StratoClim

Stratospheric and upper tropospheric processes for better climate predictions

Deep convective influence on the UTLS composition in the Asian Monsoon Anticyclone region:

2017 StratoClim campaign results

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StratoClim Overall science objective: More reliable **projections of climate change** and **stratospheric ozone** through a better understanding (and improved representation) of Upper Troposphere and Lower Stratosphere (UTLS) processes.

Focus on
Asian Summer Monsoon Anticyclone

Dominant circulation feature
of NH summer UTLS

Forced by deep convection over
India and Bay of Bengal

High-Altitude Aircraft Field Campaign and Balloonsonde measurements

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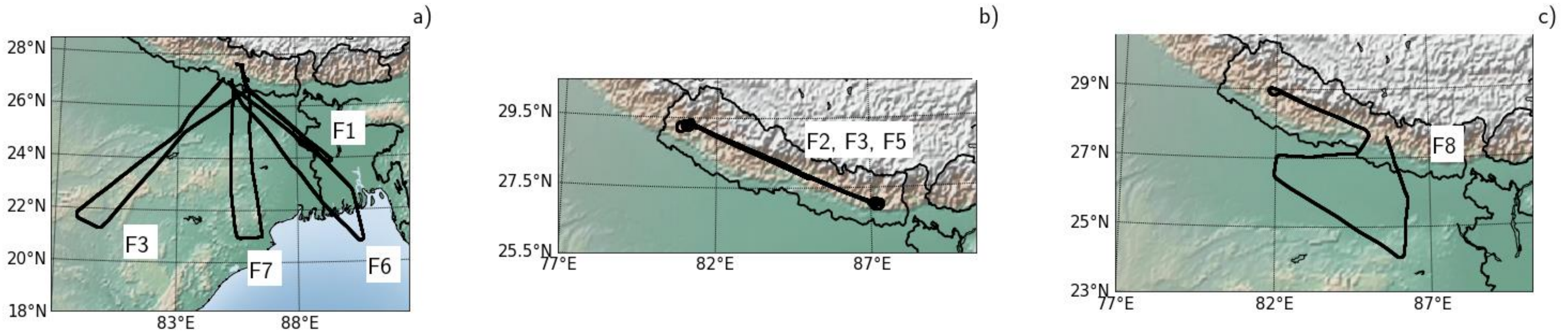
Identification of convective influence, (with sources, age and intensity) on the air masses sampled during the 8 StratoClim flights (July-August 2017)



Approach:

Carbon Monoxide (CO from COLD) used as a tracer for anthropogenic pollution.

↕

Lagrangian transport of air masses:

TRACZILLA on ECMWF reanalysis + convection by satellites (geostationary IR and VIS)

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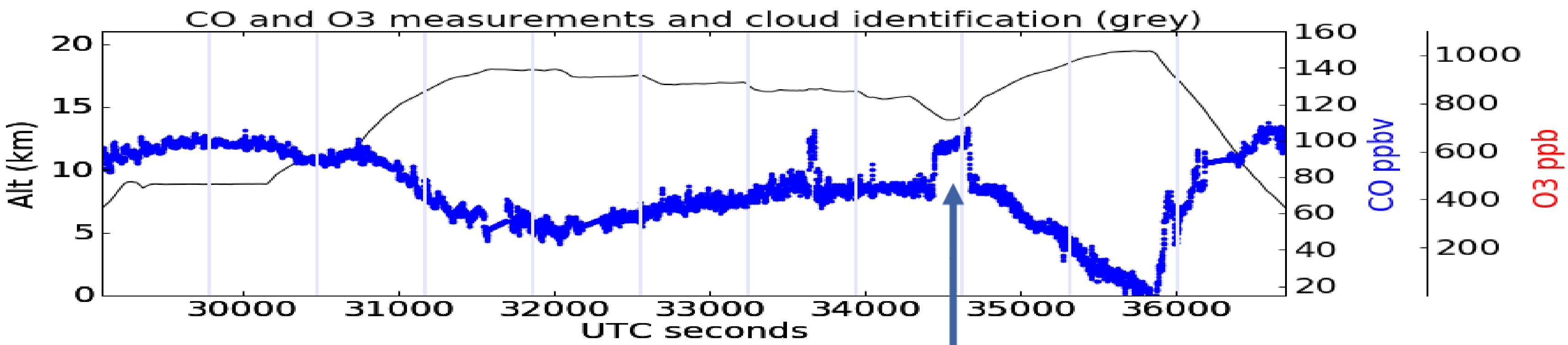
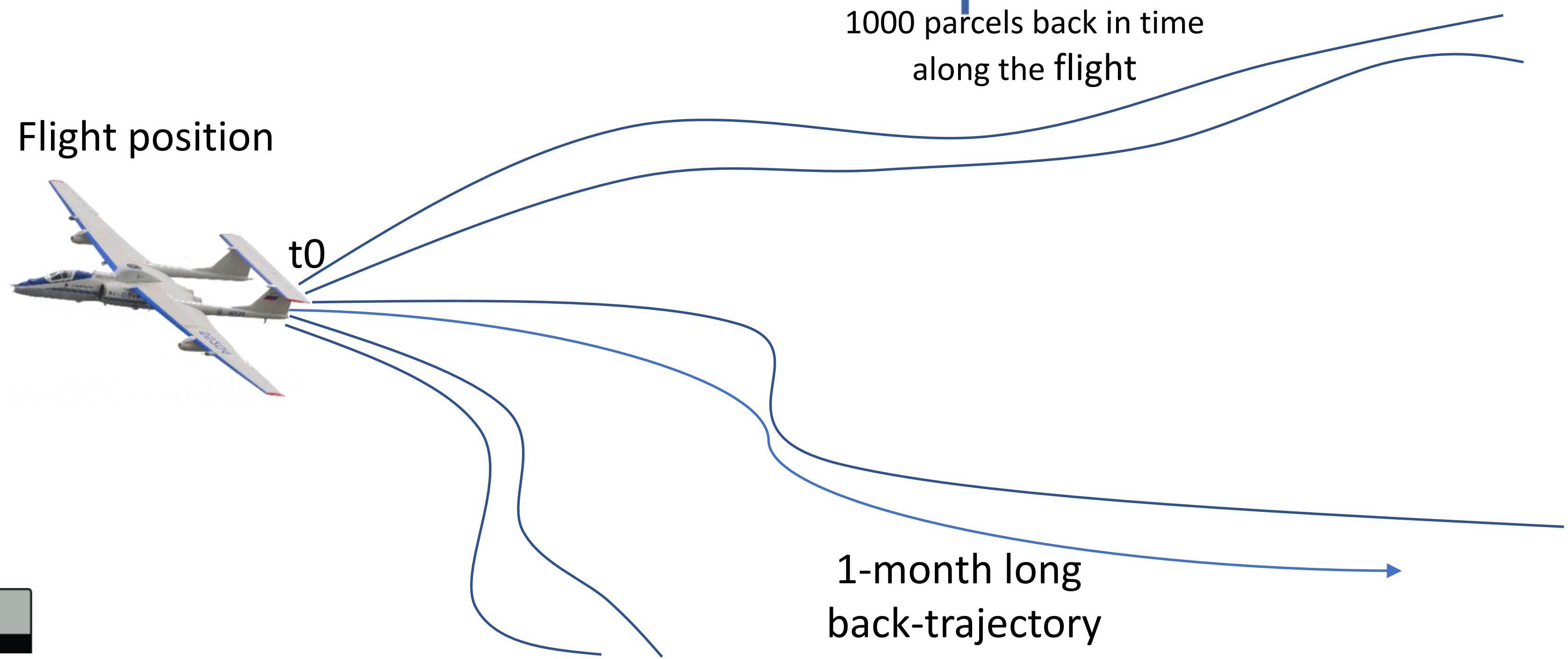
Lagrangian + Satellites Tool



1000 parcels back in time
along the flight



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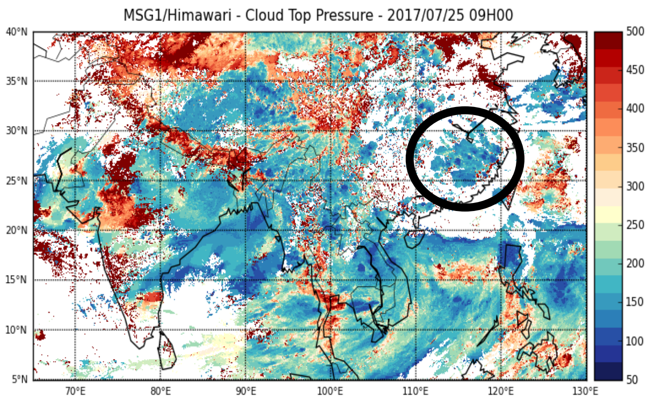
Lagrangian + Satellites Tool

SAF-NWC Cloud Top Pressure



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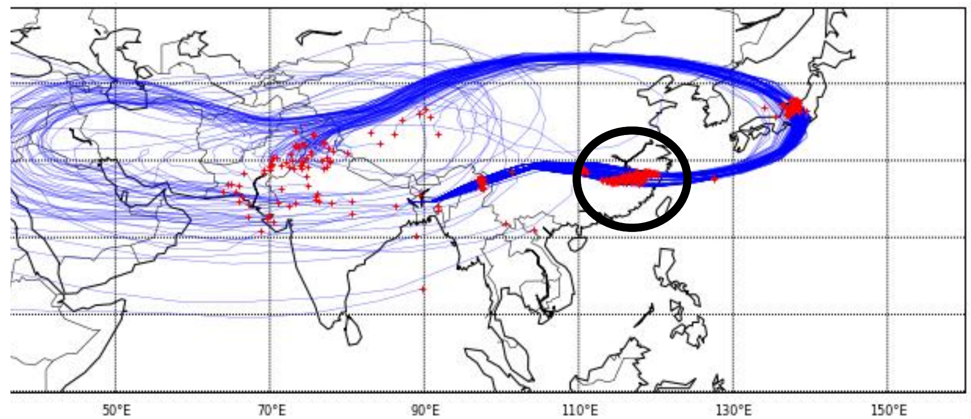

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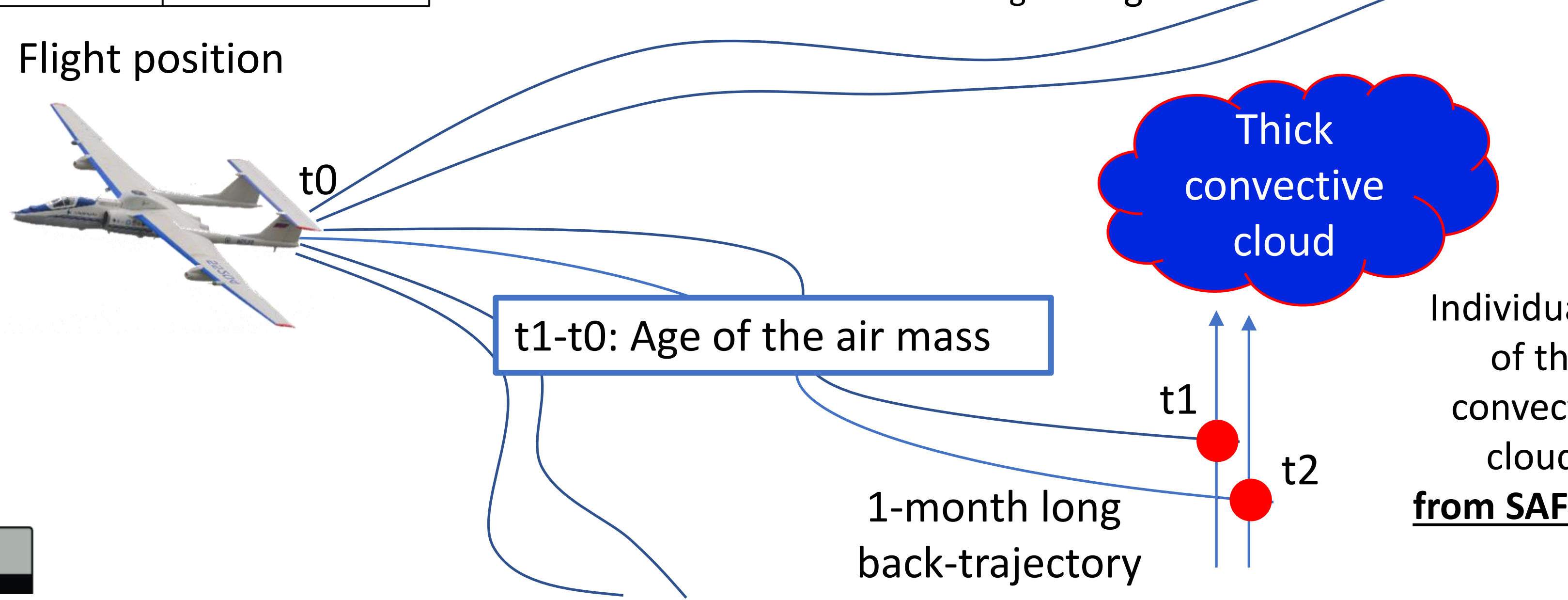

Individuation of the convective clouds **from SAF-NWC**

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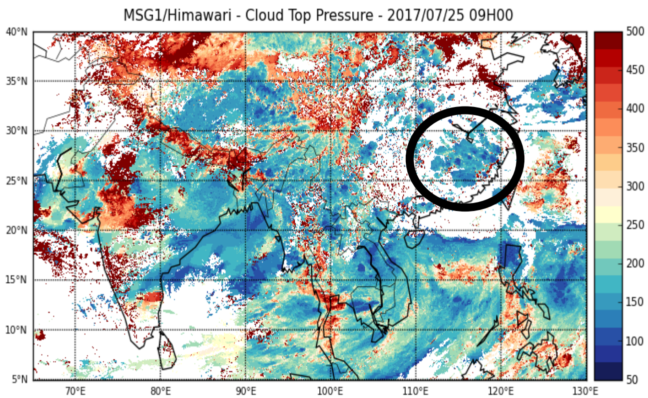
Lagrangian + Satellites Tool

The EUMETSAT Network of Satellite Application Facilities

CM SAF Climate Monitoring

SAF-NWC Cloud Top Pressure



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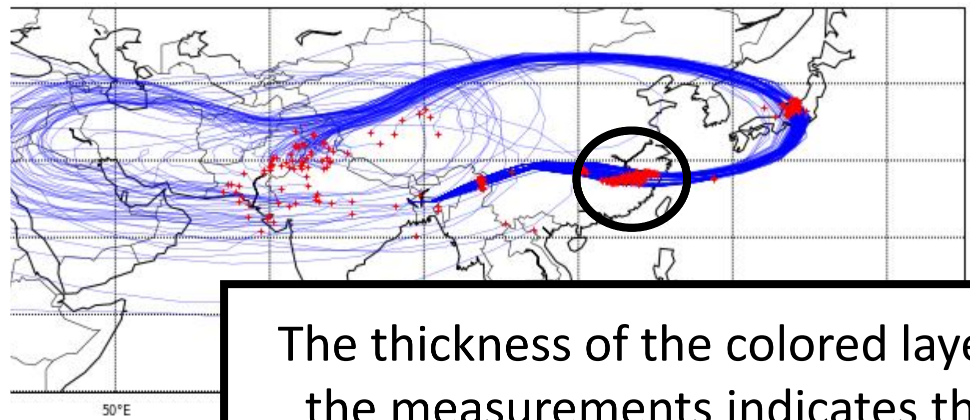
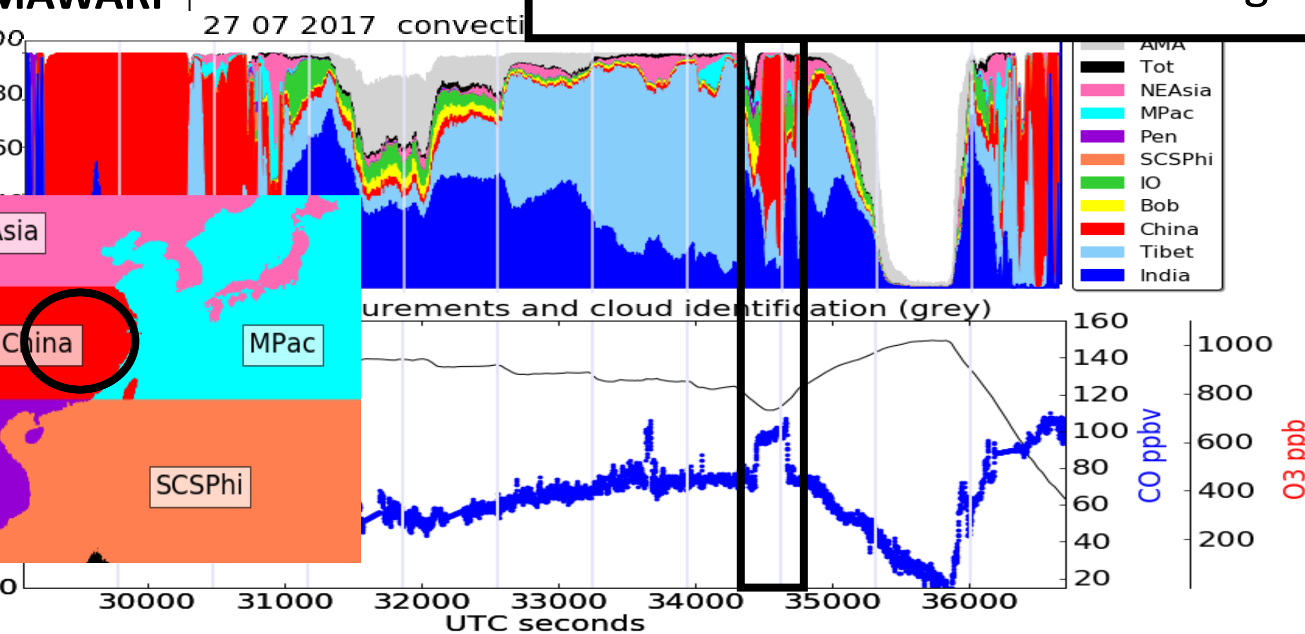
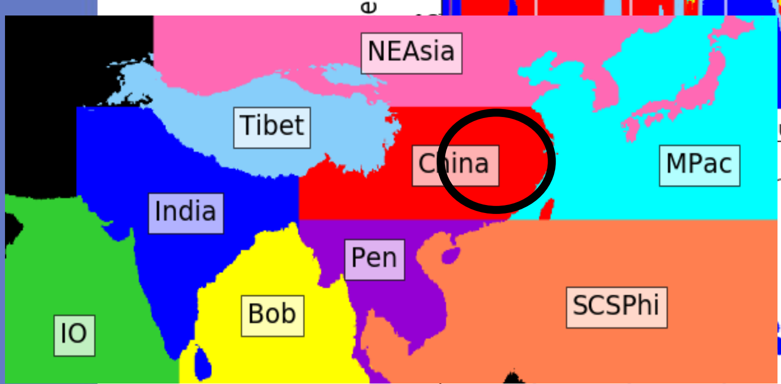


The thickness of the colored layer along the measurements indicates the % of contribution from each region





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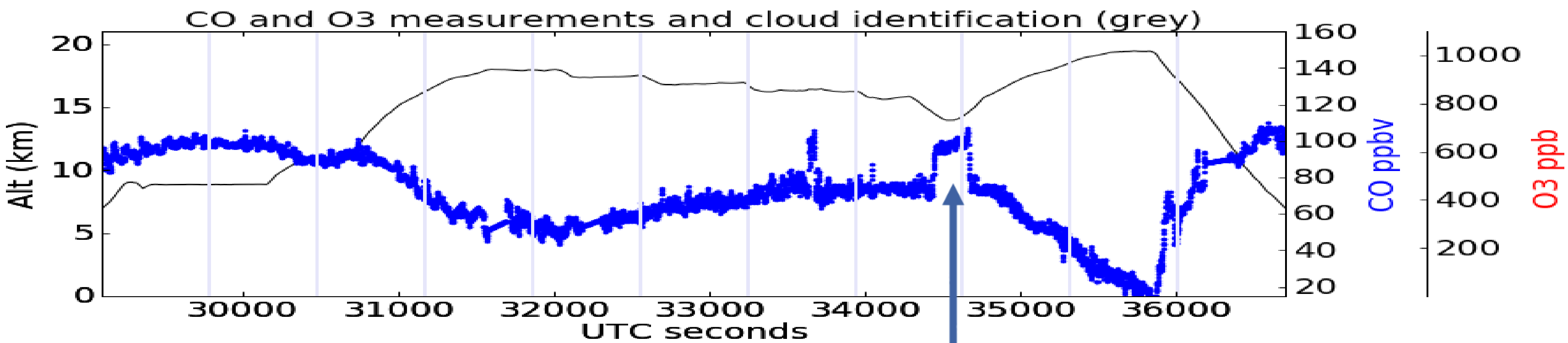
Trajectories Settings

diabatic-Kinematic trajectories with TRACZILLA (Pisso & Legras, 2008)



t0

ERA5 : 0.25°x0.25°, 137 levels, 1-hourly in the [10W-160E, 0-50N] domain

ERA-Interim : 1°x1°, 67 levels, 3-hourly in the global domain

Flight position

Are there any remarkable difference between these settings?

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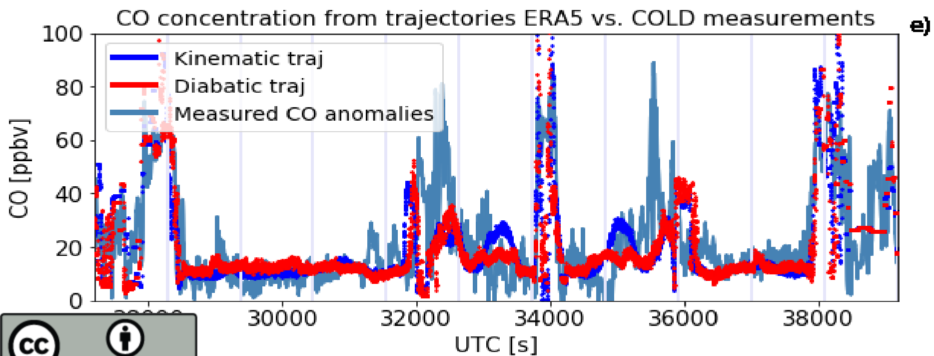
A proxy for convective CO anomalies to evaluate the model

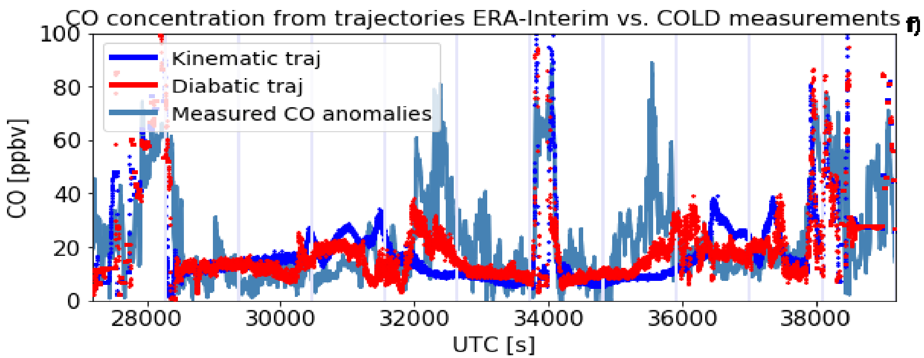
Bucci et al. 2020, ACPD

Let's compare measured and simulated <u>CO ANOMALIES</u>
(coupling transport with CO emissions from MICS database)

Worst ↓ **Best**

All Flights			
Correlation	RMSE	Mean Bias	
51,2	13,0	4,3	Era-Interim Kinematic
52,6	16,363	4,2	Era-Interim Diabatic
58,8	11,0	3,7	Era5 Kinematic
60,9	10,6	3,7	Era5 Diabatic





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Two special cases:

- Polluted convective outflow
-Overshoots + Maritime convection

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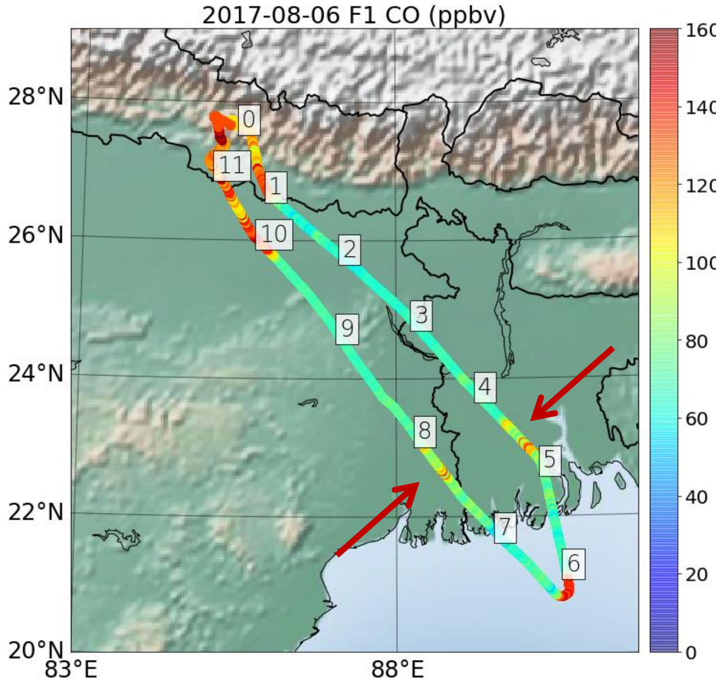
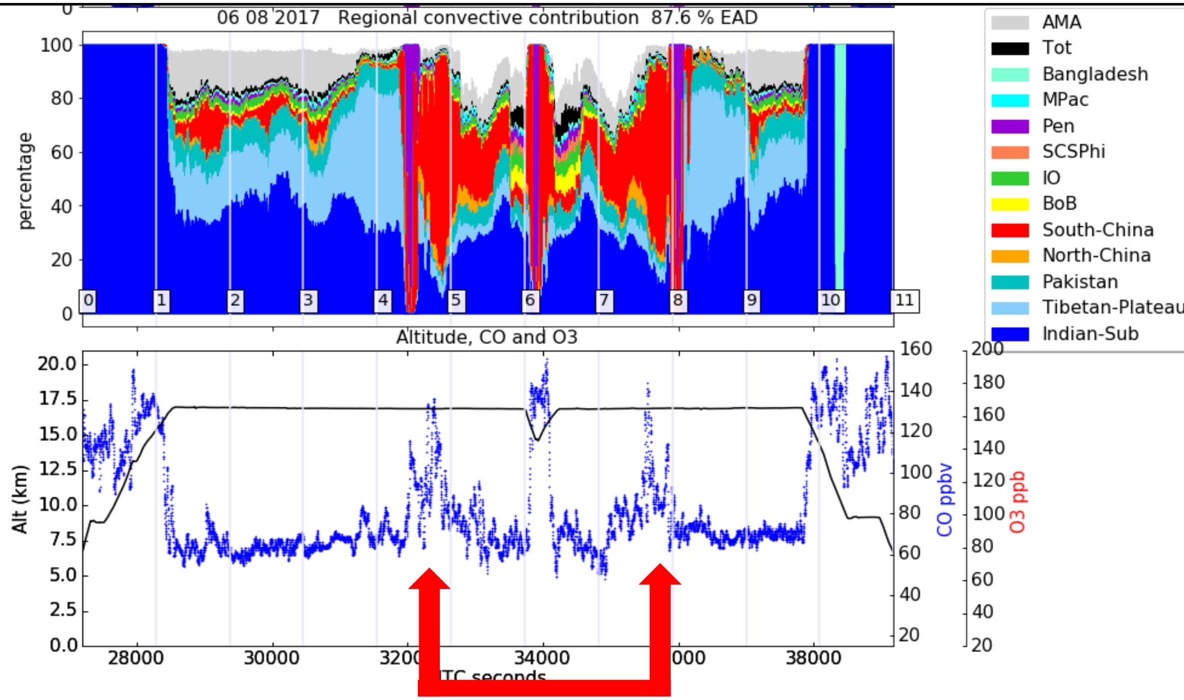
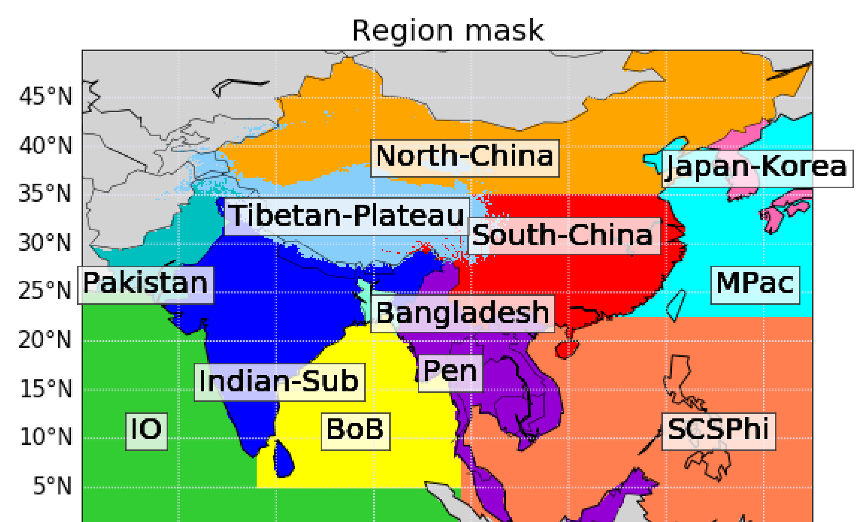
Deep Convective transport of anthropogenic pollution: F6 06/08/2017





Polluted South Chinese air at around 17 km!



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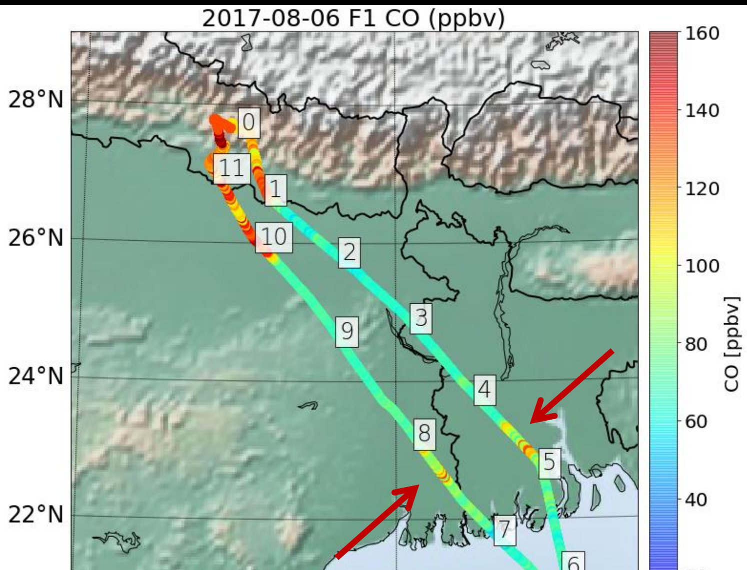
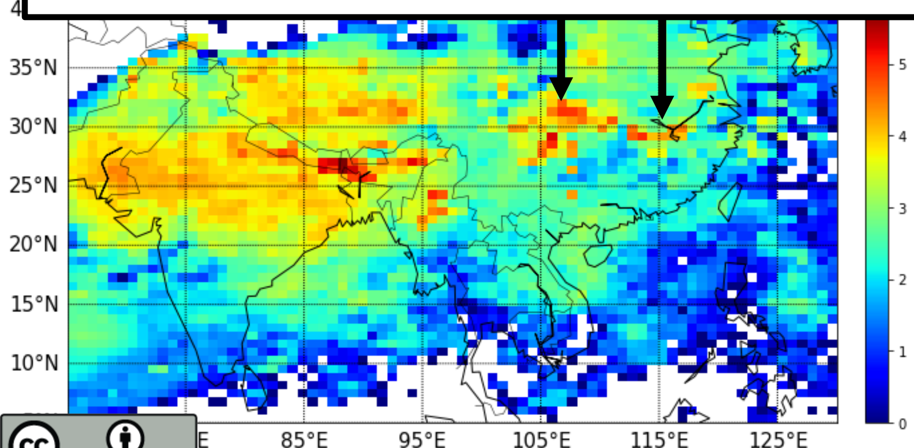


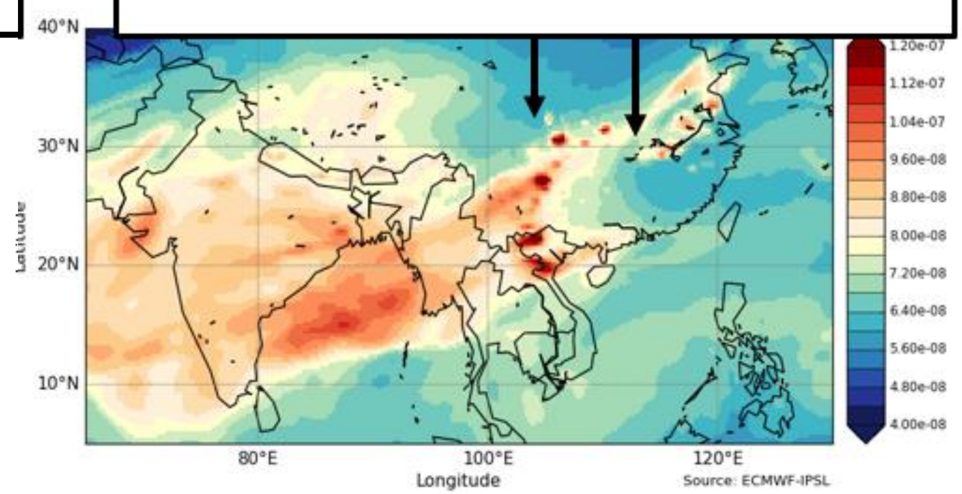
South China air:

- relatively young (~1.5 days). Quite High convection (level of injection ~16 km and then slower uplift during transport).
- Highest 100 hPa peak of CO during the campaign

South-China sources from backtrajectories, associated with the measured anomalies of CO



CO plume injection at 100hPa forecasted from CAMS



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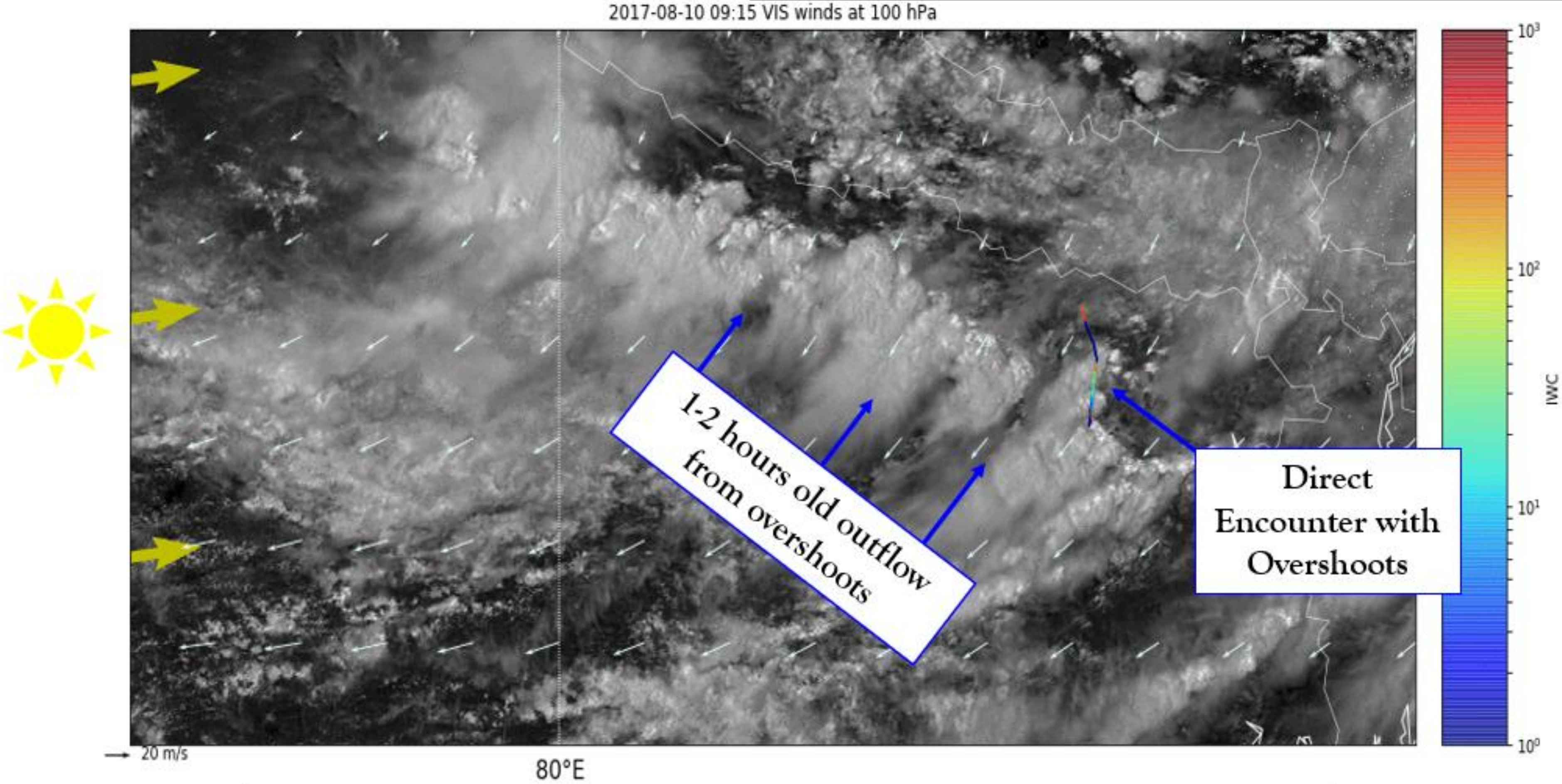
Flight 8 (10 August 2017)
-Fresh Overshoots + Maritime convection

Fresh Deep Convective outflow + Typhoon air: F8 10/08/2017

15-min resolution VIS images from MSG1



Intense Convection starts around 7:00 UTC and lasts for around 4 hours
First part of the flight was on the top of the convective tower
then it flies in an increasingly older (but still very fresh) outflow

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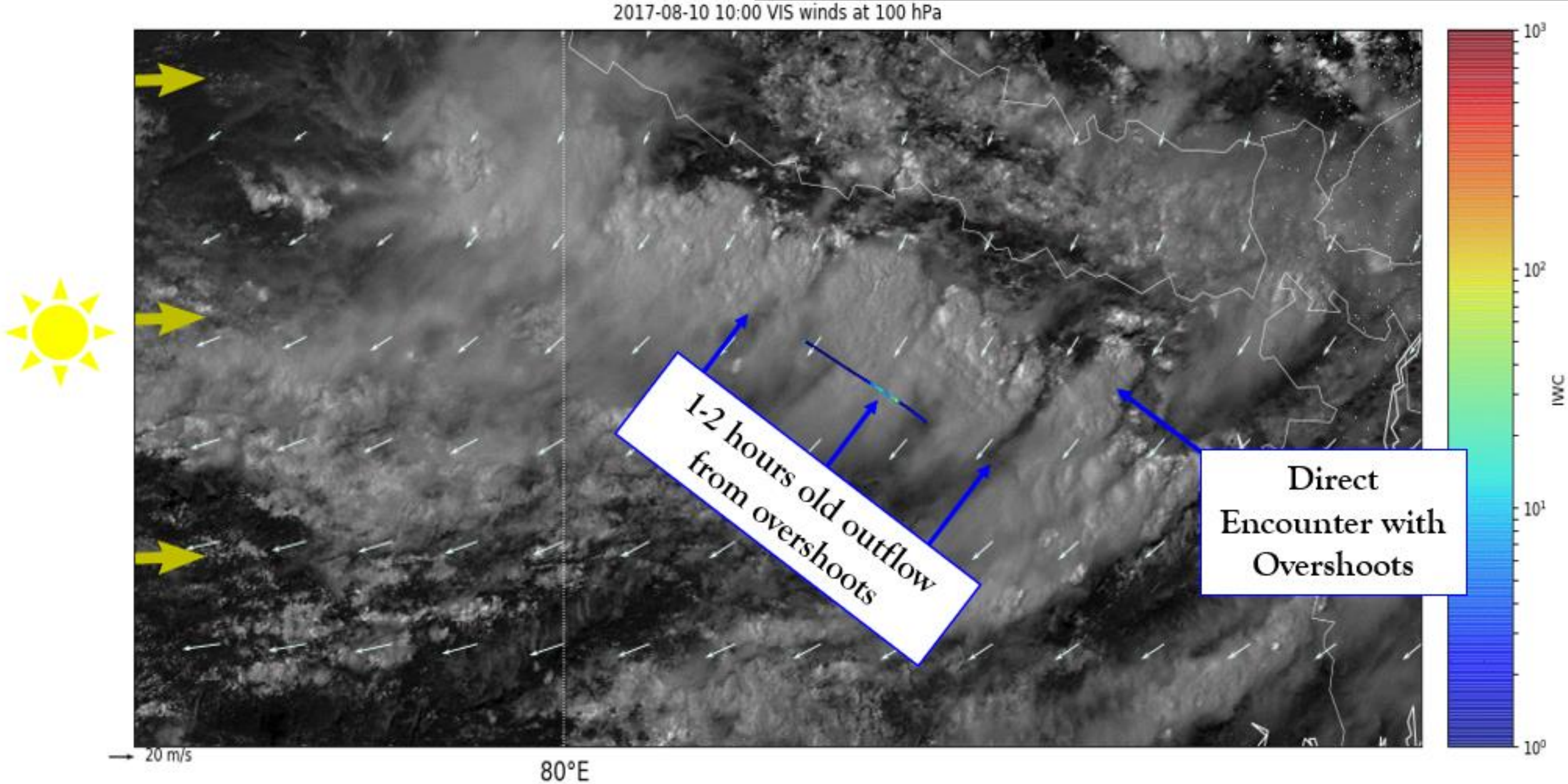
Fresh Deep Convective outflow + Typhoon air: F8 10/08/2017

15-min resolution VIS images from MSG1



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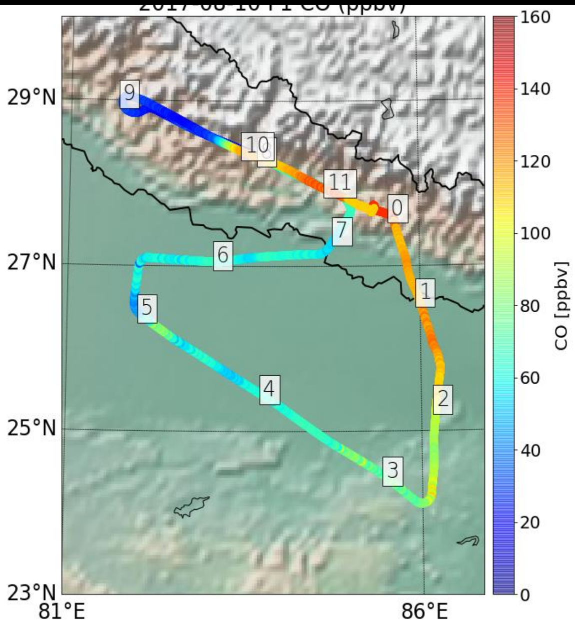
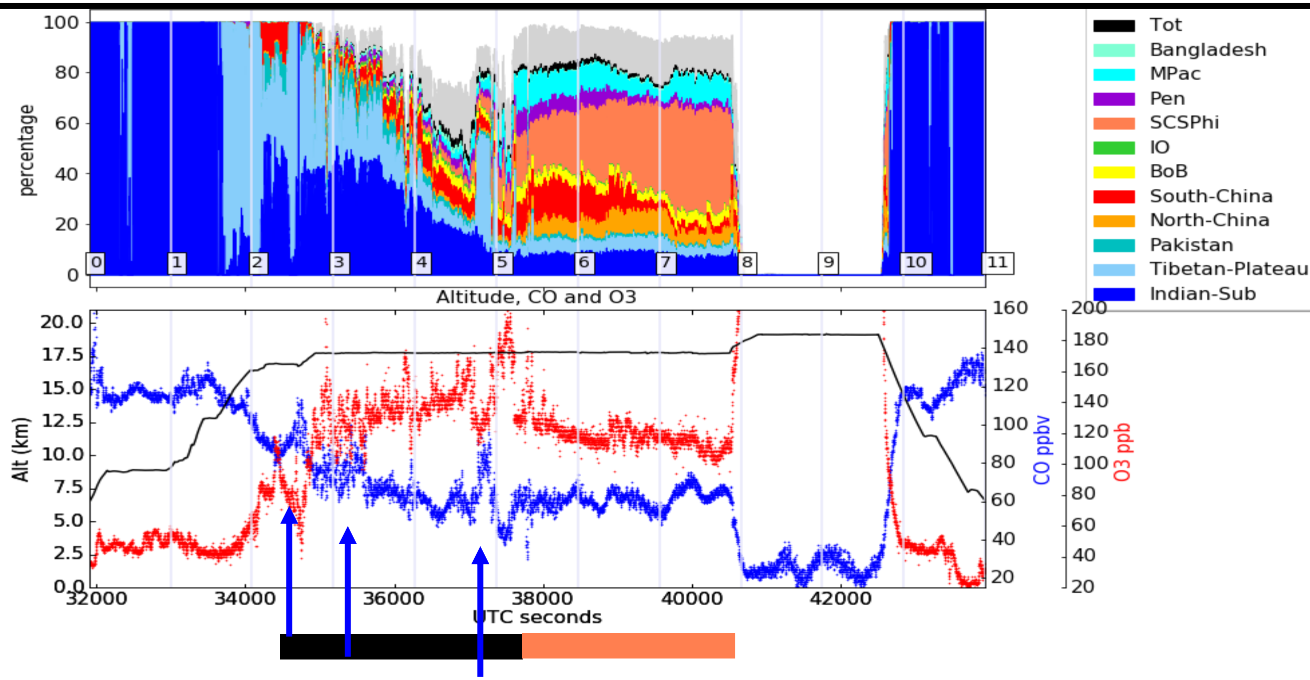
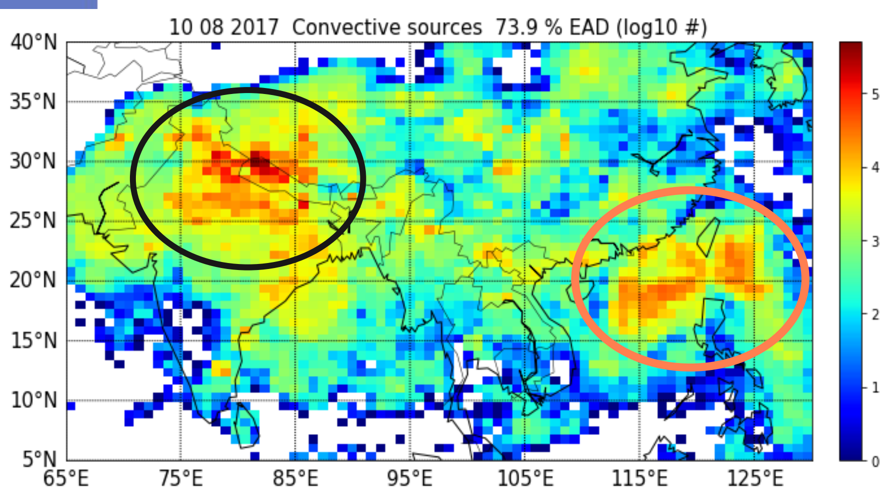
Fresh Deep Convective outflow + Typhoon air: F8 10/08/2017







Decreasing CO, Increasing O3, less convection, more recirculating air. On top of it few spots of intense convective influence

After it: Typhoon air outflow!

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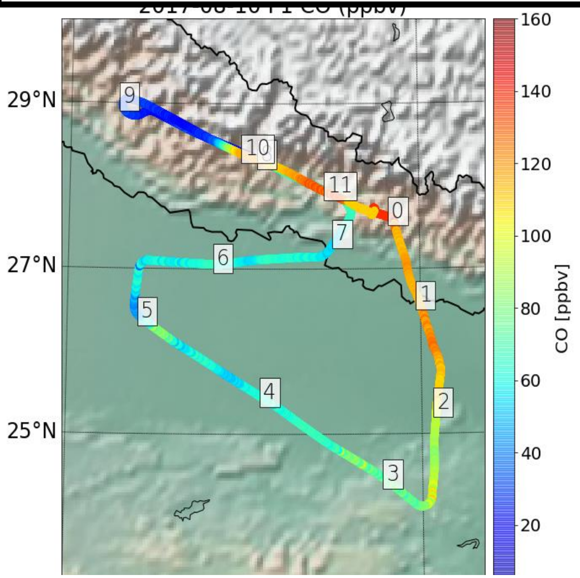
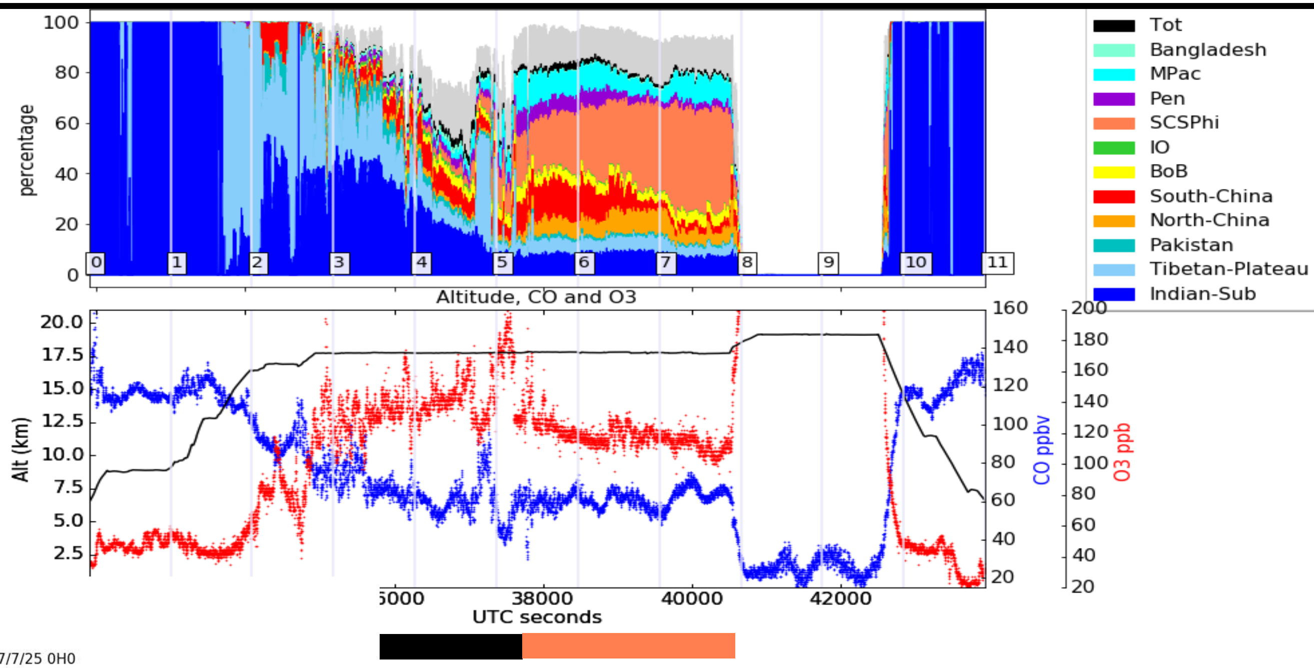
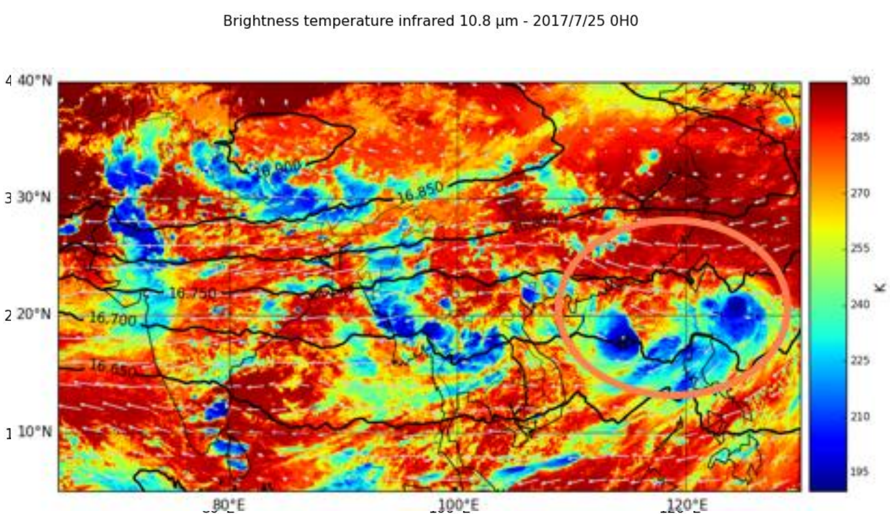
Fresh Deep Convective outflow + Typhoon air: F8 10/08/2017







Decreasing CO, Increasing O3, less convection, more recirculating air. On top of it few spots of intense convective influence

Nesat typhoon (25/07/2017 – 30/07/2017)

Bucci et al. 2020, ACPD

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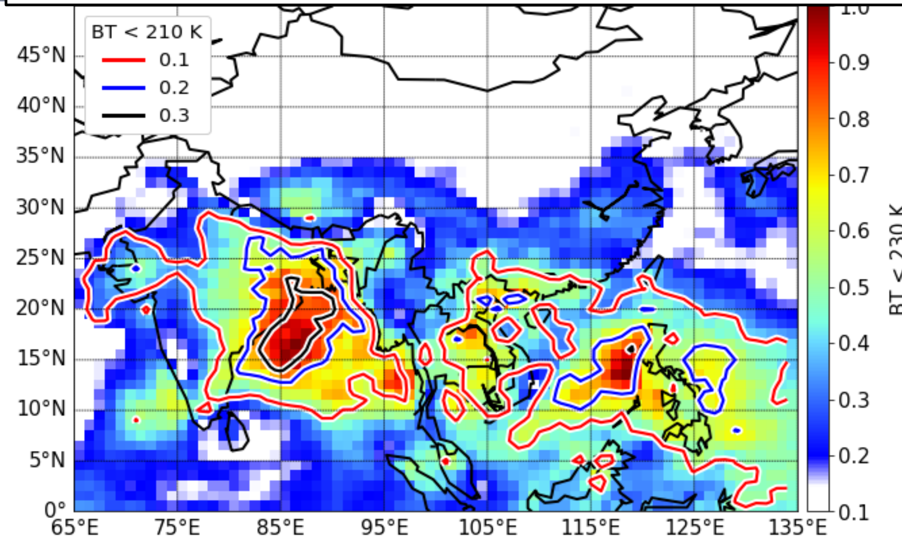
Convective Activity: overall campaign vs. 2017 JJA season

Frequency of Convection during the 2017 JJA season



Frequency of convection on the whole 2017 JJA season from geostationary

Convection (BT<230K in color)
«Deeper» convection(BT<210K in contours)

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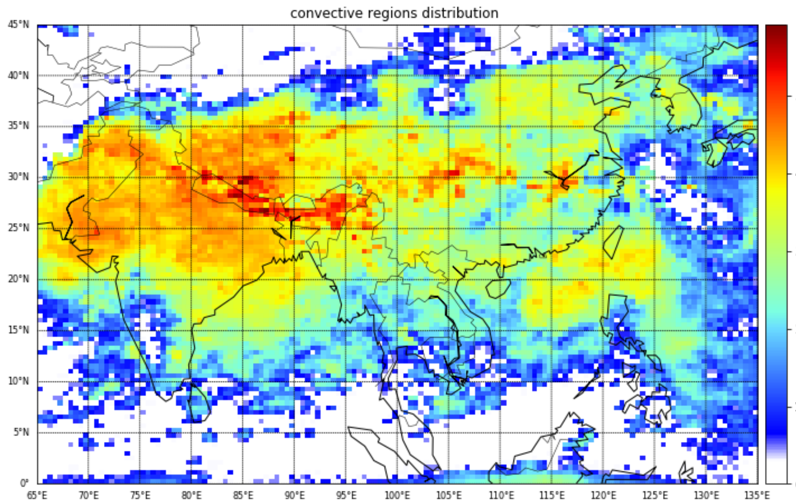
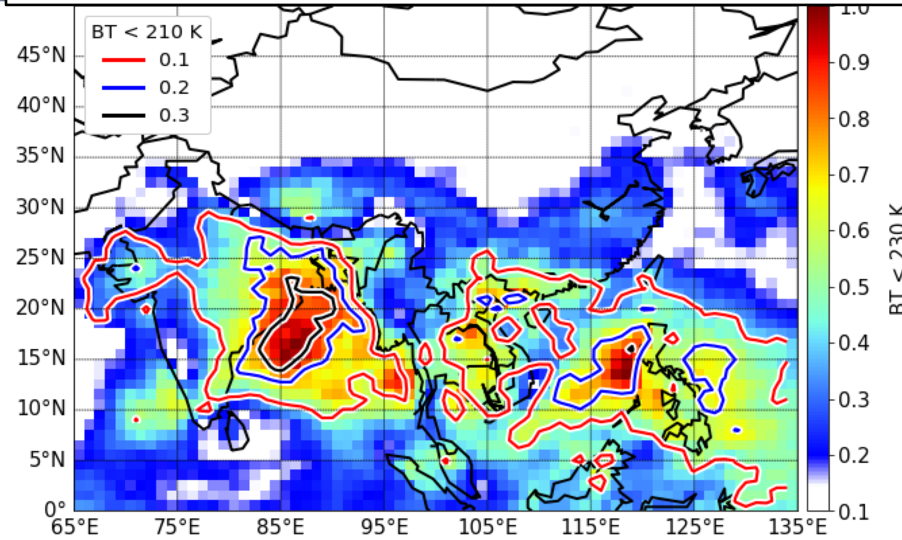
Total Convective sources SAMPLED during the whole campaign (trajectories)

Frequency of Convection during the 2017 JJA season



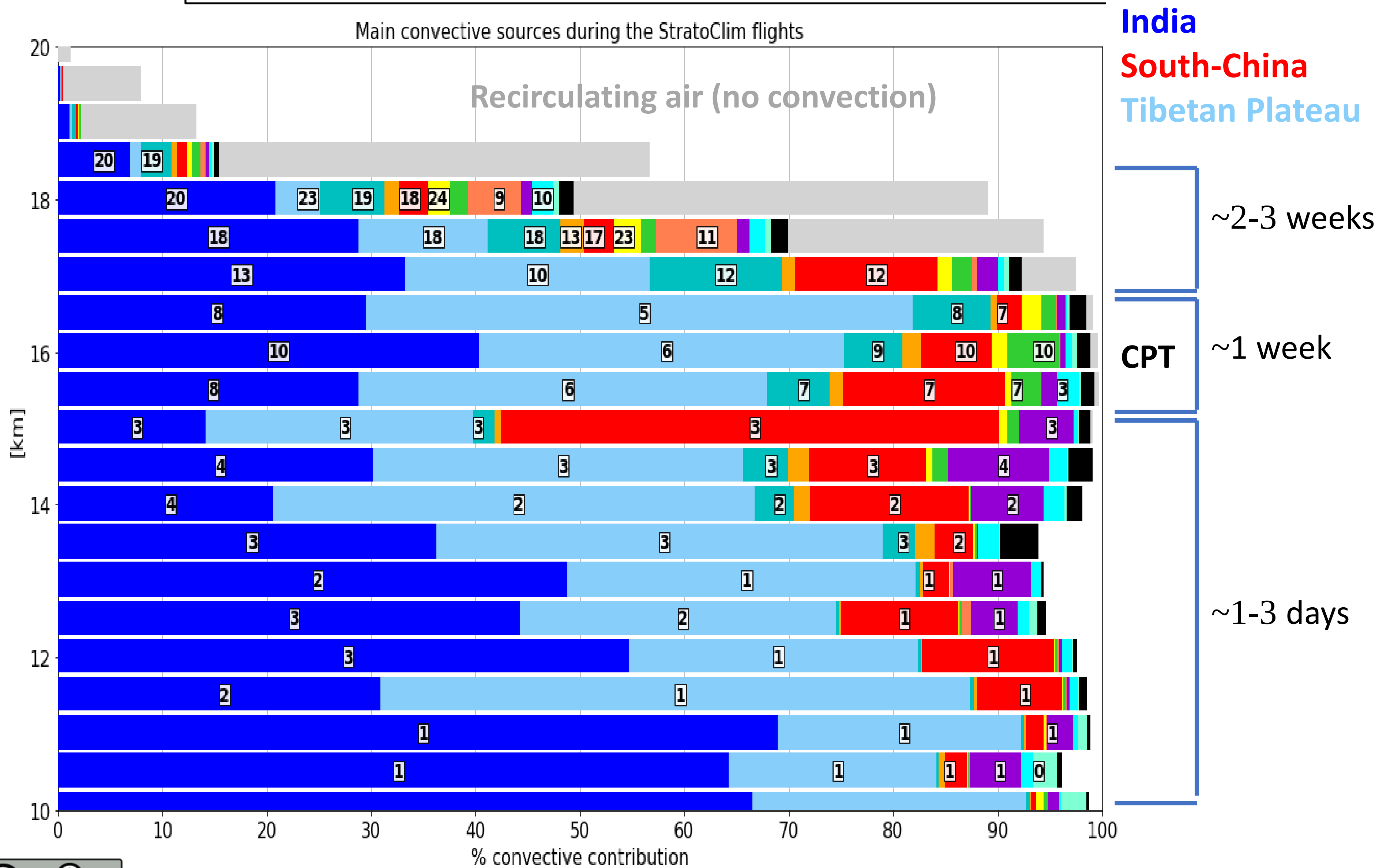


Sampled convection mainly from Tibetan Plateau, North India and Central China

Frequency of convection on the whole 2017 JJA season from geostationary

Convection (BT<230K in color)
«Deeper» convection(BT<210K in contours)

Age and impact of deep convection along the Vertical



Summary and conclusions

- Trajectory + convective activity from satellite: better fit with in situ measurements when using **ERA 5 Diabatic** winds.

- Very young convective air (age <1 hour to few hours) and young convective air (~1-2 days) associated to intense overshoot cases or recent outflow (injection above 16 km) , observed over the southern Himalayan foothills and the South China region (especially Sichuan basin and Eastern center China).

  Other dominant source is the Indian-Subcontinent, sampled in recirculating air with longer time of transport (~2 weeks) and associated to lower CO values.

- Convective events over these source regions are *not the dominant ones* in the AMA domain for 2017 JJA. In addition, the sampling happened in a overall *weaker convective phase*.

  Even under such conditions, in-situ measurements demonstrated an intense signature in the UTLS composition effect associated to these events.

- Higher influence of convective outflow around 16-17 km with time of transport of around 1 week. Above, convective contribution radically decreases and the age of transport reaches times of the order of 20 days or more.

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Thanks for your attention!

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