Advances and Challenges in Tropical Cyclone Predictions: GFDL Model Retrospective

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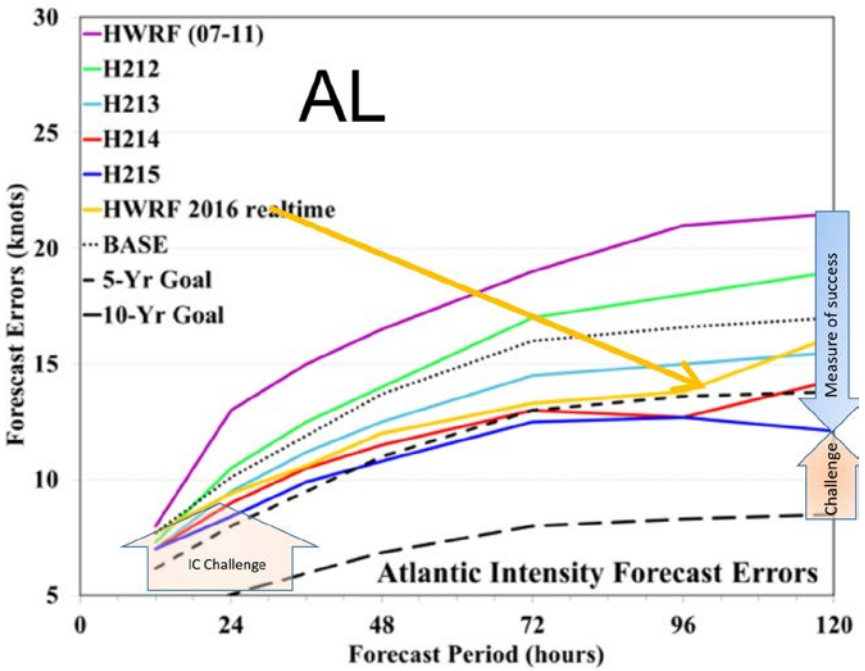
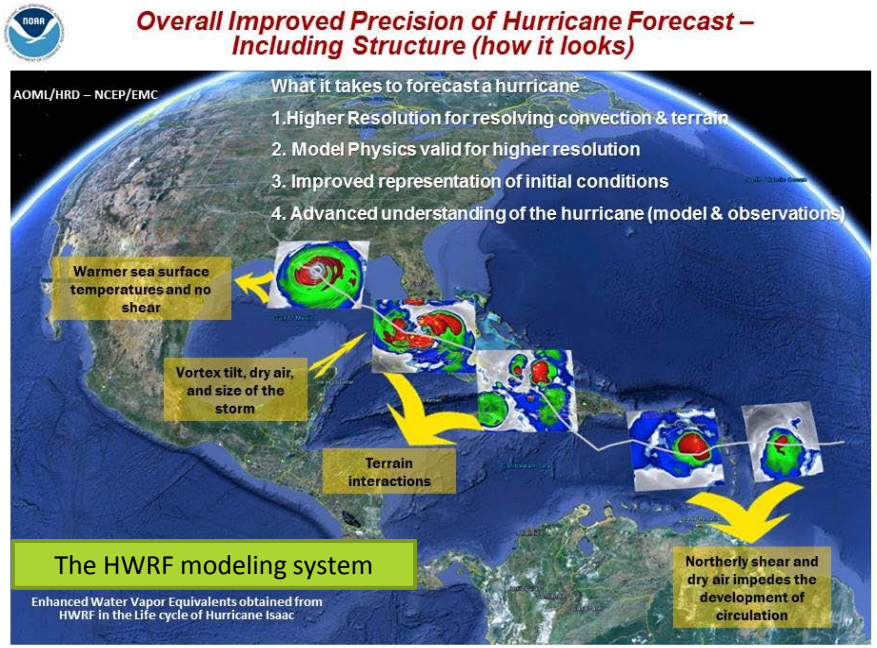
HWRF: State-of-the-art





Seeds for these future developments in NOAA were sown at GFDL in 70s and 80s!

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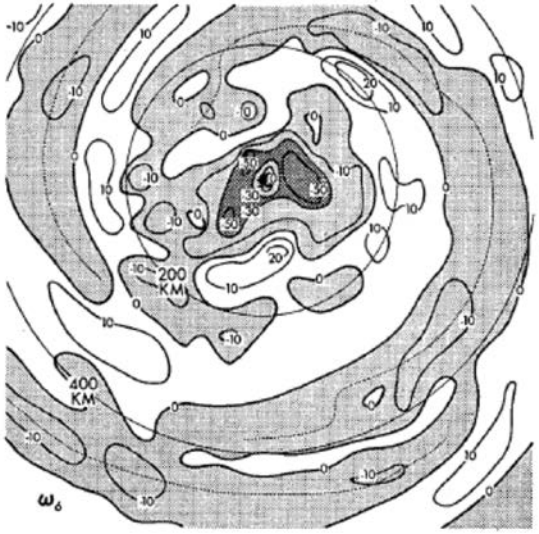
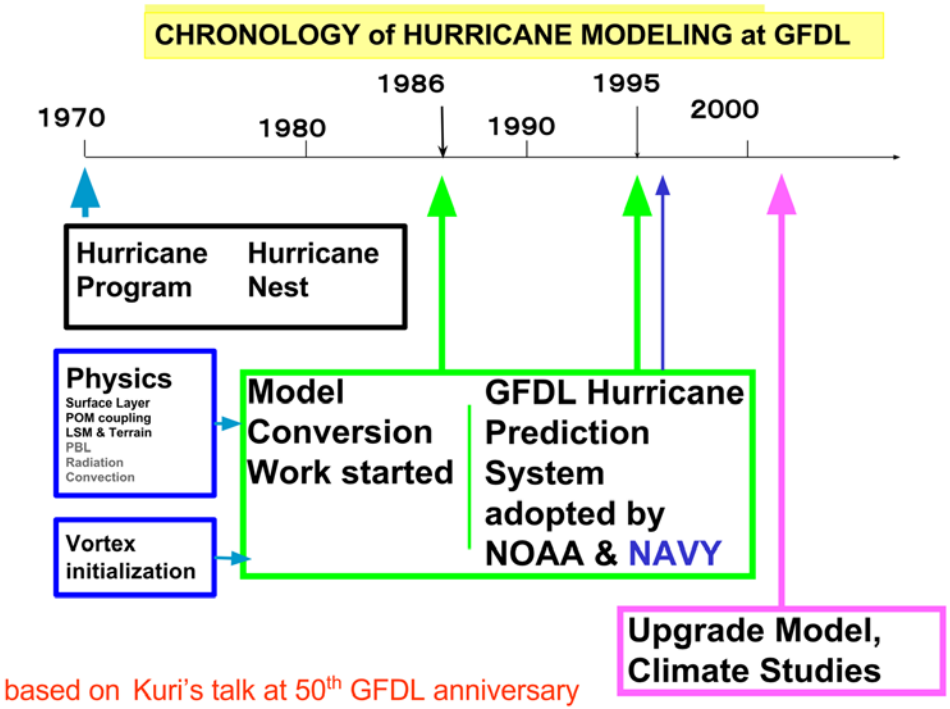
A walk down the memory lane

Early 3-D model (hurricane in a box!)

Kurihara, Y., and R. E. Tuleya, 1974 . JAS

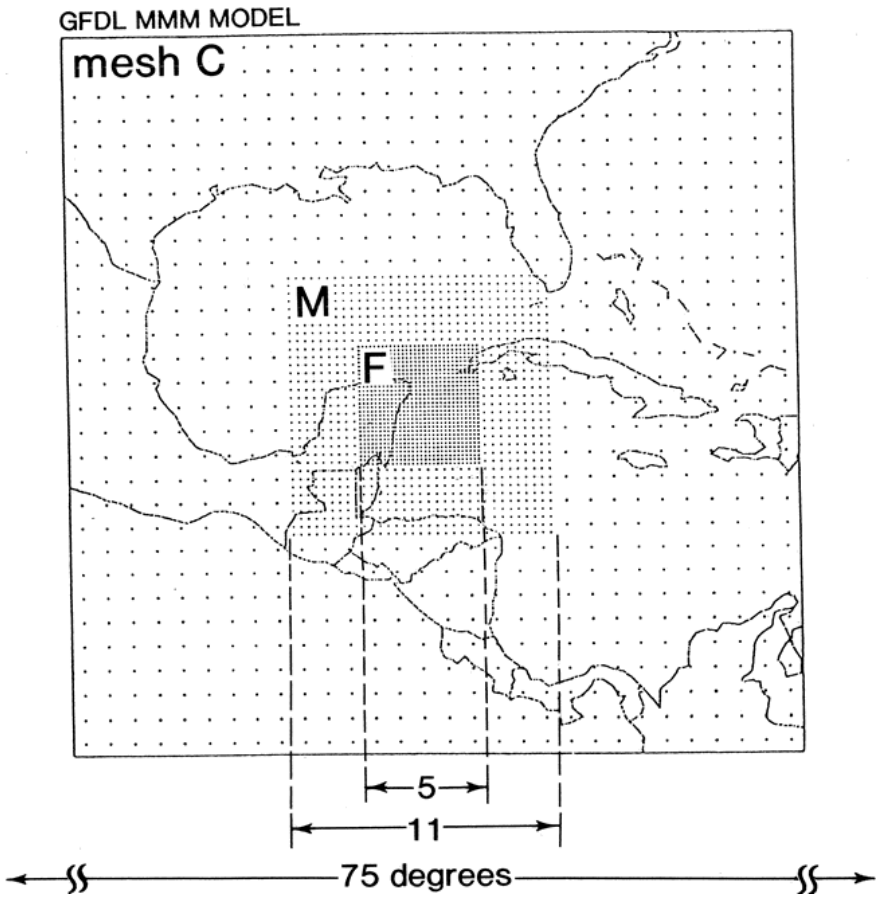


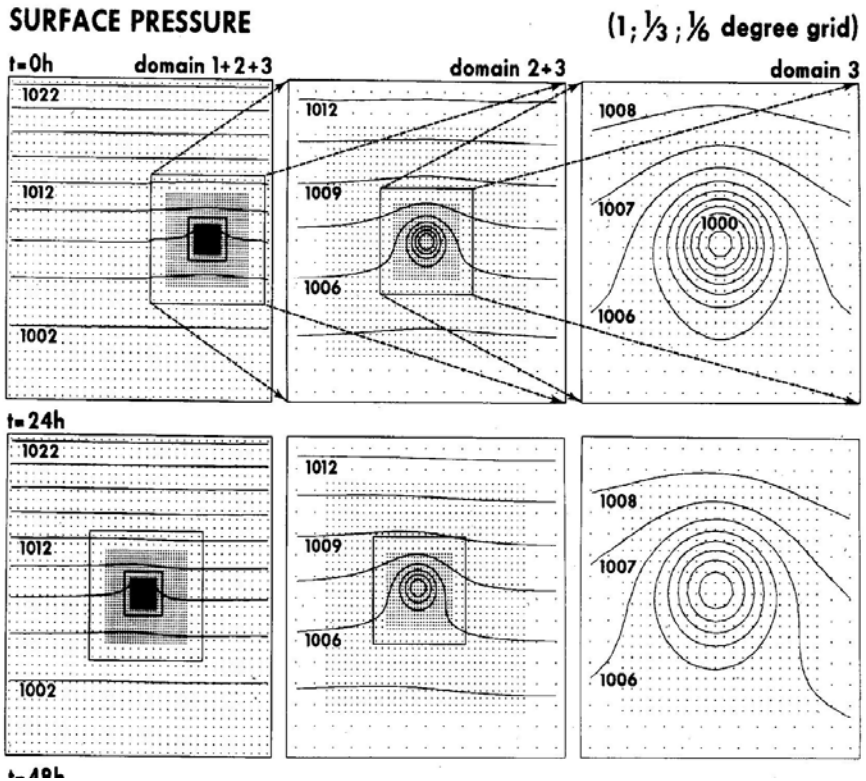


based on Kuri's talk at 50th GFDL anniversary

The GFDL Nest

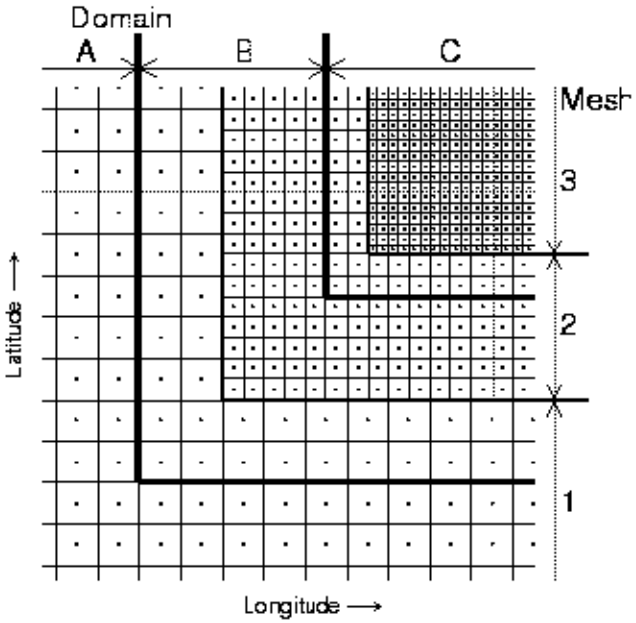
Kurihara, Y., and M. A. Bender, 1980, MWR



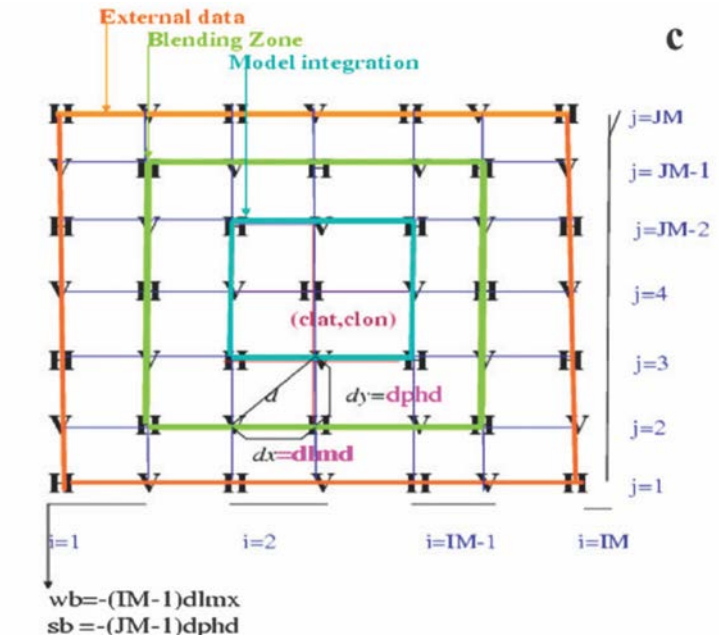


Principles of moving nest

- Separation of the mesh and dynamical interfaces



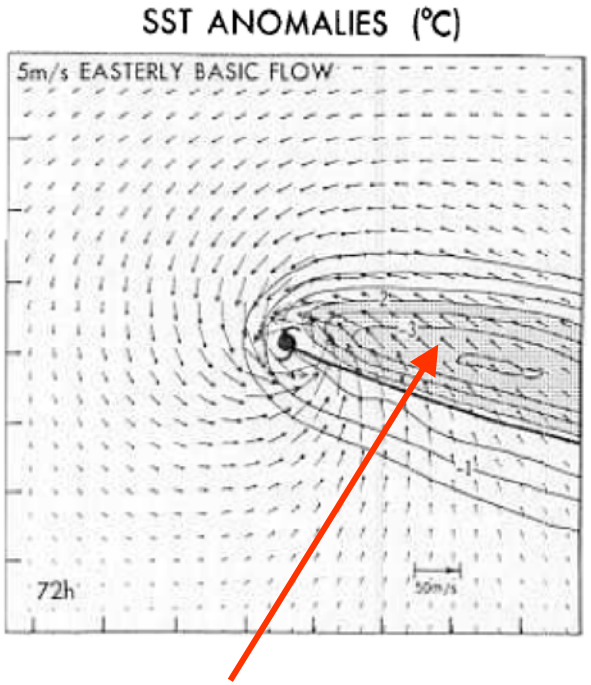
Kurihara, Y., G.J. Tripoli, and Bender, 1979: Design of a movable nested-mesh primitive equation model. *Mon. Wea. Rev.*, 107, 239-249.



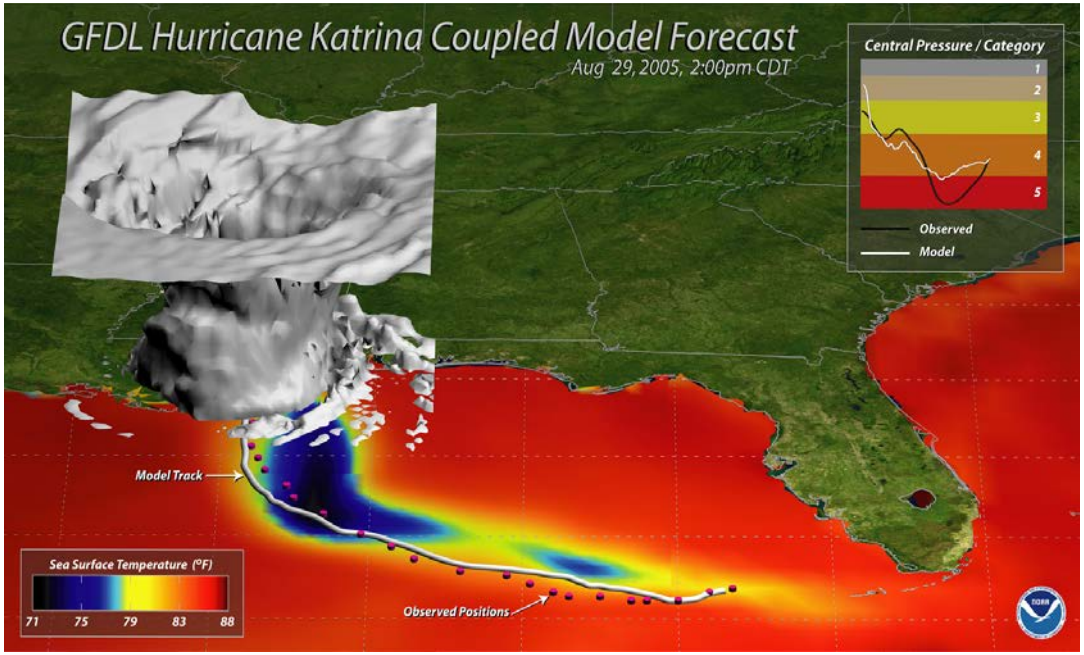
Gopal, F. D. Marks Jr., X. Zhang, J.-W. Bao, K.-S. Yeh, and R. Atlas, 2011: The experimental HWRF system: A study on the in- fluence of horizontal resolution on the structure and intensity changes in tropical cyclones using an idealized framework. Mon. Wea. Rev., 139, 1762–1784.

Effects of ocean coupling on TC

Bender, M. A., I. Ginis, and Y. Kurihara, 1993, JGR



Cold wake



This figure says it all!

Publications

An Initialization Scheme of Hurricane Models by Vortex Specification

YOSHIO KURIHARA, MORRIS A. BENDER, AND REBECCA J. ROSS

Geophysical Fluid Dynamics Laboratory, National Oceanic and Atmospheric Administration, Princeton University, Princeton, New Jersey

(Manuscript received 17 July 1992, in final form 23 November 1992)

A Numerical Scheme to Treat the Open Lateral Boundary of a Limited Area Model

YOSHIO KURIHARA AND MORRIS A. BENDER

Geophysical Fluid Dynamics Laboratory/NOAA, Princeton University, Princeton, NJ 08540

(Manuscript received 21 May 1982, in final form 8 December 1982)

The Operational GFDL Coupled Hurricane–Ocean Prediction System and a Summary of Its Performance

MORRIS A. BENDER

NOAA/GFDL, Princeton, New Jersey

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Graduate School of Oceanography, University of Rhode Island, Narragansett, Rhode Island

ROBERT TULEYA

SAIC at NOAA/NWS/Environmental Modeling Center, Camp Springs, Maryland, and CCPO, Old Dominion University, Norfolk, Virginia

BIJU THOMAS

Graduate School of Oceanography, University of Rhode Island, Narragansett, Rhode Island

TIMOTHY MARCHOK

NOAA/GFDL, Princeton, New Jersey

Structure of a Tropical Cyclone Developed in a Three-Dimensional Numerical Simulation Model

YOSHIO KURIHARA AND ROBERT E. TULEYA

Geophysical Fluid Dynamics Laboratory/NOAA, Princeton University, Princeton, N. J. 08540

(Manuscript received 29 September 1973, in revised form 23 January 1974)

A Numerical Simulation Study on the Genesis of a Tropical Storm

YOSHIO KURIHARA AND ROBERT E. TULEYA

Geophysical Fluid Dynamics Laboratory/NOAA, Princeton University, Princeton, NJ 08540

(Manuscript received 15 December 1980, in final form 14 April 1981)

Tropical Storm Development and Decay: Sensitivity to Surface Boundary Conditions

ROBERT E. TULEYA

Geophysical Fluid Dynamics Laboratory/National Oceanic and Atmospheric Administration, Princeton, New Jersey

(Manuscript received 7 June 1993, in final form 13 August 1993)

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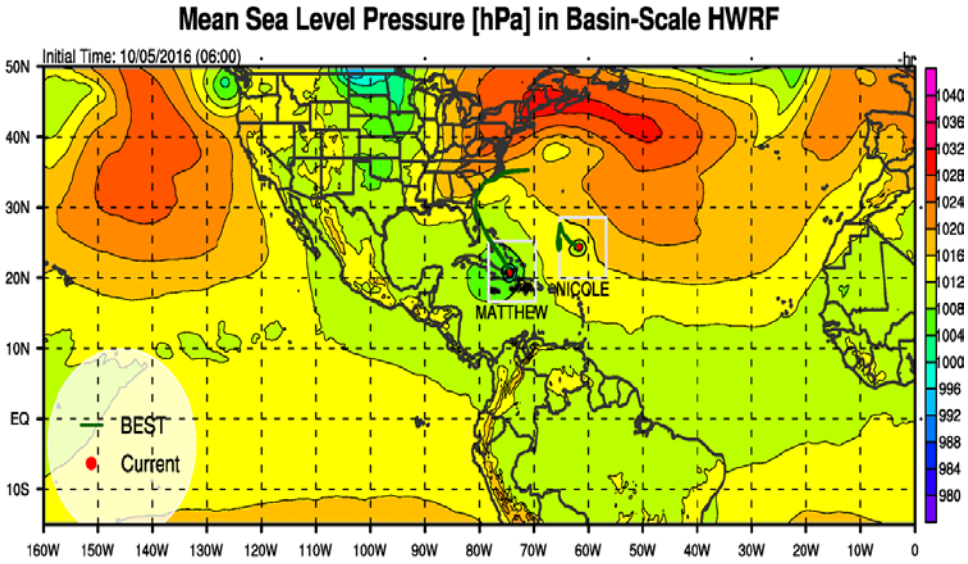
Evolution of HWRF

GFDL	HWRF (2007)
Triply nested (54:27:9)	Double nested (27:9)
GFDL vortex initialization	Vortex assimilation & cycling
GFDL surface physics	GFDL surface physics
URI-POM coupling	URI-POM coupling
GFS PBL	GFS PBL
SAS convection/ Ferrier MP	SAS convection/ Ferrier MP
GFDL radiation	GFDL radiation



NOAAs capacity to track hurricanes in 2017: Multi-nested, cycled, ocean-coupled HWRF system, with physics advanced using observations, capable of tracking any number of hurricanes at 2-km resolution over the globe. Credit: HFIP

Thank you GFDL group!