New Aerosol Particle formation in Amazonia

Matisāns M.[1], Tunved P.[1], Hamburger T.[1], Manninen H.E.[5], Backman J.[5], Rizzo L.[2], Artaxo P.[4], Riipinen I.[1], Swietlicki E.[3], Krejči R.[1], Kulmala M.[5]

[1]Department of Applied Environmental science, Stockholm University, Stockholm, 10691, Sweden
[2]Department of Earth and Exact Sciences, Federal University of São Paulo, São Paulo, Brazil
[3]Div. of Nuclear Physics, Dept. of Physics, Lund University, S-22100 Lund, Sweden
[4]Department of Applied Physics, Institute of Physics, University of São Paulo, São Paulo, Brazil
[5]Department of Physics, Helsinki University, Helsinki, Finland
Keywords: Nucleation, NPF, Amazonia, Particle growth, cluster analysis.
Presenting author email: modris.matisans@itm.su.se

Events of new particle formation (NPF) in tropical boundary layer followed by consecutive growth towards Aitken mode size range are sparse compared to mid- latitudes Kulmala et al. (2004). This is also the case for rainforest environment. More often short episodes of elevated ultra-fine and Aitken mode aerosol particle concentrations are observed their origin and the processes governing these episodes do however remain unclear. Based on observations performed in the Amazonian rainforest environment combined with statistical analysis we present a mechanism explaining the erratic appearance of ultra-fine aerosol in tropical boundary layer of the rainforest.

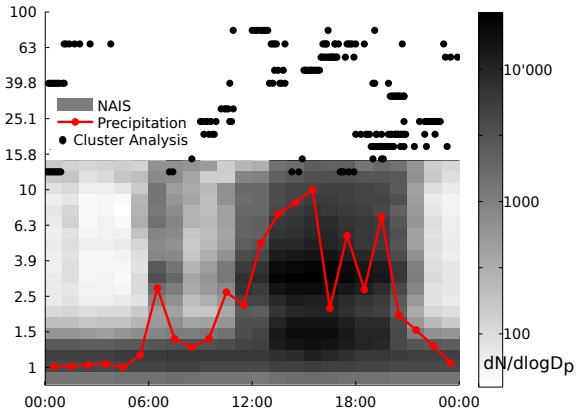

Figure 1: NAIS negative ion concentration 95th percentile diurnal pattern combined with cluster analysis method results (black dots). Mean values for precipitation are given in arbitrary units.

Abstract review

To observe any underlying ultra-fine particle processes we chose to look at the SMPS data and applied a statistical method based on kmeans cluster analysis technique. MacQueen (1967) has described kmeans cluster analysis in detail. Prior to our study cluster analysis has been implement in aerosol science for other purposes, such as principle meteorological component analysis in particle nucleation day classification (Hyvönen et al., 2005) and investigation of processes controlling the evolution of aerosol particle size distribution properties (Tunved et al., 2004). In this study we expand application of cluster analysis to a method that requires preliminary filtering and normalization of data. The introduced method allows for mining ultra fine particle statistics by analysing particle size distributions selectively.

Each scan was normalized to its maximum number concentration; thus, we are focusing on different shapes of particle size distributions instead of absolute number concentrations. Only size distributions having a local a maximum between 10 to 80 nm were considered further analysis. This was achieved by discarding size distributions whose second order derivative of number size distribution curve was greater than 0.

Diurnal occurrence cycle for the clusters reveals a pattern that we eventually compare to ion production by precipitation diurnal pattern. After ion production is stopped, 20 nm particle formation by self–coagulation estimates to 800 cm^{-3}.

Kulmala, M., Vehkamäki, H., Petäjä, T., Dal Maso, M., Lauri, A., Kerminen, V., Birmili, W., and McMurry, P. (2004) *Formation and growth rates of ultrafine atmospheric particles: a review of observations*, Journal of Aerosol Science, 35, 143âĂŞ176.

MacQueen, J. *Some methods for classification and analysis of multivariate observations* Proceedings of the fifth Berkeley symposium on mathematical statistics and probability vol. 1, p. 14, California, USA

Hyvönen, S., Junninen, H., Laakso, L., Dal Maso, M., Gronholm, T., Bonn, B., Keronen, P., Aalto, P., Hiltunen, V., Pohja, T., Launiainen, S., Hari, P., Mannila, H., and Kulmala, M. (2005) *A look at aerosol formation using data mining techniques*, Atmospheric Chemistry and Physics, 5, 3345–3356.

Tunved, P., Ström, J., Hansson, H., et al. (2004) *An investigation of processes controlling the evolution of the boundary layer aerosol size distribution properties at the Swedish background station Aspvreten*, Atmospheric Chemistry and Physics Discussions, 4, 4507–4543.