

# Long-term trend of springtime tropospheric ozone at Mt. Happo, Japan, 1998–2016

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Tropospheric ozone is one of the most important trace gases in the Earth's atmosphere because it plays a central role in global warming, oxidizing capacity of the troposphere, and air quality at local, regional and global scales. During the past decades the emissions of pollutants from East Asia have been rapidly increasing. In particular China is the largest and dominant contributor to the Asian emissions. However, recent several studies based on the analysis of satellite tropospheric nitrogen dioxides data inferred possible peaking out of nitrogen oxides emissions in China. Along with the emissions, climate plays an important role in controlling the variations in tropospheric ozone. Some studies suggested that interannual to decadal climatic variations modulate the airflow from polluted regions. We revisited and updated the long-term trend of tropospheric ozone at Mt. Happo, Japan, based on continuous measurements for the period from 1998 to 2016. We focused on the springtime ozone concentration and possible influences by the continental outflow from East Asia. Since 1998 the springtime ozone concentration has shown a large increase until 2007, very likely caused by the increase in the emissions of ozone precursors associated with economic growth in eastern China, as evidenced from satellite observations of nitrogen dioxides. After the monotonic increase until 2007, the ozone level has been flattened associated with substantial drops in 2008 and 2012. And the recent ozone levels have been sustained until 2016. We concluded that two decreases were induced by two different factors. One is the decrease of contribution from central eastern China because of the changes in meteorological fields. When the anomaly of pressure over the Pacific Ocean east of Japan decreases and the anomaly surrounding the Tibetan Plateau increases, polluted air masses from central eastern China tend to be transported to Mt. Happo by the strong westerly component. The other factor is the decrease in emissions of ozone precursors from eastern China, which is the phenomenon observed by satellite.

Keywords: ozone