Air Quality Satellite Data: From Space to Surface Concentrations?

Four CICS-MD Scientists, Hyun Cheol Kim, Tianfeng Chai, Fong Ngan and Li Pan (OAR/ARL) have a new article published in the July 2018 issue of Remote Sensing. In this article, they explore whether satellite air quality observations can be used to reconstruct surface concentrations of an air pollutant. One of the barriers to satellite data use in this field has been the low spatial resolution compared to the in situ observations. For this study, the researchers used a conservative downscaling technique on nitrogen dioxide (NO₂) column density observations from the Ozone Monitoring Instrument (OMI) and the Global Ozone Monitoring Experiment-2 (GOME-2). Their method showed strong correlation to higher resolution model results from the Community Multiscale Air Quality (CMAQ; 4 x 4 km) for NO₂ column density. They then used the CMAQ model to convert the satellite data to surface concentrations and found strong correlations with EPA Air Quality System (AQS) ground measurements.

The figure above shows the NO₂ concentrations that result from this process using OMI and CMAQ for a summer afternoon in the Los Angeles area. The pixels show the downscaled
concentration field and the circles show the AQS observations. The authors conclude that conservative downscaling has the potential to expand the usefulness of satellite data in air quality studies. Kim, Hyun Cheol, Sang-Mi Lee, Tianfeng Chai, Fong Ngan, Li Pan and Pius Lee, 2018: A conservative downscaling of satellite-detected chemical compositions: NO$_2$ column densities of OMI, GOME-2, and CMAQ, Remote Sens., 10, 1001; http://dx.doi.org/10.3390/rs10071001.

*Importance:* Exploitation of satellite measurements of air quality is an emerging important application of JPSS measurements. *POC:* H.-C. Kim

- **Land Surface Temperature: Long-Term Datasets Disagree**
  CICS-MD Scientist and UMD Graduate Student Yuhan Rao (STAR/SMCD/SCDAB) is the lead author on a new paper that was published in the June 16 issue of *Journal of Geophysical Research: Atmospheres*. The article addresses the lack of consistency among four major land surface temperature (LST) databases with long records (1901–2017): the Berkley Earth Surface Temperature land surface air temperature data set (BEST-LAND); the Climate Research Unit Temperature Data Set version 4 (CRU-TEM4v); the NASA-GISS database; and the NOAA-NCEI database. The researchers looked at the LST data at regional and local scales and found them considerably different, with the largest discrepancies are over the tropics, high latitudes and Africa. These areas have a limited number of stations so LST data is scarce. As a result, these databases could lead to inconsistent or even contrasting regional or local surface warming trend estimates. The figures below show temperature trends (degrees per decade) of the annual and seasonal mean land surface air temperature for different latitudinal bands for 1998–2017. They show that not only the magnitude of the trend varies among the databases but also whether the trend is positive or negative.
These databases are all based on LST measurements from ground stations, which vary from
country to country and year to year. By contrast, satellites can provide nearly spatial-complete
and consistent land surface temperature measurements, which could be used to improve these
datasets. Rao, Yuhan, Shunlin Liang and Yunyue Yu, 2018: Land surface air temperature data are
considerably different among BEST-LAND, CRU-TEM4v, NASA-GISS, and NOAA-NCEI. J. Geophys.

*Importance:* The synergistic use of satellite and in-situ LST data will close the uncertainty in determining
trends in land surface temperature. *POC:* Y. Rao