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**How well satellite remote sensing can inform surface level ozone production sensitivity to precursor trace gas emissions?**

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Surface-level ozone (O3) pollution mitigation strategies rely on a clear understanding of the atmospheric chemical processes involving O3, NOx (nitric oxide (NO) + nitrogen dioxide (NO2)) and volatile organic compounds (VOCs). A robust spatiotemporal classification of O3 photochemical regimes with relative chemical sensitivity of local O3 formation to emission reductions of NOx (NOx-limited regime) versus VOCs (radical-limited regime) is required to design anthropogenic emission reduction policies in order to improve surface air quality. Numerous studies found that the ratio of satellite-retrieved Vertical Column Densities (VCDs) of formaldehyde (HCHO) to NO2 can diagnose O3 production sensitivity. However, uncertainty still remains about the accuracy of such estimates using satellite-based retrievals. This study conducts an investigation to identify how well satellite data can inform surface-level O3 sensitivity by validating satellite-based estimates against aircraft-based retrievals taken during the Long Island Sound Tropospheric Ozone Study (LISTOS-2018) and Ozone Water-Land Environmental Transition Study (OWLETS-2) field campaigns. For this study, we use HCHO and NO2 retrievals from the Ozone Monitoring Instrument (OMI) onboard the Aura satellite, and high spatiotemporal resolution TROPOspheric Monitoring Instrument (TROPOMI) onboard the Sentinel-5 Precursor (S5P) satellite. The Community Multiscale Air Quality (CMAQ) modelling system is used to provide trace gas vertical profiles to recalculate air mass factor for deriving consistent satellite-based VCDs. To demonstrate the ability of satellites to diagnose O3 production regimes, we validate satellite-derived O3 sensitivity regimes, along with the OMI and TROPOMI products applied, using HCHO and NO2 retrievals from the aircraft-based instruments: Geostationary Trace gas and Aerosol Sensor Optimization (GeoTASO) spectrometer and Geostationary Coastal and Air Pollution Events Airborne Simulator (GCAS) instruments deployed during the LISTOS-2018 and OWLETS-2 campaigns. The results of this work will advance our fundamental knowledge of the spatiotemporal evolution of the complex O3-NOx-VOC chemistry, and will advance our understanding about the quality of remote-sensing, suborbital, and satellite data for accurately observing surface-level O3 production sensitivity.