



# JRA Activities UPDATE

**JRA-55C, an atmospheric reanalysis  
assimilating conventional observations only**

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# Outline

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- Overview of JRA-55&JRA-55C
  - JRA-55 family
  - JRA-55C system outline
  - Basic performance of JRA-55C
  - Some characteristics of the products
- The next Japanese reanalysis: JRA-3Q
- Summary



- The second Japanese global reanalysis conducted by JMA
- The first comprehensive global atmospheric reanalysis that applies 4D-Var to the last half century (1958-)
- Aiming at providing a comprehensive atmospheric dataset that is suitable for studies of climate change and multi-decadal variability

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## The JRA-55 Reanalysis: General Specifications and Basic Characteristics

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Concern:

How is the time-consistency at the transition time between pre-satellite era and satellite era?





# JRA-55 family



JRA-55



JRA-55C



JRA-55AMIP

- **JRA-55 (JMA)** ([S. Kobayashi et al 2015](#), [Ebita et al 2011](#),)
  - Full observing system reanalysis
- **JRA-55C (MRI/JMA)** ([C. Kobayashi et al 2014](#)) ([available on NCAR web-site from last Jul](#)  
<http://rda.ucar.edu/datasets/ds628.2/>  
and  
DIAS [http://dias-dss.tkl.iis.u-tokyo.ac.jp/ddc/viewer?ds=JRA55\\_C&lang=en](http://dias-dss.tkl.iis.u-tokyo.ac.jp/ddc/viewer?ds=JRA55_C&lang=en) )
  - Fixed observing system reanalysis
  - Using conventional observations only
    - surface, radiosondes, tropical cyclone retrievals and windprofilers
- **JRA-55AMIP (MRI/JMA)** ([available on DIAS](#) )
  - AMIP type simulation (with no observations assimilated)
- Providing a range of products using the common base NWP system for investigating impact of changing observing systems and model biases



# Outline of JRA-55(C) DA system



		JRA-25	JRA-55(C)
Reanalysis year		1979 – 2004 (26yr)	1958* - 2012 (55yr)
Equivalent operational NWP system		As of Mar.2004	As of Dec. 2009
NWP Model	Resolution	<b>T106L40</b> Top:0.4hPa Horizontal : 120km	<b>TL319L60</b> Top : 0.1hPa Horizontal : 60km
	Time integration	Eulerian	Semi-Lagrangian
	Green House Gas	CO2 : 375ppm(Const)	Annual mean data are interpolated to daily data CO2, CH4, N2O, CFC-11, CFC-12, HCFC-22
Assimilation		3D-VAR	4D-VAR
Bias Correction		[ UpperAir ] RAOB(Andrae et al.,2004)	[ UpperAir ] <b>RAOBCOREv1.4</b> (Heimberger et al.) [Satellite] (for JRA-55) Variational bias correction

Although the calculation of JRA-55C start from Nov 1972 when the satellite era start in JRA-55, the product of JRA55C include the product of JRA-55 during pre-satellite era.



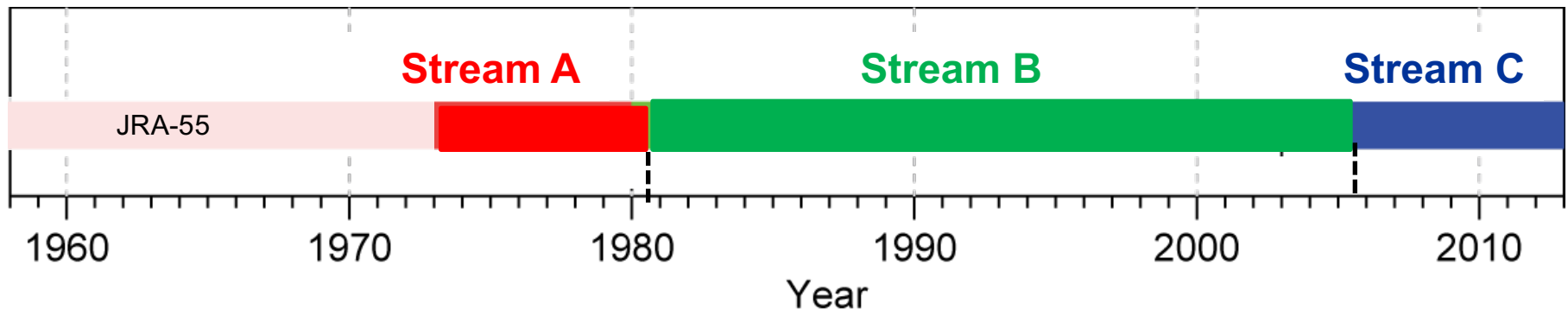
# Additional info. of JRA-55C system

- JRA-55C stream

- streamA Nov1972-Aug1980

- streamB Sep1980-Aug2005

- streamC Sep2005-Dec2012



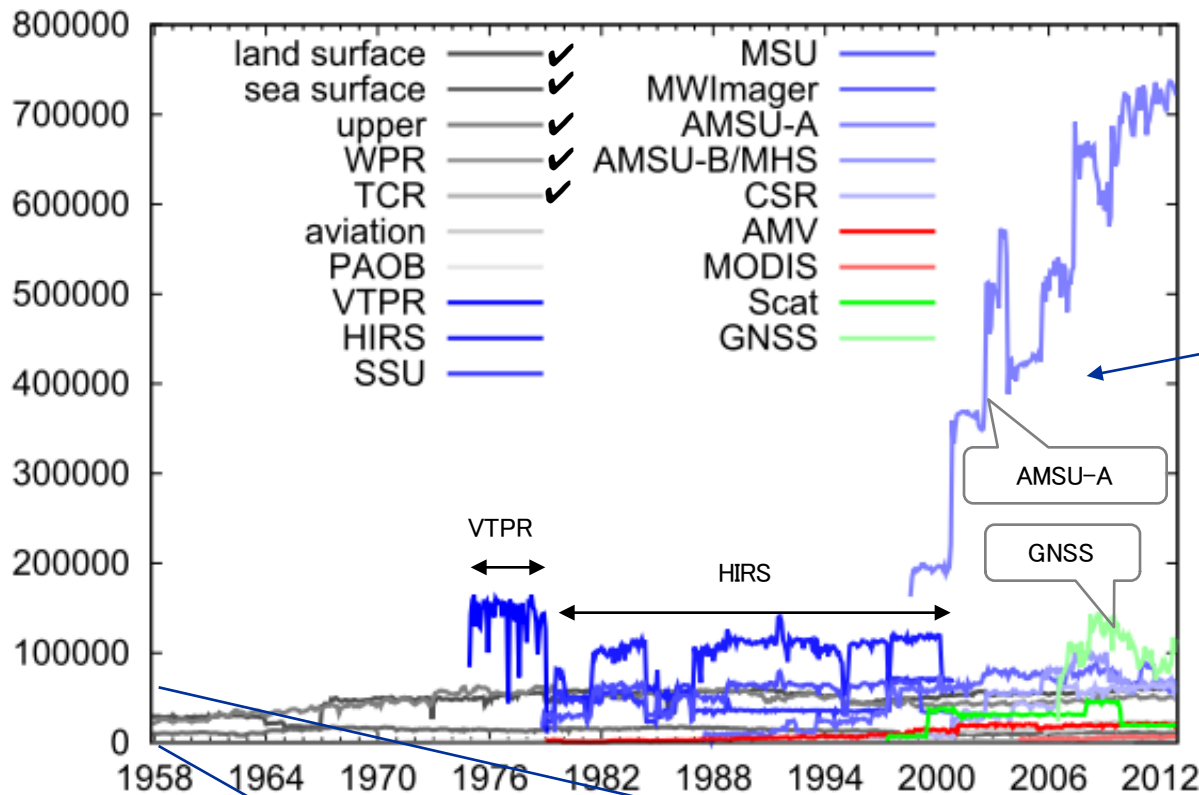
- Observation QC treatment in DA system

- In order to use the same conventional observations in the DA system, black-list information made by JRA-55 are adopted before the QC process of JRA-55C.



# The number of used observations in JRA-55 DA

[/day monthly mean]

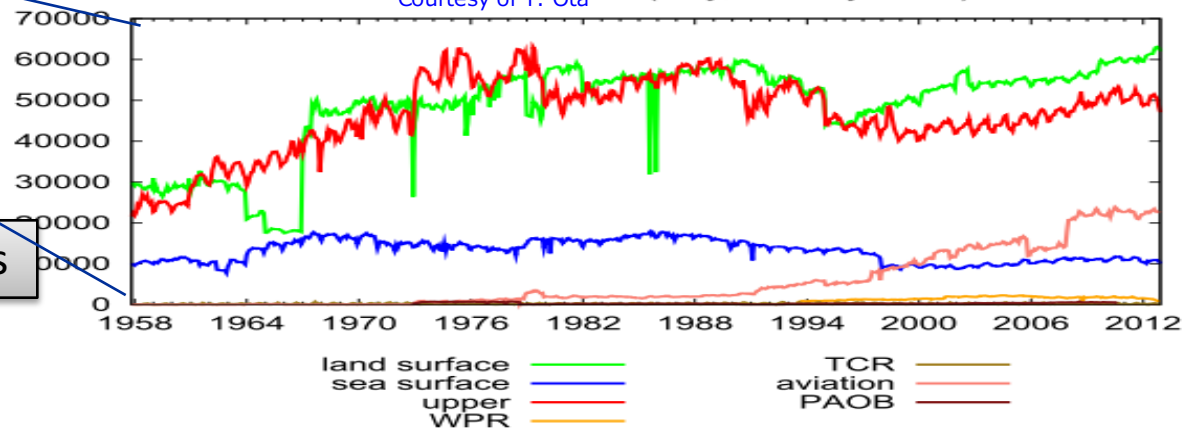


Rapid increase  
after around 2000

The number of  
conventional observations  
has NOT changed over  
time.

Courtesy of Y. Ota

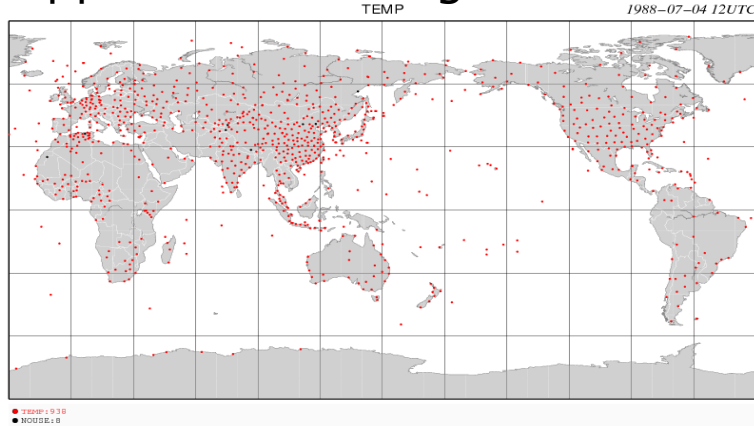
Conventional observations



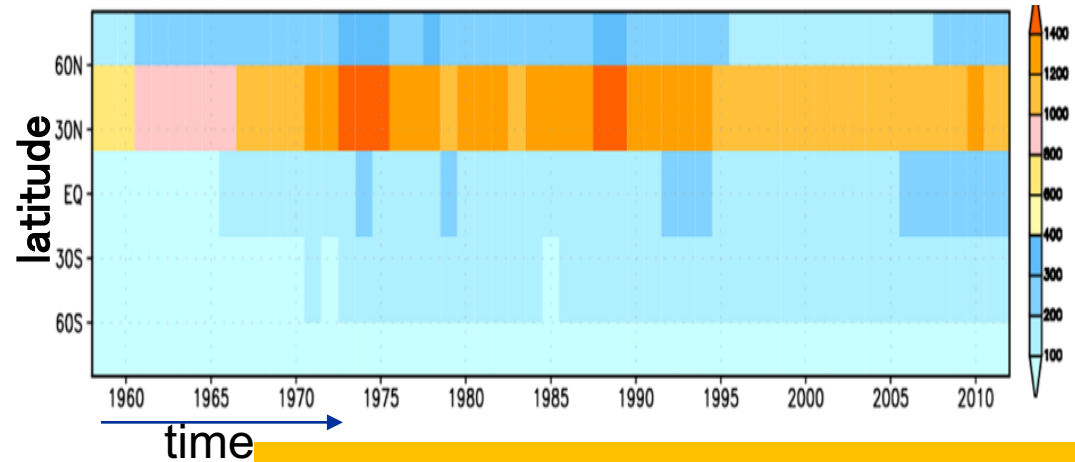
# The number of used obs. in JRA-55C (5 latitude band)

Upper obs. coverage

12UTC 4Jul1988

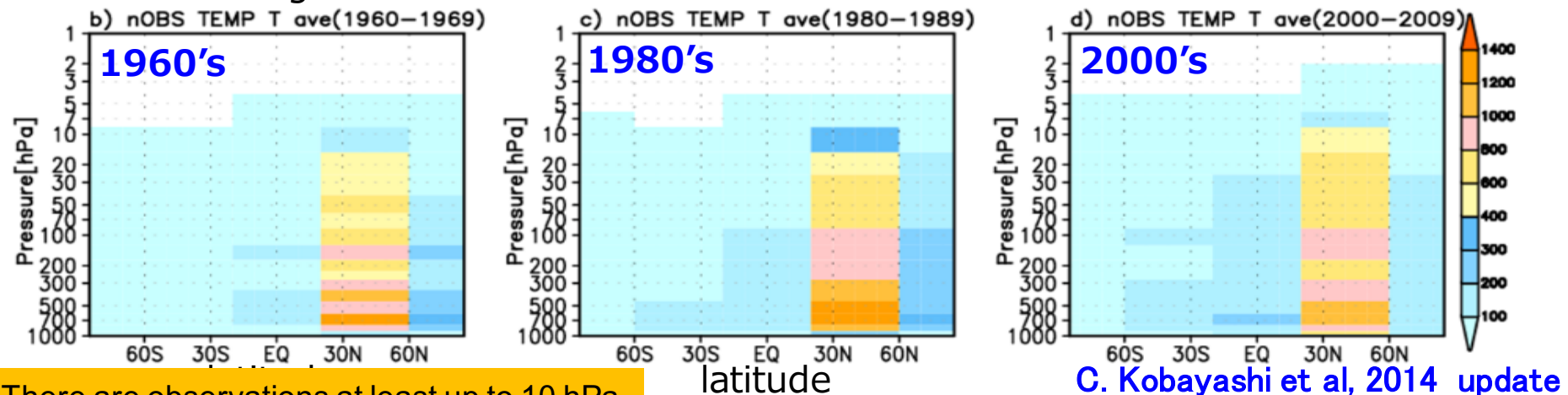


Time-latitude cross section of the number of used conventional observation at 500hPa



Most of observations exist in Northern mid latitude

Latitude-height cross section of the number of used conventional observations



There are observations at least up to 10 hPa

C. Kobayashi et al, 2014 update

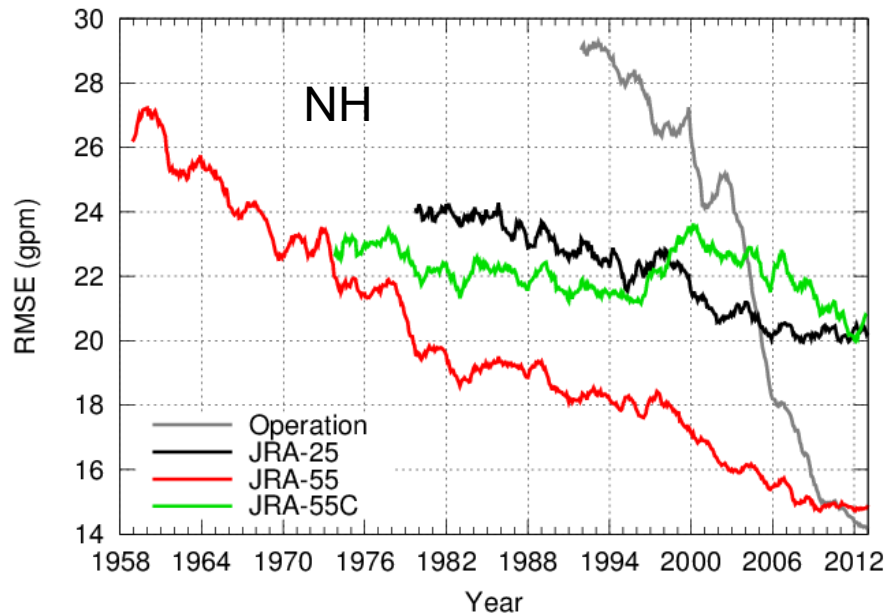




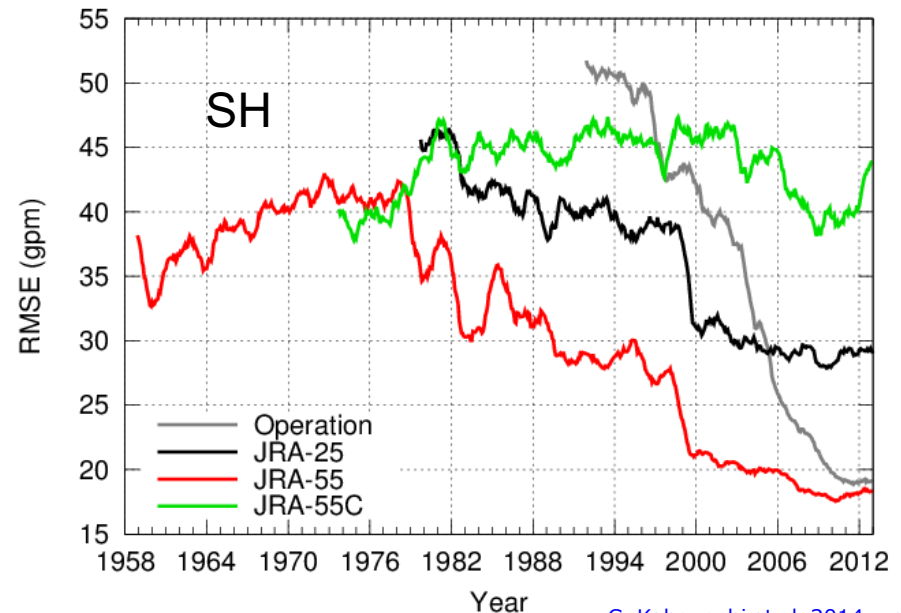
# Basic performance of the DA system

*RMS errors of 2-day forecasts of geopotential height (gpm) at 500hPa verified against their own analysis (12month running-mean)*

a) Z500 forecasts, Northern Hemisphere, FT=48



b) Z500 forecasts, Southern Hemisphere, FT=48



C. Kobayashi et al, 2014 update

JRA-55 : gradual decrease  
JRA-55C: not changed over time

JRA-55C indicate a certain level of quality

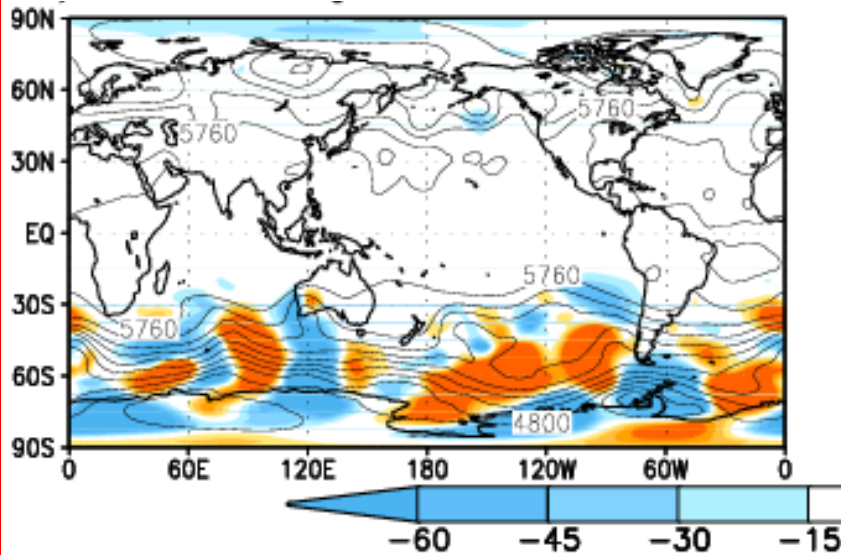


# Difference of geopotential height at 500 hPa (snap shot:12UTC25Aug1993)



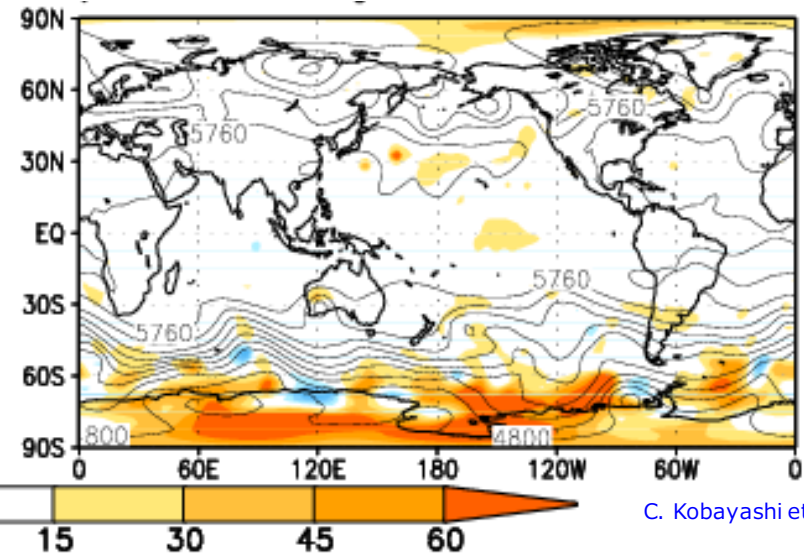
## JRA-55C vs JRA-55

shade : JRA-55C — JRA-55  
contour : JRA-55C



## ERA Interim vs JRA-55

shade : ERA Interim — JRA-55  
contour : ERA Interim



C. Kobayashi et al, 2014

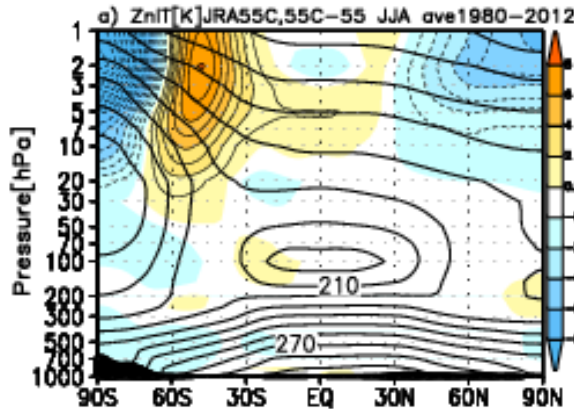
Small differences in the NH even in the neighborhood of tropical cyclones.  
Large differences in the SH.



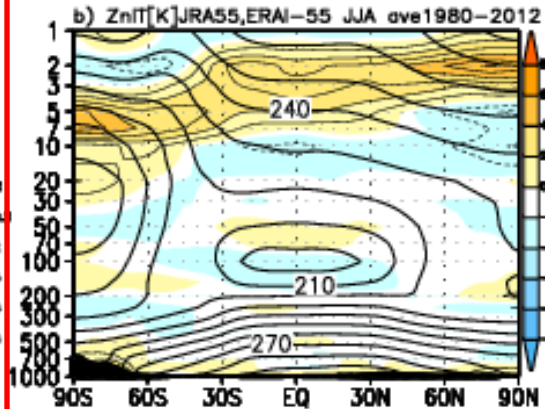
# Zonal mean temperature and zonal wind (JJA ave. 1980–2012)



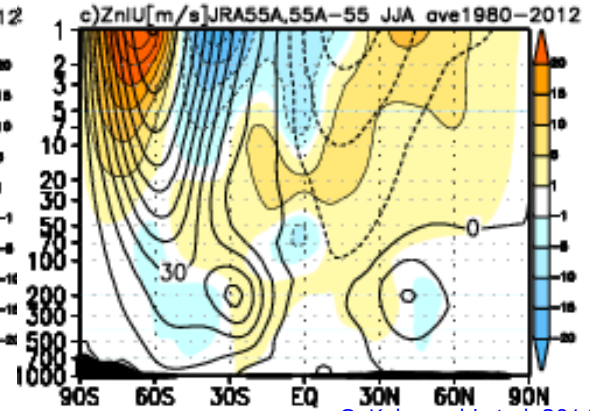
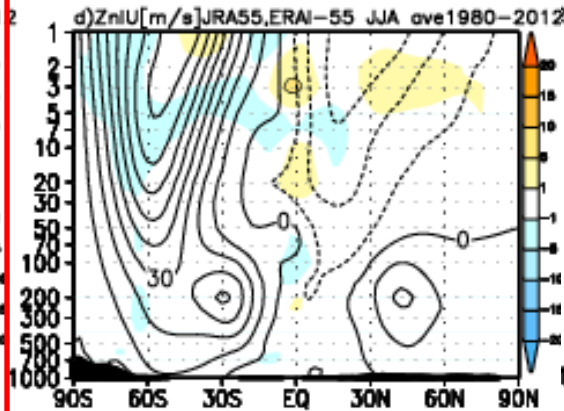
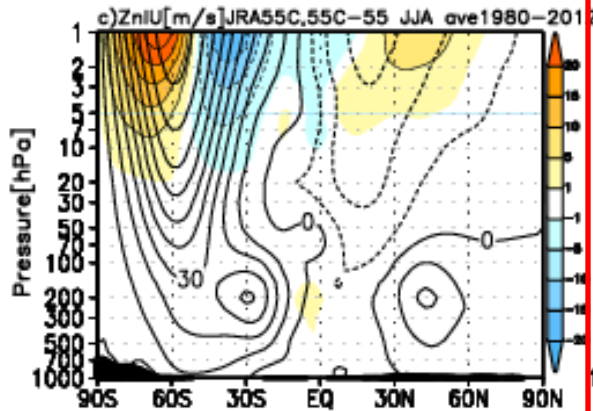
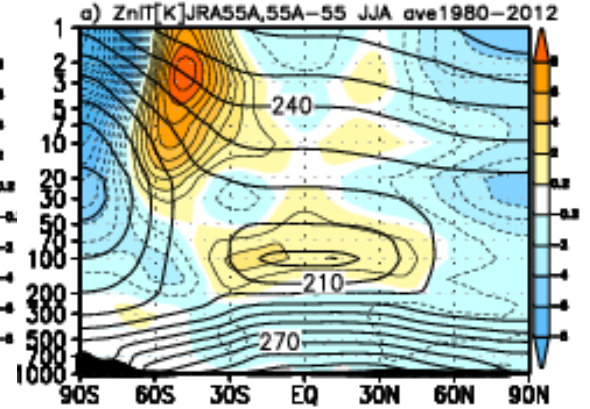
shade : JRA-55C — JRA-55  
contour : JRA-55C



shade : ERA Interim — JRA-55  
contour : JRA-55



shade : JRA-55AMIP — JRA-55  
contour : JRA-55AMIP

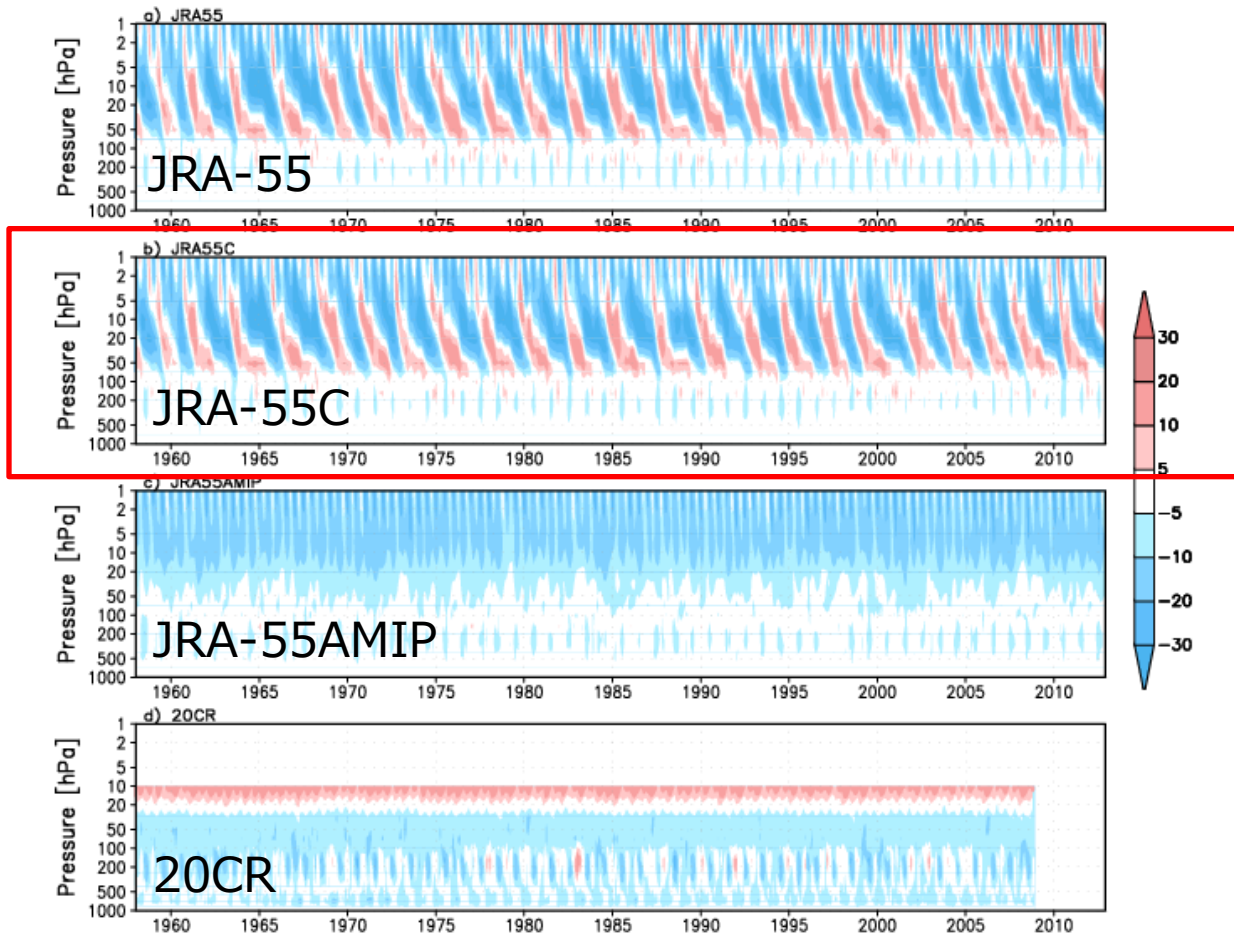


C. Kobayashi et al, 2014 update

Differences are small in the troposphere and lower stratosphere, except for high latitudes of the SH.  
Differences in the upper stratosphere are distinct. The difference patterns are consistent with model error (JRA-55AMIP).



# Time-height cross section of equatorial zonal mean U-wind



C. Kobayashi et al, 2014 update

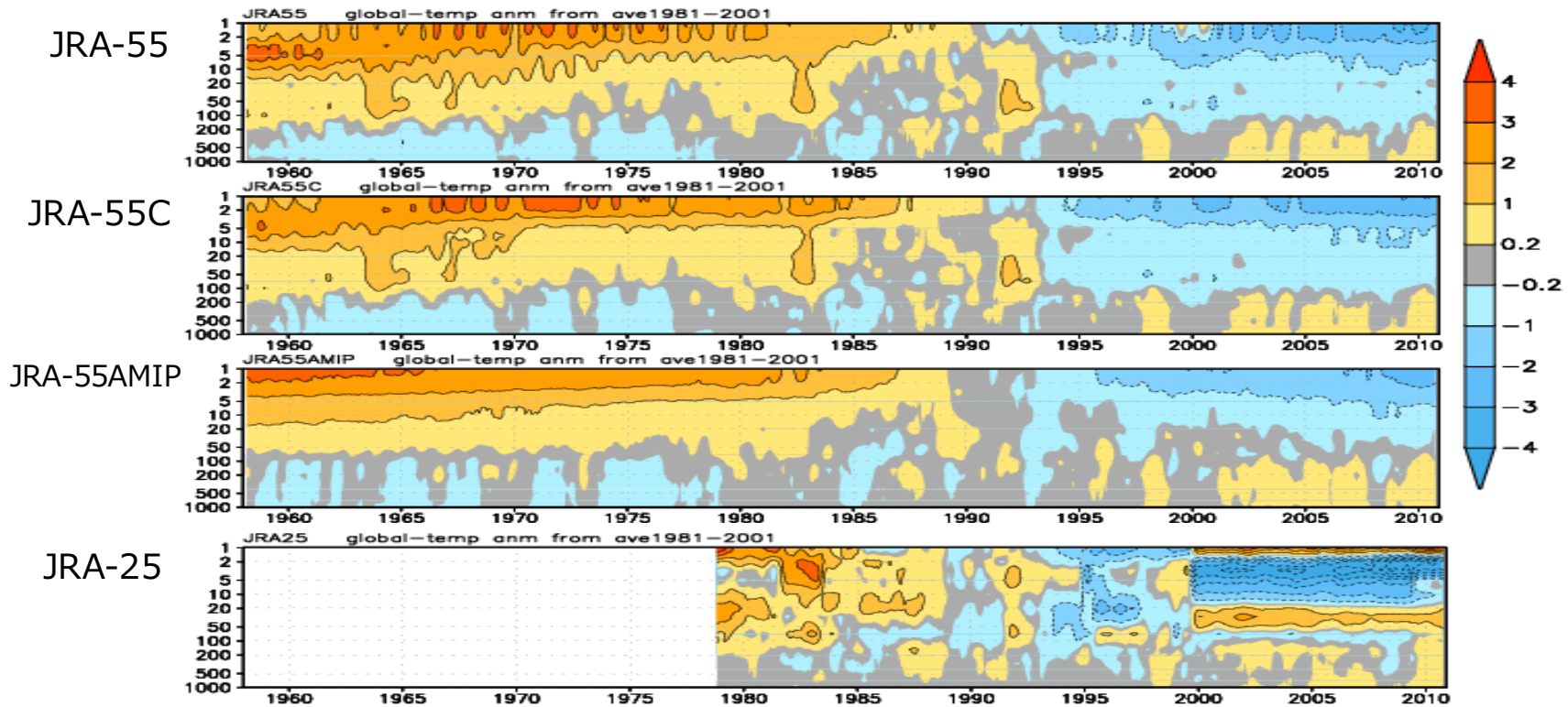
JRA-55C shows QBO ; JRA-55AMIP(model) does not show QBO.  
→Assimilation of upper observations is important to represent QBO in reanalysis product although the number of observations is small.



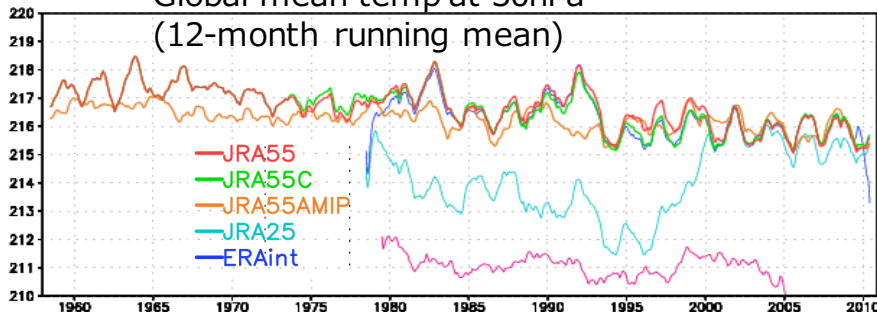


# Height-time cross section of Global mean temperature anomalies

5month running mean anomalies from monthly mean climatology(1980-2001)



Global mean temp at 30hPa  
(12-month running mean)

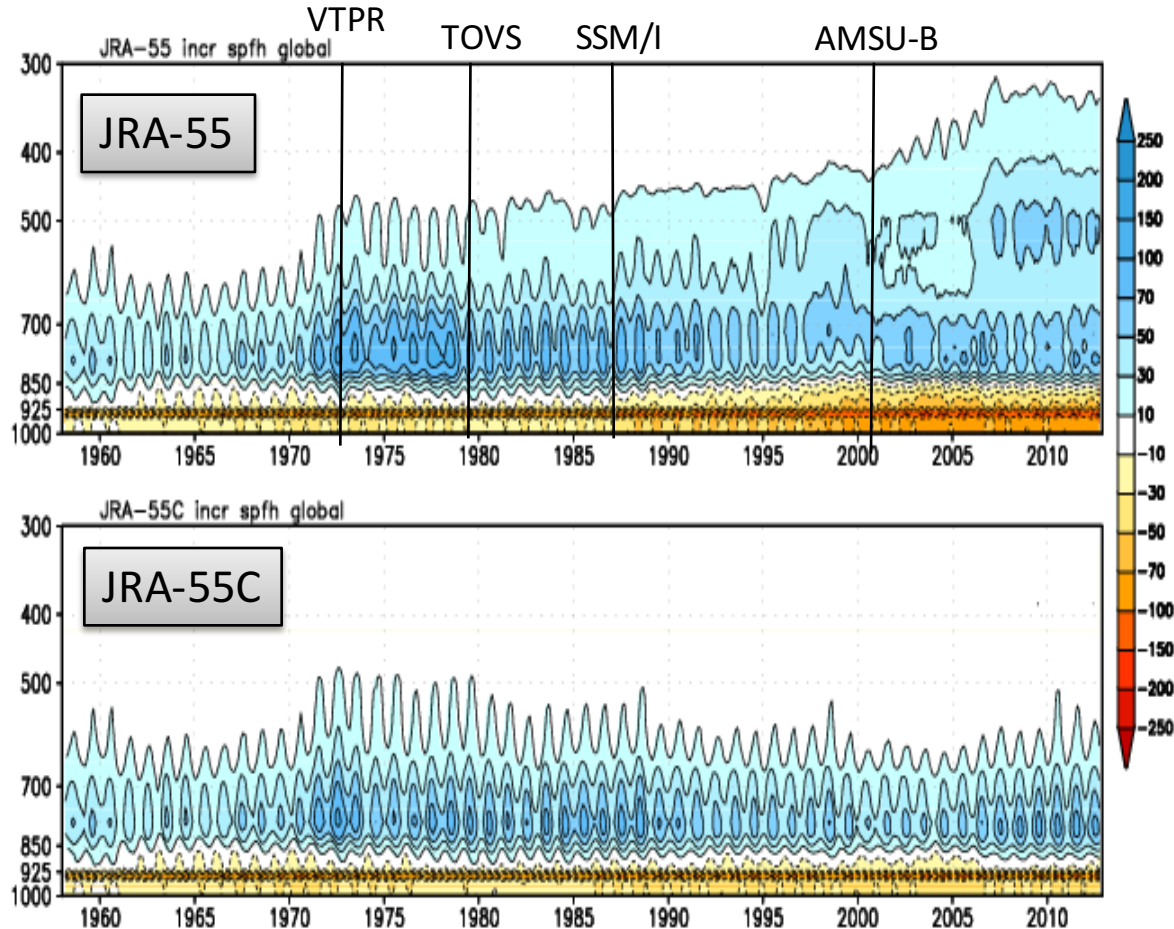


- Temperature changes smoothly in JRA-55 and JRA55C.
- Time consistency is improved from JRA-25.



# Global mean specific humidity increments

## Impact of observing system changes



- Both has significant moistening increments above 850 hPa and drying increments below it.
- The moistening increments in JRA-55 tend to slightly increase as the number of observations from satellite humidity channels increases.
- The moistening increments in JRA-55C are more moderate than that in JRA-55.



# The next Japanese reanalysis

- **JRA-3Q** (pronounced as “Thank you!” in Japanese)
  - Japanese Reanalysis for Three Quarters of a century
- **Provisional specifications**
  - Atmospheric reanalysis from 1948 (?) to present
  - Resolution: TL479L100, top level at 0.01 hPa
  - New boundary conditions and forcing fields
    - COBE-SST2 (from the beginning to 1981)
    - MGD SST (satellite-based SST from 1982 onward)
  - New observations
    - Observations newly rescued and digitised by ERA-CLIM etc.
    - Various reprocessed satellite observations
    - Improved tropical cyclone retrieval winds
- **Aiming at starting production by FY2018**



# Progress of JMA DA system related to the stratosphere

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- Ozone for JRA-3Q (provisional)
  - CTM output used for radiation calculations (as with JRA-55)
  - CTM is nudged to daily column  $O_3$   
(as with JRA-55 but using Level 2 product)
  - CTM progress
    - version MRI-CCM2 (Deushi & Shibata, 2011) (↩ MRI-CCM1 for JRA-55)
      - Enhanced tropospheric chemical processes
    - Resolution TL159L64 (top 0.01hPa) (↩ T42L60)
- Water vapor treatment in the stratosphere NWP model progress  
toward JRA-3Q
  - Introduction of seasonal change in stratospheric climatological WV for radiation calculation in NWP model (under development)
  - Oxidation of methane process in NWP model (under development)



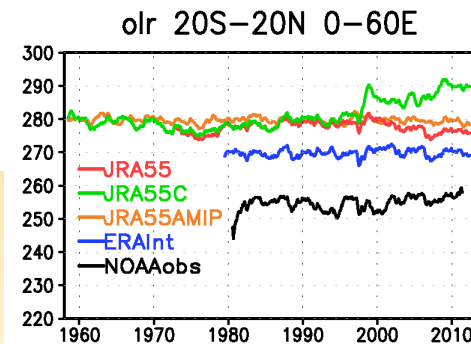


# Summary

- MRI conducted a global atmospheric reanalysis that assimilates only conventional observations, with no use of satellite observations, using the same data assimilation system as the JRA-55.
- The climatological properties of the JRA-55C are similar to those of the JRA-55 in the troposphere and lower stratosphere, except for high latitudes of the SH.
- The quality of the JRA-55C is inferior to that of the JRA-55. But, **the JRA-55C shows good time-consistency during the reanalysis period** (smoother than the JRA-55).

JRA-55C achieve the original aim in broad terms

Problem of JRA-55C:  
Questionable behavior of JRA-55C  
over Africa: abrupt change at the  
end of 1990's. ->see Poster.





# Back up

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# 熱帯平均(30S-30N)気温偏差時系列

(1980-2000平均月平均からの偏差の5か月移動平均)

