Geostationary Satellite Update

Richard Fuller

Wide Area Differential GPS Laboratory
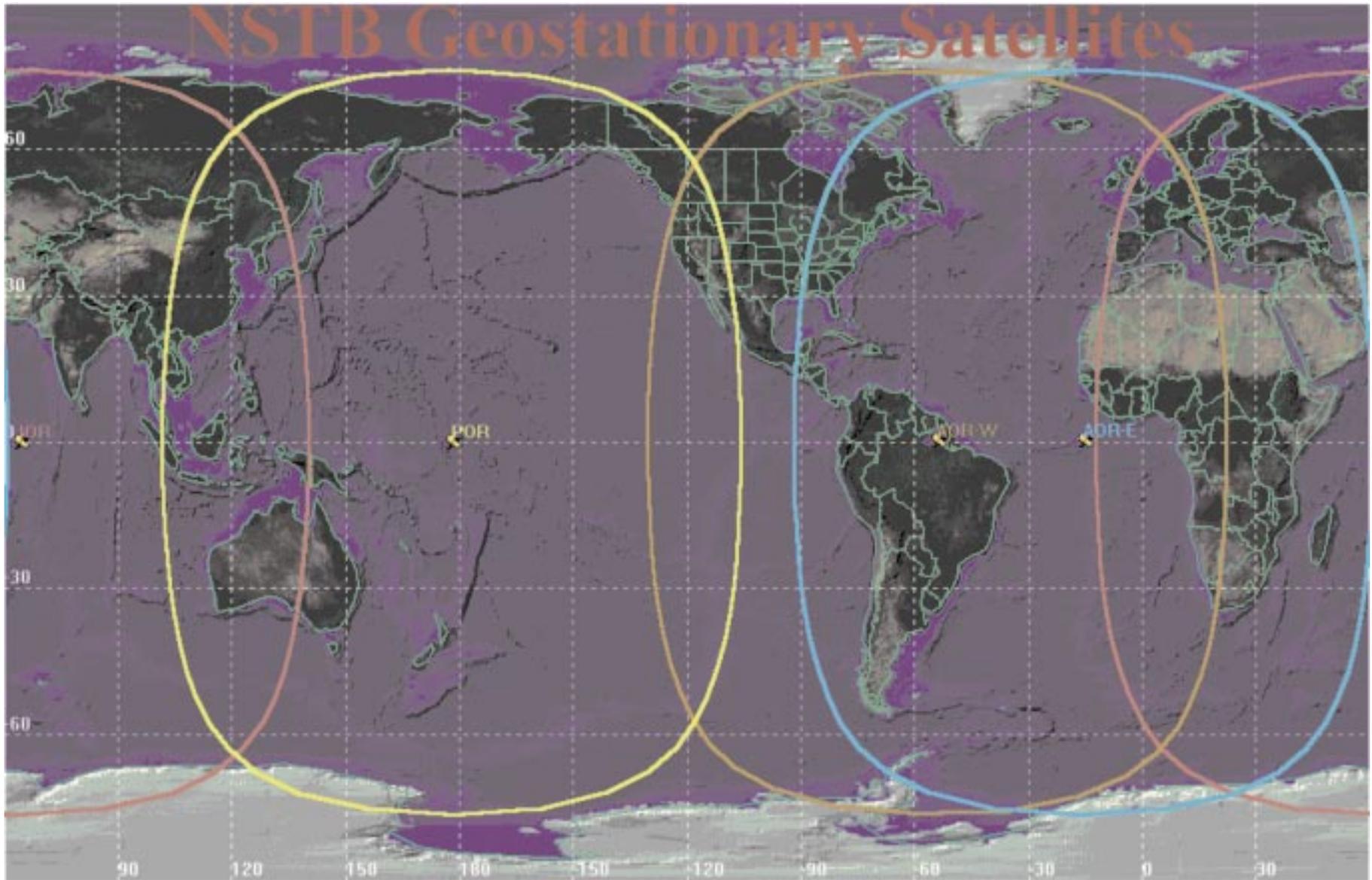
June 30, 1998
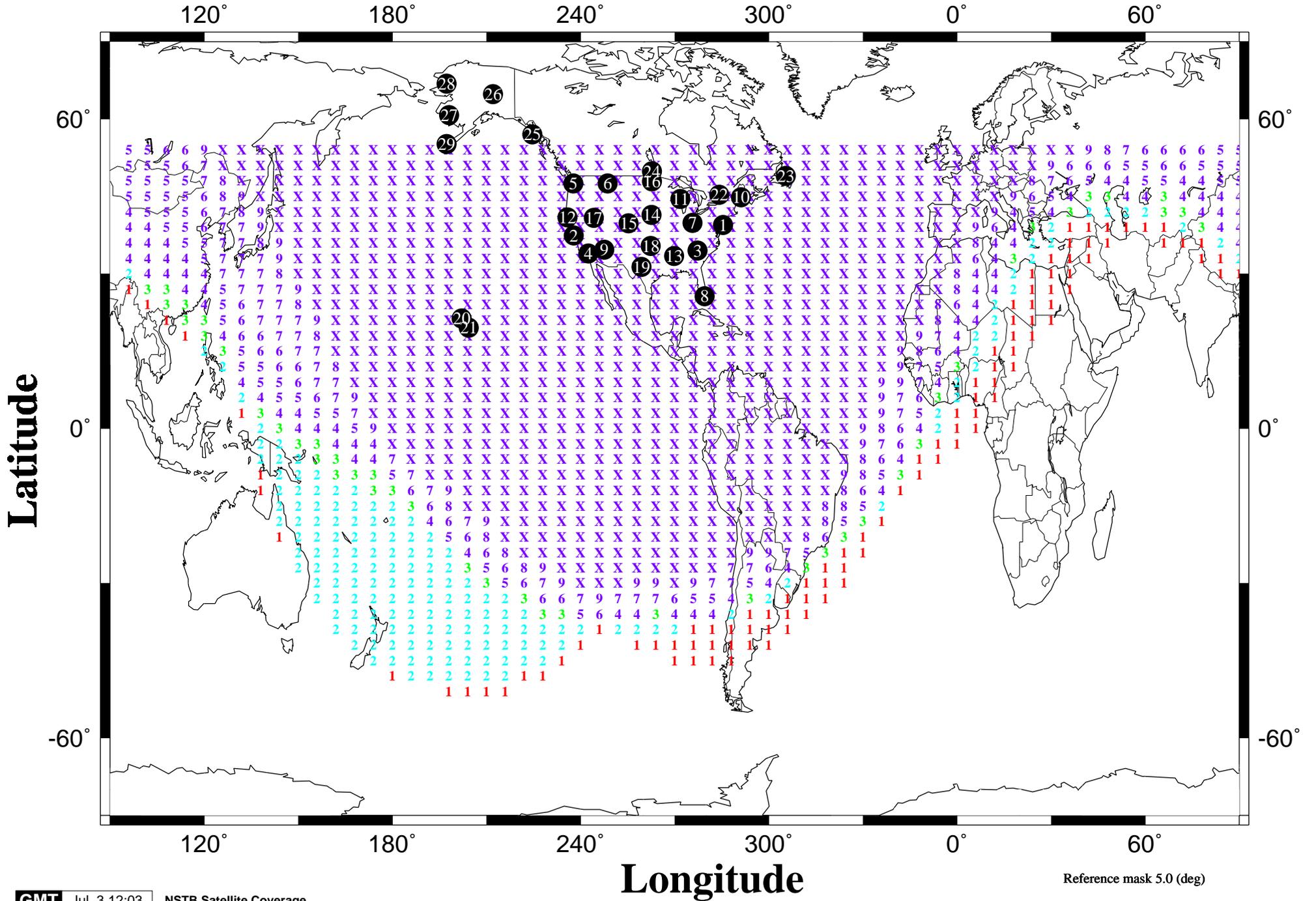
Outline

- **Geostationary Coverage Regions**
  - ⇨ User Visibility
  - ⇨ Satellite Visibility

- **POR Access**
  - ⇨ Preparations
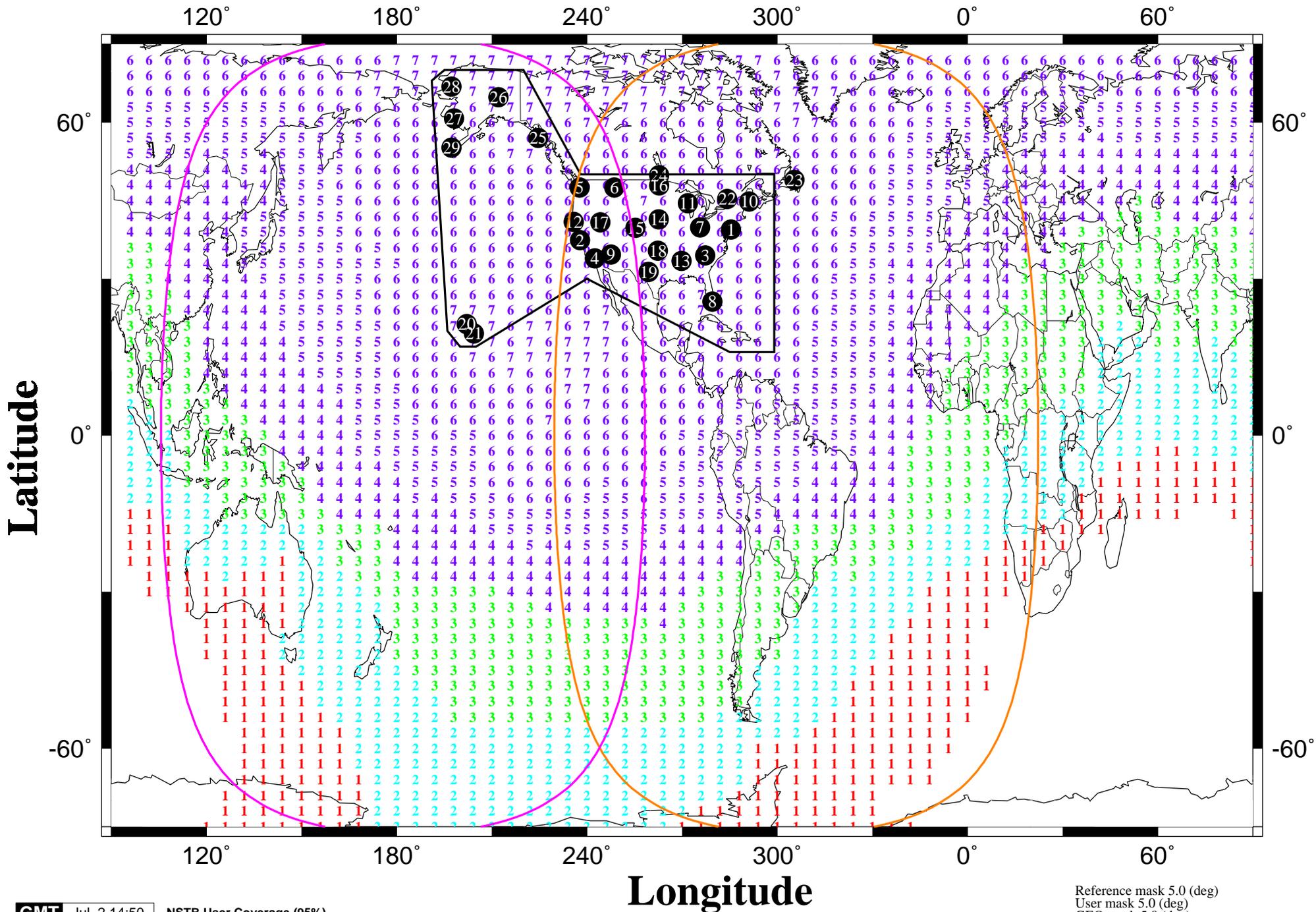 - ⇨ Signals
  - ⇨ User Positioning
  - ⇨ Upcoming work
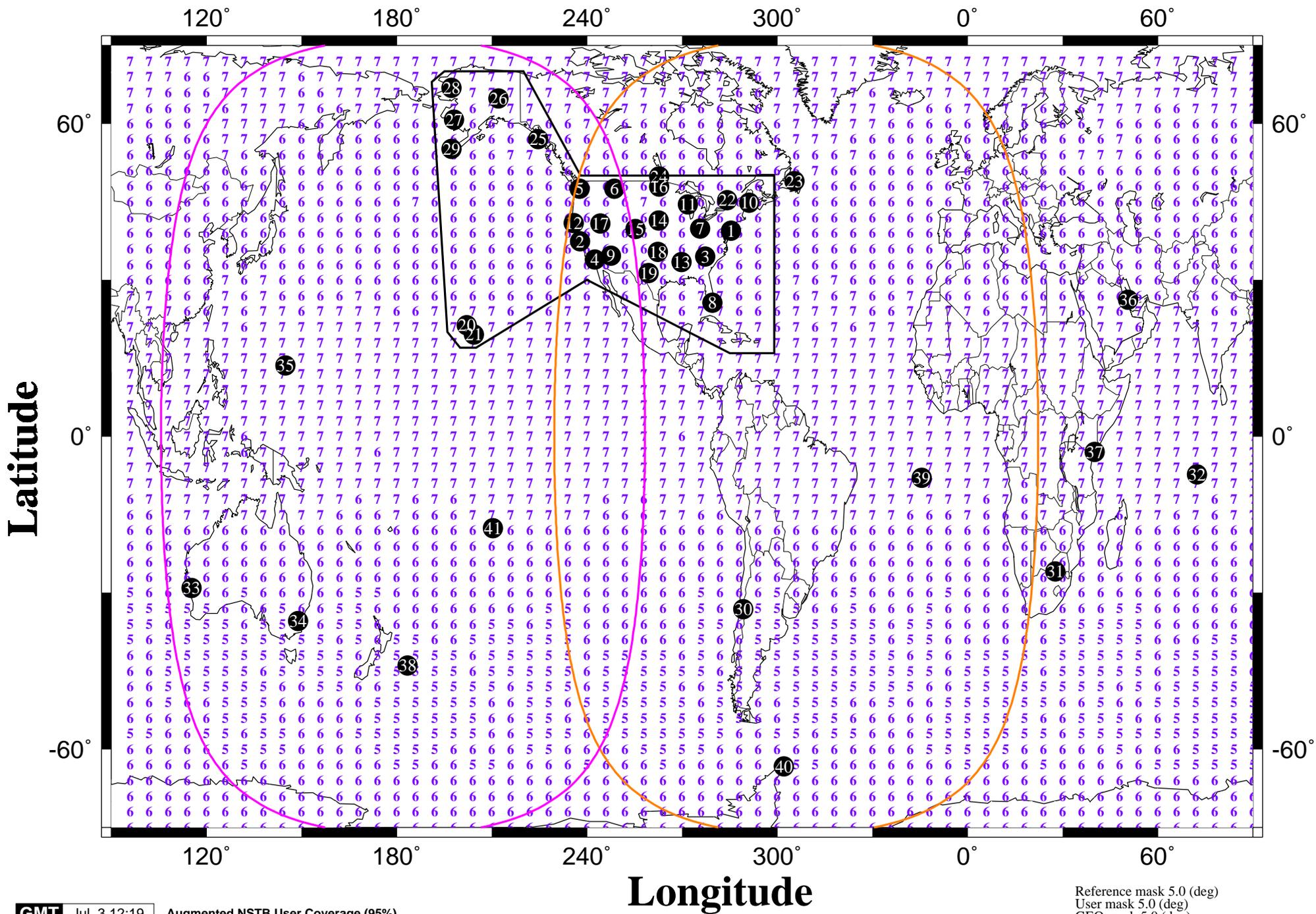
NSTB Geostationary Satellites

NSTB Satellite Coverage
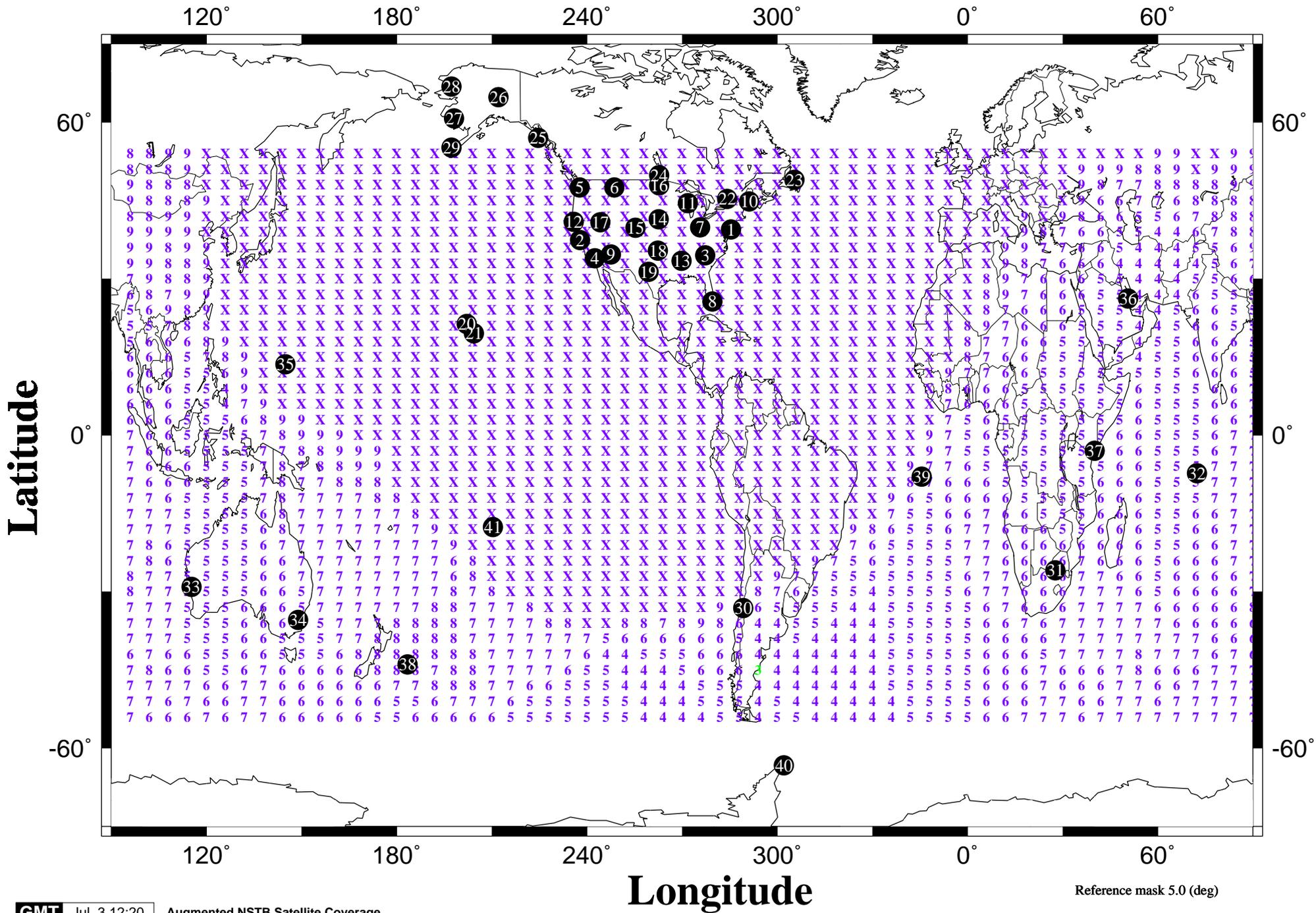
Latitude

Longitude

Reference mask 5.0 (deg)

GMT   Jul 3 12:03   NSTB Satellite Coverage

NSTB User Coverage (95%)

Reference mask 5.0 (deg)
User mask 5.0 (deg)
GEO mask 5.0 (deg)

GMT   Jul 2 14:50   NSTB User Coverage (95%)

Augmented NSTB User Coverage (95%)

Reference mask 5.0 (deg)
User mask 5.0 (deg)
GEO mask 5.0 (deg)

Augmented NSTB Satellite Coverage

Reference mask 5.0 (deg)
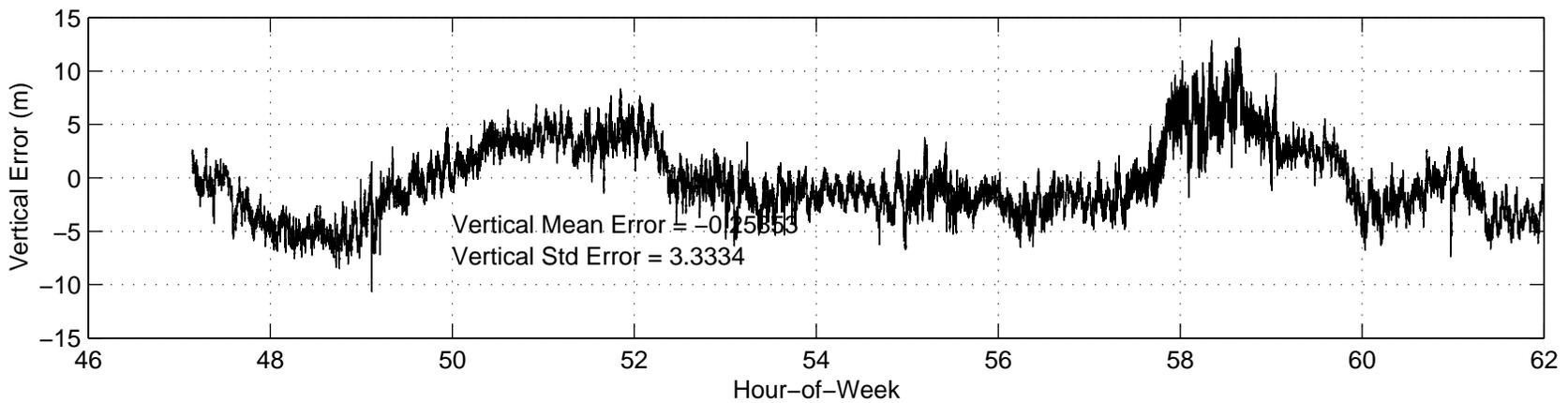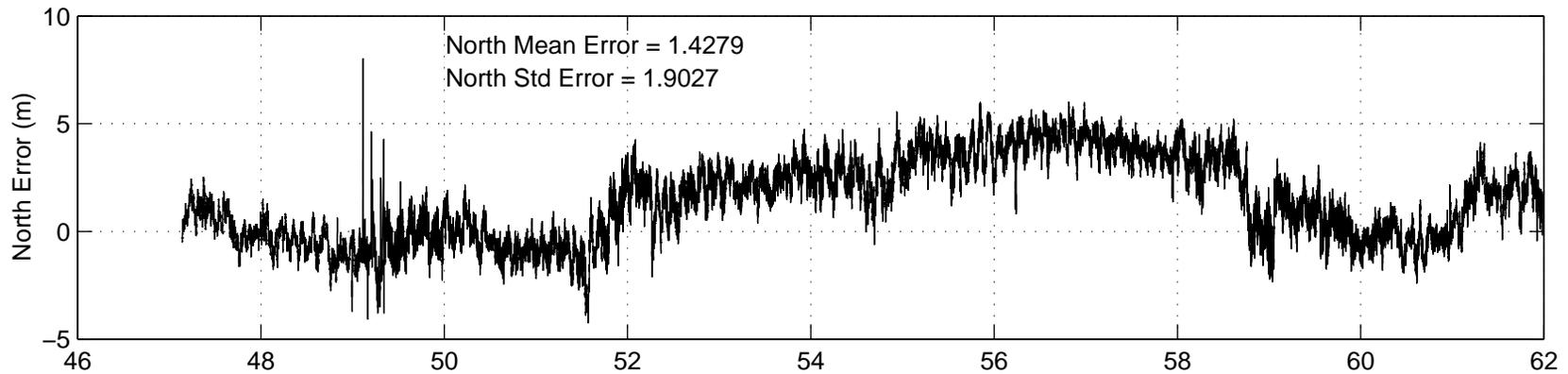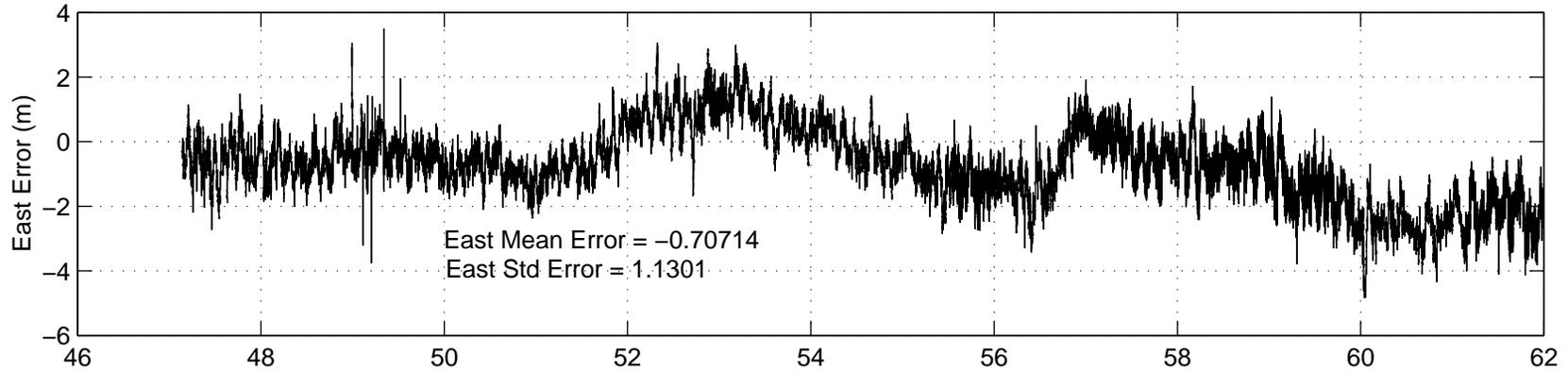
Geostationary Preparations

- **Upgraded the Ethernet aiding protocol**
  - ⇨ Rudiments previously implemented in the Stanford TMS
  - ⇨ Added proper formatting and sequence to data stream
  - ⇨ Changed the timing sequence of the correction messages (account for latency)
  - ⇨ Passed the Tech Center's 'WibServer' timing analysis on May 15

- **Obtained a Millenium 10-1 receiver from NovAtel**
  - ⇨ Updated the Stanford WAASUSER code to accept WAAS data messages from the Millenium receiver

- **First transmitted to POR TUS in Santa Paula on June 15**
  - ⇨ Since then we have 7 complete days of transmission on POR
  - ⇨ POR received power levels continue to remain *below* AOR-W

POR Satellite Data Path

POR

Stanford

W J Hughes
Technical
Center

Santa
Paula
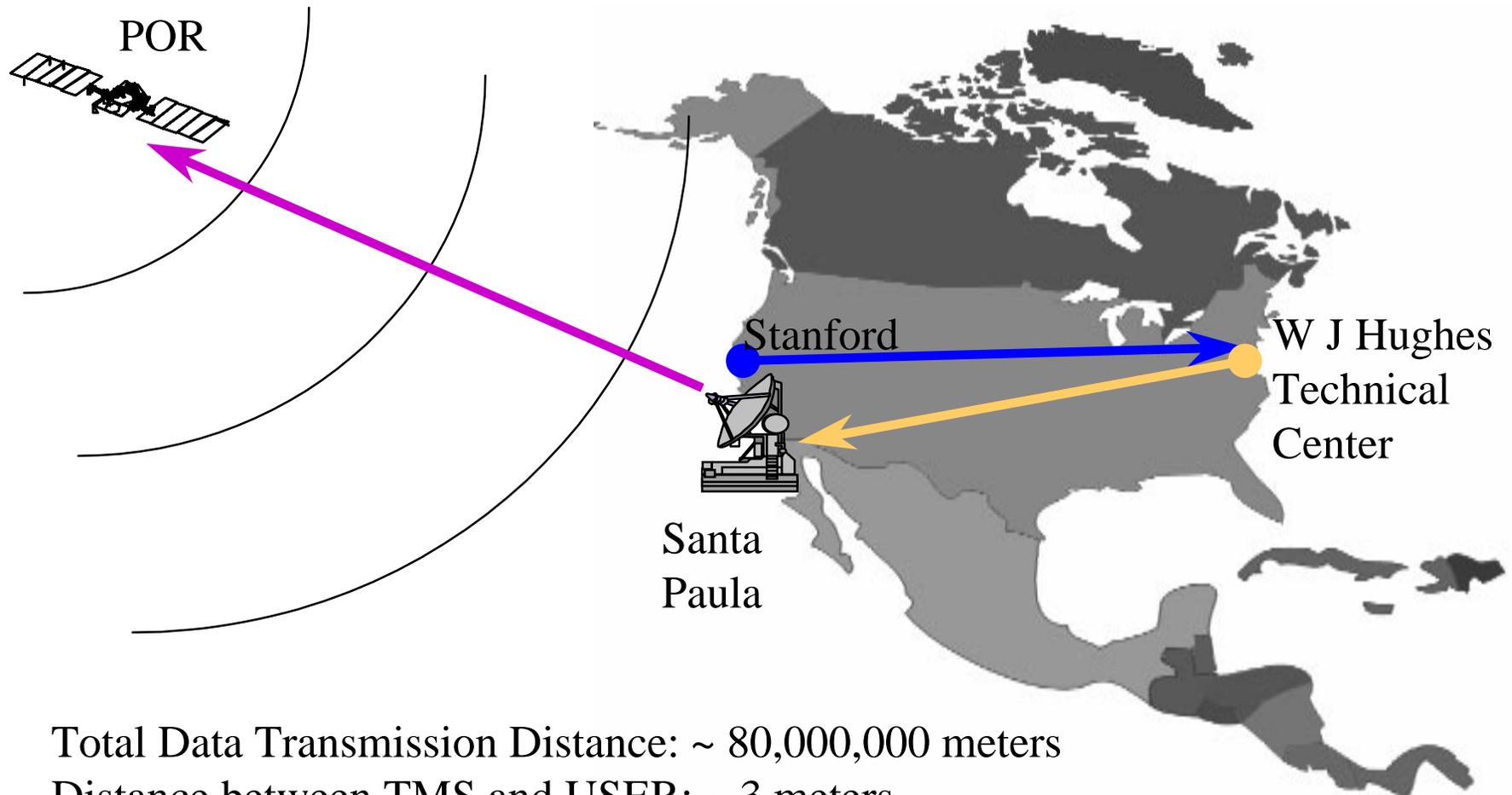
Total Data Transmission Distance: ~ 80,000,000 meters
Distance between TMS and USER: ~ 3 meters

Static GEO−Corrected WAAS Position Error

East Mean Error = −0.70714
East Std Error = 1.1301

North Mean Error = 1.4279
North Std Error = 1.9027

Vertical Mean Error = −0.25853
Vertical Std Error = 3.3334

Future Work

- **Extend User and Satellite Coverage Analysis**
  - ⇨ Add DOP, UDRE, and GIVE plots
  - ⇨ Minimize number of stations while maximizing siting reliability
- **Flight Tests with Geostationary Data Link**
  - ⇨ Ground tests have collected roughly 1 GB of positioning and raw measurement data
    - ◆ Analysis ongoing
  - ⇨ Flight tests begin today (June 30) and will continue through the summer
    - ◆ Major goal: flight test demonstration in Alaska in August
  - ⇨ Work towards Geo-ranging capability
    - ◆ Dependent on determining Millenium station tracking problems
  - ⇨ Update the USER code to utilize 3rd generation TMS software

Interoperation of Distributed Satellite Based Augmentation Systems:
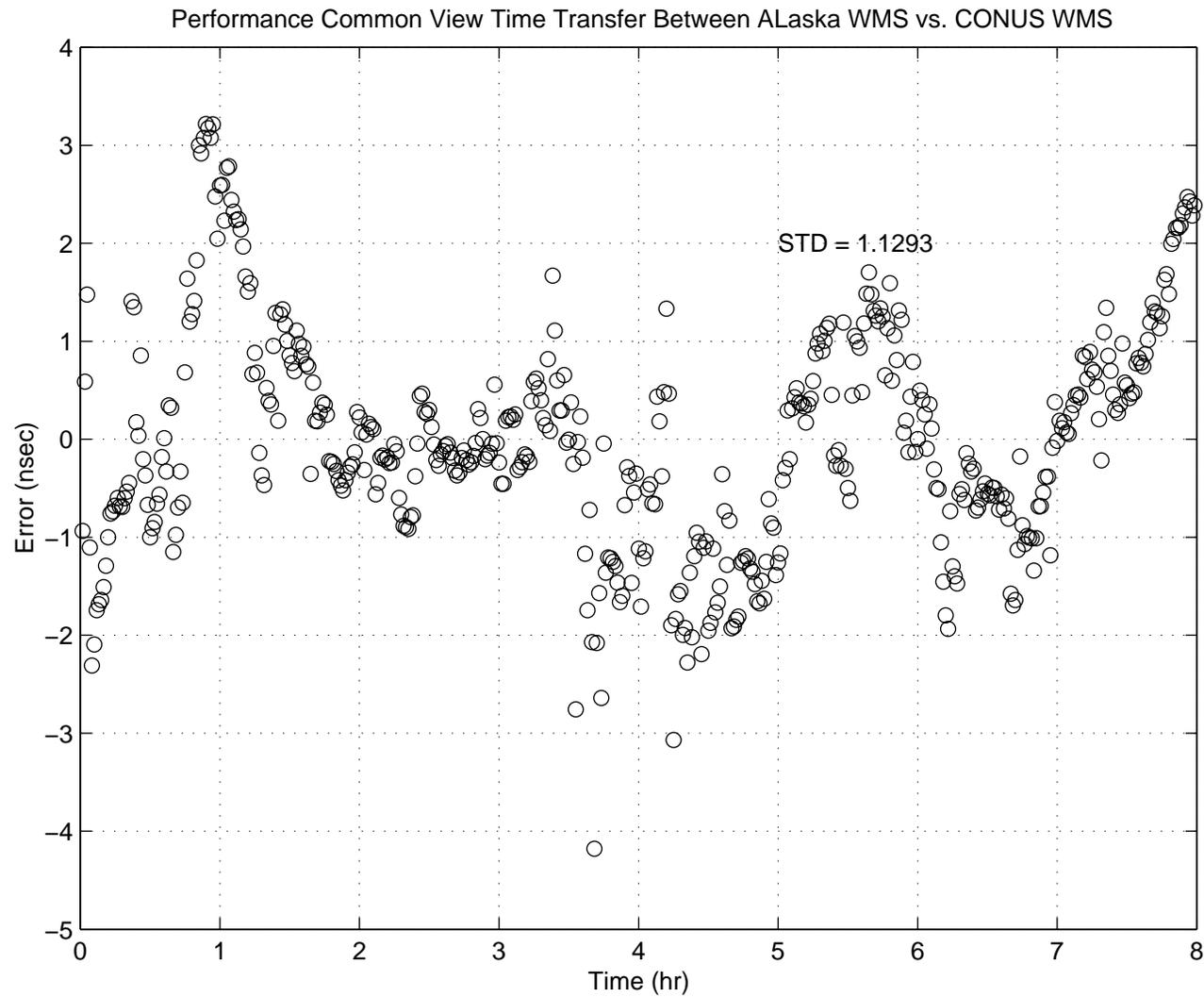## Implementation and Applications
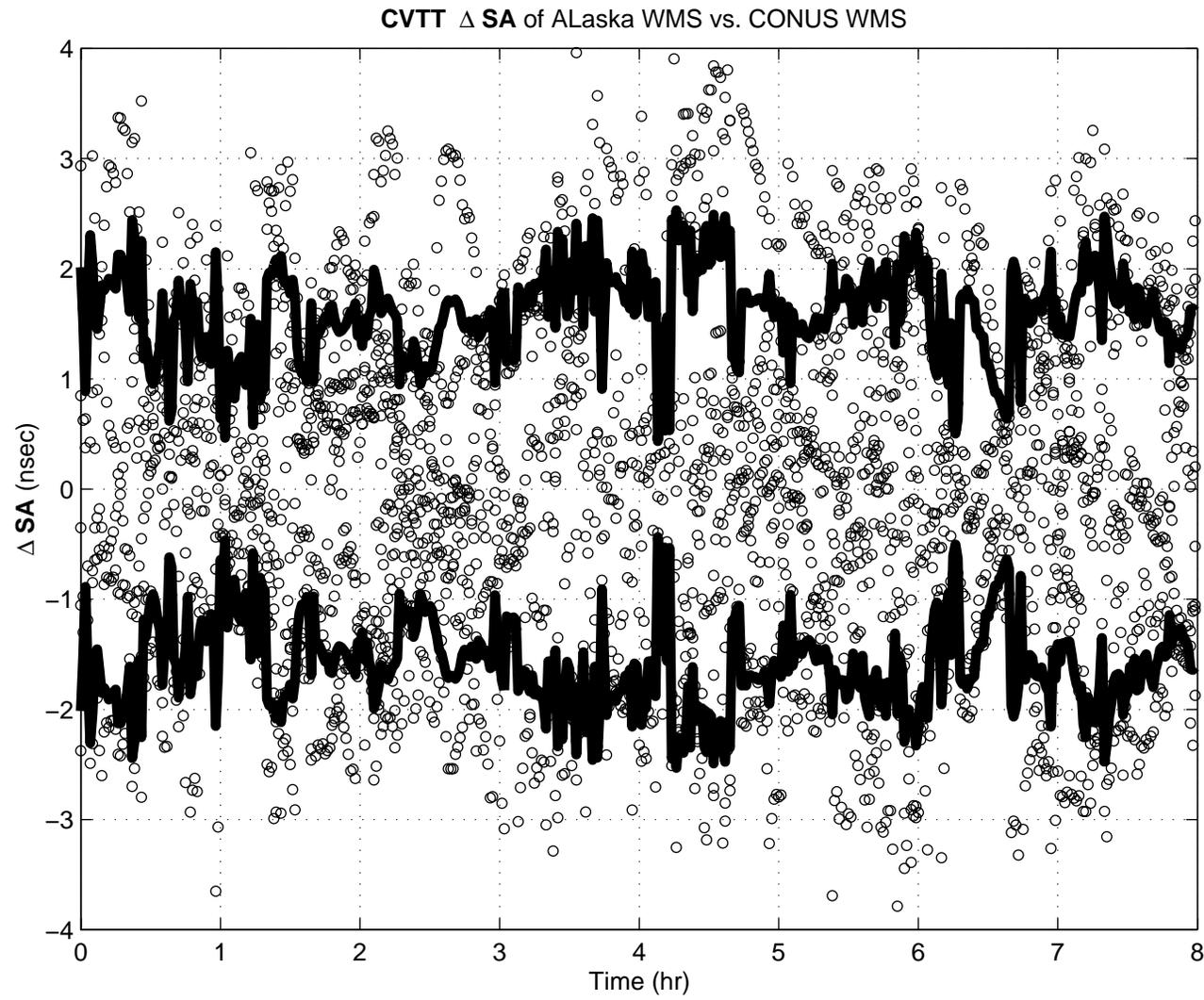
Donghai Dai
Stanford University

Alaska/CONUS Example

- **Senario**

- **Clock/Ephemeris**
  Clock Synchronization
  Clock/Ephemeris Integration

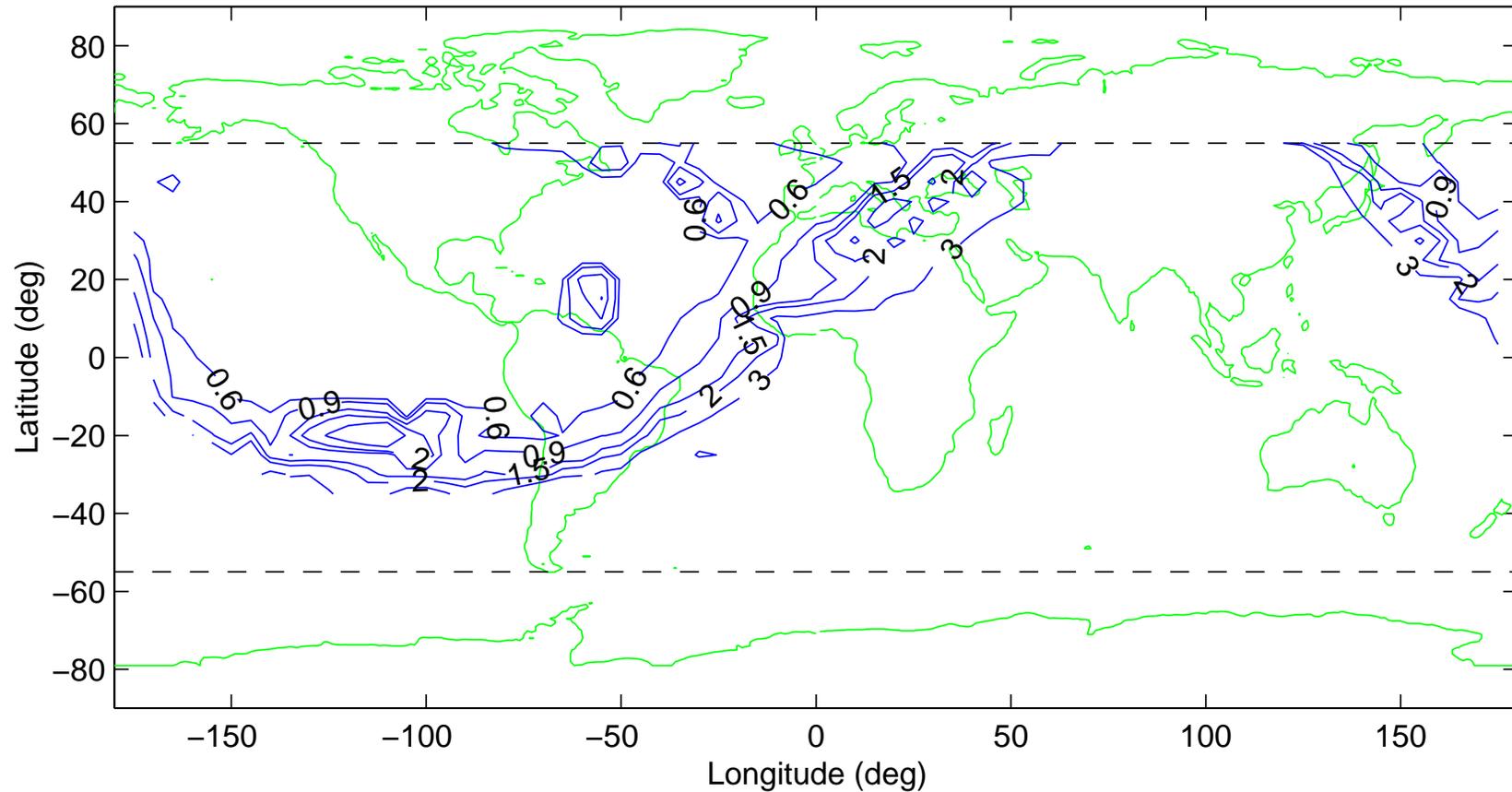- **Ionospheric**

NCVTT Accuracy

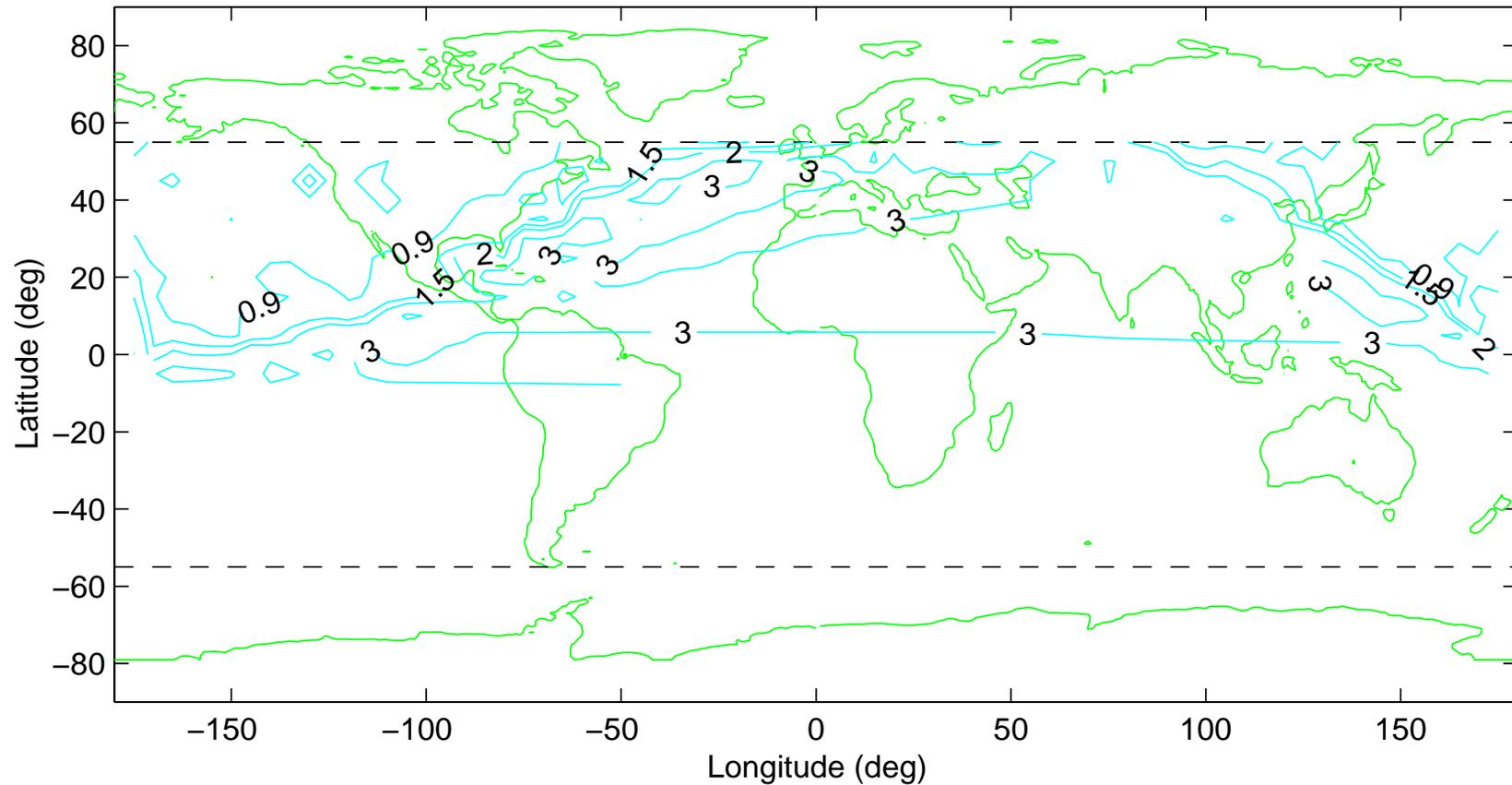Performance Common View Time Transfer Between ALaska WMS vs. CONUS WMS

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NCVTT Consistency

CVTT Δ SA of ALaska WMS vs. CONUS WMS

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99.9% UDRE : NSTB CONUS

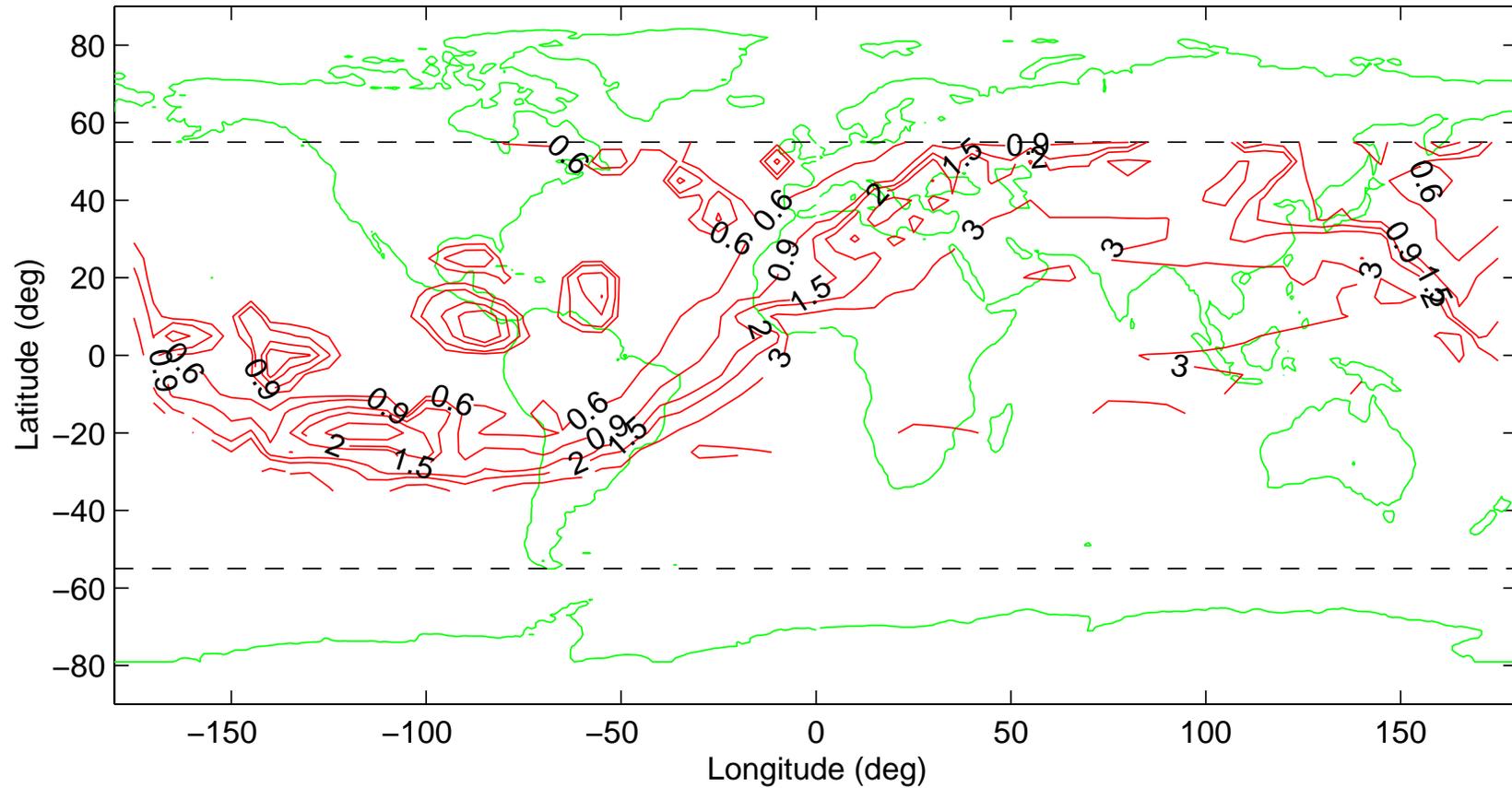**99.9% UDRE Map: NSTB CONUS Networks**

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99.9% UDRE : NSTB Alaska

99.9% UDRE Map: NSTB Alaska Networks
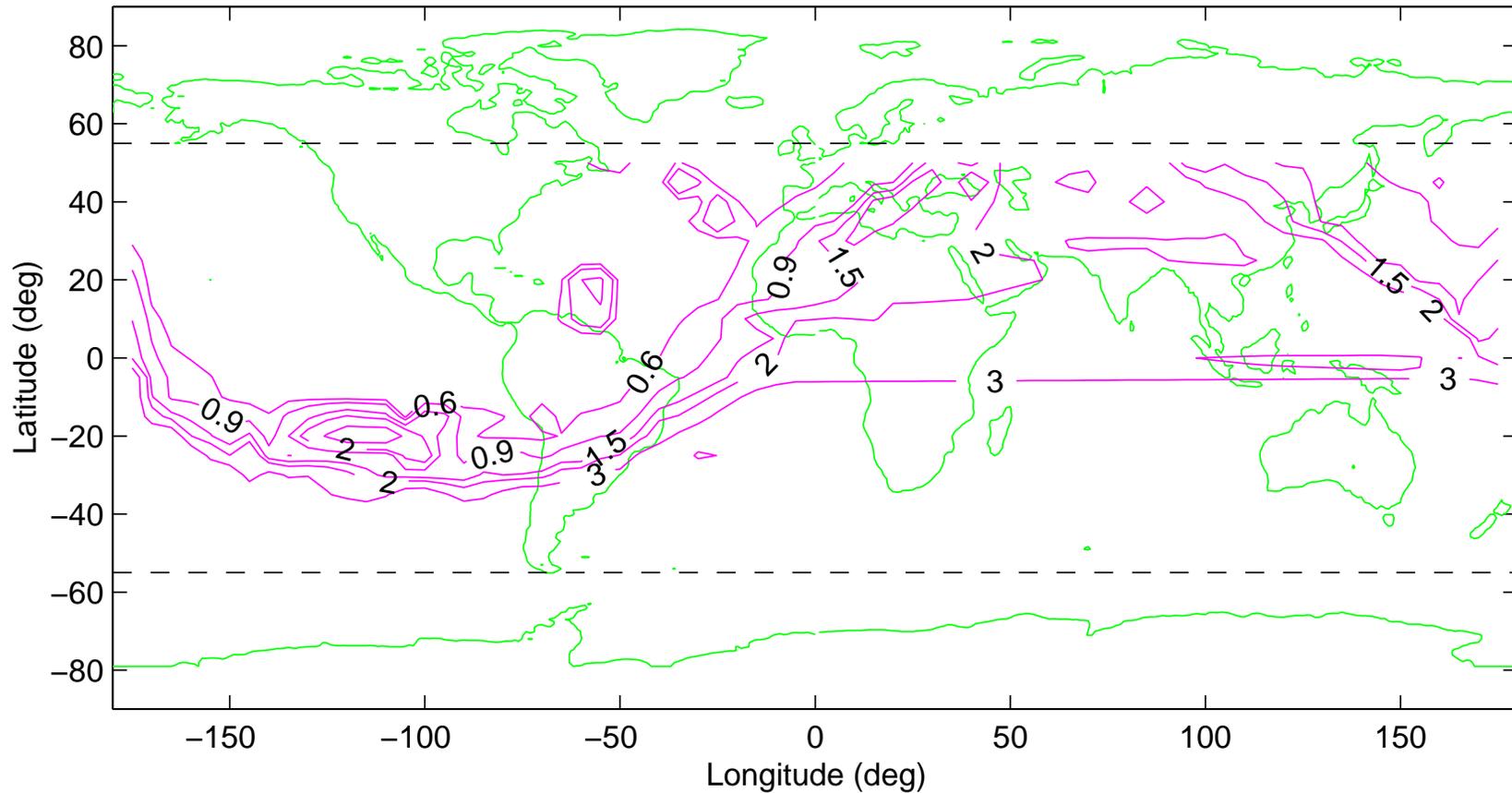

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99.9% UDRE : CONUS&Alaska

99.9% UDRE Map: NSTB CONUS & Alaska Networks
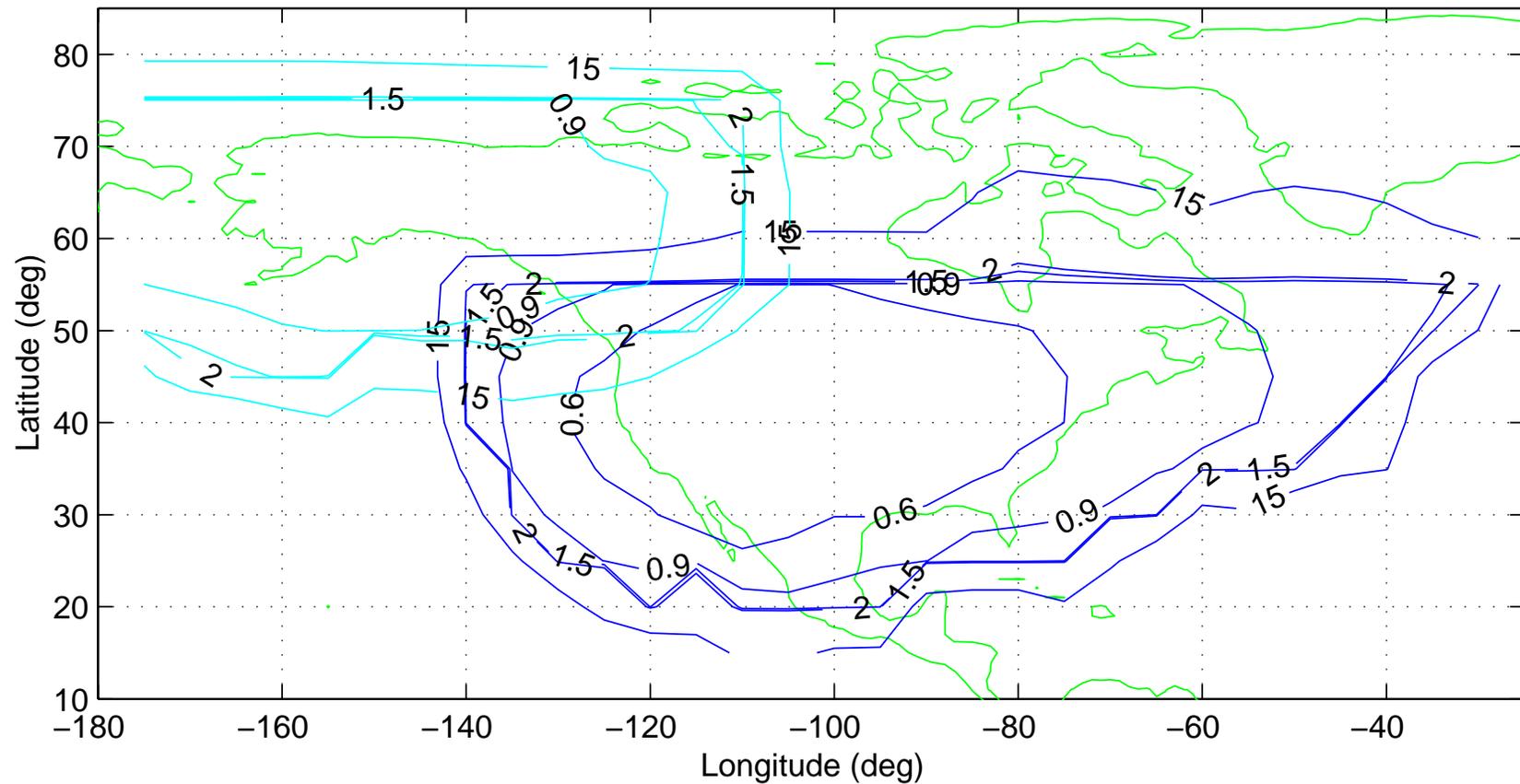

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99.9% UDRE : NSTB Integration
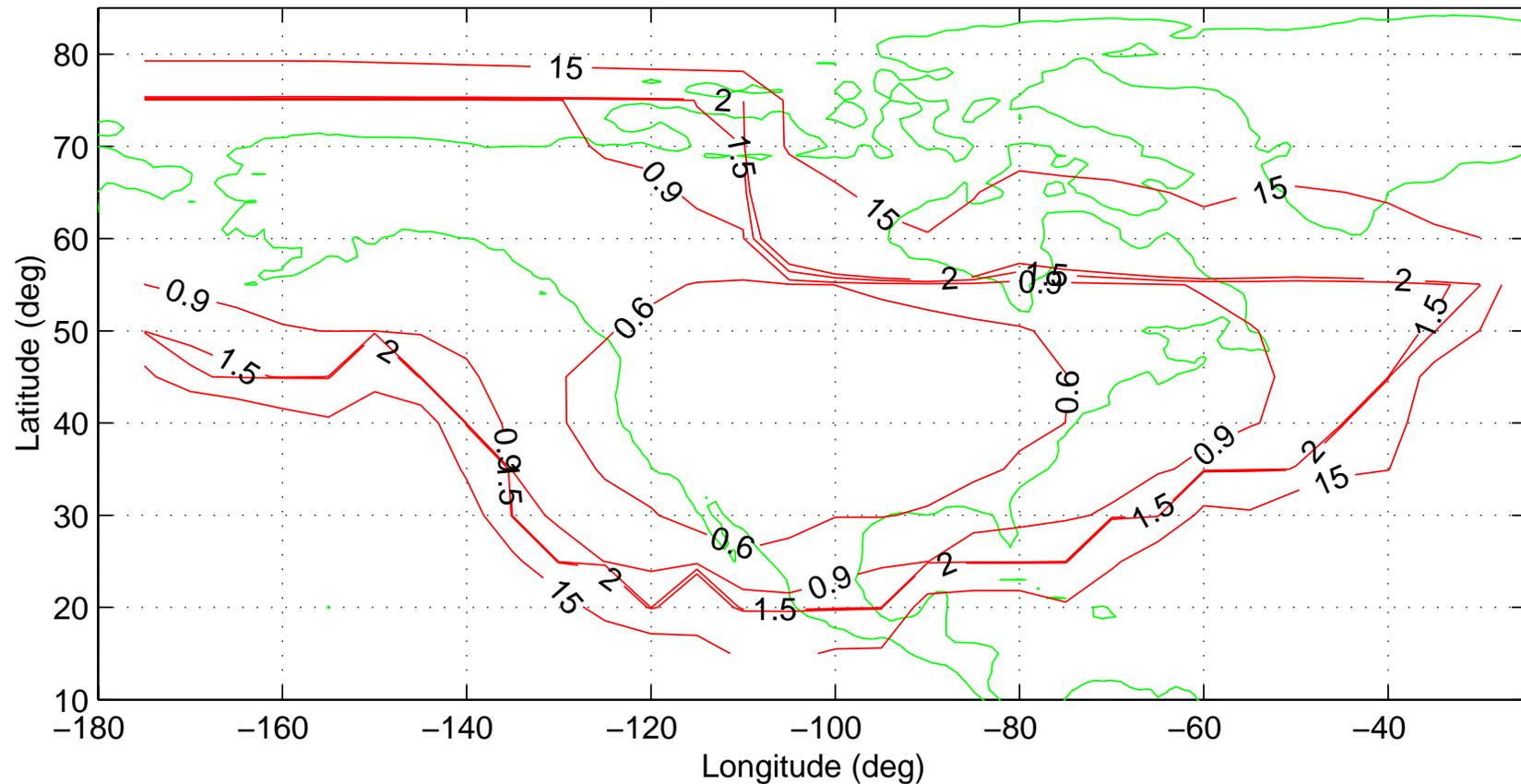
99.9% UDRE Map: NSTB CONUS/Alaska Networks

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99.9% GIVE : CONUS/Alaska

99.9% GIVE Contour: NSTB CONUS/Alaska Networks

Donghai Dai

STANFORD WAAS LAB

99.9% GIVE : CONUS&Alaska

99.9% GIVE Contour: NSTB CONUS&Alaska Networks

Donghai Dai

99.9% GIVE : NSTB Integration

99.9% GIVE Contour: NSTB CONUS/Alaska Networks (Correction Level Integration)

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