



# VIIRS Issues and Perspectives



**VIIRS Blue Marble Stamp  
June 2016**

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June 6, 2016**



# Suomi NPP Status



## Suomi NPP Instrument Status

- CrIS, OMPS CERES; all nominal
- ATMS; known bearing degradation issue
  - Change in con-ops; revealed FSW error
  - Reverse motor direction once-per-day
- VIIRS; Nominal
  - HAM-sync error; periodic short term (90s) loss of data
  - SEU-caused computer lock-up aka petulant mode
    - Std reset procedure (1-2 orbits lost)
  - Tungsten-oxide mirror contamination
    - Following thin-film model
    - Will meet requirements at EOL



## JPSS Status



JPSS-1 Launch: January 2016

- All Instruments Complete
- All Instruments Integrated on Spacecraft
- Observatory in Environmental Testing
  - Currently in EMI/EMC testing
  - Observatory T/V in July-September 2016
- J1 VIIRS is an excellent, well characterized instrument.
  - Nine M-band waivers
  - Two DNB waivers
  - All performance data is available to interested parties



# J1 VIIRS Performance Waivers



**The joint NASA/NOAA Performance Waiver WG discussed and deemed acceptable the following waivers on science performance:**

- Spatial resolution – better than allowed by spec established after NPP
- Dynamic Range – several bands saturate before spec Lmax, similar to NPP but exacerbated by somewhat higher optical throughput achieved on J1
- Near-Field Response – better than NPP but worst-case contamination at end-of-life still violates spec requirements
- Crosstalk – much better than NPP but still non-compliant to the specification
- Band-to-Band registration – overall better than NPP, but different in details (VIIRS J1 misregistration largely in track vs. mix of scan and track on NPP)
- Emissive Band Radiometric Calibration – similar to NPP, concerns on J1 mostly have to do with response uniformity and the potential for striping
- Reflective band radiometric calibration – dominated by SWIR low radiance non-linearity (new for NPP) which could impact processing approaches
- Relative Spectral Response – similar to NPP, and T-SIRCUS at Raytheon
- Polarization – non-compliance not seen on NPP but acceptable on J1 based on more extensive characterization testing, modeling, and model validation
- DNB Stray Light – similar to NPP, mitigated by correction in ground system
- DNB non-linearity – new for NPP, non-compliant at low light levels in modes baselined for edge-of-scan. Mitigation for J1 substitutes compliant modes.



## JPSS -2,-3,-4



JPSS-2 VIIRS – Complete

Almost ready for ambient testing

Launch July 2021 (notional)

JPSS-3 VIIRS and JPSS-4 VIIRS

Raytheon under contract

No significant performance changes planned

JPSS-3: Launch Date July 2026 (notional)

JPSS-4: Launch Date July 2031 (notional)



# Ground System Updates



## Level 0

New Data path for SNPP and JPSS data

EDOS network till Fall 2016

JSH in Suitland Fall 2016 – end of JPSS Program

EDOS L0 format

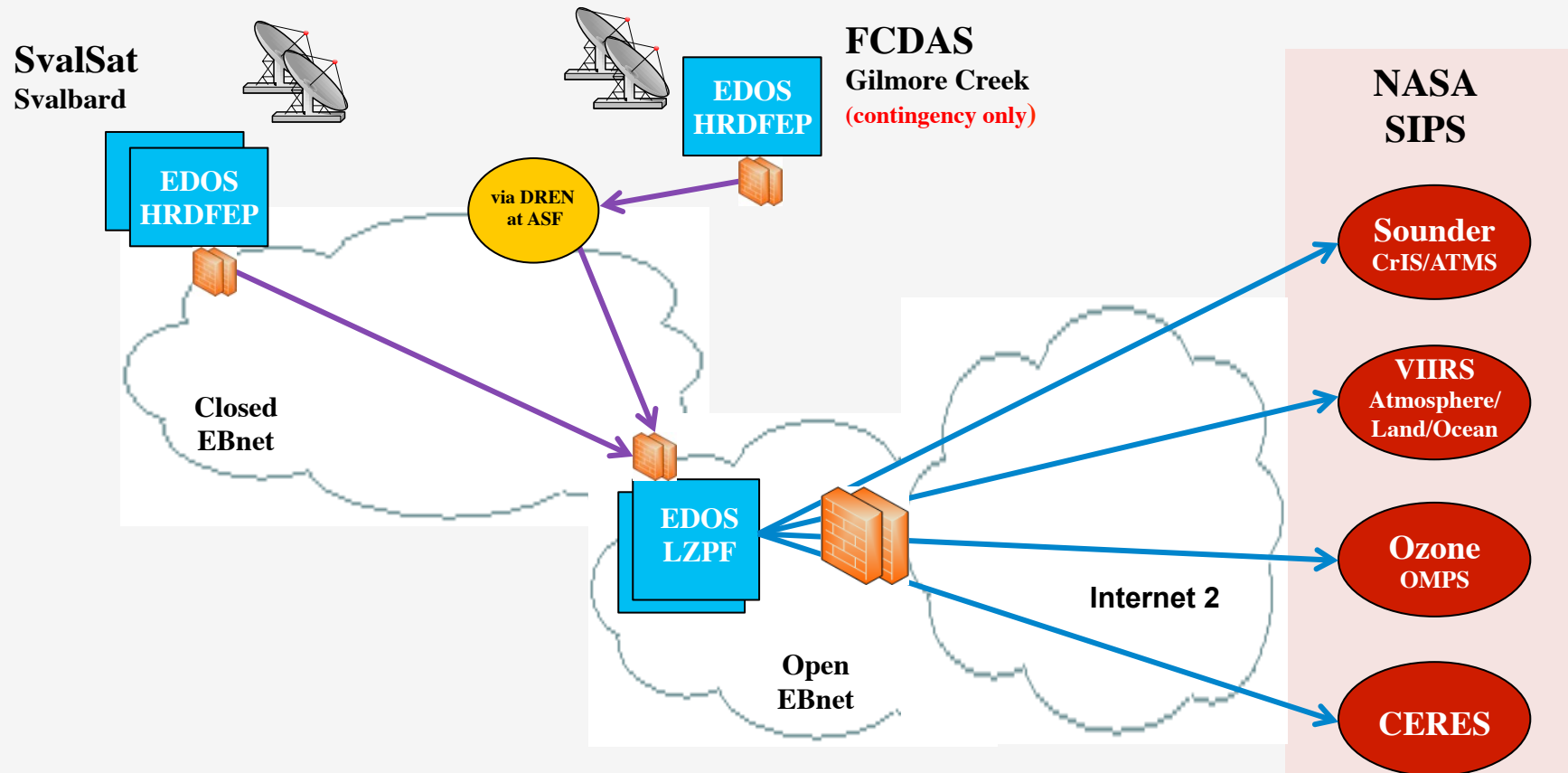
## Level 1

NASA VIIRS L1 algorithm complete

L1A format for easier reprocessing



# SDS SNPP Data Acquisition (Operational)



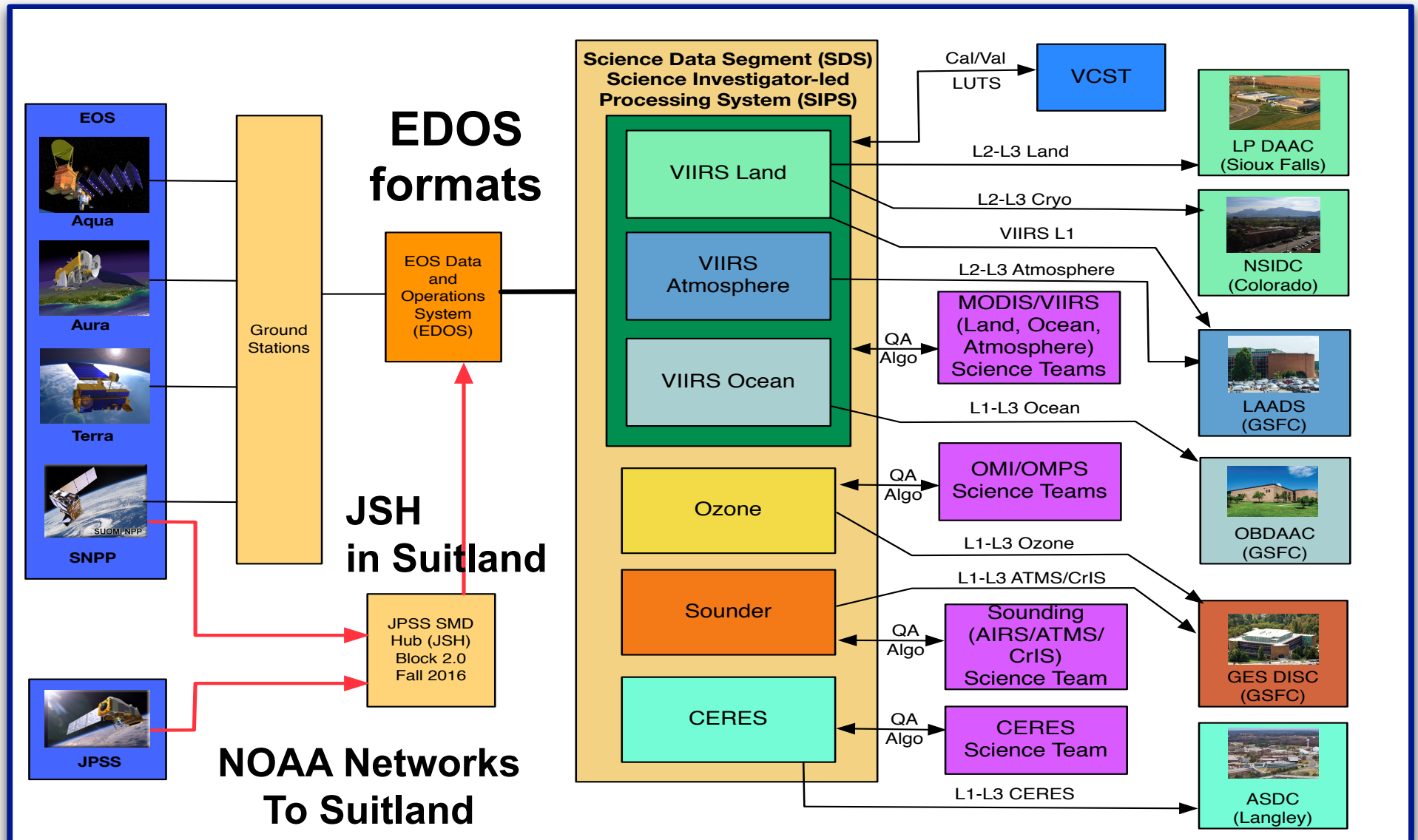
Level 0 NASA EDOS network

NASA EDOS format (not NOAA C3S/IDPS)

New Data path for SNPP and JPSS data till Block 2.0



# SDS Data Flow in Block 2.0 SNPP and JPSS







# Summary



## SNPP VIIRS

Performance nominal

New L0 data path using known EDOS L0 format

NASA L1 algorithm complete

JPSS-1 VIIRS, Complete

JPSS-2 VIIRS, Assembly in progress, ready for test

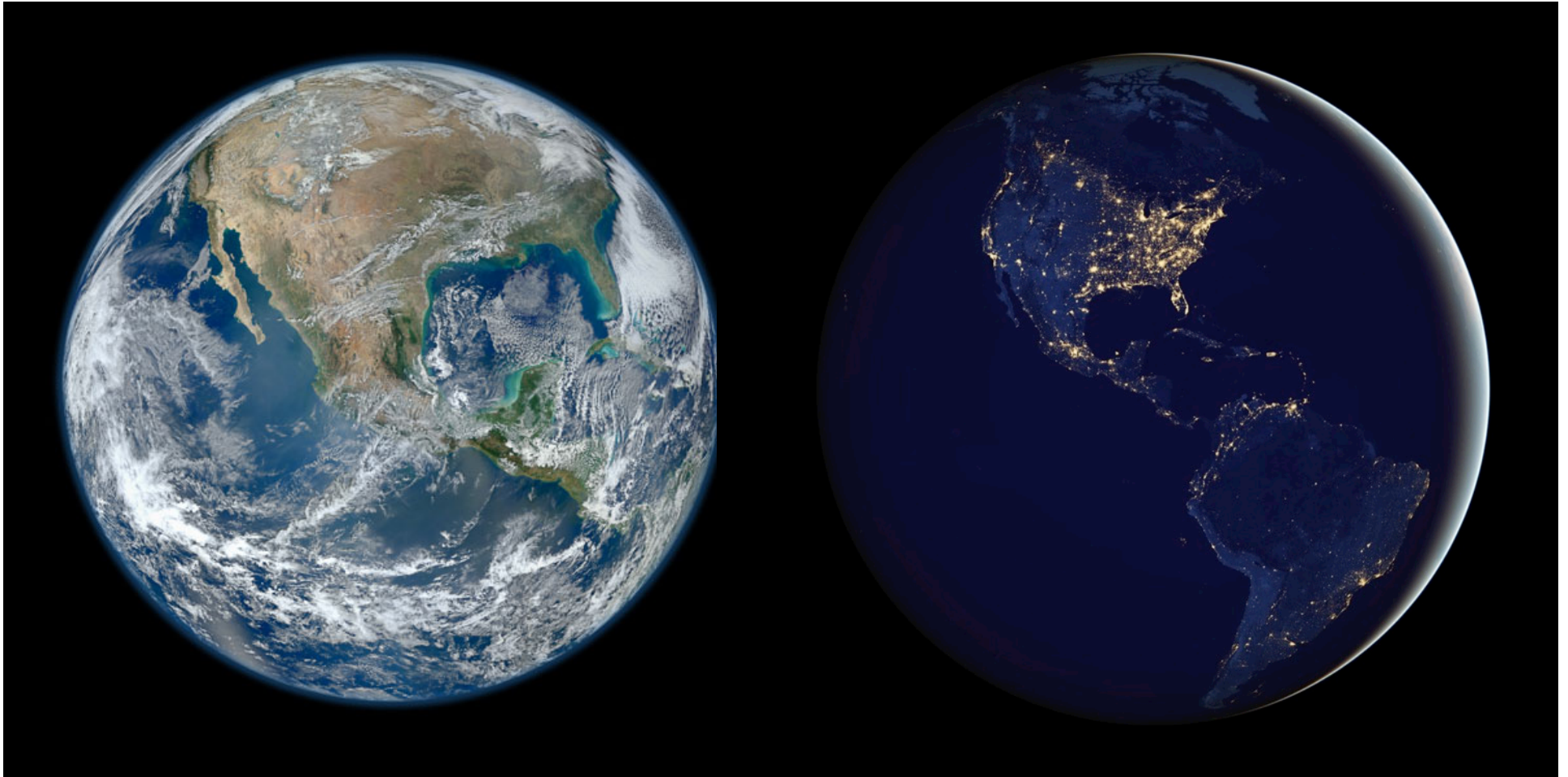
JPSS-3,-4 VIIRS, Under contract

VIIRS data record begins in 2012 and will end beyond 2036

**Opportunity for 40 year combined MODIS-VIIRS data sets**

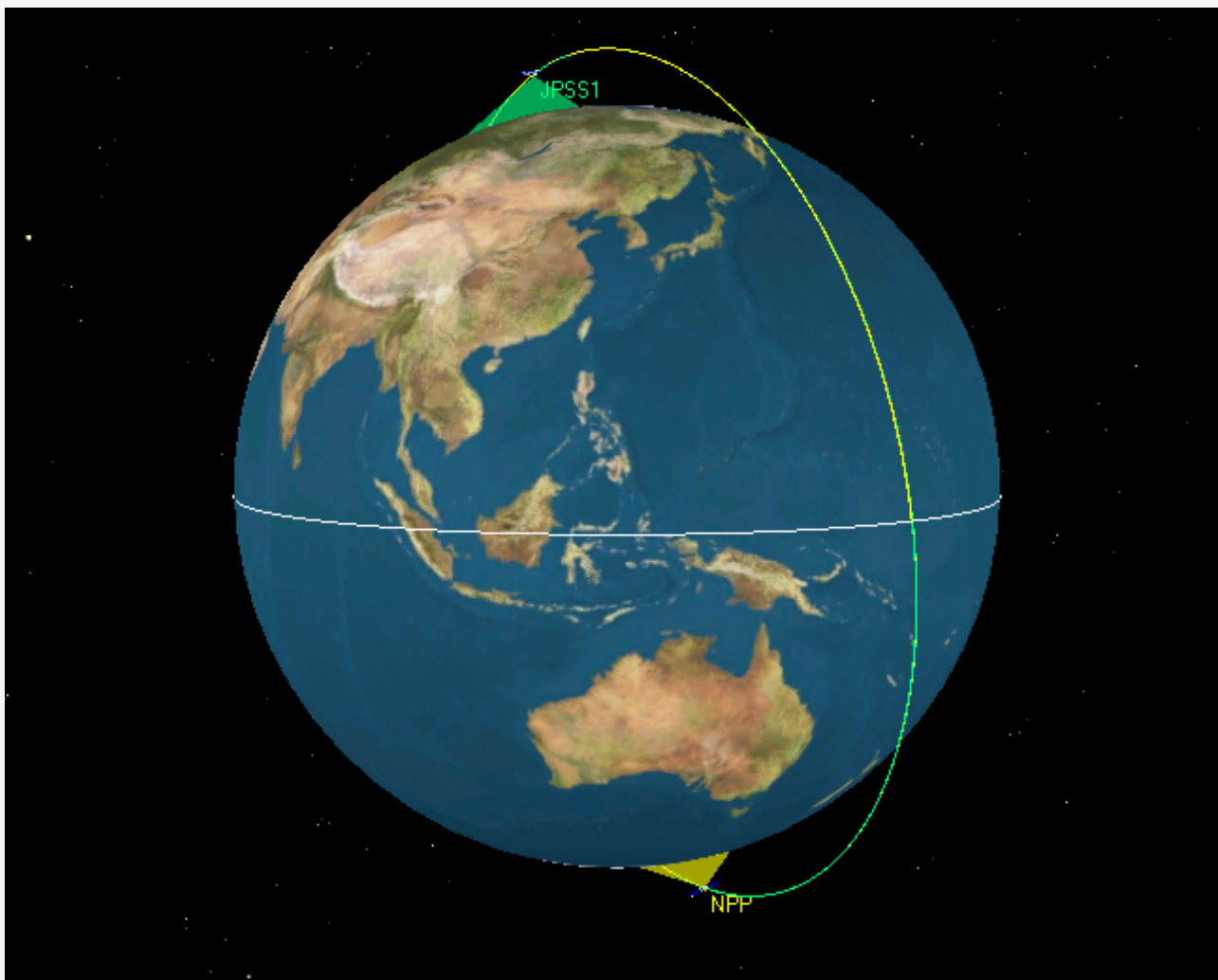


# Questions?





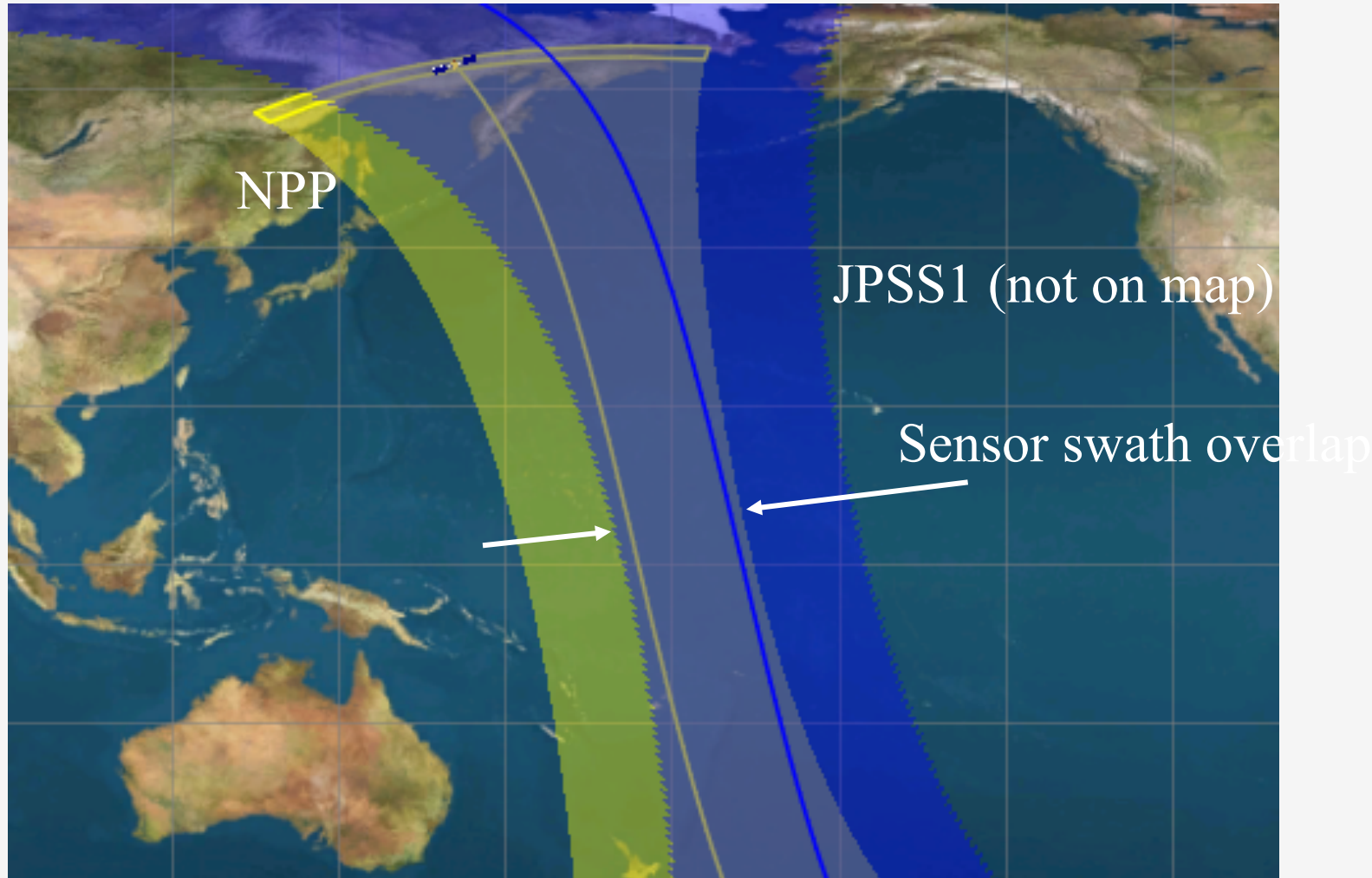
# S-NPP & JPSS-1 Mission Orbit View (1325 LTAN/824 km orbit)



$\frac{1}{2}$  orbit along-track separation



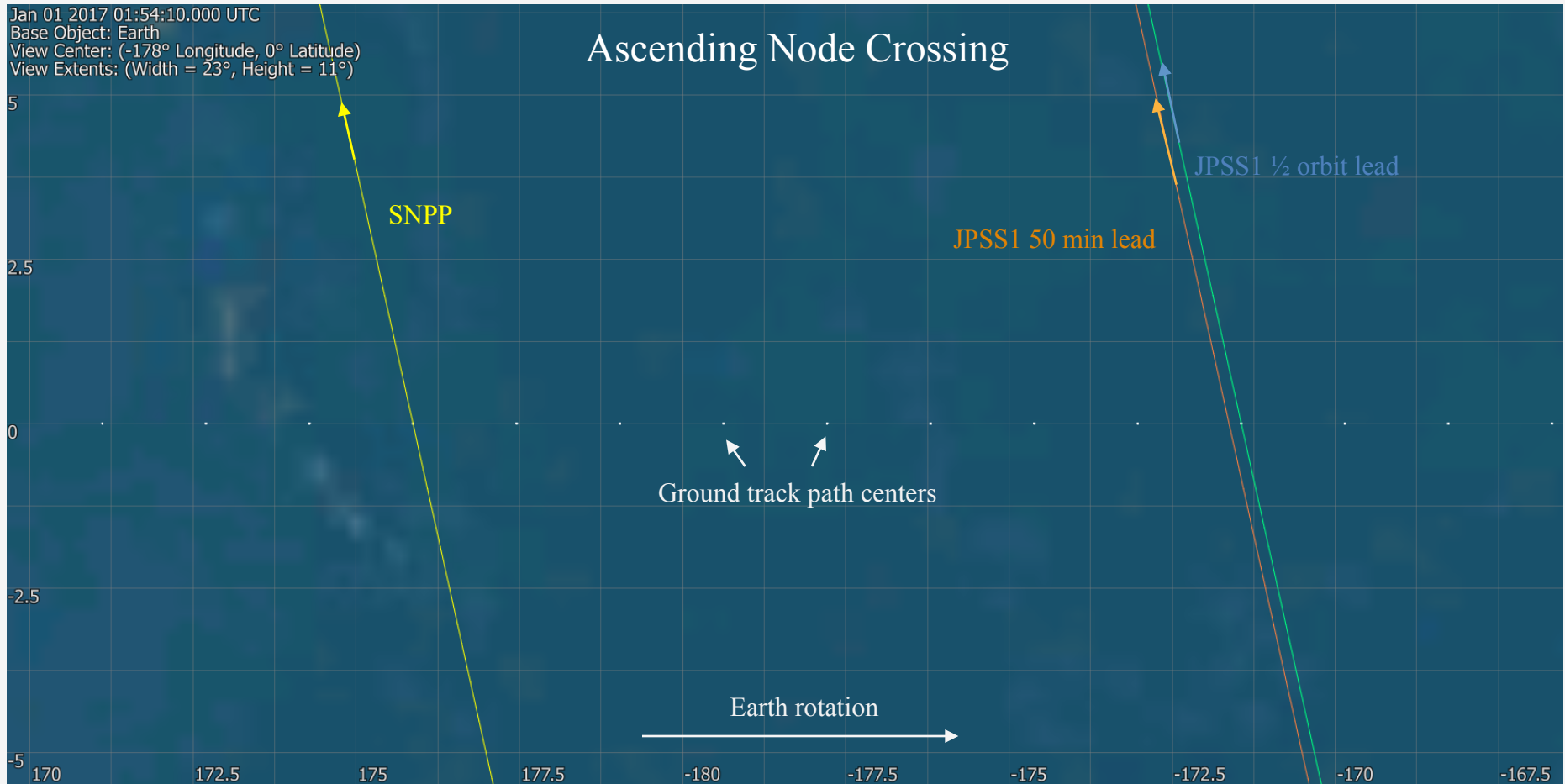
# S-NPP & JPSS-1 Sensor Overlap (1325 LTAN/824 km orbit)



Spacecraft Follow Different Ground Tracks  
Based On  $\frac{1}{2}$  Orbit Along-Track Separation



# JPSS-1 wrt S-NPP (1/2 orbit along-track separation)



- Order of equator crossing: **JPSS1**; **JPSS1** 45 seconds later; SNPP 50:45 later (1/2 orbit is  $\approx 50:45$ )
- **JPSS1** and SNPP cross through center of ground track 8 paths apart.
- **JPSS1** crosses  $\approx 21$  km to the “west” of the center of the ground track



Questions?



# Backup



# S-NPP & JPSS-1 with 5 instruments



13.2 ft long  
8.5 ft wide  
4,500 lbs

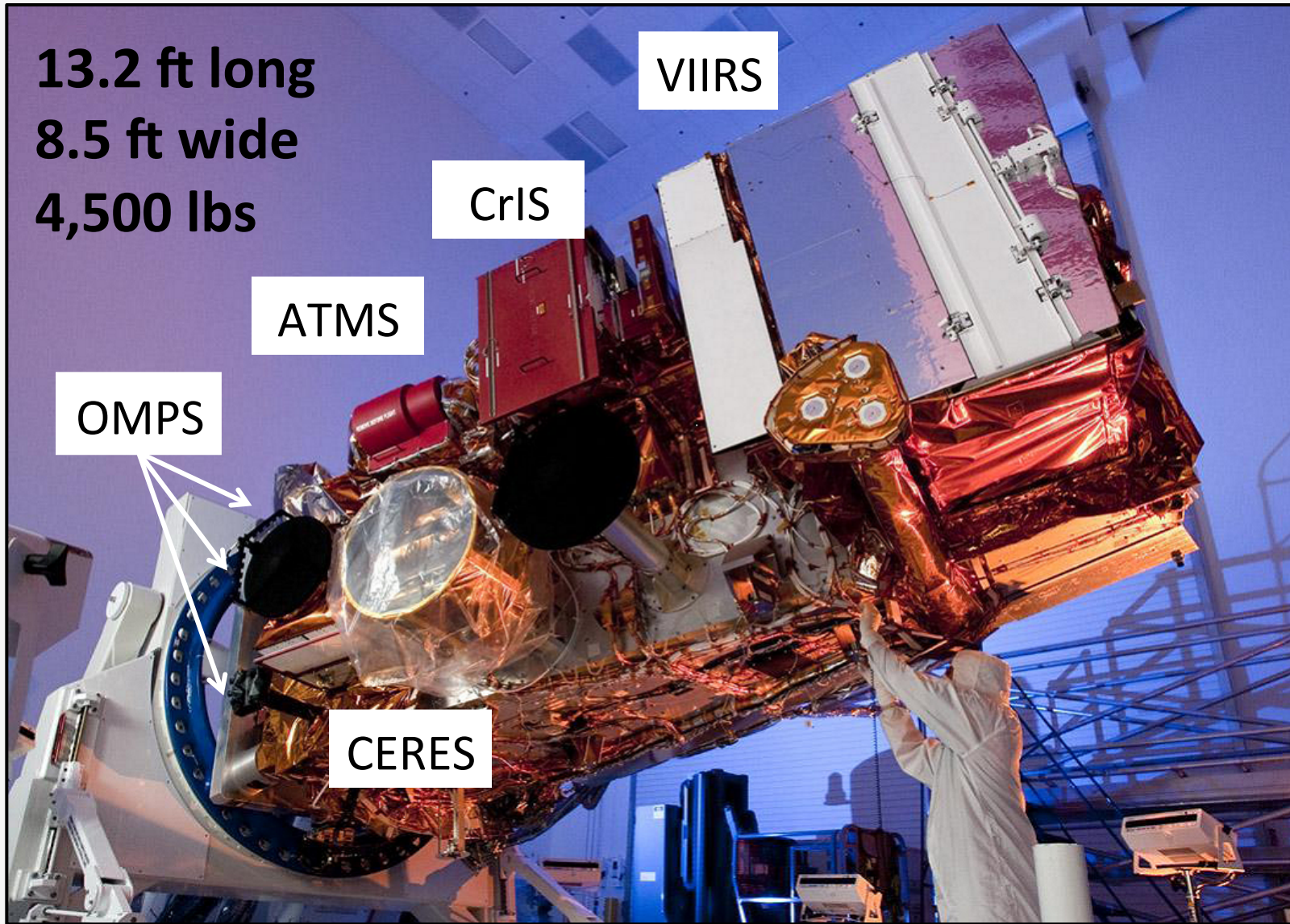
VIIRS

CrIS

ATMS

OMPS

CERES



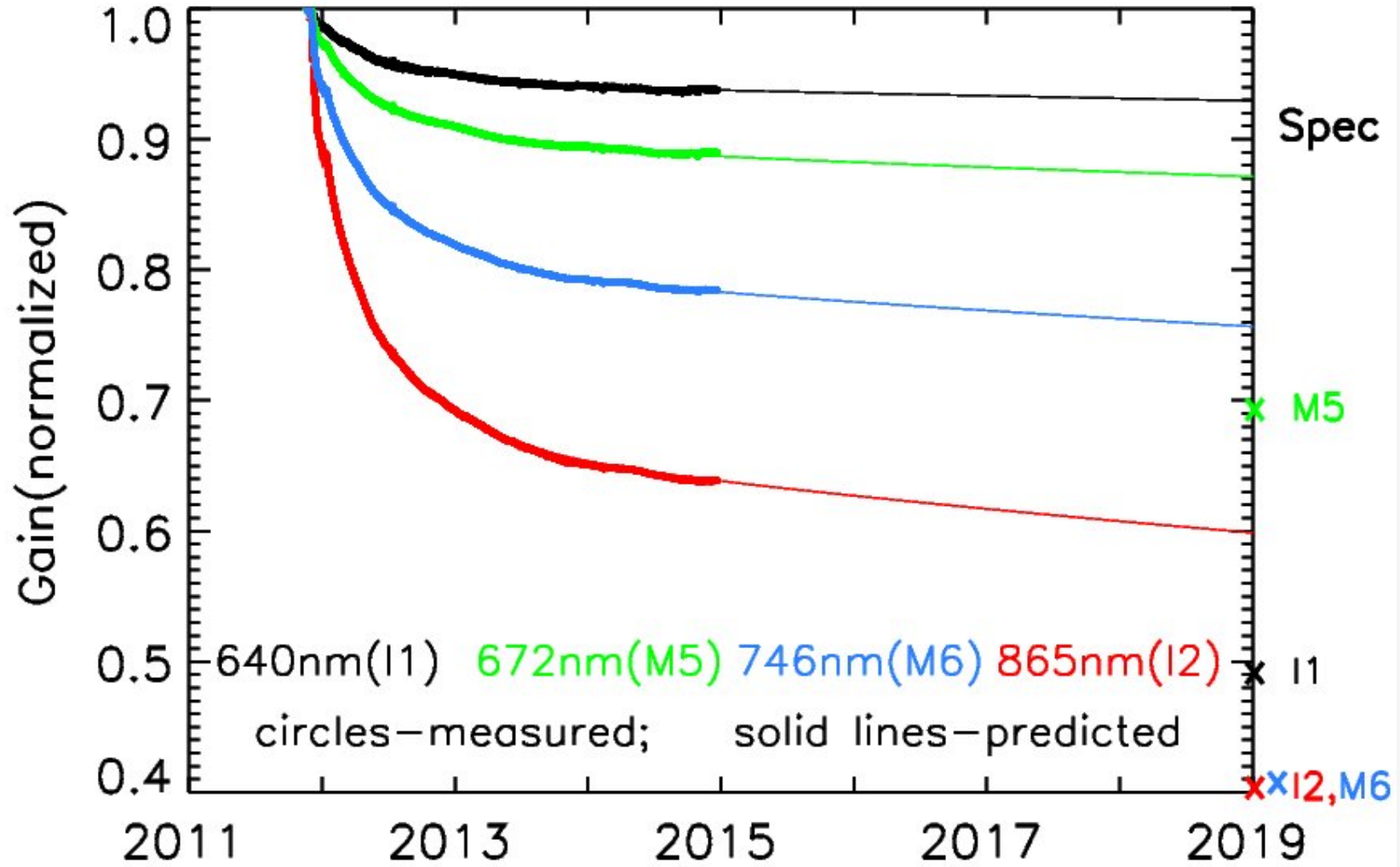


# Suomi NPP VIIRS Degradation Analysis and Prediction



Ref: Lei, et al, SPIE Proceeding, Vol 8533, paper 19 (2012)

Lei, et al, IEEE Trans. Geosci. Remote Sens., Vol 53, pp 1565-1573, (2015)



4-mirror thin-layer model





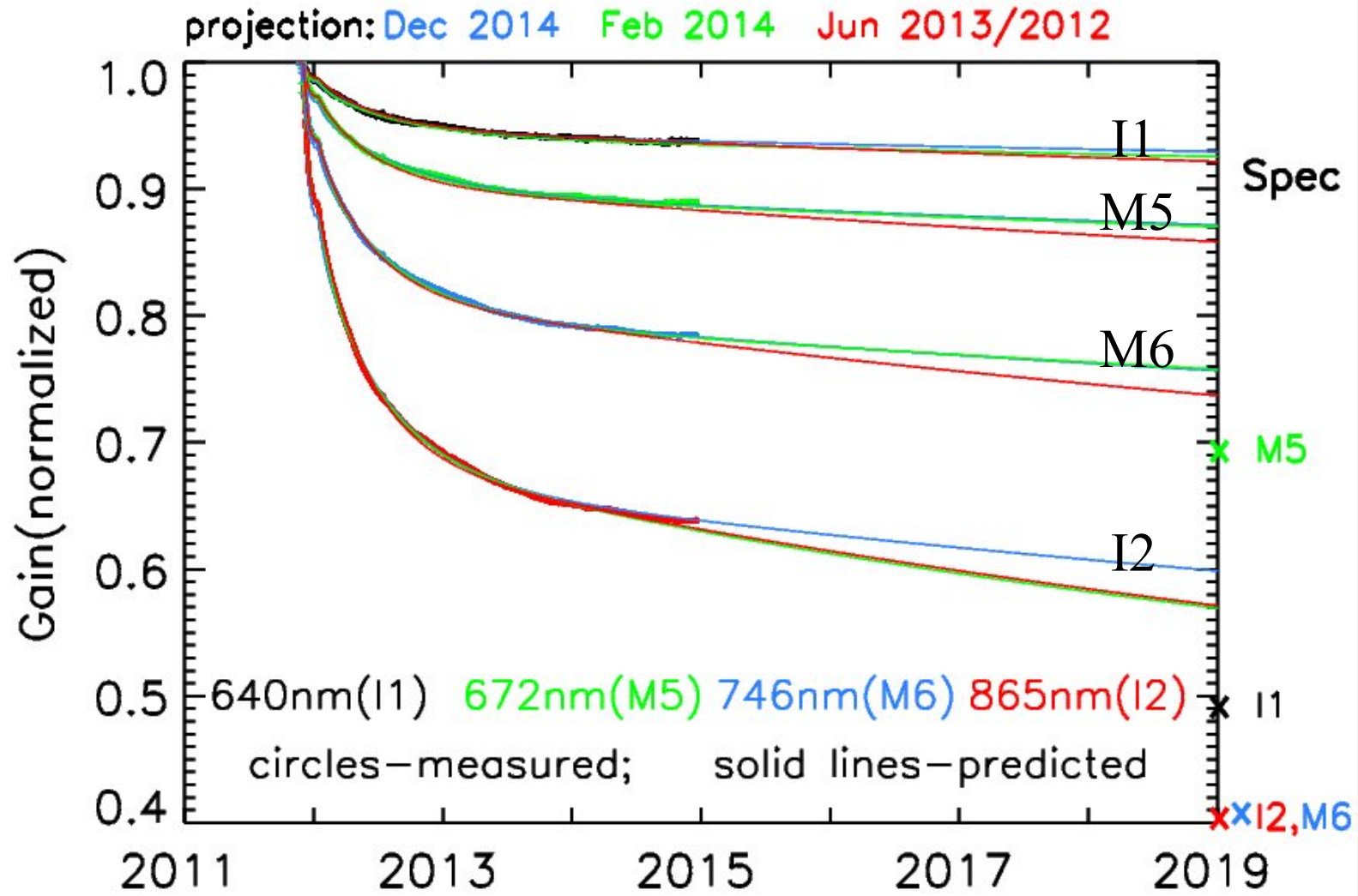
# Suomi NPP VIIRS Degradation Analysis and Prediction



VIIRS data up to Dec 19, 2014

Ref: Lei, et al, SPIE Proceeding, Vol 8533, paper 19 (2012)

Lei, et al. IEEE Trans. Geosci. Remote Sens., Vol 53, pp 1565-1573. (2015)



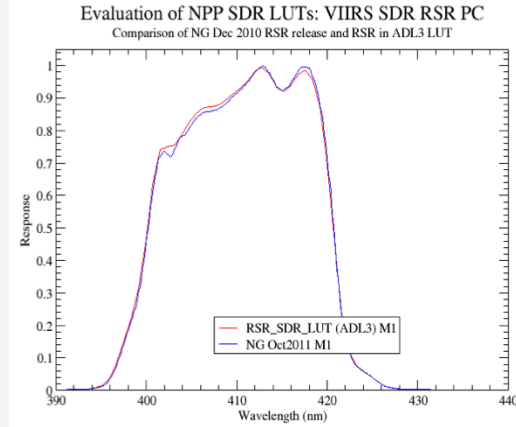
4-mirror thin-layer model



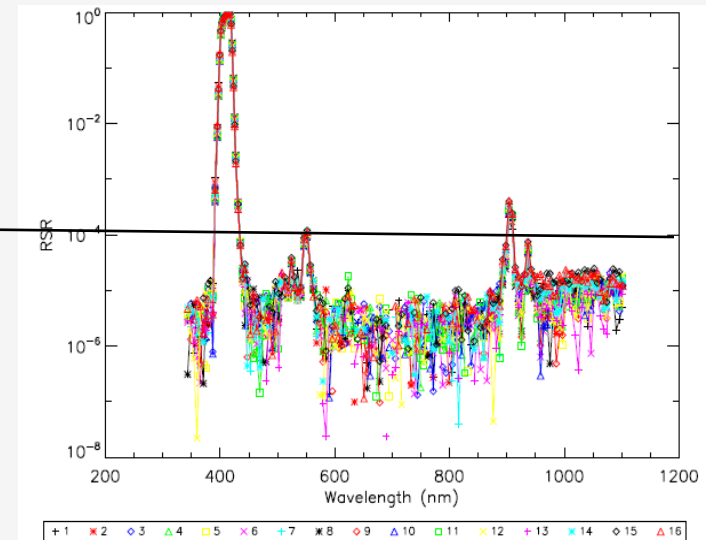
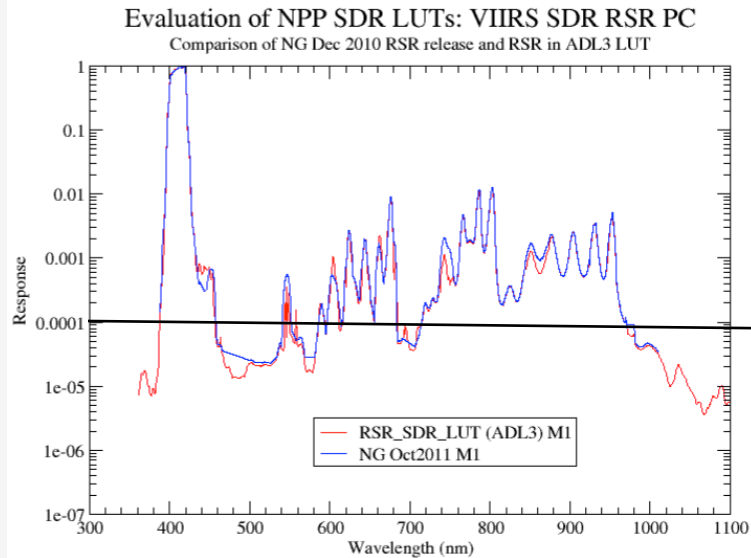
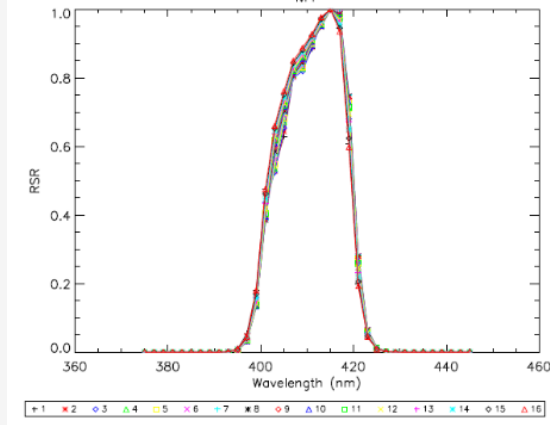
# VIIRS Spectral Response Example; M1 412 nm



## Suomi NPP VIIRS



## JPSS 1 VIIRS

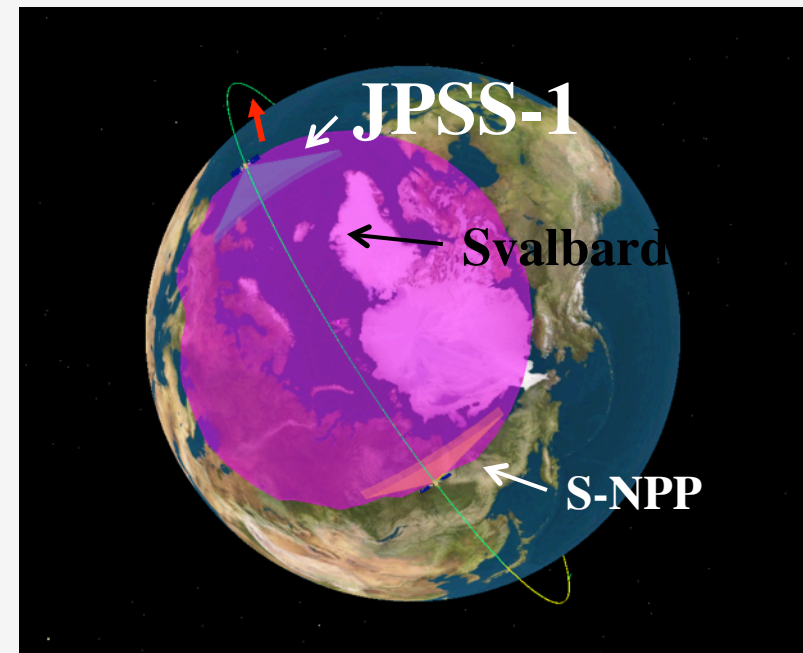
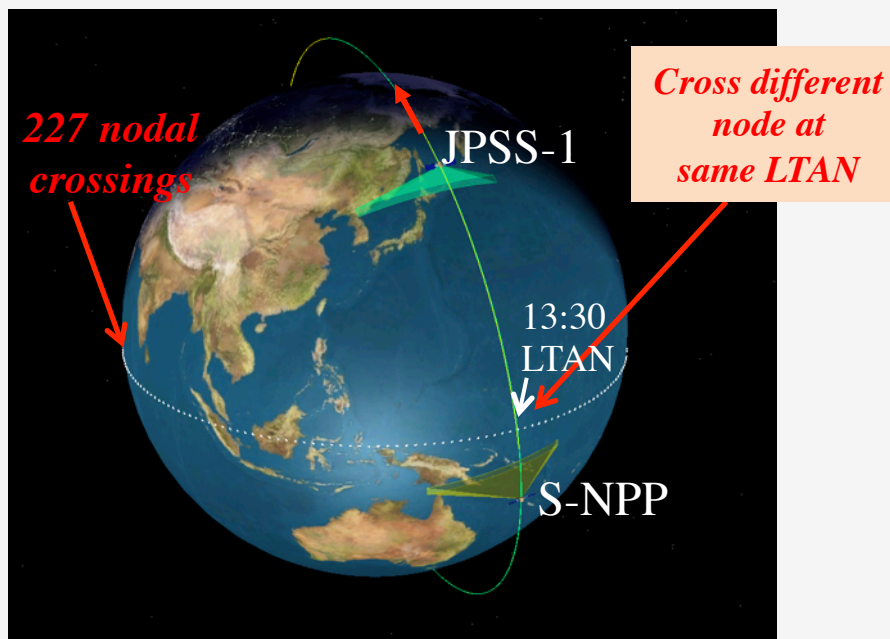




# JPSS-1 Orbit and Constellation View



- Part of JPSS satellite constellation at 824 km and 1330 LTAN, polar sun-synchronous orbit
- 16 day repeat cycle like S-NPP
- JPSS-1 leads S-NPP with a minimum of 20 min orbital separation
  - Support instrument calibration using cross reference
  - Avoid ground contact conflicts
  - Working with GSFC A-train personnel and are preparing for meetings with JPSS Flight/LV to start coordination of mission orbit insertion





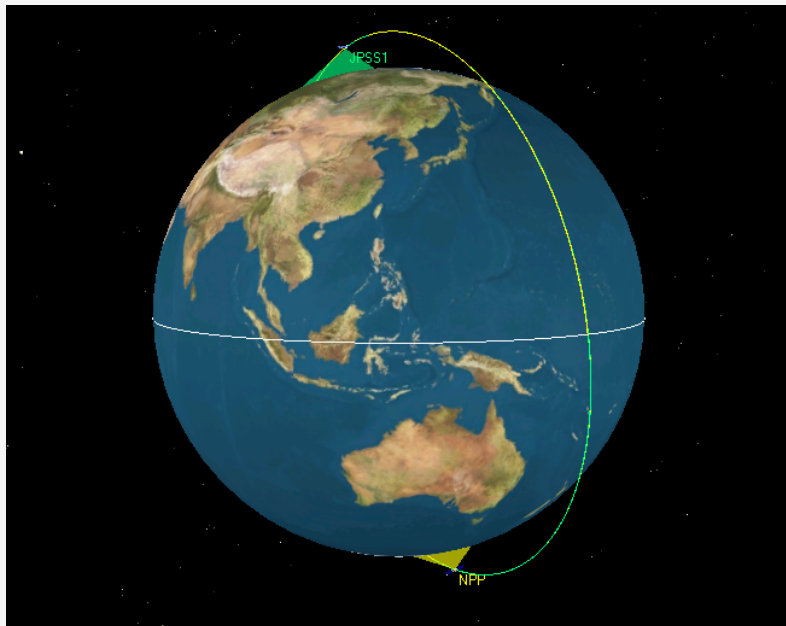
# Mission Orbit Constellation Concept



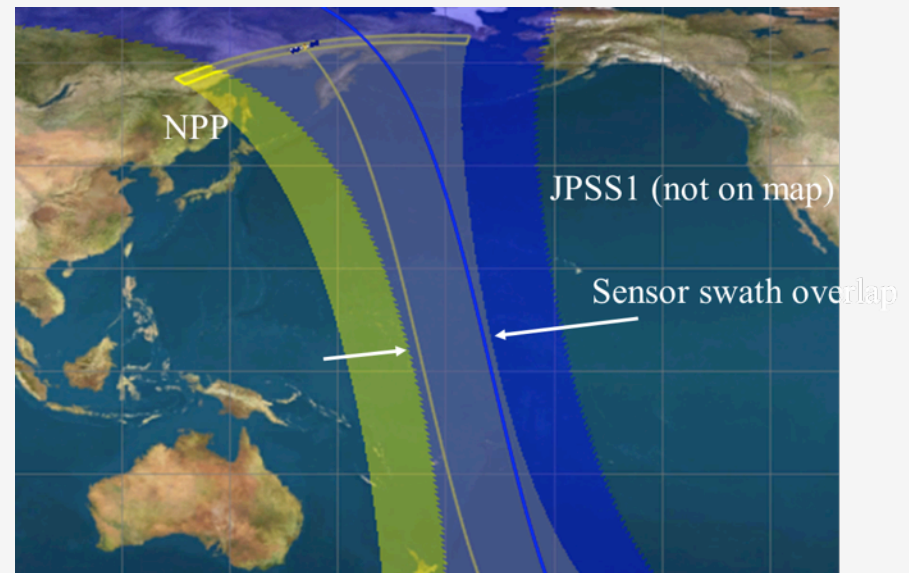
- **Current Timeframe**

- Program Science was asked to review/revisit the constellation concept (December 2014 timeframe) and responded with request to evaluate  $\frac{1}{2}$  orbit along-track separation concept (based on Eumetsat EPS-SG concept)
- PSE coordinated study involving science/flight/ground/mission ops to assess feasibility and impacts for changing the along-track separation

$\frac{1}{2}$  orbit along-track separation between JPSS-1 and S-NPP in the same mission orbit plane (824 km, 1325 LTAN)



Ground Track Diagram  
Blue line/swath – JPSS-1; Yellow line/swath – S-NPP;  
Grey swath – coverage overlap of JPSS-1 trailing edge  
with S-NPP leading edge; eliminates bow-tie effect



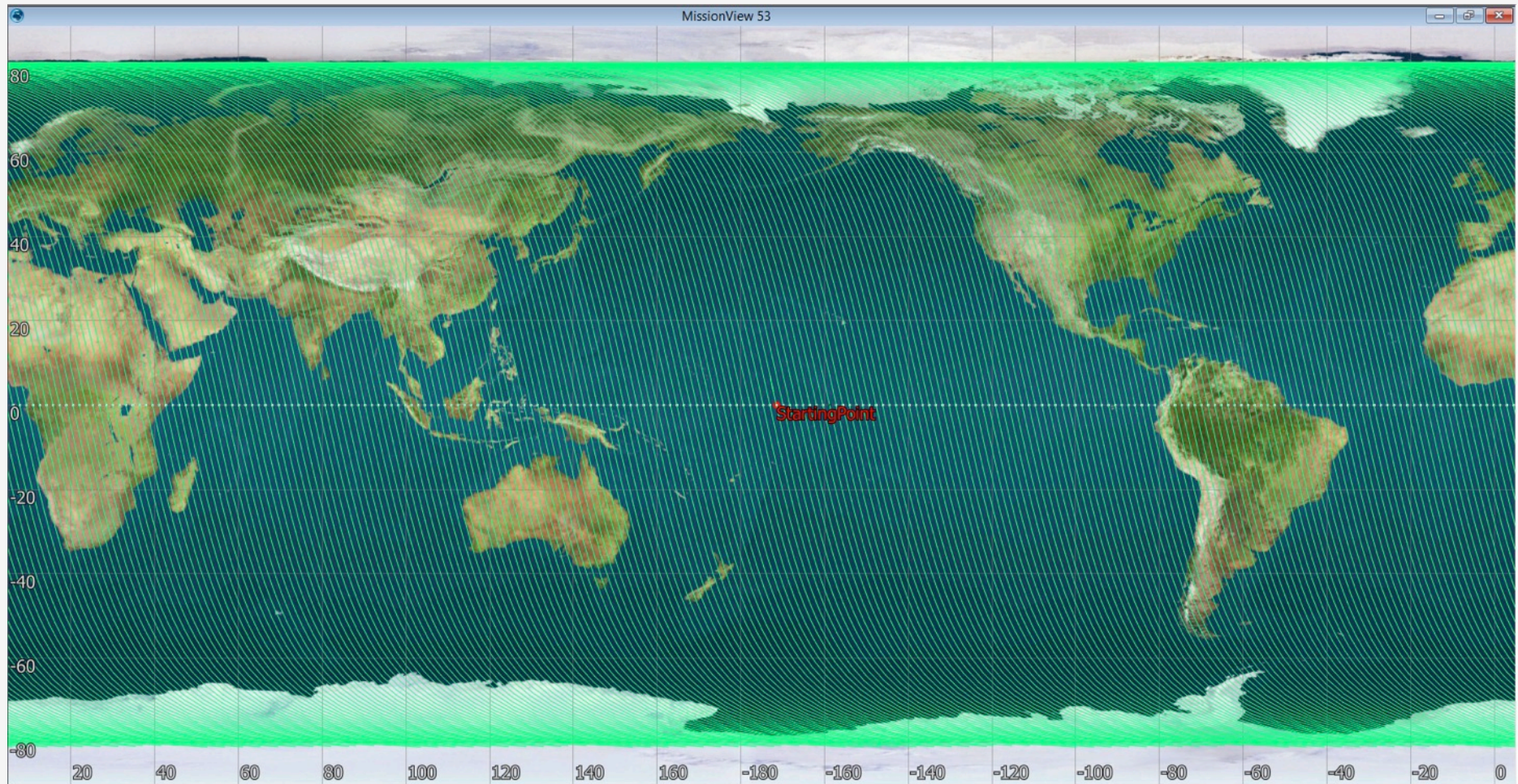
JPSS1 50 Minutes Ahead of NPP in Same Orbit (Same LTAN = 13:25)  
Spacecraft Follow Different Ground Tracks



# JPSS-1 Orbit Paths for 16 Days



Orbit grid for JPSS1 (ascending node paths shown) – there are 227 orbit paths for every 16-day cycle

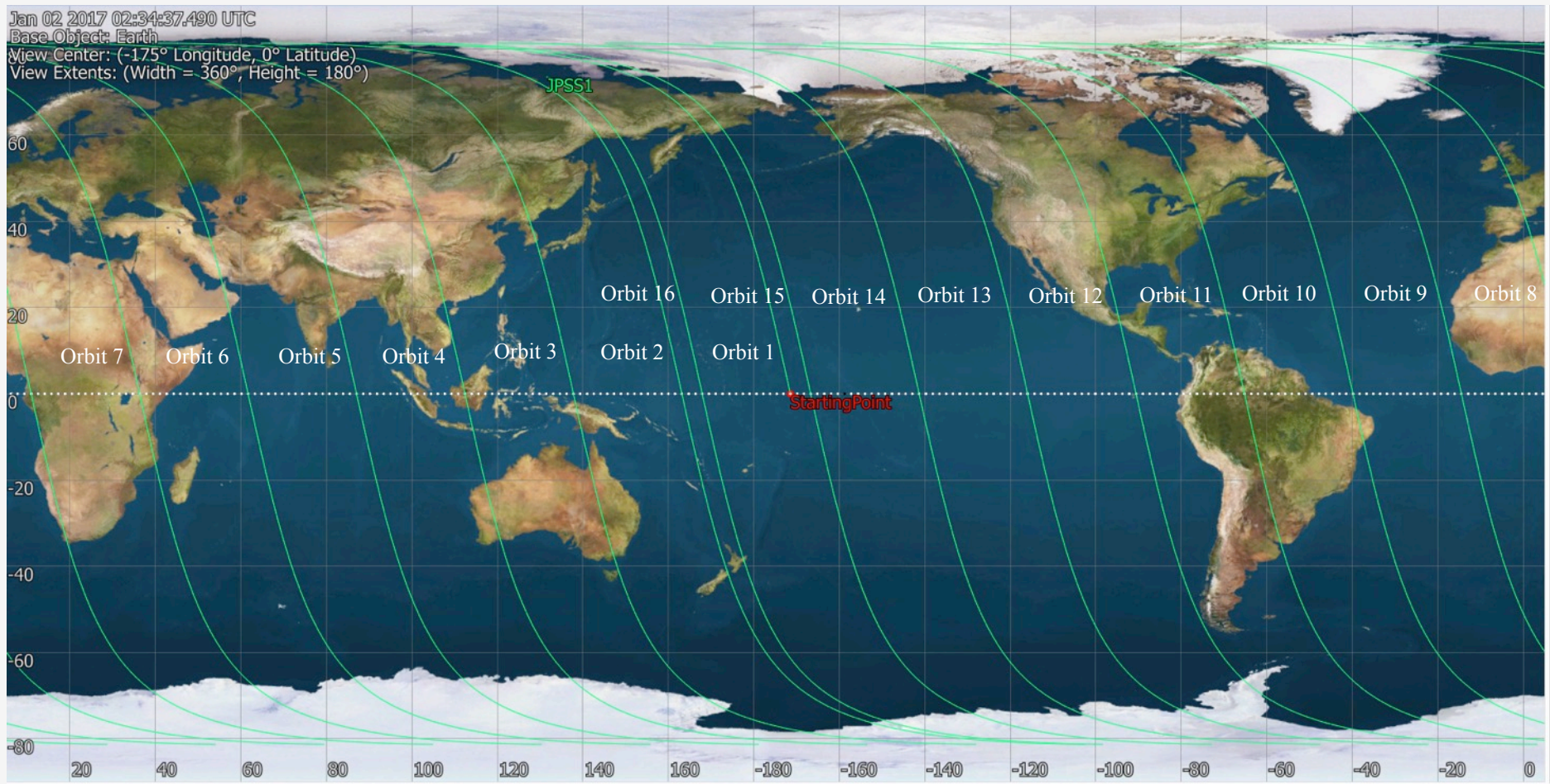




# JPSS-1 Orbit Paths

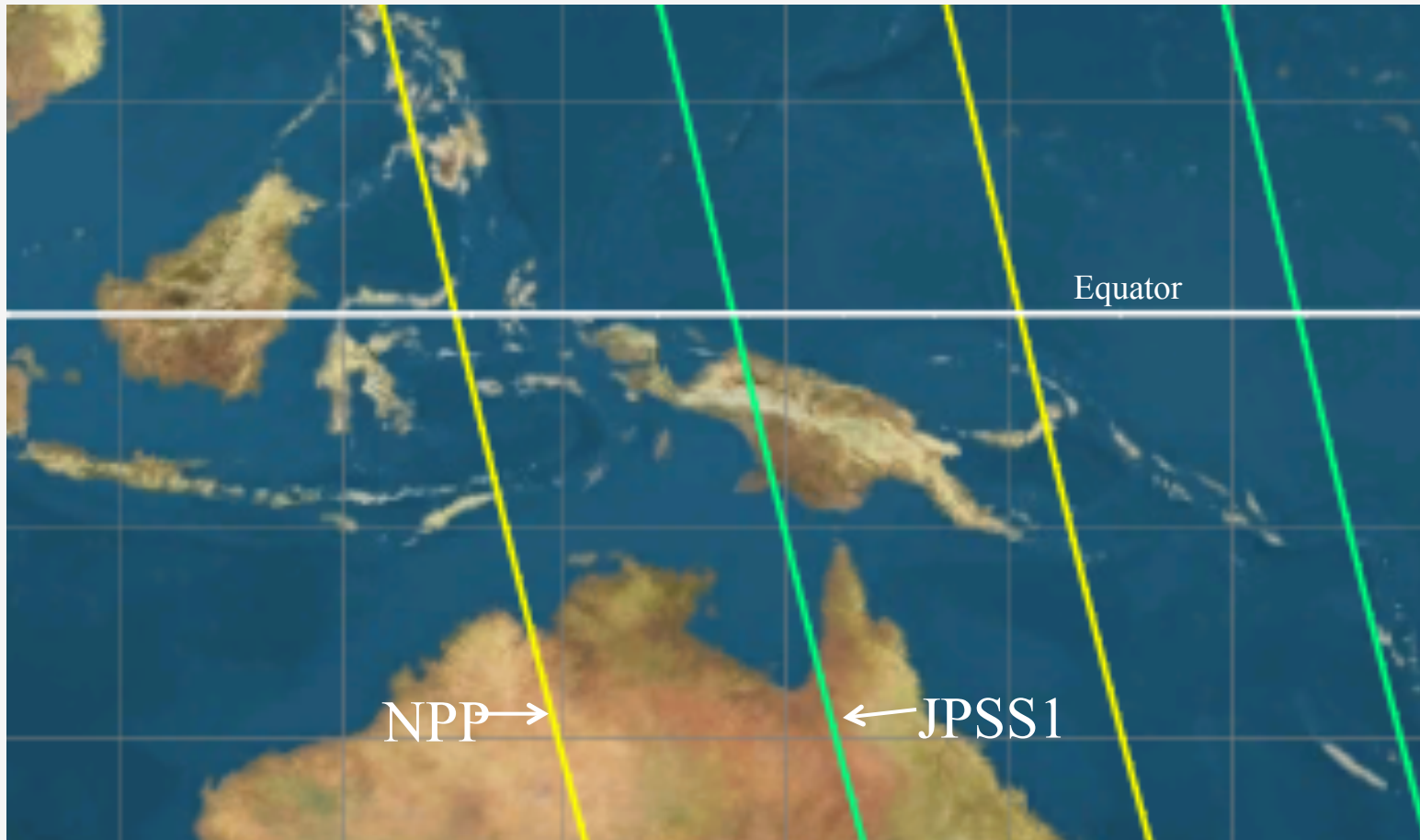


- Map shows orbit paths for slightly more than one day to see how the ground track is laid out
- Consecutive orbits track 16 paths apart





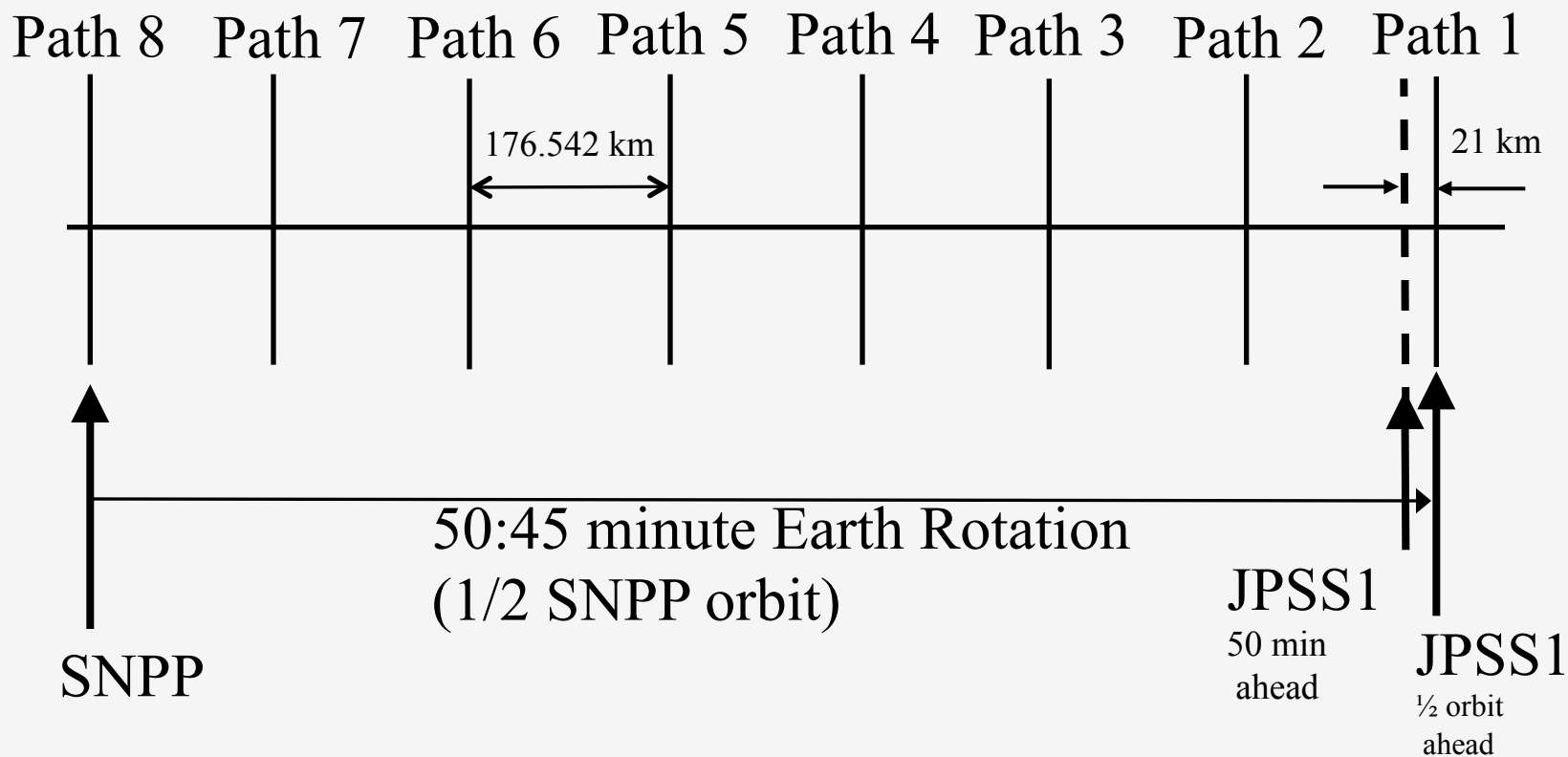
# S-NPP & JPSS-1 Ground Track (1325 LTAN/824 km orbit)



Spacecraft Follow Different Ground Tracks  
Based On  $\frac{1}{2}$  Orbit Along-Track Separation



# JPSS-1 wrt S-NPP (1/2 orbit along-track separation)



*Note: Path numbers do not correspond to orbit numbers.*