vrije Universiteit amsterdam

AMSR LPRMSM L3 Soilmoisture

Soilmoisture

1. Identification

1.1. Product description

1.1.1. Abstract

This dataset provides global soil moisture with a high temporal (day, night) and low (0.25 degree) spatial resolution, but are limited to approximately the top few cm of the soil. The soil moisture data is expressed in volumetric values (m^3 m^{-3}).

This product is based on AMSR-E satellite observations and is derived according to the Land Surface Parameter Model (LPRM) (Owe et al. 2008). The LPRM is a three-parameter retrieval model for passive microwave data and is based on a microwave radiative transfer model that links surface geophysical variables (*i.e.* soil moisture, vegetation water content, and soil/canopy temperature) to the observed brightness temperatures. It uses the dual polarized channel (either 6.925 or 10.65GHz) for the retrieval of both surface soil moisture and vegetation water content. The land surface temperature is derived separately from the vertically polarized 36.5GHz channel.

1.1.2. Purpose

Soil moisture, as the state variable of the water cycle over land, determines water flux between the atmosphere, the surface and subsurface. Because a large amount of heat is exchanged when water changes phase, the water cycle is also fundamental to the dynamics of the Earth's energy cycle. Furthermore, since water is the universal solvent in the Earth system, biogeochemical cycles (e.g., carbon, nitrogen, methane) are embedded in the water cycle. Soil moisture information will be important for elements of Earth system science, for water resource assessment, and for natural hazards mitigation.

Soil moisture is the key control on evaporation and transpiration at the land-atmosphere boundary. Since large amounts of energy are required to vaporize water, soil moisture control also has a significant impact on the surface energy flux. Thus, soil moisture variations affect the evolution of weather and climate particularly over continental regions. Initialization of numerical weather prediction (NWP) models, and seasonal climate models with accurate soil moisture information enhances their prediction skill.

Soil moisture and its freeze/thaw state are also key determinants of the global carbon cycle. Carbon uptake and release in boreal landscapes is one of the major sources of uncertainty in assessing the carbon budget of the Earth system (the so-called missing carbon sink).

1.1.3. Application

Satellite derived soil moisture products are already used successfully for drought prediction (Loew et al., 2008), crop yield prediction (de Wit and van Diepen ,2007), and flood Forecasting (Parajka et al., 2006) and are planned to be used in Numerical Weather Prediction Models (Holmes et al., 2008).

1.2. Time period of content

The dataset spans the period of June 19, 2002 to present. The soil moisture retrievals are derived from a sun synchronous satellite platform, resulting in descending orbits at approximately 1:30 AM solar time and ascending orbits at ~1:30 PM solar time. The soil moisture products are produced in a near-real time mode, with a time lag of approximately 24 hours (depends on the online facilities of the Level 2 AMSR-E brightness temperatures).

1.3. Status

1.3.1. Progress

The dataset is validated extensively (i.e. De Jeu et al., 2008) and additional data validation will continue. The algorithm development has been completed although updated versions with improvements might follow.

1.3.2. Maintenance and update frequency

Every 24 hours new soil moisture maps will be produced.

1.4. Spatial Domain

1.4.1. Bounding coordinates

Global coverage: Longitude [-180,180], latitude [-90.,90.]

1.5. Keywords

1.5.1. Theme

Soil Moisture

Hydrology

Climate

Satellite Remote Sensing

Passive Microwave

AMSR-E

1.5.2. Place

Global.

1.5.3. Stratum

Land.

1.5.4. Temporal

June 19 2002 – Now.

1.6. Access constraints

None.

1.7. Use constraints

Use citation.

1.8. Point of contact

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1.9 Citation

Owe M., RAM. De Jeu, and TRH Holmes (2008). Multi-Sensor Historical Climatology of Satellite-Derived Global Land Surface Moisture, *J. Geophys. Res.*, 113, F01002, doi:1029/2007JF000769.

1.10 Preview

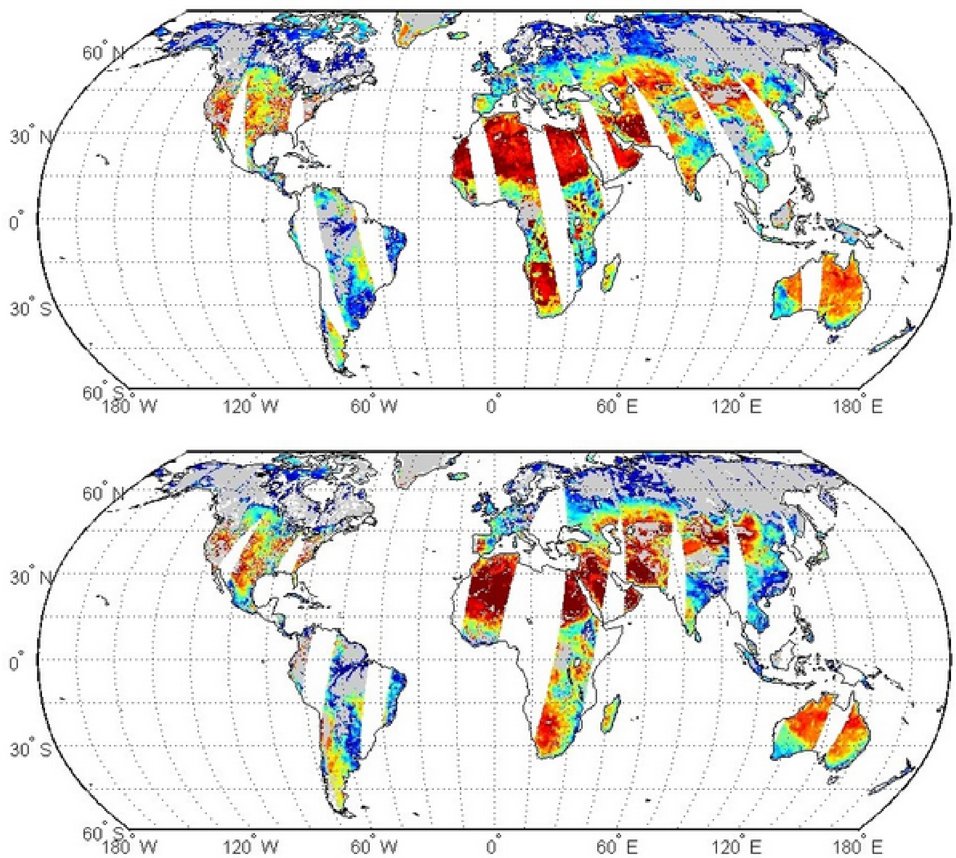

Figure 1. *Twenty-four-hour global gridded ascending (daytime; ~ 1:30 PM) and descending (nighttime; ~1:30 AM) surface soil moisture retrievals at 6.9 GHz from AMSR-E using LPRM.*

1.11. Data set credit

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1.12. Cross reference

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Njoku EG, Jackson T, Lakshmi V, Chan T, Nghiem SV (2003) Soil moisture retrieval from AMSR-E, IEEE Trans. Geosci. Rem. Sens., 41:215–229.

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Validation and cross comparison activities

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1.13. Literature

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Wang, J.R., and T.J. Schmugge, 1980, "An empirical model for the complex dielectric permittivity of soil as a function of water content", IEEE Trans. Geosci. Remote Sensing, 18:288-295.

2. Data Quality

2.1 Lineage

2.1.1. Source information

The global soil moisture product is based on level 2 resampled microwave brightness temperatures from the AMSR-E radiometer on the AQUA Earth observation satellite. The sensor is 12 channels (six frequencies), with 4 bands relevant to soil moisture retrieval. AMSR-E has a swath width of 1445 km. Daily Earth coverage is nearly 100 percent above and below 45 degrees north and south latitude, while mid-latitudes experience about 80 percent coverage. Sensor data were downloaded as brightness temperatures from their public source archives and are available from the National Snow and Ice Data Center (NSIDC) in Boulder Colorado (http://nsidc.org/). Users who use this data should cite:

Ashcroft, P., and F. Wentz, 2003. (updated daily). AMSR-E/Aqua L2A Global Swath Spatially-Resampled Brightness Temperatures (Tb) V001, September to October 2003. Boulder, CO, USA: National Snow and Ice Data Center. Digital media.

2.1.2. Processing steps

The soil moisture retrieval methodology uses a nonlinear iterative procedure in a forward modelling approach to partition the surface emission into its primary source components, i.e. the soil emission and the canopy emission, and then optimizes on the canopy optical depth and the soil dielectric constant. Once convergence between the calculated and observed brightness temperatures is achieved, the model uses a global data base of soil physical properties (Rodell et al., 2004) together with a soil dielectric mixing model (Wang and Schmugge, 1980) to solve for the surface soil moisture. No field observations of soil moisture, canopy biophysical properties, or other observations are used for calibration purposes, resulting in a model that is largely physically-based with no regional dependence, and is applicable at any microwave frequency suitable for soil moisture monitoring (i.e. L–, C–, X–, or Ku–band).

A data mask was developed on the AMSR-E data products to eliminate those data cells where data values were either meaningless due to frozen soil conditions, snow cover or excessive vegetation, or were unreliable because the residual between observed and modelled brightness temperature exceeds 0.25 K. Pixels with snow and frozen soils were detected with a simple surface temperature algorithm (De Jeu and Owe, 2003). Soil emission is attenuated by the canopy and tends to saturate the microwave signal with increasing vegetation density, resulting in decreased sensor sensitivity to soil moisture variations (e.g. Figure 1). For this reason pixels with a vegetation optical depth exceeding 0.8 were removed.

The effect of vegetation density on the decrease of sensitivity to soil moisture variations is inversely proportional to the wavelength and therefore higher at X-band than at C-band.

Surface soil moisture retrievals from the LPRM have been evaluated in several previous studies against both observational and model simulation data sets from a variety of global test sites, and compared quite well. De Jeu et al 2008 presented an overview of all validation activities and they demonstrated the strong relationship between soil moisture accuracy and vegetation density.

A poor accuracy in soil moisture can be found in the vegetated regions. This can be explained by the limited soil moisture retrieval capabilities over dense vegetation covers. Soil emission is attenuated by the canopy and tends to saturate the microwave signal with increasing vegetation density, resulting in a decreased sensor sensitivity to soil moisture variations. De Jeu et al. (2008) estimated a soil moisture accuracy of about 0.06 $m^3 m^{-3}$ for sparse to moderate vegetated regions.

3. Spatial Data Organization

3.1. Indirect Spatial Reference

Map covers the world.

3.2. Direct Spatial Reference Method

Raster.

3.3. Point and vector object information

N/A

3.4. Raster object information

3.4.1. Row count

720

3.4.2. Column count

1440

3.4.3. Vertical count

1

4. Spatial Reference

4.1. Coordinate System

4.1.1. Geographic coordinate units

Degrees.

4.1.2. Map projection

Latitude_longitude.

4.1.3. Datum

WGS84

4.1.4. EPSG Code

4326

4.1.5. PROJ4 parameters

5. Product Description Reference Information

5.1. Product Description Date

28-06-2008

5.2. Product Description Review Date

28-06-2008

5.3. Product Description Contact

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