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Enhanced tropospheric ozone associated with midlatitude cyclones: March 2018 case studies from networked Pandora observations and modeling

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Late winter and early spring are a period often associated with large numbers of extratropical disturbances in the northern mid-latitudes. Further, disturbances that develop into cyclones are critical to the balance of Earth's climate and are known to induce changes in atmospheric composition, including intrusion of ozone-rich stratospheric air into the troposphere. The late winter period of 2018 was an exceptionally explosive time for cyclogenesis in the eastern United States, with four northeasters, two achieving bomb status, developing in a period of three weeks from early to late March. During this time, as part of the NASA Pandora Project, a network of Pandora spectrometer systems was present throughout the eastern United States. In this study, we demonstrate the potential value of networked ground-based observations for tracking synoptic scale tropospheric ozone enhancement. To achieve this, networked Pandora observations were coupled with additional remote sensing, model, and reanalysis datasets to provide a more complete picture of these events. We present Pandora and similar observations detailing enhanced total column as well as tropospheric ozone associated with the passage of these storms and corroborate these observations with model and reanalysis datasets. When coupled with the vertical resolution of these datasets and additional platforms, we argue a ground-based network of air quality/atmospheric composition observations are a valuable and economical tool for observing synoptic activity.