Japanese Reanalysis JRA-25

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1. Introduction

ECMWF, NCEP and NASA/DAO have already completed their first reanalyses and their second ones are on going or in planning. In Japan, recent urgent needs for more accurate environmental and climate diagnostic information boosted the plan to produce another reanalysis data set by own system of Japan Meteorological Agency (JMA).

2. Organization and object

In April 2001, JMA and Central Research Institute of Electric Power Industry (CRIEPI) made a contract to conduct a reanalysis as a cooperative research project. The effective period of the contract is for the financial years from 2001 to 2005. This project is denominated as JRA-25 (Japanese Re-Analysis 25 years) and the data product is called JRA-25 as well. The target years of the reanalysis are from 1979 to 2004. Experts and scientists from JMA and CRIEPI organized the reanalysis working group (WG).

JMA and CRIEPI agreed to offer their technical experts, software and computational resources. JMA's main objectives of this work are; 1) preparation for consistent initial conditions and validation data set which are needed for dynamical seasonal prediction and global warming study, 2) producing a foundation for more accurate operational climate monitoring services. On the other hand, reanalysis products are useful for 3) various research activities in climate system studies and 4) to provide boundary conditions of an ocean general circulation model or initial conditions for a chemical transport model.

The performance and quality of the available reanalysis products do not agree with each other. Another reanalysis produced by Japan must be a new reference of the historical global atmosphere.

The purpose of JRA-25 is to offer the reanalysis data set and a consistent real-time objective analysis. Other intensive targets in JRA-25 are 1) to describe the Asian climate accurately and 2) to depict positions of tropical disturbances correctly.

JRA-25 Advisory Committee (AC) consists of authorities on climate system study, global atmospheric model simulation and data assimilation including representatives of JMA and CRIEPI. In addition, to assist the working group in validating reanalysis products and to promote application studies using the products, interested researchers in other institutes and universities are going to be organized into "reanalysis evaluation group" (EG). The group members are allowed to evaluate and analyze all output for their own interest. Figure 1 shows the organization and tasks of JRA-25.

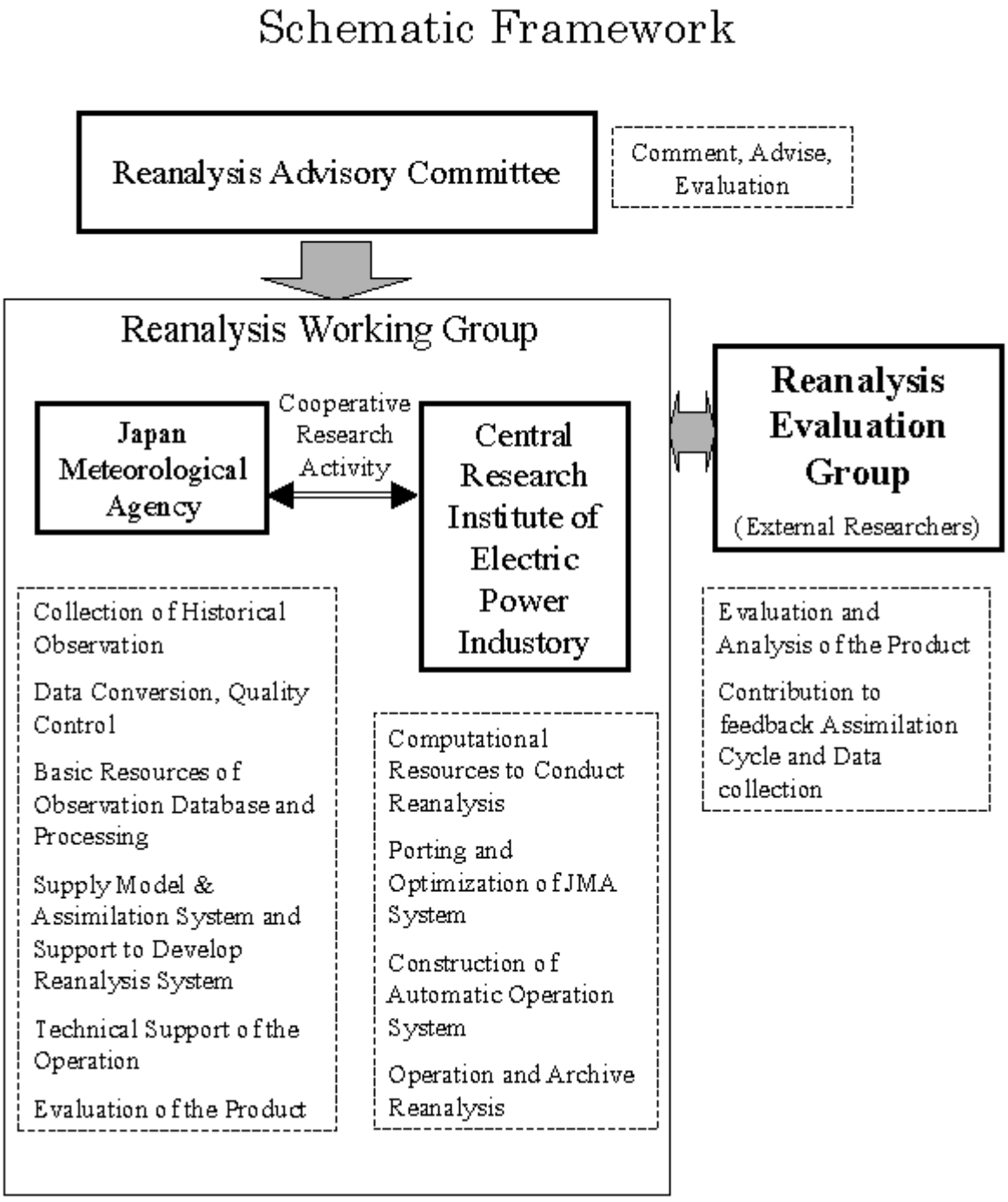


Figure 1 JRA-25 working system

3. Schedule

The period of JRA-25 consists of 3 stages.

i) 2001-2002 : Preparation of observed data, construction of the reanalysis system

WG mainly concentrates on collection of source data, format conversion, and preliminary QCs. In parallel, to perform long-term assimilation efficiently, an execution system with monitoring and visualization tools will be developed. The experiment and operation system should be designed to run highly automatically to avoid human errors.

After several kinds of experiments, the final experimental cycle for 1 or 2 years should be done before freezing the system. The products of the final experiment will be opened to EG and their comments will be reflected.

ii) 2003-2004 : Main operation

Using the frozen system, the main operation of reanalysis will be conducted. To make the total operation time short, the whole reanalysis period is divided into two streams of 1990-2004 (Stream 1; 15 years) and 1979-1991 (Stream 2; 12 years), for which operations are conducted in parallel. Throughout the operation, products should be monitored steadily 1) to find abnormal operation mainly by WG, and 2) to evaluate data quality with various analytical studies by mainly EG. If a problem caused by observation occurs, the operation will be interrupted and the appropriate treatment will be needed in each situation. If a serious problem were found in the middle of operation, AC would suggest WG for whether to rerun or to continue the operation.

iii) 2005 : Data distribution and evaluation

Averaging and formatting the output data product and developing the framework to distribute the product should be conducted. WG and EG analyze the reanalysis products from various aspects, and comprehensive report on the project should be documented.

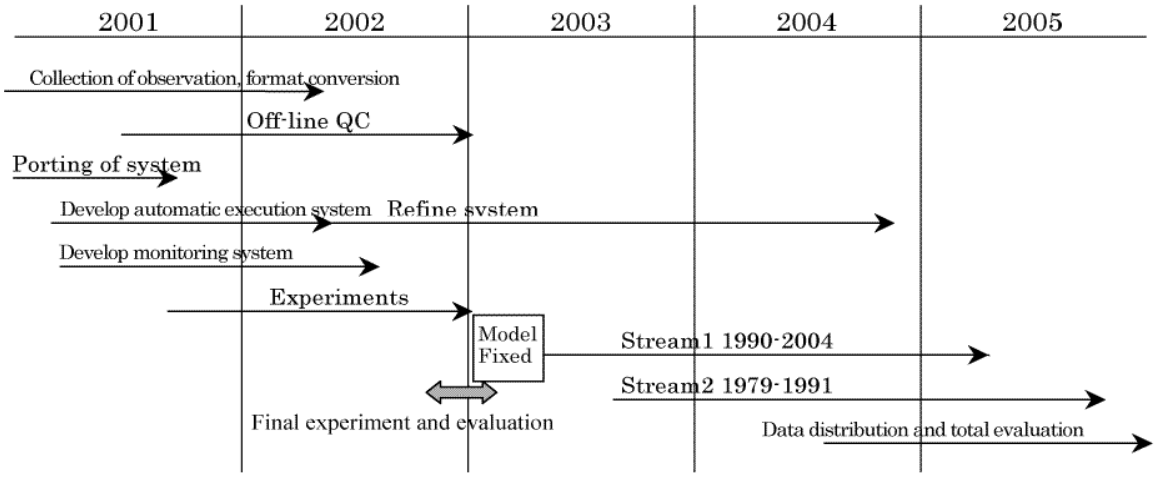


Figure 2 Schedule of JRA-25

4. Numerical models

Basically the latest JMA operational models at the beginning of the JRA-25 operation will be applied to JRA-25.

4.1. Forecast Model

The forecast model for JRA-25 is T106-L40 global model with the top level at 0.4 hPa based on the current operational T213 model. The resolution might be increased if we can improve the models faster to be able to operate within the limited computer resources. Extended forecasts (about 10-day period) are going to be executed regularly (e.g., in every 5-day interval) to monitor the forecast skill.

4.2. Data Assimilation

The 3DVAR global assimilation system, which has been operational since September 2001 at JMA, will be used in JRA-25. A TOVS 3DVAR scheme is intensively being developed. The operational quality control of observational data, internal QCs and OI-QC, will be applied.

4.3. Land surface model

A new Simple Biosphere model (n-SiB) with the refinements including 3-layered snow is intensively being developed in JMA. It is going to be operational in early 2002. The scheme for the reanalysis system is examined in the final stage of experiments after the long-term integration test of n-SiB.

4.4. SST and snow analysis

The JMA's operational 2d-OI SST analysis is going to be used in JRA-25. For the first guess, a new SST data set being compiled in JMA will be used.

A snow analysis scheme is intensively being developed and examined in Climate Prediction Division (CPD/JMA). The final decision will be made by April 2002 through the experiment related with the preliminary study for dynamical seasonal prediction.

5. Observation data

JMA has archived historical observational data acquired via GTS for the numerical data assimilation. The amount of the archived data set, however, is far less sufficient with several no data period to perform the reanalysis especially before 1983. It is necessary to acquire historical data from other centres with their co-operation. For the reanalyses in ECMWF and NCEP, observation databases were constructed mainly on the basis of the NCAR database, merging with other source data. JMA has contributed to the data archives as well. So far JMA has already obtained the conventional data used in the NCEP/NCAR reanalysis for the period from December 1978 to October 1999. The data are being transformed to the latest JMA-formatted observation database. The following kinds of observational data will be used in JRA-25.

5.1. Conventional data

- All BUFR conventional data used in the NCEP reanalysis

  JMA requested all conventional data used in the NCEP/NCAR reanalysis including retrieved TOVS and the data were kindly provided for the period from December 1978 to October 1999.

- The merged database of ECMWF and NCEP archives

  ECMWF and NCEP agreed to make a combined observation database including all conventional data of the both centres. It must be the most comprehensive database. ECMWF kindly agreed to the JMA's request to make the data set available for JRA-25 with handling costs.

5.2. TOVS

- Retrieved TOVS data is included in the NCEP BUFR data.
- Brightness temperature: ECMWF converted the brightness temperature data from level 1b to 1c for the use in ERA-40. ECMWF agreed to make the data available for JRA-25 with handling costs as well.

5.3. SSM/I

SSM/I data are available from 1987. Precipitable water retrieved by Wentz's algorism is available from Remote Sensing Systems with free of charge. Final decision will be made after examining the quality and impact of the data with some experiments.

5.4. SST, sea ice concentration

JMA's operational 2D-OI SST analysis system may be applied to JRA-25 using acquired SHIP, BUOY data and available NOAA AVHRR data. In JMA, a new SST and sea ice data set covering from 1901 is being compiled and processed. The compiled data set will be used as the first guess of the analysis. The final decision of SST analysis method will be made after examining the quality and performance with several experiments.

5.5. Snow coverage and depth

The following observations of snow coverage and depth are available.

- NOAA/NCEP/CPC issued the weekly snow coverage data set from 1970's to May 1999 with satellite input corrected by manual (subjective) analysis. The analysis method was changed in June 1999 as automatically derived from satellite input (SSM/I and visible).
- SSM/I derived snow coverage and depth by JMA algorithm (1987-present with small lacks in 1980's).
- In situ snow information reported by SYNOP.

Number of stations is rather small and their distribution is localized.

5.6. Tropical disturbances

So-called "bogus" technique was not applied in the completed reanalyses. JMA operates the Tokyo-typhoon centre as WMO Regional Specialized Meteorological Centre (RSMC) and compiles the detailed best track data. JRA-25 WG has already obtained historical best track data over the world throughout the project period from Dr. Mike Fiorino in PCMDI. However, the data do not have detailed parameters to define TC sizes and to make bogus wind profiles except recent years.

5.7. Reprocessed GMS cloud motion wind

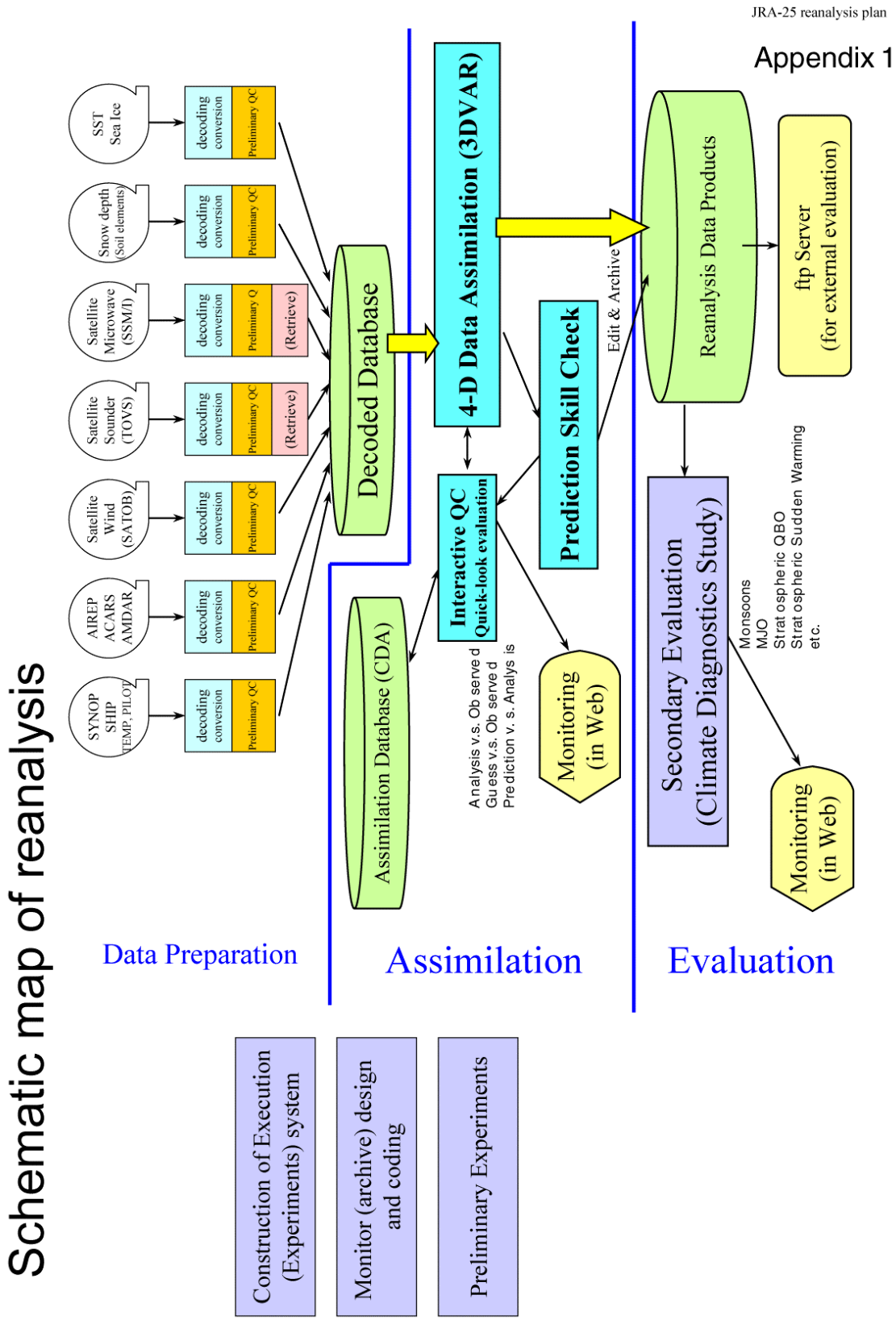
Meteorological Satellite Center (MSC/JMA) reserves infrared pictures to estimate cloud motion winds for the period from April 1987 onward. Data before 1987 were regrettably lost. MSC is going to reprocess cloud motion winds by the latest technique for JRA-25.

5.8. Other offline data

To improve the product of the atmospheric circulation field over Asia, especially Asian monsoon activity, it is important to dig out other data that were not available via GTS and to introduce them into the reanalysis. WG will gather this kind of off-line data intensively in the first two years. It is quite important not only for Japanese reanalysis but also for all reanalysis community, collection and compilation should be continued in collaboration with various data analysis experts not binding on the present reanalysis project.

Acknowledgement

For JRA-25 project, supports from other meteorological centres are the very crucial point. NCEP and ECMWF kindly offered us to make all observation data set those are not restricted by licenses available. Originally, most of those conventional data are archived and maintained by Roy Jenne in NCAR. To start JRA-25 project, Dr.M.Kanamitsu, Dr.J.Woollen, Dr.B.Kisler and Dr.W.Ebisuzaki in NCEP, and Dr.A.Hollingsworth, Dr.A.Simmons and ERA staffs in ECMWF were unsparing in their advice and help.


JRA-25 reanalysis plan
Appendix 1
Schematic map of reanalysis
SST
Sea Ice
Snow depth
(Soil elements)
Satellite
Microwave
(SSM/I)
Satellite
Sounder
(TOVS)
Satellite
Wind
(SATOB)
AIREP
ACARS
AMDAR
SYNOP
SHIP
TEMP, PILOT
decoding
conversion
Preliminary QC
Preliminary Q
(Retrieve)
Preliminary QC
(Retrieve)
Decoded Database
Assimilation Database (CDA)
4-D Data Assimilation (3DVAR)
Interactive QC
Quick-look evaluation
Analysis v.s. Observed
Guess v.s. Observed
Prediction v. s. Analysis
Monitoring
(in Web)
Prediction Skill Check
Edit & Archive
Reanalysis Data Products
ftp Server
(for external evaluation)
Secondary Evaluation
(Climate Diagnostics Study)
Monsoons
MJO
Stratospheric QBO
Stratospheric Sudden Warming
etc.
Monitoring
(in Web)
Data Preparation
Assimilation
Evaluation
Construction of Execution
(Experiments) system
Monitor (archive) design
and coding
Preliminary Experiments