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The International Global Network of Geodetic Fiducial Stations

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Abstract

Scientific need and technological opportunity require that we move toward implementing a global network of geodetic fiducial stations which feature co-located SLR, VLBI, GNSS, and DORIS instrumentation. Earth science of the next decade will require more accurate global change measurements of sea level topography, sea level change, polar ice mass balance, hydrological and atmospheric mass flux, and topographic deformation, real time mm scale navigation and precision time transfer on a global scale. These scientific requirements have been translated into a goal of mm scale annual stability for the terrestrial reference frame, earth orientation parameters, as well as the orbit and clock determinations for the GNSS systems. To meet these challenges, the four geodetic observing systems must be more tightly integrated in technology, location, and analysis. NASA strongly supports the objectives of the IGGOS initiative vis NASA's National Geodetic Observatory and INDIGO programs. The global networks of GNSS, SLR, and VLBI observatories are for the most part poorly suited for these new demands. These important geodetic networks have evolved with little planning yet these systems are providing essential measurements to a wide swath of society. New signal structures in the GPS and the developing Galileo GNSS will soon require replacement of the GNSS receivers. The SLR network is poorly distributed globally, requires labor intensive observations and analysis, and for the most part relies upon antiquated technology. The VLBI observatories utilize large radio telescopes in remote regions that are poorly distributed globally. Co-location of these networks is sparse and co-location errors contribute significantly to the observing error spectrum. Increasing use of the S and X band by commercial and other government services will also contribute to increased observational errors. The time is upon us for an international effort to develop an optimized global geodetic fiducial network of twelve or more integrated automated geodetic observatories that will provide in near real time high density measurements of Earth orientation, geodetic positioning, and GNSS system monitoring. The strategic goal for the optimized global fiducial network should be efficient autonomous operation, real time data streaming to analysis centers with an integrated near real time analysis capability for all four observing systems. These goals are achievable in the next decade given the dramatic technological improvements in all geodetic systems. For VLBI, the BKG TIGO might be viewed as a preliminary prototype of technology for fundamental stations. Mark 5, PC-VSI, e-VLBI broadband development efforts are laying the groundwork to reduce the aperture of the VLBI antennas and to allow for precision mm level co-location of observing systems. Operating costs and enhanced accuracy would accrue from the elimination of hydrogen maser clocks using double differencing, GNSS time transfer technology, GHz broadband recording, real time analysis, and mm wavelength VLBI observations. A global geodetic fiducial network will not be realizable without international efforts and the support of the four services.