# Long-term measurements of aerosol physical properties in the Noto Peninsula

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According to Zeng et al. (2019) [1] the concentration of particulate matter (PM) have decreased significantly in China since 2013. Whether this decrease can be detected eastward, remains to be validated. In particular, the 2013-2017 summary report of the Long-range Transboundary Air Pollutants project [2] has estimated that China's contributions to PM2.5 concentration affecting Japan is 24.6 percent, while South Korea's contributions are 8.2 percent, based on source-receptor relationship simulations. Then, it is expected that a decrease of Long-range Transboundary Air Pollutants (LTP) will have a positive feedback in the air quality of many cities of Japan. To validate these assumptions and improve our understanding on LTP, it is necessary to perform continuous monitoring of air quality, especially in remote sites, scarcely affected by local emissions.

In this study we report a comprehensive survey on the trend of PM2.5 measured from 2013 to 2019 at NOTOGRO (acronym for NOTO Ground-based Research Observatory). Due to its special location, the site (37.45°N, 137.36°E) is well suited to assess the influence of transboundary air pollutants with respect to the background. Through the analysis of 7 years' worth of measurement data, we have investigated the seasonal and the long-term trend of the aerosol mass and size distributions.

Figure 1 shows the boxplot of the PM 2.5 mass concentration measured by a tapered element oscillating microbalance (TEOMseries1400). The blue fitting highlights the seasonal trend, while the red fitting traces the long-term trend based on Theil-Sen analysis. Monthly average concentrations are high in spring, and low in late autumn and winter. These variations are largely associated to the occurrence of long–range transport in spring, and increased amount of precipitation characteristically seen along the western coast of Japan in winter. Furthermore, PM2.5 concentrations are higher in summer, than in autumn, due to the influence of secondary formation that are driven by photochemical reactions.

In addition to these seasonal variations, a consistent decrease in the annual mean mass concentration can be observed. Considering that the analyzed period overlaps the ‘Chinese Action Plan on Prevention and Control of Air Pollution’, we suggest that LTP arriving in NOTOGRO are changing, as response to the decrease scenario of the Asian continent emissions. To further understand these modifications, our analysis has considered also the number and size distribution of the dried atmospheric aerosols for the same period 2013-2019.

The analysis of the aerosol number concentration, for Dp>0.3 $\mu$m, measured by an optical particle counter (OPC from RION model KC-01E) shows a decrease of the total number concentration below 2 $\mu$

m and mainly in the accumulation particles mode. The analysis of the particle size distributions measured in the range 0.01-0.3 μm, by a scanning mobility particle sizer (SMPS, from TSI DMA model 3081+CPC model 3776) is also considered. From the peak analysis of SMPS data, we observe that there was no significant change in the median seasonal distributions. However, the size segregated total aerosol number concentration indicates distinct behaviors in the long-term trends of different particles modes. Furthermore, SMPS data confirms a decrease only for the range 0.2-0.3 μm.

These findings support that a preferential particle size range (0.2-2 μm) is responding mostly to the decreases of LTP, and the decreased emissions doesn't affect equally all particle sizes. Our results are worthwhile for the validation of emission inventory and simulation models.

Keywords: Long-range Transboundary Air Pollutants, Monitoring, Atmospheric Aerosols, PM2.5