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Ground-based observations of new particle formation during the summer 2012 PEGASOS - SUPERSITO field campaign in the Po Valley

Stefano Decesari (1), Maria Cristina Facchini (1), Matteo Rinaldi (1), Angela Marinoni (1), Gian Paolo Gobbi (2), Ari Laaksonen (3), Hanna Manninen (4), Michela Maione (5), Fabrizia Cavalli (6), and Vanes Poluzzi (7)

(1) CNR, ISAC, Bologna, Italy (s.decesari@isac.cnr.it, 0039 051 6399647), (2) CNR, ISAC, Rome, Italy, (3) Finnish Meteorological Institute (FMI), Helsinki, Finland, (4) University of Helsinki, Finland, (5) University of Urbino, Italy, (6) Joint Research Center, Ispra (VA), Italy, (7) ARPA Emilia-Romagna, Bologna, Italy

During the PEGASOS-SUPERSITO field campaign held in the Po Valley (Italy) in June-July 2012, new particle formation (NPF) was observed on 88% of the days at the rural station of San Pietro Capofiume (SPC). NPF started within the first two hours after sunrise, when the lowest atmospheric layer above the ground was characterized by reduced ozone concentrations (< 30 ppb), high NO_x (2 – 10 ppb), and relatively high concentrations of anthropogenic reactive VOC (> 200 ppt of alkyl aromatic compounds). The comparison of nucleation events in SPC with those recorded at other Po Valley stations indicates that regional NPF events are common in this environment. The nucleation onset at SPC was often anticipated with respect to nearby urban stations (Bologna), probably because of differences in condensation sink (CS) levels or in the local boundary layer meteorology including heat island effects. New particle formation was also observed at the mountain ridges enclosing the Po Valley (Monte Cimone, 2165 m a.s.l) but with a much lower frequency (35 %) with respect to the low-altitude stations. The reduced nucleation frequency on the Apennines is unexpected, because biogenic VOCs emissions are stronger and CS and temperature are lower over the elevated terrains compared to the plain. These findings indicate that the availability of anthropogenic precursors (aromatic VOCs, sulfur dioxide, ammonia and possibly amines) is critical for the frequent set-up of regional nucleation events in summertime in the Po Valley. The experiment provides an interesting opportunity to investigate NPF in contrasting environments as a function of anthropization level and emission patterns.