ANALYSIS OF PRECIPITATION IN WRF OPERATIONAL SIMULATIONS IN CASE OF INTENSE CONVECTION OVER RIO GRANDE DO SUL STATE: DECEMBER, 11, 2012 CASE STUDY

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Contents

1. Introduction
2. Data
3. Results and Analysis
4. Conclusions
In early morning December, 11 a MCS passed over RS State;
Causing many records of extreme rainfall and damages.
A strong squall-line system.
Over Santa Maria, the atmospheric conditions are:

Séries temporais - 10 e 11/12/2012

- Pressão atmosférica
- Velocidade do vento
- Direção do vento
- Temperatura
- Temperatura do ponto de orvalho
- Precipitação acumulada
Objectives:

- Define the skill of the model to simulate operationally a strong convective system?
- What is the function of low resolution simulations to describe the mesoscale system?
- Over the entire RS do we have the same conditions?
Contents

1 Introduction

2 Data

3 Results and Analysis

4 Conclusions
The Model:
WRF Model v.3.3
BC - GFS 1 degree each 6 hours.

Basic description:
- Two nesting grids (HR: 48 and 12km and 26 lvl.);
- With feedback between grids;
- Parameterizations Convection: Kain-Fritsch scheme
- PBL: YSU Scheme
- lw rad: RRTM Scheme
- sw rad: Dudhia Scheme
- Microphysics: Lin et al. Scheme
6 hours of accumulated rainfall (18Z 10/12 to 18Z 11/12) were analysed in two operational runnings and one final analysis runnings:

Operational:
- 36h previous: Dec, 9 initialized at 12Z - Op09
- 12h previous: Dec, 10 initialized at 12Z - Op10

Analysis:
- Started: Dec, 9/00Z - Control
Evaluating the differences between operational simulation and analysis simulation (control-C), using:

- **Root Mean Squared Error (RMSE)**

\[
RMSE = \sqrt{\frac{1}{n} \sum_{i=1}^{n} (C - P)^2} \quad (1)
\]
- HK score (Hanssen and Kuipers, 1965)

\[
HK = \frac{(U_{11} \times U_{00}) - (U_{10} \times U_{01})}{(U_{11} + U_{01}) \times (U_{10} + U_{00})}
\]  \quad (2)

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<th>Forecast</th>
<th>Analysis</th>
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<td>No</td>
</tr>
</tbody>
</table>
Contents

1 Introduction

2 Data

3 Results and Analysis

4 Conclusions
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Results and Analysis

Conclusions
The Op09 and Op10 shows the increase of RMSE in regions of high topography gradient;

In the Op10, RMSE had a decrease of maximum magnitude error but with increase of coverage area with minimum of 4mm/6h.
HK Score

![Graph showing HK Score with various data points and lines representing different operations and distances.]

![Bar chart comparing HK Scores for different operations and distances.]
The simulations with lower resolution (Op09 and Op10 with 48km) have a high skill during each individual analyzed time;

In Op09 (36h before the system) the total skill is highest, especially in 12 km simulation.
The importance of the topography in rain simulations in RS, especially in regions of transitions, suggests the use of simulations with different or adaptative resolutions to each microarea.

Also showing the applicability of low resolution simulations as a qualitative tool to evaluate rain occurrence additionally with high resolution simulations.
Thanks!
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