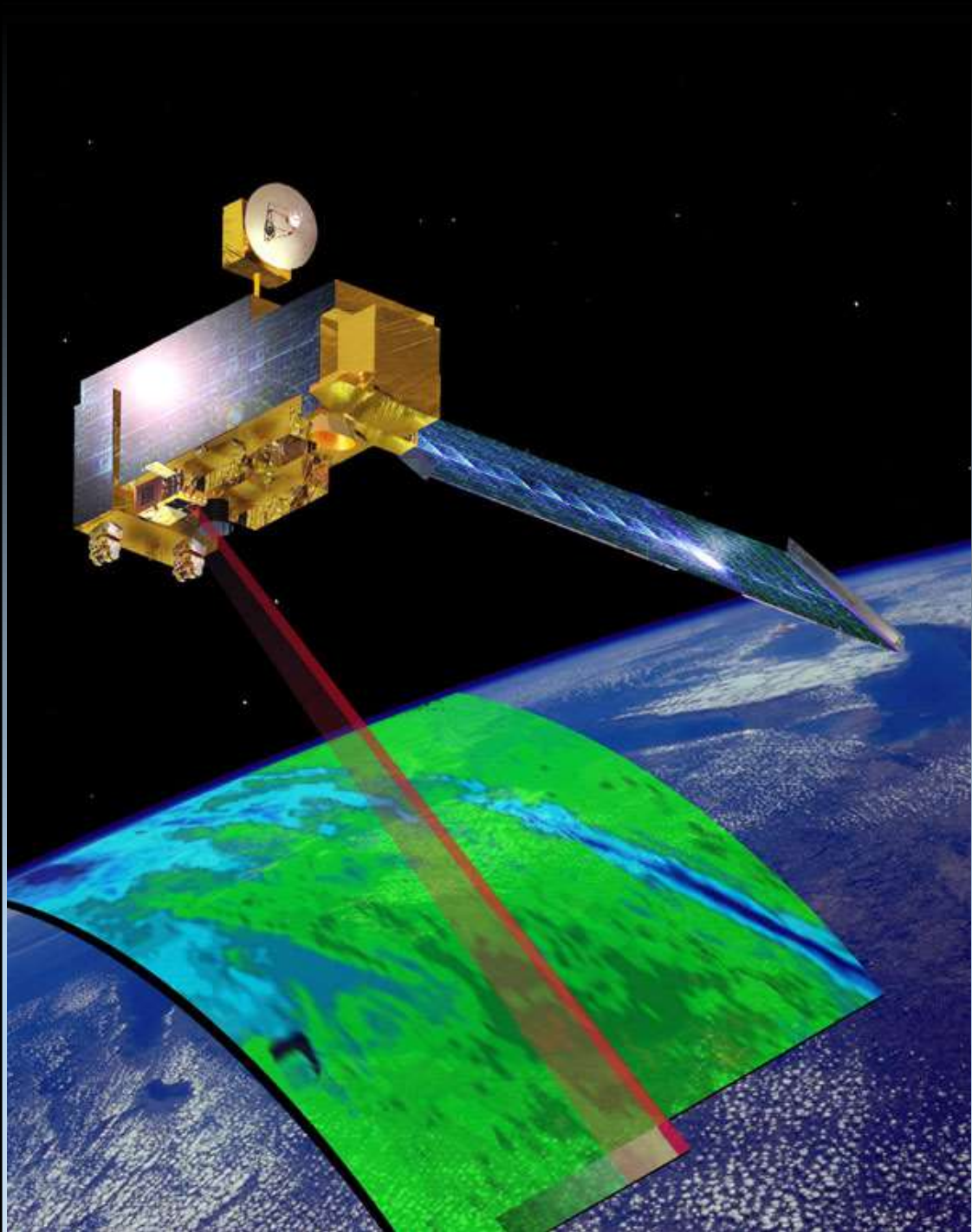


17 years of MOPITT: A satellite perspective on decadal scale trends in Asian pollution

Helen Worden (U.S. MOPITT P.I.)
and Mijeong Park, NCAR/ACOM

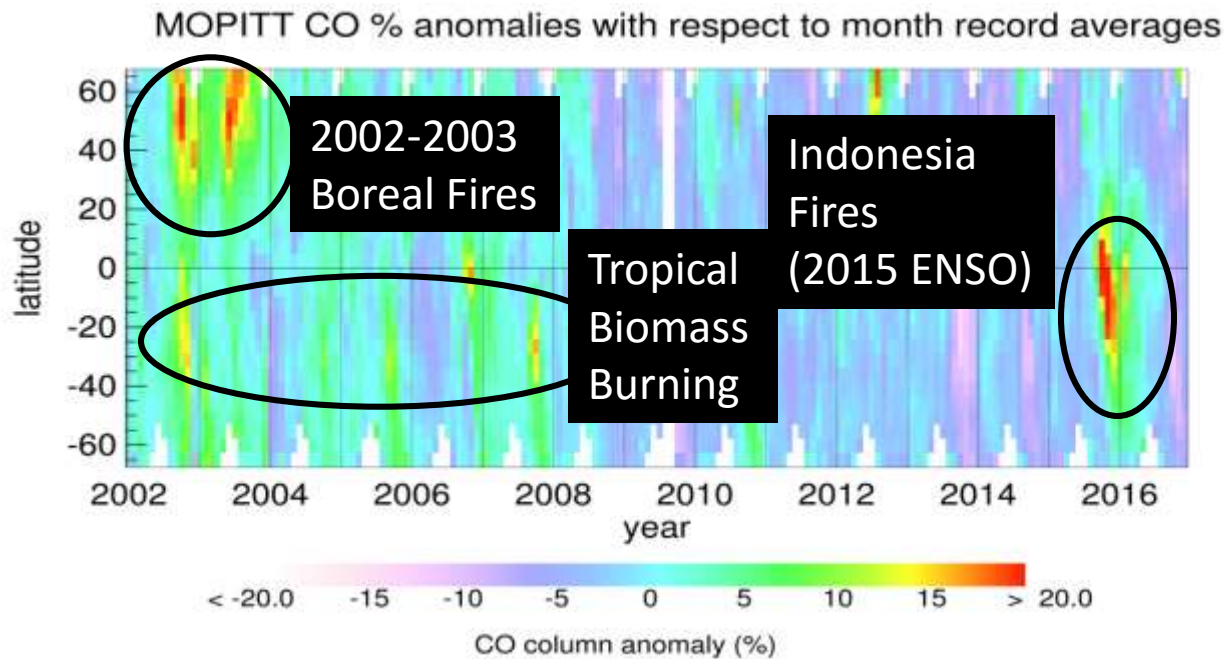
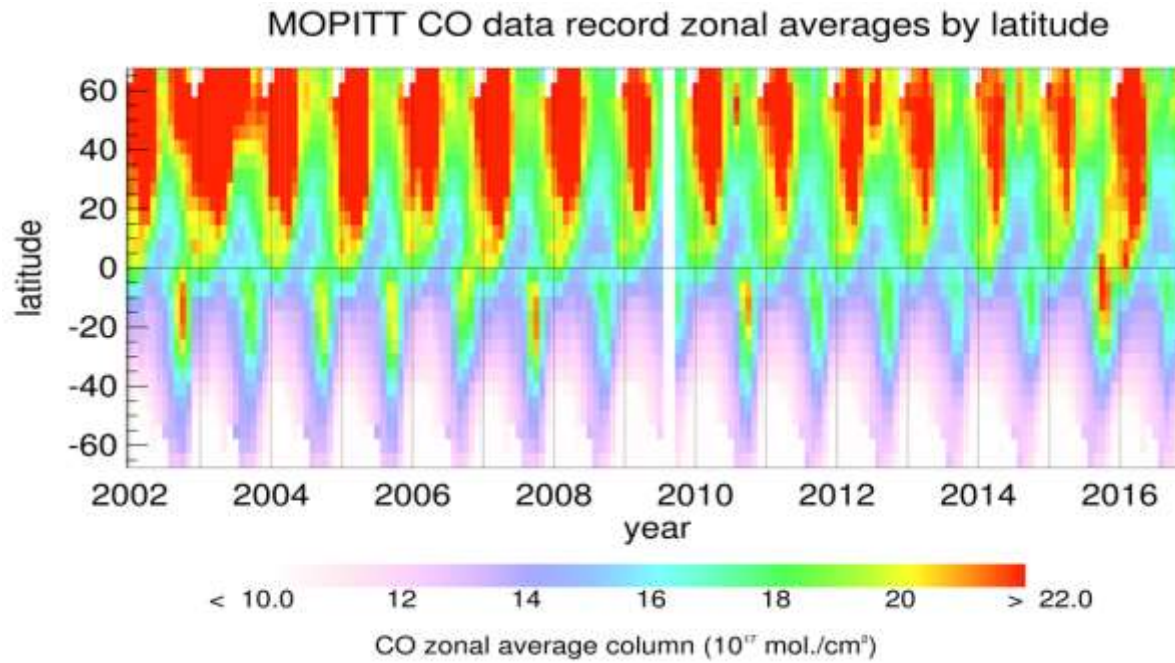


Outline

- MOPITT CO data record and multispectral measurements
- Emission trends – Global and focus on Asia
- Impact of 2015 ENSO-driven Indonesia fires
- MOPITT and MLS views of Asian Monsoon and Indonesia fires
- Conclusions

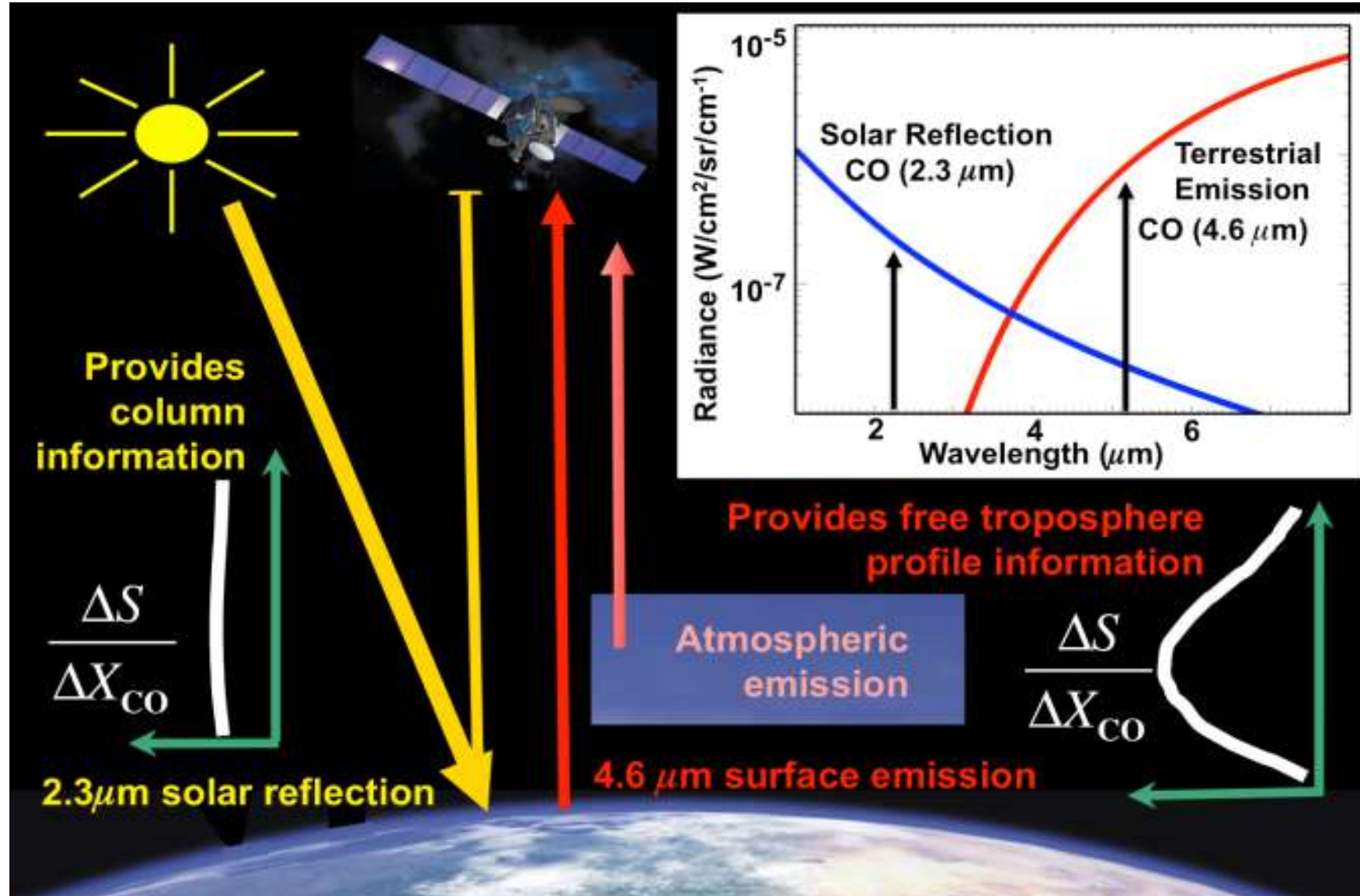


MOPITT Data Record (V7J)

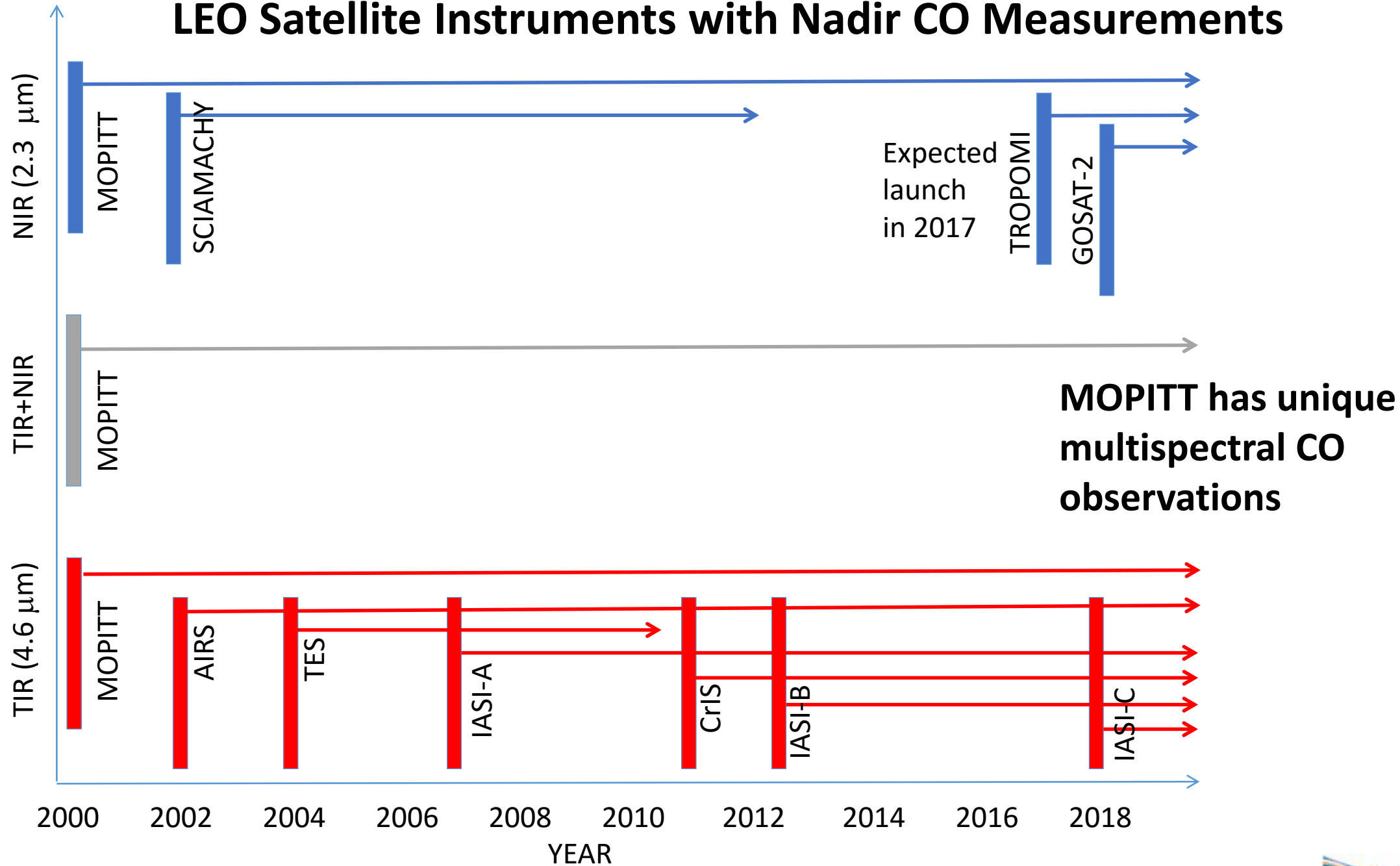


Overall decreasing trend in global CO:
~0.9 %/yr
(Worden et al., *ACP*, 2013)

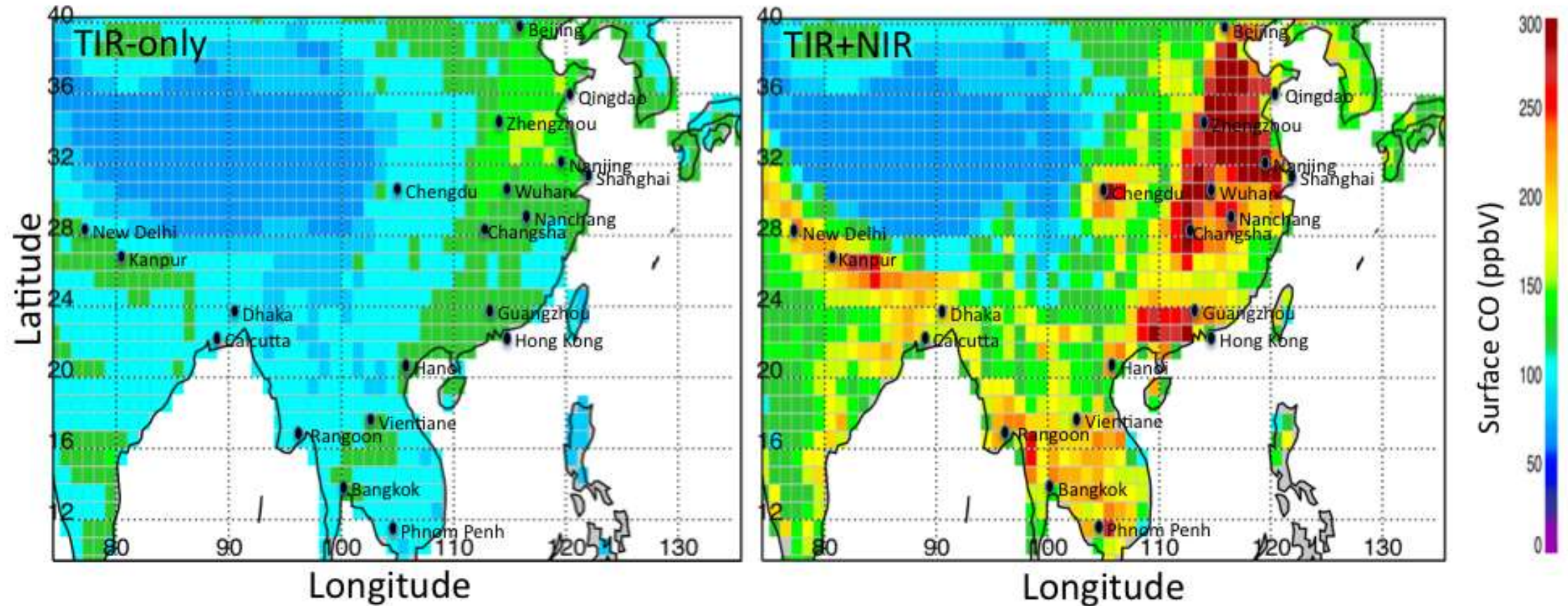
MOPITT Instrument Concepts: Thermal and Shortwave Infrared Measurements



LEO Satellite Instruments with Nadir CO Measurements



MOPITT Multispectral Measurements: China

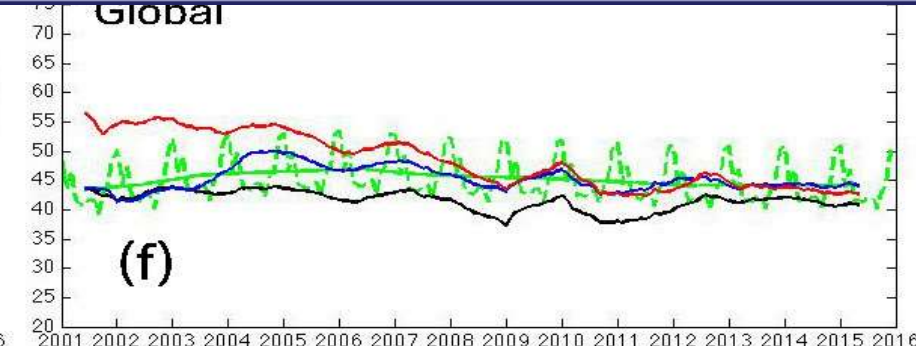
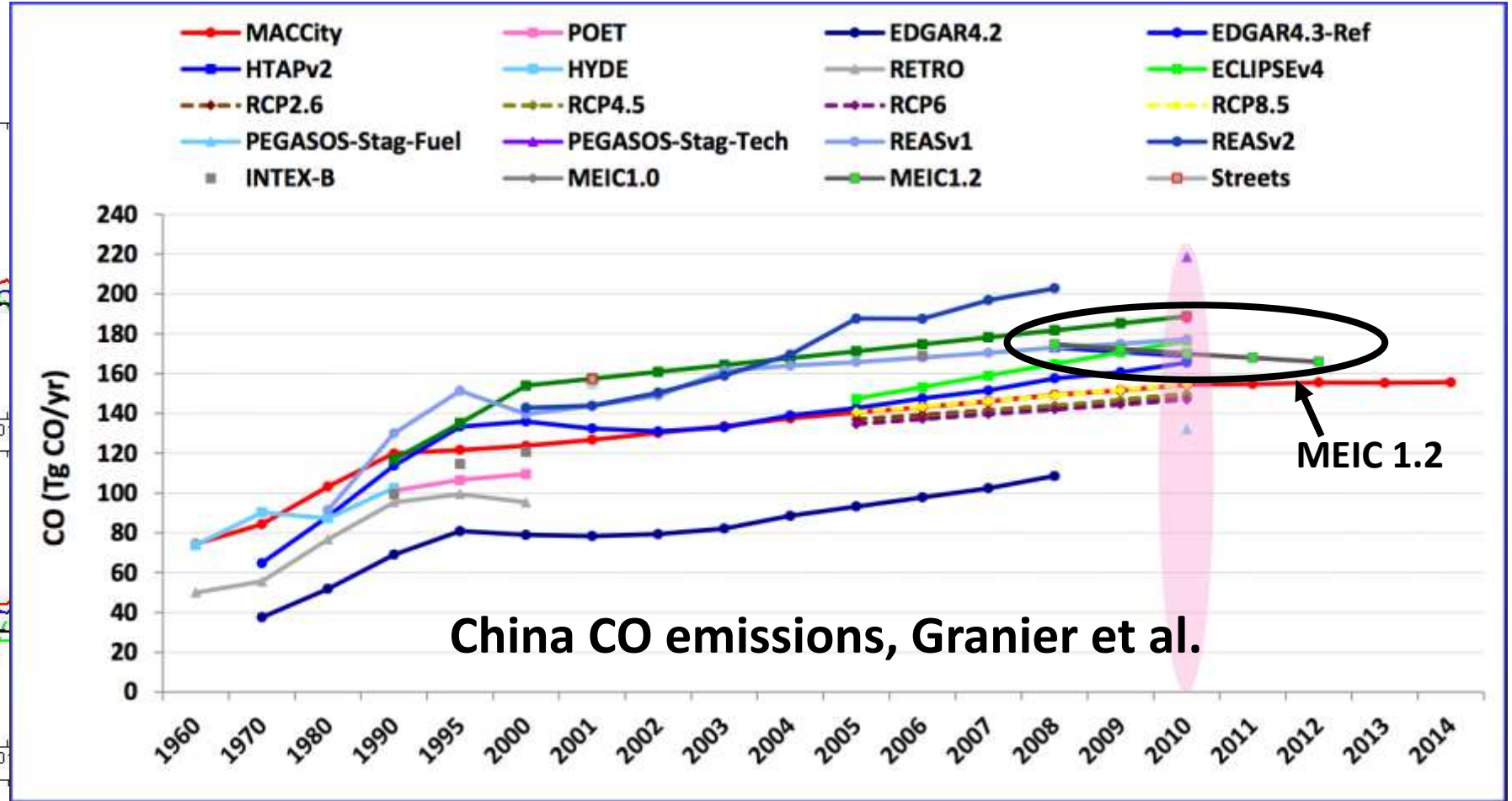
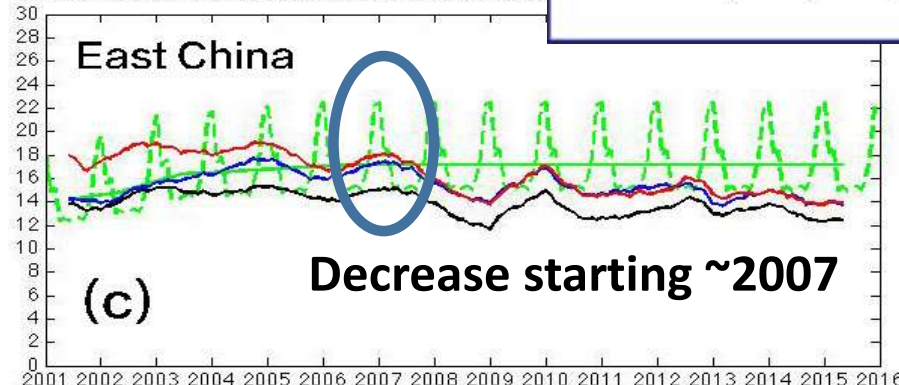
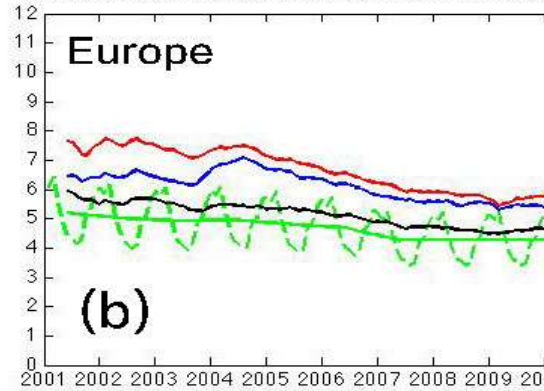
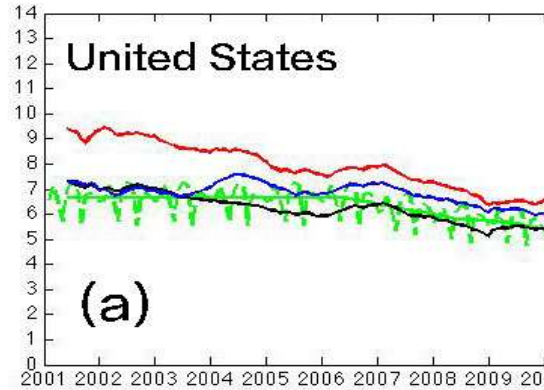


Worden et al., JGR, 2010

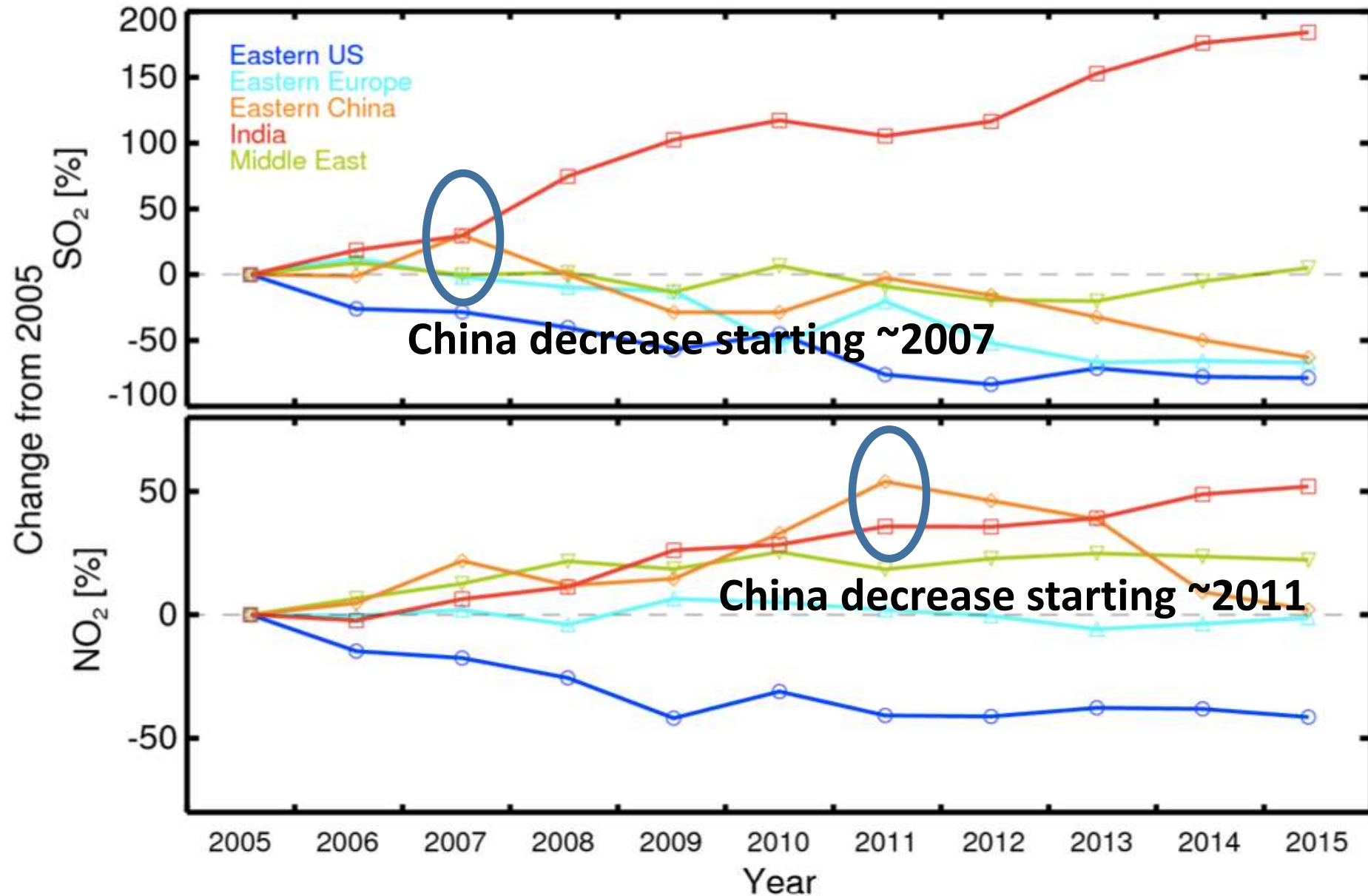


CO emissions trends: Assimilating MOPITT in GEOS-Chem Model

(Jiang et al., ACP 2017)



Changes in SO₂ and NO₂ since 2005 from OMI



(Krotkov et al., 2015)



2001-2015 trends in CO: Attribution of changes

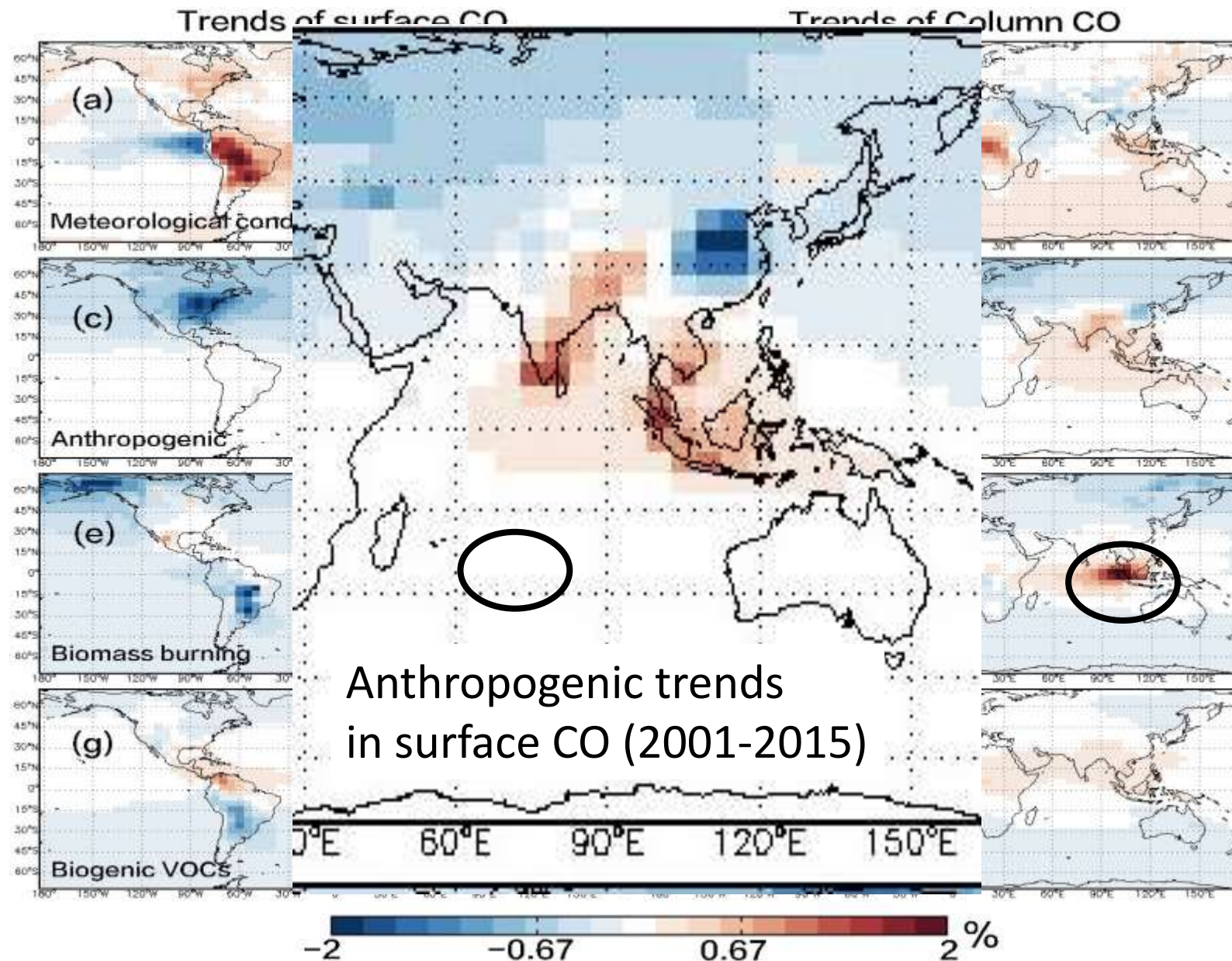
(Jiang et al., ACP 2017)

Met. changes only

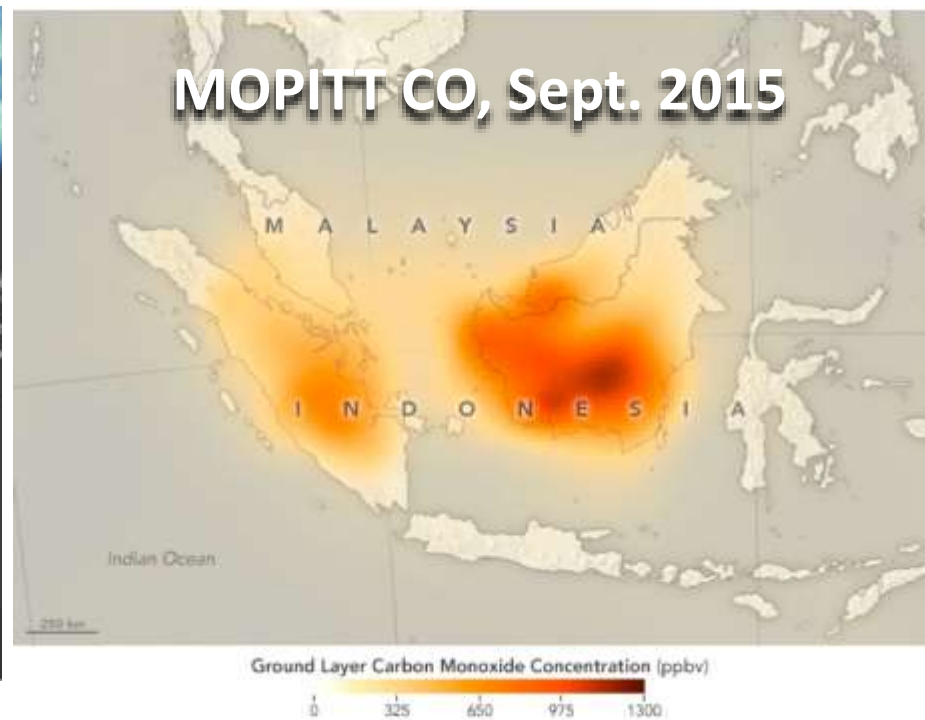
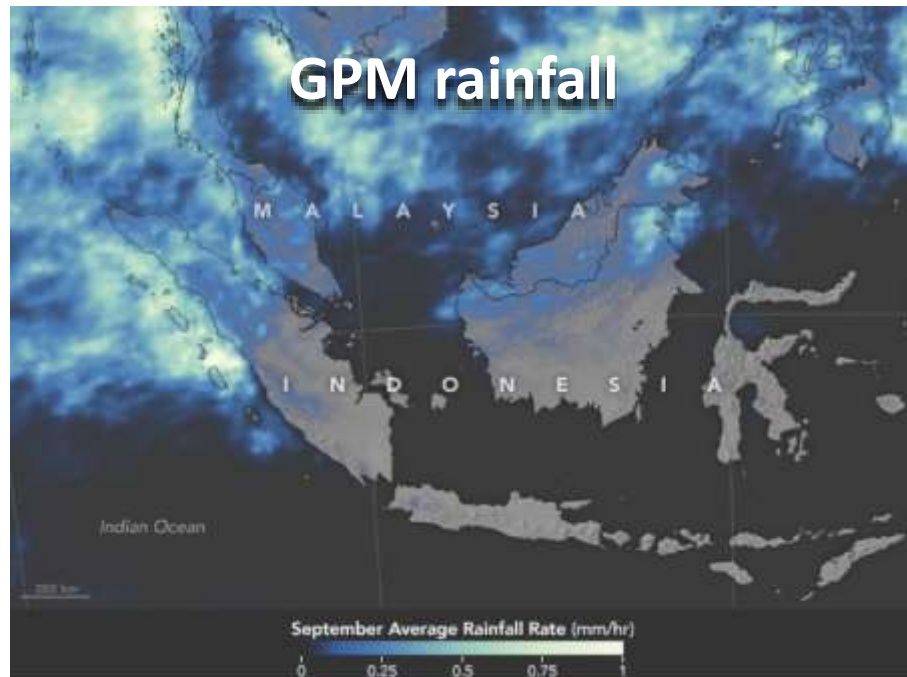
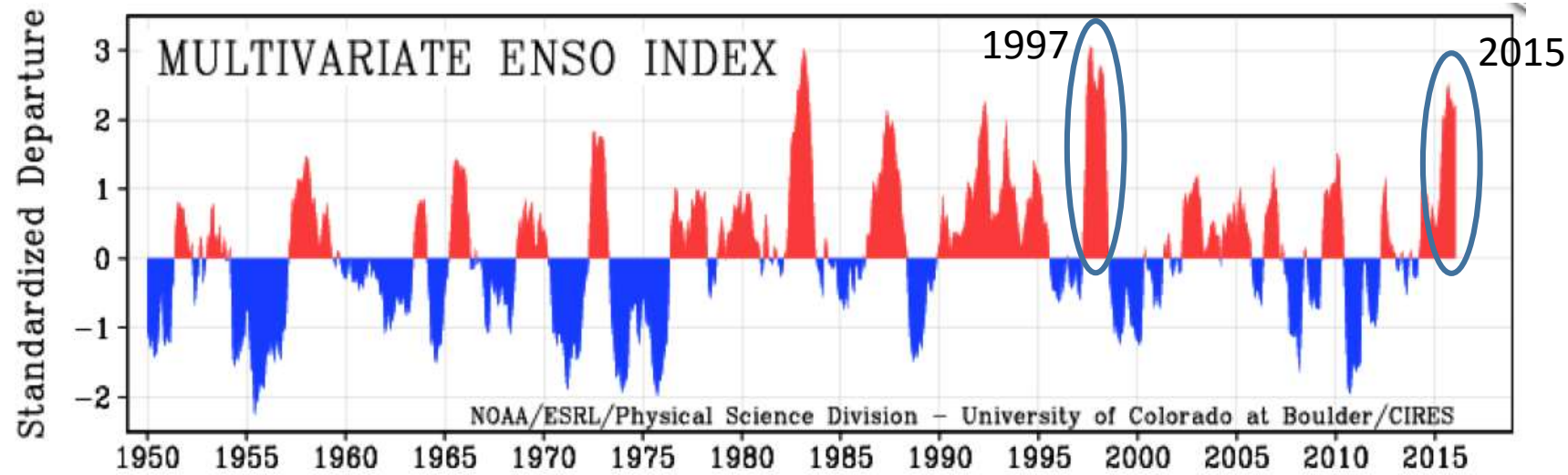
Anthropogenic

Biomass Burning

Biogenic VOCs



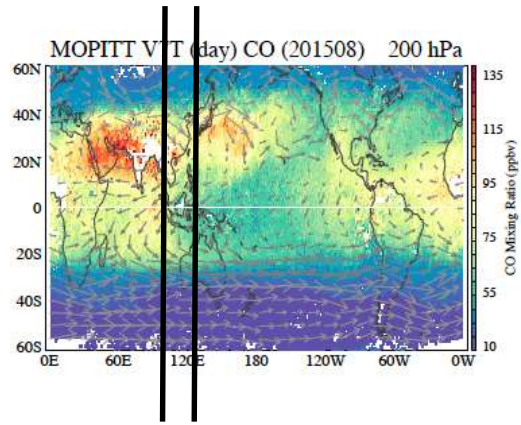
Question: Did ENSO-driven fires in Indonesia, 2105, influence Asian pollution?



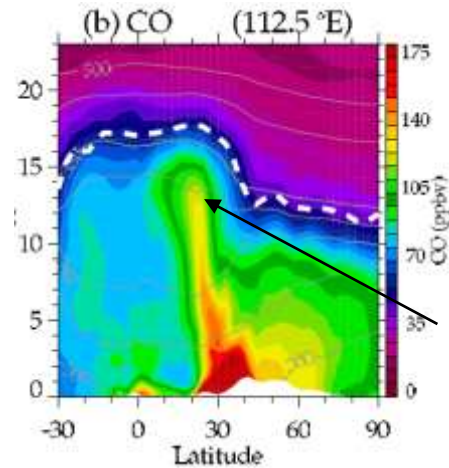
Rainfall and CO
images from NASA
Earth Observatory



MOPITT CO vertical structures (August) – Asian Monsoon

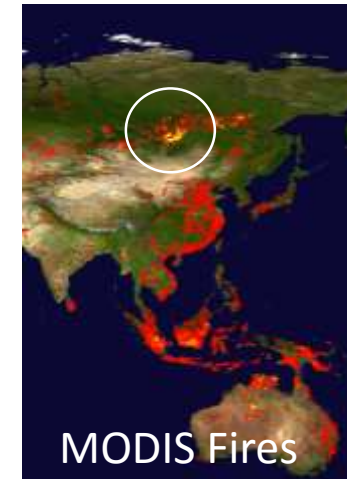


Lon: 110-120E Averages



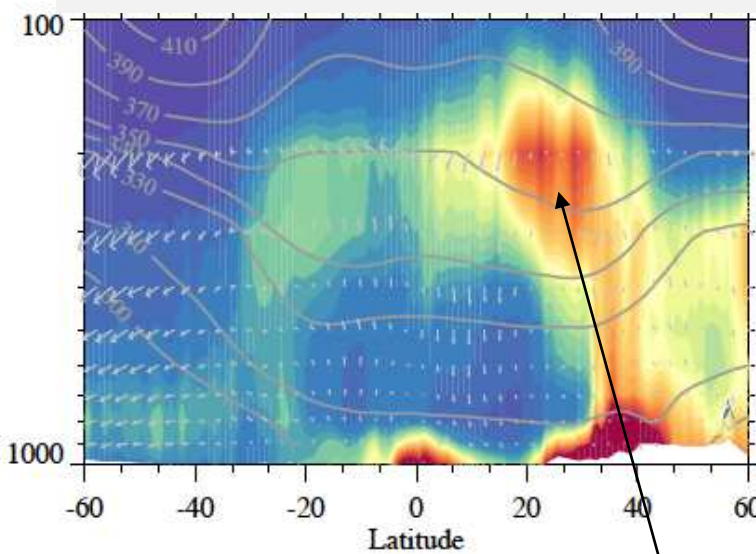
Park et al. (2009)
CO from MOZART-4

Siberian
Fires,
201508

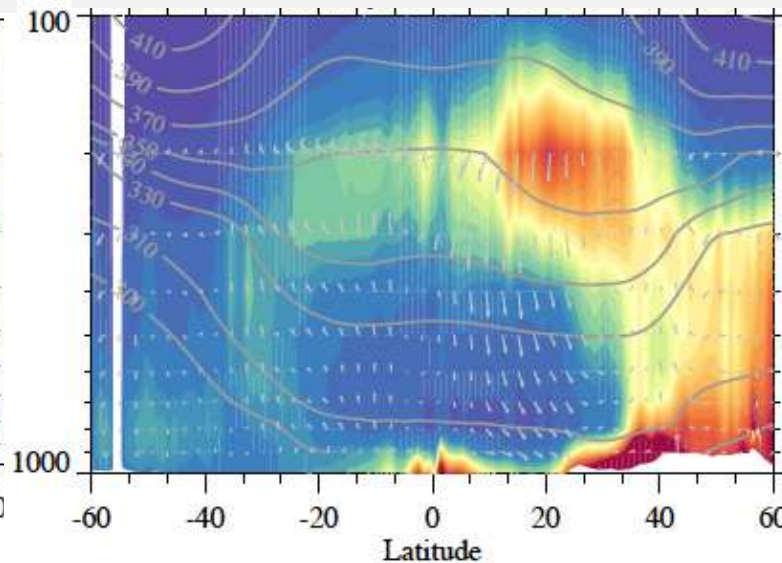


MODIS Fires

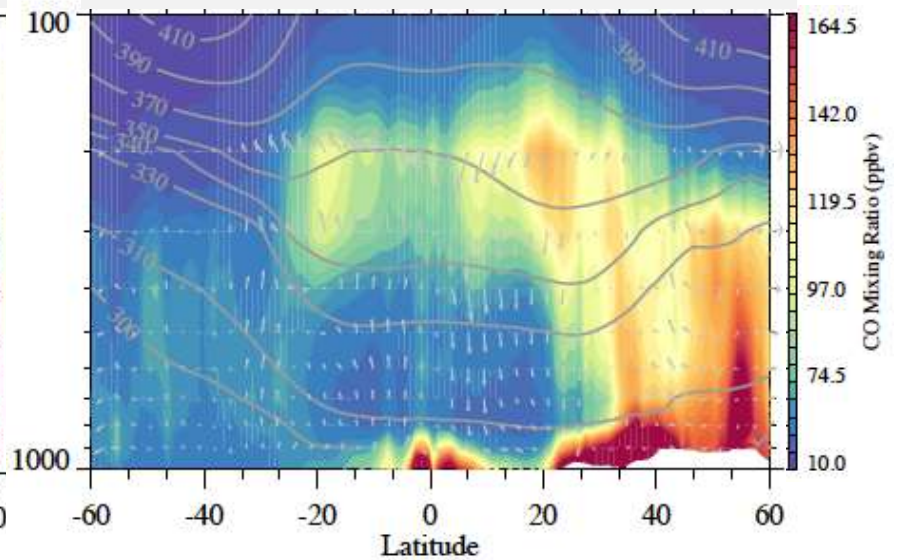
MOPITT V7J CO (201108)



(201308)



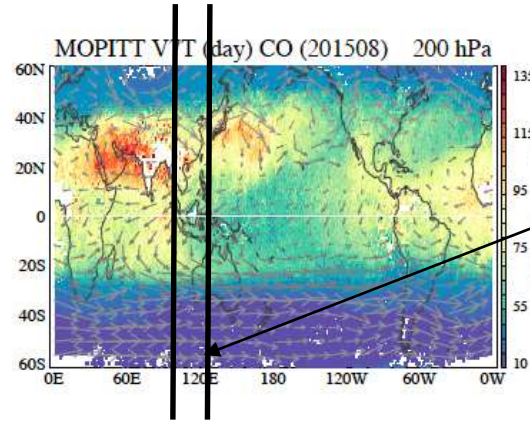
(201508)



High CO in the UTLS – due to Asian monsoon circulation

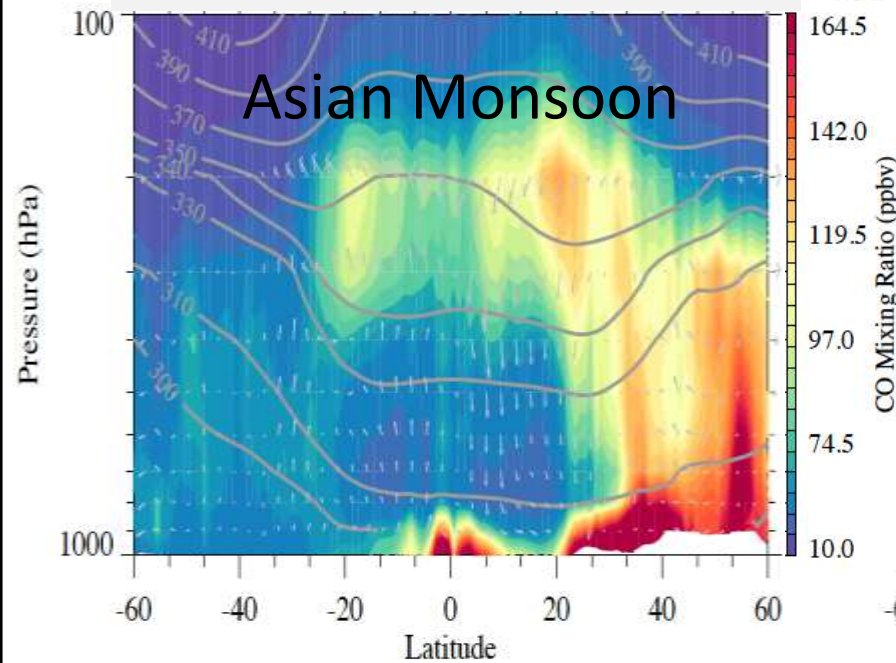
ERA_Interim potential
temperature and winds

MOPITT CO vertical structures (Aug, Sep, Oct 2015)

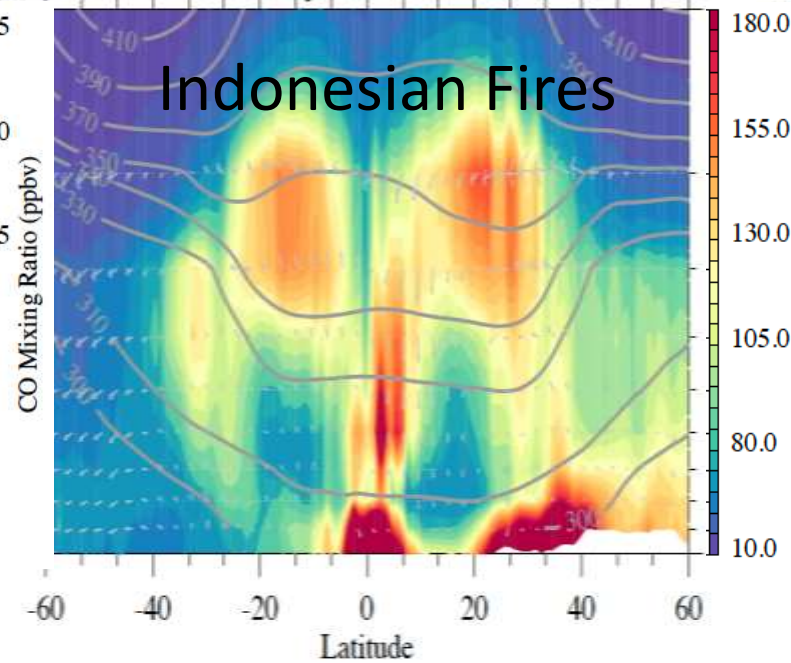


Lon: 110-120E Averages

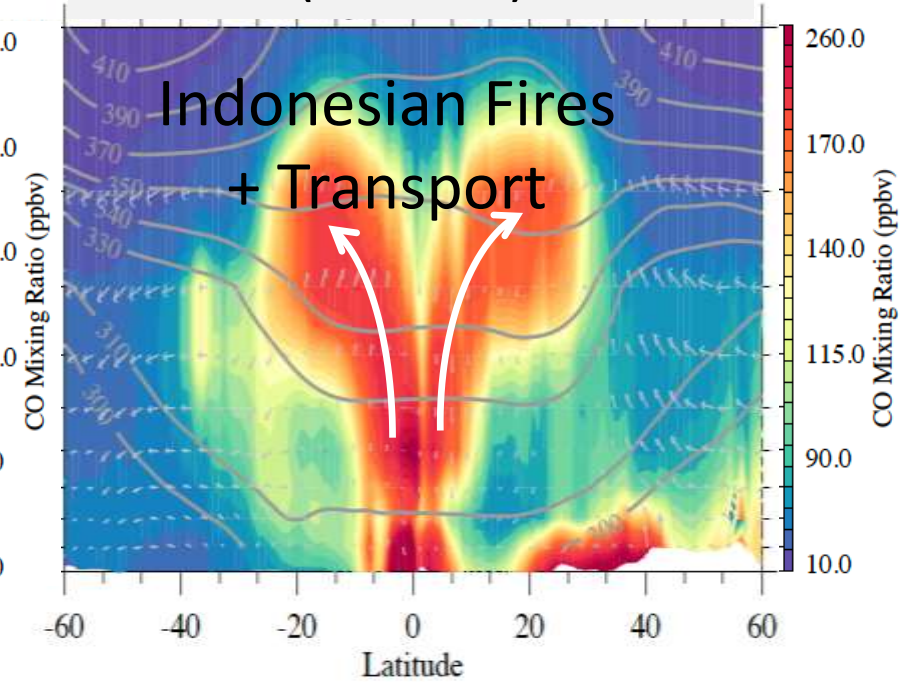
MOPITT V7J CO (201508)



(201509)



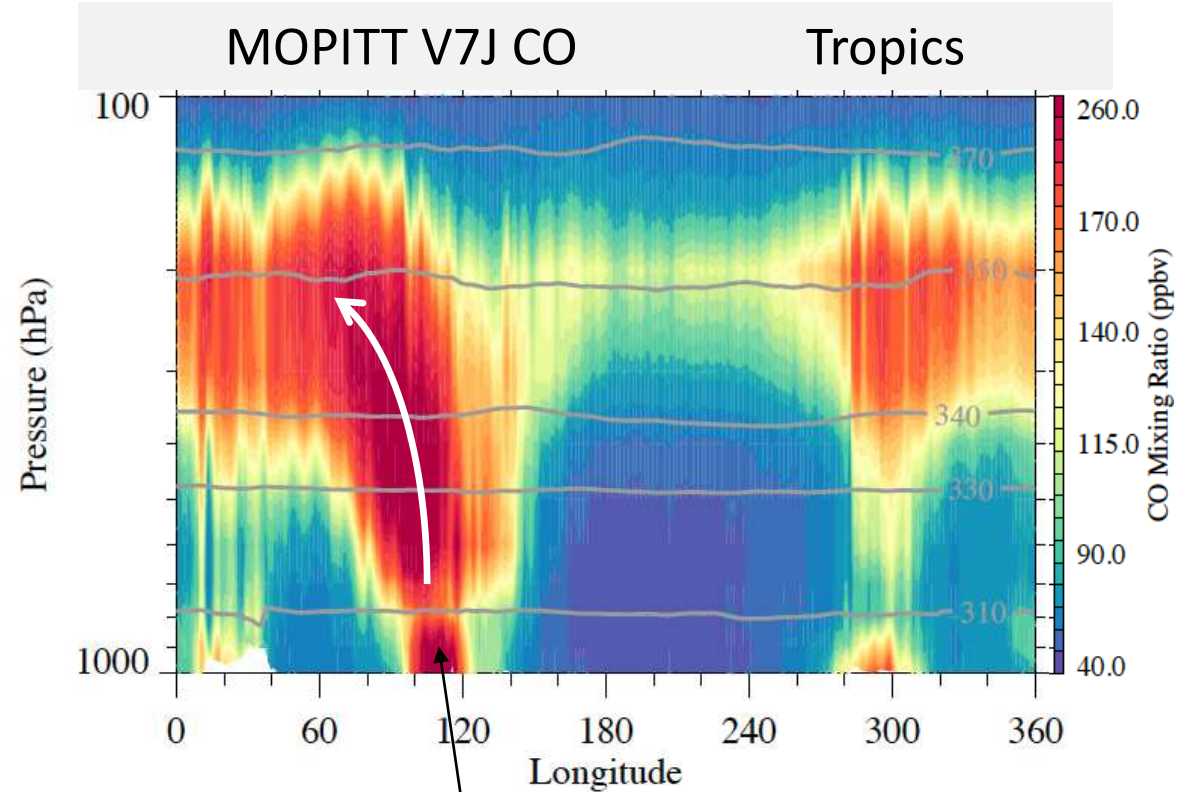
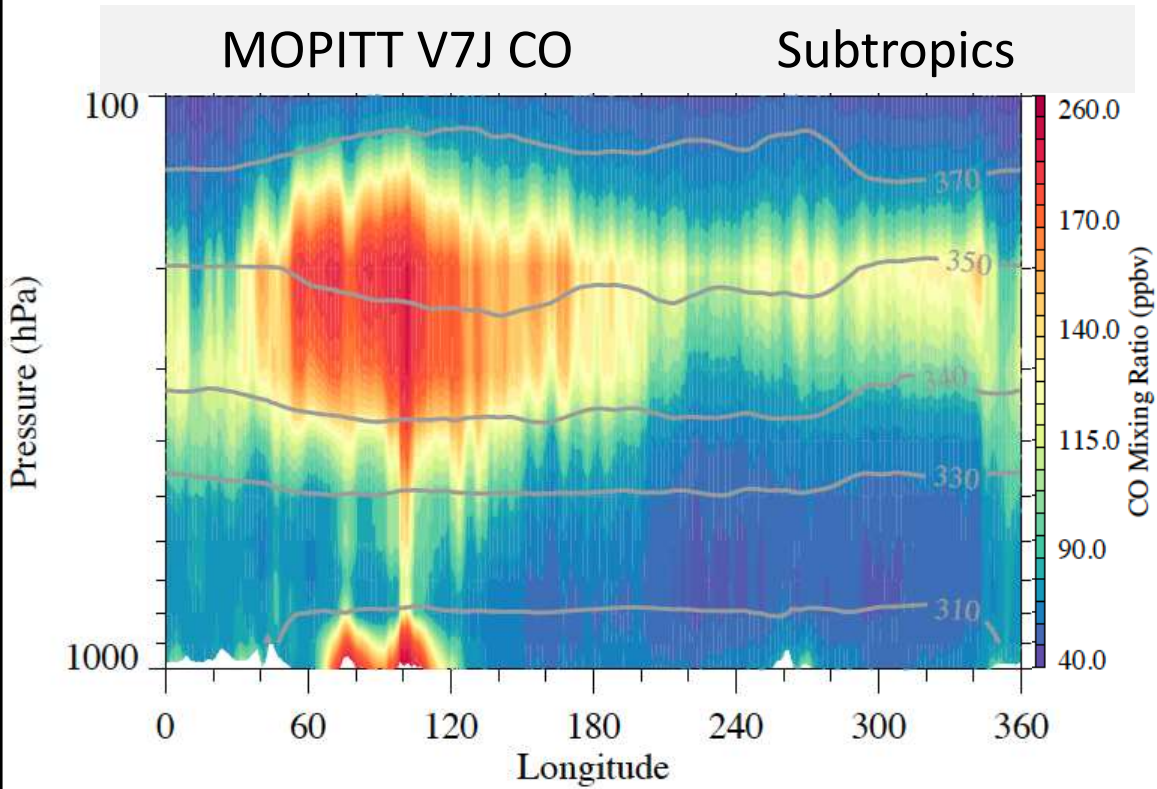
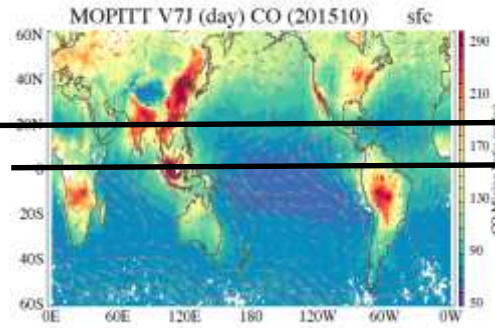
(201510)



MOPITT CO vertical structure (201510)

Subtropics (12.5-20.5N)

Tropics (5.5S-5.5N)

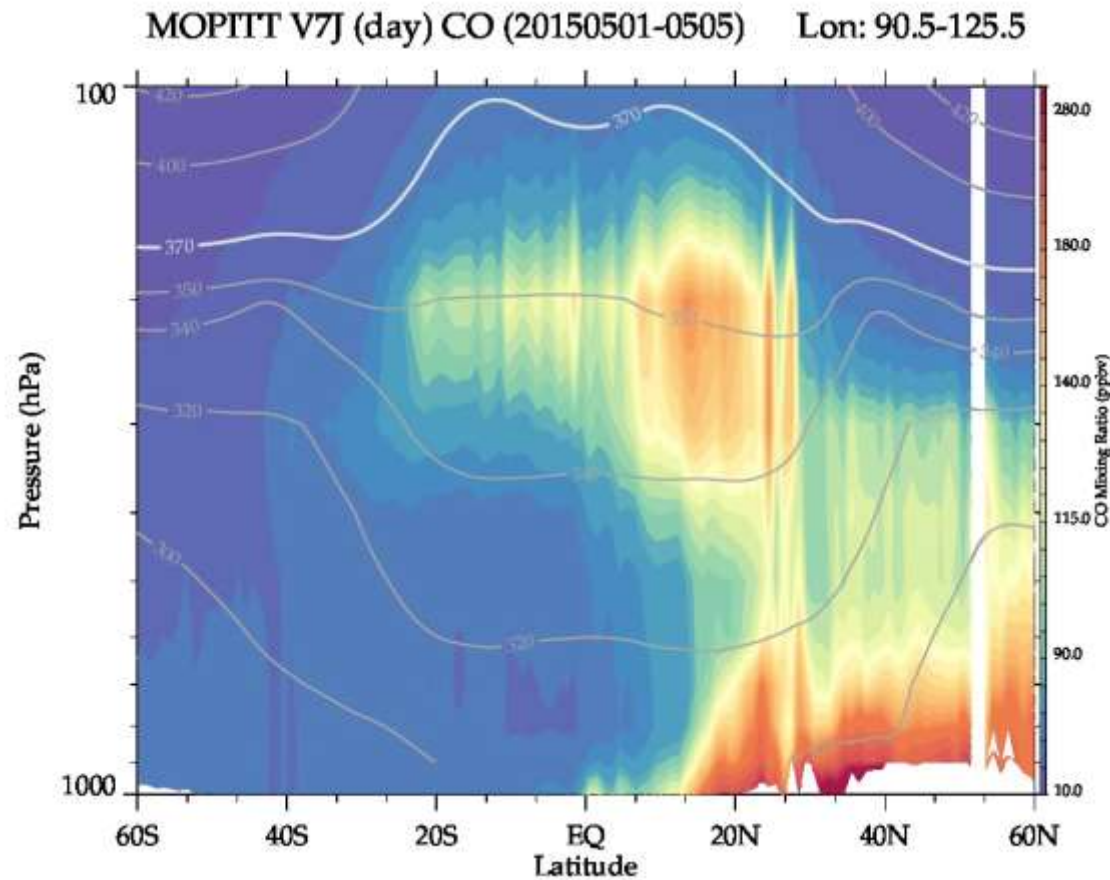


Fire



MOPITT CO (May-Dec, 2015)

Lon: 90-125E



Asian Summer Monsoon Pattern
(May-August)

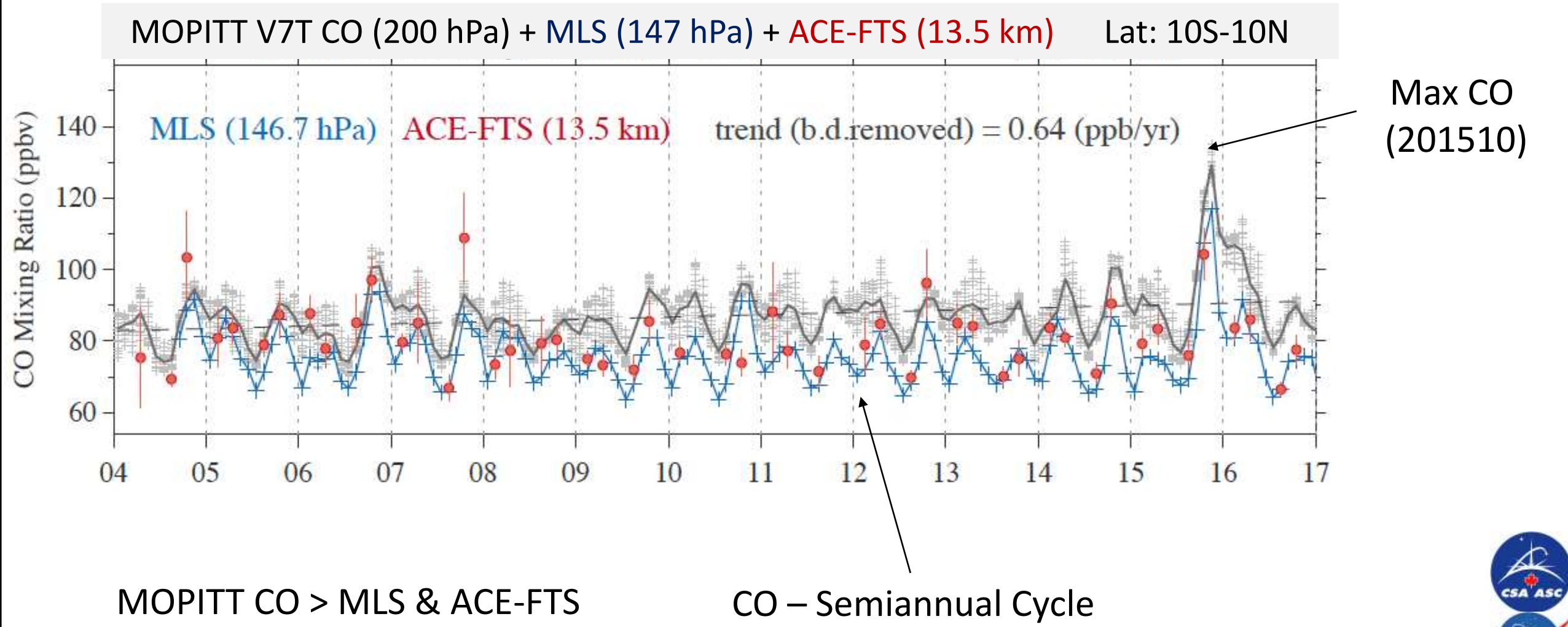
Indonesian Fire + Transport at ITCZ
(September-December)

Movie: 5 day averaged MOPITT CO & ERA_Interim potential temperature



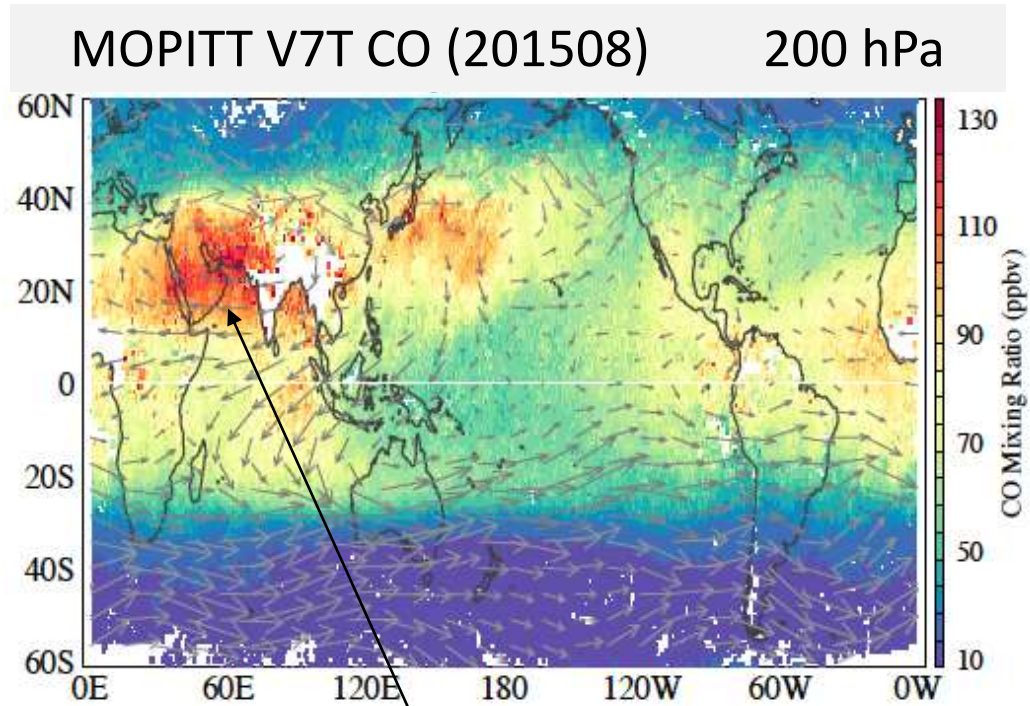
MOPITT + MLS + ACE-FTS CO

(Tropics)

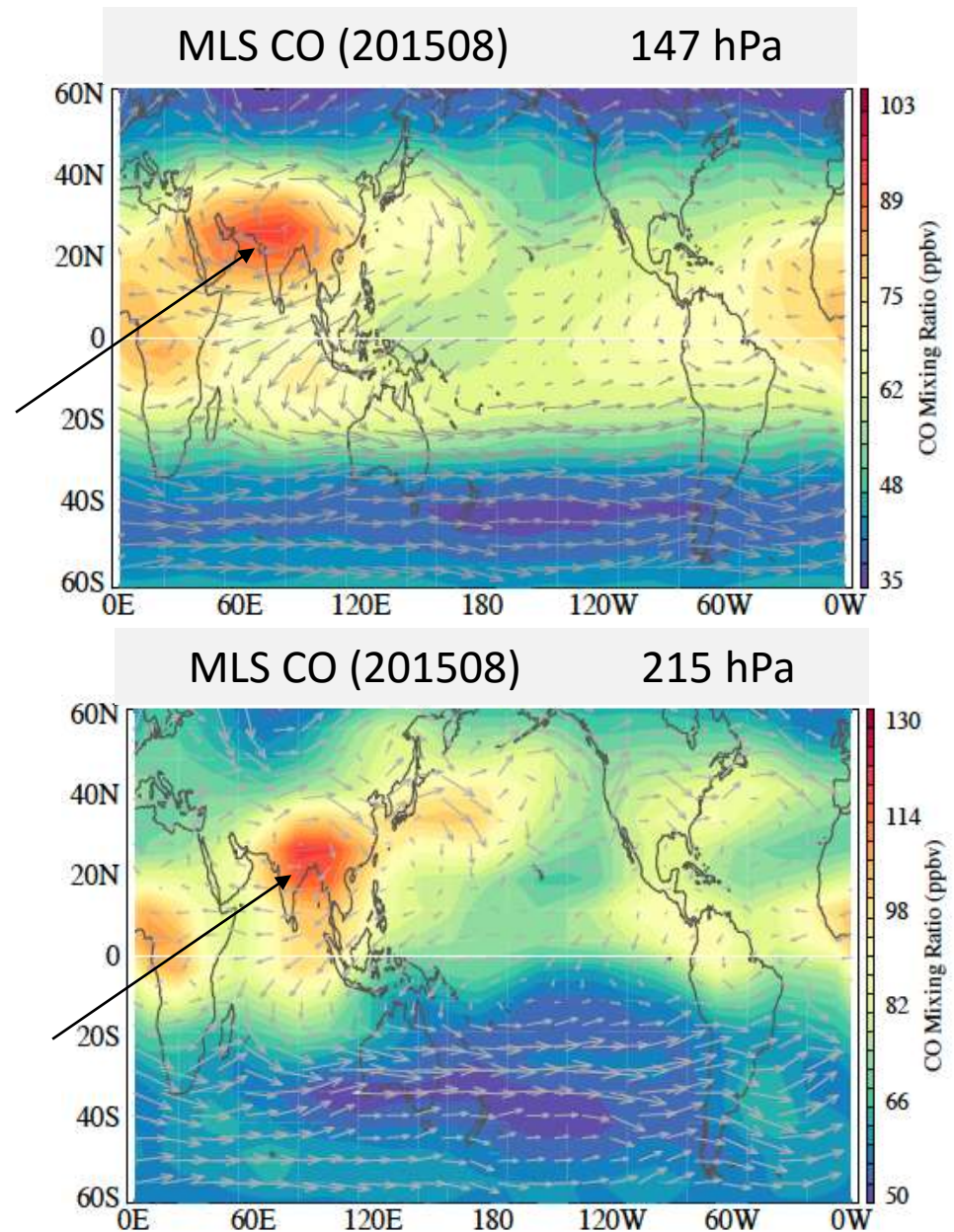


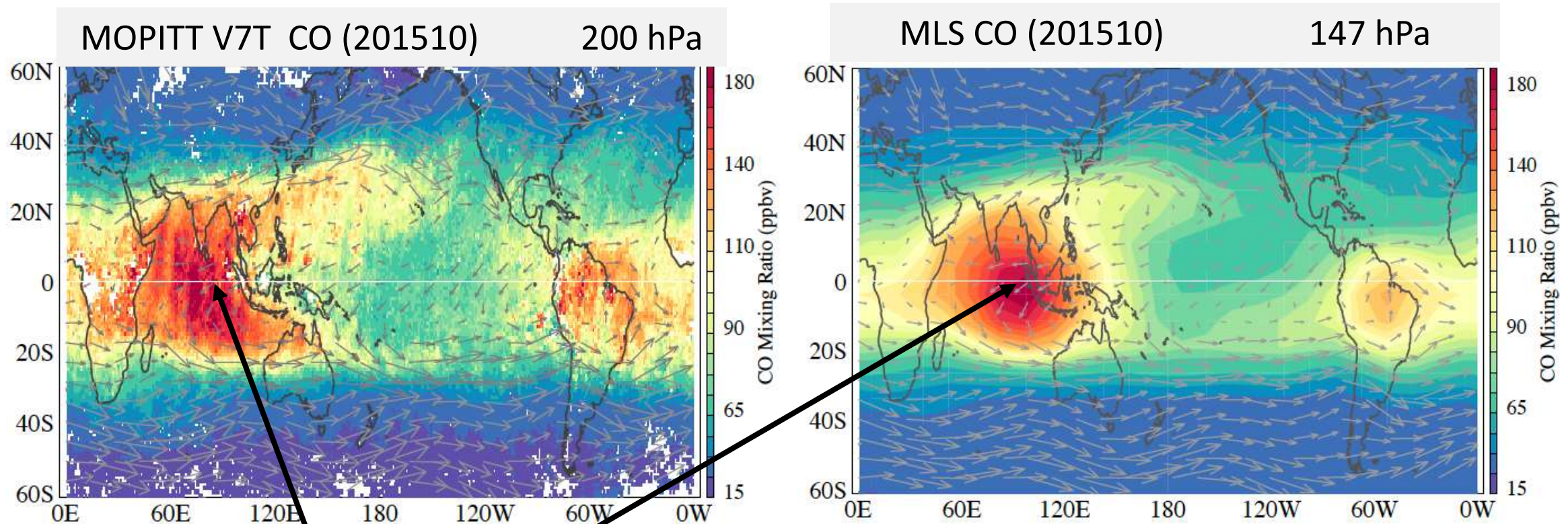
MOPITT & MLS CO (201508)

Asian Monsoon



CO Max – Asian Summer Monsoon
(MOPITT & MLS)





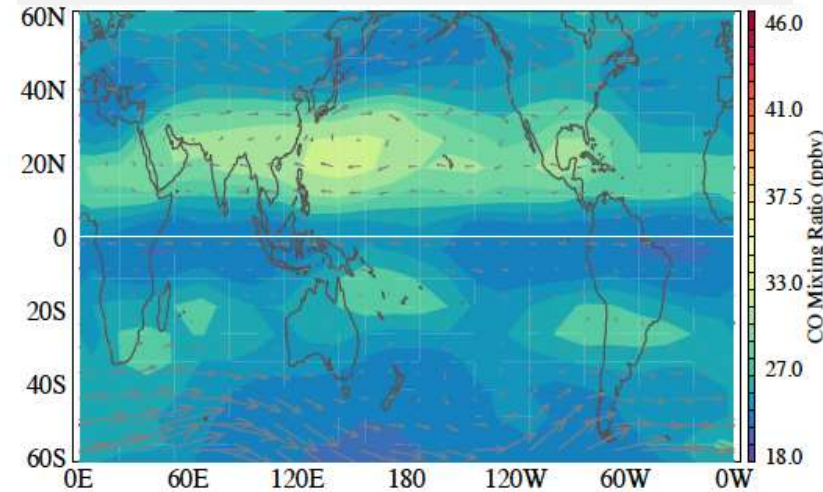
Broad maximum in the tropics due to fire

MLS CO (147 vs. 68 hPa)

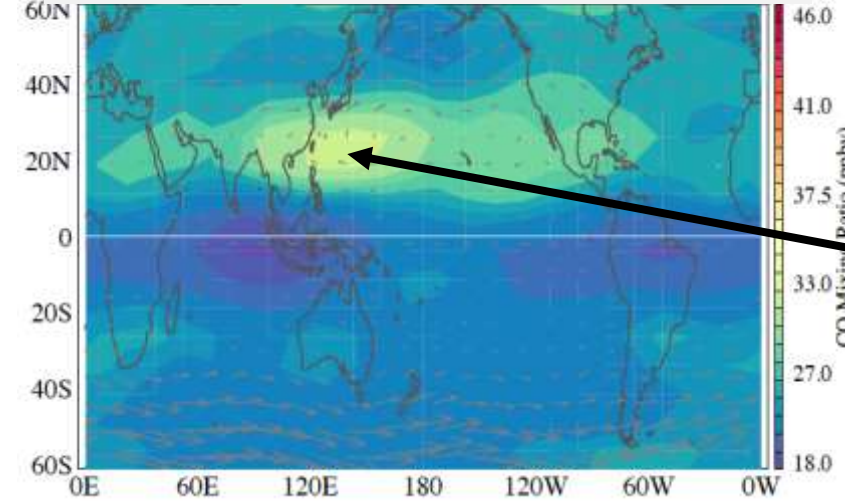
2009 & 2015

68 hPa

MLS CO (200910) 68 hPa



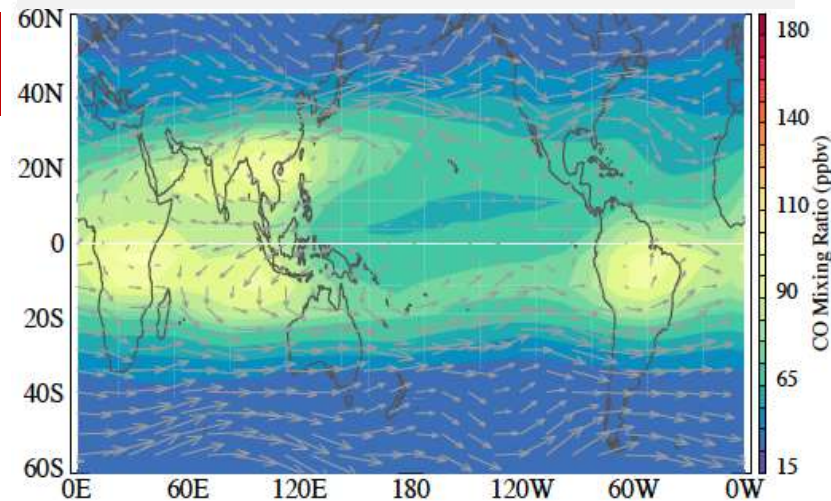
MLS CO (201510) 68 hPa



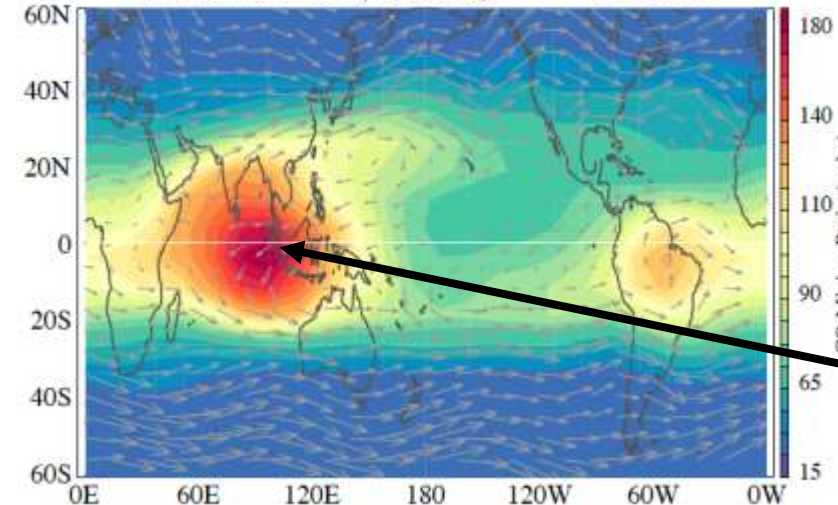
No indication
of Fire

147 hPa

MLS CO (200910) 147 hPa

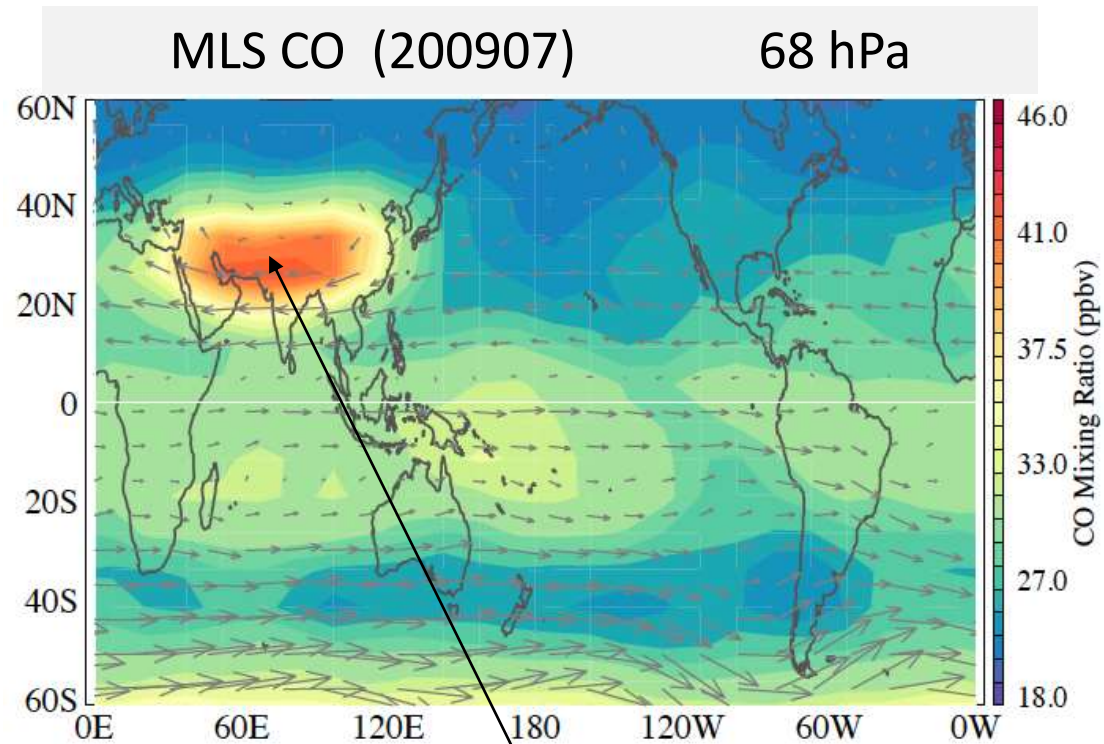


MLS CO (201510) 147 hPa



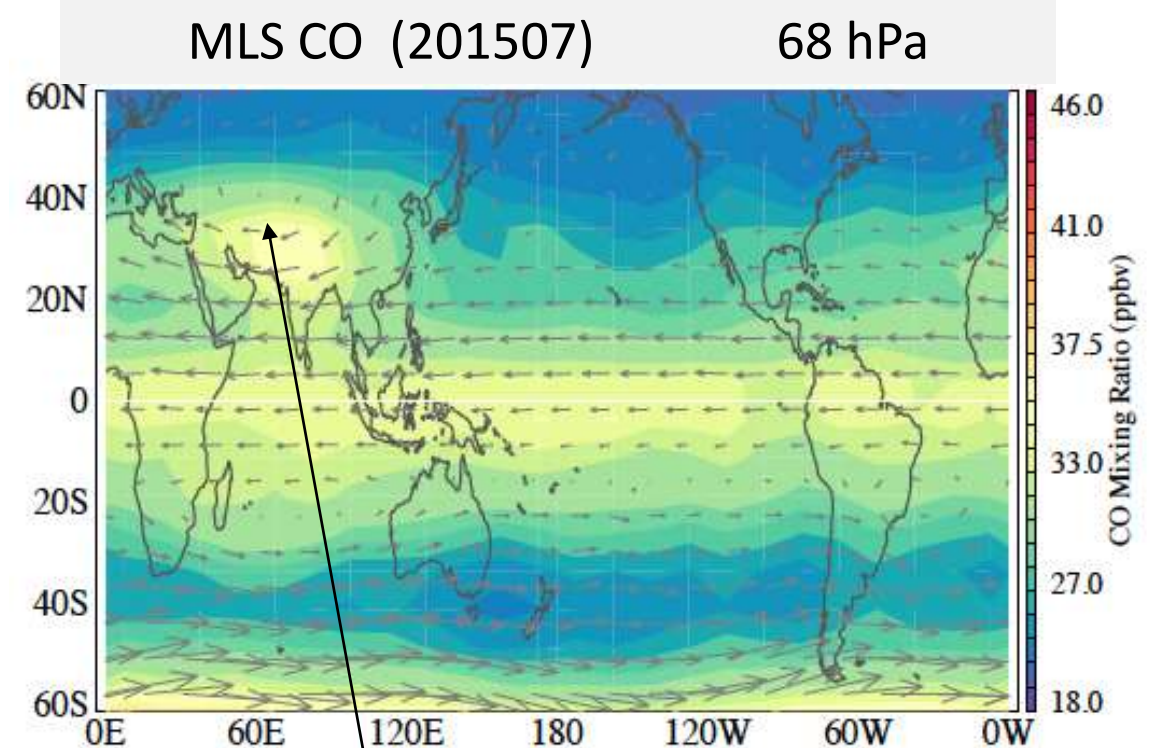
Indonesian Fire

MLS CO (68 hPa)



Strong Monsoon Signal
(reaches up to 68 hPa)

2009 & 2015

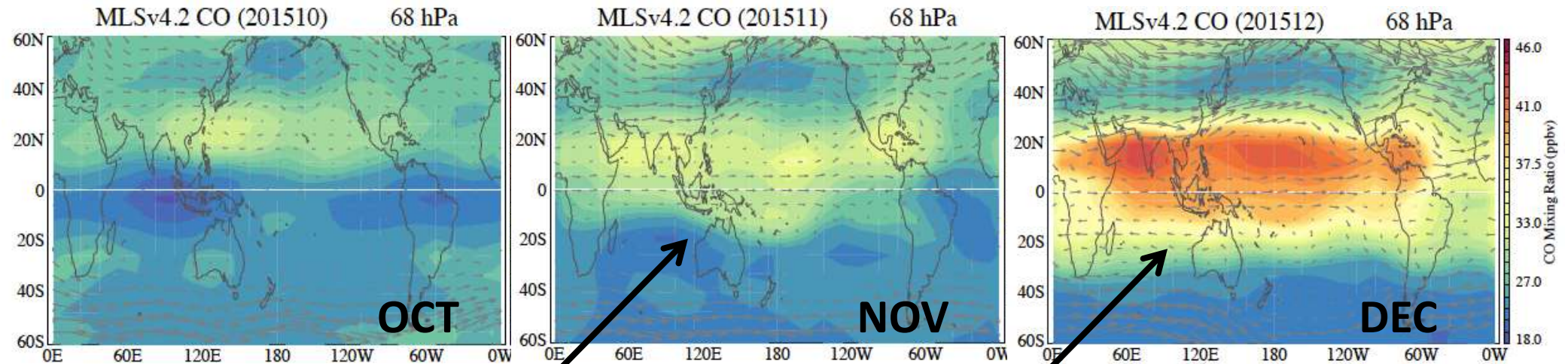


Weaker Monsoon Signal in 2015

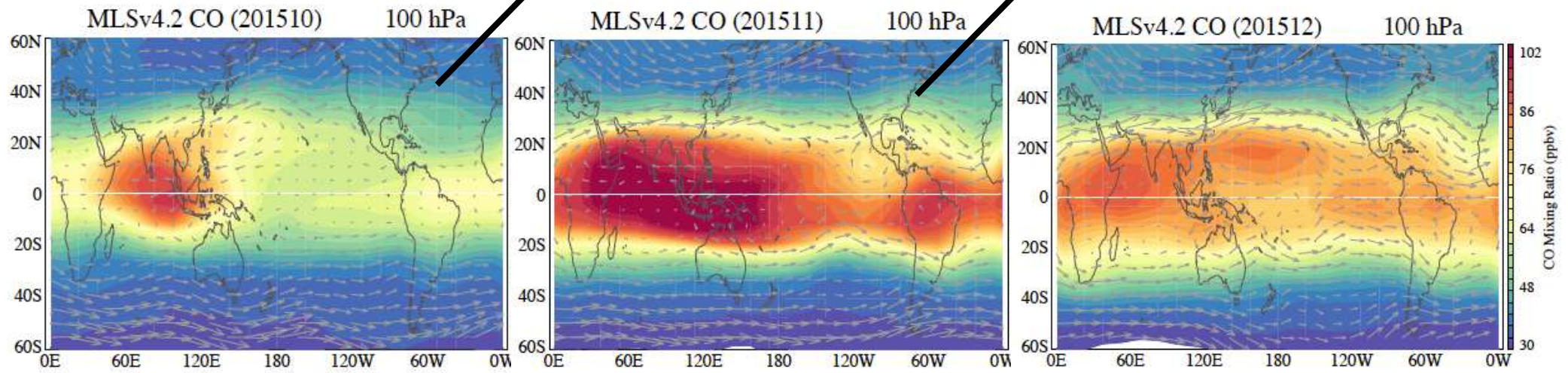
MLS CO (68 & 100 hPa)

2015 (Oct-Nov-Dec)

68 hPa

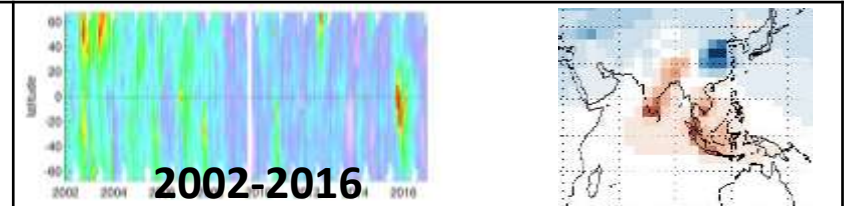


100 hPa

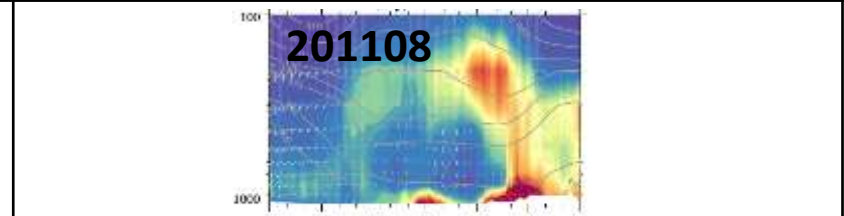


Conclusions

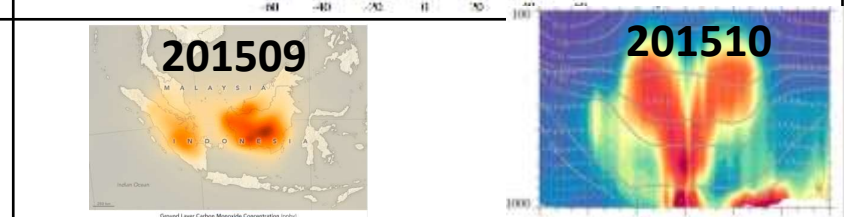
Global CO concentrations have been decreasing, but some regions still have increasing CO.



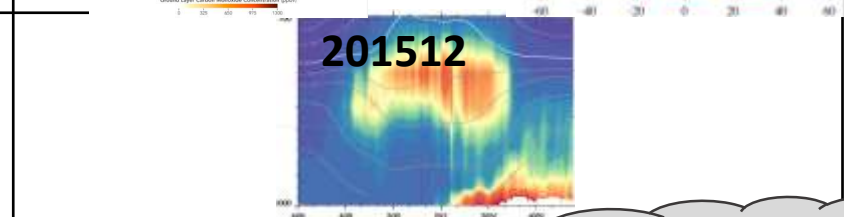
MOPITT observes Asian Monsoon pollution transport from sources to upper troposphere



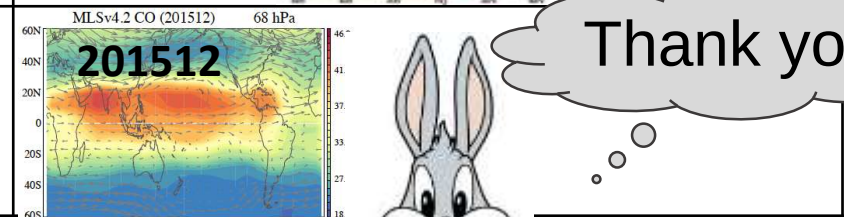
2015 ENSO-driven Indonesian fires produced highest CO values observed in MOPITT record



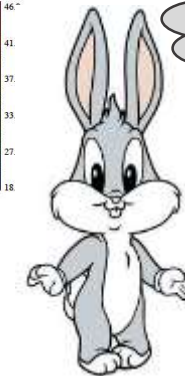
Fire CO emissions circled globe in tropical upper troposphere into Dec. 2015



No transport into lower strat (68 hPa) until NH winter convection in Pacific

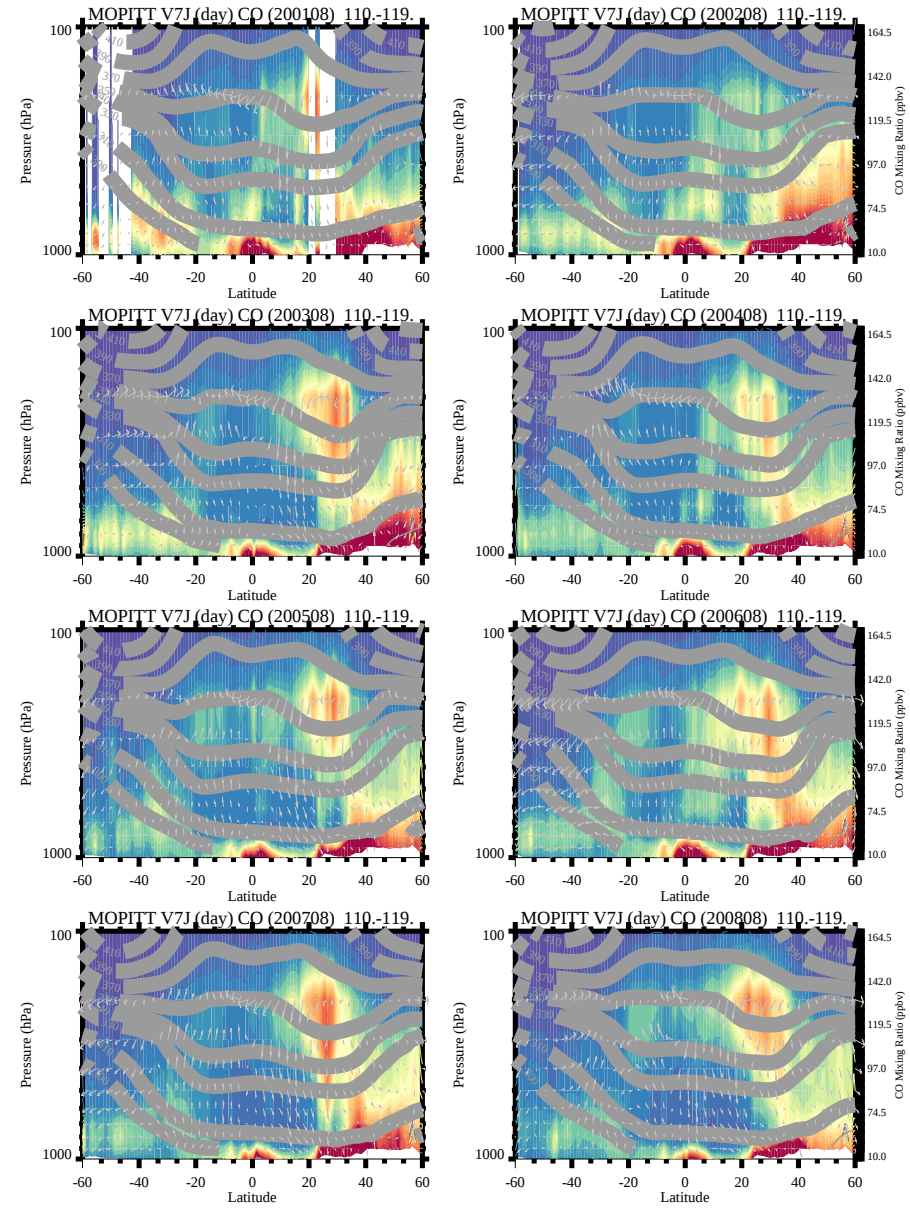


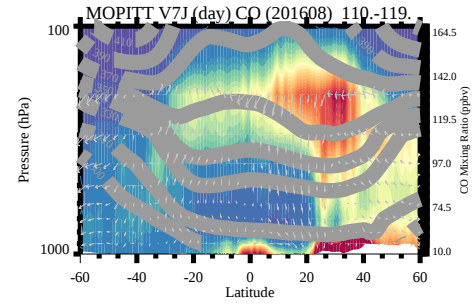
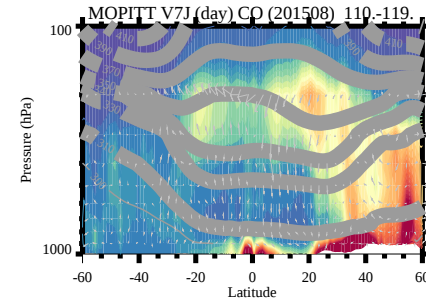
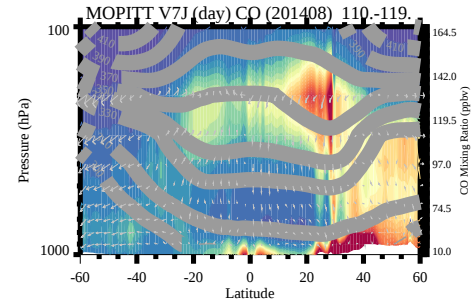
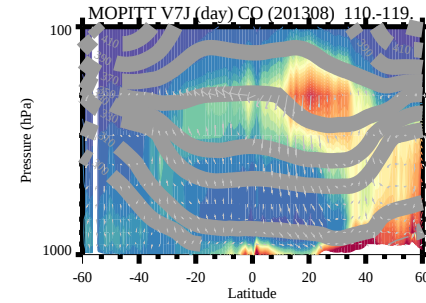
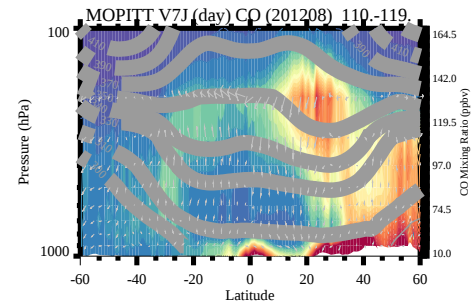
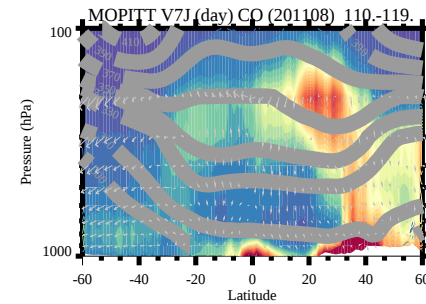
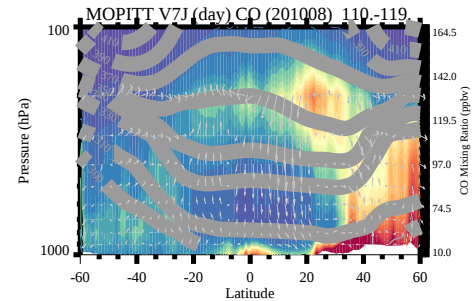
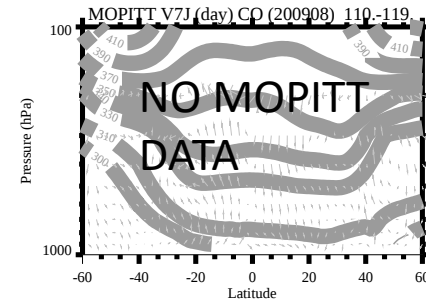
- Next steps: Look at interannual variability of Asian Monsoon features in MOPITT as compared to models



Thank you!

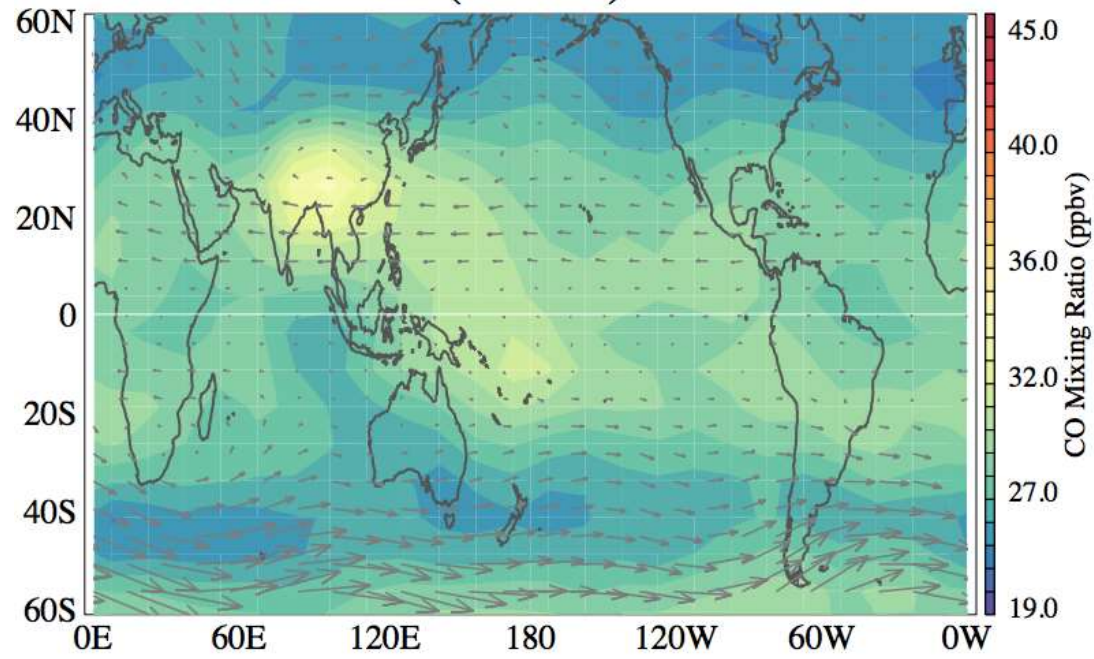






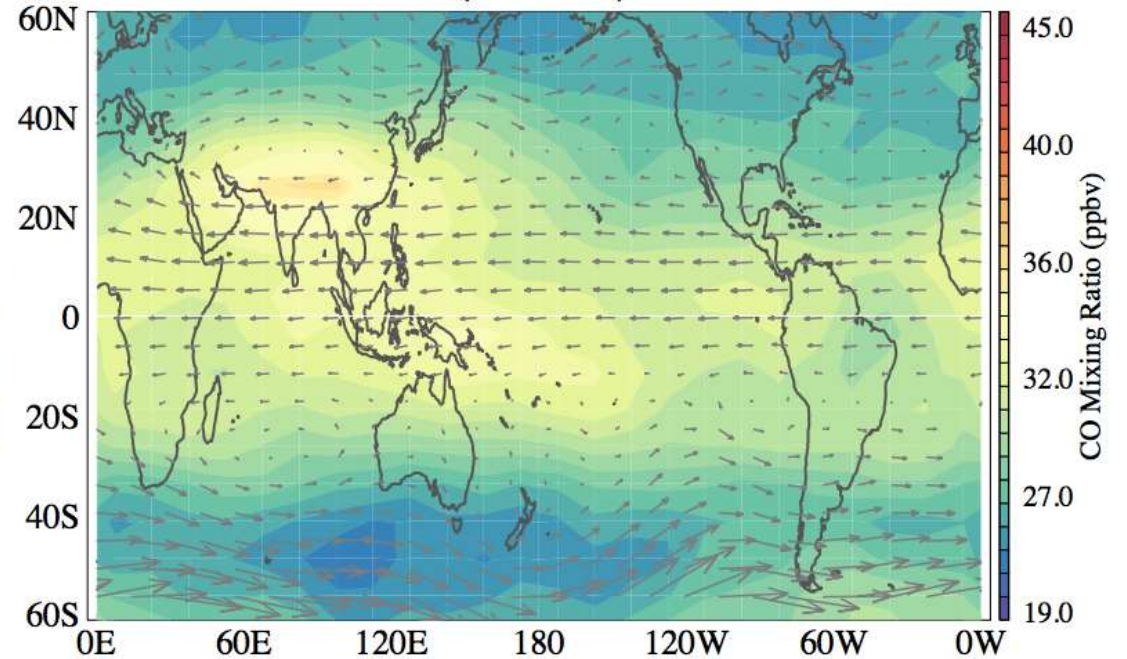
MLSv4.2 CO (201509)

68 hPa

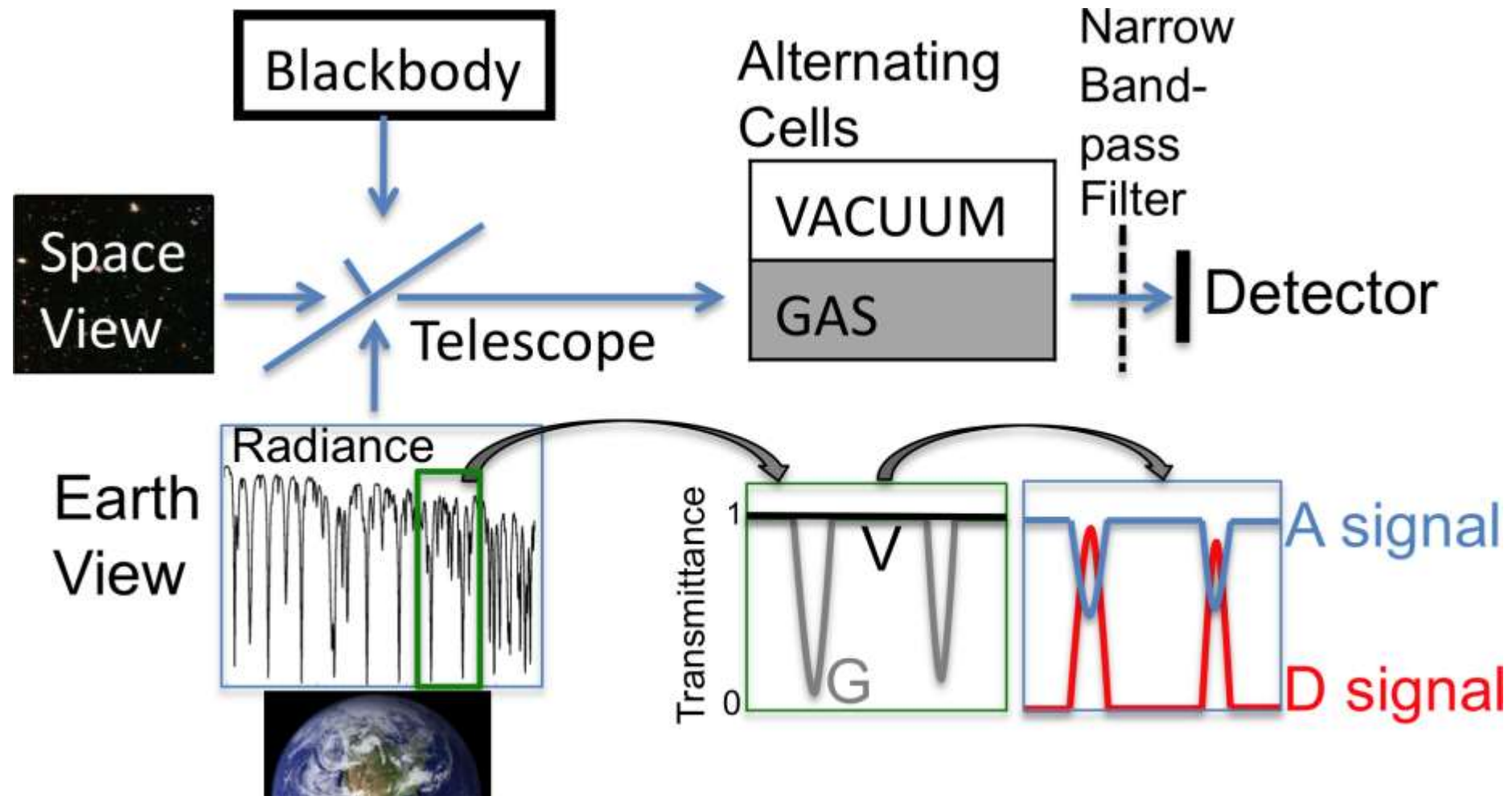


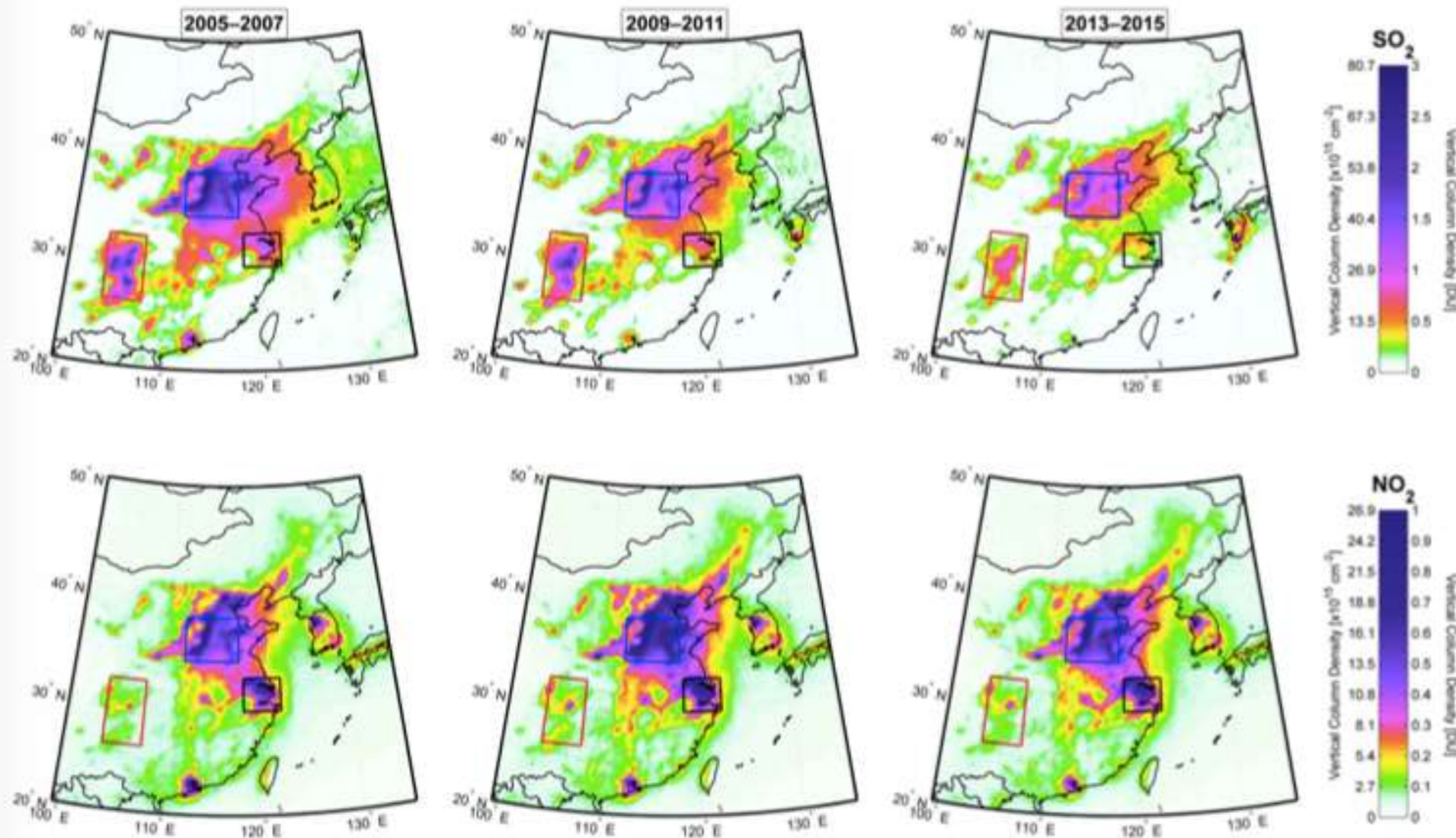
MLSv4.2 CO (201609)

68 hPa



MOPITT Instrument Concepts:
Simple Gas Filter Correlation Radiometer (GFCR)





(Krotkov et al., 2015)