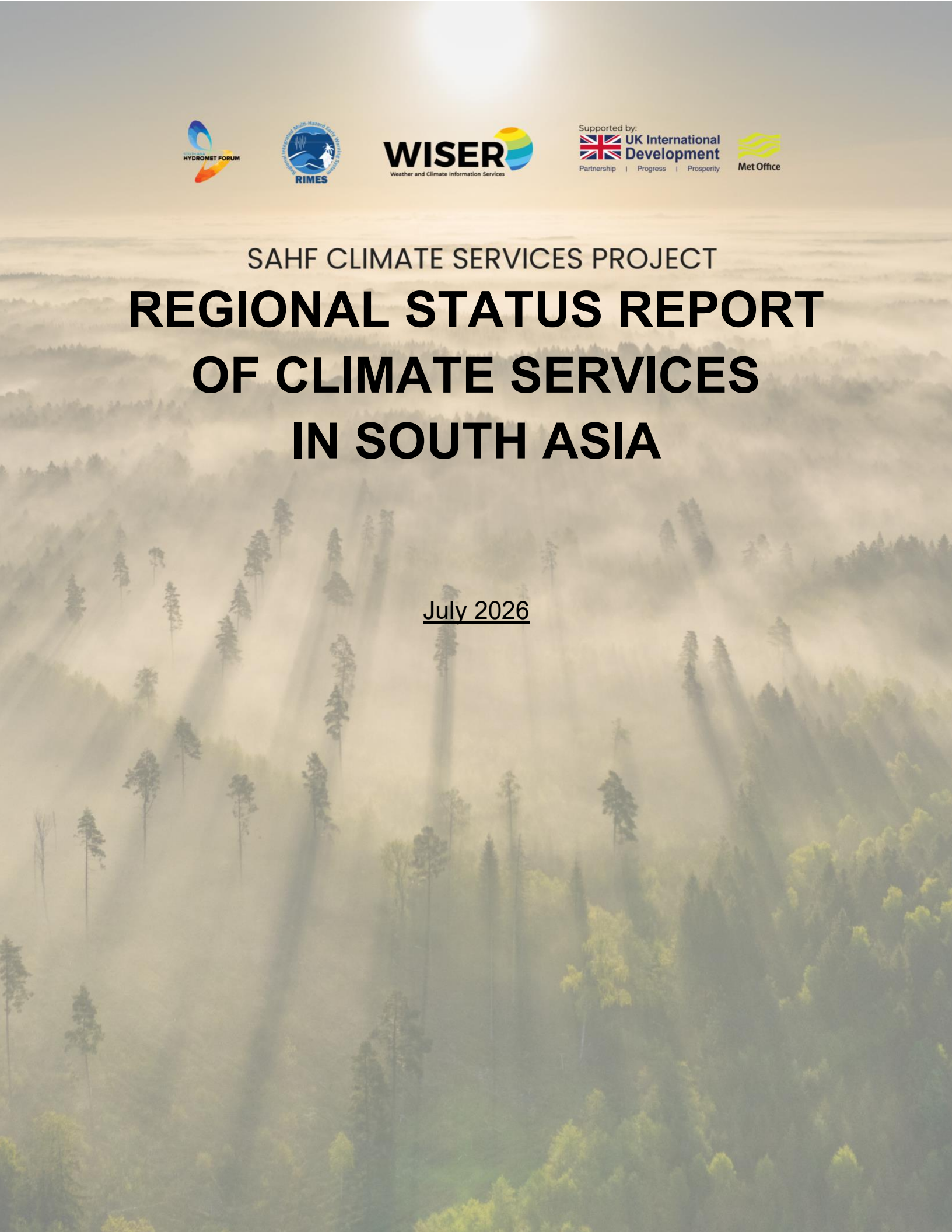

SAHF CLIMATE SERVICES PROJECT

REGIONAL STATUS REPORT OF CLIMATE SERVICES IN SOUTH ASIA

July 2026

This report was prepared with funding support from the UK Government's Foreign, Commonwealth and Development Office (FCDO). This funding is delivered through the Weather and Climate Information Services (WISER) under the Climate Action for a Resilient Asia (CARA), the UK's flagship regional programme to build climate resilience in South Asia, Southeast Asia and the Pacific Islands.

EXECUTIVE SUMMARY

South Asia is highly exposed to climate risks, including floods, droughts, heatwaves, tropical cyclones, glacial lake outburst floods, and sea-level rise. In this context, climate services are essential for supporting decision-making across agriculture, water, disaster risk management, health, energy, infrastructure, and adaptation planning.

With support from the UK Government through the Foreign, Commonwealth & Development Office (FCDO)'s Weather and Climate Information Services (WISER) Asia-Pacific Programme, the South Asia Hydromet Forum (SAHF) assessed the status of regional climate services in South Asia across timescales – from historical monitoring, sub-seasonal and seasonal forecasting, to annual–decadal prediction and long-term climate change projections. The report outlined key regional mechanisms and platforms, decision-support tools and knowledge-sharing systems, and examined their alignment with GFCS and RFCS principles.

One of the key findings from the report is that South Asia has a strong foundation for regional climate services, particularly through SASCOF and RCC-Pune, which support seasonal outlooks and CSUF, and strengthens engagement between climate information providers and users. However, the regional system remains fragmented across institutions, platforms, and timescales. Sub-seasonal services are still emerging, annual-to-decadal prediction is underdeveloped, and climate change projections are not yet consistently translated into localized, actionable guidance.

Key gaps include limited interoperability across data systems, uneven observing networks, weak cross-timescale integration, insufficient forecast verification, limited institutionalized monitoring and feedback mechanisms, and project-based financing. Capacity development also remains uneven, particularly in downscaling, ensemble interpretation, uncertainty communication, sector-specific application, and integrating climate information into operational decision-making.

To address these gaps, existing mechanisms and regional data and knowledge platforms should be leveraged as these provide a strong basis for a more coordinated regional climate services architecture. The SAHF Climate Services Working Group offers a practical pathway to support coordination, alignment of partners and initiatives, reduce fragmentation, enable shared learning, and support the phased development of a dynamic South Asian Regional Framework for Climate Services (RFCS) to complement national services and mandates, while enhancing collaboration, governance and delivery of regional climate services.

Priority next steps include developing a regional climate services roadmap and action plan (inclusive of clear governance and allocated roles and responsibilities), strengthening data sharing and interoperability, institutionalizing user feedback / monitoring evaluation and learning (MEL), engagement and co-production, enhancing integration and regional services across timescales, sustaining regional capacity development, and aligning climate services with long-term financing and adaptation priorities.

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I. INTRODUCTION

Background and Rationale

South Asia is among the most climate-vulnerable regions globally, characterized by high exposure to hydrometeorological hazards such as floods, droughts, heatwaves, tropical cyclones, glacial lake outburst floods, and sea-level rise. The region is highly sensitive to climate variability and change due to the dominance of monsoon systems, extensive shared river basins, complex mountain–cryosphere interactions, and densely populated coastal zones. Furthermore, climate drivers, such as El Niño–Southern Oscillation (ENSO) and the Indian Ocean Dipole (IOD), transcend national boundaries to influence the climate risks across the South Asia region. Recent assessments confirm that climate extremes across Asia, including South Asia, are increasing in frequency and intensity, with significant implications for food security, water availability, public health, energy systems, and disaster risk management (WMO, 2025).

Climate services—defined as the provision of "climate information prepared and delivered to meet a user's need" (WMO, 2011)—are widely recognized as essential tools for managing current and future climate risks. The Global Framework for Climate Services (GFCS), established by the World Meteorological Organization (WMO), emphasizes the need for coordinated climate services across global, regional, and national levels to reduce vulnerability, enhance resilience, and support climate-informed development (WMO, 2014). The GFCS further highlights that many foundational capabilities for climate services already exist, but remain fragmented, weakly coordinated, or insufficiently aligned with user needs, particularly in climate-vulnerable developing regions (WMO, 2011).

At the regional level, climate services play a critical role in complementing national capabilities by enabling data sharing, harmonized climate outlooks, coordinated forecasting, and knowledge exchange across borders (WMO, 2011). WMO's 2024 State of Climate Services reported substantial progress in climate services capacity in Asia in the past years. Its assessment from 2019-2024 found an increasing trend towards "higher level of sophistication and comprehensiveness" of climate services—among which, countries in Asia have shown remarkable progress in enhancing their climate services capacity levels.

In South Asia, regional platforms such as the South Asia Hydromet Forum (SAHF), South Asian Climate Outlook Forum (SASCOF), Climate Services User Forums (CSUFs), and regional climate and risk information portals provide mechanisms to address shared climate drivers and transboundary risks that cannot be effectively managed by countries acting alone. Evidence from regional initiatives demonstrates the value of regional collaboration in strengthening seasonal forecasting, improving forecast usability, and enhancing institutional and technical linkages between regional and national actors (J. Daron, 2022).

Within this architecture, SAHF plays an increasingly important role as a supporting mechanism to coordinate the implementation of global and regional frameworks, including GFCS and the Early Warnings for All (EW4ALL) initiative. Originally established to strengthen hydrometeorological services and early warning systems, SAHF has progressively expanded its scope to include climate services as a core thematic area. This has been operationalized through the

establishment of the SAHF Climate Services Working Group (CS WG) in June 2025, which aims to strengthen regional engagement, coordination, and alignment of climate services across South Asia, enhance access to and interoperability of climate data and products across timescales, and build the technical and institutional capacities of NMHSs and partners to deliver user-oriented impact-based services.

Strengthening SAHF and the CS WG has been supported by international partnerships, particularly from the UK Government through the Foreign, Commonwealth & Development Office (FCDO) and supported under the Weather and Climate Information Services (WISER) Asia-Pacific Programme, which forms part of the UK Government's Climate Action for a Resilient Asia (CARA) initiative. Such initiatives contribute to building institutional capacity, advancing impact-based forecasting approaches, enhancing user engagement, and supporting the delivery of targeted training and regional collaboration activities, including SASCOF and CSUF.

Despite these advances, gaps still remain in co-developing and co-designing tailored climate services products and coverage of observing networks (WMO, 2024). The regional climate services landscape in South Asia remains fragmented across timescales, institutions, and platforms. Climate information for historical analysis, seasonal forecasting, decadal variability, and climate change projections is often developed and disseminated through parallel initiatives with limited interoperability. Governance arrangements, financing mechanisms, and sustained institutional mandates for regional climate services remain uneven. These challenges limit the full realization of regional climate services' potential to support decision-making and amplify benefits at the regional, national and sub-national levels.

This regional status report is complemented by country-level analyses of National Frameworks for Climate Services (NFCS) across South Asia. While this regional report provides a system-level overview of climate services across timescales, platforms, and coordination mechanisms, the national-level status report offers detailed insights into national institutional arrangements, capacities, and service delivery practices. Findings from the NFCS assessments inform the regional analysis, particularly in identifying common gaps, capacity constraints, and opportunities for strengthening alignment between regional and national climate services systems. Similarly, this regional assessment identifies opportunities for coordinated regional action that can support countries in strengthening and implementing their NFCSs.

This report responds to the growing demand for a comprehensive, region-wide understanding of the current status of climate services in South Asia across timescales. It identifies synergies, gaps, opportunities across regional initiatives, and highlights existing alignment with the WMO's guidelines for Regional Framework for Climate Services (RFCS). This foundation/baseline will be used to inform next steps and strategic actions, with the goal of enhancing engagement, coordination, coherence, and co-production of sustainable, user relevant regional climate services in South Asia to "assist decision-making by addressing climate-related risks (WMO, 2025)", whilst strengthening integration and governance.

Objectives and Scope

This report's objectives are to:

1. Assess the current status of regional climate services in South Asia.
2. Identify the synergies between current regional activities and their alignment with the WMO's guidelines on Regional Framework for Climate Services (RFCS)–which provide a structured approach for coordinating climate services– across different timescales.
3. Propose strategic directions and next steps, to enhance integration, sustainability, and user relevance of regional climate services in South Asia.

This specifically includes:

a. Review of the current regional climate services landscape in South Asia across multiple timescales, from historical climate information and monitoring to sub-seasonal, seasonal, annual–decadal prediction, and climate change projections;
b. Assessment of key regional initiatives, platforms, and mechanisms that support the production, dissemination, and use of climate services;
c. Examination of enabling resources and capacities at the regional level, including data infrastructure, institutional arrangements, and coordination mechanisms; and
d. Identification of gaps, challenges, and opportunities for strengthening regional climate services and their contribution to national and sectoral decision-making;

The document covers the South Asia region, including Afghanistan, Bangladesh, Bhutan, India, Maldives, Myanmar, Nepal, Pakistan, and Sri Lanka. Particular attention is given to transboundary climate risks, shared river basins, monsoon dynamics, and regional climate drivers affecting multiple countries simultaneously.

Disclaimer

The geographical designations used in this report follow internationally recognized datasets and institutional references. Consistent with standard United Nations and World Meteorological Organization practice, the depiction of geographic boundaries and territorial references does not imply any official opinion regarding the legal status or delimitation of international boundaries.

Methodology and Approach Used

This report adopts a qualitative, desk-based and consultative approach, including:

- Review of regional climate service initiatives, reports, and platforms;
- Synthesis of insights from regional forums, working groups, and technical partners;
- Comparative analysis of roles, functions, and gaps across initiatives;
- Analysis using internationally recognized frameworks, including the Global Framework for Climate Services (GFCS), Regional Framework for Climate Services (RFCS) and National Framework for Climate Services (NFCS).

II. CONCEPTUAL FRAMEWORK AND REFERENCE STANDARDS

2.1. Frameworks on Climate Services

Climate services are defined in the GFCS as the provision of scientifically credible climate information in a manner that assists decision-making by individuals, organizations, and governments. Effective climate services require not only trusted accessible climate data and predictions, but also sustained engagement between providers and users, appropriate access mechanisms, and responsiveness to user needs (Hewitt et al., 2012).

A. The Global Framework for Climate Services (GFCS)

The GFCS envisions a society that can better manage the risks and opportunities arising from climate variability and change through science-based climate information and prediction incorporated into planning, policy, and practice. Its overarching goals are to:

- Reduce the vulnerability of society to climate-related hazards through better provision of climate information;
- Advance the key global development goals through better provision of climate information;
- Mainstream the use of climate information in decision-making;
- Strengthen the engagement of providers and users of climate services; and
- Maximize the utility of existing climate services infrastructure.

The Framework establishes a global architecture for user-driven climate services organized around five core pillars:

1) User Interface Platform, which facilitates sustained engagement, co-production, and feedback between providers and users;
2) Climate Services Information System, which enables generation, management, and dissemination of climate data and products across timescales,
3) Observations and Monitoring underpinning climate services through the systematic collection, quality control, and management of meteorological, hydrological, and related environmental data,
4) Research, Modelling and Prediction which advances scientific understanding and improves forecasting capabilities through model development, data analysis, and innovation across temporal scales,
5) Capacity Development which strengthens the institutional, technical, and human resources needed to produce, communicate, and apply climate services effectively.

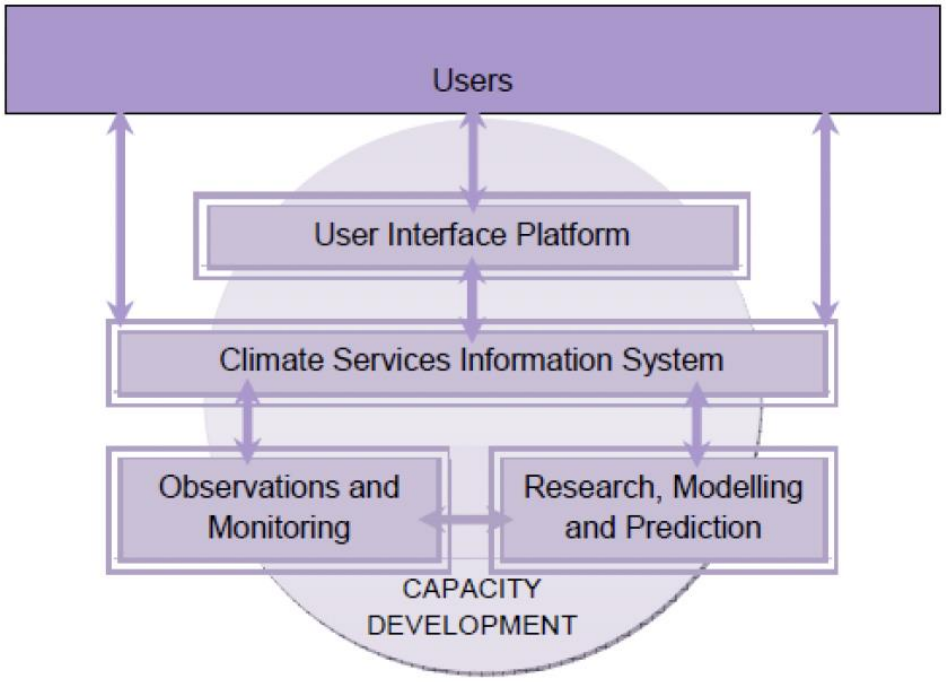


Figure 1. Illustration of the five pillars of GFCS and its links to user communities

At the global scale, the Framework will concentrate on articulating overarching objectives, identifying priority needs, and coordinating broad strategic actions necessary for its effective implementation.

At the regional scale, the Framework aims to collaborate with multilateral initiatives to respond to region-specific priorities—facilitating knowledge and data sharing, strengthening infrastructure, advancing research and training, and delivering regionally coordinated services tailored to identified requirements.

At the national scale, the Framework will be designed and managed by individual governments, in partnership with key national institutions, to ensure inclusive participation and that climate services are developed and implemented in line with the country's needs and the well-being of its population.

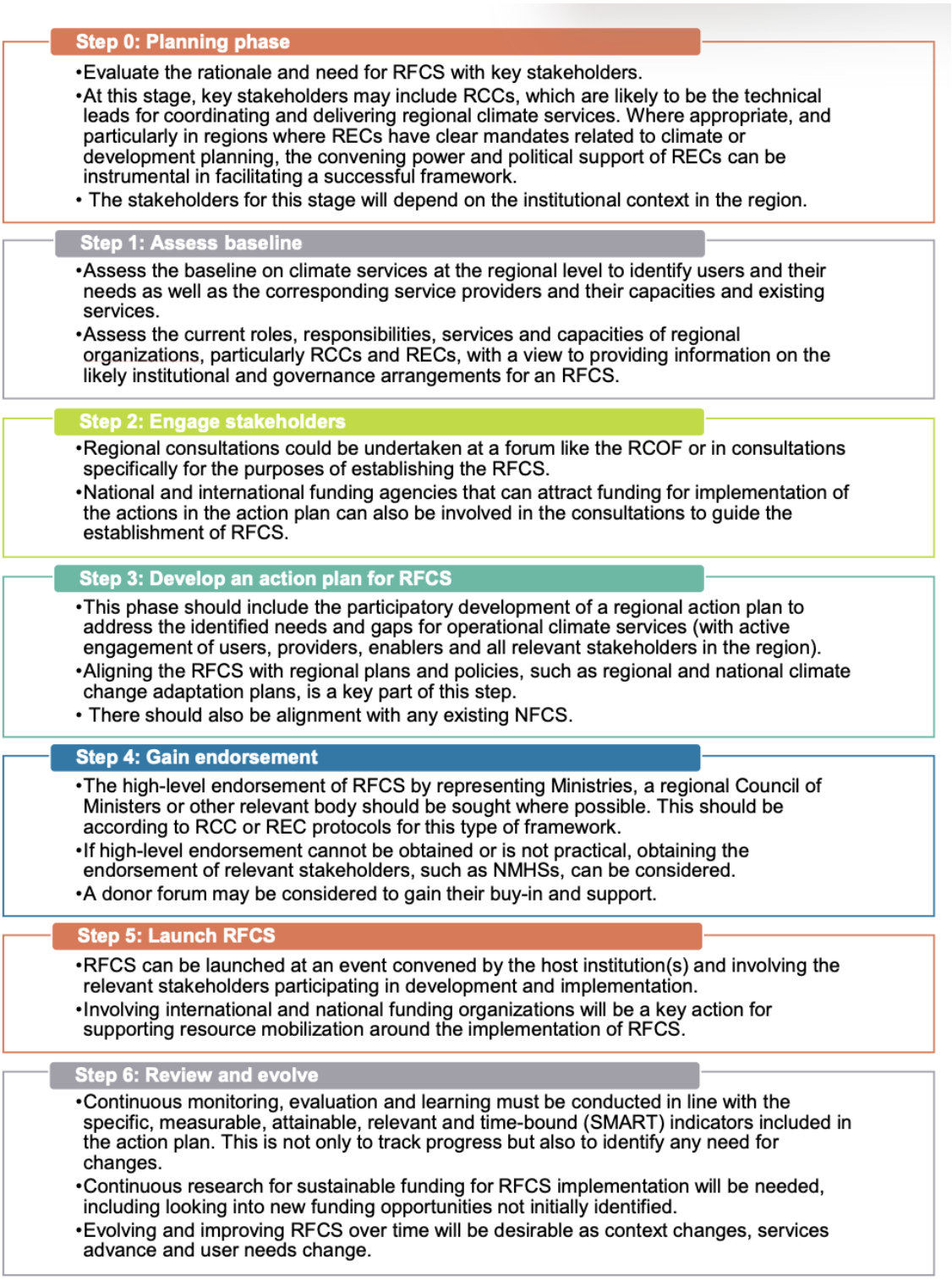
B. A Regional Framework for Climate Services (RFCS)

An RFCS provides a mechanism to support, facilitate, and strengthen collaboration and capability among regional and national institutions to enhance consistency, co-production, delivery, tailoring, use, and useability/accessibility of climate services at the regional level. An RFCS complements both the GFCS and NFCS by focusing on shared priorities, harmonized approaches, and regional value addition; rather than duplicating national functions or merely providing regional administrative oversight.

RFCSs provide a platform for integrating regional users and user interface mechanisms into the co-development and use of climate services (Daron & Parfitt, 2025). Key functions of an RFCS include establishing a common regional vision, facilitating institutional collaboration and learning, identifying priority capacity needs and resource requirements, articulating regional funding and partnership opportunities, and providing a coordination framework to enhance the development, delivery and use of consistent, credible climate services for decision-making in climate-sensitive sectors (Golding et al, 2026-in draft). RFCS must ensure regional activities complement and support national frameworks and mandates, in part by allocating clear roles and responsibilities.

C. Steps for Establishing and Implementing an RFCS

The proposed steps in establishing and implementing RFCS (see Figure 2) follow a similar process as with NFCS. It starts with the 0) ***planning stage*** where key stakeholders identify the rationale and need for RFCS; 1) ***assessing the baseline*** of climate services i.e. stakeholders' roles, responsibilities, services, and capacities; 2) ***engaging stakeholders*** through regional consultations with users and funding agencies; 3) facilitating participatory ***development of an action plan*** for RFCS; 4) ***gaining endorsement*** and support from Ministries and/or relevant stakeholders; 5) ***launching RFCS*** with stakeholders participating in development and implementation; and 6) ***continuous review and improvement*** of RFCS over time.



3.1. Figure 2. WMO suggested steps in establishing an RFCS (WMO, 2025)

2.2. Overview of Regional Mechanisms and Initiatives in South Asia

This sub-section provides an overview of the main regional mechanisms and initiatives that support climate services in South Asia, including governance platforms, coordination mechanisms, technical centres, outlook forums, user engagement spaces, and financing initiatives. It highlights how institutions such as WMO RA II, SAHF, RCC-Pune, the TP-RCC Network, SASCOF, CSUF, and CREWS contribute to regional coordination, seasonal forecasting, user engagement, capacity development, data sharing, and the alignment of national and regional climate services with broader frameworks such as GFCS, RFCS, and EW4All.

A. WMO Regional Association II

The Regional Association II (RA II) is one of the six regional bodies of the World Meteorological Organization (WMO), providing the formal intergovernmental mechanism for meteorological, hydrological, and climate-related cooperation across Asia. Comprising WMO Members from the region, RA II establishes regional priorities, policies, and technical directions that support the implementation of WMO programmes and global frameworks, including the GFCS and the Early Warnings for All (EW4All) initiative.

Its core functions include:

- Coordinating regional strategies and work programmes aligned with WMO priorities and global frameworks;
- Providing a forum for Member States to develop common policies, priorities, and technical guidance;
- Supporting capacity development, technical assistance, and knowledge sharing across countries
- Promoting standardization, data exchange, and interoperability of observing and information systems
- Overseeing and strengthening regional mechanisms that support weather, water, climate, and early warning services.

RA II operates through subsidiary bodies, including working groups, task teams, and expert panels, which address thematic areas such as climate services, hydrology, disaster risk reduction, and infrastructure. These mechanisms support the development of regional initiatives, technical guidance, and coordinated actions among Members.

In the context of climate services, RA II chiefly provides the regional governance and an institutional framework that enables and oversees mechanisms such as the Regional Climate Centres (RCCs), Regional Climate Outlook Forums (RCOFs), and other WMO-recognized initiatives. Further, it provides the strategic direction, governance arrangements, and technical oversight that facilitate coordinated regional action and alignment with global WMO priorities.

B. South Asia Hydromet Forum (SAHF)

The South Asia Hydromet Forum (SAHF) is a regional platform that brings together NMHSs, regional organizations, and development partners to strengthen hydrometeorological services and climate services across South Asia. Whilst RA II provides mostly governance and oversight, SAHF focuses on implementation and coordination among stakeholders; serving as a support mechanism to enhance regional collaboration, capacity development, and facilitate the implementation regional frameworks, including those related to early warning systems and climate services.

Its core functions include:

- Facilitating regional coordination and collaboration among NMHSs and partners on hydrometeorological and climate services
- Supporting capacity development, technical assistance, and knowledge exchange across countries
- Promoting data sharing, interoperability, and the use of common tools and methodologies
- Strengthening regional approaches to early warning systems, disaster risk reduction, and climate services
- Supporting the alignment of regional and national efforts with global frameworks such as GFCS and EW4All

SAHF is an enabling mechanism that connects countries with regional and international partners, including multilateral development banks and technical agencies, to support the design and implementation of hydromet investments and programmes. Through this role, it helps align regional priorities with financing opportunities, promotes coordinated investment planning, and reduces fragmentation across initiatives supporting hydromet modernization in the region.

SAHF also advances regional cooperation through structured technical engagements, including regional workshops, collaborative initiatives, and six thematic working groups that coordinate activities across priority areas. One of SAHF's key strengthens is that it is a collective of interconnected working groups including:

- Impact-Based Forecasting (IBF)
- Numerical Weather Prediction (NWP)
- Observational Networks
- Capacity Enhancement
- Hydrology
- Climate Services.

Together, these working groups provide a co-ordinated platform for identifying cross-cutting regional priorities, promote technical collaboration and peer learning, and support the implementation of regional strategies and activities across South Asian NMHSs.

In the context of climate services, SAHF provides an enabling platform for advancing regional initiatives through the SAHF CS WG, which serves as the primary regional mechanism for coordinating climate services initiatives across South Asia. The WG was established in 2025 to:

- Strengthen regional collaboration and cooperation to enhance climate services and promote cross-border knowledge exchange.
- Improve access to climate data and forecasting tools for enhanced service delivery.
- Strengthen NMHS and stakeholder technical expertise, infrastructure, and operational capabilities to deliver accurate and user-driven climate services.
- Promote user-oriented climate services,
- Support the integration of climate services into national and regional adaptation and resilience strategies.

C. Regional Climate Centre (RCCs)

WMO Regional Climate Centres (RCCs) are centres of excellence that generate regional-scale climate products and services, including long-range forecasts, to support regional and national climate activities. They play a critical intermediary role within the global climate services architecture by translating global-scale predictions produced by WMO Global Producing Centres (GPCs) for Long-Range Forecasts into regionally relevant information, thereby strengthening the capacity of WMO Members to deliver tailored climate services to national users and help ensure consistency, added value, and usability of climate information across scales.

Its mandatory functions include:

- Operational activities for seasonal prediction
- Operational activities for climate monitoring
- Operational data services, to support operational seasonal prediction and climate monitoring
- Capacity development and training in the use of operational RCC products and services

RCC-Pune

There are six RCC and RCC-Networks established around Asia with varying statuses of implementation. In South Asia, RCC-Pune, coordinated by the India Meteorological Department (IMD), has been designated in May 2017. This means that the Centre is formally recognized by WMO as a fully operational entity, and it delivers quality operational, regional climate products and services in a sustained and well-coordinated manner.

RCC-Pune provides monthly and seasonal deterministic and probabilistic predictions of precipitation, temperature, sea-surface temperature (SST), El Niño–Southern Oscillation (ENSO) and Indian Ocean Dipole (IOD) bulletins, ENSO indices, and works with the region's NMHSs to produce Seasonal Climate Outlooks for South Asia. The Centre also provides historical prediction verifications.

In terms of Climate Monitoring, RCC-Pune provides monthly maps of mean sea-level pressure, maximum and minimum temperatures, total rainfall, wind at 850 hectopascals (hPa), stream function at 850 hPa, velocity potential at 250 hPa, outgoing long-wave radiation and sea-surface temperature.

The Centre offers gridded data products and regional analysis dataset of the Indian Monsoon Data Assimilation and Analysis (IMDAA). It also coordinates and organizes SASCOF where training in seasonal climate prediction and climate data management is provided.

Third Pole Regional Climate Centre (TP-RCC) Network

In the high-mountain Third Pole region, the Third Pole Regional Climate Centre Network (TP-RCC Network), under WMO Regional Association II, has been established as a collaborative network of institutions to support climate services across the Hindu Kush Himalaya and Tibetan Plateau, covering South Asian countries particularly Afghanistan, Bangladesh, Bhutan, India, Myanmar, Nepal, and Pakistan. As a networked RCC, it brings together multiple RCC Nodes and their consortium members to contribute and perform functions of climate monitoring, prediction, and data services, working toward full operational designation by WMO through a phased implementation approach.

The TP-RCC Network provides regional climate products including sub-seasonal to seasonal outlooks for temperature and precipitation, assessments of large-scale climate drivers, and consensus-based seasonal forecasts through the Third Pole Climate Forum. It integrates multi-model outputs and observational data to generate harmonized regional outlooks that support decision-making across climate-sensitive sectors such as water resources, agriculture, and disaster risk reduction.

In terms of climate monitoring, the Network produces regional analyses of temperature, precipitation, snow cover, and other cryosphere-related variables, reflecting the unique mountain and glacier systems of the Third Pole. These products support the tracking of climate variability and extremes in a region characterized by complex terrain and significant data gaps.

The TP-RCC Network supports coordinated production and dissemination of regional climate monitoring products, seasonal outlooks, climate data services, and capacity development through collaboration among RCC Nodes and partner institutions.

E. South Asia Climate Outlook Forum (SASCOF)

The South Asian Seasonal Climate Outlook Forum (SASCOF) is part of the WMO Regional Climate Outlook Forum (RCOF). Since 2010, SASCOF has become the principal regional mechanism for generating seasonal climate outlooks for South Asia. Convened biannually ahead of major monsoon seasons, SASCOF brings the RCC together with NMHSs and regional and international partners to review climate drivers, assess model outputs, and produce regionally coherent seasonal outlooks. It is tasked with producing user-relevant (noting that users can include the NMHSs alongside sector stakeholders) climate outlook products in real-time to reduce climate-related risks and support sustainable development for the coming season, particularly in sectors of critical socioeconomic significance.

Role and Functions

SASCOF provides a platform for the collaborative assessment of available prediction information and the co-development of regional outlooks. It facilitates regional networking among climate service providers, particularly NMHSs, and supports alignment in forecasting approaches across countries. The forum also enables two-way engagement between climate information providers and user sector representatives, strengthening the relevance and usability of climate information.

Outputs and Processes

As of April 2026, SASCOF has been conducted in 34 sessions. Its agenda centers on a collaborative, multi-institutional assessment of regional climate conditions to produce a seasonal outlook, combining inputs from NMHSs, RCC Pune, and global and regional centres. Discussions are primarily structured around analysis of key large-scale climate drivers—notably ENSO, IOD, sea surface temperature anomalies, and intra-seasonal variability and their implications for South Asian climate across different seasons (monsoon, post-monsoon, and winter).

A core component of SASCOF is the integration of multi-model forecasts (both statistical and dynamical), combined with expert deliberation and structured consensus-building processes, to generate probabilistic rainfall and temperature outlooks in terms of deviation from climatology/normal at the regional scale. The outlook development process is complemented by systematic verification of forecasts from previous seasons to provide an evidence base for evaluating forecast performance and continuously improveme the forecasting methodologies. The forum also places strong emphasis on communicating forecast uncertainty and confidence. It strives to also promote the use of sub-seasonal and extended-range forecasts alongside seasonal outlooks and to strengthen linkages to national-level services and sectoral applications through CSUF engagements. Collectively, these functions position SASCOF as both a technical forecasting mechanism and a regional coordination platform for climate services.

User Engagement and CSUF Linkages

SASCOF is closely linked with the Climate Services User Forum (CSUF), which brings together representatives from climate-sensitive sectors such as agriculture, water, health, and disaster risk management. This joint platform provides opportunities to promote the use of SASCOF products and services, while enabling feedback from users to inform future forecast development and service delivery.

Throughout its iteration, NMHSs and sector representatives have been providing feedback aimed at strengthening the technical robustness, usability, and impact of the seasonal outlook products *produced during SASCOF.*

Limitations and Opportunities

While SASCOF has significantly strengthened regional collaboration and seasonal forecasting capacity in South Asia, opportunities remain to enhance cross-regional collaboration between RCOFs. Greater interaction and knowledge exchange between SASCOF and other regional forums could improve the consistency of outlooks, support the sharing of good practices, and strengthen the integration of climate information across broader geographic scales.

F. Climate Services User Forum (CSUF)

CSUFs are convened alongside SASCOF to enhance dialogue between climate service providers and users from climate-sensitive sectors such as agriculture, water resources, disaster risk management, health, and energy. Introduced in 2015, South Asia's CSUFs aims to promote co-production of climate services, improve understanding of user needs, and strengthen uptake of climate information in decision-making.

To get the maximum benefit of SASCOF, participation of users in the process either at regional or national level is imperative. SASCOFs, over the years, have brought climate information providers together with users to share expertise, requirements, and raise awareness on the importance of climate information to mitigate the impacts of climate variability and change.

User engagement within SASCOF began to take shape in 2015. It has been regularly conducted alongside SASCOF sessions, with participation steadily increasing over time, including during online sessions such as SASCOF-16, where diverse stakeholders from water and agriculture sectors actively contributed (Met Office & RIMES, 2022).

Evidence from regional initiatives indicates that CSUFs have improved awareness of climate information among regional stakeholders and influenced national-level service development. Nonetheless, sustained mechanisms for tracking uptake, measuring impact on decisions, and ensuring continuity of user engagement remain limited.

The GFCS five priority areas include agriculture, livestock and food security, DRR, energy, health and water. However, to engage wider sector representation there remains scope to include other key user groups e.g. governments, NGOs, media, transport, research / academia, tourism, industry, civil society, those representing marginalised and vulnerable communities etc.

G. World Bank Climate Risk and Early Warning System (CREWS) Initiative

The Climate Risk and Early Warning Systems (CREWS) Initiative is a global financing mechanism that supports Least Developed Countries (LDCs) and Small Island Developing States (SIDS) in strengthening people-centred, multi-hazard early warning systems and associated weather, sub-seasonal, and seasonal services. Hosted by the World Bank in partnership with the World Meteorological Organization and the United Nations Office for Disaster Risk Reduction, CREWS provides grant-based funding and technical assistance to enhance hydrometeorological infrastructure, forecasting capabilities, and service delivery.

CREWS-supported programmes focus on improving observations and monitoring systems, strengthening forecasting and early warning dissemination, and enhancing institutional coordination and user engagement. In 2025, the CREWS commenced a four-year initiative designed to strengthen hydrometeorological and early warning services at regional and national levels in South Asia through enhanced cooperation under SAHF that strengthen weather forecasting, sub-seasonal forecasting capacities, and data exchange. Project activities included enhancement of the Data Exchange (DataEx) Platform (a meteorological data exchange, visualization and analytics system), capacity building on numerical weather prediction, coastal and marine forecasting, and common alerting protocol compliance.

H. Asian Development Bank (ADB) Action on Climate Change in South Asia

The ADB Action on Cliamte Chane in South Asia is a regional technical assistance initiative that supports South Asian countries in strengthening climate resilience and integrating climate change considerations into development planning and investment. Through technical assistance, knowledge sharing, and capacity development, the programme assists governments in strengthening climate risk assessment, mainstreaming climate change into sectoral policies and investment decisions, and enhancing institutional capacity for climate-resilient development.

The programme supports the development and application of climate risk and vulnerability assessment methodologies, climate information, and decision-support approaches across multiple sectors, including agriculture, water resources, transport, energy, and urban development. By promoting regional collaboration and strengthening the use of climate information in planning and investment processes, the initiative contributes to improving climate adaptation, disaster resilience, and evidence-based decision-making across South Asia.

Table 1. Overview of Regional Mechanisms and Initiatives Supporting Climate Services in South Asia

Mechanism / Initiative	Primary Role	Contributions to Climate Services	Regional Value / Relevance
WMO Regional Association II (RA II)	Regional governance and coordination	Provides policy direction, technical coordination, standards, and supports implementation of WMO frameworks through regional bodies and expert groups	Enables regional cooperation and alignment with global meteorological and climate services priorities
South Asia Hydromet Forum (SAHF)	Regional coordination platform	Facilitates collaboration among NMHSs and partners, supports technical working groups, capacity development, knowledge exchange, investment coordination, and implementation of regional initiatives	Serves as the principal regional coordination mechanism for hydrometeorological and climate services in South Asia
Regional Climate Centre (RCC) System	Regional climate service delivery	Generates regional climate products, seasonal forecasts, monitoring products, data services, and technical guidance for NMHSs	Translates global climate predictions into regionally relevant climate information
RCC-Pune	Operational Regional Climate Centre	Produces seasonal outlooks, climate monitoring products, IMDAA datasets, verification products, and coordinates SASCOF	Primary operational RCC supporting seasonal climate prediction across South Asia
Third Pole RCC Network (TP-RCC)	Networked Regional Climate Centre	Produces climate monitoring, S2S outlooks, cryosphere products, data services, and technical exchanges for the Hindu Kush Himalayan region	Strengthens climate services for high-mountain and transboundary river basin systems
South Asian Seasonal Climate Outlook Forum (SASCOF)	Regional Climate Outlook Forum	Develops consensus seasonal outlooks, facilitates multi-model forecasting, forecast verification, technical exchange, and regional coordination	Principal regional mechanism for collaborative seasonal forecasting and outlook development
Climate Services User Forum (CSUF)	User engagement platform	Promotes dialogue between providers and users, co-production of climate services, and communication of sectoral climate information needs	Strengthens the relevance, usability, and uptake of climate information across sectors
CREWS South Asia Initiative	Regional financing and technical assistance	Supports hydrometeorological modernization, DataEx enhancement, forecasting capacity, early warning systems, and regional cooperation under SAHF	Provides catalytic investment and technical support for strengthening regional climate services and early warning systems
ADB Action on Climate Change in South Asia	Regional financing and technical assistance	Supports the integration of climate information and climate risk assessments into sectoral planning, infrastructure development, and investment decisions	Provides technical and financial support to strengthen the integration and application of climate information in development planning and climate resilience across South Asia

2.3 Regional Tools, Data Platforms and Decision Support Systems (DSSs)

This sub-section provides a brief overview of selected regional and global tools, data platforms, and decision support systems that are relevant to climate services in South Asia. The initiatives presented are representative examples intended to illustrate the range of resources that support climate data access, monitoring, forecasting, risk analysis, climate change projections, customization of climate products, and knowledge sharing across the region. They are not intended to constitute an exhaustive inventory of all regional initiatives or available tools.

A more comprehensive list of available and relevant tools and systems is maintained in the SAHF Climate Services Decision Support Tools and Systems Catalogue, available through the SAHF Knowledge Hub at: https://www.sahf.info/climate-services-decision-support-tools-and-systems/.

A. Intergovernmental Panel on Climate Change (IPCC) AR6 Atlas

The IPCC AR6 WGI Interactive Atlas is an open-access climate data visualization and analysis tool developed by the IPCC to support regional assessments of observed and projected climate change. It integrates global and regional observations, CMIP5/6 projections, CORDEX simulations, paleoclimate data, extreme indices, and impact drivers into an interactive platform with both public-facing and research-oriented interfaces. Designed for policymakers, researchers, educators, and practitioners, it enables spatial and temporal exploration of climate trends, future scenarios, warming levels, and associated uncertainties across atmospheric and oceanic variables (IPCC, 2021).

Building on its current capabilities, future development of the Atlas is expected to focus on sustaining and updating the platform as part of ongoing IPCC assessment cycles. This includes maintaining the Interactive Atlas as a key resource for regional climate information, improving usability and accessibility for a broad range of users, and ensuring consistency with future assessment outputs. Discussions also highlight the need to consider resource requirements and technical capacity to support continued development, including potential enhancements aligned with future IPCC reports (IPCC, 2026).

B. UN ESCAP Risk and Resilience Portal

The UN ESCAP Risk and Resilience Portal is a regional geospatial decision-support platform developed to support disaster risk reduction and climate resilience planning across Asia and the Pacific. It integrates multi-hazard datasets, exposure mapping, vulnerability indicators, and socioeconomic information into an interactive mapping interface, enabling users to assess risks and identify priority areas for intervention. Designed for policymakers, planners, researchers, and development partners, the platform supports evidence-based decision-making and alignment with regional and global resilience frameworks. The Portal provides tools for visualizing and analysing climate and disaster risks across multiple scales, including national and sub-national levels. It supports scenario-based assessments, investment prioritization, and the identification of risk hotspots by combining hazard, exposure, and vulnerability data.

In the context of South Asia, the platform is particularly relevant for addressing transboundary risks such as floods, cyclones, and droughts, as well as for supporting regional planning in shared river basins and densely populated coastal zones. By enhancing access to integrated risk information and promoting data-driven planning, the Portal aims to strengthen climate services applications and inform resilience-building efforts across key sectors such as infrastructure, agriculture, and disaster risk management.

C. WCRP Regional Information for Society (RIfS)

The World Climate Research Programme (WCRP) Regional Information for Society (RIfS) is a global research coordination initiative that aims to strengthen the scientific foundation of climate services by bridging climate science and societal applications. RIfS advances the development of actionable regional climate information through coordinated research on climate variability, climate change, and extreme events, while promoting the co-design and co-production of climate information with users. It integrates observations, modelling, prediction, and impact-relevant research to improve regional climate information across multiple timescales, supporting climate-informed decision-making in climate-sensitive sectors.

Within RIfS, several flagship activities contribute directly to regional climate services, including the Coordinated Regional Climate Downscaling Experiment (CORDEX), which develops high-resolution regional climate projections, and the Global Extremes Platform (GEP), which advances understanding and prediction of climate extremes and their societal impacts. In South Asia, these initiatives support research on monsoon dynamics, climate variability, and extreme weather, strengthening the scientific basis for climate services, adaptation planning, and regional coordination mechanisms such as SASCOF and RCC activities.

D. CORDEX South Asia

CORDEX South Asia is coordinated by the Centre for Climate Change Research (CCCR) at the Indian Institute of Tropical Meteorology (IITM) in collaboration with regional and international partners. It provides high-resolution regional climate projections to improve understanding of climate change impacts and support adaptation planning across South Asia. The initiative develops dynamically downscaled climate simulations from global climate models, providing regionally consistent datasets for historical climate analyses and future climate scenarios.

CORDEX South Asia generates climate projections at progressively higher spatial resolutions using outputs from the Coupled Model Intercomparison Project (CMIP), covering both historical periods and future climate scenarios based on Shared Socioeconomic Pathways (SSPs). Continued advances in regional climate modelling have improved the representation of key features of the South Asian climate system, including the monsoon, orographic precipitation, and tropical cyclones over the North Indian Ocean. These datasets provide an important scientific foundation for climate impact assessments, vulnerability analyses, and long-term adaptation

planning, complementing operational climate services by supporting national and regional climate risk assessments.

E. South Asia Regional Climate Information (SARCI) Framework

The SARCI Framework is a regional climate information framework developed to generate high-resolution, policy-relevant climate information tailored to the climatic conditions of South Asia. Recognizing the limitations of global climate models in representing regional temperature, precipitation, and monsoon dynamics, the framework integrates regionally optimized climate modelling, bias-adjusted boundary conditions, and statistical downscaling to produce more credible and actionable climate projections for long-term planning and climate risk assessment.

It is designed to support NMHSs, policymakers, and climate service providers to strengthen production and application of regional climate information for climate change assessment, adaptation planning, and policy development. Beyond improving the scientific quality of climate projections, the framework aims to promote regional collaboration, co-production, and institutional capacity building to strengthen the long-term capability of South Asian countries to generate and apply climate information for decision-making.

F. Copernicus Climate Change Service (C3S) Climate Data Store (CDS)

The Copernicus Climate Change Service Climate Data Store (CDS) is an open-access data platform that provides a wide range of climate datasets, tools, and applications to support climate monitoring, research, and decision-making. Implemented by the European Centre for Medium-Range Weather Forecasts on behalf of the European Union's Copernicus Programme, the CDS offers access to historical observations, reanalysis datasets, seasonal forecasts, and climate projections.

Designed for scientists, policymakers, and practitioners, the CDS enables users to explore, visualize, and download climate data through an interactive interface and application programming interfaces (APIs). It supports the development of climate services by providing consistent, high-quality datasets and analytical tools that facilitate climate risk assessments, trend analysis, and scenario-based planning. The platform also includes sector-specific applications and derived indicators, enhancing the usability of climate information for adaptation and resilience planning across multiple domains.

G. ICIMOD's Regional Database System (RDS)

ICIMOD's Regional Database System is a web-based geospatial data infrastructure developed to support environmental monitoring, climate research, and regional cooperation across the Hindu Kush Himalaya. It provides harmonized spatial datasets on climate, glaciers, hydrology, ecosystems, and land use through an interactive mapping interface with download capability. Designed for researchers, policymakers, and regional institutions, the platform strengthens

transboundary data sharing and evidence-based planning for mountain resilience and sustainable development (ICIMOD, n.d.).

RDS plays a critical role in strengthening regional data sharing and integration across countries in the HKH region, where data availability and interoperability remain key challenges. It enables multi-scale analysis of climate and environmental change, supports the assessment of cryosphere dynamics and water resources, and contributes to improved understanding of climate risks in upstream–downstream systems. In the context of South Asia, the platform is particularly relevant for informing decision-making related to shared river basins, glacial hazards, and ecosystem resilience. By enhancing access to consistent and comparable datasets, the RDS supports regional collaboration, strengthens the scientific basis of climate services, and contributes to integrated approaches for climate adaptation and sustainable development.

H. CLIMSA Climate Services Toolkit

The Climate Services Toolkit, developed through WMO's CLIMSA Project in partnership with RIMES, is a web-based system designed to provide climate data analysis and projections for both regional and national use. It supports 20 countries across eight different Regional Climate Centres.

Its key features include:

- Climate Data Analysis – allows users to visualize monthly or seasonal climatology using historical data, enables the calculation of SPI for user-defined periods, and integrates ECMWF IFS 15-day forecasts, updated daily, to provide indices such as wet days, summer days, dry days, and tropical nights. Historical indices (1980-2022) are available for comparison.
- Climate Predictions – offers tools to evaluate the performance of various climate models against observation datasets like ERA5, CHIRPS v2, and CRU. Users can analyze metrics such as anomalies, correlation, variance, root mean square error, and anomaly coefficient to identify optimal models for specific regions. It also generates seasonal forecasts, providing probabilities for below normal, near normal, and above normal conditions based on selected models. It allows users to upload their own observation data for specific stations using a provided template.

I. Forecast Customization (FOCUS) System

The FOCUS tool aims to support the NMHSs to access and generate customized seasonal forecasts using its built-in Multi-Model Ensemble (MME) methods. The tool also supports the validation and verification of the estimates, optimized for data download with its processing feature designed to standardize data format and structure. It currently hosts 18 global climate models (GCMs).

Across initiatives, strong complementarities exist, but data silos, inconsistent methodologies, and limited interoperability constrain effectiveness. Greater alignment across platforms, timescales, and user needs is essential.

J. SAHF Knowledge Hub

The SAHF Knowledge Hub is a regional information and knowledge management platform developed to support the sharing, access, and dissemination of hydrometeorological and climate services resources across South Asia. It serves as a centralized repository of datasets, tools, reports, guidance materials, and training resources, designed to support NMHSs, regional institutions, and development partners in strengthening climate services and early warning systems.

The Knowledge Hub facilitates the organization and exchange of technical knowledge, including climate products, decision-support tools, methodologies, and case studies, enabling peer learning and regional collaboration. It supports capacity development by providing access to training materials, documentation, and good practices, while also enhancing visibility and accessibility of regional initiatives and outputs. In the context of South Asia, the platform contributes to enhancing knowledge and data sharing across countries, promoting the use of standardized tools and approaches, and supporting the integration of climate information into sectoral applications. By strengthening knowledge management and information sharing, the SAHF Knowledge Hub plays an important role in advancing climate services, fostering collaboration, and supporting evidence-based decision-making across the region.

Table 2. Overview of Regional Tools, Data Platforms and Decision Support Systems (DSSs) in South Asia

Platform	Primary Climate Services Role	Timescale Coverage	Contribution to Climate Services
IPCC AR6 Atlas	Climate change assessment	Long-term	Supports adaptation planning and climate risk assessment
UN ESCAP Portal	Risk assessment	Weather – Climate	Integrates hazard, exposure and vulnerability information
RIfS	Climate research	Seasonal – Climate change	Strengthens climate science underpinning services
CORDEX South Asia	Regional climate projections	Long-term	Supports adaptation and impact assessment
SARCI Framework	Regional climate information framework	Long-term	Strengthens the generation of high-resolution, policy-relevant climate information
Copernicus CDS	Climate data services	Historical – Seasonal – Climate change	Supports monitoring, forecasting and research
ICIMOD RDS	Regional geospatial database	Historical – Climate	Supports mountain and river basin climate services
CLIMSA Toolkit	Climate analysis & prediction	Historical – Seasonal	Supports NMHS analysis and forecast generation
FOCUS	Forecast customization	Seasonal	Supports MME generation and verification
SAHF Knowledge Hub	Knowledge management	Cross-cutting	Supports information sharing and capacity development

Collectively, these platforms provide complementary capabilities spanning climate observations, monitoring, seasonal forecasting, climate projections, forecast customization, risk assessment, and knowledge sharing. However, their collective effectiveness is constrained by fragmented data systems, inconsistent methodologies, limited interoperability, and varying institutional capacities, highlighting the need for stronger regional integration and coordination.

It is also noted that these platforms operate via the “push” of data and/or information. While outside the scope of this report, future studies could consider a deeper dive into the frequency and reach of the information “pull” from their target users.

For a more comprehensive suite of tools, please visit the SAHF Climate Services Tool Catalogue.

III. ASSESSMENT OF CLIMATE SERVICES ACROSS TIMESCALES

Climate service needs in South Asia span multiple temporal scales, each supporting distinct but interlinked decision contexts. Regional climate services must therefore function coherently across historical monitoring, sub-seasonal to seasonal forecasting, annual to decadal prediction, and long-term climate change projections. The following assessment examines regional capabilities, products, users, strengths, and systemic gaps at each timescale.

3.1. Historical and Climate Monitoring

Historical data and ongoing monitoring provide the foundation for all other climate services. They enable trend detection, model calibration, infrastructure design standards, risk threshold development, and long-term adaptation planning. In South Asia, where climate variability is driven by monsoon systems, cryosphere dynamics, and shared river basins, regional aggregation of climate data is particularly critical.

Regional climate monitoring draws on a combination of national hydromet observing networks, satellite-based observations, global reanalysis products, and regional data integration platforms such as ICIMOD's RDS, ESCAP's Risk and Resilience Portal, and WMO's Global Observing System linkages. These platforms enhance regional access to harmonized datasets, particularly for temperature, precipitation, hydrology, and glacier-related variables. Regional trend assessments are also informed by global products such as WMO climate reports and IPCC assessments.

Typical users of regional monitoring products include NMHSs, disaster risk management authorities, water resource planners, development agencies, and research institutions. These users rely on historical datasets to establish baselines, define thresholds, and assess vulnerability patterns across transboundary basins.

Persistent observational gaps remain a major constraint in South Asia. In-situ coverage remains uneven in high-altitude areas of the Hindu Kush Himalaya, and metadata harmonization challenges limit interoperability (WMO, n.d.-a). Over-reliance on satellite datasets without sufficient ground validation introduces additional uncertainty in localized climate risk interpretation (IPCC, 2021). Although global reanalysis datasets such as ERA5 are increasingly accessible (Hersbach et al., 2020), operational integration into national planning systems remains uneven (WMO, 2024).

These findings are consistent with the insights gathered during the SAHF Climate Services Workshop in 2025 on the barriers to delivering and applying climate services for historical and present-day climate, which were:

- Limited access to climate data;
- The rapid evolution of methodologies raises questions about the predictability of older data for current scenarios, and an over-reliance on satellite data alone complicates future forecasting; and
- Significant data gaps are a major obstacle to understanding climate variability and change in specific regions.

3.2. Sub-Seasonal and Seasonal (S2S) Forecasting

Sub-seasonal and seasonal forecasting represent the most mature component of regional climate services in South Asia. These timescales are highly relevant for agriculture, livestock and food security, water management, disaster preparedness, and public health planning. The products are typically used to guide crop advisories, reservoir operations, contingency planning, and seasonal preparedness strategies.

At the regional level, seasonal forecasting is anchored on SASCOF, which convenes NMHSs, RCCs, and international partners to generate probabilistic outlooks for rainfall and temperature. A central technical pillar of this process is the RCC-Pune which supports the region by providing seasonal climate diagnostics, monitoring products, multi-model ensemble guidance, and technical backstopping to NMHSs. In line with WMO RCC mandates, it contributes to climate monitoring, long-range forecasting support, capacity development, and consistency of regional products, thereby strengthening the technical foundation of SASCOF consensus statements.

This seasonal consensus process is complemented by CSUFs, which facilitate structured dialogue between climate service providers and sectoral stakeholders, enhancing interpretation and application of probabilistic outlooks.

Sub-seasonal forecasting is emerging in several countries (i.e. India, Bangladesh, Nepal, and Pakistan), with increasing use of global S2S model outputs (e.g., ECMWF) to assess heatwave likelihood, rainfall variability, and potential cyclone development on weekly timescales. In addition to these global products, regional coupled model–based S2S forecasts—such as those produced by the National Centre for Medium Range Weather Forecasting (NCMRWF) in India, and the Bangladesh Climate and Weather Centre—are also available, providing additional guidance for sub-seasonal forecasting. However, regional coordination for S2S products is less institutionalized than for seasonal outlooks.

Despite these advances, forecast resolution remains coarse relative to local decision needs, and communication of probabilistic uncertainty is inconsistent across countries. Verification systems for seasonal temperature forecasts are less developed than for rainfall. Translation of regional outlooks into sector-specific advisories varies widely among countries, depending on institutional capacity. Sub-seasonal forecasts often require expert interpretation and are not always straightforward for sectoral users to apply directly. Furthermore, systematic evaluation of forecast uptake and decision impact remains limited.

3.3. Annual to decadal predictions

Annual to decadal prediction is an emerging but underdeveloped area of regional climate services in South Asia. While global decadal prediction systems are advancing, there is currently no established regional mechanism comparable to SASCOF for synthesizing or communicating annual or decadal outlooks.

At present, regional stakeholders rely primarily on global centres and research institutions for annual to decadal information, and its operational use remains limited. Furthermore, there is no formal regional forum dedicated to annual-to-decadal outlook interpretation, and systematic verification frameworks are largely absent at the regional level.

Potential users include infrastructure planners, energy authorities, and national planning commissions. However, global assessments note that user familiarity with decadal prediction remains low, and integration into planning processes is limited. The absence of structured regional coordination and limited technical capacity for interpretation constrain practical application.

3.4. Climate change projections and applications

Long-term climate change projections play a critical role in supporting National Adaptation Plans, infrastructure design standards, climate-resilient development planning, and regional risk assessments. In South Asia, projections are primarily informed by IPCC AR6 products, including the Interactive Atlas, as well as regional downscaling initiatives led by research institutions and development partners such as WCRP CORDEX and ESCAP.

Regional use of climate projections is most visible in adaptation dialogues, donor-supported resilience programs, and strategic planning processes. RCC Pune, NMHSs and research institutions use global model outputs to assess projected changes in temperature, precipitation, and extreme events under different emissions scenarios and shared socioeconomic pathways (SSPs). Regional datasets and downscaled products are sometimes incorporated into vulnerability assessments and sectoral studies.

Typical users include planning ministries, adaptation programme managers, development banks, infrastructure agencies, and research organizations. However, capacity to interpret ensemble outputs and probabilistic scenarios varies significantly across the region. Computational infrastructure and technical expertise for advanced downscaling are unevenly distributed.

Although projections are scientifically robust, translation into actionable, localized guidance remains a major challenge. Policymakers often require simplified, sector-specific interpretations, and communication of uncertainty remains complex. In some sub-regions, familiarity with localized climate projections is limited, and institutional, policy, and financial support for integrating long-term projections into planning is inconsistent.

These challenges result in weak integration between long-term projections and shorter-term climate services, limited co-production with sector stakeholders, and underutilization of climate projections in operational decision-making.

3.5. Cross-Timescale Integration Challenges

Across timescales, seamless integration remains a systemic weakness. The GFCS emphasizes the need for coherence across Observations, Research, Climate Services Information Systems, User Interface Platforms, and Capacity Development (WMO, 2012). However, monitoring, seasonal forecasting, decadal information, and long-term projections are often managed through separate initiatives with limited interoperability. Data fragmentation, inconsistent standards, and project-based institutional arrangements hinder the development of seamless climate risk information chains.

Users increasingly require integrated information that connects short-term hazard forecasts with seasonal outlooks, medium-term variability, and long-term climate change projections. However, regional systems are not yet fully configured to provide this continuum. Strengthening cross-timescale coordination, enhancing interoperability of data platforms, and institutionalizing feedback mechanisms remain critical priorities for advancing regional climate services in South Asia.

Table 3. Summary of Regional Climate Services Across Timescales in South Asia

Timescale / Data Type	Level of Maturity	Coverage	Key Uses / Applications	Critical Gaps / Limitations
Historical & Climate Monitoring	**Moderate (M)** – foundational but constrained by data limitations	Combination of national observing networks, satellite observations, global reanalysis (e.g., ERA5), and regional platforms (e.g., ICIMOD RDS, ESCAP Portal)	Baseline development, trend analysis, model calibration, infrastructure design, risk threshold setting, vulnerability assessment	Significant observational gaps (especially in HKH), limited interoperability and metadata harmonization, over-reliance on satellite data, uneven operational integration of reanalysis datasets
Sub-seasonal (S2S)	**Low–Moderate (L–M)** – emerging and less institutionalized than seasonal forecasting	Increasing use of global S2S model outputs (e.g., ECMWF), with limited regional coordination mechanisms	Heatwave outlooks, rainfall variability assessment, cyclone risk monitoring, short-term preparedness planning	Limited institutionalization, requires expert interpretation, not easily accessible for sectoral users, weak integration into decision-making processes
Seasonal Forecasting	**High (H)** – most mature component of regional climate services	Strong regional coordination through SASCOF, supported by RCC Pune and NMHS participation	Agricultural planning, water resource management, disaster preparedness, public health planning, seasonal advisories	Coarse spatial resolution, inconsistent communication of probabilistic uncertainty, uneven sectoral translation, limited verification (especially for temperature), weak evaluation of forecast uptake and impact
Annual to Decadal Prediction	**Low (L)** – emerging but underdeveloped	Primarily reliant on global centres and research institutions; no dedicated regional coordination mechanism	Long-term infrastructure planning, energy sector planning, policy and investment decisions	Absence of regional forum, low user familiarity, limited technical capacity, lack of verification frameworks, minimal operational application
Climate Change Projections	**Moderate (M)** – scientifically robust but limited in application	Global datasets (IPCC AR6, CMIP), with some regional downscaling initiatives	National adaptation planning, infrastructure design, climate risk assessments, policy development	Limited localization, uneven technical capacity, complex uncertainty communication, weak integration into operational decision-making and shorter timescales
Cross-Timescale Integration	**Low (L)** – systemic weakness across components	Fragmented across institutions, platforms, and initiatives with limited interoperability	Intended to support seamless climate risk information and decision-making across timescales	Weak interoperability, fragmented systems, lack of seamless information chains, limited institutional coordination, insufficient feedback mechanisms

IV. ASSESSMENT OF REGIONAL ENABLING ENVIRONMENT, RESOURCES, AND CAPACITIES

This section examines the regional enabling environment for climate services in South Asia, focusing on stakeholder coordination, data and technological capabilities, institutional capacities, and governance and sustainability. These factors underpin the effectiveness of climate services across all timescales and determine the extent to which regional mechanisms can complement and strengthen national systems, consistent with the RFCS and GFCS pillars.

4.1. Stakeholder Mapping

The regional climate services ecosystem in South Asia comprises a diverse and multi-layered network of institutions with complementary, and at times overlapping, mandates. Key actors include the WMO and its regional mechanisms, regional coordination platforms such as RIMES, SAHF, RCCs, national NMHSs, specialized technical organizations such as ICIMOD, UN agencies; multilateral development banks; and a range of research institutions and development partners. These actors collectively contribute to observations and monitoring, research, modelling and data generation, prediction across timescales, capacity development, sectoral application, and financing of climate services across the region.

Coordination for South Asia is largely facilitated through issue-specific and forum-based mechanisms such as SASCOF and CSUF. These NMHS and user interface platforms provide structured opportunities for technical collaboration, consensus-building, and provider-user dialogue, particularly at seasonal timescales. SAHF further serves as a collaboration space for hydrometeorological modernization and technical exchange. However, these mechanisms function primarily through voluntary participation and project-based support, rather than through a formalized regional governance mandate for climate services. Strengthening support to enable a cohesive coordination function is an emerging priority under SAHF, particularly through the CS WG. This could provide a pathway toward a more structured regional alignment, sustained programming, clearer governance and articulation of roles and responsibilities, in order to support NMHS mandates and the regional delivery of climate services across timescales.

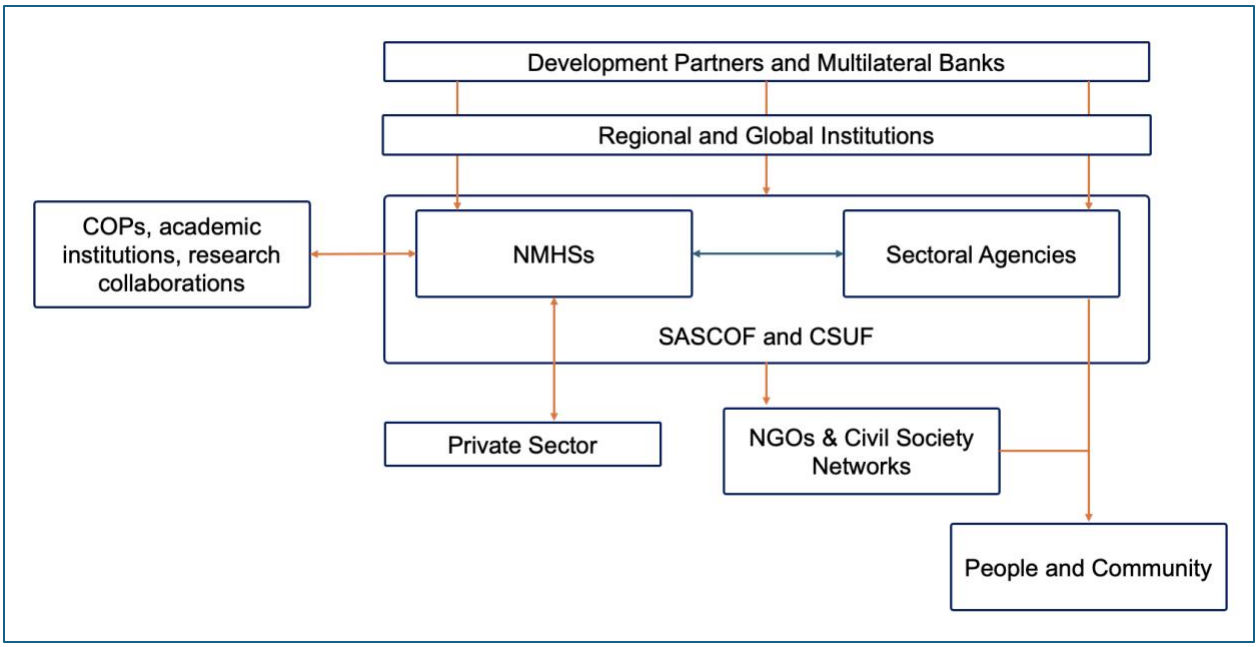


Figure 3. A diagram of the stakeholder mapping conducted for the Regional Status of Climate Services in South Asia

Stakeholder roles at the regional level can be broadly categorized into several functional groups:

- Regional and global institutions provide technical standards, guidance, and coordination support.
- NMHSs remain the primary producers and authoritative issuers of climate information within their jurisdictions, while contributing to regional forecasting processes such as SASCOF. While NMHSs are generally the primary producers and authoritative issuers of weather and climate information, their mandates for climate services—particularly for climate projections and sectoral applications—vary across countries. In some cases, specialized agencies, research institutions, or environment ministries play a leading role in generating climate projections or supporting sector-specific applications. This variation reflects differences in institutional structures, technical capacity, and national policy frameworks across South Asia.
- Sectoral agencies—including water resource authorities, agriculture ministries, disaster risk management institutions, health departments, and energy planners—serve as key users and intermediaries, translating climate information into operational decisions.
- Non-governmental organizations (NGOs) and civil society networks play an important role in translating climate information into local action, particularly through community-based adaptation, early warning dissemination, and resilience-building initiatives.
- Development partners and multilateral banks play a significant role in financing infrastructure modernization, technical assistance, and digital innovation.
- Communities of practice, academic networks, and research collaborations support methodological development and capacity strengthening across timescales.

- Private sector organizations—including agri-businesses, energy companies, climate service providers, and technology firms—are emerging as both users and providers of climate information, supporting the development of tailored services, digital platforms, and decision-support tools, as well as integrating climate information into operational and investment decisions.

Table 4. Regional Climate Services Stakeholders in South Asia

Category	Key Organizations (Examples)	Primary Roles
Global / Regional Institutions	WMO, RCC-Pune, TP-RCC	Provide technical guidance on standards, modelling, and forecasting across timescales
	RIMES, SAHF, UKMO / WISER / CARA	Facilitate coordination, consensus-building, user engagement, and capability building
NMHSs	AMD, BMD, DHM, DMH, IMD, MMS, NCHM, PMD, DOM	Forecast production, national dissemination, user engagement
Sectoral Agencies	Ministries on Agriculture, DRR, Water authorities, Health, Energy	Application of climate information in sectoral decisions
NGOs / civil society networks	IFRC, BRAC, Practical Action, local NGOs, RCCC	Community-level implementation, early warning dissemination
Development Partners / Multilateral Banks	World Bank, ADB, CREWS, UNDP, FCDO	Financing, technical assistance, programme implementation
Research & Academia	ICIMOD, IWMI, universities, regional research networks	Modelling, downscaling, innovation, capacity building
Private Sector	Agri-tech firms, energy companies, climate service providers, tech platforms	Service delivery, innovation, decision-support tools, operational use of climate information

Regional climate services in South Asia most actively support the GFCS priority areas including agriculture and food security, disaster risk reduction and emergency preparedness, water resources and hydropower management, and increasingly, public health applications such as heat stress monitoring. Engagement with the energy and infrastructure sectors is emerging but less systematically institutionalized.

Stakeholder engagement varies across climate service timescales, with operational agencies and sector users most actively engaged in weather, sub-seasonal, and seasonal services. Among sectors, agriculture and disaster risk reduction exhibit the most mature integration of regional seasonal outlooks into operational planning, largely due to established advisory systems and early warning frameworks.

Engagement in climate change information and projections is less advanced, but its use by planning, environmental, and research institutions for adaptation, longer-term planning and policy development, is a potential area for future growth.

Despite the breadth of stakeholders involved, coordination challenges persist. The State of Climate Services 2024 emphasizes that effective climate services require clearly defined institutional roles and sustained coordination across actors, noting that fragmentation remains a barrier to impact globally.

In South Asia, this fragmentation is reflected in overlapping regional initiatives pursuing similar objectives without formalized coordination frameworks; uneven participation of sectoral agencies and development partners across platforms; and limited institutional mechanisms to systematically incorporate user feedback into service refinement. While regional forums enable technical exchange, the absence of a unified regional mandate or governance framework for climate services contributes to variability in leadership clarity, accountability, and long-term strategic alignment.

Key priorities for strengthening regional stakeholder coordination include:

- Strengthening stakeholder mapping to improve visibility of institutional roles, mapping, and partnerships across the regional climate services landscape;
- Clarifying coordination roles, governance arrangements, and defining institutional functions to reduce duplication, strengthen accountability, and improve strategic alignment among regional initiatives; and
- Institutionalizing user feedback mechanisms to ensure climate services are systematically refined based on user needs and experience.

4.2. Data and Technological Capabilities

Regional climate services in South Asia depend fundamentally on the availability, accessibility, interoperability, and technological robustness of climate data systems (in parallel to understanding and alignment with user needs and decision spaces). The backbone of regional service provision consists of national observing networks, satellite products, global reanalysis datasets, and selected regional data integration platforms. South Asia has benefited from increasing access to satellite-derived datasets and global model outputs, which are incorporated into regional portals such as the UN-ESCAP Risk and Resilience Portal and ICIMOD's Regional Database System. These platforms enhance visibility of climate risks and support cross-border analysis, particularly in transboundary river basins and the Hindu Kush Himalaya region.

However, technological and infrastructural constraints continue to limit the scalability, reliability, and seamless integration of climate services across the region.

Observing systems include meteorological stations, AWS, upper-air observations, hydrological gauges, and cryosphere monitoring networks. However, uneven station density and data continuity challenges remain common in mountainous and remote regions.

Remote sensing plays a central role in regional climate monitoring and early warning. Satellite products are widely used for monsoon tracking, drought monitoring, heat stress assessment, and cyclone detection across the Bay of Bengal and Arabian Sea. These products complement historical station observations, which provide the long-term baseline for climate monitoring and climate change assessment, although the length, completeness, and spatial coverage of observational records vary considerably among countries across South Asia. In many data-sparse areas, satellite datasets compensate for limited ground-based coverage. However, reliance on externally generated satellite datasets without robust ground validation can increase uncertainty in localized analyses.

Operational climate monitoring combines national observations with remotely sensed and global datasets. NMHSs routinely integrate observations from meteorological and hydrological stations with satellite products and, where available, global reanalysis datasets to produce climate summaries, rainfall and temperature anomaly analyses, drought monitoring products, and other climate diagnostics. While satellite observations help improve spatial coverage in data-sparse areas, the quality of climate monitoring continues to depend on the completeness, continuity, quality control, and interoperability of long-term national observational records.

Data management remains fragmented. Non-uniform formats and inconsistent metadata hinder interoperability. The transition toward WMO Information System 2.0 (WIS 2.0) offers opportunities for standardized data exchange and improved interoperability. However, operational adoption across the region remains uneven.

Modelling infrastructure varies considerably. Many NMHSs rely heavily on outputs from global centres– particularly the WMO-designated Global Producing Centres (GPCs) for Long-Range Forecasts—and access these products through platforms such as the Copernicus Climate Data Store (CDS) for sub-seasonal and seasonal forecasting. Limited high-performance computing capacity constrains advanced downscaling and ensemble calibration, while interoperability remains limited with differences in metadata standards and data sharing agreements restricting seamless integration.

For sub-seasonal forecasting, operational capacity varies considerably across the region. Several NMHSs rely substantially on guidance from global forecasting centres and regional products, including those developed through SASCOF, with national forecasts refined using available observations and technical expertise. Countries with more advanced technical capacity have begun developing extended-range forecasting systems and forecast calibration approaches, whereas others continue to depend primarily on externally generated products because of

limitations in modelling infrastructure, computational resources, technical expertise, and forecast verification capacity.

In operational practice, NMHSs in South Asia typically develop seasonal outlooks by combining outputs from global climate models with regional and national-level dynamical and statistical processing tools. Outputs from global climate models produced by major international forecasting centres—particularly the WMO-designated Global Producing Centres (GPCs) for Long-Range Forecasts—are first accessed and interpreted, forming the primary technical input for seasonal prediction. These outputs are then processed using tools such as the Climate Predictability Tool (CPT) for statistical downscaling and generation of localized probabilistic forecasts. In some cases, platforms such as the FOCUS system are also used to support model evaluation and forecast generation. These national-level forecasts subsequently contribute to regional consensus processes such as SASCOF, where they are synthesized into regional outlooks and further refined for national dissemination. For example, some NMHSs apply CPT to produce district-level seasonal rainfall forecasts to support sectoral decision-making. However, operational challenges persist, including constraints in accessing and managing input datasets required for CPT, dependence on external data sources such as the IRI Data Library, and limitations in computational and technical capacity. Strengthening regional support systems—including improved access to datasets, shared tools, and interoperable platforms—could enhance the sustainability and consistency of seasonal forecasting workflows across the region.

Long-term climate information is generally produced through the application of global and regional climate model outputs rather than routine operational forecasting systems. Across South Asia, NMHSs use climate projections generated through international modelling initiatives together with regional datasets to support climate change assessments, adaptation planning, and infrastructure development. In many countries, these analyses are undertaken collaboratively with research institutions and development partners rather than as routine operational functions of NMHSs. Continued investment in regional climate modelling, statistical downscaling, and technical capacity would strengthen the application of long-term climate information for policy and planning.

Overall, South Asia's regional climate services rely on a complex mix of national observations, satellite datasets, and global reanalysis products. While technological access has improved, systemic constraints—uneven station coverage, limited real-time data exchange, fragmented data standards, insufficient computational capacity, and weak interoperability—continue to hinder the development of seamless, integrated regional climate services. Addressing these challenges will require targeted investments in expanding and sustaining observing networks, particularly in data-sparse and high-altitude regions; strengthening real-time data exchange and adoption of standardized systems such as WIS 2.0; improving data management practices and metadata harmonization to enable interoperability; and enhancing computational infrastructure and technical capacity to support downscaling, modelling, and ensemble forecasting. Strengthening integration across data sources and platforms will be critical to enabling more reliable, scalable, and user-oriented climate services across the region.

Table 5. Summary of Regional Data and Technological Capabilities for Climate Services in South Asia

Capability Area	Current Status	Key Challenges	Priority Improvements
Observing Systems	Regional climate services are supported by meteorological stations, AWS, upper-air observations, hydrological gauges, and cryosphere monitoring networks.	Uneven station density and data continuity challenges, particularly in mountainous and remote regions.	Expand and sustain observing networks, particularly in data-sparse and high-altitude regions.
Remote Sensing and Climate Monitoring	Satellite products complement national observations for climate monitoring, drought, heat stress, cyclone monitoring, and climate diagnostics, while operational climate monitoring combines observations, satellite products, and reanalysis datasets.	Limited ground validation in some areas and dependence on the completeness, continuity, quality control, and interoperability of long-term observational records.	Strengthen integration of satellite and ground observations while improving quality control and long-term observational records.
Data Management and Interoperability	Regional and global datasets are increasingly accessible, and WIS 2.0 provides opportunities for standardized data exchange.	Fragmented data management, inconsistent metadata, non-uniform formats, uneven WIS 2.0 implementation, and limited interoperability.	Harmonize metadata, strengthen data management, promote standardized data exchange, and accelerate adoption of interoperable systems.
Climate Modelling and Forecasting Infrastructure	NMHSs rely heavily on outputs from WMO Global Producing Centres and regional/global platforms to support climate prediction.	Limited high-performance computing, computational resources, interoperability, and technical capacity for downscaling and ensemble calibration.	Strengthen computational infrastructure, technical capacity, downscaling, and ensemble forecasting capabilities.
Sub-seasonal Forecasting	Operational capacity varies considerably, with some NMHSs developing extended-range forecasting systems while others depend primarily on externally generated products.	Differences in modelling infrastructure, computational resources, technical expertise, and forecast verification capacity.	Strengthen modelling systems, forecast calibration, verification capacity, and regional technical support.

Seasonal Forecasting	Operational workflows combine global climate model outputs with national statistical and dynamical tools, contributing to SASCOF regional outlooks.	Dependence on external datasets, data management constraints, and limited computational and technical capacity.	Improve access to datasets, shared tools, interoperable platforms, and regional support systems.
Long-term Climate Information	Climate projections support climate change assessment, adaptation planning, and infrastructure development, often through collaboration with research institutions and development partners.	Limited operational production within NMHSs and constrained modelling and statistical downscaling capacity.	Strengthen regional climate modelling, statistical downscaling, and technical capacity for long-term climate information.

4.3. Institutional Capacities

The State of Climate Services 2024 identifies capacity development as one of the most persistent global gaps, particularly in translating technical advances into sustained institutional capability. In South Asia, regional institutional capacity is shaped primarily by collective national capabilities rather than centralized authority. Capacity development occurs through SASCOF, CSUFs, regional workshops, and international technical assistance, consistent with RFCS guidance emphasizing complementarity with national systems.

A Training Needs Assessment (TNA) was conducted with NMHSs and select user sector representatives in early 2026 to identify priority capacity development needs across the stakeholders involved in climate service production, delivery, and application. The TNA indicates that both NMHSs and user-sector institutions are actively engaged in producing, interpreting, and applying climate information. However, capacity remains uneven across both groups. While NMHSs demonstrate strong foundations in climate monitoring and seasonal forecasting, capacities across other climate timescales remain uneven. Sub-seasonal forecasting capabilities continue to vary across countries, while proficiency in developing and applying annual, decadal, and long-term climate outlooks is generally more limited. Forecast verification, climate downscaling, and interpretation of multi-model ensemble products also emerged as common technical capacity gaps. At the same time, institutional mechanisms supporting climate services—such as standard operating procedures (SOPs), NFCS, and structured stakeholder engagement processes—are not uniformly established across countries.

For user sectors, climate information is increasingly used to support planning, preparedness, and operational decision-making, particularly in agriculture, disaster risk management, water resources, and health. Short and medium-range forecasts primarily support day-to-day operations and early action, while seasonal outlooks inform planning and resource management. Long-term climate information is used primarily for infrastructure planning, climate adaptation, and policy development. However, the ability to interpret and systematically apply climate information remains variable. Responses indicated that user sector respondents most commonly identified operational climate products and services as useful to their work, while more specialized, probabilistic forecasts, climate modelling outputs, and long-term projections were identified by fewer respondents. Challenges also persist in translating climate projections into sector-specific actions, particularly where climate information is not sufficiently localized or where institutional processes for integrating climate information into planning are lacking.

Training efforts, such as through WMO Regional Training Centres, RIMES, and UKMO, contribute to capacity strengthening, but remain largely project based. The TNA highlights that capacity development needs to extend beyond technical knowledge to include practical skills for translating climate information into useable, useful services that are used to aid decision making. Priority areas include interpretation of climate products, impact-based forecasting, sector-specific risk analysis, communication of uncertainty, and linking forecasts to early action and operational planning. Institutional embedding of these competencies remains uneven across the region.

User interface capacity also varies. The GFCS emphasizes structured user engagement and co-production, yet sustained multi-way engagement mechanisms are not uniformly institutionalized

across South Asia. The TNA further indicates that while platforms such as CSUF provide important opportunities for bi-annual dialogue, more systematic feedback mechanisms and integration of user perspectives into service co-production are still needed.

Gender equality, disability, and social inclusion (GEDSI) considerations remain insufficiently mainstreamed in climate service governance and communication strategies. Although increasingly recognized in global climate services assessments, these dimensions are not yet consistently integrated into capacity development approaches or service delivery systems across the region.

Overall, the findings highlight the need for a dual capacity development approach that strengthens both the production and application of climate services. Key regional capacity gaps include uneven technical capabilities across climate timescales–particularly in sub-seasonal forecasting, annual and decadal climate outlooks, climate projection analysis, downscaling, and forecast verification–despite generally stronger capacities in climate monitoring and seasonal forecasting. Institutional systems such as SOPs, decision-support tools, NFCS, and structured stakeholder engagement mechanisms also remain unevenly established across NMHSs. Among user sectors, constraints persist in interpreting probabilistic information, long-term climate information, and translating climate information into sector-specific planning and operational decisions.

These gaps translate into priority areas for regional training and capacity development, including:

- Strengthening technical forecasting and modelling capabilities;
- Improving interpretation and communication of probabilistic and impact-based forecasts;
- Enhancing sector-specific climate risk analysis; and
- Supporting the integration of climate information into early action and decision-making processes.

The findings further underscore the importance of structured, phased capacity development approaches that combine technical training, institutional strengthening, and sustained engagement between climate service providers and users. Emphasis should also be placed on sustainable capacity development through Training-of-Trainers models, regional knowledge exchange, and institutional knowledge transfer mechanisms to maintain, sustain, and expand expertise over time.

At the regional level, these priorities provide a basis for designing coordinated training initiatives—such as those implemented through SASCOF and CSUF—and for informing longer-term capacity development planning under regional mechanisms such as SAHF. Strengthening alignment between training activities, institutional needs, and regional coordination processes will be critical to ensuring sustained improvements in climate service delivery and use across South Asia.

4.4. Governance, Financing, and Sustainability

Governance arrangements in South Asia are predominantly network-based and anchored in consensus-driven forums such as SASCOF and CSUFs rather than treaty-based regional institutions. While this aligns with flexible coordination principles under the GFCS, the absence of formalized governance frameworks creates accountability and sustainability challenges.

Financing is largely project-based and externally supported. Multilateral banks, bilateral donors, and UN agencies provide substantial investment in hydrometeorological modernization and forecasting systems. However, the State of Climate Services 2024 notes that global climate services investment remains below required levels to meet escalating climate risks.

In South Asia, financing gaps are evident in observing network maintenance, high-performance computing (HPC) infrastructure, verification systems, and sustained regional coordination mechanisms. Short funding cycles constrain long-term planning and institutional continuity.

Policy alignment with the guidelines for RFCS is conceptually strong but institutionally incomplete. Operationalization of structured governance, sustained financing pathways, and integration into adaptation investment streams remains limited.

Long-term sustainability will depend on transitioning from informal coordination toward structured governance arrangements, diversified financing, and stronger integration with regional development strategies.

V. SYNERGIES ACROSS INITIATIVES

Regional climate services in South Asia are supported by a diverse ecosystem of organisations, mechanisms, and tools that collectively address different components of the climate services value chain across multiple timescales. While fragmentation remains a recurring theme, important complementarities exist across initiatives in terms of coordination, data systems, capacity development, and user engagement.

The strongest and most established synergy is observed at the **seasonal timescale**, where a structured regional-national system is in place. RCC-Pune provides regional seasonal products and climate monitoring functions, which feed directly into SASCOF seasonal outlooks. SASCOF synthesizes multi-model guidance through collaborative assessment among NMHSs, producing probabilistic regional outlooks. These are subsequently translated into national-level products and advisories by NMHSs. CSUFs complement this system by enabling structured engagement between climate service providers and sectoral users, supporting interpretation and application of forecasts. Together, these mechanisms form a functioning regional climate services system linking global inputs, regional synthesis, national dissemination, and sectoral application.

Across other timescales, complementarities exist but are less systematically integrated. **Historical monitoring and baseline datasets** generated from national observing systems, satellite products, and global reanalysis are increasingly consolidated through regional platforms such as ICIMOD's Regional Database System and the UN ESCAP Risk and Resilience Portal. These platforms support cross-border analysis, particularly in transboundary river basins and the Hindu Kush Himalaya region and provide critical inputs for both seasonal forecasting and longer-term risk assessments. At the **sub-seasonal scale**, emerging use of global model outputs is observed, though regional coordination mechanisms remain less institutionalized. At **longer timescales**, climate change projections from IPCC products and CORDEX initiatives are available to inform adaptation planning, although linkages with shorter-term services remain limited.

Cross-platform complementarities are also evident. Regional data platforms (e.g., ICIMOD RDS, ESCAP Portal) provide harmonized datasets that offer support to risk analysis and planning, while tools such as the Climate Services Toolkit and FOCUS system enable model evaluation, forecast generation, and customization at the national level. The SAHF Knowledge Hub further contributes by facilitating access to datasets, tools, and training materials, supporting knowledge exchange and regional learning. Together, these platforms contribute to different stages of the climate services value chain, from data access and analysis to product generation and dissemination.

Capacity development efforts demonstrate additional synergies across initiatives. WMO Regional Training Centres, RIMES technical programmes, ICIMOD initiatives, and training embedded within SASCOF and Pre-COF processes collectively support forecasting, modelling, collaboration / co-production, and impact-based services. These efforts contribute to strengthening both provider capacity (NMHSs) and user sector capacity (through CSUF engagement), enabling

improved interpretation and application of climate information. However, these activities remain largely project-based and are not yet fully institutionalized within a sustained regional framework.

At the system level, these complementarities reflect an emerging but not yet fully integrated regional climate services architecture. Coordination across initiatives is primarily facilitated through platforms such as SASCOF, CSUF, and increasingly SAHF, which provides an enabling mechanism for aligning activities, strengthening collaboration, and supporting implementation of regional priorities. However, integration remains largely functional rather than institutionalized, with limited formal or standardised mechanisms to ensure coherence across timescales, platforms, and stakeholder groups.

Key integration gaps include:

- Limited interoperability between regional data platforms and tools;
- Weak linkage between monitoring systems, forecasting platforms, and sectoral decision support systems;
- Parallel climate change projection initiatives not systematically connected to seasonal and sub-seasonal services;
- Limited institutionalization of collaboration between NMHSs and sectoral users beyond forum-based engagement;
- Lack of a unified regional coordination framework to support cross-timescale integration and sustained collaboration.

Strengthening cross-platform integration, harmonizing metadata standards, and institutionalizing collaboration and engagement beyond project cycles represent key opportunities to consolidate existing synergies. Enhancing linkages across timescales, strengthening NMHS–user co-production mechanisms, and leveraging regional coordination platforms such as SAHF to align initiatives can support the transition toward a more integrated, coherent, and sustainable regional climate services system in South Asia.

VI. REGIONAL FRAMEWORK FOR CLIMATE SERVICES MATURITY

This section utilizes the five pillars of the GFCS/RFCS architecture to assess the maturity of South Asia's current regional climate services ecosystem in terms of User Interface Platforms; Climate Services Information Systems; Observations and Monitoring; Research, Modelling and Prediction; and Capacity Development.

6.1. GFCS / RFCS Pillars

User Interface Platform

This GFCS/RFCS pillar is most evident in the functioning of SASCOF and CSUF, which provide structured opportunities for engagement between NMHSs and sectoral stakeholders. These platforms have facilitated dialogue particularly in agriculture and disaster risk reduction, and participation has expanded over time. However, systematic mechanisms for feedback incorporation, impact tracking, and sustained co-production remain underdeveloped.

Engagement between NMHSs and user sector representatives are most structured at the seasonal timescale, while comparable mechanisms for sub-seasonal, decadal, and climate change services are less institutionalized. As a result, the user interface function remains partially aligned with RFCS principles but requires strengthening to achieve continuity and measurable impact.

Table 6. Key gaps observed and priority actions under the User Interface Platform Pillar

Key Gaps	Priority Actions
Absence of systematic feedback loops	Strengthen structured multi-way feedback mechanisms by integrating user feedback into SASCOF processes and NMHS workflows, and establishing continuous engagement beyond the CSUF.
Limited mechanisms for tracking use and impact of climate services	Develop approaches for tracking uptake, application, and impact of climate services through CSUF and national systems, supported by SAHF coordination.
Uneven institutionalization of co-production across timescales	Expand co-production beyond seasonal services by strengthening NMHS–user engagement across sub-seasonal and longer timescales through SASCOF/CSUF platforms.

Climate Services Information System (CSIS)

The CSIS pillar is relatively well-developed at the seasonal level. RCC-Pune and SASCOF collectively provide a functioning regional system for probabilistic seasonal outlook generation. However, annual-to-decadal synthesis mechanisms are largely absent at the regional scale, and integration between sub-seasonal and seasonal products remains inconsistent. Regional portals such as those operated by ICIMOD and UN ESCAP enhance data accessibility but operate a more "push" system rather than collaboration, and act largely in parallel rather than through harmonized technical standards or interoperable frameworks. Consequently, while a functional information system exists, it remains fragmented across timescales and platforms.

Table 7. Key gaps observed and priority actions under the CSIS Pillar

Key Gaps	Priority Actions
Absence of regional synthesis mechanisms for annual-to-decadal timescales	Develop regional processes by extending the application of RCC outputs and enhance regional coordination mechanisms for longer timescales
Weak integration between sub-seasonal and seasonal products	Strengthen linkages between sub-seasonal and seasonal forecasting through improved coordination between RCC outputs and SASCOF processes
Limited interoperability across regional data platforms	Harmonize data standards and promote interoperability across ICIMOD, ESCAP, and other platforms through coordinated regional efforts (e.g., SAHF-supported alignment)

Observations and Monitoring

South Asia benefits from national observing networks complemented by satellite and reanalysis products. Regional aggregation platforms support cross-border analysis, particularly in mountain and transboundary river systems. Nonetheless, uneven station density, gaps in upper-air observations, limited cross-border real-time data exchange, and inconsistencies in metadata standards constrain robustness. These constraints limit the full realization of an integrated regional observing backbone aligned with RFCS objectives.

Table 8. Key gaps observed and priority actions under the Observations and Monitoring Pillar

Key Gaps	Priority Actions
Uneven station density and observational gaps in data-sparse regions	Expand and sustain observing networks, particularly in mountainous and remote areas, through coordinated regional investment efforts

Limited cross-border real-time data exchange	Strengthen real-time data sharing through adoption of WIS 2.0 and regional coordination facilitated by SAHF
Inconsistent metadata and data management practices	Standardize metadata and data management practices across NMHSs to improve interoperability and integration

Research, Modelling, and Prediction

In relation to research, modelling, and prediction, regional contributions include CORDEX-South Asia downscaling efforts and RCC seasonal modelling activities. However, coordination for decadal prediction and seamless forecasting remains limited, and reliance on global centres for sub-seasonal products persists. While technical expertise is strong in seasonal forecasting, structured regional collaboration in advanced modelling, ensemble verification, and cross-timescale prediction systems is still evolving.

Table 9. Key gaps observed and priority actions under the Research, Modelling, and Prediction Pillar

Key Gaps	Priority Actions
Limited regional coordination for multi-timescale modelling	Strengthen regional collaboration in modelling through RCC activities and partnerships with RIMES and ICIMOD
Weak integration of sub-seasonal, seasonal, and longer-term prediction systems	Advance seamless forecasting approaches by improving coordination across timescales within regional mechanisms
Limited capacity for downscaling, ensemble calibration, and verification	Enhance technical capacity through targeted regional training and integration of modelling support into existing programmes

Capacity Development

Finally, alignment with the Capacity Development pillar is visible through WMO Regional Training Centres, RIMES initiatives, ICIMOD, and Met Office projects and programmes, alongside the training embedded within SASCOF and CSUF processes. These initiatives have strengthened technical capacity across the region, yet they remain largely project-based and lack long-term institutional pathways. Sustained regional capacity frameworks, structured competency development, and embedded institutional mandates are still emerging.

Table 10. Key gaps observed and priority actions under the Capacity Development Pillar

Key Gaps	Priority Actions
Capacity development remains largely project-based	Establish a coordinated regional capacity development framework under SAHF to support sustained programming, prioritizing a “train-the-trainer” approach
Uneven institutional embedding of technical and operational competencies	Strengthen institutional systems (e.g., SOPs, NFCS) through integration of training outputs and their impacts into NMHS and sectoral workflows
Limited integration of provider and user capacity development	Promote integrated training approaches linking NMHSs and sectoral users through SASCOF, CSUF, and regional training initiatives

In conclusion, while the South Asia region does not currently have a formalized RFCS, it demonstrates partial maturity with GFCS/RFCS architecture, particularly in seasonal forecasting and user engagement mechanisms. However, limitations in governance formalization, interoperability, sustained financing and training, and cross-timescale integration constrain full realization of the RFCS vision.

6.2. Synergies between the RFCS steps and current regional activities in South Asia

South Asia has a range of existing regional platforms, mechanisms, and initiatives—coordinated in part through SAHF–that already contribute to key elements of the RFCS process. These efforts demonstrate emerging alignment with the recommended steps in establishing RFCS, while also highlighting opportunities for greater integration and coherence.

Initial progress toward RFCS development is reflected in SAHF's role in convening regional partners and stakeholders to define shared priorities for in region climate services. This includes the establishment of the SAHF Climate Services Working Group and the formulation of a regional workplan that consolidates priority actions across thematic areas such as RFCS development, capacity enhancement, tools and decision support systems, data access and sharing, research, modelling and prediction, user engagement, and enabling policy integration; with monitoring, evaluation, and learning (MEL) and gender, equity, disability and social inclusion (GEDSI) cross-cutting these themes. These efforts provide a structured foundation for coordinated regional action and reflect core RFCS principles of multi-stakeholder engagement and strategic planning.

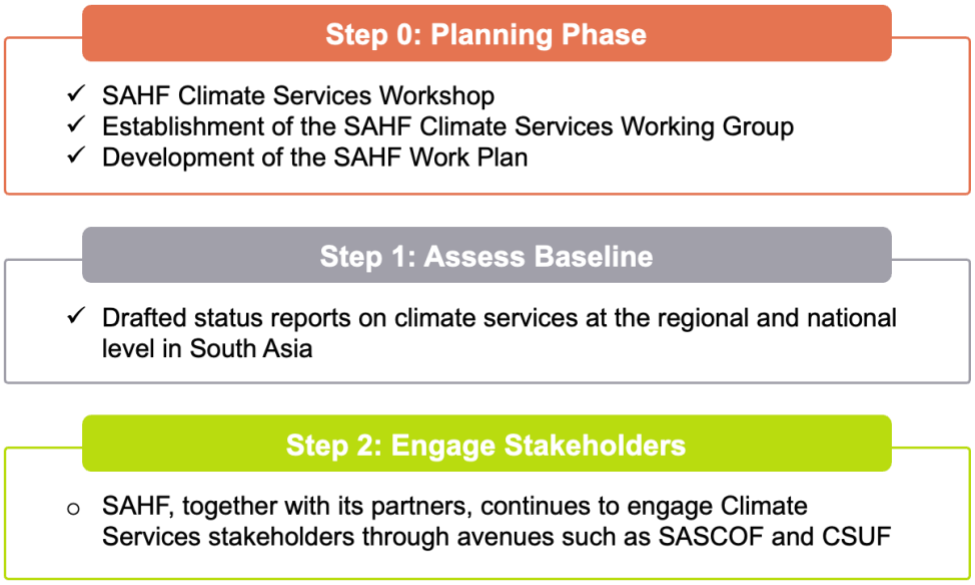


Figure 4. Current regional initiatives in South Asia vis-a-vis steps in establishing an RFCS (where ◦ indicates ongoing initiatives)

- ✓ **Step 1:** The regional and national assessments on the status of climate services, led through the SAHF CS WG, contribute directly to establishing a baseline understanding of existing capacities, systems, and gaps. These comprehensive status reports at both regional and country levels, examine institutional arrangements, data systems, service production across timescales, and dissemination mechanisms. In parallel, a regional TNA was conducted to evaluate technical capacities of both providers and users of climate services. Together, these efforts align with RFCS guidance on evidence-based planning and provide a foundation for targeted capacity development and investment prioritization.

Step 2: SAHF CS, in collaboration with international development partners, has initiated engagement activities through working group meetings and regional consultation workshops involving NMHSs, regional institutions, and sectoral stakeholders. These engagements have informed the development and refinement of the SAHF Climate Services Work Plan, reflecting shared priorities and regional needs. Engagement is further sustained through support to mechanisms such as SASCOF and CSUF, which provide regular platforms for dialogue between climate service providers and users, facilitating technical exchange and identification of sector-specific requirements. Despite this progress, continued engagement with stakeholders beyond platform and project-based mechanisms, involvement of a wider range of relevant stakeholders, and formalization of coordination among stakeholders are needed to establish a RFCS in South Asia.

Beyond these SAHF CS initiatives, several existing regional mechanisms already operationalize core components of the RFCS across its pillars and timescales. For instance, SASCOF supports seasonal forecasting and regional coordination (Climate Services Information System), while CSUFs facilitate user engagement and co-production (User Interface Platform). Regional data-sharing initiatives and emerging digital platforms contribute to strengthening observations, data access, and interoperability, while training programmes and technical exchanges support capacity development. These interconnected efforts illustrate that foundational elements of an RFCS are already in place, though often implemented through parallel or loosely coordinated initiatives and projects.

Overall, current regional activities demonstrate partial but substantive maturity in fulfilling the RFCS pillars, albeit in the absence of a formalized South Asian RFCS. The opportunity moving forward lies in achieving endorsement and systematically linking, scaling, and institutionalizing these efforts under a more cohesive RFCS structure, to enhance service provision and integration across timescales, improve sustainability, and strengthen the delivery of user-oriented climate services in South Asia.

VII. GOOD PRACTICES AND LESSONS LEARNED: REGIONAL CASE STUDIES

Drawing on the regional experiences outlined in the WMO Guidelines for Implementing a Regional Framework for Climate Services (2025 edition), the case studies from the Caribbean, Pacific, Europe, and West Africa demonstrate diverse yet converging approaches to regional coordination of climate services. While institutional contexts and capacities differ significantly across regions and this therefore drives differing approaches, several common elements of good practice and transferable lessons emerge.

7.1. Caribbean: Structured Regional Coordination Anchored in a Strong RCC

The Caribbean experience illustrates a mature and operational model of regional climate services coordination centered on the Caribbean Institute for Meteorology and Hydrology (CIMH) as the WMO-designated RCC. Four foundational components underpin its success:

- A regional consortium mechanism (EWISACTs) that facilitates co-design and co-delivery of sector-specific climate services across agriculture, water, health, disaster risk management, energy, and tourism.
- A Regional Roadmap and Plan of Action (2020–2030) aligned with the five pillars of the GFCS.
- A bi-annual Caribbean Climate Outlook Forum (CariCOF) as an institutionalized user interface platform.
- A suite of operational regional climate products, including sectoral bulletins and early warning services.

Good Practices Identified:

- Institutionalized multi-sectoral coordination through a formal consortium.
- Strong alignment of regional planning instruments with the GFCS pillars.
- Regular, structured engagement platforms for both providers and users.
- Active mentorship and support for NFCS including pilot national roadmaps.

Lessons Learned:

- Small island developing States (SIDS) benefit significantly from centralized technical capacity at the regional level.
- Regional coordination can enable services (e.g., marine risk modelling) that are not feasible at national scale.
- Clear delineation of roles between regional and national institutions is essential to avoid duplication or perceived competition.

7.2. Pacific: Integrated Regional–National Approach Under Strong Political Mandate

In the Pacific, regional coordination is driven largely by the Secretariat of the Pacific Regional Environment Programme (SPREP) and operationalized through the Pacific Roadmap for Strengthened Climate Services (2017–2026). The Pacific Island Climate Outlook Forum (PICOF) provides both a technical coordination space and a capacity-building platform.

Unlike the Caribbean, the Pacific roadmap does not strongly separate regional and national implementation; rather, it integrates both levels under one strategic framework.

Good Practices Identified:

- Strong political endorsement from the Pacific Meteorological Council and ministerial processes.
- Inclusion of additional priority sectors (e.g., tourism and fisheries) reflecting regional realities.
- Explicit incorporation of gender and minorities empowerment.
- Built-in capacity-building through NMHS-only technical sessions at PICOF.

Lessons Learned:

- In highly capacity-constrained regions, combining regional and national implementation may be more practical than pursuing parallel frameworks.
- Strong regional leadership can compensate for limited national NFCS progress.
- Embedding inclusivity and open access principles strengthens legitimacy and long-term sustainability.

7.3. Europe: Research-Driven Coordination with Market Orientation

Europe presents a different model, characterized by high national capacity, strong research ecosystems, and a developed climate services market. Rather than a single unified RFCS, regional coordination occurs through multiple complementary initiatives, including:

- A European Research and Innovation Roadmap for Climate Services (2015 onwards).
- Large-scale collaborative research projects (e.g., EU Climate Prediction project).
- Copernicus Climate Change Service and Climateurope as integrative platforms.
- The WMO RA VI RCC Network providing operational support to NMHSs.

Good Practices Identified:

- Strong integration of research, innovation, and service delivery.
- Focus on cross-boundary risks (e.g., river basin management).
- Development of shared modelling and data infrastructure at continental scale.
- Market facilitation to stimulate private sector participation.

Lessons Learned:

- In high-capacity regions, RFCS-like coordination may emerge through networks and projects rather than a single governance framework.

- Absence of a singular authoritative structure can create coordination complexity.
- Regional added value lies particularly in harmonization, shared infrastructure, and cross-border risk management.

7.4. West Africa (ECOWAS Hydromet Initiative): Investment-Oriented, Ministerially Endorsed Framework

The ECOWAS Hydromet Initiative demonstrates a politically-endorsed and investment-focused regional approach. Originating from a 2017 ECOWAS Meteorological Programme, it culminated in a formally adopted regional investment plan in 2021.

Among the activities undertaken in the establishment of the initiative include:

- A comprehensive baseline assessment of hydrometeorological services.
- Stakeholder mapping and institutional role clarification.
- Detailed costing of investment needs at national and regional levels.
- Adoption by Ministers responsible for meteorology, hydrology, disaster risk reduction, and gender.

Good Practices Identified:

- Strong political ownership and ministerial endorsement.
- Explicit costing and investment planning.
- Clear articulation of NMHS primacy in climate service responsibility.
- Integration of hydrological and meteorological services under one initiative.

Lessons Learned:

- High-level political endorsement significantly enhances funding prospects and sustainability.
- Investment planning and socioeconomic benefit demonstration are critical to mobilizing resources.
- Regional coordination can reinforce, rather than replace, national mandates when governance roles are clearly defined.

Cross-Cutting Good Practices Across Regions

Across all four regions, several consistent success factors emerge:

1. **Defined Governance and Role Clarity:** Effective frameworks specify regional–national linkages and avoid mandate overlap.
2. **Institutionalized User Interface Platforms:** Regional Climate Outlook Forums (CariCOF, PICOF, RCOFs) are central to sustained engagement and co-production.
3. **Alignment with GFCS Pillars:** Successful regional initiatives systematically address observations, modelling, information systems, user engagement, and capacity development.
4. **Action-Oriented Planning with Costing and M&E:** Particularly in West Africa and the Caribbean, structured action plans with monitoring and evaluation mechanisms enhance accountability.
5. **Capacity Building and Peer Support:** Regional coordination provides opportunities for peer learning, mentorship, and technical harmonization.
6. **Context-Specific Design:** No single RFCS model fits all regions; institutional arrangements reflect capacity, political structures, and development priorities.

The case studies collectively demonstrate strategic lessons for future RFCS development, which are that:

- RFCS must be context-driven rather than template-driven**.**
- Strong RCCs or other regional bodies are essential anchors for technical credibility.
- Political endorsement and investment planning increases sustainability.
- Regional coordination should complement, not compete with, NFCS.
- Frameworks must remain adaptive, evolving alongside national capacities and emerging climate risks.

These experiences underscore that while structural models differ, successful regional climate services coordination consistently combines governance, stakeholder engagement, trusted technical excellence, and long-term strategic planning.

VIII. GAPS AND STRATEGIC OPPORTUNITIES

8.1. Systemic Gaps in Regional Climate Services

Despite progress, significant structural gaps remain in South Asia's regional climate services ecosystem. Fragmentation across timescales and initiatives limits coherence and seamless risk communication. Structured regional coordination for annual and decadal services is largely absent, and operational integration of sub-seasonal products remains limited. Data-sharing standards vary across platforms, and interoperability constraints reduce efficiency and transparency. Financing remains predominantly project-based, limiting long-term sustainability. Co-production practices are unevenly institutionalized, and GEDSI and MEL considerations are not yet systematically integrated into service design.

These challenges reflect the absence of a fully institutionalized regional coordination mechanism for climate services, with existing systems relying largely on forum-based collaboration and project-driven support.

8.2. Strategic Opportunities

Advancing a South Asian RFCS

South Asia has already established the foundational elements required for an RFCS. Through the establishment of the SAHF Climate Services Working Group (SAHF CS WG), the development of a regional climate services workplan, the completion of regional and national climate services assessments, a regional training needs assessment (TNA), and engagement through mechanisms such as SASCOF and CSUF, the region has progressed through the initial steps of the RFCS establishment process. These efforts have generated a shared understanding of regional priorities, existing capacities / capabilities, and opportunities for collaboration, providing a strong foundation for a more coordinated regional climate services architecture.

The next strategic opportunity lies in building on this momentum to advance the formal establishment of a South Asian RFCS that would provide a common climate services vision and strategic framework that links and strengthens existing regional mechanisms, clarifies institutional roles and responsibilities, and promotes coordinated implementation across the five RFCS pillars. Through the SAHF CS WG, the region is well positioned to convene regional institutions, NMHSs, user sectors, development partners, and research organizations, to secure regional endorsement, and co-develop a strategic and costed regional action plan for RFCS implementation.

A South Asian RFCS would also provide an important bridge between regional and national climate services. By strengthening regional coordination, harmonizing technical guidance, facilitating regional and country-to-country knowledge exchange, and promoting shared approaches to capacity development, data management, and service delivery, it would support countries in strengthening and operationalizing their NFCS. Regional services, technical expertise, training, and shared investments could be more effectively leveraged to complement

national capabilities while allowing countries to tailor climate services to their own institutional arrangements, priorities, and decision contexts.

Over time, a South Asian RFCS would provide a framework for sustaining regional collaboration beyond individual projects by promoting coordinated planning and investment, strengthening interoperability across platforms and timescales, , and supporting continuous learning across countries. Building on existing regional mechanisms rather than replacing them, it offers a practical pathway toward a more integrated, sustainable, and user-oriented climate services ecosystem for South Asia.

Strengthening Regional Coordination and Platforms

There are strong opportunities for advancing a more integrated and sustainable regional climate services architecture in South Asia. One of the most promising avenues lies in strengthening regional collaboration platforms. Regional Climate Application Forums—whether embedded within SASCOF processes or organized as sector-specific dialogues—offer valuable spaces for expert exchange, cross-sector brainstorming, and co-production with sectors such as agriculture, livestock and food security, health, water, energy and disaster risk management, among others.

Leveraging existing NMHS collaboration mechanisms and expanding the focus of the SAHF CS WG to include wider structured engagement, e.g. through sectoral user forums, could deepen technical interpretation and enhance climate services and their policy relevance. In this context, the SAHF CS WG represents a key opportunity to further support regional climate services by providing a platform to align regional priorities, support activity and project co-ordination, and move towards more structured and sustained collaboration beyond individual forums and project cycles.

Enhancing Cross-Platform Collaboration and Knowledge Exchange

Greater collaboration among regional platforms represents another critical opportunity. At present, knowledge, products, and datasets are often developed independently across institutions such as RCCs, ICIMOD, RIMES, ESCAP, and national NMHSs. Structured cross-learning initiatives—including staff exchange programmes, joint technical working groups, and regional communities of practice—could accelerate knowledge transfer, build shared competencies, and reduce duplication. Such mechanisms would also strengthen south-to-south collaboration and foster peer accountability within the region.

SAHF, through its supporting role and cross-thematic working group structure, provides an opportunity to convene these actors more systematically and to facilitate alignment across initiatives, including through joint planning and implementation of regional activities.

Advancing Data Sharing and Interoperability

The establishment of a more harmonized regional data-sharing framework is equally vital. Developing a common data access architecture—aligned with WIS 2.0 principles and interoperable metadata standards—would facilitate seamless exchange of observational data, reanalysis products, and derived indices; thus benefiting forecasts and their verification.

Expanding collaborative training on the use of high-resolution gridded datasets and regional reanalysis outputs could also help mitigate observational gaps and enhance analytical consistency across countries.

Regional coordination mechanisms play an important role in facilitating dialogue on data-sharing protocols, promoting standardization, and supporting alignment across platforms and institutions. Futhermore, joint investments in outreach and last-mile communication systems would improve the accessibility, usability and use of regional climate information and services by decision-makers.

Strengthening Regional Research and Modelling Collaboration

There is also significant scope for strengthening regional research collaboration across timescales. Research priorities include strengthening climate modelling, model calibration, ensemble prediction, and forecast verification across sub-seasonal, seasonal, decadal, and climate projection timescales, together with developing sector-specific climate applications, hazard-impact analyses, and climate indices to better support decision-making across priority sectors. would improve shared scientific understanding and enhance forecast interpretation. Collaborative model evaluation exercises and ensemble verification initiatives would further strengthen the scientific robustness of regional outlooks.

Regional platforms and partnerships provide a foundation for advancing such research. More collaborative, and structured coordination—potentially facilitated through SAHF—could help consolidate research efforts and strengthen linkages between science and operational services.

Institutionalizing Co-Production and Feedback Mechanisms

Opportunities need to extend beyond technical collaboration to ensure impact of services. Implementing structured, recurring, multi-way feedback mechanisms for stakeholders would enhance accountability and ensure that user experiences systematically inform service refinement. Strengthening co-production practices across NMHSs and sectors would also support more tailored, impact-oriented advisories.

The SAHF CS WG provides a potential platform to support the institutionalization of these processes at the regional level, including through the development of common approaches to user engagement, feedback integration, and impact assessment.

Strengthening Policy Integration and Financing Pathways

Finally, integrating policy advocacy more explicitly into regional climate services activities represents a strategic opportunity. Elevating climate services within regional development agendas, adaptation planning frameworks, and multilateral financing discussions would help secure stronger political commitment and more predictable funding. Aligning regional climate services initiatives with adaptation finance mechanisms and resilience investments could transition the system from project-based dependency toward sustained institutional support.

Regional coordination platforms, including SAHF, can support engagement with policymakers, development partners and financial institutions to align investments with identified regional priorities and strengthen the sustainability of climate services systems.

Taken together, these strategic opportunities demonstrate that South Asia is well positioned to transition from a collection of complementary regional initiatives toward a more coordinated Regional Framework for Climate Services. Building on the momentum established through the SAHF Climate Services Working Group, the next phase should focus on progressing the RFCS establishment process by securing regional endorsement, co-developing a strategic and costed action plan, and institutionalizing coordination across existing mechanisms. In doing so, a South Asian RFCS could enable a cross-timescale vision in regional climate services, strengthen regional collaboration, coordination and learning, whilst supporting the implementation and operationalization of NFCSs across South Asia through shared technical guidance, capacity development, data systems, and knowledge exchange.

IX. CONCLUSIONS

Conclusions

South Asia has developed a diverse and technically capable regional climate services ecosystem supported by a range of complementary mechanisms, platforms, and partnerships. Regional initiatives—including SAHF, RCC-Pune, SASCOF, CSUF, and regional data platforms—have strengthened the production, dissemination, and application of climate information across multiple timescales. These initiatives have also fostered regional cooperation, technical exchange, and capacity development, providing an increasingly robust foundation for climate-informed decision-making across sectors.

The assessment nevertheless identifies several persistent challenges that constrain the effectiveness and long-term sustainability of regional climate services. These include fragmentation across timescales and institutions, uneven interoperability of data systems, limited institutionalization of user engagement and co-production, reliance on project-based financing, and varying technical and institutional capacities across the region. While many components of an integrated regional climate services system already exist, enhanced coordination and more systematic integration are needed to maximize their collective value and strengthen support to national climate services.

Addressing these challenges will require building on existing regional mechanisms, strengthening collaboration among regional and national stakeholders, and reinforcing the links between climate information production, service delivery, and decision-making. Collectively, the findings demonstrate that South Asia is well positioned to further strengthen its regional climate services ecosystem (through more coordinated approaches that improve integration, sustainability, and user relevance) and would benefit from the process and outputs offered by a co-produced Regional Framework for Climate Services (RFCS)

Implementing a South Asian RFCS

The findings of this assessment indicate that SAHF, through its Climate Services Working Group, provides the most appropriate regional mechanism for advancing the establishment and implementation of a South Asian RFCS. Rather than re-inventing the wheel, the RFCS can build upon existing regional mechanisms—including SAHF, RCC-Pune, SASCOF, CSUF, and other regional technical and research initiatives—by providing a common framework for coordination, implementation, and continuous improvement.

Given the progress already achieved through regional assessments, stakeholder consultations, the regional TNA, and the development of the SAHF Climate Services Work Plan, a near-term priority is envisioned to complete the next stages of the RFCS establishment process. This includes securing regional endorsement from the SAHF Executive Council and CS Working Group stakeholders, alongside gaining support from NMHSs, regional organizations, user

sectors, and development partners. Broadening stakeholder engagement would further facilitate the co-development of a regional RFCS roadmap and strategic, costed action plan that defines implementation priorities, institutional roles and responsibilities, financing pathways, and monitoring, evaluation and learning arrangements.

The implementation of this roadmap would provide the basis for progressively strengthening coordination across existing regional mechanisms while supporting countries in the development and operationalization of their NFCS through shared technical guidance, regional capacity development, interoperable data systems, and coordinated climate service delivery.

X. RECOMMENDATIONS AND NEXT STEPS

Building on the findings of this report, the SAHF Climate Services Working Group is well-positioned to drive forward priority actions to support and strengthen regional climate services coordination and implementation. Now captured within the SAHF Climate Services Work Plan, these actions focus on consolidating existing initiatives, improving alignment across stakeholders, and establishing a foundation for longer-term regional integration.

While it is noted that further prioritisation is required, the following recommendations and actions emerge as proposed next steps for strengthening regional climate services and advancing the establishment of a South Asian RFCS. Alongside governance, coordination, financing, these have been aligned to the 5 pillars of the GFCS:

Governance, Coordination and Financing

1. **Advance the establishment of an RFCS** by building on the activities achieved to date through the SAHF Climate Services Working Group, to provide a common framework for coordinating existing regional mechanisms and supporting the implementation of NFCS.
   a. Conduct stakeholder engagement and achieve regional endorsement.
   b. Co-produce a regional RFCS roadmap and action plan.
   c. Co-develop a strategic and action plan for implementation that defines priority activities, implementation arrangements, institutional roles and responsibilities, financing pathways, and monitoring and evaluation mechanisms.
   d. Develop and operationalize a support package to provide practical guidance, regional expertise, and technical resources for countries initiating or strengthening National Frameworks for Climate Services (NFCS).

2. **Strengthen regional coordination and institutionalization** through existing mechanisms including SAHF, RCCs, SASCOF, CSUF, and regional technical partners.
   a. Promote stronger policy engagement and dialogue with decision-makers to increase recognition of the value of weather and climate information services (WCIS).
   b. Develop approaches for documenting and communicating the benefits and value of WCIS for policy, planning, and investment decisions.
   c. Develop institutionalization and knowledge transfer mechanisms to sustain climate services beyond project-based implementation.

3. **Transition from project-based to sustainable capacity development and financing frameworks** to align investments with the RFCS roadmap and support the long-term sustainability of regional climate services.
   a. Institutionalize sustainable regional capacity development
   b. Align climate services with broader development, adaptation, and resilience investment programmes.
   c. Strengthen engagement with development partners and financial institutions
   d. Supporting policy integration and sustainable financing.

User Interface Platforms

4. **Strengthen sustained user engagement and co-production mechanisms** to ensure that climate services are continuously informed by user needs and decision contexts.
   a. Operationalize CSUF through a structured work plan that supports continuous interaction between providers and users throughout the seasonal climate service cycle.
   b. Establish regular knowledge-sharing and feedback mechanisms among NMHSs, sectoral agencies, and regional partners.
   c. Strengthen documentation of user needs, climate service uptake, barriers to application, and evidence of climate-informed decision-making.
   d. Promote inclusive and user-centred approaches that improve accessibility and responsiveness of climate services across priority sectors.

Climate Services Information Systems

5. **Advance seamless climate services across timescales** by strengthening linkages between climate monitoring, sub-seasonal, seasonal, annual-to-decadal, and climate change information systems, to improve continuity, consistency, and decision support.

Observations and Monitoring

6. **Promote data sharing, and integration of regional data platforms/systems**, to promote technical exchange and interoperability.
   a. Harmonizee standards, metadata, and data-sharing practices across regional platforms,
   b. Assess ICT, computational, storage, networking, and digital infrastructure supporting climate services across South Asia.
   c. Identify priority infrastructure gaps and develop a phased Infrastructure Improvement Roadmap to guide future investments and modernization.

Research and Modelling

7. **Strengthen regional collaboration on climate research, modelling, prediction, and climate information generation** across multiple climate timescales.
   a. Develop a regional climate research agenda based on user needs, operational gaps, and emerging technical priorities.
   b. Strengthen access to regional and global climate datasets and promote their application for climate modelling, downscaling, and prediction.
   c. Strengthen joint learning between providers and users.

Capacity Development

8. Sustainable regional capacity development is a cross-cutting thematic area, based on the findings and recommendations of the Training Needs Assessment.

Table 11. Summary of Key Gaps and Recommendations

Thematic Area	Key Gaps	Priority Recommendations
Coordination & Governance	Fragmented institutional landscape; reliance on forum-based coordination; absence of coordinated regional framework	Build on the momentum of the SAHF Climate Services Working Group to advance the establishment of a South Asian RFCS. Strengthen coordination across existing regional mechanisms, and develop a regional roadmap and action plan that clarifies roles, responsibilities, and implementation priorities
Financing & Sustainability	Dependence on short-term project funding; limited linkage to development and adaptation finance	Promote sustained regional investment mechanisms; align climate services with adaptation finance and development planning frameworks
Climate Services Information Systems - Co-Production	Limited feedback loops; uneven institutionalization of co-production; engagement concentrated at seasonal scale	Institutionalize multi-way feedback mechanisms within SASCOF/CSUF; expand co-production across sectors and timescales; strengthen user engagement processes
Climate Services Information Systems - Cross-Timescale Integration	Fragmentation across monitoring, S2S, seasonal, and climate projections. Weak integration across timescales; absence of regional decadal synthesis.	Strengthen seamless integration across timescales - between S2S, seasonal, and longer-term services.
User Interface Platforms	Parallel data platforms with limited interoperability. Weak linkage across systems.	Improve coordination across platforms and forecasting systems. Harmonize data standards; improve interoperability across regional platforms
Observations & Data Systems	Uneven station density; limited cross-border real-time data exchange; inconsistent metadata practices	Expand observing networks; strengthen real-time data sharing (e.g., WIS 2.0); standardize data management and metadata practices
Research, Modelling & Prediction	Limited regional coordination in modelling; reliance on global centres for S2S; constrained downscaling and verification capacity	Strengthen regional collaboration in modelling; advance seamless forecasting; enhance capacity in downscaling, ensemble calibration, and verification
Capacity Development	Project-based training; limited institutional embedding / longevity; weak integration of provider and user capacity	Establish sustained regional capacity frameworks; embed competencies into institutional systems; strengthen joint NMHS to NMHS and NMHS–user training approaches

XI. APPENDICES

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ACRONYMS

AA	Anticipatory Action
ADB	Asian Development Bank
ADPC	Asian Disaster Preparedness Center
ADVISE	Agro-meteorological Advisory System
AI	Artificial Intelligence
AMD	Afghanistan Meteorological Department
BIMSTEC	Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation
BMD	Bangladesh Meteorological Department
BRAC	Bangladesh Rural Advancement Committee
C3S	Copernicus Climate Change Service
CAP	Common Alerting Protocol
CARA	Climate Action for a Resilient Asia
CARE	Climate Adaptation and Resilience for South Asia, World Bank
CariCOF	Caribbean Climate Outlook Forum
CDS	Climate Data Store, C3S
CIMH	Caribbean Institute for Meteorology and Hydrology
CLIMADA	Climate Adaptation, Switzerland
ClimSA	Climate Services and Related Applications (Programme)
COF	Climate Outlook Forum
CORDEX	Coordinated Regional Climate Downscaling Experiment
CPT	Climate Prediction Tool
CREWS	Climate Risk and Early Warning Systems, World Bank
CS	Climate Services

CS WG	Climate Services Working Group
CSIS	Climate Services Information System
CSUF	Climate Services User Forum
DataEx	Data Exchange Platform
DHM	Department Hydrology & Meteorology, Nepal
DMH	Department of Meteorology and Hydrology, Myanmar
DOM	Department of Meteorology, Sri Lanka
DoR	Department of Roads, Nepal
DRM	Disaster Risk Management
DRR	Disaster Risk Reduction
DSS	Decision Support System
EAP	Emergency Action Plan
EC	Executive Council
ENSO	El Niño–Southern Oscillation
EW4All	Early Warnings for All
EWS	Early Warning System
FCDO	Foreign, Commonwealth & Development Office, UK
FOCUS	Forecast Customization System, RIMES
GCF	Green Climate Fund
GEP	Global Extreme Platform
GESDI	Gender, Equity, Disability and Social Inclusion
GESI	Gender Equality and Social Inclusion
GFCS	Global Framework for Climate Services
GPCs	Global Producing Centers

HKH	Hindu Kush Himalaya
HPC	High-Performance Computing
IBF	Impact Based Forecasting
ICCS	International Conference on Climate Services
ICIMOD	International Centre for Integrated Mountain Development
IDP	Internally Displaced Persons
IFRC	International Federation of Red Cross and Red Crescent
IITM	Indian Institute of Tropical Meteorology
IMD	India Meteorological Department
IMDAA	Indian Monsoon Data Assimilation and Analysis reanalysis
INGO	International Non-Governmental Organisation
IOD	Indian Ocean Dipole
IPCC	Intergovernmental Panel on Climate Change
IRI	International Research Institute for Climate and Society, USA
IWMI	International Water Management Institute
KMAL	Knowledge, Management and Learning
LDC	Least Developed Countries
MEL	Monitoring, Evaluation & Learning
ML	Machine Learning
MMS	Maldives Meteorological Service
MoU	Memorandum of Understanding
NCEP	National Centers for Environmental Prediction
NCHM	National Center for Hydrology & Meteorology, Bhutan
NCMRWF	National Centre for Medium Range Weather Forecasting

NCOF	National Climate Outlook Forum
NFCS	National Framework for Climate Services
NGO	Non-Governmental Organisation
NMF	National Monsoon Forum
NMHS	National Meteorological & Hydrological Services
NWP	Numerical Weather Prediction
PICOF	Pacific Island Climate Outlook Forum
PMD	Pakistan Meteorological Department
QA	Quality Assurance
R&D	Research & Development
RA 5	Regional Association V (South-West Pacific)
RAII	Regional Association II (includes all SASCOF member countries)
RCC	Regional Climate Centre
RCCC	Red Cross/Crescent Climate Centre
RCOF	Regional Climate Outlook Forum
RDAS	Regional Resilience Data and Analytics Service, RIMES
RDS	Regional Database System
REC	Regional Economic Community
RFCS	Regional Framework for Climate Services
RIfS	Regional Information for Society, WCRP
RIMES	Regional Integrated Multi-Hazard Early Warning System
RTC	Regional Training Centre
S2S	Sub-seasonal to Seasonal
SAFOAM	South Asia Forum on Agricultural Meteorology

SAHF	South Asia Hydromet Forum
SARCI	South Asia Regional Climate Information
SASCOF	South Asian Climate Outlook Forum
SIDS	Small Island Developing States
SKHub	SAHF Knowledge Hub
SOP	Standard Operating Procedure
SSP	Shared Socioeconomic Pathway
SST	Sea-Surface Temperature
SWFP	Severe Weather Forecasting Programme
TNA	Training Needs Assessment
ToR	Terms of Reference
ToT	Training of Trainers
TP-RCC Network	Third Pole Regional Climate Centre - Network
UKMO	Met Office, UK
UNDP	United Nations Development Programme
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific
WB	World Bank
WCIS	Weather and Climate Information Services
WCRP	World Climate Research Programme
WFP	World Food Programme (UN)
WG	Working Group
WISER-AP	Weather and Climate Information Services (Asia Pacific)
WMO	World Meteorological Organization
XCAST	Open-source software for forecast analysis