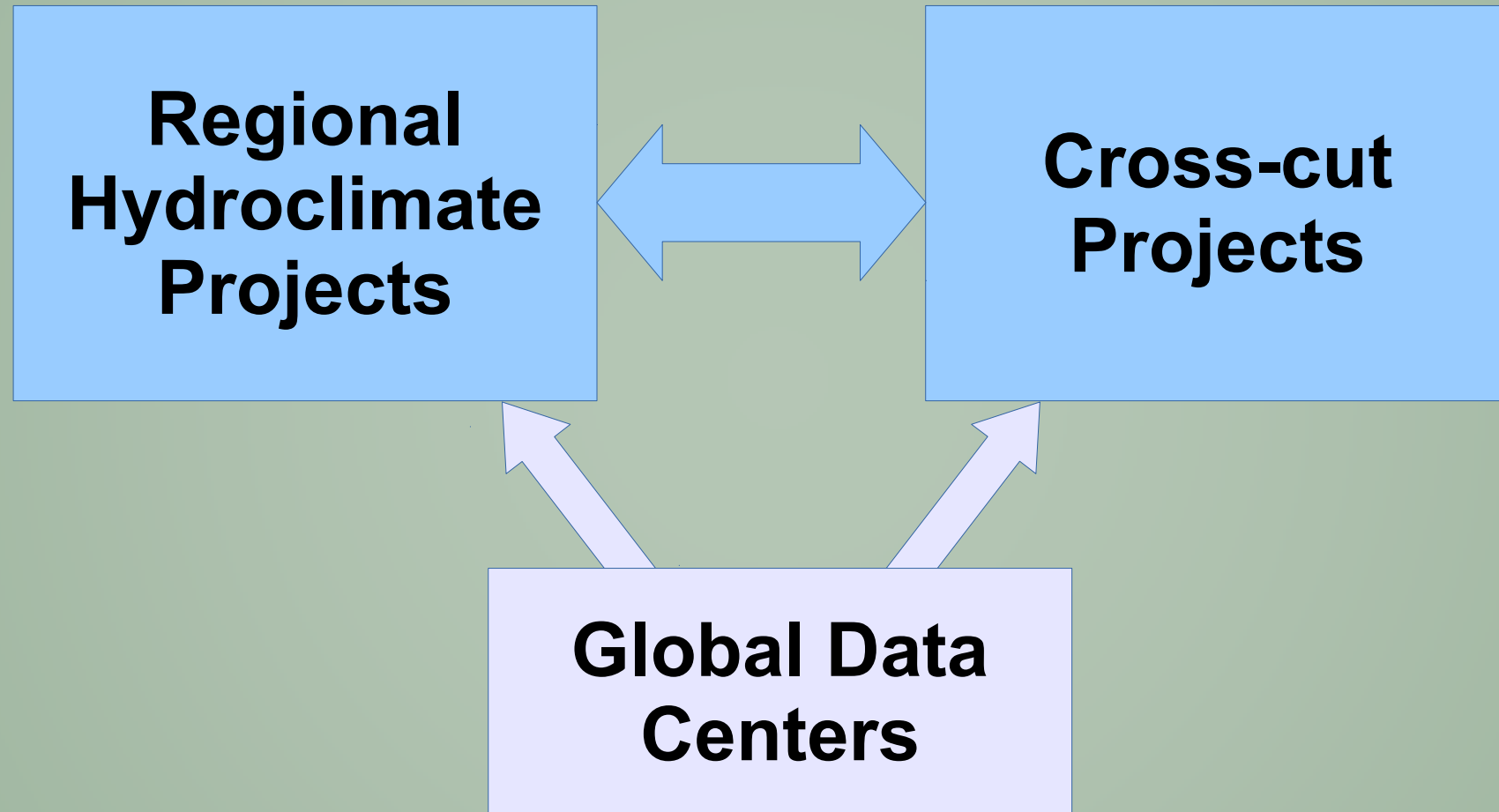


GEWEX Hydroclimate Panel – GHP

**Co-Chairs: Jason Evans
Joan Cuxart**



GHP Structure



Introducing GHP Networks

Networks should facilitate collaboration and capacity building activities in areas of GEWEX science.

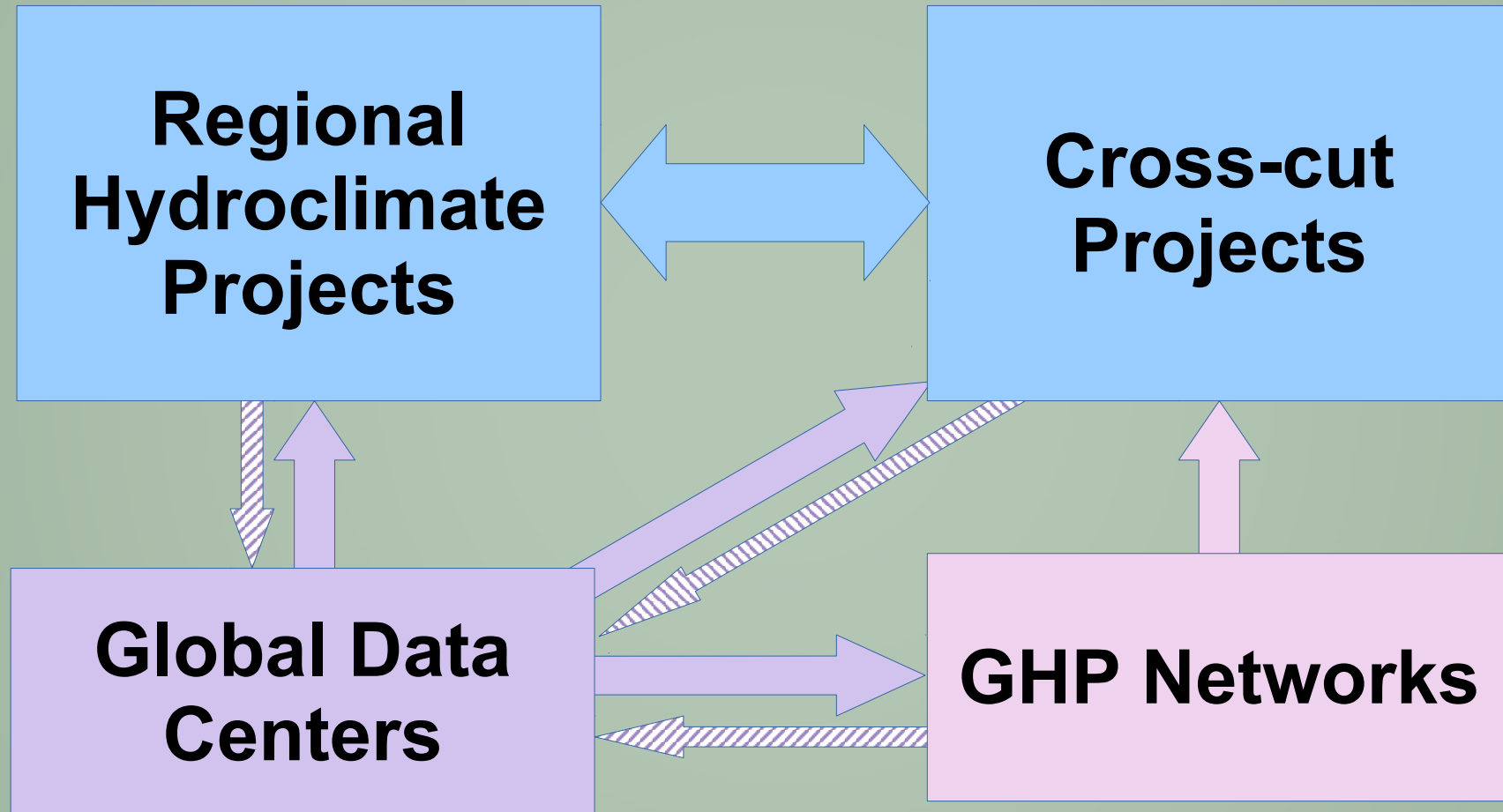
They are a mechanism for new communities to be connected to GEWEX while developing towards a RHP.

They are a way for networks developed within initiating RHPs to maintain activity and a GEWEX connection if they fail to reach the criteria required of a full working RHP.

They provide a mechanism for networks developed during RHPs to maintain activity and connections with GEWEX after the RHP has completed.



GHP Structure



RHP Status

Active:

HyMEX (2010-2020) =====> High-impact weather events, societal response

Baltic Earth (2016-) =====> Sea and land changes, biogeochemical processes

PannEx (2018-) =====> Agronomy, air quality, sustainability & water mgnt

GWF (2018-2023) => Cryospheric, ecological, hydrological interactions

Recently finished:

CCRN (2014-2018) => Cryospheric, ecological, hydrological interactions

MAHASRI (2007-2016) =====> Asian Monsoon

NEESPI (2004-2015) =====> Northern Eurasian climate-ecosystem-societal interact.

GHP Network:

OzEWEX

Discontinued:

HyVic

Prospective:

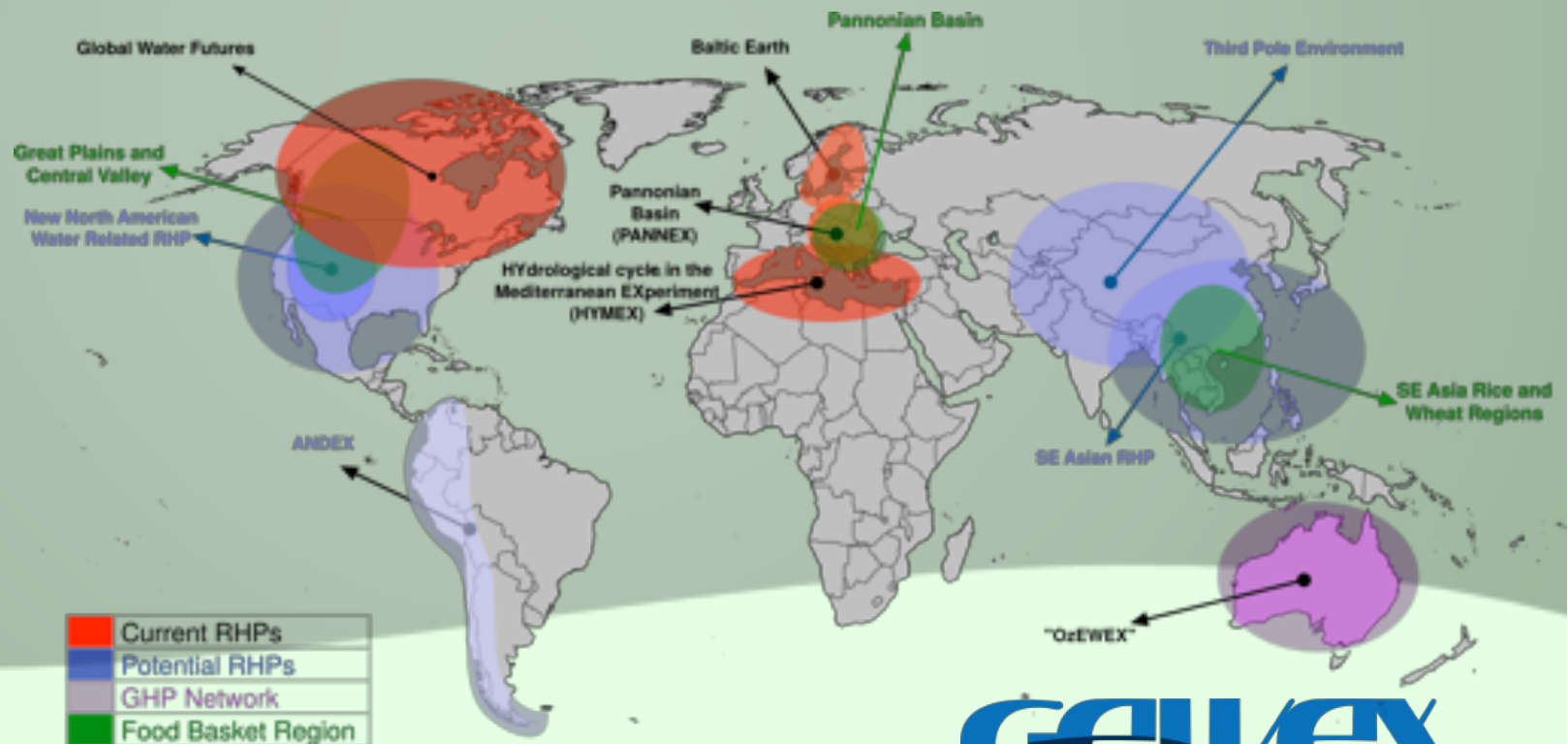
Andex

In discussion:

Western USA

TPE

Southern Asia



Regional Hydroclimate Projects

GEWEX

- Energy & Water Exchanges
- Land-atmosphere focus

Other aspects of RHPs

- Carbon
- Ocean/Sea Interaction
- Ecosystems
- Engineered systems
- Human systems
- *Food production*

Ongoing RHPs

HyMeX
Baltic Earth
Pannex
GWF

Hydrological cycle in the Mediterranean Experiment (HyMeX)

Philippe Drobinski, Veronique Ducrocq




HyMeX aims at:

- improving our understanding of the water cycle, with emphases on extreme events by monitoring and modelling the Mediterranean coupled system (atmosphere-land-ocean), its variability (from the event scale, to the seasonal and interannual scales) and characteristics over one decade in the context of global change,
- evaluating societal and economic vulnerability and adaptation capacity to extreme meteorological and climate events.

More than 400 scientists from 20 countries contribute to HyMeX in the scientific working groups and task teams. 57 PhD students.






Airborne field campaign EXAEDRE



On going field campaign (13 sept 2018 – 12 oct 2018):

Objectives:

- Characterize the electrical and microphysical environment of clouds for a better understanding and modeling of electrical processes within the storm
- Validate the new airborne and ground instrument concepts developed within the EXAEDRE project







PERLE







LIAISE



- LIAISE is an international effort initiated within HyMeX and GEWEX (GHP & GLASS) arising from the Regional Hydrological Project HyMeX in GEWEX
- Topics: Water balance over semi-arid (irrigated) areas
- Science questions:
 - How does the **anthropization impact** the boundary layer development, mesoscale circulations and potentially precipitation recycling over this region via feed-backs with the atmosphere?
 - What are the key **semi-arid surface processes**, both natural and anthropogenic, which modulate or control infiltration and evapotranspiration?
 - What is the **sustainability of ground water and reservoirs** in the face of expanding agricultural and farming activities, especially in light of projected future warming and drying over this region?
- Partners : French Laboratories involved: CNRM, CESBIO, LMD, HSM, LA
Foreign Laboratories involved: UIB, AEMET, SMC, IRTA, UV, UB, OE (Spain), KIT (Germany), UKMO (Britain)



UNIVERSITY OF SASKATCHEWAN

Global Water Futures

GWF.USASK.CA



2019-

John Pomeroy



GWF

Global Water Futures: Solutions to Water Threats in an Era of Global Change

GWFs mission is to: Improve disaster warning; predict water futures; and inform adaptation to change and risk management. Essential science wuestions include:

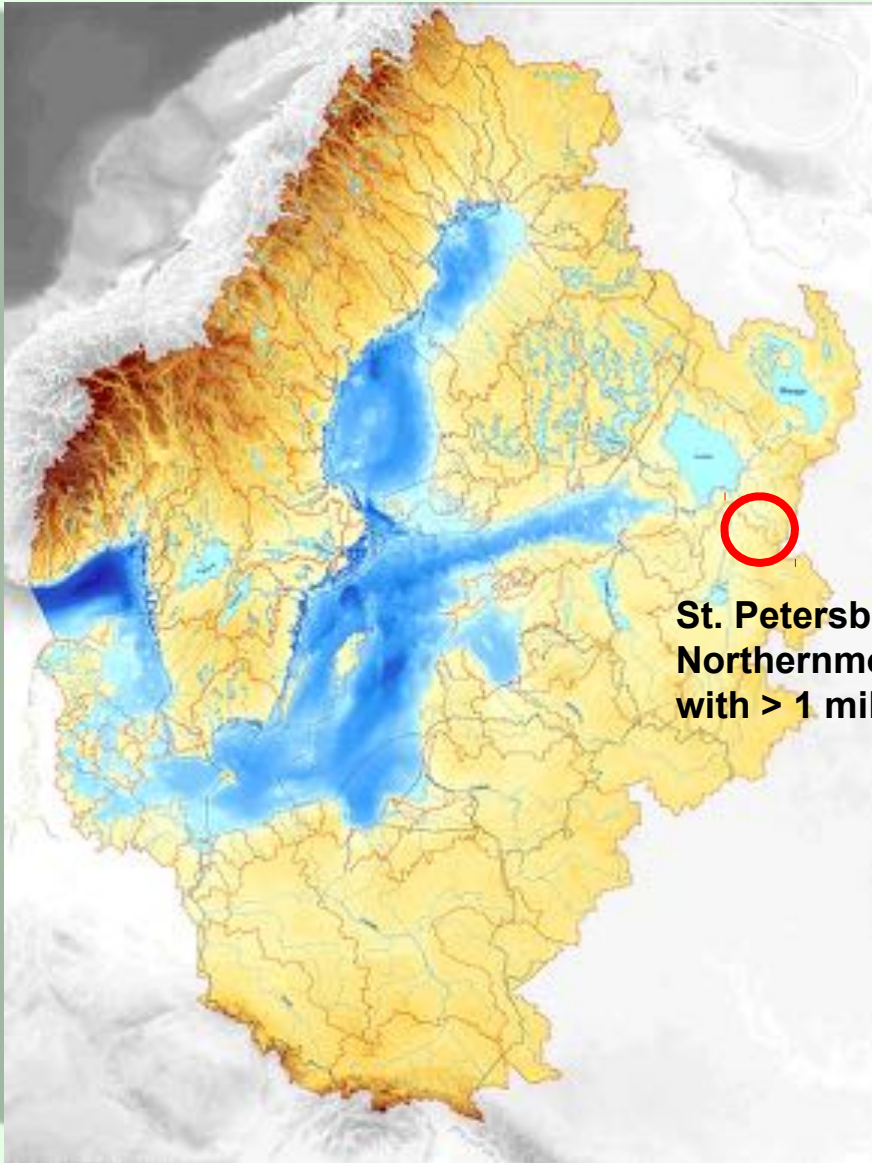
- How will extreme atmospheric events and other changes to the climate system be translated by the hydrological system into hydrological extremes?
- How will hydrological storage in lakes, managed reservoirs, glaciers, permafrost, groundwater and wetlands interact with a changing climate and shifting terrestrial ecosystems to create new hydrological regimes?
- How can humans better manage, mitigate and adapt to this change and conserve ecosystems through water and land management, prediction, and governance?

More than 150 scientists from academic institutions and government agencies in Canada, USA and Europe.

2018 Annual Science meeting, Hamilton & Ohsweken, Canada, 3-6 June
2019 Annual Science meeting, Saskatoon, Canada, 15-17 May



Baltic Earth



Markus Meier &
Marcus Reckermann



- Drainage Basin: 2.13 Mill. km²
(20% of the European continent)
- 85 million people in 14 countries
- Baltic Sea: 380 000 km²

Baltic Earth Science Plan and Grand Challenges

- Flexible science plan with a continuously on-going definition of core research questions which are identified to be key scientific issues, so-called “**Grand Challenges**” (GCs)
- New Grand Challenges will be identified at conferences and by using **assessments of existing research** by dedicated working groups. Grand Challenges are envisaged to be research foci for periods of about 3-4 years (then terminated or updated)
- The new programme will **communicate** with **stakeholders** and research funding **agencies** to promote funding relevant for the Grand Challenges
- **International embedment** (GEWEX, Future Earth)
 - Activities 2018: MedCORDEX-Baltic Earth-COST Workshop on “Regional Climate System Modelling for the European Sea Regions”; 2nd Baltic Earth Conference in Helsingor Denmark,; Summer School on Askö, Sweden, August 2018; Workshop on “Multiple drivers of Earth system changes in the Baltic Sea region”, Tallinn Estonia, 26-27 Nov 2018
 - Activities 2019: 2 winter and 1 summer schools, workshop on coupled atmosphere-ocean modelling; sessions at EGU and EMS, workshop on “Hydrology and hydrological modelling in the Baltic sea region”

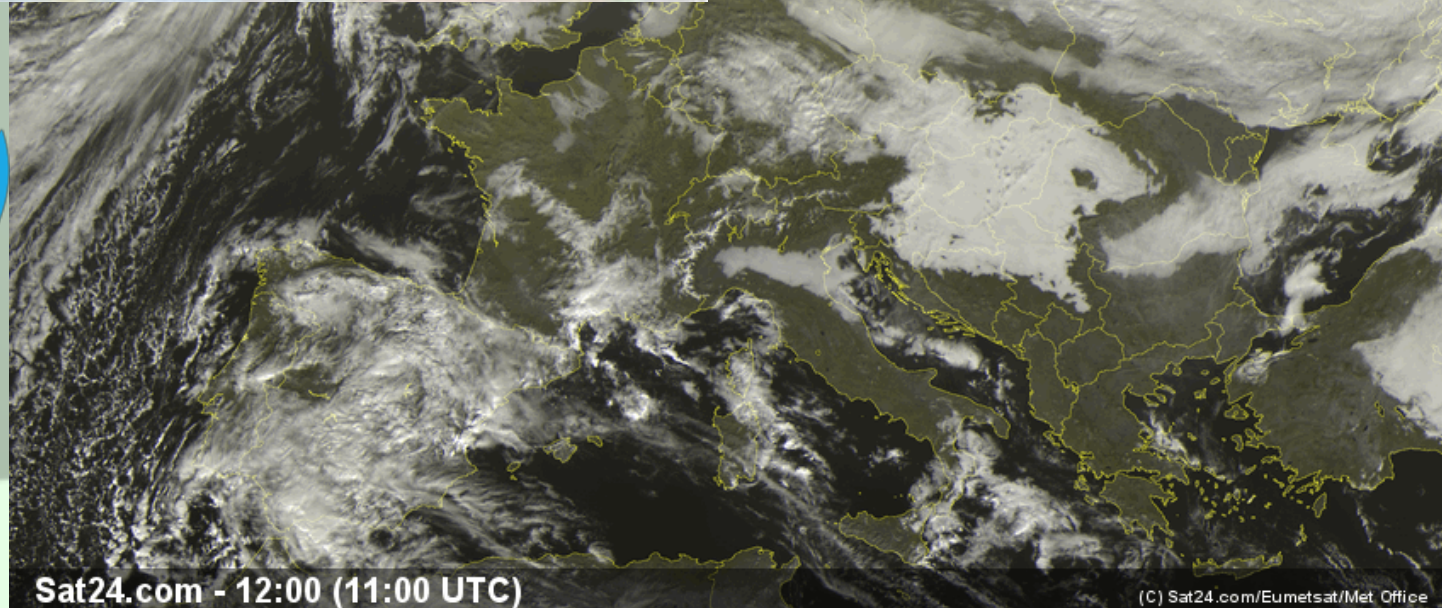
Current Grand Challenges

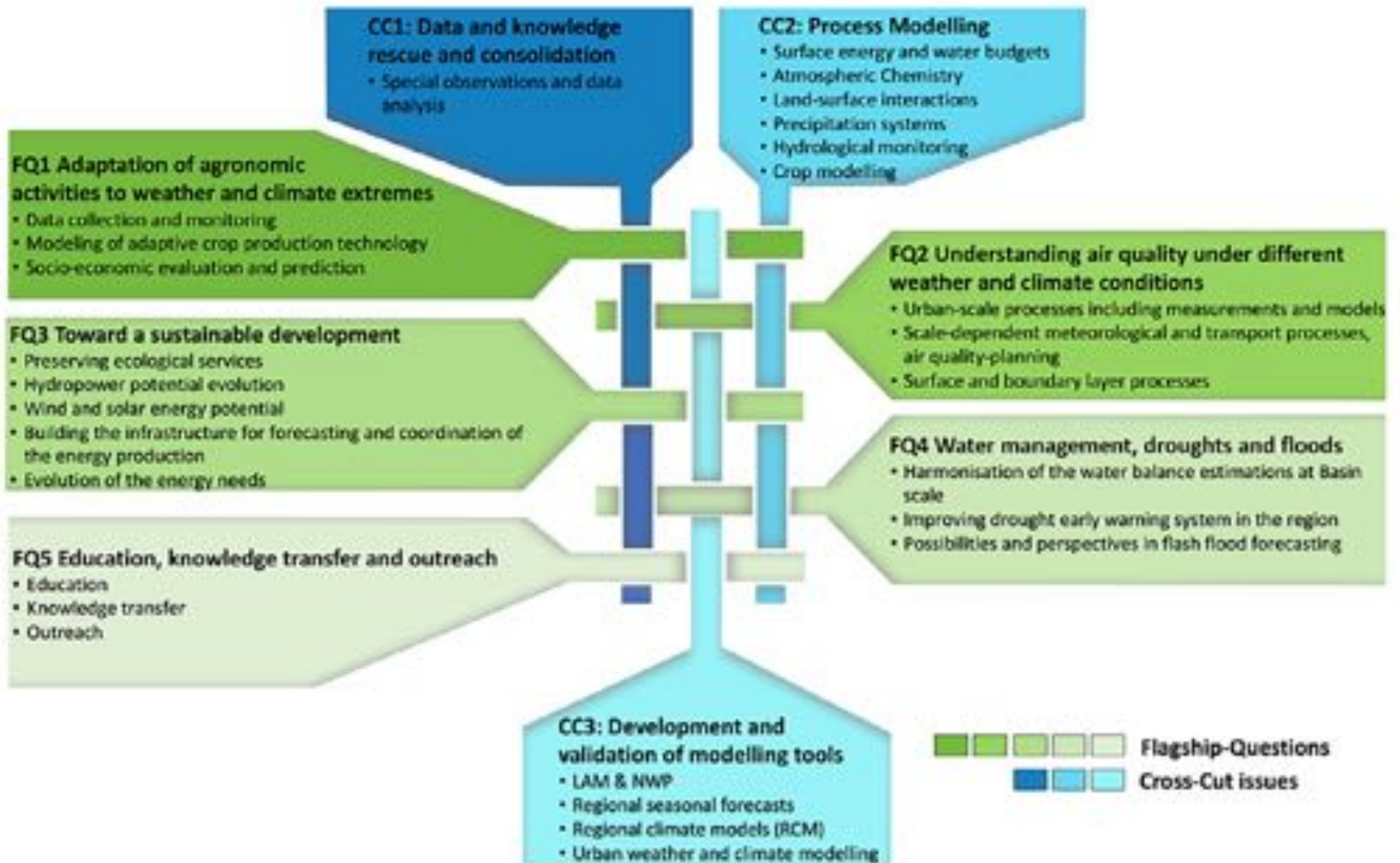
- GC1: **Salinity dynamics** in the Baltic Sea
- GC2: **Land-Sea biogeochemical feedbacks** in the Baltic Sea region
- GC3: **Natural hazards and extreme events** in the Baltic Sea region
- GC4: Understanding **sea level dynamics** in the Baltic Sea
- GC5: Understanding **regional variability of water and energy exchanges**
- The **human impact** will be assessed at all levels, wherever possible

Pannonian Basin Experiment (PannEx)



Monika Lakatos





PannEx – Status

- Annual workshops since 2015, next one in June at Novi Sad, Serbia.
- Session at EMS in 2018 and 2019
- White book completed and published by WMO (final edits)
- Task teams in formation to carry out the science plan.
 - i) Agroclimatological and Agrobiological Systems,
 - ii) Energy Production,
 - iii) Special Observations and data analysis,
 - iv) ecosystem services,
 - v) urban climate and air quality,
 - vi) outreach and education,
 - vii) micrometeorology and agronomical process modelling,
 - viii) water balance at the basin scale, ix) modelling from Climate to Flash Floods
- ESA call launched in 2018 for Drought Early Warning in the Danube region to fulfill the PannEx challenges
- Paper describing PannEx published in Climate Services (Ceglar et al, 2018)

GHP Networks

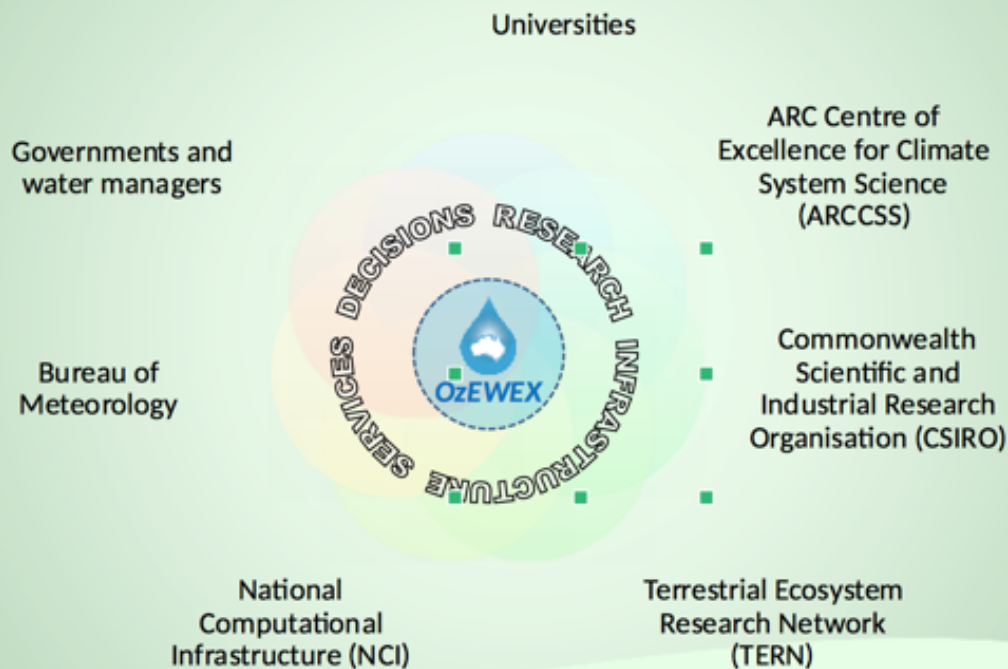


Australian Energy and Water Exchanges (Potential GHP network)



A. van Dijk, S. Westra

OzEWEX aims to **understand and predict Australia's fresh water resources and water security into the future** given Australia's many climate zones, relatively large climate variability and future climate change.



- How can we better understand and predict precipitation variability and changes?
- How do changes in land surface and hydrology influence past and future changes in water availability and security?
- How does a warming world affect climate extremes, especially droughts, floods, and heat waves, and how do land area processes, in particular, contribute?
- How can the understanding of the effects and uncertainties of water and energy exchanges in the current and changing climate be improved and conveyed?

OzEWEX – Highlights

- National workshop in January 2019
- Australian Climate and Water Summer Institute

This prestigious six-week event offers around 15 of the most talented students and early career researchers in Australia and New Zealand a unique opportunity to work closely with peers and experts from academia and government agencies to enhance climate and water information and its practical applications.

- OzEWEX website and newsletter publication frequency, original content and readership has increased



OzEWEX – Outstanding Issues

Have not been successful in attracting funding to support RHP research activities. As a result they have failed to meet some RHP criteria and GHP has decided to remove their RHP status.

They have been able to find funding for networking type activities (annual workshop, water and climate summer institute) – these activities are well attended and vibrant, and it would be good to maintain a GEWEX/GHP connection. Hence the proposal that they become a GHP network – this would need to meet the RHP criteria relevant for networking/capacity building only.



Potential RHPs

AndEx

Western USA RHP

Southern Asia RHP

Third Pole Environment

AndEx (Andean RHP)

- Workshop held in Medellin Colombia in early December
 - First-term co-chairs G. Poveda (UNAL, Medellín, Colombia) and R. Garreaud (USC, Santiago, Chile)
 - Open workshop held in Santiago de Chile end of October 2018, in conjunction with the annual GHP meeting
 - White Book writing workshop in Quito, April 21-24, 2019
- World's longest mountain range: 7,242 km (10N to 46S).
 - Seven countries: Colombia, Venezuela, Ecuador, Peru, Bolivia, Argentina and Chile.
 - About 200 to 700 km wide (widest between 18°S-20°S), and average height 4,000 m. Aconcagua: 6,962 m.
 - It contains glaciers, volcanoes, deserts, high plateaus, lakes, *páramos*, *yungas*, *punas*, cloud forests, tropical rainforests, dry forests, savannas, and intra-mountainous valleys.
 - Strong hydroclimatic variability associated with Latitudinal and Hemispheric location, but also with Aspect, Slope and Elevation.

ANDEX

Main Overarching Science Questions

- What are the main physical processes driving the water and energy budgets of the Andes (as a singular cordillera) at a broad range of spatial and temporal scales, and their interactions with the neighboring Pacific and Atlantic Oceans and major river basins of South America?
- How climate change, deforestation and land use changes are affecting the hydroclimatological functioning of the Andes across the altitudinal gradients, from glaciers, to paramos, punas, cloud forests, rainforests, dry forests, deserts?

ANDEX Specific science Questions

1. What are the dynamical feedbacks between the Andes and the processes involved in the **hydrologic cycle** over the Andes (*Water Vapor, Precipitation, Evapotranspiration, Sublimation, Soil Moisture, Infiltration, Groundwater and River Flows*) at a wide range of spatial and temporal scales, for average and extreme conditions?

- Water Vapor Sources, Precipitation Recycling, Pluviographic Optimum, Low-level Jets and Atmospheric & Aerial Rivers, the Bolivian High, the Amazon and La Plata River Basins, MJO, Tropical Easterly Waves, ENSO, et al.
- Extreme Events: MCSs, Convective Storms, Floods, Droughts, Cold Spells, Hail Storms, Lightning, Fires, Zonda wind, Landslides.

2. What is the dynamics of processes involved in the **surface energy budget** over the Andes (*SWR, LWR, SHF, LHF*) across a wide range of spatial and temporal scales?

3. How is the dynamical coupling between 1 and 2 from Glaciers to Deserts?

4. What is the influence of the cryosphere on the surface hydrological cycle on the Andes and what is the influence of the atmospheric hydrological cycle on the Andean cryosphere?

5. What are the current and future human impacts from water diversion and pollution, deforestation, LU/LC, and climate change on the processes and variables involved in the water cycle and energy budget?

6. How to deal with them from a water (and other life support systems) management perspective?

7. How the current and future water and energy balances along the Andes (will) affect ecosystem services, water supply, hydropower generation, food production and food security, natural hazards, and human health?

8. What is the effect of the Andes on pollution in urban valleys and what are the risks for human health?

Western USA RHP

- Several attempts to initiate an RHP in the USA have been made over the last several years
- A workshop was held in May 2017 that indicated interest, but science needed to be more well defined and funding sources identified. A meeting was afterwards held in Canmore (OSC, May 2018) and an update given at the joint GHP-ANDEX-INARCH workshop.
- The Water for Food Baskets Grand Challenge may also help to provide a science focus.
- The recently completed U.S. CONUS convective permitting simulation for historical and future climate provides an excellent model dataset to explore key water cycle processes in the western U.S.

A Regional Hydroclimate Project for the western U.S.

integrate ongoing research activities in Canada and the USA



- Understanding the impacts of climate variability and change on water availability across the river basins of the Rocky Mountains and Central U.S.
- Key Questions:
 - *How do changes in seasonal cycles of snow affect the partitioning of precip. between ET and runoff?*
 - *How do results depend on limitations in water and energy as manifest in gradients across latitude and elevation?*
 - *How will expected changes in extreme events (floods and of drought) impact the timing and availability of seasonal water supplies?*
 - *To what degree do landscape disturbances alter the natural patterns land-atmosphere coupling and runoff partitioning?*

Southern Asia RHP

- A proposed activity focused on the Asian monsoon has been suggested (Dr Terao)
- Science plan is being drafted after 2 planning workshops in Japan – including some international scientists
- Expect science plan version 1.1 to be ready about now.
- Intention is to submit proposal to GHP for discussion/approval at October 2019 meeting.

Third Pole Environment

- Submitted a cross-cut proposal that was actually much closer to an RHP proposal at last GHP meeting.
- They have been encouraged to convert this to a RHP proposal before the next meeting in October this year.

Cross-cut Projects - Objectives

- Target GEWEX science questions
- Tackle issues best addressed through large collaborative projects
- Should test and evaluate applications of the knowledge produced in RHPs.
- Generate interactions between RHPs and keep completed RHPs involved
- CC projects are also a tool for collaboration with other GEWEX panels and WCRP projects.
- A way for the broader Community to get involved in GEWEX/GHP.

Currently active

- INTENSE (Sub-daily precipitation) (H. Fowler)
- Cold/Shoulder Season Precipitation Near 0°C, (R. Stewart / P. Groisman)
- INARCH (Mountain Hydrology) (J. Pomeroy)

In exploration

- Including water management in large scale models (R. Harding / J. Polcher)
- Determining Evapotranspiration (workshop in Sydney Oct 2019)

Potential

- GDAP integrated product regional evaluation
- MOUNTerrain (Mountainous Terrain rainfall)

INTENSE (INTElligent use of climate models for adaptation to non-Stationary hydrological Extremes)

Hayley Fowler (Newcastle Uni., UK)

Collection and analysis of sub-daily precipitation data and model outputs



Key research questions:

- *How has sub-daily maximum precipitation changed over the last century, across continents, climate regimes and seasons?
- *How does precipitation at different time-scales vary with atmospheric temperature and atmospheric moisture as the atmosphere warms?
- *How do large-scale atmospheric and oceanic features influence or modulate the observed changes in precipitation extremes, the clustering of extremes and the variability between 'drought' and 'flood' periods, in different climate regimes and seasons?
- *What is the influence of climate model resolution and structure on the simulation of precipitation extremes for different climate regimes and seasons?
- *What is likely the response to warming of precipitation and precipitation extremes at different time- scales across different climate regimes?
- *How can we use information from both high-resolution and coarse-resolution climate models in a more intelligent way to inform climate change adaptation decision making to better manage extreme hydrological events?

INTENSE – Update 2018 and plans

- 5 full-time PDRA's working on project at Newcastle University :
- Development of dataset, QC method and now indices; work with DWD to develop website
- Development of sub-hourly precipitation datasets
- Understanding trends in sub-daily precipitation extremes and preliminary analysis of dynamical and thermodynamic drivers
- Understanding large-scale drivers of sub-daily precipitation extremes
- Understanding extreme rainfall processes using convection-permitting models

Plans

- Global scale analysis of extreme precipitation-temperature relationship
- Global scale analysis of trends in sub-daily extreme precipitation
- Intensity-Duration-Frequency (IDF) curves generation for global datasets
- Develop common analyses of model outputs and observed indices for model evaluation
- First efforts to explore sub-hourly in situ and satellite observations
- Concentration of analysis in Tropics and comparison to CPM model outputs
- Further analysis and separation of large-scale and thermodynamic drivers influence



Near 0°C Precipitation (Pavel Groisman & Ron Stewart)

To improve our understanding of future changes in hazardous cold/shoulder season precipitation and storms, especially occurring near 0°C

Motivation:

*It is difficult to predict the phase of near 0°C precipitation events and when in frozen phase,

*This precipitation may become one of dangerous weather phenomena that can cause interruptions in human activity affecting traffic, communication, housing and other man-made infrastructure, high seas fleet operation, impact on off-shore oil and gas production

including life threatening events

*These are relatively rare events but there are good reasons to expect that their frequency and strength may change with global warming

Phenomena of Interest:

*Heavy snowfall/rainfall transition

*Large fraction of blizzards

*Rain-on-snow events

*Freezing rain and freezing drizzle

*Ice load on infrastructure

Near 0°C – Update 2018 and plans

- An ongoing effort is being devoted to producing reliable datasets in different regions that can be used for the analysis of near 0°C precipitation.
- Using synoptic data across the northern extratropics, we compiled a data set of more than 1,500 long-term time series (40 years of data) of synoptic observations with freezing precipitation information
- The common atmospheric thresholds used for discerning, for example, freezing rain need to account for the actual particles falling through an upper level inversion and lower sub-freezing region. Smaller particles typically associated with low precipitation rates can melt, for example, within weaker inversions than larger particles associated with higher precipitation rates.
- A parameterization using a new microphysics scheme is being developed to simulate freezing rain. It considers gradual melting and freezing of precipitation without adding significant computing time.

Barszcz, A., J. A. Milbrandt, J. M. Thériault, 2018: Improving the explicit prediction of freezing rain in a km-scale numerical weather prediction model. Weather and Forecasting, <https://doi.org/10.1175/WAF-D-17-0136.1>

*****Plans for 2019*****

- Expand our estimates of weather conditions conducive to freezing rain to high-elevation regions
- Prepare a review article “Precipitation near 0°C in a changing climate: tendencies and related natural hazards”.
Authors: Multi-authored from several countries. Expected completion: 2019



INARCH

International Network for Alpine Research Catchment Hydrology



John Pomeroy

*To better understand alpine cold regions hydrological processes,
improve their prediction and find consistent measurement strategies*



INARCH - Update 2018 and plans

- Special Issue of Earth System Science Data.
- Mountain downscaling toolbox further development
- Comparative analysis of alpine snow and ice hydrological sensitivity to warming – “Mediterranean Climate” and “Continental Climate” snow sensitivity comparison in progress
- Trans-Iberian Snow Hydrology Transect – extend to Morocco
- Multiscale climate change vulnerability analysis of alpine snow, ice and hydrological systems
- The 3rd INARCH Workshop was held at the Schneefernerhaus Environmental Research Station, Zugspitze, Germany, 8–9, February, 2018
- 4th INARCH Workshop, Chile, 24-26 October 2018

Plans:

- WMO High Mountain summit
- With Future Earth - Working Group on Climate Impacts on Global Mountain Water Security
- Mountain downscaling toolbox completion and publication
- LSS-H Model comparison and development – link to GLASS

Cross-cut Projects Potential



Determining Evapotranspiration

Reflection initiated at SSG-29 (2017) on the need to reflect further on ET, followed by a side meeting during the Canmore GEWEX conference.

Planned activity

Meeting 7-9 October 2019 in Sydney (UNSW).

Paper in next GEWEX News defining the challenges:

- *to define and understand ET
- *the in-situ measurement of ET
- *to parameterize ET
- *estimate ET remotely and at the catchment scale

Water management in large-scale models

Aims to improve the scientific basis of the description of water management in global and regional freshwater models, suitable for coupling to climate models

Potential activities:

Identify global and regional data needs for large scale water resource models, such as on water demand, operating rules etc

Review and co-ordinate the parameterisations of water management in global hydrology models, focussing initially on reservoirs and irrigation

Provide a forum between climate scientists, hydrologists and water resource scientists to provide improved analyses of current and future freshwater supply and demand

MOUNTerrain

Mountainous Terrain Rainfall

????

Address the mismatch between the strong need for, but poor availability of, high-quality observational data sets of precipitation in mountain regions

GDAP integrated product evaluation

- Discussed over last year +
- Current status of GDAP product?
- Need to form a working group with members from GDAP & GHP

Global Data Centres

- Global Precipitation Climatology Center (GPCC)
- Global Runoff Data Center (GRDC)
 - These data centres produced improved products and there has been interaction between them and GHP
- International Data Centre on Hydrology of Lakes and Reservoirs (HYDROLARE)

GHP activities in relation to GSQs

GEWEX Science Questions		Regional Hydroclimate Projects				Cross-cut activities
		HyMex	Pannex	Baltic Earth	GWF	
Observations and Predictions of Precipitation	How well can precipitation be described?	y	y	y	y	Near 0°C precipitation Mountain precipitation
	How do changes in climate affect the characteristics?	y	y	y	y	
	How much confidence do we have in predictions?	y				
Global Water Resource Systems	How do changes in the land surface and hydrology influence water resources?	y	y	y	y	Sub-daily precipitation INTENSE Mountain hydrology INARCH
	How does climate change impact water resource systems?	y	y	y	y	
	How can new observations lead to improved management?		y		y	
Changes in extremes	Observing system requirements	y	y		y	Human management in land-surface models Determining Evapotranspiration GDAP integrated product evaluation
	Modeling capabilities	y	y	y	y	
	Modeling processes involved in extremes	y	y	y	y	
	Improved early warning systems		y		y	
Water and energy cycles	Can we balance the budget at TOA?					
	Can we balance the budgets at the surface?	y	y	y	y	
	Can we track the changes over time?	y		y	y	
	Can we relate changes and processes?				y	
	Cloud-aerosol-precipitation feedbacks	y	y			

GHP members (terms)

Co-Chairs

- Jason Evans [Australia] (2012-2019)
- Joan Cuxart [Spain] (2017-2020, reappointable)

Members

- Silvina Solman [Argentina] (2014-2019)
- Craig Ferguson [USA] (2015-2020)
- Li Xin [China] (2016-2021)
- Sylvester Danour [Ghana] (2017-2019 with option for one 3 yr reappointment)
- Francina Dominguez [USA] (2018-2020 with option for one 3 yr reappointment)

Currently need 2 or 3 new panel members + replacements for those finishing this year.

Summary

- The GHP strategy to address GSQs and WCRP GCs is through regional hydroclimate and cross-cut projects.
- The regional focus of GHP also allows to reach out to applications and transform our knowledge into actionable information.
- After a period of consolidation a steady stream of new RHPs and CCs are being proposed. These need assistance in the early stages of project creation in order to gain momentum and to ensure they align with the GSQs & GCs.
- GHP Networks are proposed to keep completed RHPs and prospective RHPs engaged with GEWEX