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The part of the solar spectrum with the highest influence on the formation of SOA in the continental boundary layer

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Abstract. The relationship between nucleation events and spectral solar irradiance was analysed using two years of data collected at the Station for Measuring Forest Ecosystem-Atmosphere Relations (SMEAR II) in Hyytiälä, Finland. We analysed the data in two different ways. In the first step we calculated ten nanometer average values from the irradiance measurements between 280 and 580 nm and explored if any special wavelengths groups showed higher values on event days compared to a spectral reference curve for all the days for 2 years or to reference curves for every month. The results indicated that short wavelength irradiance between 300 and 340 nm is higher on event days in winter (February and March) compared to the monthly reference graph but quantitative much smaller than in spring or summer. By building the ratio between the average values of different event classes and the yearly reference graph we obtained peaks between 1.17 and 1.6 in the short wavelength range (300--340 nm). In the next step we included number concentrations of particles between 3 and 10 nm and calculated correlation coefficients between the different wavelengths groups and the particles. The results were quite similar to those obtained previously; the highest correlation coefficients were reached for the spectral irradiance groups 3--5 (300--330 nm) with average values for the single event classes around 0.6 and a nearly linear decrease towards higher wavelengths groups by 30%. Both analyses indicate quite clearly that short wavelength irradiance between 300 and 330 or 340 nm is the most important solar spectral radiation for the formation of newly formed aerosols. In the end we introduce a photochemical mechanism as one possible pathway how short wavelength irradiance can influence the formation of SOA by calculating the production rate of excited oxygen. This mechanism shows in which way short wavelength irradiance can influence the formation of new particles even though the absolute values are one to two magnitudes smaller compared to irradiance between 400 and 500 nm.

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