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The influence of typhoons on atmospheric composition deduced from IAGOS aircraft measurements over Taipei

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The research infrastructure IAGOS (In-Service Aircraft for a Global Observing System) equips commercial aircraft with instruments to monitor the composition of the atmosphere on long- haul flights around the world. In this article, we use data from two China Airlines aircraft based in Taipei (Taiwan) which provided daily measurements of ozone, carbon monoxide, water vapor and cloud particles throughout the summer of 2016. We present time series from the surface to the upper troposphere, of ozone, carbon monoxide, and humidity at Taipei focusing on periods influenced by the passage of tropical cyclones. We examine landing and take-off profiles in the vicinity of cyclones using FLEXPART trajectories and ERA-5 reanalyses to elucidate the origin of the anomalies in the vertical distribution of these chemical species. Results indicate high ozone at altitudes between 6 and 10 km upstream of the storms. The high ozone mixing ratios are generally correlated with potential vorticity and anti-correlated with relative humidity, suggesting stratospheric origin. Trajectories also indicate the role of tropical cyclones in transporting air from the stratosphere to troposphere. After the tropical cyclone, the tropospheric column is filled with very low ozone mixing ratios due to the rapid uplift of marine boundary layer air. At the same time, the relative humidity increases, and carbon monoxide mixing ratios fall. Locally, the passage of typhoons has a positive effect on air quality at the surface, cleansing the atmosphere and reducing the mixing ratios of pollutants such as carbon monoxide and ozone. Such pollutants are dumped in the upper troposphere, where they have the potential to be carried over long distances with implications for air quality at distant locations.