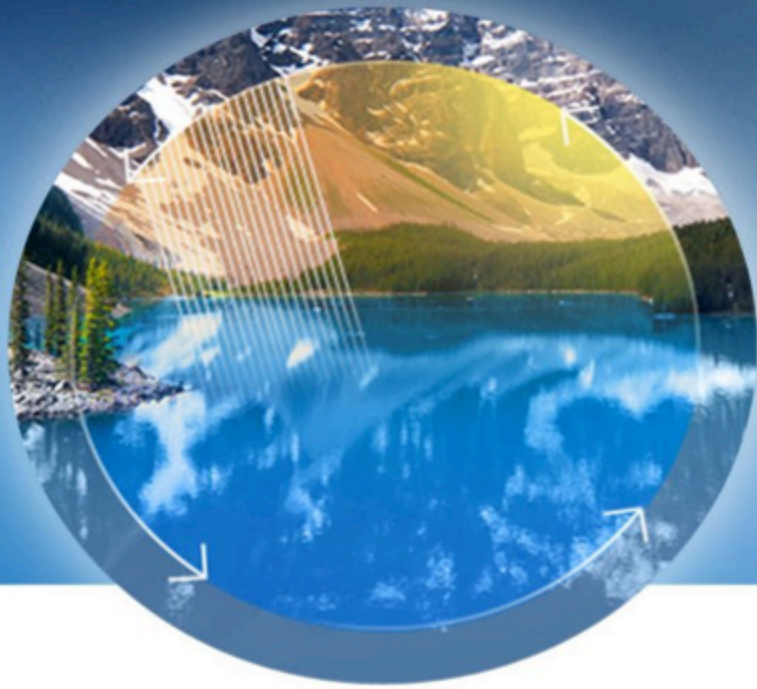


ABOUT *WATER, ENERGY, & CLIMATE*



The phases of GEWEX and our challenges in going forward

What has remained throughout is focus on processes, a strong emphasis on meaningful observations and on data stewardship, on EO assessments and on linking all this to model development all for the purpose of understanding and predicting the Earth system

“Water, Energy: Life on Earth”


“For life on Earth we will do anything” Betts, 2018

Big Science Questions that have and will continue to motivate GEWEX

❑ *Where does the heat go?*

❑ *How is the fresh water on the planet
changing?*

❑ *Where does the carbon go?*

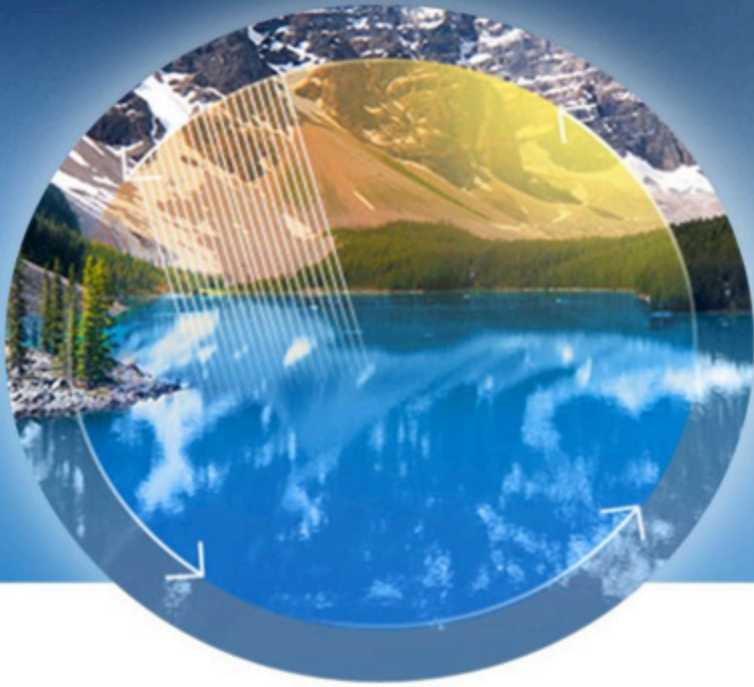


3 fundamental
'reservoir'
questions

**& we are encroaching more & more onto a third and our
GEWEX challenge is 'whither carbon?'**

The formative phase

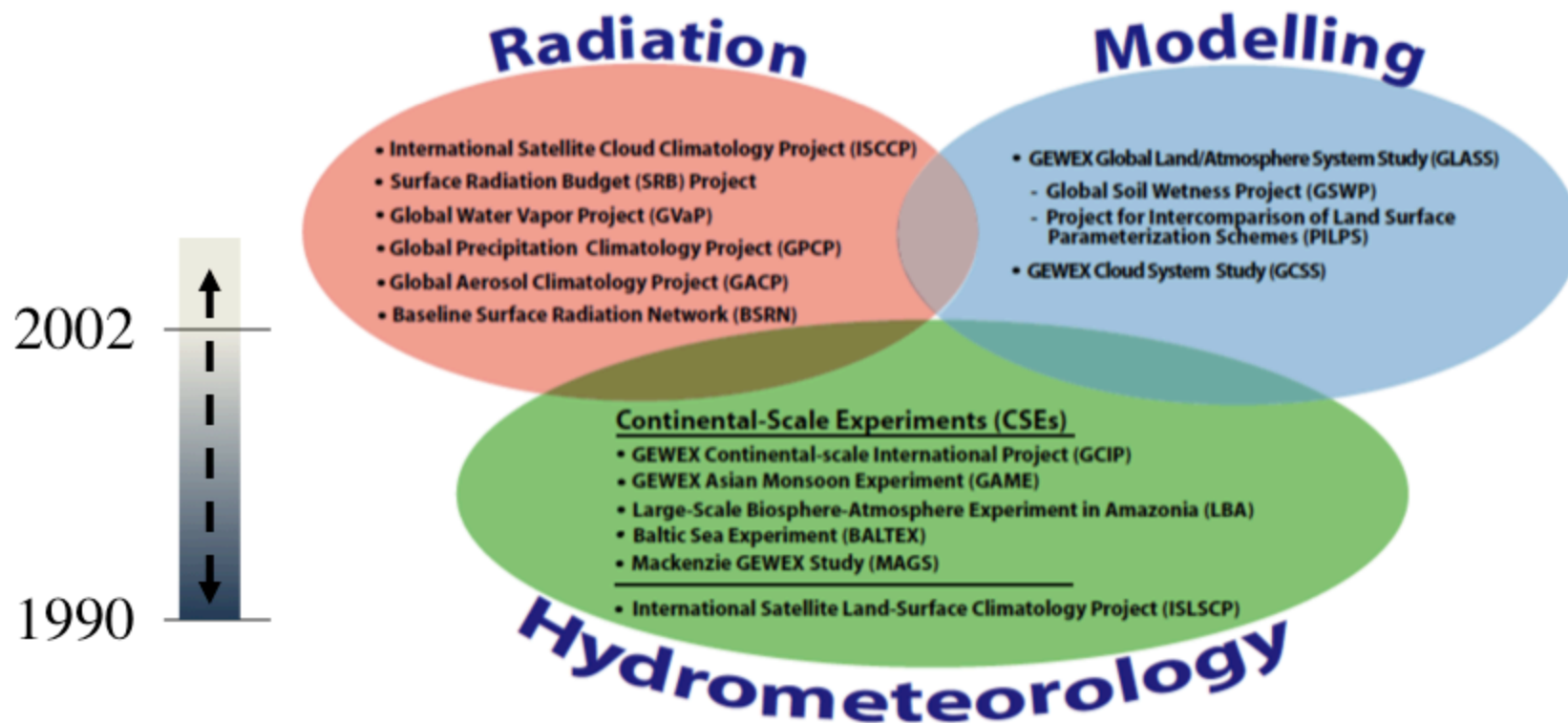
ABOUT
*WATER, ENERGY,
& CLIMATE*



GEWEX was originally launched because GARP failed to provide adequate quantitative understanding of the atmospheric processes that control climate (Pierre Morel, pers comm).

GEWEX was conceived to exploit the new Earth observations coming on line from EOS and it was formulated as a comprehensive research program (observation including new satellite instruments, data analysis and modeling) focused on fast atmospheric and hydrologic processes, in order to pursue the second objective of GARP (Pierre Morel, per comm)

PHASE I: 1990-2002



Full uncertainty on key data products needed to quantify water and energy reservoirs were not available. Oversight and important surface network observations also occurred.

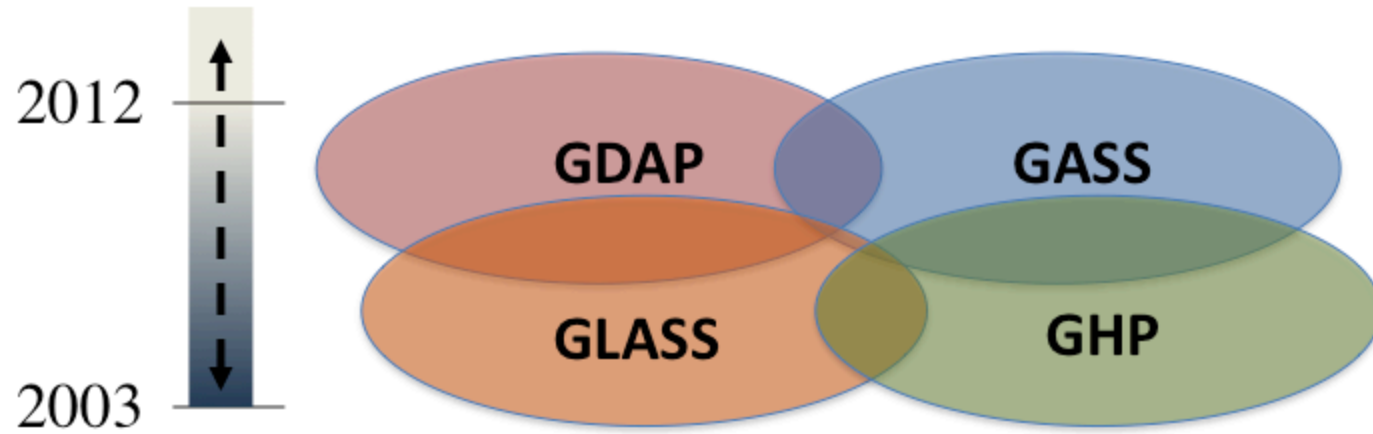
Certain energy fluxes at surface were still not developed

Cloud and precipitation data, although short of what was needed, were evolving but these still weren't fully exploited in model development activities (GCSS)

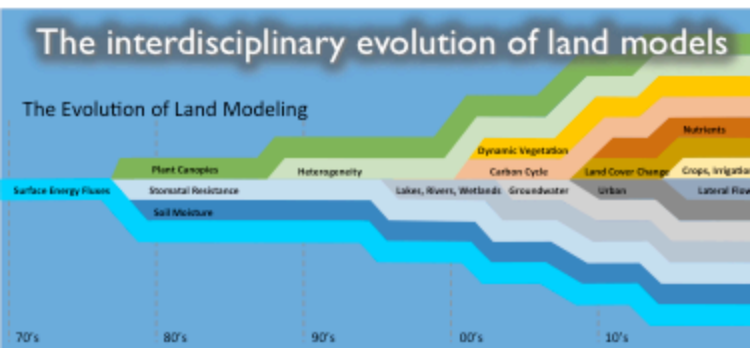
Understanding the coupling to land surface was developing, maturing

Regional hydrological research foci was becoming an important GEWEX guiding framework

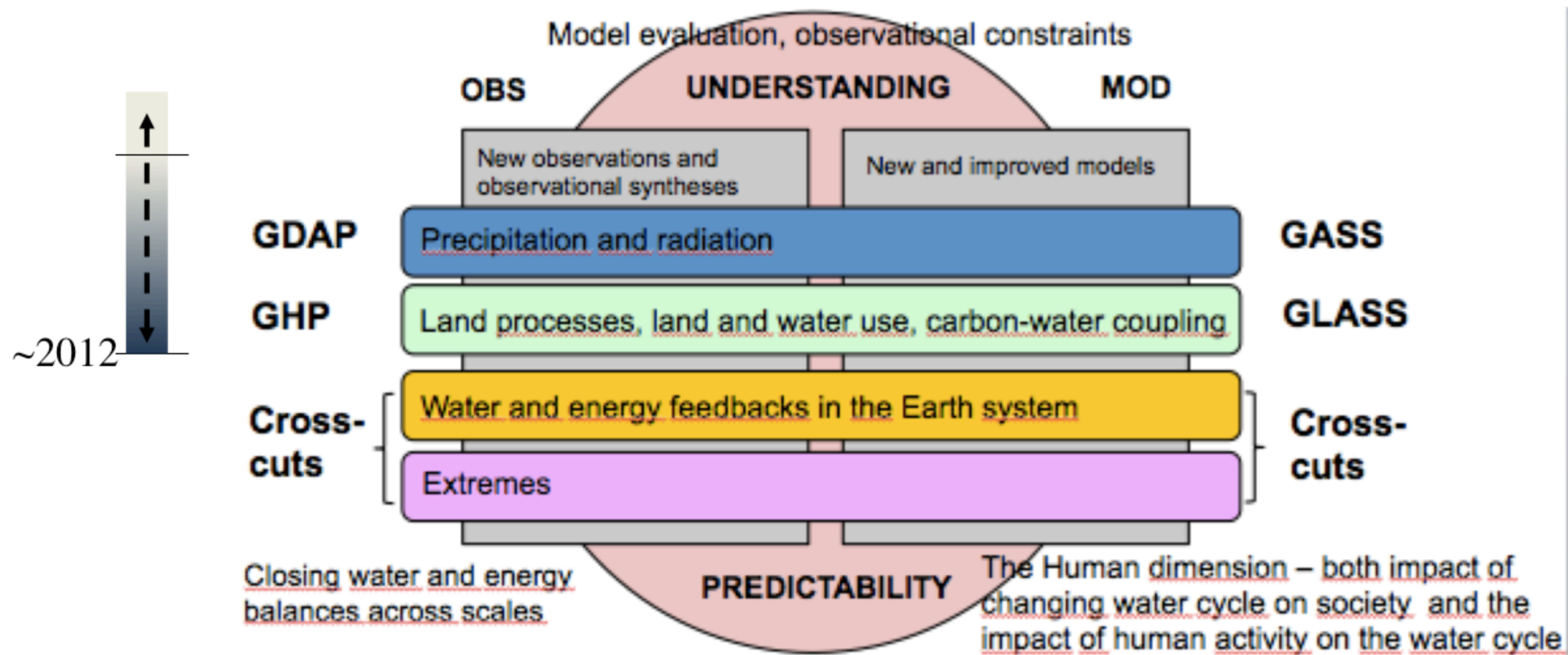
PHASE II: 2002-2012 – a period of consolidation



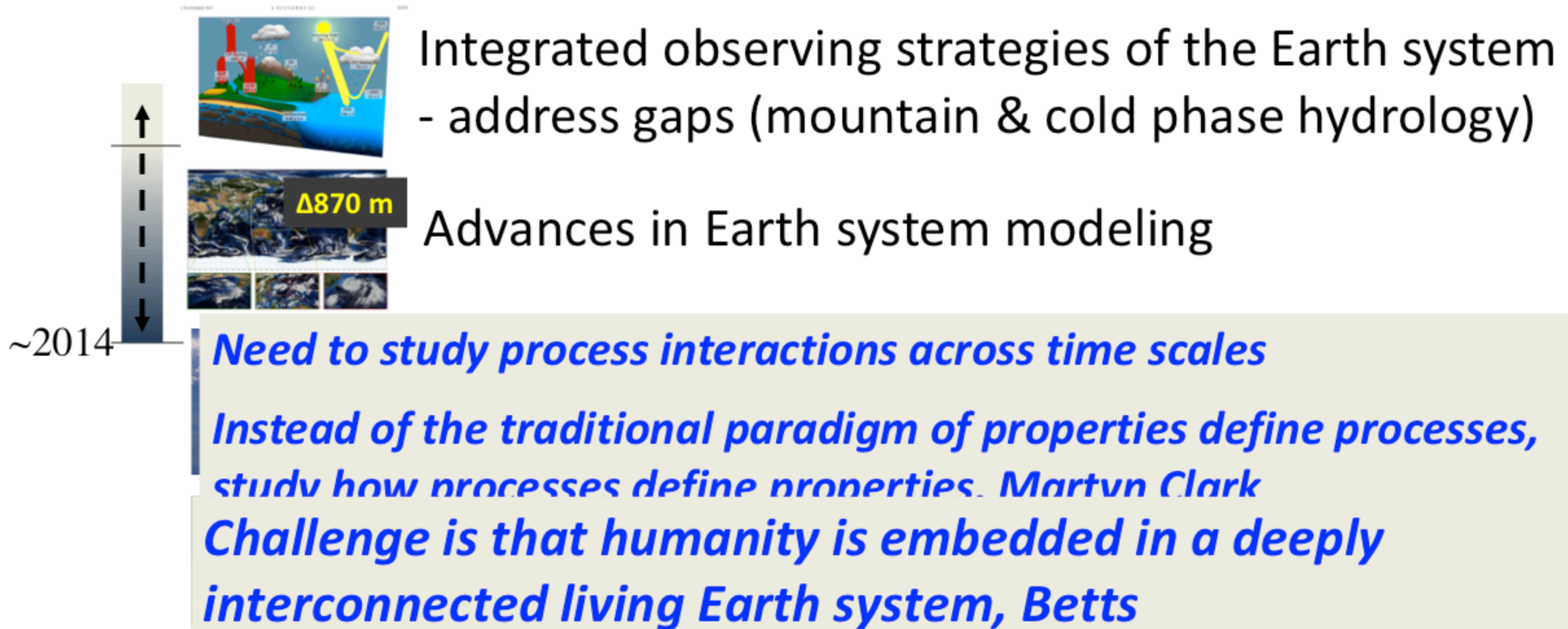
- Data products were maturing, data records were growing in length (decadal+) and detailed assessments of capabilities were developed (clouds, ERB,..)
- Gaps in representation of water and energy budgets were being filled (eg LandFlux, Seaflux)
- Regional Hydroclimate Projects began to have impact and science flourished.
- Process level understanding began to engage modeling activities (e.g. CFMIP)
- Major progress in land/atmosphere coupling, evolution in LSMs, and coupled process interactions



Phase III: Quantitative understanding and prediction of the Global water and energy system

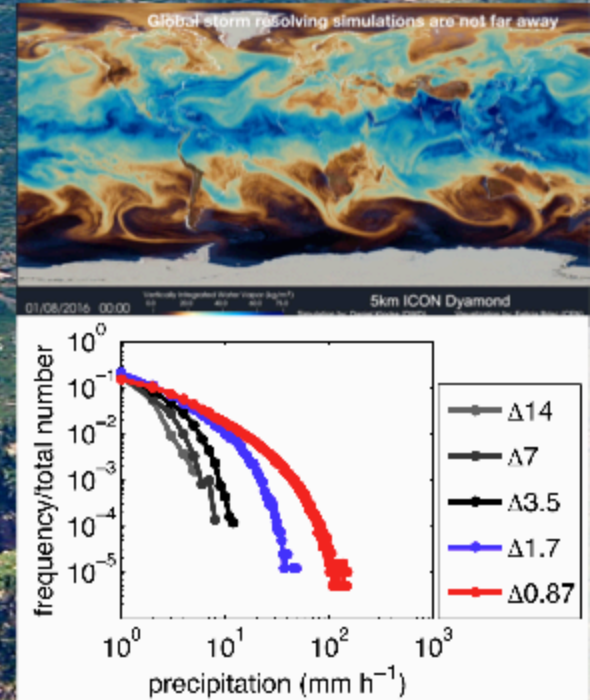


Phase III: Quantitative understanding and prediction of the Global water and energy system



One of our challenges: bridging the scale divide

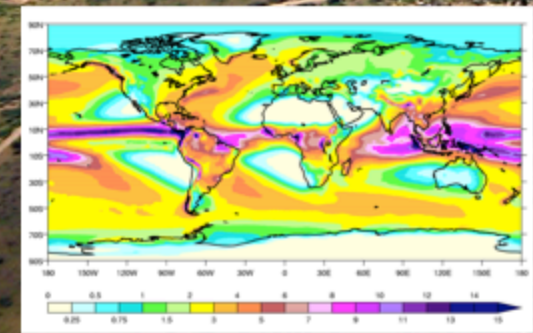
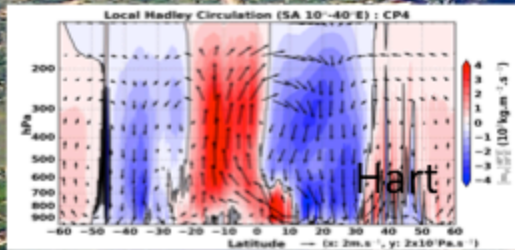
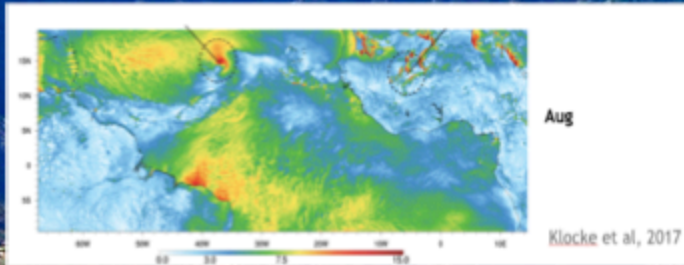
Global km-scale modeling



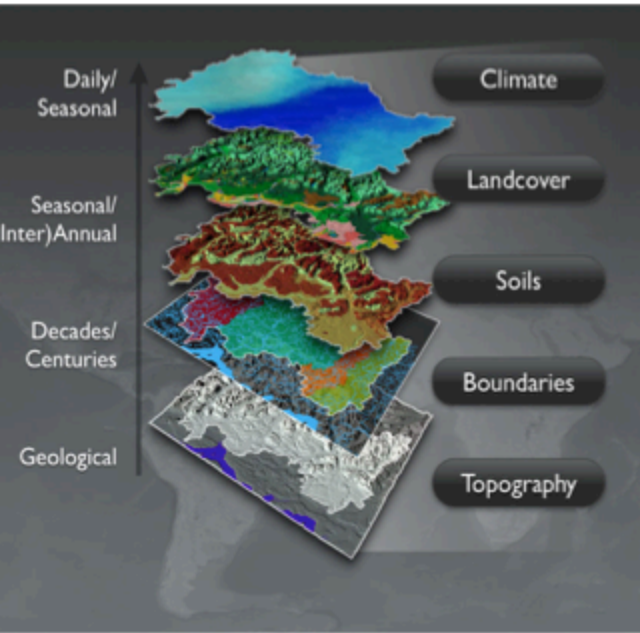
Upscale

Downscale

Global/regional scale ESM



Phase III: Quantitative understanding and prediction of the Global water and energy system



Challenge – representing the influence of humanity in the physical Earth system (Betts)

Challenge – balance between complexity and reality; as models increase in complexity, how do we know they are approaching reality (Dave Lawrence)

Challenge – a more process based understanding of the water/energy ‘system’

Challenge – can we evolve our analysis systems to provide the energy and hydrological information on increasingly finer scales.

Vision of GEWEX as expressed through this OSC

- Address the scientific problems
 - *Water and Extremes*
 - *Land-atmosphere interactions*
 - *Energy and water budgets*
 - *High-resolution modeling*
 - *Heat waves & extremes: past, present & future*
 - *Mountain water cycle*
 - *Weather & climate extremes*
 - *Cold-regions Earth system changes*
 - *Storms and high-impact weather*
 - *Irrigation & water cycle over breadbaskets*
- *Provide guidance to society and world courtesy Alan Betts*