

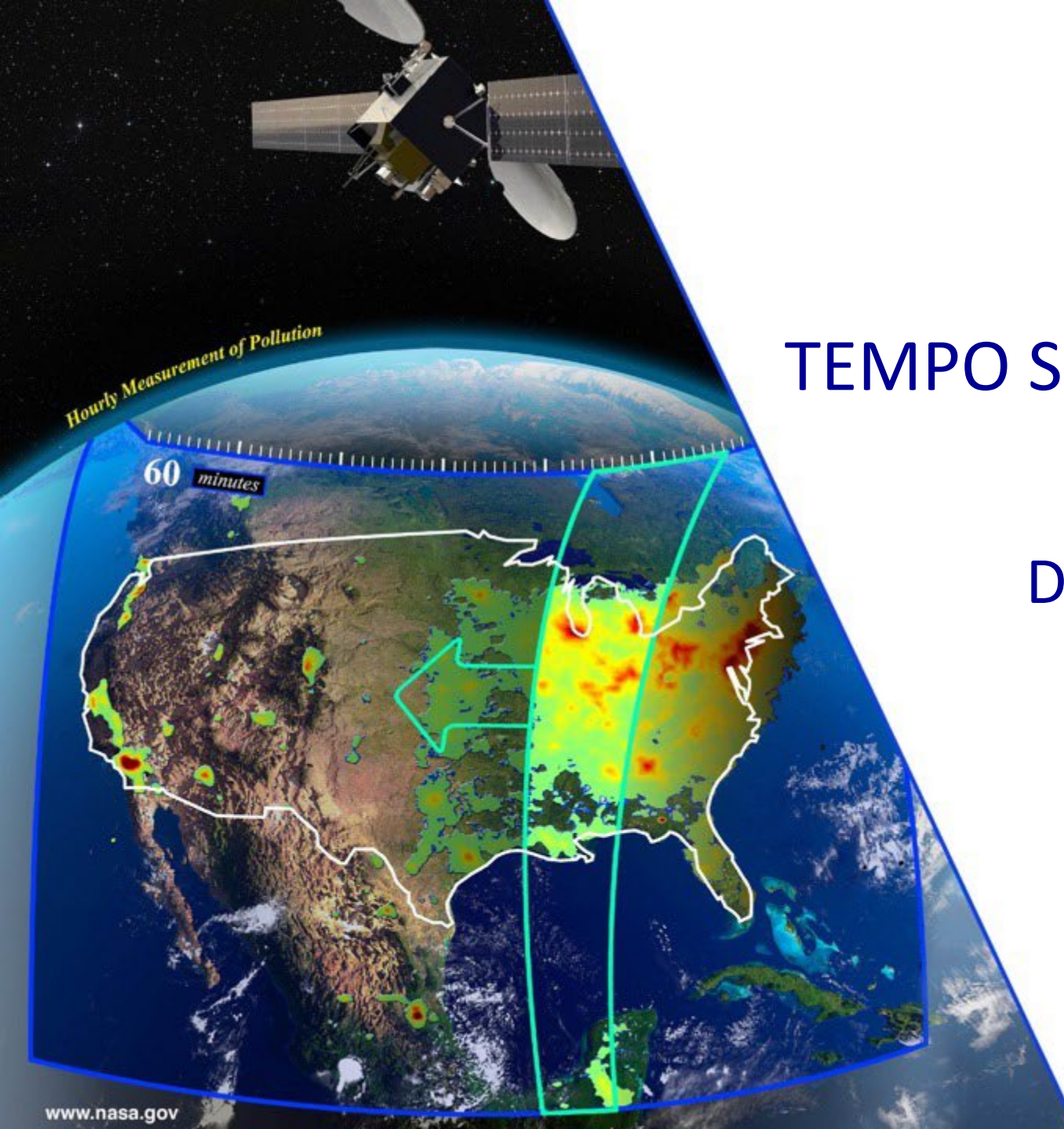
Tropospheric Emissions:
Monitoring of Pollution



Hosting Update for TEMPO Science Team Meeting

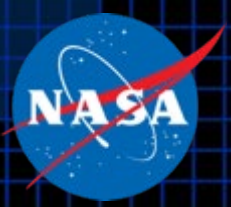
PM: Kevin Daugherty
Deputy PM: Crystal Fenn

May 31, 2022





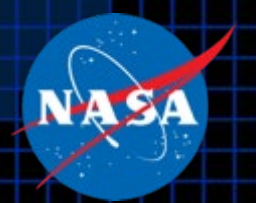
Outline



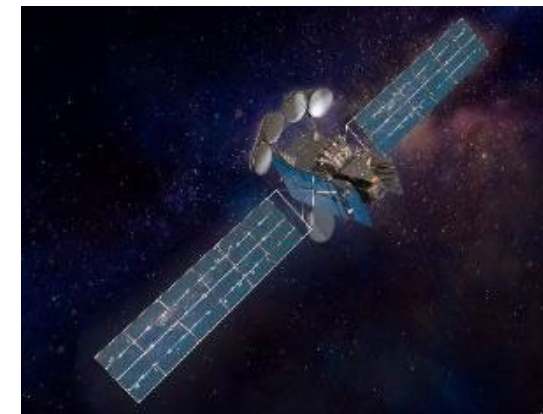
- Hosting Overview
- Where We Were
- The Past Year
- Spacecraft Level Testing
- Launch
- Commissioning



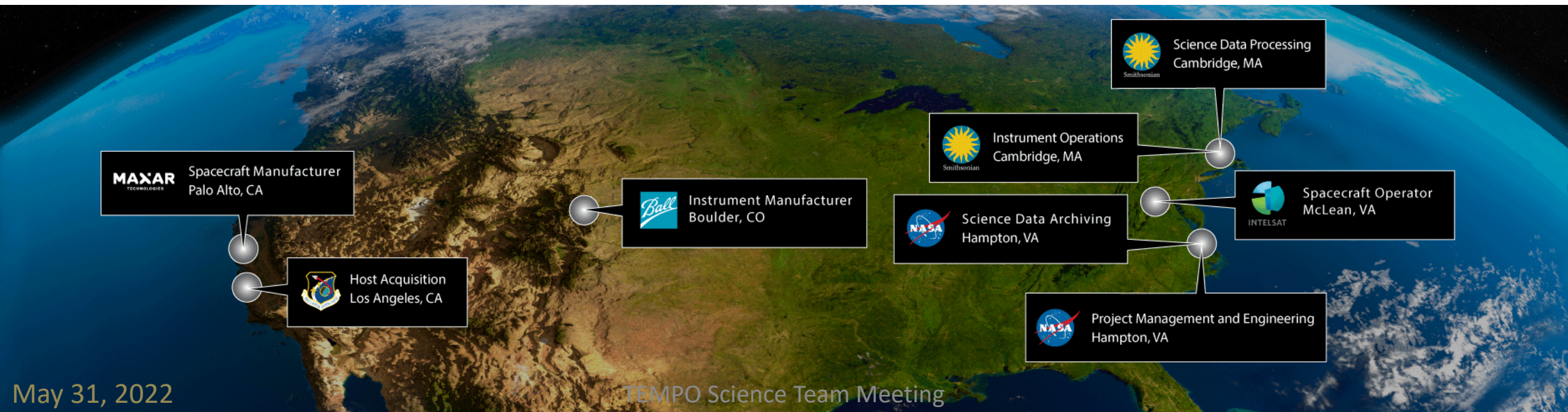
Hosting Overview



- Hosting contract with Maxar Technologies and subcontract with Intelsat General
- Hosted on Intelsat's IS40e spacecraft
- Maxar is manufacturing the IS40e spacecraft for Intelsat including all special accommodations for the TEMPO instrument at Maxar's facility in Palo Alto, CA
- Intelsat will operate IS40e at 91.0W Longitude including providing commanding and data support for TEMPO throughout TEMPO mission from the Spacecraft Operations Center in McLean, VA
- Ball Aerospace, the TEMPO Instrument manufacturer, is providing integration support

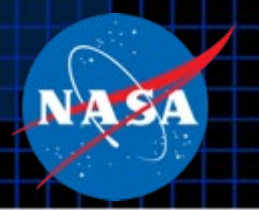


Intelsat IS40e with TEMPO

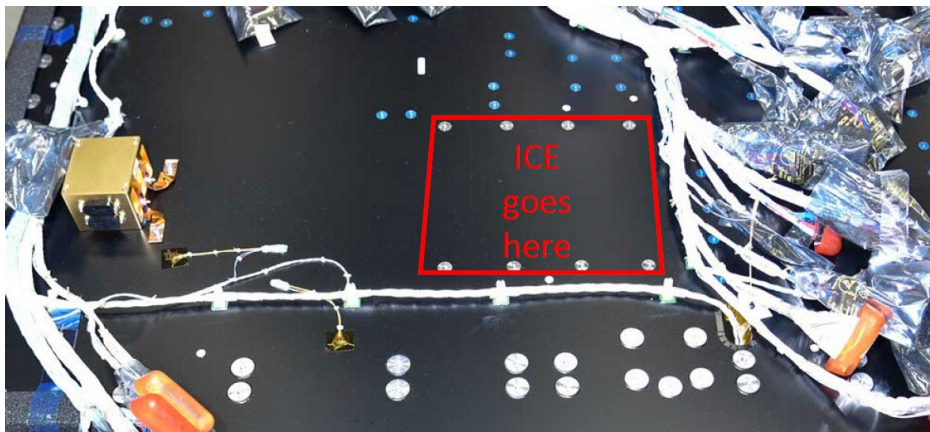
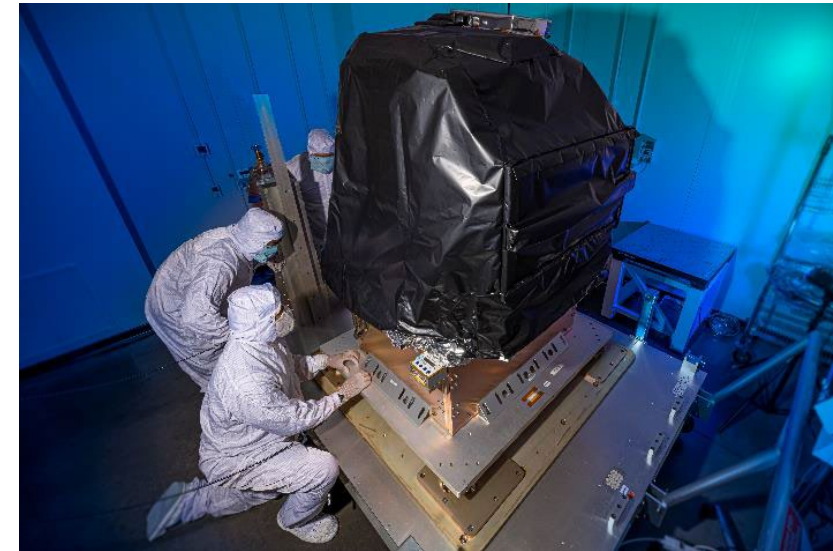




Where We Were



- TEMPO was delivered to Maxar Technologies' facility in Palo Alto, CA just before the 2021 TEMPO Science Team Meeting
- IS40e integration was separate comm panels and central cylinder



IS40e Comm Panel Awaiting TEMPO Electronics

IS40e Central Cylinder

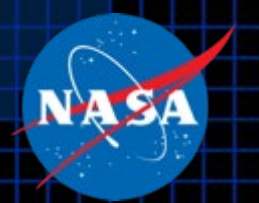
TEMPO Instrument Shipment May 2021

May 31, 2022

TEMPO Science Team Meeting



The Past Year

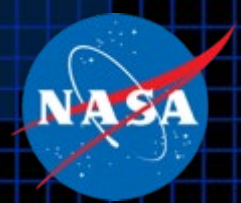


- We have come a very long way in just one year
 - Completed TEMPO Instrument mechanical Integration
 - Nearly completed TEMPO Instrument electrical integration: Only one temporary electrical mate remains to be permanently mated for flight
 - Installed several specialized heat pipes and radiators to keep the TEMPO Instrument cooled; especially the Focal Plane Array
 - Re-designed and installed a purge bag to remain over the TEMPO Instrument throughout spacecraft environmental testing to protect the sensitive optics from contamination – A top scientific concern
 - Completed preliminary testing of all data interfaces, overcoming multiple challenges
 - Functional testing with commanding through the spacecraft
 - SSIRU (gyroscope) rates and TEMPO scan mechanism motion compensation
 - Data flow from the TEMPO Instrument through the first parts of the spacecraft RF pathway

- TEMPO is ready for the reference performance test; marking the end of integration and start of spacecraft level testing



Instrument Mechanical Integration



The TEMPO Instrument was mechanically integrated with the IS40e satellite on November 17, 2021

Ball Aerospace personnel inspecting the TEMPO Instrument before integration



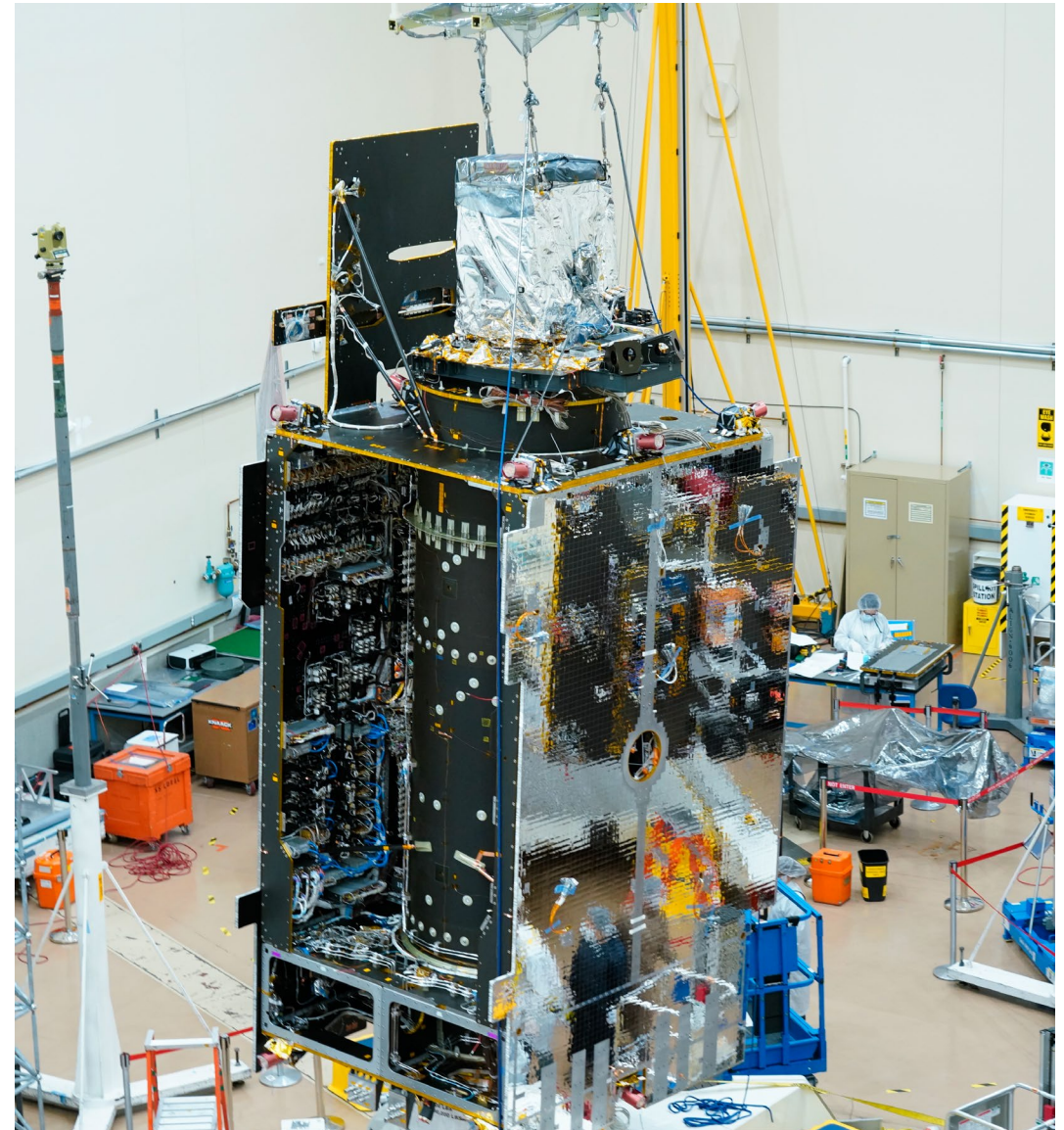
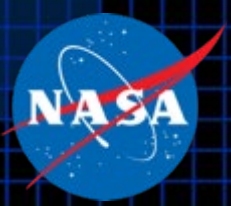
Maxar personnel lifting the TEMPO Instrument to the IS40e nadir deck

Press releases: <https://blog.maxar.com/space-infrastructure/2021/maxar-integrates-nasa-pollution-monitoring-payload-with-intelsat-40e-spacecraft>

May 31, 2022 <https://www.nasa.gov/feature/langley/tempo-air-pollution-sensor-integrated-with-satellite-host>



Instrument Mechanical Integration



- The TEMPO Instrument is covered with a tight-fitting bag with a continuous nitrogen purge to protect the sensitive optics from contamination during spacecraft environmental testing
- The TEMPO Sensor is flanked on the North and South sides of the spacecraft by radiators dedicated to cooling the sensor on-orbit
- The TEMPO Instrument is waiting for the final SpaceWire data connection with IS40e and the reference performance test

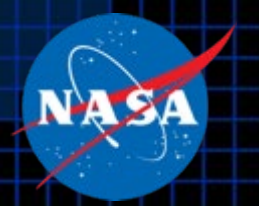


IS40e and TEMPO with purge bag viewed from Earth facing side

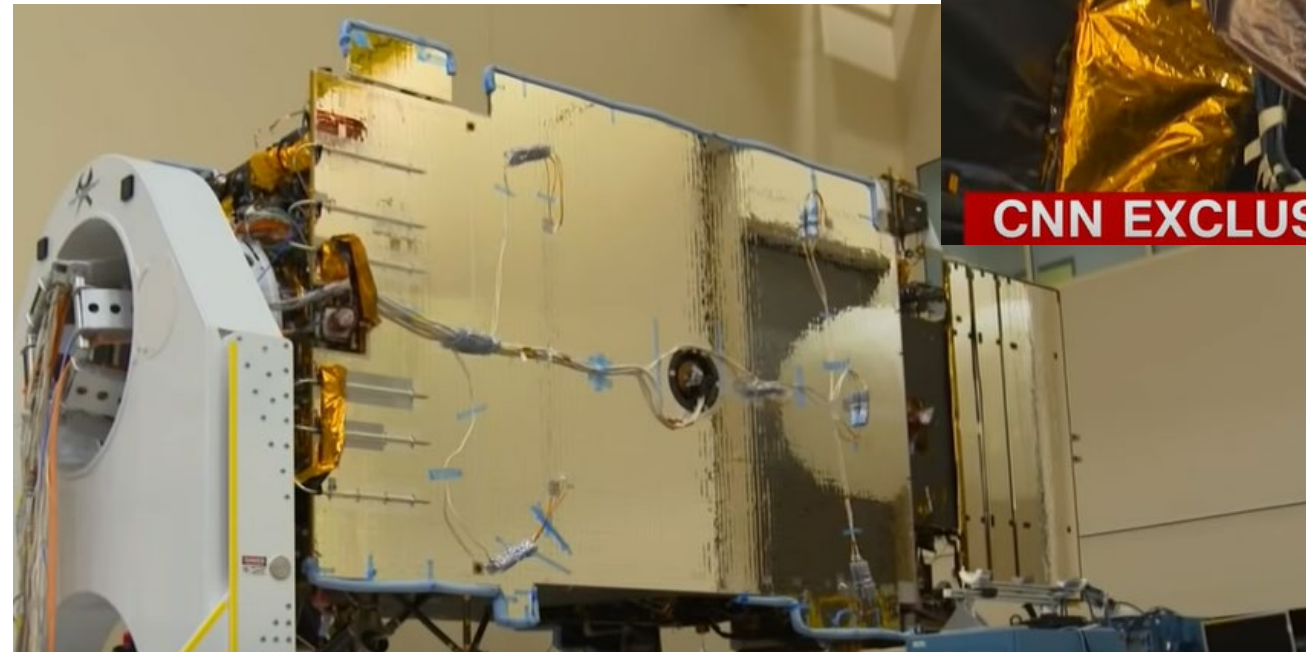
Photo will be featured in an upcoming “integration complete” press release



TEMPO Cameo



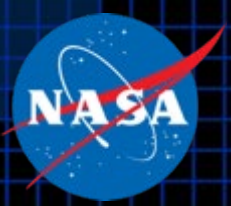
- IS40e and TEMPO were briefly shown in a recent CNN interview about other Maxar activities that have made the news recently



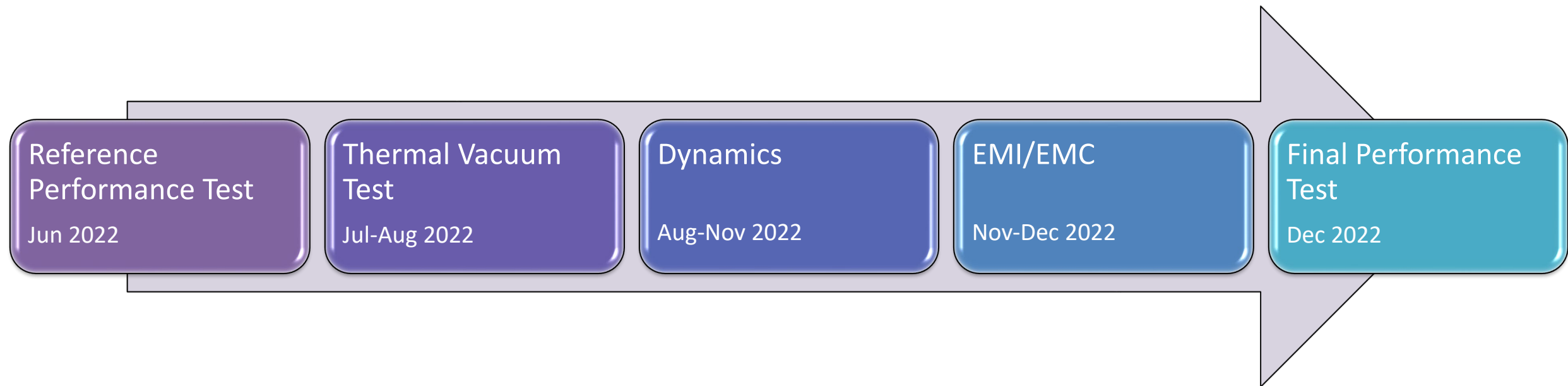
Source: <https://www.youtube.com/watch?v=ZC0tSAJ5WSY>



The Future

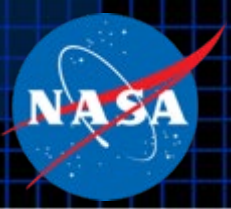


- IS40e and the TEMPO Instrument will undergo a standard commercial spacecraft environmental test flow for the remainder of this year
 - Once completed, the spacecraft will be ready to ship to the launch site



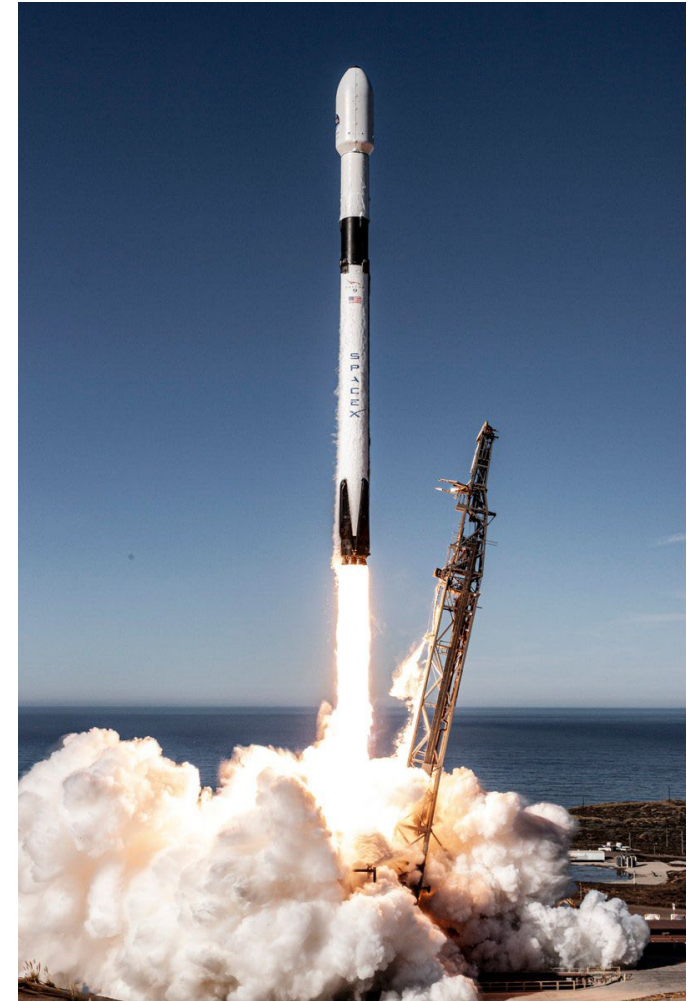


Launch



- IS40e with TEMPO will launch on a Falcon 9 from Cape Canaveral, FL
 - The spacecraft will arrive at the launch site approximately one month before launch to begin integration with the Falcon 9 rocket
 - Launch is currently set for January 27, 2023

- Currently planning launch site activities such as guest operations including presentations and viewing area(s) and a potential L-3 virtual press conference
 - More details will be distributed through SAO as we approach launch

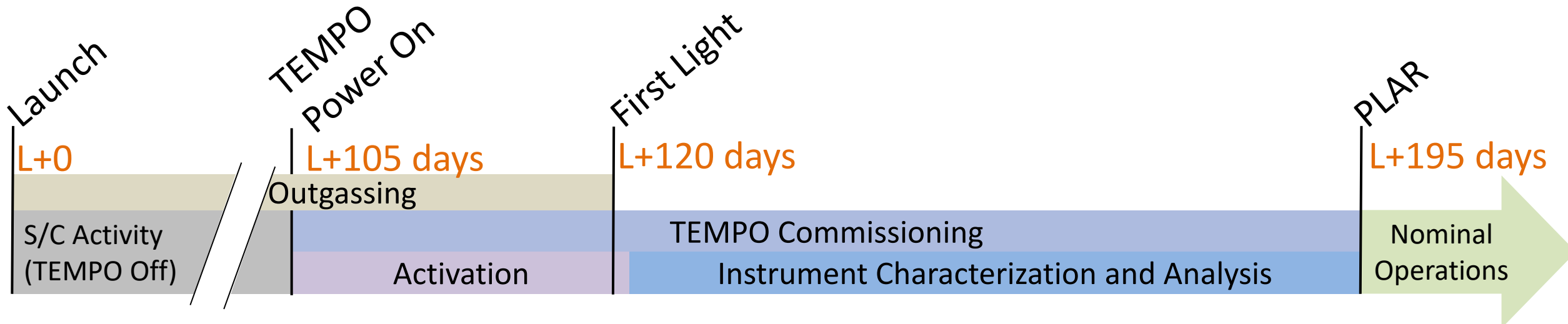




Commissioning and Operations



- IS40e will be checked out first and moved to the final orbital location of 91.0W longitude
- TEMPO commissioning will take approximately 90 days, culminating in a Post-Launch Acceptance Review (PLAR) which signifies the end of commissioning and the start of normal operations
- Normal operations and data flow will begin approximately 6.5 months after launch

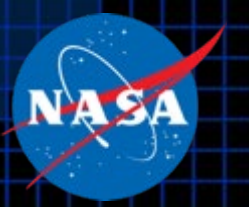


Tune into Raid Suleman's presentation on Day 2 for more details

*L+# days are approximate and will be refined as we finalize commissioning details



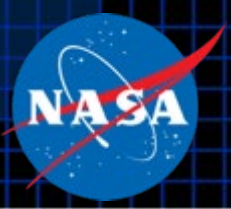
Wrap Up



- TEMPO hosting is well on its way to launch with the TEMPO Instrument integrated with IS40e
- The remainder of this calendar year is packed with spacecraft level testing, culminating with spacecraft shipment at the end of December
- Launch from Cape Canaveral, FL on a Falcon 9 will be late January 2023 and additional details for visitors will be distributed as we get closer to launch
- Operating at 91.0W Longitude, the TEMPO Instrument will begin normal operations approximately 6.5 months after launch!

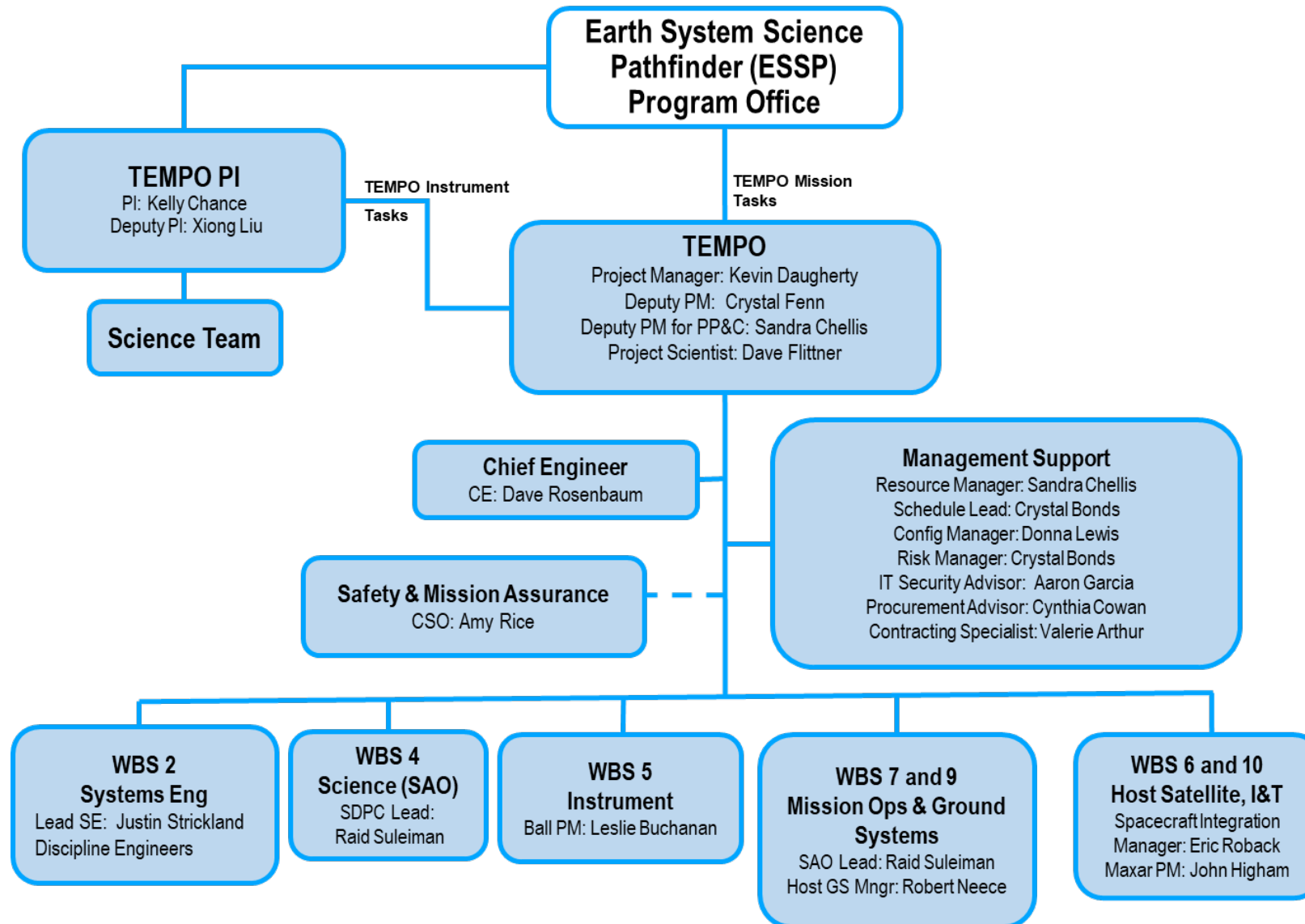
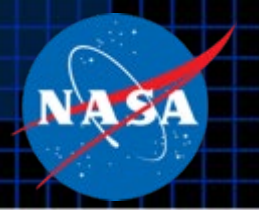


Questions?



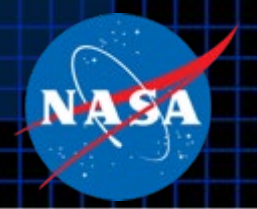


TEMPO Organization





TEMPO Operations & Data Flow Update



Spacecraft
Location: 91 W

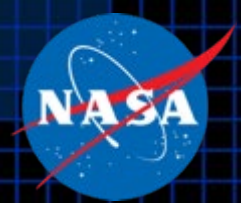


May 31, 2022

TEMPO Science Team Meeting




Partner Map




MAXAR
TECHNOLOGIES
Spacecraft Manufacturer
Palo Alto, CA





Host Acquisition
Los Angeles, CA





Instrument Manufacturer
Boulder, CO





Science Data Archiving
Hampton, VA





Project Management and Engineering
Hampton, VA





Instrument Operations
Cambridge, MA




Science Data Processing
Cambridge, MA




Spacecraft Operator
McLean, VA

