

# Meteorology and ultrafine aerosols, an airborne study

**Wolfgang Junkermann**

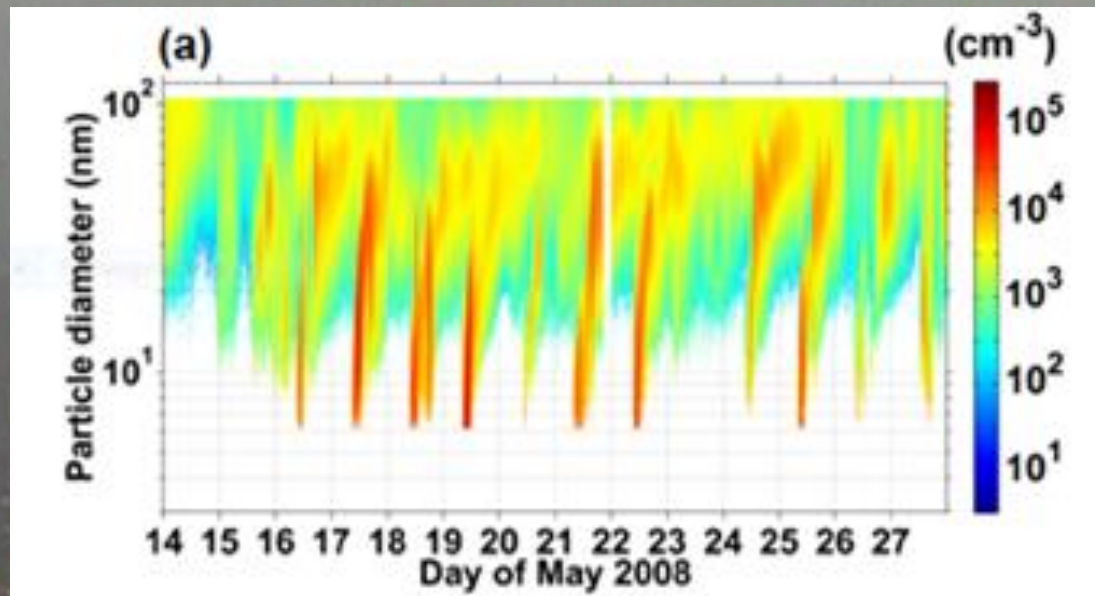
**KIT, IMK-IFU, Garmisch-Partenkirchen**



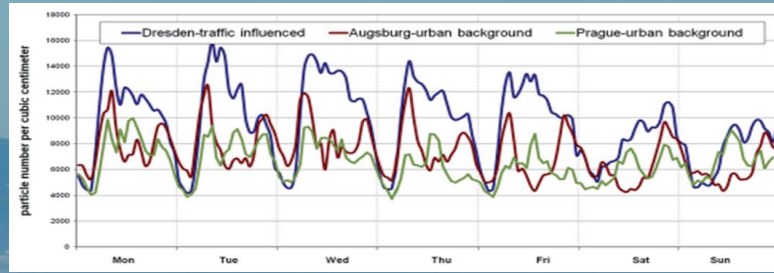
**Highly variable in space and time**

**Chemistry / Meteorology ?**

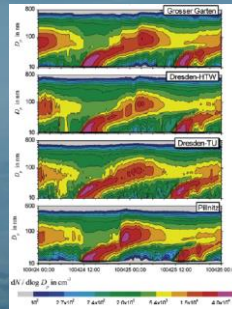
**Understanding patterns needs knowledge of sources and sinks**



# Diurnal (UFIREG), Seasonal (dal Maso, 2005)



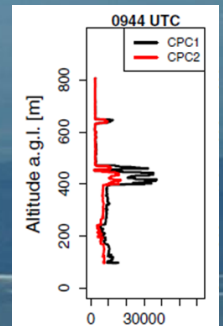
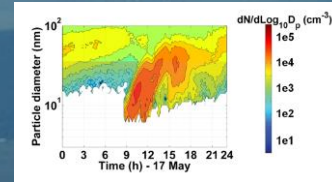
# Spatial (Birmili et al, MZ, 2013; Ma and Birmili, STE, 2015)



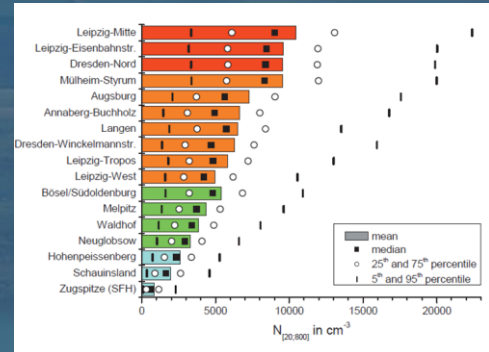
urban

rural

# Vertical (Crippa et al, ACP, 2012, Platis, BLM, 2015)

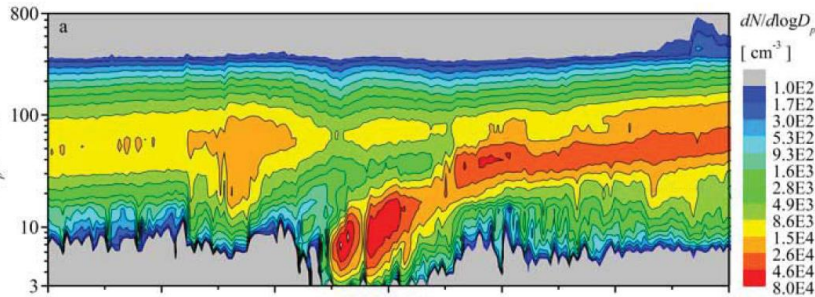


# Relation to traffic & population density (Birmili et al, GRL, 2015; Paasonen et al, APCD, 2016)

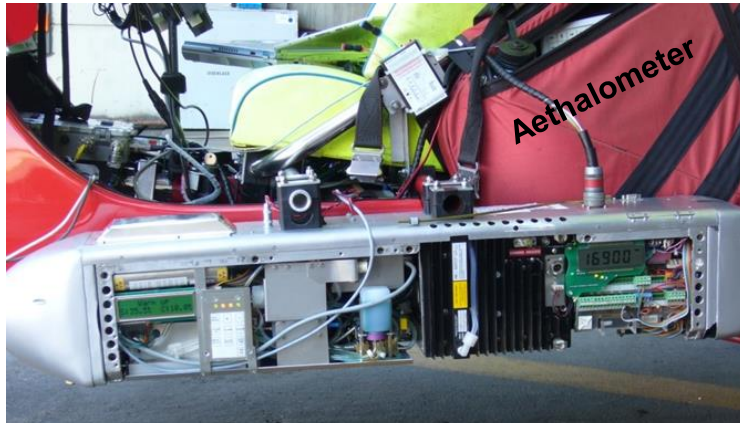


# Banana curves (Wiedensohler et al, JGR, 2009)

WIEDENSOHLER ET AL.: RAPID PARTICLE GROWTH AND CCN ACTIVITY



# MICROLIGHT FOR PBL RESEARCH



**Aerosols, CPC, OPC, SMPS**  
**Size distribution 5 nm – 20 um**

**D-MIFU**



**MODULAR SCIENTIFIC  
INSTRUMENT SYSTEM**

**Ceiling 12000 ft**

**Endurance 5 h**

**Scientific Payload max  
80 kg**

**Transponder (S-MODE),  
ELT**

**RADIATION  $uv > IR$**

**PODS FOR  
INSTRUMENTS**



**NOSEBOOM  
Meteorology  
Turbulence**

BR  
BR

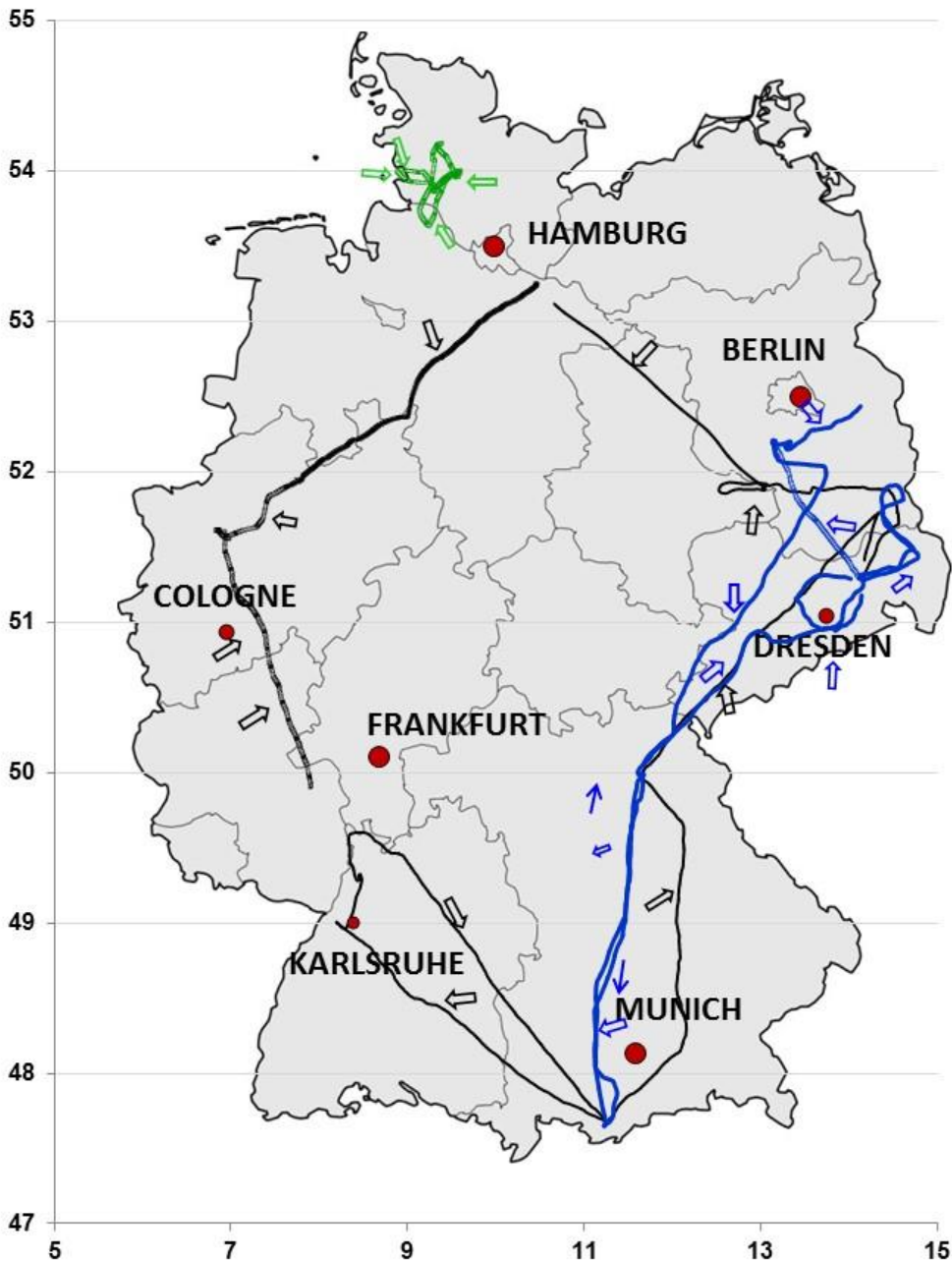


# AIRBORNE MEASUREMENTS

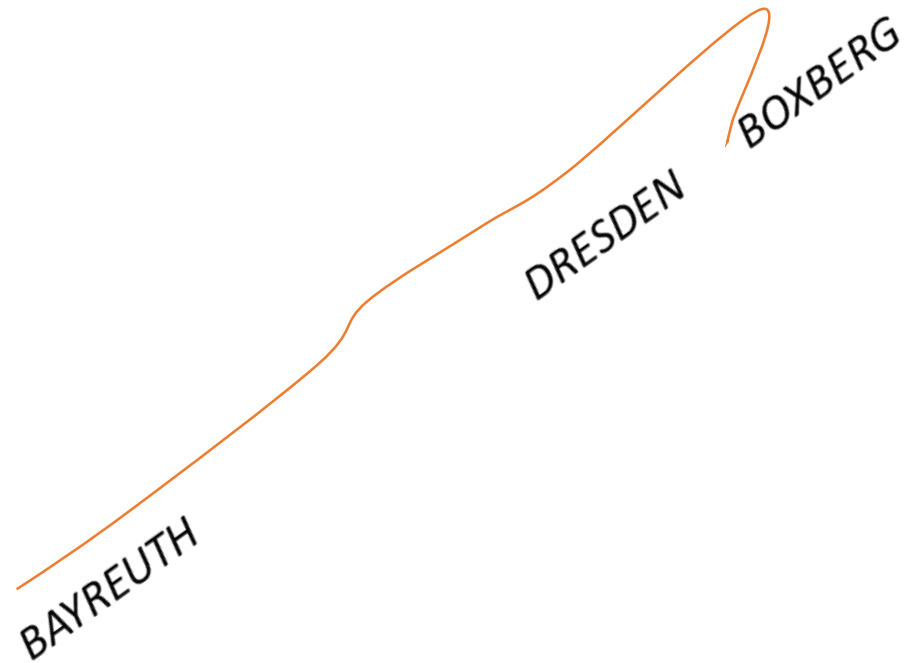
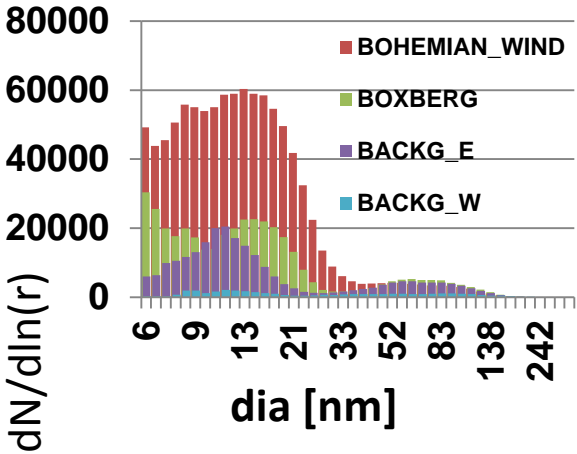
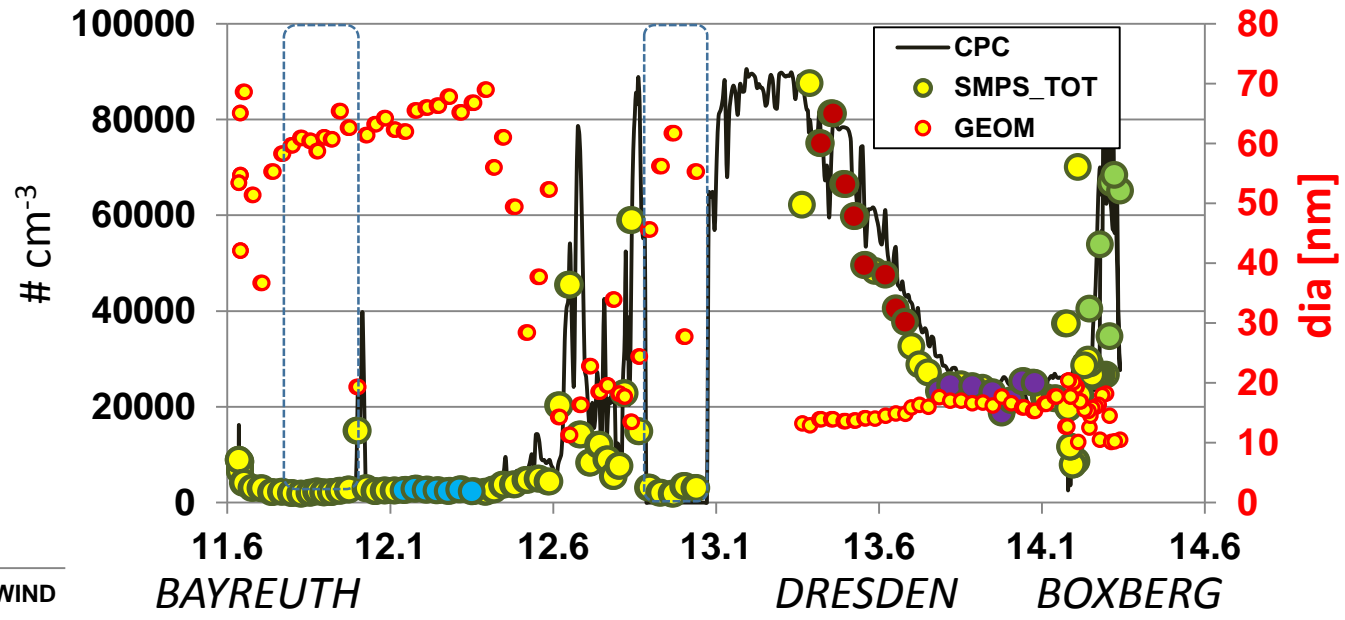
**APRIL-28 – May 17,  
2012**

**SEPT. 6-15, 2013**

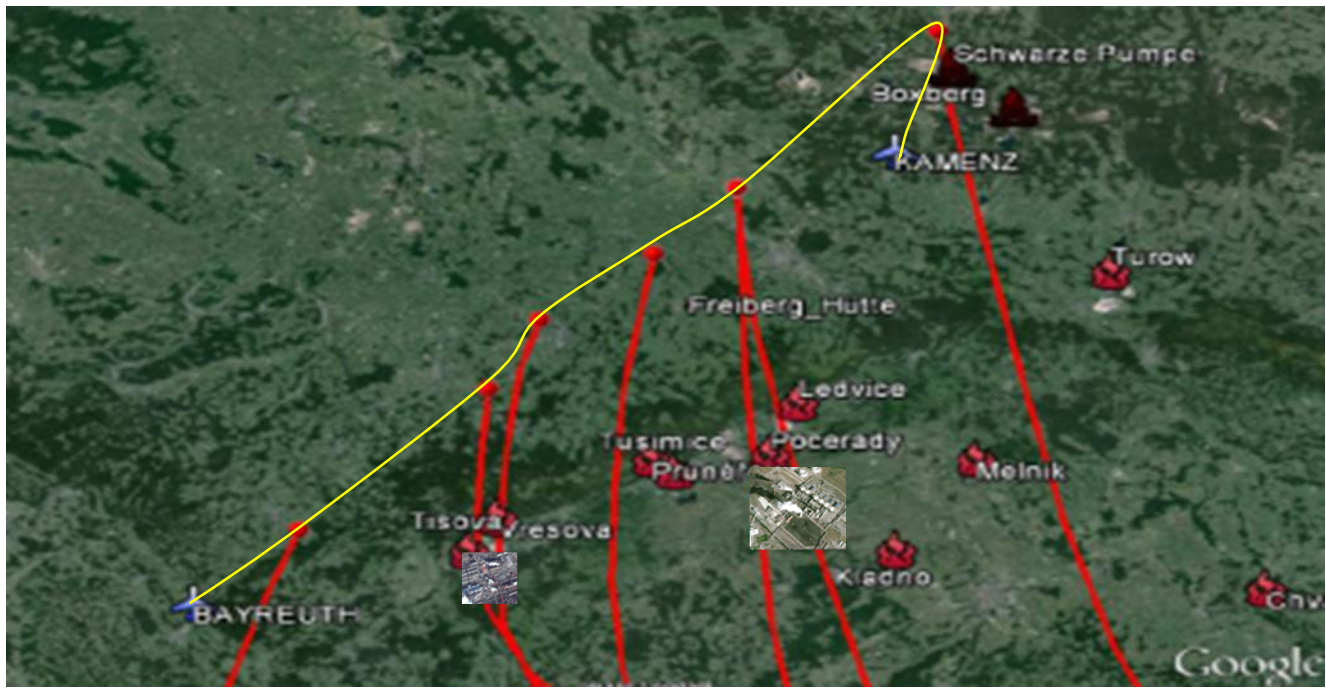
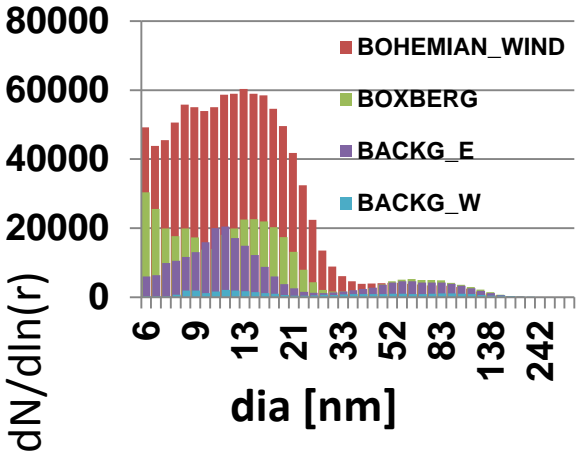
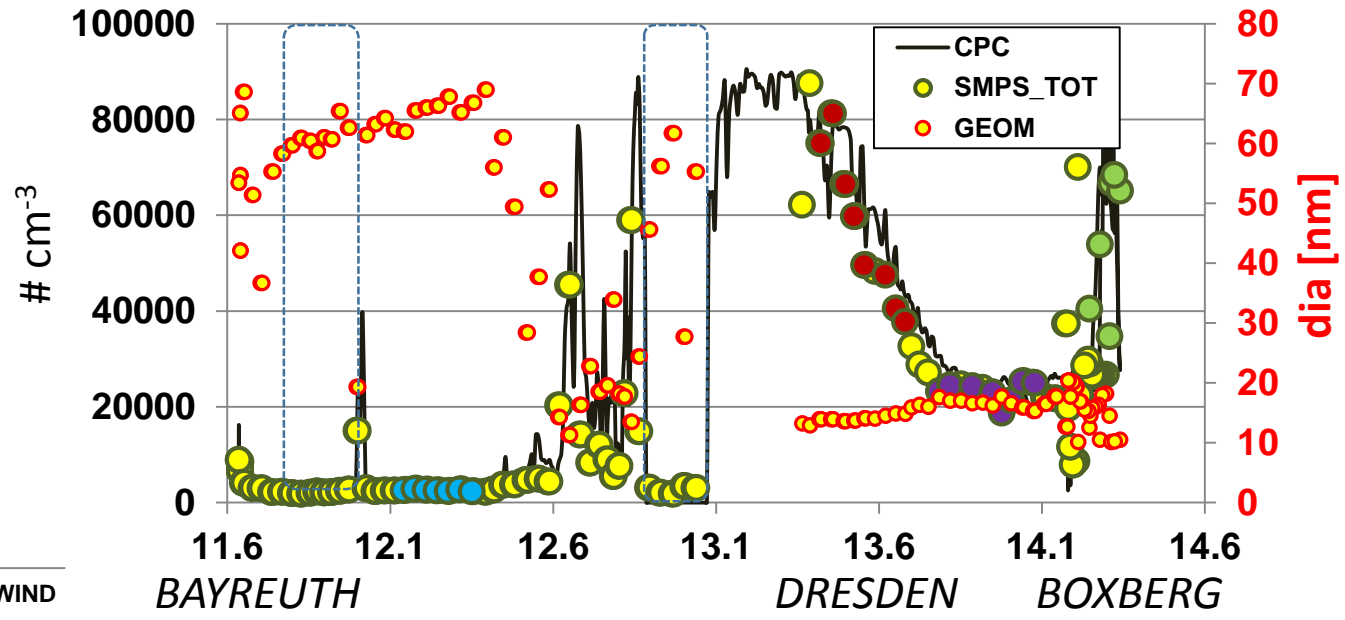
**June 6.-16, 2014**



# Aircraft



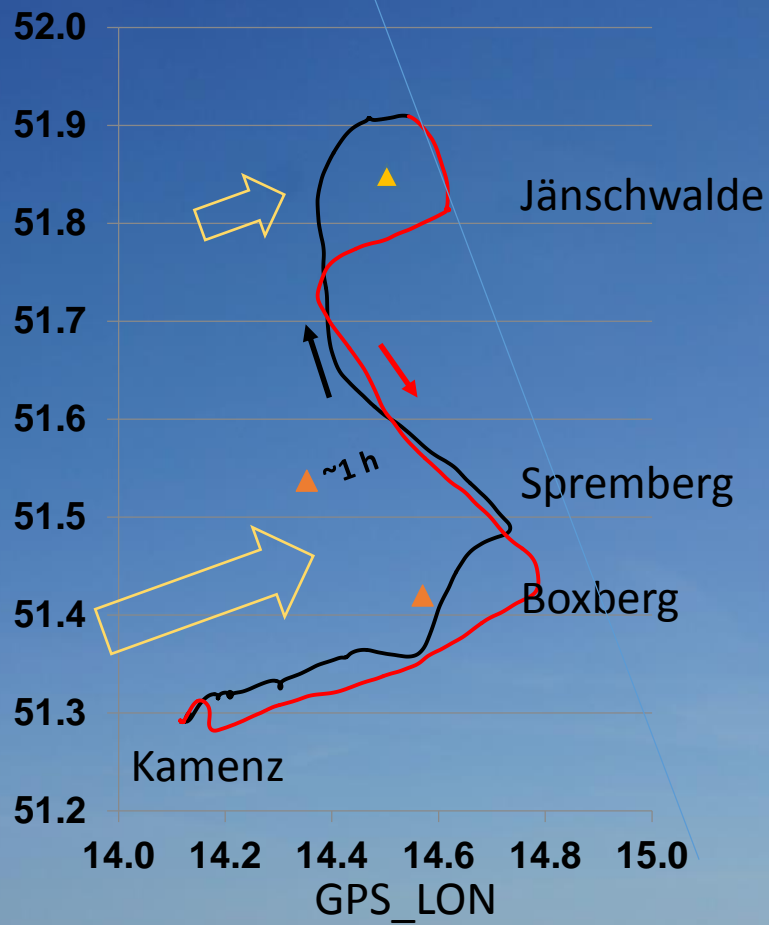
# Aircraft

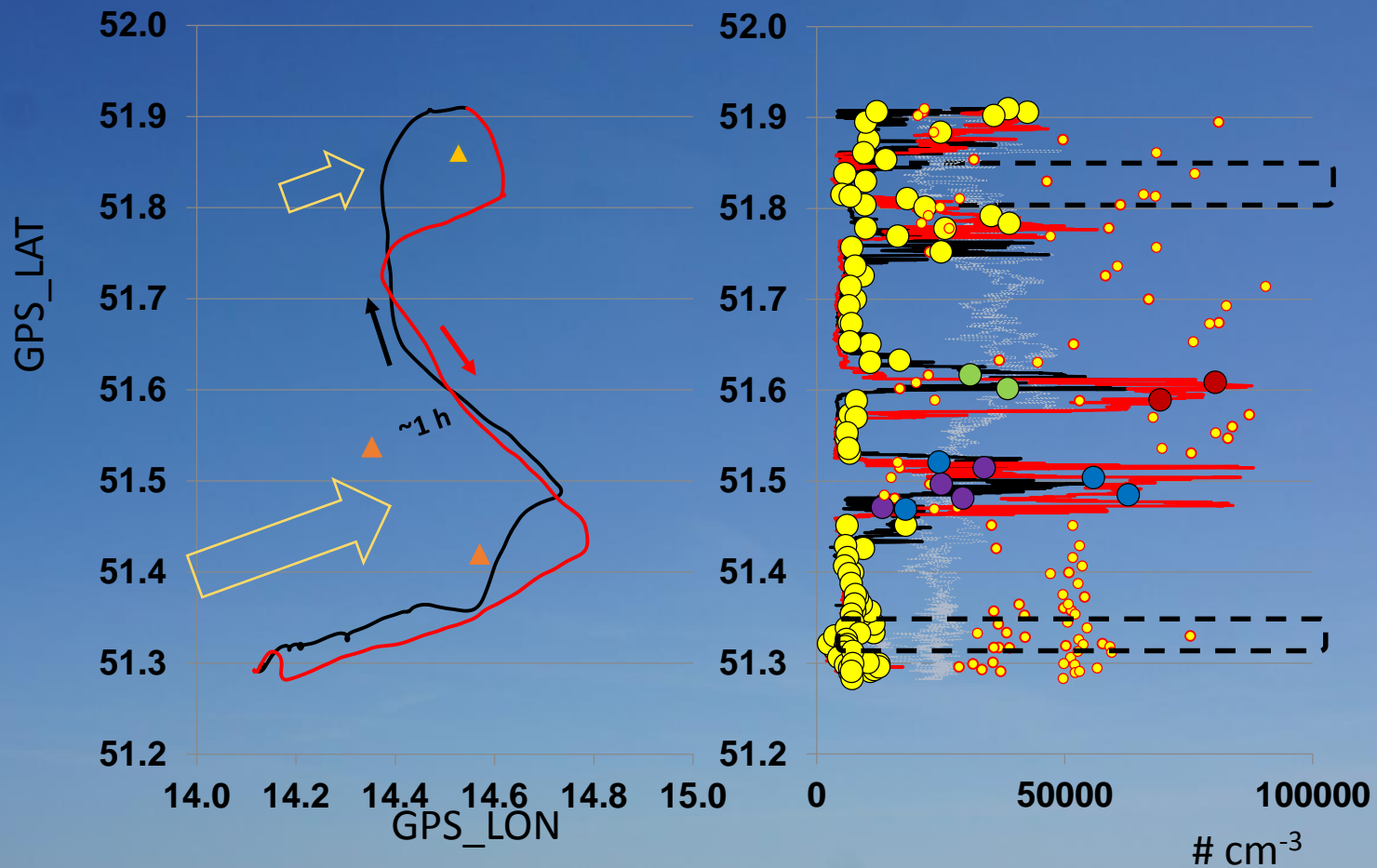




June 2014

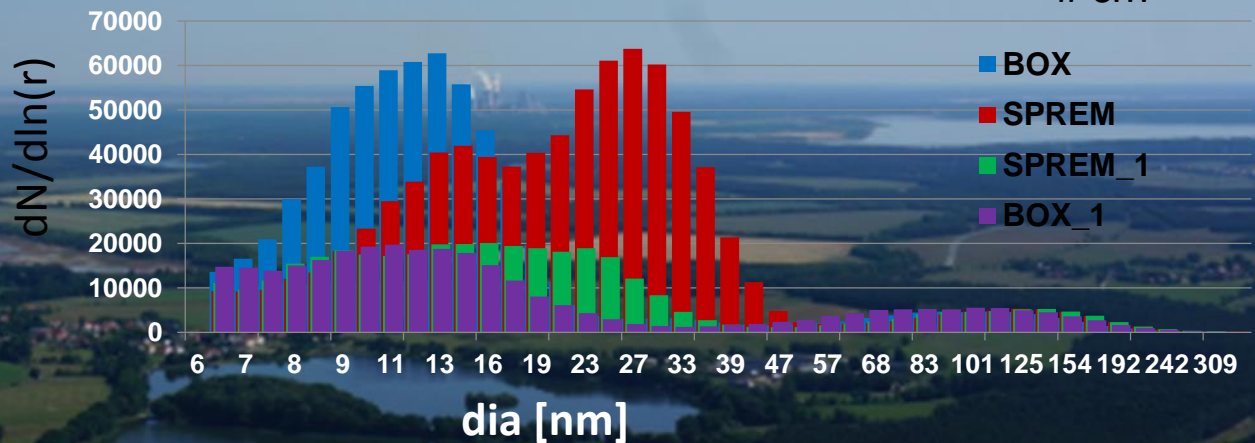
GPS\_LAT

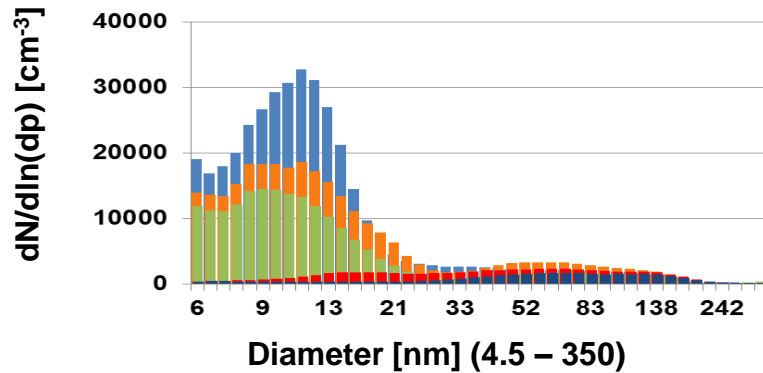
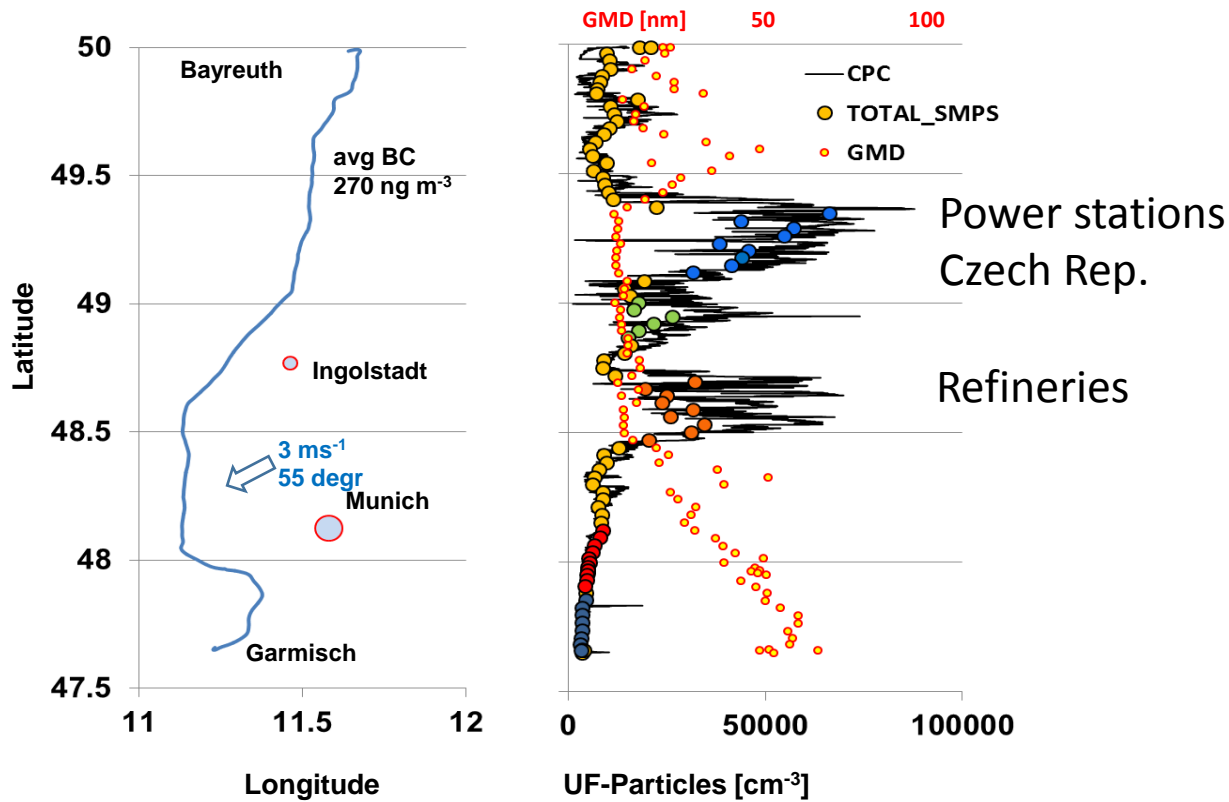


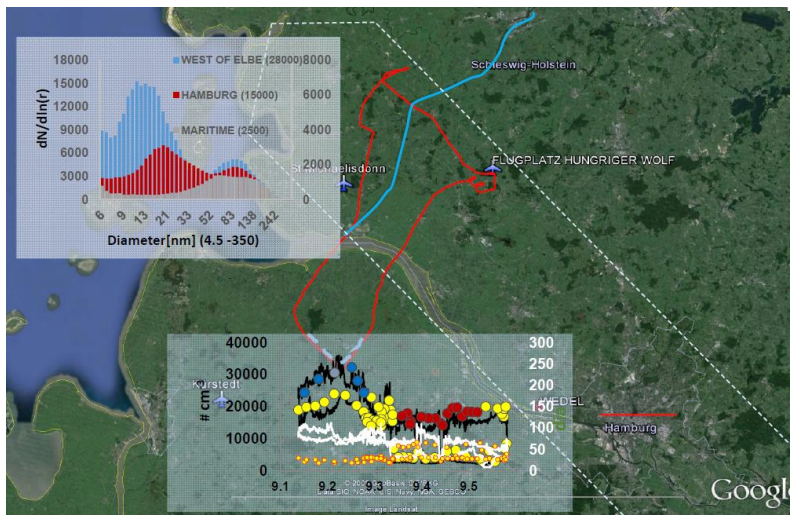


$1.5 - 2.5 \cdot 10^{18} \text{ s}^{-1}$

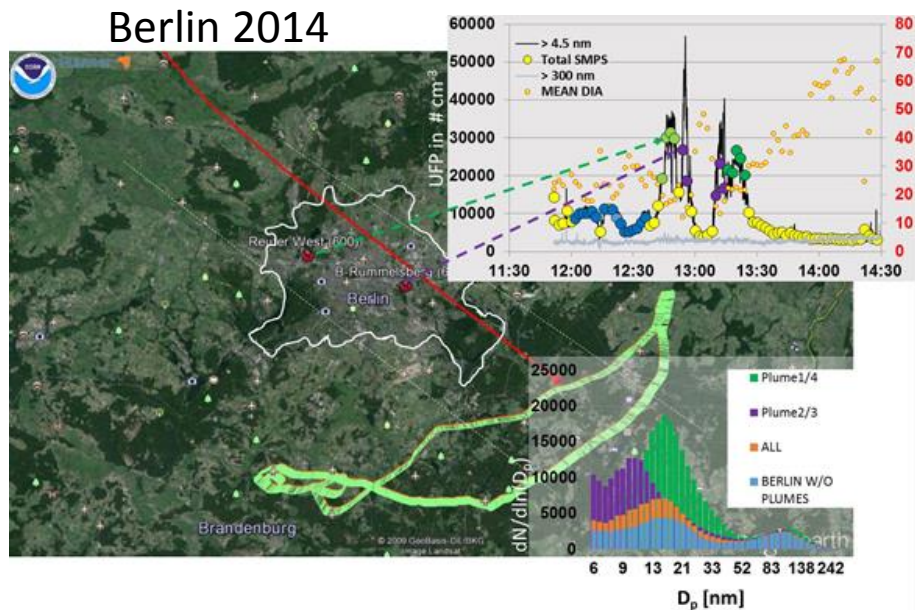
# within plume cross section \* wind speed





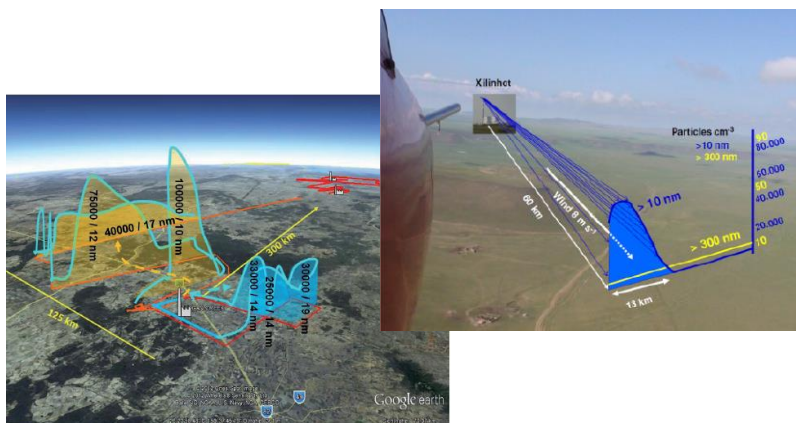
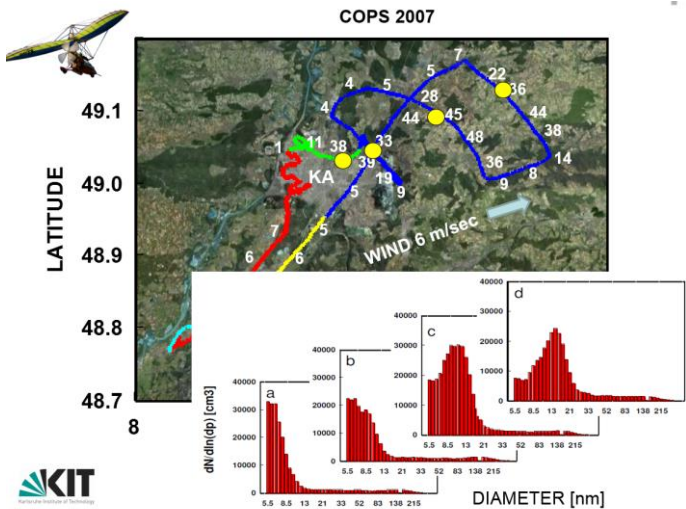


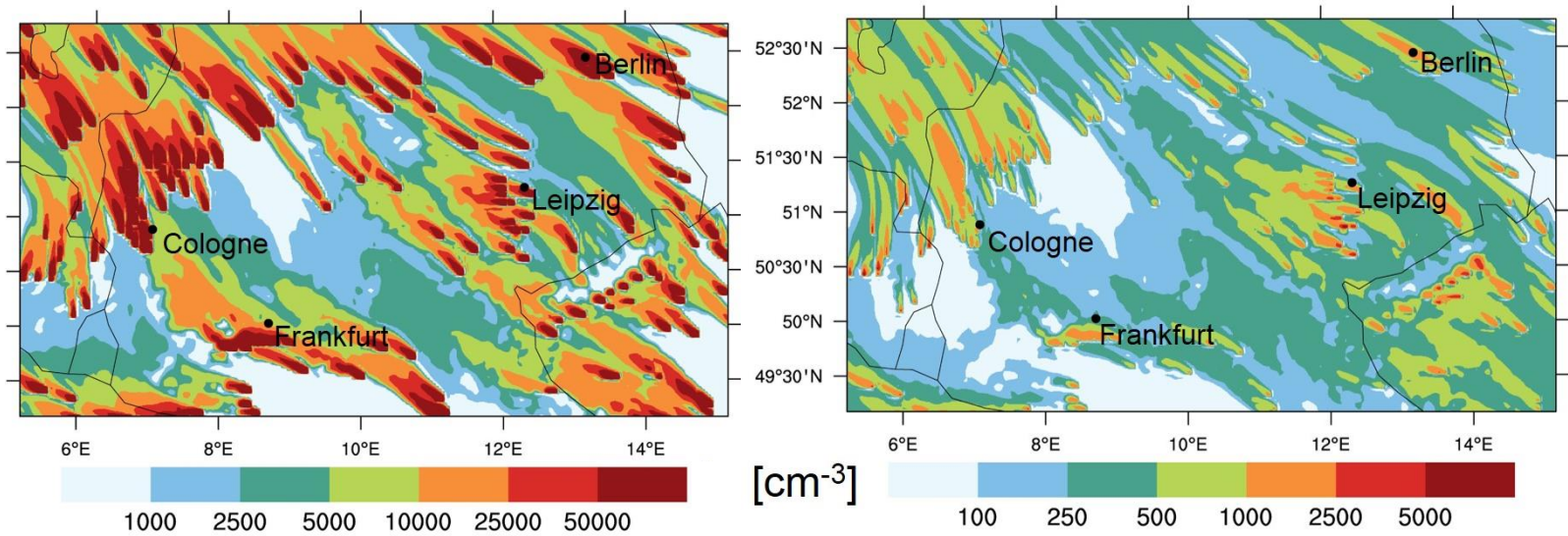
Hamburg 2013



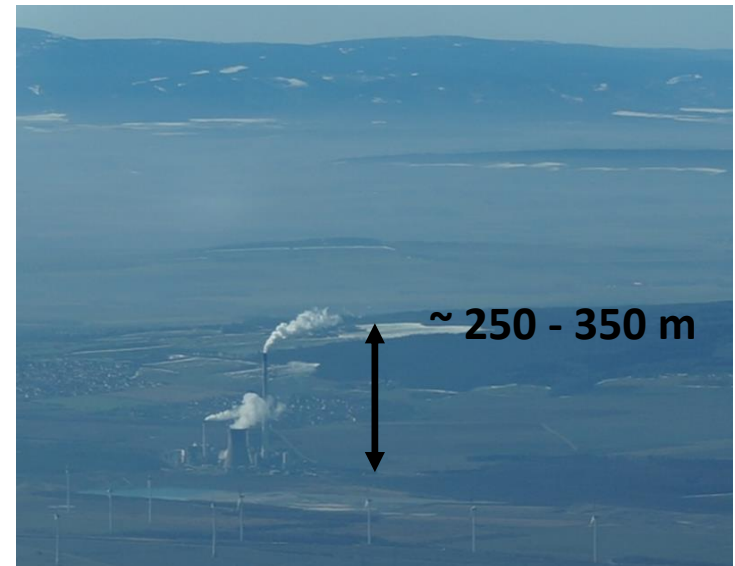
Similar observations in Australia, China, Italy, France, Great Britain

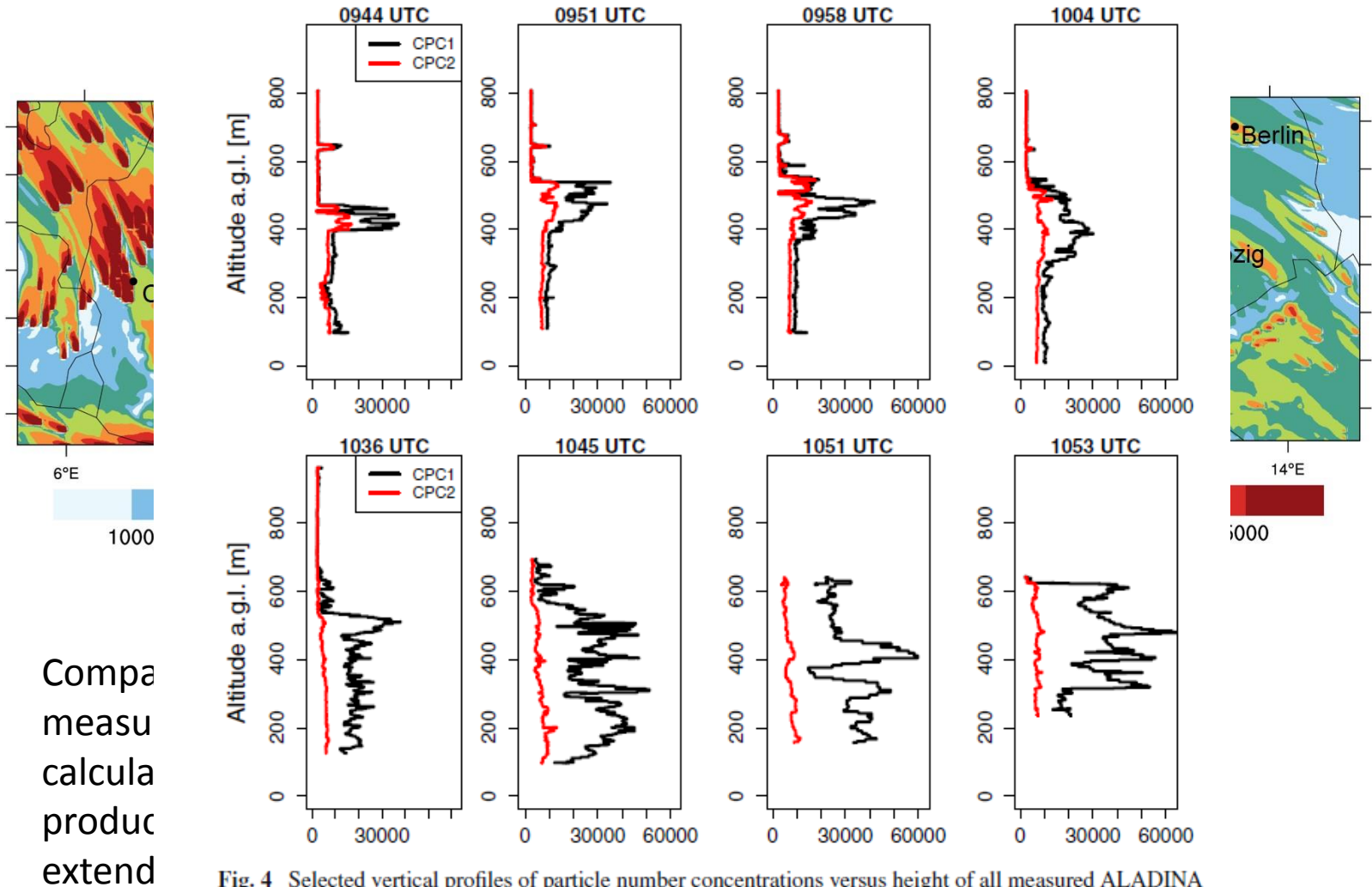
$$\sim 2 * 10^{18} \text{ s}^{-1} / 700 \text{ MW}$$





Comparison of COSMO\_ART number concentrations with AerCoDe and ,measured' particle number and size emissions calculation for November to keep secondary production as low as possible. Primary plumes extend  $\gg 100$  km (Junkermann et al, Tellus, 2016)

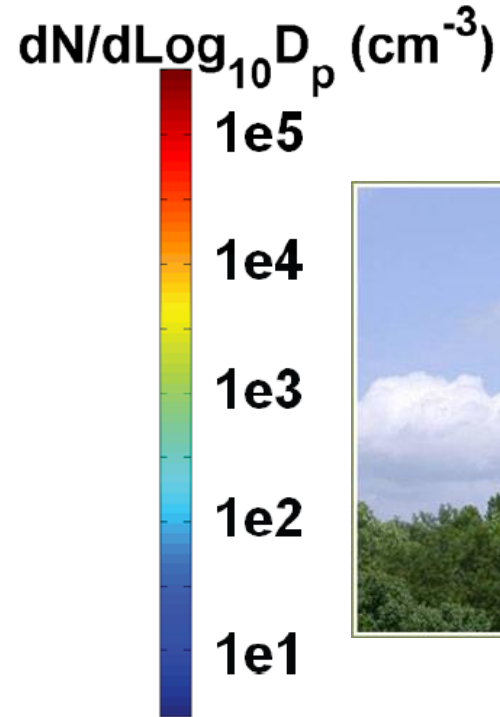
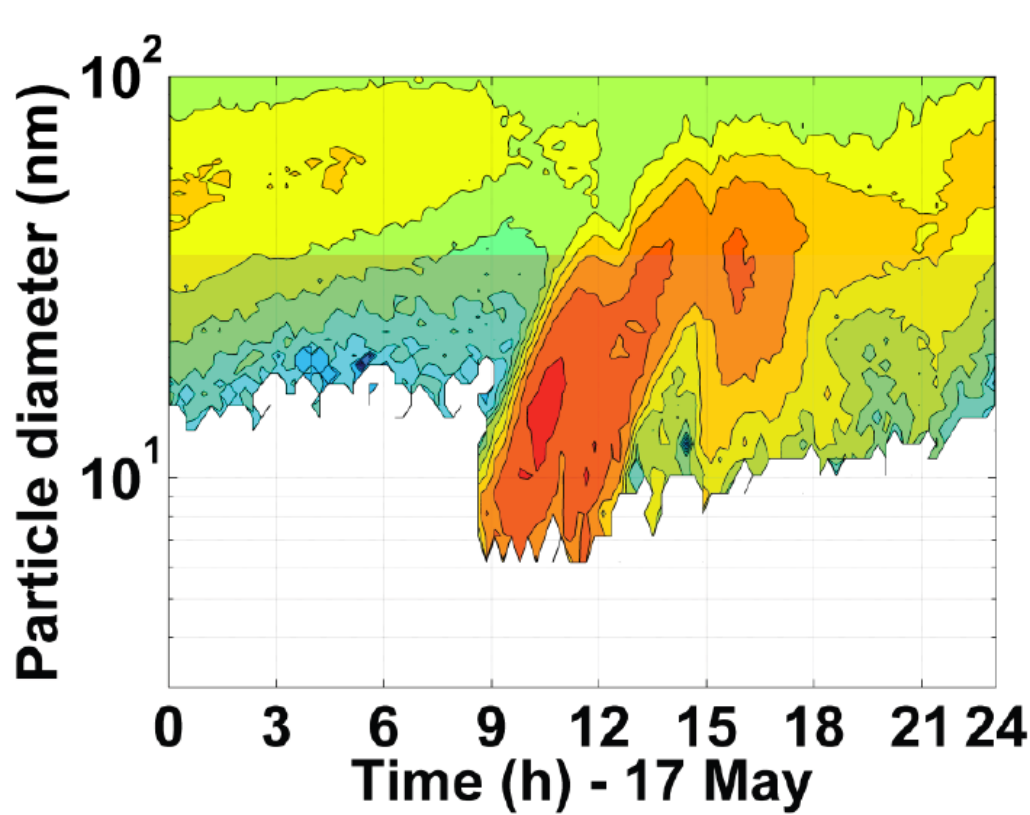




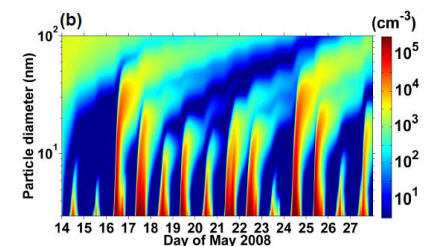
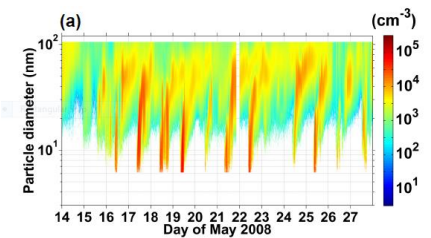
Compa  
measu  
calcula  
produc  
extend

Fig. 4 Selected vertical profiles of particle number concentrations versus height of all measured ALADINA profiles from 3 flights on 3 April 2014 during the morning transition. CPC1 ( $N_{10}$ ) is represented with a *black line*, CPC2 ( $N_5$ ) is *red*. The difference between CPC1 and CPC2 is the  $N_{5-10}$  particle number concentrations. The x-axis represents the number concentration per  $\text{cm}^3$

# Nucleation In ForesTs (NIFTy) /Morgan Monroe State Forest



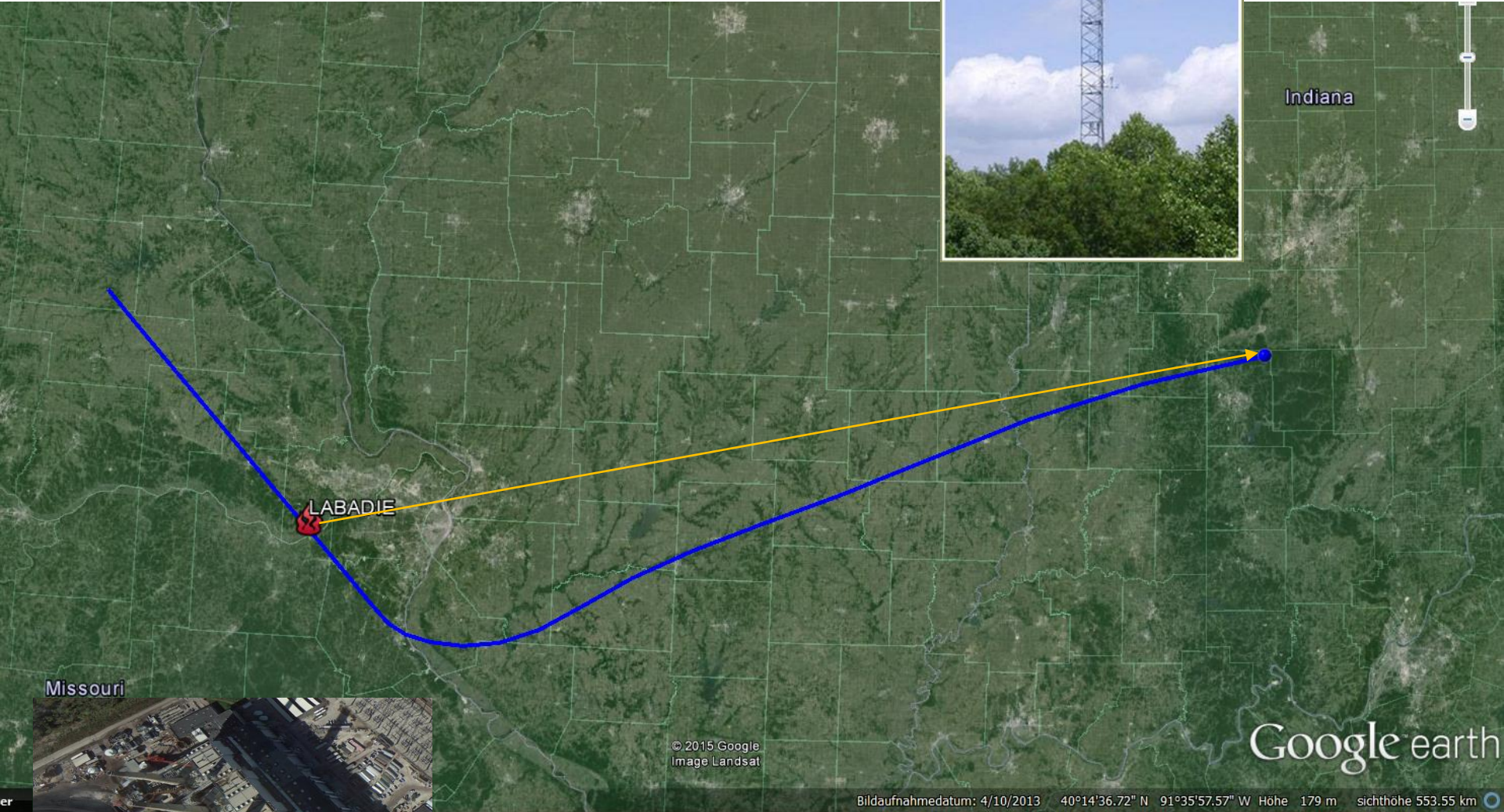
CRIPPA et al, ACP, 2012  
Evidence of an elevated source  
of nucleation based on model  
simulations and data from the  
NIFTy experiment



# HYSPLIT Backtrajectory 17 May



Indiana



Missouri

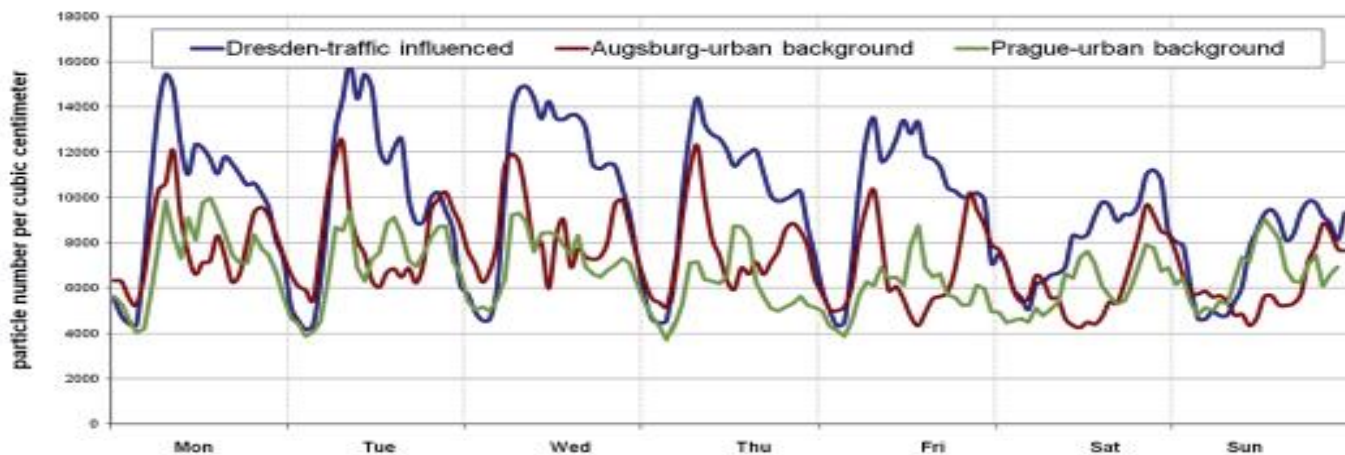
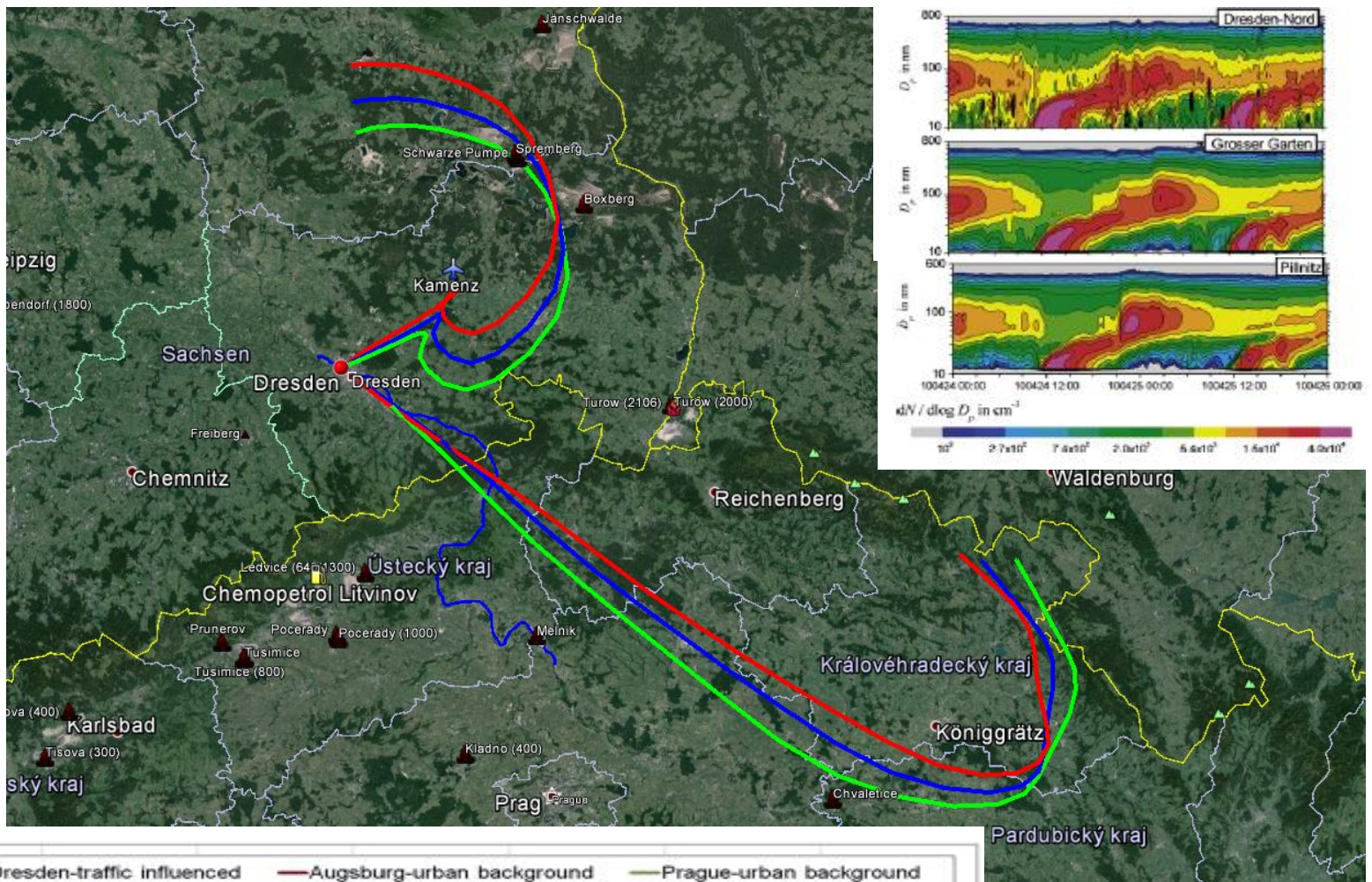


© 2015 Google  
Image Landsat

Google earth

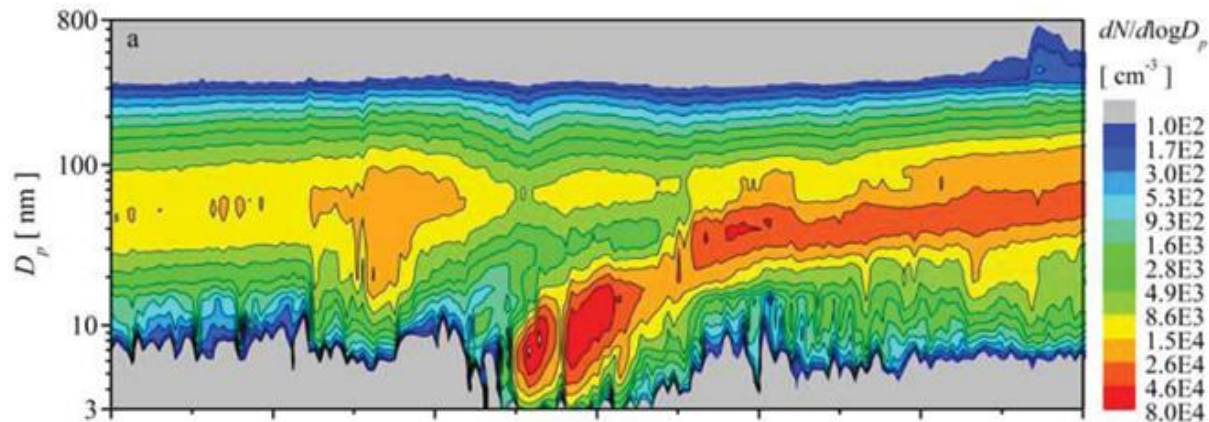
Bildaufnahmedatum: 4/10/2013 40°14'36.72" N 91°35'57.57" W Höhe 179 m sichthöhe 553.55 km





# Banana curves (Wiedensohler et al, JGR, 2009)

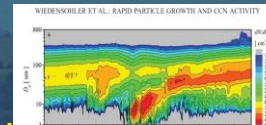
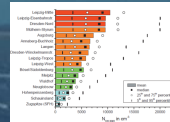
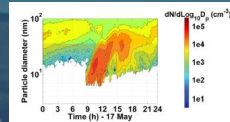
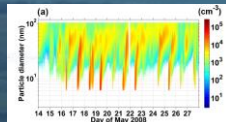
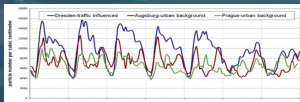
WIEDENSOHLER ET AL.: RAPID PARTICLE GROWTH AND CCN ACTIVITY

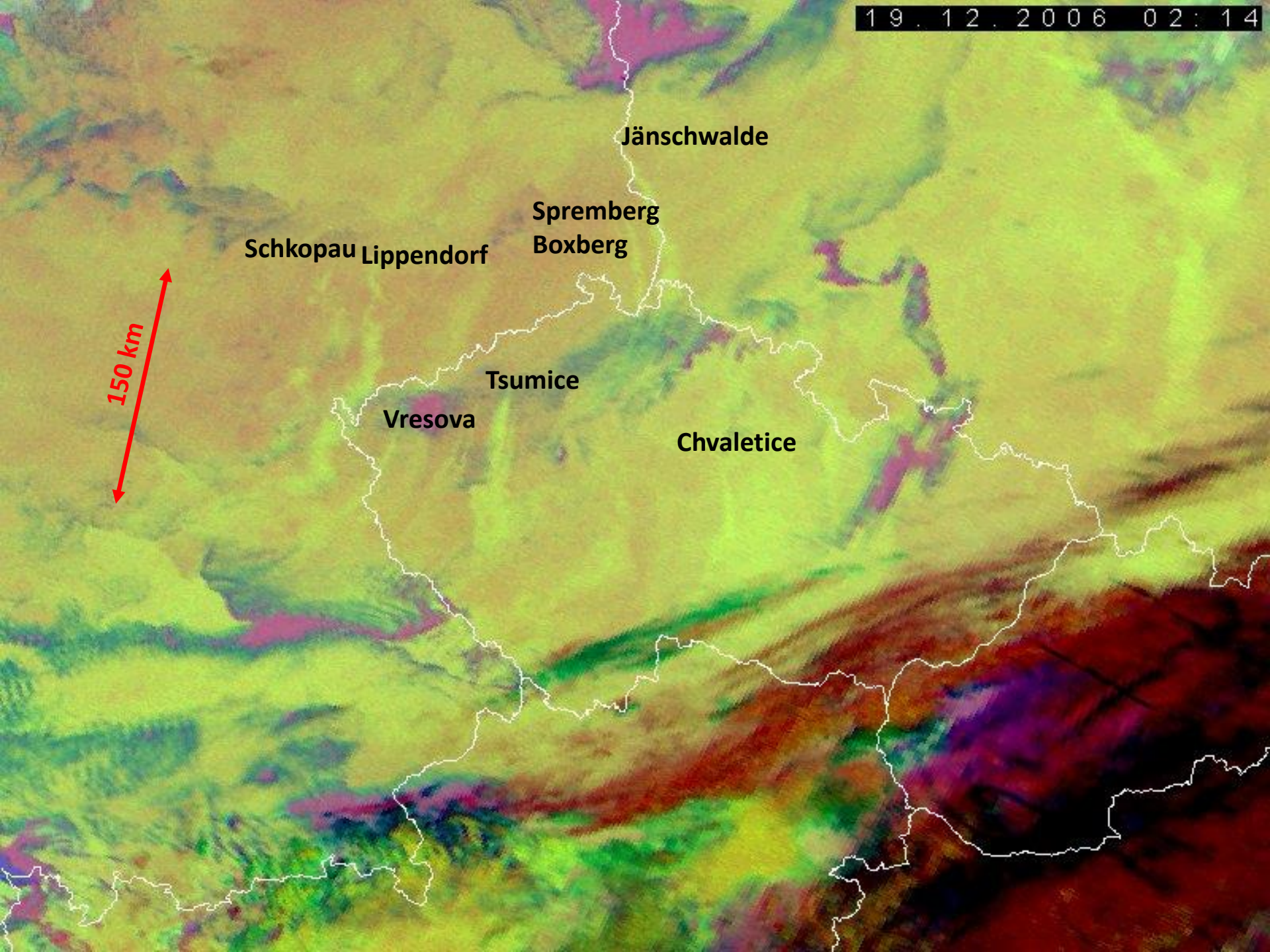


# SUMMARY

**UFP-Plumes**  
cover up to 30% of Germany  
emitted 24 h/d into ~ 250 – 400 m (+ GTP)  
elevated point sources

**Meteorology:**  
Advection (nocturnal up to 300 km within residual layer)  
Convection (vertical mixing, radiation required, ~~overcast~~)





Jänschwalde

Spremberg  
Boxberg

Schkopau Lippendorf

Tsumice

Vresova

Chvaletice

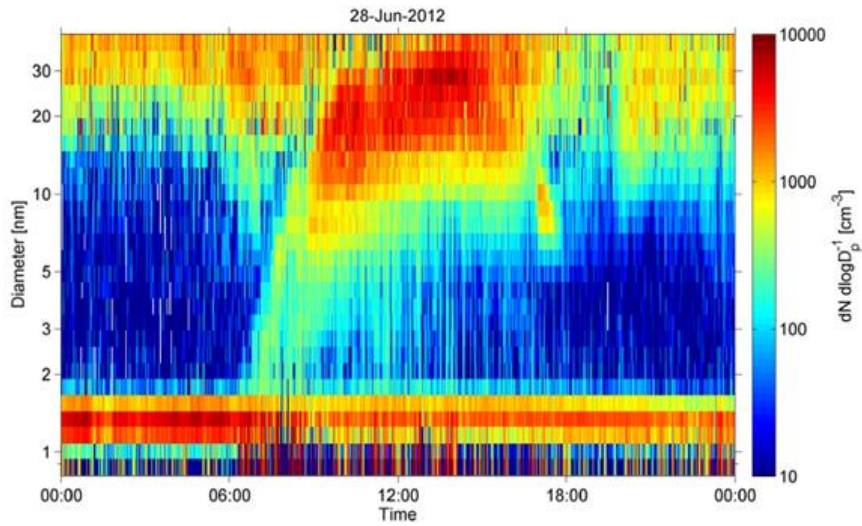
150 km

A blue-tinted landscape featuring a hang glider in flight against a backdrop of jagged mountains. The hang glider is positioned in the center-left of the frame, with its wings spread wide. The mountains are layered, creating a sense of depth. In the top-left corner, there is a logo consisting of the letters 'BR' stacked vertically.

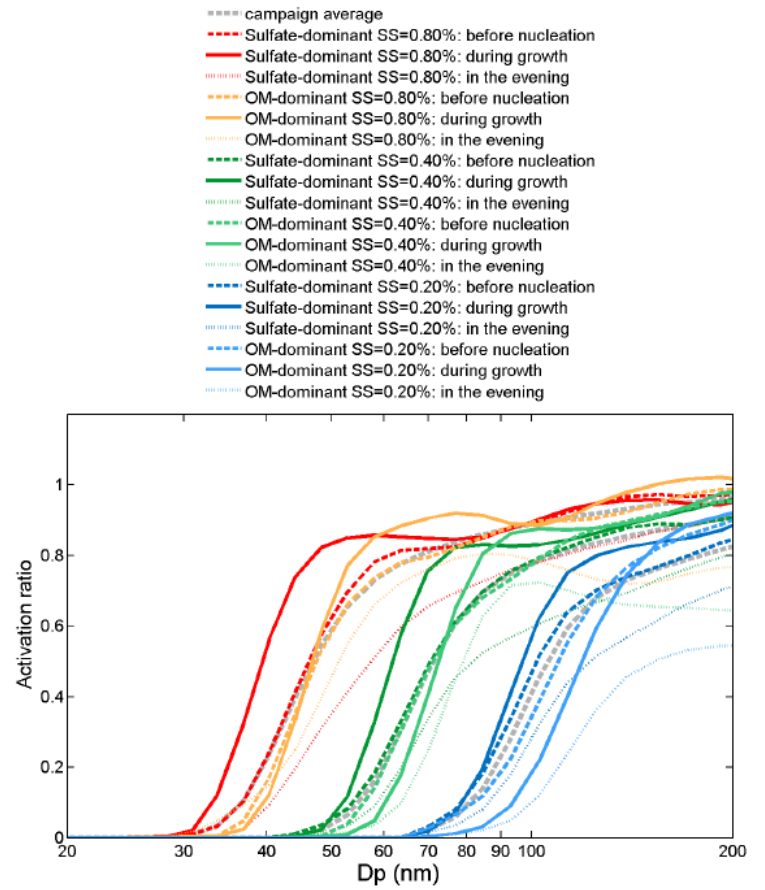
BR  
BR

*Thank you for your attention*





**Figure 4.** The size distribution of positive ions on a typical new particle formation event at the San Pietro Capofiume station (28 June 2012).



5. Average size-resolved activation ratio for the selected periods on July 22<sup>nd</sup> and 24<sup>th</sup>