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Initial Assessment of the Conventional Observation Reanalysis

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1. Introduction

The Conventional Observation Reanalysis (CORe) was recently completed at the National Centers for Environmental Prediction (NCEP), for the period of 1950 to 2009. The CORe is an atmospheric reanalysis based on the latest Semi-Lagrangian Global Forecast System (GFS) T254 L64 model using Ensemble Kalman Filter (EnKF) data assimilation system (Ebisuzaki *et al.* 2016).

The purpose of this work is to test feasibility of the ENKF based analysis over periods with different densities and time-varying qualities of conventional observed data, and to compare the performance of CORe against the NCEP/NCAR Reanalysis (R1) to assess whether this could be a suitable replacement.

2. Data

We use monthly mean fields from Jan. 1951 to Dec. 2009 to analyze CORe climate variability and trend. CORe was produced by running six simultaneous streams of analyses with one year overlap. The six streams of CORe are the following periods: Jan1950 to Dec1960; Jan1960 to Dec1970; Jan1970 to Dec1981; Jan1981 to Dec1990; Jan1990 to Dec1998; Jan1998 to Dec2009.

For a comparison with other reanalyses, temporal changes from MERRA2 (Molod *et al.* 2015), JRA55c (reanalysis using conventional observations) (Kobayash *et al.* 2014), ECMWF Reanalysis Interim (ERAI) (Dee *et al.* 2011), R1 (Kalnay *et al.* 1996) and CFSR (Saha *et al.* 2010) are also analyzed.

3. Results

The Hovmollver diagram showed the interannual variability of the 200mb heights at the equator (Fig 1) for the various reanalyses. The CFSR heights are lower than all other reanalyses,

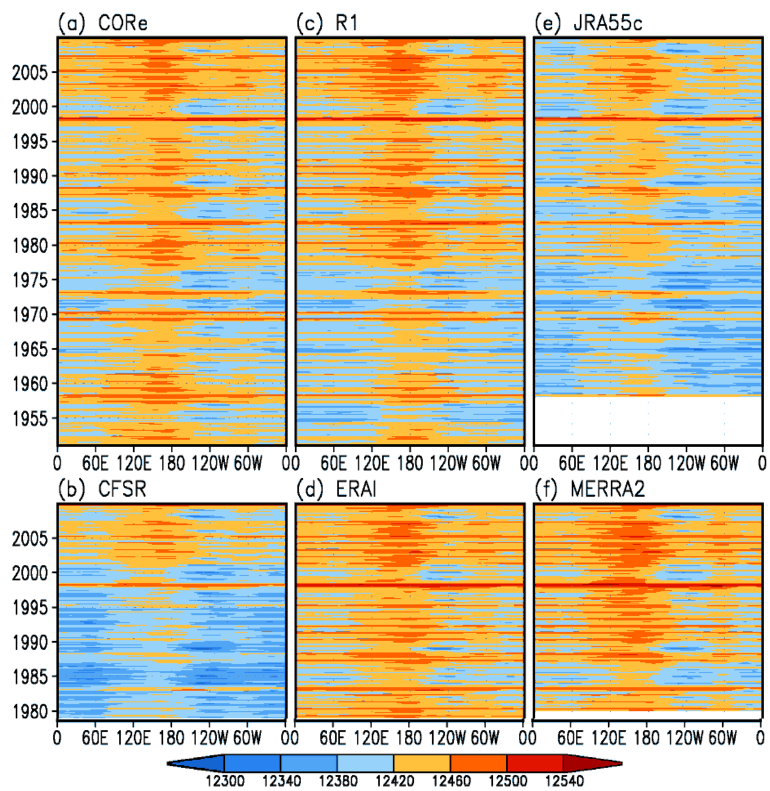

Fig. 1 Hovmoller cross section of monthly mean geopotential height in meter at 200mb along equator in a) CORe, b) CFSR, c) R1, d) ERAI, e) JRA55c and f) MERRA2.

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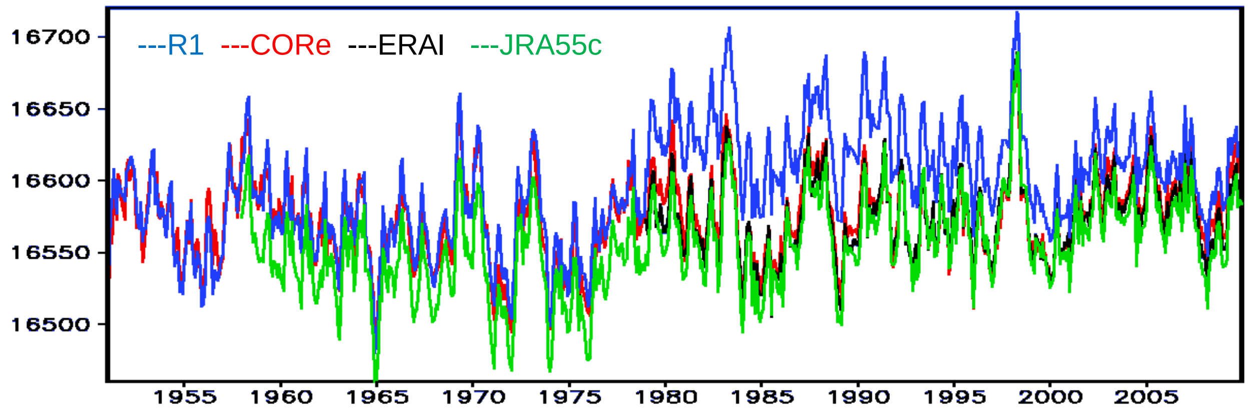

Fig. 2 100mb monthly temperature zonal mean averaged over 10°S-10°N for R1 (blue), CORe (red), ERAI (black) and JRA55c (green).

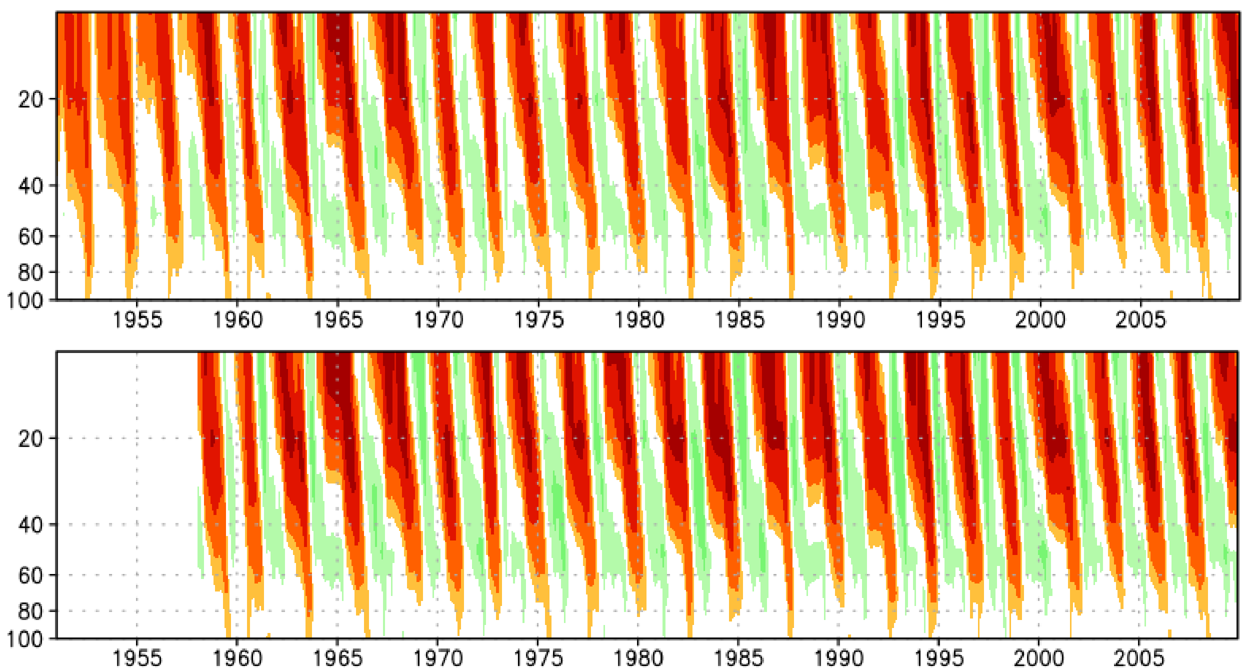

Fig. 3 Tropical monthly zonal mean zonal wind on pressure levels from 100mb to 10mb for CORe (upper panel) and JRA55c (lower panel).

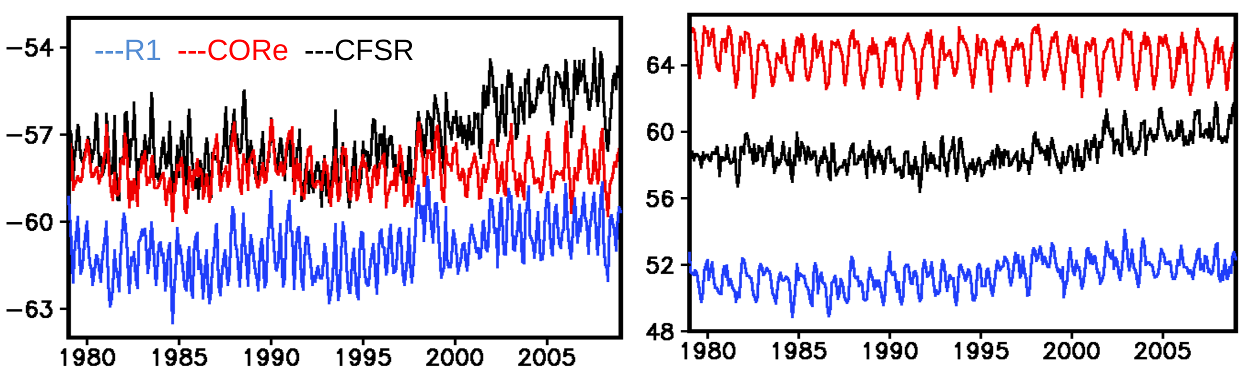

Fig. 4 Global monthly mean of surface downward long wave (left panel) and total cloud cover (right panel) for R1 (blue), CORe (red) and CFSR (black).

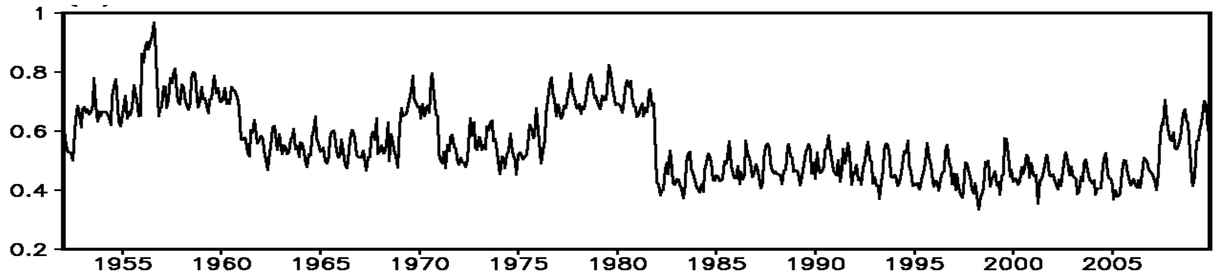

Fig. 5 Global monthly mean of precipitation minus evaporation.

particularly in the 1980s and 1990s as we already know, while the CORe height has comparable amplitude and pattern compared with ERAI and MERRA2 particularly post 1979. Before 1979, CORe is closer to R1, while JRA55c height seems lower than height in CORe and R1. R1 has the coldest 850mb temperature in the eastern equatorial Pacific; while CORe agrees very closely with the other reanalyses (picture not shown)

The zonal mean temperature averaged over tropics (10°S-10°N) at 100 mb in Fig. 2 shows that R1 has major temperature change after 1979, while CORe, ERAI and JRA55c agree post 1979 and consistent with pre-1979 values.

Figure 3 illustrates the monthly zonal mean of zonal wind on pressure levels above 100mb. Apparently, CORe (upper) and JRA55c (lower) Quasi-biennial Oscillation (QBO) winds have very good agreement at all QBO levels.

Both CFSR (black) and R1 (blue) in Fig.4 have increasing trends for surface long wave (left) and total cloud cover (right), especially after 1999, while CORe (red) has more consistent structure, though higher amount of cloud cover.

4. Discussion

In general, CORe seems competitive with R1 in the modern era and better than R1 in the earlier years. For many cases CORe appears to have fewer artifacts than other newer reanalyses. However, there are serval significant changes over the long time series of global monthly mean precipitation minus evaporation (P-E), which may be related to sea surface temperature and/or is likely affected by changes in data formats and data volumes increases: ON20 data from 1962-1972, while 1968 has upgrade format, and 1973 transition to ON23 format; 1976 transition to ON126 for surface observation; 1982 transition to updated WMO GTS character codes for surface data; 2007 may be related to introduction of COSMIC data into CORe. We will look into this further.

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