

# CLIVAR/GEWEX Monsoons Panel Annual Report 2023

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## **1. Panel overview**

### **1.1 Background**

The CLIVAR/GEWEX Monsoons Panel (MP) was established in 2014 with the remit of: (a) taking a more global view of monsoon activities, enabling knowledge and best practice to be shared between the various monsoon regions and (b) to better coordinate monsoons research between GEWEX and CLIVAR, particularly in emphasizing the role of convection and the land surface in the monsoons. The MP membership encompasses the research interests of both CLIVAR and GEWEX as well as all the regional monsoons, with in-country membership where possible. While the MP takes a global view, it is also important to address region-specific details, particularly in engaging regional stakeholders and managing local knowledge exchange and up-skilling. Keeping this in view, the MP has established a sub-structure of working groups (WGs) dedicated to three monsoon regions, namely the Asian-Australian (WG-AAM), African (WG-AFM) and American (WG-AMM) Monsoons.

The three regional monsoons WGs are working towards enhancing understanding of the monsoons in those regions through various process studies with an emphasis on improving prediction skills in those respective areas. The primary focus of these groups is to build a partnership between operational met departments and researchers that is intended work on various strengths and limitations of the present climate models in predicting weather and climate in those regions. The regional working groups also establish sub-groups to focus on different topics. In these sub-groups, researchers beyond working groups, particularly Early Career Scientists (ECS), are engaged in various studies to address the significant issues of the regional WGs. The MP guides the WGs on multiple tasks and research priorities and in promoting cross-cutting activities and synergies among groups.

See Monsoons Panel web pages for Terms of Reference (ToRs), membership and previous reports:

- <http://www.clivar.org/clivar-panels/monsoons>
- <https://impo.tropmet.res.in/wcrp-monsoon.html>

Activities of the MP are supported by the International Monsoons Project Office (IMPO), hosted at Indian Institute of Tropical Meteorology (IITM), Pune, India, under a new agreement signed between WMO and IITM on 30<sup>th</sup> July 2021. IMPO also supports the monsoon activities of the Working Group on Tropical Meteorology Research (WGTMR) of the World Weather Research Programme (WWRP), facilitating the MP's linkages with WWRP monsoon activities.

### **1.2 MP's current main missions**

The MP coordinates strategies, advises on plans and defines concrete activities to carry out studies on the suggested research priorities, including selecting, limiting, and concluding such activities as

appropriate. MP encourages studies on priority themes by groups from different monsoon domains and facilitates and/or promotes collaboration among monsoon researchers. MP stimulates the interest of researchers and students in monsoon related problems by supporting and organizing workshops, advanced schools, and promoting scientific sessions in conferences with focus on monsoons. MP also coordinates the formation and function of regional working groups and collaborates with the WCRP and WWRP substructures relevant to monsoon research regarding the organization of scientific meetings and regional working groups, as well as on relevant issues for advancing monsoon research. Finally, MP supports work in cooperation with regional, national, and multinational programs to enhance the understanding of monsoon systems and improve monsoon prediction from synoptic to decadal time scale and longer, setting strategic priorities for long-term climate projection. MP also has a mission to communicate existing products and provide guidance on their (adequate) application and limitations to the operational community, (relevant) impacts community and participate in relevant training activities.

The current goal of the MP is to identify the bottlenecks to further improve the skills of dynamical models in representing the monsoons on multi-spatiotemporal scales, including extreme weather. The activities lined up for addressing these activities include:

- Assess and improve the skill of monsoon rainfall in different regional monsoons and identify the bottlenecks in the dynamical models.
- Improve understanding of dynamical and physical processes associated with extreme events and identifying the lacuna in capturing these extremes in present-day models.
- Promote Research to Operations (R2O) activities to contribute with the Regional Climate Outlook Forums (RCOFs) and operational meteorological services.
- Build capacity by promoting ECS representation in the WGs and subgroups developing these activities

### **1.3 MP's 2023 Activities**

#### **1.3.1 Organizational Activities**

The Fifth Session of CLIVAR/GEWEX Monsoons Panel was held on 27<sup>th</sup> October 2023 during WCRP/OSC-2023 in Kigali, Rwanda in hybrid mode (with 5 members attending in-person and 3 online). A special In-person meeting of MP and WG-AFM members (with 10 members attending in-person and 3 online) was also organized on 27<sup>th</sup> October 2023. Jan Polcher (GEWEX SSG Co-chair) attended the whole meeting (2.5 hours long) and gave his valuable suggestions/comments. A photo displaying the session in-progress is given in Appendix-I.

In addition, MP held 4 virtual meetings in 2023, which have served as discussions on the highlights of the activities of MP, its regional WGs and their future work plans. In addition, the two co-chairs also held a few infrequent teleconferences.

- WG-AFM held 6 virtual meetings to discuss on the writing of a review article on “Climate Modeling of Precipitation over Africa” and the activities of their 3 sub-groups (Viz., South & East Africa, West Africa, and Central Africa)

- WG-AAM held 4 virtual meetings to discuss on the activities of the group and its 3 sub-groups (Viz., Monsoon Processes and Teleconnections; R2O for monsoon seasons in SE Asia; High Impact Weather Events) and on the Asian/Australian (summer) Monsoon 2023.
- WG-AMM had only email exchanges among its members to discuss on their activities.

MP was actively involved in the selection and appointment of the 3 new members to the panel (Dr. Ruth Cerezo-Mota, Prof. Hui Su and Dr. Hiroshi Takahashi) in February 2023.

MP was also actively involved in the selection and appointment of the 2 new members of WG-AMM (Dr. Caio Augusto dos Santos Coelho and Dr. Robin Chadwick) in June and August 2023, respectively. The details of the current memberships of MP and the regional working groups are available at the following links:

- CLIVAR/GEWEX Monsoons Panel (14 members; Female: 7, Male: 7)
  - Co-Chairs: Prof. Leila M.V. Carvalho and Dr. Suryachandra Rao Anguluri
  - <https://impo.tropmet.res.in/wcrp-monsoon.html>;
- Asian-Australian Monsoons (17 members; Female: 6, Male: 11)
  - Co-Chairs: Dr. Gill Martin and Dr. Tieh Yong Koh
  - <https://impo.tropmet.res.in/mpwg-aam-members.html>;
- African Monsoons (21 members; Female: 8, Male: 13)
  - Co-Chairs: Dr. Rondrotiana Barimalala and Dr. Akintomide Afolayan Akinsanola.
  - <https://impo.tropmet.res.in/mpwg-afm-members.html>;
- American Monsoons (15 members; Female: 7, Male: 8)
  - Co-Chairs: Dr. Alice Grimm and Dr. Ruth Cerezo-Mota
  - <https://impo.tropmet.res.in/mpwg-amm-members.html>.

About seventeen (17) members of MP and its regional working groups are early career researchers.

### ***1.3.2 Scientific Activities***

- Leila participated in the 27<sup>th</sup> Session of CLIVAR SSG on 2<sup>nd</sup> February 2023 and presented the recent activities of MP and its Regional Working Groups online.
- Surya participated in the GEWEX SSG meeting in-person during 1-4 May 2023 in Santiago, Chile and presented the recent activities of MP and its Regional Working Groups
- Surya participated in the 28<sup>th</sup> Session of CLIVAR SSG on 22 and 27 October 2023 at Kigali, Rwanda.

*Please also read Section 2.2*

## **2. Achievements for 2023**

### ***2.1 Workshops***

- SASCOF: Suryachandra Rao gave a talk on behalf of the WG-AAM entitled "Status of seasonal predictions for Asian monsoon and how to improve outlook reliability" at the

SASCOF (24-26 April, 2023). Several WG-AAM members attended and presented seasonal outlooks at this meeting.

- ASEANCOF: The R2O subgroup gave a presentation at ASEANCOF (25 May) describing their aim to develop a regional monsoon index for Southeast Asia, results from the questionnaire during ASEANCOF-18, and a brief description of the proposed regional monsoon index. Discussions during ASEANCOF highlighted that the impact of ENSO on the boreal summer monsoon (SW monsoon) is not uniform across Southeast Asia, therefore any regional monsoon index should capture this (and other) differences.
- Members of the MP and working groups were actively involved in the WCRP OSC-2023:
  - Izidine Pinto (WG-AFM) functioned as a Theme Lead for “Theme 2: Human Interactions with Climate” and a Convenor of the session “S24: Attribution of changes”.
  - Suryachandra Rao A. (MP) and Tereza Cavazos (WG-AMM) were the Convenors of the session “S03: Global and Regional Monsoons”.
  - Caio Augusto dos Santos Coelho (WG-AMM) was a Convenor of the Session 28: Regional Information – Data and Methods and also delivered an oral talk on “Cascading multi-model sub-seasonal predictions from global to regional and local scales” in the same session.
  - Izidine Pinto (WG-AFM) was a Convenor of the Session 24: Attribution of Changes.
  - Two Poster Clusters (PC) proposed by members of WG-AFM & WG-AMM and WG-AAM were presented online and displayed in the poster sessions.
  - Alice Grimm (Co-chair, WG-AMM) delivered a keynote talk on “Major issues and challenges for the American monsoons” in the Session 03: Global and Regional Monsoons.
  - Rondrotiana Barimalala (Co-chair, WG-AFM) delivered a keynote talk on “Major issues and challenges for the African monsoons” in the Session 03: Global and Regional Monsoons.
  - Masilin Gudoshava (WG-AFM) delivered a keynote talk on “The objective seasonal forecasting approach over Eastern Africa: Benefits, challenges and future prospects” in the Session 28: Regional Information – Data and Methods.
  - Paul-Arthur Monerie (WG-AFM) delivered an oral talk on “A zonal contrast in future changes in Sahel precipitation” in the Session 37: Regional Attribution.
  - Leila Carvalho and Suryachandra Rao A (MP Co-chairs) are the Co-Lead authors of the Concept Paper on Regional and Global Monsoons for the OSC Kigali Declaration with Michelle Simões Reboita & Tereza Cavazos (WG-AMM), Neil Hart & Rondrotiana Barimalala (WG-AFM), Kieran Hunt (WG-AAM) and Hiroshi Takahashi (MP) as co-authors.
  - Poster Presentations in OSC-2023:
    - Shiromani Jayawardena (WG-AAM) - Predictability of extreme rainfall event using ECMWF Extreme Forecast Index Case Study: Heavy Rain event in Sri Lanka from 1<sup>st</sup> to 3<sup>rd</sup> August 2022
    - Shiromani Jayawardena (WG-AAM) - Future projections of heat wave activity for Colombo area under moderate and high emission scenarios
    - Gill Martin (WG-AAM) - Understanding the development of systematic errors in the Asian summer monsoon
    - Thea Turkington (WG-AAM) - A Regional Monsoon Index for Southeast Asia

- Shingirai Nangombe (WG-AFM) - Attribution of climate change attribution of the 2018 early summer drought in south southern Africa.
- Neil Hart (WG-AFM) - The decline of tropical-extratropical cloud bands in the Southern Hemisphere subtropics
- Mojisola Adeniyi (WG-AFM) - Simulation of the impacts of 1.5°C to 3°C regional warming levels on heat related death over West Africa
- Paul-Arthur Monerie (WG-AFM) Uncertainty in future changes in Sahel precipitation: a role of the warming of the North Atlantic and Euro-Mediterranean areas.
- Caroline Wainwright (WG-AFM) - Investigating the Drivers of Dry Season Rainfall over Eastern Africa
- Kieran Hunt (WG-AAM) - The future of low-pressure systems in the Indian monsoon
- Kieran Hunt (WG-AAM) - Non-linear intensification of monsoon low-pressure systems by the BSISO
- Pankaj Kumar (MP) - A Regional Earth System Modelling framework for Monsoon studies over CORDEX-SA region
- Ajaya Mohan Ravindran (MP) - Atlantic Zonal Mode: An emerging source of Indian summer monsoon variability in a warming world
- Michelle Simões Reboita (WG-AMM) - Weather and Climate of South America: A Review
- Michelle Simões Reboita (WG-AMM) - Response of the Southern Hemisphere Extratropical Cyclone's Climatology to the Solar Radiation Management
- Suryachandra Rao A. (MP) - Impact of Bay of Bengal Eddies on Indian Summer Monsoon Rainfall
- Rachel James (WG-AFM) - The SALIENT Research Programme: combining adaptation-led climate science and learning from psychology and risk communication to improve understanding of possible, plausible and probable futures.
- Alice Grimm (WG-AMM) - Changes in the South American monsoon phases under El Niño-like future warming.

*Please also read Section 2.2*

## **2.2 Scientific Results from Activities**

### **• Scientific Results from WG-AAM:**

- *Monsoon Processes and Teleconnections (MPT) subgroup:* This subgroup has been examining the prediction skills of wintertime surface air temperature in C3S models preliminarily for the Asian region. The skill is found to be high in the subtropical regions and much lower in the mid- and high-latitude inner lands. The capability of the models to capture the observed temperature modes was also evaluated, but the results are very sensitive to the choice of domain. A paper is being drafted which will describe the skill

of Subseasonal to Seasonal predictions and bottlenecks, and why teleconnections to Nino SSTs are poor.

- *Research to Operations for monsoon seasons in SE Asia (R2O) subgroup*: This subgroup meets quasi-monthly and has been exploring a wind-based definition for monsoon seasons in SE Asia that draws upon research published by Lee and McBride (2016). An original formulation for the South-East Asian Monsoon Progression Index (SEAMPI), when tested using NCEP/NCAR and ECMWF reanalyses, revealed sensitivity to the nominal definition of the windows in which we look for the onsets and terminations of northerly and southerly monsoons. The group has since been working on a revised approach to identifying reference monsoon winds in SE Asia. This work was presented at ASEANCOF-20 in May, where it was well received. A poster on the work will be presented at WCRP OSC in October 2023.
- *High Impact Weather Events (HIW) subgroup*: Case studies of high impact events from recent years have been reviewed to see how they were observed and forecast, and how decision-making was affected. The group has discussed the disconnect between seasonal outlooks, which are for the country and season as a whole, and the variability on sub-seasonal and medium-range timescales, plus extreme events, that are experienced on the ground. Some countries have no capacity for creating sub-seasonal outlooks, despite a pressing need for landslide and lightning forecasts. There is also a lack of consistency in how each regional met service communicates the risks of extreme events, as inferred from the seasonal outlooks, to their stakeholders. A draft document is being written on this topic, with examples contributed by WG members documenting the issues based on some benchmark extreme event case in their respective region.
- *Unusual characteristics of monsoons 2022*:
  - As reported last year, the WG-AAM considers the unusual characteristics of the 2022 summer monsoon season to be worthy of study and documentation. We have continued to pursue this, although progress on this has been slow due to personal circumstances and commitments. However, there is still enthusiasm for taking this forward. An outline structure was discussed whereby the emphasis would be on the unusual large-scale characteristics of the Asian Summer Monsoon 2022 (including displaced monsoon trough and associated larger scale circulation variations affecting dynamical indices and path/frequency of monsoon lows and tropical depressions crossing India, Pakistan, E Asia, and low-level flow transporting moisture to Sri Lanka and Indonesian Islands, Maritime Continent etc.) and how this relates to the extreme events experienced in various regional monsoons.
  - One of the WG meetings featured a detailed presentation by Shiromani Jayawardena on the winter monsoon events of 2022/23 and the seasonal forecasts for this period issued by the Sri Lankan Meteorological Department.
  - Since 2023 has also been a somewhat unusual year for the boreal summer monsoons, a specific meeting has been arranged for November 2023 to discuss this year's AAM and sub-regional characteristics. A research paper or newsletter article comparing the contrasting monsoons in 2023 and 2022 is also being considered.

- ***Scientific Results from WG-AFM:***

- The West Africa subgroup is analyzing the representation of the mesoscale convective systems over West Africa using the DYAMOND data. Significant progress has been made, and hopefully the results will be ready early next year.
- The Central Africa subgroup is currently assessing the role of Central Africa in modulating the regional monsoons.
- Some of the South-East and Central Africa teams are involved in a “taskforce for understanding the eastern Africa March-May rainfall”. There is a discussion on writing a white paper about the critical need for observational data and a comprehensive field campaign in the area, to be co-led by members of the AFM-WG with other senior scientists who have experience from the AMMA program. This idea was also suggested to be included in the GPEX lighthouse activity.
- The entire working group is currently revising a review paper titled “Climate Modeling of Precipitation over Africa: Progress, Challenges, and Prospects.” The manuscript reviews our current knowledge of the modeling of African precipitation and, more importantly, identifies the gaps that need to be addressed by the research community.
- Since all members in the WG group are new, a mapping of the expertise and projects in which each member is involved was conducted in order to improve the collaboration and the focus of the subgroup.

- ***Scientific Results from WG-AMM:***

- Members have engaged with Climate Outlook Forums and organized or taken part in a number of conferences, workshops, and meetings, several of them with participation of stakeholders, civil defense personnel, and students. These activities have been enhanced in view of the present El Niño event 2023-2024, which will impact on the monsoons season, and the increased interest about climate change impacts following the change of government in Brazil.

## ***2.3 Scientific Capacity Building and Career Support***

- MP played a key role in the successful organization of the first [Joint WCRP/WWRP Webinar Series on Global Monsoon](#) held on 13<sup>th</sup> September 2023, which featured talks by eminent scientists, Prof. Bin Wang and Dr. Annalisa Cherchi. Dr. Suryachandra A. Rao (Co-Chair MP) chaired the webinar. A screenshot of the in-progress webinar is displayed in Appendix-II. Out of the 307 registered attendees, 175 attended the webinar. [Video recording](#) of the webinar has been made available in IITM YouTube channel for wider reach & publicity, which already has 356 views.
- WG-AAM played a key role in the successful organization of the second [Joint WCRP/WWRP Webinar Series on Asian-Australian Monsoon](#) held on 30<sup>th</sup> November 2023, which featured talks by eminent scientists, Prof. B N Goswami and Dr. Tim Cowan. Drs. Gill Martin (Co-Chair WG-AAM) and Thea Turkington co-chaired the webinar. A screenshot of the in-progress webinar is displayed in Appendix-II. Out of the 228 registered attendees, 120 attended the webinar. [Video recording](#) of the webinar has been made available in IITM YouTube channel for wider reach & publicity, which already has 220 views.



- Insights such as recent scientific advances from the WG-AAM meetings are shared with concerned operational and R&D activities of Philippine Atmospheric, Geophysical, and Astronomical Services Administration (PAGASA), more specifically in the development and definition of local monsoon index in the Philippines.
- Activities of the WG-AAM such as webinars, conferences, and call for career opportunities are shared to the technical personnel of PAGASA as a support for scientific capacity building on recent advances in monsoon community.
- As another form of diversity, equity, and inclusion (DEI) in the international monsoon community, it is noteworthy that the Philippines is represented in the WG-AAM considering that the WNP monsoon is largely observed in the Philippines.
- Caio Coelho (WG-AMM) participated in the online training activity of SISSA on calibration of seasonal predictions, 14 June 2023, and delivered the talk: Calibration of seasonal forecasts
- Caio Coelho (WG-AMM) participated in the virtual workshop of sub-seasonal prediction – Historical prediction database, organized by SISSA-RCC-SSA in collaboration with RCC-WSA, 27 September 2023, and delivered the talk on CPTEC/INPE experience in sub-seasonal predictions over South America.
- WG-AFM is in the process of organizing a training or workshop for African students and early-career researchers focusing on climate modeling, data analysis, and other topics yet to be discussed.

## 2.4 *Knowledge Exchange*

- Several of the WG-AAM members are regular contributors to the Regional Climate Outlook Forums for the Asian-Australian region (SASCOF, ASEANCOF, EASCOF), allowing the group to provide guidance on model strengths and weaknesses and to reach out to stakeholders.
- Several WG-AAM members attended and presented at the EGU General Assembly in April, in the session “Monsoon systems in the past and present and under future climate change” (Prof. Andy Turner, University of Reading):
  - Kieran Hunt: Nonlinear intensification of monsoon low pressure systems by the BSISO.
  - Gill Martin: Why is there a systematic bias in the Asian Monsoon in the Met Office Unified Model?
- Several WG-AAM members attended and presented at the WWRP/WCRP S2S Summit, in Reading, UK during 3-7 July 2023
  - Donaldi Permana presented on “The impact of the BSISO on boreal summer rainfall anomalies in Indonesia”
  - Kieran Hunt presented on “Nonlinear intensification of monsoon low pressure systems by the BSISO”.
- Several WG-AAM members attended and presented at the AOGS 2023
  - Thea Turkington presented or co-authored several talks and posters and also chaired the session on “Subseasonal to Seasonal Forecasts and Applications”
  - Wei Ting Chen presented or co-authored several talks and posters and also chaired the session on “The Physical Processes Over Complex Topography: The



Interactions Among Meteorology, Boundary Layer Turbulence, Clouds, Tracer Transport, and Chemistry”

- Donald Permana presented or co-authored several talks and posters including “The Impact of Intraseasonal Oscillation and Equatorial Waves on Rainfall Extremes in Indonesia” (invited speaker)
- Lin Wang presented or co-authored several talks and posters including “Decadal Background for Active Extreme Drought Episodes in the Decade of 2010–19 Over Southeastern Mainland Asia”.
- Huqiang Zhang presented or co-authored several talks including an invited talk “High-Resolution Weather and Climate Modelling at CCRS: Current Status and Future Priorities”.
- Shiromani Jayawardena (WG-AAM) presented at the Workshop on Long Range Forecast for the 2023 Southwest Monsoon Season Rainfall and its application on South Asian Agriculture held on 13 May 2023 virtually - “Recommended Strategies in agriculture based on LRF 2023 in Sri Lanka”.
- The WG-AAM is organizing the second webinar in the Joint WCRP/WWRP Monsoons Panel webinar series on Global Monsoons, with talks on the impact of climate change on Indian monsoon and on the development and implementation of operational services for the Australian monsoon, followed by a discussion on outstanding challenges in monsoon predictions and projections on 30<sup>th</sup> November 2023.
- A group led by Ross Dixon (WG-AFM) has successfully proposed a session titled “African Climate Change and Variability”, to be conveyed at the AMS 2024 meeting.
- In the 75<sup>th</sup> Annual Meeting of the Brazilian Society for the Progress of Science (SBPC), held in Curitiba, 23-29 July, 2023, Alice Grimm (WG-AMM) proposed two of the activities carried out in this event:
  - Conference by Dr Carlos Nobre on the need to preserve the Amazon forest and exploit it sustainably (26<sup>th</sup> July 2023)
  - Round Table on Climate Change and its impacts on climate and biodiversity in Brazil, in which Prof. Alice Grimm delivered a talk on the impacts on climate in Brazil, especially during the monsoon season.
- In the Workshop on the 2023-2024 El Niño on 31<sup>st</sup> July, 2023, organized by the Santa Catarina Association of Meteorologists (ACMET), Federal University of Santa Catarina, Civil Defense and State Company of Agricultural Research and Rural Extension of Santa Catarina, Prof. Alice Grimm (WG-AMM) delivered the [Keynote Talk](#) that opened the event, in which the impacts of the events in the monsoon season (spring, summer, early autumn) were described and explained. Researchers, students, stakeholders, civil defense personnel, stakeholders and public took part of this event.
- In the 28<sup>th</sup> IUGG General Assembly, Berlin, 11-20 July 2023, Alice Grimm (WG-AMM) delivered an oral presentation on “Conditions associated with continuing and terminating MJO events during the monsoon season”, in the session M32b - Sub-Seasonal to Decadal Prediction (S2S-S2D), 15<sup>th</sup> July 2023.
- In the WWRP/WCRP S2S Summit during 3 to 7 July 2023, University of Reading, UK:
  - Caio Coelho (WG-AMM) gave a talk on “The S2S sub-project on Research to Operations (R2O): forecast and verification products development”.

- Felipe de Andrade (WG-AMM) gave a talk on “Evaluating the representation of South America precipitation variability patterns in sub-seasonal predictions of S2S project models”.
- In the International Conference on Regional Climate ICRC-CORDEX 2023 | (ICTP, smr 3878), Michelle Reboita (WG-AMM) presented two posters:
  - A3-P-20: The South American Monsoon lifecycle projected by an ensemble of CMIP6-GCM statistically downscaled
  - A2-P-23: Assessment of homogeneous groups climatology simulated by RegCM-CP over southeastern South America
- Caio Coelho and Felipe de Andrade (WG-AMM) participated in monthly climate discussion meetings organized by CPTEC/INPE to discuss with Brazilian partners institutions (INMET-FUNCEME-CENSIPAM), the seasonal climate outlook for Brazil in the forthcoming season.
- Marcelo Barreiro (WG-AMM) has been attending the monthly meetings with the Uruguayan weather service (INUMET) to prepare the seasonal forecast.
- Alice Grimm (WG-AMM) delivered an invited talk on impacts of climate change on monsoon precipitation in Brazil during the event “Intelligence and climate change: action of public authorities in the face of natural disasters”, organized by the Brazilian Intelligence Agency (ABIN) in November 2023.

## 2.5 *Cross-panel Activities*

- Masilin Gudoshava (WG-AFM) is actively involved in the “My Climate Risk” LHA.
- Izidine Pinto (WG-AFM) is actively involved in “Safe Landing Climates” LHA.
- Caio Coelho (WG-AMM) is a member of the Expert team on Climate Services Information System Operations, co-chair of the Expert team on Operational Climate Prediction System, and co-chair of the Joint Working Group of Forecast Verification Research.
- The West African Sub-group of WG-AFM is currently looking at the GEWEX/GASS DYAMOND high resolution model outputs to see how the model represents the mesoscale convective system in the area and how does it affect the monsoon.
- Ismaila Diallo of WG-AFM is participating in the LS4P-II (Land Surface for Predictions) project of GEWEX/GASS and trying to see how we can use land surface to predict extreme events over control regions. Currently he is working on how to implement LS4P-II techniques to improve the prediction of weather extremes in Africa.
- Wei Ting Chen and Lin Wang of WG-AAM are identified for the SPARC activity on Atmospheric Composition and the Asian Summer Monsoon (ACAM). – Finally established contact with ACAM this month.
- Pankaj Kumar, Hui Su and Hiroshi Takahashi of MP are identified for collaborating with CliC on understanding the connections between the Himalayan cryosphere and Asian monsoons & Impacts of reduced Arctic sea-ice on Asian monsoons.
- WG-AFM is in discussion with SPARC about co-organizing a workshop to foster more partnership between the global South and North regarding climate change and mitigation.
- Annalisa Cherchi (MP) is a member of EPESC LHA WG2, and she is starting to co-lead with Andrea Dittus coordinated activities within the WG about “Tropical circulation variability and trends”.

- Michelle Reboita is member of the American Monsoon Working Group, collaborator of CORDEX South America and Central Asia domains and member of the Working Group on Tropical Meteorology Research (WGTMR-WMO).
- Jhan-Carlo Espinoza is a Co-Chair of the Regional Hydroclimatic Program (RHP) for the Andes, ANDEX, supported by GEWEX/WCRP. Since 2019, he has been a member of the Science Panel for the Amazon (SPA).

### 3. Plans for 2024 and Beyond

- Members of MP and the WGs will be involved as Guest Editors/Contributors for a special issue of Advances in Atmospheric Sciences on global monsoons, including Asian monsoon, American monsoon, African monsoon, and Australian monsoon.
- WG-AFM and WG-AMM will be actively involved in the organization of the Joint WCRP/WWRP MP Webinar Series on African and American Monsoons in early 2024.
- WG-AAM's Subgroup activities will continue and aim to publish results of work from past 1-2 years.
- The WG-AAM will aim to complete an article on the unusual characteristics of the past two years' Asian-Australian monsoons.
- Leila Carvalho (Co-chair, MP) is a member of the SSC of the “International Workshop on Stratosphere-Troposphere Interactions and Prediction of Monsoon weather EXtremes (STIPMEX) being organized by IITM with the support from MoES, IMD, IMPO, SPARC/ACAM, Forschungszentrum Jülich GmbH, Germany, SPARC/SSiRC and WWRP/WGTMR during 2-7 June 2024.
- Members of MP & WGs will be involved actively in MP coordinated Monsoon Sessions in GEWEX OSC in July 2024 at Sapporo, Japan.
- Several WG-AAM members will attend the GEWEX OSC in Japan during 7-12 July 2024 and also the joint meeting between MP and WG-AAM planned during that week.
- AOGS 2024 - The need for further quasi-biennial WG-led sessions on “Asian-Australian Monsoon: linking research to operational needs” of this series is under review as there are other well-attended regular monsoon sessions at AOGS.
- In the WG-AFM, the Subgroup activities will continue and aim to publish the results of works from the past two years.
- Several members of WG-AFM will be attending AMS 2024 at Baltimore, Maryland.
- WG-AMM plans to organize the second Workshop and Advanced School on American Monsoons
- WG-AMM plans to organize a special issue with articles on various aspects of American Monsoons.
- WG-AMM plans to organize webinars on the different aspects of the American Monsoons.
- MP & WGs will get involved with Pacific Region Panel and OMDP (Ocean Model Development Panel) to improve the ENSO teleconnections in models.
- MP and WGs will get involved in the [SynObs](#) Project for the evaluation of Ocean Observing System as a cross-panel activity.
- MP and WGs will provide ideas/activities for GPEX LHA which will be useful for the monsoon community.
- MP & WGs will attempt to build links with the other disciplines like agriculture, agronomy, hydrology and health.

- MP and WGs will involve actively in the MP coordinated Monsoon Sessions in IWM-8 in 2025 at New Delhi, India.

#### 4. Articles Published in 2023 as part of MP Activities (if any)

- a) **Cavalcanti, I. F. A., Coelho, C. A. S.,** Rezende, L. F., Jorge L. Gomes and Celso von Randow, 2022: Potential applications for climate services originated from the CLIMAX project. *Frontiers in Climate*, <https://doi.org/10.3389/fclim.2022.932589>
- b) Deoras, A., Turner, A.G., **Hunt, K.M.** and **Jayawardena, I.M.S.P.**, 2023: The Influence of Weather Patterns and the Madden-Julian Oscillation on Extreme Precipitation Over Sri Lanka. *Geophysical Research Letters*, 50(14), p.e2023GL103727, <https://doi.org/10.1029/2023GL103727>
- c) Mohan, T.S., Kondapalli Niranjan Kumar, **Raghavendra Ashrit, Gill Martin,** Jaya Kumar, Saji Mohandas, Abhijit Sarkar and V. S. Prasad, 2023: Moist processes in NCUM global forecasts during the boreal summer monsoon, submitted to *Atmospheric Research*, July 2023
- d) Reboita, M. S., Ferreira, G. W. D. S., Ribeiro, J. G. M., da Rocha, R. P., and Rao, V. B., 2023: South American Monsoon Lifecycle Projected by Statistical Downscaling with CMIP6-GCMs. *Atmosphere*, 14(9), 1380; <https://doi.org/10.3390/atmos14091380>
- e) Zilli, M. T., **Neil C. G. Hart, Caio A. S. Coelho, Robin Chadwick,** Dayana C. de Souza, Paulo Y. Kubota, Silvio N. Figueroa, **Iracema F. A. Cavalcanti**, 2023: Characteristics of tropical-extratropical cloud bands over tropical and subtropical South America simulated by BAM-1.2 and HadGEM3-GC3.1. *Quarterly Journal of the Royal Meteorological Society*, <https://doi.org/10.1002/qj.4470>

#### 5. Budget and Other Needs for 2024 (in CHF)

- MP has plans to convene two monsoon related sessions in GEWEX OSC, participate actively in the discussions on GPEX activities and to also organize an in-person meeting between MP and WG-AAM at Sapporo, Japan during 7-12 July 2024. For more details pl. read Annex-A.

#### 6. Contributions to Developing GEWEX Science and the GEWEX Imperatives:

- a) Datasets
  - *Monsoons Panel (MP) & its regional WGs use only the publicly available observational and model datasets to study monsoons all over world to understand its unique features.*
  - *Any observational datasets collected in future by MP members could contribute to GEWEX science development.*
- b) Analysis
  - *MP and its regional WGs are expected to develop new analysis tools and software that will be made available to the community.*
  - *The preliminary theoretical development of a South-East Asian Monsoon Progression Index was completed using CDAS and ERA5 datasets.*
  - *Hindcasts from different models were assessed to understand the strengths and limitations in South Asian Monsoon rainfall predictions.*

c) Processes

- *MP and its regional WG members are actively involved in process understanding and model treatment (e.g., precipitation, clouds, surface fluxes, coupling surface to atmosphere, aerosols, dynamics-physics coupling).*

d) Modeling Activities

- *Assess and improve the skill of monsoon rainfall prediction in different regional monsoons and identify the bottlenecks in the dynamical models.*
- *Improve understanding of dynamical and physical processes associated with extreme events and identifying the lacuna in capturing these extremes in present-day models.*
- *The West African Sub-group of WG-AFM is looking at the GEWEX/GASS DYAMOND high resolution model outputs to see how the model represents the mesoscale convective system in the area and how does it affect the monsoon.*
- *Ismaila Diallo (WG-AFM) is participating in the LS4P-II (Land Surface for Predictions) project of GEWEX/GASS and trying to see how to use land surface to predict extreme events over control regions.*

e) Application

- *MP & its regional WGs intend to suggest improvements in both weather and climate models through model evaluation, especially on extreme events.*

f) Technology Transfer

- *MP intends to promote Research to Operations (R2O) activities to contribute with the Regional Climate Outlook Forums (RCOFs) and operational meteorological services.*

g) Capacity Building

- *MP and its WGs are the main organizers of the Joint WCRP/WWRP MP Webinar Series:*
  - *MP organized the first webinar on “Global Monsoon” on 13<sup>th</sup> September 2023 during 7-8:30 UTC and 175 attended the webinar out of the 307 registered attendees. The recording of the webinar is available in the IITM YouTube Channel Video, which already has 356 views.*
  - *WG-AMM organized the second webinar on Asian-Australian Monsoon on 30<sup>th</sup> November 2023 during 7-8:30 UTC and 120 attended the webinar out of the 228 registered attendees. The recording of the webinar is available in the IITM YouTube Channel Video, which has already 220 views.*
  - *WG-AFM organized the third webinar on African Monsoons was organized on 6<sup>th</sup> March 2024 during 14-15:30 UTC and 74 out of the 138 registered attendees. The recording of the webinar is available in the IITM YouTube Channel Video, which has already 136 views.*
- *Build capacity by promoting ECS representation in the WGs and subgroups developing these activities. About seventeen (17) members of MP and its regional working groups are early career researchers.*
- *Several of the members of WG on Asian-Australian Monsoons (WG-AAM) are regular contributors to the Regional Climate Outlook Forums for the Asian-Australian region (SASCOF, ASEANCOF, EASCOF), allowing the group to provide guidance on model strengths and weaknesses and to reach out to stakeholders.*

- *MP Co-chair and members will be coordinating Monsoon Sessions in GEWEX OSC in July 2024 at Sapporo, Japan.*

## **7. Contributions to the GEWEX Science Questions and Plans to Include These:**

### **a) Observations and Predictions of Precipitation**

- *Annalisa Cherchi (MP) contributed to a draft white paper on WCRP Global Precipitation Experiment as a representative of MP in the GPEX tiger team. MP members also made several suggestions to the draft white paper.*

### **b) Global Water Resource Systems**

- *MP is focusing on extreme weather events leading to large scale/flash flooding.*

### **c) Changes in Extremes**

- *MP & its regional WGs intend to suggest improvements in both weather and climate models through model evaluation of extreme events.*
- *The High Impact Weather (HIW) events sub-group under WG-AAM, is focusing on high impact events from recent years for (i) case studies in terms of observations and forecasts (ii) linking operational forecasts to decision making (iii) how monsoon research can best support hazard mitigation. (iv) do forecasting frameworks need to adjust to account for socio-economic /climate change.*

### **d) Water and Energy Cycles**

- *MP & its regional WGs aim to improve weather and climate models, including their capability for studying the water and energy cycles through model evaluation studies (e.g., CMIP, DYAMOND)*

## **8. Contributions to WCRP, Including the Light House Activities:**

- *Activities of MP & WGs aim to improve weather and climate models, enabling the modeling study of weather and climate “Extremes”.*
- *High Impact Weather (HIW) events sub-group under WG-AAM, is focusing on high impact events from recent years during the monsoon seasons, which could lead to contributions to “Understanding High-Risk Events” LHA.*
- *There are some discussions in HIW sub-group under WG-AAM on how AI or Machine Learning could be used to enhance the warnings, and on the potential for involving social scientists to help understand public response to warnings. This could lead to contributions to “Digital Earth” LHA under "advanced digital technology".*
- *Masilin Gudoshava (WG-AFM) is actively involved in the “My Climate Risk” LHA.*
- *Izidine Pinto (WG-AFM) is actively involved in “Safe Landing Climates” LHA.*
- *Annalisa Cherchi (MP) is a member of GPEX Interim SSC.*
- *Most members of the eastern Africa subgroup of WG-AFM are involved in EPESC LHA’s "Africa Case Study" focusing on modeling the Eastern African rainfall.*



## 9. Other Key Science Questions:

*List 1–3 suggestions that you anticipate your community would want to tackle in the next 5–10 years within the context of a land-atmosphere project*

- How realistic are the high-resolution simulations of extreme rainfall events compared to the observations? How can we improve the model predictions of monsoon rainfall and associated extreme events?
- How does land surface temperature (LST) over global high mountain regions (including the Himalayas, Rocky Mountains, Andes mountains and other high mountains) affect the global monsoon precipitation at S2S scales?

## 10. Cooperation with Other WCRP Projects, Outside Bodies and Links to Applications:

- APARC, S2S Prediction Project
- MP is engaged in interactions with APARC on the role of atmospheric composition in processes relevant for the monsoons, including the Atmospheric Composition and Asian Monsoon (ACAM) activity of APARC (<https://www.sparc-climate.org/activities/asian-monsoon/>).
- IMPO (project office of MP) personnel provides wiki page support for regional activities of S2S in South Asia.
- MP will get involved with CLIVAR's Pacific Region Panel and OMDP (Ocean Model Development Panel) to improve the ENSO teleconnections in models.
- MP will get involved in the "[SynObs](#) Project" supported by CLIVAR for the evaluation of Ocean Observing System.

## 11. List contributions to the GEWEX Science Goals and Plans to include these:

*Goal # 1 (GS1): Determine the extent to which Earth's water cycle can be predicted. This Goal is framed around making quantitative progress on three related areas posed in terms of the following questions:*

a) Reservoirs:

What is the rate of expansion of the fast reservoirs (atmosphere and land surfaces), what is its spatial character, what factors determine this and to what extent are these changes predictable?  
.....

b) Flux exchanges:

To what extent are the fluxes of water between Earth's main reservoirs changing and can these changes be predicted and if so on what time/space scale?  
.....

c) Precipitation Extremes:

How will local rainfall and its extremes change under climate change across the regions of the world?

*The High Impact Weather (HIW) events sub-group under WG-AAM, is focusing on high impact events from recent years for (i) case studies in terms of observations and forecasts (ii) linking*



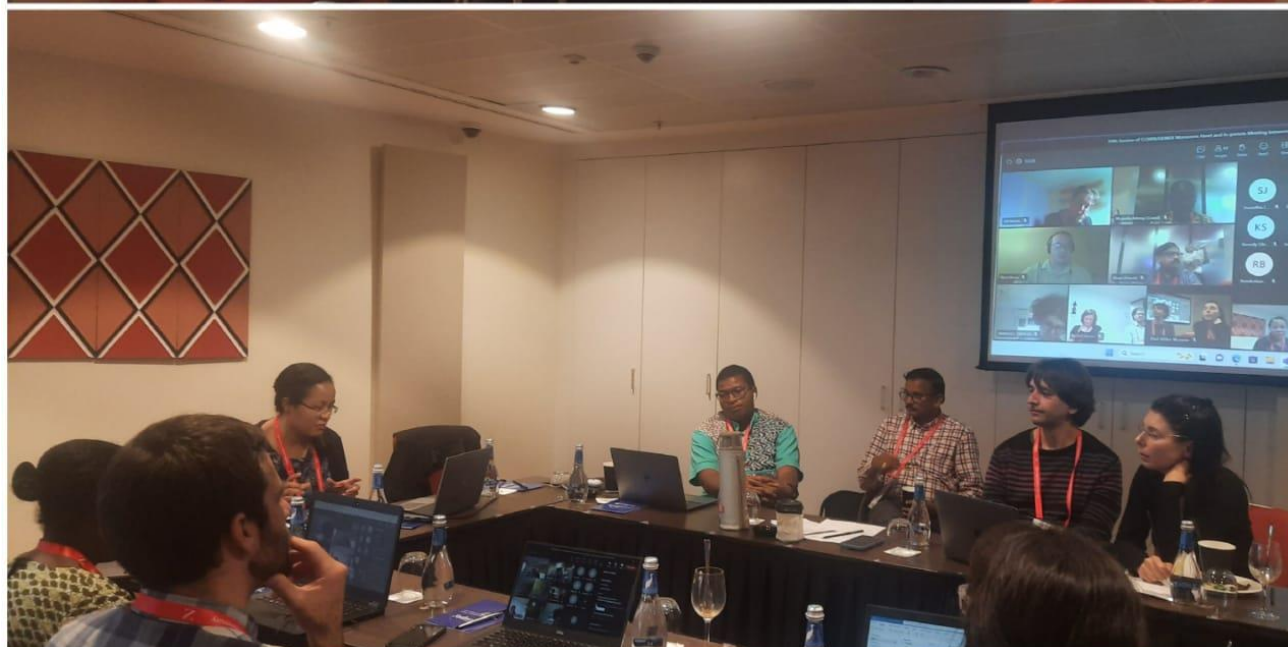
*operational forecasts to decision making (iii) how monsoon research can best support hazard mitigation. (iv) do forecasting frameworks need to adjust to account for socio-economic /climate change.*

**Goal # 2 (GS2):** Quantify the inter-relationships between Earth's energy, water and carbon cycles to advance our understanding of the system and our ability to predict it across scales:

- a) Forcing-feedback understanding:  
How can we improve the understanding of climate forcings and feedbacks formed by energy, water and carbon exchanges?  
.....
- b) ABL process representation:  
To what extent are the properties of the atmospheric boundary layer (ABL) defined by sensible and latent energy and water exchanges at the Earth's surface versus within the atmosphere (i.e., horizontal advection and ABL-free atmosphere exchanges)?  
.....
- c) Understanding circulation controls:  
To what extent are exchanges between water, energy and carbon determined by the large-scale circulations of the atmosphere and oceans?  
.....
- d) Land-atmosphere interactions:  
How can we improve the understanding of the role of land surface-atmospheric interactions in the water, energy, and carbon budgets across spatio-temporal scales?  
.....

**Goal # 3 (GS3):** Quantify anthropogenic influences on the water cycle and our ability to understand and predict changes to Earth's water cycle.

- a) Anthropogenic forcing of continental scale water availability:  
To what extent has the changing greenhouse effect modified the water cycle over different regions and continents?  
.....
- b) Water management influences:  
To what extent do water management practices and land use change (e.g., deforestation) modify the water cycle on regional to global scales?  
.....
- c) Variability and trends of water availability:  
How do water & land use and climate change affect the variability (including extremes) of the regional and continental water cycle?  
.....



Photos of the in-progress Fifth Session of CLIVAR/GEWEX Monsoons Panel held in hybrid mode on 27<sup>th</sup> October 2023 at Kigali, Rwanda

[illegible]

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**Proforma for CLIVAR Panel and Working Group requests  
for SSG approval for meetings**

1. Panel or Working Group: *CLIVAR/GEWEX Monsoons Panel (MP)*
2. Title of Meeting or Workshop: *In-person Meeting of the MP and its regional Working Group on Asian-Australian Monsoons (WG-AAM) and Organization of the Special Sessions on “Monsoons” at GEWEX OSC at Sapporo, Japan during 7-12 July 2024*
3. Proposed venue: *Sapporo, Japan (co-located with GEWEX OSC-2024)*
4. Proposed dates: *7-12 July 2024*
5. Proposed attendees, including likely number: *Members of MP and WG-AAM (10-12)*
6. Rationale, motivation and justification, including relevance to CLIVAR themes & JSC cross cutting topics and any cross-panel/working group links and interactions involved:
  - *Keeping in view that the MP has not met in-person WG-AAM members for the last 3-4 years, makes this meeting a high priority requirement.*
  - *In-person interactions between MP & WG-AAM members are considered essential to know each other better and to infuse team spirit. Such an in-person meeting will also facilitate a common understanding of the new WCRP Strategic Plan, its new Core Projects and Light House Activities, to facilitate a more coordinated approach to the relevant contributions from MP members.*
  - *Additionally, as the sessions on “Monsoon processes and Society” and “Monsoon - Atmospheric-Land and Atmospheric-Ocean Interactions” are being convened by MP at GEWEX OSC-2024, the presence of distinguished members of MP/WG-AAM will make the session a grand success.*
  - *MP members will also participate actively in the discussions on GPEX and provide MP’s ideas/activities for GPEX LHA that are beneficial for the global monsoon community.*
  - *It may be also noted that the In-person meeting between MP and WG-AFM at WCRP OSC at Kigali was a great success (Ref: [Minutes of the Fifth Session of CLIVAR/GEWEX Monsoons Panel, 27<sup>th</sup> October 2023, Kigali, Rwanda](#)).*
  - *Efforts will also be made to explore collateral funding by members who have access to alternate resources.*
7. Specific objectives and key agenda items:
  - *Review of MP’s work including the joint CLIVAR/ GEWEX context, Interactions with WG-AAM members, coordination of regional working groups and planning of future activities and deliverables.*
8. Anticipated outcomes (deliverables):
  - *A successful organization of the sessions on Monsoons in GEWEX OSC-2024 by MP.*
  - *Provision of MP’s ideas/activities for GPEX LHA that are beneficial for the global monsoon community.*

- *Better coordination between MP and WG-AAM members through the in-person meeting between MP and WG-AAM.*
  - *Updated Work Plan of the MP and its regional working groups, associated deliverables, outlines of contributions to WCRP Strategic Plan*
9. Format: *Hybrid (Face-to-Face with provision of remote participation for members unable to travel)*
10. Science Organizing Committee (if relevant): *TBD*
11. Local Organizing Committee (if relevant): *TBD*
12. Proposed funding sources and anticipated funding requested from WCRP: *20000 CHF*
- *CLIVAR – 10000 CHF*
  - *GEWEX - 10000 CHF*