Proba-V Cloud Detection Round Robin (PVCDRR)

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March 1st, 2017

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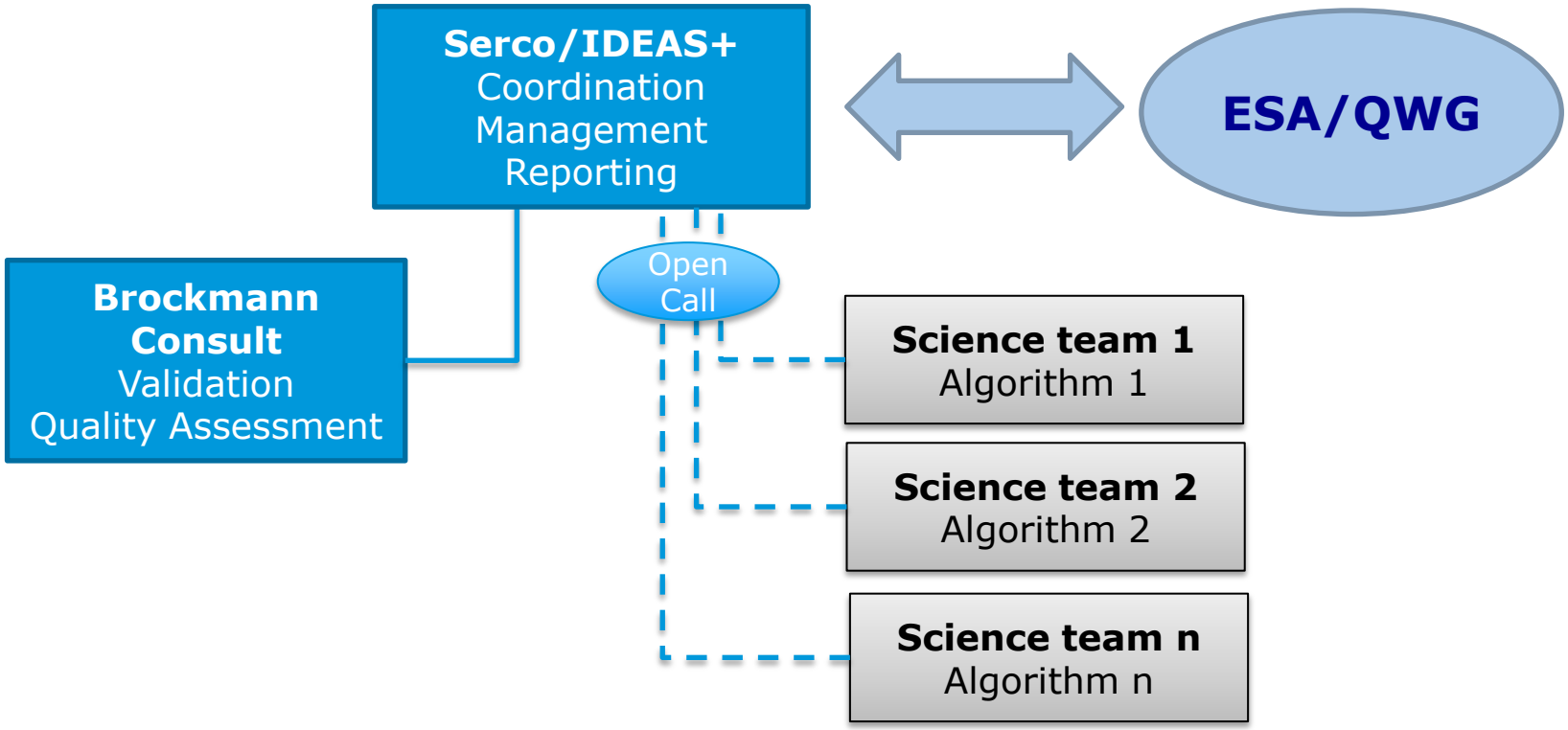
- Validation Data Set – Pixel Collection
- Semi-transparent clouds
- Recruitment and Communication
- Quality Assessment

III. Operational Proba-V Cloud Detection Algorithm

IV. Review of the Agenda

PVCDRR: Organization



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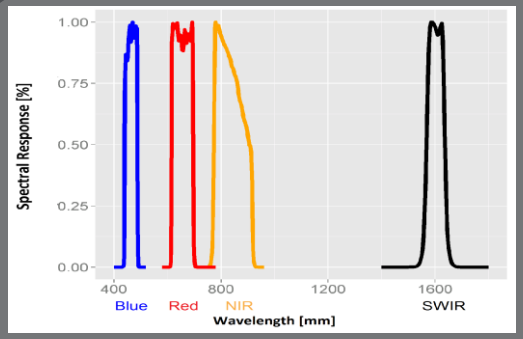
PVCDRR: Motivation

Proba-V is a multispectral imager smaller than a cubic metre. Proba-V delivers global coverage for uses including climate impact assessments, surface water resource management, agricultural monitoring, and food security estimates.



- VNIR:
  Blue (438-486 nm)
  Red (615-696 nm)
  Near IR (772-914 nm)
- SWIR (1564-1634 nm)

Products at 3 resolution: 1km, 333m, 100m (5 days revisit)

- Undetected clouds still represent a major source of uncertainty for land (and atmosphere) applications, this was clearly highlighted during last Proba-V Symposium
- The operational Proba-V algorithm for cloud detection (thresholds-based), despite the clear improvements, part of the upcoming reprocessing, has still some drawbacks (e.g. over-detection in case of large sun/viewing angles)

Alternative methods (Bayesian, statistical, NN) allow optimal use of all information from the spectrum and may be the solution to overcome the intrinsic limitations of Proba-V for clouds (only 4 bands and no TIR)

PVCDRR: Objectives and Expected Outcomes

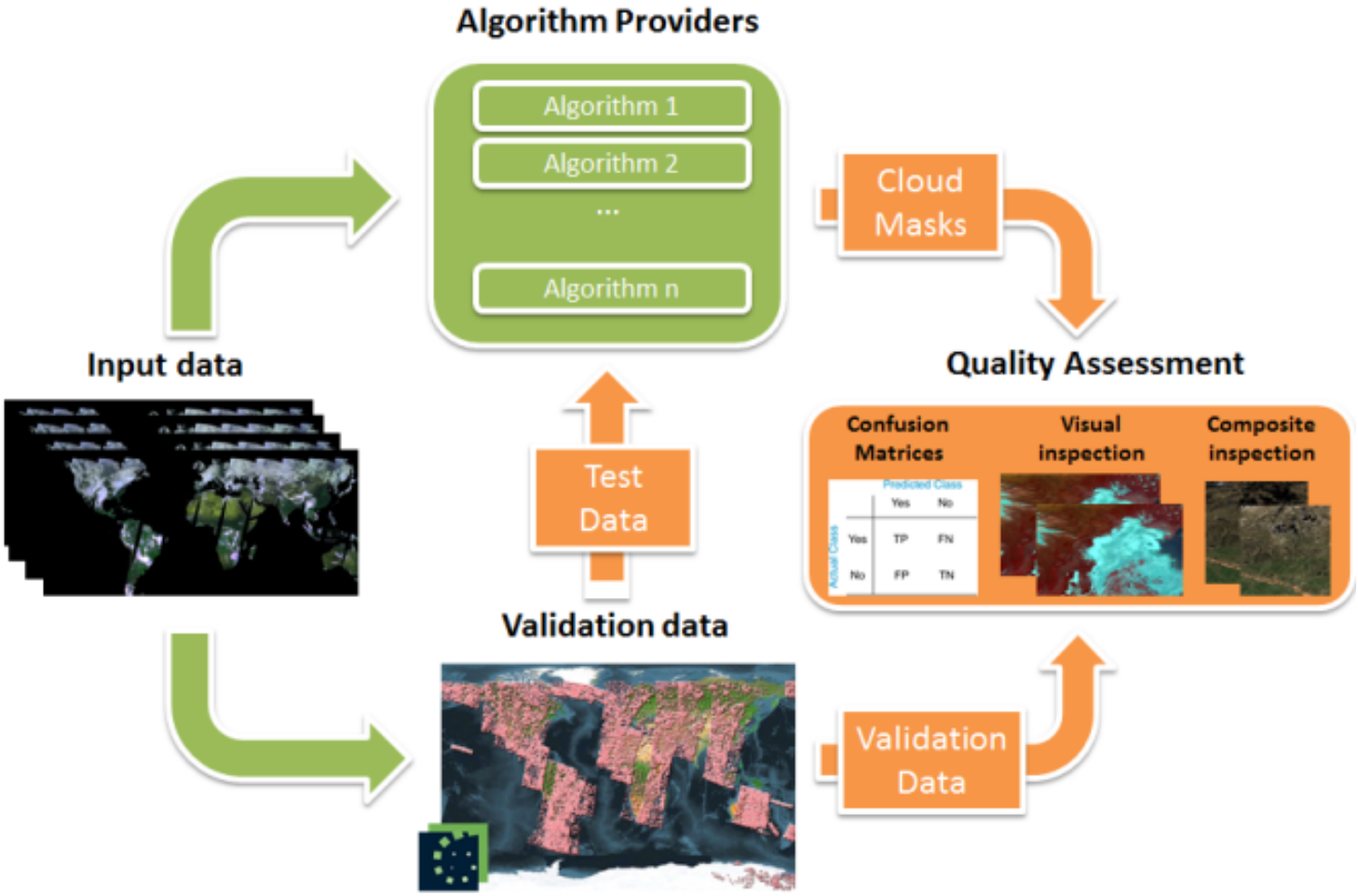
To inter-compare different clouds screening methodologies for Proba-V and learn on advantage and drawbacks of the various techniques for various clouds and surface conditions

To increase awareness on Proba-V mission by inviting new scientific teams in the Round Robin exercise and organising a final workshop on project results

To provide final recommendations to ESA on potential best candidates for implementation in the operational processing chain

To collect lessons learnt on cloud detection in the VNIR and SWIR domain for land and coastal water remote sensing and reuse them in the frame of S-2 and S-3 cloud detection

PVCDRR: Design of the Round Robin



PVCDRR: Proba-V Data

Definition of the Input Reference Scenes

- 4 days (4 seasons) global dataset
- Level 2a Proba-V products: TOA reflectance in the 4 bands: Blue, Red, NIR and SWIR projected in Plate Carrée grid
- Spatial resolution: 333m

The following data samples are considered:

- **21/03/2014**
- **21/06/2014**
- **21/09/2014**
- **21/12/2014**

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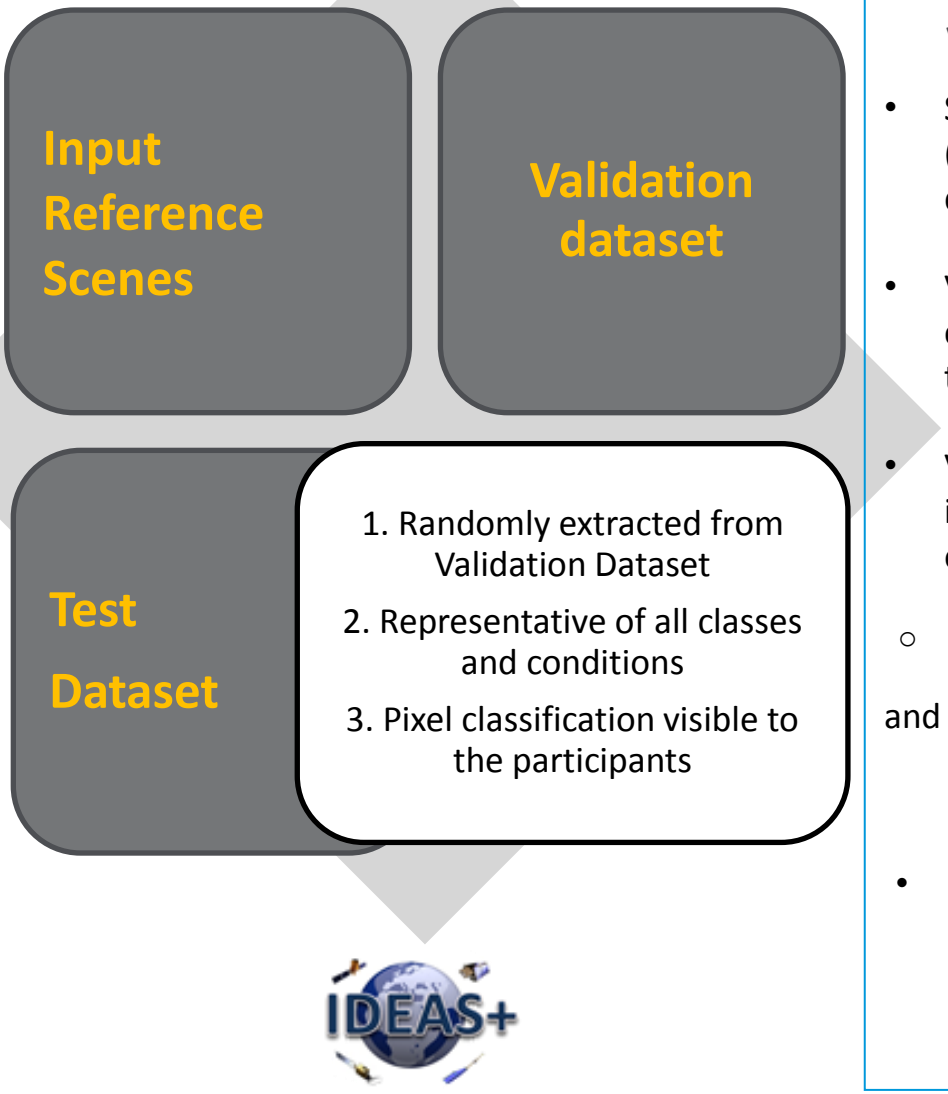

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Definition of the Validation Dataset

- Statistically significant (more than 50000 pixels) database
- Visually classified and cross-checked with PixBox tool
- Validation dataset will include a range of environmental conditions:
  - **30% thick clouds,**
  - **30% semi-transparent clouds**
  - **40% cloud-free**

  and a range of surface types:
  - **70% land**
  - **15% snow/ice**
  - **15% water**
- Globally spread covering the 4 seasons

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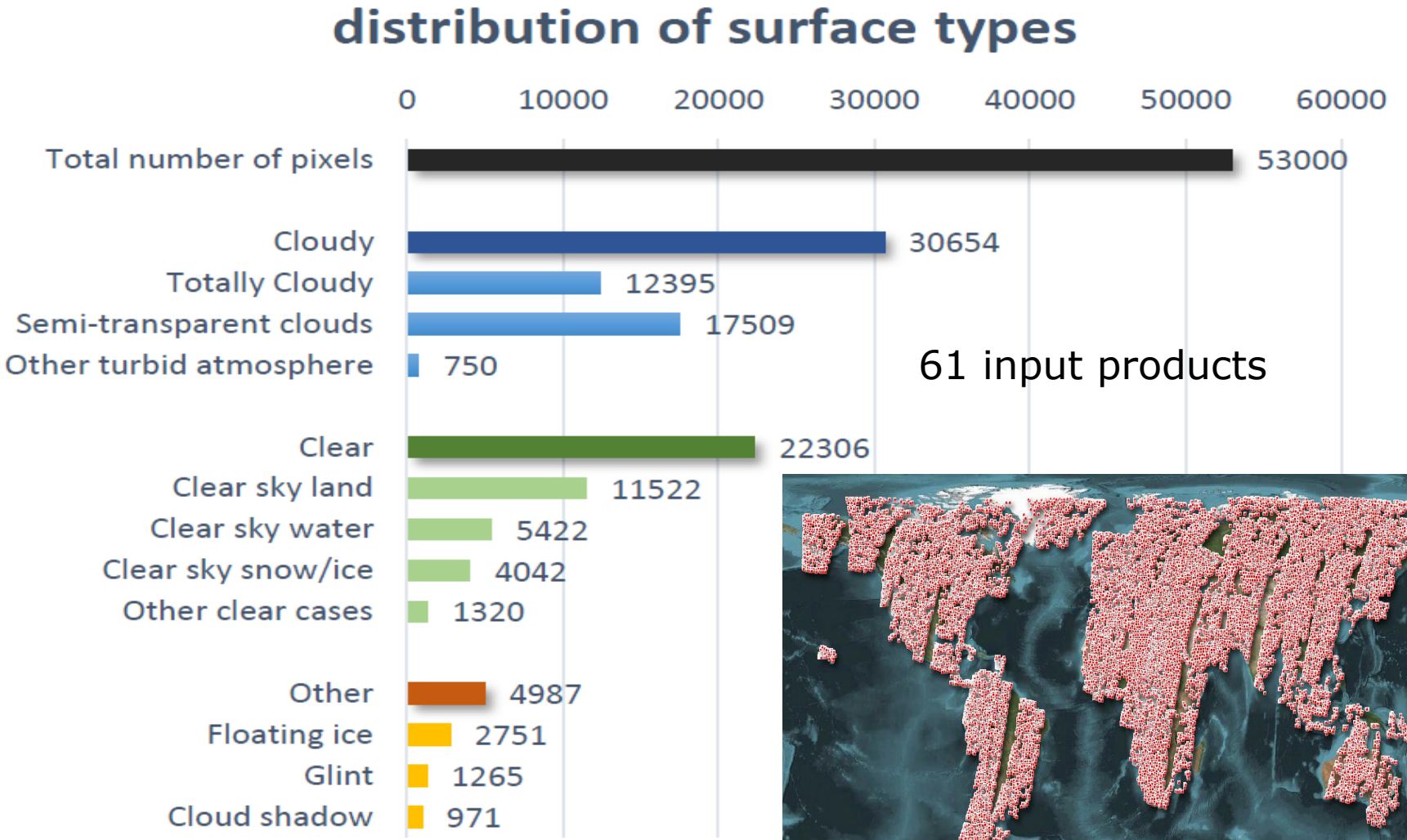
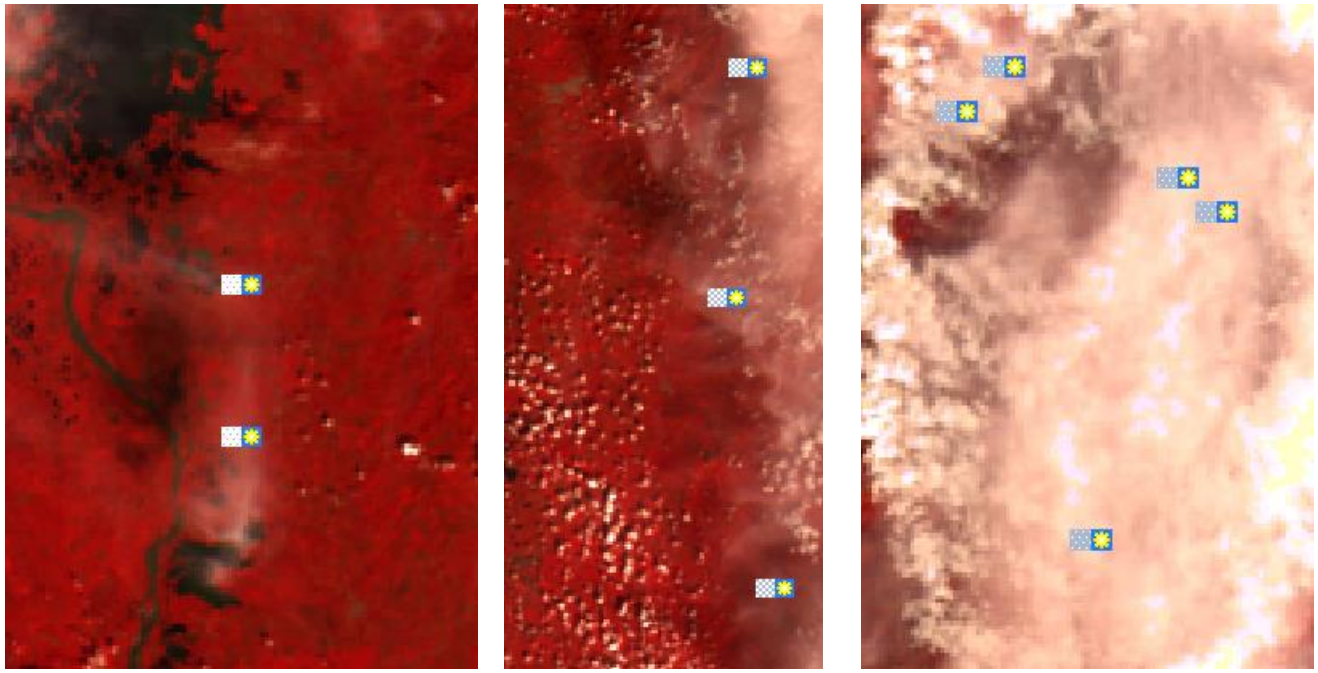
PVCDRR: Validation Data Set – Pixel Collection



61 input products

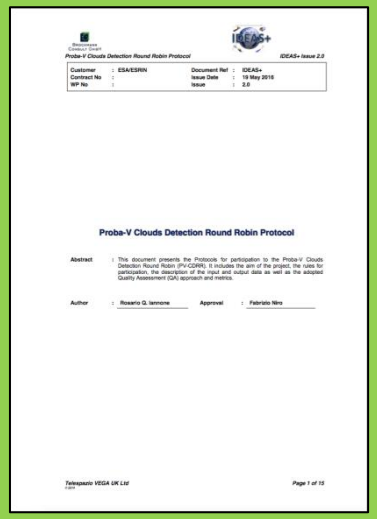
PVCDRR: Semi-transparent clouds

- ✓ Thick semi-transparent cloud
- ✓ Average or medium dense semi-transparent cloud
- ✓ Thin semi-transparent cloud



PVCDRR: Recruitment and Communication

Round Robin Protocols (May 2016)



Proba-V Clouds Detection Round Robin Protocol

IDEAS+ Issue 2.0

Customer	: ESA/ESRIN	Document Ref	: IDEAS+
Contract No	:	Issue Date	: 19 May 2016
WP No	:	Issue	: 2.0

Proba-V Clouds Detection Round Robin Protocol

Abstract : This document presents the Protocols for participation to the Proba-V Clouds Detection Round Robin (PV-CDRR). It includes the aim of the project, the rules for participation, the description of the input and output data as well as the adopted Quality Assessment (QA) approach and metrics.

Author : Rosario G. Iannone Approval : Fabrizio Niro

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Input data in cloud toolbox (June 2016)

To be delivered:

- Validation Dataset Description (Oct 2016) – Brockmann
- ATBD and Cloud Mask (Nov 2016) – Algorithm providers
- Validation Report (Jan 2017) – Brockmann/Serco
- Final Workshop (Jan/Feb 2017)
- Conference proceeding/peer-reviewed paper (Feb/Mar 2017)

PVCDRR: Quality Assessment Approach

- ✓ On the one side the Ground-truth class on the other side the Classifier class
- ✓ **Producer Accuracy (PA)**: or Accuracy is the fraction of correctly classified pixels with regard to all pixels of that ground truth class
- ✓ **User Accuracy (UA)**: or Reliability, is the fraction of correctly classified pixels with regard to all pixels classified as this class in the classified image
- ✓ E.g. clear-sky conservative: PA for clouds is very high, but we loose in UA, i.e., we flag all cloudy pixels, but also many clear pixels
- ✓ Several statistical indicators and metrics will be used in addition (e.g., Scott pi)

Pixbox Confusion Matrix

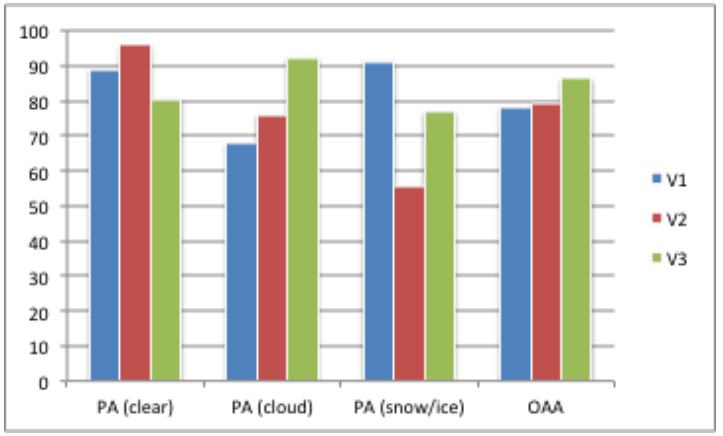
In-Situ Database

ALGO1	Class	no Cloud (w)	Cloud	Sum	P A	E
	NO CLOUD	8065	92	8157	98.9	1.1
	CLOUD	2420	6495	8915	72.9	27.1
	Sum	10485	6587	17072		
	U A	76.9	98.6		OAA:	85.29
	E	23.1	1.4			

Scotts Pi: 0.703

Krippendorfs alpha: 0.703

Cohens kappa: 0.708



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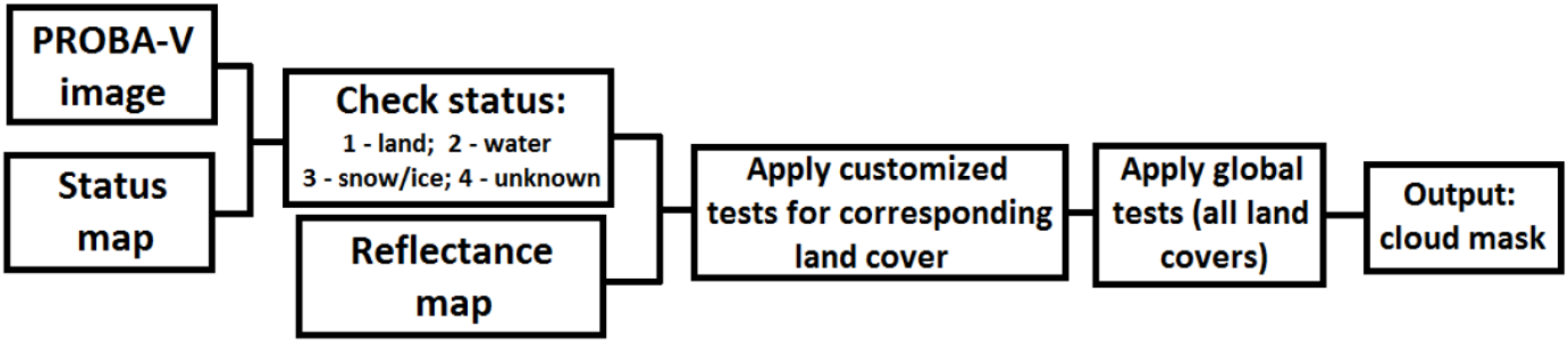
PVCDRR: Operational Cloud Detection Algorithm

Auxiliary input:

- MERIS reflectance map for the Blue band (monthly)
- MERIS status map (land/water/ice-snow/shadow/cloud/unknown)
- GlobAlbedo maps – fills in the gaps of MERIS reflectance map
- Reference spectra extracted from PROBA-V images (after the initial parameter optimization)



PVCDRR: ESA SPPA Web Pages

esa SPPA
Sensor Performance, Products and Algorithms

EO Mission Performance | Documentation | Activities | Meetings & Workshops

You are here Home › Activities › Instrument Characterization Studies › PV-CDRR

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Proba-V Cloud Detection Round Robin

Background

Cloud detection and removal is a well-known critical issue for land remote sensing in the optical domain. Despite the vast literature on the subject, uncertainties still remain on the used cloud detection approaches that can have significant impact for a wide range of applications.

In the case of Proba-V cloud detection is particularly challenging, considering the limited number of spectral bands (Blue, Red, NIR and SWIR) and the lack of TIR channels or dedicated cirrus band (as the 1.38 micron band). The legacy approach for Proba-V cloud detection was inherited from SPOT-VGT [RD-1] and based on static thresholds on the Blue and SWIR channels. The main drawback of such threshold method is that its performances are strongly dependent on the amount of contrast in radiometry between the clouds and the underlying surface.

Recent improvements were proposed for both SPOT-VGT [RD-2] and Proba-V [RD-3], using climatology of reflectances to define a dynamic threshold on the Blue band, which depends on the surface cover and on vegetation conditions. Additional improvements could be obtained using statistically-sound approaches, such as Nerual Network, allowing to optimally use all the information from the four Proba-V channels.

In order to inter-compare the performances of different cloud detection algorithms for Proba-V, the European Space Agency (ESA) and the Belgian Science Policy Office (BELSPO) decided to organize a dedicated Round Robin exercise.

This Proba-V Cloud Detection Round Robin (PV-CDRR) will be open to any interested algorithm's provider. The main goal is to learn advantages and drawbacks of the different approaches for various cloud and surface conditions. As an outcome of the study recommendations will be provided to ESA on the potential new cloud detection algorithm for the operational processing chain.

References

[RD-1] *Lisens, G., P. Kempeneers, F. Fierens, and J. Van Rensbergen. Development of Cloud, Snow, and Shadow Masking Algorithms for VEGETATION Imagery. Proceedings of Geoscience and Remote Sensing Symposium, IGARSS 2000, Honolulu, HI 2: 834–836.*

[RD-2] *Wolters, E., Swinnen, E., I. Benhadj, Dierckx, W., PROBA-V cloud detection evaluation and proposed modification, QWG Technical Note, 17/7/2015*

[RD-3] *Hagolle, O., et al. Quality assessment and improvement of temporally composited products of remotely sensed imagery by combination of VEGETATION 1 and 2 images. Remote Sensing of Environment 94.2 (2005): 172-186.*

Activities

- Activities Home
- The Quality Working Groups: QWG
- (Multi-)Sensor Timeseries
- Instrument Characterization Studies
  - ALGOM
  - ODIN-SMR
  - PV-CDRR
    - About
    - Registration
    - Project Documents
    - Project Meetings
  - PV-LAC-ATMO
  - PV-LAC-COAST
- Quality Assurance framework for Earth Observation: QA4EO
- Fiducial Reference Measurements: FRM
- Cal/Val Activities and in-situ field campaigns

https://earth.esa.int/web/sppa/activities/instrument-characterization-studies/pv-cdrr

PVCDRR: Review of the Agenda

09:00-09:30	Welcome	ESA, Italy	
09:30-10:00	Introduction	ESA, Italy	
10:00-10:30	Overview of the Algorithm and Results	University of Valencia, Spain	Luis Gomez Chova
10:30-11:00	Overview of the Algorithm and Results	CNR, Italy	Umberto Amato
11:00-11:30	Coffee Break		
11:30-12:00	Overview of the Algorithm and Results	eoConsultancy, Austria	Ute Gangkofner
12:00-13:30	Lunch Break		
13:30-14:00	Overview of the Algorithm and Results	Magellium, France	Beatrice Berthelot
14:00-14:30	Overview of the Algorithm and Results	FUB, Germany	Rene Preusker
14:30-1500	QA and Intercomparison Results	Brockmann Consult, Germany	
15:00-15:30	Summary and Final Discussion		
15:30-16:00	Meeting Wrap-up		
16:00	End of the Workshop		