THE INFLUENCE OF MICROPHYSICS PARAMETERIZATIONS ON FORECASTS OF DOWNSTREAM WAVINESS

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Motivation

- Diabatic processes affect Rossby wave structure
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- Affects on mesoscale weather and synoptic pattern
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- Diabatic processes affect Rossby wave structure
- Affects on mesoscale weather and synoptic pattern
- Model microphysics packages affect forecasts
Research Question

- Does the complexity of a microphysics package in a model significantly alter the waviness forecast?
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  - Run the WRF using 3 different microphysics packages
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- Does the complexity of a microphysics package in a model significantly alter the waviness forecast?
  - Run the WRF using 3 different microphysics packages
  - Calculate the sinuosity of each packages 200 hPa height forecast
Methods: The WRF

- **Specifics:**
  - Version 3.8 of the WRF
  - 80 x 80 km resolution
  - Initialized at 0000 UTC, out 120 hours
  - Runs 3 times, one for each MP package
Methods: The WRF

Kessler Scheme
- Warm rain
- No ice

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3-Class Package
- Ice processes below 0°C

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Ferrier Scheme
- Water, rain, ice, super-cooled liquid and ice melt

Methods: Sinuosity

Ganges River, India

Source: Jon Martin, Cyclone Workshop 2015 Presentation
Methods: Sinuosity

Ganges River, India

\[
S_{AB} = \frac{\text{(Length of CONTOUR)}}{\text{(Length of SEGMENT)}}
\]

Source: Jon Martin, Cyclone Workshop 2015 Presentation
Methods: Sinuosity

Daily Average 500 hPa $\Phi$
(60 m)
January 18, 2014

Source: Jon Martin, Cyclone Workshop 2015 Presentation
Methods: Sinuosity

Daily Average 500 hPa $\Phi$
(552 dm)
January 18, 2014

Source: Jon Martin, Cyclone Workshop 2015 Presentation
Methods: Sinuosity

Daily Average 500 hPa Φ
(552 dm)
January 18, 2014

Source: Jon Martin, Cyclone Workshop 2015 Presentation
Methods: Sinuosity

![Map showing actual area and equivalent latitude with Daily Average 500 hPa Φ (552 dm) on January 18, 2014.]

Source: Jon Martin, Cyclone Workshop 2015 Presentation
Methods: Sinuosity

\[ SIN = \frac{\text{actual length}}{\text{equivalent latitude}} \]

\[ SIN = 1.2719 \]
Case Study

• Heavy rainfall event in California
  • 7-9 January 2017

Source: NWS Los Angeles/Oxnard Facebook Page
Case Study

- Heavy rainfall event in California
  - 7-9 January 2017
- Atmospheric River
  - Landfall 1200 UTC on 7 Jan
  - Exited 1200 UTC on 9 Jan

Source: NWS Los Angeles/Oxnard Facebook Page
Source: www.esrl.noaa.gov
Case Study

- Heavy rainfall event in California
  - 7-9 January 2017
- Atmospheric River
  - Landfall 1200 UTC on 7 Jan
  - Exited 1200 UTC on 9 Jan
- WRF initialized at 0000 UTC on 5 Jan
  - River event during mid-range forecast, 48-96 hours
Case Study

1mp, 3mp, 5mp
Valid 2017-01-06 00z

Precipitable Water (mm) for 3 MP Package

24 hr forecast
Case Study

1mp, 3mp, 5mp
Valid 2017-01-08 00z

Precipitable Water (mm) for 3 MP Package

72 hr forecast
Case Study

1mp, 3mp, 5mp
Valid 2017-01-10 00z

Precipitable Water (mm) for 3 MP Package

120 hr forecast
Case Study

Heights 11250m-12150m by 180m
Case Study

Aggregate Sinuosity

Forecast Hour

1.7
1.6
1.5
1.4
1.3
1.2

24 h
48 h
72 h
96 h
120 h

1MP
3MP
5MP
Case Study

Aggregate Sinuosity
Case Study

Aggregate Sinuosity

Forecast Hour

Sinuosity

24 h 48 h 72 h 96 h 120 h
Case Study

Aggregate Sinuosity

Forecast Hour
Conclusions and Future Work

- Regional waviness appears sensitive to microphysics packages
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- Expand to the entire Northern Hemisphere
Conclusions and Future Work

• Regional waviness appears sensitive to microphysics packages

• Expand to the entire Northern Hemisphere

• Which phenomena have the largest downstream impacts on the waviness differences?
  • Atmospheric Rivers
  • Strong cyclogenesis
  • Warm Conveyor Belts
Conclusions and Future Work

- Regional waviness appears sensitive to microphysics packages
- Expand to the entire Northern Hemisphere
- Which phenomena have the largest downstream impacts on the waviness differences?
  - Atmospheric Rivers
  - Strong cyclogenesis
  - Warm Conveyor Belts
- Begin looking at specific cases
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- Martin and Morgan research groups

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Thank you!
11790m
Cumulus Scheme 1

- Kain-Fritsch (KF)
  - Includes shallow convection
  - Low-level vertical motion in trigger function
  - CAPE removal time scale closure
  - Mass flux type with updrafts and downdrafts, entrainment and detrainment
  - Includes cloud, rain, ice and snow detrainment
  - Clouds persist over convective time scale
  - Used in MM5 and Eta/NAM ensemble

- Comparing all the packages, KF seems to be a good middle ground: 12 hour forecast above comparing
Effects of changing MP

Direct Interactions of Parameterizations

Microphysics
- Cloud effects

Cumulus
- Cloud detrainment
- Convective rain

Radiation
- Non convective rain
- Surface emission/albedo

PBL
- Surface fluxes SH, LH

Surface
- Downward SW, LW
- Surface T, Q_v, wind

Case Study

- Flooding event in California
- January 7-9, 2017
Boundaries for Sinuosity