Physics Strategy

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Our aim:

Improve forecast performance through betterment of parameterizations

What's the strategy for parameterization betterment?

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We are understanding that there is no ultimate recipe to physics development, because:

- **Variety of problems! (Microphysics, PBL, Convection, radiation, land-surface)**
- **Parameters often lack a plausible observable counterpart in nature**
  (e.g. Vertical structure of eddy diffusivity)
- **Observations will remain relatively sparse (for this context)**
- **Findings from case studies may differ from broader samples**
  (there is a large diversity of storms!)

So… what do we do?

How to systematically…

…better parameterizations?

How to systematically…

1. Find suitable candidates for model changes?

2. Decide weather to incorporate them into the model?

…better parameterizations?

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3 driving agents

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Realism

- Better portray the physical processes that parameterizations represent
- Attribution (idealized simulations)

Model biases/problems

Identify/understand/eliminate

- Positive intensity bias of weak storms & negative intensity bias of strong storms
- Secondary eyewalls
- Too large Radius of Maximum Winds
- Air-sea interaction bias (Joe Cione)

Modeling interests

- Computer resources constrains
- Consistency with global models

  implement and tune imported parameterizations
- Scale aware physics
- Stochastic parameterizations

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  Tuning imported parameterizations
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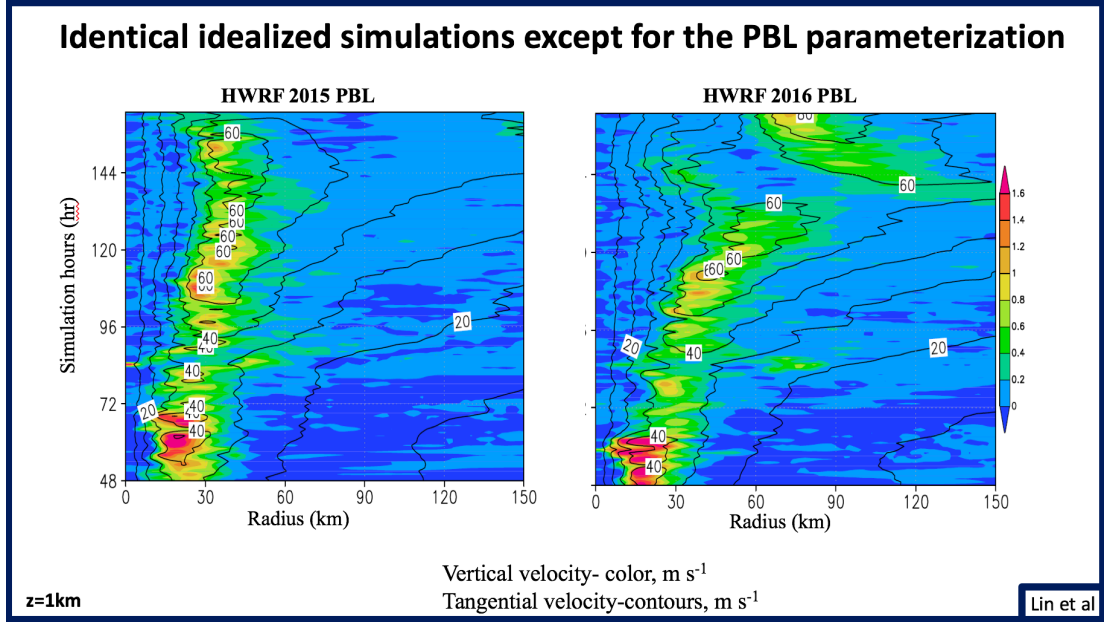
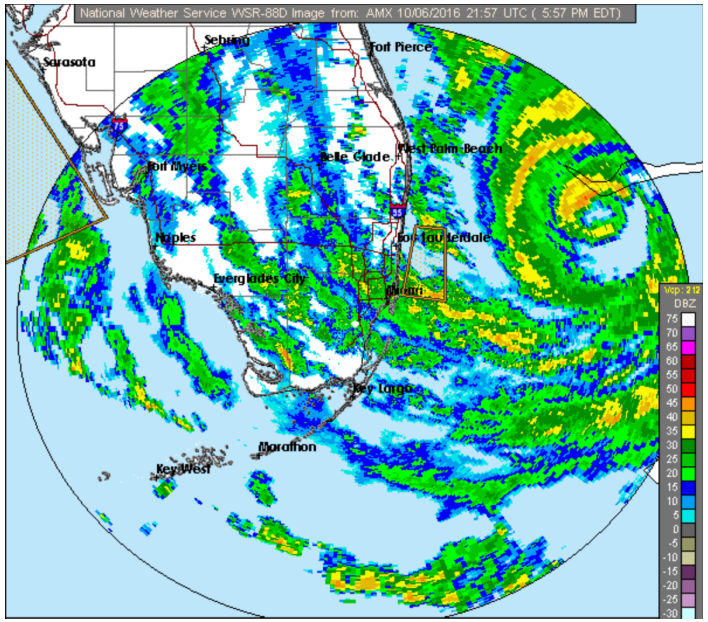
It is in the process of identification and understanding of model biases, in the aim for realism and in the exercise of modeling interest that candidates for parameterization improvements emerge

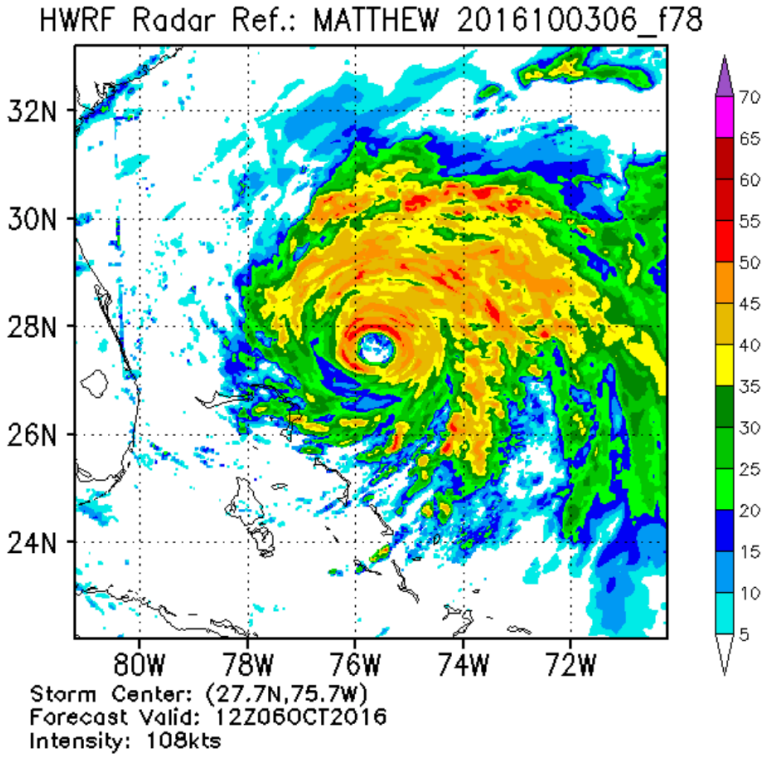
Matthew (2016)

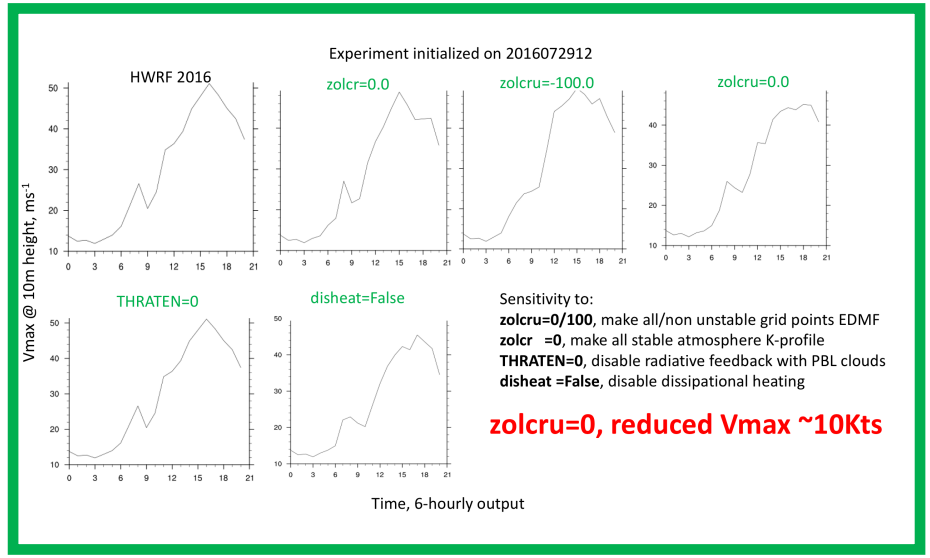
Operational cycles:

-October 01-05, ~80% cycles with ERC









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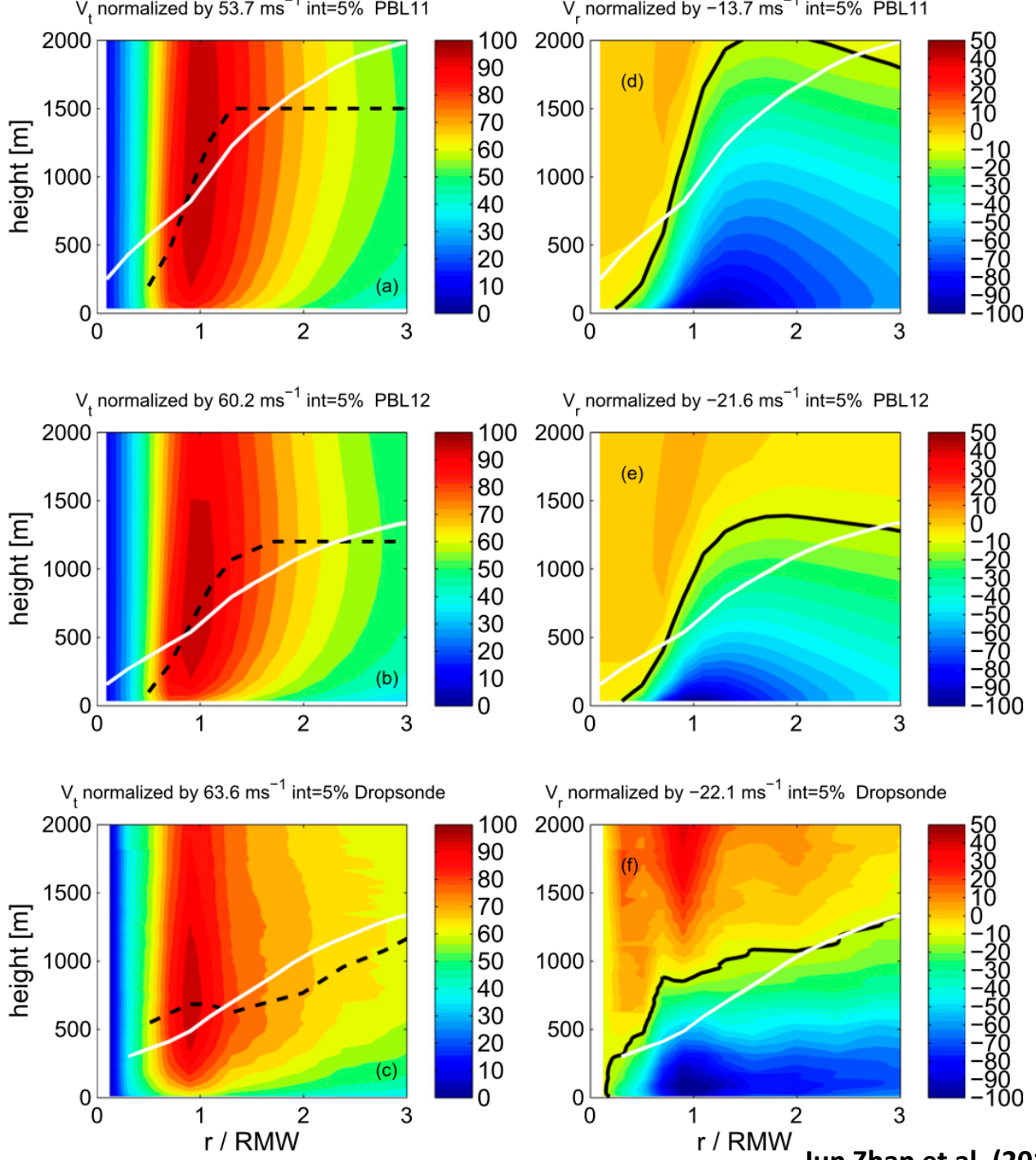
- **We can harness our (increased) understanding of basic storm structure and observational capabilities to make the best available observations handy for model development**

HWRF 2011 PBL, with different K_m
112 forecasts, 4 hurricanes

HWRF 2012 PBL
112 forecasts, 4 hurricanes

GPS dropsonde & Doppler radar composite
(106 research flights, 13 hurricanes)



Jun Zhan et al. (2015)

Despite the lack of plausible observations for every parameterization parameter we can begin by focusing on the azimuthal average storm structure to identify if proposed changes in the parameterization take us closer or farther away from observations.

High Priority Areas for Physics betterment

- Continue to incorporate scale aware physics
- Continue maintaining alignment with global models
- Microphysics higher moment (or species advection?)
- Adopt stochastic approaches

- Address identified model biases
  - RI/RW
  - Positive intensity bias of weak (<50kt) storms and negative intensity bias of strong (>50kt) storms
  - Air sea interaction (Joe Cione)
  - Storm structure
    - Secondary eyewalls
    - RMW

Successes!:

- Wavenumber 1 asymmetries!
- Progress on secondary eyewalls!
- Mean intensity bias is close to zero!
- Intensity performance in Atlantic improved systematically since 2011!
- Improvement in storm size!