

## ***Interactive comment on “Observed poleward expansion of the Hadley circulation since 1979” by Y. Hu and Q. Fu***

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Thanks for your interests in our paper and for your interesting comments. Here are our replies.

If atmospheric circulations, including the Hadley circulation, were kept unchanged, the OLR over anywhere of the globe would become smaller as CO<sub>2</sub> concentration increases. This is because increasing of greenhouse gases will cause more longwave radiation from the surface trapped in the lower atmosphere, which leads to a warming in the troposphere and the surface. In that case, the poleward 250  $Wm^{-2}$  OLR contour would shift equatorward, and the equatorward contour would shift poleward. In other words, the high-OLR band in the subtropics would become narrower.

There are many kinds of observational datasets, such as land surface, ship, aircraft,

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rawinsonde, and satellite observations. Each kind of data has errors due to various reasons, for example, observational equipment update. To reduce these errors, a data assimilation system (a sort of GCM) is used to constrain these different kinds of datasets. The reanalyses are close to observations. However, it also has some problems. The NCEP/NCAR and NCEP/DOE reanalyses have 17 levels, extending from 1000 to 10 hPa, and the ERA40 reanalysis has 23 levels, extending from 1000 to 1 hPa. The output data is on grid points, which is very convenient to use for research. For detailed information, please read the references cited in our paper.

Looking at the profile of the tropopause height as a function of latitudes, you will find that the tropopause has a higher altitude in the tropics and lower altitude at high latitudes. As the tropical belt extends poleward, the subtropical tropopause height becomes higher. Therefore, by examining the time-evolution of the tropopause height, the authors could find the expansion of the tropical belt.

The horizontal resolutions of the three reanalyses and the three OLR datasets are all  $2.5^\circ \times 2.5^\circ$  in latitudes and longitudes. An expansion less than  $2.5^\circ$  latitude is within the range of data resolution. However, the expansion of  $4.5^\circ$  latitude is certainly beyond the spatial resolution of these datasets.

Sorry for the confusion. We will make changes in the revised version. In Figure 1, the “tan band” refers to colors from yellow to dark red, roughly from about  $8^\circ\text{N}$  to about  $38^\circ\text{N}$ . In Figure 2, the blue band refers to colors from shallow blue to dark blue.

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