Global Energy and Water EXchanges (GEWEX)

44th Session of the WCRP Joint Scientific Committee

Jan Polcher, Xubin Zeng, Peter van Oevelen

May 2023

Climate Center, Brussels, Belgium

GEWEX

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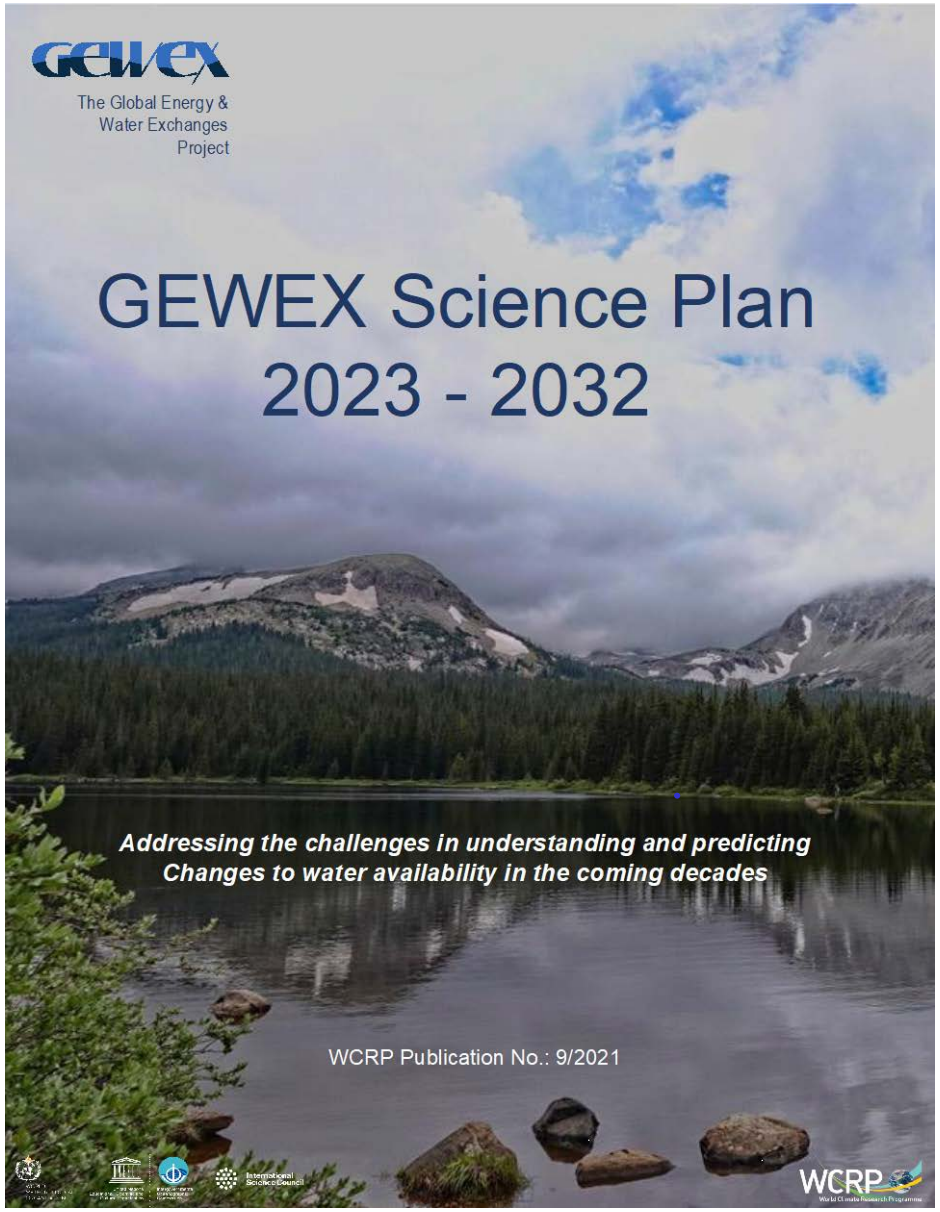
Background



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

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

- GEWEX Ambassadors

Claudia Stubenrauch
Mike Ek

Christa Peters-Lidard

Andy Pitman

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Progress and achievements over the last year

- **GEWEX has incorporated the process understanding of coupled energy, water, and carbon cycles into its strategic planning, and discussions have been made on launching related projects (e.g., related to irrigation, urbanization).**
- **GEWEX has strengthened the interaction with WMO Hydrology, and will launch related projects (e.g., on groundwater, surface water).**
- **Major publication on 30 Years of GEWEX in BAMS (2023 Stephens et al., https://doi.org/10.1175/BAMS-D-22-0061.1)**
- **4th PAN-GEWEX Meeting in Monterey, CA, USA - Speed dating between the various panels led to numerous new ideas to be developed in the coming years. Strengthened cross panel collaboration.**

Progress and achievements over the last year

The First 30 Years of GEWEX

Graeme Stephens, Jan Polcher, Xubin Zeng, Peter van Oevelen, Germán Poveda, Michael Bosilovich, Myoung-Hwan Ahn, Gianpaolo Balsamo, Qingyun Duan, Gabriele Hegerl, Christian Jakob, Benjamin Lamptey, Ruby Leung, Maria Piles, Zhongbo Su, Paul Dirmeyer, Kirsten L. Findell, Anne Verhoef, Michael Ek, Tristan L'Ecuyer, Rémy Roca, Ali Nazemi, Francina Dominguez, Daniel Klocke, and Sandrine Bony

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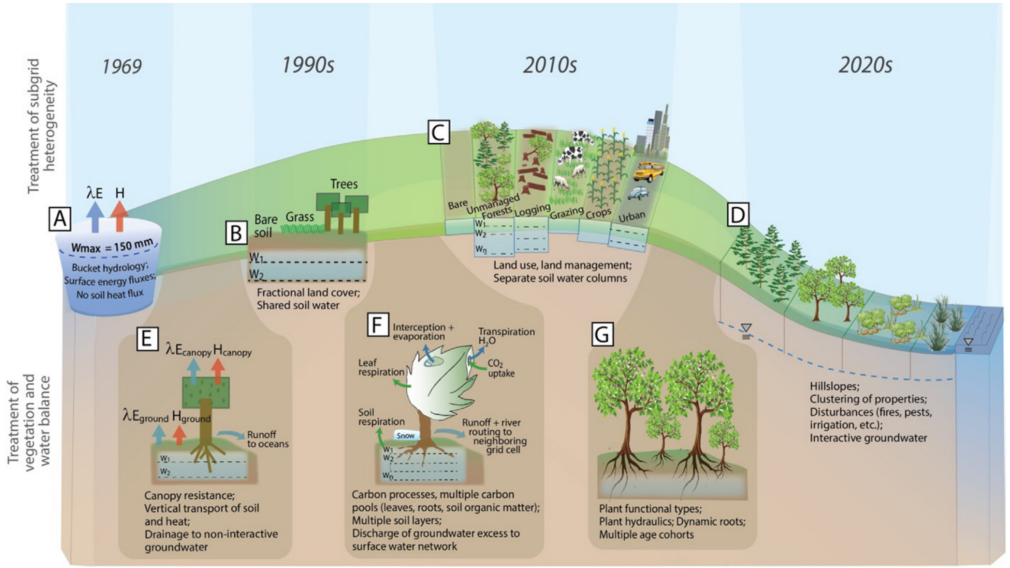
Print Publication: 01 Jan 2023

DOI: https://doi.org/10.1175/BAMS-D-22-0061.1

Page(s): E126–E157

BAMS



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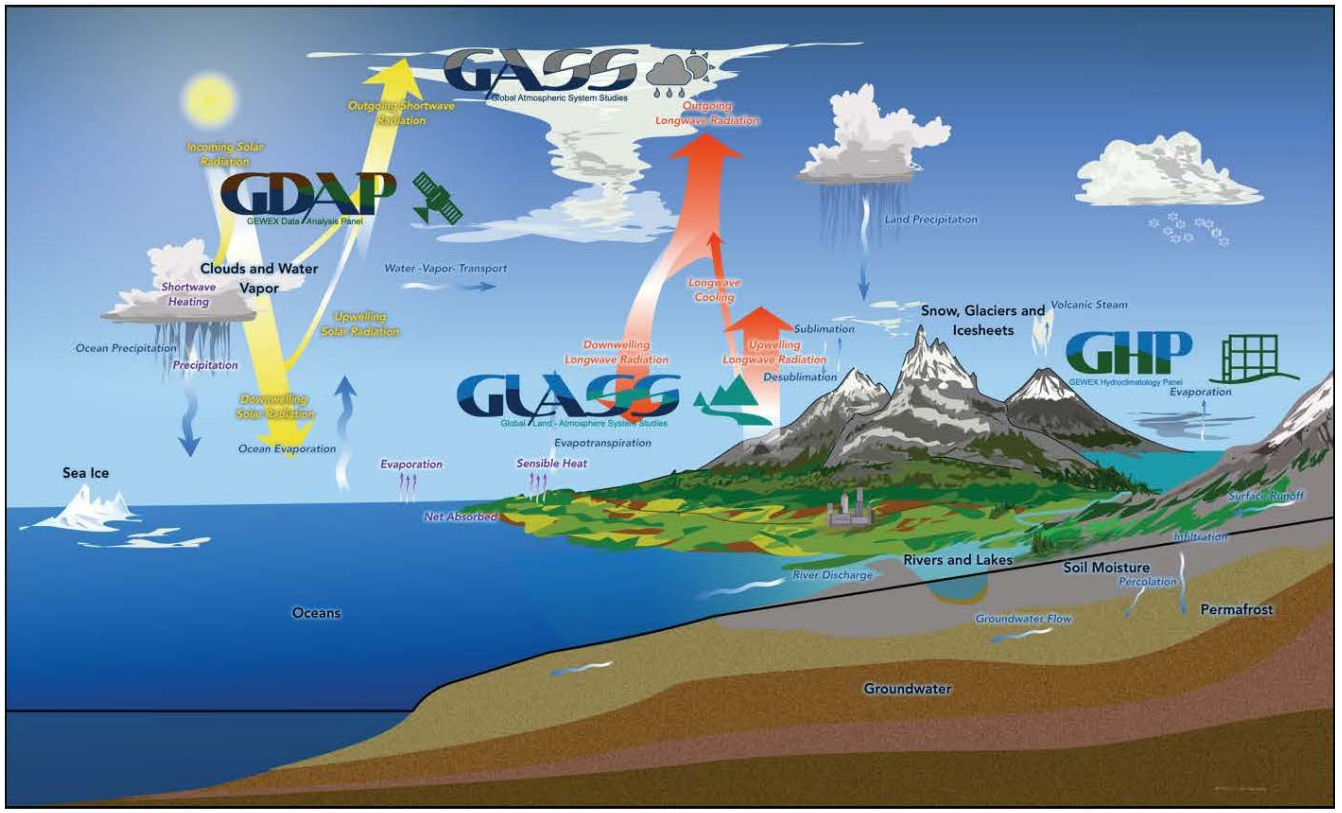
Recent GEWEX Panel Activities

- **GLASS**: launched a project on the modeling of solar-induced chlorophyll fluorescence (SIF) in land models (SIFMIP) as a bridge to better understand the coupling of energy and water cycles to the carbon cycle, and launched another project on the coupling of atmospheric land and sub-grid parameterizations (CLASP).

- **GHP**: heavily engaged with scientists in different continents to explore and develop regional hydroclimatological projects, and has proposed a crosscutting project on flooding which has not received much attention in Earth system modeling.

- **GASS**: has been efficient in completing, continuing, and initiating projects, and is expected to launch new projects soon that are related to shallow and deep convections and their organization/aggregation and other topics.

- **GDAP**: in the process of developing a new strategy in helping the data and user community: instead of labeling "GEWEX datasets", GDAP will try to develop the GEWEX criteria for satellite datasets (related to the carbon, energy and water cycles) to meet through data assessment and analysis.

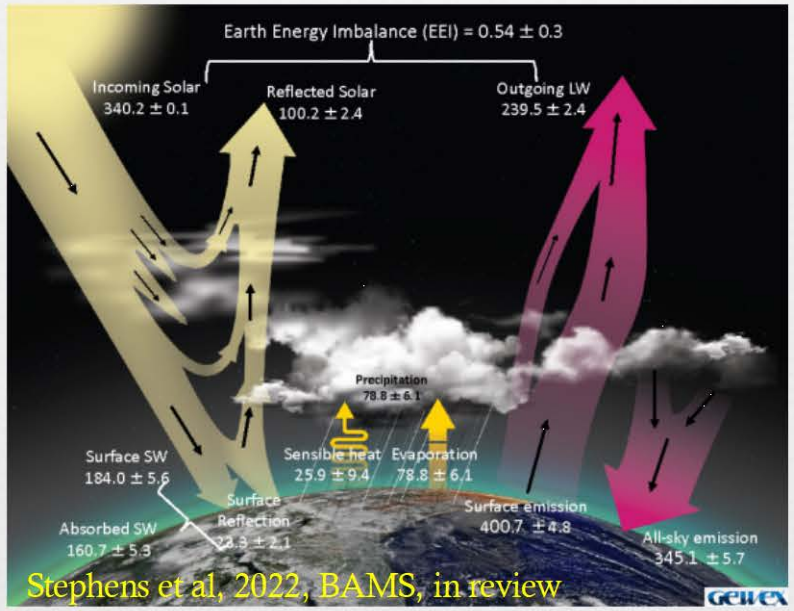


The focus of the four GEWEX panels in relation to the global and regional water and energy cycles
(© P. van Oevelen, 2020)

GDAP Activities

Observation-centric, climate-oriented, consistency-driven, global, research-focused

Precipitation

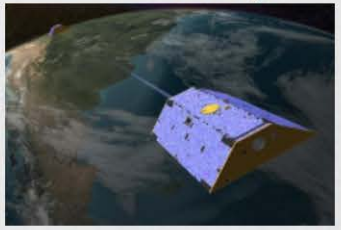


Stephens et al, 2022, BAMS, in review

Sea level

Radiation

Gravimetry



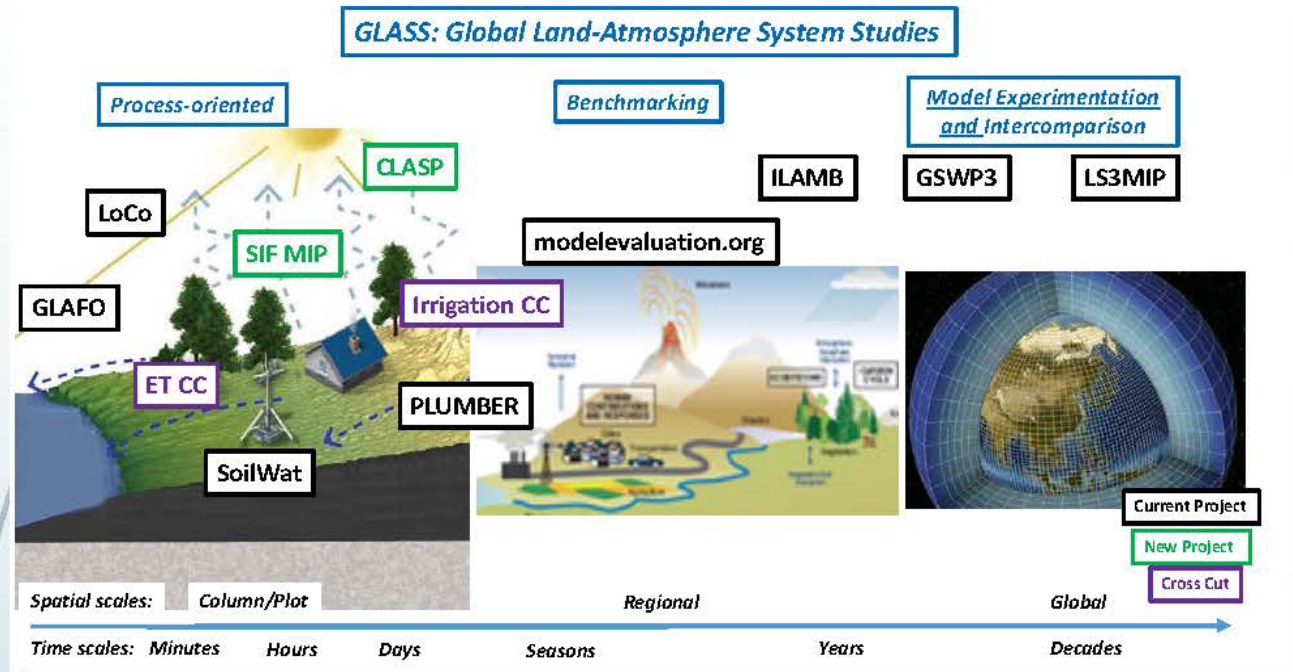
Surface Fluxes

Clouds

GASS: Overarching questions

How do the micro to meso scale atmospheric processes control global Water and Energy Exchanges?

Ten GLASS Panel Projects: From column (process) to global scale

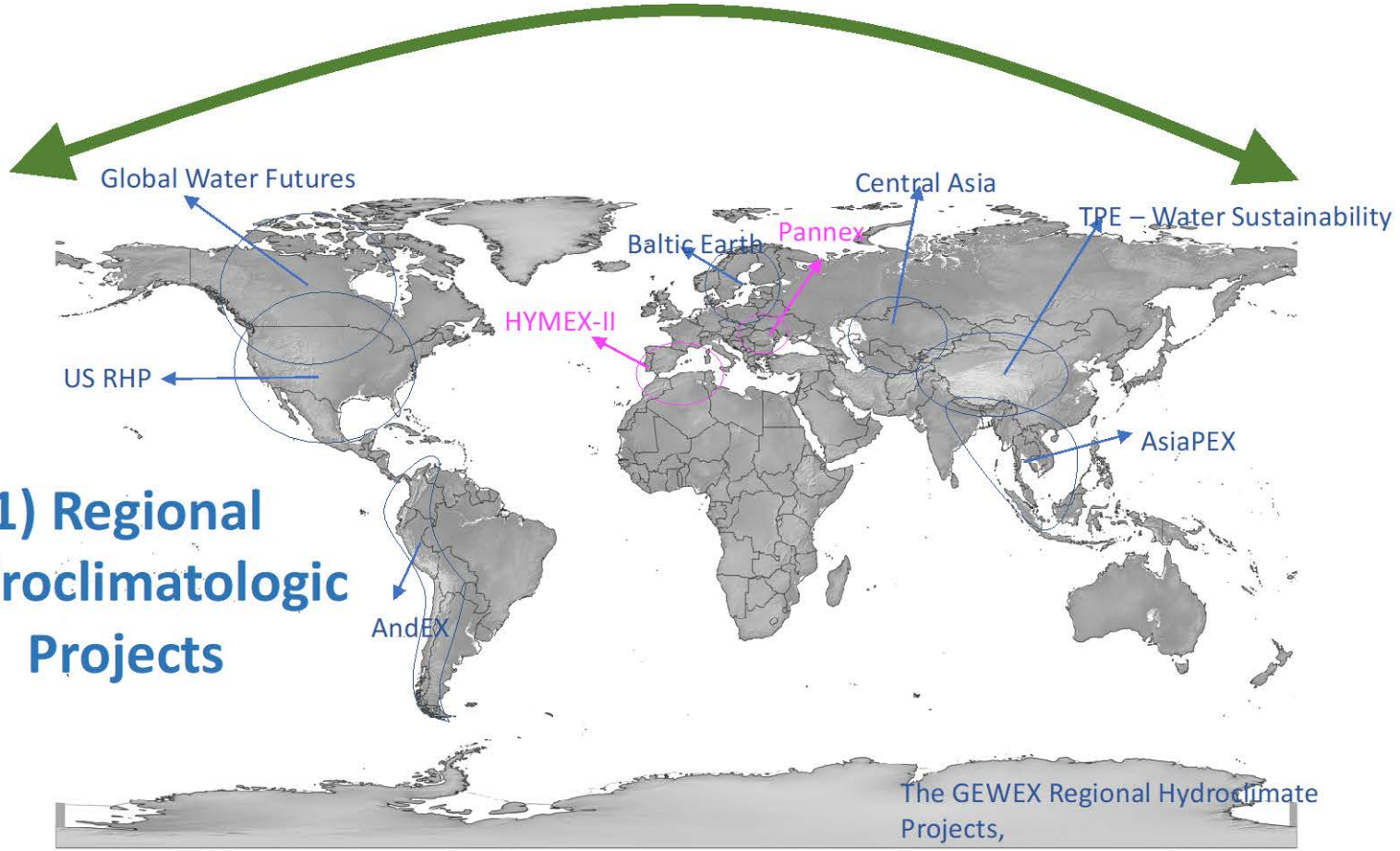


- **ILAMB**: International LAnd Model Benchmarking
- **Modelevaluation.org:** web application for evaluating and benchmarking computational models.
- **GSWP3**: Global Soil Wetness Project, phase 3
- **LS3MIP**: Land Surface, Snow and Soil Moisture MIP

- **LoCo**: Local Coupling Working Group
- **GLAFO**: GEWEX/GLASS Land-Atmosphere Feedback Observatories
- **SIFMIP**: Solar-Induced Fluorescence MIP
- **CLASP** (Coupling of Atmospheric Land and Sub-grid Parameterizations)
- **SoilWat**: Soils and Subsurface processes
- **PLUMBER2**: The Protocol for the Analysis of Land Surface Models (**PALS**) Land Surface Model Benchmarking Evaluation Project, phase 2

2) Cross-Cuts

TEAMx CC
INARCH-II CC
ET CC
FLOOD CC
GROUNDWATER CC
IRRIGATION CC
MOUNTERRAIN CC



1) Regional Hydroclimatologic Projects

3) Global Data Centers

Global Precipitation Climatology Center (GPCC)

Global Runoff Data Center (GRDC)

International Data Centre on Hydrology of Lakes and Reservoirs (HYDROLARE)

4) GHP Networks

Pannex

Future plans

- **In July 2024 we will have the 10th GEWEX Open Science Conference in Sapporo, Japan**
- **New Regional Hydroclimate Projects targeting Central Asia, Africa and New Zealand/Oceania and cross-cutting projects on flooding, groundwater and surface water.**
- **Projects in the pipeline for each Panel (GDAP, GASS, GLASS, GHP)**

- **Field campaigns to be organized in Aug-Sep 2024 over the tropical Atlantic to study the organisation of tropical convection (ORCESTRA campaign = sum of EC-TOOC + BOWTIE + MAESTRO + PICCOLO initiatives), 50 years after GATE.**

Linkages with Core Projects, Lighthouse Activities etc.

Projects Ongoing

- **CLIVAR and GEWEX continue to work together on Monsoons Panel**
- **WGNE/ESMO, Various strong collaborations with GASS (Also with ESMO incl. GLASS)**
- **Digital Earth: via RHPs (for regional) and DYAMOND GASS project (for global)**
- **GASS-CFMIP collaboration on cloud processes and cloud-climate feedbacks**

Projects with Engaged Discussions

- **CLIC: TPE in the Asian high mountain region**
- **CORDEX/RiFS: regional capacity development and modelling experiments**
- **Explaining & Predicting Earth System Change: Earth's Energy Imbalance, Water resources, modelling**
- **SPARC: GASS Project (UTCC)**

Projects with Some Initial Interactions

- **Safe Landing Climates: Water Resources?**
- **My Climate Risk: local hubs/RHP?**
- **WCRP Academy: RHP, GEWEX OSC, training school**

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Partnerships with entities outside of WCRP

Substantial Partnership

- **WWRP: GASS (along with WGNE); climate-weather connection & hydrological forecasting**
- **START: RHPs on capacity development (Central Asia and Africa)**
- **IAI: ANDEX**
- **ILEAPs/Future Earth: Land modelling summit in summer 2022 in UK**
- **GCOS: BSRN, GDAP, and 'Cycles' Initiative**

Some Collaborations

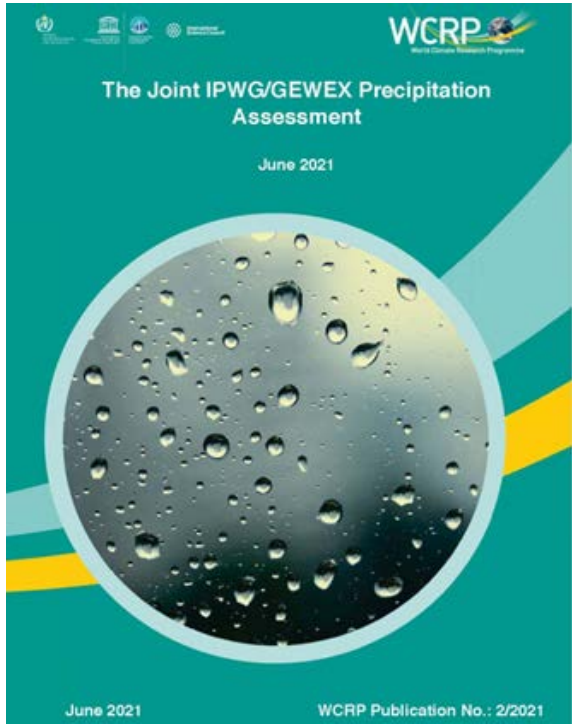
- **GEO/IGWCO and GEOGLOWS: training and capacity development activities**
- **WMO Hydrology: climate and hydrological forecasting**
- **UNESCO- IHP: RHPs**

GEWEX Approach to Coordinate Science

- **For international projects, some focus on organizing actual research activities (process understanding, data development, field campaigns, comprehensive data evaluation), while some focus on synthesis or overview papers. While both are important, the former takes much more efforts than the latter.**

  - (a) Primarily on research activities;
  - (b) Primarily on synthesis/overview;
  - (c) Equally on both

GDAP Project



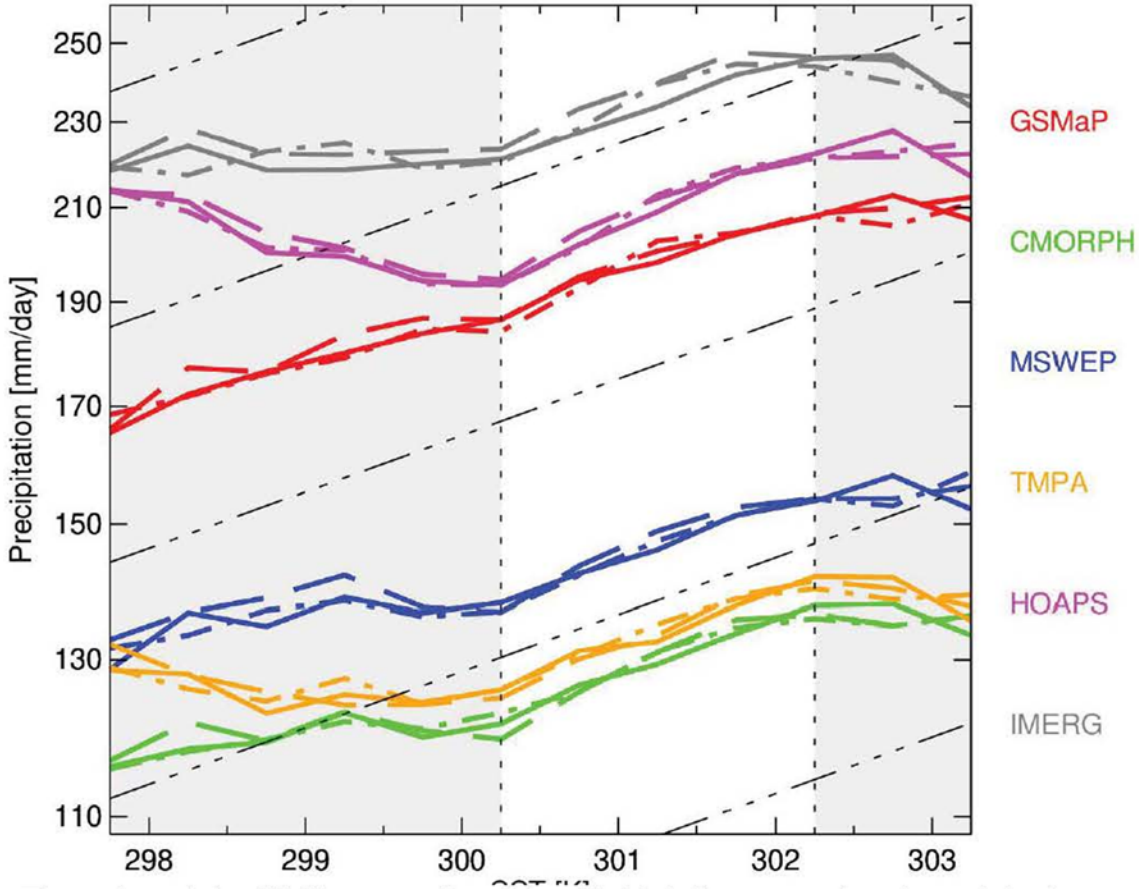
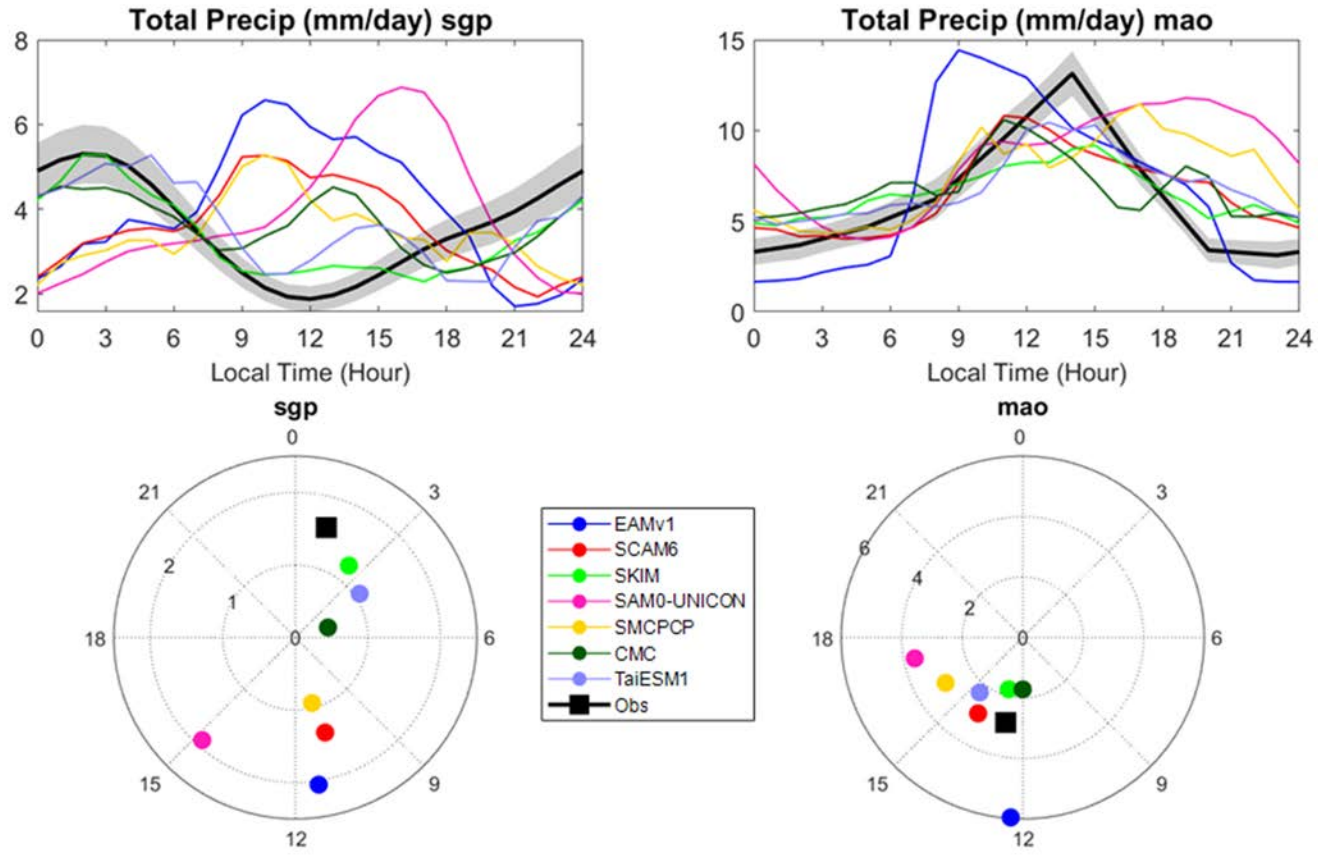


Figure 2.5.5. The value of the 99.9th percentile of the 1°x1° daily accumulated precipitation as a function of the SST lagged by 2 days. Each color corresponds to a precipitation product. Solid line for Operational SST and Sea Ice Analysis (OSTIA), dashed line for Optimally Interpolated Sea Surface Temperature (OISST) and dash-dotted lines for Optimally Interpolated Remote Sensing Systems Sea Surface Temperature (OIRSS). For the period 2007–2017. Regimes are separated by vertical dashed lines. Thegrey shaded areas indicate the non-robust cold regime between precipitation products (left) and the non-robust warm regime between SST products (right). Black dash-dotted lines correspond to the Clausius-Clapeyron 6%/K rate. From De Meyer and Roca, 2021

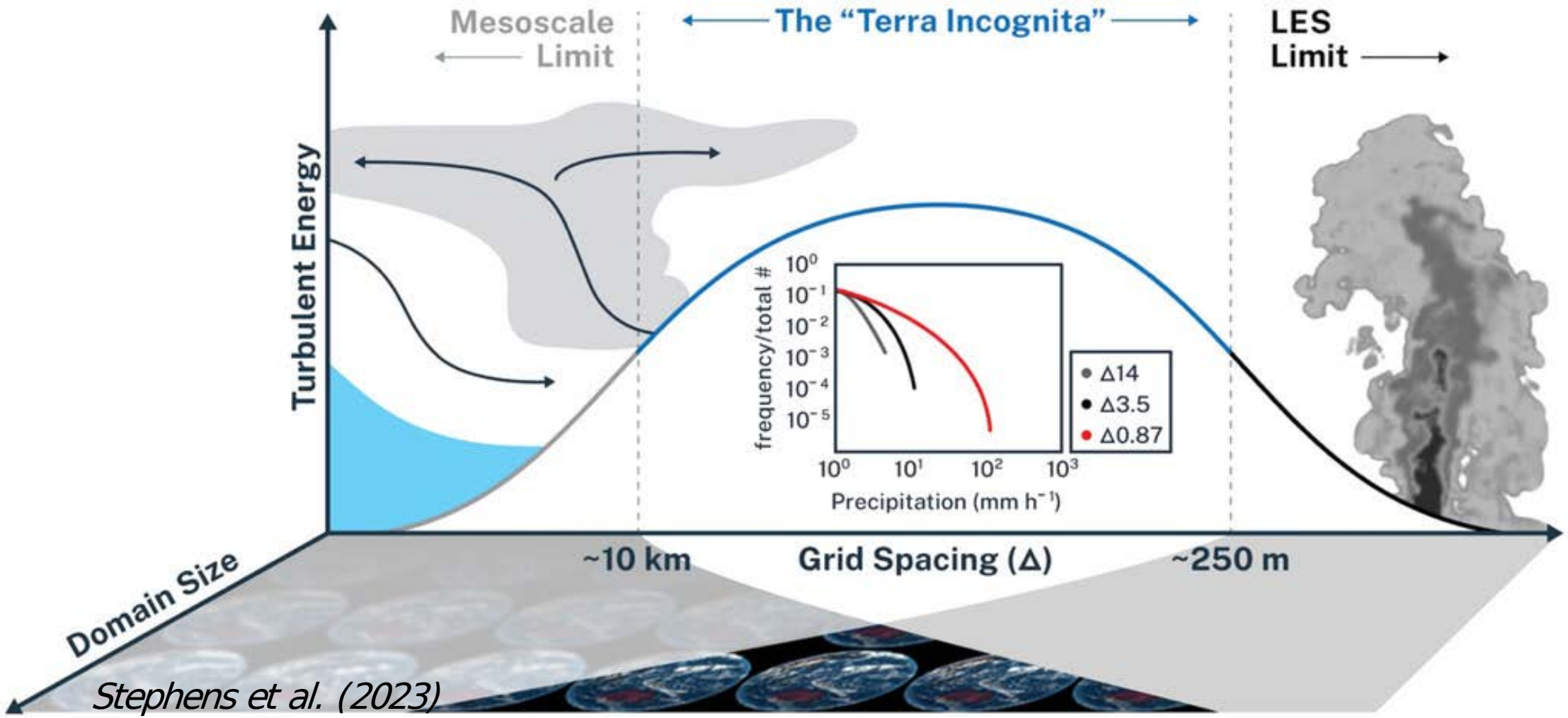
Precipitation initiatives/ cross-cut activities

- Understanding and predicting extremes
- Evaluating (global) models
- Process understanding – warm rain PROES
- Updated climatologies (e.g. GPCP)
- **Diurnal cycle of convection (GASS)**
- Aerosol-precipitation process (GAP)
- Mountain Precipitation
- Precipitation assessment (GDAP)



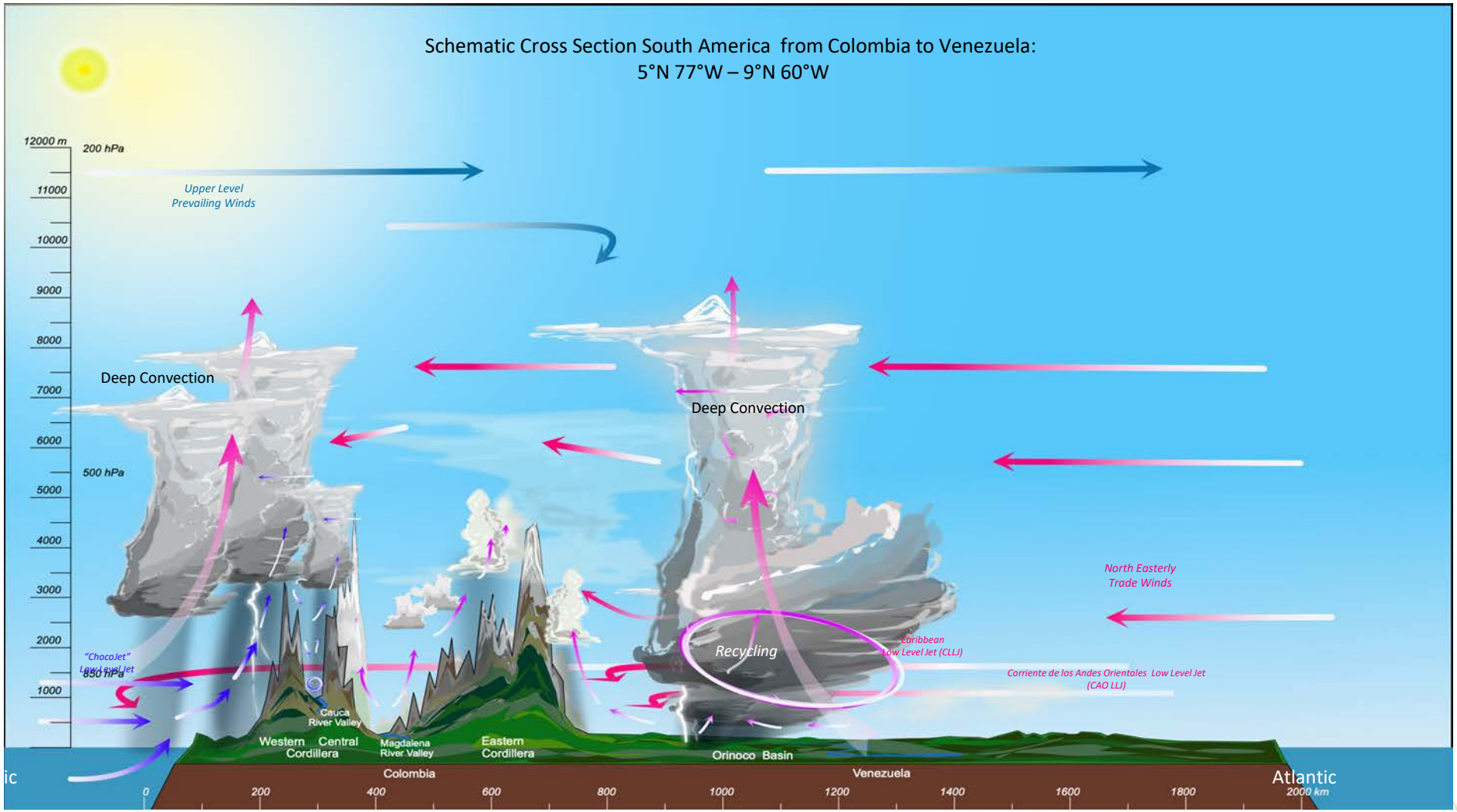
*Tang et al. (2021; **GASS project**)*

From local to global cloud-resolving modeling —
A GEWEX legacy, leading to Digital Earth and Digital Twins



Stephens et al. (2023)

ANDEX approved as a RHP in 2022



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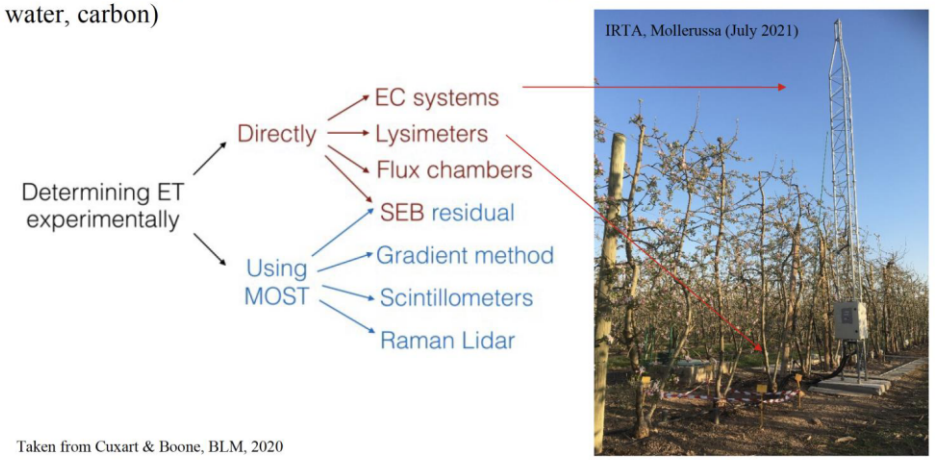
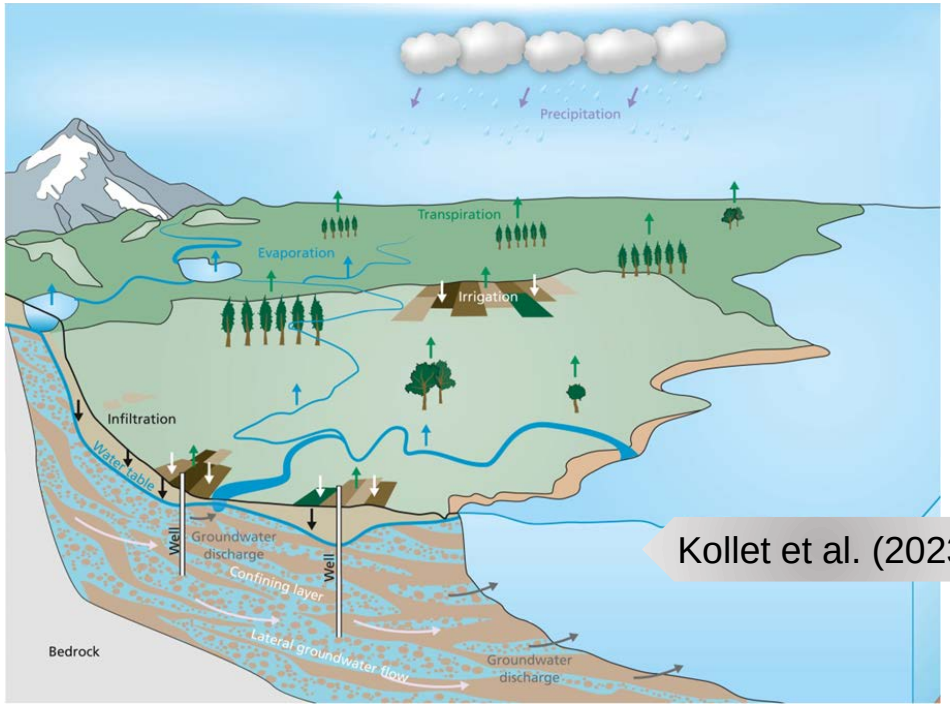
Assessment of Hydrological Forecasting in a Changing Climate

Determining ET is focused on methods allowing to determine evapotranspiration (ET), experimentally, through remote sensing methods or via models, at different spatial and temporal scales.

WG1 Measuring ET and its role in the Surface Budgets and their coupling (energy, water, carbon)



Taken from Cuxart & Boone, BLM, 2020



Kollet et al. (2023)

There are four main working groups focused on measuring, modeling partitioning and heterogeneity/irrigation.

GEWEX

Groundwater Modeling in GEWEX: Closing the Terrestrial Water Cycle from the Regional to the Global Scale

Stefan Kollet[1], Laura Condon[2], and Peter van Oevelen[3]

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Issues or Challenges for JSC Awareness

- GEWEX is requesting fund for its open science conference in 2024.
- SSG membership

- For international projects, some focus on organizing actual research activities (process understanding, data development, field campaigns, comprehensive data evaluation), while some focus on synthesis or overview papers. while both are important, the former takes much more efforts than the latter. What should WCRP projects focus on?
  - (a) Primarily on research activities (with synthesis/overview being icing on the cake);
  - (b) Primarily on synthesis/overview (with research activities secondary);
  - (c) Equally on both