Evolution of Marine Forecasting at NHC’s Tropical Analysis and Forecast Branch

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21 February 2011
TAFB Overview

• Year round (24/7/365) products
  • Marine forecasts (graphical and text) and discussions (MIM)
  • Surface analyses and discussions (TWD)
  • Aviation forecasts and warnings (backup responsibilities) ***
  • Satellite-derived rainfall estimates
• Hurricane Season – 15 May – 30 November
  • Tropical cyclone intensity estimates using Dvorak technique
  • Media support to NHC (English, Spanish, French)
  • Radar tracking of tropical cyclones
  • Forecast support to Hurricane Specialists (Marine)
Forecast Tools

**Surface Observations**
- METAR, Moored platforms (Buoy/CMAN) and Ships

**NWP Guidance**
- Global Models (GFS, ECMWF, UKMET, NOGAPS)
- Regional Models (NAM, SREF)
- Global Wave Models (**NWW3**, UKMET, ECMWF, NOGAPS)

**Satellite Tools**
- Geostationary (GOES 11-12-13)
- Polar Orbiting
  - Microwave (TRMM, AMSR-E, SSM/I)
  - Scatterometer (WindSAT, ASCAT)
- *Loss of QuikSCAT Nov 23, 2009 – Big Impact on operations*
NWW3 Timeline

- 1 July 1998 - Global NWW3 approved for operational implementation
- 18 Aug 1999 - Western North Atlantic (WNA) regional model approved
- 3 July 2000 - Addition of output points for Puerto Rico in WNA model
- 24 May 2001 - North Atlantic Hurricane (NAH) wave model approved for operational implementation
- 25 June 2002 - Restart NAH model with hourly GFDL wind fields and modified blending scheme
- 24 Sept 2002 – NWW3 runs expanded to 4X per day (00, 06, 12 and 18z)
- 2 March 2004 - Extend forecast horizon of NWW3, WNA and ENP models to 180h.
- 18 Sept 2007 – Multi-grid (MMW3) approved for operational implementation
Buoy data shows longer period swell has arrived while both the MWW3 runs are slow to move it westward.

Both the parallel and operational run agree with buoy swell period.

Longer period N swell yet to reach highlighted areas; buoy swell currently shorter period than model swell.
Tropical Analysis and Forecast Branch
Area of Responsibility

Offshore Forecast Areas

High Seas Forecast Areas

14,000,000 Square Miles

TAFB Produces 48 Text and 57 Graphical Products each day
Text Products

• High Seas Forecasts
  • Tropical North Atlantic
  • Northeast Pacific
  • Southeast Pacific
• Offshore Waters Forecasts
  • Caribbean/SW North Atlantic
  • Gulf of Mexico
• Marine Weather Discussion
• Tropical Weather Discussions
  • Atlantic
  • East Pacific
Suite of Marine Radiofax Charts Produced by TAFB

**Pt. Reyes and Honolulu Radiofax**
- **Surface Analysis**
- **Wind/Wave Forecasts**
  - 24 HR
  - 48 HR
  - 72 HR

**New Orleans Radiofax**
- **Surface Analysis**
- **Wind/Wave Forecasts**
  - 24 HR
  - 48 HR
  - 72 HR

**Sea State Analysis**

**Peak Wave Period & Swell Direction**

**High Wind Graphic**

**TC Danger Graphic**

**Broadcast Frequencies**
- **Pt. Reyes**
  - 4346 kHz
  - 8662 kHz
  - 12786 kHz
  - 17151.2 kHz
  - 22527 kHz
- **Honolulu**
  - 9982.5 kHz
  - 11090 kHz
  - 16135 kHz
  - 23331.5 kHz
- **New Orleans**
  - 4317.9 kHz
  - 8503.9 kHz
  - 12789.9 kHz

**Surface Forecasts**

**Peak Wave Period & Swell Direction**

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Marine forecasting timeline
1988-2000

• June 1988 - Tropical Satellite Analysis and Forecast (TSAF) Branch acquires High Seas responsibility from
  – WFO San Francisco (HSFEP2)
  – WFO Miami (HSFAT2)
• March 1993 – TSAF acquires High Seas responsibility for METAREA XVI – Peru (HSFEP3)
• June 1995 – TSAF becomes TAFB
• June 2000 – TAFB acquires the Offshore waters forecast responsibility from
  – WFO Miami (OFFNT3)
  – WFO New Orleans/Slidell (OFFNT4)
• July 2001 - TAFB added new offshore waters forecast zone to cover the Tropical North Atlantic east of the Windward/Leeward Islands
• May-Oct 2010 – TAFB provides enhanced decision support services (EDSS) in the wake of the Deepwater Horizon Oil Spill
  – Experimental gridded marine forecasts
  – Experimental Graphicasts
Experimental Gridded marine forecasts
Transition to Gridded Marine Forecasts

Current Setup

Satellite, data, models, etc.

- Offshore Forecast Text

Wind Wave Graphics
Surface Prog Graphics
Wave Period Graphics
High Wind Graphic

- High Seas Forecasts Text

Text and graphics only
- no gridded database

- No built-in consistency between forecast elements
- No built-in consistency between forecast products
- No built-in method to incorporate the NHC tropical cyclone forecast
- No easy way to coordinate details with OPC and WFOs
- Often labor intensive
- No gridded database
The vision of a new paradigm

Proposed TAFB Setup

1) Value-added Wind Grids into Wavewatch
2) Value-added Wave Grids back into GFE Database

Satellite, Observations, value added input, etc.

GFE Gridded Database

NWP Model Data

Wavewatch Model

Offshore Forecast Text (via GFE text formatter)

Marine Verifcation (via GFE formatter)
NAVTEX (via GFE formatter)

Wind Wave, Surface Prog and Wave Period Graphics (via N-AWIPS)

Polygon-based High Seas Forecast (via N-AWIPS)
High Wind Graphic

• Built-in consistency between forecast elements
  - Coupled winds and seas = higher quality forecast
• Built-in consistency between forecast products
• Built-in method to incorporate the NHC tropical cyclone forecast
• Inter-Site Coordination: easy to coordinate with OPC,HFO and WFOs
• More efficient – trims a couple of hours off workload per shift

...and it opens the door to a gridded database
AWIPS II Prototype
Graphical Marine Forecasts in GFE

Grids edited in GFE
MSLP
10-M Winds
Sig Wave Hghts
Primary Swell

NetCDF to GEMPAK conversion

Populate marine parameter layers in NAWIPS for legacy marine graphics

Create experimental gridded marine Forecasts on the web
Extratropical Storm Surge applications

Possible TAFB/OPC Setup

1) Value-added Wind Grids into local version of Wavewatch model
2) Value-added Wave Grids back into GFE Database
3) Value-added Wave Grids initializes/provides wave forcing for Extra-tropical ADCIRC model
4) Value-added Extra-tropical surge output provides boundary conditions for coastal Wave+Surge+Tide models

Satellite, Observations, value added input, etc.

NWP Model Data

GFE Gridded Database

Wavewatch Model

Forecaster
Proposed New Offshore Zones for TAFB
This....

CURRENT OFFSHORE WATERS ZONES
Becomes this….
Experimental Gridded Marine Forecasts

- Grids processed from 00 and 12 UTC cycles and published by 0500 and 1700 UTC
- Parameters
  - MSLP
  - 10-M winds
  - 10-M wind gusts
  - Significant Wave Height
  - Primary Swell Height, Direction and Period
Gridded Marine Forecasts in Operations

- Model blending tool incorporates other NWP solutions
- TCM Wind tool incorporates Wind radii from TCM issued by HSU with some forecasters smoothing the wind radii into ambient wind field
- NetCDF -> gempak script populates legacy charts to ensure forecast consistency and posts experimental gridded marine forecasts to Web
- Parameters
  - PMSL
  - 10-M winds
  - Significant Wave heights
Hazard Grids – Valid 0000 UTC 9 October 2010

Tropical Cyclone 34/64 KT wind radii

“Extra-tropical” 20/34/50/64 KT wind areas

8 Foot Sea Areas
OFFSHORE WATERS FORECAST FOR SM AND TROPICAL N ATLANTIC AND CARIBBEAN SEA

AMZ089-0900045:
SYNOPSIS FOR CARIBBEAN SEA AND TROPICAL N ATLIC FROM 07N TO 22N BETWEEN 55W AND 65W

140 PM EDT FRI OCT 8 2010

SYNOPSIS...
HURRICANE OTTO LOCATED N OF THE AREA NEAR 25.8N 64.0W AT 11 AM EDT WILL PRODUCE STRONG S TO SM WINDS OVER THE N PORTION OF THE TROPICAL N ATLANTIC WATERS TODAY BEFORE DIMINISHING THERE TONIGHT. A SURFACE TRough FROM JAMAICA TO MERN PANAMA WILL REMAIN NEARLY STATIONARY MOST OF THE FORECAST PERIOD. A SURFACE LOW HAS DEVELOPED ALONG THE TROUGH NEAR 13N78W AND IS ALSO FORECAST TO REMAIN NEARLY STATIONARY THROUGH THE FORECAST PERIOD.

CM001-090045:
CARIBBEAN SEA INCLUDING THE GULF OF HONDURAS

140 PM EDT FRI OCT 8 2010

TODAY...NW WINDS 10 TO 15 KT. SEAS 5 TO 7 FT.
SAT...SW WINDS 10 TO 15 KT. SEAS 4 TO 6 FT.
SAT NIGHT...SW WINDS 10 TO 15 KT. SEAS 5 TO 7 FT.
SUN...SW WINDS 10 KT. SEAS 3 TO 5 FT.
SUN NIGHT...SW WINDS 10 KT. SEAS 3 TO 5 FT.
MON...S WINDS 10 KT. SEAS 3 TO 5 FT.
TUE...NE WINDS 10 TO 15 KT. SEAS 2 TO 4 FT.
WED...NE WINDS 10 TO 15 KT. SEAS 3 TO 5 FT.

CM002-090045:
NW CARIBBEAN SEA N OF 18N INCLUDING THE COAST OF W CUBA

140 PM EDT FRI OCT 8 2010

TODAY...NW WINDS 10 TO 15 KT. SEAS 3 TO 5 FT.
SAT...NE WINDS 10 TO 15 KT. SEAS 3 TO 5 FT.
SAT NIGHT...NE WINDS 10 TO 15 KT. SEAS 3 TO 5 FT.
SUN...NE WINDS 10 TO 15 KT. SEAS 3 TO 5 FT.
SUN NIGHT...NE WINDS 10 TO 15 KT. SEAS 3 TO 5 FT.
MON...NE WINDS 10 TO 15 KT. SEAS 3 TO 5 FT.
TUE...NE WINDS 10 TO 15 KT. SEAS 2 TO 4 FT.
WED...NE WINDS 10 TO 15 KT. SEAS 3 TO 5 FT.
Additional Plans

• Sea State initialized in GFE using “optimum interpolation” techniques from NWP guidance/surface observations - Spring 2011
• 4X a day issuance of Sea State - Summer 2011
• Locally run WW3 – JHT Project with NRL – Fall/Winter 2011-12
• Work with MMAB on valued added WW3 – Q3/Q4 FY 2011
• Enhance marine products on the web
  Point and click forecasts (MFM, Zones)
• Enhanced Decision Support Services (Local high resolution grids)
• Enhanced Ecological Support Services (HAB, Oil Spill)
• Collaborate gridded marine forecasts with International MET services
Contacts

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