GEWEX Hydroclimate Panel
GHP

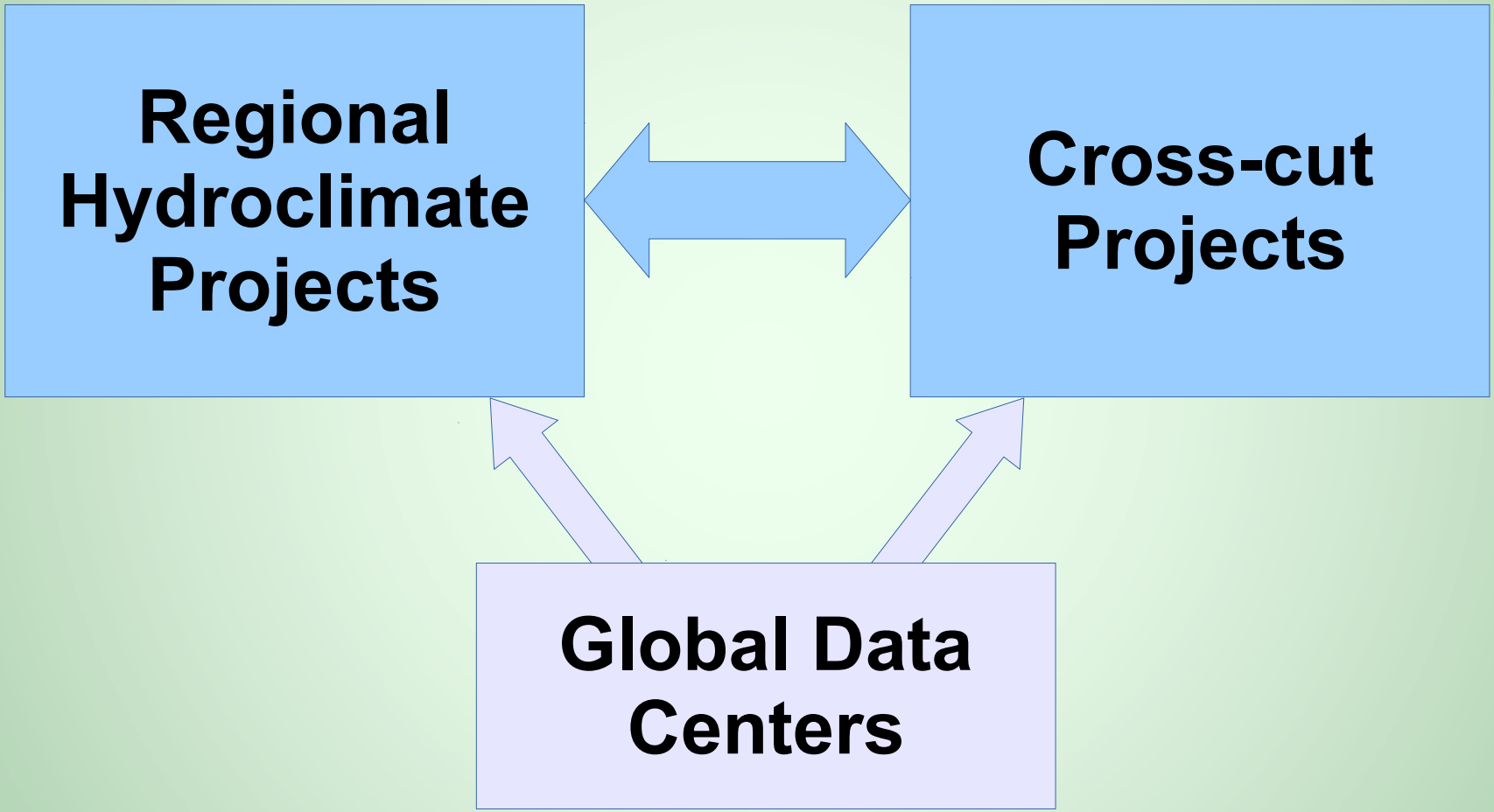
Co-Chairs: Jason Evans
Joan Cuxart

The role of GHP within GEWEX

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.

GHP Structure



RHPs

Regional Hydroclimate Projects (RHPs)

- Are generally large, regionally-focused multidisciplinary projects that aim to improve the understanding and prediction of that region's weather, climate, and hydrology, in an integrated way.
- Address the physical processes surrounding water and energy exchanges within a region, thus addressing the GEWEX Science Questions.
- Often address additional questions related to the biosphere and carbon cycle, human interaction in the landscape, and even socio-economic factors.

RHP Status

Active in 3 continents:

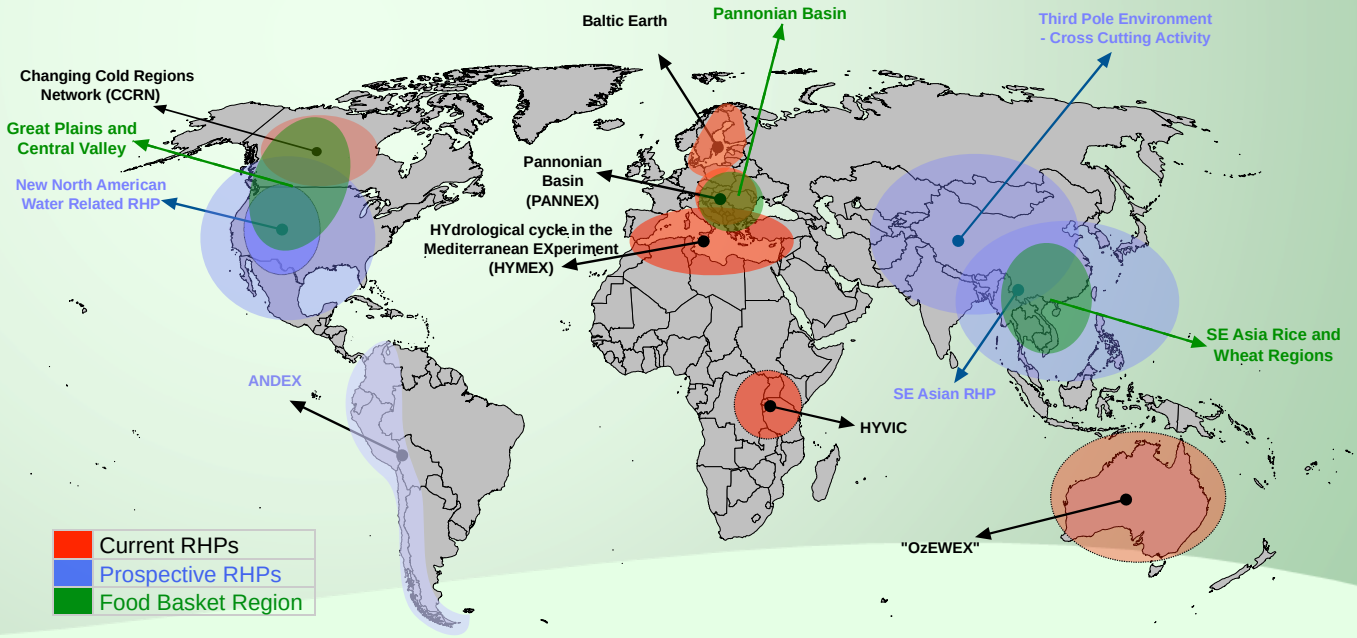
Europe: ***HyMeX***(2010-2020) =====> High-impact weather events, societal response
Baltic Earth (2016-) =====> Sea and land changes, biogeochemical processes
PannEx (end 2017?) ====> Agronomy, air quality, sustainability & water mgnt
Australia: ***Ozewex*** (2015-) ======> Water and energy cycle in Australia
Africa: ***HyVic*** (2015-2024) =======> Hydroclimatic variability over Lake Victoria basin

Recently finished:

North America: ***CCRN*** (2014-2018) => Cryospheric, ecological, hydrological interactions
Asia: ***MAHASRI*** (2007-2016) =====> Asian Monsoon
Eurasia: ***NEESPI*** (2004-2015) ====> Climate-ecosystem-societal interaction

Prospective:

South America: **Andex**
North America: **GWF**



Example RHP

HyMeX

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 Organisation

Working Groups

WG1: The water budget of the Mediterranean Sea

WG2: The continental hydrological cycle and related water resources

WG3: Heavy rainfalls, flash-floods and floods

WG4: Intense sea-atmosphere interactions

WG5: Societal and economic impacts

Task Teams

Task Teams for Observations

TTO1 - Sounding of the atmosphere
TTO2 - Hydrological and soil measurements
TTO3 - Measuring surface fluxes over land
TTO4 - Sounding the ocean
TTO5 - Measuring air-sea fluxes
TTO6 - Measuring land-sea fluxes
TTO7 - Monitoring vulnerability factors

Task Teams for Modelling

TTM1 - High-resolution (coupled, ensemble) modelling platforms for intense events
TTM2 - Multiscale modelling of the continental surfaces
TTM3 - Regional climate modelling (Atmosphere-Ocean-Land)
TTM4 - Data assimilation
TTM5 - Model verification

Task Supports

TS1 - Data base
TS2 - Satellite products
TS3 - Hydrometeorological sites
TS4 - Atmospheric sites and super-sites
TS5 - Aircraft operations
TS6 - Ocean operations
TS7 - Real-time modelling forecast during SOP/EOP
TS8 - SOP operation coordination

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

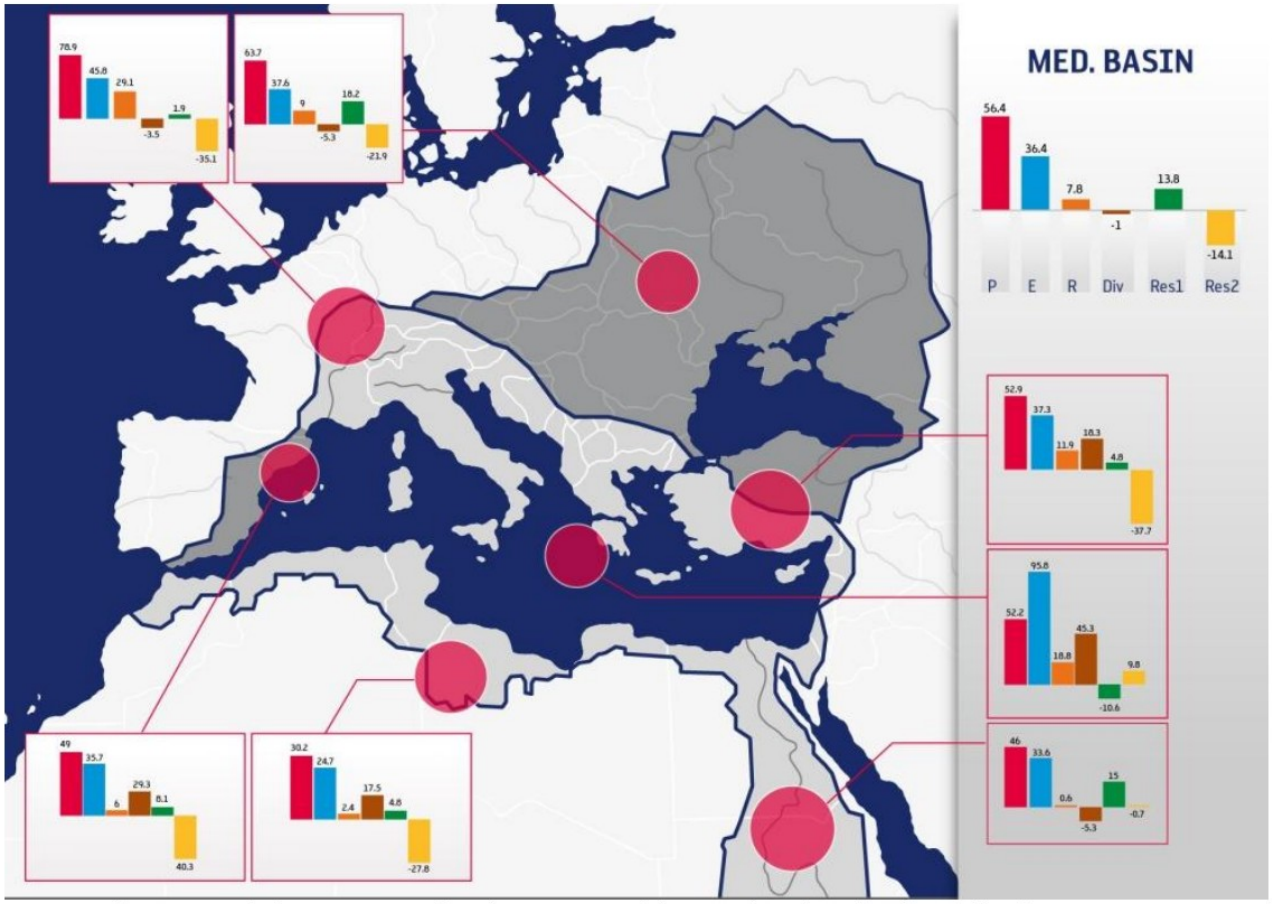


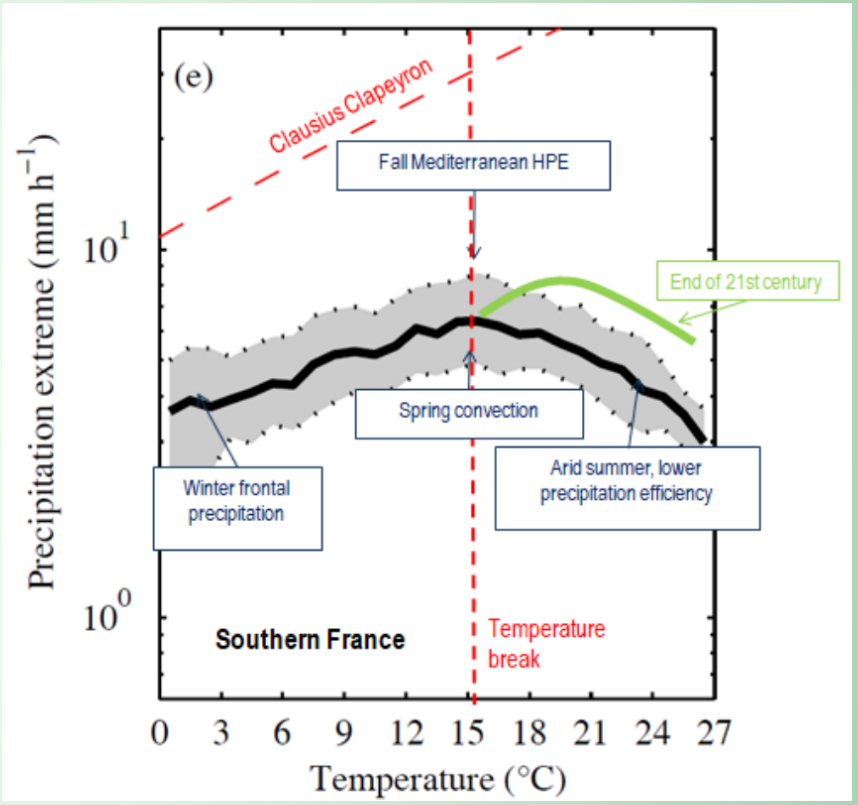
Figure 4: Mean annual terrestrial water cycle, for several large basins in the Mediterranean, as observed by our combined satellite observations dataset..

Pellet, Aires, Mariotti, and Fernandez Prieto, Analyzing the Mediterranean water cycle in an unified way using satellite data, Submitted to Pure and Applied Geophysics, special issue on Meteorology and climatology of the Mediterranean and Black Sea Regions, 2017.

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:

- reduction of the duration of rainfall events at high temperatures
- different synoptic situations leading to extreme precipitation
- decreasing precipitation efficiency and vertical moisture transport.



Drobinski, P., Da Silva, N., Panthou, G., Bastin, S., Muller, C., Ahrens, B., Borga, M., Conte, D., Fosser, 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.

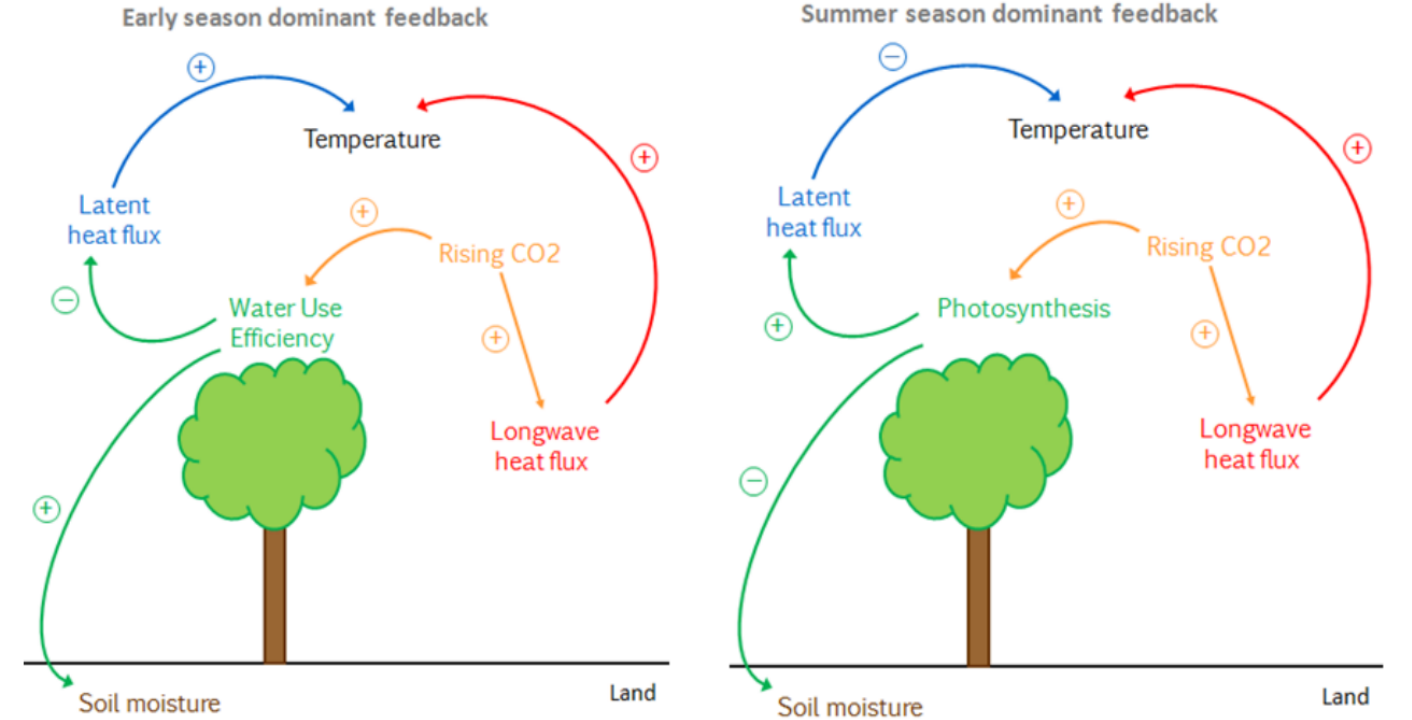


Figure 6: Feedback loops during spring and summer. Source: Lemordant et al. (2016).

Lemordant L, Gentine P, Stéfanon M, et al (2016) Modification of land-atmosphere interactions by CO2 effects: Implications for summer dryness and heat wave amplitude. Geophys Res Lett 43:2016GL069896 . doi: 10.1002/2016GL069896

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, 29 May - 2 June 2018, Lecce, Italy

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.

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

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

Potential

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

Example Cross-cut Project

INTENSE
(sub-daily precip)

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?

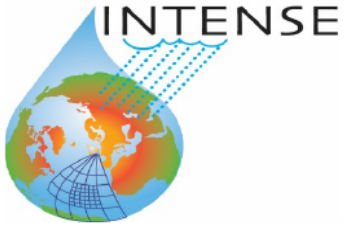
INTENSE – Update 2017

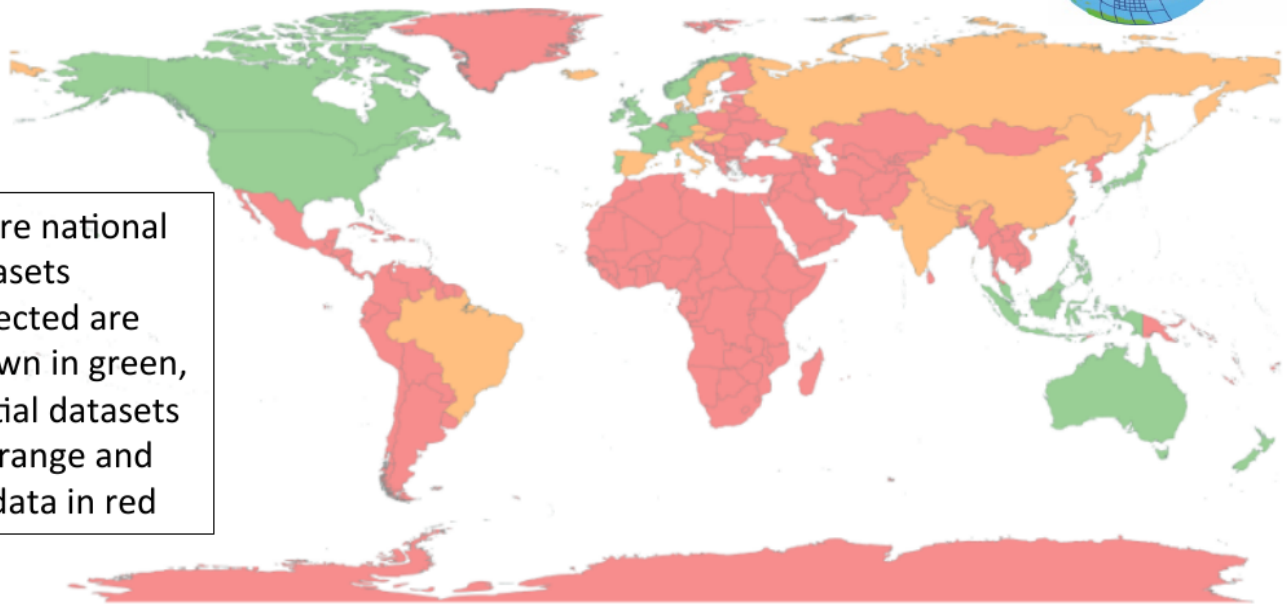
- 6 full-time PDRA's working on project at Newcastle University: Dr Stephen Blenkinsop, Dr Elizabeth Lewis, Dr Renaud Barbero, Dr Xiaofeng Li, Dr Selma Guerreiro and Dr Steven Chan (based at UK Met Office), Dr Geert Lenderink (part-time, KNMI, Netherlands) and team at UK Met Office led by Dr Lizzie Kendon
- 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 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

INTENSE: Sub-daily precipitation data collection so far…





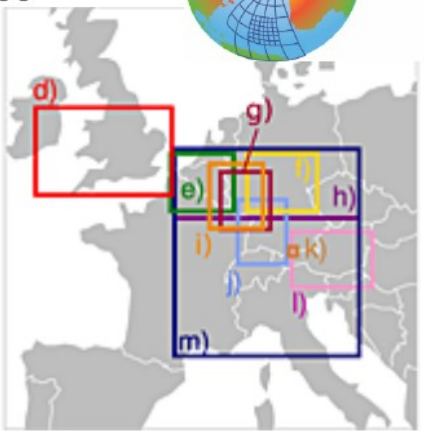
Entire national datasets collected are shown in green, partial datasets in orange and no data in red

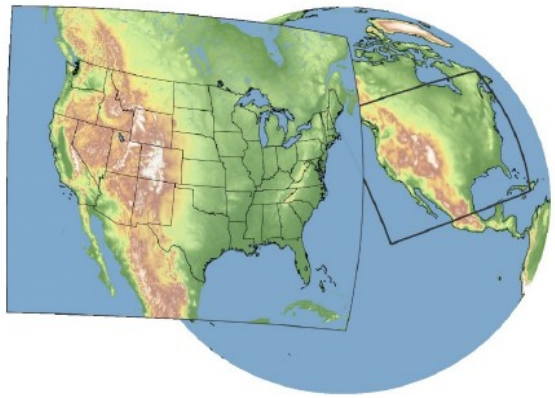
- UK, US, Canada, Brazil, France, Germany, Spain, Portugal, Italy, Israel, Philippines, India, Norway, Sweden, The Netherlands, Finland, New Zealand, Australia, Kenya, Indonesia, Slovenia, Costa Rica, Argentina, Switzerland, Austria, Hungary, Turkey, Bangladesh, Panama, Russia, Ireland, Japan, Malaysia,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

INTENSE

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”.

Global Data Centres

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)

GHP activities in relation to GSQs

GEWEX Science Questions		Regional Hydroclimate Projects				
		HyMex	Pannex	HyVic	OzEWEX	Baltic Earth
Observations and Predictions of Precipitation	How well can precipitation be described?	y	y	y	y	y
	How do changes in climate affect the characteristics?	y	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	y
	How does climate change impact water resource systems?	y	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	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			y
	Can we track the changes over time?	y				y
	Can we relate changes and processes?					
	Cloud-aerosol-precipitation feedbacks	y	y			

Cross-cut activities

- **Near 0°C precipitation**
- *Mountain precipitation*
- **Sub-daily precipitation INTENSE**
- **Mountain hydrology INARCH**
- Human management in land-surface models
- *GDAP integrated product evaluation*

Future for GHP….

New RHPs

- Andex
- USA?
- Asia?
-

New Cross-cuts

- Human management in models
- Mountain precipitation?
- Evapotranspiration?
-

If you have a scientific question, project or problem that might best be achieved through collaboration or benefit from coordination at the international level - Talk to us!
We could help make it happen.

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.
- We are always ready to discuss new RHP and CC ideas/proposals.

GHP Members

Co-Chairs

Jason Evans

Joan Cuxart

Members

Silvina Solman

Nicole Van Lipzig

Craig Ferguson

Li Xin

Sylvestor Danour

Francina Dominguez