Thoughts on Community Modeling & Long-term Predictions of the Integrated Water Cycle: Topic 3

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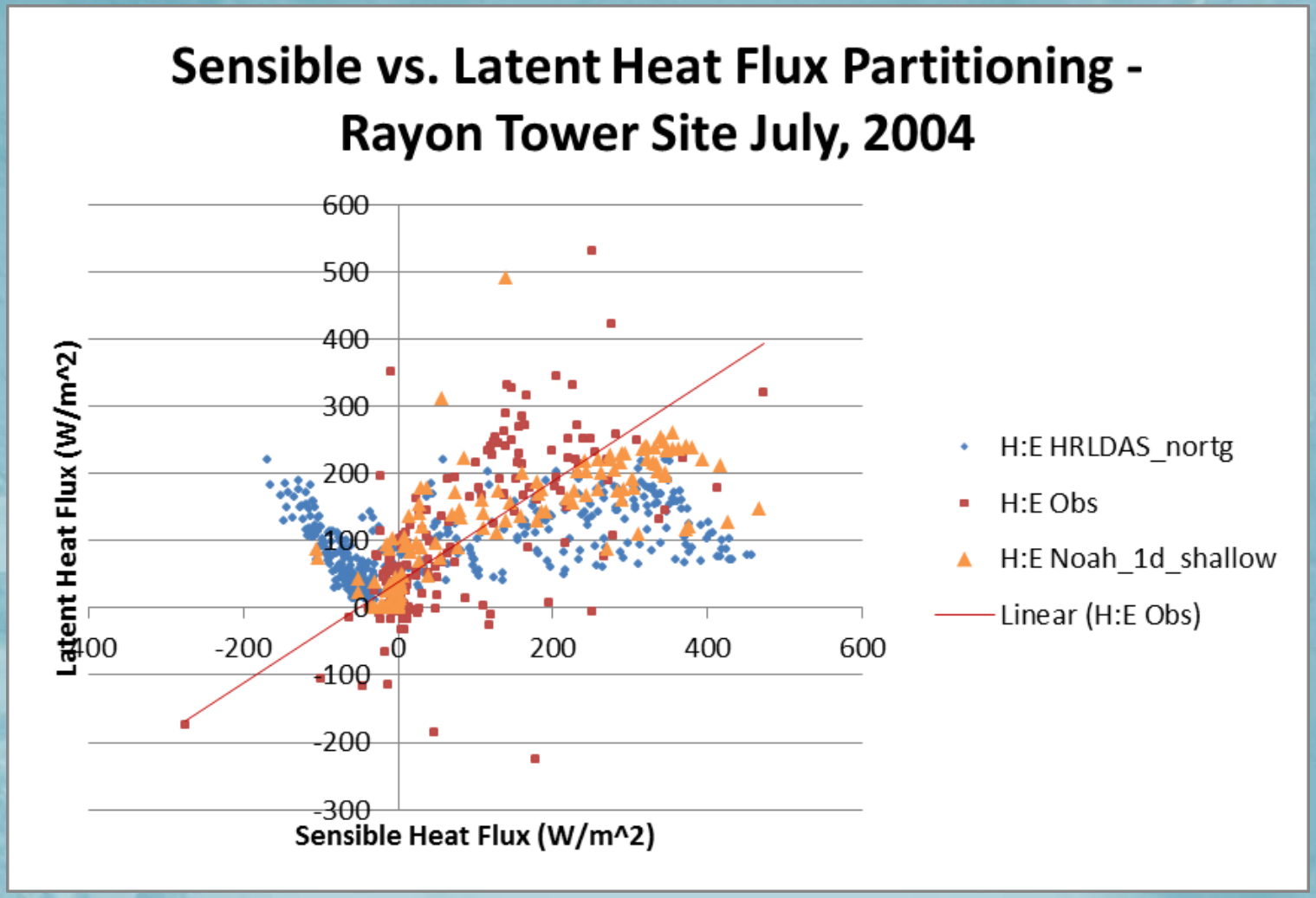
Many models, much confusion but more confidence?

- Climate is ‘global’, hydrology is ‘local’:
  - Strong boundary forcing/control on hydrologic responses
  - Strong hysteresis in runoff and recharge processes
  - Multi-timescale memory processes on landscapes as functional of
    - Climate seasonality
    - Vegetation phenology
    - Soil depth and rooting structures
    - Subsurface transport timescales
    - Water management

Offline evaluation of Noah LSM Surface Fluxes:



Gochis et al., J. Arid Env. 2010

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- Many competing but equally-plausible hypotheses:
  - Not capitulation to uncertainty
  - Proceed until refuted…
- NEED: Multi-physics, multi-scale modeling systems will need to be supported for the foreseeable future…
  - e.g. PARFLOW, hsB, DHSVM, VIC-type approaches running concurrently…
  - Continued emphasis on coupling or 'couplability'

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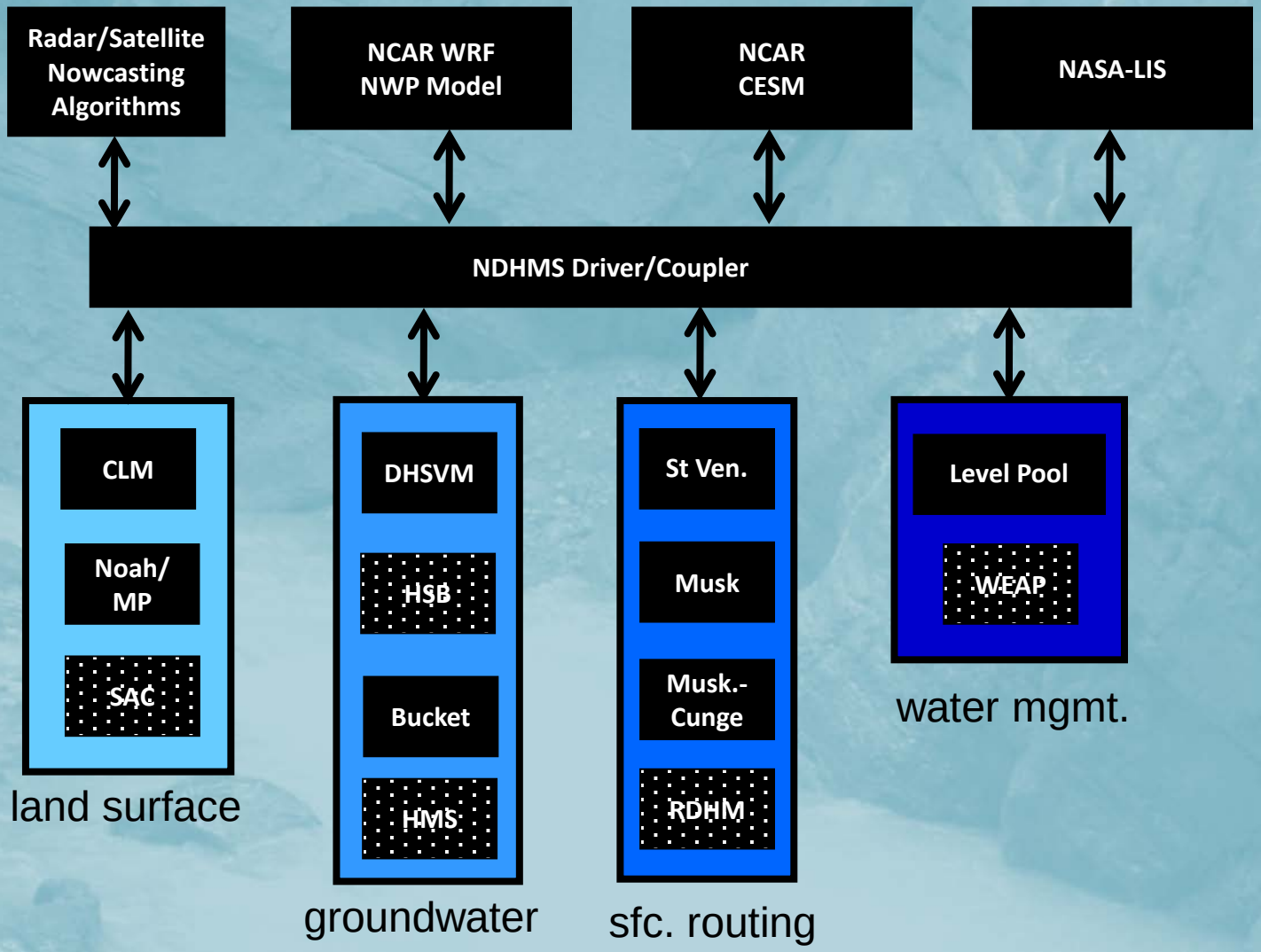
Conceptualization of WRF-Hydro:

- Current components:



Validating the unverifiable…

- Currently no national infrastructure for comprehensive evaluation of hydrologic models:
  - National observing networks have poor or inadequate overlap and coordination (e.g. NEON vs. CZO vs. radar vs. SNOTEL vs. USGS-streamflow, etc…)
  - Programs within agencies are unnecessarily stove-piped and at times, competing (i.e. "why should we support someone else's campaign/network?")
  - Perpetually difficult to support perpetual observing systems….even if they are critical to national security (USGS streamflow and GW monitoring)

- NEED: We need to have a robust national/international network of model testbeds/benchmark sites which provide basic long-term data and a testing environment for new technologies (e.g. airborne/spaceborne LIDAR)

- NEED: Testbeds need to embrace rather than avoid human infrastructure…

Huddle-up!

- The problems being bitten-off by this workshop are well beyond single PI and small 'clique' capabilities

- NEED: Adopt a 'mission' type approach to address particular modeling problems (c.f. NASA paradigm…)
  - Build a community through teamwork
    - Let groups use their strengths and avoid 'we do everything' paradigms (e.g. let educators educate, software engineers engineer, scientists research, observationalists observe…)
  - Support, er' demand (through $$$), collaborations between partners
  - Emphasize the development and attainment of rigorous deadlines and deliverables

Wake up call…

- The problems and challenges of doing surface hydrology are significant
  - C.F. "Hyper-resolved ignorance" comment from Beven on Wood et al. 2011
- However, if 'hydrologists' don't engage the challenge of multi-scale Earth System modeling it will be done for them…and this will set back the science significantly…
  - Engage ESM, HPC, coupled prediction research…