



41st Session of the  
**World Climate  
Research Programme  
Joint Scientific Committee**

18–22 May 2020

## **Documents**

Day 2 - Session 4

19 May 2020

# World Climate Research Programme

## JOINT SCIENTIFIC COMMITTEE (JSC)

### 41st online session

## CliC Report (draft 1)

### 1. Highlights for JSC

- Highlight 1  
The CliC co-sponsored ISMASS – Ice Sheet Mass Balance and Sea Level – project has sponsored major workshops on links between high- and mid-latitude climate change (Sheffield, November 2015) and on ice sheets (Brussels, Belgium, February 2017 and Davos, Switzerland, June 2018) that have resulted in the publication of the following high-profile review paper:  
[Hanna, E, F Pattyn, F Navarro, V Favier, H Goelzer, MR van den Broeke, M Vizcaino, PL Whitehouse, C Ritz, K Bulthuis, B Smith \(2020\) Mass balance of the ice sheets and glaciers–progress since AR5 and challenges. Earth-Science Reviews, 102976](#)
- Highlight 2  
The annual Polar CORDEX meeting scientific presentations focussed on following key topics:
  - (i) Surface mass balance of Greenland and Antarctic ice sheets - changes and key drivers. According model inter-comparisons have been accomplished. Simulated recent and future climate change over the Antarctic Peninsula region were presented.
  - (ii) Coupled modeling, its challenges and benefits. For the Arctic, results from atmosphere-ocean models with respect to cyclones and their feedbacks, and improved model physics have been presented. The intra-annual prediction of Arctic sea ice is a promising new capability. For Antarctica, efforts towards coupling the atmosphere with ocean and ice sheet components have been presented.
  - (iii) Model evaluation. Studies over Greenland and near Svalbard were presented. For the Arctic Ocean, a multi-model intercomparison with the ACSE2014 campaign data has been accomplished. Arctic and Antarctic sea-ice lead data sets have been compiled.
  - (iv) Challenges of high-resolution downscaling: Impacts of sea-ice forcing, different physics, resolution, uncertainty assessment, methods to select CMIP6 models.

### 2. Primary science issues (looking ahead, 3 to 5 years)

- Improved understanding and quantification of the role of the cryosphere in the global climate system, its variability and change.
- Improved utilization of cryospheric observations as indicators of global and regional climate change.
- Improved understanding of the physical, chemical and other processes that govern behaviour of the cryosphere, and the representation of these processes in Earth System Models.
- Improved ability to make quantitative predictions and projections of the cryosphere in a changing climate.

The CliC SSG is planning to update the 2017-2021 Action Plan and discussed this at the SSG15 meeting in December 2019. Some of the priorities discussed are to: strengthen the links and communication with other organizations and within the SSG; identify sources of funding; simplify the structure of CliC with only projects and MIPs; communicate CliC

results to a broader audience including organizations working with policy-makers, social science and indigenous knowledge and strengthen the links with those organizations; identify research gaps where CliC could have an impact; establish travel grants for early career or scientists from underrepresented cryosphere regions to participate in CliC sponsored workshops.

### **3. Issues and challenges, for example:**

- How you work with other WCRP activities  
CliC has a number of ongoing collaborations with the other WCRP Core Projects and was represented at the last CLIVAR and GEWEX SSG meetings. CliC and CLIVAR both support the Southern Ocean Region Panel (SORP) and the Northern Oceans Regional Panel (NORP). CliC and GEWEX jointly provide input to the Land Surface, Snow and Soil Moisture Model Intercomparison Project (LS3MIP). The Polar Climate Predictability Initiative (PCPI) is an activity that both CliC and SPARC lead together. Finally, CliC has been supporting the Polar-CORDEX project (Arctic and Antarctic Domains).
- How you see your community evolving
  - Growth in the cryosphere modelling community with a focus on integration of all aspects of the cryosphere into earth system models.
  - Expansion of research on Antarctic sea ice and connections with ocean circulation, carbon cycle, and marine biology.
  - Increased focus on the third pole and strengthened links to water resources, ecosystem services and carbon cycle research.
  - Increased engagement with communities living in polar and high mountain regions to ensure adequate modeling and access to relevant climate information.
- How you work with partners outside of WCRP  
CliC jointly supports a number of long-term activities as follows:
  - BEPSII - Biogeochemical exchange processes at Sea Ice Interfaces (joint with SCAR, SCOR and SOLAS)
  - Antarctic Sea Ice Processes & Climate (ASPeCt) (joint with SCAR)
  - Ice Sheet Mass Balance and Sea Level (ISMASS) (joint with SCAR and IASC)Permafrost Carbon Network (part of the Study of Environmental Arctic Change (SEARCH) project – jointly with IPA, IASC).  
CliC has strong links with ESA and co-sponsored the ESA Living Planet Symposium 2019, held in May, 2019, in Milan.  
CliC supported, with a number of other organizations, the MOSAiC School 2019 organized by APECS and AWI.  
CliC also provides funding for the annual meetings of other groups such as the Arctic Sub-arctic Ocean Fluxes (ASOF) project and the International Ice Charting Working Group (International Workshop on Sea Ice Modelling, Data Assimilation and Verification).
- How the current funding affects your community, your activities, your service  
While our projects could use additional funds to engage more participants and broaden their events, CliC managed to sponsor 16 meetings in 2019. However CliC has not been able to undertake new activities due to the limited funding and the lack of a project office. Additional funding needs to be secured to expand CliC's impact and continued operation.

## SPARC Report

### 1. Highlights for JSC

- Understanding and documenting the [role of stratospheric variability](#) and the [role of stratosphere-troposphere coupling](#) in [subseasonal to seasonal prediction](#)
- Documenting [solar variability as a source of decadal climate predictability](#)
- Progress in understanding atmospheric processes such as gravity waves, quasi-biennial oscillation, polar stratospheric clouds, stratospheric aerosol, and Asian monsoon, but also in analysing long-term trends of temperature and atmospheric composition
  - Global Space-based Stratospheric Aerosol Climatology (40-year data record) version 2.0 released
  - New ISSI international team working on Orographic Gravity Wave Stress and Drag
- Publication of [SPARC/IO3C/GAW “Report on Long-term Ozone Trends and Uncertainties in the Stratosphere”](#) (contribution to WMO/UNEP Ozone Assessment 2018)
- Publication of summary on the [Unreported Emissions of CFC-11](#) (symposium in Vienna, and report published in July 2019 SPARC newsletter) and participation in 2020 report for the Parties of the Montreal Protocol
- Submission of the S-RIP report on reanalysis inter-comparison (currently in review)
- Successful training schools in Kuala Lumpur (MYS) and Hong Kong (CHN)
- Currently 6 open SPARC-related journal special issues/ collections with over 55 papers published in 2019.

### 2. Primary science issues (looking ahead, 3 to 5 years)

- How will climate change on interannual to centennial timescales?
  - Exploiting long-term climate data records for fundamental understanding of short-term climate variability and long-term climate change
  - Understanding the uncertainties in observations, reanalyses, and climate models on various time scales.
  - Determining climate change effects on weather (including extremes) and regional circulations
  - Maintaining observation-modelling interactions
- How can prediction of weather and climate-related extreme events on sub-seasonal to decadal timescales be improved?
  - Characterizing dynamical extremes and compound events in the troposphere (e.g. blocking, stalled Rossby waves, others)
  - Attributing global and regional climate extremes, and improving their representation in climate models
  - Understanding stratospheric biases and uncertainties impacting sub-seasonal to decadal prediction
  - Quantifying the tropospheric responses to stratospheric extremes (e.g. sudden warmings and volcanic eruptions) and their sub-seasonal predictability

- How and why is atmospheric composition changing over time and what are the impacts?
  - Understanding the uncertainties of atmospheric composition change from past to future climate.
  - Understanding aerosol-cloud interaction in a changing climate
  - Monitoring emission change following measures to mitigate climate change
  - Exploring space weather impacts on stratosphere and mesosphere composition

### 3. Issues and challenges, for example:

- How you work with other WCRP activities
  - Joint activities with other core programs (e.g., S2S, Monsoon being re-visited)
  - New WCRP structure **must** be designed to help such joint activities
  - Inter-office telecons have started again, which is very welcome
  - SPARC office would be supportive of a central management software to share documents, meeting dates, and others between offices (preferred: not google).
- How you see your community evolving
  - SPARC now has three co-chairs, representing different regions and science themes. Seok-Woo Son became a third co-chair (end of 2019), but Judith Perlwitz stepped down in January 2020. We need to fill the vacancy.
  - New SSG member from South America, increasing geographic representation within SPARC
  - A challenge to link to African community
  - A challenge in ECS involvement: It is hard to keep good and engaged ECS. Need for more direct and strong involvement of ECS to WCRP – development of Implementation Plan is an excellent opportunity
- How you work with partners outside of WCRP
  - Co-organised activities with IGAC/Future Earth (e.g., ACAM)
  - Strong, but unclear relation to GAW through ozone-related activities; a document has been prepared by various groups involved in the Ozone Assessments and the Montreal Protocol process to clarify this
  - Initiating collaboration with TPE project
  - Inviting representatives from various programs and institutions (e.g., space agencies, science programs) to the SPARC SSG meetings
  - Newly identified liaison with ESA atmospheric satellites
- How the current funding affects your community, your activities, your service
  - Overwhelmingly reliant on participants' research funds for involvement in SPARC activities
  - Many activities ask small funding (for ECS support), but some activities ask full support. It is difficult to figure out what kind of support works well for each activity while keeping the balance between activities.
  - Need to assess the impact of the Covid-19 pandemic on how activities are run in 2020 and how that may change in future. It is likely that our resources will be spent in a different way in future, eg. publication costs of community papers, data storage
  - Need for long-term data storage for coordinated activities – can WCRP organise cloud (or other) support at lower cost?
  - Need for continued support ensuring maintenance and improving quality of long-term observations.
  - Can WCRP provide DOI for WCRP-related data set?
  - Move to a lower CO2 footprint for SPARC activities, incl. next General Assembly

# World Climate Research Programme

## JOINT SCIENTIFIC COMMITTEE (JSC)

### 41st online session

## CLIVAR Report (draft 2)

### 1. Highlights for JSC

- The [new Agreement for hosting of the International CLIVAR Project Office \(ICPO\)](#) was signed between the First Institute of Oceanography of the Ministry of Natural Resources, China (FIO, MNR) and the World Climate Research Programme (WCRP) on July 11, 2019. According to the agreement, FIO will continue to host ICPO until June 2024 in Qingdao, China.
- WCRP and the Indian Institute of Tropical Meteorology (IITM), Pune, India, have formally extended their agreement to host the International CLIVAR Monsoon Project Office (ICMPO) at IITM for one more year until February 2021 to enable consultations on future evolution of ICMPO. Consultations with the relevant stakeholders are currently underway on a proposal to evolve ICMPO to become a consolidated global Monsoon Project Office, which needs to be discussed and jointly agreed between WCRP (GEWEX and CLIVAR) and WWRP/WMO.
- The [IndOOS-2: Roadmap to Sustained Observations of the Indian Ocean for 2020-2030](#) was launched during the 2019 AGU meeting in San Francisco, USA in December 2019. The IndOOS-2 roadmap is a joint publication of CLIVAR and GOOS. It represents a four-year effort that was initiated in 2016 involving more than 60 scientific experts. A series of activities to disseminate IndOOS-2 have been organised or planned, including the [Town Hall at 2020 Ocean Science Meeting](#), Session on 2020 EGU, IIOSC2020, etc.
- [CLIVAR actively participated in OceanObs'19](#), Sep. 16-20, 2019 in Hawaii, USA. With the efforts of SSG, all panels and Research Foci, CLIVAR participated in the submission of [10 white papers](#). The [Executive Summary of IndOOS-2](#) was released during the conference, and ICPO presented a poster on 'The Contribution of CLIVAR to Sustainable Ocean Observation and Information in Support of Ocean and Climate Research'.
- CLIVAR actively participated in the Ocean Sciences Meeting 2020, which took place on Feb. 17-21 2020 at San Diego, USA. CLIVAR panels/RF organized associated sessions or town hall meetings. In particular, the WCRP town hall 'CLIVAR in WCRP: Present and Future of international collaboration in climate and ocean research', and the IndOOS-2 town hall received significant attention.
- The [Research Foci on Tropical Basin Interaction \(TBI\)](#) has been approved by the SSG. The main goal of TBI is to elucidate the complex two-way interaction between the tropical basins and to quantify the benefit to climate prediction. TBI will initiate and facilitate research activities with a focus on seasonal to multi-annual variability and predictability, thus complementing the CLIVAR DCVP RF.
- The first [ICTP-CLIVAR Summer School on Oceanic Eastern Boundary Upwelling System](#) took place from 15 to 19 July 2019 in Trieste, Italy. The research school aimed at stimulating discussion and new ideas concerning the mechanisms that influence the responses of EBUSs to climate variability and change. 37 students and 11 lecturers from 22 countries participated in the summer school.
- An [Advanced School and Workshop on American Monsoons: progress and future plans](#) was organized by the CLIVAR/GEWEX Monsoons Panel at São Paulo, Brazil, from 19-24 August, 2019, with support from ICTP, CLIVAR, GEWEX, IUGG, WCRP, FAPESP, ICTP-SAIFR, IFT-UNESP. There were 82 participants, including lecturers, scientists, graduate students, stakeholders and forecasters.
- The [2nd CLIVAR-FIO Summer School](#) is scheduled from 6-11 July 2020 in Qingdao, China on Ocean Macroturbulence and Its Role in Earth's Climate, coordinated by ARP. Leading experts in ocean

macroturbulence will address observations, dynamics and modeling of the meso/submeso- scale motions and their role in the climate system in the training courses.

- The [3<sup>rd</sup> Summer School on Theory, Mechanisms and Hierarchical Modeling of Climate Dynamics: Tropical Oceans, ENSO and their Teleconnections](#) will be organised from 3 to 14 August 2020 at ICTP, Italy. The first week of the school will focus on the phenomenology, theory, modelling and prediction of ENSO, while the second week will explore teleconnections from the tropical oceans to the extra-tropics, decadal variations of ENSO teleconnections, and inter-basin teleconnections. The summer school is co-sponsored by NOAA Climate Variability and Predictability, NOAA Modeling, Analysis, Prediction and Projection, NSF Physical Oceanography, US CLIVAR and International CLIVAR.
- The CLIVAR-ICTP joint workshop 'From Global to Local: Cultivating new solutions and partnerships for an enhanced Ocean Observing System in a decade of accelerating change', is planned for May 2021, in Trieste, Italy, with the participation of all CLIVAR region panels and GSOP. The motivation of the workshop is to discuss the similar challenges that face the ocean observation in all regions, sharing experience and lessons learnt.
- Two issues of CLIVAR Exchanges were published in 2020. [Issue #77](#) is a joint publication of CLIVAR Exchanges and US CLIVAR Variations, highlighting the recent scientific progress from the [2019 US CLIVAR/CLIVAR Sources and Sinks of Ocean Mesoscale Eddy Energy Workshop](#), and includes information on the newly formed Ocean Transport and Eddy Energy Climate Process Team. [Issue #78](#) focuses on the [decadal review](#) of the Indian Ocean Observing System (IndOOS) and its outcomes.

## 2. Primary science issues (looking ahead, 3 to 5 years)

- **Tropical Pacific Decadal Variability (TPDV)**

'A review of decadal climate variability in the tropical Pacific: characteristics, causes, predictability and prospects' has been submitted to *Science* (Power et al.) in 2019 as a result of two workshops organised by the CLIVAR Pacific Region Panel (San Pedro de Manglaralto, Ecuador; 2018 & Paris, France; 2019). This paper provides a comprehensive review of our current state-of-knowledge of TPDV, its spatial and temporal characteristics, its many proposed mechanisms, and the current ability of state-of-the-art modeling and prediction systems to simulate and predict TPDV. Several open questions have been identified by the paper, such as western Pacific off-equatorial heat content, Low-Latitude Western Boundary Currents and Pacific-Indian Oceans connections via the Throughflow in regulating the variations of equatorial Pacific heat content at decadal timescales. PRP will make further efforts to address these questions.

- **Monsoon Modelling and Prediction**

WCRP has taken a more global view of the monsoons among its core projects, under the auspices of the CLIVAR/GEWEX Monsoons Panel, to enable knowledge and best practice to be shared between the various monsoon regions and to better coordinate monsoon research between GEWEX and CLIVAR, particularly in emphasizing the role of convection and the land surface in the monsoons. It is important to extend this pan-WCRP focus on the monsoons to weather timescales through appropriate linkages with WWRP, as many of the primary science issues in representing the monsoons in models are common, with implications for monsoon prediction across time and space scales. Such a joint effort will have enormous potential for societal applications, given the large populations dependent on the monsoons. A key target in this regard is sub-seasonal to seasonal prediction (S2S), including the extremes.

- **ENSO Research**

The PRP contributed substantially to chapters of an AGU monograph titled '[El Niño Southern Oscillation in a Changing Climate](#)'. This book provides a comprehensive review of ENSO and the effect of climate change on its dynamics, predictability, and impacts. A Working group on ENSO conceptual models has been established within PRP. The ENSO metrics effort continues to make progress. A Python package has been generated to diagnose and explore ENSO characteristics in the CMIP5 and CMIP6 models and will be plugged into widely-used community diagnostic tools, including ESMValTool and the PCMDI Metrics Package.

- **Eastern Boundary Upwelling System (EBUS)**

A perspective paper on EBUS research is being prepared by the EBUS RF, and is scheduled to be submitted in 2020. This paper will highlight important research questions on the current knowledge on EBUS and on their future, on some of which group members have initiated active scientific collaboration.

- **Climate and Ecosystem Prediction**

Links between physical oceanography and biogeochemical and biological sciences have been promoted by CLIVAR panels. Two joint workshops with PICES WG-40 on Climate and Ecosystem Predictability have been organised in 2019. The [first workshop](#) was organised in FIO, Qingdao, China in June 2019, and aimed to review the current ecosystem forecasting efforts, assess the mechanisms responsible for predictability in the different areas, and discuss the steps and action required to develop a common and integrated framework for forecasting activities. The [second workshop](#) was organised on Oct. 20, 2019 in Victoria, Canada alongside the 2019 PICES annual meeting. The workshop aimed to synthesize our current knowledge on the sources of marine ecosystem predictability arising from the large-scale climate. A special issue on '[North Pacific Climate and Ecosystem Predictability on Seasonal to Decadal Timescales](#)' in *Frontiers in Marine Science* is being coordinated.

- **Climate Services**

[A workshop on WCRP Grand Challenge and Climate Services](#) has been organised by SL GC on Nov., 2019 in Orléans, France. Six topics were covered: 1) assessments of the current status of coastal climate services (CCS); 2) identification and mapping of users; 3) identification and analysis of needs for different types of users (e.g., insurance, critical infrastructures or settlements, observation needs); 4) review of existing practices and how they can be improved; 5) translating sea-level science to operations and communicating uncertainties and 6) potential framework for coastal climate services. A special issue to assess the current status of climate services supporting adaptation to sea-level rise is being coordinated by SL GC. Meanwhile, ICMPO assisted in organising the [Sixth International Conference on Climate Services \(ICCS-6\)](#), which was organised on Feb. 11-13, 2020 in Pune India.

- **Ocean Model Development**

OMDP has been pushing forward the development of ocean circulation model through identifying the challenges and prospects in ocean circulation models (Fox-Kemper et al. 2019; Griffies et al. 2010), organizing the Co-ordinated Ocean-Ice Reference Experiments (CORE-I and CORE-II) and the newest variants, the Ocean Model Intercomparison Projects (OMIP-1 and OMIP-2). The panel was involved in the coordinated development of forcing datasets: CORE-I (Large & Yeager, 2004), CORE-II (Large & Yeager, 2009), and now JRA55-do (T sujino et al. 2018). Since last year, OMDP has built protocols for comparing ocean-sea ice models at high-resolution and low resolution (Chassignet et al., 2020), and protocols for comparing ocean model parameterizations, (Li et al., 2019). Based on these protocols and previous successes, OMDP will continue leading the ocean model community to engage in intercomparison of model resolution and parameterizations, and other aspects of ocean models.

- **Climate Dynamics**

The frontline problems and techniques described in Collins et al. (2018 NCC) will constitute the science topics of the Climate Dynamics Panel; with the overarching topic of "Developing predictive theories of climate dynamics". Other science issues in the climate dynamics field are: i) Response to external forcing of mid-latitude jets, storms and blocking, ii) Basin-to-basin and tropical-extratropical teleconnections, and iii) Decadal variability and predictability. Techniques needed are: i) High-resolution coupled modelling, ii) Partial coupling and pacemaker experiments, iii) Decadal predictability experiments, and iv) Complex diagnostics and simplified models.

- **Update on Arctic freshwater storage**

Northern Oceans Region Panel is preparing a review paper on the update of Arctic freshwater storage, which will be finished in the first half of 2020. Progress and knowledge gaps on Arctic freshwater distribution, sources and sinks, reanalysis will be recognized.



### 3. Issues and challenges:

- **WCRP flagship projects**

In order to strengthen the interaction among WCRP core projects, three flagship projects have been jointly identified by the WCRP core projects and CORDEX, and linkage between CLIVAR panels and the flagship projects have been further explored. The [Third Pole Environment \(TPE\)](#), relevant to CLIVAR and GEWEX, may potentially be linked with the Monsoons Panel (MP) and Indian Ocean Region Panel; the [ANDEX program](#), potentially linking CLIVAR, GEWEX, CliC and SPARC, could be linked with the MP and Pacific Region Panel; and the Greenland project, relevant to CLIVAR and CORDEX, is potentially linked with CLIVAR through NORP and probably the Atlantic Region Panel. Meanwhile, the CLIVAR Ocean Modeling Development Panel (OMDP) may be relevant to all three flagship projects.

- **CLIVAR's contribution to WCRP 'big questions'**

The CLIVAR SSG has identified two main areas of contribution to the WCRP flagship objectives and associated projects to establish the scientific basis for adaptation and mitigation action for a climate resilient society. One is to improve the understanding and prediction of climate variability and its response to human activities. CLIVAR suggests the promotion of other experimental campaigns in addition to CMIP, in order to complement the existing CMIP protocol with initialized ensemble seamless predictions. Those experiments require truly Earth System Models operating at all time scales (by leveraging efforts among modelling centers), Earth System Reanalysis back in time (through data rescue and data analysis methods) and inclusion of innovative Machine Learning approaches. The second suggestion from CLIVAR is to establish a WCRP Climate University and/or Open Labs in order to enable the generation of actionable climate information on global to local scales.

- **Contribution to UN Ocean Decade**

CLIVAR has been involved in providing broad ideas for guidelines in ocean modeling and ocean data synthesis as well as the carbon component of the [UN Decade of Ocean Science for Sustainable Development](#). Meanwhile, CLIVAR is active and has considerable experience in implementation of specific activities especially for promoting ECS, disseminating knowledge and connecting to stakeholders, which may also contribute to the capacity building component of the Ocean Decade.

- **Cooperation with US CLIVAR**

The US CLIVAR and International CLIVAR have many shared interests in ocean and climate research. Many of them have been implemented through joint activities, e.g. the Joint Workshop on Sources and Sinks of Ocean Mesoscale Eddy Energy (March 2019), Joint Workshop on Atmospheric Convection and Air-Sea Interactions of the Tropical Oceans (May 2019), etc. Moreover, the US AMOC Science Team is sunsetting in 2020 and transitioning coordination to the CLIVAR Atlantic Region Panel is being explored.

- **How you work with other WCRP activities**

Some CLIVAR panels/RF are co-sponsored by other WCRP activities, such as SORP, NORP, IORP, Monsoon Panel, SL etc., and this needs detailed and sustained communication with partner core projects. These panels/RF may be the main platforms for CLIVAR to co-organize joint activities with partner core projects.

- **How you see your community evolving**

Greater emphasis on integrating modelling and observations, data science and machine learning, greater emphasis on interdisciplinarity, e.g. role of biophysical interactions in carbon uptake; greater emphasis on connecting understanding to improved predictions of impacts relevant to society]

- **How you work with partners outside of WCRP**

CLIVAR is also looking to engaged with partners outside the WCRP family, which share common scientific interests, among the partners that we have had recent communications include: SCOR, POGO and PICES.

- **How the current funding affects your community, your activities, your service**

In reference to funding for CLIVAR- constraints mean fewer in person meetings/workshops, less participation from developing world.

In reference to funding from governmental and intergovernmental agencies for science: funding limits ability to maintain observing system and facilities, ability to attract the next generation of researchers, ability to upgrade prediction capabilities].

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# World Climate Research Programme

## JOINT SCIENTIFIC COMMITTEE (JSC)

### 41st online session

## Global Energy and Water Exchanges (GEWEX) Report (draft 1)

### 1. Highlights for JSC

#### a. Scientific Highlights

- ISCCP-NG progressing well, involving international coordination with operational sat-met agencies enabling continuation of ISCCP Cloud related climate data records (higher space-time resolution, more accurate, stable etc.)
- EEI Assessment: Earth Energy Imbalance Assessment has begun, and community consultations have occurred in order to identify the best way forward
- Orographic drag effects when resolved are similar across models vs when parameterized are diverse in terms of magnitude and position:-> high res. Modelling can constrain parameterizations
- LES and NWP fog MIP: shows significant variations between models and lot more consistency for LES than SCMs, suggesting that microphysics & radiation are key causes (and not turbulence).
- LS4P: High elevation land surface and subsurface temperatures in the Third Pole region have substantial predictive capability for precipitation on S2S timescales.
- UTCC PROES: Cloud System Analysis allows process studies by relating anvil properties to convection & provides new observational metrics to further constrain model parameterizations. The emissivity structure of mature convective systems changes with convective depth, with more surrounding thin cirrus
- GABLS-4: better simulation of the Low Level Jet in many models (compared to the previous GABLS experiment) thanks to a TKE scheme and a height of the first level about 3m. For the LES, to reduce the differences or the uncertainties in the LES results it is necessary to use a resolution about 1 meter for the horizontal and the vertical directions
- SoilWat: Small-scale soil structural features may have large-scale implications in water and carbon cycles and ultimately on climate.
- Benchmarking: PALS - [Modelevaluation.org](http://Modelevaluation.org) web-based platform for benchmarking models against observations and iLAMB a global benchmarking toolkit for climate model variables (seasonal to annual)
- Land-Atmosphere MIPS: GSWP-3, LS3MIP and LUMIP
- GEWEX/GLASS Land-Atmosphere Feedback Observatories (GLAFOs) a new project to develop observatories for long-term, high-frequency obs. of soils, vegetation, surface fluxes and the planetary boundary layer (3-Dimensional).
- Regional Hydroclimate Projects: 4 well established(GWF, Baltic Earth, Hymex, PANNEX), 3 Initiating (ANDEX, TPE-Water Sust, AsiaPEX), 3 in development (USA-CONUS, Central Asia and Eastern-Africa) -> regional networks and application of climate science bringing together models, observations, scientists and practitioners and stakeholders. Good link with CORDEX in most of these. Convection Permitting Modeling integral part.

- Cross-cutting projects; INTENSE develop high resolution precipitation data set to study extremes, INARCH develop mountain hydrometeorology watershed observational network, and a new one TEAMx that studies transport and exchange over mountainous regions. Evapotranspiration is a new crosscut in development
- Strong collaboration/involvement global data centers (BSRN, GPCC, GRDC and to lesser extent Hydrolare)
- A coordination of model development around human water management and field campaigns have been initiated

**b. Programmatic Highlights**

- Continuation NASA support for IGPO for 5 years
- USGCRP Support for US GEWEX related activities in development with a town-hall meeting organized at AGU in December 2019 and AMS in January 2020.
- New RHPs in development focusing on high mountain regions in Central Asia and Eastern Africa in close collaboration with START
- GASS further develops strong links with other WMO atmospheric modelling activities in particular with WWRP, WGNE. The panel is now complete and fully active.
- GDAP restructuring develops well with strong focus on process-oriented activities, product assessments and new earth observation systems

**2. Primary science issues** (looking ahead, 3 to 5 years)

- GEWEX is currently developing its science plan and implementation to optimize its structure with the new WCRP strategy (SATM)
- Move to process-oriented view can bring tension to other more variable centric approaches (e.g. CDRs). But there is a clear need within the water and energy cycles to refocus on process understanding to better use observations and models.
- Water for the Food Baskets GC has the potential to become a GEWEX theme/focal point should GC disappear.
- Extremes will continue to be a dimension to future GEWEX after sunseting the GC. The growing lengths of the global climate data records overseen by GEWEX offer potential to make advances, as shown in the GEWEX contribution to the GC study of precipitation extremes.

**3. Issues and challenges**, for example:

- Tendency to over coordinate the activities (top down) where the focus is on structure and not people.
- Monsoon Panel coordination is improving but clarity is needed on responsibility. Current situation is not ideal where monsoon panel is under CLIVAR and GEWEX but the office is under CLIVAR IPO.
- Uncertainty in future structure can have a paralysing effect on activities and endangers funding from national organisations.
- The WDAC and WMAC are too isolated and rethinking of purpose is needed
- GEWEX community is growing and thriving, with many new activities in the pipeline. Stronger engagement with both the younger side of the community as well as the LDC side. The RHPs in particular have a good effect on the latter. Eastern-Europe and Latin America are current focal points, to be widened to Central Asia and Africa in near term
- GEWEX continues to work strongly with non-WCRP partners e.g. START, Space Agencies etc.
- Funding from third parties is fine. Difficulty lies in how in particular US Gov. money can be spent. WMO vs other UN agency support can also be tricky.

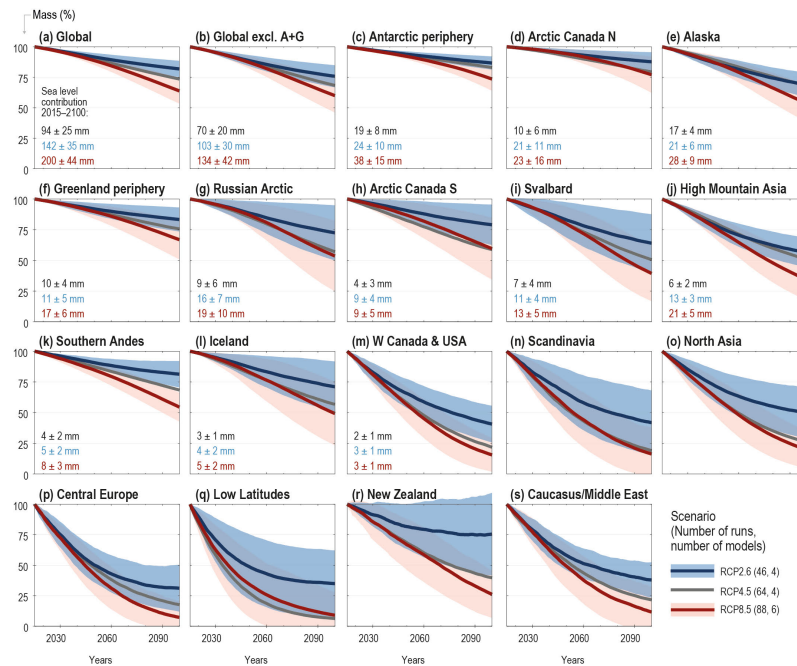
## World Climate Research Programme JOINT SCIENTIFIC COMMITTEE (JSC) 41st online session

### Grand Challenge on Melting Ice and Global Consequences Report (draft 1)

#### 1. Highlights for JSC

##### • Highlight 1

GlacierMIP has coordinated two intercomparisons of global-scale glacier projections. The results of the first comparison of glacier models from six modeling groups (Hock et al., 2019) have directly been used in the recent IPCC SROCC (Hock et al.). A second study including >250 glacier projections coordinated through GlacierMIP focused on partitioning of uncertainties and results have been submitted to Earth's Future (Marzeion et al., 2020).



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- Highlight 2  
The Ice Sheet Modelling Intercomparison Project for CMIP6 team produced the [ISMIP6 special issue in The Cryosphere](#). ISMIP6 is the primary activity within CMIP6 focusing on modeling the evolution of the Greenland and Antarctic ice sheets. The ISMIP6 experimental design relies on forcing from CMIP climate models and includes, for the first time within CMIP, coupled ice-sheet-climate models as well as standalone ice sheet models. ISMIP6 provides a basis for investigating the feedbacks, impacts, and sea-level changes associated with dynamic ice sheets and for quantifying the uncertainty in ice sheet contribution to sea-level change. The goal of this special issue is to build an evolving volume of refereed and high-quality contributions focusing on both standalone ice sheet models and coupled ice sheet-climate models, as well as new developments to improve the representation of external forcings used by ice sheet models. Such a volume will serve as a unique open reference to the rapidly evolving field of numerical modeling of ice sheet flow of the Greenland and Antarctic ice sheets. It contains the first CMIP forced ice sheet model projections for both Antarctica and Greenland and will serve as an important baseline for future iterations.

## 2. Primary science issues (looking ahead, 3 to 5 years)

The overarching question of the GC is: How will melting ice respond to, and feedback on, the climate response to increasing greenhouse gases, and what will the impacts be? To address this question, the plan of the GC was to consolidate historical observations from a range of sources, and focus effort on better representing the shrinking cryosphere in climate models used to make quantitative projections that underpin the IPCC ARs. The GC activities target three areas:

- 1) Quantifying the amount of carbon available in permafrost areas, evaluating the potential for release of this carbon, and improving our capability to simulate the response of permafrost, and its connection to the global carbon cycle, under a warming climate.
- 2) Assembling glacier and ice sheet models for use in projecting melt rates and corresponding sea-level rise.
- 3) Assembling the most reliable observational data on sea-ice and snow and using these data to evaluate and improve climate model simulations of the remarkable changes that have already been observed and to enhance confidence in future projections.

The IPCC AR6 publication was the initial cut-off date and the GC implementation plan needs to be updated. The various activities of the GC are all success stories and will be continued.

## 3. Issues and challenges, for example:

- How you work with other WCRP activities  
The activities of the Melting Ice and Global Consequences Grand Challenge are coordinated by the CliC IPO. Some of them have strong connections with other Grand Challenges such as ISMIP6 with the Sea Level Grand Challenge or other WCRP Core Projects such as ESM-SnowMIP through LS3MIP. However, the lack of communication between the GCs has been emphasized, especially when the link is obvious like between the Sea Level and Melting Ice GCs.
- How you see your community evolving - See CliC report.
- How you work with partners outside of WCRP - See CliC report.
- How the current funding affects your community, your activities, your service  
The GC receives funding from WCRP. CliC has been providing funding from its core budget to the GC activities for the past few years to ensure that the MIPs have enough funding to hold their workshops. The Melting Ice GC has 6 components and the WCRP allowance has not been sufficient on its own for 6 meetings.
- The Melting Ice and Global Consequences Grand Challenge started as a set of independent activities, mainly MIPs, which are all very successful. The issues that has been identified is that the GC remained as such and its activities do not

necessarily identify as being part of the GC. It has therefore always been difficult to present the GC as a whole.

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## World Climate Research Programme JOINT SCIENTIFIC COMMITTEE (JSC) 41st online session

### WCRP Sea Level Grand Challenge Report (draft 1)

#### 1. Highlights for JSC

- The SL GC has made a great contribution to the IPCC [Special Report on Ocean and Cryosphere in a Changing Climate \(SROCC\)](#). Meanwhile, SL GC also contributed to IPCC AR6 by submitting 10-15 papers related to ISMIP.
- The [Workshop on WCRP Grand Challenge and Climate Services](#) was organised on 12-13 November 2019 at Orléans, France, in conjunction to the [SL GC-4 \(Report\)](#). Around 40 scientists attended the workshop, including members of the SL GC (in particular WP5), and invited participants with experience in projects on coastal climate services. It was agreed during the meeting to bring more decision makers to the planned SL conference (see below) and preparatory workshops. A research topic on '[Climate Services for Adaption to Sea-Level Rise](#)' has been accepted by *Frontiers in Marine Science*, with 15 confirmed submissions.
- To strengthen the link with end users, David Behar and Kathy McInnes have been approved as new co-chairs for SL GC. Also, the leadership of the six Work Packages (WP) has been updated with consideration of the expertise, gender, age and regional spread.
- Building on the success of the New York Sea Level Conference in 2017, the SL GC agreed to organise the Second Sea Level Conference in Asia (Singapore) tentatively in July 2022. The conference aims to have 300-500 participants, with a large representation from vulnerable Asian coastal areas, and including top world stakeholders, city planners, coastal developers and managers and other relevant stakeholders to focus on the flow of knowledge from sea-level science to strengthen climate change adaptation and disaster resilience in coastal zones. The SL GC will be completed after the conference, at least in its current form.
- A preparatory workshop on user interaction will be organised in Victoria, Canada in Autumn 2020 (subject to the COVID-19 situation), while another preparatory workshop on sea-level and subsidence will be organised in 2021 at a location to be determined, feeding into the 2022 Sea Level Conference.
- Three oral sessions and one poster session on 'Sea Level Change, Coastal Impacts, and Adaptation' were successfully organised by SL GC at the 2019 AGU Fall Meeting.
- A special issue on [Relationships Between Coastal Sea Level and Large Scale Ocean Circulation](#) has been published in *Surveys in Geophysics* in November 2019. 16 review papers from the ISSI workshop in 2018 are included in this issue.
- SL GC also contributed to the WMO Statement on the State of the Global Climate 2019 (WP6).

#### 2. Primary science issues (looking ahead, 3 to 5 years)

- *High End estimate of Sea Level Rise for Stakeholder Application*

Because of the existing confusion about multiple perspectives on high-end scenarios, there needs to be a reconciliation of those perspectives by integrating the best scientific information and guidance to provide consensus on actionable science. A [conceptual framework](#) for high-end sea-level rise as a function of time scale has been developed, as a contribution of the SL GC community paper (Stammer et al., 2019). The proposed framework infers the required information from explicit conditional statements (lines of evidence) in combination with upper (plausible) physical bounds. This approach



acknowledges the growing uncertainty in respective estimates with increasing time scale. It also allows consideration of the various levels of risk aversion of the diverse stakeholders who make coastal policy and adaptation decisions, whilst maintaining scientific rigor. International and interdisciplinary co-operation and co-production are essential to achieve future success in this direction. GC leaders are planning a follow up paper that uses the conceptual approach in Stammer et al 2019 to develop consensus projections of SLR to meet user needs before the 2022 Conference.

- *Coastal Climate Services (CCS)*

Climate services provide the scientific information relevant for adaptation to and mitigation of climate change. Coastal zones are especially in need of climate services for adaptation, in particular due to committed sea level rise, as re-emphasised in IPCC SROCC in 2019. Though some coastal climate services already exist, such as observations, models, case studies, training and user support, the information and climate services supporting adaptation to sea-level rise remain fragmented and sometimes cause confusion, e.g. the probabilistic projections of SLR may not be well understood by decision makers or assist in planning. The SL GC recognise that the following issues on coastal climate services need to be further addressed: 1) assessment of the current status of coastal climate services and planned activities; 2) identification and mapping of users and their needs; 3) review of existing practices and how they can be improved; 4) translating science to application and communicating uncertainties; and 5) frameworks to develop coastal climate services. The special issue of *Frontiers in Marine Sciences* will address this in more detail.

- *Sea Level Budget*

In order to understand and reduce the uncertainty in the mass and steric contribution to contemporary sea level budget at both global (WP6) and regional to local (WP3) spatial scales, the SL GC will start in 2020 a new assessment of the sea level budget (update of the WCRP, ESSD, 2018 paper) with updated values for the components over an extended time period. Ocean reanalyses will be also considered for the steric component.

- *Sea Level Rise Risk and Responses*

In the IPCC SROCC, the importance of cross-cutting measures such as information measures (e.g. warnings, emergency preparedness) and community measures are highlighted. Also, the integrated uses of adaptive options, including protection, accommodation, ecosystem-based adaptation (multiple benefits), coastal advance and planned relocation, if alternative localities are available, can be more effective in responding to SLR than applying single options. Meanwhile, the sea level rise range that needs to be considered for planning and implementing coastal responses depends in part on the risk tolerance of stakeholders.

- *Other science issues*

The translation of global climate information for coastal hazard assessment such as coastal flooding and erosion requires appropriate regionalisation. To understand the coastal impacts of sea level rise, extreme sea levels and relative sea levels must be modelled at the local scale, especially where waves are the dominant mechanism. Local information (e.g. vertical land motion including subsidence, storms, waves and bathymetry, topography, geomorphology and catchment inputs) is needed in coastal modelling to provide regionally useful assessments. Translation of open ocean climatological signals towards coastal extreme sea level events require further attention.

### **3. Issues and challenges, for example:**

- How you work with other WCRP activities

The SL GC collaborates closely with CMIP6, e.g. to quantify the contribution of land ice to future sea level rise through ISMIP-6 (linking the CMIP with ice sheet modelling communities) and CliC; and the CESM2-CISM2 simulations focusing on Greenland Ice mass

loss. Meanwhile, several joint papers have been published together with CLIVAR OMDP, which demonstrated a good inter-panel cooperation.

- How you see your community evolving

The SL GC started as a science initiative and has evolved by improving understanding and integration between the science areas and an improving appreciation of user needs. This move to application is expected to continue as increasing engagement with users helps to shape the resulting science needs.

Climate services dedicated to sea level problems will gain more and more attraction thereby including attention for the incorporation of non-climate driven components related to relative sea level like human caused subsidence. High-end, extremes and the Antarctic contribution to SLC are topics attracting attention of the community because of their imminent importance for the impacts of sea level change on society

- How you work with partners outside of WCRP

Scientists involved in the GC are also partners in other international bodies coordinating model intercomparisons and international observing programs.

- WP1 of SL GC partners with SCAR on SERCE & ASIDSL.
- To enhance the future cooperation with GLOSS on global sea level observations.
- Enhanced interface with decision community and its science needs
- How the current funding affects your community, your activities, your service

Funding is under pressure at the international level, this is reflected in our community.

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# World Climate Research Programme

## JOINT SCIENTIFIC COMMITTEE (JSC)

### 41st online session

## Water for the Food Baskets of the World GC Report (draft 1)

### 1. Highlights for JSC

#### a. Scientific Highlights

- Convection permitting modeling (CP) performed over S. America, Europe, China and N. America with new updated and expanded experiments planned
- Water for Food Baskets as a theme is part of several regional hydroclimate projects (RHPs): PANNEX, ANDEX, HYMEX and the to be -further- developed RHPs in Central Asia, Eastern Africa and AsiaPEX (SE Asia)
- LIAISE field campaign is fully funded and was in full preparation when the COVID-19 crisis occurred. It has now been postponed to spring and summer 2021. All funding agencies and participants maintain their commitment.
- LS4P: land surface initializing important for forecasting at S2S time scales important for agriculture
- US/CONUS RHP development underway with the support of the newly established US-GEWEX coordination office.
- Sonali P. McDermid has initiated a coordination effort for the development of irrigation and water management parameterizations in Earth System models (ESMs). It includes hydrology, agronomy and land surface modelers (Town Hall meeting organized at AGU and a review paper under preparation).
- Development of agriculture management models for ESMs continue for WRF and CESM.
  - A tile-drainage model was recently implemented in WRF-Hydro along with a 30-m CONUS tile-drainage dataset (AgTile-US, see slides 1&2 in the attached ppt), and the latter represents the first attempt to map high-resolution agriculture tile-drainage installations at continental scales (Valayamkunnath et al. 2020).
  - To improve the representation of climate-crop-hydrology interactions, we applied the community Noah-MP LSM with dynamic crop-growth and irrigation schemes to jointly simulate the crop yield and irrigation amount for corn and soybean in the central U.S. Several common uncertainties in modeling crop growth were identified, including yield-gap estimation, planting date, photosynthetic rubisco capacity, irrigation processes, which point to future efforts to incorporating spatially-varying crop parameters (see slide#3).

#### b. Programmatic Highlights

- Well established link with AgMIP community
- Convection permitting modeling (CP) community well established and growing fast
- USGCRP Support for US GEWEX related activities in development of which CP modelling is important part
- Research programs funded in a number of European countries to understand the role of water usage on recent trends in water resources.

- ESA has funded two research projects on quantifying irrigation using remote sensed information.
- US agencies (NOAA, NSF, USDA) funded research projects to enhance the representation of agriculture management modelling for ESMs.

**2. Primary science issues** (looking ahead, 3 to 5 years)

- Water for the Food Baskets to become a GEWEX theme/focal point (as the GC disappears)
- This is a very broad grand challenge and can only tackled piecemeal wise

**3. Issues and challenges**, for example:

- Better linkage needed with the S2S community (when both communities are primed)
- Uncertainty in future structure can have a paralyzing effect on activities
- As a theme/focal point and with sponsors this GC is very attractive but for the scientific community it is very broad in scope, and researchers tend to focus on one or a few aspects. Will take time to connect all the “dots” and have the right people in place.
- One possible pathway forward is to unify these efforts in the context of CP modelling and improve ESMs (already happening).
- Developing joint activities with the AgMIP community/vegetation/crop modelling needs to be prioritized.
- A WCRP conference on this Grand Challenge has been requested but no news for the moment.
- A stronger integration with GEWEX panels would be helpful in order to involve more experts in either observations, land surface or atmospheric modelling.

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## Grand Challenge on Weather and Climate Extremes Report (Draft 1)

### 1. Highlights for JSC

1. **WCRP contribution to RISK-KAN:** WCRP Institute of Advanced Studies in Climate Extremes and Risk Management (Nanjing, 2019). Supported by Nanjing University of Information Science and Technology, APN, IRDR. 29 international (from all continents) plus 10 local students at PhD level (senior PhD student and recent PhDs). Three student-led papers are in the works and will be submitted for peer reviewed publication. Six lecturers including 5 past/current IPCC WGI/II lead authors.
2. **IPCC AR6 contribution:** Coordinated key analyses on past and future changes in extremes, and detection and attribution studies to provide timely publications for IPCC AR6 assessments. Most key figures in Chapter 11 (dedicated to extremes) of the IPCC AR6 WGI report come from GC coordinated analyses. The GC-Extremes team contribution to AR6 includes 3 coordinating lead authors, 3 lead authors, one review editor, and several contributing authors.
3. **Extensive participation in CMIP6**, co-ordinating on multiple MIPs including LUMIP (Sonia Senevirante), VolMIP (Gabi Hegerl), LS3MIP, and providing inputs to other MIPs that pay particular attention to extremes such as DAMIP, highresMIP, and HAPPI.
4. **Datasets and tools:** Creation of unique global-scale [daily](#) and [sub-daily](#) precipitation datasets and a dataset of climate extremes indices and associated [web portal](#) along with the co-development with GEWEX of the [Frequent Rainfall on Grids \(FROGs\) database](#) containing consistently formatted in situ, satellite and reanalysis precipitation datasets and associated [Special Issue](#) in Environmental Research Letters.

### 2. Primary science issues (looking ahead, 3 to 5 years)

- High resolution modelling
- Extreme Earth/Digital Earth
- Defining and identifying safe climate spaces
- Compound events
- Process based attribution and prediction, including extremes
- Process understanding to inform future projection of some types of extremes such as extreme precipitation, extreme wind

### 3. Issues and challenges

- Extremes cross cut many core projects, working groups and Grand Challenges but they are not necessarily well-coordinated across all WCRP and non-WCRP activities. Extremes are also vital parts of many of the proposed new 'lighthouse' activities and are hence a key part of the new WCRP strategic plan and its implementation (examples include: defining and identifying safe climate spaces; process based attribution and predicting, digital earth.)
- The Expert Team on Climate Change Detection and Indices (ETCCDI) which formed a cornerstone of GC Extremes activities and much of the framework for the IPCC

assessment of extremes has ceased to be supported by WMO leaving WCRP as the sole sponsor. A positive of this could be an opportunity to reformulate the most important and innovative aspects of the ETCCDI program, particularly those clearly linked to the WCRP strategic plan and lighthouse activities, to form the 'Global Extremes Project'. Initial activities could include: a) Global and regional monitoring and global stocktake ( ETCCDI); b) Annual updates on the status of extremes and attribution; c) Cross-WCRP coordination and integration of extreme-related activities; identification of evolving new science questions and developments on mechanism, modelling, attribution and prediction of extremes including compound events; d) Capacity building for proper applications and developing true partnership with users. In particular, the key role of extreme events in several of the proposed 'lighthouse' activities require a coordinated approach.

- Observations is not a very visible activity in the proposed lighthouse activity. Observations remain a challenge including quality, availability and accessibility. Satellite data are now starting to offer 'climate scale' records but uncertainties around extremes remain large.
- Boundaries between partners within and outside of WCRP are also barriers for knowledge transfer and collaboration for extremes linking both climate science and users. True partnership and working as one is required but this is not always possible. The term 'extreme' is viewed differently depending on the application and therefore we do not necessarily have a common language across the programme on how extremes should be defined and definitions are often vague and/or ad hoc. This can make it difficult to collaborate.
- Funding always an issue (especially now and can be worse post-COVID19). Lack of WCRP funding means many activities have to piggy-back on other activities, hard to be systematic; but we managed to do some including the Nanjing summer school, IPWG/GEWEX/GC Extremes precipitation observations workshop.
- Capacity building is very challenging: a place that needs capacity is a place that needs resources (both financial and human) and resources especially financial resources are hard to come by; incentive to attract builders/trainers is low (more effort/time to train may mean lower productivity for publishing high impact papers for trainers).