level of discharge/flow from rivers, the amount of recharge of aquifers and the volumes held in storage over time. A tool which links changes in climate averages and variability to changes in water resources will identify those areas on which the water manager may wish to place greater emphasis when developing Integrated Water Resources Management (IWRM) plans for the future. The tool would require a wide range of climatological and hydrological (including water use) inputs, and could also be used to identify hotspots. Some work has been done in some countries that show for example, that 10 per cent reductions in rainfall will lead to 20% reductions in river flows with obvious impacts on the refilling of water supplies and also groundwater recharge. The tool will need to cover all aspects of the hydrological cycle including water stored as snow and ice. Linkages across the GFCS pillars include the need for the tool to be based on the latest developments regarding scientific modelling of the water cycle and incorporate inputs from the climate modelling community (climate services). It would also be very dependent on the quality and availability of observations (hydrological in particular, but also meteorological/climate) in order for it to be applied and thus would need to be flexible. In itself, it is obviously a contribution to capacity development. The work would be undertaken by WMO and its Commission for Hydrology (CHy) in association with GWP and UNESCO.

**Objectives:**

Improved water resources management through the development and testing of a tool which links changes in climate averages and variability to changes in water resources availability which will identify those areas on which the water manager may wish to place greater emphasis when developing IWRM plans for the future.

**Activities:**

- 1.1 Description-definition of tool (links to Research and Model Development and Observations and Monitoring)
- 1.2 Development of tool
- 1.3 Testing of tool through focused workshops (links to Climate Services Information System)
- 1.4 Development of training materials (links to Capacity Development)
- 1.5 Application of tool through training workshops

**Benefits:** Water resources management will be improved.

**Deliverables/Outcomes:**

Availability of detailed tool description-definition

- 1.1 Availability of draft tool
- 1.2 Reports of testing workshops
- 1.3 Availability of training materials
- 1.4 Reports of training workshops and related feedback

**Inputs:**

Financial resources and the cooperation and contribution of expertise from selected countries. Expertise from participating agencies. Current water cycle modelling capabilities, observations and climate services.

**Risks:**

- 1.1 The tool will not be able to be developed – unlikely as existing tools can be adjusted and modified for this purpose.
- 1.2 The data and information required to implement the tool are not available – possible, but will need to be addressed in tool development.
- 1.3 Countries will not be interested in being involved – unlikely as many countries are seeking support and advice regarding possible impacts of climate change on water resources availability.

**Timeline:** 18-24 months

**Resource requirements:** CHF 200,000

Tool development would draw on the approaches taken in a number of existing studies and develop a web-based tool for application at local, national and regional levels. Associated with the tool, a capacity development programme to support its use will be established and regional and national workshops will be held to support the application of the tool. The tool development is expected to cost of the order of CHF 50,000 and initially be supported by five workshops at CHF 30,000 each. Tool development and testing is expected to take of the order of 6 months and the initial workshops will be used to evaluate and fine-tune the tool.

**Project title: 15** - Improved delivery and application of climate services through the establishment of effective and efficient User Interface Platforms for addressing the climate-water interface in transboundary river basins

**Goal:** Advancing the key global development goals through better provision of climate information

**Pillar:** User Interface Platform – but also cross cutting – water related

**Submitting Agency:** WMO

**Partners:** UNESCO, GWP, UN-Water agencies

**Scope:**

Pilot projects will be established in 5 transboundary river basins identified as water scarce regions incorporating a Water User Interface Platform between the hydrological and climatological communities. The pilot projects will provide guidance and assistance in the setting up of a Water UIP at the national and/or regional level and provide technical guidance on practices and procedures that can be adopted. Guidance on stakeholder involvement, seeking, obtaining and using feedback to identify and then improve services and their delivery, awareness raising and the development of national action plans to address the major climate-water interface issues will be addressed. The tool developed in Project 1 would assist in this activity. Depending of the issues of greatest concern to the countries involved, advice and guidance on Integrated Flood Management would be provided through the Associated Programme on Flood Management and similarly, advice on Integrated Drought Management through the Integrated Drought Management Programme (IDMP). Linkages across the GFCS pillars include the need for the project to be based on the latest developments regarding climate-hydrological modelling and incorporate inputs from the climate services information system. The project will also be very dependent on the quality and availability of observations (hydrological in particular, but also meteorological/climate) in order for it to be successful. The project will also provide feedback on the requirements for observations for this particular purpose. The project includes a strong capacity development element. The work would be undertaken by WMO and CHy in association with GWP and UNESCO.

**Objectives:**

Improved delivery and application of climate services through the establishment of effective and efficient User Interface Platforms for addressing the climate-water interface in transboundary river basins.

**Activities:**

- 1.1 Description of required workshop materials and selection of river basins (link to Research and Modelling, Observations and Monitoring and Climate Services Information System)
- 1.2 Development of workshops materials (link to Capacity Development)
- 1.3 Holding of initial workshops (link to User Interface Platform)
- 1.4 Review of workshop material on the basis of feedback from workshops
- 1.5 Further workshops

**Benefits:** The climate-water interface in transboundary river basins will be effectively addressed in 5 transboundary river basins to advance the key global development goals through better provision of climate information.

**Deliverables/Outcomes:**

- 1.1 Availability of detailed description and identification of river basins
- 1.2 Availability of workshop materials
- 1.3 Reports of initial workshops
- 1.4 Revision of workshop materials
- 1.5 Reports of follow-up workshops and associated feedback

**Inputs:**

Financial resources and the cooperation and contribution of expertise from selected countries. Expertise from participating agencies. Current water cycle modelling capabilities, observations and climate services.

**Risks:**

- 1.1 The material will not be able to be prepared – unlikely as existing material can be adjusted and modified for this purpose.
- 1.2 Countries in some River Basins will not be interested in being involved – unlikely as many countries are seeking support and advice regarding possible impacts of climate change on water resources availability, especially in transboundary river basins.

**Timeline:** 18-24 months

**Resource requirements:** CHF 200,000

As water resources management is already built on a risk management approach, the activities would build on existing initiatives, re-cast to meet the specific needs of the selected transboundary river basins. Funding for this initial activity would come from these initiatives. Additional resources would be necessary for the workshops that would follow in each of the 5 Pilot Projects (5 x CHF 40,000). The workshops would be held over 2014-2015 time frame and involve a wide range of stakeholders from the climate and water-related sectors.

**Project title: 16** - Improved delivery and application of climate services in areas highly dependent on snow or glacier melt for their water resources

**Goal:** Strengthening the engagement of providers and users of climate services

**Pillar:** User Interface Platform – but also cross cutting – water related

**Submitting Agency:** WMO

**Partners:** UNESCO, GWP, UN-Water agencies

**Scope:**

Pilot Projects will be established in 5 river basins identified as basins highly dependent on snow or glacier melt for their water resources incorporating a User Interface Platform between the hydrological and climatological communities. As with Project 2, the Project will provide guidance and assistance in the setting up of a Water UIP at the national and/or regional level and provide technical guidance on practices and procedures that can be adopted. In this case the major issue in the hydrological cycle of interest will have already been identified and therefore apart from the user interface, the workshops will involve advice and guidance on how to address the impacts of a reduction in reliability of the existing supply options. As indicated above, some measures are already in existence, but based on the issues encountered in each individual country, new approaches to integrated water resources management will be required and incorporated into water management planning. Linkages across the GFCS pillars include the need for the project to be based on the latest developments regarding climate-hydrological modelling and incorporate inputs from the climate services information system. The project will also be very dependent on the quality and availability of observations (hydrological in particular, but also meteorological/climate) in order for it to be successful. The project will also provide feedback on the requirements for observations for this particular purpose. The project includes a strong capacity development element. The work would be undertaken by WMO and CHy in association with GWP and UNESCO.

**Objectives:**

Improved delivery and application of climate services through the establishment of effective and efficient User Interface Platforms for addressing the climate-water interface in basins highly dependent on snow or glacier melt for their water resources

**Activities:**

- 1.1 Description of required workshop materials and selection of countries/regions (link to Research and Modelling, Observations and Monitoring and Climate Services Information System)
- 1.2 Development of workshops materials (link to Capacity Development)
- 1.3 Holding of initial workshops (link to User Interface Platform)
- 1.4 Review of workshop material on the basis of feedback from workshops
- 1.5 Further workshops

**Benefits:** Delivery and application of climate services will be improved in areas highly dependent on snow or glacier melt for their water resources.

**Deliverables/Outcomes:**

- 1.1 Availability of detailed description and identification of countries/regions
- 1.2 Availability of workshop materials
- 1.3 Reports of initial workshops
- 1.4 Revision of workshop materials
- 1.5 Reports of follow-up workshops and associated feedback

**Inputs:**

Financial resources and the cooperation and contribution of expertise from selected countries. Expertise from participating agencies.

**Risks:**

- 1.1 The material will not be able to be prepared – unlikely as existing material can be adjusted and modified for this purpose.
- 1.2 Countries will not be interested in being involved – unlikely as many countries are seeking support and advice regarding possible impacts of climate change on water resources availability.

**Timeline:** 18-24 months

**Resource requirements:** CHF 200,000

Funding for this initial activity would come from these initiatives. Additional resources would be necessary for the workshops that would follow in each of the 5 Pilot Projects (5 x CHF 40,000). The workshops would be held over 2014-2015 time frame and involve a wide range of stakeholders from the climate and water-related sectors.

**Project title: 17** - Develop GFCS climate, water management and hydrological cycle research strategy and set targets and priorities to support research at regional and national levels

**Goal:** Strengthening the engagement of providers and users of climate services

**Pillar:** Research, Modelling and Prediction

**Submitting Agency:** WMO

**Scope:**

The water sector is a nexus of challenges and opportunities associated with livelihood of people, ecosystems and economic development. It is affected strongly by climate variability and change on one hand, and influences the evolution of Earth's climate on the other hand. Water is essential for food, energy, transport, and many other aspects of life support. The needs for water resources related information and services vary with regions and are different for short- and longer- time scales, from days to seasons and decades. However, there are mainly three types of data/information that can benefit significantly every water-related application: (1) levels and capacity of fresh water reservoirs; (2) water availability and access; and (3) risks associated with quantity (scarcity or excess) and quality of fresh water. They depend on environmental factors such as precipitation, snow/ice melt, evaporation, etc., and on human factors such as water withdrawals, consumption, and reuse. Water availability anomalies including droughts and floods depend on dominant modes of atmospheric and oceanic circulation, land-surface and soil moisture conditions and their seasonal and longer-term variability. Seasonal prediction of these anomalies on a regional scale, particularly prediction of anomalies associated with monsoon systems, still presents a bold challenge to climate, weather and hydrological sciences.

**Objectives:**

Develop GFCS climate, water management and hydrological cycle research strategy and set targets and priorities to support research at regional and national levels

**Activities:**

A strategy for coordination and integration of meteorological and hydrological research, including coupling climate-hydrological models for weather and climate prediction that is essential to the success of GFCS in this sector, will be developed. Because the improvement of the quality of observations and models for predicting the onset, distribution and quantity of precipitation depends on the progress in our ability to represent in models all components of the hydrological cycle and related atmospheric and land surface processes, research will engage in the development of a new generation of nested high-resolution hydrological models with inclusion of aspects of water quality and biogeochemistry, and human intervention, along with data assimilation systems and reanalysis capabilities. Another focus of the research will be measurement and modelling of clouds and precipitation at a spectrum of time- and space-scales. Climate science will work on enabling assessments of climate change impacts on all elements of the hydrological cycle, on global and regional level, including its extremes, involving floods and droughts. As in the case of the food security and agriculture sector, a detailed research agenda will be developed at the initial phase of the GFCS implementation to guide global and national efforts in the hydrological and water resource research. The activities associated with the two WCRP Grand Science Challenges, namely the water availability and the cryosphere, will be particularly relevant.

**Benefits:** GFCS climate, water management and hydrological cycle research strategy will be developed and targets and priorities to support research at regional and national levels will be set.

**Deliverables/Outcomes:**

- Strategy as a document.
- Improved frameworks, communication and partnerships.
- Translation of strategic recommendations into regional and national research and development plans.
- Proposals on research Capacity Development
- Level of engagement with countries

**Inputs:**

Inputs will be required from Global Energy and Water Exchanges Project (GEWEX), WMO Commission for Hydrology, International Hydrological Programme (IHP) of UNESCO, Satellite agencies and regional stake-holders; Early Warning Systems for hydrology will need to be in place.

**Risks:**

Organizational complexity and inadequate knowledge of partner communities are among the risks.

**Timeline:** 2 years

**Resource requirements:** CHF 200,000

**Project title: 18** - Provide information for sustainable water resources development and management in key shared international river basins

**Goal:** Reducing the vulnerability of society to climate-related hazards through better provision of climate information

**Pillar:** Observations and Monitoring, UIP

**Submitting Agency:** WMO

**Partners:** UNESCO

**Scope:**

The World Hydrological Cycle Observing System (WHYCOS) initiative, focussed on improved data collection, storage, dissemination and sharing and the development of water resources management products, provides an opportunity to implement integrated hydrometeorological and climate-related networks with the specific aim of sustainable water resources management in a changing climate. WHYCOS is a global WMO Programme, developed in response to the scarcity or absence of accurate data and information on freshwater resources mainly caused by the deterioration of observing networks and insufficient data management capabilities. The programme is implemented through various components (HYCOSs) at the regional and/or basin scale, 3 to 4 of which are the focus of this project in line with the pilot projects as addressed in the Water Exemplar.

**Objectives:**

Promote and facilitate the collection, analysis, exchange, dissemination and use of water-related information, using modern information technologies and capacity building.

**Activities:**

**Benefits:**

The HYCOS components are targeted at shared river systems and address the gaps in hydrological observations. Additional emphasis will be placed on improved integration of climate observation systems with hydrological observation systems. Managing access to and use of water in a variable and changing climate will benefit all sectors of society. The project contributes to addressing needs expressed in the Water Exemplar.

**Deliverables/Outcomes:**

(i) Strengthened hydrological observation networks; (ii) Capacity development of NMHSs; (iii) Data sharing in international shared river basins; (iv) Integrated hydrological and climate observation systems; and (v) Hydrological data and products in support of integrated water resources management.

**Inputs:**

(i) Agreement from, and cooperation between, the NMHSs to share the data and information collected; (ii) The adoption of agreed and common standards for the observation systems, data management systems, and products being developed; and (iii) Long-term commitment from the

NMHSs to maintain the systems and production of products and services into the future.

**Timeline:** Individual HYCOS Projects usually consist of an initial preparatory phase of 1 year, followed by an implementation phase of between 3 and 4 years.

**Resource requirements:**

The proposed budget of **CHF 15M** would provide sufficient resources for between 3 and 4 individual HYCOS components. At this stage, it is proposed to support the second stage of the Pacific HYCOS project with resources of CHF 4M over a 4-year period, and the third stage of the Southern Africa Development Community (SADC) HYCOS with a similar level of resources, CHF 4M over a 4-year period. The remaining CHF 7M would be used to fund preparatory phase studies in 3-4 internationally shared river basins at most risk as determined through the User Interface Platform project proposed under the Water Exemplar and where feasible commence at least one additional project in Africa.

## 2. Projects across the five GFCS pillars which will enhance the quality, usefulness and availability of Climate Services

These projects emanate from the Annexes for each of the five GFCS pillars – Research, Modeling and Prediction; Observations and Monitoring; Climate Services Information Systems; User Interface Platform and Capacity Development. Many of them feature activity across several pillars, particularly the over-arching pillars of User Interface Platform and Capacity Development. They are intended to support the institutional and technical capacities need to enable operational climate services.

**Project title:** 19 – Support for the establishment of functional national user interface platforms

**Goal:** Strengthening the engagement of providers and users of climate services

**Pillar:** Capacity Development, with strong links to UIP and other pillars

**Submitting Agency:** WMO

**Partners:** FAO, WFP, WHO, UNESCO, ISDR, UNITAR

**Scope:**

Following selection of the initial major projects and countries:

Work with partner agencies to identify countries where development of personnel from the lead national institution(s) responsible for the implementation of the national user interface (UIP) will be required, and requested, to develop and sustain functioning user interface platforms.

**Objectives:**

Minimize risk of failure in major projects associated with non functioning UIPs

**Activities:**

1. Using the risk assessments in the major projects, identify those countries where there is significant risk of project failure due to a non functioning UIP
2. Working with partners identify which aspects of the risk can be treated through education and training, coaching or mentoring of the personnel responsible for creating and sustaining the UIP
3. Taking into account the available resources develop and implement education/training/coaching/mentoring activities to address the needs identified in the previous step
4. Monitor activity and maturity of the national UIP and adjust Human Resource Development (HRD) activities accordingly

**Benefits:** The establishment of functional national user interface platforms will be supported to strengthen the engagement of providers and users of climate services.

**Deliverables/Outcomes:**

Deliverable: Functioning national UIPs following invited intervention

Assessment measure: UIP in place and used as national forum for discussion on use and production of climate services.

**Inputs:**

- Risk assessments from major projects
- Identification of lead institution(s) for national UIPs
- Requests for assistance

**Risks:**

- Major projects do not identify problems with UIP
- Scale of required support greater than available financial and / or human resources
- The UIP issues may not be directly addressable through HRD activities
- May be difficult or too costly to tailor normal HRD activities to meet national cultural, gender and language policy and procedures

**Timeline:** Addressing UIP problems will be at least short- to medium-term with resources possibly required to 2020 and beyond. First activity should ideally be done in parallel with the development of the major project. Given reasonable financial and human resources and commitment by the national institution(s) it should be possible to implement activities 2 to 4 within 12 months of starting.

**Resource requirements:** Extremely difficult to estimate in any quantitative fashion. Ideally each major project would identify the risk and provide resources to address it within the project. Costs will vary from country to country and will depend upon the resources of the in-country partner agencies. Allow CHF 300,000 a year as a first estimate and this would need to address support as well as delivery costs. This should cover up to six interventions for countries with low to medium requirements.

Estimated costs: CHF 300,000 per annum

**Project title: 20** - Support for development of national Climate Service Information Systems

**Goal:** Mainstreaming the use of climate information in decision-making

**Pillar:** Capacity Development; CSIS

**Submitting Agency:** WMO

**Partners:** National climate service providers, universities and training institutions, training providers

**Scope:**

For a country to derive benefit from an increased range of climate data, products and information it will be necessary for the climate service provider(s) to have a core set of competent staff. These core staff will need to carry out tasks including - some or all of - observe, derive, produce, modify, quality control, disseminate and communicate climate data, products and information to their national clients. In many cases these will be new staff or existing staff tasked to take on new roles and responsibilities. Ideally the major projects would include some allowance for education and training of the CSIS staff or the staff on the user side to offset the resources within this project. This project requests assistance in either in-kind (provision of education and training opportunities) and/or funding to develop and deliver these opportunities on an ongoing basis. The types of roles and tasks for the personnel of the climate service providers will be determined by the types and level of services being delivered. This project does not address the funding or maintenance of new CSIS staff. Education and training for end users on how to use climate data, products and information is contained in a separate project.

**Objectives:**

Minimize the risk of major projects failing due to climate service provider staff having insufficient knowledge and skills for the required roles and tasks.

**Activities:**

Multi-tiered approach

Global

- Identify the core knowledge and skills for the common roles and tasks (in conjunction with the WMO Commission for Climatology).
- Foster the development and sharing of the education and training resources to address these knowledge and skill gaps requirements making use of existing resources and partner programmes where appropriate. Resources will need to be available for class room, synchronous and asynchronous group delivery and self study modes in a wide range of languages. A key action will be identifying national and regional education and training providers.

## National

- In parallel with the development of GFCS projects identify skill and knowledge gaps in the personnel of the climate service provider(s) that would jeopardize the projects.
- Taking into account available human and financial resources develop and implement appropriate activities to address the gaps. These activities may include short, medium and long term activities.
- Monitor the quality, range and quantity of services and adjust the education and training activities accordingly and within available resources.

**Benefits:** National Climate Service Information Systems will be developed to allow countries to derive benefit from an increased range of climate data, products and information.

### **Deliverables/Outcomes:**

Deliverable: National CSIS functioning

Assessment measures: National CSIS meeting the targets agreed through the national UIP processes

### **Inputs:**

- Global climate service competencies, and if necessary qualification, standards and recommended practices.
- Agreed targets for climate service data, products and information from the national UIPs.
- Availability of partner education and training providers.

### **Risks:**

- National UIP do not agree on minimum set of national climate data, products and services.
- Scale of required support greater than available financial and/or human resources.
- Not enough staff to deliver the services.

**Timeline:** Six months to five years depending upon the level and scale of intervention required per country.

Support to national climate service providers in developing and least developed countries will be required over many years.

**Resource requirements:** Difficult to estimate in any quantitative manner. Ideally major projects will have components for education and training of CSIS personnel. For estimation only assume

- Fostering development of open education and training resources in multiple languages: CHF 1M for five years
- Provision of long term fellowships at undergraduate and post graduate level at 50 / year for five years = CHF 1.5M / year or CHF 7.5M for five years
- Provision of four month on the job training placements at more advanced climate service providers 50 / year for five years = CHF 500,000 / year or CHF 2.5M for five years

- Provision of very short-term training via face-to-face and distance learning in English, French, Russian and Spanish 120 participants / year for five years = CHF 600,000 / year or CHF 3M for five years

Estimated costs: CHF 3.6M per year

**Project title: 21** - Implementing national legislative and policy framework for climate services

**Goal:** Mainstreaming the use of climate information in decision-making

**Pillar:** Capacity Development

**Submitting Agency:** WMO

**Partners:** UNDP

**Scope:**

For responsibility, accountability and longer term sustainability it is highly desirable that every country implementing GFCS-related projects has national legislation and policy frameworks in place. These instruments which will vary from country to country clarify the national requirements and foundation for climate services ranging from the collection, quality control, archive and dissemination of climate observations to products and services. They will also identify the roles and responsibilities of the institution(s) that are designated by the government to provide these services to meet the national needs.

**Objectives:**

National climate service legislation and policy frameworks in place.

**Activities:**

Ideally part of the risk assessment with major GFCS projects would identify any risks to the long term sustainability and short term implementation of the project following from absent or incomplete national legislative and policy frameworks.

Work with countries to adapt and adopt legislation appropriate to the situation.

**Benefits:** National legislation and policy frameworks will be in place to ensure longer term sustainability of GFCS-related projects.

**Deliverables/Outcomes:**

Deliverables: National legislation and policy frameworks in place for each country implement a major GFCS project.

Assessment measures: Policy in place, policy being used to guide the development and delivery of climate services to meet the needs agreed under the UIP and within the capabilities of the national CSIS.

**Inputs:**

- Model legislation and policy frameworks

**Risks:**

- Difficulty convincing government of the need to change legislation or introduce legislation to cover climate services
- Changes in government during legislation and policy development or implementation
- Legislation or policy frameworks cannot adapt to changing requirements

**Timeline:** 1 to 5 years per country depending upon government processes and procedures.  
Long term, this may be required in more than 100 countries

**Resource requirements:** At this stage unknown. Allow CHF 200,000 / year for the first two years to build up a better estimate of requirements.

Estimated costs: CHF 400,000

**Project title: 22** - Training for users of Climate Services

**Goal:** Assist climate service users to make better use of climate data, products and information

**Pillar:** Capacity Development

**Submitting Agency:** WMO

**Partners:** FAO, WFP, WHO, UNESCO, ISDR, national climate service provider(s), training providers

**Scope:**

For a country to benefit from improvements in the quality, quantity and range of climate data, products and information the potential users need to know how to access the services (where, when, how data formats etc), how to interpret the data / products / information (limitations in terms of accuracy and applicability, temporal and spatial domains, how the data has been quality controlled, how it has been produced) and who to contact for further information. This project complements activities under the UIP and CSIS but is focused on the needs of the climate service users

**Objectives:**

Climate service users are able to access and utilize the available national climate data, products and information

**Activities:**

- Using information from the national UIP to determine the key national climate data, products and information users will be surveyed to identify common high priority training needs.
- Using the outcome of the training needs analysis a range of options will be developed to meet the training needs against available human resources and finances.
- Education and training activities will be undertaken with follow up evaluation to determine whether the education and training activities have addressed the needs.
- Monitor the needs from the UIP and CSIS to determine if further training activities are required as the maturity of the climate service users and provider(s) increase.

**Benefits:** Better access and use of climate services.

**Deliverables/Outcomes:**

Education and training packages addressing the core needs of national climate service users are available in national language. There should be one or more national providers capable of delivering these packages. For some countries the national provider could be a regional organization.

**Inputs:**

UIP identifies the common core national data, products and information to be provided by the national climate service provider(s) and typical uses of these data, products and information.

Open educational resources available globally to adapt and adopt to national circumstances.

**Risks:**

- UIP is unable to determine the common core climate data, products and information and their typical uses, thus making it difficult to identify the themes, level and focus for the training packages
- Lack of trained staff to adopt, adapt, develop, develop and evaluate the training
- Absence of training facilities
- No funding or mandate from the UIP for the training to occur

**Timeline:**

Basic packages should be able to be delivered within 12 months.

Ongoing, the project would be expected to change with time as the range, quality and quantity of climate service data, products and information change and the climate users become more adept at utilizing the output from the service provider(s).

**Resource requirements:**

Ideally at least some of this should be incorporated into major projects however it would be best to assume that a number of pilot projects would be developed over the first five years of the GFCS to address some of the questions. Assume CHF 300,000 a year for the first five years to engage partners in developing and delivering a number of pilot projects CHF 300,000 / year or CHF 1.5M for five years.

**Project title: 23** - Improving decision-making in climate related risks

**Goal:** Mainstreaming the use of climate information in decision-making

**Pillar:** Research, Modelling and Prediction, with links to User Interface Platform, Climate Services Information System and Capacity Development

**Submitting Agency:** World Climate Research Programme in conjunction with WMO

**Partners:** FAO, WFP, WHO, IFRC, UNISDR, World Bank

**Scope:**

Improve decision-making through more effective use of climate information and climate services. This will be done through multi-disciplinary research and close engagement between climate service developers, providers and users.

**Objectives:**

Demonstrate, through analysis of case studies, how existing climate information can improve decision making in the Framework's priority areas.

Enable users to exploit climate information, with its inherent uncertainty, more easily and more effectively in their decision making, and minimize possible misinterpretation or misuse of complex climate information, for example through climate risk assessments involving collaboration between providers and users. Currently there is a large gap between users' needs for actionable and valuable information and the climate services capability to serve those needs. This activity will improve the ability of users to incorporate probabilistic climate information into their decision-making processes in order to prepare for and manage climate-related risks. The activity will engage both the users and the providers of climate information in developing tools and techniques to extract useful and actionable information, thereby bridging the gap between users' needs and climate services capabilities. It will develop new and improved methodologies to exploit more efficiently the emerging prediction capabilities being developed by climate science. It will coordinate interdisciplinary research in support of decisions that are influenced by climate variability and climate change.

**Activities:**

The World Climate Research Programme will coordinate activities. Initial activity will be to form a consortium with inclusion of NMHSs, climate research and climate service centres, sector lead agencies, local decision makers, users of climate information. The consortium will engage with ongoing activities related to this project, such as WCRP Grand Challenges, IPCC Working Groups, European Commission research projects (EUPORIAS and CLIM-RUN).

**Benefits:**

Users will be able to use climate information in their decision making more easily and more effectively; climate services and climate science will be of more use to society and used more widely; demonstrating the benefits of climate services will make it easier to attract funding for future research to further improve climate services; the risk of possible misuse of climate information will

be reduced.

**Deliverables/Outcomes:**

Deliverables:

1. Case studies (one for each of the 4 initial priority areas) demonstrating how existing climate information can improve decision making in the Framework's priority sectors
2. Development of a multi-disciplinary research programme (meteorology, natural science, social science, economics) to improve the flow and use of climate information to inform decisions
3. Research into how to make uncertain probabilistic information fit into decision support systems, communication of complex science-based information, and assessments of impacts of changes in climate on natural and human systems.

The following will be assessed by user feedback through the User Interface Platform:

- Reports on techniques to extract useful and actionable information for decision making and to more effectively exploit the emerging prediction capabilities with account of uncertainty in climate information and limits of its use.
- Guidance on verification of climate information products.

**Inputs:**

Coordination to be provided under the World Climate Research Programme, forming a consortium with inclusion of National Meteorological and Hydrological Services (NMHSs), climate research and climate service centres, sector lead agencies, local decision makers, users of climate information.

**Risks:**

There are likely to be challenges arising from the need to deal with multi-disciplinary research, spanning natural sciences, social sciences and economics, as well as effective communication and engagement between providers, developers and users of climate services.

**Timeline:** 2 years, to start late 2013

**Resource requirements:** CHF 1,000,000

**Project title: 24** - Establishment of a formal mechanism for consultation with users, and use it for an assessment of the role of observations in adaptation to climate variability and change; Development of guidelines to improve discovery of climate observational data and products

**Goal:** Mainstreaming the use of climate information in decision-making

**Pillar:** Observations and Monitoring, with strong links to the CSIS and UIP

**Submitting Agency:** WMO

**Partners:** All stakeholder agencies

**Scope:**

By means of brainstorming workshops in close co-ordination with respective liaison activities proposed in the four Exemplars, representatives of user communities and representatives of observation providers will convene to discuss mutual concerns at global, regional and national scales. Linkages to the User Interface Platform and the Climate Services Information System will be especially important to capture relevant implicit observation requirements. An international, multi-stakeholder workshop will be organized to assess the adequacy of, and future requirements for, observations to support adaptation to climate variability and change.

Guidance will be developed and training provided for GFCS contributors and users on how climate observations and products can be found, based on Discovery Metadata records, so that the benefits from investment in observations and products can be achieved. Further tools may be developed to assist users in easy data discovery. Once accessed, the data will only be usable if they can be exchanged and processed unambiguously by the use of standard data representations which will need to be enhanced because of increasing requirements for more frequent and more detailed reporting of climate information and because of the complexity of collecting and exchanging information from widely different communities.

**Objectives:**

- a) Establish a continuing mechanism, in line with GFCS Principle 8, whereby representatives of different user communities, including, but not limited to, the four focal areas of the GFCS Implementation Plan, can consult with providers of climate observations and of other relevant socio-economic, biological, and/or environmental data to clarify data needs at global, regional and national scales for the provision of climate services.
- b) Assess the adequacy of observations to support adaptation to climate variability and change. Identify the requirements for new observations and their use in monitoring to support climate services addressing adaptation needs. Identify requirements for observations to support research into adaptation, such as through the Programme of Research on Climate Change Vulnerability, Impacts and Adaptation (PROVIA) and/or the WCRP.
- c) To provide guidance and training for potential user communities on how climate observations and products are described in WIS Discovery Metadata records. To enhance the usability of climate observations by developing an abstract data model that allows seamless transition between data formats of different communities.

**Activities:****Benefits:**

- a) Among observation providers, an understanding of the needs of users is deficient. Moreover, requirements for socio-economic, biological and environmental data to support the provision of climate services are not as yet well defined. Establishment of a consultation mechanism will help to address these problems, ensure user needs are considered, and help clarify requirements for socioeconomic, biological, and environmental data. All Exemplars draw attention to the need for close liaison and coordination between the observational and user communities across all geographical scales.
- b) Focuses on gaps in observing networks within atmospheric, terrestrial, and oceanic domains specifically related to the needs for adaptation to climate variability and change. User-provider partnerships will be strengthened (GFCS Principle 8).
- c) Allows the benefits from investment in observations and products to be realized and reduces the cost of data processing. Also, the Health Exemplar, for example, points out that access to climate and health surveillance data is not always easy and openly available. This project promotes the improved coordination and trust that enables the data sharing the Health Exemplar advocates. The project is responsive, in particular, to GFCS Principle 2.

**Deliverables/Outcomes:**

Initially, a mechanism for continuing consultation between observation and data users and providers will be agreed. Subsequent consultations will address critical issues including: (1) specific requirements for climate observations and for other socioeconomic, biological, and environmental data at global, regional and national scales; and (2) data standards, formats, and protocols for the quality assurance, management, and exchange of these data types in support of the provision of climate services.

An assessment report will be compiled including strategic guidance on steps that can be taken in the coming years to address the needs for observations for adaptation to climate variability and change.

Enhanced abstract data model providing improved usability and interoperability of data, and training, guidance materials and tools for user communities on how to describe climate observations and products in WIS Discovery Metadata records.

**Inputs:**

The key for this activity is the effective engagement with different user communities, especially those representing the four focal areas of the Implementation Plan, and with data providers from relevant socioeconomic, biological, and environmental sectors.

**Timeline:**

Initial workshops on user consultation and on requirements for observations to be undertaken in the first year. Development of guidelines will take two years.

**Resource requirements:**

For initial user consultation workshop: approximately CHF.100,000  
Subsequent workshops would also cost about CHF 100,000 annually.  
Observations requirements workshop: CHF 200,000  
Development of guidelines: CHF 700,000

**Project title: 25** - Establish and coordinate operational support for Frameworks for Climate Services at the national level in developing countries

**Goal:** Mainstreaming the use of climate information in decision-making

**Pillar:** Climate Services Information System, with links to User Interface Platform and Capacity Development

**Submitting Agency:** WMO

**Partners:** FAO, WFP, WHO, UNESCO, ISDR

**Scope:**

Focusing on the needs of developing countries, the entities and necessary methods of cooperation will be identified for developing and providing climate information, products and services that meet national needs and priorities. They will then be formalized and coordinated in a consistent and sustainable manner. This activity will be closely aligned with the dialogue activities under the UIP pillar (e.g., Climate-Health Working Groups) and also with associated activities under the Capacity Development pillar.

**Objectives:**

- To identify the national providers and the national CSIS entity or entities responsible for:
  - maintaining the official climate record (normally the National Meteorological and Hydrological Services (NMHSs));
  - developing the operational climate information products that constitute the essential climate science inputs for climate services at the national level (primarily the NMHS); and
  - creating and providing authoritative, credible, usable and dependable science-based climate information and advice that is valuable to users.
- To promote internationally consistent mandates for the national CSIS entities, including (based on identified user requirements) for:
  - the timing, content and format of a minimum set of climate information products to be provided to specific users;
  - gathering, assembling and managing the data necessary to support climate services (physical climate, water, socio-economic, etc.);
  - identifying research advances and incorporating relevant ones into national practices;
  - active management of user engagement, including forums as well as dissemination and feedback mechanisms;
  - procedures for issuing early warning for fast- and slow-onset hazards;
  - cooperative mechanisms to ensure the consolidation, coordination and optimization of the development and provision of user-focused climate services; and
  - performance measurement, evaluation and response procedures.
- To identify gaps in national capacity along with options to address such gaps, including capacity development and, where necessary, options for delegating responsibilities to regional or international parties.

- To establish or expand interaction and dialogue between providers and users at the national level, i.e. the government ministries and institutions; UN and sector-based institutions representing key socio-economic sectors; the private sector; the broader community for identifying user requirements and for user training in climate matters, as well as for discussion and feedback on climate information and products.
- Ultimately, to improve user confidence in climate information and products so that they use them effectively and proactively in decision making for all aspects of climate risk management.

**Activities:**

The steps outlined under the objectives will be taken, i.e. the national entity(ies), most often a National Meteorological and Hydrological Service (NMHS), responsible for maintaining the official climate record and providing operational climate information products, will be identified, as will the stakeholders and key communities of users of climate data, products and services; the different communities of practice will be brought together, allowing them to realize and appreciate the gaps separating them. Partnerships will be built and further interactions encouraged so as to close the gaps and to identify a way forward to sustain the bridge between participants for further climate information communication from scientists to community end-users and back. Key responsibilities to users and producers in the end-to-end chain of delivery from data collection through the use of specific climate services to enhanced actions based on climate-sensitive decision making will be designed and assigned, and where national capacity is lacking, an analysis of the functions that might be delegated to regional and/or international parties will be undertaken.

**Benefits:**

Both providers and users of climate products and services will benefit from establishment of national frameworks, in that the available resources applied to product development will be optimized, consistent and more efficient; products will evolve to address gaps, improve quality and reduce uncertainty, resulting in improved confidence and trust; it will be clear where the services are developed which will help to improve access and dialogue between users and providers; dialogue between sectors on climate characteristics and impacts will improve, and greater common understanding of climate and its impacts will be possible. Countries and sectors will become active and proactive, and regularly engage in climate risk management, thus building resilience. Adherence to internationally recommended guidance will promote more internationally consistent policy and socio-economic applications.

**Deliverables/Outcomes:**

- A guidance document (developed by the WMO Commission for Climatology and the Commission for Basic Systems, Regional Associations, countries, user stakeholders) to assist in development of frameworks for climate services at national levels, in which roles and responsibilities of the various actors are proposed;
- One or more relationship-building and demonstration activities with key stakeholders to discuss opportunities and constraints, identify national requirements (for risk management and adaptation, inter alia) and agree on sustainable operating procedures for ongoing collaboration;
- National Climate Outlook Forum/National Climate Forum sessions devoted to the establishment and coordination of frameworks for climate services at the national level;
- Agreements and MOUs (e.g. on provision of physical and socio-economic data, or institutional agreements for cooperation).

**Indicators and assessment measures:**

- Number of Members with formally established operational support to frameworks for climate services at the national level;
- Numbers of meetings and meeting reports;
- Number of agreements (e.g. MOUs);
- Number of countries with access by their users (could be assessed by sector) to the climate information and products needed for climate risk management.

**Inputs:**

WMO will lead the project, with input also from partnering agencies at global and regional scales including their regional and technical constituent bodies as required (e.g. FAO, WFP, WHO, UNESCO, ISDR). At national level, entities providing services and observational and monitoring (involving physical as well as socio-economic data), and academic and research institutions have a role to play. Key national partners and stakeholders are those representing users (e.g. national ministries and agencies for agriculture and food, health, water, disaster management and climate). To achieve results, International and national banks and financing institutions, regional economic groups, aid agencies, etc. have a vital role.

**Timeline:** Mid-2014 for initial implementation; then ongoing

**Resource requirements:**

CHF 1M initially

**Project title: 26** - Implementation of Climate Watch System

**Goal:** Reducing the vulnerability of society to climate-related hazards through better provision of climate information

**Pillar:** Climate Services Information System, with links to User Interface Platform and Capacity Development pillars

**Submitting Agency:** WMO

**Partners:** FAO, WFP, WHO, UNESCO, ISDR

**Scope:**

A Climate Watch System (CWS) provides a proactive mechanism for interacting with users (e.g. governments, industry, sectors, communities, and the public) and alerting them to major climate anomalies and extremes. CWSs, which use climate data, monitoring products, imagery, and predictions, add value to existing climate monitoring and forecasting systems within the National Meteorological and Hydrological Services and should be developed to involve users fully in providing the conditional elements of the system: thresholds, indices, criteria and databases. CWS will enable climate sensitive sectors to access critical information on possible negative impacts of ongoing or foreseen climate anomalies and extremes in a timely manner. This activity includes conducting workshops and demonstration projects to facilitate interactions between NMHSs and key stakeholders as well as to develop templates for climate watches for use in key climate sensitive sectors. NMHSs, Regional Climate Centres (RCCs) and sectors will collaborate in different regions to agree on a set of procedures, tools and data bases needed for organizing and operating national and regional CWSs. This activity will also assist developing countries with trainings and guidelines on implementing climate watch systems at the national level. This activity will contribute to the DRR priority project on strengthening regional capacity for disaster risk assessment and early warning of hydro-meteorological risks, as well as to the national training needs identified under the Capacity Development pillar.

**Objectives:**

- Provide a proactive mechanism for interacting with users (e.g. governments, industry, sectors, communities, the public) and alerting them to major climate anomalies and extremes;
- Provide the conditional elements of the CWS such as thresholds, indices, criteria and databases, using climate data, monitoring and prediction products, and add value to existing climate monitoring and forecasting systems within the National Meteorological and Hydrological Services;
- Develop CWSs fully involving users and enable climate sensitive sectors to access and use in a timely manner the critical information on possible negative impacts of ongoing or anticipated climate anomalies and extremes.

**Activities:**

- Conduct workshops and demonstration projects to facilitate interactions between NMHSs and key stakeholders;
- Develop templates for climate watches for use in key climate sensitive sectors. NMHSs, RCCs and sectors will collaborate in different regions to agree on a set of procedures, tools and data bases needed for organizing and operating national and regional CWSs;
- Assist developing countries with training and guidelines on implementing climate watch

systems at the national level.

**Benefits:**

- Nations will be able to develop and take advantage of climate services with special emphasis on devising methods of adapting to, and mitigating, the adverse impacts of climate and its variations;
- Promote awareness of the potential benefits of climate services in human endeavor with particular emphasis on public safety and welfare;
- Sectors (i.e. Health, DRR, agriculture, food security...) will be able to be fully part of CWSs at national levels, enabling them to build consortiums with climate information providers for developing climate advisories for specific context and needs.

**Deliverables/Outcomes:**

- Templates of climate watches will be developed with consideration of specific needs of sectors and regional contexts;
- Regional CWS Implementation workshops leading to implementation of CWS at national levels.

**Indicators and assessment measures:**

- Organization of CWS at regional then at national level with implementation of CWS demonstration projects in the countries in the various regions.
- Progress in organizing climate watch systems at regional level;
- Progress in the provision of climate watches at national levels.

**Inputs:**

World Meteorological Organization will coordinate the work with the assistance of NMHSs, key stakeholders representing sectors at global scales (e.g. FAO, WFP, WHO, UNESCO, ISDR) and key stakeholders at national scales, e.g. national ministries and sector agencies.

**Timeline:** End of 2014

**Resource requirements:**

CHF 600,000

**Project title: 27** - Expand and sustain National Climate Outlook Forum (NCOF) or National Climate Forum (NCF) operations

**Goal:** Mainstreaming the use of climate information in decision-making

**Pillar:** CSIS, linked to UIP

**Submitting Agency:** WMO

**Partners:** FAO, WFP, WHO, UNESCO, ISDR

**Scope:**

This activity will establish or enhance national mechanisms such as National Climate Outlook Forums (NCOFs)/National Climate Forums (NCFs) in order to extend the benefits and concepts of Regional Climate Outlook Forums (RCOFs) to the national scale, and to increase access and use of climate outlooks and other climate information and products by users at the national level. It will also facilitate consistency in using climate information by all national user sectors. The activity will establish effective means of disseminating climate information, and of fostering dialogue between providers and users at national scales through NCOFs/NCFs. From a CSIS perspective, a more fundamental project objective is to strengthen the capability of CSIS entities to help users plan, produce, disseminate and secure feedback for their products and services. Deliverables include guidance on establishing and operationalizing NCOFs/NCFs as well as several demonstration projects. The activity will also facilitate consistency in interpreting and using climate information, which will improve multi-sectorial and cross-sectorial decision making.

**Objectives:**

- To ensure that National Climate Outlook Forums/National Climate Forums are established (or improved, if they already exist) and made operational for disseminating climate information effectively and for fostering dialogue between providers and users at national scales through several demonstration projects;
- To identify practices and methods, including using Internet technologies for provider-user engagement during periods when there is no opportunity for meetings;
- To strengthen the capability of CSIS entities to engage with users in planning, producing, disseminating and securing feedback for their products and services.

**Activities:**

- Establish or enhance national mechanisms such as National Climate Outlook Forums (NCOFs)/National Climate Forums (NCFs)
- Foster dialogue between providers and users at national scales through NCOFs/NCFs.

**Benefits:**

CSIS entities will benefit by having direct contact with key users of climate information, and opportunity to participate in development of national and sector decisions where climate is a factor (e.g. for climate risk management and adaptation, emergency planning and response, etc.). Users will benefit from direct access to climate information providers, for increasing their awareness and knowledge, and for advice on application of the products in decisions. Both providers and users become aware of what is needed, what is possible, and how to cooperate.

They will be prepared to optimize when climate is benign, and will be prepared should significant anomalous climate events threaten. Consistency in the interpretation and use of climate information will improve multi-sectoral and cross-sectoral decision making in cases of common influences.

**Deliverables/Outcomes:**

Guidance on establishing and operationally conducting NCOFs/NCFs;

- Several demonstration projects.

**Indicators and assessment measures:**

- Numbers of countries having NCOFs/NCFs in operation;
- Number of user sectors actively involved in NCOFs/NCFs;
- Number of NCOF/NCF sessions.

**Inputs:**

WMO, through its Commissions – CCI and CBS – will lead the project in cooperation with partnering agencies at global to national scales, national CSIS entities, national user communities and the media.

**Timeline:** End of 2014 for initial phase, then ongoing

**Resource requirements** CHF 1M

**Project title: 28** - Research on climate predictability and improving prognostic skill: subseasonal to seasonal time scales

**Goal:** Reducing the vulnerability of society to climate-related hazards through better provision of climate information

**Pillar:** Research, Modelling and Prediction

**Submitting Agency:** World Climate Research Programme in conjunction with WMO

**Scope:**

Research on improving predictive skill at the traditional interface between weather and climate is a high priority not only for meteorological services but also for GFCS. Predictions covering the timescale from weeks to a season are essential for support to various socio-economic decisions and risk management strategies related to almost all GFCS sectors. Factors and processes determining weather and climate predictability at these time scales need to be actively studied so that they can be captured in observations and represented in models. Such factors include Madden-Julian Oscillations, stratospheric processes with longer time scale than tropospheric processes, sudden stratospheric warming and cooling events, solar radiation effects, slowly varying initial conditions at the surface such as Sea Surface Temperature, sea-ice, snow height and cover, soil moisture anomalies, and, possibly, vegetation. Predictability of climate at sub-seasonal time scales is driven by a complex interaction between atmospheric predictability on weather timescales and the state and phase of dominant modes of the atmospheric and ocean larger-scale variability, such as North Atlantic Oscillation, Southern Annular Mode, Indian Ocean Dipole, El Niño and La Niña. A focus of research on modes of organized convection and the interactions between tropical and extra-tropical latitudes, as part of the Year Of Tropical Convection (YOTC) project, has recently shown promising results and may help to identify additional predictability factors for mid-latitude regions. Unprecedented changes in the Polar Regions, especially the Arctic, which is demonstrating accelerated warming with markedly decreasing multi-year sea-ice cover, have significant implications for subpolar and mid-latitude climates and require dedicated research.

Predictions on sub-seasonal to seasonal timescales are strongly dependent on the availability of accurate initial conditions for all components of the Earth system, including those that have a longer memory than the atmosphere. Hence, progress in prediction on the sub-seasonal and seasonal time scales can be expected due to more comprehensive observations, which will not only serve as the main means of initializing climate models but also are the foundation for better understanding and improved representation in models of the key phenomena and processes. It has also been concluded in the WCRP experiments on seasonal climate predictions that, even on this relatively short climate scale, it is important to ensure that models used for seasonal prediction have adequate long-term climate forcing. In the case of seasonal predictions this means the need to ensure an update for the atmospheric composition prescribed in the model.

**Objectives:** Improving predictive skill at the traditional interface between weather and climate is a high priority not only for meteorological services but also for GFCS.

**Activities:**

Several RMP activities will address predictability and predictive skill on the sub-seasonal to seasonal time scale.

In the near-term perspective, the initial focus will be on improving predictions on the sub-seasonal time scale. This will be pursued by the weather and climate modelling communities through the joint WWRP – WCRP sub-seasonal to seasonal (S2S) initiative, to be developed in cooperation with the WMO system for long-range forecasts and building on the experience of the THORPEX Interactive Grand Global Ensemble (TIGGE) database for medium range forecasts (up to 15 days) and the Climate-system Historical Forecast Project (CHFP) for seasonal forecasts. Research on and modelling of multi-scale convection processes, ocean – atmosphere and ocean – atmosphere interactions, dominant tropical modes of atmospheric variability and assessment of the research needs to identify and capture predictability of monsoon phases will be included. Procedures for specification of initial conditions for sub-seasonal predictions will be reviewed. The project is envisaged to have a 5-year lifespan with the intention to demonstrate the initial benefits within the next two years. Polar prediction at the weather and climate interface will be pursued by the WWRP through the Polar Prediction Project (PPP), which is a contribution to the Global Integrated Polar Prediction System (GIPPS). Existing professional working groups, such as the Societal and Economic Research Applications (SERA) Working Group of WWRP, are planning to analyse socio-economic benefits of this research and make recommendations to maximize it. Further recommendations will be made on using the research outcomes in practically important application areas, for example, in studying seasonal predictability of tropical cyclone activity.

The strategy to improve the skill of multi-time-scale numerical prediction systems is associated with using ensembles of “coupled” models (atmosphere, ocean, land surface and cryosphere), implicit inclusion (parameterization) and explicit resolution of all significant processes determining interactions between various components of the climate system, and creating a so-called seamless suite of forecasts that optimizes longer range products based on information already available for shorter time scales. This may require a range of models tailored to specific prediction and projection needs with optimal sharing of model code and infrastructure in a manner that allows and promotes flexible configuration of the modelling system for the problem of interest. In addition to optimizing the model runs, significant benefit with this approach may reside in the exhaustive use of information available for all time scales, in preparation of a forecast. Dedicated research efforts will be made to start implementing at least initial elements of such a comprehensive prediction approach and assessing their cost-benefit ratios in terms of improving prediction skill versus resource requirement and development complexity. Coordination of climate model development will continue through intercomparisons, process-based model evaluation, and development of guidance on the use of (multi-model) ensemble prediction schemes. The current skill of modelling and prediction of precipitation and its anomalies will be assessed to derive recommendations on ways of its improvement.

Teleconnections and interactions between tropical and extratropical latitudes and between the troposphere and stratosphere will be investigated, including the means of representation of their predictable elements in models. Seasonal predictability of polar and subpolar regions also will also be investigated, especially with respect of the rapid changes taking place in these regions and the emerging needs for services. Similarly, the ability of predictive models to adequately simulate fluxes of energy, mass, and momentum between the atmosphere and underlying ocean or land surface will be systematically reviewed, which is a prerequisite for exploiting the predictability associated with long-term climate variability and the interaction of the atmosphere with the underlying upper layer of the ocean, the ocean thermocline, and the upper layer of soil.

The research under RMP will target the improvement of both deterministic (e.g., single model run) and probabilistic (e.g., mode run ensembles and evaluation of uncertainty) predictions of significant events and corresponding variables such as heat waves, cold spells, monsoon phases, precipitation and air temperature anomalies, tropical cyclone season characteristics, sea-ice conditions, etc.

**Benefits:** Various socio-economic decisions and risk management strategies related to almost all GFCS sectors will be supported and, through better provision of climate information, the vulnerability of society to climate-related hazards will be reduced.

**Deliverables/Outcomes:**

Improved skill and enhanced availability of predictions

**Indicators and assessment measures:**

Number of centres producing predictions, regular availability of experimental forecasts, Early Warning Systems and alert systems for climate variables.

Positive evolution of standard verification scores of predictions by leading centres.

**Inputs:**

Inputs required from WWRP/WCRP Sub-seasonal to Seasonal (S2S) Initiative

**Risks:**

Risks are associated with complexity of the research field and technical complexity of experiments.

**Timeline:** 5 years

**Resource requirements:** CHF 300,000

**Project title: 29** - Research on climate predictability and improving prognostic skill: decadal to centennial time scales

**Goal:** Reducing the vulnerability of society to climate-related hazards through better provision of climate information

**Pillar:** Research, Modelling and Prediction

**Submitting Agency:** World Climate Research Programme in conjunction with WMO

**Scope:**

Decadal - centennial time scale is extremely important for adaptation to climate change and variability. Yet it is the scale where feasibility and reliability of climate predictions and projections is very difficult to estimate. Massive efforts are therefore required from the climate research community to address the corresponding scientific and technological challenges in support of major governance decisions at global, regional, national, and local levels.

The quality of the future climate projections on decadal – centennial time scale is dependent on the quality of long-term data for radiative forcing, which is influenced by concentration of greenhouse gases in the atmosphere, including carbon dioxide, methane, ozone, nitrous oxide, halocarbons, reactive nitrogen, particulate matter including black carbon and mineral dust, as well as on accuracy of treatment in models of feedback processes related to clouds and atmospheric water vapour and land surface processes. The evolution of the concentration and distribution of radiative forcing agents is therefore a crucial factor in future climate projections. Their specification results from the assumptions with respect to future emissions of anthropogenic greenhouse gases, first of all carbon dioxide, particles, and ozone-depleting substances.

The 17<sup>th</sup> Conference of Parties of the UNFCCC set up a process that envisions a legal agreement on climate change by 2015. Climate research advances would contribute to this process by providing relevant guidance on mitigation policies including informative metrics, such as cumulative carbon, which is responsible for practically irreversible elevated temperatures for hundreds of years or a millennium, and consideration of short-lived climate forcing agents, reduction of which would result in “trimming the peak” of warming on shorter time scales. For adequate support to adaptation to and mitigation of climate change, better understanding of the past and future climate evolution and forcing factors that determine it, and enabling more comprehensive climate projections and restorations, research and more regular atmospheric chemistry observations should continue to develop. This is the domain of the WMO Global Atmosphere Watch (GAW) Programme and of some research projects such as the IGBP International Global Atmospheric Chemistry and the WCRP Stratospheric Processes and their Role in Climate (SPARC) project. For enabling corresponding services, more sustained operational delivery of GAW products and support to its infrastructure will be needed.

For the decadal and longer time scales, there is a pressing need for developing quantitative research supporting climate change impact and vulnerability assessments and adaptation measures. The recent analysis of the Global Research Priorities of Programme of Research on Climate Change Vulnerability, Impacts and Adaptation (PROVIA) has identified 33 research topics that include, *inter alia*:

- Developing indicator and monitoring systems,
- Quantifying vulnerability and risks of extreme climate events,

- Advancing vulnerability reduction and adaptation solutions,
- Improving approaches to adaptation,
- Enhancing communication and stakeholder - public participation,
- Studying specific adaptation needs in key systems and regions, and
- Initiating research on emerging adaptation topics.

The climate science and Vulnerability, Impacts and Adaptation (VIA) communities have many common interests. They share several methodological approaches. For example, the climate impact researchers are starting to undertake major model intercomparisons (MIPs) and uncertainty analyses similar to the ones developed and routinely used by climate scientists. Emerging needs for tailored climate information can be expected as impact and adaptation models become refined over time. New methods of incorporating climate information (especially on high-frequency variability) into impact assessments require heightened attention, both with respect to the techniques of application and the robustness of the information being transferred.

Very significant risks for coastal zones are associated with uncertainties in assessments of the future sea level, both its global mean and its regional variations. Recent observations indicate a likelihood of accelerated sea-level rise in comparison with estimates made by IPCC in its AR4 in 2007. Significant remaining uncertainties are related to still insufficient knowledge of all mechanisms involved in the ice sheet response to a warming climate and big potential range of forcing factors. The progress in sea-level research is fast but the remaining issues are, nevertheless, very challenging. There is also a clear need to translate conclusions of sea-level assessments into effective guidance for coastal zone protection and management.

**Objectives:** Improving climate predictability and improving prognostic skill: decadal to centennial time scales.

**Activities:**

For the decadal - centennial time scale, the climate research community will continue to work on experimental decadal predictions and centennial projections of climate change and changes in climate variability. The focus will be on identifying phenomena that offer some degree of predictability, enhancing the observing and data assimilation systems that would capture the predictability signal in forecast initial conditions, developing prediction systems able to realistically represent processes associated with all forms of climate predictability, and process the output of these systems to provide probabilistic forecasts with skill sufficient for planning and decision making purposes. Research on decadal prediction of Atlantic multi-decadal variability and Pacific decadal variability shows more perspective results for the Atlantic sector, which may be instrumental for subsequent prediction of climate variations over Europe, Africa and parts of the Americas. This will be the emphasis of main experimental research efforts. Some coherent changes in the global atmosphere follow major volcanic eruptions. If such an eruption occurs, there may be a need to consider its impact on climate prediction on decadal and climate projection on centennial timescales.

Systematic research will continue on the radiative forcing agents of climate and scenarios of future emissions of anthropogenic greenhouse gases, particles, and ozone-depleting substances. Past and present emissions and fluxes of radiative forcing agents will be validated against observed fluxes and concentrations of these gases. Such validation will be an essential contribution to the development of an integrated global greenhouse gas information system. Climate reanalysis and projections using model systems that have been compared with observations of greenhouse gases and their fluxes and demonstrated a skill in describing the cycling of radiative forcing agents will be used to provide best possible information for climate change mitigation measures.

A major deliverable of climate research will be its contribution to the forthcoming IPCC AR5. The

assessment will include four reports, namely on the Physical Science Basis; Impacts, Adaptation and Vulnerability; Mitigation of Climate Change; and a Synthesis Report. After the publication of AR5, which will start in September 2013, the RMP activities under GFCS and some other components of the GFCS Implementation Plan will need to be reviewed and adjusted based on the new findings. Potential directions and themes of future research will include the role of the long- and short-living climate forcers in climate change, changes in frequency of occurrence of extreme events in temperature, precipitation, tropical and extratropical storms in changing climate, variations in tropical cyclone activity on decadal time scale, processes responsible for greenhouse gas exchange with terrestrial ecosystems, interactions of clouds, aerosols, precipitation, and radiation and their contributions to climate sensitivity using a range of scientific approaches including a hierarchy of models, etc. Plans for a significant volume of research on VIA are in preparation (PROVIA, 2013).

A comprehensive program of research on all factors contributing to the sea-level global mean and regional change, with a view of significantly reducing the remaining uncertainties and developing informative recommendations for coastal zone management, will be developed. It will rely on related activities in other sectors and the outcomes of the IPCC AR5. Among the many specific future products, WCRP with partners, such as the Global Cryosphere Watch (GCW), will aim to produce an assessment of the state of the cryosphere in the 21<sup>st</sup> century with estimates of cryospheric contributions to future water resources and an assessment of regional variations in sea-level rise with guidance on expected sea-level extremes.

**Benefits:** Better adaptation to climate change and variability.

**Deliverables/Outcomes:**

Databases of predictions and projections, regional and national studies

**Indicators and assessment measures:**

Volume of downloaded data, publications on data use and interpretation, improvement in indicators of model quality.

Information from centres responsible for data holdings

**Inputs:**

Inputs required from WCRP **Coupled Model Intercomparison Project (CMIP)** and Coordinated Regional Climate Downscaling Experiment (CORDEX), WGRC.

**Risks:**

Complexity of experiments, unknown predictability, resources.

**Timeline:** Initial activity: one year, then ongoing.

**Resource requirements:** CHF 200,000

**Project title: 30** - Research-based climate observations and dataset development

**Goal:** Maximizing the utility of existing climate service infrastructure

**Pillar:** Research, Modelling and Prediction; Observations and Monitoring

**Submitting Agency:** WMO

**Scope:**

In the area of observations, (re-)processing, and (re-)analysis of historical observations, there is an urgent need for research and development of observing techniques capable of helping to close the gaps in observations in the polar and mountainous (i.e. cold climate) regions, enhance the observations in the deep oceans and the upper part of atmosphere, and start to more actively observe the atmosphere, ocean, and land chemical and biological variables. Scientific research can help to make the case for sustainable investments in observing systems by demonstrating the added value to products emerging from the observations. There is also a need to ensure that modern observing systems include variables important for initialization, calibration, and validation of predictive climate models. This includes ocean observations and sea-ice cover. The Global Ocean Data Assimilation Experiment (GODAE) project has developed the foundations of ocean data assimilation for climate change detection and experimental climate prediction. Now ocean observations can be regularly assimilated in models to produce consistent datasets representing state of the ocean up to a certain sufficiently large depth.

As mentioned above, significant advances are required in the understanding of past and current evolution and hence observations of the atmosphere and ocean chemistry, to include spatial and temporal distributions of long-lived greenhouse gases, reactive species, aerosols and corresponding estimates of radiative forcing. For example, many important chemistry-related observations are developed and carried out mainly in the research domain and often at academic institutions. Such research concerns the chemical composition and physical properties of aerosol, carbon fluxes between the earth's surface and the atmosphere, and feedback mechanisms between biogeochemical cycles of nitrogen and carbon. The vitality of the WMO GAW Programme, which to a significant degree is driven by academia and is research oriented, is instrumental for the global exploration and mapping of greenhouse gases and aerosols in the radiative forcing context. Systematic and resourceful transition of such observations, made in research mode, into a more operational mode, is required.

**Objectives:** research and development of observing techniques capable of helping to close the gaps in observations in the polar and mountainous (i.e. cold climate) regions, enhance the observations in the deep oceans and the upper part of atmosphere, and start to more actively observe the atmosphere, ocean, and land chemical and biological variables.

**Activities:**

Research will continue on satellite climate observations including their algorithms and calibration (Trenberth et al., 2011). The quasi-operational sustained Coordinated Processing of Environmental Satellite Data for Climate Monitoring (SCOPE-CM) will be created. Retrieval algorithms for additional Essential Climate Variables will be developed and Fundamental Climate Data Records (CDRs) and Thematic CDRs will be created. Possibilities for successful cross-calibrations for old and new satellite sensors, which require major scientific input, will be reviewed. Independent observations and analysis of observations made by other means and systems will be used to

improve the reliability of conclusions on various aspects of detection of climate variability and change. An international assessment of research priorities required for filling the existing gaps in climate monitoring continuity, accuracy, and efficiency, both from space and *in situ*, and building an operational global climate observing system will be conducted. This assessment will result in recommendations for transition from research to operational capability and identification of the overlaps needed to prevent critical gaps in the climate-relevant observations administered by many national and international agencies.

Research-intensive coordinated climate data reprocessing will continue in participating agencies and centres. The scope and period of coverage of meteorological reanalyses will be extended, and new types of reanalyses (e.g. for atmospheric chemistry, cryosphere, etc.) particularly involving coupling between different components of the climate system will be initiated. Metadata standards and indication of the dataset “maturity” will be further developed. Development of standards for presentation and documentation of model- and observation-generated climate data following the Climate and Forecast (CF) metadata convention will continue. Data reprocessing and reanalysis, as well as palaeoclimate observations and research will strongly benefit from the strengthened climate data rescue activities planned through the OBS Annex.

RMP pillar will make relevant climate data more and more accessible. A single repository for all gridded and processed observational datasets that is analogous to the CMIP archive of model data, provides users with easy access to data/information in a standard format, and facilitates their comparisons and accurate citation, will be promoted, likely following the approach proposed by the Obs4MIPS initiative. Metadata standards and conventions, such as Climate and Forecast, and indication of the dataset “maturity” will be further developed. Similarly, WCRP will continue wide communication on all aspects of reanalysis activities to create a knowledge base for all users of reanalyses and facilitate further development and greater use of reanalysis products beyond the current highly specialized group of users (<http://reanalysis.org>). This work will be coordinated with CSIS and rely on the capabilities, functionalities, and the data standards provided by the WMO Information System (WIS).

Based on the outcomes of the predictability studies, requirements for advances in ocean observations, especially in the Polar Regions, will be promoted. Research will intensify on data assimilation for ocean temperature, salinity, and dynamic topography in all oceans including deeper layers than currently accessible to the Argo programme. New satellite sensors will be used for this purpose. This will enable issue of novel ocean data syntheses and production of a range of oceanographic predictions including sea-ice prediction in Polar Regions and marginal seas with sea-ice cover. Ocean biogeochemical and ecosystem observing systems will be promoted as well.

As indicated in the OBS Annex, an integrated global greenhouse gas (GHG) information system, including enhancing regional scale chemical measurements, will be developed. It will provide regular regionally specific information related to the state of greenhouse gas-driven warming, the rate of GHG increase, and projections for future decades, during which adaptation measures will take place and upon which the success of adaptation measures will depend. Necessary coordination among WMO, GCOS, GEO-Carbon and regional projects such as Integrated Carbon Observing System (ICOS) in Europe, Carbon North America (CarboNA), and other similar efforts and existing networks around the world will be ensured.

**Benefits:** Scientific research will help to make the case for sustainable investments in observing systems by demonstrating the added value to products emerging from the observations.

**Deliverables/Outcomes:**

- Substantiated fundamental climate data records and their assessment.
- Expanded scope and increased accuracy of reanalyses, contribution to assessment of

products.

**Indicators and assessment measures:**

- Number of fundamental climate data records generated, publications on regional trends and impacts.
- References to datasets, publications.
- Number of years and variables covered, use of coupled models and data assimilation techniques in producing reanalysis, publications based on the data use.
- Documentation from responsible centres

**Inputs:**

WCRP affiliated research centres, WCRP WDAC; Responsible centres

**Risks:**

Risks are associated with technical challenges and with the resources required

**Timeline:** Initial phase 2014, with subsequent continuation

**Resource requirements:** CHF 600,000

**Project title: 31** - Strengthening coordination of research activities of main organizations, agencies, and programmes of direct relevance to GFCS; developing partnership of communities producing experimental and regular climate information, including predictions, and making research products more broadly available to climate service users for assessment.

**Goal:** Maximizing the utility of existing climate service infrastructure

**Pillar:** Research, Modelling and Prediction; UIP

**Submitting Agency:** WMO

**Partners:** UNESCO, ICSU, WCRP, WCP

**Scope:**

**Objectives:**

Strengthening coordination of ongoing and planned research activities of main organizations, agencies, and programmes of direct relevance to GFCS with a focus on mid- and longer-term perspectives.

Developing partnership of communities producing experimental and regular climate information, including predictions, and making research products more broadly available to climate service users for assessment.

**Activities:**

**Benefits:** The utility of existing climate service infrastructure will be maximized.

**Deliverables/Outcomes:** Improved services and their access

**Indicators and assessment measures:**

1. More detailed plan of research activities in support of GFCS in the mid- and longer-term perspectives.
2. Agreed and published planned document containing activities, responsibilities, management arrangements, resources, etc. for all planned activities. RMP Monitoring and Evaluation arrangements.
3. Assessment measures based on input, feedback and expressed commitments of main stakeholders.
4. Experimental climate products available to users. Feedback of users on research community products
5. Number of openly available and accessible climate information products including predictions at a range of time scales, suitable for support of diverse applications in GFCS priority sectors.
6. Monitoring of available products and of user feedback on them.

**Inputs:**

Inputs required from WCRP, WCP, WMO, UNESCO and its IOC, other UN Partners, ICSU,

PROVIA, etc., from regional partners, from leading modelling centres and interested national organizations. Input from all pillars is crucial.

**Risks:**

The complexity of the task and attaining a balance of interests among the partners and stakeholders represent risks that need to be addressed in the management of the project. Other issues are insufficient commitment and concerns for possible liability due to use of pilot products in services.

**Timeline:**

Strengthening research activities: Two years with later update

Developing partnerships: one year for initial coordination, with subsequent continuation of the partnership

**Resource requirements:**

Strengthening research activities: CHF 200,000

Developing partnerships: CHF 400,000

Total: CHF 600,000

**Project title: 32** - The design of baseline networks to underpin climate services, and rehabilitation of silent stations and key stations in data poor areas to enhance the baseline networks

**Goal:** Maximizing the utility of existing climate service infrastructure

**Pillar:** Observations and Monitoring

**Submitting Agency:** WMO

**Partners:** National Meteorological and Hydrological Services, Research Institutes

**Scope:**

In order to incorporate new observing requirements for GFCS sectors across all geographical scales, the baseline (core) networks will be designed and included in global, regional, and national near- and long-term plans. The baseline network will respect standard observing practices and will be managed according to agreed QMS to ensure that data are suitable for climate purposes.

In order to sustain, fill gaps in, and generally expand the baseline networks in all its components the silent stations and key stations in data poor areas, including Global Climate Observing System Surface Network (GSN) and GCOS Upper-air Network (GUAN) stations, will be rehabilitated, and agreed standards for observing practices will be applied to ensure that data are suitable for climate purposes. Priority will be given to those stations whose data are needed to meet observational requirements derived from the four priority sector Exemplars.

**Objectives:**

- Enable and underpin improved, operational climate services through well designed, sustained baseline (core) observational networks at national, regional and global scales.
- Enable improved climate service provision at national, regional and global scales through the rehabilitation of silent stations and key stations in data poor areas, including GSN and GUAN stations.
- Address needs expressed by the priority sectors (in the Exemplars) for climate observations on appropriate temporal and spatial scales.

**Activities:**

**Benefits:**

This implementation activity will address identified gaps. Climate predictions and projections will be increasingly skilful, the global observing system will be better able to meet climate information needs and to deliver timely and authoritative information on the status of the climate system at multiple temporal and spatial scales, the evolution of global observing systems will be better linked to individual implementation plans, and all observational requirements for the GFCS will be properly addressed as observing systems evolve. This will contribute to addressing needs expressed in all Exemplars for climate observations on appropriate temporal and spatial scales and by adhering to GFCS Principles 2 and 7.

**Deliverables/Outcomes:** Enhanced baseline networks

**Indicators and assessment measures:**

- The baseline (core) national, regional and global networks are incorporated in the global observing systems and implemented.
- Data from the previously silent and key stations in data poor areas are provided to GTS in real-time.

**Inputs:**

- Entities that operate observing networks (such as NMHSs, research institutes, universities, and the private sector) will need to make their data available for improved climate service provision at global, regional and national scales;
- Technological developments and national, regional, or global economic circumstances must enable these entities to sustain the delivery of these data over the long term, and
- Provision of adequate funding, human resources, and observing and IT technology must be in place to operate observing systems, to implement QA/QC procedures (including calibration and maintenance of the systems), to ensure reliability of data delivery, to ensure staff competencies, to ensure delivery using interoperable formats, and to distribute data and information worldwide in real or near-real time.

**Timeline:**

2 years for design of baseline networks, plus 4 years to implement; 2 years for rehabilitation of silent and key stations

**Resource requirements:**

CHF 1.5M for the review process and design of baseline networks  
CHF 5M for rehabilitation of silent and key stations

Total: CHF 6.5M

**Project title: 33** - Support for the operation of baseline networks in LDCs and SIDS

**Goal:** Advancing the key global development goals through better provision of climate information

**Pillar:** Observations and Monitoring, links to Capacity Development

**Submitting Agency:** WMO

**Scope:**

Support to operation of baseline networks in Least Developed Countries (LDCs) and Small Island Developing States (SIDS) shall be provided by the international community in the form of a Trust Fund.

**Objectives:**

Enable (improved, operational) climate services at national scales with contributions to regional and global climate services by supporting operation of baseline networks in LDCs and SIDS through a Trust Fund.

**Activities:**

**Benefits:**

This implementation activity will address identified gaps. It will, especially support sustainability of critical observing stations in LDCs and SIDSs that are essential for the GFCS and aligned with GFCS Principle 1. The project will contribute to addressing needs expressed in all Exemplars for climate observations on appropriate temporal and spatial scales.

**Deliverables/Outcomes:**

Baseline networks in LDCs and SIDS are established through a Trust Fund and contributions by the international community.

**Inputs:**

Provision of adequate funding, human resources, and observing and IT technology to operate observing systems, to implement QA/QC procedures (including calibration and maintenance of the systems), to ensure reliability of data delivery, to ensure staff competencies, to ensure delivery using interoperable formats, and to distribute data and information worldwide in real or near-real time.

**Timeline:** Initial period: 2 years; then ongoing

**Resource requirements:**

CHF 500,000 for initial support to LDCs and SIDSs;

CHF 3M over the following 10 years

**Project title: 34** - Improve ground-based and space-based networks for measurement of precipitation

**Goal:** Maximizing the utility of existing climate service infrastructure

**Pillar:** Observations and Monitoring

**Submitting Agency:** WMO

**Partners:** Space agencies

**Scope:**

Measurement of precipitation will be improved by filling gaps and enhancing surface- and space-based monitoring networks in order to respond to users' needs, including those expressed in the Exemplars, for more accurate and representative precipitation data at national, regional and global scales. Agreed standards for observing practices will be applied to ensure that data are suitable for climate purposes.

**Objectives:**

Reliable, spatially-representative precipitation data from atmospheric, oceanic, and terrestrial and surface- and space-based networks in near-real-time.

**Activities:**

**Benefits:**

This implementation activity will address identified gaps. The Water Exemplar points out that "water security in a variable and changing climate continues to be a key concern at national, regional, and global scales" and that "addressing this concern has emphasized the critical importance of ongoing climate data for the assessment of fluctuations and trends in risks arising from exposure and vulnerability to natural hazards." The project adheres, in particular, to GFCS Principles 4 and 7.

**Deliverables/Outcomes:**

Error-characterized, quality-controlled, spatially representative precipitation data derived from the integration of data from surface and space-based observing systems and made available in near-real time over the GTS and other data distribution mechanisms.

**Inputs:**

(i) Entities that operate observing networks (such as National Meteorological and Hydrological Services, research institutes, universities, and the private sector) and space-based precipitation monitoring systems will need to make their data available; (ii) Technological developments and national, regional, or global economic circumstances must enable these entities to sustain the delivery of these data over the long term; and (iii) Provision of adequate funding, human resources, and observing and IT technology to operate observing systems need to be in place to implement QA/QC procedures (including calibration and maintenance of the systems), to ensure reliability of data delivery, to ensure staff competencies, to ensure delivery using interoperable formats, and to distribute data and information worldwide in real or near-real time.

<b>Timeline:</b> 4 years
<b>Resource requirements:</b> CHF 40M

**Project title: 35** - Establish a coordination mechanism for architecture for climate monitoring from space

**Goal:** Maximizing the utility of existing climate service infrastructure

**Pillar:** Observations and Monitoring

**Submitting Agency:** WMO, Committee on Earth Observation Satellites (CEOS), Coordination Group for Meteorological Satellites (CGMS)

**Partners:** GEO

**Scope:**

A sustained, coordinated Architecture for climate monitoring from space is an essential building block of the GFCS Observations and Monitoring Pillar, supporting all four priority sectors and all Essential Climate Variables (ECVs) observable from space. A broad range of international partners contribute to the Architecture, and their coordination has started in 2011 through an ad-hoc team involving satellite mission operators and user representatives including WMO, GCOS, and WCRP. A standing coordination mechanism needs to be agreed and established over the next 2 years to bring the coordination of space-based observing systems, processing activities, and user services in support of climate monitoring to the same level as currently in place for weather forecasting.

**Objectives:**

Coordination mechanism internationally agreed and established.

**Activities:**

**Benefits:**

This implementation activity will address identified gaps. This will contribute to addressing needs expressed in all Exemplars for climate observations on appropriate temporal and spatial scales. The project is especially responsive to GFCS Principles 2 and 7.

**Deliverables/Outcomes:**

(i) Agreed procedures for analyzing and addressing gaps in space-based climate monitoring; (ii) Establishment of initial inventory of ECV-relevant observing systems, datasets, and user expert groups; (iii) Identification of gaps and opportunities based on the ECV inventory; and (iv) Prioritized action plan to implement the Architecture.

**Inputs:**

(i) Entities that operate observing networks (in this case, space agencies operating satellites and ground-based processing systems) will need to make their data available (this is a prerequisite for a system to be considered as part of the Architecture); and (ii) Technological developments and national, regional, or global economic circumstances must enable these entities to sustain the delivery of these data over the long term. It can be expected that international coordination will mitigate the risks associated with implementing and sustaining the Architecture.

**Timeline:** 2 years

**Resource requirements:** CHF 500,000/year.

**Project title: 36** - Define, build and make available a Climate Services Toolkit to all countries

**Goal:** Maximizing the utility of existing climate service infrastructure

**Pillar:** CSIS, with links to RMP and OBS

**Submitting Agency:** WMO

**Scope:**

One of the Principles guiding the Global Framework for Climate Services is “The primary goal will be to ensure greater availability of, access to and use of enhanced climate services for all countries”. For the effective delivery of climate services to the users, it is imperative that appropriate institutional mechanisms are in place to generate, exchange and disseminate information at the global, regional and national levels on an operational basis. Facilitating the use of climate information at national level is a key step in achieving that goal.

Through the collection and enhancement of material and knowledge from many institutions, a Climate Services Toolkit will be developed that will assist all countries, but particularly developing countries, to provide climate services. The toolkit will comprise knowledge products, software tools, public domain datasets and training materials that will enable the latest scientific and technological advances to be applied to the provision of climate services. The Climate Services Toolkit will make training workshops more focused and efficient in imparting operational skills, will help ensure consistency and quality of products and services developed through the CSIS and will contribute to the activities in key sectors such as DRR and Health.

**Objectives:**

- To ensure that climate sensitive sectors in any country have access to the most up-to-date, reliable and consistent climate information and products that meet at least their basic needs;
- To provide a conduit for technology transfer to developing countries, enabling their access to the latest methods, techniques and information required for CSIS activities and products;
- To increase efficiency, consistency and quality of the CSIS activities and outputs;
- To identify, collect, enhance and package a high-quality set of knowledge products, software tools, and related training materials - a climate services toolkit;
- To distribute the toolkit to CSIS entities, and advise on its application;
- To establish a procedure for maintenance and updating the toolkit; as users increase their participation in the GFCS, and increasingly benefit from climate information, their requirements will likely evolve, which could mean development of new tools to meet the requirements – as well, as research advances are made, the toolkit must be updated to accommodate new materials.

**Activities:**

World Meteorological Organization will coordinate the compilation, production and distribution of the Climate Services Toolkit. Many institutions will contribute to the toolkit, and considerable effort will be required to develop, test and complete the materials for widespread use.

Testing of the usefulness of the Toolkit to specific projects within sectors will be coordinated by World Meteorological Organization with sector experts.

**Benefits:**

Implementation of GFCS at national scales will impose considerable demands on the service providers, including NMHSs. Having a toolkit based on standards and good practices to support CSIS activities will improve efficiency and raise the capacity of service providers, and will ensure that the information and products developed for and provided to users are reliable, consistent (through time and across regions) and of high quality. A toolkit can be kept up to date with new tools, information and methods, and therefore will enable all CSIS providers to take advantage of research advances. The datasets included in the toolkit will enable more countries to develop their national products and should encourage improved data sharing. The availability of the toolkit, with training materials, should reduce the need for expensive capacity building. The Climate Services Toolkit will also make training workshops more focused, tangible and efficient in imparting the operational skills.

**Deliverables/Outcomes:**

- A toolkit, consisting of knowledge products; bespoke software for data management, data analysis (including indices), climate monitoring, prediction, downscaling and verification, with the requisite training materials; a set of standards, and a certification process for new tools.
- A collection of standard public domain datasets (e.g. global gridded data, monthly Sea Surface Temperature data, etc.), as well as data generated by data rescue, digitization homogenization and CDMS projects will be put together for inclusion in the toolkit.
- A plan for maintenance and updating of the toolkit and its datasets

**Indicators and assessment measures:**

The following assessment indicators will be used:

- Number of countries with access to and using the toolkit;
- Number of training workshops based on Climate Services Toolkit;
- Number of operational CSIS products using the Climate Services Toolkit;
- Number of contributors to Climate Services Toolkit;
- Feedback from national agencies and other users through the UIP mechanisms.

**Inputs:**

The World Meteorological Organization will lead the project, with input from experts drawn from CCL and CBS, advanced NMHSs, academic and research institutions. Expertise in CSIS, RMP and Observations and Monitoring will be required, together with ability to make the outputs available in a user-friendly fashion.

**Risks:**

Coordination of a large amount of inputs from different areas of expertise presents a challenge. There is a risk that the complexity of the task will result in an incomplete toolkit. Careful management of the project from the beginning, with a full identification of the information required, will minimize that risk.

Another risk is that effective use of the toolkit in operational situations, particularly by users who require skills development, will be hindered by inadequate training and lack of understanding. Placing emphasis on the usability of the toolkit from its conception to production and allowing for sufficient training will address that risk.

**Timeline:**

The Climate Services Toolkit will be available by mid-2015

**Resource requirements:**

In addition to the human resource requirements, CHF 1M investment will be needed.

**Project title: 37** - Establish modern Climate System Monitoring based on improved operational monitoring products

**Goal:** Maximizing the utility of existing climate service infrastructure

**Pillar:** CSIS

**Submitting Agency:** WMO

**Partners:** FAO, WFP, WHO, UNESCO

**Scope:**

This activity facilitates international coordination and collaboration in developing a set of standard climate monitoring products and climate indices to be generated by NMHSs and other climate centres. This includes developing gridded data sets and assisting developing countries with training and guidelines concerning new climate monitoring products, standards and exchange protocols and mechanisms. The activity contributes to the risk communication initiative of the DRR exemplar and enhances user awareness of ongoing or foreseeable climate anomalies, along with their associated health consequences, as highlighted by the Health Exemplar. National products will be disseminated using standard templates and exchange protocols that will enable rapid aggregation of information on regional and global scales. Climate assessment reports and reviews (e.g., climate statements, state of the climate reports and reviews, reports and advisories on extreme weather and climate events, etc.) will improve in content and coverage with a reduced time delay. Sectorial users will be able to access consistent, systematic and timely climate monitoring reports and assessments covering national, regional and global scales.

**Objectives:**

Improve Climate System Monitoring based on standard definitions, new product templates and data exchange protocols while improving procedures for gridded data sets.

**Activities:**

This project will:

- Coordinate international work and collaboration in developing a set of standard climate monitoring products and climate indices to be generated by NMHSs and other climate centres;
- Develop gridded data sets based on *in situ*, model- and space-based data and products; and
- Assist developing countries with trainings and guidelines on new climate monitoring products and related definitions, standards and exchange protocols and mechanisms.

**Benefits:**

- Enhanced national operational climate monitoring and related services. The national products will be disseminated using standard templates and exchange protocols that will help quick aggregation of information at regional and global scales;
- Climate assessment reports and reviews (e.g., climate statements, state of the climate reports and reviews, reports and advisories on extreme weather and climate events...) will improve in content and coverage with a reduced time delay;

- Sectoral users will be able to access consistent, systematic and timely climate monitoring reports and assessments covering national, regional and global scales.

**Deliverables/Outcomes:**

- Standard templates of national climate monitoring products and climate reports will be delivered with guidance on definitions, procedures and exchange protocols and mechanisms;
- Identification and development of suitable procedures and tools for developing gridded data sets for climate monitoring and assessment at national and regional scales.

**Indicators and assessment measures:**

- Availability of and access to improved climate monitoring products on operational basis;
- Feedback on the usefulness of the reports from at least the priority sectors;
- Progress in developing standards and templates for the national climate monitoring products;
- Progress in the provision of tools and procedures for gridded data sets.

**Inputs:**

WMO will coordinate the various aspects of the project in cooperation with international partners such as FAO, WFP, WHO, UNESCO. The WMO Commission for Climatology will build on work being carried out by its Task Team on national climate monitoring products which is working on the definition of a set of new products to improve Climate System Monitoring;

**Timeline:** End of 2014

**Resource requirements:**

CHF 400,000

**Project title: 38** - Standardize the operational CSIS products and promote CSIS-wide use of WMO Information System (WIS)

**Goal:** Maximizing the utility of existing climate service infrastructure

**Pillar:** Climate Services Information System, with links to the OBS and UIP pillars

**Submitting Agency:** WMO

**Scope:**

It is imperative that CSIS products adhere to internationally accepted standards in order, *inter alia*, to: (i) enable systems to work interchangeably or together; (ii) provide a common set of tools for communicating effectively; and (iii) offer assurance that a product can deliver a certain level of performance. Adherence to standards will be critically important for the various CSIS entities in delivering effective climate products and services, both on the input and the output sides. Given that the national CSIS entities essentially operate based on global and regional inputs, it is essential that CSIS-wide standards are developed, agreed and implemented. This activity aims to identify global and regional products that should have well-defined and commonly-agreed characteristics of content, format, frequency, etc. It will also develop standards and protocols for developing and disseminating those products. The WIS component of this activity will complement the efforts outlined under the Observation and Monitoring pillar and will focus on training CSIS information managers and information system developers on relevant WIS concepts and interoperability to ensure that WIS is widely used throughout CSIS operations.

**Objectives:**

- To ensure that all national CSIS entities generating climate information adhere to a set of standardized global and regional climate products.
- To the extent possible, to promote common standards in the generation and packaging of CSIS products at the global, regional as well as national levels to facilitate interoperability.

**Activities:**

- Identify global and regional products that should have well-defined and commonly-agreed characteristics of content, format, frequency, etc.
- Develop standards and protocols for developing and disseminating those products
- Training CSIS information managers and information system developers on relevant WIS concepts and interoperability to ensure that WIS is widely used throughout CSIS operations.

**Benefits:**

Adherence to internationally accepted standards will:

- Enable systems to work interchangeably or together;
- Provide a common set of tools for communicating effectively;
- Offer assurance that a product can deliver a certain level of performance;
- Facilitate comparison of products from different sources;
- Increase adherence to best practices, which should improve product quality and consistency;
- Facilitate product dissemination and data discovery.

**Deliverables/Outcomes:**

- Assessment of products that should be common to all global and regional providers, and developed and presented following common standards;
- a set of standards and protocols for specific products. Guidance and training on WIS implementation.

**Indicators and assessment measures:**

- Number of standardized CSIS products of Global Production Centres (GPCs), Regional Climate Centres (RCCs) and National Meteorological and Hydrological Services (NMHSs);
- Number of CSIS entities generating standardized products;
- Number of countries/sectors using standardized CSIS products.

**Inputs:**

WMO entities such as CCI, CBS, CAS and WCRP will provide experts across Observations and Monitoring, RMP and CSIS pillars; Global Production Centres, Regional Climate Centres and National Meteorological and Hydrological Services will also contribute together with other institutions operationally providing CSIS-related products.

**Timeline of Project:** Mid 2014**Resource requirements:**

CHF 1M

**Project title: 39** - Facilitate the effective use of Global Production Centres (GPC) and other global climate products by regional and national providers (e.g. Regional Climate Centres (RCCs) and National Meteorological and Hydrological Services (NMHSs)), including the operational provision of Global Seasonal Climate Update

**Goal:** Mainstreaming the use of climate information in decision-making

**Pillar:** CSIS

**Submitting Agency:** WMO

**Partners:** IRI, National Meteorological and Hydrological Services

**Scope:**

At present, regional and national entities have access to many global products but have to identify the most robust signals and likely future states of the climate in their areas on their own. Effective access, along with expert guidance and training in using global products including the Global Seasonal Climate Update (GSCU), will help regional and national users quickly identify where the global models are providing the most useful information for their areas of interest. This will help them apply the information in developing their own products. The activity will promote wider and more effective use of all global-scale CSIS products, such as those of GPCs, in the operational activities of RCCs, Regional Climate Outlook Forums (RCOFs) and NMHSs, offering better access and guidance as well as training/capacity development where needed. This will further ensure the operational production and provision of the GSCU and will enable regional and national CSIS entities to access, understand and use global products (e.g. from GPCs), including the GSCU.

**Objectives:**

- To ensure the operational development and dissemination of the GSCU to regional and national CSIS entities;
- To ensure that regional and national providers of climate information access and use GPC products and the GSCU for generating their own products;
- To develop appropriate training modules that explain the global products, including GSCU, and demonstrate their use in regional and national exercises;
- To train staff in all current RCCs (including those in pilot mode), and in NMHSs (perhaps through regional workshops).

**Activities:**

The activity will develop training modules to explain the global products and will demonstrate their use in regional and national exercises. It will also train staff in RCCs and NMHSs (complementing the training activities proposed under the Capacity Development pillar).

**Benefits:**

Access to the GSCU and training in the use of global products including the GSCU will help regional and national users to quickly identify where the global models are providing the most useful information for their areas of interest, and to apply the information in development of their own products.

**Deliverables/Outcomes:**

- The Global Seasonable Climate Update;
- training modules in the use of GSCU and other global products; training sessions.

**Indicators and assessment measures:**

- Availability of GSCU;
- number of regional and national CSIS entities accessing and applying global products including GSCU;
- Number of regional and national CSIS entities with staff trained in use of global products.

**Inputs:**

The World Meteorological Organization and its constituent bodies such as CCI and CBS, in collaboration with global and regional centres and some National Meteorological and Hydrological Services, and with research institutes such as the IRI, will provide the necessary expertise.

**Timeline:** Mid-2014 for initial implementation, then ongoing

**Resource requirements:**

CHF 1M

**Project title: 40** - Strengthening regional systems for providing climate services

**Goal:** Reducing the vulnerability of society to climate-related hazards through better provision of climate information

**Pillar:** CSIS

**Submitting Agency:** WMO

**Partners:** FAO, WFP, WHO, UNESCO, ISDR

**Scope:**

At present, climate services in many vulnerable countries are weak. While the capacity to develop and deliver climate services on a national scale is being strengthened, Regional Climate Centre (RCCs) products and information, including for long-range forecasts and regional climate monitoring among others, will quickly support improved development and delivery of national climate services, thereby informing user decisions and improve climate risk management. This activity will support developing countries with regional climate services and mechanisms for capacity development, professional networking and Regional Climate Outlook Forums (RCOFs), and will also bring together countries sharing common climate concerns for collaborative assessments and to develop common understanding. Its major focus will be promoting and strengthening WMO RCCs, expanding RCC coverage to all WMO Regions, and expanding, improving and sustaining RCOFs, giving priority to vulnerable developing countries. Enhancing, strengthening and expanding the RCOF process, improving methods, implementing efficiencies and increasing user-focus will augment the sustainability of the RCOFs. This will provide users with more consistent and regular information and products pertinent to their needs, along with improved access to and dialogue with climate providers. The project will also assist RCCs and practitioners of RCOFs in optimizing, making more efficient and standardizing their practices and methods. It will complement activities aimed at developing/strengthening the RCC infrastructure and RCOF mechanisms under the Capacity Development pillar.

**Objectives:**

- To promote and strengthen WMO Regional Climate Centres (RCCs), to expand RCC coverage to all WMO Regions, and to expand and sustain Regional Climate Outlook Forums, giving priority to vulnerable developing countries;
- To ensure that all RCCs and RCOFs have the capacity to meet the needs of relevant national bodies for regionally-focused, high quality and reliable climate information;
- To identify a well-defined and commonly-agreed set of climate information products useful in any region, along with some region-specific products that address unique regional requirements; and
- To develop guidelines providing best practices in creating and delivering the identified products.

**Activities:**

- Promoting and strengthening WMO RCCs, and expanding RCC coverage to all WMO Regions,
- Expanding, improving and sustaining RCOFs, giving priority to vulnerable developing countries.

- Enhancing, strengthening and expanding the RCOF process, improving methods, implementing efficiencies and increasing user-focus will augment the sustainability of the RCOFs.
- Assisting RCCs and practitioners of RCOFs in optimizing, making more efficient and standardizing their practices and methods.

**Benefits:**

- Improved development and delivery of national climate services, and therefore user decisions, for improved climate risk management;
- Improved, more reliable products, thus reducing uncertainty of users, and improving trust in and application of the information;
- Provision to users of more consistent and regular information and products pertinent to their needs, and improved access to and dialogue with climate providers;
- Increased comparability between and quality of RCC and RCOF procedures and outcomes.

**Deliverables/Outcomes:**

- Facilitation of the launch of the demonstration phase of new RCC operations in critical areas (it is proposed to inaugurate 3-5 RCCs in Africa, Asia, the Pacific or a trans-regional RCC, with the participation and support of the Regional Associations and countries to be served or acting as host(s)),
- Fast-tracking of the capabilities of RCC candidates to meet designation criteria (this could include support for computing facilities, skills development, networking, Internet access, satellite feeds, storage media, WIS compliance, resource materials, and consultancies);
- Standardizing technical procedures and tools;
- Enhancing capacities for the development and coordinated operational flow of information and products from RCCs to national CSIS entities;
- Guidance on the optimal utilization of RCC products by national CSIS entities;
- Training in the use of RCC products as required;
- Launch and stabilization of new RCOFs in vulnerable regions not yet served by RCOFs (three to five based on needs and engagement);
- Promotion of sustainable funding structures for COFs in vulnerable areas;
- Guidance on maintaining RCOF activity during periods when there is no opportunity for meetings.
- Guidance document on best practices within RCCs and RCOFs.

**Indicators and assessment measures:**

- Numbers of RCCs or RCC-Networks providing the mandatory minimum functions;
- Level of regional ownership/participation and sustained funding for RCC operations;
- Numbers of countries served by regular RCOFs (note frequency of RCOF products); types of products (e.g. for Long Range Forecast/seasonal outlooks, monitoring products, bulletins and advisories);
- Extent of participation, by sector, of user communities and partnering agencies in RCOFs (numbers and frequency);
- Satisfaction of RCOF user groups with the RCOF process and products including the extent to which users feel products are tailored for their use and useable;
- Extent to which RCOF products are used in decision making at national and regional levels;
- Availability of the guidance document.

**Inputs:**

Inputs will be required from:

- WMO Members, International and national funding organizations, existing designated and pilot-mode RCCs, WMO Regional Associations, WMO Technical Commissions, especially CCI and CBS for the RCC designation process and development of guidance;
- GFCS Research, Modelling and Prediction entities for improvements to methods and skill;
- RTCs, to participate in training;
- GFCS UIP experts and entities to facilitate and guide the user liaison aspects of RCOFs,
- GFCS partnering agencies for (at least) the high priority sectors, namely FAO, WFP, WHO, UNESCO, ISDR, and their regional and national counterparts;
- Additional entities of national level of CSIS (e.g. academic institutions, government ministries) as recommended by the countries in question.

**Timeline:** Mid-2015

**Resource requirements:**

CHF 3M per annum – total CHF 9M