

GHP Panel Reports for the 32nd GEWEX SSG Meeting 2020

Full Panel Name (Acronym) : GEWEX Hydroclimatology Panel
Reporting Period : 01 January - 31 December 2019
Starting Date :
End Date (where appropriate) : NA
URL : <https://www.gewex.org/panels/gewex-hydroclimatology-panel/>

Membership

Chair(s) and Term Dates : Joan Cuxart, 2017 - Present
Francina Dominguez, 2019 - Present
Members and Term Dates : Craig Ferguson, 2015 - Present
Xin Li, 2016 - Present
Sylvester Danuor, 2017 - Present
Ivana Stiperski, 2019-Present
Paola Arias, 2019-Present
Li Jia, 2019-Present
Vydia Samadi, 2019-Present
Ali Nazemi, 2019-Present
Andreas Preim, 2019-Present

Panel Objectives, Goals and Accomplishments during Reporting Period

Overall Panel Objective(s)

- To understand and predict continental to local-scale hydroclimates for hydrologic applications by concentrating on improving our understanding of environmental water and energy exchanges at the regional scale and from an integrated perspective.

List of Panel Goals

Adjust yearly

- The GEWEX Hydroclimatology Panel (GHP) aims to understand and predict continental to local-scale hydroclimates for hydrologic applications. GHP concentrates on improving our understanding of environmental water and energy exchanges at the regional scale and from an integrated perspective. Addressing the water cycle at the regional scale allows us to better understand the many components of the system, from its physical to economic to social aspects. There are four types of projects within GHP that allow us to do this:
 - i) Regional Hydroclimatological Projects (RHPs) are an essential tool in understanding and predicting hydroclimates as they bring together various disciplines on water-related issues;
 - ii) Cross-Cutting Projects allow GHP to propagate knowledge from one region to another and synthesize results at the global scale. They also facilitate the development and testing of applications derived this new understanding,
 - iii) Global Data Centers collect and distribute important hydrology-related data.
 - iv) GHP Networks provide continuity to ending actions in GEWEX and also to welcome activities that have a regional aspect and are not currently structured as an RHP.

List of Key Results

Adjust yearly with respect to goals

- Mature RHPs (HyMeX, Baltic Earth and Global Water Futures-GWF) have mainly reached their scientific objectives, characterizing more deeply, with new observations and modelling exercises, parts of the hydrological cycle in their regions and are also managing to transfer the new knowledge into applications for weather and climate. HyMeX is finishing the last planned

activities, with the semi-arid irrigated experiment LIAISE planned for 2020. Baltic Earth, has been very active this past year, focused on the improved understanding of their region, with a strong focus on biogeochemical and marine processes and some current work related to regional climate system modeling in the Baltic Sea region. During the past year, GWF continued to successfully engage researchers in Canada and the United States with their focus on observations within river basins throughout the region and hydrologic/atmospheric modeling initiatives. At the initiating status, PannEx is organizing itself into Task Teams, it is likely that their research questions will be re-visited this year to more closely align with the team's activities.

- There are three groups that are in the process of applying for RHP status: AsiaPEX, TPE and ANDEX. AsiaPEX aims to better understand Asian land precipitation, the group is in the process of finalizing their science plan and hopes to begin activities in early 2020. TPE-WS is an initiative to explore the water sustainability in the Third Pole Environment. The TPE-WS team is working on their science plan and will then submit the full proposal. ANDEX aims to improve our understanding and prediction of climate and hydrology along the Andes cordillera.
- "Cross-cuts": Precipitation near 0°C in the changing environment has just ended with the generation of a data base with records and related climate analysis coming from different regions, especially in the Northern Hemisphere. The INTENSE CC, focused on sub-daily precipitation is coming to an end, data acquisition has been completed, along with climatological studies and high-resolution modeling. INARCH CC focused on mountain hydrology, continues to be very active, and we now have the potential to integrate ANDEX and TPE, once these are full working RHPs.
- TEAMx CC has applied for a Cross-Cut status. This CC focuses on multi-scale transport and exchange in the atmosphere over mountains. The team is organized and active, with a MoU, review papers and a workshop, with the goal for an intensive field campaign in 2023 focusing on the European Alps.
- Data Centers for the Global Runoff (GRDC) and Global Precipitation Climatology (GPCC) maintain their activities, with less information reaching the panel about HYDROLARE on lakes and reservoirs.

Other Science Highlights

Not part of the 2-3 major accomplishments

- We welcomed six new members into the GHP panel: Vidya Samadi of the University of South Carolina, Li Jia from the Lab of EO-Water RAD1 of the Chinese Academy of Sciences, Ali Nazemi of Concordia University and Andreas Prein of NCAR, Ivana Stiperski, University of Innsbruck and Paola Arias, Universidad de Antioquia.
- After this meeting Jason Evans stepped down as co-chair of GHP after seven years of leadership. Francina Dominguez has been appointed as the new co-chair of GHP.
- Silvina Solman has ended her service as Panel member after her second three-year term.

Panel Activities during Reporting Period

List of Panel Activities and Main Result

- Baltic Earth: The main areas of study and publications from the Baltic Earth group have focused on the following topics: 1) Oxygen minimum zones in coastal seas as many coastal seas suffer from expanding bottom-water deoxygenation and hypoxia primarily because of excessive nutrient loads from land. 2) New projections for the Baltic Sea region including the marine ecosystem and comprehensive uncertainty analysis of climate projections. 3) Detection and attribution of past (~1000 years) climate variability.
- GWF (Global Water Futures): The coordinated analysis continues with modelling and observations of changing land, ecosystems water and climate for eight large river basins that cover most of Canada and part of the US. During the reporting period, GWF held five different meetings with water managers, GWF Operations Team, the Canadian National Streamflow Forecasting, a national discussion on water security and its Second Annual Open Science Meeting. GWF approved 6 new Indigenous community water research projects.

- HyMeX: This RHP is approaching its end in 2020, after a very intense activity, both experimental and by numerical simulation, in the Mediterranean basin. Analysis of the campaigns continues, while an experimental and modelling effort over semi-arid terrain with irrigation (LIAISE) is being organized and will take place in 2020. The community indicates its willingness to continue working together.
- PannEx: This RHP was granted initiating status at the end 2017. During the past year, their White Book was published by the WCRP in March 2019 (<https://www.wcrp-climate.org/WCRP-publications/2019/WCRP-Report-No3-2019-PannEx-WB.pdf>), also all of the 9 task teams consolidated and enlarged. It was noted that some of the science teams have been more active than others, and perhaps the science questions will be re-visited. While PannEx were not successful in obtaining funding from the European Space Agency, this opened an opportunity to join efforts with the team that was awarded funding (DryPan) and will have representatives attend the PannEx workshop in 2020.

Cross-Cuts (CCs)

- Near 0°C precipitation: this CC is focused on improving our understanding of future changes in hazardous cold/shoulder season precipitation, especially occurring near 0°C. The CC ended this year. The main effort is producing reliable datasets in different regions that can be used for the analysis of near 0°C precipitation, they compiled a data set of more than 1,500 long-term time series (40 years of data), climatology studies have either been finished or are underway and particular effort has been devoted to Canada.
- INTENSE: is a community effort into the collection and analysis of sub-daily precipitation data and model outputs through the GHP cross-cut. The data acquisition is concluded at this point with more than 25000 hourly data records worldwide, the data base is transferred to DWD and will be given to Copernicus. Collaboration with climate modelling team at ETH Zurich and UK Met Office to set up first convection permitting resolution model comparison study for the European domain at 2.2km. Progress has been made towards developing a blended radar-gauge-satellite precipitation product for the UK at 1hr, 1km resolution, with the methodology finalized. There have been numerous publications in high-impact journals including Nature, and PI Fowler will contribute to the IPCC report.
- INARCH: A Cross-Cut action devoted to increase the understanding and prediction of the alpine cold regions hydrological processes, in particular defining consistent measurement strategies. There are currently 26 INARCH research basins in the Americas and Eurasia. There was an INARCH special issue in Earth System Science Data covering Hydrometeorological data from mountain and alpine research catchments. INARCH has also been focus on the development of a downscaling methodology toolbox in collaboration with NCAR.

List of New Projects and Activities in Place and Main Objective(s)

- See below.

List of New Projects and Activities Being Planned, including Main Objective(s) and Timeline, Lead(s)

- New RHPs are in the horizon. i) ANDEX, a prospective hydroclimate research project for the Andes. ANDEX aims to improve our understanding and prediction of climate and hydrology along the Andes cordillera. In doing so, ANDEX will integrate atmospheric and hydrologic models, and assimilate local and remotely sensed data products. The first five chapters of their white book have been submitted for peer-review in Frontiers in Earth Sciences, and the community continues to come together with special meetings and sessions at AGU and EGU.
- ii) the Water Security side of TPE is in the process of organizing as an RHP. The main lines under consideration are the water-energy exchanges and transport mechanisms as observed

and modelled, the study of the changes in progress in the hydrological cycle, and the societal impact of extreme events. TPE is looking for regional cooperation through the establishment of the Pan-TPE program in cooperation with the neighboring countries, essentially on the impacts of the Pan changes on regional sustainability under human-nature dual influences, and the environmental uncertainty under the westerly-monsoon interplay. They are also in the process of writing their science plan and formally applying for RHP status.

- iii) AsiaPEX is the third proposed RHP. Focusing on understanding Asian land precipitation, AsiaPEX will apply for RHP status shortly. Many in-person meetings and their Kick-off Conference in Sapporo, Japan in September 2019 have been successful. They are planning a 2020 field campaign.
- TEAMx is a new Cross-Cut initiative focused on atmospheric processes specific to mountainous regions that heavily affect the exchange of momentum, heat and mass between the Earth's surface and the atmosphere. They have formally applied for CC status.
- ET is a potential Cross-Cut focused on the subject of evapotranspiration. They held a workshop on "Determining Evapotranspiration" in Sydney in October of 2019. As the action is better defined, it will be seen if takes the form of a CC or of a PROES.

Science Issues and Collaboration during Reporting Period

Contributions to Developing GEWEX Science and the GEWEX Imperatives.

a. Data Sets

- The active RHPs (HyMeX, Baltic Earth and GWF) maintain their datasets and generate new ones as their activities progress, either with new campaigns or with the expansion of their networks. PannEx is still in the initial phase and data sets are been defined.
- Cross-cuts also produce new data sets: i) INTENSE has completed a database on sub-daily precipitation and has obtained complementary numerical model data, ii) INARCH is compiling data from the 26 basins that form the network; iii) Precipitation near 0°C has gathered observational data from the northern hemisphere, together with congruent numerical model data
- Data Centers on precipitation and runoff report continuous feeding of their data bases, whereas no new information is available from HydroLARE on basin water levels.

b. Analysis

- Most actions use the same basic information inputs: analysis of existent data bases, generation of data in experimental campaigns to study specific process and numerical modelling to have a comprehensive description of the processes in place, always checking against available observational information.

c. Processes

- As described above, each action focusses on some particular aspects. Precipitation extreme events and the role of the sea surface waters is the dominant issue in HyMeX, the functioning of the Baltic Sea region as a complex biogeochemical earth system is Baltic Earth main aim, similarly to GWF, that was more oriented to changing land, ecosystems water and climate. Cross-Cuts as described above tackle specific processes in a transregional perspective, so far mostly devoted to precipitation (sub-daily, in mountains or near 0°C).

d. Modeling

- Due to the variety of purposes that the different GHP actions have, many kinds of model types and simulation strategies are used. In the study of processes, detailed modelling is used at short-time scales, including single-column modelling, large-eddy simulation and high-resolution mesoscale modelling. In what refers to climate studies, they range from regional models with various techniques and time scales to global earth system modelling at the century scale. Impact of severe weather events are usually studied with mesoscale models, often taking advantage of operational forecasting systems.

e. Application

- The overall objective of the GHP actions is to generate data bases and methodologies that can become of use in the centers that study the earth system, many of them being Meteorological and Hydrological Services providing direct service to society.

f. Technology Transfer

- Data bases, model comparisons, parameterization testing have a direct impact in the day-to-day operational activities of weather and climate modelling centers, for instance in the generation of improved reanalyses, observed timeseries and expected trends.

g. Capacity Building

- In most of the GHP actions capacity building is high, firstly because of the continuous improvement of the scientific and technical capabilities of the personnel involved and secondly because there is a sustained flow of PhD subjects related to the actions that contribute to the maintenance, renewal and eventually enlargement of the related scientific community.

List contributions to the GEWEX Science Questions and plans to include these.

a. Observations and Predictions of Precipitation

- Those provided by HyMeX, GWF, INTENSE, INARCH, Precipitation near 0° and GPCC, usually obtained from National Services, but also from research networks. PannEx will contribute to this subject as well as they progress.

b. Global Water Resource Systems

- In addition to precipitation (listed in the previous point), INARCH and GWF have a well-defined hydrological component, also covered by the GRDC data center on Runoff. PannEx has planned to work intensively on the water management at the basin scale.

c. Changes in Extremes

- The study of the occurrence and trends of extremes in the present climate is made by all GHP actions. The INTENSE CC is particularly focused on this aspect. The future changes are usually studied in the frame of regional climate modelling, by specific studies or through coordinated actions, such as in CORDEX.

d. Water and Energy Cycles

- Most RHPs do not devote an equivalent effort to all parts of the energy and water cycles. Concerning the water cycle, precipitation is well addressed in general, while only some RHPs analyze the hydrological part, and evapotranspiration is not a subject of organized research to the date, which is a well-detected limitation and will be tackled by the ET CC if it comes to fruition. Concerning the energy cycle, measurements are well treated in GEWEX under GDAP, while the reflection at the regional scale could be much deeper in GHP, either observationally or numerically.

Other Key Science Questions

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

- i) Monitor water use over land and Introduce water management in models
- ii) Characterize properly evapotranspiration, observationally and in models
- iii) strengthen effectively community work regionally (through RHPs) and across regions (through CCs and other actions), improving communication and harmonizing the way tools are used.

Contributions to WCRP including Current Grand Challenges

Briefly list any specific areas of your panel's activities in particular to the grand challenges "Extremes" and "Water for the Food Baskets" which is not covered under 2.

- Most GHP actions contribute to the "weather and climate extremes" grand challenge by data base building, campaigning and modelling.

- "Melting ice and global consequences" is an important subject for Baltic Earth and GWF and it will be for ANDEX and TPE-WS if they become RHPs.
- "Regional sea level change and coastal impacts" is a main item for Baltic Earth in general and for HyMeX essentially on severe weather impacts.
- "Water for the food baskets of the world" is an issue that is being considered in the new actions, such as PannEx or the actions in an exploratory phase like ANDEX or the Western USA RHP.
- "Carbon feedbacks in the climate system" is explored in Baltic Earth, that has a very important biogeochemical component.
- "Near-term climate prediction" is considered, but normally handled within other actions such as CORDEX.
- "Clouds, circulation and climate sensitivity": usually these are matters taken into account in modelling studies within RHPs.

Cooperation with other WCRP Projects, Outside Bodies and links to applications

e.g. CLIVAR, CliC, SPARC, Future Earth, etc.

- Within GEWEX: cooperation is sustained with the other panels (GDAP, GASS and GLASS)
- Within WCRP: by its regional nature over land, there is interaction with CliC related to the GHP activities in high mountains and high latitudes. Cooperation with CORDEX is increasing as each RHP is interested in performing regional climate studies.
- The new AsiaPEX RHP will strengthen collaborations with the CLIVAR Monsoon Panel.
- With Future Earth: there are contacts with the research action iLEAPS (Integrated Land Ecosystem-Atmosphere Processes Study) in the building of an activity related to evapotranspiration.

Workshops and Meetings

List of Workshops and Meetings Held in 2019

Meeting title, dates and location.

- 2019 GHP - ET CC Meeting, October 2019, Sydney, Australia.

List of Workshops and Meetings Planned in 2019 and 2020

Meeting title, dates and location and anticipated travel support needs.

- 2020 GHP meeting and Pan-GEWEX meeting, Versailles, France, October 2020

Other Meetings Attended On Behalf of GEWEX or Panel in 2019

- There was a session on European RHP at the EMS conference in Lyngby (Denemark), co-chaired by JC and representatives of PannEx, Baltic Earth and HyMeX. It was mostly attended by PannEx scientists, with a few HyMeX and Baltic Earth participants too.
- Co-chair JC attended the 5th PannEx workshop in Novi Sad (Serbia)

Publications during Reporting Period

List of Key Publications

- See the individual action reports