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

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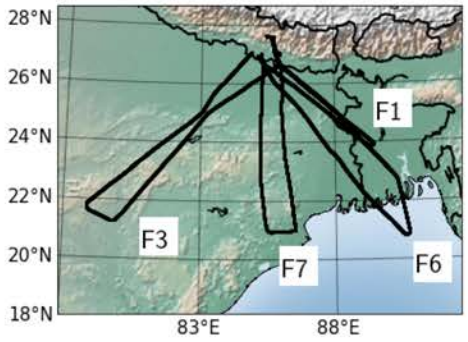
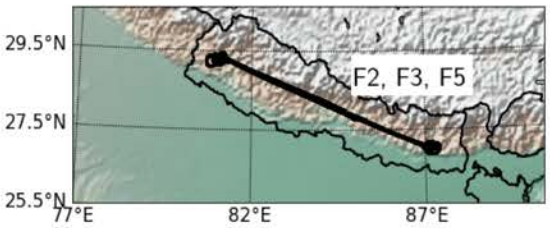
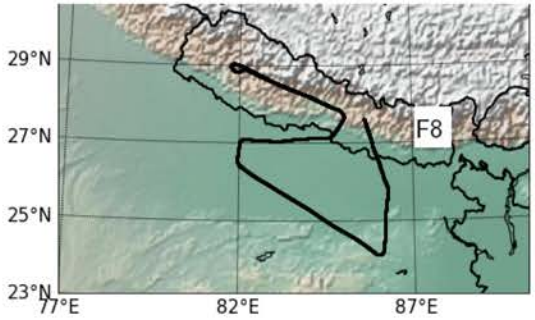
Identification of convective influence, (with sources, age and intensity) on the air masses sampled during the 8 StratoClim flights (July-August 2017)







Approach:

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

↕

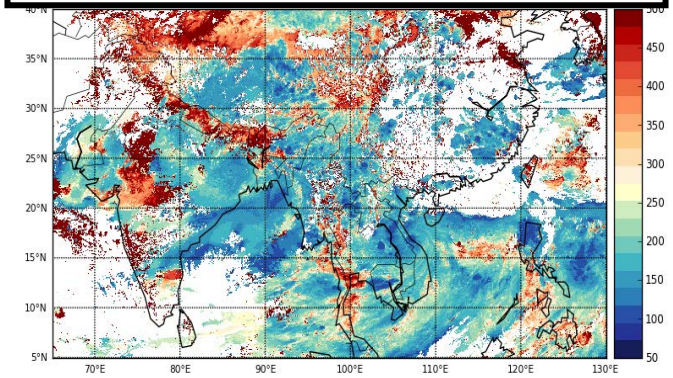
Lagrangian transport of air masses:

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

The EUMETSAT Network of Satellite Application Facilities

CM SAF
Climate Monitoring

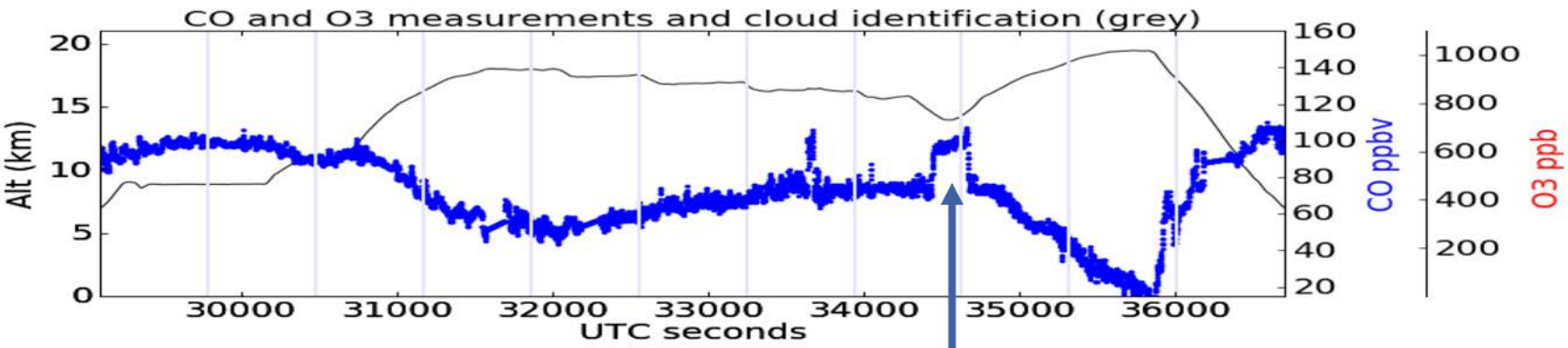
SAF-NWC Cloud Top Pressure



MSG1	HIMAWARI-8

Thick convective cloud

Lagrangian + Satellites Tool



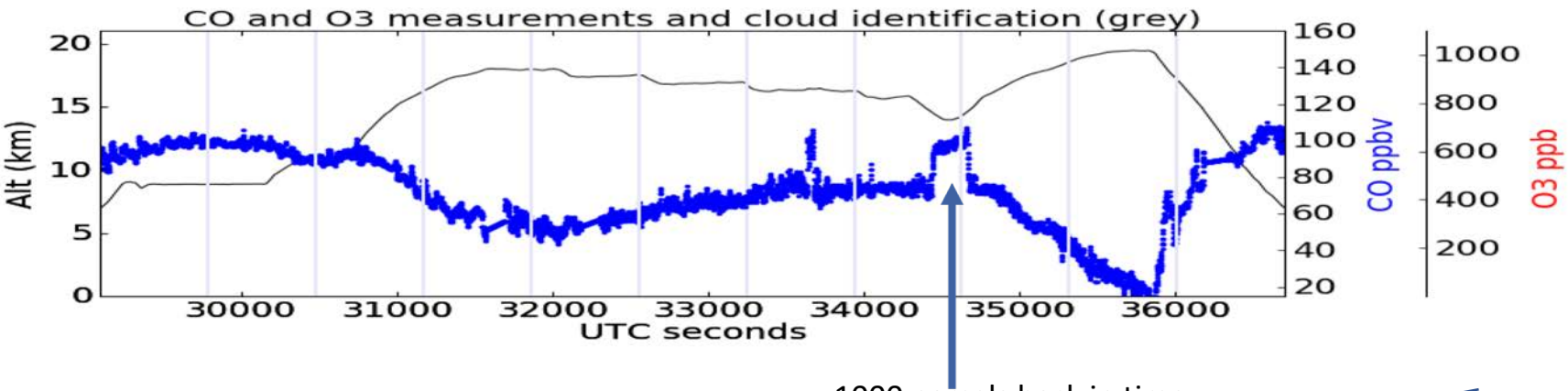
1000 parcels back in time along the flight

Flight position

t0

1-month long back-trajectory

Lagrangian + Satellites Tool



1000 parcels back in time along the flight

Flight position

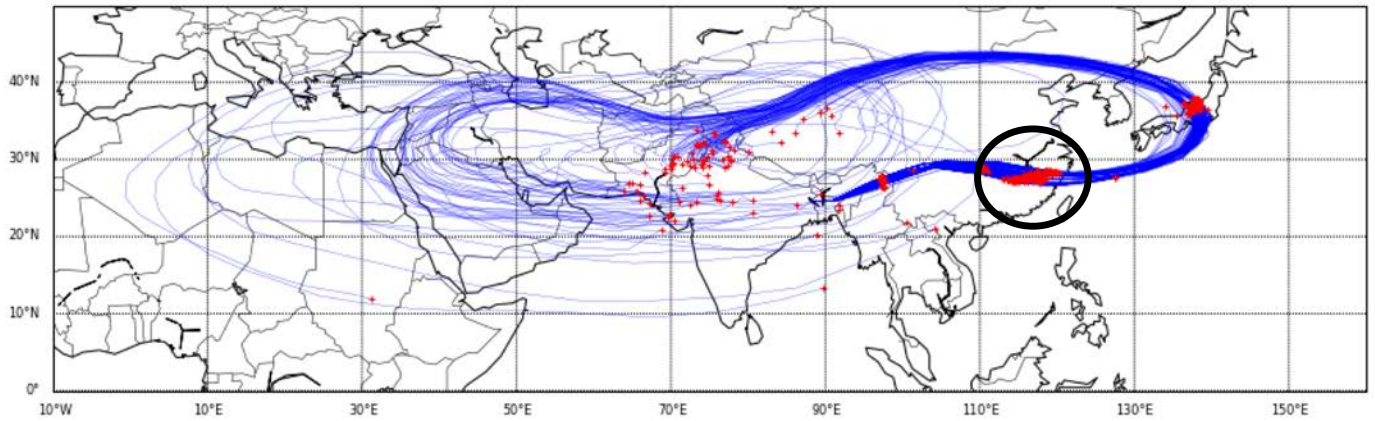
t0

Thick convective cloud

Convective uplift from the troposphere/ surface

1-month long back-trajectory

Lagrangian + Satellites Tool



1000 parcels back in time along the flight

Flight position

t0

Thick convective cloud

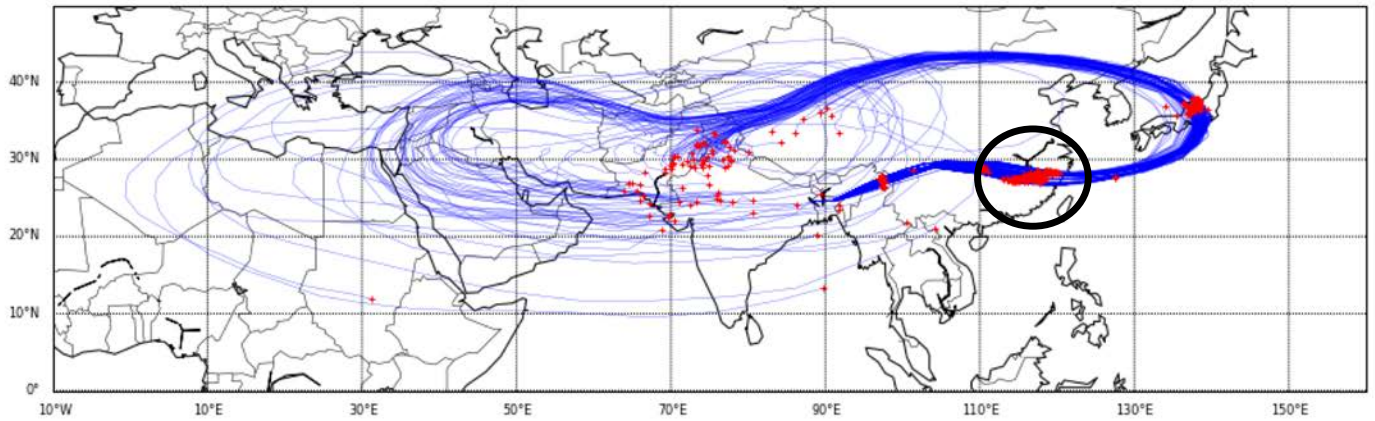
Individuation of the convective sources

t1

t2

1-month long back-trajectory

Lagrangian + Satellites Tool



1000 parcels back in time along the flight

Flight position

t0

Altitude of encounter: level of injection

Thick convective cloud

t1-t0: Age of the air mass

Individuation of the convective sources

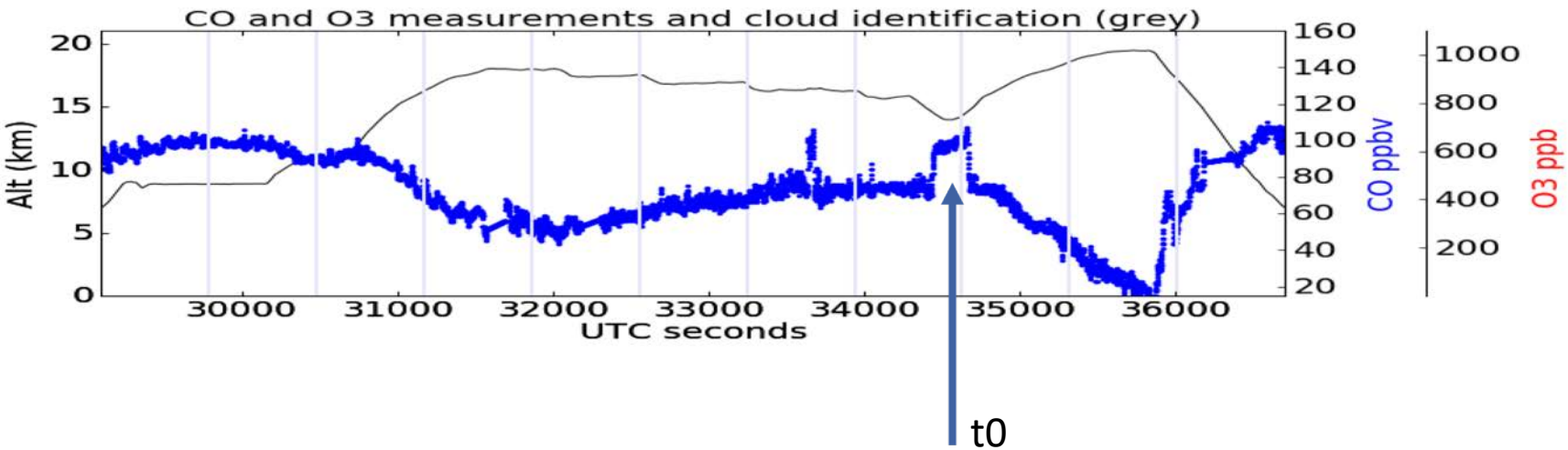
t1

t2

1-month long back-trajectory

Lagrangian + Satellites Tool

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



Flight position

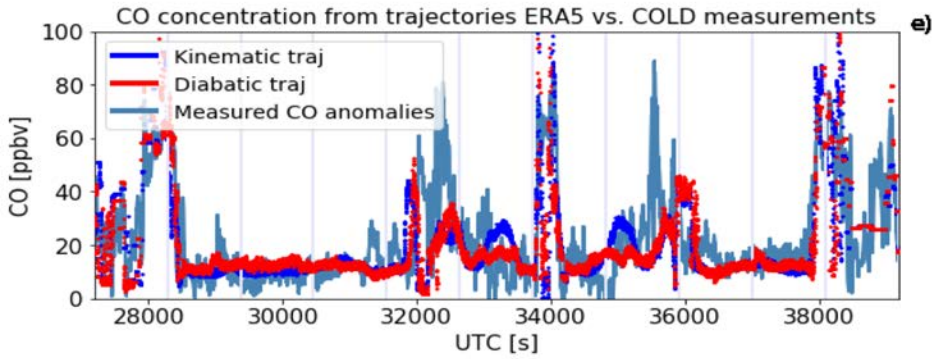
ERA5 : 0.25°x0.25°, 137 levels, 1-hourly in the [10W-160E, 0-50N] domain

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

A proxy for convective CO anomalies to evaluate the model

Let's compare measured and simulated CO ANOMALIES (combining trajectories with MICS CO database)

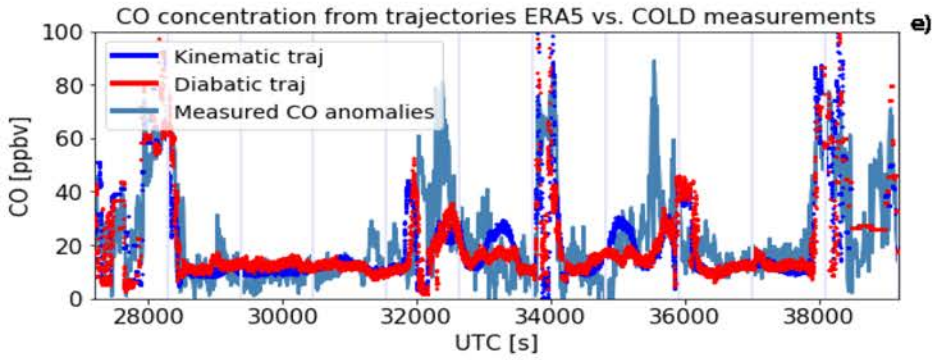
All flights		
Correlation	RMSE	Mean Bias



A proxy for convective CO anomalies to evaluate the model

Let's compare measured and simulated CO ANOMALIES (combining trajectories with MICS CO database)

	All flights		
	Correlation	RMSE	Mean Bias
Worst			
↓			
Best			



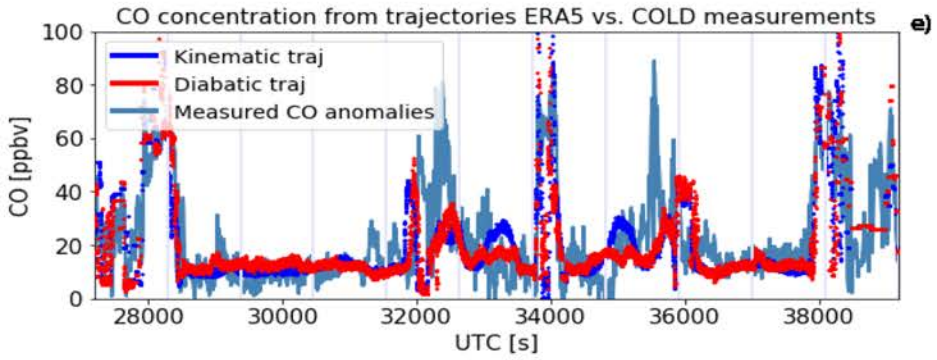
A proxy for convective CO anomalies to evaluate the model

Let's compare measured and simulated CO ANOMALIES (combining trajectories with MICS CO database)

Worst

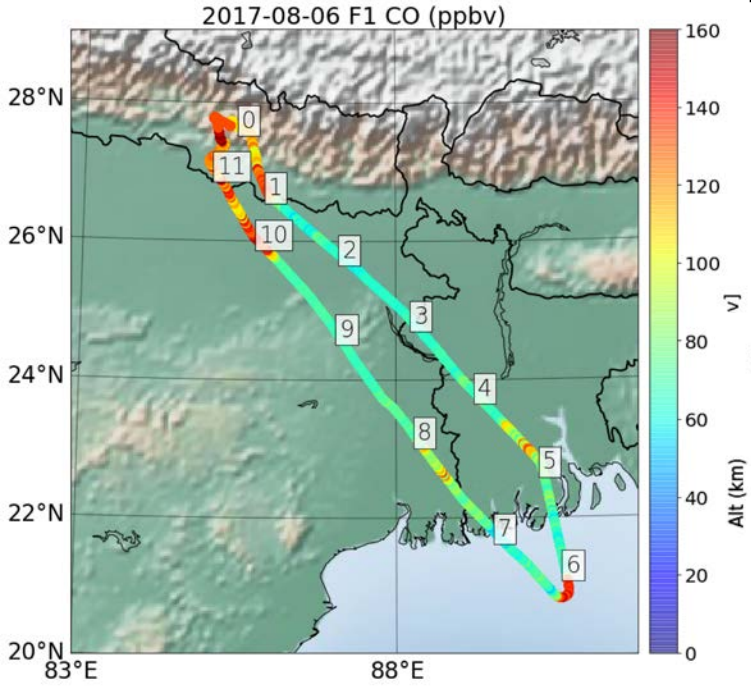
Best

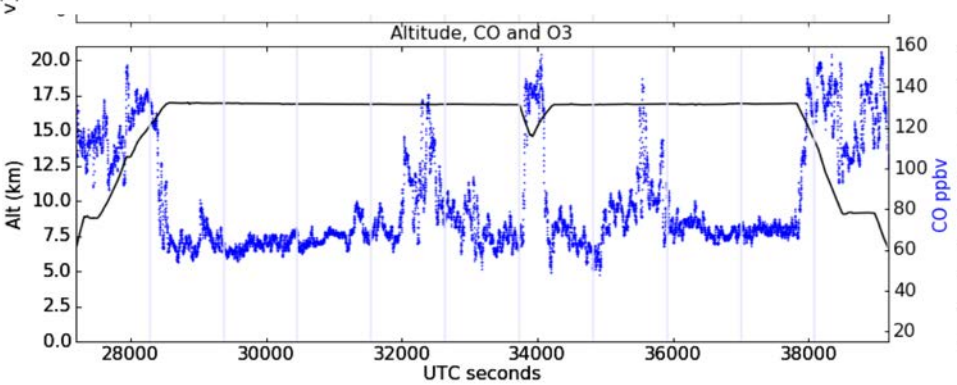
All flights			
Correlation	RMSE	Mean Bias	
41,3	15,9	1,7	Era-Interim Kinematic
47,6	25,3	1,8	Era-Interim Diabatic
48,8	13,0	1,9	Era5 Kinematic
52,5	12,5	1,7	Era5 Diabatic



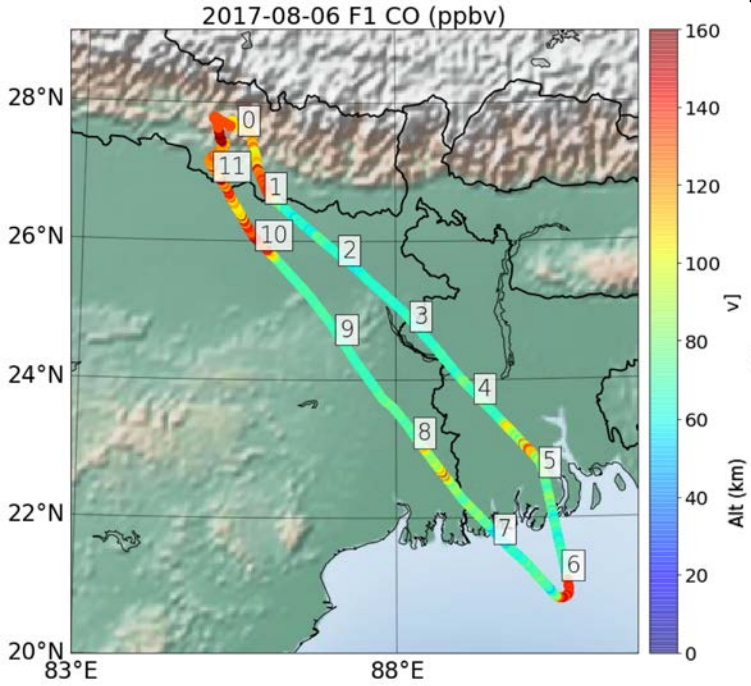
Some examples of Intense Convective activity observed during the campaign

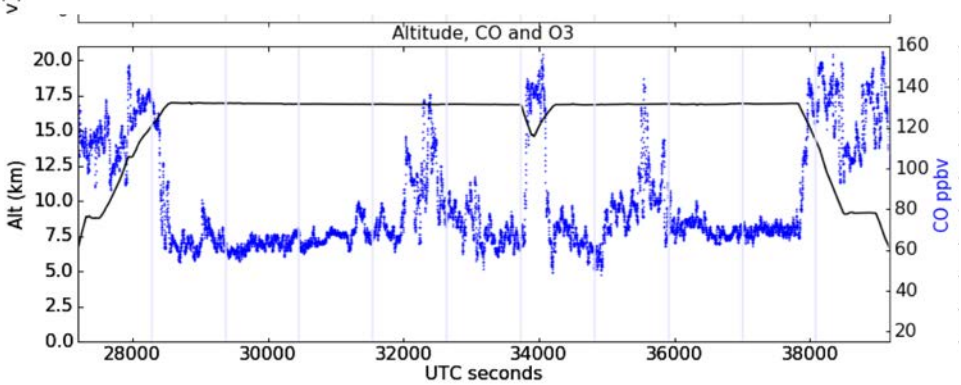
Deep Convective transport of anthropogenic pollution: F6 06/08/2017

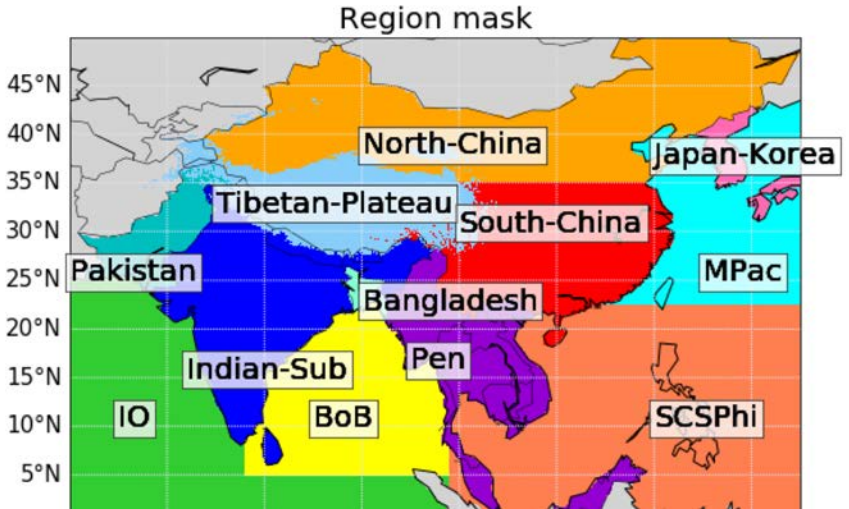




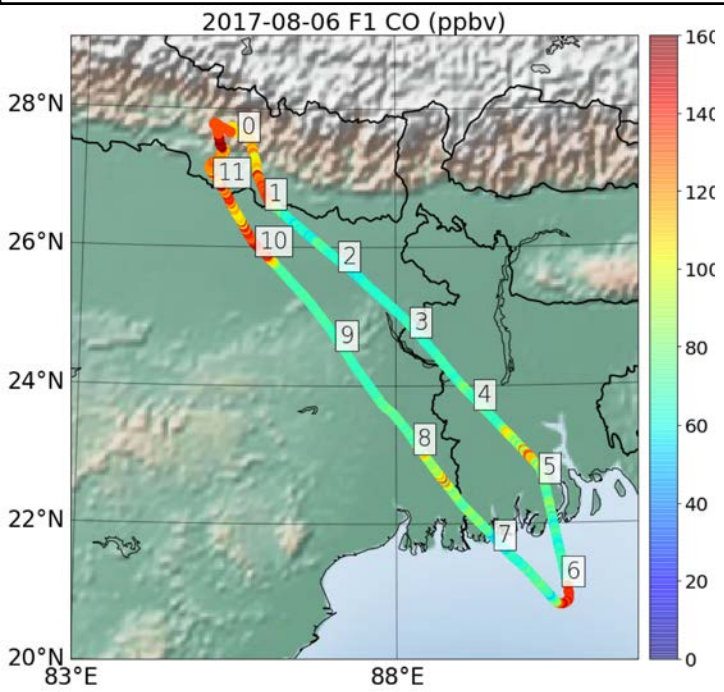
Deep Convective transport of anthropogenic pollution: F6 06/08/2017

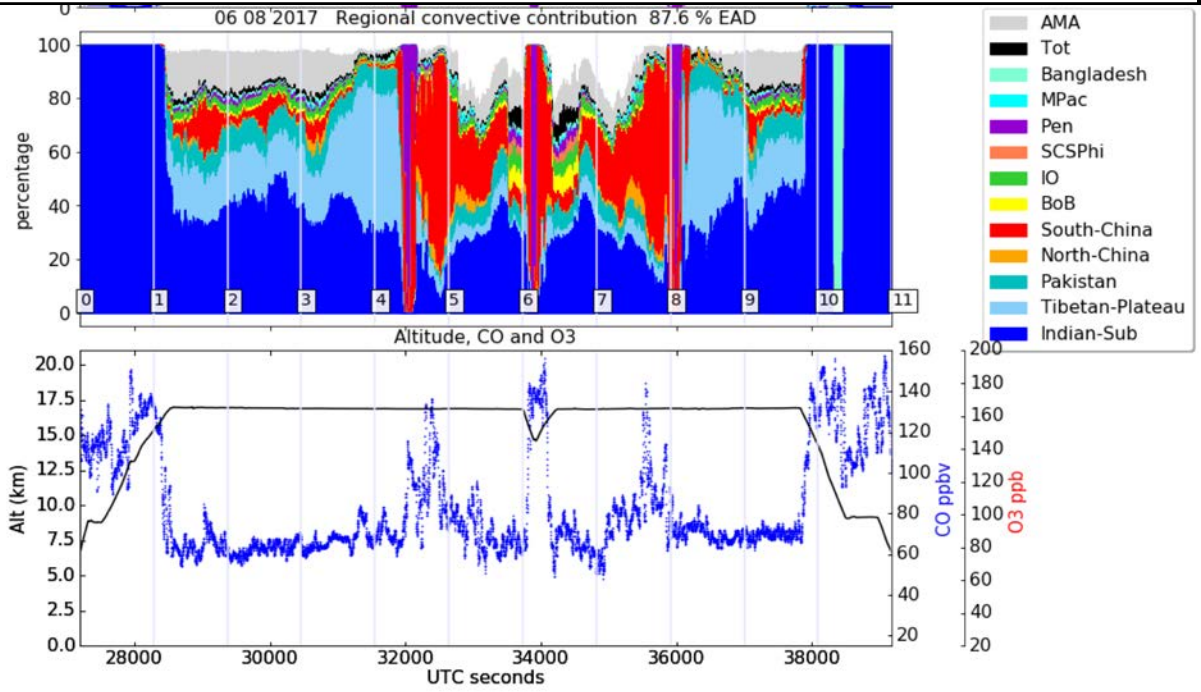


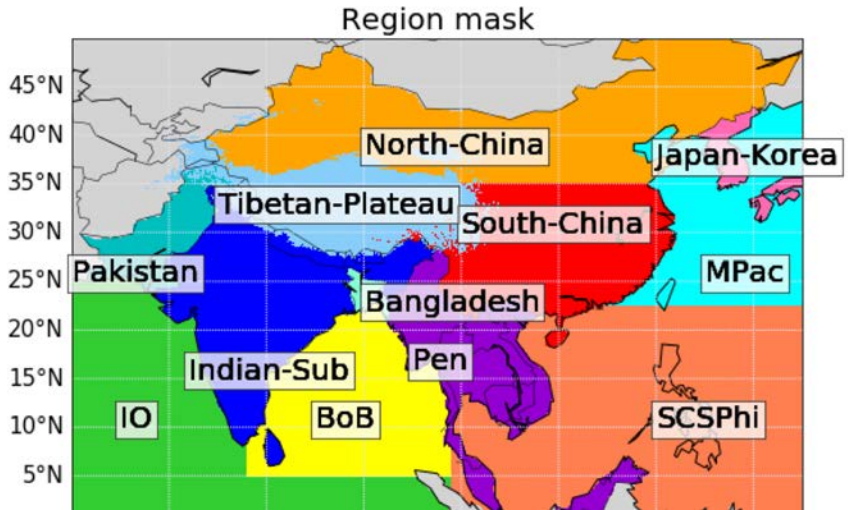




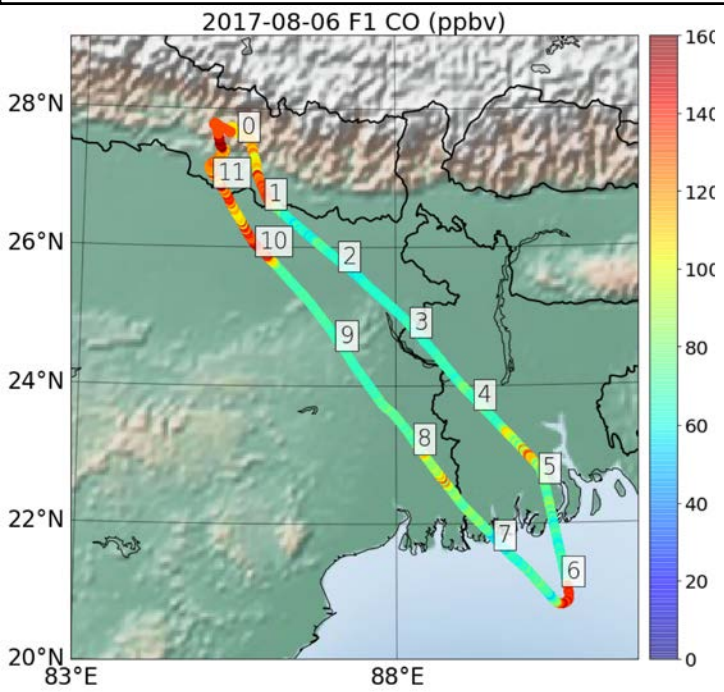
Deep Convective transport of anthropogenic pollution: F6 06/08/2017

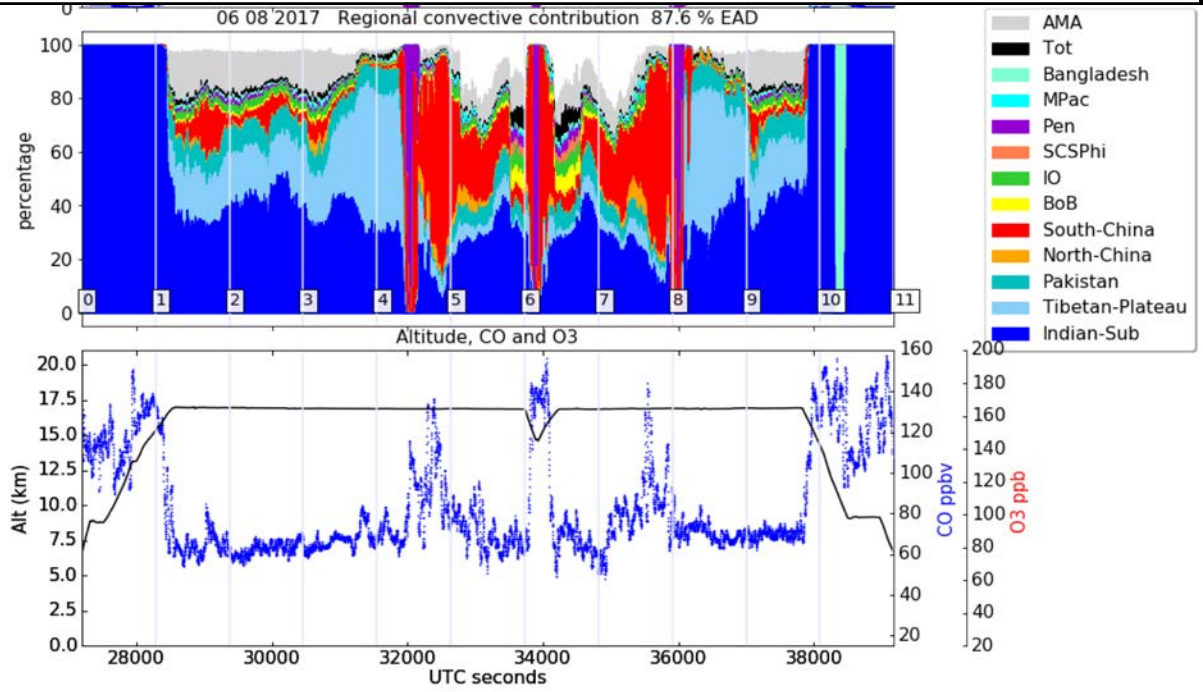


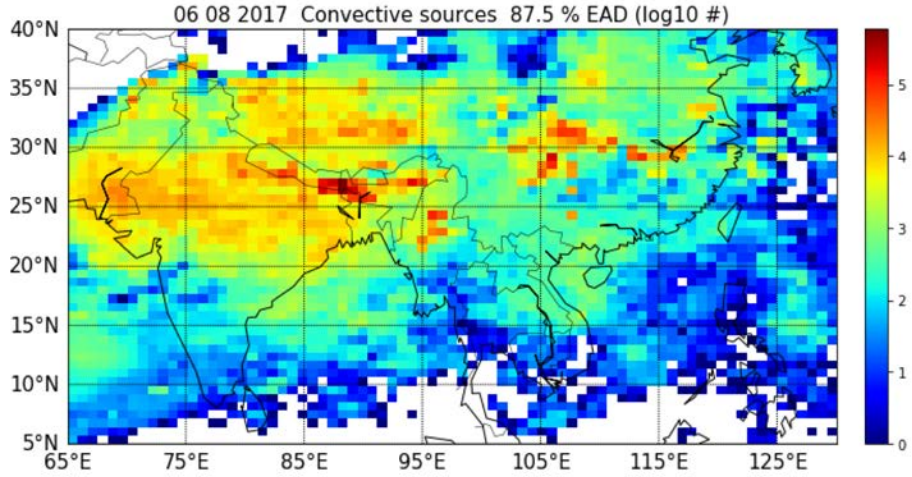


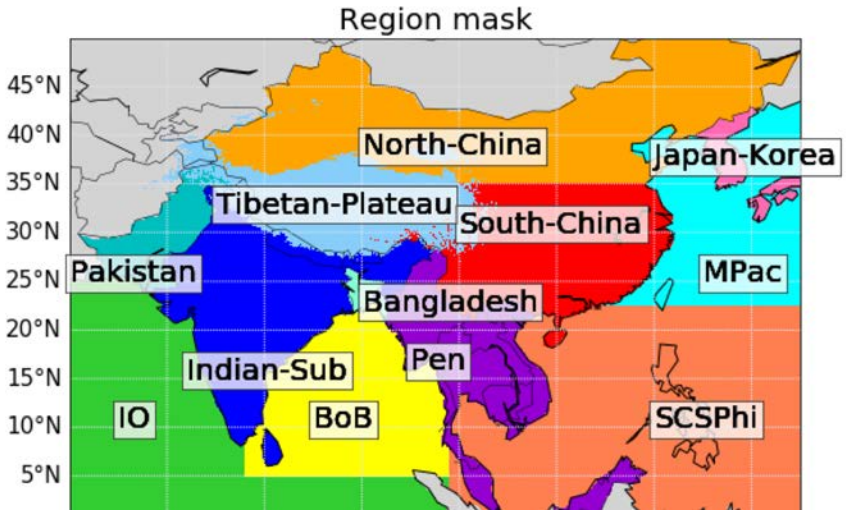


Deep Convective transport of anthropogenic pollution: F6 06/08/2017

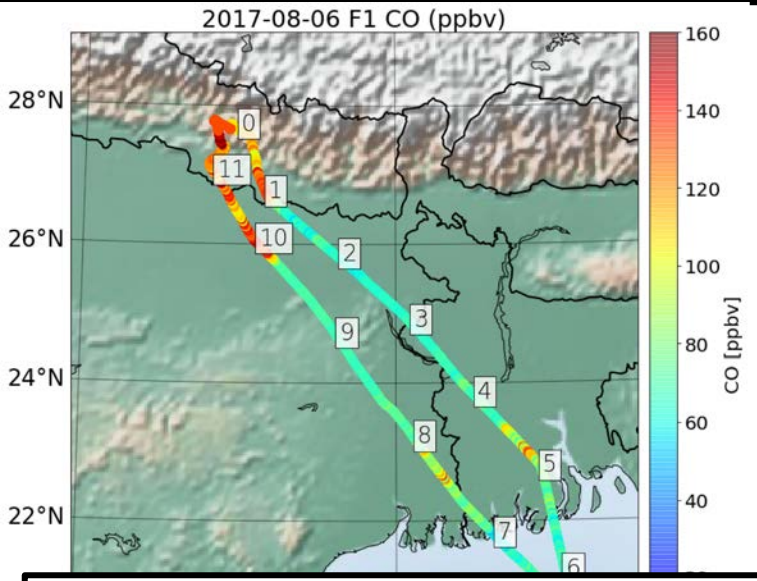








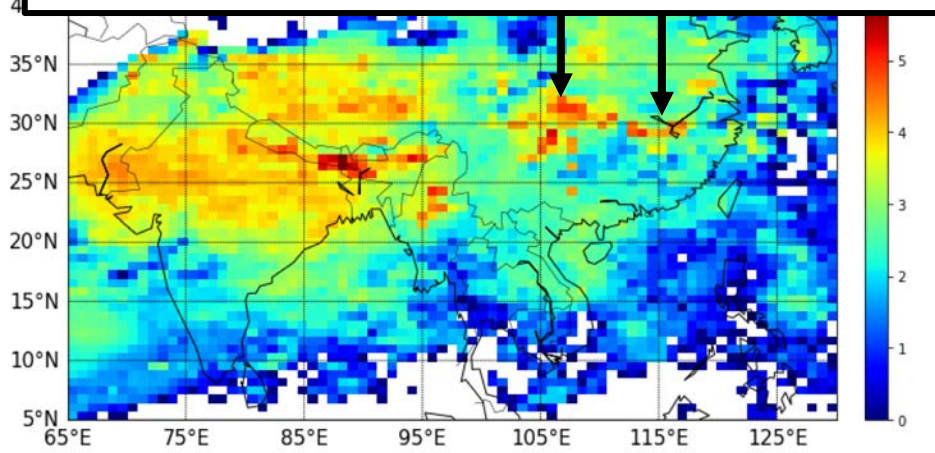
Deep Convective transport of anthropogenic pollution: F6 06/08/2017



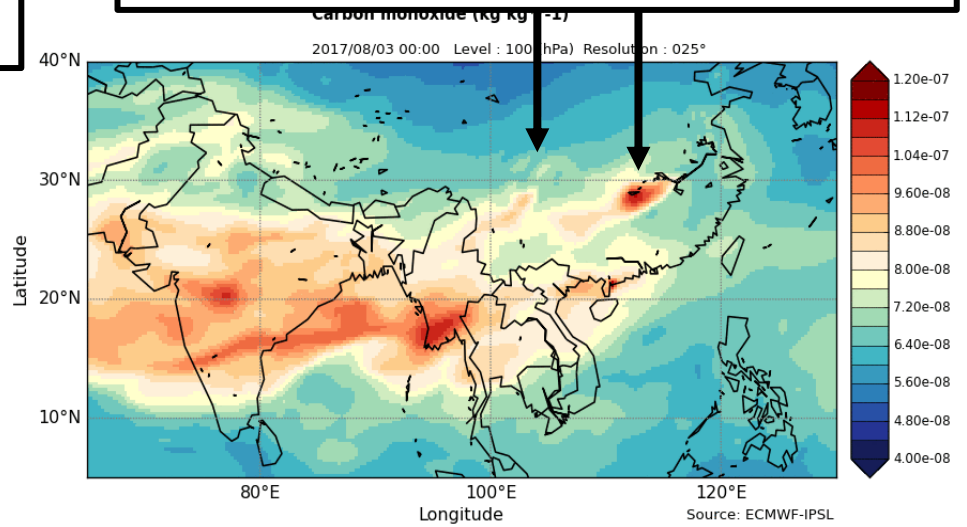
South China air:

- relatively young (~1.5 days). Quite High convection (level of injection ~16 km).
- In a cloud, with ice particles. Highest 100 hPa peak of CO.

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

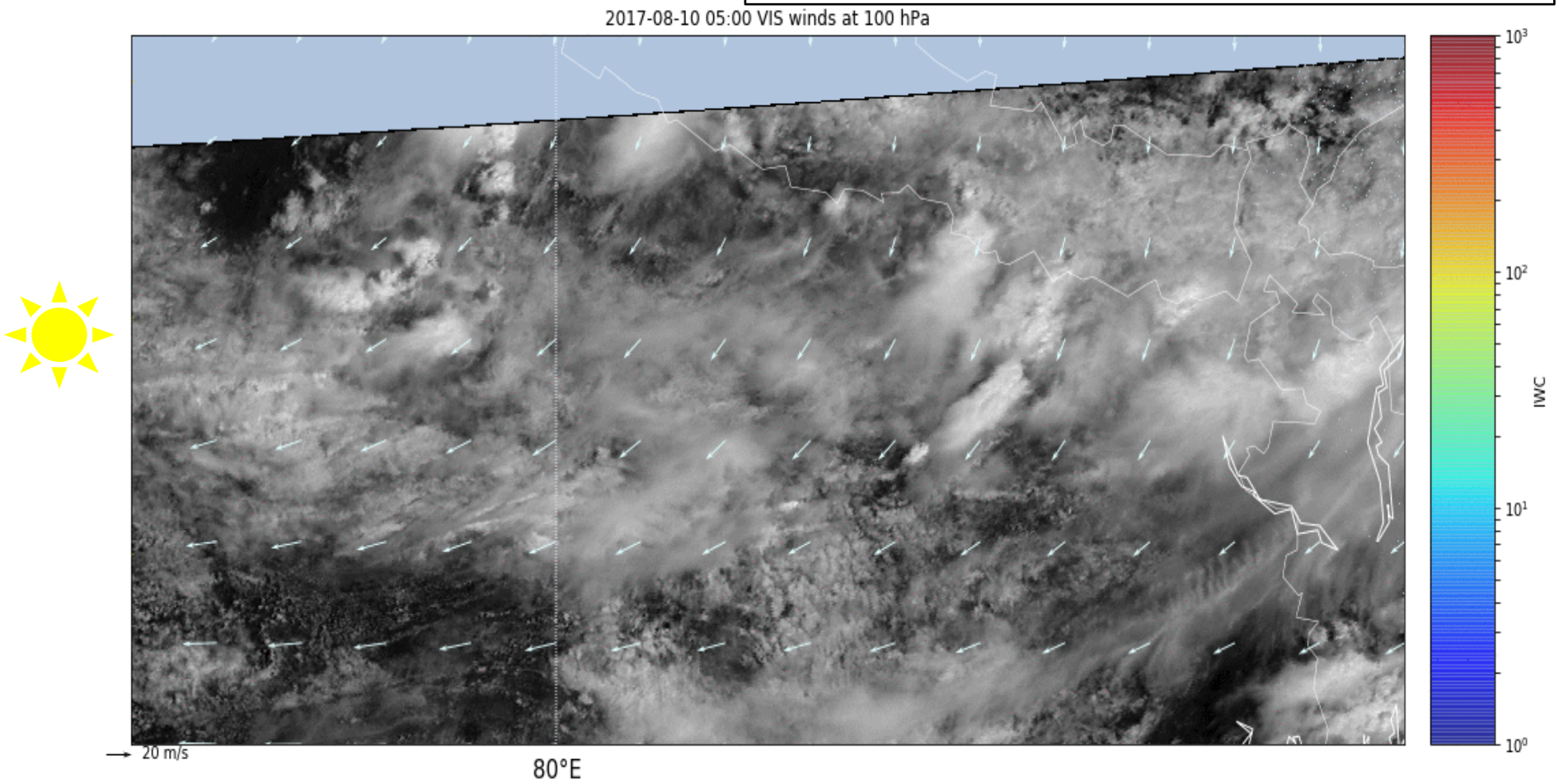


CO plume injection at 100hPa forecasted from CAMS



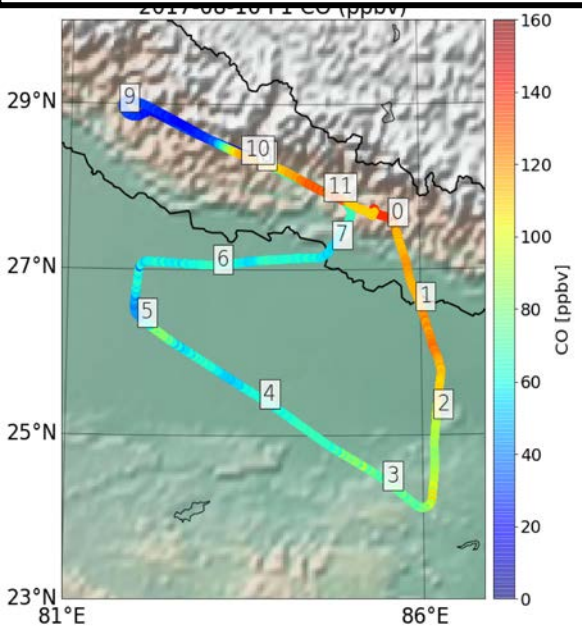
Fresh Deep Convective outflow + Typhoon air: F8 10/08/2017

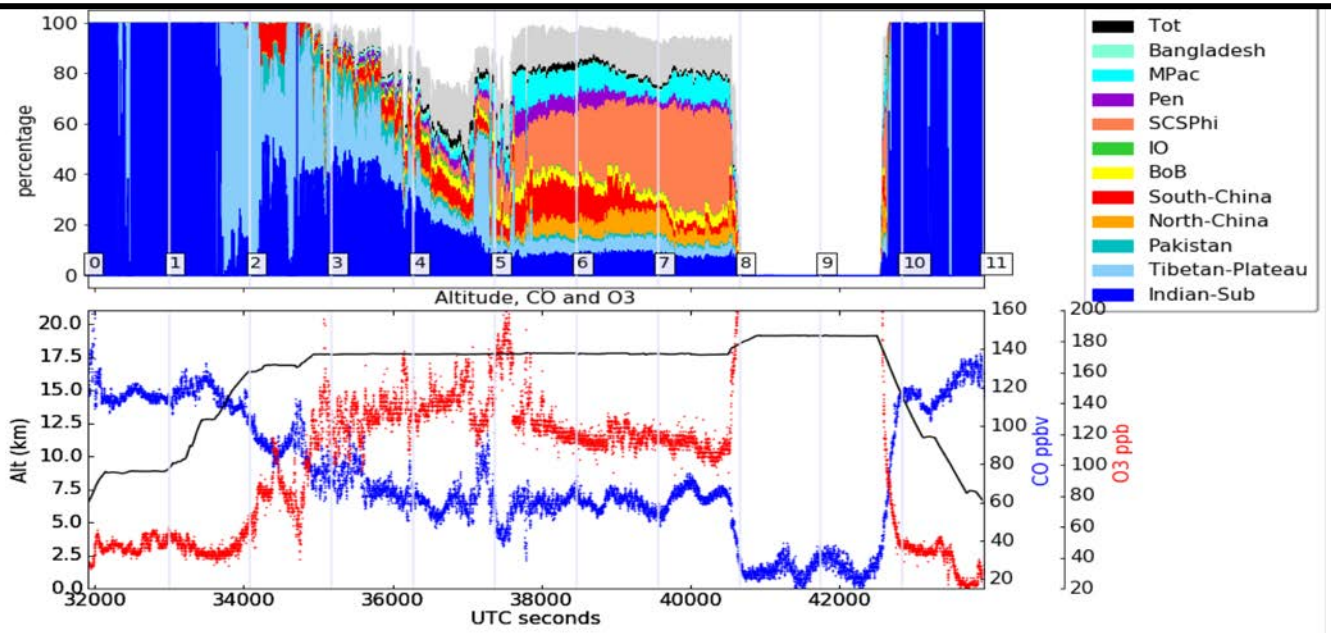
15-min resolution VIS images from MSG1

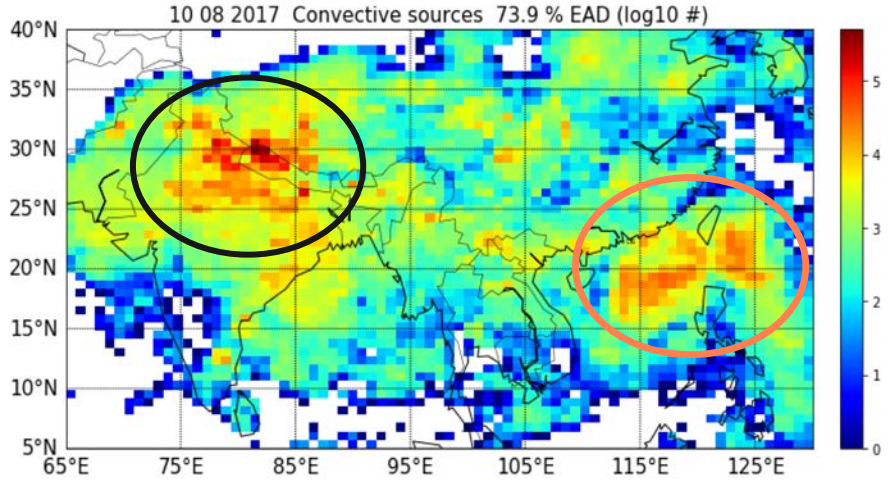


Intense Convection starts around 7:00 UTC and lasts for around 4 hours
First part of the flight was on the top of the convective tower
then it flies in an increasingly older (but still very fresh) outflow

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





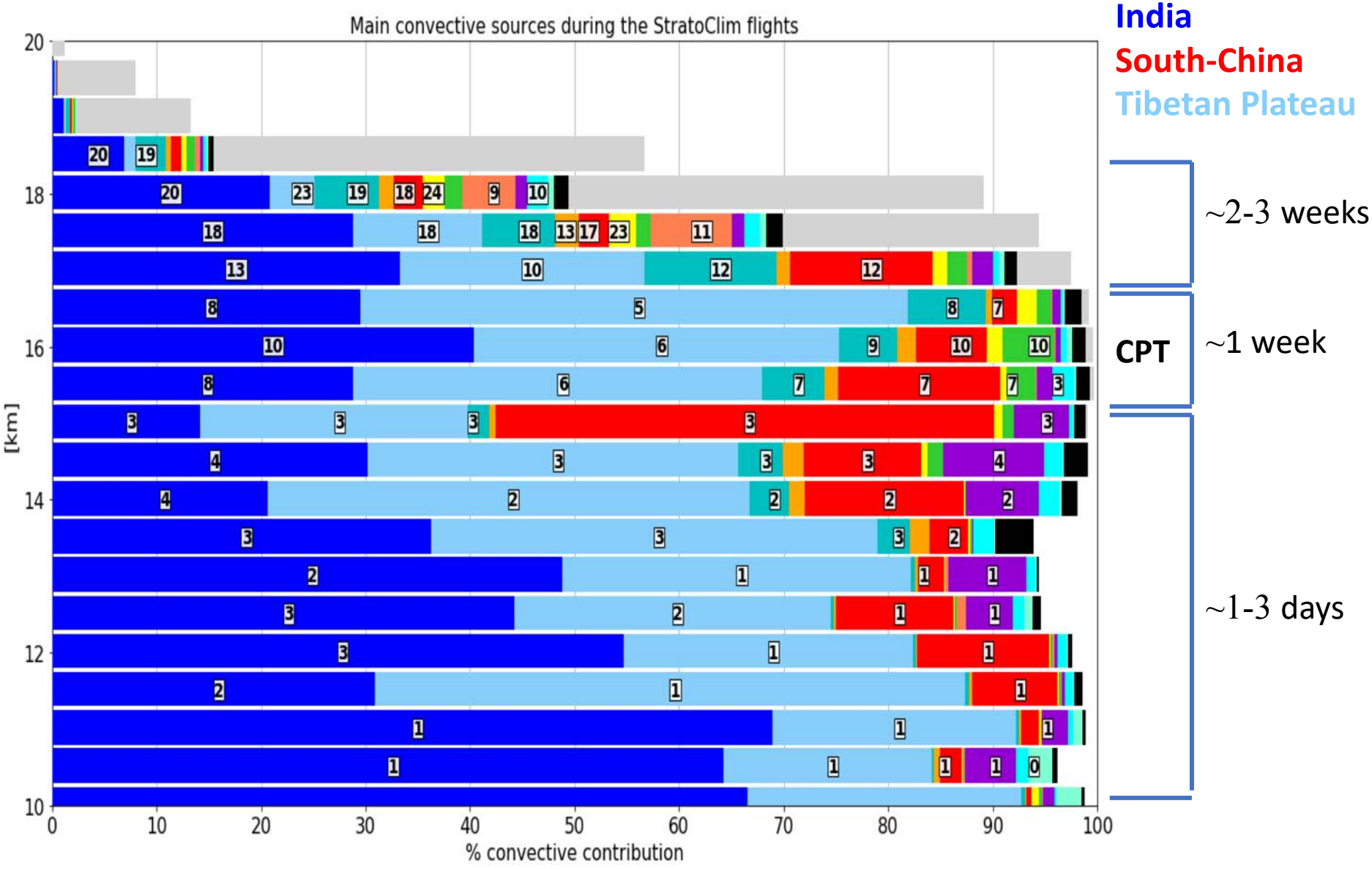


Decreasing CO, Increasing O3, less convection, more recirculating air. On top of it few spots of intense convective influence

After it: Typhoon air outflow!

Overall campaign view on deep convective influence inside the UTLS

Source Influence along the vertical and their time of transport



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.

Vertical distribution of convective impact suggests the higher influence of convective outflow around 16-17 km. There, the time of transport from convective sources is around 1 week. Above this level, convective contribution radically decreases and the age of transport reaches times of the order of 20 days or more.