BIOMASS: Mission Planning and Operations Concept

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Introduction

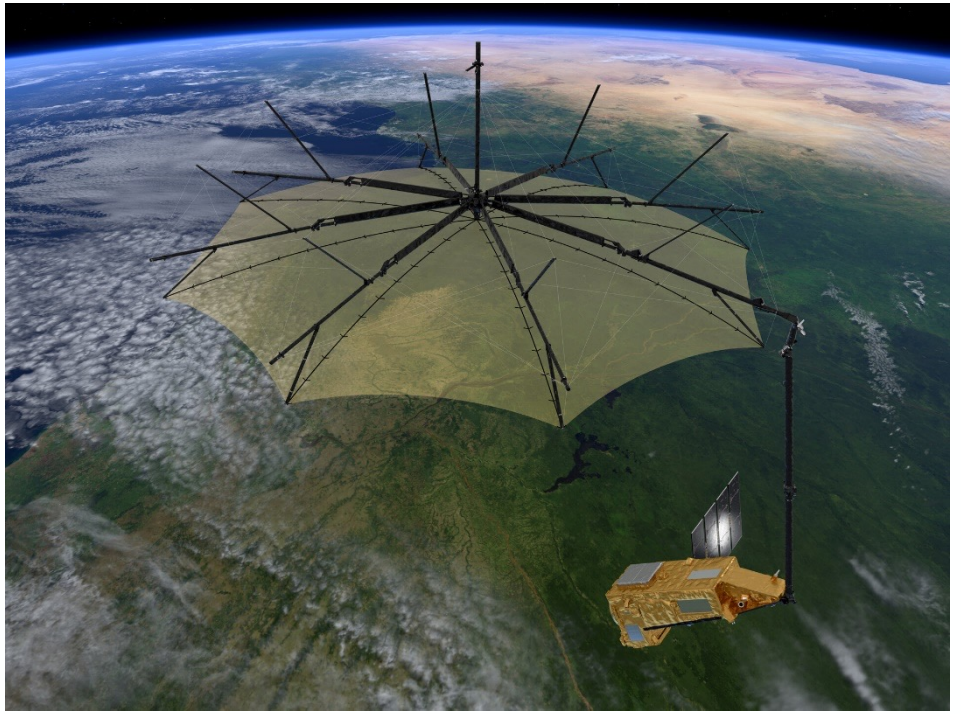
Instrument: P-Band synthetic aperture radar

Reflector: 12 m

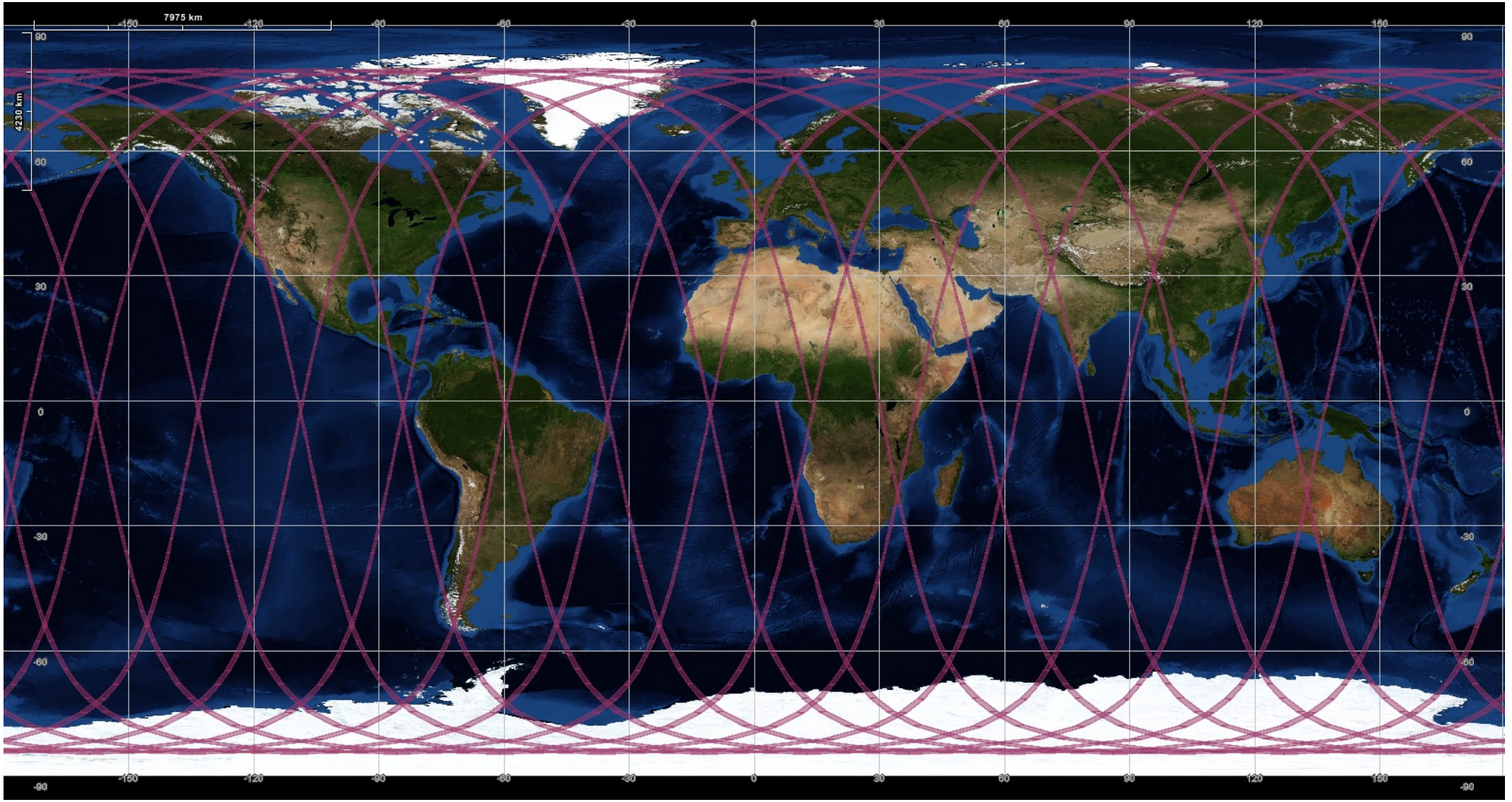
Mass: 1250 kg

Orbit :

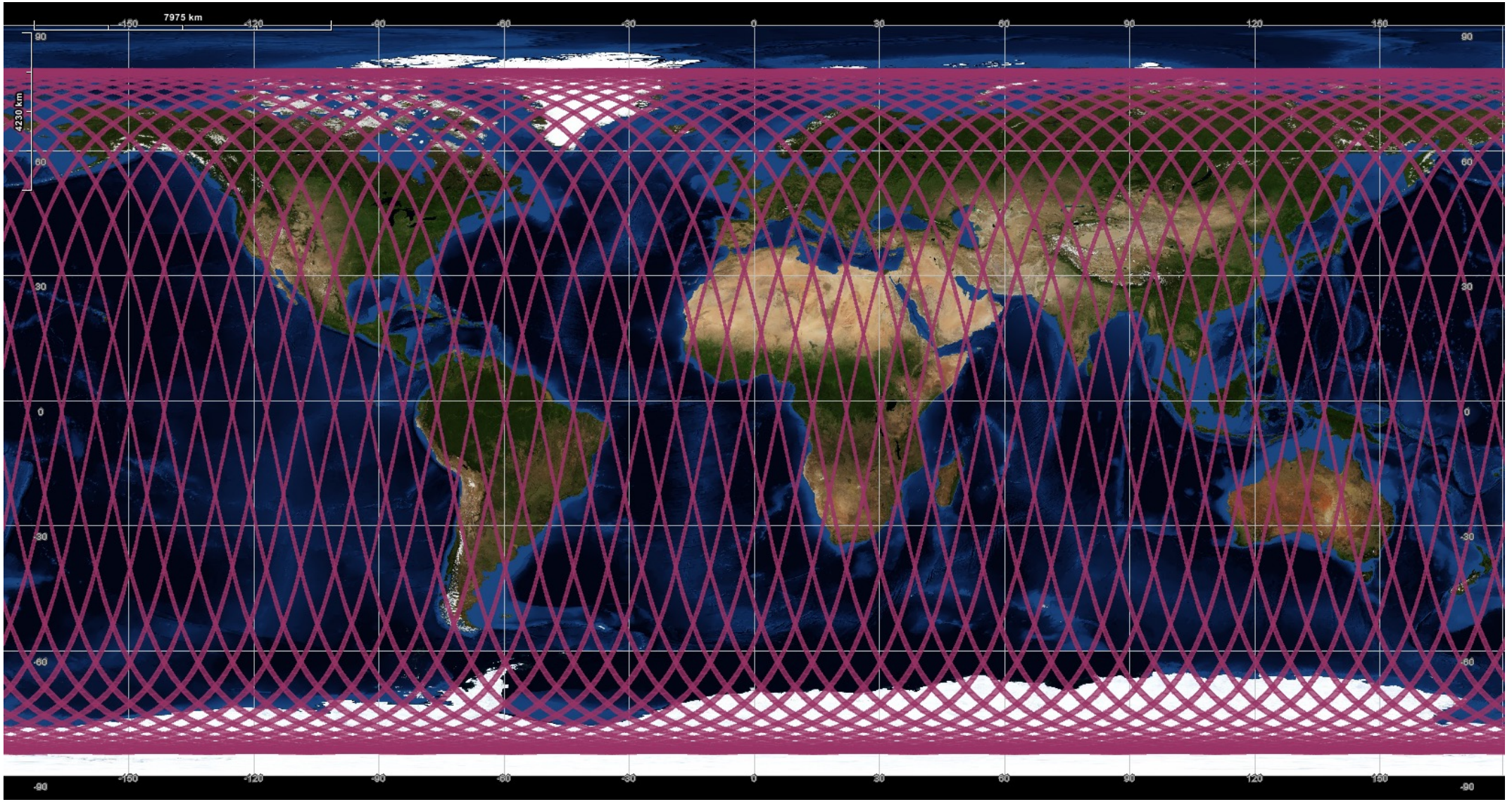
- Sun-synchronous, dawn-dusk
- Orbit height: 666 km
- (Near) repeat cycle: 44
- (Near) cycle length: 3



Observation geometry (1 day coverage)

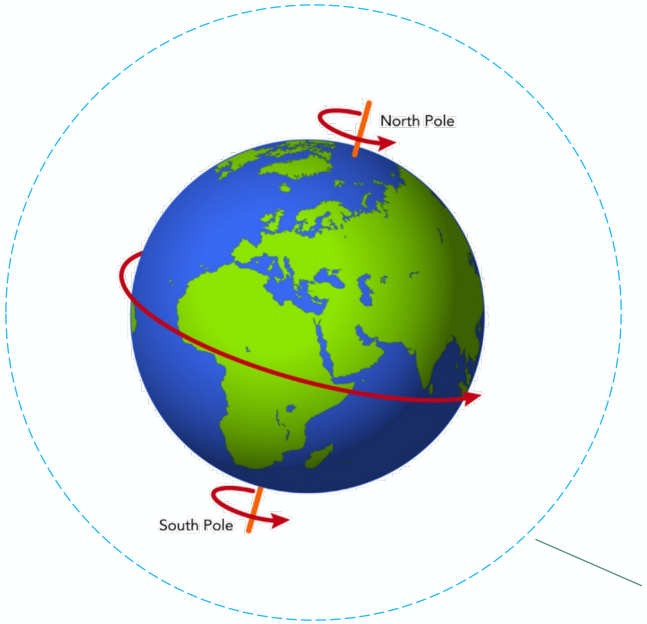


Observation geometry (3 day coverage)

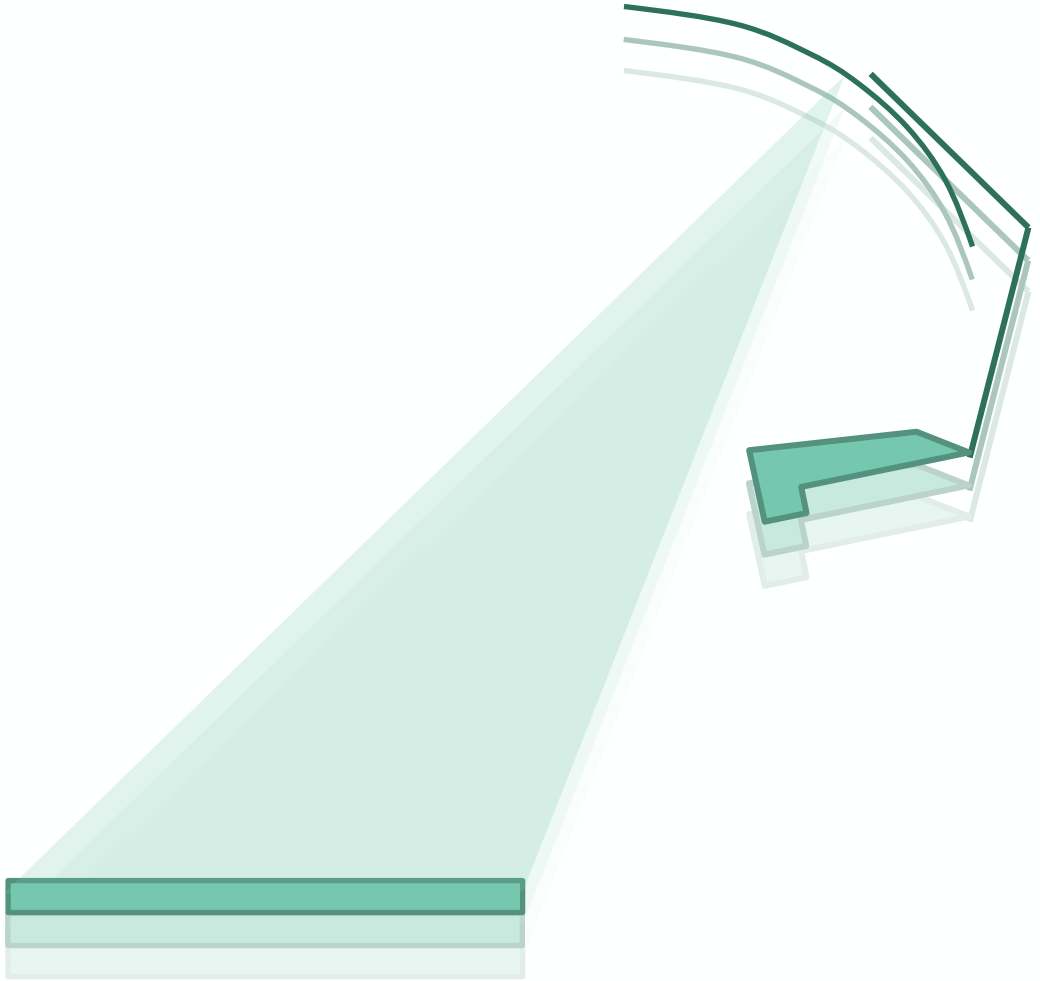


Observation geometry (repeat cycle orbit)

A spacecraft in an orbit with a pure 3 days / 44 orbit, observes exactly same observation every 3 days.



3 days / 44 orbits

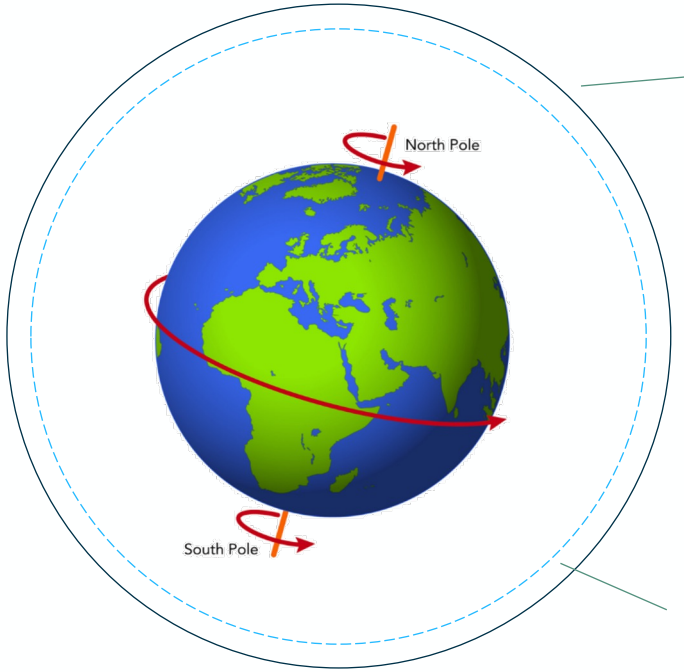


Observation geometry (near repeat cycle orbit)

Biomass will be operated at a slightly higher altitude.

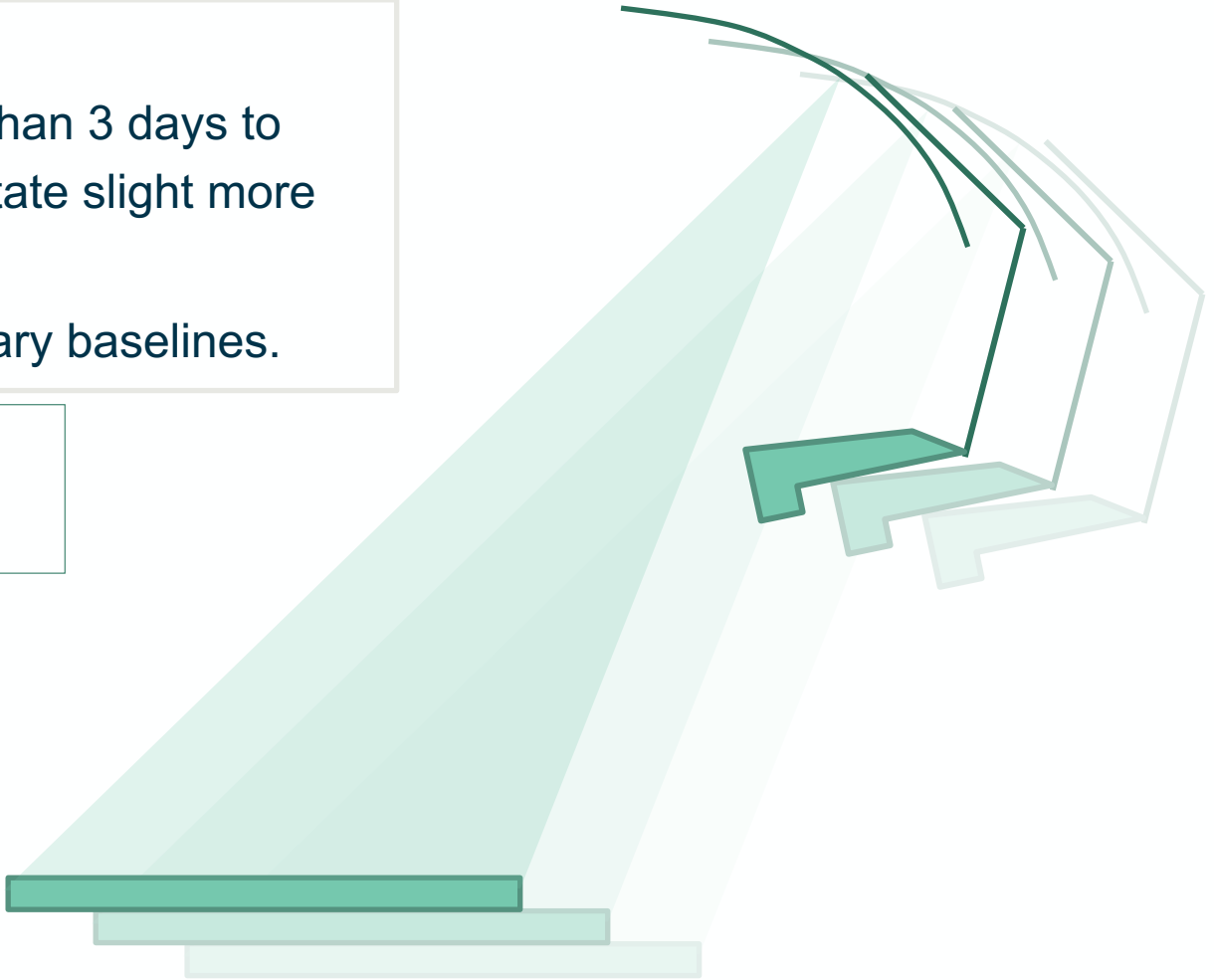
This means that the spacecraft will take slightly longer than 3 days to perform the 44 orbits, and the Earth will have time to rotate slight more eastwards.

This longitude drift is leveraged to generate the necessary baselines.



Biomass orbit

3 days / 44 orbits



Observation geometry (swath 1)

Tomographic coverage

Interferometric coverage

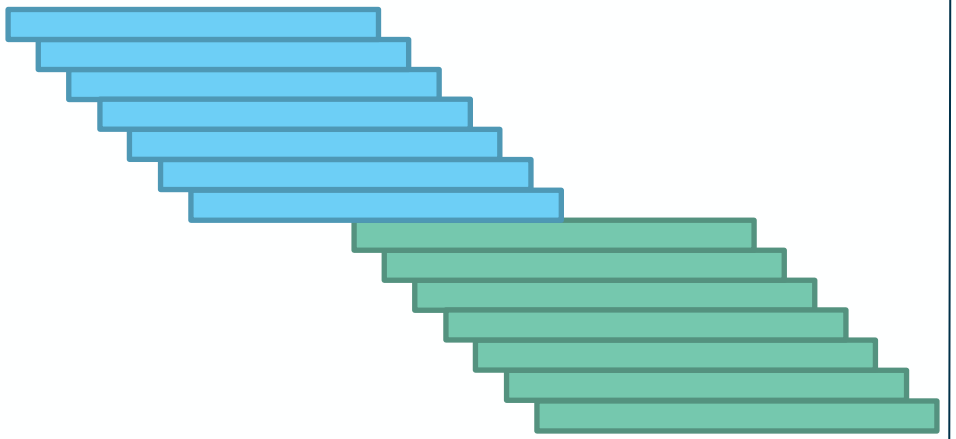
If Biomass would stay always in its drifting orbit, it would take too long to achieve global coverage.

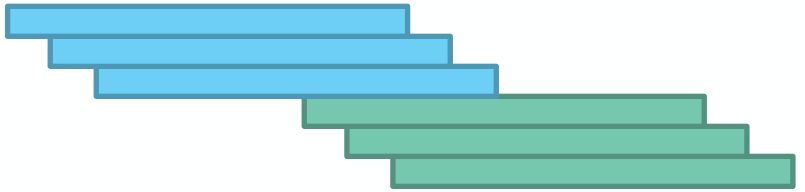
Observation geometry (swath 1 & swath 2)

Tomographic coverage

Interferometric coverage

If Biomass would stay always in its drifting orbit, it would take too long to achieve global coverage.
The solution is to perform a roll manoeuvre to observe the adjacent areas once a full observation stack has been acquired.





Observation geometry (swath 1 & swath 2 & swath 3)

Tomographic coverage

Interferometric coverage

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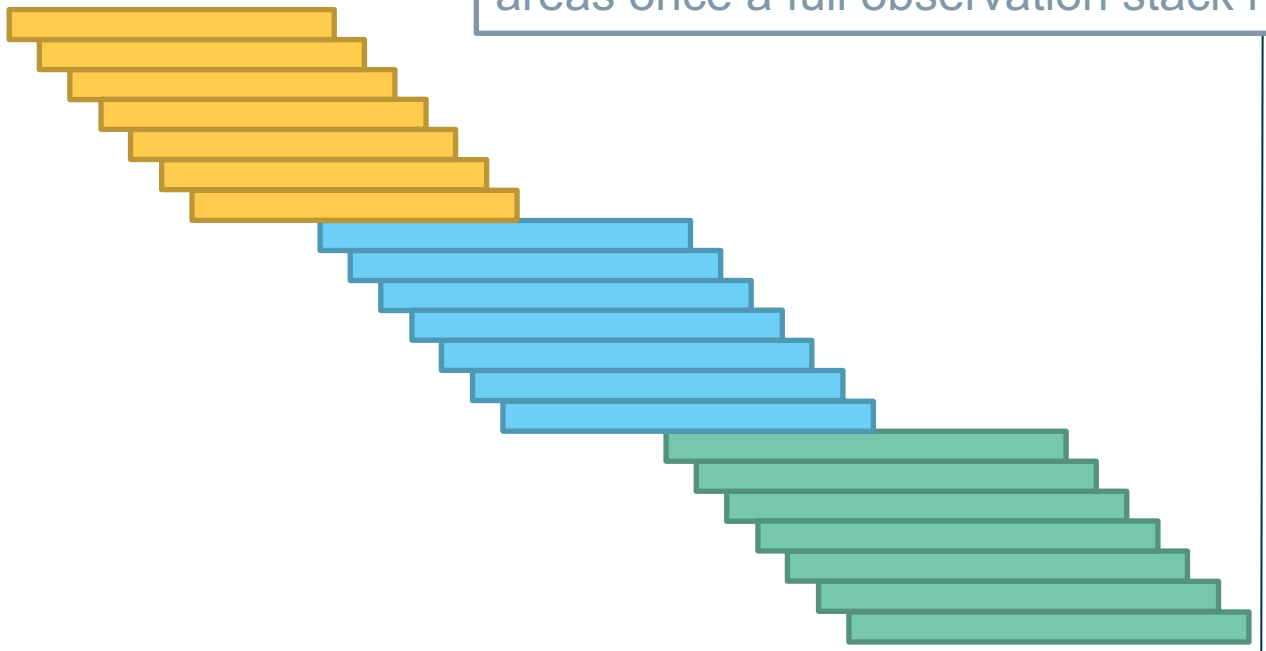
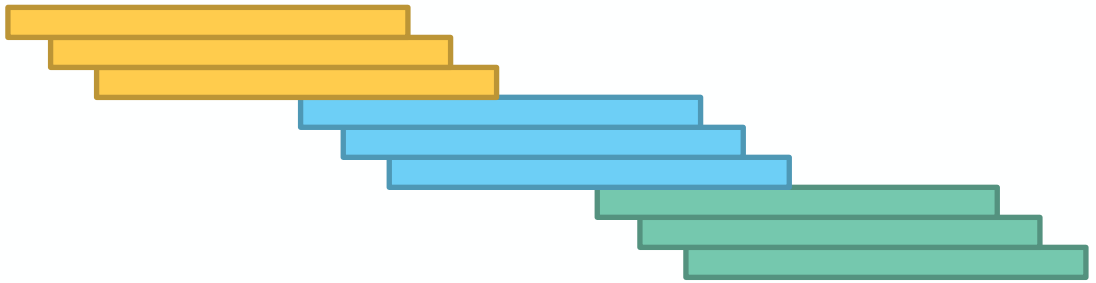
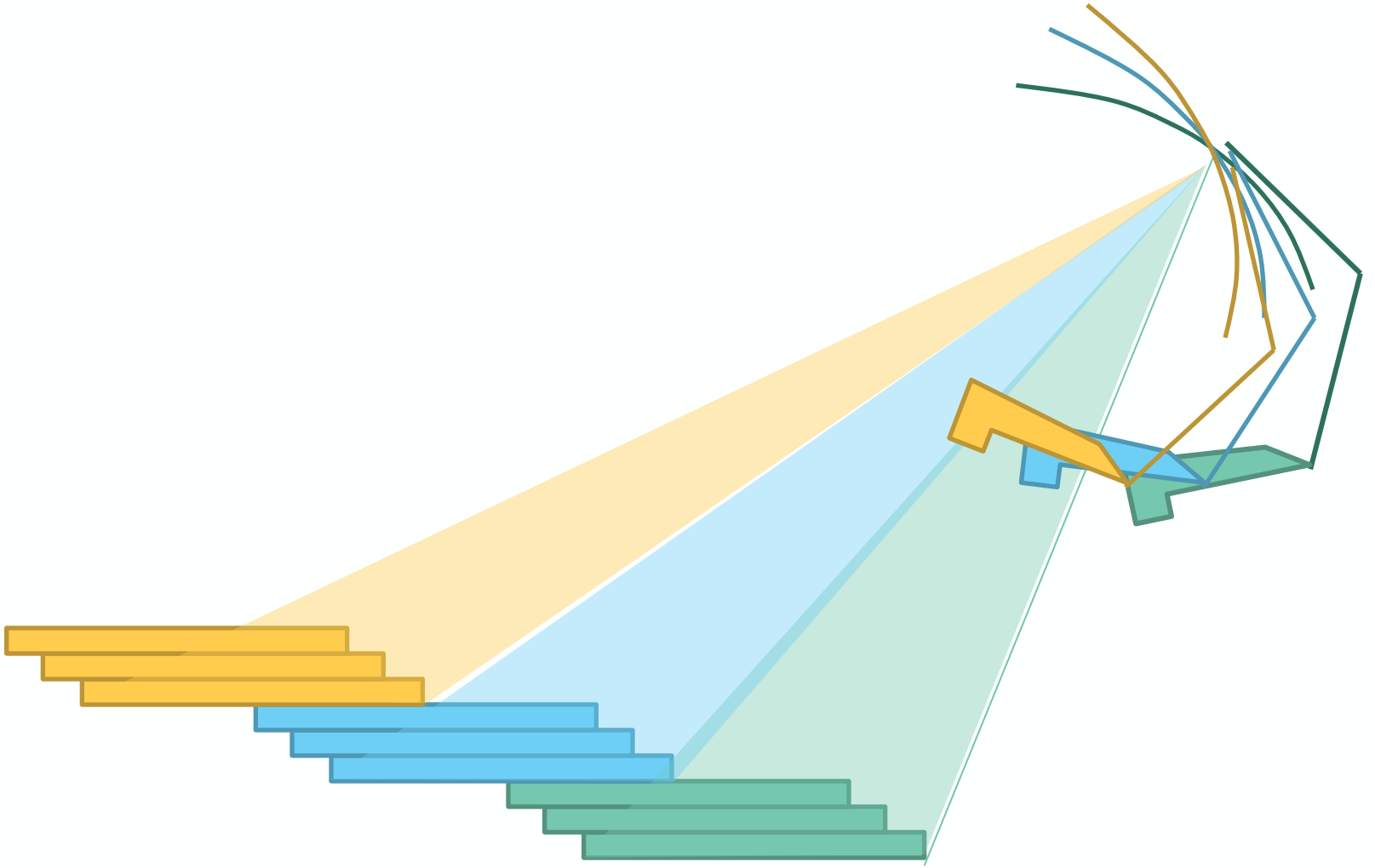


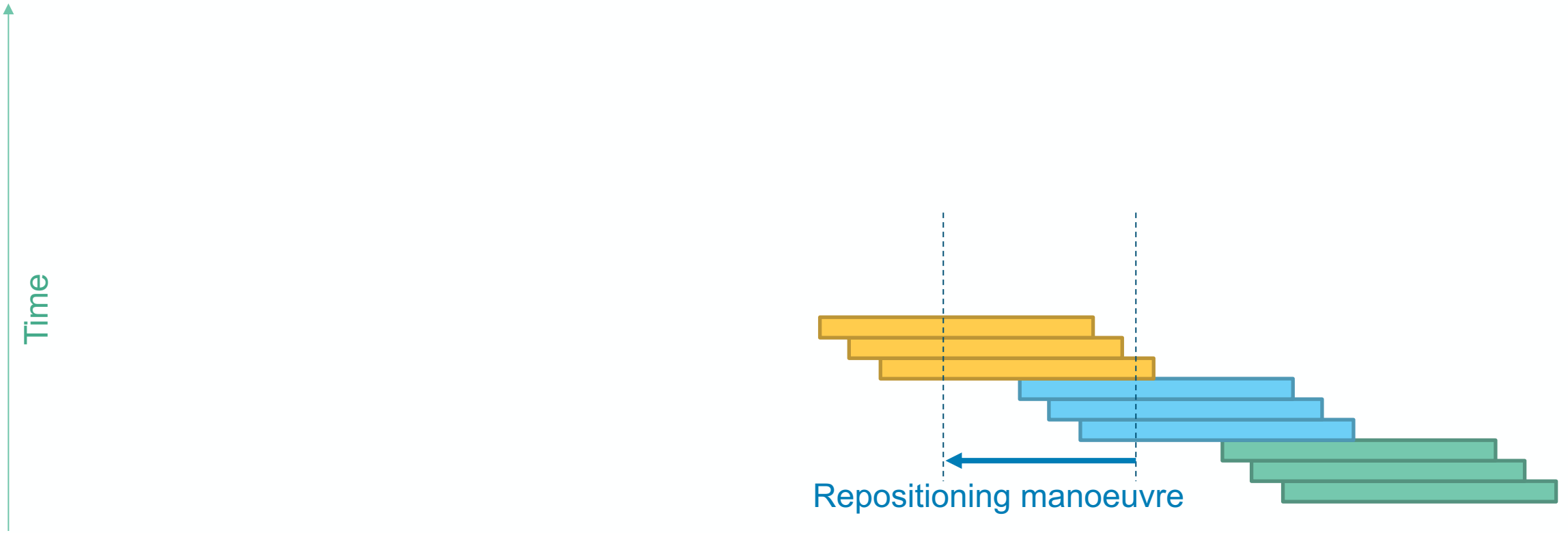


Observation geometry (swath 1 & swath 2 & swath 3)



Satellite repositioning manoeuvre

But there is a limit the incidence angle of the observations.
Thus, at the end of the observations with the 3 swaths, Biomass raises its orbit so that the longitude drift increases.



Satellite repositioning manoeuvre

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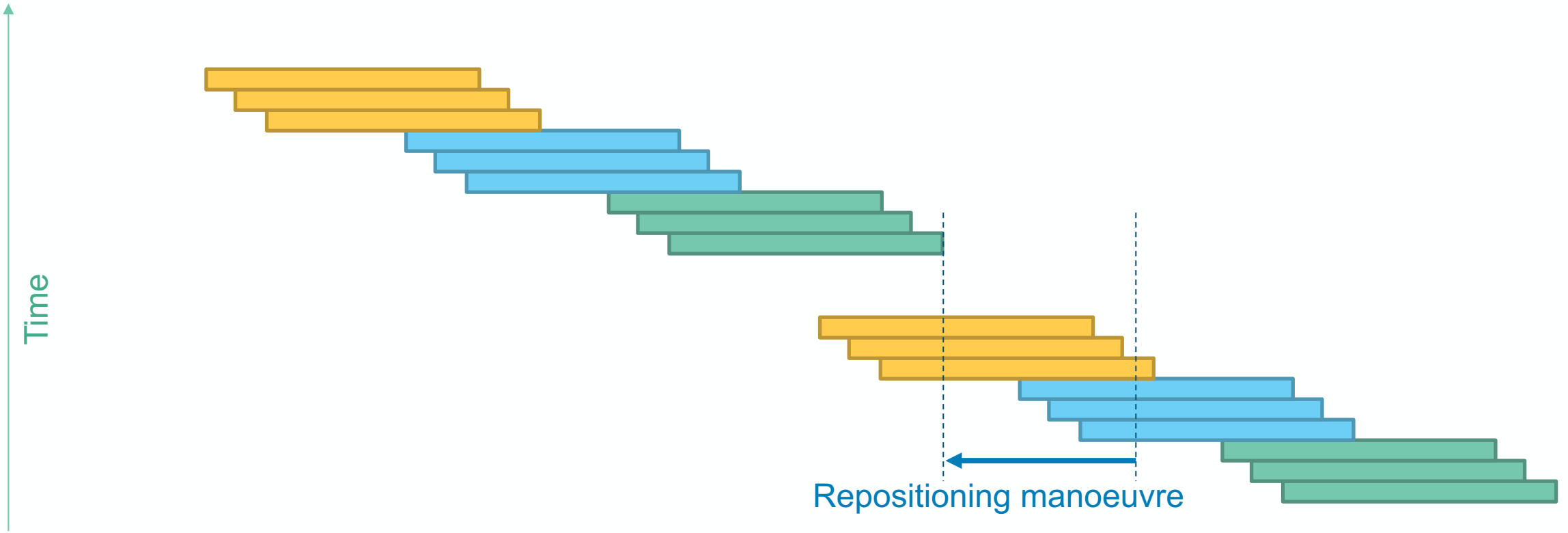
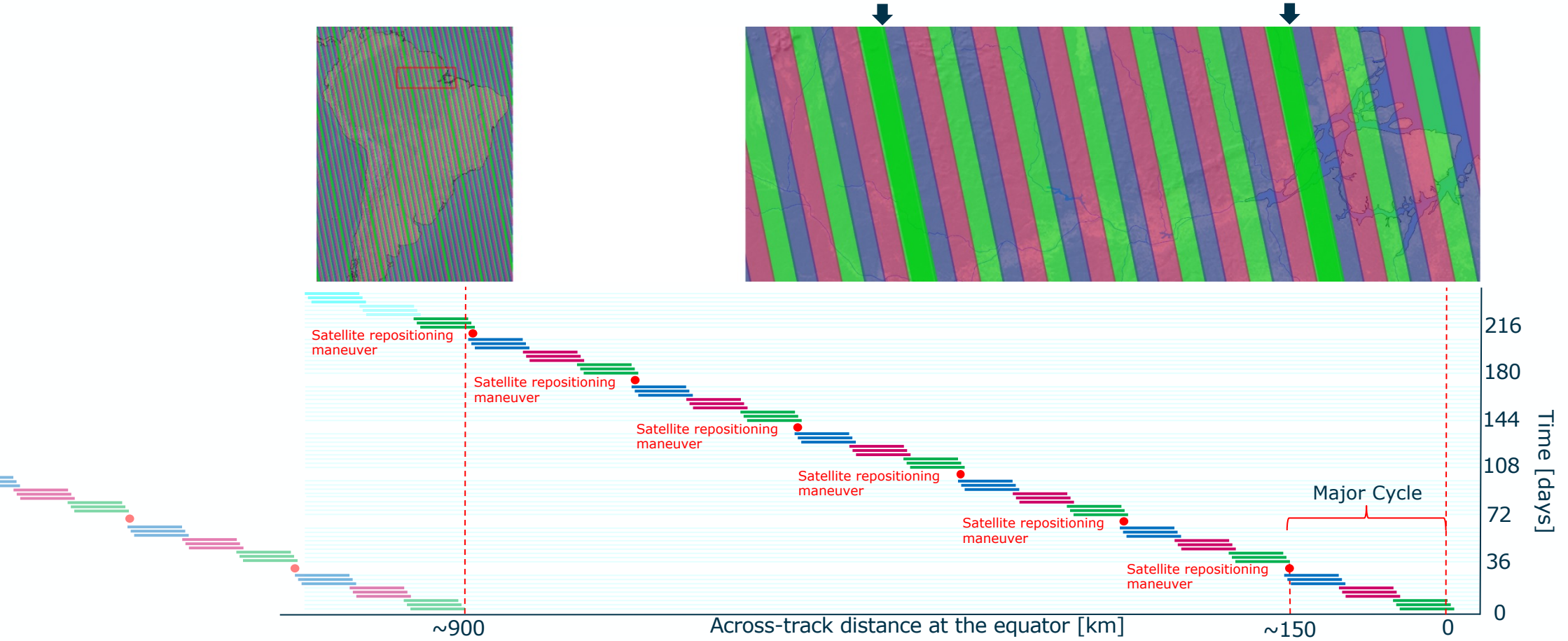
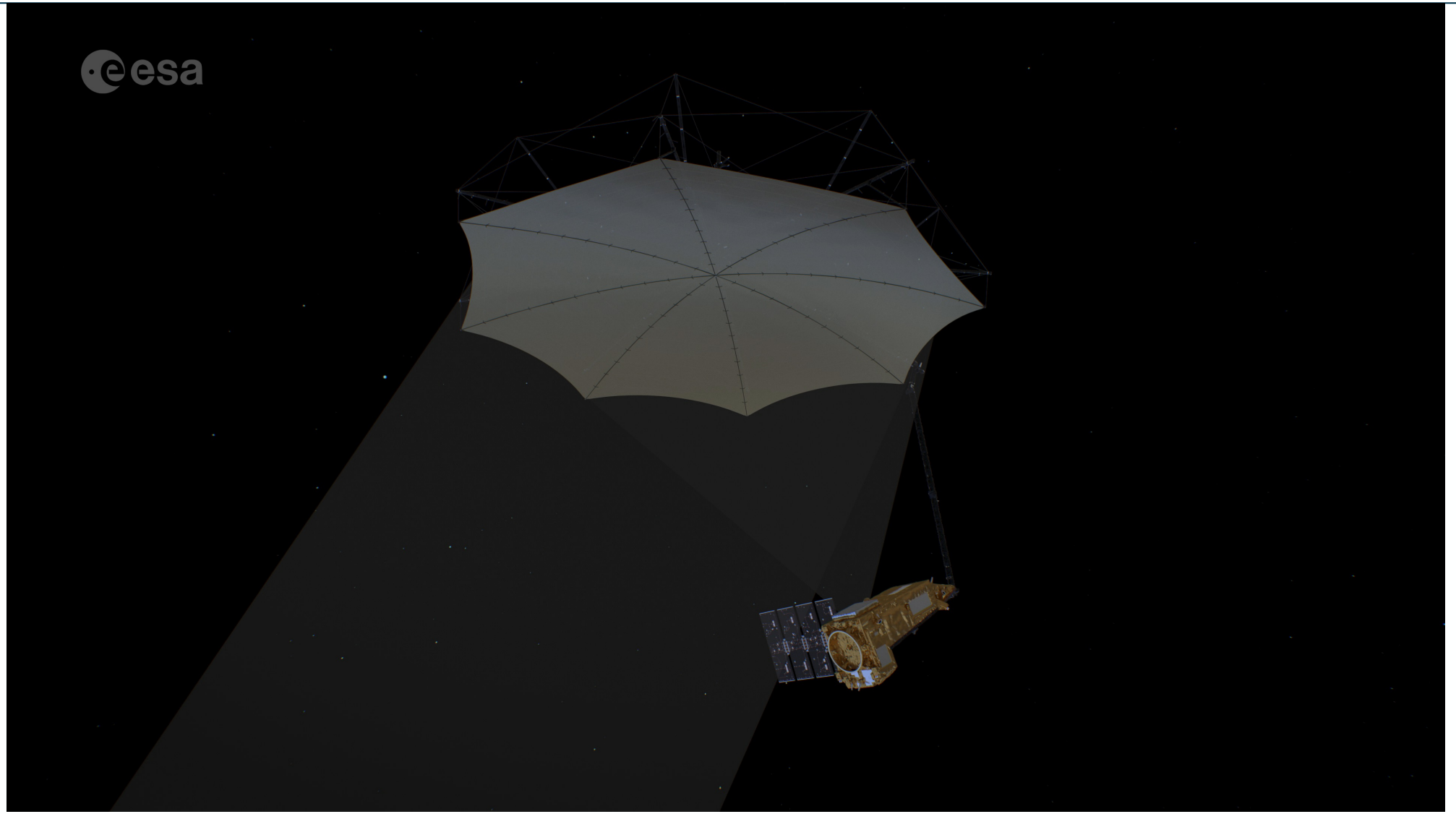
Thus, at the end of the observations with the 3 swaths, Biomass raises its orbit so that the longitude drift increases.
Once the drift is enough, the spacecraft returns to its nominal orbit and a new cycle begins.



Putting the pieces together to achieve global coverage

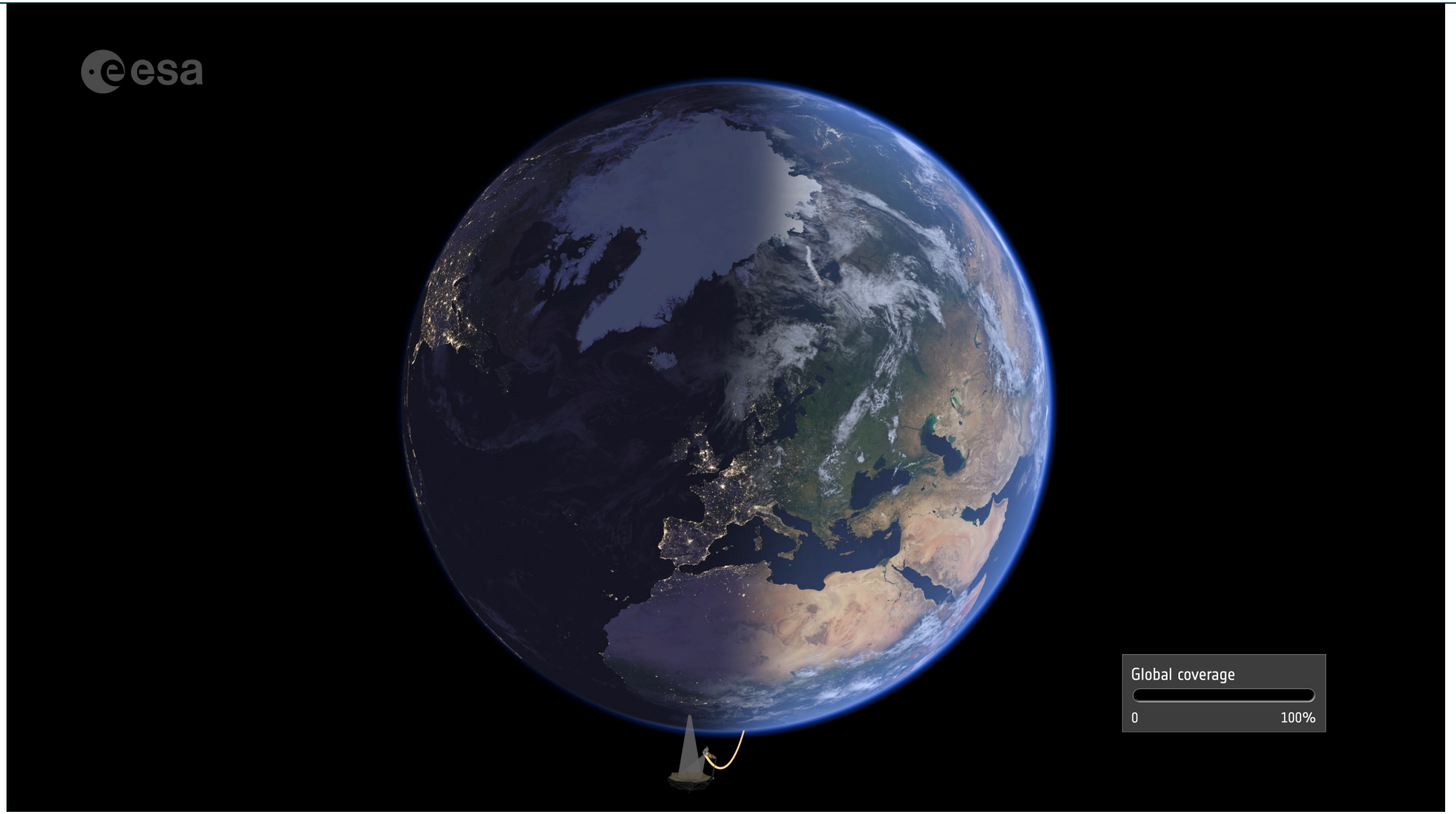


Because video is worth more than a thousand words



https://www.esa.int/ESA_Multimedia/Missions/Biomass/

Polar coverage



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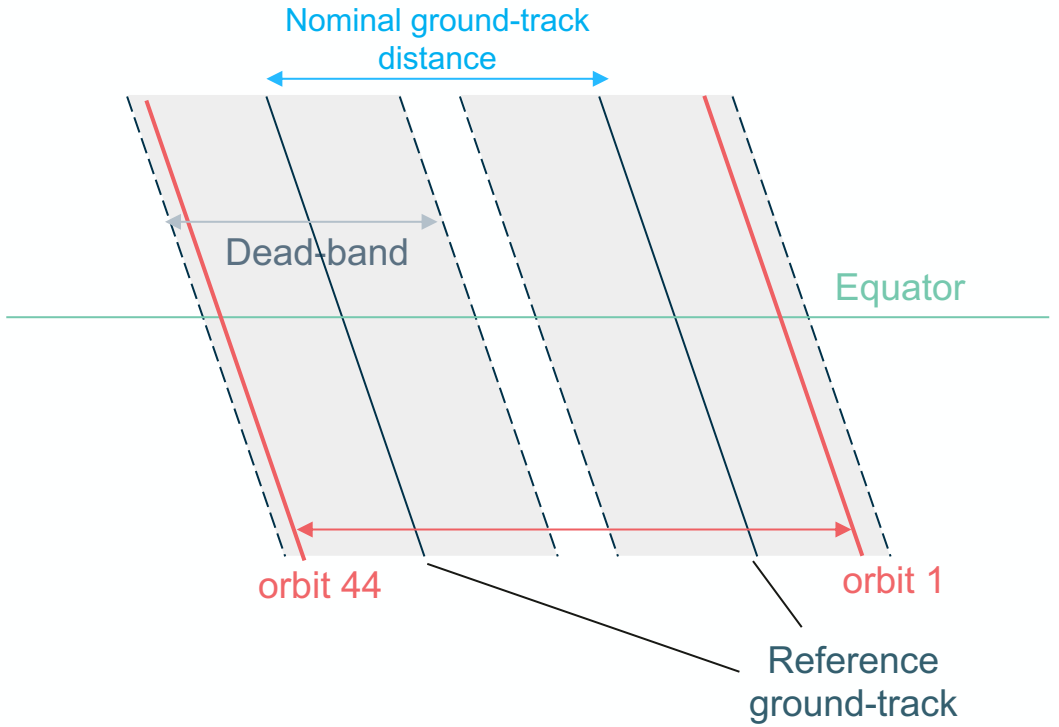
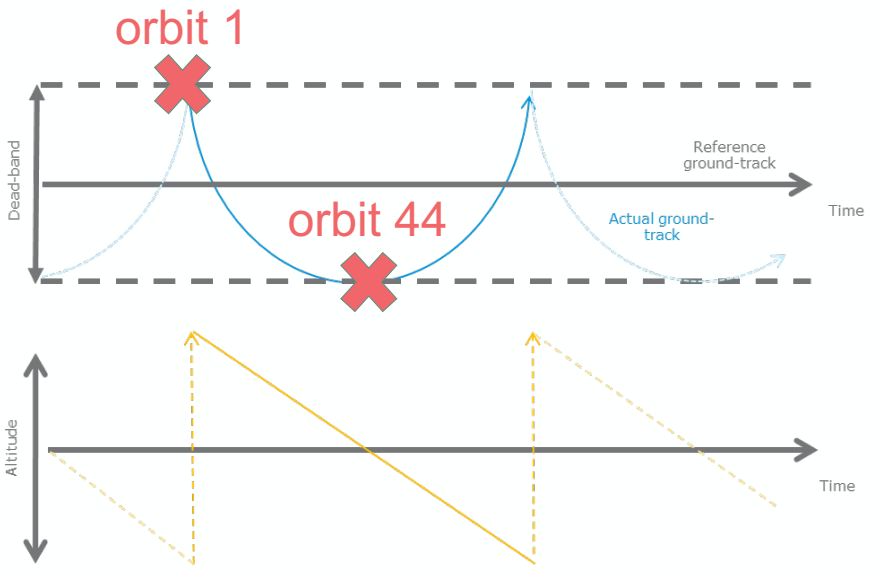
Innovative orbit control strategy of BIOMASS

Classical orbit control:

- Manoeuvres are performed when the spacecraft reaches the limit of the dead-band
- The size of the interferometric baselines can vary significantly

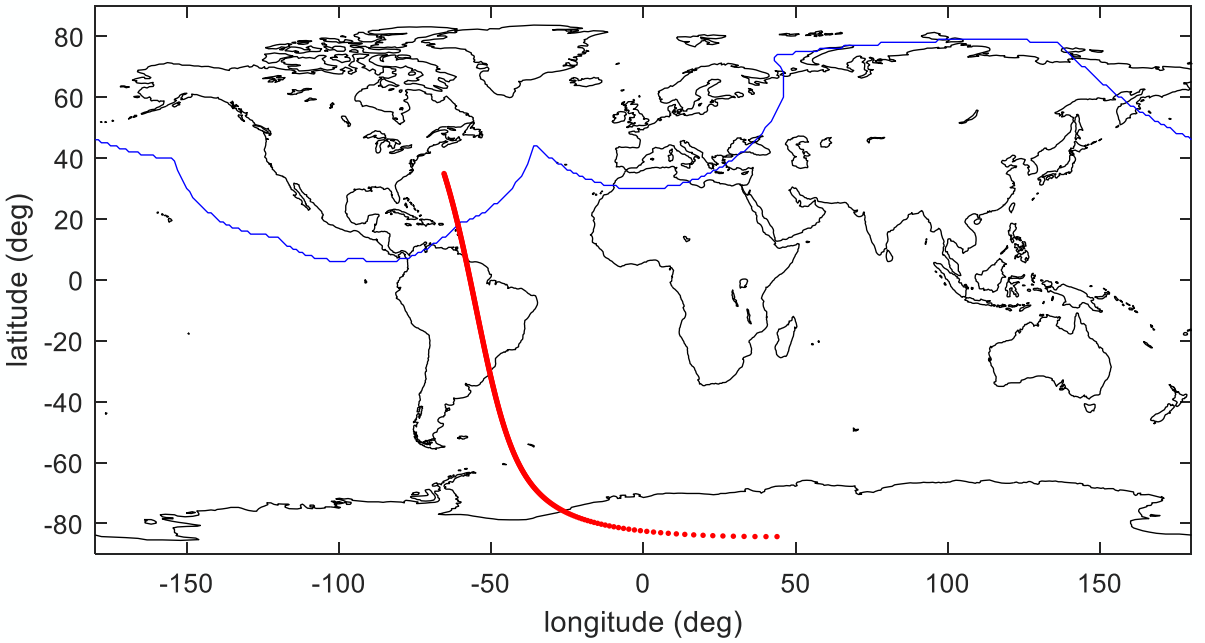




Innovative orbit control strategy of BIOMASS

Classical orbit control:

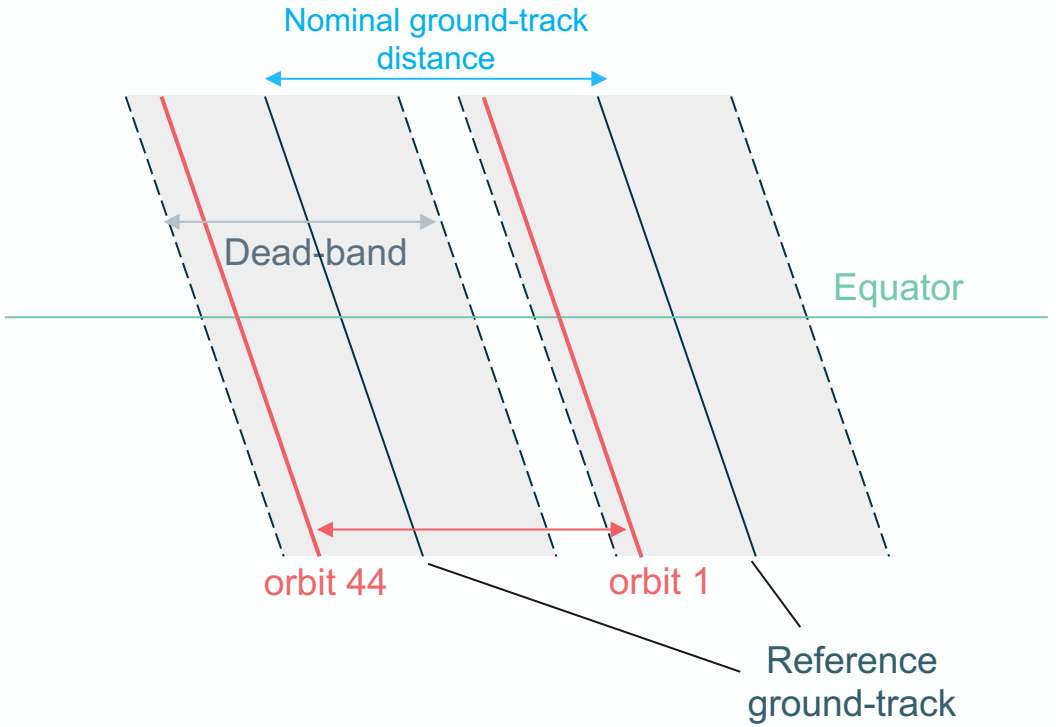
- Manoeuvres are performed when the spacecraft reaches the limit of the dead-band
- The size of the interferometric baselines can vary significantly
- Manoeuvres can be performed over any location on Earth

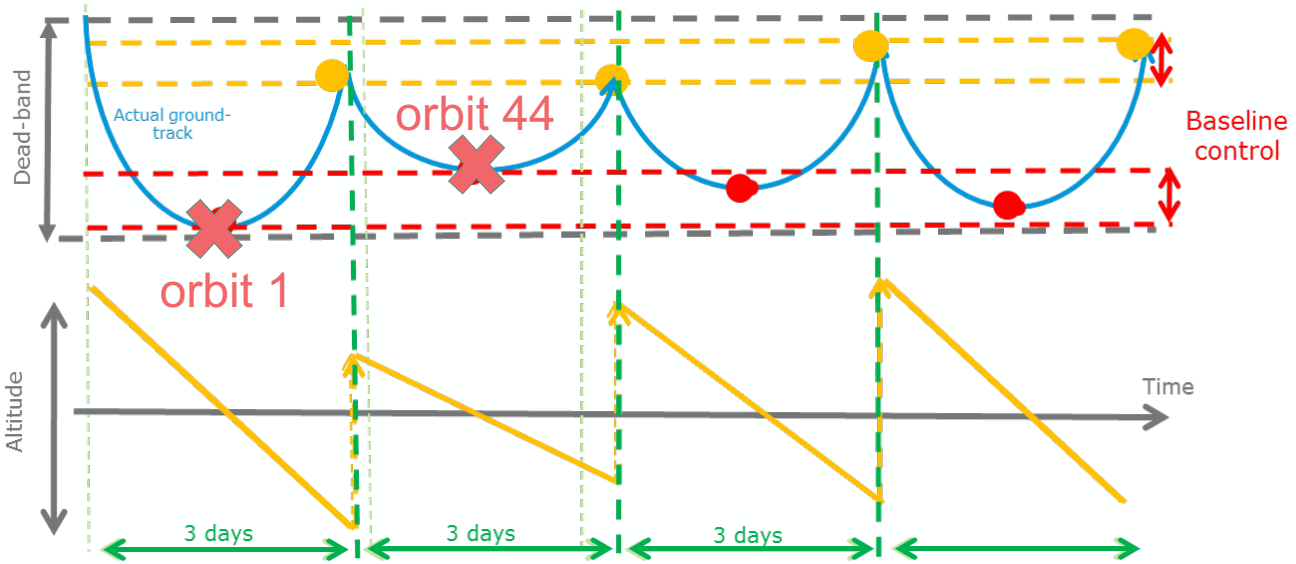


Innovative orbit control strategy of BIOMASS

BIOMASS orbit control:

- Manoeuvres are performed every 3 days (same as the orbit cycle)
- The size of the interferometric baselines is much more

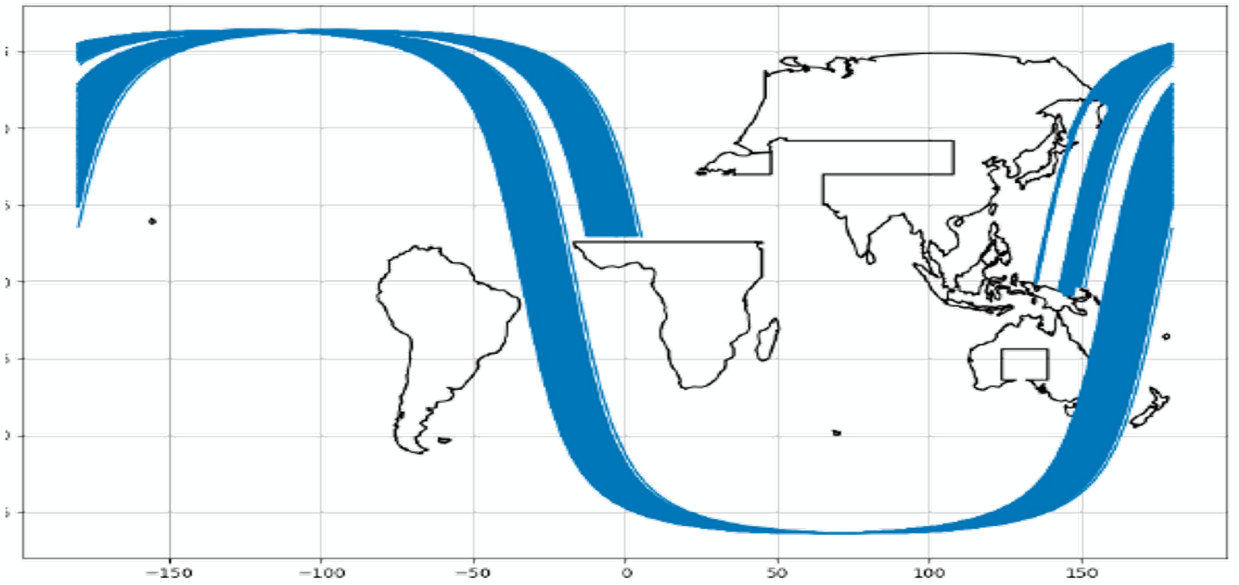




Innovative orbit control strategy of BIOMASS

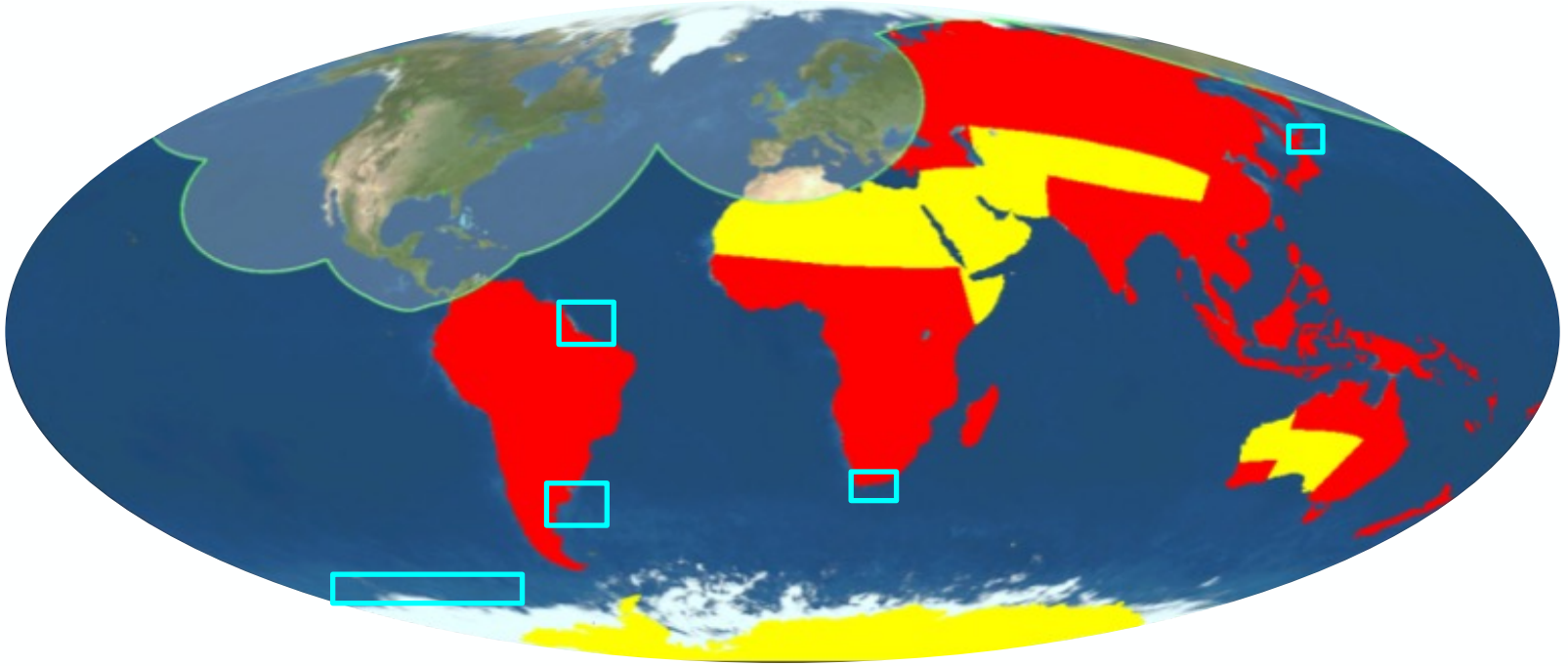
BIOMASS orbit control:

- Manoeuvres are performed every 3 days (same as the orbit cycle)
- The size of the interferometric baselines is much more
- Manoeuvres can be performed only over specific locations on Earth



Observation objectives

1. Systematic Acquisitions for forested land (red area) on both ascending and descending orbits
2. Global coverage in < 9 months (INT phase) and < 17 months (TOM phase).
3. Best effort acquisitions for non-forested areas (yellow + ocean/sea ice ROIs)
4. Acquisition mask restricted by US Space Objects Tracking Radar (SOTR)



(Red = Primary objective coverage mask, Yellow = Secondary objective coverage mask)

Mission timeline

Nominal mission duration: 5.5 years

Launch

Commissioning
<6 months

TOM
Global coverage
<17 months

INT
Global coverage
<9 months

INT
Global coverage
<9 months

INT
Global coverage
<9 months

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Global coverage
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Global coverage
<9 months