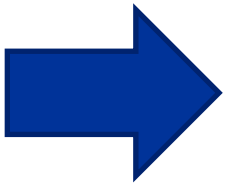


The Japanese 55-year Reanalysis "JRA-55"

Kazutoshi Onogi

on behalf of JRA group

2013/11/11 TCC training seminar

~ Introduction ~
What is reanalysis?

Required dataset for climate research

- For several decades
- Consistent and high quality for any time and any region
- Many meteorological variables
  - Pressure, temperature, wind, humidity, …
    - They can be observed.
    - But these are not sufficient for climate research.
  - Variables at the top of atmosphere (i.e. radiation), surface fluxes, vertically accumulated variables (i.e. precipitable water), …
    - They are difficult to observe.

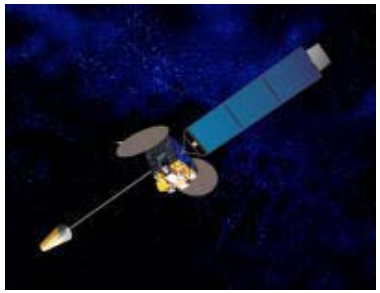
Approach for producing climate data

1. From observational data only
   - Example) GSN, GUAN managed by GCOS
   - High quality climate dataset can be generated at the observation station and surrounding region, but the regions and variables are limited.

2. **Numerical data assimilation using observational data**
   - Uniformly distributed grid point values are generated based on consistent dynamics and physics.
   - Advanced NWP model with high performance supercomputer.
   - Many kind of variables are produced at every grid point.
   - Numerical data assimilation cycle is performed for several decades. → **Long-term Reanalysis**

Outline of Data Assimilation

Observation



DA System
(numerical model, quality control, etc)

Super Computer System

First Guess for analysis
for the next time

Best Estimation of the Global Atmospheric field

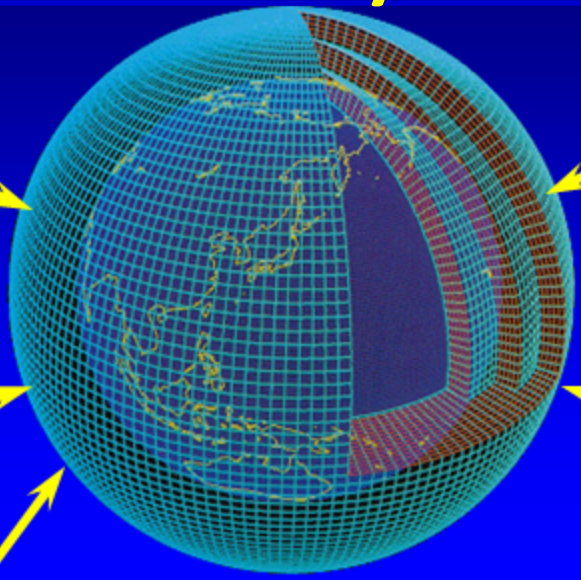
Reanalysis

Satellite

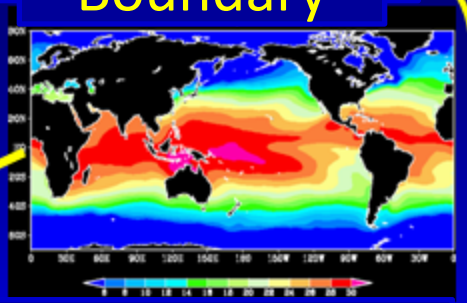
Surface, Upper

Ship, aircraft

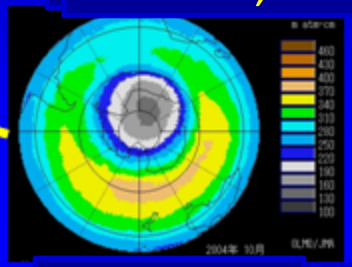
Observation



Boundary



SST, sea ice



ozone

Assimilate past observational data

Data assimilation cycle

Consistent quality Reanalysis Product

- Provide Initial Condition and Verification data for seasonal forecast
- Climate Monitoring
- Research on climate system and water circulation etc.

The JRA-55 reanalysis

Japanese Global Atmospheric Reanalysis

1st JRA-25

By JMA and CRIEPI (1979~2004)

(Central Research Institute for Electric Power Industry)

2nd JRA-55 (JRA Go! Go!)

By JMA (1958~2012)

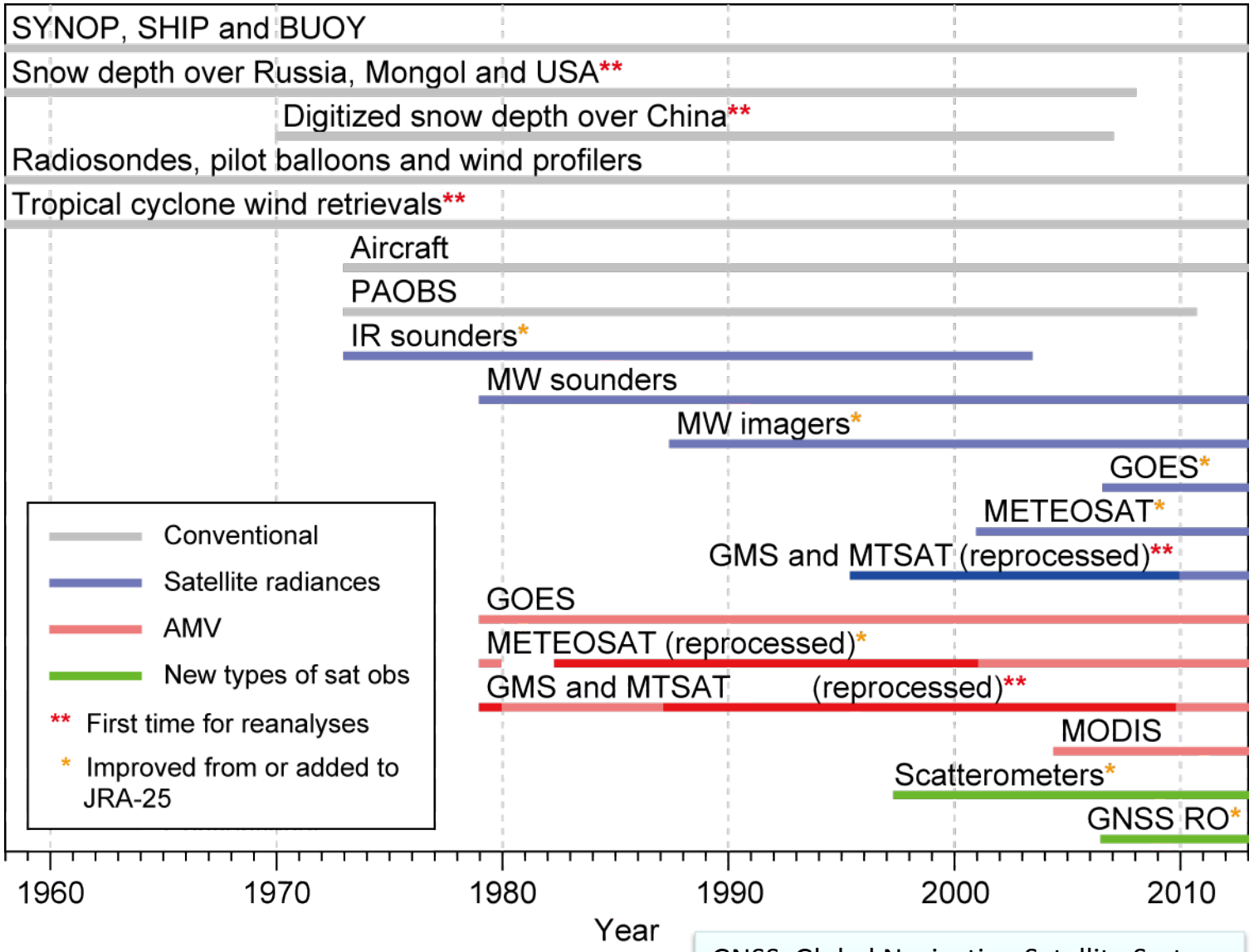
JRA-55 is the first reanalysis
which covers more than 50 years since 1958
with 4D-var data assimilation system.

JMA operates JRA-55 continuously
in real time basis after 2013.

JRA-55 Reanalysis system

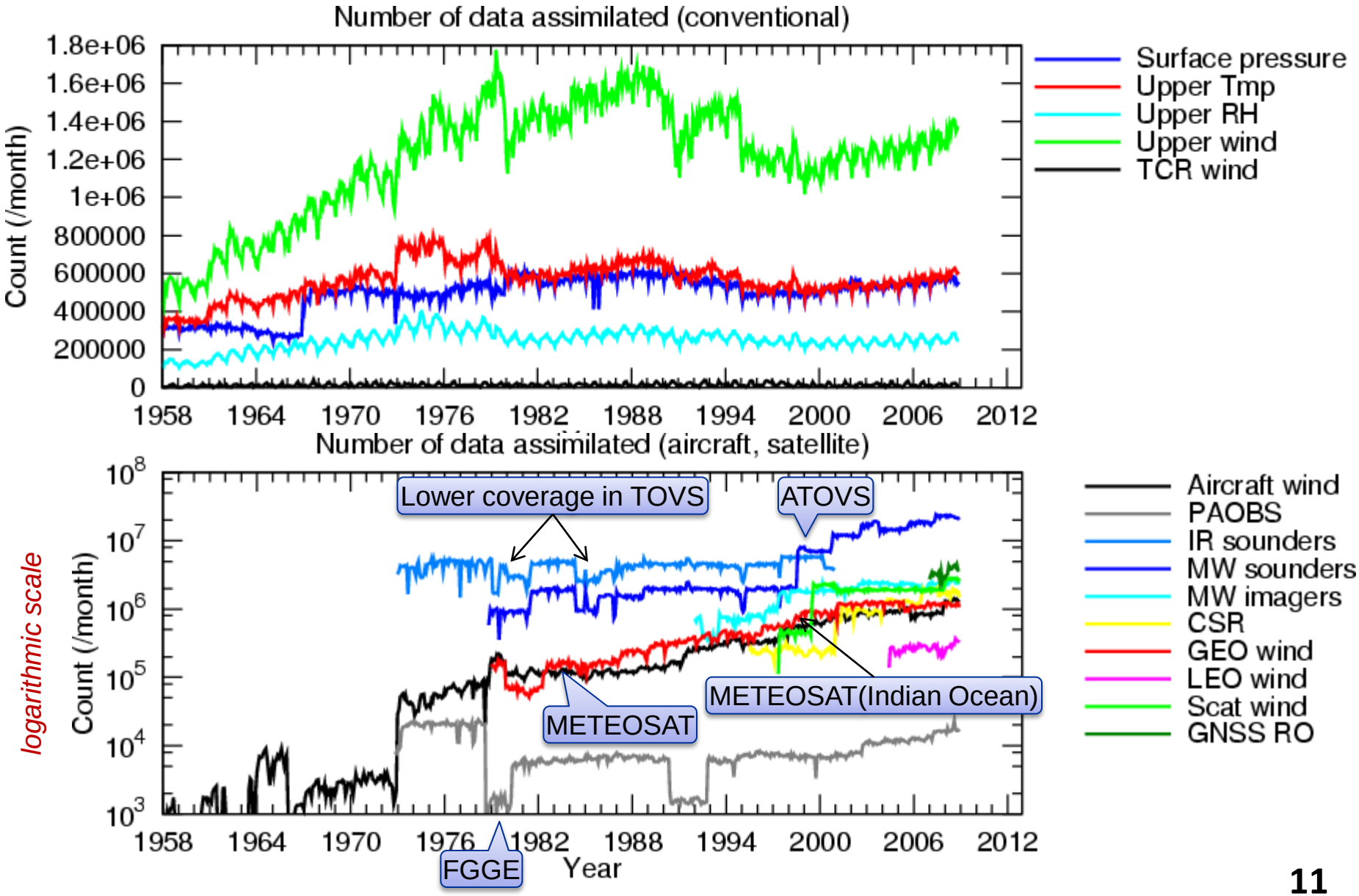
	JRA-25	**JRA-55**
Reanalysis years	1979-2004 (26 years)	**1958-2012 (55 years)**
Equivalent operational NWP system	As of Mar. 2004	**As of Dec. 2009**
Resolution	T106L40 (~120km) *(top layer at 0.4 hPa)*	**TL319L60 (~60km)** ***(top layer at 0.1 hPa)***
Time integration	Eularian	**Semi-Lagrangian**
Assimilation scheme	3D-Var	**4D-Var** ***(with T106 inner model)***
Bias correction (satellite radiance)	Adaptive method (Sakamoto et al. 2009)	**Variational Bias Correction (Dee et al. 2009)**
GHG concentrations	Constant at 375 ppmv (CO_2)	**Annual mean data are interpolated to daily data (CO_2,CH_4,N_2O)**

Observational Data available for JRA-55



GNSS: Global Navigation Satellite System

Number of observations assimilated (Global)

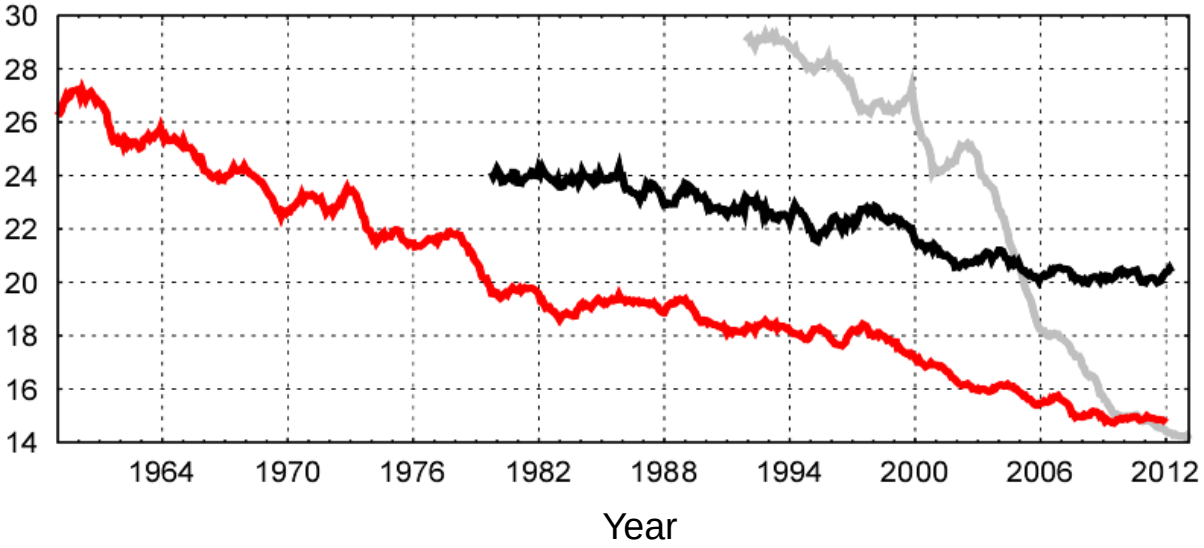


Quality of JRA

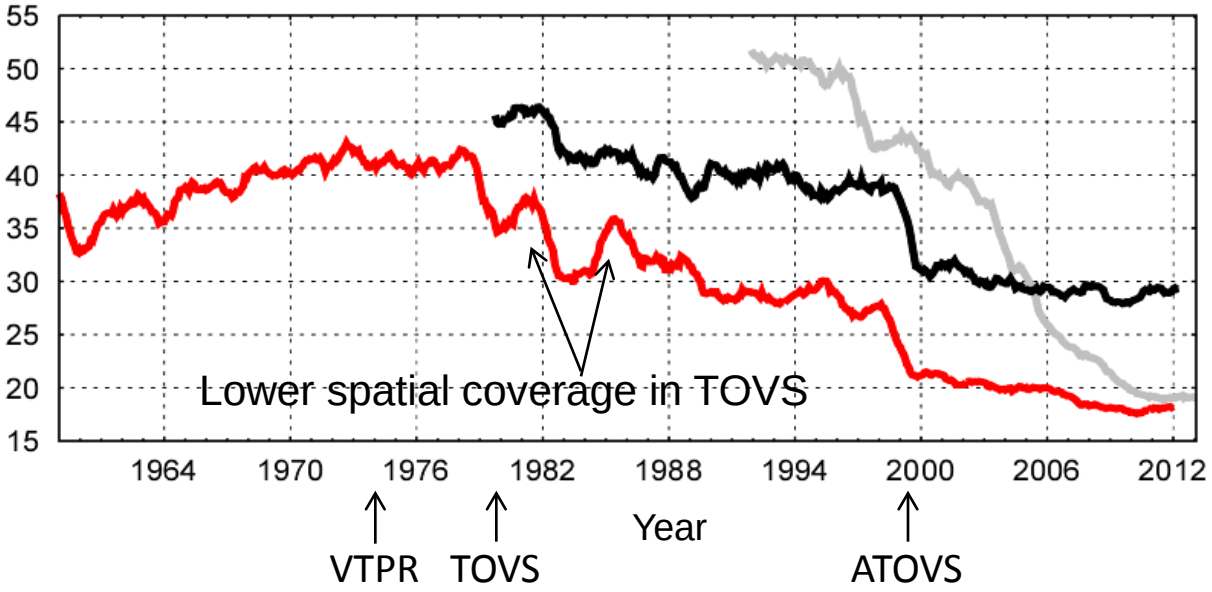
Forecast [FT=48] Scores

RMSE of Z500 for N.H. and S.H. [gpm]

N.H.



S.H.

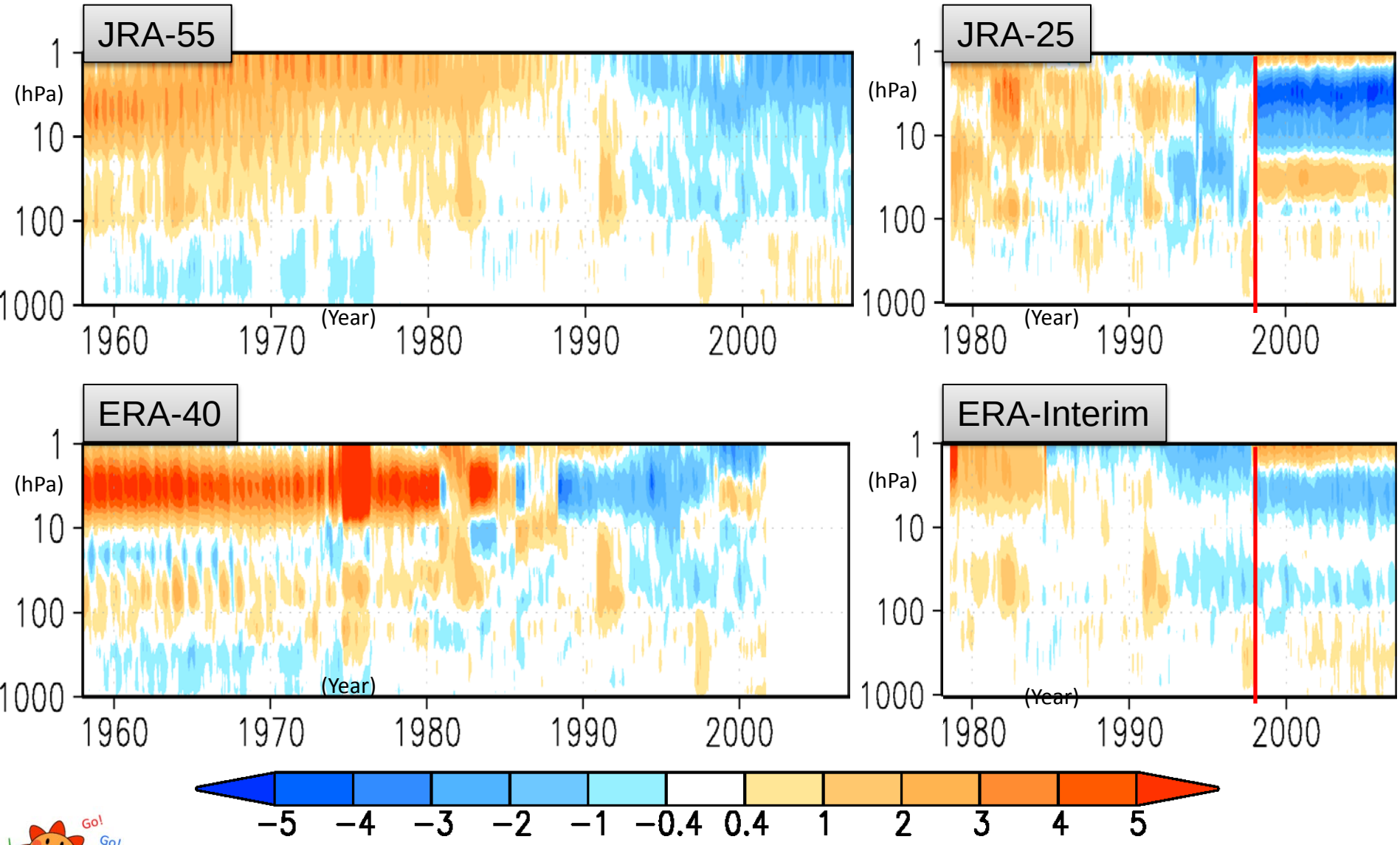


JRA-55

JRA-25

Operation

Time-Height Cross Sections of global mean Temperature [K] anomalies in JRA and ERA reanalyses



Anomalies from the mean temperature at each pressure level for years 1980 to 2001 of each reanalysis, JRA-55, ERA-40, JRA-25 and ERA-Interim , respectively.

JRA-55 data available

http://jra.kishou.go.jp/

JRA project

JRA-55 : Japanese 55-year Reanalysis

気象庁55年長期再解析

1958年以降を対象とした、気象庁による日本で2回目の長期再解析プロジェクト。

Japanese 55-year Reanalysis

The second Japanese reanalysis project conducted by the Japan Meteorological Agency (JMA), which covers the period from 1958 onward.

日本語

JRA-55

English

JRA-55

Application of JRA 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

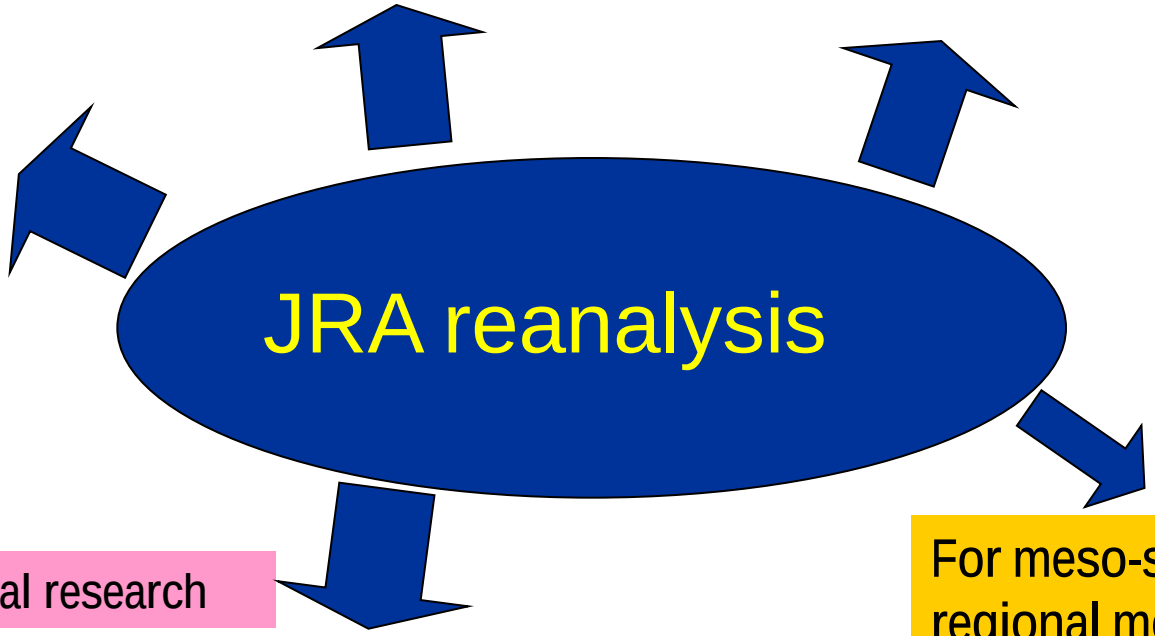
Climate information

- Time series of a point
- JRA-25 Atlas

Earth Environment

Carbon cycle, reference data for ozone analysis

Forcing data for a chemical transport model



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.

Summary

- **Observational Data for JRA-55**
  - Improvement in both quality and quantity from JRA-25
    - Many reprocessed Satellite Data
    - Newly available data
- **Validation of JRA-55**
  - JRA-55 has much better quality than JRA-25.
  - Unnatural gaps have been significantly reduced.
- **References**
  - Ebita et al. (2011) SOLA, 2011, **7**, 149-152
    - The Japanese 55-year Reanalysis “JRA-55”: An Interim Report
    - Interim report as of 2011
  - **Comprehensive reports are under preparation.**

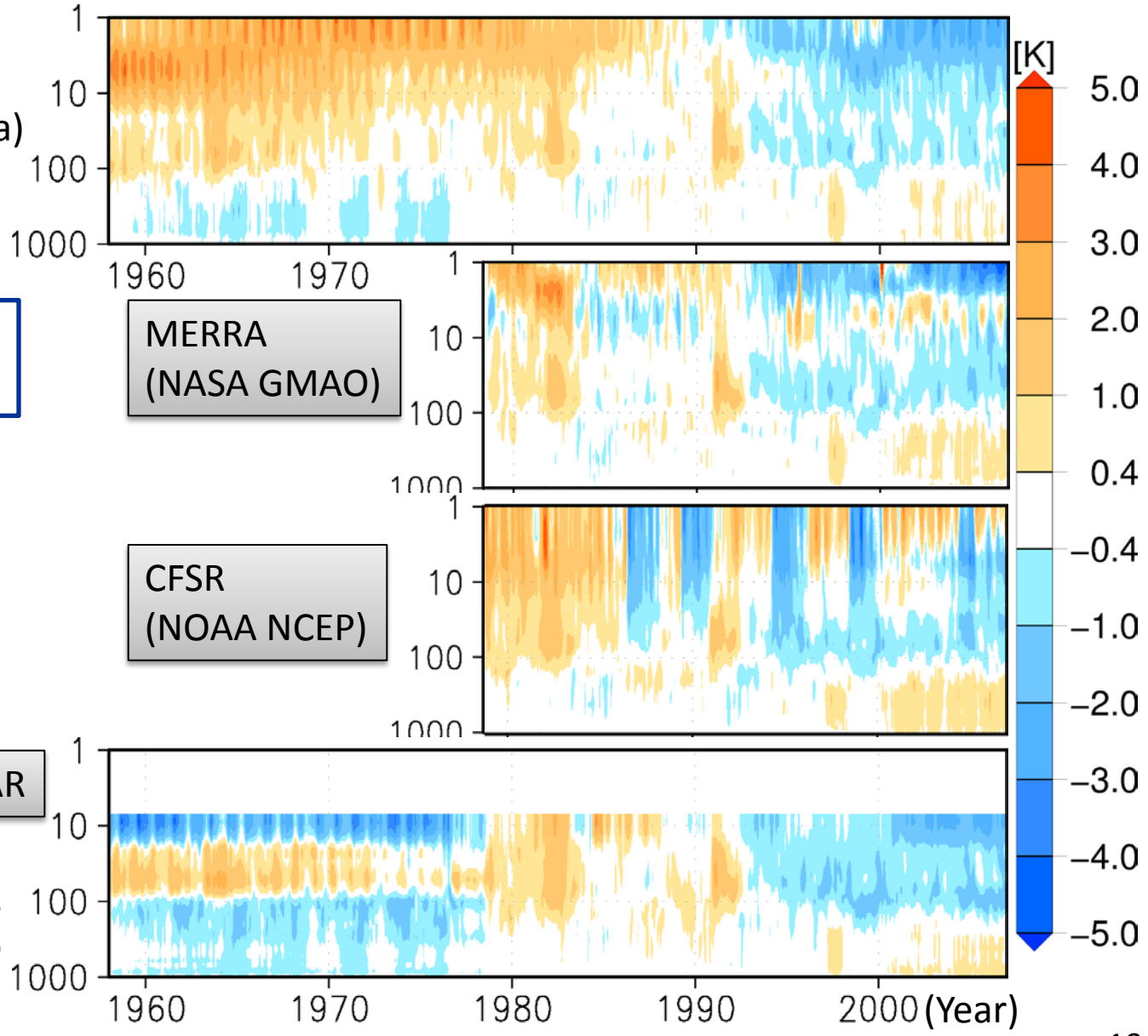
Thank you for your attention

Red leaves of Japanese maple in autumn
at Heirinji temple in Niiza city on 23 Nov. 2009

Backup slide

Temporal consistency of temperature analysis (Part 2)

Time series of global mean temperature anomalies



Anomalies are calculated with respect to their own averages for the years from 1980 to 2001.