Advances and Challenges in Tropical Cyclone Predictions: GFDL Model Retrospective

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HRD/AOML/Miami
Developmental Manager, HFIP
HWRF: State-of-the-art

Seeds for these future developments in NOAA were sown at GFDL in 70s and 80s!
A walk down the memory lane

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

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

CHRONOLOGY of HURRICANE MODELING at GFDL


Hurricane Program Hurricane Nest

Physics
Surface Layer
POM coupling
LSM & Terrain
FSL
Radiation
Convection

Model Conversion Work started

GFDL Hurricane Prediction System adopted by NOAA & NAVY

Upgrade Model, Climate Studies

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


Effects of ocean coupling on TC

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

Cold wake

This figure says it all!
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

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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, NJ 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)
**Evolution of HWRF**

<table>
<thead>
<tr>
<th>GFDL</th>
<th>HWRF (2007)</th>
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<td>Triply nested (54:27:9)</td>
<td>Double nested (27:9)</td>
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<td>GFDL radiation</td>
<td>GFDL radiation</td>
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NOAA's 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!