Making The Best Hurricane We Can:

Design of the ECWMF/ARW-WRF Hurricane Nature Run

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I. Objectives and Considerations

- Our goal is to make a very high quality simulation of an Atlantic hurricane that can be used as a "nature run" for Observing System Simulation Experiments (OSSEs) and other research purposes.

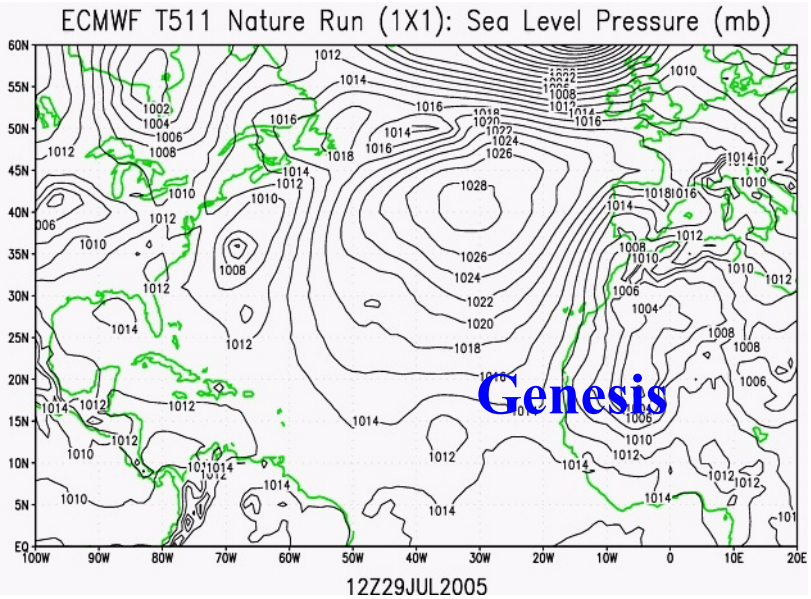
- The model output will be used to generate synthetic observations for forecast models - presumably HWRF.

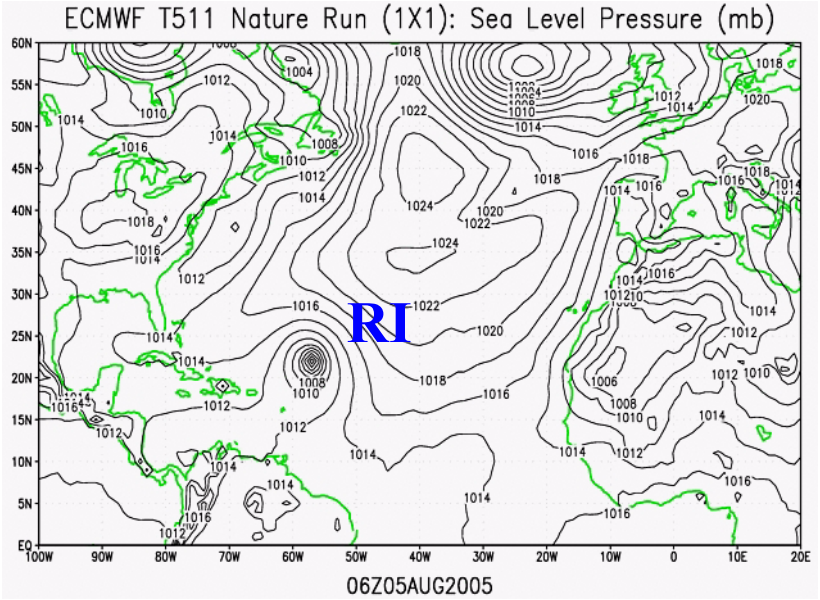
- To take advantage of a pre-existing, pre-validated global data set, we use output from the ECMWF global nature run as boundary conditions.

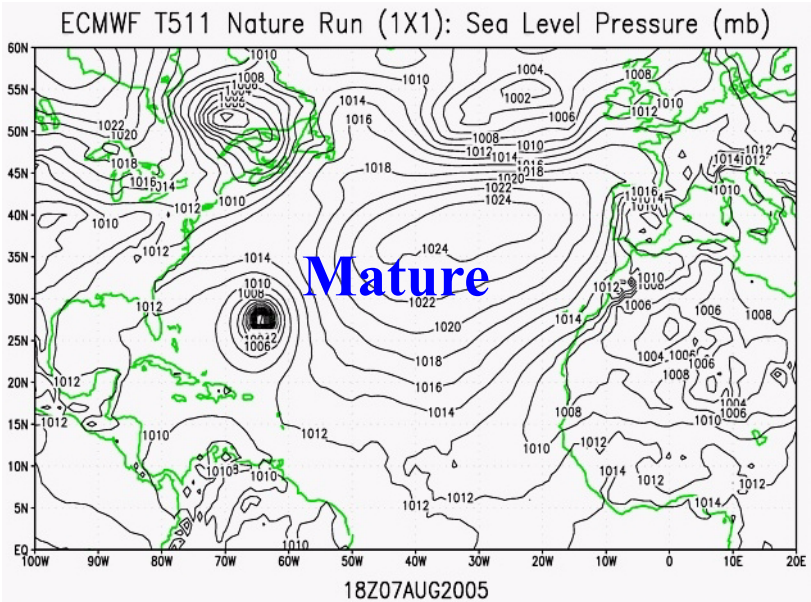
  For access to a wide range of advanced physics options, very high resolution capability, and to avoid the "identical twin problem," we use WRF-ARW.

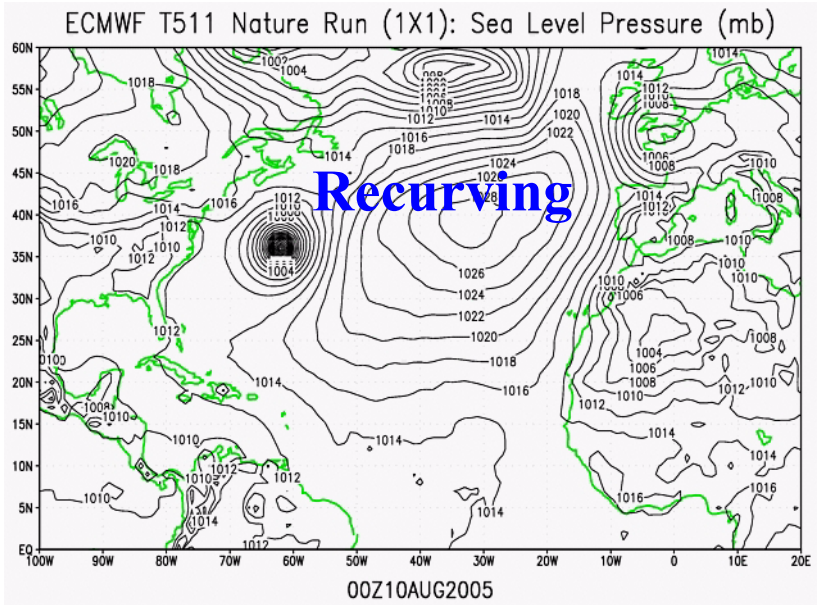
II. The ECMWF Nature Run and Case Selection

- The ECMWF nature run is a free-running simulation with prescribed surface (SST only?) boundary conditions for summer and fall 2005







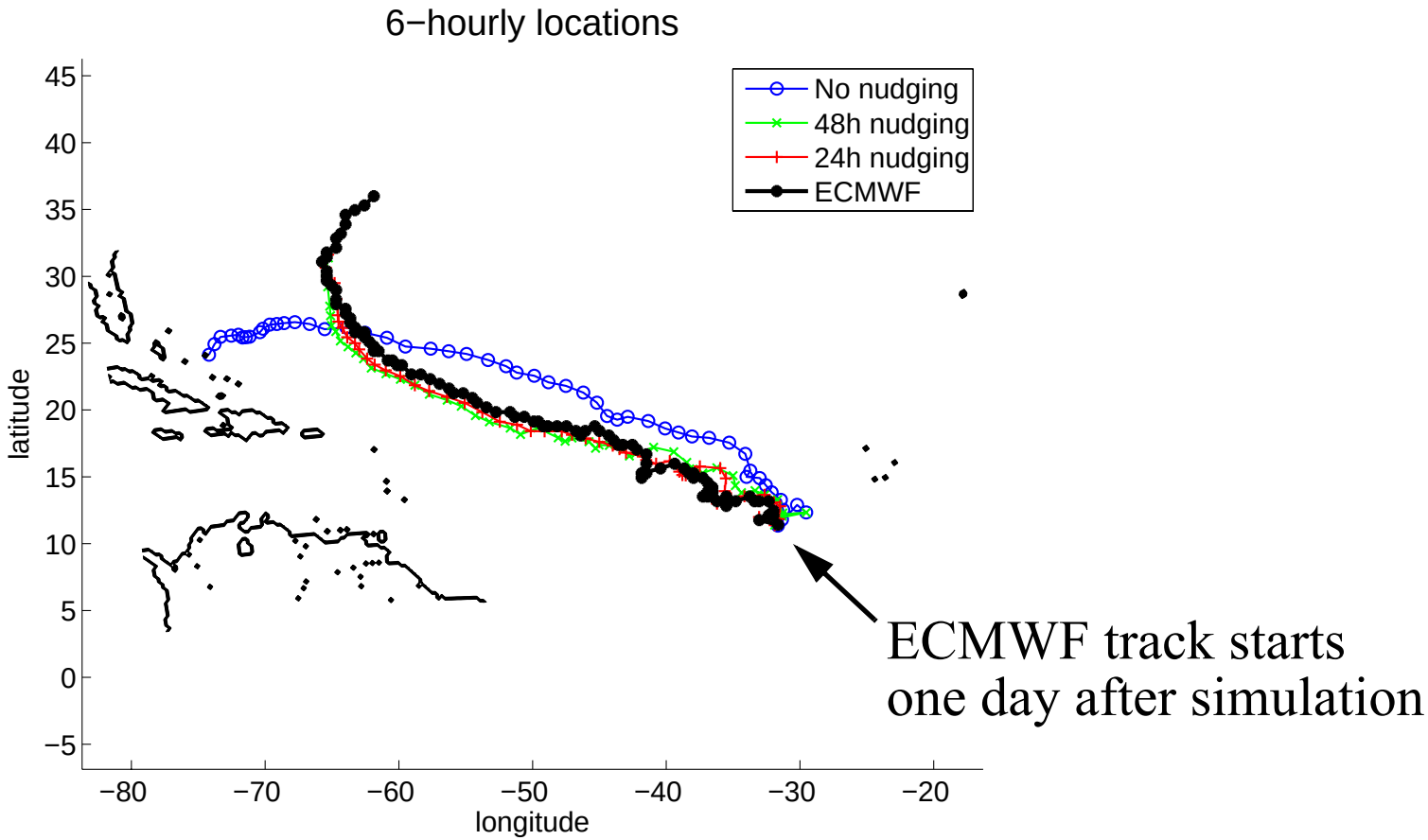


III. Planned WRF Configurations

- Domain:
  - * 27 km grid covering tropical Atlantic.
  - * Nesting to 9km, 3km, and 1km. Inner grid 480km x 480 km.
  - * 60 vertical levels. First 20 levels below 850 hPa, lowest at 60 m.
- Physics:
  - * Kain-Fritsch cumulus parameterization on 27km and 9km grids.
  - * 6-class, double-moment microphysics (WDM6).
  - * New RRTM advanced longwave and shortwave radiation schemes.
  - * YSU PBL scheme with TC-relevant modifications to Ck and Cd.
- Other issues:
  - * Use updated SSTs from nature run, or simple ocean model?
  - * Use “nudging” on the outermost, 27km grid?

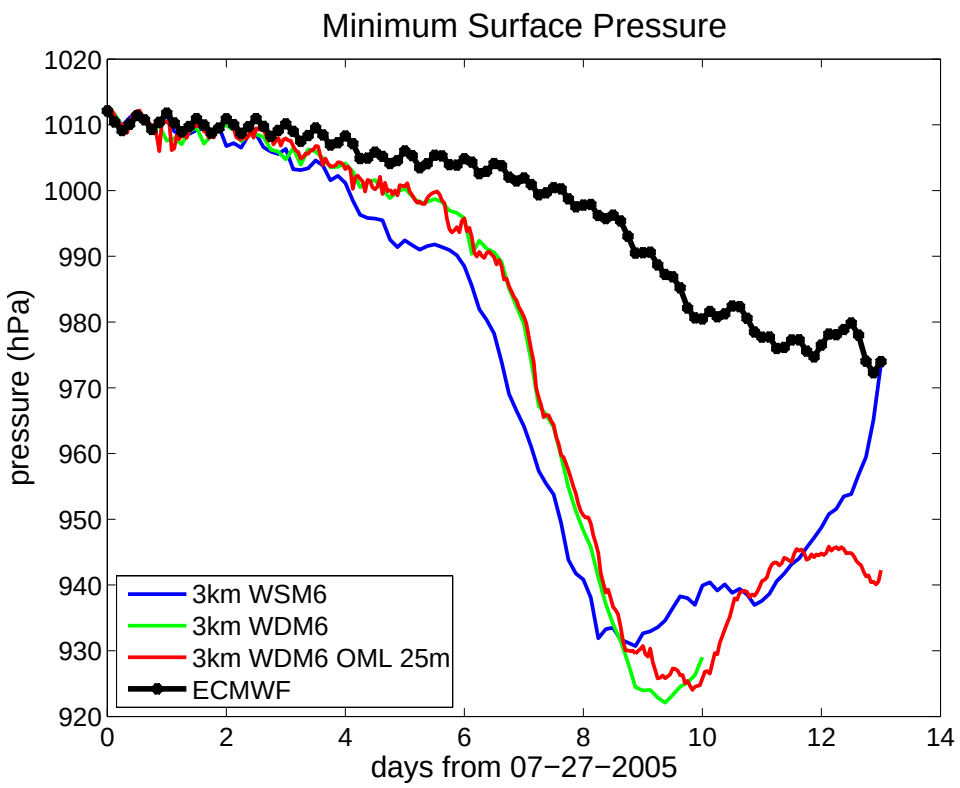
IV. Testing and Preliminary Results

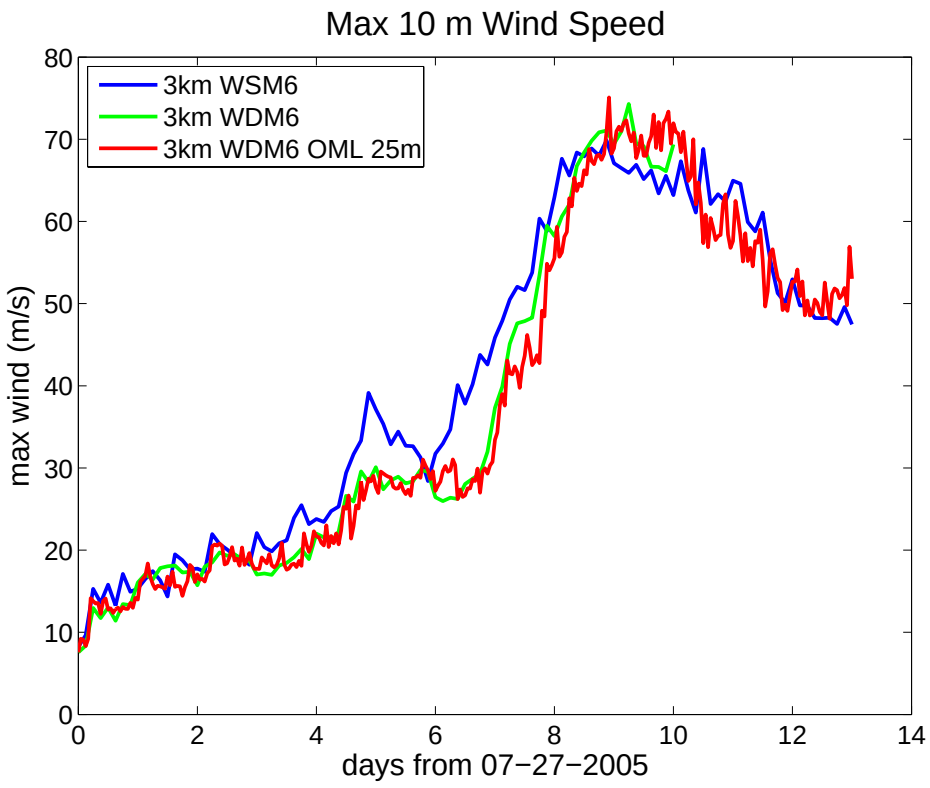
- "Nudging" means forcing the outer-domain model data toward the global model data with a prescribed relaxation time scale.



- While conceptually undesirable, nudging is necessary for consistency between the WRF and ECMWF nature runs for both track *and* large-scale fields.

Resolution, Physics, and Intensity





(3km runs use 24 h nudging)

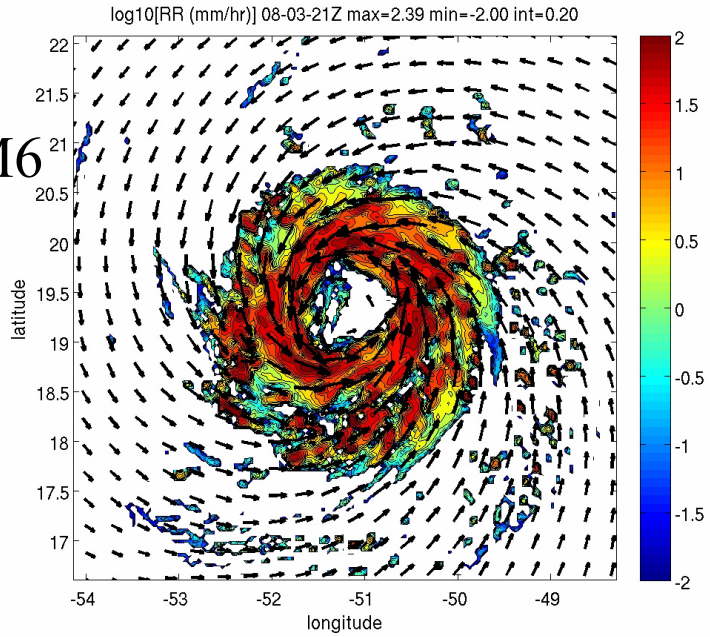
- Double moment scheme delays RI, but then storm gets stronger.

- Simple ocean mixed layer scheme has almost no effect on peak intensity.

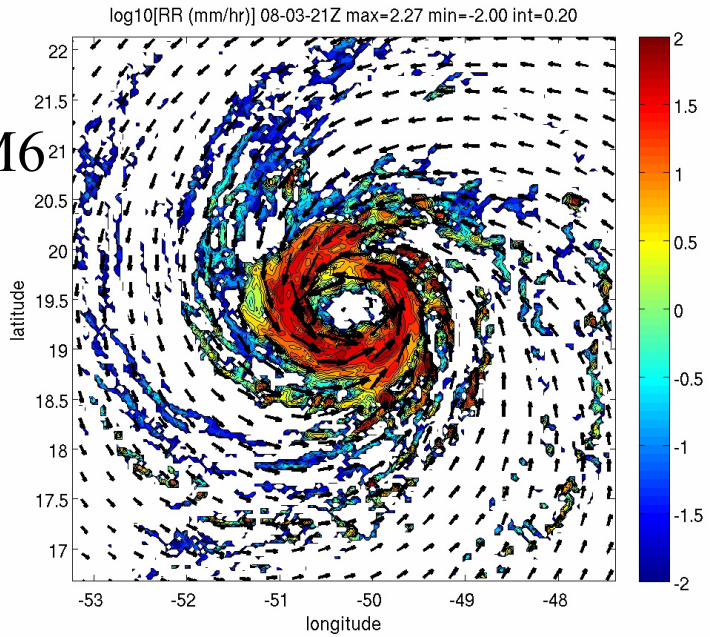
Benefits of Advanced Microphysics and Resolution

plots show log10[Rain Rate (mm/hr)]

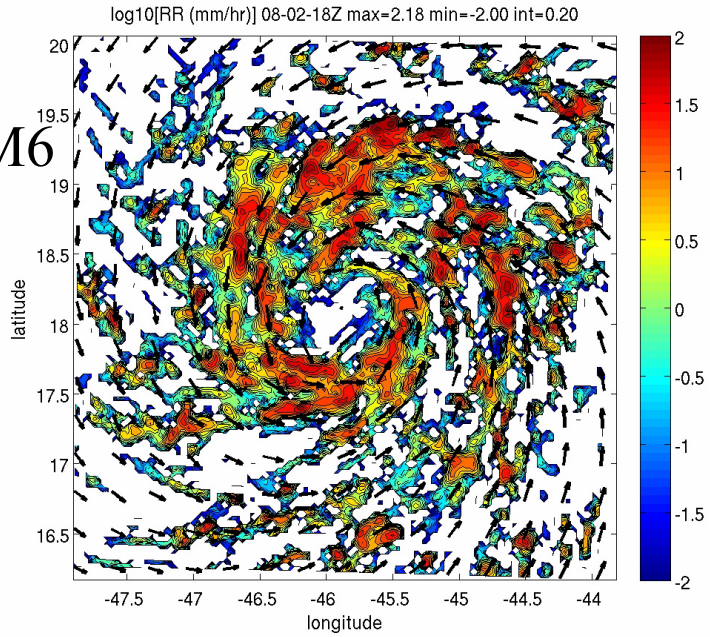
3km, WSM6



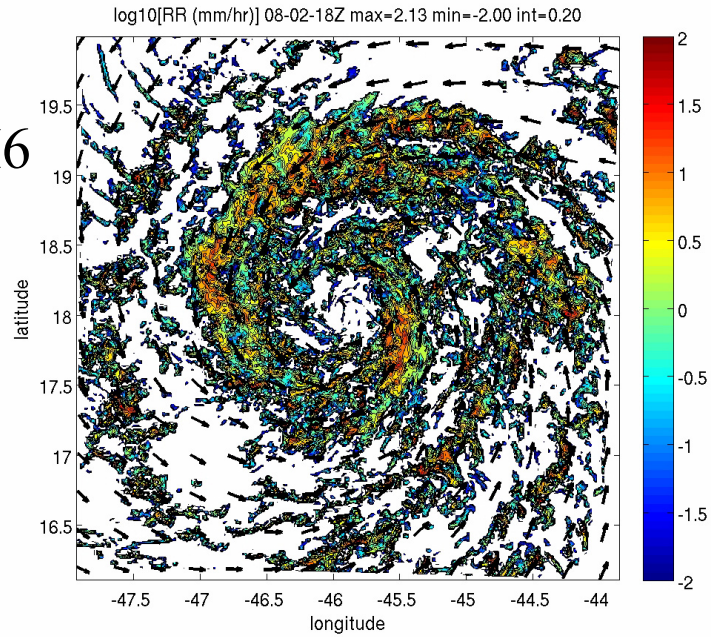
3km, WDM6

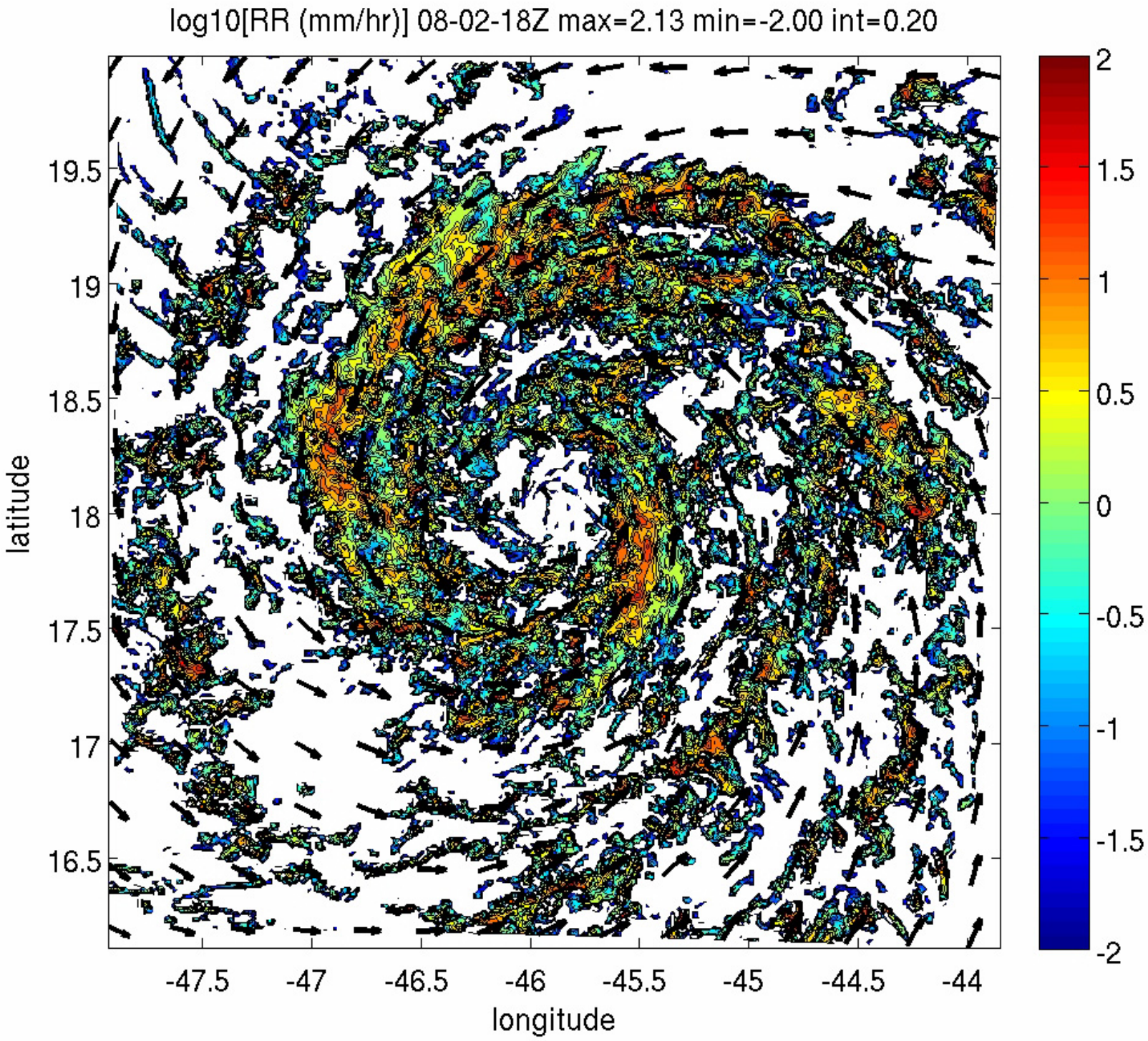


3km, WDM6



1km, WDM6




log10[RR (mm/hr)] 08-02-18Z max=2.13 min=-2.00 int=0.20
latitude
19.5
19
18.5
18
17.5
17
16.5
-47.5
-47
-46.5
-46
-45.5
-45
-44.5
-44
longitude
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2

V. Current Plans

- Extend domain northward to capture full recurving stage. (Done)

- Perform 15 day simulation with 3km resolution, 1 hour output. (In progress)

  Evaluate as nature run "rough draft."

- Plan for 1km run, 10 minute output.

  Requirements:

  * 20 days of run-time on 96 processors on UM Supercomputer.

  * 4TB of disk space for storage.