

The Current and Future Role of GEWEX in the Central Asia Region

Presentation for Central Asia Regional Workshop
Osh, Kyrgyz Republic

GEWEX introduction by Peter J van Oevelen

What is GEWEX

- GEWEX is the Global Energy and Water Exchanges project of the World Climate Research Programme
- Goal: facilitate international research collaboration to advance biogeophysical climate and weather research
- Around since 1990: more than 3 decades of experience in supporting the international research community

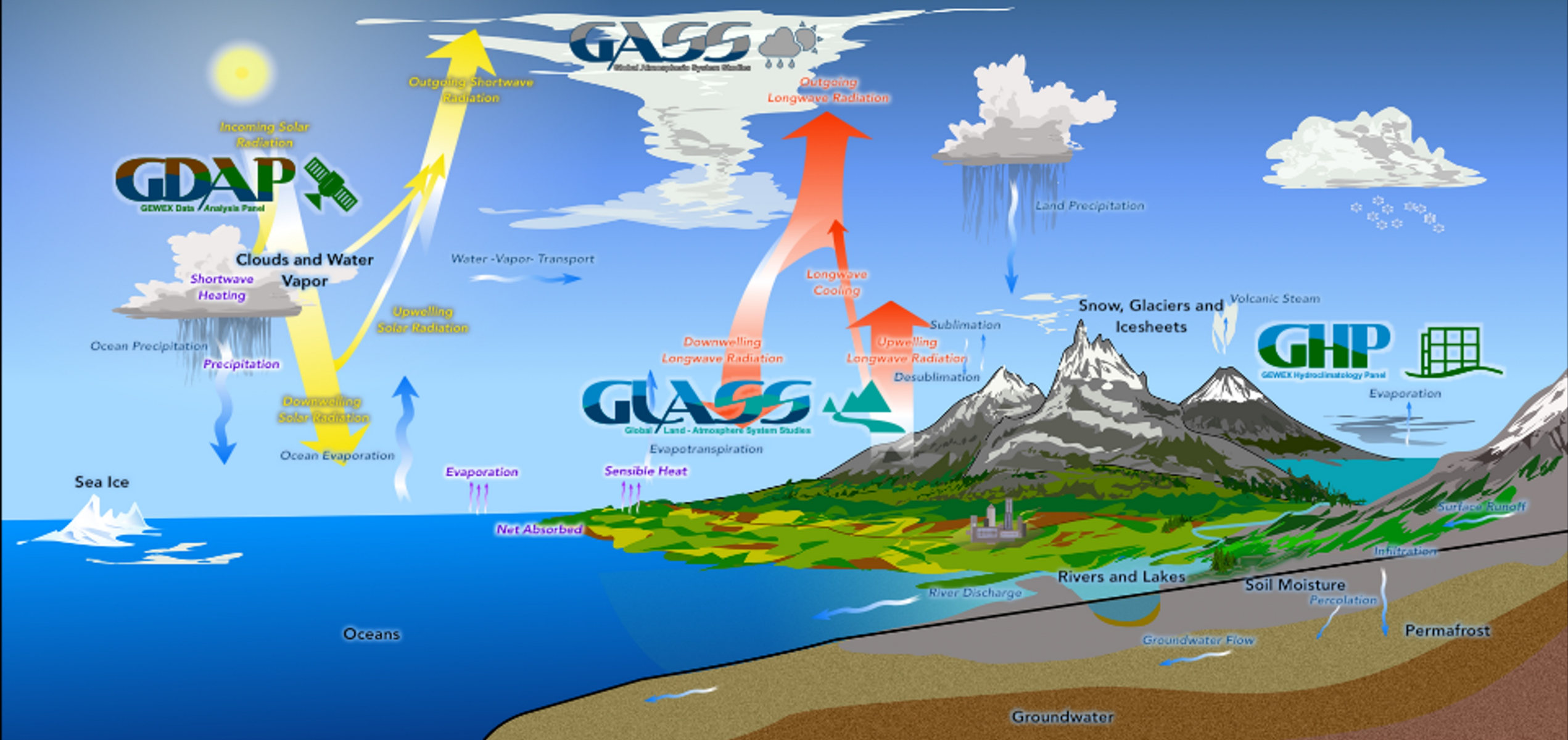
GEWEX Science Plan 2023 - 2032

*Addressing the challenges in understanding and predicting
Changes to water availability in the coming decades*

WCRP Publication No.: 9/2021

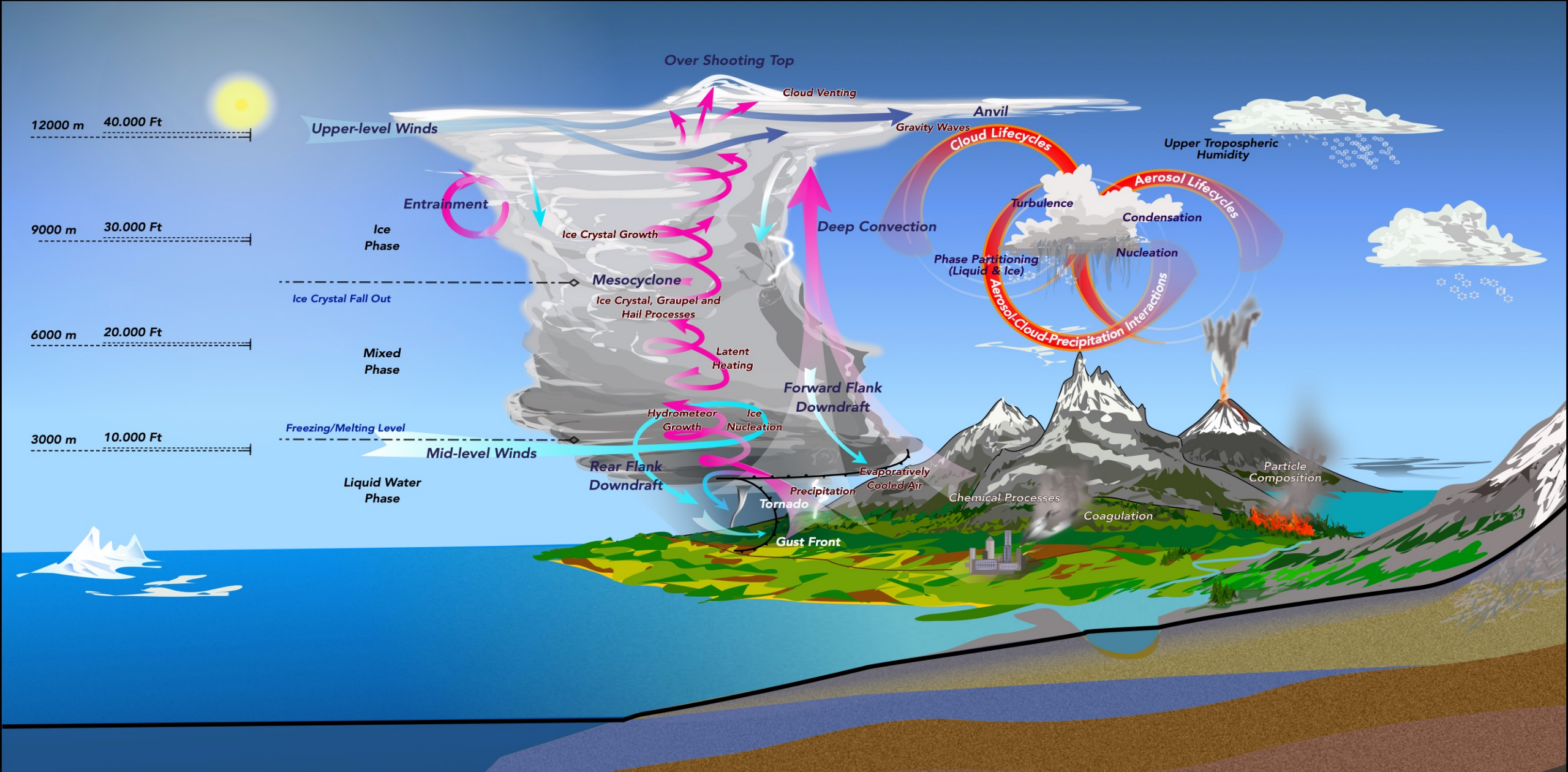
<https://www.gewex.org/about/science/gewex-science-goals/>

- <https://www.gewex.org/gewex-content/uploads/2022/05/GEWEX-science-plan-v8.pdf>



- GEWEX Data Analysis Panel
- Global Atmospheric System Studies
- Global Land-Atmosphere System Studies
- GEWEX Hydroclimatology Panel

*Global Datasets Analysis and Assessments
Atmospheric Processes - Dynamics
Land-Atmosphere Interactions and Processes
Regional Focused Processes and Hydroclimate Projects*



The GEWEX Panels:

- GEWEX Data Analysis Panel
- Global Atmospheric System Studies
- Global Land–Atmosphere System Studies
- GEWEX Hydroclimatology Panel
- Global Datasets Analysis and Assessments
- Atmospheric Processes - Dynamics
- Land-Atmosphere Interactions and Processes
- Regional Focused Processes and Hydroclimate Projects



Land Atmosphere Interactions at our Core

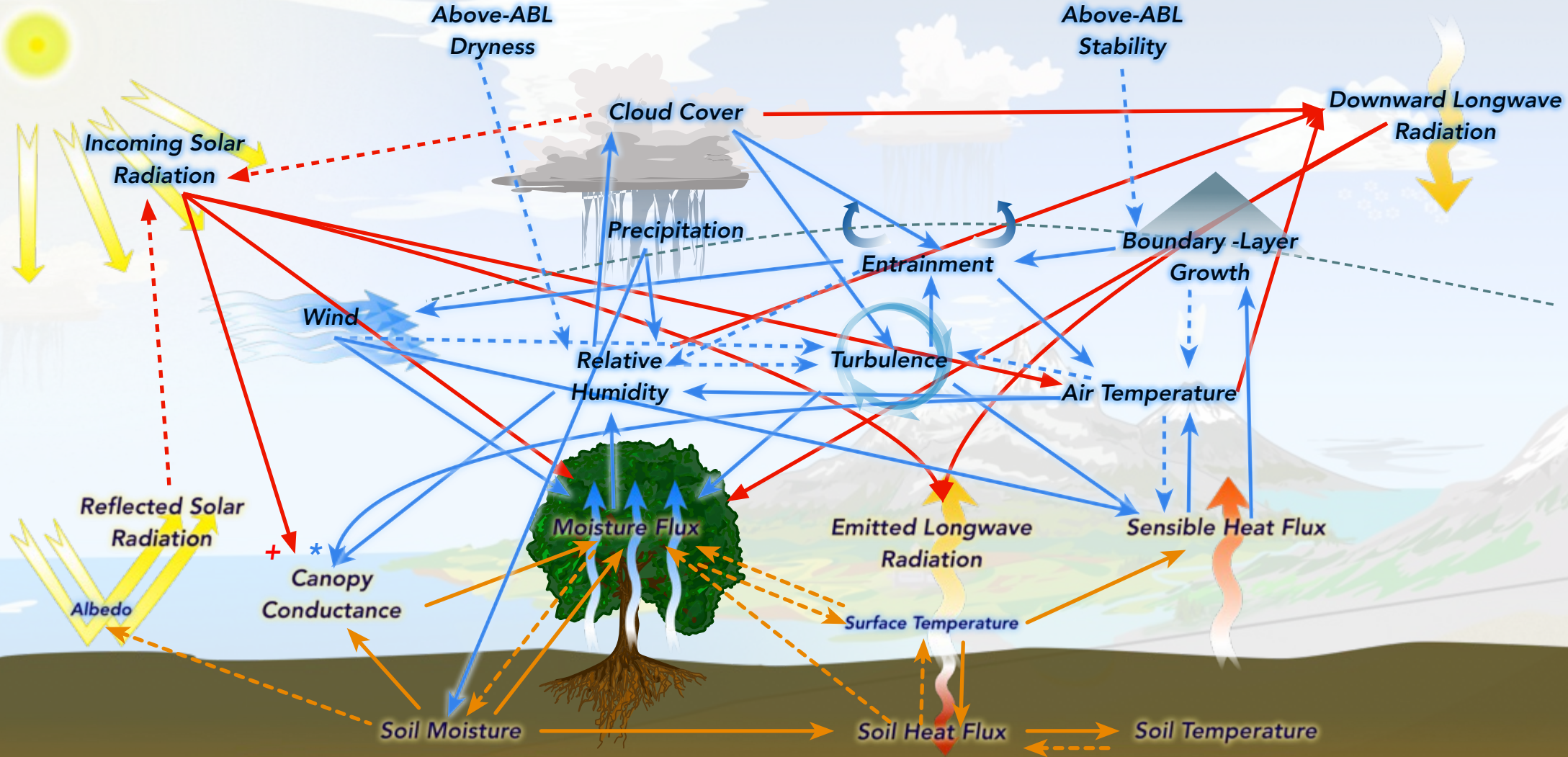
Soil moisture-vegetation-atmosphere feedbacks

- 1) Land Atmosphere interactions are COMPLEX (see next slide)
 - a) Need to choose what to tackle and how (see 3)
 - b) Pure observational approach on processes is a myth

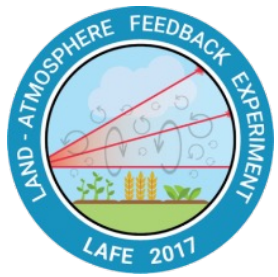
- 2) Common definitions need between disciplines and communities in particular that of soil moisture/soil water content/soil matrix potential and usage (still widely diverges in both observational and modeling communities)!

- 3) Key Questions:
 - a) How do land atmosphere interactions change with climate
 - b) Which processes are in particular relevant? (subsurface – surface – atmosphere)
 - c) Which of those can we observe (and not) (See GLAFO Slide on modern observational bedrock to boundary layer observational systems)
 - Which in situ networks/systems mesh best with EO systems? Need for change?
 - d) Human interactions: Land cover issue within retrievals (temporal) / need to disentangle land cover/use from ‘naturally’ induced change.
 - e) Consistency need in our ‘data’ products
 - f) Models are outstripping our observational capabilities (see USRHP slide)

Local Land-Atmosphere Interactions – All Processes



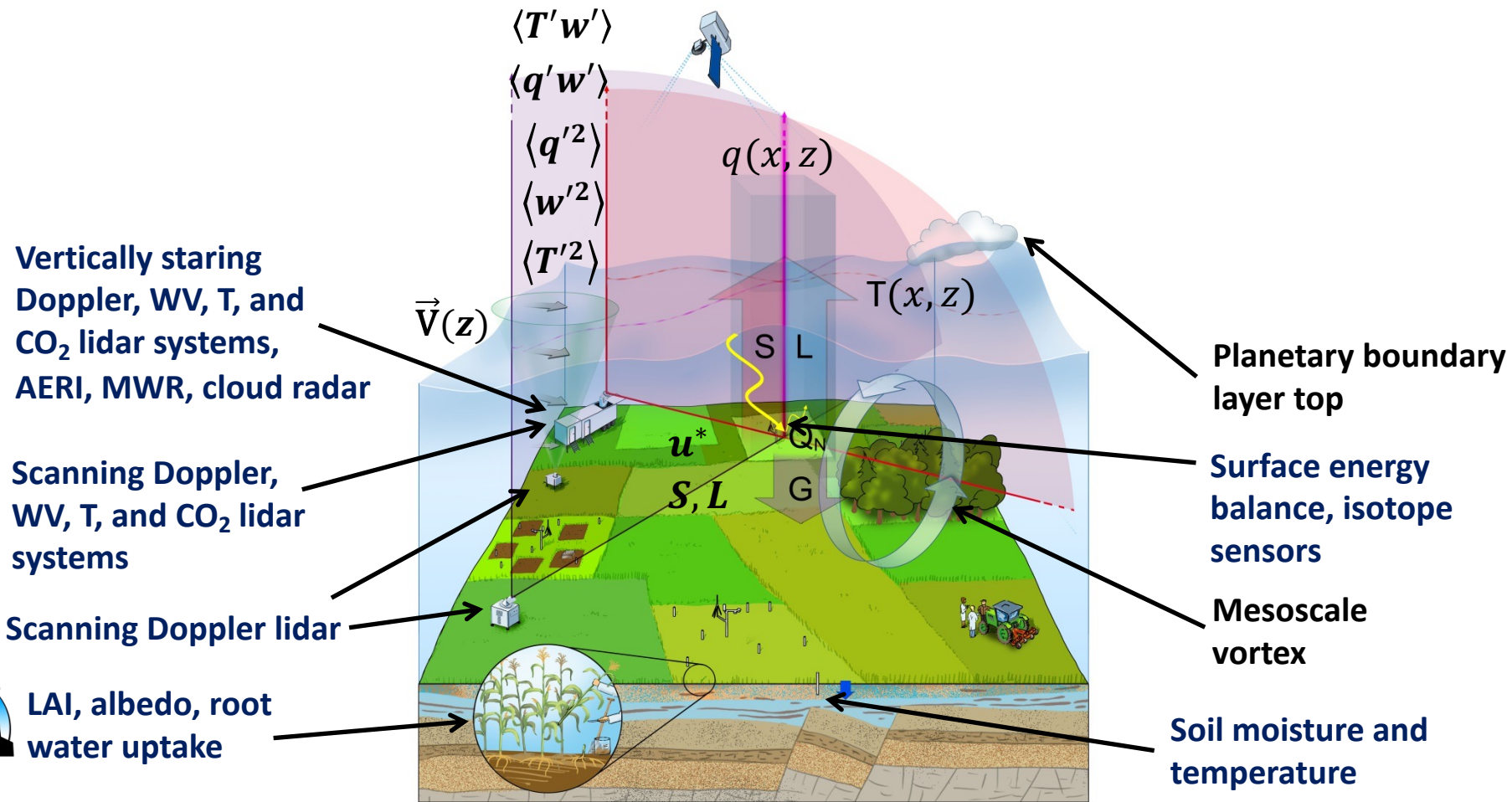
+ Positive Feedback for C3 & C4 Plants, Negative Feedback for CAM Plants
 * Negative Feedback Above Optimal Temperature
 Radiation (Red Arrow) Positive Feedback (Red Arrow)
 Land Surface Processes (Orange Arrow) Negative Feedback (Dashed Orange Arrow)
 Surface Layer & ABL (Blue Arrow)



The GEWEX/GLASS Land-Atmosphere Feedback Observatory (GLAFO)



Slide courtesy: Volker Wulfmeyer



A combination of vertical staring instruments will be the starting point. In a next step, scanning instruments will be added.

Wulfmeyer et al. BAMS 2018, DOI:10.1175/BAMS-D-17-0009.1



The Science Case

- Despite many large scale experiments (CSE/RHP) and observational networks, our observations still cannot “close” the water and energy balances.
 - Several in Asia (GAME, MAHASRI, AsiaPEX, TPE-WS etc.)
 - No open science / open data sharing
 - Numerous disconnected networks (country, institutional etc.)
- Our models are “outstripping” the observations; but are the models right?
 - We are now capable of modeling the CONUS at “high” resolutions over multiple decades.
 - Emerging observational capabilities; e.g. the GEWEX Land Atmosphere Feedback Observatory (GLAFO) & the USGS Next Generation Water Observing System (NGWOS).
- **We need action now as a community, *TOGETHER*, to close the energy, water and carbon balances in regional human-natural systems; to address the pressing science questions of the day.**

It is a complex, coupled system:

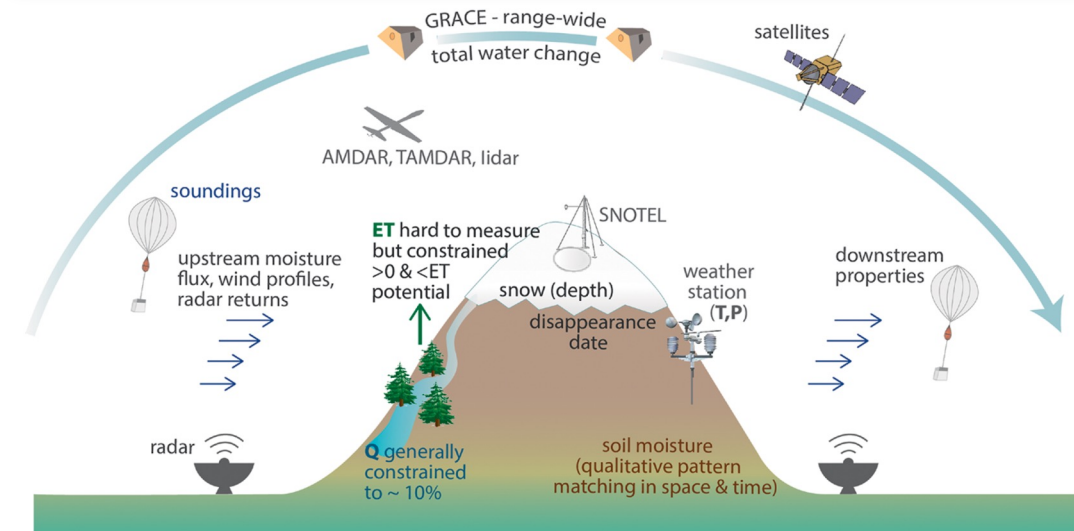
$$\text{Water: } P + Q_{\text{in}} = \text{ET} + \Delta S + Q_{\text{out}}$$

$$\text{Energy: } R_n + G = \lambda \text{ET} + H$$

Refine estimates of these terms; quantify their uncertainties; understand how will they change.

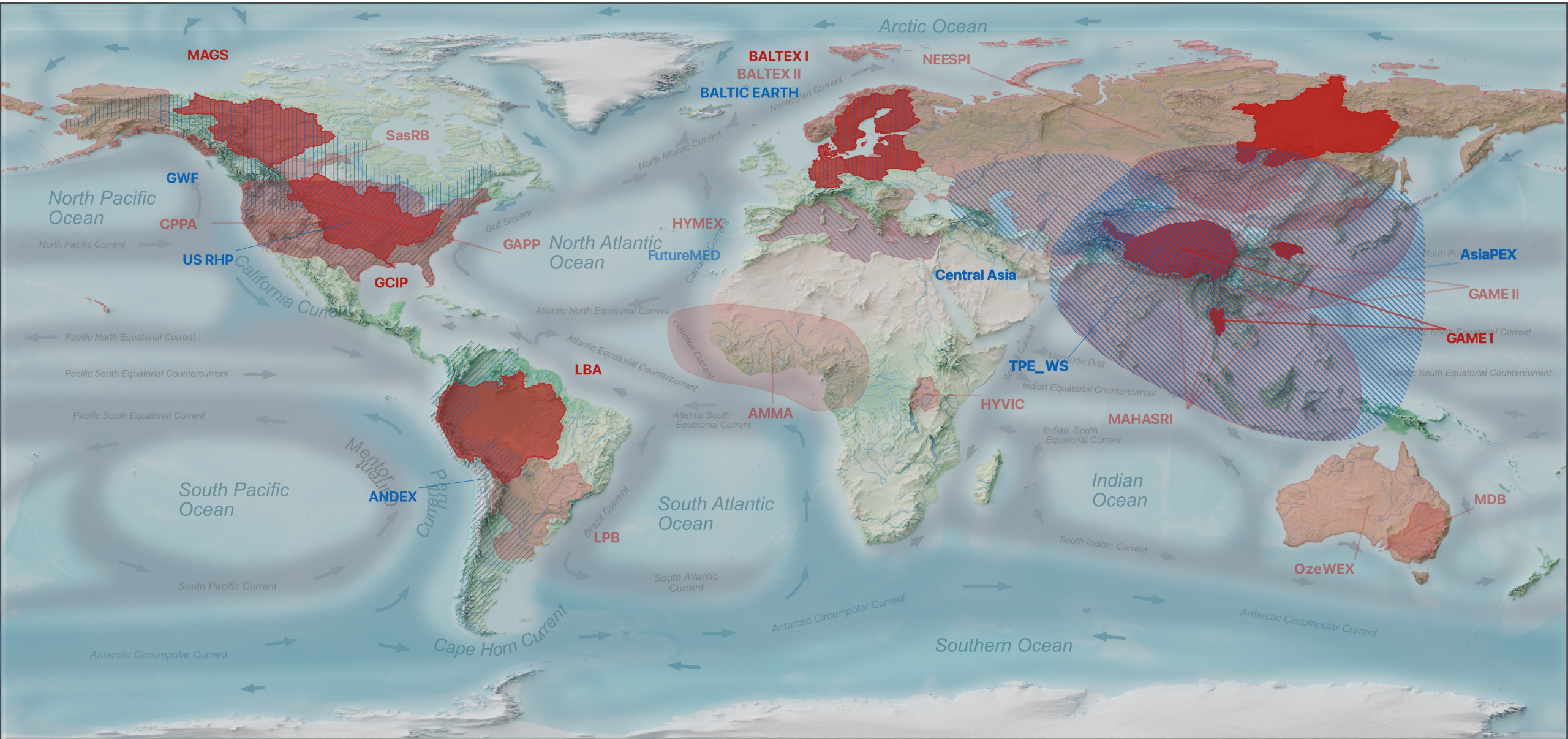
The *Carbon Cycle* most directly ties in through the “ R_n ” (energy) and “ET” terms.

Anthropogenic influences are manifold and impact all of these cycles through GHG emissions; land use/land cover change; and water resource management.



Lundquist et. al., 2019: Our Skill in Modeling Mountain Rain and Snow is Bypassing the Skill of Our Observational Networks. Bull. Amer. Meteor. Soc., **100**, <https://doi.org/10.1175/BAMS-D-19-0001.1>

GEWEX Regional Hydroclimate Projects



Major Climate Issues in Central Asia

A case for a Regional Hydroclimate Project

- Melting glaciers and shrinking snowpack that are the foundation of the region's water resources
- Changing Precipitation (type/occurrence/quantity/uncertainty)
- Glaciers are primarily located in Kyrgyzstan & Tajikistan (transboundary water resource issues)
- Extremely high summer temperatures and getting hotter
- Very vulnerable agricultural systems (irrigation dependent / high summer temps)
 - Uzbekistan & Kazakhstan in particular
- Vulnerable habitats and ecosystems that are critical
 - Traditional pastoral lifestyles
 - Riparian ecosystems (dams will affect these strongly)
 - Big cat conservation – especially snow leopard
- CA generally considered to be a data poor region by both the WCRP & IPCC



Priority for Observations and Modeling

- Better (precipitation) observations/network/measurements (covering region and elevations)
 - Can we better indicate how much/many and where (can we use our models to figure that out)
- What is needed in terms of observations/models to better understand regional atmospheric circulation changes (as perturbed by large scale circulation changes) (topic next workshop)
- Understand regional hydrological response (L-A interactions / Flows / Runoff)



9th The Global Energy and Water Exchanges Open Scientific Conference



Water
•
Climate



水
•
気候



7-12 July 2024
Sapporo, Japan
Keio Plaza Hotel



Join us in beautiful Sapporo, Japan, to address the challenges facing humanity in terms of freshwater availability and associated disaster risk reduction and the sustainable development in the context of climate change and human activities.

<https://www.gewexevents.org/meetings/gewex-osc2024/>



Thank You

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