Name of research institute or organization:

## Laboratoire de Météorologie Physique, Université Blaise Pascal, Clermont Ferrand, France

Title of project:

Study of new particle formation and ion concentrations

Project leader and team:

Dr. Karine Sellegri, Dr. Hervé Venzac, Julien Boulon, David Picard

Project description:

The potential impact of nanoparticles on the environment and on health is a high profile contemporary concern. At present, the quantification of nanoparticle sources remains a major uncertainty, especially for secondary organic sources, thus weakening our capacity in predicting air quality (chemical weather) and the global climate models reliability (Pierce and Adams 2008). In some environments, it has been shown that new particle formation by nucleation and growth can contribute significantly to the total number concentrations. Once produced, these nano-particles will have a major impact on health because they will penetrate deeper in the respiratory system than bigger particles do. Moreover, after reaching a critical size, they will spontaneously grow to radiative relevant size and will contribute significantly, because of their number, to the earth radiative balance. New particle formation occurs as “events” of several hours, during which particles of 3 nm rapidly grow to larger sizes.

The spatial and temporal coverage of these observations has been confirmed by monitoring activities at atmospheric research stations in Europe. Recently long term measurements performed by the LaMP at the Ev-K2 pyramid station (Nepal, 5079 m a s l.) have shown that nucleation is the dominant process leading to elevated number concentrations of particles at high altitude (Venzac et al. 2008). Evidences indicate that nucleation process occurs at the interface between clean free tropospheric air from the residual nighttime layer and boundary layer air rising from the valley in correspondence with the shift in wind direction at the station (from a weak down-slope N-NE breeze prevailing at night to a strong up-slope S-SW wind prevailing by day). Up-slope winds bring boundary layer air from the polluted areas in the Nepal plains south of the Himalaya mountain range.

At the Puy de Dôme station, new particle formation (NPF) events take place more than 30% of the time (Venzac et al. 2007). Clearly, the frequency of this episodes calls for a better understanding of the processes involved, which are complex. To address this problem, a one-year-long European measurement campaign has been designed around simultaneous multi-station observations in the frame of the Integrated European project EUCAARI. This intensive measuring campaign is taking place at more than ten field sites around Europe: Pallas and Hyytiälä (Finland), Cabauw (Netherlands), Mace Head (Ireland), K-Puszta (Hungary), Finokalia (Greece) , San Pietro Capofiume (Italy), Hohenpeissenberg (Germany), Vavihill (Sweden), Melpitz (Germany), Jungfraujoch (Switzerland), Puy de Dôme (France) and brings together the leading European research groups and state-of-the-art infrastructure to investigate the role of aerosol on climate and air quality. The participants putting together this intensive measuring campaign are University of Helsinki, University of

Lund, University of Tartu, The French National Center for Scientific Research, Institute of Atmospheric Sciences and Climate (Italy), University of Veszprém (Hungary), Finnish Meteorological Institute, National University of Ireland, Netherlands Royal Meteorological Institute, University of Crete, HFSJG International foundation, and Leibniz Institute for Tropospheric Research. It is in this context that the NAIS has been installed at the Jungfraujoch station since April 2008, and should measure continuously cluster ions, and new particle formation events for a year long.

The classification of nucleation events has been performed from April to October 2008, into 4 major classes described in (Venzac et al. 2007). Nucleation occurred about 40% of the time, which is lower than observed at the puy de Dôme. Nucleation followed by a continuous growth occurred only 5% of the time which is a quite low frequency, compared to boundary layer sites (Kulmala et al. 2004). A significant effect of clouds was observed on the cluster ions, as illustrated on Figure 1. We observed that in clear skies, the positive cluster ion concentrations significantly exceed the ones of the negative cluster ions. In cloud, both polarities of cluster ions are scavenged and the resulting cloudy concentrations drop to a fifth of their clear sky concentrations for positive ions, and half of their concentrations for negative cluster ions. Negative cluster ions might be scavenged by cloud droplet more efficiently than negative ions because of a charged state of the droplets themselves. Another possibility to investigate is a source of positive ions in clear skies which might be inhibited under cloudy conditions. We emphasis that the charge equilibrium in cloudy conditions is inverse of the one observed under clear sky conditions (negative ions favoured). The full data set will enable us to provide a seasonal analysis of the new particle formation events at the JFJ station, and compare the results with the other 11 European stations.

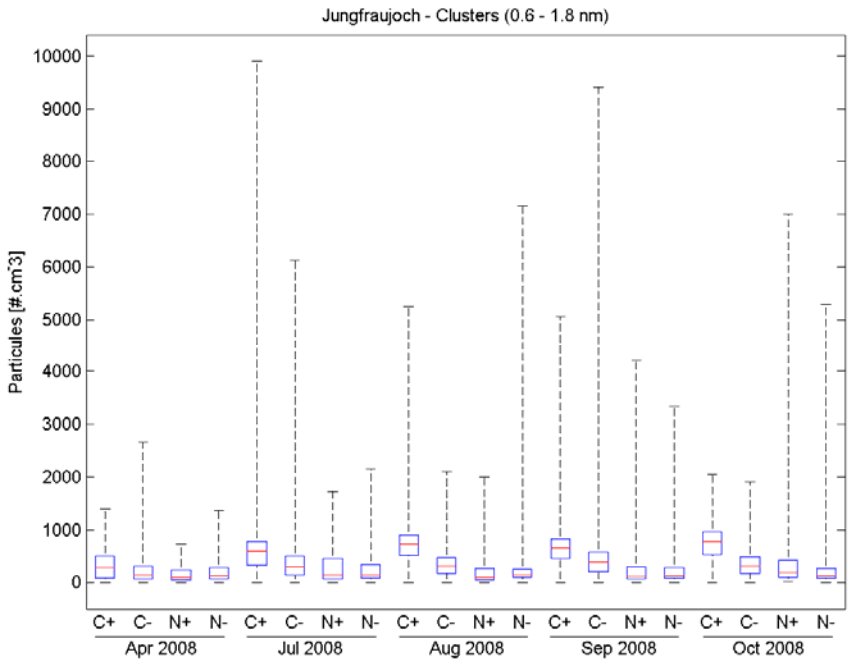


Figure 1 : Statistical analysis of the effect of clouds on the cluster ion concentrations (mobility diameter lower than 1.8 nm). C stands for measurements under clear sky situations, while N stands for cloudy situations. + and – are the polarities of the ions measured by the NAIS.

Key words:

Nucleation events, new particle formation, cluster ions, clouds

Collaborating partners/networks:

PSI, E. Weingartner, EUSAAR P. Laj, EUCAARI, M. Kulmala

Address:

Laboratoire de météorologie Physique
Université Blaise Pascal
24, avenue des landais
63170 AUBIERE, FRANCE

Contacts:

Karine Sellegri
Tel.: +33 4 73 40 73 94
Fax: +33 4 73 40 51 36
e-mail: K.Sellegri@opgc.univ-bpclermont.fr