CA4

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1. Given the sounding, please plot the vertical profiles of dry static energy, discuss the vertical structure, and compare it to the potential temperature.

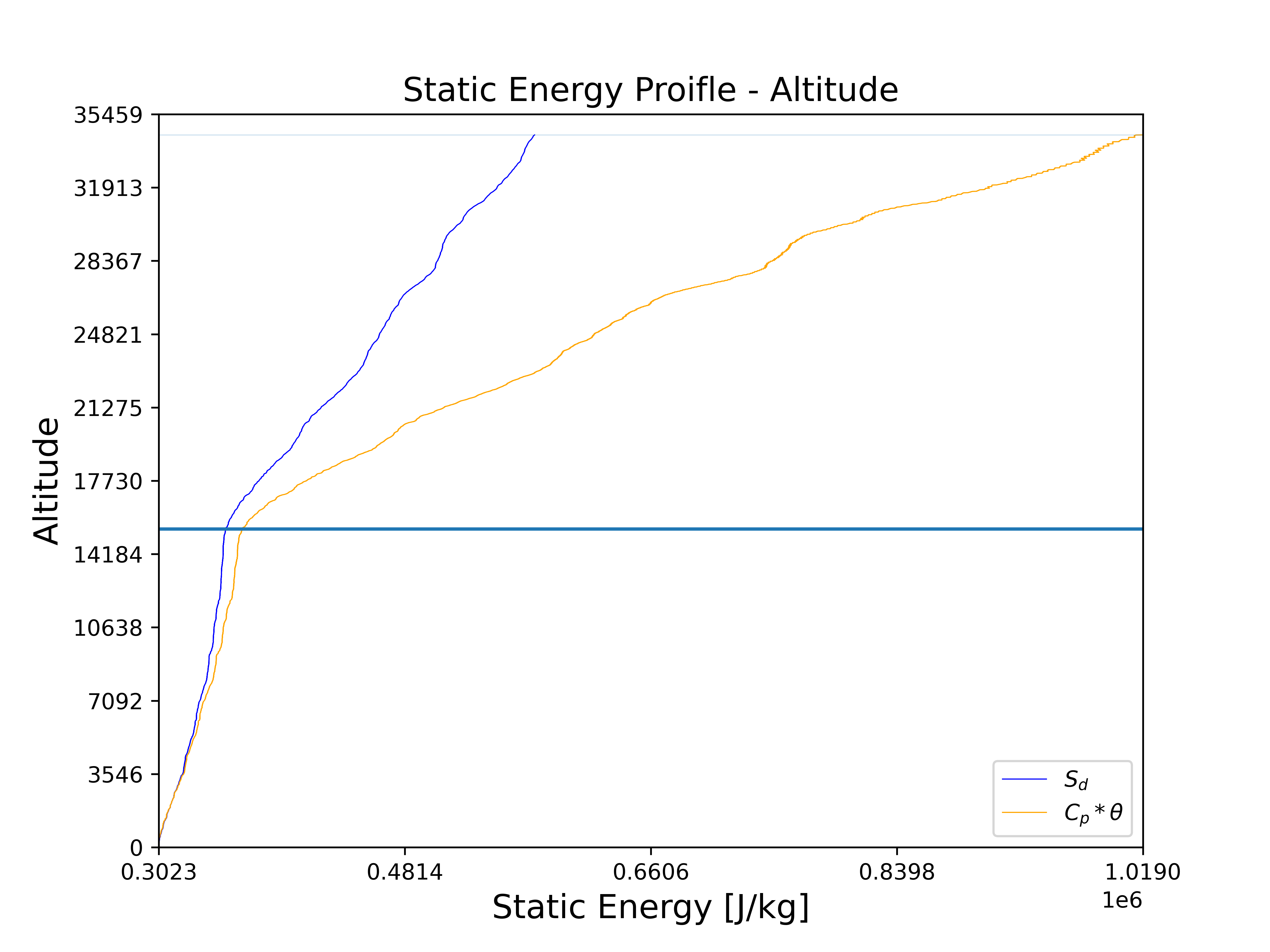


Figure Plotting:

The graph is composed of static energy and potential temperature. The blue line represents the static energy, the orange line represents potential temperature times heat capacity in isobaric process. The thick blue line represents the tropopause. The thin blue line represents the upper limit of the data.

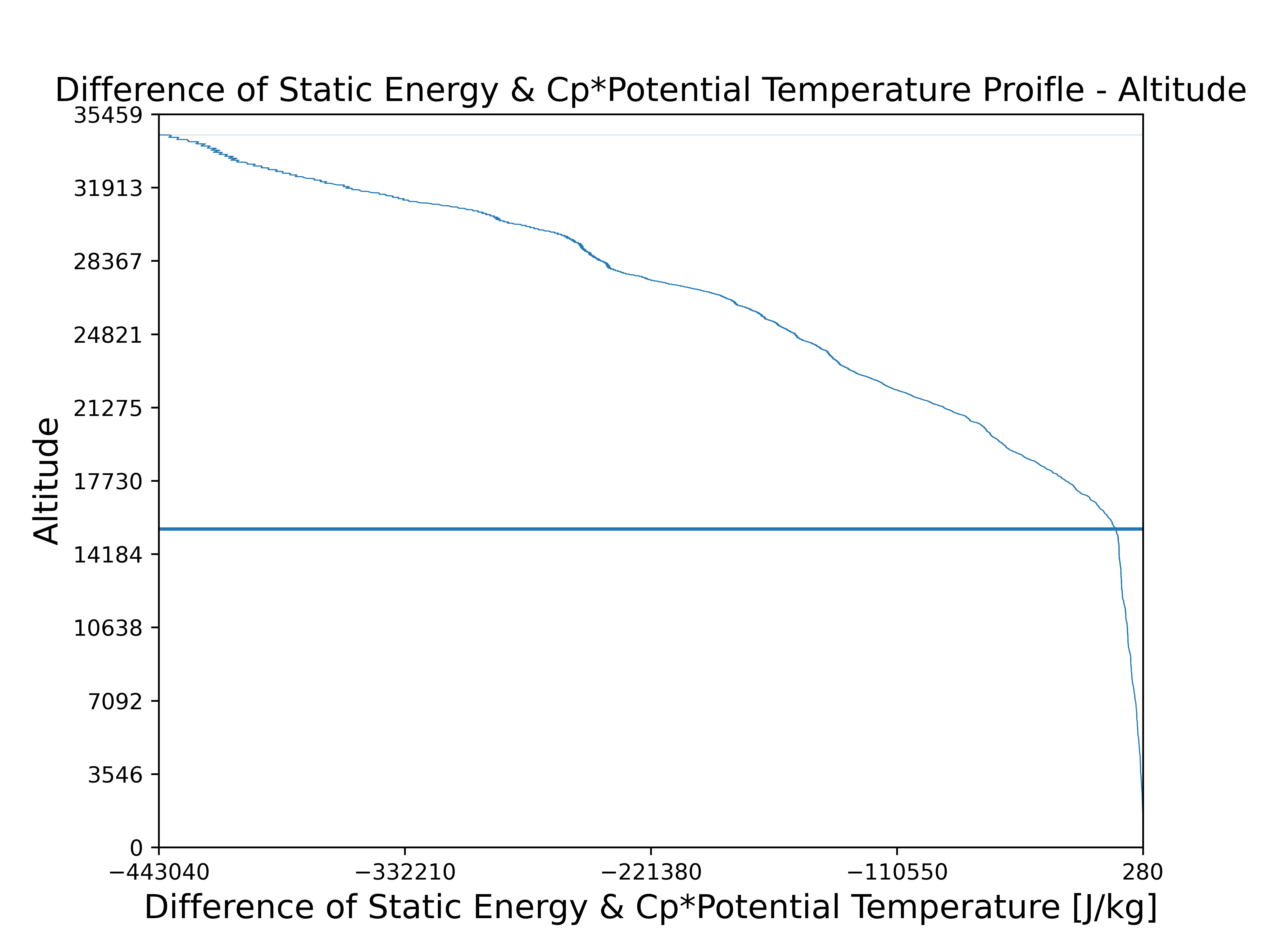
Discussion:

To derive the relationship between potential temperature and static energy, we need to use the definition of potential temperature and calculus to conduct:

By the relationship of and , we can observe that if , then:

By the definition of , the temperature is decreasing, however, the geopotential energy is constantly greater than . In the other cases, the stratospheric temperature is constantly increasing, the sum becomes greater. Therefore, both of lapse rate of the features are greater than troposphere.

In the plot, in lower atmosphere, the two factors are almost the same, however, when the altitude is higher than tropopause, the difference like below:



The difference between two features, static energy minus \*potential temperature, become greater as the altitude increasing.

Because air parcel lifting process in atmosphere can somehow be approximated as adiabatic process. Thus, static energy can be regard as a constant. By the difference be written in:

In the discussion above, static energy can be regarded as constant. However, the pressure is decreasing as the altitude increasing.

In the discussion above, static energy can be regarded as constant. However, the pressure is decreasing as the altitude increasing. Thus, is constantly increasing and positive, transfer from positive to negative. The difference is constantly decreasing in the profile.

1. Consider an infinitesimally small dry surface parcel which has same temperature as the environment, what is the temperature, potential temperature, and dry static temperature difference between this parcel and the environment if it is moved adiabatically to the tropopause?
2. Following (2), a line-shaped dry parcel with 1 km thickness is hydrostatic balanced near surface, what is the temperature, potential temperature, and dry static temperature difference between this parcel and the environment if it is moved adiabatically and hit to the tropopause. (Assume that the parcel is still 1 km thick)