



兰州大学大气科学学院

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Space-Time Variability of UTLS Chemical Distribution in the Asian Summer Monsoon Viewed by Limb and Nadir Satellite Sensors

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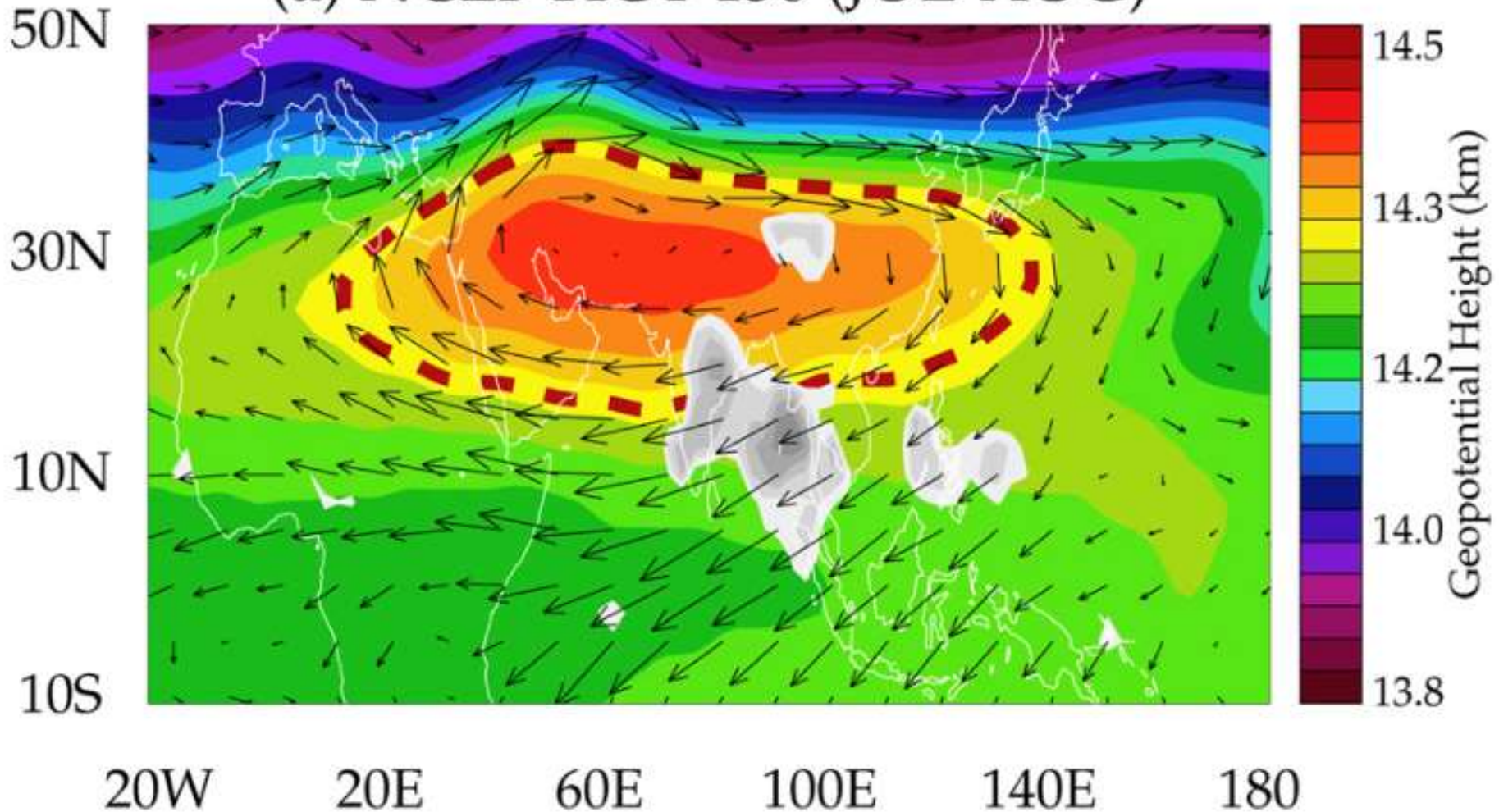
With contributions from

**Laura Pan, Shawn Honomichl, John Bergman, Bill Randel, Gene Francis,
Cathy Clerbaux, Maya George, Xiong Liu, and Wenshou Tian**

**Atmospheric Composition and the Asian Monsoon Workshop, Guangzhou
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Asian summer monsoon anticyclone (ASM)

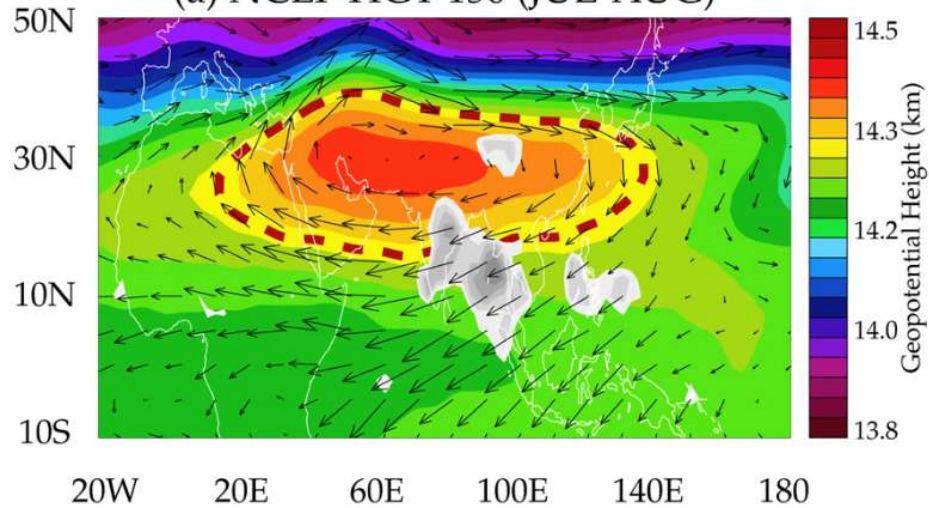
(a) NCEP HGT 150 (JUL-AUG)



Randel and Park, 2006

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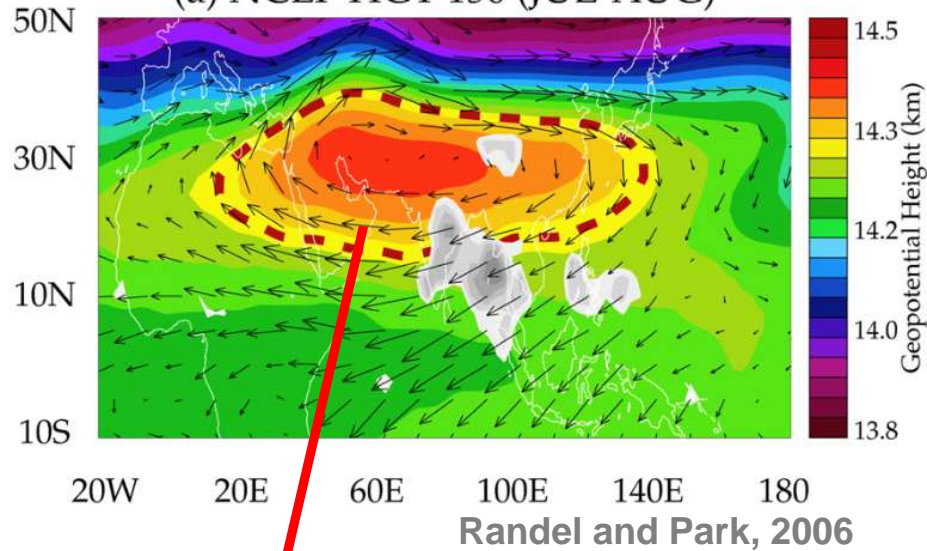
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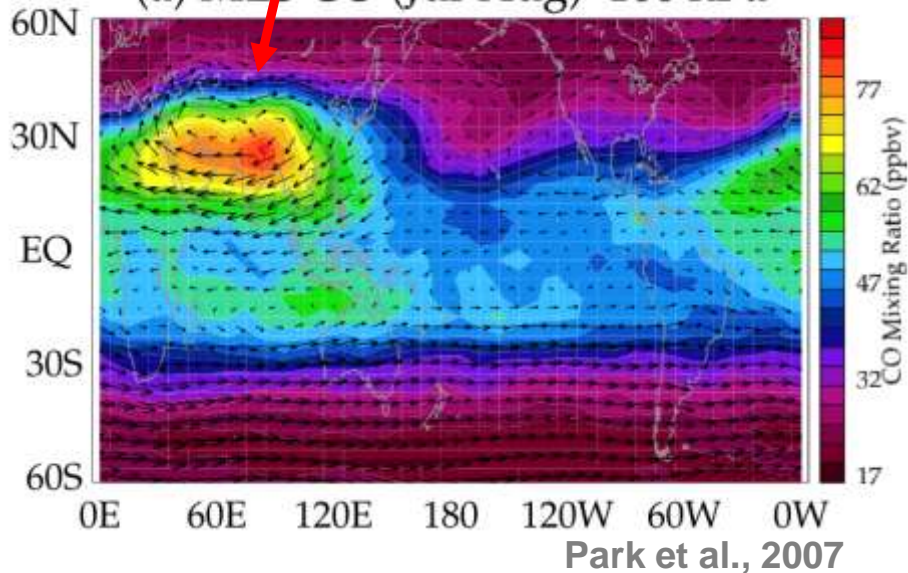
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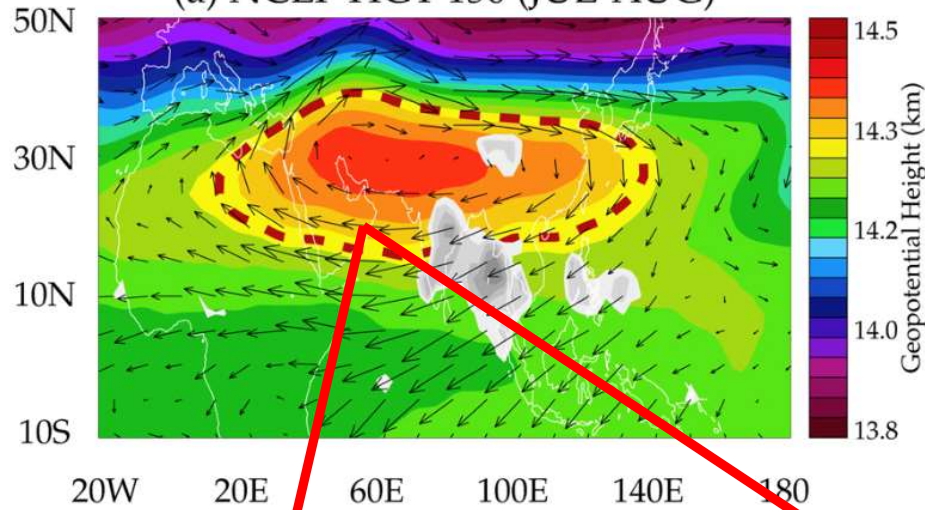


(a) MLS CO (Jul-Aug) 100 hPa

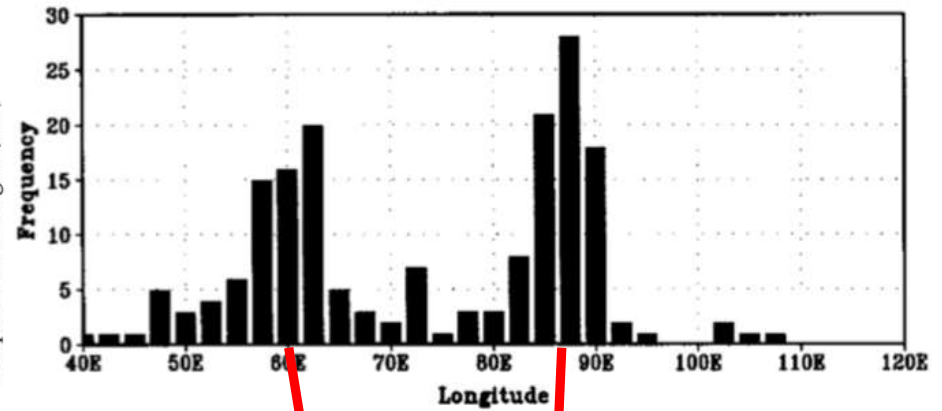


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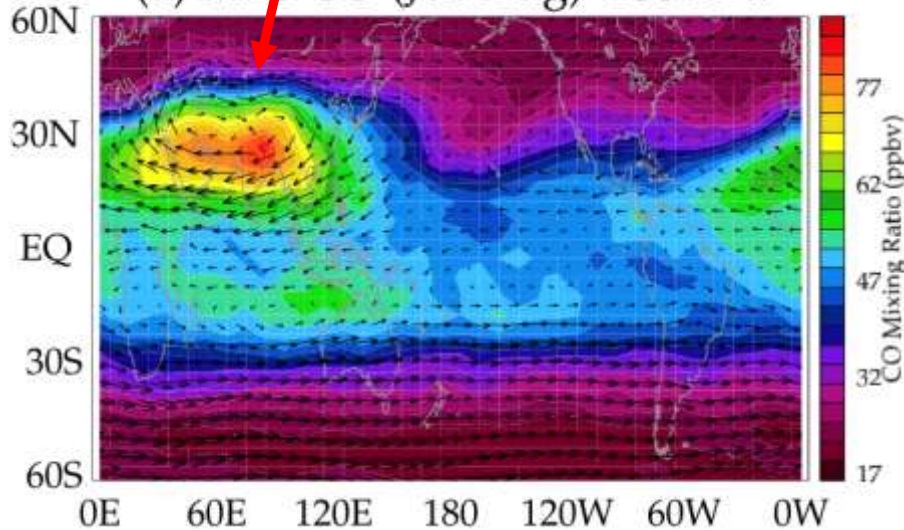
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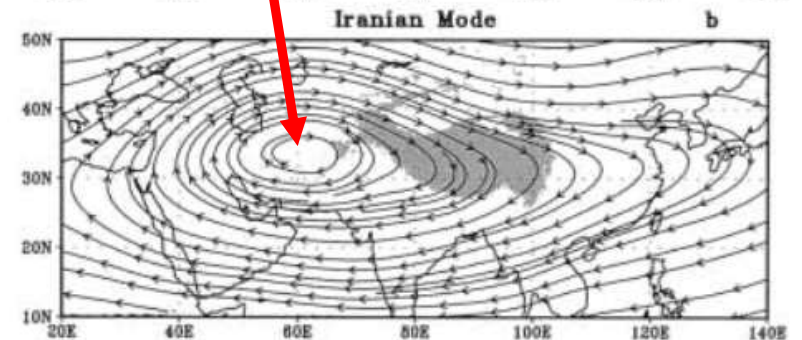
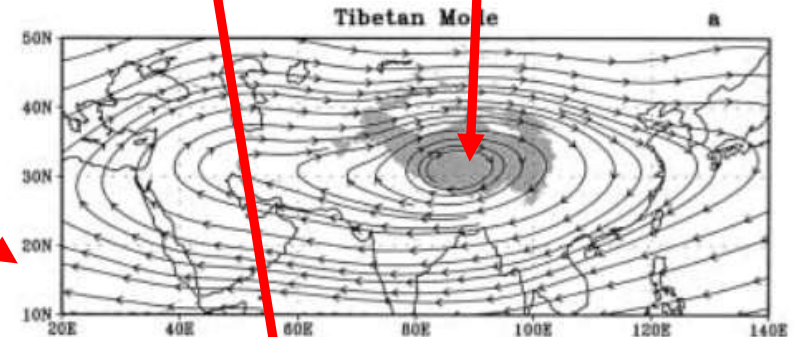
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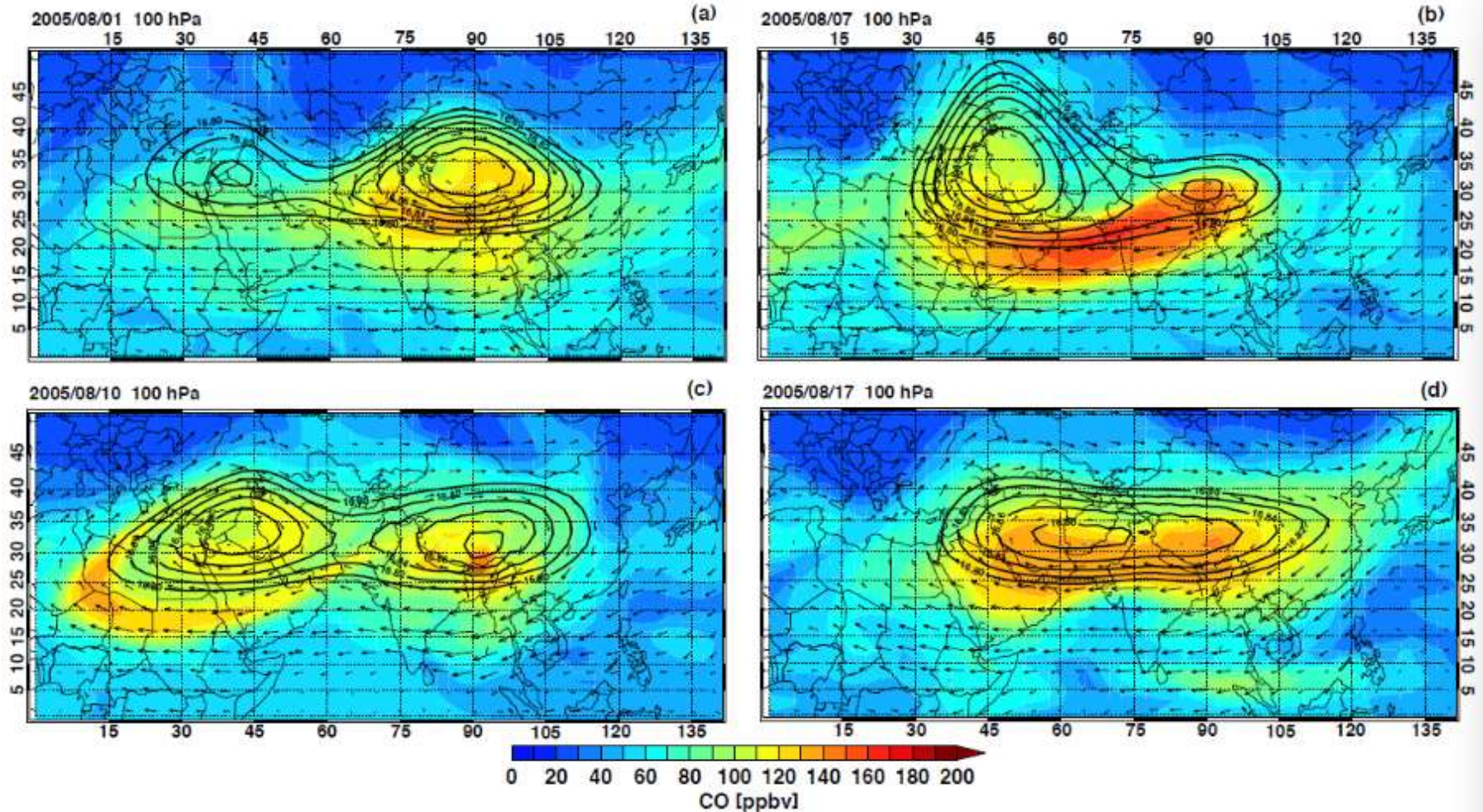
Park et al., 2007



Zhang et al., 2007

Intra-seasonal variability of CO in UTLS

WACCM-SD CO at 100 hPa



Motivation and Objective

- Whether the east-west oscillation we found in model output **is also shown in satellite data?**

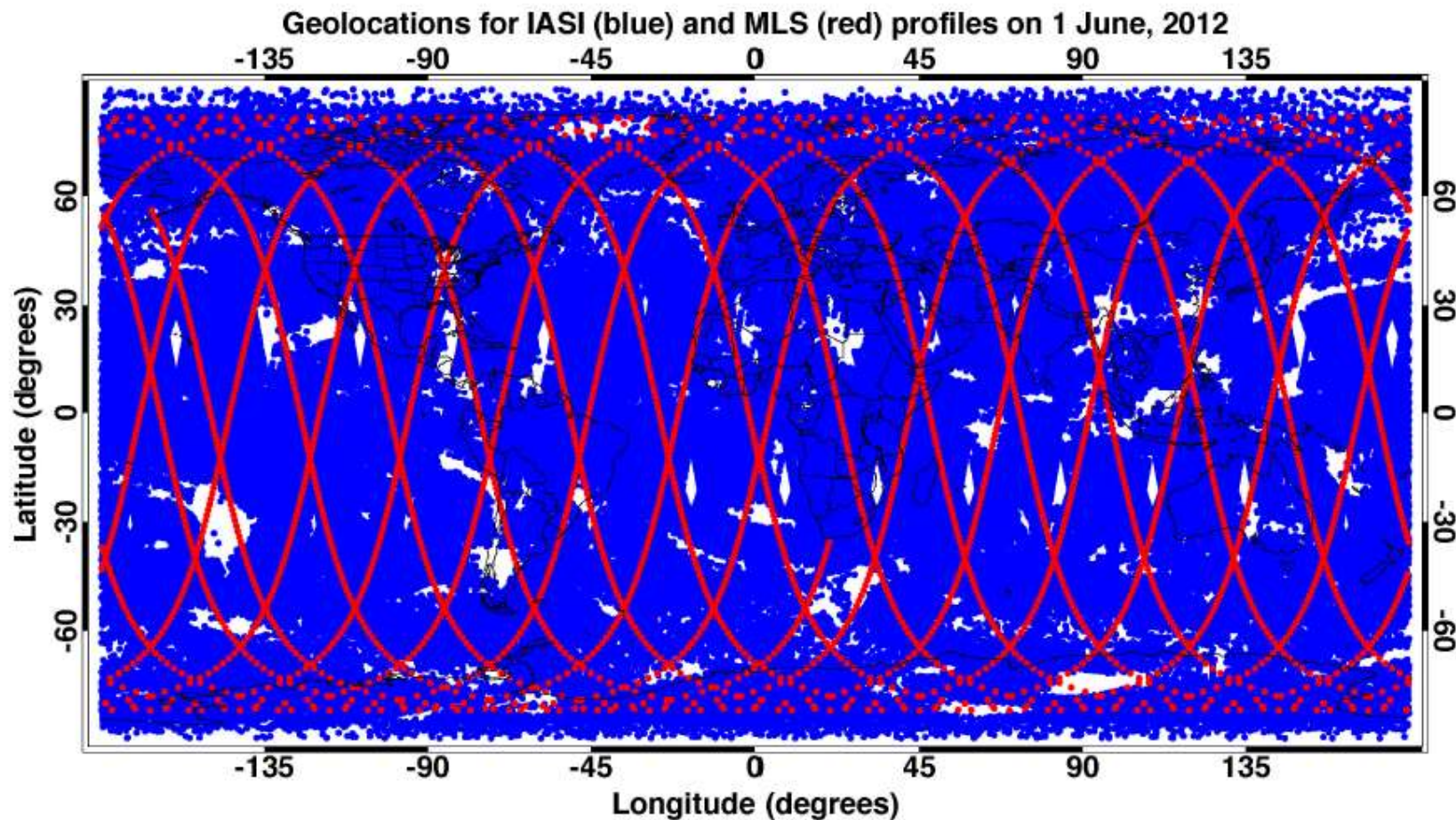
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- Typically we use limb sounders which have **limited horizontal sampling on daily timescales** to show the seasonal features.

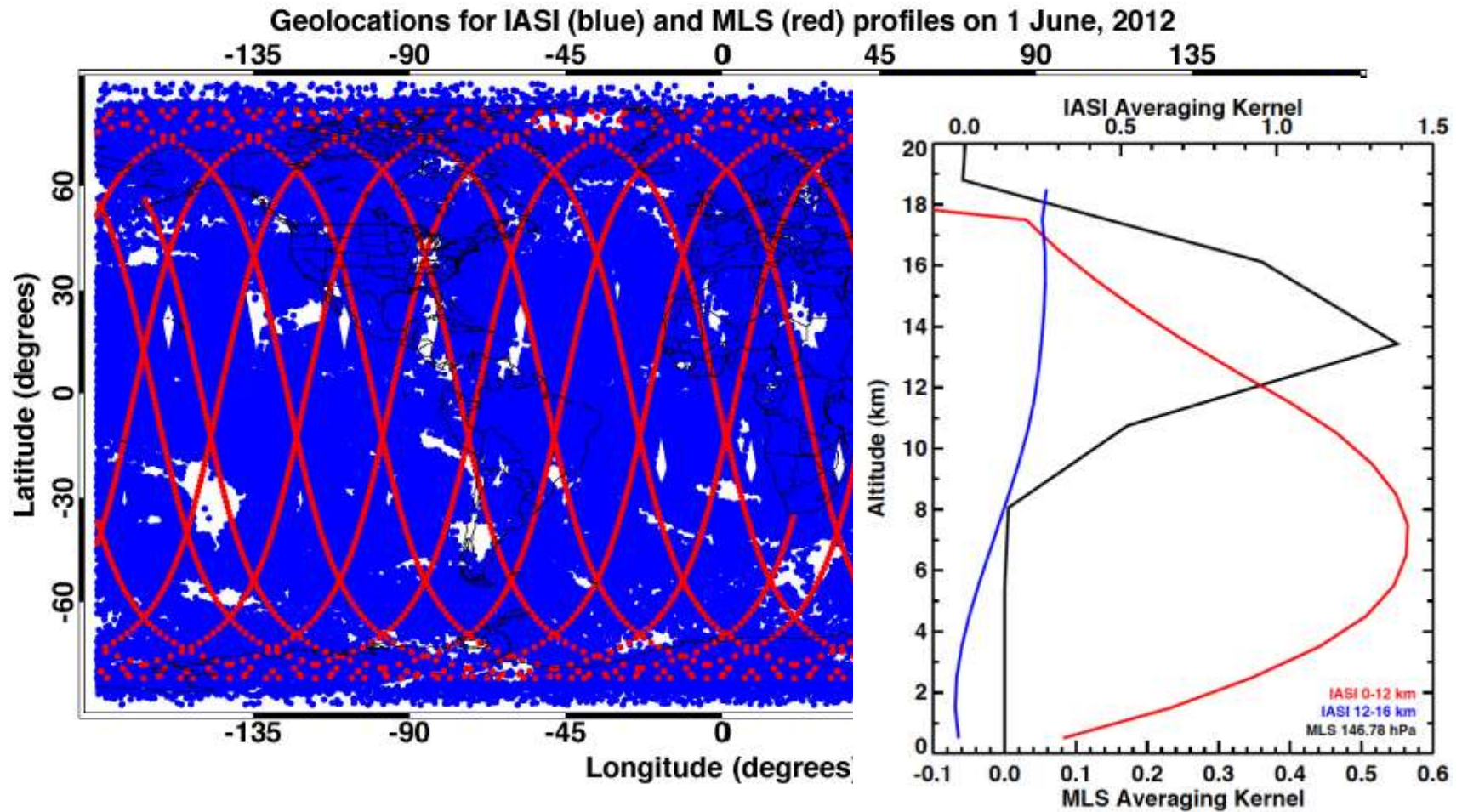
Motivation and Objective

- Whether the east-west oscillation we found in model output **is also shown in satellite data?**
- Typically we use limb sounders which have **limited horizontal sampling on daily timescales** to show the seasonal features.
- **The goal of this study** is to see **whether** the denser sampled **nadir sounding can show** the ASM impact on the **UTLS** tracer distributions and variabilities.

Limb sounder (MLS) and Nadir sounder (OMI/IASI)



Limb sounder (MLS) and Nadir sounder (OMI/IASI)

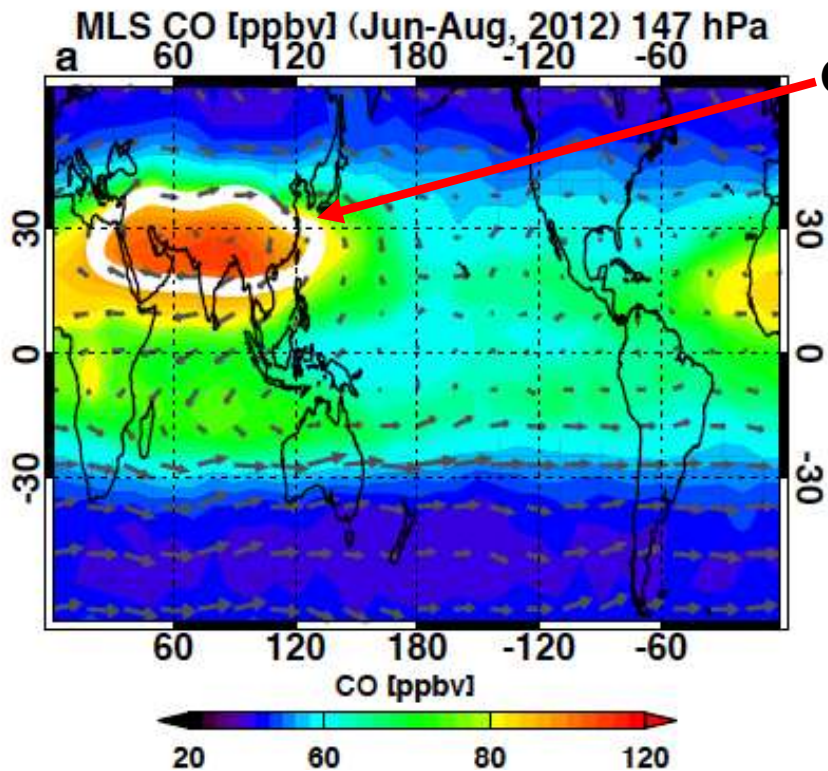


Key Questions

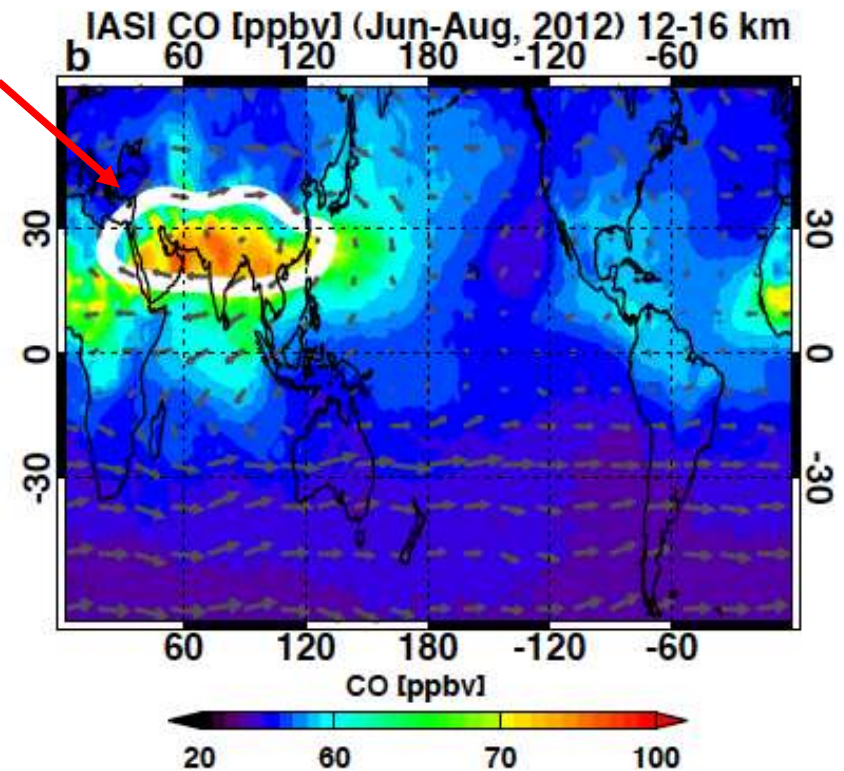
- Do **nadir view instruments** have sufficient information to show the ASM dynamics driven trace gas distributions and variability at the **UTLS levels**?
- Are the data from nadir sensors consistent with the limb-viewing data **on sub-seasonal scales** with respect to dynamical variability of tracers in the ASM region?
- What can we learn from the **complementary information** from limb and nadir viewing instruments?

Seasonal mean CO distribution (MLS at 147 hPa and IASI at 12-16 km)

Limb



Nadir

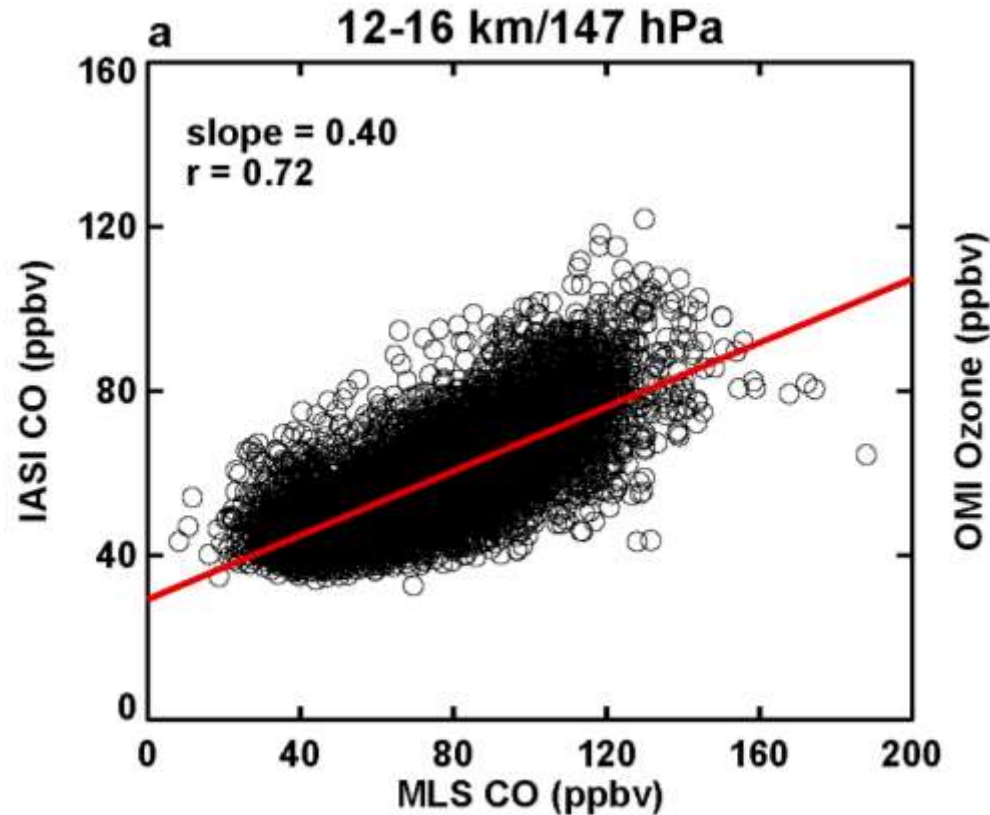


IASI CO data is capable of showing the impact of the ASM circulation on UT CO on seasonal scale

Consistency of MLS and IASI CO variability

Co-located bin averages from IASI CO to MLS CO in the monsoon region during JJA

0-50° N, 0-150° E

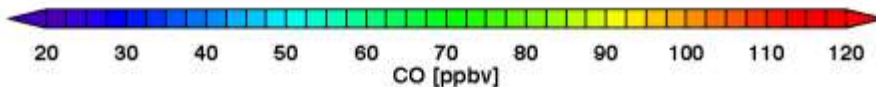
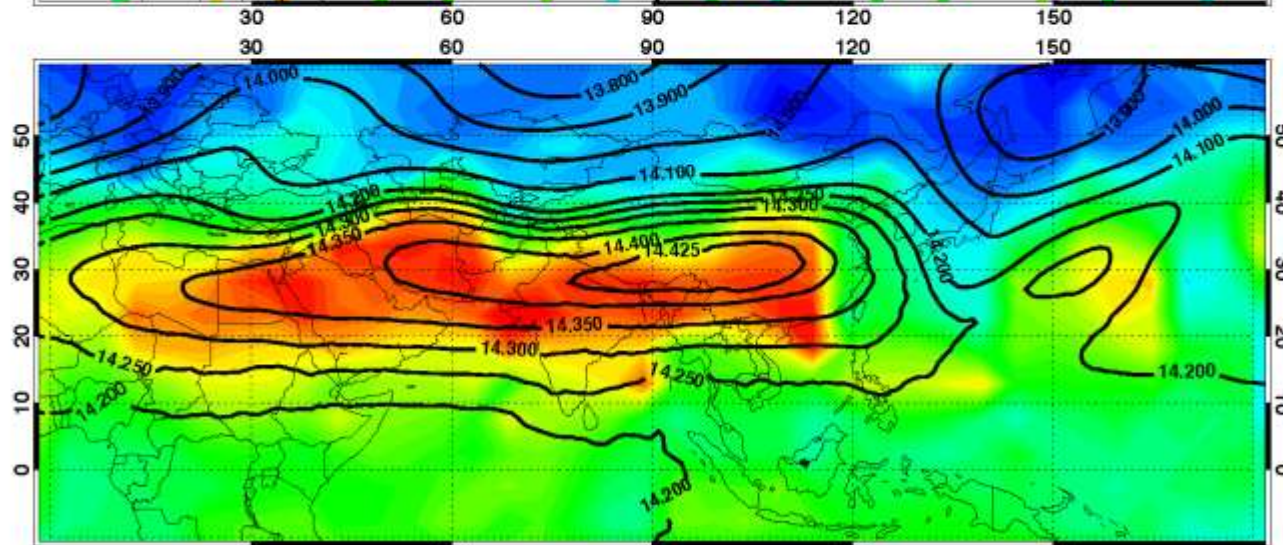
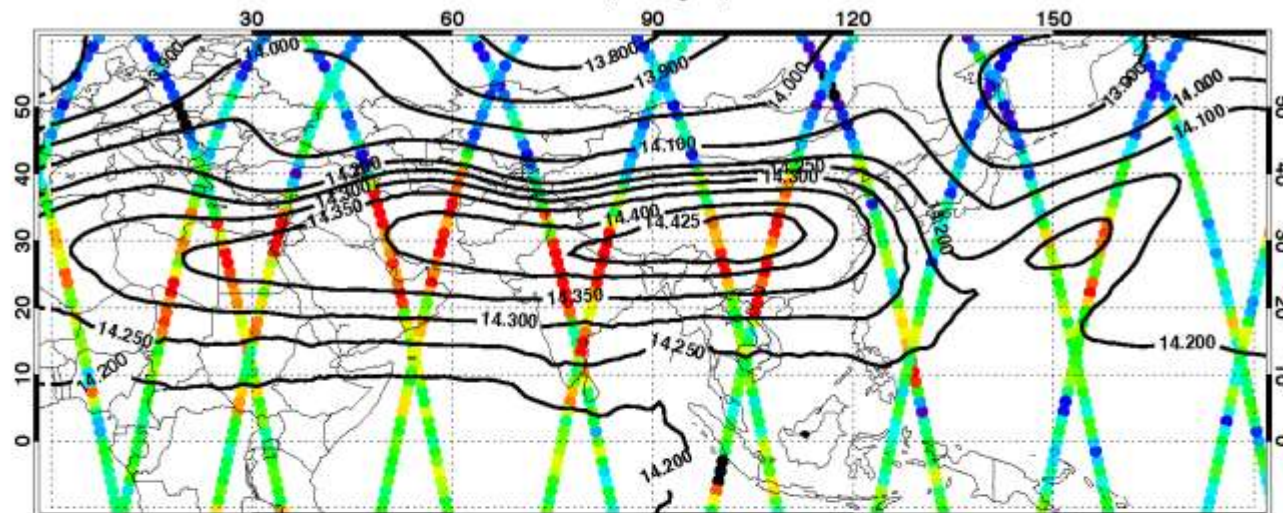


IASI layer averaged CO have a smaller range of variability than MLS.
It may be influenced by a weaker detection sensitivity in UT .

What about sub-seasonal scales?

Original level 2 data and interpolated data

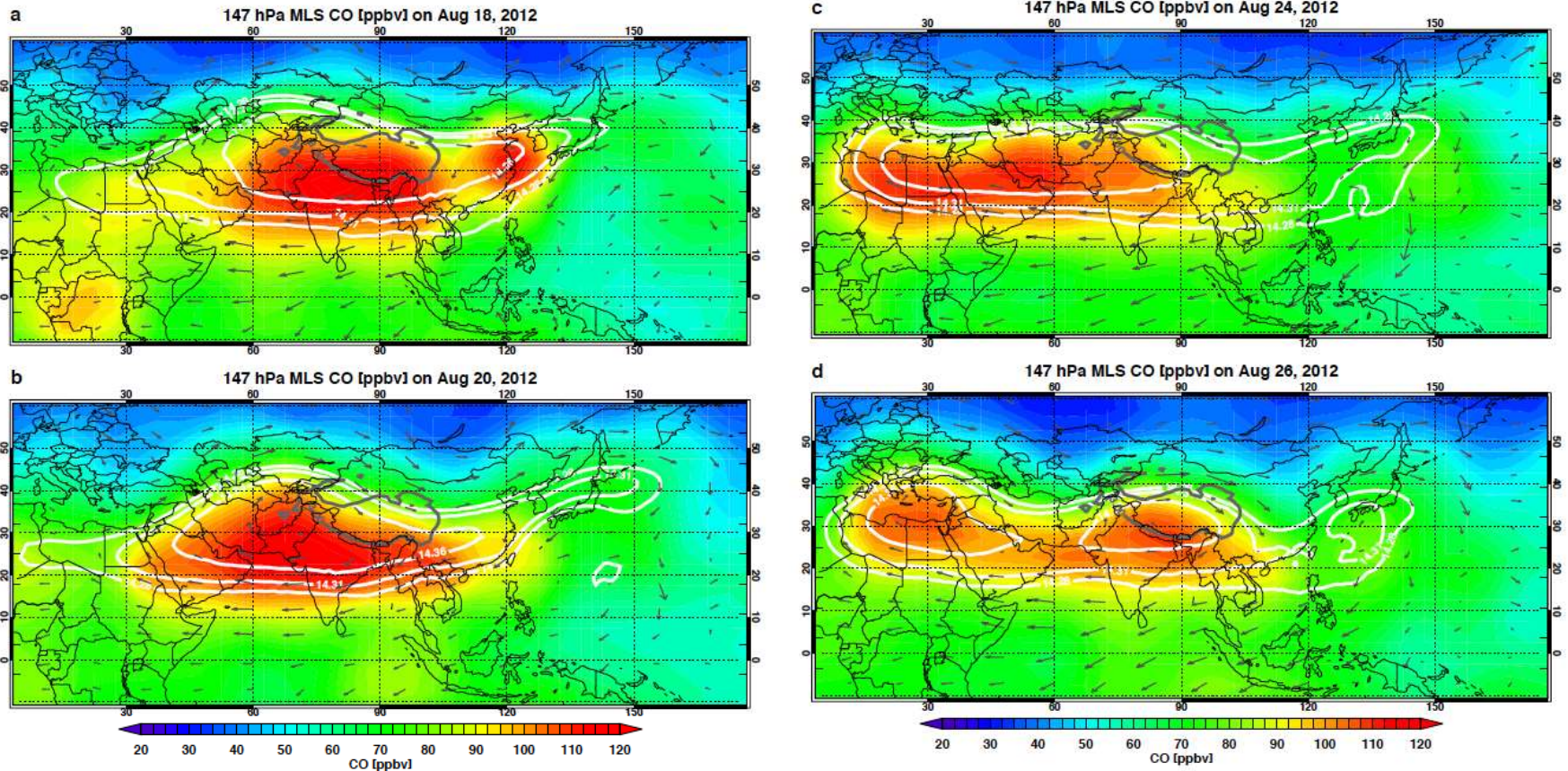
147 hPa, July 7, 2012



5° x 5°
Gaussian smoothing

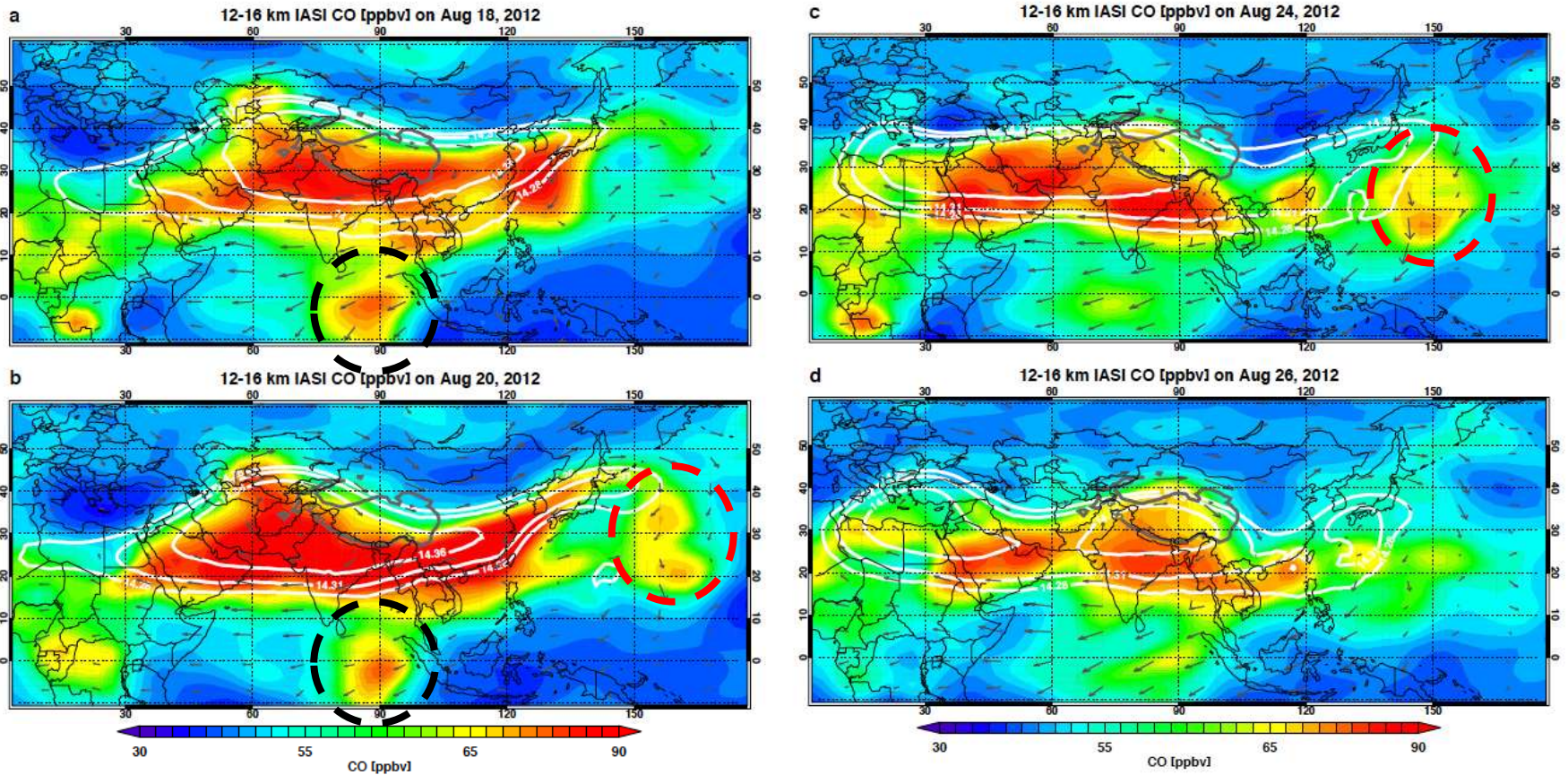
Daily maps of MLS CO mixing ratio at 147 hPa

White contours indicate the location of the anticyclone



MLS successfully captures the day to day co-variability of CO with dynamical fields

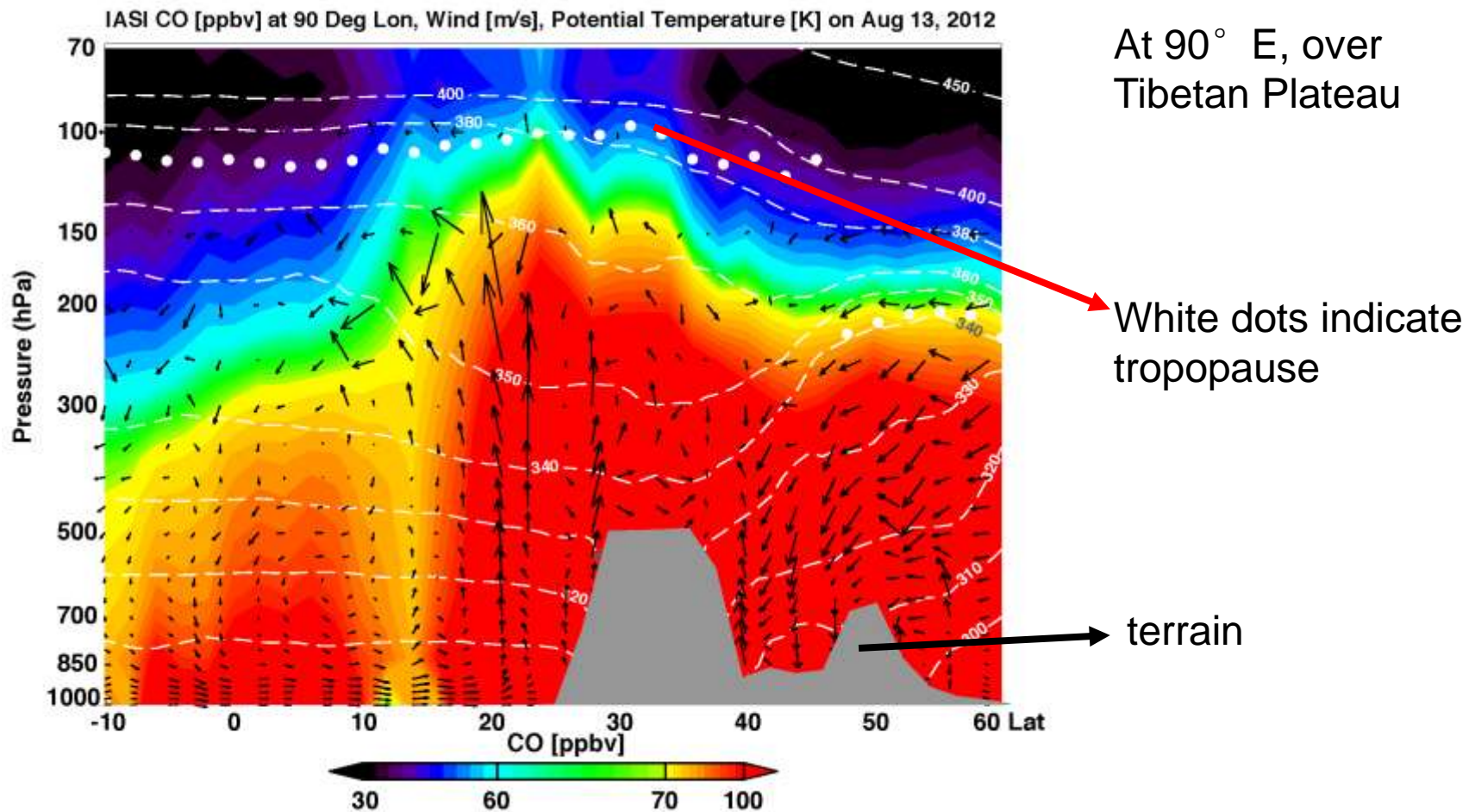
Daily maps of IASI CO mixing ratio at 12-16 km



IASI UT CO provides additional eastward shedding over the western Pacific, which subsequently migrates southward.

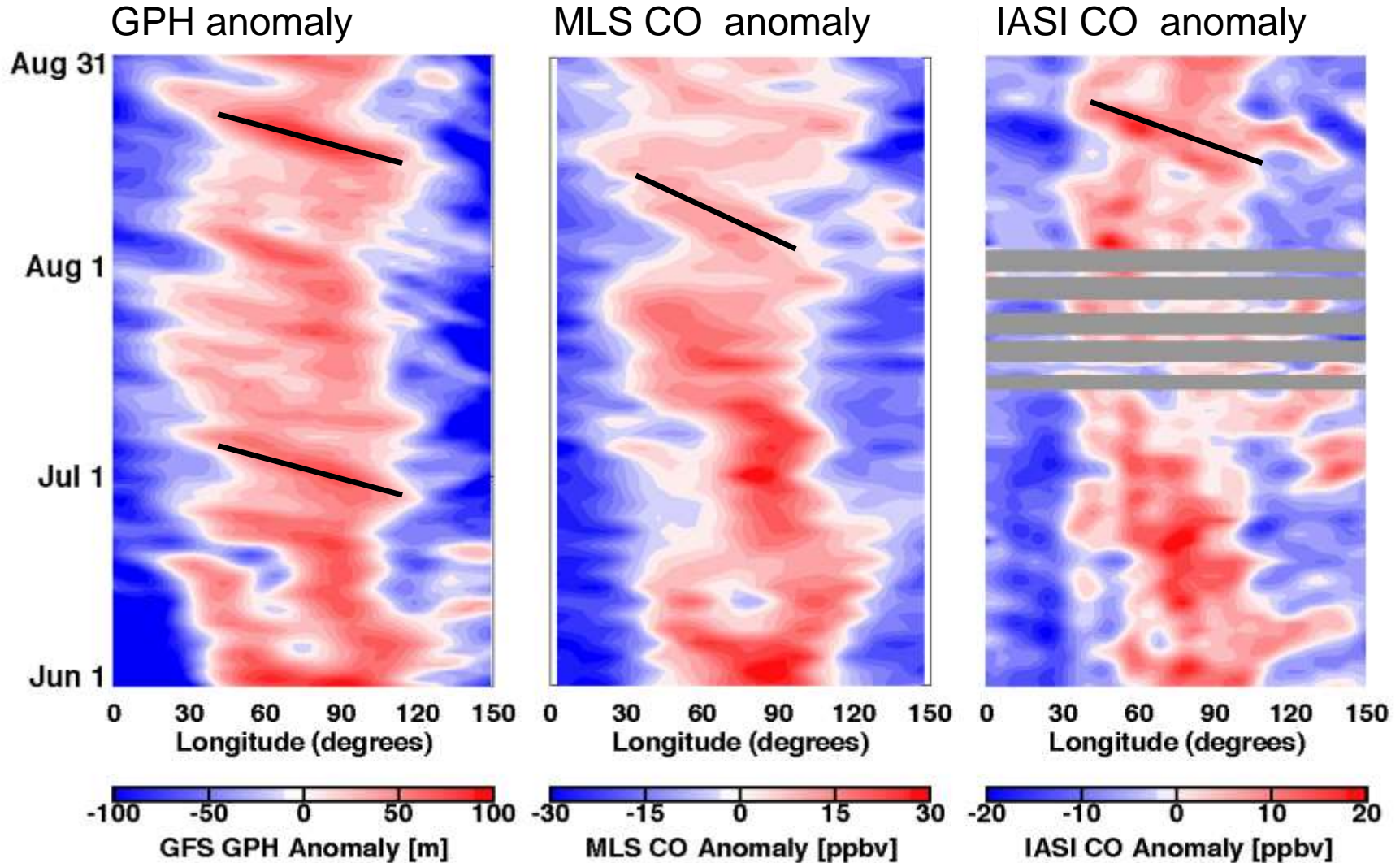
Latitudinal-Pressure cross section of IASI CO and dynamical fields

Enhanced CO in UT is consistent with upward transport



Hovmoller diagrams of GPH and MLS/IASI CO anomalies

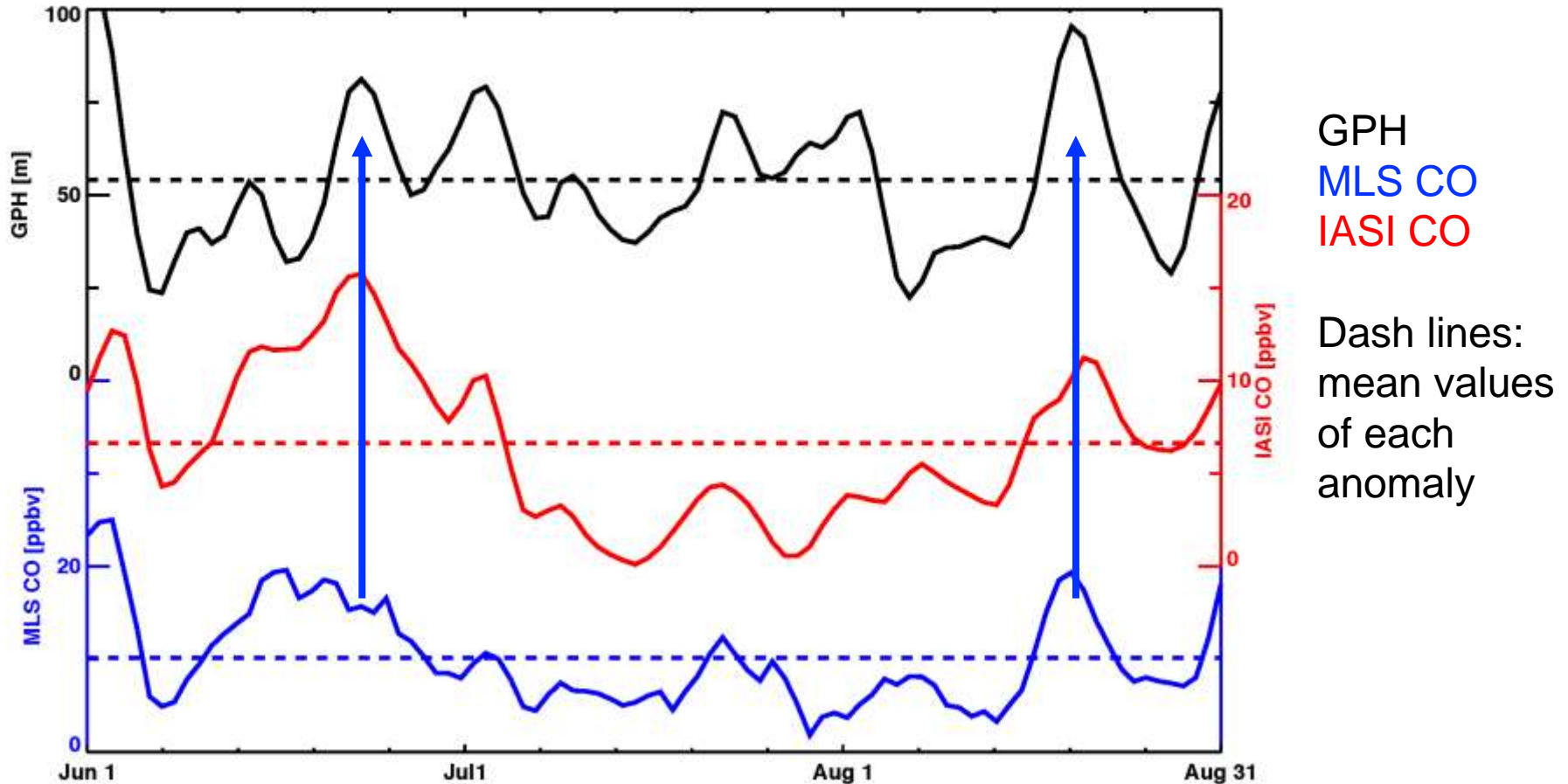
Anomalies are calculated with respect to the regional mean ($15\text{-}35^\circ\text{ N}$, $0\text{-}150^\circ\text{ E}$) for 2012



Westward oscillation is evident while the amplitudes and timing are different

Time series of dynamics and MLS/IASI CO

Averaged anomalies over 60-90° E



Correlation coefficients:

MLS CO and IASI CO: 0.80; GPH and MLS CO: 0.67; GPH and IASI CO: 0.50

Conclusions

- IASI UT (12-16 km) CO distribution highlights the significant role of ASM dynamics in controlling the UTLS tracer distribution;
- The UT CO enhancement in IASI data displays finer scale structures in daily maps, and shows additional transport of CO enhanced air over the western Pacific and spreading equatorward following the anticyclonic flow;
- It also adds information to the vertical CO structure in ASM region;
- The analysis demonstrates the value of high horizontal sampling density from the nadir viewing sensors in capturing the dynamical variability of UTLS tracer distributions.