7th CGMS Risk Assessment

Presented to CGMS-53 WGI session
CGMS-53-WGIII-WP-02WGI

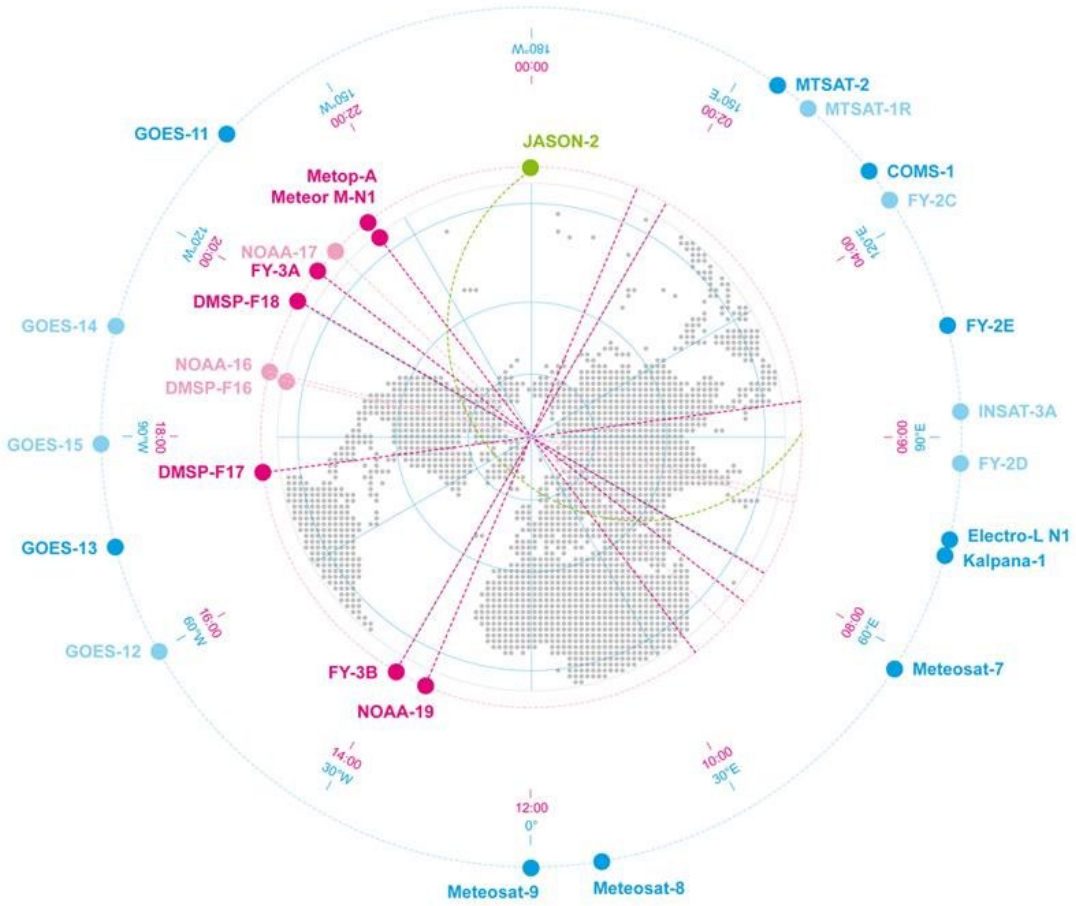
The CGMS Baseline:

- ***Enumerates the sustained observations, measurements, and services*** that form the CGMS contribution to observing the Earth System, Space Environment and the Sun, and responds to end-user requirements expressed in ***WMO's Rolling Review of Requirements (RRR)***.

- Constitutes the ***CGMS response to the WMO Integrated Global Observing System (WIGOS) 2040 vision*** to document what missions are currently being, or planned on being flown.

Key Principles of the CGMS Baseline:

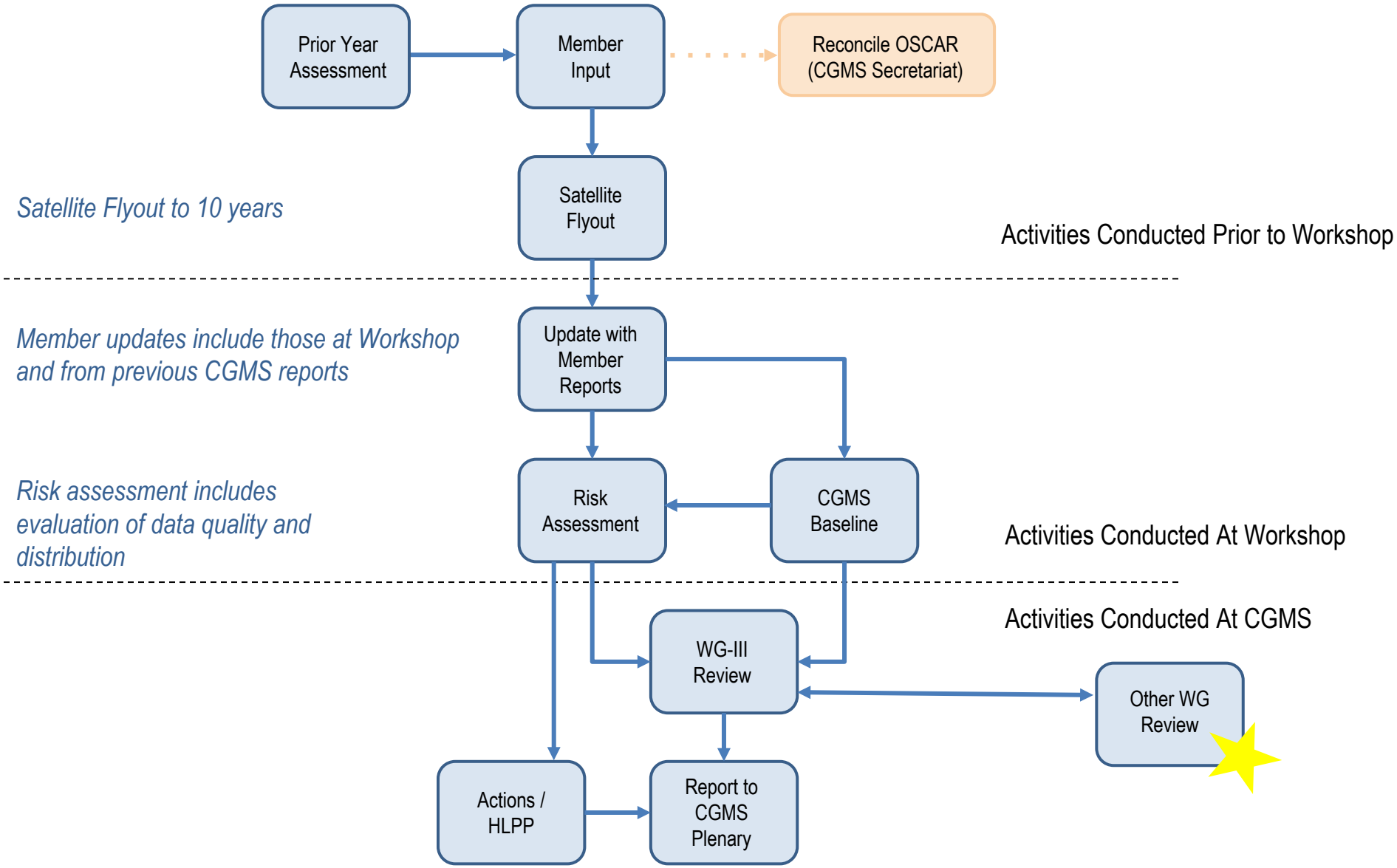
- *Commitment*: The CGMS Members are providing, or have firm plans to provide, the observations, measurements, and services
- *Sustained*: The observations, measurements, and services are provided on a sustained basis
- *Available*: The observations, measurements, and services are available on a free and open basis
- *Operational*: The data and products can be utilized in operational applications



CGMS Risk Assessment

- ***CGMS conducts an annual risk assessment against the CGMS baseline*** to track how well CGMS is meeting its commitments.
- The top-level risk assessment for each sensor/observation is based on a qualitative analysis of all the orbits and satellite missions from which the observation is provided.
    - This assessment is given from a CGMS Member prospective and may not:
        - Include contributions from non-CGMS agencies
        - Include contributions from commercial providers
        - Incorporate all WMO requirements (which are covered by the gap analysis).
    - The assessment is based on planned launch dates, design life, and updated by operational experience.
    - System resiliency, nor the consequence of not meeting commitments was not specifically addressed.
    - Quality and availability were not analyzed in detail for all measurements.
    - Agency commitment to mission assumes related user readiness and ground segment operationalization.
    - Member owned and operated payloads hosted on commercial platforms are included when launch dates are determined, and members may provide commercially sourced data to meet commitments to the Baseline, with the understanding that they commit to the provision of such data consistent with the Baseline principles.

CGMS Baseline Update / Risk Assessment Process



Updates - 2025

- Updates to mission data were received January-February, and reviewed at the 7th RAW, 25-27 February 2025
- Each flyout chart has been updated with the new launch and EOL information
- GOES-16, GOES-17, Himawari-8 and INSAT-3D have been listed as on-orbit spares for appropriate observations
- AWS and EPS Sterna 1, 2 and 3 have been added to the Microwave Sounder flyout
- GeoXO-I2 has been added to the flyouts for GEO Imager, Lightning Mapper, and Narrow Band Visible & Near Infrared Imager
- FY-4D has been added to the flyouts for Hyperspectral Infrared Sounder, GEO Imager, Lightning Mapper, EUV Imager, and Energetic Particle Sensors in GEO (Low, High and Very High)
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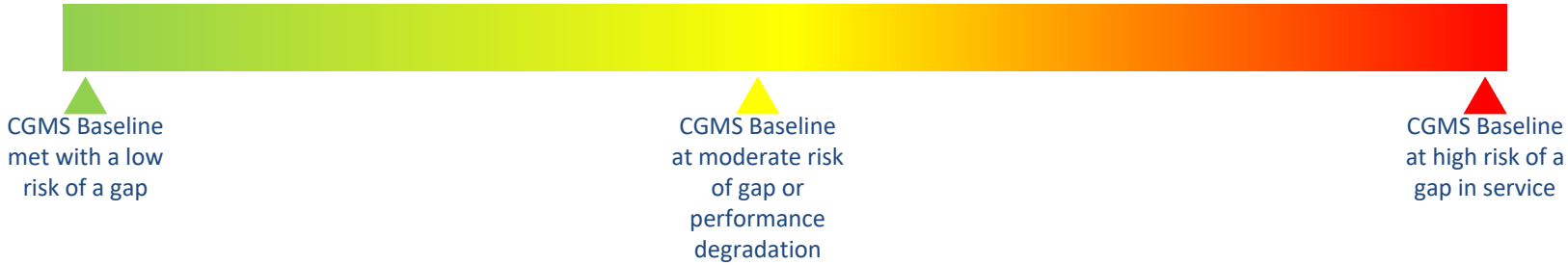
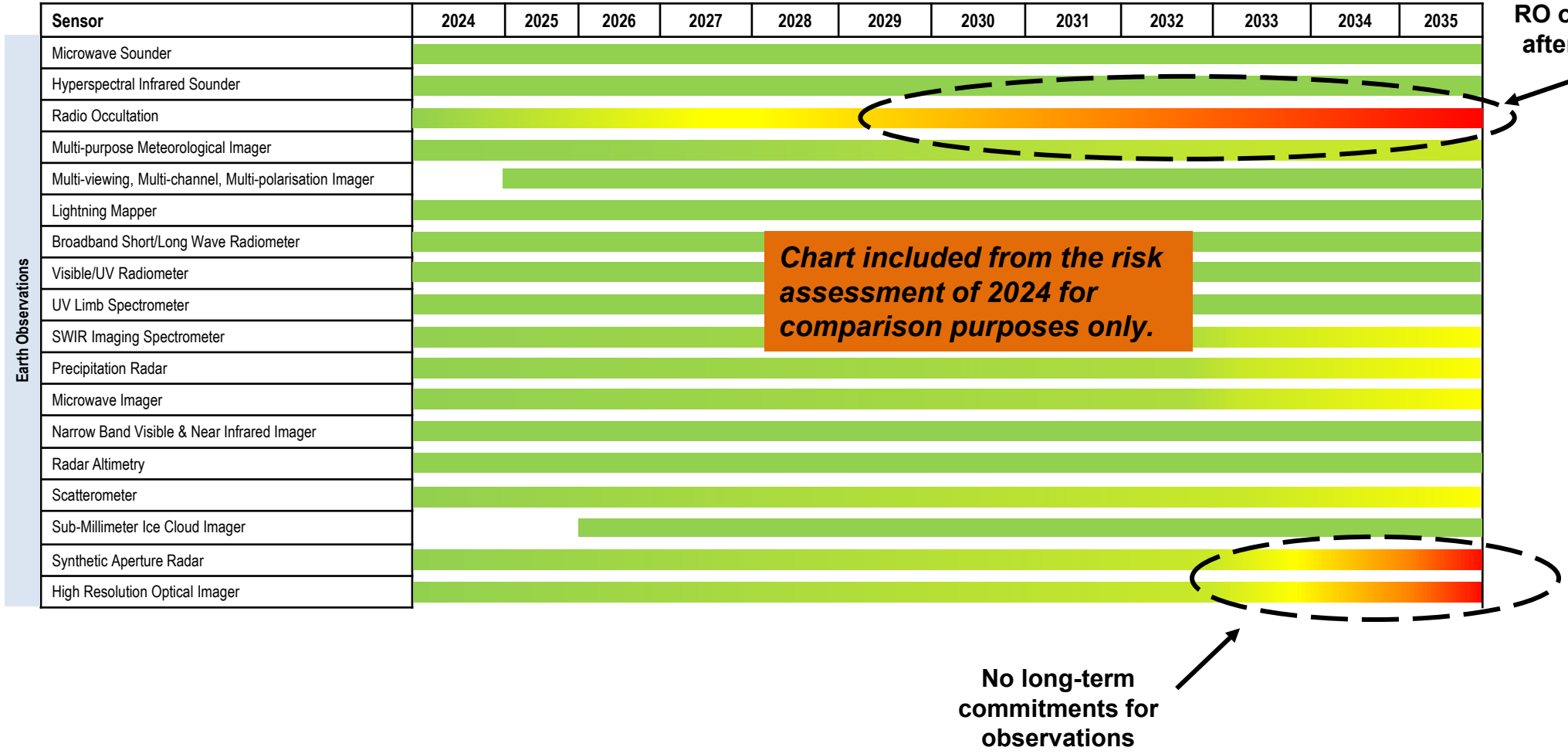
- Metop-SG-B2 has been added to the flyout for Radio Occultation
- GK-2B removed from the flyouts for GEO Imager, Narrow Band Visible & Near Infrared Imager, and Visible/UV Spectrometer
- SWNext SOL-A and SOL-B have been added to the flyouts for Magnetometer at L1, Energetic Particle Sensor at L1, Plasma Analyzer, Coronagraph, and X-ray Spectrograph
- GK-5 has been added to the flyouts for GEO Imager, Energetic Particle Sensor High, and Magnetometer GEO
- CIMR-A and B has been added to the Microwave Imager

CGMS Risk Assessment Assumptions

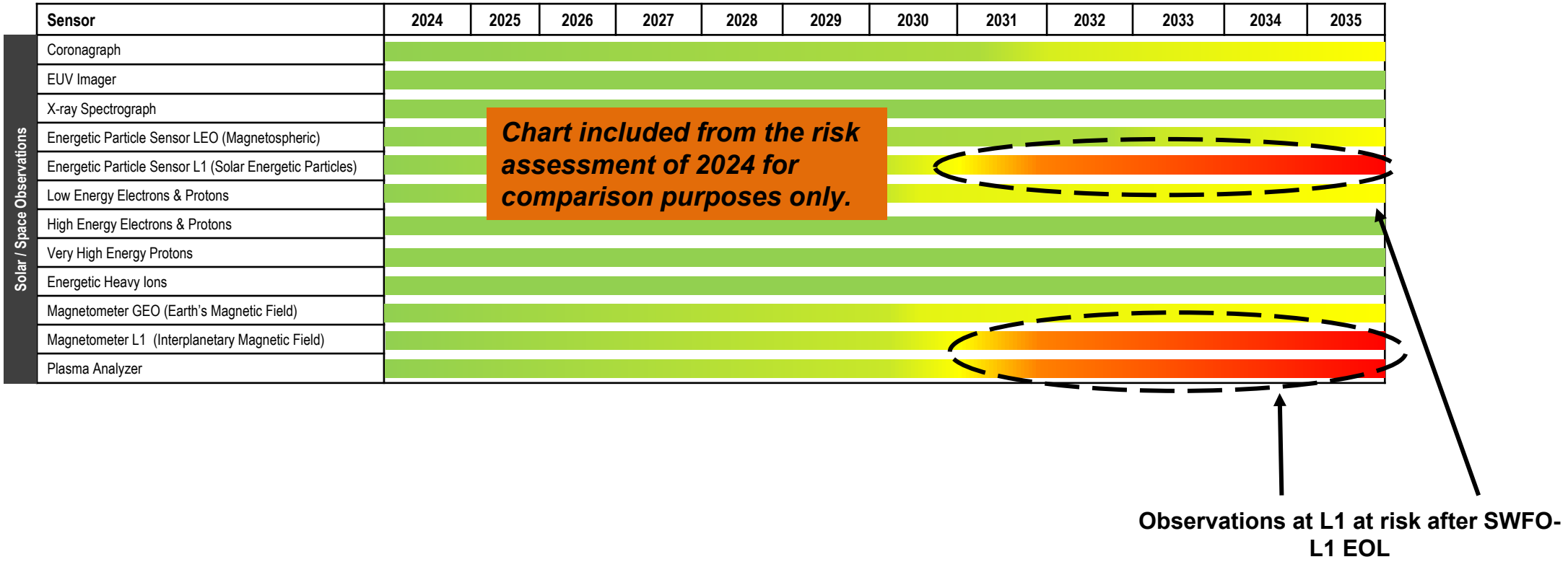
- CGMS Risk Assessment uses **Green**, Yellow, and Red to graphically represent the overall status of that sensor/observation. The criteria for each colour is as follows:
  - **Green:** CGMS Baseline met with a low risk of a gap.
  - **Yellow:** The CGMS Baseline is at moderate risk of not being fully met. Some mitigation by CGMS Members may be required.
  - **Red:** There is a high risk of not meeting the CGMS Baseline without CGMS Member action
  - No Colour: Observation is not planned to be available until a later date



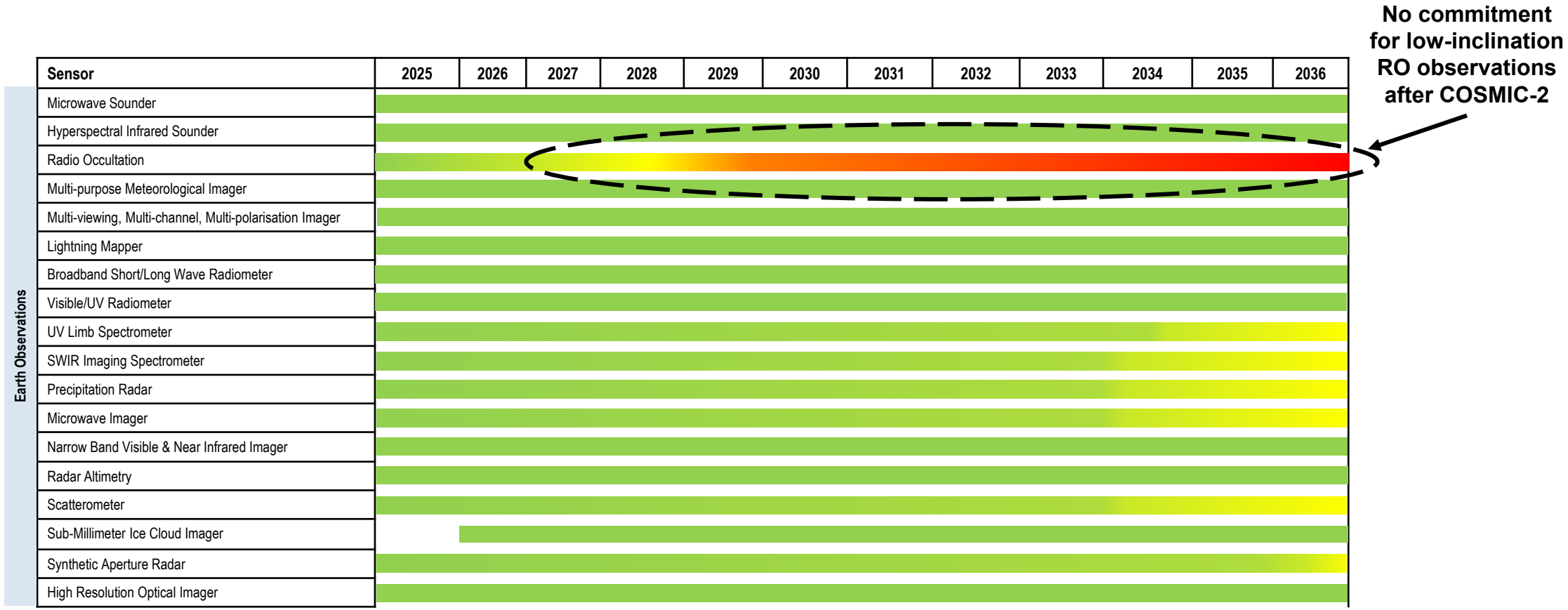
Top-Level Risk Assessment - Earth Observations (2024)



Top-Level Risk Assessment - Solar/Space Observations (2024)



Top-Level Risk Assessment - Earth Observations (2025)



Top-Level Risk Assessment - Solar/Space Observations (2025)

	Sensor	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Solar / Space Observations	Coronagraph												
	EUV Imager												
	X-ray Spectrograph												
	Energetic Particle Sensor LEO (Magnetospheric)												
	Energetic Particle Sensor L1 (Solar Energetic Particles)												
	Low Energy Electrons & Protons												
	High Energy Electrons & Protons												
	Very High Energy Protons												
	Energetic Heavy Ions												
	Magnetometer GEO (Earth's Magnetic Field)												
	Magnetometer L1 (Interplanetary Magnetic Field)												
	Plasma Analyzer												

Top-Level Risk Assessment – Focus Areas

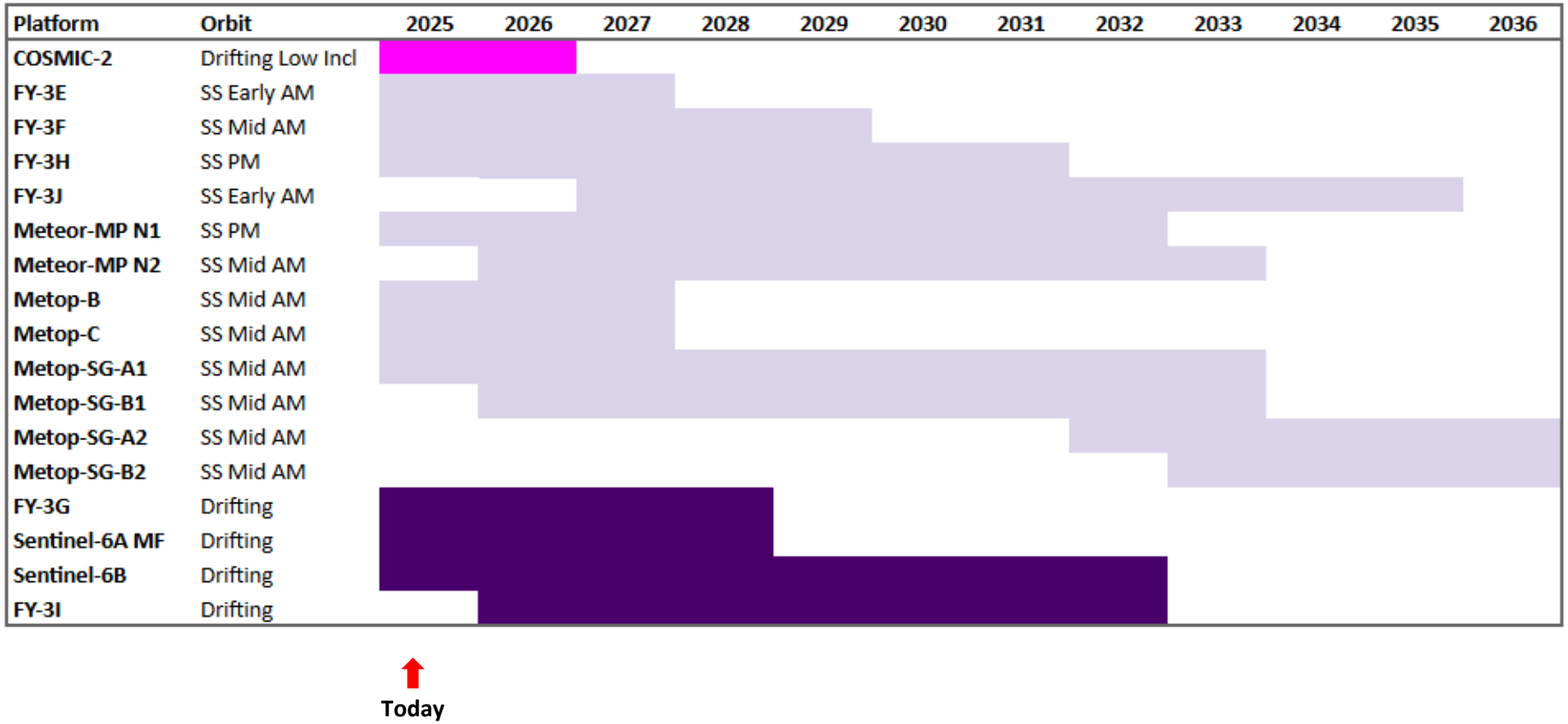
High risk of a gap in service

- Continuity risk for RO observations in low inclination orbits in the later part of the decade as there is no commitment for a follow-on to COSMIC-2. *(slide 12)*
  - EUMETSAT to provide updated graphics of the RO profiles to determine if the baseline target is being met in the short term by commercial providers.
  - SWCG to make a recommendation to WGIII how to separate RO and Ionospheric Electron Density profiles.

Moderate risk of gap or performance degradation

- Slight long-term continuity risk for the UV Limb Spectrometer. *(slide 13)*
  - WGII to investigate other capabilities for UV limb sounding to complement JPSS
- Slight long-term continuity risk for the SWIR Imaging Spectrometer. *(slide 14)*
  - GHG TT via WGII has action to indicate if SWIR missions for CH4 and CO2 be added to the baseline.
- Slight long-term continuity risk for the Precipitation Radar. *(slide 15)*
  - NASA and JAXA to provide additional information on the GPM continuation mission.
- Slight long-term continuity risk for Coronagraphy in GEO. *(slide 16)*
- Slight long-term continuity risk for Energetic Particle Sensors in LEO. *(slide 17)*

Radio Occultation (Atmospheric Temperature, Humidity, and Ionospheric Electron Density)



WGIII Assessment:

Risk of not meeting the CGMS Baseline commitment in low-inclination RO observations after COSMIC-2 at the end of the decade, and in other drifting orbits in the mid 2030s. The SWCG to make a recommendation to WGIII how to separate RO and Ionospheric Electron Density profiles in the CGMS Baseline and Risk Assessment

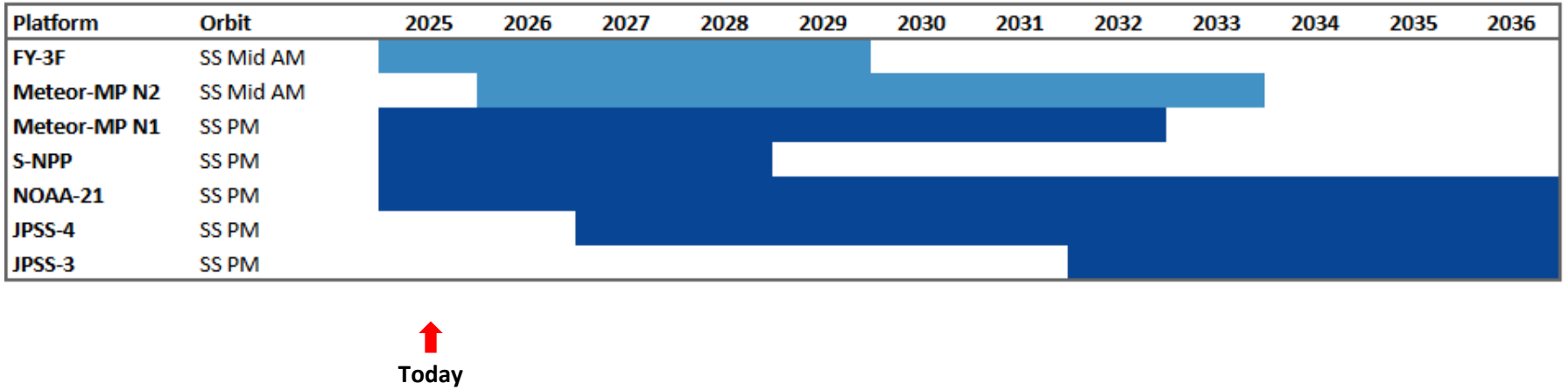
LEO - 3 Orbits

6000 occultations from **low inclination (<30°)**

7600 occultations from **sun-synchronous**

1000 occultations from **other drifting orbits**

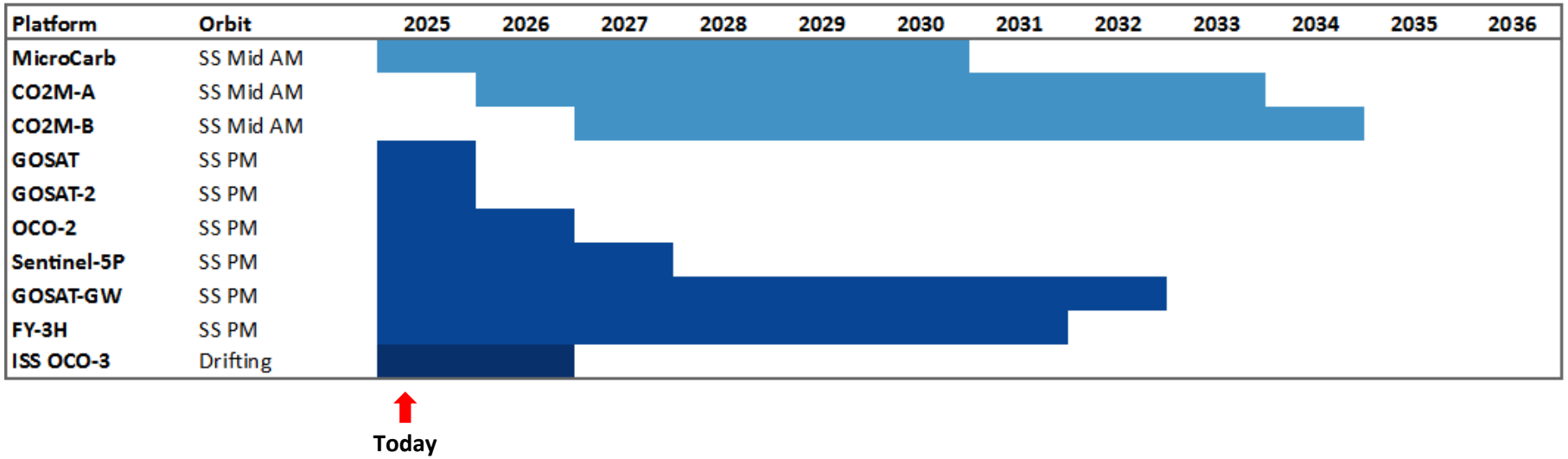
UV Limb Spectrometer (Aerosol, Atmospheric Composition: O3)



LEO - 2 Orbits
Sun-synchronous mid-morning
Sun-synchronous afternoon

WGIII Assessment:
Slight risk of not meeting the CGMS Baseline commitment in the mid-morning orbit in the mid 2030s. WGII to investigate other capabilities for UV limb sounding to complement JPSS.

SWIR Imaging Spectrometer (Atmospheric Composition: CO2, CH4)



LEO - 2 Orbits

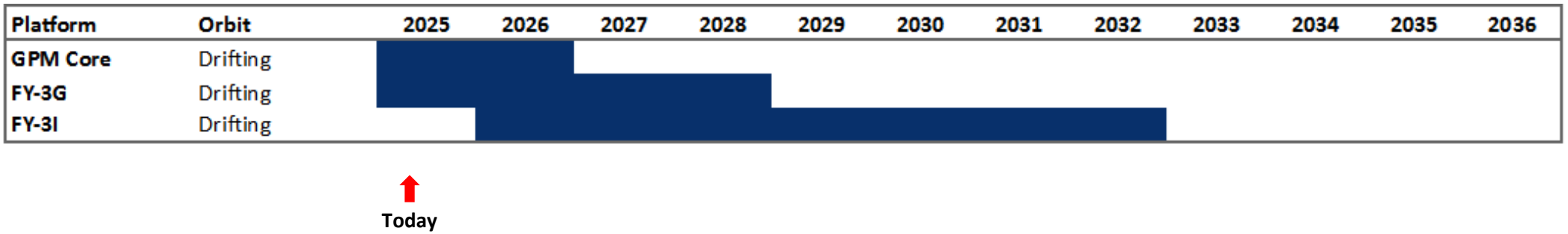
Sun-synchronous late morning

Sun-synchronous afternoon

WGIII Assessment:

Slight risk of not meeting CGMS Baseline commitment in the mid 2030s. GHG TT via WGII has action to indicate if SWIR missions for CH4 and CO2 be added to the baseline.

Precipitation Radar (Precipitation)

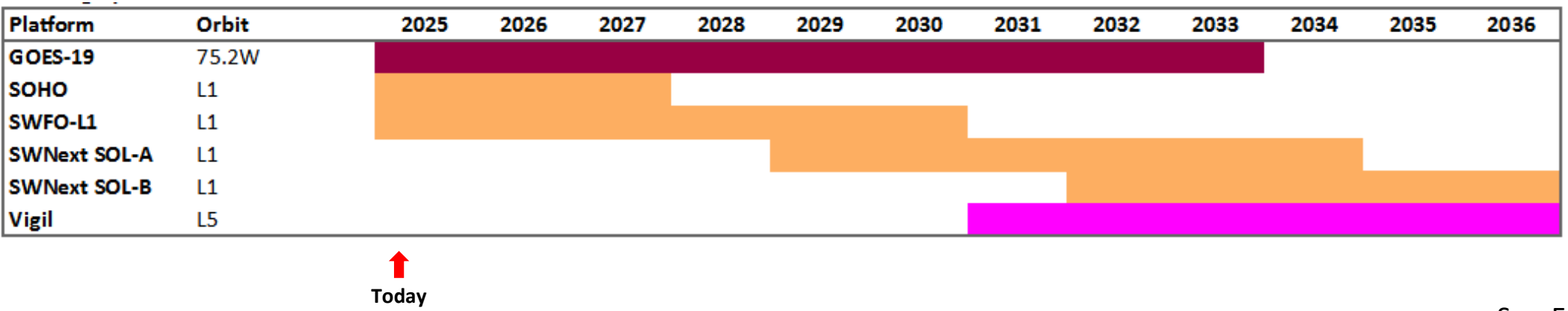


LEO - 1 orbit
Drifting

WGIII Assessment:

Slight risk of not meeting the GGMS Baseline commitment in the early 2030s. NASA and JAXA to provide additional information on the GPM continuation mission.

Coronagraph (Coronagraphy)

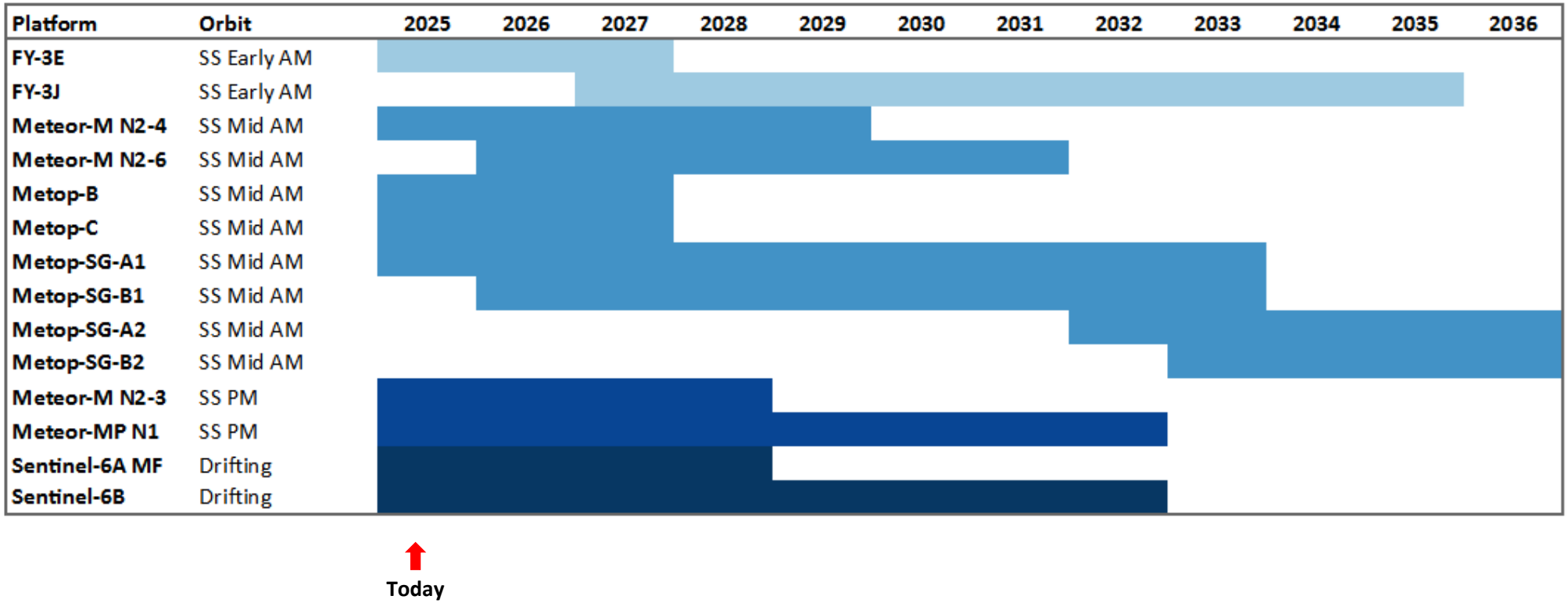


Sun-Earth Line
L1, **GEO - 1 slot**
L5

WGIII Assessment:

Slight risk of gap in GEO in the mid 2030s. Slight risk of a gap at L1 until SWFO-L1 is launched and operational as SOHO is operating well past design life, but NOAA is prepared to provide STEREO-A coronagraphy from the Wallops and Fairbanks stations in the event of loss of SOHO/LASCO.

Energetic Particle Sensor LEO (Magnetospheric)



WGIII Assessment:

Slight risk of not meeting the CGMS Baseline commitment in the afternoon orbit in the mid 2030s.

LEO - 3 orbits as in-situ measurements

Thank you!

BACKUP

Full Risk Assessment

Updates - 2025

- Updates to mission data were received January-February, and and reviewed at the 7th RAW, 25-27 February 2025
- Each flyout chart has been updated with the new launch and EOL information:

- FY-4D EOL moved to 2034
- FY-4E EOL moved to 2035
- FY-4F launch moved to 2029
- HY-2B EOL moved to 2025
- Sentinel mission EOLs now include 2.5 yr life extension
  - Sentinel-1A EOL moved to 2025
  - Sentinel-1C EOL moved to 2034
  - Sentinel-1D EOL moved to 2035
  - Sentinel-2C EOL moved to 2034
  - Sentinel-2D EOL moved to 2038
  - Sentinel-3C EOL moved to 2036
  - Sentinel-3D EOL moved to 2038
  - Sentinel-5P EOL moved to 2027
  - Sentinel-6A/MF EOL moved to 2028
- MetOp-B EOL moved to 2027
- MTG-I3 launch moved to 2033 and EOL to 2043
- INSAT-3DS EOL moved to 2034
- GCOM-C and GCOM-W EOLs moved to 2025
- GOSAT and GOSAT-2 EOLs moved to 2025
- GOSAT-GW launch moved to 2025 and EOL to 2032
- Himawari-10 launch moved to 2028
- GOES-18 EOL moved to 2040
- GEO-XO I1 launch moved to 2032 and EOL to 2040
- NOAA-15, 18 and 19 EOL moved to 2025
- NOAA-20 EOL moved to 2031
- NOAA-21 EOL moved to 2036
- JPSS-4 EOL moved to 2036
- JPSS-3 EOL moved to 2041
- ALOS-2 EOL moved to 2025
- ALOS-4 launch moved to 2024 and EOL to 2031
- SOHO EOL has been moved to 2027
- DSCOVR EOL has been moved to 2028

Updates cont.

- The flyout charts also reflect the following additional updates:
  - GOES-16, GOES-17, Himawari-8 and INSAT-3D have been listed as on-orbit spares for appropriate observations
  - GOES-U is now GOES-19
  - AWS and EPS Sterna 1, 2 and 3 have been added to the Microwave Sounder flyout
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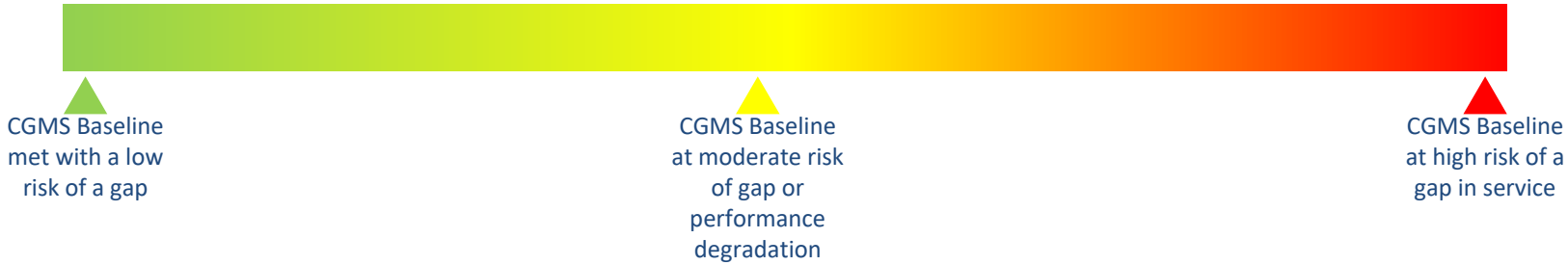

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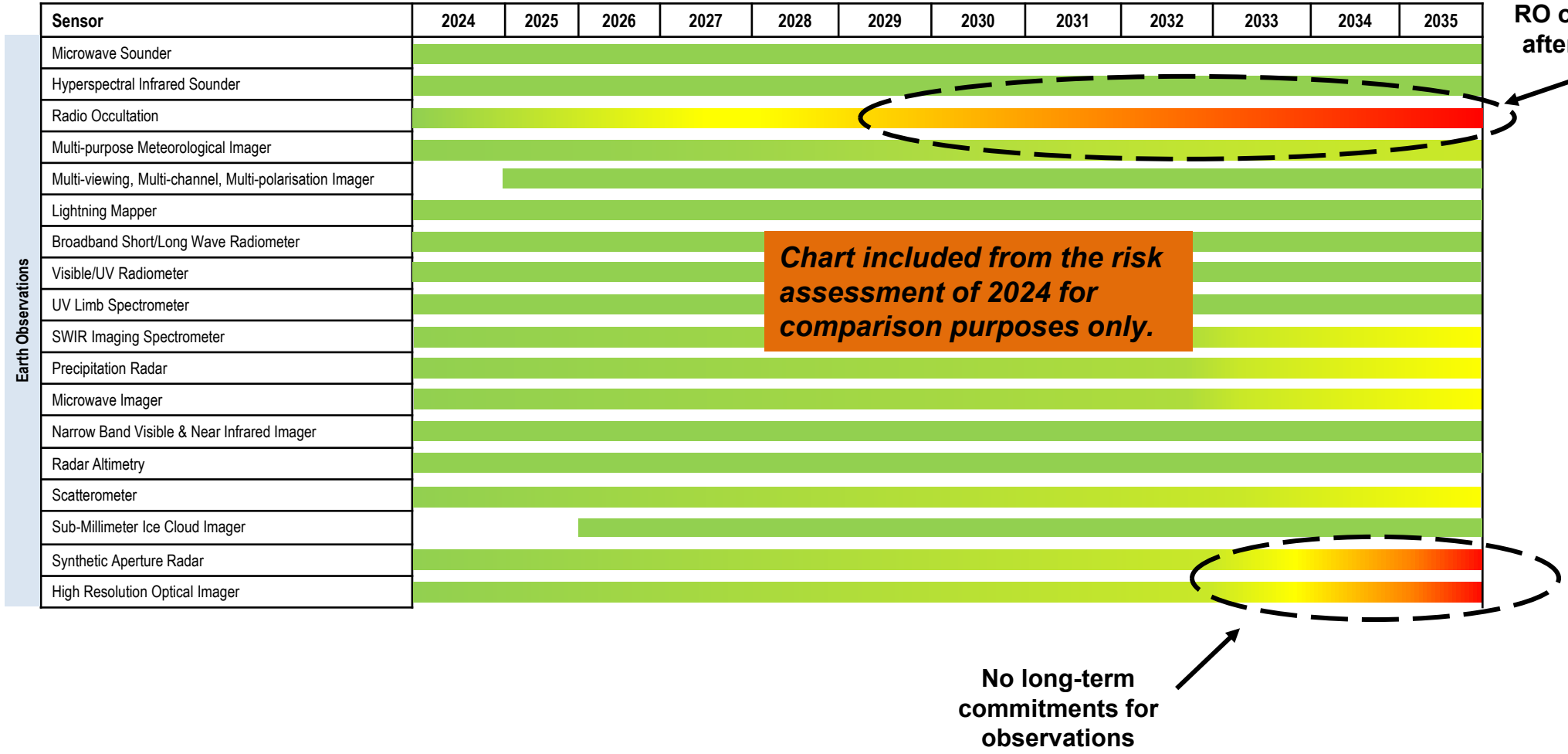

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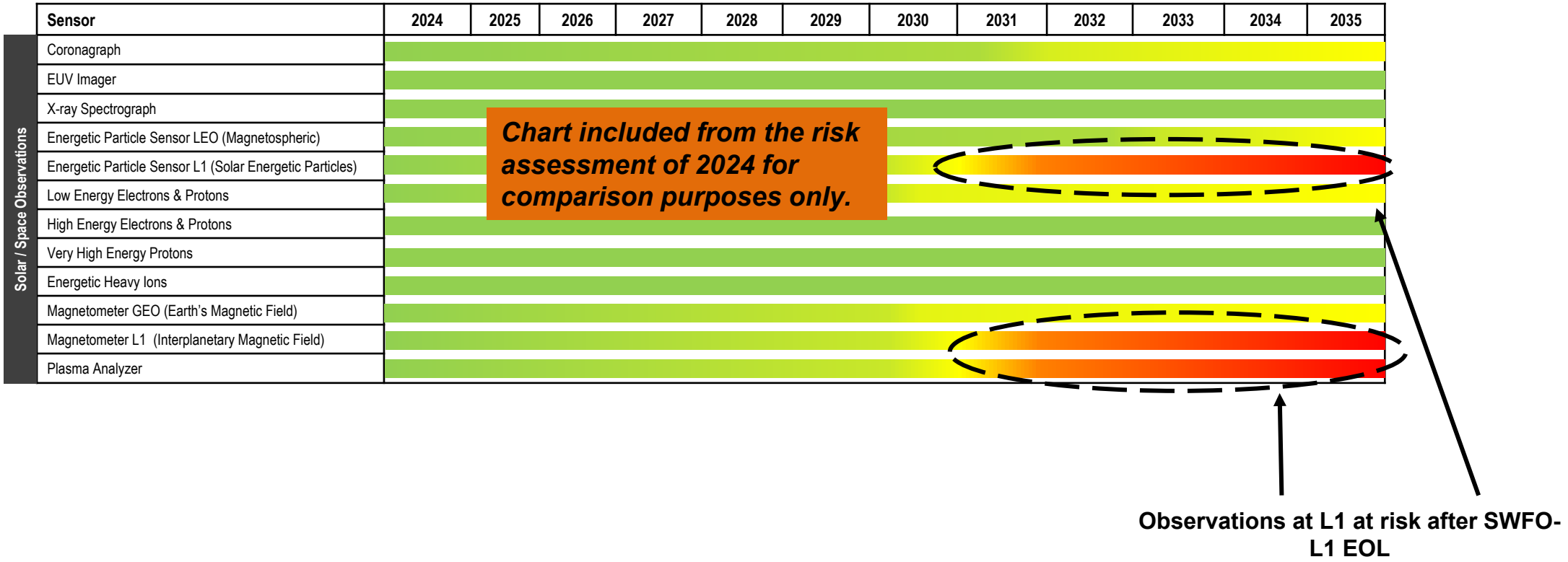

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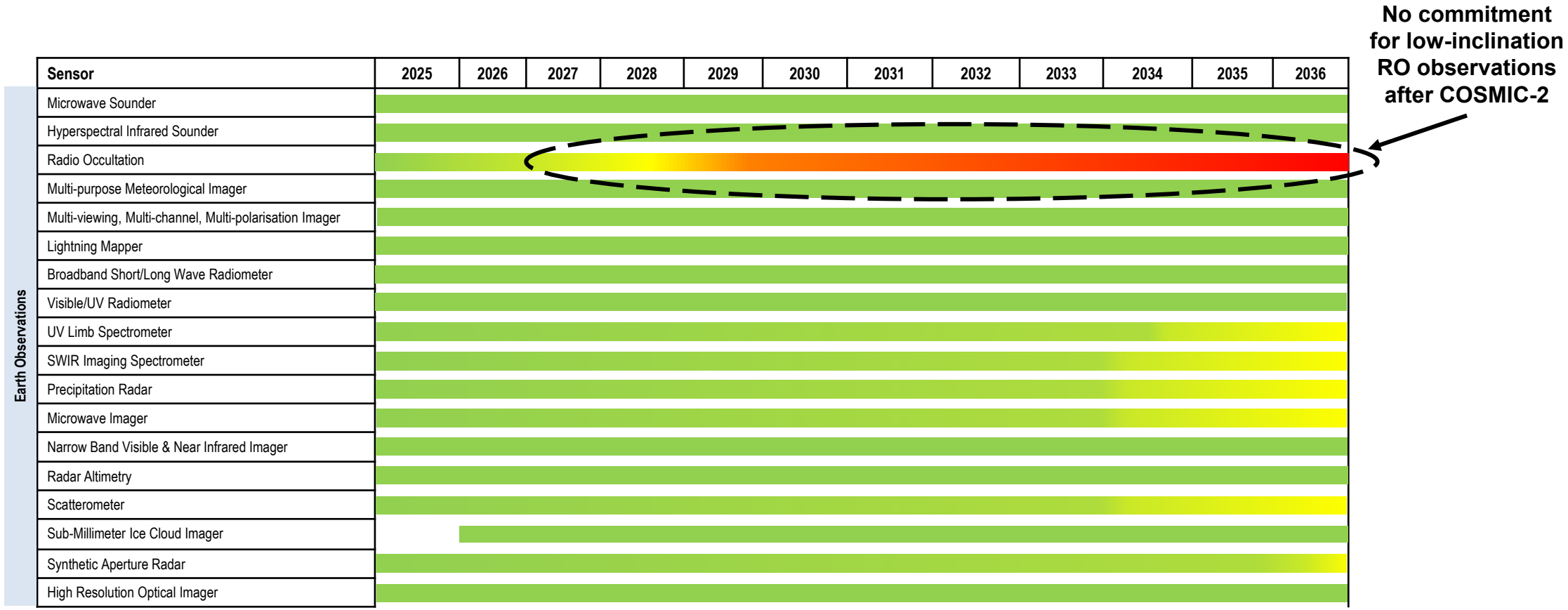

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	Energetic Heavy Ions												
	Magnetometer GEO (Earth's Magnetic Field)												
	Magnetometer L1 (Interplanetary Magnetic Field)												
	Plasma Analyzer												

Top-Level Risk Assessment – Focus Areas

High risk of a gap in service

- Continuity risk from RO observations in low inclination orbits in the later part of the decade as there is no commitment for a follow-on to COSMIC-2.
  - EUMETSAT to provide updated graphics of the RO profiles to determine if the baseline target is being met in the short term by commercial providers.
  - SWCG to make a recommendation to WGIII how to separate RO and Ionospheric Electron Density profiles.

Moderate risk of gap or performance degradation

- Slight long-term continuity risk for the UV Limb Spectrometer.
  - WGII to investigate other capabilities for UV limb sounding to complement JPSS
- Slight long-term continuity risk for the SWIR Imaging Spectrometer.
  - GHG TT via WGII has action to indicate if SWIR missions for CH4 and CO2 be added to the baseline.
- Slight long-term continuity risk for the Precipitation Radar.
  - NASA and JAXA to provide additional information on the GPM continuation mission.
- Slight long-term continuity risk for the Microwave Imager.
- Slight long-term continuity risk for Scatterometry.
- Slight long-term continuity risk for Coronagraphy in GEO.
- Slight long-term continuity risk for Energetic Particle Sensors in LEO.

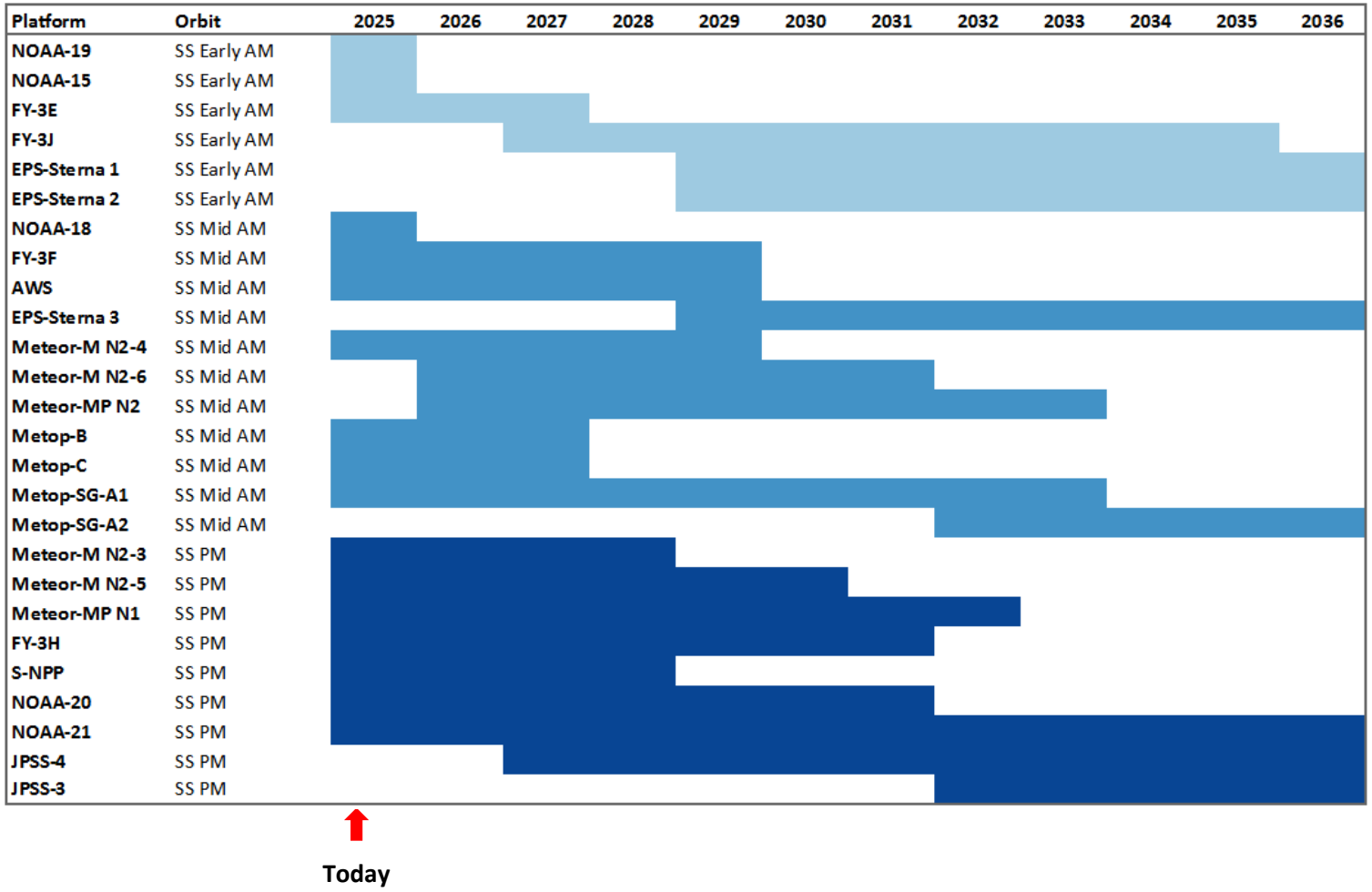
Top-Level Risk Assessment – Associated Actions

Associated Open Actions

- WGII to consider whether observations from geostationary orbit should be added to the CGMS baseline requirements for the broadband short/long wave radiometer.
- WGII to articulate how MW missions with different frequencies should be addressed and visualized in the CGMS Baseline and Risk Assessment.
- WGII to investigate other capabilities for UV limb sounding to complement JPSS
- GHG TT (via WGII) to indicate if SWIR missions for CH4 and CO2 missions should be added to the CGMS baseline and the risk assessment.
- The SWCG to make a recommendation to WGIII how to separate RO and Ionospheric Electron Density profiles in the CGMS Baseline and Risk Assessment.
- NASA and JAXA to provide a coordinated update on possible GPM continuation mission.
- NASA to determine if IMAP mission data is compliant with CGMS Baseline criteria to be incorporated into the Risk Assessment.
- ESA to confirm CRISTAL mission inclusion in the Risk Assessment.
- EUMETSAT to provide updated RO monthly daily occultations chart

Coordination Group for Meteorological Satellites - CGMS

Microwave Sounder (Atmospheric Temperature, Humidity, and Precipitation)



LEO - 3 Orbits

Sun-synchronous early morning

Sun-synchronous mid-morning

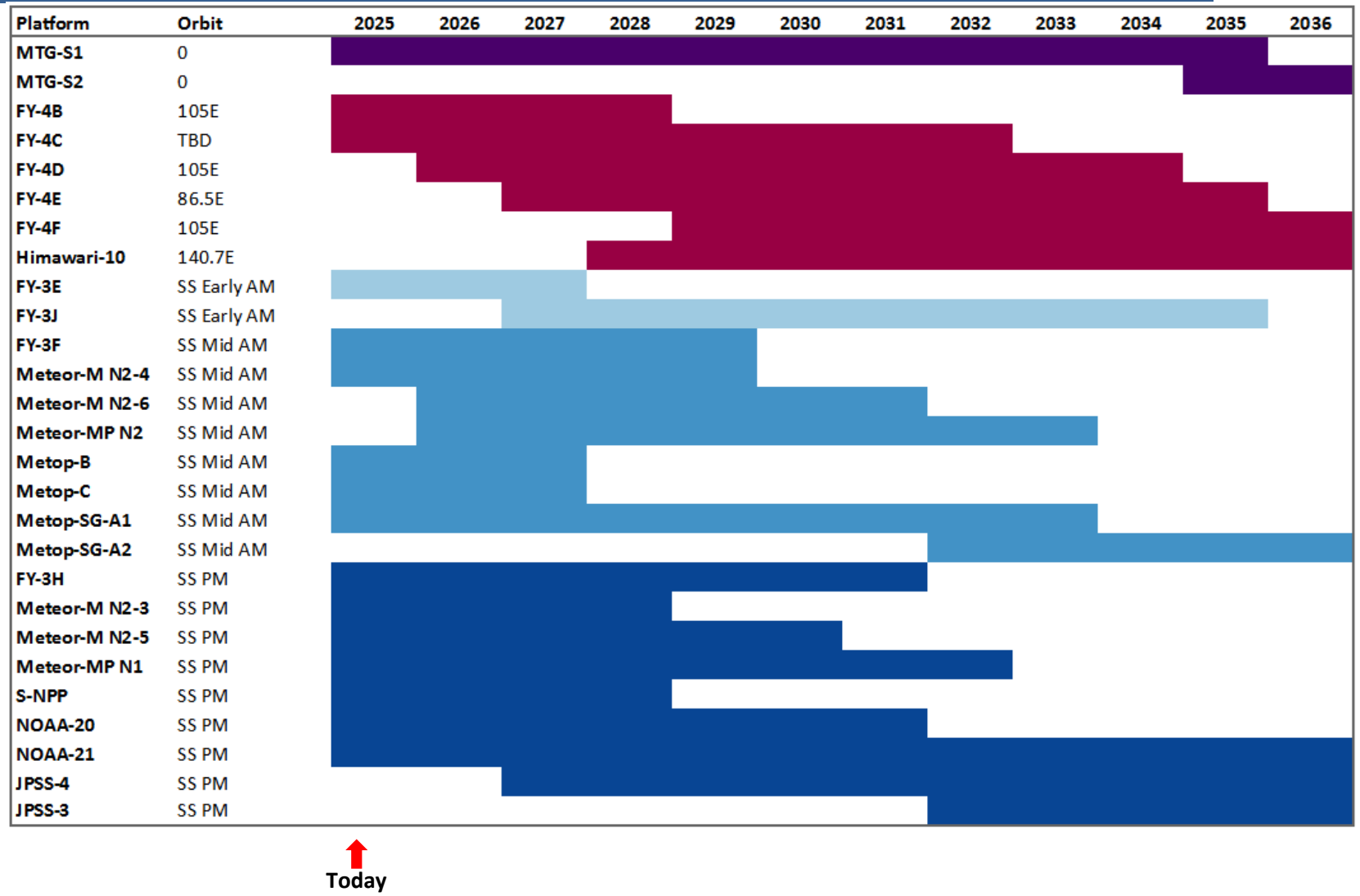
Sun-synchronous afternoon

WGIII Assessment:

Low risk of not meeting the CGMS Baseline commitment.

Coordination Group for Meteorological Satellites - CGMS

Hyperspectral Infrared Sounder (Atmospheric temperature, humidity, and winds Atmospheric composition: CO, CO2, SO2 , depending on spectral band also CH4 and NH3)



GEO - 2 Slots

0°

86.5°-140°E range

LEO - 3 Orbits

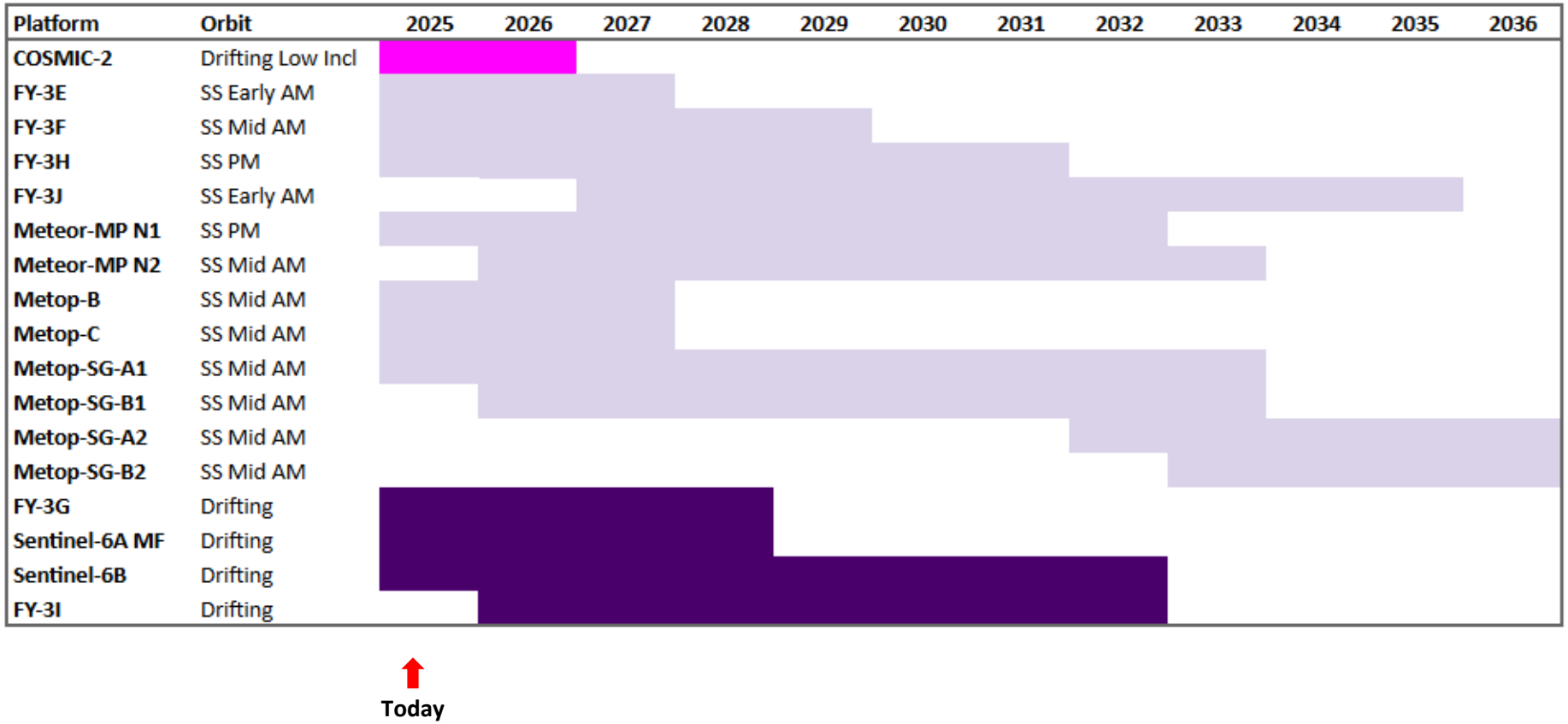
Sun-synchronous early morning

Sun-synchronous mid-morning

Sun-synchronous afternoon

WGIII Assessment: Low risk of not meeting CGMS Baseline commitment. Note the HLPP objective (1.2) to expand hyperspectral sounding from GEO to the full geostationary ring.

Radio Occultation (Atmospheric Temperature, Humidity, and Ionospheric Electron Density)



WGIII Assessment:

Risk of not meeting the CGMS Baseline commitment in low-inclination RO observations after COSMIC-2 at the end of the decade, and in other drifting orbits in the mid 2030s. The SWCG to make a recommendation to WGIII how to separate RO and Ionospheric Electron Density profiles in the CGMS Baseline and Risk Assessment

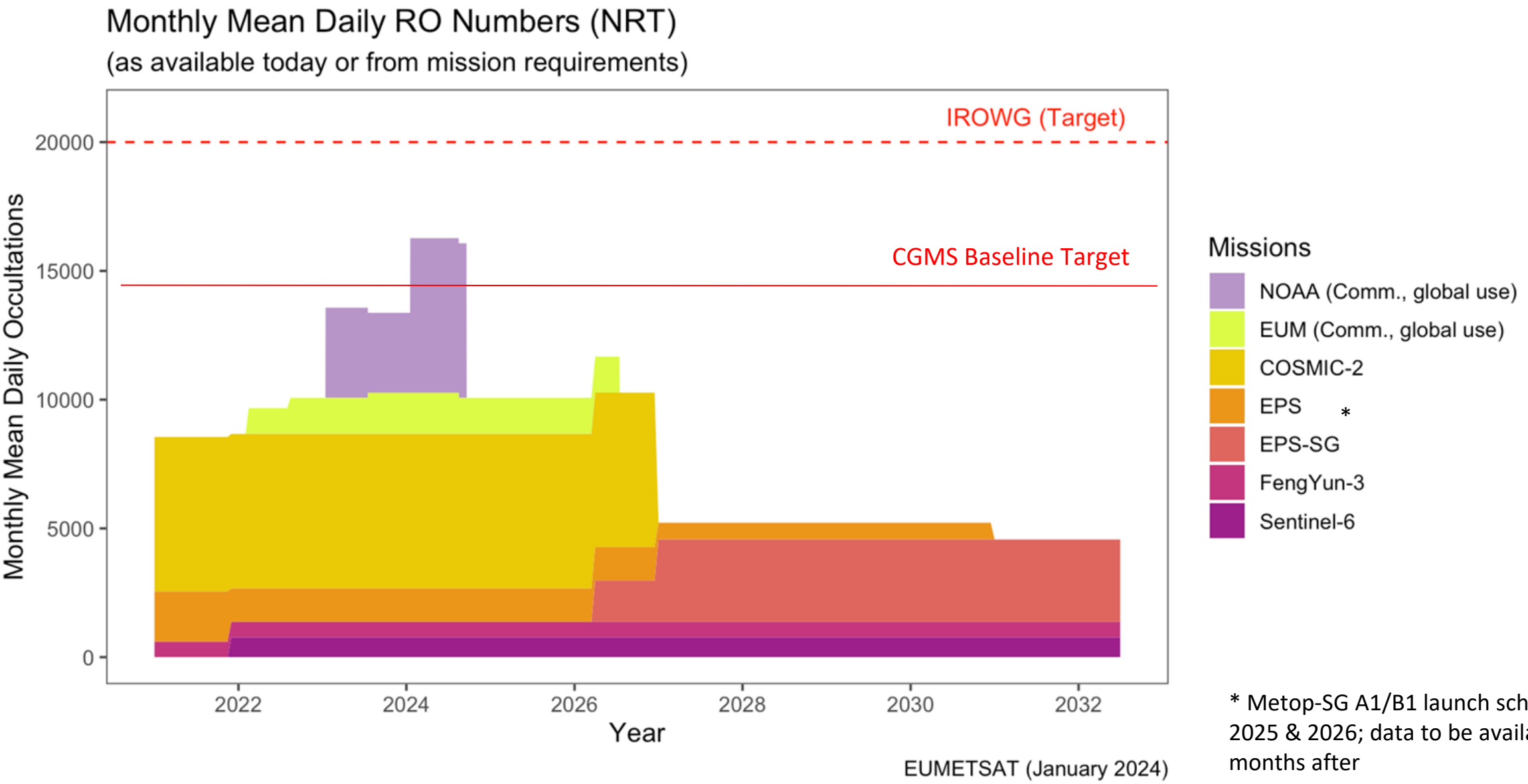
LEO - 3 Orbits

6000 occultations from **low inclination (<30°)**

7600 occultations from **sun-synchronous**

1000 occultations from **other drifting orbits**

Radio Occultation (Atmospheric Temperature, Humidity, and Ionospheric Electron Density)



* Metop-SG A1/B1 launch scheduled 2025 & 2026; data to be available 6 months after

Coordination Group for Meteorological Satellites - CGMS

Multi-purpose Meteorological Imagers (multispectral, visible and IR) (Sea Surface Temperature, Aerosols, Land Surface Temperature, Cloud Properties, Feature Tracking Winds (AMV), Flood Mapping, Fires, Cryosphere Applications (sea ice, snow cover, etc.)

GEO - Evenly spaced satellites

137°W

75.2°W

0°-45.5°E range

14.5°W-165.8°E range

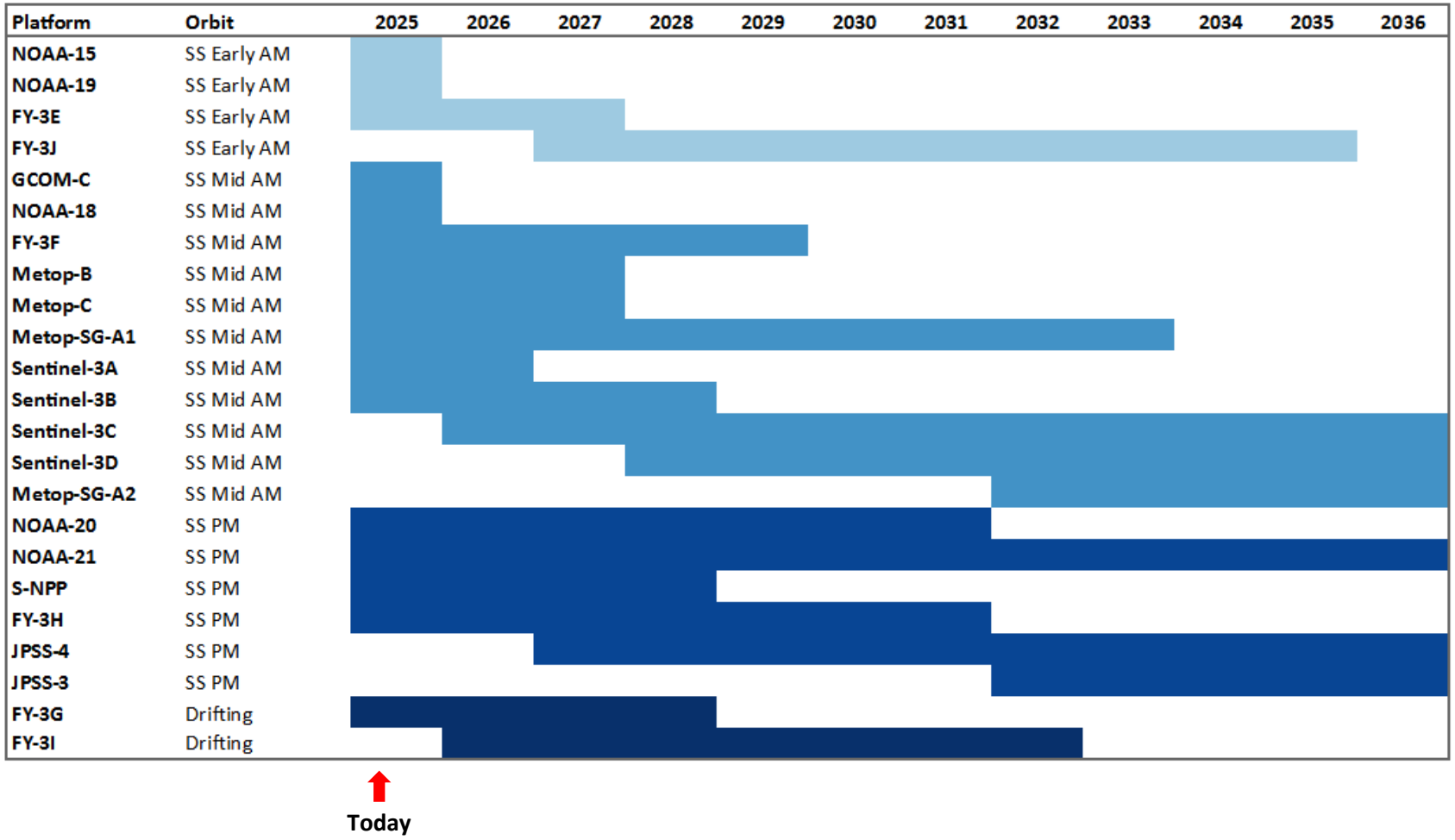
74°-82°E range

86.5°-140°E range

WGIII Assessment: Low risk of not meeting the CGMS Baseline commitment.

Coordination Group for Meteorological Satellites - CGMS

Multi-purpose Meteorological Imagers (multispectral, visible and IR) (Sea Surface Temperature, Aerosols, Land Surface Temperature, Cloud Properties, Feature Tracking Winds (AMV), Flood Mapping, Fires, Cryosphere Applications (sea ice, snow cover, etc.),



WGIII Assessment:

Low risk of not meeting the CGMS Baseline commitment.

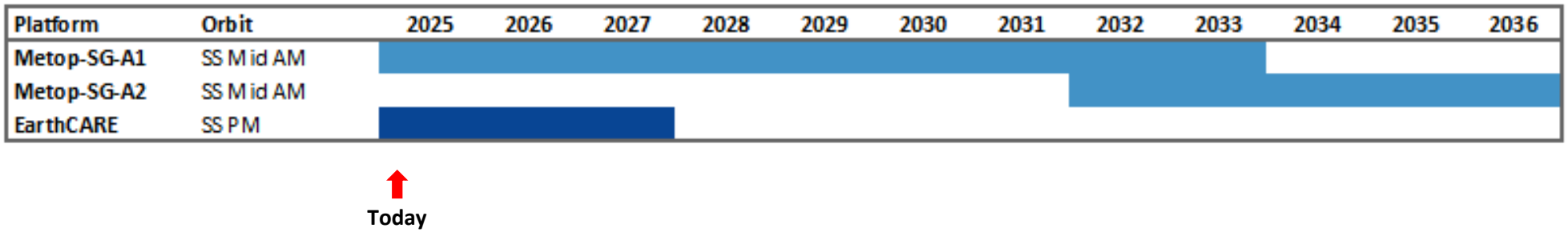
LEO

Sun-synchronous early morning

Sun-synchronous mid-morning

Sun-synchronous afternoon

Multi-viewing, Multi-channel, Multi-polarisation Imager (Aerosol)



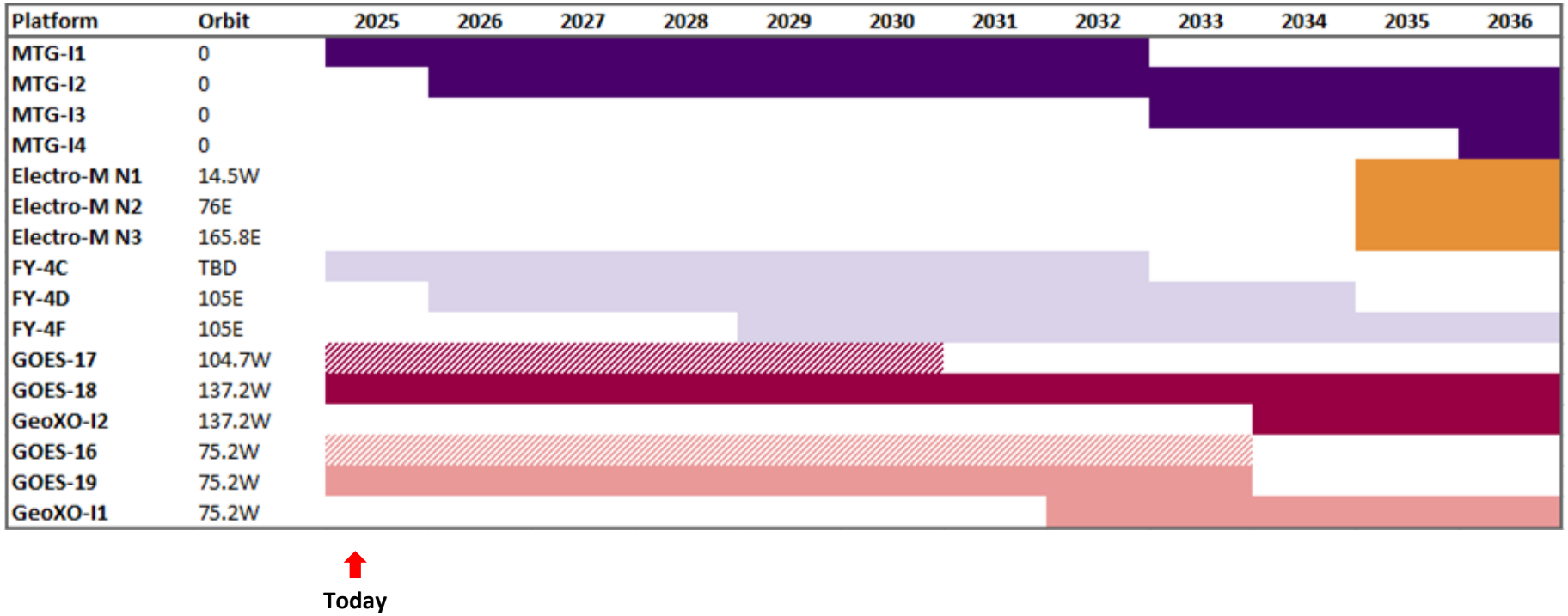
LEO - 1 orbit

Sun-synchronous

WGIII Assessment:

Low risk of not meeting the CGMS Baseline commitment.

Lightning Mapper (Lightning)



GEO - 4 slots

0°

86.5°-105°E range

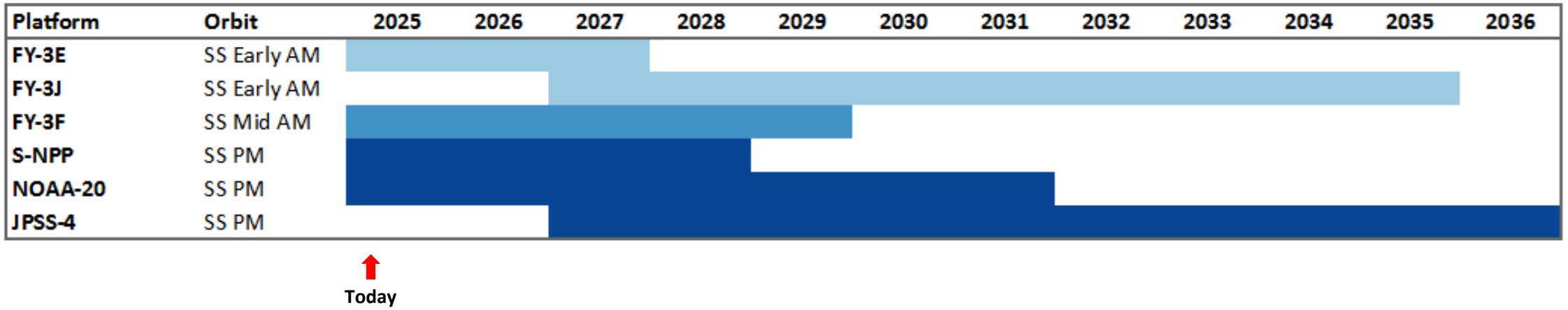
137°W

75.2°W

WGIII Assessment:

Low risk of not meeting the CGMS Baseline commitment. An HLPP objective (1.2) exists to provide the capability for the whole geostationary ring.

Broadband Short/Long Wave Radiometer (Radiation Balance)



LEO - 2 Orbits

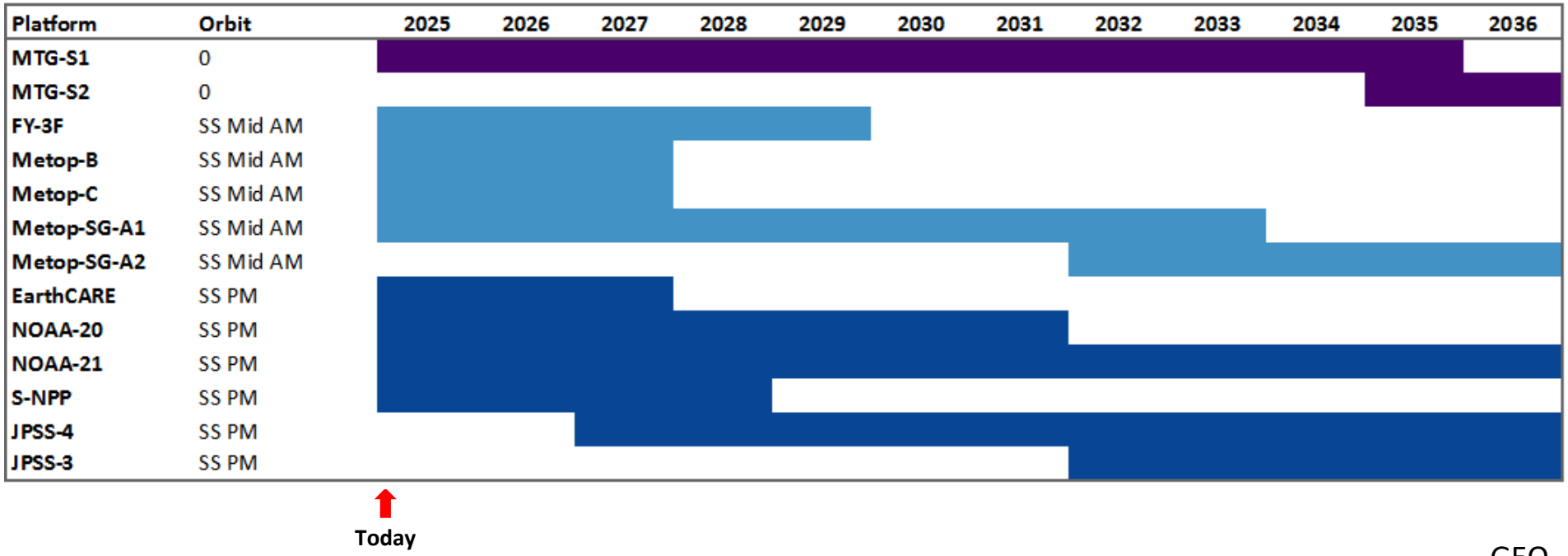
Sun-synchronous morning

Sun-synchronous afternoon

WGIII Assessment:

Low risk of not meeting the CGMS baseline commitment. Action on WGII to investigate the addition of GEO contributions to the CGMS Baseline.

Visible / UV Spectrometer (Aerosol, Atmospheric Composition: O3, CO2, NO2, SO2, BrO. C)



WGIII Assessment: Does not meet the baseline commitment in GEO as GK-2B has been removed due to the data not being provided in NRT and the agency is not a CGMS member. Proposed update to remove the GEO slot at 128.2 from the CGMS Baseline Document is being considered.

GEO - 2 Slots

0°

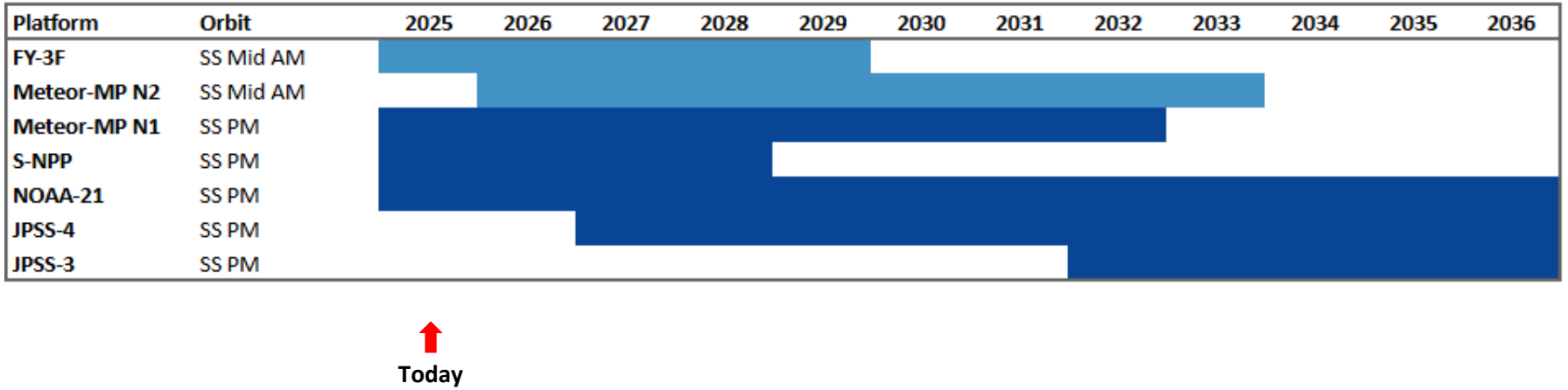
128.2°E

LEO - 2 Orbits

Sun-synchronous mid-morning

Sun-synchronous afternoon

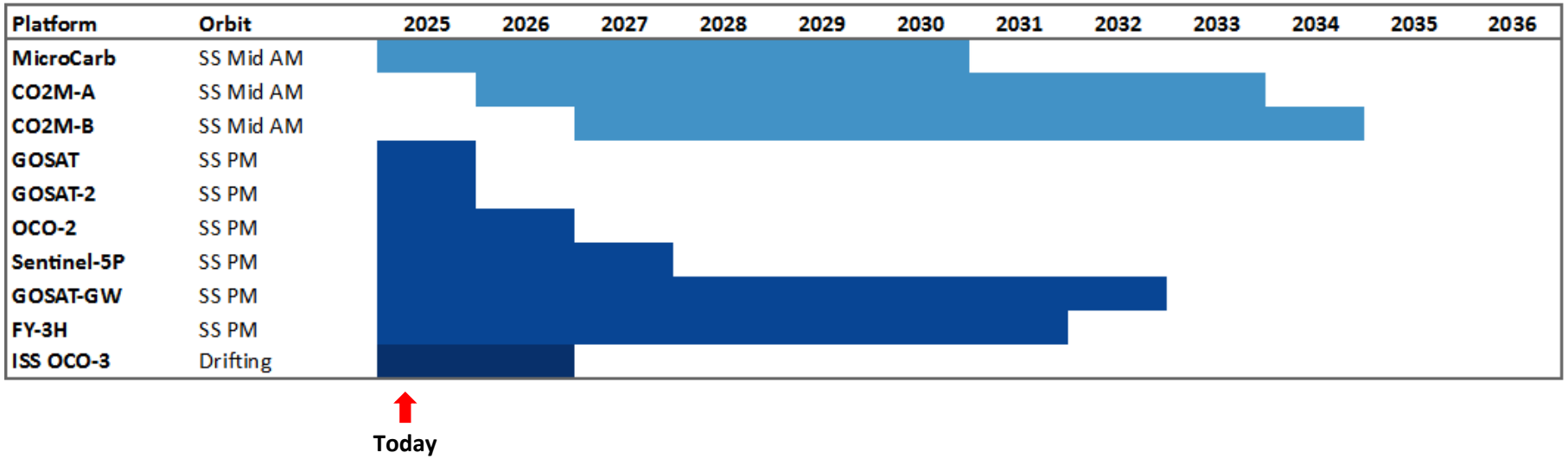
UV Limb Spectrometer (Aerosol, Atmospheric Composition: O3)



LEO - 2 Orbits
Sun-synchronous mid-morning
Sun-synchronous afternoon

WGIII Assessment:
Slight risk of not meeting the CGMS Baseline commitment in the mid-morning orbit in the mid 2030s. WGII to investigate other capabilities for UV limb sounding to complement JPSS.

SWIR Imaging Spectrometer (Atmospheric Composition: CO2, CH4)



LEO - 2 Orbits

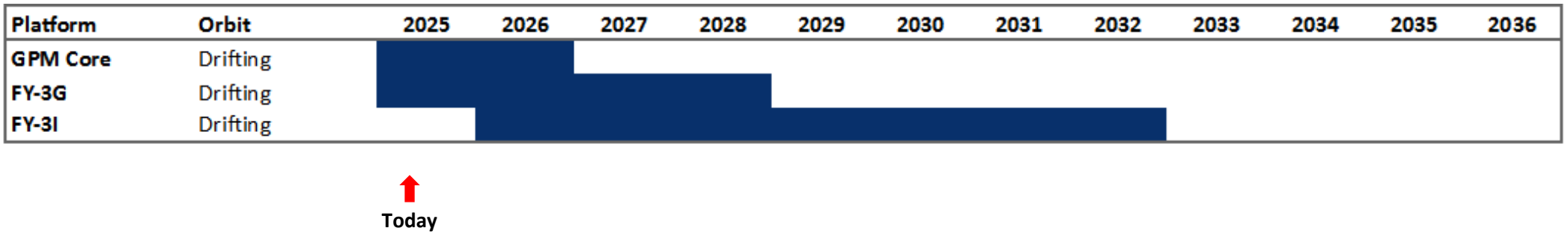
Sun-synchronous late morning

Sun-synchronous afternoon

WGIII Assessment:

Slight risk of not meeting CGMS Baseline commitment in the mid 2030s. GHG TT via WGII has action to indicate if SWIR missions for CH4 and CO2 be added to the baseline.

Precipitation Radar (Precipitation)

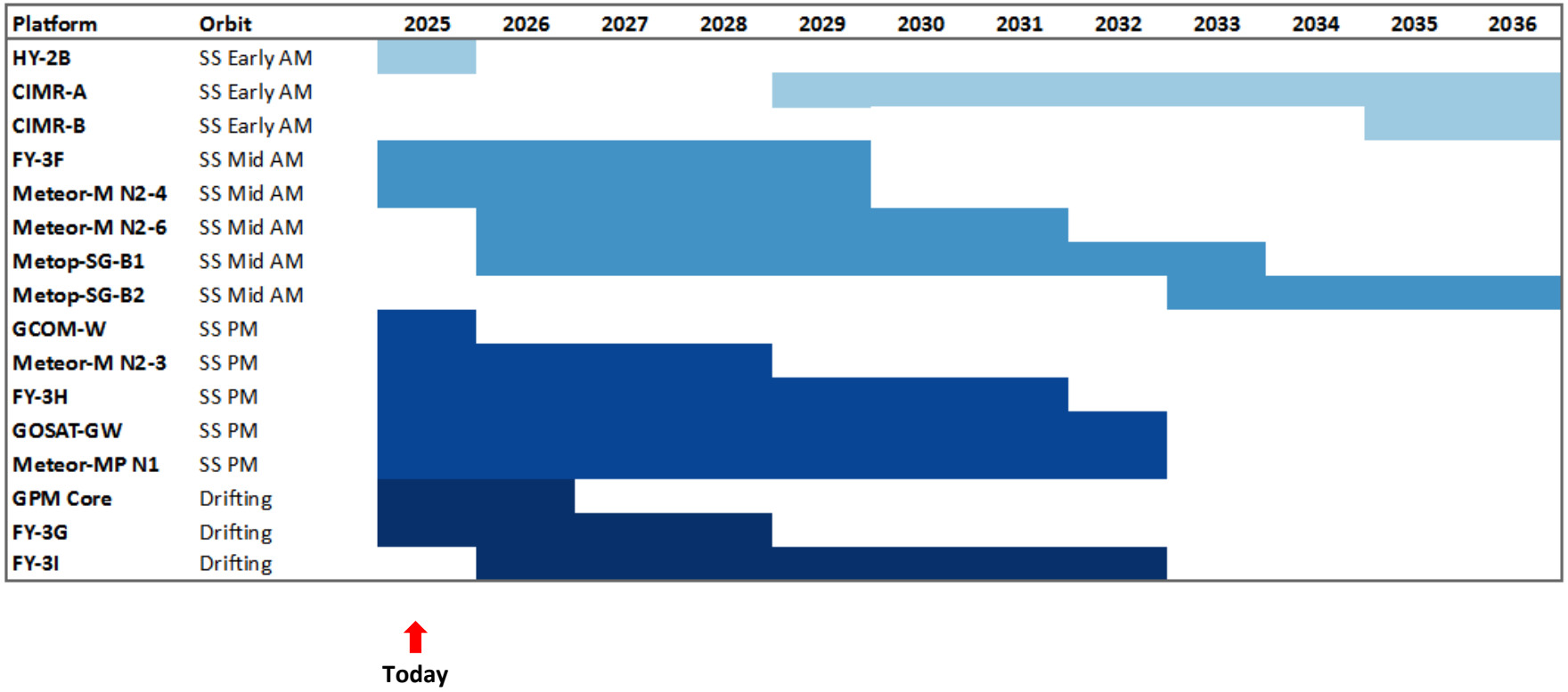


LEO - 1 orbit
Drifting

WGIII Assessment:

Slight risk of not meeting the GGMS Baseline commitment in the early 2030s. NASA and JAXA to provide additional information on the GPM continuation mission.

Microwave Imager (Sea Surface Temperature, Ocean Surface Winds, Precipitable Water, Soil Moisture, Snow and Ice properties, Sea Ice Properties)



LEO - 2 Orbits

Sun-synchronous mid-morning

Sun-synchronous afternoon

WGIII Assessment:

Slight risk of not meeting the CGMS Baseline commitment in the afternoon orbit in the mid 2030s.

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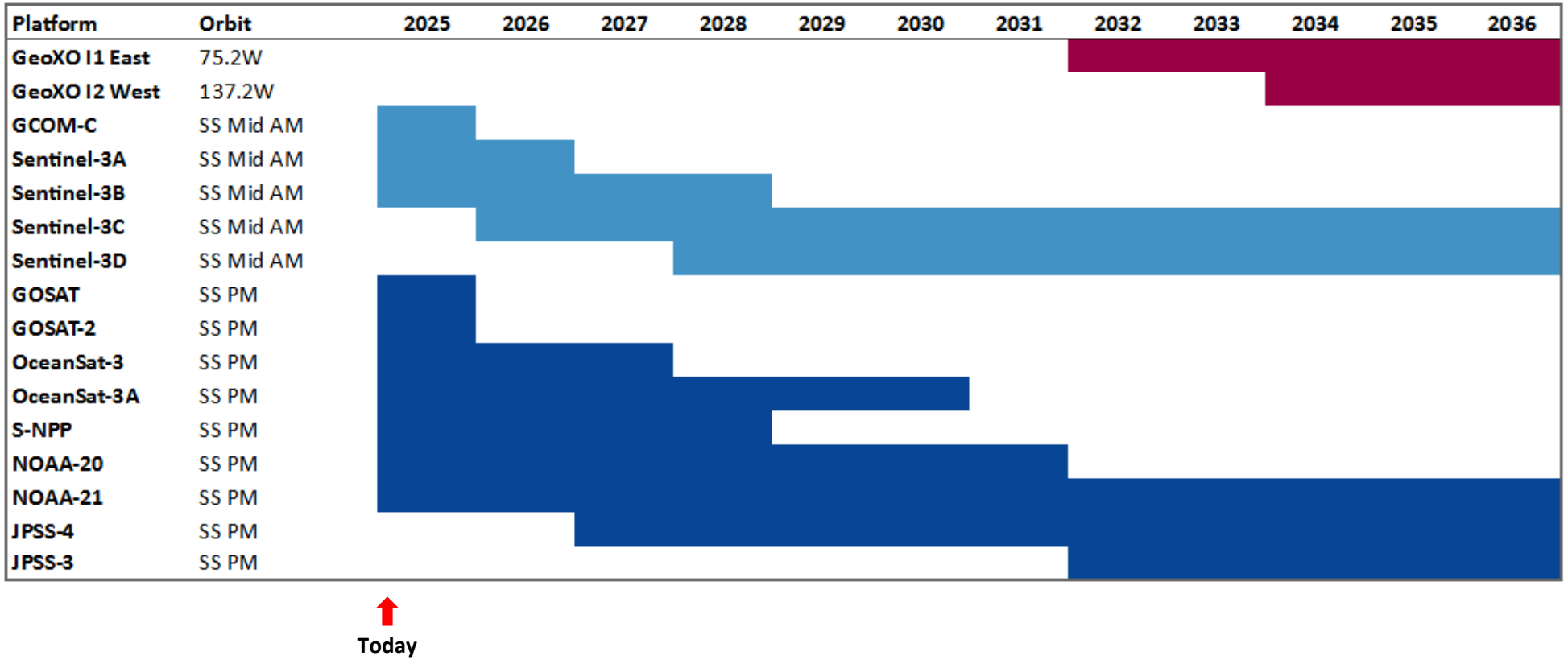
Narrow Band Visible IR Imager (Ocean Colour, Aerosols)



WGIII Assessment: Does not meet the baseline commitment in GEO as GK-2B has been removed due to the data not being provided in NRT and the agency is not a CGMS member. Proposed update to remove the GEO slot at 128.2 from the CGMS Baseline Document is being considered.

LEO - 2 Orbits

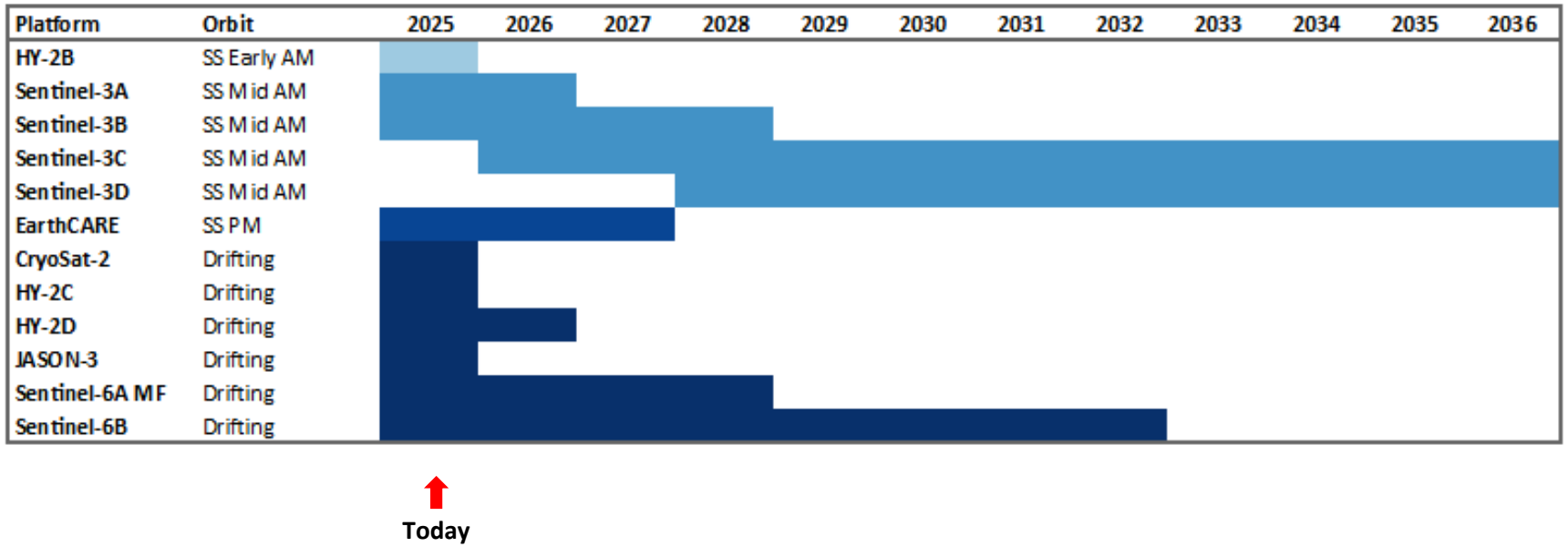
Sun-synchronous mid-morning

Sun-synchronous afternoon

GEO - 1 Slot

128.2°E

Radar Altimetry (Ocean Surface Topography)



LEO - 1 Orbit

Sun-synchronous mid-morning

WGIII Assessment:

Low risk of not meeting the CGMS Baseline commitment.

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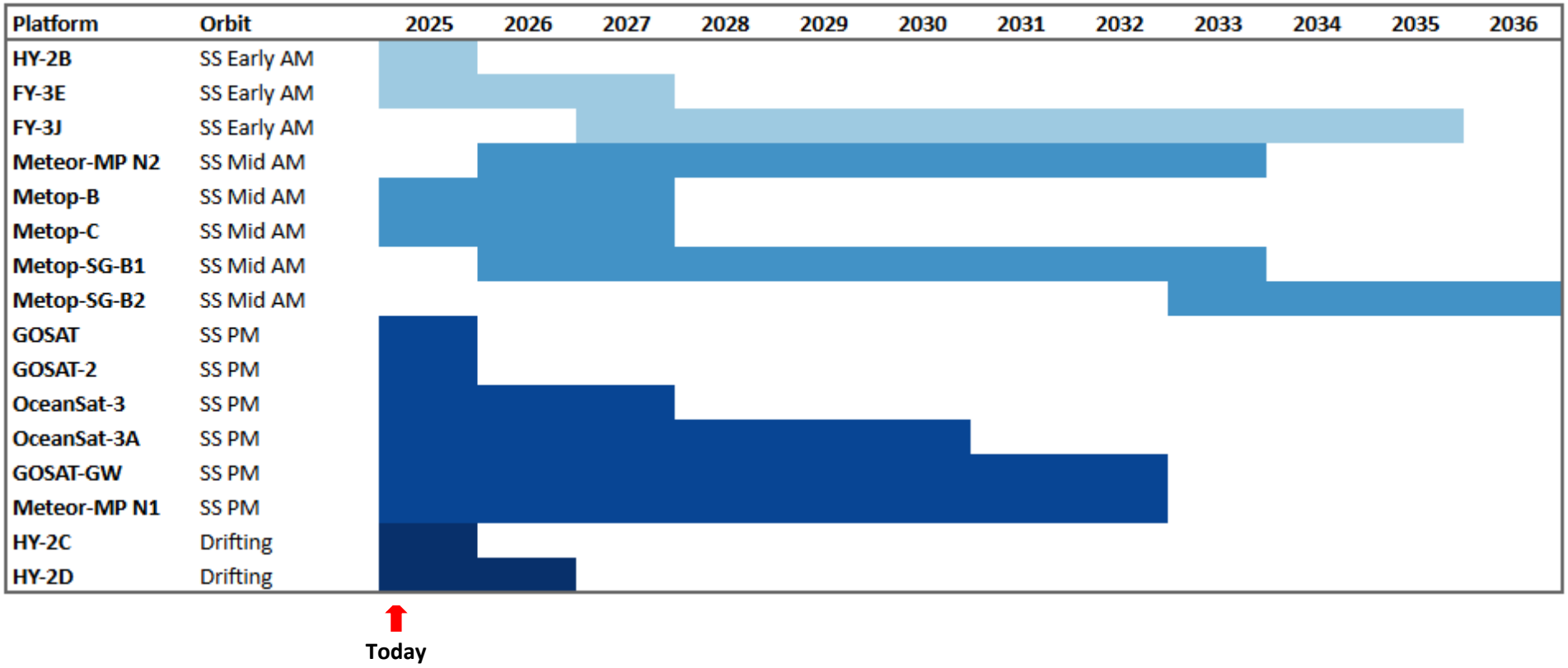
Scatterometry (Ocean Surface Winds)



LEO

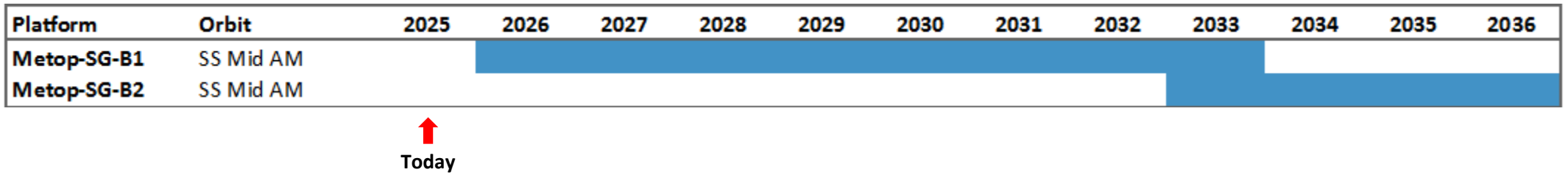
Sun-synchronous early morning

Sun-synchronous mid-morning

Sun-synchronous afternoon

WGIII Assessment: Slight risk of not meeting the CGMS Baseline commitment in the afternoon orbit in the mid 2030s.

Sub-millimetre Ice Cloud Imager (Cloud Ice)



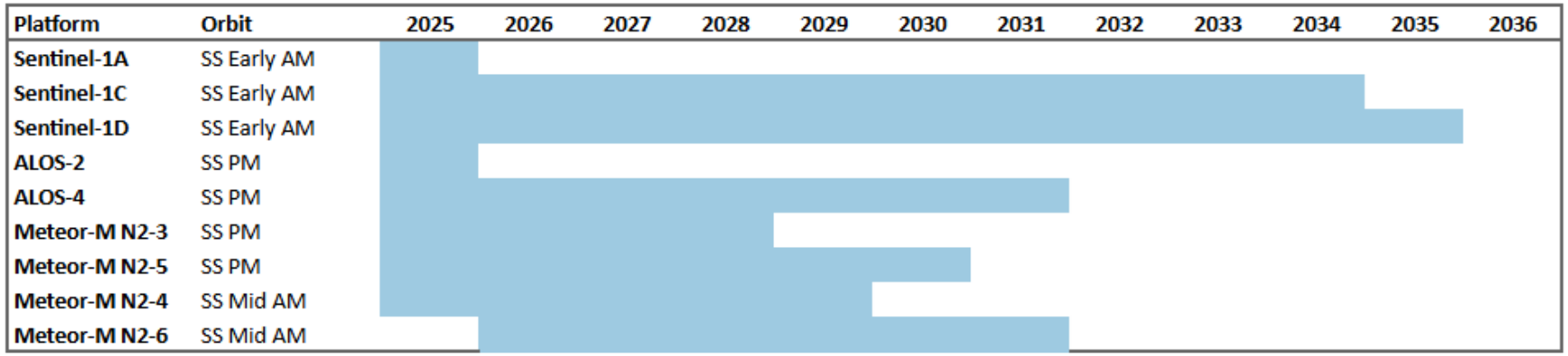
LEO - 1 Orbit

Sun-synchronous mid-morning

WGIII Assessment:

Low risk of not meeting CGMS Baseline commitment.

Synthetic Aperture Radar (Soil Moisture, Sea Ice)



Today

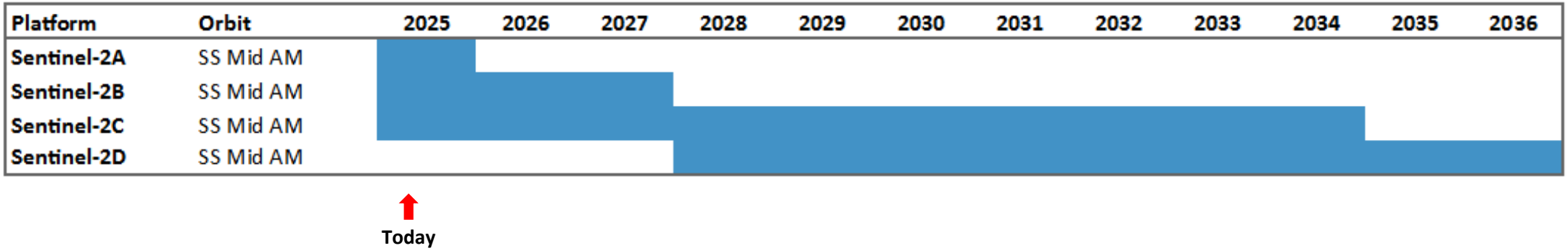
LEO - 1 Orbit

Sun-synchronous

WGIII Assessment:

Low risk of not meeting CGMS Baseline commitment.

High Resolution Optical Imager (Land Use, Vegetation Type and Status, Aerosols)



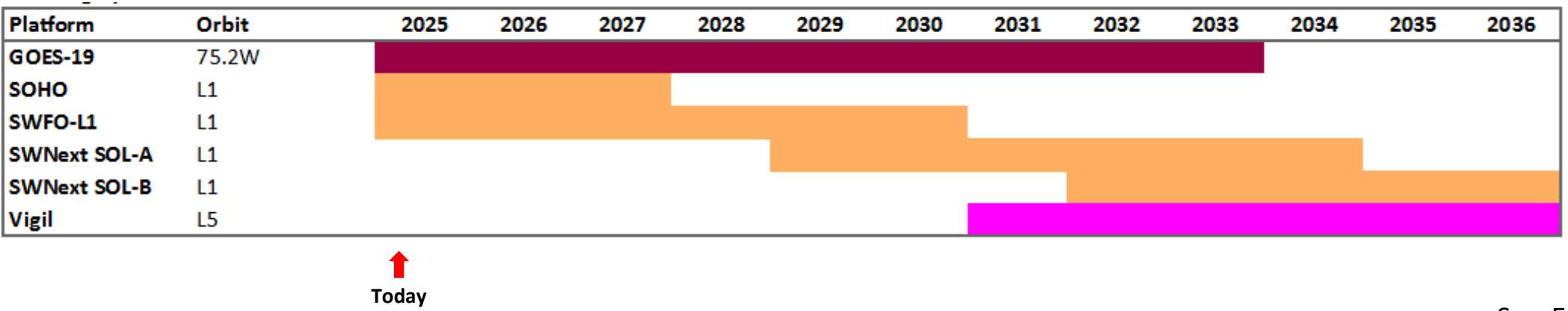
LEO - 1 Orbit

Sun-synchronous

WGIII Assessment:

Low risk of not meeting CGMS Baseline commitment.

Coronagraph (Coronagraphy)

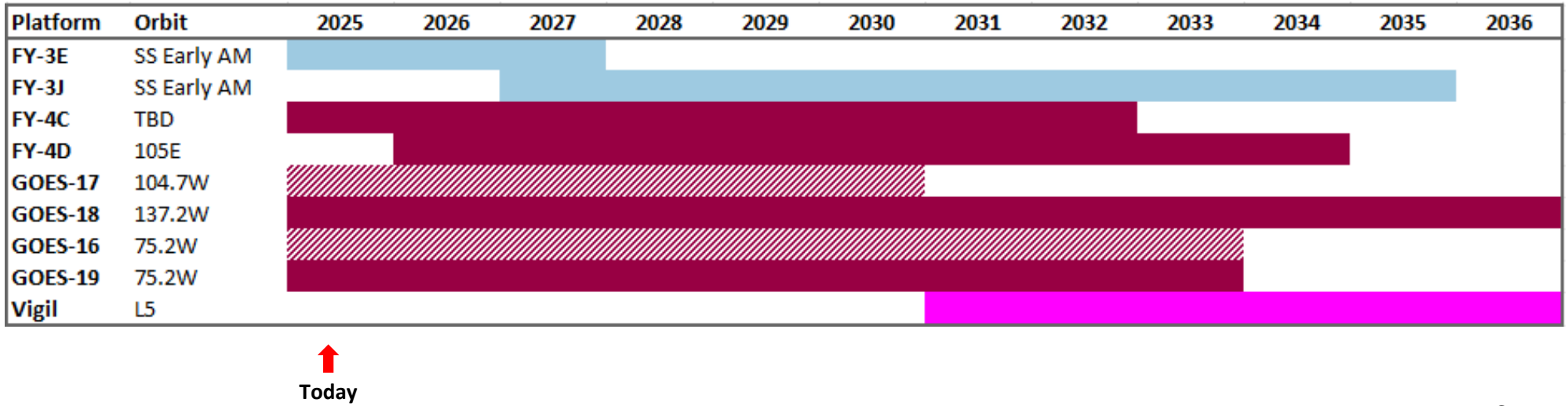


Sun-Earth Line
L1, **GEO - 1 slot**
L5

WGIII Assessment:

Slight risk of gap in GEO in the mid 2030s. Slight risk of a gap at L1 until SWFO-L1 is launched and operational as SOHO is operating well past design life, but NOAA is prepared to provide STEREO-A coronagraphy from the Wallops and Fairbanks stations in the event of loss of SOHO/LASCO.

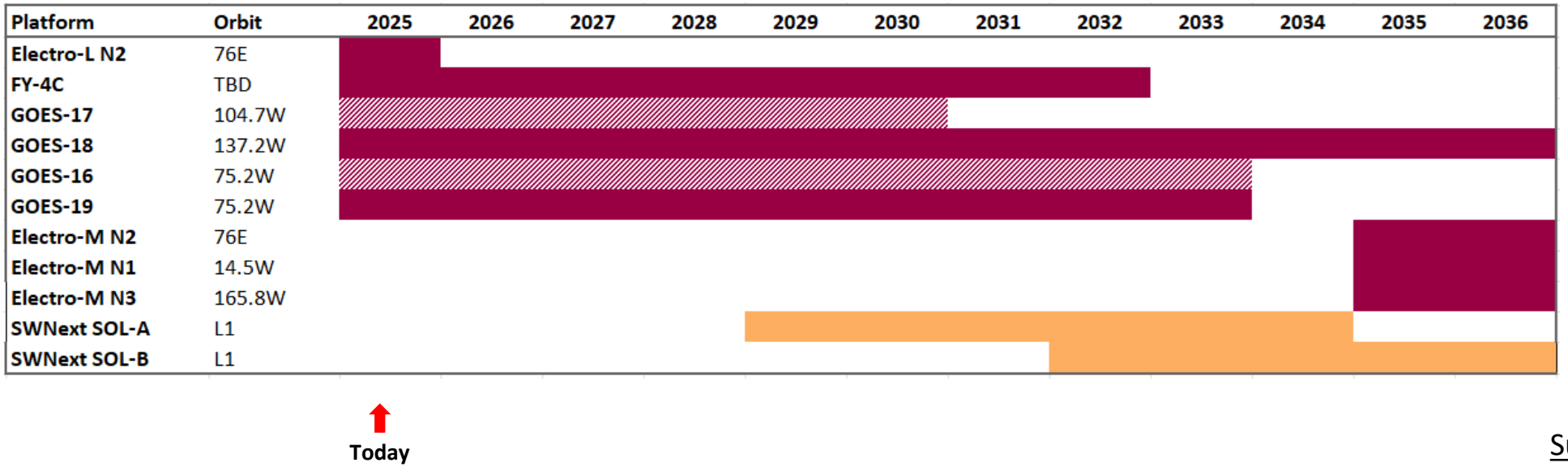
EUV Imager (EUV Imagery)



Sun-Earth Line
LEO - 1 orbit
GEO - 2 slots
L5

WGIII Assessment:
Low risk of not meeting CGMS Baseline commitment.

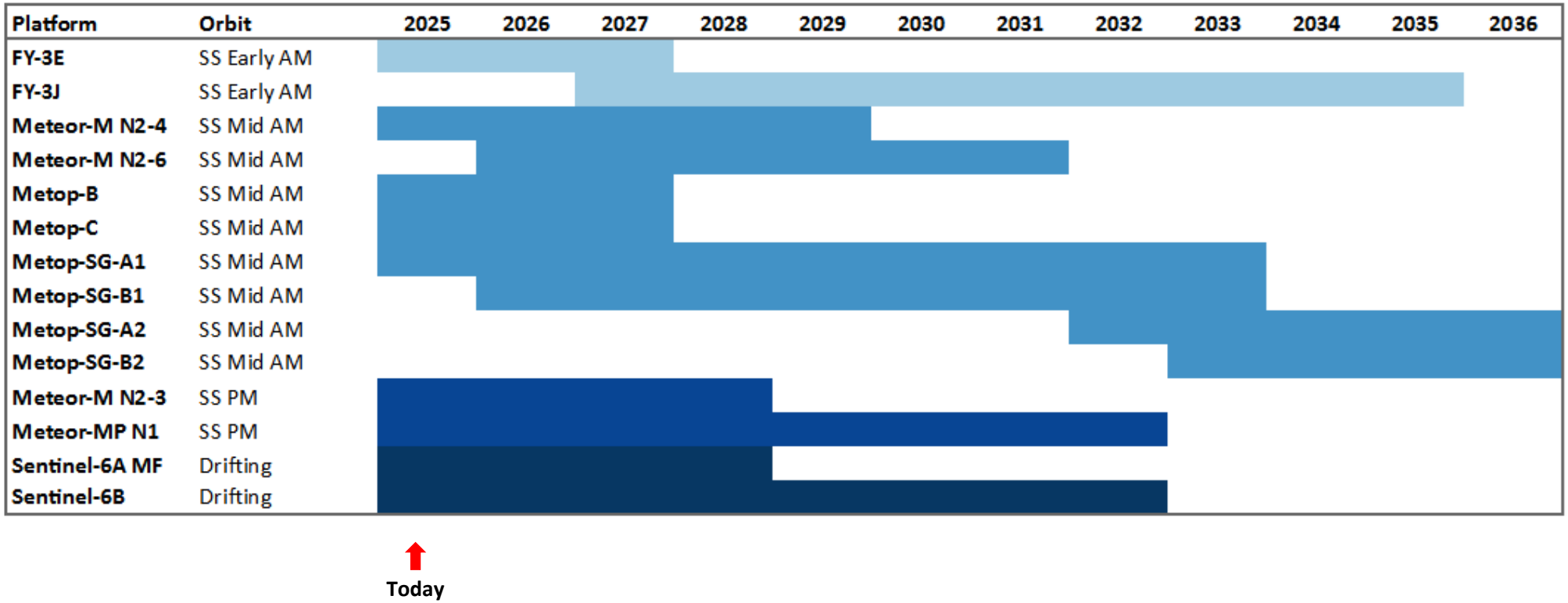
X-Ray Spectrograph (X-Ray Flux)



WGIII Assessment:

Low risk of not meeting CGMS Baseline commitment.

Energetic Particle Sensor LEO (Magnetospheric)



WGIII Assessment:

Slight risk of not meeting the CGMS Baseline commitment in the afternoon orbit in the mid 2030s.

LEO - 3 orbits as in-situ measurements

Energetic Particle Sensor L1 (Solar Energetic Particles)

Platform	Orbit	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
ACE	L1												
DSCOVR	L1												
SWFO-L1	L1												
SWNext SOL-A	L1												
SWNext SOL-B	L1												

Today

L1 as in-situ measurement

WGIII Assessment:

Low risk of not meeting CGMS Baseline commitment.

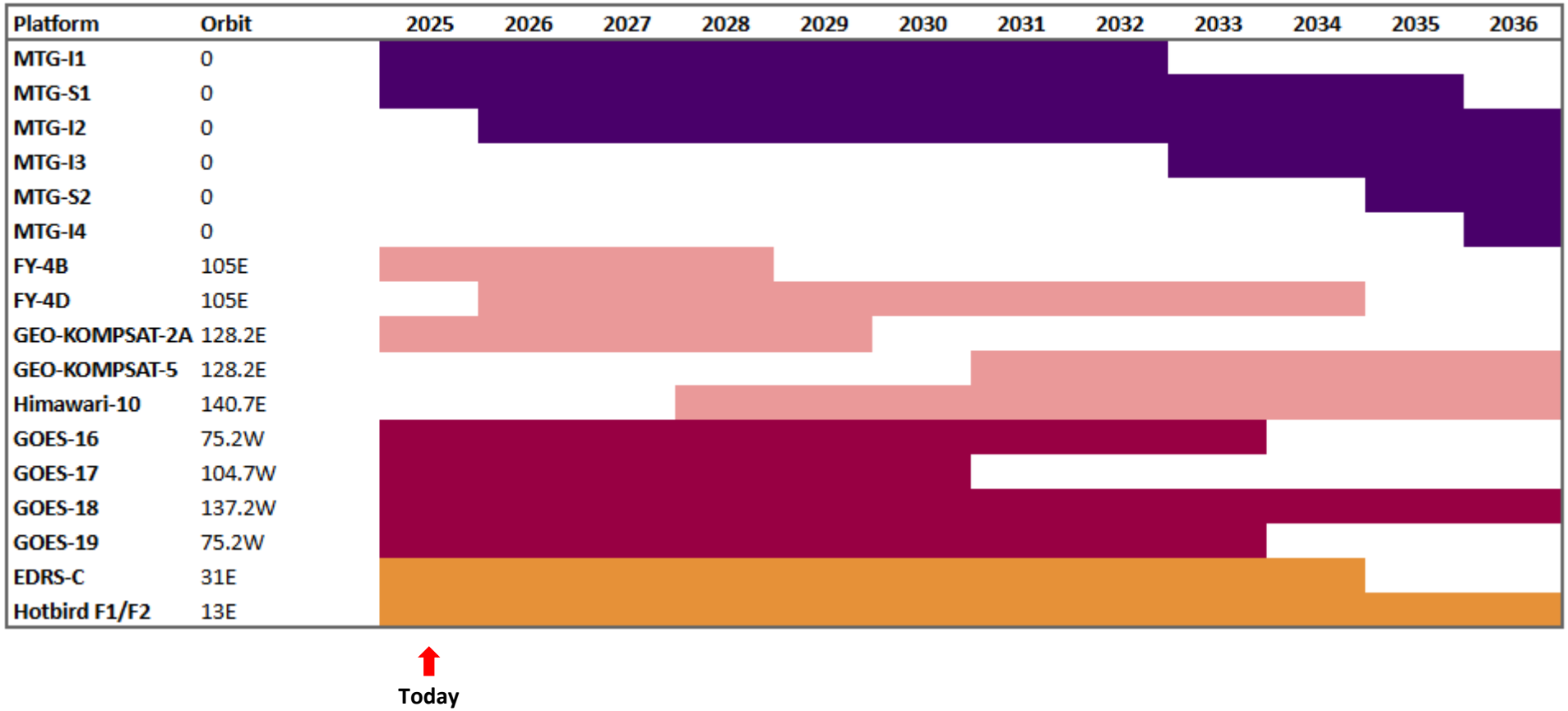
Low Energy Electrons and Protons (Magnetospheric particles)

Platform	Orbit	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
FY-4B	105E												
FY-4D	105E												
GOES-17	104.7W												
GOES-18	137.2W												
GOES-16	75.2W												
GOES-19	75.2W												

GEO - 2 slots
86.5°-123°E range
75.2°- 137°W range

WGIII Assessment:
Low risk of not meeting CGMS Baseline commitment.

High Energy Electrons and Protons (Magnetospheric and solar energetic particles)



GEO - 3 slots

0°

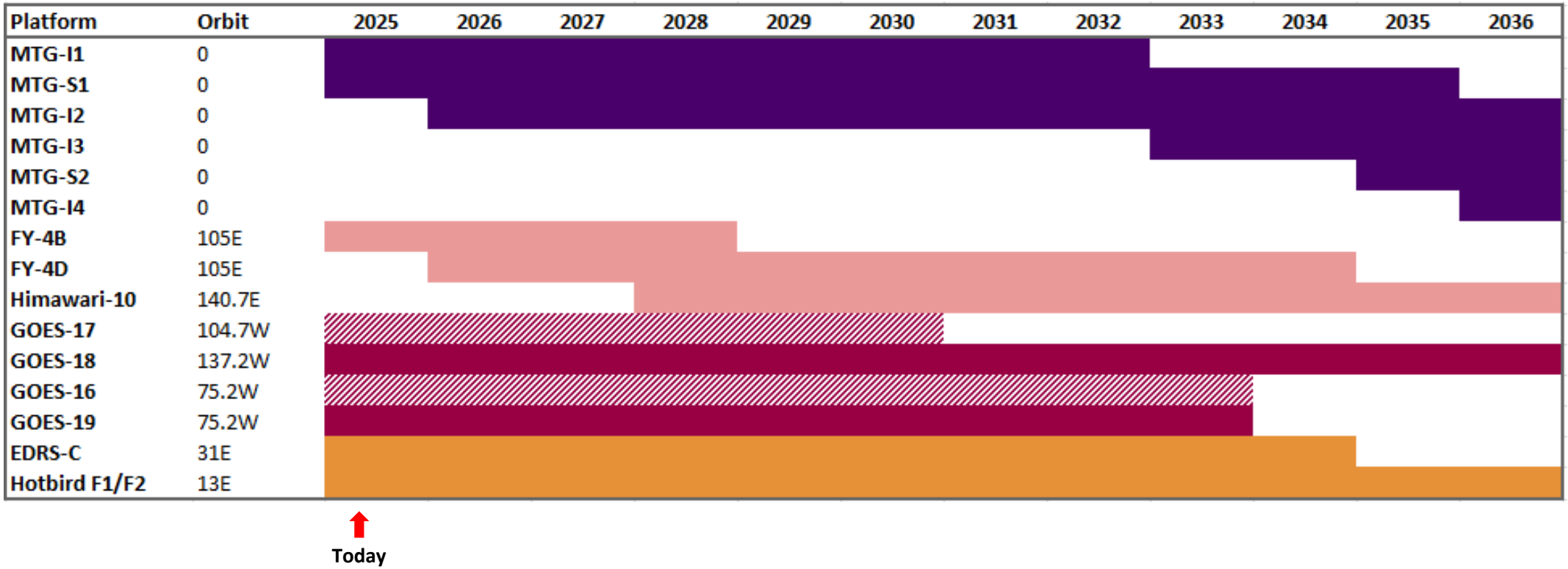
86.5°-123°E range

75.2°- 137°W range

WGIII Assessment:

Low risk of not meeting CGMS Baseline commitment.

Very High Energy Protons (Magnetospheric and solar energetic particles)



GEO - 3 slots
0°
86.5°-123°E range
75.2°- 137°W range

WGIII Assessment:
Low risk of not meeting CGMS Baseline commitment.

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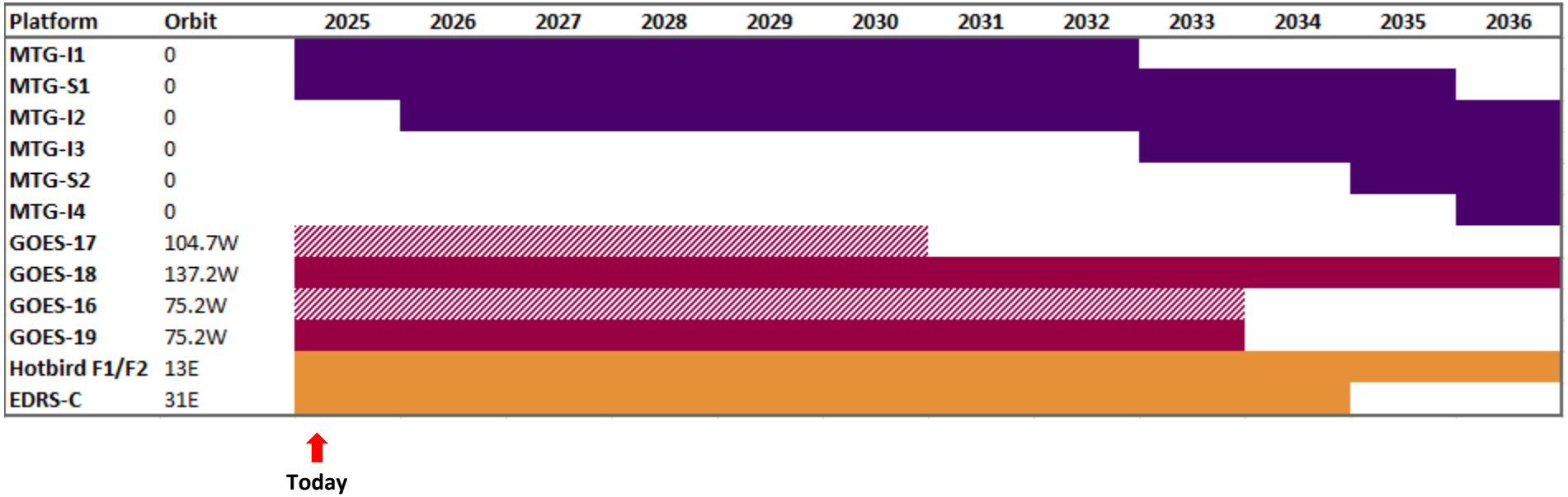
Energetic Heavy Ions (Magnetospheric and solar energetic particles)



GEO - 2 slots

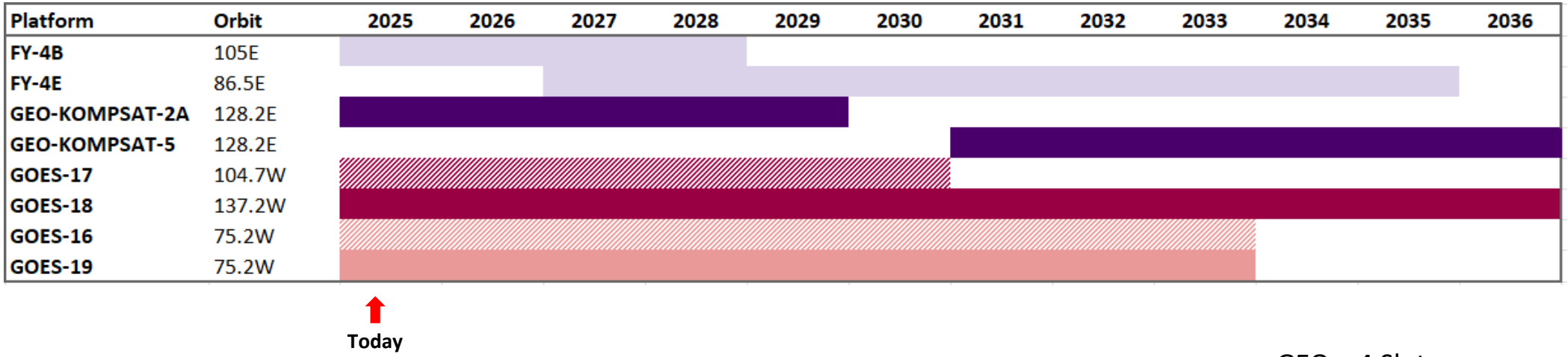
0°

75.2°- 137°W range

WGIII Assessment:

Low risk of not meeting CGMS Baseline commitment.

Magnetometer GEO (Earth's Magnetic Field)



GEO – 4 Slots

75.2°W

137°W

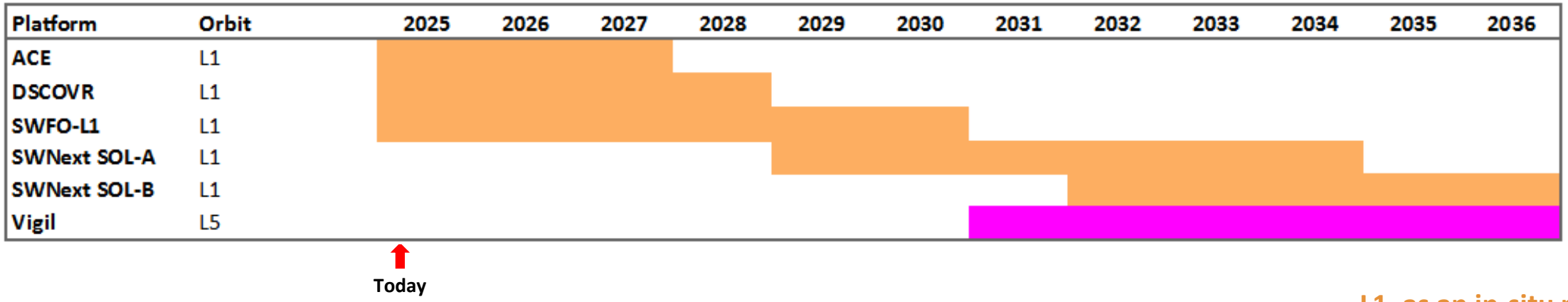
86.5°-105°E range

128°E

WGIII Assessment:

Low risk of not meeting CGMS Baseline commitment.

Magnetometer L1 (Interplanetary Magnetic Field)



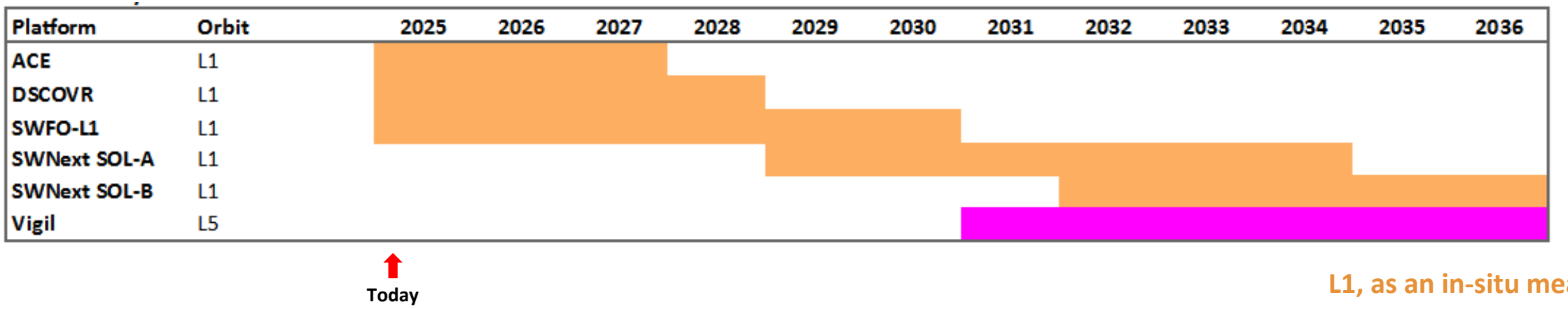
L1, as an in-situ measurement

L5, as an in-situ measurement

WGIII Assessment:

Low risk of not meeting CGMS Baseline commitment.

Plasma Analyzer (Solar Wind)



L1, as an in-situ measurement
L5, as an in-situ measurement

WGIII Assessment:

Low risk of not meeting CGMS Baseline commitment.