Ionospheric Calibration Using GPS/GLONASS/Galileo Data

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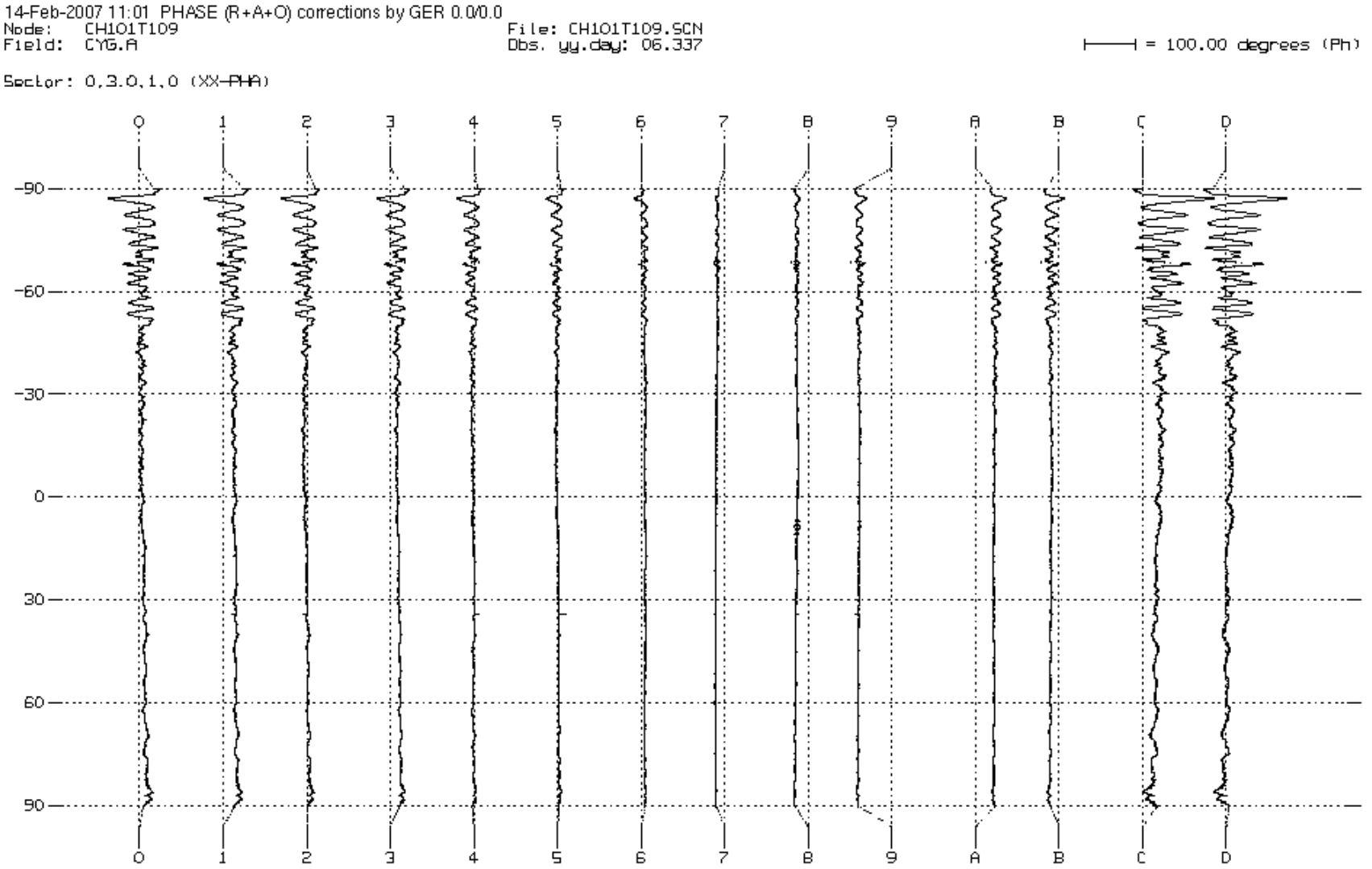
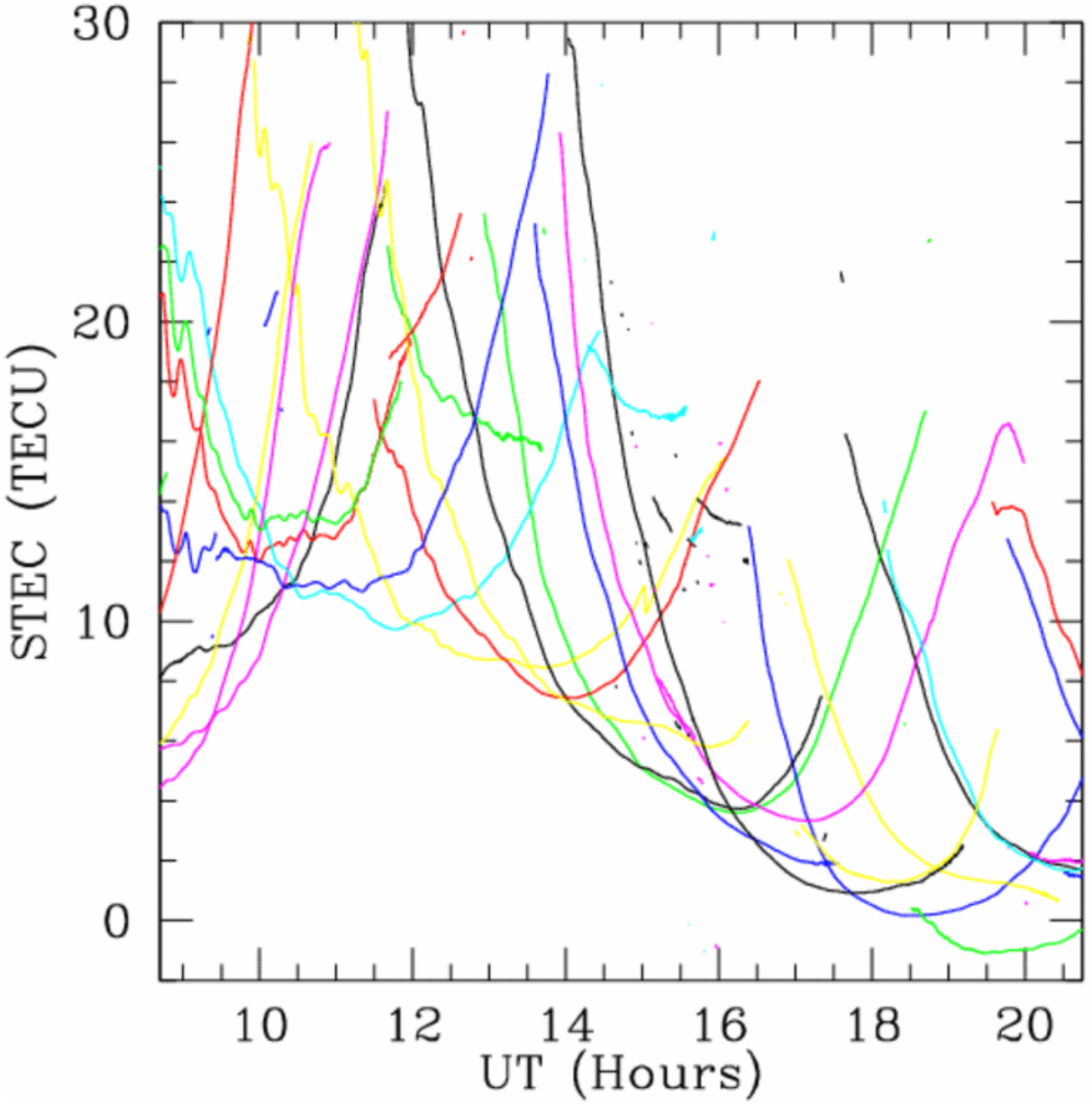
Westerbork LFFE Data (2006 Dec 03)



Note: Hopefully Paul will present a visualization tool next week

Westerbork GPS Data (2006 Dec 03)

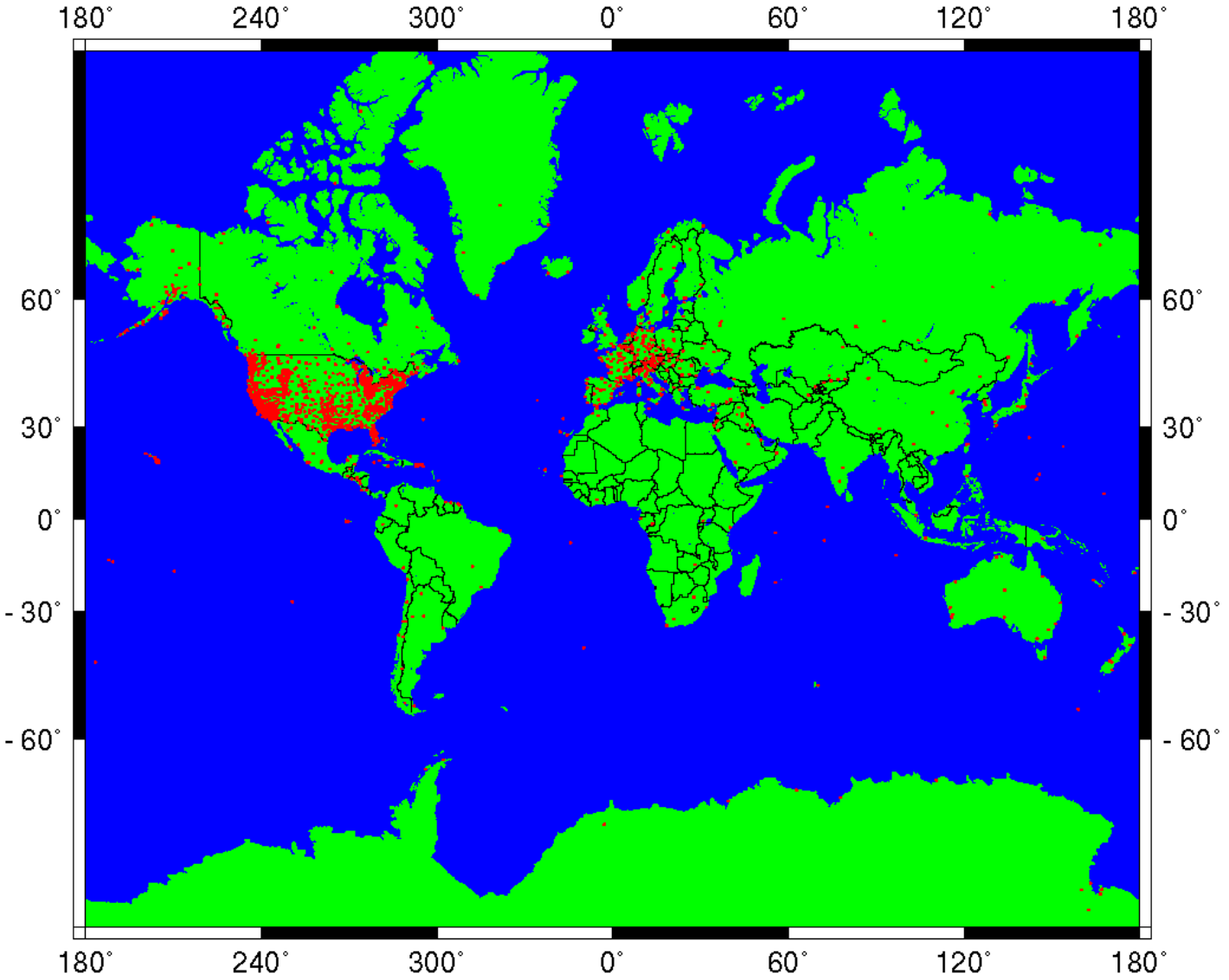


- Same time period as LFFE observations
- TIDs clearly visible in morning data
- Remainder of day more calm, but can still see fluctuations

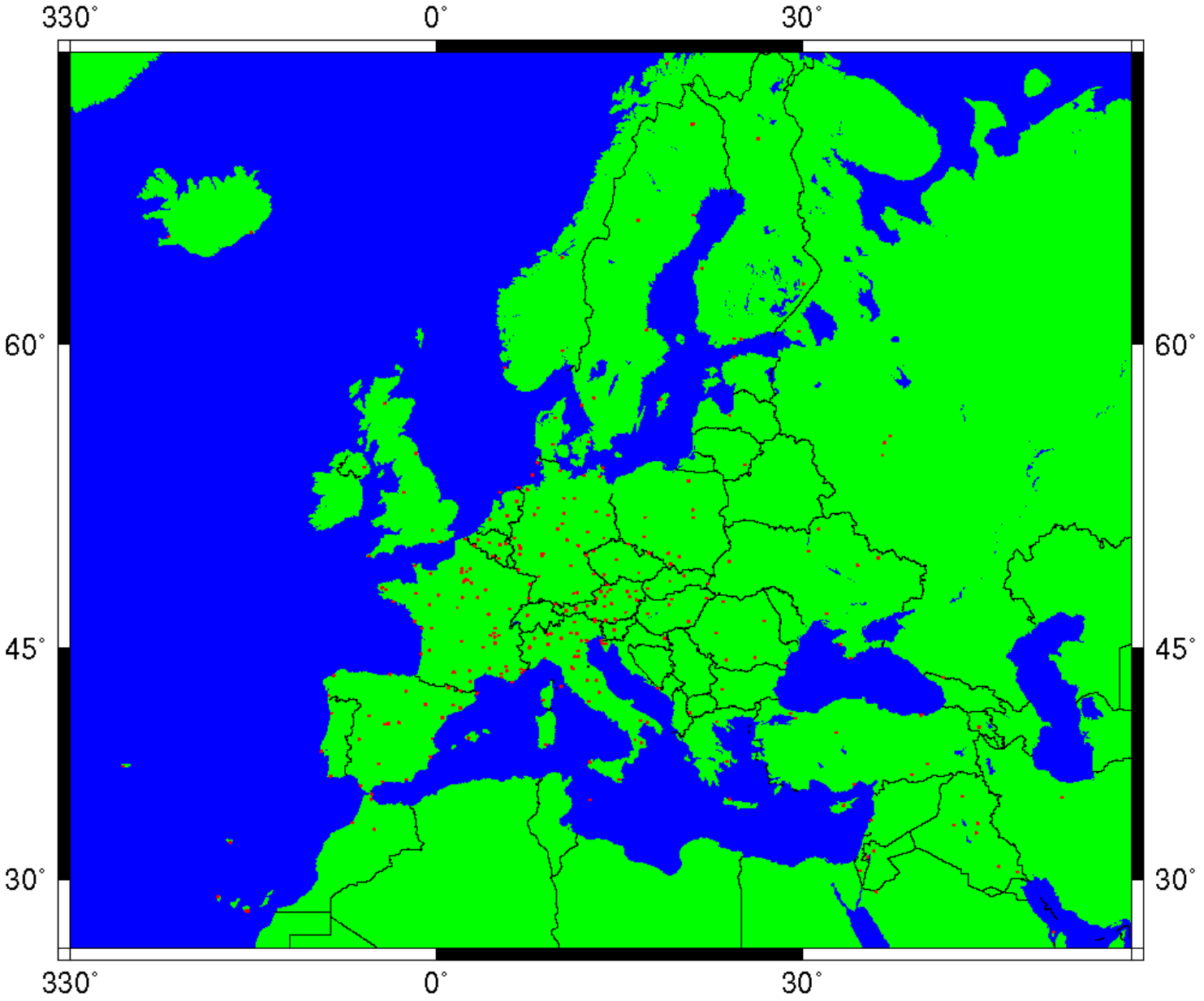
GPS Data Properties

- Get ~8 directions on sky simultaneously
- Phase data appear precise and smooth to better than 0.01 TECU
  - (~ 1 radian at 75 MHz)
- Individual satellite and receiver biases remain
- Phase lock a problem, but mostly solvable

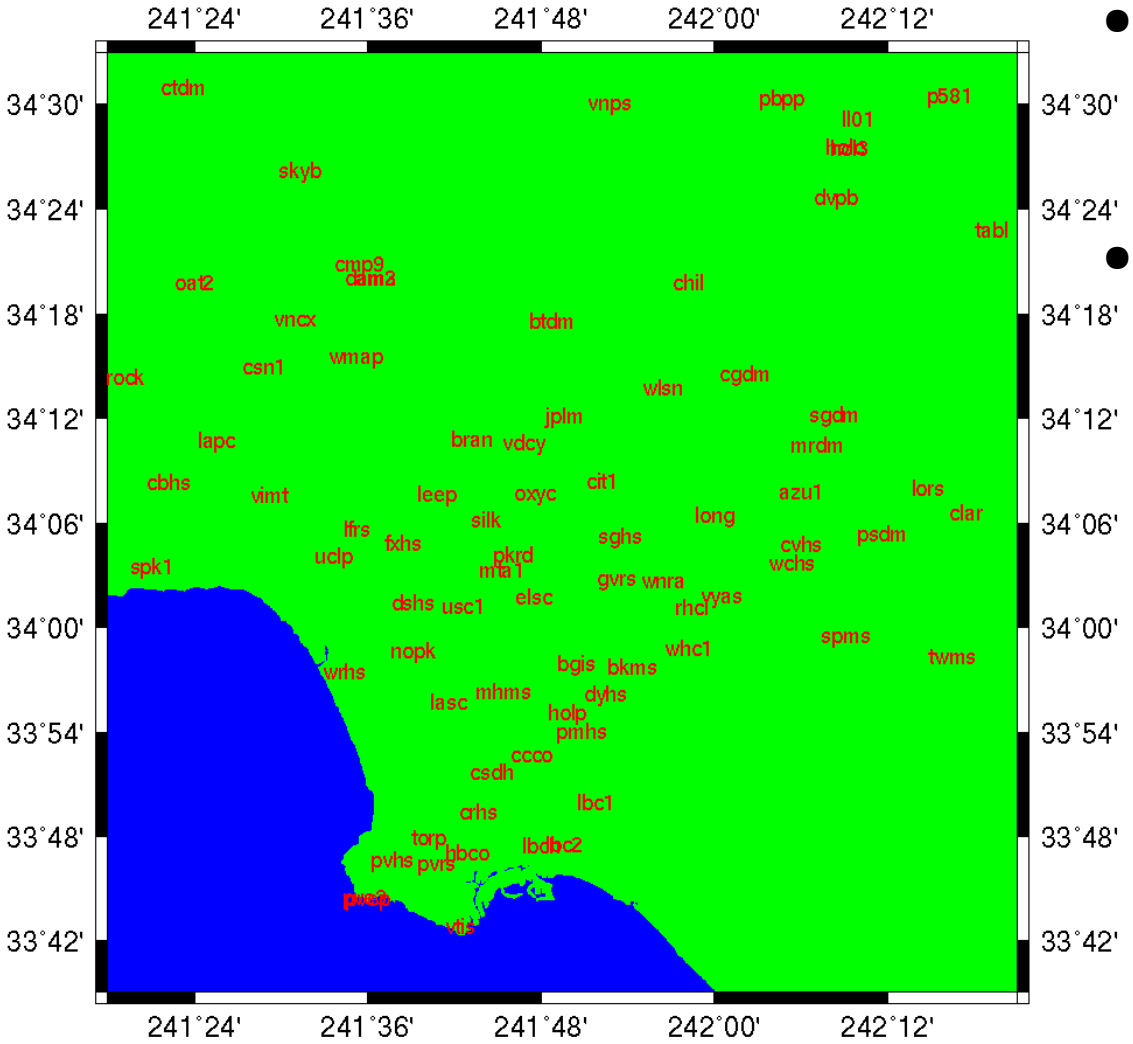
>~ 2000 GPS Receivers With Publicly Available Data



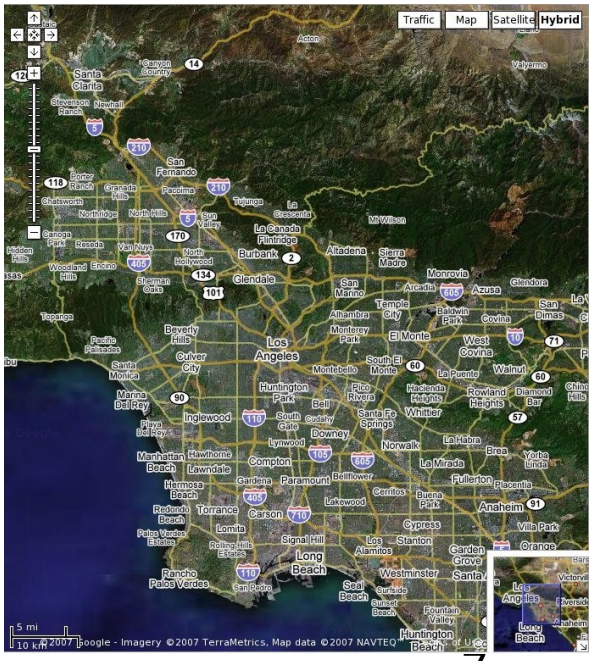
European Coverage Poor At Present



US Coverage Better --- Especially Over Los Angeles



- ~72 GPS receivers within 50 km radius
- ~ 10 km spacing between receivers perfect for simulating LOFAR



Present Status

- JMA has Python/C++ tools to automatically download and process GPS RINEX data
  - Processes RINEX to binary format
  - Converts to STEC and provides initial bias correction and phase lock correction
- Maaijke Mevius has written Python software to import JMA GPS data-files into MeqTrees
- Minimum Ionosphere Model implemented in MeqTrees
  - Currently have JMA 2D model written
  - Solves for smooth ionosphere and satellite/receiver biases
  - Parameters appear to change very smoothly with time

(Near) Future Work

- Debug MeqTree implementation
- Visualize and understand residuals to smooth ionosphere model
- Implement ionospheric wave fitting
- Implement Noordam 2D MIM and the JMA 3D MIM models in MeqTrees
- Reduce current residual RMS from ~1 TECU to 0.01 TECU