

Summary REPORT

SOUTH ASIA **HYDROMET FORUM** ANNUAL SESSION 2021



GFDRR
Global Facility for Disaster Reduction and Recovery



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Foreign &
Commonwealth
Office

SOUTH ASIA HYDROMET FORUM ANNUAL SESSION 2021

SUMMARY REPORT

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All queries should be addressed to: Regional Integrated Multi-hazard Early Warning System (RIMES), AIT Campus, 58 Moo 9, Paholyothin Road, Pathumthani, Thailand -12120; e-mail: rimes@rimes.int



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ACRONYMS

ACMAD	African Centre of Meteorological Applications for Development
ADB	Asian Development Bank
AIT	Asian Institute of Technology
AMISDP	Agro-Meteorological Information Systems Development Project
ANDMA	Afghanistan National Disaster Management Authority
ARRCC	Asia Regional Resilience to a Changing Climate
AWS	Automatic Weather Station
BANCCA	Bangladesh National Center for Climate Applications
BARI	Bangladesh Agriculture Research Institute
BCWC	BIMSTEC Centre for Weather and Climate
BIMSTEC	Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation
BMD	Bangladesh Meteorological Department
BRRI	Bangladesh Rice Research Institute
BUET	Bangladesh University of Engineering and Technology
BWDB	Bangladesh Water Development Board
CAFEWS	Canadian Adaptive Flood Forecasting And Early Warning System
CARISSA	Climate Analysis for Risk Information and Services in South Asia
CC	Climate Change
CDRMP	Comprehensive Disaster Risk Management Programme
CIIC	Climate Change Impact & Integration Cell
CIS	Climate Information Service
COMET	Cooperative Programme for Operational Meteorology Education and Training
CRS	Climate Research & Services
CTO	Chief Technology Officer
DAE	Department of Agriculture Extension
DATAEX	Data Exchange Platform by RIMES
DDG	Deputy Director General
DG	Director-General
DGM	Deputy General Manager
DHM	Department of Hydrology and Meteorology
DLS	District Livestock Services
DMH	Department of Meteorology and Hydrology

DoI	Department of Irrigation, Sri Lanka
DPPC	Disaster Preparedness and Prevention Center
DRM	Disaster Risk Management
DRR	Department of Risk Reduction
DSS	Decision Support System
EC	European Commission
ECMWF	European Centre for Medium-Range Weather Forecasts
ERPAS	Extended Range Prediction For Applications To Society
ESA	European Space Agency
ESCAP	United Nations Economic and Social Commission for Asia and the Pacific
EU	European Union
EUD	Delegation Of The European Union
EUMETNET	European Meteorological Services Network
EUMETSAT	European Organization for the Exploitation of Meteorological Satellites
EWS	Early Warning Systems
FCDO	Foreign, Commonwealth & Development Office
GCF	Green Climate Fund
GDP	Gross Domestic Product
GFDRR	Global Facility for Disaster Reduction and Recovery
GFDRR	Global Facility for Disaster Reduction and Recovery
GIS	Geographic Information System
GLOF	Glacial Lake Outburst Flood
GWE	Global Weather Enterprise
IBF	Impact-based Forecasting
ICIMOD	The International Centre for Integrated Mountain Development
ICMR-NIMR	Indian Council of Medical Research–National Institute of Malaria Research
IEDCR	Institute of Epidemiology Disease Control and Research
IFAD	International Fund for Agricultural Development
IHR	International Health Regulation
IISER	Indian Institutes of Science Education and Research
IITM	Indian Institute of Tropical Meteorology
IMD	India Meteorology Department
INCOIS	Indian National Centre for Ocean Information Services
INTPA	Directorate-General for International Partnerships
IPCC	Intergovernmental Panel on Climate Change

IRAD	Integrated Research and Action for Development
IRU	India Regional Unit
ITCOcean	The International Training Centre for Operational Oceanography
IUE	The Institute of Urban Environment
IWFM	Institute of Water and Flood Management
JICA	Japan International Cooperation Agency
JMA	Japan Meteorological Agency
LGED	Local Government Engineering Department
LGS	Local Government Services
MAIL	Ministry of Agriculture, Irrigation and Livestock
MERL	Mercy Corps Nepal
MMS	Maldives Meteorological Services
MOECCT	Minister of State for Environment, Climate Change and Technology
MoES	Ministry of Earth Sciences
MOS	Model Output statistics
MoWHS	Ministry of Works & Human Settlement
MTI	Meteorological Training Institute
NARA	National Institute of Oceanography & Marine Sciences
NCAER	National Council of Applied Economic Research
NCHM	National Center for Hydrology and Meteorology
NCMRWF	National Centre for Medium Range Weather Forecasting
NDMA	National Disaster Management Authorities
NDRI	Nepal Development Research Institute
NDRRMA	National Disaster Risk Reduction And Management Authority
NGO	Non-Governmental Organization
NMHS	National Meteorological and Hydrological Services
NOAMI	National Oceanographic And Maritime Institute
NWP	Numerical Weather Prediction
OPML	Oxford Policy Management
OSDMA	Odisha State Disaster Management Authority
PMD	Pakistan Meteorological Department
QMS	Quality Management System
RCC	Regional Climate Center
RCCC	Red Cross Red Crescent Climate Centre
RIMES	Regional Integrated Multi-hazard Early Warning System

RTC	Regional Training Centre
SA	South Asia
SAHF	South Asia Hydromet Forum
SATARK	System for Assessing, Tracking and Alerting Disaster Risk Information based on Dynamic Risk Knowledge
SCIPSA	Strengthening Climate Information Partnerships South Asia
SCOPE	South Asia Consortium for data and weather Predictions
SEARO	WHO South-East Asia Regional Office
SNCCA	Sri Lanka National Center for Climate Applications
SOFF	Systematic Observations Financing Facility
SPRC	Social Protection Resource Centre
SRG	Support Relief Group
TOT	Training of Trainers
TROSA	Transboundary Rivers of South Asia
UCAR	University Corporation for Atmospheric Research
UKMO	UK Met Office
UN	United Nations
UNDP	United Nations Development Programme
UNDRR	United Nations Office for Disaster Risk Reduction
UNEP	United Nations Environment Programme
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific
UNRCO	United Nations Volunteers
USAID	U.S. Agency for International Development
USPCASW	U.S.-Pakistan Center for Advanced Studies in Water
WB	World Bank Group
WBG	World Bank Group
WCSD	Weather and Climate Services Division
WG	Working Group
WHO	World Health Organization
WMO	World Meteorological Organization

EXECUTIVE SUMMARY

With climate change (CC) and severe weather events rapidly intensifying around the globe and in the South Asia region, it is imperative for countries to evolve collaborative strategies and develop action plans to minimize adverse impacts. Although the majority of the work happens at the national and sub-national level, regional cooperation is key for prospective advancement of building guidance strategies based on international best practices. Climate services are the core of regional development in forecasting and service delivery. At the center of developing effective climate services is the ability to translate climate into actionable guidance for decision support cutting across various sectors. South Asia Hydromet Forum (SAHF) works to reinforce national activities leading to a more sustainable program of rendering state of the art meteorological and hydrological services throughout the region. SAHF aims to identify specific fit-for-purpose investments towards building technical and intellectual capacity of Nation Meteorological and Hydrological Services to respond to the main users’ needs through overall skill development of the service professionals in the region in line with global standards.

SAHF III expanded on SAHF I & II by largely focusing on service delivery, regional collaboration, and innovation, through adoption of a climate/early warning information value chain approach. SAHF III brought together a wide range of user and stakeholder institutions that connect NMHSs with the societal systems, climate sensitive sectors of the economy, academic and private institutions. SAHF III discussed challenges faced by the region to evolve and adopt collaborative regional strategies for enhanced use of observations, open data accessibility, sustainability of observation systems, ensemble predictions, impact-based forecasting (IBF) systems and user-oriented advisory & decision support services.

In order to meet the explosive growth in demand for weather and climate data products and services, SAHF III resolved to dramatically strengthen the South Asia overall extreme weather and climate services through a systematic increase in expansion of critical observing system networks and rapid exchange of observational data and forecast products by establishing a robust regional Data Exchange mechanism.

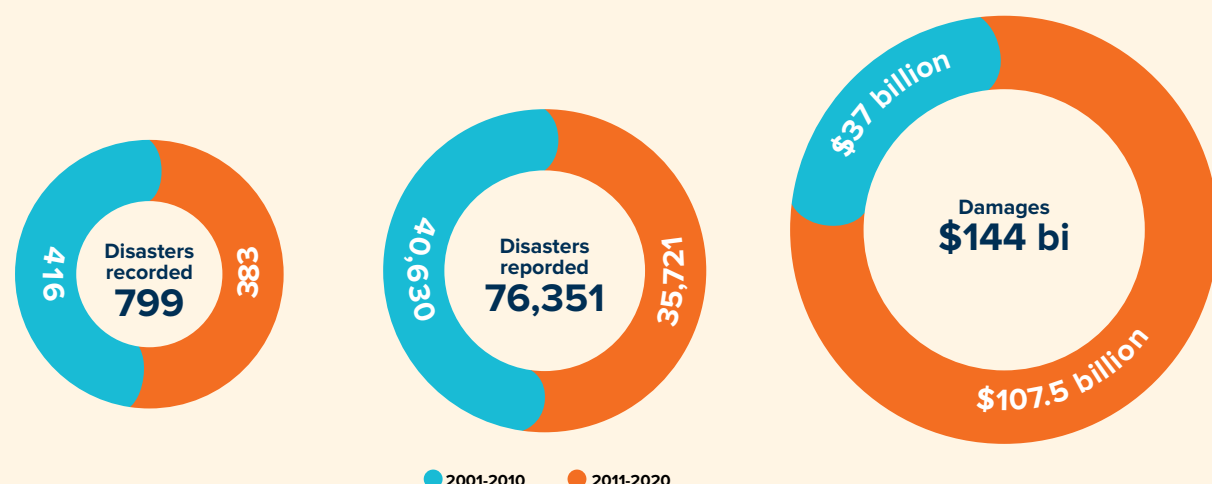
Further, SAHF III resolved to set-up a South Asia Consortium for data and weather Predictions (SCOPE), to serve as a regional collaborative mechanism that blends both cutting-edge technological advances and conventional techniques potentially enabled by SAHF regional cloud computing, storage, and networking services infrastructure with investment by pooling of resources. All efforts in this endeavor will be through leveraging significant commitment from institutions and partners of the region. SAHF III has worked out specific targets and action plans for implementation.

INTRODUCTION

Almost 600 million people—nearly one-third of South Asia’s population—have been affected by at least one climate-related disaster in the last decade. Bangladesh, India, Nepal, Pakistan, Sri Lanka and Myanmar were ranked among the top 25 countries in the 21st century in the think tank Germanwatch’s 2021 Global Climate Risk Index. One in four people in South Asia were affected by floods in the last two decades.

8 out of the world’s 20 most populous coastal cities exposed to coastal floods are in SAR, which also has 45% of the world population inhabiting high-risk, low-elevation coastal zones. Most of these are in heavily populated delta regions exposed to flood risks also from rising tides, tropical storms, sea level rise, and their coincidental combinations. SAR is home to the lowest lying country in the world—the densely populated island nation of the Maldives, which could be submerged in the not-too-distant future. Landlocked Afghanistan, Bhutan, and Nepal face rising temperatures, droughts, floods, and glacial melts.

A total of 799 weather/ climate-related disasters reported in SAR in the last two decades have thus affected 3 out of 5 people (1.22 billion), led to 76,350 deaths and damaged assets worth over US\$144 billion.



The [IPCC in its Sixth Assessment Report](#) in August 2021 noted that the South Asia weather hazard elements are worryingly intensifying. Hotter weather with longer and highly variable monsoon seasons—and cyclones, storm surge flood, drought, heat and cold waves and glacier melt events continuing to pose serious risks. Rapid economic growth, greater capital stocks, rising population and continued urbanization have increased exposure to weather element hazards in SAR, i.e., more people and assets are exposed to hazard events. The vulnerability of exposed assets in SAR is high—unplanned human settlements, unsafe building practices, and high population densities, particularly in growing urban areas, have further compounded the complex matrix of hazards, exposure, and vulnerability of the region. COVID-19 pandemic has further worsened the

risk matrix by escalating inequalities and worsening poverty. These current trends and CC projections necessitate urgent climate action.

Effective interventions need to first address the current socio-economic realities in SAR in the decade ending 2030. Despite these weather/ climate risks, rapid population growth in flood plains and coastal settlements, particularly in urban areas, is putting more people at risk to weather hazards. Reducing risks through preparedness and mitigation is paramount, as migration away from these zones, though possibly the most appropriate measure, is not easily acceptable due to low public support. Establishing/ enhancing multi-hazard early warning systems (EWS) is a more apt preparedness measure and has proved to be cost effective as international experience suggests that for every dollar invested in strengthening entire early warning information value chain services, the estimated benefits are up to US \$10. Further, by covering high-frequency, but low impact hazards, multi-hazard warning systems will be activated more often than a single-hazard warning system, and could provide cost effectiveness, functionality, and reliability for dangerous low-frequency but high-impact events. Leveraging this multi-hazard early warning infrastructure to integrate a comprehensive weather/ climate information service aimed at minimizing weather /climate risks and maximizing potential gains could enhance cost effectiveness even more, as a [National Council of Applied Economic Research \(NCAER\)](#) study reveals even one dollar invested in reaching out NMHS tailor-made services to farmers and fishers yields an estimated benefit of up to US \$ 50.

Lack of awareness of the economic value of NMHS services has led to reduced public investment in NMHSs in many countries. This has affected NMHSs in two ways: (i) Loss of accuracy in forecasting (as Russia found a loss of accuracy/ capability in its NMHSs due to reduced expenditure on infrastructure and human resources); and (ii) increased vulnerability due to lack of preparedness (as Mozambique found that the severe flooding/ cyclones in recent years cost the country half of its GDP due to lack of weather/ climate information that would have guided preparedness efforts for those floods/cyclones). There is a compelling rationale to invest in entire weather/ climate information value chain—both up-stream and down-stream, while institutionalizing a multi-stakeholder mechanism built around the centrality of the NMHSs. These investments will yield manifold benefits through adoption of a comprehensive Climate Information Service (CIS) approach to transform NMHS forecast data into tailor-made user information. CIS could guide decisions for efficient operation of climate sensitive sectors to accelerate the rate of economic growth during favorable climate/ weather situations and minimize economic losses during adverse conditions.

Establishment of impact-based forecast capabilities is the first step to establish CIS in South Asia. Impact based forecast entails multi-stakeholder engagement for co-production of user relevant services. This presents an opportunity for providers and users of climate information to exchange data and value-added services, allowing for immediate feedback and decisions made in line with user needs.

Efforts to strengthen hydromet services have a regional dimension particularly with respect to rendering impact-based forecast services delivery. The South Asia NMHS up-stream information value chain has common requirements to improve their weather forecasting systems and services utilizing ensemble prediction, IBF techniques and user-oriented advisory services. In their efforts to modernize their systems for provision of user-oriented hydro-meteorological climate services, most countries face similar technical, capacity, resource, and other challenges. There is a growing understanding of the potential for regional collaboration to address these constraints in operationalizing technologically complex systems and strengthening capacities to enhance the service delivery component of the value chain. Regional cooperation is also critical for countries to keep up with rapid advances in technology as well as data science and progress towards IBF. This would transform data into information through tailored services for a wide range of users through fostering collaboration with weather-sensitive sector user institutions, academic and research systems across countries.

The [First South Asia Hydromet Forum](#) (SAHF) organized in Geneva in September 2018 by the WB in collaboration with World Meteorological Organization (WMO) recognized the need to strengthen the regional approach to address common needs. The countries in South Asia expressed a commitment for regional collaboration through SAHF.

The [Second South Asia Hydromet Forum](#) (SAHF II) was held in Kathmandu, Nepal in November 2019, where the heads of NMHSs of eight South Asia countries and Myanmar agreed to move forward with the development and roll-out of a regional approach for operational cooperation. Further, it was agreed that RIMES should support the WB in administering the SAHF delivery of priority activities for regional capacity building, dialogue, engagement, and knowledge sharing under the WB’s Regional Program on hydromet, early warning and climate services and the SAHF. The WB designed the “SAHF South Asia Regional Development in Operational Forecasting and Service Delivery” program in December 2020 to address technical, institutional, and capacity gaps in SAR and tasked RIMES to implement it.

Building on national efforts in the region, the WB supported by the Global Facility for Disaster Reduction and Recovery (GFDRR) through the European Union financed EU-South Asia Capacity Building for Disaster Risk Management (DRM) program, along with WMO and other development partners, has been proactively investing in hydromet modernization efforts in the region to address CC impacts and enhance overall resilience. The WB’s program takes a bottom-up approach with national level investments and engagement in the countries of the South Asia Region.

SOUTH ASIA HYDROMET FORUM III

SAHF III expanded on the SAHF I & II focus areas of service delivery, regional collaboration, and innovation, through adoption of a climate/ early warning information value chain approach. Priorities of SAHF are to iteratively strengthen key elements of the hydromet services value chain by bringing together a wide range of public, academic and private institutions, with capacity enhancement (CE) aligned to these requirements by adopting a demand and context driven approach that leverages regional actions while addressing differential needs of NMHSs of SAHF countries.

Partnerships

The Forum was organized with the continued support and collaboration of SAHF partners – NMHSs of the SAHF countries, Foreign Commonwealth and Development Office (FCDO), the European Union (EU), WMO and the Global Facility for Disaster Reduction and Recovery (GFDRR).

SAHF III brought together representatives from government development institutions and private sectors working on the supply and demand side of weather and climate services, that comprise essential elements of sustainable development:

- NMHSs & national governmental departments representing key user sectors
- Academic institutions and professional associations
- User communities and private sector representatives—part of the Global Weather Enterprise
- International and regional agencies and development partners

Annex 4 lists all key partners who made the Forum possible.

Objectives

The SAHF III aimed to:

1. Showcase regional best practices and approaches in the hydromet and climate services value chain;
2. Deepen and strengthen SAHF program and weather, water, and climate services at the national and regional levels;
3. Share knowledge about innovations and the socio-economic benefits of the value chain for hydromet and climate services as countries invest in new technology over the next decade; and
4. Discuss and agree on the design of future SAHF activities.



The vision is “South Asia weather, climate and water-related information and advisory services for all through regional collaboration”. An important aspect of the forum was “learning from each other” which involves developing solutions for the meteorological and hydrological service delivery challenges that are unique to the region. The Forum highlighted the best practices in SAR and beyond and emerging innovative initiatives such as the [Global Weather Enterprise \(GWE\)](#), [Asia Regional Resilience to a Changing Climate \(ARRCC\)](#) with the participation of regional agencies. Participants noted that SAHF is helping in minimizing and closing gaps between NMHSs in the region. SAHF countries highlighted that the forum is useful to share experiences and learn about new features and data platforms from developed countries.

Structure and Sessions

The SAHF III was organized over four days from 15 to 18 November 2021 as a cluster of online meetings that saw registration of over 300 participants from 19 countries in the region and beyond. The conference was also live streamed on [YouTube](#) and the WB’s [events page](#) and [SAHF-III website](#) enabling a large audience to participate.

SAHF III had six sessions covering the entire hydromet information value chain, bookended by well-attended high-level opening and closing sessions. Each session was structured around an introductory presentation to set the tone, followed by interventions by experts and speakers, interactive panel discussions and Q&A sessions. All the presentations and recordings are available on the event website. Each of the sessions are summarized in the following sections.

Please see the forum agenda in Annex 5 briefly summed below:

- Day 1 opened the forum with participation of high-level dignitaries.
- Day 2 concentrated on information needs of users, the mechanisms to generate impact-based forecasts and how forecasting can be improved in the region.

- Day 3 focused on observational networks and data that are critical for forecasting and capacity development priorities.
- Day 4 stressed the importance of regional collaboration for improved weather and climate services and laid the way forward for the SAHF.

Outcomes

SAHF participants unanimously acknowledged SAHF as a vital & ongoing process in the South Asia region that would remain relevant in the future as well so as to strengthen and support the hydromet service delivery capacities of SAHF countries.

The forum agreed that:

1. **The changing landscape of real time observing system networks and forecast data acquisition** for monitoring, detection, and early warning of multi-hazards requires efforts to enhance actionable weather and climate services to protect lives & yield economic benefits.
2. **Collaborative efforts and resources are necessary** to tailor forecasts for key user sectors as per country’s needs by generating a suite of useful indices to assist forecasters as well as for value addition towards sectoral applications. Enhancing observing systems—both terrestrial and upper air—in critical gap areas such as mountainous regions and oceans along with innovative mechanisms for their establishment and operation is a key need along with public-private sector engagement centered around NMHSs.

The Forum agreed on several tangible priorities to be undertaken in a time-bound manner as part of an Action Plan with measurable targets. The key outcomes of the Forum are listed below:

Driving the early-warning information value-chain with impact-based Forecasts:

- Pool collaborative efforts and resources to post-process and tailor forecasts for different sectors and country requirements
- Generate a range of useful indices that both assist forecasters as well as add value to users’ situations within sectors
- **IBFs offer opportunities for an integrative approach** towards better delivery of hydromet services. Such context oriented forecast information would lead to suitable decision support tools co-developed with sector/ line departments such as agriculture, water resources and fisheries, public health which would benefit them.
- All SAHF countries would establish an institutional framework to connect NMHS and sector institutions for co-production of IBF services integrating geospatial and socio-economic data with real-time weather data and its exchange for improved IBF , development of Decision Support Systems (DSSs) for risk informed development.

Improving weather and climate forecasts

- To synergize efforts and to leverage global and regional strengths, **set up a South Asia Consortium for data and weather Predictions (SCOPE), a regional collaborative mechanism** blending both cutting-edge technological advances and conventional techniques potentially enabled by SAHF regional cloud computing, storage, and networking services infrastructure with investment by pooling of resources. All efforts in this endeavor would leverage significant commitment from institutions and partners collaborating with countries in the region. SCOPE would focus on post-processing data blending conventional MOS techniques, ensemble probabilistic forecasts, high-resolution regional domains for specific country clusters within the region and modern approaches like AI/ML to exploit all the forecast data and observational data to bring best science approaches for the generation of relevant forecast products and derived indices tailored to a range of users.
- Focus on forecasting weather and climate extremes –tropical cyclones, severe thunderstorms & lightning, heavy rainfall events and heatwaves
- Prioritize specific national requirements that are also common to sub-regions like marine & coastal services focusing on coastal hazards, shoreline management, mountain meteorology and similar requirements
- Create knowledge repositories to support high-quality operational weather and climate forecasts

Observational Networks (OBN):

- Improve observations in critical gap areas such as mountainous areas, upper-air networks and oceans along with innovative mechanisms to establish and maintain OBN.
- **Establish a robust Regional Data Exchange mechanism for rapid exchange of observational data and forecast products and significantly strengthen South Asia’s** overall extreme weather and climate services through a systematic increase in expansion of critical observing system networks.
- Setup mechanism to lead to utilization of the additional data in forecasting systems, post-processing, and above-all value-addition for better hydromet services.
- Enhance assimilation, leading to improved high-resolution forecasts and also better verification, evaluation, and downscaling.

Capacity Enhancement :

- **Capacity development is the backbone for improved services, and SAHF III sought to design and implement a capacity development calendar across all components of the information value-chain.**

Agreed Action Plan & Targets

The forum identified and agreed on several tangible priorities to be undertaken in a time-bound manner as a part of an action plan with measurable targets. The table below outlines the priorities and action plans that were agreed upon. Feasibility, resources required, and a phased approach will be initiated to implement the agreed action plans within the current phase of the SAHF project and beyond.

Priority	Targets	Time Frame	Considerations for implementation
1. Enhance observations & integration into forecasting	1.1 NHMS-ECMWF and RIMES -Data Exchange Platform to be scaled up.	6- 9 months	Mechanism of feedback for improving medium range skill (3–5-day lead) of extreme weather prediction will be established using country level data for performance evaluation.
	1.2 Real-time data exchanged within the region: 15% improvement		RIMES data exchange platform is already operational. Countries will be pursued to meet the targets.
	1.3 Historical observation data: 20% improvement.		Historical data of extreme events for past 5-years will be used - to evaluate global severe weather forecasts - show value of additional data improving past country level severe weather predictions
2. Address user needs through tailor-made products leveraging collective strengths	2.1 Forecast Accuracy: 10% improvement.		By using real time data from countries for continuous assimilation at 3Km grid scale for SAHF countries NWP needs
	2.2 Establish SAHF Regional Cloud computing, storage, and networking services infrastructure with investment by pooling of resources Through scaling up existing DATAEX Platform to acquire, host and share new and additional global and regional digital ensemble prediction products		Under SAHF implementation knowledge platform will be operational within 1 year. This can be further enhanced based on a feasibility study to implement 2.2
3. IBF- An integrating approach for better service delivery	3.1 National institutional mechanisms involving User Sector institutions established on lines of BANCCA (Bangladesh), IRU (India) & SNCCA (Sri Lanka) for co-production of Services in all other 6 SAHF countries	1 Year	Initial steps to be taken to interface with relevant sectoral partners. Other follow up activities to be pursued beyond the current SAHF implementation
	3.2 National institutional mechanisms involving User Sector institutions established on lines of BANCCA (Bangladesh), IRU (India) & SNCCA (Sri Lanka) for co-production of Services in all other 6 SAHF countries	2 Years	Initial steps to be taken to interface with relevant sectoral partners. Other follow up activities to be pursued beyond the current SAHF implementation
4. Capacity development is the backbone	4.1 At least 30% of the NMHS operational staff trained	2-3 Years	All necessary efforts to be taken in working group activities and continue beyond current SAHF implementation
	4.2 At least 20% Staff of user sector institutions trained	2-3 Years	All necessary efforts to be taken in working group activities and continue beyond current SAHF implementation

The following sections of the report summaries the sessions held at the SAHF III

OPENING SESSION

Key Messages:

1. SAHF is uniquely designed and positioned to capacitate country-owned mechanisms and address their hydromet service delivery needs, leveraging regional technical capacities
2. Regional cooperation is critical to keep up with the pace in data forecasting and technology development, while maximizing the effectiveness of investments.
3. Enhanced collaboration of NMHSs with beneficiaries is key to addressing the increasing impacts of climate hazards in SAHF countries

Chair:

Dr. M. Ravichandran, Secretary, Ministry of Earth Sciences, Government of India and Chair RIMES Council

Speakers:

- Dr. Mrutyunjay Mohapatra, Director General of Meteorology, India Meteorological Department and Chair, SAHF EC
- Ms. Cecile Fruman, Regional Director, World Bank
- Mr. Ben Churchill, Head, Regional Office for Asia, and the South-West Pacific, WMO—on behalf of Secretary General, WMO
- Mr. Kamal Kishore, Member Secretary, National Disaster Management Authority, Government of India
- H.E. Dr. Abdulla Naseer, Minister of State for Environment, CC and Technology of the Government of Republic of Maldives
- Mr. A.R. Subbiah, Director, RIMES

Opening Session

Date: 15 November 2021

SESSION CHAIR



Dr. M. Ravichandran

Secretary, Ministry of Earth Sciences and
Chair RIMES Council

SPEAKERS



Mr. Karma Dupchu

Co-Chair, Executive
Council, SAHF &
Director, NCHM,
Bhutan



Ms. Cecile Fruman

Regional Director,
World Bank



Mr. Ben Churchill

Head, Regional
Office for Asia and
the South-West
Pacific, WMO



Mr. Kamal Kishore

Member
Secretary,
National Disaster
Management
Authority,
Government of
India



**H.E. Dr. Abdulla
Naseer**

Minister of State,
Ministry for
Environment,
Climate Change
and Technology,
Republic of
Maldives



Mr. A. R. Subbiah

Director, RIMES

Adverse weather and climate impact greatly the poor and vulnerable communities and threaten resilience of societies and nations. Regional investments for modernization of weather and climate services are crucial in building climate resilient economies and safeguarding sustainable development in SAHF countries.

Chairing the opening session, Dr. M. Ravichandran, Secretary, Ministry of Earth Sciences, India, and Chair RIMES Council noted—*“Regional cooperation is critical for countries to keep pace with rapid advances in technology and data science, and progress towards impact-based forecast service delivery”*. Dr. Mrutyunjay Mohapatra, Chair of the SAHF Executive Council and Director General, India Meteorological Department in his remarks said—*“Weather and climate services are even more critical now in face of CC, but gaps in the observational system and high-resolution weather data pose a significant challenge in hydromet service delivery threatening resilience and sustainability of development. In the regional context, SAHF countries are yet to accomplish the objective of providing high-quality weather and climate services to risk-inform development decisions”*

Other speakers opined that precisely in this context, SAHF is designed with participation of all South Asian countries and Myanmar to identify their hydromet needs and address their varying requirements in accordance with their capacities, strengths and needs. Extreme weather events will result in impacts across the South Asia region as long as challenges and gaps in delivering climate and weather information to user groups persist. Several countries are in the process of modernizing their hydromet services but addressing these gaps is not a simple task: it requires involvement of all stakeholders –from research communities to NMHSs and local

communities. Resource constraints are often common among countries, and thus regional collaboration can lead to resource effectiveness and optimization in addressing several of these gaps.

SAHF is designed to evolve and implement programs to enhance forecasting and service delivery, wherein regional technical partners such as RIMES strengthen and facilitate the collaboration and bring in necessary support of global and regional centers and build upon rapidly advancing technologies and services.

Societies need enhanced and modernized weather and climate services to be climate resilient. The WB is committed in expanding its support to broaden hydromet and flood forecasting services. Ms. Cecile Fruman, Regional Director, WB noted—*Hydromet services make critical contributions to weather dependent economic sectors, so hydromet services investments not only contribute directly to the resilience of communities but have a very high return on investment (for every US \$ spent, return can be as high as 13 US\$)*”.

Mr. Kamal Kishore, Member Secretary, National Disaster Management Authority, India said—*“Increasing impacts of hydromet hazards underlines the fact that South Asian countries are not making sufficient progress: e.g., reducing the impact of lightning strikes, urban floods. EWS and public awareness mechanisms need to be strengthened through a collaborative approach regionally and specifically among NHMSs”*. SAHF working groups have recognized this huge demand for useable information from the users and stakeholders and deliberations are focused on identifying pragmatic actions to address these demands.

The [WMO Strategic Plan 2020-2023](#) would guide WMO activities to address the increased demand for weather and climate services globally. Speaking on behalf of the WMO Secretary General, Dr. Petteri Taalas, Mr. Ben Churchill, Head, WMO Regional Office for Asia and Southwest Pacific said, *“WMO is working closely with the region and anticipates that all nations will be more resilient to weather and climate shocks by 2030. Through Systematic Observations Financing Facility (SOFF) and other initiatives, WMO will continue cooperation with SAHF from collecting and sharing of data, to generating user relevant information all the way to issuing warnings to the last mile. Cooperation and collaboration are key to address the challenges posed by CC.”*

Dr. Abdulla Naseer, Minister of State for Environment, CC and Technology, Maldives opined that the advances in forecasting can help tackle the growing demand for hydromet data and services to protect the life and livelihood of people living in South Asia. He said – *“SAHF will ensure CE of NMHSs in SAHF member countries through collaborative & sustainable approach to address emerging demands of all stakeholders by improving weather, climate & hydromet services.”*

SAHF is designed to support the evolution and modernization of hydromet services through cooperation and collaborative approaches. The SAHF will also support the dissemination and adoption of innovative technologies, which is key to enhancing the resilience of communities. SAHF will provide a platform to foster collaboration among South Asian countries on training and capacity building in key sectors related to hydromet while strengthening linkages and collaboration among nations in a seamless manner. Mr. A.R.Subbiah, Director, RIMES said *“SAHF agenda is based on the climate information value chain where users will determine the information that they require. The process will be completely user-driven and need-based.”*

SESSION 1: WHAT USERS NEED?

USER-FOCUSED TAILOR-MADE WEATHER AND CLIMATE SERVICES DRIVING THE CLIMATE/EARLY WARNING INFORMATION VALUE CHAIN

Key Messages:

1. Forecast based action ensures early response in protecting lives, livelihoods, and assets from disasters through preparedness.
2. There is a gap in hydromet information being provided which is not fully meeting the user needs.
3. Regular dialogues between users and providers as well as community outreach is at the core of forecast based action.
4. South Asia has countries of varying capacity, while facing common challenges, therefore, thinking and acting without regional coordination pose a risk to investment effectiveness.
5. Research and development have to be rapidly operationalized to provide practical outputs to benefit people –livelihoods, lives –economic activities.

Chairs:

- Mr. Fazlur Rashid, Director General, Bangladesh Water Development Board
- Dr. David Rogers, Lead Meteorological Consultant, World Bank

Presenter:

- Mr. Raihanul Haque, Country Lead, RIMES, Bangladesh

Panelists:

- Ms. Sumaiya Kabir, Consortium Coordinator, [Supporting Flood Forecast-based Action and Learning in Bangladesh \(SUFAL\)](#), CARE, Bangladesh
- Dr. Parvinder Maini, Scientist G, Ministry of Earth Sciences, Government of India
- Ms. Arati Belle, DRM Specialist, World Bank
- Prof. Sonia Quiroga, Professor, Complutense University of Madrid
- Ms. Ruby Rose, Team Leader, Institutional Development, RIMES

Session 1		What Users need? Customized weather and climate services that yield value to economies and communities	
Day 1: 16 November 2021			
SESSION CO-CHAIRS		PRESENTER	
			
Mr. Fazlur Rashid Director General, Bangladesh Water Development Board	Dr. David Rogers Lead Meteorological Consultant, World Bank	Mr. Raihanul Haque Country Lead, RIMES, Bangladesh	
PANEL DISCUSSION			
MODERATOR		PANELISTS	
			
Dr. David Rogers Lead Meteorological Consultant, World Bank	Ms. Sumaiya Kabir Consortium Coordinator - Scaling-up Forecast-based Action and Learning (SUFAL), CARE Bangladesh	Ms. Arati Belle, Senior Disaster Risk Management Specialist	Dr. Sonia Quiroga World Bank
			
		Dr. Parvinder Maini Scientist G, Ministry of Earth Sciences, Government of India	Ms. Ruby Rose Team Leader, Institutional Development, RIMES

The gaps between information being sought by the users and the hydromet information generated by NMHSs needs to be bridged through regular dialogue between providers and users and community outreach. IBF efforts will strength forecast based actions enabling at-risk communities to protect lives and assets.

The session showcased innovative, proven best practices from Bangladesh that are designed around user-needs and demands in the climate/ early warning information value chain and thereby provide an economic rationale

for investing in NMHS that deliver these services. Climate and weather impact positively or negatively all walks of life. Socio-economic activities are impacted varyingly depending on their climate sensitivity-exposure and vulnerability. This in turn affects the population dependent on these activities. Tailor made climate/ weather information that could facilitate users to undertake anticipatory Forecast-based Actions (FbAs) for effective risk reduction and resources management measures were discussed.

Some of the key lessons were that scenario-based triggers worked well to enable forecast-based action that minimized risk and helped communities save productive assets, contributing to their long-term resilience. Through anticipatory actions undertaken prior to the disaster, FbA was able to help at risk communities to reduce flood impacts–90% of early warning recipients acted upon it and 3 out of 5 households were able to take actions a few days prior to the event and each of these households saved an average of 200 \$ as a direct consequence of the FbA that was a result of improved hydromet services. Coordination and regular dialogues were key as was two-way engagement in operationalizing and implementing FbA.

The session also highlighted the common needs for hydromet services and advisories among the South Asian countries, wherein the key is understanding how much to invest and where. This was done through a deep dive conducted by the WB in Sri Lanka and Bangladesh where modernization plans were developed by considering improvements at a) agency level, b) national and c) regional level, yielding manifold benefits, which are enhanced through regional cooperation and engagement with private sector. Ms. Arati Belle, Senior DRM Specialist, WB said–“*Realizing the potential benefits of investing in and enabling transformative hydromet services through national and regional partnerships will lead to more optimized modernization scenarios for each country and the region as a whole.*”



Enhancing Data Availability	Modeling and Forecasting	Transforming Data into Usable Information	Capacity Building, Community Outreach and Feedback	Research and Development
<ul style="list-style-type: none">• Sustained and adequate investments• Common, accessible digital platform for integration of quality-check data• Focused investment for improving forecasts can generate more investments for data availability	<ul style="list-style-type: none">• Regional vs national modelling systems• Deterministic vs probabilistic forecasts• Forecast spatial and temporal scales: utility and reliability• Use of advnaced computational algorithms (AI) for improving forecast• Continuous advanced research	<ul style="list-style-type: none">• Sustained integraion of evolving user requirements into NMHSs products• Sectoral decision support systems (DSSs) for generating customized multi-timescales climate informed products	<ul style="list-style-type: none">• Sustained invest-ments on capacity building from national to communi-ty levels• Robust feedback mechanism• Sustained campacity building for enabling enhanced in-country capacities over time	<ul style="list-style-type: none">• Data accessibility, coherence and integrity• Domain-specific knowledge• Integrated platforms• Research to operation• Additional data collection–Internet of things• Analytical Services

Case studies from India elaborated on how an investment of approximately 10 billion INR in 2010 resulted in an economic benefit of 504 billion INR over a 5-year period (2015-2020), across the information value chain. There is a huge opportunity for sectoral DSSs to contribute to the development of tailored/ user-specific climate information for users to respond to climate hazards. Policies need to be available and conducive to derive such national economic benefits from hydromet information.



SESSION 2: MAKING SENSE OF FORECASTS!

EVOLVING PROTOCOLS AND SUPPORT SYSTEMS FOR IBF

Key Messages:

1. Forecasts, EWS and alerts will need to be integrated seamlessly and need to be bought-in by authorities to result in behavioral changes and individual/ community level actions.
2. Access to fine resolution forecasts is of utmost importance since they are needed by sectors for transformation into useful advisories at sub-national and sub-provincial and local levels.
3. To ensure operational integration of hydromet information within development sectors there is a necessity to bring together all stakeholders in a co-production model.

Chairs:

Mr. Anil Pokhrel, Chief Executive, National Disaster Risk Reduction and Management Authority, Nepal

Presenters:

- Mr. Md. Azizur Rahman, Director, Bangladesh Meteorological Department
- Dr. B N Mishra, GIS Expert, Odisha State Disaster Management Authority, India
- Ms. Catrina Johnson, Science Manager and Weather Analytics, UKMO

Panelists:

- Dr. Azmat Hayat Khan, Head-CIIC, Pakistan Meteorological Department
- Dr. Reuben Samuel, Programme Area Manager–Country Preparedness & IHR, World Health Organization (WHO)/SEARO
- Dr. Punyawardena, Director, Department of Agriculture, Sri Lanka

Session 2
Day 1: 16 November 2021
Making sense of Forecasts! Evolving protocols and support systems for impact-based forecasting
SESSION CHAIR



Mr. Anil Pokhrel
Chief Executive,
NDMA, Nepal

PRESENTERS			PANEL DISCUSSION		
PRESENTERS			PANELIST		
Mr. Md. Azizur Rahman Director, BMD Bangladesh	Mr. Arabinda Ray Odisha State Disaster Management Authority, Odisha	Ms. Catrina Johnson Science Manager and Weather Analytics, UK Met Office	Dr. Azmat Hayat Khan Head-CIIC, PMD, Pakistan	Dr. Reuben Samuel Programme Area Manager- Country Preparedness & IHR, WHO/SEARO	Dr. B.V.R Punyawardena Director, Department of Agriculture, Sri Lanka

The session highlighted evolving institutional and technological innovations to address SAHF priorities, by drawing from ongoing IBF program implementation experiences in the South Asia region, where forecasters and users co-design integrated and tailor-made services bringing forecast data into decision making through DSSs.

The session shared design of Bangladesh National Center for Climate Applications (BANCCA) established by BMD, with support from RIMES. BANCCA links with all climate-sensitive sectors by providing comprehensive impact-based weather forecasts through capacity building and DSS co-developed with sectoral agencies.



It also focused upon the System for Assessing, Tracking, Alerting based on dynamic Risk Knowledge (SATARK)– a DSS for impact-based forecast, operationalized by the Odisha State Disaster Management Authority (OSDMA) in Odisha State for early action before disasters, mobilization of resources and financing for affected communities.

The session discussed Asia Regional Resilience to a Changing Climate (ARRCC) as an innovative approach for strengthening end-to-end climate service delivery, incorporating feedback mechanisms to ensure that IBF can be improved over time, to enable anticipatory actions by relevant authorities and local communities.

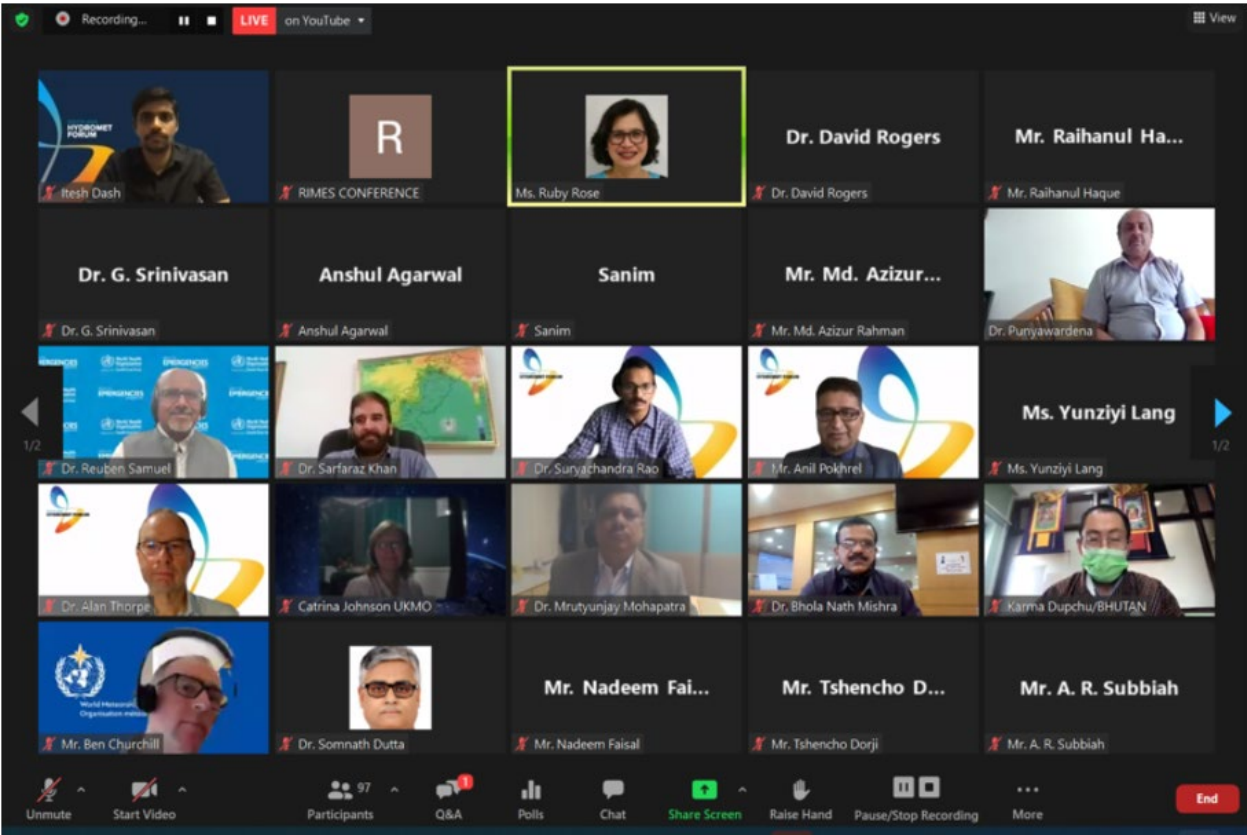


A highly interactive panel discussed sectoral user perspectives for integrating weather and climate information into sectoral decision-making. WHO shared how an Integrated DSS can be used to monitor disease trends, to identify emerging health problems and implement actions to mitigate their effects. “Traditionally, information

was collected directly on the ground (e.g., hospital, health centers, etc.), now we can leverage new technologies to collect information on potential disease spread (e.g., use of search engines, social media trawlers) to collect information on the frequency of certain disease”, said Dr. Ruben Samuel of WHO/ South-East Asia Regional Office. He also highlighted how weather forecasts and other climatic forecasts can be used to either prevent or mitigate public health impacts.

Feedback mechanisms adopted by Sri Lanka to enhance resilience in the agriculture sector focused on access to information, timeliness of the delivery, acceptance by farmers, usage of the agromet advisory and effectiveness of the advisories. It resulted in a paradigm shift in the institutional context: a separate Advisory Cell, comprised of Directors from various departments to ensure co-production and customization of the agromet advisory.

The panel discussion highlighted hydromet service delivery constraints due to lack of river discharge and bathymetry data in Pakistan. One of the main challenges in the South Asia region is high resolution forecasts, for which regional collaboration can be beneficial. Weather experts are working closely with health researchers to identify ways to utilize lead time for early interventions to reduce morbidity and mortality as well as reduce the effects of these health consequences on people, communities, and systems.



SESSION 3: CATCHING UP TO THE SCIENCE!

IMPROVING WEATHER AND CLIMATE FORECASTS FOR THE REGION

Key Messages:

- 1. Regional mechanisms to be leveraged to address critical observation gaps to maximize advantages for improving forecast skill and to improve sector level customization.
- 2. Collaboration for sustaining observation systems is important particularly for ocean observation systems, aviation, and the Himalayan region.
- 3. Capacity building is critical for sustaining and upgrading the observational networks to keep pace with technology.
- 4. Every country does not have sufficient resources - finance, skilled manpower, computational power to cater to NWP requirements. For this reason, NWP consortium is a very important element of the regional approach.

Chairs:

- Mr. Karma Dupchu, Director, National Center for Hydrology and Meteorology, Bhutan
- Mr. Ben Churchill, Head, Regional Office for Asia, and the South-West Pacific, WMO

Presenters:

- Dr. Shiromani Jayawardane, Director, Weather Forecasting and Decision Support, Department of Meteorology, Sri Lanka
- Dr. Alan Thorpe, Visiting Professor, University of Reading & Former DG ECMWF

Panelists:

- Dr. Suryachandra Rao, Indian Institute of Tropical Meteorology (IITM)
- Dr. T. Srinivas Kumar, Director, Indian National Center for Ocean Information Services (INCOIS)
- Mr. Ahmed Rasheed, Director, Meteorology, Maldives Meteorological Services (MMS)
- Dr. Singay Dorji, Chief Meteorologist, National Center for Hydrology and Meteorology (NCHM), Bhutan
- Dr. Jehangir Ashraf Awan, Pakistan Meteorological Department (PMD)

Session 3

Day 1: 16 November 2021

Catching up to the Science - Improving weather and climate forecasts in the region

SESSION CO-CHAIRS



Mr. Karma Dupchu

Director, National Center for Hydrology and Meteorology, Bhutan



Mr. Ben Churchill

Head, Regional Office for Asia and the South-West Pacific, WMO

PRESENTERS

PANEL DISCUSSION MODERATED BY MR. BEN CHURCHILL

PRESENTERS

PANELISTS



Dr. Shiromani Jayawardane

Director, Weather Forecasting and Decision Support, Department of Meteorology, Sri Lanka



Dr. Alan Thorpe, Visiting

Professor, University of Reading & Former DG ECMWF



Dr. Suryachandra Rao Indian

Institute of Tropical Meteorology, Pune



Dr. T. Srinivas Kumar

Director, Indian National Center for Ocean Information Services



Mr. Ahmed Rasheed

Director, Meteorology, Maldives Meteorological Services



Dr. Singay Dorji

Chief Meteorologist, NCHM, Bhutan



Dr. Jehangir Ashraf Awan

Pakistan Meteorological Department

South Asia region needs to seize opportunities to make full use of global resources and regional collaboration for strategic investments and plans over the next decade. Such actions will enable NMHSs to meet stakeholder expectations to deliver improved and actionable hydromet services.




The session featured the [Global Weather Enterprise \(GWE\)](#) representing public, private, and academic entities. Minimizing the impact of extremes at local levels increasingly require weather and climate service providers to make more effective use of global and regional forecasts and observational resources. High quality weather and hydrological forecasts from hours to weeks and potentially months ahead are made possible by an enterprise that includes scientific research, observations, numerical models, high-end computing to integrate the models and observations.

The main challenges include a) seamless prediction from short range to sub-seasonal and seasonal forecasts and high-resolution NWP products; b) institutional and technical gaps which persist, such as the lack of sector specific DSS. These gaps are common across South Asia. In addition, there are similar requirements in terms of weather and climate information. As such, collaborative research at a regional level can be extremely

effective. Existing regional mechanisms can be effectively leveraged to support South Asian countries in addressing these gaps.

Within the value chain of the weather enterprise (organizations from public, private, and academic sectors that contribute to the research, development, and production of weather forecast products), science and technology drives many of the innovations in the sector leading to social and economic benefits for the society. However, within the different pieces of the value chain, there are often weaknesses that hamper an effective deployment of the value chain itself. Integrated services combine information from multiple sources. For example, Hydromet information is merged with additional data layers, such as energy distribution and generation, where the rescue workers are and how they can be deployed in the most fragile area. Requirements for future enhancement of the services include national capacity and capability to access and use digital hydromet data; enhanced collaboration across sectors and private sectors at a national and international level; finally, enhanced integration across national institutions.



“OCEANS RESPECT NO BOUNDARIES. Ocean observation systems are still in nascent phase in South Asia region. We need to:

- 1. continue to improve ocean observation and EWS through regional collaboration;**
- 2. ensure capacity development for coastal nations on all aspects of ocean monitoring and forecasting.”**

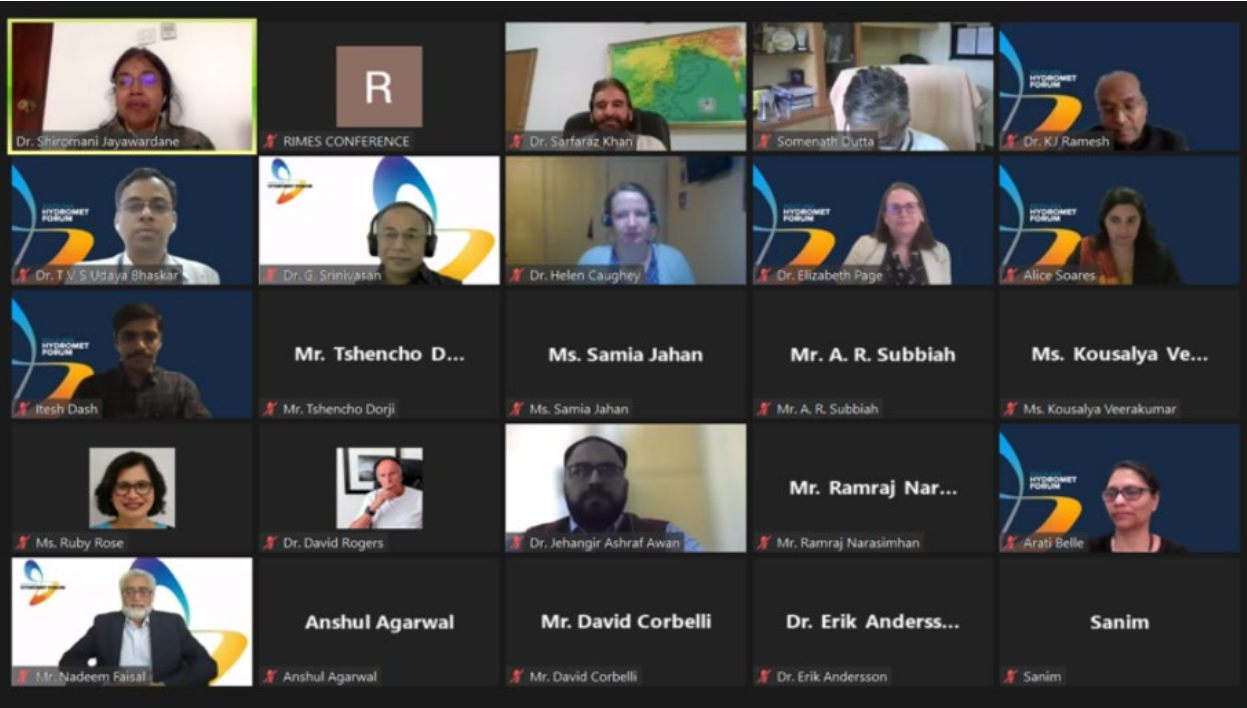
DR. T. SRINIVAS KUMAR
DIRECTOR, INDIAN NATIONAL CENTER FOR OCEAN INFORMATION SERVICES

The panel discussions focused on advances in research and development for improving operational weather forecasts in the South Asia region encompassing Monsoon Mission, Marine/ Coastal Weather & Climate Forecast, Marine/ Coastal Services, Mountain Meteorology and Regional NWP requirements. The Monsoon Mission program is being implemented by India since 2012 to improve prediction of monsoon weather and climate through continuous research and to enhance both accuracy and lead time of information being provided to different sectors (e.g., agriculture, etc.). Challenges remain, such as high-resolution prediction of extremes, extended range forecasts and long-range forecasting using artificial intelligence and machine learning, which could be addressed through regional collaboration.

Regional collaboration is key in marine weather and climate services provision. It is also crucial to further strengthen marine observation systems and EWS. Though countries in South Asia are moving ahead on IBF and high-resolution numerical weather prediction (NWP) models, regional collaboration can further enhance effectiveness and cost/benefit for each country. National investments, in addition to meeting national requirements, need to also align with an optimal regional design of observational networks catered towards enhancing

prediction systems that cover the SAHF domain. Data from across the region is crucial for model verification so that regional investments to strengthen and maintain weather observation network is a beneficial strategy, as compared to an exclusively nationally centered approach while modernizing observational systems.

The discussion highlighted the challenges faced by NMHSs in the region. For example, extreme events in Bhutan have caused extensive damage, spurring NMHS efforts for prevention of damages or at least a reduction in the losses occurred, especially as CC poses additional threats, such as GLOF and flash floods. Despite technological advances resulting in higher resolution NWP models, in complex mountainous terrain such as that of northern Pakistan, weather forecasts are not accurate enough and pose a major challenge for PMD. While observation networks are improving, very often data acquisition and sharing is not shared regionally. EWS are one of the most relevant adaptation measures, hence enhancement of the public weather services and regional partnerships are the way forward. A consortium of NWP in the region was proposed to move forward on this together.



SESSION 4: SKILLING UP SAR HYDROMET

PRIORITIZING TRAINING AND CAPACITY DEVELOPMENT REQUIREMENTS

Key Messages:

1.

Emphasis on training young meteorologists, which is a key barrier in building sustained technical capacities.

2.

Training should be conducted in a virtuous cycle including training needs assessment, design, organization, and evaluation. Assessment and evaluation are important to understand the demand and the usefulness of the product.

3.

The need for Impact data that must be blended with the forecast data is very important and needs to be collected from the relevant sectors. There are not many available modules for this type of training program which needs to be developed and implemented.

Chair:

Dr. Shiromani Jayawardane, Director, Weather Forecasting and Decision Support, Department of Meteorology, Sri Lanka

Presenters:

- Dr. G. Srinivasan, Chief Scientist, RIMES
- Dr. K. J. Ramesh, Advisor, RIMES

Panelists:

- Dr. Elizabeth Page, University Corporation for Atmospheric Research (UCAR)
- Dr. Somnath Dutta, India Meteorological Department
- Dr. Sardar Sarfaraz, Pakistan Meteorological Department
- Dr. Helen Caughey, UKMO
- Dr. T V S Udaya Bhaskar, Scientist F, INCOIS

Session 4

Day 2: 17 November 2021

Skilling up SAR hydromet – Training that leaves an impact

SESSION CHAIR



Dr. Shiromani Jayawardane

Director, Weather Forecasting and Decision Support, Department of Meteorology, Sri Lanka

PRESENTERS

PANEL DISCUSSION MODERATED BY DR. G. SRINIVASAN

PRESENTERS

PANELISTS



Dr. G. Srinivasan

Chief Scientist, RIMES



Dr. K. J. Ramesh

Advisor, RIMES



Dr. Elizabeth Page

The University Corporation for Atmospheric Research



Dr. Somnath Dutta

IMD, India



Dr. Sarfaraz

PMD



Dr. Helen Caughey

UKMO



Dr. T V S Udaya Bhaskar

Scientist F, INCOIS

SAR faces a significant threat from CC which makes climate change adaptation crucial. Capacity development initiatives of SAHF can help the region adapt to climate change by helping improve (NWP) systems, medium range and extended range forecasting to guide adaptation measures and improved service delivery.

A wide range of capacity building initiatives for NMHSs have been implemented in the South Asia region. Despite these efforts there are residual gaps in capacity development, particularly in service delivery. The session discussed training needs of SAHF countries across the entire hydromet services information value chain building on the assessment taken up by World Bank and RIMES through reviews, individual country consultations and assessment surveys. The session also highlighted best practices from global experiences and other innovations relevant for South Asia.

Capacity development is at the core of the SAHF initiative. It is a cross cutting topic, relevant for all the different SAHF themes. Analyses of capacity building needs considering vertical, horizontal linkages of NMHSs and delivery mechanisms identified several gaps in the region as below:

- Gradual dilution in technical capacities, induction training, lack of recruitment and on-the-job training
- Observational networks and O&M requirements



- Needs for basic NWP training, including interpretation, verification, access to tools and capabilities
- Gaps in application & services. For example: aviation, agriculture, marine and mountain meteorology

IBF training –including training of trainers; as an additional aspect, there are challenges in terms of training using online courses (despite the advantages) The panel discussion brought together global, regional, and national institutions to articulate their contributions to SAHF CE priorities, and engaged key knowledge partners such as the Cooperative Programme for Operational Meteorology Education and Training (COMET) of UCAR, India Meteorological Department (IMD) Regional Training Center, Pakistan Meteorological Department (PMD) Training Division, UK Met Office (UKMO) and the International Training Centre for Operational Oceanography (ITCOcean).



The session highlighted a wide range of capacity development and training programs that are readily available across the entire information value chain that provided a valuable opportunity for all stakeholders to benefit from such program, as briefly summed below:

Cooperative Programme for Operational Meteorology Education and Training (COMET)

- COMET training is part of the program of University Corporation for Atmospheric Research (UCAR). Training portal and YouTube channel where videos are designed for a broader audience are available.
- The courses are for professional forecasters—specifically environmental forecasters.
- E-learning and classroom training are also part of the program. IBF and in-person workshops are also introduced.
- Tailored courses that are specific to audience needs and location are designed. Audience needs are taken into consideration and training courses are designed accordingly.
- Probabilistic forecasting is a relatively new area introduced as a COMET training topic.
- COMET program is also working with WMO for NHMS in Myanmar

- Recognized experts are involved in teaching; Language of instruction for the COMET courses is English. However, interpreters for other language speaking trainees are also made available.
- Some of the specialized COMET courses are –winter Olympics, aviation forecasting and hydrology

India Meteorological Department (IMD), Regional Training Center

- Capacity Development starts with training need assessments and evaluation of the training.
- IMD offers a faculty development program. Important activity that can be considered is training of trainers for internal staff which can be taken up regionally by RIMES.
- IMD plans of retaining blended mode of training even after pandemic situation to ensure maximum reach and efficiency.
- Role of Regional Training Centre (RTC) include long term certification.
- IMD' as of now offers training program for national and overseas stakeholders.
- IMD's international commitment includes developing the field of operational weather and climate services; continuous update of knowledge and skills.
- Current difficulties and gaps in training: Nomination of wrong participations, lack of proper training need assessment, not considering stakeholder's feedback.
- RTC can assist in regional training need assessment and develop template questionnaire for countries in South Asia in association with RIMES.

Pakistan Meteorological Department (PMD), Training Division

- A broad range of training is being delivered by PMD on hydromet issues, including aviation meteorology and others. Training of trainers, IBF, satellite meteorology and radar meteorology are among the key areas which would require strengthening. This also reflects on the need for early warning training and system enhancing and communication.
- PMD is regularly conducting courses, instrument check, tailored courses for aviation, competency assessments conducted, QMS in aviation, refreshers courses and others.
- TOT needed for satellite meteorology, optimum use of NWP products and hazard mapping.
- There is requirement to share the EWS experience and learning on regional basis for improvement.
- Social media plays an important role. Effective communication between forecasters and social media entities is crucial to appropriately use the medium for conveying weather information.

UK Met Office (UKMO)

- ARRCC provides a full range of training to the region, from IBF to SCIPSA and CARISSA
- MET Office – ARRCC program, standard courses-forecaster training at MET Office College
- ARRCC provides capacity development as 3 work packages—IBF, SCIPSA and CARISSA
- IBF—stakeholder training, sensitization to IBF, capacity building support to regional initiatives—extends area of expertise of the stakeholders, forecast uncertainty and other technical aspects are included.
- Country focused trainings—for Bangladesh tropical cyclones and seasonal forecasting are also provided as part of the programme.
- Online trainings proved to be more effective in certain cases than face-to-face trainings

- The program is tailoring climate science for different audience
- Media and social media training are ongoing—recent training in Nepal focused more on the social media aspect

ITCOcean (ITCOo)

- Integrated classrooms for hands-on training and online participation available
- Individual centered learning – designed according to the country’s demand is also available
- Need specific courses—advanced training on integrated multidisciplinary oceanography is also offered
- Pre-course surveys for selecting topics are also an option.

SESSION 5: DATA, DATA EVERYWHERE BUT NOT ENOUGH TO USE

OBSERVATIONAL SYSTEMS AND REGIONAL DATA EXCHANGE FOR MONITORING AND PREDICTION OF EXTREMES

Key Messages:

1.

CC and extreme events pose threats to all countries and, extension and modernization of the observation network is key to better monitor and improve warning systems to reduce adversities.

2.

Data remains at the core of the hydromet and climate value chain process

3.

In the South Asia region meteorology is mostly driven by the public sector. Public Private Partnership is essential in this regard

Chairs:

- Dr Jagadishwor Karmacharya, Deputy Director General of Department of Hydrology and Meteorology, Nepal
- Dr. Kyaw Moe Oo, Director General, Department of Meteorology and Hydrology (DMH), Myanmar

Presenters:

- Mr. Nadeem Faisal, SAHF WG on Observational Networks
- Mr. Anthony Rea, Director, Infrastructure (D/I), WMO
- Mr. Clement Albergel, Climate Application Scientist, ESA
- Dr. Itesh Dash, RIMES
- Mr. Kumar Margasahayam, Regional Manager, Earth Networks/ Advanced Environmental Monitoring

Panelists:

- Mr. Simon Brown, Services Director, UK Met Office
- Dr. Jagadishwor Karmacharya, DDG, Department of Hydrology and Meteorology, Nepal
- Mr. Erik Andersson, Seconded National Expert to the European Commission, ECMWF
- Mr. Ali Shareef, DDG, Maldives Meteorological Services
- Mr. Jerry Lengoasa, Director, Disaster Risk Solutions Pty.
- Dr. P. Srinivasalu, General Manager (R&D), Astra Microwave Private Limited

Session 5

Day 2: 17 November 2021

'Data, data everywhere but not enough to use' – Observational systems, regional exchange, information systems

SESSION CO-CHAIRS

PRESENTERS



Dr. Jagadishwor Karmacharya

DDG, DHM, Nepal



Dr. Kyaw Moe Oo

DG, DMH, Myanmar



Mr. Nadeem Faisal

AHF WG on Observational Networks



Mr. Anthony Rea

Director, Infrastructure (D/I), WMO



Mr. Clement Albergel

Climate Application Scientist, ESA



Dr. Itesh Dash

RIMES



Kumar Margasahayam

Regional Manager, Earth Networks/ Advanced Environmental Monitoring

PANEL DISCUSSION MODERATED BY DR. ALICE SOARES, WORLD BANK AND DR. K.J RAMESH, SENIOR ADVISOR, RIMES

PANELISTS



Mr. Simon Brown

Services Director, UK Met Office



Mr. Erik Andersson

Seconded National Expert to the European Commission , ECMWF



Mr. Jerry Lengoasa

Director, Disaster Risk Solutions Pty.



Dr. Jagadishwor Karmacharya

DDG, DHM, Nepal



Mr. Ali Shareef

DDG, Maldives Meteorological Services



Dr. P. Srinivasalu

General Manager (R&D), Astra Microwave Private Limited

SESSION 5: DATA, DATA EVERYWHERE BUT NOT ENOUGH TO USE

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Observational network and data exchange infrastructure and protocols form the backbone of hydromet service delivery capacity for forecasting weather and climate events.

The session showcased the [European Space Agency \(ESA\)](#) data products and the RIMES Data Exchange Platform that could drive better forecasts. The RIMES Data Exchange Platform is an integrated platform to collect the data on real time that undergo automatic quality control following WMO standards. 14 countries share data on a daily basis and others are in process, with data being used for forecast verification and improvements.

An optimal observational system requires the ability to integrate and manage diverse sources of hydrometeorological data. Major observational system considerations in South Asia are sustaining observational networks, operation and maintenance issues, interoperability, and data-sharing. The session featured a discussion on development of strategic plans for observational networks and enhancing data sharing arrangements in the region to improve detection and warning for extreme events.

Common issues in operation and maintenance (O&M) in the South Asia region include, 1) inadequate network, difficulties of access; 2) lack of skills and HRs; 3) large gaps in some areas both in surface and upper air observation. The priorities are to fill the gaps in surface observations, including upper air networks especially in remote areas including mountain and sea, improving AWS networks and regional data exchange.

WMO recently launched the [system observations financing facility](#) for least developed countries and small island developing states for enhancing their observational network infrastructure and international data exchange. Members should provide free and unrestricted data according to the unified data policy.

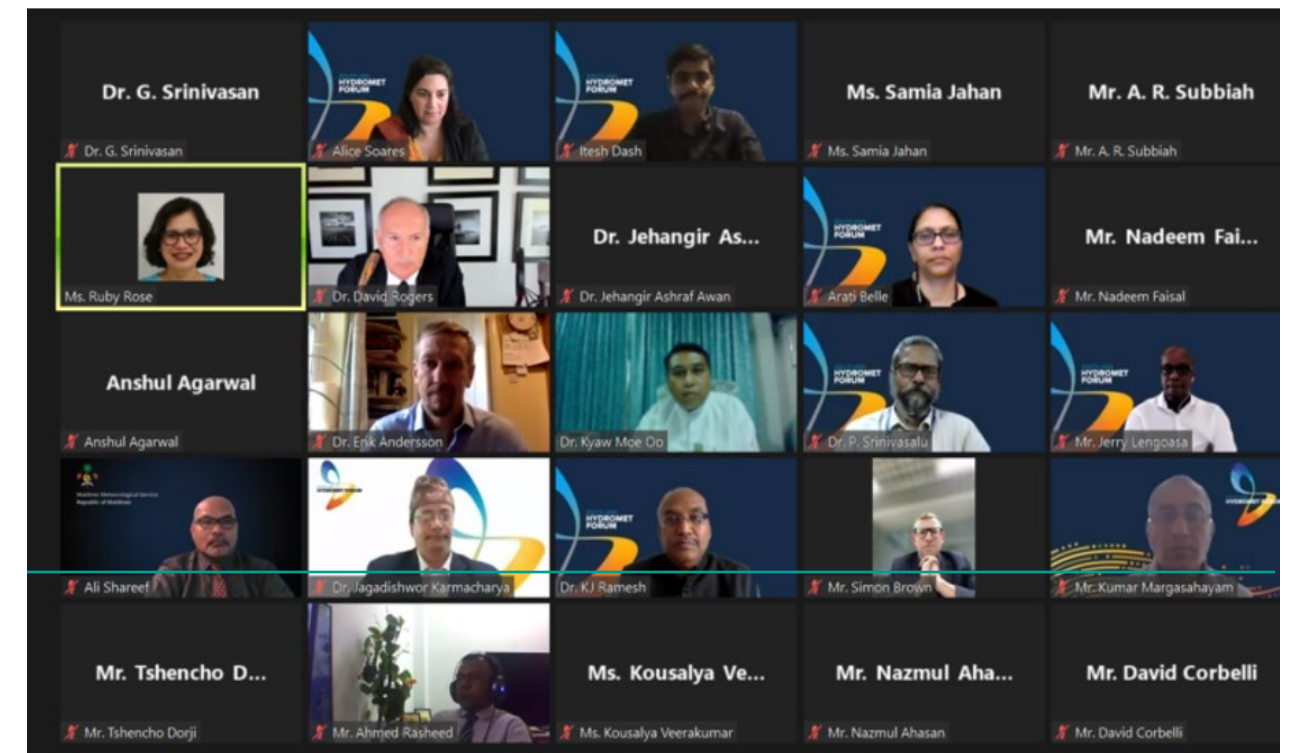
Challenges in setting up public private sector engagement on disaster are lack of investments, lack of sustainable infrastructure and often lack of interoperability of data. Mr. Kumar Margasahayam shared a few successful examples of public-private engagement: a) Odisha State: engaged to reduce lightning deaths in the state (avg. 400/year). This included infrastructure (Automated Lightning Warning System) and storm tracking/alerting. Data is also shared with RIMES to foster collaboration with other realities in the region; b) Peru – Early Warning Flood System merging data gathering and a central collection, processing, and analysis tool to disseminate early warning messages through multiple means.

The panel discussion brought together several representatives discussing harnessing innovations in observation systems and enhancing effectiveness of O&M to meet SAHF priorities. UK Met Office (UKMO) and European Centre for Medium-Range Weather Forecasts (ECMWF) provided their insights into criticality of observation networks to improve their global models.

The Department of Hydrology and Meteorology (DHM), Nepal shared about the innovative model adopted for maintenance of observation networks through outsourcing to private sector, while the Maldives Meteorological Services (MMS) elucidated the challenges and needs in a marine context. Disaster Risk Solutions Pty., and Astra Microwave Private Limited highlighted the opportunities to engage with private sector in strengthening observation networks. Improved access to regional observations will enhance the quality of the forecast in the region.



Sustainability of the observing network at a global, regional, and national level is key. The challenges posed by CC require answers, from many points of view: economic, social but also environmental. In South Asia, the key question is how to provide sustainable solutions to reduce environmental hazard. This is difficult, requiring advancing the science (e.g., through enlarging observation networks) while simultaneously addressing the needs of users (e.g., provide advisory). In this regard, cooperation between the public and private sector is key. An additional level of complexity is decreasing due to technological service providers that can provide simple solutions without going through the bureaucratic processes that NMHS often have to face. Technology should be promoted and be enabled by improved services delivery throughout the region



SESSION 6: COLLABORATIONS FOR IMPROVED WEATHER AND CLIMATE SERVICES IN SOUTH ASIA

Key Messages:

1. Financing is not a major constraint- US\$274 million is available from the UK for the Climate Action for Resilient Asia program to strengthen adaptation across the region. UK government's Catalytic Green Finance is the largest bilateral climate financier providing finance for critical infrastructure and support development sustainable - renewable energy, clean transportation, and green development.
2. Priorities and targets for JICA engaged in South Asia on early warning, weather infrastructure and capacity building since the 1980s include strengthening of the weather observation network, IBF and strengthening dissemination of weather information to the public.
3. 27 climate resilience projects have been approved by GCF for South Asia. GCF noted lack of an enabling environment and lack of coverage and scale, because of limited information as key challenges in hydromet service delivery and that 44% of investments in the region are for modernizing hydromet services, within which IBF and EWS are areas of interest
4. Scale-up of successful activities into investment projects should be prioritized. ADB noted that majority of its investments are hazard-specific and for capacity building, often through TA assistance. Regional integration in this space is critical to leverage existing programs and arrangements.
5. Regional cooperation is at the core of the mandate for the UN. The Tsunami Trust Fund initiative which was activated in 2005 had supported the creation of regional capacities through RIMES. UNESCAP is also promoting regional knowledge exchange. Along with RIMES and UKMET Office, ESCAP supports IBF and the use of seasonal forecasts for decision-making.

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6. The regional ARRCC program of the UKMO would be continued for an additional 5 years. It would focus on strengthening NMHS long term strategies, using a value-chain approach, and on enabling factors - not only investments on infrastructure, technical guidelines. ARRCC highlighted the socio-economic benefits of value chain investments, and that regional cooperation can provide great opportunity to enhance access to data- hence SAHF is a very apt framework.
7. Progress made by SAHF has increased the collaboration and cooperation among South Asia countries, sharing resources and working together collaboratively. The value chain approach to hydromet modernization in South Asia that SAHF is bringing forward, is particularly relevant and useful as it provides a common framework to plan interventions also from the donor perspective. USAID support is particularly focused on EWS development to enhance community resilience. Gaps are often in the last mile - reaching people and linking the value chain to the last mile, particularly from a humanitarian perspective.

Chair:

Mr. Abhas Jha, Practice Manager, Climate Change and Disaster Risk Management, World Bank South Asia Region

Presenters:

- Mr. Daniel Kull, Senior DRM Specialist, World Bank Europe, and Central Asia
- Dr. Michael Staudinger, President of WMO RA VI (Europe)
- Dr. Branka Ivancan-Picek, Director General, Croatian Meteorological and Hydrological Service
- Dr. Kornélia Radics, President, Hungarian Meteorological Service

Panelists:

- Ms. Archana Shukla, Senior Programme Manager, Asia Regional Team, UK Foreign Commonwealth and Development Office (FCDO)
- Mr. Joseph Intsiful, Senior Climate Information and Early Warning Systems Specialist, Green Climate Fund

- Dr Masahito Ishihara, Senior Advisor on Meteorological Sector, Japan International Cooperation Agency (JICA)
- Dr. Michael Ernst, Support Relief Group (SRG) Senior DRR/Hydro-Meteorological Hazards Advisor, Bureau of Humanitarian Assistance, US Agency for International Development (USAID)
- Mr. Steven Goldfinch, DRR Specialist, Asian Development Bank (ADB)
- Dr. Sanjay Srivastava, Chief of Disaster Risk Reduction UN Economic and Social Commission, United Nations Economic and Social Commission for Asia and the Pacific (UN ESCAP)
- Mr. David Corbelli, Senior International Development Manager, ARRC program, UK Meteorological Office (UKMO)

Session 5

Day 3: 18 November 2021

Collaborations for improved weather and climate services in South Asia

SESSION CHAIR

PRESENTERS



Mr. Abhas Jha

Practice Manager, Climate Change and Disaster Risk Management, World Bank SA



Mr. Daniel Kull

Senior Disaster Risk Management Specialist, World Bank Europe, and Central Asia



Dr. Michael Staudinger

President of WMO RA VI (Europe)



Dr. Branka Ivancan-Picek

Director General, Croatian Meteorological and Hydrological Service



Dr. Kornélia Radics

President, Hungarian Meteorological Service

PANEL DISCUSSION: REGIONAL APPROACH AND INVESTMENTS FOR STRENGTHENING HYDROMET SERVICES IN SAR: MODERATED BY MR. ABHAS JHA, WORLD BANK

PANELISTS



Archana Shukla

Senior Programme Manager, Asia Regional Team



Dr. Sanjay Srivastava

Chief of Disaster Risk Reduction UN Economic and Social Commission



Dr. Joseph Intsiful

Senior Specialist Green Climate Fund



Mr. David Corbelli

Senior International Development Manager, ARRC program



Dr. Masahito Ishihara

Senior Advisor on Meteorological Sector, JICA, Japan



Mr. Steven Goldfinch

DRR Specialist



Mr. Ben Churchill

Regional Office for Asia and the South-West Pacific, WMO

Observational networks, computing resources and technical skills are shared needs of all countries. As the region seeks to modernize and deliver accurate and timely services, investments at the agency, country and regional level that maximize shared benefits while also providing tailored services to user specific needs will become inevitable.



Investments in hydromet and Early Warning Systems are among the most effective investments a country can make. Policies, processes and people need to leverage observational resources and significance of regional collaboration for this cannot be overemphasized. Using regional and global frameworks is important, and additional data from the region is key."

MR. ABHAS JHA

PRACTICE MANAGER, CLIMATE CHANGE AND DISASTER RISK MANAGEMENT
WORLD BANK SOUTH ASIA REGION

Significant efforts are being made to improve weather and climate services in South Asia mostly through national investments. These are essential to build the capability to exploit scientific and technological advances to deliver a wide range of services demanded by users. However, these demands are growing with increasing climate risks and severe weather events and scientific and technical advancements. Discrete investments and country alone approaches do not have lasting impacts in sustaining these services. The increasing volume of data and the technical knowledge needed to interpret information is a limiting factor in the performance of many national meteorological services.



Regional projects are challenging, but essential, as we tend to be focused on individual countries. WMO regional mechanisms and approaches are geared to help countries address these challenges.

In the EU, there are a several regional consortiums that support specific activities (ECMWF, EUMETSAT, etc) and we all work together. These frameworks can help optimise operations and resources on the ground."

DR. MICHAEL STAUDINGER

PRESIDENT, WORLD METEOROLOGICAL ORGANIZATION REGIONAL OFFICE FOR EUROPE

Countries in Europe have equal access, by pooling skills and resources, to a very high level of shared knowledge that would otherwise be prohibitively expensive or unavailable through organizations such as ECMWF, EUMETSAT and EUMETNET. This session highlighted the opportunities (and obstacles) for regional collaboration and investments in weather and climate services that have potential to significantly increase the value of national meteorological services and showcased lessons and experiences from Regional hydromet investments in Southeast Europe.

Regional cooperation in hydromet services cannot be over emphasized. Similar engagements have been implemented in Europe and Central Asia. **CAFEWS** –Central Asian Flood EW System is an initiative under development, being implemented in 5 countries taking a basin approach. The importance of working through a regional perspective is key, given the topography and geography of the area. To support the engagement, there is a series of components: 1) NWP, which is run by the Uzbek NMHS (WMO regional center); 2) the existing flash flood guidance system that covers the whole region is already operational but is being further enhanced, with the addition of snow melt, riverine routing routine and will add landslide routines. A wide area network and specific forecaster workstations will be installed in each country as part of CAFEWS. The initiative is testing the use of NWP through cloud to reduce the burden on national NMHSs, and the related running cost. Lesson learned is that there is a huge national benefit of data exchange, importance of local “champion”, building relationships while regional financing and fairness is important. Multiple financing streams can support this. From a technical perspective, improvement of models and technologies was the objective of the initiative. Exchange of data allowed the enhancement of regional weather and water forecasting capabilities. The initiative started with a pilot and concluded with a full-fledged project.

The panel discussion brought together leading agencies at the forefront of economic and social development around the globe– UK Foreign Commonwealth and Development Office (FCDO), Japan International Cooperation Agency (JICA), Green Climate Fund (GCF), Asian Development Bank (ADB), United Nations Economic and Social Commission for Asia and the Pacific (UN ESCAP), UK Met Office (UKMO), and United States Agency for International Development (USAID).



CLOSING SESSION

SAHF VOICES AND FUTURE DIRECTIONS

Key Messages:

1. There is an urgent need to invest on robust regional observational systems to enhance capacities to detect severe and extreme weather events and to support their integration with forecasts systems.
2. User needs must be addressed through tailor made products- NMHSs need a platform to process the forecast data to utilize for value-addition. This can be facilitated through SCOPE Data consortium , linked to Regional Cloud Computing Network for pooling resources.
3. IBF was identified as a key priority requiring co-production approach for R&D to understand the relationship between hazard and vulnerability and risk, and in co-development of a DSS to support risk-informed time decision making by key sectors- water resources, disaster management, agriculture.
4. CE in terms of training must address all aspects of hydromet service delivery- Observation techniques, forecast development, IBF and sectoral application.

Presenters:

- Ms. Arati Belle, Sr Disaster Risk Management, World Bank
- Dr. Mohapatra, Director General of Meteorology, India Meteorological Department
- Mr. A.R. Subbiah, Director, RIMES

SAHF III Voices and Future Directions

Day 3: 18 November 2021

FACILITATION BY



Mr. Ramraj Narasimhan
RIMES



Dr. K. J. Ramesh
Advisor, RIMES



Dr. Alice Soares
Sr. Hydromet Advisor

SAHF - WAY FORWARD

PANELIST



Ms. Arati Belle
Disaster Risk Management Specialist



Dr. Mrutyunjay Mohapatra
Chair, Executive Council, SAHF &
Director General of Meteorology, IMD,
India



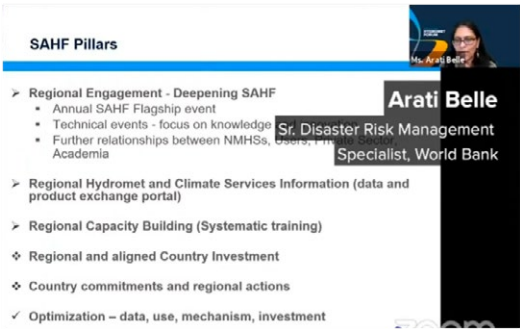
Mr. A. R. Subbiah
Director, RIMES

SAHF participants unanimously acknowledged SAHF as a vital & ongoing process in South Asia region that would remain relevant to strengthen the hydromet service delivery capacities of SAHF countries.

The session elicited feedback from SAHF Executive Council and Working Group members, user sectors and donor partners. Representatives expressed that SAHF III has helped closing gaps between NMHSs in the region. The participants endorsed SAHF III as a highly relevant and useful initiative for countries to share experiences and learn about new features, data products, platforms from other countries in the region and beyond.

The forum strongly advocated the need for implementing DSS and IBFs within key sector services as a priority in each of the SAHF countries. The forum recognized capacity development as the backbone for improving service delivery and sight to design and implement a capacity development calendar across all components of the information value-chain. A South Asia Hydromet Cloud was proposed as a key part of the SAHF program. It resolved to set-up a South Asia Consortium for data and weather Predictions (SCOPE) blending both cutting-edge technological advances and conventional techniques.

The Forum agreed on several tangible priorities to be undertaken in a time-bound manner as part of an Action Plan with measurable targets. This Action Plan integration of upstream and downstream hydromet value chains to optimize resources, giving a clear direction and way forward for addressing the priorities identified by the Forum, to be implemented and monitored by the SAHF Executive Council.



SAHF priorities include enhancing observations and integration into forecasting through scaling up of NMHS-ECMWF data exchange of real time data within the South Asia region, exchange of real time data within the region and improvement of historical observational data. Leveraging collective strengths to address user needs through tailor made products like Regional Cloud Computing storage and networking services infrastructure was also emphasized. IBF as an integrating approach was identified as a priority for better service delivery through co-production with sectoral partners. Training of NMHS operational staff and user sector institution staffs was also noted as important targets in the forum (detailed priorities and targets are listed in Table 1).

ANNEX 1: SAHF EC COUNCIL AND WORKING GROUPS

Executive Council Members

Country	Name	Designation
Afghanistan		Director, Afghanistan Meteorology Department, Afghanistan
Bangladesh	Mr. Md. Azizur Rahman	Director, Bangladesh Meteorological Department, Bangladesh
Bhutan	Dr. Karma Dupchu (EC Co-Chair)	Director and PR of Bhutan with WMO, National Center for Hydrology and Meteorology, Bhutan
India	Dr. Mrutyunjay Mohapatra (EC Chair)	Director General and PR of India with WMO, India Meteorological Department, India
Maldives	Mr. Ali Shareef	Deputy Director General (Meteorology), Maldives Meteorology Service, Maldives
Myanmar	Dr. Kyaw Moe Oo	Director General and PR with WMO, Department of Meteorology and Hydrology, Myanmar
Nepal	Dr. Saraju Kumar Baidya	Director General, Department of Hydrology and Meteorology, Naxal, Kathmandu
Pakistan	Dr. Muhammad Riaz	Director General and PR with WMO, Pakistan Meteorological Department, Pakistan
Sri Lanka	Mr. Athula Karunanayake	Director General of Meteorology, Department of Meteorology, Sri Lanka
	Dr. Shiromani Jayawardena (Alternate member of EC from Sri Lanka)	Director, Weather Forecasting and Decision Support, Department of Meteorology, Sri Lanka

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Working Group Members

Country	Impact-based Forecasting	Numerical Weather Prediction	Observational Networks	Capacity Enhancement
Afghanistan	Mr. Bashir Ahmad S/Name: Rashidi Designation: Head of Observation, Afghanistan Meteorology Department, Afghanistan	Mr. Humayoun S/Name: Akbari Designation: Manager of Forecast, Afghanistan Meteorology Department, Afghanistan. Ms. Kubra S/ Name: Mohaoodi Designation: Member of forecast	Mr. Said Rahman S/ Name: Naim Designation: IT Manager, Afghanistan Meteorology Department, Afghanistan	Mr. Khayberr S/ Name: Rahmani Designation: General Manager of Environmental and Agriculture Research, Afghanistan Meteorology Department, Afghanistan
	Dr. Muhammad Abul Kalam Mallik Designation: Meteorologist, Bangladesh Meteorological Department, Bangladesh.	Dr. Md. Abdul Mannan Designation: Meteorologist, Bangladesh Meteorological Department, Bangladesh.	Mr. Md. Abdul Matin Designation: Senior Communication Engineer, Bangladesh Meteorological Department, Bangladesh.	Mr. S. M. Quamrul Hassan Designation: Meteorologist, Bangladesh Meteorological Department, Bangladesh.
Bhutan	Mr. Saraj Acharya Designation: Meteorology/ Hydrology Officer, WCSD, Bhutan.	Ms. Monju Subba Designation: Engineer, WCSD, Bhutan.	Mr. Jangchup Choephyel Dorji, Designation: Sr. Meteorology/Hydrology Officer, HOID, Bhutan.	Ms. Ugyen Tshomo Designation: HR Officer, NCHM, Bhutan
India	Dr. R.K. Jenamani Designation:Scientist F, India Meteorological Department	Dr Ananda Kumar Das Designation: Scientist E, DGM New Delhi, NWP, India Meteorological Department, India	Shri Uday Kumar Shende Designation: Scientist E, CRS Pune, Surface Instrument Division, India Meteorological Department, India.	Dr. Somenath Dutta Designation: Scientist E, CRS Pune, Meteorological Training Institute, India Meteorological Department, India
Maldives	Mr Ali Shareef Designation: Deputy Director General Meteorology, Maldives Meteorological Services, Maldives.	Mr Ahmed Rasheed Designation: Director Meteorology, Maldives Meteorological Services, Maldives.	Mr Ibrahim Humaid Designation: Maldives Meteorological Services, Maldives.	Ms Shaheema Ibrahim Designation: Met. Technician, Maldives Meteorological Services, Maldives.

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Myanmar	Ms. Chaw Su Hlaing Designation: Staff Officer Department of Meteorology and Hydrology, Myanmar	Dr. Tin Mar Htay Designation: Assistant Director Department of Meteorology and Hydrology, Myanmar	Mr. Htay Lwin Designation: Executive Engineer Department of Meteorology and Hydrology, Myanmar	Ms. Han Swe Designation: Assistant Director Department of Meteorology and Hydrology, Myanmar
Nepal	Ms. Shanti Kandel Designation: Senior Divisional Meteorologist Meteorological Forecasting Division Department of Hydrology and Meteorology, Nepal	Mr. Rajudhar Pradhananga Designation: Senior Divisional Meteorologist Meteorological Forecasting Division Department of Hydrology & Meteorology, Nepal	Mr. Suman Kumar Regmi Designation: Divisional Meteorologist, Climate Data and Network Section, Climate Division, Department of Hydrology and Meteorology, Nepal	Mr. Shiva Nepal Designation: Senior Divisional Meteorologist, Department of Hydrology and Meteorology, Nepal
Pakistan	Dr. Zaheer Ahmed Babar Designation: Director, National Weather Forecasting Center, Pakistan.	Dr. Jehangir Ashraf Awan Designation: Deputy Director, R&D Division, Pakistan.	Mr. Nadeem Faisal Designation: Director, Climate Data Processing Center, Pakistan.	Mr. Sarfaraz Designation: Director, Institute of Meteorology & Geophysics, Pakistan.
Sri Lanka	Dr. I.M.S.P. Jayawardane Designation: Director, Weather Forecasting and Decision Support, Department of Meteorology, Sri Lanka.	Mr.T.P.N. Peries Designation: Meteorologist, Climate Change Studies, Department of Meteorology, Sri Lanka	Mr.A.G.M.M. Wimalasuriya Designation: Deputy Director, Observational Networks and Electronics, Department of Meteorology, Sri Lank	Mr.A.L.K. Wijemanna Designation: Director, Aviation and Development, Department of Meteorology, Sri Lanka

ANNEX 2: SAHF III 2021–PARTICIPANTS

Sr. No.	Date: 15 Nov. 2021 Name	Designation	Organization	Country
1	Abul Basar Md. Zahid Hossain	Senior Scientific Officer	BRRI	Bangladesh
2	A. R. Subbiah	Director, RIMES Program Unit	RIMES	Thailand
3	Abdul Muhsin Ramiz	Director Meteorology	MMS	Maldives
4	Abdulla Naseer	Minister of State	MOECCT	Maldives
5	Abhushan Gautam	Communications Specialist	RIMES	Nepal
6	Addrita Haque	Student	BUET	Bangladesh
7	Afruza Sultana	Meteorologist	BMD	Bangladesh
8	Ahmed Rasheed	Director Meteorology, Public Weather Service	MMS	Maldives

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9	Ali Shareef	Deputy Director General at Weather Service Division	MMS	Maldives
10	Alice Soares	Sr. Hydromet Advisor	World Bank	Portugal
11	Amna bibi	Assistant Meteorologist	PMD	Pakistan
12	ANANDA DAS	Scientist E	IMD	India
13	Anshul Agarwal	Team Leader, Hydrology	RIMES	India
14	Arati Belle	Sr. DRM Specialist	World Bank	United States
15	Arti Bandgar	Scientist C	RCC	India
16	Arti Shrestha	Student	AIT	Thailand
17	Arun Poudel	IT Specialist	UN	Nepal
18	Ashis Mitra	Head	NCMRWF	India
19	Asif Mahmud	Technical Officer (GIS)	RIMES	Bangladesh
20	Ben Churchill	Head, Regional Office for Asia and the South-West Pacific	WMO	Singapore
21	Carlyne Yu	Team -Leader ,Societal Applications	RIMES	Philippines
22	Cecile Fruman	Regional Director	World Bank	United States
23	Chaw Su Hlaing	Staff Officer	DMH	Myanmar
24	Clint Lagang	Web Application Developer	RIMES	Philippines
25	Dasun Gamage			Sri Lanka
26	David Rogers	Lead Meteorological Consultant	World Bank	Switzerland
27	Debbie Menezes	M&E	World Bank	India
28	Dechen Tshering	DRM Specialist	World Bank	Bhutan
29	Deepak KC	Senior Programme Officer–CCA and DRR	UN	United States
30	Devindi Budhawattha	Inter	Dialog Axiata PLC	Sri Lanka
31	Dilip Gautam	Country Technical Lead	RIMES	Nepal
32	Dinanath Bhandari	Disaster Resilience Expert	Community-Centred EWS	Nepal
33	Divya Surendran	Meteorologist	IMD	India
34	Dmytro Glazkov	Senior Energy Specialist	World Bank	United States
35	Efrem Ferrari	DRM consultant	World Bank	Italy
36	Erik Andersson	Seconded National Expert to the European Commission	ECMWF	Belgium
37	Faisal Qamer		ICIMOD	Nepal
38	Fardini Khandaker	Project Officer	RIMES	Bangladesh
39	Farhana Hoque	Senior Monitoring & Evaluation Officer	DAE	Bangladesh
40	Fariha Ferdous Deeny	Project Officer (Communication)	RIMES	Bangladesh
41	Francis Colledge	Senior Consultant –Hydromet and Climate Services	RedCROSS	United Kingdom
42	G. Srinivasan	Chief Scientist -Climate Applications	RIMES	India
43	Hafizur Rahman	Meteorologist	BMD	Bangladesh
44	Htay Lwin	Engineer	DMH	Myanmar
45	Itesh Dash	Team Leader – Systems Research and Development	RIMES	Thailand
46	J. Elaine Naparat	Team Leader – Earthquake and Tsunami Unit	RIMES	Thailand
47	Jagadish Karmacharya	Deputy Director General	DHM	Nepal
48	Janaki Meegastenna	Additional Director General of irrigation	Dol	Sri Lanka
49	Janet Minatelli	Senior Operations Officer	World Bank	United States

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50	Jehangir Ashraf Awan	Deputy Director, R&D Division	PMD	Pakistan
51	Jie Qiu	Applications Development Specialist	RIMES	Thailand
52	Julie Vorman	Communications consultant	World Bank	United States
53	Junaid Ahmad	Country Coordinator	RIMES	Pakistan
54	Kamal Kishore	Member Secretary	NDMA	India
55	Karma Dupchu	Director	NCHM	Bhutan
56	KJ Ramesh	Senior Advisor	RIMES	India
57	Kousalya Veerakumar	Project Coordinator	RIMES	India
58	Kyaw Lwin Oo		DHM	Myanmar
59	M. Ravichandran	Secretary	MOES	India
60	Madhab Uprety	Asia Pacific Regional Lead/Technical Adviser	RCCC	Nepal
61	Madhubhashani Ranaweera	Intern	Dialog Axiata PLC	Sri Lanka
62	Manish Basnet	Consultant	World Bank	Nepal
63	Masahito Ishihara	Senior Advisor	JICA	Japan
64	Mazharul Aziz	Chief Instructor	DAE	Bangladesh
65	Md Majibur Rahman Miaji	Assistant Director (Meteorology)	Civil Aviation Authority	Bangladesh
66	Md. Abdul Mannan	Meteorologist	BMD	Bangladesh
67	Md. Faqru Arefin	Program Manager	RIMES	Bangladesh
68	Md. Mofazzel Hossain	Chief Scientific Officer	BRRI	Bangladesh
69	Md. Shaheenul Islam	Meteorologist	BMD	Bangladesh
70	Md. Rafiqul Islam		DLS	Bangladesh
71	Melanie Kappes	DRM Specialist	World Bank	United States
72	Michael Ernst	Hydro-Meteorological Hazards Advisor	USAID	Thailand
73	Mitesh V. Sawant	Project Officer	RIMES	Thailand
74	Mohammad Ferdous Rahman Sarker	Senior Scientific Officer	IEDCR	Bangladesh
75	Monowar Hossain	Meteorologist	BMD	Bangladesh
76	Mrutyunjay Mohapatra	Director General of Meteorology	IMD	India
77	Muhammad Arif Hossain	Meteorologist	BMD	Bangladesh
78	Muhammad Khalid Bin Siddique	Hydrologist, Climate Change Expert	LGED	Bangladesh
79	Nabansu Chattopadhyay	Former DDG and Head, Agricultural Meteorology Division	IMD	India
80	Nadeem Faisal	Director	CDPC, PMD	Pakistan
81	Najibullah Osmani	Meteorologist	AMD	Afghanistan
82	Nasir Yaseen	Asstt. Meteorologist	PMD	Pakistan
83	Nawaraj Chhetri	Portfolio Analyst	UN	Bhutan
84	Nazmul Ahasan	IT Developer	RIMES	Bangladesh
85	Neamul Ahsan Khan	GIS Specialist	RIMES	Bangladesh
86	Niraj Shakya	Application Developer	RIMES	Nepal
87	Nishanthi Kalatheeswaran	Regional IT specialist	RIMES	India
88	Nitisha Kafle	Student		Nepal
89	Pabitra Gurung	Consultant (DRR Innovation)	Mercy Corps	Nepal
90	POL NADAL CROS	DRM Consultant	World Bank	United States
91	Prabuddha Boralugoda		WFP	Sri Lanka
92	Prem Awasthi	Humanitarian Coordination Officer	UN	Nepal

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93	Raihanul Haque	Country Program Lead	RIMES	Bangladesh
94	Raju Dhar Pradhananga	Senior Divisional Meteorologist	DHM	Nepal
95	Ram	Senior Programme Manager	EU	India
96	Ramraj Narasimhan	Chief, Special Programs Management	RIMES	India
97	Razia Safdar	Chief technical advisor	SPRC	Pakistan
98	Ricky Dador	Weather Observer	LGS	Philippines
99	Ruby Rose	Team Leader – Institutional Development	RIMES	Thailand
100	S.M.Quamrul Hassan	Meteorologist	BMD	Bangladesh
101	SABAI LWIN	Agrometeorology	DMH	Myanmar
102	Sabuj Roy	Technical Officer	DAE	Bangladesh
103	Sajib Hasan	IT Expert	RIMES	Bangladesh
104	Samia Jahan	Project Associate	RIMES	Bangladesh
105	Sangay Chophel	Project Technical Specialist	UN	Bhutan
106	Sangha Ratna Shakya	Meteorologist	DHM	Nepal
107	Sanim	Hybrid Mobile App Developer	RIMES	Thailand
108	Sarath Premalal	Advisor	RIMES	Sri Lanka
109	Sarfaz Khan	Meteorologist	PMD	Pakistan
110	Saroj Acharya	Hydro-met officer	NCHM	Bhutan
111	Sebin John	Project Scientist	IMD	India
112	Shaheema Ibrahim	Planning Officer	MMS	Maldives
113	Shahzada Adnan	Meteorologist	PMD	Pakistan
114	Shiromani Jayawardane	Director (Weather Forecasting and DSS)	DoM	Sri Lanka
115	Singay Dorji	Chief, Weather and Climate Services Division (WCSD)	NCHM	Bhutan
116	Somnath Dutta	Scientist-F & Head	MTI, IMD	India
117	Sreejith op	Scientist E & Head, CRS	IMD	India
118	Srima	Research Associate	THINKlab	United Kingdom
119	Subesh Dhakal	Country Coordinator	RIMES	Nepal
120	Susmitha Joseph	Scientist E and Deputy Project Director, ERPAS	IMD	India
121	Syeda Sabrina Sultana	Technical Officer (Meteorology)	BMD	Bangladesh
122	Thanut Rittichai	Project Analyst	RIMES	Thailand
123	Thurailingam Suganthalingam	Irrigation engineer	Dol	Sri Lanka
124	Tin Mar Htay	Deputy Director	DMH	Myanmar
125	Tshencho Dorji	Project Officer	RIMES	Bhutan
126	Ugyen Phuntsho	Engineer	MoWHS	Bhutan
127	Upeashika Bandara	Hydrologist	RIMES	Sri Lanka
128	W.T. Thilini De Silva	Irrigation Engineer	Dol	Sri Lanka
129	Yasotha Thevaruban	Chief Engineer	Dol	Sri Lanka
130	Yunziyi Lang	Analyst	World Bank	Pakistan
Sr. No.	Date: 16 Nov. 2021 Name	Designation	Organization	Country
1	A. R. Subbiah	Director, RIMES Program Unit	RIMES	Thailand
2	Abdoulaye HAROU	Senior Adviser, Strategic Partnerships	RIMES	Canada
3	Abdul Muhsin Ramiz	Director Meteorology	MMS	Maldives
4	Abhijit Sarkar	Scientist 'F'	IMD	India
5	Abhushan Gautam	Communications Specialist	RIMES	Nepal

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6	Aditi Paul	Consultant	World Bank	India
7	Afruza Sultana	Meteorologist	BMD	Bangladesh
8	Ahmed Rasheed	Director Meteorology, Public Weather Service	MMS	Maldives
9	Alan Thorpe	Professor & Former DG ECMWF	University of Reading	United Kingdom
10	Ali Shareef	Deputy Director General at Weather Service Division	MMS	Maldives
11	Alice Soares	Sr. Hydromet Advisor	World Bank	Portugal
12	Amna Bibi	Assistant Meteorologist	PMD	Pakistan
13	ANANDA DAS	Scientist E	IMD	India
14	Angela Tamrakar	Disaster Risk Reduction Researcher		USA
15	Anil Pokhrel	Chief Executive	NDMO	Nepal
16	Anjum Nazir Zaighum	Senior Forecaster	PMD	Pakistan
17	Anshul Agarwal	Team Leader, Hydrology	RIMES	India
18	Arati Belle	Sr. DRM Specialist	World Bank	United States
19	Arifuzzaman Bhuyan	Executive Engineer	BWDB	Bangladesh
20	Arjumand Zaidi			Pakistan
21	Asad Ullah			Pakistan
22	Ashis Mitra	Head	NCMRWF	India
23	Asif Mahmud	Technical Officer (GIS)	RIMES	Bangladesh
24	Asmat Ullah	Assistant Professor	USPCASW	Pakistan
25	Atika Khan	Development trainee	CARE	Bangladesh
26	Azmat Hayat Khan	Head-CIIC	PMD	Pakistan
27	B. P. Yadav	govt job	IMD	India
28	Babar Naeem	GIS Specialist	MEHRAN UNIVERSITY JAMSHORO	United States
29	Ben Churchill	Head, Regional Office for Asia and the South-West Pacific	WMO	Singapore
30	Bhola Nath Mishra	GIS Expert	OSDMA	India
31	Binod Dawadi	Associate Professor	Tribhuvan University	Nepal
32	Bishnu Prasad Neupane	Meteorologist	DHM	Nepal
33	Carlyne Yu	Team -Leader ,Societal Applications	RIMES	Philippines
34	Catrina Johnson	Science Manager and Weather Analytics	UKMO	United Kingdom
35	Chaw Su Hlaing	Staff Officer	DMH	Myanmar
36	Daniel Ryan	Senior International Development Manager	UKMO	United Kingdom
37	David Corbelli	Senior International Development Manager	UKMO	United Kingdom
38	David Rogers	Lead Meteorological Consultant	World Bank	Switzerland
39	Dechen Tshering	DRM Specialist	World Bank	Bhutan
40	Dilip Gautam	Country Technical Lead	RIMES	Nepal
41	Dinanath Bhandari	Disaster Resilience Expert	Community-Centred EWS	Nepal
42	Dinee Tamang	Resilience MERL Advisor	Mercy Corps	Nepal
43	Dineesha Wickramaarachchi	Intern	Dialog Axialta PLC	Sri Lanka
44	Dorji Wangmo	Engineer	Flood Engineering and Management	Bhutan
45	Dushmanta Pattanaik	Scientist	IMD	India

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46	Efrem Ferrari	DRM consultant	World Bank	Italy
47	Elizabeth Gogoi		OPML	India
48	Elizabeth Page	Director	COMET	United States
49	Fardini Khandaker	Project Officer	RIMES	Bangladesh
50	Farhana Hoque	Senior Monitoring & Evaluation Officer	DAE	Bangladesh
51	Fariha Ferdous Deeny	Project Officer (Communication)	RIMES	Bangladesh
52	Fazlur Rashid	Director General	BWDB	Bangladesh
53	G. Srinivasan	Chief Scientist -Climate Applications	RIMES	India
54	GANESAN M	RESEARCH SCHOLAR	SRM INSTITUTE OF SCIENCE AND TECHNOLOGY	India
55	GHIZLANE Gray			United States
56	Hafizur Rahman	Meteorologist	BMD	Bangladesh
57	Htay Lwin	Engineer	DMH	Myanmar
58	Ibrahim Humaid	Seismologist	MMS	Maldives
59	Itesh Dash	Team Leader – Systems Research and Development	RIMES	Thailand
60	J. Elaine Naparat	Team Leader – Earthquake and Tsunami Unit	RIMES	Thailand
61	Jagadishwor Karmacharya	Deputy Director General	DHM	Nepal
62	Jangchup Dorji	Sr. HydroMet Officer	NCHM	Bhutan
63	Jehangir Ashraf Awan	Deputy Director, R&D Division	PMD	Pakistan
64	Jerry Lengoasa	Director	Disaster Risk Solutions Pty	South Africa
65	Jidapa Santipatee			Thailand
66	Jie Qiu	Applications Development Specialist	RIMES	Thailand
67	Kai Shang	Social Development Specialist	World Bank	China
68	Karan Agarwal	Partnership Manager	Google	India
69	Karma Dupchu	Director	NCHM	Bhutan
70	KJ Ramesh	Senior Advisor	RIMES	India
71	Kousalya Veerakumar	Project Coordinator	RIMES	India
72	Kyaw Lwin Oo		DHM	Myanmar
73	Kyaw Moe Oo	Director General	DMH	Myanmar
74	Lucile Gingembre	Consultant	World Bank	France
75	M. Ravichandran	Secretary	MoES	India
76	Manish Basnet	Consultant	World Bank	Nepal
77	Masahito Ishihara	Senior Advisor	JICA	Japan
78	Mazharul Aziz	Chief Instructor	DAE	Bangladesh
79	Md Abdul Mugeed	Sectoral expert, Agriculture	RIMES	Bangladesh
80	Md Majibur Rahman Miaji	Assistant Director (Meteorology)	Civil Aviation Authority	Bangladesh
81	Md. Mobinur Rahman	Program Manager	RIMES	Bangladesh
82	Md. Abdul Mannan	Meteorologist	BMD	Bangladesh
83	Md. Azizur Rahman	Director	BMD	Bangladesh
84	Md. Faqrul Arefin	Program Manager	RIMES	Bangladesh
85	Md. Hossain	Humanitarian Program Manager	Concern Worldwide	Bangladesh
86	Md. Ikram Hossain Bhuiyan	Assistant Program Officer –Humanitarian & Resilience	BWDB	Bangladesh

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87	Md. Lutfur Rahman	Civil Engineering Specialist	LGED	Bangladesh
88	Md. Razikul Islam	Assistant Civil Engineer	China Railway Group Limited	Bangladesh
89	Md. Shaheenul Islam	Meteorologist	BMD	Bangladesh
90	Md.Chanchal Mia	Senior Manager	Crystal Future Venture Lanka Pvt. Ltd	Sri Lanka
91	Md. Rafiqul Islam		DLS	Bangladesh
92	Medhani Jayakody	Chief Engineer	Dol	Sri Lanka
93	Michael Ernst	Hydro-Meteorological Hazards Advisor	USAID	Thailand
94	Michael Hammond	Technical Specialist / Consultant	World Bank	China
95	Mitesh V. Sawant	Project Officer	RIMES	Thailand
96	Mohamed Hadhil	Coordinator	Dialog Axialta PLC	Sri Lanka
97	Mohan kumar DAS	Executive Director	NOAMI	Bangladesh
98	Mrutyunjay Mohapatra	Director General of Meteorology	IMD	India
99	Muhammad Abul Mallik	Meteorologist	BMD	Bangladesh
100	Muhammad Arif Hossain	Meteorologist	BMD	Bangladesh
101	Muhammad Nawaz	Scientific Officer	Climate Energy and Water Research Institute	Pakistan
102	Nabansu Chattopadhyay	Former DDG and Head, Agricultural Meteorology Division	IMD	India
103	Nadeem Faisal	Director	CDPC, PMD	Pakistan
104	Najibullah Osmani	Meteorologist	AMD	Afghanistan
105	Nasir Yaseen	Assistant Meteorologist	PMD	Pakistan
106	Nazmul Ahasan	IT Developer	RIMES	Bangladesh
107	Neamul Ahsan Khan	GIS Specialist	RIMES	Bangladesh
108	Niraj Shakya	Application Developer	RIMES	Nepal
109	Nishanthi Kalatheeswaran	Regional IT specialist	RIMES	India
110	Nofiano Gregorio Henrique Ruas	Climate and environmental technician	OASIS	Timor-Leste
111	Nusrat Yaqoob	PhD fellow	University of Karachi	Pakistan
112	Pabitra Gurung	Consultant (DRR Innovation)	Mercy Corps	Nepal
113	Padmapriya Tissera	Consultant Specialist	Dialog Axialta PLC	Sri Lanka
114	Parvinder Maini	Scientist-G	MoES	India
115	Pone Nyet Khaing	Regional Preparedness Technical Advisor	American RedCross	Myanmar
116	Prem Awasthi	Humanitarian Coordination Officer	UN	Nepal
117	Priyanka Dissanayake	DRM Specialist	World Bank	United States
118	Punyawardena B.	Former Director, Department of Agriculture	DOA	Sri Lanka
119	Raihanul Haque	Country Program Lead	RIMES	Bangladesh
120	Raju Dhar Pradhananga	Senior Divisional Meteorologist	DHM	Nepal
121	RAM	Senior Programme Manager	EU	India
122	Ramraj Narasimhan	Chief, Special Programs Management	RIMES	India
123	Reuben Samuel	Programme Area Manager	WHO	India
124	Rhea C		OPML	India

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125	Ricky Dador	Weather Observer	LGS	Philippines
126	Ruby Rose	Team Leader – Institutional Development	RIMES	Thailand
127	S. C Bhan	Scientist	IMD	India
128	S.M.Quamrul Hassan	Meteorologist	BMD	Bangladesh
129	SABAI Lwin	Agrometeorology	DMH	Myanmar
130	Sabuj Roy	Technical Officer	DAE	Bangladesh
131	Safa Khan	Assistant Consultant	OPML	India
132	Sajib Hasan	IT Expert	RIMES	Bangladesh
133	Samia Jahan	Project Associate	RIMES	Bangladesh
134	Sanim	Hybrid Mobile App Developer	RIMES	Thailand
135	Sarath Premalal	Advisor	RIMES	Sri Lanka
136	Sarfaraz Khan	Meteorologist	PMD	Pakistan
137	Saroj Acharya	Hydro-met officer	NCHM	Bhutan
138	Shaheema Ibrahim	Planning Officer	MMS	Maldives
139	Shahzada Adnan	Meteorologist	PMD	Pakistan
140	Shalinda Fernando	Country Coordinator	RIMES	Sri Lanka
141	Shiromani Jayawardane	Director (Weather Forecasting and DSS)	DoM	Sri Lanka
142	Singay Dorji	Chief, Weather and Climate Services Division (WCSD)	NCHM	Bhutan
143	Somnath Dutta	Scientist-F & Head	MTI, IMD	India
144	Sonia Quiroga	Professor	Complutense University of Madrid	Spain
145	Subesh Dhakal	Country Coordinator	RIMES	Nepal
146	Sudarshan Humagain	Meteorologist	DHM	Nepal
147	Sumaiya Kabir	Consortium Coordinator	CARE	Bangladesh
148	Suryachandra Rao	Scientist	IMD	India
149	Sushant Sharma	Project Coordinator	UNDP	United States
150	Syeda Sabrina Sultana	Technical Officer (Meteorology)	BMD	Bangladesh
151	T. Srinivas Kumar	Director	INCOIS	India
152	Tarakesh Laksman	DSS Data Scientist	RIMES	India
153	Thurailingam Suganthalingam	Irrigation engineer	Dol	Sri Lanka
154	Tin Mar Htay	Deputy Director	DMH	Myanmar
155	Tshencho Dorji	Project Officer	RIMES	Bhutan
156	Upeashika Bandara	Hydrologist	RIMES	Sri Lanka
157	W.T. Thilini De Silva	Irrigation Engineer	Dol	Sri Lanka
158	Waheedullah Yousafi	Advisor	MAIL	Afghanistan
159	Wangda Dukpa	Chief Agriculture Officer	DoA	Bhutan
160	Yasotha Thevaruban	Chief Engineer	Dol	Sri Lanka
161	Yunziyi Lang	Analyst	World Bank	Pakistan
162	Zannatul Moua	Finance & Operations Officer	RIMES	Bangladesh
Sr. No.	Date: 17 Nov. 2021 Name	Designation	Organization	Country
1	A. R. Subbiah	Director	RIMES	Thailand
2	Abdul Muhsin Ramiz	Director Meteorology	MMS	Maldives
3	Abhijit Sarkar	Scientist 'F'	IMD	India
4	Abhushan Gautam	Communications Specialist	RIMES	Nepal

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5	Ahmed Rasheed	Director Meteorology, Public Weather Service	MMS	Maldives
6	Alan Thorpe	Professor & Former DG ECMWF	University of Reading	United Kingdom
7	Ali Shareef	Deputy Director General at Weather Service Division	MMS	Maldives
8	Alice Soares	Sr. Hydromet Advisor	World Bank	Portugal
9	Amjad Masood			United States
10	Amna Bibi	Assistant Meteorologist	PMD	Pakistan
11	Ananda Das	Scientist E	IMD	India
12	Anshul Agarwal	Team Leader, Hydrology	RIMES	India
13	Anthony Rea	Director, Infrastructure	UN	Switzerland
14	Anubinda Gurung	Data Visualization Expert	RIMES	Nepal
15	Arati Belle	Sr. DRM Specialist	World Bank	United States
16	Archana Shukla	Sr Programme Manager –Indo Pacific Regional Team	FCDO	India
17	Arun Poudel	IT Specialist	UN	Nepal
18	Ashis Mitra	Head	NCMRWF	India
19	Asif Mahmud	Technical Officer (GIS)	RIMES	Bangladesh
20	Asif Uddin Bin Noor	Research Associate	RIMES	Bangladesh
21	Bishnu Prasad Neupane	Meteorologist	DHM	Nepal
22	Catrina Johnson	Science Manager and Weather Analytics	UKMO	United Kingdom
23	Chaw Su Hlaing	Staff Officer	DMH	Myanmar
24	Clement Albergel	Climate Application Scientist	ESA	Netherlands
25	David Corbelli	Senior International Development Manager	UKMO	United Kingdom
26	David Rogers	Lead Meteorological Consultant	World Bank	Switzerland
27	Dechen Tshering	DRM Specialist	World Bank	Bhutan
28	Dilip Gautam	Country Technical Lead	RIMES	Nepal
29	Dinanath Bhandari	Disaster Resilience Expert	Community-Centred EWS	Nepal
30	Dineesha Wickramaarachchi	Intern	Dialog Axialta PLC	Sri Lanka
31	Dushmanta Pattanaik	Scientist	IMD	India
32	Efrem Ferrari	DRM consultant	World Bank	Italy
33	Elizabeth Gogoi		OPLM	India
34	Elizabeth Page	Director	COMET	United States
35	Erik Andersson	Seconded National Expert to the European Commission	ECMWF	Belgium
36	Fardini Khandaker	Project Officer	RIMES	Bangladesh
37	Farhana Hoque	Senior Monitoring & Evaluation Officer	DAE	Bangladesh
38	G. Srinivasan	Chief Scientist -Climate Applications	RIMES	India
39	Gyanendra Karki		ICDPI	United States
40	Hafizur Rahman	Meteorologist	BMD	Bangladesh
41	Han swe	Assistant Director	DMH	Myanmar
42	Helen Caughey		UKMO	United Kingdom
43	Ibrahim Humaid	Seismologist	MMS	Maldives
44	Itesh Dash	Team Leader – Systems Research and Development	RIMES	Thailand
45	Jagadishwor Karmacharya	Deputy Director General	DHM	Nepal

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46	Janaki Meegastenna	Additional Director General of irrigation	Dol	Sri Lanka
47	Jehangir Ashraf Awan	Deputy Director, R&D Division	PMD	Pakistan
48	Jerry Lengoasa	Director	Disaster Risk Solutions Pty	South Africa
49	Jie Qiu	Applications Development Specialist	RIMES	Thailand
50	KJ Ramesh	Senior Advisor	RIMES	India
51	Kousalya Veerakumar	Project Coordinator	RIMES	India
52	Kumar Margasahayam	Regional Manager,	Earth Networks/ Advanced Environmental Monitoring	India
53	Kyaw Lwin Oo		DHM	Myanmar
54	Kyaw Moe Oo	Director General	DMH	Myanmar
55	Laura Bahlman	Programme Support Officer	Concern Worldwide	Bangladesh
56	Madhab Uprety	Asia Pacific Regional Lead/Technical Adviser	RCCC	Nepal
57	Manish Basnet	Consultant	World Bank	Nepal
58	Masahito Ishihara	Senior Advisor	JICA	Japan
59	Mazharul Aziz	Chief Instructor	DAE	Bangladesh
60	Md. Abdul Mannan	Meteorologist	BMD	Bangladesh
61	Md. Faqrul Arefin	Program Manager	RIMES	Bangladesh
62	Md. Mobinur Rahman	Program Manager	RIMES	Bangladesh
63	Md. Shaheenul Islam	Meteorologist	BMD	Bangladesh
64	Medhani Jayakody	Chief Engineer	Dol	Sri Lanka
65	Michael Ernst	Hydro-Meteorological Hazards Advisor	USAID	Thailand
66	Mitesh V. Sawant	Project Officer	RIMES	Thailand
67	Muhammad Abul Mallik	Meteorologist	BMD	Bangladesh
68	Muhammad Nawaz	Scientific Officer	Climate Energy and Water Research Institute	Pakistan
69	Muhibuddin Usamah		UN	Singapore
70	Nabansu Chattopadhyay	Former DDG and Head, Agricultural Meteorology Division	IMD	India
71	Nadeem Faisal	Director	CDPC, PMD	Pakistan
72	Najibullah Osmani	Meteorologist	AMD	Bangladesh
73	Nazmul Ahasan	IT Developer	RIMES	Bangladesh
74	Neamul Ahsan Khan	GIS Specialist	RIMES	Bangladesh
75	Niraj Shakya	Application Developer	RIMES	Nepal
76	Nishanthi Kalatheeswaran	Regional IT specialist	RIMES	India
77	P. Srinivasalu	General Manager (R&D)	Astra Microwave Private Limited	India
78	Pabitra Gurung	Consultant (DRR Innovation)	Mercy Corps	Nepal
79	Pone Nyet Khaing	Regional Preparedness Technical Advisor	American RedCross	Myanmar
80	Prem Awasthi	Humanitarian Coordination Officer	UN	Nepal
81	Raju Dhar Pradhananga	Senior Divisional Meteorologist	DHM	Nepal
82	Ramraj Narasimhan	Chief, Special Programs Management	RIMES	India
83	Ricky Dador	Weather Observer	LGS	Philippines
84	Ruby Rose	Team Leader – Instituional Development	RIMES	Thailand
85	S.M.Quamrul Hassan	Meteorologist	BMD	Bangladesh

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86	SABAI Lwin	Agrometeorology	DMH	Myanmar
87	Sabuj Roy	Technical Officer	DAE	Bangladesh
88	Safa Khan	Assistant Consultant	OPML	India
89	Samia Jahan	Project Associate	RIMES	Bangladesh
90	Sanim	Hybrid Mobile App Developer	RIMES	Thailand
91	Sarfaraz Khan	Meteorologist	PMD	Pakistan
92	Shaheema Ibrahim	Planning Officer	MMS	Maldives
93	Shahzada Adnan	Meteorologist	PMD	Pakistan
94	Shanti Kandel	Meteorologist	DHM	Nepal
95	Shiromani Jayawardane	Director (Weather Forecasting and DSS)	DoM	Sri Lanka
96	Simon Brown	Services Director	UKMO	United Kingdom
97	Singay Dorji	Chief, Weather and Climate Services Division (WCSD)	NCHM	Bhutan
98	Somenath Dutta	Scientist-F & Head	MTI, IMD	India
99	Subesh Dhakal	Country Coordinator	RIMES	Nepal
100	Sushant Sharma	Project Coordinator	UNDP	United States
101	Syeda Sabrina Sultana	Technical Officer (Meteorology)	BMD	Bangladesh
102	T V S Udaya Bhaskar	Scientist F	INCOIS	India
103	Tarakesh Laksman	DSS Data Scientist	RIMES	India
104	Thanut Rittichai	Project Analyst	RIMES	Thailand
105	Thurailingam Suganthalingam	Irrigation engineer	Dol	Sri Lanka
106	Tin Mar Htay	Deputy Director	DMH	Myanmar
107	Tshencho Dorji	Project Officer	RIMES	Bhutan
108	U Htay Lwin	Engineer	DMH	Myanmar
109	Yunziyi Lang	Analyst	World Bank	Pakistan
Sr. No.	Date: 18 Nov. 2021 Name	Designation	Organization	Country
1	A. R. Subbiah	Directors, RIMES Program Unit	RIMES	Thailand
2	Abdul Muhsin Ramiz	Director Meteorology	MMS	Maldives
3	Abhas Jha	Practice Manager, Climate Change and Disaster Risk Management,	World Bank SA	Singapore
4	Abhijit Sarkar	Scientist 'F'	IMD	India
5	Abhushan Gautam	Communications Specialist	RIMES	Nepal
6	Afruza Sultana	Meteorologist	BMD	Bangladesh
7	Ahmed Rasheed	Director Meteorology, Public Weather Service	MMS	Maldives
8	Ali Shareef	Deputy Director General at Weather Service Division	MMS	Maldives
9	Alice Soares	Sr. Hydromet Advisor	World Bank	Portugal
10	Amjad Masood			United States
11	ANANDA DAS	Scientist E	IMD	India
12	Anshul Agarwal	Team Leader, Hydrology	RIMES	India
13	Arati Belle	Sr. DRM Specialist	World Bank	United States
14	Archana Shukla	Sr Programme Manager –Indo Pacific Regional Team	FCDO	India
15	Arifuzzaman Bhuyan	Executive Engineer	BWDB	Bangladesh
16	Arun Poudel	IT Specialist	UN	Nepal
17	Ashis Mitra	Head	NCMRWF	India

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18	Asif Mahmud	Technical Officer (GIS)	RIMES	Bangladesh
19	Bapon Fakhruddin	Technical Director	Tonkin and Taylor Ltd	New Zealand
20	Ben Churchill	Head, Regional Office for Asia and the South-West Pacific	WMO	Singapore
21	Bikram Manandhar	student		China
22	Branka Ivancan-Picek	Director General	Croatian Meteorological and Hydrological Service	Croatia
23	Catrina Johnson	Science Manager and Weather Analytics	UKMO	United Kingdom
24	Chaw Su Hlaing	Staff Officer	DMH	Myanmar
25	Chinthaka Wijayaweera	IT Expert	SNCCA	Sri Lanka
26	Daniel Kull	Senior DRM Specialist	World Bank	Switzerland
27	David Corbelli	Senior International Development Manager	UKMO	United Kingdom
28	David Rogers	Lead Meteorological Consultant	World Bank	Switzerland
29	Dechen Tshering	DRM Specialist	World Bank	Bhutan
30	Dilip Gautam	Country Technical Lead	RIMES	Nepal
31	Dinanath Bhandari	Disaster Resilience Expert	Community-Centered EWS	Nepal
32	Efrem Ferrari	DRM consultant	World Bank	Italy
33	Elizabeth Page	Director	COMET	United States
34	Fardini Khandaker	Project Officer	RIMES	Bangladesh
35	Farhana Hoque	Senior Monitoring & Evaluation Officer	DAE	Bangladesh
36	Fariha Ferdous Deeny	Project Officer (Communication)	RIMES	Bangladesh
37	Fazlur Rashid	Director General	BWDB	Bangladesh
38	G. Srinivasan	Chief Scientist -Climate Applications	RIMES	India
39	Han Swe	Assistant Director	DMH	Myanmar
40	Henriette B. Mampuya	Operations Officer	GFDRR, WB	Belgium
41	Hussain Waheed	Assistant Meteorologist	MMS	Maldives
42	Ibrahim Humaid	Seismologist	MMS	Maldives
43	Itesh Dash	Team Leader – Systems Research and Development	RIMES	Thailand
44	Jehangir Ashraf Awan	Deputy Director, R&D Division	PMD	Pakistan
45	Jerry Lengoasa	Director	Disaster Risk Solutions Pty	South Africa
46	Jie Qiu	Applications Development Specialist	RIMES	Thailand
47	Jochen Luther	Policy/Programme Officer – Disaster Risk Reduction	EU	United States
48	Joseph Intsiful	Senior Specialist Green Climate Fund	GCF	Senegal
49	KJ Ramesh	Senior Advisor	RIMES	India
50	Kornélia Radics	President	Hungarian Meteorological Service	Hungary
51	Kousalya Veerakumar	Project Coordinator	RIMES	India
52	Kumar Margasahayam	Regional Manager,	Earth Networks/ Advanced Environmental Monitoring	India
53	Kyaw Lwin Oo		DHM	Myanmar

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54	Kyaw Moe Oo	Director General	DMH	Myanmar
55	Madhab Uprety	Asia Pacific Regional Lead/Technical Adviser	RCCC	Nepal
56	Masahito Ishihara	Senior Advisor	JICA	Japan
57	Mazharul Aziz	Chief Instructor	DAE	United States
58	Md. Abdul Mannan	Meteorologist	BMD	Bangladesh
59	Md. Faqrul Arefin	Program Manager	RIMES	Bangladesh
60	Md. Rafiqul Islam		DLS	Bangladesh
61	Md. Shaheenul Islam	Meteorologist	BMD	Bangladesh
62	Michael Ernst	Hydro-Meteorological Hazards Advisor	USAID	Thailand
63	Michael Staudinger	President	WMO RA VI (Europe)	Austria
64	Milan Sacic			Switzerland
65	Mitesh V. Sawant	Project Officer	RIMES	Thailand
66	Mrutyunjay Mohapatra	Director General of Meteorology	IMD	India
67	Muhammad Abul Mallik	Meteorologist	BMD	Bangladesh
68	Muhammad Nawaz	Scientific Officer	Climate Energy and Water Research Institute	Pakistan
69	Nabansu Chattopadhyay	Former DDG and Head, Agricultural Meteorology Division	IMD	India
70	Nadeem Faisal	Director	CDPC, PMD	Pakistan
71	Najibullah Osmani	Meteorologist	AMD	Afghanistan
72	Nazmul Ahasan	IT Developer	RIMES	Bangladesh
73	Neamul Ahsan Khan	GIS Specialist	RIMES	Bangladesh
74	Nishanthi Kalatheeswaran	Regional IT specialist	RIMES	India
75	Padmapriya Tissera	Consultant Specialist	Dialog Axiata PLC	Sri Lanka
76	Raihanul Haque	Country Program Lead	RIMES	Bangladesh
77	Raju Dhar Pradhananga	Senior Divisional Meteorologist	DHM	Nepal
78	Ramraj Narasimhan	Chief, Special Programs Management	RIMES	India
79	Razia Safdar	Chief technical advisor	SPRC	Pakistan
80	Ruby Rose	Team Leader – Institutional Development	RIMES	Thailand
81	S.M.Ataur Rahman	Supertending Engineer	BWDB	Bangladesh
82	S.M.Quamrul Hassan	Meteorologist	BMD	Bangladesh
83	SABAI Lwin	Agrometeorology	DMH	Myanmar
84	Sabuj Roy	Technical Officer	DAE	Bangladesh
85	Sajib Hasan	IT Expert	RIMES	Bangladesh
86	Samia Jahan	Project Associate	RIMES	Bangladesh
87	Sanjay Srivastava	Chief of Disaster Risk Reduction	UNESCAP	India
88	Sarfaraz Khan	Meteorologist	PMD	Pakistan
89	Saroj Acharya	Hydro-met officer	NCHM	Bhutan
90	Shaheema Ibrahim	Planning Officer	MMS	Maldives
91	Shanti Kandel	Meteorologist	DHM	Nepal
92	Singay Dorji	Chief, Weather and Climate Services Division (WCSD)	NCHM	Bhutan
93	Steven Goldfinch	DRR Specialist	ADB	Philippines
94	Syeda Sabrina Sultana	Technical Officer (Meteorology)	BMD	Bangladesh
95	Thanut Rittichai	Project Analyst	RIMES	Thailand

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96	Thurailingam Suganthalingam	Irrigation engineer	Dol	Sri Lanka
97	Tin Mar Htay	Deputy Director	DMH	Myanmar
98	Tshencho Dorji	Project Officer	RIMES	Bhutan
99	U Htay Lwin	Engineer	DMH	Myanmar
100	WMS Priyankara	Engineer	Dol	Sri Lanka
101	Yunziyi Lang	Analyst	World Bank	Pakistan

ANNEX 3: SAHF III PARTNERSHIPS

[KNOWLEDGE PARTNERS AND DEVELOPMENT PARTNERS]

Development Partners:

1. UK Foreign Commonwealth and Development Office (FCDO)
2. Global Facility for Disaster Reduction and Recovery (GFDRR)
3. European Union (EU)
4. World Bank

Knowledge Partners:

1. Japan International Cooperation Agency (JICA)
2. Green Climate Fund (GCF), Asian Development Bank (ADB)
3. United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP)
4. UK Met Office (UKMO)
5. United States Agency for International Development (USAID)
6. European Centre for Medium-Range Weather Forecasts (ECMWF)
7. Maldives Meteorological Services (MMS)
8. Disaster Risk Solutions Pty.
9. Astra Microwave Private Limited
10. Indian National Centre for Ocean Information Services (INCOIS)
11. Cooperative Programme for Operational Meteorology Education and Training (COMET), University Corporation for Atmospheric Research

ANNEX 4: SAHF III ANNUAL SESSION AGENDA

Day 1 [15 November 2021]

11:00 AM to 12 noon (UTC)
(Session duration: 1.0 hours)

Opening Session

Weather and climate services are evolving to serve numerous sectors and support nations to understand and respond to climate risks that are already increasingly being felt in the region. Investments for modernization of weather and climate services are crucial for sustainable development to build climate resilient economies in a context where the science is rapidly evolving and where the impacts further weaken the resilience of poor and vulnerable communities. This session will highlight SAHF’s evolution and its potential contribution to climate resilient economies in South Asia. Speakers include policy makers, NMHSs representatives from the SAHF Executive Council (EC) and development partners.

Session Chair: Dr. M. Ravichandran, Secretary, Ministry of Earth Sciences and Chair RIMES Council –Welcome remarks (5 minutes)

Rapporteurs: Ms. Upeakshika Bandara, RIME, Ms. Dechen Tshering, World Bank and Mr. Efrem Ferrari, World Bank

- Remarks: Dr. Mrutyunjay Mohapatra, Director General of Meteorology, India Meteorological Department and Chair, SAHF EC (5 minutes)
- World Bank – Priorities and support to enhance regional cooperation: Ms. Cecile Fruman, Regional Director, World Bank (7 minutes)
- [WMO Strategic Plan 2020-2023](#) and support to the region on weather and climate services delivery: Mr. Ben Churchill, Head, Regional Office for Asia, and the South-West Pacific, WMO– on behalf of Secretary General, WMO (7 minutes)
- Potential contribution of SAHF to DRR: Mr. Kamal Kishore, Member Secretary, National Disaster Management Authority, Government of India (7 minutes)
- Keynote Address: H.E. Dr. Abdulla Naseer, Minister of State for Environment, Climate Change and Technology of the Government of Republic of Maldives (10 minutes)
- Closing remarks: Mr.A.R. Subbiah, Director, RIMES (5 minutes)

Day 2 [16 November 2021]

04:00 AM to 05:30 AM (UTC) (Session Duration: 1.5 hours)	Session 1. User-focused tailor-made weather and climate services driving the climate/ early warning information value chain
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The session showcases the innovative, proven best practices that are designed around user-needs and demands in the climate/ early warning information value chain and economic rationale for investing in NMHS

Session Co-chairs: Mr. Fazlur Rashid, Director General, Bangladesh Water Development Board and Dr. David Rogers, Lead Meteorological Consultant, World Bank

Rapporteurs: Ms. Carlyne Yu, RIMES, Ms. Dechen Tshering, World Bank and Mr. Efrem Ferrari, World Bank

- Design and delivery of tailor-made services to facilitate Forecast based Actions (FbAs) at the Community Level in Bangladesh – Lessons from Northwest Bangladesh: Mr. Raihanul Haque, Country Lead, RIMES, Bangladesh (15 minutes)
- Panel Discussion (45 minutes) To be moderated by Dr. David Rogers
 - Institutionalizing Forecast-based Action: Learning from 2020 Monsoon in Northwest Bangladesh–Ms. Sumaiya Kabir, Consortium Coordinator, Supporting Flood Forecast-based Action and Learning in Bangladesh (SUFAL), CARE, Bangladesh
 - Benefits of Climate Information Services to National Economy: rationale for investing on NMHSs – by National Council for Applied Economic Research–Dr. Parvinder Maini, Scientist G, Ministry of Earth Sciences, Government of India
 - Economic Valuation of Hydromet and Climate Services – Case Studies from Bangladesh and Sri Lanka–Ms. Arati Belle, DRM Specialist, World Bank & Prof. Sonia Quiroga, Professor, Complutense University of Madrid
 - Challenges and opportunities for institutionalizing user-needs based climate information value chain–Ms. Ruby Rose, Team Leader, Institutional Development, RIMES
- Q&A session (20 minutes)
- Summary: Session Co-chairs (5 minutes)

Session Break: 10 minutes

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05:40 AM to 07:20 AM (UTC) (Session Duration: 1.5 hours)	Session 2. Evolving protocols and support systems for impact-based forecasting
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Forecasters and users work together to co-design integrated and tailor-made services to integrate forecast data into decision systems. SAHF Working Group process identified challenges and opportunities to institutionalize impact-based forecasts in South Asia region. This session will highlight evolving institutional and technological innovation to meet SAHF priorities

Session Chair: Mr. Anil Pokhrel, Chief Executive, National Disaster Risk Reduction and Management Authority, Nepal

Rapporteurs: Mr. Subesh Dhakal, RIMES, Ms. Dechen Tshering, World Bank and Mr. Efrem Ferrari, World Bank

- Evolution of interface institutional mechanisms between NMHS and user/ stakeholder institutions and pilot programs to transform climate/weather data into actionable information (10 minutes each)
 - Bangladesh Center for Climate Applications: Mr. Md. Azizur Rahman, Director, BMD Bangladesh
 - SATARK impact forecast system: Dr. B N Mishra, GIS Expert, Odisha State Disaster Management Authority, Odisha
 - ARRCC contribution to SAHF priorities: Ms. Catrina Johnson, Science Manager and Weather Analytics, UKMO
- Panel Discussion: Sector representatives (45 mins) To be moderated by Mr. Subbiah, Director, RIMES
 - Pakistan Climate Impact and Integration Centre: Dr. Azmat Hayat Khan, Head-CIIC, Pakistan Meteorological Department
 - Integration of Disease Surveillance technologies and climate information for forecast based public health actions: Dr. Reuben Samuel, Programme Area Manager–Country Preparedness & IHR, WHO/SEARO
 - Applications of weather and climate information for agriculture: Dr. Punyawardena, Director, Department of Agriculture, Sri Lanka
- Q&A Session: Google Jam board with sector participants using questions on data, and co-development required for successful implementation of IBF: Lisa, World Bank (20 mins)
- Summary (5 minutes)

Session Break: 10 minutes

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07:30 AM to 09:00 AM (UTC)
(Session Duration: 1.5 hours)

Session 3.
Improving weather and climate forecasts for the region

Weather and climate services to minimize the impacts of extremes at local levels increasingly depend on global and regional forecasts and observational resources. The South Asia region needs to seize opportunities to make full use of global resources and regional collaboration to make strategic investments and plans over the next decade. Such actions will enable NMHSs to meet stakeholder expectations to deliver actionable impact-based forecasts. This session will highlight SAHF priorities and make recommendations to address challenges during the next decade.

Session Co-Chairs : Mr. Karma Dupchu, Director, National Center for Hydrology and Meteorology, Bhutan and Mr. Ben Churchill, Head, Regional Office for Asia, and the South-West Pacific, WMO

Rapporteurs: Tshencho Dorji, Ms. Dechen Tshering, World Bank and Mr. Efrem Ferrari, World Bank

- SAHF program design to meet challenges and harness opportunities in the coming decade: Dr. [Shiromani Jayawardane](#), Director, Weather Forecasting and Decision Support, Department of Meteorology, Sri Lanka (10 minutes)
- Evolution of the [Global Weather Enterprise](#): Dr. [Alan Thorpe](#), Visiting Professor, University of Reading & Former DG ECMWF (10 minutes)

Panel Discussion: Advances in research and development for improving operational weather forecast in the SA region (45 minutes) To be moderated by Mr. Ben Churchill, WMO

- [Monsoon Mission](#): Dr. Suryachandra Rao, IITM, Pune
- Marine/ Coastal Weather & Climate Forecast: Dr. [T. Srinivas Kumar](#), Director, Indian National Center for Ocean Information Services (INCOIS)
- Marine/ Coastal Services: Mr. [Ahmed Rasheed](#), Director, Meteorology, [Maldives Meteorological Services](#)
- Mountain Meteorology: Dr. Singay Dorji , Chief Meteorologist, National Center for Hydrology and Meteorology, Bhutan
- Regional NWP requirements: Dr. [Jehangir Ashraf Awan](#), [Pakistan Meteorological Department](#)
- Open Q&A (20 minutes)
- Summary (5 minutes)

Day 3 [17 November 2021]

05:00 AM to 06:15 AM (UTC)
(Session Duration: 1.25 hours)

Session 4.
Prioritizing training and capacity development requirements

A wide range of capacity building initiatives for NMHSs have been implemented in the South Asia region. Despite these efforts there are residual gaps in capacity development, particularly in service delivery. The session will discuss the training needs of SAHF countries across the entire hydromet services information value chain building on the assessment taken up by World Bank and RIMES through reviews, individual country consultations and assessment surveys. The session will highlight best practices from global experiences and other innovations that could be adopted in South Asia.

Session Chair: Dr. Shiromani Jayawardane, Director, Weather Forecasting and Decision Support, Department of Meteorology, Sri Lanka

Rapporteurs: Ms. Samia Jahan Chowdhury, RIMES, Ms. Dechen Tshering, World Bank and Mr. Efrem Ferrari, World Bank

- SAHF Capacity Development Challenges and Priorities: Dr. G. Srinivasan, Chief Scientist, RIMES and Dr. K. J. Ramesh, Advisor, RIMES (10 minutes)

Panel Discussion: Contributions of global, regional, and national institutions to SAHF CE priorities (45 minutes) To be moderated by Dr. G. Srinivasan, RIMES

- Customization of [COMET training modules](#) for SAHF: Dr. [Elizabeth Page](#), The University Corporation for Atmospheric Research (UCAR)
- Contribution to SAHF priorities: India Meteorological Department (IMD), Regional Training Center, Pune: Dr. Somnath Dutta, IMD
- Contribution to SAHF priorities: Pakistan Meteorological Department (PMD), Training Division, Karachi: Dr. Sarfaraz, PMD
- Training resources for addressing SAHF priorities by UK Met Office: Dr. Helen Caughey, UKMO
- Opportunities for Advanced Training on Operational Oceanographic Services to SAHF Countries by International Training Centre for Operational Oceanography ([ITCOcean](#)), INCOIS: Dr. T V S Udaya Bhaskar, Scientist F, INCOIS
- Q&A session (15 minutes)
- Summary (5 minutes)

Session Break: 10 minutes

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06:30 AM to 08:30 AM (UTC)
(Session Duration: 2 hours)

Session 5.
**Observational systems and regional data exchange for
monitoring and prediction of extremes**

An optimal observational system requires an ability to integrate and manage diverse sources of hydrometeorological data. Major observational system considerations in South Asia are sustaining observational networks, operation and maintenance issues, interoperability, and data-sharing. The session will feature a discussion on development of strategic plans for observational networks and enhancing data sharing arrangements in the region to improve detection and warning for extreme events.

Session CO-Chairs: –Dr Jagadishwor Karmacharya, Deputy Director General of Department of Hydrology and Meteorology, Nepal and Dr. Kyaw Moe Oo Director General, Department of Meteorology and Hydrology, Myanmar

Rapporteurs: Dr. Anshul Agarwal, RIMES, Ms. Dechen Tshering, World Bank and Mr. Efrem Ferrari, World Bank

- SAHF priorities for enhancing and sustaining observation networks: Mr. Nadeem Faisal, SAHF WG on Observational Networks (5 minutes)
- Updates on WMO Observations & Data exchange Infrastructure and protocols: Mr. Anthony Rea, Director, Infrastructure (D/I), WMO (10 minutes)
- [European Space Agency](#) data and products support to South Asia hydromet services: Mr. Clement Albergel, Climate Application Scientist, ESA (10 mins)
- Contribution of RIMES regional data sharing mechanisms by harnessing state of art data analytics technologies and innovative institutional practices to address SAHF priorities: Dr. Itesh Dash, RIMES (10 minutes)
- Leveraging public and private sector engagement to meet SAHF priorities: Mr. Kumar Margasahayam, Regional Manager, Earth Networks/ Advanced Environmental Monitoring (10 minutes)

Panel Discussion: Harnessing innovations in observation systems and enhancing effectiveness of O&M to meet SAHF priorities: Global Weather Enterprise (GWE) (60 minutes) To be moderated by Dr. Alice Soares, World Bank and Dr. K.J Ramesh, Senior Advisor, RIMES

- [Mr. Simon Brown](#) (Services Director, UK Met Office)
- Dr. Jagadishwor Karmacharya, DDG, DHM, Nepal
- [Mr. Erik Andersson](#) (Seconded National Expert to the European Commission , ECMWF)
- Mr. Ali Shareef, DDG, Maldives Meteorological Services
- [Mr. Jerry Lengoasa](#) (Director, Disaster Risk Solutions Pty.)
- Dr. P. Srinivasalu (General Manager (R&D), Astra Microwave Private Limited)
- Q&A session (10 minutes)
- Summary (5 minutes)

Session Break: 10 mins

Day 4 [18 November 2021]

05:00 AM to 06:40 AM (UTC)
(Session Duration: 1.5 hours)

Session 6.
**Regional partnerships for improved weather and climate
services in South Asia**

Significant efforts are being made to improve weather and climate services in South Asia mostly through national investments. These are essential to build the capability to exploit scientific and technological advances to deliver a wide range of services demanded by users. However, these demands are growing with increasing climate risks and severe weather events and scientific and technical advancements. Discrete investments and country alone approaches do not have lasting impacts in sustaining these services. The increasing volume of data and the technical knowledge needed to interpret information is a limiting factor in the performance of many national meteorological services. Observational networks, computing resources and technical skills are shared needs of all countries. As the region seeks to modernize and deliver accurate and timely services, investments at the agency, country and regional level that maximize shared benefits while also providing tailored services to user specific needs will become inevitable. This has been well demonstrated in Europe through organizations such as ECMWF, EUMETSAT and EUMETNET. By pooling skills and resources, countries have equal access to a very high level of shared knowledge that would otherwise be prohibitively expensive or unavailable.

This session considers the opportunities (and obstacles) for regional collaboration and investments in weather and climate services that would have the potential to increase significantly the value of national meteorological services.

Session Chair: Mr. Abhas Jha, Practice Manager, Climate Change and Disaster Risk Management, World Bank South Asia Region

Rapporteurs: Dr. G. Srinivasan, RIMES, Ms. Dechen Tshering, World Bank and Mr. Efrem Ferrari, World Bank

- Regional investments in Hydromet: Southeast Europe showcase, World Bank (30 minutes)
 - Daniel Kull, Senior DRM Specialist, World Bank Europe, and Central Asia
 - Dr. Michael Staudinger, President of WMO RA VI (Europe)
 - Dr. Branka Ivancan-Picek, Director General, Croatian Meteorological and Hydrological Service
 - Dr. Kornélia Radics, President, Hungarian Meteorological Service

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Panel Discussion: Regional approach and investments for strengthening hydromet services in SAR (45 minutes) To be moderated by Mr. Abhas Jha, World Bank

- UK Foreign Commonwealth and Development Office (FCDO): Ms. Archana Shukla, Senior Programme Manager, Asia Regional Team
 - Green Climate Fund (GCF): Mr. Joseph Intsiful, Senior Climate Information and Early Warning Systems Specialist
 - Japan International Cooperation Agency (JICA): Dr Masahito Ishihara, Senior Advisor on Meteorological Sector
 - US Agency for International Development (USAID): Dr. Michael Ernst, Support Relief Group (SRG) Senior DRR/Hydro-Meteorological Hazards Advisor, Bureau of Humanitarian Assistance
 - Asian Development Bank (ADB): Mr. Steven Goldfinch, DRR Specialist
 - United Nations Economic and Social Commission for Asia and the Pacific (UN ESCAP): Dr. Sanjay Srivastava, Chief of Disaster Risk Reduction UN Economic and Social Commission
 - UK Meteorological Office (UKMO): Mr. David Corbelli, Senior International Development Manager, ARRC program Q&A session (20 minutes)
- Summary (5 minutes)

06:40 AM to 07:40 AM (UTC)
(Session Duration: 1 hour)

Closing Session

Rapporteurs: Ms. Kousalya V Kumar, RIMES, Ms. Dechen Tshering, World Bank and Mr. Efrem Ferrari, World Bank

- Feedback and comments from participants – Mr. Ramraj, RIMES(facilitator); Dr. K.J Ramesh, RIMES; Dr. Alice Soares, WB (moderators) (30 minutes)
- SAHF III: Way forward: Ms. Arati Belle, Sr Disaster Risk Management, World Bank; Dr. Mohapatra, Director General of Meteorology, India Meteorological Department ;Mr.A.R. Subbiah, Director, RIMES (30 minutes)



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