GEWEX

40th Session of the WCRP Joint Scientific Committee

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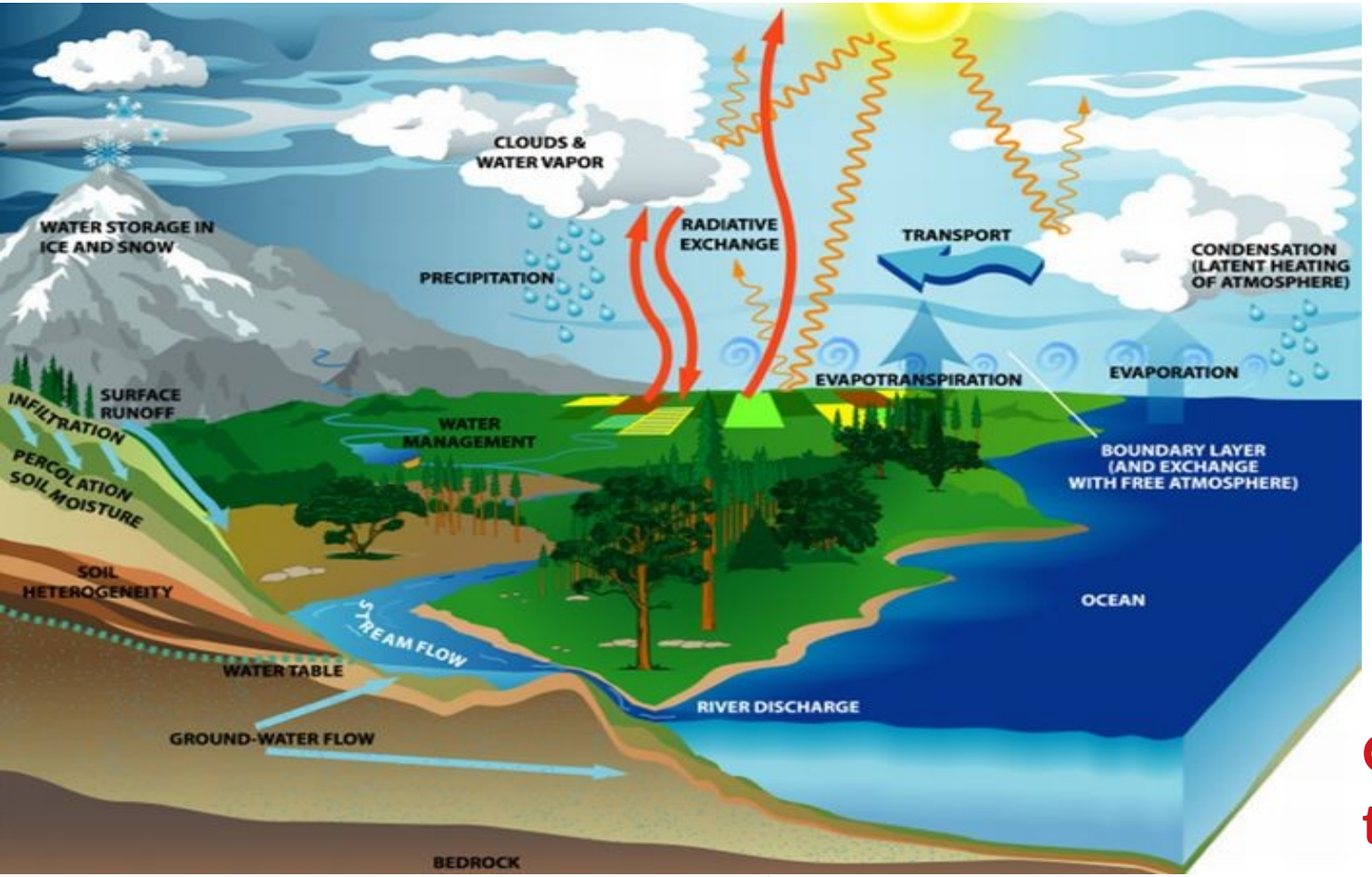
WORLD METEOROLOGICAL ORGANIZATION
UNESCO United Nations Educational, Scientific and Cultural Organization
Intergovernmental Oceanographic Commission
International Science Council
WCRP World Climate Research Programme

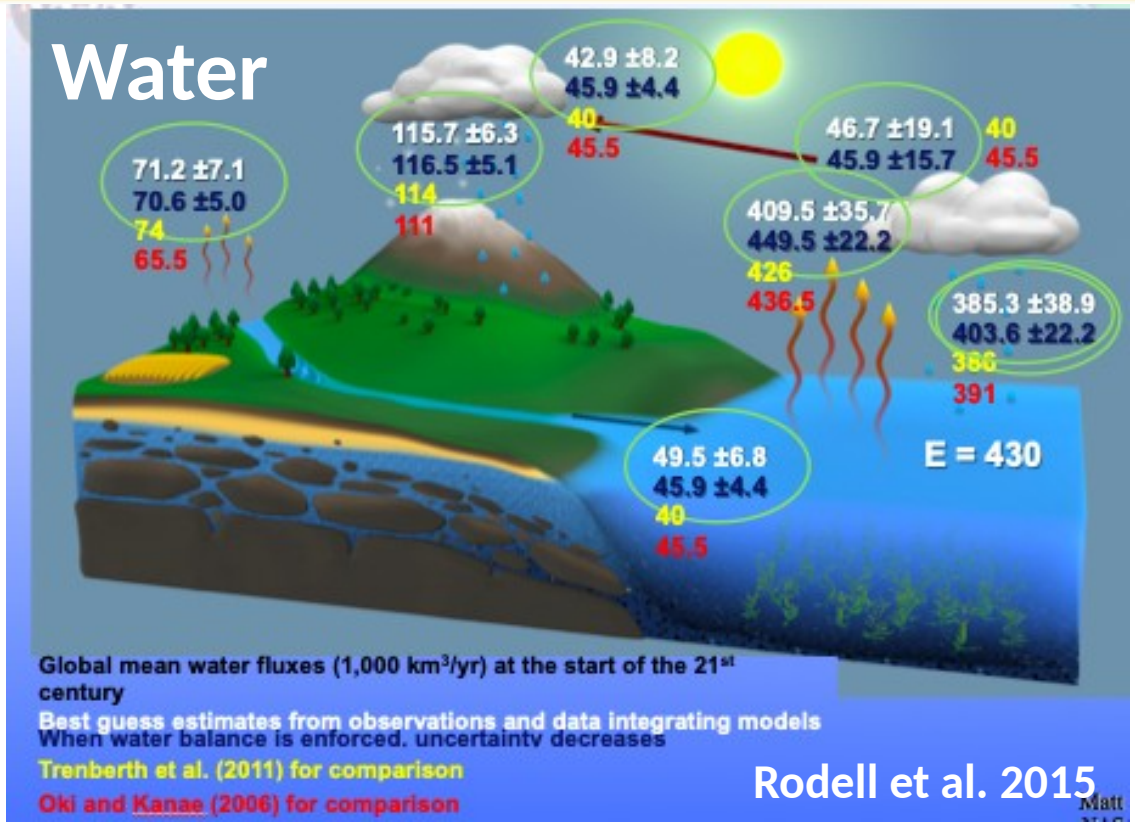
The GEWEX core projects

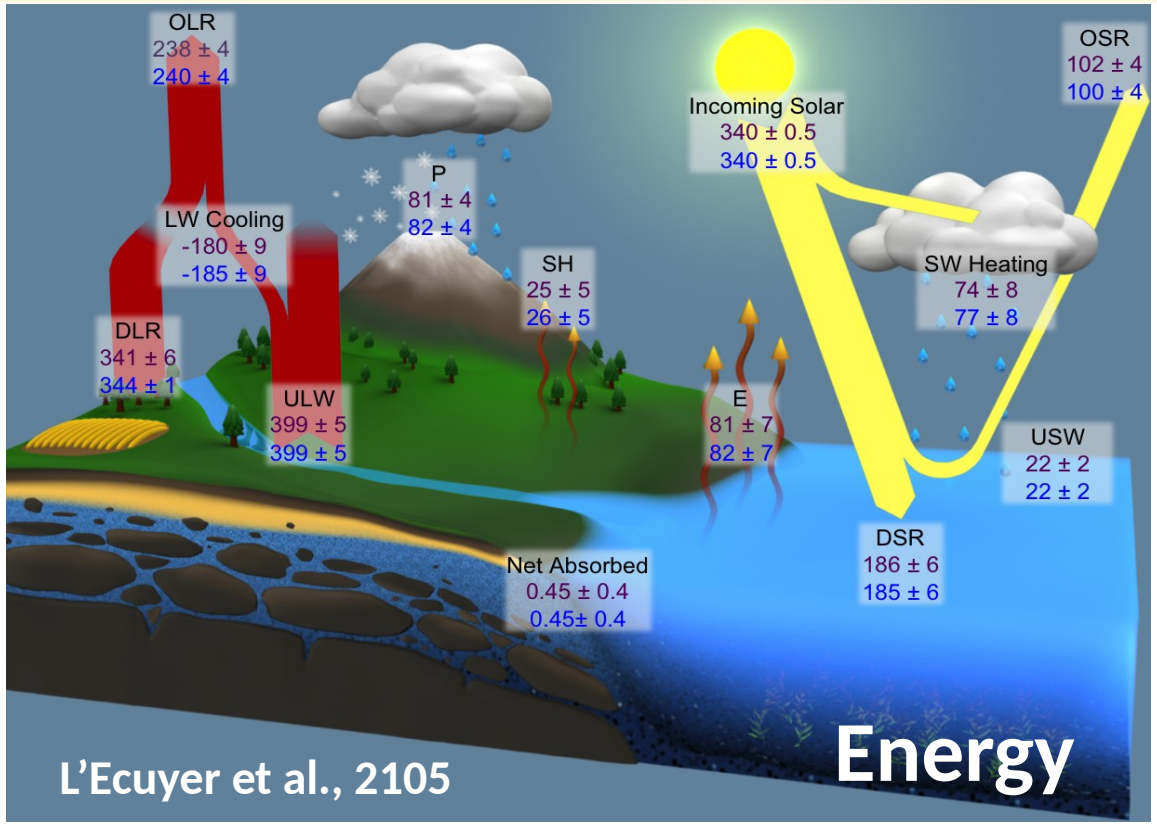


- Is an integrative multi-disciplinary program on the water and energy cycle and their coupling.
- It is global to regional and local.
- It is process driven and focuses on fast feedback (precipitation, clouds, convection, ABL, evaporation, …).
- It focuses on the coupling of land and atmosphere.
- Continental water storage

GEWEX evolved from flux quantification to process understanding.

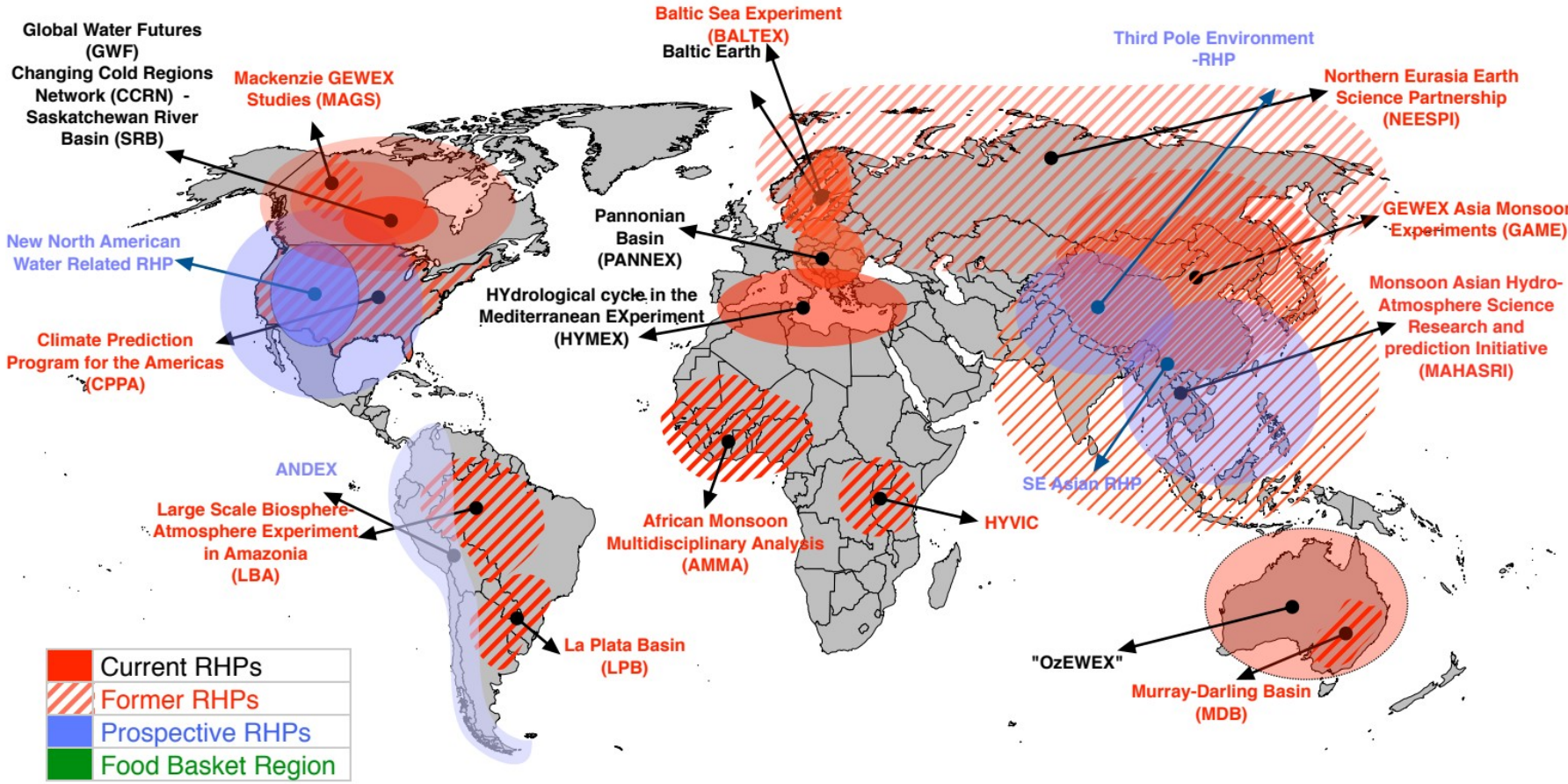
GEWEX has led the integration of global observations





More than 50 different global data streams were objectively integrated to produce these synthesized views of earth fresh water and energy cycles

The GEWEX a regional integrator



- Building and integration of scientific communities and interaction with stakeholders.
- Integrate global regional and local observations.
- Enable scientists in the regions to apply global data sets.

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WCRP
World Climate Research Programme

A GEWEX ‘science and applications traceability matrix’

Provides traceability from WCRP strategies, to core science, to defined metrics to applications and to programs

The GEWEX Mission: Quantitative understanding and prediction of the coupling of energy and water in the changing Earth system

WCRP SP	GEWEX Goals	Overarching Science Questions	Objectives	Quantified metrics	Societal applications	Programmatic Links	WCRP IP

GEWEX $ATM is still work in progress

SSG

SSG

WCRP strategy

Panels : Bedrock science

WCRP implementation

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International Science Council

GEWEX Goal 1

WCRP SP	GEWEX Goals	Overarching Science Questions	Objectives	Quantified metrics	Societal applications	Programmatic Links	WCRP IP
WCRP science Objectives **Contributes to :**   	**Determine the extent to which Earth's water cycle can be predicted?**	**1) Reservoirs:** What is the rate of expansion of the atmospheric reservoir, what is its spatial character and and what factors determine this? **2) Fluxes**: To what extent are the fluxes of water between Earth's main reservoirs changing and are these changes predictable? **3) Extremes:** How will local rainfall and its extremes change under climate change across the regions of the world?	**O1** Quantify and explain space time changes to water vapor and clouds and associate to processes that influence them **O2** Soil moisture characterization **O3** Provide quantitative assessment of fluxes of water between Earth's water reservoirs, including their space/time variability and uncertainty. **O4** Global assessment of the weather features that cause rainfall including extremes **O5** Assessment of climate models' ability to simulate the rain-bearing weather systems? **O6** Reduction of model systematic errors in rainfall to within the observational uncertainty **O7** Reduction of observational uncertainty in global daily rainfall products	Assessment reports on rain-bearing weather features Assessment report on model's ability to simulate the weather-to-rainfall connection Model systematic error in rainfall is within observational uncertainty Observational uncertainty reduced by 30%	Hazard prediction Adaptation Planning Insurance Risk assessment …	WWRP Hydrology activities CLIVAR …	**WCRP science Objective** 

GEWEX Goal 2

WCRP SP	GEWEX Goals	Overarching Science Questions	Objectives	Quantified metrics	Societal application	Programmatic Links	WCRP IP
WCRP science Objectives **Contributes to :**   	**Determine the interrelationships between Earth's energy and water cycles.**	1) How can we improve the understanding of climate forcings and feedbacks formed by energy and water exchanges? 2) To what extent are the properties of the the ABL defined by energy and water exchanges at the Earth's surface and within the atmosphere? 3) To what extent are exchanges between water and energy determined by the circulations of the atmosphere and oceans?	*Comment - the objectives will address forcings that involve aerosol and aerosol-cloud and water based feedbacks including water vapor, cloud, precipitation and surface related feedbacks* *Comment – will involve fluxes of energy and water exchanges, P, E and ET at surface, PLBL clouds, etc I can imagine a PROES – we have global PBL heights for decade + that are barely studied* *O# - PBL diurnal cycle*		Climate policy, et …	WWRP Hydrology activities CLIVAR CLIC SPARC CFMIP and CMIP6 Clouds/ circulation GC	**WCRP science Objective** 

GEWEX Goal 3

WCRP SP	GEWEX Goals	Overarching Science Questions	Objectives	Quantified metrics	Societal application	Programmatic Links	WCRP IP
WCRP science Objectives **Contributes to :**   	**Quantify the anthropogenic influences on the water cycle**	1) To what extent has the changing greenhouse effect modified the water cycle over the continents? 2) To what extent do water management practices modify the water cycle on regional to global scales? 3) How do hydrological processes and warer & land use affect the variability of the continental water cycle ?	O1 Quantify the effects of water withdrawals and usage on the freshwater flows into the oceans O2 Attribute observed changes to the continental water cycle to climate change and water management. O3 Quantify effects of water withdrawal on river discharge within climate variability O4 Quantify effects of irrigation on land-atmos interaction O4 Extremes in a managed environment.	1) Add human influence to coupled high res models (eg USRHP/water GC)	• Water resources • Water managem ent	ILEAPS, CORDEX, IHP, WMO-Hydro, ...	**WCRP science Objective :** 

Goal 1 implementation

WCRP SP	GEWEX Goals	Overarching Science Questions	Obj		
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1) Reservoirs:
GVaP Water vapor Assessment
Cloud Assessments
New cloud initiative (ISCCP nex-gen)
Soil and ground water

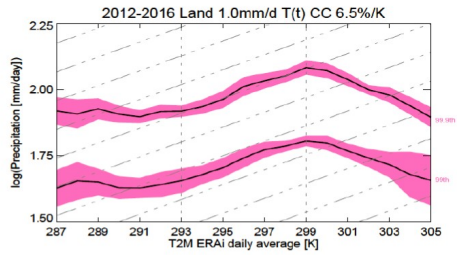
2) Fluxes:
1) E,ET (GHP)
2) Precipitation Assessment (GDAP, GHP)
3)Precipitation extremes (GDAP, extremes GC)

Joint GC Extremes and GDAP meeting (2/3)

$$P_e = -\epsilon\left\{\omega_e \frac{dq_s}{dp}\Big|_{\theta^*}\right\}$$

$$\frac{\delta P_e}{P_e} \propto \frac{\delta q_s^{surface}}{q_s^{surface}}$$

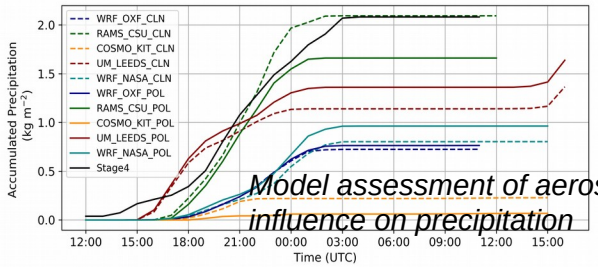
~6-7%/K



Ensemble of satellite precipitation data using the microwave constellation shows strong consistency with surf Temp confirms the theory for the tropics

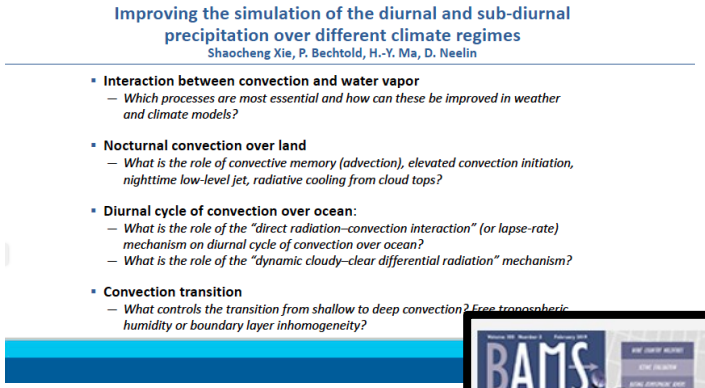
3) Precipitation Processes

1) PROES
- Warm rain PROES – why are all models so dreary?
- GAP – aerosol influences on precipitation (Nat Geosci. review)



Model assessment of aerosol influence on precipitation

2) Improving the simulations of the diurnal and sub-diurnal precipitation (GASS)



3) New model Assessment tools

New SSG Initiative

Goal 2 implementati

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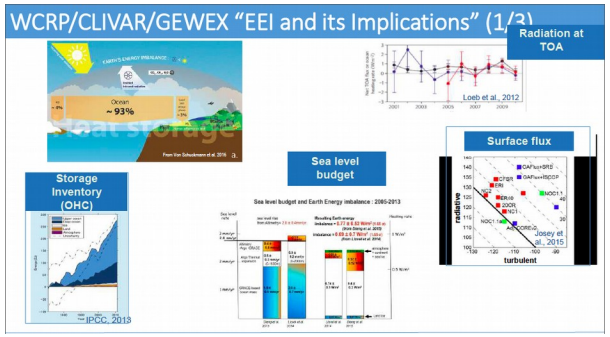
1) Energy balance activities

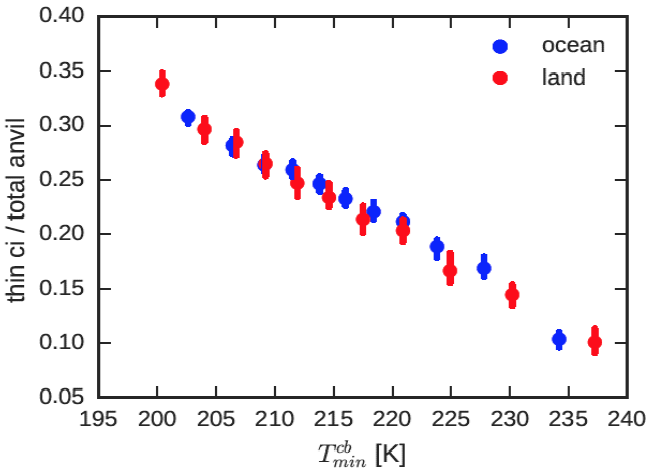
1) New initiative - EEI Assessment



2) Ongoing TOA and Sfc ERB evaluation

2) Cloud Feedbacks activities

1)UTCC PROES

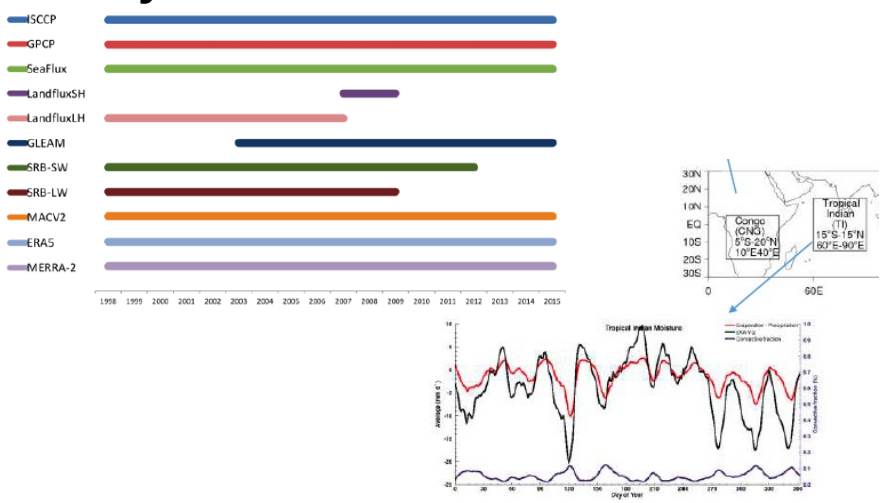


Basic understanding of relation between high clouds and convection – central to high cloud feedback

2) CFMIP (circulation)

3) ISCCP-Next Generation (new initiative) - cloud property variability

3) Integrated energy/water data & analysis activities



Goal 3 implementa

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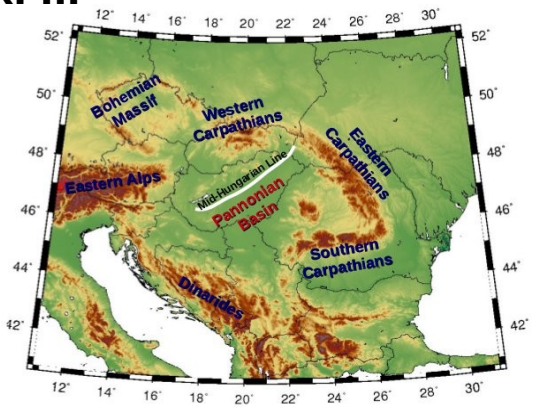
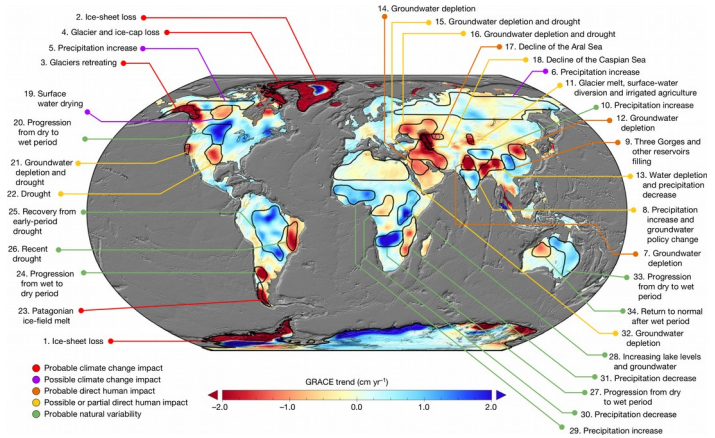
1) Water for the Food baskets of the World Grand Challenge
2) Regional hydroclimate projects (RHP) : PannEx, AndEx. ...

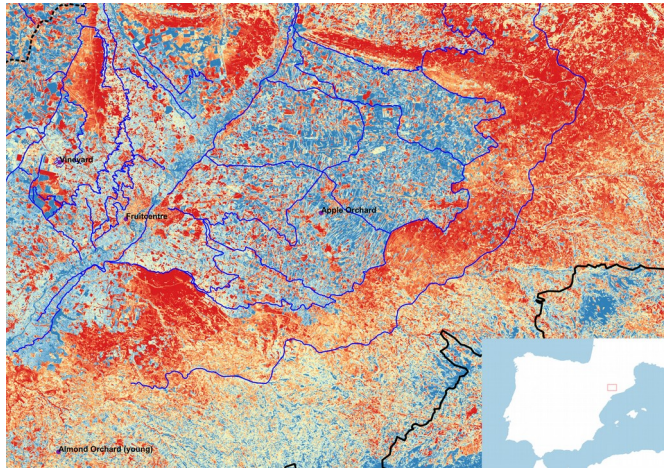


1) Remote sensing of reservoirs



2) Assimilation of fluxes to detect anthropogenic signals

1) LIAISE field campaign of the HyMeX program in the North East of Spain



Extremes Grand Challenge

L. Alexander, G. Hegerl, S. Seneviratne, and X. Zhang

Looking Forward:

- Questions remain (data, process understanding, modeling, detection and attribution)
- Inclusion of compound events
- Development of guidance documents on future projection of extremes to be released after the conclusion of IPCC WGI AR6 report
- Completion of guidance document on suitability of rainfall datasets for studying extremes and the coordination of input into IPWG and IPCC (both latter: Alexander)
- ‘old extremes’ to test methods and processes
- What gives skill to decadal predictions – forcing for sure do initial conditions add beyond 1-2yrs?

Issues:

- Interaction with other WCRP groups with extremes angles: ensure cross-fertilization and use of a coordinated approach
- Potential for transitioning to a more sustained activity within WCRP to interface with society.
- Implementation is heavily relying on in kind support; need continued WCRP support for grand challenges (financially and programmatically)

Water for Food Baskets Grand Challenge

J. Polcher, R. Rassumssen P. van Oevelen

Looking forward :

- More RHPs initiated around dense agricultural areas to better understand the interactions with the water cycle.
- First field campaign to understand the interactions of irrigated parameters and the lower atmosphere.
- Developing crop tiles in land surface models and adding irrigation and water management to the hydrology.
- Model inter-comparisons to be organized to evaluate the details needed for anthropogenic water use to Earth system models.

Challenges :

- Involve the various panels of GEWEX and ensure they contribute their expertise :
  - GLASS in order to coordinate crop and irrigation modeling in LSMs.
  - GLASS/GASS : for coupling studies over managed land areas.
  - GHP for interaction with regional climate research and the Evaporation CC.
- Interactions with CliC, CLIVAR & CORDEX to evaluate the impact on the Earth system.

Issues brought to the attention of the JSC

- **Earth Energy Imbalance initiative** :
  - Quantitative uncertainty assessment of current EEI approaches.
  - Broader WCRP energy balance integrative theme?
    - Regular updates and assessments of water and energy sythesis.
    - Regional assessments as well.

- **Regional activities within WCRP** :
  - Regional activities are key for GEWEX because of the strong link between the water cycle and human activities.
  - An ideal setting to perform process oriented observations.
  - An opportunity to help and coordinate climate research communities in the area.
  - Ensures our research is disseminated to all regions of the world.
  - WGRC has developed a strategy over the years to ensure that WCRP science serves also serves societies which are not at the forefront of climate research.