
Satellite Weather Information Service

November 2002 Update
NASA WxAP Review

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**Rockwell
Collins**

Agenda

- Purpose and Effort
- Team Members
- Space Segment and Geographical Coverage
- Aircraft Configurations
- Data Routing and Timing
- Weather Graphics
- Future Possibilities

Purpose and Effort

o Purpose :

- Provide updated graphical weather to air transport aircraft while enroute where there is no ground support infrastructure.
- Improve flight safety, reduce fuel burn, improve time enroute.

o Efforts:

- Trials both on test and revenue service aircraft
- Verify commercial benefits and technology feasibility

Team Members

**Rockwell
Collins**

- Rockwell Collins
 - File Server, Displays, Receivers, Antennas, Wireless LAN, Integration, STC.



- WorldSpace Corporation
 - Satellite Channel, Receiver Card, Ground Station Feed



- Jeppesen
 - Weather Products & Laptop Software

American Airlines®

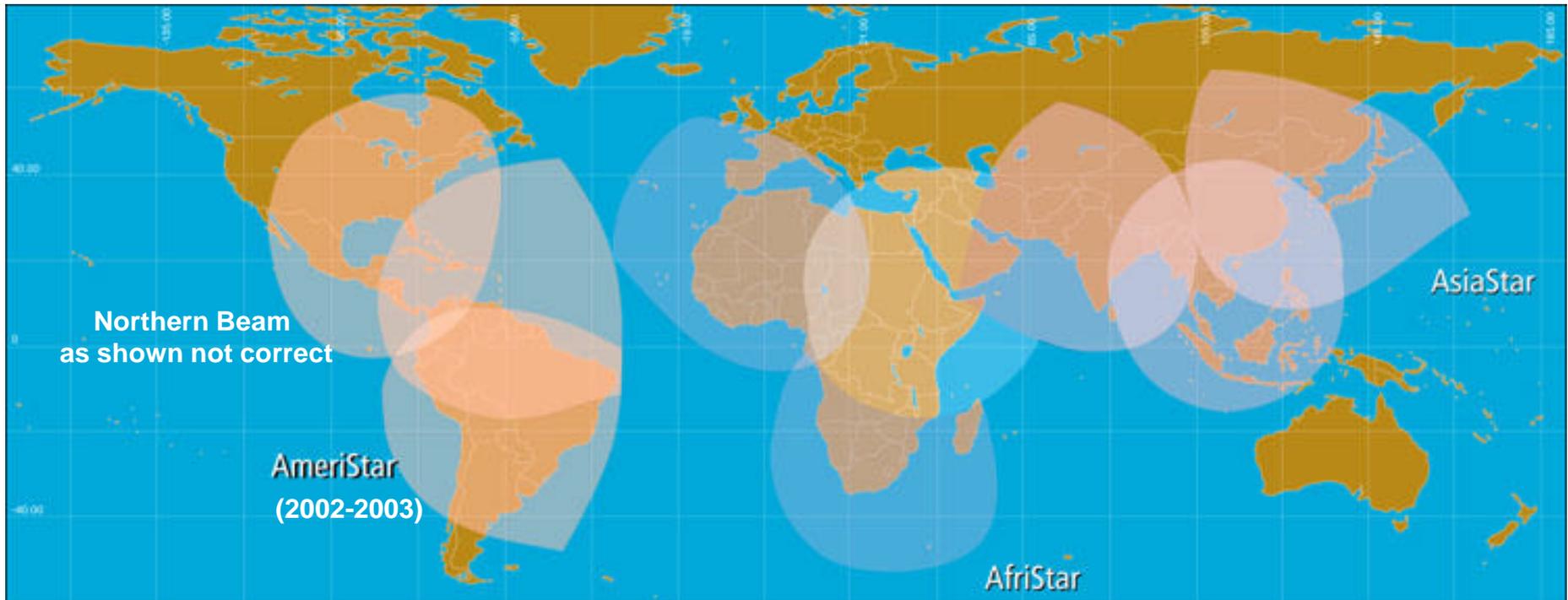
- American Airlines
 - STC Installation Support, Flight Test and Evaluation

NASA

- NASA
 - Support

**Rockwell
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WorldSpace Coverage Areas



(NOTE: AmeriStar footprint shown pending frequency coordination outcome)

- 80 percent of the world's population
- 120 countries
- 3 continents

The WorldSpace Receivers



Program Phases

- Phase 1. Verified that geostationary satellite can provide a sufficient signal level to aircraft using a fixed pattern antenna.
 - Trials in South Africa in September, 1999
 - Cessna 182 aircraft, Afristar satellite
- Phase 2. Validated the usefulness and pilots preferences of real time weather data
 - Routes to the Pacific rim May 2001 to Feb 2002
 - American Airlines B777-200, Asiastar satellite

Phase 1 System

WorldSpace
AfriStar at (21° E)

WorldSpace Johannesburg (ROC)
Regional Operations Center



Uplink Equipment



Transmission PC



X-Band

L-Band

Patch Antenna



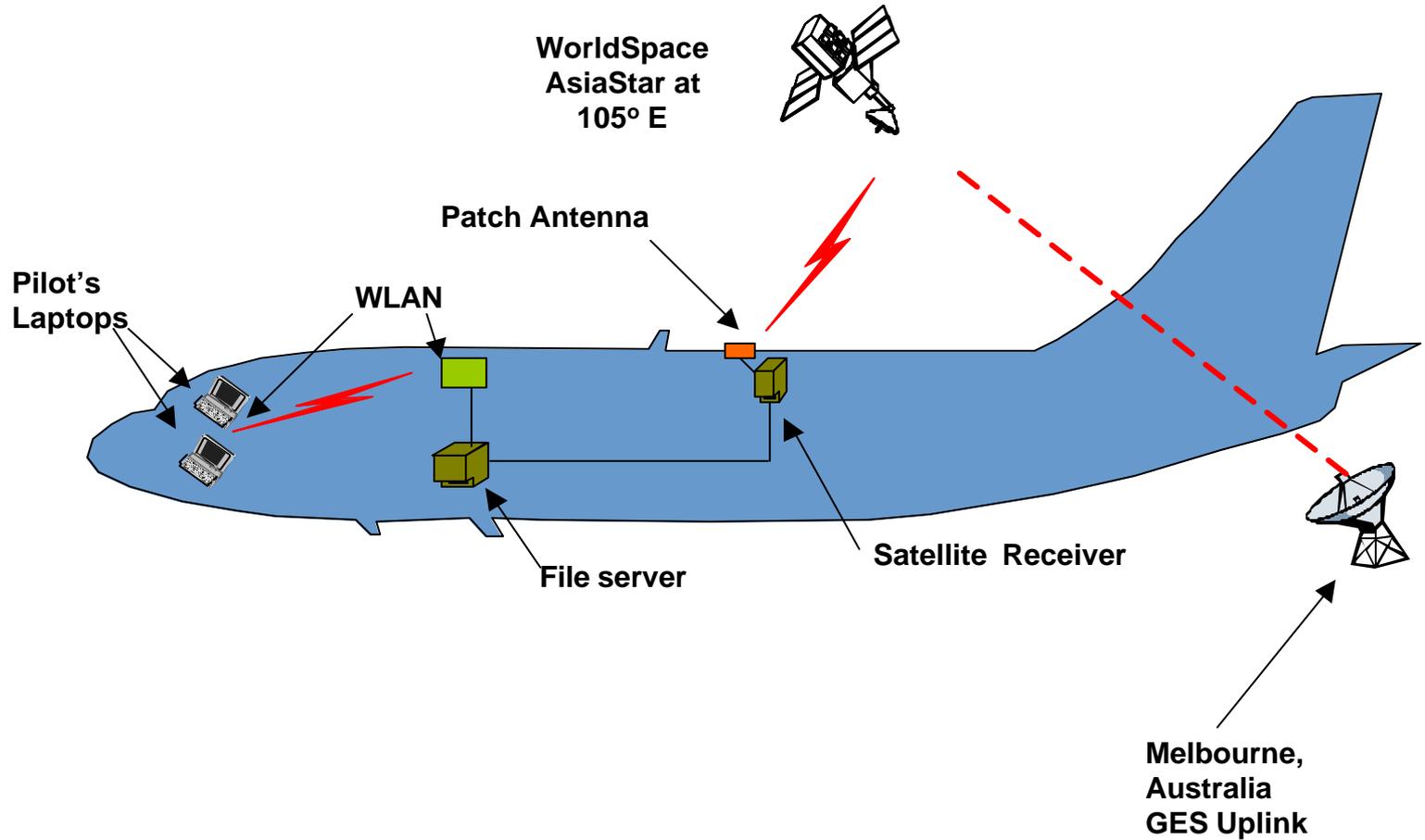
C-182 Test Aircraft

Phase 2 Aircraft Elements

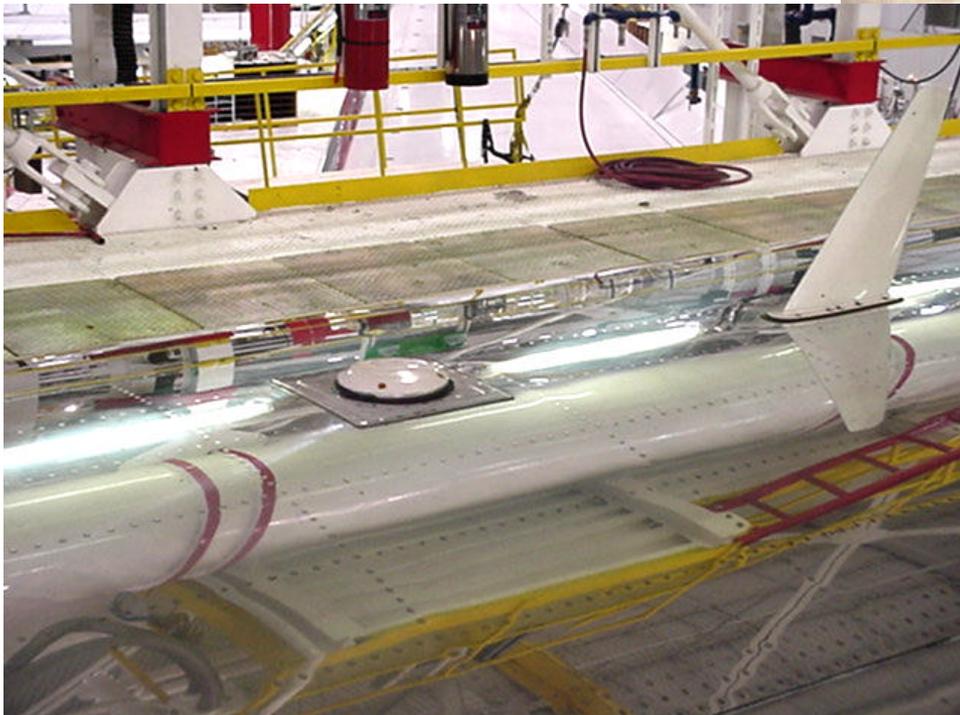
- Systems installed on two American Airlines B777-200 **in revenue service**. STC approved by FAA. System includes:

- Patch antenna,
- Satellite receiver,
- File Server Unit (FSU),
- Avionics Secure Interface Unit,
- Wireless LAN network and
- Pilot laptop computers
- Jeppesen Flight Star Software

Phase 2 Configuration



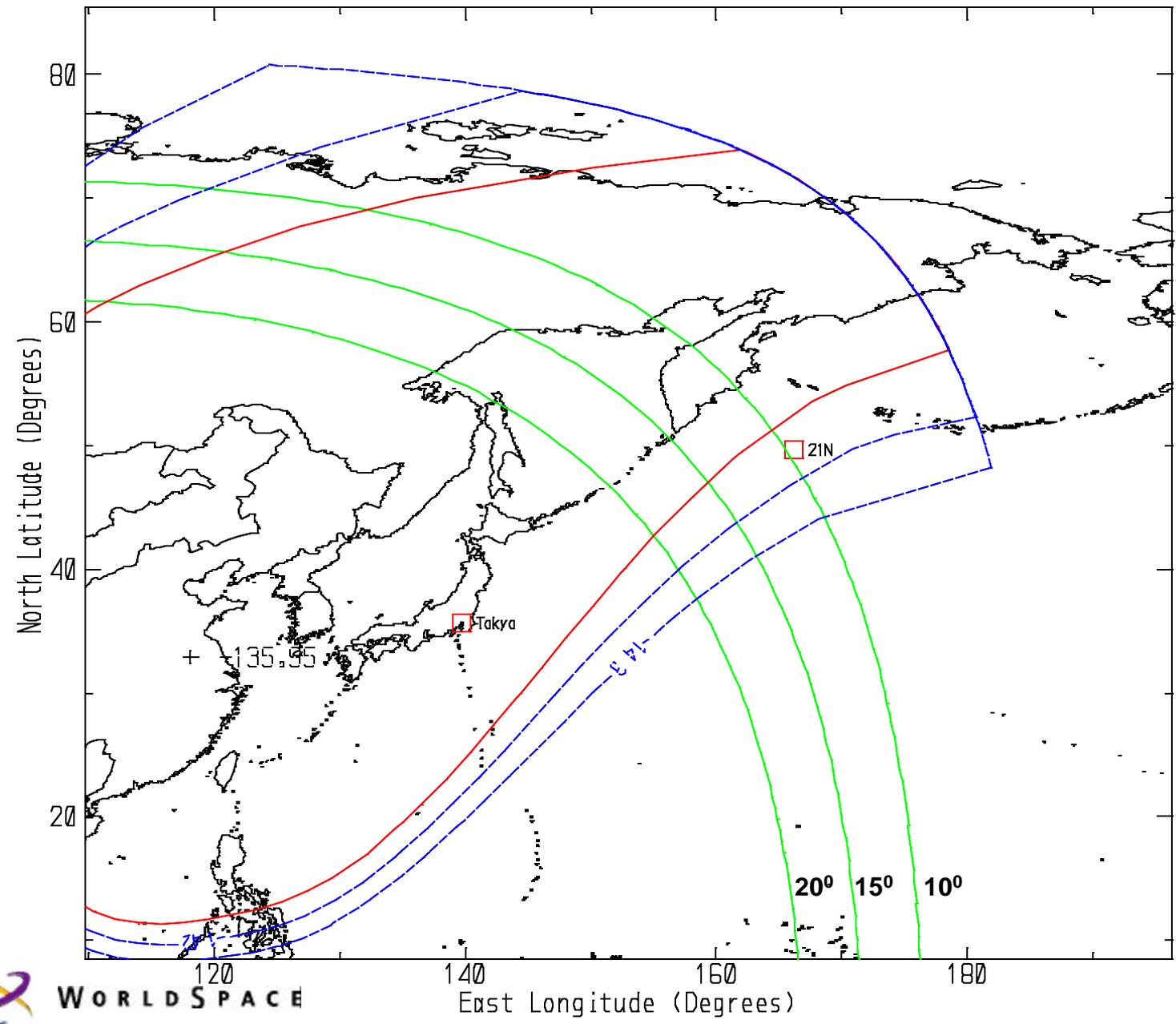
B777 Antenna and Receiver Installation



Route Coverage

- B777-200 aircraft scheduled for all long haul routes for American Airlines, not just transpacific routes.
 - City pairs where system was used include:
 - Chicago, Dallas, San Jose CA to and from:
 - Narita, Osaka and Taipei.
- System provides coverage using NE Asiastar Beam
 - Coverage initiated SW of Aleutian Islands (WP 21N)

SWIS: Data Reception Near Kamchatka Peninsula



Initial reception at waypoint 21N.

Center of Beam over China at + mark as indicated

Data Routing

- Jeppesen generated weather graphics at scheduled intervals at Los Gatos, CA.
- Graphics were encoded and sent to WorldSpace Ground Earth Station in Melbourne, Australia via Internet FTP.
- Melbourne GES uplinked each file to satellite 3 times at short intervals.
 - Data embedded in TDM composite audio
- Satellite broadcast data at 64 Kbits/second.

Data routing (cont'd)

- Satellite receiver recovered files, checked data validity and transferred good files to File Server Unit (FSU) for storage.
- FSU managed data files and made files available to pilot via WLAN on aircraft.
 - FSU maintained aircraft position and time.
- Time delay from Jeppesen to Aircraft was less than 60 seconds.
 - Satellite typical transmission time - 2.5 to 5 seconds

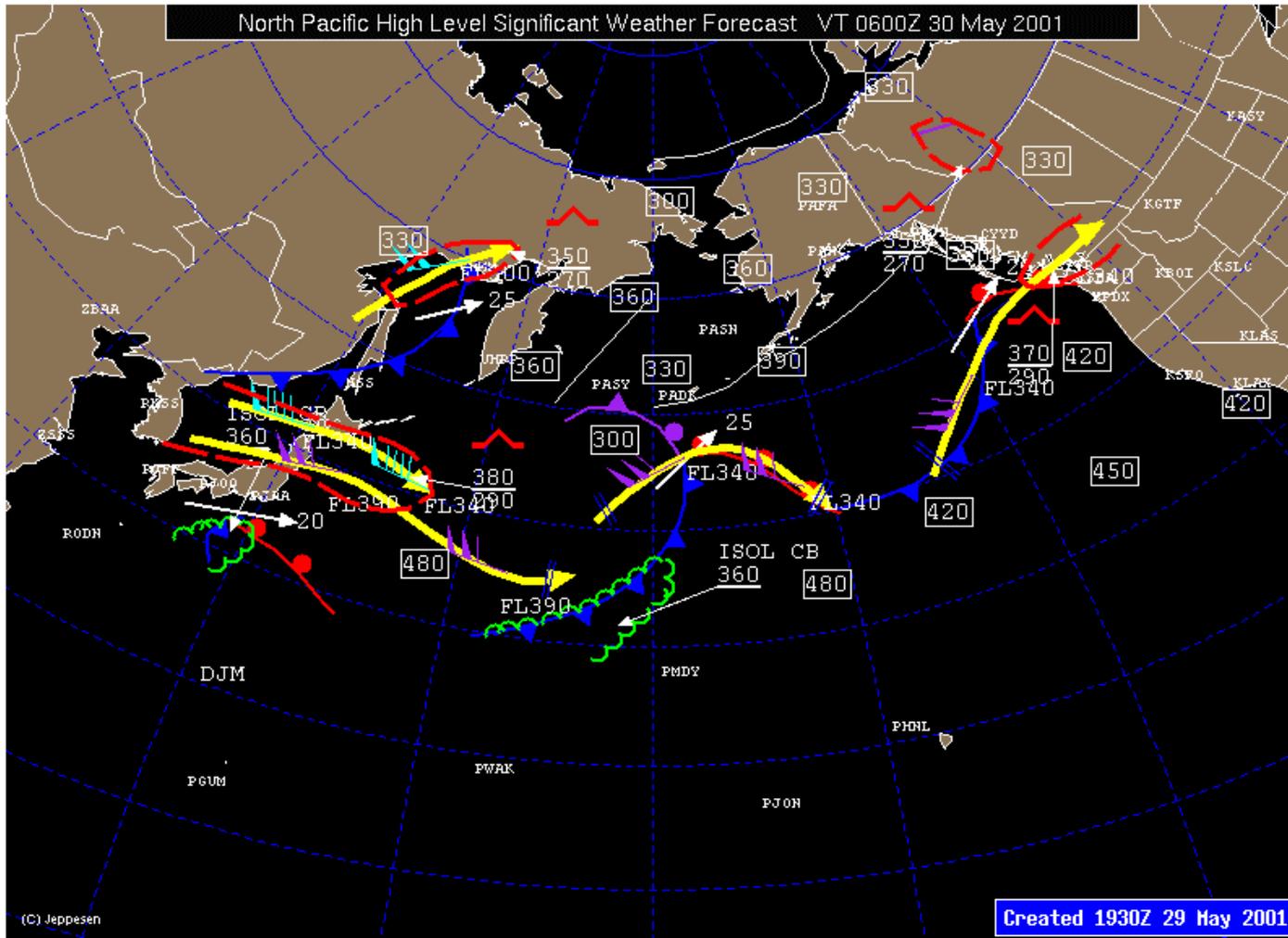
Weather Graphics

- Winds and Temperatures aloft
 - **Flight Levels 050 through 450**
- Surface Weather (Ceiling, Winds and Visibility)
- Hi-level Significant Weather
- Visible and Infra Red satellite imagery
- Surface Analysis

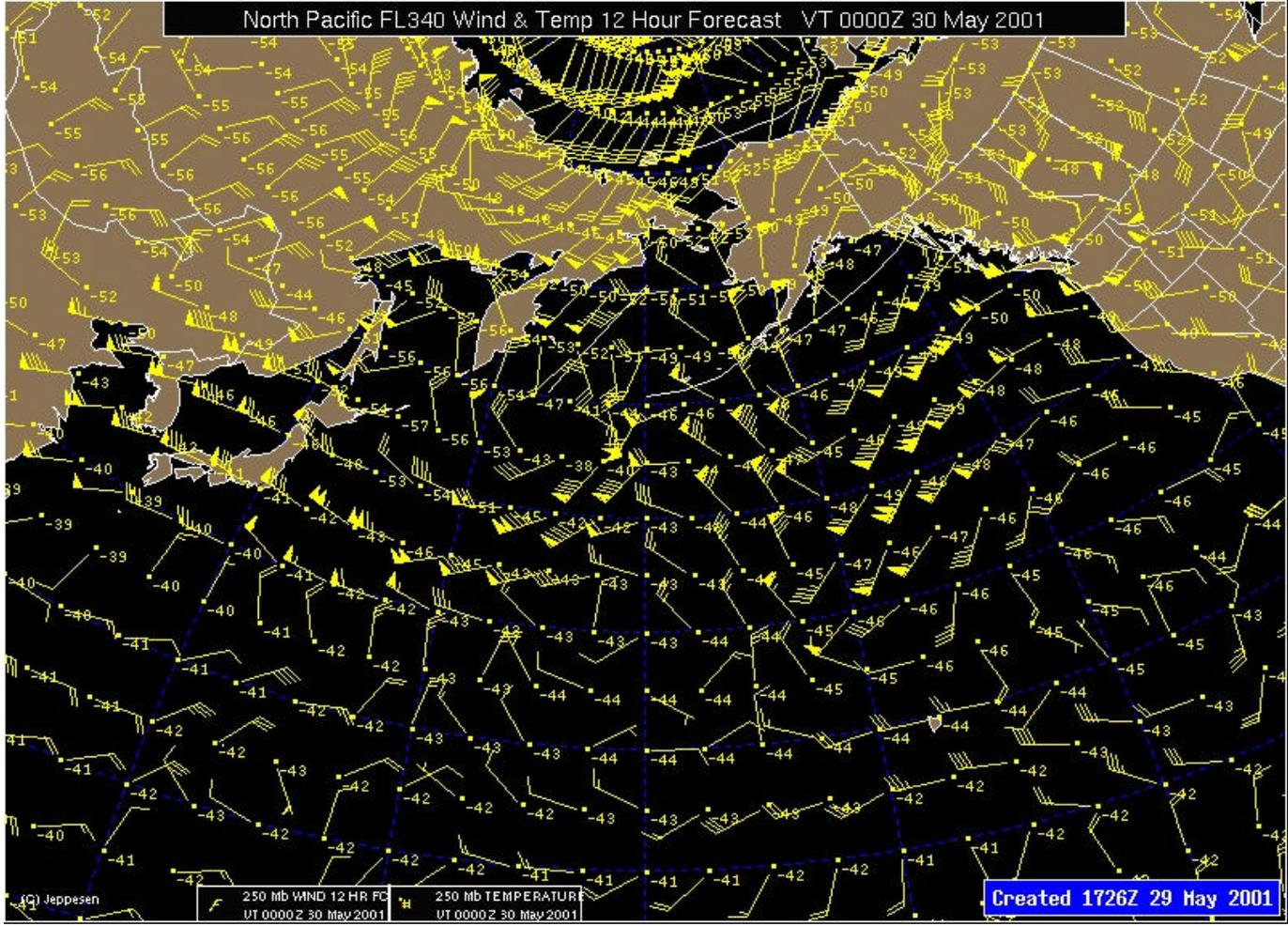
Weather Graphics

- Update rate varied from once per 30 minutes to once per 6 hours
 - **Specific to type of graphic**
- All weather graphics have track file and aircraft position overlays, zoom capability.
- Detailed geographic features and airport diagrams could be inserted by pilots as needed.
- File server provided “time lapse” weather movement graphics as called for by pilots

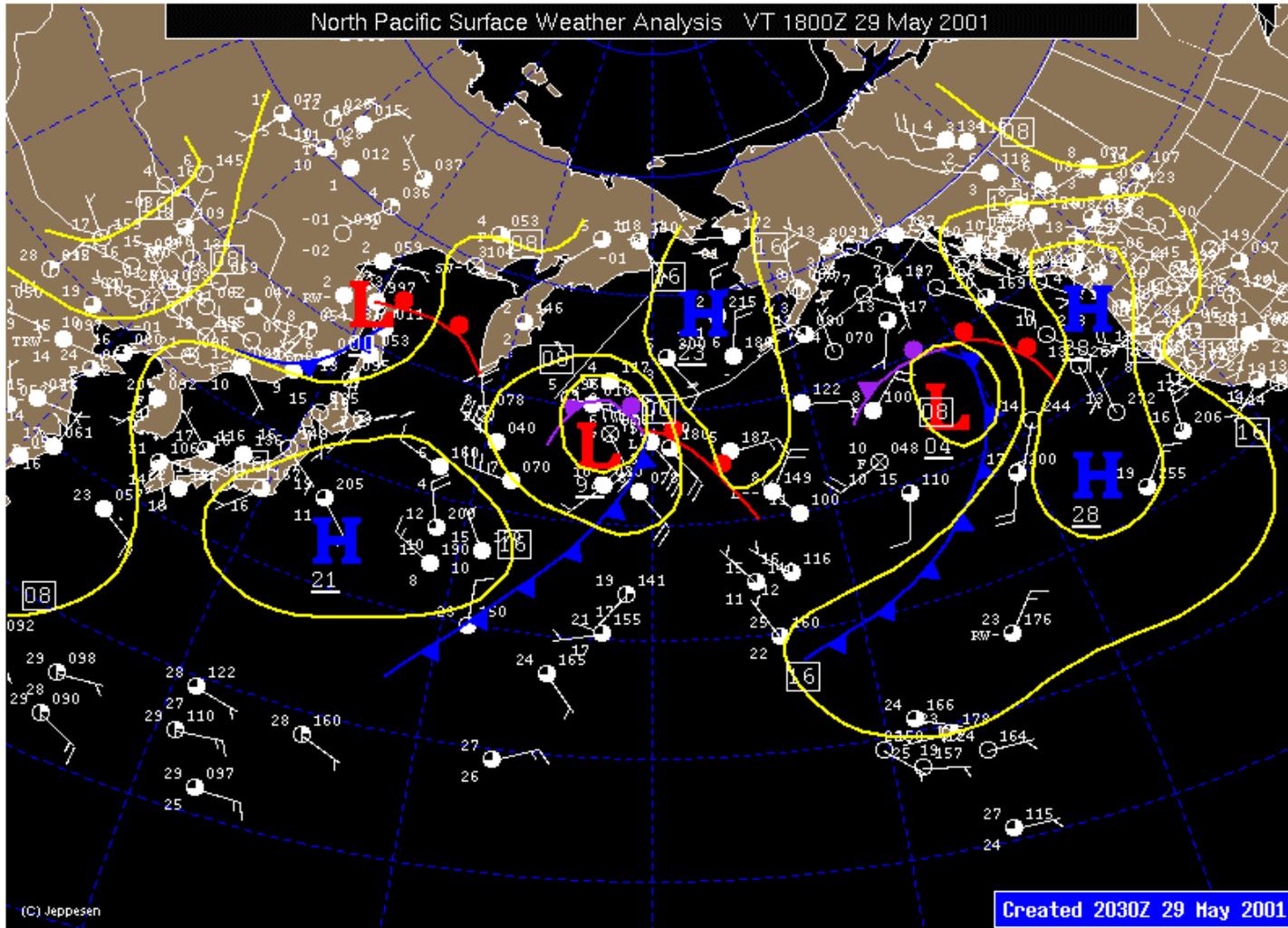
N. Pacific High Level Significant WX



N. Pacific Winds, FL 340



Surface Analysis



Results

- Signal coverage initiated 1600 miles East of Narita.
 - Elevation angle, 10 degrees above aircraft horizon
 - Signal reception, very reliable and dependable
- Pilots reaction to the system was very favorable.
 - System provided up-to date information
 - Pilots on occasion made in-flight route changes to avoid poor weather.
 - Pilots requested CONUS information to the weather downlink to aid flights returning to the US.
- Updates averaged 12 new graphics each hour.

Future Possibilities

- Provide Additional Geographical Coverage
 - Use other satellite systems, esp CONUS
- Maintain low cost system implementation options
 - Patch antenna
 - Receive Only capability needed
 - Use other graphical display devices
- Provide additional graphical weather information
 - GCD has global convection data in graphical form
- Distribute non-weather information