Dataset name: **iCUPE Dataset (DS) from Deliverable 4.1.2:**

Pilot DS aerosol reanalysis for SMEAR-II

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Introduction

Regional new particle formation (NPF) events take place around the world (Nieminen et al., 2018) and contribute significantly to total concentration of atmospheric aerosol particles and to their climate impacts (Merikanto et al., 2009). Classification of days to NPF event and non-event days (Dal Maso et al., 2005) has been traditionally a tool to investigate the atmospheric chemical, physical and meteorological conditions favourable for NPF to take place (e.g. Dada et al., 2017). However, the traditional classification based on Dal Maso et al. (2005) does not make difference between days when regional NPF event takes place at the measurement site and the days when the new NPF particle mode appears at slightly larger diameters, the latter indicating that the regional NPF event occurred in upwind of but not at the measurement site (Buenrostro Mazon et al., 2009; Leino et al., 2019).

The novel automatic method presented by Dada et al. (2018) classifies regional NPF events to those taking place at the measurement site and those during which the particles are transported to the site. In addition to regional NPF events, the method also detects ion formation events, during which charged molecular clusters in diameter range 2-4 nm are observed, but the formation of neutral particles does not take place (Buenrostro Mazon, 2016). The days when neither regional NPF event or ion burst is observed are classified as non-events. The classification is done based on measurements with Neutral cluster and Air Ion Spectrometer (NAIS, Airel Ltd., Estonia Mirme and Mirme, 2013).

The method also automatically determines the time windows during which NPF and ion cluster formation takes place at the measurement station. This information is crucial for analysing the chemical, physical and meteorological drivers of these processes.

In this deliverable, we produce an open dataset on the event classification at SMEAR II station in Hyytiälä, Southern Finland (Hari and Kulmala, 2005), for years 2006-2020 according to Dada et al. (2018). An adjustment to the original method was made by loosening the original limitation of event start and end times from 6:00-19:00 to 4:00-24:00.

Classification dataset

Classification for SMEAR II station is openly available in AVAA service (Junninen et al., 2009) at https://smear.avaa.csc.fi/download under Creative Commons 4.0 Attribution (CC-BY) license. Initial dataset includes years 2006 to 2020 (October) and will be updated repeatedly.

The data set (under Station "SMEAR II Hyytiälä forest" and Variable category "Aerosol (intermittent)") includes the following data for each day (excluding days with insufficient data):

- Variable "NPF event class (NAIS)"
  - Event classification

    1 regional NPF events taking place at the station
    2 transported NPF events
    -1 ion bursts
    0 non-events

  - Date and start time (YYYY-MM-DD-HH-MM-SS)

    For classes 1 and -1 date and the start time of new particle or cluster ion formation
    For classes 0 and 2 the date (YYYY-MM-DD-00-00-00)

- Variable "NPF duration"
  - Date and start time (YYYY-MM-DD-HH-MM-SS)

    For classes 1 and -1 date and the start time of new particle or cluster ion formation
    For classes 0 and 2 the date (YYYY-MM-DD-00-00-00)

  - Duration of events in hours

    For classes 1 and -1

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