

United States Brazil Canada Finland France Japan Netherlands United Kingdom

International Earth Science Constellation Mission Operations Working Group (MOWG)

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Aura Spring 2018 IAM Series Results

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Agenda

- Recap Aura 2018 Inclination Adjust Maneuver (IAM) Campaign
  - Maneuver Results
  - Post-2018 IAM Mean Local Time (MLT) Evolution
- Aura's Recent IAM Performance
- 2019 IAM Campaign Dates and Planning
- Aura Latest Lifetime MLT Term Predictions

Aura Spring 2018 Series Summary

- Aura performed 5 inclination maneuvers between February 28th to April 18th
- The final IAM had to be shifted back a week from April 11th to April 18th to match Aqua
  - Helps maintain phasing
  - Prevents the phasing spike that would cause a violation of the tighter operational phasing limits
- Maneuver angles and durations were adjusted through the series to attempt to maintain phasing and ground track control
- All angles and durations were within historical limits
- This series utilized a more dynamic and updated trending method to predict both the series performance and each maneuver's performance
- Like Aqua, Aura's performance was similar to previous series performance, though colder than desired
  - The pitch offset error is growing while the yaw offset error is decreasing
  - Recent inclination burn segment duty cycles appear to be trending downward

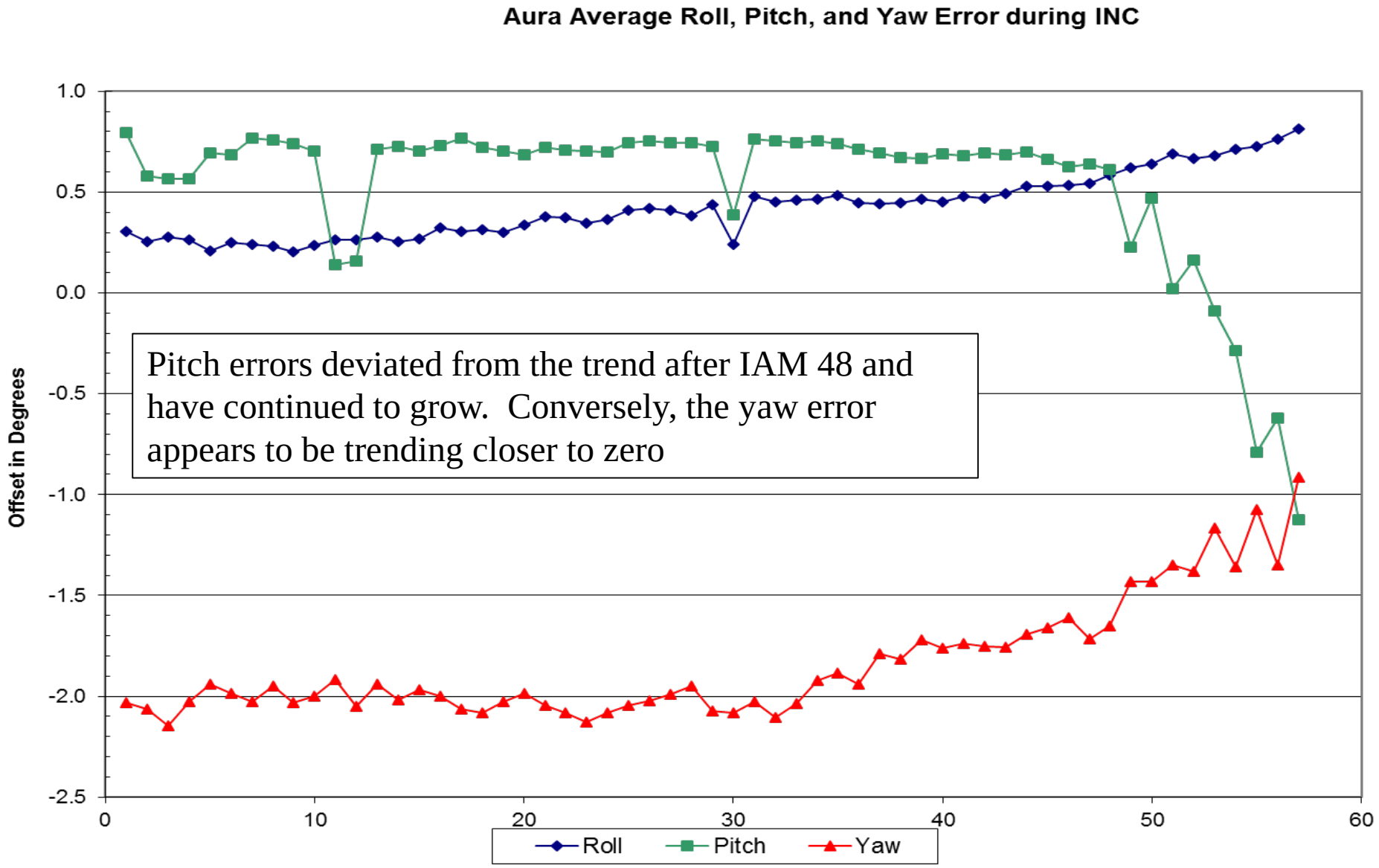
Results

Inc #	Date	Burn Dur (sec)	Commanded Yaw (deg)	Achieved Yaw (deg)		Delta Inclination (deg)		Delta RAAN* (deg)	
				Predicted	Definitive	Predicted	Definitive	Predicted	Definitive
53	Feb 28	393	-84.0	-82.57	-82.84	-0.00852	-0.00853	0.00176	0.00174
54	Mar 07	393	-84.0	-82.64	-82.64	-0.00857	-0.00851	0.00130	0.00125
55	Mar 14	393	-83.9	-82.57	-82.83	-0.00857	-0.00840	0.00083	0.00083
56	Mar 28	378	-83.7	-82.45	-82.35	-0.00835	-0.00813	-0.00003	-0.00000
57	Apr 18	378	-84.5	-83.23	-83.59	-0.00820	-0.00798	-0.00130	-0.00128
*Right Ascension of the Ascending Node (RAAN)						**Total:**	**0.04155**		

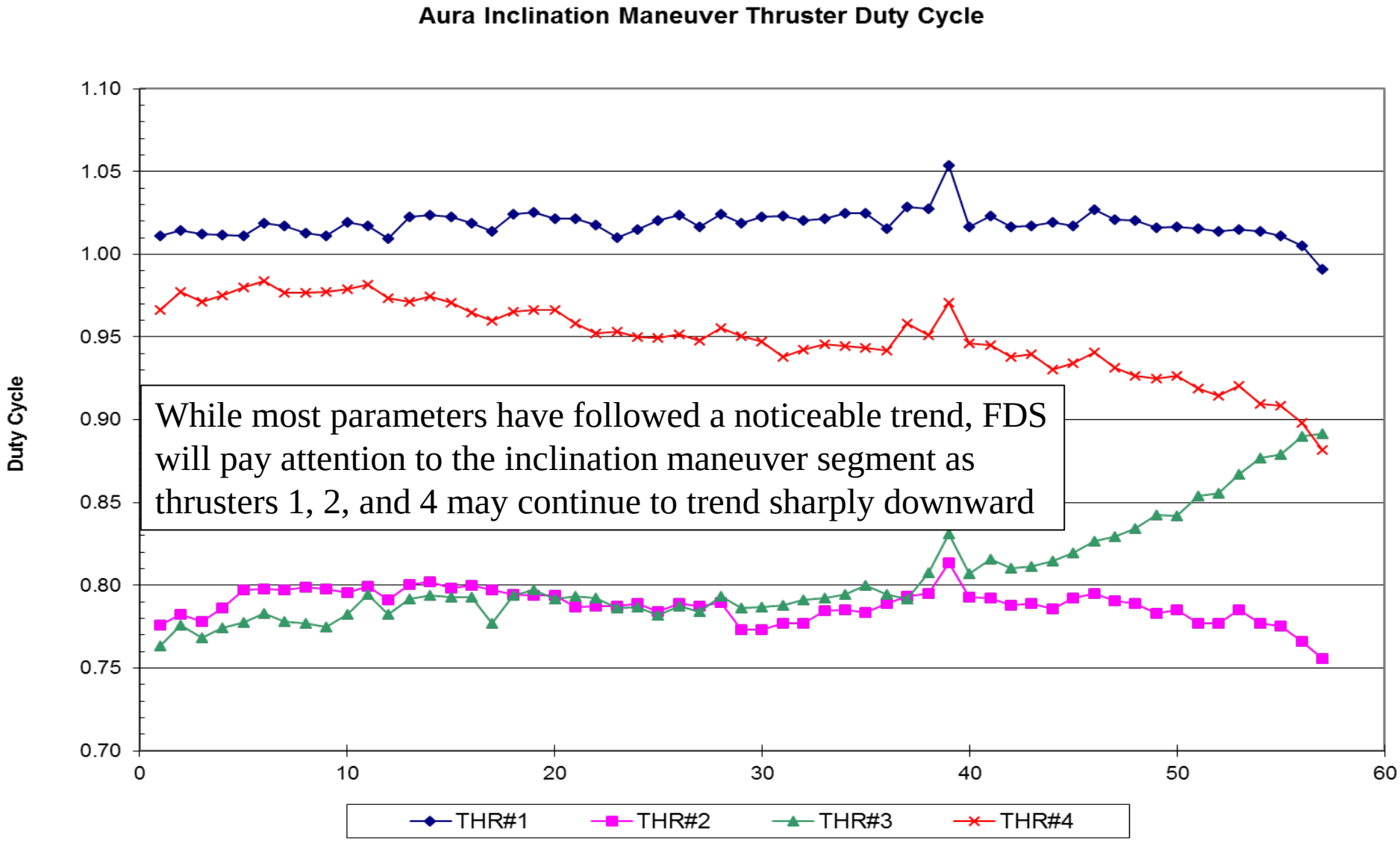
Aura Spring 2018 Series Summary

- While Aqua is the focus of the post-maneuver performance analysis, there are some interesting trends that will be analyzed
- After an initial analysis of the available data, Aura does not appear to be exhibiting the same behavior as Aqua

Aura's IAM Performance



Aura's IAM Performance



While most parameters have followed a noticeable trend, FDS will pay attention to the inclination maneuver segment as thrusters 1, 2, and 4 may continue to trend sharply downward

Aura Spring 2019 IAM Campaign Planning

- The Aura Spring 2019 IAM plan consists of 6 inclination maneuvers
- Aura's predicted ideal burn date occurs around March 28, 2019
- Proposed plan has 5 maneuvers occurring before the ideal burn date, and 1 after
  - February 27 (IAM #58)
  - March 7 (IAM #59)
  - March 13 (IAM #60)
  - March 20 (IAM #61)
  - March 27 (IAM #62)
  - April 3 (IAM #63)
- Dates are set so Aura maneuvers a day before Aqua

Proposed Aqua/Aura 2019 Maneuver Schedule

Aqua/Aura 2019 Inclination Maneuver Series Schedule

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
February 24	25	26	27 Aura IAM #58	28 Aqua IAM #61	**March** 1	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* Aura IAM #61	21 Aqua IAM #64	22	23
24	25	26	27 Aura IAM #62	28** Aqua IAM #65	29	30
31	**April** 1	2	3 Aura IAM #63	4 Aqua IAM #66	5	6
7	8	9	10 Aura Back-up	11 Aqua Back-up	12	13
14	15	16	17	18	19	20

*Spring Equinox on March 20
**Aura Ideal Date on March 28
*** Golden Week in Japan starts April 29

Predicted Maneuver Performance

Inc #	Date	Commanded Yaw* (deg)	Duration (sec)	Delta SMA** (m)	Delta Inc (deg)	Delta RAAN (deg)
58	Feb 28	-83.9	378.5	7.22	-0.00804	0.00185
59	Mar 07			5.56	-0.00809	0.00142
60	Mar 14			3.88	-0.00813	0.00097
61	Mar 21			2.03	-0.00814	0.00053
62	Mar 28			0.22	-0.00814	0.00008
63	Apr 03			-1.85	-0.00810	-0.00030
				Total:	**-0.04864**	

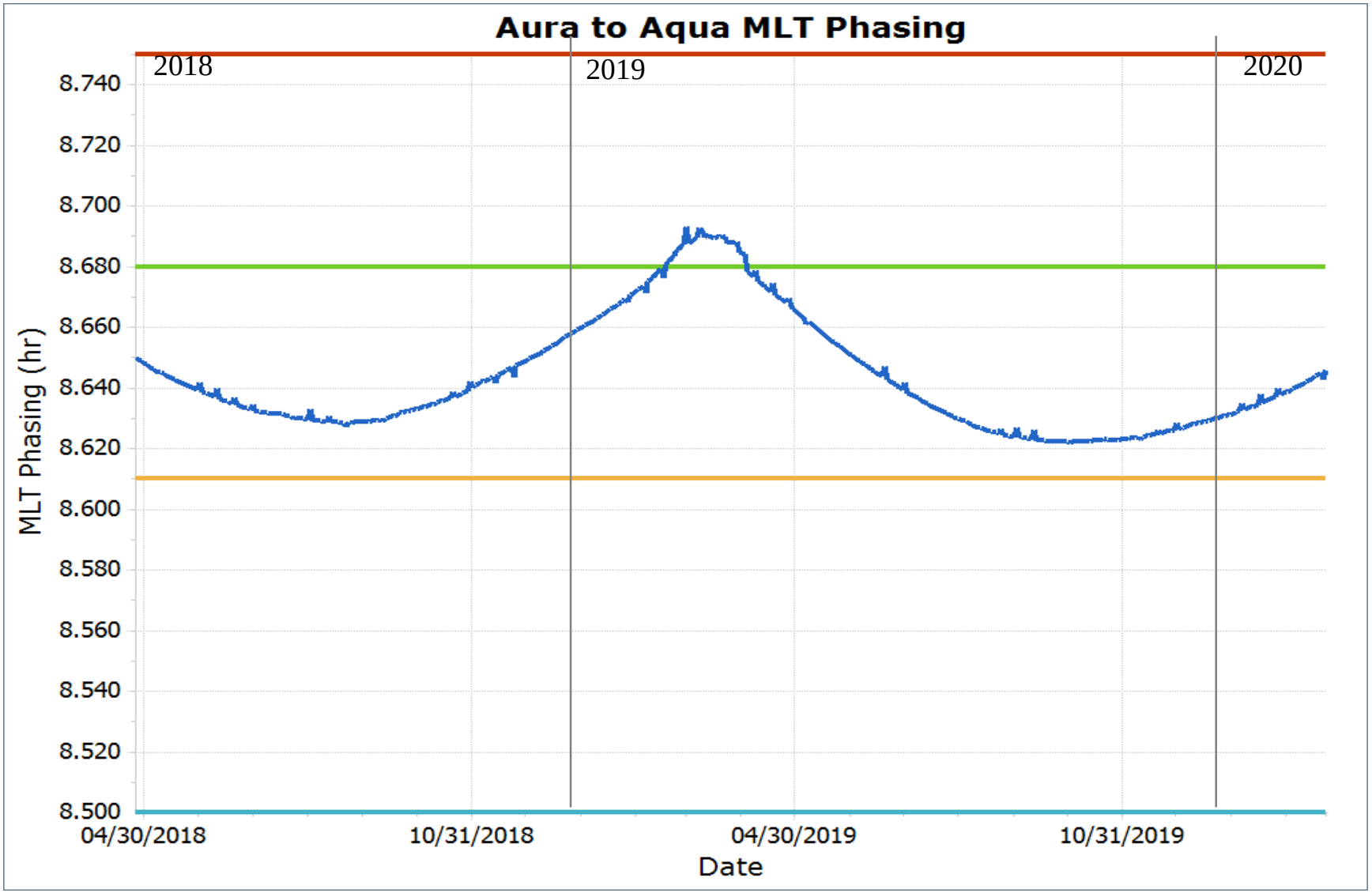
*Preliminary angles
**Semi-Major Axis (SMA)

- Utilized trending equations that were updated after the 2018 series was completed

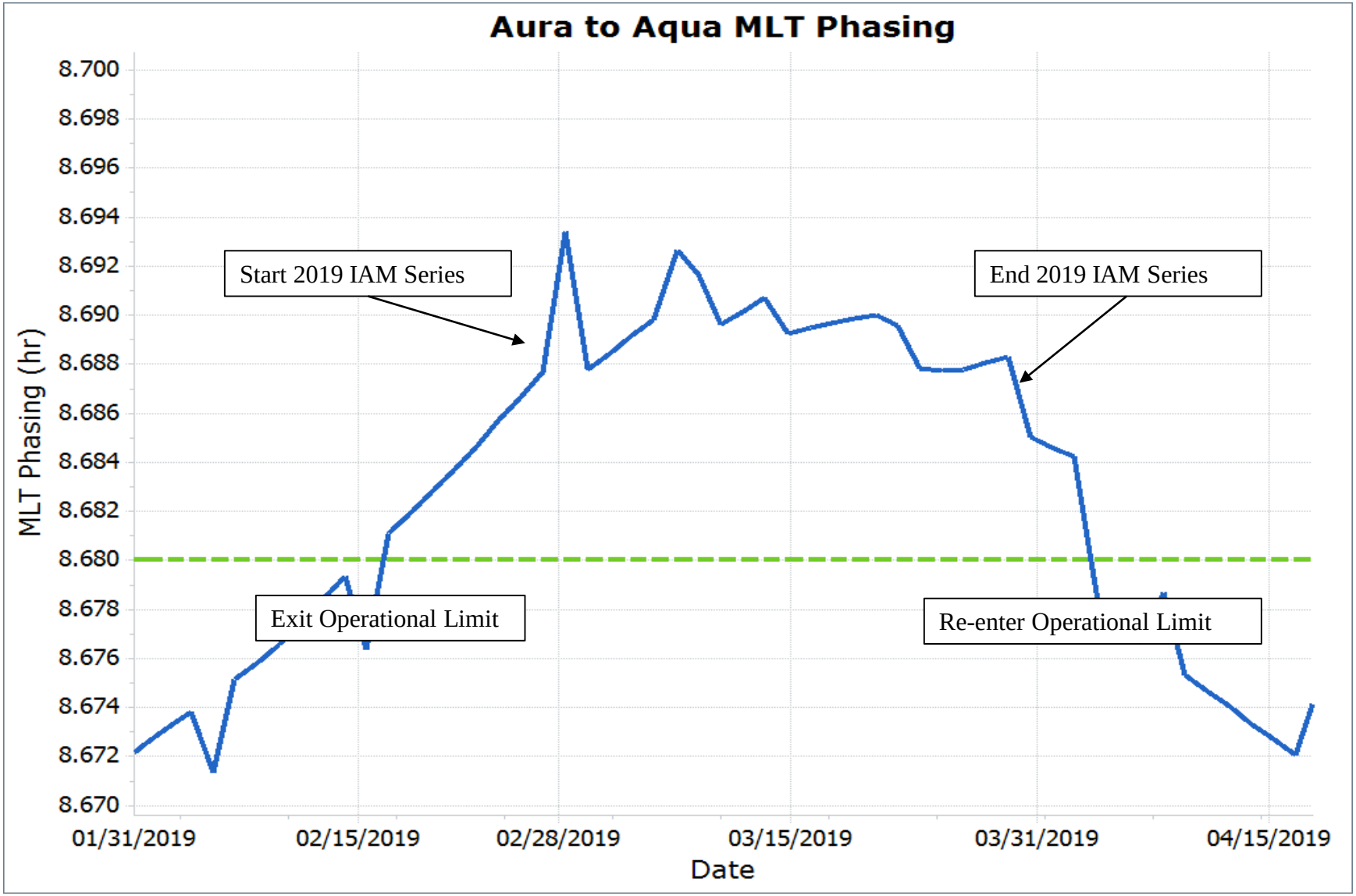
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Predicted Pre- and Post-2019 IAM MLT Standard Drag Make-up Maneuver (DMU) Locations



Predicted 2019 IAM Series MLT Progression



Aqua Spring 2019 IAM Campaign Planning

- Due to the cold maneuver performance, Aura is predicted to exit its “operational goal” MLT phasing limit prior to the 2019 IAM series
  - Predicted to exit on February 16
  - 2019 IAM series: February 27 – April 03
  - Predicted to re-enter April 03
- Aura is predicted to be near the center of the MLT phasing control box at the start of the 2020 IAM series
  - Can compensate for cold IAM performance by executing DMUs at descending node
  - Descending node DMUs will help Aura maintain the tight MLT phasing box and will reduce the IAM burn durations in the 2019 IAM series

Predicted Maneuver Performance

Inc #	Date	Commanded Yaw* (deg)	Duration (sec)	Delta SMA (m)	Delta Inc (deg)	Delta RAAN (deg)
58	Feb 28	-83.9	372.5	11.22	-0.00793	0.00185
59	Mar 07			9.67	-0.0799	0.00142
60	Mar 14			8.08	-0.00803	0.00098
61	Mar 21			6.23	-0.00804	0.00055
62	Mar 28			4.48	-0.00803	0.00010
63	Apr 03			2.47	-0.00800	-0.00027
				Total:	**0.04802**	

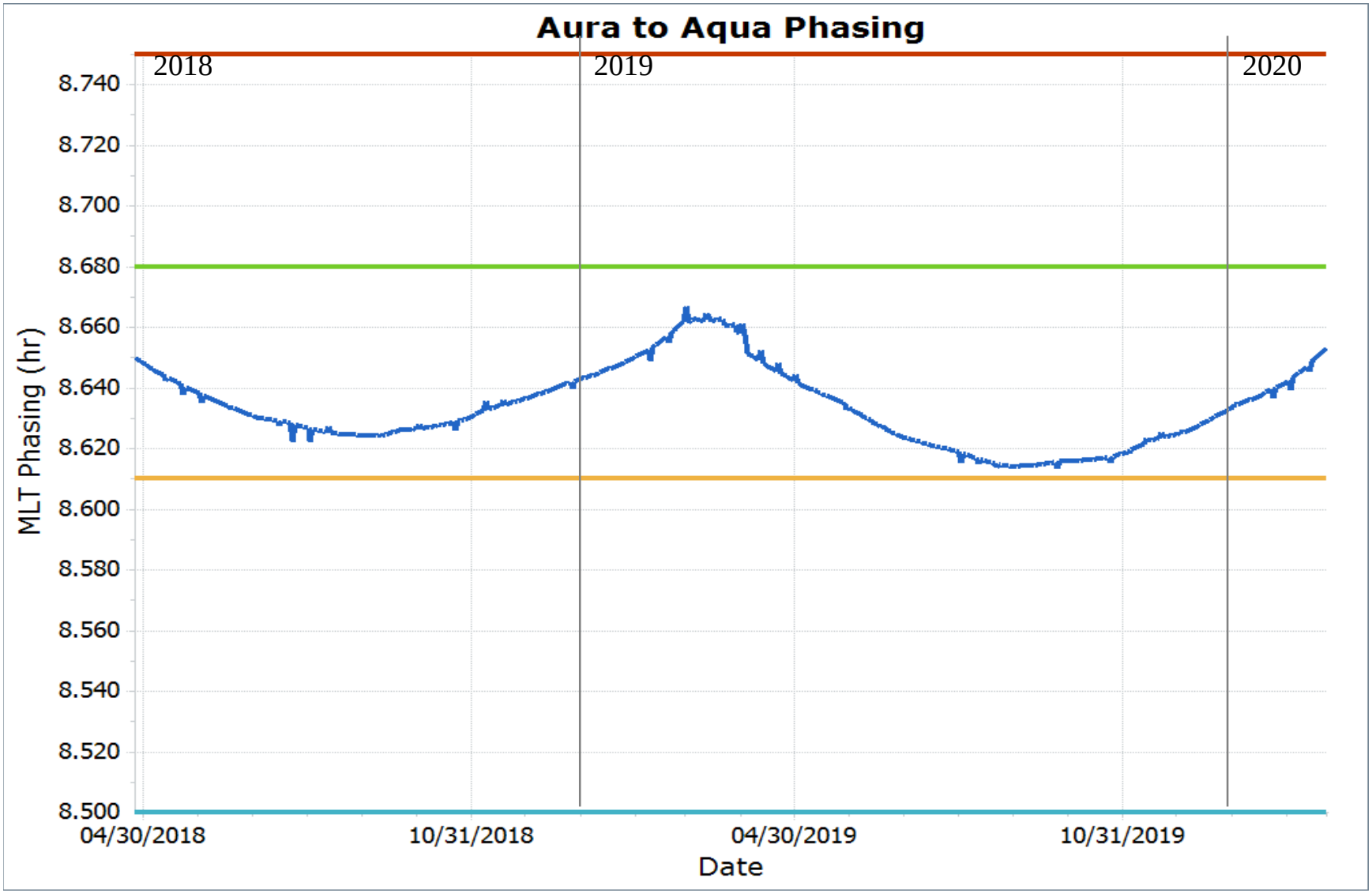
*Preliminary angles

- Utilized trending equations that were updated after the 2018 series was completed

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Predicted Pre- and Post-2019 IAM MLT Descending Node DMUs



Summary

- The 2018 IAM series requires some additional analysis to better understand the degrading performance
- Due to the lower than expected performance, Aura is predicted to be outside the operational phasing limits during the 2019 IAM series, which can be corrected with descending node DMUs
- The 2019 IAM series will have 6 maneuvers and is predicted to keep Aura near the center of the MLT phasing control box prior to the 2020 series
- The predicted 2019 IAM series performance may be updated after further analysis of the observed 2018 IAM series performance