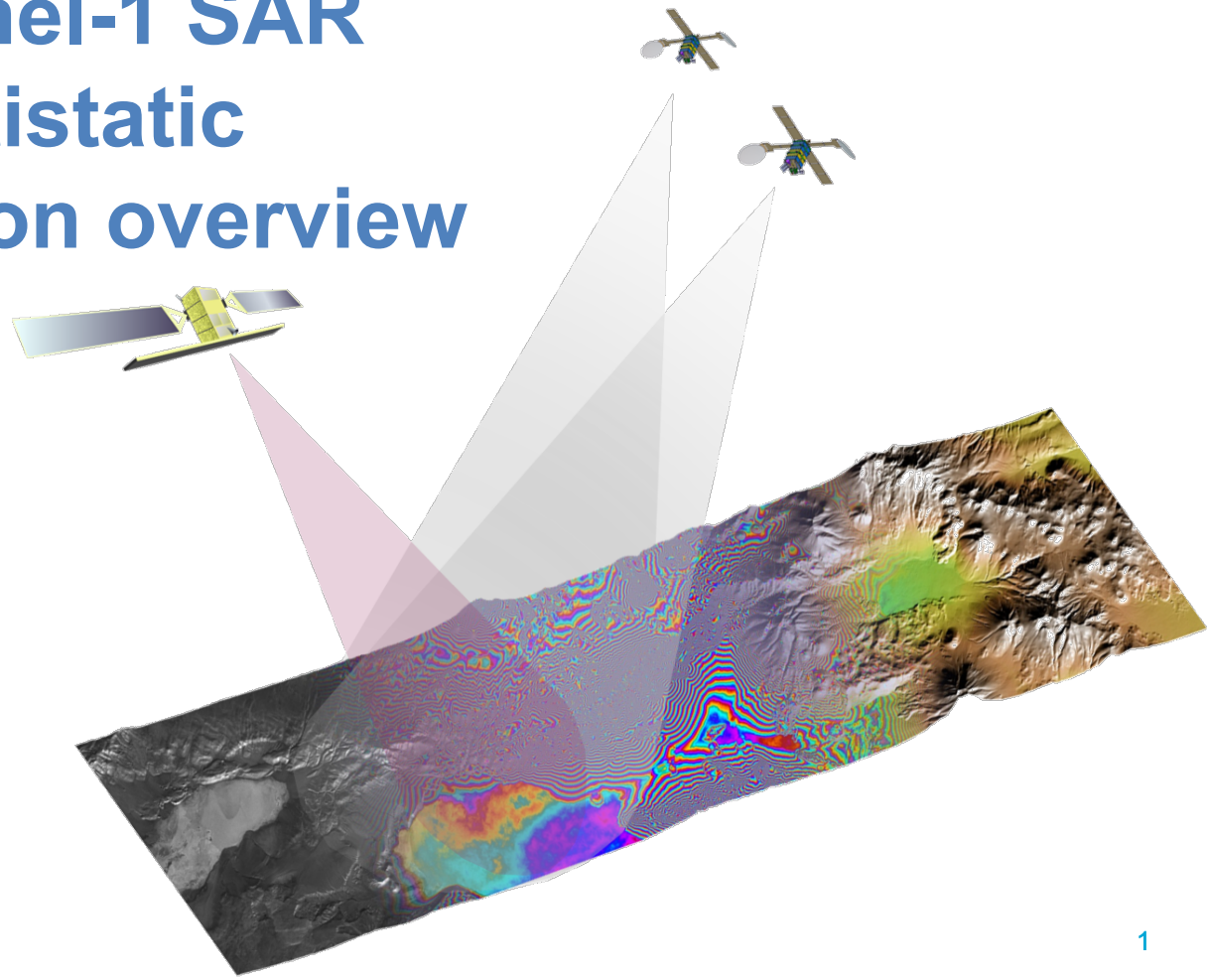
SESAME (SEntinel-1 SAR Companion Multistatic Explorer): mission overview

Paco López Dekker, TU Delft, NL
Helmut Rott, *ENVEO IT*
Svein Solberg, NIBIO
Mariantonietta Zonno (DLR)
Pau Prats (DLR)
Alberto Moreira (DLR)



Science & mission objectives

SESAME, operating in ***SP-InSAR mode***, will deliver precise, spatially detailed, multitemporal maps on surface topography to:

Cryosphere

- Quantify volume/mass changes of glaciers and ice-caps
- Map and monitor permafrost degradation

Solid earth

- Quantify displaced volume in natural disasters (landslides, volcanic eruptions…)
- Support emergency response
- Monitor 3-D surface motion in unstable ground and volcanic zones.

Biosphere

- Monitor temporal change in forest height and structure

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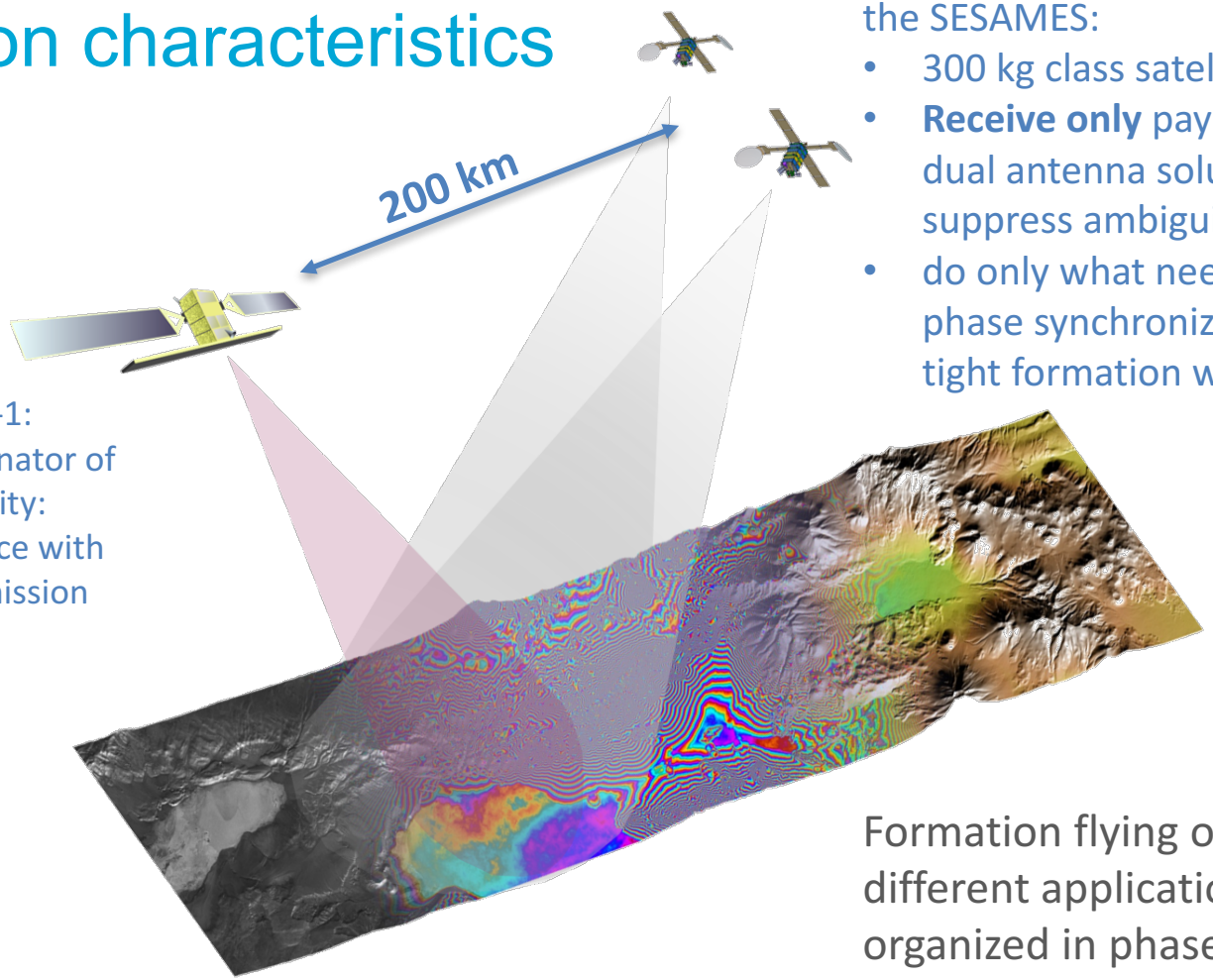
Mission characteristics



Sentinel-1:
Used as illuminator of opportunity:
no interference with Sentinel-1 mission

the SESAMES:

- 300 kg class satellites
- **Receive only** payload with dual antenna solution to suppress ambiguities
- do only what needed: no phase synchronization nor tight formation with S1

Formation flying optimizes to different applications/ROIs: mission organized in phases.

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Driving requirements

Id	What	Prod. horizontal resolution [m]	Temporal sampling [yr]	Accuracy (1σ) [m]
R1	Land and ice topography	100 (T) - 50 (G)	5 (T) – 1(G)	5 (T) – 0.5 (G)
R2	**Glacier ΔDEM**	200 (T) - 50 (G)	3 (T) – 0.5 (G)	2 (T) – 0.3 (G)
R3	Permafrost **ΔDEM**	100 (T) – 30 (G)	5 (T) – 1 (G)	2 (T) – 0.2 (G)
R4	**ΔDEM** for landslides, volcanoes	100 (T) - 50 (G)	0.5 (T) – 1/36 (G)	2 (T) – 0.3 (G)
R5	**ΔDEM** for hazard management	100 (T) - 50 (G)	Single coverage	2 (T) – 0.3 (G)
R7	Forest **ΔDSM**	100 (T) - 50 (G)	1	1

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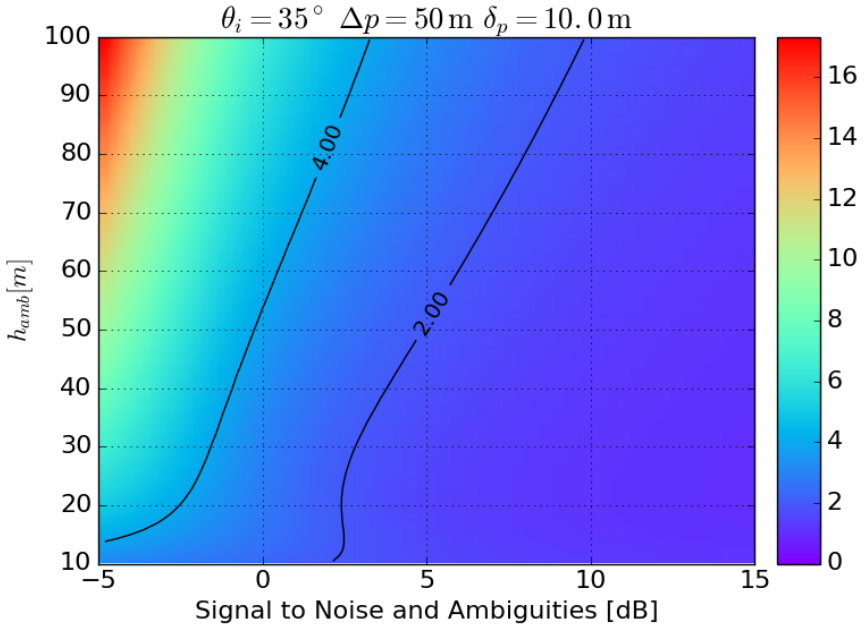
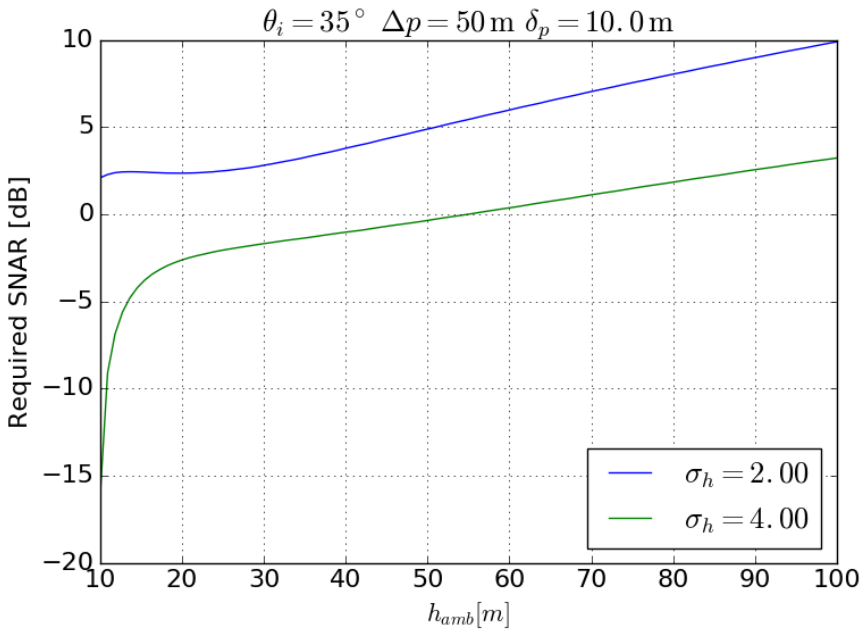
Product to system requirements: Glacier ΔDSM

Performance



Requirement



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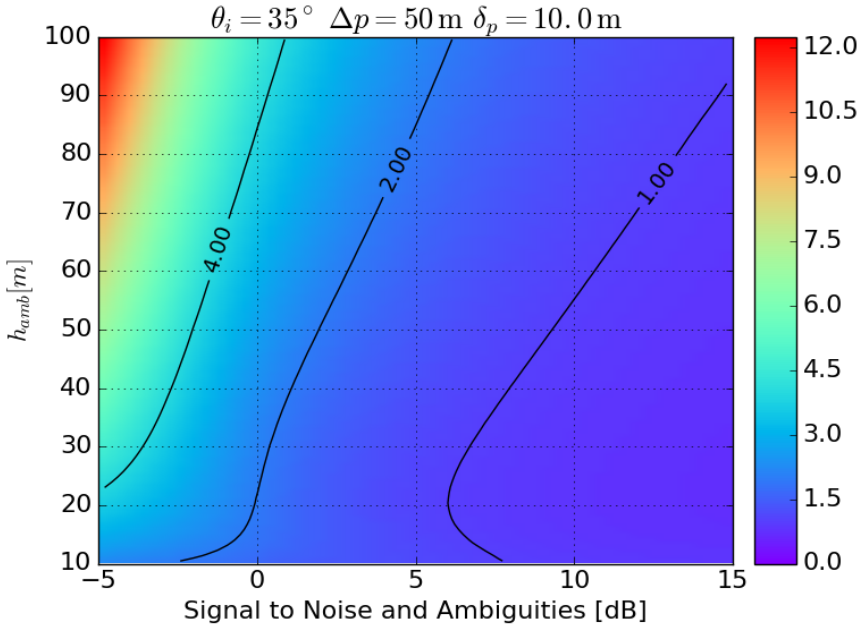
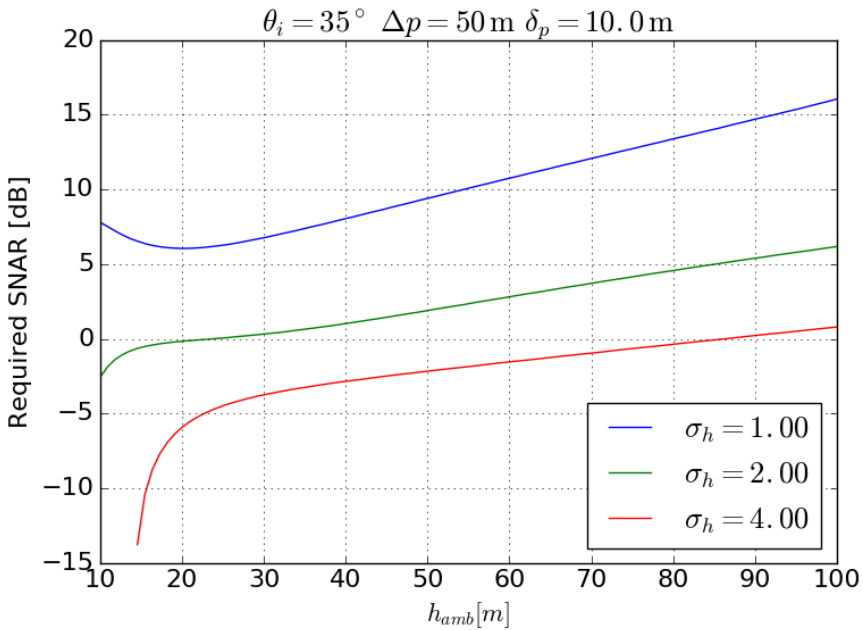
Product to system requirements: Glacier ΔDSM

Performance



Requirement



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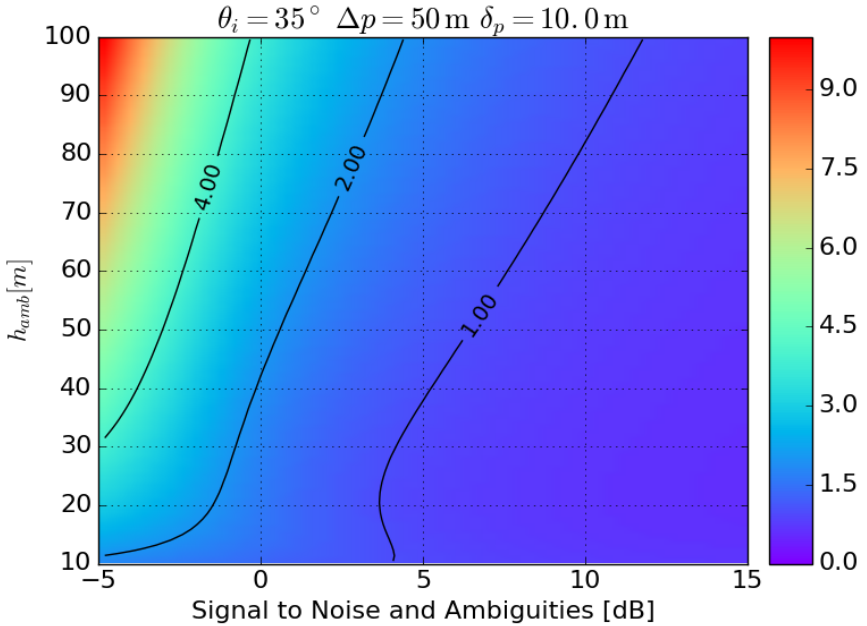
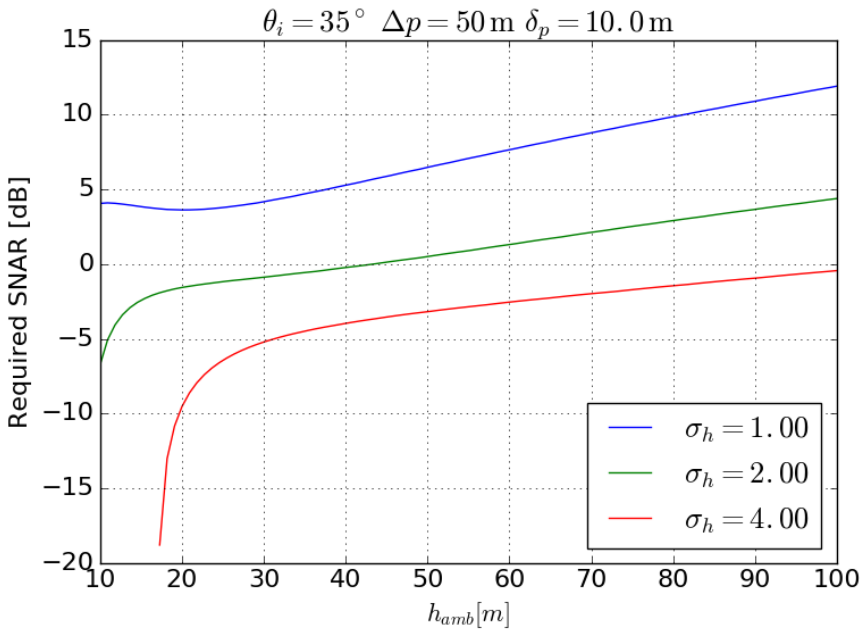
Product to system requirements: Glacier ΔDSM

Performance



Requirement



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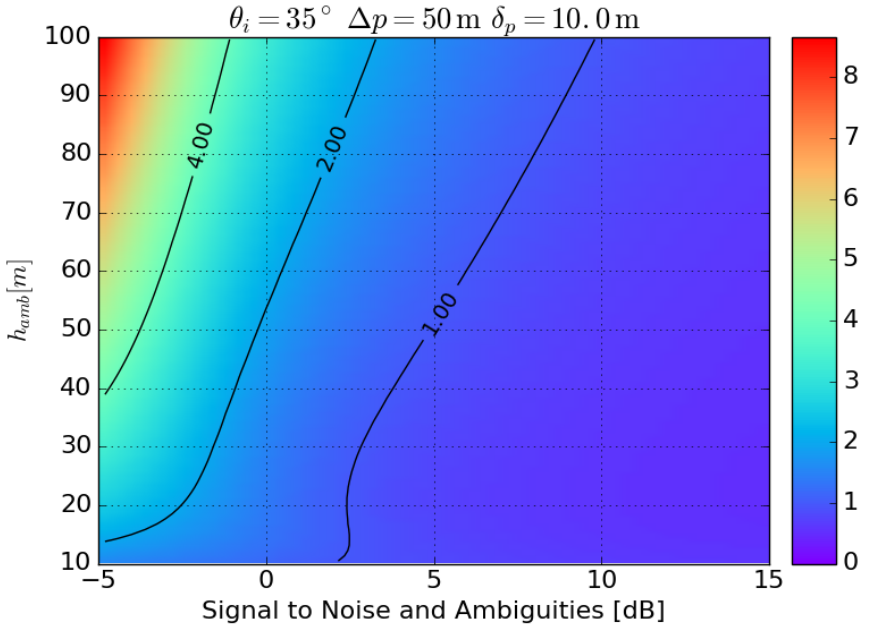
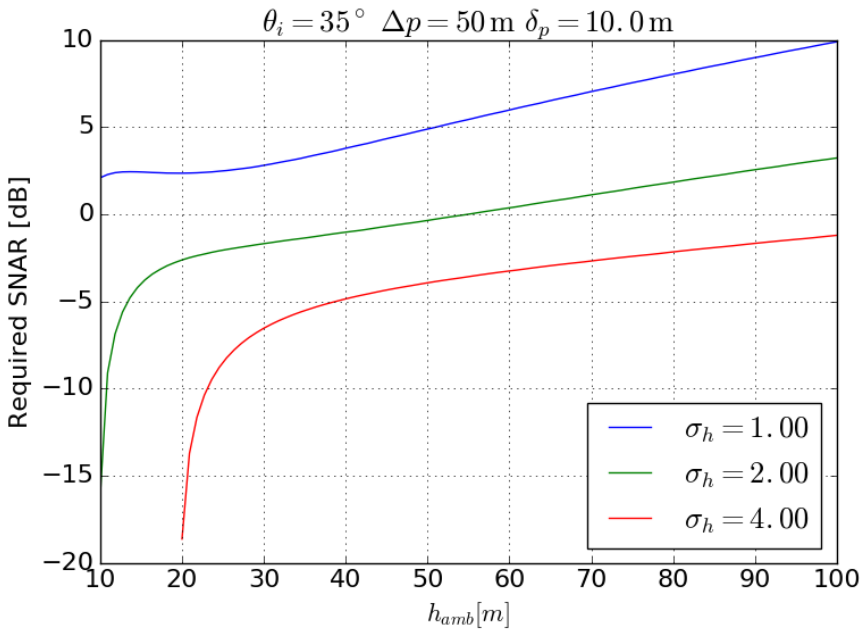
Product to system requirements: Glacier ΔDSM

Performance



Requirement



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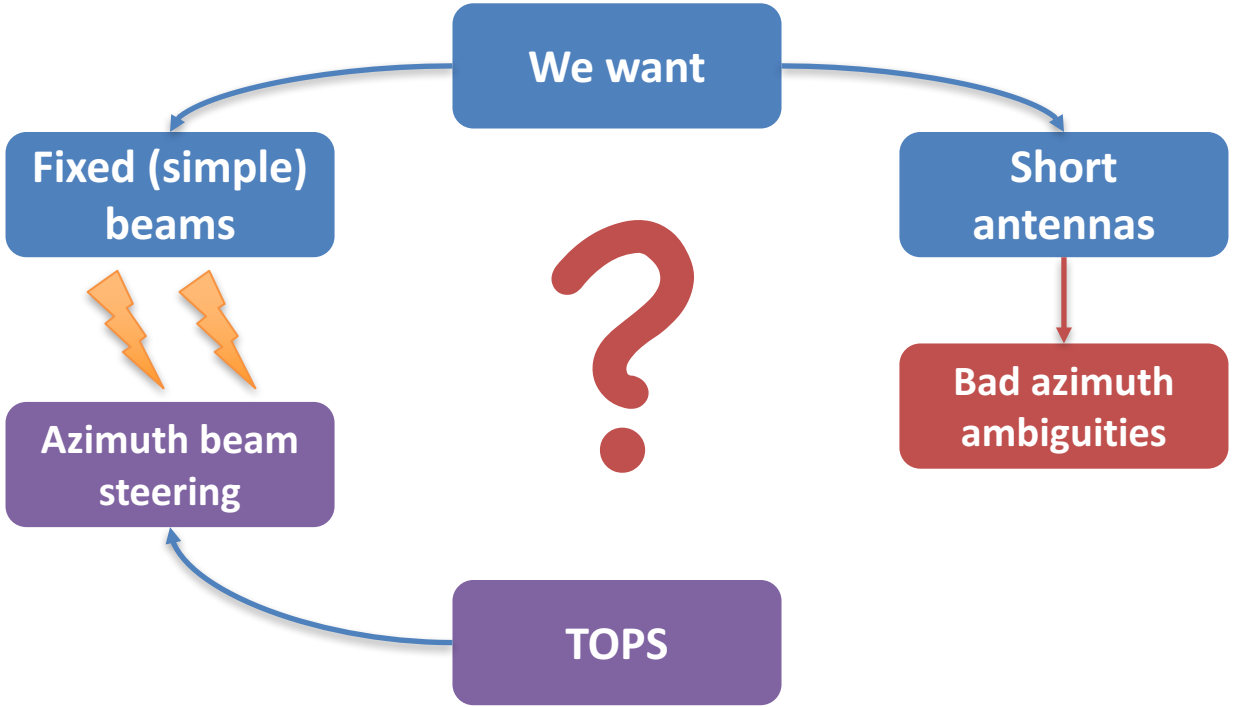
What to tweak to meet requirements

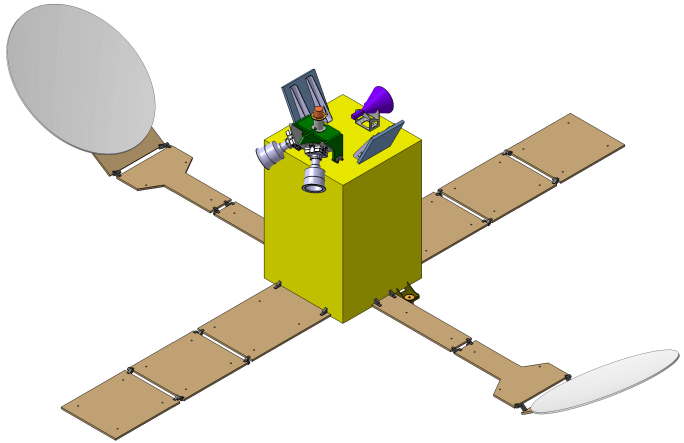
- ~~Single-look resolution~~ → set by Sentinel-1
- Signal to noise + ambiguities ratio
  - NESZ
  - AASR and RASR
- Cross-track baselines → formation timeline
- Number of acquisitions → acquisition timeline

NESZ, DTAR and, again, TOPS

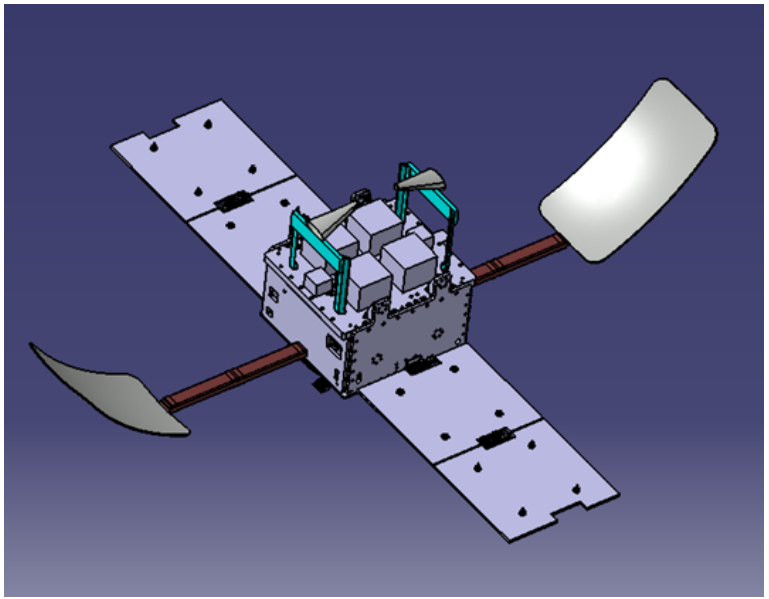


Approach (and space-segment illustration)

TAS-I design

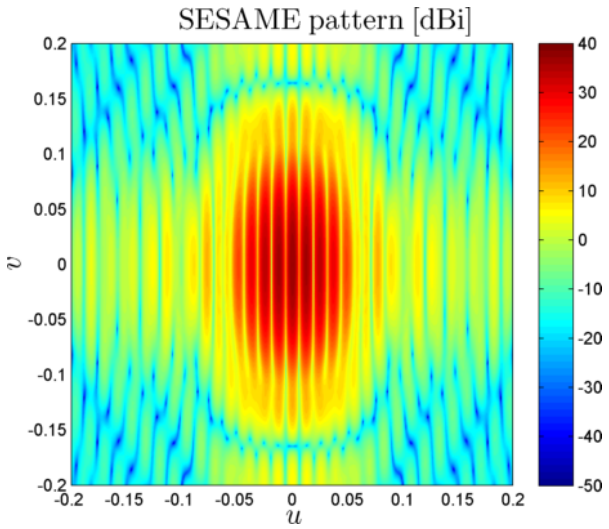


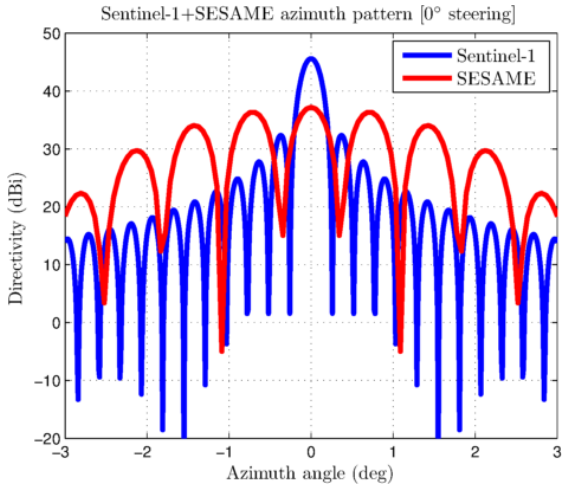
ADS-CASA design



Antenna concept

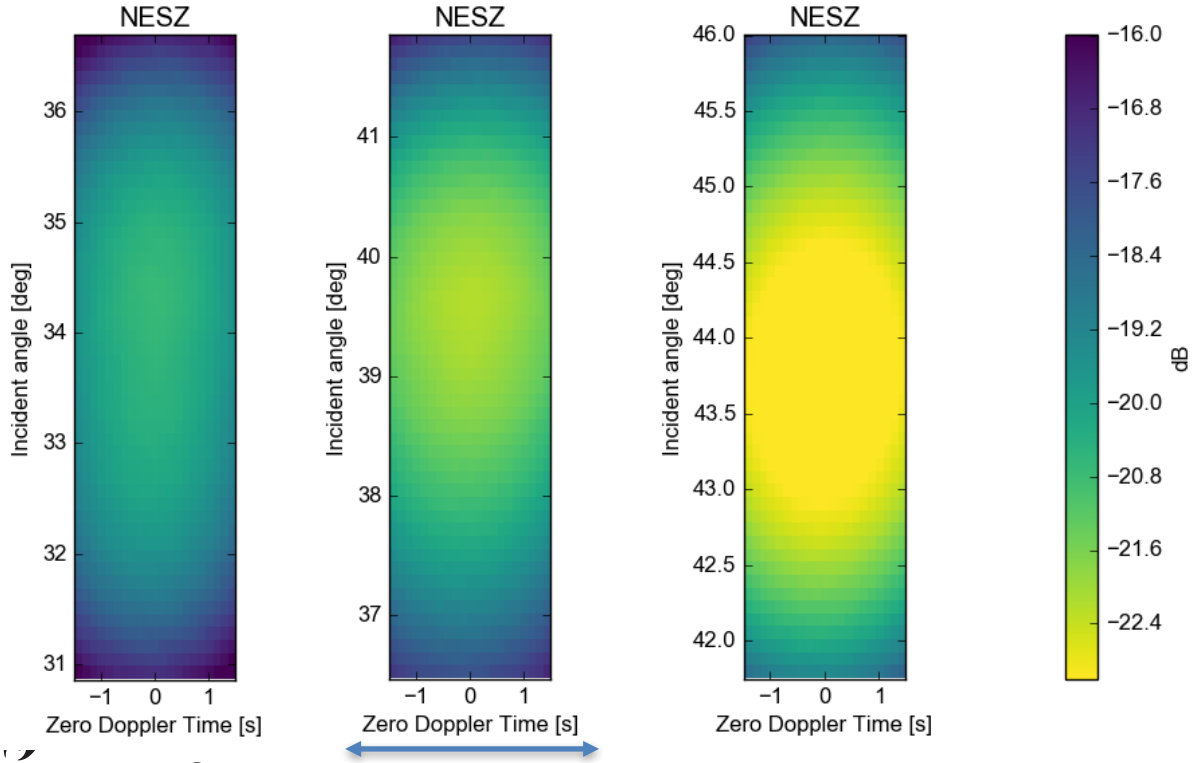
- Dual antenna architecture
- Sample and down-link signal at antenna
- Azimuth steering using DBF on the ground





Imaging performance: NESZ

sub-swath 1 sub-swath 2 sub-swath 3

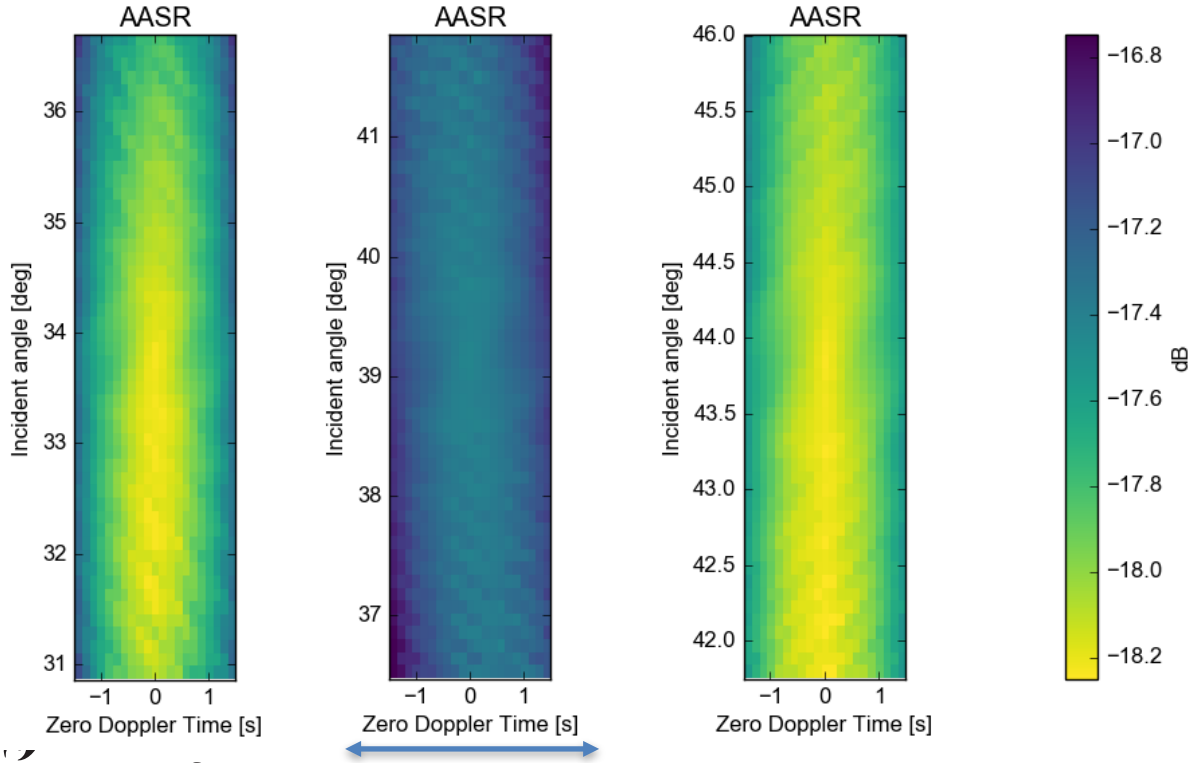


Position in burst

- NESZ generally adequate to good
- Probably a bit less gain in exchange of wider elevation beams would be better.

Imaging performance: AASR

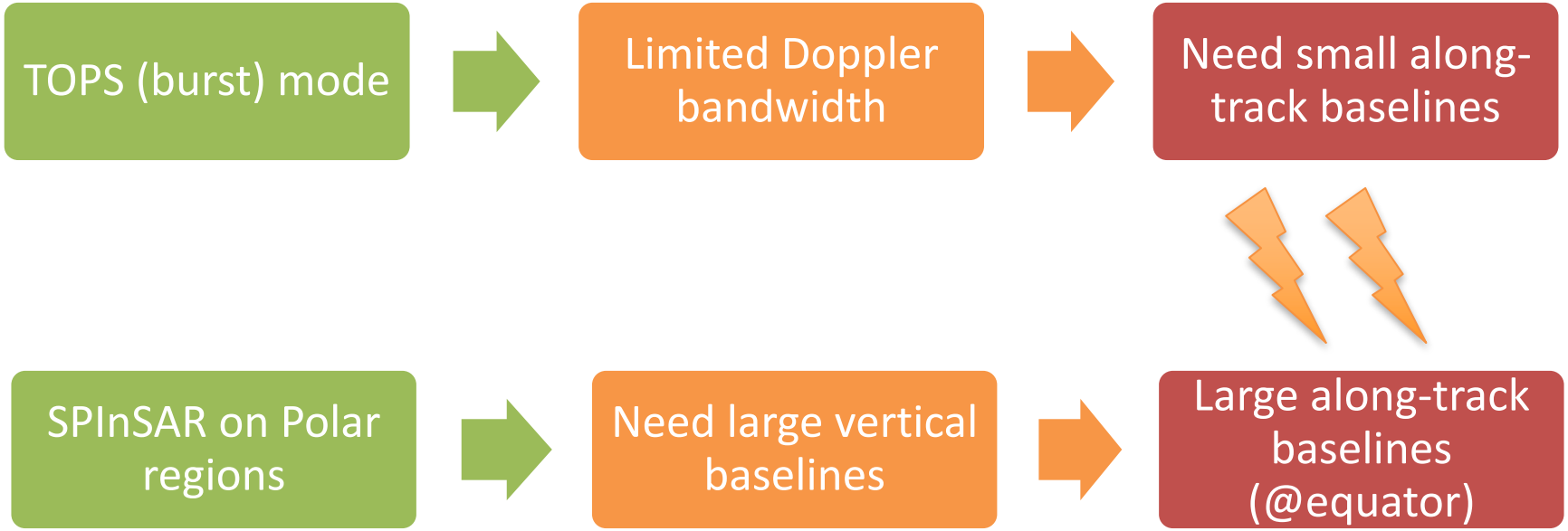
sub-swath 1 sub-swath 2 sub-swath 3



Position in burst

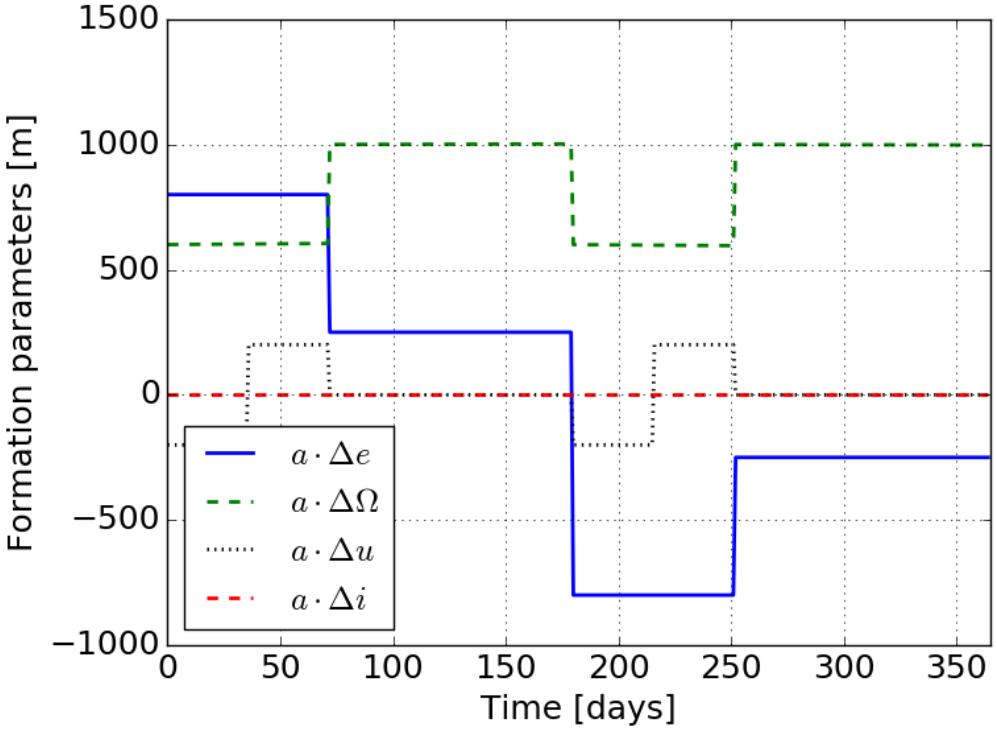
- AASR in -17 to -18 dB range.
- Quite good given small total antenna area
- Sub-swath variability due to Sentine-1 PRFs

Formation Flying & TOPS



Formation design approach

- Alternate between polar/regular formation
- Go for systematic repeated acquisitions



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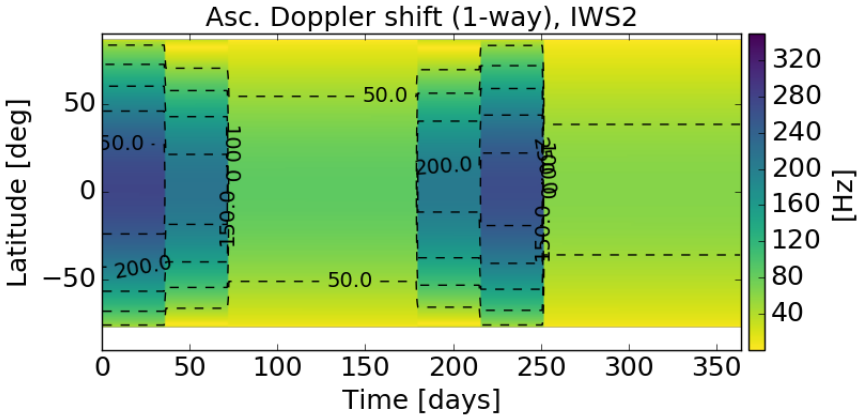
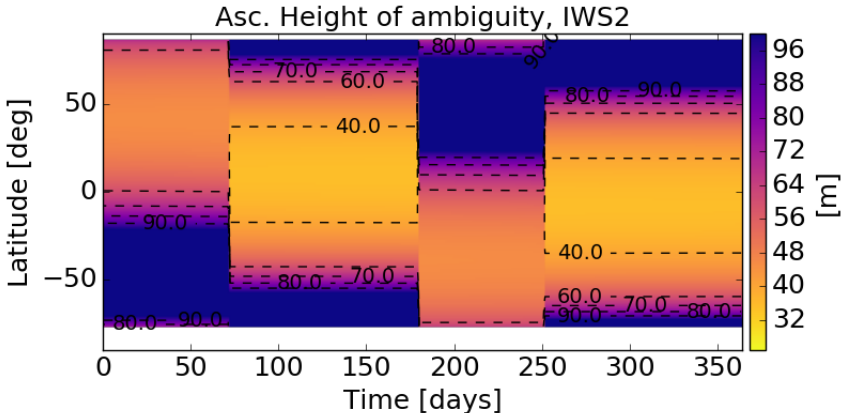
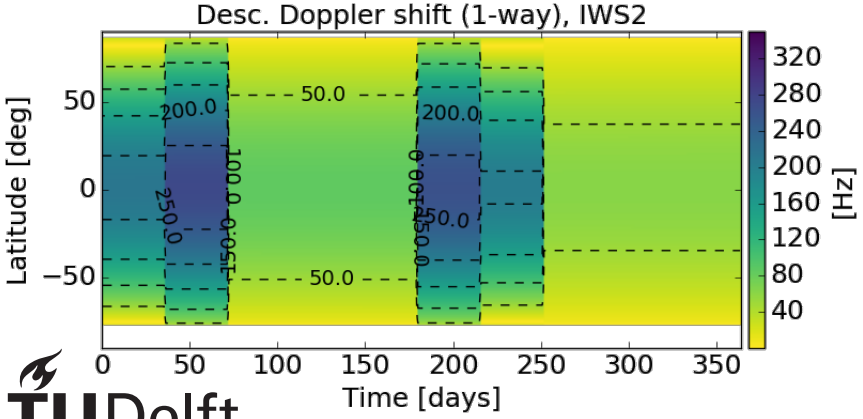
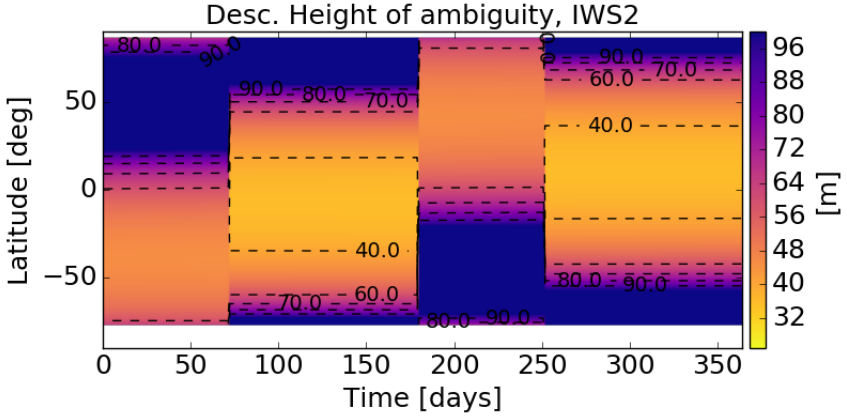
Formation









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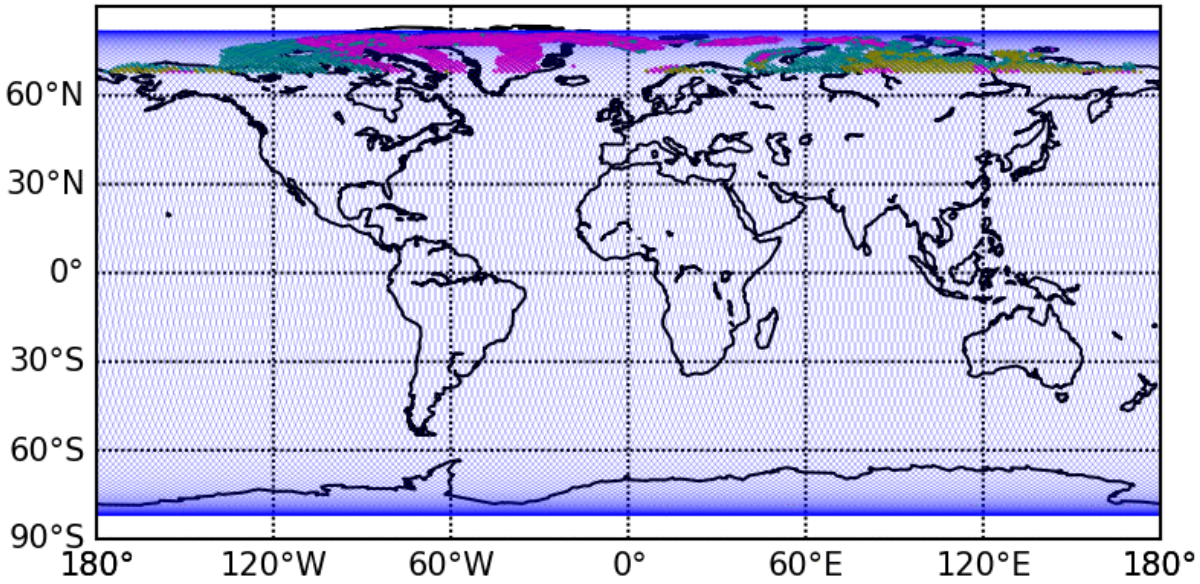
Acquisition (activation) plan

- Limited to one sub-swath (we cycle sub-swaths by mechanical steering)
- Acquisition limits by HoA, common Doppler, down-link capacity



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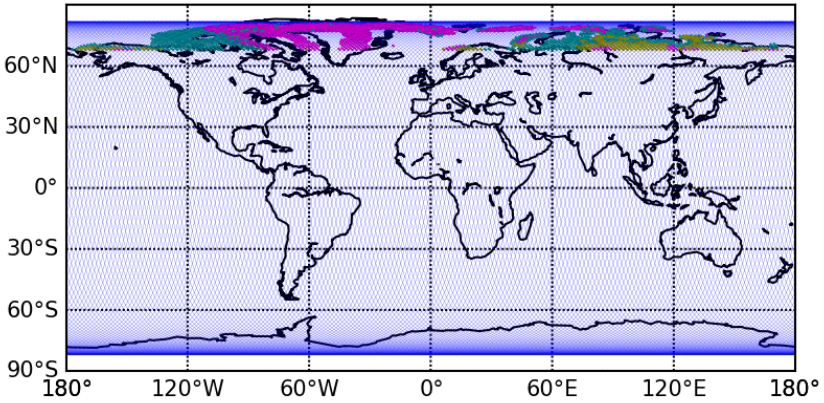
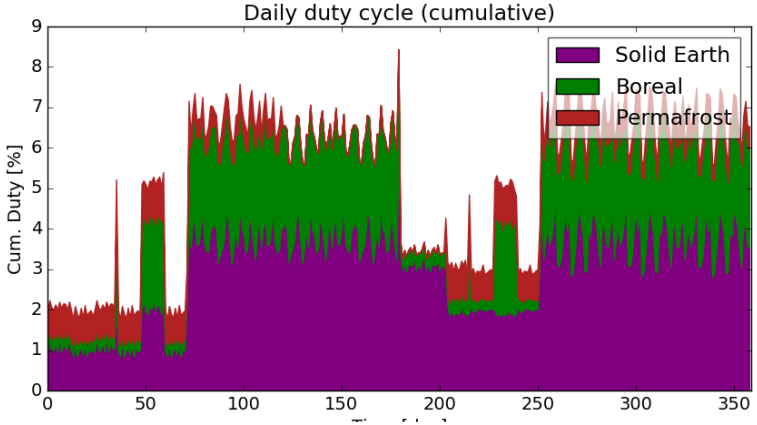
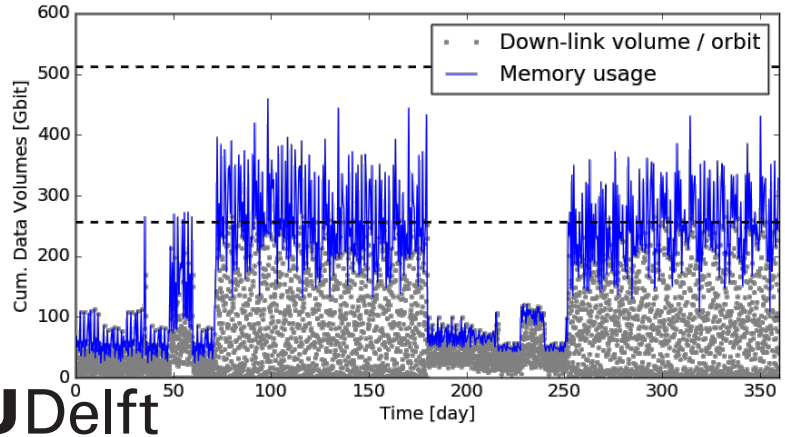
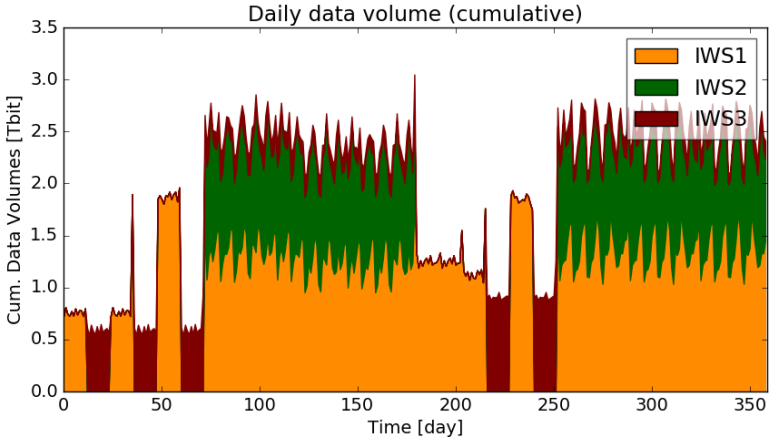
Acquisition (activation) plan









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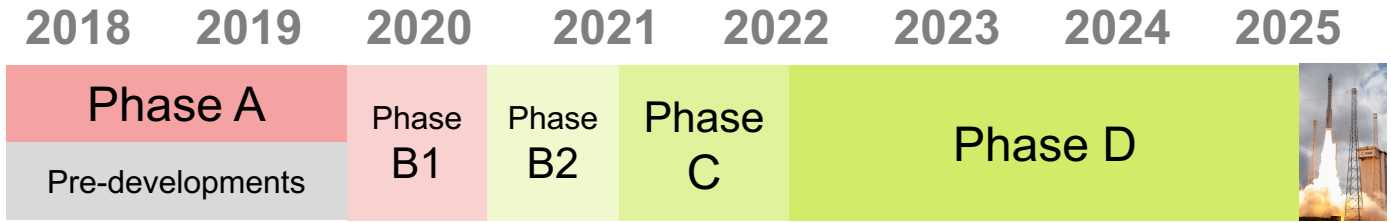
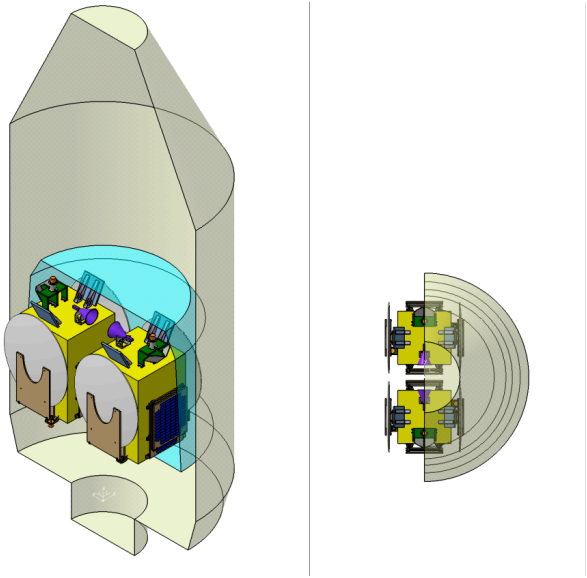
Programmatic issues

- Costs
  - Proposal supported **by two independent industrial teams**
  - Estimated space segment costs < 150 M€.
  - Some reserves to accommodate dedicated (dual) launch.
- Rough implementation schedule



Vega launch accommodation

TAS-I design



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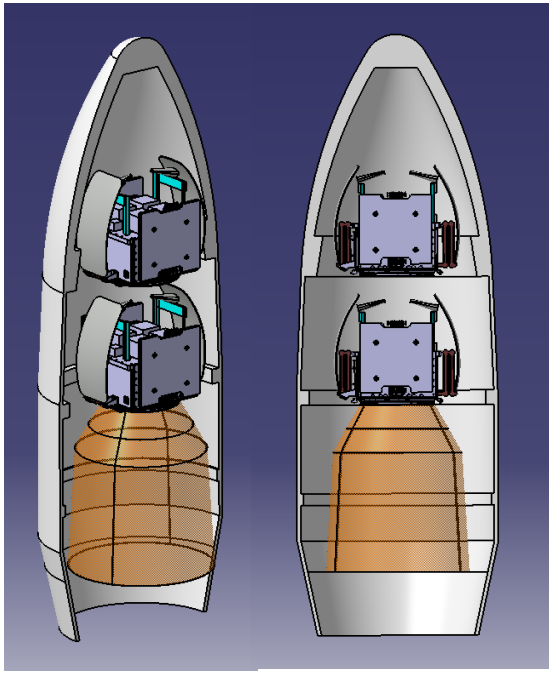

SESAMEs will fly in the future….

…and they will be great