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World Meteorological Organization
Organisation météorologique mondiale
Organización Meteorológica Mundial
Всемирная метеорологическая организация
المنظمة العالمية للأرصاد الجوية
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Ref.: 19399/2024-L21 S/RCP

Our ref.: 19399/2024/S/RCP 4 December 2024

Annex: 1 (available in English only)

Subject: Information about the commencement of the demonstration phase of the Third Pole Regional Climate Centre-Network (TPRCC-Network)

Action: Nominate a national point of contact of your Service to facilitate communication between TPRCC-Network and your Service

Dear Sir/Madam,

I am pleased to inform you of the considerable progress made towards implementation of the Regional Climate Centre (RCC) concept in the Third Pole region under the coordination of the China Meteorological Administration (CMA) and contribution of National Meteorological and Hydrological Services (NMHSs) of Pakistan, India, and of relevant members of Regional Association II.

Following a series of consultations among stakeholders since 2018, it has been agreed that the structure for the Third Pole Regional Climate Centre-Network (TPRCC-Network) be composed of three geographically delineated nodes having sub-regional domains of responsibility, each of which performs all mandatory functions for the countries in its domain, and additionally, each node undertakes a significant cross-node mandatory function for the entire Third Pole geographical domain, as follows:

- Northern Node, led by China with Bhutan, Mongolia, Nepal and Pakistan as members of consortium, performs the climate monitoring function for the Third Pole region;
- Southern Node, led by India with Bangladesh, Bhutan, Myanmar and Nepal as members of consortium, fulfils the operational data services function for the Third Pole region;
- Western Node, led by Pakistan with Afghanistan, China, Tajikistan, and Uzbekistan as members of consortium, addresses the long-range forecast function for the Third Pole region.

More information about the TPRCC-Network structure and activities can be found in the Implementation Plan (see Annex).

I am further pleased to inform you that the TPRCC-Network launched its demonstration phase during the inaugural session of the Third Pole Climate Forum (TPCF), which was successfully organized in Lijiang, China, from 4 to 6 June 2024. Throughout the demonstration phase, the TPRCC-Network will start providing relevant climate products and services to the Members of the Third Pole region as defined in the WMO Integrated Processing and Prediction System (WIPPS) *Manual on the WIPPS* (WMO-No. 485). The TPRCC-Network will also promote sub-regional collaboration and knowledge exchange to improve climate services

To: Permanent Representatives of Members with WMO: Afghanistan, Bangladesh, Bhutan, China, India, Kazakhstan, Kyrgyzstan, Mongolia, Myanmar, Nepal, Pakistan, Tajikistan, and Uzbekistan (limited distribution)

cc: President of WMO Regional Association II, President of SERCOM and President of INFCOM

for sustainable development at the regional and national levels. The demonstration phase will enable the TPRCC-Network upon its successful completion to be designated as a WMO RCC.

All products and services provided by TPRCC-Network are accessible through the WMO TPRCC-Network web portal.

In view of the above, I would like to invite the NMHSs of the countries within the TPRCC-Network domain to actively support the demonstration phase through (i) accessing and using RCC products in support of national climate services; (ii) applying RCC products and services for national needs; (iii) supporting the generation of RCC products and services by sharing national data and expertise; and (iv) providing feedback in order to help the TPRCC-Network to further refine and improve its products and services.

To facilitate the communication and exchange of knowledge and information between the TPRCC-Network and the Members NMHSs, I kindly request you to nominate a national point of contact, desirably an expert responsible for climate services in your Institution. Please, provide the name of the expert to Ms Anahit Hovsepyan (ahovsepyan@wmo.int), Scientific Officer, Regional Climate Prediction Services at WMO with a copy to Ms Lijuan Ma (CMA) (malj@cma.gov.cn), coordinator of the TPRCC-Network.

I take this opportunity to thank you for your cooperation and support to WMO activities.

Yours faithfully,

Ms Ko Barrett
for the Secretary-General

Ref.: 19399/2024-L21 S/RCP

Ref.: 19479/2024-L0 S/RCP

WORLD METEOROLOGICAL ORGANIZATION

Third Pole Regional Climate Centre Network (TPRCC-Network) Implementation Plan

Version 1.3, 15 February 2022

CONTENT

Version Number	Date	Updates coordinated by	Content of updates
1.1	01.07.2021	Pengling Wang/ Lijuan Ma	Version circulated for the virtual meeting 30.06-01.07.2021
1.2	03.09.2021	Lijuan Ma	Incorporated input from ICIMOD and next steps; document submitted as INF 6.3 for RA II-17 (II), 27-30 Sept 2021
1.3	15.02. 2022	Lijuan Ma, Pengling Wang, Shahzad Sultan, Mandira Shrestha, Peter Van Oevelen, Weicai Wang	Incorporated input from GEWEX, TPE; Separate cross-regional and sub-regional products in tables for RCC Mandatory and Highly Recommended Function as Annex III and IV, respectively; Domain; Preliminary Transfer Process for Products and Data to be presented on web portal; TPCF

1. Introduction

Regional Climate Centres (RCCs) are Centres of Excellence that assist WMO Members in a given region to deliver better climate services and products including regional long-range forecasts, climate monitoring and climate data services, and to strengthen their capacity to meet national climate information needs. The primary 'clients' of an RCC are National Meteorological and Hydrological Services (NMHSs) and other RCCs in a region and in neighbouring areas. The RCC responsibilities should be regional by nature and not duplicate or replace services provided by NMHSs. RCCs serve the regional level of a three-level (climate-related) infrastructure: Global Producing Centres (GPCs, global level), Regional Climate Centres (RCCs, regional level), National Meteorological and Hydrological Services (NMHSs, national level).

The RCC-related amendments to the WMO Manual on the Global Data Processing and Forecasting System (GDPFS), as adopted by CBS-XIV, provide the reference documentation. According to the Manual on the GDPFS, *"a group of centres performing climate-related activities that collectively fulfill all the required functions of an RCC may be designated by WMO as a "WMO Regional Climate Centre Network". Each centre in a designated WMO RCC Network will be referred to as a 'node'. A node will perform, for the region or sub-region defined by the Regional Association, one or several of the mandatory RCC activities". Each of the nodes should have a lead organization and the RCC-Network as a whole requires a 'point of contact'.*

Noting the recommendations of the Regional Consultation on Climate Services for the Third Pole Region (Jaipur, India, from 9 to 11 March 2016) on establishing a Regional Climate Centre Network (RCC-Network) and a Regional Climate Outlook Forum (RCOF) focused on the special needs of the Third Pole Region, the World Meteorological Organization (WMO) Regional Association II, at its sixteenth session (RA II-16) in 2017, endorsed the proposal to establish a WMO RCC-Network for the Third Pole Region (Decision 11 (RA II-16)). The WMO Executive Council (EC), at its sixty-ninth Session in 2017 (EC-69), requested the EC Panel of experts on Polar and High-mountain Observations, Research and Services (EC-PHORS) to develop and propose, in consultation with appropriate partners, a roadmap to implement the Third Pole RCC-Network learning from the lessons of developing the Arctic Polar Regional Climate Centre (PRCC)-Network (Decision 46 (EC-69)). The EC-70, through its Decision 47 (EC-70), *endorsed the structure of the Third Pole RCC-Network (TPRCC-Network) based on geographical distribution of responsibilities with three nodes, namely Northern Node led by China, Southern Node led by India and Western Node led by Pakistan, with China as the overall coordinating node, and invited the President of Regional Association II to facilitate the development of a detailed implementation plan under the guidance of EC-PHORS, CCl and CBS and commencement of a demonstration phase.*

2. Pre-Implementation

2.1 Concept

In responding to RA II Decision 11 (RA II-16), draft concept paper of a Polar RCC (PRCC) on Asian High Mountain Region (AHM-RCC) was developed by China and submitted to the Executive Council Panel of Experts on Polar and High Mountain observations, Research, and Services (EC-PHORS) Services Task Team (STT) in March of 2017, which was thus discussed in the seventh session of EC-PHORS (EC-PHORS-7) in Ushuaia, Argentina. After revision according to the feedback from EC-PHORS-7, a concept paper of AHM-RCC was officially submitted to WMO through the office of the Permanent Representative (PR) of China in May of 2017. The president of RA II, Dr. Abdulla Al Mandous, in August of 2017, officially announced his full support for the AHM-RCC.

In the concept paper, the domain of the Asian High Mountains Region (AHMR) was defined as a high mountain area, which is characterized by the presence of the cryosphere, as a prominent feature of the environment, being centered on the Qinghai-Tibetan Plateau (QTP), and it includes not only the QTP characterized by the cryosphere, but also the surrounding regions affected by climate change and resources of cryosphere over the QTP. Also, the threats being exposed to AHMR and urgent needs were described, and the capacity of delivering services so as to meet requirements was analyzed. Accordingly, missions and functions of the AHM-RCC were proposed in the concept paper.

Following the formal submission of the concept paper, WMO organized a series of consultations, within the framework of WMO, including an international consultation organized as part of the WMO side event on the WMO High Mountain Summit during the Third Pole Science Summit in July of 2017 (Kunming, China), an informal workshop attended by the WMO Assistant Secretary-General, the chairman of WMO Global Cryosphere Watch (GCW) program, and chief of WMO Observing System Division in August of 2017, an in-depth discussion with GCW experts during its 5th Steering Group meeting in January of 2018, and a remote coordination meeting with WMO Secretariat in February of 2018. To be in tune with the concept of WMO Polar RCC and the official approval document of WMO, China accepted to revise the name to the Third Pole RCC, although the actual geographical scope of this centre would provide services to will remain the same.

The QTP and its surrounding mountains are referred by scientists as the Third Pole[1]. It covers an area over 5 million km^2, stretching from the Pamir and Hindu-Kush in the west to the Hengduan Mountains in the east, from the Kunlun and Qilian mountains in the north to the Himalayas in the south[2].

2.2 Scoping and Planning

Built on series of consultations, in February-March 2018, a survey was conducted amongst Members within the domain of TPRCC on the requirements and capabilities for RCC Services for the Third Pole Region. Results showed a clear indication by

[1] Qiu, J., 2008. The Third Pole. Nature 454, 393–396.
[2] Yao, T., et al. 2012. Third Pole Environment (TPE). Environmental Development 3: 52–64

Members of interest in contributing to the TPRCC operation, either as a node lead or as a consortium member. In quick succession, there followed a Scoping Meeting on the TPRCC-Network Implementation (27-28 March, 2018, Geneva, Switzerland); provision by Members in October-November 2018 of detailed information on potential contributions to the operations of the envisaged TPRCC-Network by specifying products and services relevant to RCC Mandatory Functions, as well as specific inputs beyond mandatory functions relevant to the Third Pole region; and the TPRCC-Network Implementation Planning Meeting (13-14 December 2018, Beijing, China).

The Scoping Meeting on the TPRCC-Network Implementation discussed in–depth the potential structure of the future TPRCC-Network and brainstormed on important TPRCC-Network products and services beyond WMO RCC mandatory functions, taking into account specific requirements on cryosphere aspects. Presentations from Bhutan, China, India, Mongolia, Myanmar, Nepal and Pakistan on their national needs and capabilities relevant to TPRCC-Network informed the discussion. The meeting recognized that, while there are already designated WMO RCCs serving the region (e.g., RCC-Beijing, RCC-Tokyo, RCC-Pune), they do not adequately address the special needs across/over the Third Pole region, and that there is a need for a dedicated RCC arrangement to cater to the unique requirements of the large region.

At the Implementation Planning meeting, experts agreed upon key aspects in developing the Implementation Plan of the TPRCC-Network, which is the basis of this document, and set up a plan for activities that will ensure the network to launch a demonstration phase by the end of 2019. Affected by the unexpected COVID-19, this plan had to be postponed and the task team agreed to pursue the goal of entering into demonstration phase in early 2022, and consequently initiate the process of designation by WMO in about two years as planned. The process for designation of the TPRCC-Network, being align with the criteria documented in Manual on GCPFS, will be discussed within the task team and updated in this document accordingly after entering into demonstration phase. As the designation needs to go through a certain process, it is estimated that the designation may take one to two years.

3. Overview of the TPRCC-Network

3.1 Potential contributing Members

The following WMO Members have expressed interest to contribute to the activities of the TPRCC-Network: Afghanistan, Bangladesh, Bhutan, China, India, Mongolia, Myanmar, Nepal, Pakistan, Tajikistan, and Uzbekistan.

As a living document, this implementation plan was submitted to the Phase 2of the 17th session of RA II in September 2021, as an INF document. In the session, RA II "*decides that a focus approach is required to accelerate the development and provision of climate information in the framework of the TPRCC-Network by concerned Members to be included in the RA II Operating plan* 2021-2024 and *endorses an increased engagement of Members and partners for enabling the access to cryosphere data, in support of the delivery of the WMO strategic goals* (Resolution 6.3/2 (RA II-17(II)). It *requests Members to enhance the access to the available*

cryosphere and ancillary data, in-situ and remotely sensed, in the framework of WIS and through the GCW Data Portal, and to register their observations in the polar and mountain regions, in OSCAR/Surface, with priority given to those observations supporting the implementation of the TPRCC Network. It *urges Members to facilitate the access to cryosphere and ancillary observations and data maintained by partners, as identified in the IP of the TPRCC-Network, and to rescue and digitize historical records and make them available for climate research and services*." This information was shared through tele-conference of TPRCC-Network task team.

As a follow-up action, the president of RA II called for co-sponsorship for the projects approved in its 17th session, in which the joint demonstration project for promoting polar and high-mountain activities was included and the TPRCC Network lead Members took the sponsor role. The task team agrees to keep close connection with RA II WG Infrastructure and WG Services and make joint effort to promote acceleration of provision of climate information in the third pole region. Further contributions from more Members and partners are hence welcome and encouraged.

3.2 Structure

Based on the outcomes of the discussions and the needs, capabilities and interests expressed in the Scope Meeting on TPRCC-Network Implementation, the participants agreed that a suitable RCC-Network with geographical distribution of responsibilities to perform RCC functions, similar to that adopted for the Arctic RCC-Network, will provide a more sustainable operational arrangement. The meeting then considered the interests of Members to contribute/host RCC arrangements, and agreed on a provisional structure of the TPRCC-Network, which was approved by EC-70 in June of 2018 (Decision 47 (EC-70), as below.

The approved TPRCC-Network consists of three geographical nodes, as shown below, with China as the overall coordinating node. Each node of the TPRCC-Network is composed of the node lead and the consortia Members, hosted by respective institutions, as shown in Annex I to this plan.

Northern node:
China (lead)
Bhutan, Mongolia, Nepal, Pakistan (consortia member)

Southern node
India (lead)
Bangladesh, Bhutan, Myanmar, Nepal (consortia member)

Western node
Pakistan (lead)
Afghanistan, China, Tajikistan, Uzbekistan (consortia member)

A task team was hence proposed to be set up for leading the formulation of the implementation plan, which is composed of focal points of node leads and partners/contributors, with a representative from China as an overall coordinator of the network (Annex I). This plan was developed by the TPRCC-Network task team,

building on the skeleton of the Arctic RCC-Network Implementation Plan, by integrating concept of the previous submitted AHM-RCC and the survey responses received from China, India, and Pakistan. Known gaps and challenges that need to be addressed during the demonstration phase are identified in section 5 below.

The Task Team for the development and implementation of the TPRCC-Network was formed consisted of the Focal Points of each of the Node Lead and an overall Coordinator of TPRCC-Network at initial stage represented by China. Furthermore, the Task Team will include representatives from the Network partners. The Team will be responsible for the TPRCC-Network operation and timely provision of services and products.

Geographically, each node will develop all RCC mandatory functions (Annex II) within its own domain. But during the Implementation Planning Meeting, node leads also agreed on thematic responsibilities for mandatory functions for the entire region of the TPRCC-Network, as below.

Cross-node LRF services:

Pakistan will lead the production of Long-Range Forecasts (LRF). The LRF product(s) will cover the whole domain of the TPRCC-Network, on a large scale, with appropriate projection. Each Node will be responsible to downscale and provide more tailored products for their sub-regions.

Cross-node Climate Monitoring:

China (NCC/CMA) will coordinate the development of all Mandatory Climate Monitoring products covering the whole domain of the TPRCC-Network.

Cross-node provision of operational data services:

India will host operational data services for the TPRCC-Network domain.

Responsibility for the training function will be shared among the three main TPRCC Nodes, as well as technical partners and contributors. Detailed cross-regional products and services for both mandatory and highly recommended functions that meet RCC criteria documented in GDPFS manual are listed in Annex III and IV, respectively. During demonstration phase, the listed products might be modified based on user feedback and will be finalized towards the end of demonstration phase. Additionally, as Annex III and IV list dataset/product/service identified by nodes and partners so far and do not necessary include all the activities/criteria required by GDPFS Manual, base tables for collecting newly proposed dataset/product/service covering either the whole or sub-domain of the network from nodes and partners during the demonstration phase were prepared according to Annex I and was provided in the working folder on Elios.

The TPRCC-Network will prepare a single web portal as the interface with end users. China will lead the development and maintenance of the web portal with support from other node leads and partners. The web portal is the only interface of the Network to provide operational products and services to users, through which access to the website of each of the Nodes will be provided. To ensure timely and efficient delivery of climate services, products and data transfer process has been preliminarily established. See Annex V for the identified brief steps and flow chart. The

development and improvements of the web portal as well as individual websites of Nodes will be responsibility of all nodes and partners.

3.3 Domain

The concept of 'third pole' was first proposed for Mt. Qomolangma due to its highest elevation around the world. Nowadays, it more and more refers to the highest plateau in the world, the QTP, as clarified in section 2.1, due to more knowledge on the huge plateau and its complex climate change and effect to the world. However, there's no single definition yet although some scientific paper regarding the domain of the QTP was newly published in 2021.

Note Decision 48 (EC-69)—POLAR AND HIGH-MOUNTAIN REGIONS PRIORITY ACTIVITY decides that high mountain regions shall be defined as "mountain areas where seasonal or perennial cryosphere is present and poses potential and serious risks to society related to water scarcity and disaster resilience". Also note that the high mountain areas used in the *IPCC Special Report on Ocean and Cryosphere in a Changing Climate* included all mountain regions where glaciers, snow or permafrost are prominent features of the landscape, but without a strict and quantitative demarcation.

As described in section 2.1, the mandate of the TPRCC-Network is to provide services to an area centred on the QTP and extended, from Pamir and the Hindu-Kush in the west to the Hengduan Mountains in the east, complementing the existing RCC service functions of the RA II. As a result, the TPRCC-Network domain does not constitute a definition of the Third Pole, is intended for operational purposes, and may vary for different activities. Therefore, the geographical domain for contributions to and for the products and services of the TPRCC-Network has been loosely defined, allowing some flexibility for domain variation for different services, if needed. Based on the planning process of the TPRCC-Network and a large number of scientific researches in the High Mountain Asia region, as well as concerns of consortia and users, the domain of the TPRCC-Network covers a rectangular area of 25 ℃N-50 ℃N Latitude, 65 ℃E-105 ℃E Longitude, with a 2000 m contour line within this area highlighting the concept of high mountain, which is the mean altitude that the main rivers in the third pole region flow out of mountain passes. Additionally, considering the complexity of mountain areas and diversity of requirements by Members, products for sub-domains will be developed to deliver better services, and an appropriate variation to its boundary may vary based on the requirements of the countries in the Network's sub-regional domains. The following basic consideration is hence highly recommended:

(1) To serve at regional level, with regional responsibilities by nature and not to duplicate or replace services provided by NMHSs;
(2) All relevant variables observed by consortia members being covered by the selected sub-region boundary;
(3) To extend the boundary appropriately from impact perspective.

The northern node extends its north boundary to 55 ℃N Latitude, but beyond that as needed, for development of products and services needed for the node (e.g. for glacier monitoring products and services).

Furthermore, during demonstration phase Nodes can explore whether there might be a need to expand/modify boundaries of their respective domains. Therefore, the domains boundaries will be finalized towards the end of demonstration phase.

3.4 Partners and technical assets/contributors

In terms of TPRCC-Network relevant climate data, products and services, prediction capabilities, science guidance on the Mandatory and Highly Recommended Functions, etc., the identified technical contributors and partners so far include:

(1) The Global Cryosphere Watch (GCW) program
(2) Third Pole Environment (TPE) program
(3) International Centre for Integrated Mountain Development (ICIMOD)
(4) The Global Energy and Water Exchanges (GEWEX) project

Other potential partners and contributors are welcome to engage.

3.4.1 Global Cryosphere Watch (GCW)

In renewed mandate of GCW, as approved at EC-73, Resolution 18 (EC-73) – Transition and pre-operational plan of GCW, the activities in support to the development and implementation of the TPRCC-Network, have been specifically identified as a priority, as the accelerated changes in the cryosphere have profound impacts on mountain environments.
To meet special service requirements on cryosphere changes, in the context of climate change, cryosphere observational data within the domain of the TPRCC-Network, on snow, glacier, permafrost, seasonally frozen ground, and lake and river ice observations from meteorological stations supervised by NHMS, as well as other organizations within the geographical scope of TPRCC-Network, are necessary. For snow, it's desired to be used for validating satellite retrieval products or developing merging snow monitoring products, especially snow depth or snow water equivalent, which is valuable for the data assimilation system. For glaciers, it's desired for developing glacier mass balance curves in different climate zones, which reflect the response of different glaciers to climate change. For permafrost, it's desired for monitoring the changes/variations of the active layer thickness and ground temperature in key permafrost zone of Asian High Mountain regions, e.g. along highway or railway.

The TPRCC-Network Implementation Plan meeting, on 13-14 December 2018, which took place in Beijing (China), invited GCW to contribute to the implementation and operations of the TPRCC-Network, by:

a. GCW experts to review the draft implementation plan of the TPRCC-Network, on request;
b. Sharing of data from CryoNet stations and by providing guidance in developing cryospheric products.

Furthermore, the Task Team asked WMO Secretariat to facilitate the engagement of the focal points of consortium members with GCW, on the expansion/contribution of CryoNet station/cluster/contributing stations, such

that more data from stations of third party operators (e.g. research networks) could be integrated into products to be delivered by the TPRCC-Network.

Based on these requirements, the GCW contribution to the implementation and operations of the TPRCC-Network would include:

- Facilitate the registration of cryospheric and ancillary observations in the OSCAR/Surface database, in support of the data discovery supporting the TPRCC-Network functions;
- Through the GCW Data Portal, facilitate the access to additional sources of data in a standardized format, including in-situ, remotely sensed, and space-based, and in conjunction with other TPRCC-Network partners and consortia Members;
- Extending the snow trackers to the Third Pole by involving one or more experts of the TPRCC-network, in the GCW Snow Watch Team.
- Assessing the impact of snow observations over the Third Pole region for Numerical Weather Prediction (NWP).
- Support additional data exchange on GTS and facilitate the development of monitoring tools for relevant observations available for NWP (as exchanged via GTS).
- Providing guidance on developing snow related products, which could take place in the form of participating in workshops, reviewing proposed methodologies, and providing inputs to specific documents, based on specific tasks/requests underway of the TPRCC-Network.
- Facilitating the sharing of experiences in implementing the Arctic RCC-Network, in the form of, e.g., giving talks at meetings, if needed.

Additionally, other current activities of GCW have potentials to contribute to the implementation of TPRCC. Among these, are:

- Disseminate observing best practices developed and published by GCW for TPRCC-relevant cryosphere observations (snow, glacier, permafrost, seasonally frozen ground, etc.)– for use by station operators within the geographical domain of TPRCC. Publication in *Guide to Instruments and Methods of Observation* (WMO-No. 8), Volume II, Measurement of Cryospheric Variables, under way
- Making available data representation templates for observed cryosphere variables, relevant WIGOS and WIS metadata standards, and data interoperability methods and tools to enable access to data provided from stations operated by providers other than NMHSs (e.g. research organizations), for machine-to-machine access.
- Promoting cryosphere data policies, which would enable the free and open access to the available data, as obtained from observing programmes of diverse stakeholders, linked to the WMO Unified Data Policy.

To increase the availability of cryosphere data via the GCW Data Portal, GCW invites the consortium members to advocate with their national partner organizations to register their cryosphere observing stations as part of the GCW observing network, to ensure access to the GCW Data Portal functions, and to adopt the GCW recommended observing and reporting practices.

The collaboration of the TPRCC-Network is expected to contribute to the GCW framework of WMO, and GCW invites the consortium member to provide inputs regarding their observational needs. The engagement between GCW and TPRCC-Network TT will be facilitated on the GCW side through the GCW Polar RCC Focal Point, and will ensure the engagement of the relevant Expert Teams.

The entries of contributions suppose be updated and revised according to the progress of follow-up work and actual needs.

The Standing Committee on Earth System Modelling and Prediction (SC-ESMP) at its first meeting in March 2021,noted the potential that the Third Pole Regional Climate Centre network, under implementation, may meet one of the goals pursued by the S/GDPFS: geographical application, and that a pilot project may be considered in this sense.

3.4.2 Third Pole Environment (TPE)

The Third Pole Environment (TPE) is an international program for the interdisciplinary study of the relationships among water, ice, air, ecology and humankind in the Third Pole region and beyond. This program has been endorsed by UNESCO as its flagship program and is in close partnership with UNEP and WMO. The TPE program has achieved outstanding accomplishments over the past decade on integrated observation networks, multi-source datasets, modelling, international scientific collaboration and decision support services for sustainable development in the Asian High Mountain region centred on the QTP.

In terms of TPE contribution to the implementation and operations of the TPRCC-Network, it has been identified as follows:

a. TPE will support in transitioning research advances to operational capabilities, and should serve as an excellent resource for technical innovations in research methods and tools to support of common goals with the TPRCC-Network.
b. The development of TPRCC-Network would benefit from the outcomes of TPE on improved observations, Third Pole Environment Dataset, numerical modelling including high-resolution regional models, to efficiently realize the mandatory and highly recommended functions required for RCC in the Asian High Mountain regions.
c. Improved scientific knowledge on climate-water-environment-human systems in the Third Pole region will ensure or provide better climate and cryosphere-related services and enhanced environmental risk management to support regional sustainable development.
d. TPE experts would contribute to the development and implementation plan of the TPRCC-Network on request. TPE program will also engage TPRCC-Network to relevant TPE research projects and activities.
e. Assessing the environment change on the Third Pole with TPRCC-Network.
f. Facilitating the sharing of experiences in implementing the TPE, PAN-TPE and STEP programs, in the form of, e.g., giving talks at meetings.

g. Training of younger generations through TPE summer school and TPE centres.
h. Providing guidance on developing glacier, snow and water related products, organizing workshops, reviewing proposals, writing specific documents, and developing methodologies, together with TPRCC-Network

3.4.3 International Centre for Integrated Mountain Development (ICIMOD)

The International Centre for Integrated Mountain Development (ICIMOD) is an intergovernmental knowledge and learning centre that develops and shares research, information, and innovations to empower people in the eight regional member countries of the HKH – Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal, and Pakistan. It serves the region through information and knowledge generation and sharing to find innovative solutions to critical mountain problems. It bridges science with policies and on-the-ground practices. It provides a regional platform where experts, planners, policy makers, and practitioners can exchange ideas and perspectives towards the achievement of sustainable mountain development. It facilitates knowledge exchange across the region, help customize international knowledge and tailor it to the region's needs, and bring regional issues to the global stage.

ICIMOD works along with partners to develop and test new approaches to address change and build resilience, and base this on reliable and well-documented analyses. It feels most successful when innovations are scaled out beyond the programme boundaries. Large data gaps exist in the region and filling these gaps is a core part of our mission. ICIMOD has been most successful when communities, government agencies, practitioners, and scientists use the data and information generated and this is widely shared. It believes that greater human and institutional capacity is needed to upscale positive change in the region and work to enhance capabilities across our areas of expertise. It plays a key role in enhancing the interface between science-based evidence and policy and practice and seek to positively influence policies and practices across the HKH.

ICIMOD's contribution to the implementation and operations of the TPRCC-Network has been identified as follows:

a) A regular bulletin on drought monitoring and 3-mothly lead outlook of probable drought condition with possible impact is issued each month.
b) Several products on climate projections are available for RMCs including climate change scenarios on different RCPs, decadal changes in weather parameters, extreme indices and application.
c) Community based Flood Early Warning Systems (CBFEWS) is developed for glaciated basins prone to GLOF events. This is community-based flood EWS operational with a satisfactory performance.
d) Climate services for mountain ecosystem restoration urging comparative advantage of users and non-users.
e) Knowledge base of the Cryosphere of the HKH region through its programme on Cryosphere monitoring

f) ICIMOD follows open data policy. Its Regional Database System archives a range of data sets such as past and future climate, Earth Observation, Geospatial information for the HKH region.
g) Based on the needs and priorities of the countries ICIMOD will strengthen capacities at various levels for delivery and uptake of climate services.
h) Value added user friendly products may be developed for easy understanding, communication and integration with various application models.

3.4.4 The Global Energy and Water Exchanges (GEWEX) project

The Global Energy and Water Exchanges (GEWEX) project is a core project of the World Climate Research Programme (WCRP), which is dedicated to understanding Earth's water cycle and energy fluxes at, and below the surface and in the atmosphere. It is a network of scientists gathering information on and researching the global water and energy cycles, which will help to predict changes in the world's climate.

As a network of volunteers, we can contribute to the implementation through direct connection with current active projects as well as continued scientific guidance and support. The following current activities should connect to TPRCC:

1) Mounterrain: A project in its initial phases that looks at all aspects of precipitation processes (including wet and dry precipitation) in mountainous and complex terrain
2) Regional Hydroclimate Projects (RHPs) in Asia, including AsiaPEX, TPE-Water Sustainability and a Central Asia activity that should lead to an RHP in the Central Asia region (Hindu-Kush, Pamir and Tien-Shan) mountain ranges. These RHPs are generally large, regionally-focused multidisciplinary projects that aim to improve the understanding and prediction of a region's water, weather and climate process
3) INARCH: The International Network for Alpine Catchment Hydrology which focusses on improved hydrological observations and their networks in mountainous terrain.
4) TEAMx, Multi-scale transport and exchange processes in the atmosphere over mountains –programme and experiment. Which currently focusses on the Alps in Europe but plans to expand its research on boundary layer meteorology and climatology in mountainous environments
5) GEWEX Land-Atmosphere Feedback Observatories (GLAFOs) will observe the relevant processes and variables with respect to mass, energy, water, and momentum transport with unprecedented spatial and temporal resolutions, from bedrock to the lower troposphere. The measurements will be realized through the synergistic combination of in-situ instruments as well as active and passive remote sensing systems, partly with 3D scanning capability. Although complex the ambition is to have this global network include mountainous terrain
6) Impact of Initialized Land Temperature and Snowpack on Sub-Seasonal to Seasonal Prediction (LS4P). The focus area of the first phase of this project will be the QTP, and will be a joint effort with the Third Pole Experiment (TPE) Earth System Model (ESM) inter-comparison project (TPEMIP). This project intends to address two questions:
    a. What is the impact of the initialization of large scale land surface and subsurface temperature (LST/SUBT) and snow pack, including

aerosols in snow and in climate models on the Subseasonal-to-Seasonal (S2S) prediction over different regions?

b. What is the relative role and uncertainty in these land processes versus in SST and in S2S prediction? How do they synergistically enhance the S2S predictability?

This project focuses more on the process understanding and predictability rather than operational S2S prediction.

The specific activities GEWEX addressed above can contribute to the TPRCC-Network implementation through co-developed summer/winter schools and workshops as well as a regular exchange of information through its Quarterly Newsletter.

4. Next step plan

Follow Decision 47 (EC-70) – Polar Regional Climate Centres and Regional Climate Outlook Forums and Decision 11 (RA II-16) IMPLEMENTATION AND COORDINATION OF REGIONAL CLIMATE CENTRE OPERATIONS IN REGIONAL ASSOCIATION II, and the decision of the Seventeenth Session of RA II (RA II-17), at the appropriate time by early 2022, the Demonstration Phase of TPRCC-Network will commence, with the facilitation of the President of RA II and the WMO Secretariat. The following steps are planned for commencing the demonstration phase:

- The Node leads agree that their activities are progressing as identified in this plan and that a demonstration phase could be commenced e.g. web portal and websites displaying examples of products are accessible to users.
- Node leads advice their respective PRs of their readiness to commence the demonstration phase.
- PRs of Members hosting the TPRCC-Network Nodes Leads indicate their readiness to commence the demonstration phase to the PR of China, as China holds the overall coordination of the TPRCC-Network.
- The PR of China with WMO informs the President of RA II and the WMO Secretary General of the intent to start the demonstration phase, on behalf of the network.
- WMO Secretariat General informs the RA II Members about the launch of the network demonstration phase and invites them to start using products and providing feedback.

The duration of the demonstration phase will be decided by the TPRCC-Network Task Team in consultation with the relevant structures of RA II and other WMO bodies; a minimum two years is, generally, recommended to enable the Nodes, contributing partners and consortia members to implement the functions and develop the set of products and services as defined in the Implementation Plan. During the demonstration phase, the Implementation Plan will be updated by the TPRCC-Network Task Team, to reflect specific needs and conditions. As needed, additional guidance will be provided by the RA II relevant subsidiary bodies operational RCCs/RCC-Networks in RA II and the WMO Secretariat.

The primary focus for demonstration phase will be to ensure conduct of Mandatory Functions, to the standards set out in the WMO Technical Regulations (as per the Manual on the GDPFS). The following actions are proposed in order to fully implement the TPRCC-Network during the Demonstration Phase with the guidance of relevant WMO subsidiary bodies:

- The TPRCC-Network Nodes will focus on establishing their operational capabilities to deliver the mandatory functions in each of the functional areas for the domain of their responsibility. Nodes Leads and contributing Members will endeavor to translate the implementation plan into an operational plan. The Network will also initiate an RCOF for the Third Pole region as a user interface platform, which is also a mechanism to understand user requirements and identify gaps.

- Taking into account the outcomes of the High Mountain Summit in October 2019, there are crucial research and development areas identified for the region with high priority, including development of downscaling methods for outputs from regional and global climate models tailored to Third Pole region; monitoring, seasonal prediction and risk assessment on special climatic events over Asian High Mountain regions; monitoring and prediction information on cryosphere-related disasters; regional projection over Asian High Mountain regions to assist development of adaptation strategies. These will be pursued as a second stage, after the mandatory requirements have been established operationally. The engagement of scientific community may be required to address the research needs.

This implementation plan in conjunction with the RCC-related amendments to the Manual on the GDPFS provides a basis for the TPRCC-Network operation in mutual collaboration. Continuous improvement of services in the future will enable the TPRCC-Network to fully meet the Members' needs in RCC-related products.

All the above preparatory efforts being in place, actions will be taken to apply for formal WMO designation of TPRCC-Network. Further details on the process for designation of an RCC or RCC-Network are described in the document 'How to establish and run a WMO Regional Climate Centre (RCC)' (WMO/TD-No. 1534).

5. Addressing gaps and challenges

High priority issues to be addressed during the Demonstration Phase include the following, related to the structure, governance and coordination of the Network, and to the full implementation of the Mandatory Functions:

- Consistency in methods and procedures for cross-Node operational products to be determined. While there are many climate monitoring and LRF products available at national levels, no process has yet been established to determine common methodologies (including algorithms, models, normal, formats, projections, etc.) that will help merge national and sub-regional products into seamless operational products to cover the entire Third Pole region.

- Improvement of accuracy, spatial resolution and applicability of operational products and climate-related information, based on limited observation and research in the Third Pole region, especially in high mountainous areas, with highly complex terrain.

- Establishment of sustained and efficient interactive mechanism with relevant and interested user communities – the Third Pole Climate Forum (TPCF). The Network agreed to explore the effective mechanism for communicating with users, and to sustain their engagement and benefiting from TPCF, as its flagship activity.

Establishing and operating the TPRCC-Network will be largely based on existing human and financial resources, but there will be new tools, training activities, and other activities that will require additional resources. It is greatly appreciated that the Nodes leads, technical partners/contributors, and contributing WMO Members are committed to this initiative and will collaborate closely to ensure the TPRCC-Network viable and sustained for the future.

The participating WMO Members are encouraged to consider the Implementation Plan as a living document and to set up within it the tasks and milestones for addressing current and future high priority requirements.

Annex I — Focal Points of the TPRCC-Network

Dr. Lijuan Ma, China Meteorological Administration, overall Coordinator of TPRCC-Network

The Northern Node

1. Lead Institution

Leading Institution	Focal Point (s)
National Climate Centre (NCC) China Meteorological Administration 46, Zhongguancun Nandajie, Haidian District,Beijing, 100081, China	**Dr. Pengling Wang** Phone: +86 10 58994216 Fax: +86 10 62176804 Email: wangpl@cma.gov.cn

2. Consortium Members

Consortium members	Focal Point (s)
Bhutan	
Information and Research Institute of Meteorology, Hydrology and Environment, National Agency for Meteorology and Environmental Monitoring of Mongolia Chingeltei district, Juulchiny street-5, BagaToiruu-3, Ulaanbaatar 15160, Mongolia	**Mr. Purevdagva Khalzan** Phone: +976 11 329406, Fax: +976 11 326611, Email: purevdagva@namem.gov.mn
Nepal	
Pakistan Meteorological Department H-8/2, Pitras Bukhari Road Islamabad, Pakistan	**Dr. Shahzad Sultan** Phone: +92 51 9250367, Fax: +9251 9250368, Email: shahzad.sultan@gmail.com

The Southern Node

1. Lead Institution

Leading Institution	Focal Point (s)
India Meteorological Department Mausam Bhawan, Lodhi Road, New Delhi - 110003, India	**Dr. Vijay Kumar Soni**, Scientist-E Phone: +91 11 43824440, Fax: +91 11 24615371 E-mail: vijay.soni@imd.gov.in, soni_vk@yahoo.com

2. Consortium Members

Consortium members	Focal Point (s)
Bhutan	
Bangladesh	
Department of Meteorological and Hydrology, Ministry of Transport and Communications, Myanmar	**Mr. Hla Tun** Phone: +959 250954642 Fax: +95 673 411449 Email: hlatunmr@gmail.com
Nepal	

The Western Node

1. Lead Institution

Leading Institution	Focal Point (s)
Pakistan Meteorological Department H-8/2, Pitras Bukhari Road Islamabad, Pakistan	**Dr. Shahzad Sultan** Phone: +92 51 9250367, Fax: +9251 9250368, Email: shahzad.sultan@gmail.com

2. Consortium Members

Consortium members	Focal Point (s)
Afghanistan	
National Climate Centre (NCC) China Meteorological Administration 46, Zhongguancun Nandajie, Haidian District, Beijing, 100081, China	**Dr. Pengling Wang** Phone: +86 10 58994216 Fax: +86 10 62176804 Email: wangpl@cma.gov.cn
Tajikistan	
Uzbekistan	

Partners and Contributors

Partners/Contributors	Focal Point (s)
Global Cryosphere Watch (GCW/WMO)	Name: Rodica Nitu Phone: Fax: Email: rnitu@wmo.int
Third Pole Environment (TPE)	Name: Weicai Wang Phone: +86-10-84249468 Fax: / Email: weicaiwang@itpcas.ac.cn
International Centre for Integrated Mountain Development (ICIMOD)	Name: Mandira Shrestha Phone: Fax: Email: mandira.shrestha@icimod.org
Global Energy and Water Exchanges (GEWEX)	Name: Peter Van Oevelen Phone: Fax: Email: pvanoevelen@gewex.org

Annex II — WMO RCCs/RCC Networks Functions and Criteria

1. MANDATORY FUNCTIONS

APPENDIX 2.2.16 of the Manual on the Global Data-processing and Forecasting System (Annex IV to the WMO Technical Regulations) Edition 2019

Functions	Activities	Criteria
Operational activities for LRF (both dynamical and statistical, within the range of a one-month to two-year timescale, based on regional needs)	Interpret and assess relevant LRF products from GPCs, make use of the Lead Centre(s) for SVSLRF, distribute relevant information to RCC users, and provide feedback to GPCs (see GDPFS Attachment 2.2.2)	***Product:*** Assessment of the reliability and outcomes of GPCs or Lead Centre(s) for LRFMME products, including the reasoning (make use of the Lead Centre(s) for SVSLRF), for the region of interest, in the form of texts, tables, figures, etc. ***Element:*** 2-m mean temperature, total precipitation ***Update frequency:*** monthly or at least quarterly
	Generate regional and sub-regional tailored products, relevant to RCC user needs, including seasonal outlooks	***Product:*** Probabilities for tercile (or appropriate quantile) categories for the region or sub-region ***Element:*** 2-m mean temperature, total precipitation ***Output type: R****endered images (maps, charts), text, tables, digital data* ***Forecast period*****:** one month up to 6 months

		Update frequency: 10 days to one month
	Generate consensus* statement on regional or sub-regional forecasts * A collaborative process involves discussion with experts in the region (e.g., through Regional Climate Outlook Forums (RCOFs) and teleconferencing). Consensus is both the agreed process and its joint conclusion, and the consensus can be that there is limited skill in the prediction for a region or subregion	***Product:*** Consensus statement on regional or sub-regional forecast ***Element:*** *2-m mean temperature, total precipitation* ***Output type:*** *report* F***orecast period*****:** *a climatologically significant period (from one month to one year)* ***Update frequency:*** *at least once per year (to be defined by the region)*
	Perform verification of RCC quantitative LRF products, including the exchange of basic forecasts and hindcast data	***Products:*** verification datasets (e.g. SVS LRF scores, Brier Skill Score; ROC; Hit Rate Skill Score) ***Element:*** 2-m mean temperature, total precipitation

	Provide online access to RCC products and services to RCC users	***Product:*** an on-line data/information portal
	Assess use of RCC products and services through feedback from RCC users	***Product:*** analysis of feedback (which is made available using a template) ***Update frequency:*** annually, as part of a regular reporting of RCCs to WMO RAs
Operational Activities for Climate Monitoring	Perform climate diagnostics including analysis of climate variability and extremes, at regional and sub-regional scales	***Products:*** Climate diagnostics bulletin including tables, maps and related products ***Element:*** Mean, Max and Min temperatures, Total precipitation; other elements (esp. GCOS essential climate variables) to be determined by the region, ***Update frequency:*** Monthly
	Establish an historical reference climatology for the region and/or sub-regions	***Product:*** Database of climatological means for various reference periods (e.g. 1931-60; 1951-80; 1961-90; 1971-2000; etc) ***Spatial resolution:*** *By station* ***Temporal resolution:*** *Monthly at a minimum* ***Elements:*** Mean, Max and Min temperatures, Total precipitation; other elements (esp. GCOS essential climate variables) to be determined by the region,

		Update frequency: at least 30 years, preferably 10 years
	Implement a Regional Climate Watch	***Products:*** Climate advisories and information for RCC Users ***Update:*** Whenever required, based on the forecast of significant regional climate anomalies.
Operational Data Services, to support operational LRF and climate monitoring	Develop quality controlled regional climate datasets, gridded where applicable	***Products:*** Regional, quality-controlled climate datasets, gridded where applicable, following CCl guidance on QA/QC procedures ***Elements:*** Mean, Max and Min Temperature, and Precipitation, at a minimum ***Temporal resolution:*** *Daily* ***Update:*** Monthly
	Provide climate database and archiving services, at the request of NMHSs	***Products:*** National databases with metadata, accessible to the NMHS in question (backup service, development site, etc). ***Elements:*** As determined by the NMHS

		Update: At the request of the NMHS
Training in the use of operational RCC products and services	Provide information on methodologies and product specifications for mandatory RCC products, and provide guidance on their use	***Products:*** *Manuals, guidance documents and information notes*. ***Update frequency:*** When methods/products are revised or introduced or discontinued
	Coordinate training for RCC Users in interpretation and use of mandatory RCC products	***Products:*** Survey and analysis of regional training needs, and proposals for training activities.

NOTE: An RCC is expected to perform certain functions (for example, for homogeneity testing; database management; metadata management; statistical evaluation of climate data) using procedures proposed in the Guide to Climatological Practices (WMO-No.100) and in other official WMO guidance documents.

2. ADDITIONAL HIGHLY RECOMMENDED FUNCTIONS

Attachment 2.2.2 of the Manual on the Global Data-processing and Forecasting System (Annex IV to the WMO Technical Regulations) Edition 2019

1. Climate prediction and climate projection:
   - Assist RCC users in the access and use of World Climate Research Programme Coupled Model Inter-comparison Project climate model simulations;
   - Perform downscaling of climate-change scenarios;
   - Provide information to RCC users for use in development of climate adaptation strategies;
   - Generate, along with warnings of caution on uncertainty, seasonal forecasts for specific parameters where relevant, such as:
     - Onset, intensity and cessation of rainy season;
     - Tropical cyclone frequency and intensity;
   - Perform verification on consensus statements for forecasts;
   - Perform assessment of other GPC products such as SSTs and winds.

2. Non-operational data services:
   - Keep abreast of activities and documentation related to WIS, and work towards WIS compliance and data collection or production-centre designation;
   - Assist NMHSs in the rescue of climate data from outmoded storage media;
   - Assist NMHSs to develop and maintain historical climate datasets;
   - Assist RCC users in the development and maintenance of software modules for standard applications;
   - Advise RCC users on data quality management;
   - Conduct data homogenization, and advise RCC users on homogeneity assessment, and development and use of homogeneous datasets;
   - Develop and manage databases, and generate indices, of climate extremes;
   - Perform quality assurance and quality control on national datasets, at the request of an NMHS;
   - Provide expertise on interpolation techniques;
   - Facilitate data and metadata exchange among NMHSs, including online access, through an agreed regional mechanism;
   - Perform quality assurance and quality control on regional datasets.

3. Coordination functions:
   - Strengthen collaboration between NMHSs on related observing, communication and computing networks including data collection and exchange;
   - Develop systems to facilitate harmonization and assistance in the use of LRF products and other climate services;
   - Assist NMHSs in user liaison, including the organization of climate and multidisciplinary workshops and other forums on user needs;
   - Assist NMHSs in the development of a media and public-awareness strategy on climate services.

4. Training and capacity-building:
   - Assist NMHSs in the training of users on the application and implications of LRF products;
   - Assist in the introduction of appropriate decision models for end users, especially as related to probability forecasts;
   - Promote technical capacity-building at the NMHS level (for example, acquisition of hardware and software), as required for implementation of climate services;
   - Assist in professional capacity-building (training) of climate experts for generating user-targeted products.

5. Research and development:
   - Develop a climate research and development agenda and coordinate it with other relevant RCCs;
   - Promote studies of regional climate variability and change, predictability and impact in the region;
   - Develop consensus practices to handle divergent climate information for the region;
   - Develop and validate regional models, methods of downscaling and interpretation of global output products;
   - Promote the use of proxy climate data in long-term analyses of climate variability and change;
   - Promote application research, and assist in the specification and development of sector-specific products;
   - Promote studies of the economic value of climate information.

Annex III — Cross-regional Products/Services

This is an overview of all cross-regional products identified by the nodes and partners and can be updated during the demonstration phase. Otherwise, contributions of partners are identified in "REMARKS" – the last column of below tables, if there's any. Each product in this annex shall cover the whole domain of the TPRCC-Network.

1. Operational Activities for Long Range Forecasts (LRF)

Function/Activity/Criteria	Product/Service	Producer	Areal coverage	Time of issuance	Means of service provision	Remarks
Interpret and assess Asian High Mountain-related LRF products from Global Producing Centers of LRF (GPC-LRFs), distribute relevant information to TPRCC users; and provide feedback to GPC-LRFs						
Generate regional and sub-regional tailored products, relevant to TPRCC User needs, including seasonal outlooks etc.	Monthly and Seasonal Forecast (3-monthly) of temperature and precipitation for TPRCC	PMD	TPRCC-Network domain	Monthly	web portal	Cooperation for statistical/dynamical downscaling of the products for improved seasonal outlooks.
Performance verification of TPRCC quantitative LRF products, including the exchange of basic forecasts and hindcast data;						

Provide online access to TPRCC products/services to TPRCC Users;						
Assess use of TPRCC products and services through feedback from TPRCC Users						

2. Operational Activities for Climate Monitoring

Function/Activity/Criteria	Product/Service	Producer	Areal coverage	Time of issuance	Means of service provision	Remarks
Perform climate diagnostics including analysis of climate variability and extremes, at regional and sub-regional scales	Annual Bulletin on the Climate in the Third Pole region	NCC(host), CAMS, NSMC/CMA; ITPCAS, NIEER/CAS; BNU	TPRCC-Network domain (25°-50°N; 65°-105°E)	End of June of next year	Web Portal/ Print version;	
	Monthly maps of maximum/mean/minimum Temperature, Precipitation	NCC/CMA	TPRCC-Network domain (25°-50°N; 65°-105°E)	Second week of the month for previous	Web Portal	
	Monthly anomaly of Temperature and Precipitation	NCC/CMA	TPRCC-Network domain (25°-50°N; 65°-105°E)	Second week of the month for previous	Web Portal	

	Maps and graphs of Temperature, Precipitation extreme indices based on station/gridded data	NCC/CMA	TPRCC-Network domain (25°-50°N; 65°-105°E)	Once per month and ad hoc on demand (extreme events)	Web Portal	
	Spatial distribution and anomalies of the number of snow cover days, as well as time series of snow cover extent and its anomalies	NCC/CMA	TPRCC-Network domain (25°-50°N; 65°-105°E)	Once per month and per season	Web Portal	
Establish a historical reference climatology for the region and sub-regions	Reference climatology for maximum/mean/minimum Temperature, Precipitation	NCC /CMA	TPRCC-Network domain		Web Portal	GCW would provide guidance on developing snow related products
Implement a Regional Climate Watch	Climate advisories and information	NCC, CAMS, NSMC/CMA; ITPCAS, NIEER/ CAS; BNU	TPRCC-Network domain	Whenever required	Web Portal	Operational work done by NCC supporting the activities in issuing Climate Watches, based on monthly diagnostic, anomaly maps, climate extremes indices and LRF

3. Operational Data Services, to support operational LRF and climate monitoring

Function/Activity/Criteria	Product/Service	Producer	Areal coverage	Time of issuance	Means of service provision	Remarks
Develop quality controlled regional climate datasets, gridded where applicable						
Provide climate database and archiving services, at the request of NMHSs						

4. Training in the use of operational TPRCC products and services

Function/Activity/Criteria	Product/Service	Producer	Areal coverage	Time of issuance	Means of service provision	Remarks
Provide information on methodologies and product specifications for mandatory RCC products, and provide guidance on their use	Short term training course and seminars in climate modeling and interpretation of model outputs, applied climatology, climate change adaptation	NCC, CMATC/CMA	TPRCC-Network domain	On request	Web portal or teleconference	Responsibility for the training would be shared among the TPRCC Nodes
Coordinate training for RCC Users in interpretation and use of mandatory RCC products	Seminars and training courses open to end users of TPRCC Network-related products and climate information	NCC/CMA; ITPCAS/CAS	TPRCC-Network domain	On request	Web portal, documentations, on-site training (on request)	Responsibility for the training would be shared among the TPRCC Nodes

5. Cross-regional products and services for Highly Recommended Functions

Function/Activity/Criteria	Product/Service	Producer	Areal coverage	Time of issuance	Means of service provision	Remarks
Assist TPRCC users in access and use of WCRP-CMIP products simulated by climate/earth system models	Training for young researchers to access to GCMs/RCMs data on ESGF Portal	Pakistan	Global/Regional			

Notes: Implementation of an annual meeting of TPRCC Network node coordinators to discuss issues of service delivery and of collaboration.

Annex IV — Sub-regional Products/Services

This is an overview of all sub-regional products identified by the nodes and partners. Tables for overview of the sub-regional products to be contributed by each partner can be added as needed during the demonstration phase. Contributions of partners can be also identified in “REMARKS” – the last column of below tables, if there's any. Each product shall cover the sub-domain of the TPRCC-Network, as identified by the corresponding producer.

The Northern Node

1. Long-Range Forecasting

Attachment 1: Service provision overview: Long-Range Forecasting

Function/Activity/Criteria	Product/Service	Producer	Areal coverage	Time of issuance	Means of service provision	Remarks

Interpret and assess Third Pole region-related LRF products from Global Producing Centers of LRF (GPC-LRFs), distribute relevant Information to TPRCC users; and provide feedback to GPC-LRFs	Graphs and maps of model performance (Temperature and Precipitation)	NCC/CMA	The north Third Pole domain	When GPC models are updated	Web Portal	In accordance with the requirements of WMO's Standardized Verification System (GDPFS/SVS) for LRF
Generate regional and sub-regional tailored products, relevant to TPRCC User needs, 1ncluding seasonal outlooks	Seasonal outlook	NCC/CMA	The north Third Pole region and sub-regions	End of month	Web Portal	
Generate a consensus statement on regional or sub-regional forecasts	Bulletin and Tele-conference or consulting meeting	NCC,CAMS/CMA	Members of TPRCC Network	Teleconference or consulting meeting twice a year (TBC)	Web Portal	In conjunction with FOCRAII (TBC)
Perform verification of	Verification datasets	NCC/CMA	The north	On request	Web Portal	For Members of TPRCC Network,

TPRCC quantitative LRF products, including the exchange of basic forecasts and hindcast data			Third Pole region			password protected
Provide online access to TPRCC products/services to TPRCC Users	Web Portal	NCC/CMA	The north Third Pole region			
Assess use of TPRCC products and services through feedback from TPRCC Users	Summary report	NCC/CMA	The north Third Pole domain	Annual	Web Portal	Input via Website, workshops

Attachment 2: Short product/service description: Long-Range Forecasting

Dataset/Product/ Service	**Methodology, spatial/temporal resolution, quality indicators, validation etc.**
Graphs and maps of model performance in terms of standard skill metrics (LRF)	**Methodology:** Evaluation of model performance using WMO SVS specifications. A selection of GPC models will be used based on regional skill assessments. **Spatial resolution:** 1 °x 1 ° **Temporal resolution:** 12 monthly (+1 month lead time) and 10 overlapping 3-month seasons **Quality indicators/Validation:** SVS scores

Maps of model long-range predictions (include textual and graphical information)	**Methodology:** Post processing of monthly (+1 month lead time) and 3-month seasonal forecasts from selected GPC models. Variables include precipitation and surface air temperature. Beyond tercile and standard anomaly forecasts of these variables, products will include a probabilistic threshold forecast for different percentiles thresholds of temperature and precipitation variables. Includes a brief narrative of the outlook and a review of the outlook of the previous month. **Spatial resolution:** 1 °x 1 ° **Temporal resolution:** 12 monthly (+1 lead time) and 10 3-month overlapping seasons **Quality indicators/Validation:** On-time delivery and review of previous month's outlook
Quarterly bulletins which include: (1) analyzing and interpreting GPCs model predictions, (2) qualitative review of recent outlooks/bulletins	**Methodology:** Qualitative compilation of temperature and precipitation seasonal forecasts from the GPC model predictions including review of the forecast in the previous bulletin. **Spatial resolution:** Third Pole region **Temporal resolution:** Every 3 months of standard seasons (DJF, MAM, JJA and SON) **Quality indicators/Validation:** On-time delivery and review of previous season's outlook
Maps of model subseasonal predictions (with brief narrative)	**Methodology:** Post processing of 10-day (+1 month lead time) subseasonal forecasts from selected GPC subseasonal models. Variables include precipitation and surface air temperature. Beyond ensemble range anomaly forecasts of the variables' weekly means, products will include the appropriate outlook for extremes variables of temperature and precipitation. Includes a brief narrative of the outlook and a review of the outlook of the previous forecasts. **Spatial resolution:** 1 °x 1 ° **Temporal resolution:** 10-day (+1 month lead time) **Quality indicators/Validation:** On-time delivery and review of previous month's outlook

Consensus statements: Winter (DJF) and Summer (JJA) RCOF bulletins for the Third Pole region	**Methodology:** Regional consensus on probabilistic temperature and rainfall forecasts from participants of the twice-yearly Climate Outlook Forum (TPCOF) **Spatial resolution:** Third Pole region **Temporal resolution:** Twice a year ahead of the DJF and JJA seasons **Quality indicators/Validation:** On-time delivery
Verification datasets	**Methodology:** Verification datasets provided and updated (Available on request) **Spatial resolution:**1 °x1 ° **Temporal resolution:** month **Quality indicators/Validation:** dataset availability
Information and guidance on methodologies and products	**Methodology:** documents available on request on forecasting suite configuration and product computation **Quality indicators/Validation:** availability on request
Web Portal/ftp	**Methodology:** web portal and ftp site with password protected **Temporal resolution:** monthly update **Quality indicators/Validation:** link available on request

2. Climate Monitoring

Attachment 1: Service provision overview: Climate Monitoring

Function/Activity/Criteria	Product/Service	Producer	Areal coverage	Time of issuance	Means of service provision	Remarks
Perform climate diagnostics	1. Annual Bulletin on	1.NCC(host);	The north	1.End of	1.Web Portal/	

including analysis of climate variability and extremes, at regional and sub-regional scales	the Climate in the Third Pole region 2. Monthly maps of maximum/mean/minimum Temperature, Precipitation 3. Monthly anomaly of Temperature and Precipitation 4. Maps and graphs of Temperature, Precipitation extreme indices based on station/gridded data	CAMS;NSMC/CMA,ITPCAS; NIEER/CAS, BNU 2. NCC/CMA 3.NCC/CMA 4.NCC/CMA	Third Pole domain	June of next year 2.Second week of the month for previous 3.Second week of the month for previous 4.Once per month and ad hoc on demand (extreme events)	Print version; 2. Web Portal 3. Web Portal 4. Web Portal	
Establish an historical reference climatology for the region and sub-regions	Reference climatology for maximum/mean/minimum Temperature, Precipitation and other	NCC /CMA	The north Third Pole region and sub-regions		Web Portal	GCW would provide guidance on developing snow related products

	ECVs					
Implement a Regional Climate Watch	Climate advisories and information	NCC; CAMS; NSMC/CMA, ITPCAS; NIEER/ CAS, BNU	The north Third Pole region	Whenever required	Web Portal	Operational work done by NCC supporting the activities in issuing Climate Watches, based on monthly diagnostic, anomaly maps, climate extremes indices and LRF

Attachment 2: Short product/service description: Climate Monitoring

Dataset/Product/ Service	**Methodology, spatial/temporal resolution, quality indicators, validation etc.**
Annual Bulletin on the Climate in the Third Pole region	**Methodology:** compilation of national contributions of TPRCC members. NCC will combine the inputs from all consortium partners and produce the bulletin **Spatial resolution:** sub-region/national/local **Temporal resolution:** yearly **Quality indicators/Validation:** internal review

Monthly Climate Monitoring and Assessment of Temperature and Rainfall for Third Pole region	**Methodology:** development of gridded precipitation and temperature data for the Third Pole region; Establishment of brief qualitative assessment of conditions over the region. Initially, contexts will include (mean, max and min) temperature and rainfall. At a later stage, this will be enhanced to include additional cryosphere-related ECVs based on deep data sharing of consortium partners. **Spatial resolution:** Resolution based on available near real-time precipitation and temperature observations over the Third Pole region; It is proposed to produce the gridded precipitation and temperature data of Third Pole at 25 km resolution **Temporal resolution:** monthly **Quality indicators/Validation:** On-time delivery
Dataset for reference climatologies (Temperature and Rainfall) based observation and gridded data	**Methodology:** Calculation of monthly and seasonal climatological normals from the data available **Spatial resolution:** stations in the domain of Third Pole region; 0.25 °×025 ℃(for the maps) **Temporal resolution:** monthly (1981-2010/1991-2020 normal period) **Quality indicators/ Validation:** Several stages of quality control of the dataset prior to publishing
Climate Watch bulletins for Third Pole region (containing advisories or statements on foreseen climate anomalies)	**Methodology:** Compilation of all available climate information from the National Meteorological and Hydrological Services in the region, other regional centers and GPCs, in accordance with the WMO Guidelines on Climate Watches and agreed procedures by the participating NMHSs from Third Pole region **Temporal resolution:** monthly or quarterly. **Quality indicators/ Validation:** Timely delivery **Reference:** Guidelines on Climate Watches, WMO/TD No. 1269, 2005, WMO

3. Operational Data Services

Attachment 1: Service provision overview: Operational Data Services

Function/Activity/Criteria	Product/Service	Producer	Areal coverage	Time of issuance	Means of service provision	Remarks
Develop quality controlled regional climate datasets, gridded where applicable	Guidance on QC-procedures and homogenization of climate datasets	NCC/CMA	The north Third Pole domain	Whenever required	Web Portal	Seminars, software, documentation (on request) Majority of data is obtained through: - GTS - Other sources: GCW, GHCND, and data from TPRCC members
Provide climate database and archiving services, at the request of NMHSs	Safe, recoverable storage of all TPRCC Network-related datasets	NCC/CMA	The north Third Pole region	Whenever required	Web Portal	
Collection the data of the integrated observing network and their quality assessment	Ground-based data: snow depth and pressure, depth of frozen soil, soil moisture and temperature, radiation, weather phenomenon	NCC/CMA	The north Third Pole region	Annual	Web Portal	

Attachment 2: Short product/service description: Operational Data Services

Dataset/Product/ Service	Methodology, spatial/temporal resolution, quality indicators, validation etc.
Time series graphs and maps of daily data and derived indices for extreme events	**Methodology:** Time series plots and maps of climate parameters and their derived indices, based on the ETCCDI index **Spatial resolution:** Point based observation **Temporal resolution:** daily, monthly, seasonal, annual. **Quality indicators/ Validation:** Quality control mechanism is available for all parameters. Newly inserted data will be quality controlled before made available to user
Daily gridded data (to be developed; Temperature and Rainfall)	**Methodology:** Spatial interpolation of in-situ observations **Spatial resolution:** 0.25 ° x 0.25 ° **Temporal resolution :** daily **Quality indicators/ Validation** : Validation using cross-validation type of metric

4. Training

Attachment 1: Service provision overview: Training

Function/Activity/Criteria	Product/Service	Producer	Areal coverage	Time of issuance	Means of service provision	Remarks

Provide information on methodologies and product specifications for mandatory TPRCC products, and provide guidance on their use	Short term training course and seminars in climate modeling and interpretation of model outputs, applied climatology, climate change adaptation	NCC/CMA	The north Third Pole domain	On request	Web portal (available after portal establishment) or teleconference	
Coordinate training for TPRCC Users in interpretation and use of mandatory TPRCC products	Seminars and training courses open to end users of TPRCC Network-related products and climate information	NCC /CMA ; ITPCAS/CAS	The north Third Pole region	On request	Web portal, documentations, on-site training (on request)	

Attachment 2: Short product/service description: Training

Dataset/Product/ Service	**Methodology, spatial/temporal resolution, quality indicators, validation etc.**
Information and guidance on methodologies and products: User guides on products	**Methodology:** User guides for interpretation of LRF products/outlook provided on the Web Portal., including interpretation of skill and guidance on the limitation of model outlook. **Quality indicators/Validation:** Continuous update following feedback from portal users

Coordinate training for multi-Users on interpretation and use of TPRCC products (LRF products, Climate monitoring and diagnosis, Climate dataset and application)	**Methodology:** On-site or online training on the use and interpretation of the products of the Web Portal. Training will be co-hosted and organized with the Regional Training Center (WMO-RTC) for efficiency purpose. Parts of the training may be given in the form of online training for cost efficiency reason **Quality indicators/ Validation:** Feedback form for participants of the training

The Southern Node

1. Long-Range Forecasting

Attachment 1: Service provision overview: Long-Range Forecasting

Function/Activity/Criteria	Product/Service	Producer	Areal coverage	Time of issuance	Means of service provision	Remarks
Interpret and assess Asian High Mountain-related LRF products from Global Producing Centres of LRF (GPC-LRFs), distribute relevant Information to TPRCC users; and provide feedback to GPC-LRFs;	Graphs and maps of model performances, Monthly or quarterly bulletins analysing and interpreting GPC products	IMD/IITM	Third Pole Domain and South Asia Mountain Region	Monthly	Website	In accordance with the requirements of TPRCC for LRF WMO's Standardized Verification System. Data sharing needed from countries.
Generate regional and sub-regional tailored products, relevant to TPRCC User needs, including seasonal outlooks etc.;	Seasonal outlook	IMD/IITM	Third Pole domain and South Asia Mountain Region	Monthly	Website	

Generate consensus statement on regional or sub-regional forecasts;	The consensus climate outlook prepared through exchange of expert assessment among a team of experts from southern TP node countries via teleconference, meeting, etc.	IMD	South Asia Mountain Region	Seasonal	Website	
Performance verification of TPRCC quantitative LRF products, including the exchange of basic forecasts and hindcast data;	Verification dataset	IMD	South Asia Mountain Region	Monthly/Annual	Web Portal /ftp	
Provide online access to TPRCC products/services to TPRCC Users;	Website	IMD	South Asia Mountain Region	Regular	Website	
Assess use of TPRCC products and services through feedback from TPRCC Users	Summary report	IMD	South Asia Mountain Region	Annual	Web Portal	Input via Website, workshops

Attachment 2: Short product/service description: Long-Range Forecasting

Dataset/ Product/ Service	Description
Mandatory function: Long-Range Forecasting	
Graphs and maps of model performance in terms of standard skill metrics (LRF).	**Methodology:** Evaluation of model performance using WMO SVS specifications. A selection of GPC models will be used based on regional skill assessments. **Spatial resolution:** 1 °x 1 ° **Temporal resolution:** 12 monthly (+1 month lead time) and 12 overlapping 3-month seasons **Quality indicators/Validation:** SVS scores
Maps of model long-range predictions (with brief narrative)	**Methodology:** Post processing of monthly (+1 month lead time) and 3-month seasonal forecasts from selected GPC models. Variables include precipitation and surface temperature. 925 hPa and 850 hPa winds will also be provided if these are assessed to have a useful skill. Beyond tercile and standard anomaly forecasts of these variables, products will include probabilistic threshold forecast for different percentiles thresholds (1%,10%,25%,50%,75%,90%,99%-iles) of temperature and precipitation variables. Includes brief narrative of the outlook and a review of the outlook of the previous month.
Quarterly bulletins which include: (1) analysing and interpreting GPCs model predictions, (2) assessment and outlook for ENSO and IOD, and (3) qualitative review of recent outlooks/bulletins	**Methodology:** Qualitative compilation of temperature, precipitation and possibly wind (925 hPa and 850 hPa) seasonal forecasts from the GPC model predictions including assessment of processes that affect the region (e.g. ENSO and IOD). Includes a review of the forecast in the previous bulletin. **Spatial resolution:** Southeast Asia region **Temporal resolution:** Every 3 months of standard seasons (DJF, MAM, JJA and SON)

	Quality indicators/Validation: On-time delivery and review of previous season's outlook
Outlook for number of tropical cyclone in the season ahead (6-months) and preferred tracks based on climatology.	**Methodology:** Analog method based on the historical record. **Temporal resolution:** Monthly for 6-months ahead. **Quality indicators/Validation:** Statistical evaluation of forecast tropical cyclone frequency. In the longer term the use of dynamical models for forecast frequency and tracks will be investigated.
Graphs and maps of model performance in terms of standard skill metrics (sub-seasonal).	**Methodology:** Evaluation of model performance using WMO SVS specifications. A selection of GPC sub-seasonal models will be used based on regional skill assessments. **Spatial resolution:** Model-dependent resolution as available in archive **Temporal resolution:** Weekly (+1, +2, +3, +4 lead time), at least fortnightly **Quality indicators/Validation:** SVS scores
Maps of model sub-seasonal predictions (with brief narrative)	**Methodology:** Post processing of weekly (+1,+2,+3 and +4 month lead time) sub-seasonal forecasts from selected GPC sub-seasonal models. Variables include precipitation and surface temperature. 925 hPa and 850 hPa winds will also be provided if these are assessed to have a useful skill. Beyond ensemble range anomaly forecasts of the variables' weekly means, products will include the appropriate outlook for extremes variables of temperature and precipitation. Includes a brief narrative of the outlook and a review of the outlook of the previous 2 weeks (for fortnightly frequency, for the previous week otherwise). **Spatial resolution:** Model-dependent resolution as available in archive **Temporal resolution:** Weekly (+1, +2, +3, +4 lead time), at least fortnightly **Quality indicators/Validation:** On-time delivery and review of previous month's outlook

Monthly bulletins which include: (1) analysing and interpreting GPCs model predictions, (2) assessment and outlook for MJO and other sub-seasonal processes , and (3) qualitative review of recent outlooks/bulletins	**Methodology:** Qualitative compilation of temperature, precipitation and possibly wind (925 hPa and 850 hPa) seasonal forecasts from the GPC model predictions including assessment of processes that affect the region (e.g. MJO and other sub-seasonal processes). Includes a review of the forecast in the previous bulletin. **Spatial resolution:** Southeast Asia region **Temporal resolution:** Every month **Quality indicators/Validation:** On-time delivery and review of previous month's outlook
Consensus statements: Winter (DJF) and Summer (JJA) Monsoon RCOF bulletins for Southeast Asia	**Methodology:** Regional consensus on probabilistic temperature and rainfall forecasts from participants of the twice-yearly ASEAN Climate Outlook Forum (ASEANCOF). Includes assessment of possible impacts on region from ENSO and/or IOD. **Spatial resolution:** Third Pole region and South Asia Mountain Region **Temporal resolution:** Twice a year ahead of the DJF and JJA Monsoon seasons **Quality indicators/Validation:** On-time delivery
Verification datasets	**Methodology:** Verification datasets provided and updated (Available on request) **Spatial resolution:** 1 °x1 ° **Temporal resolution:** month **Quality indicators/Validation:** dataset availability
Information and guidance on methodologies and products	**Methodology:** documents available on request on forecasting suite configuration and product computation **Quality indicators/Validation:** availability on request
Web Portal/ftp	**Methodology:** web portal and ftp site with password protected (*in preparation*)

	Temporal resolution: monthly update **Quality indicators/Validation:** link availability on request

2. Climate Monitoring

Attachment 1: Service provision overview: Climate Monitoring

Function/Activity/Criteria	Product/Service	Producer	Areal coverage	Time of issuance	Means of service provision	Remarks
Perform climate diagnostics including analysis of climate variability and extremes, at regional and sub-regional scales	1. Annual Bulletin on the Climate in the Third Pole region 2. Monthly maps of maximum/minimum Temperature, Precipitation 3. Monthly anomaly of Temperature and Precipitation 4. Maps and graphs of Temperature, Precipitation extreme indices based on	1.IMD 2. IMD/IITM 3. IMD/IITM 4. IMD/IITM	Third Pole domain and South Asia Mountain Region	1.End of June of next year 2.Second week of the month for previous 3.Second week of the month for previous 4.Once per month and ad hoc on demand (extreme events)	1.WebPortal/Print version; 2. Web Portal 3. Web Portal 4. WebPortal	

	station/gridded data					
Establish an historical reference climatology for the region and sub-regions	Reference climatology for maximum/mean/minimum Temperature, Precipitation and other ECVs	IMD/IITM	Third Pole region and South Asia Mountain Region		Web Portal	GCW would provide guidance on developing snow related products
Implement a Regional Climate Watch	Climate advisories and information	IMD (host)	Third Pole region	Whenever required, operational work done by IMD supporting the activities in issuing Climate Watches, based on monthly diagnostic, anomaly maps, climate extremes indices and LRF)	Web Portal	

Attachment 2: Short product/service description: Climate Monitoring

Dataset/Product/ Service	**Methodology, spatial/temporal resolution, quality indicators, validation etc.**

Annual Bulletin on the Climate in the Third Pole region	**Methodology:** compilation of national contributions of TPRCC members. IMD will combine the inputs from all consortium partners from sub-region and produce the bulletin **Spatial resolution:** sub-region/national/local **Temporal resolution:** yearly **Quality indicators/Validation:** internal review
Monthly Climate Monitoring and Assessment of Temperature and Rainfall for Third Pole region	**Methodology:** development of gridded precipitation and temperature data for the Third Pole region; Establishment of brief qualitative assessment of conditions over the region. Initially, contexts will include (mean, max and min) temperature and rainfall. At a later stage, this will be enhanced to include additional cryosphere-related ECVs based on deep data sharing of consortium partners. **Spatial resolution:** Resolution based on available near real-time precipitation and temperature observations over the Third Pole region; It is proposed to produce the gridded precipitation and temperature data of Third Pole at 25 km resolution **Temporal resolution:** monthly **Quality indicators/Validation:** On-time delivery
Data set for reference climatologies (Temperature and Rainfall) based observation and gridded data	**Methodology:** Calculation of monthly and seasonal climatological normals from the data available **Spatial resolution:** stations in the domain of Third Pole region; 0.25 °×0.25 °(for the maps) **Temporal resolution:** monthly (1981-2010 normal period) **Quality indicators/ Validation:** Several stages of quality control of the dataset prior to publishing

Climate Watch bulletins for Third Pole region (containing advisories or statements on foreseen climate anomalies)	**Methodology:** Compilation of all available climate information from the National Meteorological and Hydrological Services in the region, other regional centers and GPCs, in accordance with the WMO Guidelines on Climate Watches and agreed procedures by the participating NMHSs from Third Pole region **Temporal resolution:** monthly or quarterly. **Quality indicators/ Validation:** Timely delivery **Reference:** Guidelines on Climate Watches, WMO/TD No. 1269, 2005, WMO

3. Operational Data Services

Attachment 1: Service provision overview: Operational Data Services

Function/Activity/Criteria	Product/Service	Producer	Areal coverage	Time of issuance	Means of service provision	Remarks
Develop quality controlled regional climate datasets, gridded where applicable	Guidance on QC-procedures and homogenization of climate datasets	IMD-NCC, IITM	Third Pole domain (25°-50°N; 65°-105°E)	After data portal available	Web Portal	Seminars, software, documentation (on request) Majority of data is obtained through: -GTS -Other sources: GCW, GHCND, and data from TPRCC members
Provide climate database and	Safe, recoverable	IMD	Third Pole	After data	Web Portal	

archiving services, at the request of NMHSs	storage of all TPRCC Network-related datasets		region	portal available		
Collection the data of the integrated observing network and their quality assessment	Ground-based data	IMD-NCC	Third Pole region	After data portal available	Web Portal	

Attachment 2: Short product/service description: Operational Data Services

Dataset/Product/ Service	**Methodology, spatial/temporal resolution, quality indicators, validation etc.**
Time series graphs and maps of daily data and derived indices for extreme events	**Methodology:** Time series plots and maps of climate parameters and their derived indices, based on the ETCCD Index **Spatial resolution:** Point based observation **Temporal resolution:** daily, monthly, seasonal, annual. **Quality indicators/ Validation:** Quality control mechanism is available for all parameters. Newly inserted data will be quality controlled before made available to user
Daily gridded data (to be developed; Temperature and Rainfall)	**Methodology:** Spatial interpolation of in-situ observations **Spatial resolution:** 0.25 °x0.25 ° **Temporal resolution:** daily **Quality indicators/ Validation**: Validation using cross-validation type of metric

4. Training

Attachment 1: Service provision overview: Training

Function/Activity/Criteria	Product/Service	Producer	Areal coverage	Time of issuance	Means of service provision	Remarks
Provide information on methodologies and product specifications for mandatory TPRCC products, and provide guidance on their use	Short term training course and seminars in climate modeling and interpretation of model outputs, applied climatology, climate change adaptation	IMD/IITM	Third Pole domain (25 °-50 °N; 65 °-105 °E)	On request	Web portal (available after portal establishment) or teleconference	
Coordinate training for TPRCC Users in interpretation and use of mandatory TPRCC products	Seminars and training courses open to end users of TPRCC Network-related products and climate information	IMD	Third Pole region	On request	Web portal, documentations, on-site training (on request)	

Attachment 2: Short product/service description: Training

Dataset/Product/ Service	Methodology, spatial/temporal resolution, quality indicators, validation etc.

Information and guidance on methodologies and products: User guides on products	**Methodology:** User guides for interpretation of LRF products/outlook provided on the Web Portal, including interpretation of skill and guidance on the limitation of model outlook. **Quality indicators/Validation:** Continuous update following feedback from portal users
Coordinate training for multi-Users on interpretation and use of TPRCC products (LRF products, Climate monitoring and diagnosis, Climate dataset and application)	**Methodology:** On-site or online training on the use and interpretation of the products of the Web Portal. Training will be co-hosted and organized with the Regional Training Center (WMO-RTC) for efficiency purpose. Parts of the training may be given in the form of online training for cost efficiency reason **Quality indicators/Validation:** Feedback form for participants of the training

The Western Node

1. Long-Range Forecasting

Attachment 1: Service provision overview: Long-Range Forecasting

Function/Activity/Criteria	Product/Service	Producer	Areal coverage	Time of issuance	Means of service provision	Remarks
Interpret and assess Asian High Mountain-related LRF products from Global Producing Centers of LRF (GPC-LRFs), distribute relevant Information to TPRCC users; and provide feedback to GPC-LRFs	PMD is producing Bias Adjusted Seasonal Forecast (1-monthly and 3-monthly) of temperature and precipitation for Pakistan. Using BCC_CSM1.1 model.	PMD	Global	Monthly	Website of the Northern node	Node members cooperation for statistical/dynamical downscaling of the products for improved seasonal outlooks over the Western TP Node region.
	9-Month Forecasts: Time Series & Monthly Means data can be used for seasonal outlooks.	PMD	Global	Daily, Monthly	Website of the Northern node	Presently it is limited to Pakistan only, however it may be extended to other consortium members, in future.

Generate regional and sub-regional tailored products, relevant to TPRCC User needs, including seasonal outlooks etc.	Probabilistic Seasonal and Monthly Outlook for Pakistan	PMD	Pakistan	Monthly	http://nwfc.pmd.gov.pk/MON&TC/Monsoon/Seasonal-Outlook.html	Presently it is limited to Pakistan only, however it may be extended to other consortium members, in the future.
Performance verification of TPRCC quantitative LRF products, including the exchange of basic forecasts and hindcast data;	Verification datasets are not developed presently, however, they may be developed for consortium countries.	Members may produce this report, individually, or a mechanism may be set up at PMD to generate these reports for consortium members	Western TP Node	Yearly	Website/Report	Discussion and Meeting among consortium member is required

		collectively.				
Provide online access to TPRCC products/services to TPRCC Users;	Limited online Data/Information Portal is built by PMD.	PMD	Western TP Node	Monthly/Yearly	Website/Report	The experimental website has been launched for western node http://ffd.pmd.gov.pk/cp/rain_test/tprccn-pak.html
Assess use of TPRCC products and services through feedback from TPRCC Users	Report on Analysis of Users Feedback.	Members are required to produce this report.	Western TP Node	Annual	Website/Report	Such reports are only possible if consortia focal points are in the TPRCC loop, and demonstration phase is in place.

Attachment 2: Short product/service description: Long-Range Forecasting

Dataset/Product/ Service	**Methodology, spatial/temporal resolution, quality indicators, validation etc.**
……	**Methodology:** **Spatial resolution:** **Temporal resolution:** **Quality indicators/Validation:**

2. Climate Monitoring

Attachment 1: Service provision overview: Climate Monitoring

Function/Activity/Criteria	Product/Service	Producer	Areal coverage	Time of issuance	Means of service provision	Remarks
Perform climate diagnostics including analysis of climate variability and extremes, at regional and sub-regional scales	Report on Climate Diagnostic Bulletin presenting Regional scale climate extreme	PMD	Pakistan	Annual	Website	Discussion and meeting among consortium member are required
	Regional scale climate extremes for past and future	Pakistan	Pakistan		Reports/Research Papers	
Establish a historical reference climatology for the region and sub-regions	Climate Normals e.g., 1981-2010	PMD	Pakistan	10 years	Website	Discussion and meeting among consortium member are required
	Climate Normals e.g., 1981-2010	Pakistan	Pakistan	10 years	Report	

Implement a Regional Climate Watch	Climate advisories	Members	Western TP Node	whenever required	Website	Discussion and meeting among consortium member are required

Attachment 2: Short product/service description: Climate Monitoring

Dataset/Product/ Service	**Methodology, spatial/temporal resolution, quality indicators, validation etc.**
……	**Methodology:** **Spatial resolution:** **Temporal resolution:** **Quality indicators/Validation:**

3. Operational Data Services

Attachment 1: Service provision overview: Operational Data Services

Function/Activity/Criteria	**Product/Service**	**Producer**	**Areal coverage**	**Time of issuance**	**Means of service provision**	**Remarks**

Develop quality controlled regional climate datasets, gridded where applicable	PAK-HYM-1.0, (0.05 ℃x0.05 ℃) Daily Maximum and Minimum Temperature, Daily Precipitation from 1961-2013 is in development.	PMD	Pakistan	Annual	Website	Discussion and meeting among consortium member are required to develop the same product for other consortium members.
Provide climate database and archiving services, at the request of NMHSs	Climate Data Processing Center, PMD	PMD	Pakistan	Whenever required	Report, Databases	PMD may host climate data from other countries, if required.

Attachment 2: Short product/service description: Operational Data Services

Dataset/Product/ Service	**Methodology, spatial/temporal resolution, quality indicators, validation etc.**
……	**Methodology:** **Spatial resolution:** **Temporal resolution:** **Quality indicators/Validation:**

4. Training

Attachment 1: Service provision overview: Training

Function/Activity/Criteria	Product/Service	Producer	Areal coverage	Time of issuance	Means of service provision	Remarks
Assist TPRCC users in access and use of WCRP-CMIP products simulated by climate/earth system models	Training to consortium member user for access and use of WCRP-CMIP models	PMD	Global/Regional	On request	In-house Training of researchers	Logistical Support from TPRCC-Network
Provide regional projection over Asian High Mountain regions to assist the development of adaptation strategies	High Resolution Climate Change Projections for Upper Indus Basin are available.	PMD using outputs from CMIP5 GCMs	Sub regional	On request	Dataset/Reports	Coordinated regional adaptation strategies in the light of climate change projections.
Perform monitoring and seasonal prediction on special climatic events over the Asian High Mountain regions	Seasonal outlook and extreme weather events warnings are issued for Pakistan	PMD	Pakistan	Hazard warning issued as required, Seasonal forecast issued monthly	Dataset/Reports	Discussion and meeting among TPRCC-Network are required to identify the needs of individual member and logistics to fulfil the needs.

Attachment 2: Short product/service description: Training

Dataset/Product/ Service	Methodology, spatial/temporal resolution, quality indicators, validation etc.

……	**Methodology:** **Spatial resolution:** **Temporal resolution:** **Quality indicators/Validation:**

5. Sub-regional products and services for Highly Recommended Functions

Attachment 1: Service provision overview: Sub-regional products and services

Function/Activity/Criteria	Product/Service	Producer	Areal coverage	Time of issuance	Means of service provision	Remarks
Provide regional projection over Asian High Mountain regions to assist the development of adaptation strategies	High Resolution climate Change Projections for Upper Indus Basin	PMD using outputs from CMIP GCMs	Subregional		PMD	Coordinated regional adaptation strategies in the light of climate change projections
Perform monitoring and seasonal prediction on special climatic events over the Asian High Mountain regions	Seasonal outlook and extreme weather events warnings	PMD	Subregional		PMD	
……						

Attachment 2: Short product/service description: Sub-regional products and services

Dataset/Product/ Service	Methodology, spatial/temporal resolution, quality indicators, validation etc.
……	**Methodology:** **Spatial resolution:** **Temporal resolution:** **Quality indicators/Validation:**

ICIMOD

1. Sub-regional products and services for Highly Recommended Functions

Function/Activity/Criteria	Product/Service	Producer	Areal coverage	Time of issuance	Means of service provision	Remarks
Generate, along with warnings of caution on uncertainty, seasonal forecasts for specific parameters where relevant	Regional flood outlook for the Ganges Brahmaputra basins http://www.icimod.org/initiative/climate-services/regional-flood-outlook/	ICIMOD	Ganges Brahmaputra basin		Web-based information system	The regional flood outlook provides a three day flood outlook in the Ganges Brahmaputra basin. The information sheet can be found in the following link https://lib.icimod.org/record/34366
	Streamflow Prediction Tool – Nepal http://tethys.icimod.org/apps/streamflownepal/ http://tethys.icimod.org/apps/hiwatnepal/	ICIMOD	Nepal		Web based information system	The Streamflow Prediction Tool for Nepal provides 10-day streamflow forecasts for 519 river segments in Nepal. Each river segment displayed in the map is assigned a unique identifier. Users can click on a particular river segment to display 10-day streamflow forecasts for the river stretch. This tool can be used as part of the decision

						support system for flood forecasting services and can assist decision makers and managers to provide flood early warnings and response during extreme events. The High-Impact Weather Assessment Toolkit (HIWAT) Streamflow Prediction Tool for Nepal provides 48-hour flash flood forecasts for 12,428 river segments in Nepal. The tool provides predicted estimates for flash floods from localized extreme weather phenomena like convective storms and thunderstorms.
	Regional Drought Monitoring and Outlook System. https://servir.icimod.org/science-applications/regional-drought-monitoring-and-outlook-system-south-asia/	ICIMOD	HKH region		Web-based information system	The Regional Drought Monitoring and Outlook System (RDMOS) is an operational service which produces reliable drought indicators for the Hindu Kush Himalayan (HKH) region with a specific focus on Afghanistan, Bangladesh, Nepal, and Pakistan. The system incorporates climatic models with suitable Earth observation data and land surface models to

						produce drought indices – precipitation, temperature, soil moisture, and evapotranspiration – and vegetation conditions at 10-day intervals for near real-time monitoring of droughts. The RDMOS also provides seasonal outlooks at four-month intervals to support drought management and preparedness processes.

Annex V — Preliminary Transfer Process for Products and Data

1. Nodes or partners provide detailed info of products to be shown on the web portal through sending QUESTIONNAIRE to the focal point of China, one product per each. The QUESTIONNAIRE can be found in the working folder on Elios.
2. Upon receiving confirmation of completing the configuration from the focal point of China, nodes or partners upload the specified products to their own folder on FTP Sharing Server where an account has been assigned in advance.
3. The product quality management system will send a warning message to the focal point for the product that may not comply with the agreed operational specifications, e.g., lack of product.
4. The uploaded products that meet the agreed operational specifications are synchronized to the web portal and displayed, and at the same time, each node and partner can download all the products shared through the FTP Sharing Server.
5. Services are provided through web portal to multi-users of the TPRCC-Network, and at the same time, receiving users' feedbacks, which are managed by the web portal management system.