

Monsoons Panel (Joint GEWEX/CLIVAR)

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Panel overview

Background The GEWEX/CLIVAR Monsoons Panel was proposed at and established following the 7th International GEWEX Conference at The Hague, July 2014 following the closure of the CLIVAR Regional Panels (AAMP, VAMOS, Africa) and 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 Monsoons Panel membership crosses CLIVAR and GEWEX research interests and all monsoon regions, with in-country membership where possible. While the Panel can take a global view, it may miss region-specific details, in particular in accessing regional stakeholders and managing local knowledge exchange and up-skilling. The Monsoons Panel has established a structure of Regional Monsoon Working Groups beneath it, comprising the Asia-Australia, Americas and Africa Regional Monsoon Working Groups. See Annex B for outlines of the structure, remit and ToR for the regional working groups.

See Monsoons Panel website for ToR and membership: <http://www.clivar.org/clivar-panels/monsoons>.

Summary of panel current main mission and 2017-2018 activities

Organizational activities

Following the 2nd Monsoons Panel meeting in Singapore, November 2017, the main meeting activity this year has been the 3rd Monsoons Panel meeting held in conjunction with the 8th GEWEX Open Science Conference in Canmore, Canada, May 2018. This meeting held a cross-cutting discussion with the GEWEX GASS & GLASS activities. Further interactions were held with the SPARC SSG at the SPARC General Assembly, October 2018, Kyoto.

The Panel has also held telecons, including guest speakers from the Regional Working Groups, for example on the subject of stakeholder engagement (most recently 10 July 2018).

In addition, Regional Monsoon Working group activity is also supported by telecons (e.g. for the Asia-Australia WG:

- October 2018 Presentation by MM Ali (India): “Southwestern Indian Ocean heat content is a better predictor of Indian Summer Monsoon Rainfall compared to the existing indices”
- July 2018 Presentation of G Srinivasan (Regional Integrated Multi-hazard Early-warning System, RIMES, Thailand): “Enhancing Climate Services in South Asia”
- April 2018 Presentation by Randy Wu (IAP, China): “Origins of intraseasonal rainfall variations in the southern South China Sea during boreal winter”)
- March 2018 Presentation by G Srinivasan: “On Climate Services aspects, particularly the RCOFs, NCOFs and other user interfaces implemented during the GFCS South Asia project”)

Further communication is carried out via email.

Scientific work can be summarized under the following topics (see later sections):
Observational/field studies work; Engagement with IPCC AR6/CMIP6 and MIPs;
Stakeholder engagement/end users & Climate Services; Cross-group collaborations;
Climate change detection & attribution (including CORDEX); S2S

Obstacles

The combination of small funding and diversity (of scientific interests) presents a philosophical problem over choice of Panel meeting location. Regional meetings pertaining to the monsoon (or a monsoon) are not necessarily attractive to the full range of membership. A pragmatic way forward therefore may be to hold Panel meetings in conjunction with major international meetings (such as the AGU Fall meeting) in future.

Achievements for 2017-18

IPCC AR6/CMIP6

- **Andy Turner** has established an informal mailing list covering all the monsoon-expert authors in the IPCC AR6 WGI process. This has discussed the distribution of monsoon topics across the 12 WGI chapters and will continue to liaise to ensure the monsoons are properly represented.

Conference session organisation

- A21F Monsoons of the Americas, Teleconnections, and the Subseasonal to Decadal Earth System Prediction Capability, at the **2017 AGU Fall Meeting**, Nova Orleans, LO, USA (**Alice Grimm** with others) (December 2017)
- Monsoon session at the AMOS-ISHMO 2018 conference, Sydney, Australia (March 2018). Special session on Monsoon teleconnections which was co-chaired by Aurel Moise and had presentations from two AAMWG members:
 - Moise: “GCM Precipitation Biases in Australian Monsoon and Maritime Continent linked to Temporal and Spatial Intermittency of Sub-Daily Precipitation
 - G. Martin: “Monsoons and Tropical Rainfall in models and Observations” and “Diagnosing Remote and Locally Forced Systematic Errors in Monsoon Simulations”
- AS1.27/CL4.06 The global monsoons in current, future and palaeoclimates and their role in extreme weather and climate events at **EGU 2018**, Vienna (April 2018) (Jianping Li, **Andy Turner** et al.)
- Monsoons of the Americas: variability and predictability of extreme events, at the Conference on Tropical Cyclones and Extreme Monsoon Precipitation: Prediction, Impacts, and Communication, at the **99th AMS, Phoenix, USA, January 2019** (**Francina Dominguez** with others). Includes invited talks from Americas WG members:
 - Multiscale interactions in determining the hydrological extremes in the American monsoon regions (**Rong Fu**)
 - South American Monsoon: Variability of Extreme Events and Subseasonal Prediction (**Alice M. Grimm**)

To follow in 2019:

- AS1.34/CL4.02.2 The global monsoons in current, future and palaeoclimates and their role in extreme weather and climate events at **EGU 2019**, Vienna (April 2019) (Jianping Li, **Andy Turner** et al.)
- Processes in global and regional monsoons, at the AMOS-ICTMO conferences, Darwin (July 2019) (**Aurel Moise, Andy Turner** et al.)

Scientific results from activities

Ongoing observational field campaign exploitation

- FP7 DACCIWA project (Dynamics-aerosols-chemistry-cloud interactions in West Africa; field campaign over the Southern West Africa in June-July 2016); Presently the biggest field and research project over Africa (**members of Africa WG**)
- AEROCLO-SA (Aerosol Radiation and Clouds in Southern Africa; field campaign over Namibia and near-by Atlantic in August- September 2017) (**members of Africa WG**)
- Continued exploitation of the AMMA field campaign (2006) observations in evaluation and improvement of climate model parametrisations (**members of Africa WG**)
- Indo-UK INCOMPASS projection (June/July 2016), first campaign of foreign aircraft in India. Special Issue of *QJRMS* in preparation, led by **Turner**, Bhat et al. (2018)

Other projects

- On-going FCFA (Future Climate for Africa) projects (-2019) over various areas of sub-Saharan Africa (AMMA-2050, UMFULA, FRACTAL, HyCRISTAL, and Pan-Africa IMPALA including CP4 high-resolution Convection-Permitting simulations) (**Turner, Janicot, Guichard**, and members of the Africa WG)
- On-going ACASIS project focuses on Sahelian heat waves during the pre- & early monsoon season (**Janicot, Guichard**)
- On-going ECLAIR2 project focused on the Senegal climate, CREWS Burkina project, focused on S2S weather forecast. These different UK and French project involve several African institutions (universities and national meteorology services).

Activities of the Americas WG:

- Multi-scale climate variability in South America
- Sub-seasonal to seasonal forecasting
- South America Monsoon: intraseasonal and interannual variability
- Paleo-Constraints on Monsoon Evolution and Dynamics

Activities of the Asian-Australian WG:

- Monsoon lows/depressions (**Bill Boos** leading efforts in creating diagnostics packages)
- Process-based diagnostics (**AAWG** has a monograph for the IWM6 book)
- S2S (**Andrew Marshall** is leading this effort)
- CMIP6 (**WG** members developing plans to actively participate in CMIP6 diagnoses)

- Climate services (**Srinivasan** is leading this effort to coordinate with RCOFs; plans underway for CLIVAR-hosted website)

Workshops / Scientific capacity building and career support

Management and Operational Center of the Amazon Protection System

Alice Grimm conducted a training activity with lectures for meteorologists at the Management and Operational Center of the Amazon Protection System (Censipam), 28 October-1 November 2018, in Manaus, Amazonas, Brazil. She also contributed to the climate forecast for the beginning of the rainy season in the Amazon Region. The objective of this training activity for the meteorological teams of the regional centers of Manaus, Belém and Porto Velho, in the Amazon Region, is to improve weather forecast skill and Amazon regional climate forecasts, provided by Censipam. Graduate and undergraduate students, as well as Faculty members of the University of the State of Amazonas and the Federal University of Amazonas also participated in this training activity (<http://www.sipam.gov.br/pesquisadora-realiza-treinamento-com-meteorologistas-do-censipam-em-manaus>)

Serge Janicot and colleagues (including **Françoise Guichard**) organized a conference at the University of Saint-Louis (Senegal) on early-monsoon heat waves, 8-12 October 2018 (https://acasis.locean-ipsl.upmc.fr/doku.php?id=sessions_et_exposes)

Invited presentations at the 2nd WCRP Grand Challenges Meeting on Monsoons and Tropical Rain Belts, ICTP Trieste, Italy (July 2018)

Building on the knowledge and practical skills acquired during the ICTP Summer School held in the preceding week, this workshop aims to bring together expertise on large-scale atmospheric and oceanic dynamics, small scale cloud and precipitation processes, hierarchical climate modelling and observation. Several Panel and WG members attended and gave presentations at the workshop (**Bill Boos, Brian Mapes, Aurel Moise, Andy Turner**)

Additional workshop/conference participation (examples only):

- **Alice Grimm** participated in the AGU Fall Meeting 2017, New Orleans, LO, USA, December 2017: *Why is the Skill of the Models in Reproducing MJO and its Impacts on the South American Monsoon Important for Subseasonal Prediction?*
- **Alice Grimm** participated in the EGU 2018, Vienna, Austria, April 2018: *Subseasonal prediction of active and break phases of the South American monsoon and the influence of the MJO*
- **Alice Grimm** participated in the 8th GEWEX open Science Conference: Extremes and Water on the Edge, May 2018: *Subseasonal prediction of South American monsoon rainfall: active and break episodes, extremes and the contribution of the MJO*
- **Francina Dominguez** gave the talk: *How Tracing Water in the Atmosphere and Below the Earth's Surface can Challenge our Assumptions of the Hydrologic System*, in the "Land Atmosphere Interactions and Extremes Workshop", as part of the 2018 US Climate Modeling Summit. April 2018
- **Pedro Leite da Silva Dias** participated in the AGU Fall Meeting 2017, New Orleans, LO, USA, December 2017: *South American Monsoon System: from the Last Glacial to the Last Millennium*
- **Rong Fu** participated in the 43rd Annual NOAA Climate Diagnostic and Prediction Workshop, Santa Barbara, California, October, 2018: *A hybrid dynamic-statistical*

approach to link predictive understanding to improve seasonal prediction of rainfall anomalies at the regional scale

- **Tereza Cavazos** delivered the invited presentation: *Intercomparison of regional climate models and climatic trends in the Central America/Mexico CORDEX domain*, at the Ninth ICTP Workshop on the theory and use of regional climate models, May/June 2018, Trieste, Italy.

Knowledge exchange / Cross-group activities

PanGASS meeting, Lorne, Australia (March 2018)

- This meeting progressed the GASS white papers, providing the opportunity for members of the community to propose common activities (e.g., inter-comparisons, dedicated diagnostics, observational campaigns) that can be organised under the GASS umbrella. Two members of the Asia-Australia WG attended, and one gave a presentation: **Partha Mukhopadhyay**: “Recent Advancement in Cloud-Convection-Radiation parameterization for improved model forecast vis-à-vis high resolution model for extreme prediction over India”.

Indian Ocean Panel / IndOOS White Paper

- **Annamalai** was invited by the CLIVAR Indian Ocean panel to write a white paper for IndOOS (2020-50) entitled “Indian Ocean and South-Asian monsoon: upper-ocean processes relevant to the monsoon annual cycle”. Towards this, Annamalai attended the IndOOS Review meeting in Jakarta, Indonesia (March 2018), and made a presentation of the white paper. Based on various comments by the review board, the white paper is now revised and submitted to the Indian Ocean panel.

GASS and GLASS discussions at the 8th GEWEX Open Science Conference, Canmore, Canada (May 2018)

- Co-chairs from GASS were invited to attend the Monsoons Panel meeting to discuss collaborations and links to the activities outlined in the GASS White Papers.

Monsoons Panel-SPARC

- **Andy Turner** led a straw-man ideas white paper on potential impacts of stratospheric variability on monsoon teleconnections. This was presented at the SPARC SSG meeting, following the SPARC General Assembly (October 2018) by **Tianjun Zhou**.

Plans for 2019 and beyond

The major organisational challenge is for membership restructuring following the expiry of several terms (8 in total, including a Co-Chair). Following new appointments in 2019 we will commence with regular telecons and aim for a Panel meeting associated with an international meeting such as AGU 2019.

Further cross-WG Panel activities are:

- Continued interaction with the IPCC AR6 and CMIP6 process

- Continued S2S diagnosis
- Engagement with CMIP6 MIPs, including a GMMIP workshop at IAP, Beijing in autumn 2019 (**Tianjun Zhou & Andy Turner**)
- Develop plans for further engagement with SPARC
- Develop plans for further engagement with GEWEX GLASS & GASS

The Panel is also supporting a planned workshop of the Americas WG (see below), for which funding is requested.

Americas WG plans:

- Operate American Monsoons Session at AMS January 2019 meeting;
- Deliver an invited talk and participate in a round table discussion at the Brazilian Congress of Meteorology, 26-30 November 2018;
- Exploitation of the S2S database for the South American monsoon, in order to assess its possibilities for subseasonal prediction of several aspects, such as extreme events onset and demise, active and break periods;
- Assess skill of S2S participating models in simulating MJO impacts on the American monsoons, regarding precipitation anomalies and associated teleconnections;
- Test possibilities of improvement in subseasonal prediction through calibration procedures;
- American Monsoons Workshop and Training Activity (see financial request, Annex A)
 - Detail the program
 - Organize the workshop
 - Select the students that will participate in it
 - Operate the event in August 2019.

Africa WG plans:

- CORDEX-Africa (on-going activities and development of potential FPS projects; entrainment of Central Africa into this work, lead C. Lennard)
- +1.5°C IPCC report for Africa (ongoing studies in this area)
- S2S activities for Africa and in the context of the global monsoons
- Detection-Attribution issue □ GMMIP & other potential research initiatives - FCFA programme □ on-going; CP4 & atlas for end-users
- Climates Services for Africa (on-going)
- Capacity building (on-going)

Asia-Australia WG plans:

Given the growing importance of stakeholder engagement we are continuing to push activities in this area. The initial focus was asking somebody to join the Asia-Australia WG (Dr Srinivasan of RIMES: Regional Integrated Multi-Hazard Early-warning System, Thailand; he is now nominated to join the Monsoons Panel). The follow up, the plan is to attend the regional climate outlook fora (RCOFs) to engage with players in the region; specifically, to get feedback on how the AAMWG could contribute and enhance already existing activities.

Additional plans:

- Start to assemble a website on regional monsoons to be hosted via the CLIVAR site; content to be generated in conjunction with the other regional WGs;
- Continue to lead work on identifying the grand challenges in monsoon modelling including representation of processes and source(s) of model errors. Analyse CMIP6 models accordingly and prepare a manuscript co-authored by **WG members**;
- Further progress research on monsoon lows & depressions and encourage national meteorological agencies to implement automated tracking of monsoon depressions (**Bill Boos**);
- Continued exploitation of the S2S database for short time-scale prediction, through the monsoons subproject (**Andrew Marshall**).

Articles published in 2017/18 as part of panel activities (if any)

Major contributions include revisions to chapters to be published for the forthcoming book, “*Global Monsoon: Research and Forecast*” arising from the WMO/WWRP 6th International Workshop on Monsoons, Singapore, November 2017.

In addition, contributions such as Nikulin et al., “The effects of 1.5 and 2 degrees of global warming on Africa in the CORDEX ensemble” in addition to five other submissions to a Special Issue of *Environmental Research Letters: Focus on Modelling of Regional Climate Change over Africa at 1.5C and 2C of Global Warming*

Further Panel and Working Group publications are listed in Annex C.

Budget and other needs for 2019

Please keep in mind that the overall budget of CLIVAR is limited and this needs to be distributed between all activities and the SSG meeting.

The primary budget request represents \$14,000 USD to support the Americas Monsoon WG training school/workshop (see Annex A).

In addition, we will hold informal self-funded meetings for a small group at the Darwin conference, July 2019, and the AGU Fall Meeting, December 2019.

If additional funding can be gained over and above the training school/workshop, we would request the sum of ~\$2000 USD to support a 2/3-day visit of a Member to an appropriate Regional Climate Outlook Forum meeting to engage with end-users such as National Met and Hydrology Services).

Annex A

Proforma for CLIVAR Panel requests for SSG approval for meetings

1. **Panel or Working Group:** Monsoons Panel and its Americas Monsoons WG
2. **Title of meeting or workshop:** American Monsoons – progress and future plans workshop
3. **Proposed venue:** ICTP South American Institute for Fundamental Research (SAIFR). Ideally located for participants from Brazil as well as from North America and other South American participants.
4. **Proposed dates:** 19-23 August 2019, over 5 working days
5. **Proposed attendees, including likely number:** Around 40, including researchers and students.
6. **Rationale, motivation and justification, including: relevance to CLIVAR science & WCRP Grand Challenges, and any cross-panel/research foci links and interactions involved:**

The American monsoons are important components of the global monsoon system. Most of the annual precipitation over most of South America occurs during the summer monsoon, including subtropical regions. The economy, agriculture, water and energy resources and, consequently, the livelihoods of the great majority of South American population are heavily dependent on the summer monsoon. Also, precipitation associated with the North American monsoon provides crucial water resources for Mexico, Central American countries, several island nations in the Caribbean and parts of the southwest USA. Predicting the intensity of American monsoon rainfall is not only a regional challenge but is also relevant in the framework of a global subseasonal-to-seasonal forecasting system.

We do not recall a previous workshop on North/South American monsoon activities, and this represents a great opportunity to continue building the research community.

- The workshop has relevance to ongoing activities of the WGNE/CMIP such as the CMIP6 and forthcoming IPCC 6th Assessment Report.
- It is also directly relevant to the ongoing S2S efforts of the WMO/WWRP/WCRP, since S2S (including MJO variability) has direct relevance for the regions.
- The Workshop will be relevant to WCRP Grand Challenges on *clouds and circulation* and *weather extremes* given systematic biases present in simulating tropical convection, monsoons, and the impacts present in the regions.
- Given the pressures of land use change in South America (deforestation, urbanization) and the potential for large local recycling of moisture, this Workshop is directly relevant to GEWEX activities.

7. Specific objectives and key agenda items:

- Scientific presentations on the workshop theme from invited and contributing speakers (Members of the American Monsoons WG)
- Poster presentations by students
- Lectures on statistical and modeling studies applied to the theme
- Discussions on challenges and future plans for studies

8. Anticipated outcomes (deliverables):

- Build community of experienced researchers and students/early career scientists on North/South American monsoons topics;
- Assessment of current level of understanding of these monsoon systems and their variability on a range of temporal and spatial scales, and the performance of models at simulating the same;
- Plan key focus areas for research over next 5 years and outline future collaborations, particularly in the societal impacts sector.

9. Format:

Day 1: Introduction and main features, including the life cycle of the South American Monsoon System (SAMS) and North American Monsoon System (NAMS) (observational, modelling and prediction)

Day 2: Variability on diurnal, mesoscale and synoptic time scales, intraseasonal variability, subseasonal-to-seasonal variability (observational, modelling and prediction)

Day 3: Interannual variability, decadal/interdecadal variability, modulation of extreme events by climate variability, longer term variability and climate change (observational, modelling and prediction)

Day 4: Statistical and modelling analysis – discussions; Poster session

Day 5: Impacts on society and the future challenges, future plans for observational studies, future model experiments and modelling activities on the subject. Discussions on future collaborations.

10. Science Organizing Committee (if relevant): Alice M. Grimm, Iracema F. A. Cavalcanti, Fred Kucharski

11. Local Organizing Committee (if relevant): As above

12. Proposed funding sources and anticipated funding requested from WCRP:
Funding requested here: (for the support of students)

Estimated number of students (with support): 20, approximately distributed as:

- 5 students from National Institute for Space Research (INPE, S. José dos Campos, S. Paulo)
- 3 students from the Federal University of Paraná (UFPR, Curitiba, PR)
- 5 students from other regions of Brazil
- 7 students from Latin America (e.g., Mexico, Uruguay, Argentina, etc.)

There will be more students who do not need support, from Sao Paulo and USA (at least 5).

Travel:

Flight tickets:

- 3 students from the Federal University of Paraná (UFPR, Curitiba, PR): 3 x US\$150 = US\$ 450
- 5 students from other regions of Brazil: 5 x US\$430 (average) = US\$ 2,150
- 7 students from Latin America (e.g., Mexico, Uruguay, Argentina, etc.): 7 x US\$460=US\$ 3,220

Bus tickets

- 5 students from National Institute for Space Research (INPE): 5 x US\$20= US\$ 100

Total tickets: US\$ 5,820 + US\$ 100 = US\$ 5,920

Hotel and meals

- 6 nights hotel: 6 x US\$ 50 = US\$ 300
- 6 daily meals: 6 x US\$ 25 = US\$ 150

Total daily allowances: US\$ 450 for each student

Total for 20 students: US\$ 9,000

Total travel tickets, hotel and meals: US\$ 14,920

Funding already secured:

- 10,000 Euros, from the International Centre for Theoretical Physics (ICTP, Trieste) **[For the avoidance of doubt, these discussions developed prior to CLIVAR's new training workshop arrangement with ICTP]**
- Venue and coffee-breaks, from the ICTP South American Institute for Fundamental Research (ICTP-SAIFR, Sao Paulo, Brazil, <http://www.ictp-saifr.org/2019-activities/>)

This money will be used to support the participation of part of the international researchers and Brazilian researchers. It is expected that researchers and students from USA will be supported by US-CLIVAR and/or other funds.

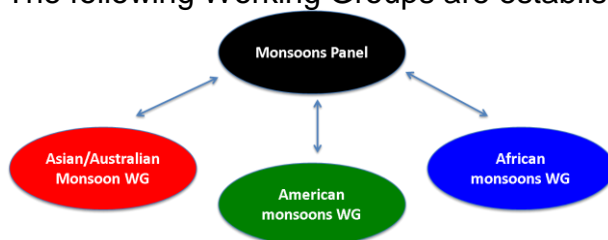
Annex B: Regional Working Groups

Justification for Regional Working Groups of the WCRP/CLIVAR Monsoons Panel
Monsoon systems represent the major annual mode of variability in the tropics and affect the lives of billions of people, often in some of the world's poorest nations. Despite this, the skill at which the monsoons can be simulated and forecast on all time scales from NWP to decadal remains a considerable challenge.

The overarching Monsoons Panel (MP) offers the advantage of bringing wide-ranging global expertise to the monsoons problem, offering the viewpoint of common aspects of tropical dynamics and convective physics to the monsoons, tapping into the Global Monsoon discipline. However, the global nature of the MP means that expertise is spread thinly in terms of fields of knowledge and local expertise. The various regional monsoons (Asian-Australian; African; American) feature unique problems and challenges that need to be overcome in order to achieve societal benefits as the science advances. These unique factors include regional surface and atmospheric processes, levels of local development, regional change factors such as pollutant emissions and land-use change, and varying levels of engagement between local forecasting agencies and the international weather and climate science research community.

To foster engagement of the monsoons research community at a local level and to facilitate improvement in monsoon forecasts on the various time scales for end users, three regional Working Groups (WGs) are formed under the umbrella of the MP. Each consists of a Chair or two Co-Chairs selected from its membership, and a liaison to the main MP who must be a current member of the MP. The liaison may be a Chair or Ordinary Member of the WG. Since the liaison is drawn from the MP membership, the MP will make the selection of the liaison. The MP will also invite the *initial* Chair positions of the regional WGs. Total membership consists of 6-8 persons including Chair(s).

The following Working Groups are established:



- Asian-Australian monsoons (AAMWG)
- American monsoons (NSAMWG)
- African monsoons (AfMWG)

The Regional Working Groups will define membership based on the expertise required to fulfil the ToRs and likely resource needs, seeking possible funding routes where necessary (to organise meetings, workshops etc).

Terms of Reference for Regional Working Groups of the WCRP GEWEX/CLIVAR Monsoons Panel

1. Mapping of relevant initiatives and areas of research to identify the working group structure (membership);
2. Identify key regional focus issues to be fostered 3-5 years ahead;
3. Evolve a strategy to assess the current levels of predictive skill for the region both at the level of the research community and forecasting centre, identifying where knowledge or implementation gaps can be bridged;
4. Engage directly with the relevant Regional Climate Outlook Forum to assist in promotion of best practice in critical evaluation of model performance for seasonal forecasting;
5. Develop diagnostics for understanding of monsoon processes and assessment of model errors on a range of scales, and inform the need for new observations, both over land and ocean, to advance understanding and undertake model performance assessments, reporting results via the Monsoons Portal;
6. Support cross-fertilisation of efforts within WCRP and elsewhere by liaising with:
 - Relevant process groups such as GEWEX GLASS and GASS to ensure raised profile of key interactions (land surface, convection) and facilitate development of process studies and diagnostic tools in models;
 - Relevant regional Ocean Panels to support design of a monitoring strategy necessary for investigating the structure, variability and change of the regional monsoons;
 - The Pan-WCRP numerical experimentation groups (WGSIP and WGCM) on modelling priorities for advancing monsoon research;
7. Contribute to the development of the Monsoon Portal to foster the growth of a regional user-researcher network, communicate existing products and their correct application and limitations, particularly to the impacts community, and contribute to and promote relevant training activities;
8. Evaluate likely resource needs for WG activities and offer suggestions for possible funding routes outside of WCRP when virtual meetings are impractical;
9. Report to the GEWEX/CLIVAR Monsoon Panel on an annual or more frequent basis, as appropriate, also logging efforts via the Monsoons Portal.

Andy Turner and Paul Dirmeyer, August 2015 (v4)

Annex C – Panel member publications (excerpt only, monsoon-relevant)

Annamalai, H., W. Boos, G. Martin, B. Mapes, Y. Ming, P. Mukhopadhyay, T.-Y. Koh, and S. Rao: CLIVAR-GEWEX Working Group on Asian-Australian Monsoons: Grand Challenges in Monsoon Modeling – Representation of Processes and Source of Model Errors. A chapter in IWM6; Edited by C.P. Chang and N.C. Lau (revised)

Annamalai, H., Motoki Nagura and Kelvin Richards, 2018: Indian Ocean and South-Asian monsoon: upper-ocean processes relevant to the monsoon annual cycle. A white paper for IndOOS Review (2020-50).

Bader, D. A., R. A. Blake, **A. M. Grimm**, R. Hamdi, Y. Kim, R. Horton, C. Rosenzweig (2018) Urban Climate Science. In Rosenzweig, C., W. D. Solecki, P. Romero-Lankao, S. Mehrotra, S. Dhakai, S. Ali Ibrahim (eds.), *Climate Change and Cities: Second Assessment Report of the Urban Climate Change Research Network*, Cambridge University Press, New York, pp 27-60. ISBN: 978-1-316-60333-8. [In this chapter a case study is presented for the city of Rio de Janeiro on monsoon extremes due to the MJO.]

Barreiro M., L. Sitz, S. de Mello, R. Fuentes Franco, M. Renom and R. Farneti (2018) Modeling the role of air-sea interaction in the impact of MJO on South American climate Int. J. Climatology, in press.

Brown, J. R., A. F. Moise and R. A. Colman (2017) Projected increases in daily to decadal variability of Asian-Australian monsoon rainfall, GRL, 44(11), DOI:10.1002/2017GL073217.

Chakraborty, S., K. Schiro, **R. Fu** and D. Neelin (2018) On the role of aerosols, humidity, and vertical wind shear in the transition of shallow to deep convection in the Green Ocean Amazon, ACP, 18, 11135-11148.

Chevuturi, A., N. P. Klingaman, **A. G. Turner** and S. Hannah (2018) Projected changes in the Asian-Australian monsoon region in 1.5°C and 2.0°C global-warming scenarios. *Earth's Future*, 6(3): 339-358, March 2018.

Chevuturi, A., **A. G. Turner**, S. J. Woolnough, G. M. Martin and C. MacLachlan (2018) Indian summer monsoon onset forecast skill in the UK Met Office initialized coupled seasonal forecasting system (GloSea5-GC2). *Climate Dynamics*, accepted.

Colorado-Ruiz, G., **T. Cavazos**, J. A. Salinas, P. De Grau and R. Ayala (2018) Climate change projections from Coupled Model Intercomparison Project phase 5 multi-model weighted ensembles for Mexico, the North American monsoon, and the mid-summer drought region. *Int. J. Climatol.*, <https://doi.org/10.1002/joc.5773>

Fletcher, J., D. J. Parker, **A. G. Turner**, A. Menon, G. M. Martin, C. E. Birch, A. K. Mitra, G. Mrudula, K. M. R. Hunt, C. M. Taylor, R. A. Houze, S. R. Brodzik and G. S. Bhat (2018) The dynamic and thermodynamic structure of the monsoon over southern India: New observations from the INCOMPASS IOP. *Quarterly Journal of the Royal Meteorological Society*, accepted 14 November 2018.

Franchito, S. H., **Gan, M. A.**, Fernandez, J. P., Rao, V. B., Espirito Santo C. E. (2017) Rainstorms during spring in Sao Paulo State, Brazil: A Case Study of 27-28 September 2015. *IIARD International Journal of Geography and Environmental Management*, v. 3, p. 12-25-25.

Grimm, A. M. (2018) South American Monsoon and its Extremes. In Vuruputur, V., J. Sukhatme, R. Murtugudde, R. Roca (eds.), *Tropical Extremes: Natural Variability and Trends*, Elsevier, Amsterdam, 51-93. ISBN 978-0-12-809248-4. <https://www.elsevier.com/books/tropical-extremes/vuruputur/978-0-12-809248-4>

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