NASA MAP Program (80NSSC17K0352)

Why Do Large-Scale Land Surface Models Produce a Low Ratio of Transpiration to Evapotranspiration (T/ET)? (PI: Guo-Yue Niu)

Table 1: Model Experiments:

CTRL	→ Using real elevation data
FLAT	→ Assuming 1/10 slope angle of CTRL
RSOIL	→ Using a different water vapor diffusion scheme.

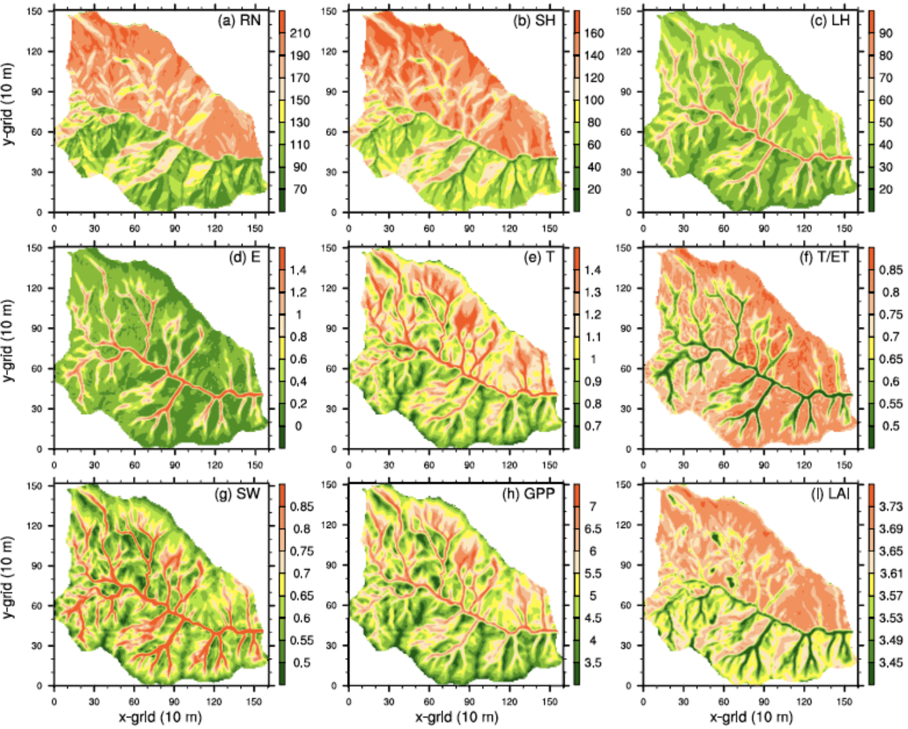

Figure 1. Modeled 2-year averages of (a) net radiation (W/m), (b) sensible heat (W/m^2), (c) latent heat (W/m^2), (d) soil surface evaporation (mm/day), (e) transpiration (mm/day), (f) T/ET ratio, (g) soil wetness (saturation), (h) gross primary productivity (GPP; g C/m^2/day), and (i) Leaf area index (m^2/m^2) by a control experiment (CTRL).

- ***Problem:*** *Land surface models (LSMs) used in climate models generally produce a weaker ecosystem resilience to climate change as indicated from the T/ET ratio that is lower than field estimates. This may degrade the credibility of the climate projection by these Earth System Models and the modeled ecosystem responses to climate change.*
- ***Approach:*** *We conducted a series model experiments using a 3D, process-based ecohydrological model in a subhumid, mountainous catchment (Table 1).*
- ***Conclusions: 1)*** *Terrain-driven lateral water flows spread out soil moisture to a wider range along hillslopes with a subrange from the middle to upper slopes, where more water infiltrates into deeper soil for use by plants through root uptake (Figure 2) and* ***2)*** *The water vapor diffusion from the rising/falling evaporating surface in the soil to the soil surface is not well understood or represented in current LSMs (Figure 3)*

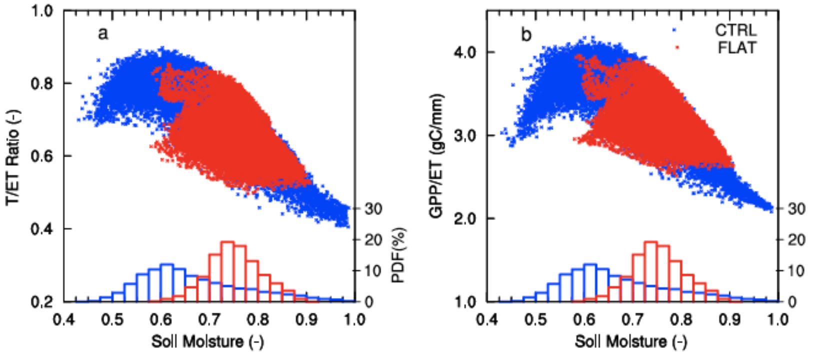

Figure 2. Modeled (a) T/ET, (b) plant water use efficiency (GPP/ET in g C/mm H2O) changing with soil moisture by CTRL and FLAT. GPP = gross primary productivity.

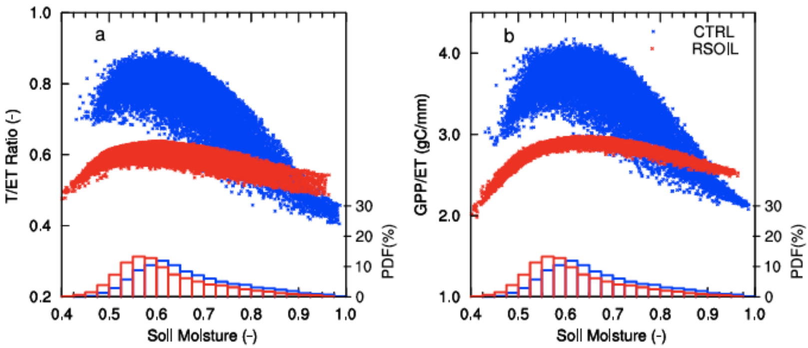

Figure 3. Modeled (a) T/ET, (b) plant water use efficiency (GPP/ET in g C/mm H2O) changing with soil moisture by CTRL and RSOIL.

Chang, L.-L., Dwivedi, R., Knowles, J. F., Fang, Y.-H., Niu, G.-Y., Pelletier, J. D., et al. (2018). Why do large-scale land surface models produce a low ratio of transpiration to evapotranspiration? Journal of Geophysical Research: Atmospheres, 123. https://doi.org/10.1029/2018JD029159