COMPARISON OF TWO AAM FUNCTIONS CALCULATED FROM NCEP/DOE AND ERA-40 REANALYSIS DATA SETS

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ABSTRACT. We compared the AAM functions calculated from NCEP-2 and ERA-40 and found that the discrepancies between two AAMs are due to the wind term. A candidate source(s) of these discrepancies is the wind field in the upper troposphere, especially in the equatorial area and in the Southern Hemisphere.

1. INTRODUCTION

The time-varying Earth rotation is excited by the geophysical fluids, but the atmosphere plays a main role. However, atmospheric angular momentum functions calculated from different meteorological data sets have different values. What is/are the origin(s) of such differences? In this study, we examined the differences between AAM functions calculated from the two meteorological data sets; NCEP/DOE reanalysis (hereafter, NCEP-2) and ERA-40 reanalysis.

2. METHOD

We calculated AAM functions from monthly averaged meteorological reanalysis data with SP method (no wind blowing inside the mountain, after Aoyama & Naito (2000)) under the IB hypothesis. In order to examine the spatial distribution of the differences, we divided the atmospheric layer into six (surface to 850 hPa, 850-700 hPa, 700-500 hPa, 500-300hPa, 300-100hPa and 100-10hPa; hereafter, we numbered the layers from bottom to top) such that each layer contains the nearly same air-mass. Then we partitioned each layer into 15deg by 15deg blocks. We separated seasonal and non-seasonal signals from the retrieved difference signals.

3. RESULTS

Prior to the main analysis, we checked the fact that these differences are almost due to the differences in the wind AAM term.

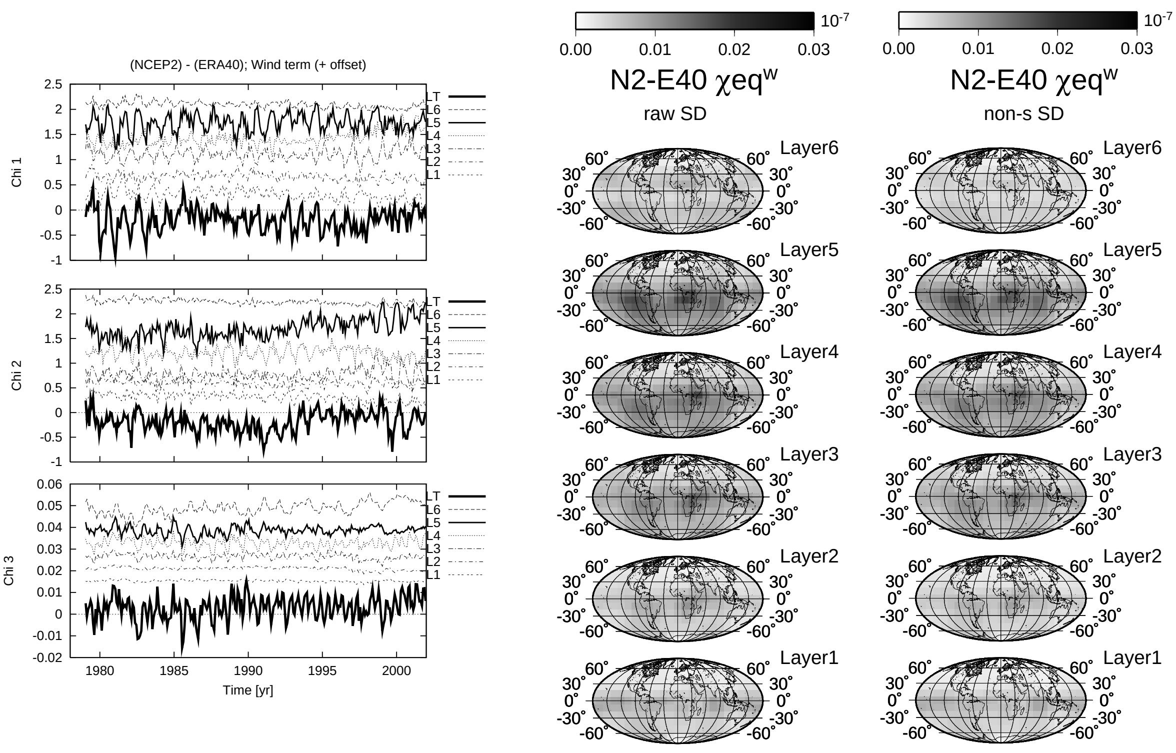
Next, we examined which layers these wind differences came from. Figure 1(a) shows the Layer 5 (300-100hPa) contributes to large differences. From the spatial distribution of the differences in wind AAMs (Figure 1(b)), we can observe large differences in the equatorial region, also in the Southern Hemisphere. The differences are almost non-seasonal (Figure 1(c)). As we expected from Figure 1(a), large differences are observed in the upper troposphere (Layer 4 and

5, corresponding to the isobar from 100hPa to 500hPa).

Interestingly, in contrast to large wind AAM excitations in the jet streams, large differences between NCEP-2 and ERA-40 do not correspond to the jet streams; rather, correspond to the areas with sparse meteorological observation. The area near Australia shows small differences than the surrounding areas.

4. DISCUSSION

We think that these differences are due to the difficulties in wind analysis, although the wind observation from satellite images has improved the accuracy of the wind field. (For example, the Coriolis parameter, which is used in the estimation of the upper wind under the thermal wind assumption, will vanish at the equator.) This is an ironical fact that the wind at the equator most efficiently excites the Earth rotation due to the large distance from the rotational axis.



(a) (b) (c)

Figure 1: (a) Time series of the wind AAM differences of NCEP2 minus ERA40, from six vertical layers. These lines are drawn with vertical offsets. LT (the bottom series in each panel, highlighted by thick line) means the total (summed-up) differences over six layers. The difference in Layer 5 (the second series from the top in each panel, highlighted by thick line) is larger than those in other layers. Units are 10^{-7}. (b) Spatial distribution of the AAM differences of NCEP2 minus ERA-40. We only draw the equatorial component of the wind AAM (i.e. $\sqrt{(\chi 1^w)^2 + (\chi 2^w)^2}$). (c) Same as (b), but extracted only the non-seasonal components.

REFERENCES

Aoyama, Y. and Naito, I., 2000, "Wind Contributions to the Earth's Angular Momentum Budgets in Seasonal Variation", J. Geophys. Res., 105(D10), 12417-12431.