IAG Commission 10 – N.A. Subcommission

NAREF:
An Initiative to Densify the ITRF in North America

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Abstract

The International Association of Geodesy (IAG) is undergoing growth and evolution, particularly regarding the aspects of providing and coordinating geodetic services. The most prominent example of new services is the International GPS Service (IGS), which promotes international standards for GPS acquisition and analysis, deploys and operates a global GPS tracking network, and distributes GPS data and data products, such as precise orbits, clock estimates and coordinate solutions. In an effort to densify this reference frame, the IGS initiated a program of distributed regional processing to better manage the computational load. The North American Subcommission of the International Association of Geodesy's Commission X has recently formed a North American Reference Frame (NAREF) Technical Working Group to promote and coordinate such regional processing in North America. This coordination will involve setting standards and guidelines for station selection, operation, data processing, archiving, redundancy, and the combination and integration of regional solutions within the ITRF reference frame and global IGS network. Most of these standards and guidelines will be adopted from those proposed by the IGS and those used by the European Reference Frame (EUREF) Technical Working Group, NAREF's sister group in Europe. An overview of the proposed organization and operation of NAREF will be presented, together with a discussion of required standards and some of the unique characteristics of the North American densification network.

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Subcommission for NA

To provide international focus and cooperation for issues involving the horizontal, vertical, and three-dimensional geodetic control networks of North America, including Central America, the Caribbean and Greenland (Denmark).

Issues to be Addressed

- *Densification of ITRF* in North America and promotion of its use
- *Vertical datum* maintenance & future evolution, incl. NAVD88 and IGLD
- *Crustal motion* effects, incl. tectonic (west coast) and post-glacial rebound
- *Standards* for accuracy of geodetic positions
- *Outreach* (tech. transfer) to public

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Membership

- *One representative from each country*
  - Canada: Mike Craymer (Commission 10 rep)
  - USA: Dennis Milbert (Commission 10 rep)
  - Greenland/Denmark: Per Knudsen
  - Caribbean: TBD
  - Mexico: TBD
  - Chairpersons from each Technical Working Group
- *Interim Officers*
  - President: Dennis Milbert
  - Secretary: Mike Craymer

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Technical Working Groups

- *To address specific technical issues*
- *Current TWGs:*
  - Reference Frame Transformations
  - North American Reference Frame (NAREF)
  - International Great Lakes Datum (IGLD)
- *Other work by Subcommission:*
  - Outreach & technology transfer through publications/ Web site, workshops/symposia, software tools

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NAREF

- *Purpose*
  - To densify the ITRF reference frame in North America
  - Incorporate continuously operating GPS stations that are not part of IGS network
  - Consolidate IGS regional networks into a continental one
  - Following IGS “distributed processing” approach
  - Goal is to produce
    - Coordinate solutions with accuracy information
    - Weekly combinations
    - Cumulative solutions with velocity estimates

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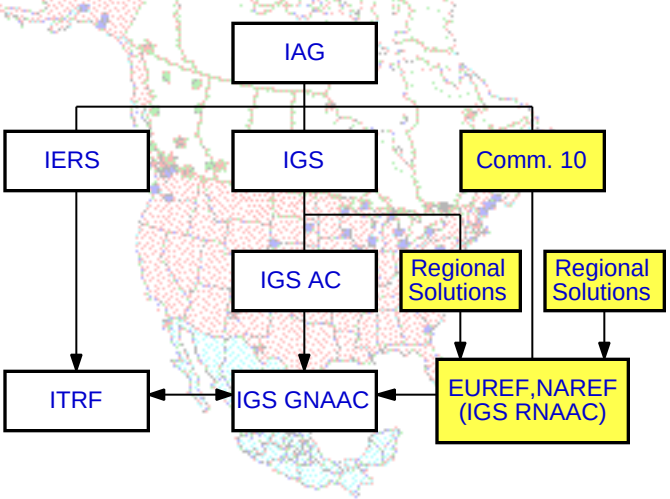
Distributed Processing



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Proposed Standards

- *IGS and EUREF Standards*
  - Follow as much as possible
- *Station Selection & Operation*
  - 24 hr data, 10 deg. elev. mask angle
  - Continuous operation (min. 5 days/week?)
  - Stable monumentation, recoverable
- *Data Archiving*
  - Archive at a central site (most already at SOPAC)
  - Ensure complete/consistent meta-data (RINEX,SINEX,Logs)

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Standards (con't)

- *Data Processing*
  - Fix IGS precise orbits & EOPs
  - Need redundant solutions
    - To average out software-dependent biases
    - Each station in at least 3(?) solutions
    - Use different software but with consistent models when possible
- *Combination of Solutions*
  - Two independent combinations (agencies) for QC
  - Accumulate normals of each solution
    - Allow for translations, rotations and scaling of each solution
    - Use variance component estimation for better relative weighting

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Current Commitments

- *Regional Processing*
  - NRCan: CACS, WCDA, northern CORS
    - Two independent solutions with GIPSY and Bernese software
  - PGC: WCDA
  - NGS: CORS
  - JPL: ??
- *Continental NAREF Combinations*
  - NRCan
  - NGS

More Contributors Needed

- *Seeking more participants/networks*
  - Possible networks that could contribute:
    - AKDA (Alaska Deformation Array) – AK (2 sta.)
    - Bay Area Regional Deformation GPS Network (BARD) – CA (34)
    - Basin and Range GPS Network (BARGN) – AZ,CA,NV,UT (48)
    - Eastern Basin Range Yellowstone (EBRY) – WY,UT,ID (10)
    - Forecast Systems Laboratory (FSL) – all US (40)
    - JPL – CA (6)
    - Pacific Northwest Geodetic Array (PANGA) – CA,NV,OR,WA (16)
    - S. California Integrated GPS Network (SCIGN) – CA,MX (163)
- *Need redundant processing*

Proposed Action Plan

- *Adopt standards*
  - Especially for station selection
- *Define solutions to use in testing phase*
  - GSD (CACS, WCDA, BCACS, some CORS)
  - PGC (WCDA)
  - Others ?? – NGS (best CORS), U. Alaska (AKDA)
- *Test methods of combining solutions*
- *Begin submissions to GNAACs*
- *General call for participation*

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