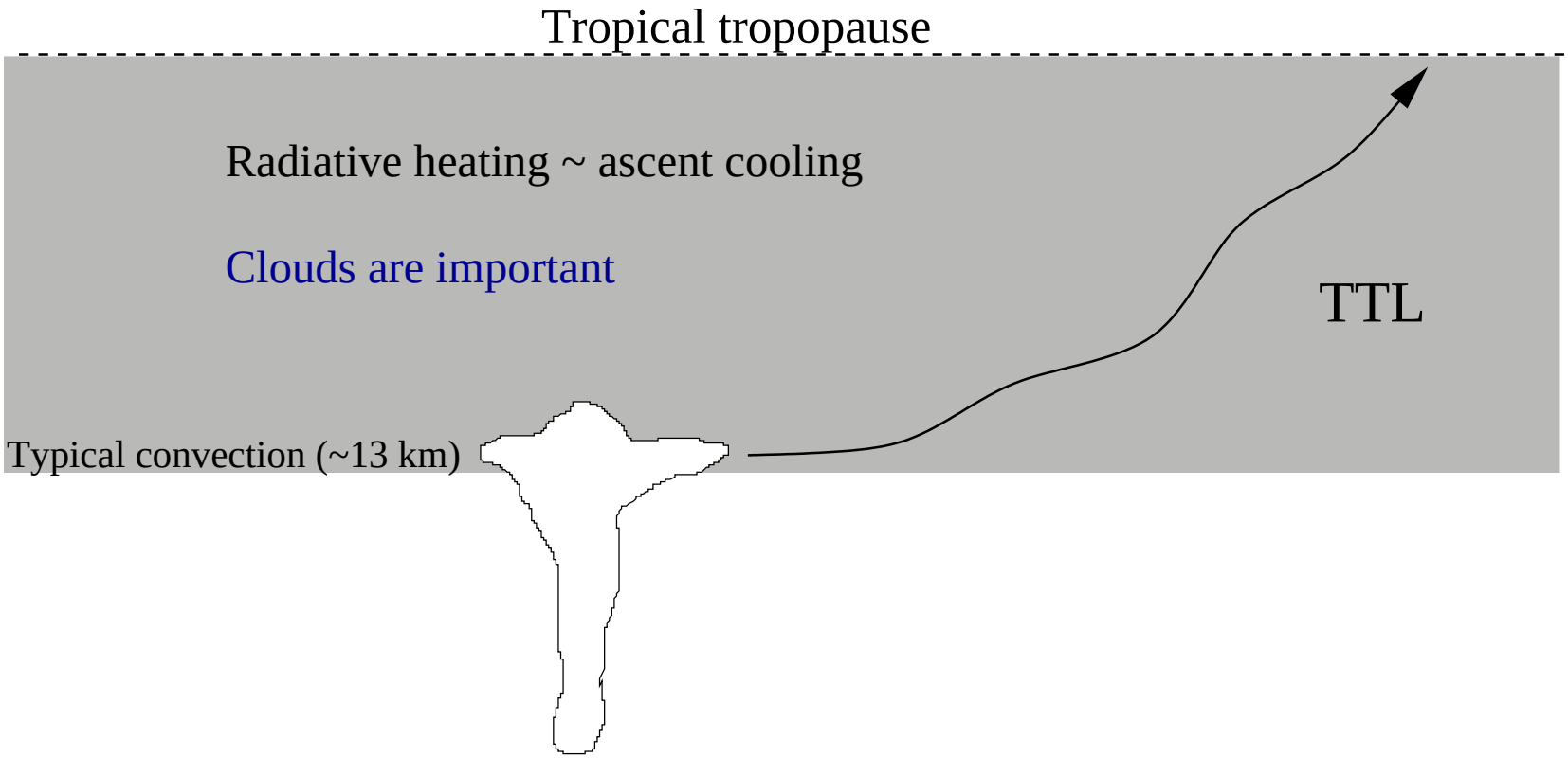
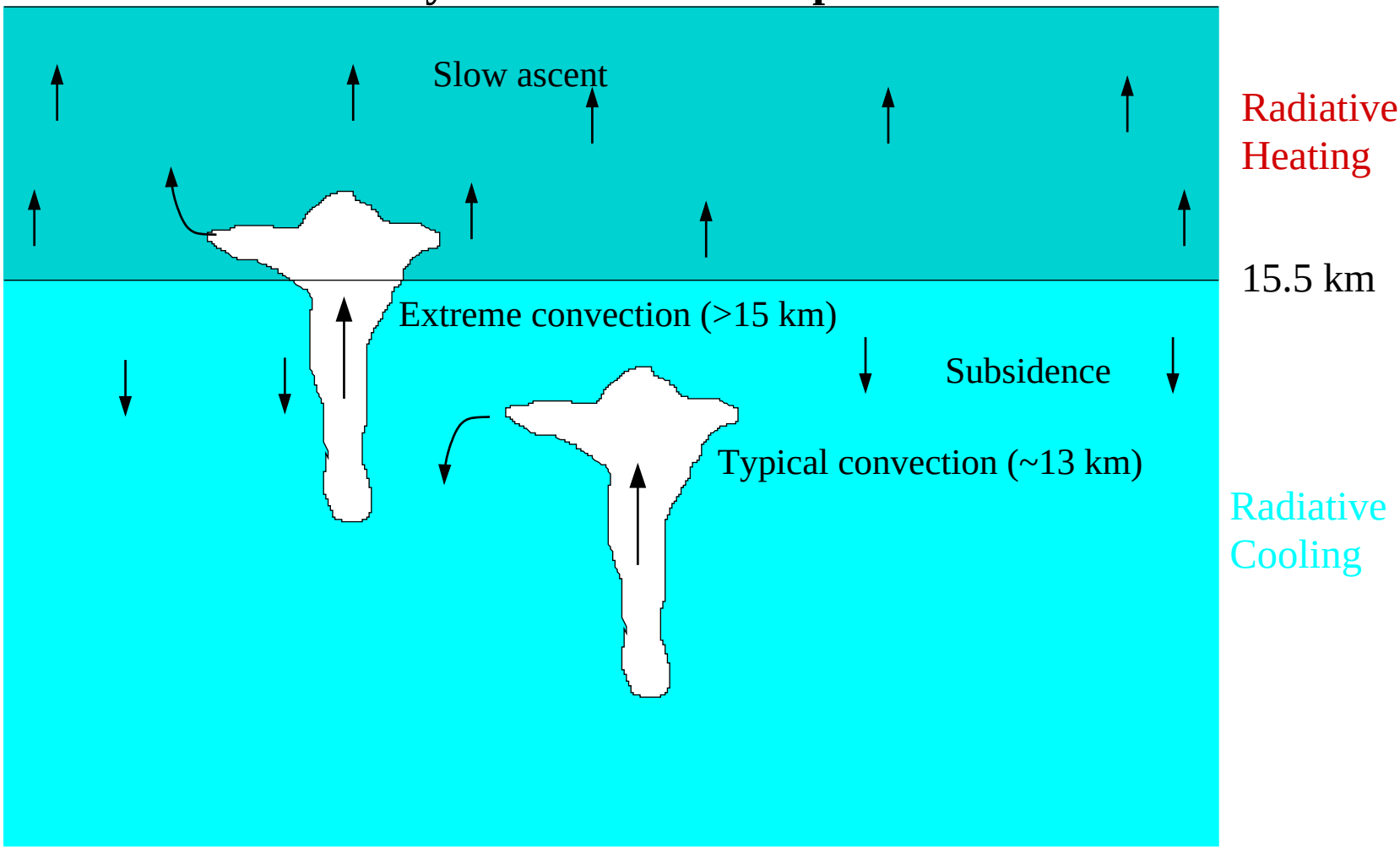
Diagnosing Vertical Transport Through the Tropical Tropopause Layer

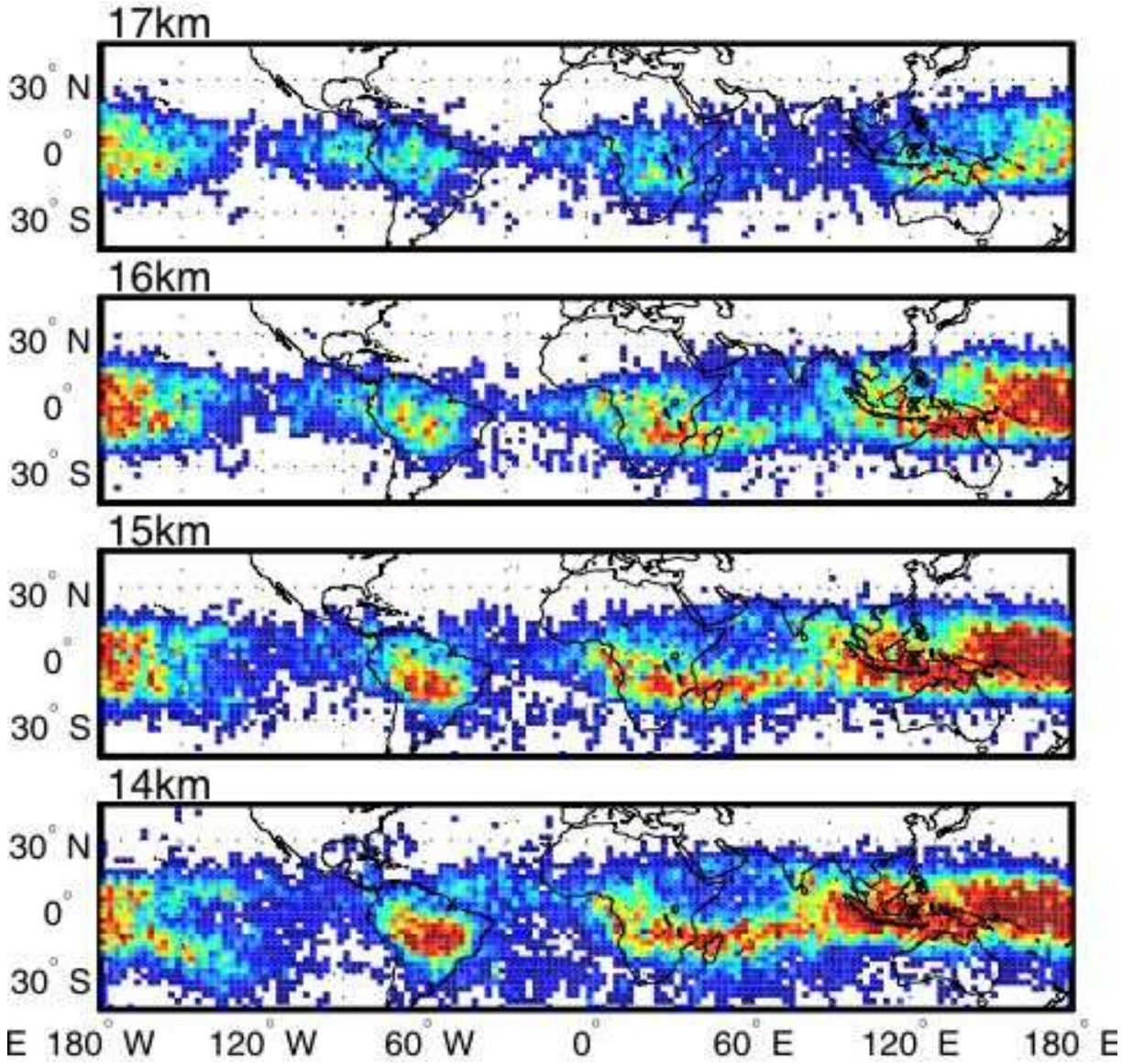


E. Jensen, L. Pfister, Q. Yang, Q. Fu, and M. Schoeberl

Clear sky view of TTL transport

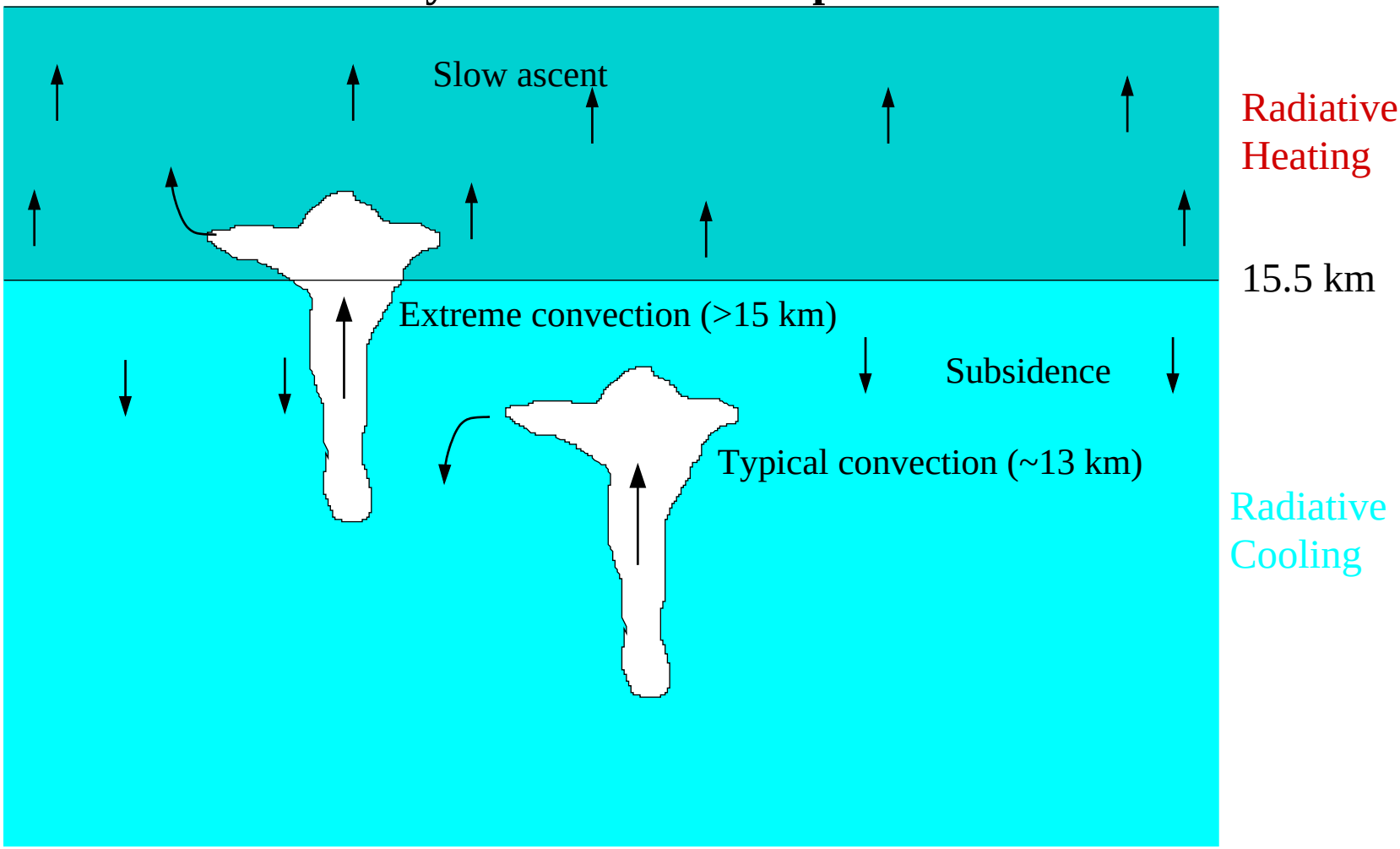


CALIPSO cloud frequencies (DJF)

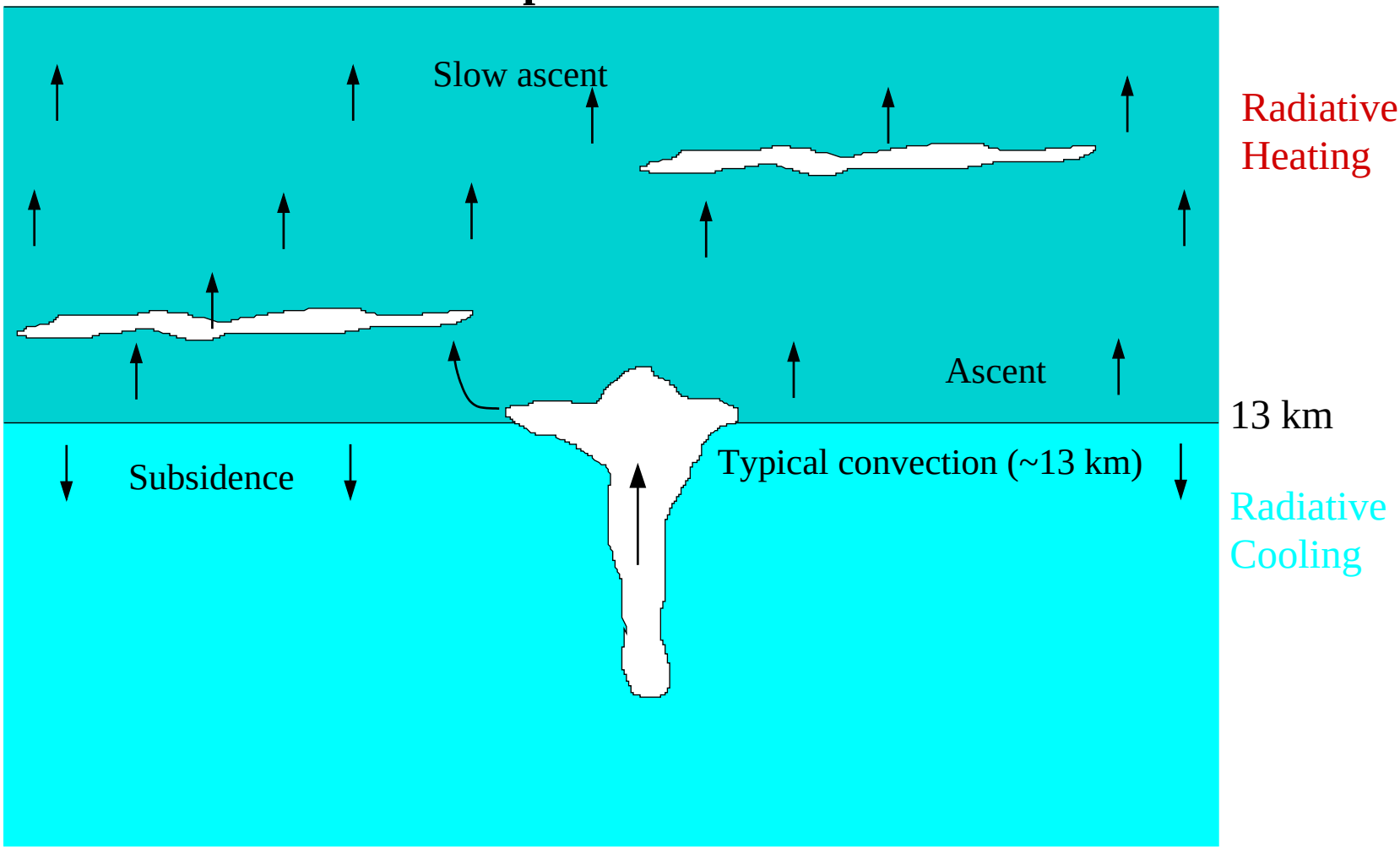


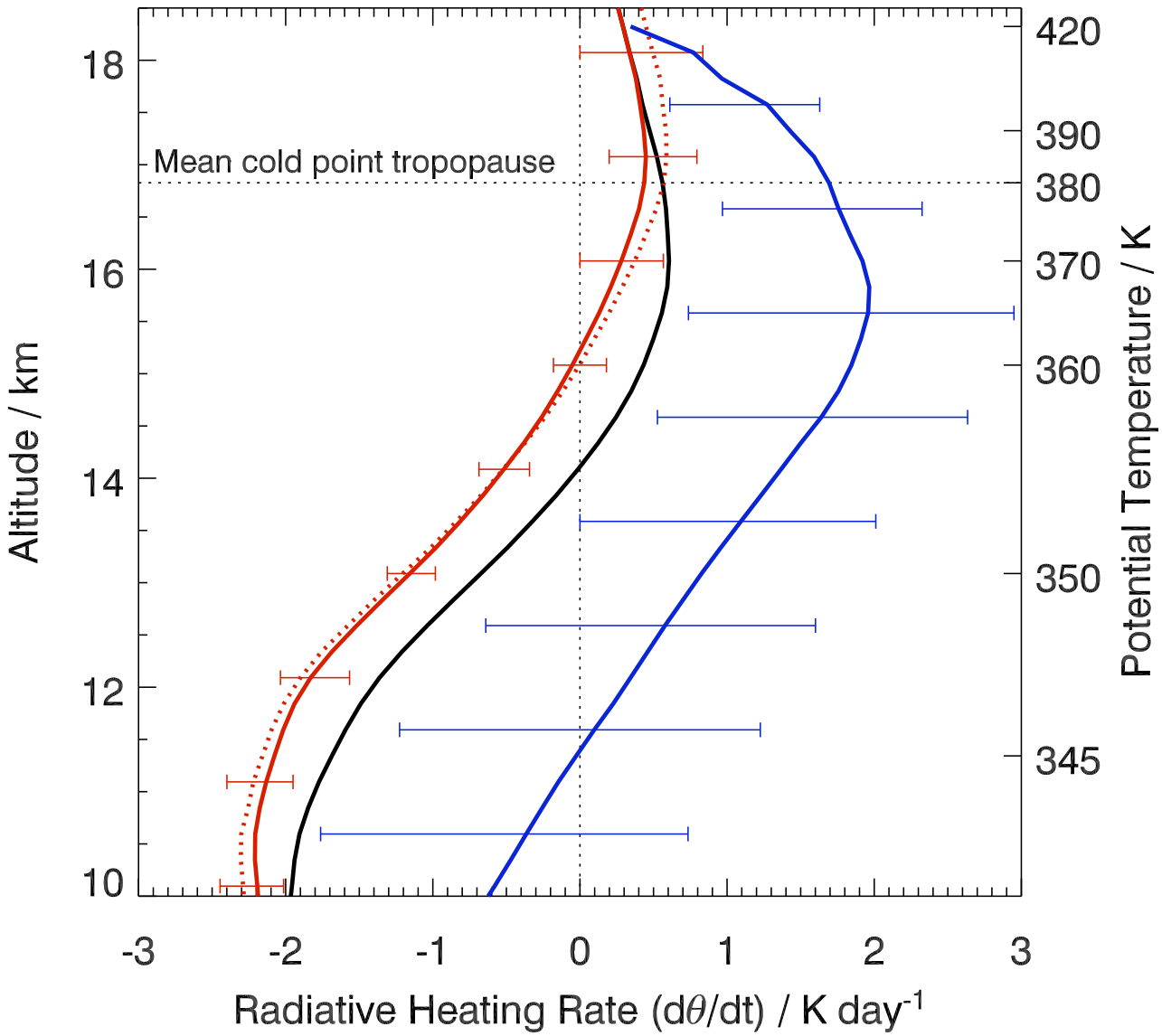
Yang et al. [2009]

Clear sky view of TTL transport



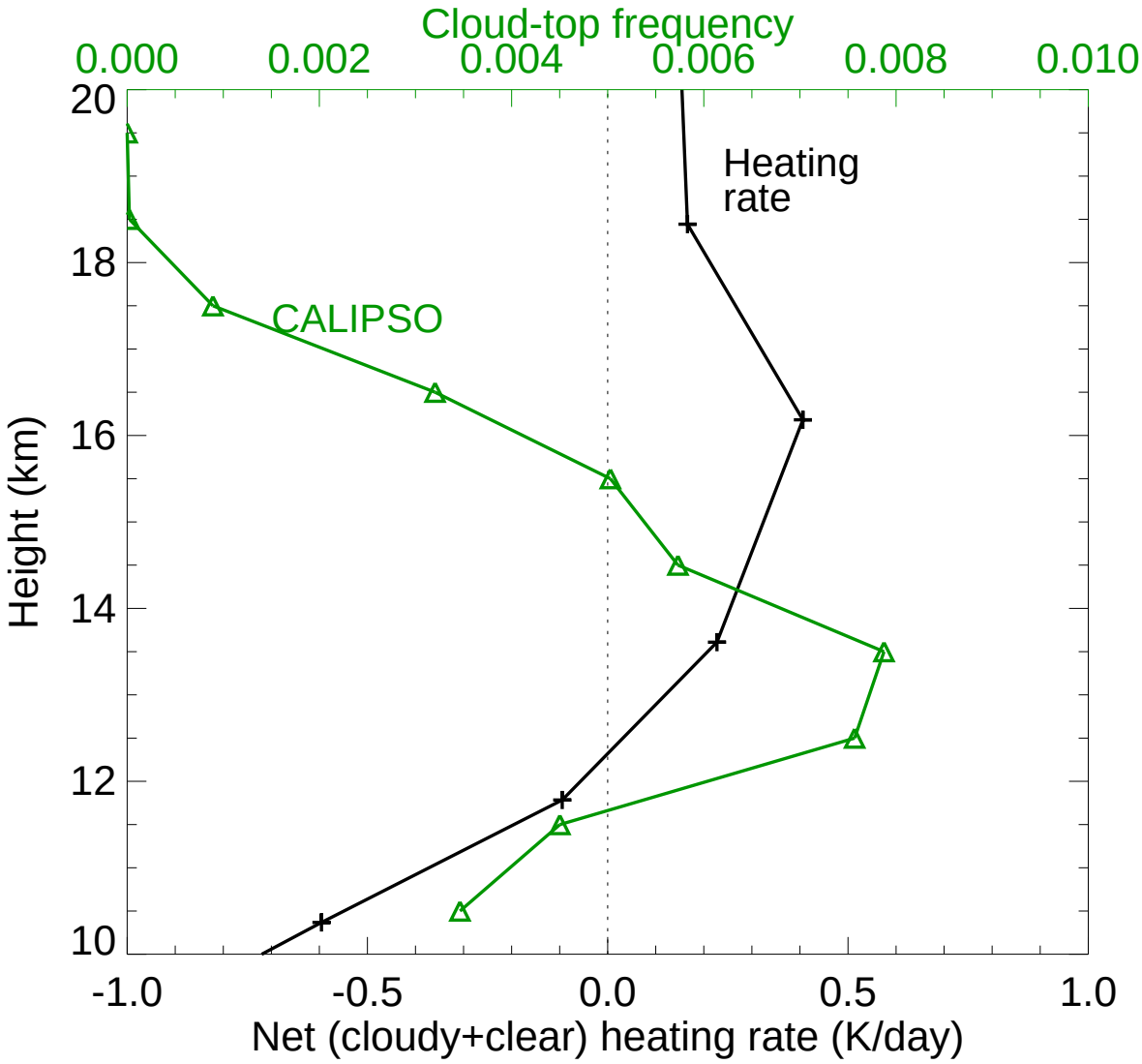
TTL transport with clouds



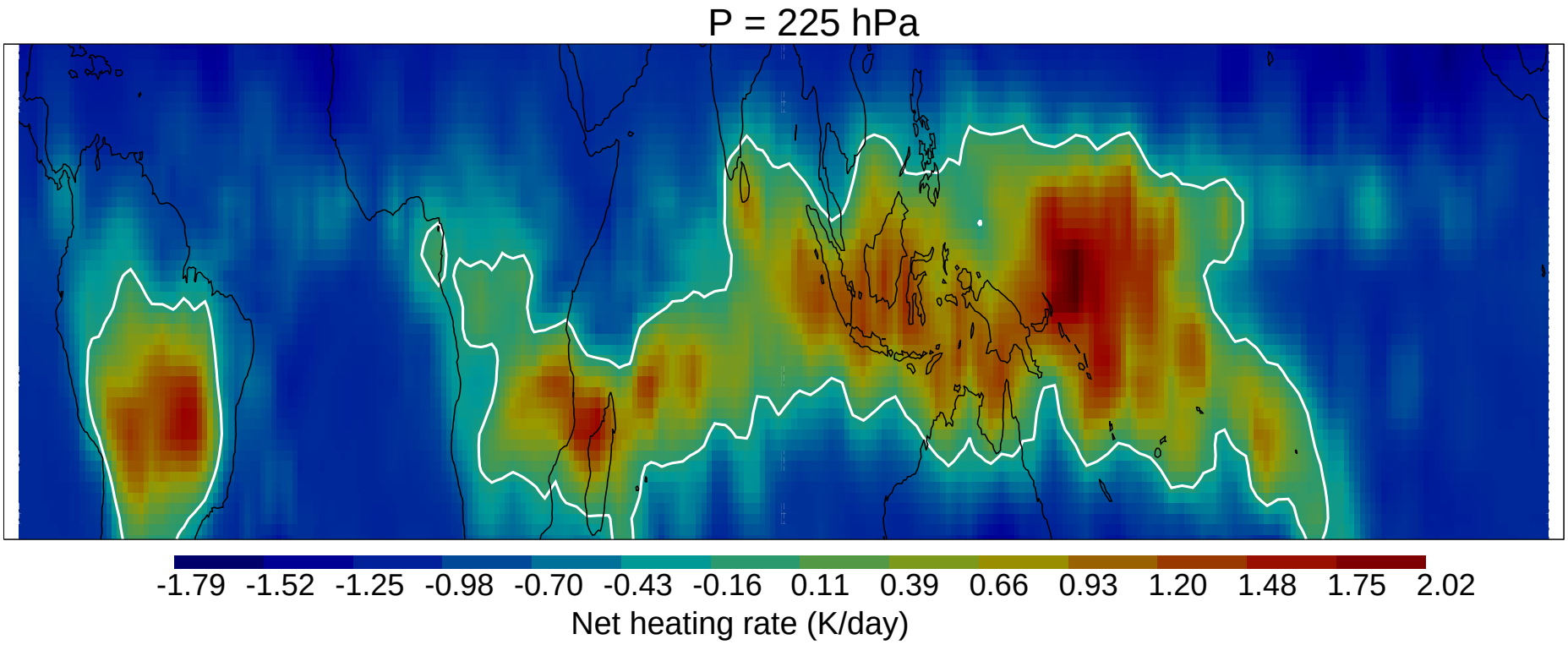


Corti et al. [2006]

Q. Yang and Q. Fu heating rate calculations



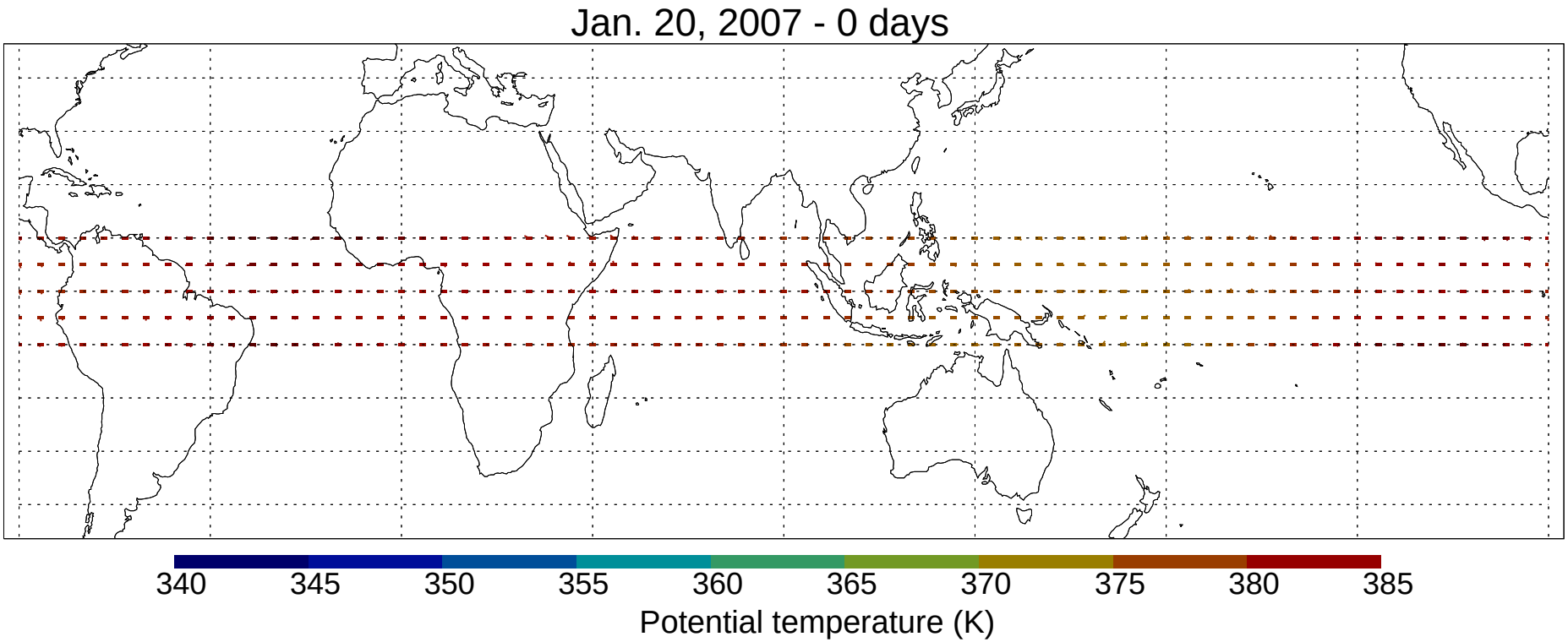
Q. Yang and Q. Fu heating rate calculations



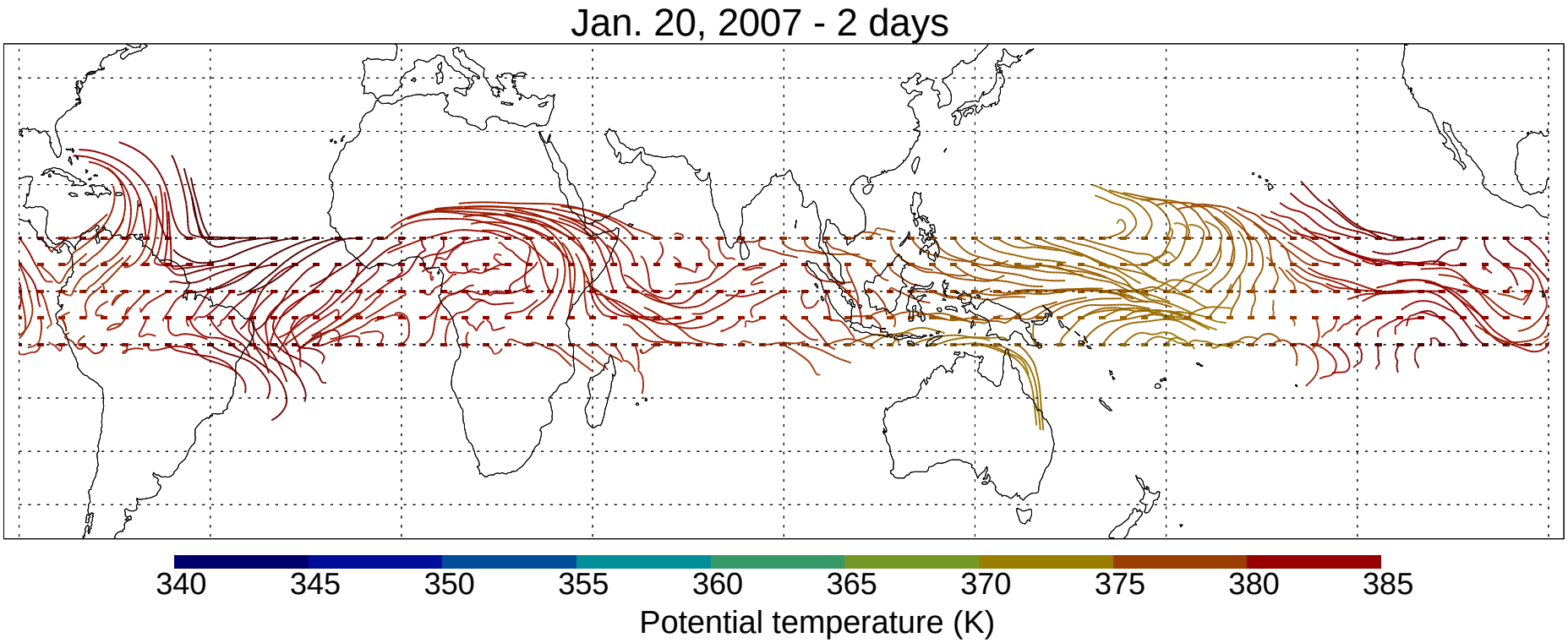
Science questions:

- What convective outflow altitudes contribute most to air entering the stratosphere?
- In what geographic regions do these convective events occur?
- What is the fate of parcels detrained at the peak detraiment level (12-13 km)?

Back trajectories from tropical tropopause



Back trajectories from tropical tropopause



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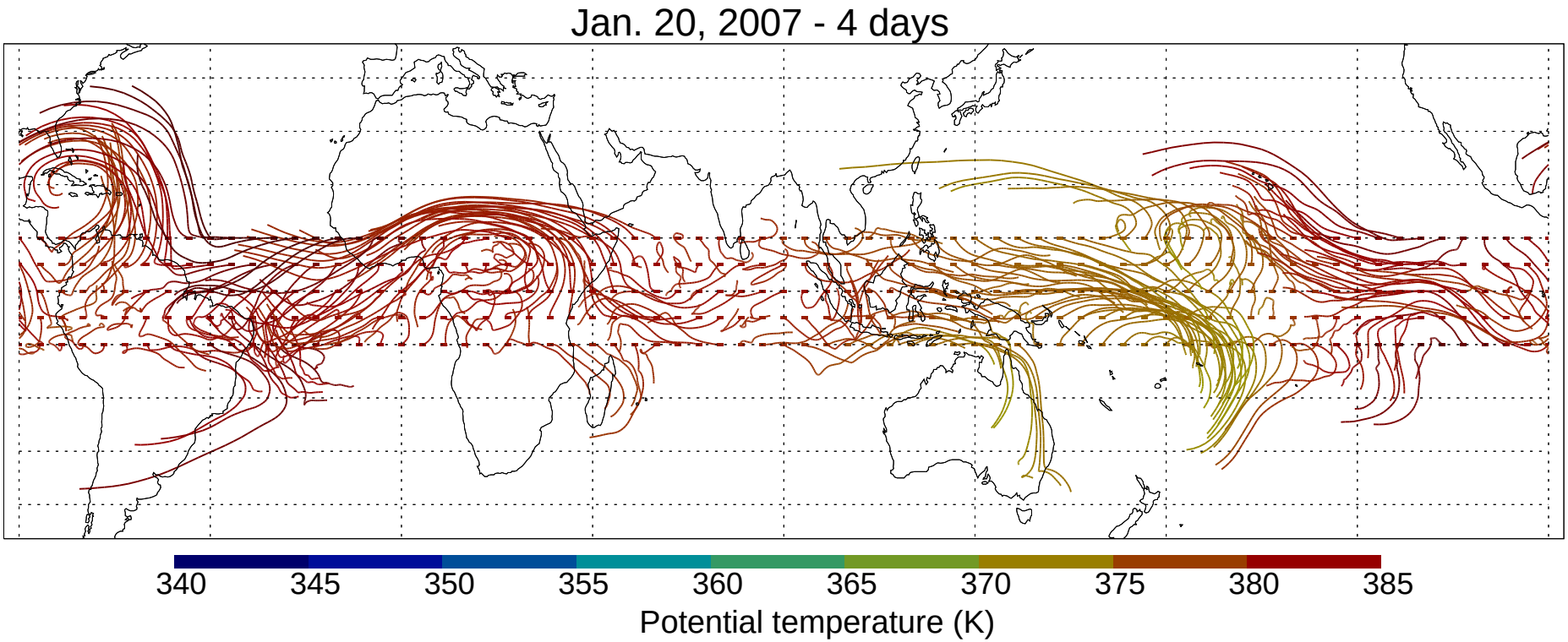

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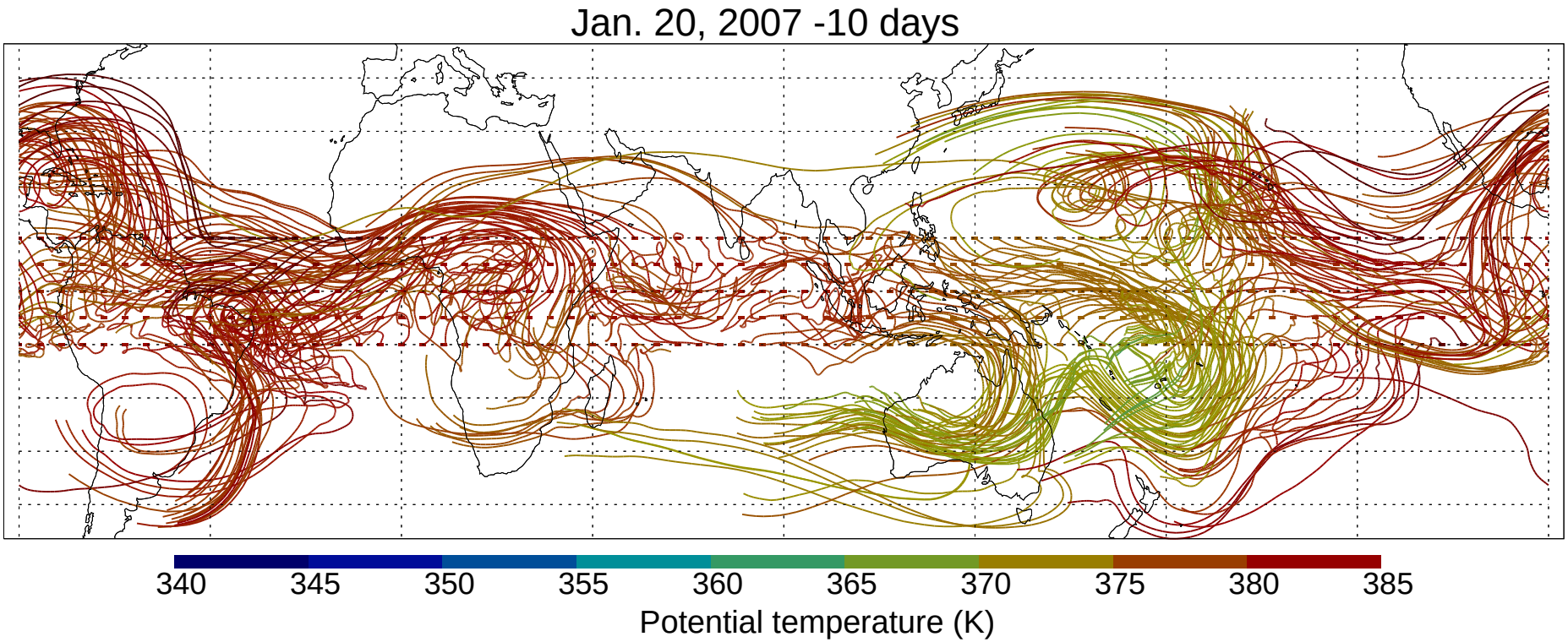
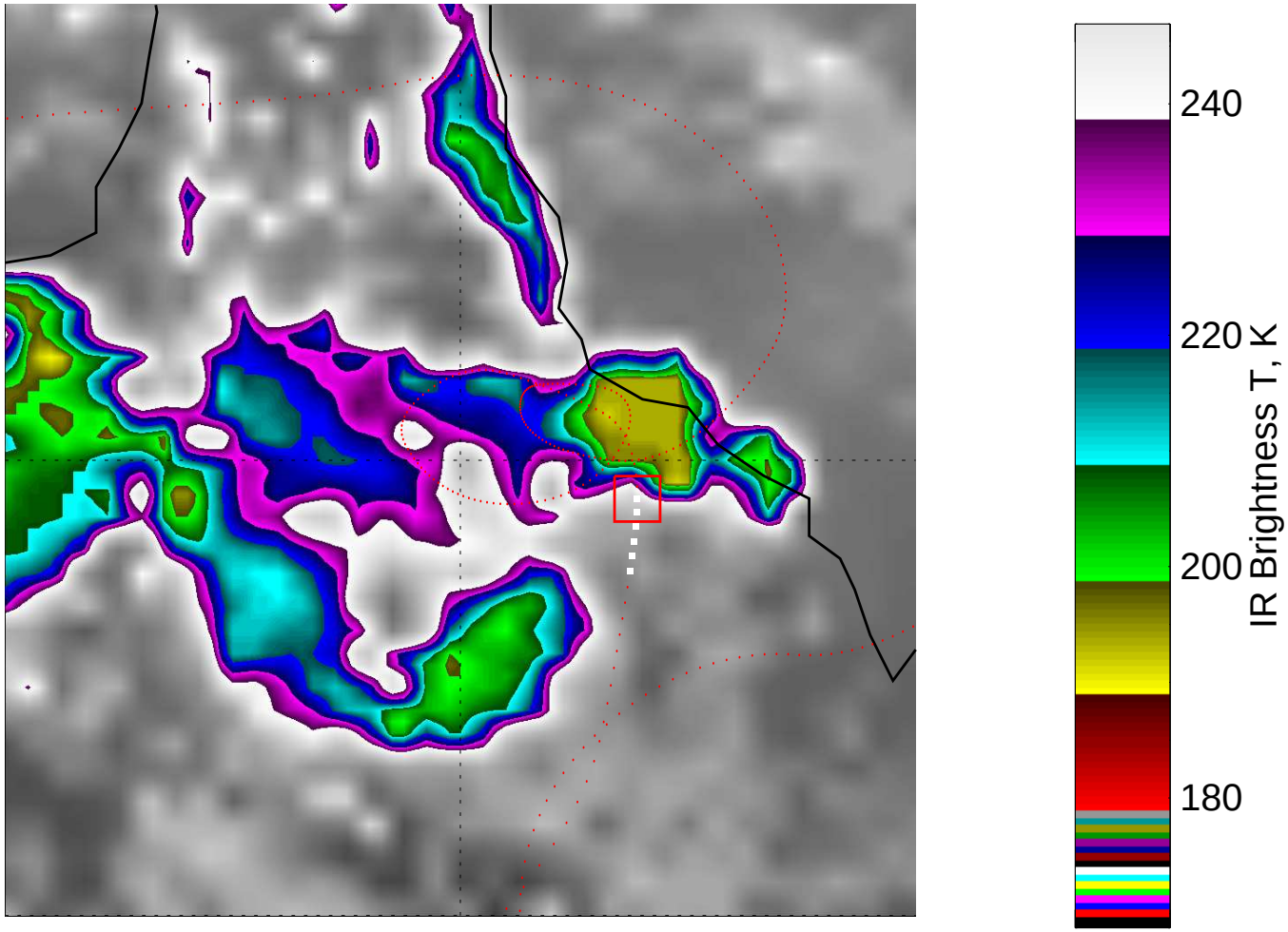


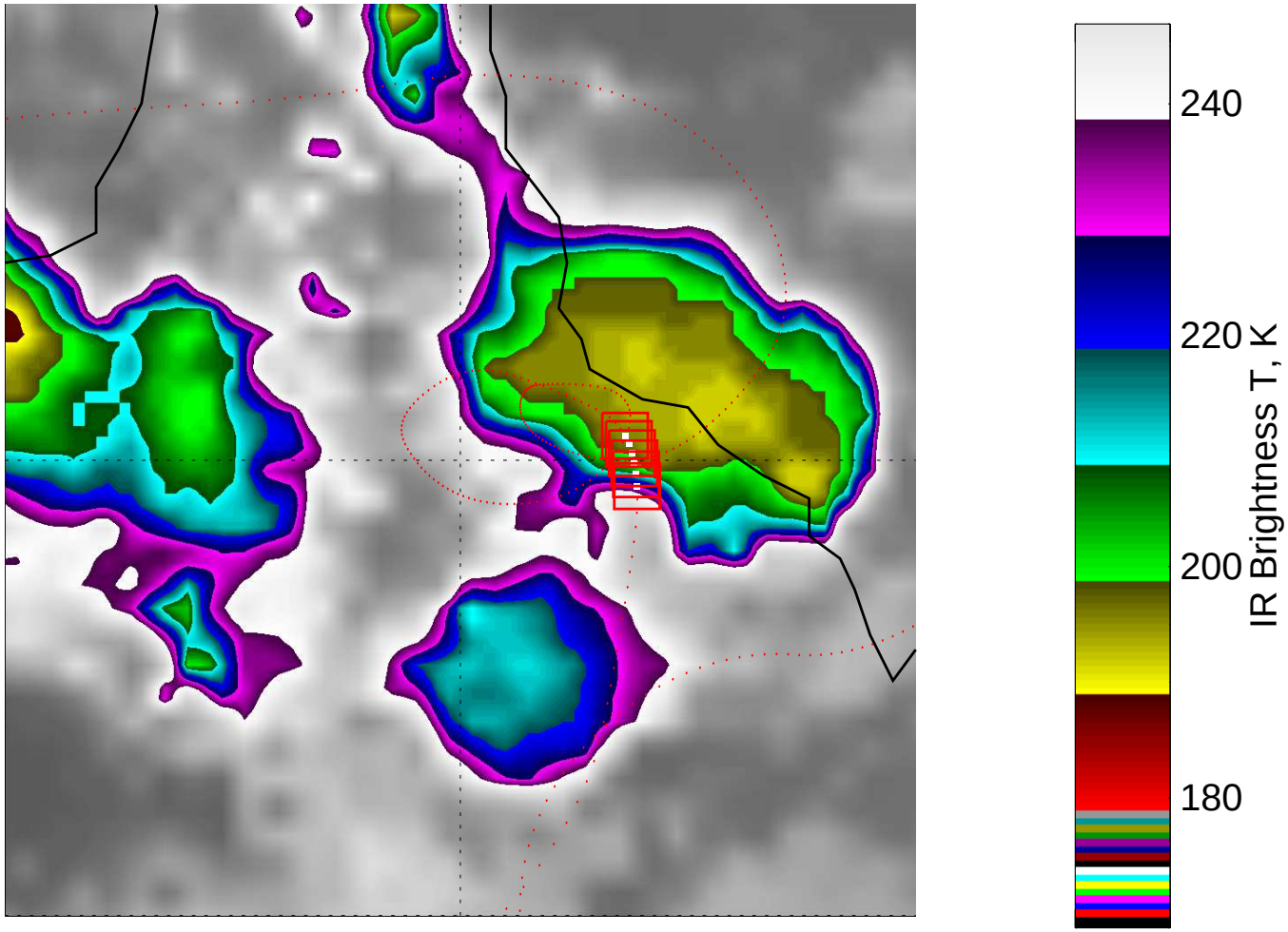
Pfister convective influence analysis

ISCCP IR Image at 199512220600



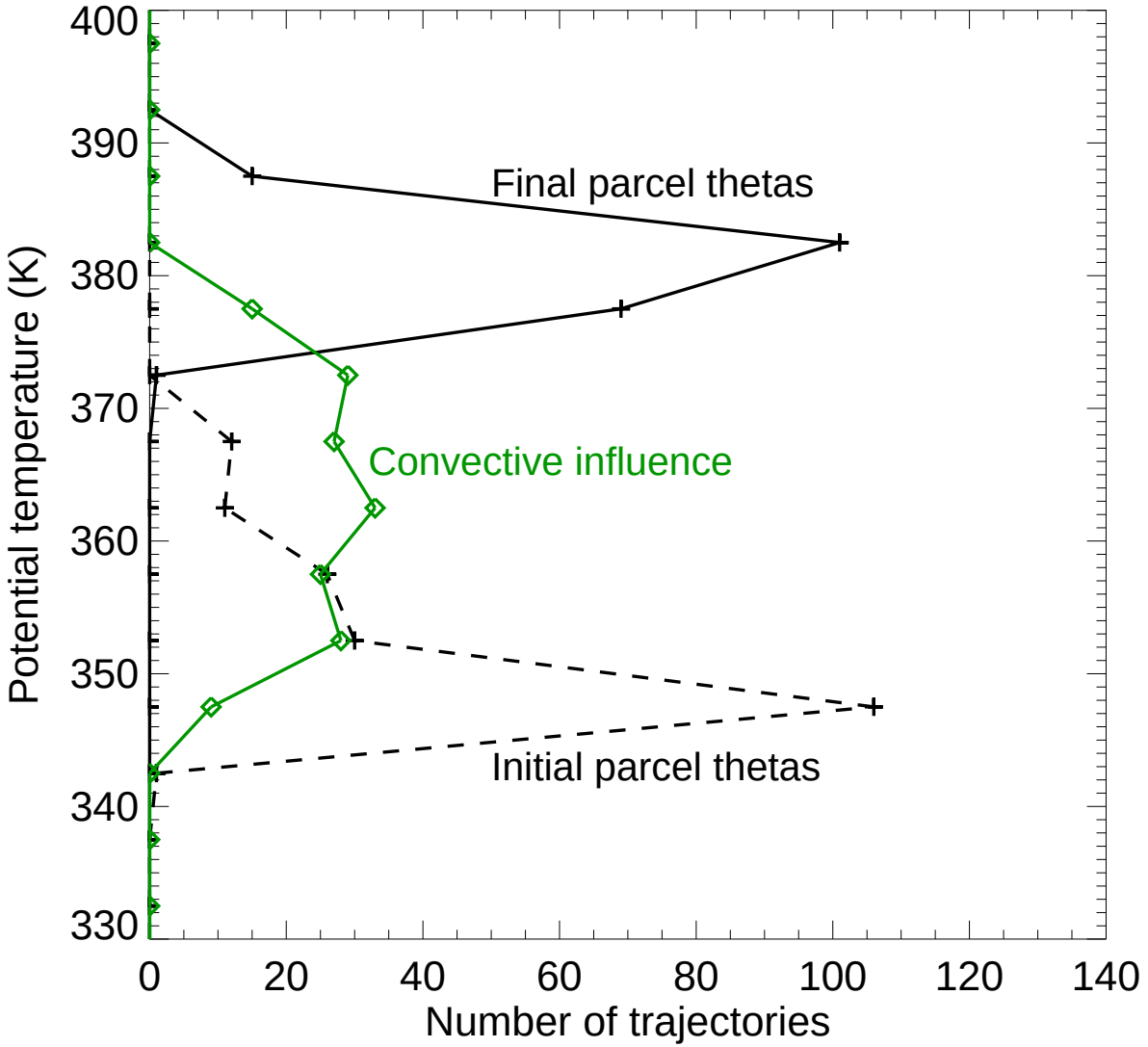
Pfister convective influence analysis

ISCCP IR Image at 199512220900

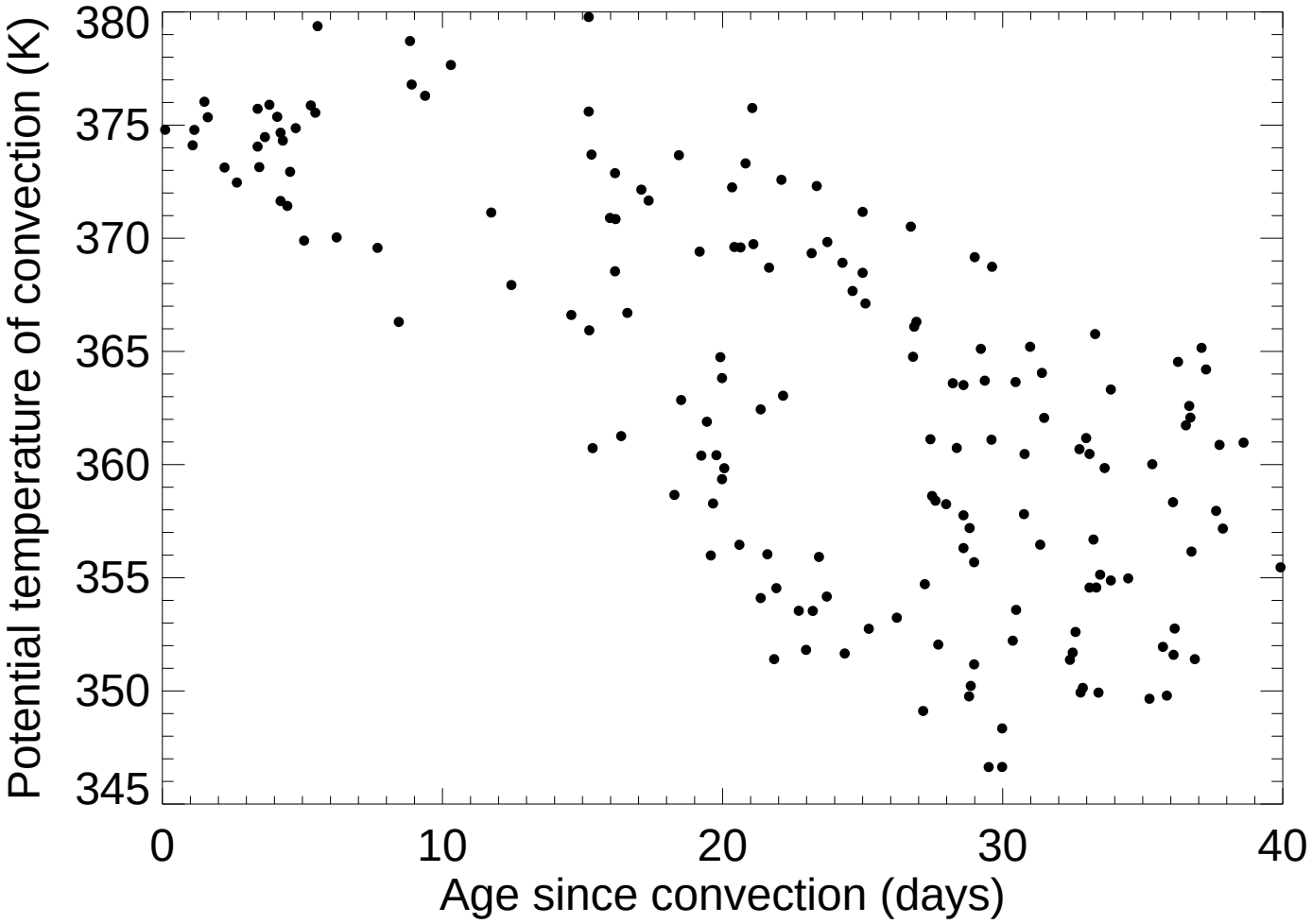


- Tuned to match CloudSat/CALIPSO convective cloud-top statistics

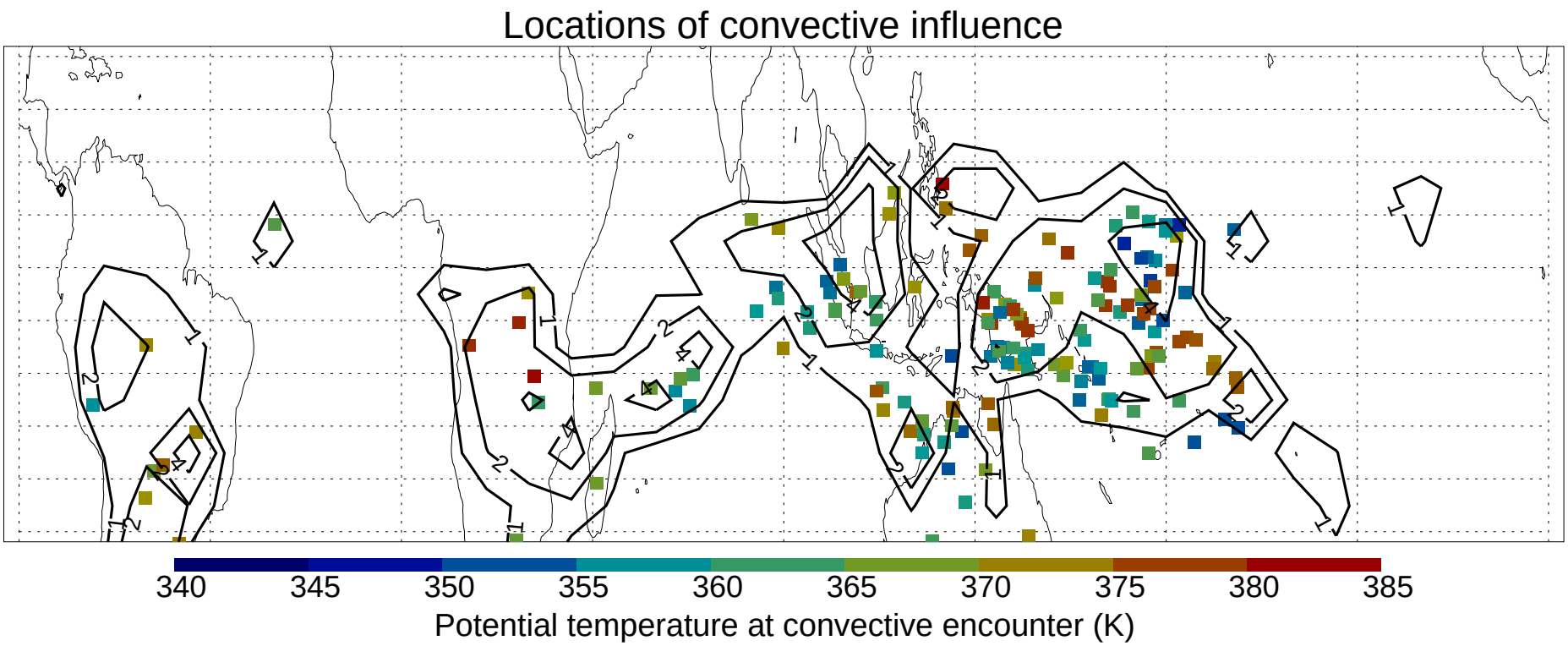
Where do back trajectories hit convection?

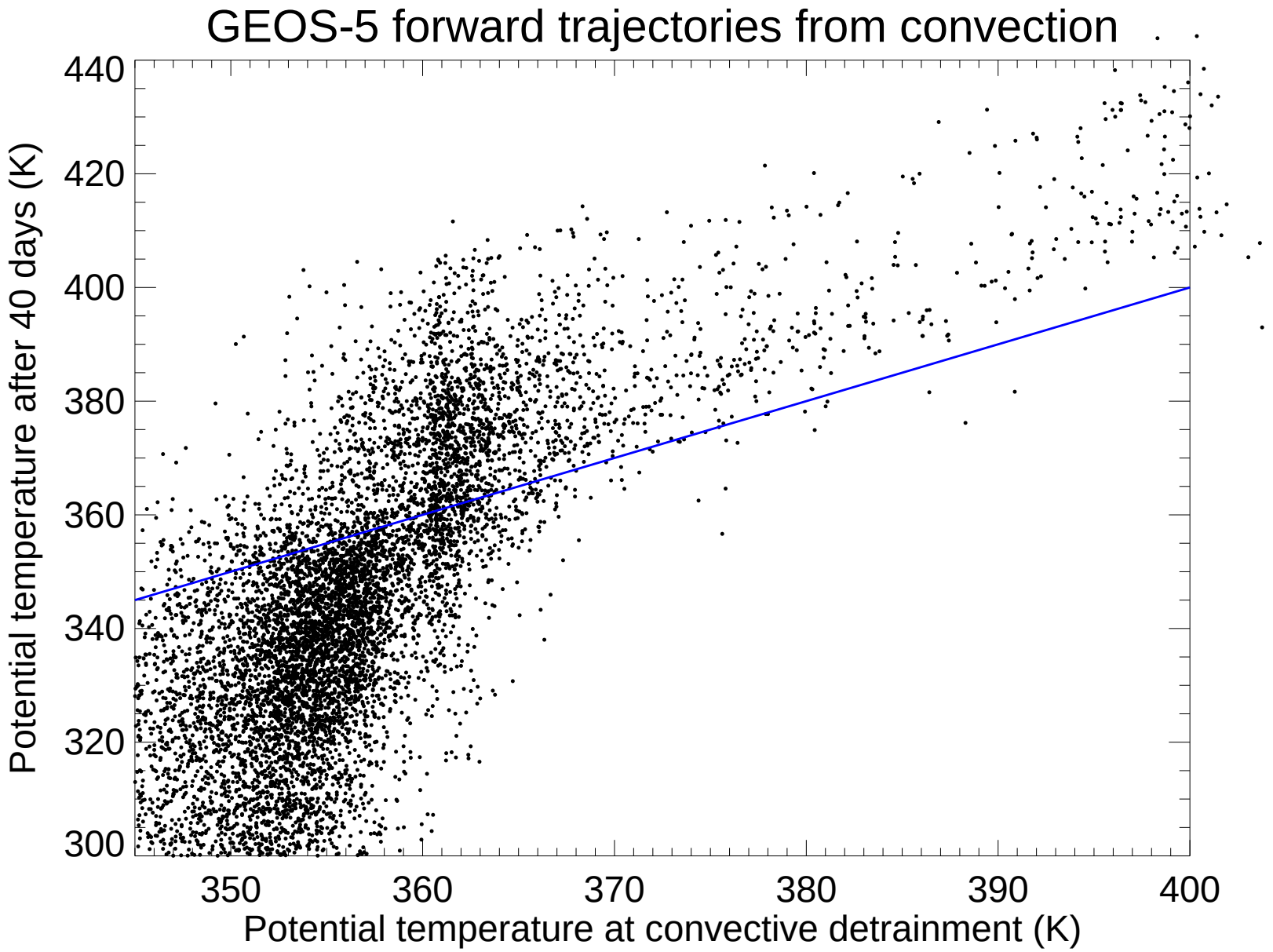


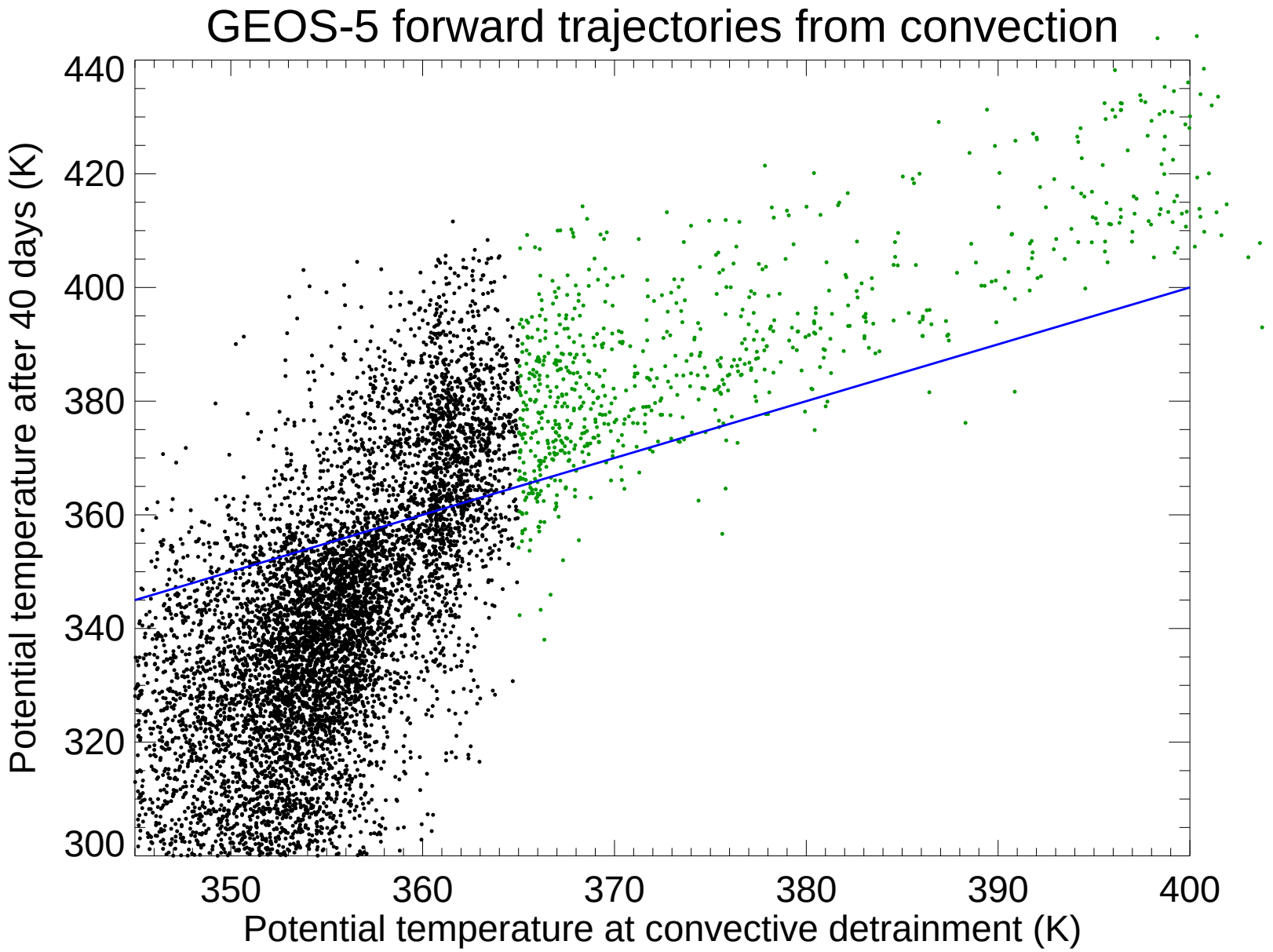
Age since most recent convective influence



Where do trajectories hit convection?




GEOS-5 forward trajectories from convection
Potential temperature after 40 days (K)
440
420
400
380
360
340
320
300
350
360
370
380
390
400
Potential temperature at convective detrainment (K)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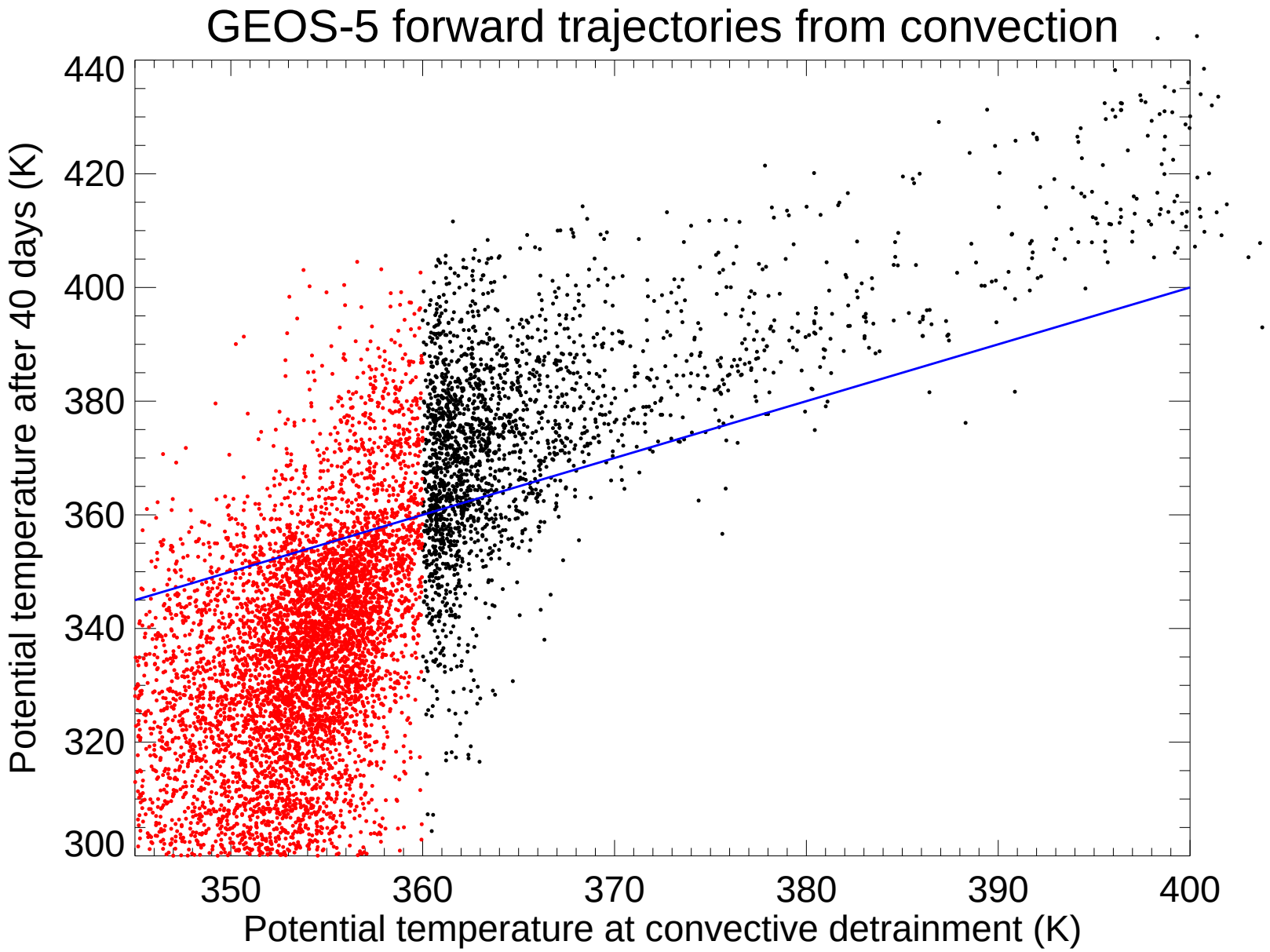

- GEOS-5 TTL transport seems to match clear-sky radiation.

Summary

- TTL cirrus have a large impact on radiative heating rates $\Rightarrow$ they are important for diagnosing transport.
- Detrainment from a broad range of convective outflow levels (including the main convective outflow level (12–13 km)) may affect stratospheric composition

Next steps...

- Directly compare heating rates in models with Yang and Fu calculations
- Repeat for Boreal summer