Evaluation of GFDL wind field structure during rapid intensification TC cases using H*Wind

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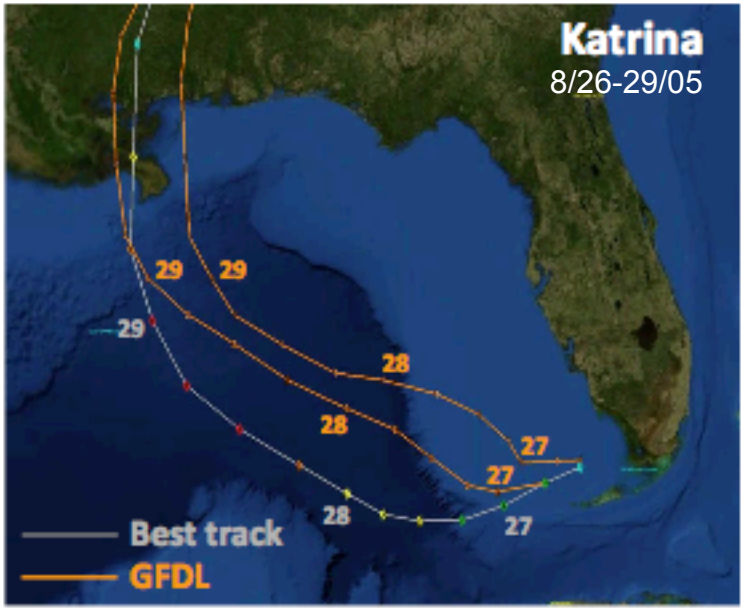
Motivation

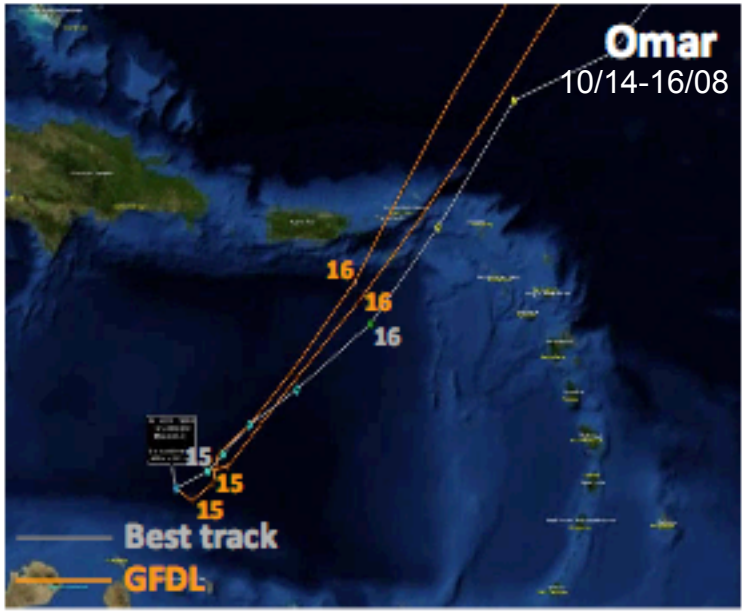
- Rapid intensification (RI) challenging forecast problem
- Can cause significant property loss and damage at landfall
- Much research on understanding and predicting intensity during RI, less attention on wind structure, especially surface wind structure
- Ability to predict RI, and the structure and evolution of surface wind field during RI, vital for preparedness

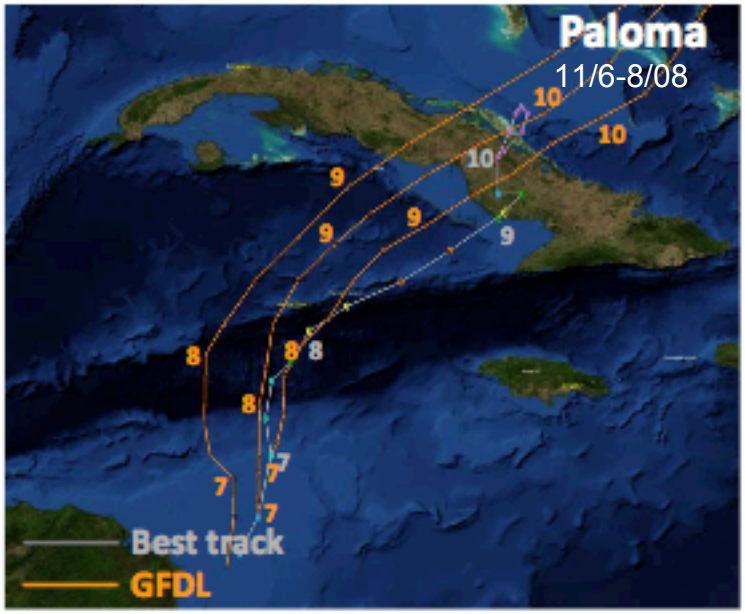
Methods

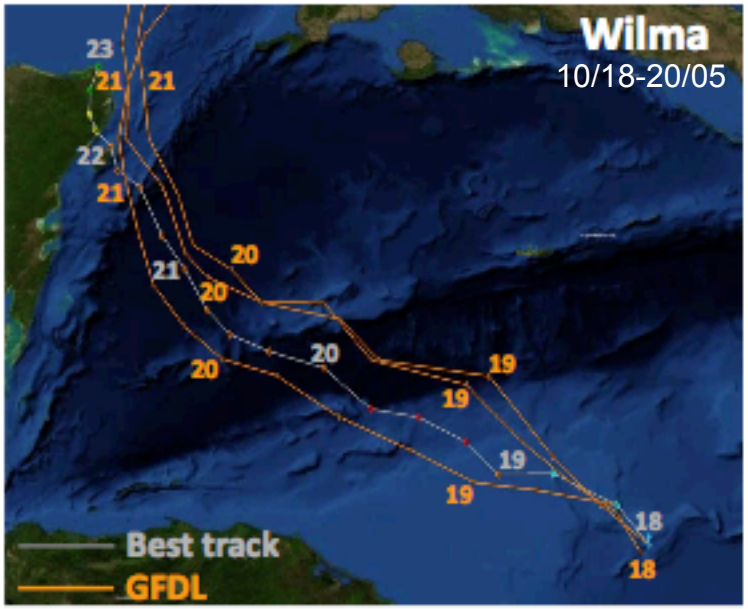
- Evaluate surface wind field evolution from the GFDL model and H*Wind
  - Symmetric wind field
  - Structure parameters e.g. RMW and IKE
- GFDL model
  - Used model grids (runs 4x a day)
    - Model resolution ~9km
  - Model grids were analyzed within H*Wind
- H*Wind
  - HRD's surface wind analyses, resolution of 6 km
  - uses all available obs
    - Obs are standardize to a common framework
- Test cases (observed RI storms)
  - Katrina (8/26-28/05)
  - Wilma (10/18-20/05)
  - Paloma (11/6-8/08)
  - Omar (10/14-16/08)

Storm tracks



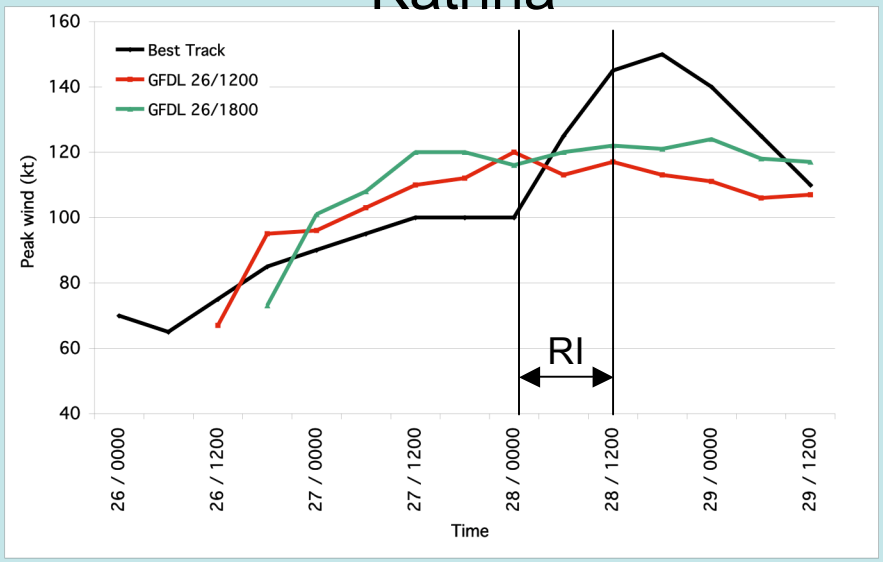




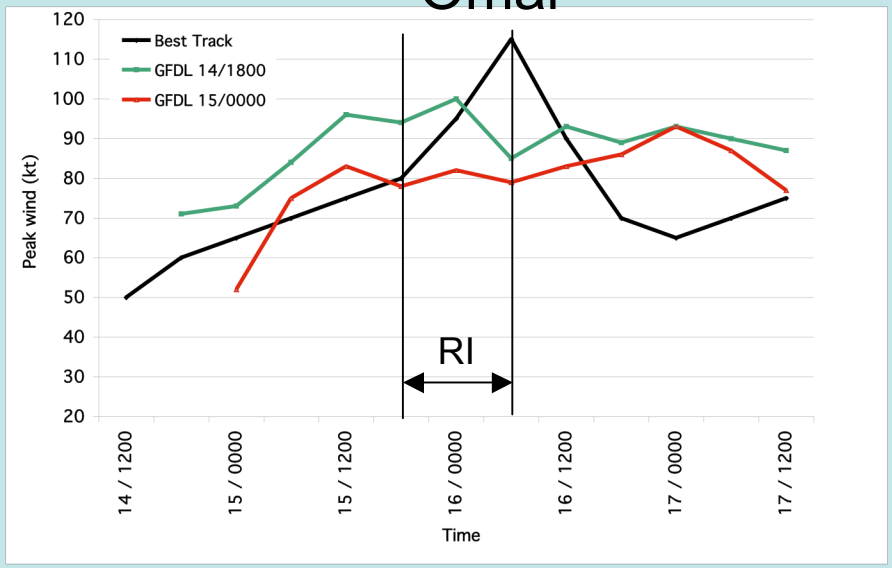


Intensity

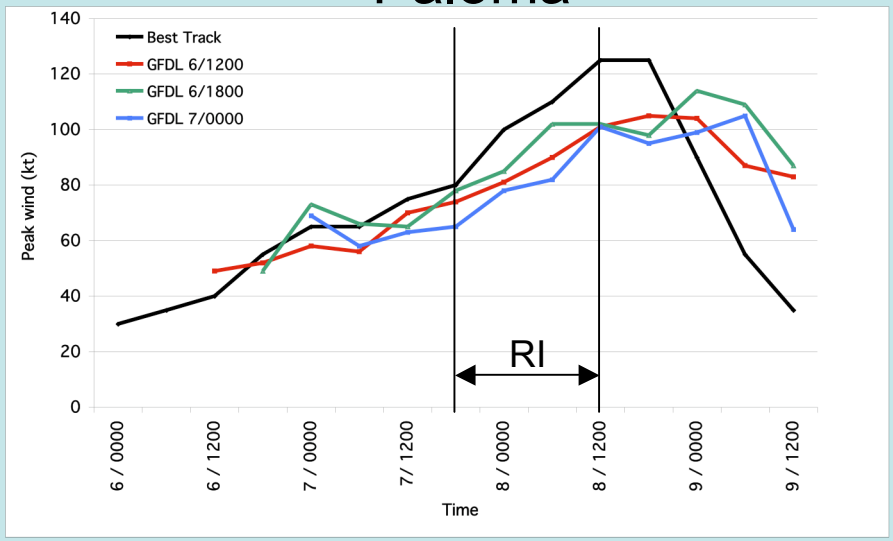
Katrina



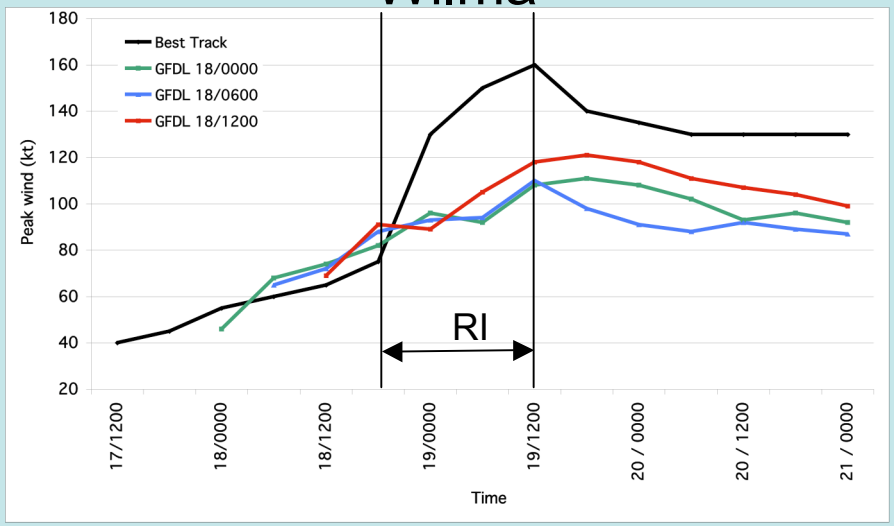
Omar



Paloma

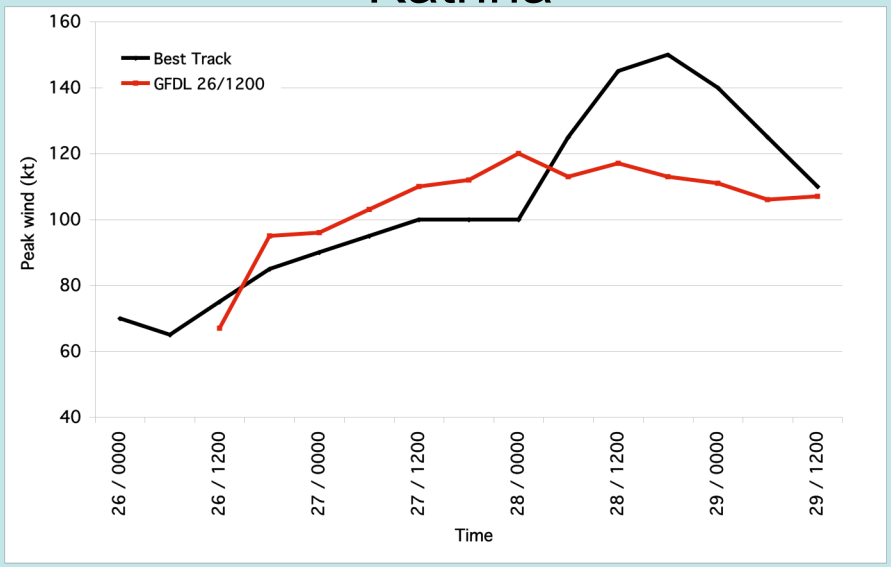


Wilma



Intensity

Katrina



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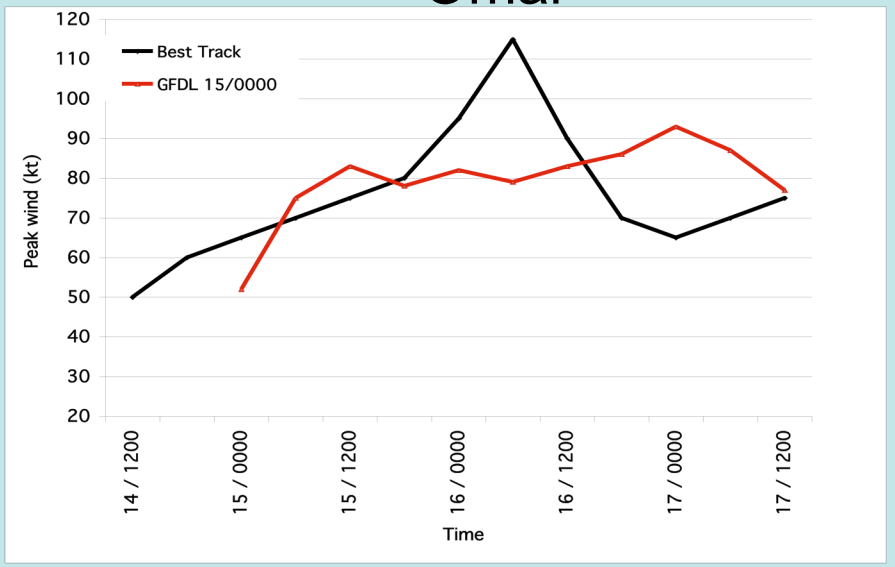
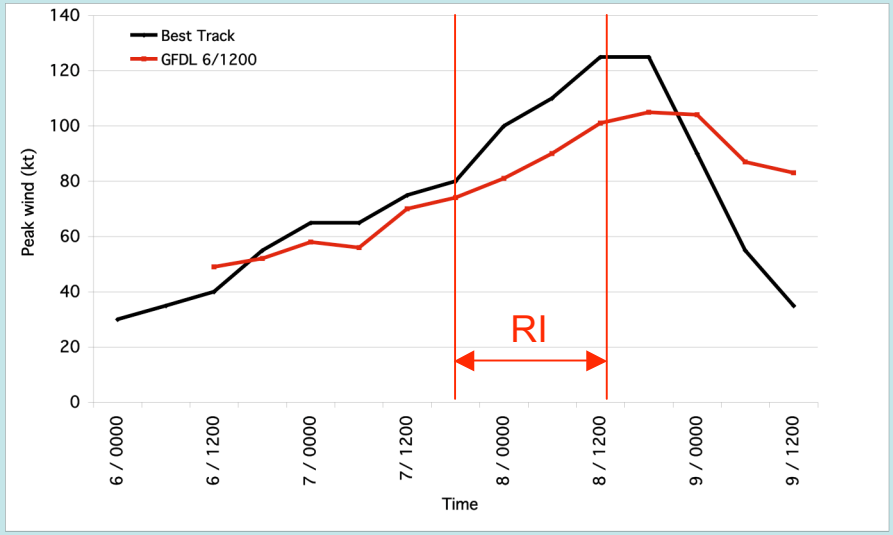
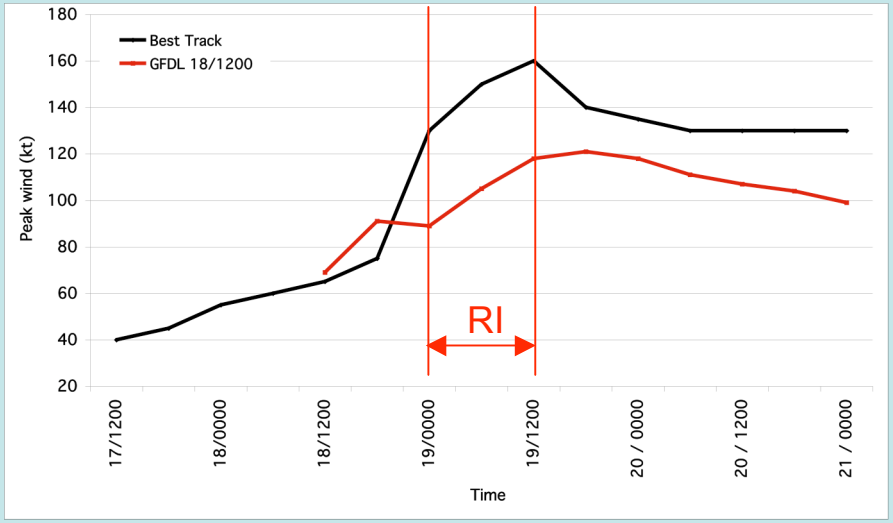


Paloma



Wilma

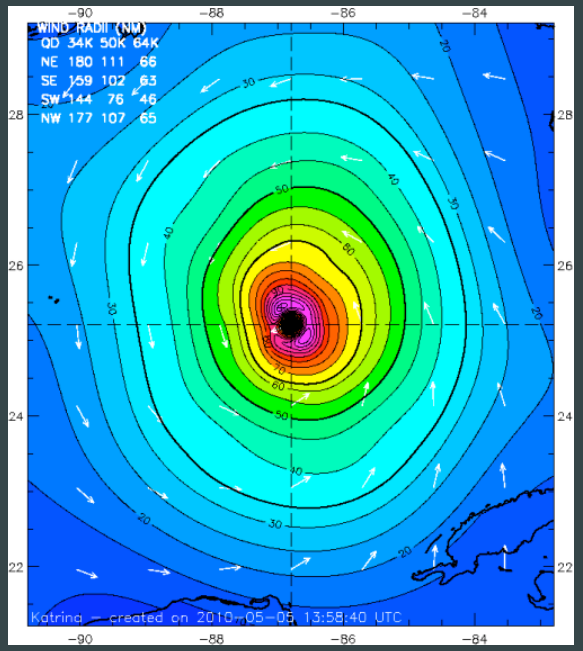


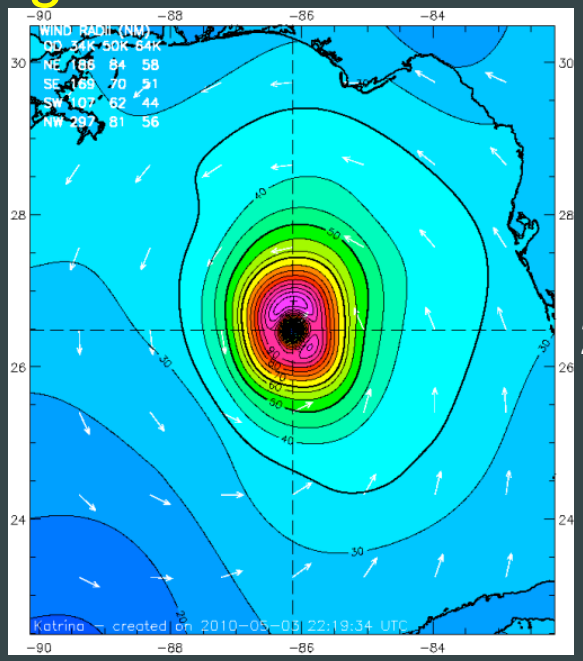
Wind Analyses using H*Wind

Katrina
8/26 6Z

Max wind
113 kt

16 nm RMW





Katrina
8/26 6Z

Max wind
109 kt

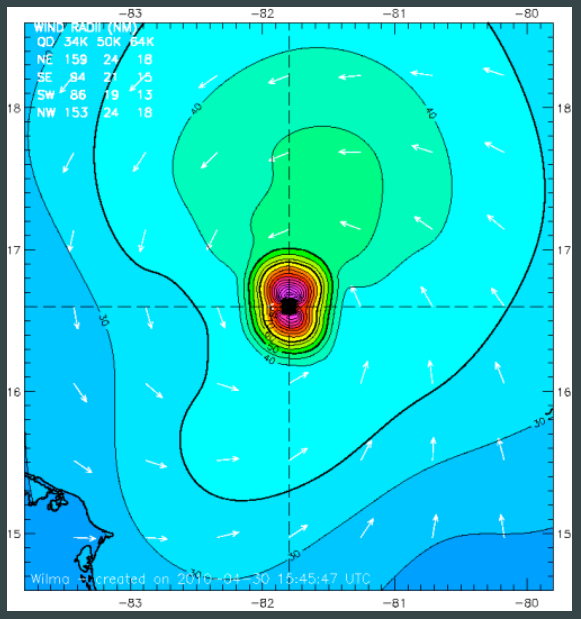
23 nm RMW

Observations

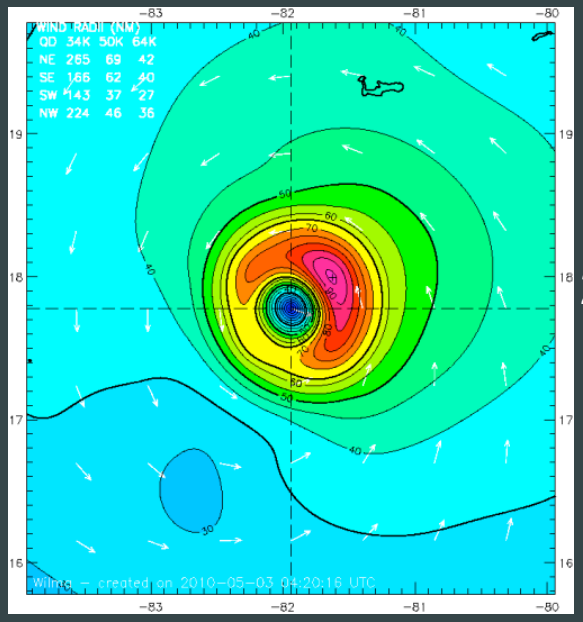
Wilma
10/19 0Z

Max wind
109 kt

7 nm RMW



GFDL model



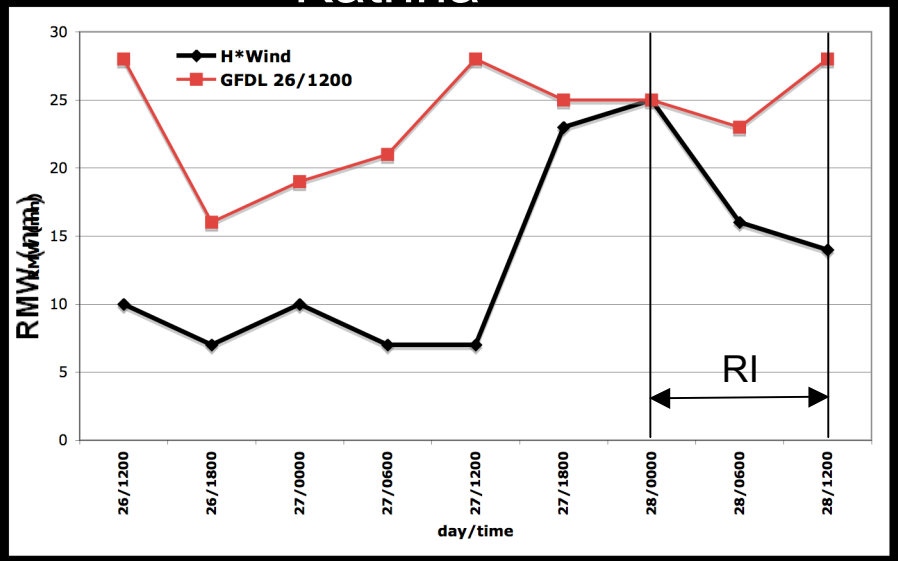
Wilma
10/19 0Z

Max wind
96 kt

23 nm RMW

Radius of Maximum Wind (nm)

Katrina



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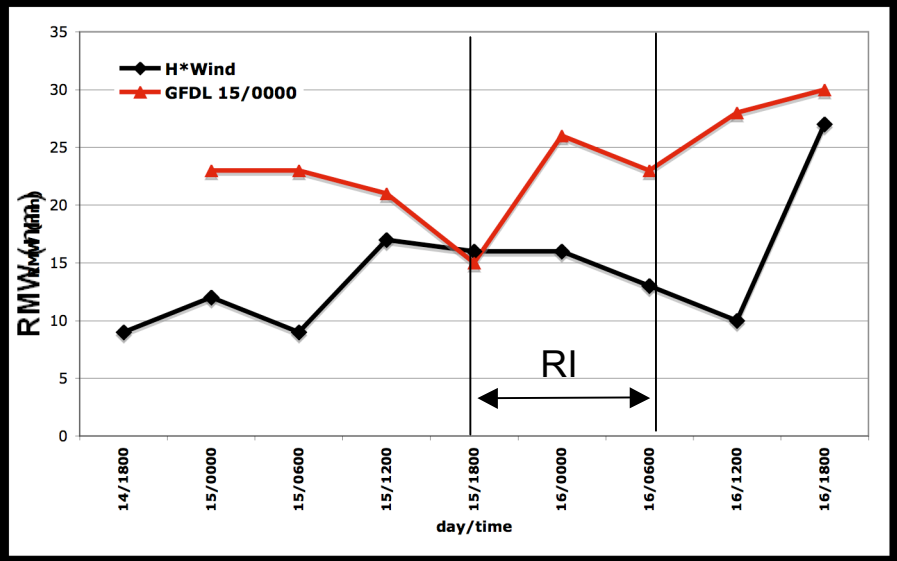
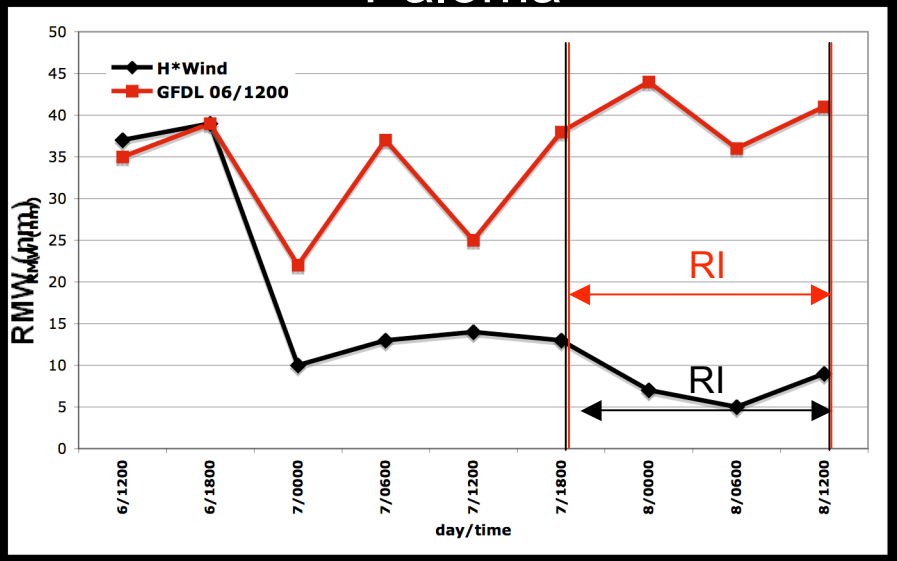
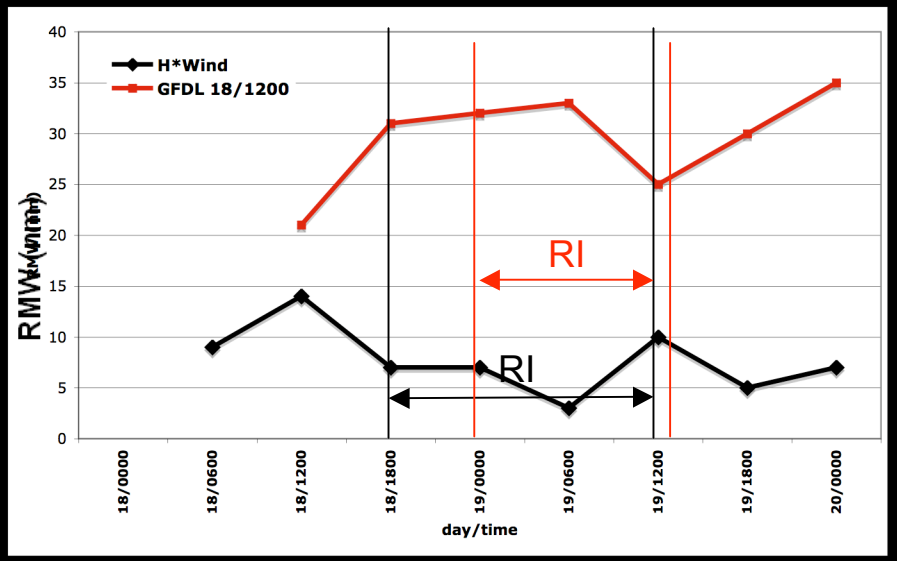


Paloma

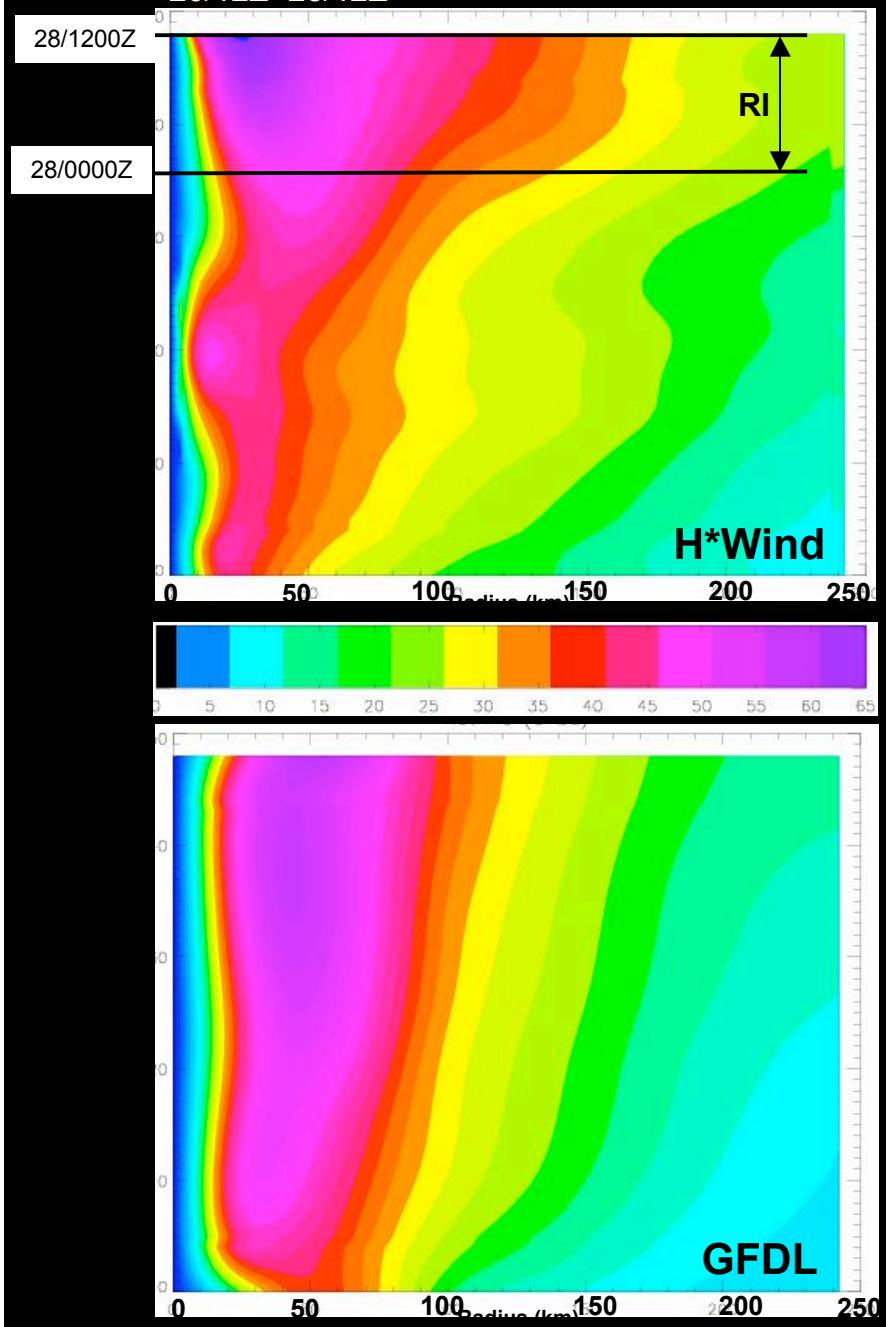


Wilma

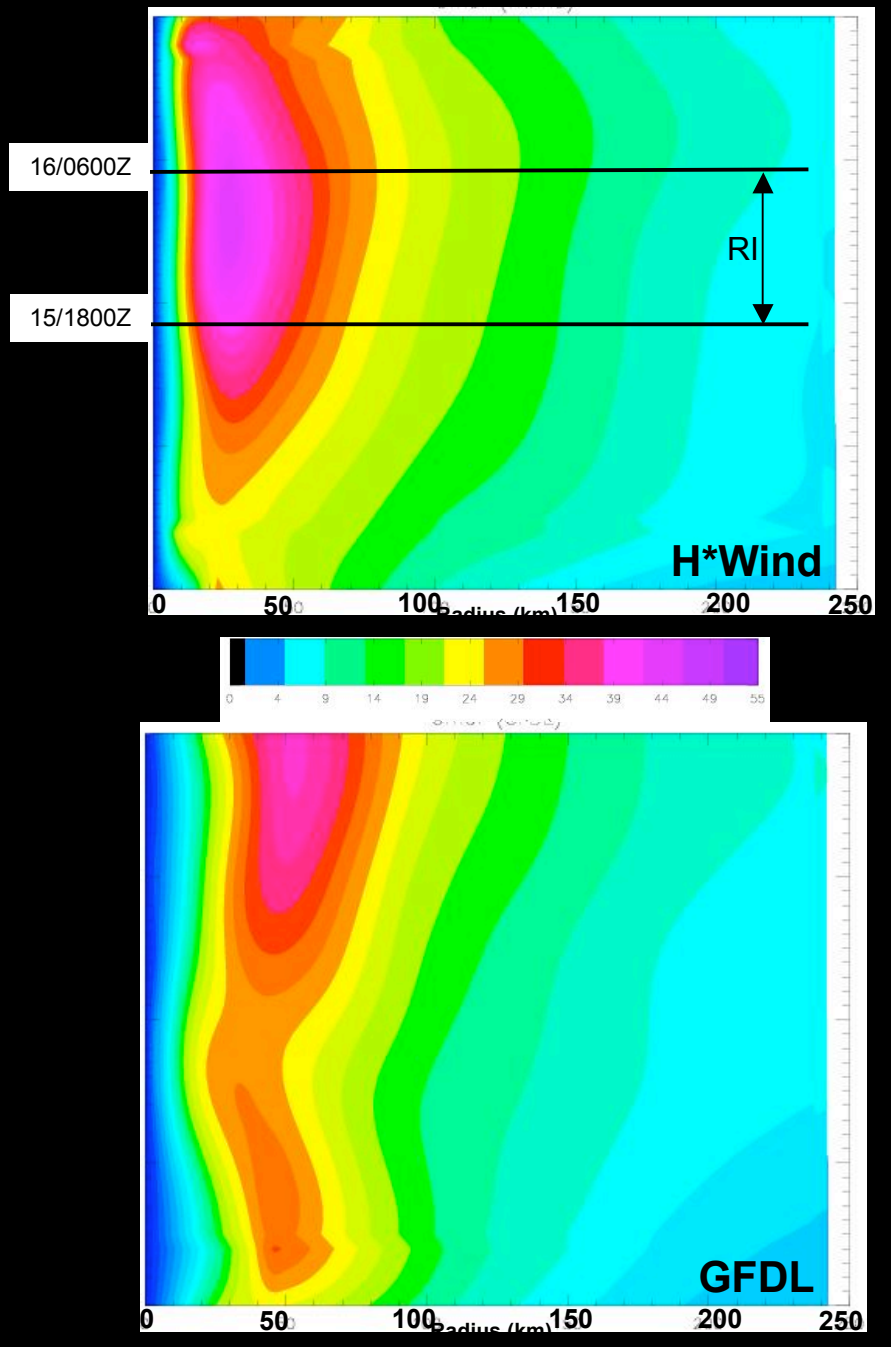


Symmetric wind field evolution (m/s)

Katrina
26/12Z -28/12Z



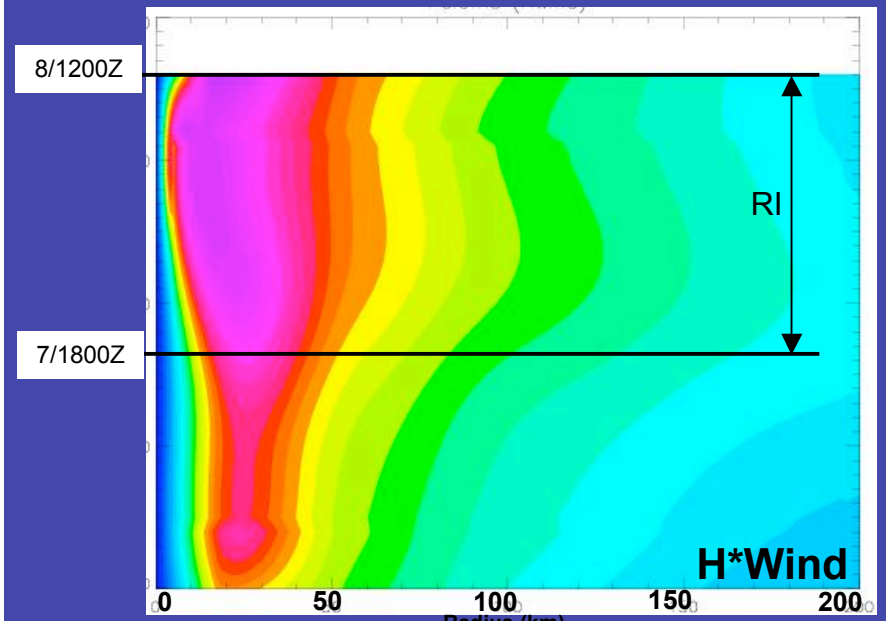
Omar
15/00Z -16/18Z

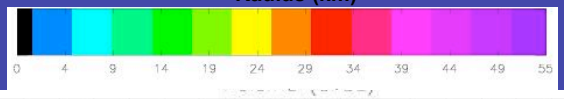


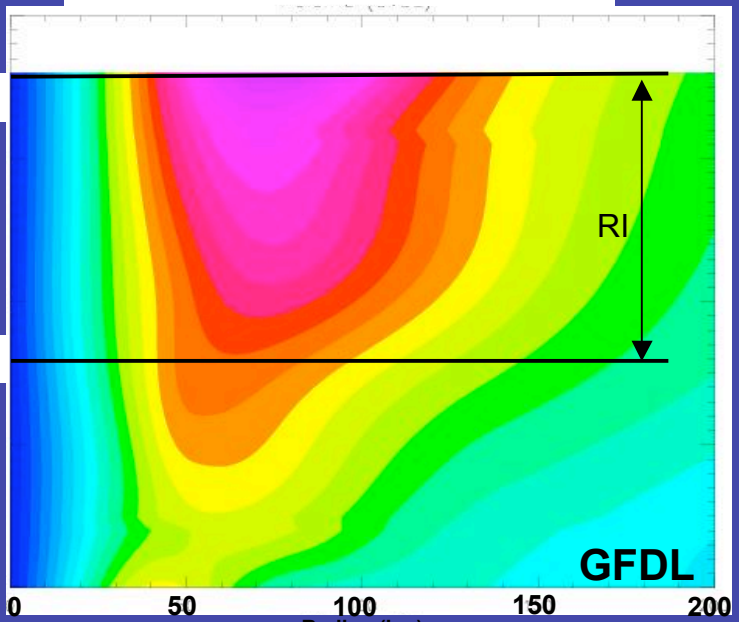
Symmetric wind field evolution (m/s)

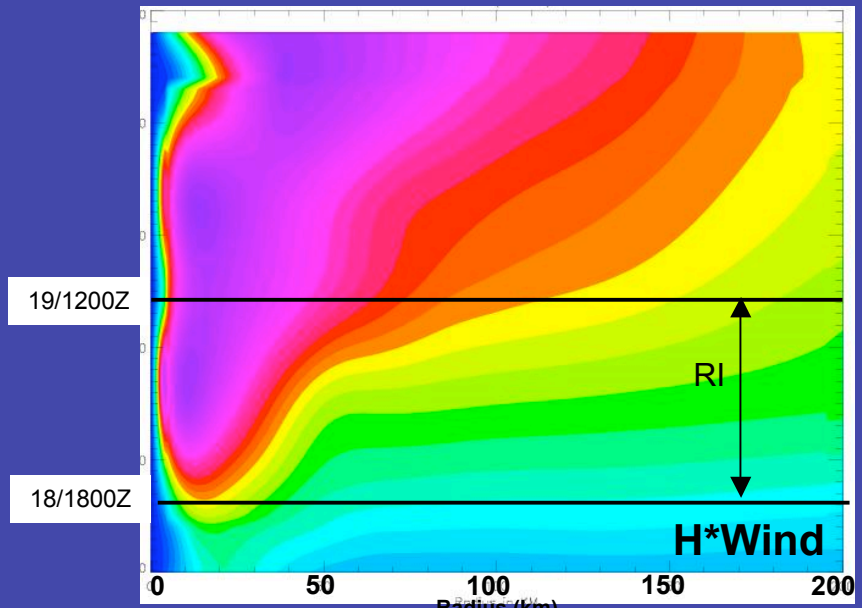
Paloma
17/00Z -18/12Z

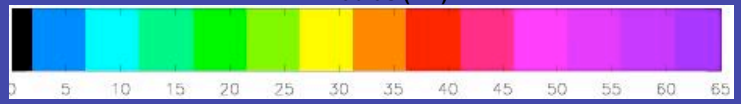
Wilma
18/12Z -20/12Z

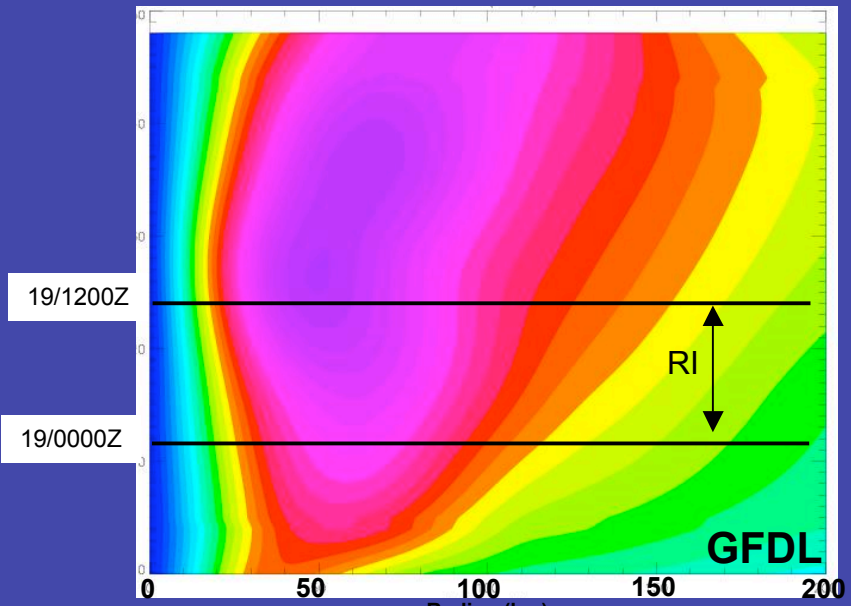






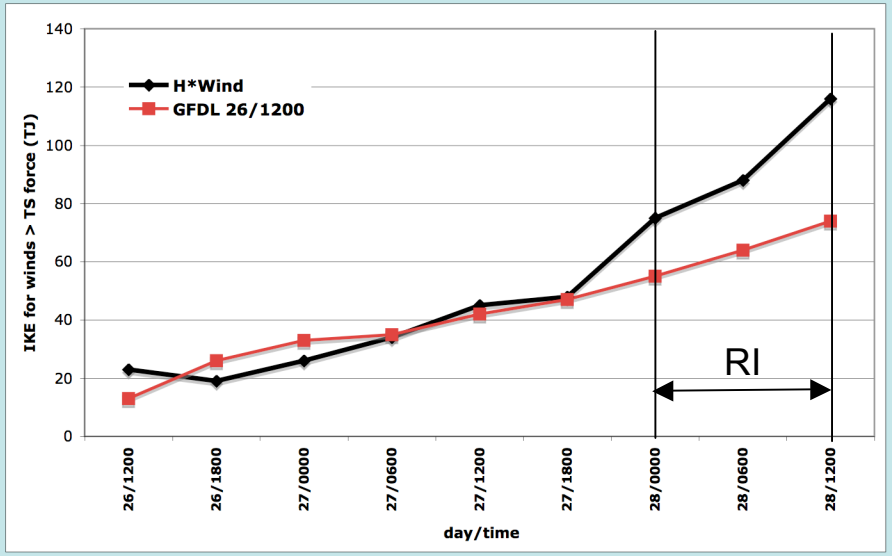




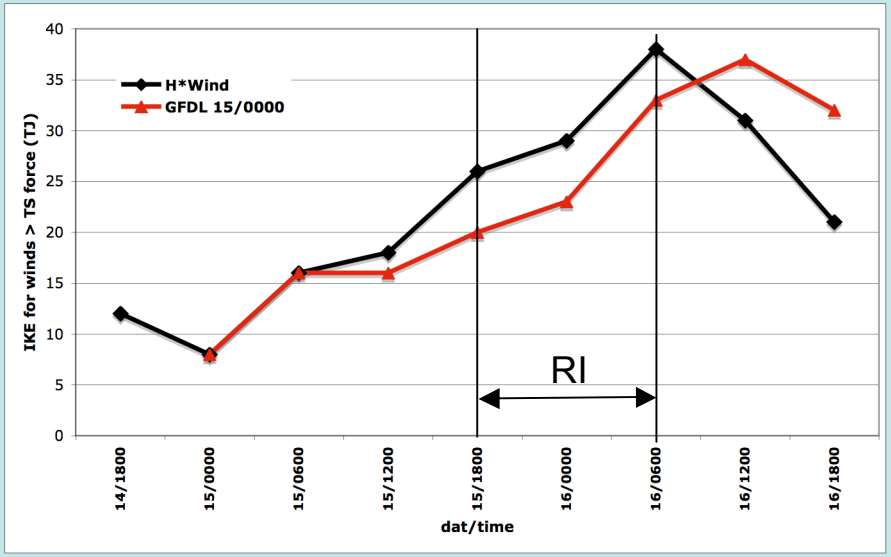


Integrated Kinetic Energy (TJ)

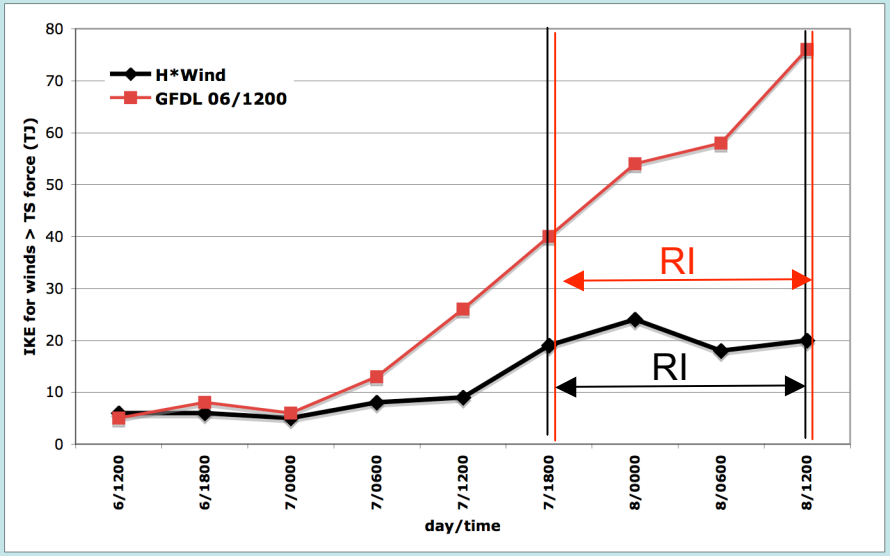
Katrina



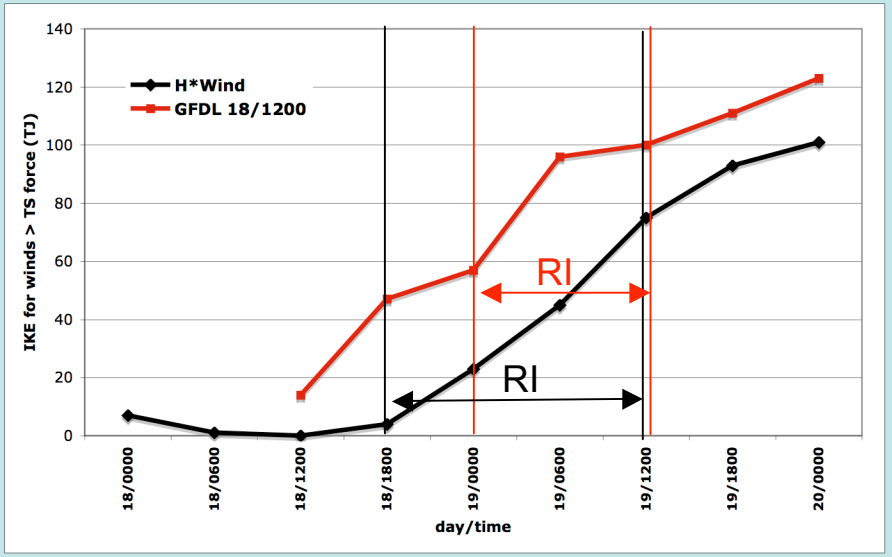
Omar



Paloma



Wilma



Summary

- 4 cases shown: 2 where GFDL produced RI, 2 where it did not.
- RMW in GFDL either similar to or larger than obs in all cases
  - RMW larger in GFDL for cases where GFDL produced RI
- In obs, RMW sometimes decreased during RI, sometimes remained nearly constant. In model, RMW remained generally constant during RI cases.
- Wind field expanded, and IKE increased, in all cases (obs and model) during RI except observed Paloma
  - wind field size crucial to determining IKE changes during RI.
  - not enough just to look at RMW, but 64-, 34-kt wind radii
- Model-derived IKE larger than observed in cases where GFDL produced RI, similar in cases where GFDL did not produce RI

Questions

What determines RMW contraction? Wind field expansion? What is role of outer-core wind field in determining likelihood of RI? How is that tied to surface wind field? How well does model represent these processes?

Future Work

- Examine evolution of other wind thresholds (e.g., 64-, 34-kt radii)
- Expand data set
  - Include more RI cases
- Composite wind fields for multiple cases and model runs
- Consider vertical structure of wind field
  - Incorporate airborne Doppler, GPS dropsondes
- Include other models (e.g. HWRF)
- Examine azimuthal asymmetries
  - Radial profiles of winds as a function of quadrant