Sentinel-6A: Orbit Determination using Galileo

The mission Sentinel-6 (https://www.esa.int/Applications/Observing_the_Earth/Copernicus/Sentinel-6) is part of the EU Copernicus program for Earth monitoring, in particular for measuring sea level rise, and is operated in cooperation by the American and the European Space Agencies NASA and ESA, as well as the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT) and the National Oceanic and Atmospheric Administration (NOAA). The mission comprises two identically constructed satellites, Sentinel-6A and -6B, which are equipped, among others, with radar altimeters. The first satellite was successfully launched last November by a SpaceX Falcon 9 rocket into an Earth orbit of about 1340 km altitude. The second one will follow presumably in 2025.

To be able to precisely measure the height of sea level using radar altimetry, the absolute position of the satellite has to be determined very accurately with respect to an Earth-fixed reference frame. As for many low Earth orbiting satellites, a GNSS receiver serves for that purpose. The instrument on board of Sentinel-6 is capable to receive not only the signals of the American GPS, but also from the European Satellite System Galileo. Thus up to 18 GPS or Galileo satellites can simultaneously be used for very precise orbit determination.

As a member of the Copernicus Precise Orbit Determination (POD) Quality Working Group, the AIUB is now determining highly precise orbit parameters of Sentinel-6A on a regular basis. These orbits are determined by using the Bernese GNSS Software (http://www.bernese.unibe.ch) developed at the AIUB and are used to compare with other orbit solutions as well as to validate the official orbital data.

To independently validate the orbital quality, Sentinel-6A carries laser reflectors, allowing it to measure the distances to the satellite in its orbit by using Satellite Laser Ranging (SLR). The diagram below shows the SLR residuals, i.e., the differences between the calculated and the observed distances measured by SLR between laser telescopes and the satellite. These orbits were recently determined for Sentinel-6A and submitted by the AIUB in the context of the Regular Service Review No. 21. For this validation, the observations of 12 SLR stations were used and range biases were estimated for each station. The results show that in general the orbits conform to the SLR measurements better than 1 cm.