



GLASS Panel Meeting• 16 May 2017



GHP addresses the science questions from a <u>regional and integrated</u> (physical-humansocioeconomic) perspective. Looks at common issues among the regions. GHP structure includes the regional hydroclimate projects (RHPs) and crosscuts. The crosscut projects facilitate the transfer of regional project insights (from RHPs), as well as product and applications development.

Moreover, three global centers report to GHP: International Data Centre on Hydrology of Lakes and Reservoirs (HYDROLARE), Global Runoff Data Center (GRDC), and Global Precipitation Climatology Centre (GPCC).





Co-Chairs

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



- Nicole Van Lipzig [Belgium] (2014-2016, is willing to go for another 3yr term)
- Craig Ferguson [USA] (2015-2017 with option for one 3 yr reappoitnment)
- Ben Zaitchik [USA] (2015-2017 with option for one 3 yr reappoitnment)
- Christel Prudhomme [UK] (2015-2017 with option for one 3 yr reappointment)
- Li Xin [China] (2016-2018 with option for one 3 yr reappoitnment)
- Sylvestor Danour [Ghana] (2016-2018 with option for one 3 yr reappoitnment)





2016 GHP Meeting w/GLASS Dates: 3-5 October 2016 Location: Gif-sur-Yvette, France

2017 GHP Meeting w/Third Pole Environment ProjectDates: 17-19 October 2017Location: Kathmandu, Nepal

RHP Status



Active in 4 continents:

Europe: HymEx (2010-2020) =====> High-impact weather events, societal response Baltic Earth (2016-) =====> Sea and land changes, biogeochemical processes Australia: OzyWex (2015-) =====> Water and energy cycle in Australia Africa: HyVic (2015-2024) =====> Hydroclimatic variability over Lake Victoria basin North America: CCRN (2014-2018) => Cryospheric, ecological, hydrological interactions

Recently finished:

Asia: MAHASRI (2007-2016) =====> Asian Monsoon Eurasia: NEESPI (2004-2015) =====> Northern Eurasian climate-ecosystem-societal interact

Prospective:

Europe: PannEx (end 2017?) ====> Agronomy, air quality, sustainability & water mgnt



HyMeX (leads: Philippe Drobinski and Veronique Ducrocq)

aims at:

• improving our understanding of the water cycle, with emphases on extreme events by monitoring and modelling the Mediterranean coupled system (atmosphere-landocean), 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.

HyMeX Home About HyMeX Organisation Resources Workshops Projects Offers Links Contacts Science & Task teams Coordinatio News Upcoming events SIMED annual meeting OUARTERI V IOURNAI 23-24 March 2017, Marseilles ROYAL METEOROLOGICAL SOCIETY European Geosciences Union, General Assembly 2017 HyMeX SOP1 results released 23-28 April 2017, Vienna in a special issue of QJRMS: 10th HyMeX International Workshop 4-7 July 2017, Barcelona Advances in understanding and forecasting of heavy precipitation in the Mediterranean through the HyMeX SOP1 field campaign HvMeX mid-term review Access the SI articles freely Mid-Term Program Review 00000 Westers 1.4 2.2 Fertilizated 2016 10th HyMeX Workshop, 4-7 July 2017, Barcelona, Spain Updated 16.03.2017 ANR-funded projects The 10th hyMeX workshop will be hosted by the Water Research Institute (IdRA) and the Faculty of Physics from the MUSIC University of Barcelona, from 4 to 7 July 2017, Short abstracts for oral or poster presentations are invited on heavy ASICS-MED precipitation, flash-flood and vulnerabilities, Mediterranean cyclones, ocean circulation and dense water formation, droughts MobiClimEx and water resources. Contributions on recent advances in prediction and management of the water cycle, its link with REMEMBER renewable energy, its related hazards and their impacts, from nowcasting to climate scales, are also welcome. The abstracts EXAEDRE can be submitted until 17 March 2017. Details on the HyMeX workshop are available here.

GLASS-related highlights: HyMeX as testbed for incorporating water management in land models? (from 2016 Joint GLASS-GHP meeting)

Next events: 10th HyMeX workshop, Barcelona, Spain : 4-7 July 2017

Baltic Earth (lead: Marcus Reckermann)

aims at: achieving an improved Earth System understanding of the Baltic Sea region

Themes:

• Interdisciplinary and international collaboration (conferences, workshops, etc.)

• Holistic view on the Earth system of the Baltic Sea region, encompassing processes in the atmosphere, on land and in the sea and also in the anthroposphere

• "Service to society" in the respect that thematic assessments provide an overview over knowledge gaps which need to be filled (e.g. by funded projects)

• Education (summer schools)

• Inherits the BALTEX network of scientists and infrastructure



GLASS-related highlights: atmosphere-ocean modeling in ESMs; 2017 conference programme: http://www.baltic.earth/caom2017/IBESP_No10.pdf

Next events: Baltic Sea Science Congress (June 2017), Baltic Earth Summer School (28 Aug- 4 Sept, 2017), Shipping and the Environment Conference (October 2017), 2nd Baltic Earth Conference (June 2018)

OZEWEX (leads: Albert van Dijk and Seth Westra)

aims at: understanding and predicting 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.

Science questions:

• 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?



GLASS-related highlights: Protocol for the Analysis of Land Surface models (PALS) development; Soil Water Estimation and Evaluation Project (SWEEP)

Next event: MODSIM2017 conference session, held at The Hotel Grand Chancellor Hobart, Tasmania, from Sunday 3 to Friday 8 December 2017.

CCRN (lead: Howard Wheater)

aims at: understanding, diagnosing, and predicting interactions amongst the cryospheric, ecological, hydrological, and climatic components of the changing Earth system at multiple scales.

Themes:

- hydro-meteorological extremes
- key land surface systems, including Rocky Mountains, Boreal Forest, Prairies, and sub-arctic, and their response to climate variability and climate change
- effects on water quantity and quality and aquatic ecosystems, of anthropogenic land use change
- societal controls on water management, integrating humans and their activities into water science

More than 50 scientists from academic institutions and government agencies in Canada, USA and Europe.

\$5mil (2013-2018) initial; new funding ?\$mil to support ~150 scientists.



GLASS-related highlights: Including water management (MODSIM-DSS) in the MESH LSM (Annis et al., in-prep); using GRACE for model calibration (Yassin et al., under review). "extreme event focus helps bring researchers together"; complex terrain focus—NA RHP connection; land modification (drainage effects)

Next event: Spring Modeling workshop on land and water futures (June 2017) and CCRN 5th Annual General Meeting (November 2017)

HyVic (lead: Fred Semazzi)

aims at: a Hydroclimate project for Lake Victoria Basin

Themes

- Translational Research Interface with Applications: develop application-based threshold metrics for guiding the basic science themes and pilot studies to demonstrate the use of HYVIC research outcomes for applications
- Severe Weather and Water Currents (collaboration with WWRP-LVP): understanding the evolution of severe weather that occurs over Lake Victoria, the impact of the lake and surrounding terrain on these atmospheric processes, improving Numerical Weather Prediction (NWP) and hydrologic models to better forecast and nowcast the severe weather hazards
- Lake Victoria Basin Water Budget: close the hydrological, energy & nutrients budgets over LVB to acceptable accuracy
- **Climate variability and model development:** investigate the variability across time scales (intraseasonal, interannual, decadal and climate change time scales) of the primary physical climate processes; develop a regional earth system model for the region
- **Observation of the Hydroclimatological System:** install better/more extensive observation monitoring network; perform specific field campaigns to improve the observational knowledge of the region



GLASS-related highlights: land-lake breeze circulations, impact of wind farm aggregates, airborne campaign option from Entebbe airport (unrelated: DACCIWA)

Next event: Establish steering panel and project website, next meeting TBD.



- What GEWEX gains from regional projects:
 - Brings regional scientific communities to the forefront in WCRP – They are often under-represented.
 - Allows to address water issues in a multi-disciplinary context.
 - Highlights regional processes and questions their relevance elsewhere or globally.
- Regional activities of GHP are weak in some areas:
 - Interaction with decision makers.
 - Address climate change issues.
 - Co-develop knowledge with stake holders.



Currently active

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

Proposed

- MOUNTerrain (Mountainous Terrain rainfall) (J. Renwick)
- Including water management in large scale models (R. Harding / J. Polcher)

Potential

GDAP integrated product regional evaluation

INTENSE – Key research questions

lead: Hayley Fowler

- 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 2016

- 6 full-Eme PDRA's working on project at Newcastle University: Dr Stephen Blenkinsop, Dr Elizabeth Lewis, Dr Renaud Barbero, Dr Xiaofeng Li, Dr Selma Guerreiro and Dr Steven Chan (based at UK Met Office), Dr Geert Lenderink (part-time, KNMI, Netherlands) and team at UK Met Office led by Dr Lizzie Kendon
- Standard request letter and identified routes to data providers (with Lisa Alexander). Data provided for many countries Elisabeth Lewis
- Development of quality control procedures for sub-daily precipitation using UK data Stephen Blenkinsop
- Understanding trends in sub-daily precipitation extremes and preliminary analysis of dynamical and thermodynamic drivers Renaud Barbero/Geert Lenderink
- Understanding extreme rainfall processes using convection-permitting models Steven Chan/Lizzie Kendon
- Extent to which CPMs are needed for reliable future climate projections paper in press in BAMS (Kendon et al. 2016).
- A gridded hourly rainfall product for the UK for 1991-2013
- Website: https://research.ncl.ac.uk/intense/



Westra S, Fowler H J, Evans J P, Alexander L V, Berg P, Johnson F, Kendon E J, Lenderink G and Roberts N M 2014 Future changes to the intensity and frequency of short-duration extreme rainfall Rev. Geophys. 52 522–55



Near 0°C – Phenomena of interest

leads: Ron Stewart and Pavel Groisman

- 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 2016

- 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 called the Predicted Particle Properties (Morrison and Milbrandt, 2015) is being developed to simulate freezing rain using WRF and GEM (Canadian operational weather model). It will consider gradual melting and freezing of precipitation without adding significant computing time.





INARCH – Science questions

lead: John Pomeroy

- How different are the measurement standards and the standards for field sampling and do we expect distinctive differences in model results and hydrological predictability because of the sampling schemes, data quality and data quantity?
- How do the predictability, uncertainty and sensitivity of catchment energy and water exchange vary with changing atmospheric dynamics in various high mountain regions of the Earth?
- What improvements to high mountain energy and water exchange predictability are possible through improved physics in land surface hydrological models, improved downscaling of atmospheric models in complex terrain, and improved approaches to data collection and assimilation of both in-situ and remotely sensed data?
- Do the existent model routines have a global validity, are they transferable and are they meaningful in different mountain environments?
- How do transient changes in perennial snowpacks, glaciers, ground frost, soil stability, and vegetation impact models of water and energy cycling in high mountain catchments?





INARCH: International Network for Alpine Research Catchment Hydrology

<u>Canada</u> – Canadian Rockies, BC & Yukon; <u>USA</u> – Reynolds Creek, ID; Dry Creek, ID; Senator Beck, CO, Niwot Ridge, CO. <u>Chile</u> - Upper Maipo & Upper Diguillín River Basins, Andes, <u>Germany</u> – Schneefernerhaus & Zugspitze; <u>France</u> – Arve Catchement, Col de Porte & Col du Lac Blanc; Switzerland – Dischma & Weiseflubisch:

Switzerland – Dischma & Weissfluhjoch;

<u>Austria</u> - OpAL Open Air Laboratory, Rofental <u>Spain</u> – Izas, Pyrenees;

<u>China</u> – Upper Heihe River, Tibetan Plateau, <u>Nepal</u> – Langtang Catchment, Himalayas

Sweden – Tarfala Research Catchment



INARCH – Planned activities

- Special Issue of Earth System Science Data.
- Mountain downscaling toolbox further development
- LSS-H Model comparison and development link to GLASS
- Comparative analysis of alpine snow and ice hydrological sensitivity to warming – "Mediterrenean 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
- Link with Canadian-funded GWF (Global Water Future) Program





MOUNTerrain – Proposed activities

lead: James Renwick

- Collation of available digitized observational data for high-elevation precipitation along orographic gradients.
- Data rescue of high-elevation precipitation records, such as un-digitized meteorological station records, non-conventional written records from ski fields, alpine clubs, etc.
- Intercomparison studies: Comparing gridded precipitation data sets (and reanalyses) both with station records and through cross-comparison. Development of best-estimate integrated, gridded data sets of mountain precipitation for all major high-elevation terrain regions of the globe.
- Model validation and model experiments: Validating global and regional climate model output against gridded data sets developed under (1). Development of coordinated model experiments to guide process studies and model development – "MtnPrecMIP"?
- Development of proposals for Integrated Observing Periods/Programmes in identified areas, on the basis of (1) and (2).





Water management – Proposed activities

leads: Richard Harding and Jan Polcher

- 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







GHP activities in relation to GSQs

GEWEX Science Questions		Regional Hydroclimate Projects					Cross-cut
		HyMex	CCRN	HyVic	OZEWEX	activitio	activities
Observations and Predictions of Precipitation	How well can precipitation be described?	ÿ	у	Ŷ	У	1	Near 0°C precipitation
	How do changes in climate affect the characteristics?	y	У	У	У	6-	Mountain
	How much confidence do we have in predictions?	y.					Sub-daily
Global Water Resource Systems	How do changes in the land surface and hydrology influence water resources?	y.	У	¥	У		precipitation INTENSE
	How does climate change impact water resource systems?	у	У	ÿ	y	1	Mountain hydrology
	How can new observations lead to improved management?		у	y	y	11	INARCH
Changes in extremes	Observing system requirements	¥	(¥)	¥	ų.	7-	Human management in land-surface
	Modelling capabilities	ý	y.	y	¥		GDAP
	Modelling processes involved in extremes	y.	*	× X	y.	2	integrated product
	Improved carly warning systems			9	¥	1	evaluation
Water and energy cycles	Can we balance the budget at TOA?					11	
	Can we balance the budgets at the surface?	y.				/	
	Can we track the changes over time?	v					
	Can we relate changes and processes?						
	Cloud-aerosol-precipitation feedbacks						

Potential WaterAvail GC RHP: PannEx (lead: Monika Lakatos)

Science Themes

1) Adaptation of agronomic activities to weather and climate extremes

2) Understanding air quality under different weather and climate conditions

- 3) Toward a sustainable development
- 4) Water management, droughts and floods
- 5) Education, knowledge transfer and outreach

Tasks

- 1) Data and knowledge rescue and consolidation
- 2) Process modelling
- Quantifying surface energy and water budgets
- Atmospheric chemistry
- Land-atmosphere interactions
- Precipitating systems
- Crop modelling
- Hydrological modelling
- 3) **Development and validation of modelling tools**



GLASS-related highlights: closed basin presents opportunity to study water and energy budgets w/human influence, and homogenous fetch for I-a coupling studies

Next event: March 2017 workshop to outline science and implementation plans and initiate funding search

Science Themes

high-resolution regional weather-, hydrological-, and ecohydrological-model applications and development

downscaling of remote sensing and climate model outputs

mountain meteorology and hydrology

water resources management

new observations and data

the water-energy-people nexus

socio-economic-environmental impacts vulnerability and adaptation, and more.

Proposed geographic focal areas for the RHP include the U.S. Central Valley and U.S./Canada Great Plains food basket regions, which are hydroclimatically dependent on the adjacent Sierra Nevada and Rocky Mountains. Processes:

Global circulation modes Atmospheric blocking (Arctic warming or tropical source?) Great Plains low-level jet (LLJ) Convection and mesoscale convective systems (MCSs) Mountain meteorology and hydrology Dynamic vegetation Land-atmosphere interactions Water management for agriculture, energy, and tap water

Applications:

Enhanced short-range weather forecasts Improved flood, drought and heatwave prediction Informed water, forest, and agricultural management

Tools:

Numerical Weather Prediction models (NWP) Short range and seasonal forecast system Satellite retrievals in complex terrain Integrated water+energy measurements; diurnal PBL T, q, and winds Data assimilation

Multi-agency OSSE in a cloud? CMIP-6 DECK and MIPs, incl. Hi-Res

PAST

2016 NA RHP Planning Workshop

Dates: 3-5 May 2016 Location: Columbia, MD, USA Contacts: Peter van Oevelen, Roy Rasmussen, Ana Barros, Graeme Stephens, Margaret Srinivasan, Craig Ferguson, and Ben Zaitchik http://www.gewexevents.org/water-availability-grand-challenge-for-north-america/

2016 Fall AGU Session: Water for the Food Baskets of World; A Regional Hydroclimate Project Initiative for North

America (<10 submissions; merged w/Transforming Hydrologic
Prediction and Decision Making)
Dates:11-15 December 2016
Location: San Francisco, CA, USA
Contacts: Peter van Oevelen, Roy Rasmussen, Jeff Basara, and Ana
Barros

2016 Convection-Permitting Climate Modeling Workshop

Dates: 6-8 September 2016 Location: Boulder, CO, USA Notes: presentations online; special issue of Climate Dynamics inprogress Contacts: Roy Rasmussen and Andreas Prein (UCAR) https://ral.ucar.edu/events/2016/gewex-convection-permitting-climate-modeling-workshop

UPCOMING

2017 AMS Conference on Mesoscale Processes: Mesoscale Processes in Climate Simulations

Dates: 24-27 July 2017 Location: San Diego, CA, USA Contacts: Stan Trier and Andreas Prein (UCAR)

2017 Fall AGU Session: Water for the Food Baskets of World; A Regional Hydroclimate Project Initiative for North America

Dates:11-15 December 2017 Location: New Orleans, LA, USA Contacts: Peter van Oevelen, Roy Rasmussen, Jeff Basara, and Ana Barros

2017 AMS Conference on Climate Variations and Change (CVC): Convection-Resolving/Eddy-Permitting Climate Modeling

Dates: 7-11 Jan 2018 Location: Austin, TX, USA Contact: Kerry Cook (UT-Austin)



2016 Convection-Permitting Climate Modeling Workshop

1. An informational website to channel current and prospective participants http://www.gewex.org/panels/gewex-hydroclimatology-panel/regional-hydroclimate-projects-rhps/north-american-regionalhydroclimate-project-initiative/

- 2. Plans for an email newsletter (edited by Paul Houser?)
- 3. Upcoming Sessions: AMS Convection-permitting (AMS) and Fall AGU RHP
- 4. Next Community meeting at Mammoth Lakes, CA; Date TBD (Tom Painter).

Excerpts:

Tom Painter:

"focus is water cycling in the complex terrain of the Western US."

Craig Ferguson:

"...need highly instrumented datasets of land-atmosphere continuum for interrogating model coupled processes. Currently, n=2? 19? in the U.S." (Paul Dirmeyer: "**long-term** network".) Ana Barros: "...frame a broad agenda of national science questions in complex terrain including: 1) complex terrain across CONUS overall, including specifically mountain hydrology and hydrometeorology... 2) the role of the Western Cordillera from Alaska to the Sonora desert and the Gulf of Mexico and the Appalachians from Newfoundland to the Gulf of Mexico as the two big continental divides organizing weather and climate...and 3) the importance of the Rockies and Western US as the headwaters of the west and southwest providing water resources for X million people."

Anonymous :

"What about water <u>quality</u> for drinking water and ecosystems? What about agriculture in the NE US?

Jan Polcher:

"...include water management and LULCC and socioeconomic dimensions"

Obstacles to RHP lift-off:

- California Water Program has much of the community busy
- No cohesive team due to lack of common science agenda and geographic domain.
- No strong consensus that an integrated, coordinated, simultaneous effort is critical (i.e., piece by piece is sufficient and perhaps the only fundable path)
- No multi-agency call coming. Agencies say they are already funding research in these areas (e.g., NSF Infuse; USDA AFRI, NASA NEWS)
- Senior scientists have hands full with current efforts and hesitant to commit to grassroots campaign to organize effort over 3-5yr time horizon
- Young scientists (incl. Craig) at the mercy of projects that are funded.
- Lack of mid-career scientists with time, technical- and salesmanship skills to drive the RHP.

Outlook:

U.S. RHP appears to have a low probability of occuring due to aforementioned challenges.

Nevertheless, Roy's UCAR team is pushing ahead with convection permitting model theme and Jeff Basara, Craig and Paul are pushing ahead with coupled I-a observing network theme.



Jeff Basara (right) and Jerry Brotzge (left) at the Voorheesville, NY mesonet site in May 2017.

Gen/ex Regional Hydroclimate Experiments (RHPs)





Massive economic and population growth and urbanisation are expected to lead to a tripling of anthropogenic emissions in southern West Africa (SWA) between 2000 and 2030, the impacts of which on human health, ecosystems, food security and the regional climate are largely unknown.

- An assessment of these impacts is complicated by:
- 1.a superposition with effects of global climate change,
- 2.the strong dependence of SWA on the sensitive West African monsoon,
- 3.incomplete scientific understanding of interactions between emissions, clouds, radiation, precipitation and regional circulations 4.by a lack of observations to advance our understanding and improve predictions.

DACCIWA will quantify the influence of anthropogenic and natural emissions on the atmospheric composition over South West Africa and assess their impact on human and ecosystem health and agricultural productivity. It will quantify the coupling between aerosols and clouds and identify controls on the formation and persistence of low-level clouds. Further it will identify meteorological controls on precipitation, focusing the transition from stratus to convective clouds and the forcing from weather systems. Dynamics-aerosol-chemistry-cloud interactions in West Africa http://www.dacciwa.eu/



DACCIWA will undertake a range of activities ranging from flying research aircraft over West Africa, to running complex numerical models of the composition of the atmosphere. You can find out about some of these activities by clicking on the tabs to the left.

Similar motivations to HyVIC.

GLASS-related highlights: June-July 2016 field campaigns focused on deep convection and CBL. 3 sites: Ghana, Benin, and Nigeria.