Weekly Report – December 06, 2024

Cooperative Institute for Satellite Earth System Studies (CISESS)

NOAA/NESDIS/STAR

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PUBLICATIONS

Trends in Temperature, Water Vapor, and Surface Pressure: Signals of Climate Change and Atmospheric CO_2 Increases

Citation: Liu, Quanhua, **Christopher Grassotti**, **Yan Zhou**, **Yong-Keun Lee**, Shuyan Liu, and John Xun Yang, 2024: Trends of temperature and total precipitable water, as well as the trend of surface pressure induced by CO_2. Sci. Rep., 14, 29202, https://doi.org/10.1038/s41598-024-80685-8.

Summary: In a recently published paper "Trends of temperature and total precipitable water, as well as the trend of surface pressure induced by CO_2 ", led by NOAA/STAR scientist Quanhua Liu, and coauthored by CISESS Scientists Yan Zhou, Chris Grassotti, and Yong-Keun Lee and colleagues, the researchers analyzed trends in atmospheric water vapor (total precipitable water, or TPW), surface air temperature, and surface pressure from European Centre for Medium-Range Weather Forecasts Reanalysis version 5 (ERA5) data. The work, published in the Nature open-access journal *Scientific Reports*, analyzed long-term trends in all three variables during the period of 2012 to 2024. The analysis yielded several important results: (1) Positive trends in TPW and 2-meter air temperature during this period were 0.227 mm and 0.332 K per decade, respectively; (2) an increase in carbon dioxide concentration during the period of analysis contributes to an increase of roughly 0.037 hPa per decade in surface pressure, which represents 57% of the total surface pressure trend; and (3) global trends based on using ERA5 hourly analyses and trends based only on analyses near 1:30 am and 1:30 pm local times are nearly identical. This last result is important because it indicates that well-calibrated satellite observations from a single polar-orbiting satellite, such as those from the NOAA-21 Advanced Technology Microwave Sounder, which observes most locations only twice daily, may be sufficient for accurately determining trends in climate-sensitive variables, such as water vapor and temperature.

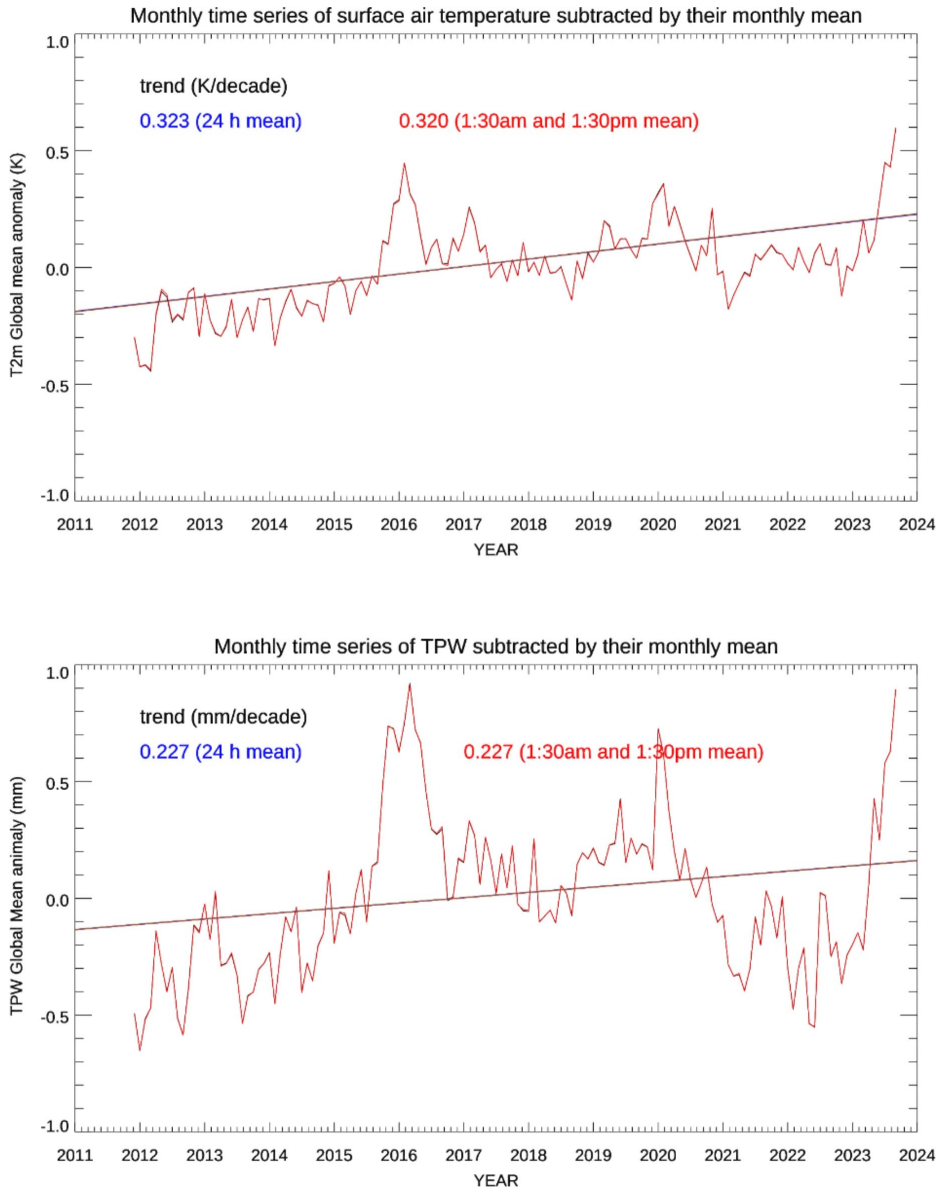

Figure: Time series of global monthly anomalies of 2-meter air temperature (top) and TPW (bottom) derived from ERA5 analyses. The straight lines are the linear trends derived from the monthly anomalies. Anomalies and trends are shown for global means based on 1:30 am/1:30 pm local time data only (red) and all hourly data (black). The anomalies and trends for both data sets are so similar that the black curves are almost obscured by the red curves. Computed annual trend values for both 24-hour and 1:30 am/pm data are shown in blue and red, respectively.

(Christopher Grassotti, CISESS, christopher.grassotti@noaa.gov, Funding: DACS, JPSS PGRR, JSTAR, METOP-SG; Yan Zhou, CISESS, yanzhou@umd.edu, Funding: JPSS PGRR, JSTAR, PSDI

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High Ozone Levels over the North China Plain in the Spring and Summer of 2016
Citation: He, Hao, Zhanqing Li, and **Russell R. Dickerson**, 2024: Ozone pollution in the North China Plain during the 2016 Air Chemistry Research in Asia (ARIAs) campaign: observations and a modeling study. Air, 2, 178–208, https://doi.org/10.3390/air2020011.
Summary: The North China Plain (NCP) is one of the most densely populated regions in the world and has experienced rapid economic growth in recent decades. The accompanying fossil fuel energy consumption and associated poor air quality has, for one, become a serious health concern for people living in the NCP. Tropospheric ozone (O_3), with its relatively long lifetime of days to weeks, is one of many pollutants that has become problematic in the area. To better understand the characteristics of O_3 pollution, the Air Chemistry Research in Asia (ARIAs) aircraft campaign was conducted in Hebei Province in the NCP in May and June of 2016. In a recent article in the journal *Air*, CISESS Scientist Russel Dickerson and colleagues at the University of Maryland evaluated anthropogenic emissions and O_3 pollution in the NCP using a combination of aircraft measurements from the campaign, satellite observations, and modeling results. On the observational side, they report that high concentrations of air pollutants, including O_3, carbon monoxide (CO), and nitrogen compounds, were measured during the study period. On the modeling side, Community Multiscale Air Quality (CMAQ) model simulations driven by the 2010 Emissions Database for Global Atmospheric Research (EDGAR) underestimated levels of O_3 and its precursors in the campaign region. Adjusting EDGAR emissions over East Asia based on satellite observations improved the simulation of O_3 and its precursors. Satellite observations and CMAQ simulations suggest that local ozone production is mainly controlled by volatile organic compound emissions, pointing the way towards developing regulations to mitigate this particular pollutant in the region.

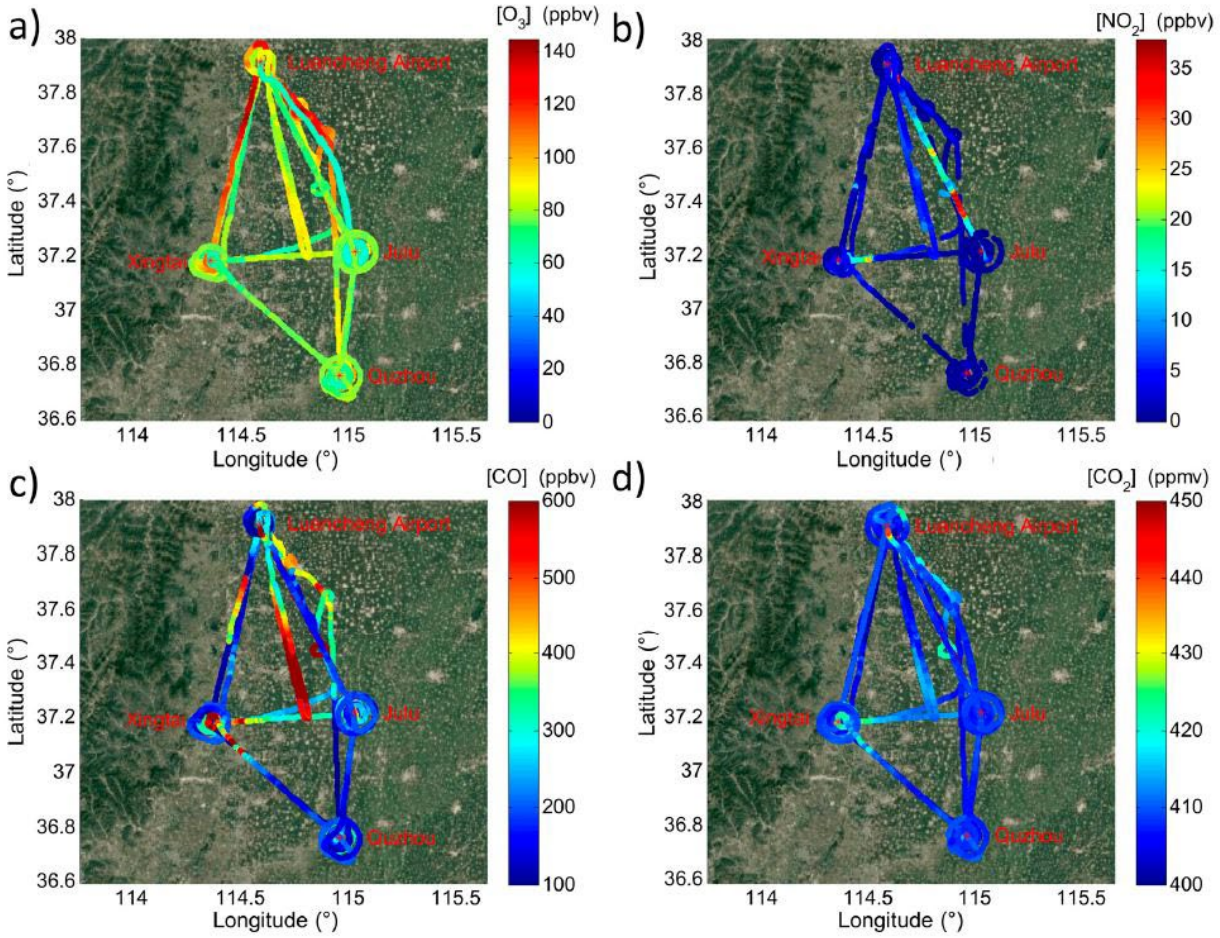

Figure: Aircraft-observed air pollutant concentrations over the NCP: (a) O_3, (b) nitrogen dioxide, (c) CO, and (d) carbon dioxide. Note the high levels of O_3 (> 80 ppbv) observed between 2 to 3 km above ground level.

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