Introduction and early results of JRA-55C: subset of JRA-55
---- Data assimilation using only Conventional observation data ----

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1. background

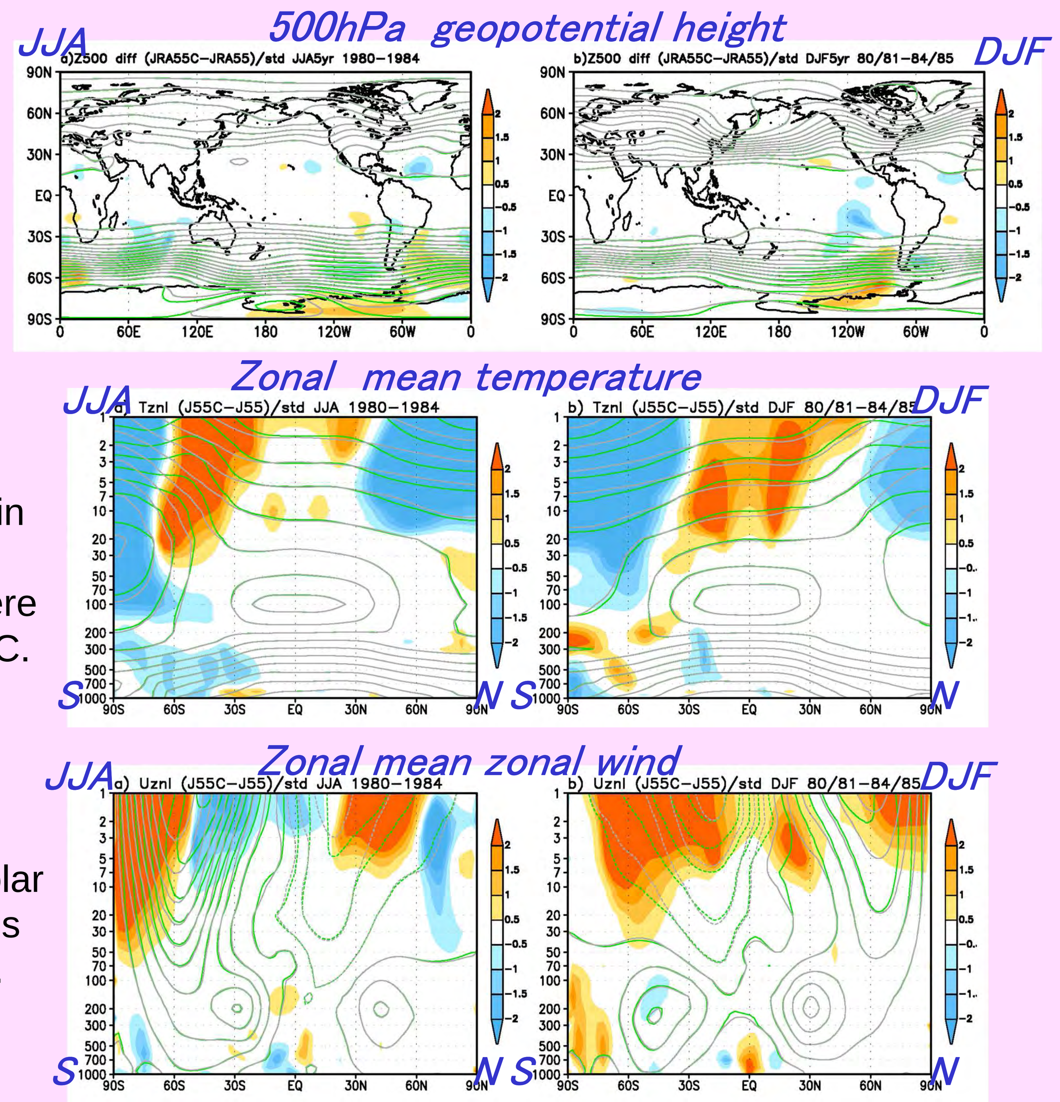
- •Meteorological Research Institute (MRI) of JMA started a global atmospheric reanalysis, called JRA-55**C**.
- •This subproject assimilates only the conventional surface and upper air observations, without satellite observations, using the same assimilation system as JRA-55 (Ebita et al, 2011).
- •The JRA-55C aims to produce a more homogeneous dataset for a longer period. To avoid the inhomogeneities caused by the changes in satellite observation systems, the JRA-55C does not assimilate satellite observations. This makes the product a suitable dataset for studies of climate change or multi-decadal variability.
- •The JRA-55C will provide reanalysis data from 1958 to 2012, which consists of using the pre-satellite data of JRA-55 (1958-1972) and the reanalysis of JRA-55C from 1973-2012.
- •We are also providing an AGCM simulation, called JRA-55AMIP, to examine the effect of surface and upper air observations. The JRA-55AMIP uses the same boundary condition of JRA-55 and JRA-55C without data assimilation.
- •Comparing three datasets, JRA-55, JRA-55C and JRA-55AMIP, it is expected to clarify how and why the meteorological variables change for the last 55 years.

2. Assimilation system and boundary forcing

- •Assimilation system and boundary forcings are same as JRA-55 (*Onogi, Oral presentation 7 May*) except for only using SYNOP, SHIP, BUOY, TEMP, PILOT and TCR.
- • The scaling factor for background error covariance matrix is 1.8 times that of JRA-55 satellite era (same value used in pre-satellite era of JRA-55).
- • The computations for 5 years have been completed so far.

3 Difference between JRA-55C and JRA-55
5-yr mean (1980-1984) seasonal mean field

(JRA-55C systematic error from JRA-55)



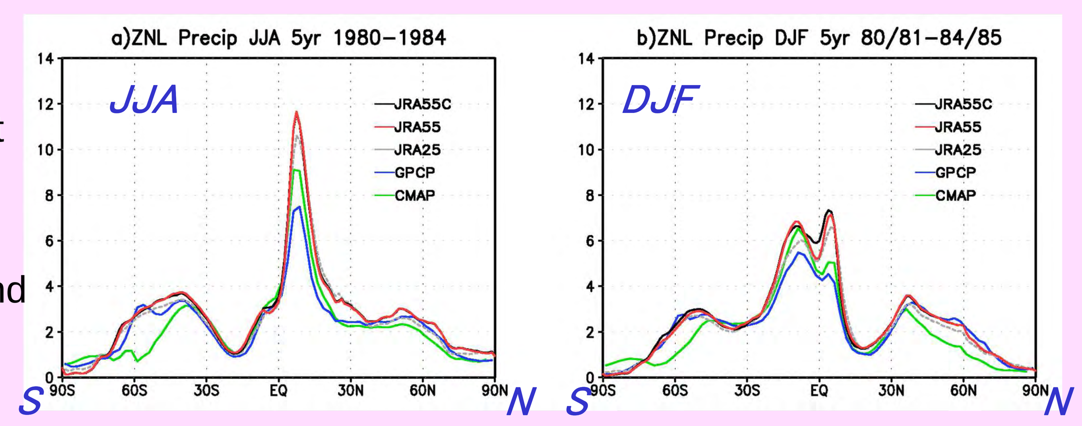
Small differences in NH.

Cold bias in polar stratosphere in JRA-55C.

Not tilted polar night Jet axis in JRA-55C.

Fig.1 Normalized difference between JRA-55C and JRA-55 (color) gray line : JRA-55C, green line: JRA-55, Normalized by seasonal mean STD.

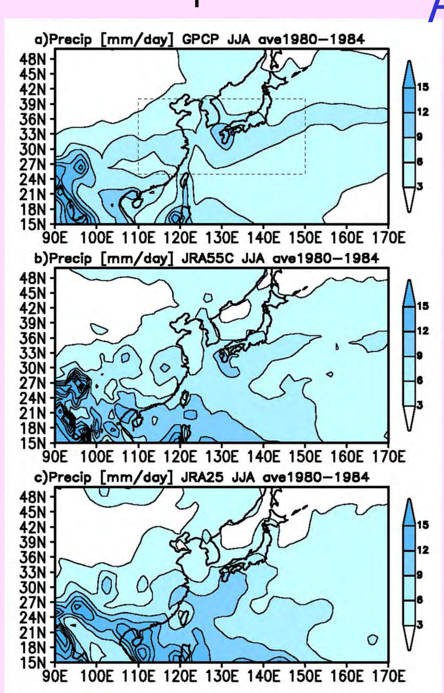
- •Differences between JRA-55 and JRA-55C are small in the troposphere and lower stratosphere except for the southern extra-tropics.

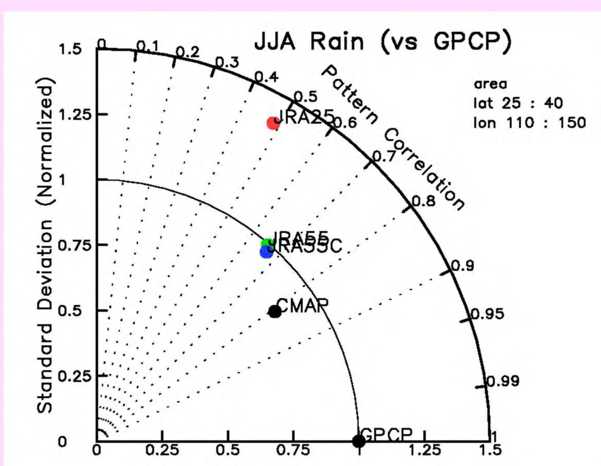


Better agreement with GPCP in JRA-55C.

Both JRA-55 and JRA-55C overestimate in Tropics.

Fig.2 Zonal mean seasonal precipitation (mm/day)





JRA-55 and JRA-55C show better climatological precipitation pattern than JRA-25

Fig.3 JJA mean Precipitation pattern validation .vs. GPCP over East Asia. (Taylor diagram)

5. Summary

- ***•We started JRA-55C to produce a more homogeneous dataset for climate research, which assimilates only conventional observations, without satellite observations.***
- ***•The early results indicate good performance in the troposphere and the lower stratosphere except for the southern extra-tropics.***
- ***•We expect the entire JRA-55C will contribute to the understanding of the impact of observation changes on the representation of climate trends and variability in JRA-55.***

4. Performance of JRA-55C
4.1 Year-to-year variation of global mean temperature anomalies.

- •JRA-25 has clear discontinuous change in 1998 caused by TOVS-to-ATOVS transition.
- •JRA-55 is more homogeneous than JRA-25.
- •Previous reanalysis using all available observations have inhomogeneities caused by the time-changing observations mainly caused by satellite.
- •JRA-55C indicates negative anomalies in the troposphere and positive anomalies in the stratosphere during the pre-satellite era.
- •JRA-55C represents lower stratospheric (100-30hPa) positive temperature anomalies of Agung (1963) and El Chichon (1982) volcanic eruptions. They last about 2 yr.
- •JRA-55 series and ERA-40 indicate negative trends over upper stratosphere (10-3hPa) in the pre-satellite era. All the JRA-55 series are using monthly mean climatology of ozone concentrations as boundary forcing in the pre-satellite era. Then the negative trend may be caused by CO2 changes. (Additional model simulation will help clarify this.)

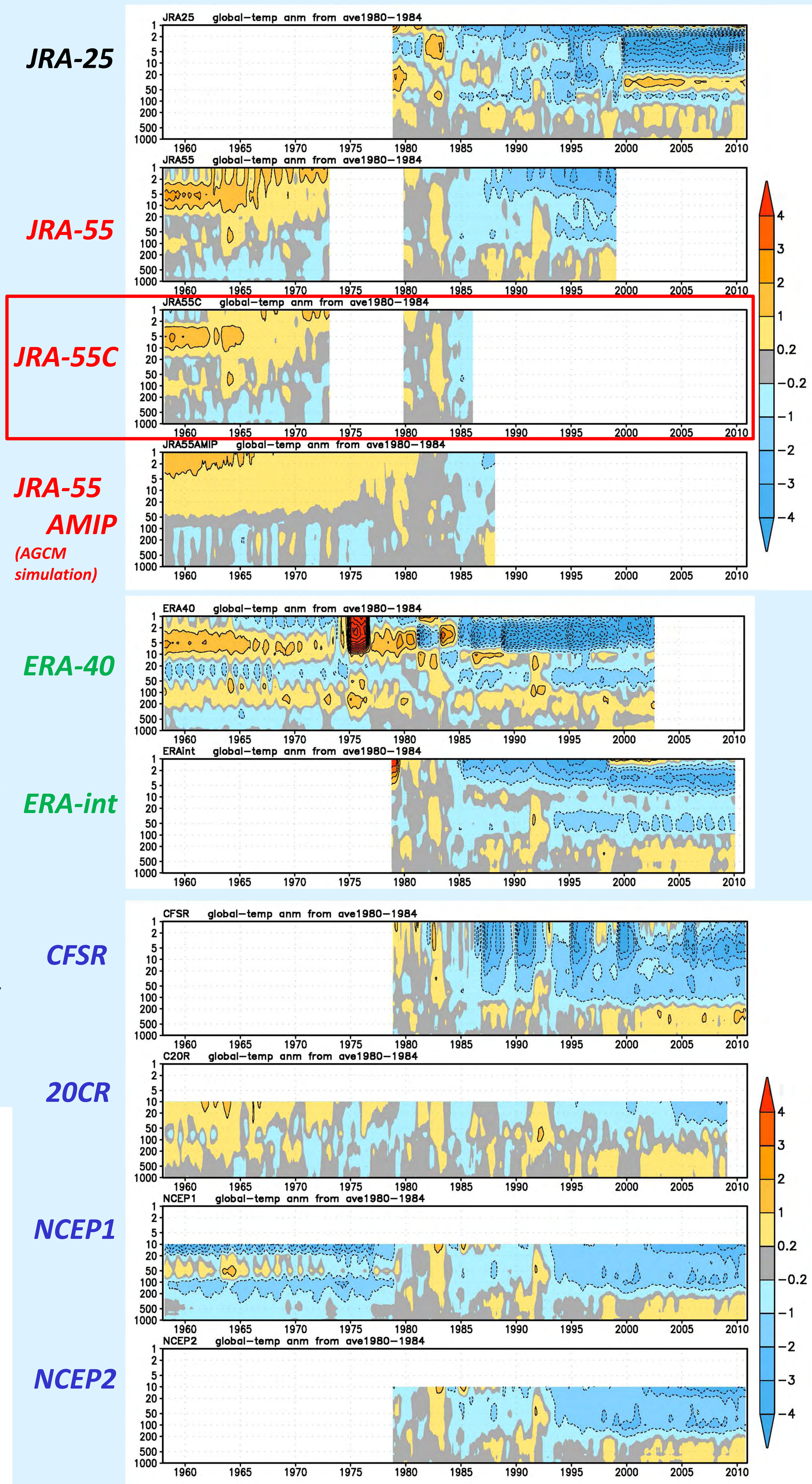


Fig.4 Global-mean monthly temperature anomalies from 1000 to 1hPa from Jan1958 to Dec2010. Units;K, The base period for the normal is 1980-1984.

4.2 QBO

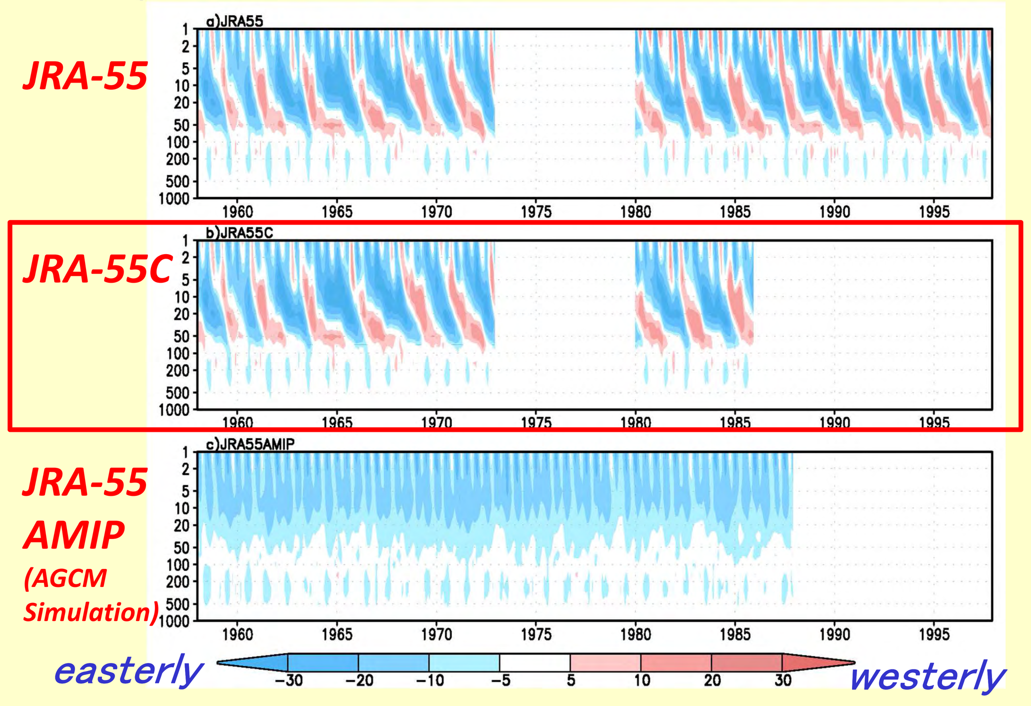


Fig.5 Equatorial (5S-5N) zonal mean U wind time series from 1958-1997 (Units: m/s)

- •QBO is properly represented in JRA-55C, which is not appeared in JRA55AMIP.
- •JRA-55 assimilation system using only conventional observation data can produce QBO.

4.3 Large scale equatorial velocity potential at upper troposphere. -- ENSO and MJO --

- •Large scale divergence area shifted eastward during ENSO warm phase from 1982-1983. The shift is properly represented in JRA-55C, which is not so clear in JRA55AMIP.
- •MJO is properly represented in JRA-55C. Although JRA-55AMIP has a potential to represent MJO, the timings are different.

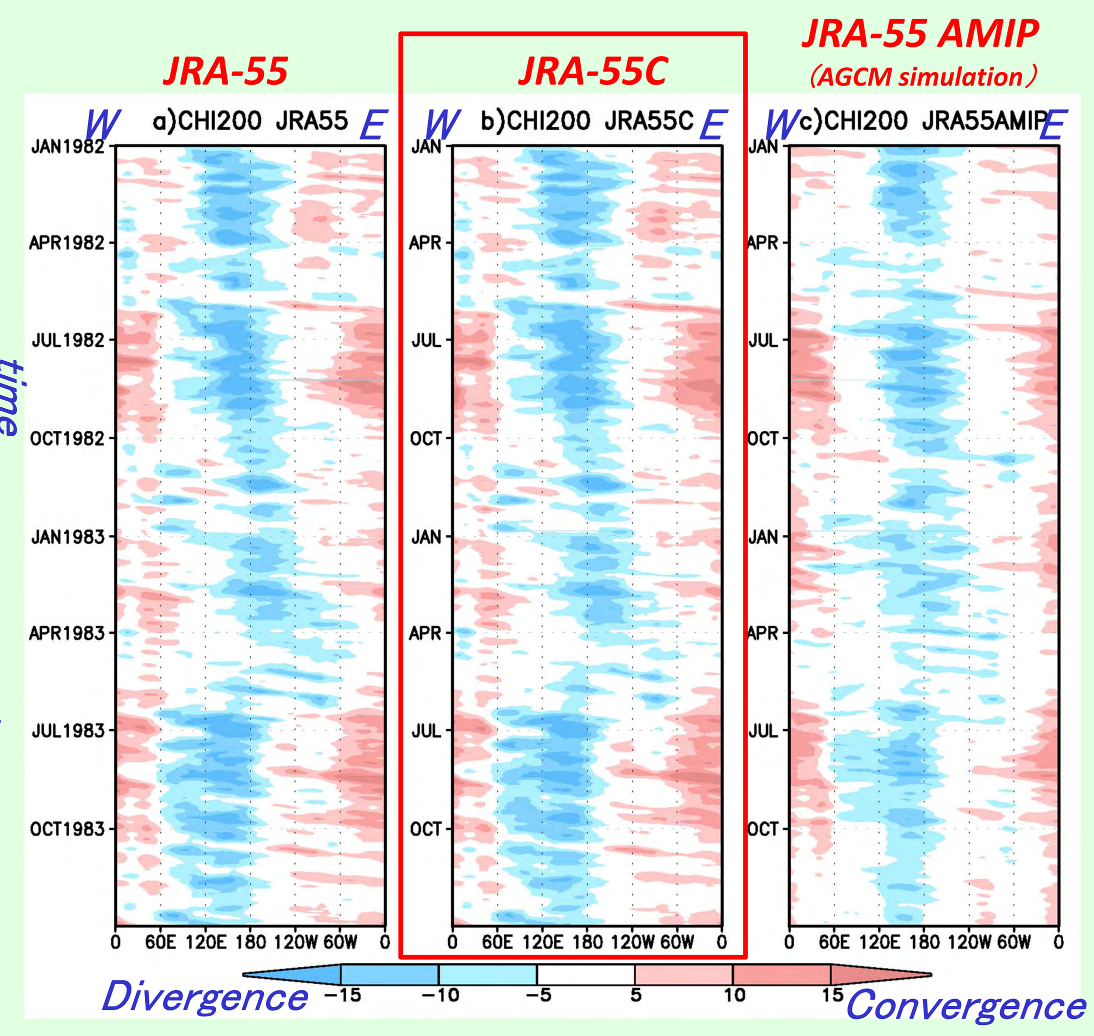


Fig.6 Equatorial (5S-5N) 200hPa Velocity potential time series from 1Jan1982 to 31Dec1983 (2yr).

Reference

•Andrae, U., N. Sokka, and K. Onogi, 2004: 'The radiosonde temperature bias corrections used in ERA-40'. ECMWF ERA-40 Project Report Series, 15, 34 pp.
•Ebita, A., S. Kobayashi, Y. Ota, M. Moriya, R. Kumabe, K. Onogi, Y. Harada, S. Yasui, K., Miyaoka, K. Takahashi, H. Kamahori, C. Kobayashi, H. Endo, M. Soma, Y. Oikawa, and T. Ishimizu, 2011: The Japanese 55-year Reanalysis 'JRA-55': An Interim Report. SOLA, 7, 149-152. doi:10.2151/sola.2011-038
•Haimberger, L., 2007: Homogenization of radiosonde temperature time series using innovation statistics. J. Climate, 20, 1377–1403.
•Ishii, M., A. Shouji, S. Sugimoto, and T. Matsumoto, 2005: Objective analyses of sea-surface temperature and marine meteorological variables for the 20th century using ICOADS and the KOBE collection. Int. J. of Climatology, 25, 865–879.

QR code of my poster

http://icr4.org/posters/Kobayashi_AT-30.pdf

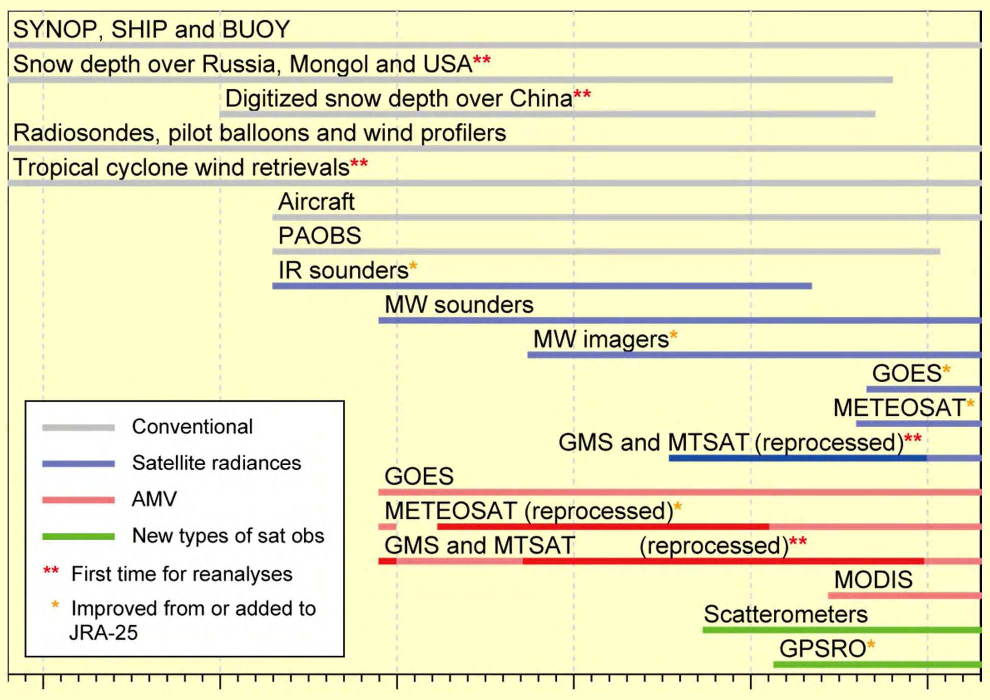
2.1 JRA-55 Reanalysis system

	JRA-25	JRA-55
Reanalysis years	1979-2004 (26 years)	**1958-2012 (55 years)**
Equivalent operational NWP system	As of Mar. 2004	**As of Dec. 2009**
Resolution	T106L40 (~120km) *(top layer at 0.4 hPa)*	**TL319L60 (~60km)** ***(top layer at 0.1 hPa)***
Time integration	Eularian	**Semi-Lagrangian**
Assimilation scheme	3D-Var	**4D-Var** ***(with T106 inner model)***
Bias correction (radiosonde)	Correct tempereture bias (Andrae et al. 2004)	**RAOBCORE v1.4 (Haimberger, 2007)**
Tropical Cyclone	Wind profile retrievals (TCRs) provided by Dr.Fiorino were assimilated.	**Same as JRA-25**

2.2 Boundary and forcing fields

	JRA-25	JRA-55
Radiatively active gases	H_2O, CO_2, O_3	**H_2O, CO_2, O_3, CH_4, N_2O, CFC-11, CFC-12, HCFC-22**
GHG concentrations	Constant at 375 ppmv (CO_2)	**Annual mean data are interpolated to daily data (CO_2,CH_4,N_2O)**
Ozone	Daily 3-D ozone *(produced by AED/JMA)*	(-1978) **Monthly climatology** (1979-) **New daily 3-D ozone** ***(produced using a revised CTM)***
Aerosols	Annual climatology for continental and maritime aerosols	**Monthly climatology for continental and maritime aerosols**
SST	COBE SST	**COBE SST**
Sea ice	(Ishii *et al.*, 2005, *I.J.Clim.*)	**(ver. 1.5)**

2.3 Observational data used in JRA-55



Supplement

•The quality of JRA-55C is approximately that of half-day forecasts.

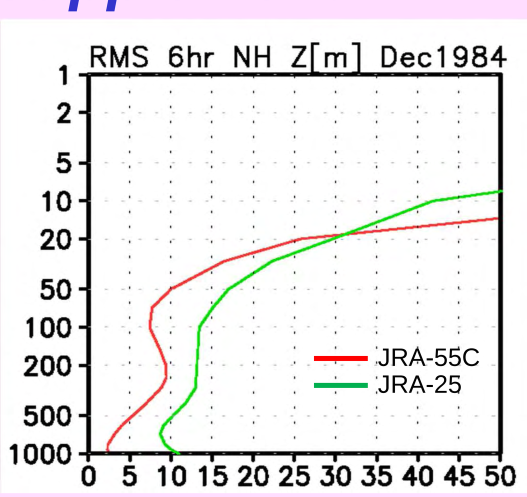


Fig.A RMSE of 6hrly NH geopotential height of JRA-55C vs that of JRA-55 (Dec 1884).

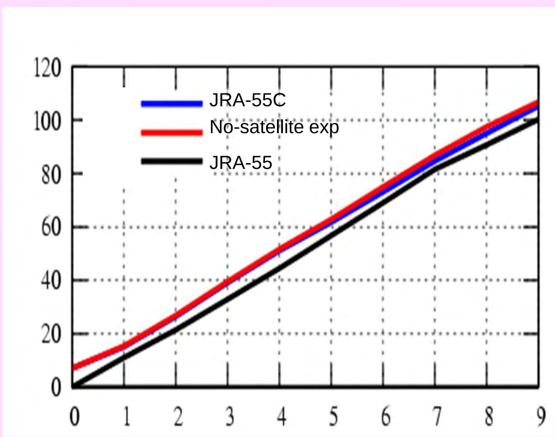


Fig.B Forecast score (RMSE) of 500hPa height over NH of JRA-55 vs JRA-55 (pre-experiment, Jan 1990).