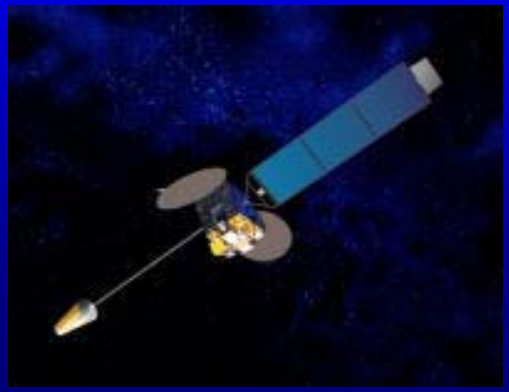
Application of Japanese Reanalysis JRA-25 for climate information

Kazutoshi Onogi

Climate Prediction Division, JMA

21 Feb. 2007, OPRF



Contents

- Introduction of reanalysis and JRA-25
- Performance of JRA-25
- JRA-25 applications
- Data service and announcement

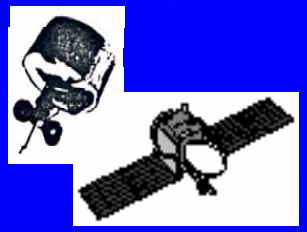
Conception of Long-term Reanalysis

Observation for decades

Operational Numerical Analysis & Prediction System

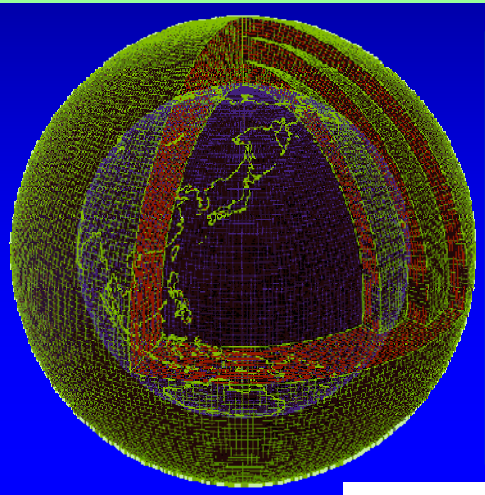
★Conventional (1958～2004)

★Satellite (1979～2004)



TOVS
SSM/I

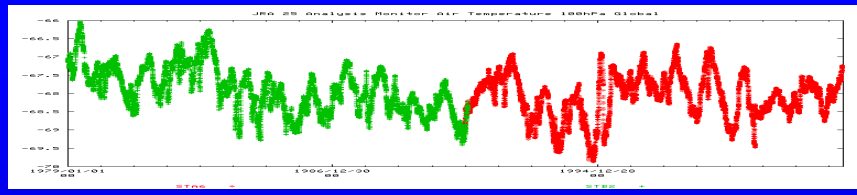
★Tropical Cyclone Wind Retrieval



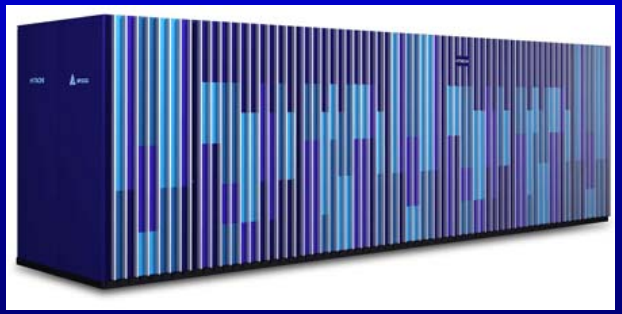
Japanese 25-year Reanalysis

JRA-25

(1979-2004)



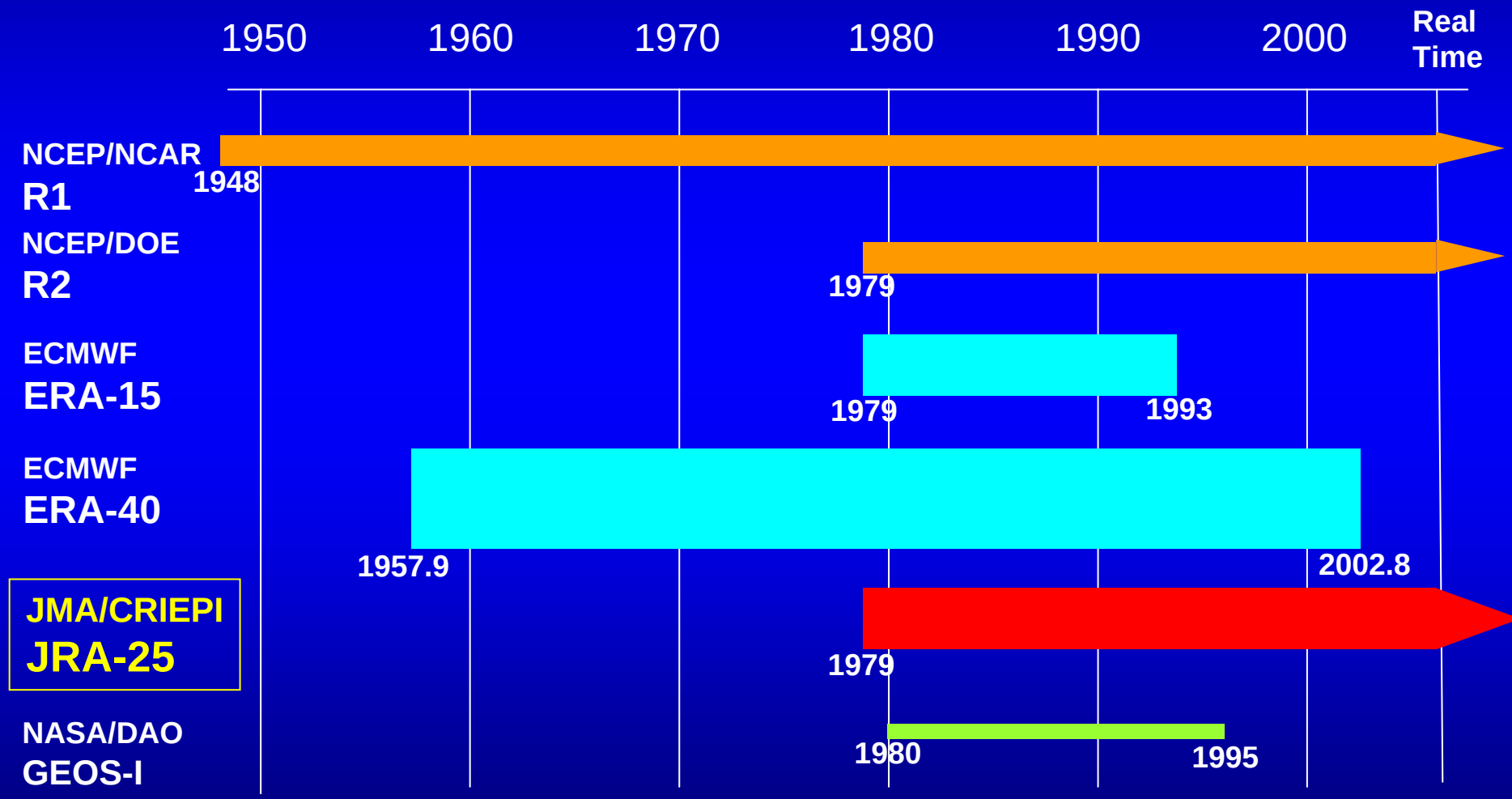
Super Computer System



✧Temporally Consistent
✧Global Coverage
✧Comprehensive Archives
✧Many physical variables

Consistent Best Estimation of Global Atmospheric & Surface Climate

Long-term Reanalyses



Thickness: Resolution, Allow of a Bar: Operational Climate Data Assimilation System

Outline of JRA-25

- Joint research project of JMA and CRIEPI
- The first reanalysis project in Asia
- Assimilation & Forecast Model:

  JMA's Operational 3-Dimensional Variational DA Scheme

  JMA GSM T106, 40 layers with top at 0.4hPa

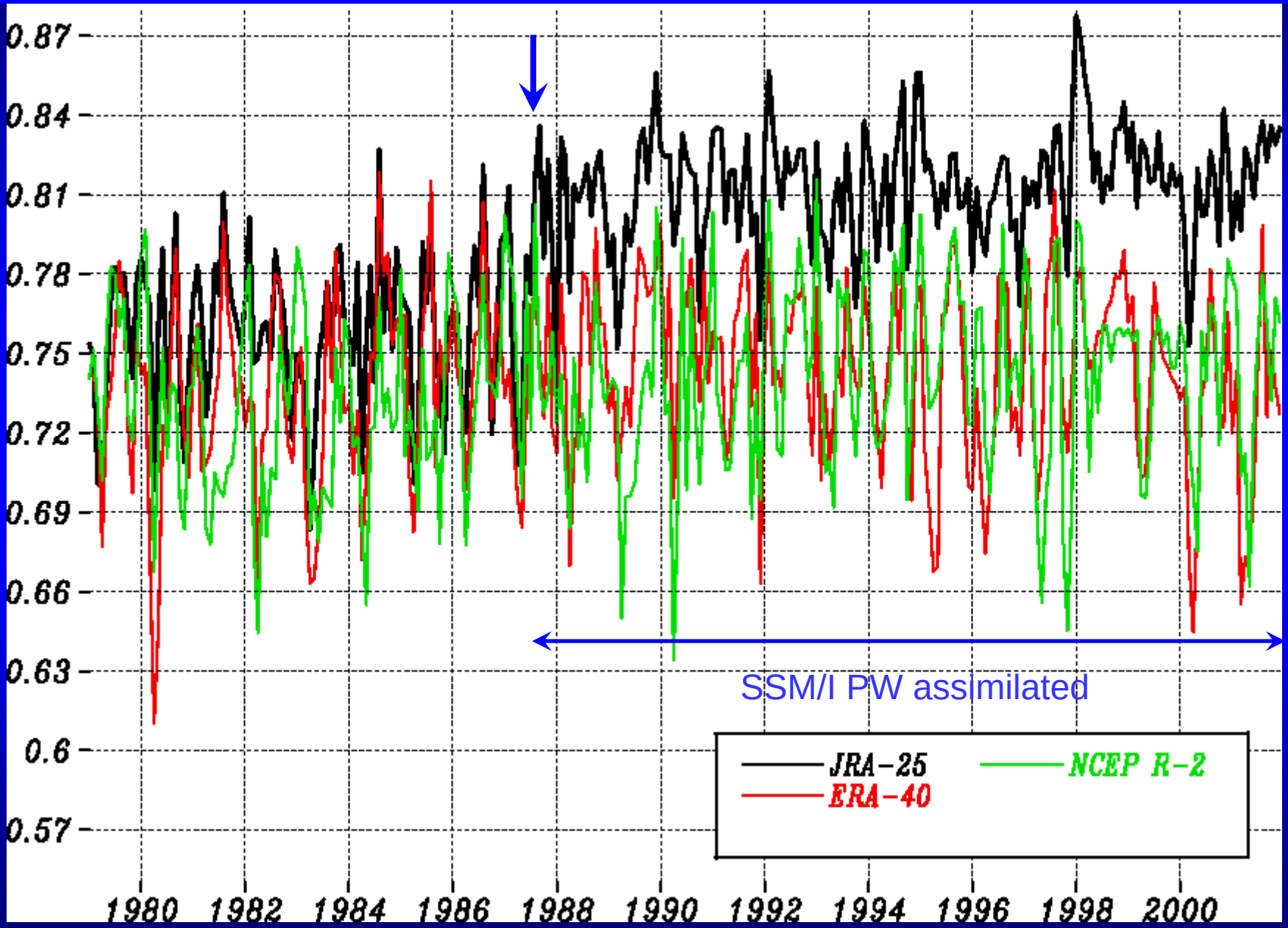
  Land model : JMA SiB and Snow Analysis
- Reanalysis Period : 1979-2004 (26 years)

  The analysis cycle was transitioned to JCDAS(JMA CDAS) after JRA-25 completion.

Source Data

- JMA historical conventional observation dataset
- ECMWF & NCEP merged data (ERA-40 observation)
- TOVS/ATOVS brightness temperature (level 1c)
- SSM/I (SMMR) retrieved precipitable water and snow coverage
- GMS/METEOSAT re-processed atmospheric motion winds
- COBE SST and sea ice produced by JMA
- 3-Dimensional historical daily ozone data
- Tropical cyclone wind retrieval from best tracks by Dr M. Fiorino
- Chinese snow depth digitized from printed reports

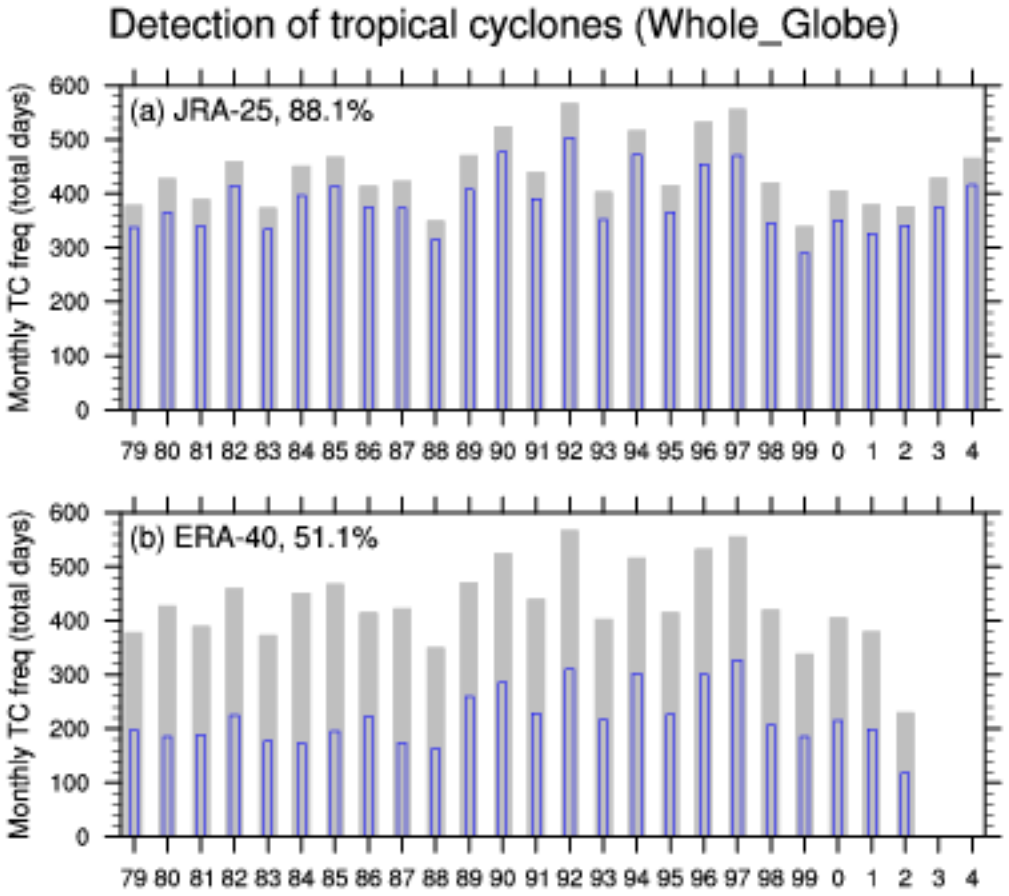
Correlation of Monthly Precipitation with GPCPv2



Courtesy: H. Koide

Global Detection rate of Tropical Cyclones

JRA-25 and ERA-40



Grey : Observed TC (Best track)

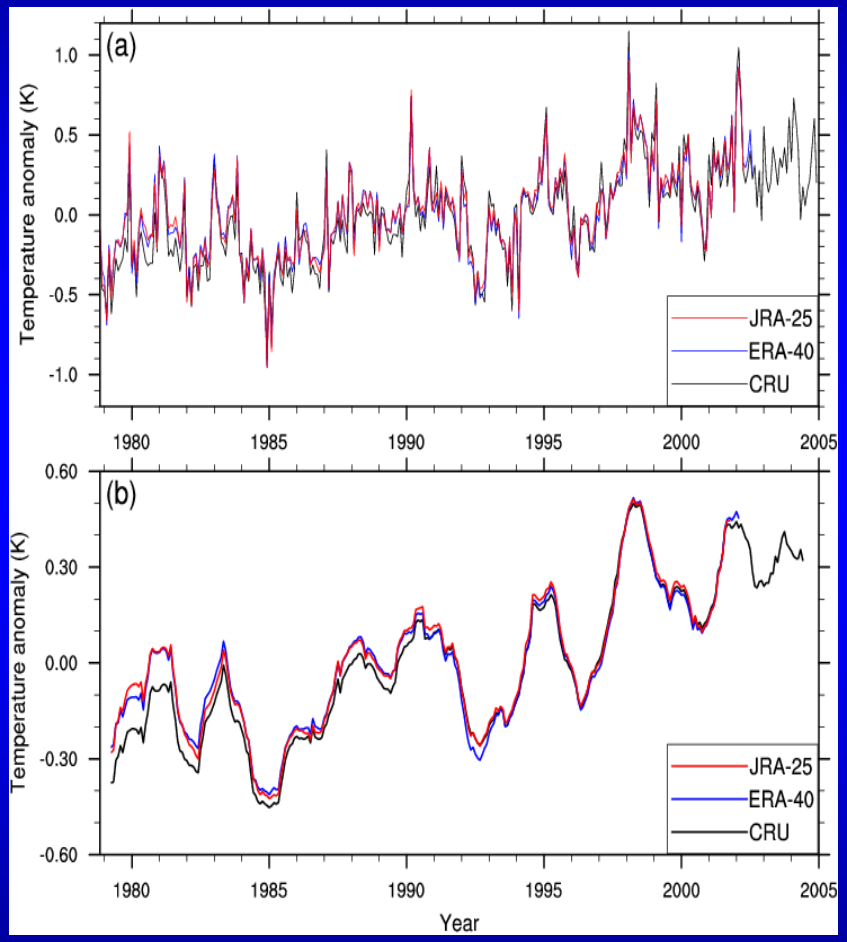
Blue : Detected TC

The detecting method is based on relative vorticity, sea level pressure (SLP) and middle to upper tropospheric thickness.

Courtesy: H. Hatsushika

Trend of Surface temperature

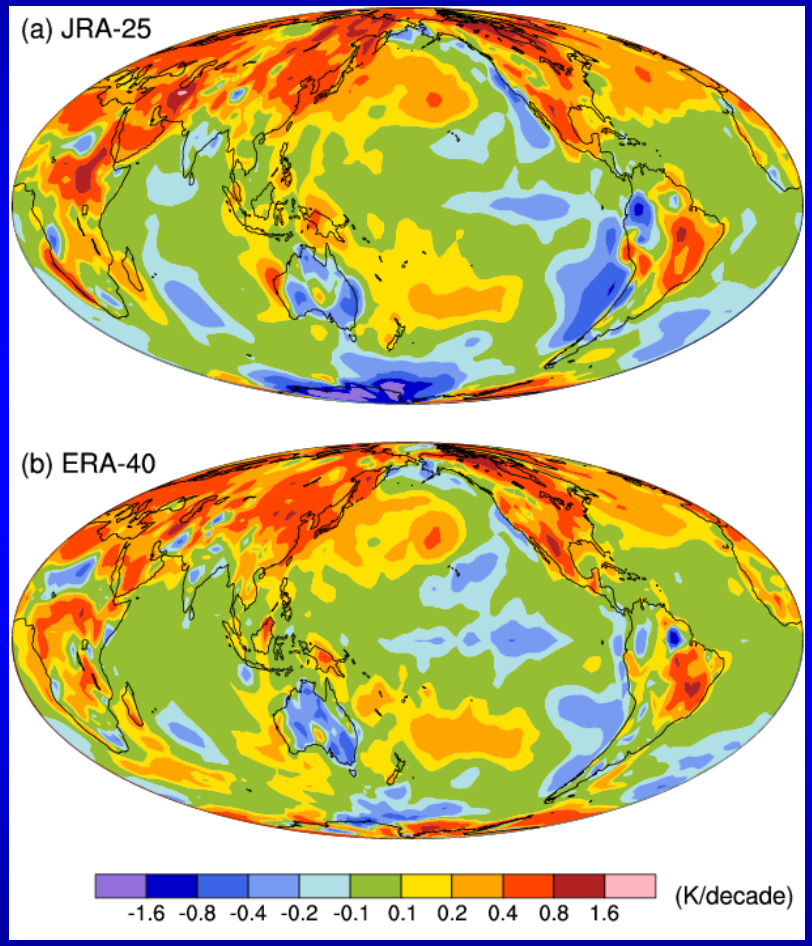
JRA-25 and ERA-40



Global Temperature Anomaly

JRA-25, ERA-40, CRU(Jones)

Top : monthly mean, Bottom : 5-year moving avarage

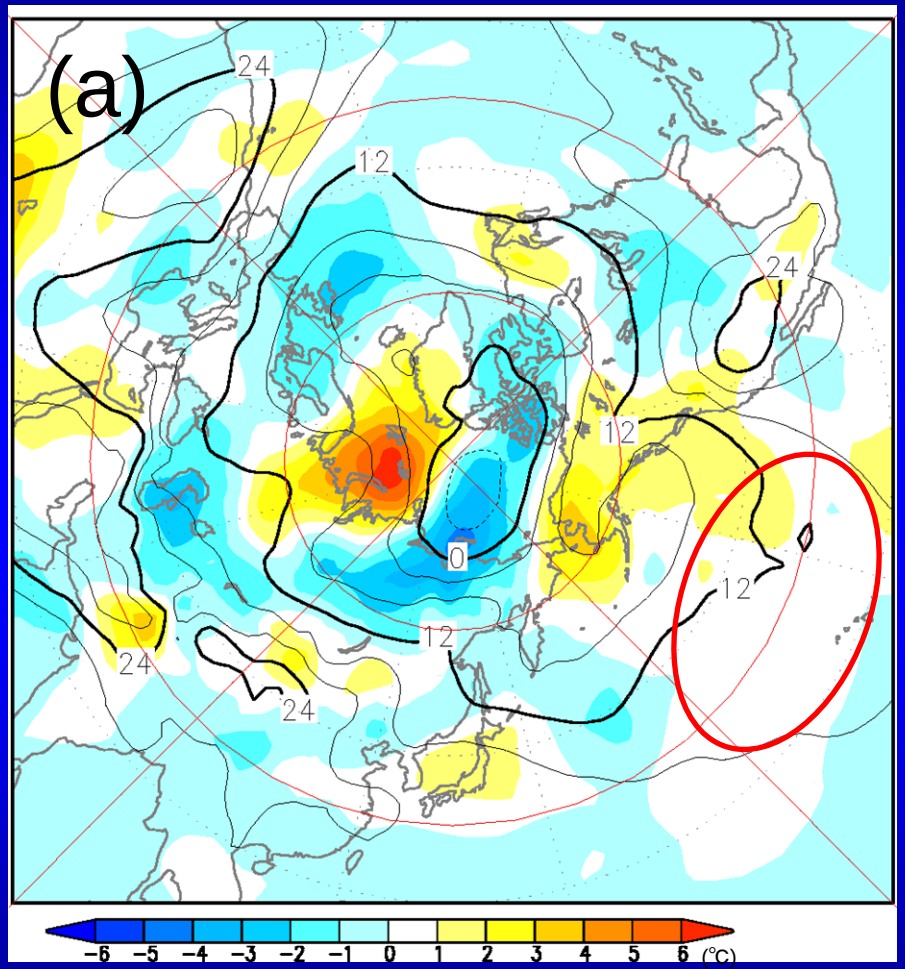


Distribution of tendency (K/decade)

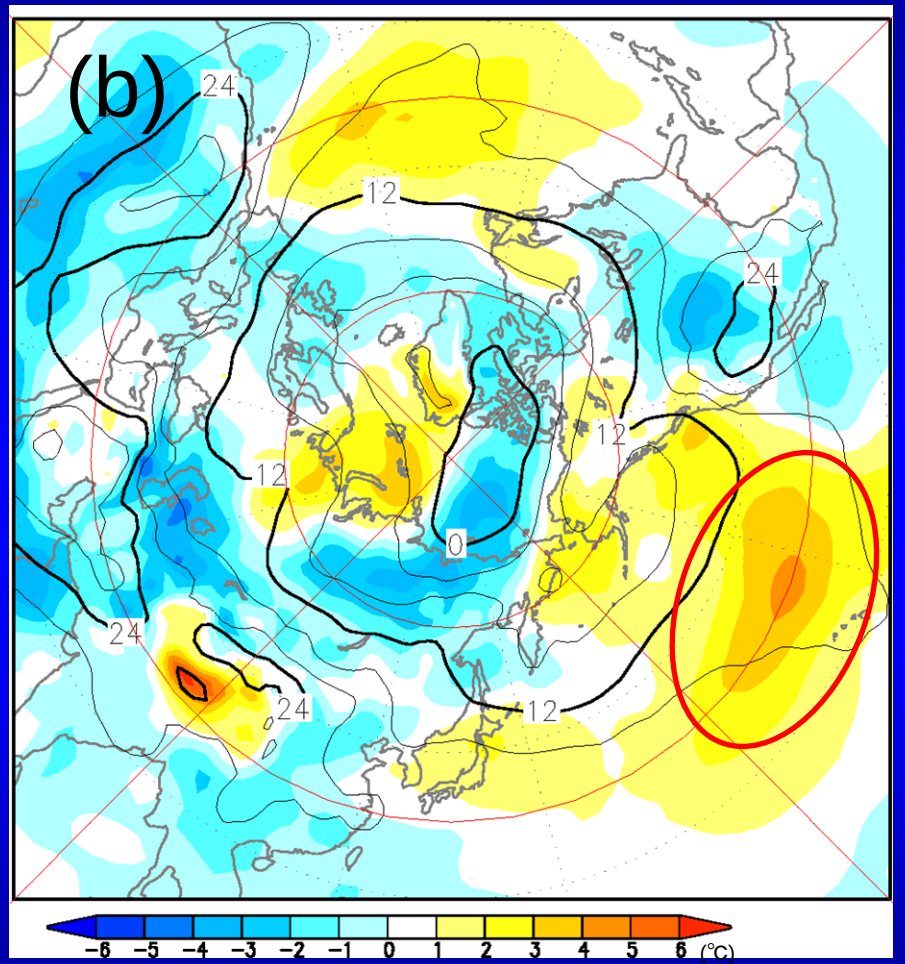
Courtesy: J. Tsutsui

Climate monitoring

Monthly mean 850hPa temperature and anomaly (July 2004)



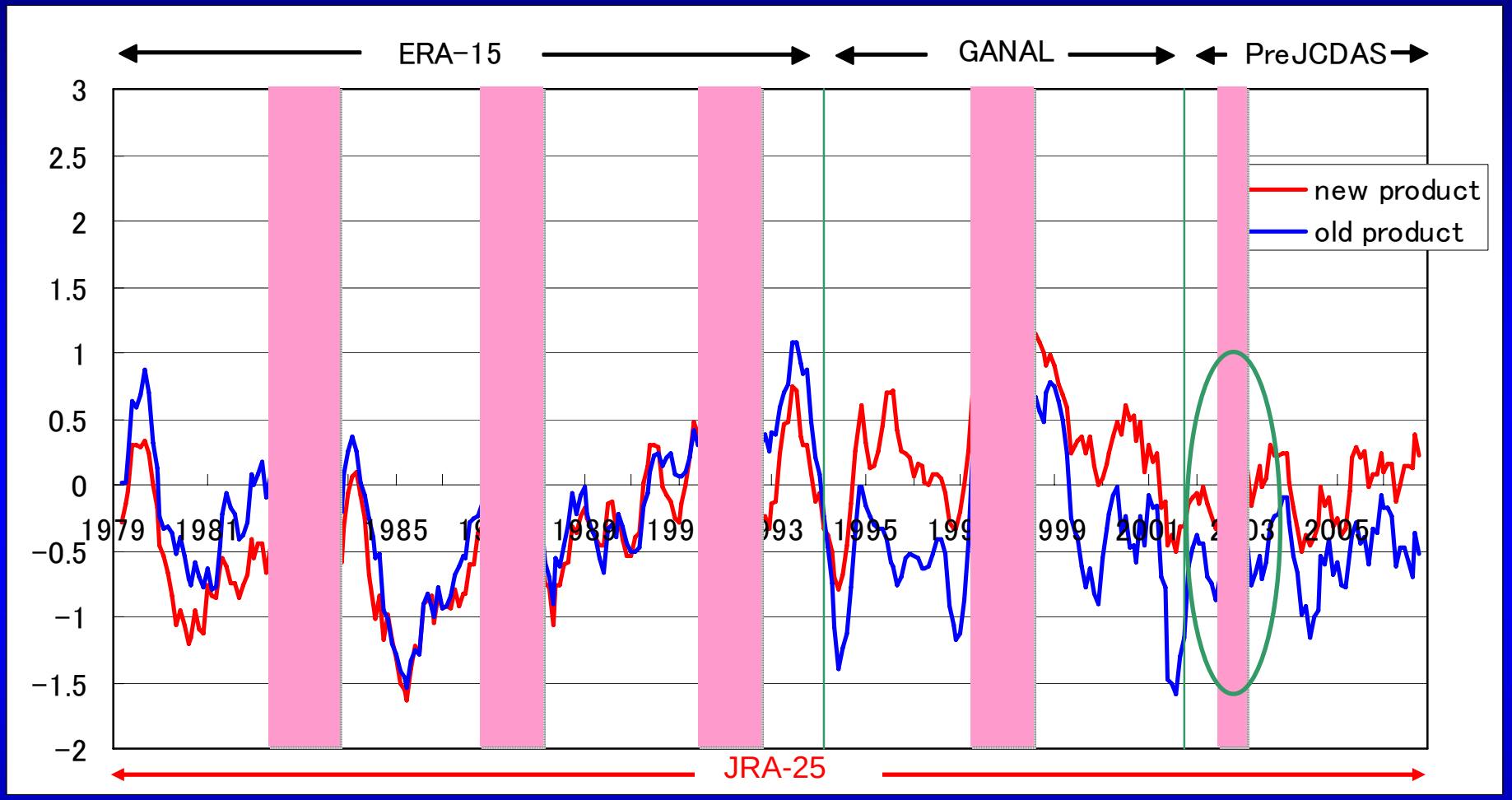
New (JRA-25 both for normal and analysis)



Old (ERA-15 for normal and Pre-JCDAS for analysis)

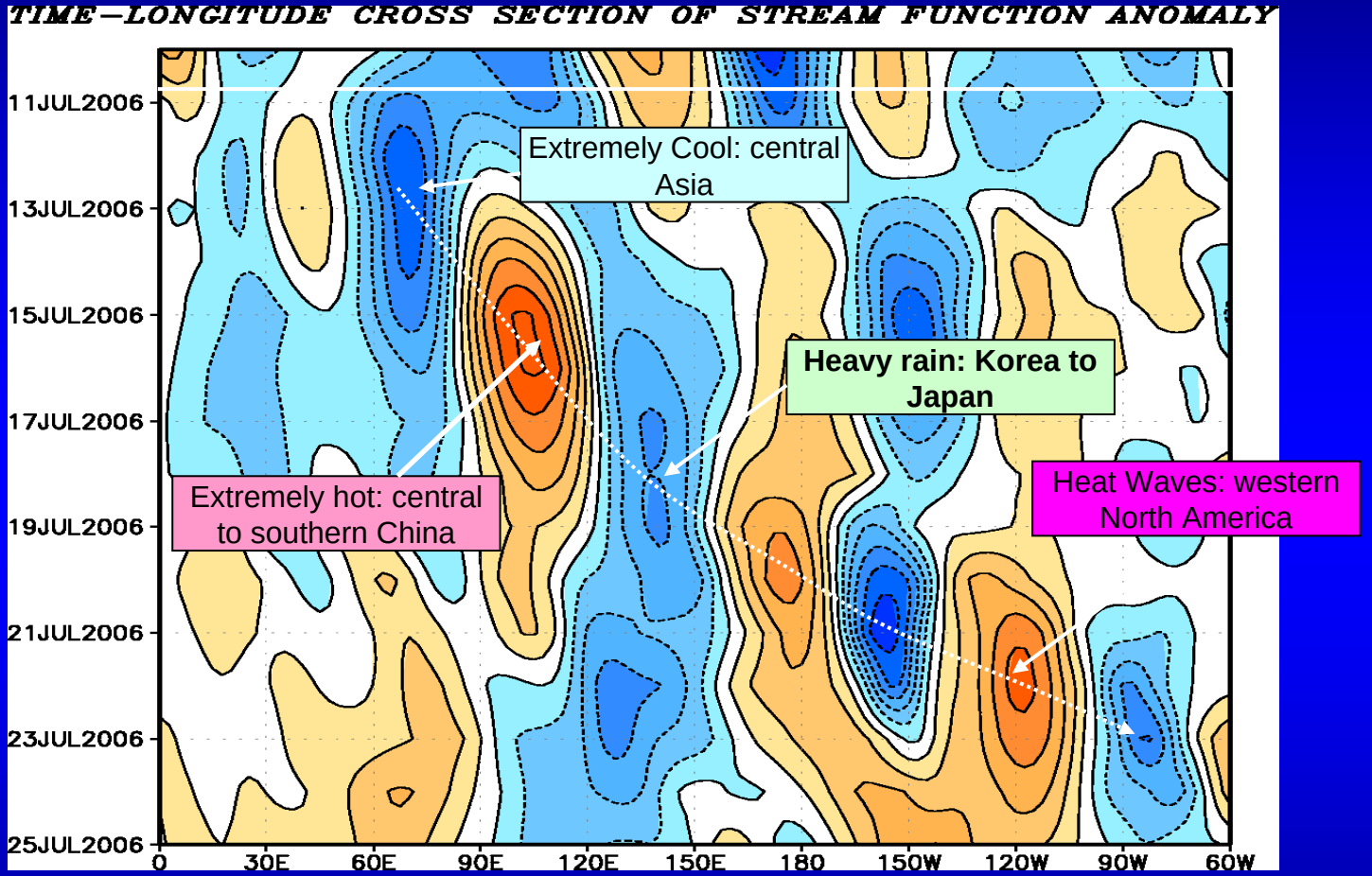
Unrealistic positive anomaly area due to the difference of the models is found in (b).

Time series of monthly mean equatorial zonal index in the Eastern Pacific



-The index is defined as regional mean (5S-5N, 130W-100W) zonal wind anomalies normalized its standard deviation at 850hPa.
-The old product was combined the 3 data sources.
-The index should be positive (westerly) anomaly in El Nino periods. Negative bias is found in the old after 1994 while no bias in the new.

Time-longitude cross section of 250hPa stream function anomaly averaged in 40-50N (July 2006)

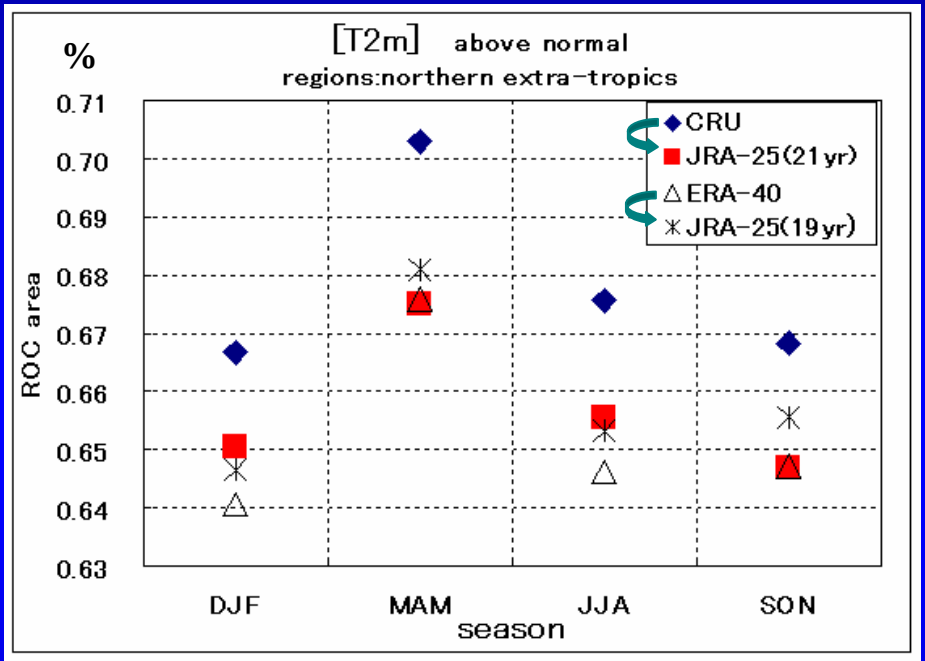


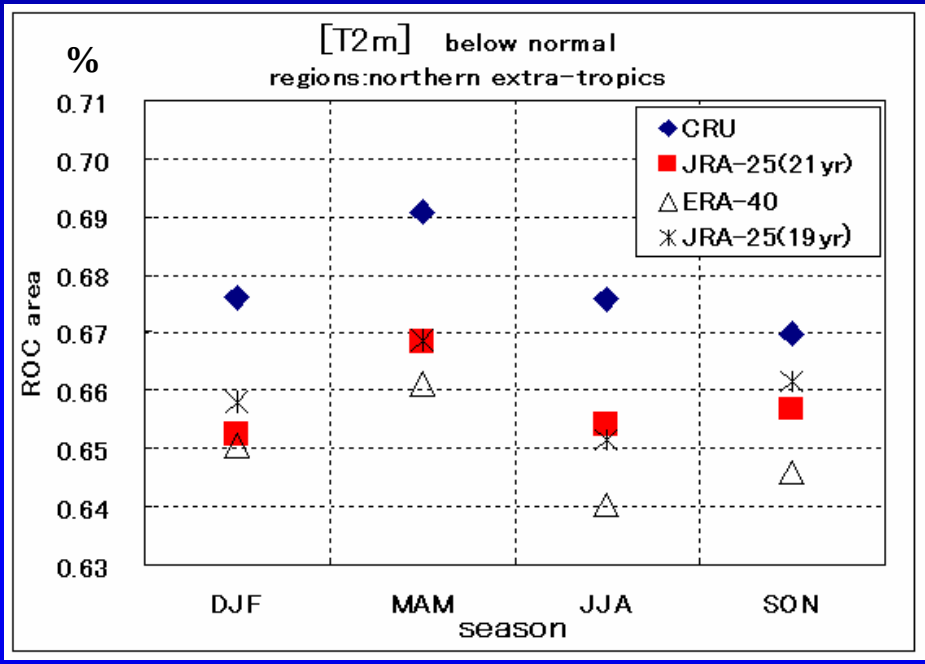
The active Rossby wave propagation brought large circulation anomalies resulting in extreme weather.

The propagation is well represented in JCDAS.

SVSLRF

Standard Verification System for Long Range Forecast of WMO





ROC areas of predicted categories probabilities of 3-monthly mean T2m in the Northern extra-tropics for each season. Left : upper category, Right : lower category

CRU and ERA-40 are currently recommended as reference data.
Quality of JRA-25 is comparable to them, also JRA-25 can be used as reference.

(ROC : Relative Operating Characteristics)

Reproduction of El Nino event in 1986/87

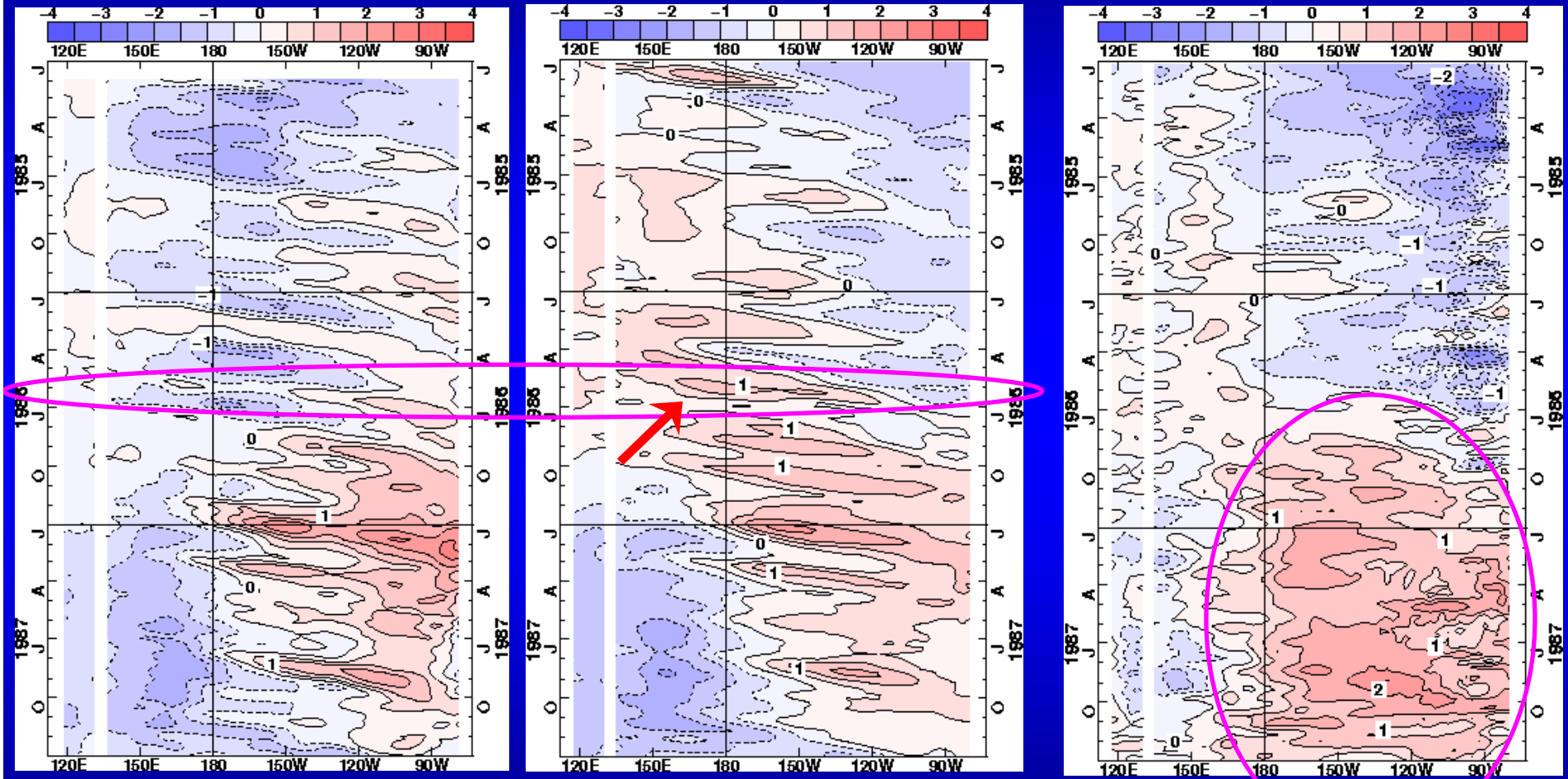
OHC anomaly (OHC : Ocean Heat Content)

Previous

New (using JRA-25)

SST anomaly

(COBE-SST)



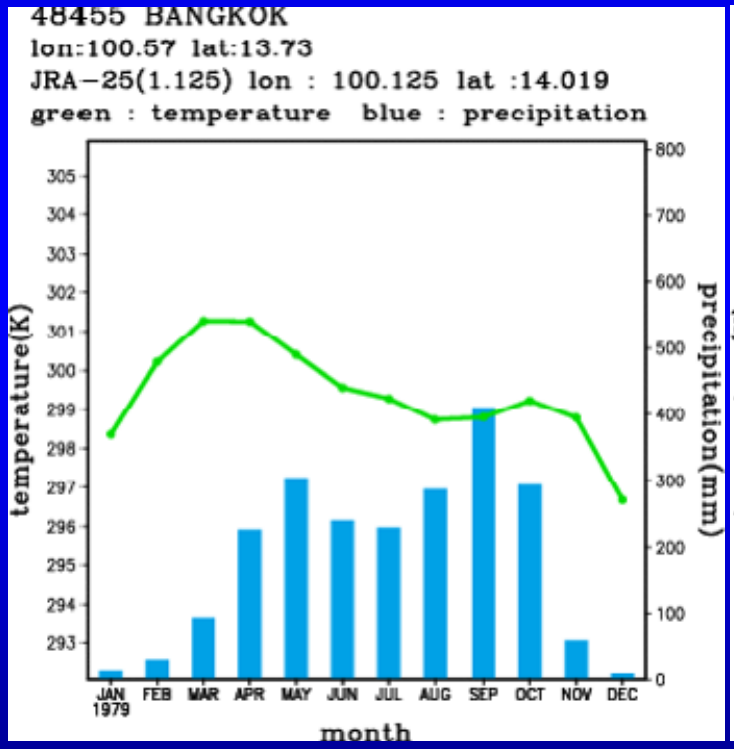
Sea surface wind, heat flux and precipitation of JRA-25 are used in the New.

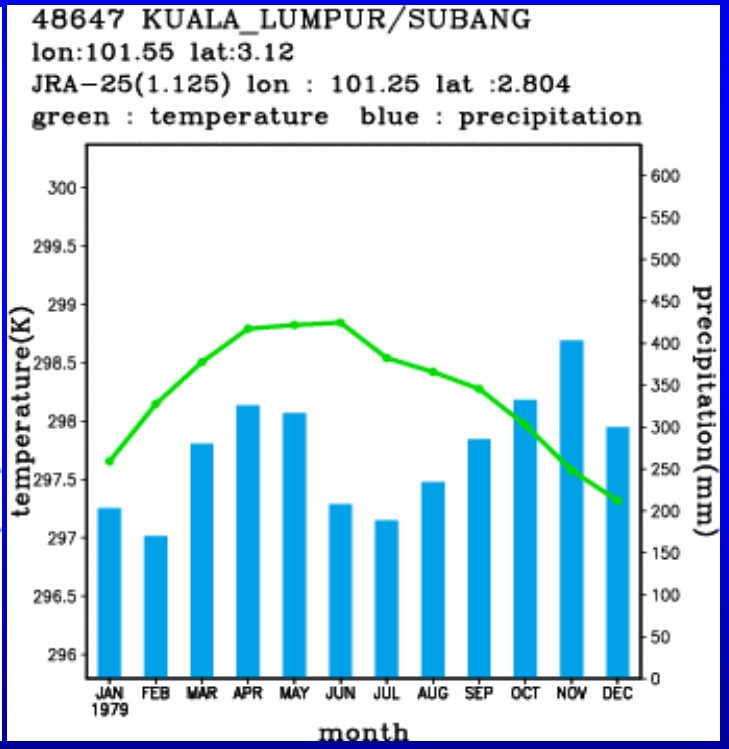
Warm water Kelvin wave in May 1986 triggered the 1986/87 El Nino event.

Downscaling application

TCC (Tokyo Climate Center)

Monthly averaged temperature and precipitation are estimated from the nearest JRA-25 GPV of each station.





Statistic relationships are estimated between local observations and large scale atmospheric field using JRA-25.

Application of JRA-25 for operation and research

Extreme Event / Seasonal Forecast

Monitoring worldwide extreme events and climate system

Atmospheric, terrestrial and oceanic initial and verification data for seasonal prediction model, El Nino prediction model

Forcing data for ocean models

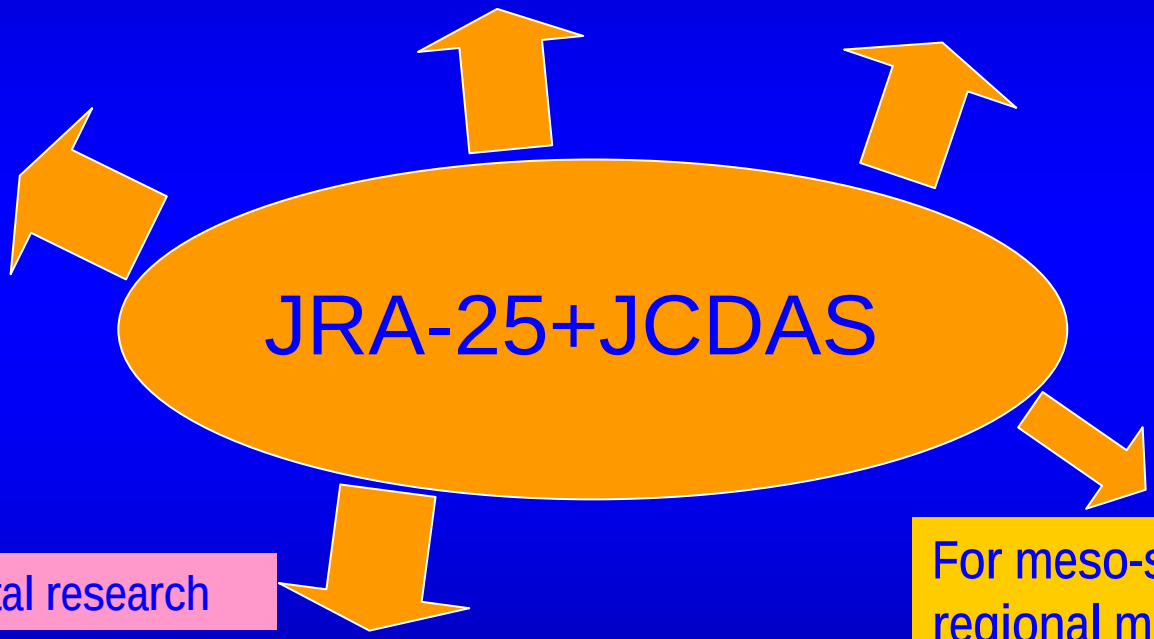
Earth Environment

Carbon cycle, reference data for ozone analysis

Forcing data for a chemical transport model

Climate information

- Time series of a station
- JRA-25 Atlas



Climate and environmental research

Extreme events, climate change, development and improvement of seasonal prediction model

Analysis of Energy and water cycle, for any research

For meso-scale regional models

To provide proper initial and boundary data to perform numerical experiments for severe events in the past.

JRA-25 & JCDAS data are available for research use through the internet.

Extended applications

- Exhibition of ‘Miraikan’ museum
  - Estimation of possibility of solar power plant
- Atmospheric reference for launching a rocket (JAXA)
  - Estimation of strength of rocket body
- Precipitation climatology map (Chronological Scientific : “Rika Nenpyo”)
  - Japanese general science handbook
- Database for agricultural meteorological application

Data Service

JRA-25 & JCDAS official data

JRA-25 paper / report

- **The JRA-25 Reanalysis**

  JMSJ (Journal of Meteorological Society of Japan), likely to be accepted in March.

  K. Onogi, J. Tsusui, H. Koide, M. Sakamoto, S. Kobayashi, H. Hatsushika, T. Matsumoto, N. Yamazaki, H. Kamahori, K. Takahashi, S. Kadokura, K. Wada, K. Kato, R. Oyama, T. Ose, N. Mannoji and R. Taira

- JRA-25 : Japanese 25-year Reanalysis

  – progress and status –

  Onogi et al. (2005), QJRMS, 131, 3259-3268.

  Special issue of the WMO 4th DA workshop (April 2005)

Announcement

The 3rd WCRP International Conference on Reanalysis

To be held in Tokyo

from 28th Jan. to 1st Feb. 2008

Co-host : JMA, CRIEPI and the University of Tokyo

The 3rd WCRP Reanalysis Conference
Agenda

- Introduction of reanalysis
- Applications of reanalysis products
- Characteristics of reanalysis products
- Data assimilation techniques for reanalysis
- Future reanalysis

The 3rd WCRP Reanalysis Conference

- No registration fee is charged.
- Financial supports from WCRP, GCOS and GEO are available.
- Many participants from Asian countries are expected.
  - Probably many participants come from the US and Europe.