SAR Water Bodies V2 product guide

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This document is the Product Guide for the version 2 release of the 150m resolution regional 'open water surface' product. It has been compiled for the DUE Permafrost project (ESRIN Contract No. 22185/09/I-OL), a project of the Data User Element initiative of the European Space Agency.

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1 Product overview

Water is a class in all available global and regional land cover maps. The spatial resolution of those existing products ranges between 300m to 1km. The majority of lakes within tundra environment is however much smaller than the spatial resolution of those maps. ENVISAT ASAR Wide Swath data with 150 m resolution can identify 50% more open water surface areas than land over maps based on MODIS (Bartsch et al. 2008) and allows regular (annual) updates on regional scale.

The DUE Permafrost SAR processing subsystem for the Water Bodies (WB) product uses ENVISAT ASAR Wide Swath level 1b data, a Digital Elevation Model and orbit state vector information (e.g. DORIS files).

The data cover the years 2007 to 2011 for the regional sites Ob Estuary, Alaska, Mackenzie and Laptev Sea Coast. Product availability is limited due to availability of ASAR WS data. The site Central Yakutia is not included from 2009 to 2011 because of this problem.

The offline processing makes use of ENVISAT ASAR Wide Swath (WS) mode level 1b data, a Digital Elevation Model (DUE Permafrost panarctic product). For geocoding of the ASAR WS data also DORIS orbit files (or other satellite state vector specifications) are used in order to optimise geolocation accuracy.

The offline SAR WB processing subsystem consists of:
1. Extraction of metadata from ASAR WS datasets to metadata library
2. Mapping of data coverage (using extracted metadata) for regional sites for identifying datasets to process
3. Geocoding and radiometric calibration of the identified WS data to the polar stereographic projection
4. Resampling geocoded images to a fixed grid database
5. Normalisation of backscatter to 30 degrees local incidence angle based on the parameter database
6. Classification of water bodies, based on data acquired during the summer months, in order to produce seasonal maps
7. Extraction of geocoded seasonal image tiles of the WB product

Figure 1 gives an overview of the offline processing subsystem. The WB classification is carried out on an annual basis and is based on backscatter measurements for the summer months July and August. A pixel is classified as representing a water body if the backscatter measurements in the time series for that pixel are lower than a threshold value more than once.

During post-processing, oceans were masked using a coastline mask derived from the Global Self-consistent, Hierarchical, High-resolution Shoreline Database (GSHHS, Wessel & Smith 1996).
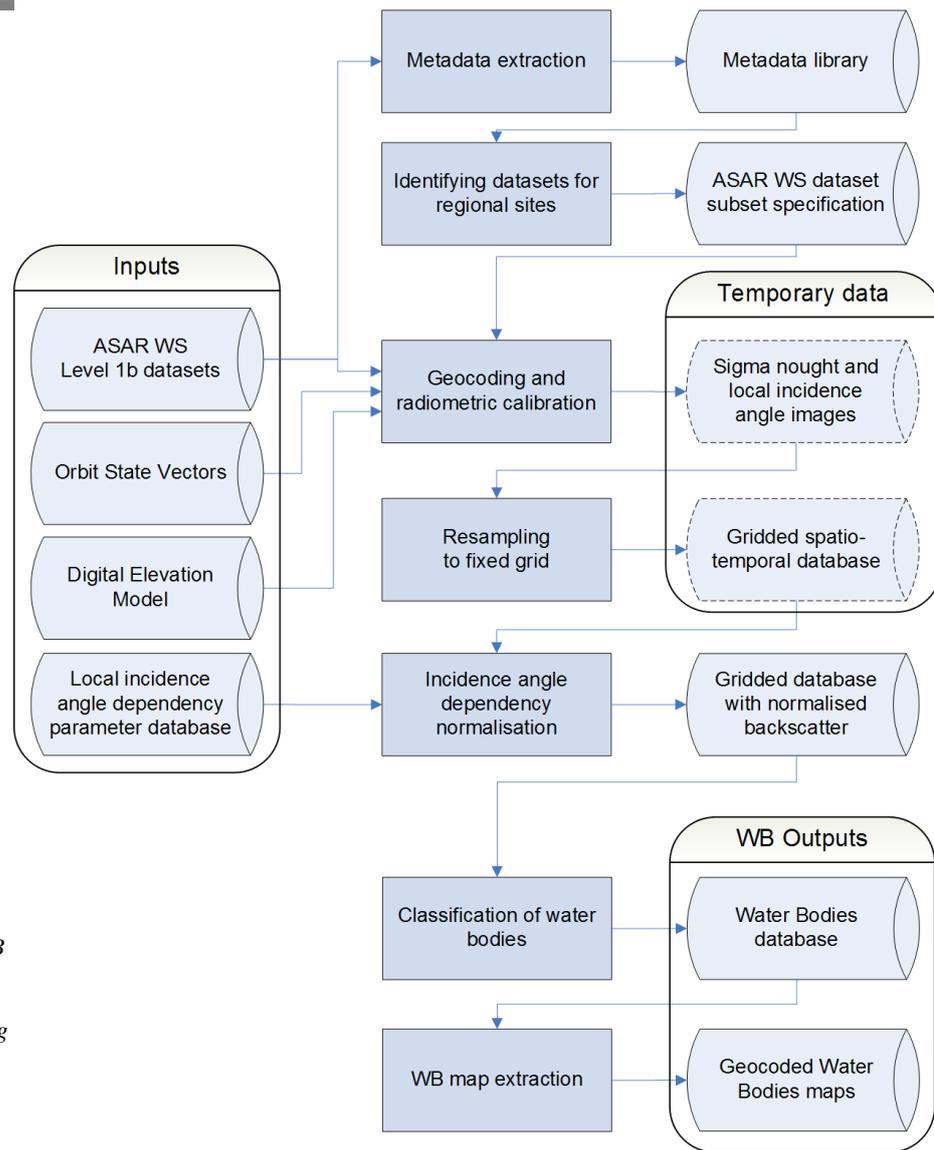
Figure 1

Overview of offline SAR WB subsystem. The processing carried out on the PEO system consists of producing the user-ready Geo-Tiff/NetCDF images of the product (not shown in the flowchart).

2 Product specification

The Water Bodies maps represent extent of water bodies for the summer months and are produced on an annual basis. The unit is a binary indicator with the pixel value 1 representing water and 0 representing non-water. In addition to the water body indicator the number of measurements used to derive the water bodies product are also provided. The specifications of the mosaic product are given in Table 2–1, Table 2–2 and Table 2–3.

Subject	Specification
Variable	Water Body indicator
Units	Binary
Coverage	Five regional sites: Ob Estuary, Mackenzie, Alaska, central Yakutia and Laptev Sea Coast.
Time period	2007-2011
Temporal frequency	yearly
Coordinate system	Polar Stereographic, WGS84
Pixel size	75 m (150 m resolution)
Geometric accuracy	Subpixel
Thematic accuracy	Kappa > 0.8 (Bartsch et al. 2008)
Data format	GeoTIFF NetCDF
Other data codes	-1/-32768 for missing data

Table 2–1
dat.tif Mosaic files

| Subject	Specification
Variable	Number of measurements
Units	Integer
Coverage	Five regional sites: Ob Estuary, Mackenzie, Alaska, central Yakutia and Laptev Sea Coast.
Time period	2007-2011
Temporal frequency	yearly
Coordinate system	Polar Stereographic, WGS84
Spatial resolution	75 m (150 m resolution)
Geometric accuracy	Subpixel
Data format	GeoTIFF NetCDF

Table 2–2
Num.tif Mosaic files

Subject	Specification
Organisation	TUW
Sensor and Mode	ASAWS
Product	WBO
Version	002
Processing index	003
Start Date/Time	YYYYMMDD_HHMMSS
End Date/Time	YYYYMMDD_HHMMSS
Region of Interest	001*
Extension	.tif or num.tif

Table 2–3
Mosaic Filename Structure

*The value of the "Region of Interest" field, specified in Table 2–4, is defined according to the Permafrost Observation Strategy document ("Service Case Areas").

Permafrost Regional site	"Region of Interest" field
Alaska	001
Mackenzie	002
Laptev Sea Coast	003
Central Yakutia	004
Ob Estuary	005

Table 2–4

Definitions for the "Region of Interest" field in the product file name.
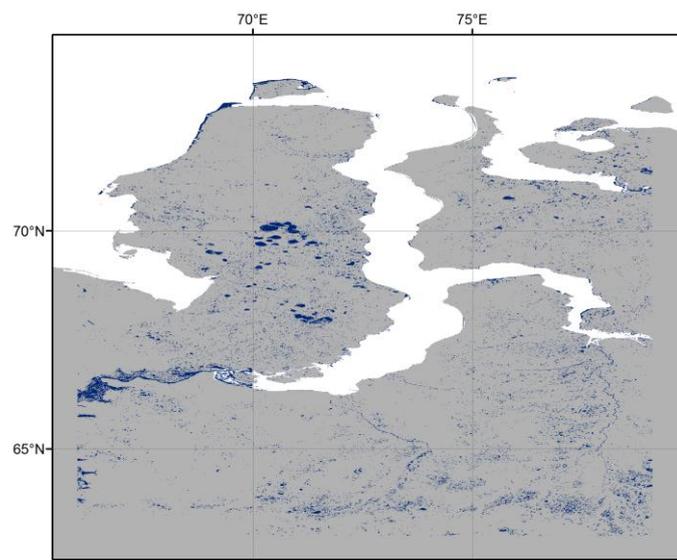
Figure 2

*Examples of Water Body mosaic products over Ob-Esturary region (*dat.tif)*

3 Known issues

3.1 Artefacts

Artefacts are caused by
- Errors in the original N1 datasets provided by ESA
- Inconsistencies in the DEM used for orthorectification

Figure 3
Examples for Artefacts in the ENVISAT ASAR WS water surface product: due to errors in original data (Western Taymir)

3.2 Data coverage

ENVISAT ASAR WS data are not acquired on a regular basis. Data availability varies spatially and temporally. Due to that reason, no water layer can be provided for central Yakutia in 2010-2011.

In Alaska, the DEM used for orthorectification contained a void between 149°W 68°N and 147°W 69°N. This void was filled using GTOPO30 in version 1 of this dataset. However, this led to artefacts in the final product for this region (see product guide for v. 1). Therefore it was chosen to deliver data for these coordinates as No Data in this version.

4 Data access and contact information

The SAR Water Bodies regional product version 2 can be accessed via PANGAEA (http://doi.pangaea.de/10.1594/PANGAEA.780111) and should be cited as:

Schlaffer, Stefan; Sabel, Daniel; Bartsch, Annett; Wagner, Wolfgang (2012): Regional water bodies remote sensing products with links to geotiff images, Institute of Photogrammetry and Remote Sensing, TU Vienna, doi:10.1594/PANGAEA. 779754
In: DUE Permafrost Project Consortium (2012): ESA Data User Element (DUE) Permafrost: Circumpolar Remote Sensing Service for Permafrost (Full Product Set) with links to datasets. doi:10.1594/PANGAEA.780111

The product is alternatively stored on the Institute of Photogrammetry and Remote Sensing (TU Wien) FTP server which can be accessed via the DUE Permafrost data portal (www.ipf.tuwien.ac.at/permafrost). The dataportal includes a WebGIS for visualization. Login information is available on request.

For login access to the dataportal, contact Annett.Bartsch@tuwien.ac.at.

For questions about the product, contact Annett.Bartsch@tuwien.ac.at.
For ESA's technical officer, contact Frank.Martin.Seifert@esa.int.

Additional information on the ESA DUE Permafrost project can be found at the web‑site: http://www.ipf.tuwien.ac.at/permafrost

5 References

Bartsch A., Pathe C., Wagner W., and Scipal, K. (2008): Detection of permanent open water surfaces in central Siberia with ENVISAT ASAR wide swath data with special emphasis on the estimation of methane fluxes from tundra wetlands. Hydrology Research, 39(2): 89-100.

Wessel, P. and Smith, W.H.F. (1996): A Global Self-consistent, Hierarchical, High-resolution Shoreline Database. J. Geophys. Res., 101: 8741-8743.