Using PPP-GPS to Estimate Tidal Motions in the Arctic & Comparison to a Tidal Model

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INTRODUCTION

- Background
- Process
- Discussion
- Results
  - Comparisons
  - Differences
- Conclusion

http://frametoframe.ca/wp-content/uploads/2013/05/arctic-ocean-off-kerkerten-island-nunavut-canada-1024x773.jpg

BACKGROUND

- DEW Line 1950s
- Localized charting
- 600 nautical miles
- Fisheries mandate
- MV Nuliajuk
- Mapping/Shipping
- Vertical motion

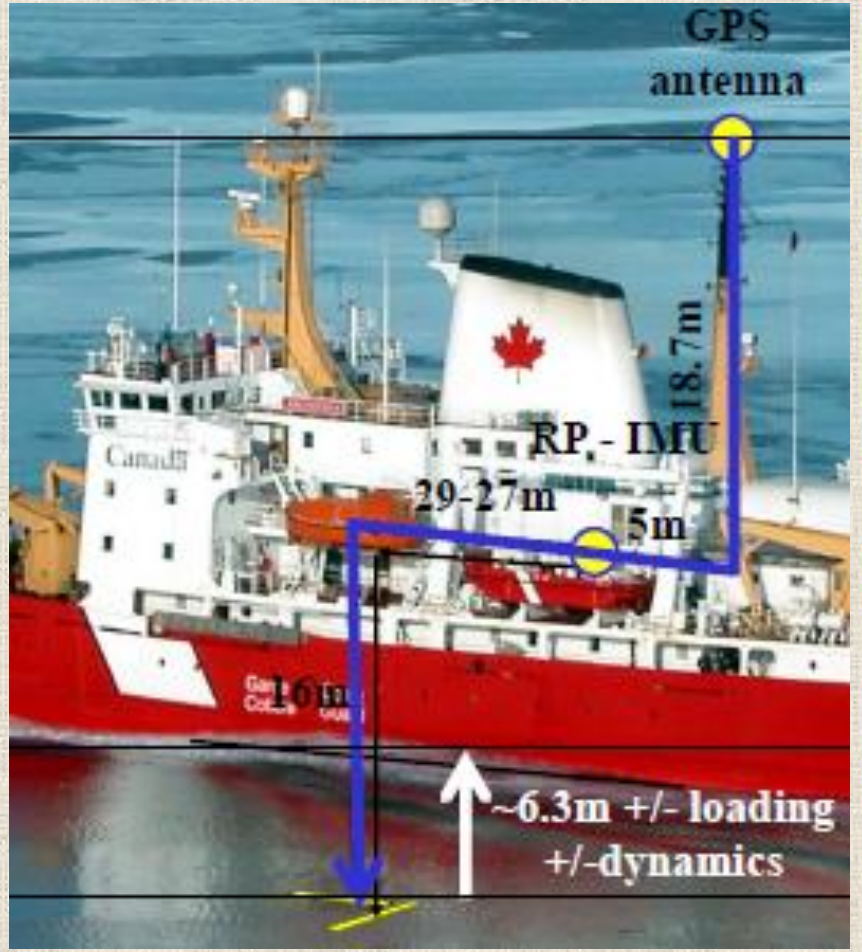
http://www.nunatsiaqonline.ca/pub/photos/nuliajuk.jpg

POST-PROCESSING

- Precise Point Positioning (PPP)
  - Measured satellite clock & ephemeris errors
  - Based on analysis of prior and post tracking
- PPP direct
  - NRCAN desktop application
  - RINEX convert to results folder (.pos)

WATER LEVEL

- GPS Ellipsoid height
- Reference point
  - Heading
  - Pitch
  - Roll
- Water level
  - Heave
  - Water line



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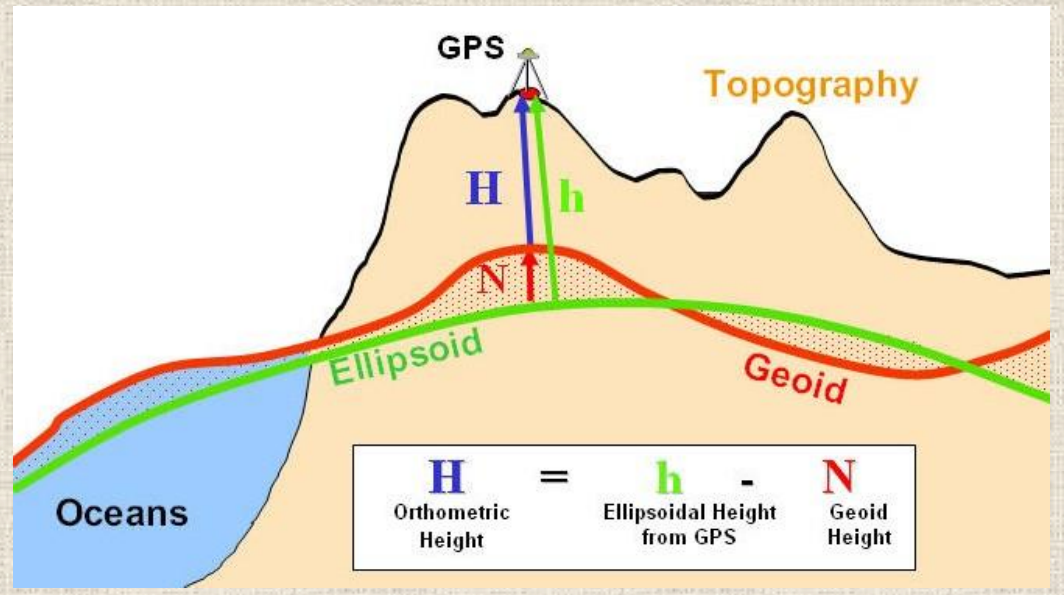
GEOID

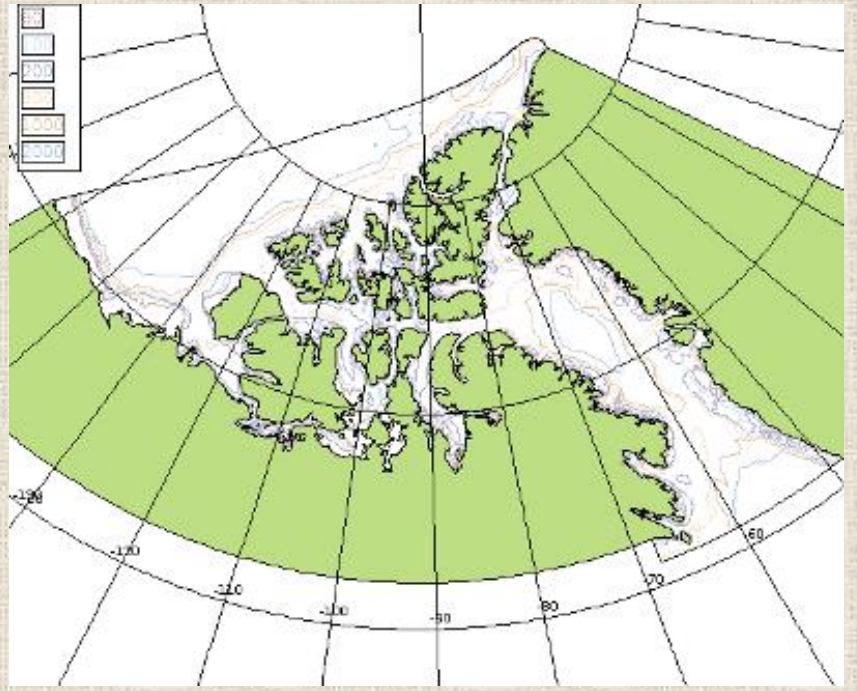
- Ellipsoidal WL height → geoid WL height
- CGG2013
- GPS-H
  - NRCAN desktop application
  - Input lat, lon, height
  - Output N
- h → H



http://principles.ou.edu/earth_figure_gravity/geoid/geoid-ellipsoidal-orthometric_height.jpg

Arctic9 Tidal Model

- DFO WebTide
- Smoothed model
- Historic tide data
- Coastal gauges
- No dynamic & static draft adjustments
- Does not account for SST



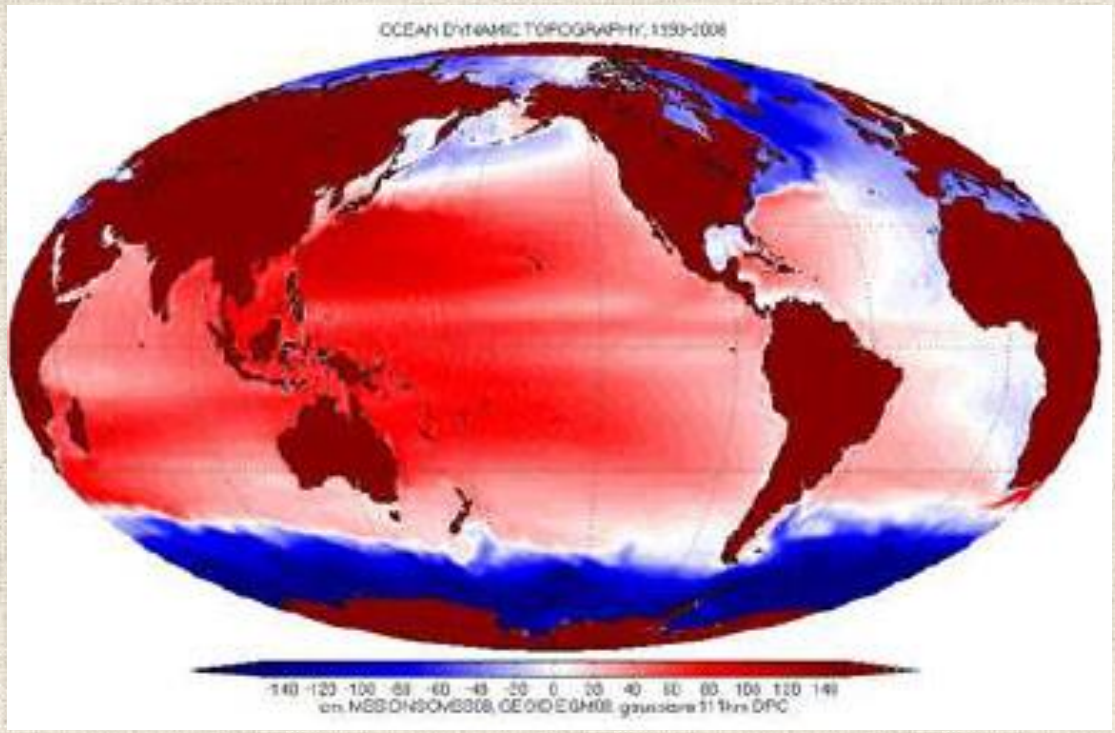
http://www.bio.gc.ca/science/research-recherche/ocean/webtide/arctic-arctique-eng.php

DIFFERENCES

- Loading & Squat
- Signal loss
  - Arctic meteorology activity
  - Radio frequency interference
  - High latitude – satellite geometry
- Constrictions & bathymetry
- Non-tidal water level variations
  - Storm surges
  - Sea Surface Topography

DYNAMIC OCEAN TOPOGRAPHY

- SST/DOT
- MSL – GEOID
- Satellite altimetry for height of sea surface
- GRACE gravity missions
- Steady state, multi-annual average of sea surface
- Departures from geoid



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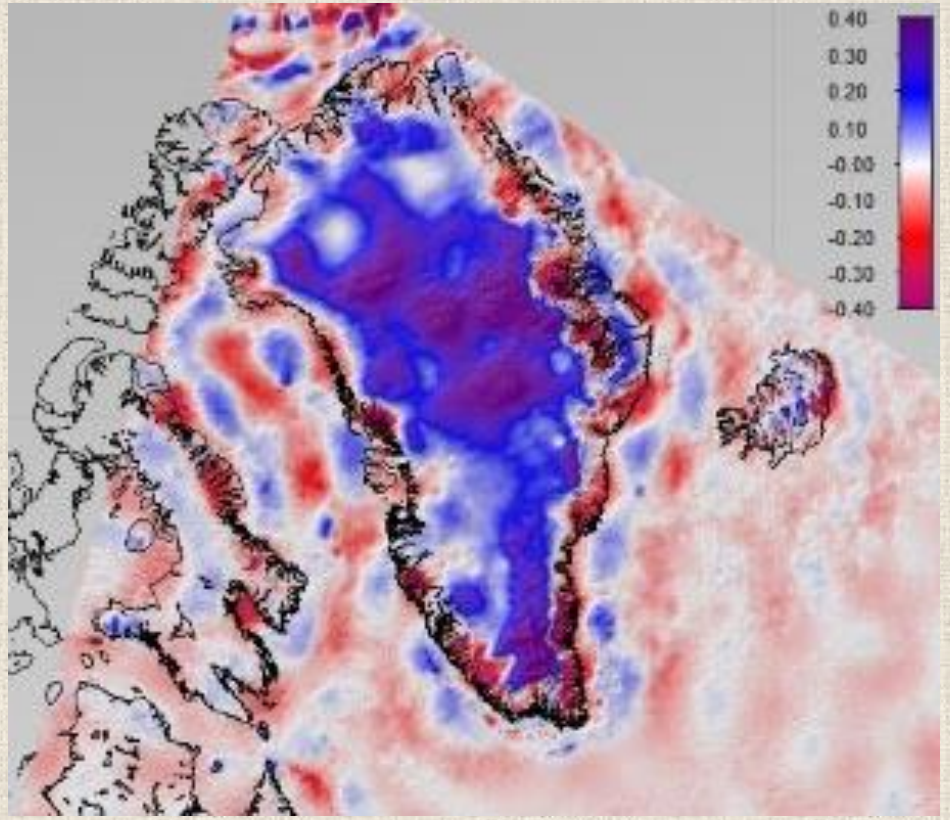
SEPARATION

- CGG2013
  - Min: -1.191m
  - Max: 0.221m
  - Mean: -0.036m +/- 0.028m
- EGM2008 reference
- Global gravity missions:
  - GRACE
  - GOCE
- Eastern Baffin Island complex
  - Large gradient



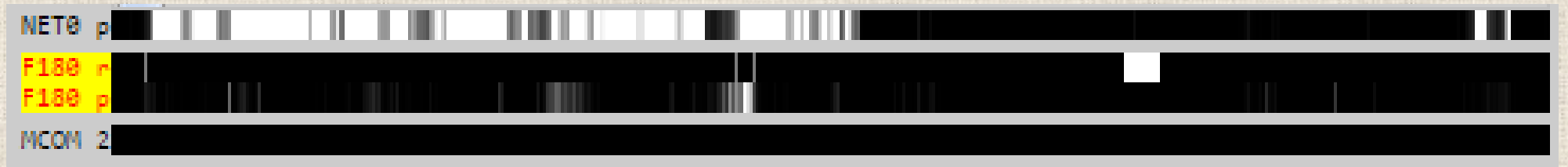
Renoud, W., Unpublished Report

ROUTE OF MV NULIAJUK

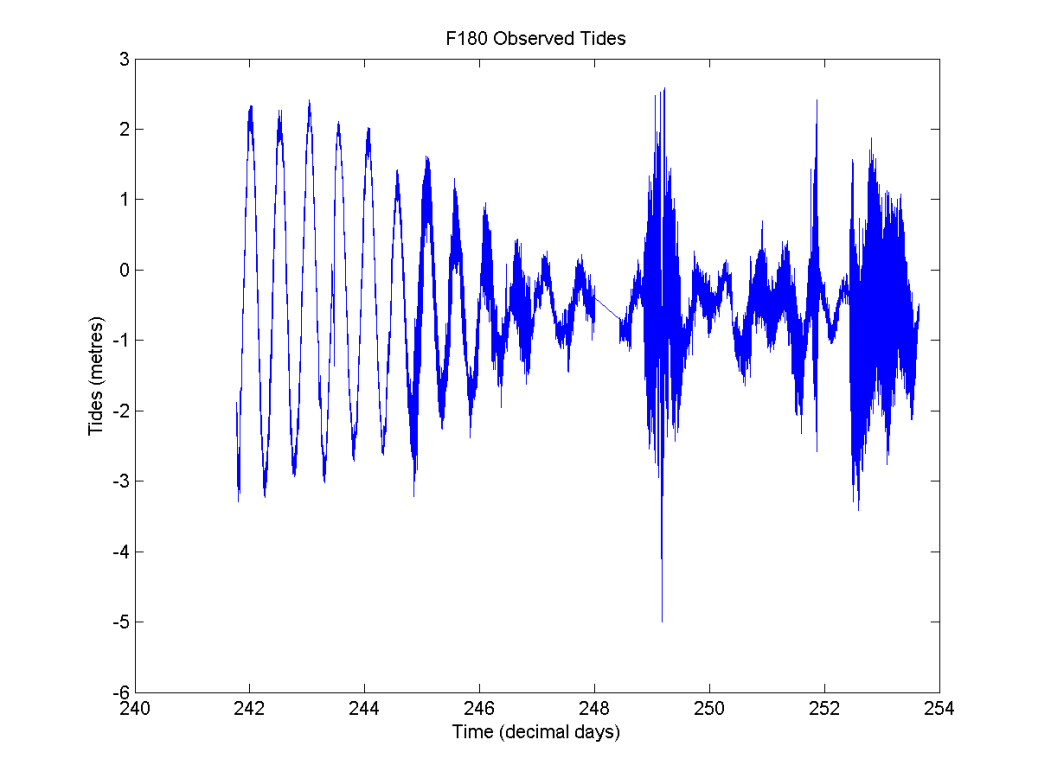
- Pangnirtung
- Qikiqtarjuaq
- Clyde River

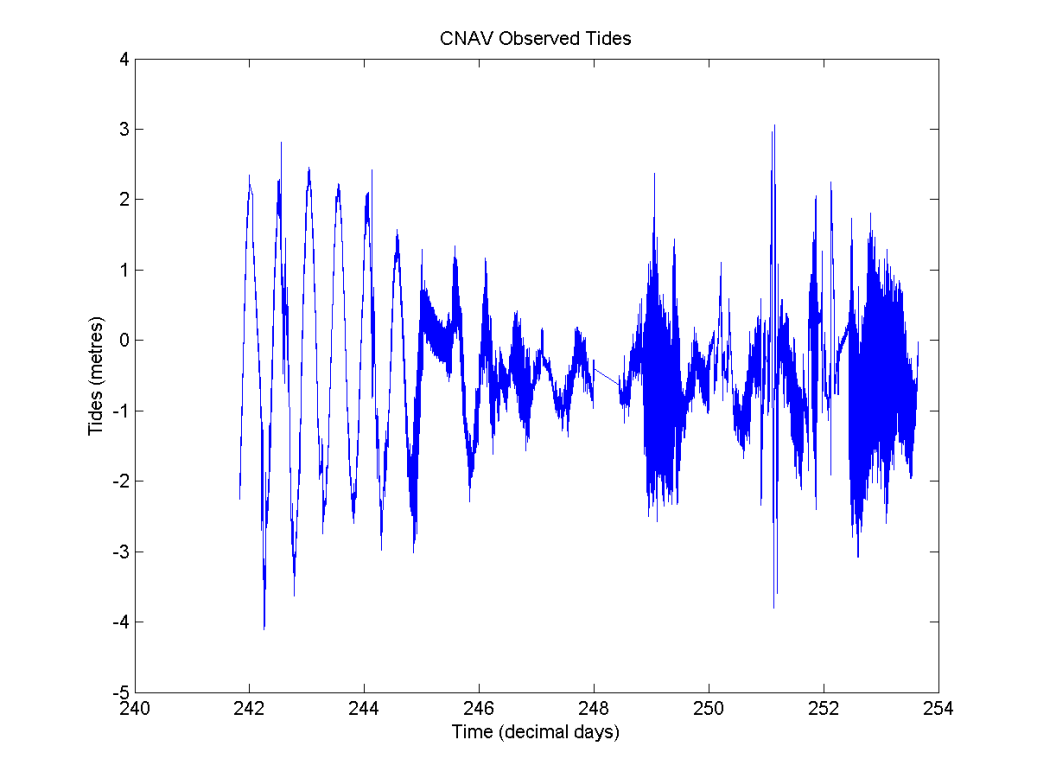
AVAILABILTY

- September 3rd example
- CNAV3050: internet
- F180 less noisy

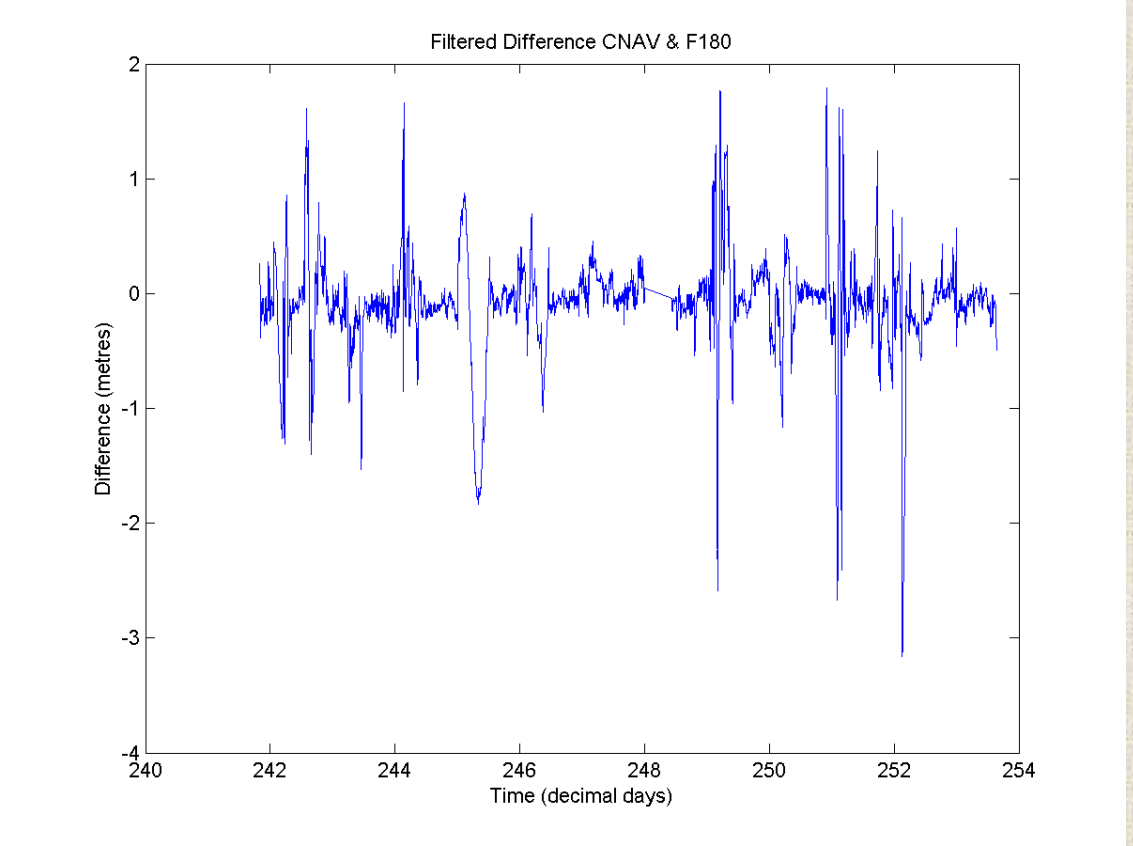


OBSERVED TIDES

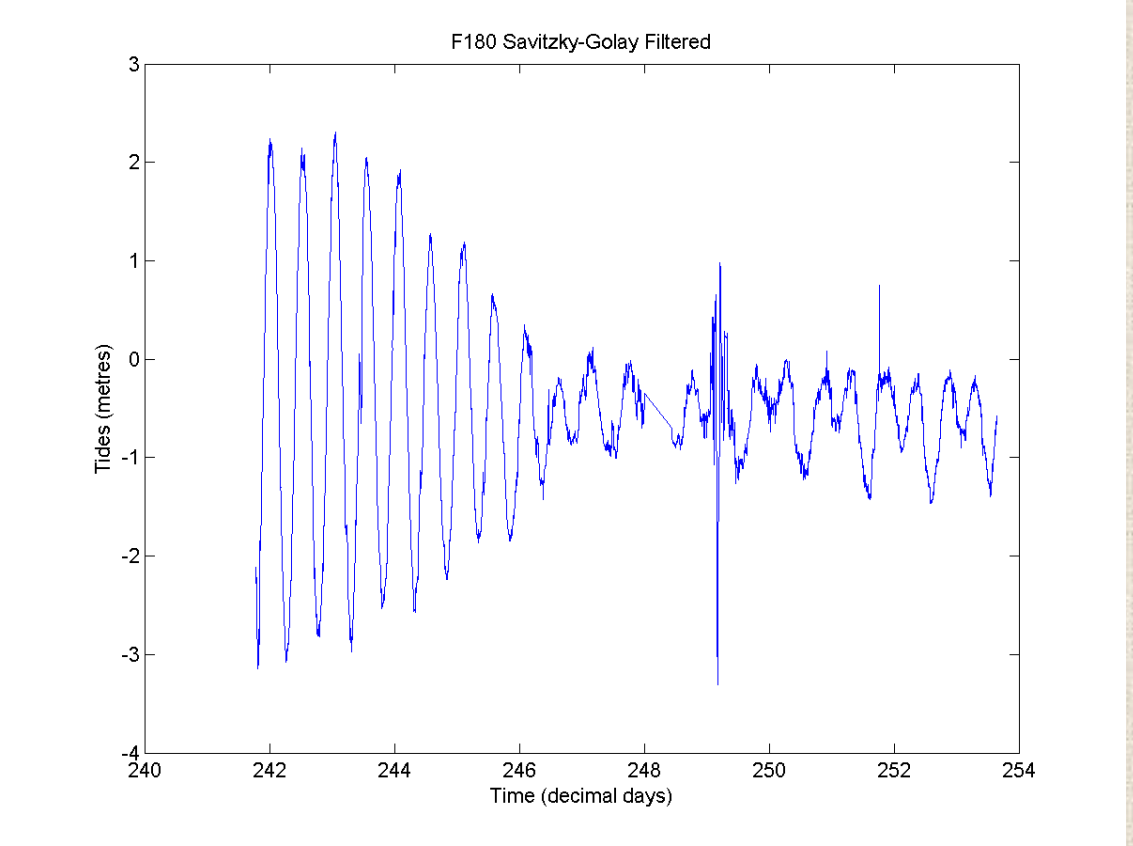




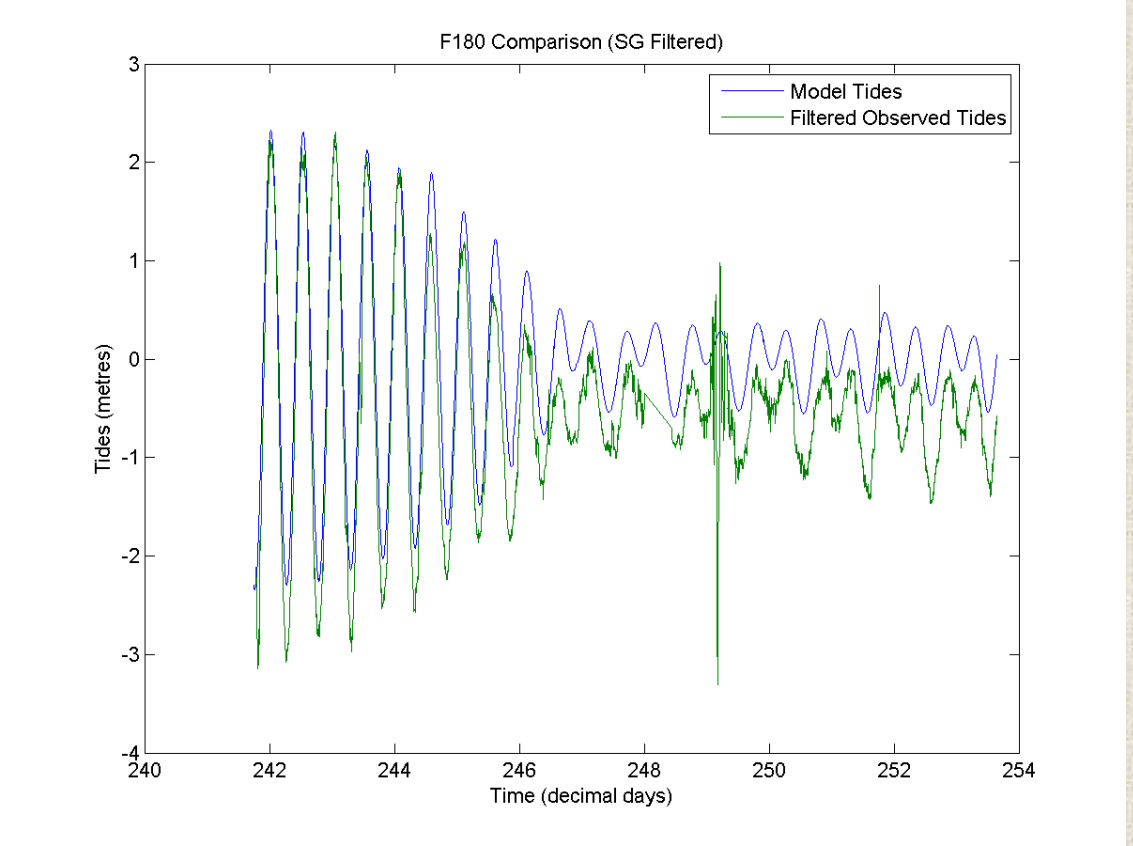
DIFFERENCE FROM EACH OTHER



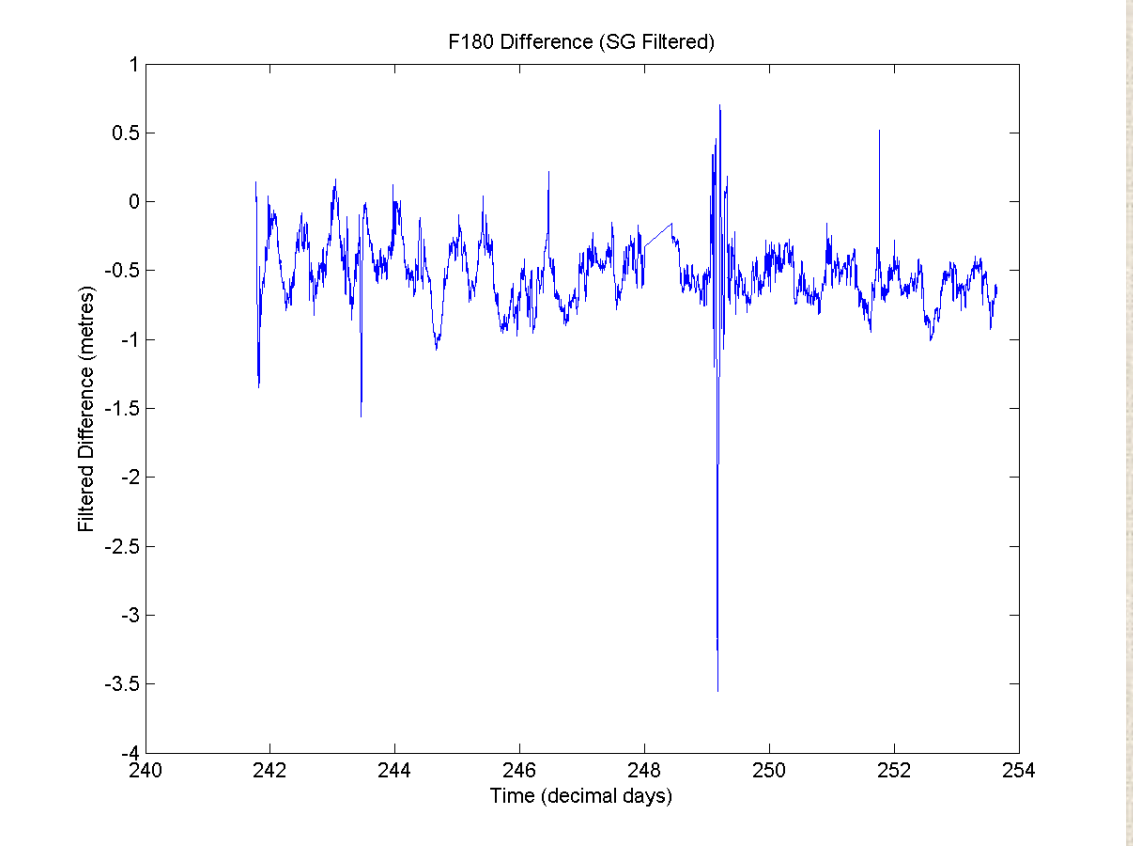
SAVITZKY-GOLAY FILTERED



COMPARISON WITH MODEL



DIFFERENCE FROM MODEL



SUMMARY & CONCLUSIONS

- Differences:
  - Poor GPS signal
  - Loading/Squat
  - Constrictions & bathymetry
  - Non-tidal sea level variations
  - Dynamic Ocean Topography
  - Geoid Model
- PPP-GPS way to validate hydrodynamic models

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