

CCN in an urban and remote location during wintertime: the role of biomass burning

A. Bougiatioti^{1,2}, D. Paraskevopoulou³, L. Fountziou⁴, I. Stavroulas⁴, G. Kouvarakis⁴, S. Vratolis⁵,
B. Psiloglou³, A. Nenes^{2,6}, K. Eleftheriadis⁵, G. Kallos⁷ and N. Mihalopoulos^{3,4}

¹Laser Remote Sensing Laboratory, National Technical University of Athens, 15780 Athens, Greece

²School of Earth & Atmospheric Sciences, Georgia Institute of Technology, Atlanta, GA 30332, USA

³IERSD, National Observatory of Athens, Palaia Penteli, 15236 Athens, Greece

⁴ECPL, Department of Chemistry, University of Crete, 71003 Heraklion, Crete, Greece

⁵ERL, INRSTES, N.C.S.R. Demokritos, 15310 Agia Paraskevi, Attiki, GREECE

⁶School of Chemical & Biomolecular Engineering, Georgia Institute of Technology, Atlanta, GA 30332, USA

⁷Department of Physics, University of Athens, 1584 Athens, Greece

Keywords: CCN, biomass burning, hygroscopicity, BC, CO

Presenting author email: kbougiatioti@gmail.com

CCN concentrations depend on aerosol size distribution, particle composition and mixing state of the atmosphere [1], therefore CCN are expected to vary depending on the environment. A significant portion of submicron aerosol is comprised of organic material, which can be largely derived from biomass burning (BB) [2]. In an urban environment where various sources may contribute to CCN activity, it is interesting to investigate the role of BB.

During wintertime 2015, two CCN counters [3] were concurrently deployed in Greece, for the first time. One was situated in downtown Athens, and one at the remote background site of Finokalia, Crete. Measurements took place from 30 January until 15 February 2015. Both instruments were running in a constant-flow mode, measuring total CCN concentrations, and iterating between five supersaturations (0.2, 0.4, 0.6, 0.8 and 1%) every 10 min. At the same time, Scanning Mobility Particle Sizers (SMPS) provided the submicron aerosol size distribution at both sites. Atmospheric monitors provided the main gas constituents as well as particulate matter concentration. Finally, particulate sulfate and nitrate was provided by a Particle-Into-Liquid Sampler (PILS) at Athens and by an Aerosol Chemical Speciation Monitor (ACSM, Aerodyne Inc.; [4]) at the Finokalia Station. During that period an extreme mineral dust transport event from Sahara took place, followed by cold weather conditions a few days later. Therefore it was a unique opportunity to study the different sources of CCN (dust, traffic and BB) and CCN hygroscopicity in a heavy urban environment and in a remote site.

At a first glance, CCN concentrations at the urban environment are almost an order of magnitude, higher than those at the remote site. This is, more or less, expected due to the larger particle load in the urban environment. Another important difference is the peak of CCN concentrations, with diurnal variability shown in Fig.1, which in Athens are during night-time while in Finokalia around noon. At Athens, the extremely high CCN concentrations during night-time can be associated to sources such as domestic heating, as the timeseries and diurnal variability as well, show very good correlation with BB tracers such as BC and CO. At the remote site this peak may be attributed to atmospheric

processing from long-range transport, rendering particles more CCN-active. The role of biomass burning is once more evident from the correlation in the diurnal variability with BC.

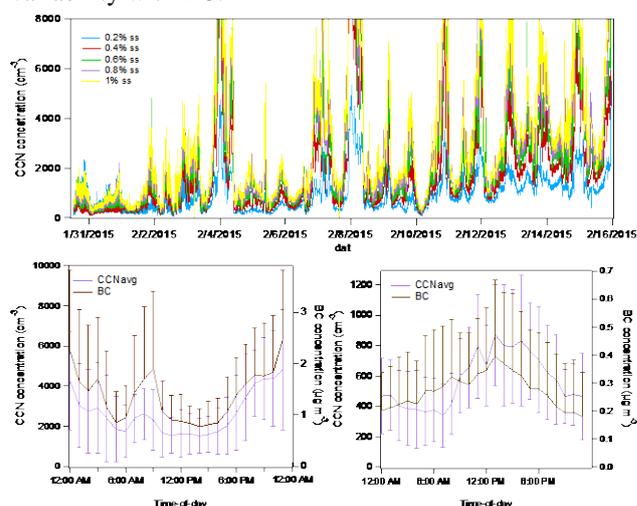


Figure 1. CCN concentrations at Athens and diurnal variability at urban (left) and remote (right) site where both CCN and BC are one order of magnitude lower

With the use of size distributions the total hygroscopicity parameter, kappa [5] as well as the activation fractions are calculated and the relative contribution of different sources, with emphasis on BB, are presented and thoroughly discussed.

- [1] Dusek, U., Frank, G. P., Hildebrandt, L., Curtius, J., Schneider, J., Walter, S., Chand, D., Drewnick, F., Hings, S., Jung, D., Borrmann, S., and Andreae, M. O (2006), *Science*, **312**, 1375–1378.
- [2] Bond, T., Streets, D., Yarber, K., Nelson, S., Woo, J.-H., and Klimont, Z. (2004), *J. Geophys. Res.*, **109**, D14203.
- [3] Roberts, G. and Nenes, A. (2005), *Aerosol Sci. Tech.*, **39**, 206–221.
- [4] Ng, N.L., Herndon, S.C., Trimborn, A., Canagaratna, M.R., Croteau, P.L., Onasch, T.B., Sueper, D., Worsnop, D.R., Zhang, Q., Sun, Y.L., and Jayne, J.T. (2011), *Aerosol Sci. Technol.*, **45** (7), 780-794.
- [5] Petters, M. D. and Kreidenweis, S. M. (2007), *Atmos. Chem. Phys.*, **7**, 1961–1971.