





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?

changing?

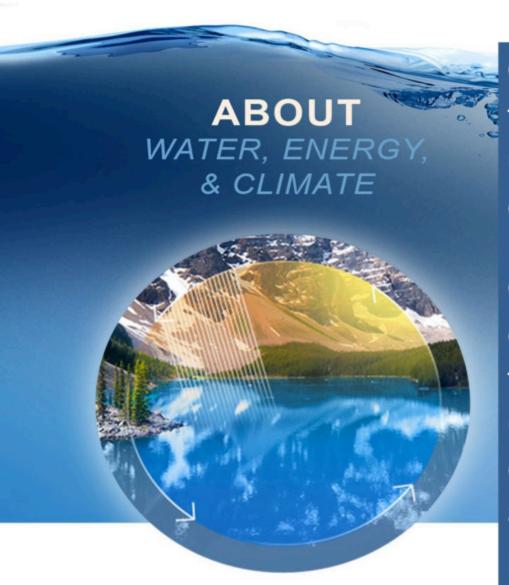
☐ How is the fresh water on the planet

☐ Where does the carbon go?

3 fundamental 'reservoir' questions

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

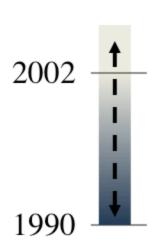
The formative phase



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



Radiation

Modelling

- International Satellite Cloud Climatology Project (ISCCP)
- Surface Radiation Budget (SRB) Project
- Global Water Vapor Project (GVaP)
- Global Precipitation Climatology Project (GPCP)
- Global Aerosol Climatology Project (GACP)
- Baseline Surface Radiation Network (BSRN)

- GEWEX Global Land/Atmosphere System Study (GLASS)
- Global Soil Wetness Project (GSWP)
- Project for Intercomparison of Land Surface Parameterization Schemes (PILPS)
- GEWEX Cloud System Study (GCSS)

Continental-Scale Experiments (CSEs)

- GEWEX Continental-scale International Project (GCIP)
- GEWEX Asian Monsoon Experiment (GAME)
- Large-Scale Biosphere-Atmosphere Experiment in Amazonia (LBA)
- Baltic Sea Experiment (BALTEX)
- Mackenzie GEWEX Study (MAGS)



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

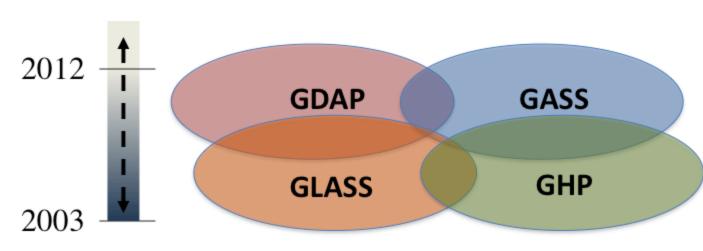
Certain energy fluxes at surface were still not developed

Cloud and precipitation data, although short of what was needed, were evolvirg 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



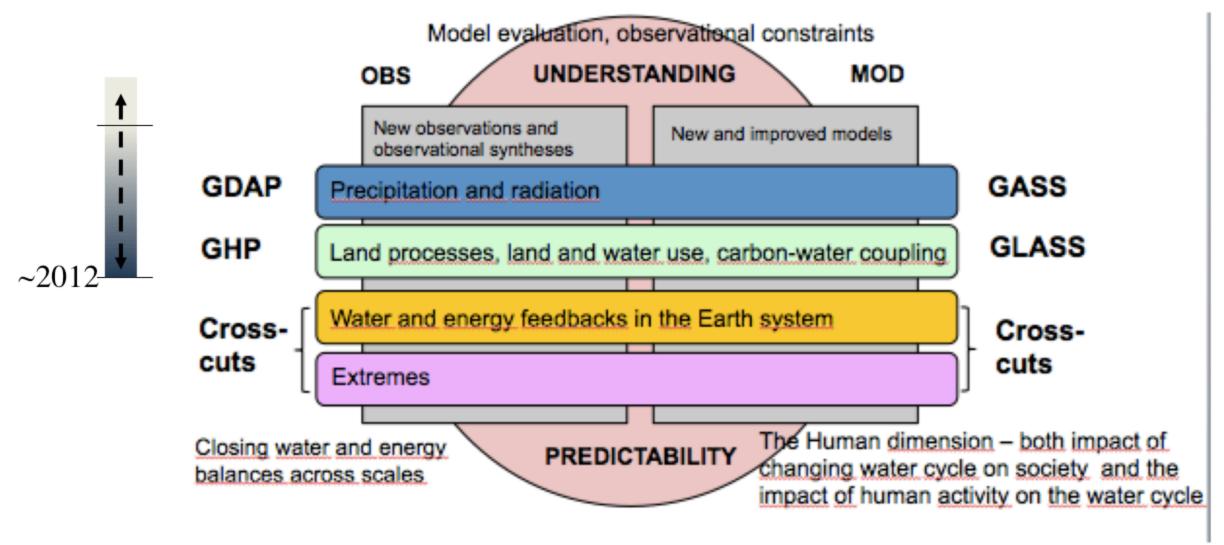
The interdisciplinary evolution of land models

The Evolution of Land Modeling

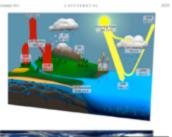
| Common Value |

- 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 activies (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



Integrated observing strategies of the Earth system - address gaps (mountain & cold phase hydrology)



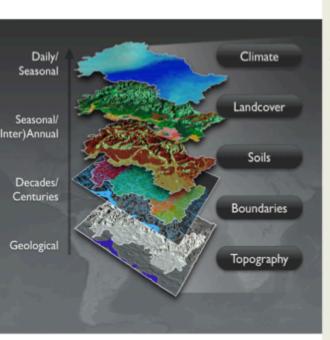
Advances in Earth system modeling

Need to study process interactions across time scales

Instead of the traditional paradigm of properties define processes, study how processes define properties. Martyn Clark Challenge is that humanity is embedded in a deeply interconnected living Earth system, Betts

One of our challenges: bridging the scale divide Global km-scale modeling Global/regional scale ESM precipitation (mm h

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