

Presented at the FIG e-Working Week 2021,
21-25 June 2021 in Virtually in the Netherlands

SMART SURVEYORS FOR LAND AND WATER MANAGEMENT CHALLENGES IN A NEW REALITY



e WORKING WEEK 2021
20-25 JUNE

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Paper 10876

Geodetic Datum in Terrestrial Surveys: ITRS versus WGS84

Session 5.1 - Managing the Land/Water Interface: WGS84 vs. the ITRS

Tuesday, 22 June 2021 15:00–16:30

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PNT, Reference Systems, and GNSS

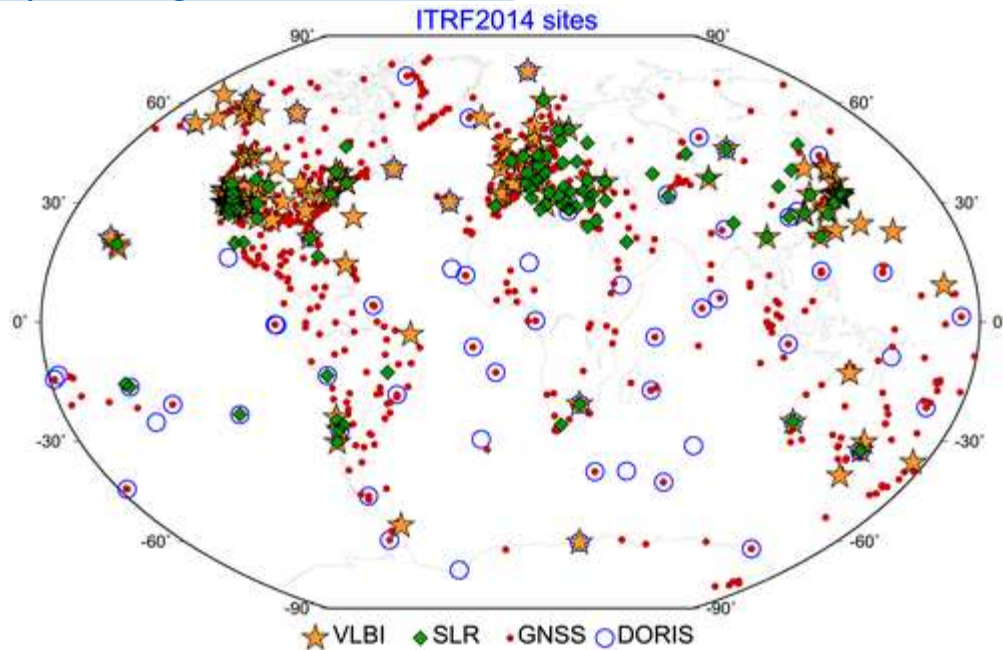
- Positioning, Navigation and Timing
 - Positioning: defining the location of an object in relation a reference origin
 - More static and relates generally to the fixed infrastructure (roads, bridges, terrain, etc.)
 - Navigation: moving between objects/locations in a reference system
 - More dynamic and real time related to moving between positioned points
- Reference Systems
 - International Terrestrial Reference System (ITRS) => IAG
 - World Geodetic System of 1984 (WGS84) => NGA
- Global Navigation Satellite Systems (GNSS)
 - Systems for positioning/navigation either directly (PPP) or indirectly (DGNSS)



Global Reference Systems

ITRS

Z Alta Mimi, P Rebeschung, L Métivier, X Collilieux (2016) ITRF2014: A new release of the International Terrestrial Reference Frame modeling nonlinear station motions, JGR Solid Earth, 121 (8), 5577-5579, <https://doi.org/10.1002/2016JB013098>



WGS84

U. Texas-Austin/ARL: 30 Years of Success: The Monitor Station Network

<https://research.utexas.edu/showcase/articles/view/30-years-of-success-the-monitor-station-network>

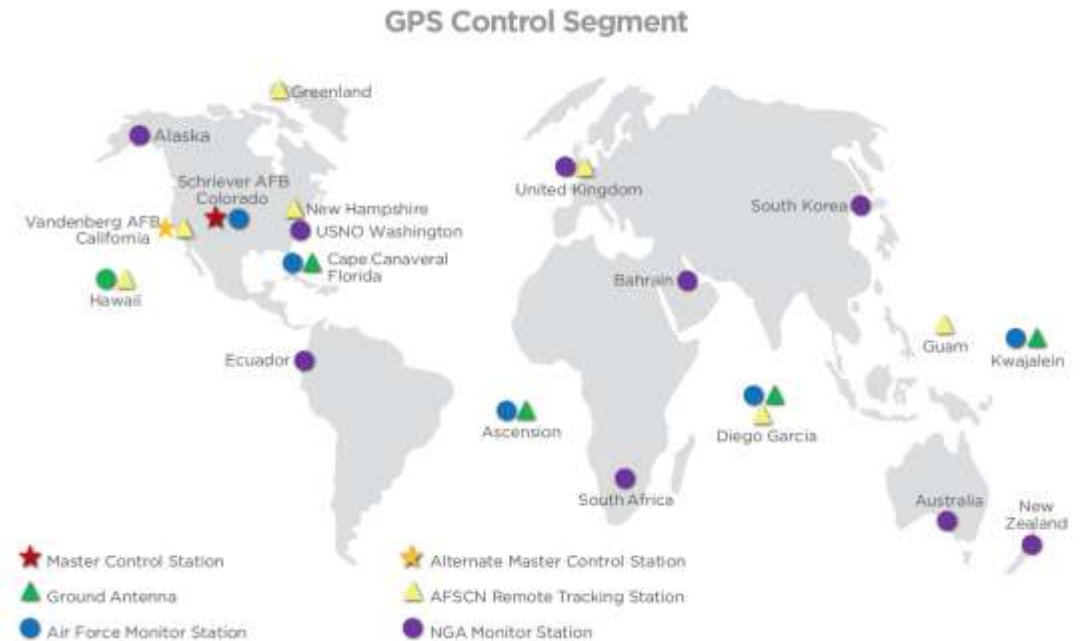


Figure 1 ITRF2014 network highlighting VLBI, SLR, and DORIS sites collocated with GNSS.



Reference Frames

- Defined by the reference systems & data
- Different data means different frames

WGS84 \neq ITRS
next presentation will cover this in more detail

- WGS84 is *approximately* equal to the ITRS
- This may be sufficient for **navigation**, but it is not sufficient for **positioning**



Post-processing versus broadcast ephemerides

Broadcast

- Real time location service
- Best estimate position (projection)
- Broadcast from satellite
- Errors in positioning larger
- Ideal for aircraft/ship operations

Post-processing

- Final orbits determined usually in conjunction with CORS
- Much more accurate positions and consistency
- Requires more rigor in solutions
- More suited for cadaster, terrestrial/boundary surveys



Geospatial Data Exchange and Consistency

- Consistency of cadastral surveys at international and intranational levels
- Regional agreements (MEGA), international and intranational boundaries
- Autonomous commercial activities in built environment
 - Transition from offshore to pierside
 - Transfer off shipping (drayage), movement of goods inland (trucking)
- Need all data in same reference frame – offshore and onshore

DANE
INFORMACIÓN PARA TODOS

WORKING GROUP ON INTEGRATION OF STATISTICAL AND
GEOSPATIAL INFORMATION (GT-IIEG)

UN-GGIM: AMERICAS

STATISTICAL AND GEOSPATIAL FRAMEWORK FOR THE
AMERICAS (MEGA, for its acronym in Spanish)

MEGA IMPLEMENTATION REPORT VERSION 1.

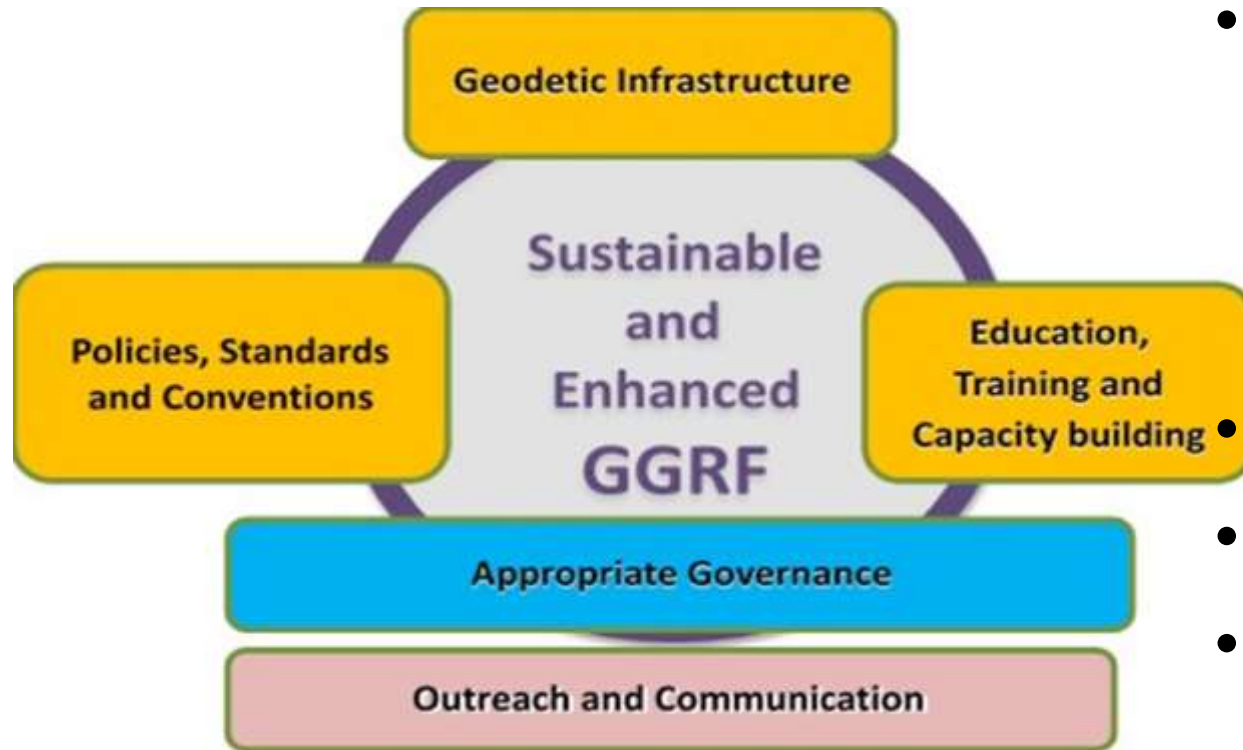
February 2021





UN Resolution 69/266

A global geodetic reference frame for sustainable development



- Adopted by the GA on 26 February 2015
 - GGRF => political agreement by all Nations to use common system for geospatial data
- Meets Geospatial Data Exchange need
- Governance => National laws
- Standard => ISO 19161-1:2020 – ITRS



ISO 19161-1:2020

International Terrestrial Reference System

INTERNATIONAL
STANDARD

ISO
19161-1

First edition
2020-01

**Geographic information — Geodetic
references —**

Part 1:

**International terrestrial reference
system (ITRS)**

Information géographique — Références géodésiques —

Partie 1: Système international de référence terrestre (ITRS)

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- Basic information and definitions of the ITRS
- Its realizations and how to access these realizations.
- Consistent with the conventions adopted by
 - International Union of Geodesy and Geophysics (IUGG)
 - International Association of Geodesy (IAG) of IUGG
 - International Astronomical Union (IAU).
- The various realizations of ITRS are then presented as
 - crust-based reference frames (global, regional or local)
 - GNSS satellite ephemerides
- Annex A describes the access methods to ITRS and the various processes required to determine positions expressed in this system.



Summary

- Need consistent system & frame
- For IOCM, need same onshore/offshore
- WGS84 not sufficient onshore
 - $WGS84 \neq ITRS$
 - Transformations too uncertain
- UN agreement points to ITRS
- ISO provides standard & access
 - ISO Geodetic Registry
 - <https://geodetic.isotc211.org/>
- **Daniel Roman, dan.roman@noaa.gov**

$$h = H + N \quad \text{or} \quad H = h - N$$

$$\text{Geoid} + \text{TSS} = \text{LMSL}$$

