Prospects for the Microwave Constellation

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- Data sources
- PMW constellation overpass times
- Time between overpasses
- The planned constellation
- What do we need to do?

Thanks to:
Chris Kidd

Data Sources for Precipitation Estimates

Radar

- great data, but very expensive, narrow swaths

PMW imagers

- specifically designed for precipitation, but expensive

PMW sounders

- useable for precipitation, less expensive

Geosynchronous IR (and multi-spectral)

- limited skill, but plentiful data

Precipitation gauges

- gold standard, but gaps, only over land, with administrative “issues”

PMW sensors have been the workhorse since 1987

What We Show

The international constellation of “precipitation relevant”

- some sensor on the satellite is useful for estimating precipitation

“satellites of opportunity”

- the satellites are flown by some agency for its own purposes, and they contribute their data to the constellation archive

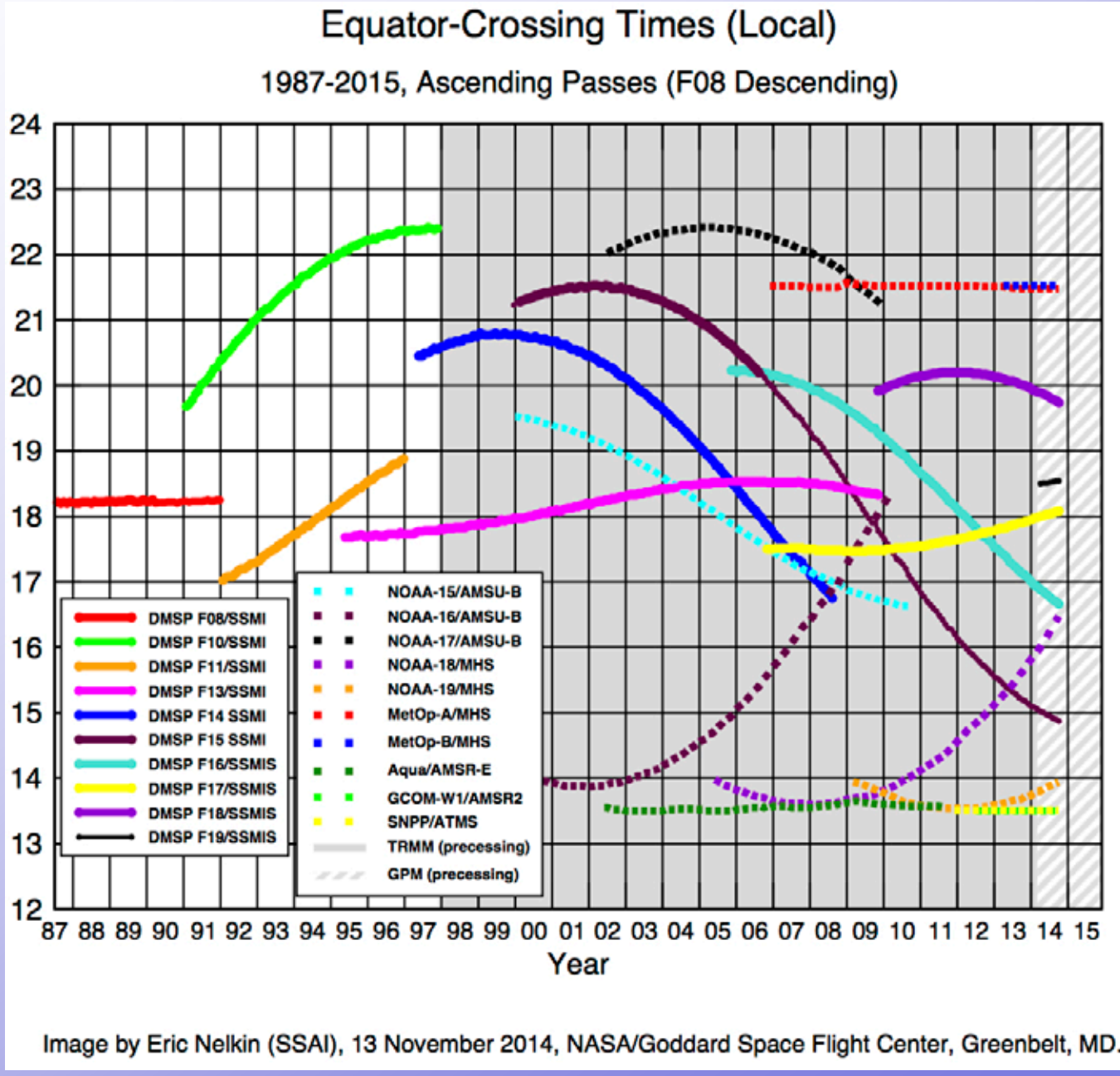
What We've Got

PMW p.m. overpass times

- DMSP F08 SSMI was the first "modern" PMW
- some satellites drift a lot
- shading indicates precessing TRMM and GPM (Megha-Tropiques does as well)
- persistent gap at 00/12 LT

Radar-equipped, precessing satellites since 1998

- facilitate calibration



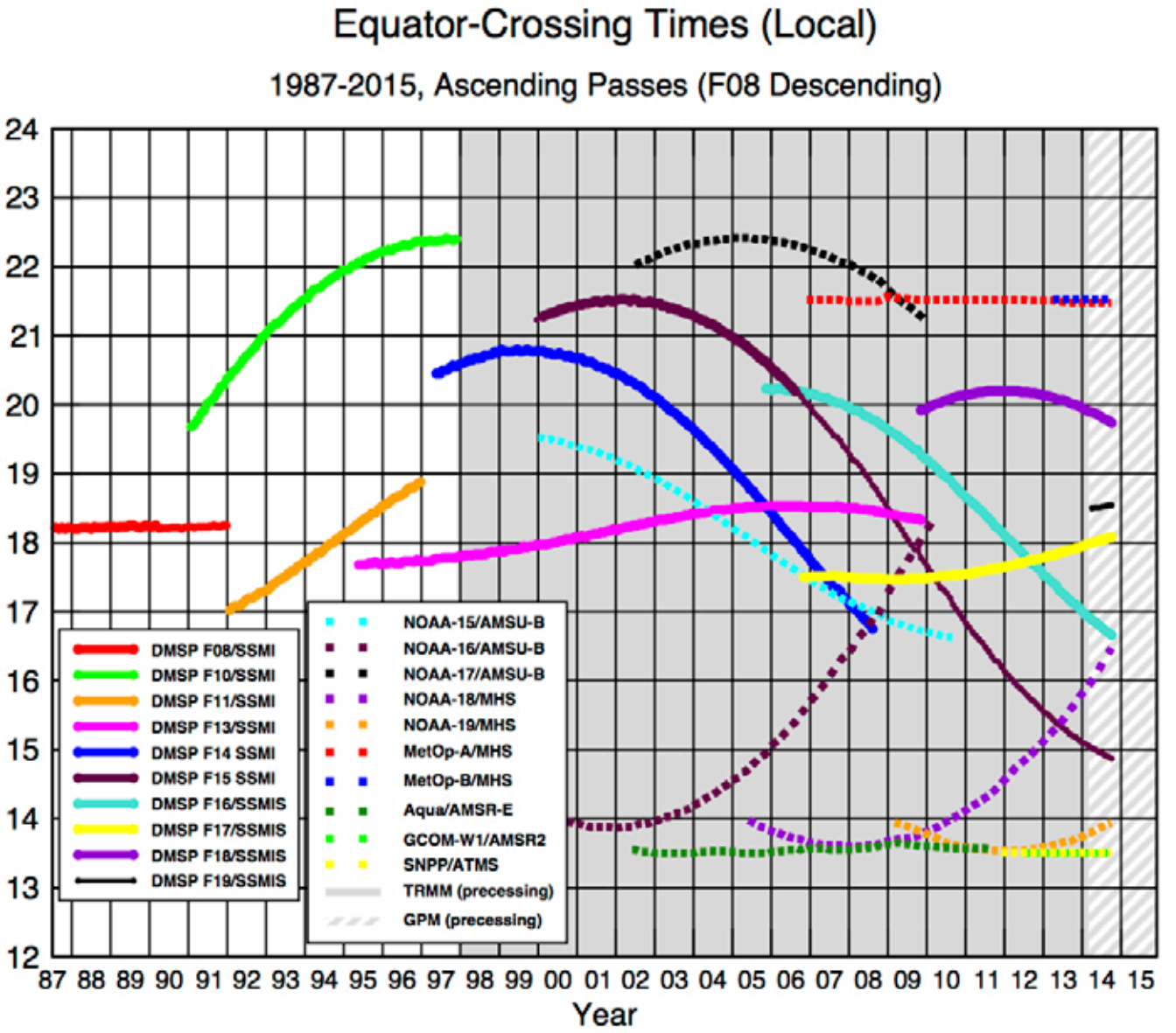
Overlapping Orbits Reduce the Number of Samples

The A-Train (at 1330 LT)

- provides a wide selection of sensors
- has duplicate PMW coverage part of the time
- legacy sensors drifting out of the A-Train improve coverage

Again, persistent gap at 00/12 LT

These factors will continue to be true



How Long Between Overpasses?

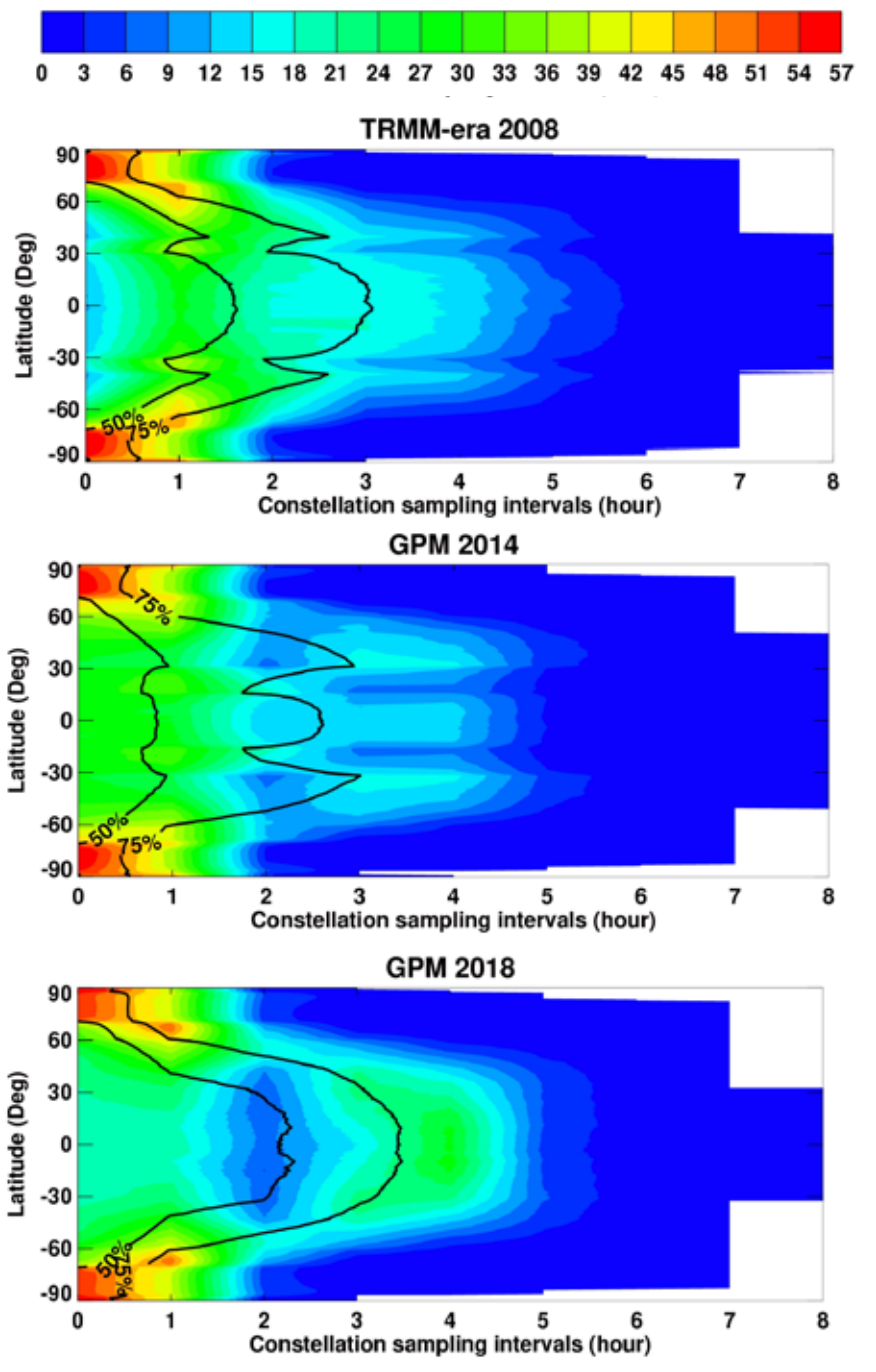
The current standard is ≤ 3 hours

- originally chosen to resolve a smooth diurnal cycle
- turns out this is also the interval over which microwave estimates are better than IR (Joyce & Xie, others)

This is satisfied well over 75% of the time with current sampling (including Megha-Tropiques), but less so after MT ends

- color-fill is % of latitude band's occurrences
- black lines are cumulative from zero hours
- 50% of the Earth's surface is in 30 ° N-S; 13% is in 60-90 ° N and S together
  - "good" results at poles are secondary

We need 2014-type coverage



images courtesy of Xin Lin

The Full CEOS List of Current, Planned, and Proposed Precip-Related Satellites Is Impressive

Satellites and sensors have mostly proved durable

- agencies have mostly maintained legacy satellites for their useful lives

Nonetheless, planned launches are key to maintaining the present virtual constellation

- are we now in the “golden age”?

Clearly, future launches are speculative

- announced plans might be delayed or cancelled
- some plans aren’t yet on the table

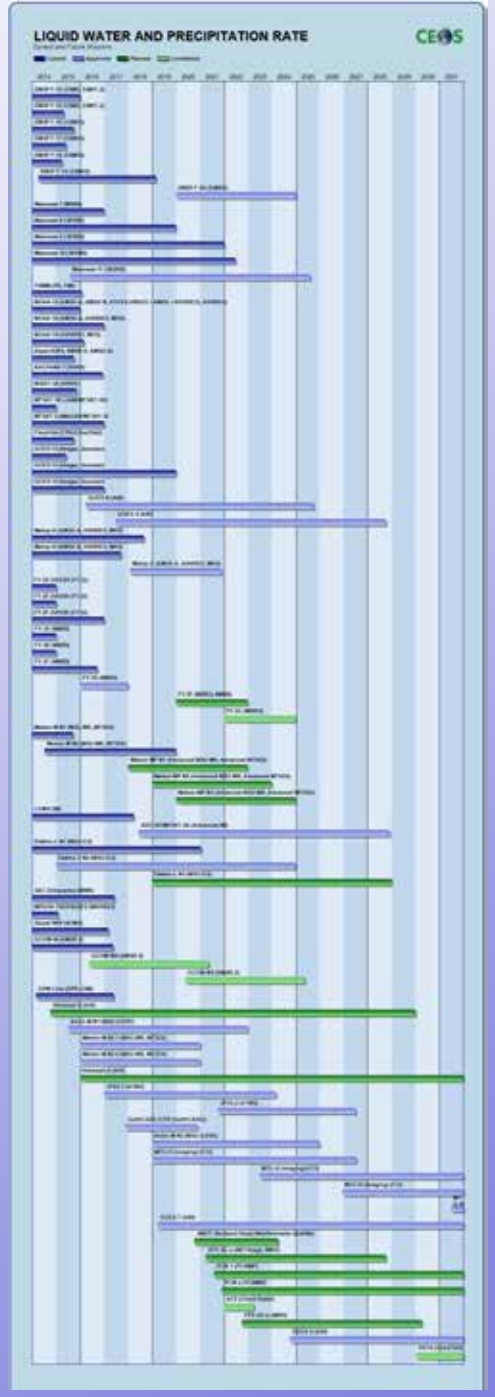


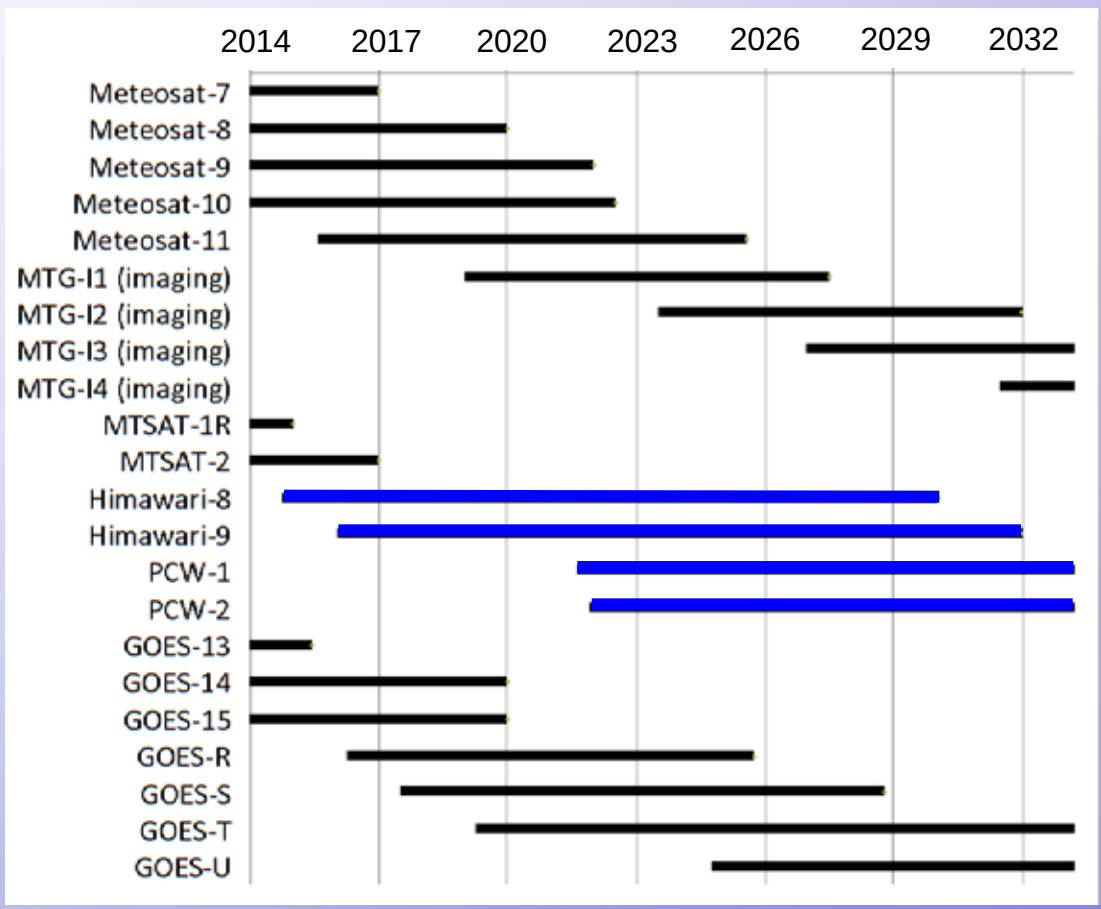
image courtesy of CEOS

The CEOS List of Geo-IR / Multi-Spectral Is Mostly Well in Hand

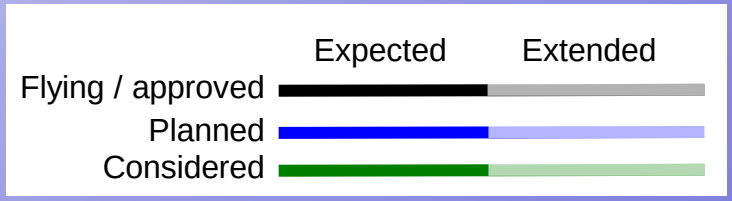
These are the workhorses for operational agencies

Freely available coverage over the Indian Ocean sector is an open question past 2016

- EUMETSAT has provided coverage since mid-1998 using an “old” Meteosat
- they are weighing options past the end of 2016



based on CEOS



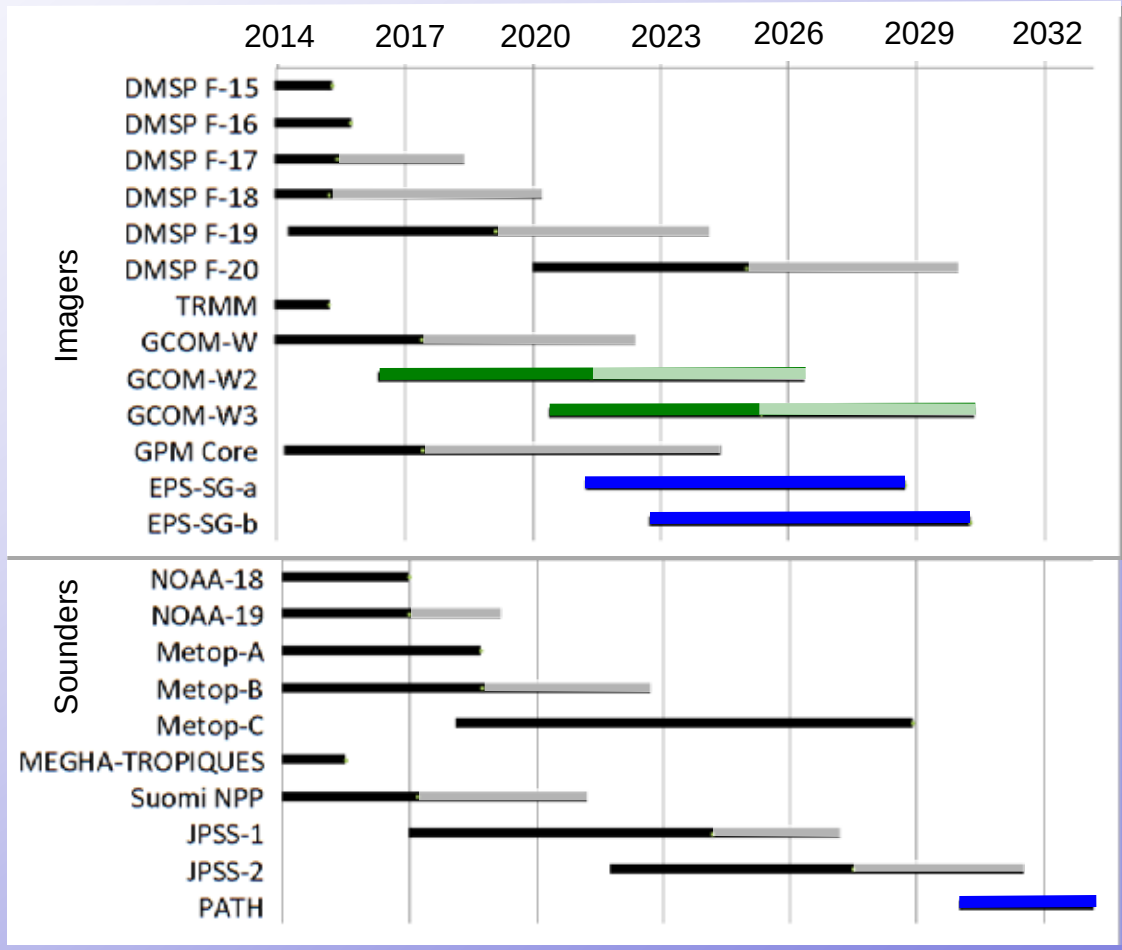
The List of Microwave Satellites Available to Me Depends on Some Things Going Right

Satellites and sensors have mostly proved durable

- agencies have mostly maintained legacy satellites for their useful lives
- I extended most satellite life spans to 10 years, based on current performance
- a few “early” failures could drastically limit sampling
- what about “other” satellites?

Planning needs to start now for launches in the mid-’20’s

- the planning cycle is 10+ years
- U.S. DoD is questionable in the next generation, at least for imagers
- what follows GPM core?



based on CEOS

What Is Needed to Maintain the Current “Good” Observational Database?

Cover the entire day, by design or drift

- 00 / 12 LT is a particular gap

Maintain functioning legacy satellites

Make “other” satellite data available

Ensure continued launches of microwave imagers

Ensure continuity of calibration satellites

- does this imply a radar?
- does this imply a precessing orbit?

What Does the Future Hold?

Satellites and sensors have mostly proved durable

- agencies have mostly maintained legacy satellites for their useful lives

Nonetheless, planned launches are key to maintaining the present virtual constellation

- are we now in the “golden age”?