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High Quality Products from Satellite Laser Ranging

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Satellite Laser Ranging (SLR) is used to measure accurately the distance from ground stations to retro-reflectors on satellites and the Moon, with current normal-point precision at the 1mm level for the major stations of the International Laser Ranging Service (ILRS) network. These high-precision measurements ensure that SLR is one of the fundamental space geodetic techniques that define the International Terrestrial Reference Frame (ITRF), which is the basis upon which to measure many aspects of global change over space, time, and evolving technology. Laser Ranging provides precision orbit determination and instrument calibration/validation for satellite-borne altimeters for the better understanding of sea level change, ocean dynamics, ice budget, and terrestrial topography. Many of the GNSS satellites now carry retro-reflectors for improved orbit determination, harmonization of reference frames, and in-orbit co-location and system performance validation. The ILRS delivers weekly realizations that are accumulated sequentially to extend the ITRF and the Earth Orientation Parameter (EOP) series with a daily resolution. Additional products are currently under development such as precise orbits of satellites, EOP with daily availability, and low-degree gravitational harmonics for studies of Earth dynamics and kinematics. Ranging precision is improving as higher repetition rate, narrower pulse lasers and faster detectors are implemented. Automation and pass interleaving at some stations is expanding temporal coverage and improving station efficiency. Web-based safety keys are allowing the SLR network stations to range to optically vulnerable satellites. We will discuss many of the science applications enabled and supported by these laser-ranging activities and also point out some of the tough challenges that the SLR network currently faces.