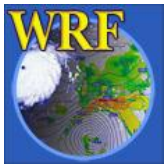
AHW (WRF-ARW): Moving Nest and Ocean Initialization

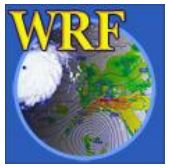
Wei Wang

NCAR/NESL/MMM

Hurricane Tutorial, Apr 27 - 29, 2011

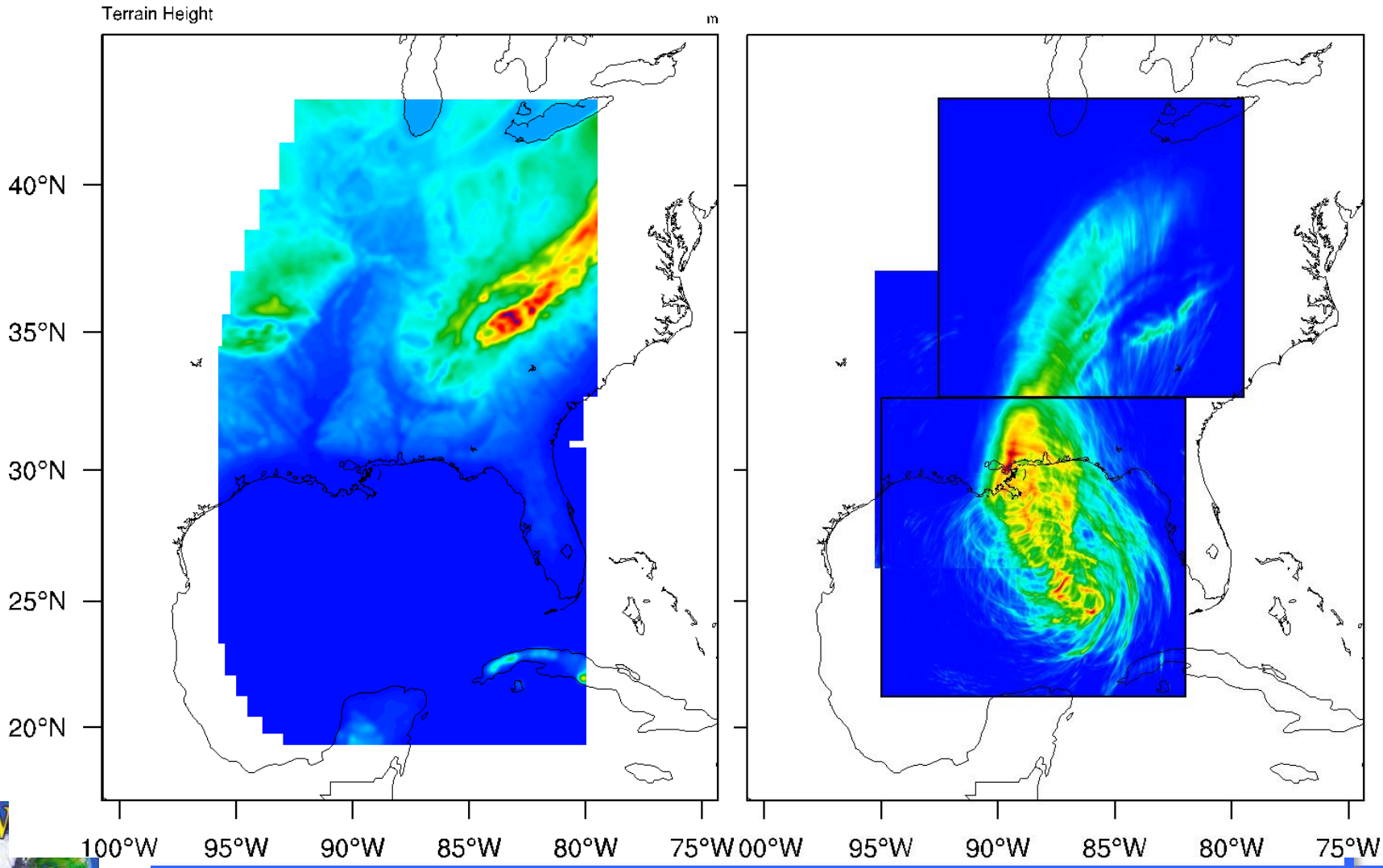


Moving Nest



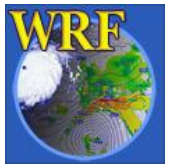
Nest Positions

Forecast Rainfall



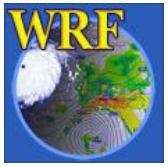
Moving Nest

- Adapted from the algorithm in MM5 by Chen and collaborators in U. of Miami
- Designed to use computing resources efficiently for hurricane work
- Available since Version 2.1
- Capabilities
  - Runs in MPI
  - All nests can move
  - Two-way interactive
  - Simple control via namelist
  - Tracking information in standard out file
  - Works with most of the physics options



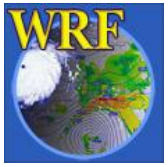
How Moving Nest Works?

- The algorithm tracks an upper level geopotential height minimum. Originally the level is set at 500 mb. The vortex center at 500 mb is smoothed to avoid local extremes
- It can read in 30 second topography data during the run. Landuse data also possible
  - Can be important at landfall
- The leading edge of the nest is initialized from interpolating parent domain data



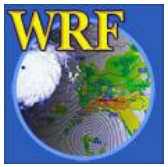
Improvements

- Make vortex-tracking level a runtime option
  - Improving the tracking of relatively weaker storms
- Add option to start moving nest at a later time
  - Helping with simulations where the storm is in its early development stage



Moving Nest

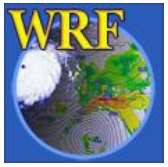
- It works well with developed storms
  - Tested over the past four hurricane seasons in real time at NCAR
- Where it might have difficulties..
  - Developing storms
  - Storms in extratropical transition where it loses vertical structure
  - Over complex terrain (mainly for weak storms)



Where is the code?

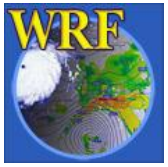
WRFV3/share/mediation_nest_move.F

- computes vortex center
- computes the moves
- computes 10 m wind max and min SLP
- process nest topography if asked

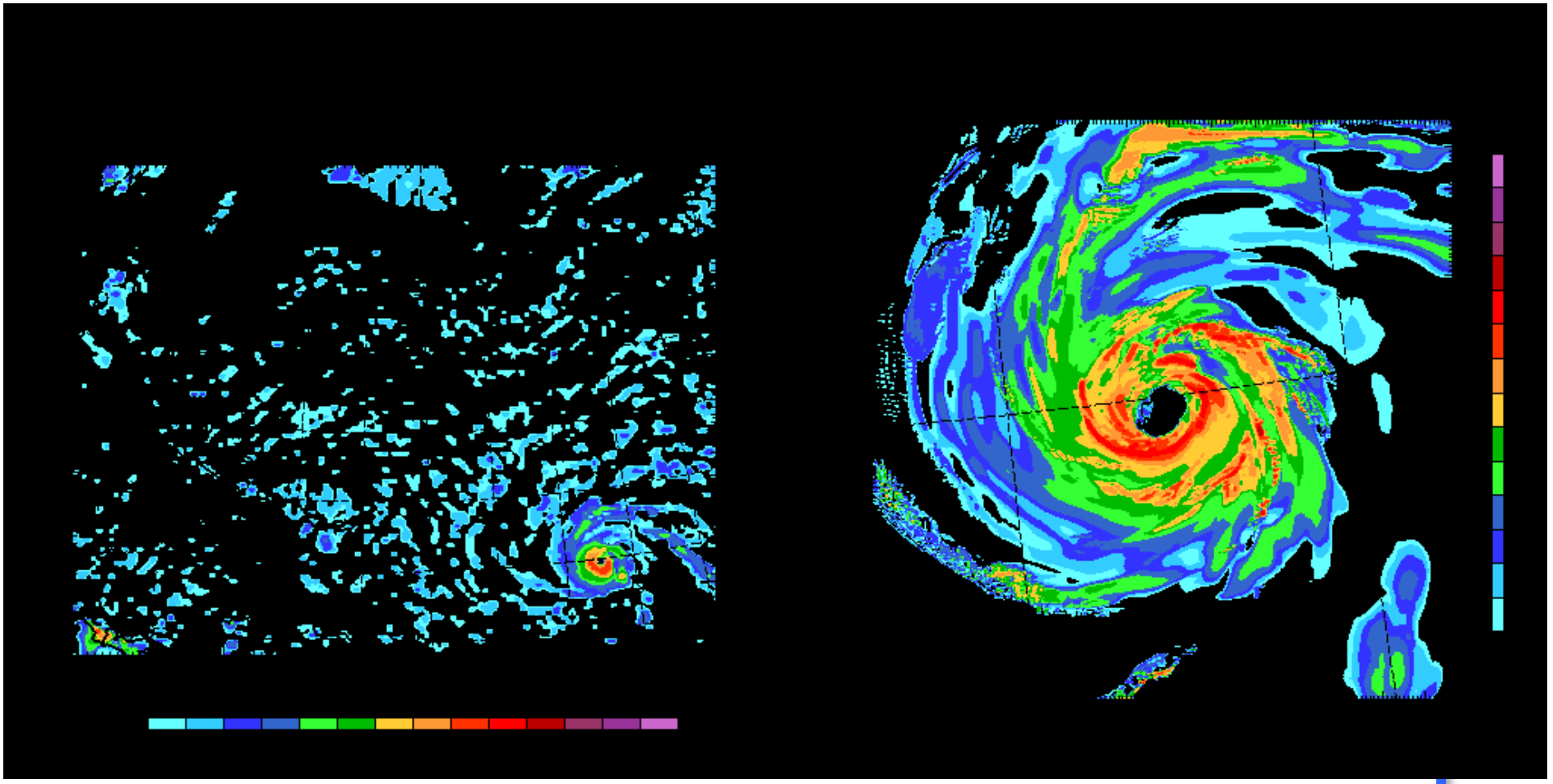


An Example of Moving Nested Run

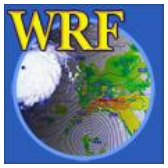
- Hurricane Bill (2009) in mid-Atlantic
- Grid dimensions:
  - Domain 1: 12 km, 424 x 325
  - Domain 2: 4 km, 277 x 277
  - Domain 3: 1.33 km, 682 x 682



Forecast radar reflectivity



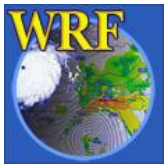
Initialization for Simple Ocean Mixed Layer Model



Initialization for Simple OML

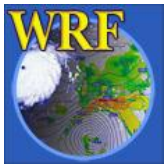
- Constant initial depth via namelist
  - oml_hml0 > 0

  or
- Use mixed layer depth from an ocean model
  - May process the data via WPS with variable name H0ML



An Example

- 3D HYCOM ocean data
  - Estimate two fields for the simple OML:
    - mixed layer depth: H0ML
    - top 200 m mean ocean temperature: TMOML, which is used as minimum SST to limit mixing.

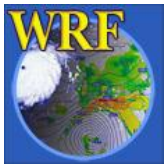


Estimate of H0ML

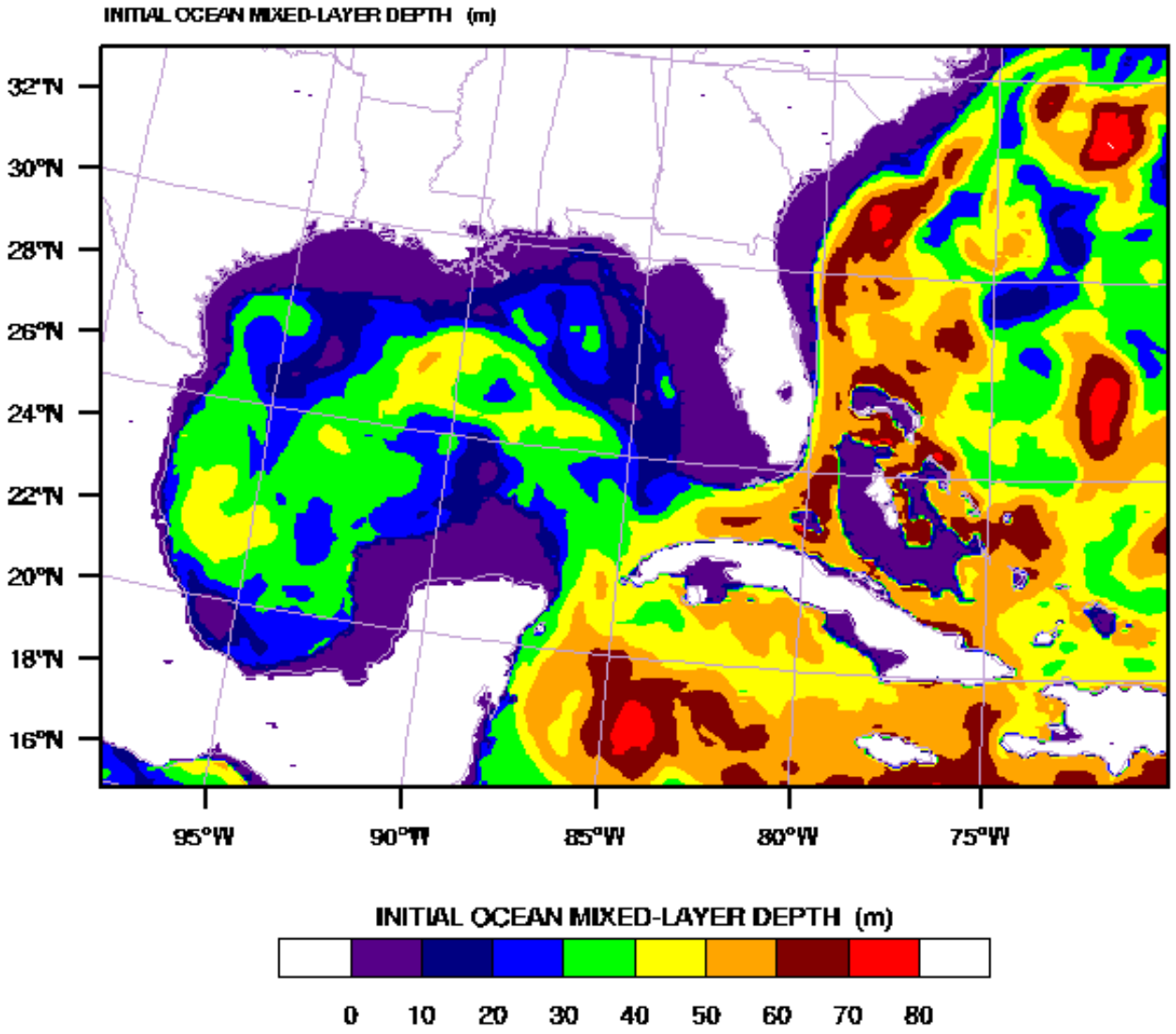
- Use heat content to determine an effective mixed-layer depth
- Horizontal variation of MLD “mirrors” variation of heat content

$$D = Z - \left(\frac{2(T_s Z - H)}{\Gamma} \right)^{\frac{1}{2}}$$

Where D is MLD, T_s is top level ocean T, Z = 100 m, H is the heat content of the top layers, Γ is lapse rate below 100 m, ~ 0.2 K/m

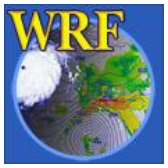


Estimated OML on Aug 26, 2005



Estimate of TMOML

- Mean ocean temperature in top 200 m layer
- Used in OML to limit mixing, especially in shallow water



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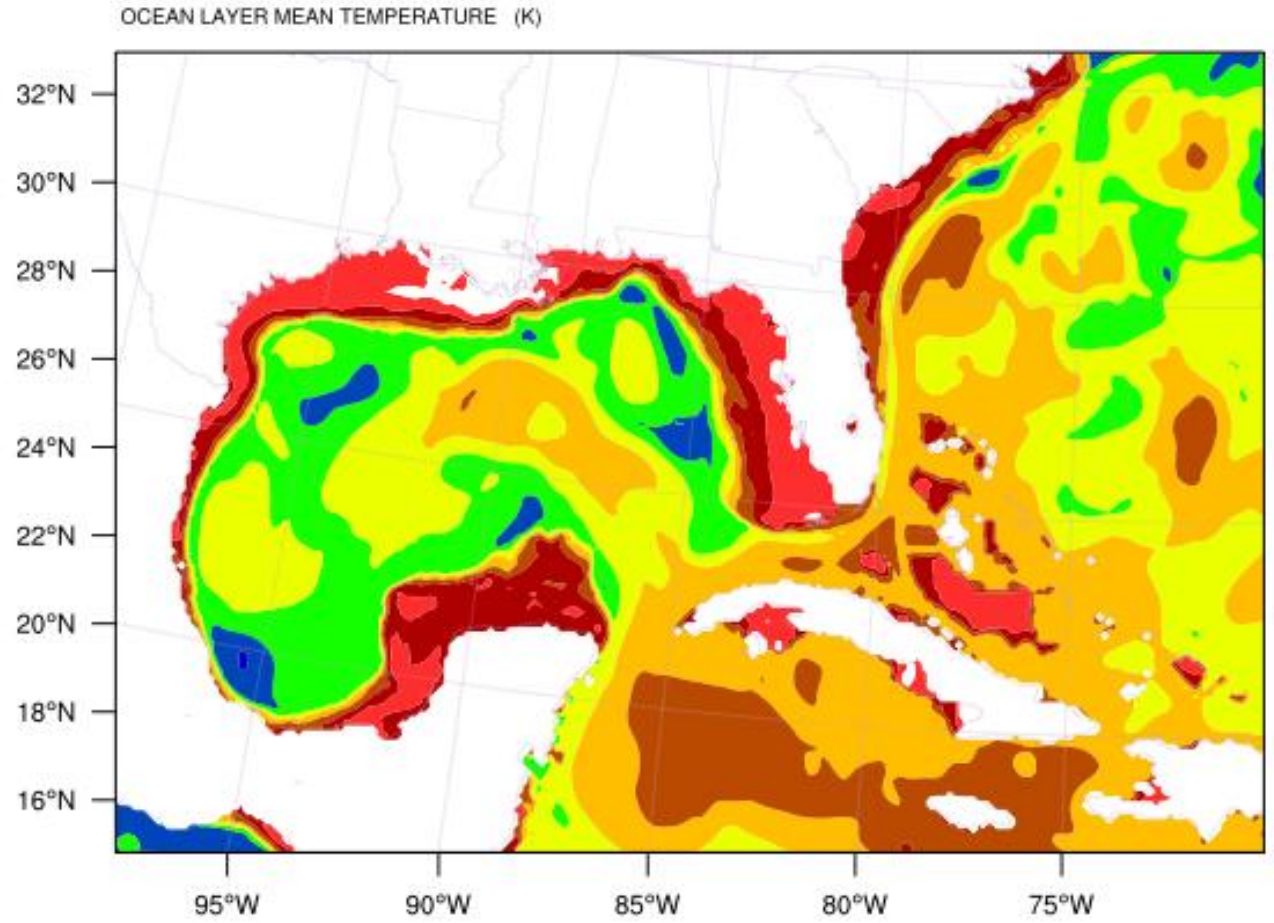


Working with HYCOM Data

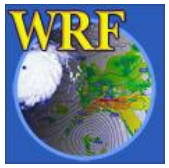
- Obtain HYCOM 3D temperature data from

  http://www.hycom.org

  or

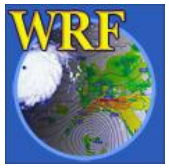
  ftp://hycom.coaps.fsu.edu/datasets/GLBa0.08/expt_90.8/data/temp

  Get file: archv.2009_*218*_00_3zt.nc



Working with HYCOM Data

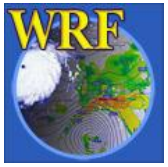
- Compile and run the utility program *proc_oml.f*
  - reads the netCDF HYCOM data
  - Estimate H0ML and TMOML
  - Interpolate the data to regular lat/lon grid
  - Write data out in ungrib/intermediate format, *MLD*
  - The reformatted data is currently for Atlantic and Gulf of Mexico, but can be extended to global or another basin
- The program is available on the ARW Users' page



Working with HYCOM Data: *metgrid*

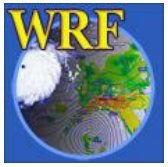
- Use the field, *MLD*, when running *metgrid*:
  - add *MLD* to '*constants_name*'

- In V3.2 WPS, these fields are added in METGRID.TBL

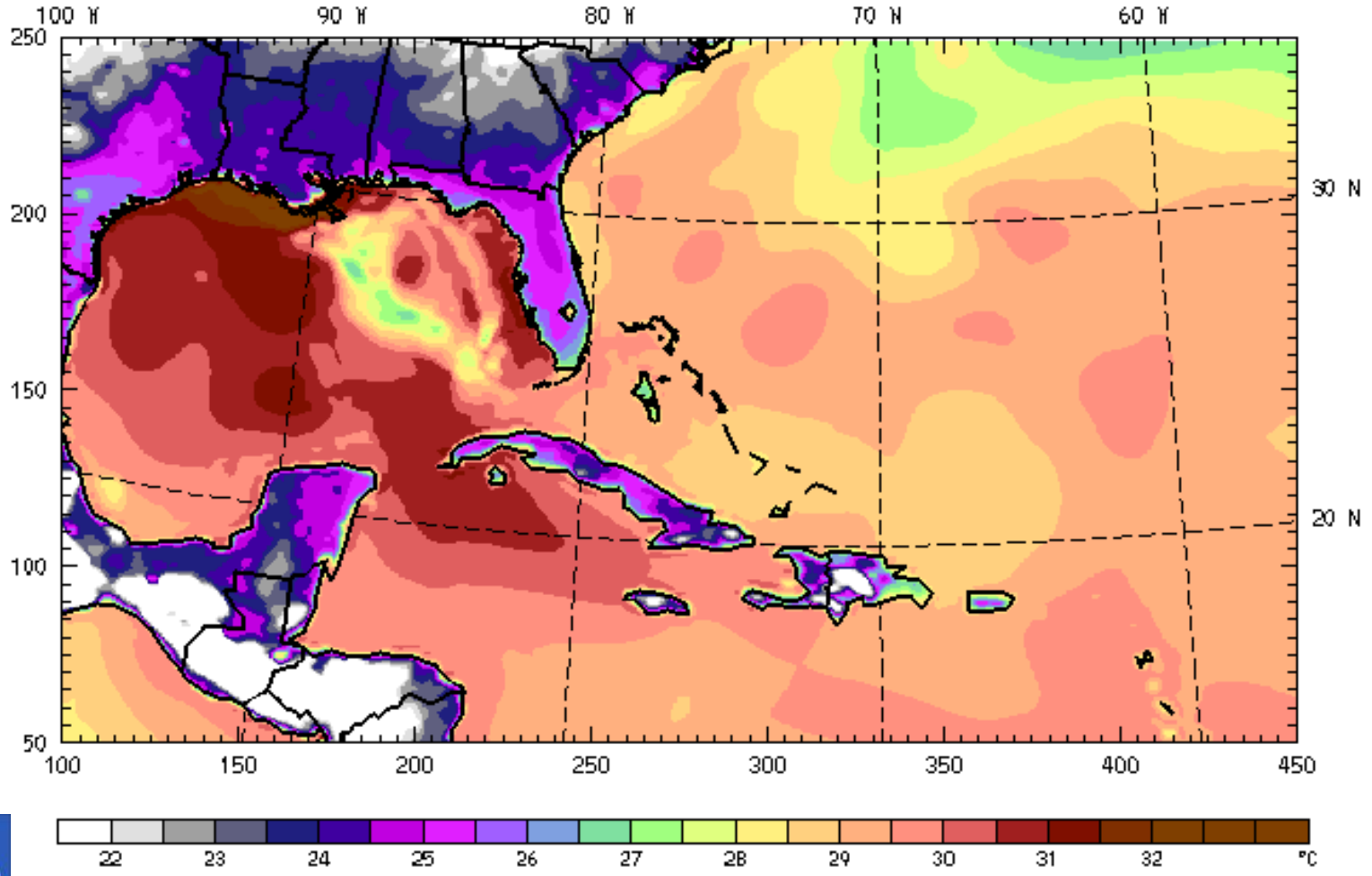


Working with HYCOM Data: *real & wrf*

- The capability of using input mixed layer depth is added to V3.2:
  - Set omlcall = 1
  - Set oml_hml0 < 0



60 h Forecast of SST



Cautionary Notes

- Know the limitation of this simple OML model, and use it with caution
- It may work for a forecast problem, but probably limited usefulness in research
- Feedback and improvement are welcome
- Look to the future for the capability of multi-layer, 3D ocean model, and HYCOM