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Stratospheric radiative anomalies associated with water vapor in a long-lived pyroCb plume

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A group of close proximity pyroconvective events occurred on 12 August 2017 in the Pacific Northwest that injected an unprecedented smoke plume directly into the lower stratosphere. The size and duration of this plume allowed for observations for over 100 days using satellite-based instruments. During this time, two remarkable aspects of this plume were observed by A-Train sensors: 1) it separated into multiple layers that circumnavigated the globe at different latitudes, altitudes and travel directions, and 2) it underwent diabatic lofting such that a portion reached an altitude approximately 10 km greater than the initial injection. The Microwave Limb Sounder (MLS) on-board NASA's Aura satellite observed significant enhancements in CO and H_2O that confirm this movement, and are corroborated with lidar observations of aerosol made by the Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations (CALIOP) instrument. Using these observations, we have tracked several parts of the plume and input the anomalous trace gas amounts into line-by-line radiative transfer simulations. Making comparisons with regional 10-year stratospheric climatologies from MLS, we find an average longwave (25-3000 cm^{-1}) heating rate anomaly ranging from +0.2 to +0.7 K day^{-1} just below the plume, and -1.0 to -0.5 K day^{-1} within and just above the plume. Similar comparisons with surface downward flux show anomalies ranging from -0.2 to +0.3 W m^{-2}.