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Understanding temperature, humidity, and ozone profiles from unmanned aerial system flights at the Lake Michigan shoreline in relation to lake breeze

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Understanding temperature, humidity, and ozone profiles from unmanned ...

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Abstract



0 Datasets

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Abstract

In June 2020, a series of Unmanned Aerial System (UAS) flights were conducted as part of the Wisconsin's Dynamic Influence of Shoreline Circulations on Ozone (WiscoDisco20) campaign over the Chiwaukee Prairie State Natural Area in Southeastern Wisconsin. Temperature and humidity measurements were taken using an iMet-XQ2 atmospheric sensor and ozone measurements were taken by a 2B Tech POM sensor. Both sensors were mounted on a DJI M600 Hexacopter and two flights were conducted a day, one in the morning around 8 am (CDT), and one in the afternoon around 2 pm (CDT). Each flight was broken up into three subsections to land and switch batteries, and hover altitudes were 10 meters above ground level (m AGL), 15, 30, 45, 60, 75, 90, 105, and 120 m AGL. Observations aloft were compared with observations from a regulatory ground station to verify the reliability of the UAS measurements. Using the field data compiled from June 15-19, 2020, the existence of atmospheric inversions that were introduced by east to southeast winds illustrated a clear lake breeze effect. Atmospheric inversions are sections of the atmosphere where the temperature, humidity, and pollutant composition can have sudden dramatic shifts. These inversions occurred at different heights each day, but the inversion layer's beginning ranged from 40 m to 100 m. The inversions demonstrated a large change in both humidity and temperature, often sharply changing up to 5 °C and by up to 35% relative humidity. With this change also comes a significant increase in ozone concentration in the inversion layer compared to its surroundings, with ozone peaking in concentration at the beginning of the inversion layer. Ozone in the inversion layer was regularly found to be in excess regulatory safety standards of throughout the week.

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