NMAP Development Status and Plans

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Computing Development Branch

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WHERE AMERICA'S CLIMATE AND WEATHER SERVICES BEGIN

AGENDA

- Computing Development Branch (CDB) mission

- NMAP customers
  - NCEP service center descriptions and product samples
  - Generic high-level requirements
- Overview of NMAP
  - NMAP capabilities
  - NCEP service center product creation scenario
- NMAP development approach
- Current and future projects
- Questions

CDB MISSION

PRIMARY MISSION:

- Develop meteorological workstation software to meet NCEP service center requirements, NCEP-AWIPS (NAWIPS)

  - Provide access to high resolution datasets

  - Provide meteorological analysis and display tools

  - Provide integrated product generation capabilities for current and future modernized products

- NMAP is an NAWIPS GUI application

NMAP CUSTOMERS

- NCEP service centers
  - Climate Prediction Center; Hydrometeorological Prediction Center; Ocean Prediction Center (Camp Springs, Maryland)
  - Aviation Weather Center (Kansas City, Kansas)
  - Storm Prediction Center (Norman, Oklahoma)
  - Tropical Prediction Center (Miami, Florida)

- NCEP supercomputer and Environmental Modeling Center

- NWS Alaska & Pacific regions

- NWS River forecast centers

- Unidata (~150 universities + private industry)

- Government labs (MDL, ARL, ...)

Aviation Weather Center (AWC)

The AWC provides high-level and low-level products to the aviation community that focus on wind forecasts and hazardous weather

| CATEGORY	GEOG DOMAIN	TEMP DOMAIN
Tactical:		
➢ Conv Sigmet	US	0 – 6 hours
➢ Sigmet, Airmet	US	0 – 4 hours
➢ Oceanic Sigmet	NY/OAK/HOU/MIA	0 – 4 hours conv,turb
	FIRS	0 – 6 hours volc ash, trop cyclone
Strategic:		
➢ High/Mid level sig wx	2/3 globe	24 hours
➢ Low level sig wx	US	12 & 24 hours
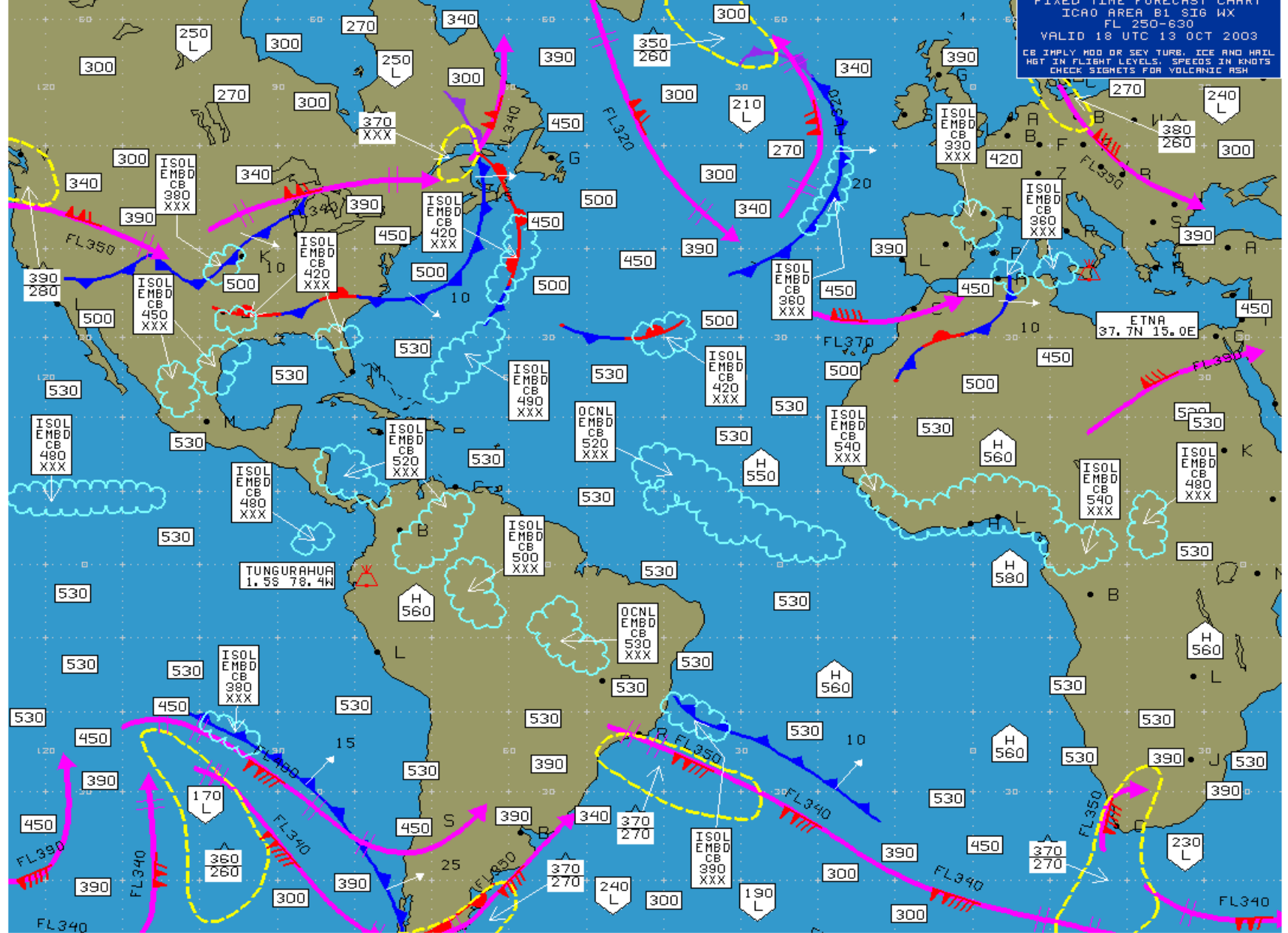
Climate Prediction Center (CPC)

The CPC provides a continuous watch on short-term climate fluctuations to diagnose and predict them

| CATEGORY	GEOG DOMAIN	TEMP DOMAIN
8-14 day forecasts	CONUS	5 day avg 8-14 days
30 day forecasts	CONUS, AH, HI	30 day avg
90 day forecasts	CONUS, AH, HI	½ –12 ½ months
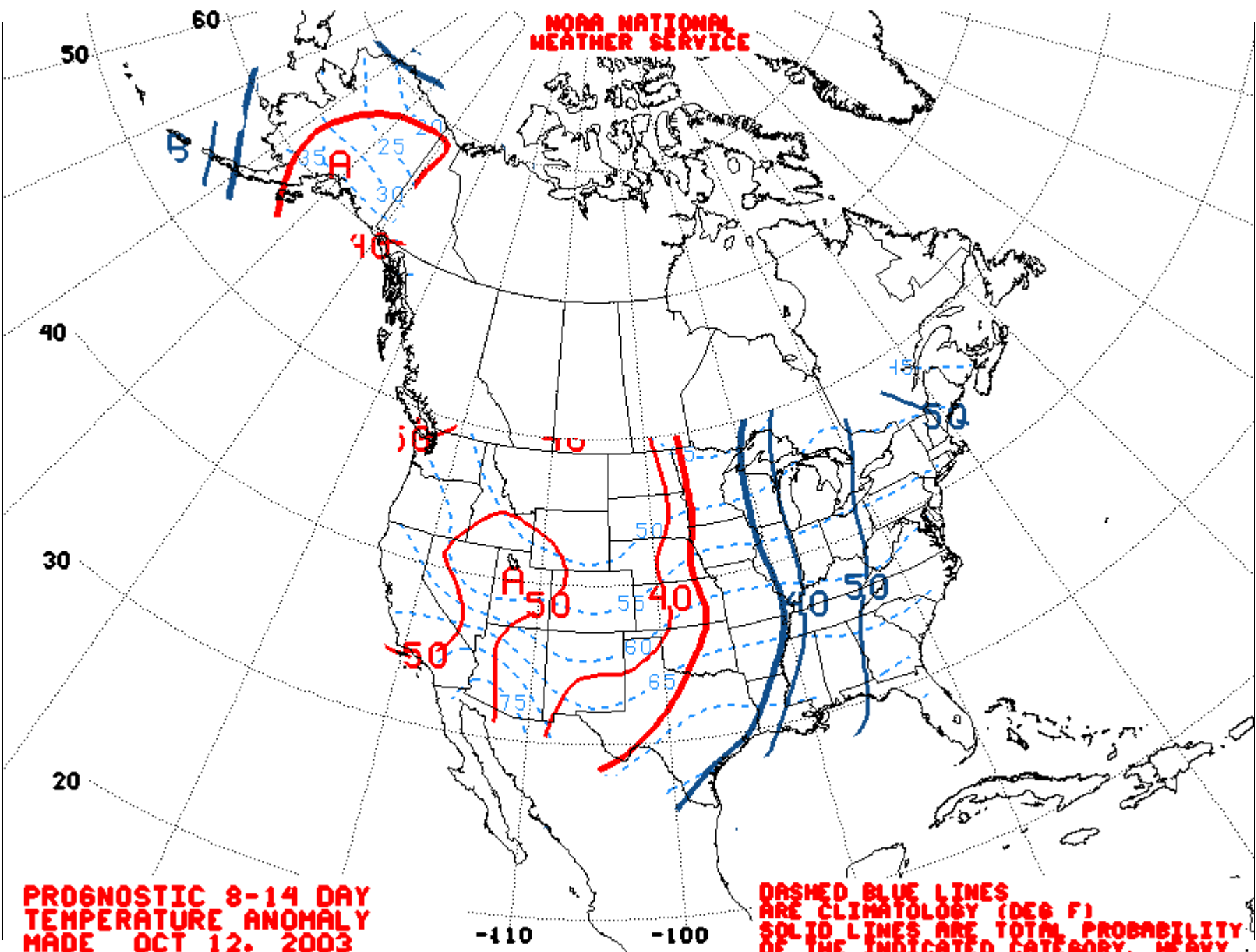
PROGNOSTIC 8-14 DAY
TEMPERATURE ANOMALY
MADE   OCT 12, 2003
VALID OCT 20 - 26, 2003

DASHED BLUE LINES
ARE CLIMATOLOGY (DEG F)
SOLID LINES ARE TOTAL PROBABILITY
OF THE INDICATED CATEGORY. HEAVY
SOLID LINES ARE 33.3% PROBABILITY

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The HPC provides a suite of Quantitative Precipitation Forecast (QPF) products, surface analyses, outlooks for heavy rain and snow, as well as guidance weather forecasts through seven days

CATEGORY	GEOG DOMAIN	TEMP DOMAIN
QPF	US	
➢ Liquid		0 – 72 hours
➢ Solid (snow & ice)		0 – 48 hours
Short Range	US	0 – 48 hours
Medium Range	US	3 – 7 days
SFC Analyses	N. America	Analysis
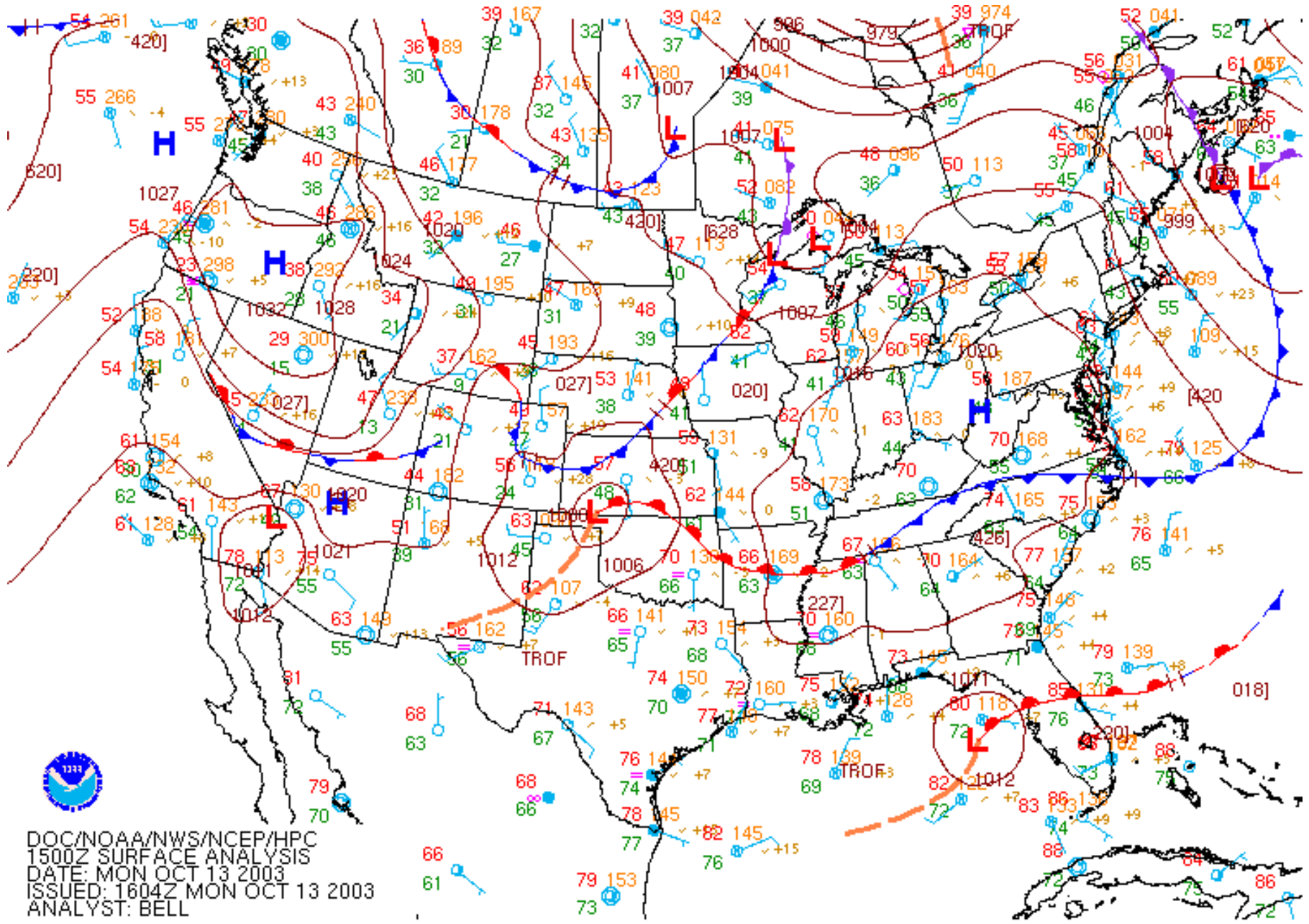
DOC/NOAA/NWS/NCEP/HPC
1500Z SURFACE ANALYSIS
DATE: MON OCT 13 2003
ISSUED: 1604Z MON OCT 13 2003
ANALYST: BELL

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Ocean Prediction Center (OPC)

The OPC issues forecasts and warnings for the Atlantic and Pacific Oceans, north of 30 degrees north.

CATEGORY	GEOG DOMAIN	TEMP DOMAIN
Regional Offshore	West Atlantic East Pacific	0 – 5 day
High Seas	Atlantic & Pacific, Gulf of Mexico, Caribbean Ocean Basins	0 – 5 day

48-HR WIND & WAVE FCST (METERS)
FROM: 12 UTC 12 OCT 2003
VALID: 12 UTC 14 OCT 2003
FCSTR: SHAW

SIGNIFICANT WAVE HEIGHT IS SHOWN
[THE AVERAGE HEIGHT OF THE
HIGHEST ONE-THIRD OF THE WAVES]
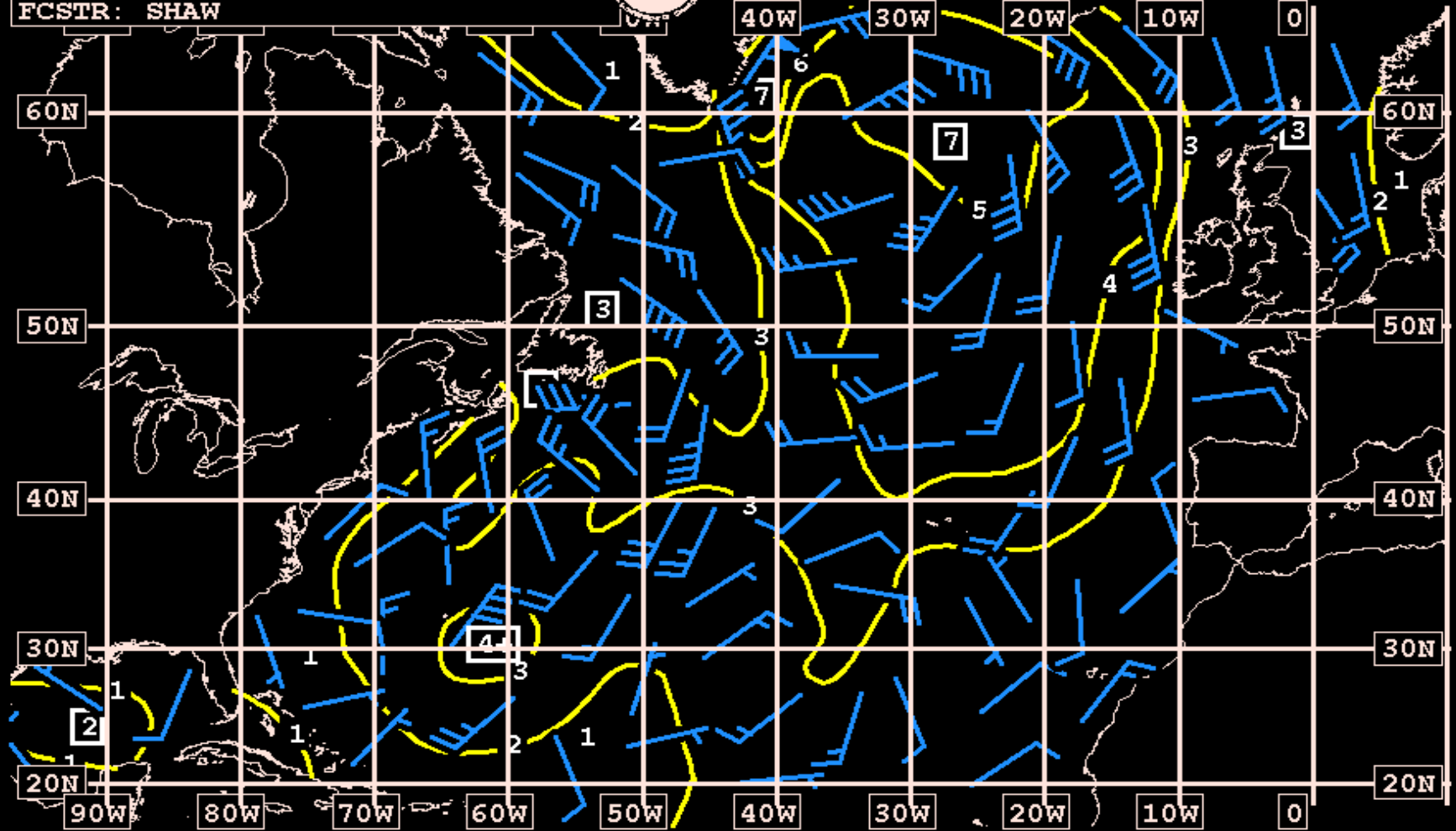
NWS/NCEP – Ocean Prediction Center

Storm Prediction Center (SPC)

The SPC provides hazardous weather forecasts, mesoscale guidance products, and continuous watch on mesoscale atmospheric processes especially as they relate to severe weather outbreaks, extreme winter weather and fire weather over the CONUS.

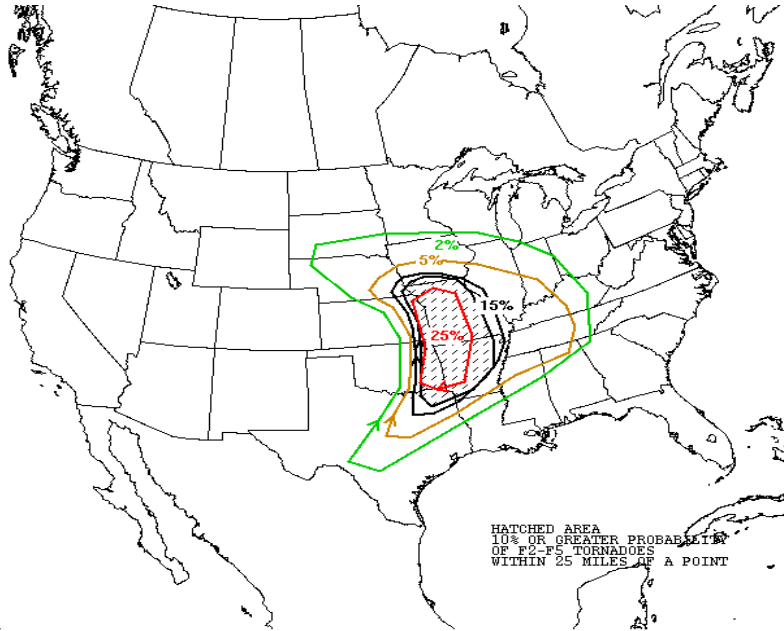| CATEGORY	TEMP DOMAIN
Severe weather outlooks	Day 1, 2 and 3
Mesoscale discussion	0 – 6 hours
Tornado/severe thunderstorm watch	1 – 6 hours
Fire outlook	Day 1 and 2
Severe thunder and tornado summaries	Hourly, daily and monthly

DAY 1 TORNADO

PROBABILITY OF A
TORNADO WITHIN 25
MILES OF A POINT

ISSUED 05/04/2003 1600Z
VALID 041630Z - 051200Z
FCSTR: EVANS
NOAA/NWS/NCEP
STORM PREDICTION CENTER

2%
5%
15%
25%

HATCHED AREA
10% OR GREATER PROBABILITY
OF F2-F5 TORNADOES
WITHIN 25 MILES OF A POINT
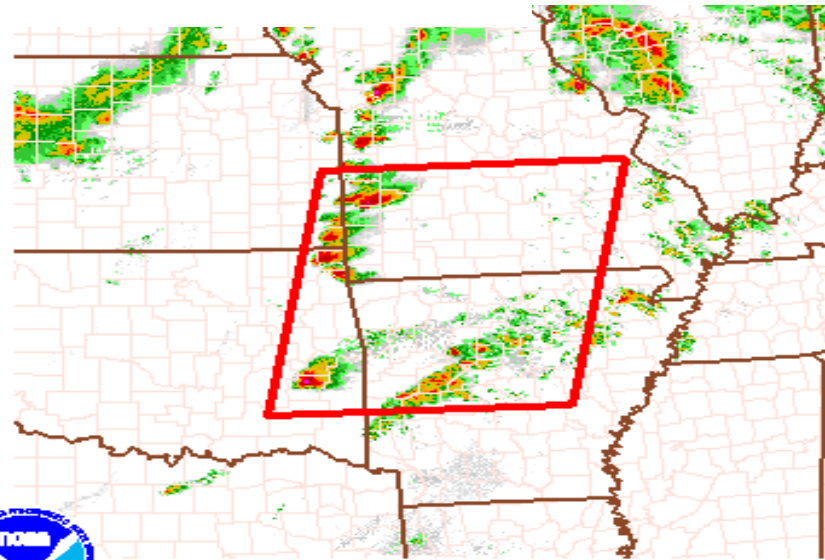
TORNADO WATCH # 237
VALID FROM   605 PM UNTIL   100 AM CDT

20030504/2254

Tropical Prediction Center (TPC) / National Hurricane Center

The TPC provides official NWS forecasts of the movement and strength of tropical weather systems and issues watches and warnings for US and the Caribbean. The TPC also issues a suite of marine products covering the tropical Atlantic.

| CATEGORY	TEMP DOMAIN	GEOG DOMAIN
Marine Products		
➢ Offshore	0 – 5 days	
➢ High Seas	0 – 2 days	Tropical West Atlantic
		Tropical East Pacific
Surface Forecasts	0 – 96 hours	Gulf of Mexico
Watch/Warnings	0 – 5 days	

Hurricane Isabel
September 17, 2003
5 AM EDT Wednesday
Advisory 45
Current Center Location 29.4 N 72.2 W
Max Sustained Wind 110 mph
Current Movement 9 mph

Current Center Location
Forecast Center Positions
Potential Day 1–3 Track Area
Hurricane Warning
Tropical Storm Warning
Tropical Storm Watch
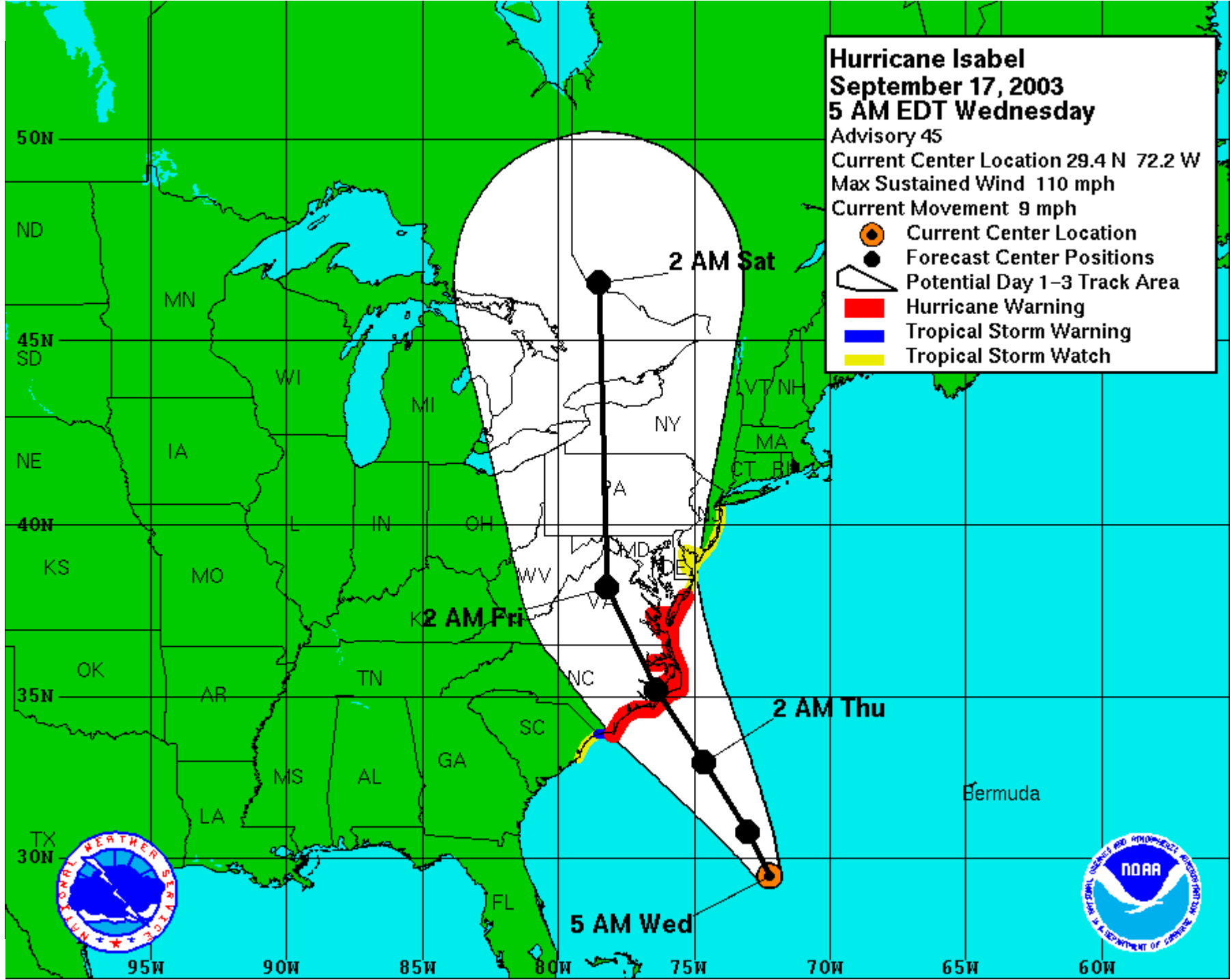
Service Center High Level Requirements

- Diverse products, geographic and temporal scales

- Somewhat diverse forecast processes

- Mostly common/generic software requirements

NMAP Fundamental Capabilities

- Data visualization

- Integrated product generation

NMAP Data Visualization Capabilities

- Definition:
  - Calculation and display of meteorological data

- Meteorological data types include:
  - Radar and satellite imagery
  - Model data: grids, MOS
  - Observations: METAR, marine, aircraft, upper-air, lightning, pilot reports, profilers, …
  - Forecast products: flash flood, Sigmets, Airmets, watches, warnings, ….

# NMAP Data Visualization Capabilities Continued

- Critical requirements include:
  - Flexible user-defined geographic and temporal scales and map projections
  - Wide variety of user-specified calculations, e.g., grid diagnostics
  - Variety of display options, e.g., station plotting models, contour attributes, etc.
  - User-defined data overlay options
- Key NMAP display functions:
  - Multiple animation loops: max of 8 loops with total of 120 frames
  - Automatic data time matching to frame time to support data overlay comparisons
  - Procedures for automatic loading of data into multiple loops
  - Continuous roaming to allow detailed views of data over large geographic regions

21

Loop: 4

45

35

55

45

45

35

25

35

25

25

GFS surface streamlines and isotachs

23
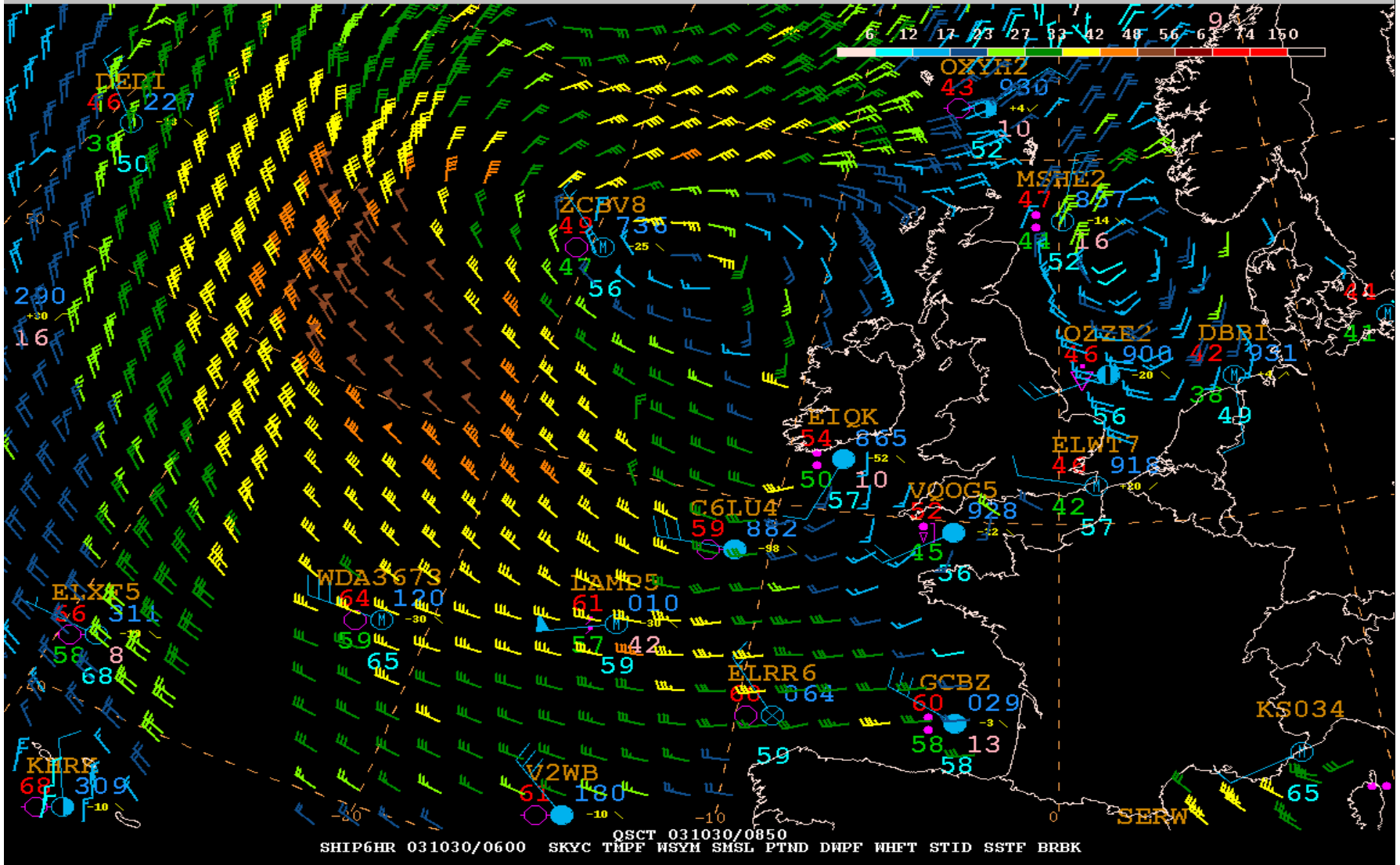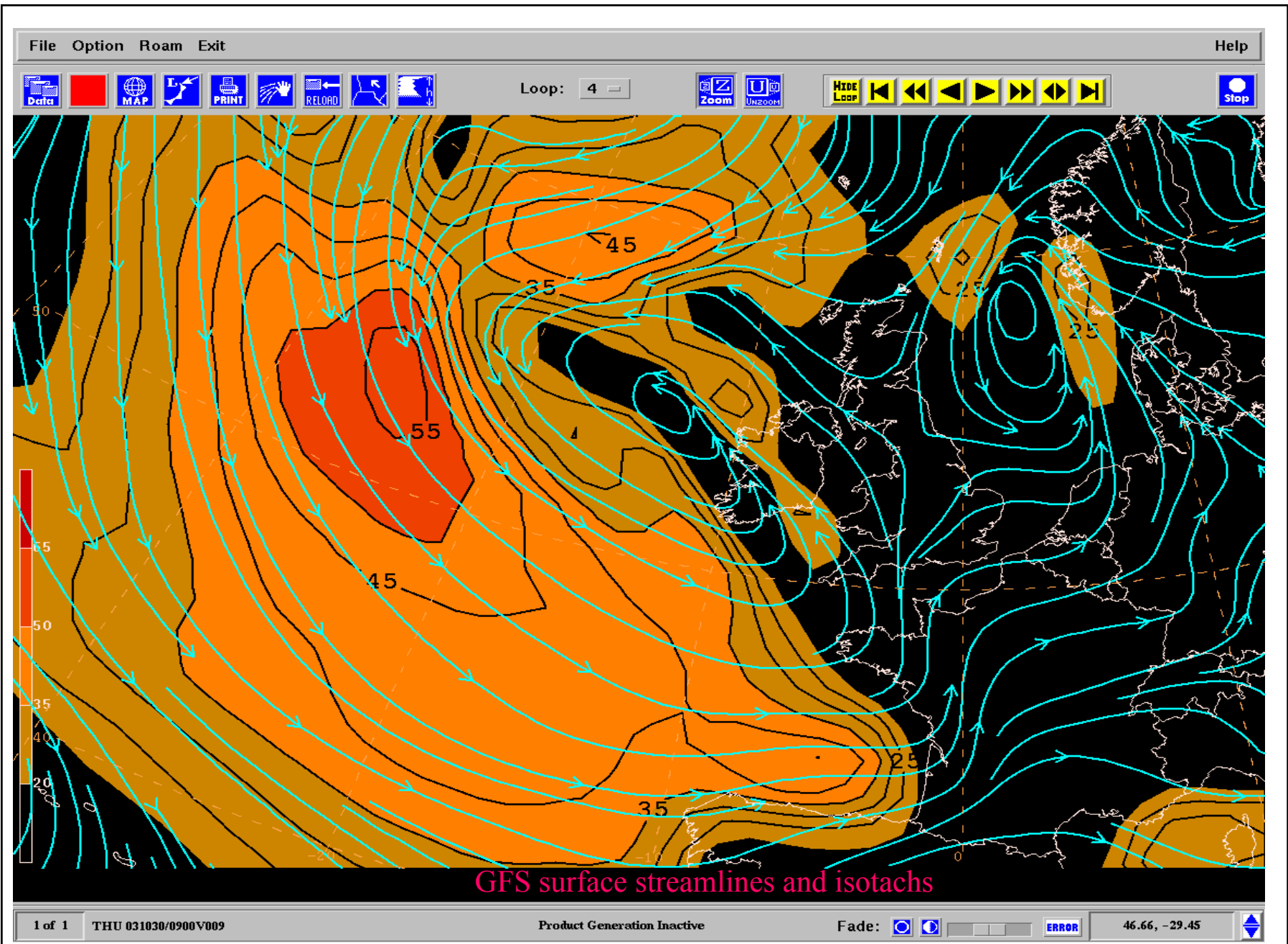
Integrated Product Generation Capabilities

- Definition:
  - Creation/Editing of graphical products overlaid on meteorological data displays

- Critical requirements:
  - Drawing and editing tools using meteorological objects, e.g., fronts, weather symbols, etc.
  - Graphical objects navigated to account for multiple product sectors and projections, wind rotation, …
  - Facility to import first guess fields, e.g., model fields and other centers' graphical products
  - Product formatting to support GIF, TIFF, PostScript, GRIB, BUFR, …
  - Product layering to support multi-component or multi-time concurrent editing
  - Object grouping

NMAP Product Generation Files

Vector Graphics Files (VGFs) used to describe NMAP objects. Information includes:

- Geographic location
  - Latitude, Longitude
- Class, type, subtype of each object
  - e.g. Class = symbol; type = weather; subtype = rain
- Attributes of each object
  - Class = line; attributes = line width; pattern spacing ; color
- Group for each object
  - e.g. Group = tornado_outlook line & label text grouped together
- Meta-information for meteorological object
  - e.g. Watch includes watch number, list of counties, hail size; …

High-Level Sig Wx Chart Production Scenario

- Center - AWC

- Product Description - Forecast of high level(25k to 60k ft) flight conditions of turbulence, jet and front positions, convection, tropopause height, etc

- Customer – International aviation community (ICAO, FAA)

- Product Frequency - Schedule driven, 4 times/day

- Product Formats - GIF, Fax, BUFR messages

- Geographic Domain – Nearly global, 7 sectors

- Data Underlays – Satellite, Model, Pirep, Lightning, HPC/OPC fronts, soundings, extensive use of roaming

- Key Product Generation Tools – Layering, object drawing/modification, grouping

- Post Processing – GEMPAK programs executed to generate displays over ICAO areas in various formats (PostScript, FAX, GIF, BUFR) using NMAP VGFs as input
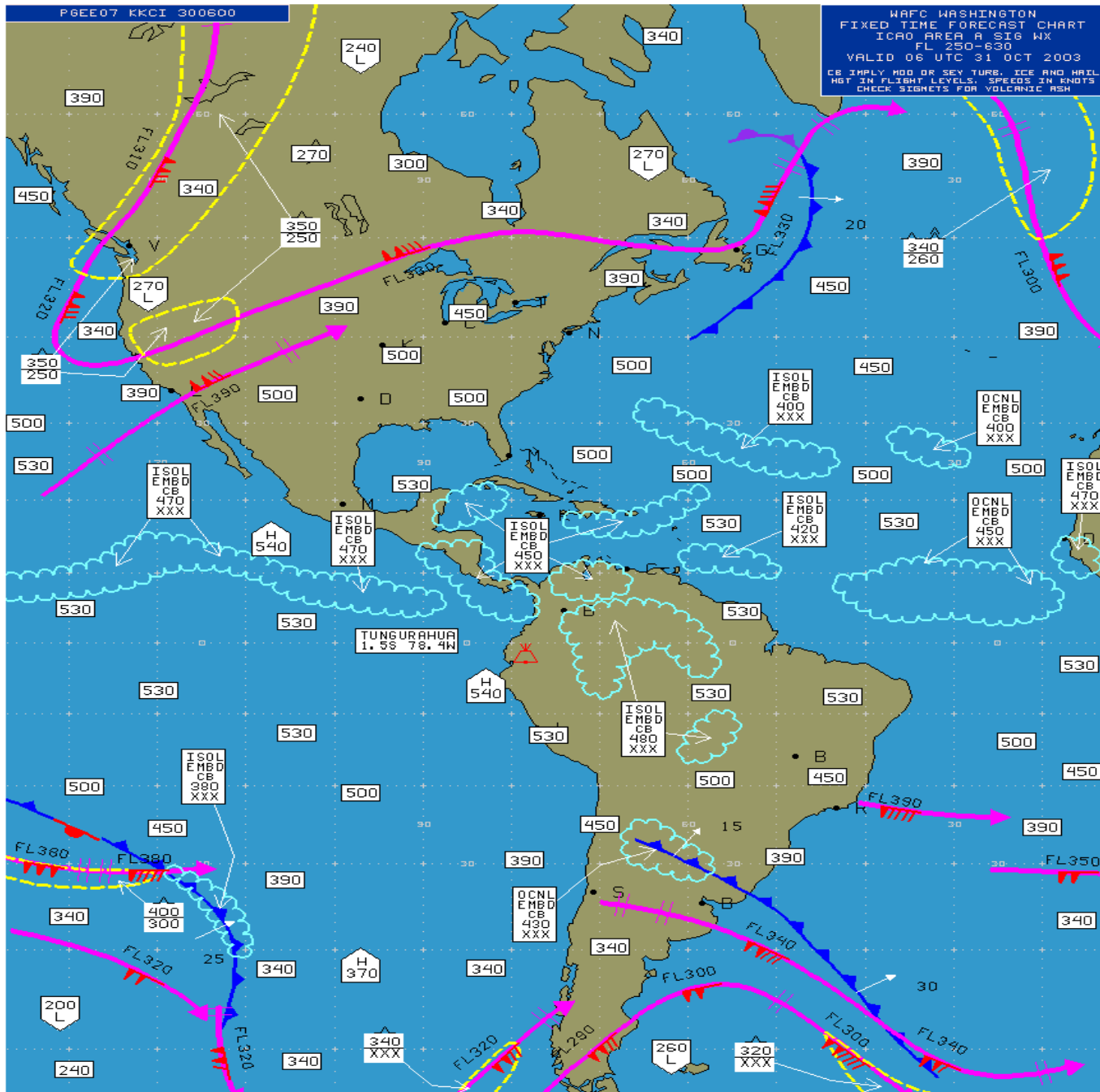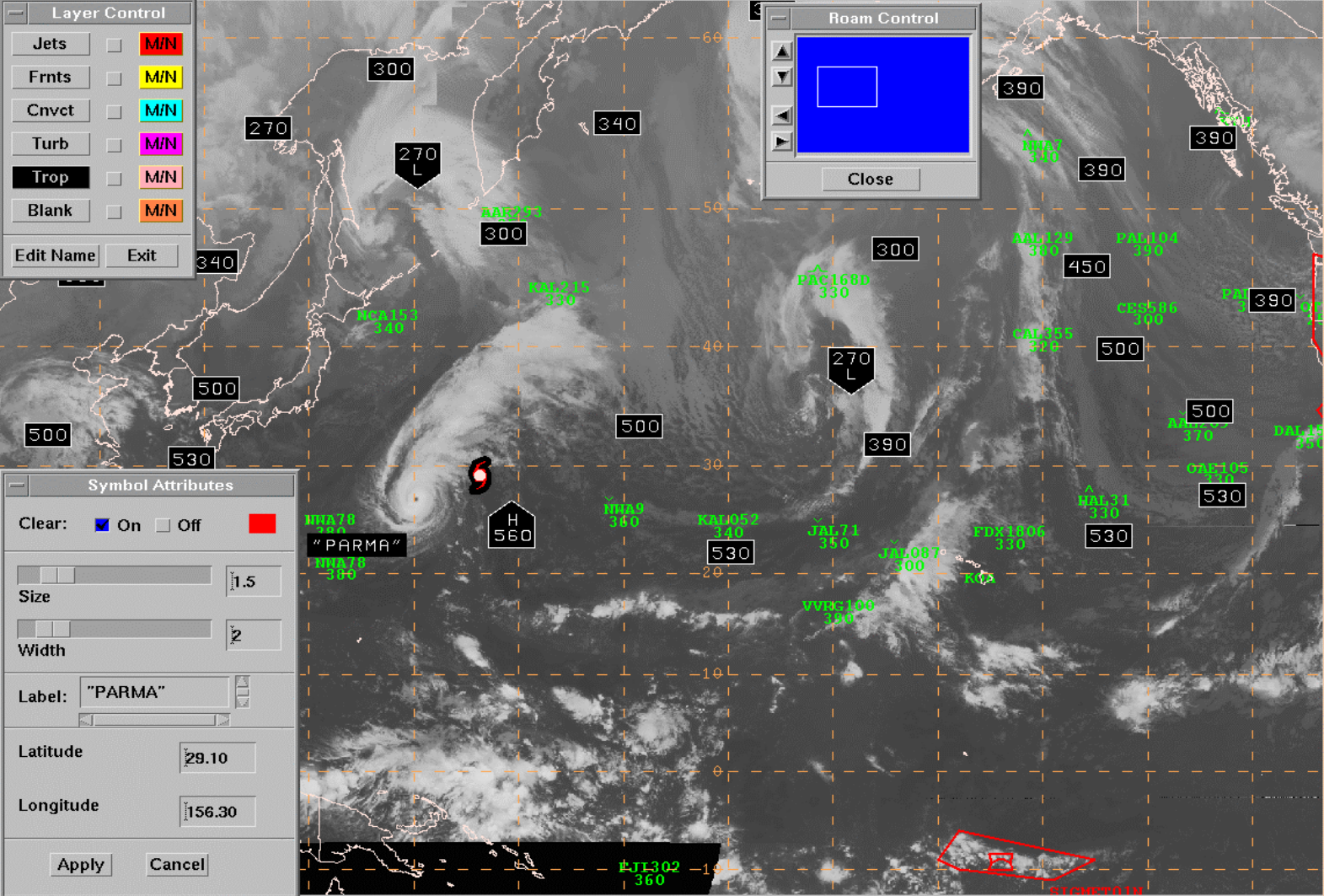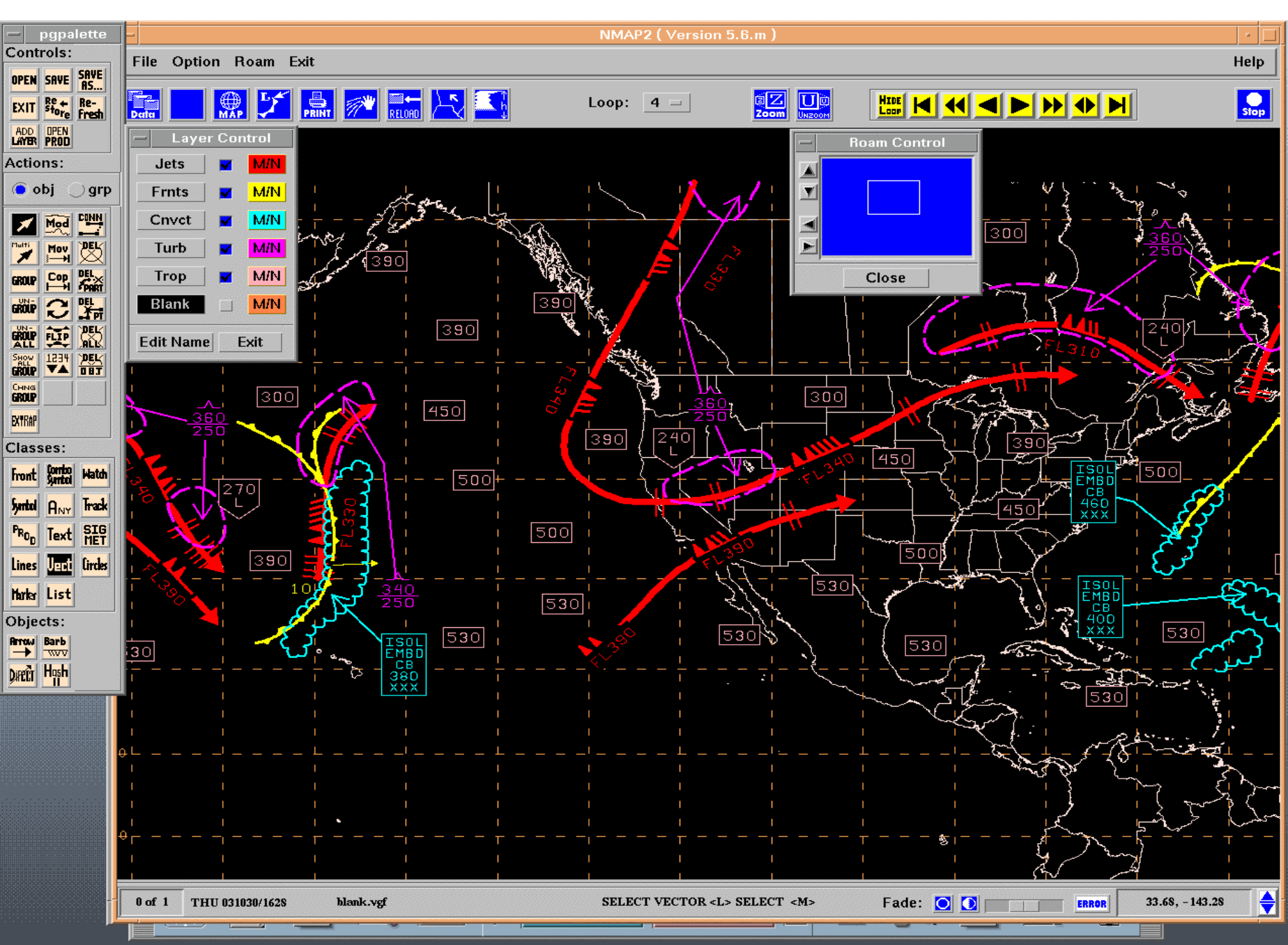
NMAP Development Strategy

- Provide a single workstation software system for all the NCEP service centers, address multiple requirements with generic functionality

- Use an evolutionary development strategy
  - Build in small frequent increments, quarterly release cycle
  - Refine requirements based upon forecaster feedback
  - Continue to improve system to support new products, refinements of existing products and increase forecaster productivity

- Support multiple platforms: Unix (IRIX, SUN, HPUX, AIX), Linux, single or multi-headed workstations
  - FORTRAN and C programming languages
  - X Windows / Motif for display and GUIs

NMAP Development Strategy Continued

- **Use robust software (GEMPAK) as a foundation**
  - Originally developed at NASA in 1980s, migrated to NWS in 1990s
  - Extensive use in university and research communities
    - ❖ Exchange of ideas, algorithms and codes
  - Provides set of libraries (reusable code) for decoding, data basing, performing calculations, displaying, and product formatting

- **Keep the system as simple as possible**

Current/Future Projects

New Products:

- Graphical Area Forecast (GFA) for AWC
    - Graphical and derived text for domestic aviation product to replace existing text based Area Forecast (FA)
    - Forecast about 15 aviation parameters for 7 time periods
    - Tools required – polygon combination, and interpolation, GAMET production, new NMAP VGF element and GUIs

- Volcanic Ash Advisory (Was., Alaskan VAAC)
    - Graphical and derived text product for aviation covering western Atlantic, Pacific and northern South America

- BUFR generation for additional selected NCEP graphical products

- Generate new hurricane watch/warning product for ingest into local forecast offices (TPC)

Current/Future Projects Continued

Improve Forecaster Productivity:

- Enhance grid diagnostics
  - Horizontal interpolation on the fly to support model comparison calculations
  - Calculate diagnostics on ensemble members
  - Additional diagnostics over selected vertical layers

- Generate categorical severe wx outlooks (e.g. slight, moderate, high) from probabilistic outlooks (e.g. 5% tornado, 10% hail, etc.)
  - Polygon combination tools needed

- Display additional data types
  - High Resolution QuikScat data set
  - Canadian Sigmets

Current/Future Projects Continued

Product Refinements:

- Severe Weather Watches
  - Add marine zones
  - Updates to support NWS VTEC and WBC programs

- Severe Weather Outlooks
  - Update text product to include watch corner points

- Update 3/5 day hurricane graphics based on customer feedback from 2003 hurricane season

QUESTIONS???