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of Transportation

Research and
Innovative Technology
Administration

Nationwide Differential Global Positioning System (NDGPS) Status

Presentation to:

**48th Civil GPS Service Interface Committee
(CGSIC) Meeting**

ION GNSS 2008

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Bottom Line

- **Inland NDGPS recognized as a national utility; manage as a Combined DGPS**
- **DOT to Continue NDGPS Operations**
 - Inland system at risk due to deferred equipment recapitalization
 - FY09 inland O&M remains underfunded
- **Assessment affirmed mission requirements for inland NDGPS**
 - Operational Requirements (DOT, USDA, DOI, DOC, and their stakeholders)
 - Research Requirements
 - No other GPS augmentation meets real-time terrestrial accuracy requirements



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System Operations

- **Operated/managed by USCG/NAVCEN as a joint system with Maritime DGPS**
- **Extension of Maritime DGPS**
 - Corrections broadcast at 285 and 325 kHz using Minimum shift Keying (MSK) modulation
 - Real-time differential GPS corrections provided in Radio Technical Commission for Maritime Services (RTCM) SC-104 format
 - No data encryption
 - Real-time differential corrections for terrestrial mobile and static applications
 - Single coverage on the ground over 92% of CONUS; double coverage over 65% of CONUS



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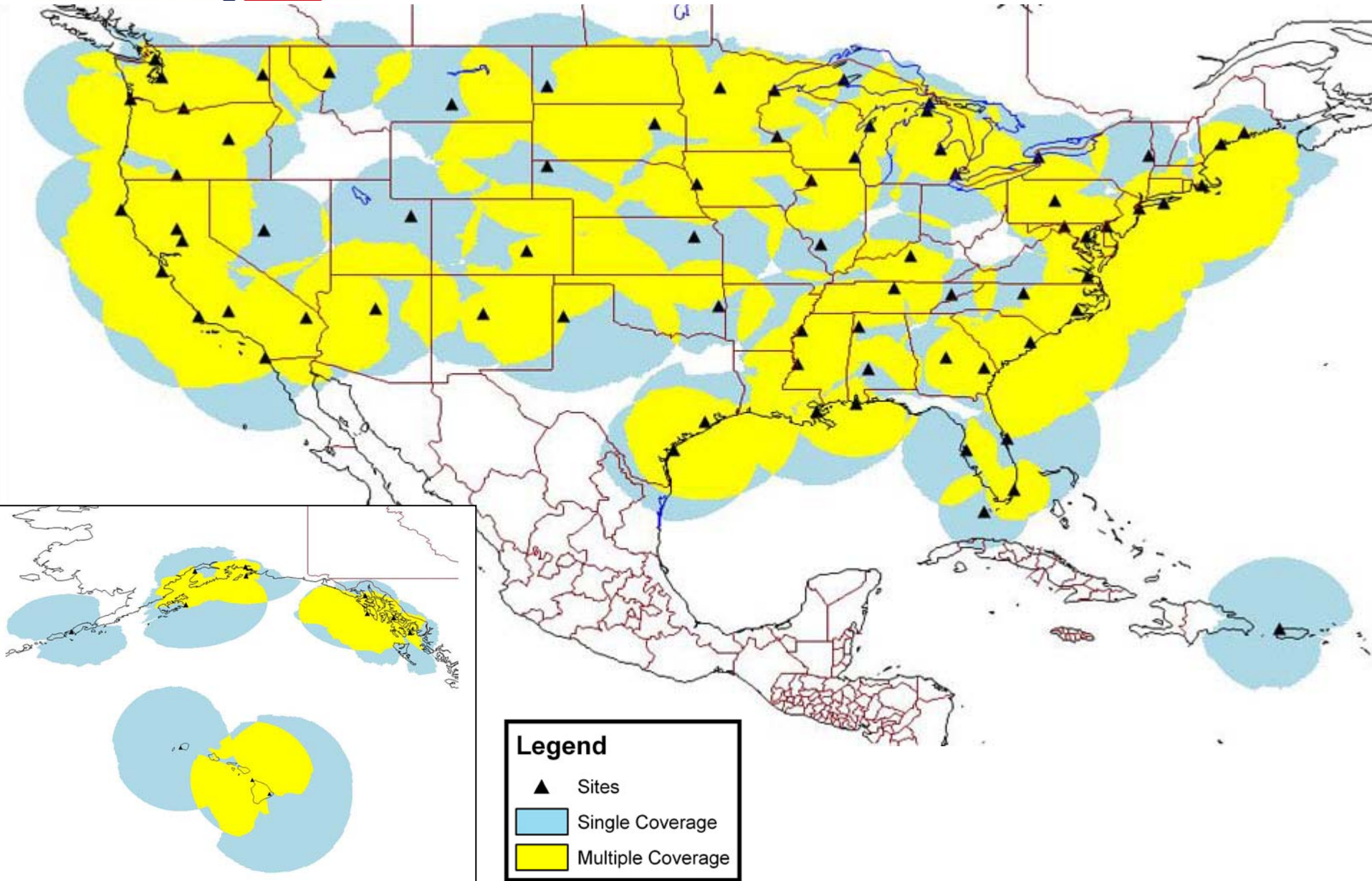
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System Characteristics

- **From the *Federal Radionavigation Plan***
 - Accuracy: < 1 meter at broadcast site
 - *Degrades at an approximate rate of 1 meter for each 150 km distance from site*
 - *Typical user equipment achieves 1-2 meter horizontal accuracies throughout the coverage area, in real time*
 - *High-end user equipment achieves accuracies better than 1 meter, real time*
 - Availability: 99%+
 - Integrity: alarm within 6 seconds; site monitors
 - Fix rate: 1-20 per second, three dimensional



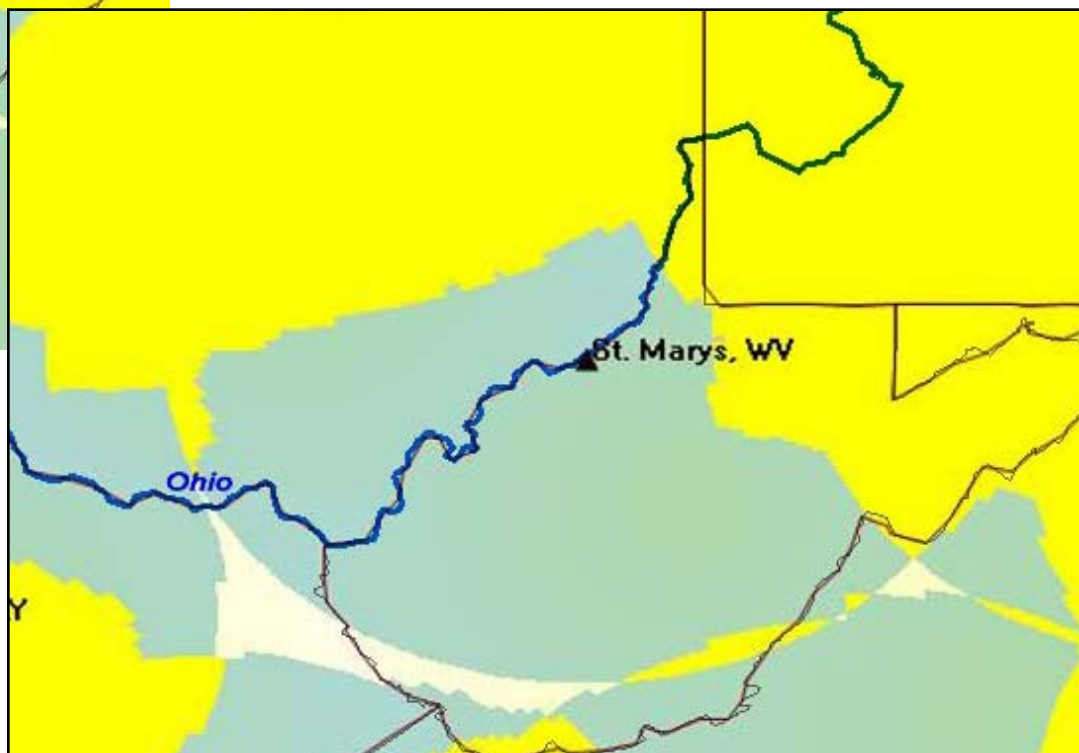
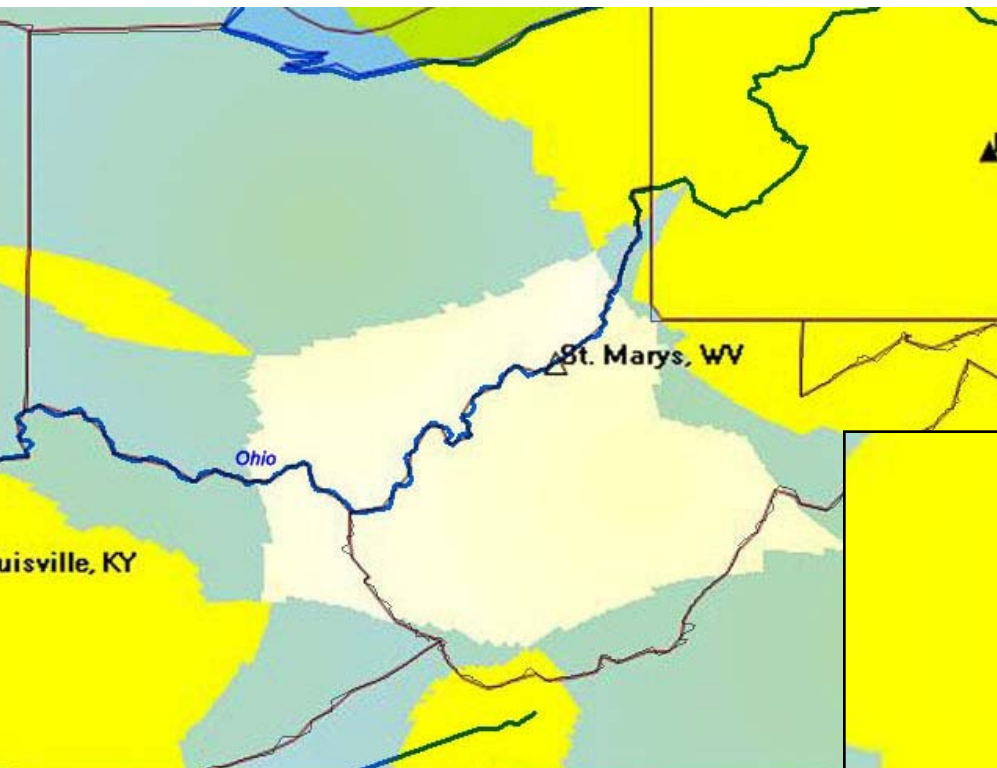
Combined DGPS Coverage Today





Work in Progress – St. Mary's, WV

- **Fills large coverage gap on Ohio River**





CORS Supports Precise Positioning

Before CORS:

**Accurate differential GPS positioning
with multi-person field crew.**



After CORS:

**Accurate differential GPS positioning
with one-person field crew.**

- **M/NDGPS sites are ~15% of CORS stations**
- **Provides “robust backbone”**

Current Highway Applications

- Surveys: **Land, roads, hydrological and environmental location, and management and maintenance**
- Inventory and asset management: **Infrastructure asset location, assessment, management, maintenance and protection**
- Utilities: **Location, management, and maintenance**
- Roadside management: **Precision application of pesticides, runoff minimization, avoidance of protected species, roadside features (condition and location)**
- Law Enforcement: **Incident location and reporting, emergency response.**
- **Similar applications in use for Federal/state/local/private/university resource and environmental management missions and research**

Precision Agriculture



- **Maximize use of resources**
 - Optimized plowing of crop rows
 - Tailored applications of seeds, fertilizer, water, pesticides
 - Improved management of land, machinery, personnel, time
 - Greater crop yields
- **Minimize environmental impacts**
 - Localized identification and treatment of distressed crops reduces chemical use
 - Precise leveling of fields prevents fluid runoff



This grain combine can be outfitted with a GPS receiver, yield monitor, and electronic sensors to track crop production based on location. These data can be transferred to a geographic information system to create a yield map and subsequently used to analyze the field and make site-specific management decisions.



**US Army Corps
of Engineers®**

DGPS in Dredging

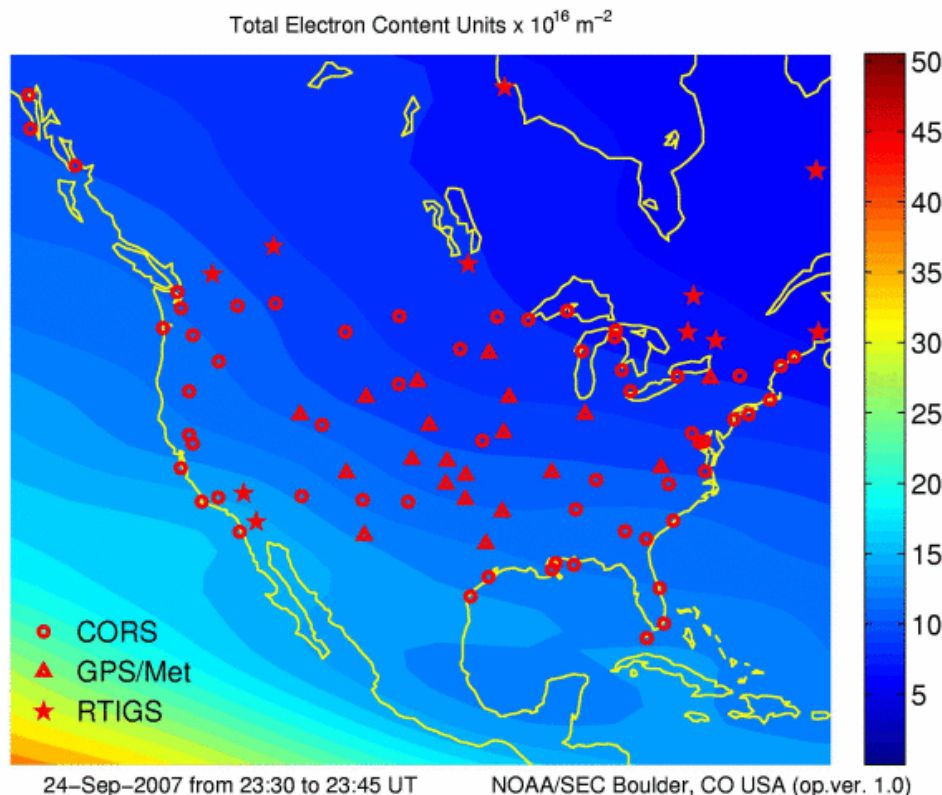
- **Army Corps of Engineers requires 2 meter accuracy to position dredges**





Monitoring Space Weather

- NOAA's Space Weather Prediction Center uses M/NDGPS data to map the spatial distribution of free electrons in the ionosphere, once every 15 minutes



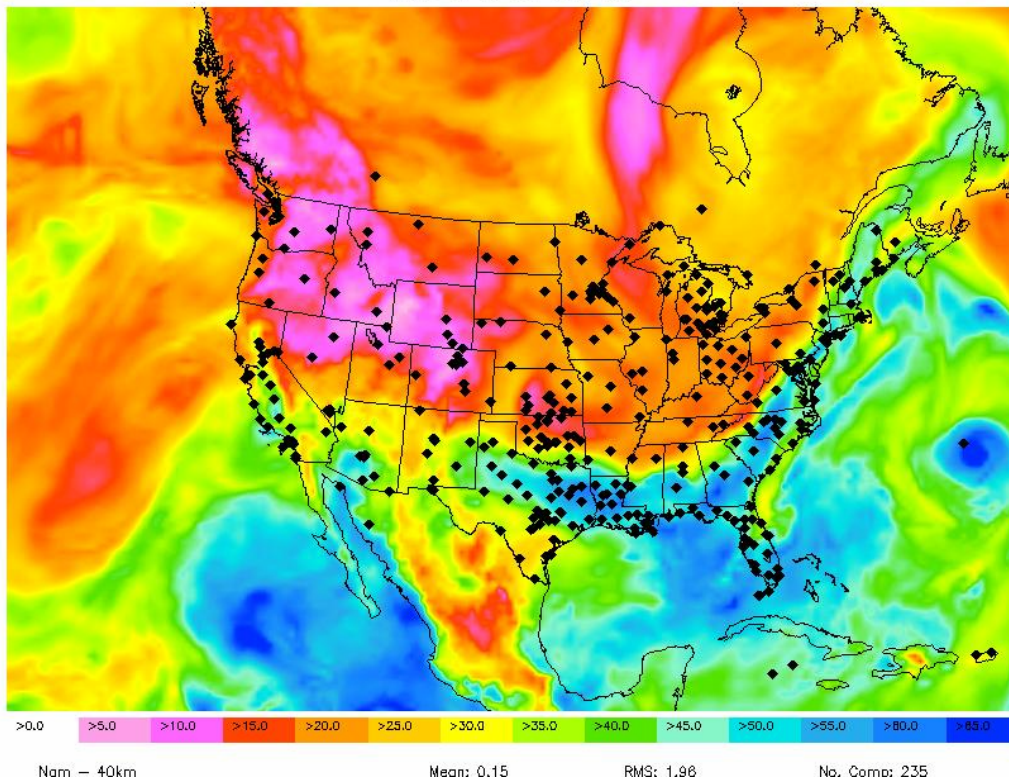
➤ The distribution of free electrons in the ionosphere affects HF radio communication and delays the arrival of GPS signals that is interpreted as position errors, which can be as large as 100 meters in extreme cases



Monitoring Atmospheric Moisture

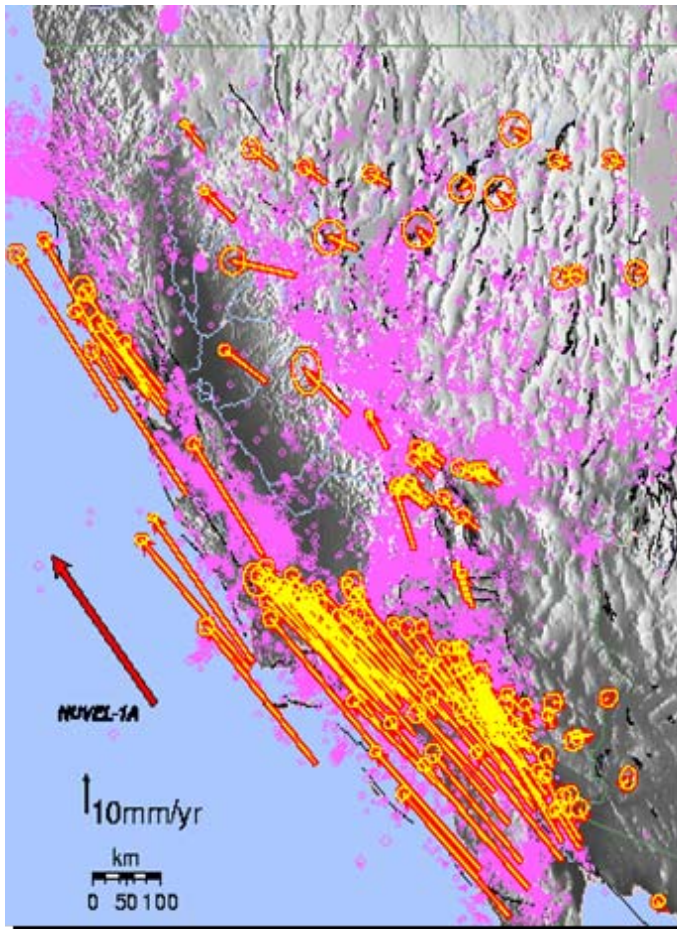
- **NOAA's Earth Systems Research Laboratory uses M/NDGPS data to estimate the amount of water vapor over the U.S. every 30 minutes**

NAM - 40 km Analysis
Valid: 14-Jul-08 12:00 UTC



- Used in several operational NOAA weather models
- Used by weather forecasters to monitor rapidly changing conditions
- This knowledge is critical for forecasting severe weather events such as tornados, hurricanes, thunderstorms, and snow storms

- Non-profit organization
- Measures plate movement and deformation to the millimeter level using precise geodetic GPS equipment





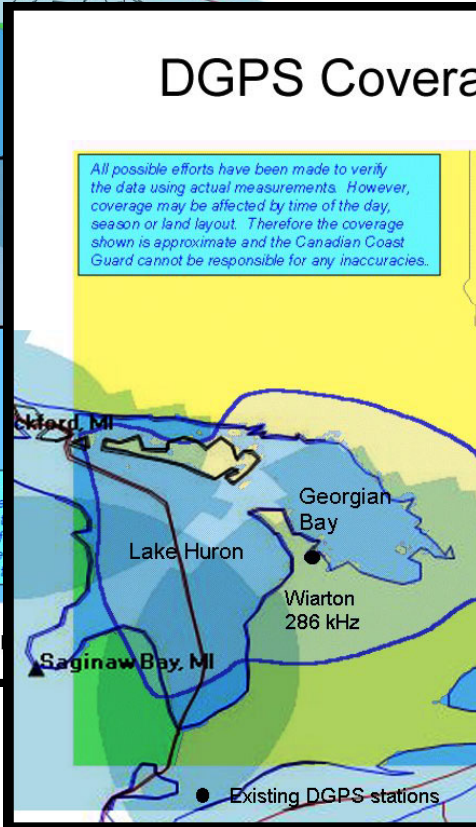
Cooperation with Canada

- 16 U.S. and 11 Canadian DGPS sites cooperate for increased coverage along the border

DGPS Coverage - Pacific Region



DGPS Coverage - Central Region



DGPS Coverage - St. Lawrence Seaway

