Integration of Multi-Satellite Indices for Drought Monitoring in Diverse Climate Zone over East Asia

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Abstract: The frequency and severity of drought has increased and intensified over East Asia region during the recent years. Drought usually occurs by the deficit of precipitation however it does not indicate only precipitation can determine the state of drought. Lots of indices such as Standardized Precipitation Index (SPI), Palmer Drought Severity Index (PDSI) and Standardized Precipitation Evapotranspiration Index (SPEI) have been developed based on in-situ data with various perspectives due to the complexity of drought. Drought is categorized as four types which are meteorological, agriculture, hydrological and socioeconomic drought according by its duration and severity. Both SPI and SPEI can be calculated with multi-time scales so they are widely used for drought monitoring. However, ground-based indices have the limitation of its spatiality by the number of stations. Remote sensing data can not only overcome this problem with its drought related factors such as precipitation, Land Surface Temperature (LST), Evapotranspiration (ET) and soil moisture but also provide additional products such as Vegetation Indices (VI). Many previous remote sensing-based indices were proposed with one ground-based index as the target variable, so it usually indicates only one or both of first two drought categories (i.e. meteorological and agriculture). Also, they are usually developed within local or regional area, not whole extent of East Asia. Therefore, the purpose of this study is focused on developing integrated drought index over East Asia region with multi-target data (i.e. SPI, SPEI, and PDSI) in order to improve the explanation power for diverse drought types simultaneously with only one drought index. The spearman correlation analysis was performed between ground-based indices and remote sensing variables from 2010 to 2018 before developing new index. Total 7 types of variables were used which are ET, LST, potential evapotranspiration (PET), and two VIs from Moderate Resolution Imaging Spectroradiometer (MODIS), the Advanced SCATterometer (ASCAT) soil moisture, and precipitation data from Tropical Rainfall Measuring Mission (TRMM). Especially for 2012-2018, the products from Visible Infrared Imaging Radiometer Suite (VIIRS) on board the Suomi National Polar-orbiting

Partnership (SNPP) were used instead of MODIS/Aqua products, to assess whether VIIRS can be applicable to drought monitoring as the follow-up of the products from MODIS in the perspective of data continuity. TRMM precipitation data showed the highest average correlation coefficient with ground-based indices (avg$(|r_s|) = 0.38, 0.19 \leq |r_s| \leq 0.87$ where $p < 0.05$). In the next order, ASCAT soil moisture was high (avg$(|r_s|) = 0.29, 0.19 \leq |r_s| \leq 0.87$ where $p < 0.05$). Finally, new drought index for East Asia region was developed based on the correlations with the consideration of landcover and climate characteristics.

Keywords: Drought Monitoring; East Asia; Remote Sensing; Correlation; VIIRS