

GEWEX Hydroclimate Panel – GHP

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

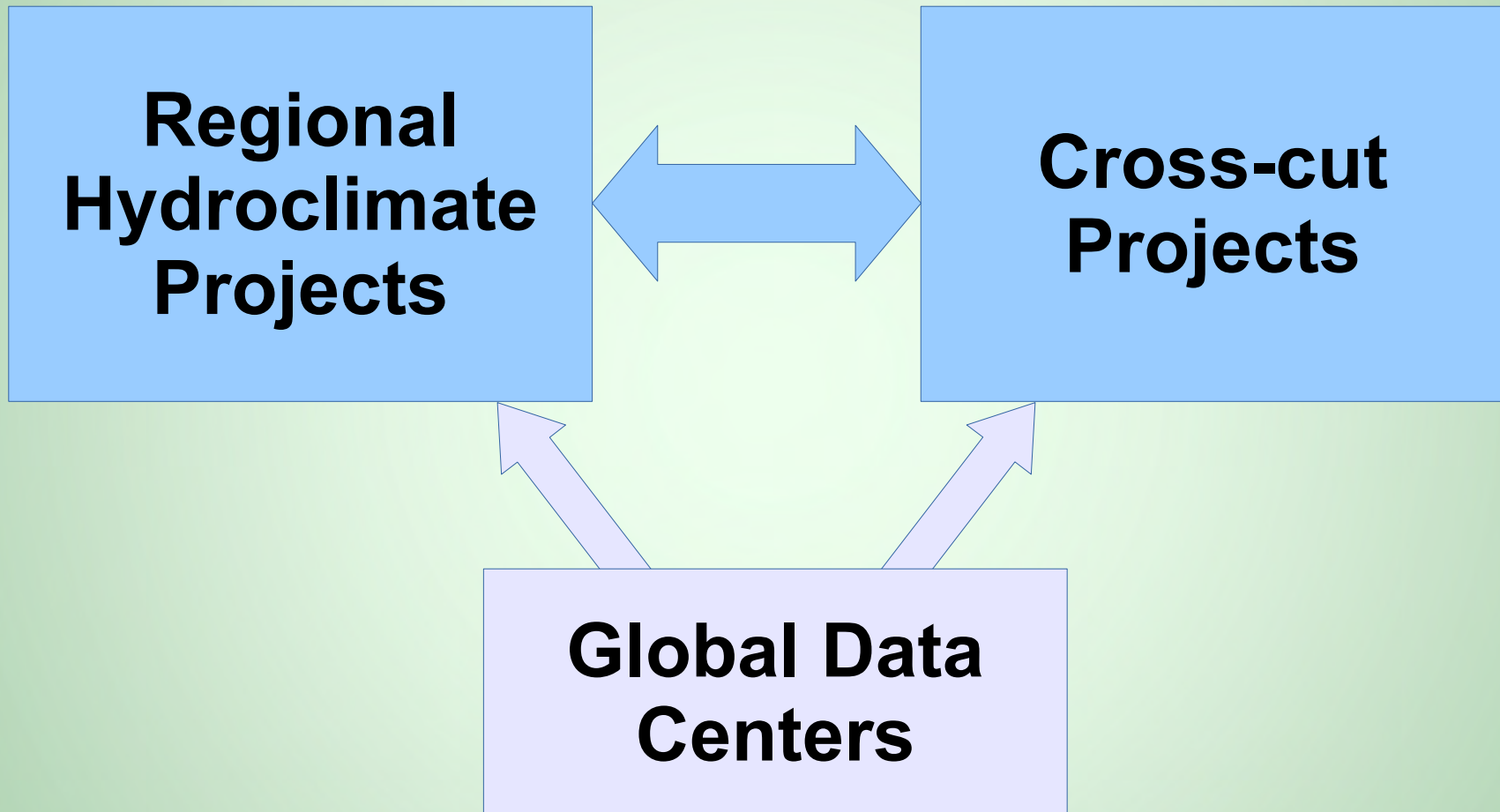


The role of GHP within GEWEX

The GHP aims to address the GEWEX Science Questions from a regional and integrated perspective.

- Only at the regional scale can the water cycle be addressed from its physical to human and socioeconomic dimensions
- The Regional Hydroclimate Projects (RHPs) are an essential tool in this endeavour as they bring together various disciplines on water issues.
- The cross-cut projects allow GHP to propagate knowledge from one region to another and synthesize results at the global scale. They also allow development and testing of applications developed

GHP Structure



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: **OzeWex** (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:

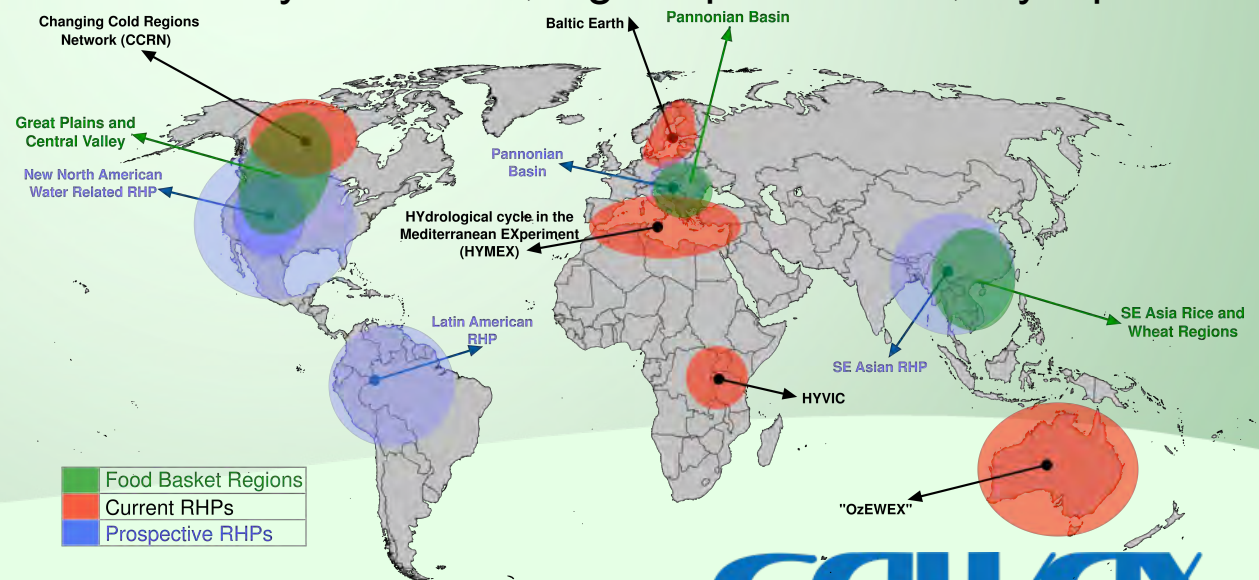
- Asia: **MAHASRI** (2007-2016) =====> Asian Monsoon
- Eurasia: **NEESPI** (2004-2015) =====> Northern Eurasian climate-ecosystem-societal interactions

Prospective:

- Europe: **PannEx** (2018?-) =====> Agronomy, air quality, sustainability & water mgnt
- America: **AndEx** (2019?-) =====> Andes hydroclimate, high impact events, cryosphere...

In discussion:

Exploring new possibilities in the Americas and Asia.



Multiple formats and origins

RHPs usually take the form of a network, which structure varies between RHPs

Some are former initiatives that become RHPs

Others are formed with the RHP structure in mind

Some have clear institutional leaderships, other are more transversal

Relation with GEWEX's Science questions and imperatives

i) understanding the precipitation variability,

ii) changing water availability,

iii) extreme events like drought and floods,

iv) processes in the water and energy cycles

Most of the RHP are in line with the questions and address most of the 7 imperatives:

i) Data sets; ii) analysis; iii) processes; iv) modelling; v) applications; vi) technology

Transfer & vii) capacity building.

GHP activities in relation to GSQs

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

RHPs are a regional way of organizing most of the GEWEX-oriented activities and make the community grow from the bottom, attracting scientists that would otherwise act in a more isolated manner.

Interaction with the other GEWEX actions is going on and could be intensified through more transversal actions, probably stimulated by enhanced communication between Cross-cut (CC) activities and the other Core programs.

More coordination between CCs and RHPs is encouraged.

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.

Cross-cut Projects List

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

- Including water management in large scale models (R. Harding / J. Polcher)

Potential



- GDAP integrated product regional evaluation



Global Data Centres

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

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 us 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.

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

CCRN

HyVic

OzEWEX

Baltic Earth

Hydrological cycle in the Mediterranean Experiment (HyMeX)

2020



**Philippe Drobinski,
Veronique Ducrocq**

Institut Pierre Simon
Laplace/Laboratoire de
Météorologie Dynamique, Ecole
Polytechnique, Palaiseau Cedex,
France

HyMeX

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.

HyMeX – recent science highlights

This first combined dataset has then been used to characterize the seasonality and the long-term trends over large Mediterranean basins

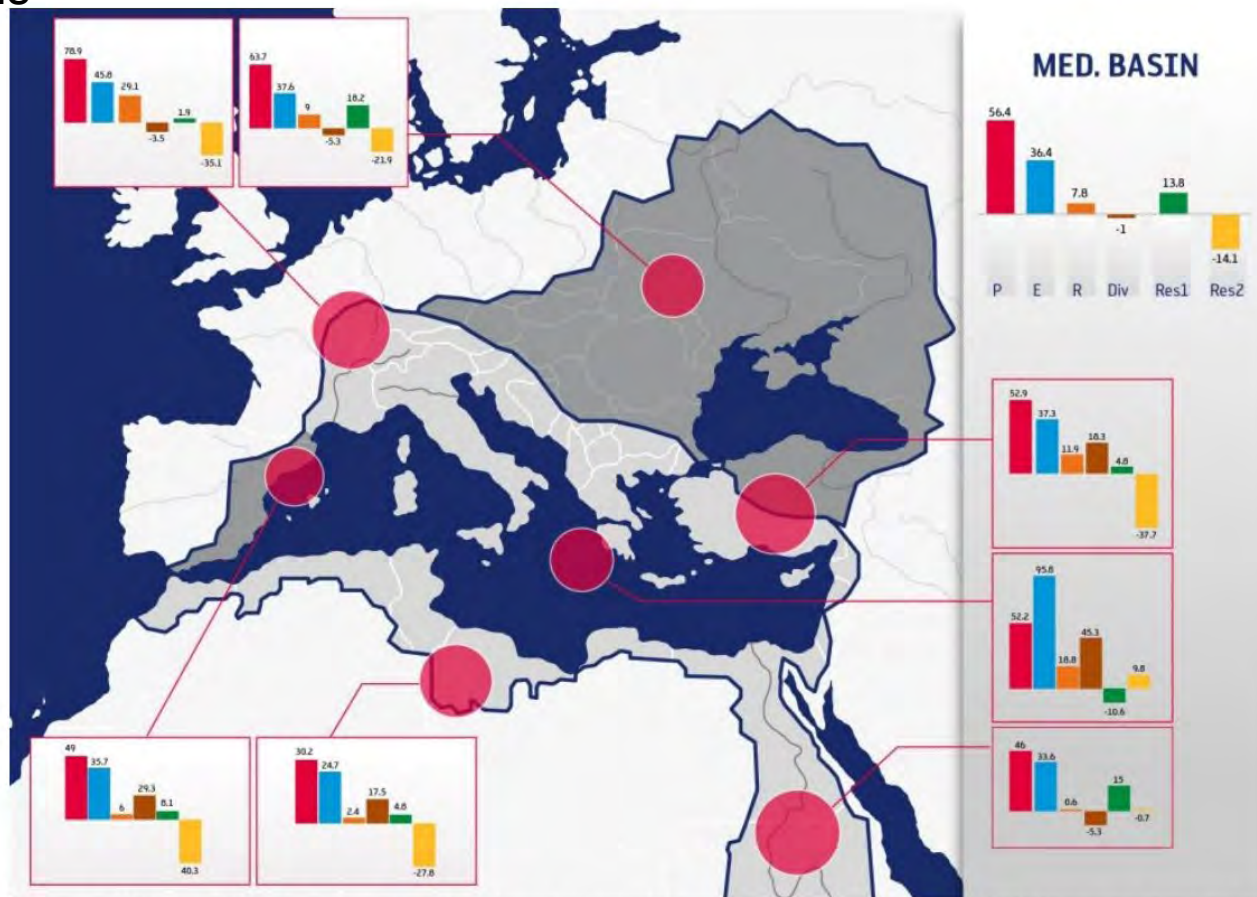
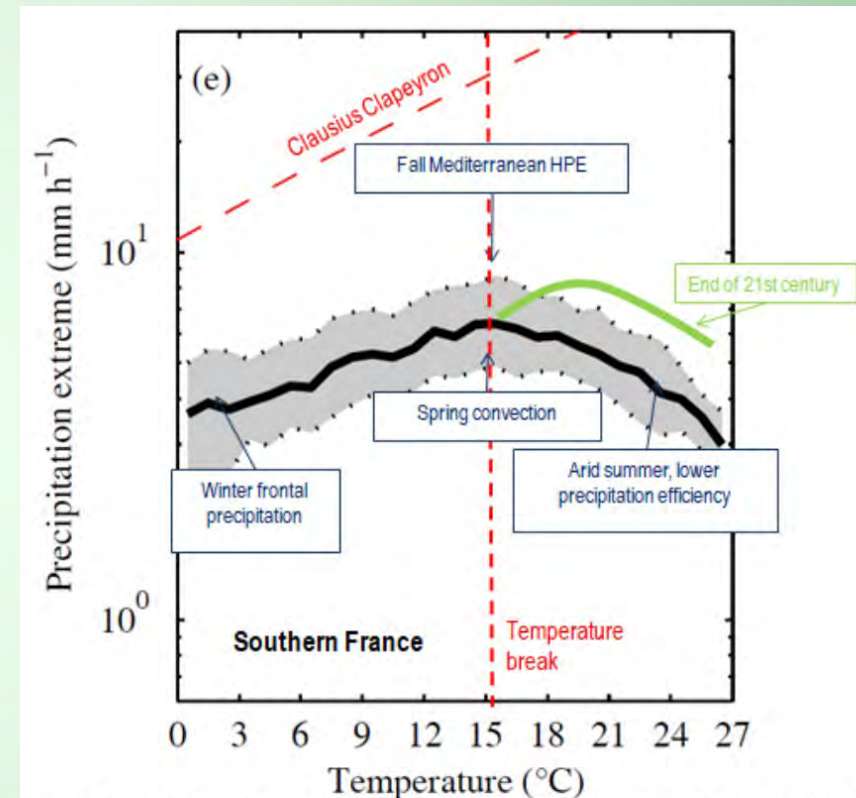


Figure 4: Mean annual terrestrial water cycle, for several large basins in the Mediterranean, as observed by our combined satellite observations dataset..

HyMeX – recent science highlights

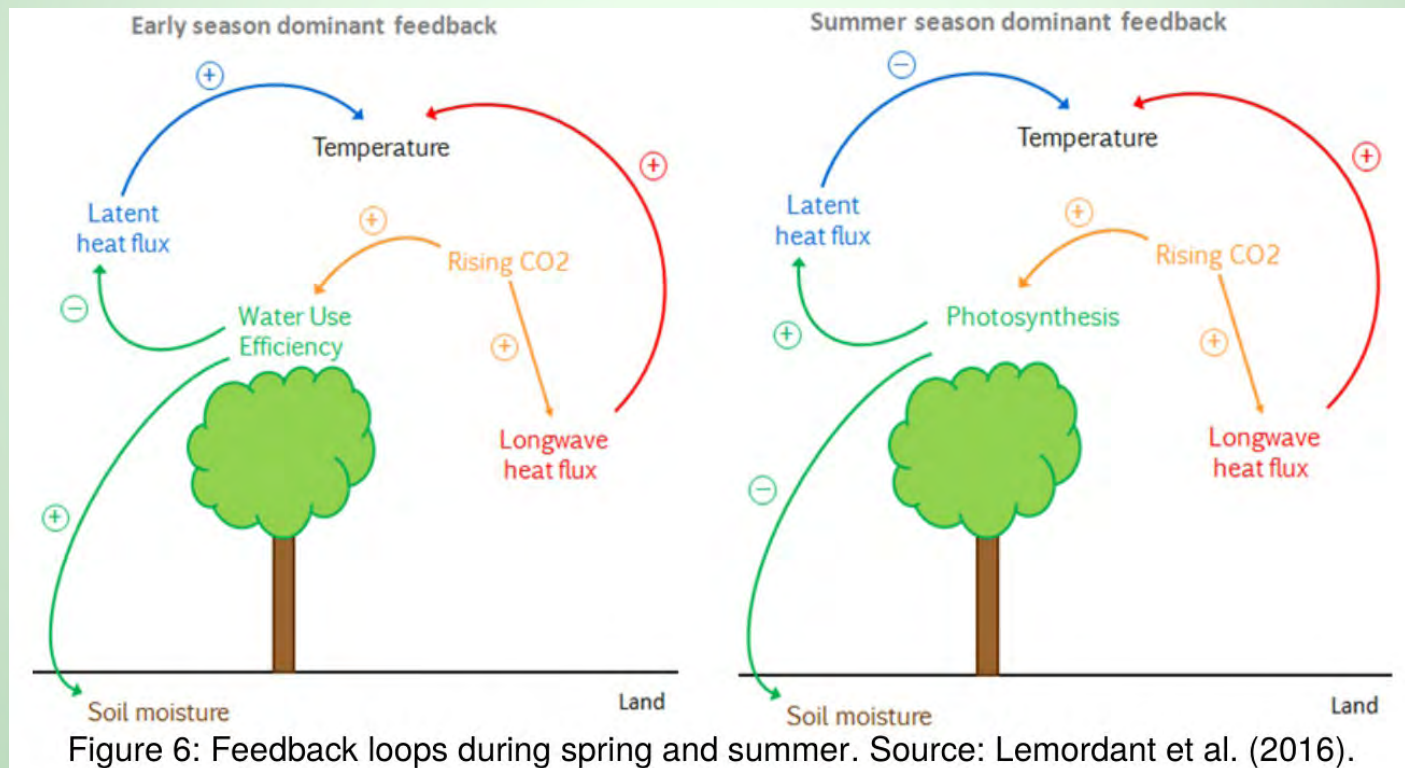
Drobinski et al. (2016) show that the daily intensity of extreme precipitation increases with the daily temperature of the surface at low temperatures and decreases at high temperatures. This "hook shape" can be attributed to several factors: (i) reduction of the duration of rainfall events at high temperatures, (ii) different synoptic situations leading to extreme precipitation, (iii) decreasing precipitation efficiency and vertical moisture transport. Drobinski et al. (2017) have also shown using the HyMeX / MED-CORDEX simulations that in a future climate the range of temperatures over which the daily intensity of extreme precipitation increases with daily temperature rises and that the rate at which the intensity of precipitation decreases at high temperatures decreases.



Drobinski, P., Da Silva, N., Panthou, G., Bastin, S., Muller, C., Ahrens, B., Borga, M., Conte, D., Fossier, G., Giorgi, F., Güttler, I., Kotroni, V., Li, L., Morin, E., Onol, B., Quintana-Seguí, P., Romera, R. and Torma, C.Z., 2016: Scaling precipitation extremes with temperature in the Mediterranean: past climate assessment and projection in anthropogenic scenarios. *Climate Dynamics*.

HyMeX – recent science highlights

Lemordant et al. (2016) show that the fertilization of vegetation by an increased concentration of atmospheric CO₂ can mitigate the heat waves at mid-latitudes by mobilizing the preserved water thanks to greater water efficiency before the onset of the heat wave. However, the aridity of the soil at the end of the summer in the Mediterranean is generally exacerbated because a greater vegetation cover "overcompensates" the greater water efficiency.



HyMeX – activities

- 10th HyMeX workshop, Barcelona, Spain : 4-7 July 2017
- MED-CORDEX FPS started
 - Convection permitting RCMs
 - Air-sea interactions
 - aerosols

Planned

- 11th HyMeX workshop, Barcelona, Spain : 4-7

July 2017



HyMeX – future field campaigns

The field experiments in preparation are:

- EXAEDRE to be conducted in September 2018 on atmospheric electricity in complement to what has been performed during SOP1
- PERLE oceanic experiment to be conducted in October 2018, February 2019 and June-July 2020 in complement to what has been performed during SOP2 but in the Levantine region in the Eastern Mediterranean
- LIAISE to be conducted between April 2020 and March 2021 which focuses on land surface interactions over the Iberian semi-arid environment



Figure 3: Location of the future field campaigns planned in the frame of HyMeX.

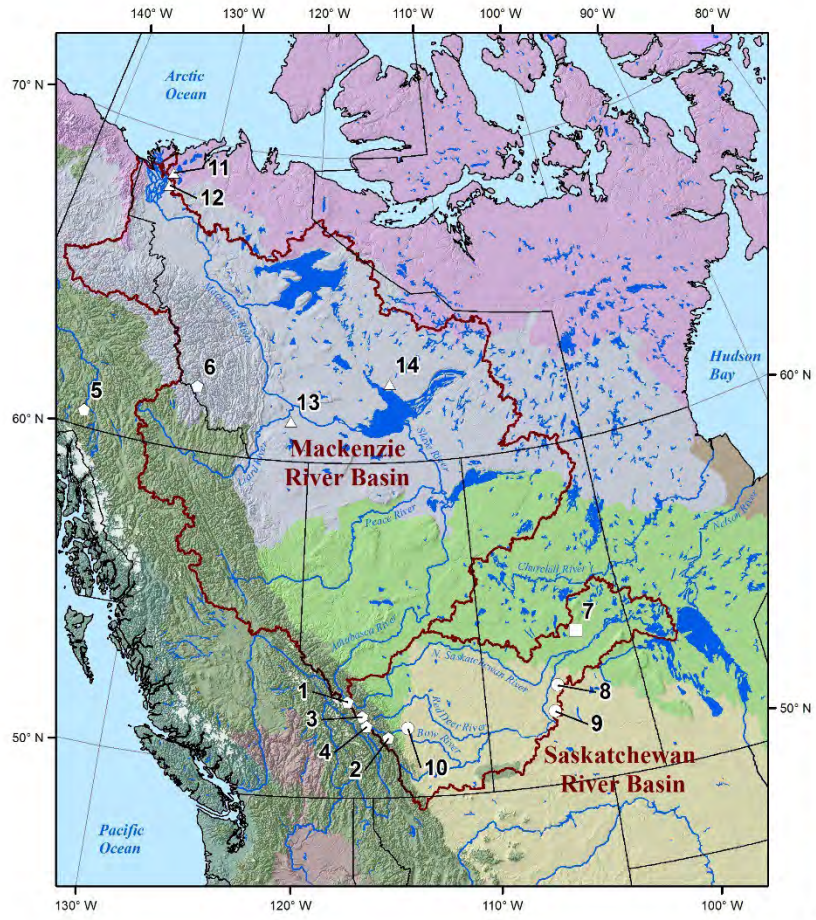
Changing Cold Regions Network (CCRN)

2018



Howard Wheeler

Global Institute for Water Security,
University of Saskatchewan,
Saskatoon, Canada



Changing Cold Regions Network Study Domain

Water, Ecosystem, Cryosphere and Climate Observatories

- **Western Cordillera**
 - 1: Columbia Icefield, AB
 - 2: Marmot Creek Research Basin, AB
 - 3: Wapta Icefield/Peyto Glacier, AB
 - 4: Lake O'Hara, BC
 - 5: Wolf Creek Research Basin, YT
 - 6: Brintnell-Bologna Icefield, NT
- **Boreal Forest**
 - 7: Boreal Ecosystem Research and Monitoring Sites (BERMS), White Gull Creek, SK
- **Prairie**
 - 8: St. Denis National Wildlife Area, SK
 - 9: Kenaston/Brightwater Creek Mesonet Site, SK
 - 10: West Nose Creek, AB
- △ **Sub-Arctic Lowlands**
 - 11: Trail Valley Creek, NT
 - 12: Havikpak Creek, NT
 - 13: Scotty Creek, NT
 - 14: Baker Creek, NT

Ecoregions and Landcover

Glaciers	Northwestern Forested Mountains
Tundra	Marine West Coast Forest
Taiga	Great Plains
Hudson Plains	North American Deserts
Boreal Forest	

0 250 500 1,000 km

CCRN

CCRN project is focused on understanding, diagnosing, and predicting interactions amongst the cryospheric, ecological, hydrological, and climatic components of the changing Earth system at multiple scales. Including particular focus on:

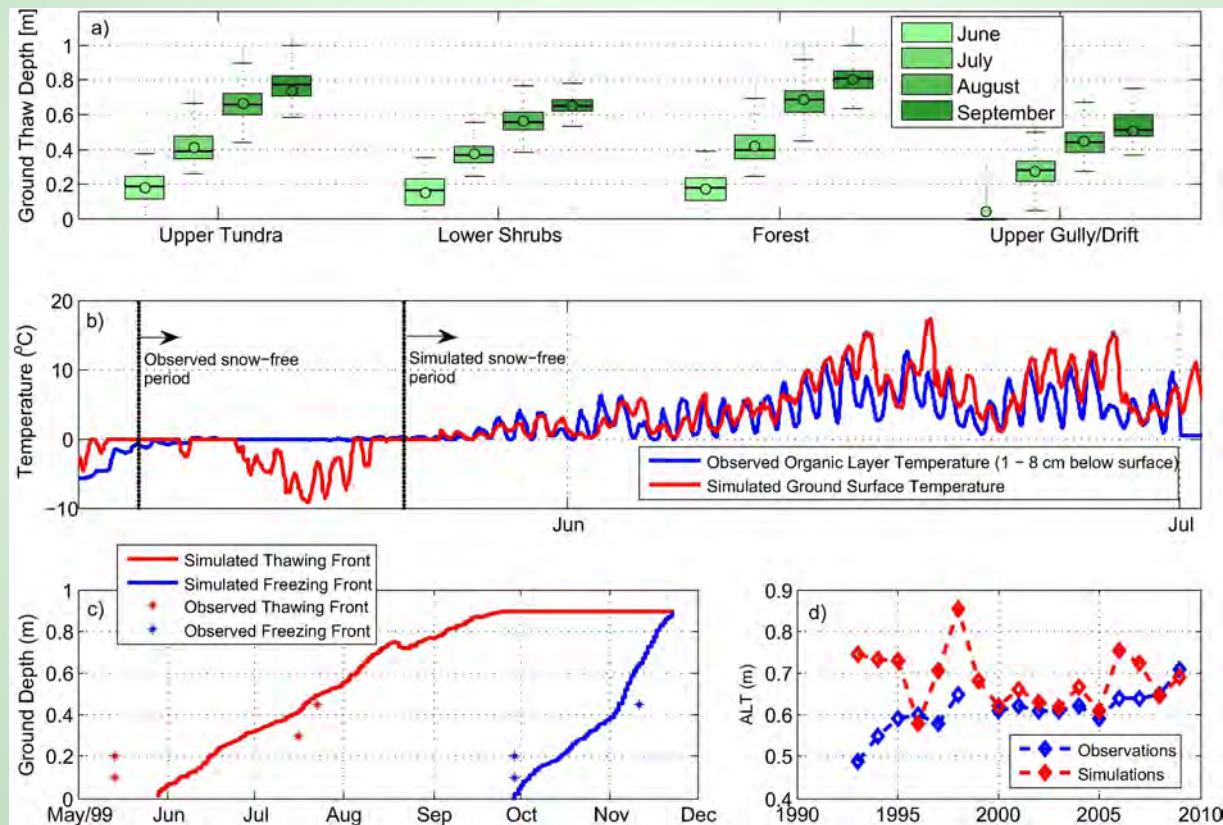
- hydro-meteorological extremes
- key land surface systems, including Rocky Mountains, Boreal Forest, Prairies, and sub-arctic, and their response to climate variability and climate change

• effects on water quantity and quality and aquatic ecosystems of anthropogenic land use



CCRN – Improved modelling of soil freeze/thaw transitions

Krogh et al. (2017) examined the relationship between snow cover and soil freezing/thawing in a high latitude catchment, including their ability to simulate it with a physically based hydrology model.

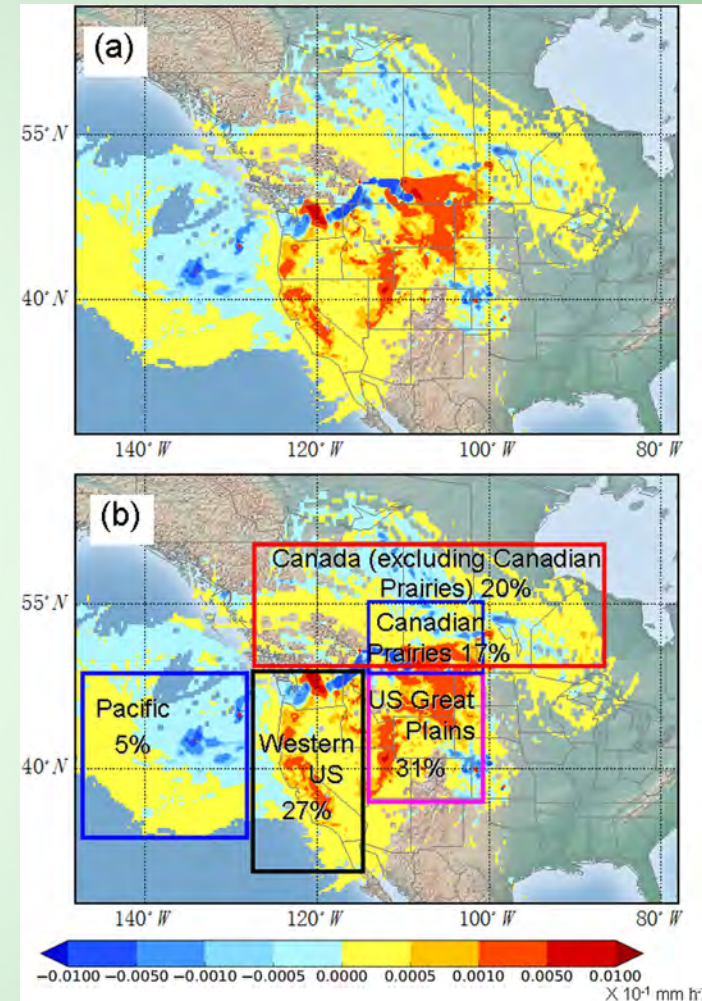


CCRN – Examining extreme events

The Weather Research and Forecasting (WRF) Model was used to simulate this event and was validated against several observation datasets.

The application of a conventional convective/stratiform separation algorithm shows that convective activity was dominant during the early stages, then evolved into predominantly stratiform precipitation later in the event.

The HYSPLIT back-trajectory analysis and regional water budget assessments using WRF simulation output suggest that the moisture for the precipitation was mainly from recycling antecedent soil moisture through evaporation and evapotranspiration over the Canadian Prairies and the U.S. Great Plains.



Moisture sources for Alberta June 23 flood event

CCRN – activities 2017

- Fall 2017 modelling workshop, Coast Hotel, Canmore, AB, November 2-3, 2017
- Wolf Creek Research Basin 25th Anniversary Science Summit, Gold Rush Inn, Whitehorse, YT, September 28-29, 2017
- Modelling workshop, National Hydrology Research Centre, Saskatoon, SK, June 19-20, 2017
- Scenarios of change workshop, National Hydrology Research Centre, Saskatoon, SK, March 20-21, 2017

CCRN – planned activities 2018

- Final CCRN general meeting, Saskatoon, 4-7 March 2018

Hydroclimate project for Lake Victoria Basin (HyVic)

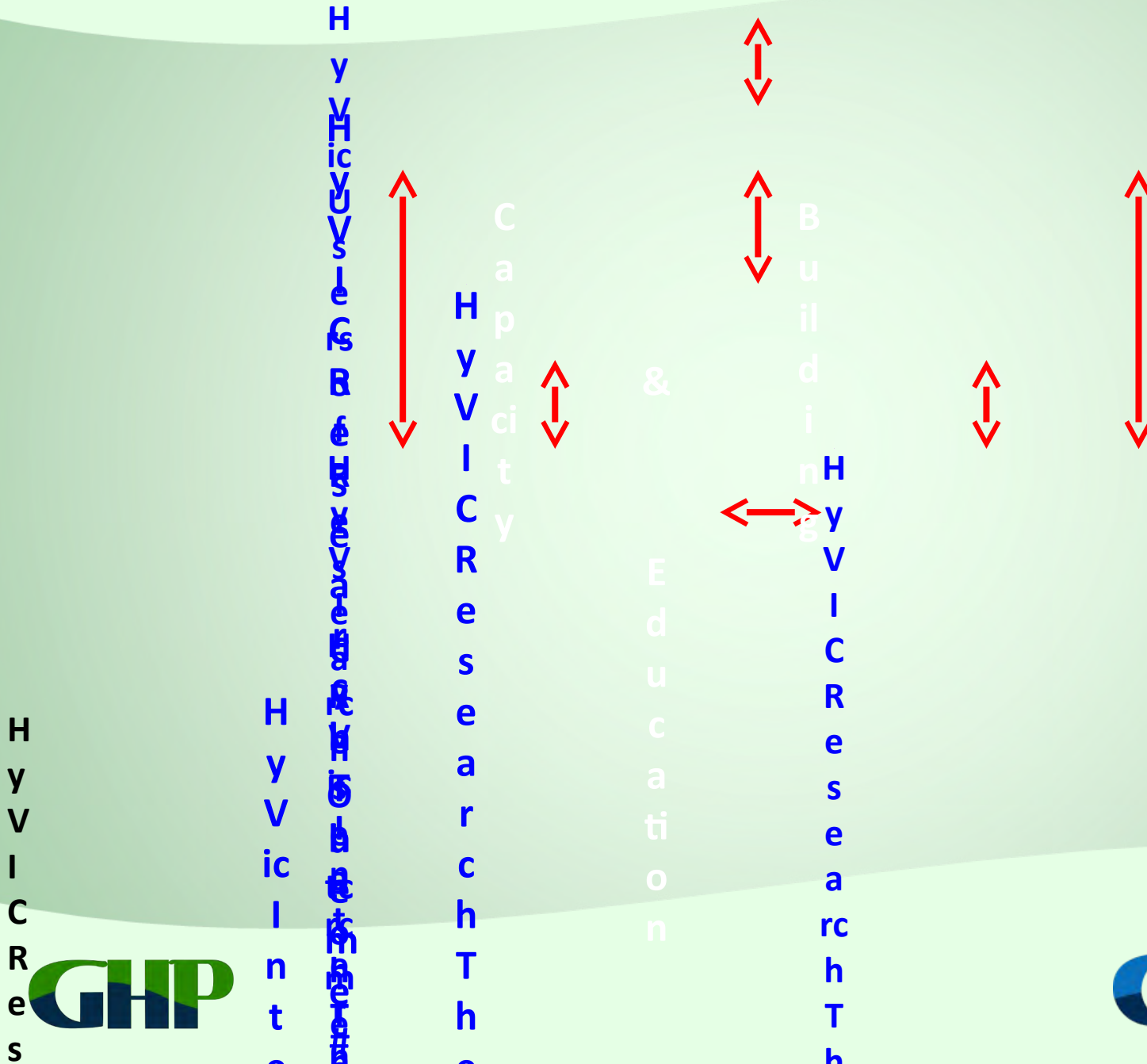
2024



Fred Semazzi

North Carolina State
University, USA

HyVic – Science Plan Components



HyVic – Funded projects

- HyCRISTAL (Integrating Hydro-Climate Science Into Policy Decisions For Climate-Resilient Infrastructure And Livelihoods In East Africa)
- HyTPP (HyCRISTAL Transport Pilot Project)
- HIGHWAY (HIGH impact Weather IAkesYstem)

HyVic – Institutional Coordination (Regional)

- **LVB-HyNEWS** (Lake Victoria Basin - HydroClimate to Nowcasting for Early Warning Systems)
 - Formed to enhance the coordination, visibility and sustainability of HyVic, SWNDP (Severe Weather Nowcasting Development and Demonstration Project) and EAC NEWS (Navigation Early Warning System).
- **UCRRI** (Uganda Climate Resources Research Institute – planned)
- **ICPAC** (IGAD Climate Prediction and Applications Centre) Climate Projections initiative (planned)

HyVic – Outstanding Issues

- Establishing project office and steering panel
- Updating website?
- Is planning to expand the focus area to include all IGAD nations (best regional source of funds)
 - Will reassess research priorities in this context. May require a whole new science plan and RHP proposal.

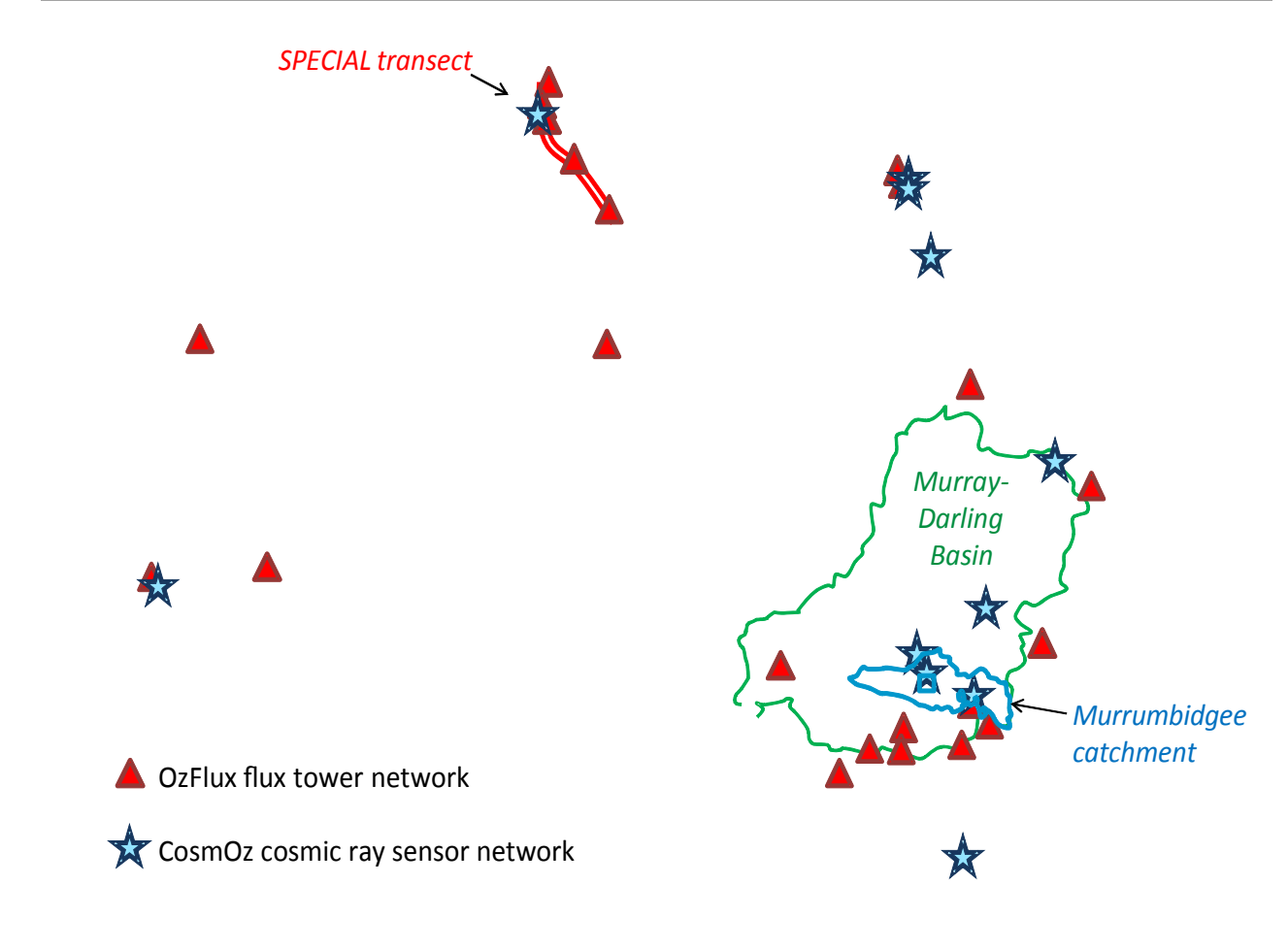
Australian Energy and Water Exchanges (OzEWEX)

2019



**Albert van Dijk,
Seth Westra**

Australian National
University, Canberra,
Australia



OzEWEX – Science Questions

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.

It will address the 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?

Who is involved?

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OzEWEX – Highlights

- National workshop in December 2017
- 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 – Website & Newsletter

OzEWEX THE AUSTRALIAN ENERGY AND WATER EXCHANGE RESEARCH INITIATIVE

FEATURED ABOUT US NEWSFEED EVENTS WORKING GROUPS DATASETS CLASSIFIEDS RELATED SITES

RESEARCH HIGHLIGHTS – OCTOBER 2015

This month in Research Highlights, among others: the latest on flood detection and monitoring, climate drivers of rainfall, assessments of contrarian climate change research and how to integrate satellite data [...]

QUICK LINKS

- OzEWEX '15 workshop
- OzEWEX '14 proceedings
- What is OzEWEX?
- Contact us

UPCOMING EVENTS

21st International Congress on Modelling and Simulation (MODSIM2015)
November 29 @ 8:00 am - December 4 @ 5:00 pm

2nd annual OzEWEX workshop
December 2 @ 9:00 am - 5:00 pm

Research priorities for 2015-2020
November 17, 2015 | source: Bureau of Meteorology
Targeted, high quality research and development drives advances in the quality, breadth, timeliness and utility of the Bureau's products and services. To reach our key science and service targets during 2015-2020 we've identified five research themes: scientific compute: f...1

A suite new way to look below the surface
November 17, 2015 | source: Bureau of Meteorology
For the first time, the Bureau's Groundwater Information Suite gives decision-makers easy access to comprehensive, nationally consistent information about groundwater in Australia. Groundwater is a major source of water for agriculture.

OzEWEX – Outstanding Issues

Has not been successful in attracting funding to support RHP research activities. As a result they have failed to meet some RHP criteria and will likely have their RHP status removed at the next GHP meeting.

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. One proposal is to establish a new type of activity within GHP – a GHP network – that would need to



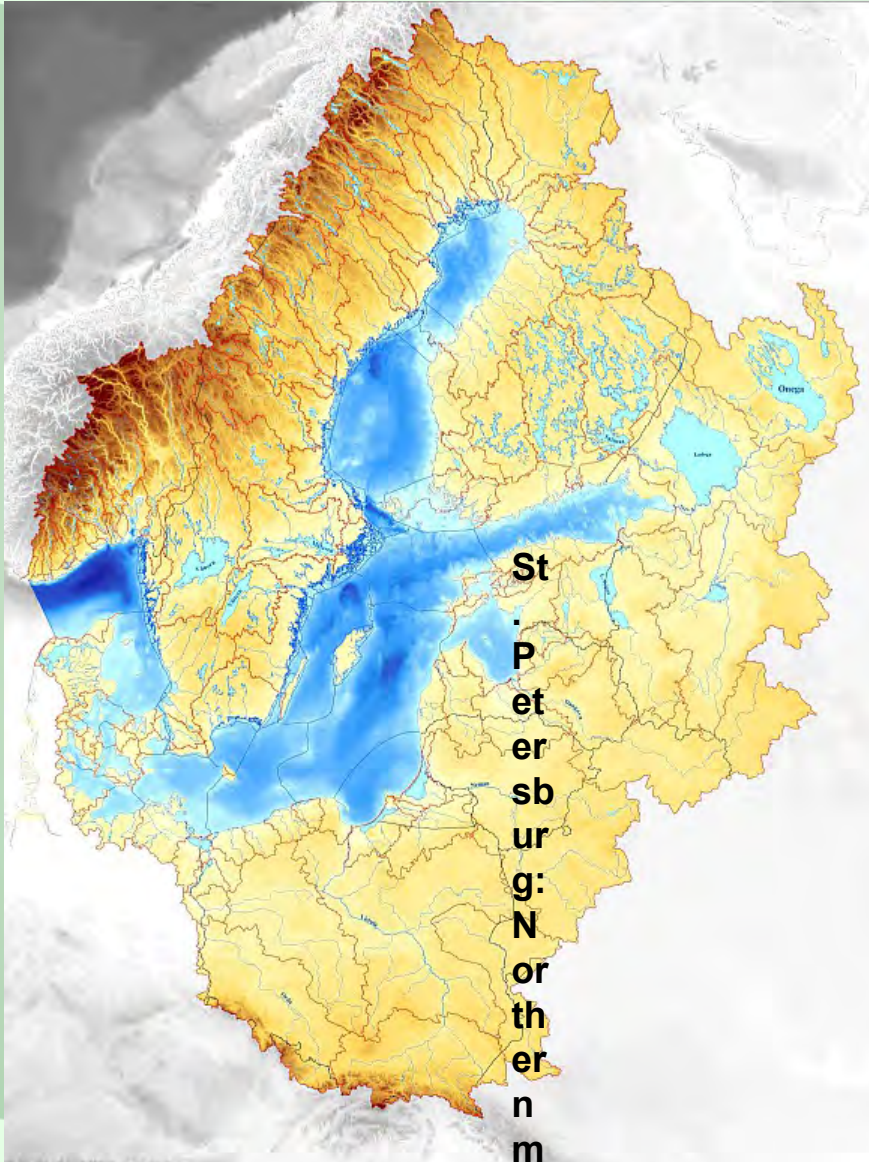
Baltic Earth



**Marcus
Reckermann**

International Baltic Earth
Secretariat, Helmholtz-
Zentrum Geesthacht,
Germany

Baltic Earth



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Baltic Earth

Vision of the new programme

To achieve an improved Earth System understanding of the Baltic Sea region

- **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

Baltic Earth – Science plan

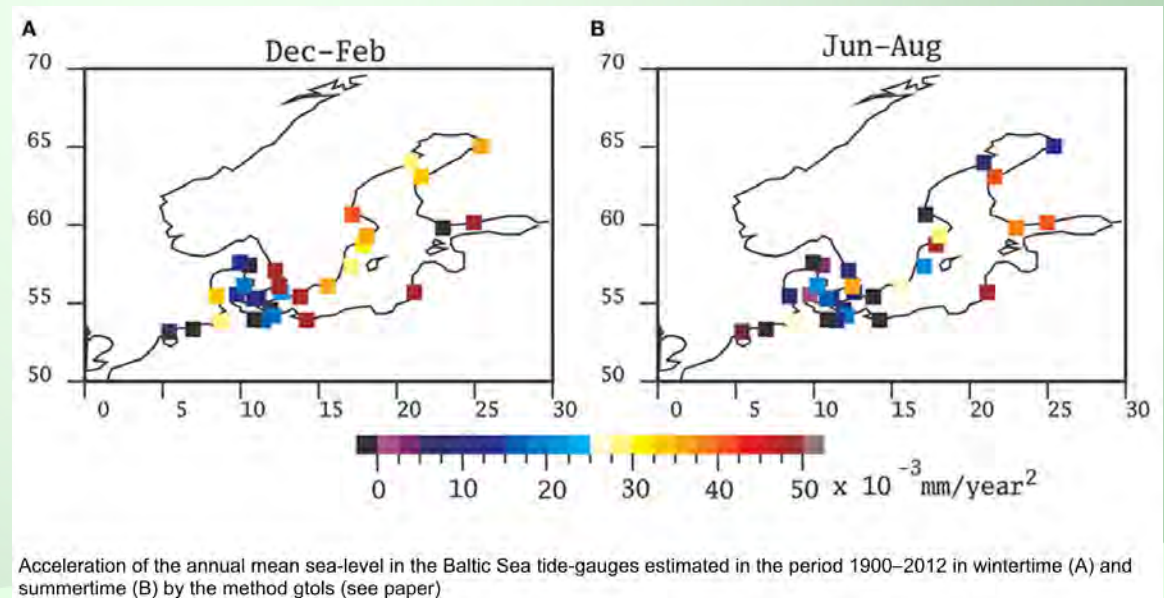
• Flexible science plan

Current Grand Challenge



Baltic Earth – Sea level rise

- Globally, sea level is expected to accelerate
- An acceleration for the Baltic Sea was tested statistically since 1900
- Acceleration was found to be mostly positive but very low and statistically not significant
- Absolute values due to acceleration would only add some cm to the expected rise of up to 1m at 2100



Baltic Earth – Activities 2017

- 23-28 April 2017: EGU General Assembly 2017, Vienna, Austria. Baltic Earth Session on Climate change and its impacts in the Baltic and North Sea regions: Observations and model projections is based on the work of the recently published regional BACC II (Baltic Sea region) and NOSCCA (North Sea region) climate change reports
- 29-31 March 2017: Baltic from Space: Joint ESA-Baltic Earth Workshop on remote sensing applications in the Baltic Sea region, Helsinki,

Baltic Earth – planned Activities 2018

- 2nd Baltic Earth Conference in Helsingor, June 2018
- A Baltic Earth Workshop on “Multiple drivers of Earth system changes in the Baltic Sea region”, Fall-winter 2018

Potential RHPs

PannEx
AndEx
USA RHP
South East Asia RHP

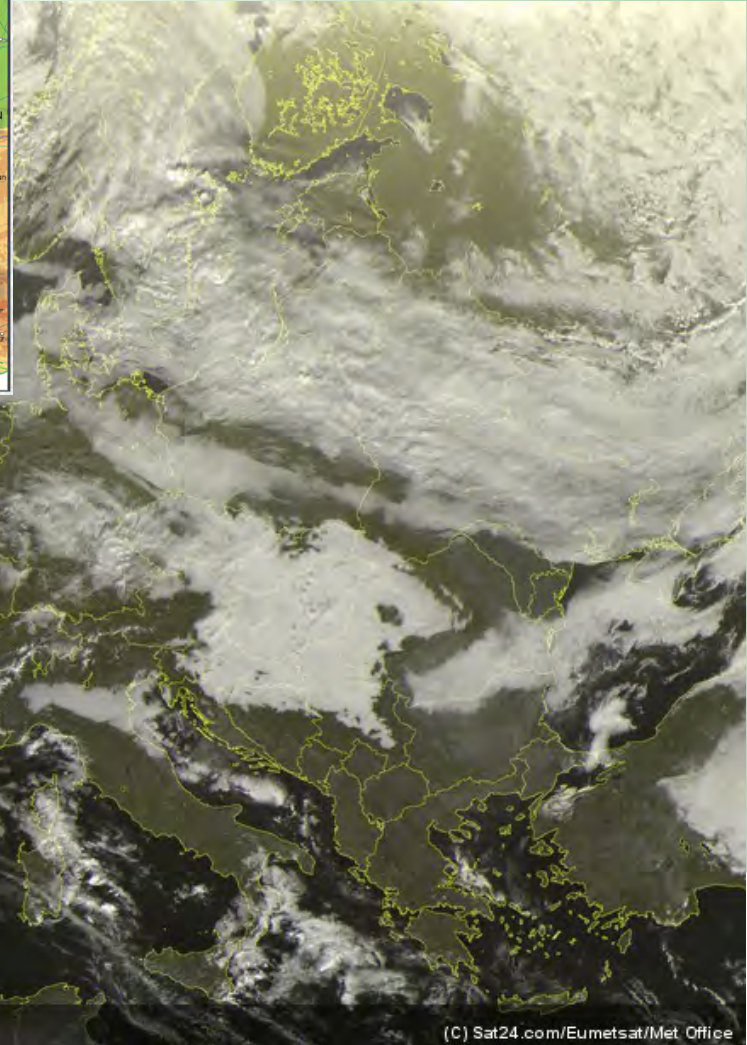
Pannonian Basin Water and Energy cycle Experiment (PannEx)

Monika Lakatos

Hungarian Meteorological
Service,

Budapest, Hungary

PannEx



PannEx – Status

- First workshop: Nov 2015 at Osijek, Croatia, defines scope of the action and nominates Chair and Panel
- Second workshop: June 2016 at Budapest, Hungary, defines the contents of the White Book
- Third workshop: March 2017 at Cluj-Napoca, Romania, defined the Science and Implementation plans and start the search of funding
-  GHP meeting (Belgrade, Sept 2017):  first version of Science and Implementation plan ready

PannEx – White Book contents I

- **Flagship Questions:**

- 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

PannEx – White Book contents II

- **Crosscut actions:**

- 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

GHP – Hydrological modelling

GEWEX

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 will be held in Santiago de Chile end of October 2018, in conjunction with the annual GHP meeting

AndEx – proposed topics

- the hydroclimate of the Andes (paleoclimate, patterns and drivers)
- climate and environmental change (trends, regional modelling, deforestation and land use changes, erosion)
- high impact events (severe weather, flooding, droughts, landslides, extremes, disaster management, urban pollution)
- cryosphere of the Andes (glaciers, seasonal snow cover, paramos, impact on water management, interaction with volcanic eruptions)

USA RHP

Roy Rassmussen, Tom
Painter, Ana Barros,
Francina Dominguez, Ben
Zaitchik, Craig
Ferguson,...

USA RHP

- Some years ago an effort to foster a new RHP in the USA, led by Paul Houser, produced a white paper
 - Unfortunately this effort did not make progress after the white paper
- A workshop was held in May 2016 - <http://www.gewexeevents.org/water-availability-gran>
 - After some promising signs this effort also appears to have stalled...?

South East Asia RHP

- A proposed activity focused on the Asian monsoon has been suggested (Dr Terao)
- A more detailed plan and a wider proposing team (especially at the international level) have been requested.

Cross-cut Projects



Cross-cut Projects - Objectives

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Currently active

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- Cold/Shoulder Season Precipitation Near 0°C, (R. Stewart / P. Groisman)
- INARCH (Mountain Hydrology) (J. Pomeroy)

Proposed

- Including water management in large scale models (R. Harding / J. Polcher)

Cross-cut Projects Ongoing





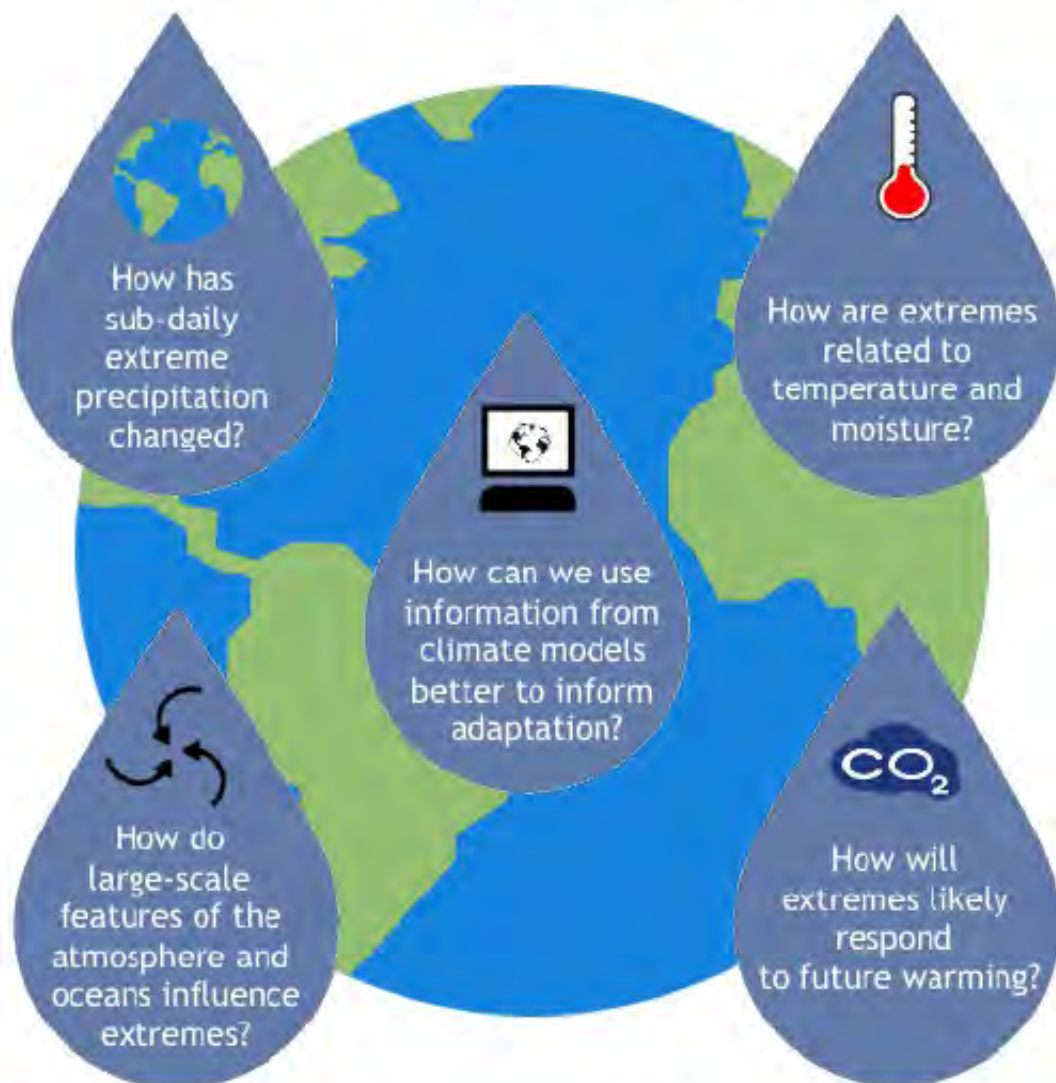
INTENSE

(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

INTENSE research questions



Thanks to:

- Lizzie Kendon and team, Robert Dunn, Nigel Roberts (UK Met Office)
- Stephen Blenkinsop, Renaud Barbero, Steven Chan, Liz Lewis, Selma Guerreiro, Xiao-Feng Li (Newcastle University)
- INTENSE partners (especially Geert Lenderink, Seth Westra, Christoph Schär, Nicolina Ban, Jason Evans, Lisa Alexander)

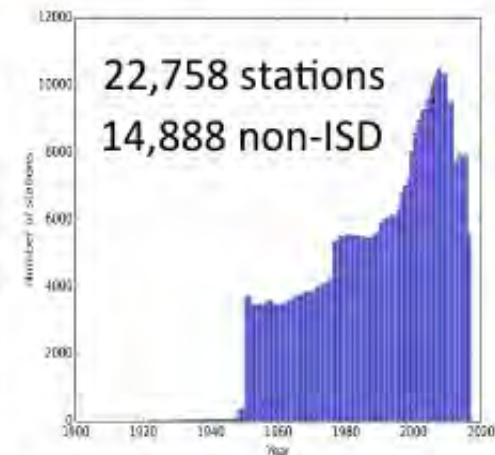
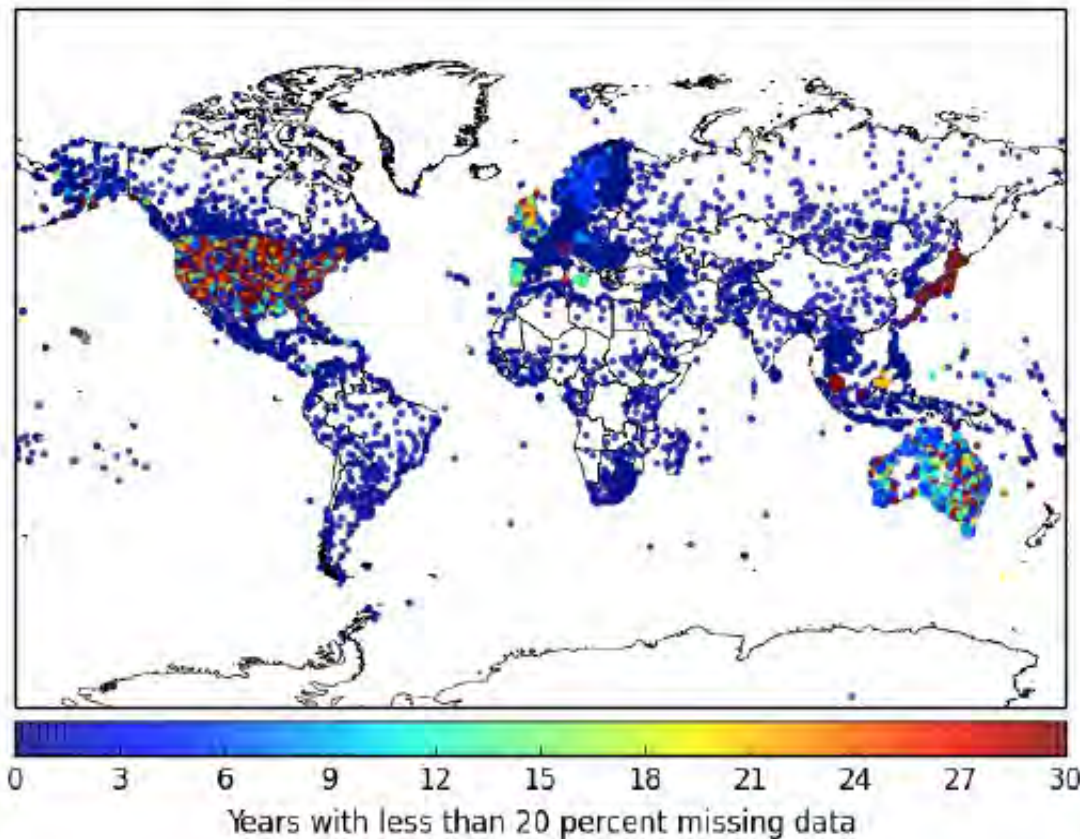
INTENSE: INTElligent use of climate models for adaptationN to non-Stationary hydrological Extremes (2M€ ERC Consolidators Grant)

INTENSE – Update 2017

- 5 full-time PDRA's working on project at Newcastle University: Dr Stephen Blenkinsop, Dr Elizabeth Lewis, 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



INTENSE: Sub-daily precipitation data collection to date...



% missing data	% stations
0	6.8
<10	38.6
<20	53.8
<30	61.6
<40	65.3
<50	68.1
<60	70.3
<70	72.5
<80	73.8
<90	76.5

Getting: Spain, Argentina, Ecuador, Columbia, Bahamas, the Philippines, New Zealand, a few stations in Kenya, Tuvalu, the Caribbean, South Africa, Colombia, Fiji, Israel, India, Denmark, Slovenia, Iran, Bangladesh, Russia, Hungary, Czech Republic, China, Uruguay, Vanuatu, Hong Kong, Poland, Vietnam, Mexico



Produce new sub-daily precipitation indices from new global dataset



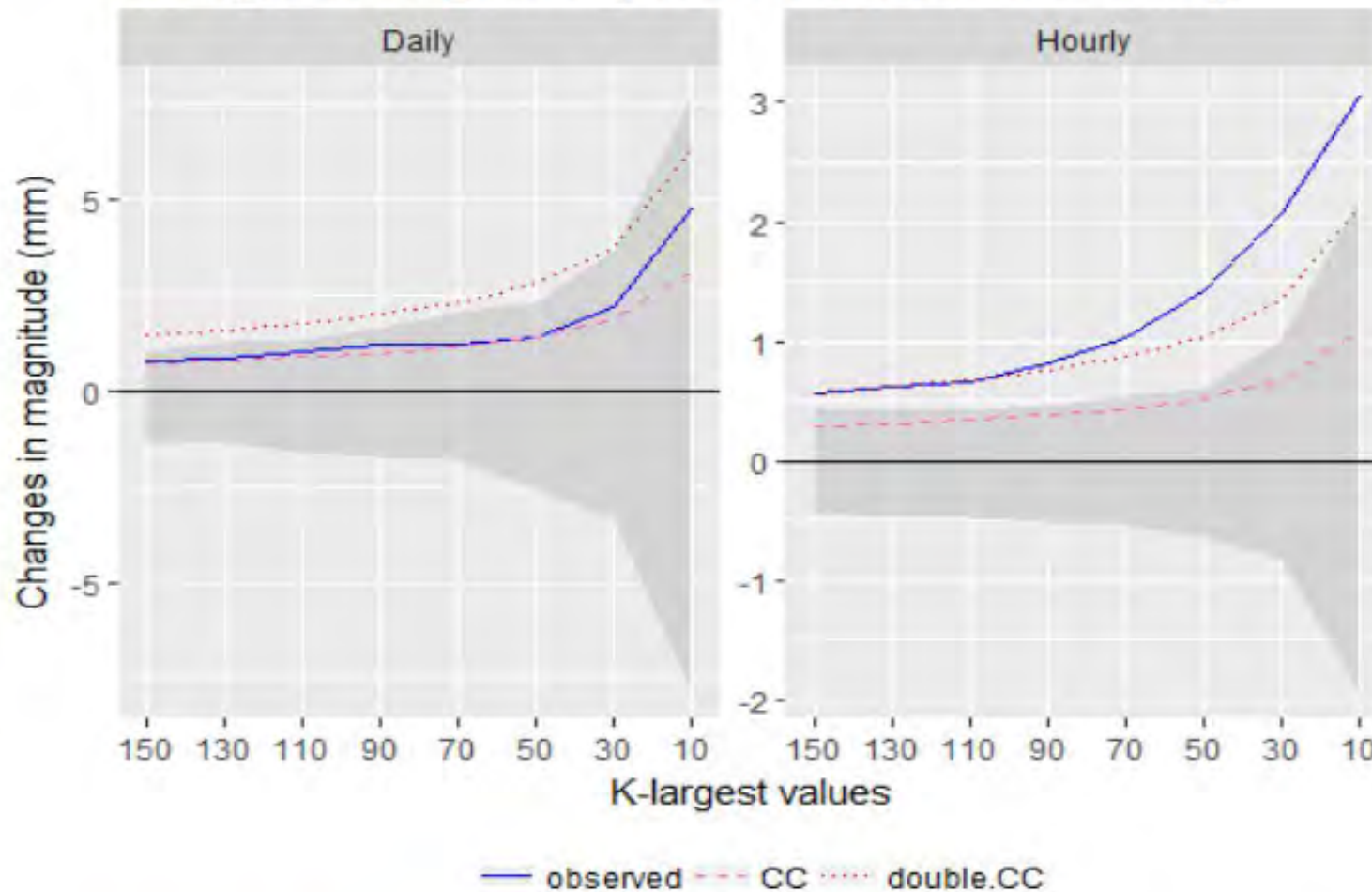
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| <ul style="list-style-type: none">• Rx1hr Monthly maximum 1-hour precipitation• Rx3hr Monthly maximum 3-hour precipitation• Rx6hr Monthly maximum 6-hour precipitation• Rx1hrP Percent of daily total that fell in the Monthly maximum 1-hour precipitation | Monthly maximum indices |
| <ul style="list-style-type: none">• LW1H Monthly likely wettest hour within a day• LD1H Monthly likely driest hour within a day• DLW1H Dispersion around Monthly likely wettest hour within a day• S1HII Simple hourly precipitation intensity index• CW1H Maximum length of wet spell | Diurnal cycle indices |
| <ul style="list-style-type: none">• R10mm1hr Monthly count of hours when $PRCP \geq 10\text{mm}$• R20mm1hr Monthly count of hours when $PRCP \geq 20\text{mm}$• Rxmm1hr Annual count of hours when $PRCP \geq n\text{mm}$, n is a user defined threshold | Frequency/threshold indices |
| <ul style="list-style-type: none">• PRCPTOT1hr Annual total precipitation in wet hours | General indices |

Lewis et al, in prep(c)



Australia: Changes in magnitude

Changes in magnitude (1990-2013 from 1966-1989)



precision=0.1mm

Guerreiro et al., in prep

INTENSE – planned activities

Database

- Continued data acquisition strategy and initiatives on a regional basis to

update and expand

Near 0°C Precipitation

Ron Stewart (Uni. Manitoba, Canada) & Pavel Groisman (NCDC, USA; P.P. Shirshov Institute for Oceanography, Russia)

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

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

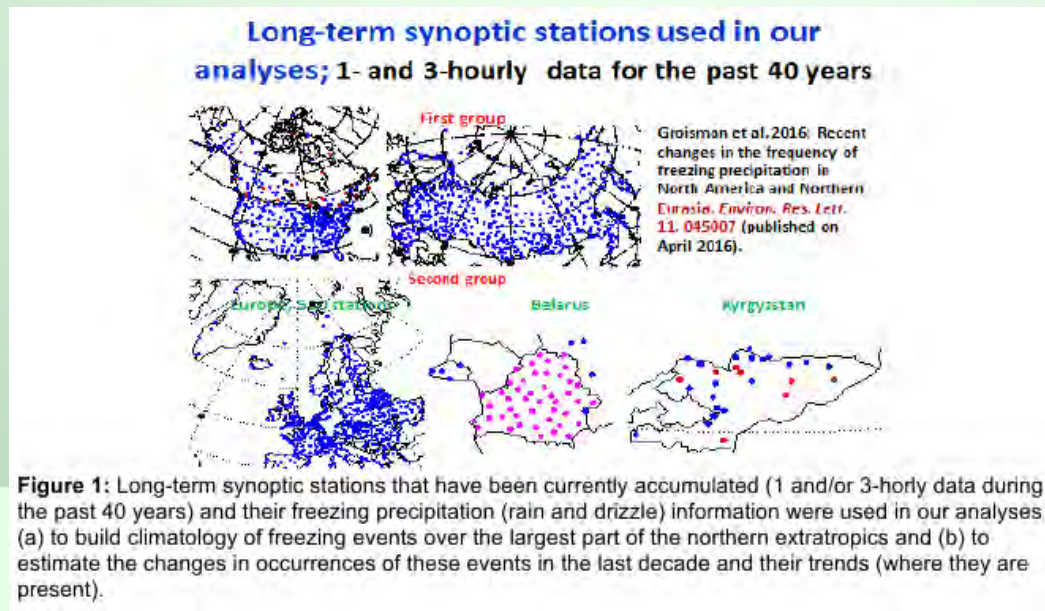
- traffic
- communication
- housing and other man-made infrastructure
- high seas fleet operation
- impact on off-shore oil and gas production

Near 0°C – 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 2017

- 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



Near 0°C – Update 2017

- The CRCM5 Canadian Regional Climate Model (using the empirical technique of Bourgouin, 2000) was found to provide a somewhat realistic ability to simulate freezing rain over parts of eastern Canada (Bresson et al., 2017; Matte et al., 2017).
- A parameterization using a new microphysics scheme has been developed to simulate freezing rain. It considers gradual melting and freezing of precipitation without adding significant computing time (Barszcz et al., 2017).

Near 0°C – Planned activities

- As more datasets from different regions become available, we will move towards greater standardization and making this information as readily available as possible.
- We have established collaboration with a research group in China that will use our joint analyses of daily and sub-daily data for North America and Russia in order to overcome the deficiency of Chinese sub-daily data about the freezing events occurrence.
- We plan to utilize information from the WRF CONUS runs (Liu et al., 2016) to examine how



INARCH

International Network for Alpine Research Catchment Hydrology

John Pomeroy (Uni. Saskatchewan, Canada)

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

INARCH - Objectives

To better

- understand alpine cold regions hydrological processes,
- improve their prediction,
- diagnose their sensitivities to global change

and

- To find consistent measurement strategies.

INARCH – Science questions

- How do varying mountain measurement standards affect scientific findings around the world?
- What control does changing atmospheric dynamics have on the predictability, uncertainty and sensitivity of alpine catchment energy and water exchanges?
- What improvements to alpine energy and water exchange predictability are possible through improved physics, downscaling, data collection and assimilation in models?

INARCH Research Basins

Canada – Canadian Rockies, BC & Yukon;

USA – Reynolds Creek, ID; Dry Creek, ID;
Senator Beck, CO, Niwot Ridge, CO.

Chile - Upper Maipo & Upper Diguillín River
Basins, Andes,

Germany – Schneefernerhaus & Zugspitze;

France – Arve Catchement, Col de Porte & Col
du Lac Blanc;

Switzerland – Dischma & Weissfluhjoch;

Austria - OpAL Open Air Laboratory, Rofental

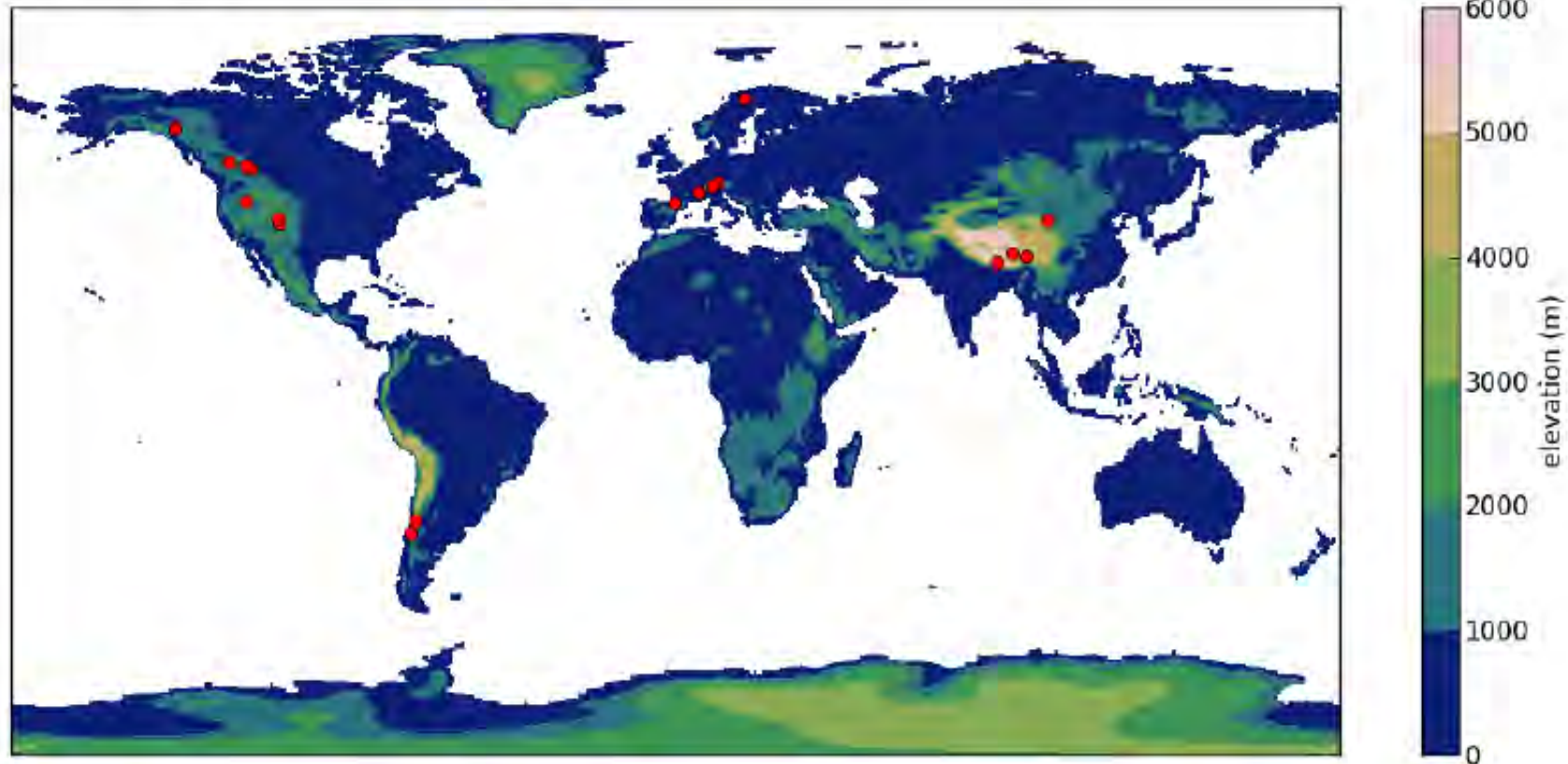
Spain – Izas, Pyrenees;

China – Upper Heihe River, Tibetan Plateau,

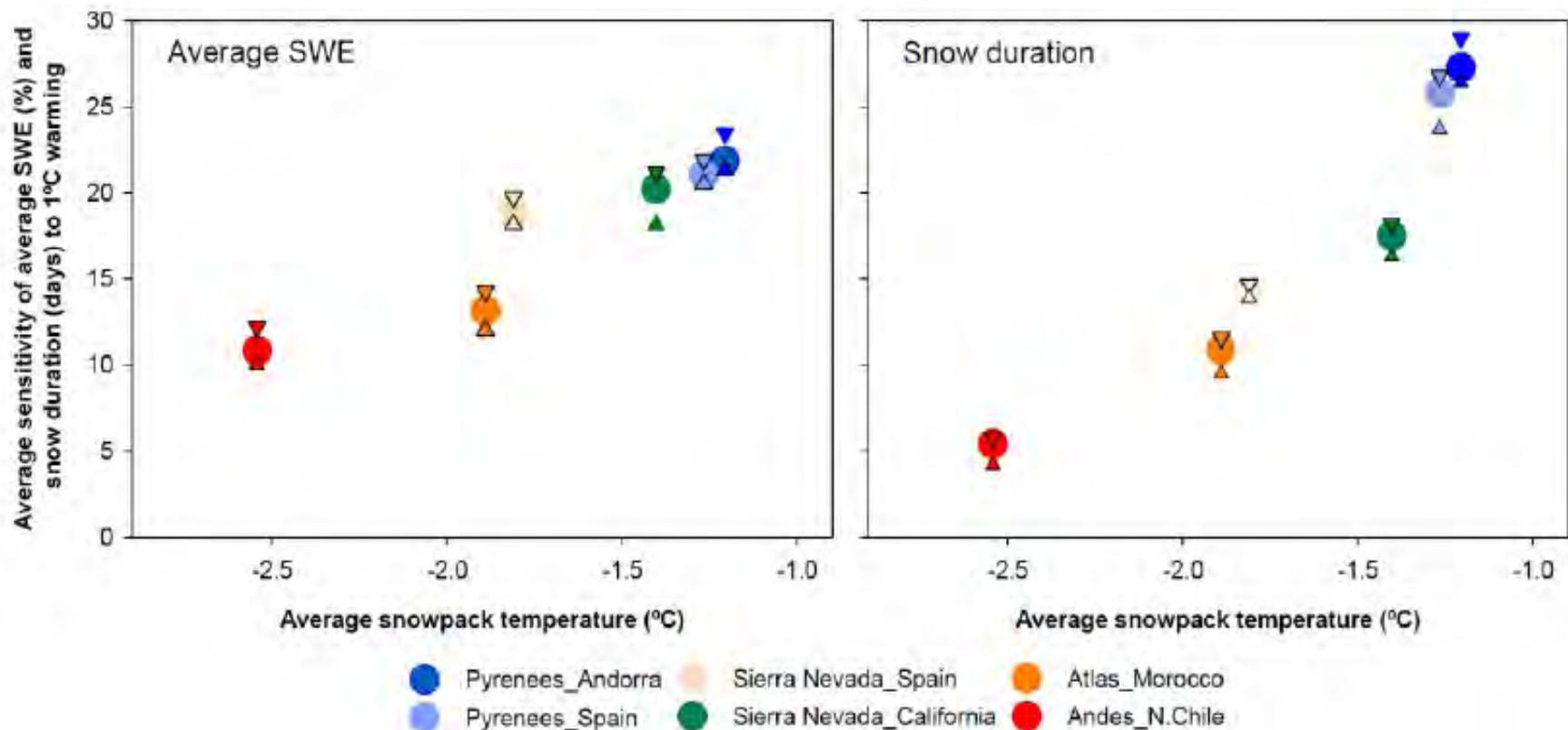
Nepal – Langtang Catchment, Himalayas

Sweden – Tarfala Research Catchment

Norway - Finse Alpine Research Centre



WCRP Grand Challenges: Melting Ice and Global Consequences

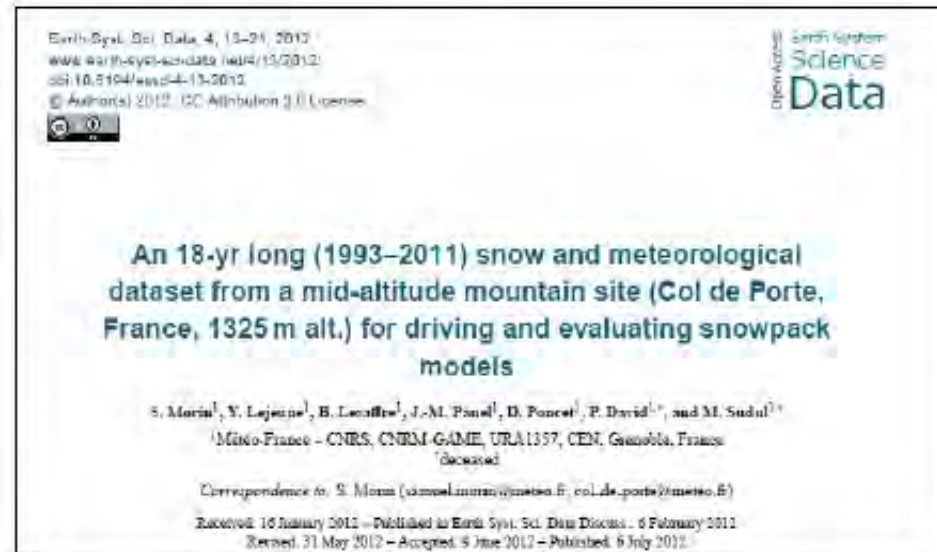


Lopez Moreno et al., Environ. Res. Letters, 2017



INARCH Special Issue

- Special Issue open in **Earth System Science Data (ESSD)**
- Editors: Dr. John Pomeroy, and Dr. Danny Marks (USA)



- **Topic:** Hydrometeorological data from mountain and alpine research catchments
- Contributions of openly available detailed meteorological and hydrological observational archives from long-term research catchments at high temporal in well-instrumented mountain regions around the world
- Submission possible until 6 April, 2018. Six submissions and more in prep.!

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 – “Mediterranean Climate” and “Continental Climate” snow sensitivity comparison in progress

Cross-cut Projects Proposed



Water management in large-scale models

Collaboration with GLASS

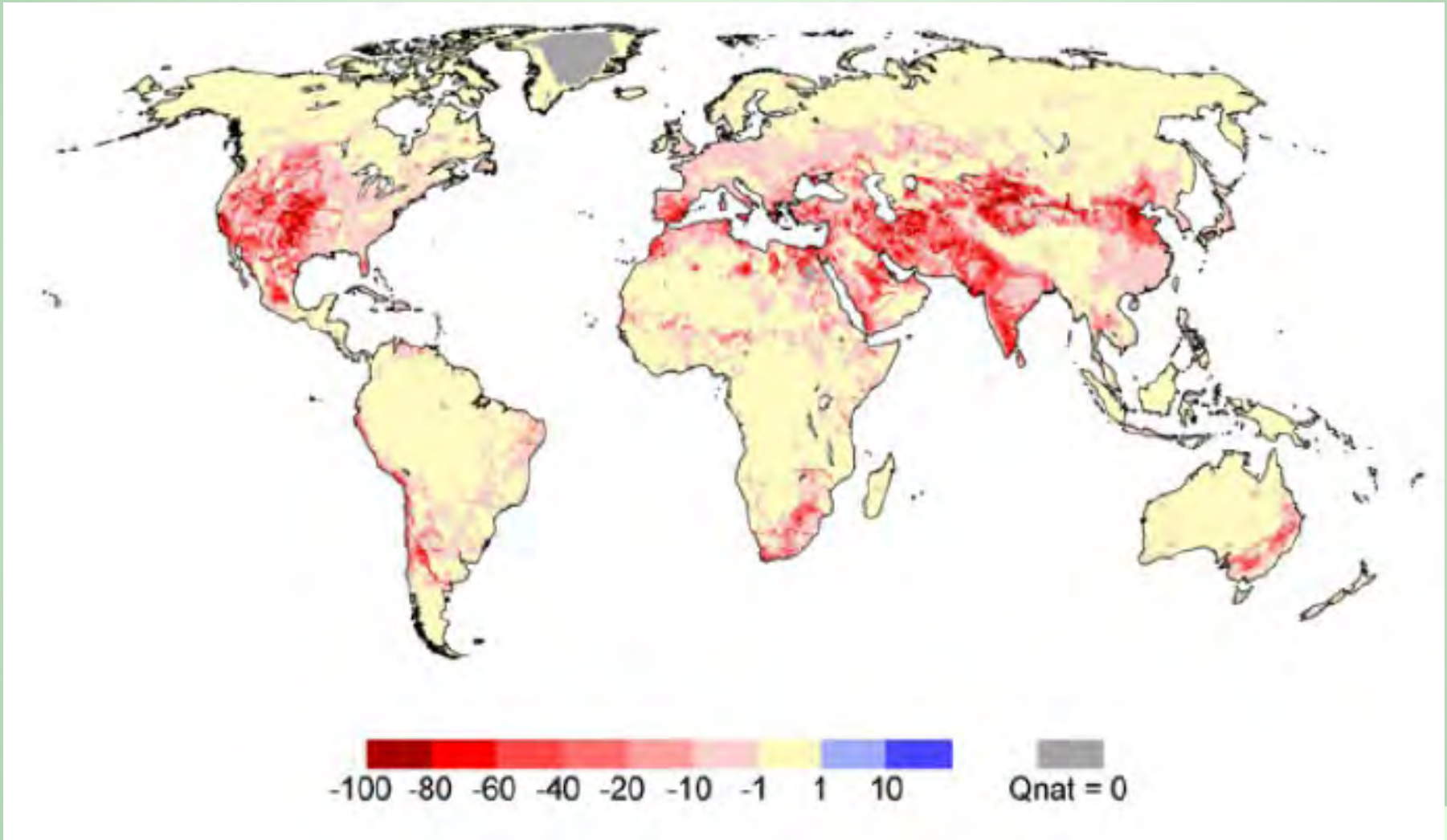
Jan Polcher, Richard Harding, Aaron Boone, Martina Flörke, Taikan Oki and Pere Quintana Seguí and others

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

Water management - motivation

- Flow in many rivers is reduced by 30% (or more) by man's activities
- Impoundments fundamentally change the seasonality and extremes in the flow
- Most irrigation water is lost to the freshwater system through evaporation and this may have important impacts on regional climate
- Historically models of the global water and energy cycles have not included the impact of river management and extractions

Anthropogenic impact on long-term average (1961-90) annual river discharges



Clouds suppressed over irrigated areas

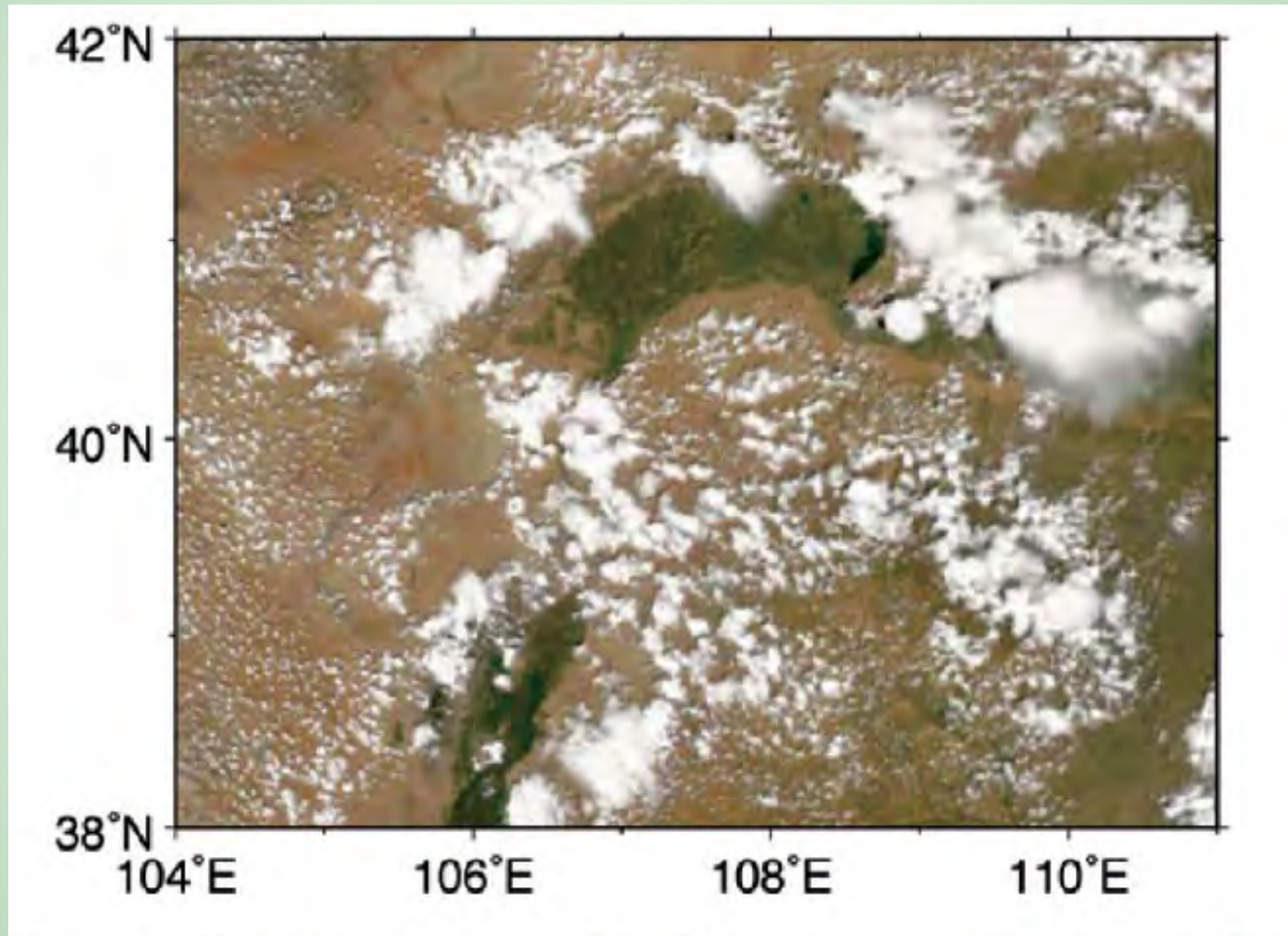


Figure 2. Clouds forming around the Heato irrigation district on the Yellow river in China. MODIS/AQUA true color image provided by T. Sato (personal communication).

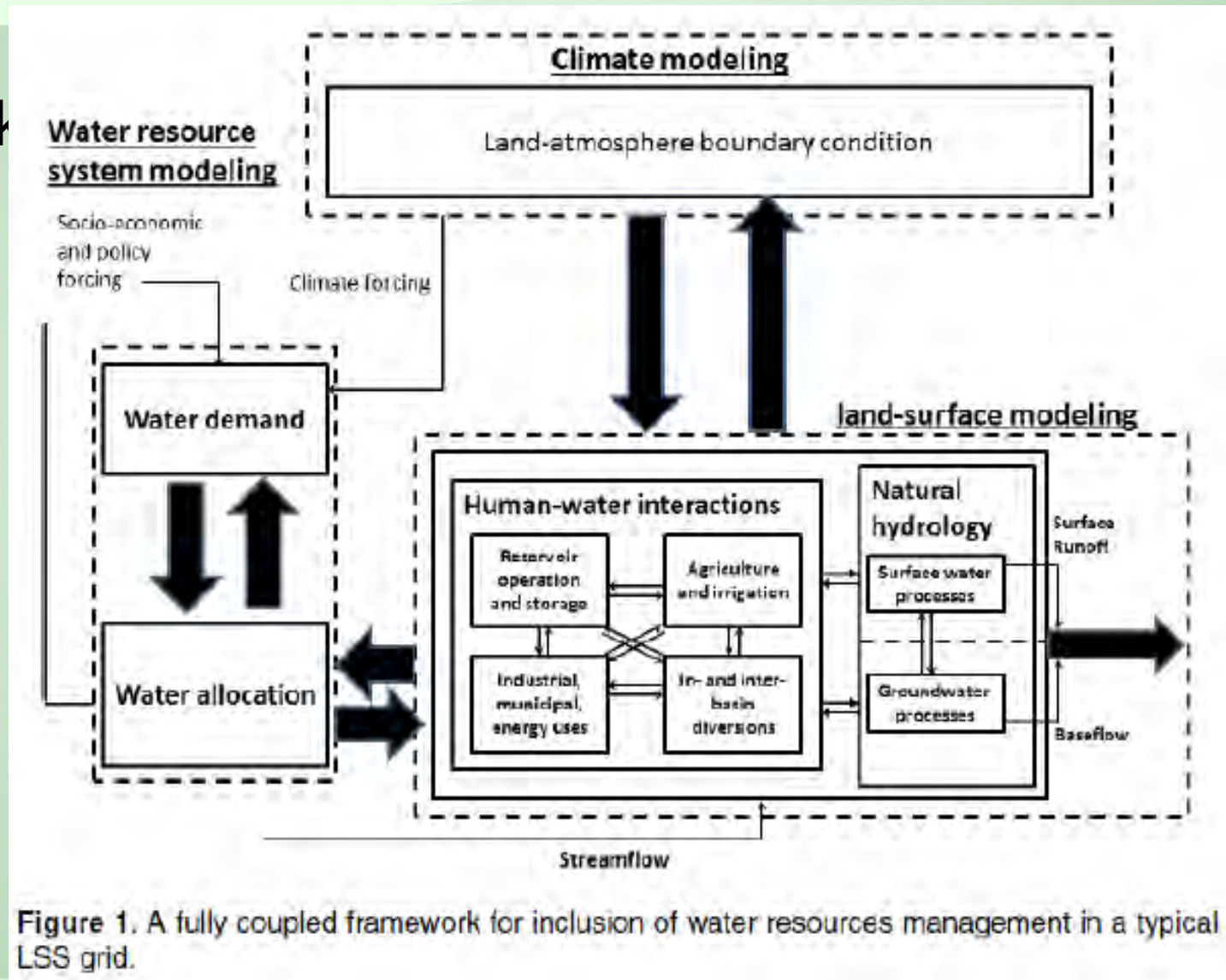
Current state of LSMs

- Irrigation can be included by modifying soil water stress but little scope for actual management and water conservation can be lost
- Groundwater is often included but frequently neglects lateral subsurface flow and detailed hydrogeology
- Many LSMs have river routing and some dams and reservoirs but very few include realistic reservoir management

• Some LSMs use a simple estimation for water demand but projecting into the future will

Demand and allocation into climate models?

- Click



Water management – Proposed activities

- Modelling case studies in RHPs?
- Review paper and or white paper?
- GEWEX Conference: Nexus of water, energy, and food Session

- Prepare and submit proposal for official GHP cross-cut status

Cross-cut Projects Potential



GDAP integrated product evaluation

- Discussed over few years – evaluate the GDAP integrated product over RHP regions
- Current status of GDAP product?
- Need to form a working group with members from GDAP & GHP

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

MOUNTerrain – Science questions

- How useful are (and how best do we utilize) remotely-sensed and gridded data sets such as TRMM, GPCP, and reanalyses for characterizing high-elevation precipitation?
- How well are we measuring solid precipitation in mountain areas and how representative are the available datasets?
- What are the statistics of high-elevation precipitation around the globe – means, extremes, seasonal cycle, spatial distribution, trends at different space and time scales?
- What are the key processes involved in

MOUNTerrain – Proposed activities

- 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

MOUNTerrain – Needed actions

- Little action in last year – chairs stepped down
- Need some leadership
- Establish a working group to drive the project forward?
- Identify specific tasks that can be pursued and completed in the next few years

CC on ET determination

The idea arose during last SSG meeting at Hainan, to investigate further the Evapotranspiration part of the water cycle.

A Session has been set in the next Open Science Conference in Canmore, in which communications from modellers, experimentalists and remote sensing scientists have been received.

In the recent months, contacts on this issue have been established, raising general interest. Scientists that will not be able to attend Canmore have asked to be included in any initiative that may arise from there.

The intention is to set a Working Group on ET determination in Canmore and open it to the community, also see if a CC would a suitable way of organization.

The target expertises are PBL researchers (theoretical, modellers, experimentalists), numerical modellers, remote sensing scientists, agronomer engineers, ...

Potential CC on "TPE Water Security"

The will to strengthen links between GEWEX and TPE has resulted in a potential CC in which TPE will explore if GEWEX ideas fit their interests, combining HR climate modelling, land-atm interaction and watershed hydrology. The idea is now in discussion within the TPE community.

Global Data Centres



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 contributions to GEWEX Science Questions (GSQs)



GHP activities in relation to GSQs

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

GHP members (terms)

Co-Chairs

- Jason Evans [Australia] (2013-2020)
- Joan Cuxart [Spain] (2017-2020, reappointable)

Members

- Silvina Solman [Argentina] (2014-2019)
- Nicole Van Lipzig [Belgium] (2014-2019)
- Craig Ferguson [USA] (2015-2020)
- Ben Zaitchik [USA] (2015-2017)*

- Christel Prudhomme [UK] (2015-2020)

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.

Items to be discussed at SSG regarding GHP

- 1) Endorsing fully working RHP status to Baltic Earth and Initiating status to PannEx
- 2) Discuss endorsement to AndEx, CC-TPE, ...
- 3) RHP vs Networking activities: OzEWEX and others to come
- 4) Assessing the overall GHP mission
- 5) Identifying missing activities and links to be made/improved
- 6) Funding GHP meetings and workshops
- 7) Renewing the Panel