GEWEX Hydroclimate Panel – GHP

Co-Chairs: Jason Evans
Joan Cuxart

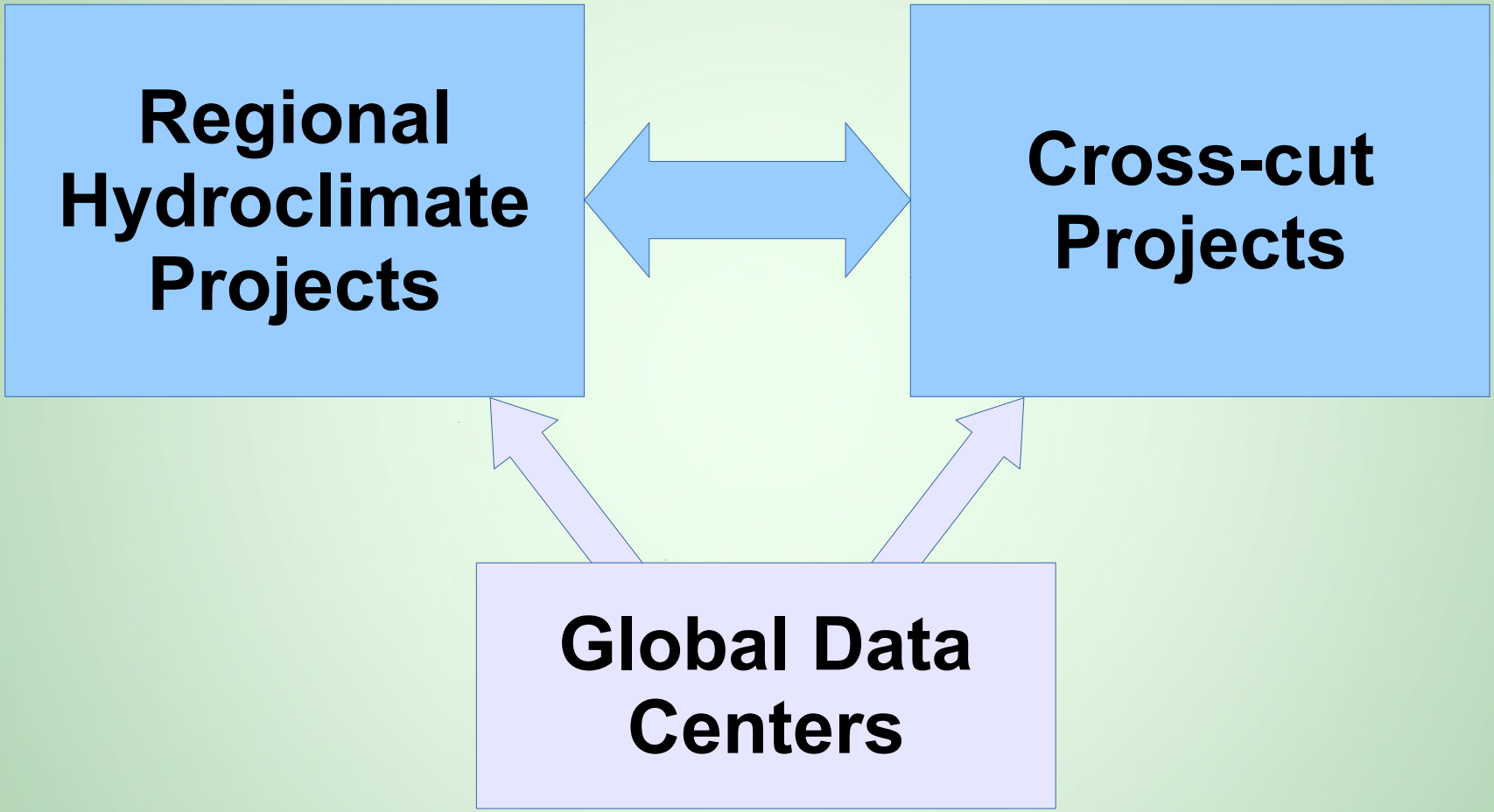
Short “subjective” version (8 slides)

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 with the new knowledge. (actionable science)

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: ***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:

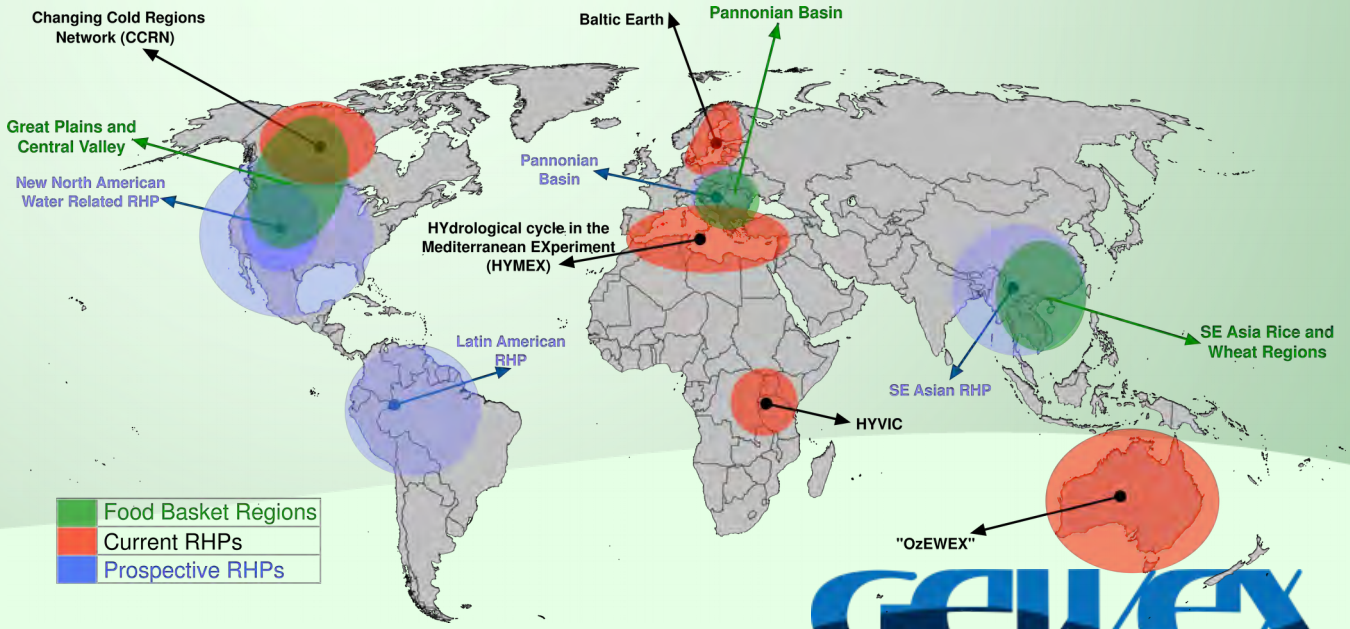
Asia: ***MAHASRI*** (2007-2016) ======> Asian Monsoon
Eurasia: ***NEESPI*** (2004-2015) =====> Northern Eurasian climate-ecosystem-societal interact

Prospective:

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

In discussion:

Exploring 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			
		HyMex	SaskRB	HyVic	OzEWEX
Observations and Predictions of Precipitation	How well can precipitation be described?	y	y	y	y
	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
	How does climate change impact water resource systems?	y	y	y	y
	How can new observations lead to improved management?		y	y	y
Changes in extremes	Observing system requirements	y	y	y	y
	Modelling capabilities	y	y	y	y
	Modelling processes involved in extremes	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			
	Can we track the changes over time?	y			
	Can we relate changes and processes?				
	Cloud-aerosol-precipitation feedbacks				

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.

Each RHPs can define its own CC actions where basic scientific transversal research is made. Better coordination between CC among RHPs would be interesting. Also connection with general GHP CC would need extra coordination.

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

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

Potential

- GDAP integrated product regional evaluation

Focussed mostly in the descending branch of the hydrological cycle

Perhaps some coordinated effort on Evapotranspiration would be needed, especially now that the importance of semi-arid regions is under study.

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)

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.

Long “informative” version (90 slides)

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

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.

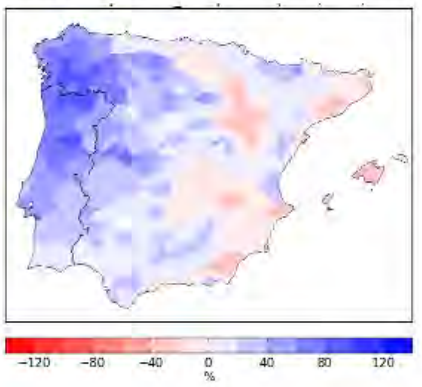
More than 400 scientists from 20 countries contribute to HyMeX in the scientific working groups and task teams. 57 PhD students.

HyMeX – recent science highlights

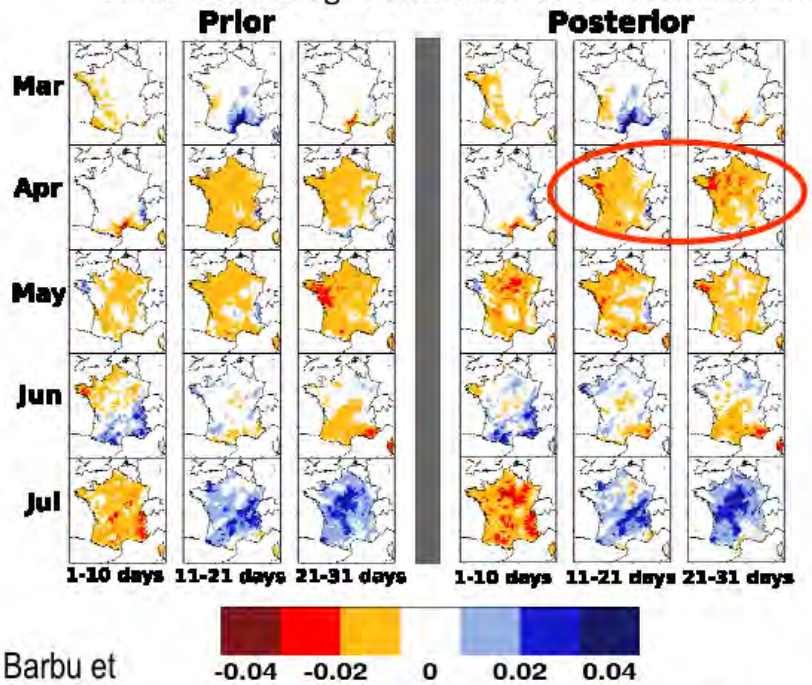
➲Improved simulation of the continental water cycle at basin, country and Mediterranean scales.

New meteorological gridded datasets, used to force LSM simulations, allow a better quantification of the continental water cycle.
Quintana-Seguí et al. 2015.

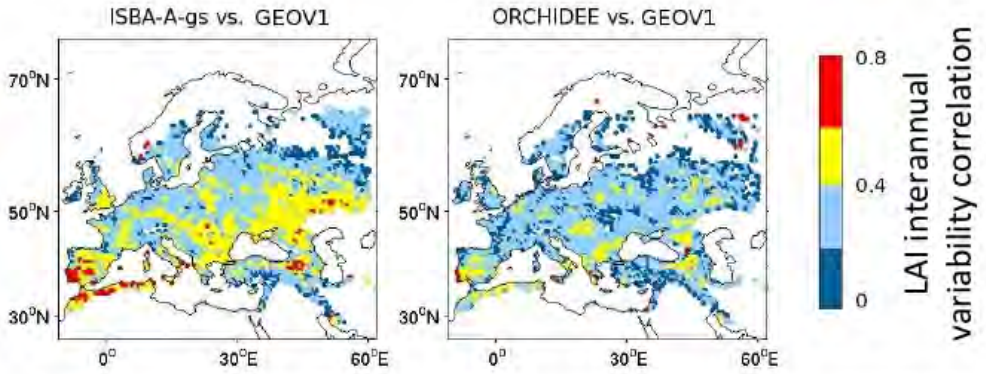
Yearly anomalies of precipitation



Enhanced drought onset due to LAI assimilation.



Barbu et al. (2014)



The use of LSMs with active vegetation and remote sensing data is improving our knowledge on the role of Mediterranean vegetation on the water cycle.

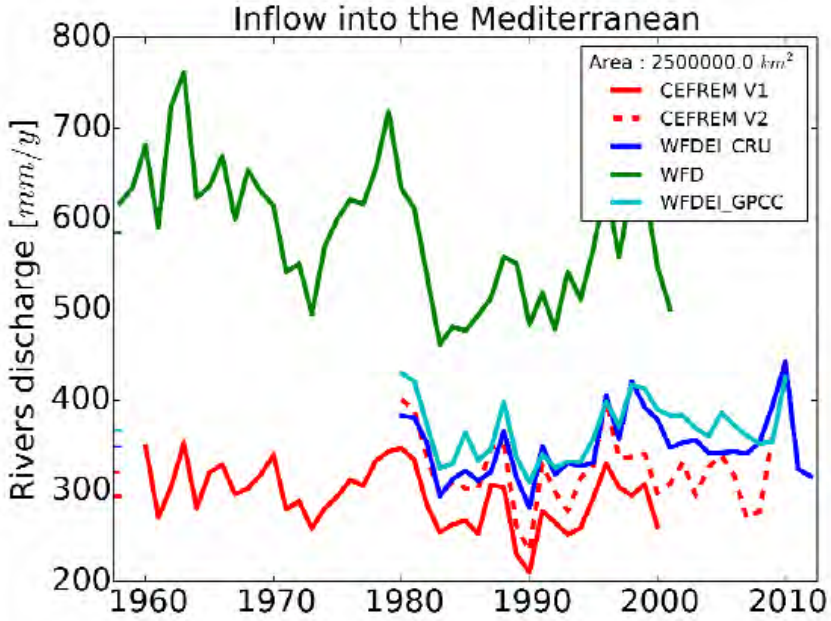
Szczypta et al. (2014)

HyMeX – recent science highlights

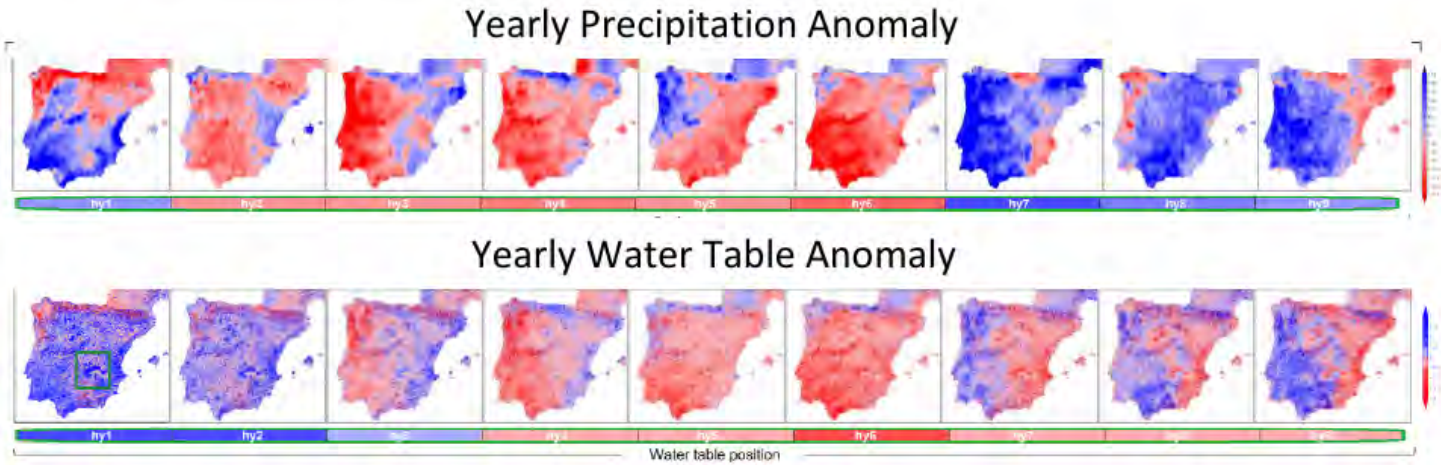
➲ Quantification of freshwater inputs to the Mediterranean.

➲Better understanding of underground water processes.

The quantification of the freshwater inputs to the Mediterranean with a LSM (ORCHIDEE) is allowing us to investigate sources of error in forcing datasets and model processes and physiography at large scale. J. Polcher et al. 2015.



Underground water is coupled with the land surface and it introduces memory into the system. Míguez-Macho et al. 2014.



HyMeX – Mid Term Achievements

Quantification of water cycle

- Land surface models allowed us to quantify the Mediterranean water cycle at different scales

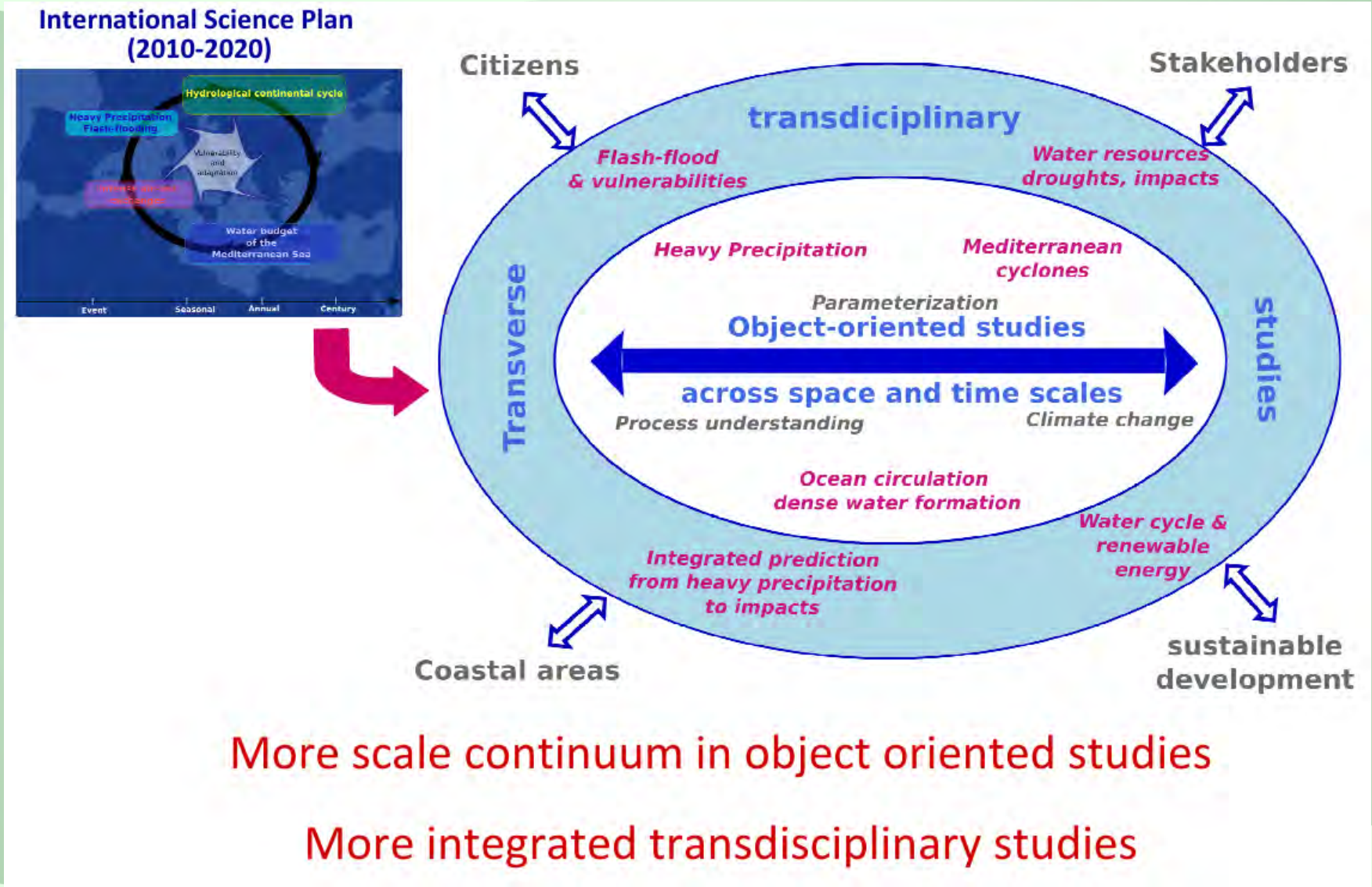
Mediterranean specifities of the hydrological processes

- Remote sensing data and LSMs with active vegetation allowed us to better understand the role of vegetation on drought and heatwaves

Future evolution in relation to global change

- Uncertainty propagation is better understood and quantified
- RCM models are improving our ability to study the impacts of climate change on hydrological cycle and extremes

HyMeX – Next 5 years



More scale continuum in object oriented studies

More integrated transdisciplinary studies

HyMeX – activities

- 9th HyMeX workshop, 21-25 September 2015, Mykonos, Greece

Planned

- MetMed Conference, 20-22 February 2017, Zagreb
- 10th HyMeX workshop, Barcelona, Spain : 4-7 July 2017

Changing Cold Regions Network (CCRN)

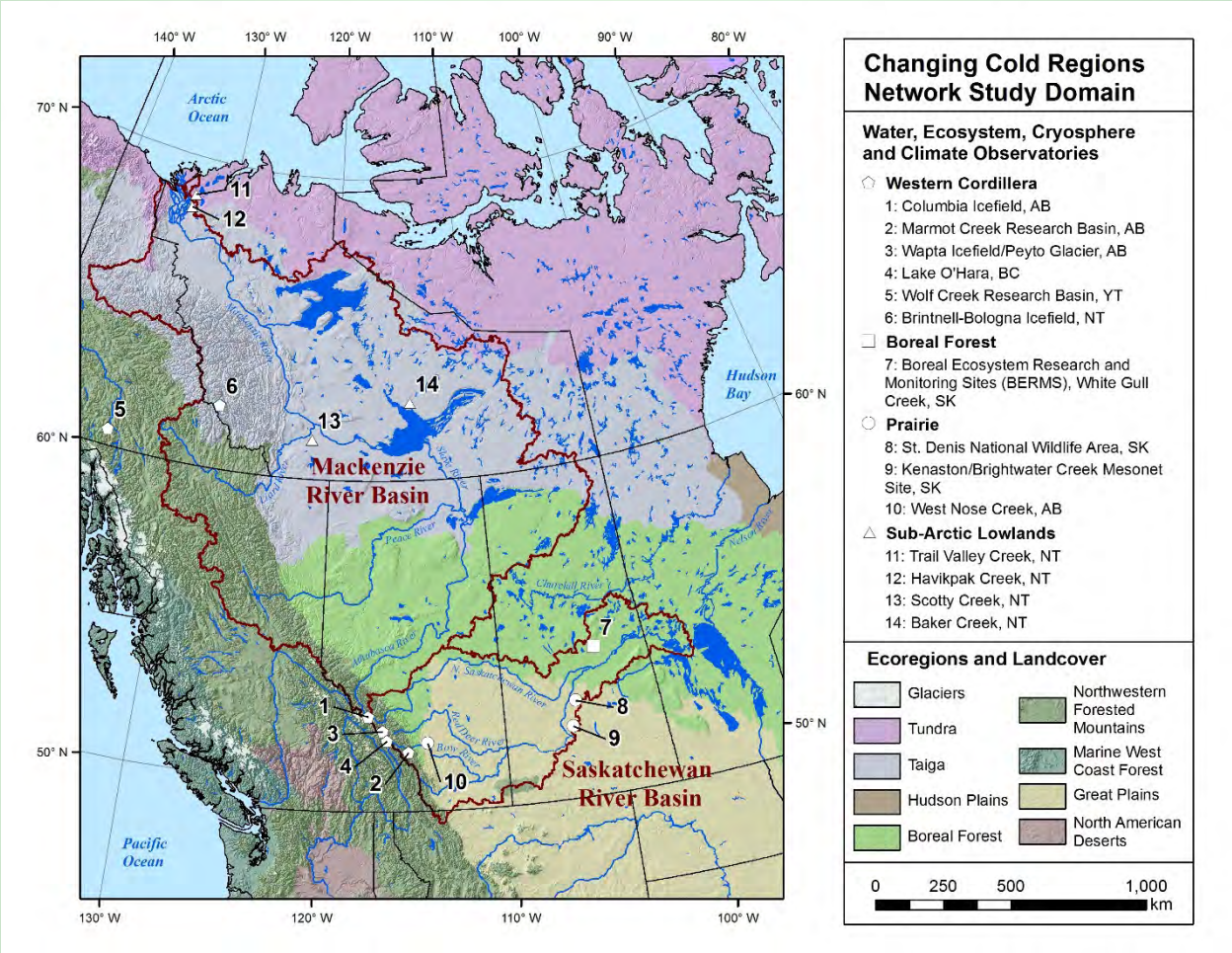
2018

Howard Wheater

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

GHP

GEWEX


140° W
130° W
120° W
110° W
100° W
90° W
80° W
70° N
60° N
50° N
Arctic Ocean
Hudson Bay
Pacific Ocean
Mackenzie River Basin
Saskatchewan River Basin
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
Tundra
Taiga
Hudson Plains
Boreal Forest
Northwestern Forested Mountains
Marine West Coast Forest
Great Plains
North American Deserts
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:

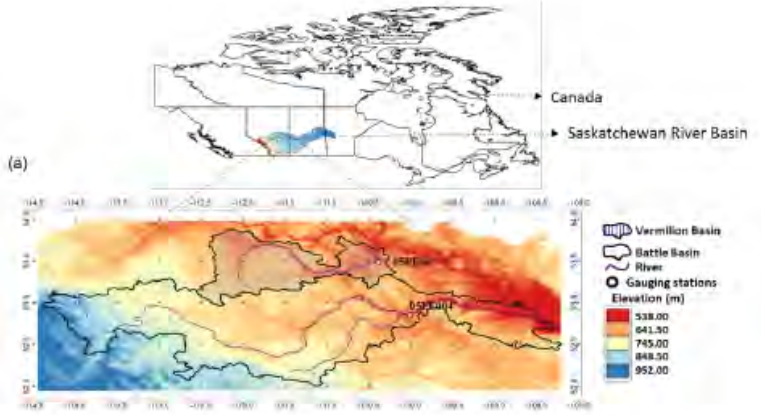
- hydro-meteorological extremes
- key land surface systems, including Rocky Mountains, Boreal Forest, Prairies, and sub-arctic, and their response to climate variability and climate change
- effects on water quantity and quality and aquatic ecosystems, of anthropogenic land use change
- societal controls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

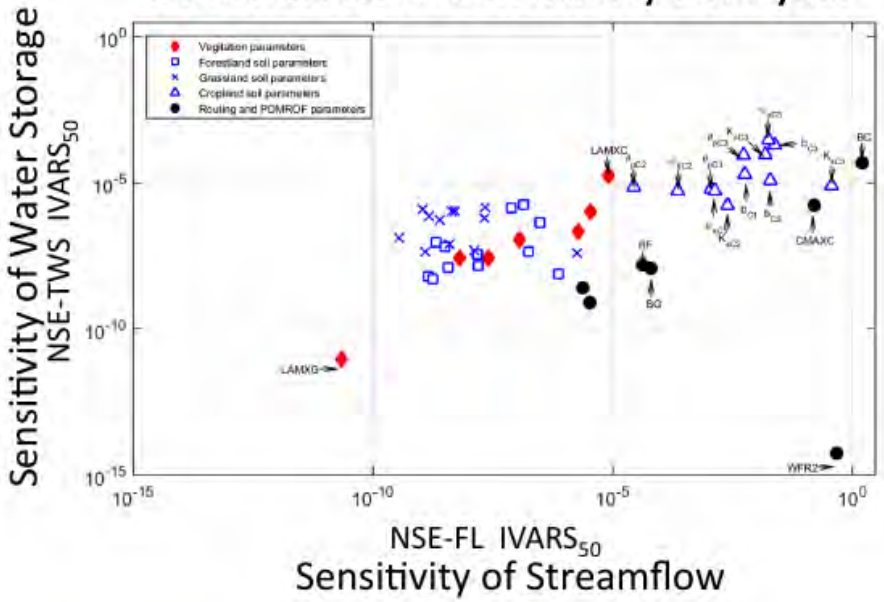
CCRN – Improved large scale modelling

Using GRACE for improved model parameterization

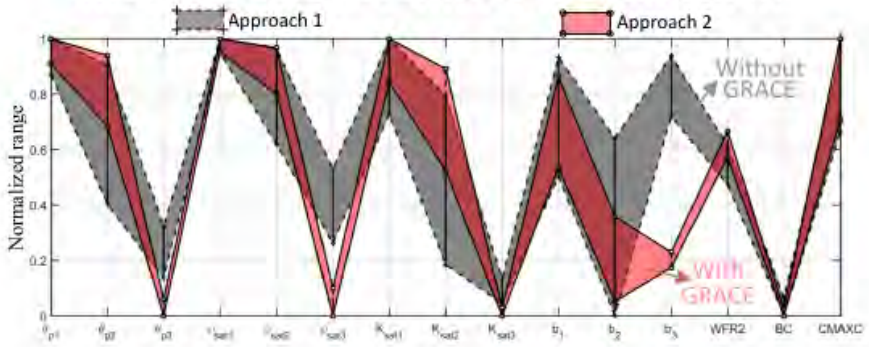
Yassin et al. (under review, WRR)



Multi-criteria Sensitivity Analysis



Multi-criteria Parameter Identification



www.ccrnetwork.ca

CCRN
Changing Cold Regions Network

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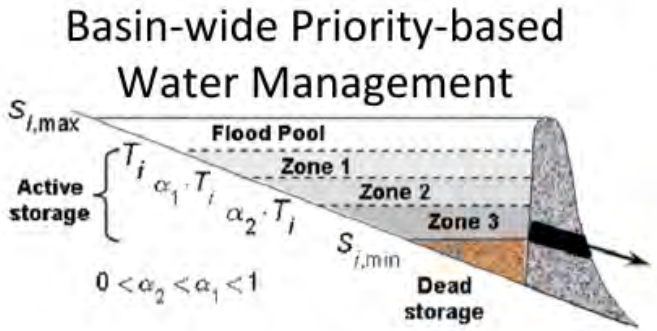
CCRN – Improved large scale modelling

Including Water Management in a Land surface-Hydrology Model

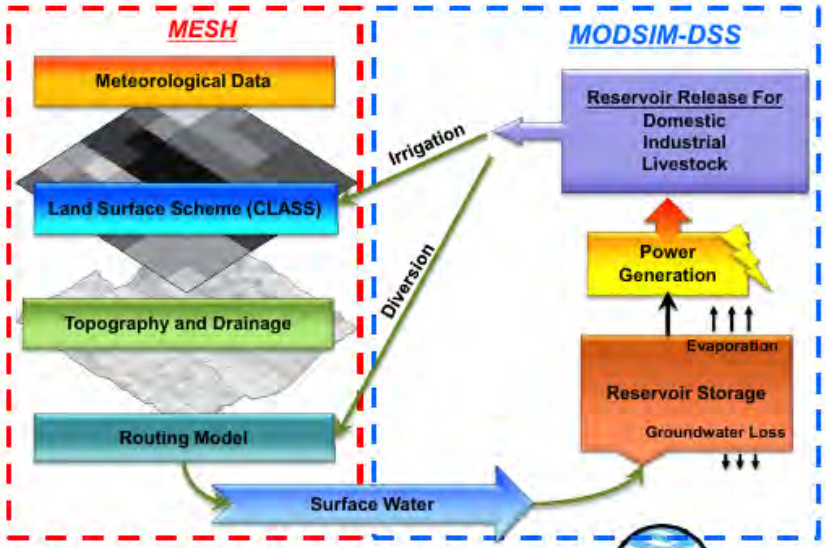
Annis et al. (in prep.)

Basin-wide Priority-based Water Management



MODSIM-DSS

Integrated Modelling



www.ccrnetwork.ca

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CCRN – activities 2016

- CCRN modelling workshop, Saskatoon, SK, November 28-29, 2016
- CCRN 4th Annual General Meeting - OAC Centennial Arboretum Centre, University of Guelph, Guelph, ON, November 2-4, 2016
- CCRN Special Observation and Analysis Period (SOAP) workshop, Saskatoon, SK, October 3-4, 2016
- Cold Regions Hydrological Model (CRHM) Expert Workshop, Saskatoon, SK, June 6–7, 2016
- CCRN Theme D synthesis workshop, University of Manitoba, Winnipeg, MB, May 10-11, 2016

CCRN – planned activities 2017

- Scenarios of future change follow up workshop, National Hydrology Research Centre, Saskatoon, SK, March 20-21, 2017
- Spring modelling workshop on land and water futures, location TBD, Saskatoon, SK, June 19-20, 2017
- CCRN 5th Annual General Meeting - Delta Bessborough Hotel, Saskatoon, SK, November 1-3, 2017

Hydroclimate project for Lake Victoria Basin (HyVic)

2024

Fred Semazzi

North Carolina State University, USA

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Lake Victoria Basin

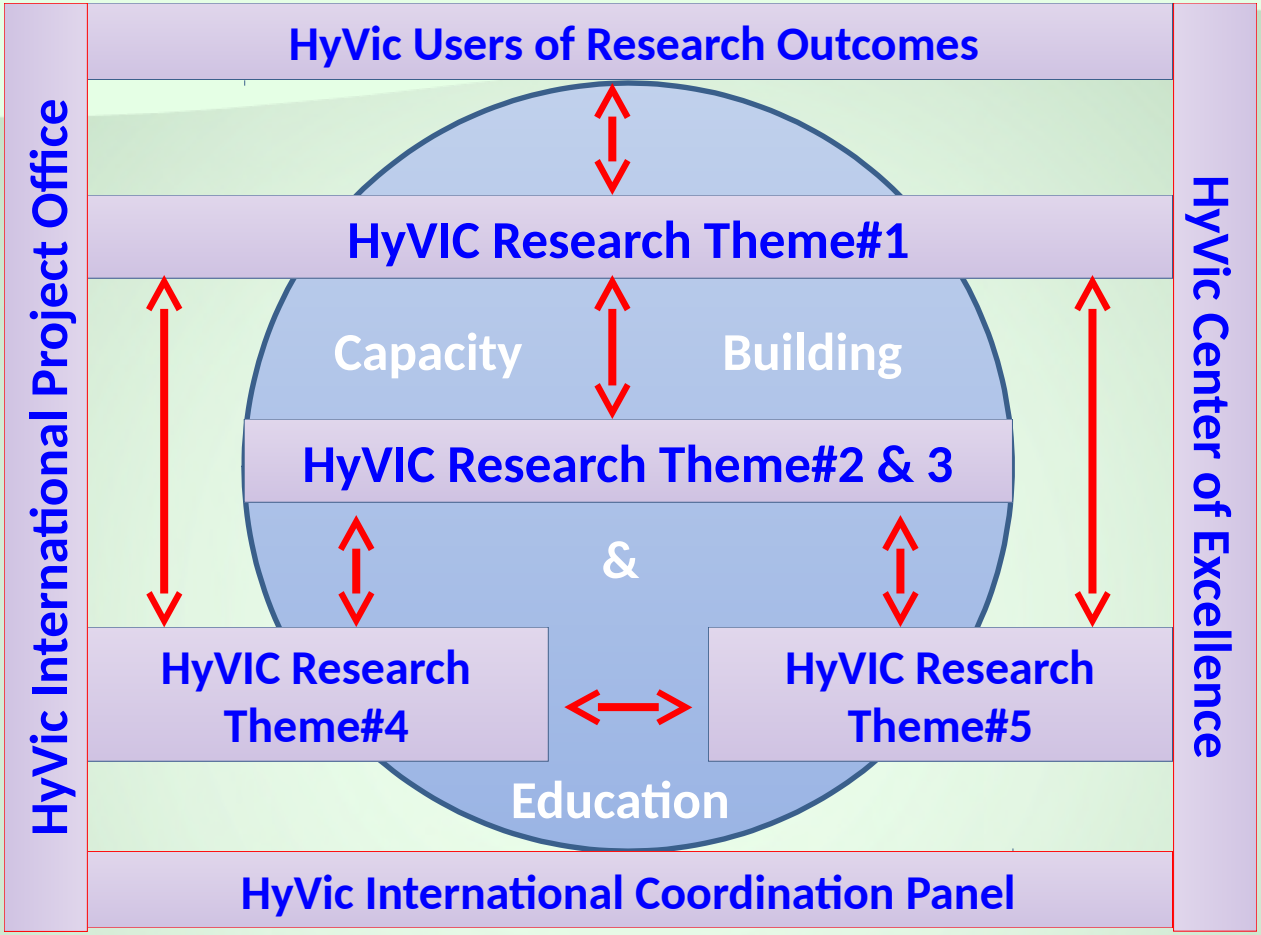
- LVB is the social-economic nerve center for EA (Burundi, Rwanda, Kenya, Tanzania, Uganda) – 30 to 40 million

- Mainly rain fed agricultural economy with LV supplying fish as a major part of the diet

- Lake Victoria also provides hydroelectric energy and relatively inexpensive form of transportation

- Geopolitical significance of LVB as the source of the White Nile

HyVic – Science Plan Components



HyVIC Research Theme-1: Translational Research Interface with Applications
HyVIC Research Theme-2: Severe Weather and Water Currents (collaboration with WWRP-LVP)
HyVIC Research Theme-3: Lake Victoria Basin Water Budget
HyVIC Research Theme-4: Climate variability and model development
HyVIC Research Theme-5: Observation of the Hydroclimatological System

(Customized from GFCS)

HyVic – Science Plan Components

HyVIC Research Theme-1: Translational Research Interface with Applications

- to develop application-based threshold metrics for guiding the basic science themes, 2 through 5
- to undertake a series of pilot studies to demonstrate the use of HYVIC research outcomes for applications

HyVIC Research Theme-2: Severe Weather and Water Currents (collaboration with WWRP-LVP)

- understanding the evolution of severe weather that occurs over the lake,
- 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

HyVIC Research Theme-3: Lake Victoria Basin Water Budget

- close the hydrological, energy & nutrients budgets over LVB to acceptable accuracy

HyVic – Science Plan Components

HyVIC Research Theme-4: 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

HyVIC Research Theme-5: Observation of the Hydroclimatological System

- Install better/more extensive observation monitoring network
- Perform specific field campaigns to improve the observational knowledge of the region

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).
- **LVB HyNEWS Executive Council**: Governed by EC comprising Heads of NMHS, EAC/LVBC coordinator and AMCOMET Secretariat (invited observer).
- **LVB HyNEWS Task Force**: Projects' PIs and five NMHS technical contacts act as a day-to-day coordinating team.

MEETING OF HEADS OF METEOROLOGICAL SERVICES AND JOINT EAC/WCRP/WWRP WORKSHOP. *Meeting recommended the creation of HyNEWS to EAC Council of Ministers. The recommendation was approved* *(photo taken from AMCOMET Newsletter 003, July 2014)*

(Customized from GFCS)

HyVic – Outstanding Issues

- Establishing project office and steering panel
- Establishing project website
- HyCRYSTAL is first funded project

(Customized from GFCS)

Australian Energy and Water Exchanges (OzEWEX)

2019

Albert van Dijk, Seth Westra

Australian National University, Canberra, Australia

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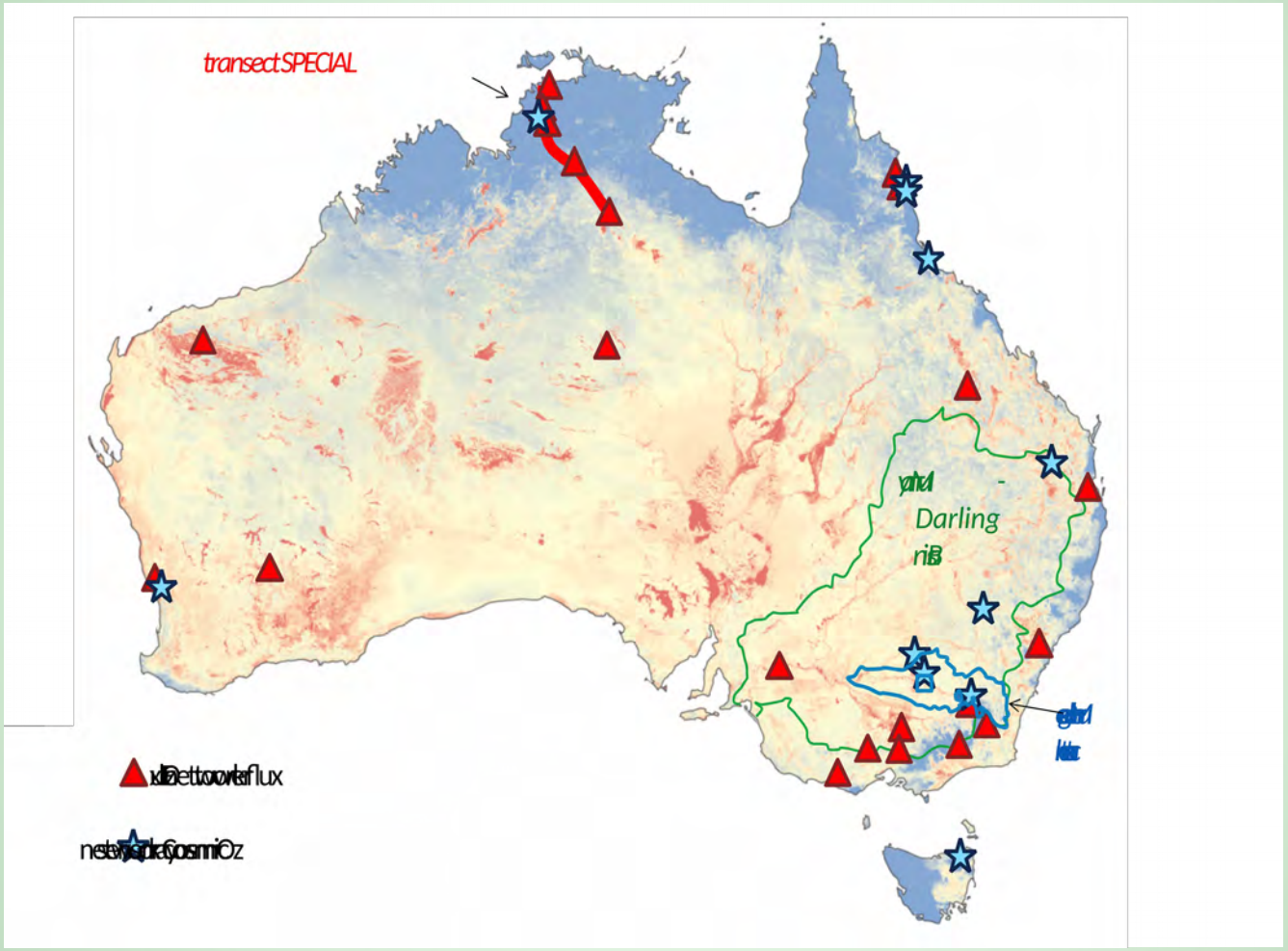
GEWEX


transect SPECIAL
Darling

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?
- 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?

Who is involved?

Universities

Governments and water managers

ARC Centre of Excellence for Climate System Science (ARCCSS)

Bureau of Meteorology

Commonwealth Scientific and Industrial Research Organisation (CSIRO)

National Computational Infrastructure (NCI)

Terrestrial Ecosystem Research Network (TERN)

OzEWEX – Highlights

- National workshop in December 2015
- Special issue in Climatic Change on Australian Natural Hazards
- OzEWEX Soil Water Estimation and Evaluation Project (SWEEP)
- Protocol for the Analysis of Land Surface models (PALS) development continues
- OzEWEX newsletter publication frequency, original content and readership has increased

OzEWEX – Natural Hazards in Australia

Special Issue of Climatic Change

Articles explore our understanding of historical and projected changes to Australian Natural (climatic) Hazards

- Floods - http://link.springer.com/article/10.1007/s10584-016-1689-y
- Droughts - http://link.springer.com/article/10.1007/s10584-016-1798-7
- Coastal Extremes - http://link.springer.com/article/10.1007/s10584-016-1647-8
- Heatwaves - http://link.springer.com/article/10.1007/s10584-016-1650-0
- Extreme Bushfires - http://link.springer.com/article/10.1007/s10584-016-1811-1
- Storms, Wind and Hail - http://link.springer.com/article/10.1007/s10584-016-1737-7

OzEWEX – Natural Hazards in Australia: Floods

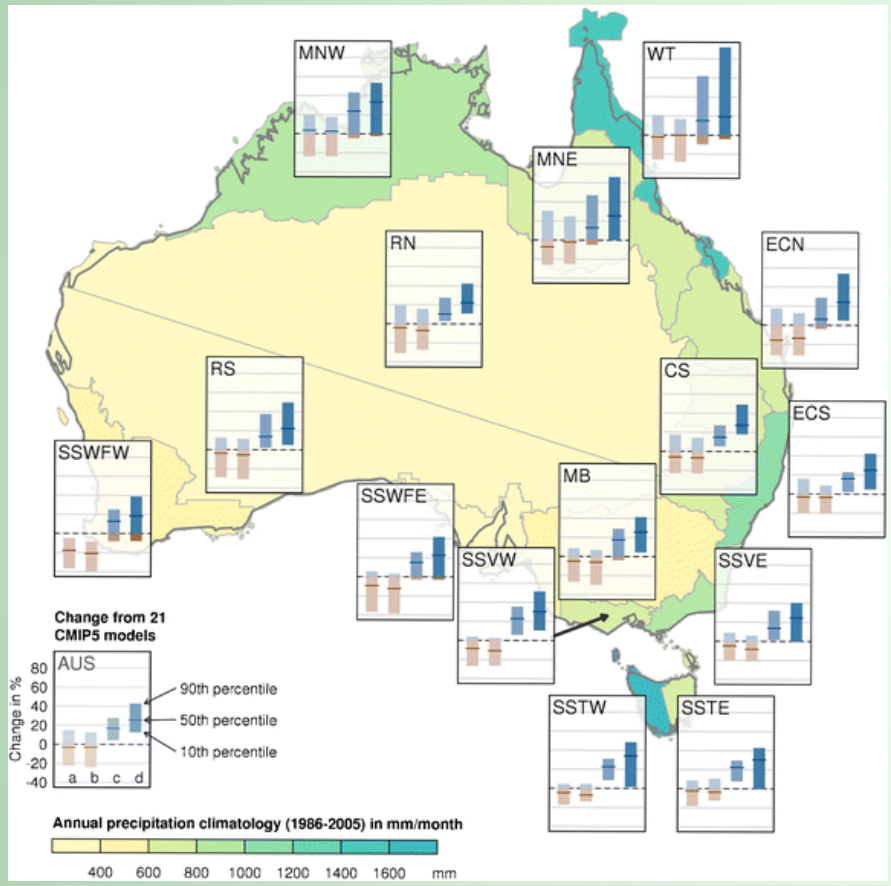


Fig. 3: Bars showing median and the 10th to 90th percentile range of projected change in daily rainfall for 2080–2099 relative to 1986–2005 for RCP8.5. Each box shows from left: (a) annual mean rainfall based on a set of 39 models and from a consistent subset of 21 CMIP5 models the (b) annual mean rainfall, (c) annual maximum daily rainfall, and (d) 20 year return level of the annual wettest day rainfall. Blue indicates increase and brown indicates decrease. The Australia average results are shown in the bottom left. Reprint from Figure 7.2.13 in CSIRO and Bureau of Meteorology (2015)

OzEWEX – Natural Hazards in Australia: Storms, Wind and Hail

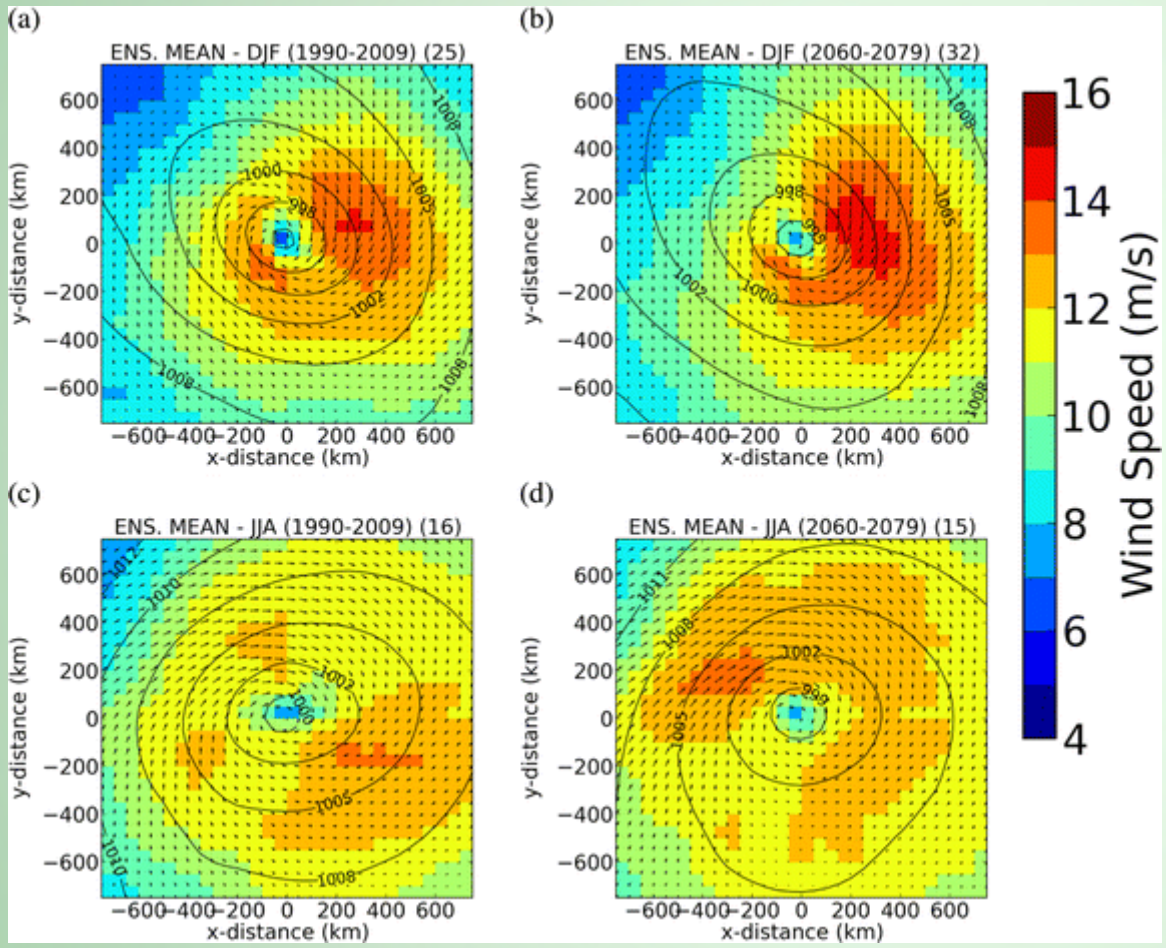


Fig. 1: Ensemble composites of summer (DJF: top row) and winter (JJA: bottom row) ECLs with a maximum wind speed greater than 20 ms−1 from the NARCliM ensemble for the recent past (1990–2010: left column) and the future (2060–2079: right column). Coloured contours and vectors indicate wind speed while solid line contours indicate the sea level pressure. The ensemble-mean number of events within the composite is indicated to the top-right of each panel

OzEWEX – Website & Newsletter

GHP

GEWEX

OzEWEX – Outstanding Issues

- Secure further funding.
  - Current projects supported through many (relatively) small grants.

New RHPs

Baltic Earth

Baltic Earth

Marcus Reckermann

International Baltic Earth Secretariat, Helmholtz-Zentrum Geesthacht, Germany

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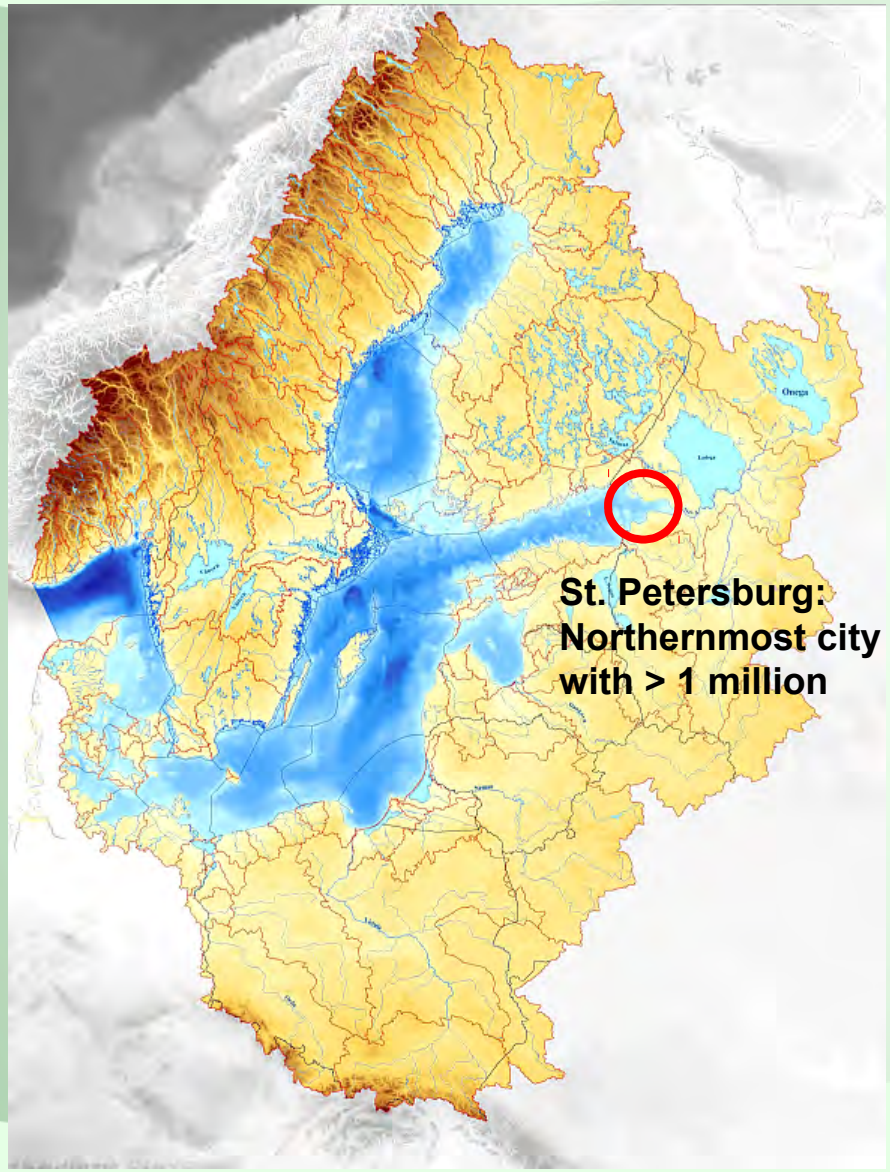
GEWEX

Baltic Earth



- Drainage Basin: 2.13 Mill. km^2 (20% of the European continent)
- 85 million people in 14 countries
- Baltic Sea: 380 000 km^2

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 over knowledge gaps which need to be filled (e.g. by funded projects)
- **Education** (summer schools)
- Inherits the BALTEX network of scientists and infrastructure

Baltic Earth – Science plan

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)

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

- Website: www.baltic-earth.eu

Baltic Earth - Status

- Baltic Earth is up and running
- Various workshops and co-organized conferences already completed, many in preparation
- New BESSG in office
- New website http://www.baltic.earth/
- Science Plan based on GCs

Formal application for RHP status submitted and accepted October 2016

Potential RHPs

PannEx
USA RHP
Latin America RHP
South East Asia RHP

Pannonian Basin Water and Energy cycle Experiment (PannEx)

Monika Lakatos

Hungarian Meteorological Service,

Budapest, Hungary

PannEx


EUROPE
0 km 210 420 630 km
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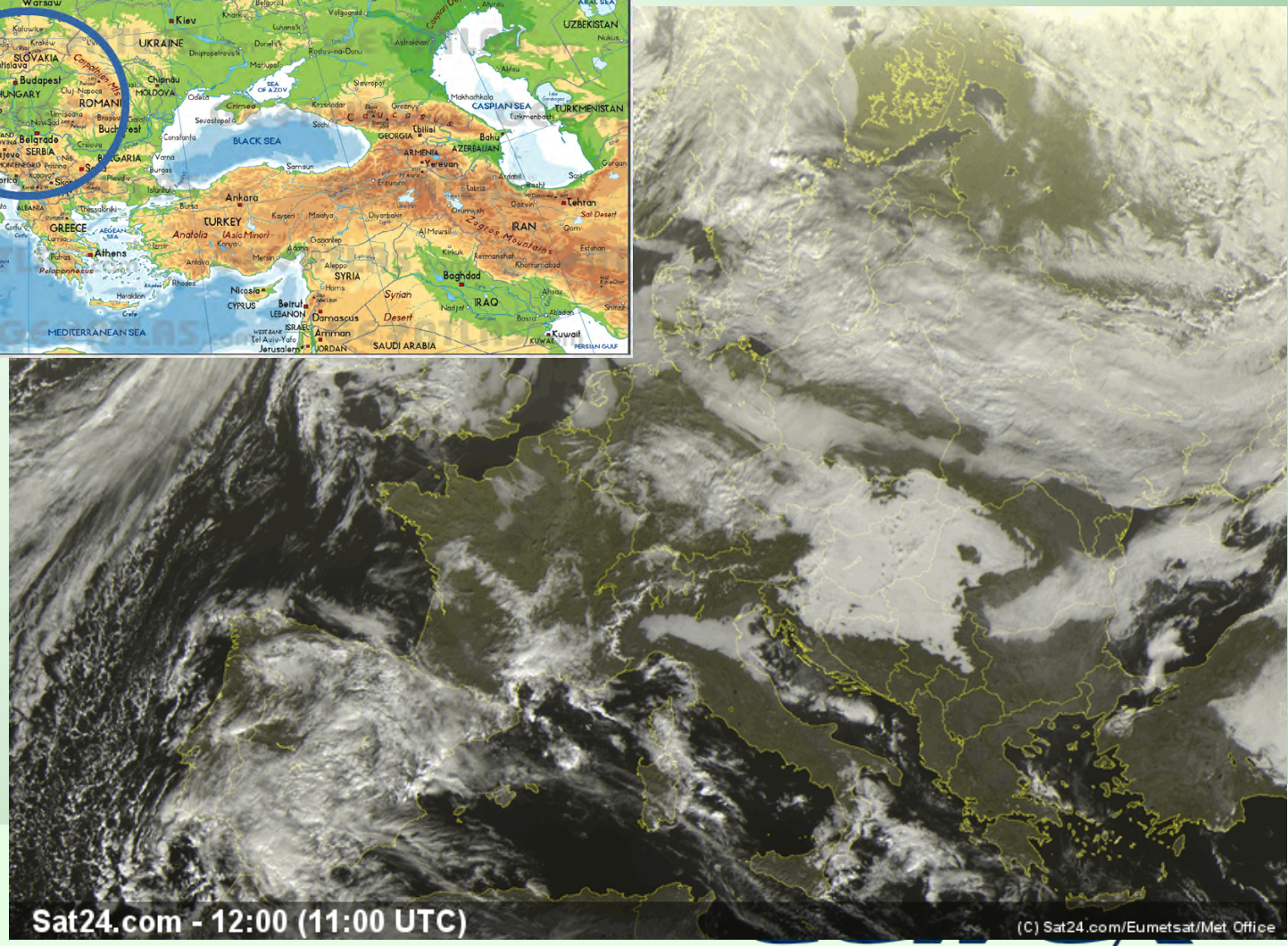
National Capital
other main city
- KOSOVO, under transitional administration
- F.Y.R.O.M., the Former Yugoslav Republic of Macedonia
- The Israel Parliament (KNESSET) decided JERUSALEM to be the capital. As negociations regarding the status of this city haven't come to something yet, most of the embassies are based at TEL-AVIV-JAFFA
2000 m
1000 m
500 m
200 m
0 m
below sea level
200 m
1000 m
2000 m
4000 m
ATLANTIC OCEAN
NORWEGIAN SEA
BARENTS SEA
NORTH SEA
BALTIC SEA
MEDITERRANEAN SEA
BLACK SEA
CASPIAN SEA
ICELAND
NORWAY
SWEDEN
FINLAND
RUSSIAN FEDERATION
UNITED KINGDOM
IRELAND
DENMARK
ESTONIA
LATVIA
LITHUANIA
BELARUS
POLAND
GERMANY
NETHERLANDS
BELGIUM
FRANCE
SWITZERLAND
AUSTRIA
HUNGARY
SLOVAKIA
CZECH REP.
UKRAINE
MOLDOVA
ROMANIA
BULGARIA
SERBIA
CROATIA
SLOVENIA
ITALY
SPAIN
PORTUGAL
GREECE
TURKEY
CYPRUS
SYRIA
LEBANON
ISRAEL
JORDAN
IRAQ
IRAN
SAUDI ARABIA
KUWAIT
GEORGIA
ARMENIA
AZERBAIJAN
TURKMENISTAN
KAZAKHSTAN
UZBEKISTAN
MOROCCO
ALGERIA
TUNISIA
LYBIA
Reykjavik
London
Paris
Berlin
Amsterdam
Brussels
Dublin
Madrid
Lisbon
Rome
Vienna
Budapest
Prague
Warsaw
Kiev
Minsk
Moscow
Athens
Ankara
Istanbul
Tehran
Baghdad
Damascus
Beirut
Nicosia
Tripoli
Algier (Algiers)
Tunis
Rabat
Kola Peninsula
Lapland
Scandinavian Mts
Ural Mts
Caucasus
Caspian Depression
Pyrenees
Alps
Balearic Is.
Atlas Mountains
Anatolia (Asia Minor)
Syrian Desert
Zagros Mountains
Peloponnesus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(C) Sat24.com/Eumetsat/Met Office

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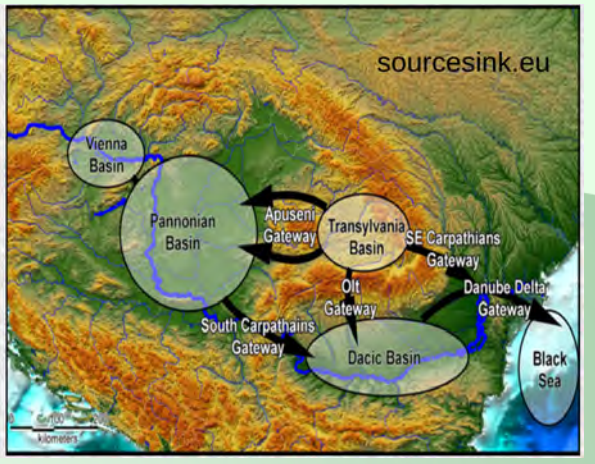


Opportunity

- An area fragmented between many countries, with a troubled past, but with very similar socioeconomical profiles: eastern European countries that entered the EU in the last decade, or have agreements with it.
- Good research institutions and universities.
- Eastern European countries are in good position to receive EU research funding.
- Cooperation: some initiatives have made way in the last decade (carptclim: climatological data exchange, icpdr: on the monitoring of the danube river, ...)
- However, there is still a difficulty in fluid communication between the countries, that, otherwise, share most of the interests and problems related to the basin hydroclimatology.
- GEWEX could be a external driver to initiate a convergence in the Pannonian basin hydroclimatological research through an RHP.
- Area between the HyMeX and Baltic Earth areas.

PannEx – Some Challenges

1. An almost closed structure: a good opportunity for studying the water and energy cycles at the basin scale
2. A privileged area for the surface-vegetation-atmosphere exchanges, with a high degree of homogeneity locally and topographic forcings well defined.
3. Possibility of studying the mountain and slope aspects of the W&E cycles at the borderline ranges.
4. A region threatened by an increase of the frequency of droughts.
5. Floods take place and are severe and deadly (f.i, in May 2014, 62 dead in Serbia)
6. In anticyclonic conditions: persistent surface inversions, fog and air quality issues.
7. Cold air accumulated in the basin may be pushed by NE wind to the Adriatic Sea, which may cause cyclogenesis and be related to severe Bora wind events.
8. A challenge: using data from many different national sources (Carptclim EU project has made a good work on this already)

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, will outline the Science and Implementation plans and start the search of funding
- Status presented at GHP in Paris in October, aiming to become an initiating RHP end 2017
- Most active countries so far: Hungary, Croatia, Serbia, Romania
- Presence of Ukraine, Slovakia, Slovenia, ...

PannEx – White Book contents I

- **<u>Flagship Questions:</u>**

  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

- **<u>Crosscut actions:</u>**

  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***

USA RHP

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

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

- GHP is attemptign to foster a new effort
- A workshop was held in May 2016 - http://www.gewexevents.org/water-availability-grand-challenge-for-north-america/

USA RHP workshop actions

- Monthly RHP WebEx teleconferences to be set up
- Proposed science questions to be sent to IGPO
- Overview presentation of workshop to be prepared
- Early to mid-career scientist support for addressing observations
- Next meeting to be held at Mammoth Lakes CA (Tom Painter)

USA RHP

GHP has suggested that a USA RHP should

- Consider time scales from weather to climate
- Be focused on application driven research
- Consider the Colorado Basin as the focus region

Once a (draft) white paper is ready they should

- Write an article for the GEWEX newsletter
- Organise a workshop to foster wider involvement

Latin America RHP

- Workshop being planned for May 2017

South East Asia RHP

- Discussed at MAHASRI final conference and further discussed in Japanese community
- Workshop in SE Asia with SE Asia participants has been suggested

Cross-cut Projects

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)

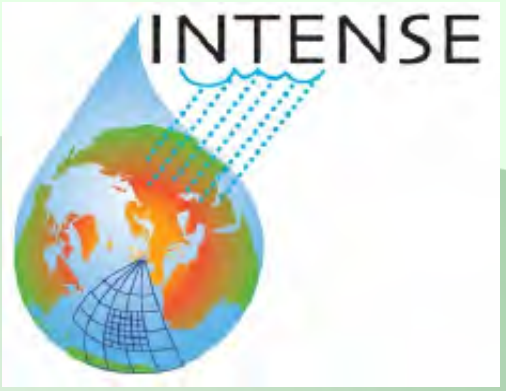
Proposed

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

Potential

- GDAP integrated product regional evaluation

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

GHP

GEWEX

INTENSE – Key research questions

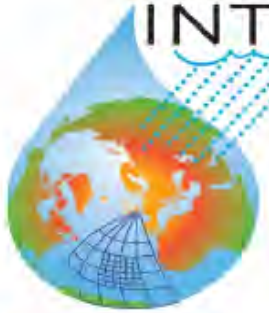
- How has sub-daily maximum precipitation changed over the last century, across continents, climate regimes and seasons?
- How does precipitation at different time-scales vary with atmospheric temperature and atmospheric moisture as the atmosphere warms?
- How do large-scale atmospheric and oceanic features 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?

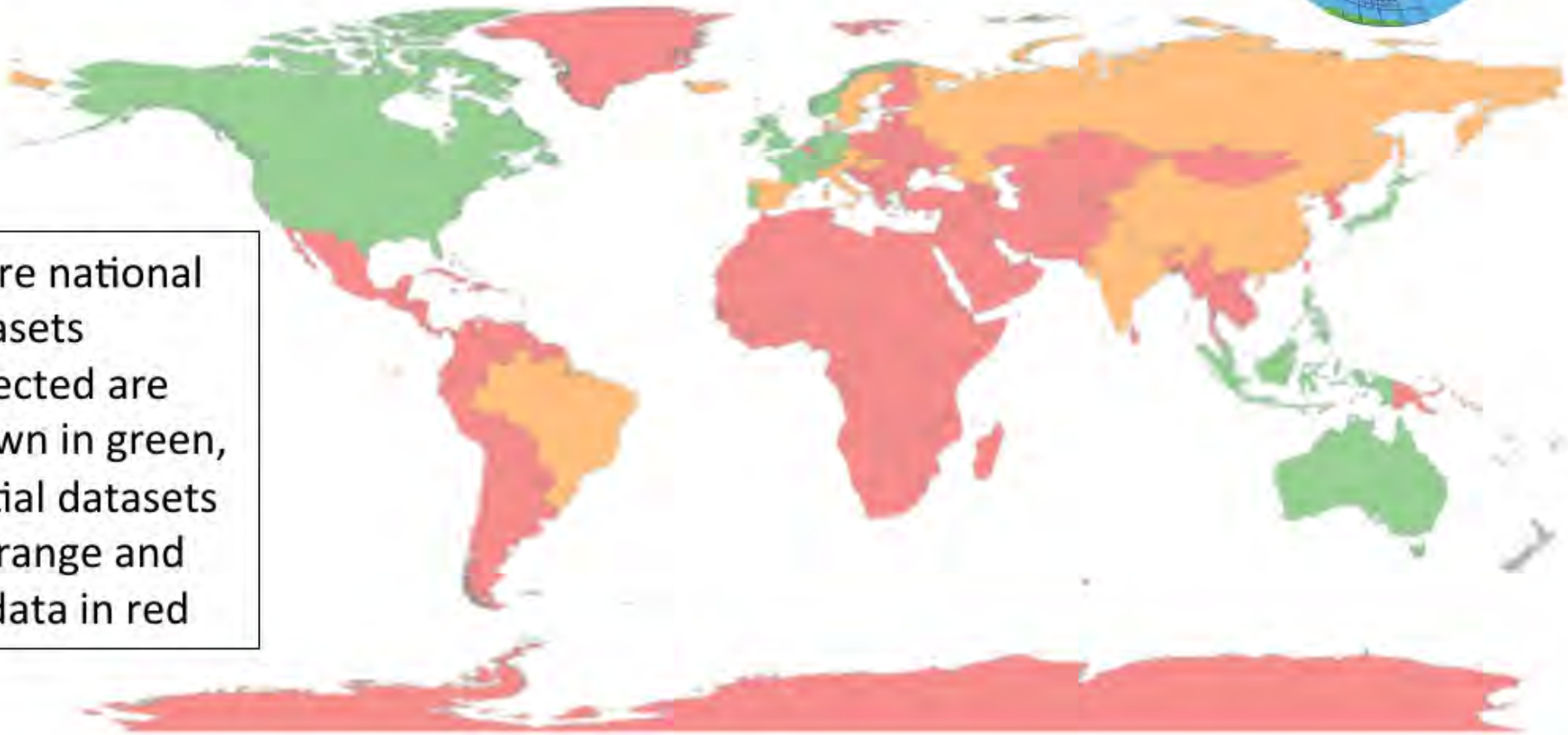
INTENSE – Update 2016

- 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

INTENSE: Sub-daily precipitation data collection so far…

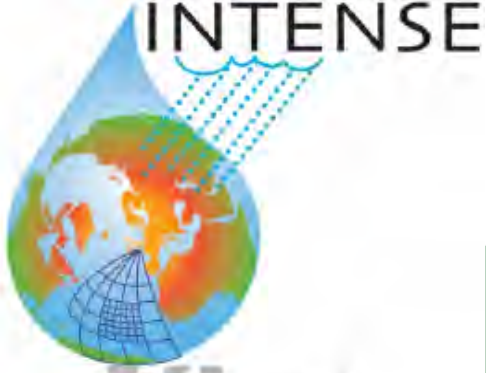




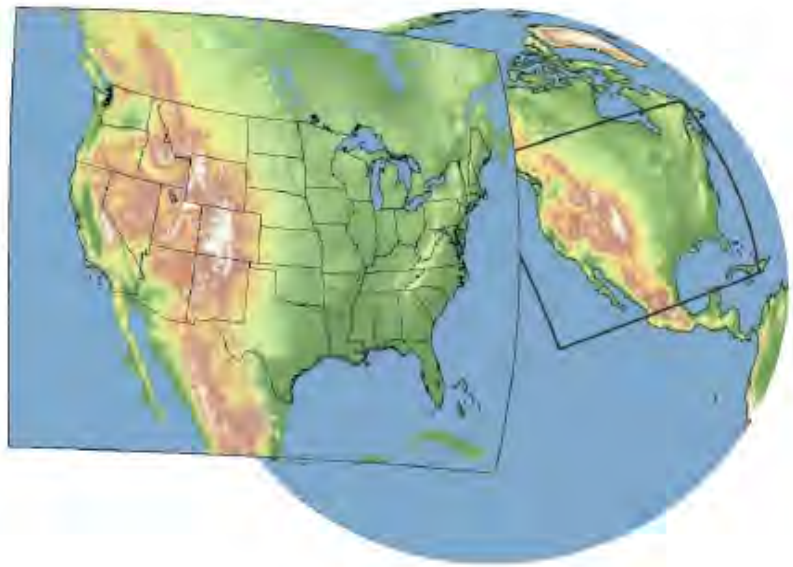
Entire national datasets collected are shown in green, partial datasets in orange and no data in red

- UK, US, Canada, Brazil, France, Germany, Spain, Portugal, Italy, Israel, Philippines, India, Norway, Sweden, The Netherlands, Finland, New Zealand, Australia, Kenya, Indonesia, Slovenia, Costa Rica, Argentina, Switzerland, Austria, Hungary, Turkey, Bangladesh, Panama, Russia, Ireland, Japan, Malaysia, Singapore, Some Africa, Some SE Asia,
- Global datasets: HadISD, ISD, NOAA, MSWEP, NLDAS-2, InERG, EuMETGRD,

First comparison of CPM climate projections at high resolution



- Now many CPM runs: southern England, Northern England, Alps, Germany, US, Greater Sydney, Singapore etc.
- Planned runs in China and runs in progress at 2.2km over European domain (comparison study ETH Zurich – Schar – and UK Met Office – Kendon/INTENSE)
- CORDEX Flagship pilot study to compare CPMs over common domain – KO meeting Trieste 3-4th November. Likely domain – Alps.
- Common model diagnostic set and observed sub-daily indices under development



INTENSE – planned activites

Database

- Continued data acquisition strategy and initiatives on a regional basis to update and expand the existing database. Thought given to where to host data and development of new indices for sub-daily precipitation.
- Continue to support the development of quality control measures for sub-daily precipitation data including release of common QC code.
- Construction and analysis of a comprehensive UK sub-hourly (10-15 minute) dataset is planned using UK rain gauge data.

Research

- A global scale analysis of the extreme precipitation-temperature relationship will be undertaken using sub-daily datasets gathered by INTENSE.
- Global scale analysis of trends in sub-daily extreme precipitation
- Intensity-Duration-Frequency (IDF) curves generation for UK and global datasets
- Further develop the working group on very high resolution models and common analyses of model outputs.
- First analyses of large-scale drivers of sub-daily extreme precipitation
- Initiation of efforts to explore how sub-hourly in situ and satellite observations can help each other.
- Session proposed at the EGU 2017 on “Development and analysis of sub-daily rainfall datasets: characteristics, change and drivers of extremes”.

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 0ºC – 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

Near 0ºC – 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 0ºC – 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.

Near 0ºC – Planned activities

- We submitted proposals to the U.S. and Russian funding agencies to support further activity on the Cross-cut Project keeping in mind that (a) we shall need to go into more detail of near-0°C precipitation events and associated perils (changes in timing, intensity, and spatial pattern, handling the inhomogeneity in the data); (b) modify and complete our analyses for those countries, where synoptic information about freezing events is not readily available (first of all, for East Asia countries); and (c) to assess the impact of perils associated with the near 0°C precipitation and project their changes in the next decades.
- A concerted effort is being made to quality control Canadian operational data that addresses near 0°C conditions. This includes the many types of precipitation as well as the associated state variables. It is intended that, once complete, this dataset will be made available to everyone via a web portal

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

GHP

GEWEX

INARCH - Objectives

To better

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

and

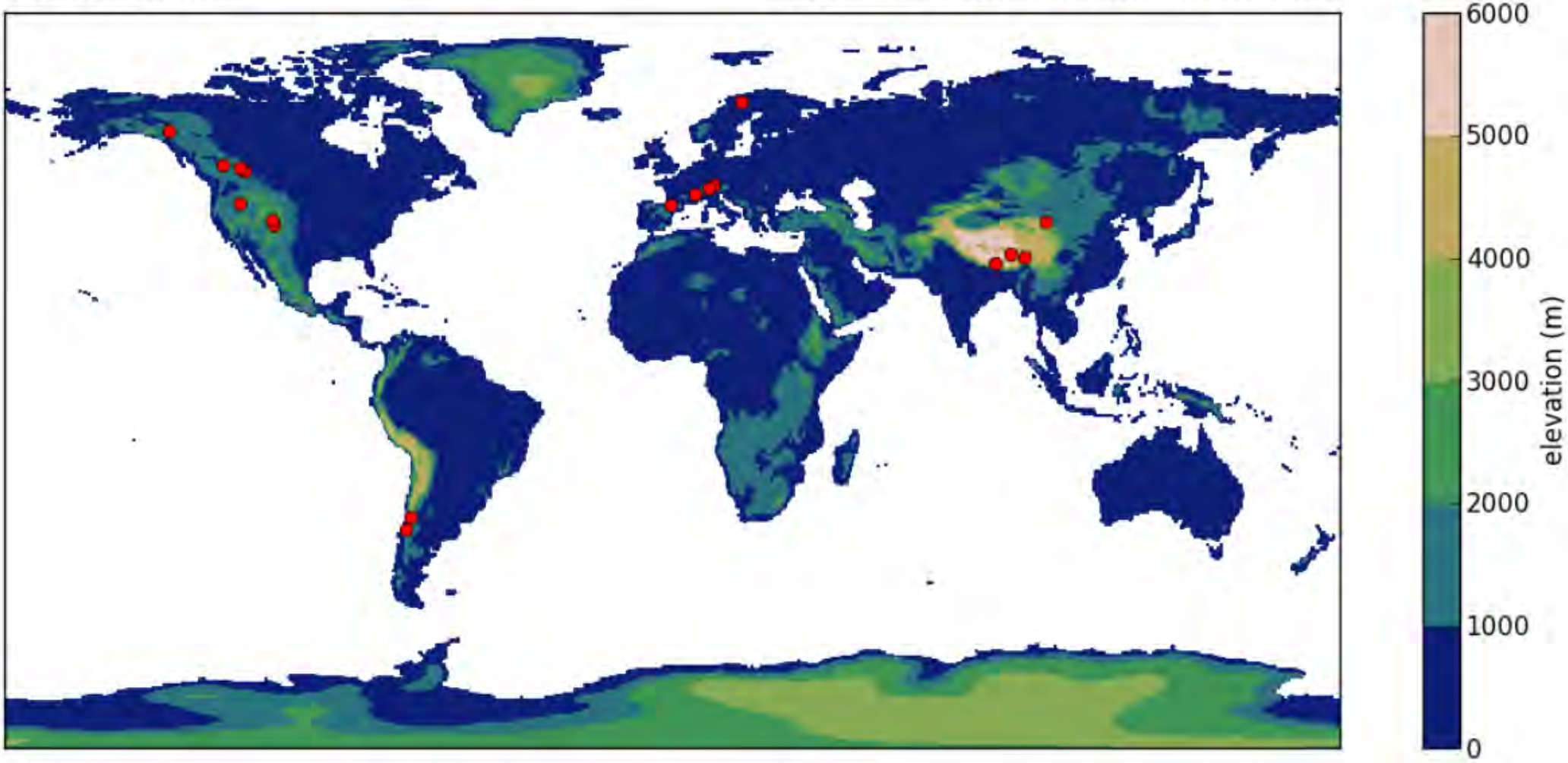
- To find consistent measurement strategies.

INARCH – Science questions

- How 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?

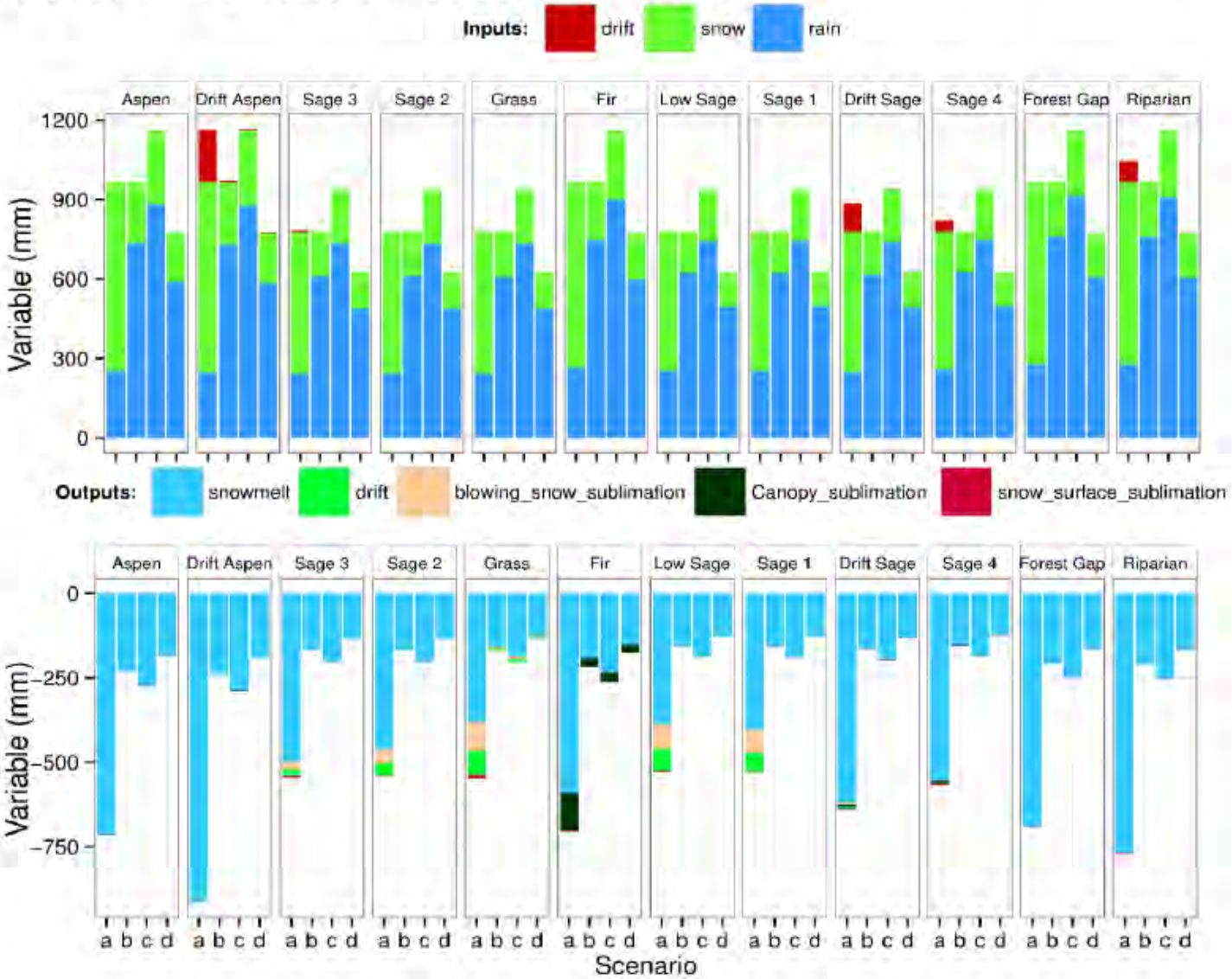
INARCH: International Network for Alpine Research Catchment Hydrology

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



GSQ4: Water and energy cycles

- Annual contribution of snow mass and energy exchange processes by ecozone in the Reynolds Creek Research Watershed (USA)
- Sensitivity to perturbed climate: a) control period of current climate, b) P=100%, T= +5 C, c) P=120%, T=+5C. d) P=80%, T=+5C



CHRM model

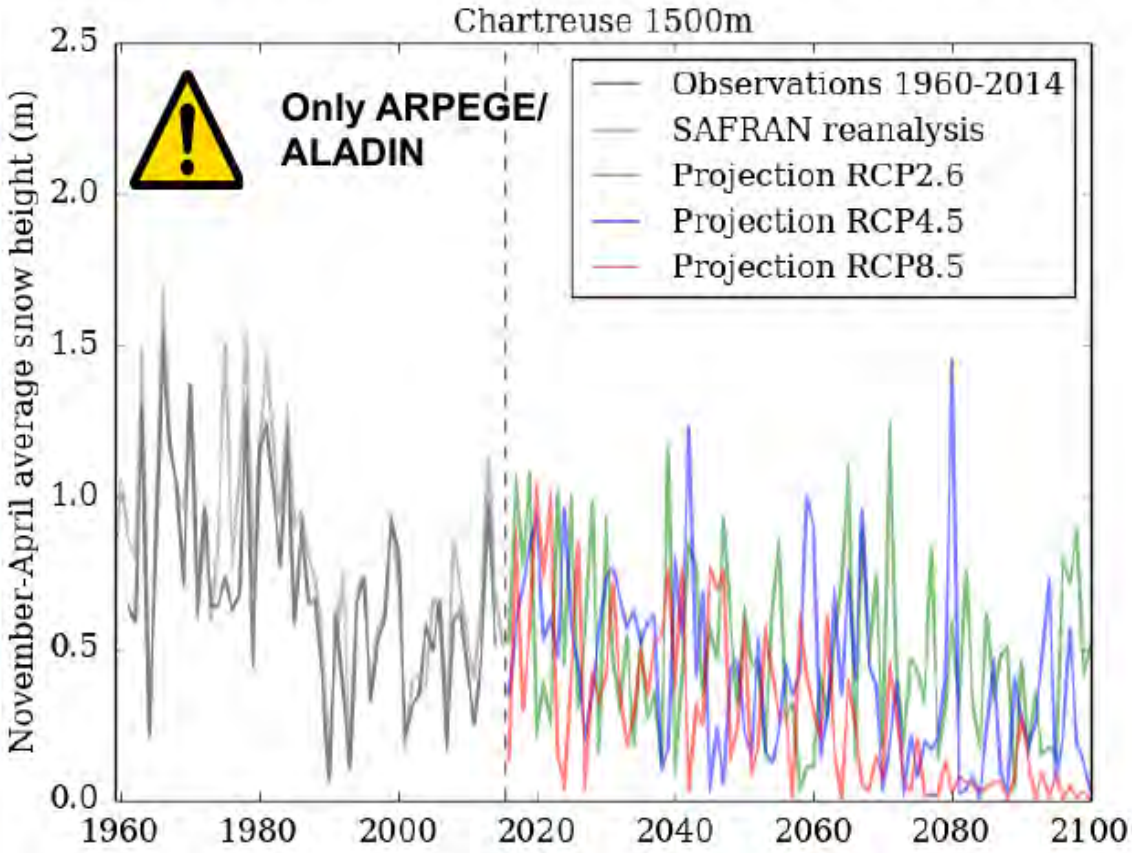
Rasouli (2016)

GSQ4: Water and energy cycles

ADAMONT: ADAptation of RCM outputs to MOuNTain regions:

- Downscaling of projections from a RCM against a regional reanalysis of hourly meteorological conditions using quantile mapping.
- Application to multi-scenario, multi-RCM simulation of snowpack evolution in the French mountains

Verfaillie et al (GMDD, 2016)



Snow height from ALADIN – Crocus at Col de Porte

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

Cross-cut Projects Proposed

Water management in large-scale models

Richard Harding (Centre for Ecology and Hydrology, UK), Jan Polcher (CNRS, France)

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

Water management – Proposed 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

Water management – update 2016

- review work in progress to establish what is being done and where there are global data gaps
- Established a working group
- Author a GEWEX Newsletter article
- Hold workshop – October 2016 - http://www.gewexevents.org/water-management-in-models/

Water management – needed actions

- Prepare and submit proposal for official GHP cross-cut status
- Setup sessions on this topic at International Meetings;
- Establish connections with EartH2Observe http://www.earth2observe.eu/, and seek support from WCRP to obtain possible support to organize a relevant Workshop on this topic in the context of the WCRP GC-2 on Water Availability.

MOUNTerrain

Mountainous Terrain Rainfall

James Renwick (Victoria Uni., New Zealand)

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 features of high-elevation precipitation – spillover, orographic lifting, slope effects, spatial gradients, location of the pluviometric optimum, phase and amplitude of the diurnal cycles?
- How well is high-elevation precipitation modeled, and what advances are needed to improve model performance (e.g., orographic enhancement, convective initiation, …)?
- What are the effects of climate variability and climate change on the characteristics and features discussed in the previous questions?

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 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).

MOUNTerrain – Needed actions

- Little action in last year – chair too busy – need to find a replacment
- Establish a working group to drive the project forward
- Identify specific tasks that can be pursued and completed in the next few years

Cross-cut Projects Potential

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 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			
		HyMex	SaskRB	HyVic	OzEWEX
Observations and Predictions of Precipitation	How well can precipitation be described?	y	y	y	y
	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
	How does climate change impact water resource systems?	y	y	y	y
	How can new observations lead to improved management?		y	y	y
Changes in extremes	Observing system requirements	y	y	y	y
	Modelling capabilities	y	y	y	y
	Modelling processes involved in extremes	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			
	Can we track the changes over time?	y			
	Can we relate changes and processes?				
	Cloud-aerosol-precipitation feedbacks				

GHP members (terms)

Co-Chairs

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

Members

- Silvina Solman [Argentina] (2014-2016, is willing to go for another 3yr term)
- 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 reappoitnment)
- Li Xin [China] (2016-2018 with option for one 3 yr reappoitnment)
- Sylvestor Danour [Ghana] (2016-2018 with option for one 3 yr reappoitnment)

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.