AEOLUS weekly mission planning concept and strategy

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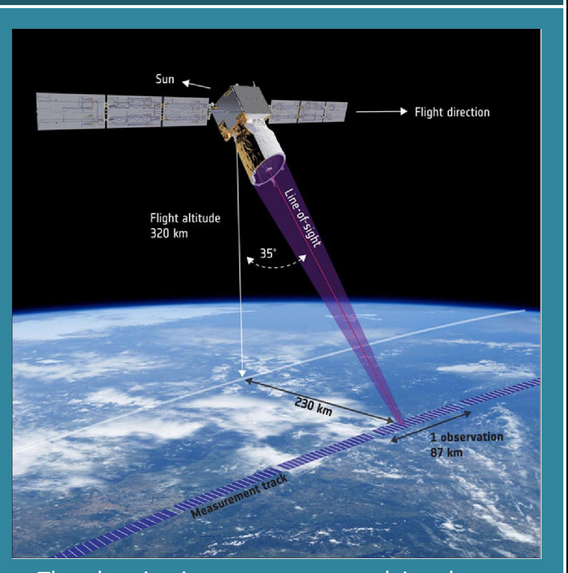
Introduction

- In this poster we present the concept and strategy of the **AEOLUS** weekly mission planning, in particular for the **ALADIN** instrument.
- The preparation of the routinely planning is one of the task of the AEOLUS **PDGS** (Payload Data Ground Segment) in ESRIN. The planning is prepared via the **MMPF** (Mission Management and Planning Facility) tool and other supporting tools, and includes the following activities: weekly mission analysis, satellite and instrument requirements check, files preparation and dissemination, configuration control of the instrument parameters.
- The planning is built as a timeline of requests, for alternating WIND profile acquisitions (with different settings) and maintenance & calibration activities. Additional special activities can also be included.
- The satellite repeat cycle is 111 orbits length, span exactly one calendar week. The baseline planning is therefore covering one week, from Monday at 00:00 up to Sunday evening at 24:00.



- The planning is prepare one week in advance, then is sent to **FOS** (Flight Operations Segment), which prepare the sequence of telecommands and uplink them to the satellite.

WIND 1 | WIND 2 | WIND 1 | ISR | WIND 1 | WIND 3 | WIND 1 | IDC | WIND 2

Range Bin Settings

- The WIND profile data acquisition depends on the settings for **Mie** and **Rayleigh** channels range bins, on the distance between the start of the acquisition to the Earth surface, and on the onboard terrain model (DEM – Digital Elevation Model) as optimisation of the Earth topography.
- The Mie and Rayleigh Range Bin Settings (**RBS**) can be adjusted at the mission planning level in a very flexible way, depending on the mission objectives.

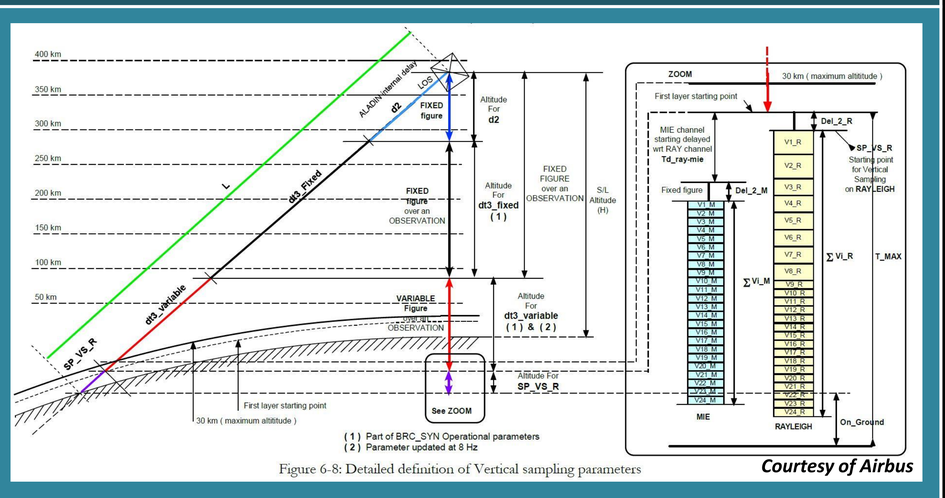
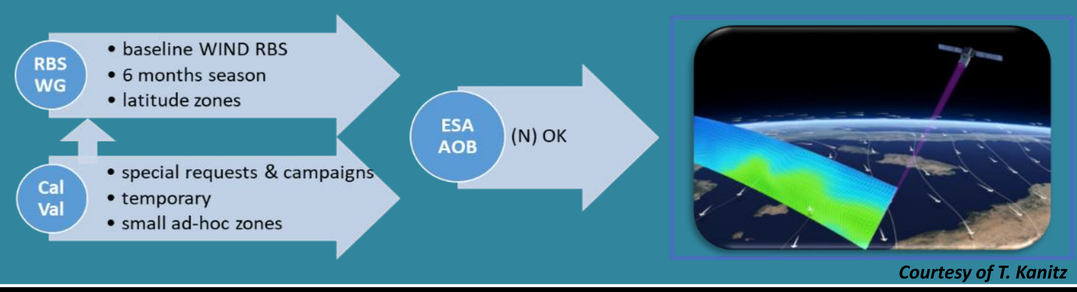


Figure 6-8: Detailed definition of Vertical sampling parameters
Courtesy of Airbus

- The Range Bin Settings for global WIND acquisitions are defined by the RBS Working Group (**RBS WG**), a group of different entities including representative from AEOLUS SAG (Science Advisory Group), CalVal and Campaigns PIs (Principal Investigators), DISC (Data, Innovation, and Science Cluster) team.
- All changes to the baseline acquisition scenario must be anyway authorized by the ESA Aeolus Operations Board (**AOB**).

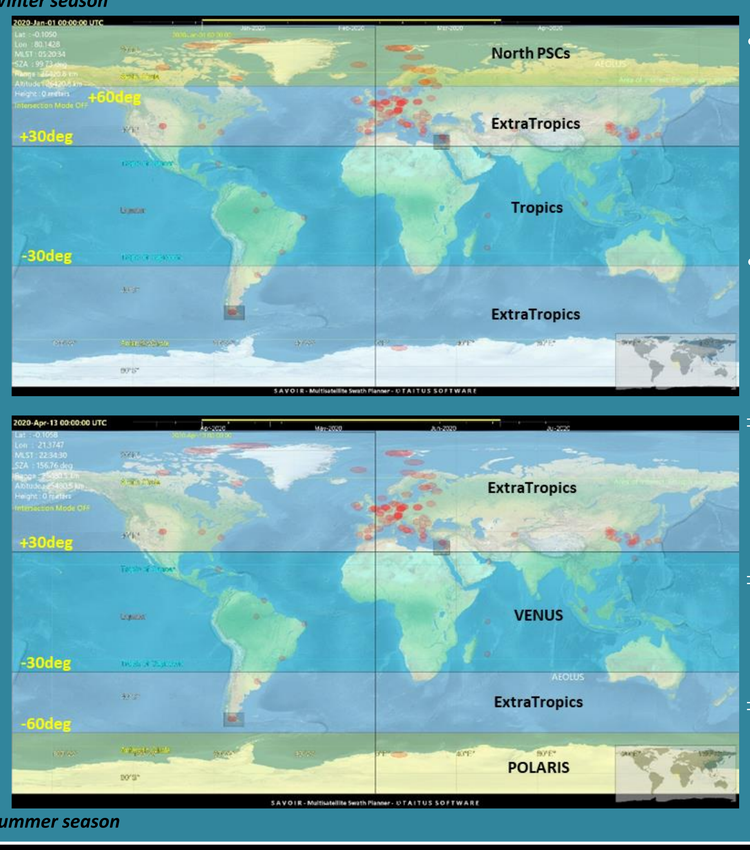


Courtesy of T. Kanitz

Wind measurements

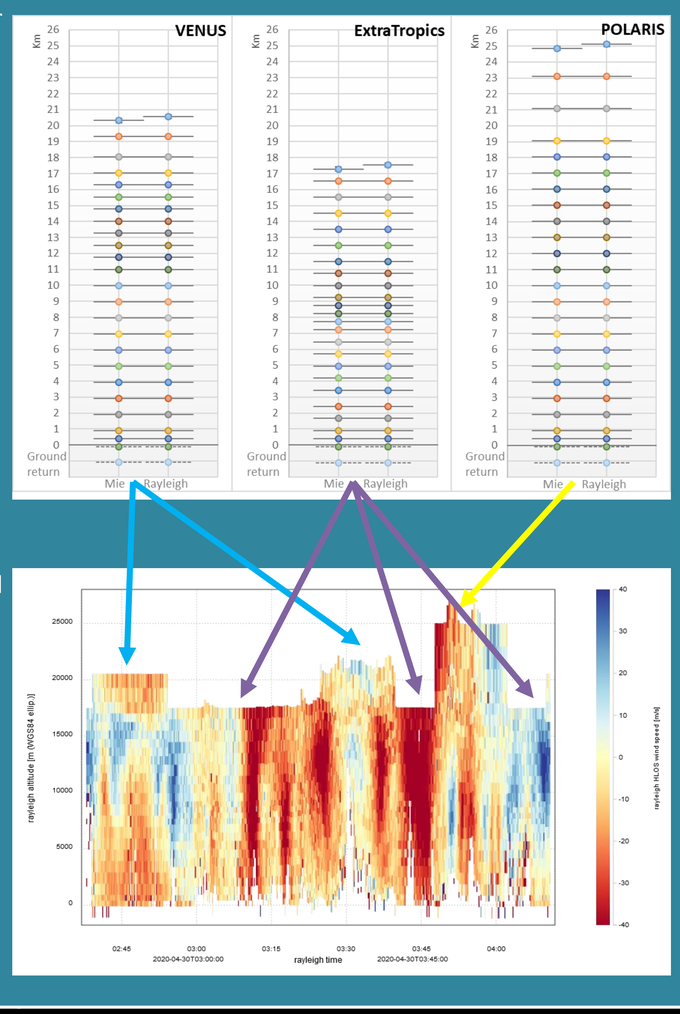
- The Range Bin Settings for global **WIND** profiles are mainly based on latitude bands and seasonal variation.
- In the figure below, two pictures show the definition of latitude zones for the **Winter** season (upper panel) – applied from mid October 2019 until mid April 2020 – and for the **Summer** season (lower panel) – applied from mid April onwards.
- In addition WIND measurements can be also optimized at regional level in specific small zones interested by validation campaigns and reference observations. In the pictures, two **black boxes** are shown indicating current special acquisitions over south-east Mediterranean for reference aerosol measurements, and south Chile.
- The **red circles** are instead indicating the network of AEOLUS CalVal ground based sites.

Winter season



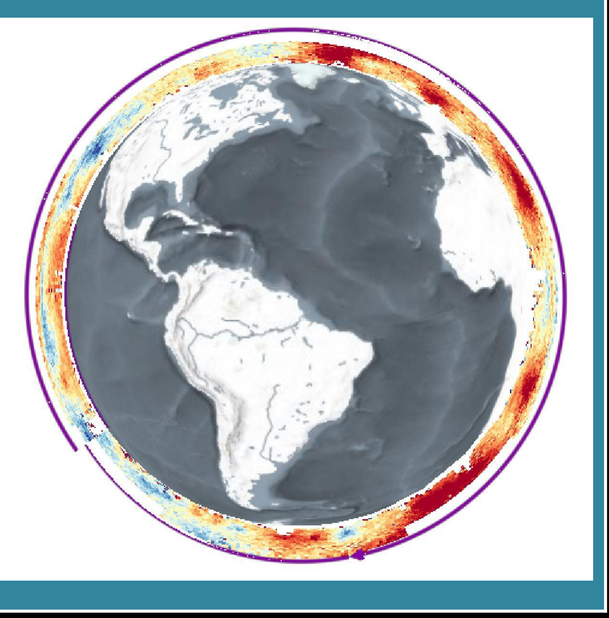
Summer season

- Although not exercised yet, sudden events like desert dust, smoke from fires, volcanoes eruption, etc. might be also observed by planning them in a very short time.
- The RBS for summer season WIND profiles are shown in the plot on the right (upper panel). Three different settings are applied for:
  ⇒ the tropical belt, NWP oriented setting influenced to support measurements for vertical momentum flux, called **VENUS** (VErtical momeNtum flUxeS)
  ⇒ south pole, for the observation of polar stratospheric clouds and vortex, called **POLARIS** (POLAR Instrument Setting)
  ⇒ and the remaining zones (**ExtraTropics**).



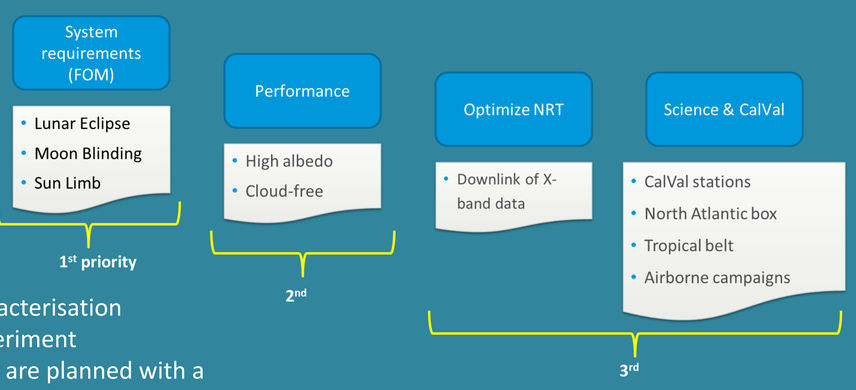
- The plots below show the Rayleigh measurements altitude on WGS84 ellipsoid taken from the AEOLUS **L1b** products (on the left) along one full orbit (on the right).
- In the plots the alternation of different WIND RBS altitudes can be easily recognize, as for the planning on the upper left panel (see reference arrows).
- Lower Rayleigh altitudes follow the behavior of the terrain model along the orbit. The color code provides the HLOS (Horizontal Line-Of-Sight) wind speed.

L1b products are plotted with VirES tool – https://aeolus.services

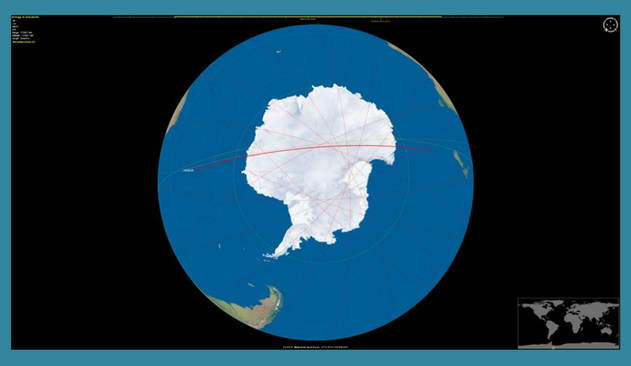


Maintenance and calibration activity

- In order to ensure healthy operations of the laser and the ALADIN instrument more in general, a sequence of in-flight activities must be performed during the whole lifetime of the satellite. The Maintenance and Calibration Sequence (**MCS**) was already foreseen before the launch and was revised at the end of the IOCV (In-Orbit Commissioning Verification).
- Currently a number of calibrations are planned routinely every week, while some activities are planned from time to time, but all of them are commanded following a predefined sequence of planning requests and by tuning some of the thousands instrument parameters setting: this is the most critical task of the mission planning.
- In addition each time a maintenance activity is required, a deep analysis is needed in order to verify mission system requirements and constraints, in order to optimize calibration performance, NRT data production and science and Cal/Val needs.
- The following routine calibrations are planned every week:
  ⇒ **IRC** – Instrument Response Calibration (in nadir attitude mode)
  ⇒ **ISR** – Instrument Spectral Registration
  ⇒ **LBM** – Laser Beam Monitoring
  ⇒ **IDC** – Instrument Defocus Characterisation
  ⇒ **DUDE** – Down Under Dark Experiment
- Additional maintenance activity are planned with a lower frequency:
  ⇒ **LFA** – Laser Frequency Adjustment
  ⇒ **RCT** – Rayleigh Cover Temperature adjustment
  ⇒ **ITR** – Instrument Telescope Refocussing
  ⇒ TxA Sensitivity Test
  ⇒ Cold Plate Sensitivity test



- In the pictures an example of the IRC requirements and constraints priorities is reported, together with the plot of the selected baseline track over Antarctica.
- In the table on the right, the requirements for the other weekly calibrations and the following selected locations.



IRC	ISR	LBM	IDC	DUDE
No X-band data down-link during nadir attitude				
No Sun limb during slew manoeuvres [Sun is +/-2deg from the Earth limb]				
No Moon blinding during nadir pointing				
		Sun Elevation Angle at the satellite >-30deg	Sun Elevation Angle at the satellite >-30deg	
			Sun Elevation Angle at the surface <0deg	Sun Elevation Angle at the surface < -7deg
High surface albedo [index >0.8] - based on ADAM albedo maps	High surface albedo [index >0.8] - based on ADAM albedo maps	Low surface albedo [index <0.8] - based on ADAM albedo maps	High surface albedo [index >0.8] - based on ADAM albedo maps	Low surface albedo [index <0.8] - based on ADAM albedo maps
Cloud-free conditions [optical thickness <0.05] - based on climatological maps			Cloud-free conditions [optical thickness <0.05] - based on climatological maps	
Avoid ground-based CalVal stations [radius =150km]	Avoid ground-based CalVal stations [radius =150km]	Avoid ground-based CalVal stations [radius =150km]	Avoid ground-based CalVal stations [radius =150km]	Avoid ground-based CalVal stations [radius =150km]
Avoid Northern Atlantic area for NWP	Avoid Northern Atlantic area for NWP	Avoid Northern Atlantic area for NWP	Avoid Northern Atlantic area for NWP	Avoid Northern Atlantic area for NWP
Avoid tropical belt [+/-25deg]	Avoid tropical belt [+/-25deg]	Avoid tropical belt [+/-25deg]	Avoid tropical belt [+/-25deg]	Avoid tropical belt [+/-25deg]
Within 24 hours from ISR	Within 24 hours from IRC	Within 24 hours from IDC	Within 24 hours from LBM	4 measurements per day, every ~6 hours
• Antarctica as baseline • Arctic ocean + Greenland from May to August	• Antarctica	• South Pacific ocean	• Antarctica in spring and summer • Arctic ocean + Greenland in autumn and winter	• South hemisphere oceans • North Russia + north Pacific ocean

MISSION HISTORY:
The full history of AEOLUS mission operations is recorded live on the following CalVal ESA page:
https://www.aeolus.esa.int/confluence/display/CALVAL/Schedule+Aeolus