

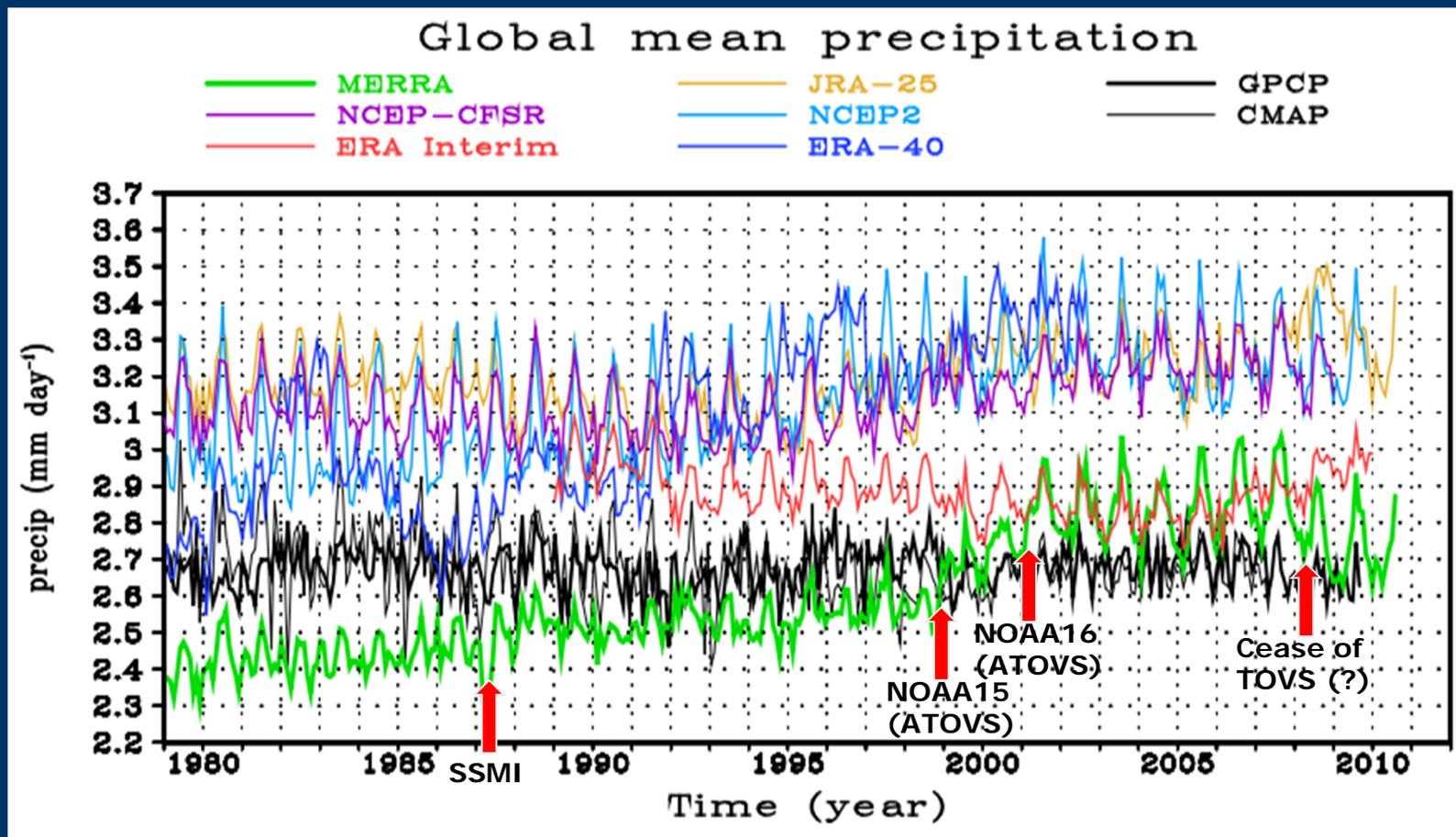
# Impacts of ATOVS and SSM/I Data in MERRA Reanalysis

Junye Chen<sup>1,2</sup> and Mike Bosilovich<sup>2</sup>

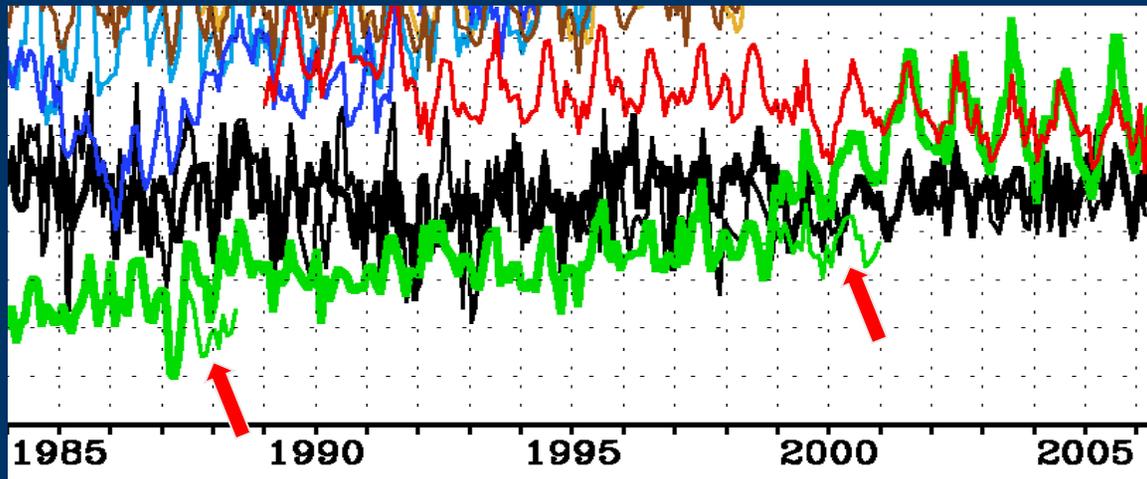
1: ESSIC/UMD 2: GMAO/GSFC/NASA



The changes of observing system have significant impact on the temporal consistency of all reanalysis datasets. Especially when new observation types are introduced, the related discontinuities or jumps could be big obstacles for climate study.

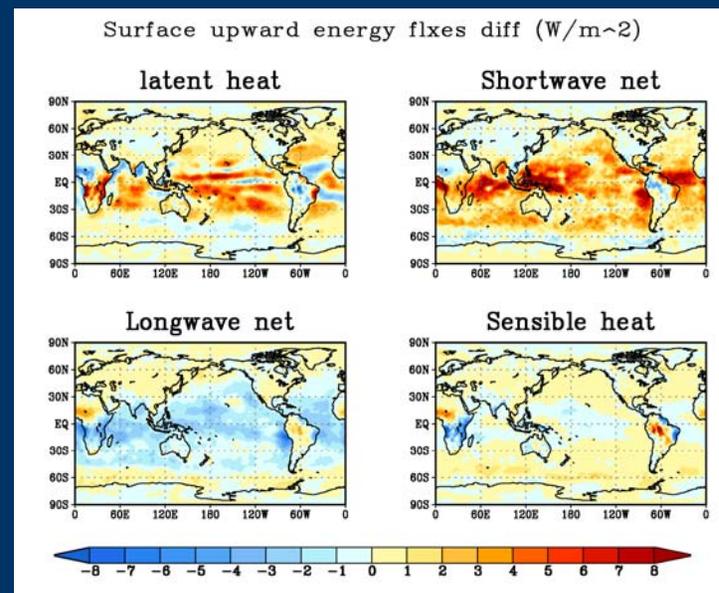
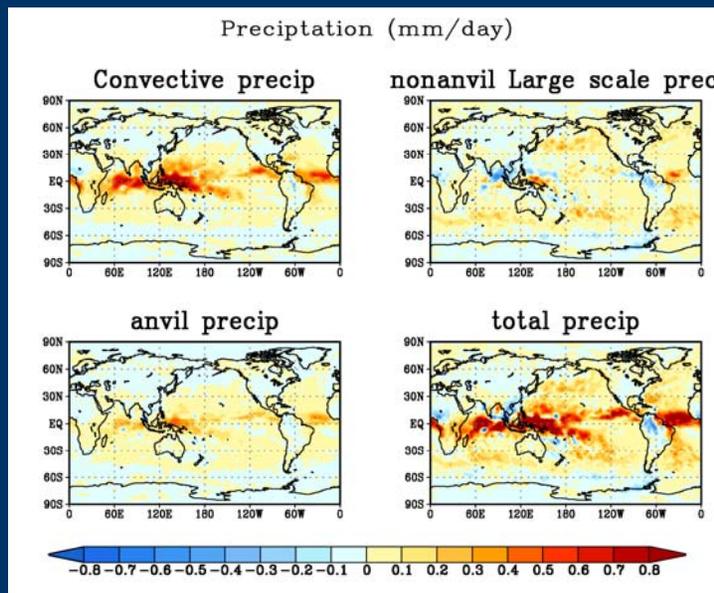
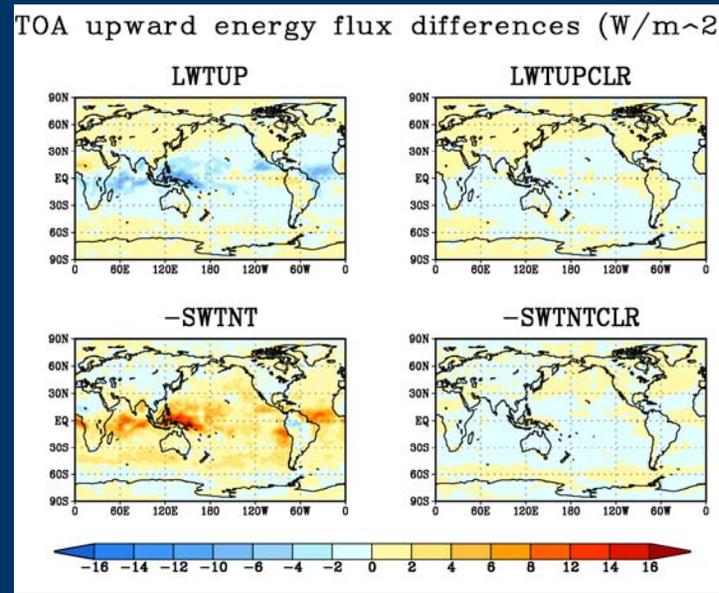
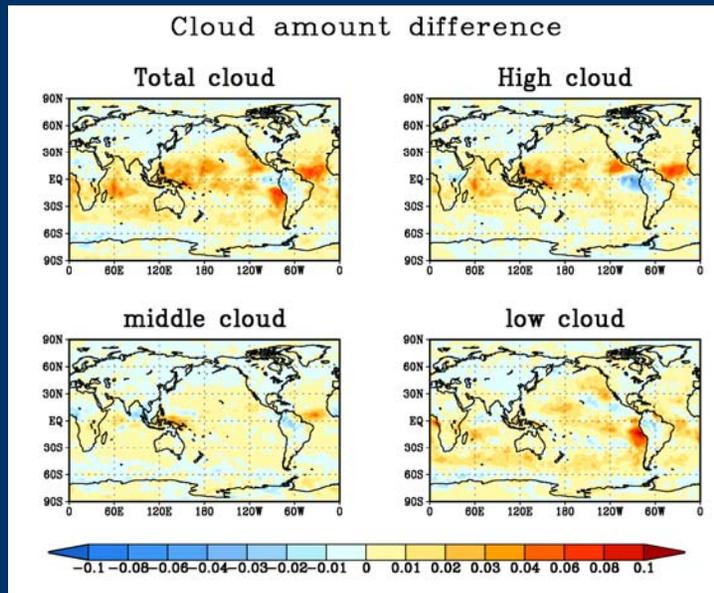


Here we present the impacts of introduction of SSM/I (1987) and NOAA-15 ATOVS (1998) data in NASA MERRA reanalysis. This is a part of an ongoing effort to homogenize the MERRA reanalysis.



Two observing system experiments (OSE) withholding SSM/I and NOAA-15 ATOVS data have been produced to reveal the impact of the introductions of SSM/I data in 1987 and ATOVS data in late 1998, respectively.

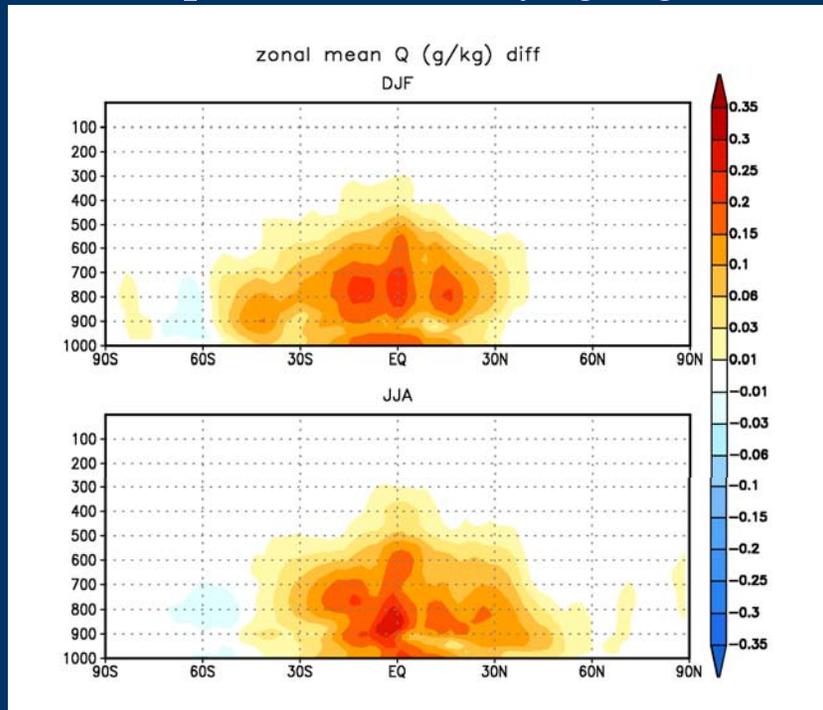
# Impact of SSM/I: Cloud, Precipitation, TOA and Surface Fluxes



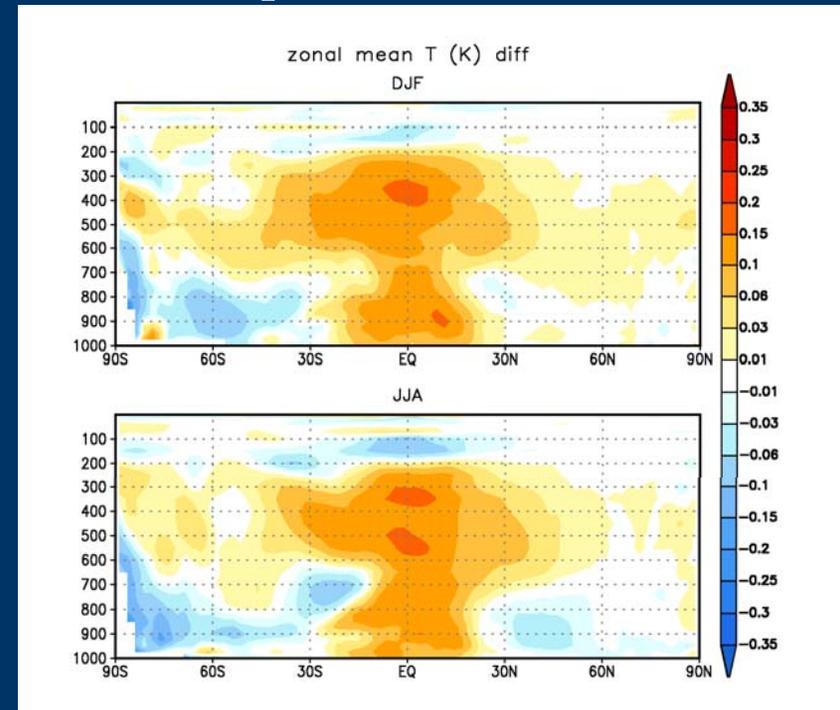
As expected, the change of these parameters are tightly related.

# Impact of SSM/I: Humidity and Temperature

## Specific Humidity (g/Kg)



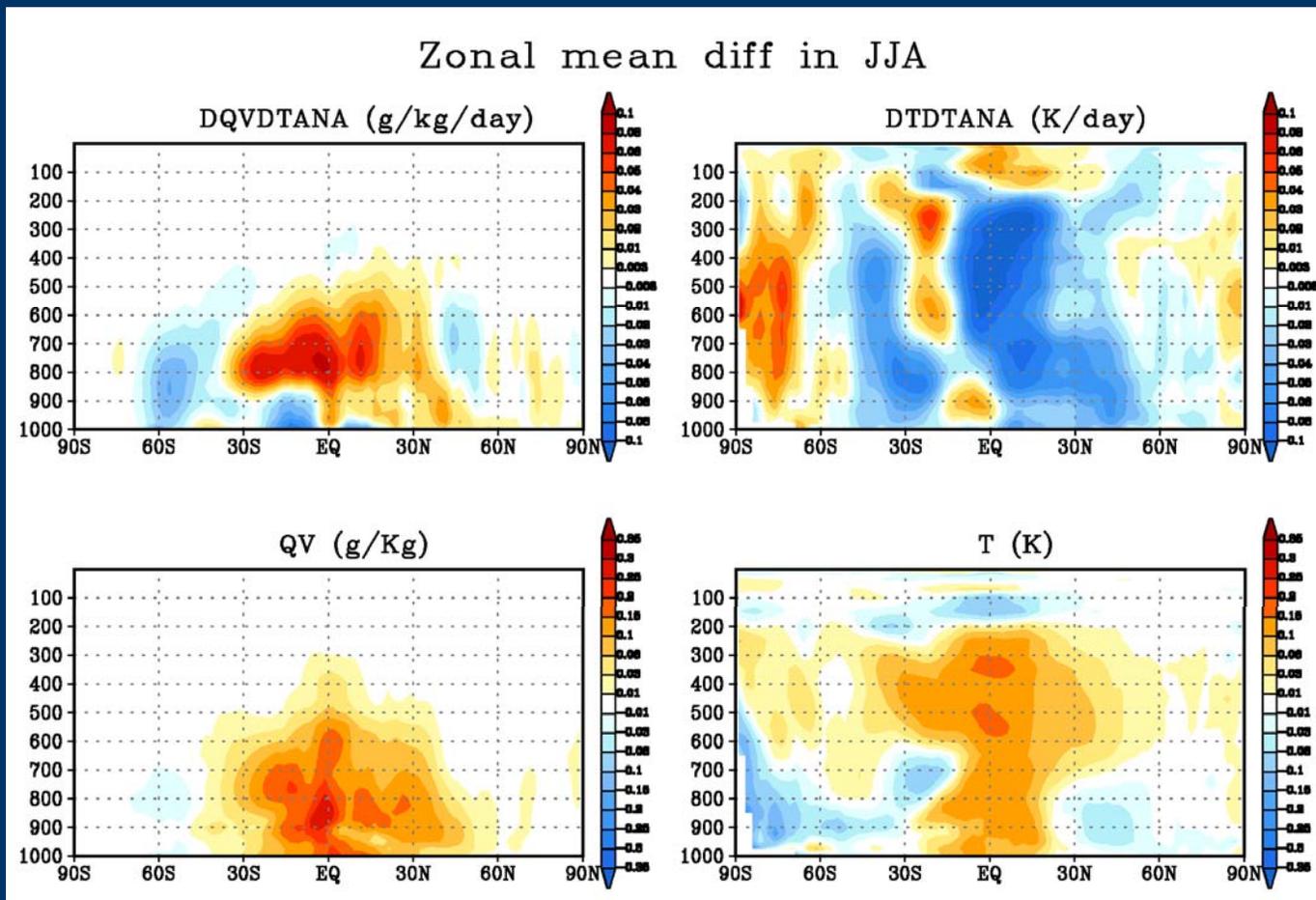
## Temperature (K)



Above three slides show that the changes of different parameters are mainly happened in the tropical region.

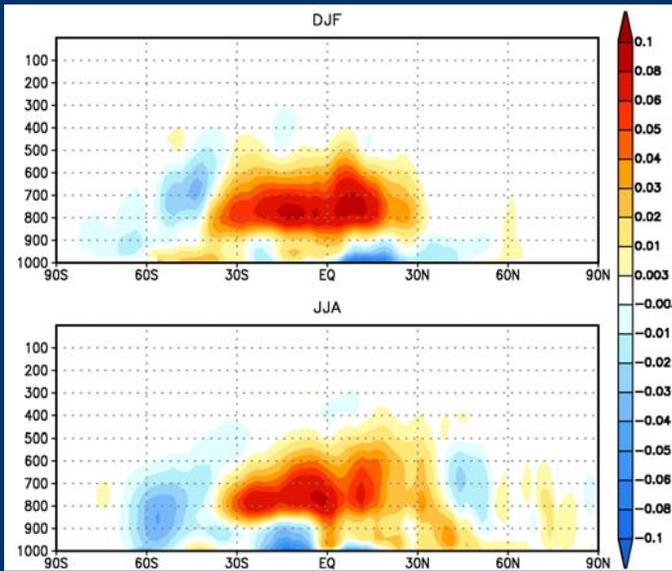
How to understand the relationship between the changes in state parameters and the corresponding observation induced analysis increment:

DQVDT\_Analysis and Q have same sign, but DTDT\_Analysis and T have opposite sign? Implying cause and effect relationship?

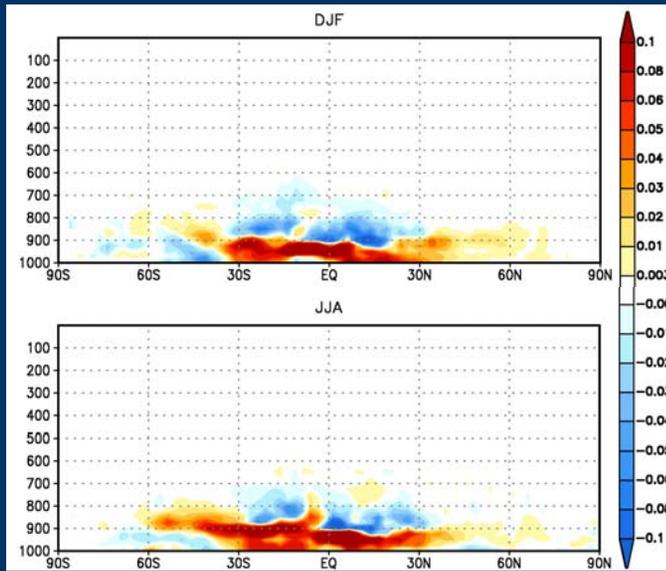


# Impact of SSM/I: Humidity Tendencies

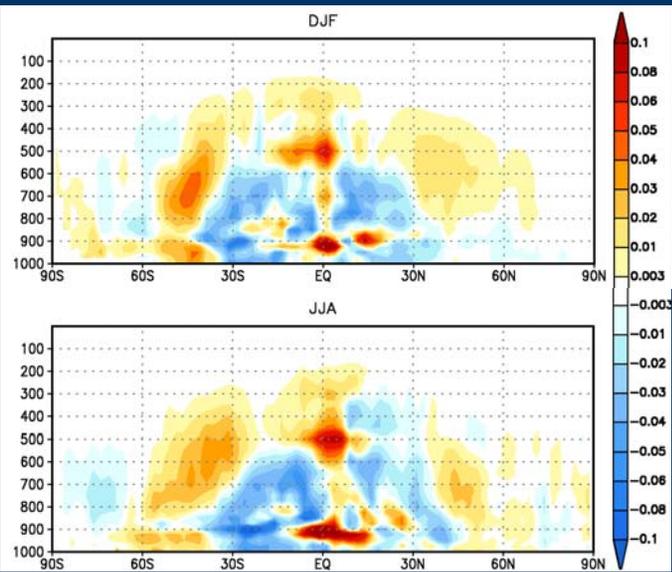
## DQVDT\_analysis



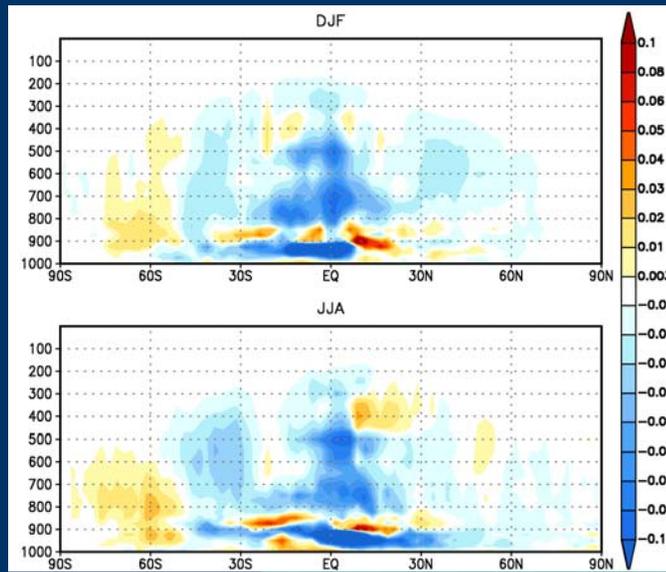
## DQVDT\_turbulence



## DQVDT\_dynamic



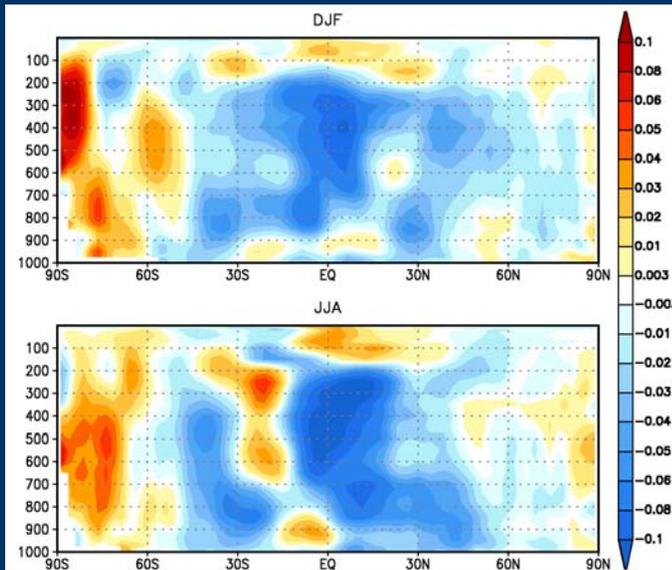
## DQVDT\_moisture



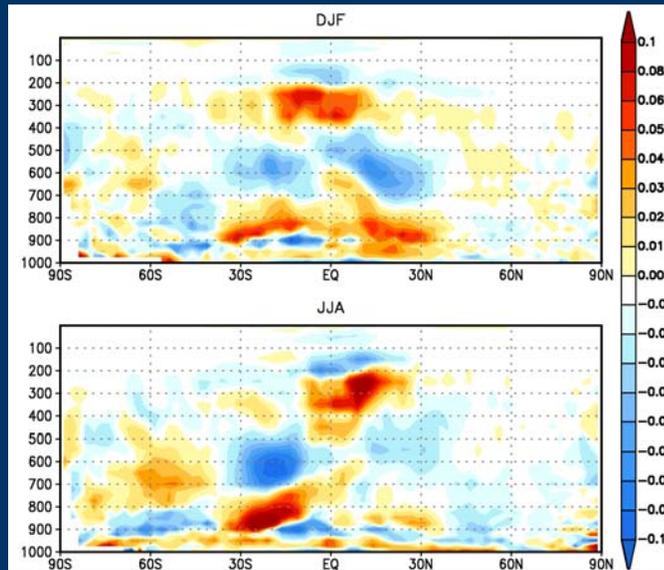
SSM/I observation causes more moisture injected in the tropical middle and low troposphere, the additional moisture is depleted through convective precipitation in the tropics, increases the Hadley Circulation, causes dynamical redistribute moisture field and changes in the boundary layer height(?) and more evaporation.

# Impact of SSM/I: Temperature Tendencies

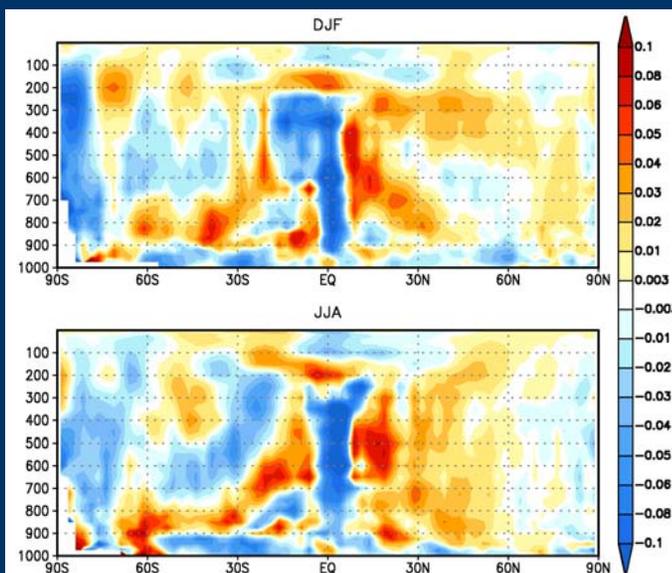
## DTDT\_analysis



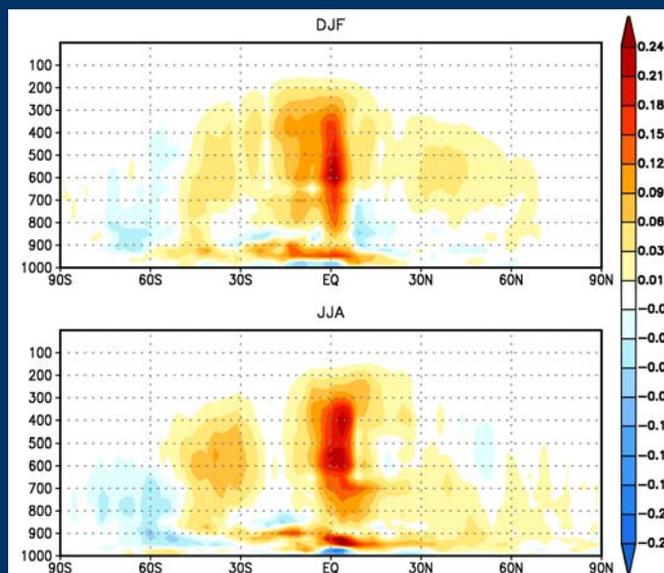
## DTDT\_radiation



## DTDT\_dynamic



## DTDT\_moisture



The released latent heat from moisture process (convective precipitation) heats the tropics, especially the equatorial region, and the associated intensification of Hadley Circulation make adiabatic cooling in equatorial region and warming in subtropical region, the net effect of the moisture, dynamic and radiative processes is positive warming, and the temperature observation from other platforms (SSM/I contents little temperature info) passively adjust the temperature increment negatively.

# Comparing the impacts of SSM/I and NOAA-15 ATOVS: Precipitation

SSM/I

NOAA-15

Precipitation (mm/day)

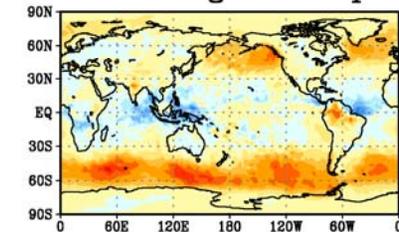
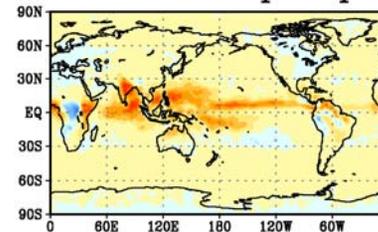
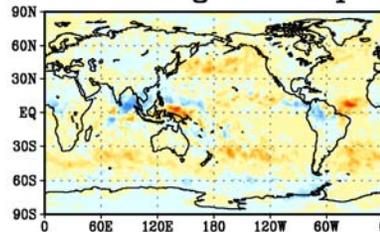
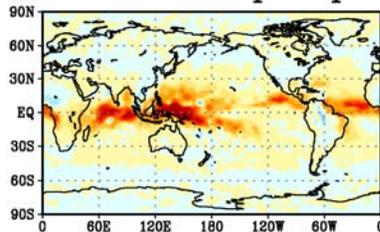
Precipitation (mm/day)

Convective precip

nonanvil Large scale precip

Convective precip

nonanvil Large scale precip

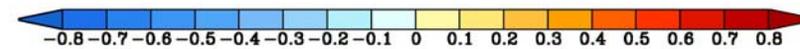
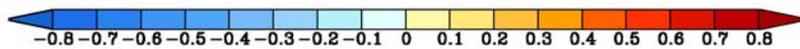
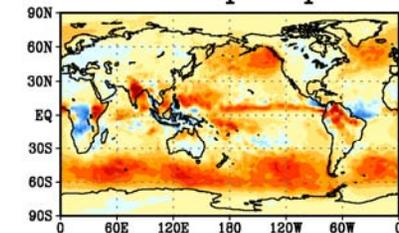
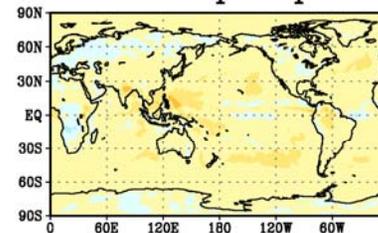
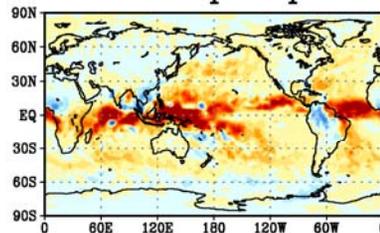
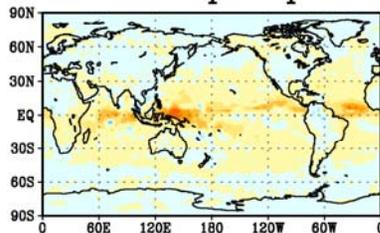


anvil precip

total precip

anvil precip

total precip

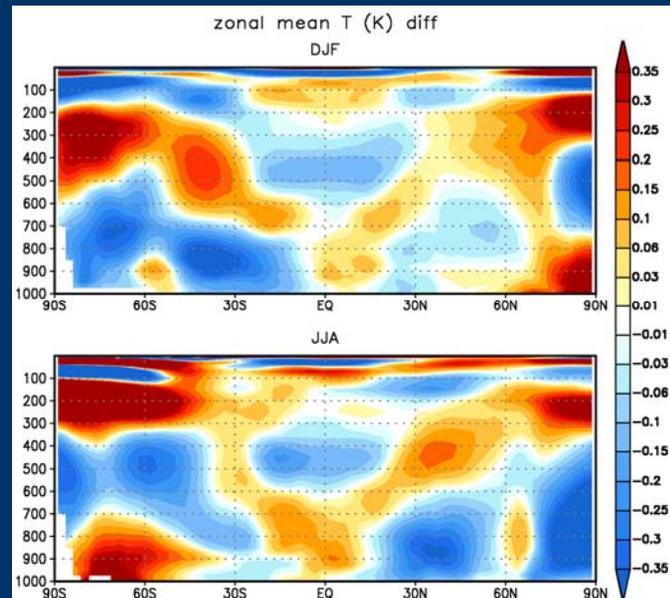
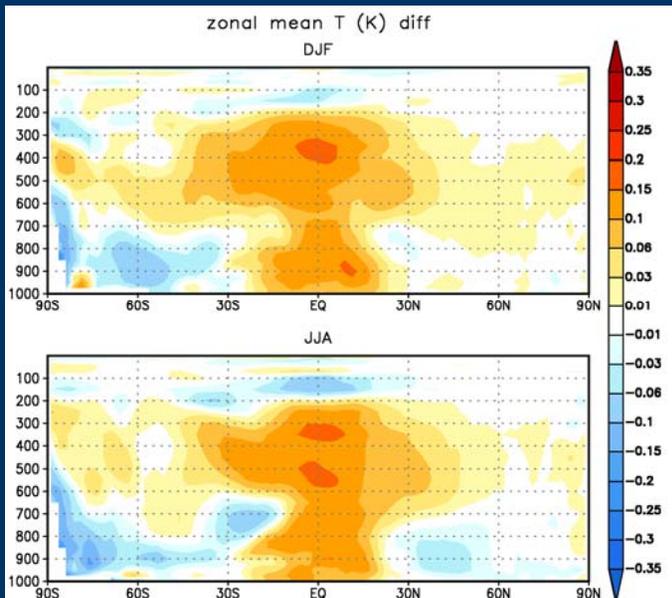
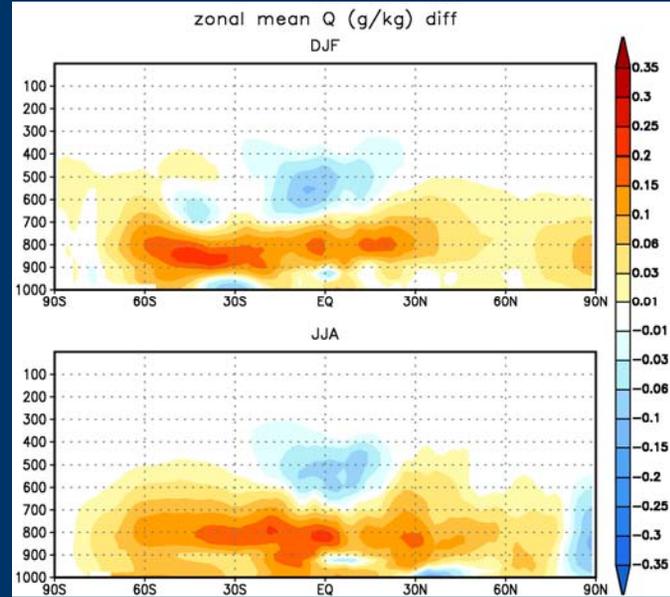
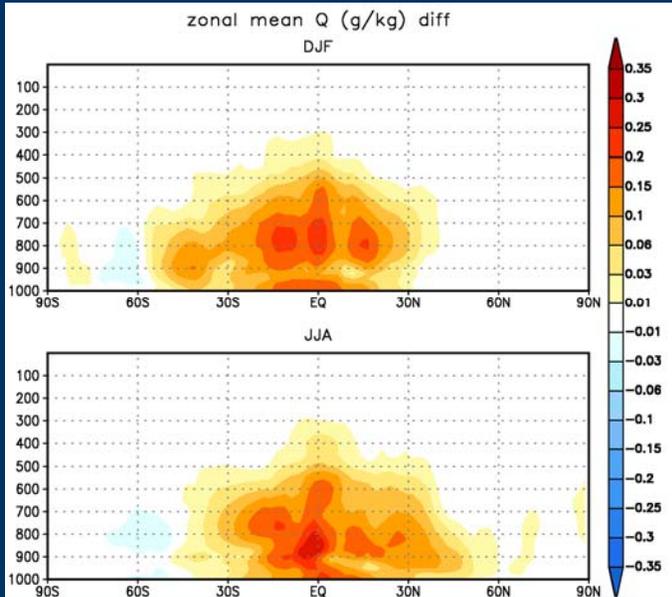


Except tropics, the NOAA-15 makes significant impact in the middle latitudes over ocean.

# Comparing the impacts of SSM/I and NOAA-15 ATOVS: moisture and temperature

SSM/I

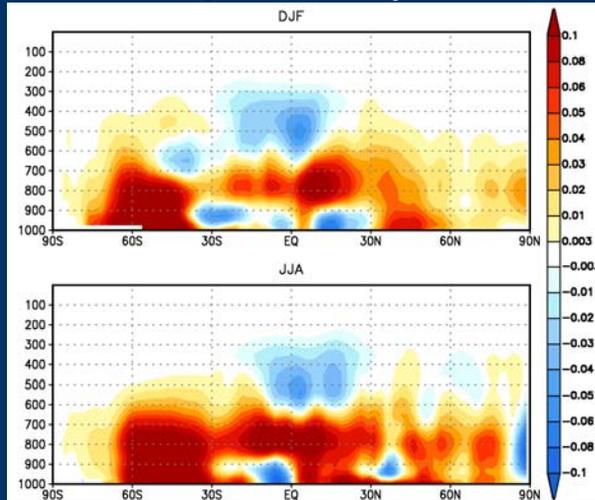
NOAA-15



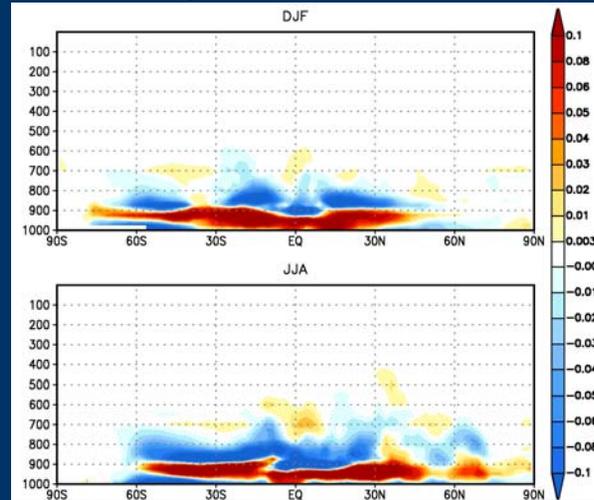
The moisture and temperature patterns are quite different too.

# Impact of NOAA-15: Humidity Tendencies

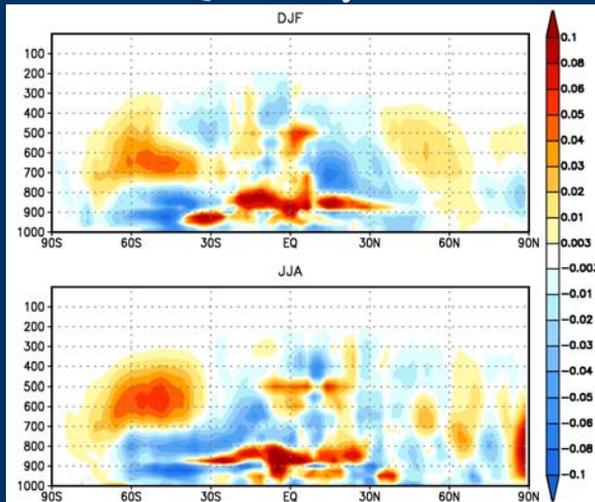
## DQVDT\_analysis



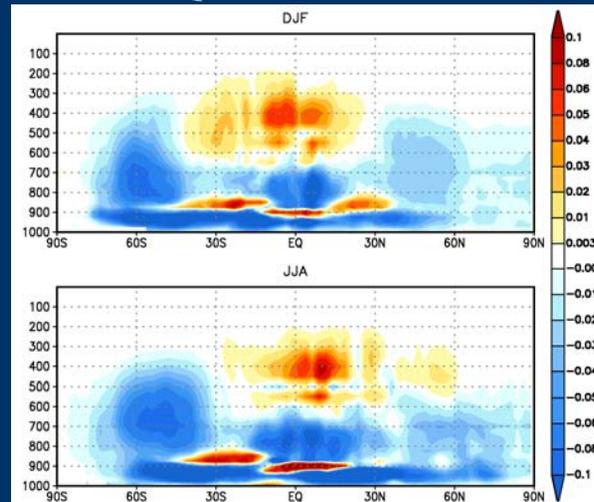
## DQVDT\_turbulence



## DQVDT\_dynamic

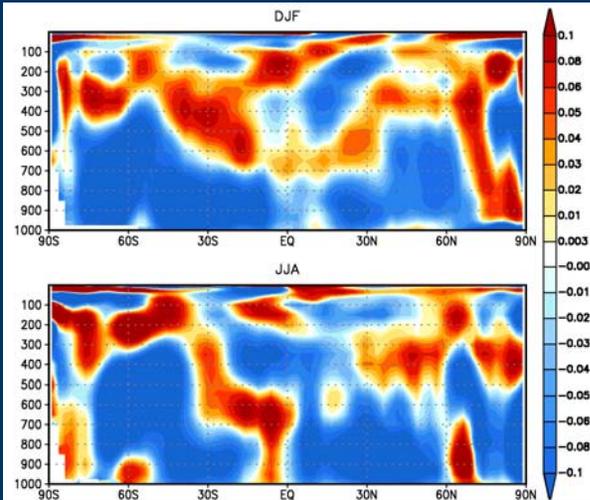


## DQVDT\_moisture

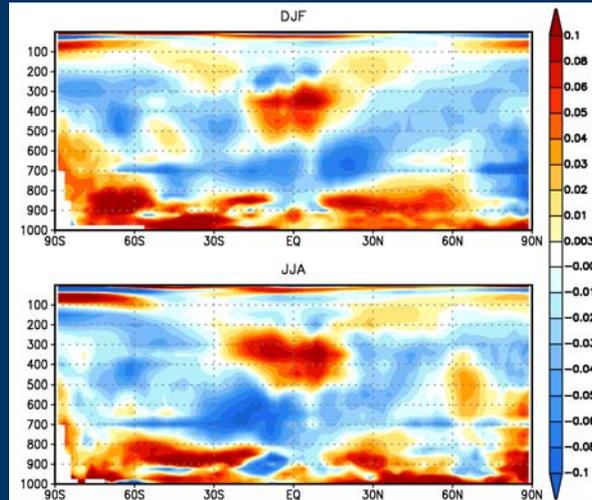


# Impact of NOAA-15: Temperature Tendencies

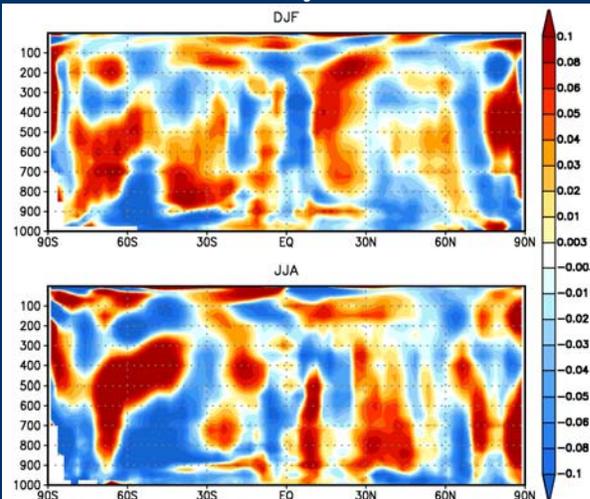
## DTDT\_analysis



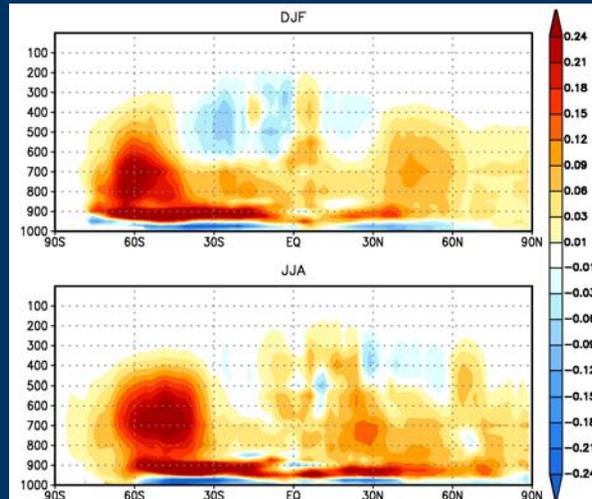
## DTDT\_radiation



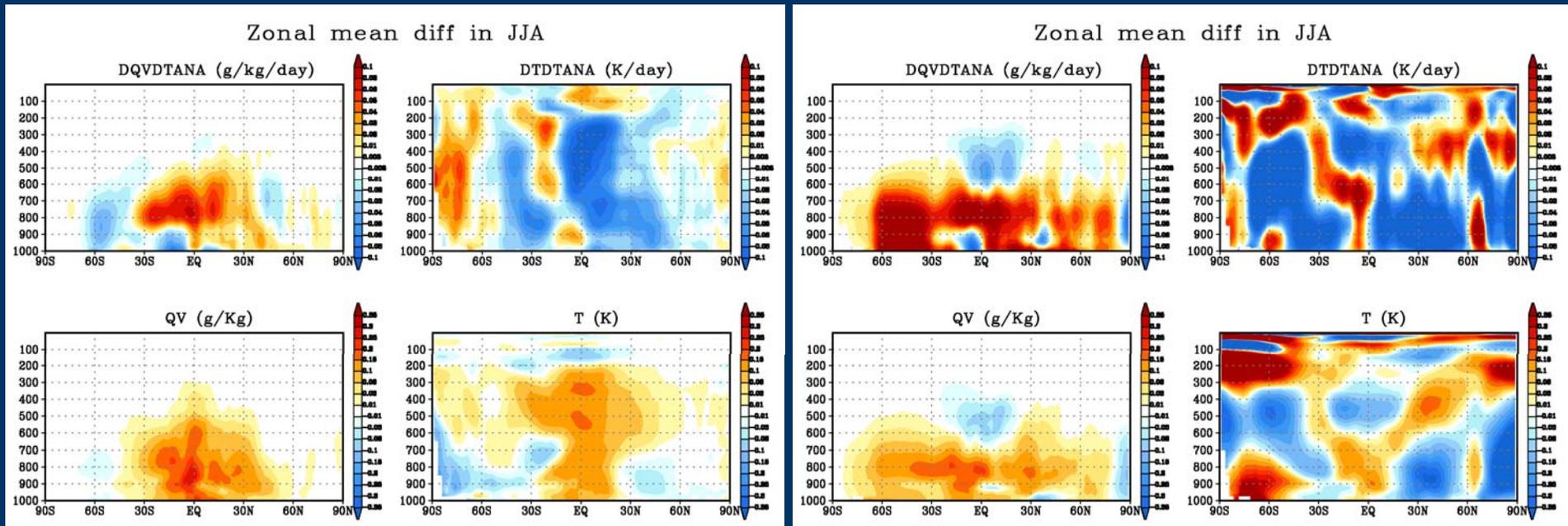
## DTDT\_dynamic



## DTDT\_moisture



# Comparing the impacts of SSM/I and NOAA-15 ATOVS: state parameters and their analysis increments



- Why big increase of moisture increment over South Ocean does not happen because of the earlier SSM/I but the later NOAA-15 ATOVS?
- Except the different spatial distribution from SSM/I, the NOAA-15 associated temperature and its increment appear to be positively correlated. Implying the temperature increment is not just passively changing?
- Does the opposite or same signs between a state parameter and the corresponding analysis increment indicate the cause and effect relationship between them?

# Conclusion

- The impact of a new observation type in the reanalysis could be systematic.
- The impacts from different observation could be very different, so needs to address them case by case.
- The inherent relationship between changes in a state parameter and its analysis increment could be an interesting research topic.