Western Water in the Anthropocene: Water on the Edge

A Proposed GEWEX Regional Hydroclimate Program (RHP)

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GEWEX SSG-32, Pasadena, CA
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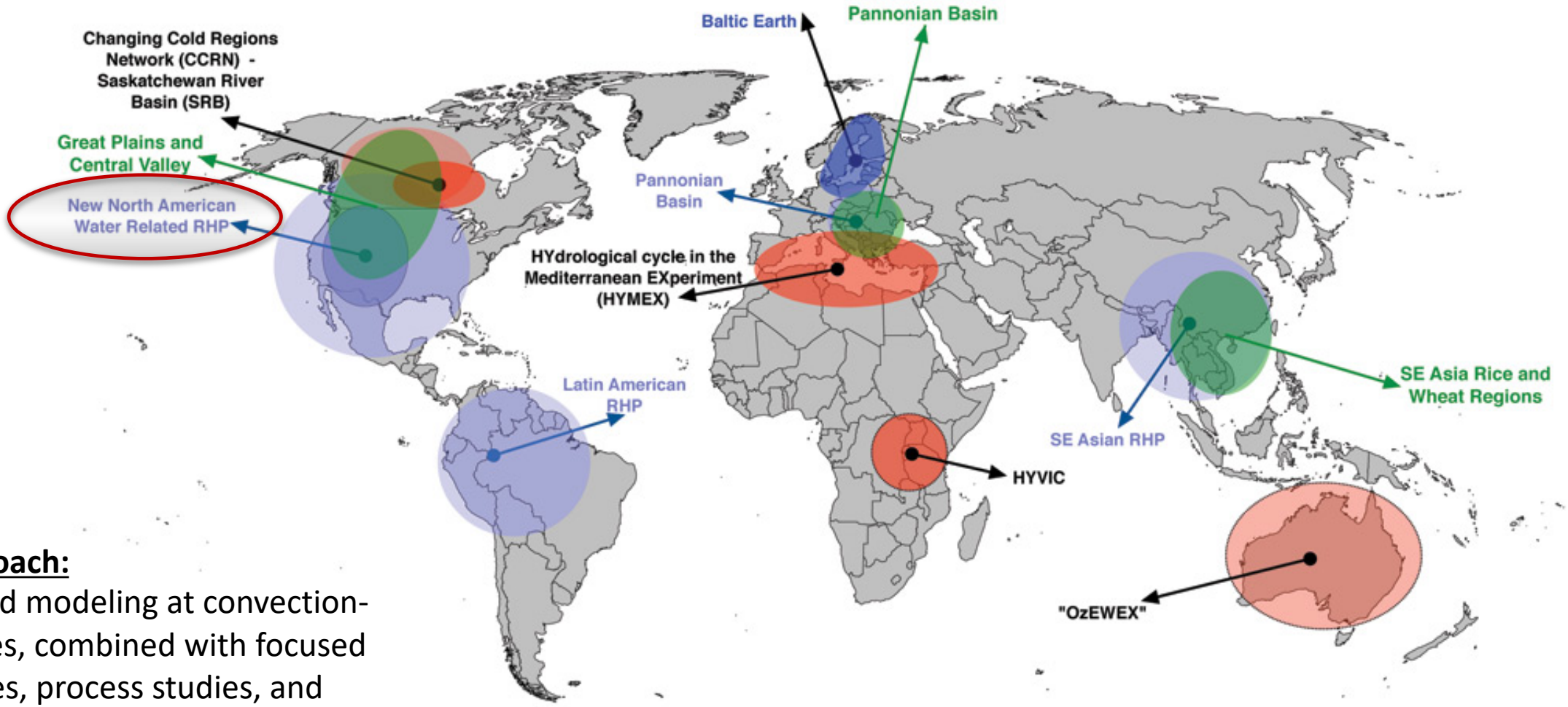
GEWEX Priority - RHP in the U.S.



Proposed Approach:

CONUS+ coupled modeling at convection-permitting scales, combined with focused regional analyses, process studies, and observations in western headwaters

Today's Objectives

I. Reintroduce US RHP focused on Water-Energy Cycle

II. GEWEX SSG Buy-In

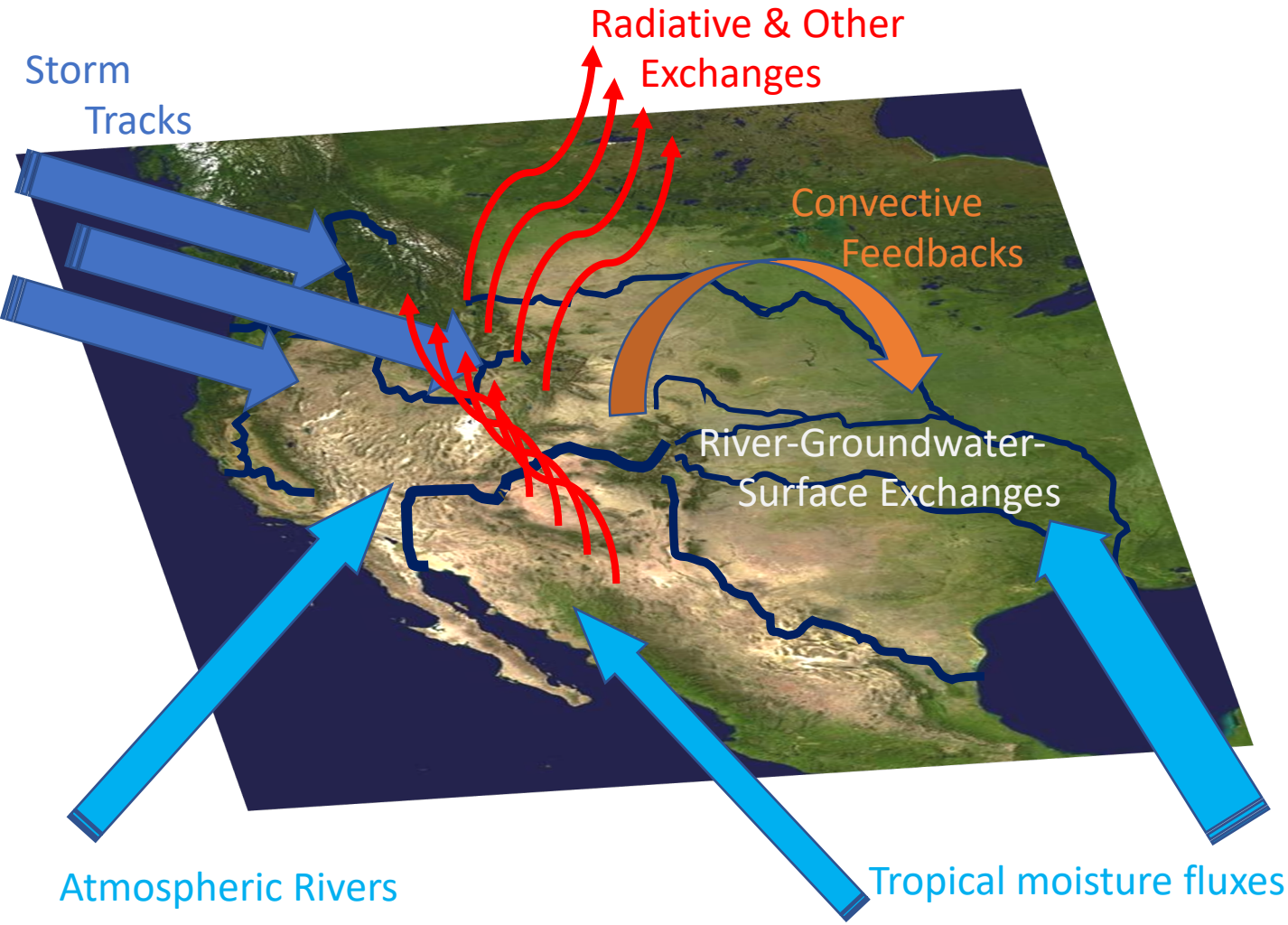
III. Propose Next Steps

The Problem:

- Agriculture in the western US relies on mountain headwater resources that are vulnerable to secular trends in water budget changes, as well as to endemic modes of climate variability
- The long-term security of these '*breadbaskets*' lies in predictive understanding of the energy and water cycles that sustain water supplies and drive the regional hydroclimate

(Image created by the Pacific Institute using NHDPlus River Data)

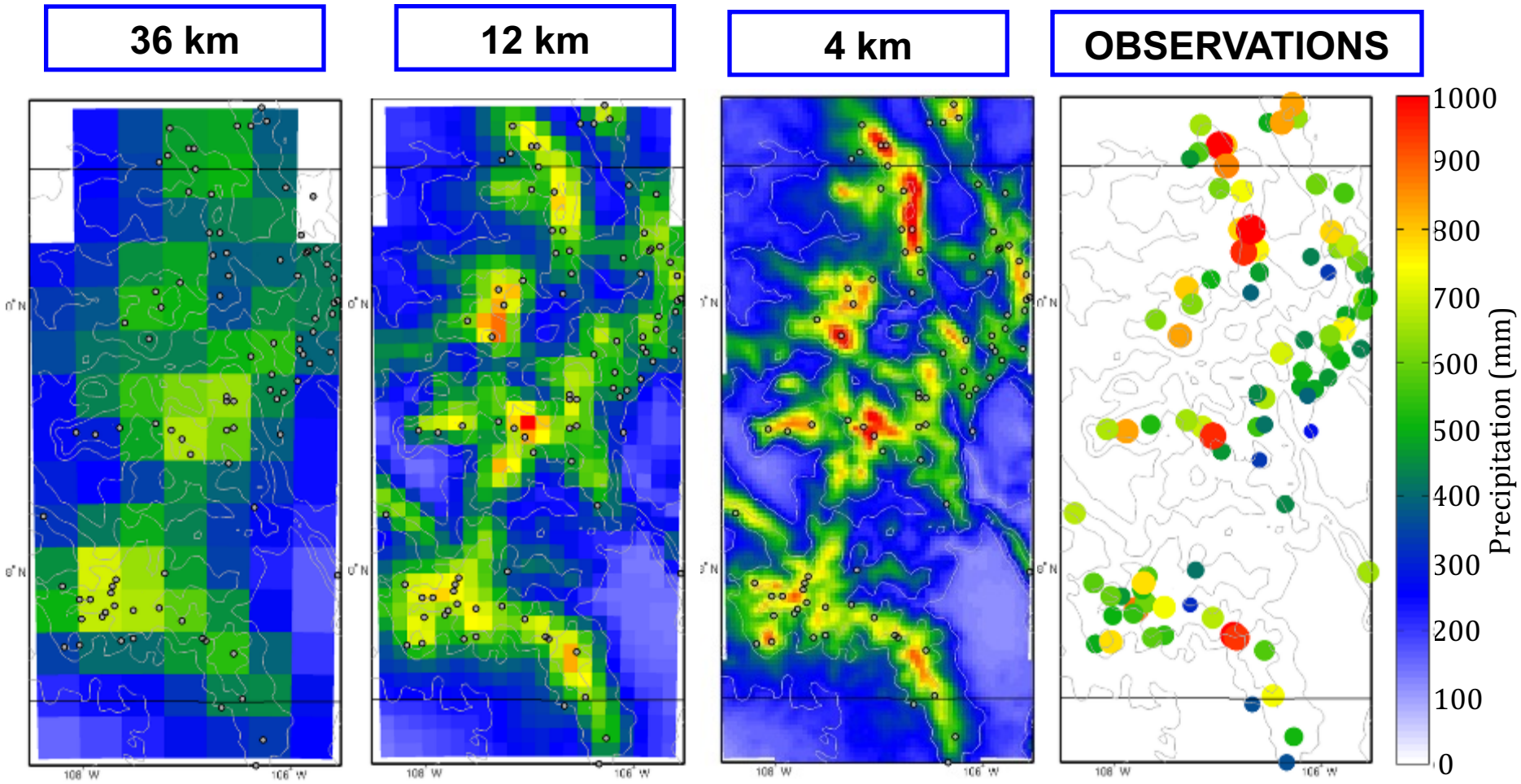
Core Science Questions:



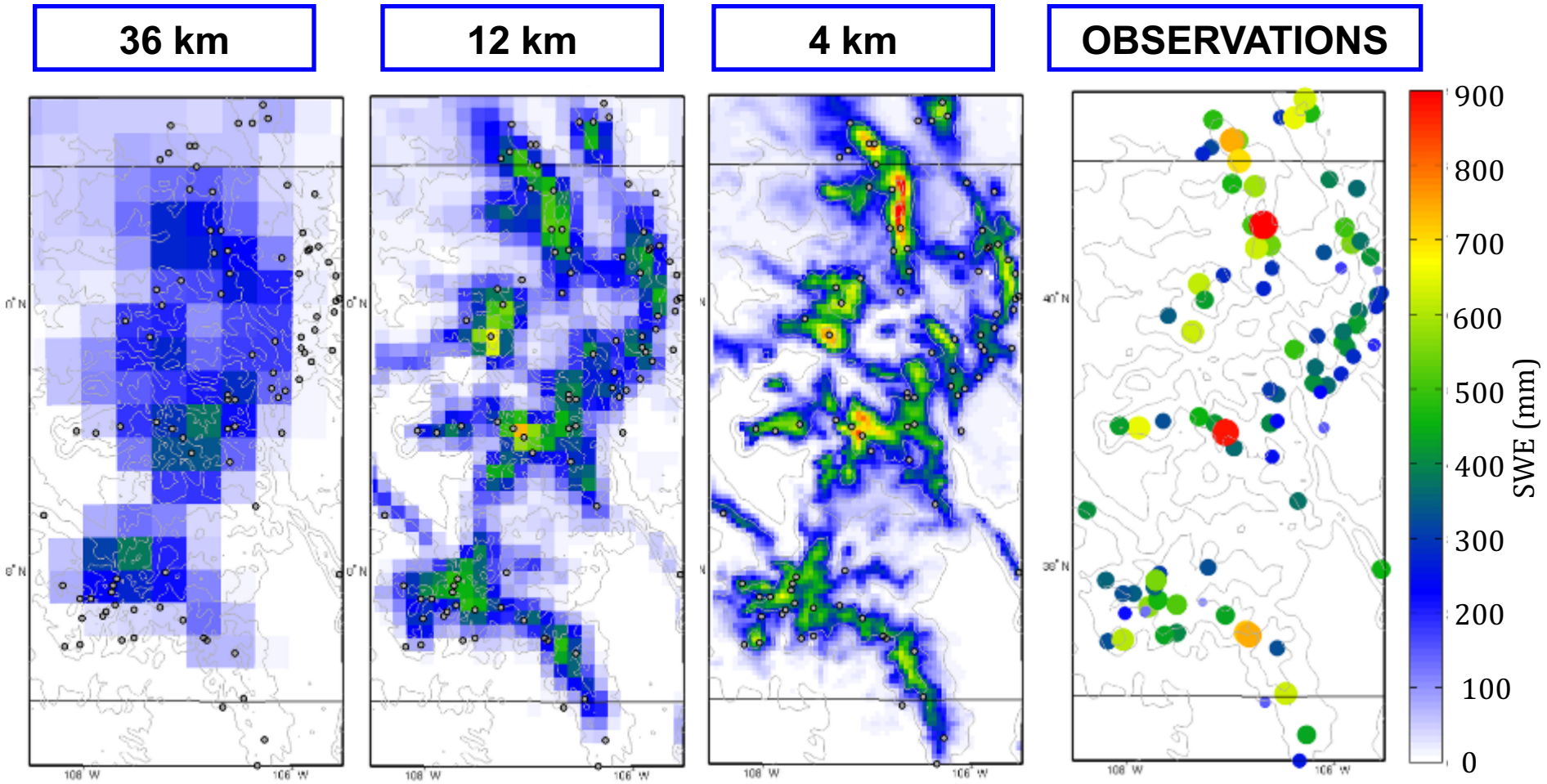
1. To what fidelity can we close the coupled water & energy budgets of the western water & agricultural systems?
2. How much change in the water cycle is driven by land cover/use change and irrigation practices vs. climate change?
3. How will headwater water supplies change in the future?
4. Feedbacks: How do land conditions (moisture, land cover/land use) influence precipitation?
5. What modes of variability favor the occurrence of high-impact events (drought and flood)?
6. What observations are needed to reduce water budget and predictive uncertainties?
7. Processes: how do we build coupled modeling systems to address these issues?

7-year average cool-season precipitation:

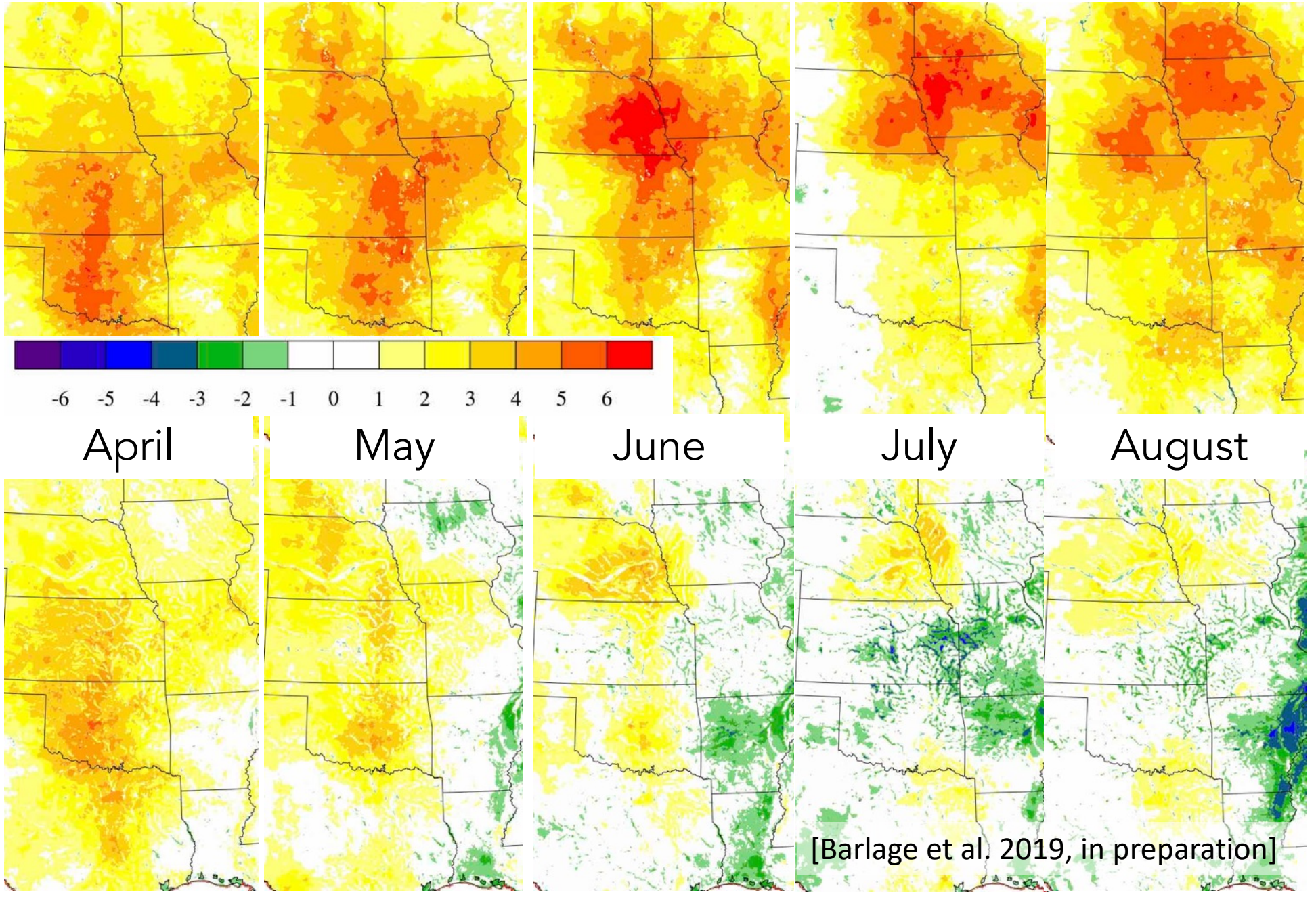
1 October – 31 May



7-year average SWE on April 1st



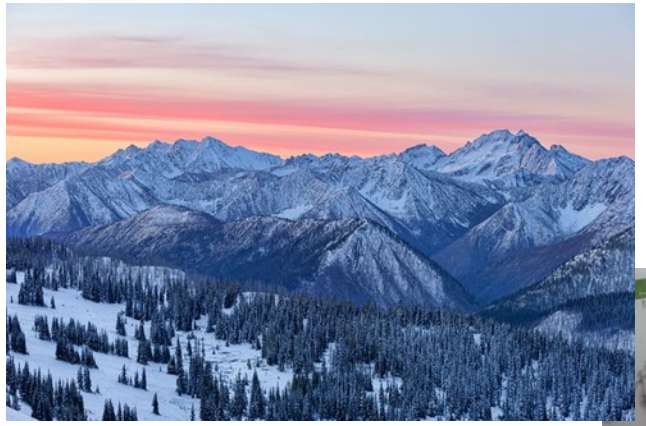
Evolving Temperature Bias over Central U.S.



[Barlage et al. 2019, in preparation]

The Solution

- Integrated observational, modeling and data assimilation research strategy to rigorously quantify coupled water and energy budgets
- New era of fully coupled re-analyses of past 40 years
- Multi-decade projections under various climate change scenarios
- Integrated process-based models which can be both calibrated and validated for operational prediction
- Improved generation of actionable prediction and management products with state of the art spatial and temporal fidelity



Strategic Elements

Process Studies

Observing System Design

Data Assimilation

Model Evaluation

Observational Network

"Headwaters"

40-Yr CONUS+ High resolution coupled reanalyses

Community

40-Yr CONUS+ Projections

Physics Development

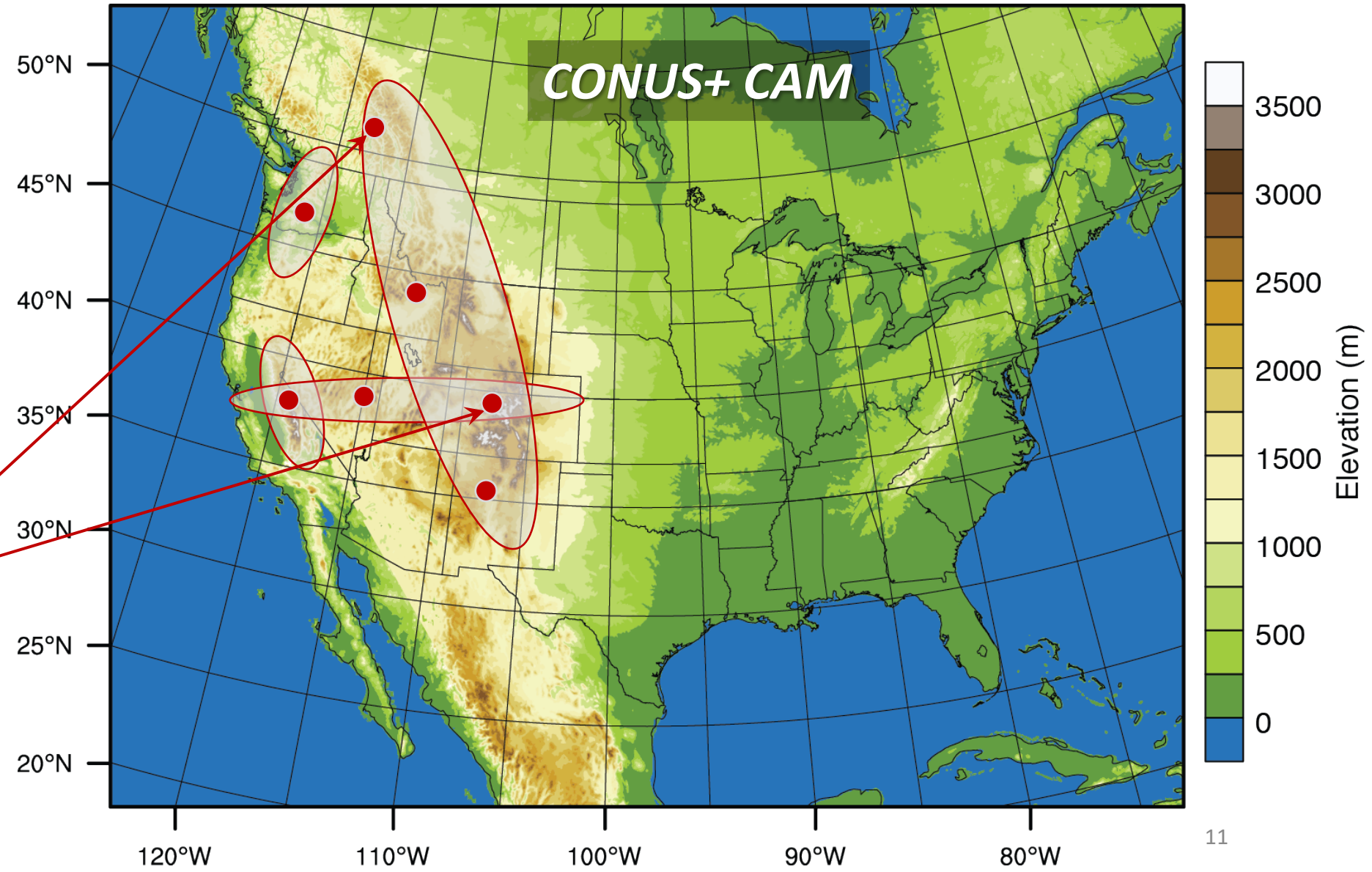
Land Use/Cover Change

Coupled Model Development

Notional Scope

Western Headwaters:
Intensive studies supported by observational transects.

Leveraged observations e.g, Global Water Futures (Canada); USGS NGWOS (coming soon); etc.



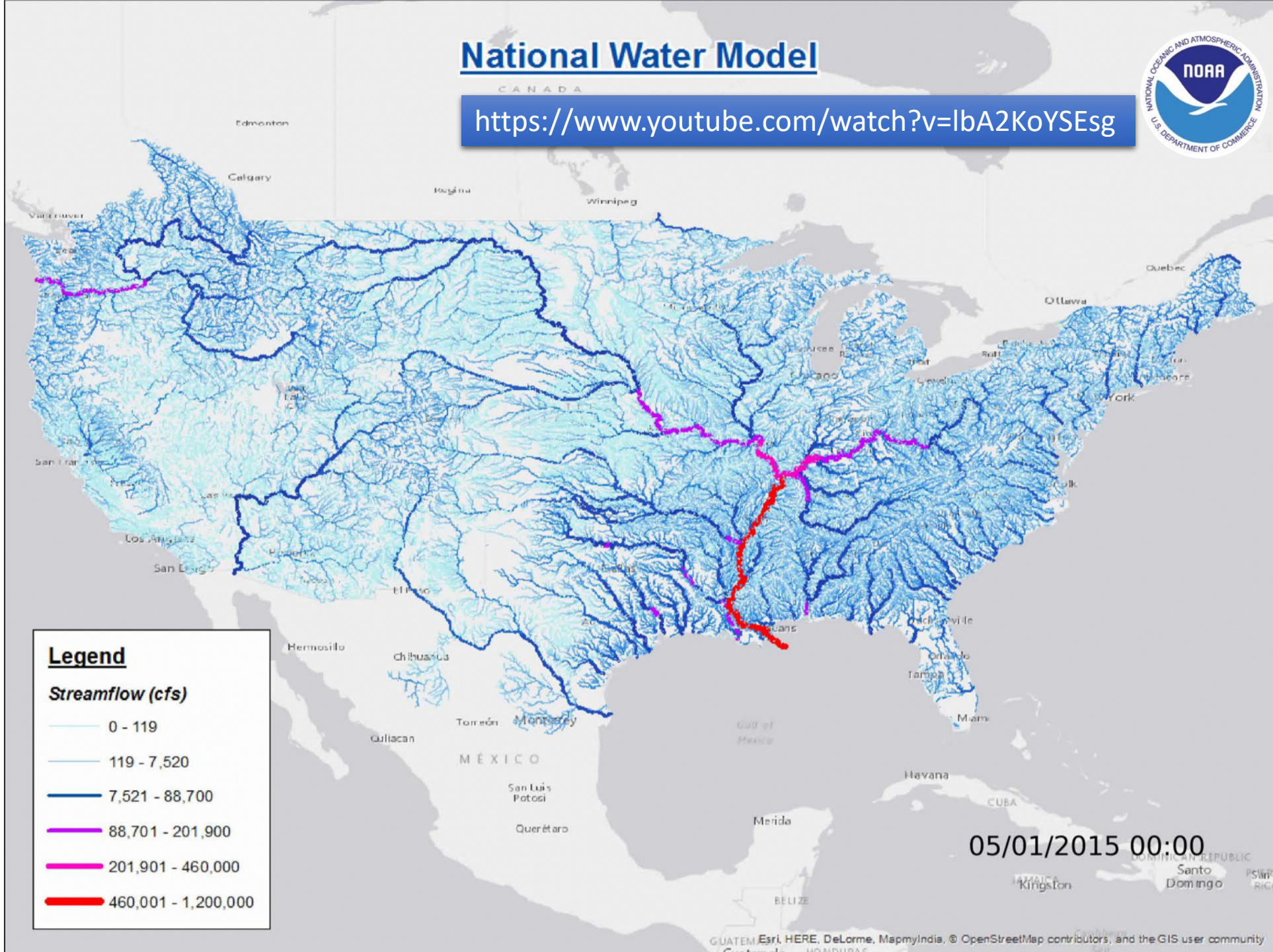
WRF-Hydro®

Powering the NOAA National Water Model

https://ral.ucar.edu/projects/wrf_hydro/overview

National Water Model

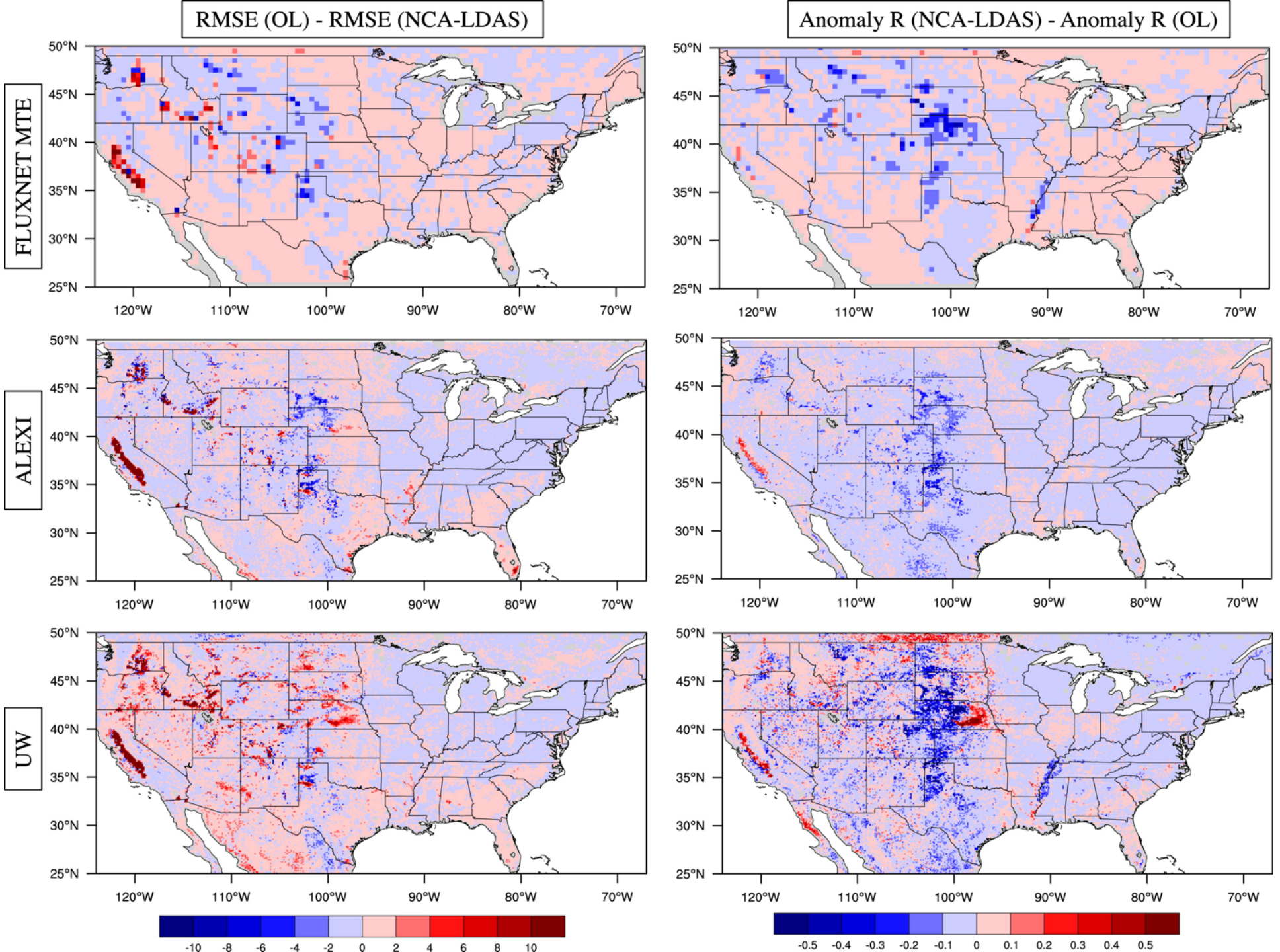
https://www.youtube.com/watch?v=lbA2KoYSEsg



ET Comparison

North American Land Data Assimilation System

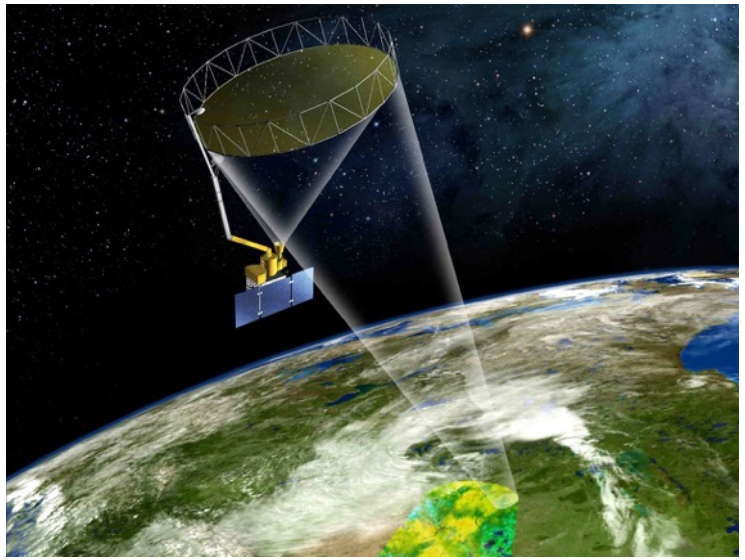
https://ldas.gsfc.nasa.gov/nldas



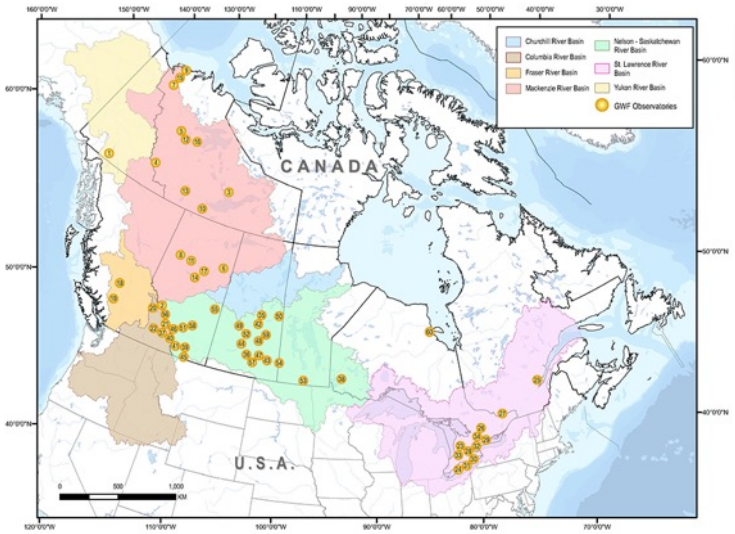
Monitoring: Bedrock to Boundary Layer

Taking Inspiration from Around the Globe

Satellites

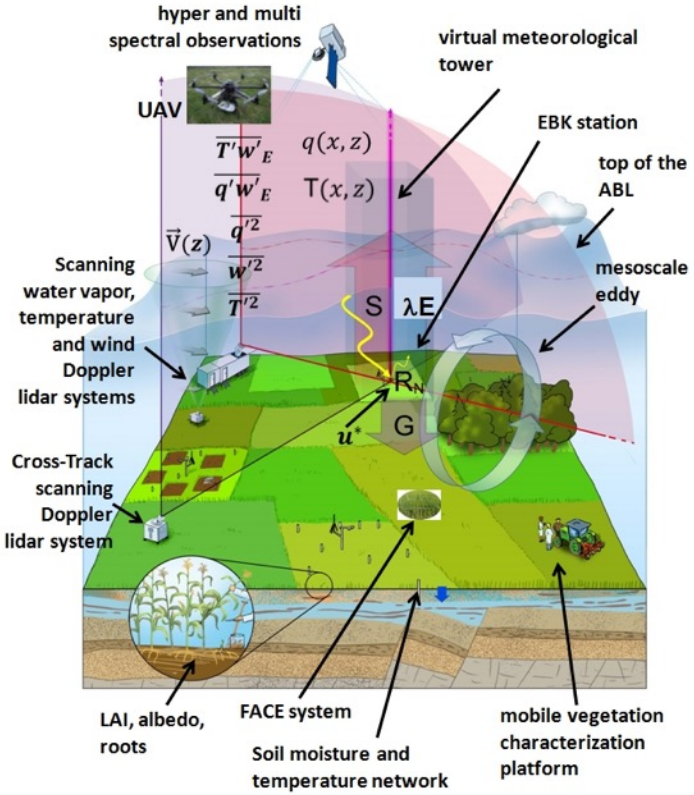


DOE Mobile ARM Facility



Global Water Futures

NCAR monitoring system Purple Lake (AK)



GEWEX Land-Atmosphere Feedback Observatories

Next Steps

I. Develop a Strategy 'Whitepaper'
- Form writing team
- Finalize needs assessment, science questions and program goals & deliverables
- Map out how "Strategic Elements" answer "Science Questions"
- Develop Integrated Observing System – Modeling Plans (5-7 year timeframe)
- Outline RHP Implementation Timeline

II. Get the US Federal Agencies Involved
- Engage Program Offices/Managers
- US GEWEX Program Office

III. RHP Timeline:
- Fall 2020 - Plan/hold an 'Implementation Workshop' (kickoff)
- Begin RHP "Initiation Phase 1" in 2021 (2-year period; 2021-2022)
- Phase-2 would commence ~2023

Challenge:
Managing scope!

Thank You!

Questions?

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