Integrated Requirements and Functional Specifications

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Global Geodetic Observing System
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Tasks of GGOS

- Define:
  - Unique celestial reference system
  - Unique terrestrial reference system
  - Unique geodetic reference system
  - Unique gravity reference system
  - All physical and mathematical models needed to analyze GGOS observations
- Provide and maintain:
  - Accurate, stable, & homogeneous:
    - Celestial reference frame
    - Terrestrial reference frame including its origin
  - Time-dependent EOPs
  - Definitions, constants, models of geodetic reference system

Tasks of GGOS, cont.

- Provide and maintain:
  - Parameters describing:
    - Static and time-dependent components of Earth gravity field
    - Static and time-dependent components of shape of land, ice, ocean surfaces
    - Total electron content of ionosphere
    - Water vapor content of troposphere
    - Transport of mass within and between atmosphere, oceans, land

Products of GGOS

- Celestial reference frame
  - Catalog of celestial radio sources including their coordinates
- Terrestrial reference frame
  - Catalog of terrestrial sites
    - Including their coordinates and parameters (trend, periodic terms) describing their temporal evolution
  - Time series of coordinates of additional terrestrial sites
    - Including necessary models and/or observations
    - Needed to densify TRF to provide access to TRF anywhere on Earth's surface
- Earth orientation parameters
  - Time series of values and their rates-of-change
- Geodetic reference system
  - Values of defining constants
  - Values of derived physical and geometrical parameters

Products of GGOS, cont.

- Gravity field
  - Values of parameters describing static component
  - Time series of parameters describing time-dependent component
- Total electron content of ionosphere
  - Time-dependent maps
- Water vapor content of troposphere
  - Time series of zenith path delays
- Mass transport within Earth system
  - Time series of angular momentum of
    - Atmosphere, oceans, continental water, mantle, core
- Shape of land surface
  - Time series of site displacements caused by loading effects
    - Atmospheric surface pressure, ocean-bottom pressure, continental water

Products of GGOS, cont.

- Shape of ocean surface
  - Time series of sea surface height measurements
    - Altimetry
  - Time series of sea level measurements
    - Tide gauge
- Shape of ice surface
  - Time series of ice sheet and glacier elevations
- Other planets and celestial bodies in solar system
  - Time-dependent, body-fixed site coordinates
  - Orientation parameters
  - Gravity parameters

Accuracy of GGOS Products

- Focus on most demanding user
  - Requirements of all other users will be automatically met
- Terrestrial Reference Frame
  - Most demanding user: Studies of sea level change
    - Sea level rising at a few mm/yr
    - Reference frame should be at least an order of magnitude more accurate
    - TRF should be accurate to 1 mm, stable to 0.1 mm/yr (including geocenter)
    - Scale should be accurate to 0.01 ppb, stable to 0.001 ppb/yr
- Earth orientation parameters
  - Most demanding user: Tracking and navigating interplanetary spacecraft
    - Capability driven: Uses most accurate EOPs available
    - Needs EOPs consistent with TRF and CRF
    - Thus, for consistency with TRF, EOPs should be:
      accurate to 1 mm with 2-week latency, to 3 mm in near real-time, daily resolution

Accuracy of GGOS Products, cont.

- Celestial reference frame
  - To be consistent with TRF and EOPs
    - Should be accurate to 30 μas, stable to 3 μas/yr
- Gravity field
  - Most demanding users of geoid: (1) Ocean modeling (2) GNSS determinations of height above geoid
    - Static geoid should be accurate to 1 mm, stable to 0.1 mm/yr with spatial resolution of 10 km
    - Time varying geoid should be accurate to 1 mm, stable to 0.1 mm/yr with spatial resolution of 50 km and temporal resolution of 10 days

Functional Specifications of GGOS

- Focus on high level specifications
  - Premature to give low level specifications
    - e.g., number & distribution of VLBI / SLR / GNSS sites for TRF
- Operate global networks
  - Geodetic reference stations, gravimeters, tide gauges
- Operate global sub-networks
  - Collocated reference stations / gravimeters / tide gauges
- Determine survey ties between collocated stations
- Process observations
  - With accuracy and consistency of at least 1 ppb
- Document
  - Procedures, standards, conventions

Functional Specifications, cont.

- Maintain databases
  - Observations, products
- Ensure continuity, accuracy, consistency
  - Observations, products
    - as networks, data reductions procedures evolve