Weekly Report – August 5, 2022

Satellite Climate Studies Branch (SCSB)/CISESS

NOAA/NESDIS/STAR

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PUBLICATIONS

Analysis of Differences between Aeolus Wind Observations and NOAA Global Forecast Model

Citation: Liu, Hui, Kevin Garrett, **Kayo Ide, Ross Hoffman,** and **Katherine Lukens**: 2022: A statistically optimal analysis of systematic differences between Aeolus horizontal line-of-sight winds and NOAA's Global Forecast System, *Atmos. Meas. Tech*., **15** (13), 3925–3940, https://doi.org/10.5194/amt-15-3925-2022. Speed-dependent systematic differences between the European Space Agency (ESA) Aeolus wind observations and NOAA global forecast model background were estimated and found by the Total least squares (TLS) regression in the tropics and Southern Hemisphere. Bias correction of Aeolus wind data using the TLS approach increases the positive impact of Aeolus data on NOAA global, medium-range weather forecasts.

Summary: CISESS Scientists Hui Liu, Kayo Ide, Ross Hoffman, and Katherine Lukens and NOAA Scientist Keven Garrett co-authored a study published on July 5, 2022 in *Atmospheric Measurement Techniques* on a statistically optimal analysis of systematic differences between Aeolus horizontal line-of-sight (HLOS) Winds and NOAA's Global Forecast System. The ESA Aeolus mission launched a first-of-its-kind spaceborne Doppler wind lidar in August 2018. To optimize the assimilation of the Aeolus Level-2B wind profiles, significant systematic differences between the wind observations and numerical weather prediction (NWP) background winds were accurately estimated and removed. The Total least squares (TLS) regression was used to estimate speed-dependent systematic differences between the Aeolus winds and NOAA 6-hour global forecast winds. Unlike ordinary least squares (OLS) regression, TLS regression optimally accounts for random errors in both predictors and predictands, and so provides more accurate estimates of the bias. The figure below shows the vertical distribution of average bias estimates for various methods investigated in this study. Large, well-defined, speed-dependent differences were found in the lower stratosphere and troposphere in the tropics and Southern Hemisphere. Bias correction of Aeolus wind data using the TLS approach increases the positive impact of Aeolus data on NOAA global, medium-range weather forecasts.

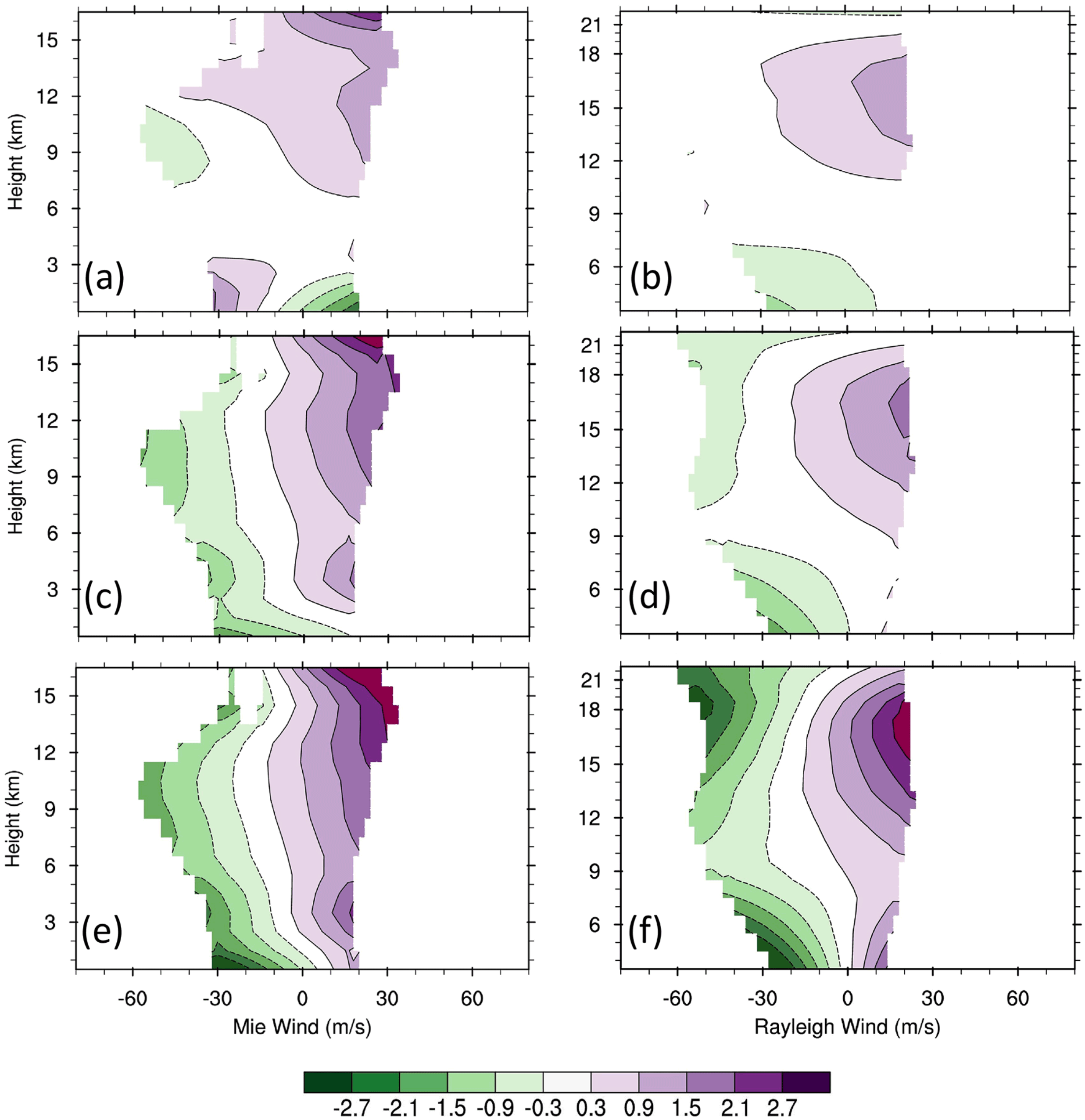

Figure: Vertical distributions of average bias estimates (color scale; m s−1) for Aeolus Mie (a, c, e) and Rayleigh (b, d, f) winds as a function of Aeolus winds using one of three methods for descending orbits for all latitudes. The methods are Ordinary Least Squares using NOAA global forecast model winds as a predictor (a, b), Total Least Squares estimates (c, d), and Ordinary Least Squares using the average of Aeolus and NOAA winds as a predictor (e, f).

(POC: Hui Liu, CISESS, hliu6@umd.edu, Funding: STAR, DARTM, OPPA)

A Decade of S-NPP VIIRS Lunar Calibrations in Reflective Solar Bands

Citation**:** Choi, Taeyoung, Changyong Cao**, Xi Shao,** and **Wenhui Wang,** 2022: S-NPP VIIRS Lunar Calibrations over 10 years in Reflective Solar Bands (RSB), *Remote Sens.*, **14**, 3367, https://doi.org/10.3390/rs14143367. This publication provides an overview of Suomi National Polar-orbiting Partnership (S-NPP) VIIRS Infrared Imaging Radiometer Suite (VIIRS) lunar calibration and its algorithms and summarizes Solar Diffuser (SD) calibration results over a decade of operation. Lunar observations played a crucial role for S-NPP VIIRS on-orbit calibration in conjunction to the SD calibration and proved to be indispensable for ensuring the long-term radiometric accuracy of its related scientific products.

Summary: CISESS Scientists Xi Shao and Wenhui Wang co-published an article in *Remote Sensing* on July 13, 2022 that describes more than a decade of research on S-NPP VIIRS reflective solar bands (RSBs). Over the last ten years, S-NPP VIIRS has performed well and successfully provided earth view (EV) observations. The onboard Solar Diffuser (SD), has provided a primary source of on-orbit calibration as a transferring radiometer with the measured SD surface properties, called the Bidirectional Reflectance Distribution Function (BRDF) from the extensive prelaunch calibration. Due to increased surface roughness from the UV portion of solar illumination, the reflectance of SD has been degraded, and it was measured and compensated to the on-orbit calibration, called SD F-factors (see figures below). The SD F-factors have been successfully validated using monthly lunar calibration coefficients (called lunar F-factors) within two percent standard deviation compared to SD trends over a decade. Lunar observations played a crucial role for S-NPP VIIRS on-orbit calibration in conjunction to the SD calibration. The long-term lunar trends provided an independent source of calibration to validate or correct the relative calibration differences from the SD calibration. The authors concluded that on-orbit lunar calibration is a necessary for future remote sensing instruments to ensure the long-term radiometric accuracy of its related scientific products.

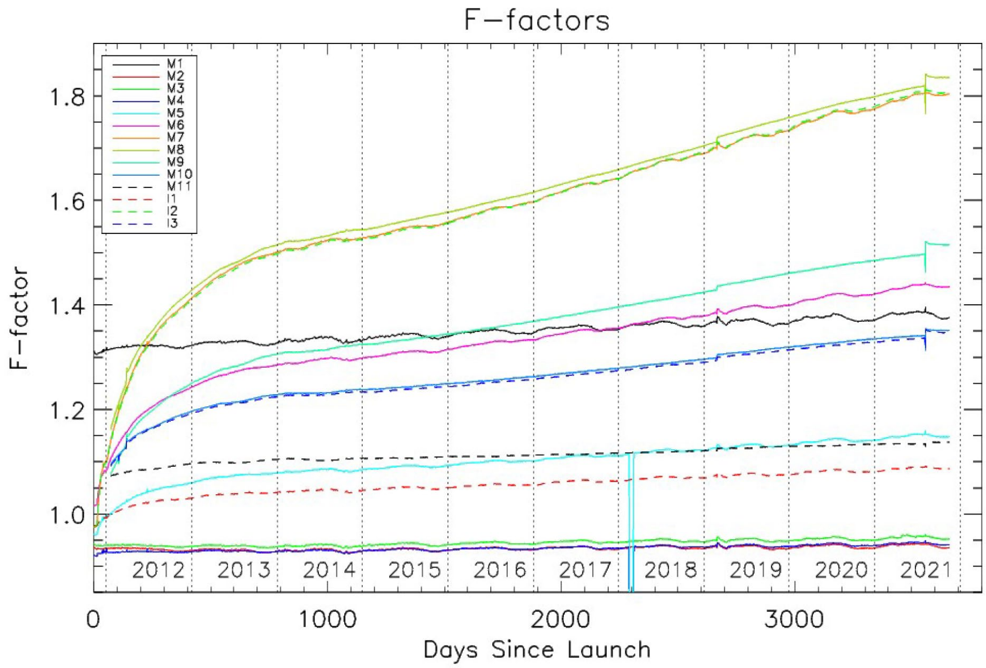

Figure: S-NPP VIIRS normalized SD F-factors from over ten years. The vertical dotted lines represent year division lines.

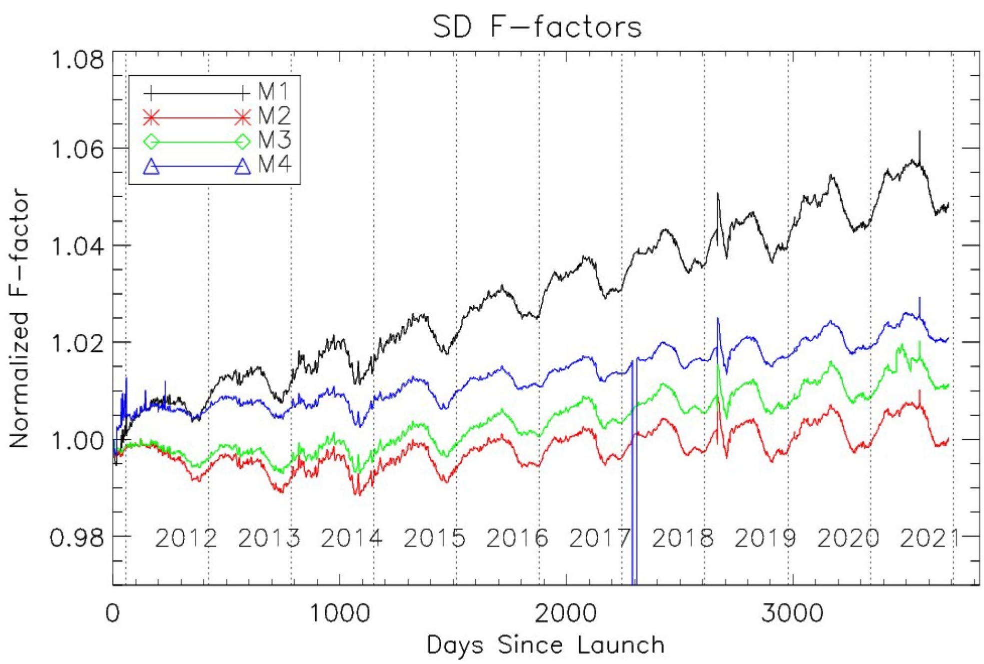

Figure: S-NPP VIIRS normalized SD F-factors from M1 to M4. These short-wavelength bands showed stable responses over ten years.

(POC: Xi Shao, CISESS, xshao@umd.edu, Funding: JSTAR, METOP-SG, COSMIC-2)