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Formation and characteristics of ions and charged aerosol particles in a native Australian Eucalypt forest

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Abstract. Biogenic aerosol formation is likely to contribute significantly to the global aerosol load. In recent years, new-particle formation has been observed in various ecosystems around the world but hardly any measurements have taken place in the terrestrial Southern Hemisphere. Here, we report the first results of atmospheric ion and charged particle concentrations as well as of new-particle formation in a Eucalypt forest in Tumbarumba, South-East Australia, from July 2005 to October 2006. The measurements were carried out with an Air Ion Spectrometer (AIS) with a size range from 0.34 to 40 nm. The Eucalypt forest was a very strong source of new aerosol particles. Daytime aerosol formation took place on 52% of days with acceptable data, which is 2–3 times as often as in the Nordic boreal zone. Average growth rates for negative/positive 1.5–3 nm particles during these formation events were 2.89/2.68 nmh^{-1}, respectively; for 3-7 nm particles 4.26/4.03, and for 7–20 nm particles 8.90/7.58 nmh^{-1}, respectively. The growth rates for large ions were highest when the air was coming from the native forest which suggests that the Eucalypts were a strong source of condensable vapours. Average concentrations of cluster ions (0.34–1.8 nm) were 2400/1700 cm^{-3} for negative/positive ions, very high compared to most other measurements around the world. One reason behind these high concentrations could be the strong radon efflux from the soils around the Tumbarumba field site. Furthermore, comparison between night-time and daytime concentrations supported the view that cluster ions are produced close to the surface within the boundary layer also at night but that large ions are mostly produced in daytime. Finally, a previously unreported phenomenon, nocturnal aerosol formation, appeared in 32% of the analysed nights but was clustered almost entirely within six months from summer to autumn in 2006. From January to May, nocturnal formation was 2.5 times as frequent as daytime formation. Therefore, it appears that in summer and autumn, nocturnal production was the major mechanism for aerosol formation in Tumbarumba.

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