Transport in the Asian Anticyclone from the interannual to the daily scale
How pollutants and water vapor enter ?

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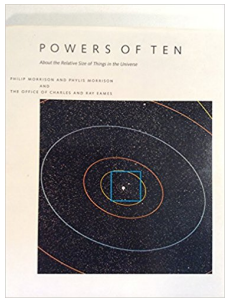
10-8

10+2

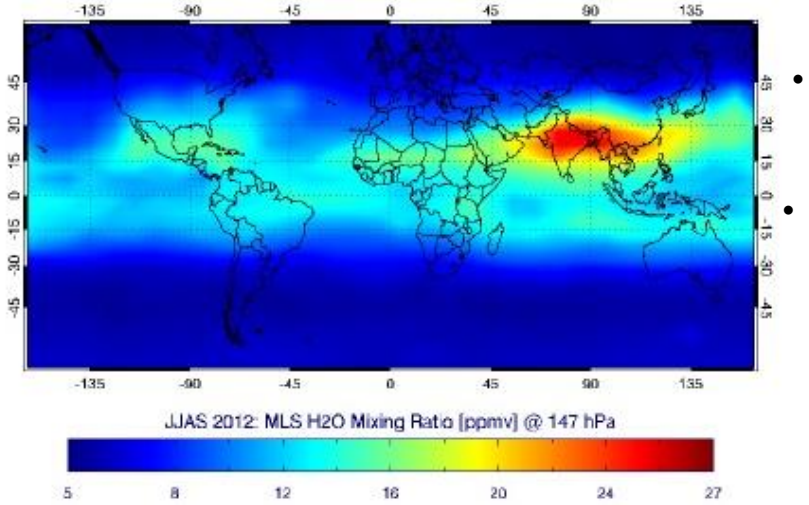
????????

10+8

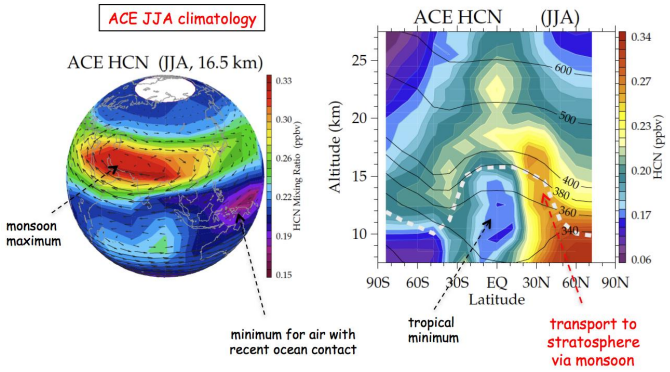
Powers of ten
Philip & Phylis Morrison



On the planetary scale we see the Anticyclone as a “local” bulk feature and investigate on its global role



On the regional scale we investigate the variability, permeability and morphology



On the local scale we hypothize the role of local (over Tibetan Plateau) specific convection in triggering moisture

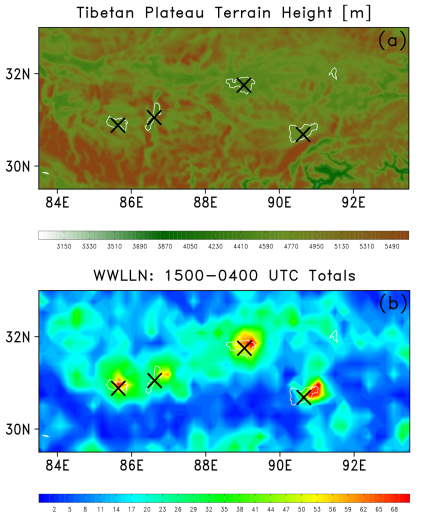
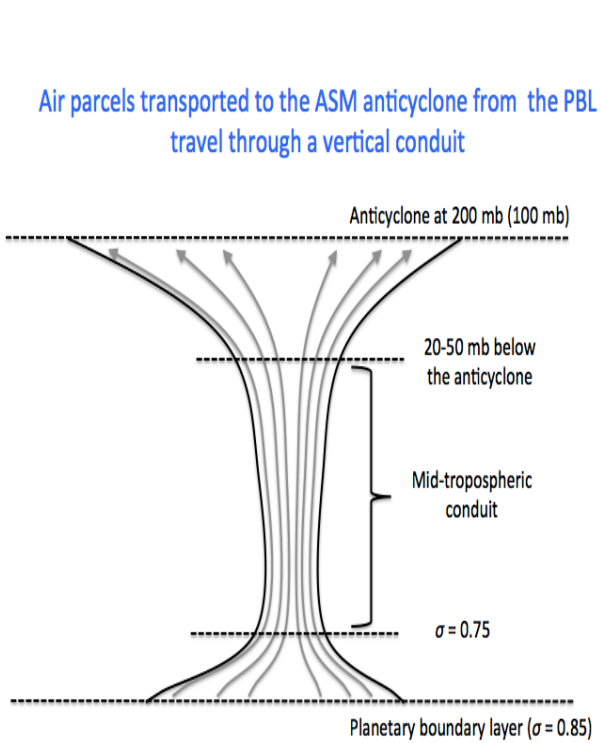
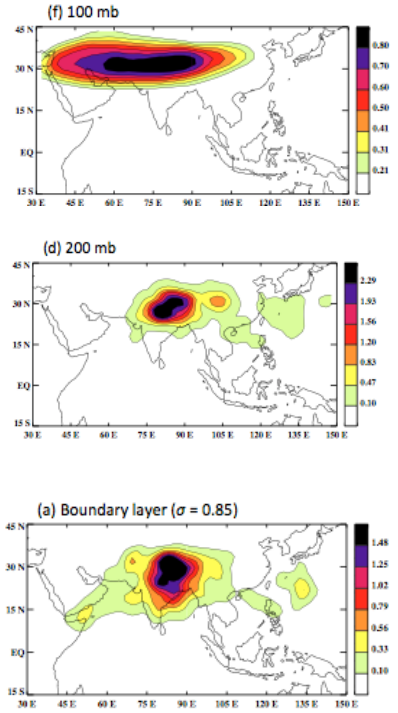


Fig. 13. **(a)** Terrain (m) of the Tibetan Plateau with black Xs denoting the locations of lakes. **(b)** Six year (2007–2012) WWLLN lightning totals for 15:00–04:00 UTC for August and September showing “hot spots” of lightning (deep convection) near the lakes (black Xs). The lightning data were binned into 25 km × 25 km grid boxes.

Transport (1) - the role of a conduit ?

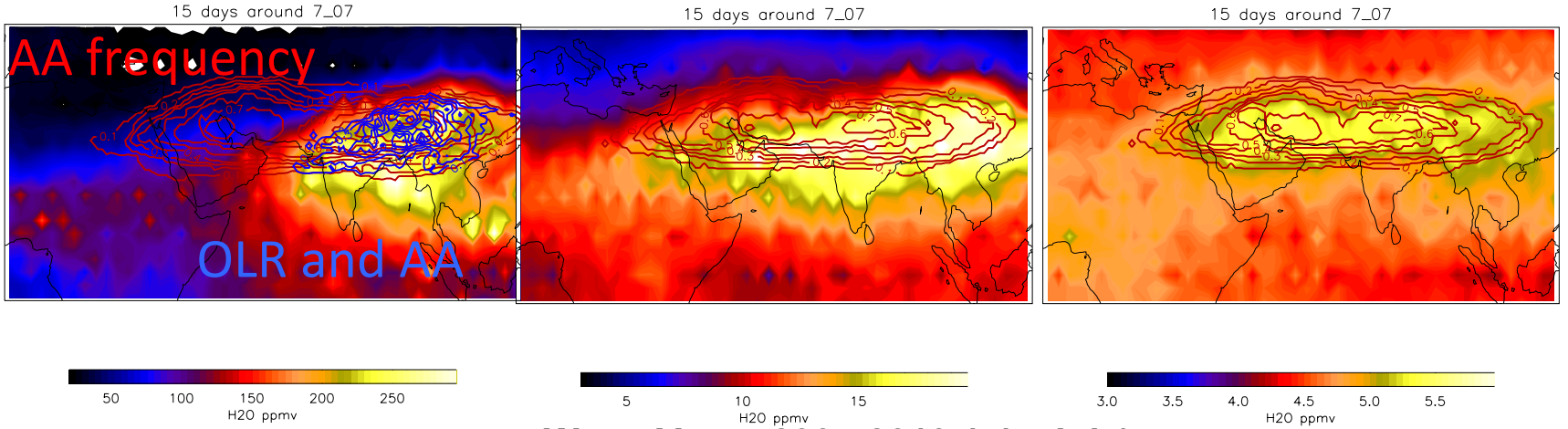




Bergman et al. 2013

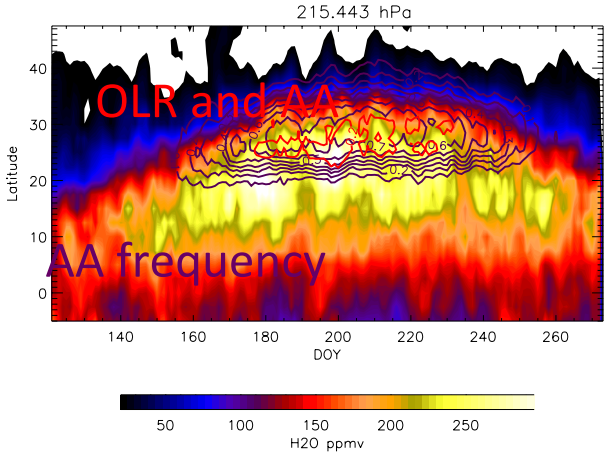
Important role of land convection and sources feeding the Asian Anticyclone:
Bergman et al 2013: 30 % From Tibetan Plateau & 40 % From Land India
Vogel et al., 2015: 30 % From India & 10 % From East China
→ **"BULK" sources and convection**
Heath et al., 2015: 55 % From Tibetan Plateau on a specific week with high resolution modelling

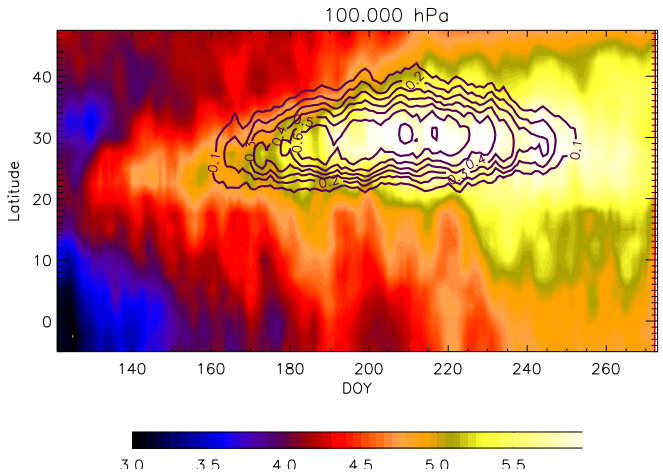
Conduit from MLS H2O data



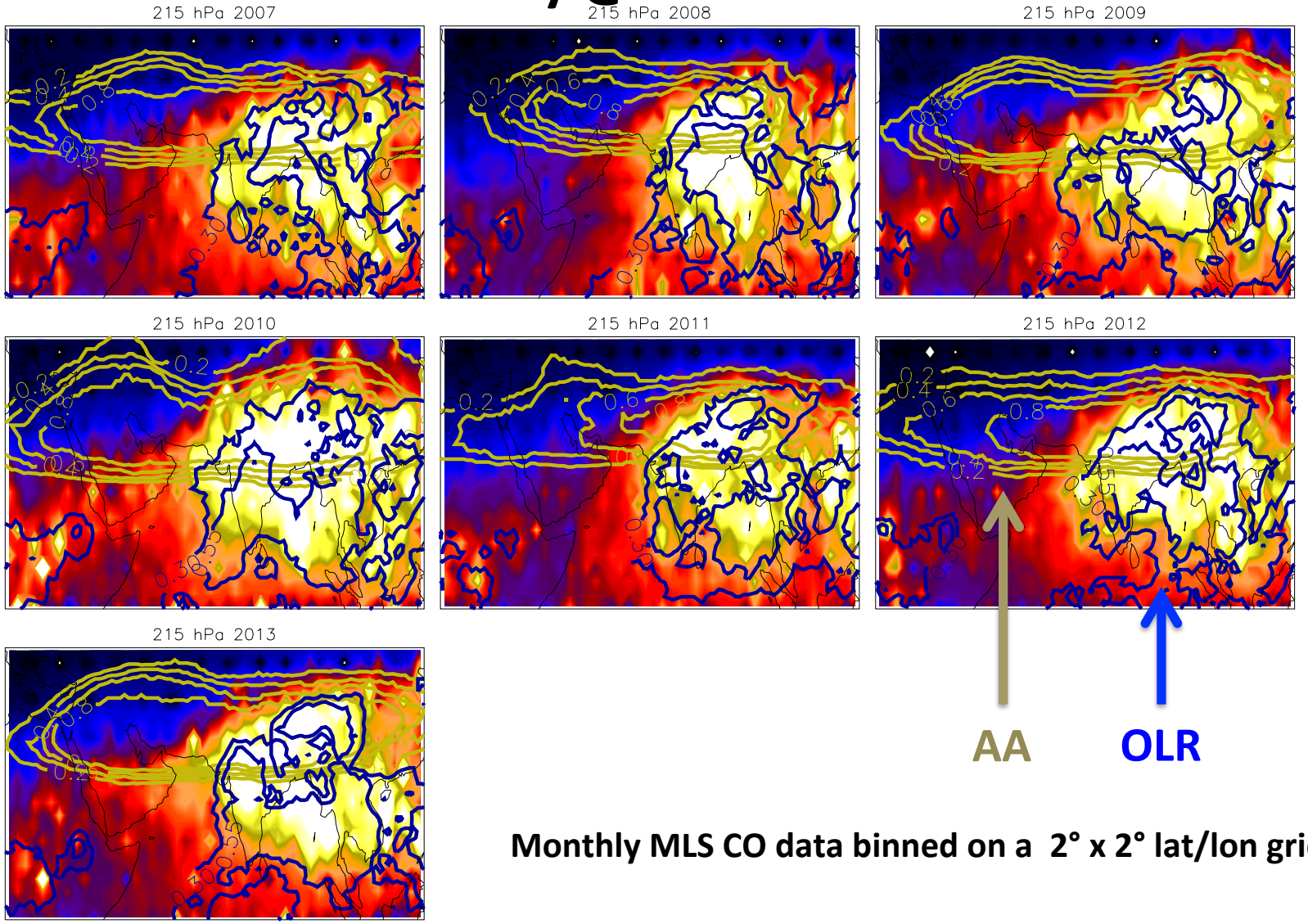
- **Water Vapor 2005-2013 1-15 July)**

- **Enhanced WV in the monsoon area at 215 hPa (10-25 N)**
- **Confinement inside the AA at 100 hPa**
- **Confirm the hypothesis of a conduit (Bergman, Fierli 2013)**





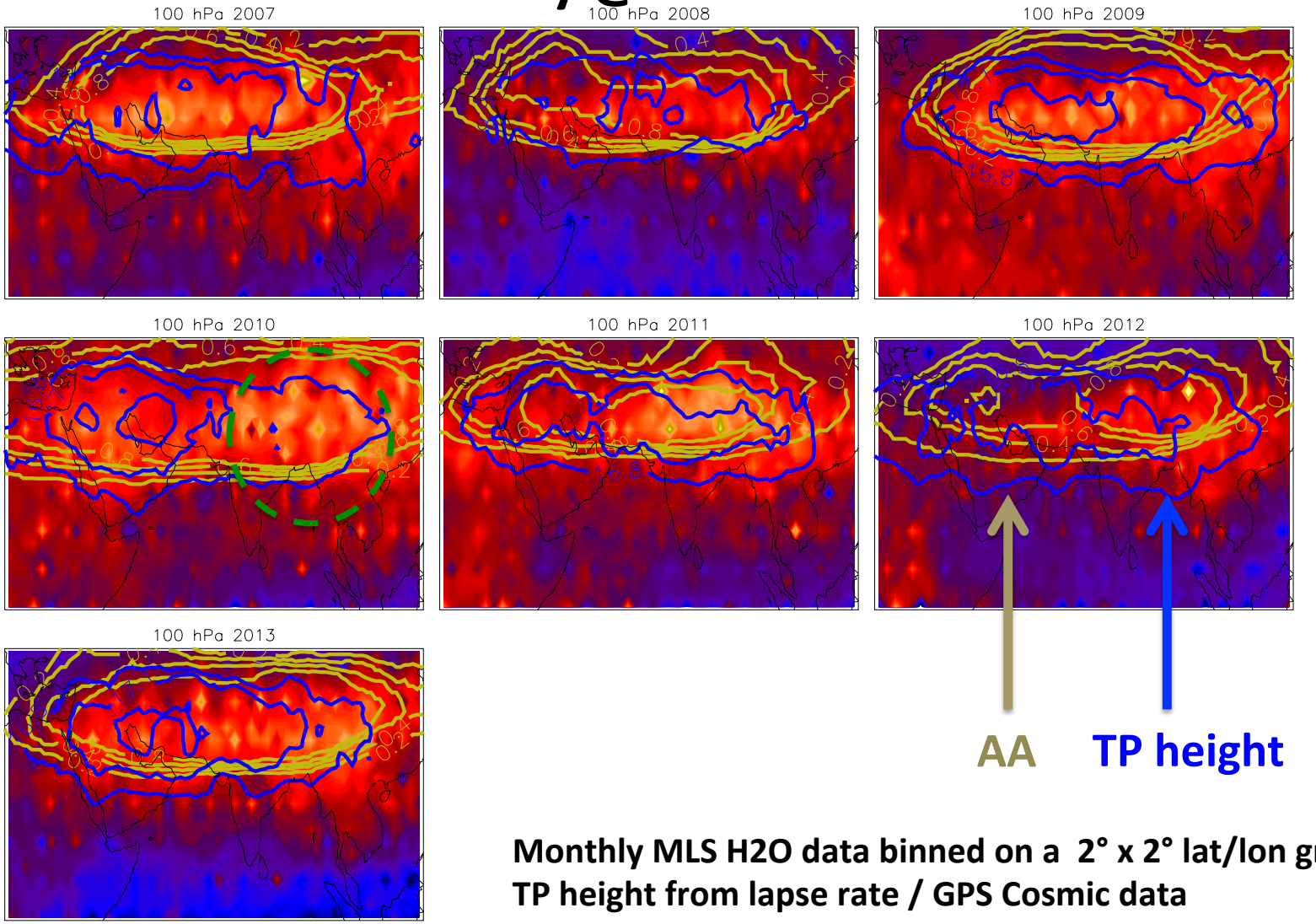
Water vapour interannual variability
July @ 215 hPa



Monthly MLS CO data binned on a 2° x 2° lat/lon grid

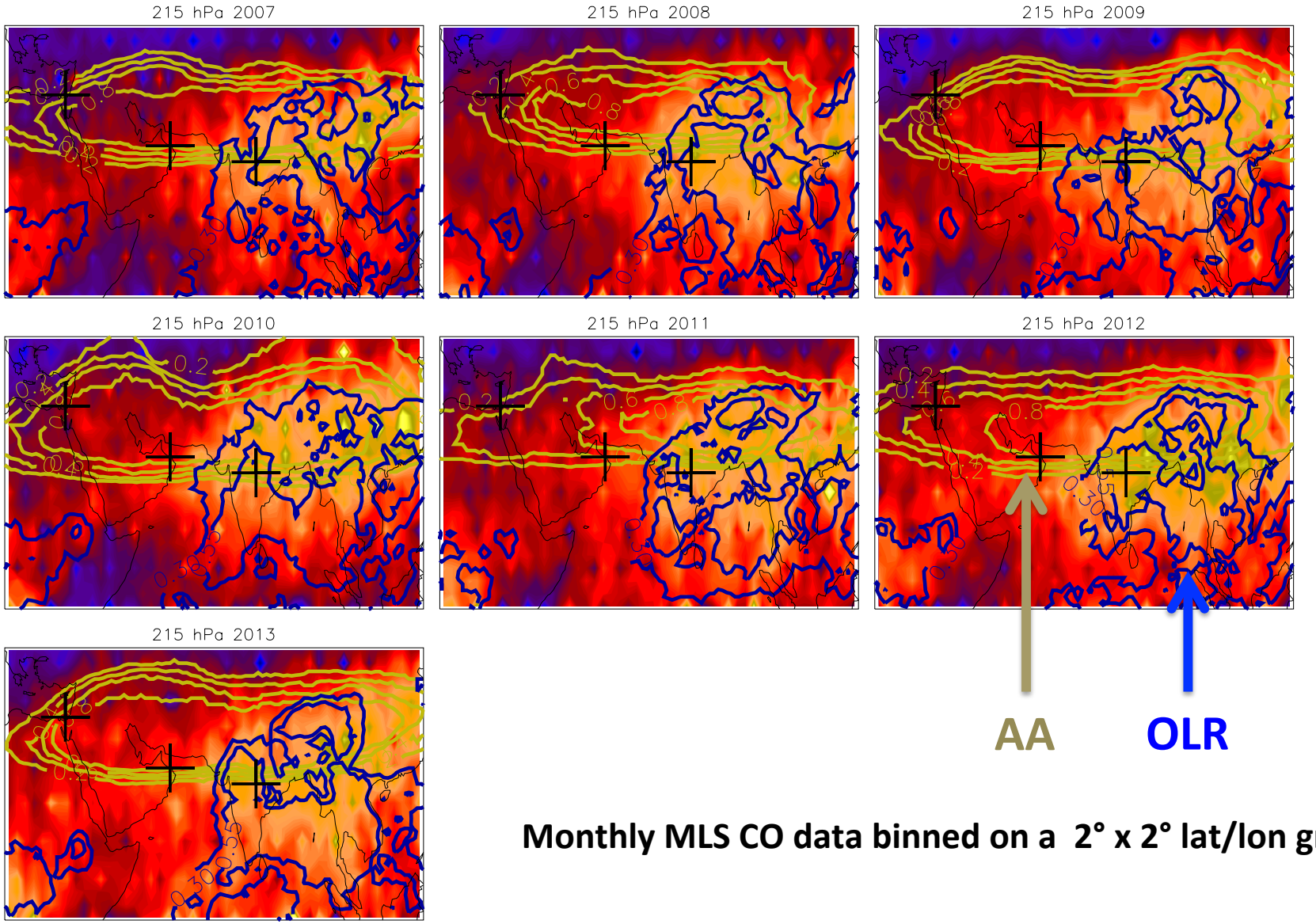
H_2O interannual variability

July @100 hPa



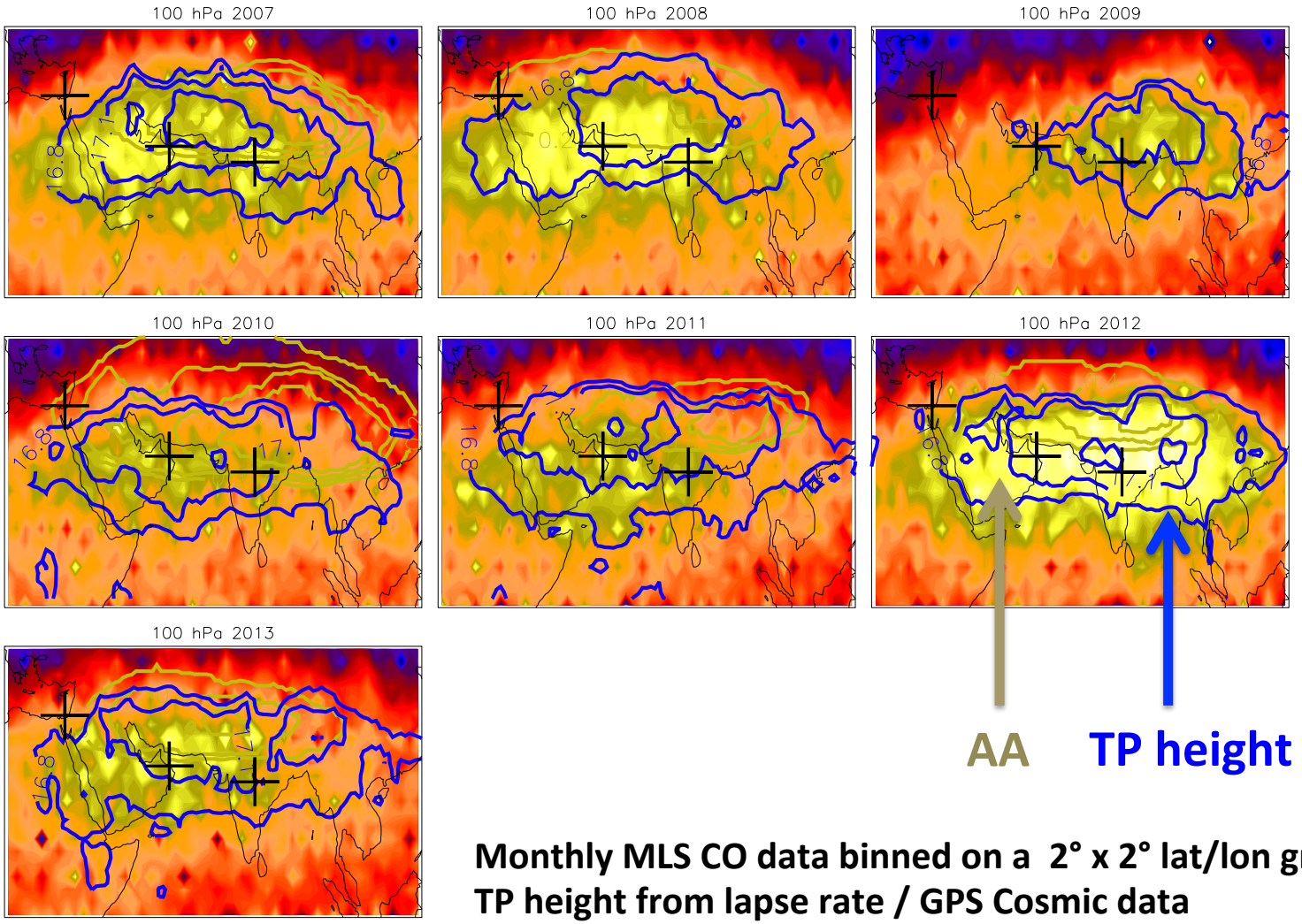
Monthly MLS H2O data binned on a 2° x 2° lat/lon grid
TP height from lapse rate / GPS Cosmic data

CO interannual variability
July @ 215 hPa



Monthly MLS CO data binned on a 2° x 2° lat/lon grid

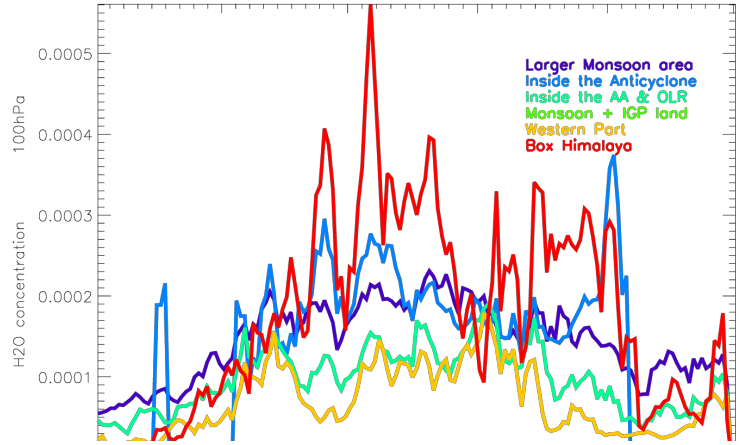
CO interannual variability
July @100 hPa



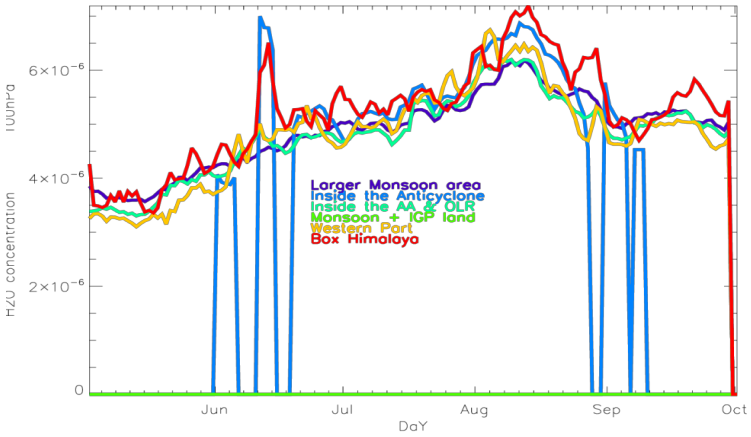
Monthly MLS CO data binned on a 2° x 2° lat/lon grid
TP height from lapse rate / GPS Cosmic data

Intraseasonal: how much observed H2O varies over a single season ?

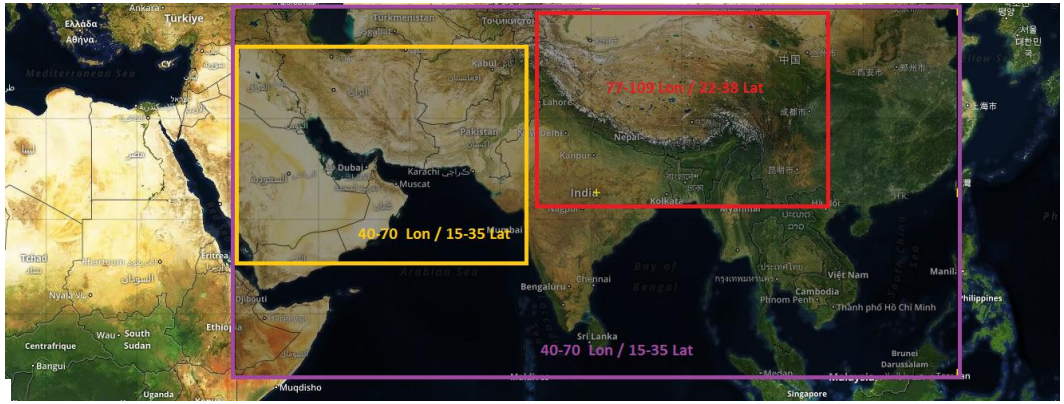
215 hPa/12 Km



100 hPa/16 Km

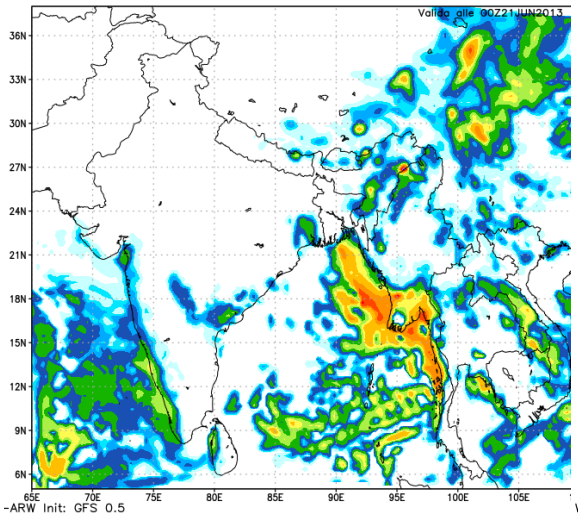


MLS data v3.3 averaged over different regions

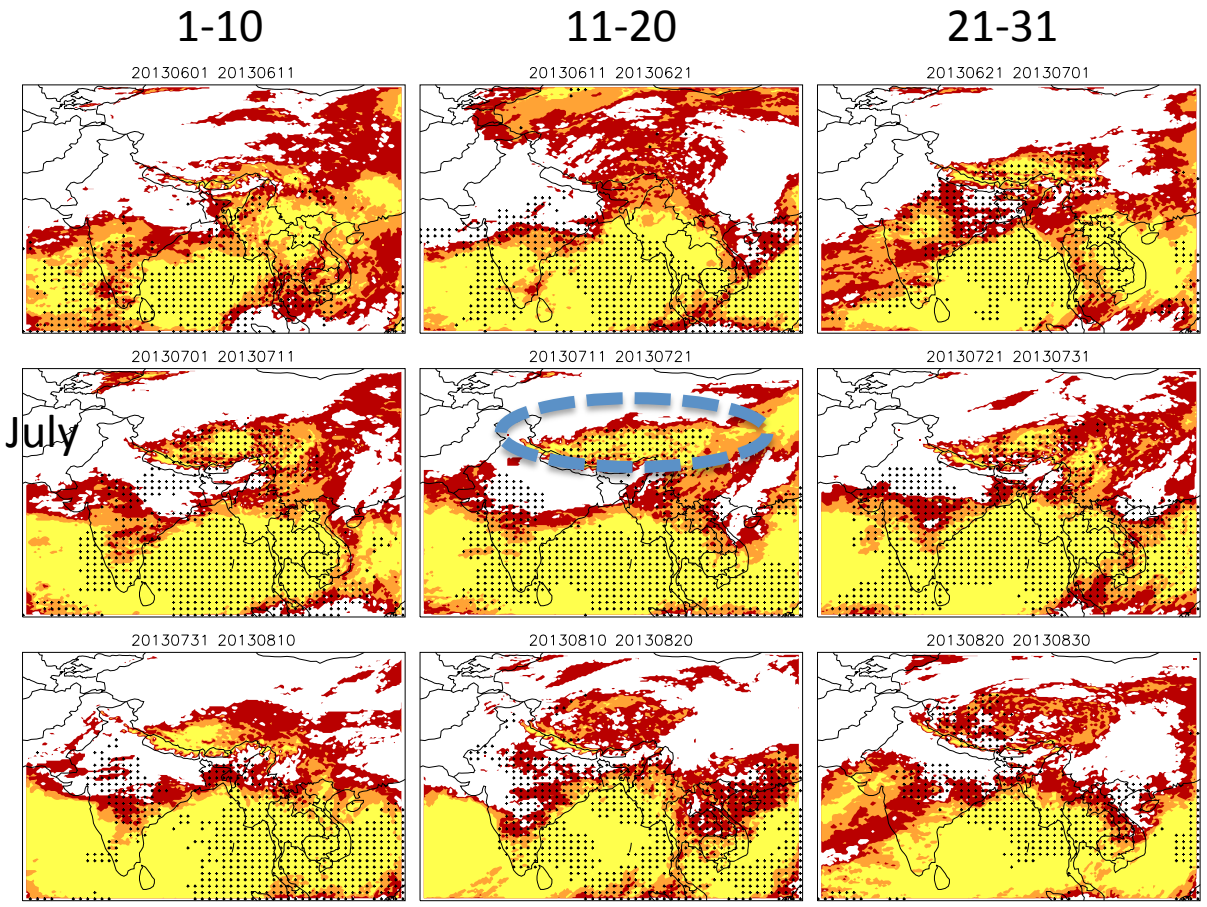


Focus on the Tibetan Plateau and surroundings: make use of regional simulations

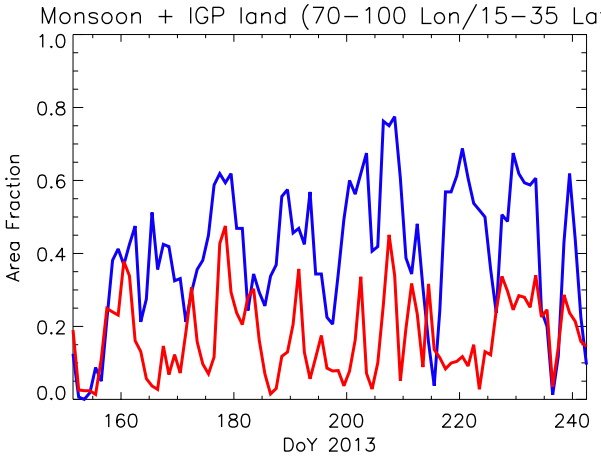
WRF seasonal simulation
15 May-15 Sept

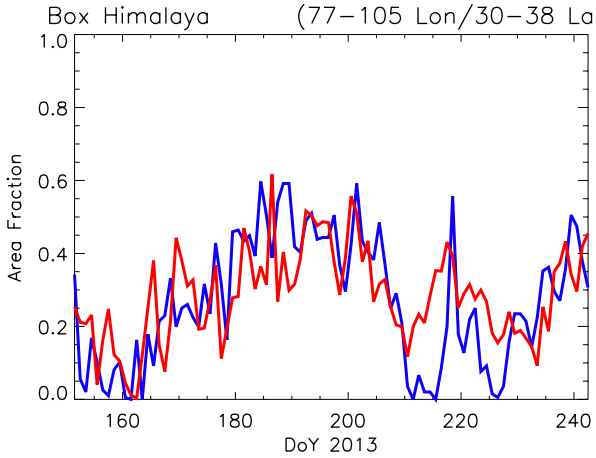


25 x 25 km – 60 LEV



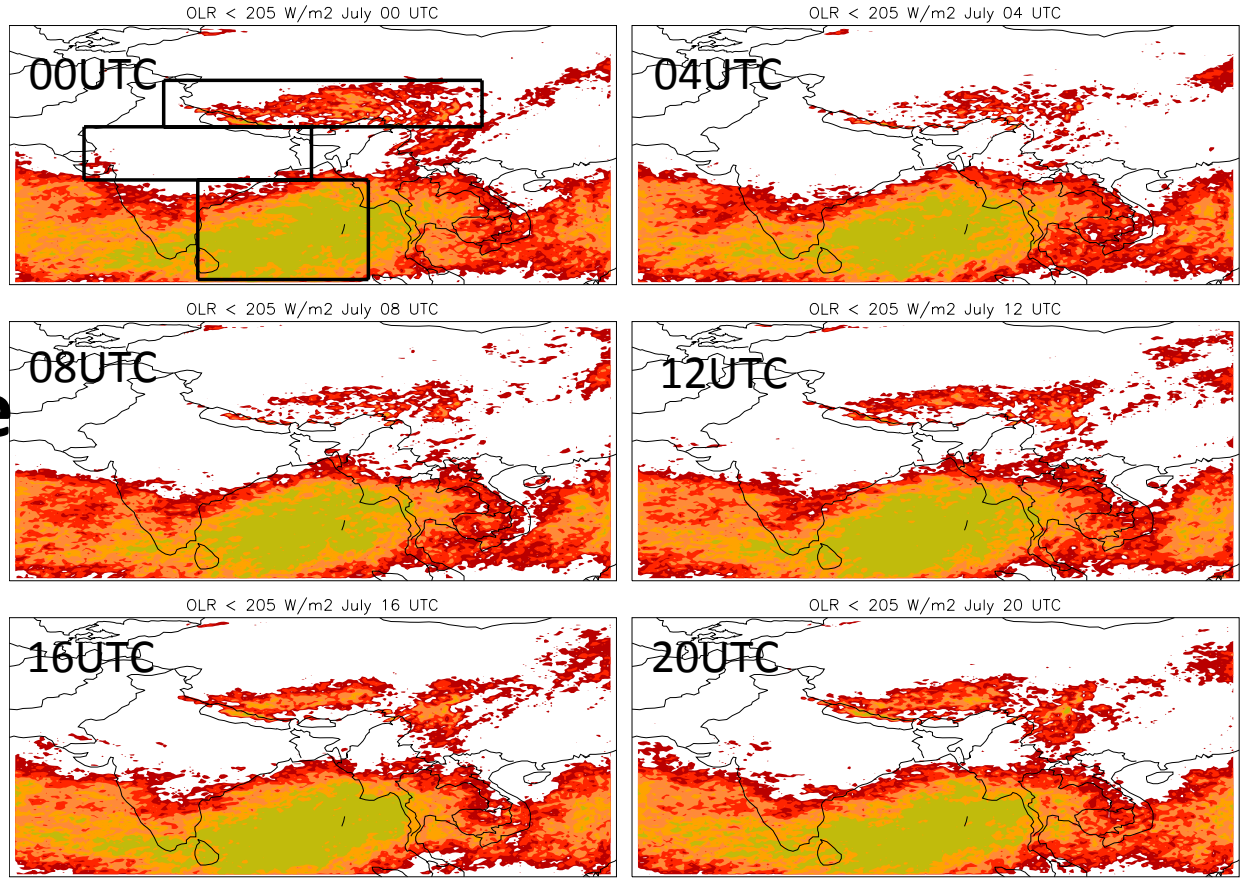
Low OLR probability for WRF and ISCCP data

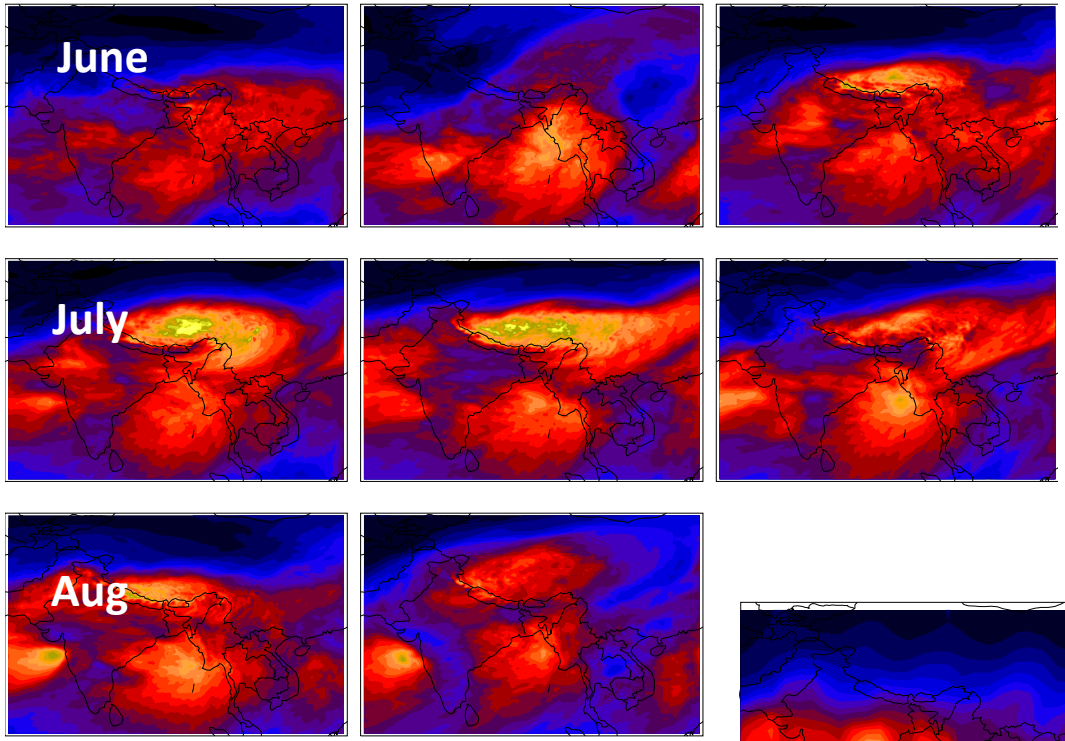




WRF ISCCP low OLR area seasonal cycle

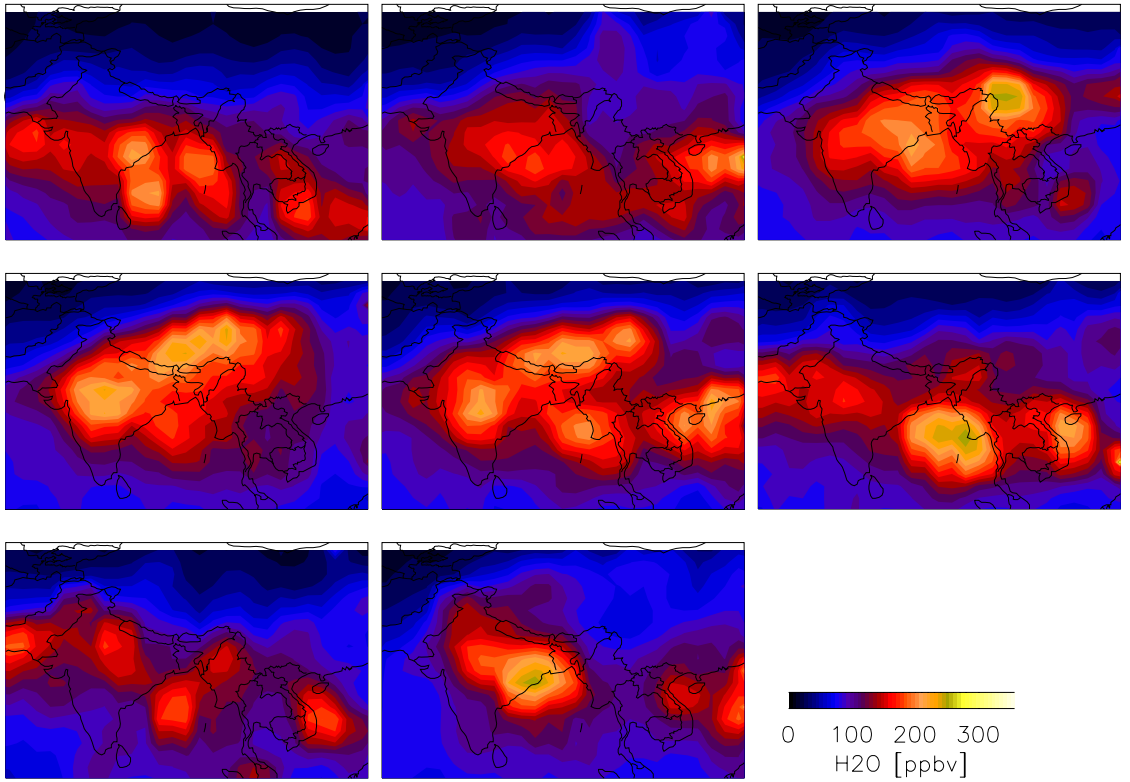
WRF Daily Cycle

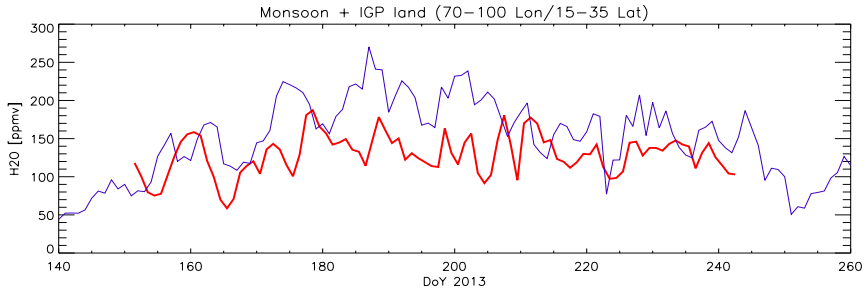


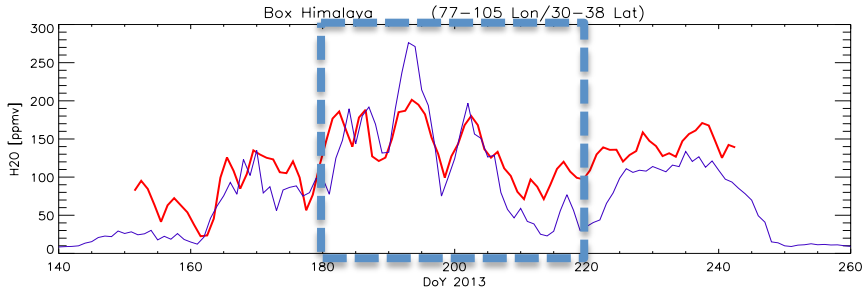


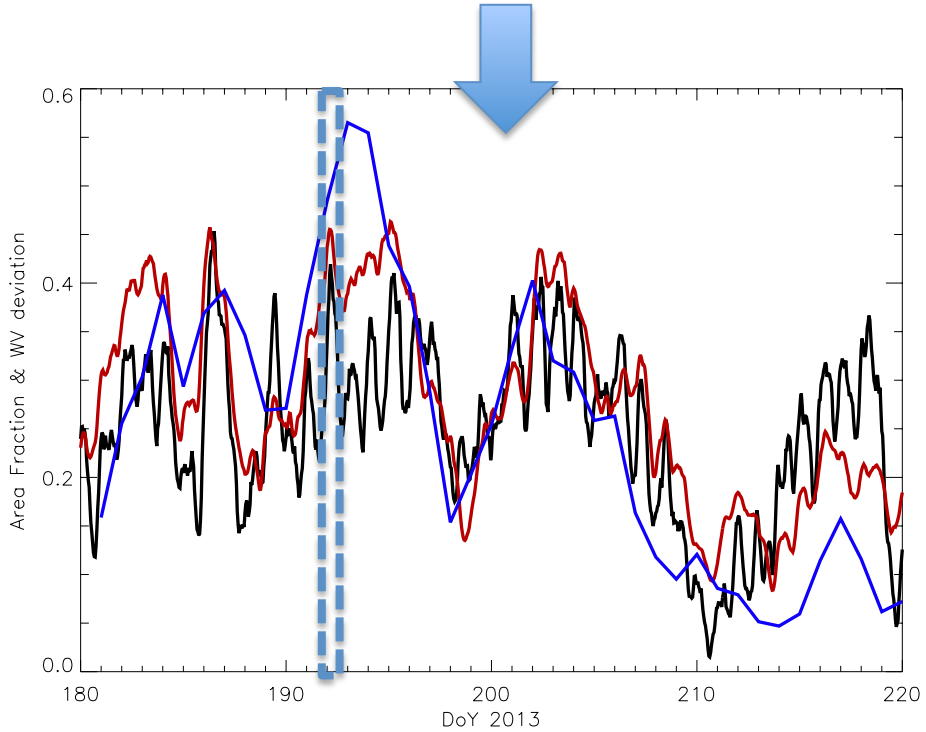
WRF Seasonal Evolution water vapor at 200 hPa

MLS Seasonal Evolution water vapor at 200 hPa





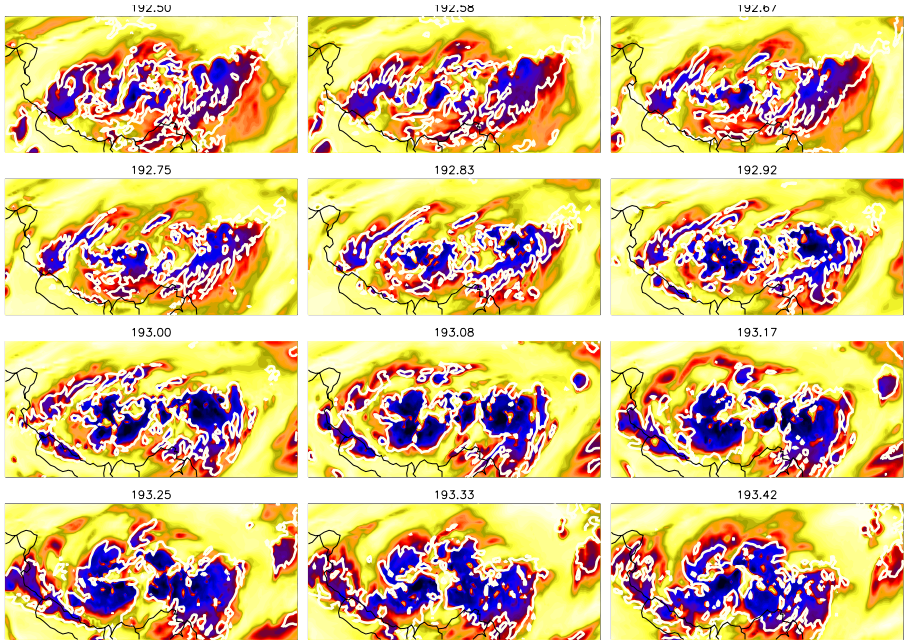




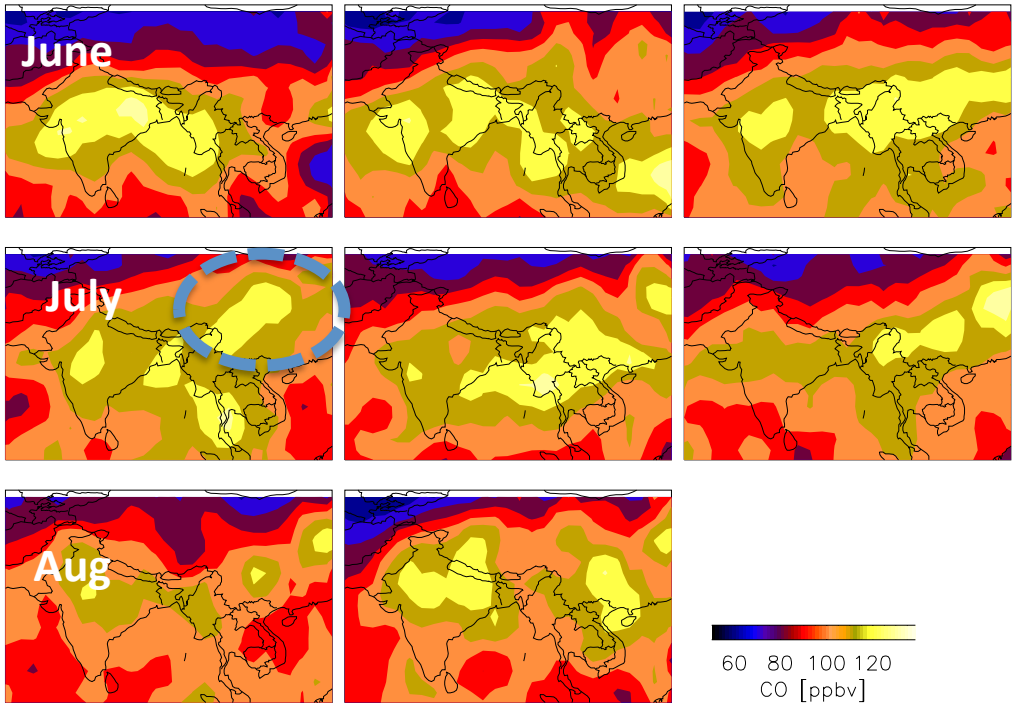
WRF and MLS water vapour at 200 hPa on:

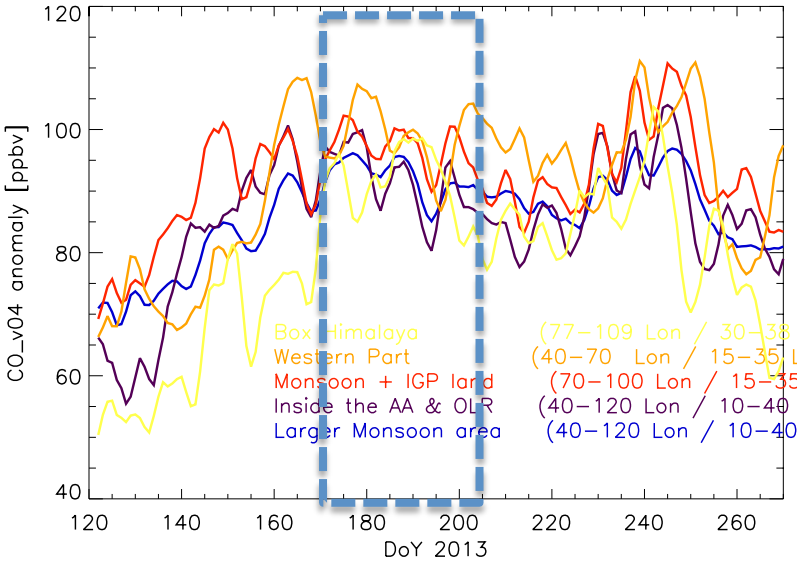
A wide region

HP region

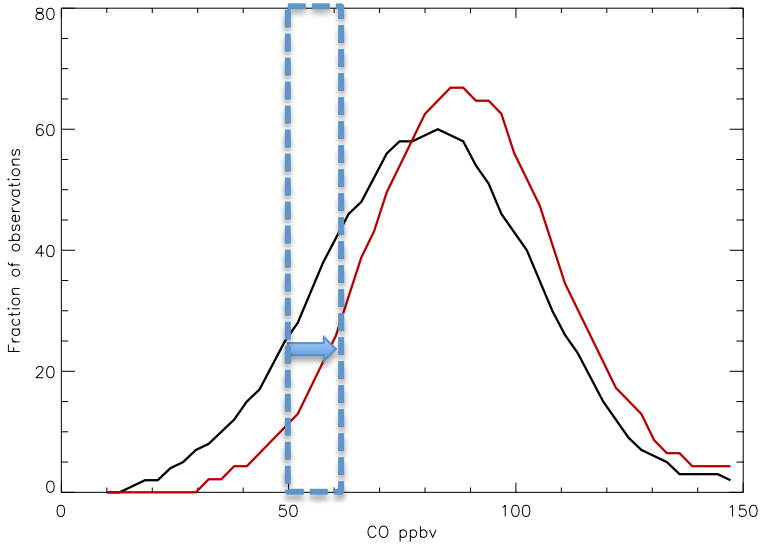


MLS CO in 2013
200 hPa

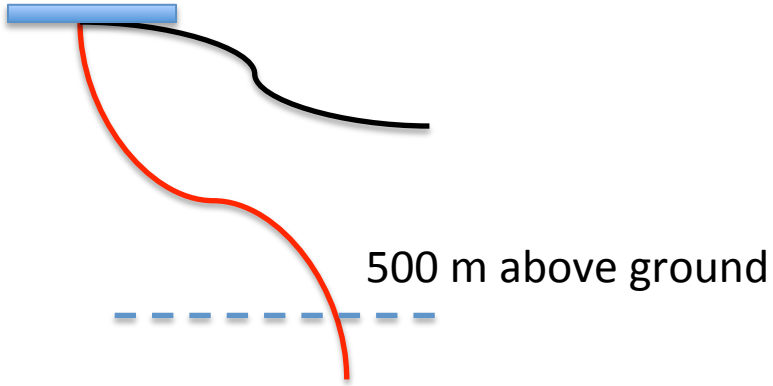




20 ppbv shift



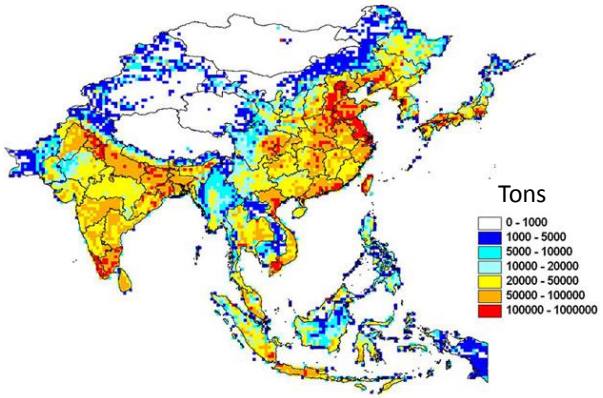
MLS Observations 200 hPa



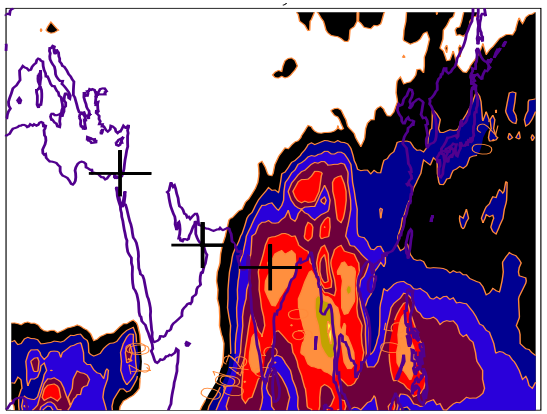
MLS CO observations above TP **+** **Flexpart-WRF based on WRF**

CO uplift in the Asian Anticyclone is the convolution of three elements:

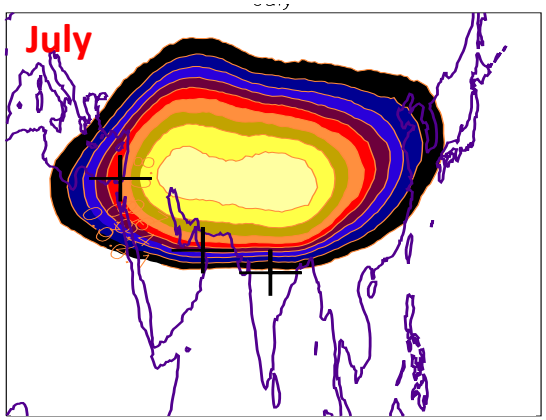
CO emissions

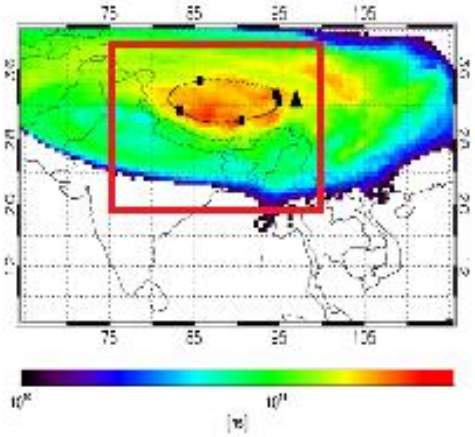


Convection

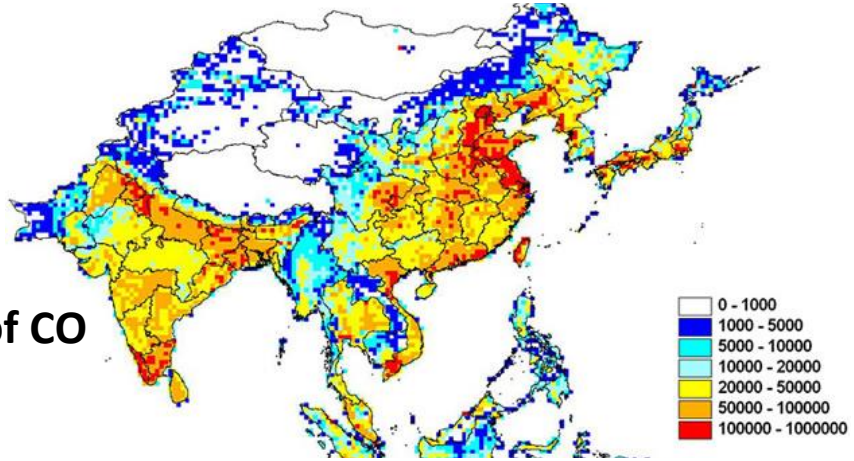


Anticyclone

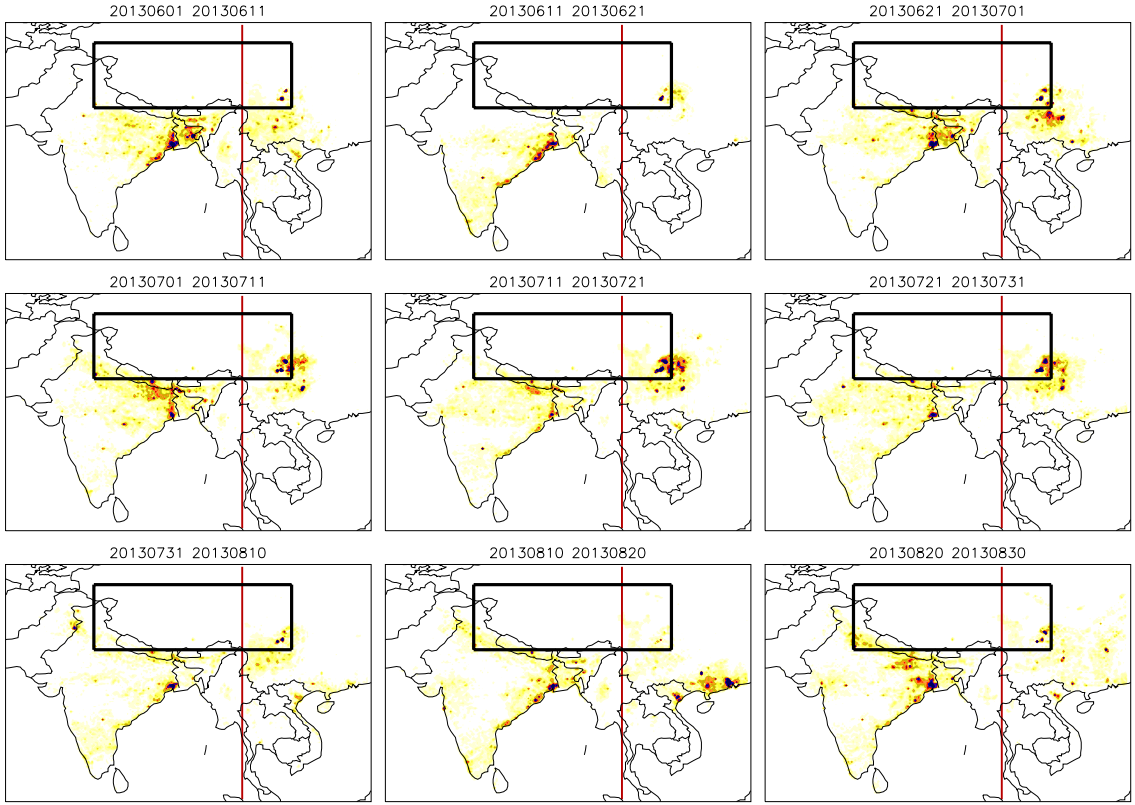




$$\int (\text{time}) \times (\text{CO mass/area/time})\, d(\text{area}) = \text{CO Mass}$$



Flexpart reconstruction of CO sources



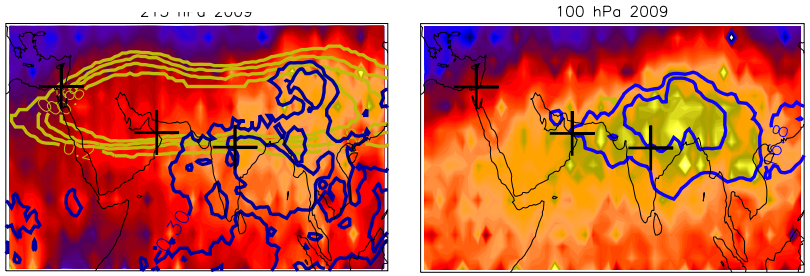
Role of different sources

Conclusions

-Satellite data on the Continental scale:

Support the “Conduit” mechanism

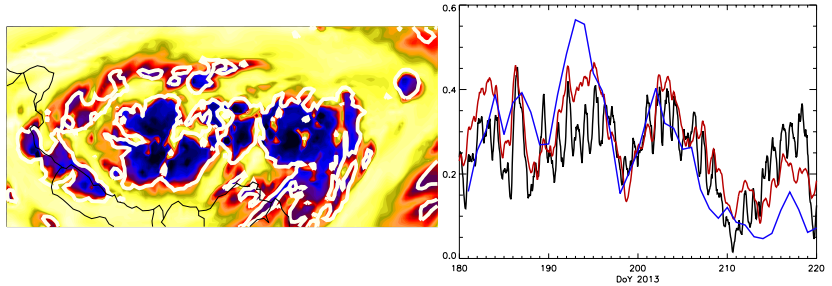
Show a bubble-like dynamics



- Regional simulations + Satellite data

Efficient convection on the Tibetan Plateau feeding the Anticyclone representing an important source

Role of diurnal cycle and localized convection



- Regional simulations + Emissions

CO can be uplifted in the core of the Anticyclone. Both Indian and Chinese

Sources may play a role