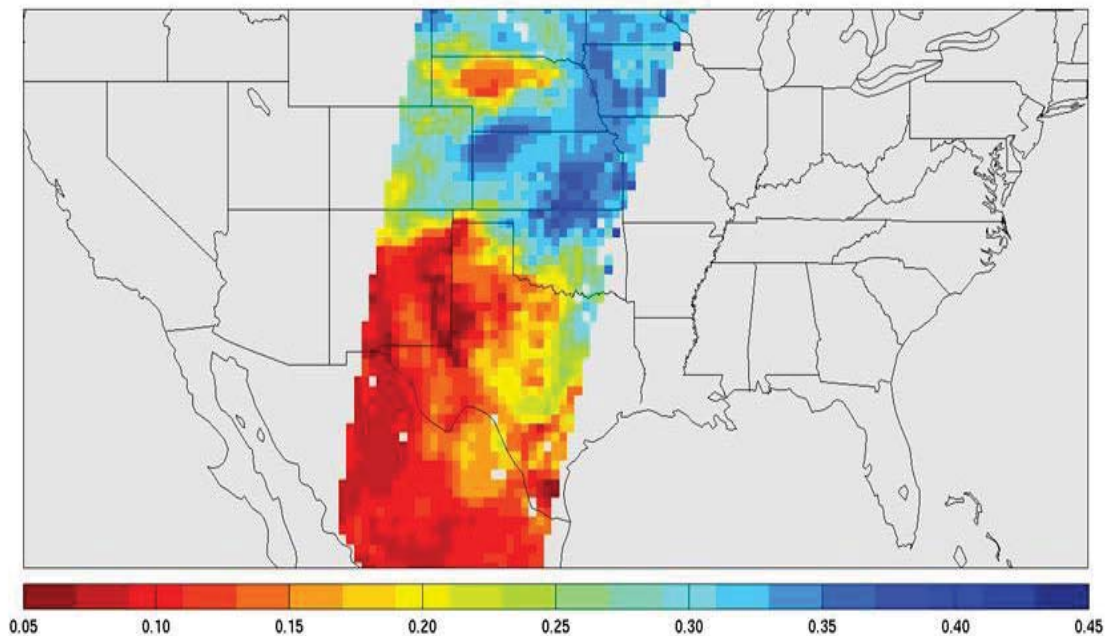


(such as corrections for open water to be discussed in Section 4) or the quality of the retrievals (e.g. precipitation flag). Basically, these flags would provide information as to whether the ground is frozen, snow-covered, or flooded, or whether it is expected to be actively precipitating at the time of the satellite overpass. Other flags will indicate whether masks for steeply sloped topography, or for urban, heavily forested, or permanent snow/ice areas are in effect. All input data to the L2\_SM\_P processor are pre-mapped to the 36-km EASE2 grid.

Consistent with the SMAP Level 2 mission requirements [28], the L2\_SM\_P product is a half-orbit product —  $T_B$  observations from a given half orbit go through the retrieval algorithm to produce retrieved soil moisture for the same half orbit. An example of the L2\_SM\_P soil moisture from part of a single half orbit over the United States as simulated on the SMAP Algorithm Testbed (Section 5) is shown in Figure 11. This example is based on a single-channel algorithm operating on H-polarized  $T_B$  observations simulated using geophysical data from a land surface model.



**Figure 11. Example of SMAP retrieved soil moisture in  $\text{cm}^3/\text{cm}^3$ . The half-orbit swath pattern is simulated using the orbital sampling module on the SMAP Algorithm Development Testbed.**

### 3.7 Level 3 Radiometer-Based Soil Moisture Product (L3\_SM\_P)

The L3\_SM\_P product is a daily global product. To generate the product, individual L2\_SM\_P half-orbit granules acquired over one day are composited to produce a daily multi-orbit global map of retrieved soil moisture.

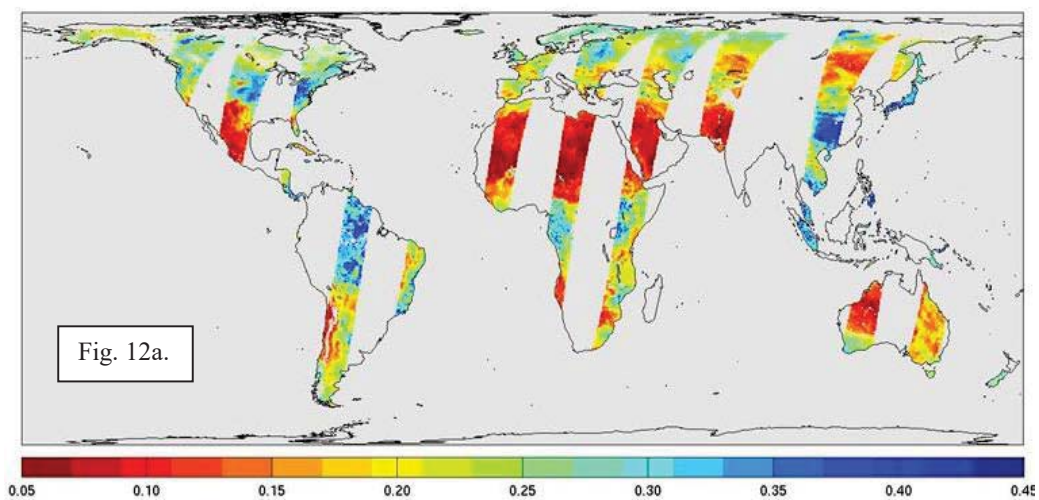
The L2\_SM\_P swaths overlap poleward of approximately  $\pm 65^\circ$  latitude. Where overlap occurs, three options are considered for compositing multiple data points at a given grid cell:

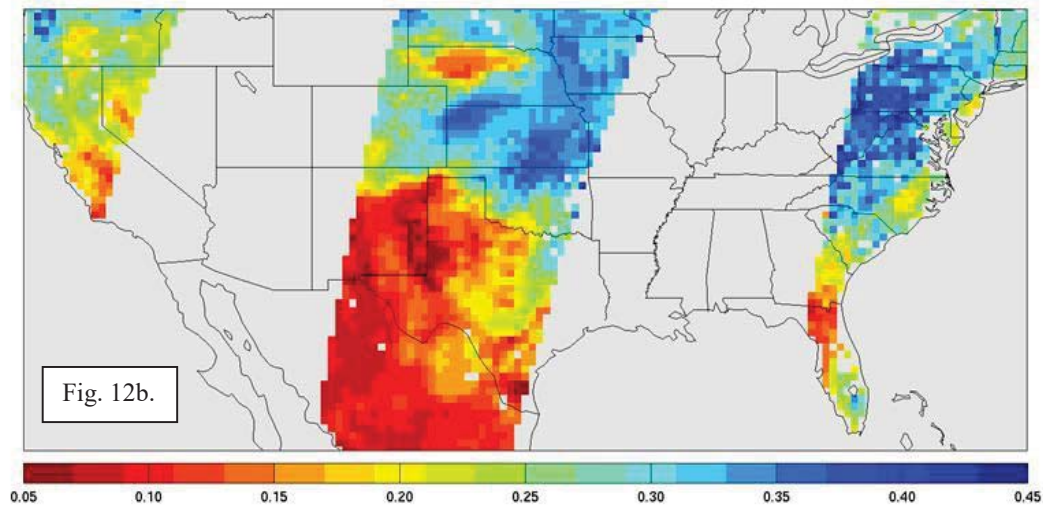
1. Use the most recent (or “last-in”) data point
2. Take the average of all data points within the grid cell
3. Choose the data point observed closest to 6:00 am local solar time

The current approach for the L3\_SM\_P product is to use the nearest 6:00 am local solar time (LST) criterion to perform Level 3 compositing (a similar procedure is used for 6 pm starting in Data Release Version 4). According to this criterion, for a given grid cell, an L2 data point acquired closest to 6:00 am local solar time will make its way to the final Level 3 granule; other 'late-coming' L2 data points falling into the same grid cell will be ignored. For a given granule whose time stamp (yyyy-mm-ddThh:mm:ss) is expressed in UTC, only the hh:mm:ss part is converted into local solar time. For example,

UTC Time Stamp	Longitude	Local Solar Time
2011-05-01T23:19:59	60E	23:19:59 + (60/15) hrs = 03:19:59

The local solar time 03:19:59 is then compared with 06:00:00 in Level 3 processing for 2011-05-01 to determine if the swath is acquired closest to 6:00 am local solar time. If so, that data point (and only that data point) will go to the final Level 3 granule. Under this convention, an L3 composite for 2011-05-01 has all Level 2 granules acquired within 24 hours of 2011-05-01 UTC and Level 2 granules appearing at 2011-05-02 6:00 am local solar time at the equator. Note that this is also the conventional way to produce Level 3 products in similar missions and is convenient to users interested in global applications. Figure 12 shows an example of the L3\_SM\_P soil moisture output for one day's worth of simulated SMAP descending orbits globally (Fig. 12a) and over just the continental U.S. (CONUS) (Fig. 12b).





**Figure 12.** Simulation of L3\_SM\_P retrieved soil moisture in  $\text{cm}^3/\text{cm}^3$ . This example is based on the single channel algorithm operating on H-polarized  $T_B$  observations simulated using geophysical data from a land surface model.

#### 4. RETRIEVAL ALGORITHMS

Decades of research by the passive microwave soil moisture community has resulted in a number of viable soil moisture retrieval algorithms that can be used with SMAP  $T_B$  data. ESA's SMOS mission currently flies an aperture synthesis L-band radiometer which produces  $T_B$  data at multiple incidence angles over the same ground location. The baseline SMOS retrieval algorithm is based on the *tau-omega* model described in Section 2.1 but utilizes the SMOS multiple incidence angle capability to retrieve soil moisture. SMAP retrievals will also be based on the *tau-omega* model but will use the constant incidence angle  $T_B$  data produced by the SMAP conically-scanning radiometer. Other needed parameters in the retrieval will be obtained as ancillary data.

SMAP baseline and optional algorithms will be evaluated for their soil moisture retrieval performance during the pre- and post-launch time frames. The optional algorithms will be compared against the baseline algorithm using theoretical simulations and observational data. Upon periodic assessment and review by the SMAP science team, a retrieval algorithm option with better performance than the baseline algorithm may replace the earlier baseline and become the new baseline.

For the SMAP L2\_SM\_P product, five soil moisture retrieval algorithms are currently being evaluated:

- Single Channel Algorithm at V polarization (baseline) (SCA-V)
- Single Channel Algorithm at H polarization (SCA-H)
- Dual-Channel Algorithm (DCA)
- Microwave Polarization Ratio Algorithm (MPRA)
- Extended Dual Channel Algorithm (E-DCA)