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A Multi-Year Comparison of PM2.5 and AOD in the Region of Finnish Capital Helsinki

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Particulate matter (PM) is a significant air pollutant originating from natural and anthropogenic sources. The ground-based network of measurements is usually sparse, thus, there have been several attempts to obtain PM estimates from satellite measurements. However, the relationship is different from one location to another due to different environment and site properties, for instance local pollution sources. In addition, the chemical composition and concentration of PM changes substantially as a function of time and location.

We studied the relationship between satellite-based aerosol optical properties and aerosol mass concentration measured on the ground. The aerosol optical depth (AOD) is a measure describing atmospheric columnar attenuation of radiation caused by aerosols. AOD is retrieved from data supplied by Moderate Resolution Imaging Spectroradiometer (MODIS) on board two satellite platforms Terra and Aqua. PM concentration with aerodynamic diameter less than 2.5μm (PM2.5) is measured on the ground. The PM data for this study is from four sites within the Helsinki (Finnish capital) region with approximately 1 million inhabitants. Depending on the site, the length of the data record varies between two and seven years starting in 2000 and ending in 2006.

In this study, we investigated how long temporal average of PM supplies the best correlation with AOD of the same day. We found, that depending on the site, the temporal PM averaging of few hours resulted in a better correlation with AOD than the one-hour PM averages. Furthermore, the correlation was strongest between monthly PM and AOD averages (R=0.75). We also studied PM and AOD gradients between an urban and a rural site. Monthly averages at the urban site were typically higher than those at the rural site, still having also similar seasonal behaviour.