The water balance of the urban Salt Lake Valley

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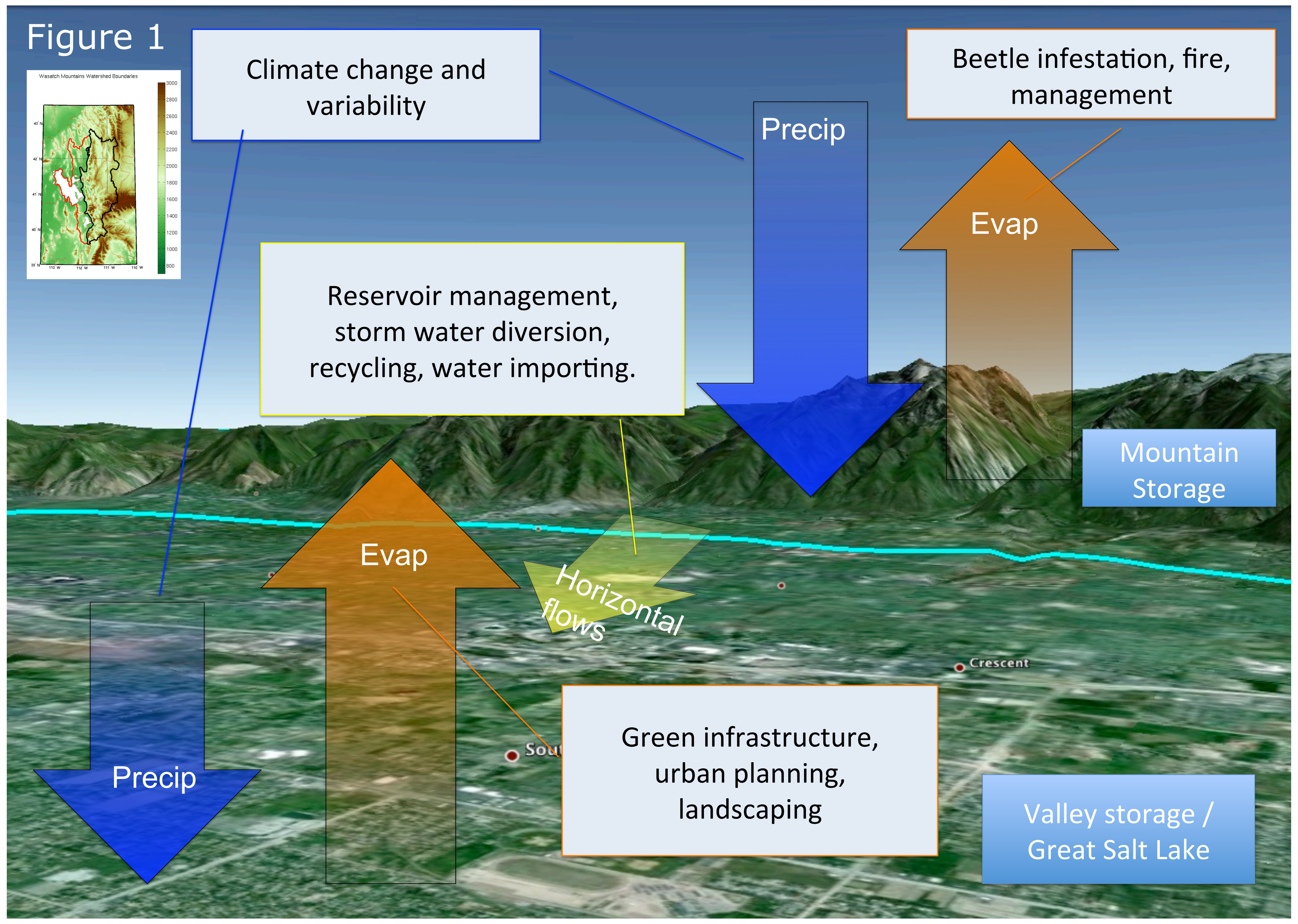
iUTAH EPSCoR
CI-WATER
CENTER FOR HIGH PERFORMANCE COMPUTING THE UNIVERSITY OF UTAH

Motivation: iUTAH EPSCoR

- iUTAH, **innovative Urban Transitions and Aridregion Hydro-sustainability**, is a statewide effort dedicated to maintaining and improving water sustainability in Utah.
- UT is the nation's third driest state - water is critical to Utah's continued growth and economic development. The delivery of freshwater resources is in jeopardy both in the immediate future and in the long-term
- iUTAH will invigorate statewide research productively through an integrated program that enhances research, human, and CI capacities
- Interdisciplinary effort between Utah State University, the University of Utah, Brigham Young University, and two dozen other Utah institutions of higher education, government agencies and industry and non-profit partners

Big picture: iUTAH factors influencing water balance



Role of CI-Water EPSCoR

Provide climate simulations of spatially and temporally continuous, high quality variable estimates gridded over a large region.

What's special:

1. Irrigation scheme: prevent soil moisture from dropping below a certain threshold

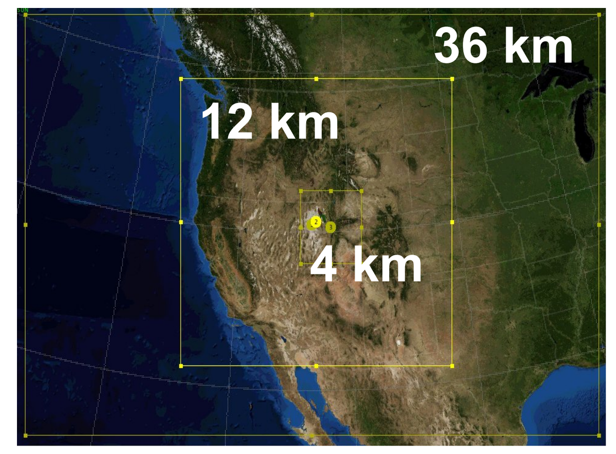


Figure 2. Nested domain of the WRF simulation.

2. 2D Lake slab model based on Equation (1) used to model temperature

$$\frac{\partial T_w}{\partial t} = -\frac{1}{(\rho C_p D)}[F_h + F_e + F_{lu} + F_{ld} + F_s], \quad (1)$$

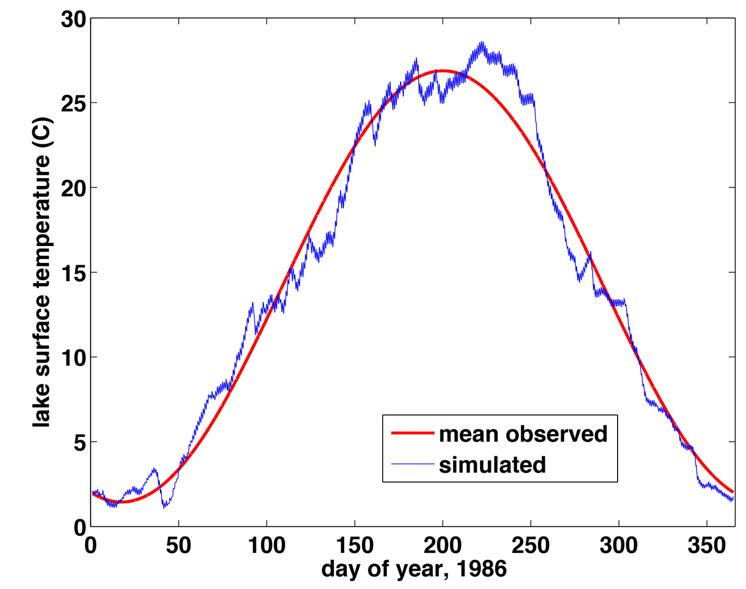


Figure 3. Red curve shows smooth fit to lake surface temperature based on MODIS data (Crossman and Horel, 2009). Blue curve shows simulated lake surface temperature based on slab lake model with fixed depth 4.5 m.

Crosman, E. T. & Horel, J. D. (2009) MODIS-derived surface temperature of the Great Salt Lake. Remote Sensing of Environment, 113, 73 – 81.

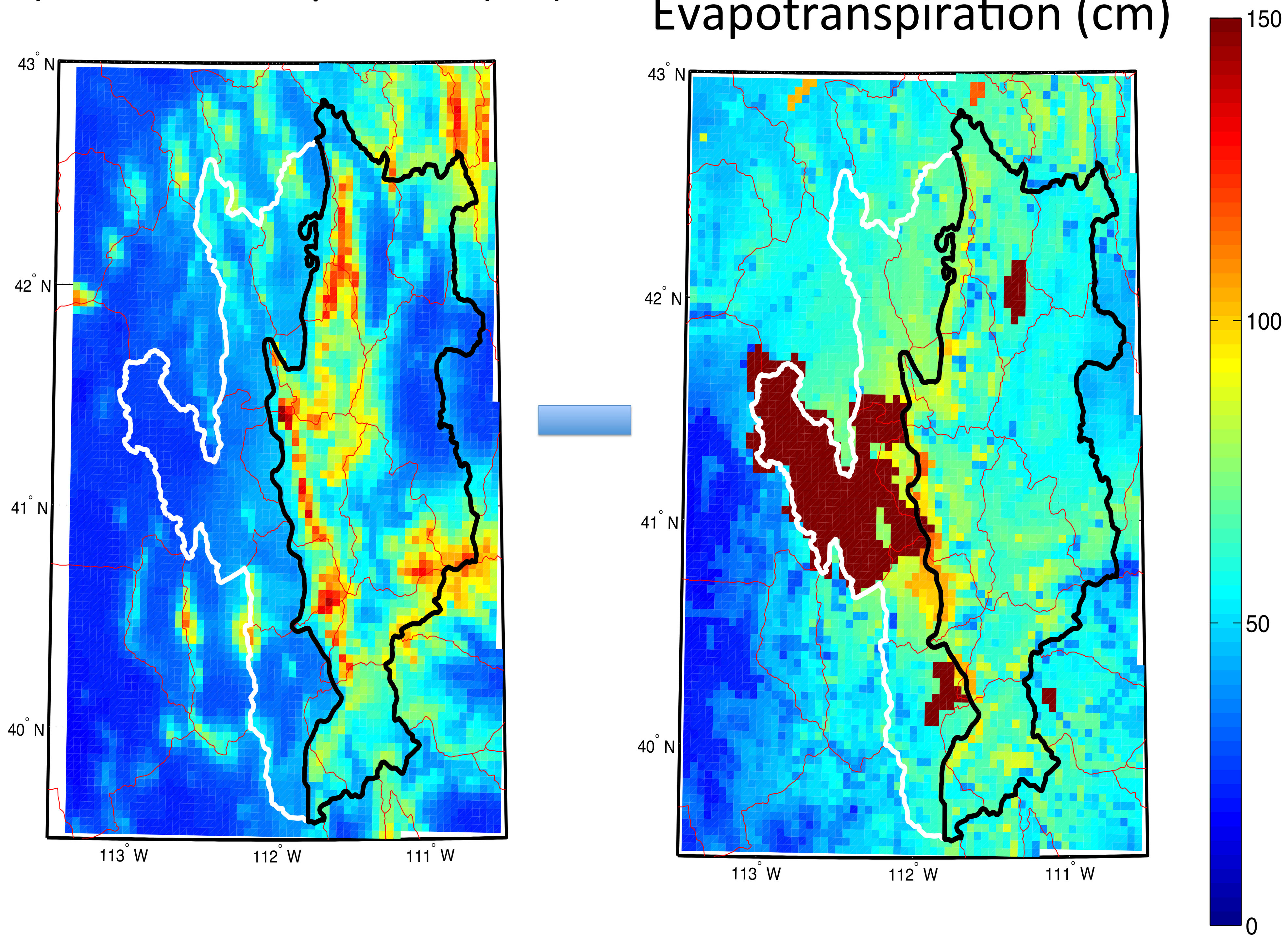
LJUNGEMYR, P.; GUSTAFSSON, N. & OMSTEDT, A. (1996) Parameterization of lake thermodynamics in a high-resolution weather forecasting model. Tellus A, Munksgaard International Publishers, 48, 608-621.

Figure 4

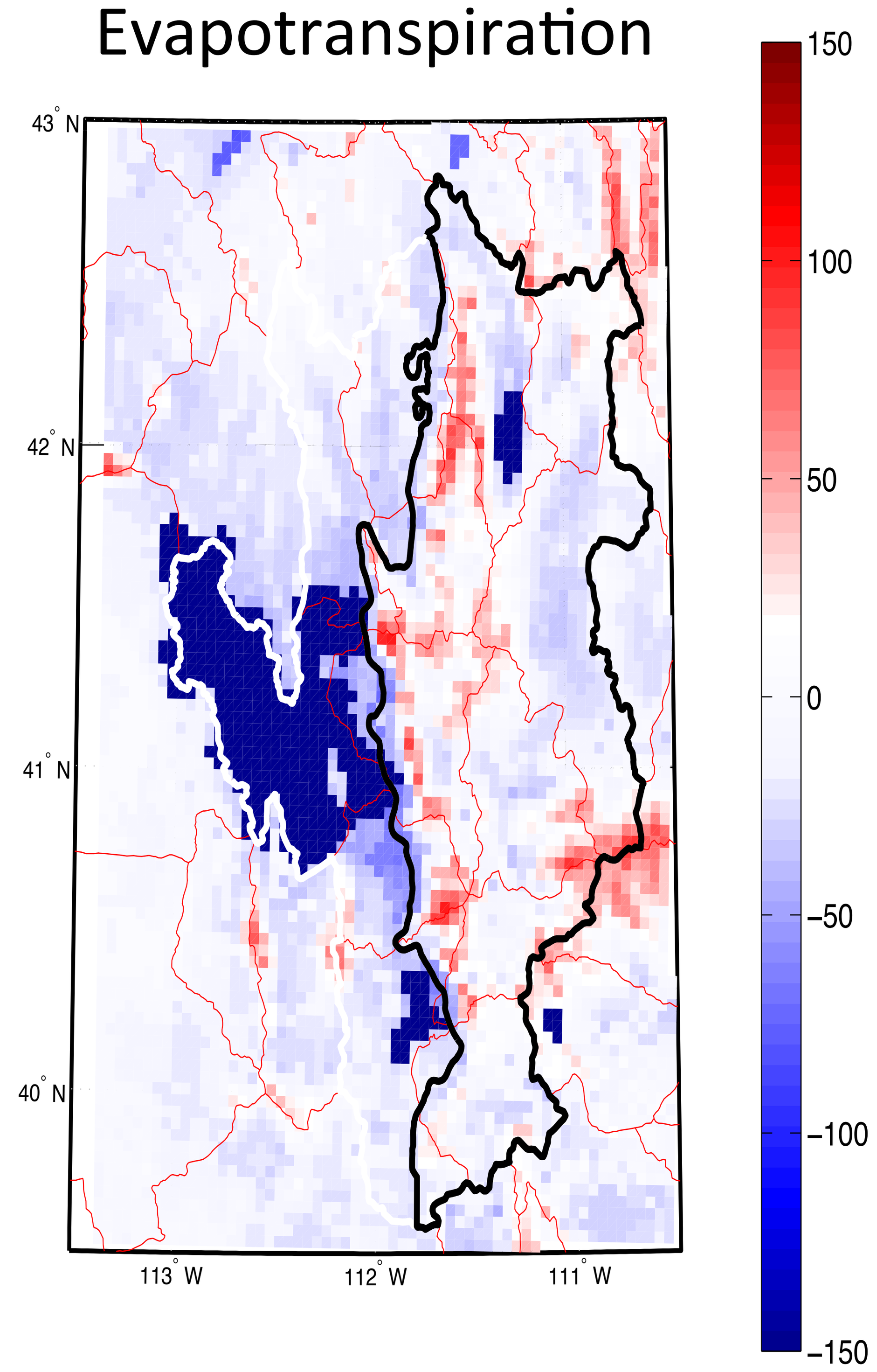
Annual Mean Water Balance

a) Annual Precipitation (cm)

b) Annual Evapotranspiration (cm)



c) Precipitation - Evapotranspiration



Annual Mean Water Balance Discussion

a) Precipitation

- Largest over high terrain in mountain region
- Decreases to the west through the valley region
- Curve separating two regions is 500 mm
- Most land surfaces have a surplus of water, particularly windward high terrain

b) Evapotranspiration

- Evaporation highest over lakes, and compares well with observations (e.g., Butts, 1972)
- Evaporation moderately high where precipitation elevates soil moisture
- Evaporation likely underestimated in urban regions

c) Precipitation – Evaporation

- Most land surfaces have a surplus of water, particularly windward high terrain
- Lakes have strong water deficit