

## Report to CLIVAR SSG-20

### Panel or Working Group: Asian-Australian Monsoon Panel (AAMP)

#### 1. Contributions to developing CLIVAR science and fit, where appropriate, to the CLIVAR imperatives

- a) The Asian-Australian Monsoon Panel ad hoc Monsoon Metrics Team has published a systematic evaluation of Asian summer monsoon (ASM) in CMIP5 and CMIP3 climate models:
- Sperber, K. R., H. Annamalai, I.-S. Kang, A. Kitoh, A. Moise, A. Turner, B. Wang, and T. Zhou (2012) The Asian summer monsoon: An intercomparison of CMIP5 vs. CMIP3 simulations of the late 20<sup>th</sup> century. *Clim. Dynam.*, doi: 10.1007/s00382-012-1607-6). The findings indicate that the CMIP5 simulations show improvement relative to the CMIP3 models in terms of the mean state, the interannual variability of the East Asian monsoon, the ENSO-monsoon teleconnection, the timing of climatological monsoon onset, peak and decay, and the duration of the monsoon, and (4) the fidelity of the simulation of monsoon intraseasonal variability. (Imperative I)

AAMP members have contributed to other Imperative I relevant peer-reviewed publications, for example:

- Kitoh, A., H. Endo, K. Krishna Kumar, I.F.A. Cavalcanti, P. Goswami, T. Zhou, 2013: Monsoons in a changing world: a regional perspective in a global context. *J. Geophys. Res.*, 118, doi:10.1002/jgrd.50258. Global as well as regional monsoonal rainfall and their changes in the 21st century under RCP4.5 and RCP8.5 as projected by 29 CMIP5 models are investigated. Over the Asian monsoon domain, projected changes in extreme precipitation indices are larger than over other monsoon domains, indicating the strong sensitivity of Asian monsoon to global warming. The projected increase of the global monsoon precipitation can be attributed to an increase of moisture convergence due to increased surface evaporation and water vapor in the air column though offset to a certain extent by the weakening of the monsoon circulation.
- Wang, B., S.-Y. Yim, J.-Y. Lee, J. Liu, and K.-J. Ha, 2013: Future Change of Asian-Australian Monsoon under RCP 4.5 Anthropogenic Warming Scenario. *Clim. Dynam.*, revised. The results indicate that total AAM precipitation will increase significantly (by 4.5%/°C) mainly due to the increases in ISM (5.0%/°C) and EA summer monsoon (6.4%/°C) rainfall. The Australian summer monsoon rainfall will increase moderately by 2.6%/°C. The combined effects of “warm land-cool ocean” and the “warm Northern Hemisphere-cool Southern Hemisphere” explain the differences between the Asian and Australian monsoon changes. The low-level tropical AAM circulation will weaken by 2.3%/°C) due to atmospheric stabilization that overrides the effect of increasing moisture convergence. Different from the CMIP3 analysis, the EA subtropical summer monsoon circulation will increase by 4.4%/°C. The Asian monsoon domain over the land area will expand by about 10%. The spatial structures of the leading mode of interannual variation of AAM precipitation will not change appreciably but the ENSO-AAM relationship will be significantly enhanced.
- Dong L., T. Zhou, and B. Wu, 2013: Indian Ocean warming during 1958-2004 simulated by a climate system model and its mechanism, *Climate Dynamics*, DOI: 10.1007/s00382-013-1722-z. The mechanism responsible for Indian Ocean Sea surface temperature (SST) basin-wide warming trend during 1958–2004 is studied based on both observational data analysis and

numerical experiments with a climate system model FGOALS-g1. The relative contributions of external forcing (anthropogenic and natural forcing) and internal variability are quantified. The results show that the observed warming trend during 1958–2004 ( $0.5\text{K (47-year)}^{-1}$ ) is largely attributed to the external forcing (more than 90 % of the total trend), while the residual is attributed to the internal variability. The anthropogenic forcing accounts for approximately 98.8 % contribution of the external forcing trend. Previous studies have demonstrated the forcing of Indian Ocean warming to Asian monsoon changes. This finding suggests the anthropogenic forcing to monsoon changes via Indian Ocean SST.

- Feng L., and T. Zhou, 2012: Water Vapor Transport for Summer Precipitation over the Tibetan Plateau: Multi-dataset Analysis, *Journal of Geophysical Research*, 117, D20114, doi:10.1029/2011JD017012. The atmospheric water vapor transport for summer precipitation over the southeastern Tibetan Plateau during 1979–2002 is examined by using five precipitation data sets and three reanalysis data sets. The finding has clarified the origin of water vapour supply for summer precipitation over the southeastern Tibetan Plateau in the context of climatology and interannual variability. The relationship between Indian monsoon and plateau summer precipitation is discussed.
  - Lee, J.-Y., and B. Wang (2012) Future change of global monsoon in CMIP5. *Clim. Dynam.*, DOI: 10.1007/s00382-012-1564-0. The findings indicate a 10% expansion of the monsoon over Asian land, the annual mean and percentage of summer rainfall will increase, with the Northern Hemisphere onset advanced, and the withdrawal delayed.
  - Levine, R. C., A. G. Turner, D. Marathayil, and G. M. Martin (2013) The role of northern Arabian Sea surface temperature biases in CMIP5 model simulations and future projections of Indian summer monsoon rainfall. *Clim. Dynam.*, DOI: 10.1007/s00382-012-1656-x. This manuscript links errors in Indian summer monsoon rainfall to a cold bias in sea-surface temperature that arises due to excessively strong winter monsoon circulation. These biases impact available moisture for monsoon rainfall.
- b) AAMP has sponsored the monsoon Intraseasonal Variability Hindcast Experiment (ISVHE) and has contributed to the development and continuing analysis of the numerical hindcast and forecast experiments. Currently, hindcast datasets produced by 12 models have been collected from six operational centers and six research groups covering the period from January 1989 to December 2008 initiated either every 10 days in each calendar month or every first day of each month for at least a 45-day integration. The ISVHE hindcast dataset can be used to determine predictability and prediction skill of the MJO and boreal summer ISO (BSISO), identify predictability sources in ISV time scale, investigate ISO's teleconnection and impact on mid-latitude weather/climate and tropical cyclone, and construct optimal methods of the deterministic multi-model ensemble prediction and probabilistic multi-model prediction for ISV. The daily prediction data are available at [apcc1.soest.hawaii.edu](http://apcc1.soest.hawaii.edu) upon request ([juneyi@hawaii.edu](mailto:juneyi@hawaii.edu)). Detail information on the ISVHE can be found the following website: <http://iprc.soest.hawaii.edu/users/jylee/clipas>. A overview paper tentatively entitled "advance in the intraseasonal prediction with multi-national and multi-institutional efforts" is under preparation. (Imperative III)
- c) The AAMP supports and contributes to the development of metrics and diagnostics of the MJO and monsoon intraseasonal variability (especially targeting the northward and eastward ISO propagation during the boreal summer monsoon) through interactions with the WGENE MJO Task Force and the development of diabatic heating experiments with YOTC. (Imperative III)

**2. Briefly list any specific areas of your panel's activities that you think would contribute to the WCRP Grand Challenges as identified by the**

## **JSC at its most recent meeting<sup>1</sup>**

- a) AAMP members A. Turner, B. Wang, and T. Zhou and AAMP ICPO contact C. Ereno have taken the lead in developing the Tiger Team white paper for “CLIVAR Grand Challenge: Intraseasonal, seasonal and interannual variability and predictability of monsoon systems”
- b) AAMP members A. Turner and T. Zhou have been involved in developing the Tiger Team white paper for “CLIVAR Grand Challenge: Decadal variability in the climate system and its predictability”
- c) Evaluation of decadal prediction and predictability of the AAM is seen as a new effort by AAMP. This has been facilitated by a September 2012 workshop “International Workshop on Interdecadal Variability of Global Monsoons” that AAMP is sponsoring in Nanjing, just prior to AAMP-12. AAMP raised key monsoon-decadal questions for consideration by “CLIVAR Grand Challenge: Decadal variability and predictability of ocean and climate variability”
- d) The evaluation of monsoon intraseasonal variability and predictability in present-day and climate change simulations in CMIP5 and operational forecast models may yield insight into potential changes to the frequency and intensity of active and break cycles that are associated with short-term extremes of regional drought and flood and provide insight into model shortcomings that are acting to limit monsoon intraseasonal predictions (see Item 5g)

### **3. Key new science findings in the context of the new ocean-atmosphere CLIVAR (1-3 suggestions)**

As discussed in Item 1a, Levine et al. (2013) demonstrate that model error in the simulation of SST in the Arabian Sea contributes the model errors in the amplitude of the and timing of the seasonal cycle of rainfall over India, and Wang et al. (2013) find that projected differences in the gradient of ocean and atmosphere temperature explain projected differences on projected rainfall between Asia and Australia

### **4. Key science questions that you anticipate your community would want to tackle in the next 5-10 years within the context of the new ocean-atmosphere CLIVAR (1-3 suggestions)**

- a) An improved understanding of the role of the Indian Ocean in modulating and limiting predictability of the Asian-Australian monsoon on subseasonal to interdecadal time scales
- b) Understanding the role of the global oceans for driving monsoon interdecadal variability, especially related to ENSO and its teleconnection to the monsoon, and climate regime changes
- c) An improved understanding of the role of land surface processes in modulating and providing predictability of the Asian-Australian monsoon on subseasonal to interannual time scales
- d) An improved understanding, model treatment, and evaluation of the role of

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1. Provision of skillful future climate information on regional scales (includes decadal and polar predictability)
2. Regional sea-level rise
3. Cryosphere response to climate change (including ice sheets, water resources, permafrost and carbon)
4. Improved understanding of the interactions of clouds, aerosols, precipitation, and radiation and their contributions to climate sensitivity
5. Past and future changes in water availability (with connections to water security and hydrological cycle)
6. Science underpinning the prediction and attribution of extreme events

aerosols for monsoon variability and change

- e) An improved understanding of natural variability and anthropogenic forcing in modulating the interdecadal changes of Asian-Australian monsoon

## **5. Cooperation with other WCRP projects, other global change bodies (e.g., IGBP) and links to applications**

- a) AAMP, in conjunction with GEWEX, is developing options for a Pan-WCRP Monsoon Advisory Panel. We have also solicited input for this proposal from Monsoon Asia Integrated Regional Study (MAIRS)
- b) Following the CLIVAR/IOC-GOOS Indian Ocean Panel report at AAMP-12 (provided by Weidong Yu), AAMP expressed its interest in remaining abreast of progress in this observational campaign, and coordinating with the IOP in analysis of the forthcoming data products
- c) Following the IMBER presentation by Liuming Hu at AAMP-12, AAMP member M. Lengaigne attended the IMBER IMBIZO III workshop, and met with members of IMBER to address the issue CLIVAR-IMBER collaboration. Topics of common interest included, but were not limited to (a) What controls interannual and long-term (including anthropogenic climate change) upwelling, and how does this impact ecosystems? (b) Can biogeochemistry and fishery proxies improve our description of decadal ocean variability? (c) Are there biophysical feedbacks that affect ocean properties?
- d) Following the MAIRS presentation by Ailikun at AAMP-12, AAMP has communicating with Mike Manton to establish closer ties for investigations of the physical climate system and their impact on sustainability. Of particular interest to AAMP is the "MAIRS Dryland Theme." Interaction would be promoted through proposed AAMP membership changes, with the acquisition of a land surface expert, and a proposed member with ties to CORDEX, in which similar issues to MAIRS are also being addressed. To foster the coordination, Tianjun Zhou will represent AAMP at the 8<sup>th</sup> MAIRS SSC meeting in Guangzhou, China (25-26 March, 2013)
- e) Harry Hendon represented AAMP at the GEWEX SSG meeting in Sydney. To better foster coordination of monsoon research across CLIVAR and GEWEX, AAMP will organize a monsoon session at the next GEWEX Science Meeting
- f) AAMP is working with the WWRP Monsoon Panel as a co-organizer of the Fifth WMO International Workshop on Monsoons to be held in Macau in October-November 2013. AAMP members are lead and/or co-authors of numerous chapters that will be part of the conference proceedings book
- g) In the interest of investigating intraseasonal predictability and prediction, AAMP is collaborating with the WGNE MJO Task Force, YOTC, the WCRP/WWRP Subseasonal to Seasonal Prediction Project, CINDY/DYNAMO representatives, and (possibly) the CLIVAR IOP. Contributions have been made in (1) the development of metrics for assessing MJO skill in models, (2) the development of process-oriented MJO diagnostics, (3) improving the method of making forecasts of boreal summer intraseasonal variability, (4) establishment of a case study diabatic heating experiment to evaluate convective processes and the MJO in climate and NWP models, and (5) evaluation of new observations (e.g., CINDY/DYNAMO) and application of the full range of modeling abilities (AGCMs, OGCMs, CGCMs, tropical channel, coupled regional mesoscale, regional, cloud resolving, SCM, ocean mixed layer models) relevant to intraseasonal processes. Based on an AAMP-12 suggestion, we are working with the relevant parties to hold an intraseasonal workshop in 2014
- h) For IPCC AR5, A. Kitoh, G. Vecchi, and T. Zhou are lead authors, K. Sperber and B. Wang are contributing authors, and A. Turner is an expert reviewer

**6. Activities in the context of scientific capacity building and career support?**

- a) AAMP organized the International Workshop on Interdecadal Variability of the Global Monsoons that was held in Nanjing, China on 10-12 September 2012, just prior to AAMP-12. AAMP obtained \$15K from NSF, \$4K from WCRP, and ~2K from Nanjing University of Information Science and Technology (the host) to support the participation of early career scientists at this workshop

**7. Activities in the context of knowledge exchange with societal actors?**

AAMP outreach to MAIRS regarding AAMP/GEWEX development of “Pan-WCRP Monsoon Advisory Panel”, and AAMP presence (T. Zhou) at the upcoming 8<sup>th</sup> MAIRS SSC meeting (See item 5d).

**8. New activities being planned, including timeline, request for endorsements, potential for new funding opportunities**

- a) The CLIVAR Asian-Australian Monsoon Panel seeks to promote/implement during 2013/2014 the:
- Developing and application of standard diagnostics and metrics for evaluation/validation to CMIP5 and CMIP3 numerical experiments for the East Asian summer monsoon
  - Application of standard diagnostics and metrics for evaluation/validation to CMIP5 and CMIP3 numerical experiments for the Australian component of the monsoon
  - Analysis of the ENSO monsoon teleconnection and its interdecadal variability, including the possible impact of anthropogenic climate change on this relationship
  - Continued analysis and peer-reviewed publications based on AAMP sponsored Intraseasonal Variability Hindcast Experiment (ISVHE) and release of the model data archive to the public
  - Promote a better understanding to the role that land surface processes play in monsoon variability and predictability. This could be done in conjunction with AMY by selecting case studies that could be simulated by RCMs, CORDEX, and GCMs. This could include AMY data withholding experiments and evaluation using AMY reanalysis
- b) The CLIVAR Asian-Australian Monsoon Panel, WGNE MJO Task Force, CINDY/DYNAMO, and the Monsoon Onset Monitoring and its Social and Ecosystem Impact (MOMSEI) seek to promote/implement during 2013/2014 the:
- Development of process oriented diagnostics for improved understanding of MJO/MISO processes
  - Ongoing evaluation of real-time MJO forecasts, including impacts (tropical cyclones and higher latitude effects)
  - Development of diagnostics and metrics for boreal summer MISO, including forecast approaches that best capture the northward propagating component of the MISO
  - In combination with YOTC, GEWEX GASS, AAMP, and the MJOTF, complete numerical case-study simulations and begin analysis of MJO Diabatic Heating experiment
- c) Improved coordination/cooperation of AAMP with WWRP Monsoon Panel has been established through joint sponsorship of the WMO Fifth International

## **9. Workshops / meetings planned**

- a) AAMP-13, Macao, China on 26-27 October 2013. We will have a half-day joint session with the WGNE MJO Task Force
- b) AAMP is involved in the planning of the WMO Fifth International Workshop on Monsoons, Macao, China on 28 October-1 November 2013
- c) AAMP-14, The Netherlands, June 2014
- d) 1<sup>st</sup> Workshop of the Pan-WCRP Monsoon Advisory Panel, The Netherlands, June 2014
- e) International Workshop on Intraseasonal Prediction, Predictability, Simulation, and Processes (sponsored by the Pan-WCRP Monsoon Advisory Panel, AAMP, WGNE MJOTF, the WCRP/WWRP Subseasonal to Seasonal Prediction Project, CINDY/DYNAMO representatives, and the CLIVAR IOP, are planning a workshop in observations, simulation, prediction and predictability of intraseasonal variability, The Netherlands, June 2014

## **10. Issues for the SSG**

## Annex A

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

Requests should be made through D/ICPO ([rogbar@noc.ac.uk](mailto:rogbar@noc.ac.uk)), against the following headings:

1. **Panel or Working Group:** CLIVAR Asian-Australian Monsoon Panel
2. **Title of meeting or workshop:** 14th Session of the AAMP
3. **Proposed venue:** The Netherlands
4. **Proposed dates:** June 2014 (after the 2<sup>nd</sup> Pan-GEWEX Meeting, the PMAP Workshop, and the Intraseasonal Workshop)
5. **Proposed attendees, including likely number:** AAMP panel members and invited experts participating in the Fifth International Workshop on Monsoons (IWM-V). Panel members: ~10-12 people, and special guests: 6-8
6. **Rationale, motivation and justification, including: relevance to CLIVAR themes & JSC cross cutting topics and any cross-panel/working group links and interactions involved:** Core WCRP CLIVAR panel meeting
7. **Specific objectives and key agenda items:** (1) Review the status of the actions and recommendations approved at AAMP-13, (2) Assess the results of the Pan-WCRP Monsoon Advisory Panel meeting and the Intraseasonal Workshop, (3) Assess the interaction of AAMP with other WCRP panels and WGs, the WWRP Monsoon Panel and AMY, including other field program developments for the region
8. **Anticipated outcomes (deliverables):** Ensure cross-panel and cross-programmatic interactions continue to make progress as related to (1) analysis of monsoon climate change, (2) role of land-surface interactions in monsoon variability, (3) understanding processes/forecasting/hindcasting of monsoon intraseasonal variability, and (4) the usefulness (including potential applications) of further investigation of decadal/interdecadal predictability of monsoon variability
9. **Format:** Targeted presentations and discussion sessions
10. **Science Organising Committee (if relevant):** AAMP co-chairs and representatives of other monsoon panels (e.g., WWRP Monsoon Panel)
11. **Local Organising Committee (if relevant):** TBD depending on host/location of meeting
12. **Proposed funding sources and anticipated funding requested from WCRP:** WCRP and US CLIVAR

## Annex A

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

Requests should be made through D/ICPO ([rogbar@noc.ac.uk](mailto:rogbar@noc.ac.uk)), against the following headings:

1. **Panel or Working Group:** Pan-WCRP Monsoon Advisory Panel (PMAP)
2. **Title of meeting or workshop:** 1<sup>st</sup> Workshop of the Pan-WCRP Monsoon Advisory Panel
3. **Proposed venue:** The Netherlands
4. **Proposed dates:** June 2014 (prior, after, or in conjunction with the 2<sup>nd</sup> Pan-GEWEX Meeting)
5. **Proposed attendees, including likely number:** PMAP members and members of the relevant CLIVAR regional panels and GEWEX panels. Panel members: ~30 people, and special guests: 20
6. **Rationale, motivation and justification, including: relevance to CLIVAR themes & JSC cross cutting topics and any cross-panel/working group links and interactions involved:** Core WCRP activity
7. **Specific objectives and key agenda items:** (1) Assess current state of monsoon research, (2) Identify the outstanding monsoon issues that are common to all monsoon domains, (3) Identify the outstanding regionally specific monsoon issues
8. **Anticipated outcomes (deliverables):** (1) Ensure and develop strategy for Pan-WCRP coordination on monsoon issues, (2) Ensure relevance to CLIVAR and GEWEX imperatives and WCRP Grand Challenges, (3) Prioritization of scientific issues to be addressed
9. **Format:** Targeted presentations and discussion sessions
10. **Science Organising Committee (if relevant):** PMAP members
11. **Local Organising Committee (if relevant):** TBD depending on host/location of meeting
12. **Proposed funding sources and anticipated funding requested from WCRP:** WCRP and US CLIVAR



## Annex A

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

Requests should be made through D/ICPO ([Catherine.beswick@noc.ac.uk](mailto:Catherine.beswick@noc.ac.uk)), against the following headings:

1. **Panel or Working Group:** Pan-WCRP Monsoon Advisory Panel (PMAP), AAMP, WGNE MJO Task Force, WCRP/WWRP Subseasonal to Seasonal Prediction Project (S2S), CINDY/DYNAMO
2. **Title of meeting or workshop:** International Workshop on Intraseasonal Prediction, Predictability, Simulation, and Processes
3. **Proposed venue:** The Netherlands
4. **Proposed dates:** June 2014 (prior, after, or in conjunction with the 2<sup>nd</sup> Pan-GEWEX Meeting)
5. **Proposed attendees, including likely number:** Members of the relevant CLIVAR regional panels and GEWEX panels, WGNE MJO Task Force, WCRP/WWRP S2S members, CINDY/DYNAMO representatives. 75-100 people
6. **Rationale, motivation and justification, including: relevance to CLIVAR themes & JSC cross cutting topics and any cross-panel/working group links and interactions involved:** Core WCRP/WWRP activity relevant to Grand Challenges and Imperatives
7. **Specific objectives and key agenda items:** (1) Assess relevant process from observations, (2) Assess model representation of intraseasonal processes, (3) Assess prediction skill, (4) Assess predictability, (5) Investigate impact of climate change on intraseasonal characteristics, including associated teleconnections and extreme rainfall events
8. **Anticipated outcomes (deliverables):** (1) Improved understanding of key intraseasonal processes and recommendations of approved metrics, (2) Promote translation of improved understanding to model development, (3) Development of experimental modeling framework, (4) Develop roadmap for improved intraseasonal representation across the full-range of weather and climate models
9. **Format:** Targeted presentations and discussion sessions
10. **Science Organising Committee (if relevant):** Representatives of the Panels and Working Groups listed in (1)
11. **Local Organising Committee (if relevant):** TBD depending on host/location of meeting
12. **Proposed funding sources and anticipated funding requested from WCRP:** WCRP, WWRP, US CLIVAR, NSF