

## ***Interactive comment on “Is there bimodality of the South Asian High?” by Matthias Nützel et al.***

**Anonymous Referee #1**

Received and published: 11 July 2016

Review report on "Is there bimodality of the South Asian High?" by Nützel et al.

This paper analyzes the northern-summer South Asian High (SAH) at 100 hPa and related variables in six reanalysis data sets, and found that the "bimodality" of the SAH is only significant in NCEP1 (and with a lesser extent in NCEP2). All more recent reanalyses do not show such a strong bimodality. This is a very interesting and important work. However, to me, it would be much more appropriate to hypothesize that NCEP1 and NCEP2, the old 1990s reanalysis systems, are wrong in terms of the possible SAH bimodality and to discuss why they are wrong. The authors, however, do not give their answer (or hypothesis) clearly to the question, and continue to make further data analyses. Thus, after reading through the manuscript, I am somewhat at a loss regarding the question in the manuscript title.

It is unfortunate that the authors do not analyze the latest NCEP reanalysis, the CFSR (Saha et al., BAMS, 2010). If the CFSR also shows similar tendencies to the mod-

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ern reanalyses, the authors would also be able to obtain advice from the NCEP colleagues why the old NCEP reanalyses are wrong regarding the 100 hPa geopotential height over the middle to south Asian regions. Some hints might be as follows. (1) NCEP1 and NCEP2 are the only reanalyses available now that assimilate temperature retrievals for TOVS and ATOVS measurements; all more recent reanalyses assimilate radiance data directly. (2) NCEP1 and NCEP2 are the only reanalyses that use the sigma coordinate, while all others use the hybrid sigma-pressure coordinate. (3) As discussed by Kanamitsu et al. (2002), NCEP2 is an updated version of NCEP1, where several errors in the original NCEP1 system were corrected; thus, NCEP2 is generally closer to the truth than NCEP1.

Also, it may be useful to make a separate analysis using data only for the recent 10 years when several advanced satellite measurements are available (which NCEP1 and NCEP2 cannot utilize because of the oldness of their system). (Also, though it may not be a key here, investigation on GNSS Radio Occultation impact may also be interesting. MERRA does not assimilate GNSS RO, while MERRA-2, JRA-55, CFSR, and ERA-I do assimilate it.) If there is an influence of changing observing systems, the results of such an analysis would give us another hint.

In Introduction, and in other places, the authors cite several previous works that discuss the SAH's bimodality. It would be important and useful to summarize the information (in a table) on: (1) data used, (2) period of the analysis, (3) variables used, and (4) details of how to define the SAH centre(s) for the SAH bimodality study in each paper. Are there any works that use a reanalysis other than NCEP1?

In the latter half of Section 4 (page 8, lines 34-), and beyond (to the end), I cannot follow the discussion fully because the authors do not give any conclusion which is correct, NCEP1 or ERA-I (and others) regarding the SAH bimodality, and because they switch the main data set to ERA-I and continue discussion.

In conclusion, I think that the SAH's possible bimodality problem is a very interest-

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ing and important one, but the current manuscript is not conclusive. Major revisions explained above are necessary.

ACPD

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Interactive comment on *Atmos. Chem. Phys. Discuss.*, doi:10.5194/acp-2016-362, 2016.

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