# Non-Nominal Attitude Manoeuvres during Metop-A Extended Lifetime

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Metop-A is the first of the satellites constituting the space segment of the EUMETSAT Polar System. It was launched in October 2006 with a planned operational lifetime of five years. More than ten years later it is, however, still in operation and providing high-quality data, very valuable for weather prediction and climate monitoring, especially when used in combination with those coming from the second spacecraft of the series, Metop-B, launched in September 2012.

Although designed before current international regulations on space debris were established, it is EUMETSAT's desire to comply with them while extending the satellite's operational lifetime for as long as possible, for the benefit of their user community and, ultimately, of the whole society. In order to achieve this double objective, strategies have been designed for the extension of the mission on a drifting local time (see [1]) and for the spacecraft de-orbiting (see [2]).

Analyses show that the platform and instruments will continue working satisfactorily during the foreseen drift in local time. But, as discussed in [3], the GOME-2 spectrometer requires regular Sun calibrations, which will not be possible beyond 2018 during certain periods of the year with the satellite's nominal attitude. Dedicated yaw manoeuvres could allow those calibrations again.

In addition, there is an interest to perform with Metop-A and its instruments, once Metop-C data can be used operationally, certain technology tests that could improve Metop climate and meteorological products through additional instrument characterisation and new processing algorithms. The knowledge gained would be applicable to all Metop satellites, including re-processing of past data, as well as to future LEO missions. One of these possible tests consists in pointing the Metop instruments to the deep space instead of to the Earth by maintaining an inertial attitude during a complete orbit. This would allow a deep study of instrument antenna responses, space calibration views and asymmetric scan biases, which would be very beneficial for microwave radiometers and their data processing and recalibration activities. Besides, by stopping the spacecraft rotation at a specific position in the orbit, the test could also be useful to re-evaluate the bi-direction diffuser reflection distribution and to assess the spectral response function of the GOME-2 spectrometer. Still the envelope of allowed orbital positions for the operation start needs to be assessed in order to avoid permanent damage to the instruments by direct Sun illumination.

Although the satellite is not designed for performing such attitude manoeuvres, these can be achieved by consistent modification of some parameters within the AOCS commands: application of large yaw biases in the Sun sensor command and in the definition of the gyroscope alignment for the first case, or modification of the parameters defining the spacecraft rotation while programming the masking of the Earth sensor and stopping the rotation of the solar panel for the second. Simulations have been carried out to assess the feasibility of these operations and their impact on the mission and, especially, the probability of complying with the international regulations on space debris: if they, intentionally or accidentally, brought the spacecraft to a thruster-controlled attitude mode, they would reduce the amount of fuel available for de-orbiting.

**References**

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