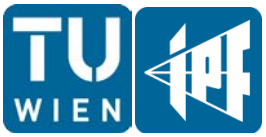
ESA STSE-ALANIS methane

ASAR WS Local Wetlands product guide

alanis methane

support to science element

Centre for Ecology and Hydrology



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Scope

The European Space Agency (ESA) has initiated the *A*tmosphere-*LAN*d *I*nteractions *S*tudy (ALANIS) in collaboration with the Integrated Land Ecosystem-Atmosphere Processes Study (iLEAPS). The overall objective of the ALANIS project is to advance towards the development and validation of novel Earth Observation-based (EO-based) multi-mission products and their integration into suitable land-atmosphere coupled models responding directly to the specific scientific requirements of the iLEAPS community.

One of the three themes in ALANIS considers wetland dynamics and CH_4 emissions ('ALANIS methane'). The main goal of the ALANIS methane project is to produce and use a suite of relevant information derived from Earth Observation (EO) to validate and improve one of the next generation land-surface models and thus reduce current uncertainties in wetland-related CH_4 emissions.

The 'ASAR WS Local Wetlands product guide' presents the description of dataset for the initially defined parameters:

- Extent of temporary open water bodies with additional information on
  - Number of available acquisitions
  - Number of days since last update
  - Extent of maximum open water bodies
  - Permanently high saturated areas

The temporary open water information is provided for 10-day periods.

Applicable Documents

[AD-1] STSE-LAND-EOPG-SW-09-0001 Statement of Work: STSE-ALANIS 2009
[AD-2] STSE ALANIS methane Proposal – Part A: Proposed by CEH et al. 2009
[AD-3] STSE ALANIS methane progress meeting minutes, 10.05.2009
[AD-4] Requirements Baseline (RB): STSE ALANIS methane team 2010
[AD-5] Preliminary Analyses Report (PAR): STSE ALANIS methane team 2010
[AD-6] Technical specifications (TS): STSE ALANIS methane team 2010
[AD-7] Validation plan (VP): STSE ALANIS methane team 2010

List of abbreviations

AD	Applicable document
ALANIS	Atmosphere-LANd Interactions Study
ASAR	Advanced Synthetic Aperture Radar
ASCAT	Advanced Scatterometer
CEH	Centre for Ecology and Hydrology
DUE	Data User Element
EO	Earth Observation
ERA	ECMWF Reanalysis
ESA	European Space Agency
GSHHS	Global Self-consistent, Hierarchical, High-resolution Shoreline Database
iLEAPS	Integrated Land Ecosystem-Atmosphere Processes Study
MetOp	Polar-orbiting satellite dedicated to operational meteorology
SAR	Synthetic Aperture Radar
SOW	Statement of Work
SSF	Surface State Flag
STSE	Support to Science Element
WS	Wide Swath

Contents

1 Product overview

1.1 Introduction

The majority of SAR data currently available for civil use has been acquired by C-band instruments (ERS, Radarsat ENVISAT ASAR). Continuation of these records is assured because of the future plans of the European Space Agency (ESA) with respect to the Sentinel series of satellites (launch 2013 onwards at time of writing, www.esa.int). These kinds of sensors are attractive for climate research applications for which long time records are required. The wavelength is between 5–6 cm, which means that even moderate wind action on the water surface can impede the specular reflection. Longer wavelengths such as L-band (>20 cm) would be preferable but their availability is limited at present, as well as in the near future. A further problem related to the use of C-band radar is the very limited penetration of the signal through emerging vegetation, for example along lake shores. Backscatter can also increase considerably when open water bodies start to freeze. (Bartsch et al. 2012)

C-band data from ENVISAT ASAR (Advanced SAR) operating in wide swath mode (150m resolution) were investigated and an automated detection procedure for deriving open water fraction has been developed within the STSE ALANIS-Methane project.

1.2 Methods

Open smooth water surfaces cause specular reflection and thus appear as areas with low backscatter. This phenomenon enables a straightforward identification of inundation in areas with limited vegetation coverage (Bartsch et al., 2008, 2012). Water bodies larger than 2 ha can readily be identified using a simple threshold-based classification applied to the normalized ENVISAT ASAR wide swath (WS) data. Open permanently high saturated areas such as peatlands can also be identified with SAR due to their higher moisture content and thus higher backscatter (Bartsch et al., 2007, 2009). Inundation is most extensive after snowmelt and is present for a few days to weeks only. Therefore (i) snowmelt timing needs to be precisely identified and (ii) sampling intervals need to be sufficient. Frozen areas have been identified using the Surface State Flag derived from Metop ASCAT. A quality indicator which contains the number of available acquisitions has been introduced.

1.3 Datasets

The wetland product is delivered as a ten-day composite with a spatial resolution of 150 m. The product covers Northern Eurasia (north of 50° N) in regions where the Regional Wetlands product (Prigent et al., 2001) shows occurrence of wetlands. The processed areas are subdivided into zones which are shown in Figure 1.

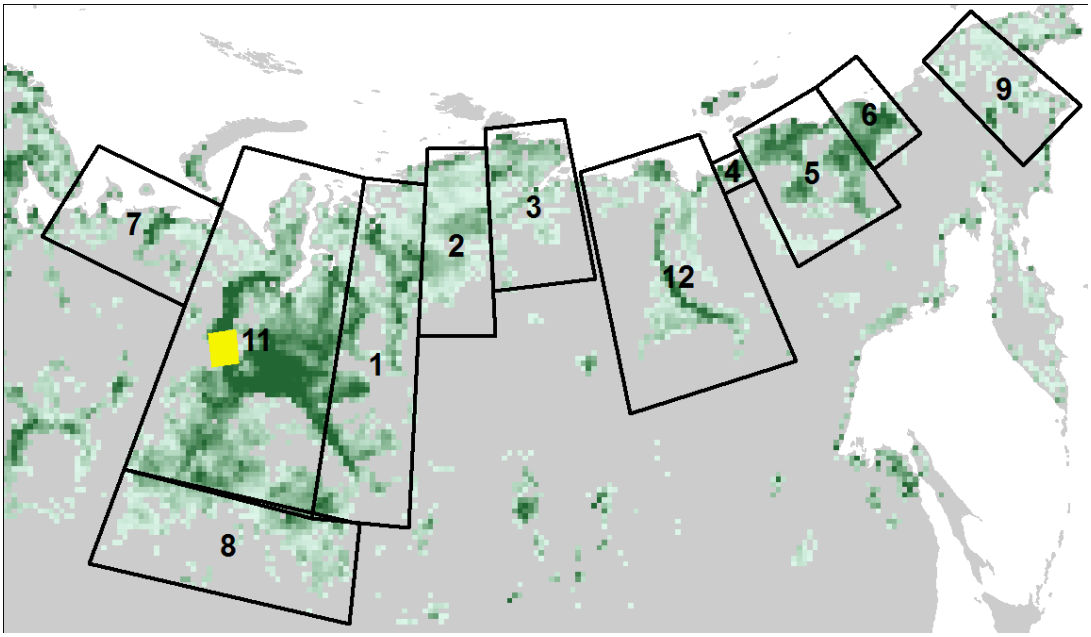

Fig. 1: Extent of subzones of the local wetland product. Green areas indicate wetland extent from the regional wetland product. The yellow area shows the extent of the sample dataset.

2 Product specification

2.1 File naming

OOO_SSSSS_PPP_VVV_vvv_yyyymmdd_hhmmss-
YYYYMMDD_HHMMSS_RRR_DDD.EEE

where
OOO="organisation", e.g. TUW
SSSSS="sensor and mode", e.g. ASAWS for ASAR Wide Swath
PPP="product", e.g. WBO for water bodies
VVV="product/software version"
vvv="processing index"
yyyymmdd_hhmmss="start date and time" (for period for which the data represents), e.g. 20070409_000000

(if applicable) YYYYMMDD_HHMMSS="end date and time" (same as above if data represents snapshot), e.g. 20070415_235959

RRR="region of interest", e.g. 011 for Ob region

(if applicable) DDD="data type", e.g. dat

(if applicable) EEE="file extension", e.g. tif for GeoTIFF, missing for ENVI format

2.2 Data description

The local wetlands product (Table 2-1 to Table 2-4) provides improved spatial information and subclasses for areas which are identified as inundated in the regional wetland product (see Figure 1). The coastline was masked using the Global Self-consistent Hierarchical High-resolution Shore Database GSHHS (Wessel and Smith, 1996). The number of acquisitions used is provided as quality indicator. More than 50% of data are affected by weather conditions. When rain or wind occurs, delectability is reduced (Bartsch et al. 2012).

Table 2-1: Characteristics of the Local wetlands product (*_dat files)

Subject	Specification
Variable	Open water (low wind conditions)
Units	16 bit integer
Coverage	Lowlands, where wetlands are identified in the regional wetland product
Time period	April to September 2007/2008
Temporal frequency	10 day
Coordinate system	Universal Polar Stereographic North, WGS84
Spatial resolution	150 m, nominal resolution 74.5 m
Geometric accuracy	Subpixel (foreseen)
Thematic accuracy	Kappa > 0.8
Data format	GeoTIFF, netCDF
Data codes	0 – not inundated 1 – permanently smooth 2 – open water -1 for missing data -2 for masked pixels

Table 2-2: Characteristics of the Local Wetlands product (*_num files)

Subject	Specification
Variable	Number of measurements
Units	16 bit integer
Coverage	lowlands, where wetlands are identified in the regional wetland product
Time period	2007/2008
Temporal frequency	10 day
Coordinate system	Universal Polar Stereographic North, WGS84
Spatial resolution	150 m, nominal resolution 74.5 m
Geometric accuracy	Subpixel
Data format	GeoTIFF, netCDF
Other data codes	-1 for missing data -2 for masked pixels

Table 2-3: Characteristics of the Local Wetlands product (*_day files)

Subject	Specification
Variable	number of days between latest measurement and start date
Units	32 bit float
Coverage	lowlands, where wetlands are identified in the regional wetland product
Time period	2007/2008
Temporal frequency	10 day
Coordinate system	Universal Polar Stereographic North, WGS84
Spatial resolution	150 m, nominal resolution 74.5 m
Geometric accuracy	Subpixel
Data format	GeoTIFF, netCDF
Other data codes	-9999 for missing data -10000 for masked pixels

Table 2-4: Characteristics of the Local Wetlands product (*_aux files)

Subject	Specification
Variable	Classes from seasonal statistics
Units	32 bit float
Coverage	lowlands, where wetlands are identified in the regional wetland product
Time period	2007/2008
Temporal frequency	annually
Coordinate system	Universal Polar Stereographic North, WGS84
Spatial resolution	150 m, nominal resolution 74.5 m
Geometric accuracy	Subpixel
Data format	GeoTIFF, netCDF
Data codes	70 – maximum open water extent 150 – permanently high saturated areas 200 - other

3 The sample dataset

The sample dataset is available as ENVI raster format and consists of four raster datasets: *dat, *aux, *num, *day. Except for the auxiallary record, 12 bands are included. Each band represents one 10 day period. The names of the bands contain meta information in accordance with the structure in section 2.1.

The sample dataset covers an approximate area of 200km x 200 km along the Ob river valley. It contains data from 1st of June until 20th of September 2007. The different data types dat, day and num are shown in Figure 2 for the first 10 day period in August. The Auxillary record represents the snow free season of 2007.

Artefacts as seen in the *aux example (narrow striping) are caused by

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

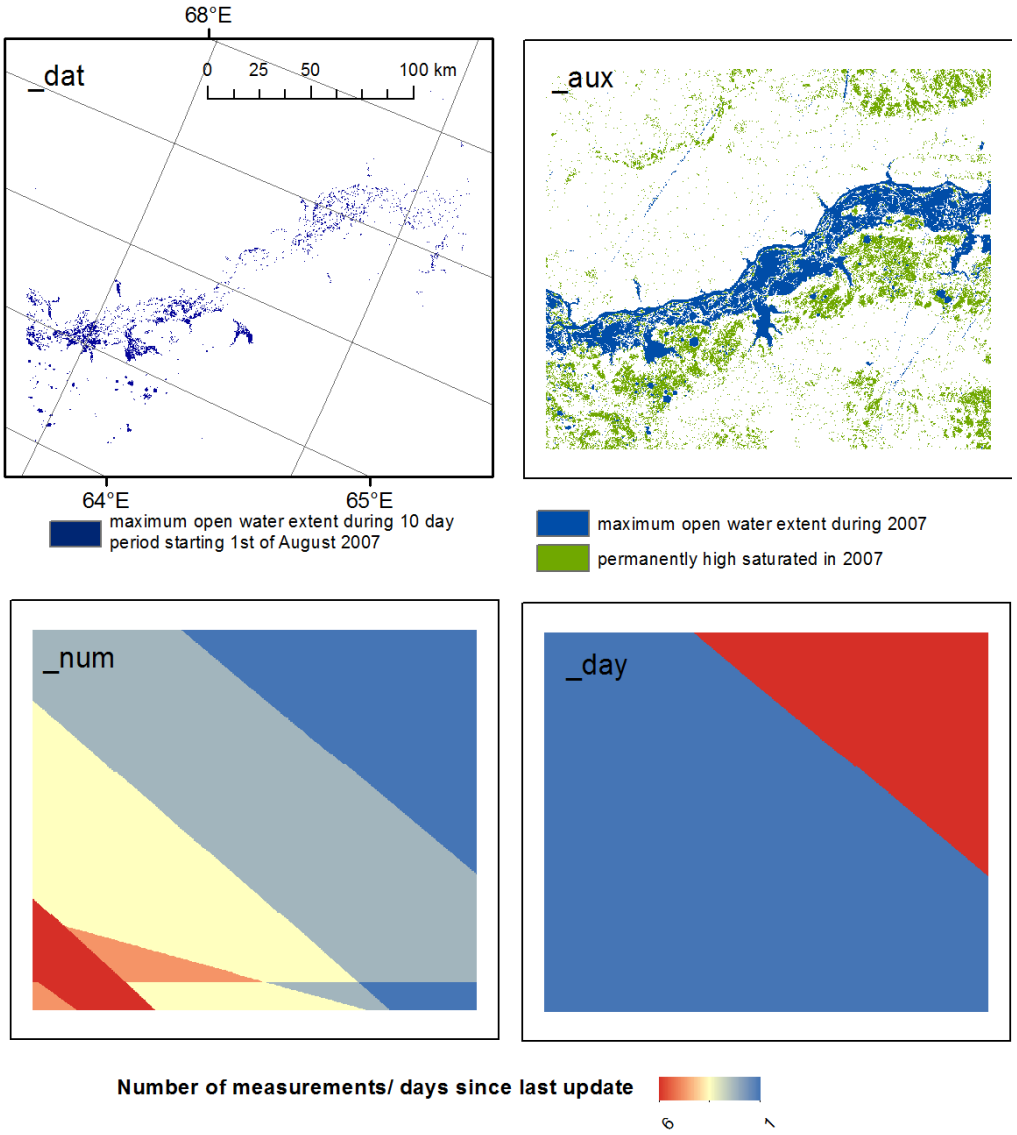

Fig. 2: Example dataset

4 References

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