

A 3D rendering of the Earth Science Orbiting Carbon Observatory-2 (OCO-2) satellite, also known as the Aura satellite. The satellite is shown in orbit over the Earth, with the planet's blue and white clouds visible in the background. The satellite itself is a complex, multi-faceted structure with a prominent gold-colored thermal blanket covering most of its body. It features a large, white, circular parabolic antenna on the right side, and various instruments and sensors protruding from its surface. The overall design is compact and aerodynamic, typical of a polar-orbiting satellite.

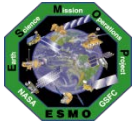
**Mission Status for
Earth Science Constellation
MOWG Meeting
@ GSFC**

EOS Aura

December 4, 2018

**Dominic Fisher
Aura Mission Director (Code 584)
phone 301-286-3171**

dominic.m.fisher@nasa.gov

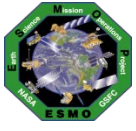


Topics



- **Mission Summary**
- **Spacecraft Subsystems Summary**
- **Recent Activities**
- **Planned Activities**
- **Propellant Usage & Lifetime Estimates**
- **Overall Summary**

- **Additional Slides:**
 - **Spacecraft Maneuvers & Ground Track History**
 - **Conjunction Assessment**
 - **Data Capture & Ops Error Statistics**
 - **Extended Mission Plans**

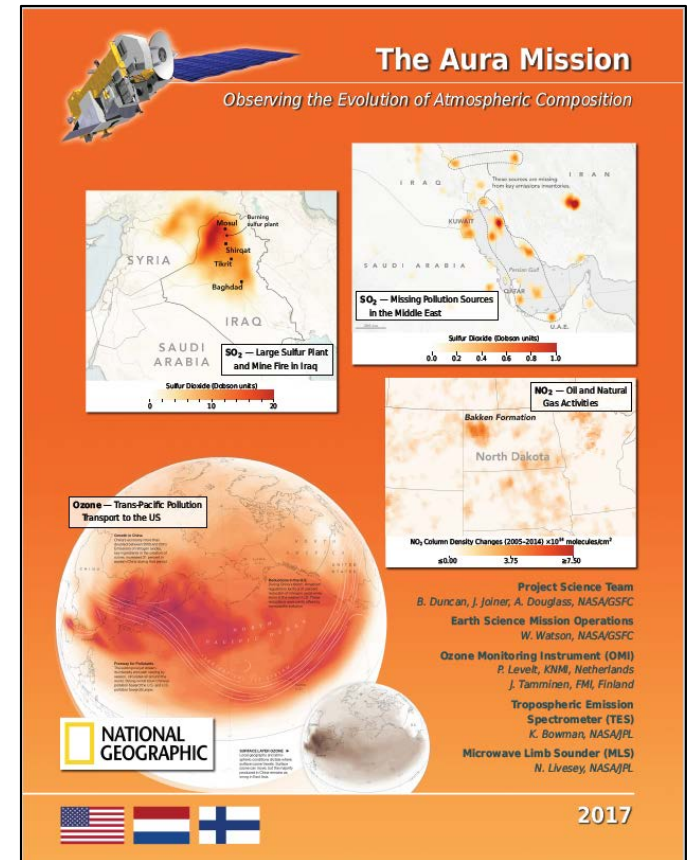


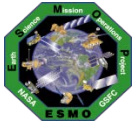
EOS Aura Mission Summary



(Updates since June 2018 MOWG @ Sioux Falls)

- **07/15/04: Launch**
 - 6-Year Design Life
- **09/30/10: End of Prime Mission Review**
- **09/18/15: 2015 Mission Extension Senior Review Proposal Panel Report**
- **03/03/17: Senior Review Proposal #5**
 - Reliability Estimates thru 2022
 - Consumables through 2022
- **06/22/17: NASA Earth Science Senior Review Subcommittee Report**
 - High Utility, Excellent science merit
- **12/21/17: Received NASA HQ Guidance**
- **01/24/18: ESMO Annual Review #11**
- **01/31/18: TES Decommissioning**
- **03/30/18: Updated Aura Phase F Plan**
- **07/15/18: Aura 14-Year Anniversary**





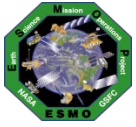
Aura Spacecraft Subsystems



(Updates since June 2018 MOWG @ Sioux Falls)

- **Command & Data Handling (CDH) – Nominal**
 - **Formatter Multiplexer Unit (FMU) / Solid State Recorder (SSR) Anomaly**
 - » Initial symptoms occurred December 4-18, 2007
 - » Newest symptoms started in January 2017 and remain active (impacting S-Band HK data capture)
- **Communications (COMM) – Nominal**
 - **Transmitter-B Reflected Power Anomaly (10/17/17, 01/05/18)**
- **Electrical Power System (EPS) – Nominal**
 - **Array Regulator Electronics (ARE) Anomalies:**
 - » **Solar Panel Connector Anomaly – ARE-3C (01/12/05) – loss of 11 strings**
 - » **MMOD Strike – ARE-5A (3/12/10) – loss of 6 strings**
 - **ARE Degradation due to aging – ARE-5C (9/27/12, 2/4/13), ARE-1A (3/12/10, 11/5/11), ARE-5A (4/25/13), ARE-6A (9/14/13), ARE-4A (12/8/14), ARE-1C (7/14/17, 12/22/17), ARE-2C (8/18/17)**
 - » **Estimated that Aura has lost 28 strings of solar cells out of a total of 132 strings (~78.8% remain)**
 - » **Investigating ARE-4A (12/08/14) event to see if in fact 2 strings were lost, not just 1 string**
 - » **Aura continues to have significant power margin where the life limiting item is fuel**
- **Flight Software (FSW) – Nominal**
- **Guidance, Navigation & Control (GN&C) – Nominal**
- **Propulsion (PROP) – Nominal**
- **Thermal Control System (TCS) – Nominal**

All subsystems configured to primary hardware

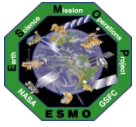


Recent Activities

(June 2018 – November 2018)



- **5 CARA High Interest Orbital Debris Events (Tiers 1-4) (As of 10/31/18)**
 - **5** required significant action (T3 / T4)
 - 10/22/2018: CA vs. 81982 at 10:09:41 GMT – Planned DMU rescheduled due to post-maneuver conjunction of concern (T4)
- **0 Spacecraft Bus Anomalies**
- **5 Instrument Anomalies**
 - **MLS:** 1 GHz Receiver-1A (R1A) Anomaly (06/04/18, recovered on 06/11/18),
1 GHz Mirror Electronics (GME-B) Anomaly (06/20/18, recovered on 06/26/18),
1 Survival Mode Transition (07/10/18, recovered on 07/18/18),
1 GHz Mirror Electronics (GME-B) Anomaly (10/25/18, recovered on 10/25/18)
 - **OMI:** 1 OMI-IAM Multi-bit Error Warm Restart (07/30/18, recovered on 07/31/18)
- **6 Spacecraft Maneuvers**
 - **5 Drag Make-up Maneuvers (DMUMs #112 – 116)**
 - » Routine: 06/28/18, 08/22/18, 09/19/18, 10/23/18, 11/08/18
 - » Rescheduled DMU #115 from 10/17/18 due to post-DMU conjunction of concern
 - **1 Inclination Adjust Maneuvers (IAM #58)**
 - » 08/01/18 - Summer IAM needed to keep phasing with Aqua
- **1 Spacecraft Test Maneuver (Non-propulsive) (RWA TM #2)**



Recent Activities

(June 2018 – November 2018)



- **TES post-Decommissioning:**
 - Instrument reconfiguration into decommissioned state – 01/31/18
 - Close-out Review & Science Highlights @ NASA HQ – 04/13/18
 - **Laser End-of-Life (EOL) Testing Phase 1 approved by NASA HQ – 05/14/18**
 - » Phase 1 testing characterized performance for Laser A and B under varying conditions (operating temperatures and input current)
 - **Laser EOL Testing Phase 1 Activities:**
 - » Start of testing activities – 06/04/2018
 - » End of testing activities – 07/27/2018
 - » Debrief of Phase 1 testing activities – 08/07/2018
 - **Following the Phase 1 debrief, NASA HQ revisited the proposed Phase 2 testing plan in August 2018**
 - » Phase 2 testing plan is to alternate leaving Laser A or B ON for extended durations and characterize performance every 6 months
 - Laser EOL Testing Phase 2 approved by NASA HQ – 09/25/18
 - **Laser EOL Testing Phase 2 Activities:**
 - » Phase 2 planning discussions held bi-weekly
 - » Start of testing activities target – 11/15/2018



Recent Activities

(June 2018 – November 2018)



- **Aqua/Aura Maneuver Working Group:**
 - Picked back up RWA maneuver development efforts following the Spring 2018 IAM Series
 - Finished remaining simulations for abort scenarios and contingency responses – Summer 2018
 - **Updated fault management thresholds to address momentum and attitude errors – Fall 2018**
 - » AFM delivered new FM patch at the end of September
 - » FOT checked out new patch to validate contingency procedures in October
 - **Aura RWA Maneuver Engineering Peer Review (EPR) – Completed on 10/24/18**
 - » Independent panel provided concurrence to proceed with planned test maneuver activity
 - » Captured a few questions and actions to address in preparation for the test activity (nothing show stopping)
 - » Presented preliminary plan to perform 2019 Aura IAM Series with RWAs
 - **Aura RWA Test Maneuver #2 – Scheduled for 11/30/18**
 - » Yaw slew out to -76.5° at $0.168^\circ/\text{s}$ using reaction wheels, mimicking IAM #59

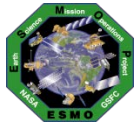


Recent Activities

(June 2018 – November 2018)

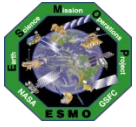


- **Aura Alternate Decommissioning Plan Evaluation**
 - **OMI Science Team Meeting @ De Bilt, Netherlands (3-days) – September 2018**
 - » OMI IOT / FOT MOWG – Meeting held on 09/12/18:
 - » Aura Early A-Train Exit Planning Discussion – Briefed Science Team leadership on 09/12/18
 - Operations and science teams held a splinter discussion about the implications of changing Aura's orbit
 - **Assumptions for this Early Exit scenario included:**
 - » Full IAM Series through 2019
 - » MLT allowed to drift and Constellation Exit Maneuver (CEM) in May 2020
 - » MLT allowed to continue to drift until October 2025 (approximate MLTAN of 16:30)
 - » Perigee Lowering Maneuvers (PLM) to begin in October 2025
 - » Note: These assumptions shift ~1 yr with updated scheme which now includes 2020 IAMs
- **Aura Decommissioning Review (*DRAFT*)**
 - Document Phase F spacecraft activities, any new products to be developed for spacecraft / instrument calibration, proposed Engineering Tests, and Passivation Sequence
 - Presented to ESMO Management – 11/29/18



Planned Activities

- **January 2019: Aura Alternate Decommissioning Plan Evaluation**
 - Brief early exit plan at Aura Science Team Meeting in Pasadena, CA (01/22/19)
- **February 2019: ESMO Annual Review #12**
- **March 2019: Annual Inclination Adjust Maneuvers (new RWA approach)**
 - 3/6/19 (#59), 3/13/19 (#60), 3/21/19 (#61), 3/27/19 (#62), & 4/3/19 (Backup)
- **Spring 2019: Earth Science Constellation (ESC) MOWG (Toulouse, France)**
 - Update propellant budget, decommissioning analysis, reliability predictions, etc.
- **Summer 2019: EOMP and Decommission Plan (Lifetime Analysis) Updates**
 - Updates will lead into 2020 Senior Review Proposal cycle
- **Mid-to-Long-Term Plans:**
 - **EOS Automation (EA) – automation of routine operations**
 - » EA Phase 3.2 ORR – December 2018
 - » Continue FOT automation procedure development into 2019
 - **Continue to improve RMM / DAM execution**
 - » CRMS Release 7.0 – Winter 2019
 - » Support ESMO / CARA devolution initiative – Parallel Operations in Winter 2019



Collision Risk Management System (CRMS) Process Improvements



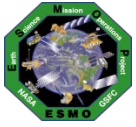
- **ESMO has developed ground system capabilities to autonomously identify and develop maneuver options to assist in Risk Mitigation Maneuver (RMM) / Debris Avoidance Maneuver (DAM) planning**
- **Developed in response to an increased number of predicted close approaches with orbital debris and operational satellites**
 - **More High Interest Events (HIEs) had led to more effort to plan mitigation maneuvers**
 - **Concern is that updates to the US Air Force Space Fence will significantly increase the size of the Space Catalog**
- **Key CRMS capabilities include:**
 - User defined collision risk thresholds
 - Maneuver optimization to address multiple conjunctions with secondary object conjunctions
- **EOC is currently operating with CRMS Release 6 (Δ ORR 01/18/18)**
- **Refine ESMO MOCA process in support of CARA Devolution initiative (Fall 2018 / Winter 2019)**



Spring 2019 Inclination Adjust Plan (*DRAFT*)



Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
24 Feb	25	26	27	28	1 March	2
3	4	5	6 Aura IAM #59	7 Aqua IAM #62	8	9
10	11	12	13 Aura IAM #60	14 Aqua IAM #63	15	16
17	18	19	20 Equinox EPS SOH Test	21 Aura IAM #61	22 Aqua IAM #64	23
24	25	26	27 Aura IAM #62	28 Aqua IAM #65	29	30
31	1 April	2	3 Aura Backup	4 Aqua Backup	5	6
7	8	9	10	11	12	13

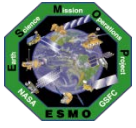


Remaining Fuel Estimate

(Analysis Updated November 2018)



- **Long-term orbit simulations were run for Aura through Feb 2023**
 - Used mean nominal Schatten solar flux predictions ([May 2018](#))
 - Estimated the frequency of drag make-up maneuvers to maintain Aura's WRS-2 ground track requirements
 - Estimated the required number of annual inclination maneuvers for Aura to maintain its mean local time (MLT) requirement ([20 IAMs through 2022](#)) [[w/ Baseline Plan](#)]
 - Did not include potential debris avoidance maneuvers
 - Utilized FreeFlyer [6.10.0](#) which incorporated the solid earth tide model allowing greater accuracy for long term predictions of inclination, beta angle, and mean local time
- **Lifetime predictions for Aura shows that the spacecraft will have sufficient fuel to maintain its current orbit within the Afternoon Constellation through 2022 (before 2023 IAM series) [[w/ Baseline Plan](#)]**
- **Aura will hold sufficient fuel in reserve after exiting the constellation to lower perigee such that reentry will meet the NASA 25-year reentry requirement.**
- **Analyses are updated annually by ESMO Flight Dynamics Team**
 - Currently developing a retrograde maneuver capability and a more efficient inclination/mean local time option to extend the potential lifetime

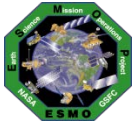


Debris Assessment Software

(Analysis Updated November 2018)



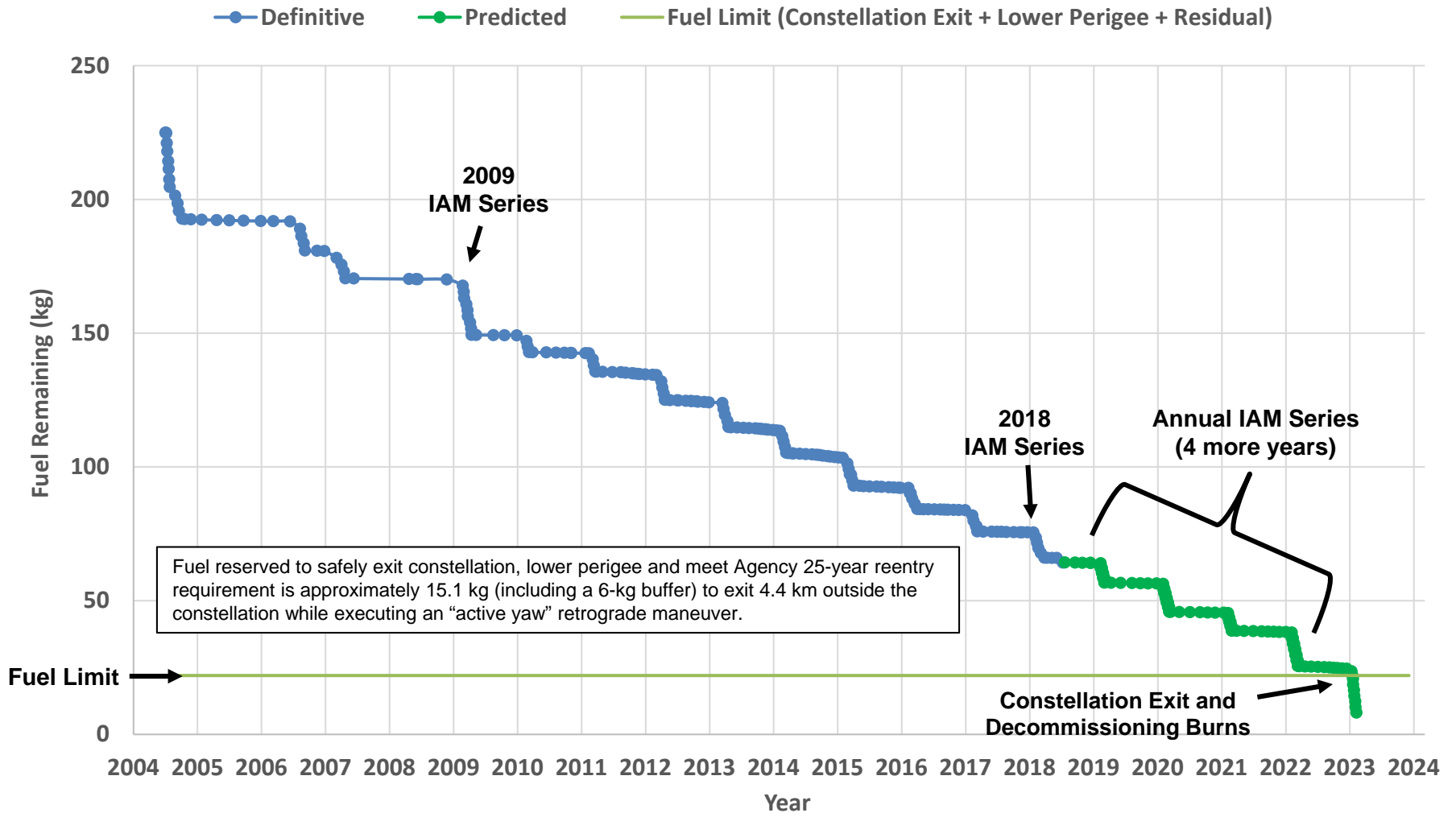
- **The Debris Assessment Software (DAS) was created by the Orbital Debris Office at Johnson Space Center and is the Agency standard for end of mission life analyses and lifetime estimations (Version 2.1.1)**
- **Solar Flux file from [April 2018](#)**
- **DAS requires several inputs describing the spacecraft's mission:**
 - Start apogee = Average Height = **~695 km** (at constellation exit)
 - Spacecraft Dry Mass = 2791.746 kg (includes 1.2 kg of unusable fuel and 4.8 kg of uncertainty)
 - Tumbling Area = 46.1 m² (FDSS-II-07-0085_Aura Average Area _V1.0 (3/1/17))
 - Area-to-Mass Ratio = Tumbling Area / Dry mass = 0.016485 m²/kg
 - Start inclination = 98.2°
 - Launch date = 07/15/2004
- **In turn, DAS outputs:**
 - If the mission is compliant with NASA requirements for limiting orbital debris
 - A recommended apogee and perigee that will allow the spacecraft to reenter within a specific period and satisfy the NASA requirements
- **Aura has a waiver to the 30-years from launch requirement**
- **Aura will hold sufficient fuel in reserve to meet the 25-year requirement**

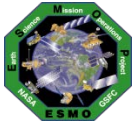


Fuel Usage: Actual & Predicted



(Current Baseline Plan – Analysis Updated November 2018)

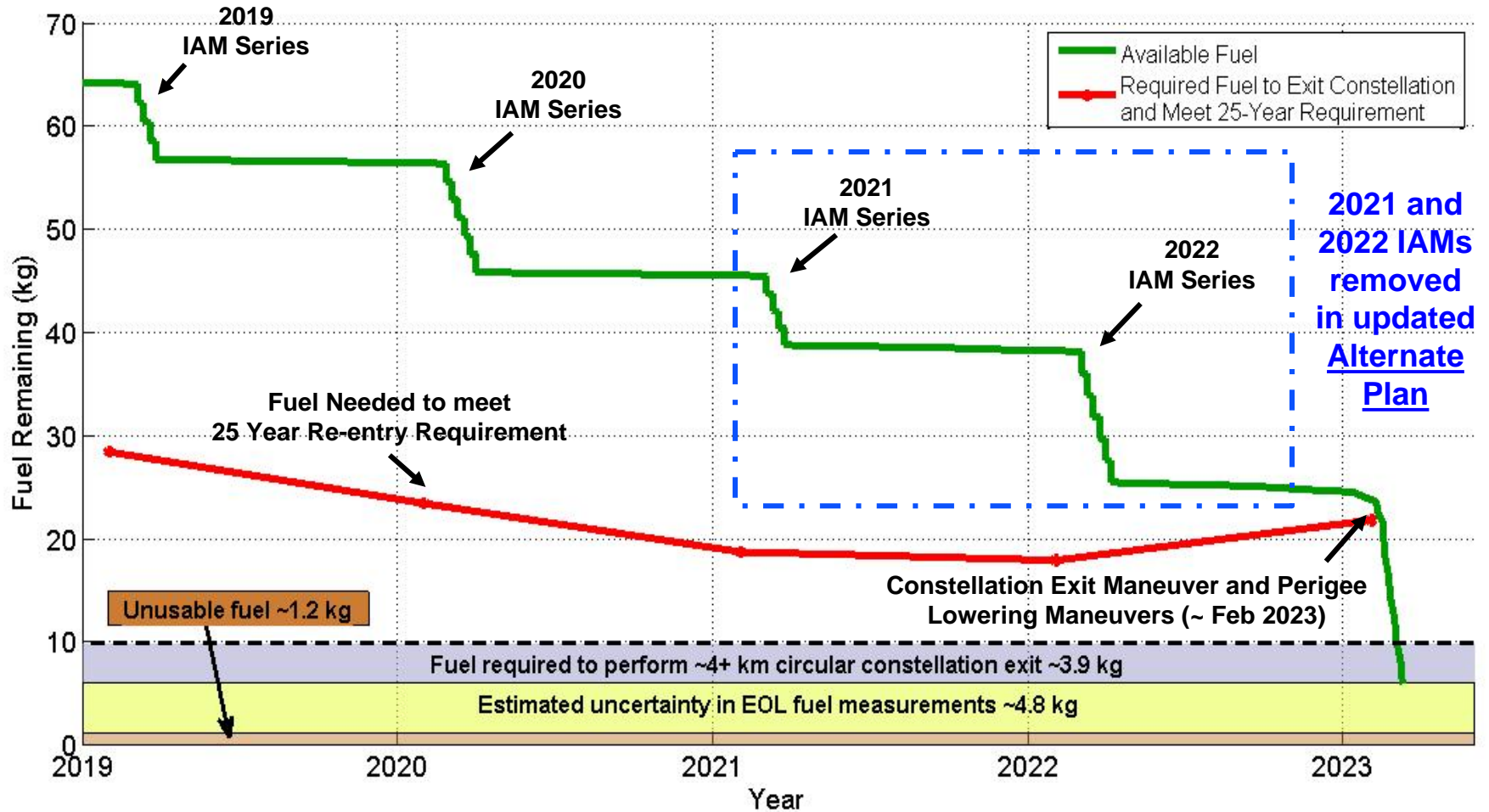




Aura DAS End of Life Predictions



(Current Baseline Plan – Analysis Updated November 2018)

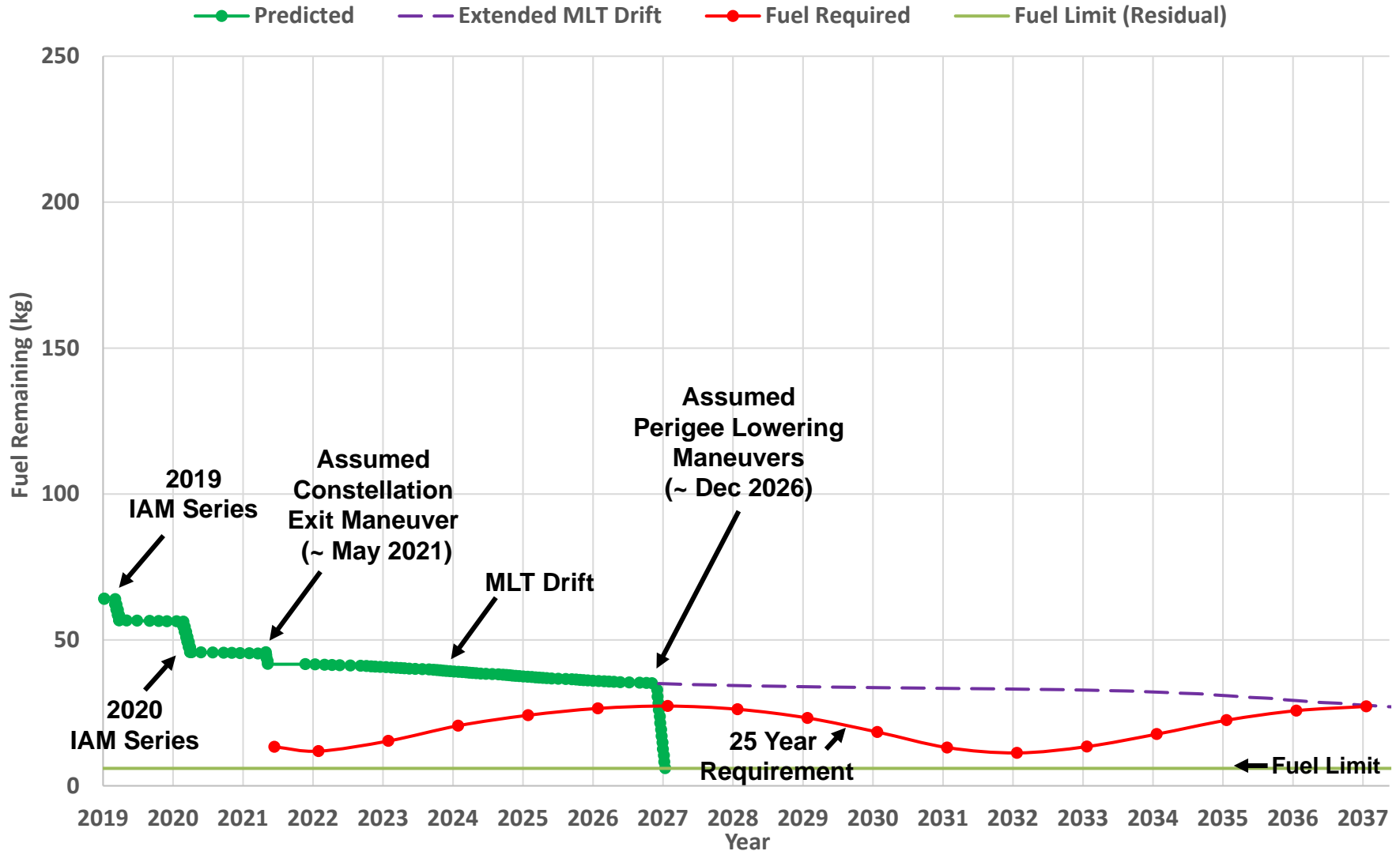




Aura Predicted Fuel Usage



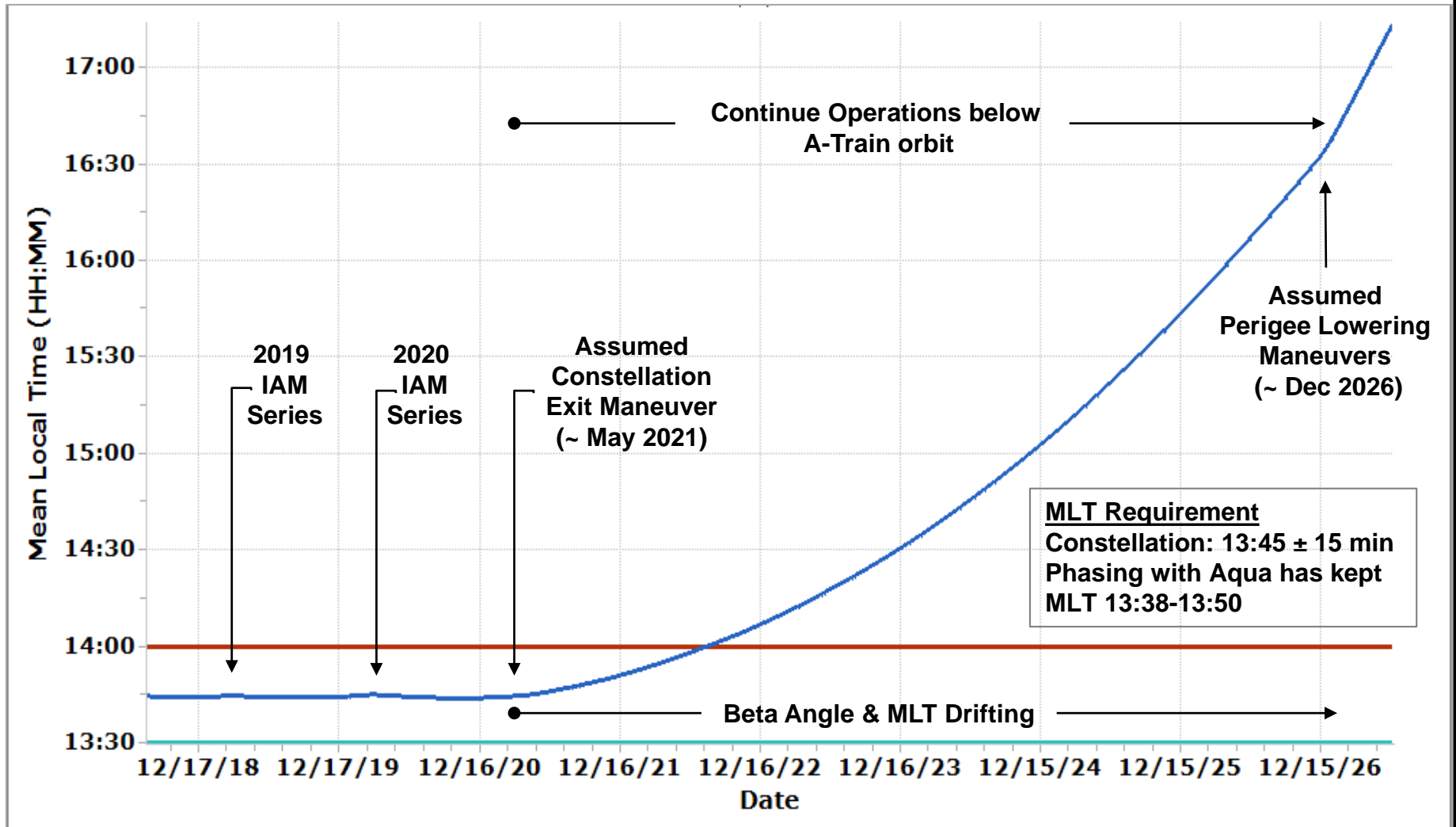
([Alternate Plan](#) – Analysis Updated November 2018)





Aura Predicted Mean Local Time

([Alternate Plan](#) – Analysis Updated November 2018)

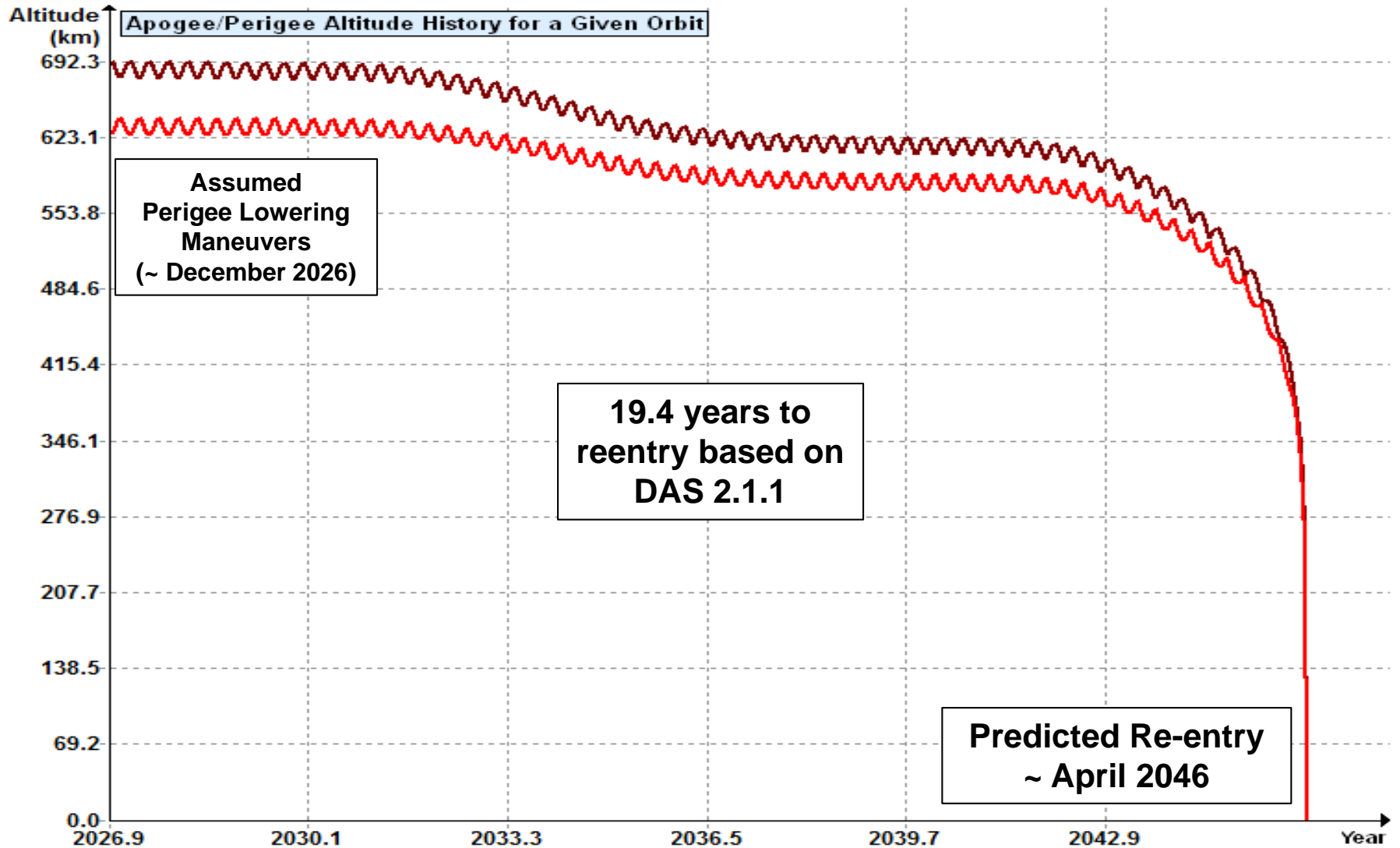




Aura Predicted Re-entry



([Alternate Plan](#) – Analysis Updated November 2018)



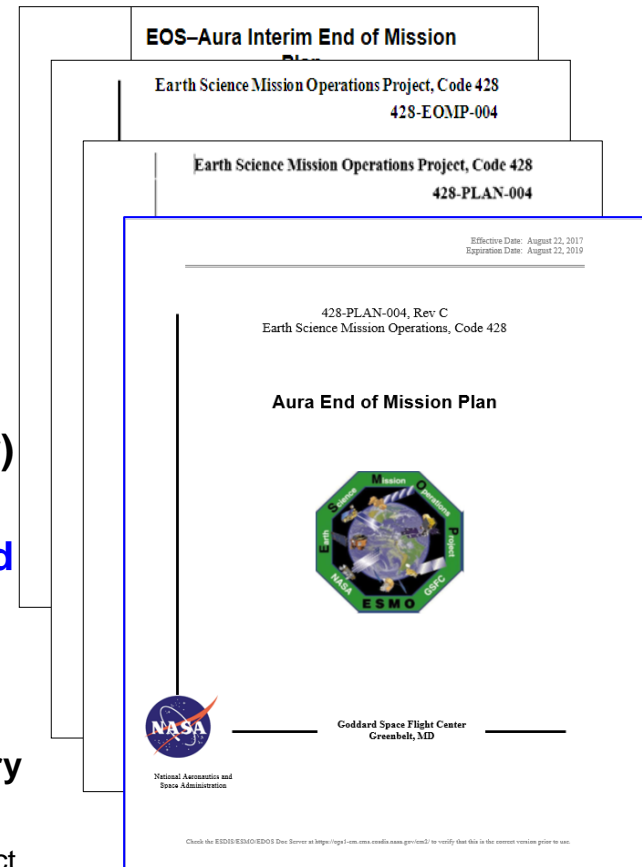


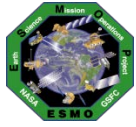
Aura End of Mission Plan (EOMP)

(Rev. C Updated Spring 2017)



- Initial draft February 2009
- Produced the first “Interim” End of Mission Plan (EOMP) in May 2011
 - Approved by NASA HQ July 2011
- Produced EOMP Rev A: February 2013
 - Updated Lifetime estimates, Small Object Collision Assessment
 - Waivers were approved in May 2013
- Produced EOMP Rev B: February 2015
 - Updated Lifetime Estimate
- Produced EOMP Rev C: August 2017 (in Code 400 review)
 - Lifetime estimates (as of 12/2016) & Reliability estimates
- **Rev D. to be produced for Summer 2019 with re-baselined plan – will need some waivers updated & reapproved**
- **Content Synopsis:**
 - Safely exit the A-Train Constellation
 - Passivate Aura to the extent possible for uncontrolled reentry
 - Aura has five (5) approved waivers for passivation
 - » Pressurant Passivation, Large Object Collision Probability, Small Object Collision Probability, Orbital Lifetime (30-Year), and Re-entry Risk (Uncontrolled)
- **Final will be produced 60 days before End of Mission**

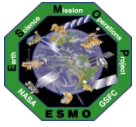




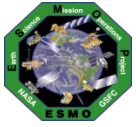
Summary



- **Spacecraft Status – GREEN**
 - COMM: Transmitter-B Reflected Power Anomaly (01/05/18) – No active impact
- **Instrument Status - GREEN**
 - HIRDLS: Chopper Stalled 03/17/08 – Not collecting science data
 - MLS: Operating Normally –
 - » 06/04/2018: 118 GHz Receiver-1A (R1A) Anomaly (Recovered 06/11/18)
 - » 06/20/2018: GHz Mirror Electronics (GME-B) Anomaly (Recovered 06/26/18)
 - » 07/10/2018: MLS Survival Mode Transition (Recovered 07/18/18)
 - » 10/25/2018: GHz Mirror Electronics (GME-B) Anomaly (Recovered 10/25/18)
 - OMI: Operating Normally
 - » 07/30/2018: OMI IAM Warm Restart (Recovered 07/31/18)
 - TES: Instrument Decommissioned on 01/31/18
- **Data Capture/L0 Processing Status – GREEN**
 - SSR Data Capture to 10/31/18: 99.99594810%
- **Ground Systems – GREEN**
 - Responding to new security requirements and upgrades to obsolete hardware or COTS systems, as required
 - 05/01/2018: MMS Build 25.2.0 Transition for Aura
 - 09/06/2018: EOS Automation (EA) Release 3.1 ORR



Questions



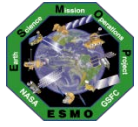
Additional Charts

**Maneuvers & Ground Track History
Orbital Trends**

**Aura Conjunction Assessment
High Interest Events (HIEs)**

Data Capture & Operations Errors

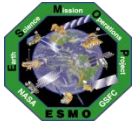
**Extended Mission Plans
(Analysis Updates)**



Orbit Maintenance



- **Mission Requirements:** Perform Drag Make-Up Maneuvers (DMUMs) to maintain Aura's Ground Track Error (GTE) with respect to the World Reference System (WRS-2)
 - Requirement: +/-20 Km as measured at the Descending Node
- To meet coincident viewing requirements, Aura's initial ground track was offset from Aqua's by one WRS path plus 25.4 Km
 - Aura was maintained -5.4 to -45.4 Km west of Aqua until late 2007
 - Since May 8, 2008, a new control box, +/- 10 Km from a +18 Km (east) offset of the Aqua WRS-2 path is used to maintain MLS-CALIPSO viewing request
- To date a total of **116** routine DMUMs have been performed
 - 07/19/2012: DMUM # 43 No Yaw Slew Maneuver (NYS) #1 – NYS Maneuvers (37)
 - Last maneuver 11/08/2018 (#116) – Next maneuver target for 12/12/2018 (#117)
 - Variation in performance from -3.5% (cold) to +3.3% (hot)
- Conducted **13** series of inclination adjustment maneuvers
 - Fall '04 (4), Fall '06 (4 of 6), Spring '07 (4), Spring '09 (9), Spring '10 (3), Spring '11 (3), Spring '12 (4), Spring '13 (4), Spring '14 (4), Spring '15 (5), Spring '16 (4), Spring '17 (4), Spring '18 (5) & Summer '18 (1)
 - Variation in performance from -4.5% (cold) to +1.9% (hot)

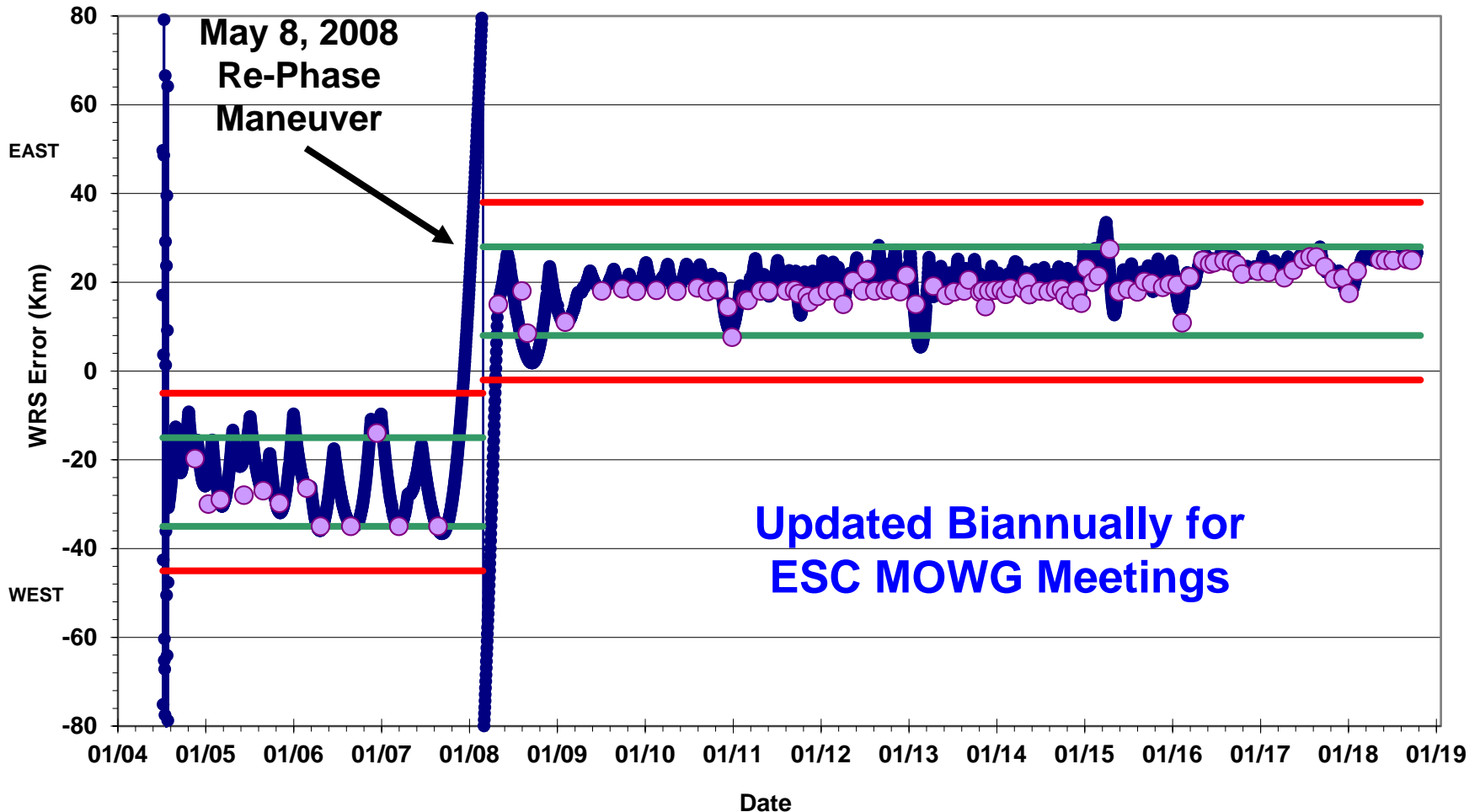


WRS Ground Track Error (GTE)

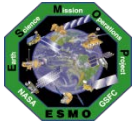
(As of October 21, 2018)



Aura WRS Groundtrack Error at the Descending Node
(Maneuver planning targets included)



Updated Biannually for
ESC MOWG Meetings

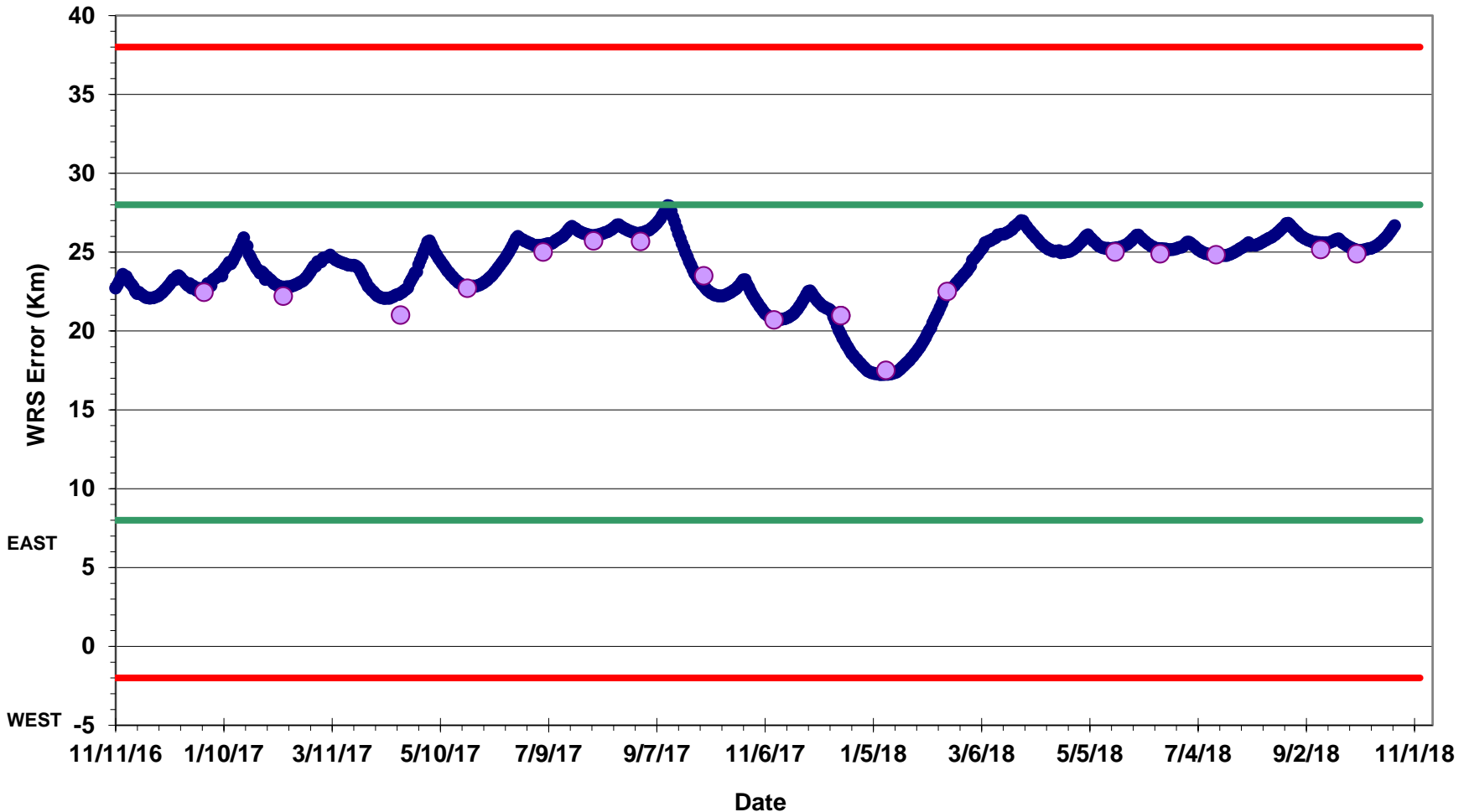


WRS Ground Track Error (GTE)

(As of October 21, 2018)



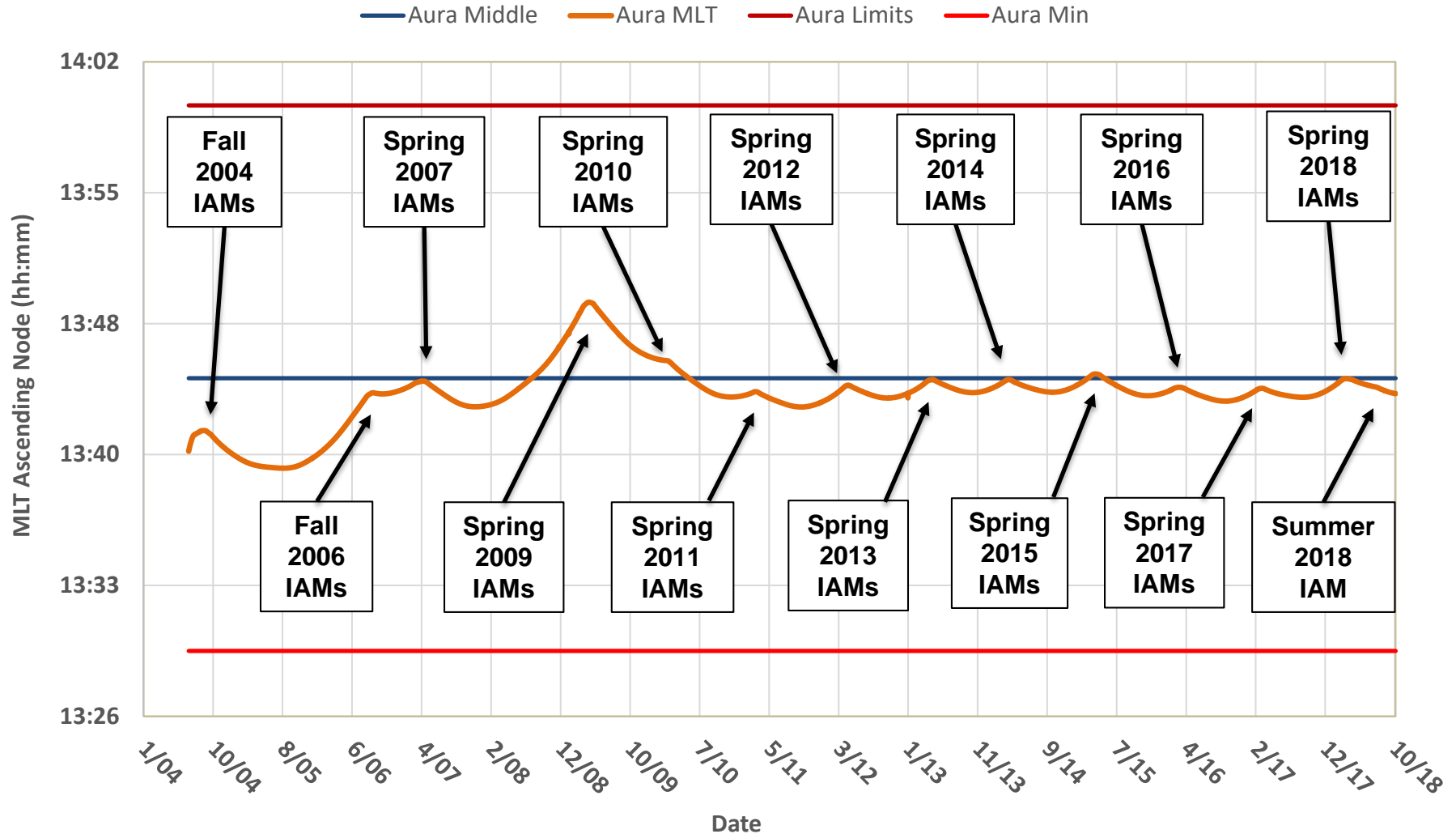
Aura WRS Groundtrack Error at the Descending Node
(Maneuver planning targets included)

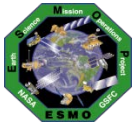




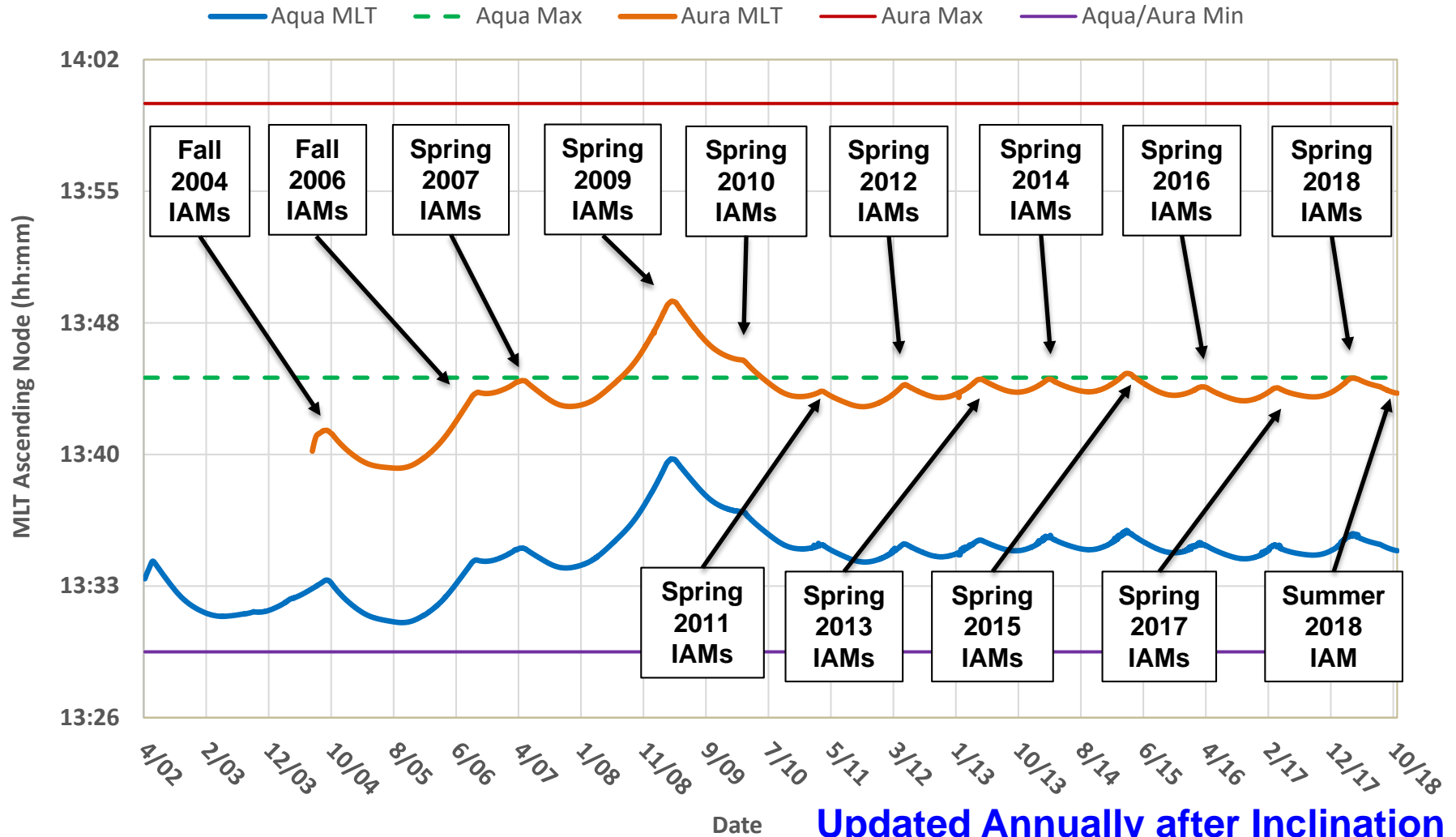
Aura Averaged MLT @ Ascending Node

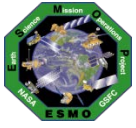
(As of October 21, 2018)



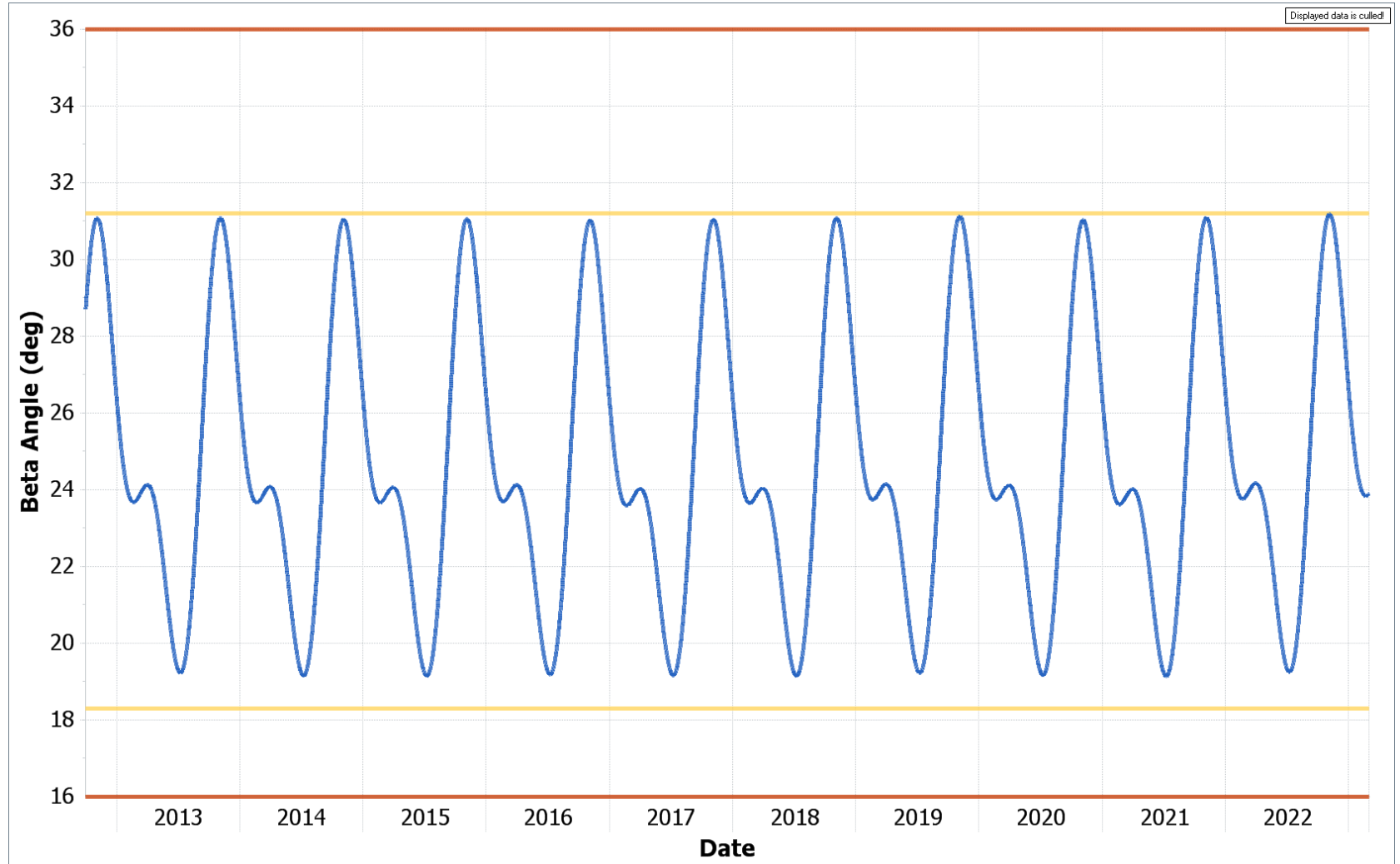


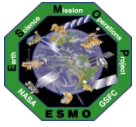
Aqua/Aura Mean Local Time (MLT) @ Ascending Node (As of October 21, 2018)





Aura Predicted Beta Angle (With Yearly Inclination Maneuvers) (No Change)



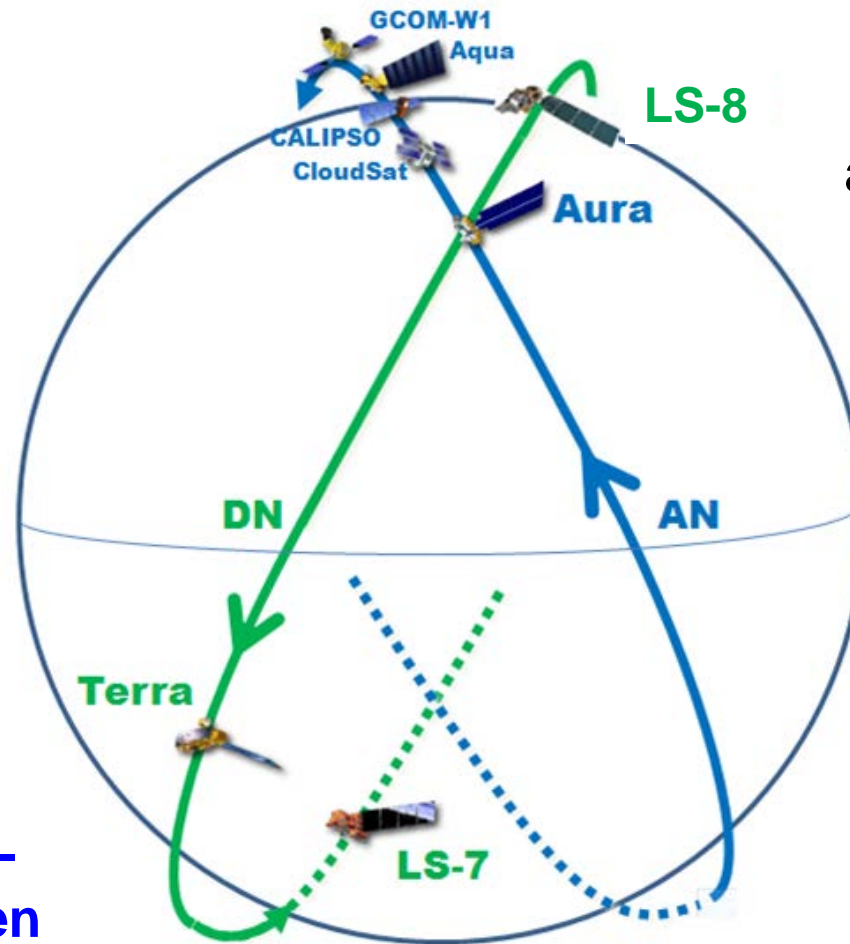


Aura and Landsat-8 (LS-8) Orbit Phasing



With Aura in the intersection point
LS-8 will be ~ 77 seconds away from the intersection
Point worse case

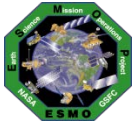
By Design –
LS-8 and LS-7
are 1/2 orbit apart



Over the past 12 months (Dec-Nov) there has been 205-310 seconds between Aura and LS-8

Terra ~ 30 min behind LS-7

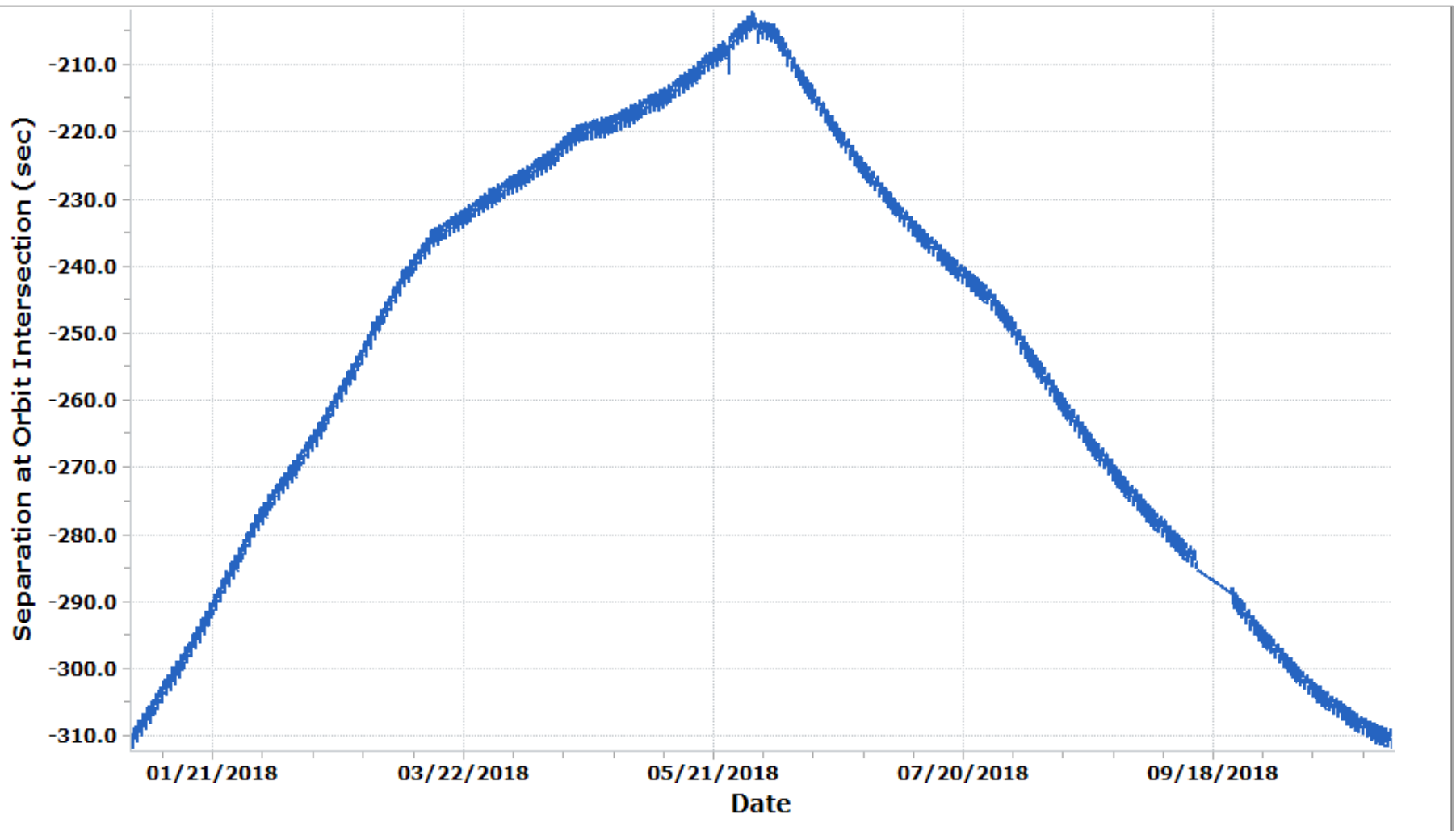
1 Orbit = ~ 100 minutes

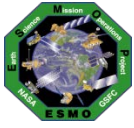


LS-8/Aura Phasing at Poles



@ Northern Intersection Point (as of October 31, 2018)





Aura Conjunction Assessment High Interest Events (HIEs)



	Jun `18	Jul `18	Aug `18	Sep `18	Oct `18	Nov `18	Total
Tier 1	0	0	0	0	0		0
Tier 2	0	0	0	0	0		0
Tier 3	0	1	1	1	1		4
Tier 4	0	0	0	0	1		1
Total	0	1	1	1	2		5

2014: 33 CARA HIEs – 18 required significant action (T2-T4)

2015: 32 CARA HIEs – 18 required significant action (T2-T4)

2016: 24 CARA HIEs – 16 required significant action (T2-T4)

2017: 19 CARA HIEs – 16 required significant action (T2-T4)

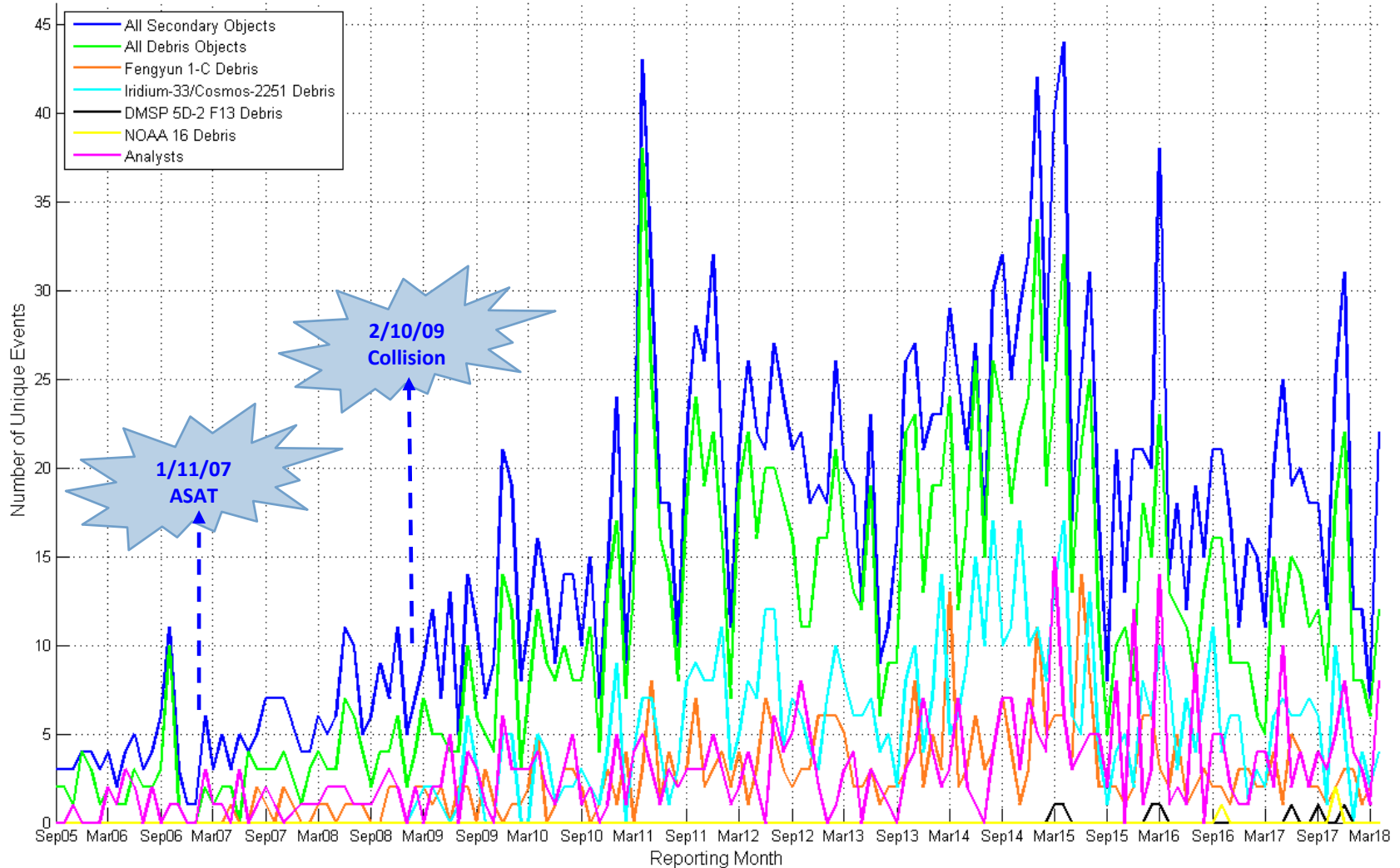
2018: 11 CARA HIEs (thru 10/25/2018) – 11 required significant monitoring and/or actions (T2-T4)

1. 01/16/2018: CA vs. 80720 at 08:46:49 GMT – DAM planned but conjunction Pc rolled off (T3)
2. 02/03/2018: CA vs. 89363 at 20:45:22 GMT – Automated options generated and screened but conjunction Pc rolled off (T3)
3. 02/13/2018: CA vs. 38243 at 06:29:36 GMT – DAM planned but conjunction Pc rolled off (T3)
4. 03/01/2018: CA vs. 30499 at 12:27:12 GMT – Post-IAM conjunction of concern, TCA was 22 hours post burn, Pc rolled off (T3)
5. 04/09/2018: CA vs. 89188 at 12:30:36 GMT – Maneuver options generated and screened, Pc dropped w/ updated tracking (T3)
6. 04/15/2018: CA vs. 89301 at 19:15:35 GMT – Briefed for IAM CAM, after IAM postponement Pc rolled off (T2)
7. 07/17/2018: CA vs. 81061 at 00:35:33 GMT – Maneuver options generated and screened, Pc dropped w/ updated tracking (T3)
8. 08/09/2018: CA vs. 82553 at 02:21:15 GMT – Maneuver options generated and screened, Pc dropped w/ updated tracking (T3)
9. 09/09/2018: CA vs. 43387 at 10:33:47 GMT – Maneuver options generated and screened, Pc dropped w/ updated tracking (T3)
10. 10/03/2018: CA vs. 82528 at 14:00:07 GMT – Maneuver options generated and screened, Pc dropped w/ updated tracking (T3)
11. 10/22/2018: CA vs. 81982 at 10:09:41 GMT – Planned DMU rescheduled due to post-maneuver conjunction of concern (T4)

Tier 1 – Notify (email/phone), Tier 2 – Conduct Briefing,
Tier 3 – Plan Maneuver, Tier 4 – Execute Maneuver



Aura Conjunction Assessment (September 2005 thru April 2018)

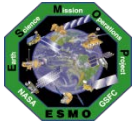


Credit: NASA CARA Team

12/04/2018

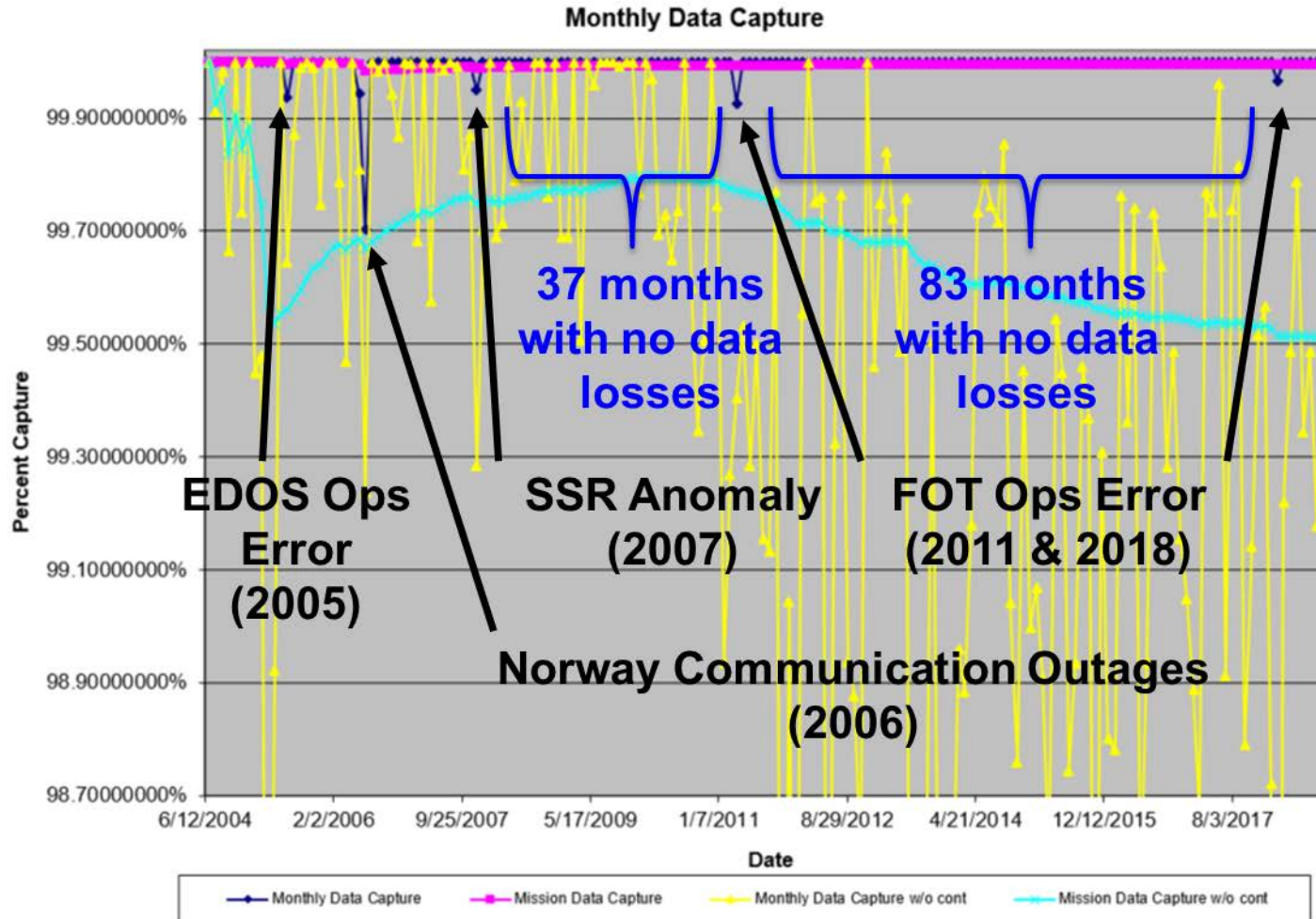
ESC MOWG - December 2018

33



Aura Monthly Data Capture

SSR Data Capture to 10/31/2018: 99.99594810%



Mission Capture Req. = 95%

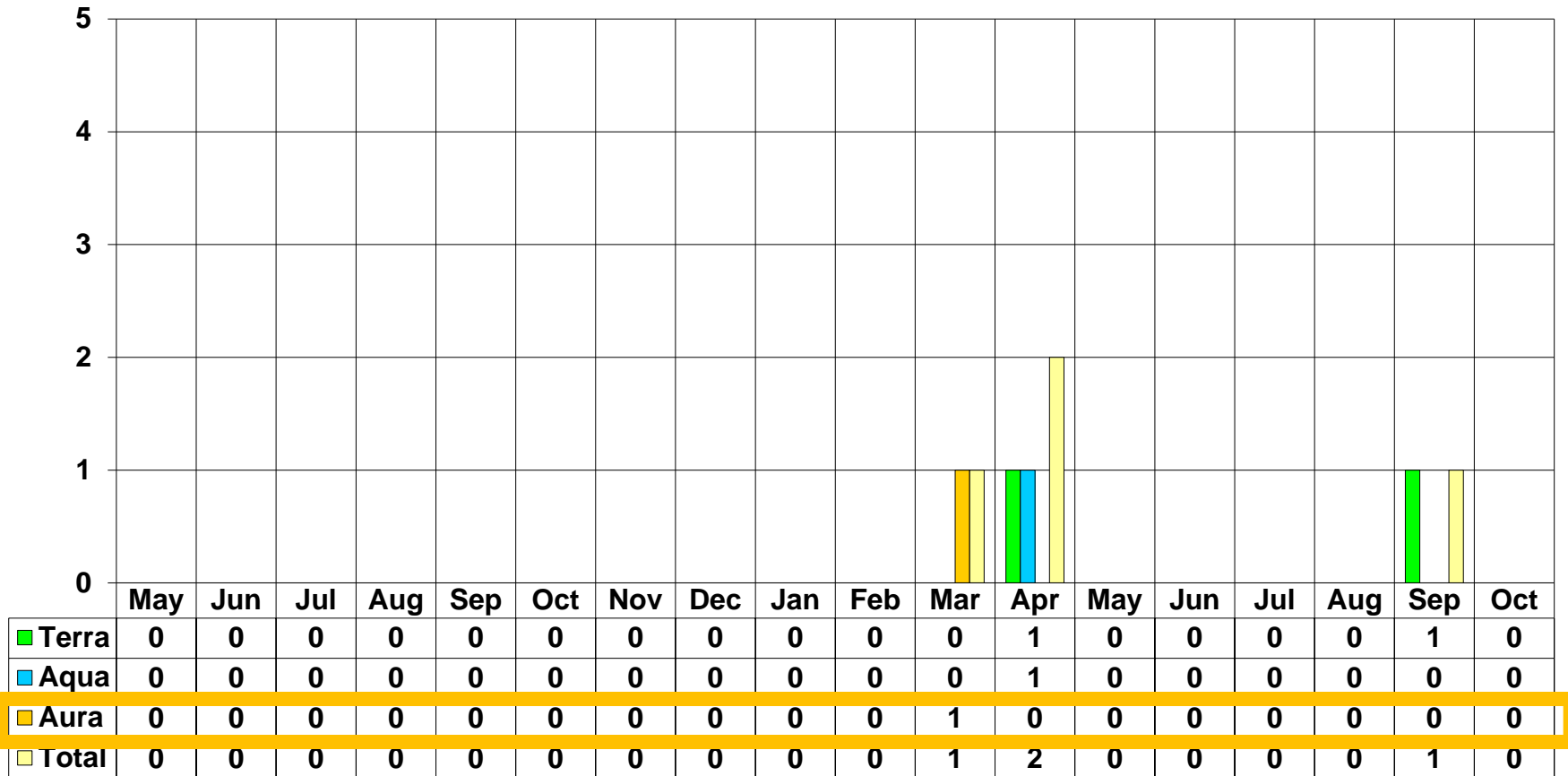


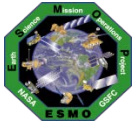
Operational Errors

(18-Months: **May 2017 – October 2018**)



Aura: 7 Months since last operational error (March 2018)





Aura Baseline Decommissioning Plan

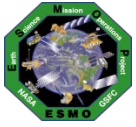
(Current Baseline Plan – Analysis Updated November 2018)



- **Baseline Decommissioning Plan Assumptions:**

- Maintain MLT and WRS-2 Ground Track requirements until the DAS 25-year re-entry fuel limit is reached (Spring 2023)
 - Perform nominal annual IAMs to maintain MLT
 - Perform periodic DMUs to maintain WRS-2 Ground Track Error

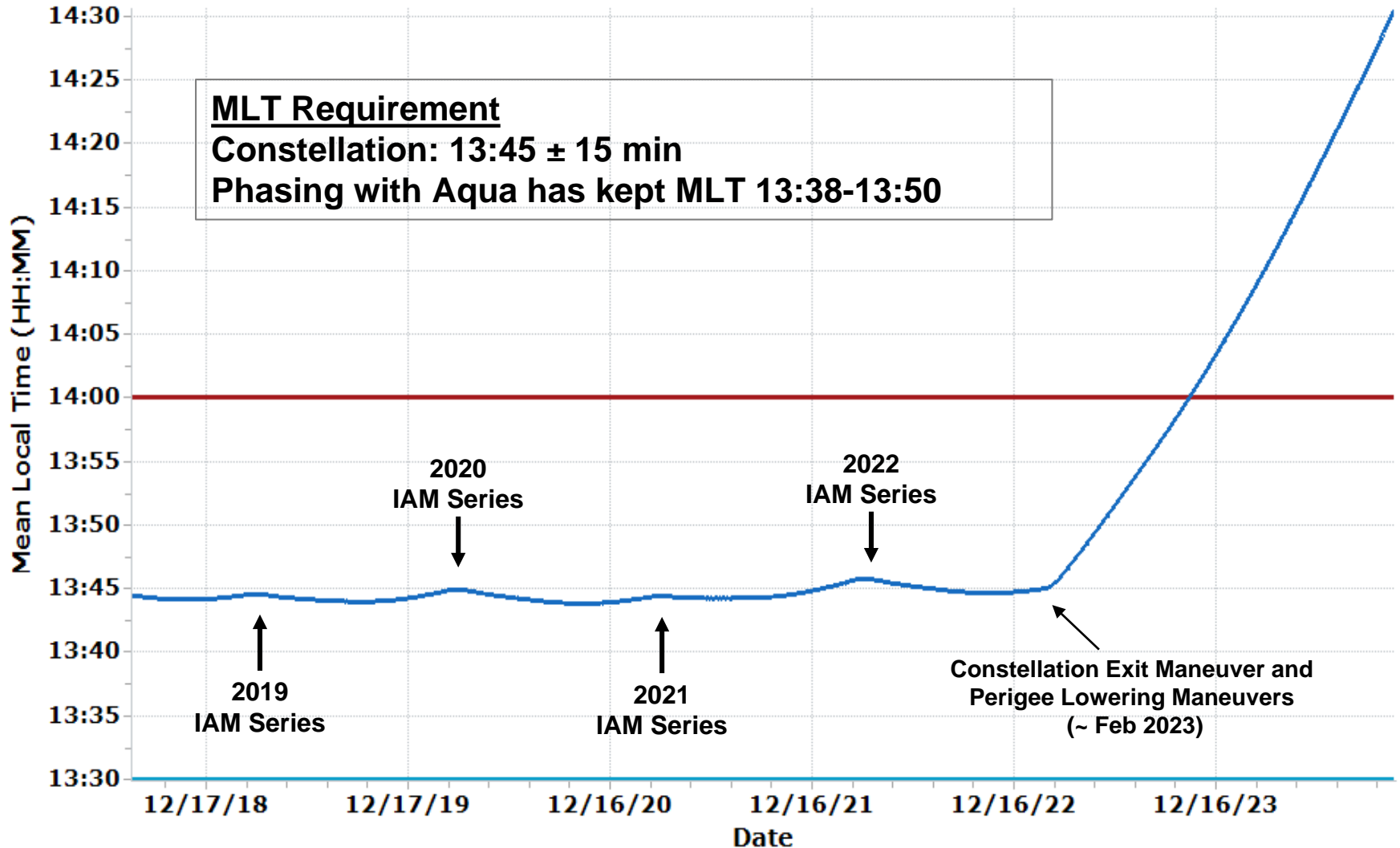
To be documented in 'EOS FDS Updated Analysis for Aura Decommissioning'
(v2.0, 11/__/18)

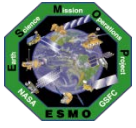


Aura Predicted Mean Local Time



(Current Baseline Plan – Analysis Updated November 2018)

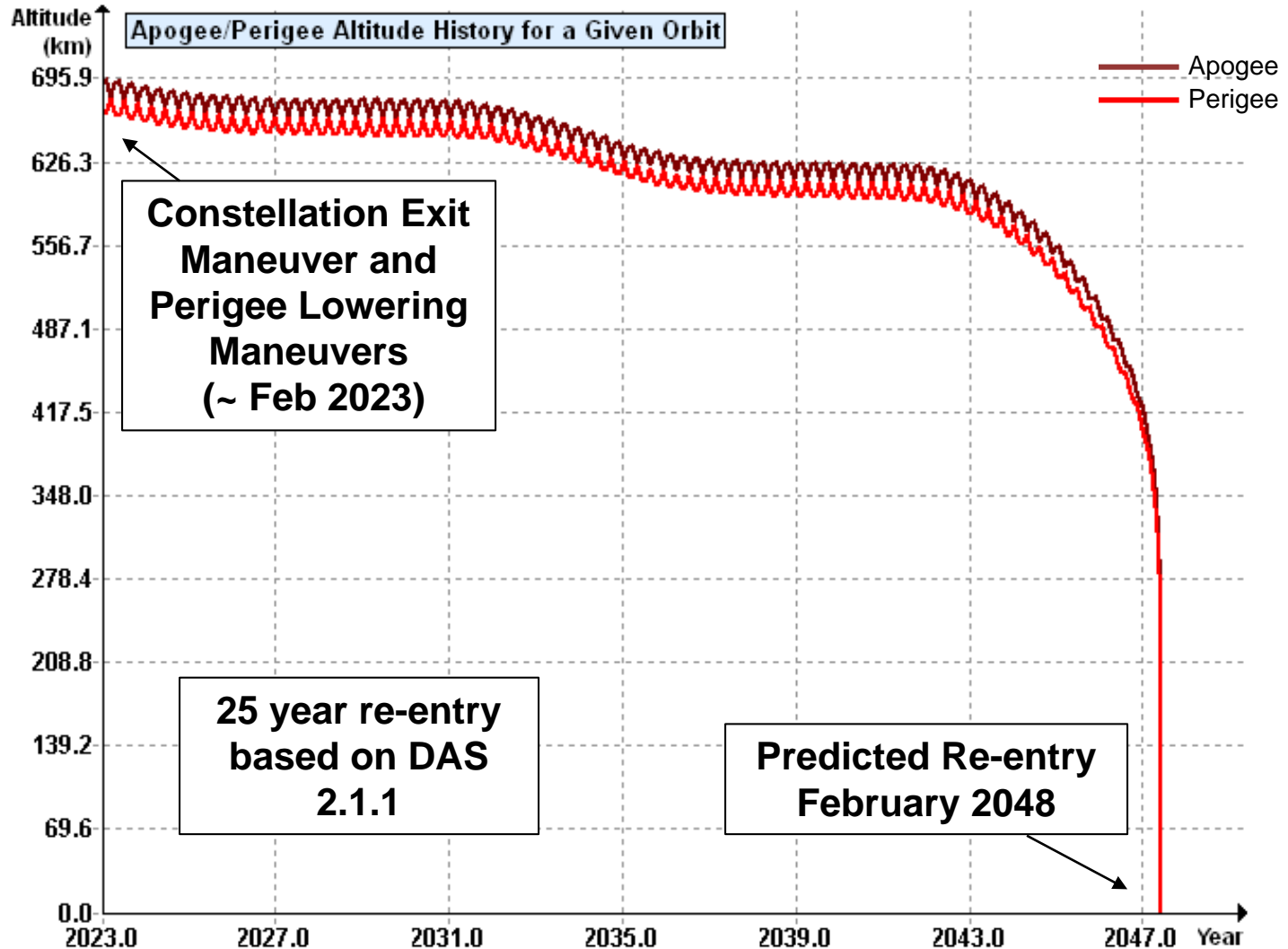




Aura Predicted Re-entry



(Current Baseline Plan – Analysis Updated November 2018)

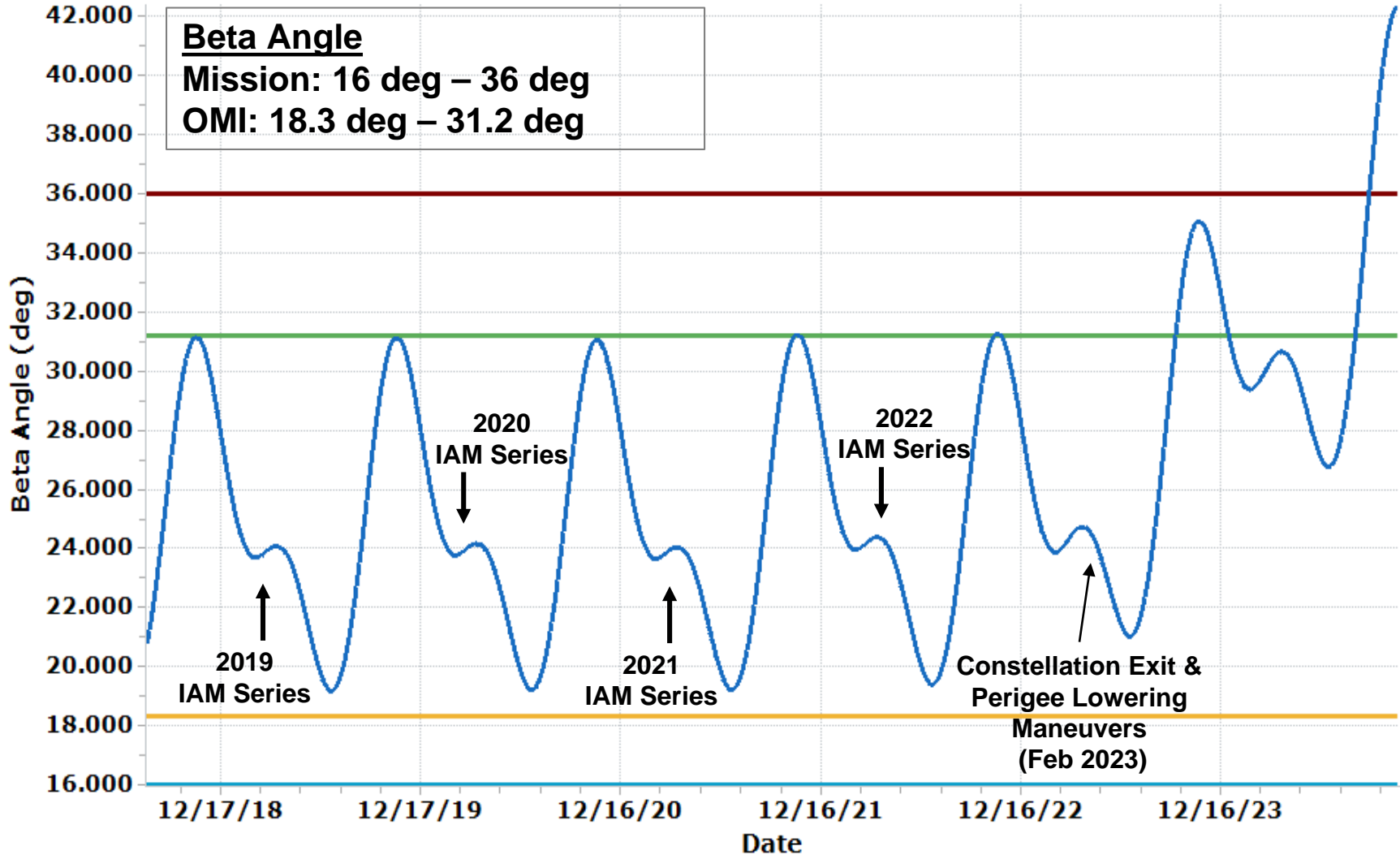




Aura Predicted Beta Angle



(Current Baseline Plan – Analysis Updated November 2018)

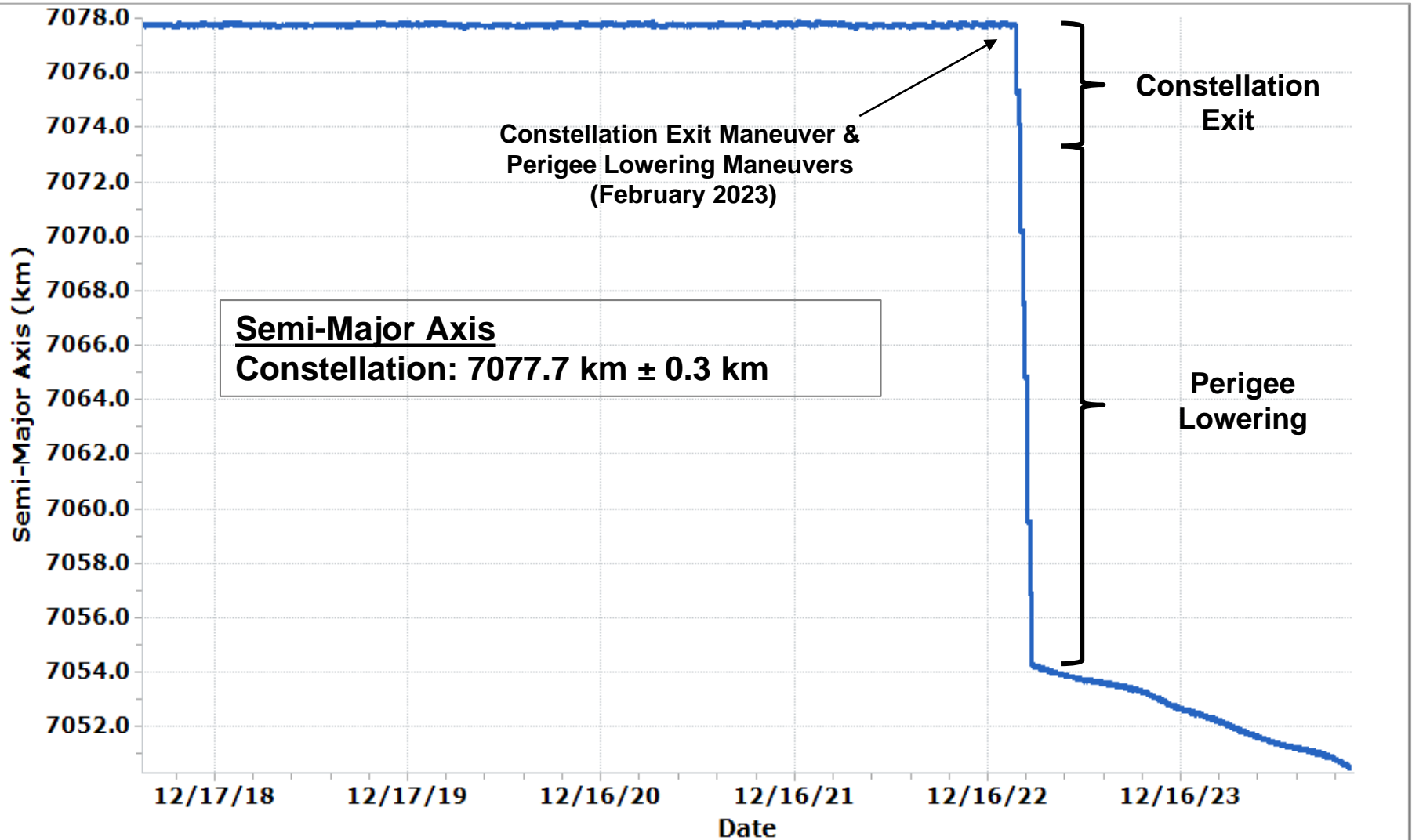


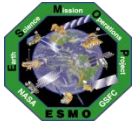


Aura Predicted Semi-Major Axis



(Current Baseline Plan – Analysis Updated November 2018)

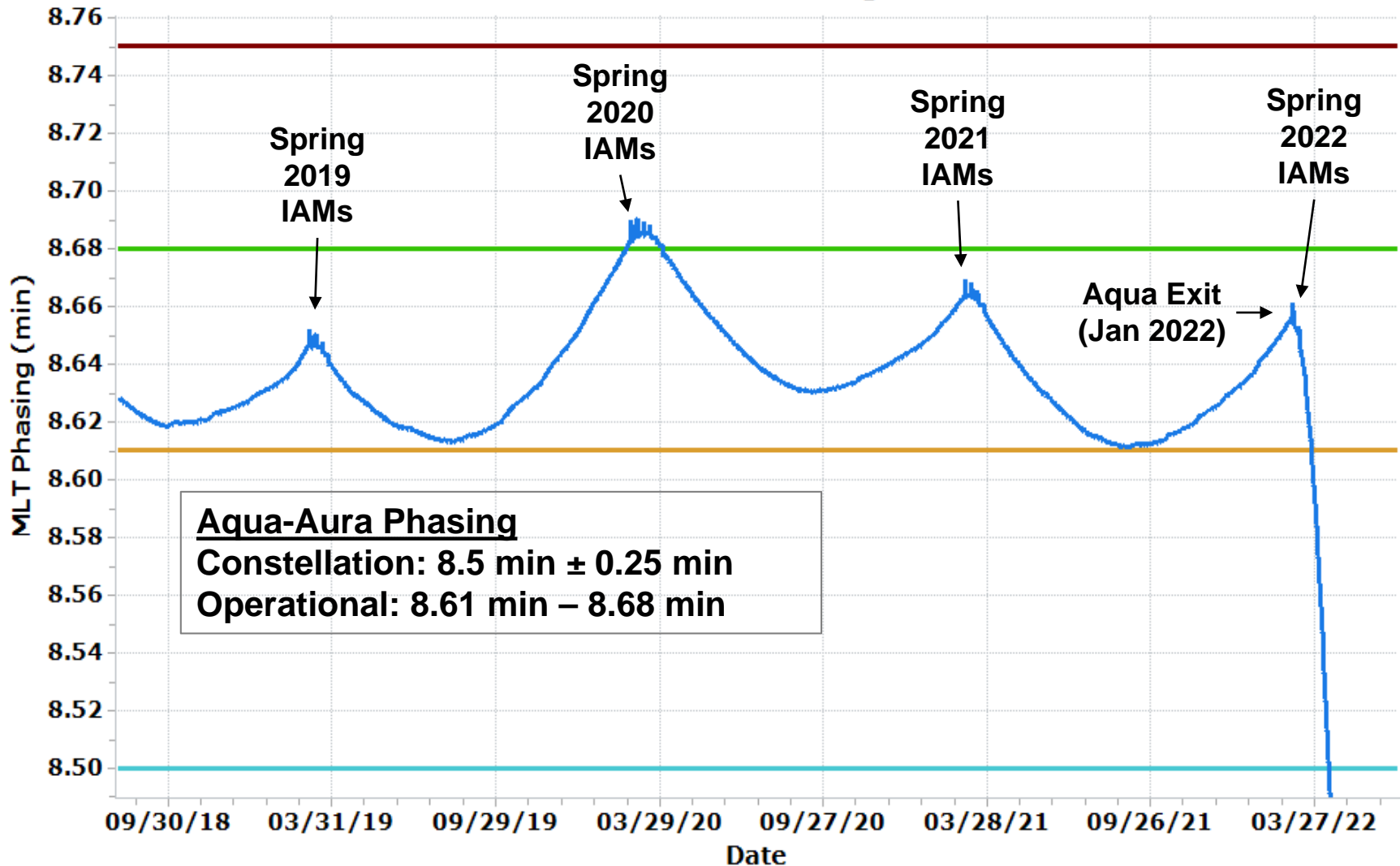


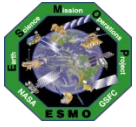


Aura MLT Phasing with Aqua



(Current Baseline Plan – Analysis Updated November 2018)





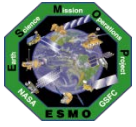
Aura Alternate Decommissioning Plan

(Alternate Plan – Analysis Updated November 2018)



- **Alternate Decommissioning Plan Rationale:**
 - After the OMI / TROPOMI 2-year overlap period ends, **May 2020**, fuel saving orbital maintenance schemes may be a consideration (Sentinel-5P launch on 10/13/17, TROPOMI completed check out in **April 2018**)
- **Alternate Decommissioning Plan Assumptions:**
 - Full IAM Series through 2019 & **2020**
 - Exit A-Train in **May 2021** (4.4 km lower in SMA)
 - Stop performing annual IAMs after the **2020** series
 - Allow MLT and Solar Beta Angle to drift through **2026**
 - Perform periodic DMUs until **2026**
 - Maintain WRS-2 ground track and frozen orbit

To be documented in 'EOS FDS Updated Analysis for Aura Decommissioning'
(v2.0, 11/__/18, Appendix B)

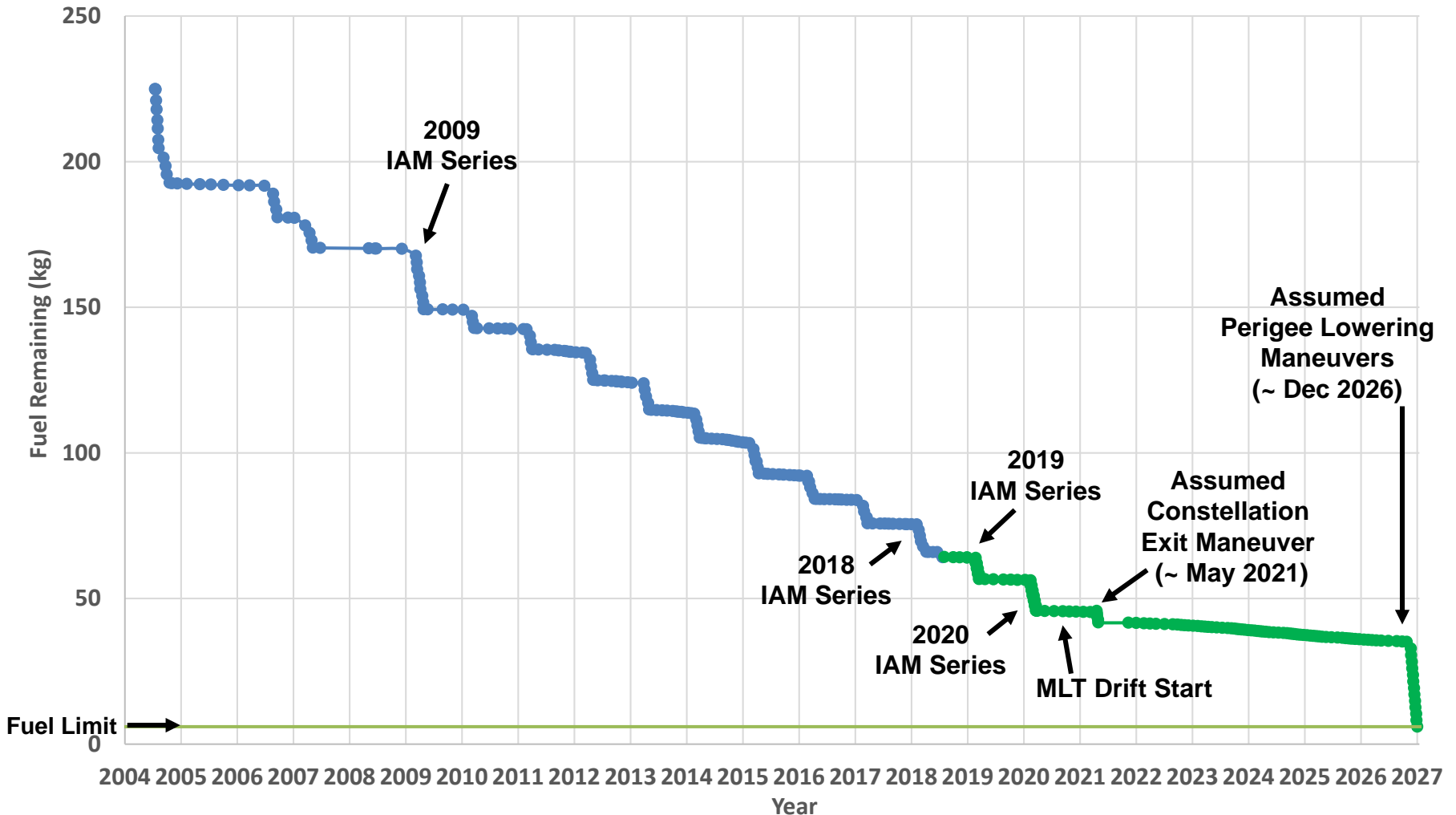


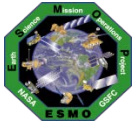
Aura Fuel Usage: Actual & Predicted

([Alternate Plan](#) – Analysis Updated November 2018)



—●— Definitive —●— Predicted — Fuel Limit (Residual)

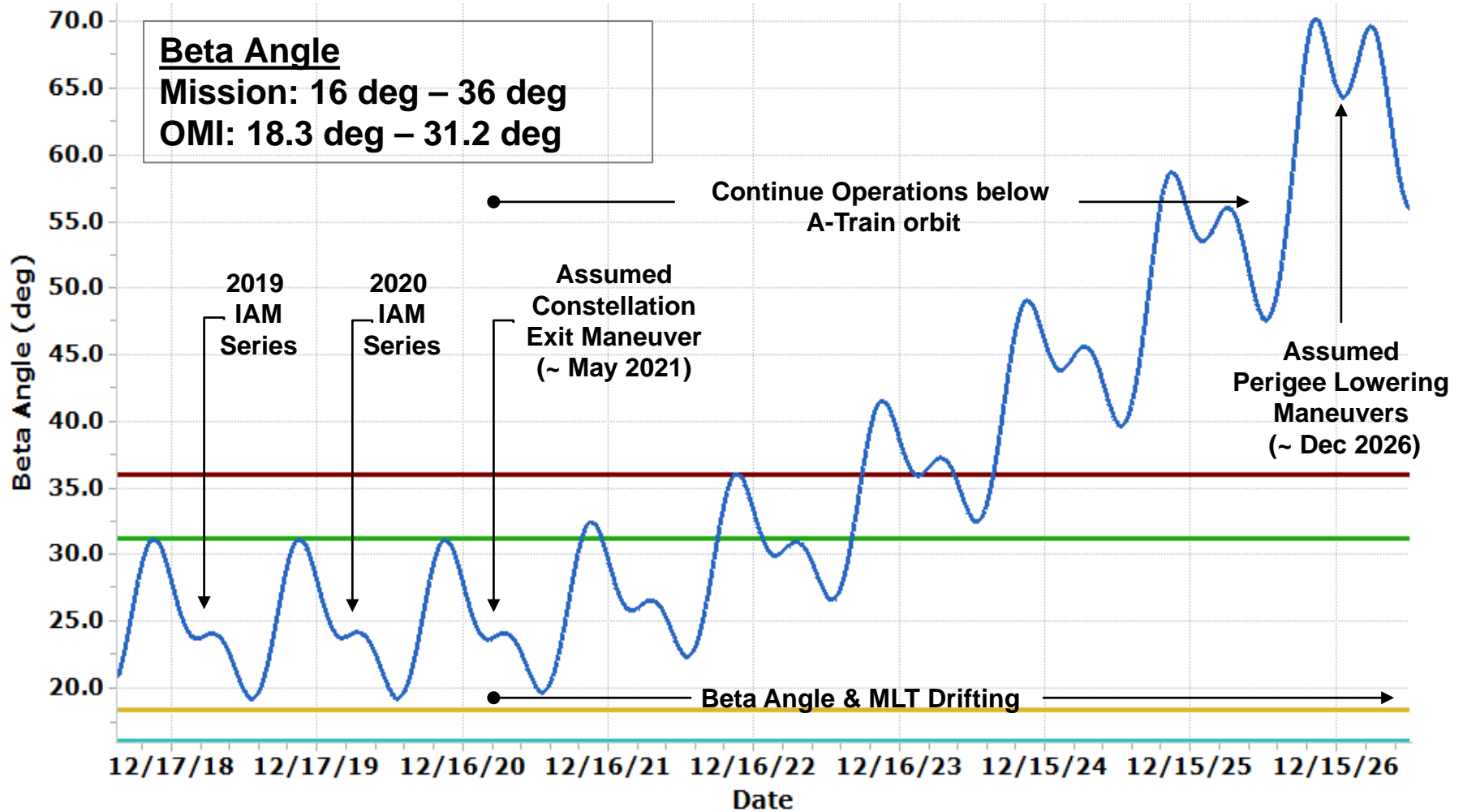


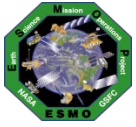


Aura Predicted Beta Angle



(Alternate Plan – Analysis Updated November 2018)

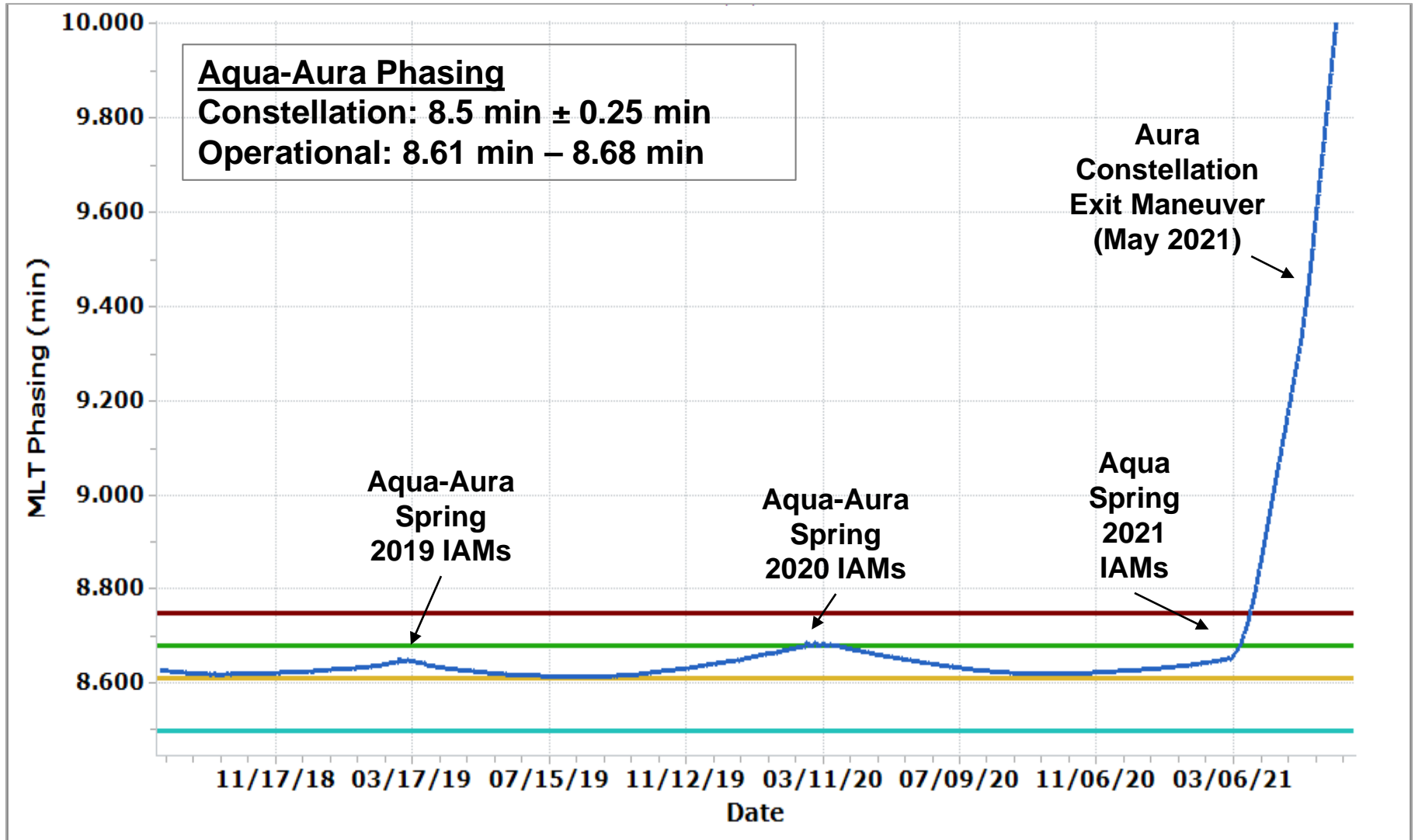


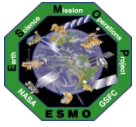


Aura MLT Phasing with Aqua



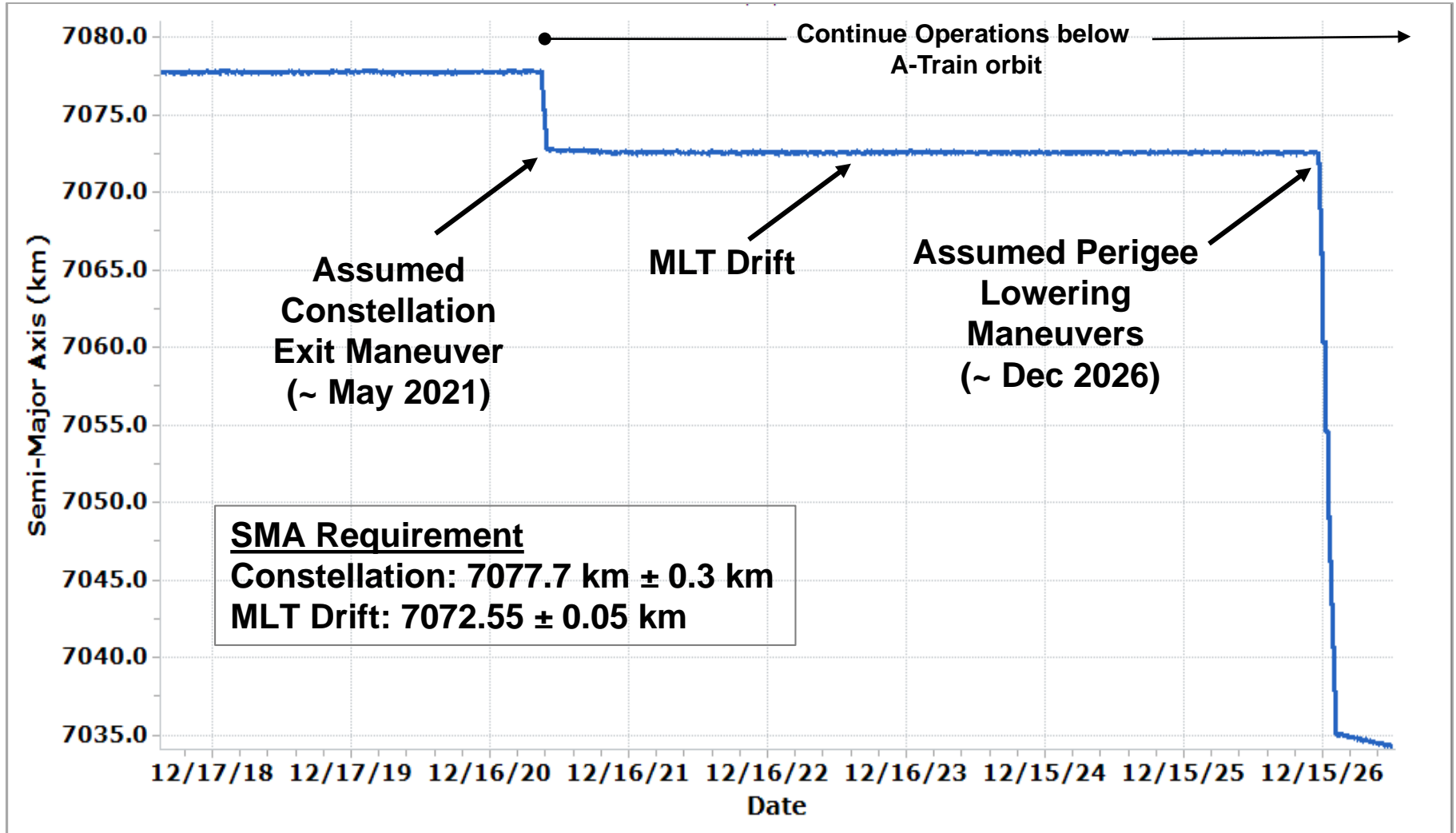
(Alternate Plan – Analysis Updated November 2018)

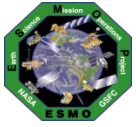




Aura Predicted Semi-Major Axis

([Alternate Plan](#) – Analysis Updated November 2018)

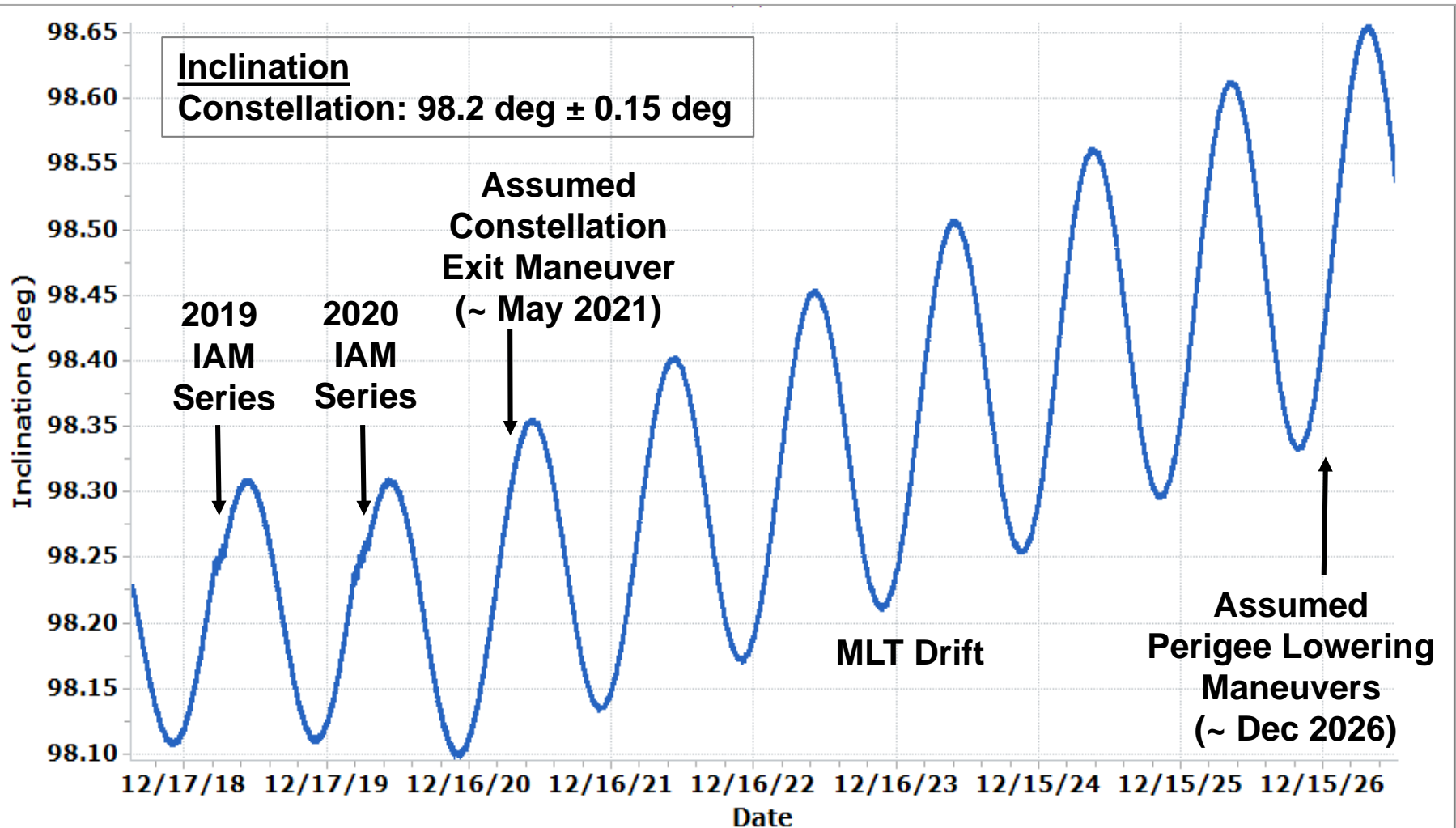




Aura Predicted Inclination



([Alternate Plan](#) – Analysis Updated November 2018)





Abbreviations / Acronyms List



AFM –	Aqua/Aura FSW Maintenance	FM –	Fault Management	NASA –	National Aeronautics & Space Administration
AN –	Ascending Node	FMU –	Formatter Multiplexer Unit	NOAA –	National Oceanic and Atmospheric Administration
ARE –	Array Regulator Electronics	FOT –	Flight Operations Team	NYS –	No Yaw Slew
ASAT –	Anti-satellite Weapon	FSW –	Flight Software	Ops –	Operations
CA –	Conjunction Assessment	GCOM-W –	Global Change Observation Mission- Water	OMI –	Ozone Monitoring Instrument
CALIPSO –	Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations	GMT –	Greenwich Mean Time	OMI-IAM –	OMI Interface Adapter Module
CARA –	Conjunction Assessment Risk Analysis	GNC –	Guidance Navigation & Control	ORR –	Operational Readiness Review
CDH –	Command & Data Handling	GS –	Global Survey	PROP –	Propulsion
CDR –	Critical Design Review	GSFC –	Goddard Space Flight Center	Pc –	Probability of Collision
CDM –	Conjunction Data Message	GTE –	Ground Track Error	R2 –	Receiver 2
COMM –	Communications	HIE –	High Interest Event	RHEL –	Red Hat Enterprise Linux
COTS –	Commercial-Off-The-Shelf	HIRDLS –	High Resolution Dynamics Limb Sounder	RMM –	Risk Mitigation Maneuver
CRMS –	Collision Risk Management System	HK –	Housekeeping	RW –	Reaction Wheel
DAM –	Debris Avoidance Maneuver	HQ –	Headquarters	RWA –	Reaction Wheel Assembly
DAS –	Debris Assessment Software	IAM –	Inclination Adjustment Maneuver	SC –	Spacecraft
DMSP –	Defense Meteorological Satellite Program	ICS –	Interferometer Control System	SCS –	Stored Command Sequence
DN –	Descending Node	ID –	Ideal Date	SD –	South Dakota
DMUM –	Drag Make-up Maneuver	IEM –	Integrated Electronics Module	SMA –	Semi-Major Axis
EA –	EOS Automation	IOT –	Instrument Operations Team	SMD –	Science Mission Directorate
EDOS –	EOS Data Operations System	JPL –	Jet Propulsion Lab	SSR –	Solid State Recorder
EOC –	EOS Operations Center	JSpOC –	Joint Space Operations Center	TBD –	To Be Determined
EOL –	End of Life	kg –	kilogram	TCA –	Time of Closest Approach
EOMP –	End of Mission Plan	km –	kilometer	TCS –	Thermal Control System
EOS –	Earth Observing System	KSC –	Kennedy Space Center	TES –	Tropospheric Emissions Spectrometer
EOSSIM –	EOS Simulator	L0 –	Level-Zero	THz –	Terahertz
EPS –	Electrical Power System	LS –	Landsat	TMON –	Telemetry Monitor
EPR –	Engineering Peer Review	MLS –	Microwave Limb Sounder	TROPOMI –	Troposphere Measuring Instrument
ESC –	Earth Science Constellation	MLT –	Mean Local Time	WRS –	World Reference System
ESD –	Earth Science Division	MLTAN –	MLT of the Ascending Node		
ESMO –	Earth Science Mission Operations	MMOD –	Micrometeorite Orbital Debris		
ETSF –	EOC Training Simulator Facility	MMS –	Mission Management System		
FDS –	Flight Dynamics System	MOWG –	Mission Operations Working Group		
		MTS –	Maneuver Trade Space		