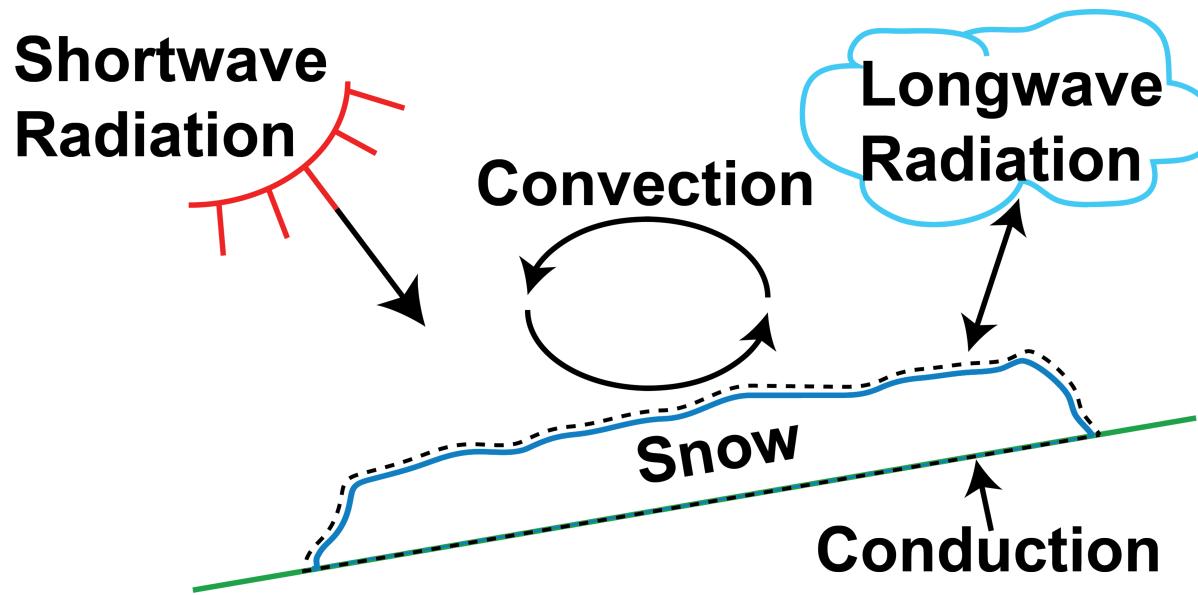
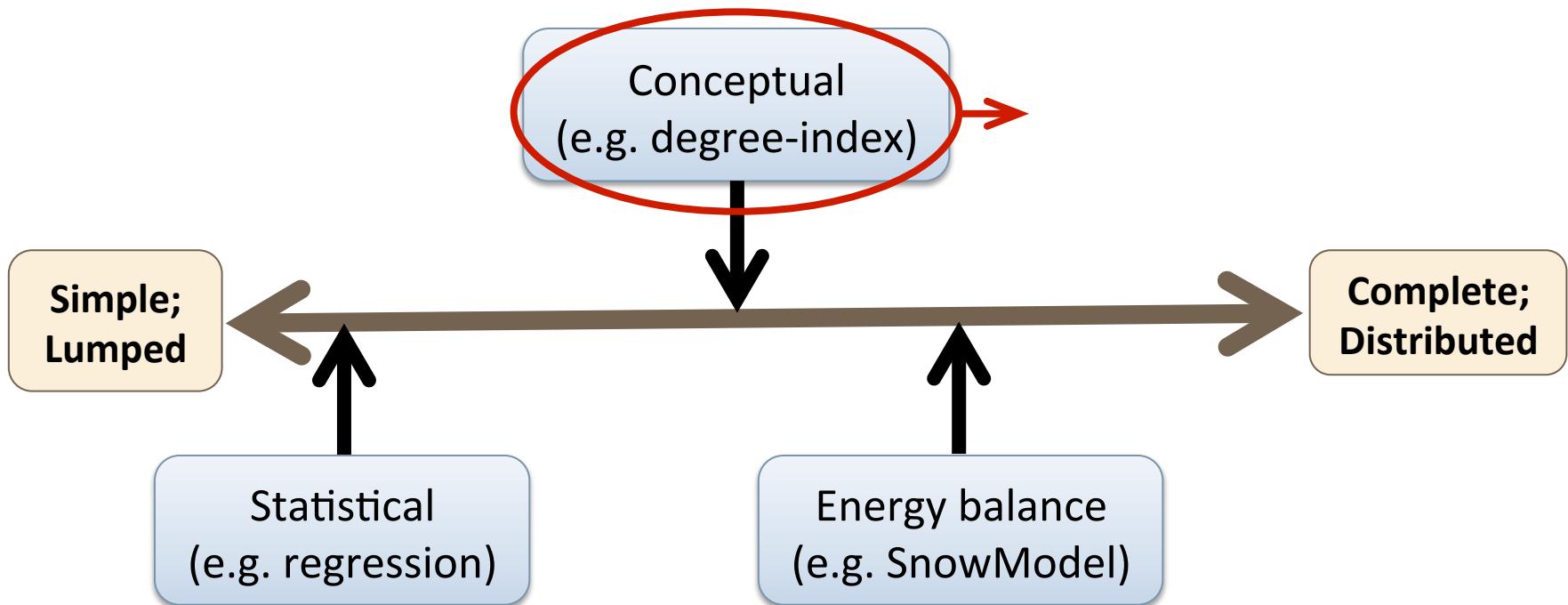


My research assesses how snow/glacier model complexity impacts accuracy

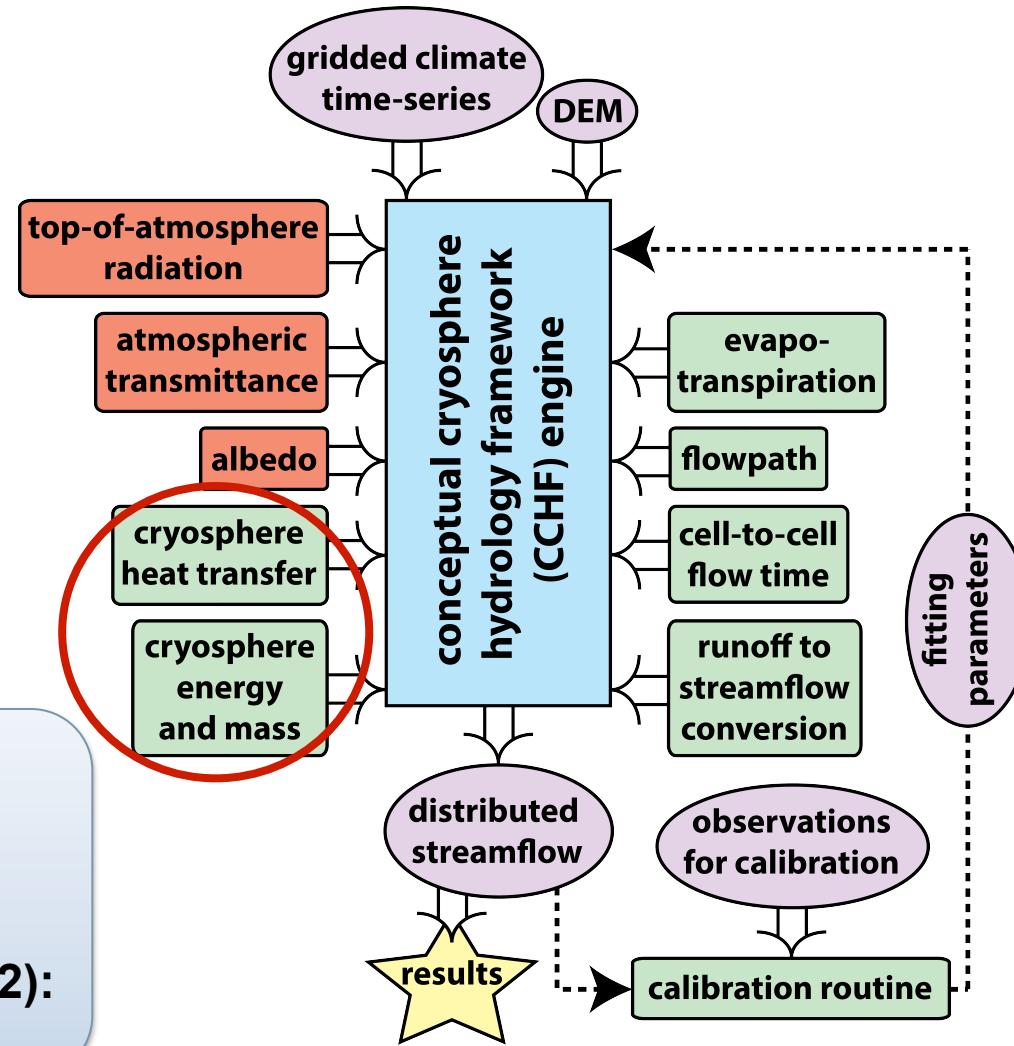


- Explicitly representing energy and mass balances requires many inputs: precip, temp, wind, humidity, soil, vegetation
- How certain are these inputs? How should this inform model complexity?

Hydrology model spectrum: where's the optimum pt?



The Conceptual Cryosphere Hydrology Framework (CCHF) enables intercomparison of model structures



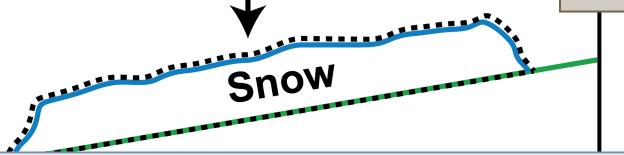
I compare

- Heat transfer (4):**
SDI, ETI(H), ETI(P),
and LST
- Energy and mass (2):**
Step and CC

Assess four heat flux representations

Simple Degree Index (SDI)

$$\text{heat} = c_1 T + c_2$$

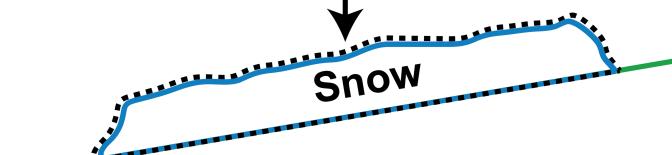
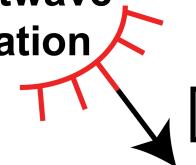


e.g. Wang et al., 2004: GOA study

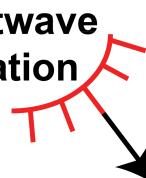
Enhanced Temperature Index (ETI)

Shortwave Radiation

$$\text{heat} = c_1 T + c_2$$



Longwave, Shortwave, and Temperature (LST)



$$\text{heat} = c_1 T$$

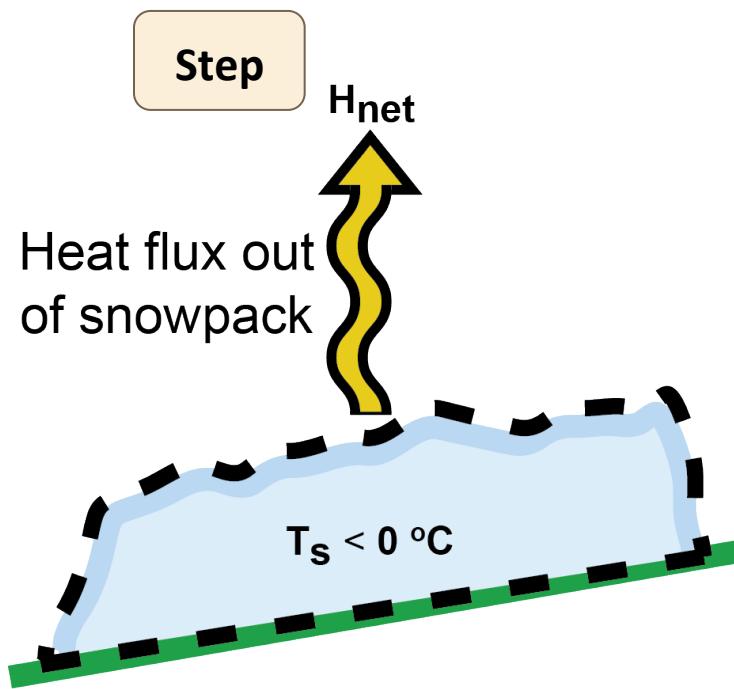


LST – By me. Open-source gridded model

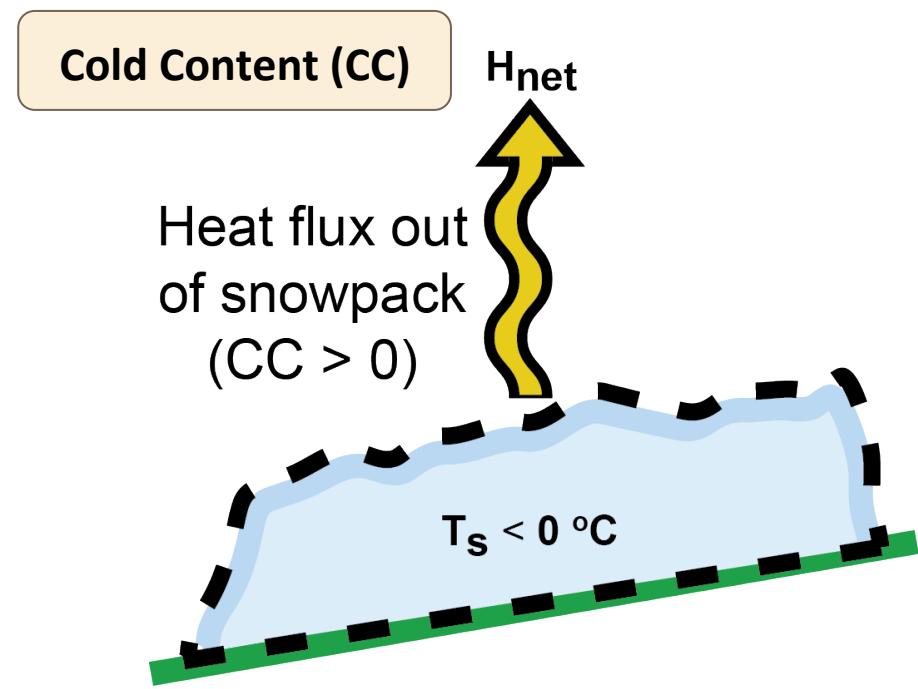
Two existing ETI models

- **ETI(H)** – By Regine Hock. Open-source gridded model
- **ETI(P)** – By Francesca Pellicciotti. Only point-based

Assess two energy and mass representations

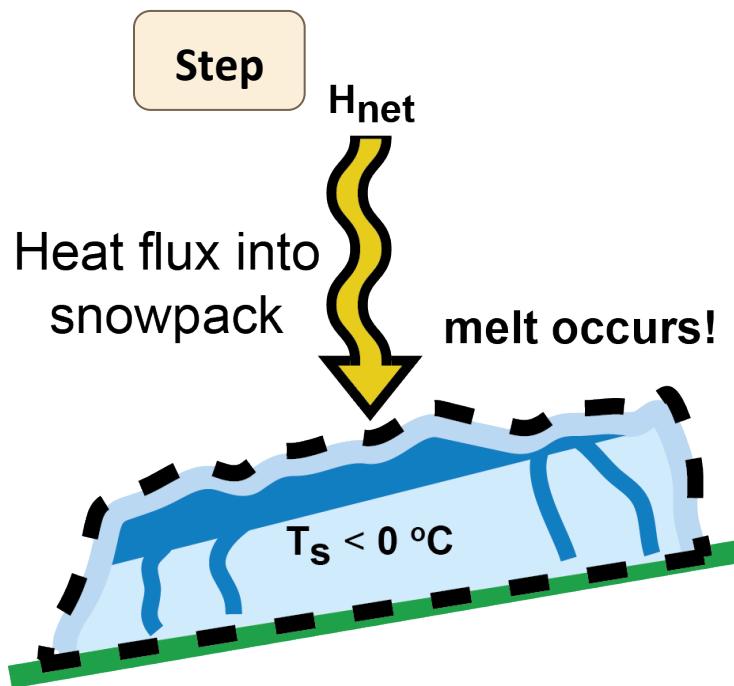


Commonly used in existing conceptual hydrology models

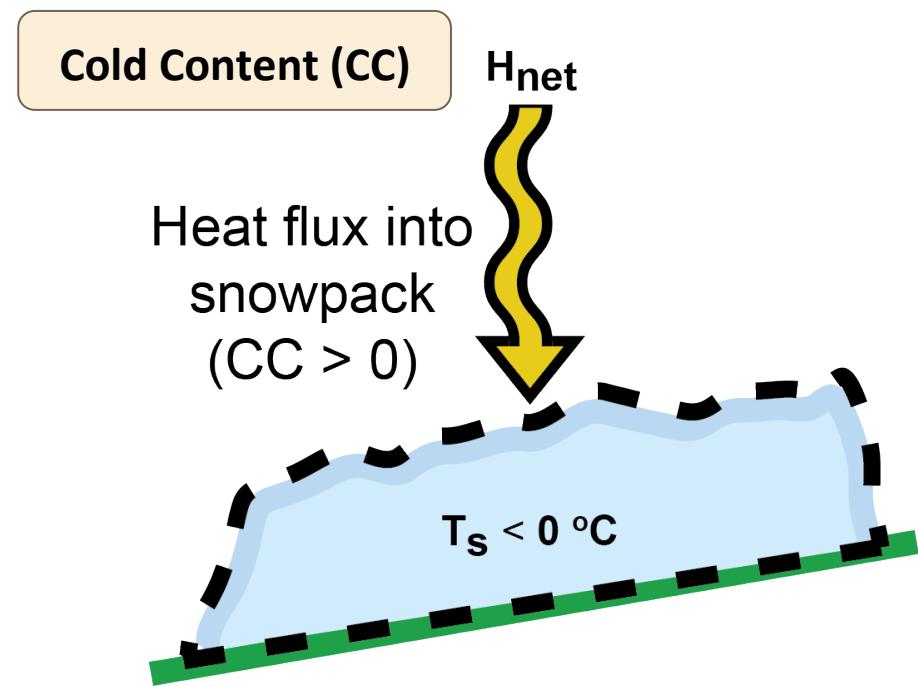


Not previously used in conceptual hydrology models

Assess two energy and mass representations

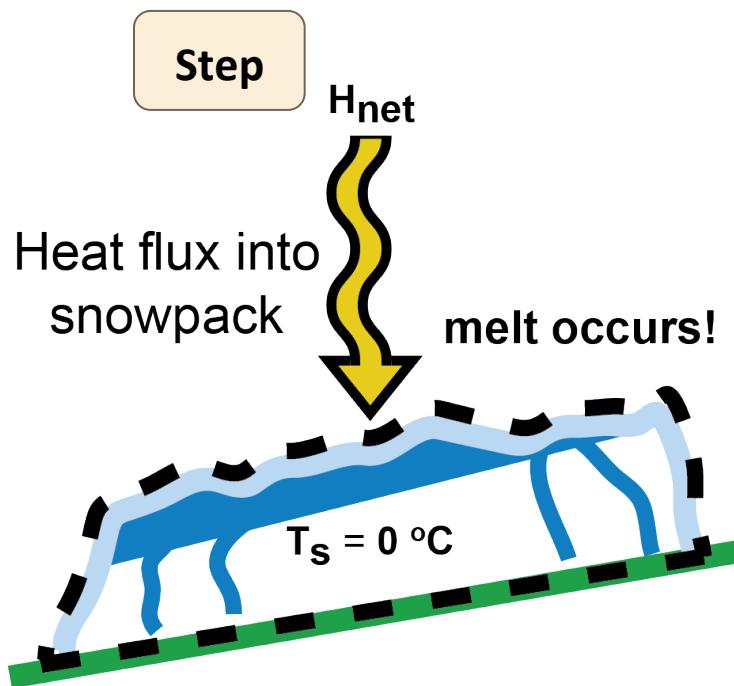


Commonly used in existing conceptual hydrology models

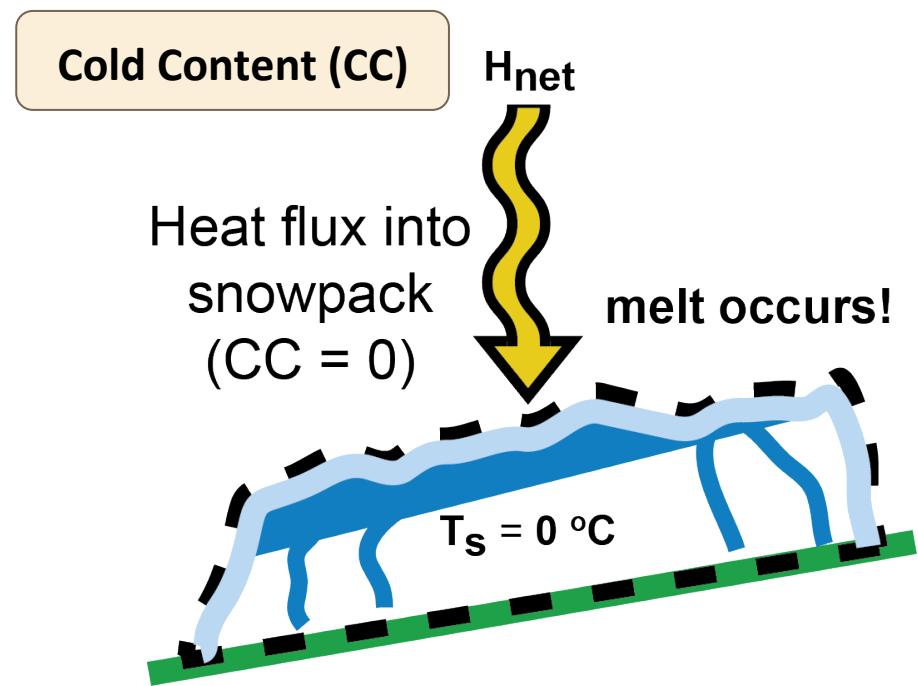


Not previously used in conceptual hydrology models

Assess two energy and mass representations

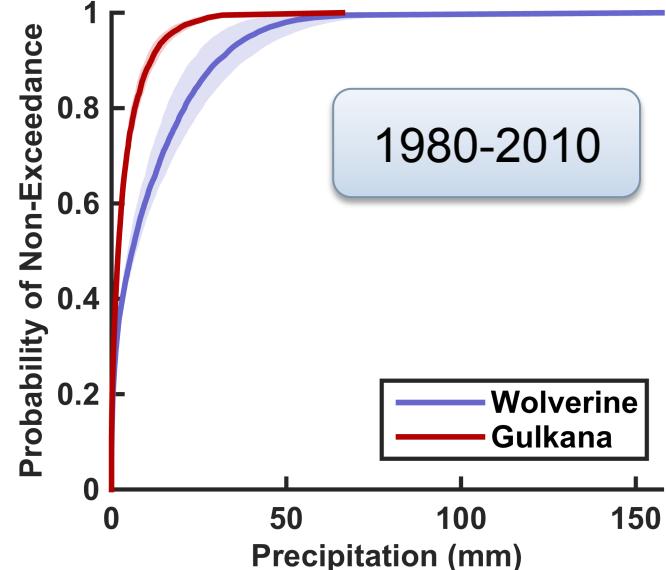
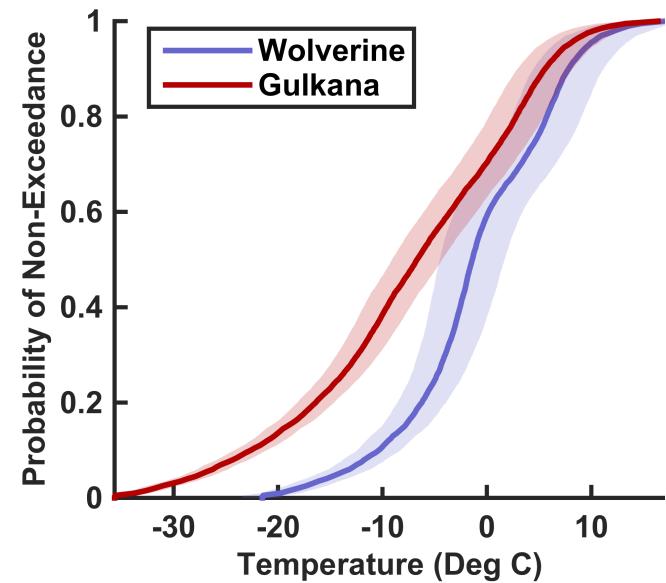
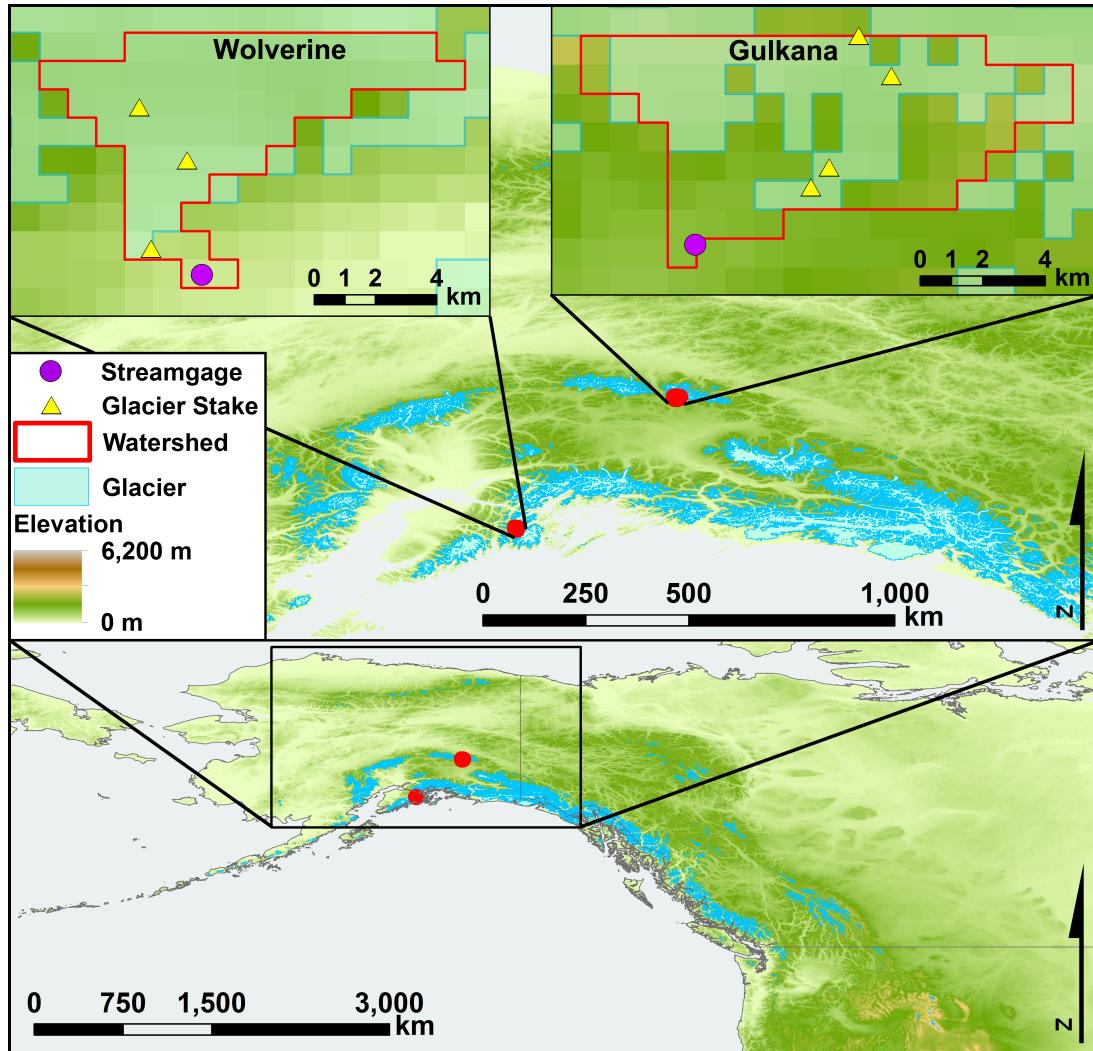


Commonly used in existing conceptual hydrology models



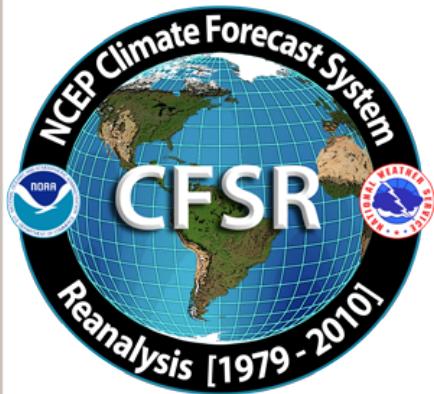
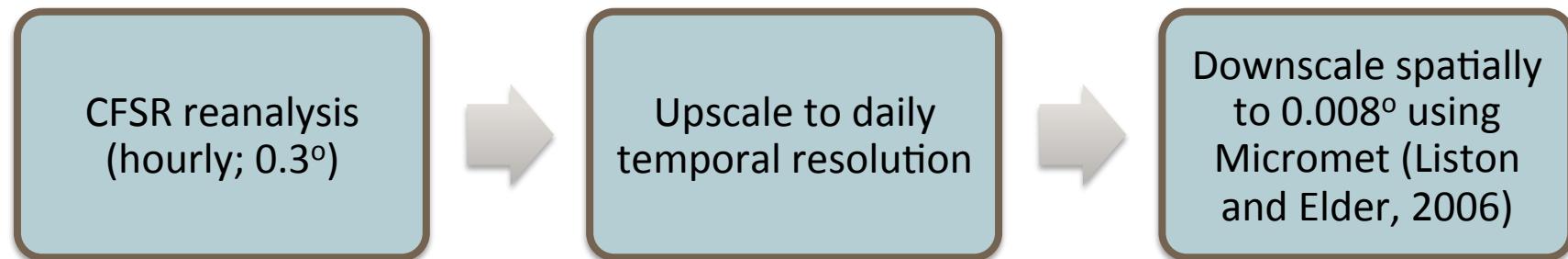
Not previously used in conceptual hydrology models

Implement for USGS study glaciers with different climates



CFSR used as climate forcing

- CFSR captures regional climate variations for Alaska better than MERRA or NARR (Wang et al., 2011 and Lader, 2014)



Three types of observations used in assessment

- Models calibrated in two stages
 - Cryosphere processes
 - MODIS snow covered area images
 - Glacier stake measurements
 - Streamflow processes
 - USGS streamgage

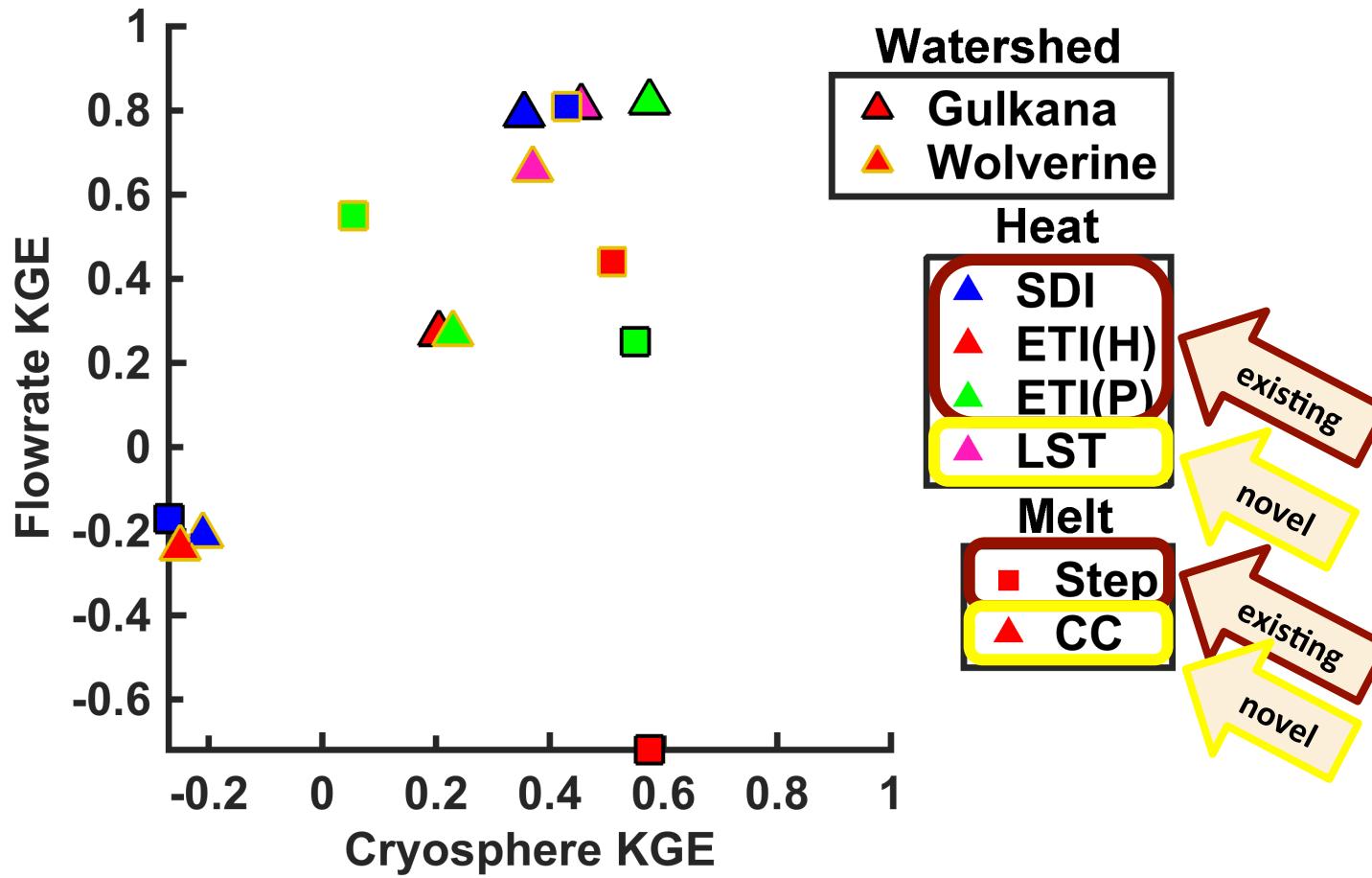


(USGS Benchmark Glaciers)

- **Calibrate:** each watershed; July 2000 – June 2010; hybrid optimization routine I developed
- **Validate:** apply to opposite watershed; same time period

$$KGE = 1 - \sqrt{(r - 1)^2 + (\alpha - 1)^2 + (\beta - 1)^2}$$

LST_{CC} model more robust than existing conceptual cryosphere models



$$KGE = 1 - \sqrt{(r - 1)^2 + (\alpha - 1)^2 + (\beta - 1)^2}$$