Soil Moisture Active Passive (SMAP)

Ancillary Data Report

Permanent Ice and Snow

Preliminary, v.1
SMAP Science Document no. 048

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January 11, 2013
JPL D-53062

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Preface

The SMAP Ancillary Data Reports provide descriptions of ancillary data sets used with the science algorithm software in generation of the SMAP science data products. The Ancillary Data Reports may undergo additional updates as new ancillary data sets or processing methods become available. The most recent versions of the ancillary data reports will be made available, along with the Algorithm Theoretical Basis Documents (ATBDs), at the SMAP web site http://smap.jpl.nasa.gov/science/dataproducts/ATBD/.

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1 Overview

1.1 Purpose

The purpose of this report is to evaluate options and select a permanent ice and snow dataset to support generation of the SMAP science data products. The permanent ice and snow dataset is one of a suite of ancillary datasets required by the SMAP science processing algorithms. The algorithms and ancillary data are described in SMAP algorithm theoretical basis documents (ATBDs) and ancillary data reports. The ATBDs and ancillary data reports are listed in Appendices A and B and are available at the SMAP web site:
http://smap.jpl.nasa.gov/science/dataproducts/ATBD/.

1.2 Requirement

The permanent ice and snow dataset is applied within the L2 and L3 soil moisture and freeze/thaw algorithms to provide a spatial mask that indicates areas of permanent ice and snow within a sensor footprint or retrieval grid cell. The permanent ice and snow regions correspond to areas where the freeze/thaw product would not be useful for characterizing soil moisture or seasonal freeze/thaw transitions, and the associated geophysical retrievals would not be relevant to SMAP mission objectives.

2 Candidate Datasets

Candidate datasets defining permanent ice and snow regions have been identified by the SMAP team and are listed in Table 1. The datasets listed are global in extent and are characterized by their source data (e.g., MODIS) and classification scheme (e.g., IGBP).

The classification schemes for the MODIS and SPOT datasets are subsets of the IGBP scheme. The ECOCLIMAP (Masson et al., 2003) dataset is used by the ECMWF forecast model and the SMOS (Soil Moisture Ocean Salinity) mission soil moisture retrieval. The ECOCLIMAP provides 215 classes within Europe and 17 classes for the rest of the world. The sources of the European classification data are CORINE and PELCOM. Outside of Europe, the classification schemes of the Pan-European Land Cover Monitoring UMD and IGBP were used in combination. The Global Land Cover Characteristics Data Base provided by the USGS is derived using one year of AVHRR data.

Table 1. List of the candidate datasets.

Dataset Name	Spatial Resolution	Temporal Resolution
MODIS_IGBP – MCD12Q1	500 m	Annual 2001-2007
SPOT_IGBP	1 km	1998-1999
ECOCLIMAP	1 km	One time
Global Land Cover Characteristics Data Base (USGS)	1km	Seasonal 1992-1993

3 Dataset Selection and Description

Based on assessment of the characteristics of the datasets in Table 1, the permanent ice landcover class component of the MODIS MCD12Q1 IGPB classification was determined to be the most suitable dataset for application to SMAP processing. This assessment was based on the product's higher spatial resolution (500m), annual update, and widespread utilization within the Earth science community as a standard land cover product. Selection of this dataset also provides internal project consistency with other SMAP processing needs, since the MODIS landcover product was also identified as the landcover dataset of choice for use in the SMAP L2 soil moisture algorithms.

The MODIS Land Cover Type product contains multiple landcover classes that describe land cover properties derived from observations spanning a single year's input of Terra and Aqua data. The primary land cover scheme identifies 17 land cover classes defined by the IGBP, which includes 11 natural vegetation classes, 3 developed and mosaicked land classes, and three non-vegetated land classes which include the permanent ice and snow class, defined as "lands under snow and ice throughout the year". It is identified as class #15 in the MODIS_IGBP classification product and covers 11.04% of the globe. Figure 1 shows the MODIS IGPB classification.

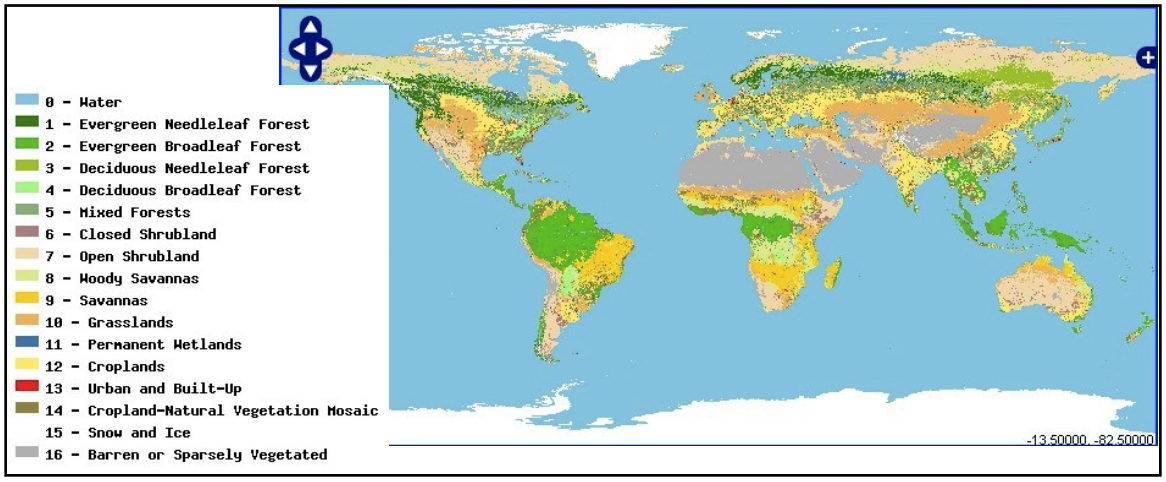

Figure 1. The MODIS IGBP classification. Permenant ice corresponds to class 15, delineated in white. (http://webmap.ornl.gov/wcsdown/wcsdown.jsp?dg_id=10004_16)

The annually updated MODIS-IGBP files at 500 m resolution are available through the NASA DAAC at http://lpdaac.usgs.gov. The dataset has the following characteristics:

Collection: MODIS (MCD12Q1) LAND COVER
Native Projection: WGS 84 (EPSG:4326)
Spatial Extent: N: 90.0, S: -90.0, E: 180.0, W: -180.0
Updates: Updated annually, datasets from 2001-2007
Map Units: degrees

Resolution: 500 meters
Earth-Gridded Tile Area: ~1200 x 1200 km (~10° x 10° at the equator)
Image Dimensions: 2400 x 2400 rows/columns
File Size: ~88 MB
Projection: Sinusoidal
Data type: 8-bit unsigned integer
Data Format: HDF-EOS

4 Processing

The annual classification files were produced at 1, 3, 9, and 36 km resolutions by determining the dominant percent permanent ice and snow within each resolution. The outputs were projected to the EASE grid coordinates. Figure 1 shows an example map of the MODIS IGBP classification, which includes permanent snow and ice as a landcover class.

5 Acknowledgment

This work was carried out in part at the Jet Propulsion Laboratory, California Institute of Technology, under contract with the National Aeronautics and Space Administration.

6 References

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Crow, W. T., and co-authors (2005): An observing system simulation experiment for Hydros ramiometer-only soil moisture products, *IEEE Trans. Geosci. Remote Sens.*, *43,* 1289-1303.

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Masson, V., J. L. Champeaux, F. Chauvin, C. Meriguet, and R. Lacaze (2003): A global database of land surface parameters at 1-km resolution in meteorological and climate models, *Journal of Climate*, *16,* 1261-1282.

Strahler, A., D. Muchoney, J. Borak, F. Friedl, S. Gopal, L. Lambin, and A. Moody (1999): *MODIS Land Cover Product Algorithm Theoretical Basis Document (ATBD)*, 72 pp.

Appendix A: SMAP Science Data Products and ATBDs

The SMAP Algorithm Theoretical Basis Documents are available at the SMAP web site http://smap.jpl.nasa.gov/science/dataproducts/ATBD/.

Data Product	Description	ATBD
L1A_Radar	Radar raw data in time order	(Joint with L1C_S0_HiRes)
L1A_Radiometer	Radiometer raw data in time order	(Joint with L1B_TB)
L1B_S0_LoRes	Low resolution radar σ_o in time order	(Joint with L1C_S0_HiRes)
L1C_S0_HiRes	High resolution radar σ_o (half orbit, gridded)	West, R., L1B & L1C radar products, JPL D-53052, JPL, Pasadena, CA.
L1B_TB	Radiometer T_B in time order	Piepmeier, J. et al., L1B radiometer product, GSFC SMAP-006, GSFC, Greenbelt, MD.
L1C_TB	Radiometer T_B (half orbit, gridded)	Chan, S. et al., L1C radiometer product, JPL D-53053, JPL, Pasadena, CA.
L2_SM_A	Soil moisture (radar, half orbit)	Kim, S. et al., L2 & L3 radar soil moisture (active) product, JPL D-66479, JPL, Pasadena, CA.
L2_SM_P	Soil moisture (radiometer, half orbit)	O'Neill, P. et al., L2 & L3 radiometer soil moisture (passive) product, JPL D-66480, JPL, Pasadena, CA.
L2_SM_AP	Soil moisture (radar/radiometer, half orbit)	Entekhabi, D. et al., L2 & L3 radar/radiometer soil moisture (active/passive) products, JPL D-66481, JPL, Pasadena, CA.
L3_FT_A	Freeze/thaw state (radar, daily composite)	McDonald, K. et al., L3 radar freeze/thaw (active) product, JPL D-66482, JPL, Pasadena, CA.
L3_SM_A	Soil moisture (radar, daily composite)	(Joint with L2_SM_A)
L3_SM_P	Soil moisture (radiometer, daily composite)	(Joint with L2_SM_P)
L3_SM_AP	Soil moisture (radar/radiometer, daily composite)	(Joint with L2_SM_AP)
L4_SM	Soil moisture (surface & root zone)	Reichle, R. et al., L4 surface and root-zone soil moisture product, JPL D-66483, JPL, Pasadena, CA.
L4_C	Carbon net ecosystem exchange (NEE)	Kimball, J. et al., L4 carbon product, JPL D-66484, JPL, Pasadena, CA.

Appendix B: SMAP Ancillary Data Reports

The SMAP Ancillary Data Reports are available with the ATBDs at the SMAP web site http://smap.jpl.nasa.gov/science/dataproducts/ATBD/.

Data/Parameter	Ancillary Data Report
Crop Type	Kim, S., Crop Type, JPL D-53054, Pasadena, CA
Digital Elevation Model	Podest, E. et al., Digital Elevation Model, JPL D-53056, Pasadena, CA
Landcover Classification	Kim, S., Landcover Classification, JPL D-53057, Pasadena, CA
Soil Attributes	Das, N. et al., Soil Attributes, JPL D-53058, Pasadena, CA
Static Water Fraction	Chan, S. et al., Static Water Fraction, JPL D-53059, Pasadena, CA
Urban Area	Das, N., Urban Area, JPL D-53060, Pasadena, CA
Vegetation Water Content	Chan, S. et al., Vegetation Water Content, JPL D-53061, Pasadena, CA
Permanent Ice	McDonald, K., Permanent Ice & Snow, JPL D-53062, Pasadena, CA
Precipitation	Dunbar, S., Precipitation, JPL D-53063, Pasadena, CA
Snow	Kim, E. et al., Snow, GSFC SMAP-007, Greenbelt, MD
Surface Temperature	Fisher, J. et al., Surface Temperature, JPL D-53064 Pasadena, CA
Vegetation and Roughness Parameters	Colliander, A., Vegetation & Roughness Parameters, JPL D-53065, Pasadena, CA