The Japanese 25-year Reanalysis Project

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1. Introduction

JMA has been conducting the Japanese 25-year Re-Analysis project (JRA-25) as a joint research project with the Central Research Institute of Electric Power Industry (CRIEPI) of Japan since April 2001 to make a long-term (about 26 years from 1979 to 2004) and high quality reanalysis dataset (JRA-25 Working Group, 2001). The major objective of this work is to make a fundamental dataset for dynamical seasonal prediction, accurate climate system monitoring, and climate system studies. Production of JRA-25 was completed in March 2006. Present status is briefly introduced in the following sections.

2. System and Data

The global forecast model used for JRA-25 has the resolution of spectral T106 (equivalent to horizontal grid size around 110km) and 40 vertical layers of the top level at 0.4hPa, and the data assimilation scheme is 3-dimensional variational (3DVAR) system with the land surface assimilation system. These are the low-resolution version of the JMA's operational numerical models.

JRA-25 introduced some new historical observational data which had not been used in the other reanalyses. Wind retrieval data surrounding tropical cyclones (TC), which are provided by Dr. Mike Fiorino of LLNL/USA, is assimilated. These data brought more precise position and intensity of tropical cyclones in the analyses. Meteorological Satellite Center (MSC/JMA) provided high density atmospheric motion vectors (AMV) derived from GMS-3 to 5 observation for the period from March 1987 to May 2003. The JMA new centennial SST/sea-ice dataset named COBE is used as boundary condition. TOVS brightness temperature data are assimilated directly with 3DVAR system. Three-dimensional daily ozone distribution produced by JMA is given to the forecast model. Retrieved precipitable water (PW) from SSM/I is assimilated from 1987 onward, which gives more precise precipitation analysis over the ocean. Distribution of snow coverage retrieved from SSM/I data is used in the snow analysis as well as snow depth from the SYNOP report.

3. Features of JRA-25

Preliminary evaluation shows that JRA-25 data have some advantages in the performances of 6-hour precipitation and tropical cyclones analysis. The spatial correlation coefficients between monthly precipitation of various reanalysis datasets and CPC Merged Analysis of Precipitation (CMAP) are shown in Figure 1. Precipitation in JRA-25 keeps the highest correlation with CMAP in almost the whole period. In particular, the performance of JRA-25 precipitation is outstanding after the SSM/I data are assimilated in 1987. This fact indicates the successful handling of the SSM/I data in the assimilation process as well as basically good skills of the precipitation scheme in the JMA model. In addition, the total precipitation of JRA-25 over the globe is relatively stable for all the periods as compared with ERA-40 (Figure 2). Considering that ERA-40 total precipitation may be influenced by volcano eruptions, the satellite data are treated carefully and successfully in JRA-25 assimilation system.

The most prominent features of JRA-25 are obtained by using the wind retrieval data surrounding tropical cyclones (TC). The impact of the TC wind data is clear when reanalyzed TCs are compared over the eastern North Pacific between JRA-25 and the control without the TC wind data (upper figures in Figure 3). For the control, the assimilation system fails to reproduce not only wind-field around the two TCs but also the locations of their centers. It is also impressing that over dense observation area such as over Japan Islands, TCs and their wind-filed are reanalyzed in JRA-25 in the same way as those in the control (lower figures in Figure 3). The TC detection rate is much improved over the eastern North Pacific by applying the TC wind data as compared between JRA-25 and the control without the TC wind data or ERA-40 (right figures in Figure 4). On the other hand, the TC detection rates of both the control and ERA-40 are comparable to that of JRA-25 over the western North Pacific due to relatively many observations (left figures in Figure 4).

Surface air temperature is an important element for climate monitoring as well as seasonal and climate prediction. It is confirmed that the long-term variability of the global mean surface air temperature of JRA-25 is comparable with that of other datasets (Figure 5).

4. Summary

Production of the Japanese 25-year Re-Analysis project (JRA-25) for the period of about 26 years from 1979 to 2004 was completed in March 2006. From March 2006 onward, JMA has started quasi-real-time JMA CDAS with the same system as that for JRA-25. The latest information of the project status can be found in the official web site (http://www.jreap.org).

JRA-25 has advantages in the performance of precipitation and tropical cyclones. JRA-25 and JMA CDAS will be good fundamental datasets for seasonal forecast and hindcast verifications, climate monitoring, and climate research. In order to contribute to the above climate activities in Asia and the Pacific regions, JMA is willing to supply the JRA-25 products as well as JCDAS to operational meteorological organizations and research institutes. Current JRA-25 product availability via Internet is found in the web site (http://www.jreap.org/download/download-e.html).

JRA-25 has been produced in international cooperation with observational data contributors in the world. We wish to give special thanks to NCEP, ECMWF, NCDC and NCAR for their contributions.

References

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Onogi, K. et al.: JRA-25 ; Japanese 25-year Reanalysis. Submitted to Quart. *J. Royal Meteor. Soc.* in 2005.
Hatsushika, H., J. Tsutsui, K. Onogi and M. Fiorino : Analysis of tropical cyclones in the Japanese 25-year reanalysis (JRA-25). Submitted to *J. Meteor. Soc. Japan* in 2005.

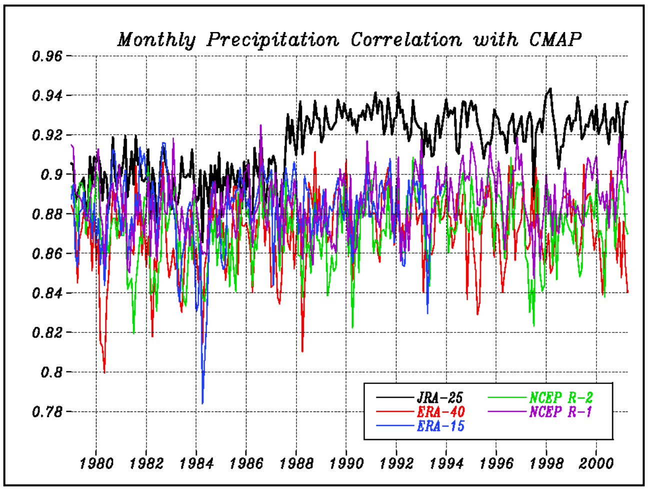

Figure 1 Spatial correlation of monthly precipitation of JRA-25, ERA-15 and 40, NCEP-R1 and R2 with CMAP. Precipitation in JRA-25 keeps the highest correlation with CMAP in almost the whole period. In particular, the performance of JRA-25 precipitation is outstanding after the SSM/I data are assimilated in 1987. (This figure is from K.Onogi et al. submitted to QJRMS in 2005)

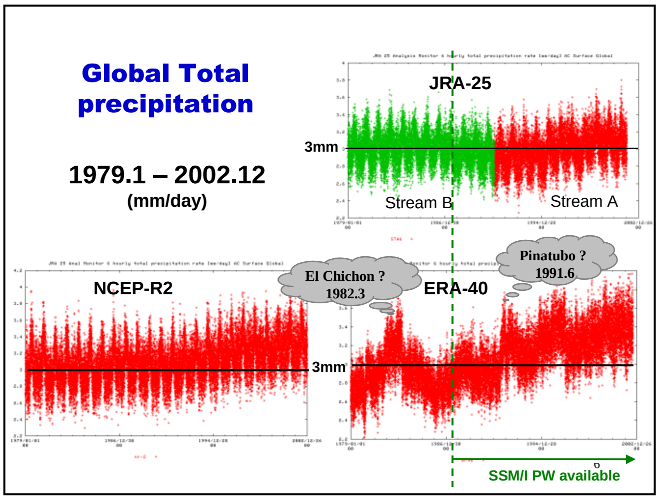

Figure 2 Variability of global total precipitation of JRA-25, ERA-40, and NCEP-R2 over the period of 1979-2002. The global total precipitation of JRA-25 is relatively stable for all the periods. The satellite data are treated carefully and successfully in JRA-25 assimilation system.

(This figure is from K.Onogi et al. submitted to QJRMS in 2005)

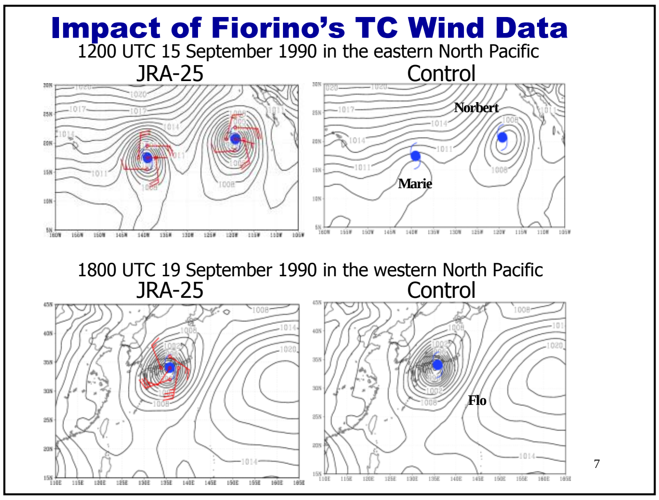

Figure 3 Impact of Fiorino's Tropical Cyclone (TC) wind data on sea level pressure reanalysis over the eastern North Pacific (upper figures) and over the western North Pacific (lower figures). JRA-25 products (left figures) applying the TC wind data are compared with the controls (right figures) without that data. Impact is clear over the eastern North Pacific where observational data are scarce.

(This figure is from H.Hatsushika et al. submitted to JMSJ in 2005)

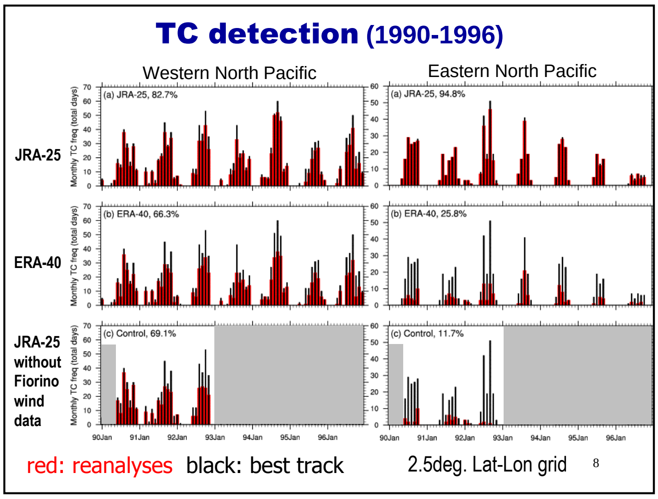

Figure 4 Tropical Cyclones (TC) detection over the western North Pacific (left figures) and over the eastern North Pacific (right figures). Unit is total days. Upper and middle figures are for JRA-25 and ERA-40. Lower figures are for JRA-25 except for without the Fiorino TC wind data. The TC detection rate is much improved over the eastern North Pacific by applying the TC wind data. (This figure is from H.Hatsushika et al. submitted to JMSJ in 2005)

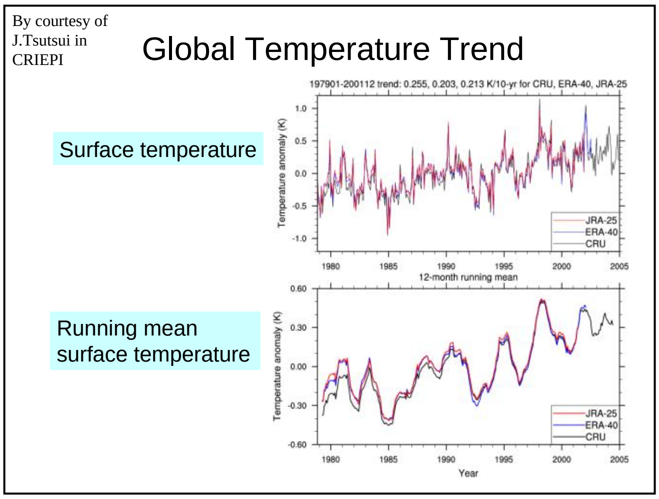

Figure 5 The temporal change of global mean temperature in JRA-25 is compared with those of ERA-40 and CRU (Climate Research Unit) for the period from 1979 through 2000 in the upper figure. Lower one is the same except for running mean. The long-term variability of the global mean surface air temperature of JRA-25 is quite similar to those of other datasets. (This figure is by courtesy of J.Tsutsui in CRIEPI)