

IGS Weekly Solutions: “Some Issues”

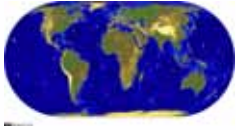
Rémi Ferland
Geodetic Survey Division



Natural Resources
Canada

Ressources naturelles
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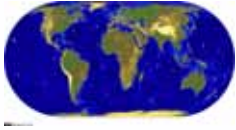
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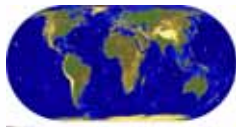




1. IGS Mission

- Provide the highest quality data and products
- For earth science research, multidisciplinary applications and education
- To advance the understanding of earth system components and their interactions





IGS Context

- Decentralized Operations
 - ~ 200 agencies / 75 countries / 379 stations
- Voluntary - Inclusive - Available
- Rapid Usage Growth
 - More applications
 - More demanding requirements
- + GLONASS & GALILEO
 - International GPS Service -> International GNSS Service

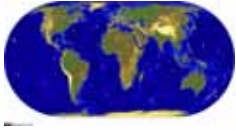
Strategic Plan: 2002-2007



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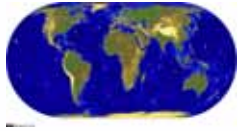
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2. General Issues

- Improvement Process is Iterative
 - Testing & Quality Assurance
- Contributing individuals & agencies have changing priorities and limitations
- Redundancy & Quality Assurance
- Cooperation vs. Competition

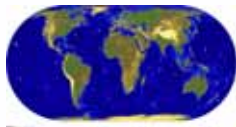




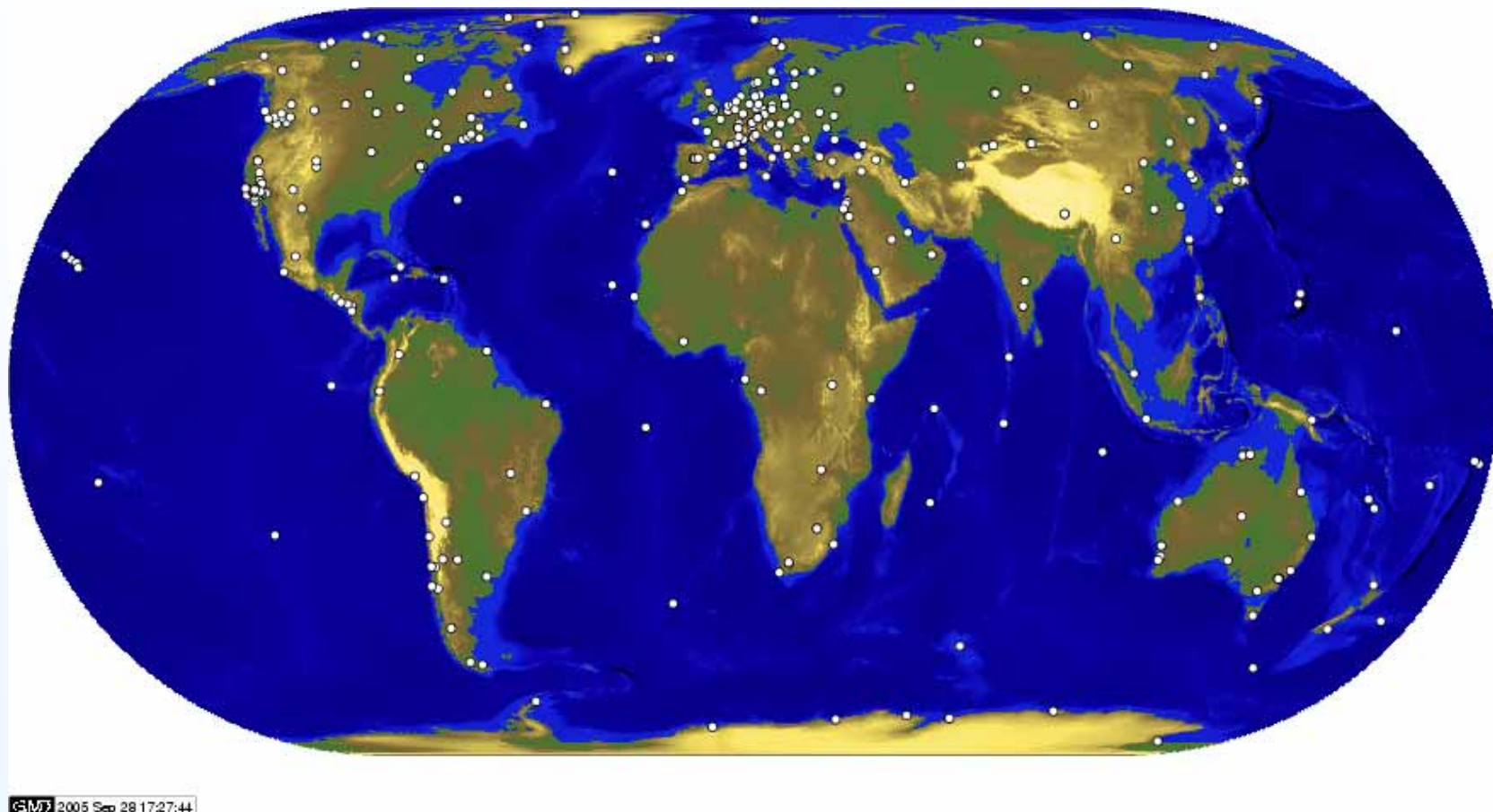
3. Network Issues

- Guidelines
 - Monumentation
 - Equipment & Maintenance
 - Antenna / Receiver
 - Power / Communication
 - Event Logs
- Variety of Local Conditions
- Collocation and local ties with other space techniques (IERS)
- Geographical Distribution





IGS Network



From IGSCB (<http://igscb.jpl.nasa.gov/network/netindex.html>)

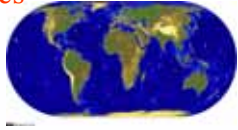
379 Active Stations



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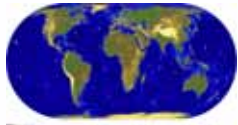
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4. Data and Product Issues

- Production = Deadlines
- Data / Products:
 - Latency / Completeness / Quality
- Communication Issues
- Redundancy - Alternate Sources

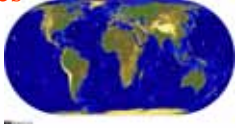




5. Processing Issues

- Data Availability
- Software Improvement Cycle
 - Testing & Documentation
 - Announcement & Synchronization
- Software problems/bugs
 - Effect Documented / Fixed / Announced





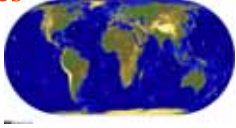
AC Software

AC	Software	Comment
cod	Bernese	D.D. / L.S.
emr	GIPSY	U.D. / Kalman
esa	BAHN ...	U.D. / L.S.
gfz	EPOS.P	U.D. / L.S.
jpl	GIPSY	U.D. / Kalman
mit	GAMIT ...	D.D. / L.S. / Kalman
ngs	PAGES	D.D. / L.S.
sio	GAMIT ...	D.D. / L.S.

- 6 Independent Software packages
- Largely using the same data
- Evolve at their own pace

U.D. = Undifferenced
D.D. = Double Differences
L.S. = Least Squares

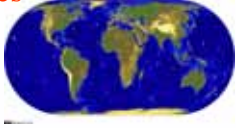




6. Combination/Analysis Issues

- Distributed Processes
 - More people involved
 - Sub – Optimal
- Optimal with SINEX
 - Coordinates / ERP's / Geocenter
- Sub-optimal:
 - Orbit / Clock / Troposphere / Ionosphere...
 - Approximate rigorous solution

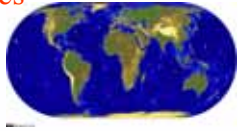




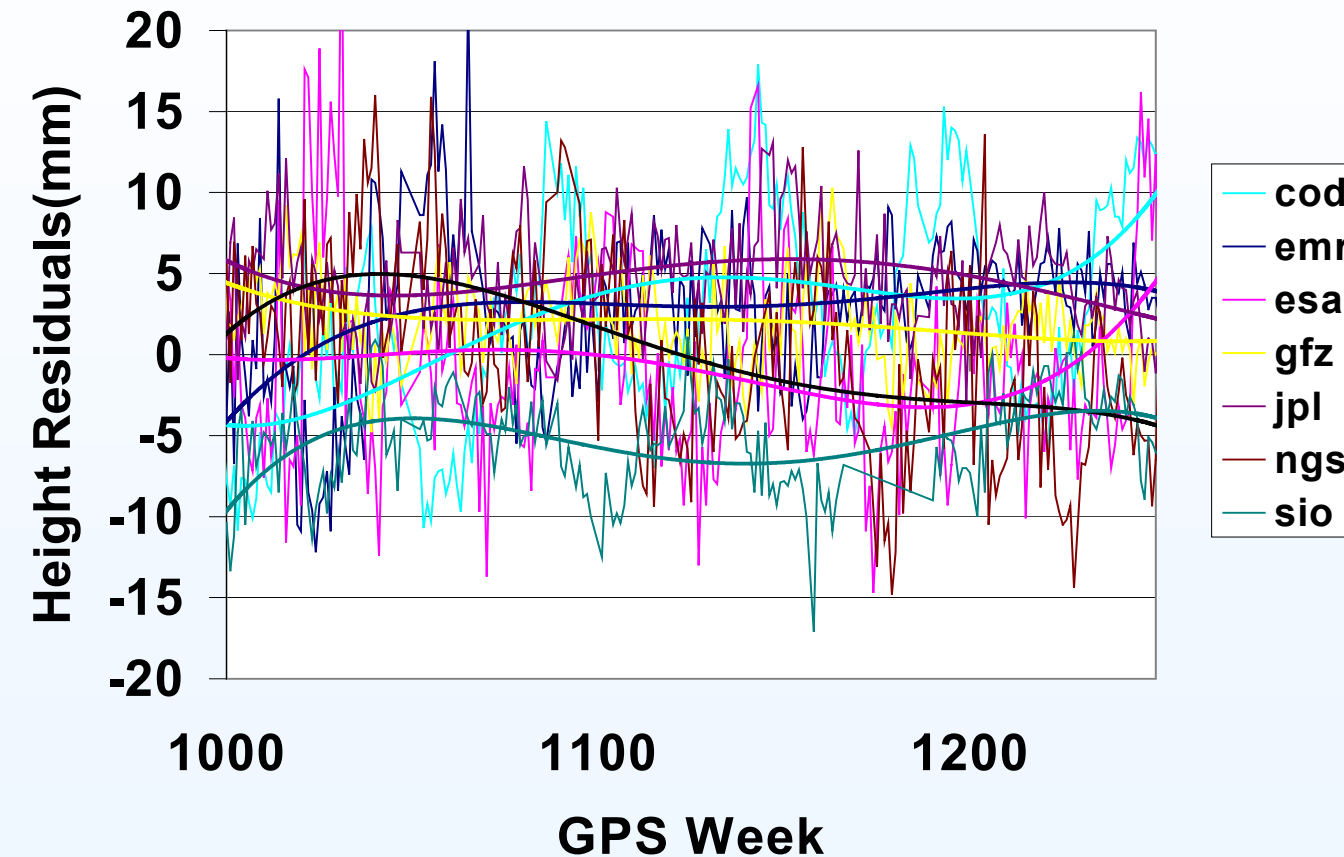
AC Modeling Differences

- Reviewed AC Processing Strategies
- Some differences were identified
- Upgrade to IERS standard was gradual
 - (e.g.: modeling station displacement)
 - Solid Earth tides
 - Pole tides
 - Ocean loading
- The quantification of the effect of the modeling differences on the coordinates variations can be difficult





Example of Coordinates Time Series Differences



- Systematic
effects btw. Acs
for all stations

H.: 1-2 mm

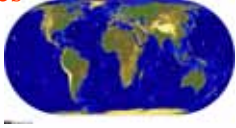
V.: 5 mm

- Processing &
network induced

- Missing ACs
may generate
small artificail
jumps in IGS time
series

Note : Smooth lines are 4th order polynomial fit on the residuals time series.

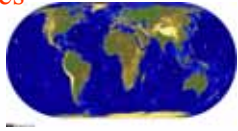




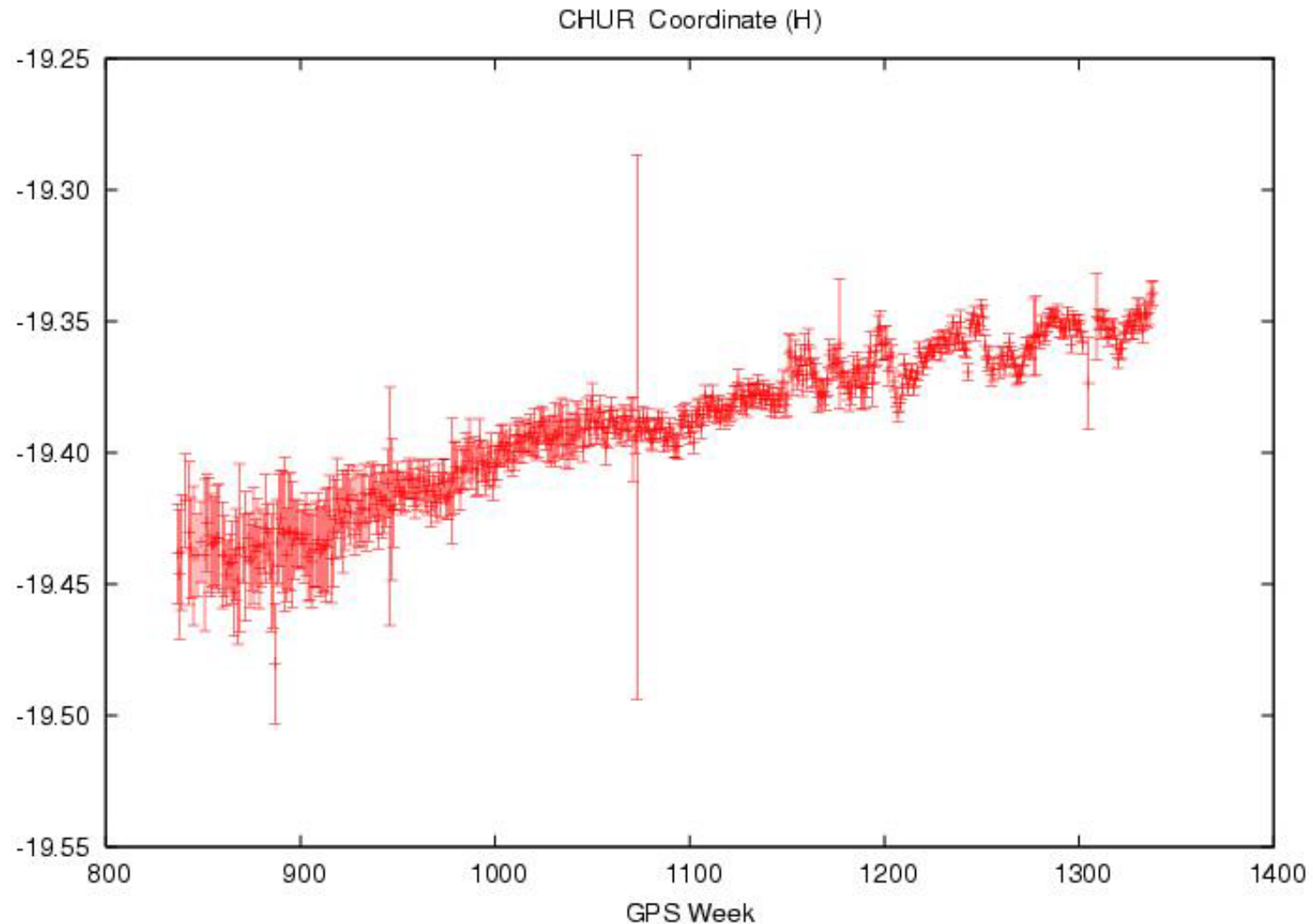
Some Sources of Short Term Instabilities

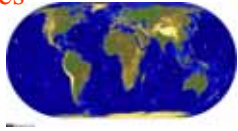
- Mostly vertical ($\sim 1\text{cm}$)
- Atmospheric Pressure Loading
- Ground Water loading
- Local Environment Changes
 - Structures / Vegetation
 - Snow & Ice (On and Around the antenna)
 - Temperature Dependency
- Equipment & Measurement Quality
- Multipath
- Processing (Satellite Geometry)



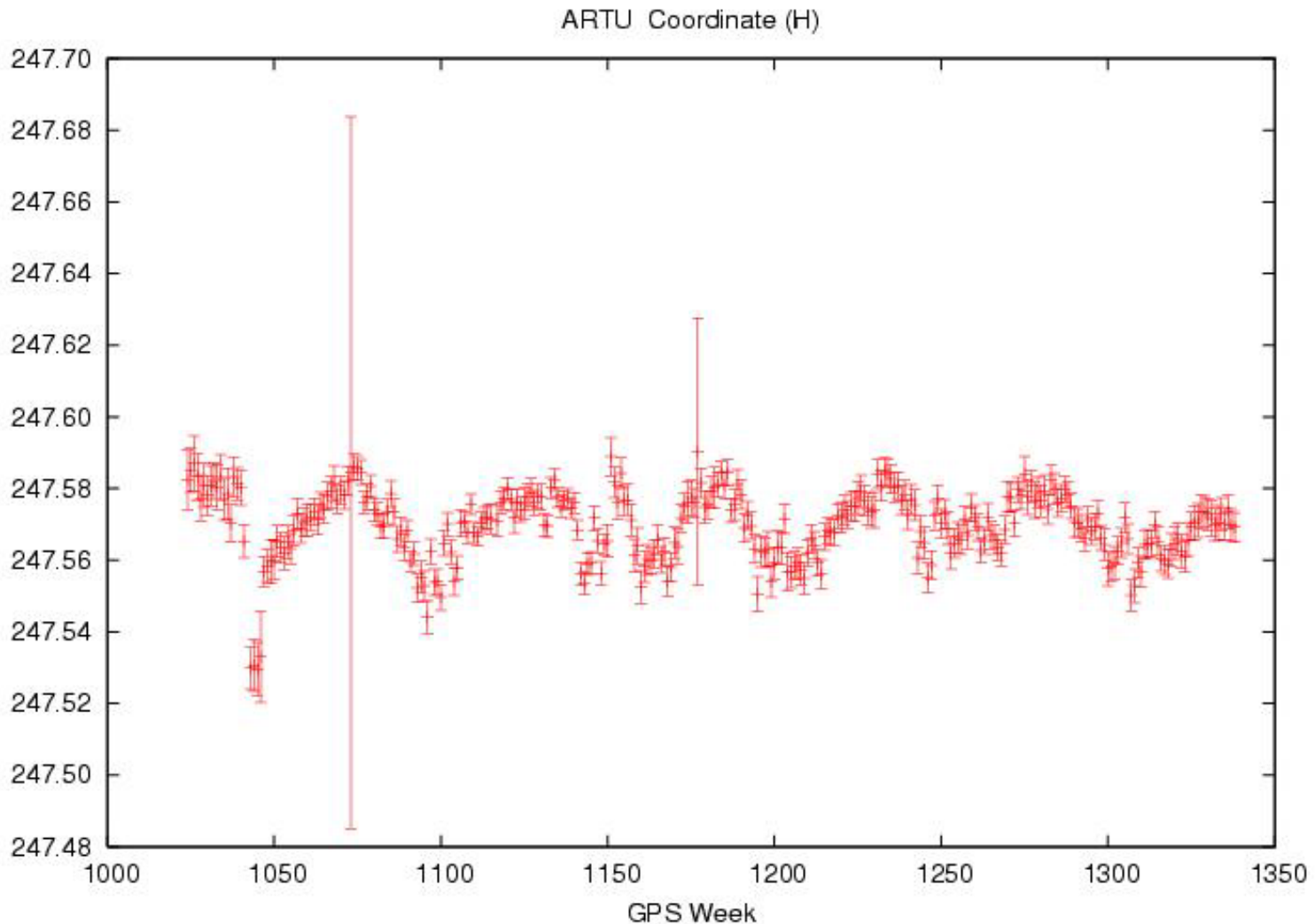


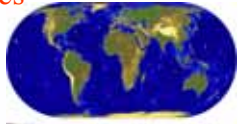
Time Series Example “CHUR”



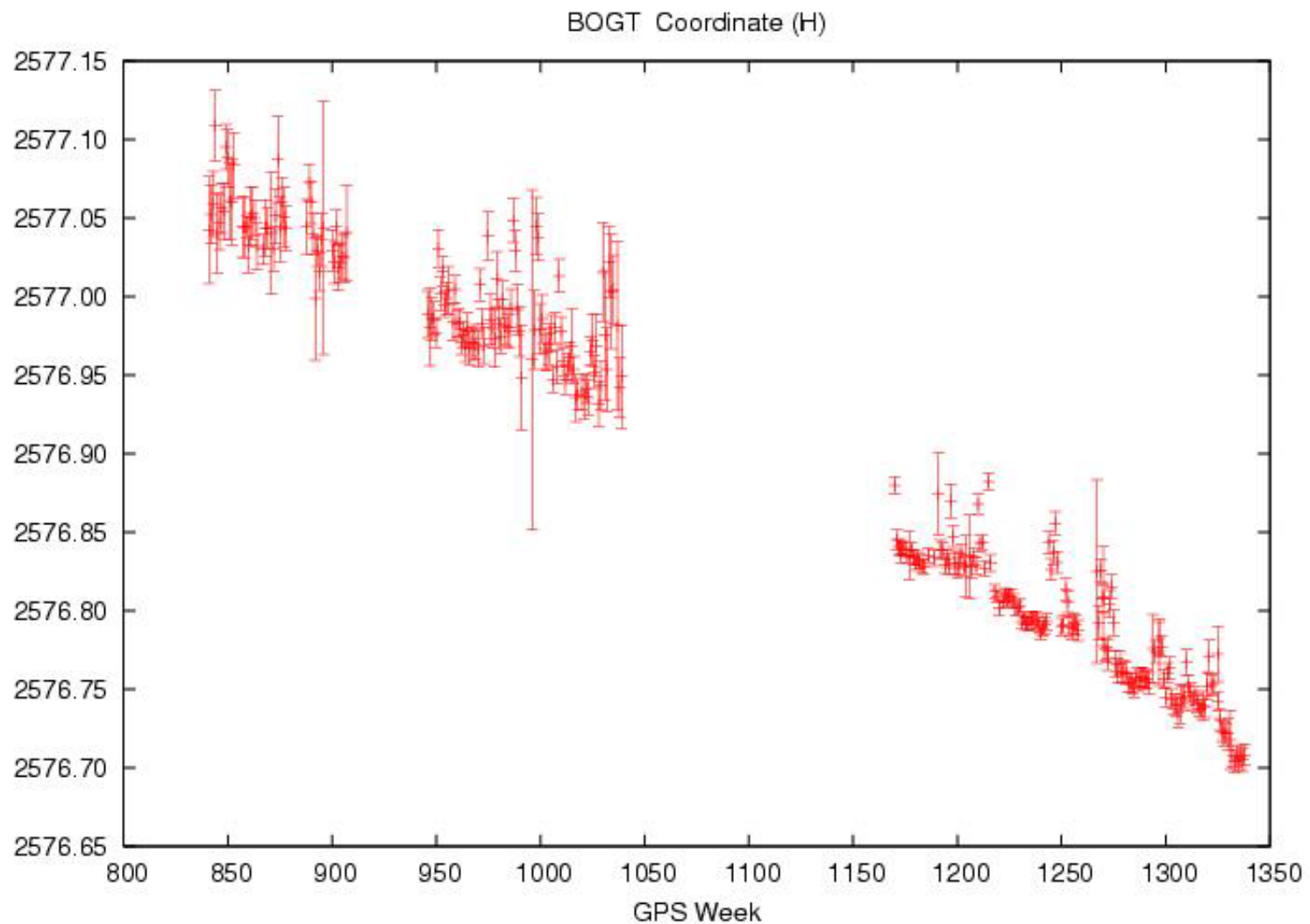


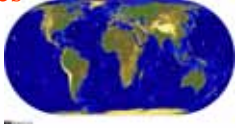
Time Series Example “ARTU”





Time Series Example “BOGT”

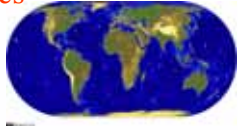




Time Series Discontinuities

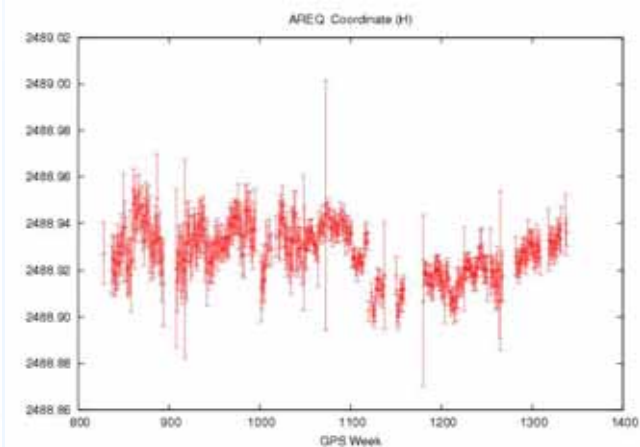
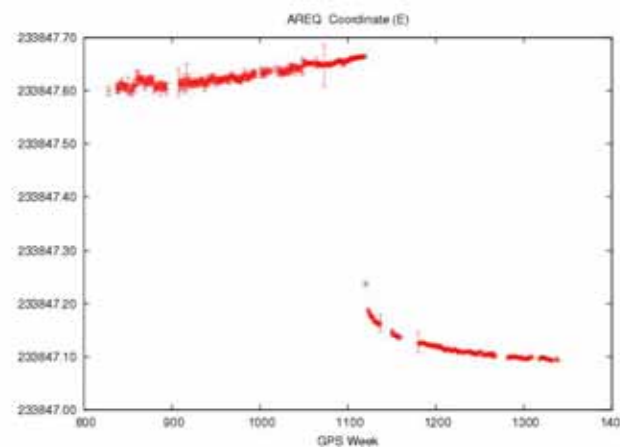
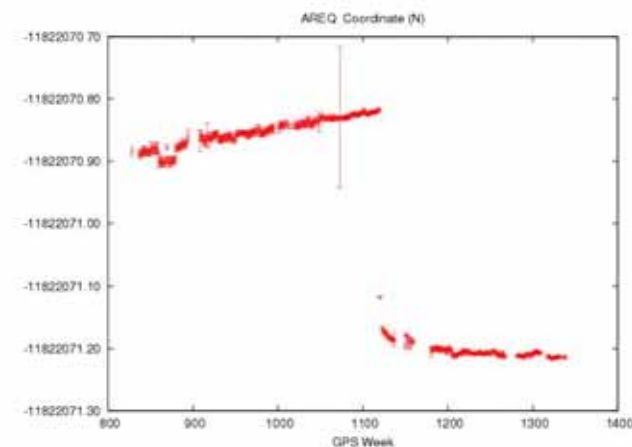
- Multiple solutions for a DOME #
- For collocated sites
 - Which solution to use to connect the local survey?
 - Which solution best “describes” the physical location of the marker?
 - First segment / most recent segment / best fit ???
 - Should any be used?
- Data Breaks

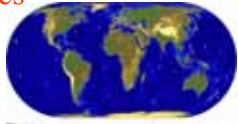




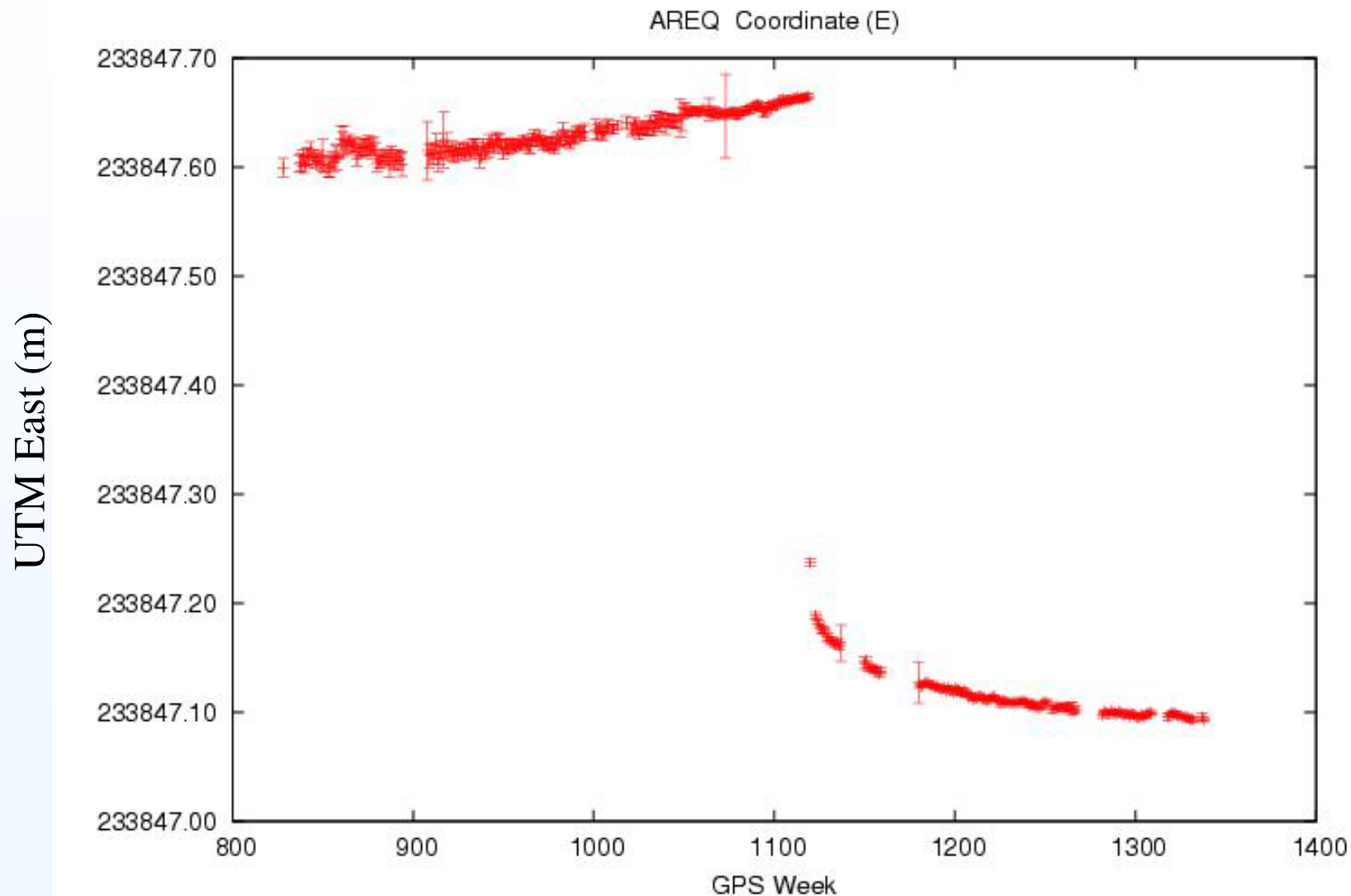
Other Modeling

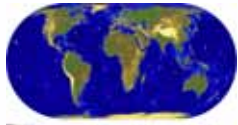
- Non-linear effects:
 - Periodicities (Annual, semi-annual)
 - Exponential Decay (earthquake)
 - Isolated anomalies (delete ???)





Time Series Example “AREQ”





7. Summary

- Decentralized – Accommodate Rapid Evolution
- Redundancy – Quality assurance
- Rigorous Combination
- Modeling:
 - Discontinuities – some subjectivity
 - Non-linear processes
 - Instabilities

