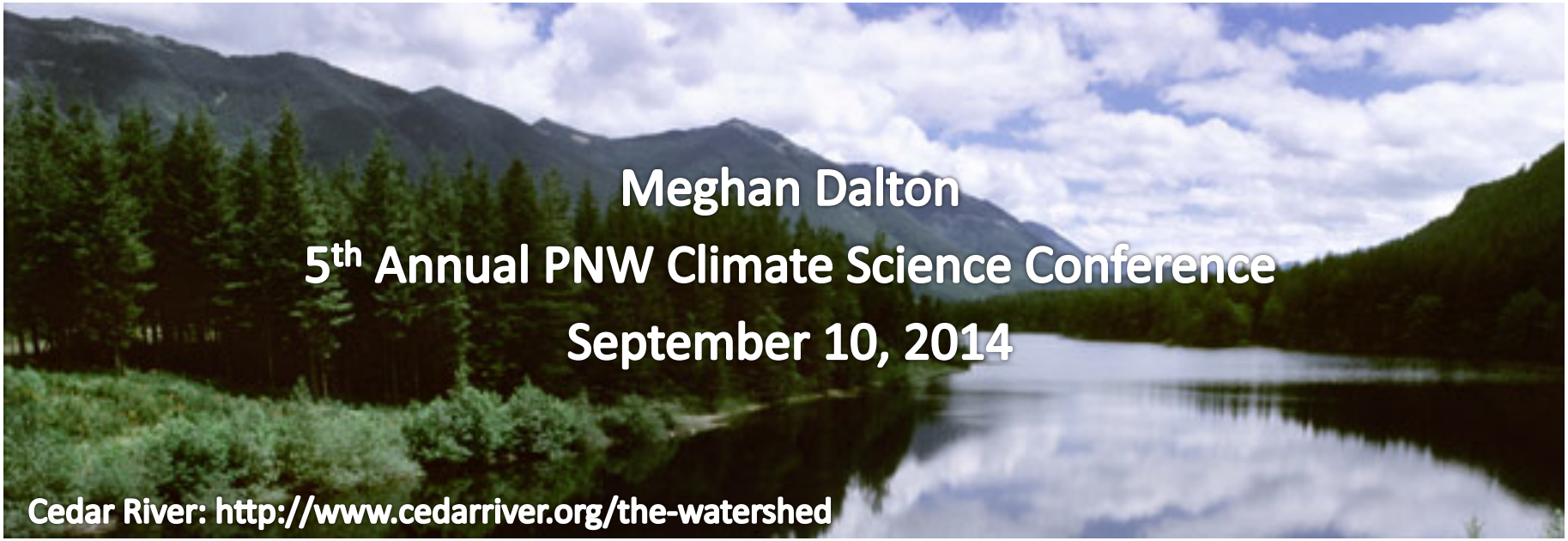
Piloting Utility Modeling Applications:

Evaluation & Examination of Custom-Downscaled CMIP5 Global Climate Model Data Supporting SPU's Climate Change Impact Assessment



CIRC
Climate Impacts Research Consortium

Seattle Public Utilities

OSU
Oregon State University

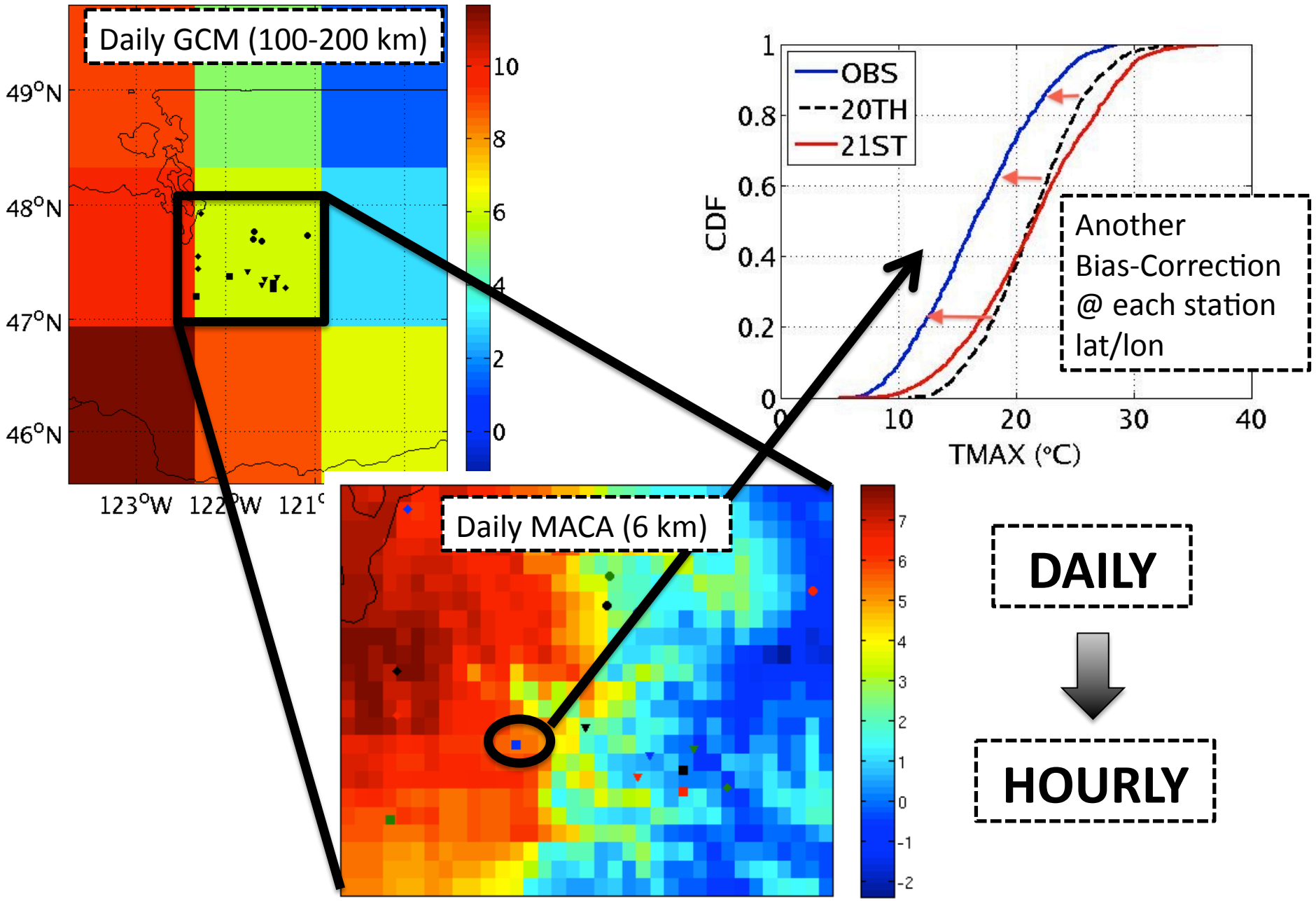
University of Idaho

CIRC's Tasks

1. Custom-downscale global climate models (GCMs)
2. Evaluate GCMs & custom-downscaled data
3. Investigate potential future changes in:
   - Timing of return of fall rains
   - Forest fire danger
   - Frequency of exceeding operational thresholds
4. Topical literature review: atmospheric rivers (ARs), El Niño-Southern Oscillation (ENSO), Pacific Decadal Oscillation (PDO)

Custom Downscaling GCMs

1. Global Climate Models (100-200 km):
   - 20 GCMs from Coupled Model Intercomparison Project phase 5 (CMIP5)
2. Statistical Downscaling Method (6 km)
   - Multivariate Adaptive Constructed Analogs (MACA), http://maca.northwestknowledge.net
3. Extra Bias-Correction:
   - @ SPU station locations
4. Daily to Hourly Disaggregation:
   - SPU's transform function



Figures provided by Katherine Hegewisch, University of Idaho

Daily➔Hourly: How we get there matters

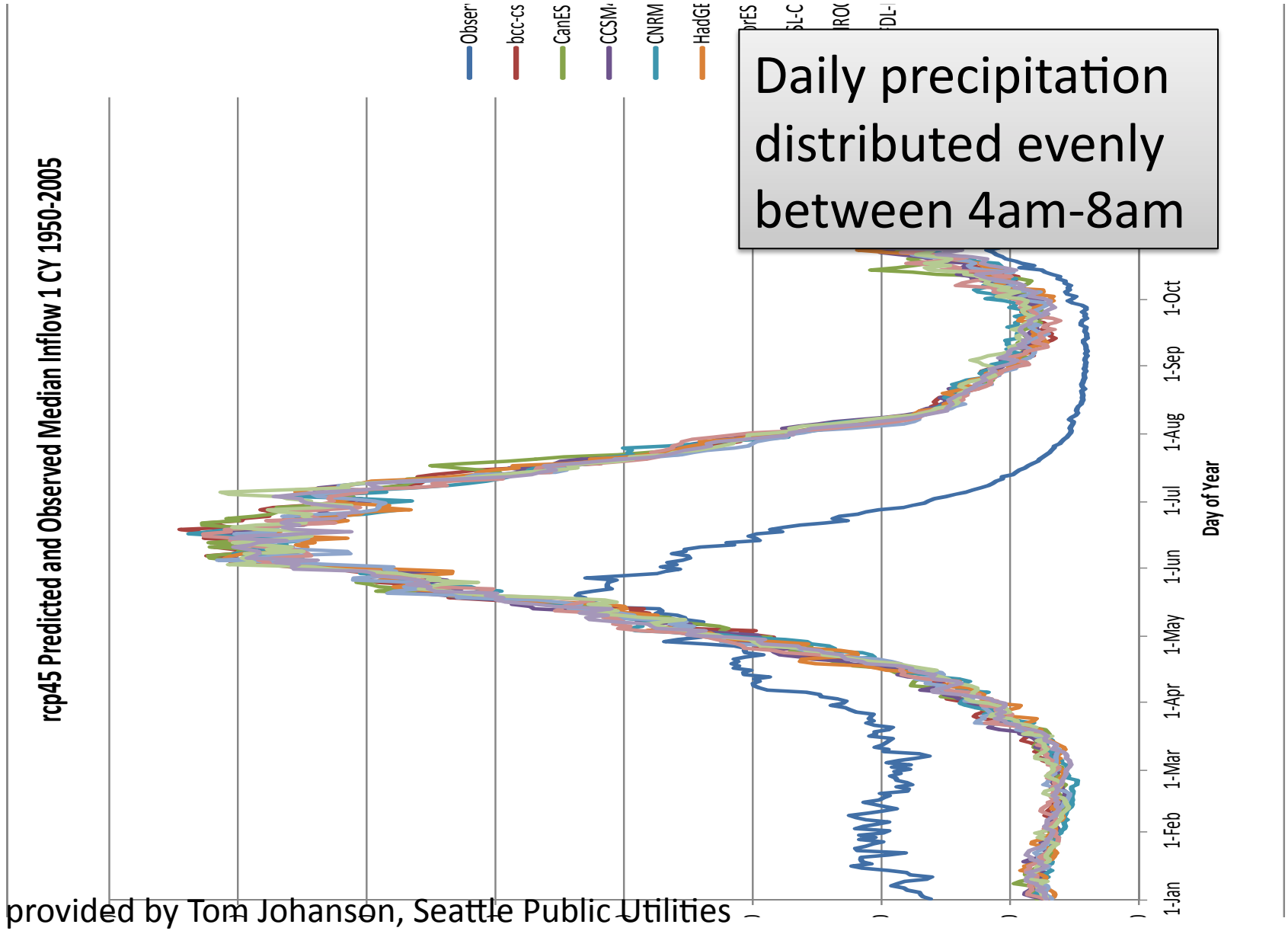
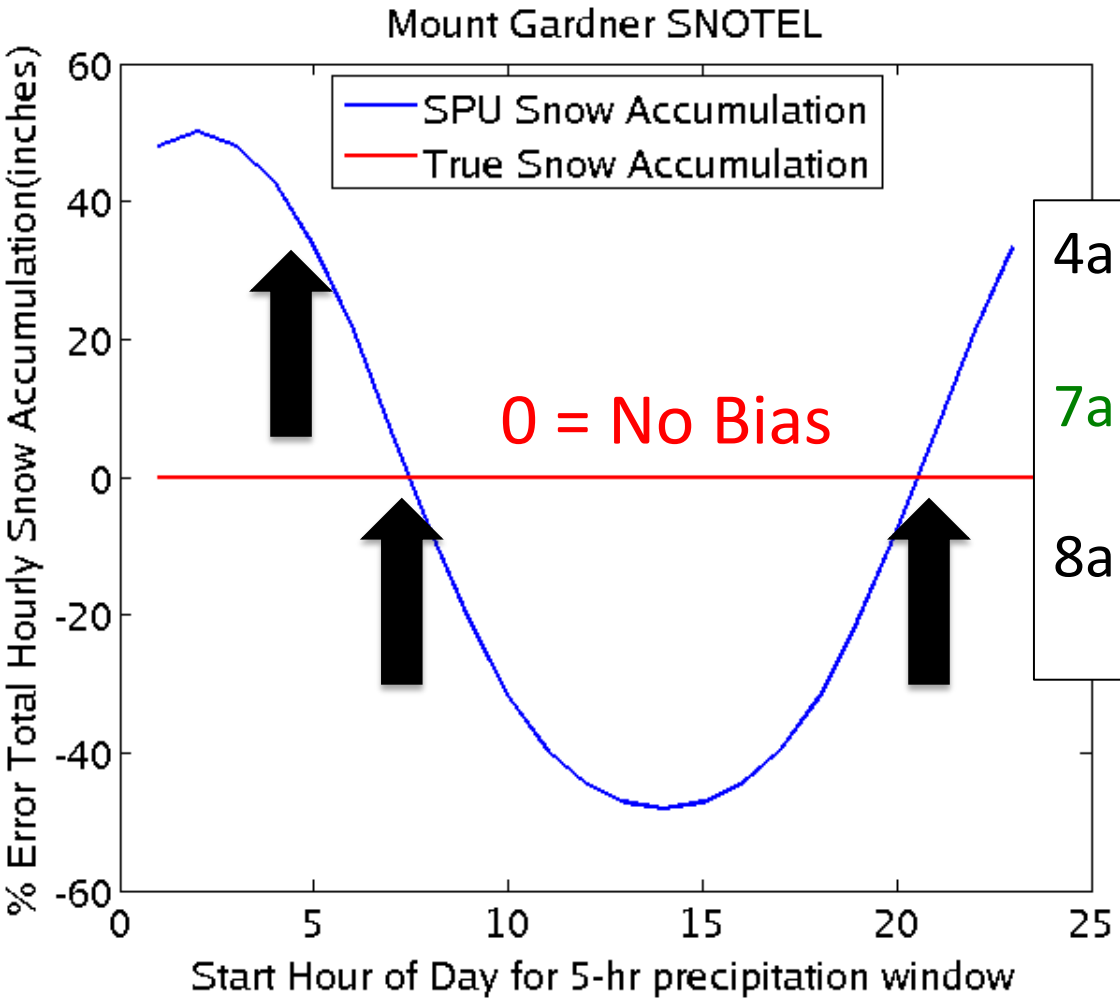


Figure provided by Tom Johanson, Seattle Public Utilities

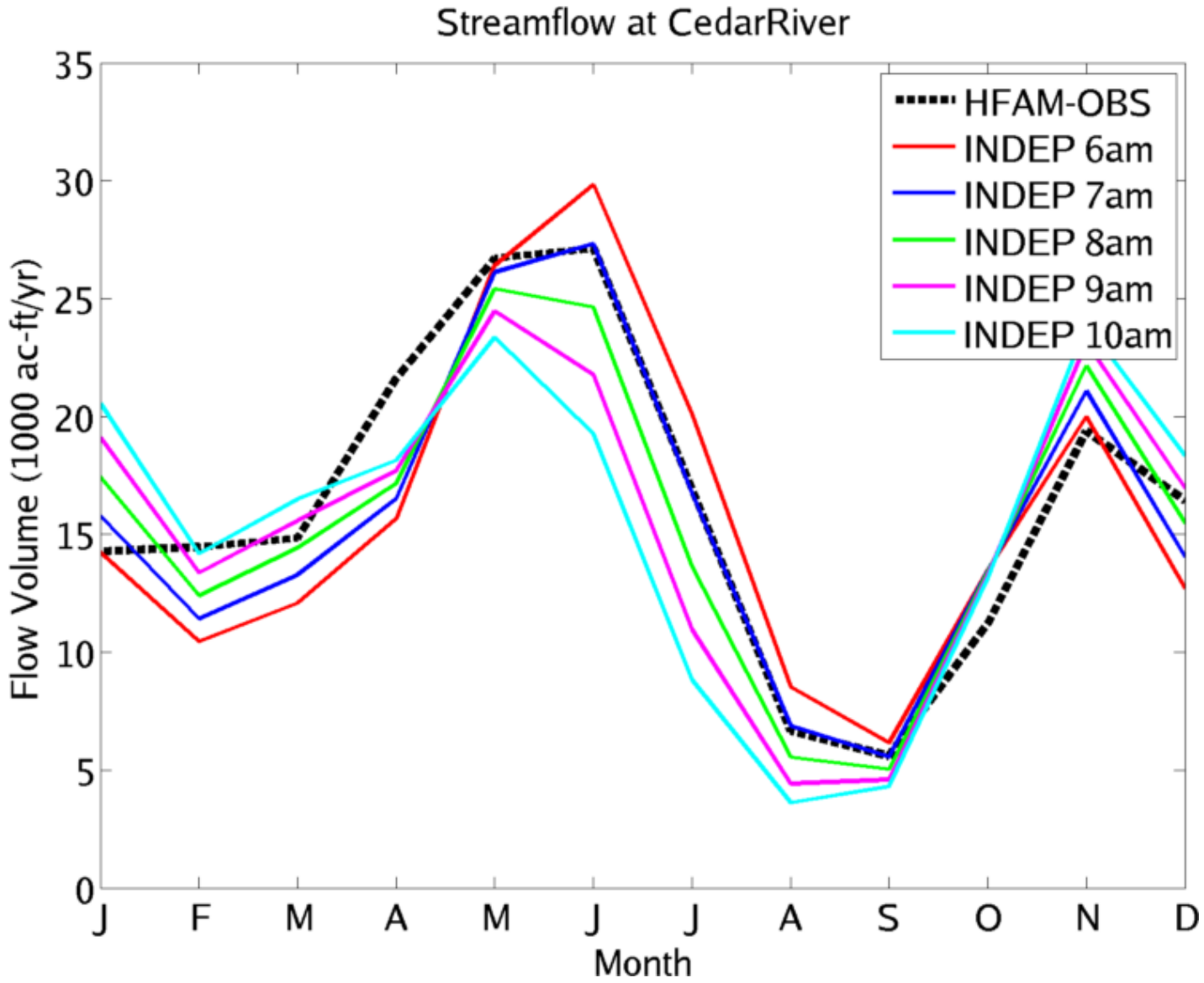
Snow Sensitivity to Varying Precipitation Window



4am-8am:
+40% error
7am-11am/9pm-1am:
~ 6% error
8am-12pm/8pm-12am:
~7% error

Figure from Katherine Hegewisch, University of Idaho

Co-Producing a Solution



Understand & Isolate Problem

Verify downscaling & hydrology modeling

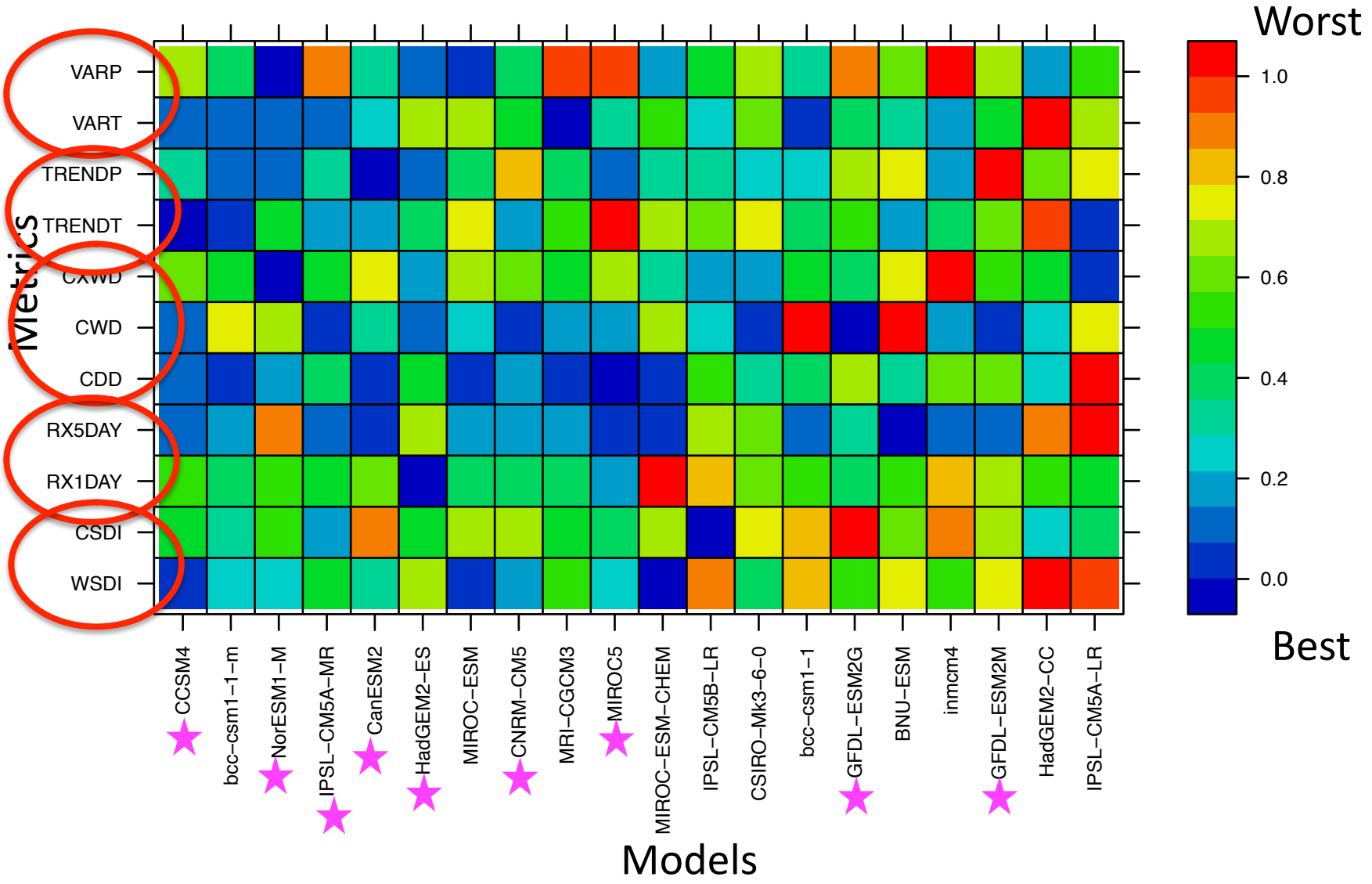
Sensitivity study:
CIRC=adjusted data
SPU=new hydrologies
BOTH=evaluate & select

Data provided by SPU; Figure provided by Katherine Hegewisch, University of Idaho

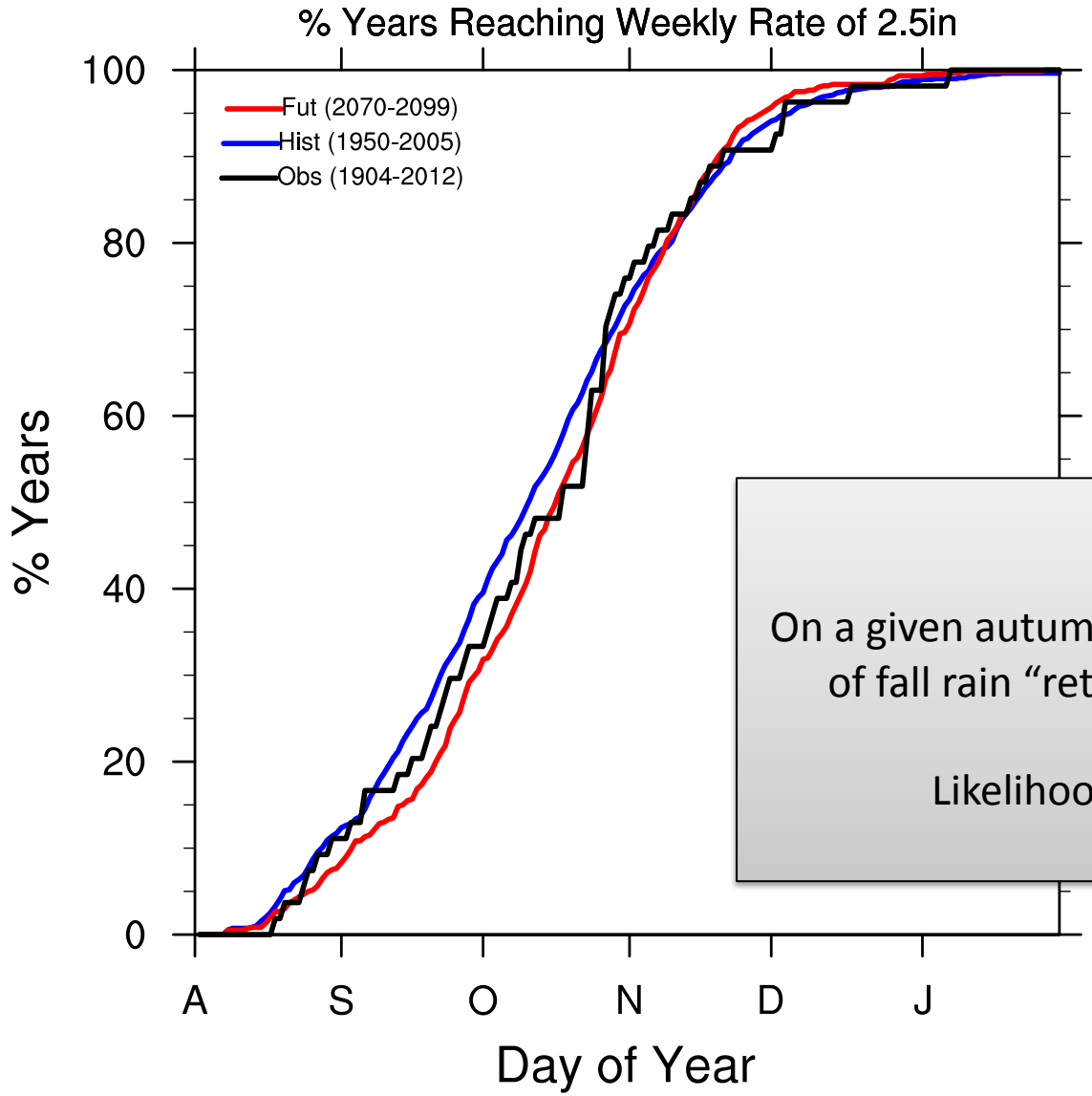
GCM Evaluation

- In impacts studies it is generally best to:
  - use at least 10 GCMs that
  - simulate PNW climate well and
  - span the range of future outcomes.
- Evaluated GCMs over Pacific Northwest
  - Rupp et al., 2013, J. Geophys. Res.
- Evaluated downscaled data at station level
  - Downscaling corrects some GCM biases, but others remain (daily sequencing, serial correlation)

Evaluation of Custom-Downscaled Station Data



Return of Fall Rains

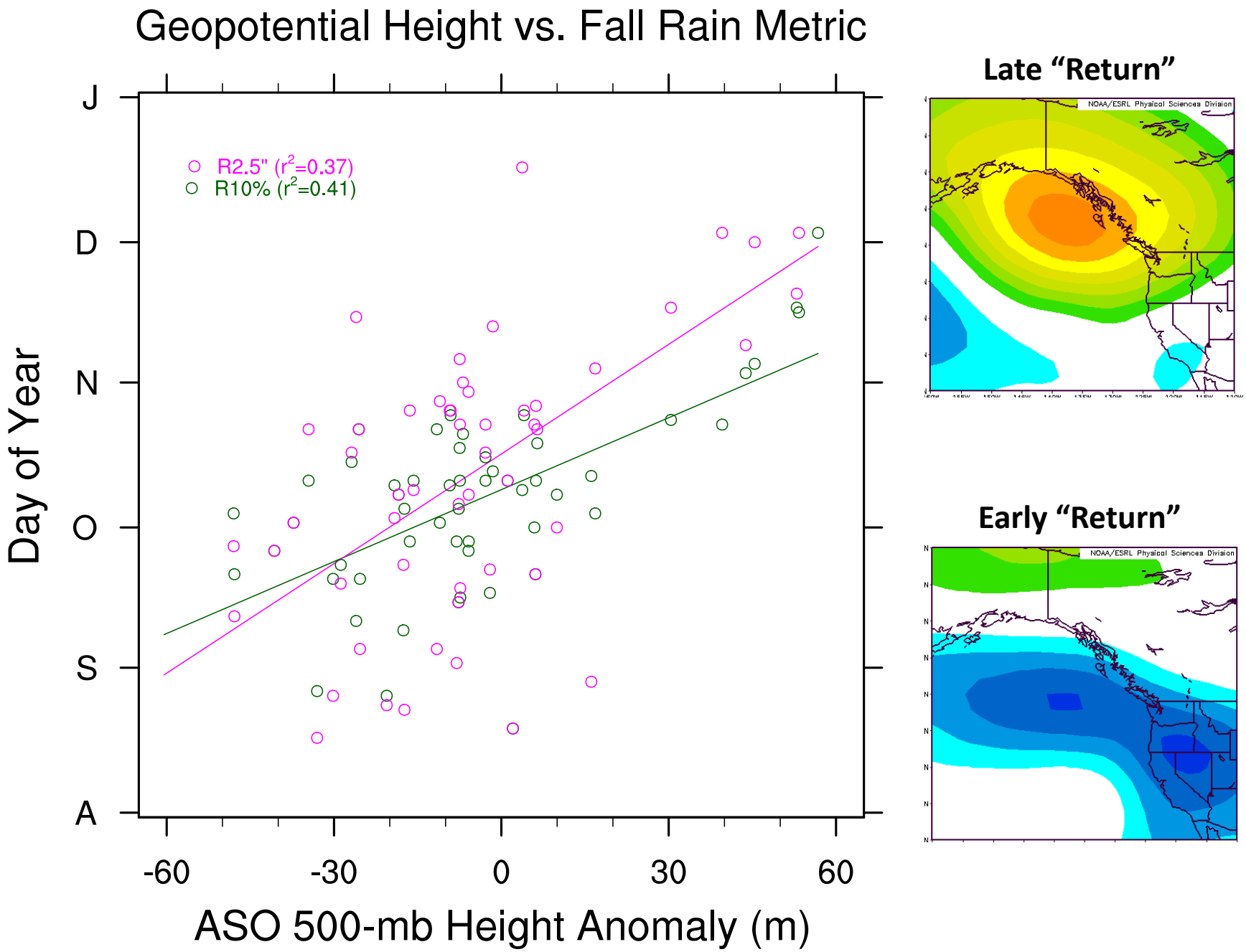


DEFINITION:
First date after August 1 with a 7-day cumulative sum of 2.5" or more precipitation at Landsburg Co-op station at Masonry Dam.

RESULTS

On a given autumn day, there is lower likelihood of fall rain "return" by end of 21st century.

Likelihood shifts ~1 week later.


Geopotential Height vs. Fall Rain Metric
R2.5" (r^2=0.37)
R10% (r^2=0.41)
Day of Year
J
D
N
O
S
A
-60
-30
0
30
60
ASO 500-mb Height Anomaly (m)
Late "Return"
NOAA/ESRL Physical Sciences Division
Early "Return"
NOAA/ESRL Physical Sciences Division

What are we learning?

SPU-CIRC Lessons Learned → PUMA White Paper by Stratus Consulting: Winter 2015

- Operationally relevant questions => climate stories
- Importance of testing the data: both climate & hydrology
- Fine-tuning production & use of custom-downscaled data with an operational hydrological model learning limitations & caveats
- though desired, “one size” may not fit all, customization needed

Questions?

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http://pnwcirc.org