Observing water availability impacts on vegetation using an enhanced passive microwave remote sensing method

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Abstract: Satellite-based passive microwave observations are sensitive to water amounts on the land surface, including surface soil moisture and vegetation water content. Unlike optical-based observations which are primarily sensitive to canopy greenness, passive microwave observations are available regardless of cloud cover. Its main disadvantage is the relatively coarse spatial resolution that is a consequence of the low energy of the Earth's natural microwave emissions.

The history of satellite-based passive microwave observations goes back to a few decades ago and there are several retrieval algorithms available to derive surface soil moisture and vegetation water content. Unlike other algorithms, the Land Parameter Retrieval Model (LPRM) developed by researchers from VU University Amsterdam in collaboration with NASA can be applied to the passive microwave emissions across all low-frequency microwave bands (<20 GHz) (Owe et al., 2001). The LPRM retrieves surface soil moisture and vegetation optical depth (VOD) simultaneously. VOD is primarily an indicator of total water content contained in all aboveground biomass, including leaves and woody components. It is currently available at 0.25° (~25 km) spatial resolution and it has been demonstrated that this VOD product can capture the biomass changes over various land cover types, including grassland, cropland, savannas and forests at the global and continental scales (Liu et al., 2013).

To observe water availability impacts on vegetation water content at the regional scale, a VOD product with finer spatial resolution is needed. Parinussa et al. (2014) presented an approach to use LPRM and a downscaling method to derive 0.10° (~10 km) surface soil moisture product and demonstrated that the downscaled product is very promising for hydrological applications.

Here the LPRM algorithm and downscaling method is applied to the Advanced Microwave Scanning Radiometer for Earth Observation System (AMSR-E) observations (2002-2011) over Australia to derive downscaled 10-km VOD product which is further compared with currently available 25-km VOD product and optical-sensor based vegetation indices (e.g. enhanced vegetation index (EVI) and normalized difference vegetation index (NDVI)). The analysis includes comparing long-term changes, investigating the influence of ocean circulation indices on vegetation dynamics, and examining the aboveground biomass carbon estimation based on the VOD product. This downscaled VOD product is expected to provide deeper insights into spatiotemporal variations of vegetation water content and biomass over Australia.

Keywords: *Satellite observation, Vegetation water content, Enhanced spatial resolution*

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