Weekly Report – November 15, 2024

Cooperative Institute for Satellite Earth System Studies (CISESS)

NOAA/NESDIS/STAR

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PUBLICATIONS

Characterizing Trends in Global Total Precipitable Water

Citation: Zhou, Yan, **Christopher Grassotti**, **Quanhua Liu**, Shuyan Liu, and **Yong-Keun Lee**, 2024: Evaluation of total precipitable water trends from reprocessed MiRS SNPP ATMS observations, 2012-2021. *IEEE J. Sel. Top. Appl. Earth Obs. Remote Sens.*, 17, 19,798–19,804, https://doi.org/10.1109/JSTARS.2024.3481444.

Summary: CISESS Scientists Yan Zhou, Christopher Grassotti, Quanhua Liu, and Yong-Keun Lee recently published a paper in the *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing*. The study focused on trend analysis using the total precipitable water (TPW) retrieval product from the recently reprocessed Microwave Integrated Retrieval System (MiRS) Suomi National Polar-Orbiting Partnership (SNPP) Advanced Technology Microwave Sounder (ATMS) data and compared it with the European Centre for Medium-Range Weather Forecasts Reanalysis Version 5 (ERA5). Primary results show that the global TPW trend during the period 2012–2021 from reprocessed SNPP ATMS data is 0.46 mm/decade, in good agreement with the trend from ERA5 of 0.39 mm/decade. Trends for tropical and mid-latitude subregions are also in good agreement, with the same trend of 0.43 mm/decade seen in both datasets in the mid-latitudes. Both datasets show a large positive anomaly associated with the strong El Niño event in 2015–2016, which increased TPW amounts in the tropics. We also found that the spatial TPW trend is not uniformly distributed, with significant regional variations in both sign and amplitude. Nevertheless, the spatial patterns from MiRS SNPP ATMS retrievals and the ERA5 analysis are in reasonable agreement. Both datasets show that positive TPW trends in terms of relative percentage in the polar regions were on par with those seen in lower latitudes. Results suggest that water vapor observations from a single polar-orbiting microwave instrument with only two local observation times daily may be sufficient to characterize trends in TPW.

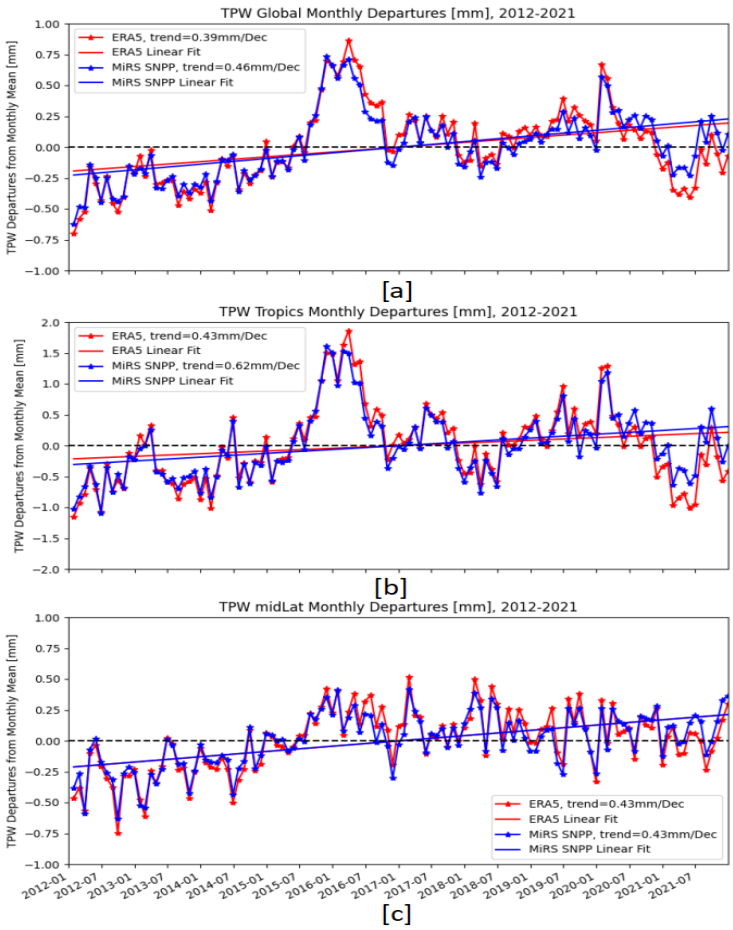

Figure: Monthly TPW anomaly time series (a) on a global scale, (b) for the tropics, and (c) for the mid-latitudes from ERA5 (red) and MiRS SNPP (blue) for the period 2012–2021. The straight lines are the best-fit lines from linear regression.

(Yan Zhou, CISESS, yanzhou@umd.edu, Funding: JPSS PGRR, JSTAR; Christopher Grassotti, CISESS, christopher.grassotti@noaa.gov, Funding: DACS, JPSS PGRR, JSTAR, METOP-SG; Quanhua Liu, CISESS, quanhua.liu@noaa.gov, Funding: IRA; Yong-Keun Lee, CISESS, yong-keun.lee@noaa.gov, Funding: DACS, JPSS PGRR, JSTAR, METOP-SG)

Diminishing Sea Ice Extent Leads to More Intense Storms in the Bering Sea
Citation: Fischer, Reint, **Sinead L. Farrell**, John M. Kuhn, and **Kyle Duncan**, 2024: Understanding decadal-scale dynamics in the Bering Sea: investigating trends and variability in sea ice, winds, and waves. *J. Clim.*, 37, 6381-6394, https://doi.org/10.1175/JCLI-D-23-0485.1.
Summary: The coastal communities that dot the Bering Sea are feeling the impact of diminishing sea ice, experiencing winter storm-surge events, more hazardous wave conditions,

coastal erosion, and flooding, aside from the detrimental economic ramifications. In their latest paper published in the *Journal of Climate*, CISESS Scientists Sinead Farrell and Kyle Duncan and colleagues report on how extreme wind and wave conditions in the Bering Sea have increased in recent years as sea ice has declined. Based on satellite observations and reanalysis data, they found that along with the unusually low sea ice extent in nine of the past ten years, gale-force winds have become more frequent, and significant wave heights have increased by greater than 6 m. They also note that the duration of the sea ice season has decreased at a rate of 1–5 days/year between 2003 and 2023, quicker than the rate previously observed and faster than the rate projected for the future. As an example of the drastic changes occurring in this region, they describe the extreme sea-state conditions generated by the passage of extratropical cyclone Merbok in September 2022, an unprecedented event in terms of season and location, leading to widespread coastal inundation, flooding, and damage to property and infrastructure. As Duncan pointed out in an article published in MarylandToday, "The decline in sea ice is directly affecting the coastal communities of Alaska and [Indigenous communities] have personally witnessed the changes that have happened in the region."

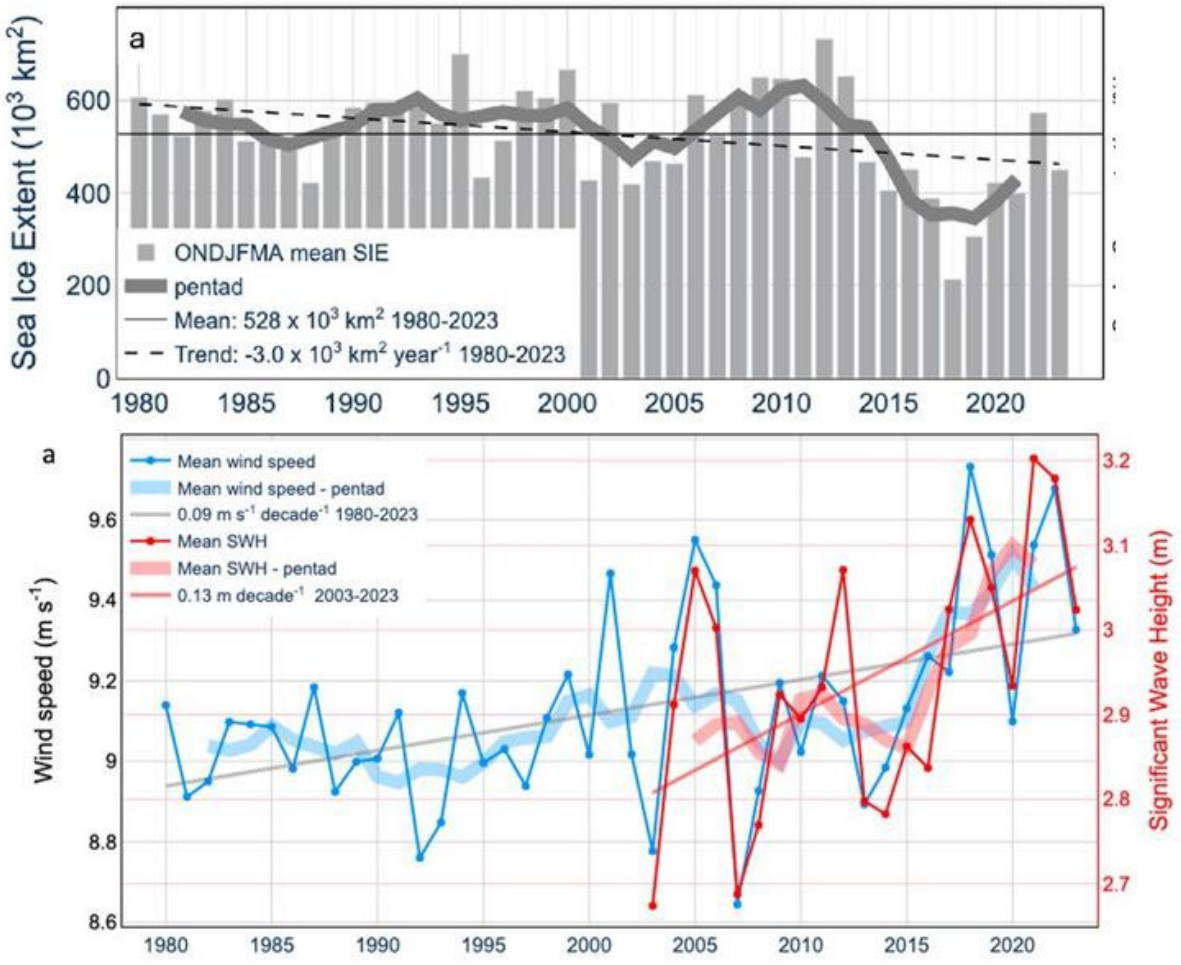

Figure: (Top) Decadal variability of Bering Sea winter (October to April) sea ice extent. The thin solid, thick gray, and dashed lines show the 44-yr mean, the 5-yr rolling mean, and the linear trend, respectively. (Bottom) Trends in Bering Sea wind speed (blue) and significant wave height (red) in winter (annual October to April average).

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