A water droplet is shown falling from the top center of the frame, just below the 'GEWEX' text. It has just struck the surface of a dark blue liquid, creating a series of concentric ripples that spread outwards. The droplet itself is suspended in the air just above the surface, with a small tail of water behind it.

GEWEX

**Global Energy and Water
Exchanges**

World Climate Research Programme

**GEWEX Hydro-meteorological Panel
(GHP)**

WCRP Grand Challenges

- Actionable regional climate information (mainly CLIVAR lead)
- Regional Sea-Level (CLIVAR lead, with CliC and **GEWEX**)
- Cryosphere in a changing climate (CliC lead)
- Cloud and Climate Sensitivity (WGCM lead, with **GEWEX** and SPARC)
- Changes in water availability (**GEWEX** lead) (*more regional*)
- Prediction and attribution of extreme events (**GEWEX** lead) (*more project input*)



WCRP Organization

Joint Scientific Committee

Joint Planning Staff

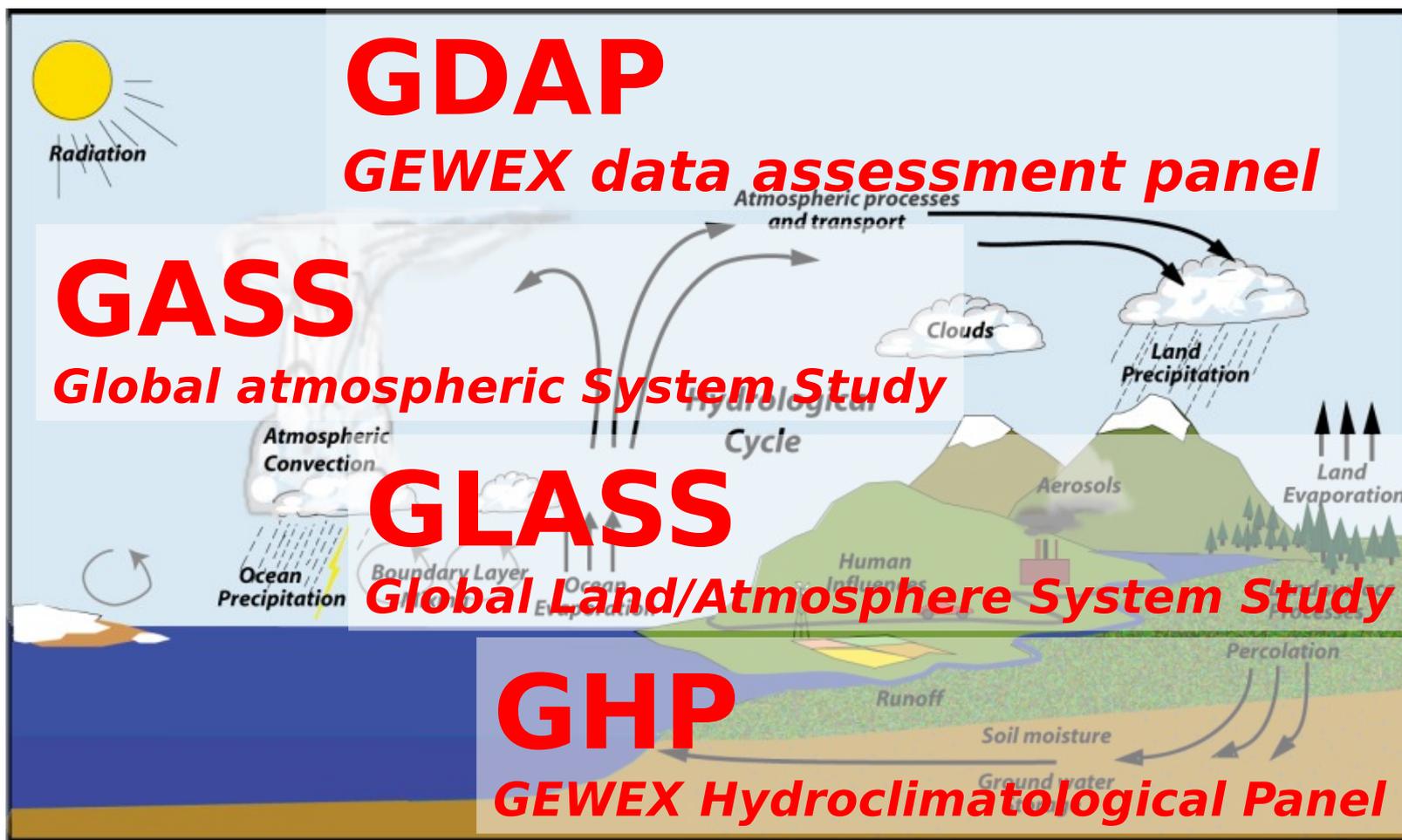
Modeling Advisory Council

Data Advisory Council

Working Groups on: Coupled Modelling (WGCM), Regional Climate (WGRC), Seasonal to Interannual Prediction (WGSIP), Numerical Experimentation (WGNE)



GEWEX : Major components



GEWEX Science questions

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

Science question 1

How can we better understand and predict variations and changes in precipitation?

- use and development of expected improved **datasets** on: precipitation and soil moisture from ongoing and planned satellite missions, as well from in-situ observations;
- evaluation and **analysis** into various products;
- document the mean, variability, patterns, extremes and full probability density functions,
- **confront models** in new ways;
- improve understanding of atmospheric and land surface **processes** and their **modeling** that improve simulations of precipitation;
- employ new techniques of data assimilation and forecasts that improve predictions of the hydrological cycle.

These results should lead to improved climate services.



Hymex

Extreme rainfall events in the Mediterranean

La Méditerranée sous haute surveillance

Le programme Hymex vise à mieux prévoir les événements climatiques extrêmes.

KÉVIN LAMOTHE

MÉTÉOROLOGIE Il y a vingt ans, Vaison-la-Romaine, petite commune du Vaucluse, était dévastée par une inondation spectaculaire. Des torrents de pluie s'abattent sur la région et, en quelques heures, l'Ouvèze, la petite rivière qui traverse la ville, sort de son lit, tuant 47 personnes. La tragédie, encore présente dans les mémoires, a profondément marqué les esprits. Pourtant, ces événements « extrêmes », couramment appelés épisodes cévenols, ne sont pas rares sur le pourtour méditerranéen. Au nord comme au sud : en novembre 2001 sur les côtes algériennes, l'un d'eux a coûté la vie à 800 personnes et provoqué plus de 3 milliards de dommages.



L'inondation de septembre 1992 à Vaison-la-Romaine a provoqué la mort de 47 personnes. PARROT / SYGMA / CORBIS

C'est quoi, un épisode cévenol ?

MÉTÉOROLOGIE | L'étude de ce phénomène de Méditerranée est au cœur du programme HyMex

VAINC TEN MANSKAN
A u centre de coordination, installé dans le camping de FOC à La Grande-Motte-Bécarré, la présence alerte les médias et lance un direct de concertation. Mardi 10 septembre, des douzaines de journalistes se retrouvent en début de matinée à la mairie de Vaison-la-Romaine (Vaucluse) pour discuter de la catastrophe. Le maire, Jean-Claude Guille, est entouré de représentants du programme HyMex et de journalistes de la région. L'ordre du jour est de bien avoir en tête les enjeux de la recherche de solutions. Après le déjeuner, l'après-midi est consacré à la visite de la commune. Les journalistes sont accompagnés par le maire et le directeur de la mairie. L'après-midi est consacré à la visite de la commune. Les journalistes sont accompagnés par le maire et le directeur de la mairie.



Les épisodes cévenols sont à l'origine d'écarts répétés. Ici, les inondations de Vaison-La-Romaine en 1992. COURTESY OF Météo France

Les épisodes cévenols sont à l'origine d'écarts répétés. Ici, les inondations de Vaison-La-Romaine en 1992. C'est que, explique Christophe Calas, de l'Observatoire de la météorologie de Toulouse, « malgré les progrès réalisés depuis vingt ans, déterminer le moment et le lieu exacts où un épisode cévenol va se déclencher, c'est encore très difficile ». Mais, poursuit-il, « c'est ce qui est le plus intéressant et ce qui est le plus difficile ». C'est ce qui est le plus intéressant et ce qui est le plus difficile. C'est ce qui est le plus intéressant et ce qui est le plus difficile.

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Valencia 1957

Extreme rainfall events in the Mediterranean are part of the geography :

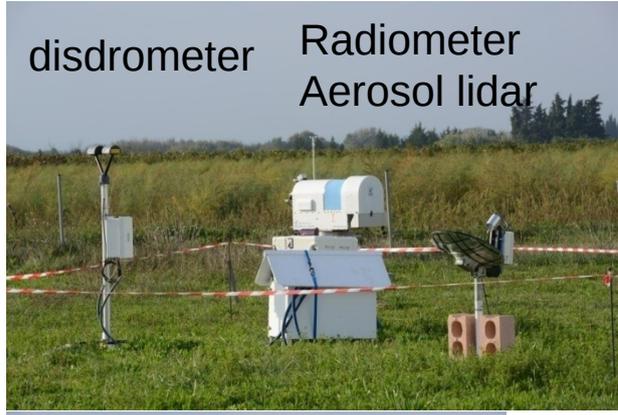
★ They have structured cities (los ramblas)

★ They have lead to the deviation of rivers (Valencia)

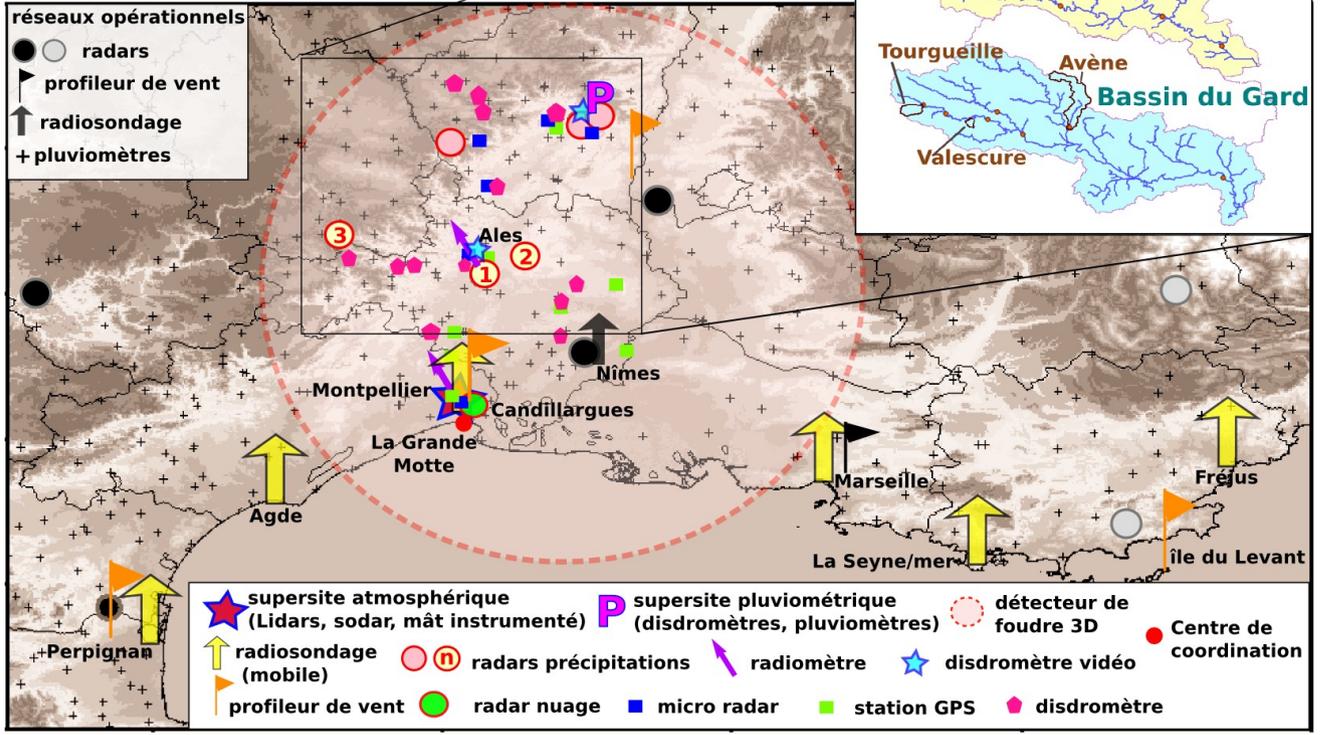
★ Today they cause damage to infrastructures and cause death.

Understanding the processes involved is the first step to forecasting.

HyMeX Cevennes-Vivarais hydrometeorological measurements

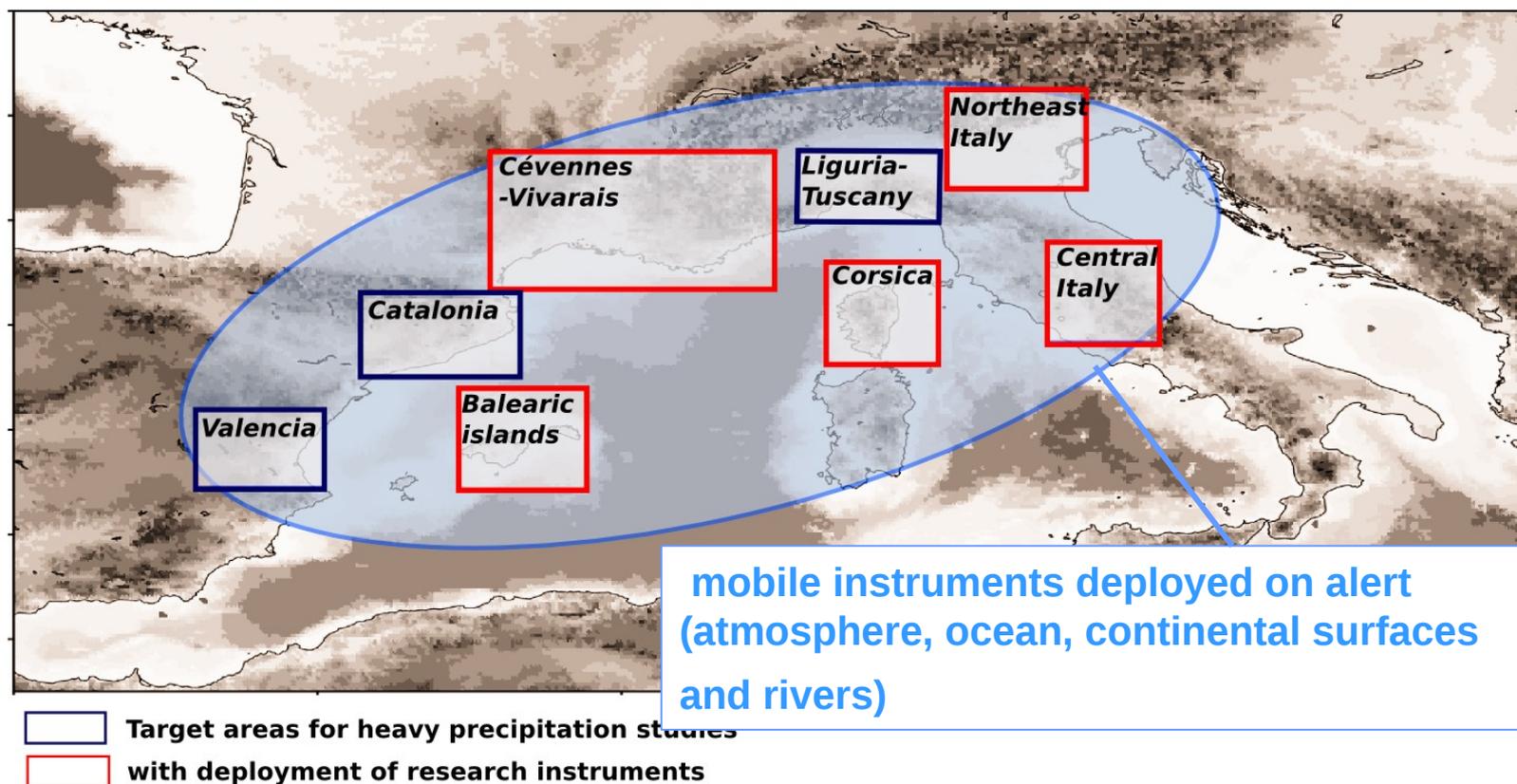


Candillargues



HyMeX SOP1 domain

SOP1 dedicated to heavy precipitation and floods in NorthWestern Mediterranean: 5 Sept. to 5 Nov. 2012



~200 instruments

~300 scientists in the field

HyMeX SOP1 Intensive Observation Periods (IOPs)

- **34 days with on alert observations during 2 months :**
 - 13 IOPs dedicated to heavy precipitation (HPE) and flash floods
 - 5 IOPs with orographic precipitation (ORP)
 - 2 IOPs with windstorms (SWE)
 - 5 IOPs for lidar validation,
- in
- France: 11 events over Cévennes-Vivarais CV and 6 over Corsica
 - Italy: 6 events over Liguria-Toscana, 5 over Central Italy, 5 over North-Eastern Italy
 - Spain: 4 events over Balearic Islands, 3 over Catalonia et 2 over Valencia

Sop1

Day:	Sep 11	12	13	14	23	24	26	27	28	29	Oct 02	11	12	14	15	16	17	18	19	20	21	22	23	25	26	27	28	29	30	31	Nov 01	03	04	05	
IOP:	1	2	3	4	5 6	6	7a	7b	8	8	9	12a	12a 12b	13	13	13	14	14	14	15a	15b	15b 15c	15c	16a	16a	16b	16b 16c	16c	17	18 18	18 18	18	19	19	19 20

The analysis of the collected data is underway !

Science question 2

How do changes in the land surface and hydrology influence past and future changes in water availability and security?

- *Address terrestrial water storage changes and **close the water budget over land***
- *Exploit new datasets, data assimilation, improved physical understanding and modeling skill across scales,*
- *Catchments to regional to global to the entire hydrological cycle including hydrogeological aspects of ground water recharge.*
- *Use of **realistic land surface** complexity with all anthropogenic effects included instead of a fictitious natural environment.*

Science question 2 ... cont.

- *Includes all aspects of **global change**: water management, land use change and urbanization; water quality and especially water temperature; nutrients ...*
- *The **ecosystem response** to climate variability and responsive vegetation must be included.*
- *Cryospheric changes such as permafrost thawing and changes in mountain glaciers must be included.*
- *Feedbacks, tipping points, and extremes are of particular concern.*

The results should enhance the evaluation of the vulnerability of water systems, especially to extremes and which are vital for considerations of water security. They should increase resilience through good management and governance.

Climate also determines the state of the surface

May



- ★ As the weather changes with seasons so does the state of the surface.
- ★ This modifies land surface processes.
- ★ Climate anomalies produce variations in surface characteristics.

July



In the Sahel :

- ◆ May and June the surface energy balance is driven by bare soil evaporation. Runoff and ponding is important.
- ◆ July vegetation starts to smooth out evaporation. Role of infiltration increases.
- ◆ August and September the vegetation drive the surface processes. The roots extract deeper water.

August



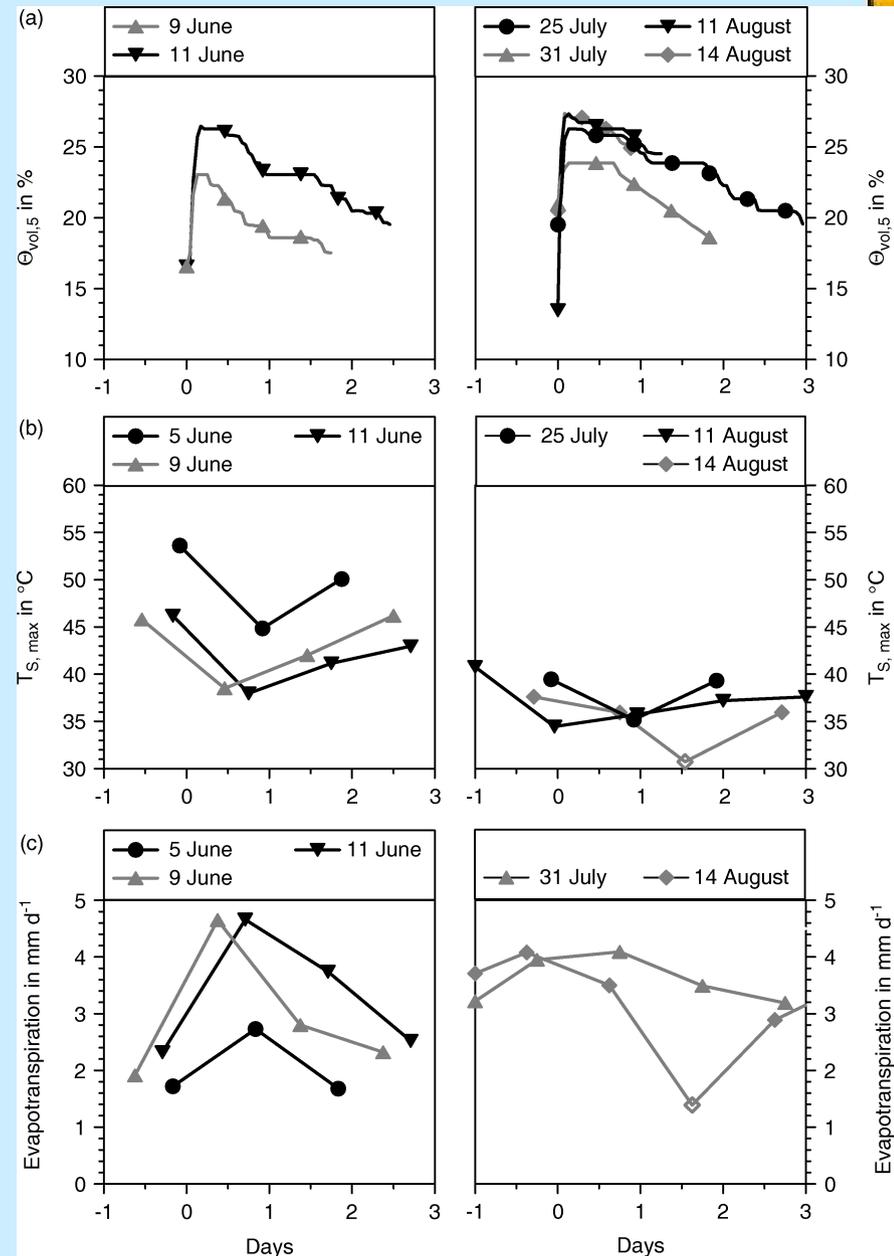
Impact on the surface fluxes

In June the surface keeps a memory of the last rain event for 2-3 days => Spatial contrasts of **surface fluxes** between wet and dry patches are maintained.

But this evolves through the season as the soil moistens and the vegetation grows.

How far can these evolutions of the surface processes be taken into account without a Dynamic Global Vegetation Model (DVGM) ?

This goes hand in hand with a representation of the CO₂ cycle.



Science question 3

How does a warming world affect climate extremes, and especially droughts, floods and heat waves, and how do land area processes, in particular, contribute?

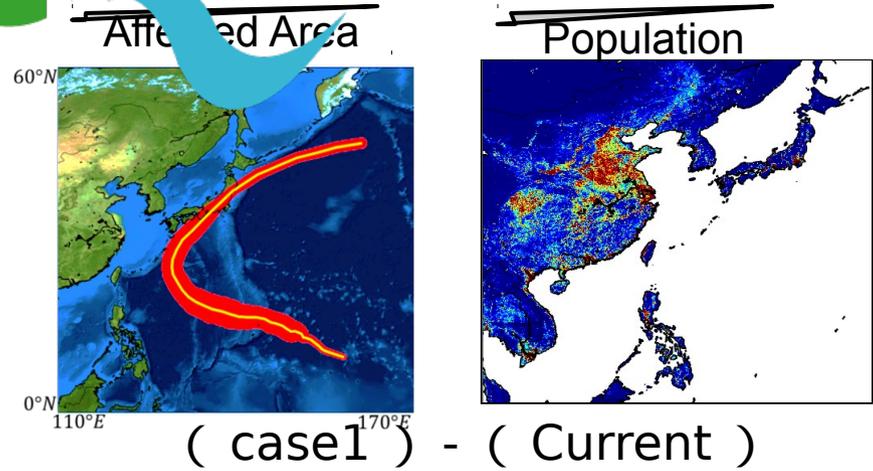
A warming world is expected to alter the occurrence and magnitude of **extremes** from droughts to rainfall intensity, and the geographic distribution of rain and snow.

Such changes are related to an acceleration of the hydrologic cycle and circulation changes as well as to the direct impact of warmer conditions on atmospheric water vapor amounts, rainfall intensity, and snow-to-rain occurrence.

How well are models able to handle extremes and how can we improve their capability?



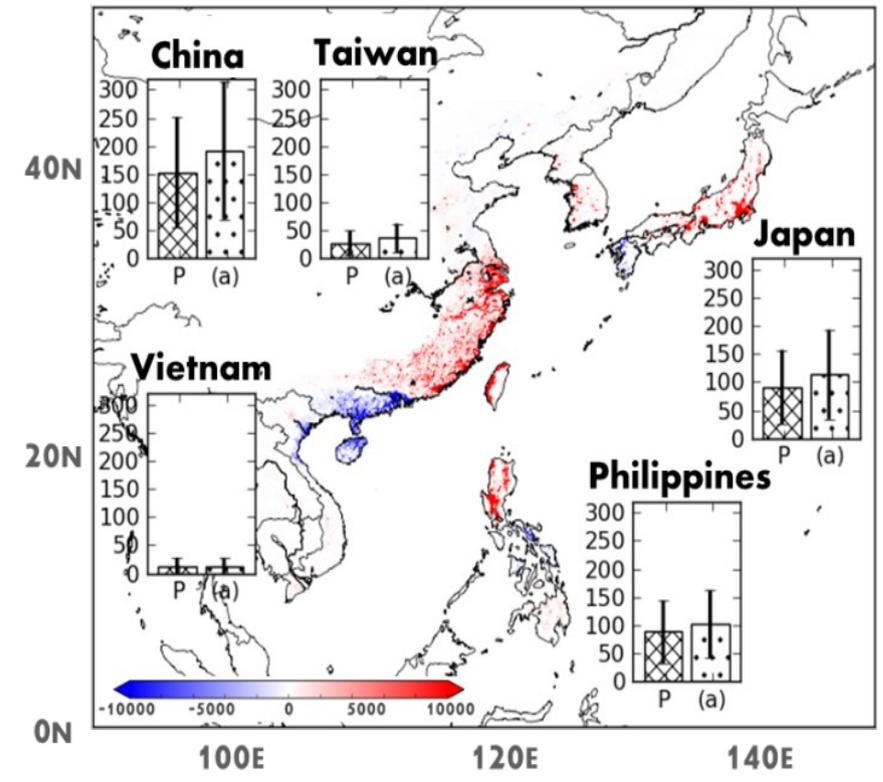
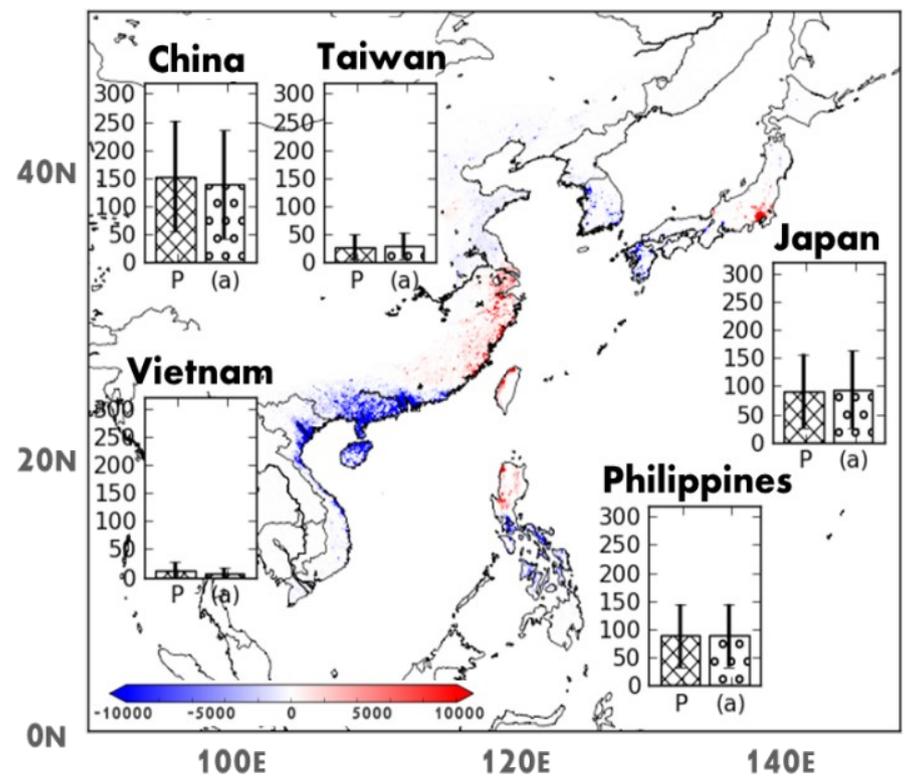
Tropical cyclone Exposure Changes (Above 25m/s by TC) (2000 → 2100)



Risk Assessment

Pressure Course	No Change	21% Change
	No Change	Current
With Change	Case1	Case2

(case2) - (Current)



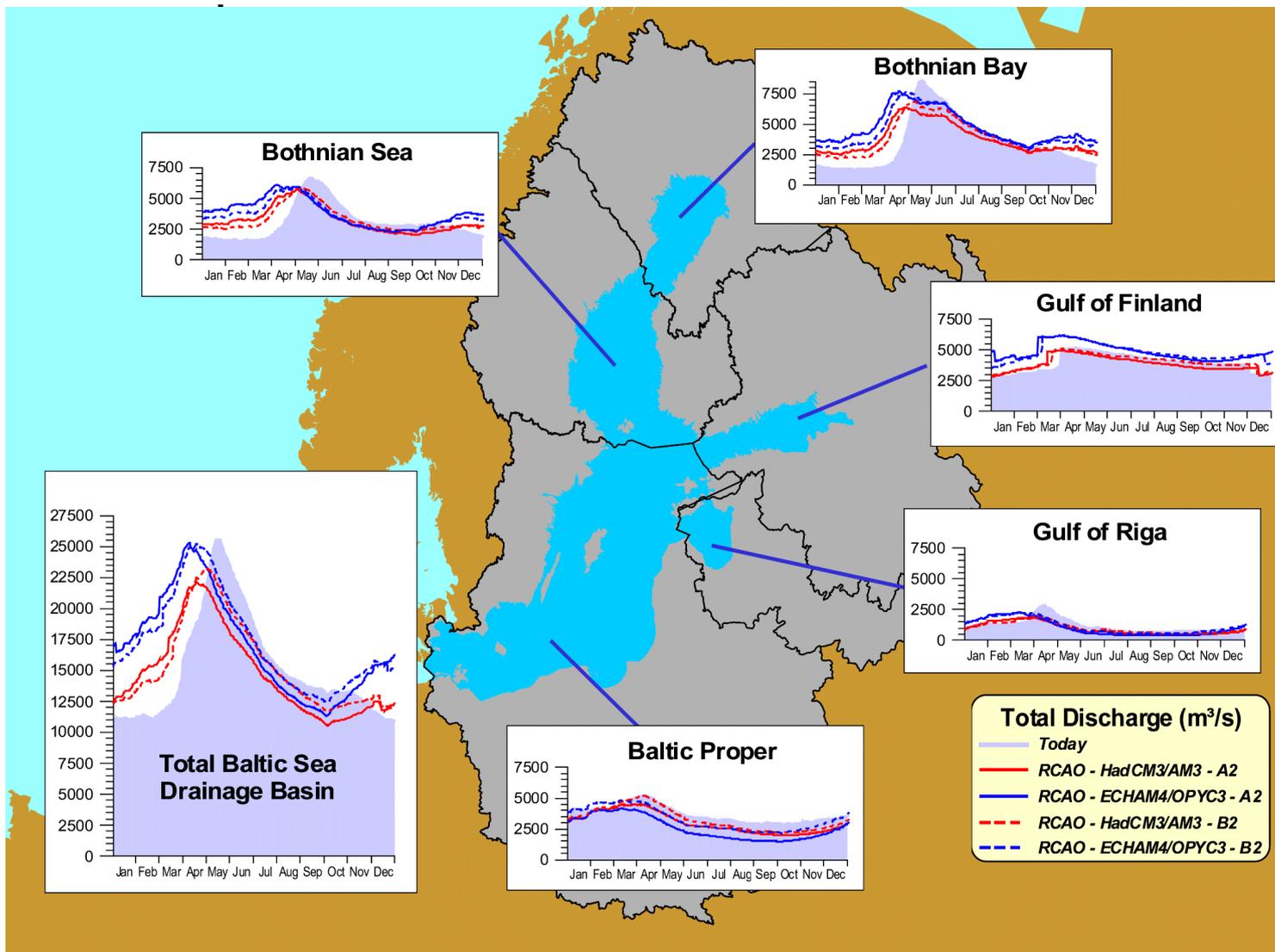
Vertical axis = Exposure [million],
Horizontal axis = (Present and Future)

(Kanae S. et al. in preparation)



BALTEX Phase II (2003-2012)

Projections of future anthropogenic climate



BACC

Total riverine discharge to the Baltic Sea

RCAO projections for 2071-2100 relative to 1961-1990

Discharge peaks come earlier in the year

Overall amounts increased

Lower salinities expected for the Baltic Sea

Science question 4

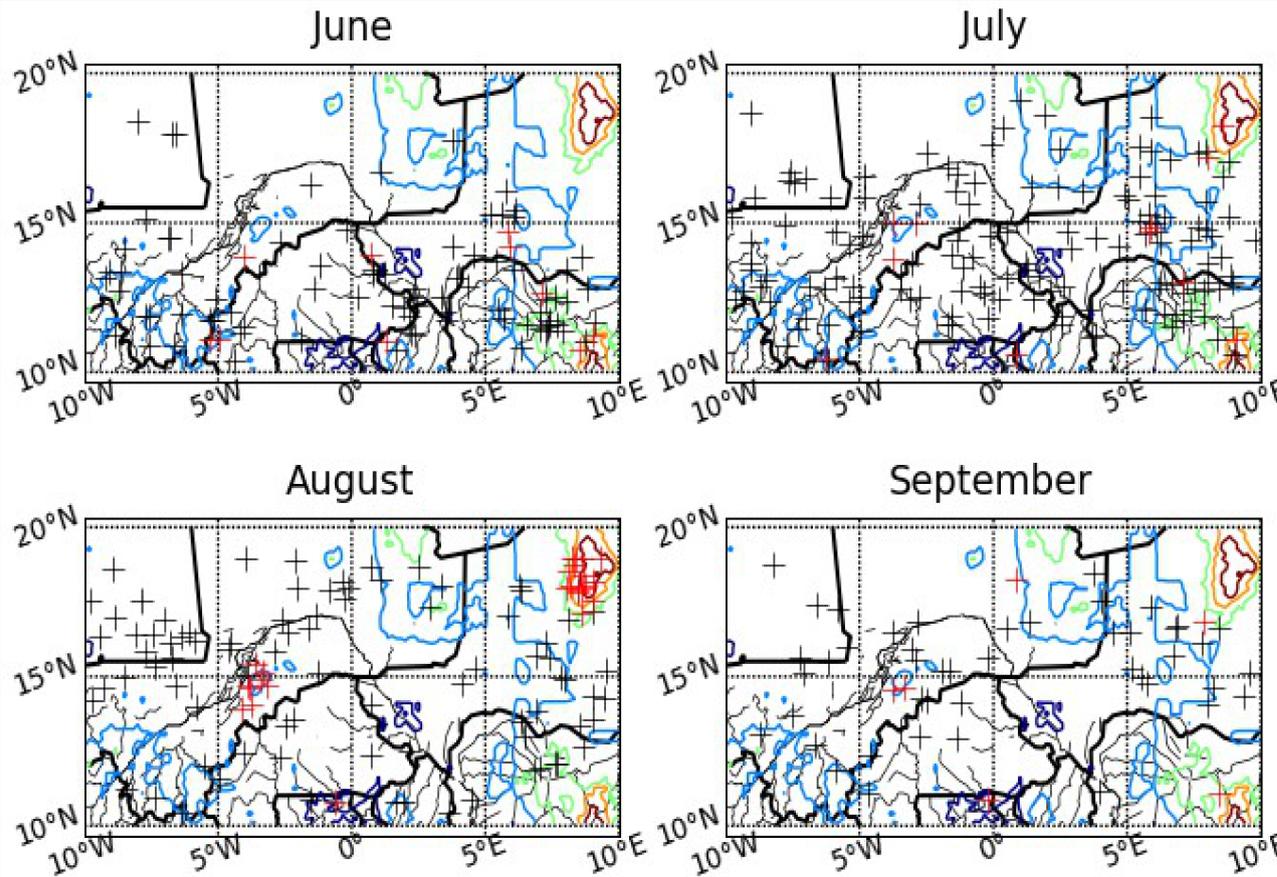
How can understanding of the effects and uncertainties of water and energy exchanges in the current and changing climate be improved and conveyed?

- *improve **consistency** between net solar and infrared radiation and sensible and latent heat fluxes at the surface*
- *understand **cloud-aerosol-precipitation interactions** and their **feedbacks** on the climate system.*
- *determine **processes**: must be replicated in climate models.*
- *better understand **uncertainties in observations and models***

*New **satellite, in situ observations, upgraded GEWEX datasets, global reanalyses of atmosphere and ocean, improved modeling, and advanced diagnostics** play key roles.*

Initiation of convection in 2006

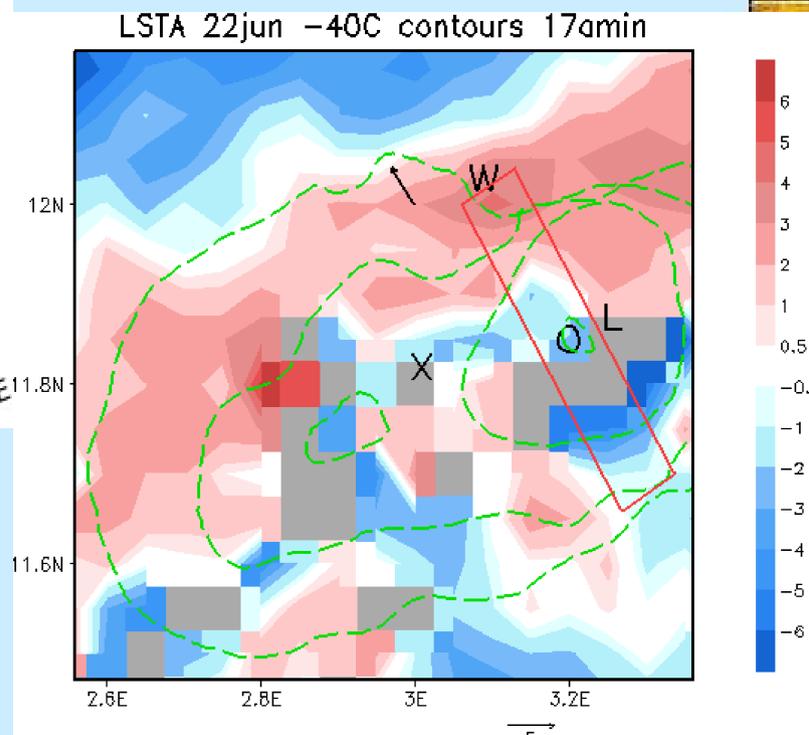
Using the ISIS system of Météo-France and Meteosat images the initial location of storms could be traced back .



(ISIS picks-up most systems around 16Z but first cold clouds are visible 2 hours earlier.)

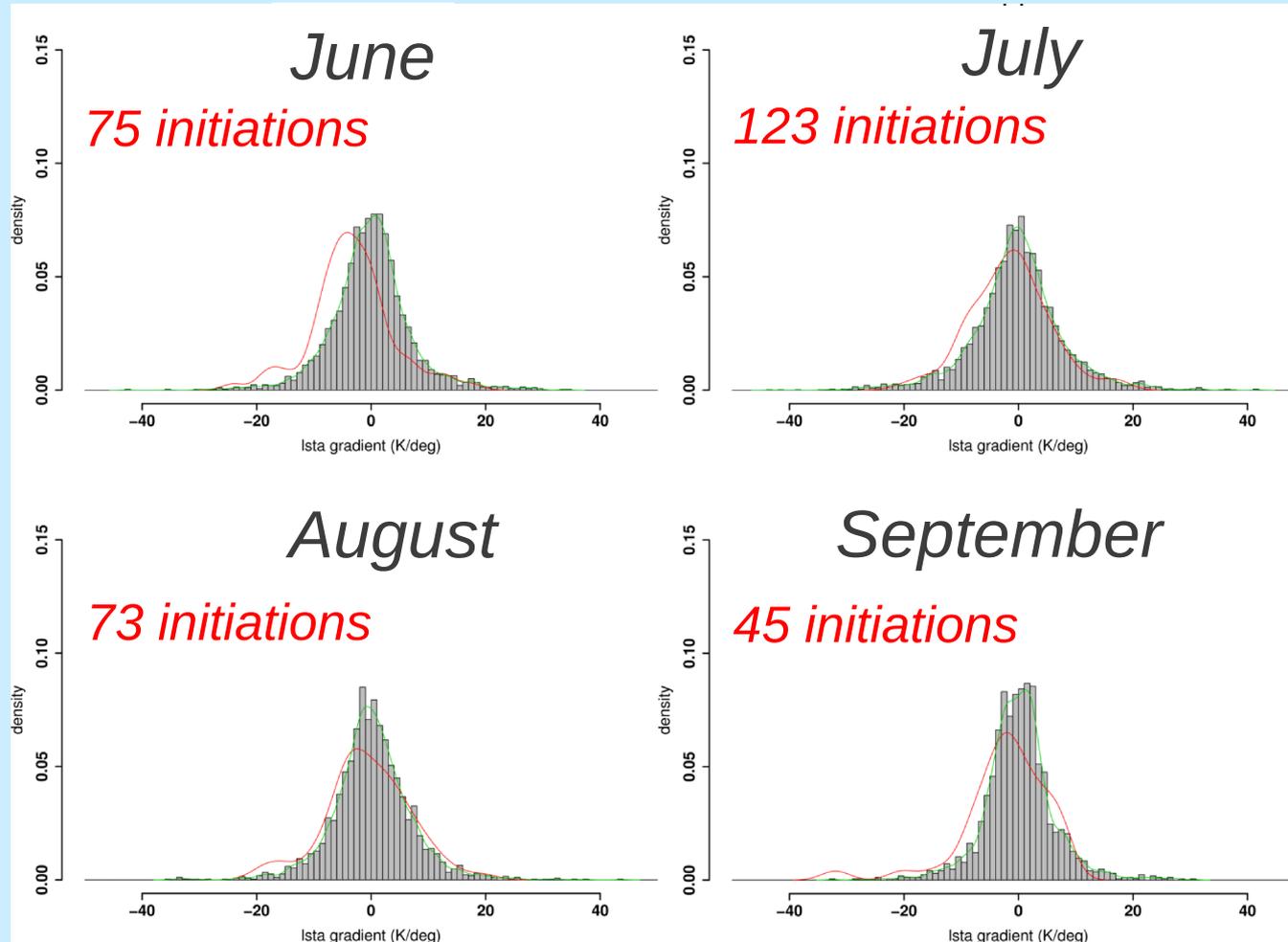
Taylor et al. 2011

The locations are then placed on the maps of surface temperature anomalies to compute gradients.



Initiation and temperature gradients

Gradients on randomly chosen points are computed to define a reference distribution.



Maximum initiation when :

- ★ T_s gradient is opposite to the direction of background wind.
- ★ Wind opposes the soil moisture induced circulation.
- ★ The length scale of grad. is 40km.

In this region soil moisture gradients enhance initiation of convection by 13% compared to 12% by orography. The role of soil moisture changes during the season.

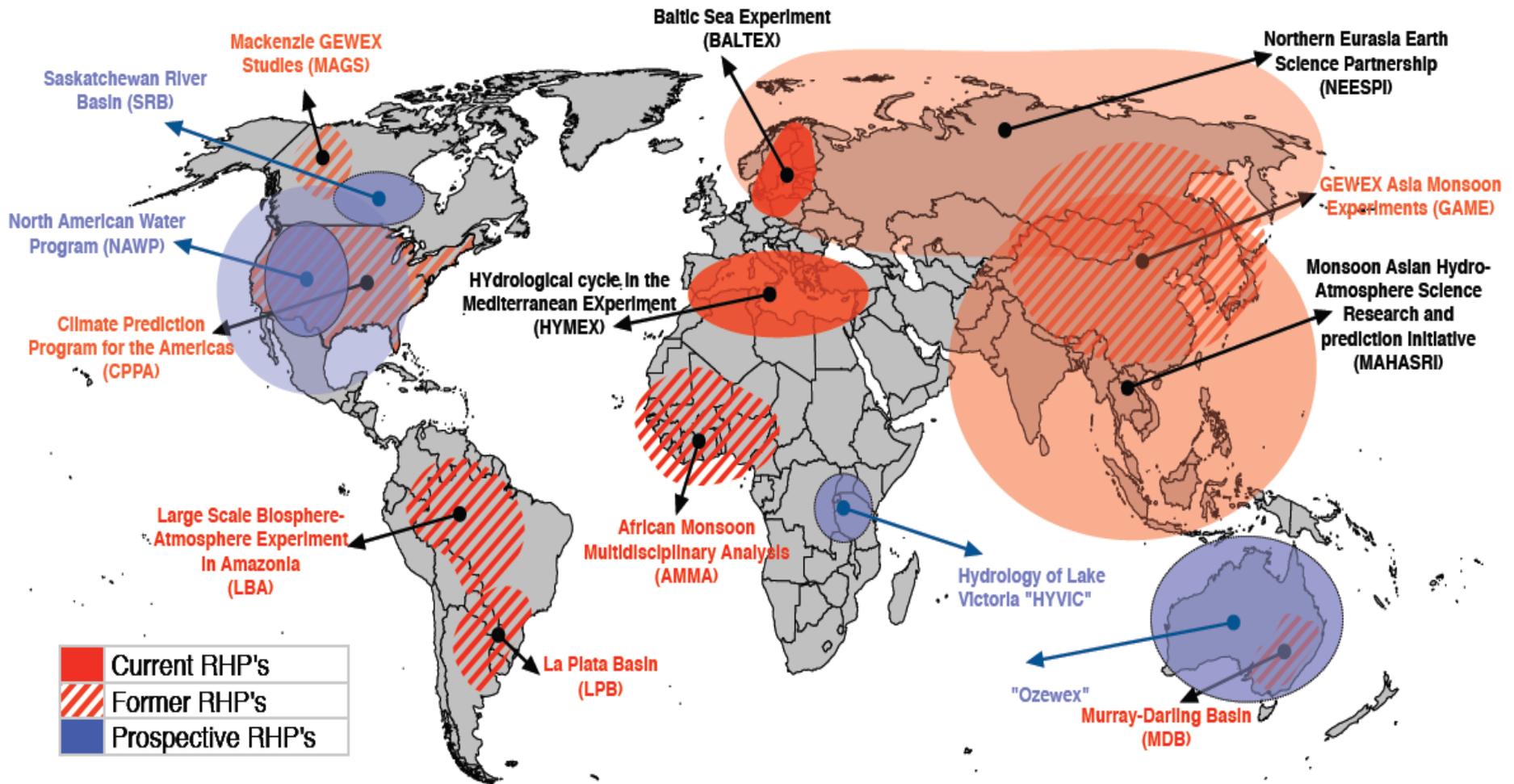


ID card of GHP within GEWEX

The GEWEX Hydrometeorological Panel aims to address these 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 aspects.
- ★ The Regional Hydrological Projects (RHPs) are an essential tool in this endeavor as they bring together various disciplines on the water issues.
- ★ The Cross-Cut projects allow GHP to propagate knowledge from one region to the other and synthesis results at the global scale. They also allow to develop and test applications developed with the new understanding (actionable science).

GEWEX REGIONAL HYDROCLIMATE PROJECTS



Completed
 LBA LPB
 MDB AMMA

active
 BALTEX, HYMEX
 MAHASRI NEESPI

proposed
 SaskRB HYVIC BALTEX-3
 NAWP MDB-2

Objectives of Cross-cut projects

- ★ Push GEWEX grand science questions
- ★ Cross-cut projects should also test and evaluate applications of the knowledge produced in RHPs.
- ★ Keep completed RHPs involved
- ★ CC projects are also a tool for collaboration with other GEWEX panels and WCRP projects.
- ★ Generate interactions between RHPs
- ★ A way for the broader Community to get involved in GEWEX/GHP.
- ★ GHP calls for volunteers to propose and lead Cross-cut projects. Only a short proposal to the panel is needed.

GHP and the GEWEX science questions

Grand Science Questions

Regional Hydrometeorological Experiments

Cross-cut activities

Grand Science Questions	Regional Hydrometeorological Experiments					Cross-cut activities
	BALTEX-II	HyMeX	MAHSRI	NEESPI	SRB	
1) Observations and Predictions of Precipitation	How well can precipitation be described ?	y	y	y	y	High elevation precipitation Rainfall extremes
	How do changes in climate affect the characteristics ?	y	y	y	y	
	How much confidence do we have in predictions ?	y	y	y		
4) Global Water Resource Systems	How do changes in the land surface and hydrology influence water resources ?	y	y	y	y	Climate change & Water resources
	Climate change and water resource systems impacts.	y	y	y	y	
	How can new observations lead to improved management ?			y	y	
3) Changes in extremes	Observing system requirements.		y	y	y	Droughts GHP/CORDEX cross-cut
	Modelling capabilities.		y		y	
	Modelling processes involved in extremes.		y		y	
	Improved early warning systems.			y	y	Hydrological seasonal forecasting
4) Water and energy cycles	Can we balance the budget at TOA ?					LSM validation GDAP product evaluation
	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.					

Collaboration with global projects

The regional work also needs to be linked with global data sets and expertise.

This is done through collaboration within GEWEX :

- ★ Global Data Assessment Panel (GDAP)
- ★ GEWEX Land/Atmosphere system study (GLASS)

Outside of GEWEX GHP collaborates with :

- ★ Global Runoff Data Center (GRDC)
- ★ Global Precipitation Climatology Center (GPCC)
- ★ HYDROLARE

GHP's regional expertise and data allow to anchor and strengthen the global products.

Conclusion

- ★ GHP is an essential element in GEWEX's strategy to answer key questions on the energy and water cycle.
- ★ The strategy to address GEWEX's scientific questions is through regional hydrometeorological projects and cross-cut activities.
- ★ The regional focus of GHP also allows to reach out to applications and transform our knowledge into actionable information.
- ★ The panel has gone through a reorganization and is thus looking for volunteers and opportunities for
 - ◆ Building new RHPs
 - ◆ Proposing cross cut projects.