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The Climatic Significance of Organic Aerosol in the Boreal Region

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Biogenic secondary organic aerosol (BSOA) constitutes a major fraction of aerosol over boreal forests. As the emissions of BSOA precursors are temperature dependent, changes in temperature have potentially important implications on regional aerosol radiative forcing. Here, we have used long-term aerosol composition and temperature data measurements from a boreal forest site together with remote sensing observations of aerosol and cloud properties to investigate the effect of increasing temperature on organic aerosol mass loadings, and further on aerosol direct and indirect radiative effects. The analysis was based on 7 years of measurements done at Hyytiälä, Southern Finland, and they cover the summer months (July-August) between 2012-2018. We limited the analyses to these summer months to isolate the temperature dependence of the organic mass loadings from the seasonal effects arising from the vegetation growth cycle. Our analysis showed that organic aerosol loadings and cloud condensation nuclei concentrations increased in concert with surface temperature. Furthermore, we found that cloud reflectivity increased when the organic aerosol loadings increased. This research presents the first direct observational evidence on the effect of BSOA on cloud properties and their climatic significance.