Surface WAter Microwave Product Series [SWAMPS]

Version 3.2

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Schroeder R, McDonald KC, Chapman BD, Jensen K, Podest E, Tessler ZD, Bohn TJ, Zimmermann R. Development and Evaluation of a Multi-Year Fractional Surface Water Data Set Derived from Active/Passive Microwave Remote Sensing Data. *Remote Sensing*. 2015; 7(12):16688-16732.

Dataset Description

This dataset is an updated release of the global, daily time series inundated area fraction (**fw**) dataset component of the NASA Inundated Wetlands Earth System Data Record (ESDR) (http://wetlands.jpl.nasa.gov). Brightness temperature records from the Special Sensor Microwave Imager (F11 and F13 **SSM/I**) and the Special Sensor Microwave Imager/Sounder (F17 and F18 **SSMIS**), along with active microwave radar backscatter from ESA's European Remote Sensing (**ERS**), NASA's SeaWinds-on-QuikSCAT (**QuikSCAT**), and ESA's Advanced Scatterometer (**ASCAT**) provide the basis for the construction of this global time series of inundated area fraction record. The Boston University MOD12Q1 V004 (BU-MODIS) Land Cover Product provides ancillary land cover information to support determination of the potential global domain of open water impacted land, and land cover-specific parameterization supporting implementation of a dynamic mixture model.

Spanning over 26 years, this record relies on observations from a variety of satellite sensors and can be viewed as 3 consecutive series of satellite observation combinations (summarized in **Table 1**). Due to sparse data availability, the first segment (1992-1999) is composited at a bimonthly time scale, while the remainder of the time series is posted at a daily time step.

The stable release extends from January 1, 1992 – Mar 31, 2018, and is updated monthly. A near real-time (NRT) version of the dataset is also available for more recent time periods, with a 2-3 day data latency. Since MERRA2 data are only released monthly, the NRT SWAMPS product is based on a climatology of atmospheric variables, calculated over a 10-year period, 2008-2017.

Table 1. Description of temporal compositing and satellite sources for three segments of SWAMPS data record.

	[I] 1992-1999	**[II] 2000-2008**	**[III] 2009-present**
Temporal Compositing	Bimonthly	Daily	Daily
Data Sources			
Passive [Tb]:	SSM/I F11 & F13	SSM/I F13	SSMIS F17 & F18
Active [σ0]:	ERS	QuikSCAT	ASCAT
NDVI:	AVHRR	MODIS	MODIS
Snow Cover:	SSMI/I	MODIS	MODIS
Reanalysis:	MERRA2	MERRA2	MERRA2

This update was primarily focused on reducing anomalous retrievals and improving data comparability with complementary observations. Modifications include:

1) Reduction of coastal contributions
   SWAMPS aims to detect *terrestrial* surface water dynamics, including those from wetlands, rivers, lakes, reservoirs, rice paddies, and episodically inundated areas. In past versions of SWAMPS (<= v 3.0), gridcells along coastlines are heavily influenced by ocean water and can eclipse the signal from terrestrial inundated surfaces. We filtered out contributions from coastal areas using a 1km coastal mask before gridding of both the passive and active components and provide an estimated permanent coastal water fraction at 25km.

2) Inclusion of permanent terrestrial water fraction
   In the same spirit as the previous modification, we include *all* terrestrial waters in the **fw** reported. Prior versions of SWAMPS focused only on the *dynamic* portion of terrestrial waters; permanent water and wetland classes from BU-MODIS had been originally ignored.

3) Reduction of anomalous retrievals over semi-arid and arid regions
   SWAMPS has systematically produced erroneously high water fraction over some arid and semi-arid regions. This is in part due to limitations in the mixture model of capturing characteristically large emissivity and variable backscatter gradients present within the barren and sparsely vegetated land cover classes. The SWAMPS algorithm relies on general landcover classes from MODIS and assumes a constant dielectric as a function of backscatter over areas that fall in the general "barren/sparse vegetation" land cover class. This general class has been subsetted by dominant mineral type in the soil, and vegetation classes are re-assigned in semi-arid regions based on observed NDVI. Highly arid regions (NDVI < 0.1) are masked out completely and flagged.

File Naming Convention

SWAMPS.FW.{*passive platform*}.{*radar sensor*}.{*year*}{*month*}{*day*}.nc

passive platform: platform on which SSM/I or SSMIS brightness temperatures were observed (**F11**, **F13**, **F17**, or **F18**)
radar sensor: concurrent active microwave radar backscatter time series in use (**ERS**, **QuikSCAT**, or **ASCAT**)
year: four-digits (ranging from **1992**-**2016**)
month: two-digits (ranging from **01**-**12**)
day: two-digits (ranging from **01**-**31**)

* Note: The date in the filenames from the 1992-1999 period reflects the first day of the bimonthly period. For example, YYYYMM01 represents the first half of the month (1^{st}-15^{th}), while YYYYMM16 the second half (16^{th}-end of month).

Data Format

Daily fractional water (FW) files are in netCDF4 format, with values provided on a 25km global cylindrical Equal Area Scalable Earth grid (EASE-grid); see: http://nsidc.org/data/ease/ for a detailed description of this projection. Each individual daily file is composed of the following:

Dimension information:

lat: latitude of gridcell center point
data type: float32
units: decimal degree
valid range: -90 to 90
size: 586

lon: longitude of gridcell center point
data type: float32
units: decimal degree
valid range: -180 to 180
size: 1383

Variable information:

fw: fractional surface water
data type: float32
units: n/a
valid range: 0 to 100
size: 586 x 1383
fill value: -9999

flag: data flag
data type: int8
units: n/a
valid range: 0 to 4
size: 586 x 1393

Flag information:
0 = Missing data
1 = Valid observation
2 = Not mapped (ocean / large water body / Antarctica)
3 = Snow
4 = Arid Region

Ancillary Data

There is a static ancillary file with additional surface water fraction information:

PERMANENT_WATER _FRACTIONS_EASE25KM.nc

Like the dynamic SWAMPS datafiles, this ancillary file is in netCDF4 format, posted on the 25km global EASE-grid with identical latitude and longitude coordinates.

Three variables are included,

1) *ter_open_water*
   Permanent terrestrial open water fraction, according to BU-MODIS (included in SWAMPS **fw**).

2) *ter_wetland*
   Permanent wetland fraction, according to BU-MODIS (also included in SWAMPS **fw**). According to BU-MODIS, this class is defined as:

   > Lands with a permanent mixture of water and herbaceous/woody vegetation. The vegetation can be present in either salt, brackish, or fresh water.

3) *coastal_water*
   Coastal water fraction (excluded from SWAMPS **fw**). Coastal waters are defined as all ocean waters and select large landlocked water bodies (e.g. Great Lakes, Caspian & Black Seas)

   NOTE: All terrestrial **fw** reported in this dataset is calculated as a percentage of total "terrestrial" surface (that is, ignoring this coastal water fraction).

   For example, say a gridcell on the coast has **coastal_water** estimated to be 30% of total area. If for a given time period, this gridcell observes **fw** of 15% of its land surface – you would calculate total inundated land area by:

   TOTAL_AREA: 25.067525km x 25.067525 km = 628.4km^2

   LAND_FRACTION: 100% - 30% = 70%

   TOTAL_INUNDATED_LAND_AREA:
   LAND_FRACTION * FW * TOTAL_AREA = 0.70 * 0.15 * 628.4 km^2 = 66km^2

All three variables have the following attributes:

data type: float32
units: n/a
valid range: 0 to 100
size: 586 x 1383
fill value: -9999