The effect of cloudiness on new particle formation: investigation of radiation levels

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The importance of solar radiation as a driver of new particle formation has been firmly confirmed in the literature. Boy and Kulmala (2002) showed that appearance of clouds during new particle formation (NPF) events in May 1999 did sometimes stop the nucleation. However, seasonal cloud effects on NPF events have not been systematically investigated. In this research, we look into this question by analysis of the ratio Half-hourly measured global-radiation (I) divided by calculated half-hourly clear-sky global radiation (I_{max}) during NPF events recorded at Hyytiälä station in 2008-2011. The time during which the ratio I/I_{max} was analyzed (hereafter the time range) for each NPF event corresponded to the period of appearance of newly formed 3nm particles. The time range was defined visually from the so called banana. The global radiation (I) data are actual measurement data downloaded from SMEAR II station and I_{max} data are modelled data downloaded from AERONET website (http://aeronet.gsfc.nasa.gov/).

We classified the event days as "quantifiable" and a "Non-quantifiable" according the criterion introduced by Dal Maso *et al* (2005) which is whether the event is homogeneous enough to quantify the basic characteristics such as formation rate and growth rate or not. The half-hourly ratio of I/I_{max} on event days versus hour of day has been plotted for four seasons winter (Dec-Jan-Feb), spring (Mar-Apr-May), summer (Jun-Jul-Aug), see Fig. 1, and autumn (Sep-Oct-Nov). The results show that in the winter, the NPF events only start when I/I_{max} have high values (> 0.65). Also, in the three other seasons the radiation level is mostly high at the start time of the NPF events.

Table 1. Frequency (%) of ratio (I/I_{max}) values in the given ranges, at start time of event days

Season	[0-0.5] Quant	[0.5-1] Quant	[0-0.5] Non-Quant	[0.5-1] Non-Quant
Winter	0	100	0	100
Spring	11.11	88.9	5.26	94.8
Summer	0	100	8	92
Autumn	20	80	25	75

Table 1 shows that in the summer, all quantifiable events and 94.8% of non-quantifiable events happen when I/I_{max} > 0.5. The frequency of quantifiable events in the range [0-0.5] is 11.11% and 20 % in spring and autumn, respectively. This means there is a possibility that NPF events occur also at cloudy conditions in spring and autumn (note, however, that the amount of data is limited so that we cannot exclude the possibility of NPF in cloudy conditions also in winter and summer).

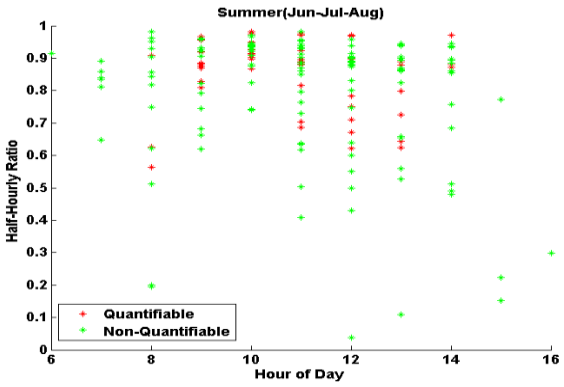

Figure 1. Half-hourly ratio (I/I_{max}) during the time range during 2008-2011at Hyytiälä .

In future work we will extend the study to longer periods and other stations beside Hyytiälä. We will also investigate the relations between I/I_{max} and particle formation and growth rates.

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