ISO 19131 Percent Saturated Surface Soil Moisture – Data Product Specifications

Revision: A

Data product specifications: Percent Saturated Surface Soil Moisture

- **Table of Contents-**

Data product specifications: Percent Saturated Surface Soil Moisture

1. Overview

1.1. Informal description

These products represent the volumetric soil moisture (percent saturated soil) for the surface layer (<5 cm). The products are produced from passive microwave satellite data collected by the Soil Moisture and Ocean Salinity (SMOS) satellite and converted to soil moisture using version 6.20 of the SMOS soil moisture processor. The data are produced by the European Space Agency and obtained under a Category 1 proposal for Level 2 soil moisture data. The data are gridded to a resolution of 0.25 degrees. Data quality flags have been applied to remove areas where rainfall is present during the acquisition, where snow cover is detected and when Radio Frequency Interference (RFI) is above an acceptable threshold.

1.2. Data product specification - metadata

This section provides metadata about the creation of this data product specification

Data product specification – title:	Percent Saturated Surface Soil Moisture
Data product specification - reference date:	March 8, 2016
Data product specification - responsible party:	AAFC, STB, ACGEO
Data product specification – language:	English
Data product specification - topic category:	Geoscientific Information

1.3. Terms and definitions

- Feature attribute
  characteristic of a feature

- Class
  description of a set of objects that share the same attributes, operations, methods, relationships, and semantics [UML Semantics]
  NOTE: A class does not always have an associated geometry (e.g. the metadata class).

- Feature
  abstraction of real world phenomena

- Object
  entity with a well-defined boundary and identity that encapsulates state and behaviour [UML Semantics]
  NOTE: An object is an instance of a class.

- Package
  grouping of a set of classes, relationships, and even other packages with a view to organizing the model into more abstract structures

1.4. Abbreviations

AAFC	Agriculture and Agri-Food Canada
STB	Science and Technology Branch
ACGEO	Agri-Climate, Geomatics and Earth Observation
SMOS	Soil Moisture and Ocean Salinity
ESA	European Space Agency
CESBIO	Centre d'Etudes Spatiales de la BIOsphère (CESBIO)
RFI	Radio Frequency Interference

2. SPECIFICATION SCOPE

This data specification has only one scope, the general scope.

NOTE: The term ‘specification scope’ originates from the International Standard ISO19131. ‘Specification scope’ does not express the purpose for the creation of a data specification or the potential use of data, but identifies partitions of the data specification where specific requirements apply.

3. DATA PRODUCT IDENTIFICATION

3.1. Data series identification

3.1.1. Percent Saturated Surface Soil Moisture

Title	Percent Saturated Surface Soil Moisture
Alternate Title	Surface Soil Moisture
Abstract	This data series represents the volumetric soil moisture (percent saturated soil) for the surface layer (<5 cm). The data is created daily and is averaged for the ISO standard week and month. The data is produced from passive microwave satellite data collected by the Soil Moisture and Ocean Salinity (SMOS) satellite and converted to soil moisture using version 6.20 of the SMOS soil moisture processor. The data are produced by the European Space Agency and obtained under a Category 1 proposal for Level 2 soil moisture data. The data are gridded to a resolution of 0.25 degrees. Data quality flags have been applied to remove areas where rainfall is present during the acquisition, where snow cover is detected and when Radio Frequency Interference (RFI) is above an acceptable threshold.
Purpose	
Topic Category	Geoscientific Information
Spatial Representation Type	grid
Spatial Resolution	0.25 degrees
Geographic Description	Canada
Supplemental Information	
Constraints	Open Government Licence - Canada (http://data.gc.ca/eng/open-government-licence-canada)
Keywords	Soil, Soil Drainage, Remote Sensing, Land Surface Hydrology
Scope identification	series

3.1.2. Percent Saturated Surface Soil Moisture Anomalies

Title	Percent Saturated Surface Soil Moisture Difference from Long Term Average
Alternate Title	Surface Soil Moisture Anomalies
Abstract	This data series represents the volumetric soil moisture (percent saturated soil) for the surface layer, expressed as a difference from the long term average. The average is calculated from all available years for each location and each time period, based on the length of the satellite data record. Values higher than zero represent areas that are wetter than the long term average, and areas lower than zero represent areas drier than the long term average. The data is created daily and is averaged for the ISO standard week and month. The data is produced from passive microwave satellite data collected by the Soil Moisture and Ocean Salinity (SMOS) satellite and converted to soil moisture using version 6.20 of the SMOS soil moisture processor. The data are produced by the European Space Agency and obtained under a Category 1 proposal for Level 2 soil moisture data. The data are gridded to a resolution of 0.25 degrees. Data quality flags have been applied to remove areas where rainfall is present during the acquisition, where snow cover is detected and when Radio Frequency Interference (RFI) is above an acceptable threshold.
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Keywords	Soil, Soil Drainage, Remote Sensing, Land Surface Hydrology
Scope identification	series

3.2. Data product identification

3.2.1. Weekly Percent Saturated Surface Soil Moisture

Title	Weekly Percent Saturated Surface Soil Moisture
Alternate Title	Weekly Surface Soil Moisture
Abstract	This data product represents the weekly volumetric soil moisture (percent saturated soil) for the surface layer (<5 cm). The data is produced from passive microwave satellite data collected by the Soil Moisture and Ocean Salinity (SMOS) satellite and converted to soil moisture using version 6.20 of the SMOS soil moisture processor. The data are produced by the European Space Agency and obtained under a Category 1 proposal for Level 2 soil moisture data. The data are gridded to a resolution of 0.25 degrees. Data quality flags have been applied to remove areas where rainfall is present during the acquisition, where snow cover is detected and when Radio Frequency Interference (RFI) is above an acceptable threshold.
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Topic Category	Geoscientific Information
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Spatial Resolution	0.25 degrees
Geographic Description	Canada
Supplemental Information	
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Keywords	Soil, Soil Drainage, Remote Sensing, Land Surface Hydrology
Scope identification	series

3.2.2. Monthly Percent Saturated Surface Soil Moisture

Title	Monthly Percent Saturated Surface Soil Moisture
Alternate Title	Monthly Surface Soil Moisture
Abstract	This data product represents the monthly volumetric soil moisture (percent saturated soil) for the surface layer (<5 cm). The data is produced from passive microwave satellite data collected by the Soil Moisture and Ocean Salinity (SMOS) satellite and converted to soil moisture using version 6.20 of the SMOS soil moisture processor. The data are produced by the European Space Agency and obtained under a Category 1 proposal for Level 2 soil moisture data. The data are gridded to a resolution of 0.25 degrees. Data quality flags have been applied to remove areas where rainfall is present during the acquisition, where snow cover is detected and when Radio Frequency Interference (RFI) is above an acceptable threshold.
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Topic Category	Geoscientific Information
Spatial Representation Type	grid
Spatial Resolution	0.25 degrees
Geographic Description	Canada
Supplemental Information	
Constraints	Open Government Licence - Canada (http://data.gc.ca/eng/open-government-licence-canada)
Keywords	Soil, Soil Drainage, Remote Sensing, Land Surface Hydrology
Scope identification	series

3.2.3. Weekly Percent Saturated Surface Soil Moisture Anomalies

Title	Weekly Percent Saturated Surface Soil Moisture Anomalies
Alternate Title	Weekly Percent Saturated Surface Soil Moisture Difference from Long Term Average
Abstract	This data product represents the weekly volumetric soil moisture (percent saturated soil) for the surface layer, expressed as a difference from the long term average. The average is calculated from all available years for each location and each time period, based on the length of the satellite data record. Values higher than zero represent areas that are wetter than the long term average, and areas lower than zero represent areas drier than the long term average. The data is produced from passive microwave satellite data collected by the Soil Moisture and Ocean Salinity (SMOS) satellite and converted to soil moisture using version 6.20 of the SMOS soil moisture processor. The data are produced by the European Space Agency and obtained under a Category 1 proposal for Level 2 soil moisture data. The data are gridded to a resolution of 0.25 degrees. Data quality flags have been applied to remove areas where rainfall is present during the acquisition, where snow cover is detected and when Radio Frequency Interference (RFI) is above an acceptable threshold.
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3.2.4. Monthly Percent Saturated Surface Soil Moisture Anomalies

Title	Monthly Percent Saturated Surface Soil Moisture Anomalies
Alternate Title	Monthly Percent Saturated Surface Soil Moisture Difference from Long Term Average
Abstract	This data product represents the monthly volumetric soil moisture (percent saturated soil) for the surface layer, expressed as a difference from the long term average. The average is calculated from all available years for each location and each time period, based on the length of the satellite data record. Values higher than zero represent areas that are wetter than the long term average, and areas lower than zero represent areas drier than the long term average. The data is produced from passive microwave satellite data collected by the Soil Moisture and Ocean Salinity (SMOS) satellite and converted to soil moisture using version 6.20 of the SMOS soil moisture processor. The data are produced by the European Space Agency and obtained under a Category 1 proposal for Level 2 soil moisture data. The data are gridded to a resolution of 0.25 degrees. Data quality flags have been applied to remove areas where rainfall is present during the acquisition, where snow cover is detected and when Radio Frequency Interference (RFI) is above an acceptable threshold.
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Scope identification	series

4. REFERENCE SYSTEMS

4.1. Spatial reference system

Horizontal coordinate reference system: WGS84
Map projection: Web Mercator Auxiliary Sphere; EPSG: 3857; Version 8.1.4

4.2. Temporal reference system

Julian calendar

5. DATA QUALITY

5.1. Completeness

Measure not used at this time.

5.2. Logical consistency

Measure not used at this time.

5.3. Positional accuracy

Each pixel represents an integrated value of soil moisture over the pixel extent. Data are processed by ESA from multiple views of the same pixel, and are distributed on a 15km discrete global grid. The final product is re-gridded to a 0.25 degree grid to be consistent with other global monitoring products, and to better reflect the larger spatial precision of the radiometric data (approximately 40km grid resolution)

DQ_Scope	All pixels = 0.25 degree grid
DQ_Element	3 – Gridded data position accuracy
DQ_Subelement	1 – Absolute or external accuracy
DQ_Measure	
DQ_MeasureDesc	Pass-Fail
DQ_MeasureID	
DQ_EvalMethod	
DQ_EvalMethodType	2 - external
DQ_EvalMethodDesc	Verify pixel size after resampling
DQ_Result	
DQ_ValueType	1 - Boolean
DQ_Value	True
DQ_ValueUnit	
DQ_Date	11-Aug-14
DQ_ConformanceLevel	All pixels equal to 0.25 degrees
Dataset Parameters	Parameters Omitted
Quality Result Meaning	Dataset passes

5.4. Temporal accuracy

The gridded data are processed using daily averages of all available swaths in a given day, based on Universal Time 24 hour day. Ascending and Descending passes are used, which cover areas at local 6am/6pm overpass time.

DQ_Scope	All daily data included in dataset
DQ_Element	4 – Temporal accuracy
DQ_Subelement	2 – Temporal consistency
DQ_Measure	
DQ_MeasureDesc	Pass-Fail
DQ_MeasureID	
DQ_EvalMethod	
DQ_EvalMethodType	1 - external
DQ_EvalMethodDesc	Check dataset to ensure relevant daily information captured
DQ_Result	
DQ_ValueType	1 - Boolean
DQ_Value	TRUE
DQ_ValueUnit	NA
DQ_Date	11-Aug-14
DQ_ConformanceLevel	All daily information included in dataset
Dataset Parameters	
Quality Result Meaning	Dataset passes.

5.5. Thematic accuracy

ESA product specifications indicate this is accurate to within +/- 4% volumetric soil moisture over low biomass vegetation. Accuracy over areas with significant topography, forest cover and non-mineral soils may differ.

DQ_Scope	Low Biomass Vegetation soil moisture content
DQ_Element	5 – Thematic accuracy
DQ_Subelement	1 – Classification correctness
DQ_Measure	
DQ_MeasureDesc	Percent correctly classified (PCC)
DQ_MeasureID	
DQ_EvalMethod	
DQ_EvalMethodType	2 - External
DQ_EvalMethodDesc	
DQ_Result	
DQ_ValueType	4 - Percentage
DQ_Value	+- 4%
DQ_ValueUnit	NA
DQ_Date	12-Jun-14
DQ_ConformanceLevel	Dataset must be accurate to within +- 4% of volumetric soil moisture over low biomass areas
Dataset Parameters	
Quality Result Meaning	Dataset passes.

5.6. Lineage statement

Lineage Statement	N/A
Scope	

6. DATA CAPTURE

The SMOS sensor captures upwelling, naturally emitted microwave emissions from the earth's surface. Using an interferometric approach, measured brightness temperature values from multiple view angles are used to solve an iterative model to retrieve soil moisture and vegetation water content at a pixel scale. Final values are output on a 15km discrete global grid. More details on this approach can be found here:

Kerr, Y.H., Waldteufel, P., Richaume, P., Wigneron, J.P., Ferrazzoli, P., Mahmoodi, A., Al Bitar, A., Cabot, F., Gruhier, C., Juglea, S.E., Leroux, D., Mialon, A., & Delwart, S. (2012). The SMOS Soil Moisture Retrieval Algorithm. IEEE Transactions on Geoscience and Remote Sensing, 50, 1384-1403

7. DATA MAINTENANCE

Data are generated on a weekly basis during the Canadian growing season, spanning from April 1 to November 30 each calendar year. Periodic updates to the processing are made, and new versions of the data are released. Changes to the ESA processing stream also occur every few years. The current data is using version 5.51 of the ESA soil moisture processor, and version M5 of the AAFC gridding and quality control algorithm.

8. PORTRAYAL

Not applicable.

9. DATA PRODUCT DELIVERY

TIF
format name: Tag Interleaved File:
version: 6.0
specification: GeoTIFF is format extension for storing georeference and geocoding information in a TIFF 6.0 compliant raster file by tying a raster image to a known model space or map projection.
languages: eng
character set: utf8

PDF
format name: Portable Document Format:
version: 1.7
specification: ISO 32000-1:2008 specifies a digital form for representing electronic documents to enable users to exchange and view electronic documents independent of the environment they were created in or the environment they are viewed or printed in. It is intended for the developer of software that creates PDF files (conforming writers), software that reads existing PDF files and interprets their contents for display and interaction (conforming readers) and PDF products that read and/or write PDF files for a variety of other purposes (conforming products).
languages: eng
character set: utf8

10. METADATA

The metadata requirements follow the Government of Canada's Treasury Board Standard on Geospatial Data (ISO 19115)