

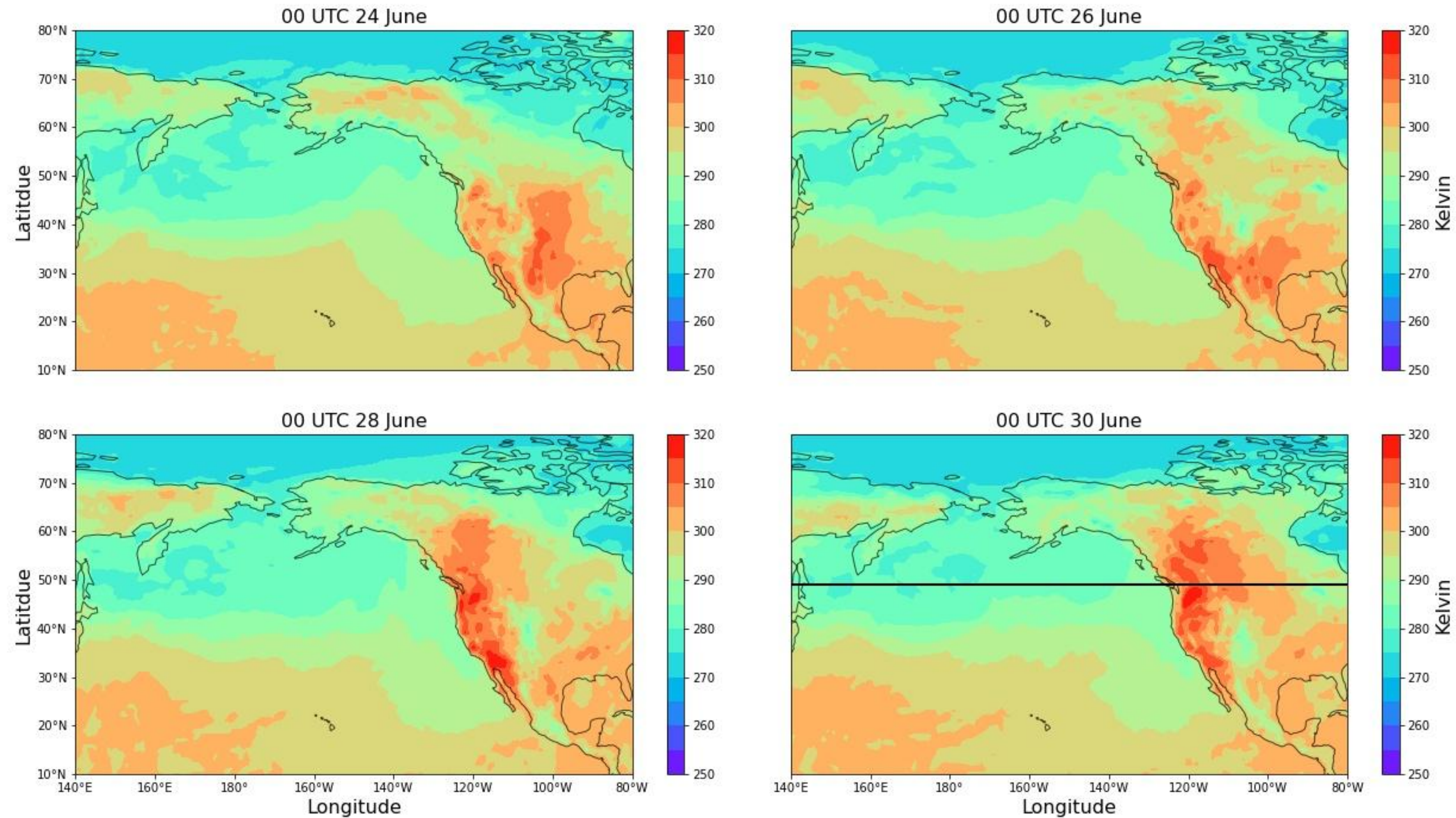
# The Top-Down Thermodynamic Control of Atmospheric Blockings on the Magnitude of Surface Heat Waves

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# 2021 Pacific Northwest heat wave

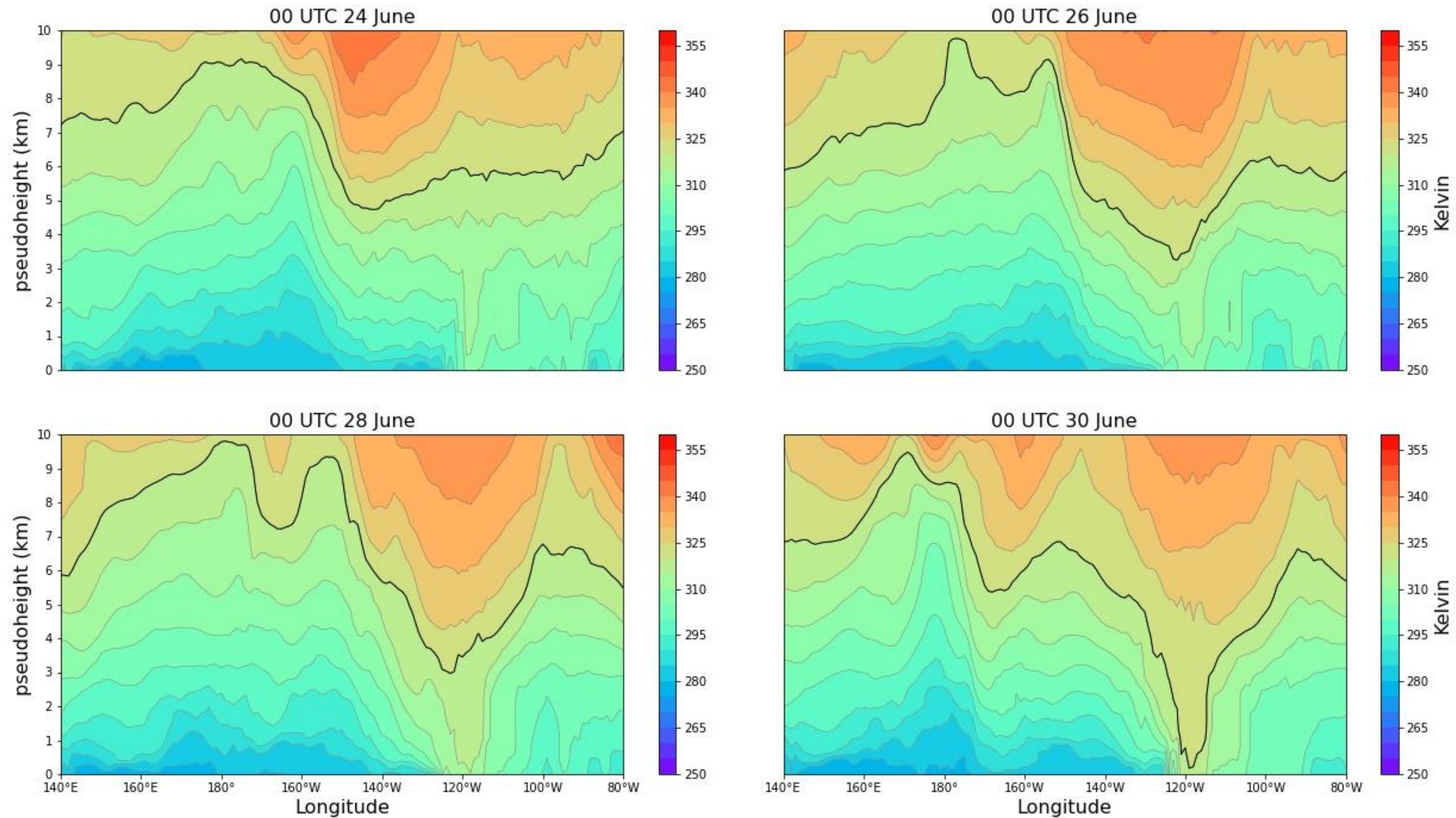
2m Temperature



Neal et al. (2022)

# 2021 Pacific Northwest heat wave

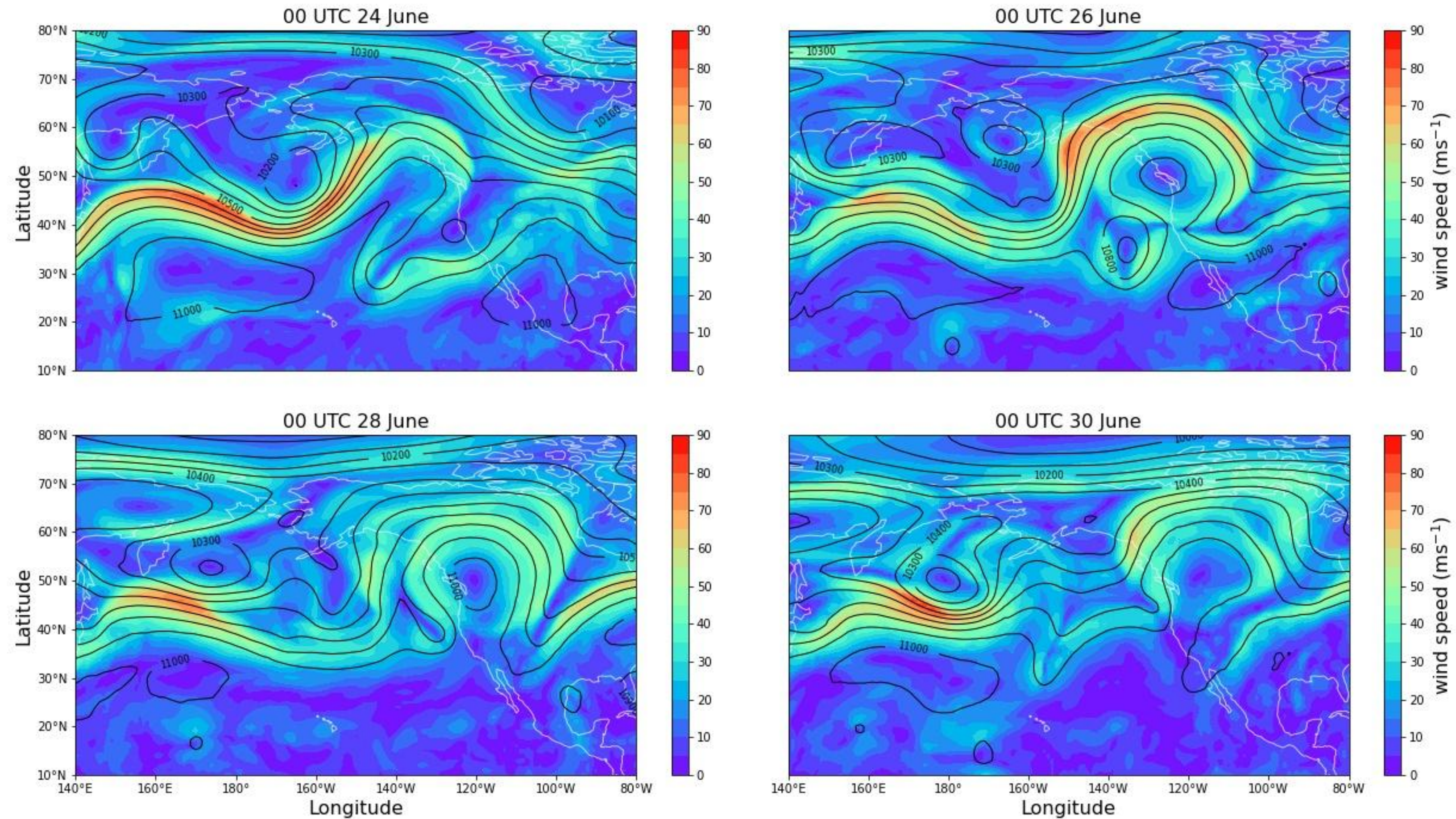
49°N  $\theta$  cross section



Neal et al. (2022)

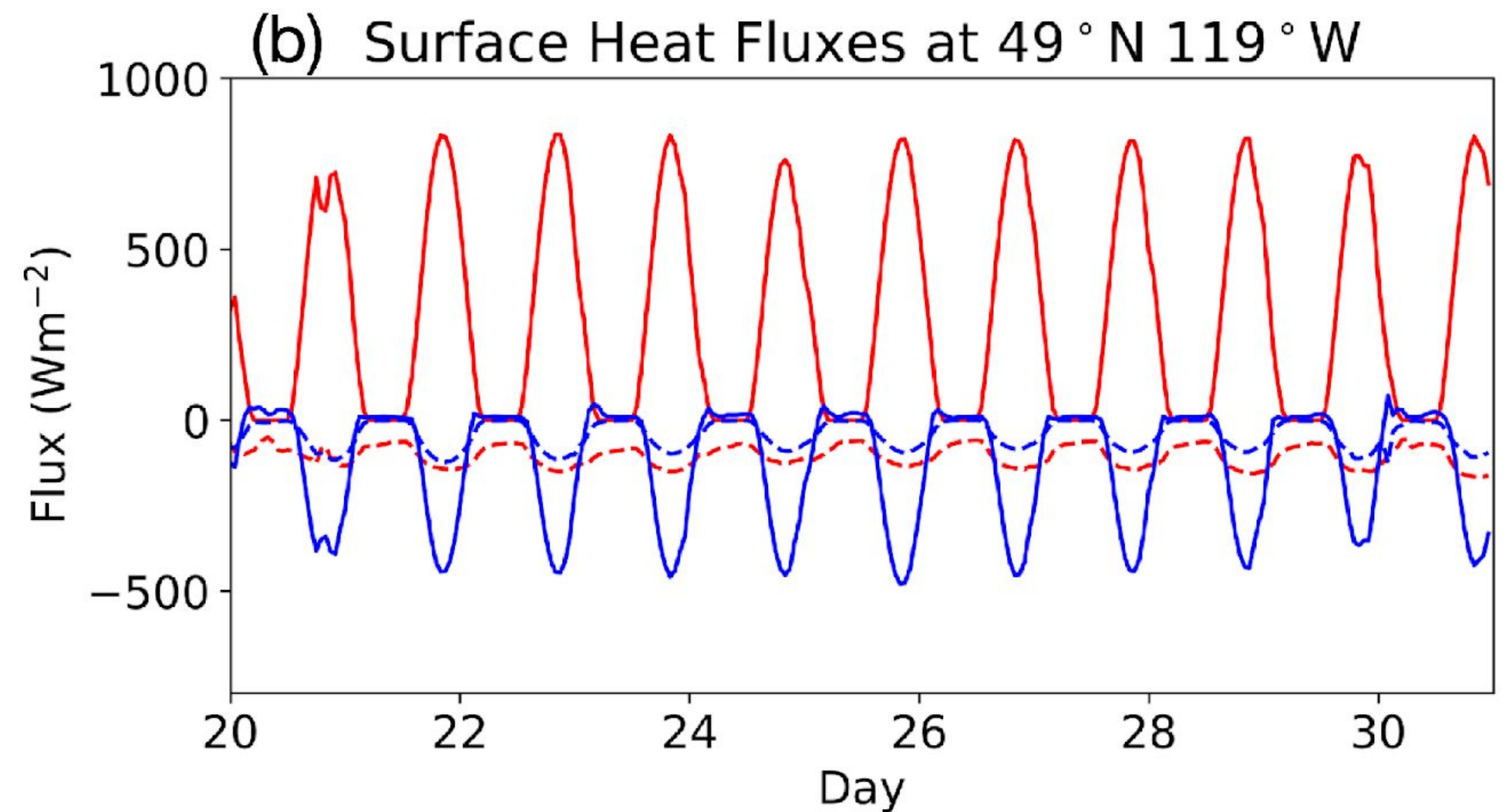
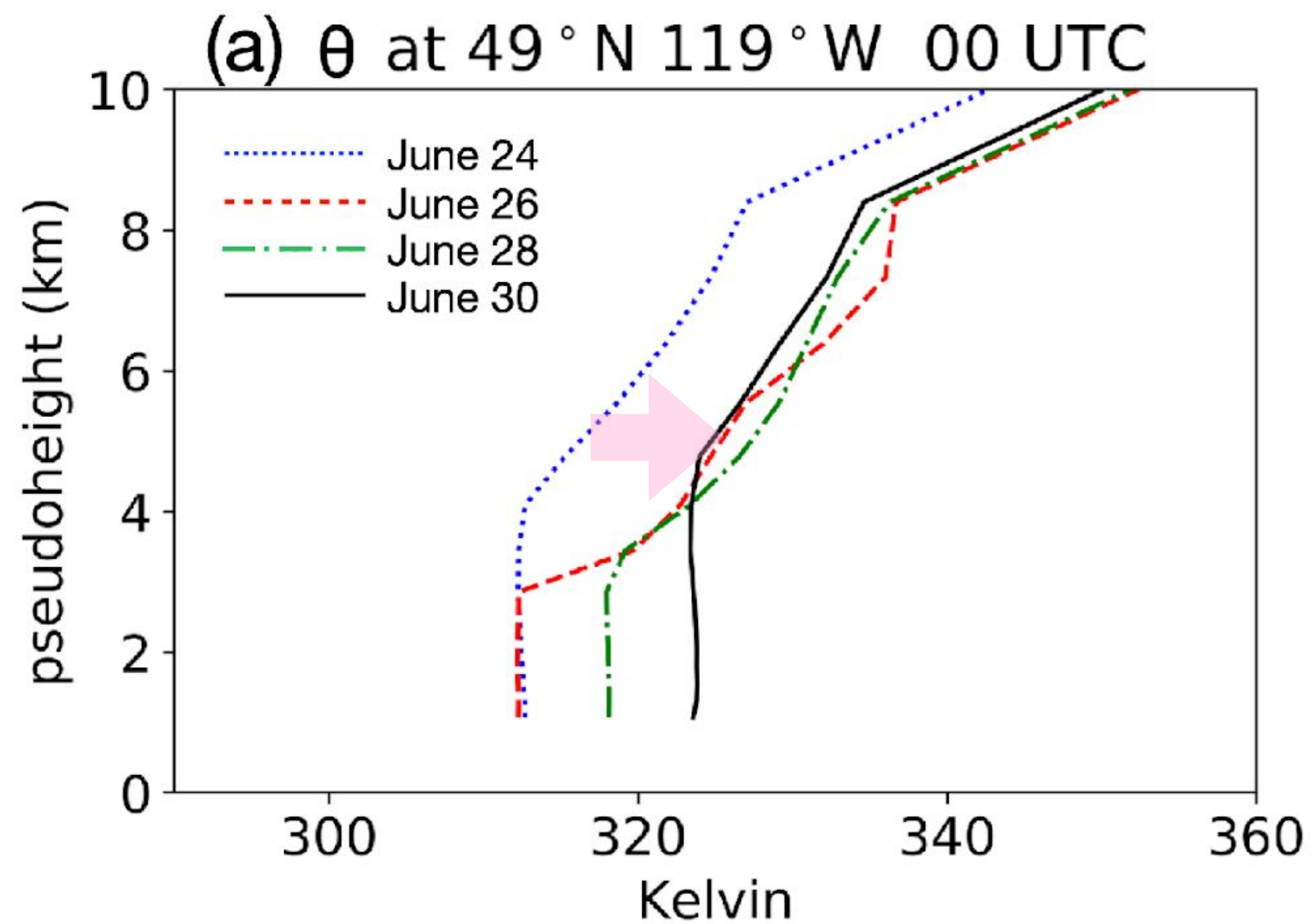
# 2021 Pacific Northwest heat wave

Z250 and wind speed



Neal et al. (2022)

# 2021 Pacific Northwest heat wave

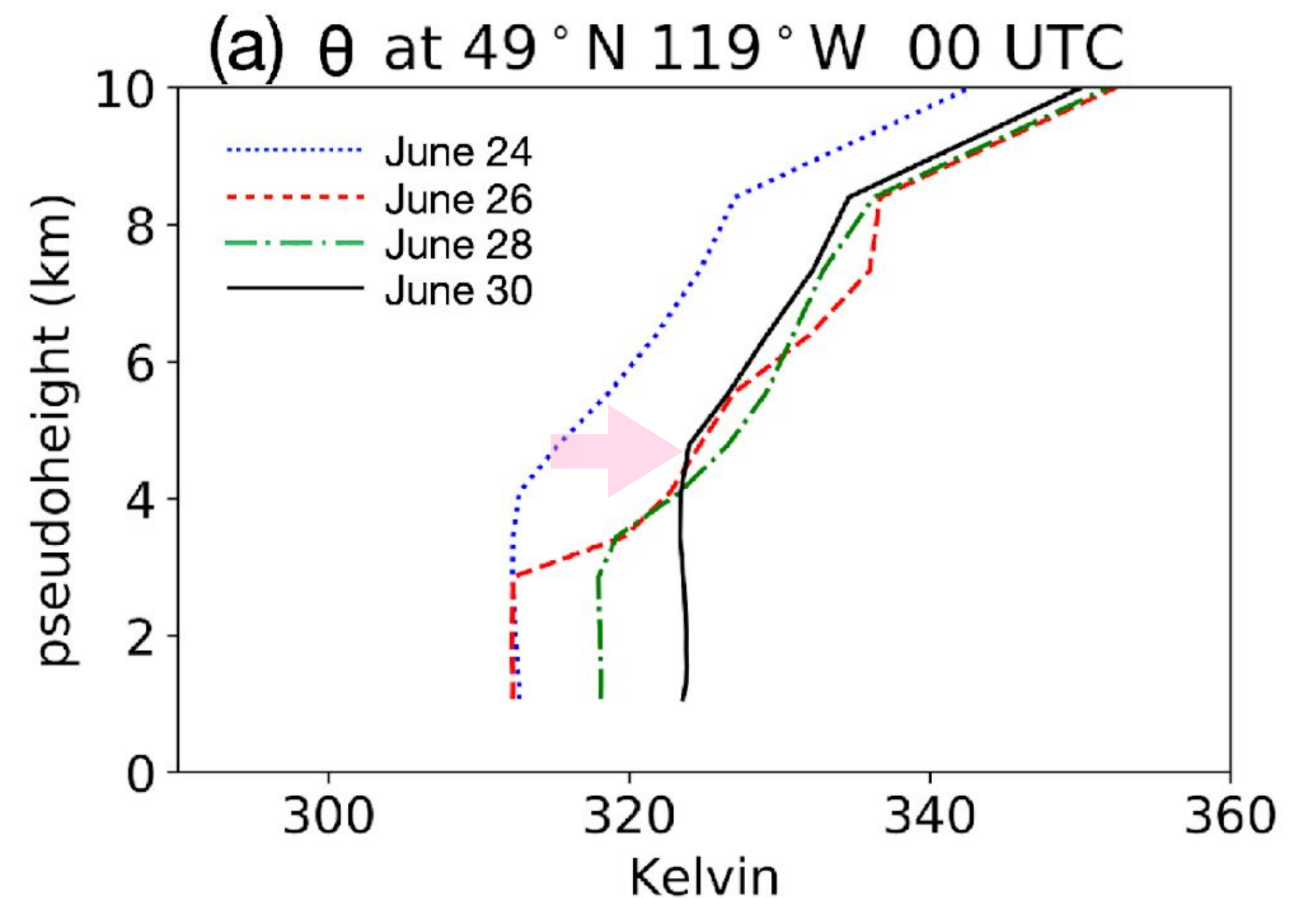


# Question

- What mechanism set the maximum surface temperature?

# Hypothesis

- A warm anomaly aloft, set up by atmospheric blocking, suppressed convection.

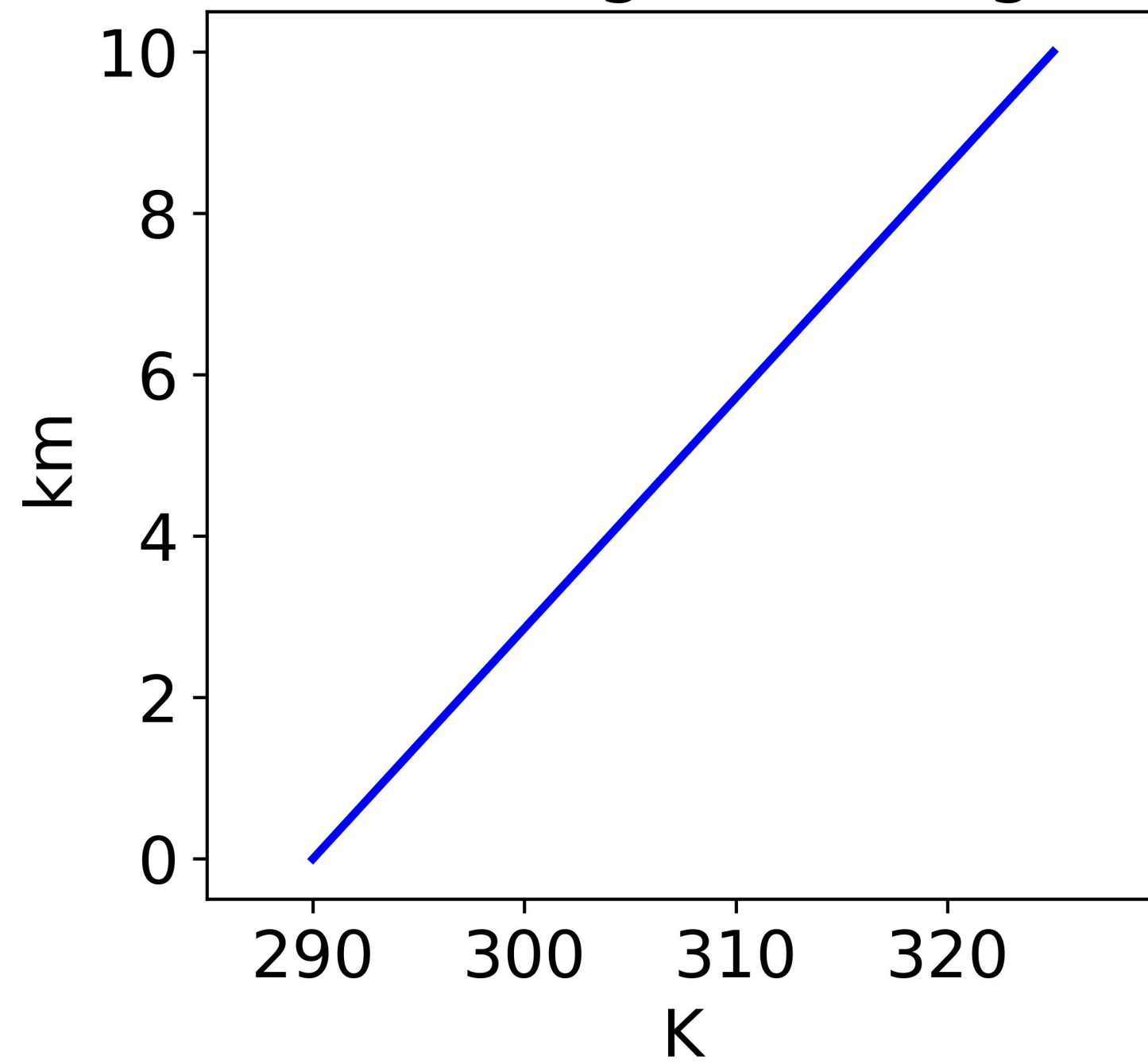


# Encroachment

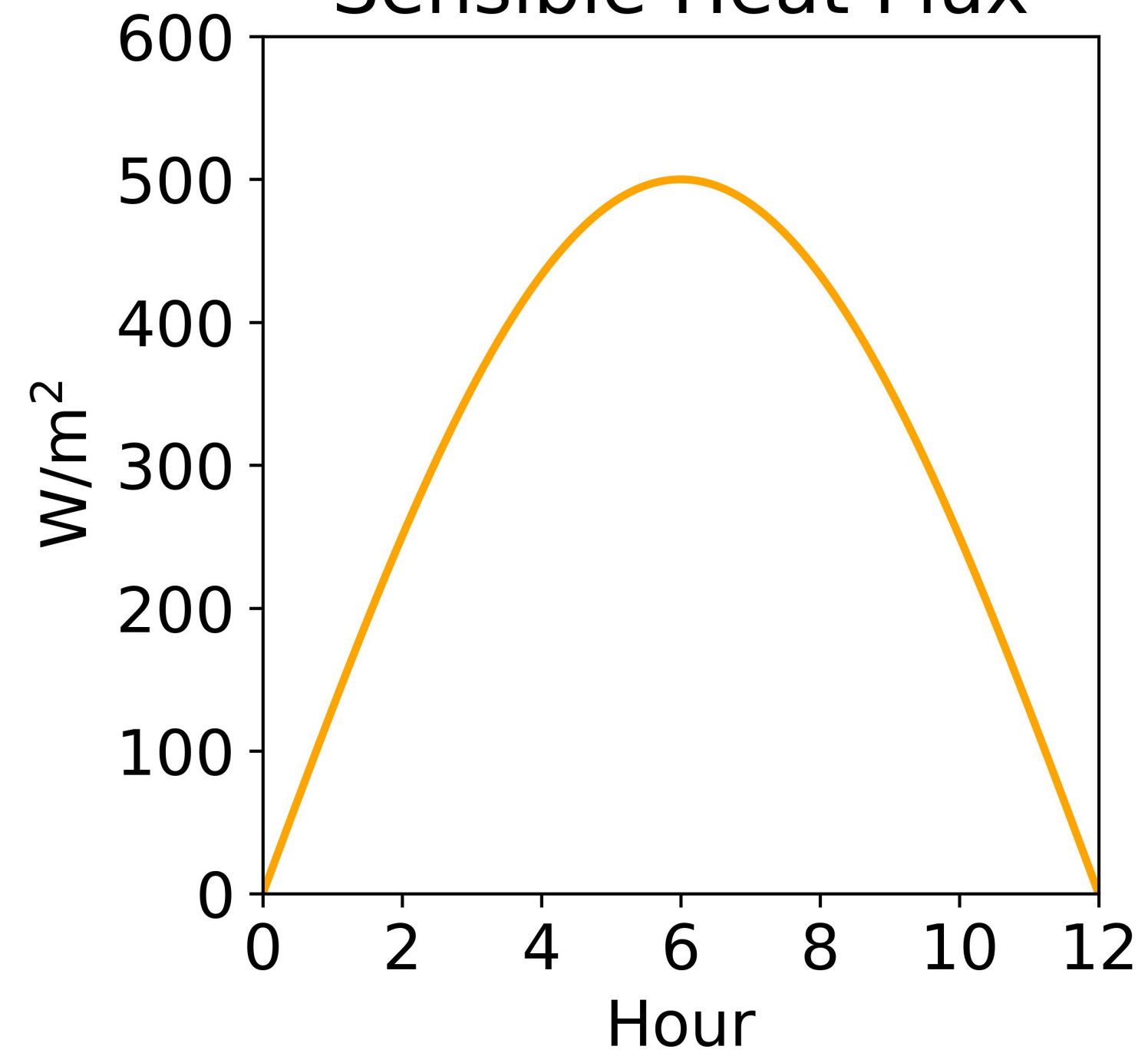
Prediction of boundary layer temperature and height based solely on the thermodynamics (e.g., Stull, 1988).

# Encroachment | Example

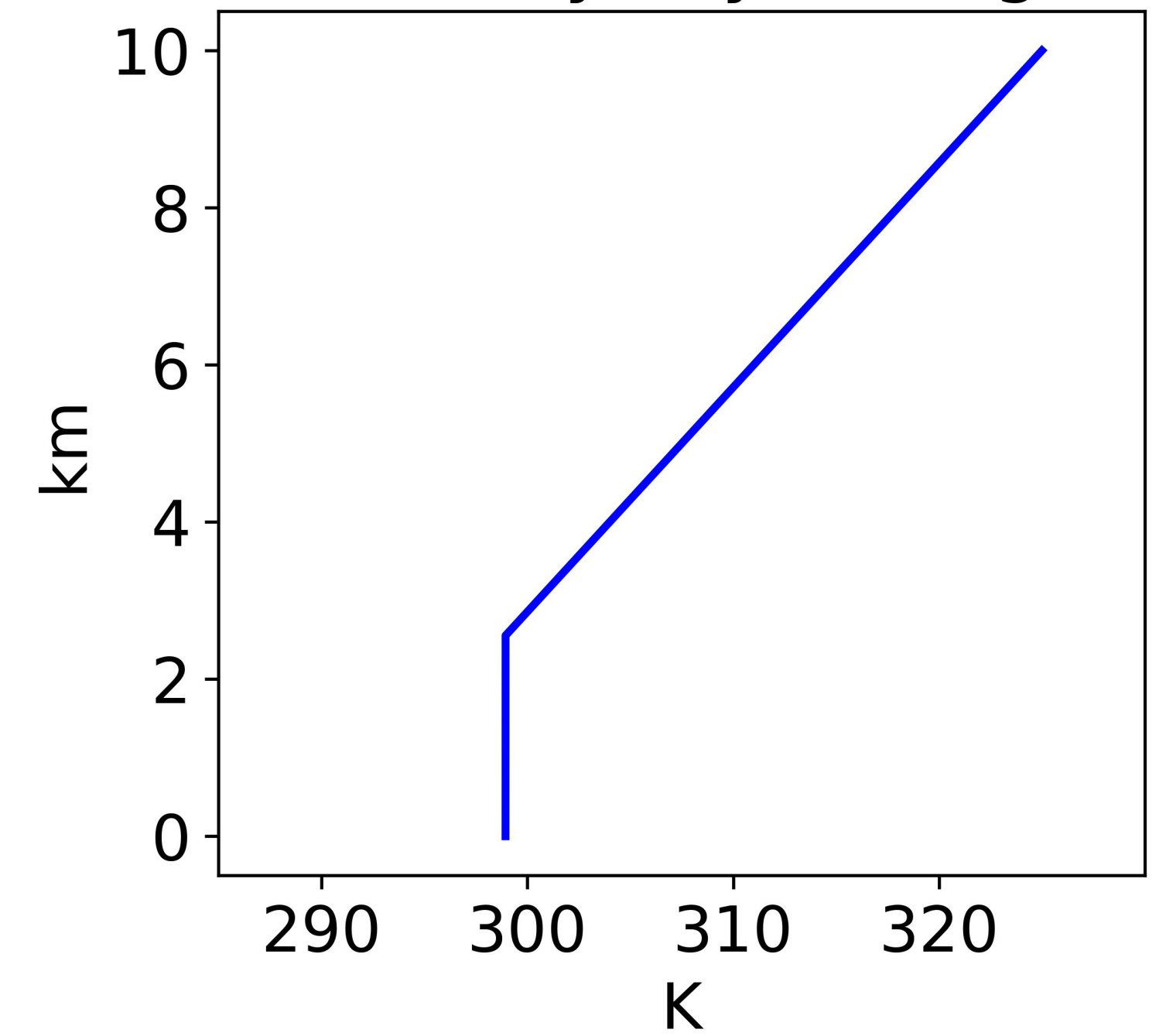
Morning Sounding



Sensible Heat Flux

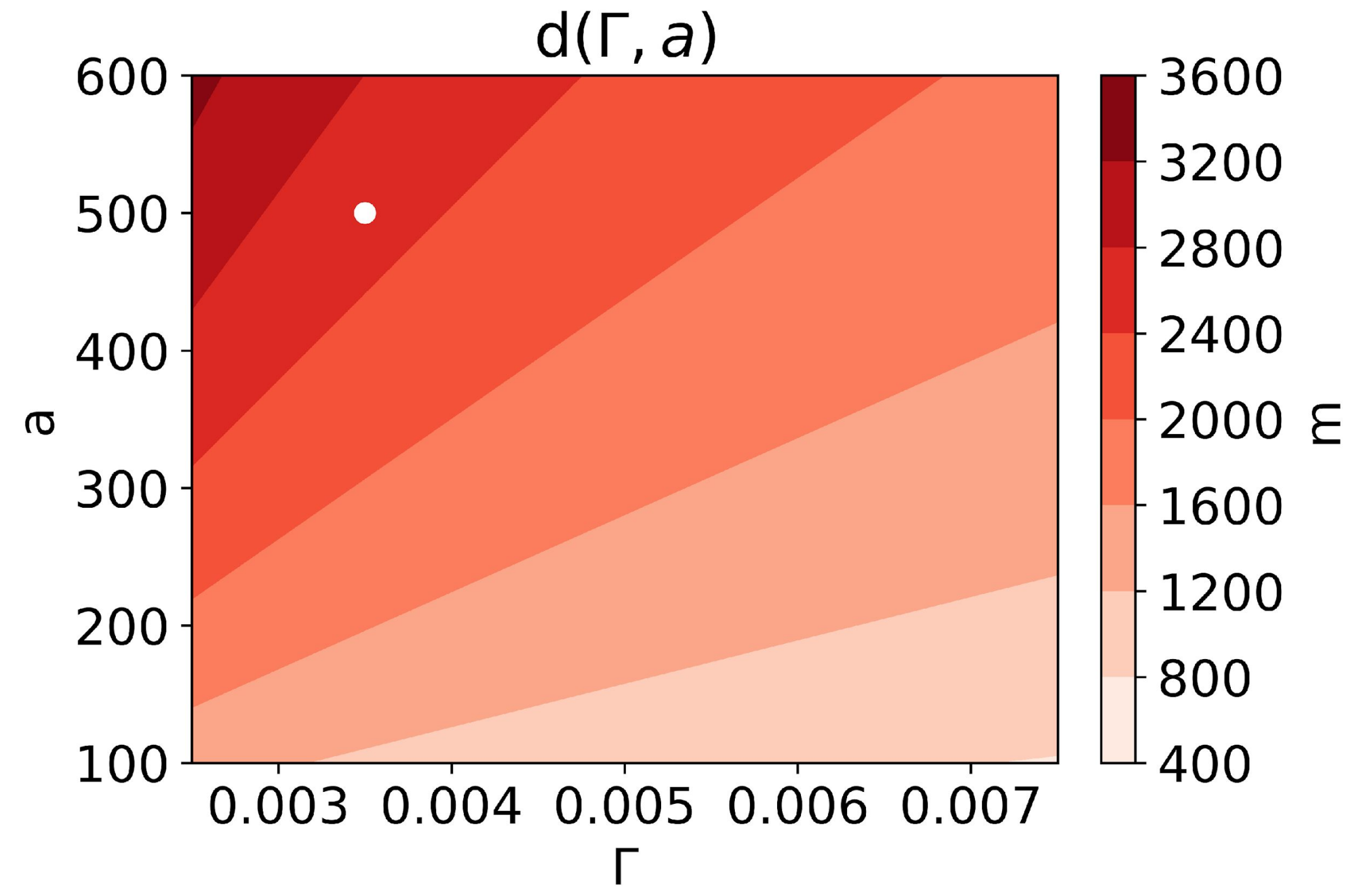
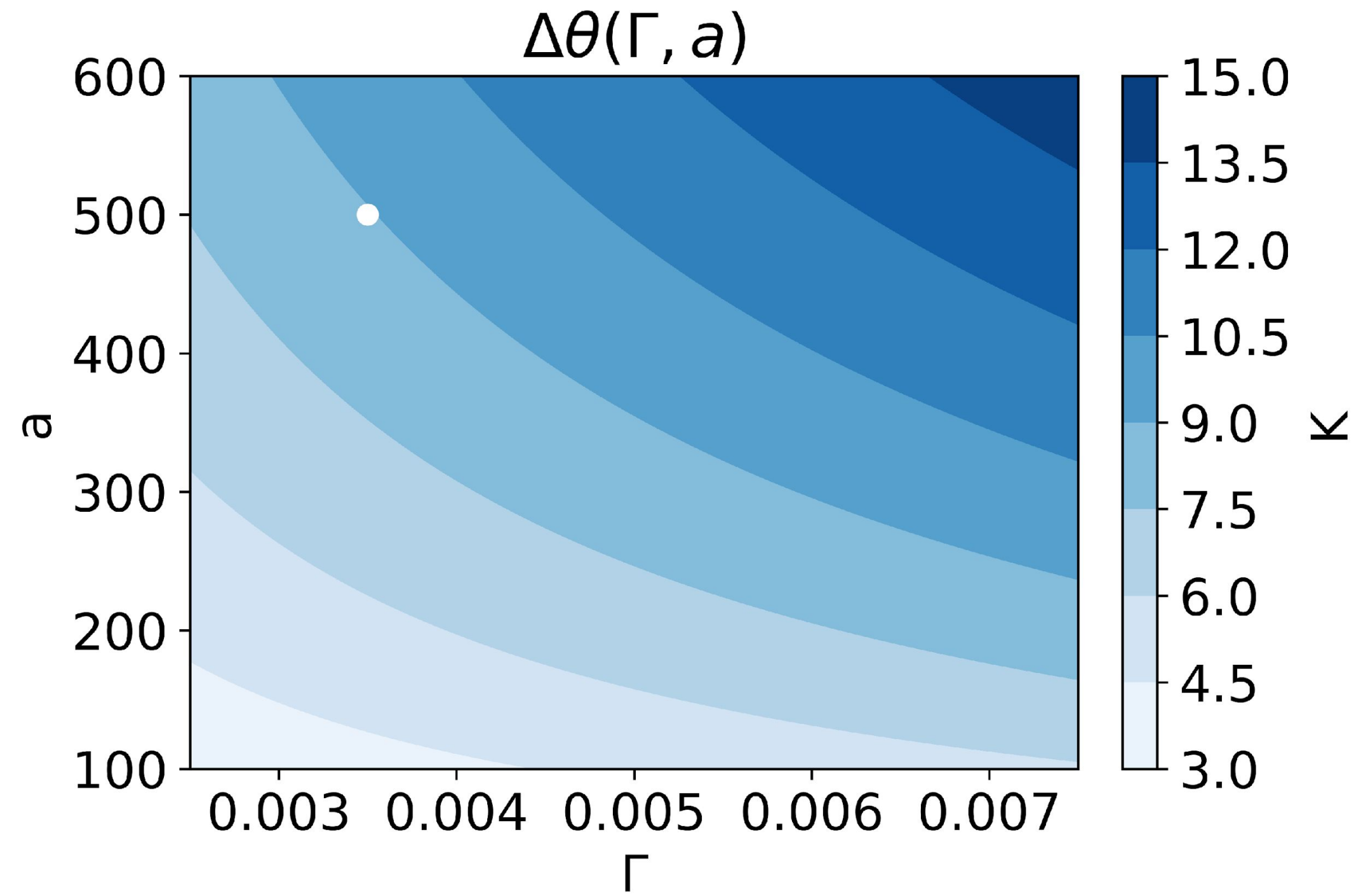


Boundary Layer Height



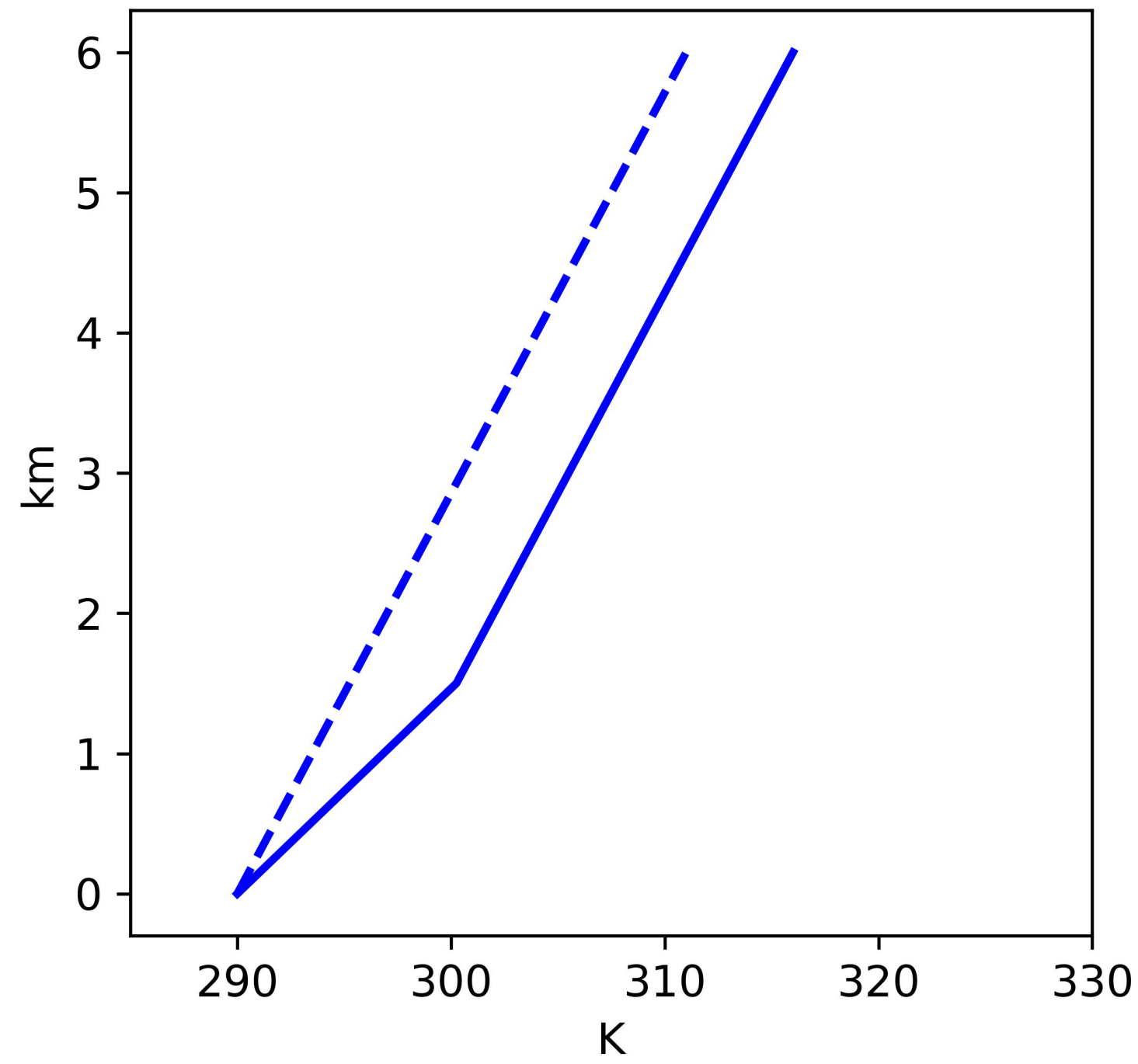


# Encroachment | Example

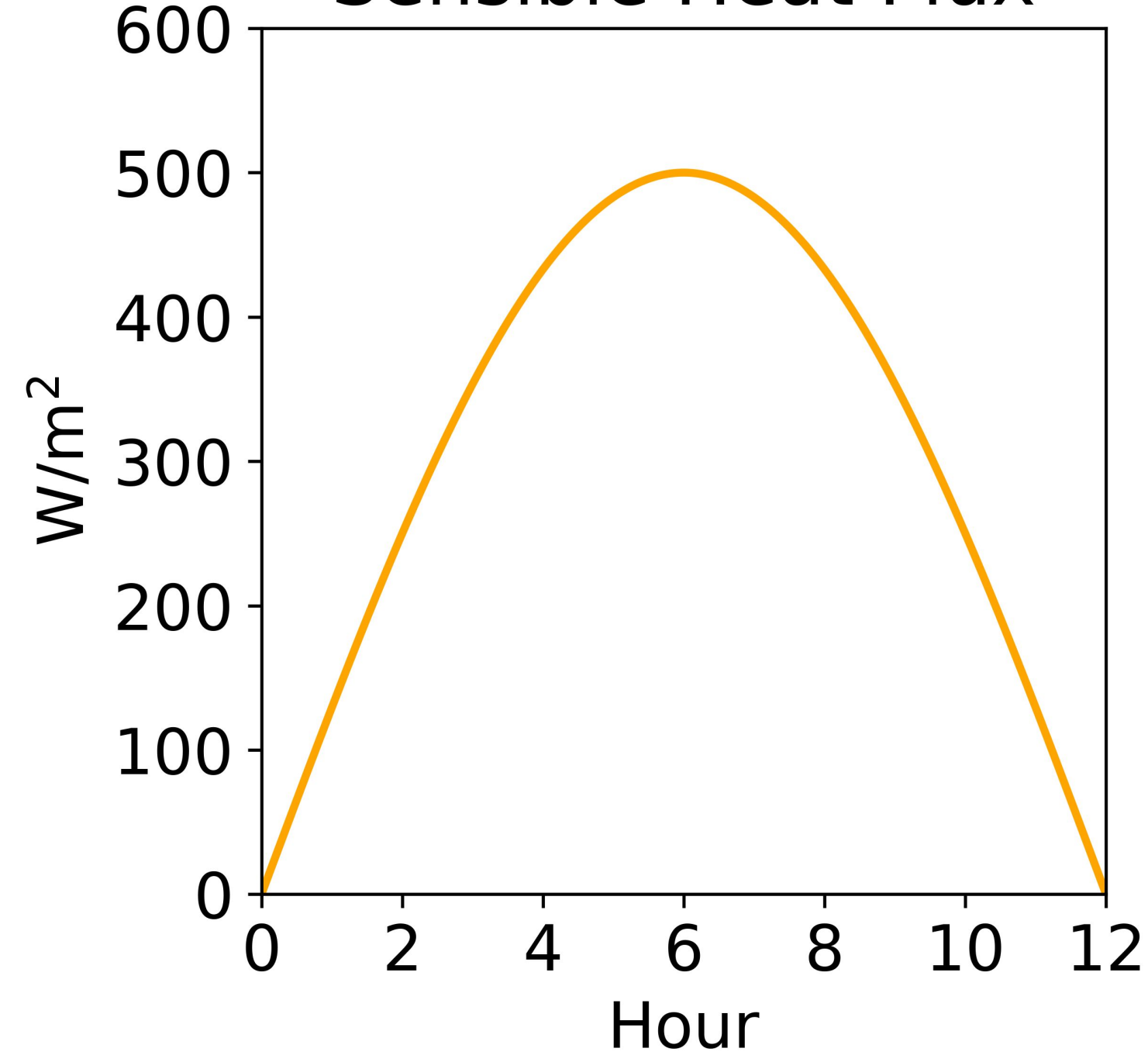


# Encroachment | Thought Experiment

Morning Sounding

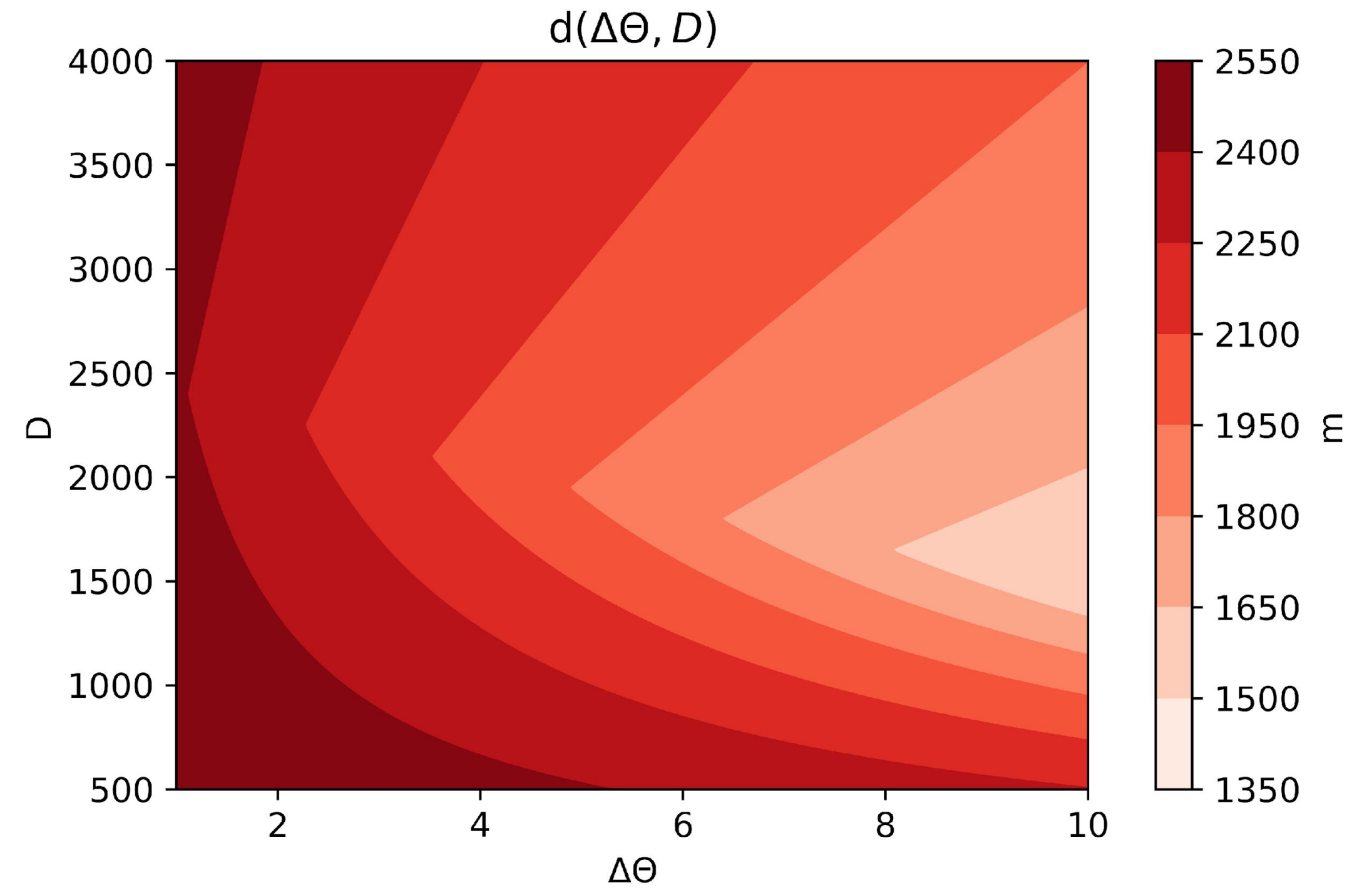
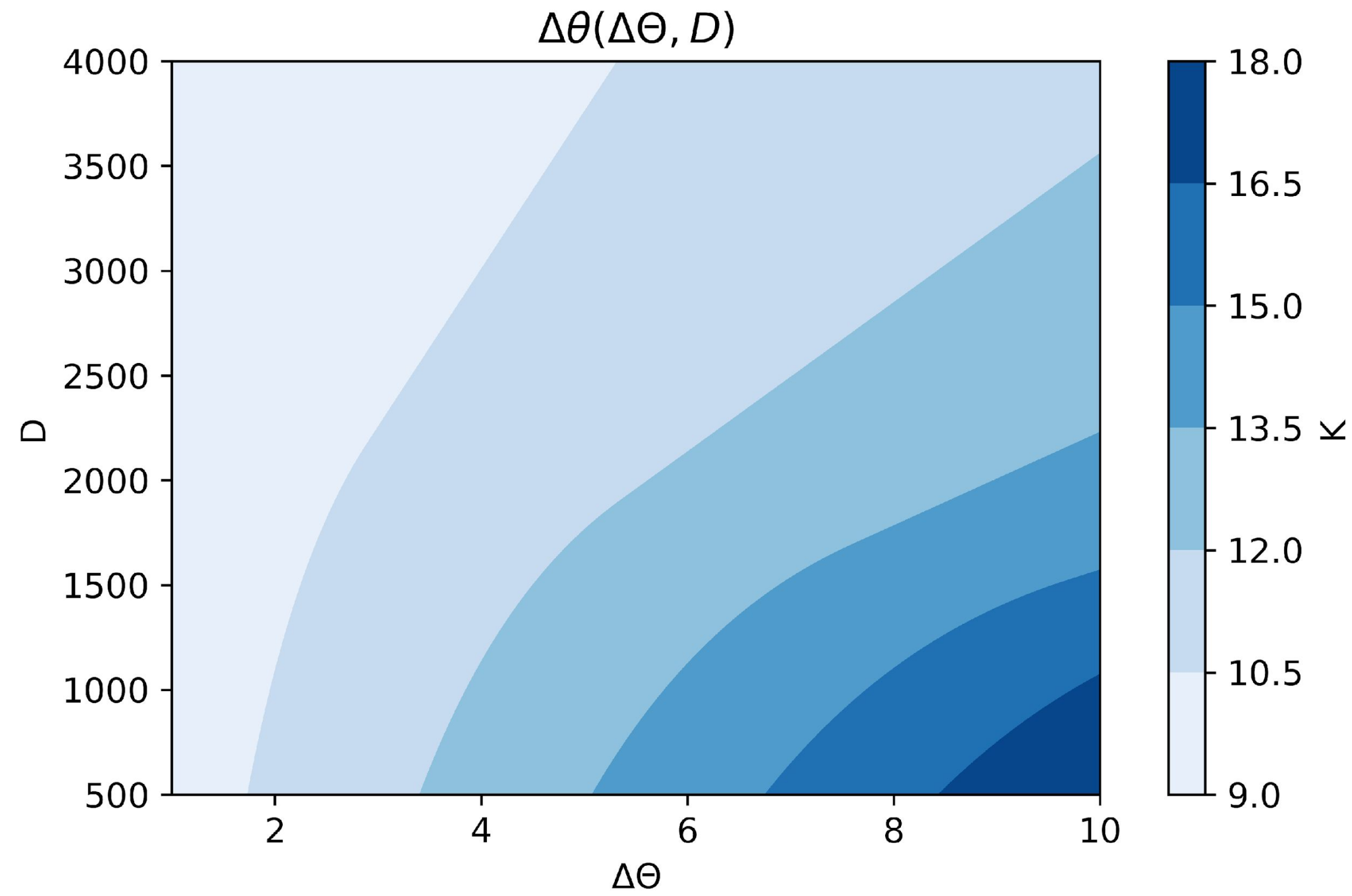


Sensible Heat Flux

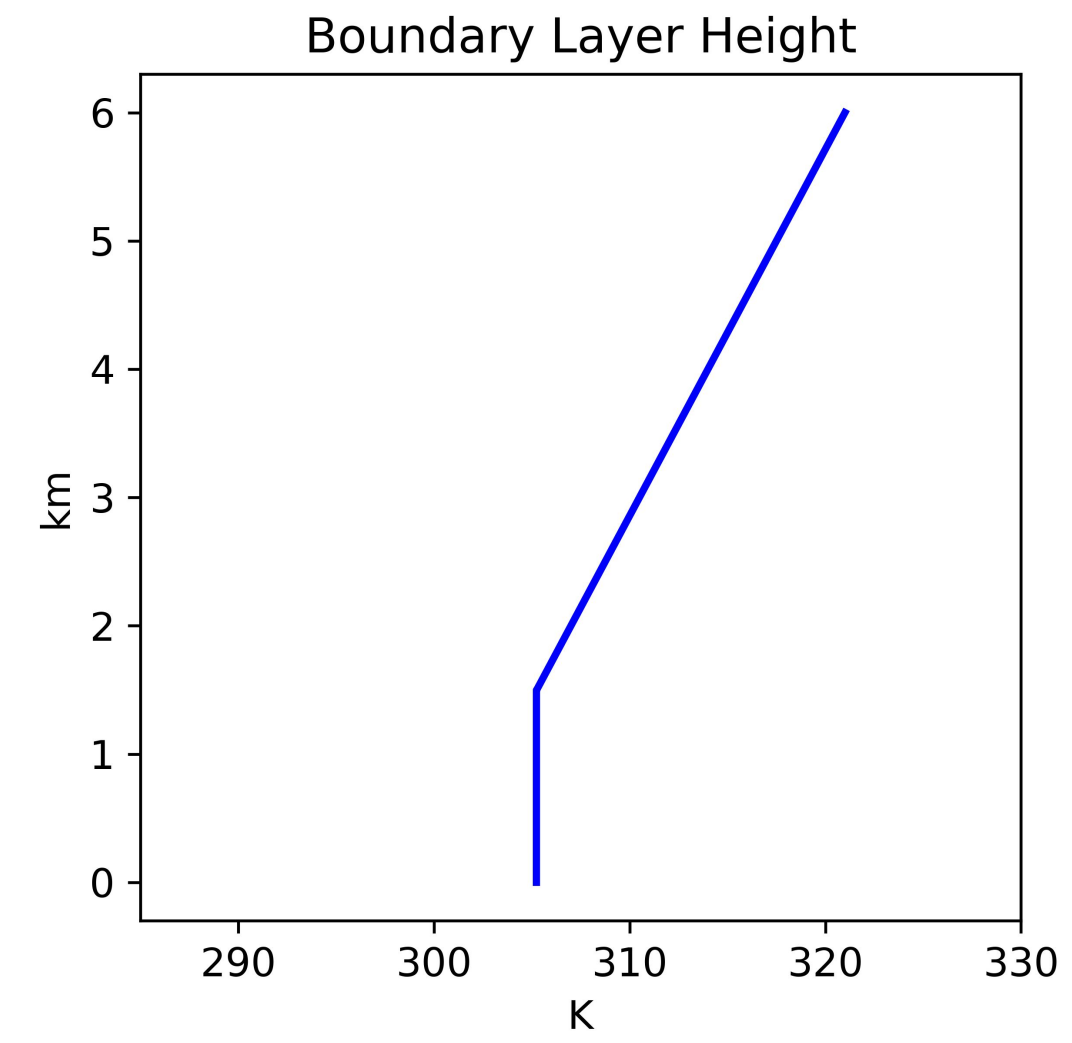
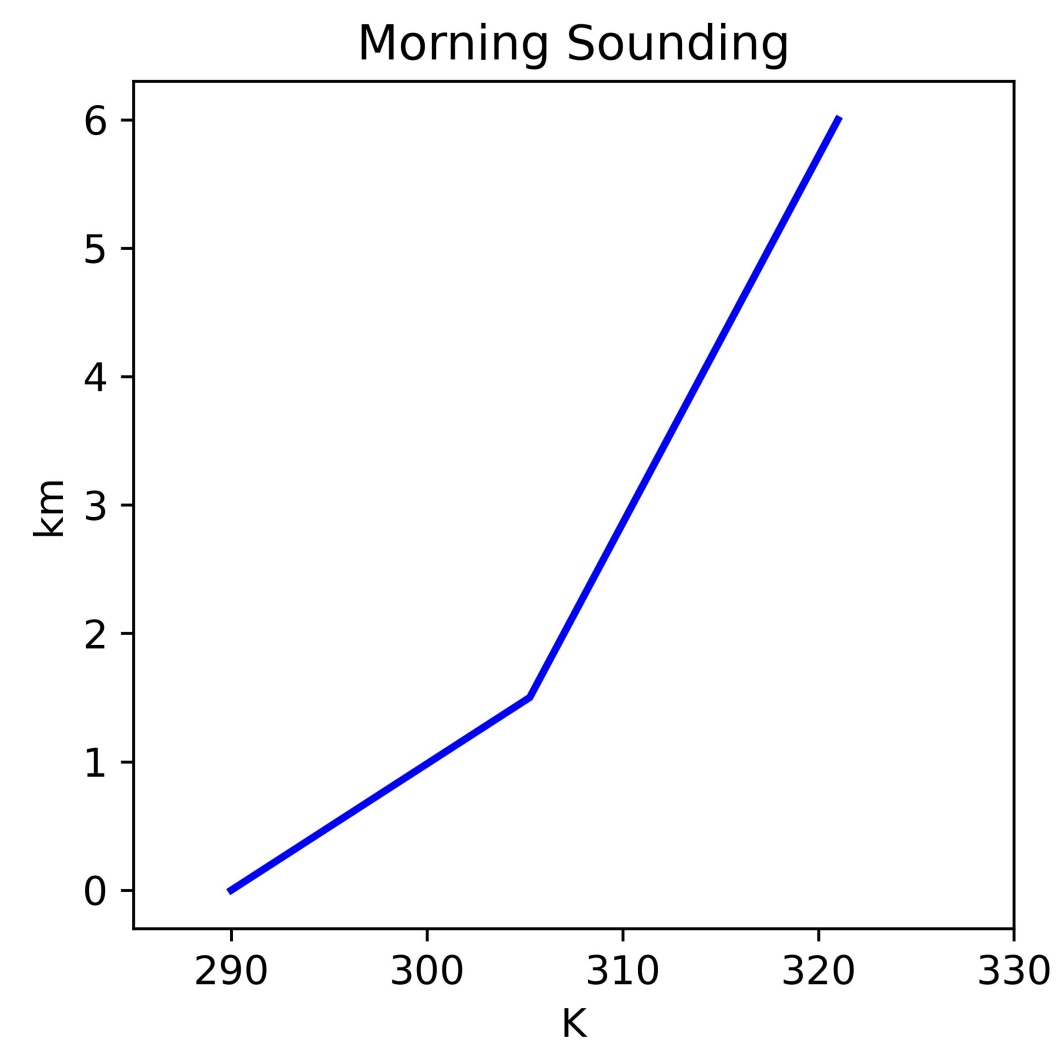
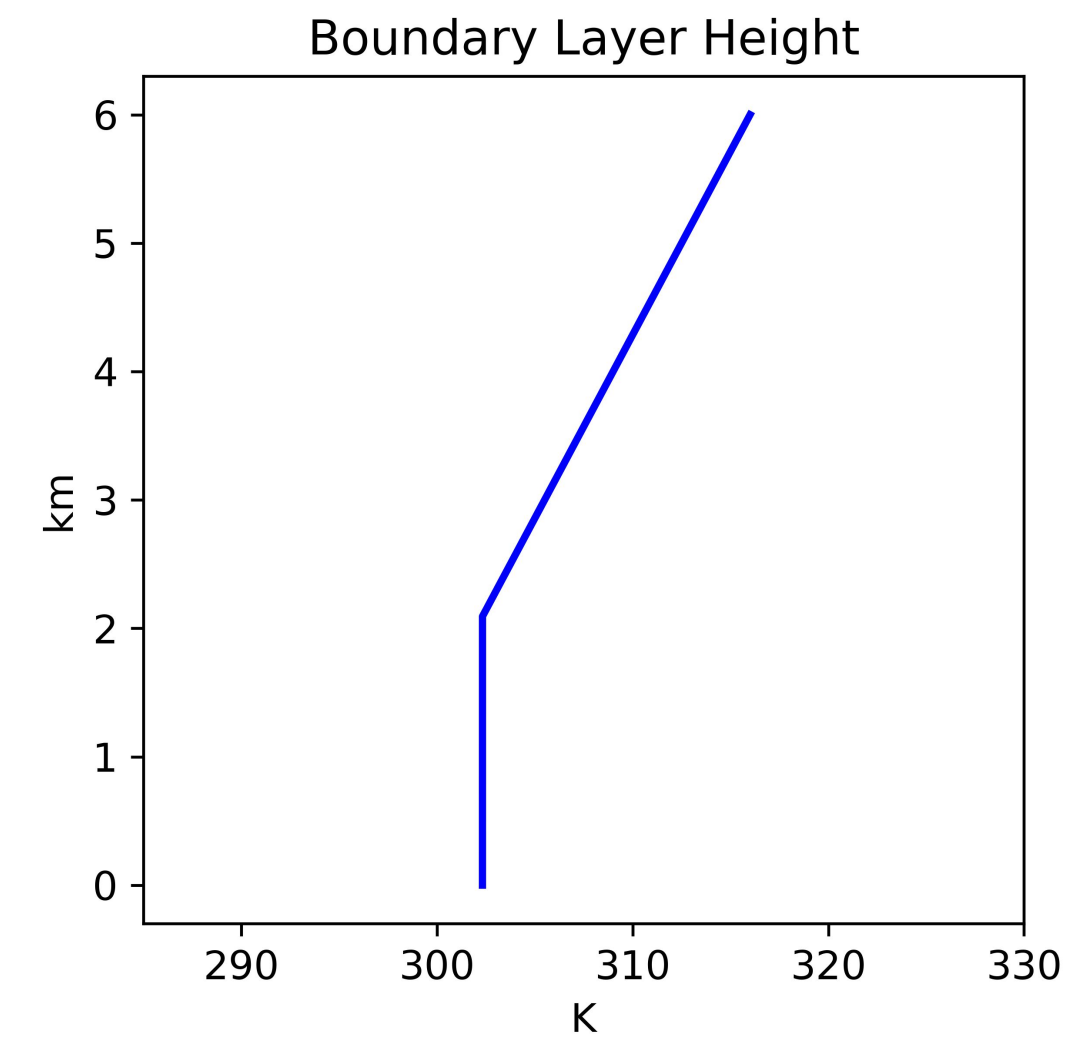
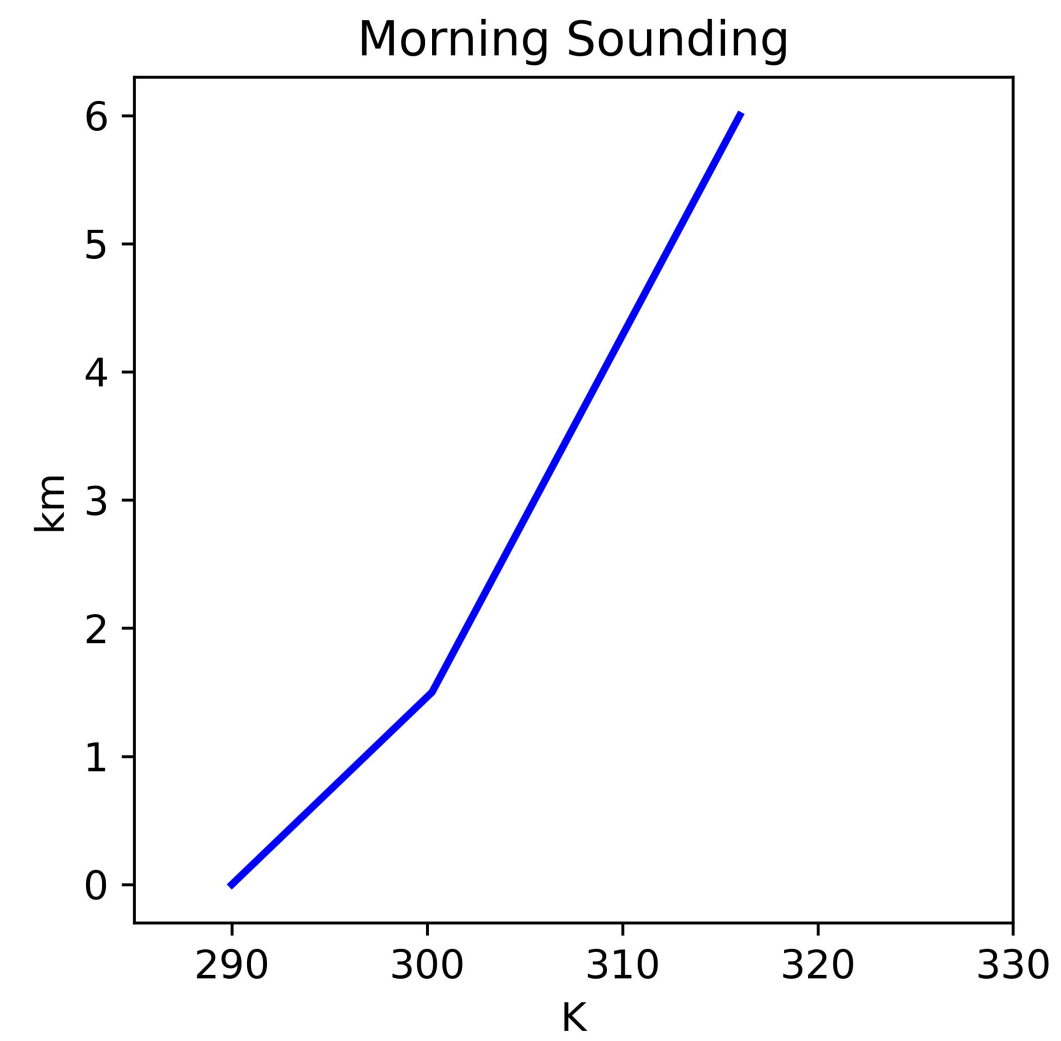


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# Encroachment | Thought Experiment

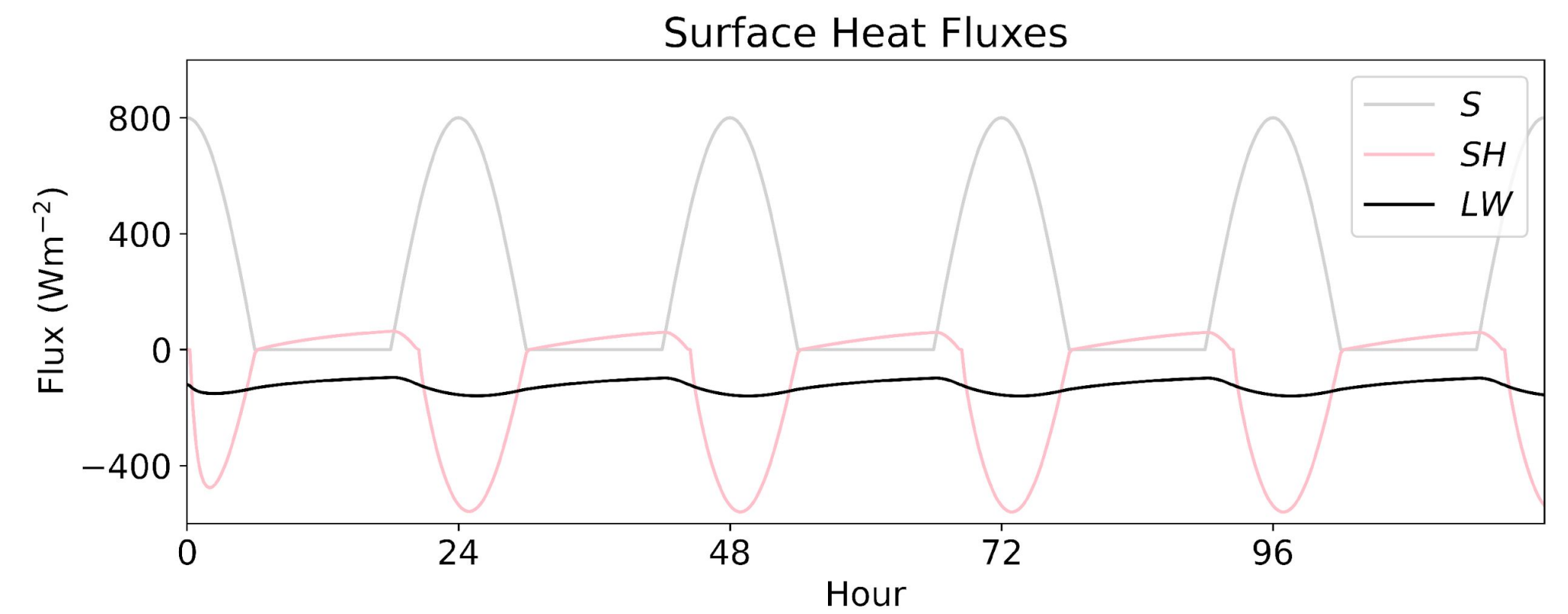
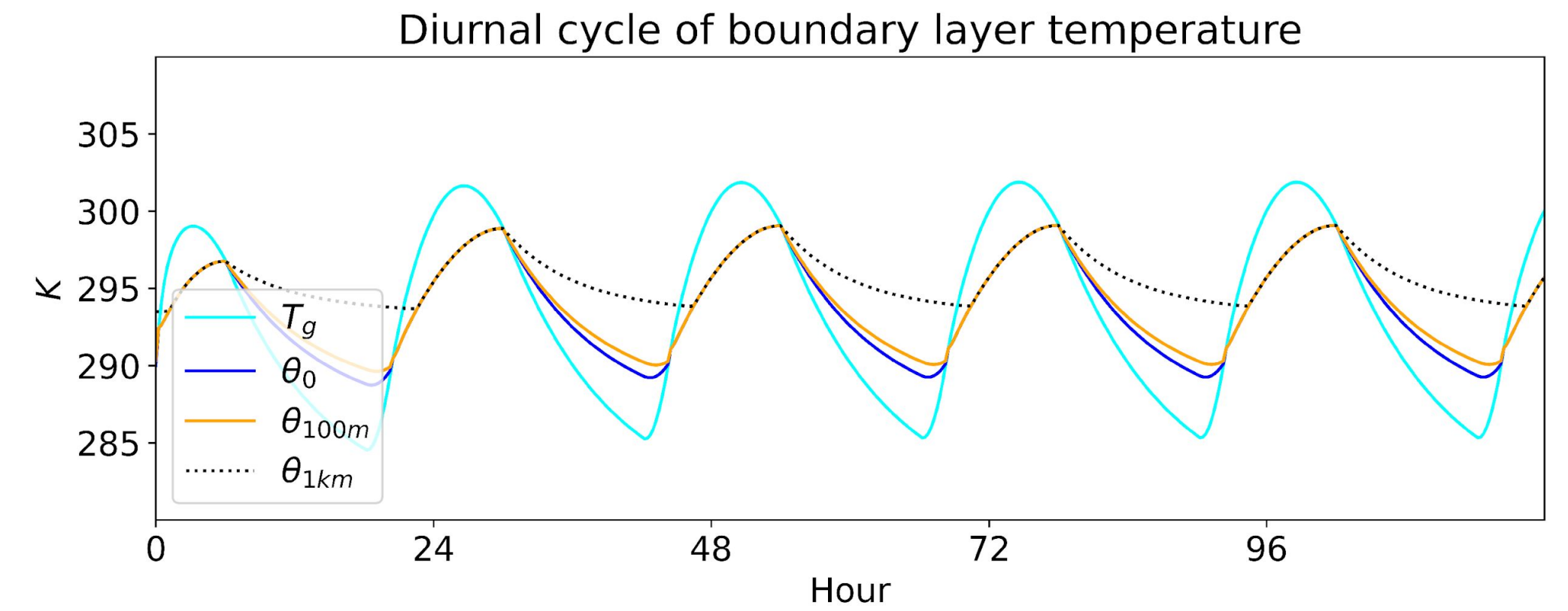
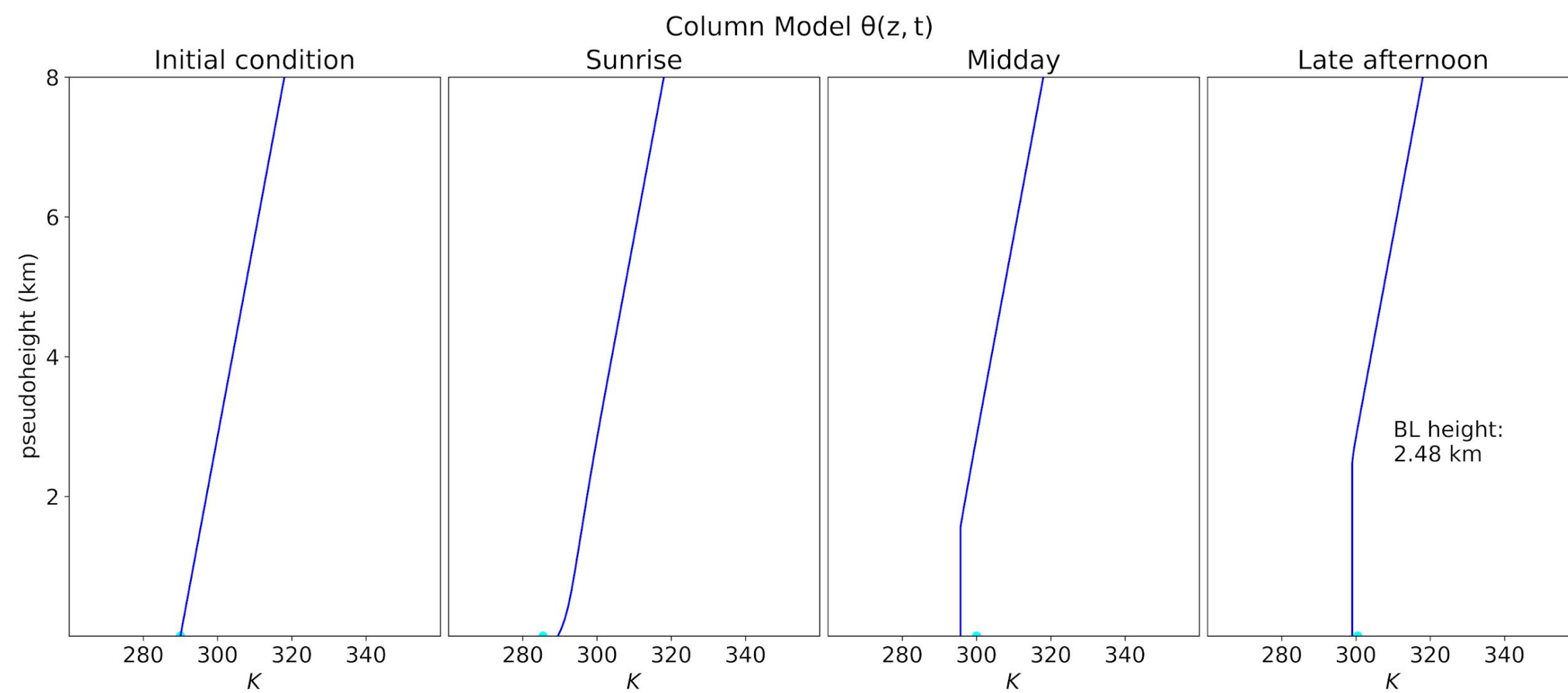


# Encroachment | Thought Experiment

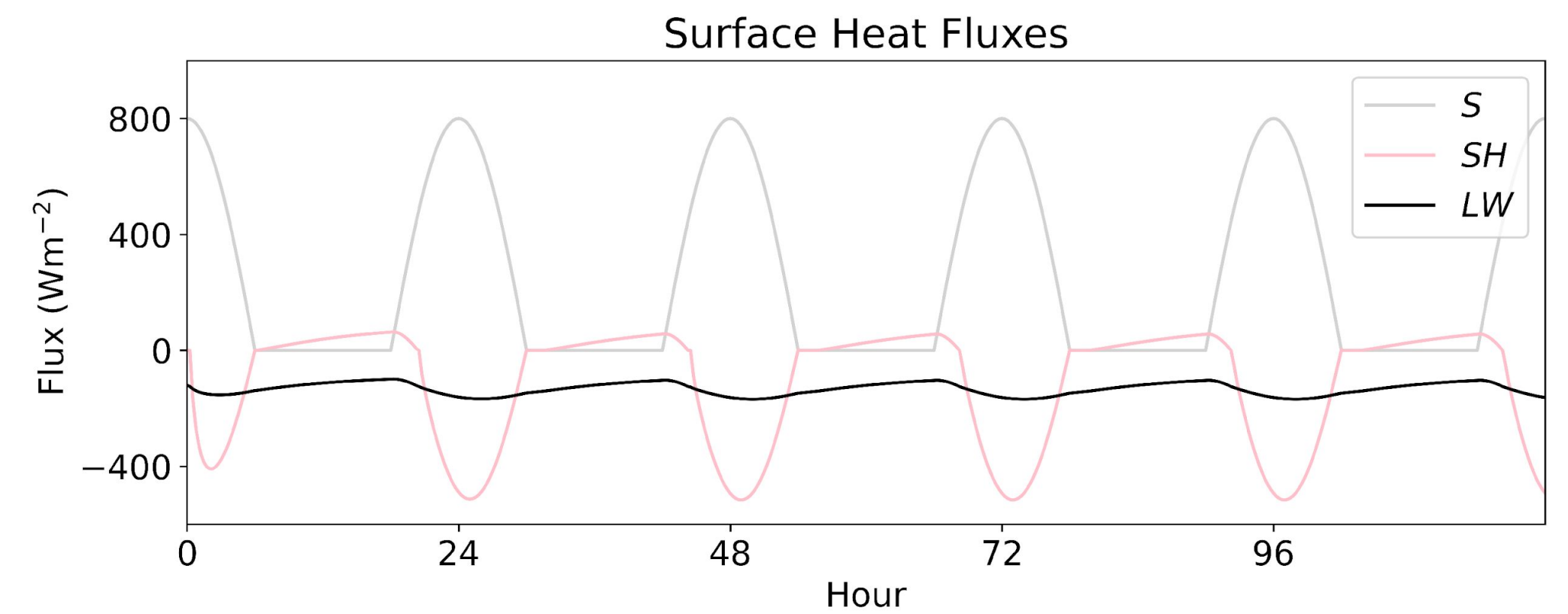
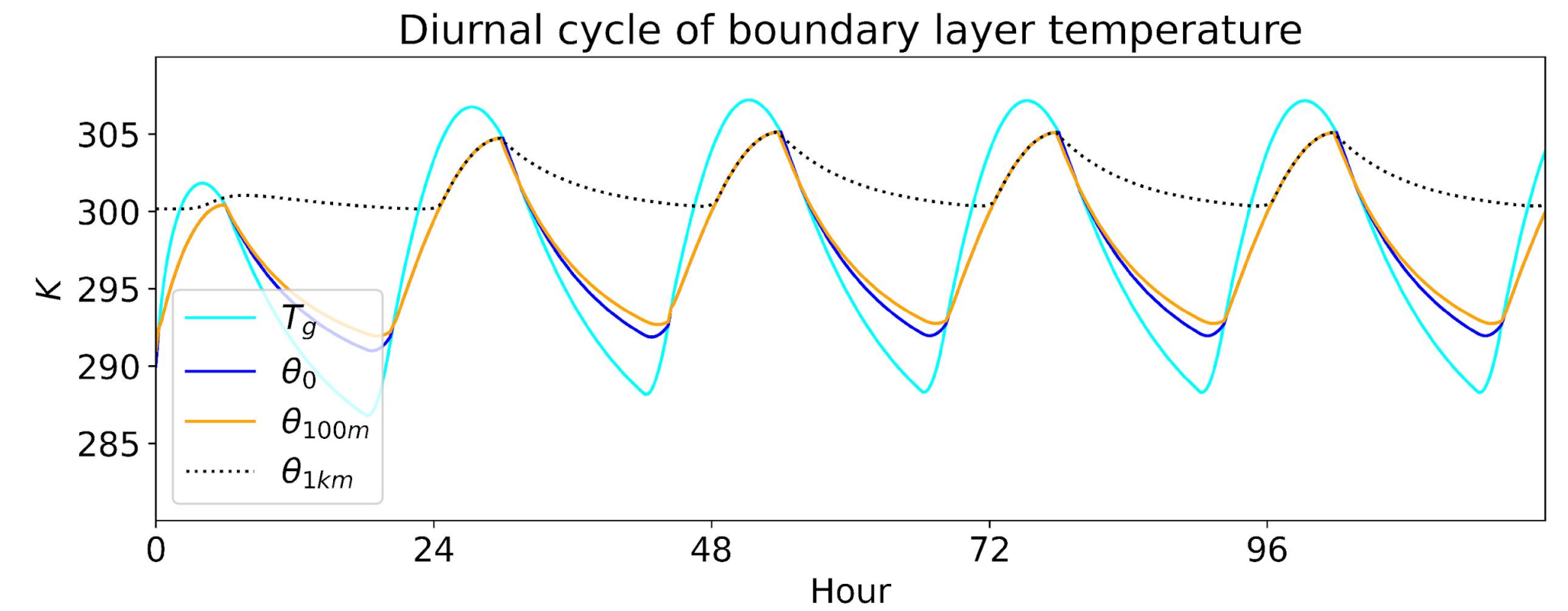
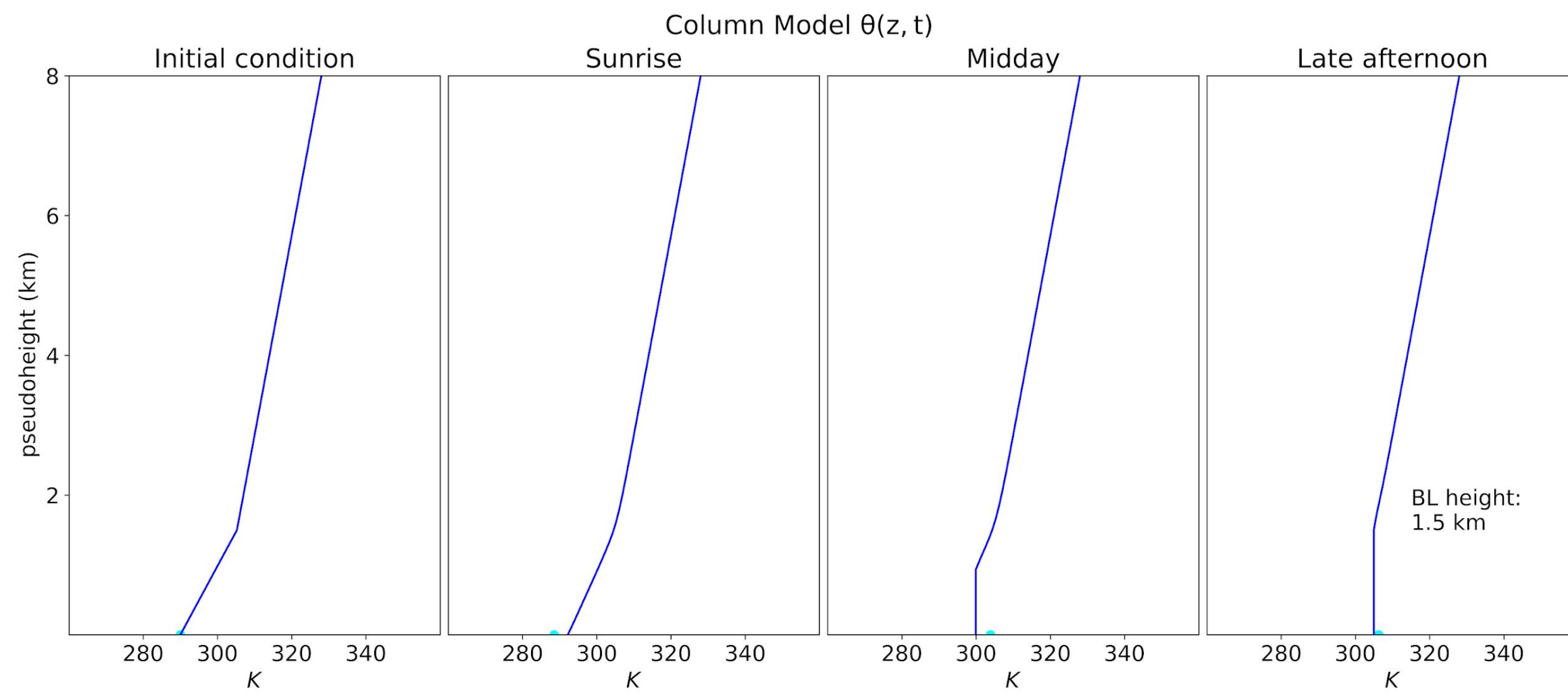


# Encroachment | Column Model

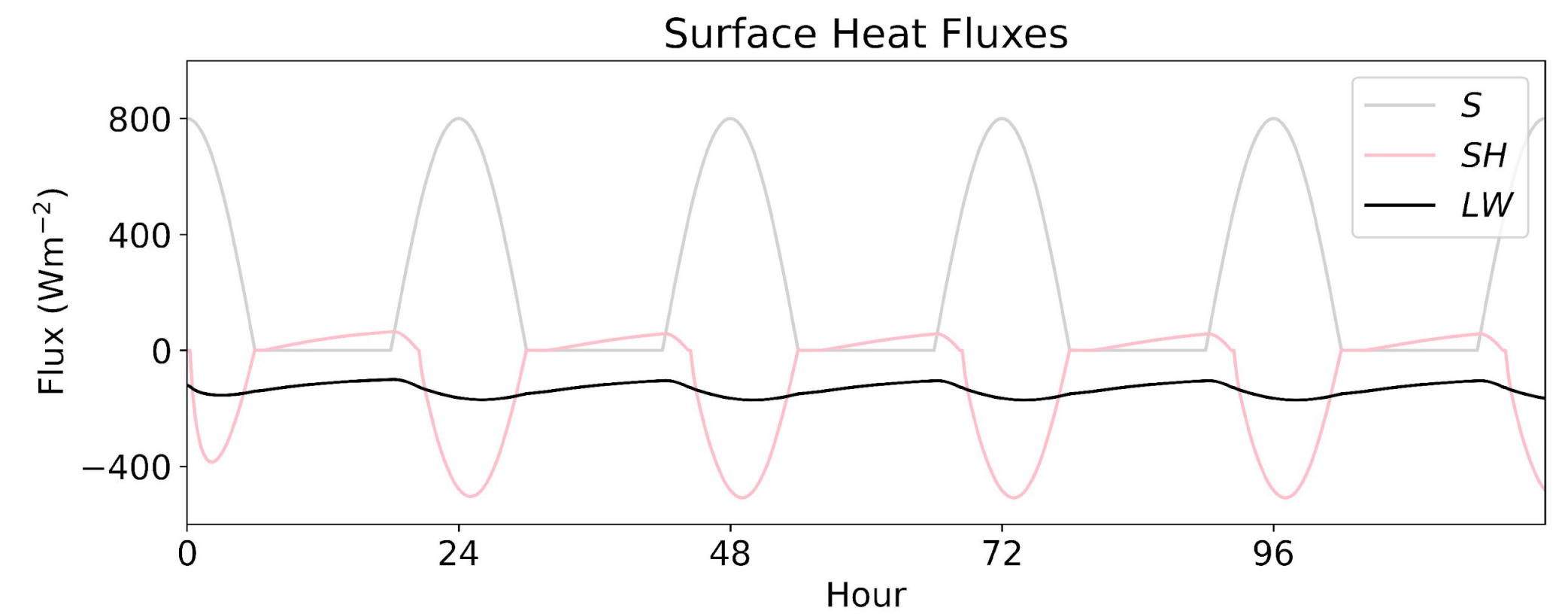
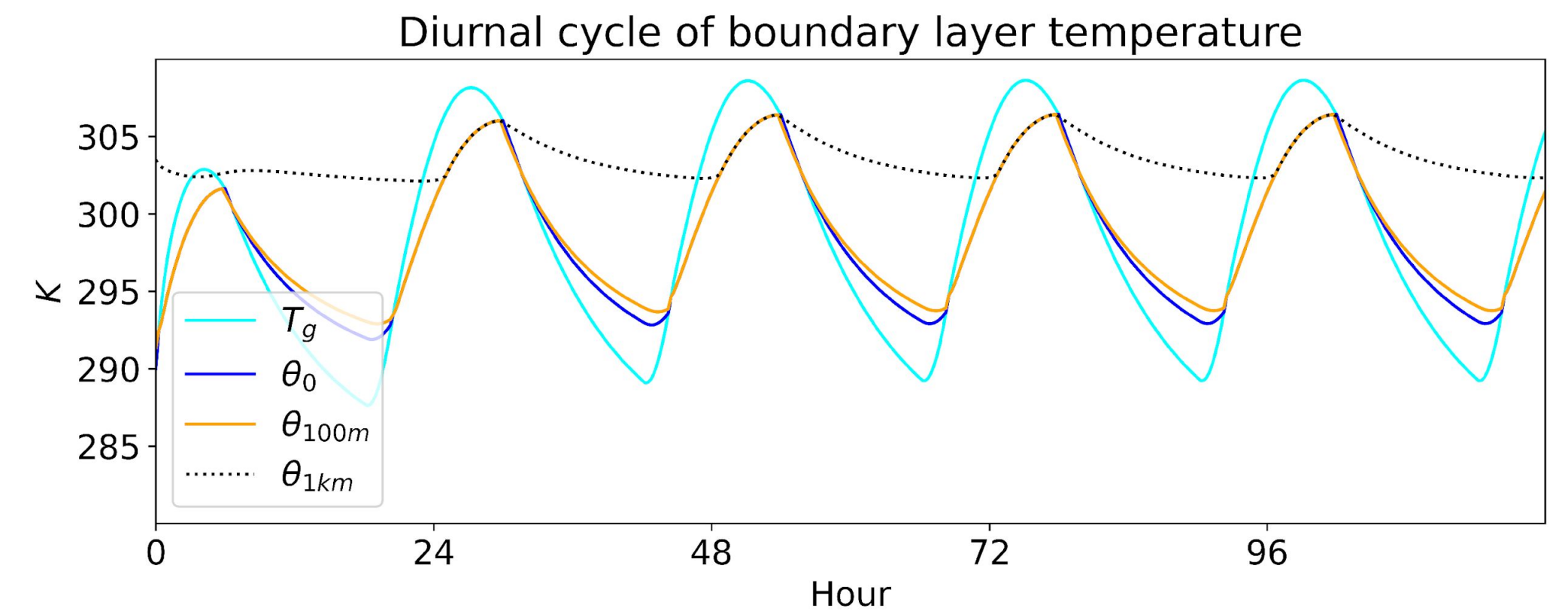
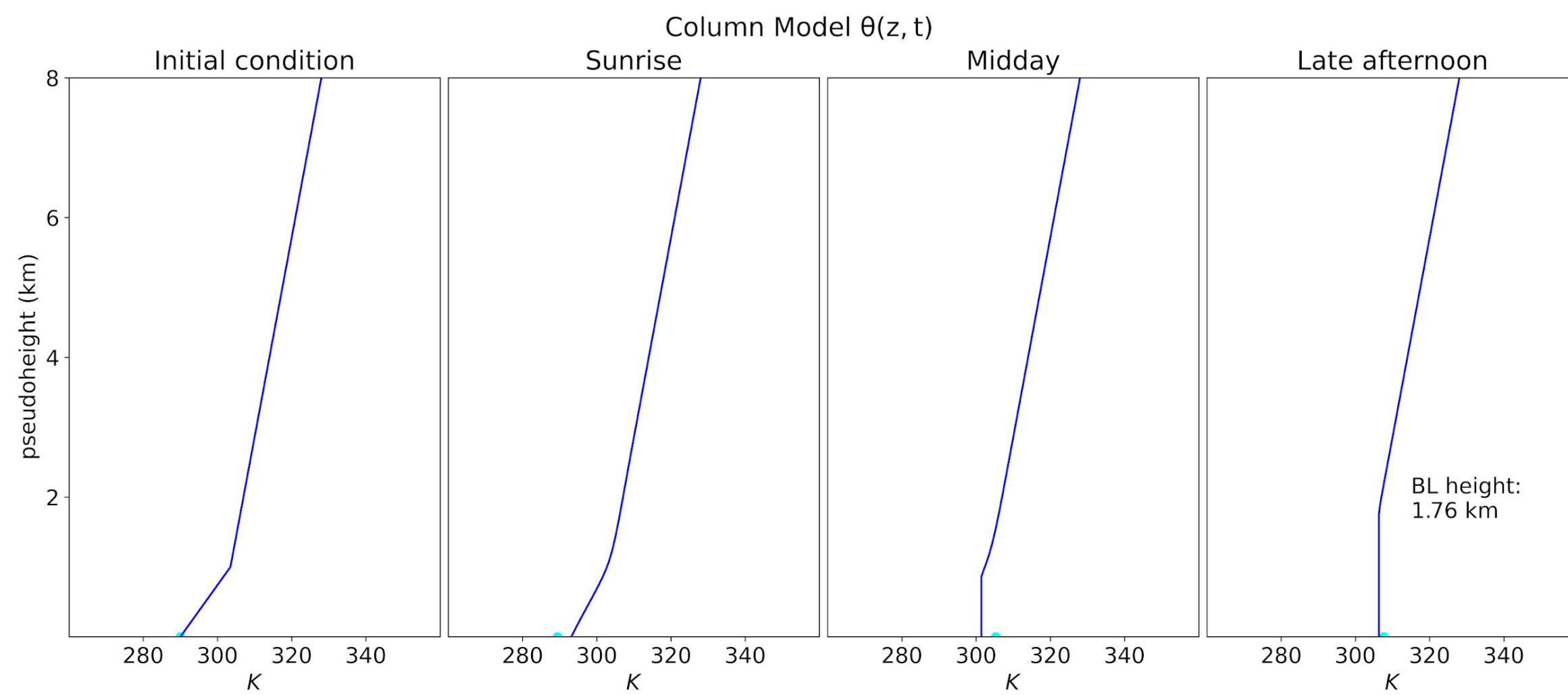
# Encroachment | Column Model



# Encroachment | Column Model



# Encroachment | Column Model





# Summary

- Extreme heat waves in the midlatitudes are linked to anomalies in the upper level jet.
- We expect warming aloft to influence surface extremes by influencing the convective boundary layer.
- Future modeling work will investigate the role of top-down warming in the presence of processes such as cooling overnight and changes to the ground layer.