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# COPERNICUS SENTINEL-6 MICHAEL FREILICH ON-GROUND AND IN-ORBIT VERIFICATION, AND IN-ORBIT PERFORMANCES

**Abstract**

On 29th of November 2021, the Sentinel-6 Michael Freilich (S6-MF) successfully completed the 12-month commissioning phase, after which dissemination of high-resolution science products commenced. The mission is the result of a 10-years development effort by a unique international partnership between ESA, NASA, Airbus, Thales Alenia Space, EUMETSAT, CNES, NOAA and the European Union (EU). The S6-MF satellite joined the TOPEX-Poseidon/Jason satellites family which has successfully accumulated an uninterrupted data record on ocean topography stretching back to 1992, enabling scientists to track ocean currents and to precisely determine sea level rise. However, S6-MF is not only a continuity-of-service mission, rather it is the first of a new generation of ocean-altimetry satellites achieving unprecedented resolution level thanks to a synergetic multi-instrument approach, consisting of: an open-burst dual-frequency Ku/C-band synthetic aperture radar with near continuous internal calibration (Poseidon-4), an ultra-stable oscillator (USO) coupled with a ground-based radiopositioning instrument (DORIS) and with newly developed dual-constellation (GPS-Galileo) receivers for precise-orbit-determination (POD), and finally a multifrequency microwave radiometer (AMR-C) for atmospheric water vapour path delay correction. The S6-MF was launched into the ocean reference orbit, preceded by TOPEX/Poseidon, Jason-1,-2 and -3, covering 95% of the ocean's surface. Unprecedented performances have been measured in-orbit for range, Significant Waveheight (SWH) and Sigma0. In all case they improve on the results of Jason-3 (J3) for data recorded over the same time-period in 30-second trailing formation: range accuracy is 3.5cm in SAR RMC versus 7.2cm, SWH accuracy is 24.6cm versus 49.8cm, Sigma0 is 0.079dB versus 0.386dB. The paper presents the S6-MF satellite, with focus on the payload suite and its measurement principles. The main technological drivers and their verification through on-ground testing as well as in-orbit-validation are illustrated together with the presently achieved in-orbit performance. It is given also a brief status overview of the S6-B satellite, currently in the final phases of environmental testing. S6-MF products will help climate scientists and policymakers preparing our resilience and adaptation to sea level rise caused by climate change. Near-realtime information is already contributing to marine and weather forecasts, improving hurricanes' intensity predictions and forecasts of ocean weather for navigation. Observing sea-surface height changes with a newly provided high resolution offers insights into global sea levels, speed and direction of ocean currents, and ocean heat storage. Understanding the ocean dynamics and developing a global view of Earth's oceans is essential to understand climate change that impacts social and economic life around the World.