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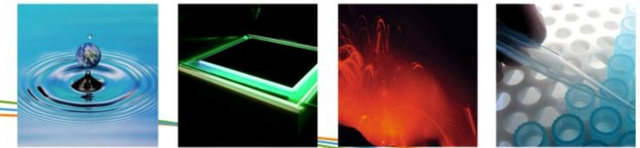

Proba-V: Status on Products Quality and Preparing for SPOT's Vegetation's continuity

Belgian Earth Observation Day, 25 May 2011, Oudenburg, Belgium

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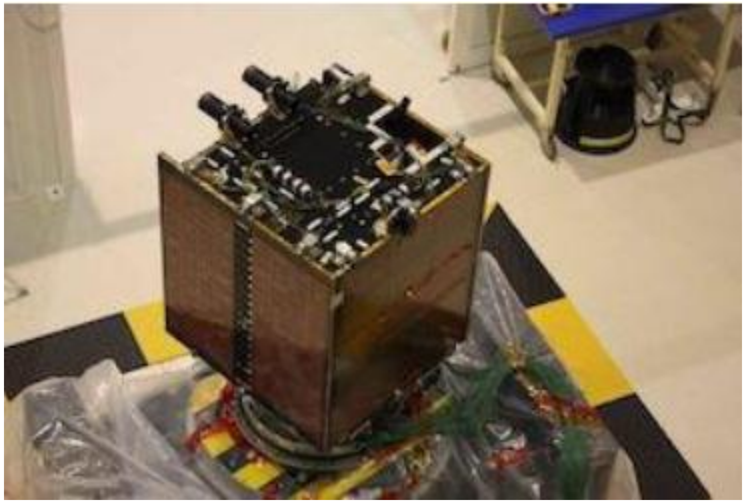
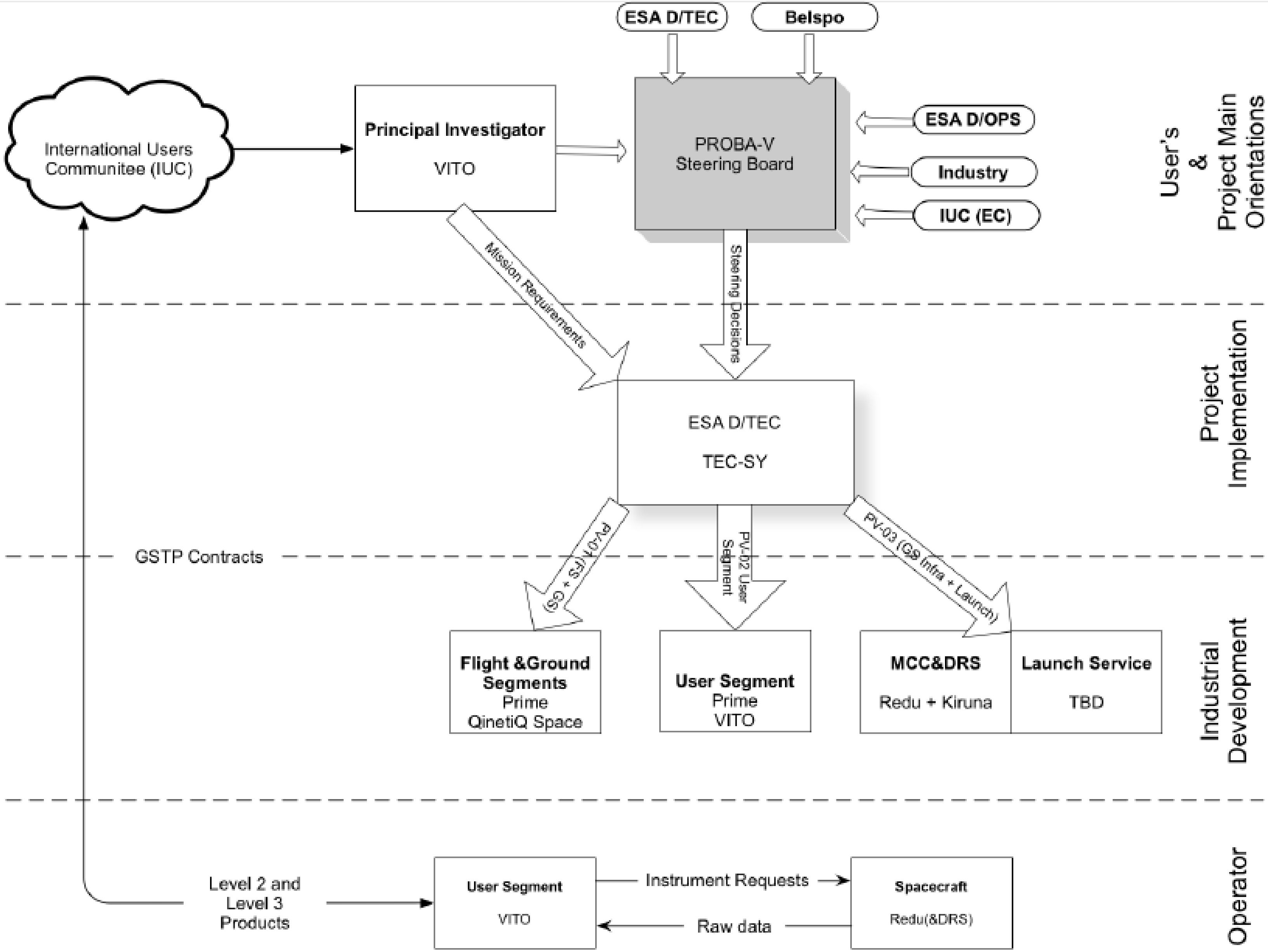
Acknowledgement for input from Proba-V teams at Belspo – ESA – VITO – Qinetiq and OIP

proba VEGETATION

Project Context

- The main objective of Proba is to ensure continuity of SPOT/VGTproducts after its decommissioning and before the Sentinel-3 operation.
- As such Proba-V has been identified as gap fillermission.
- Proba-V is exploiting advanced small satellite technology.
- The development is taking place in the frame of In Orbit Demonstration(IOD) technological program following Proba-1 and Proba-2 approach.

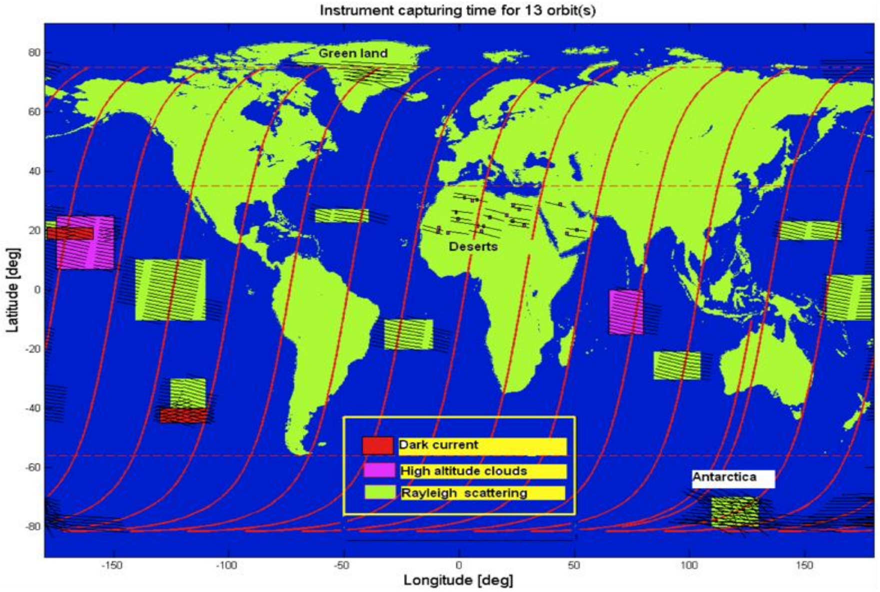



ESA D/TEC
Belspo
International Users Communitee (IUC)
Principal Investigator
VITO
PROBA-V Steering Board
ESA D/OPS
Industry
IUC (EC)
User's & Project Main Orientations
Mission Requirements
Steering Decisions
ESA D/TEC
TEC-SY
Project Implementation
GSTP Contracts
PV-01 (FS + GS)
PV-02 User Segment
PV-03 (GS Infra + Launch)
Flight &Ground Segments
Prime
QinetiQ Space
User Segment
Prime
VITO
MCC&DRS
Redu + Kiruna
Launch Service
TBD
Industrial Development
Level 2 and Level 3 Products
User Segment
VITO
Instrument Requests
Raw data
Spacecraft
Redu(&DRS)
Operator

Orbit selection based on SPOT-VGT

- 90% daily coverage of equatorial zones
- 100 % daily coverage from +75°to +35°and from -35°to 56°
- 100% two-daily coverage from +75°to -56°
- Minimum swath width of 2250 km
- LTDN between 10:30-11:30 AM

- Optimal orbital parameters are:
  - Altitude: 820 ±10 km
  - Eccentricity: 0
  - Inclination: SSO + 0.1°



- With these parameters the mission requirements are met and 90% coverage of equatorial zones in one day and the remaining 10 % next day;

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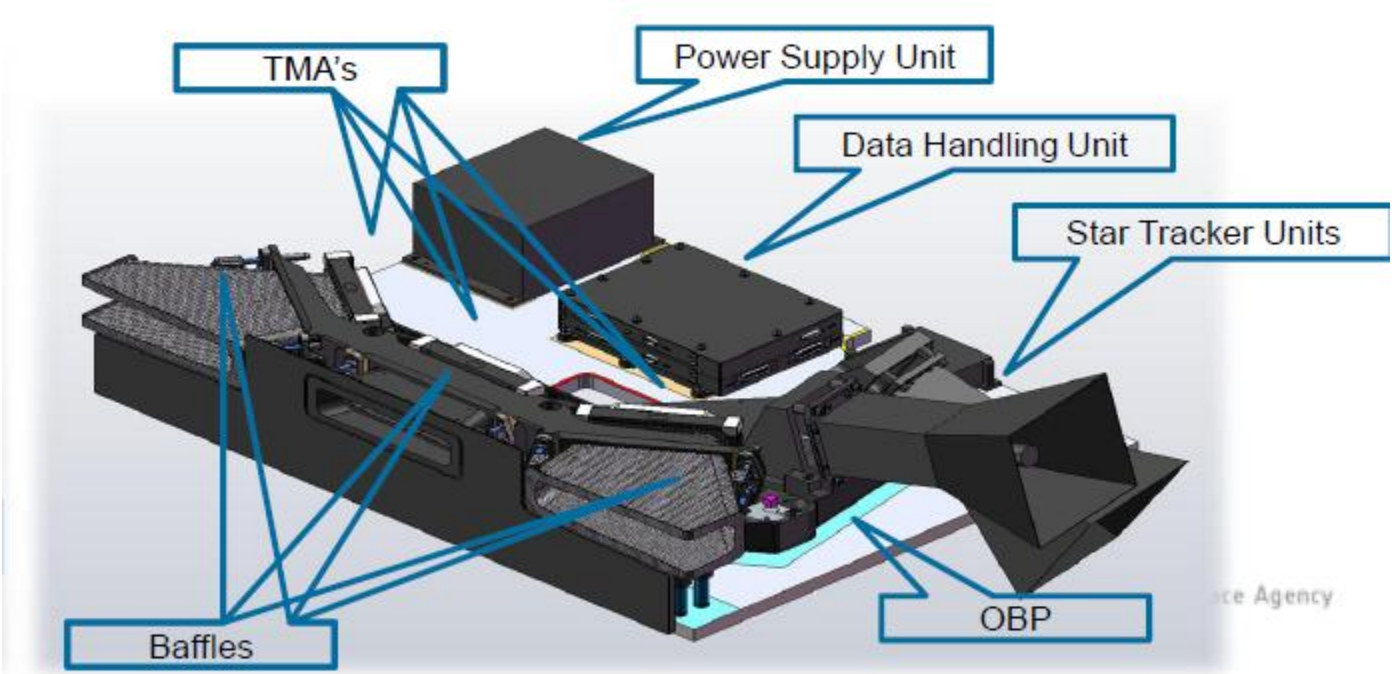
- Optics:
  - 3x compact wide FOV Three Mirror Anastigmatic telescope (TMA) (34.6°x5.5°)
  - 3 x 5200 pxl 13µm size VNIR detector
  - 3 x 1024 pxl mechanically butted InGas SWIR detector
- Mechanics: lightweight and compact mechanics
- Thermal: complete passive thermal control system as no power available for active thermal control



Status of performances

- Performances are presented based on the current information available to the PI. As the CDR finalization is still in process, performance aspects are subject to change. Goal is to give an order of magnitude of the expected performances.
- Design goal (1/3 km product) performances should be viewed in the context of a microsatellite mission: limited mass, volume, power and budget.

Coverage

- Guaranteed by orbit altitude of **820 km (+/- 10 km**)
- Limiting factor is onboard power budget for transmission of the data. **Onboard lossy compression** (CCSDS standard) required in trade-off with SNR.
- **No onboard propulsion** for drift correction, mission lifetime is 2,5 years with possible extension to 5 years
- **Overlap** between sensors and camera's and **platform pointing stability** avoid holes in the coverage

Spatial resolution

Requirement:

- Mandatory product similar to SPOT-VGT
  - 1 km product (VNIR+SWIR)

- Design goal product = new product
  - 1/3 km product VNIR
  - 2/3 km product SWIR (upsampled to 1/3 km product)

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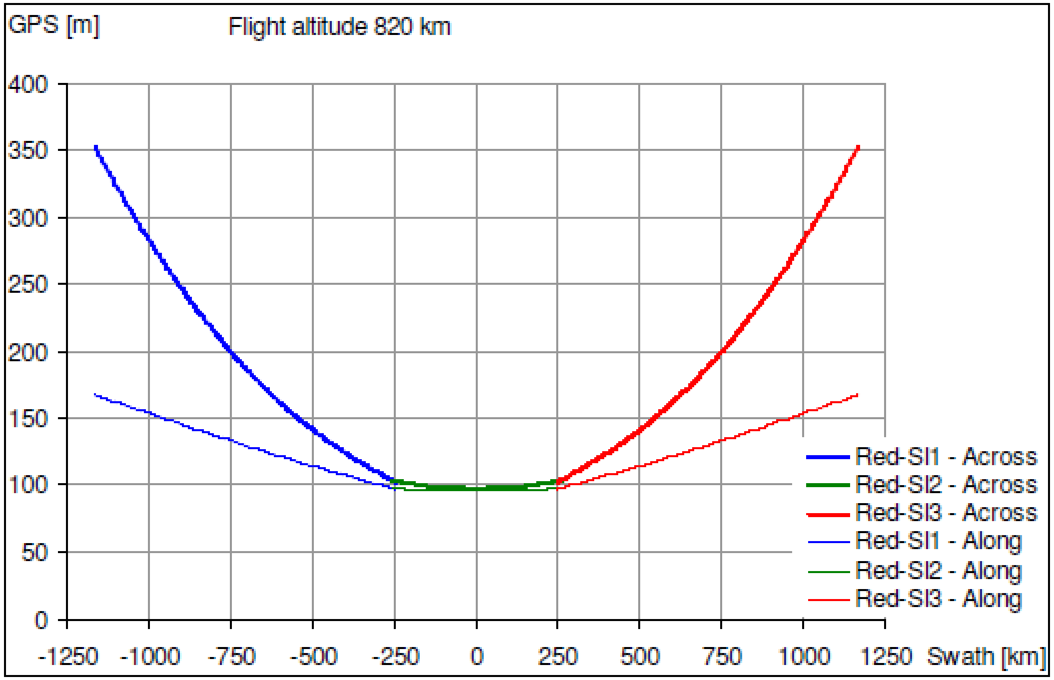
Spatial resolution – GSD/GPS VNIR

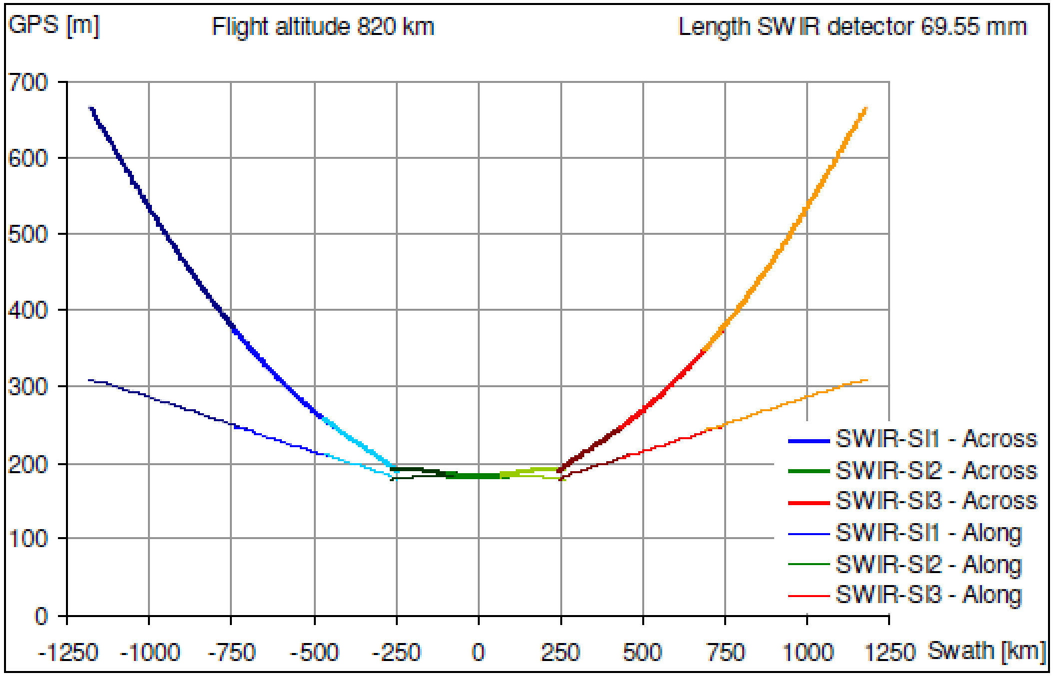


- Ground pixel size (GPS)
- Ground Sampling Distance (GSD))

- Across
  - GPS = 100 to 350 m = GSD
- Along
  - GPS = 100m to 170m; GSD = 100m

Spatial resolution – GSD/GPS SWIR

- Ground pixel size (GPS)
- Ground Sampling Distance (GSD))



- Across
  - GPS = 200 to 666 m = GSD
- Along
  - GPS = 200m to 300m; GSD = 200m

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Geolocation accuracies

Geolocation requirements (all 95%, all Level-2):

	design goal	mandatory
Interband geol. : VNIR:	*100m*	-
Interband geol. : SWIR+VNIR:	*150m*	*300m*
Multitemporal geol. VNIR:	*150m*	-
Multitemporal geol. SWIR+VNIR:	*225m*	*500m*
Absolute geol. : VNIR:	*300m*	-
Absolute geol. : SWIR + VNIR:	*450m*	*1000m*

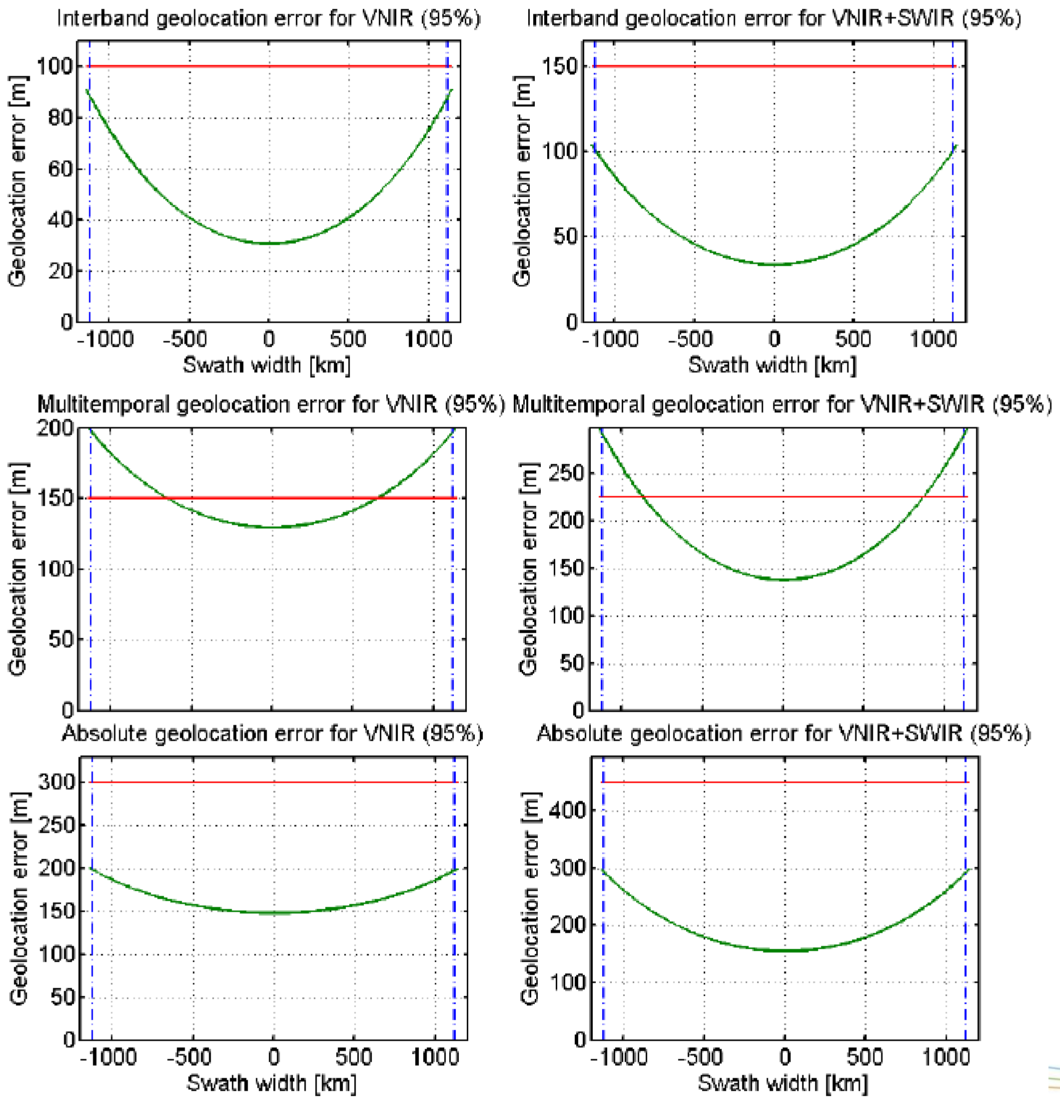
Geolocation accuracies

- Geolocation performances **preliminary**
- Dominant contributor is the thermo-elastic distortions over the orbit and seasons

- Mandatory requirements (1 km) are met.
- Design goal requirements (1/3 km): currently not met for multi-temporal.

- End performances are pending:
  - Final thermo-elastic analysis results
  - Optimization of in-flight geometrical calibration to partially correct for thermal variations

Geolocation accuracies – Design Goal



Interband

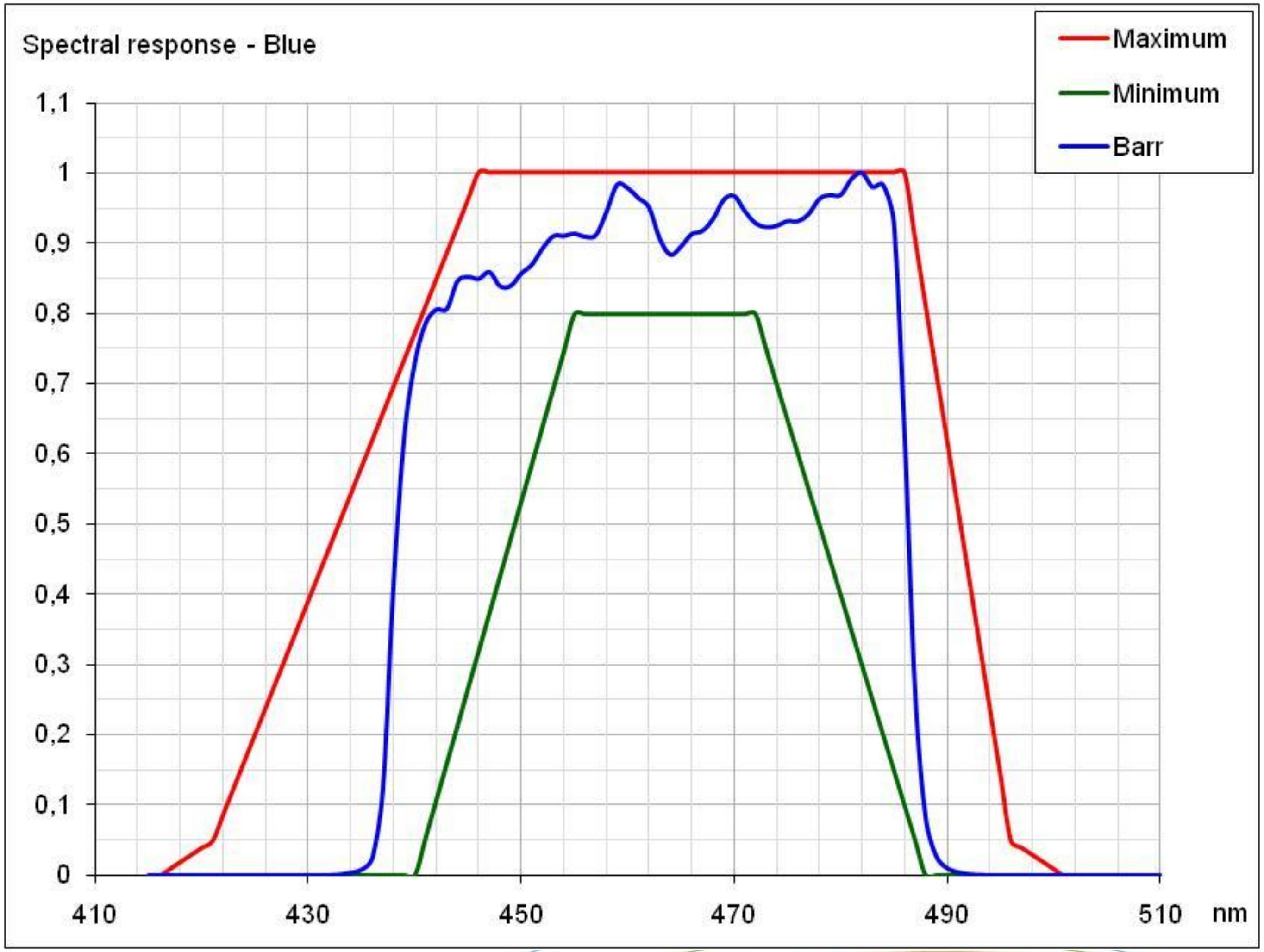
Multi-temporal

Absolute

Spectral accuracies

- VNIR bands:
  - Differences between Proba-V and VGT2 spectral responses are of the same order as VGT1 and VGT2
  - Radiometric differences of the order of NEdR or slightly higher. These changes to be taken into account through careful calibration.
  - Better discrimination between RED and NIR than SPOT-VGT
- SWIR band:
  - Shift to the left in spectrum
  - Proba-V SWIR spectral response curve is situated far enough from the strong water vapor absorption region.
  - The shift of the Proba-V SWIR channel results in higher contrast for the NDWI.

Spectral accuracies – Spectral response BLUE



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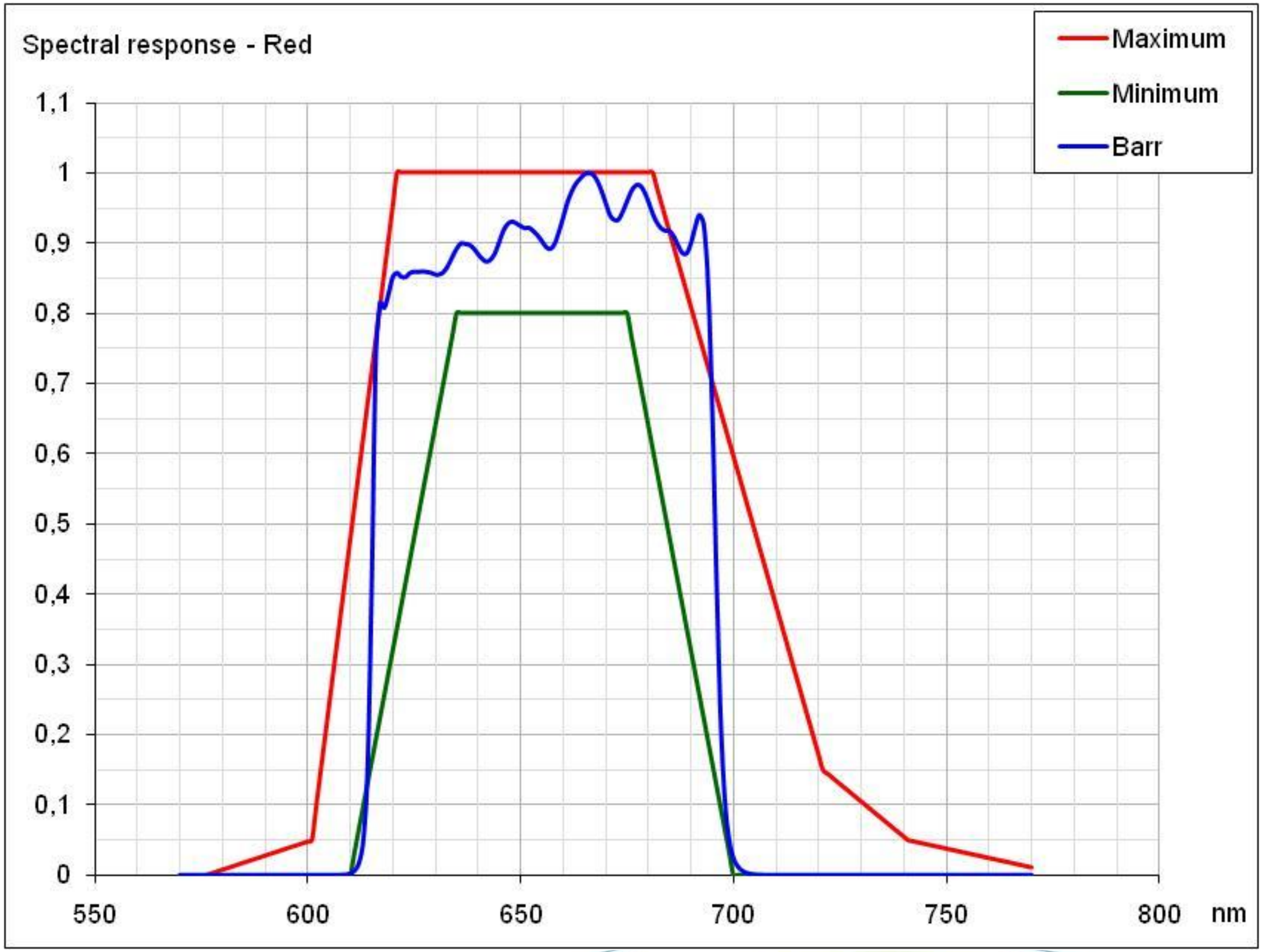
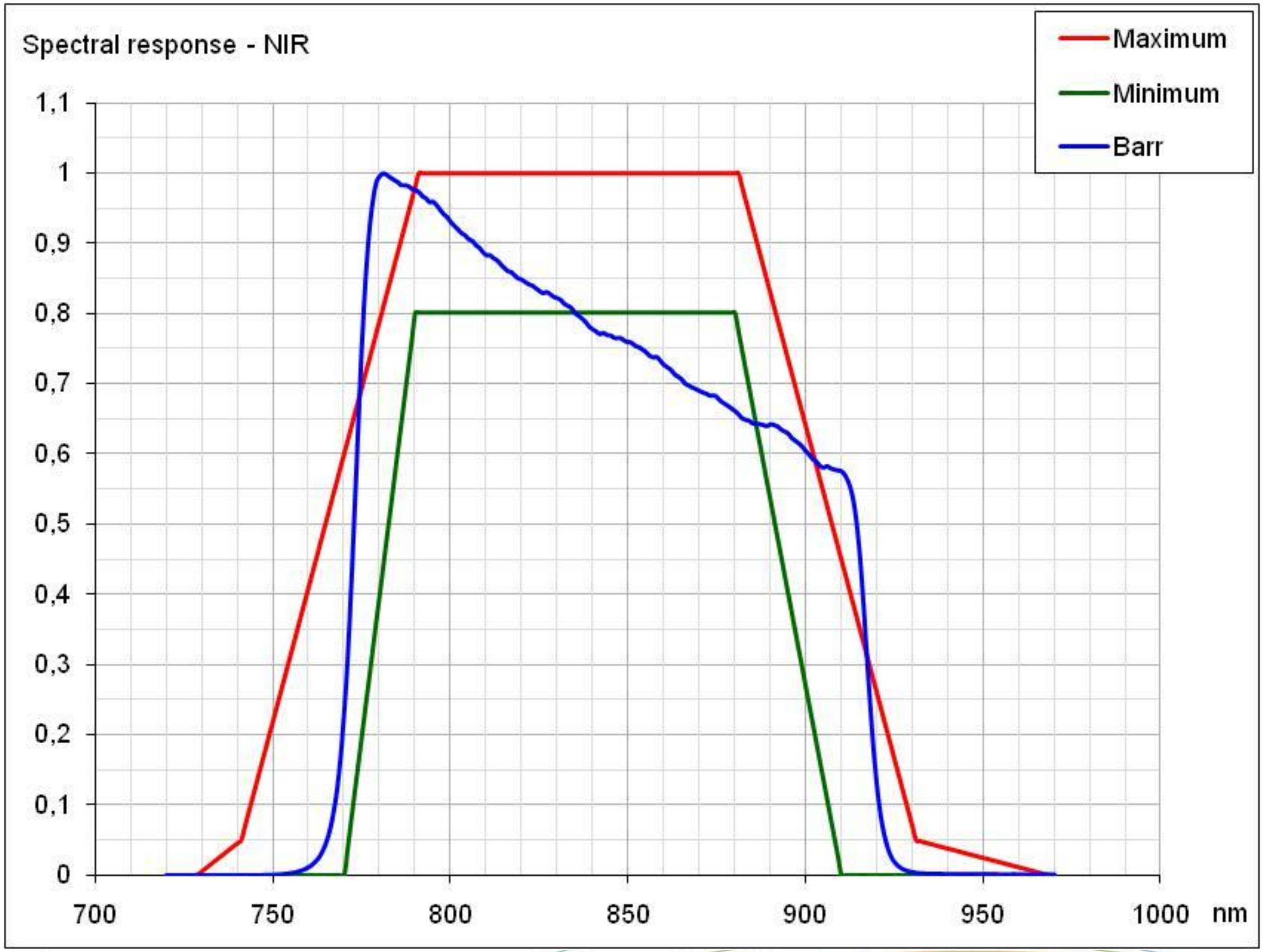
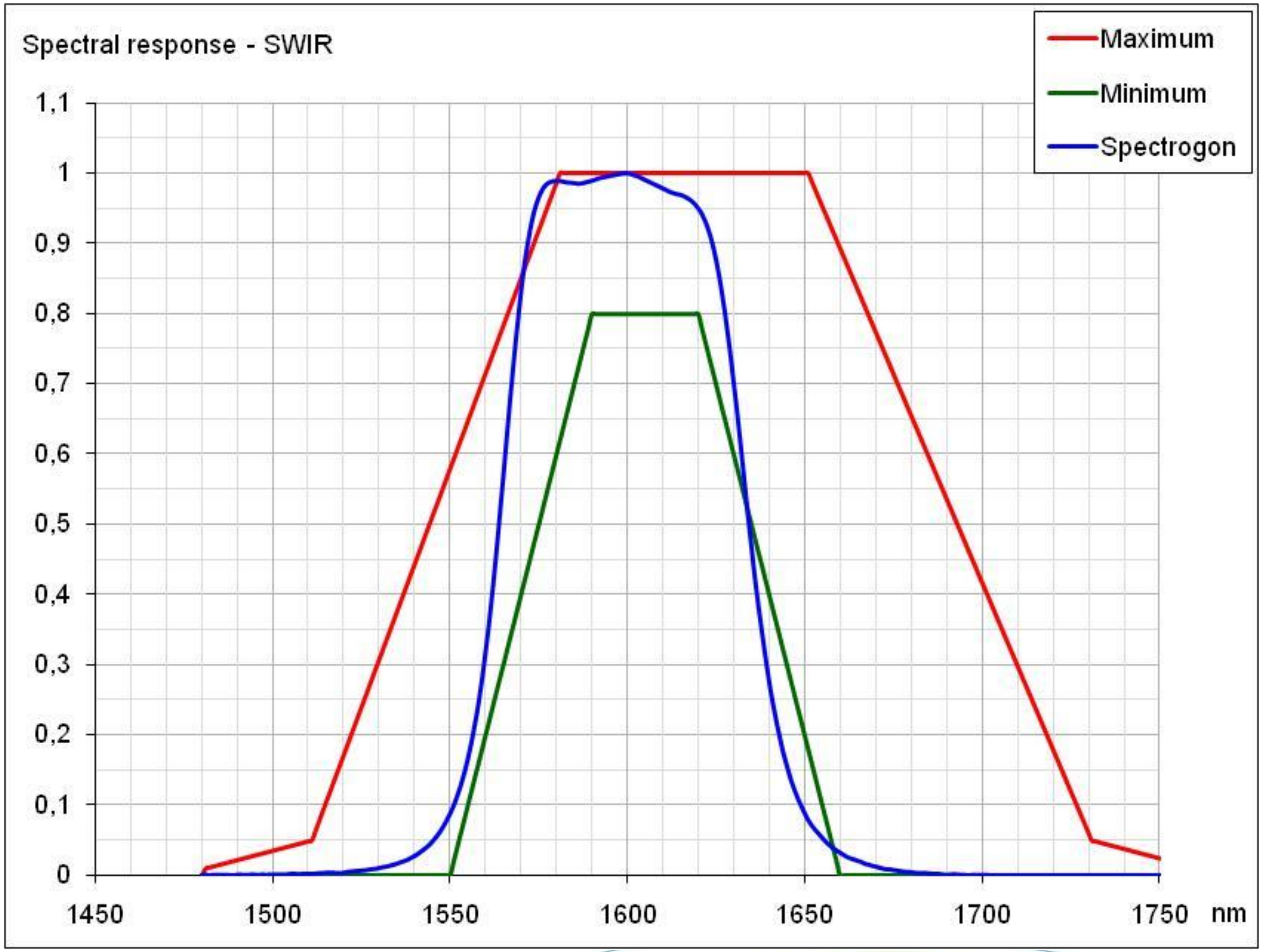
Spectral accuracies – Spectral response RED



Spectral accuracies – Spectral response NIR



Spectral accuracies – Spectral response SWIR



Radiometric accuracies – SNR budget

- SNR budget includes:
  - Signal shot noise
  - System noise
  - Straylight shot noise
  - Dark current shot noise
  - Compression noise

Band	CR
BLUE centre	**11.5**
BLUE side	**5.0**
RED centre	**3.7**
RED side	**2.4**
NIR centre	**3.4**
NIR side	**2.3**
SWIR centre	**2.4**
SWIR side	**1.8**

- Compression noise is important factor. Compression ratio configurable on board for optimization during commissioning

Radiometric accuracies - SNR

- Worst-case performances for “difficult” high-feature MERIS images above Europe with default integration times.
- Better results expected above other land masses and with dynamic integration times.

	L2			
Input for SNR calculation	**Blue**	**Red**	**NIR**	**SWIR**
TOA Radiance	111	110	106	20
SNR 1 pixel centre	**43**	**75**	**93**	**112**
SNR 1 pixel edge	**109**	**192**	**223**	**230**
SNR 333/667m product				
Centre	**149**	**260**	**320**	**409**
Edge	**151**	**263**	**305**	**337**
SNR 1000m product				
Centre	**448**	**781**	**960**	**613**
Edge	**452**	**790**	**915**	**506**
Requirement	**188**	**333**	**393**	**333**
NeDR requirements	**0.59**	**0.33**	**0.27**	**0.06**

Radiometric accuracies

Requirements:

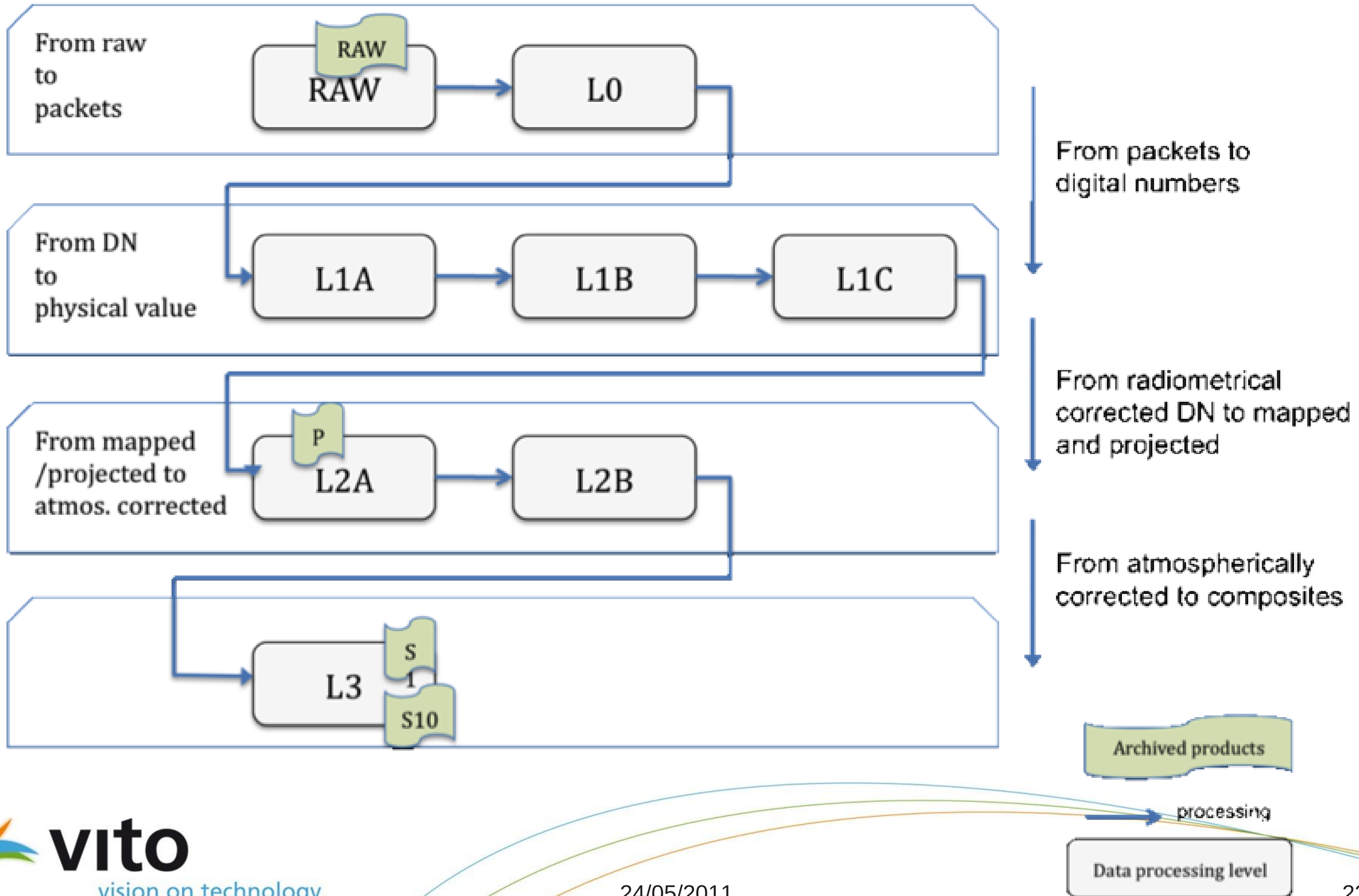
- Instrument Absolute radiometric accuracy ≥ 5%.
- Instrument Relative radiometric accuracy ≥ 3%.
- The radiometric Temporal Stability ≥ 3% over a period of at least 6 months including radiometric calibration.
- Instrument Interband Calibration ≥ 3%.

Radiometric accuracies

Defined by:

- Straylight currently a dominant factor
- Sensor Non-linearity: Input-dependent, only level after correction in the US (<1%) has to be taken into account.
- Spectral misregistration effect on radiances
- Dark current temperature dependence after correction based on temperature measurements
- Instrument radiometric stability (remaining error after calibration, multi-temporal)
- Polarization: dependent on the polarization of the input radiance

Processing chain



Products for both 1 km and 1/3 km

- 1) P-Product per camera/strip (L2A) on request for ordering
- 2) S1 TOA synthesis Product starting from L2A
- 3) S1 TOC synthesis Product starting from L2B
- 4) S10 TOC synthesis Product starting from S1s over decade.
- The SPOT-VGT P-product (a swath-wide L2A product) is not feasible anymore due to the three distinct camera's and strips but is still available per camera/strip (product 1).
- The S1 TOA synthesis (Product 2) is proposed as an alternative containing L2A values, but is a synthesis of the different camera's and strips.
- Products 3 and 4 are the same as SPOT-VGT.

Project Status

Flight Segment and Ground Segment

Phase B :

- ✓ Kick-off January '09
- ✓ System Requirements Board May '09
- ✓ Preliminary Design Review Board September'09

Phase C/D:

- ✓ Kick-off December 2009
- ○ System (Platform+Instrument) CDR -Pending Reporting to Board
- ✓ Ground Segment October'10
- ○ Integration Readiness Review April '11
- ○ Flight Acceptance Review April '12

User Segment

Phase B:

- ✓ Kick-off August 2009
- ✓ System Requirements Review October 2009
- ✓ Preliminary Design Review April 2010

Phase C/D:

- ✓ Kick-off end July 2010
- ○ System CDR March- May 2011
- ○ System Deployment October 2011
- ○ Acceptance Review December 2011

Launcher

Target Launch date in Q3-Q4 2012

Main Launcher :

Vega -Verta-1

Backup Launchers (in negotiation) :

DNEPR

European Space A

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