

# Quantifying the mean, variability, and trends in the water and energy cycles across NEESPI through modeling and observations

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# Science questions

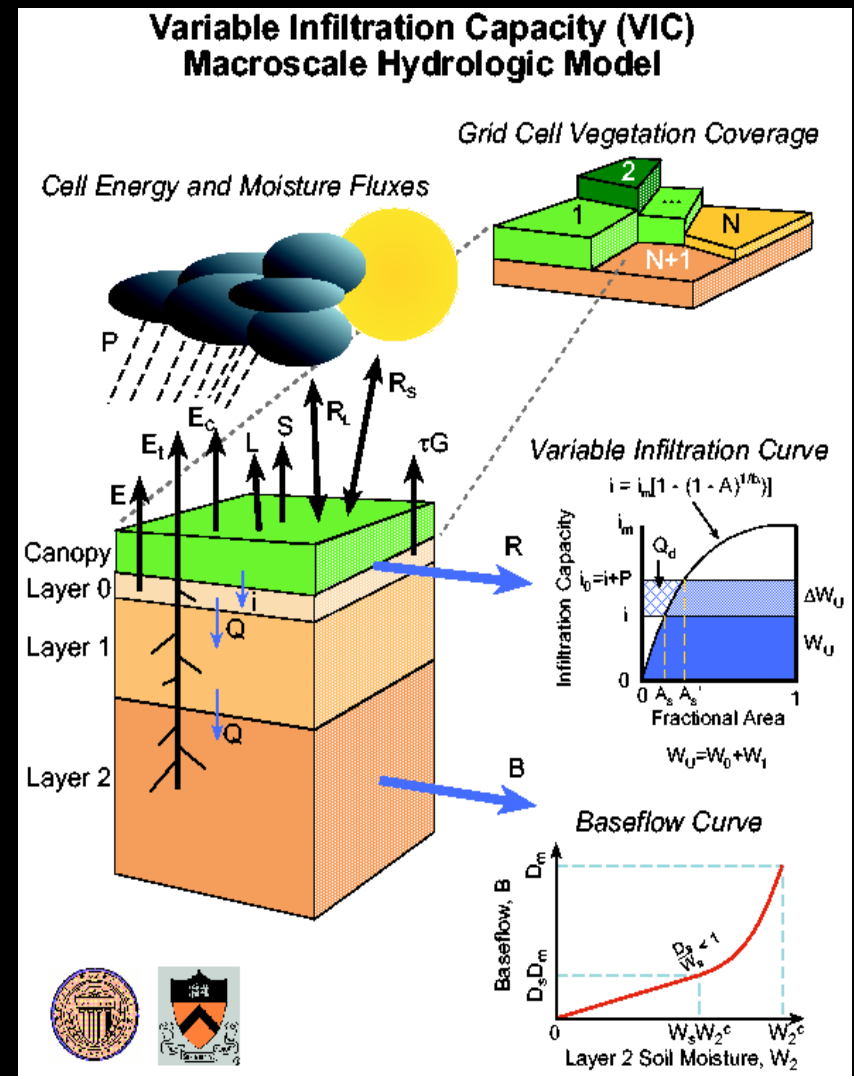
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- How well does the gridded forcing dataset match climate-quality regional station observations?
- How well can we model the water and energy cycles?
- Are the modeled trends and variability in the water budget components consistent?

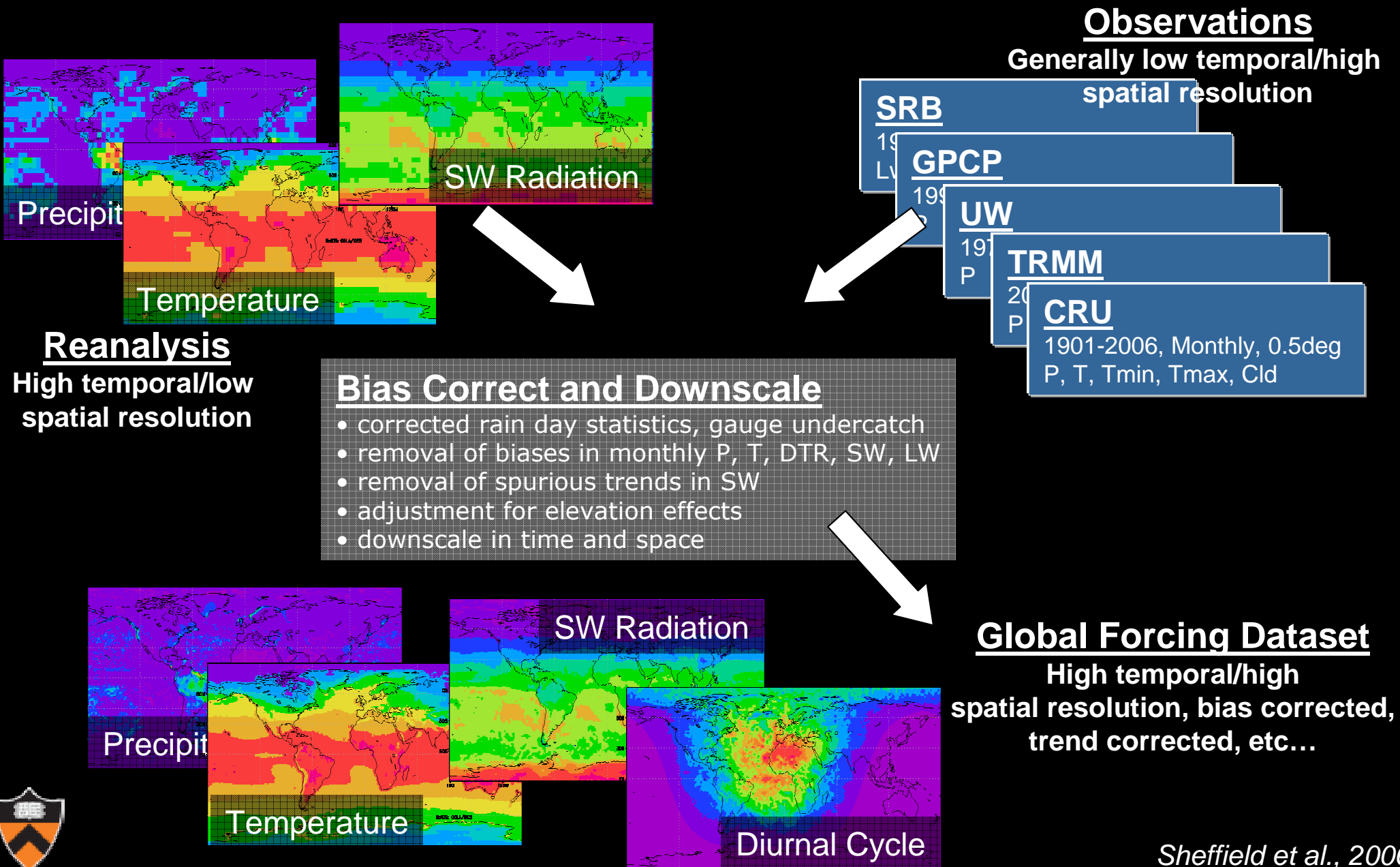


# VIC Land Surface Model

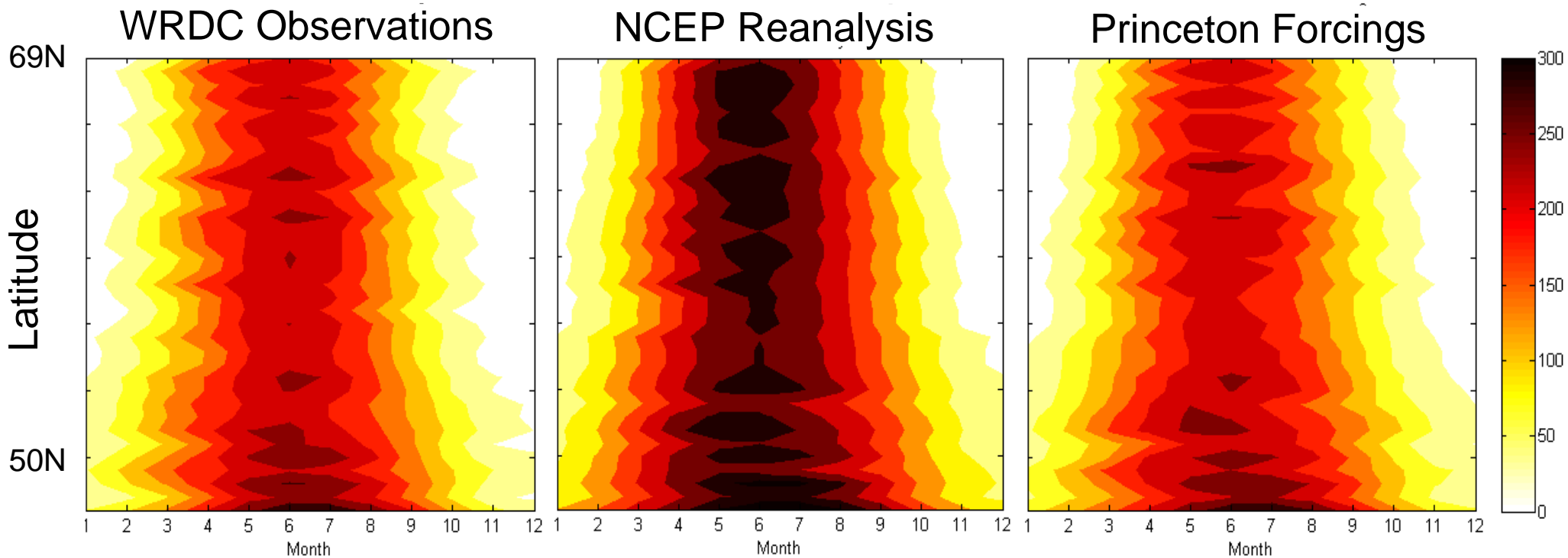
- Large grid cells (100x100 km)
- Land cover “tiles” (vegetation types) within one cell
- At 3-hour time step, simulate:
  - Soil moisture
  - Snow pack
  - Runoff
  - Evapotranspiration/Latent heat flux
  - Soil temperature
  - Sensible heat flux
  - Ground heat flux



# Princeton Global Meteorological Forcing Dataset



# Shortwave Radiation



- 35 Stations, 1964-1993
- Princeton forcings are scaled to match monthly SRB data
- Bias-corrected Princeton forcings match observations well

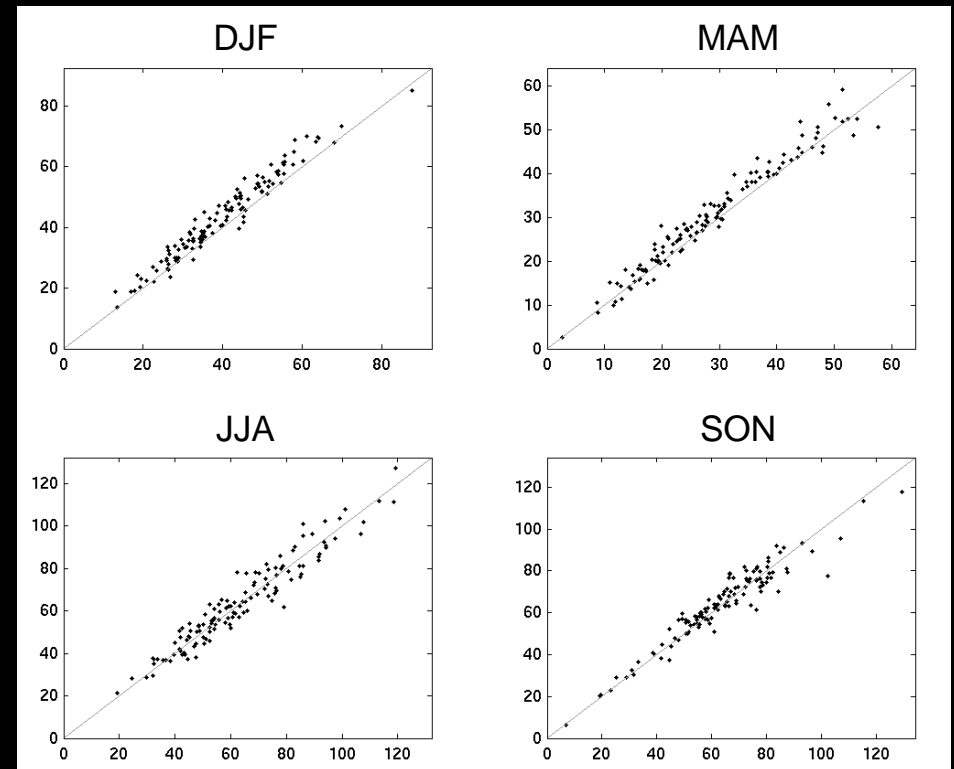
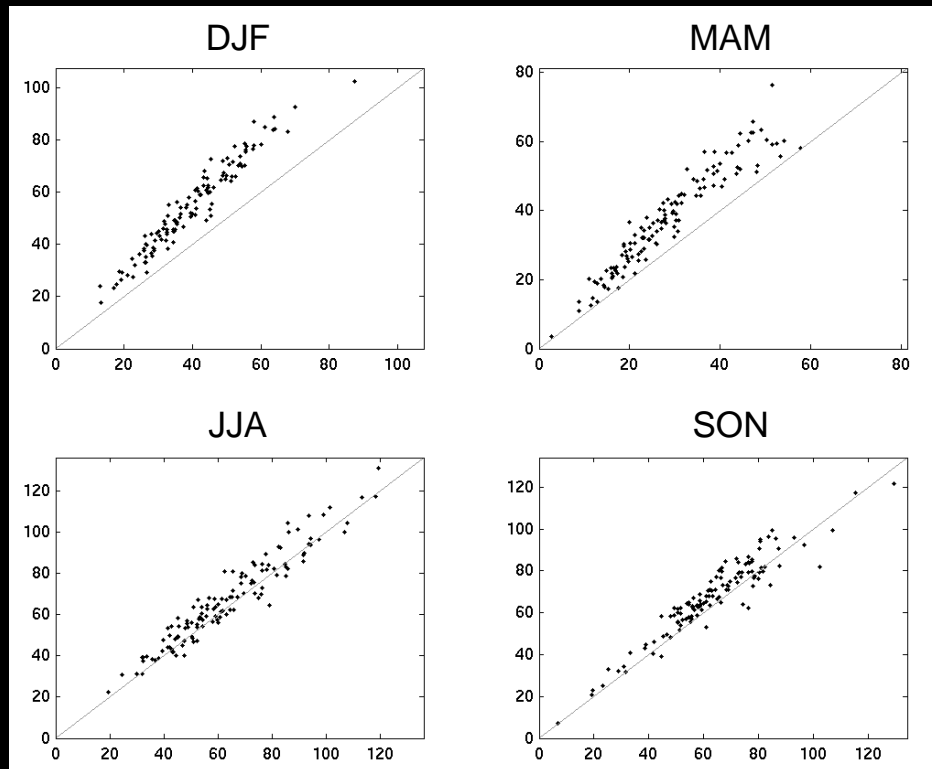
# Precipitation

## Severnaya Dvina

With Undercatch Corrections

Without Undercatch Corrections

Princeton Forcings



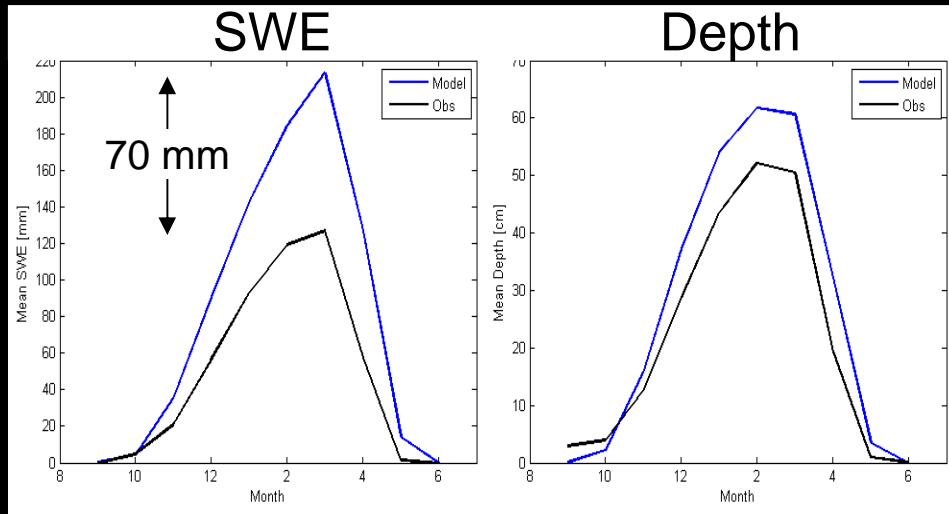
Gauges

Gauges

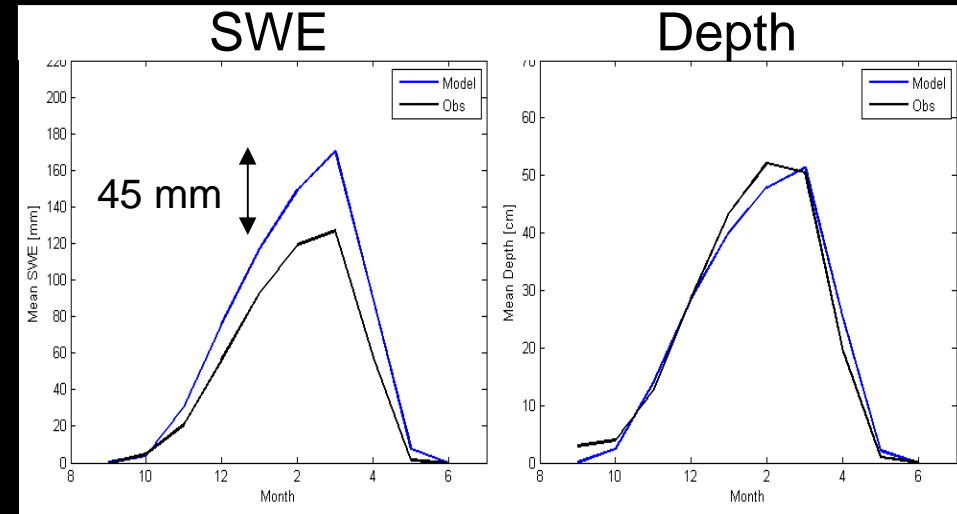


# Influence of forcings corrections: Severnaya Dvina

## With Undercatch Corrections

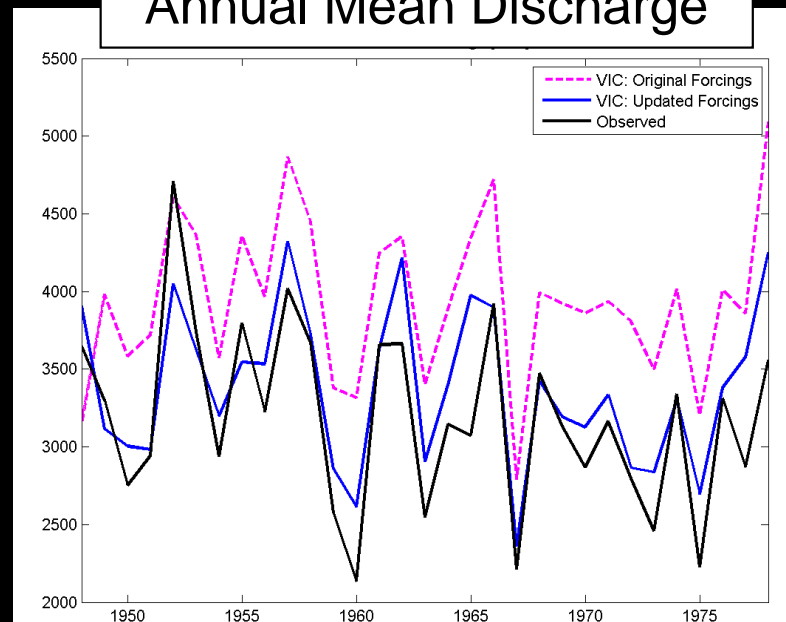


## Without Undercatch Corrections



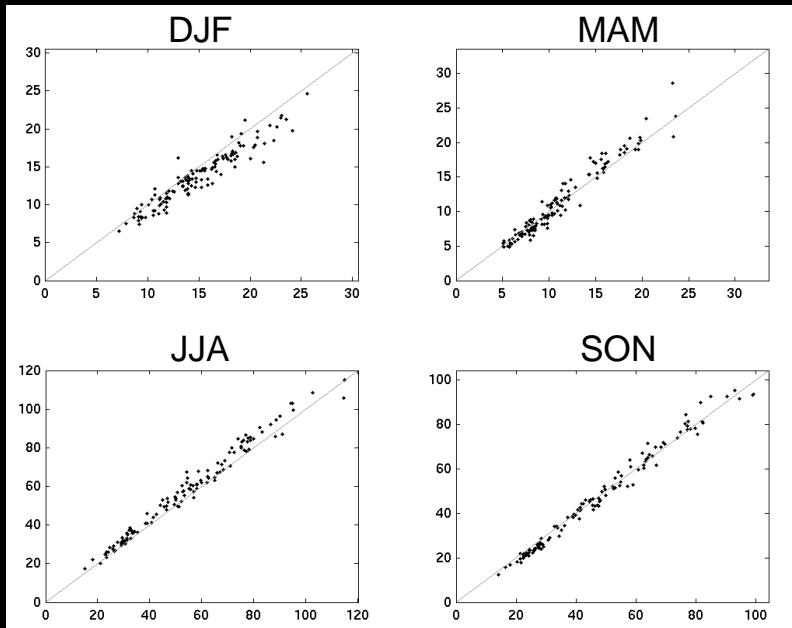
— Obs  
— VIC

## Annual Mean Discharge



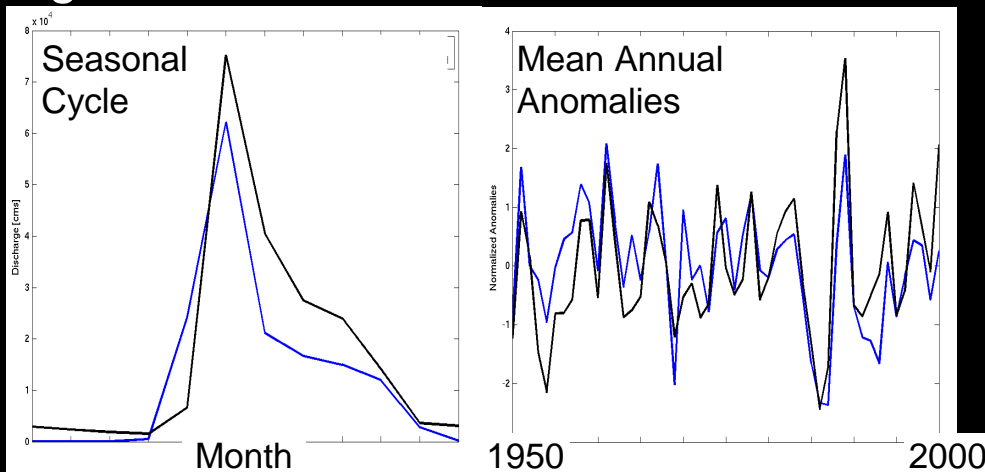
# Water Budget – Lena River

## Precipitation

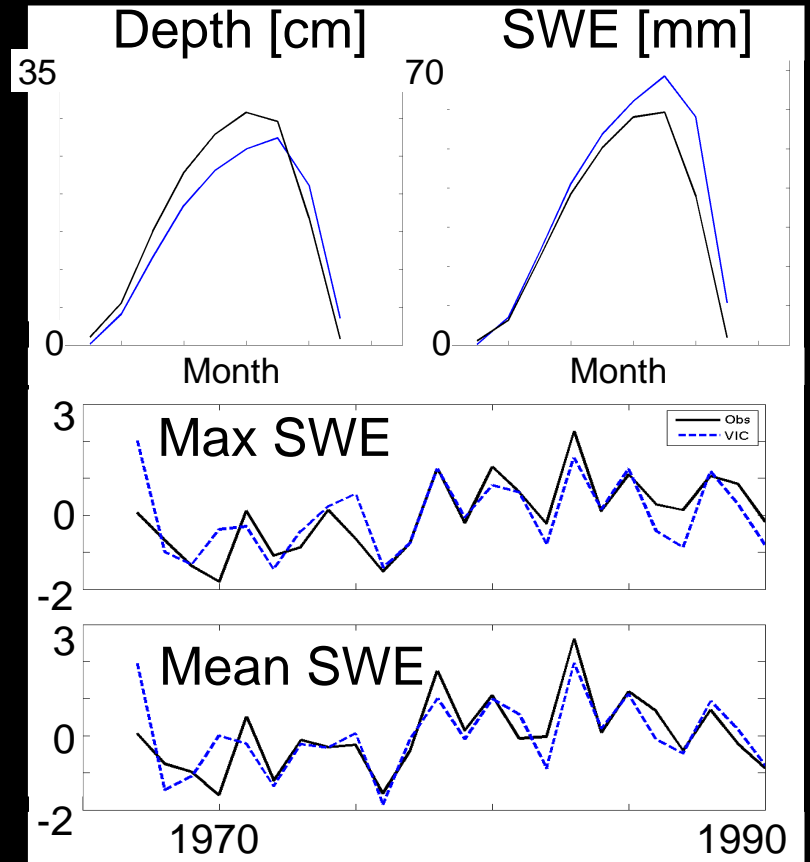


## Gauges

## Discharge



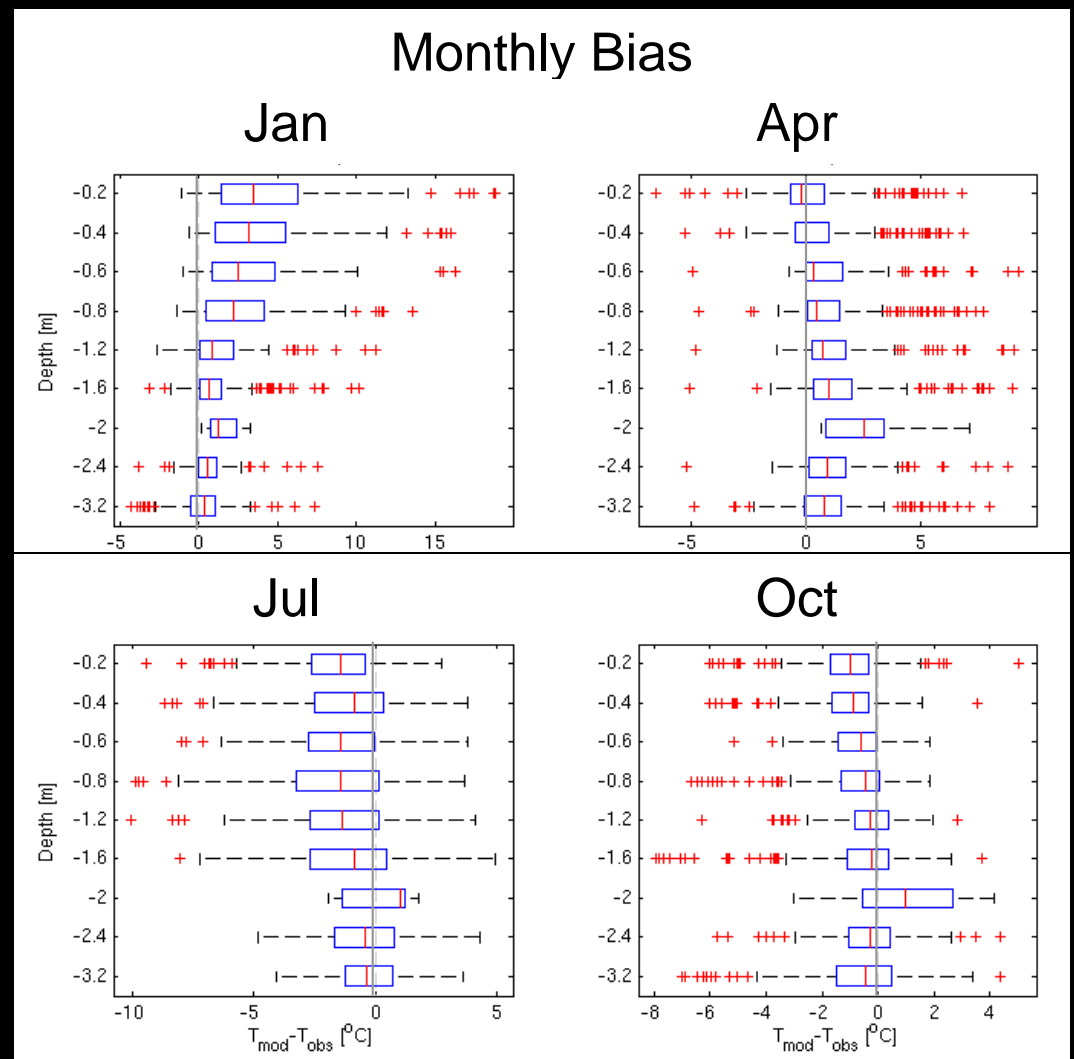
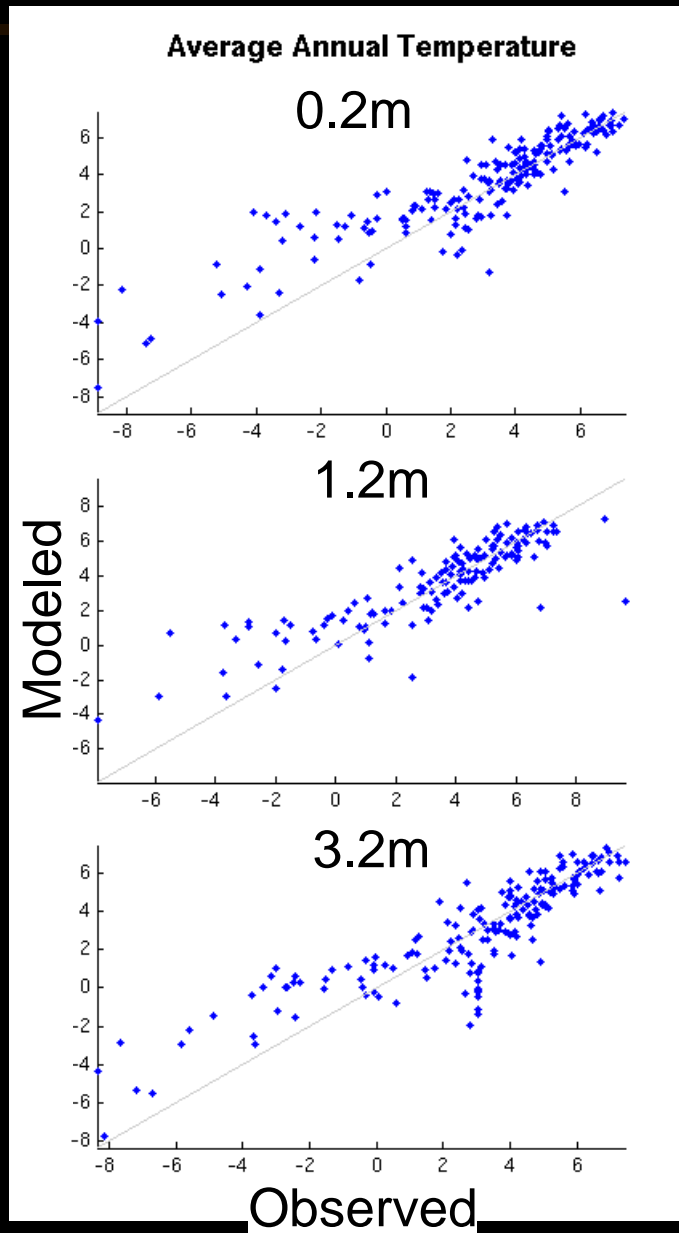
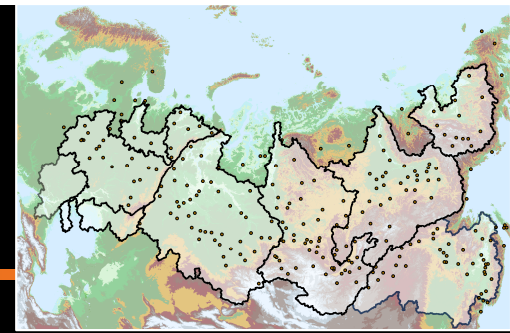
## Snow



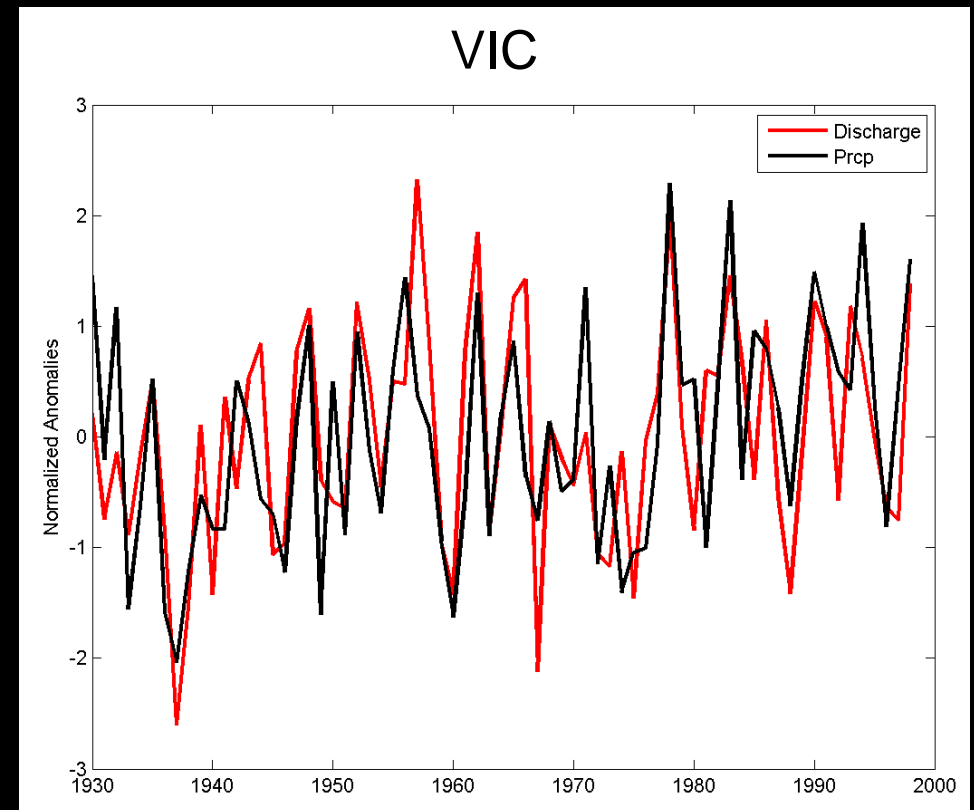
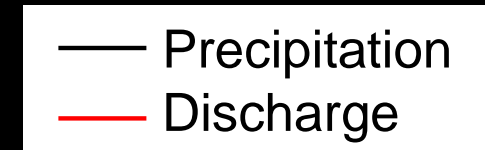
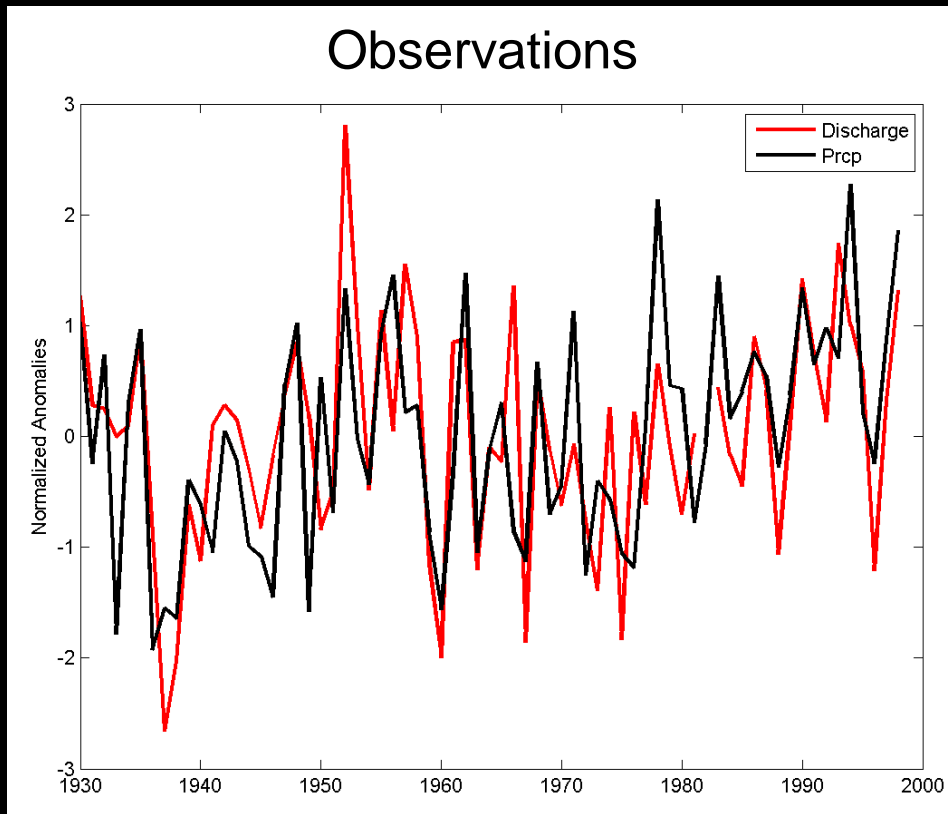
— Obs  
— VIC



# Soil temperature



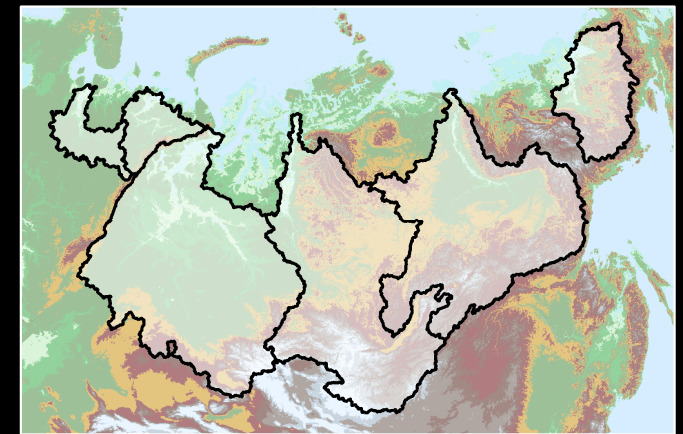
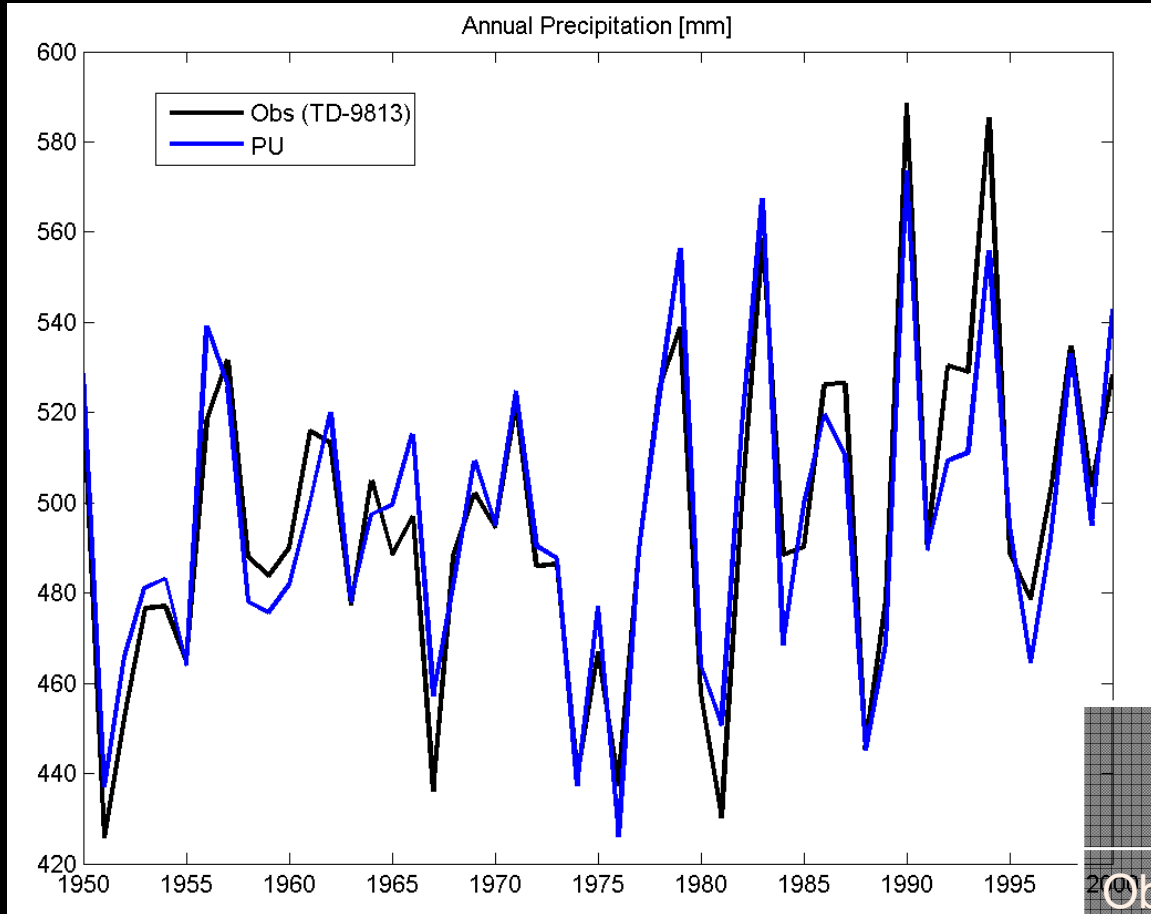
# Severnaya Dvina: Anomalies in Annual Precipitation & Discharge



- Annual discharge and precipitation have same strength of relationship for obs. and model ( $\tau_k=0.40$  for obs,  $\tau_k=0.43$  for model)



# Precipitation Trends

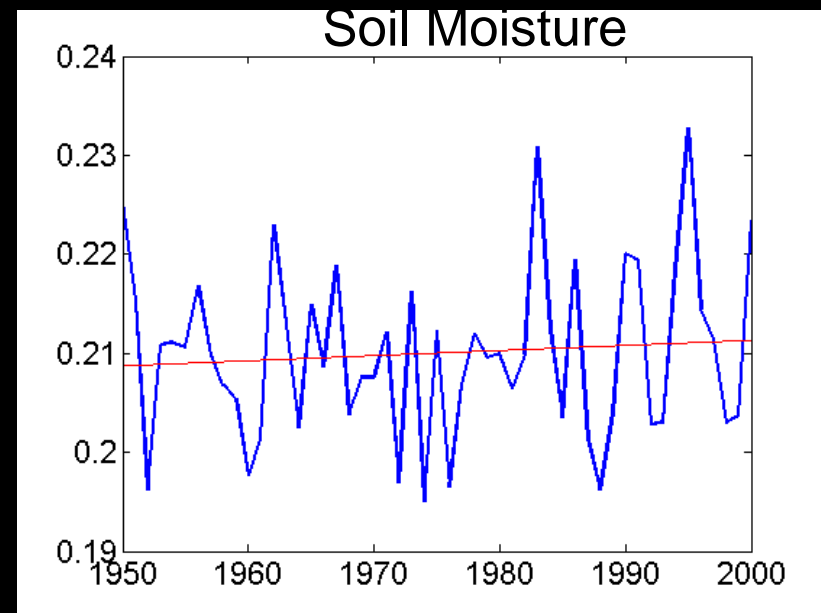
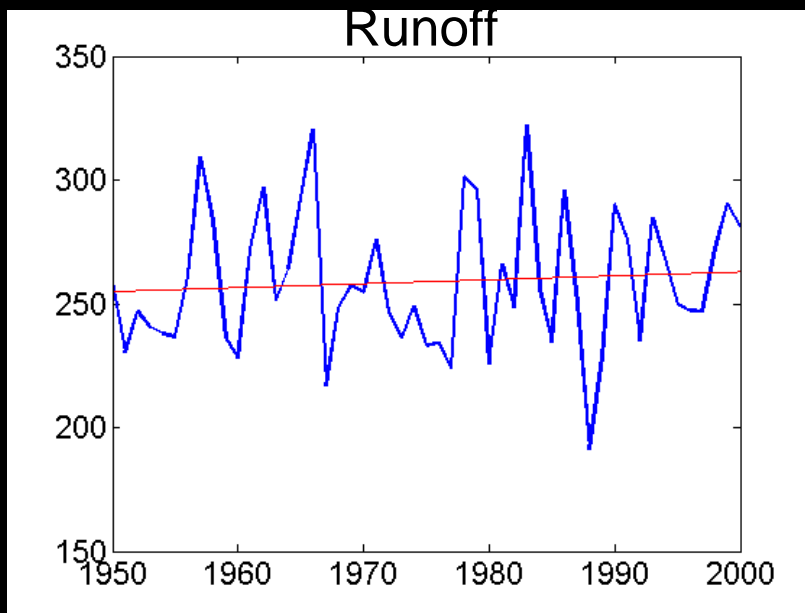
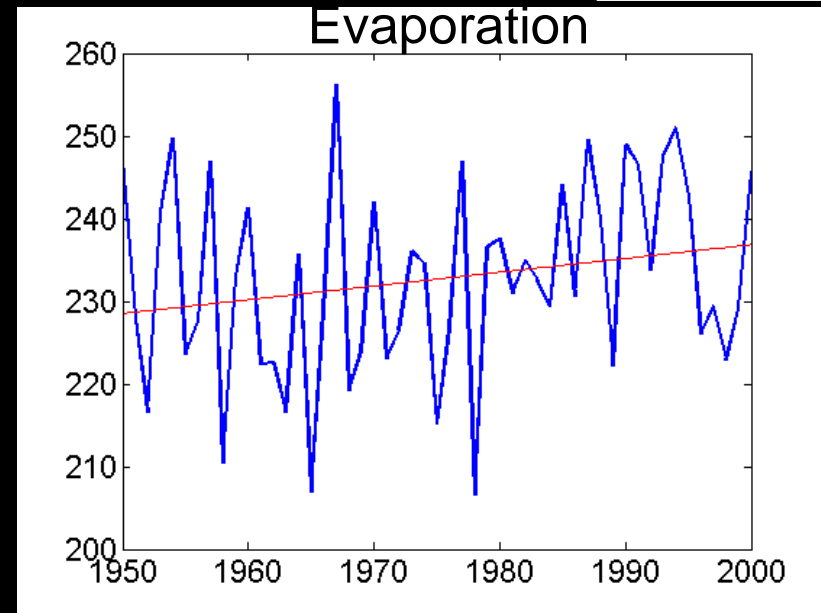
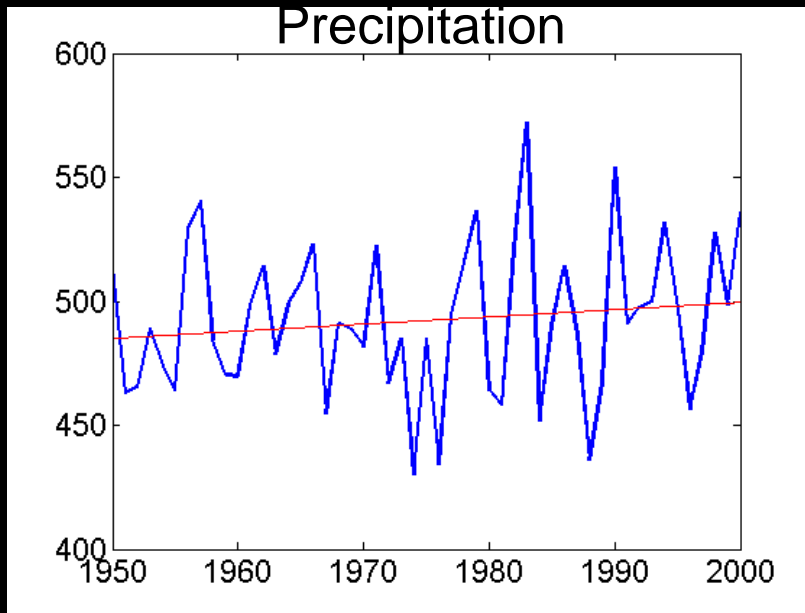
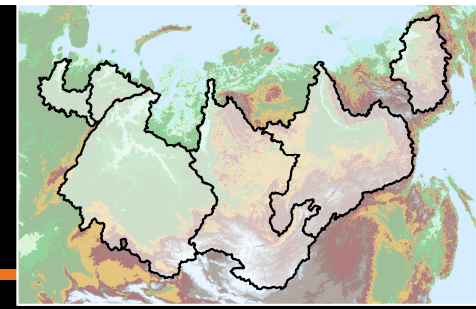


## Eurasian Basins

	Trend [mm/yr]	p-value
Observations	0.55	<0.01
PU (subset w/ observations)	0.48	0.07
PU (entire domain)	0.36	0.13



# Water Budget Trends



# Summary

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- Gridded forcing dataset matches observations well for variety of variables, with some regional improvements needed.
- Winter precipitation corrections improve modeling of the spring freshet; biases in summer discharge can be improved through calibration.
- Although biases exist in the modeling of some variables, interannual variability matches observations well. Trends remain elusive.

