Japanese 25-year Reanalysis Plan

13/Aug/2001

JRA-25 working group

Japanese 25-year Reanalysis Plan

Content

1. Introduction

Leading meteorological centers in USA and Europe have performed “reanalysis” projects starting early 1990's. “Reanalysis” means producing historical global objective analysis dataset for over last decades in a consistent manner with a fixed state-of-the-art numerical weather prediction data assimilation system. Since this kind of dataset had not been in existence before, the release of these pioneering data products, although they still depend their quality on each system, gave many impacts on operational climate-system monitoring routines and climate analysis studies.

In Japan, recent urgent needs for more accurate environmental and climate diagnostic information boosted the plan to produce another reanalysis dataset by own system of Japan Meteorological Agency (JMA), and JMA and Central Research Institute of Electric Power Industry (CRIEPI) agreed to conduct a reanalysis as a cooperative research project in combination with other research institutes or universities. This project is denominated as JRA-25 (Japanese Re-Analysis 25 years) and the data product is also called JRA-25.

2. Target and outline

JMA and CRIEPI agreed to offer their technical experts, software and computational resources, which are necessary to complete around 26-year reanalysis from 1979 to 2004. They signed the cooperative research contract on 27th April 2001 and the period of this cooperation is for the fiscal years from 2001 to 2005. On one hand, JMA's main objectives of this work are as follows: 1) preparation for consistent initial conditions and validation dataset which are necessary 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 as 4) boundary condition of an ocean general circulation model or input for a chemical transport model. Also many feedbacks for numerical prediction model and data assimilation system are expected by conducting reanalysis in collaboration with third party.

Data assimilation techniques are rapidly developing now, so that available reanalysis products do not necessarily agree with each other and their qualities depend on generating systems. Another version of reanalysis by Japan provides another reference for the historical global atmosphere and can potentially contributes to reduce its error-bar. From this point of view, the target of JRA-25 is to offer the reanalysis dataset and a consistent real-time objective analysis, which is competitive with NCEP/NCAR reanalysis-1 (CDAS) in quality. Other intensive targets in JRA-25 are 1) to depict

positions of tropical disturbances correctly and 2) to describe Asian climate accurately.

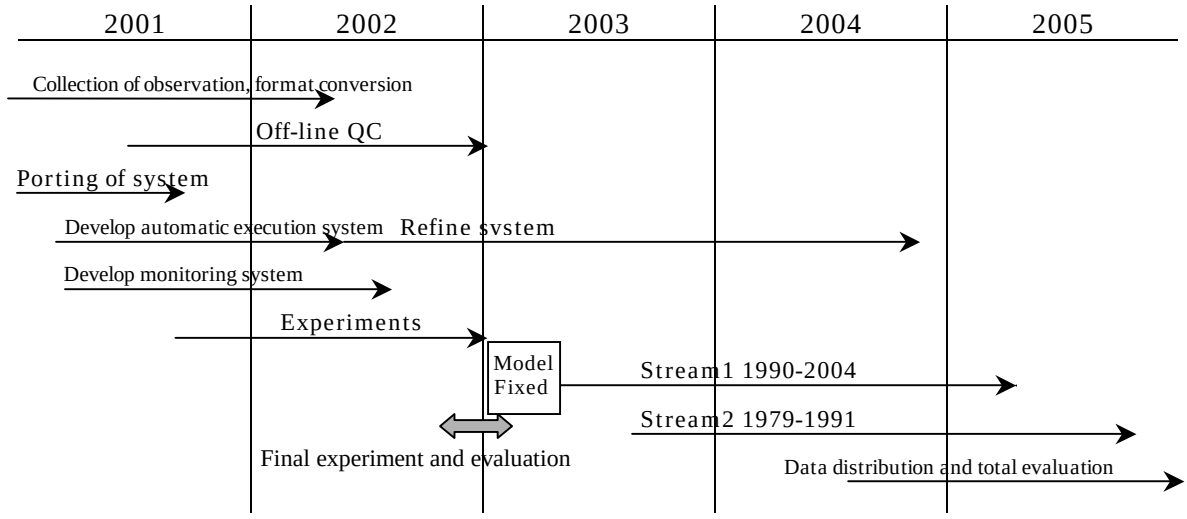
"Japanese reanalysis advisory committee" (AC, see section 4) consists of authorities on climate system study, global atmospheric model simulation and data assimilation including representatives of JMA and CRIEPI. In addition, to assist the working group in validating reanalysis products and to promote application studies using the products, interested researchers in other institutes and universities are organized into "reanalysis evaluation group" (EG, see section 4). The group members are allowed to evaluate and analyze the all output for their own interest.

Table 1 Comparison between JRA-25 and other reanalyses

Name	Organization	Period	Resolution	Assimilation	
JRA-25	JMA-CRIEPI	1979-2004	T106L40(plan)	3DVAR	
ERA-15	ECMWF	1979-1993	T106 L31	OI	Completed in 1996
ERA-40	ECMWF	1958-	TL159 L60	3DVAR	Ongoing, expected to complete in 2003.
NCEP-NCAR (Reanalysis-1)	NCEP-NCAR	1948-	T62 L28	3DVAR	Data for 1957～1996 were offered in 1996. CDAS ongoing afterwards.
NCEP-DOE AMIP-II (Reanalysis-2)	NCEP-DOE	1979-1999	T62 L28	3DVAR	Completed up to 1996.
GEOS1	NASA/DAO	1980-1996	2×2.5 L20	OI + IAU	Completed up to 1994
GEOS2	NASA/DAO	started from 1979	1×1 L48	3DVAR	Analysis for the period of FGGE started.

T: Triangular truncation, TL: Triangular with Linear reduced Gaussian grid, L: Vertical layers.
T106, TL159 is comparable to lat-lon grid with about 110km interval, T62 is comparable to about 180km.

Figure 1 Summary schedule



3. Summary plan

A summary schedule is shown in Fig.1 and a detailed one is attached in appendix 1. Period of the project is the fiscal year from 2001 to 2005, and the principal task will change in each stage of the progress.

1) First 2 years (Apr.2001-Mar.2002): Preparation of observed data, development of the reanalysis system

In this period, WG mainly concentrates on the collection of source data, the format conversion, and the preliminary QC. In parallel, to perform long-term assimilation efficiently, an execution system with monitoring and visualization tools will be developed. Then various assimilation experiments are conducted before the fixing of the system to operate the reanalysis cycle. The purposes of preliminary experiments are, firstly to collect quality information of the observations, and secondly to assure the quality of reanalysis product by checking the model physics and the model climate. The second kind of experiments should be performed under the close collaboration with modelers. The final experimental cycle for 1 or 2 years in the assimilation period and the evaluation of its result should be done before freezing the system. The result of the latter ones of experiments will be opened to EG as the sample evaluation data, and their comments will be reflected.

2) The third and forth year(Apr.2002-Mar.2004): Main operation

Using the frozen system developed in the first stage, the main operation of reanalysis will be conducted. The experiment and operation system should be designed to run highly automatically to avoid human errors. To compress total schedule, two streams divided into 1990-2004 (15 years), and 1979-1991 (12 years) will be operated. At the beginning of the main operation, most careful monitoring is needed. Therefore, the period after 1990, where the quality and quantity of observation is assured, is chose to be conducted. After necessary check of the source data and the system, more difficult preceding period will be done. Throughout the operation, results should be monitored steadily 1) to find abnormal operation mainly by WG, and 2) to evaluate data quality with various analytical studies by mainly the evaluation group. If a problem occurs, the operation will be interrupted and the appropriate treatment will be needed in each situation. If a serious problem was found in the middle of operation, AC would suggest for whether to rerun or to continue the operation.

3) Final year (Apr.2004-Mar.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 data from various aspects (for example, interannual variability of Asian monsoon, tropical disturbances, etc.), and comprehensive report on the project should be documented.

4. Framework

The figure in appendix 3 shows the schematic framework of the reanalysis. It is constituted of 1) reanalysis advisory committee (AC); 2) reanalysis working group (WG) which mainly consists of experts from JMA, MRI: Meteorological Research Institute, and CRIEPI; and 3) reanalysis evaluation group (EG) which consists of researchers in third party.

Reanalysis Advisory Committee (AC)

The committee is in charge of total scientific consultation. If a serious problem would occur in the course of the operation, it examines scientifically whether to continue the operation and make data consistent but partly erroneous, or to dissolve the problem and rerun the stream from the start. The committee consists of authorities of meteorology, climate system study and climate model from the universities and research institutes, and representatives from JMA, MRI and CRIEPI. It will be held once or twice a year in response to the achievement.

Reanalysis Working Group (WG)

The working group is composed of technical experts from JMA, MRI and CRIEPI under the cooperative research contract. To carry out the project, following tasks have to be achieved:

- Preparation of the observation database and preliminary quality control.
- Design and coding of an automated experiment, operation and monitoring system.
- Diagnosis and evaluation of output data.

The loading of each task changes in stages of the project achievement.

Reanalysis Evaluation Group (EG)

To improve the quality of reanalysis product, it is needed to organize the evaluation group including outside researchers from various fields covering climate system. Members of EG conduct validation and data analysis from multiple aspects. The framework of EG should be prepared so that many researchers can freely access dataset by their interests without much obligation and take part in the project by

giving their voluntary feedbacks. It is desirable that EG members can perform both real-time validations and climate diagnostic studies, give comments, requests and warnings at any time. Requests and advises to the WG are also needed at the stage of the selection of the output elements and making the archival design. To grow up the EG activity effectively, making rapporteurs in EG as the core members who owe some obligation to evaluate and report in particular fields is recommended. In this case, to clarify the merits of core members, for example, preferential use of final data products before public release, is important.

5. Technical details

Assigned human and computational resources are limited with 5-year deadline. Therefore, to complete the project, we should set up the minimal level of the output quality and aim higher target in response to the achievement. The target period for this time is set after 1979 where global observing system including satellites was established. The more predated reanalysis will be expected in the planning of the next generation reanalysis.

5-1. System

The JRA-25 reanalysis system will be constructed based on the latest most stable version of the model and assimilation system in JMA.

1) Model resolution

Giving consideration of the ability to represent tropical disturbances and orographic effects, model resolution is set to T106-L40 (horizontal grid size around 110km, 40 vertical layers with the top at 0.4 hPa) based on the present operational T213 model. Resolution might be increased in some circumstances depending on the result of experiments. Throughout the operation, extended forecasts (about 10-day period in length) are regularly (e.g., in every 5-day interval) performed to monitor the forecast skill. Final decision on the model resolution will be made after the stage of experiments by estimating computational resources for both assimilation cycle and extended forecasts.

2) Assimilation

The assimilation scheme is planned to be the 3-dimensional variational method (3DVAR) that will be adopted in JMA's operational system in September 2001. The assimilation parameters have to be adjusted to T106 model resolution. To follow the

update of JMA's operational system and adopt robust and well-adjusted version of it for the reanalysis system, close commitment of Numerical Prediction Division(NPD)/ JMA is necessary.

3) Snow analysis

A snow depth analysis by SYNOP reports is working in the present JMA's operational system. However the output of land surface model (SiB) is not utilized as the 1st guess in the operation. For the reanalysis, there are alternative of 1) constructing forecast-analysis cycle by coupling the snow output of SiB to snow depth analysis step, or 2) using standalone snow depth analysis only to make initial conditions with the input of weekly snow coverage data issued by the Climate Prediction Center (CPC) in USA and SYNOP reports. The decision will be made by April 2002 through the impact study by Climate Prediction Division (CPD) related with the preliminary study for dynamical seasonal prediction. The present snow depth analysis does not use satellite data since their quality is unknown. However the present code has the function to utilize satellite input by only parameter changes.

4) Land surface model

The present version of land surface model (SiB) had already been improved in CPD to be utilized in the dynamical seasonal prediction model. The off-line 10-year integration of SiB model by atmospheric forcing with ERA-15 proved its good nature without the drift of soil elements. The new SiB (n-SiB) with the refinements including 3-layered snow is intensively being developed now in NPD, MRI and CPD. It is going to be in operation in December 2001. The alternative for reanalysis system is examined in the final stage of experiments after the long-term integration test of n-SiB. The way of calculation of the soil moisture and other land elements will be examined whether to use the only forecast value or to use some kind of assimilation, for example, making use of observed precipitation as forcing.

5-2. Observation database

As an operational meteorological center, JMA reserved historical observation data for the numerical prediction or other purposes procured from the global telecommunication system (GTS) network. The amount of these dataset is far less enough with many lacks of data to perform the reanalysis. On the other hand, conventional data prepared for NCEP/NCAR reanalysis were kindly transferred to JMA by NCEP for the period December 1978-October 1999. In the first stage, we will use these source data to

integrate the latest JMA-formatted observation database. The deadline of the preparation of the input data will be set around in the middle of 2002. Therefore available data is rather limited and intensive effort to gain data will be continued until then.

Besides, on the operation of completed reanalysis in NCEP or ECMWF, observation database is constructed based mainly on NCAR database, merging with other source data. JMA cooperated to send own data archive at their request at the time.

Following data are already obtained (or requested):

1) Conventional data (in situ data like SYNOP, TEMP, PILOT, AIREP, SATOB cloud drift wind and so on, other than remote-sensing data by satellites)

- All BUFR conventional data by NCEP reanalysis
  JMA requested all conventional data for NCEP/NCAR reanalysis including retrieved TOVS and they kindly sent them for the period from December 1978 to October 1999. These data are copies of NCEP's counterpart to be merged in ECMWF for the "big merge" (see below).
- The combined database between NCEP and ECMWF（the big merge）
  ECMWF and NCEP agreed to make a combined observation database including all conventional data of both centers. This is more comprehensive database but the licenses from both centers are needed to use it.（On October 2000, NCEP sent data for the big merge, and on June 2001, merging is ongoing in ECMWF）. ECMWF accepted the JMA's request to use this data for the reanalysis with their handling cost.

2) Satellite：TOVS（Vertical sounding unit boarding on polar orbiter NOAA by USA）

- Retrieved TOVS is already included in BUFR conventional data from NCEP.
- Brightness temperature：ECMWF converted the brightness temperature data from level 1b to level 1c in the preparation of ERA. The request of JMA to use this data in Japanese reanalysis is accepted by ECMWF with their handling cost.

It is desirable that TOVS brightness temperature is directly assimilated with 3DVAR.

3) Satellite：SSM/I

SSM/I data are available after 1987. The use of these data would cause data gap in product at that time. From SSM/I, one can retrieve many elements including total precipitable water and sea surface wind speed. NCEP did not use SSM/I in their

reanalysis. There are following alternatives on SSM/I:

- SSM/I data can be purchased from Remote Sensing Systems (www.ssmi.com). In this way, all existent data are available but the estimated cost is very high. ECMWF maybe bought these data on ERA-15 project.
- JMA has already obtained the brightness temperature limited from single satellite series for the period for August 1987-August 1996. The EOS Distributed Active Archive Center (DAAC) at the National Snow and Ice Data Center (NSIDC), University of Colorado provided this data.
- Retrieved precipitable water by Wentz's algorism is available from Remote Sensing Systems for free, but the limitation of the license is unknown at the moment.

Experiments are needed on 1) the comparison between direct assimilation of brightness temperature with variational method and using retrieved precipitable water. After the consideration on the trade-off between homogeneity of input data and the quality of the output, and the policy of the development of JMA's operational assimilation, decision will be made on how to assimilate SSM/I. However, it seems difficult to modify from the JMA's operational system in large extent.

4) SST, sea ice concentration

SST and sea ice concentration covering throughout the reanalysis period (1979-2004) with steadily higher quality are necessary. JMA has the following datasets:

- The output of the present operational SST analysis system by NPD/JMA with SATOB (STBSST) and COADS input.
- The present SST analysis by the Office of Marine Prediction (OMP) /JMA. Since these data are assimilated with only in situ observations, large data-lack area spreads over the southeastern Pacific. This is not applicable to use in an assimilation cycle unless data-lack filled. Data period starts from 1946 but data-lack covers more area in older time.
- The new SST, sea ice dataset covering from 1901 to be compiled and processed around in 2001.

At the moment the last choice looks most suitable for the reanalysis.

5) Snow coverage and depth

The following observations of snow coverage and depth are available for input:

- NOAA/NCEP/CPC issued the weekly snow coverage dataset from 1970's to May 1999 with satellite input corrected by manual (subjective) analysis. These data are

renewed from June 1999 as automatically derived from satellite input (SSM/I and visible). Their connectivity is yet unknown.

- 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 spatiotemporally localized.

6) Ozone, Aerosol

Daily mappings of total ozone by TOMS are accumulated in JMA. Real-time data are also available via network. Vertical profiles can be estimated with SAGE data.

In JMA, direct assimilation of ozone have not been achieved. Therefore, it is difficult to assimilate ozone (or aerosol) with coupled chemical transport model in this reanalysis. The impact test to introduce estimated three-dimensional distribution of ozone by TOMS, are going to be performed.

7) Tropical disturbances

We are gathering various best track data of tropical disturbances. The introduction of tropical disturbances tracks by some "bogus" technique was not applied in forgoing reanalyses. If track data were introduced the product could describe more realistic characteristics of tropical disturbances. However, many original data only include the location so that the development of the technique to estimate wind distribution is necessary. JMA operates Tokyo-typhoon center as WMO Regional Specialized Meteorological Center (RSMC), and compiles the detailed best track data. On the other hand, WG obtained historical best track data over the project period from Dr. Mike Fiorino in PCMDI. These data do not have detailed elements to make bogus wind profile except recent data. To make wind profile around typhoons is a problem.

8) Reprocessed GMS cloud drifting wind

Meteorological Satellite Center (MSC)/ JMA reserves infrared picture to estimate cloud drifting wind for the period from April 1987 onward. Data before 1987 were unfortunately discarded. It is already planned to reprocess the cloud drifting wind with the present level of technique in the preparation of the reanalysis for the all available period.

9) 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. Because this activity is most 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 where temporal deadline of input data scheduled very tight.

5-3. Tasks

The schematic diagram of the reanalysis project is shown in Appendix 1. The details are following:

1) Input data preparation (decoding, unifying formats, pre-QC and retrieving)

Decoding and unifying formats

Obtained observation data will be decoded and converted to fit the JMA's observation database. Source data prepared by forgoing reanalysis projects should be adopted as much as possible. Converting from the obtained BUFR-formatted data to JMA's "DCD" format is necessary. Since the format of the old data reserved by JMA is not compatible with the present system, a newly converted database of JMA's historical data are ongoing in MRI until Autumn 2001.

Preliminary quality control

For each of the SYNOP, SHIP, BOUY, TEMP, PILOT, AIREP, SATOB and TOVS, the preliminary QC will be done in order to discard the low-quality observation. Tests by the data record itself (internal consistency check), check with time series and intercomparison among other reanalysis and observations will be made. WG members cooperatively cover the each observation element. Solar radiation corrections for TEMP reports and comparison with ERA-15 for drifting buoys are recommended.

Retrieving physical parameters from satellite observation

If we take the policy to assimilate SSM/I by retrieval with MSC algorithm the pre-processing will be needed. On direct assimilation of TOVS brightness temperature it will be needed to assign an expert against the complex expertise on the correction of aging in brightness temperature and the format conversion.

2) System construction

The JMA's operational numerical prediction model assimilation system will be ported to the main frame of the reanalysis: VPP5000 in CRIEPI. A new reanalysis operation

system will be constructed. The system should have the function of automated execution and experiment with series of routines in assimilation cycle, also with monitoring and archiving. This system is based on the experiment system developed in NPD/JMA in May 2001 (NAPEX). Since many sub-programs compose the present assimilation cycle it is demanded to use the automated execution and monitoring system to diminish the human-errors. Introduction of SMS will be considered, which is a program developed in ECMWF to control the operation and the experiments. To access the output from remote sites outside of the operation platform, web applications in a rental server will be planned because the security policies in JMA and CRIEPI are rather tight for this purpose. The system and source codes will also be ported in MRI (Tsukuba science city) where some experiments and improvements are performed. These works will be done parallel in three locations (CRIEPI, JMA and MRI), so that the version control of programs is very important.

3) Preliminary experiments and evaluations

Systematic schedule for experiments will be made and conducted before fixing the final model and assimilation system. The results of the experiments will be available for all EG members. The framework that experts from various fields (atmospheric circulation, radiation, hydrology and polar climate etc.) in EG could evaluate the quality of the products and smoothly give their comments or warning is necessary. The distribution policy and method including data set for validation will be hence further discussed.

The following types of experiment are considered:

- interactive quality control test of all kinds of data
- system dependency test:

  to check if the difference in numerical calculations is negligible between Hitachi SR8000 in JMA and FUJITSU VPP5000 in CRIEPI
- solar radiation correction of radiosonde data:

  to examine and define the values of solar radiation correction of radiosonde data
- the parameter tuning of 3DVAR:

  If T106 resolution is adopted the operational 3DVAR for T213 should be modified and parameter-tuned to fit T106 model resolution.

  ([Note] Since the operational system will use the T106 resolution for increment, many cases of the experimental prediction is not always necessary.)

・tests related with land surface:

to check which (new and old) SiB is more drift-free and shows good nature. Firstly off-line runs without coupling on atmospheric model are necessary. Intercomparison between the forecast cycle and simple assimilation of observed precipitation (introduced in NCEP reanalysis-2) is expected to be effective.

・OSE(Observing System Experiment) of satellite data:

to compare between the cases on and off a particular satellite data-type

・final model test:

The prediction model will be integrated alone for over a year to check model climate from various aspects.

4) Main operation, monitoring and evaluation

The reanalysis cycle will come into operation throughout the planned period. Automatic system should be introduced as much as possible. It is necessary to monitor and evaluate whether system is running without trouble or serious bias: to be precisely, the number of rejected observation data sorted in type and area, the consistency between analysis and observation, and the forecast skill of regular extended prediction will be monitored. This is not always light duty because 2- or 3-month outputs will be produced for a week in peak of the operation. In the beginning of the main operation it is very important to distribute the output among EG members for the multi-aspect validation and the earlier warning against potential errors.

It is impossible to eliminate all the bugs or human-errors. The posture to adjust the quality control and assimilation, and to execute experiment again in case of necessity, should be kept through the operation.

5) Distribution of the product

Experiment and operation outputs will be distributed to the researchers who participate in the project. If the quality is confirmed, final product will be offered even in the middle of the operation streams. The method for distribution should be further discussed, while the network should be highly utilized. Tape handlings should be avoided. The way to supply the reanalysis product after the cooperative research period of JMA and CRIEPI should be further discussed hereafter.

5-4. Archive design

WG will issue the “JRA-25 archive plan” separately. At that stage, the advices and

comments on the archival design: the selection of output elements, and spatiotemporal resolution, will be approved from AC and EG and other potential users.

Table 2 Tasks and related data

Task category	Task	Data
Source data	Collection of input data Format conversion NCEP/BUFR TOVS others Off-line Quality Control Time series (Independent validation data)	NCEP/BUFR (NCEP&ECMWF, Big Merge) Atmosphere (land) TEMP, PILOT, SYNOP, etc. SATOB TOVS (Soil moisture?) Boundary condition SST, sea ice Snow coverage and depth (SSM/I) (Ozone, aerosol)
System	Porting to CRIEPI and MRI T106L40 & 3DVAR Develop monitor(visualization) and validation tools Check correspondence (JMA, CRIEPI) Validation method Automated operation control	Parameter files Test input data
Experiments	On-line QC, OSE Land model Condition of model soil moisture (3DVAR tuning) (Improvement of model scheme)	
Operation	Fix system(T106) Fix input data Period(1979-2004) Stream number (execution about in one year) Fix archive design Final estimate of computer resources Backup system Execution Monitoring (element, framework) Number of rejected data Forecast skill	Raw output Product for evaluation
Research and publication	OSE results Development in assimilation Number of tropical disturbances Asian monsoon General (comprehensive) report	
Information Distribution	Arrange the advisory committee Web site Mailing list Distribution to the evaluation group	Distribution data (method)

5-5. Computational Resources

Main assimilation cycle of the present reanalysis will be executed on the supercomputer system in CRIEPI where FUJITSU VPP5000/32PE, mass storage: SONY PetaSite (38TB) and other peripherals are available. The experiments will be performed also on computer system in MRI with HITACHI SR8000.

Computational power in need is directly dependent on the resolution. Horizontal resolution of reanalysis model is assumed T106 (or more) as the following. In T106 case, the computation time is estimated as the following by 4PE of JMA's SR8000.

Assimilation cycles daily 4-times	134 minutes
Per 10 day	1 day
Per 10years	1 year

(Without the computation of regularly extended forecasts)

The real computation time on VPP5000 is unknown at the moment and a test run is being prepared now. The nominal performance for SR8000/80PE is 768GFLOPS, while for VPP5000/32PE it is 307.2 GFLOPS, and 9.6GFLOPS per PE is in common.

The work disk capacity for 1-day assimilation is estimated to a few GB when the output elements are the same as the present operational numerical weather prediction. Since this estimation is dependent on the number of the elements, whenever the plan is changed the update of the accurate values of work disk size, CPU time and archive storage size is necessary.

6. Data availability

While the reanalysis dataset is very beneficial to climate research and model development, it is also expected that many helpful feedbacks will be given to model and assimilation developers by the use of experts in various fields of studies, so that we should pay attention to maximize the availability of the product to potential users.

This project is managed mainly by the cooperative research of a national agency and a private foundation with some other participants as the evaluation group members. The products will be firstly the common property of participants. In addition, we should establish the framework that various users, who potentially contribute to the evaluation of the products and feedback to model and assimilation improvements, can easily access the dataset basically for nothing.

Acknowledgement

In this project, supports from other meteorological centers are the very crucial point. NCEP and ECMWF kindly offered us all observation dataset that not restricted by

licenses. Originally, much of those conventional data are archived and maintained by Roy Jenne in NCAR. In the beginning stage Masaru Kanamitsu, Jack Woollen, Bob Kisler and Wesley Ebisuzaki in NCEP, and A. Hollingsworth and other staffs in ECMWF were unsparing in their advices and helps.

Glossary

BUFR	Binary Universal Form for Representation
COADS	Comprehensive Ocean-Atmosphere Data Set
CPC	Climate Prediction Center
CRIEPI	Central Research Institute of Electric Power Industry
DAO	Data Assimilation Office
ECMWF	European Centre for Medium-Range Weather Forecasts
GEOS	Goddard Earth Observing System
GMS	Geostationary Meteorological Satellite
GTS	Global Telecommunication System
IAU	Incremental Analysis Update
JMA	Japan Meteorological Agency
MSC	Meteorological Satellite Center
NASA	National Aeronautics and Space Administration
NSIDC	National Snow and Ice Data Center
NOAA	National Oceanic and Atmospheric Administration
NCEP	National Centers for Environmental Prediction
NCAR	National Center for Atmospheric Research
ERA-15	ECMWF 15-year reanalysis (their first reanalysis project for 1979-1993)
SAGE	Stratospheric Aerosol and Gas Experiment
SATOB	Report of Satellite Observations of Wind, Surface Temperature, Cloud, Humidity, Radiation
SiB	Simple Biosphere
SMS	Execution and experiment system developed in ECMWF
SSM/I	Special Sensor Microwave/Imager
SST	Sea Surface Temperature
TOMS	Total Ozone Mapping Spectrometer
TOVS	TIROS Operational Vertical Sounder
VAR	VARiational method, a type of data assimilation
SYNOP reports	data of surface station observation and its report in text format.
Retrieval	The algorithm for the conversion from satellite brightness temperature to

physical parameters such as temperature or humidity.

JRA-25 reanalysis advisory committee

Chairperson	Dr. Tomio Asai	(Univ. of Tokyo/ JSTC)
Board	Dr. Toshiki Iwasaki	(Tohoku Univ.)
	Dr. Masahide Kimoto	(CCSR, Univ. of Tokyo)
	Dr. Toshio Koike	(Univ. of Tokyo)
	Dr. Hisashi Nakamura	(Univ. of Tokyo)
	Dr. Kimio Hanawa	(Tohoku Univ.)
	Dr. Tetsuzo Yasunari	(Univ. of Tsukuba)
	Mr. Nobuo Sato	(Numerical Prediction Division, JMA)
	Mr. Shingo Osano	(Climate Prediction Division, JMA)
	Dr. Hiroki Kondo	(Director of climate research dept.,MRI)
	Dr. Koki Maruyama	(Director of environment research dept., Abiko research institute, CRIEPI)

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Mr. Masami Sakamoto	(CPD, JMA)
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Dr. Kiyotoshi Takahashi	(CRD, MRI)
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Dr. Shinji Kadokura	(Komae inst., CRIEPI)
Dr. Koji Wada	(Komae inst., CRIEPI)

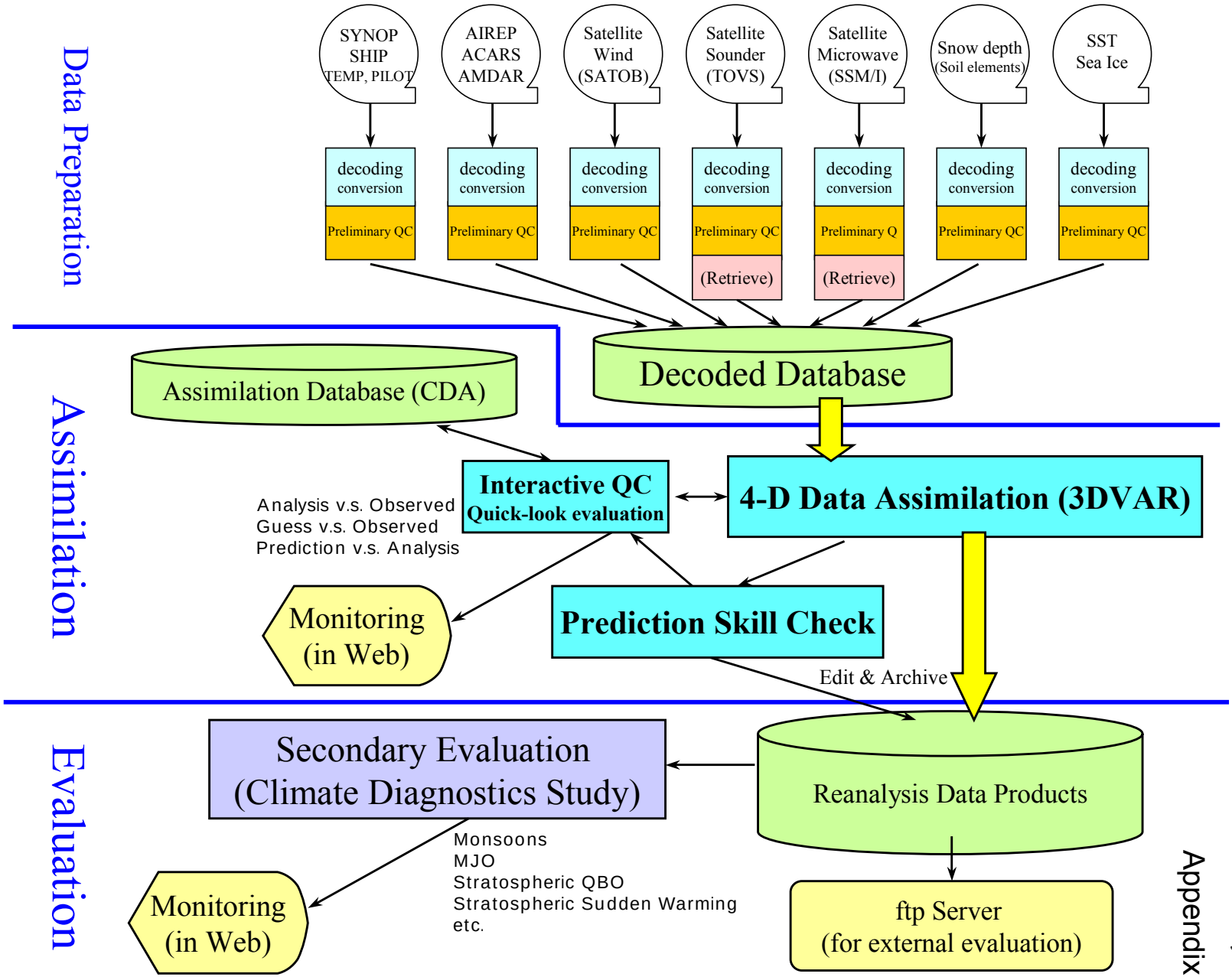
Appendices

Schematic map of reanalysis

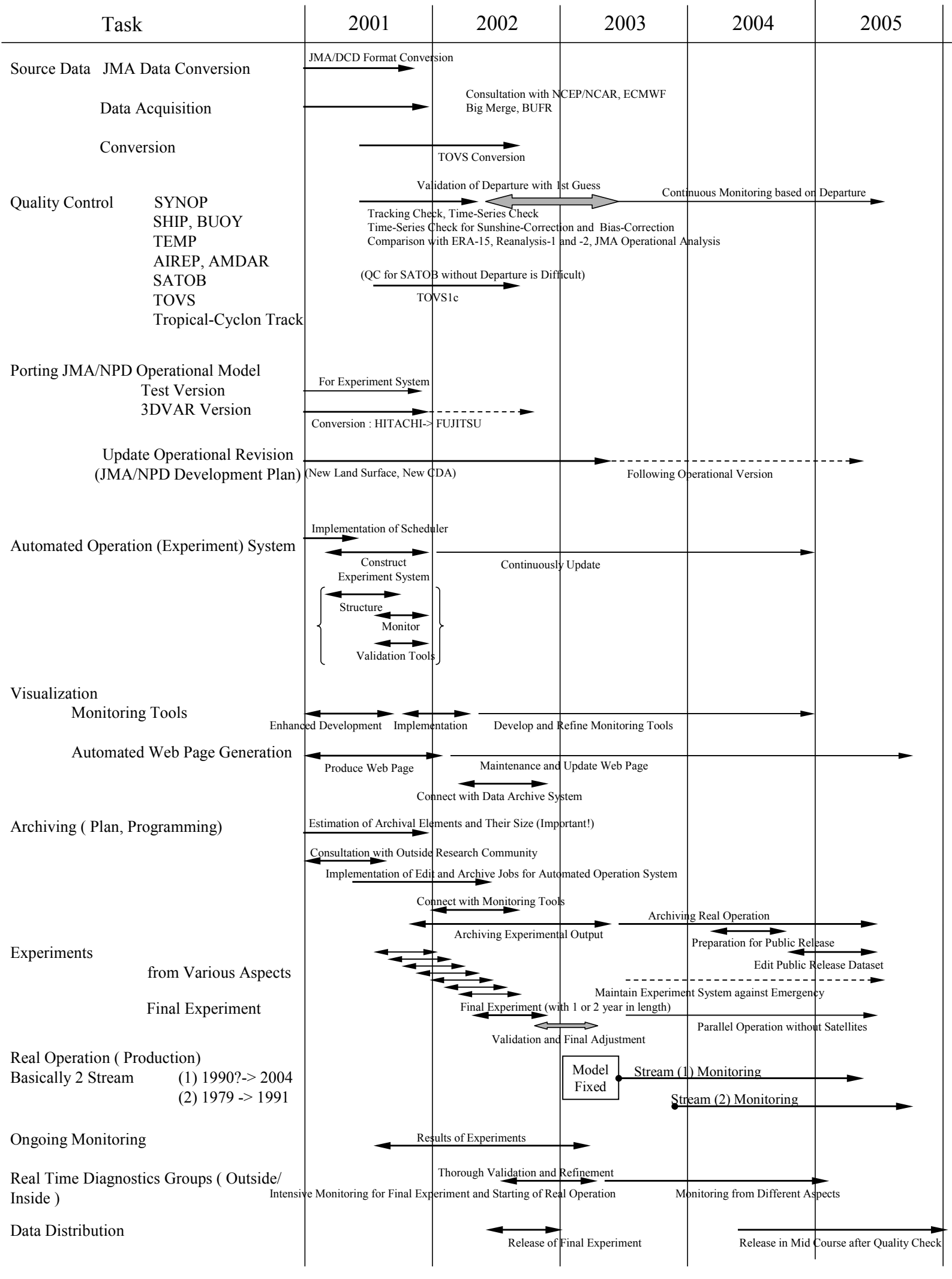
Construction of Execution (Experiments) system

Monitor (archive) design and coding

Preliminary Experiments



Schedule of Japanese Reanalysis



Appendix 3

Schematic Framework