Near Rear Time One-kilometer SMAP Soil Moisture Data Product for Potential Use in National Water Model

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Motivation: NOAA has undertaken a major effort to improve its hydrological forecast services through the development of a new National Water Model (NWM) at the National Water Center. Because of the uncertainties in model physics and input parameters, and potential errors in forcing data, the soil moisture (SM) estimates may be erroneous, resulting uncertainties in the output of the NWM. These type of model errors can be compensated for by assimilating fine resolution satellite SM observations. For operational users, the downscaling approach should be feasible for operational implementation, requiring limited ancillary information and primarily depending on readily available satellite observations. Thus, a near-real-time 1 km SMAP SM data product is proposed to be routinely generated at the NOAA-NESDIS using remotely sensed land surface temperature (LST) and enhanced vegetation index (EVI) observations.

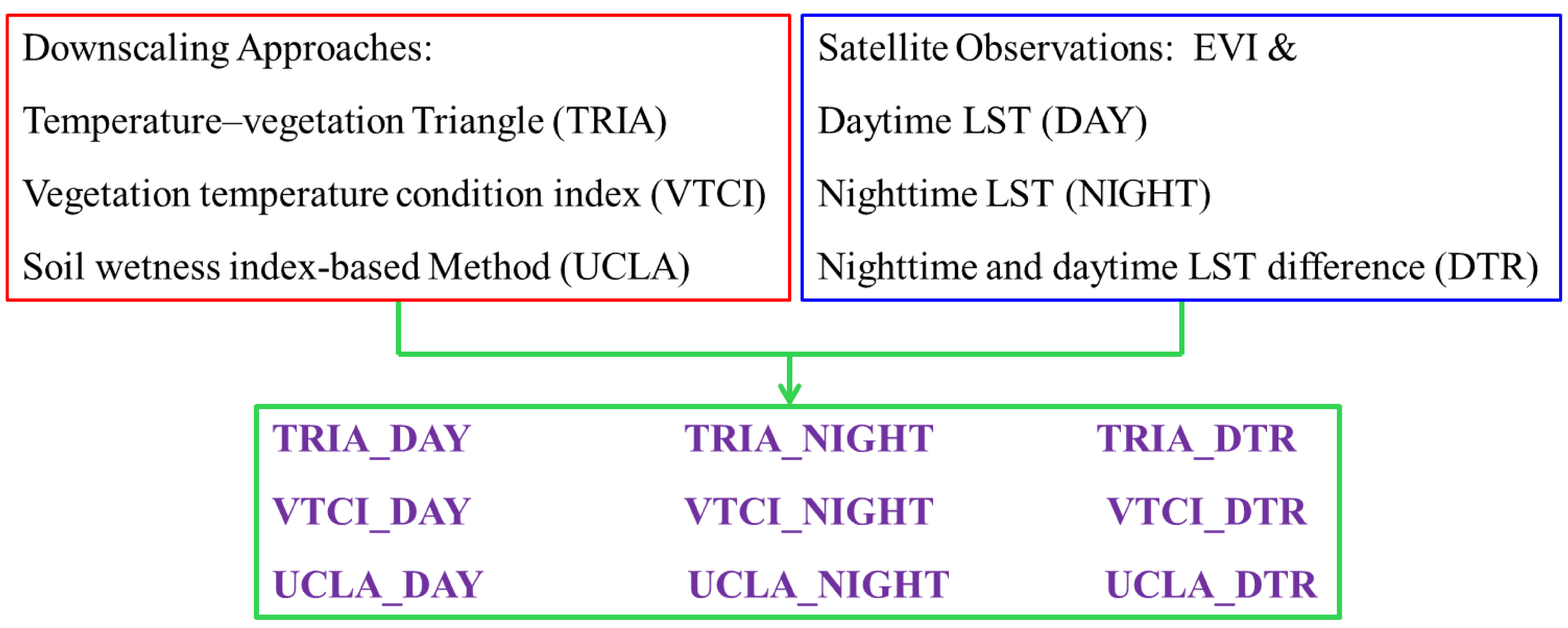

Fig. 1 Nine selected downscaling schemes for developing an optimal downscaling strategy.

Metrics	SMAP (25 km)	VTCI (1 km)			UCLA (1 km)			TRIA (1 km)		
		DAY	NIGHT	DTR	DAY	NIGHT	DTR	DAY	NIGHT	DTR
R	***0.642***	0.582	0.584	0.596	0.640	0.632	***0.642***	0.576	0.574	0.582
RMSE	0.089	0.091	0.092	0.086	0.084	0.086	***0.082***	0.097	0.097	0.091
ubRMSE	0.054	0.060	0.059	0.054	0.051	0.053	***0.049***	0.062	0.063	0.060

Tab. 1 Summary of the statistical comparison results when averaged across the CONUS, including correlation coefficient (r), RMSE (m^3/m^3), and ubRMSE (m^3/m^3) over the 1 May 2017- 30 April 2019 period. Italic bold indicates the optimal metric.

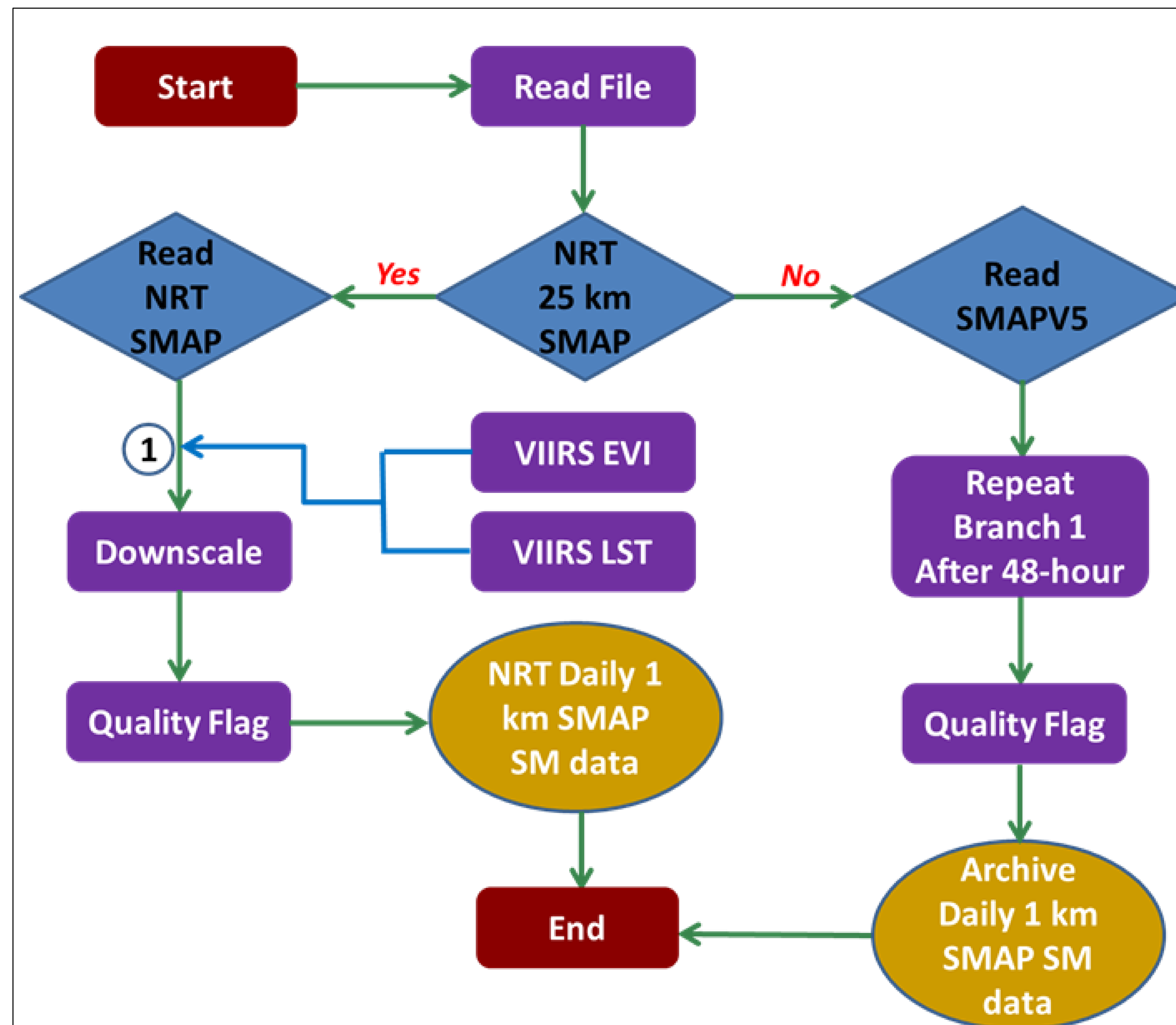

Fig. 3 Process flow of producing a NRT 1 km downscaled SMAP soil moisture map using the UCLA_DTR method.

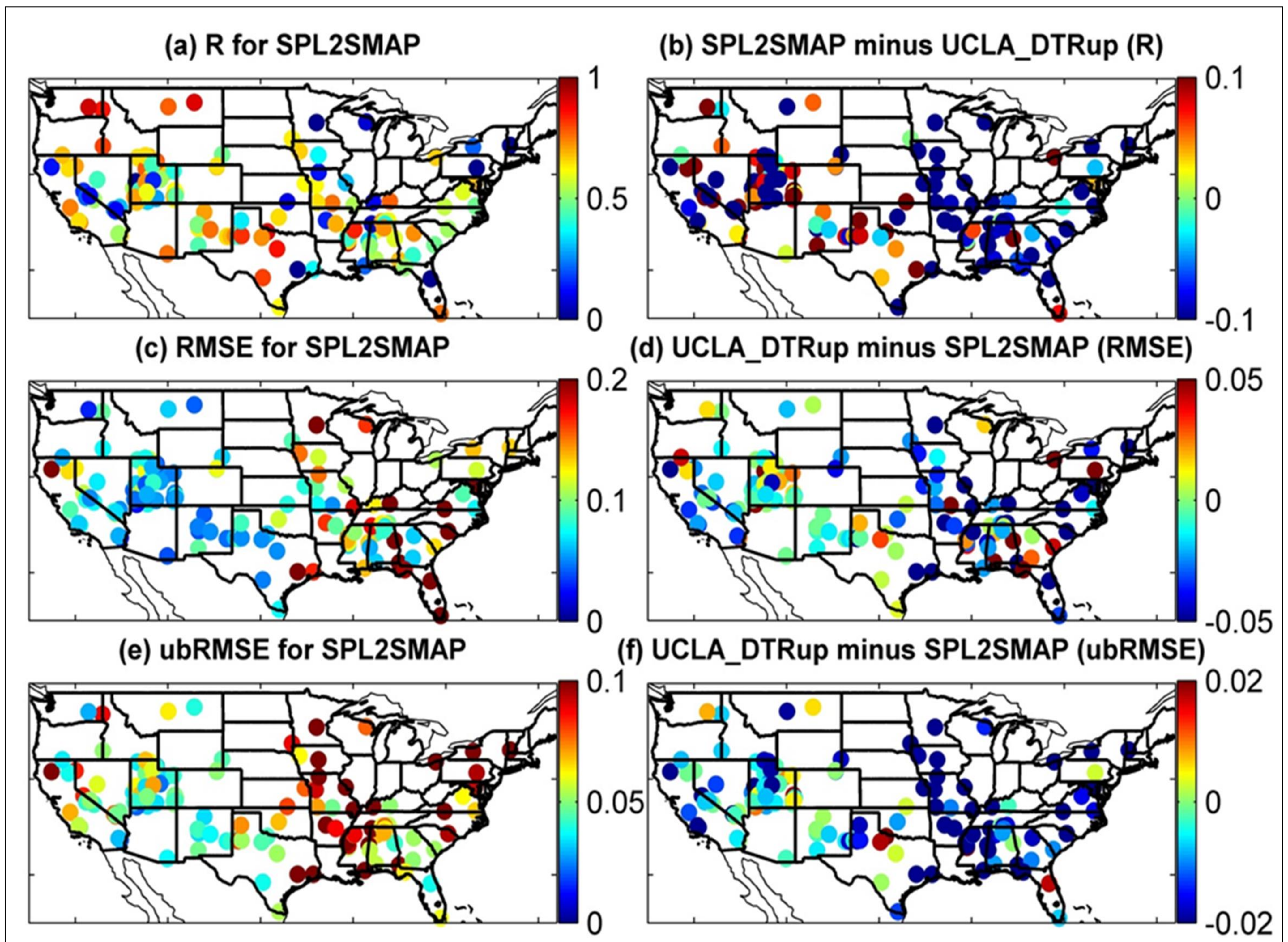

Fig. 2 With respect to the quality controlled SCAN SM observations, left column shows the metrics for SMAP/Sentinel 3 km SM product (SPL2SMAP), while the right column shows metric differences between SPL2SMAP and 3 km UCLA_DTRup during the 1 May 2017- 30 April 2019 period. Top, middle and bottom rows are for correlation coefficients (r), RMSE (m^3/m^3) and ubRMSE (m^3/m^3), respectively.

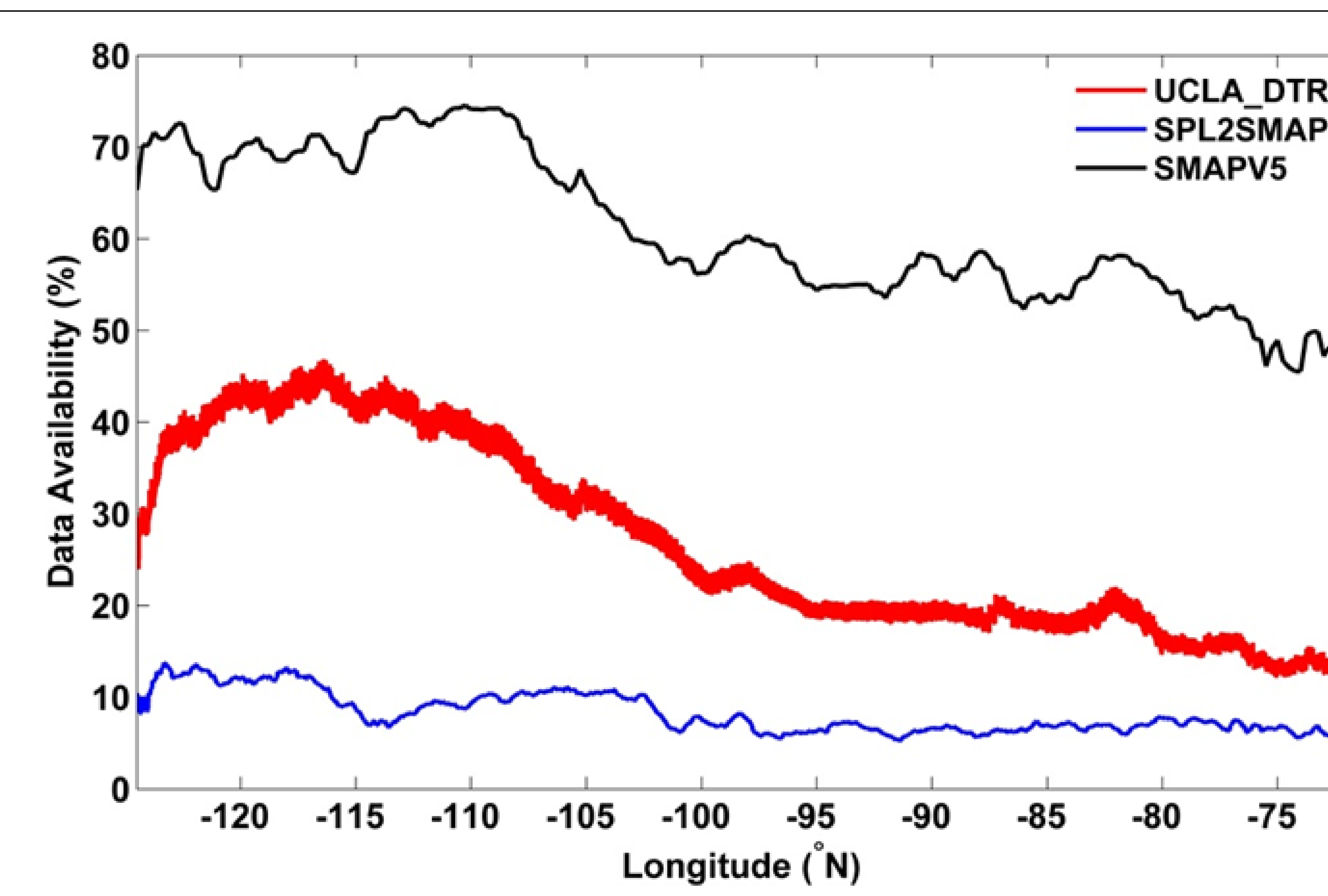

Fig. 4 Longitude-averaged data availability over the CONUS domain.

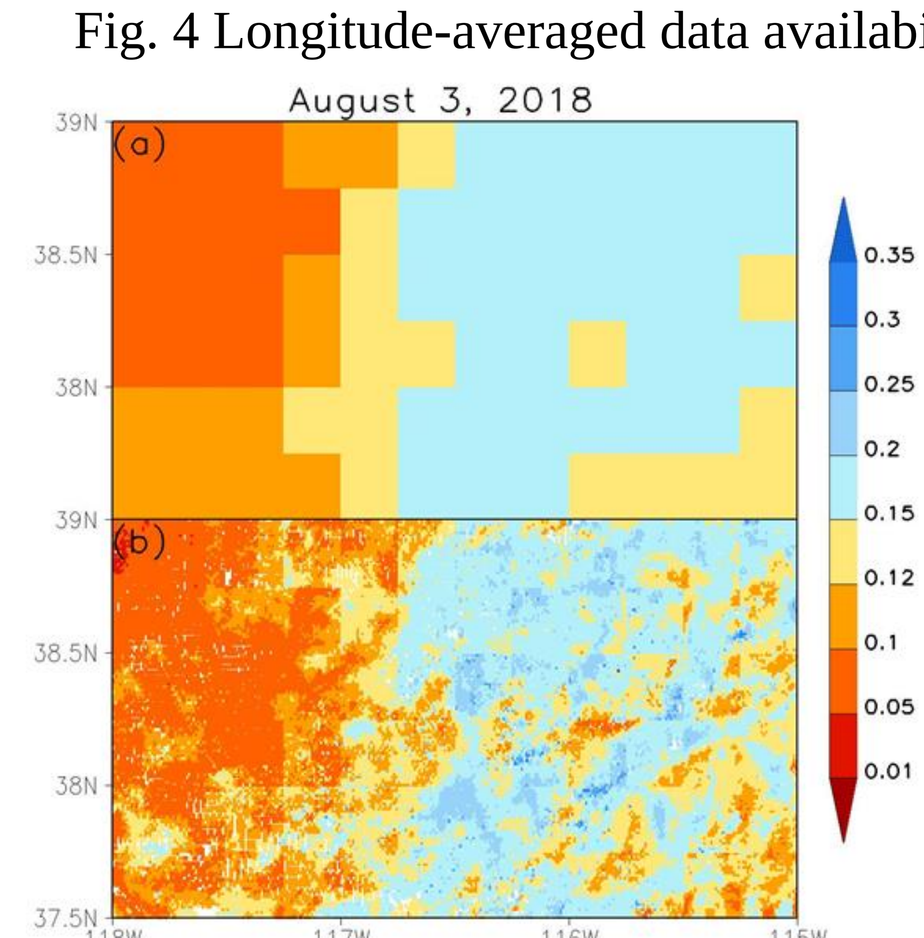

Fig. 5 Sample maps for (a) 25 km SMAP and (b) the downloaded 1 km SMAP SM retrievals over the sub-region from -118˚E, 37.5˚N to 115˚E, 39˚N on August 3, 2018.

Conclusions:

(1) The advantages of the downscaling technique include simplicity, feasibility of operational implementation, pure reliance on remote sensing measurements, computationally fast and limited ancillary information requirements.

(2) With respect to the quality controlled SCAN observations, the UCLA_DTR method showed the most successful performance out of the 9 downscaling schemes. As expected, the accuracy level is significantly improved with the advance of the fine scale satellite SM measurements.

(3) Compared to the NASA 3 km SMAP/Sentinel product, the accuracy level was significantly improved. The downscaled 1 km SMAP SM data product also provides larger data availability, although the VIIRS observations used as ancillary information can be affected by cloud coverage.

(4) Building on the results shown in this paper, a near-real-time 1 km SMAP SM data product is proposed to be developed at NOAA-NESDIS.