Development of an Ensemble Gridded Hydrometeorological Forcing Dataset over the Contiguous United States

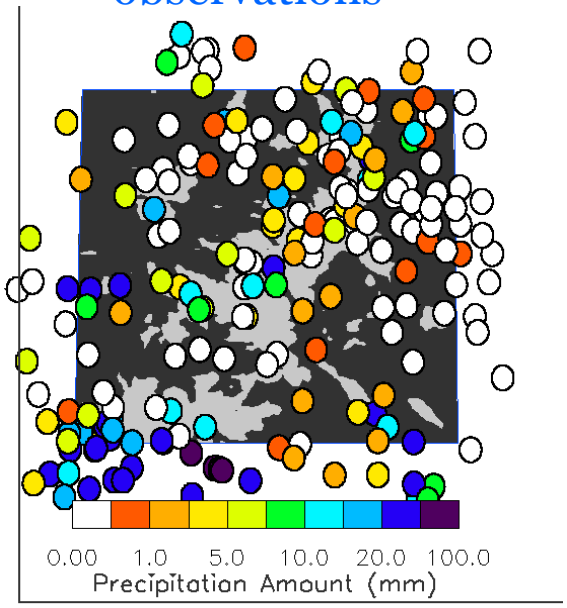
Andrew J. Newman[1], Martyn P. Clark[1], Jason Craig[1], Bart Nijssen[2], Andrew Wood[1], Ethan Gutmann[1], Naoki Mizukami[1], Levi Brekke[3], and Jeff R. Arnold[4]

[1] National Center for Atmospheric Research, Boulder CO, USA
[2] University of Washington, Seattle WA, USA
[3]U.S. Department of Interior, Bureau of Reclamation, Denver CO, USA
[4] U.S. Army Corps of Engineers, Institute for Water Resources, Seattle WA, USA

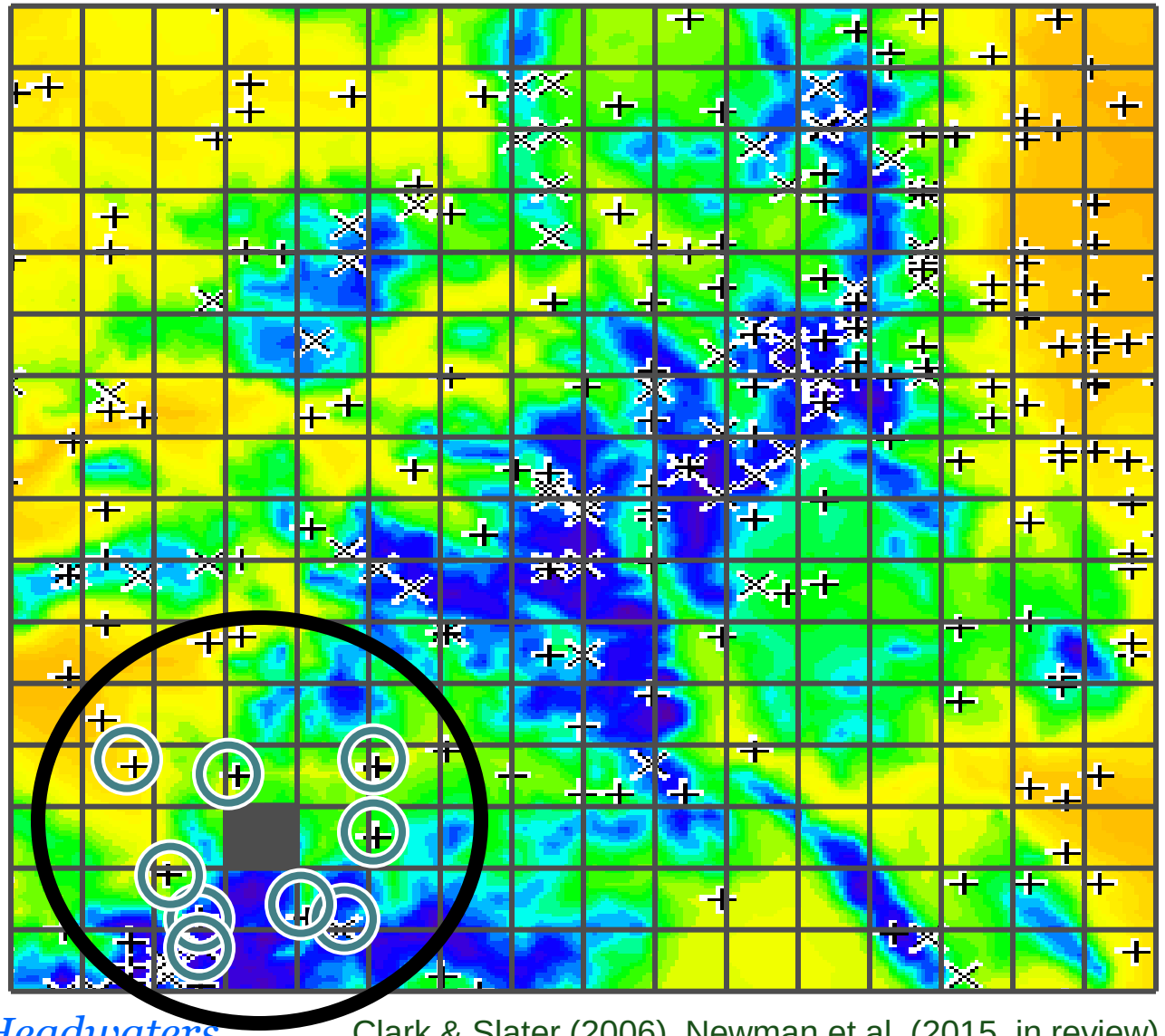
Ensemble Generation

Step 1: Transform Precip, then locally weighted regression at each grid cell: Probability of Precipitation (PoP) via logistic regression, then amount and uncertainty (least squares mean & residuals)

observations



Example over the Colorado Headwaters

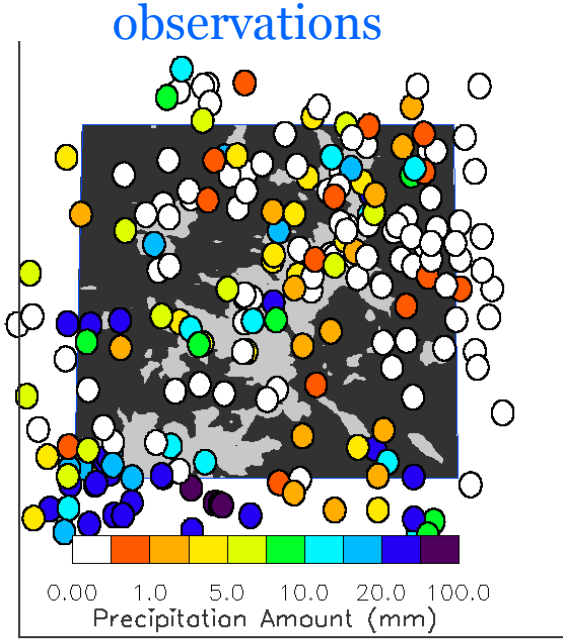


Example over the Colorado Headwaters

Clark & Slater (2006), Newman et al. (2015, in review)

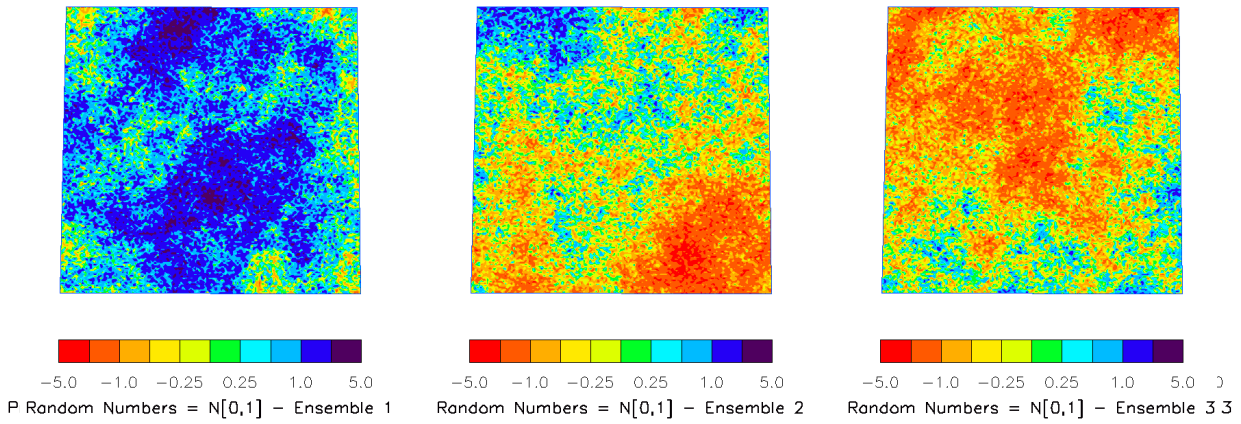
Ensemble Generation

Step 2:
Synthesize ensembles from PoP, amount & uncertainty using spatially correlated random fields (SCRFs)



Other Methodological Choices:
- Topographic lapse rates derived at each grid cell for each day vs. climatology (e.g. PRISM)
- **Used serially complete (filled) station data rather than only available obs** vs. using only available observations
- Included SNOTEL observations vs. excluding

- **Final Product: 12 km, daily 1980-2012, 100 members, precipitation & temperature** (1.5 TB)

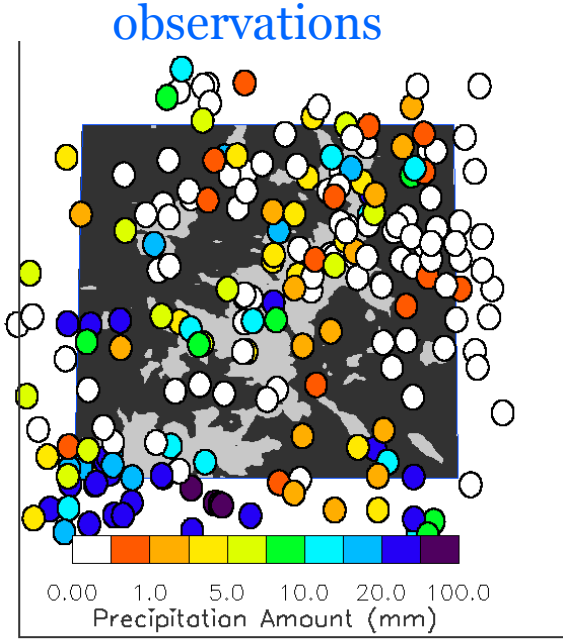


Example over the Colorado Headwaters

Clark & Slater (2006), Newman et al. (2015, in review)

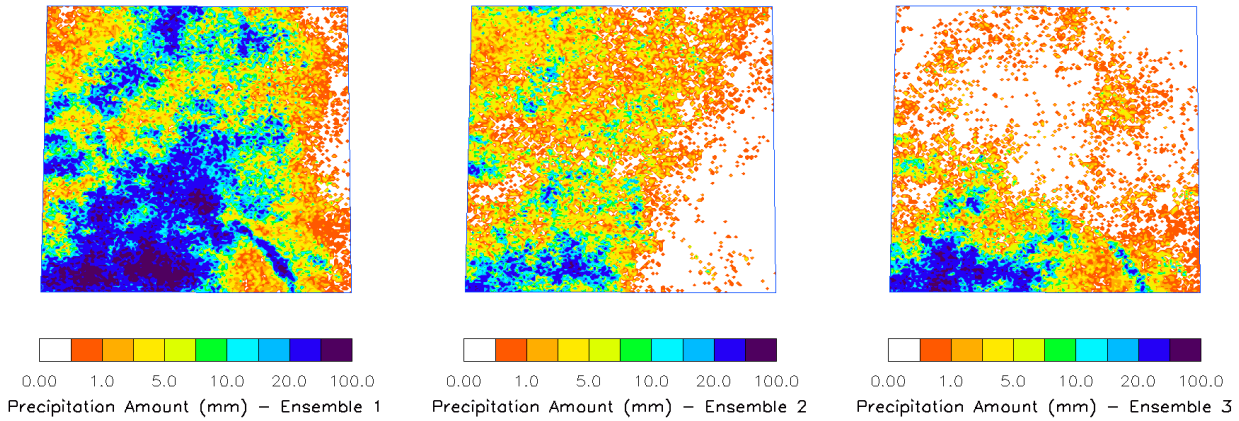
Ensemble Generation

Step 2:
Synthesize ensembles from PoP, amount & uncertainty using spatially correlated random fields (SCRFs)



Other Methodological Choices:
- Topographic lapse rates derived at each grid cell for each day vs. climatology (e.g. PRISM)
- **Used serially complete (filled) station data rather than only available obs** vs. using only available observations
- Included SNOTEL observations vs. excluding

- **Final Product: 12 km, daily 1980-2012, 100 members, precipitation & temperature** (1.5 TB)

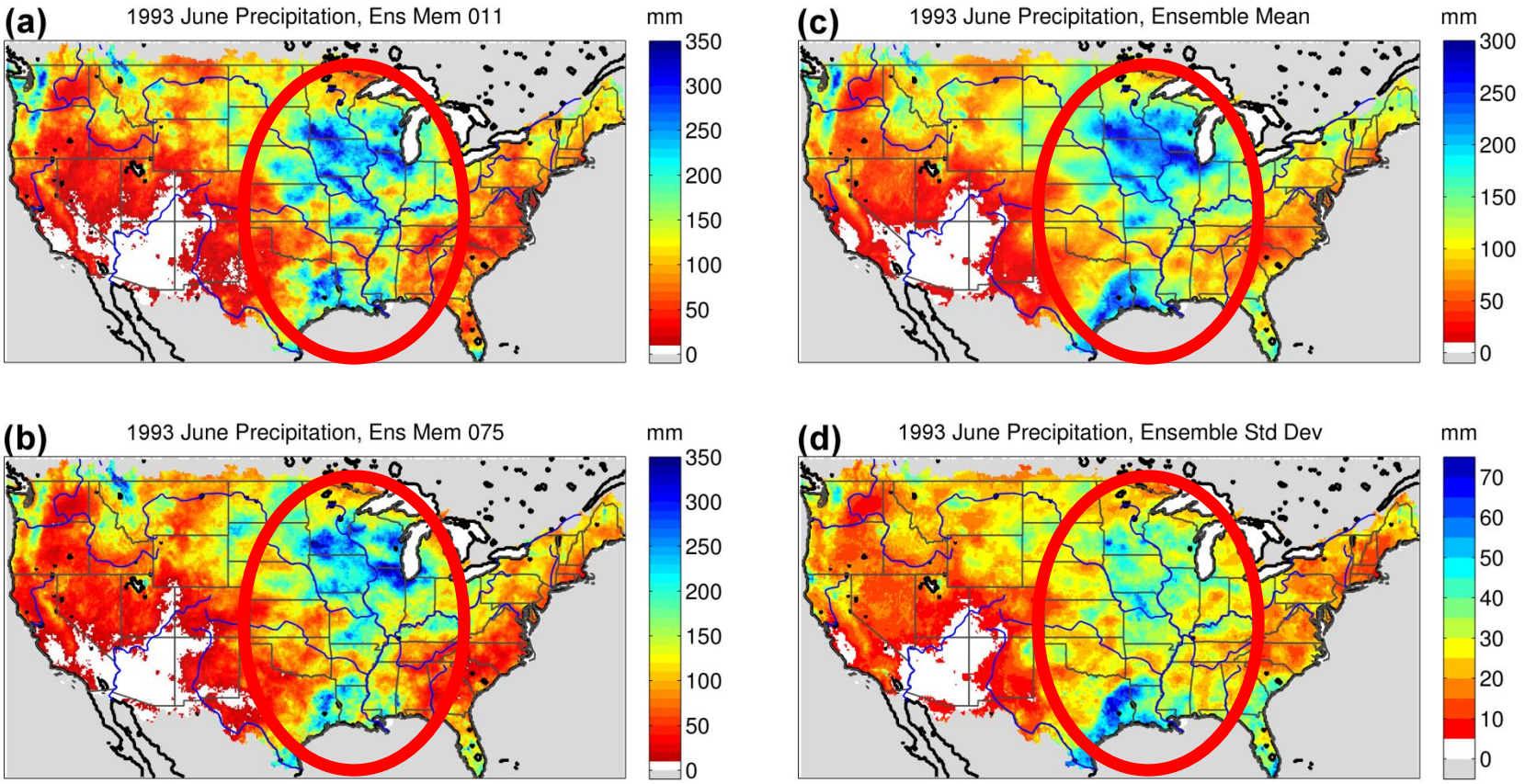


Example over the Colorado Headwaters

Clark & Slater (2006), Newman et al. (2015, in review)

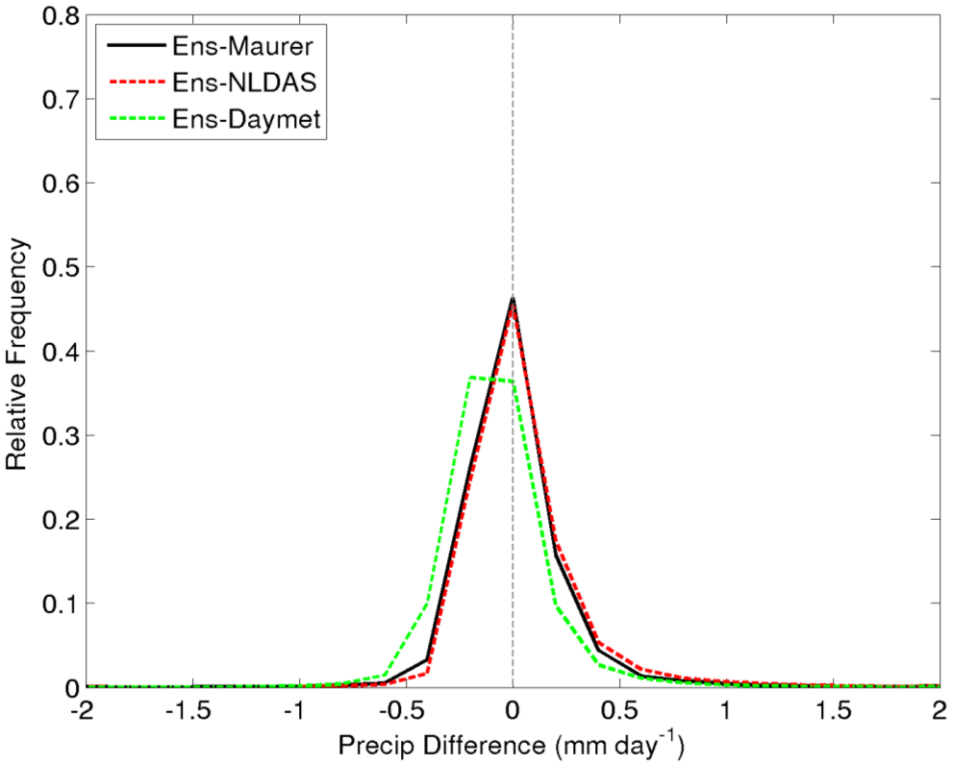
Example Output

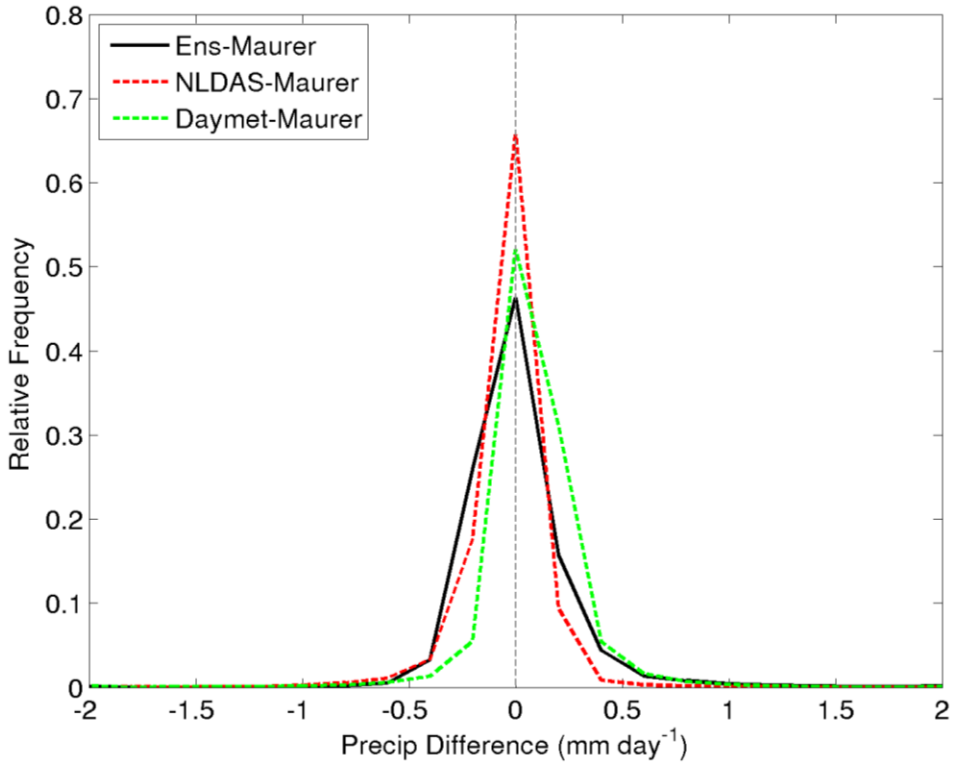
- Central US Flood of 1993
  - June 1993 accumulated precipitation



Validation: Comparisons to other datasets (precipitation)

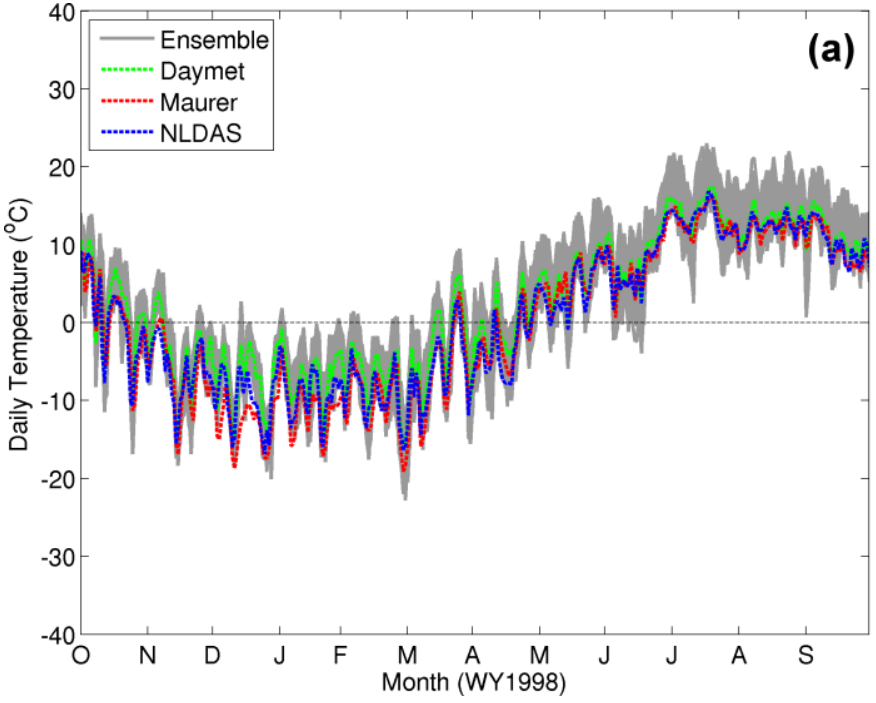
- Precip difference PDFs
  - Nearly symmetric differences, except vs. Daymet (left panel)
  - NLDAS & Maurer agree very closely (both use PRISM correction) (right panel)
  - Slightly larger spread in ensemble – most distinctly different

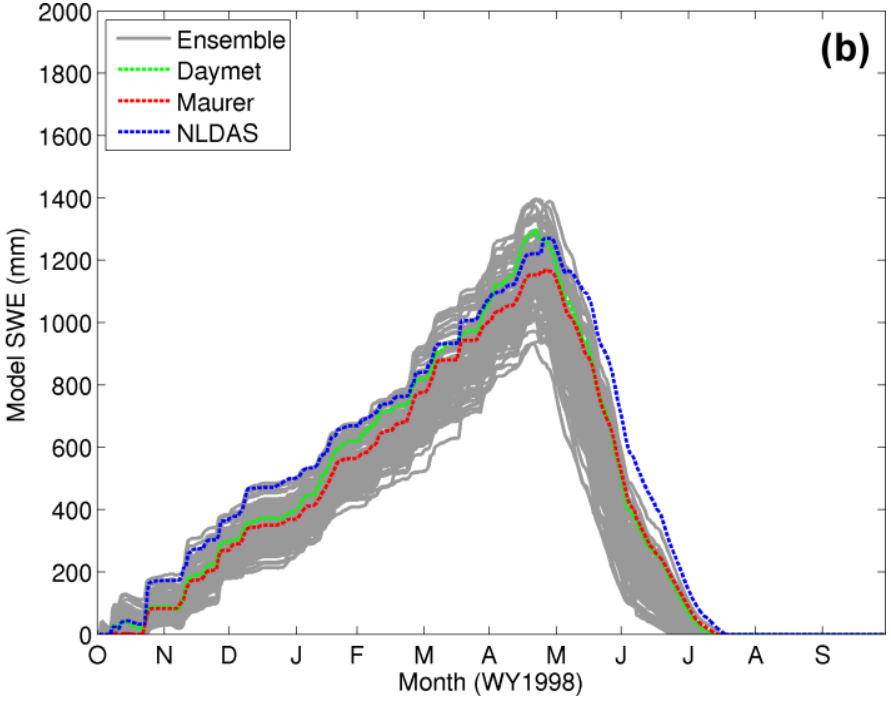




Example Application

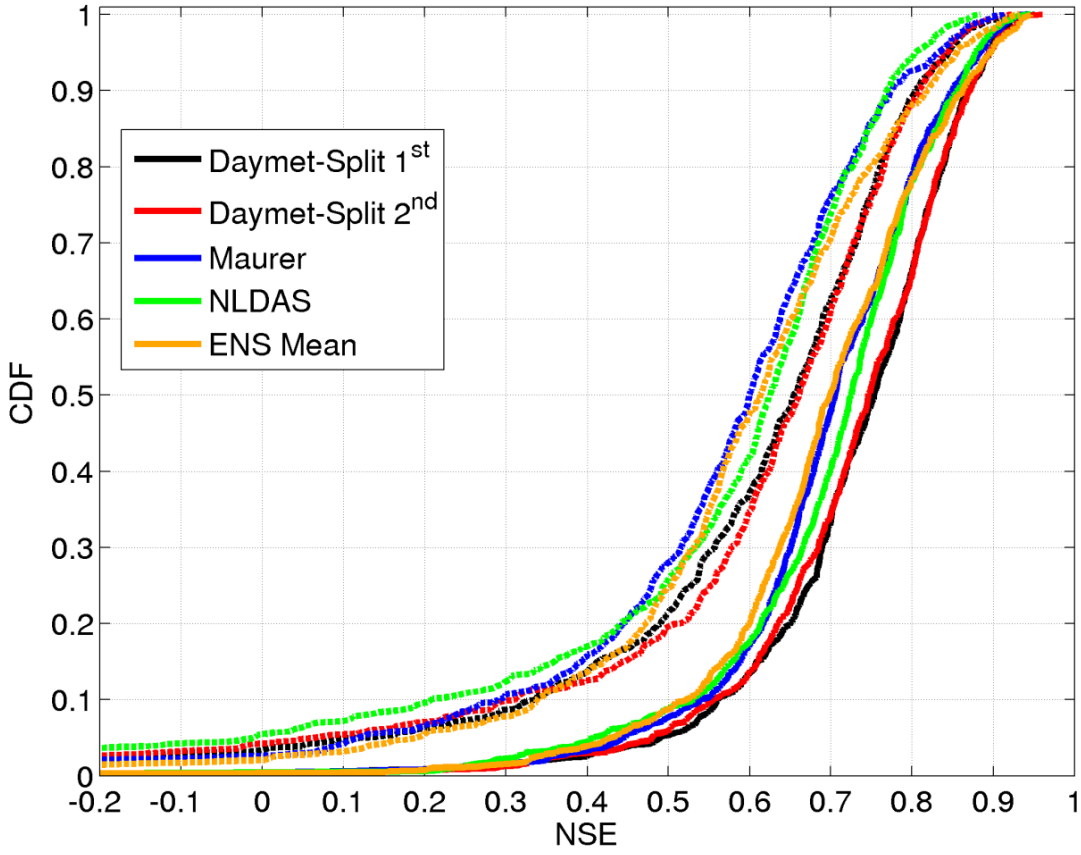
- Snowmelt dominated basin in Colorado Rockies
- Example water year daily temperature (a)
- Snow water equivalent accumulation (b)
  - Simple temperature index model (optimized for Daymet (green))





Ensemble Hydrologic Performance

- Ensemble mean forcing data run through subset of HCDN basins (see Newman et al. 2015, HESS)
- Compared to Maurer, NLDAS, and Daymet
- Ensemble mean performance similar to Maurer and NLDAS for calibrated conceptual model



CONUS Hyper-Resolution Ensemble

- NASA AIST proposal led by Martyn Clark
  - Co-Is: J. Arnold, US Army Corps of Engineers; L. Brekke, DoI; B. Nijssen, University of Washington; C. Peters-Lidard, NASA GSFC
- Develop the capability to improve characterization of risk and uncertainty in water resource management:
  - At 1km resolution from local to continental scale, using ~100 ensemble members, with adequate computational infrastructure
    - Transfer functions at original spatial scale, flexible upscaling methods for model domain
    - Develop 1km ensemble forcing dataset
- Mature the Structure for Unifying Multiple Modeling Alternatives (SUMMA):
  - Integrate into NASA Land Information System (LIS)