NEW PARTICLE FORMATIONS AND ULTRAFINE CHARGED AEROSOL CLIMATOLOGY AT A HIGH ALPIN SITE (Jungfraujoch, 3580m *a.s.l.*)

J. Boulon[1], H. Venzac[1,], D. Picard[1], S. Crumeyrolle[1], E. Weingartner[2], G. Wehrle[2], K. Sellegri[1] & P. Laj[3]*

[1] Laboratoire de Météorologie Physique, CNRS UMR6016, Clermont-Ferrand, France, [2] Paul Scherrer Institute, Villigen PSI, Switzerland, [3] Laboratoire de Glaciologie et Géophysique de l'Environnement, CNRS UMR5183, Grenoble, France. [*] Now at Weather Measures, Aubière, France.

contact : j.boulon@opgc.univ-bpclermont.fr

SCIENTIFIC CONTEXT

Number size distributions of charged particles were measured on a continuous basis during an extended field campaign at a high alpine site (Jungfraujoch, 3580 m a.s.l., Switzerland). Those measurements were performed within EUCAARI program. High altitude sites allowed long term studies of long range transport and free tropospheric aerosol background. We report aerosol number size distribution related to the air mass origin and new particle formation events analysis over a ten month field experiment (from July 2008 to May 2009).

ULTRAFINE CHARGED AEROSOL BACKGROUND

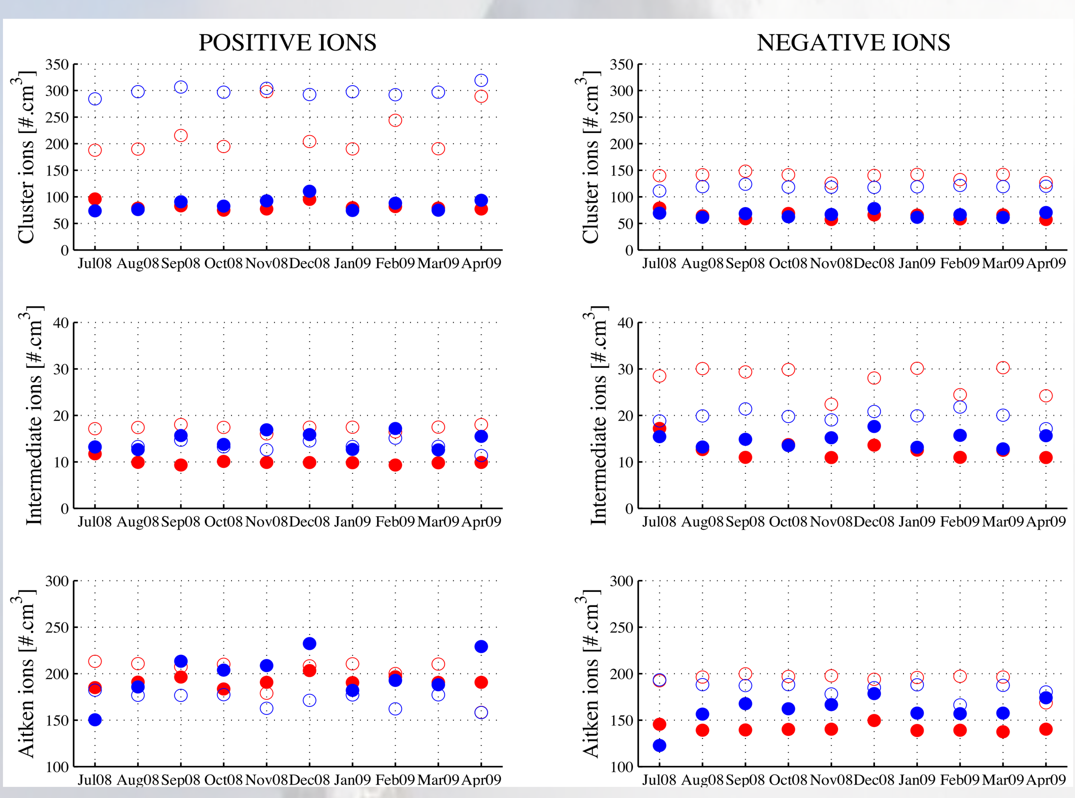


Fig. 1- Evolution of median ions concentration from July'08 to April'09. *Filled circles are for "in cloud" conditions and empty ones for "clear sky" conditions ; Red is for diurnal conditions and blue for free tropospheric (FT) conditions.*
Cluster : [0.5 to 1.8nm]
Intermediate : [2.1 to 6.8nm]
Aitken : [20 to 47nm]

FT [Clusters$^+$]$_{\text{clear sky}}$ > Diurnal [Clusters$^+$]$_{\text{clear sky}}$, this effect is less important for negative ions.
Diurnal [Intermediate$^-$]$_{\text{clear sky}}$ > FT [Intermediate$^-$]$_{\text{clear sky}}$. For positive intermediate ions this phenomenon is not observed.
When cloudy conditions occur, concentrations of both polarity become equals. Furthermore, cloud effect is stronger for clusters ions than charged particles, intermediate & Aitken mode (Fig. 2).

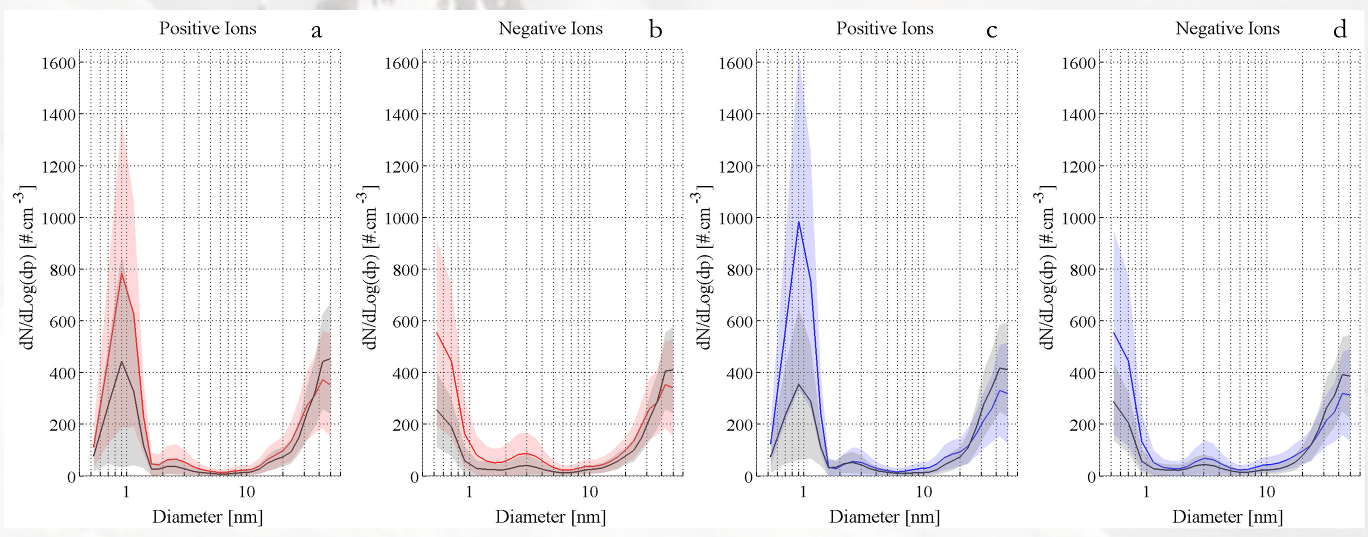


Fig. 2- Mean number size distribution of charged particles. *Red, blue and black are for diurnal, FT and "in cloud" conditions respectively.*

Cloud effect. Diurnal (a. & b.) and FT (c. & d.) conditions present the similar shape of size distributions. Cloud effect tends to decrease the cluster mode whereas intermediate and Aitken mode tend to increase. This effect is stronger for FT conditions : the enhencement of Aitken mode population start for smaller diameters than in boundary layer conditions.

AIR MASS ORIGIN & AEROSOL BACKGROUND

Three-days backtrajectories were computed using HYSPLIT model. We present here back trajectories with ending point at JFJ research station at 00:00 LT. Air mass were divided into 4 classes according to their origin.

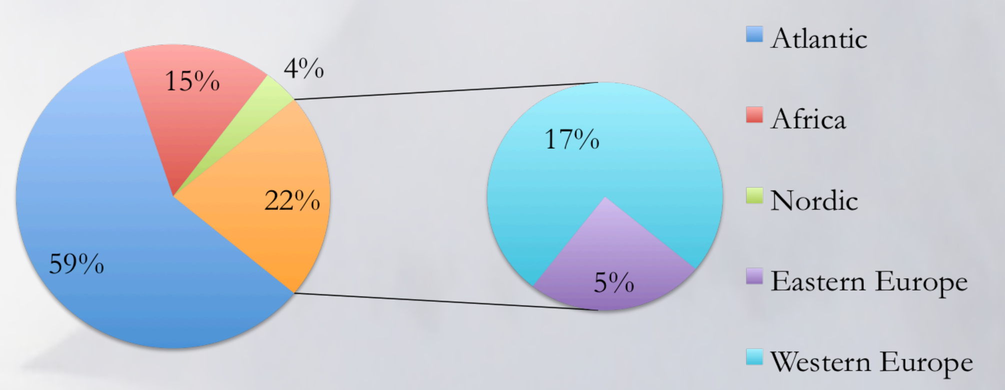


Fig. 3- Frequency distribution of three-days back trajectories arriving at the Jungfraujoch's station, calculated using HYSPLIT model from July'08 to May'09 on a day-to-day basis at 00:00 LT.

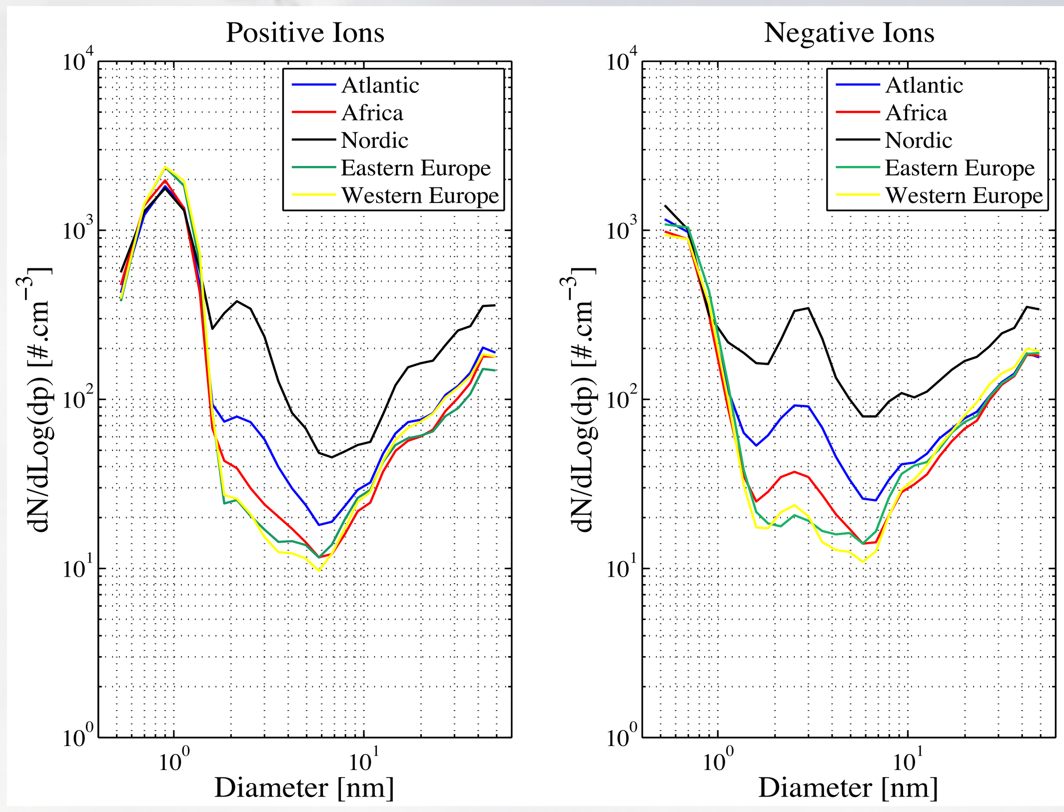
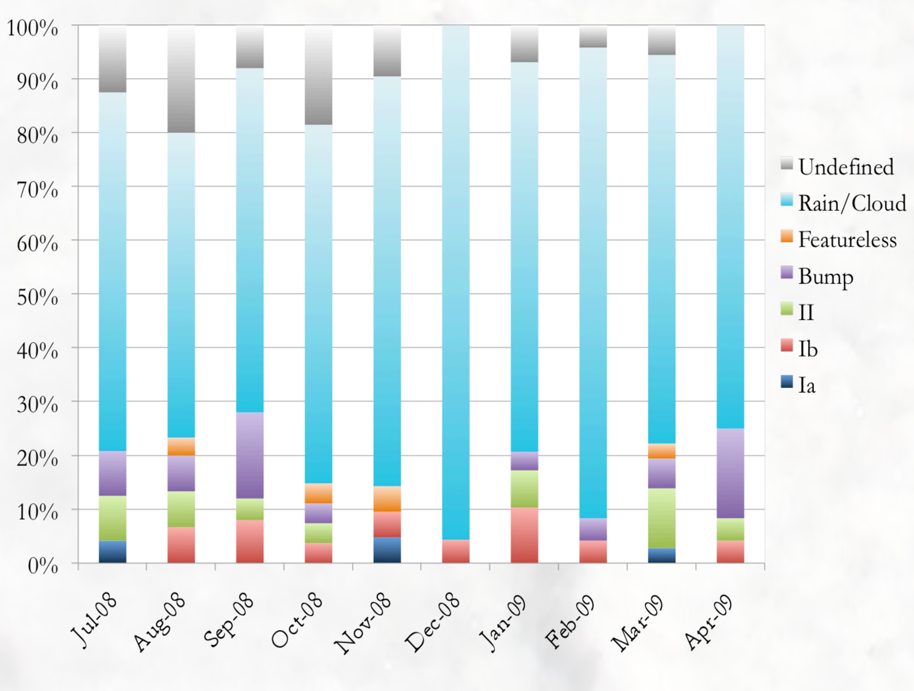


Fig. 4- Mean number size distribution of charged particles according to the air mass origin.

Background origin. Strong differences exist between the distribution according to the air mass origin. Those differences mainly concern intermediate and Aitken mode, cluster mode's remaining "constant".

NEW PARTICLE FORMATION EVENTS

During field experiment, many new particles formation (NPF) events were identified and classified according to the Hirsikko's method (Hirsikko *et al.*, 2005). Statistics are presented on figure 5.



GR 1.3 – 3nm [nm.h^{-1}]	GR 3 – 7nm [nm.h^{-1}]	GR 7 – 20nm [nm.h^{-1}]
5.7	3.6	5.7

Tab. 1- Median growth rates calculated from the measured ion size distributions for size classes 1.3-3, 3-7 and 7-20 nm.

Jtot [cm^{-3}.s^{-1}]	J_2 pos. ions [cm^{-3}.s^{-1}]	J_2 neg. ions [cm^{-3}.s^{-1}]
0.25	0.032	0.038

Tab. 2- Median formation rates for total particles and ions calculated from the charged and total particle size distributions at 2 nm.

Seasonal variation. New particle formation events are maximum during summer and spring months, minimum of NPF frequency occurs during winter time.

AIR MASS ORIGIN	Atlantic	Africa	Nordic	Eastern Europe	Western Europe
1) NPF rate for the air mass **[%]**	15.5	21.6	0	15.4	7.5
2) Total NPF frequency [%]	62.8	22.9	0	5.7	8.6

Tab. 3- New particle formation event frequencies.

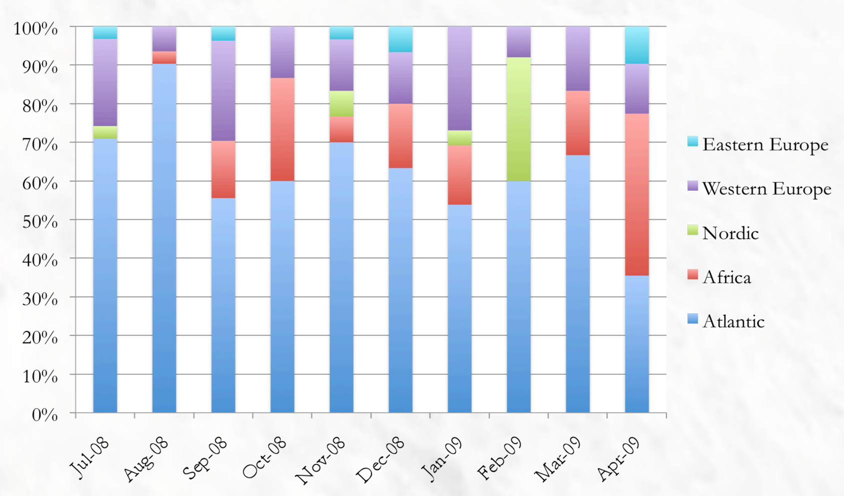


Fig. 6- Monthly frequencies of air mass origin.

"Nucleating air mass " ? Back-trajectories analysis shown on table 3 suggests that NPF events are strongly dependent to the air mass origin but other factors may play an important role such as the path of air mass or local meteorology since winter months could have similar air mass origins but not the same nucleation rate (Fig. 6 & Fig. 5).

OUTLOOK

During the EUCAARI year 2008, we collected data on charged aerosol background and new particle formation events at the Junfraujoch station. We characterized the charged aerosol distribution of the boundary layer and in free tropospheric conditions. We also analyzed the link between the air mass origin and the shape of the charged aerosol background.
Other studies are needed to further investigate the cloud effects on the distribution but first results are consistent with observations made by Weingartner *et al.* (1999) and Venzac *et al.* (2007). Next step in the analysis of new particle formation events is to perform a principal component analysis with all meteorological (air mass origin, gases, radiations…) in order to identify a set of parameters which can lead to a new particle formation event at Jungfraujoch.

REFERENCES & ACKNOWLEDGMENTS

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