



Jet Propulsion Laboratory
California Institute of Technology

Soil Moisture
Active Passive

SMAP

Mission

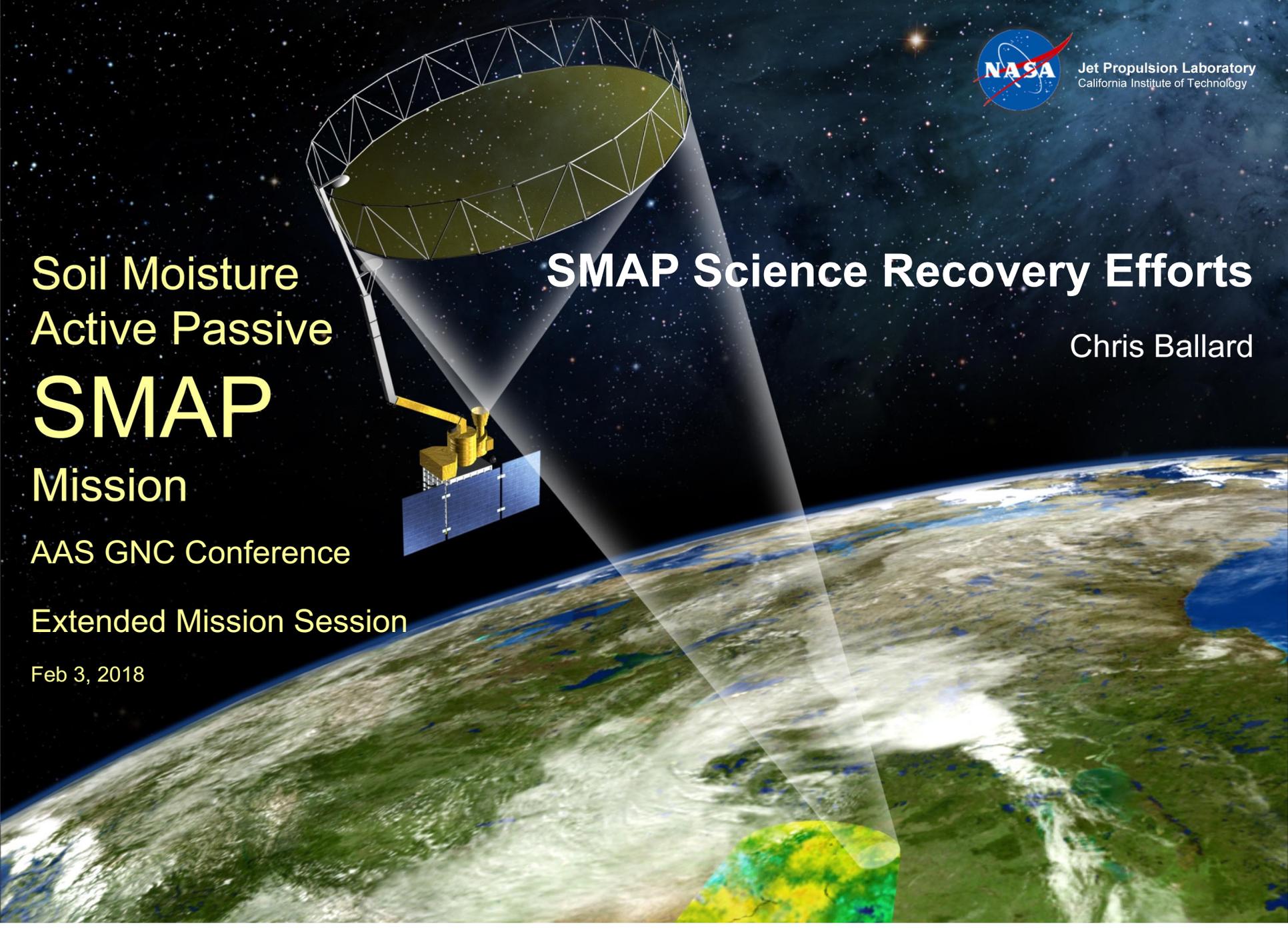
AAS GNC Conference

Extended Mission Session

Feb 3, 2018

SMAP Science Recovery Efforts

Chris Ballard



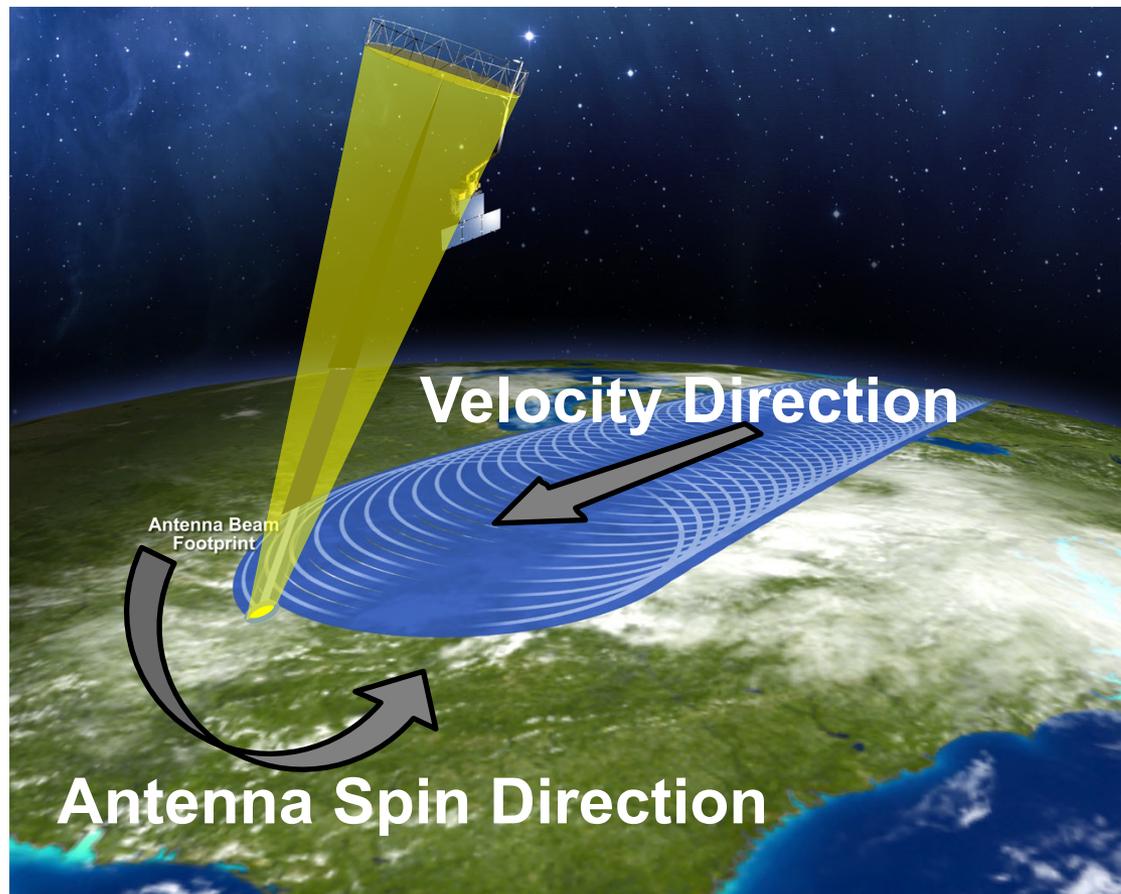


Introduction

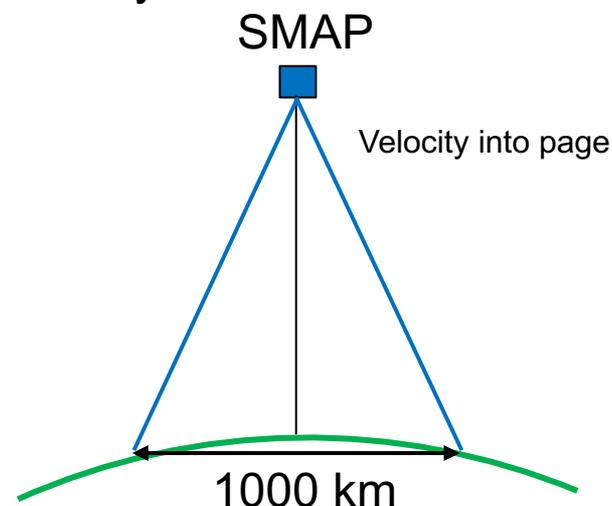
- SMAP launched January 2015, commissioned by May. In July, radar high power amplifier stopped drawing current, was never recovered.
- High resolution soil moisture product no longer produced. In fall 2015 the scientists began exploring options to increase resolution with only radiometer data.
- Options included creating enhanced resolution radiometer-only product (taking advantage of oversampling), and combining radiometer data with data from other spacecraft.
- Main one was Sentinel-1A (at the time), with Sentinel-1B on the way (launched April 2016).
 - These are C-band SAR in a repeat sun synchronous orbit similar to SMAP.
- Needed to evaluate the possible overlapping coverage between SMAP and the Sentinel-1 observations.
- Sample result from SMAP scientists will be shown combining the data from the Sentinel-1 constellation and SMAP.



SMAP Overview

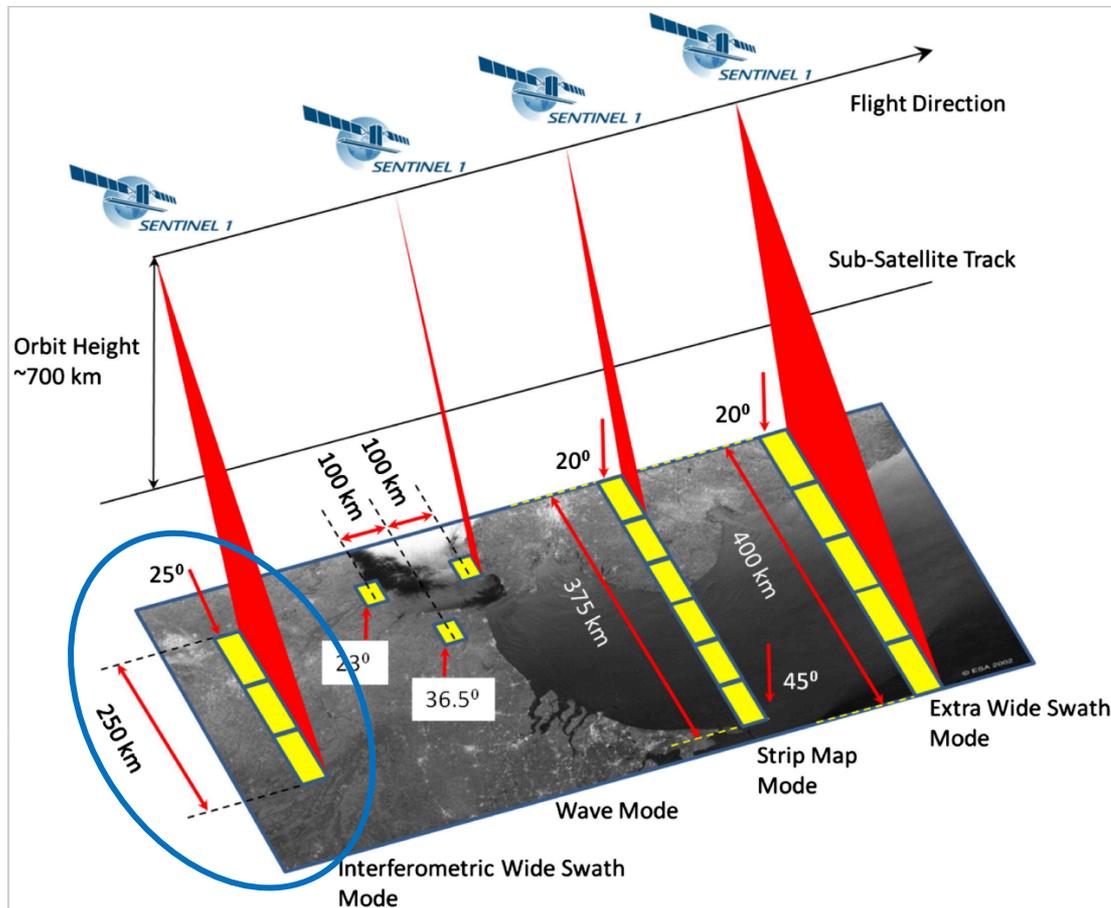


- Orbit: 8 day repeat cycle, 117 orbits/cycle, 6 pm ascending node
- Instrument swath: 30 km footprint on conical scanning antenna, effective swath of 1000 km
- Global coverage every 2 days



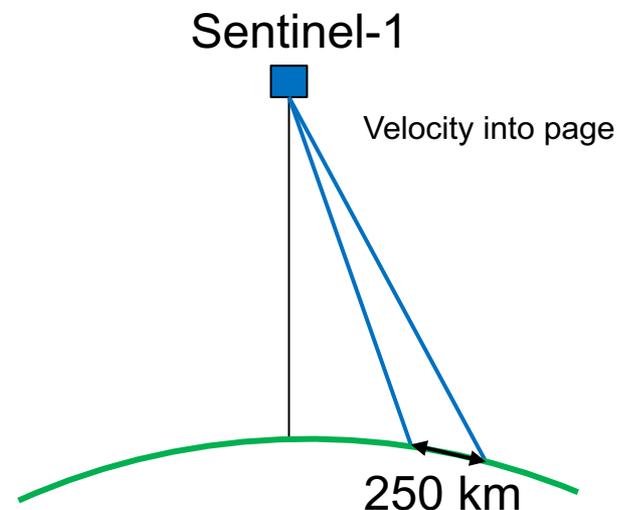


Sentinel-1 Overview



<https://sentinel.esa.int/web/sentinel/missions/sentinel-1/instrument-payload>

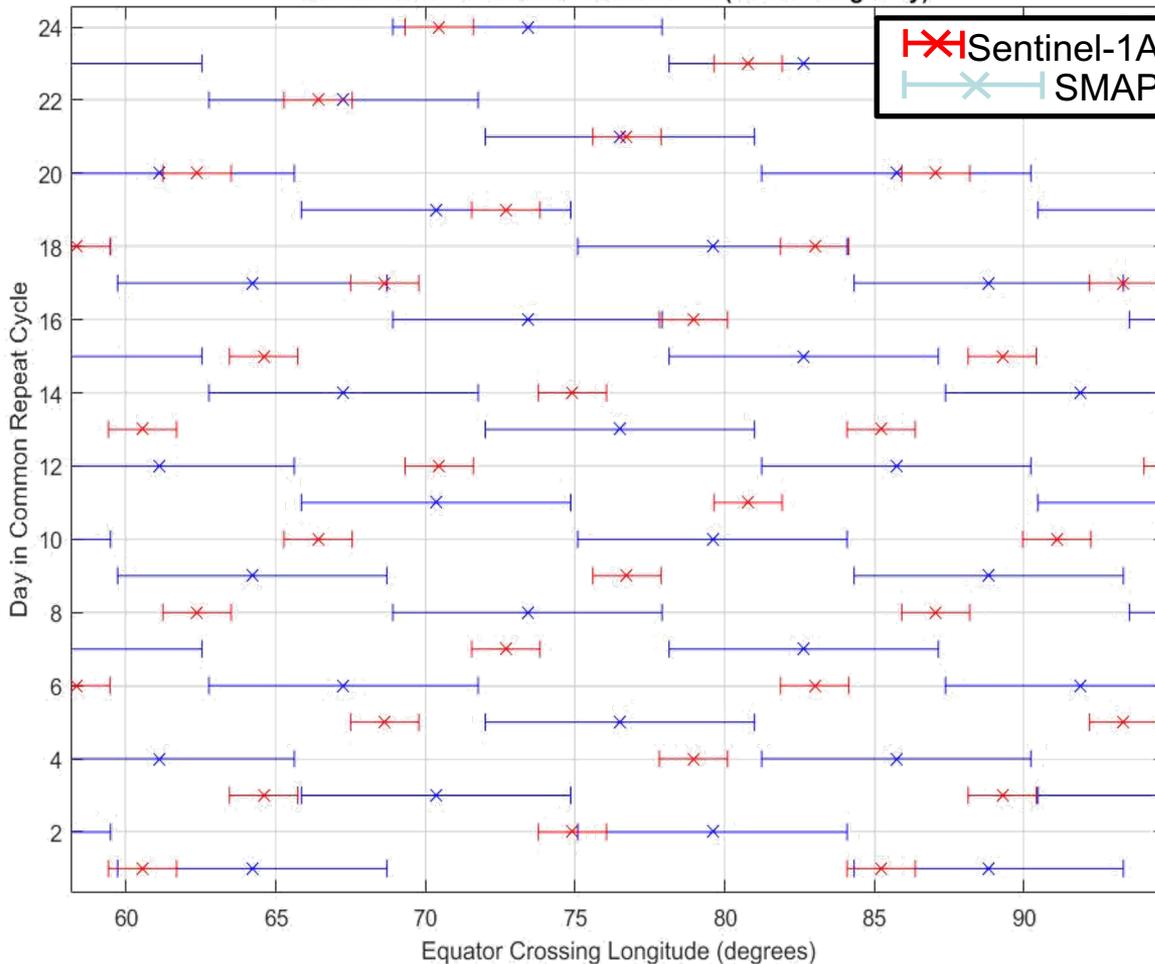
- Orbit: 12 day repeat cycle, 175 orbits/cycle, 6 pm ascending node, 1A and 1B 180 degrees apart in same orbit
- Instrument swath: 250 km, right looking (IW mode)
- With 1A and 1B, global coverage in 6 days





SMAP/Sentinel-1 Swath Pattern

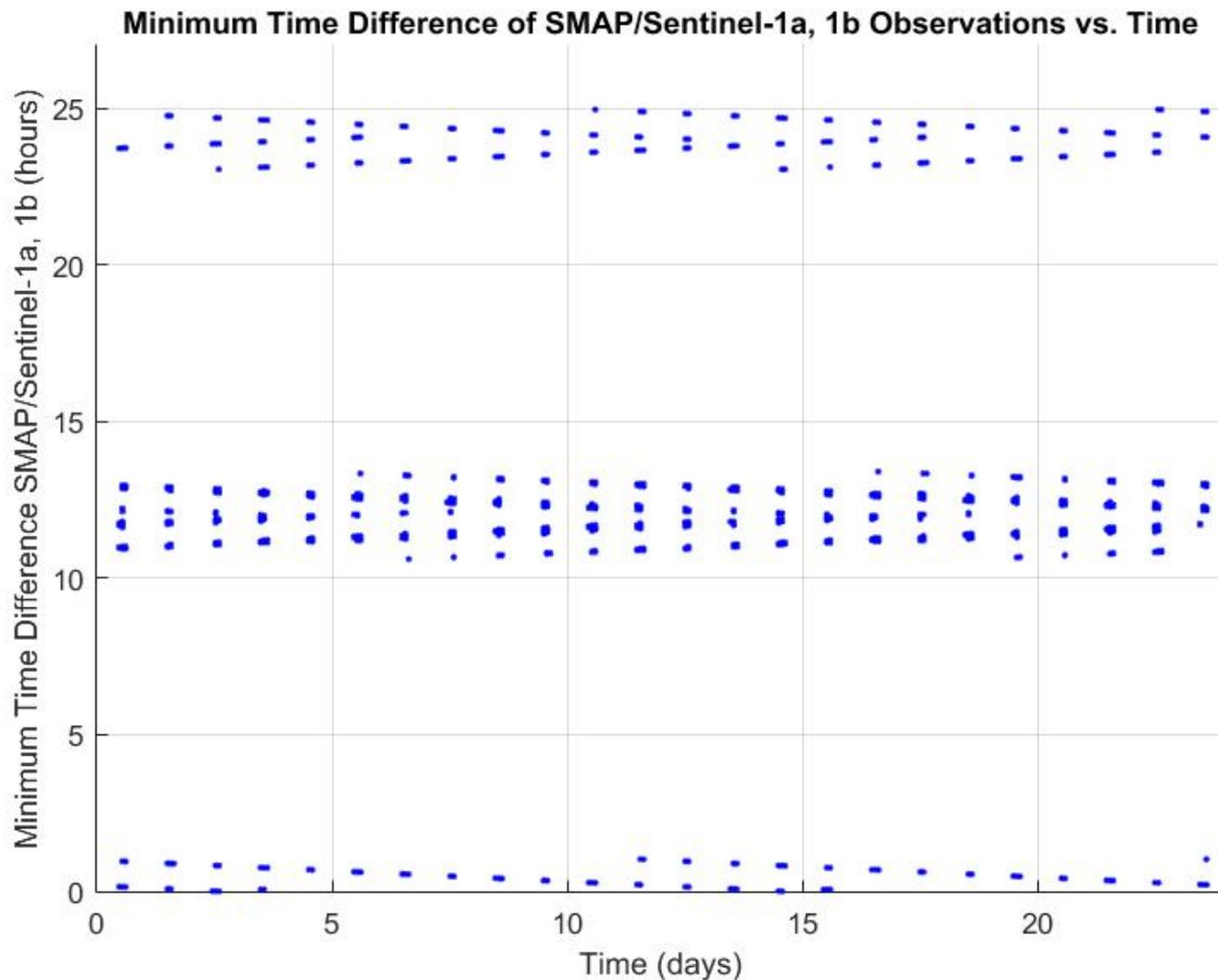
Swath Patterns for SMAP/Sentinel-1a (Descending Only)



- For qualitative understanding of coverage.
- If a given Sentinel-1 swath isn't covered by a SMAP swath in a given day, it is always covered within +/- 1 day.
- Rate of cumulative *common* coverage will be less than that for SMAP-only coverage.



SMAP/Sentinel-1 Observation Time Difference

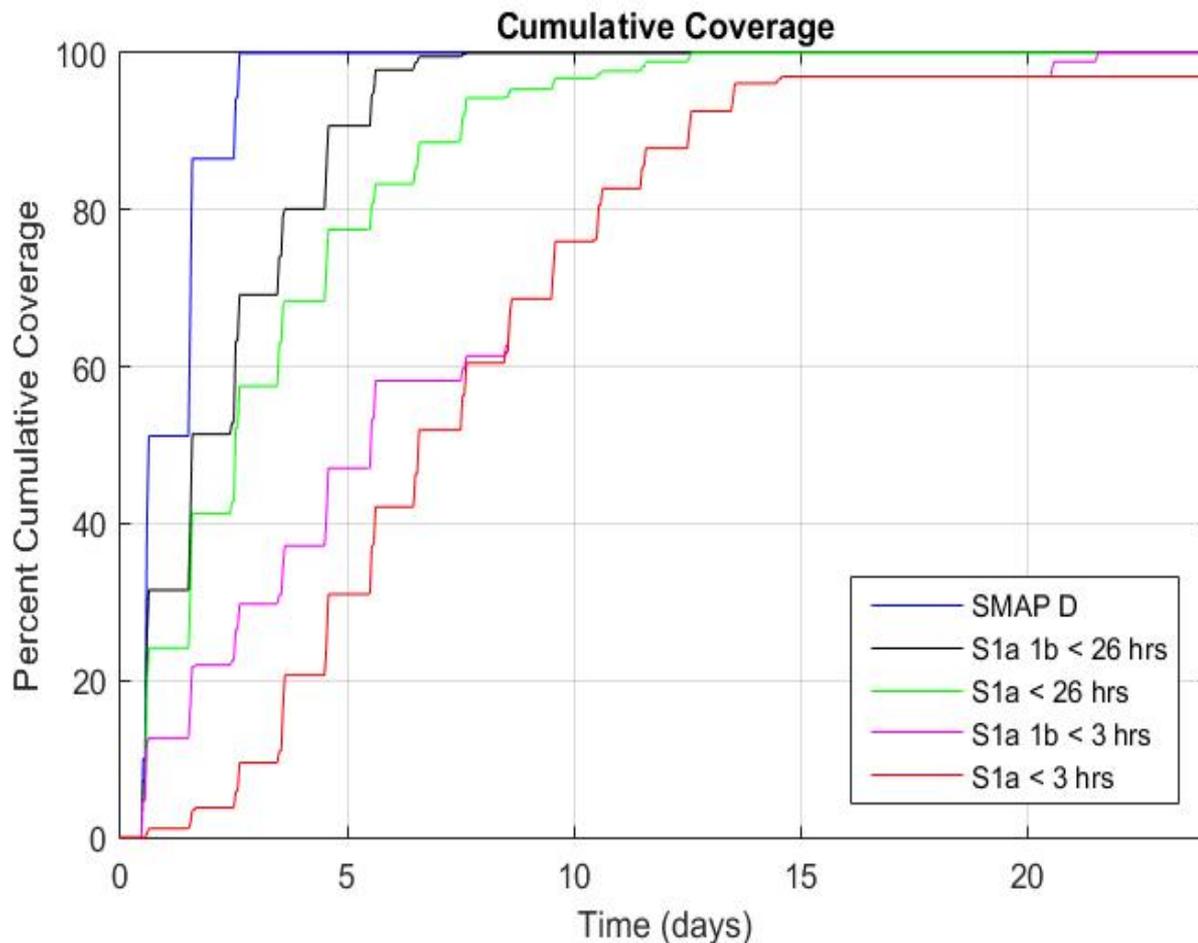


- To see what time differences exist, must look at the distribution over time.
- Three distinct “bins” emerge: 1 day, 12 hrs, and 1.5 hrs (one orbit period).

Gaps are filled in with Sentinel-1B due to being 180 degrees offset from 1A.



SMAP/Sentinel-1 Coverage Results

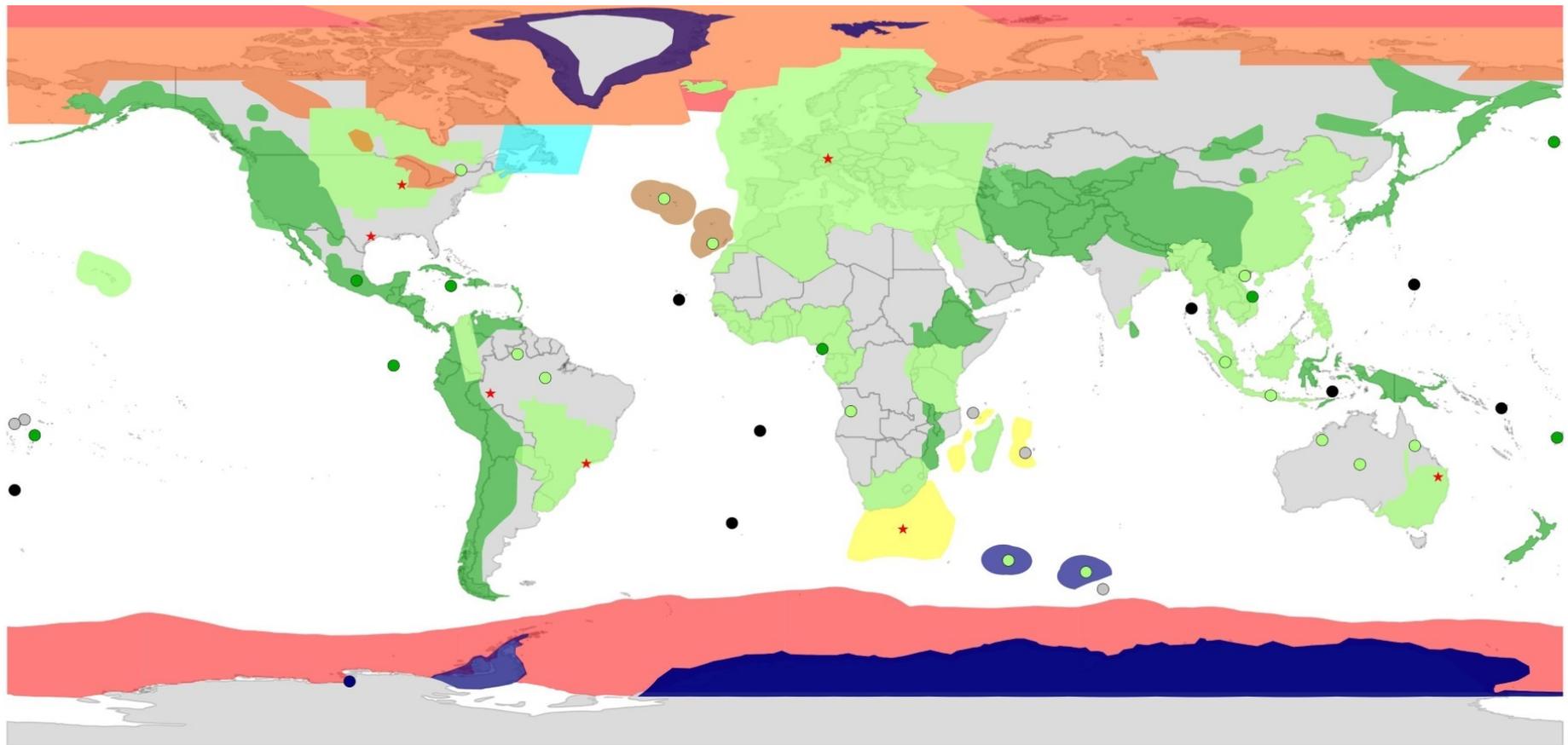


- This is for contiguous US only, hence the stair step nature.
- The coverage benefit of being able to use Sentinel-1 data up to +/-1 day from SMAP is large, and is in fact the baseline (acceptable for science).



Sentinel-1 Coverage Improvement

Fall 2015 (1A only)



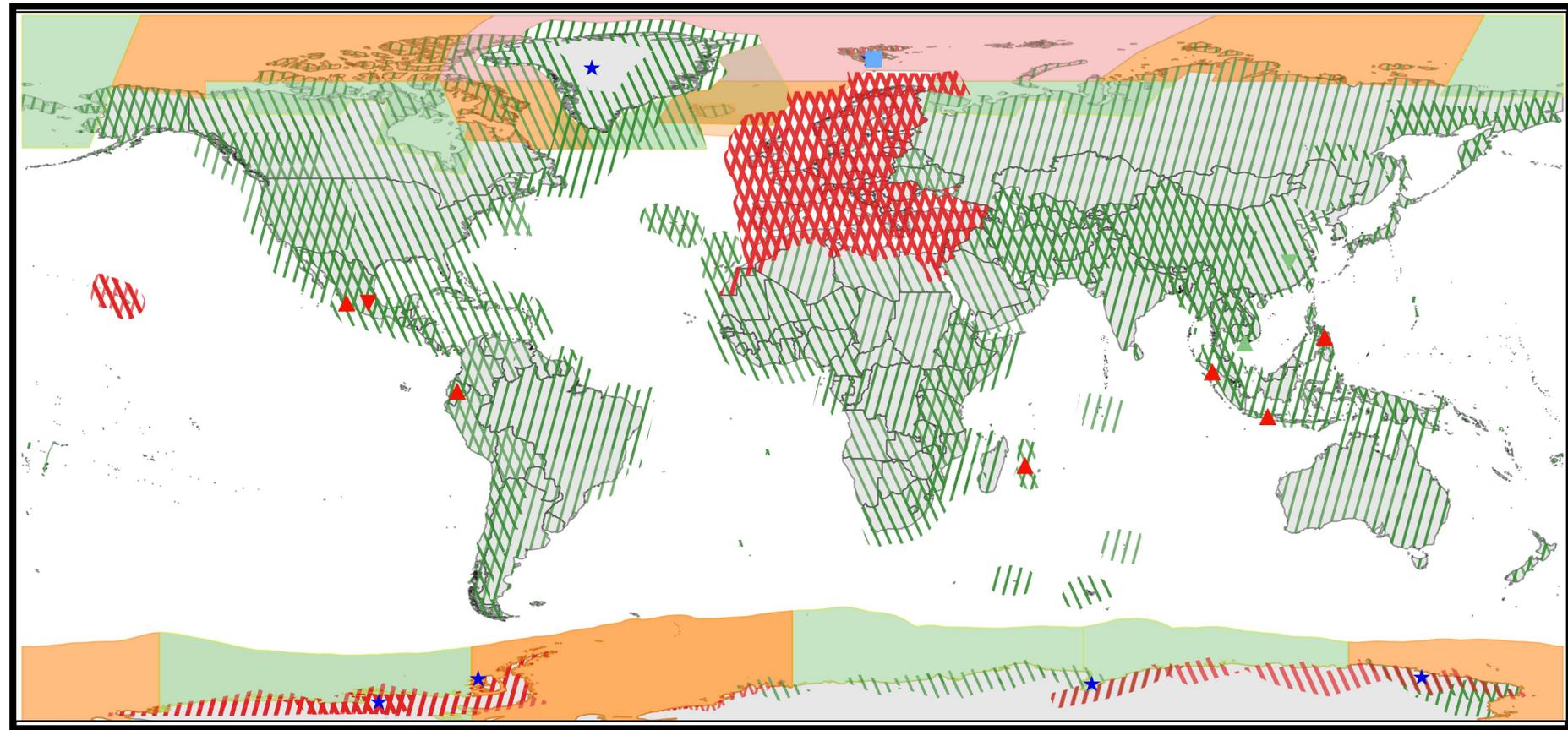
 IW mode

<https://sentinel.esa.int/web/sentinel/missions/sentinel-1/observation-scenario>



Sentinel-1 Coverage Improvement

Present World Coverage (1A and 1B)



REVISIT	FREQUENCY *
//// 6 days	//// 12 days
////	////
xxx	xxx

<https://sentinel.esa.int/web/sentinel/missions/sentinel-1/observation-scenario>



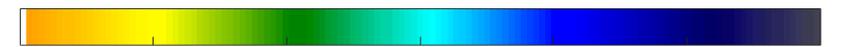
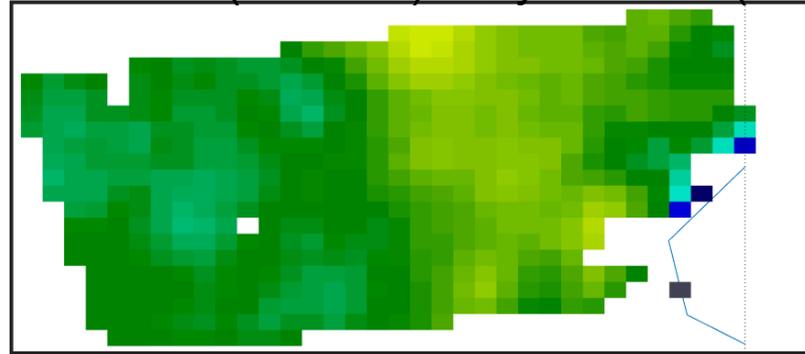
SMAP Science Recovery Example

Core Site



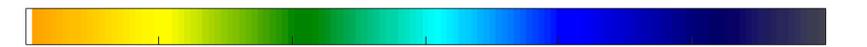
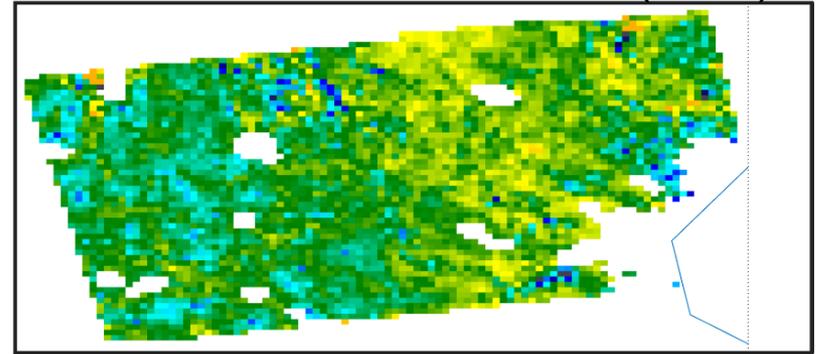
**Valencia,
Spain**

Radiometer (Passive) Only Product (9 km)



Soil Moisture [cm^3/cm^3]

SMAP/Sentinel-1 Product (3 km)



Soil Moisture [cm^3/cm^3]