VENµS WATER COLOUR PRODUCTS WITH THE POLYMER ATMOSPHERIC CORRECTION ALGORITHM

LEVEL 2 PRODUCTS DESCRIPTION

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Version : 1.0

TABLE DES MATIERES

1. Introduction

The Polymer atmospheric correction algorithm (Steinmetz et al., 2011; Steinmetz and Ramon, 2018) has been applied to the Venμs observations (Dick et al., 2022) for a selection of sites of interest – the sites which present a significant coverage of coastal and inland waters (see section **Erreur ! Source du renvoi introuvable.**). This document describes this processing.

Polymer is available on github at: https://github.com/hygeos/polymer.

The following elements are requited for the application of Polymer to Venμs products:

- A reader of the level1 products, implemented in a separate library called eoread (https://github.com/hygeos/eoread/). This reader loads level1 products using xarray objects. The use of the xarray library is central to the redesign of the data flow in the version 5 of Polymer.
- A configuration for processing Venμs with Polymer, which defines in particular:
    - The spectral bands used in the atmospheric correction process ("bands_corr" and "bands_oc"): [443,490,555,620,667,742,782,865]
    - The spectral bands at which the water reflectance is computed ("bands_rw"): [420,443,490,555,620,667,742,782,865]
    - The radiometric calibration coefficients, which are all set to one (calib = None)
    - The source of spectral response function data
    - The default source of ancillary data (wind speed, surface pressure, ozone total column) and land mask (global surface water – GSW - https://global-surface-water.appspot.com/).

2. Example

Figure 1 shows an example of Polymer level 2 product at the Lucinda Aeronet-OC site, at the eastern coast of Australia. This product shows the water reflectance at 555 nm.

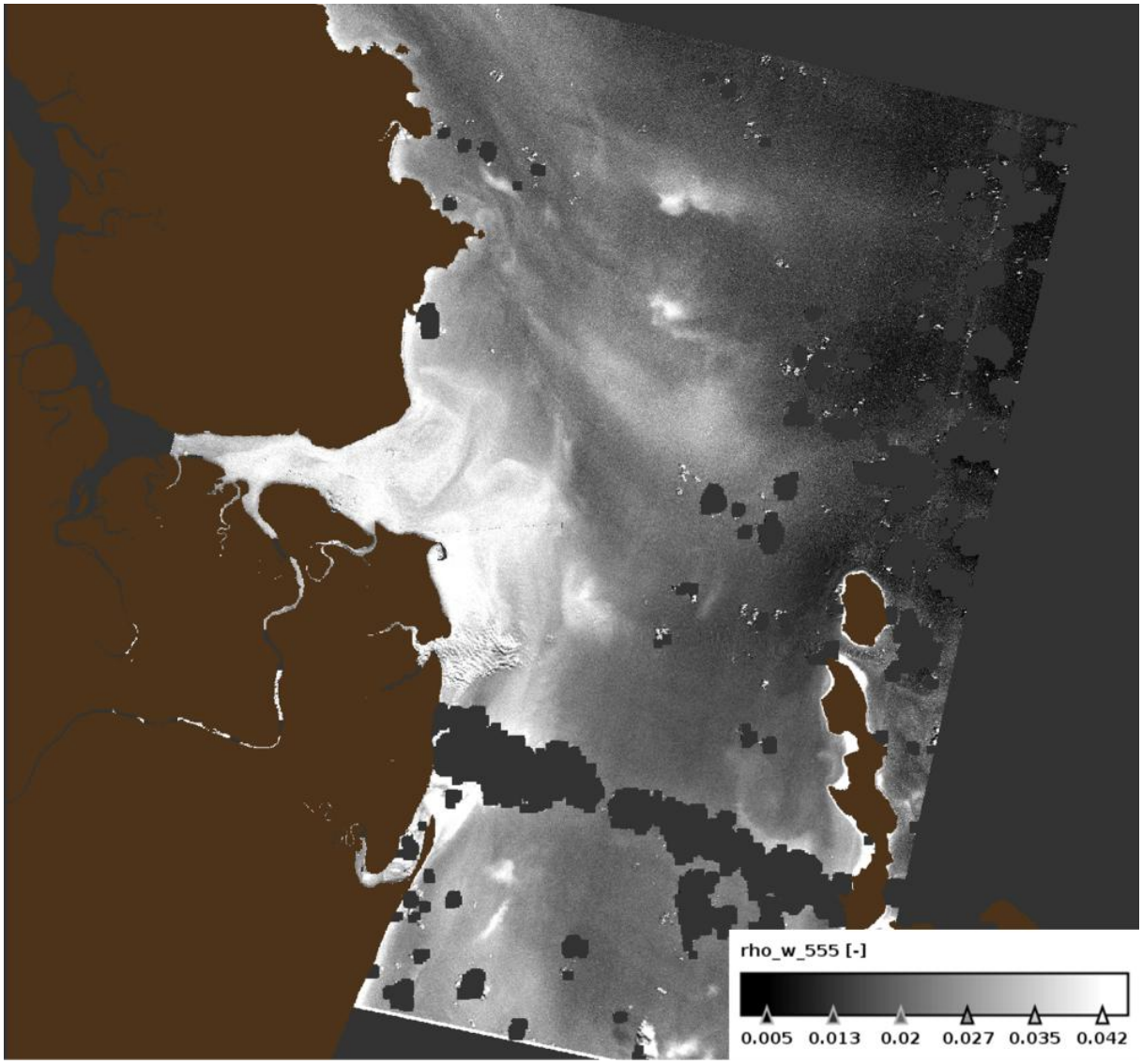


Figure 1: Example of the Venμs product VENUS-XS_20171217-002801-000_L2_LUCINDA3_D processed with Polymer. The parameter presented is the water reflectance at 555nm, rho_w(555). The land mask is shown in brown (it is included in the "flags" variable). The visualization is obtained with ESA SNAP (https://step.esa.int/main/download/snap-download/).

3. Format and structure of the products

The products are in the NetCDF4 format.
The Polymer level 2 naming is derived from L1C by replacing “L1C” by “L2”. Example:

Level1 : VENUS-XS_20191226-105908-000_L1C_ESTUAGIS_D.zip
Level2 : VENUS-XS_20191226-105908-000_L2_ESTUAGIS_D.nc

The variables available in the products are listed in the following table:

Variable	Description	Units	Dimensions	Data type
latitude	Latitude	Degrees	(y, x)	Float32
longitude	Longitude	Degrees	(y, x)	Float32
rho_w_420	Water reflectance for Venµs bands from 420 to 865 nm. These reflectances are dimensionless and include a normalization for angular effects, such that the normalization corresponds to an observation where the sun and sensor are positioned at nadir.	-	(y, x)	Float32
rho_w_443		-	(y, x)	Float32
rho_w_490		-	(y, x)	Float32
rho_w_555		-	(y, x)	Float32
rho_w_620		-	(y, x)	Float32
rho_w_667		-	(y, x)	Float32
rho_w_742		-	(y, x)	Float32
rho_w_782		-	(y, x)	Float32
rho_w_865		-	(y, x)	Float32
Rgli	Sun glint reflectance, estimated from the wind speed based on (Cox and Munk, 1954)	-	(y, x)	Float32
Rnir	Top of atmosphere (TOA) reflectance in the near infrared (865nm) band. This parameter is used for the visual interpretation of the product.	-	(y, x)	Float32
flags	Binary quality flags (detailed hereafter).	-	(y, x)	uint16

4. Binary quality flags

The variable « flags », coded in uint16, provides the following masks:

Flag	Description	Value
LAND	Land mask	1
CLOUD_BASE	Cloud mask	2
L1_INVALID	Invalid data at level 1	4
NEGATIVE_BB	(deprecated flag)	8
OUT_OF_BOUNDS	The parameters retrieved by Polymer are out of bounds	16
EXCEPTION	Processing error	32
THICK_AEROSOL	Optically thick aerosol plume detected	64
HIGH_AIR_MASS	The air mass ($= \frac{1}{\cos(\theta_s)} + \frac{1}{\cos(\theta_v)}$ where θ_s and θ_v are the sun and observation zenith angles) is above 5. The observation is expected to be degraded.	128
EXTERNAL_MASK	An external mask has been provided	512
CASE2	The Polymer « case 2 » mode has been activated.	1024
INCONSISTENCY	Inconsistent result (out of bounds atmospheric reflectance).	2048
ANOMALY_RWMOD_BLUE	Excessive difference between the observation and the model in the blue (band 420 nm for Venμs)	4096

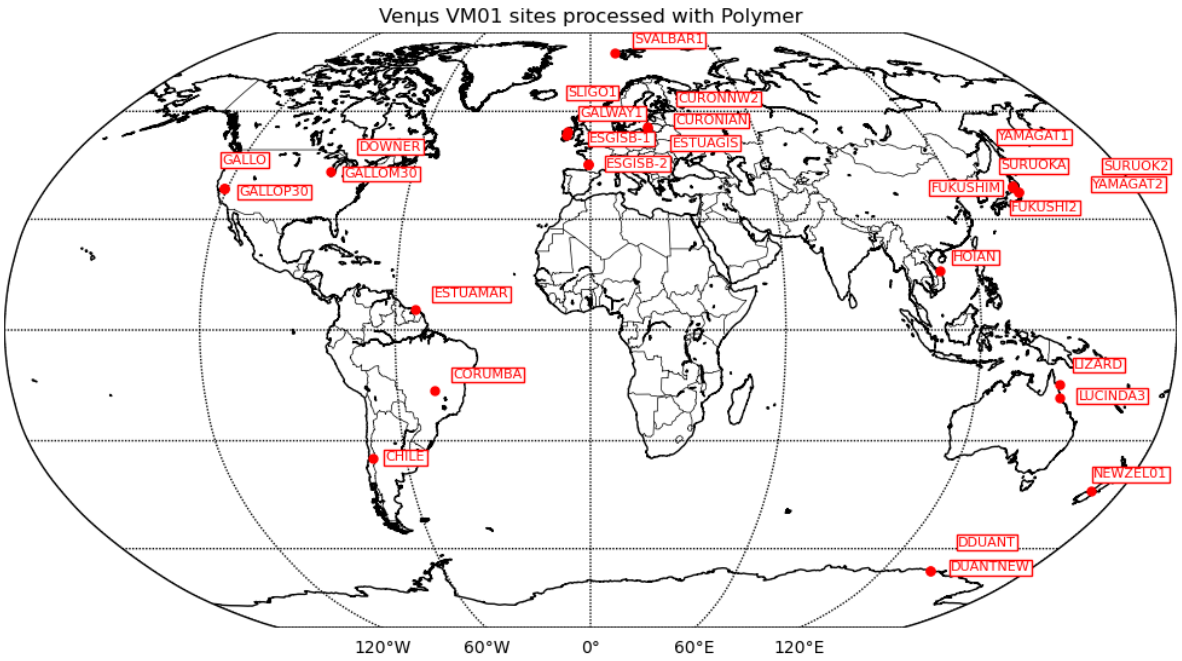
The recommended binary mask expression to select valid pixels is the following:

```
(flags & 1023 == 0)
```

5. List of the processed VM01 sites

The following VM01 sites have been selected for processing with Polymer, based on their water coverage:

CHILE	CORUMBA	CURONIAN	CURONNW2	DDUANT	DOWNER
DUANTNEW	ESGISB-1	ESGISB-2	ESTUAGIS	ESTUAMAR	FUKUSHI2
FUKUSHIM	GALLO	GALLOM30	GALLOP30	GALWAY1	HOIAN
LIZARD	LUCINDA3	NEWZEL01	SLIGO1	SURUOK2	SURUOKA
SVALBAR1	YAMAGAT1	YAMAGAT2			



Note: the VM5 phase will be processed with Polymer once the level1 reprocessing is completed.

6. References

Cox, C., Munk, W., 1954. Measurement of the Roughness of the Sea Surface from Photographs of the Sun's Glitter. J. Opt. Soc. Am. 44, 838. https://doi.org/10.1364/JOSA.44.000838

Dick, A., Raynaud, J.-L., Rolland, A., Pelou, S., Coustance, S., Dedieu, G., Hagolle, O., Burochin, J.-P., Binet, R., Moreau, A., 2022. VENµS: Mission Characteristics, Final Evaluation of the First Phase and Data Production. Remote Sensing 14, 3281. https://doi.org/10.3390/rs14143281

Steinmetz, F., Deschamps, P.-Y., Ramon, D., 2011. Atmospheric correction in presence of sun glint: application to MERIS. Optics Express 19, 9783–9800. https://doi.org/10.1364/OE.19.009783

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