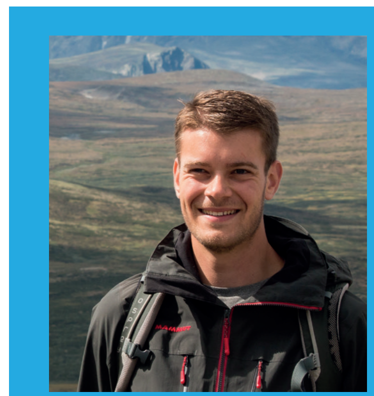

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Modeling permafrost active layer thermal properties of the Qinghai–Tibet Plateau

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Goal

Determine the active layer thermal conductivity, heat capacity and porosity using a numerical heat transer model.

Motivation

- Reduce the need for sampling
- Alternative to emperically determined thermal properties
- Timescale of thaw events

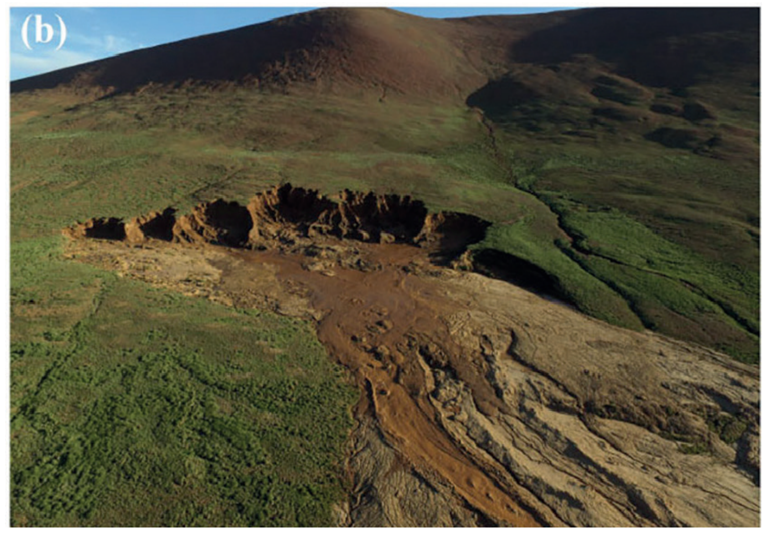


Figure 1. Thaw slump at the QTP , photo by (Luo, J. et. al. 2019)

Method

- 1D numerical model based upon heat transfer equation (1)

$$\delta z\left(\lambda_t \frac{\delta T}{\delta z}\right) = C_v \frac{\delta T}{\delta t} + \phi \rho_i L \frac{\delta S_w}{\delta t} \qquad (1)$$

- Varying thermal properties
  - Thermal conductivity (λ)
  - Heat capacity (C)
  - Porosity (θ)
- Ensemble of 768 1D numerical models

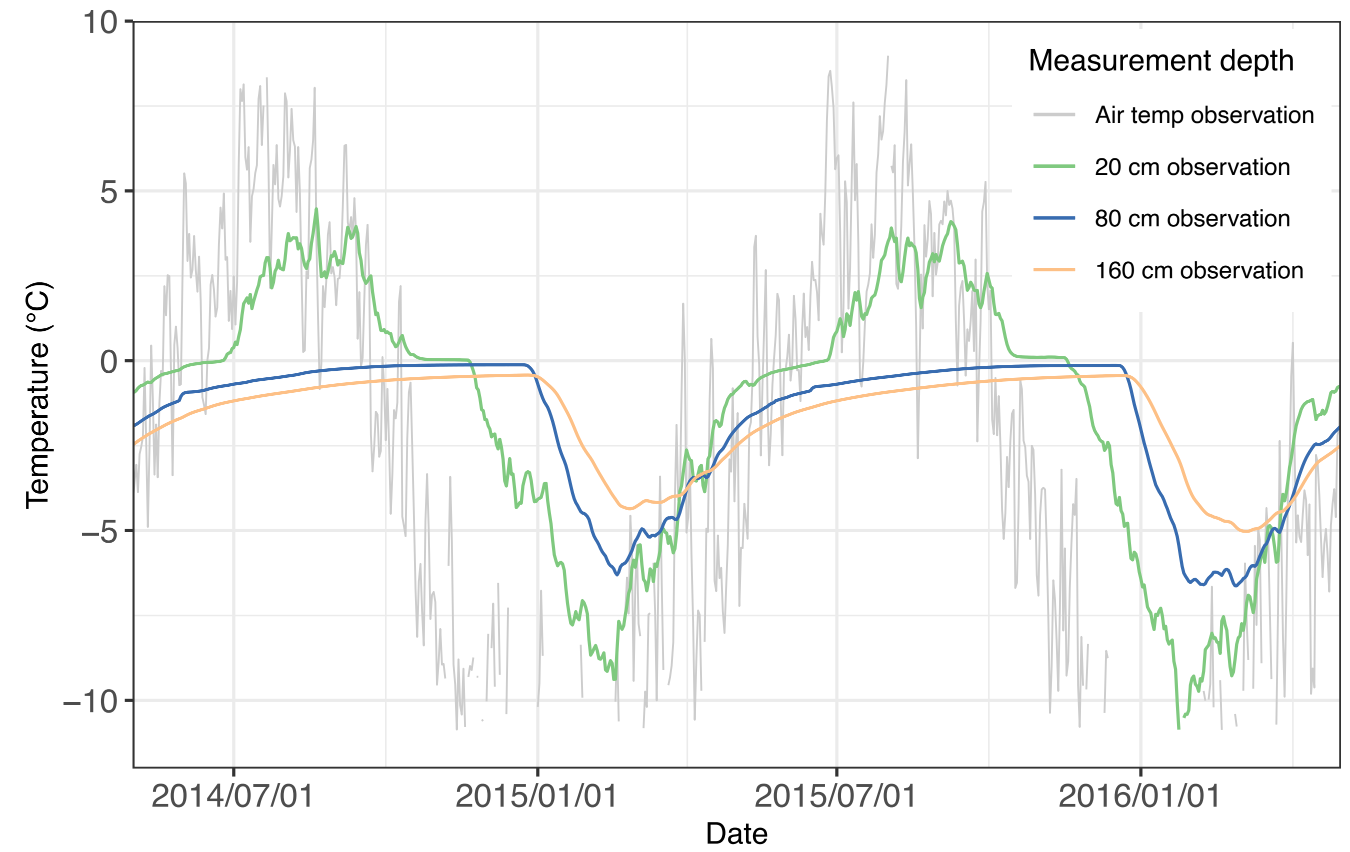
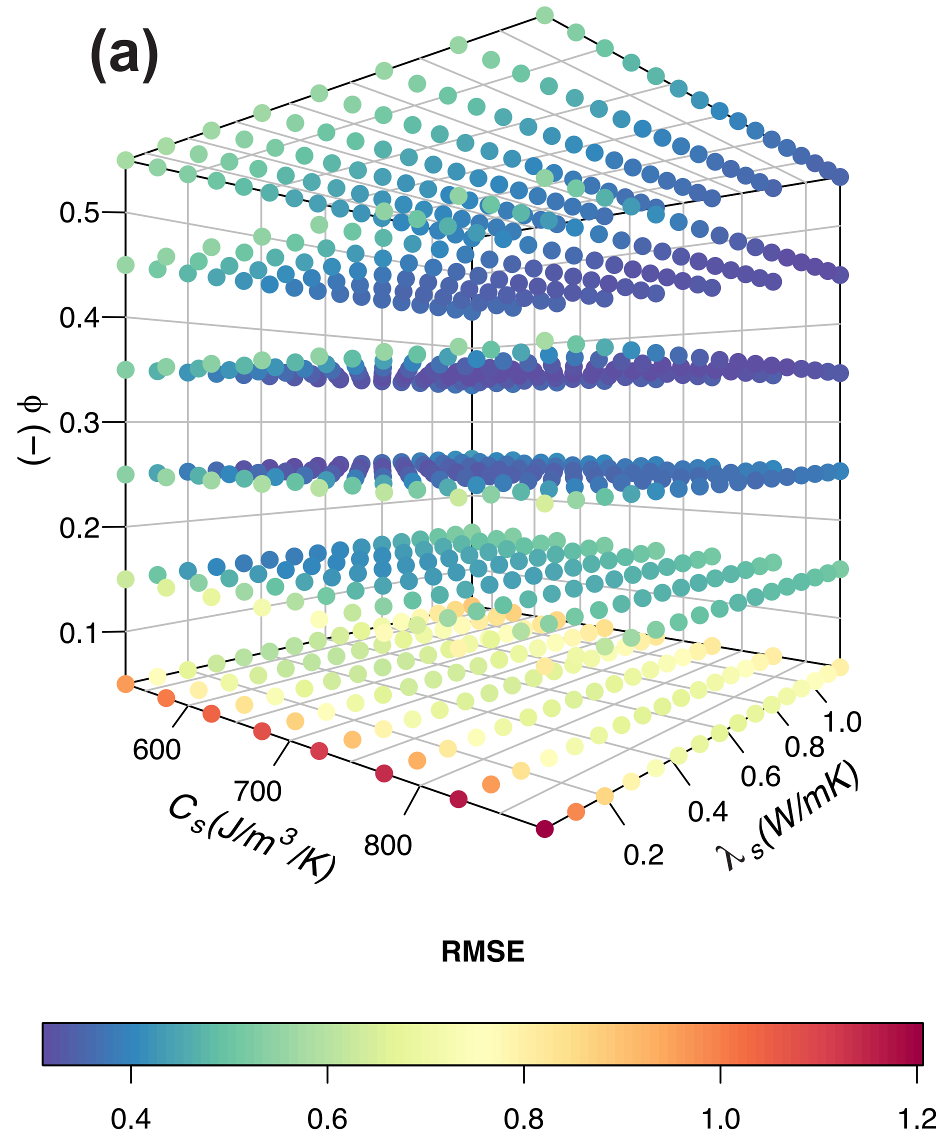


Figure 2. Selection of observed temperatures at the QTP by (Luo D. et. al 2018)

Results



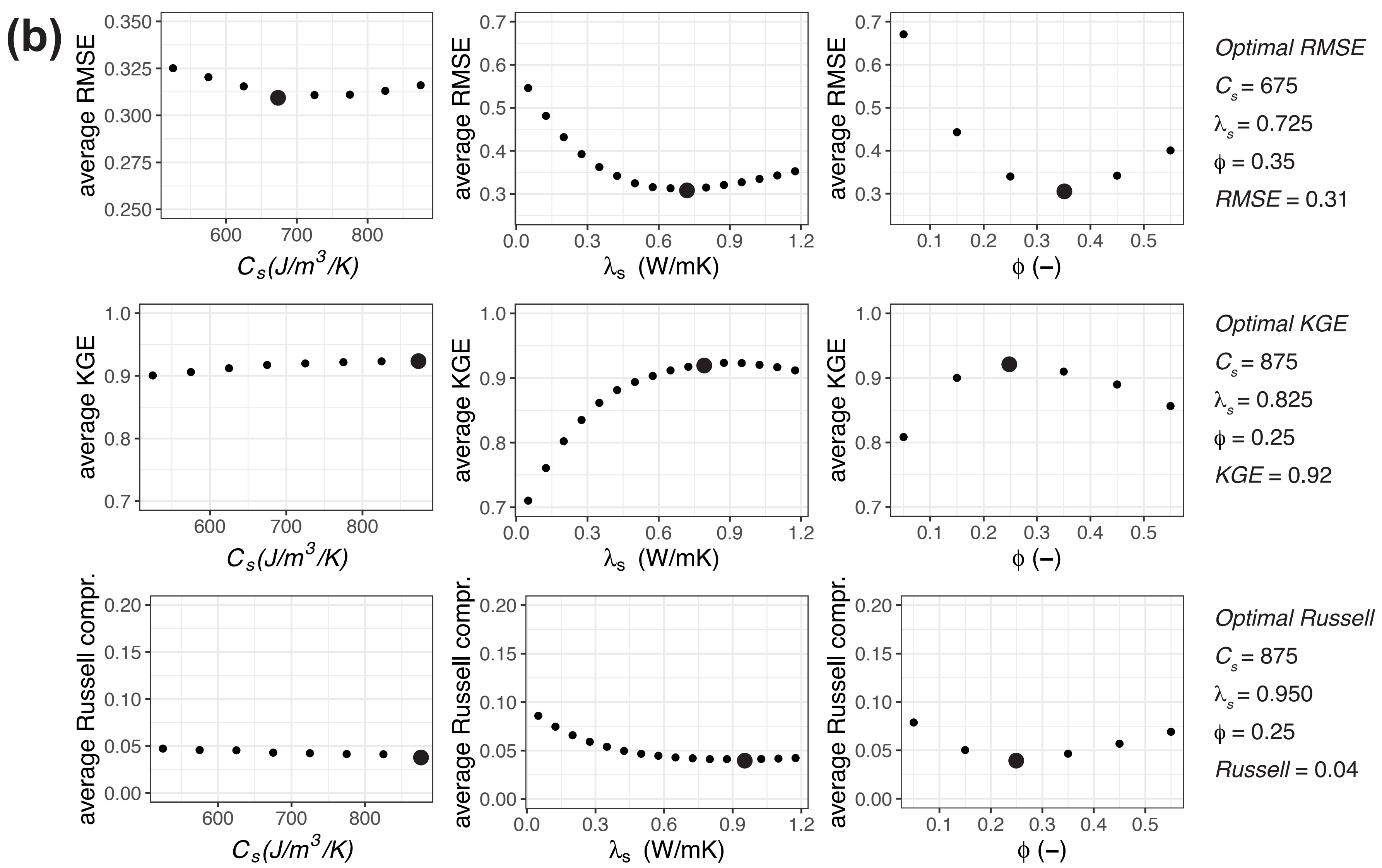


Figure 3(a) shows the average RMSE between the observations and model results for the investigated parameter space. Figure (b) shows the sensitivity of the parameter space for the various error measures.

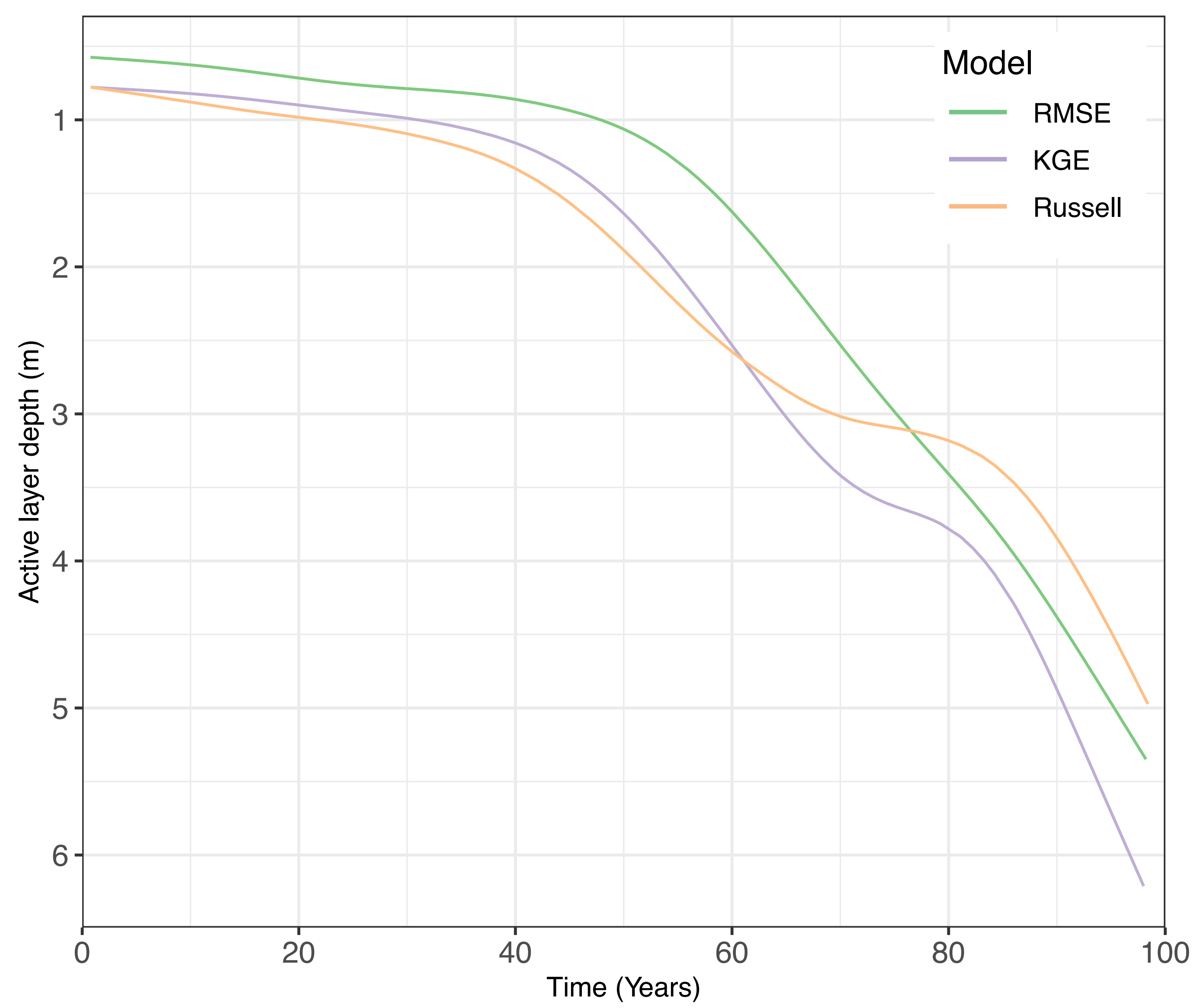


Figure 4. Future scenario of active layer development based upon three optimal parameter combinations

References

- Temperature observations courtesy to: Luo, D. L., Jin, H. J., He, R. X., Wang, X. F., Muskett, R. R., Marchenko, S. S., & Romanovsky, V. E. (2018). Characteristics of water-heat exchanges and inconsistent surface temperature changes at an elevational permafrost site on the Qinghai-Tibet Plateau. *Journal of Geophysical Research: Atmospheres*, 123, 10,057–10,075. https://doi.org/10.1029/2018JD028298
- Photo by: Luo J., Niu, F., Lin. Z., Liu, M., Yin, G. (2019). Recent acceleration of thaw slumping in permafrost terrain of Qinghai-Tibet Plateau: An example from the Beiluhe Region. *Geomorphology, 341, 79-85.* https://doi.org/10.1016/j.geomorph.2019.05.020