





Understanding the Natural **Processes that Produce Hazards:** The Hurricane Example John Gaynor NOAA Office of Weather and Air Quality for Naomi Surgi **Hurricane Modeling Program Leader NOAA/National Centers for Environmental Prediction** WHERE AMERICA'S CLIMATE AND WEATHER SERVICES BEGIN



• OPERATIONAL HURRICANE FORECAST ISSUES

 HISTORICAL PERSPECTIVE ON IMPROVING HURRICANE TRACK FORECASTS

 SCIENCE AND MODELING CHALLENGES FOR INTENSITY/STRUCTURE, RAINFALL

• DEVELOPMENT OF A NEW OPERTIONAL MODELING SYSTEM

• SOME PRELIMINARY RESULTS

• FUTURE CHALLENGES

OPERATIONAL FORECAST ISSUES:

CONTINUED ADVANCEMENT OF TRACK FORECASTS

• IMPROVED INTENSITY PREDICTION

• IMPROVED PREDICTION OF SURFACE WIND DISTRIBUTION

IMPROVED RAINFALL FORECASTS

WAVES, STORM SURGE, HURRICANE GENESIS

TPC Atlantic 72 hr Track Earocast Errors

With the exception of "stalling and looping storms", hurricane track prediction has shown remarkable progress over the past three decades. This is due to advancement of observations (both satellite and aircraft), advancement of numerical modeling systems, investment in high speed super computing and technology infusion.



Error (nautical miles)

How NOAA Improved Track Forecasts

Three components of modeling system:

- •<u>HIGH QUALITY OBSERVATIONS</u> (large scale environment surrounding hurricane, e.g. satellite, aircraft)
- <u>MADE BETTER USE OF OBSERVATIONS IN</u> <u>HURRICANE MODELS</u> (advances in data assimilation, e.g. for satellites- direct assimilation of radiances)
- •<u>IMPROVED HURRICANE MODELS</u> (improved representation of physical processes, increased resolution, improved initial specification of vortex)

NOAA's Hurricane Aircraft

NOAA's G-IV (high altitude jet)

flies in storm environment

releases dropsondes to obtain measurements of wind, temperature and moisture - TRACK

upgrade w/ doppler radar to obtain core observations - INTENSITY/STRUCTURE

NOAA's P-3's (turbo- props)

augments G-IV observations in environment

hurricane core observations

****AFRES (Bilxoxi, MS) provides mainstay of recon for NHC

NOAA G-IV AIRCRAFT



FLIGHT LEVEL: ~45K RANGE: 4200nm SPEED: 442 KTS. ~30 drops per mission





GIV Aircraft Synoptic Surveillance Pattern

Hurricane Isabel Synoptic Surveillance Sept 13 to Sept 17, 2003 Red tracks: AFRES WC-130 Blue tracks: NOAA G-IV 00Z Green tracks: NOAA G-IV 12Z

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We are now at the juncture of improving intensity forecasts, where we were a decade ago in advancing hurricane track forecasts.....

But let's put the intensity problem into the proper forecast context.....





Tropical Storm Franklin 21 - 29 July 2005

Hurricane Ophelia 6 - 17 September 2005



AFTER QUICKLY STRENGTHENING TO A STRONG CAT. 4 HURRICANE, LILI WEAKENED EVEN MORE RAPIDLY THAN IT HAD INTENSIFIED



Naval Research Laboratory http://www.nrlmry.navy.mil/sat products.html <-- Visible (Sun elevation at center is 30 degrees) ---> Naval Research Laboratory http://www.nrlmry.navy.mil/sat products.html <-- Visible (Sun elevation at center is 13 degrees) -->

LILI NEAR ITS MAXIMUM INTENSITY OF 145 MPH

LILI MAKING LANDFALL AS A CAT. 1 HURRICANE

Charley/Frances Core Sizes



Hurricane-Wave-Ocean-Surge-Inundation Coupled Models



SST Before Hurricane Dennis



Hurricane Dennis' Cool Wake





GrADS: COL#/IGES

HYCOM T&E Katrina



Center Fixes from NHC Tropical Cyclone Advisories

The Future





THANK YOU FOR YOUR ATTENTION...