



# XIX CBMET

CONGRESSO BRASILEIRO DE METEOROLOGIA

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METEOROLOGIA: TEMPO, ÁGUA E ENERGIA



## EVALUATING AEROSOLS IMPACTS ON NUMERICAL WEATHER PREDICTION: A CASE STUDY

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### 1. INTRODUCTION

This project aims to improve our understanding about the following questions:

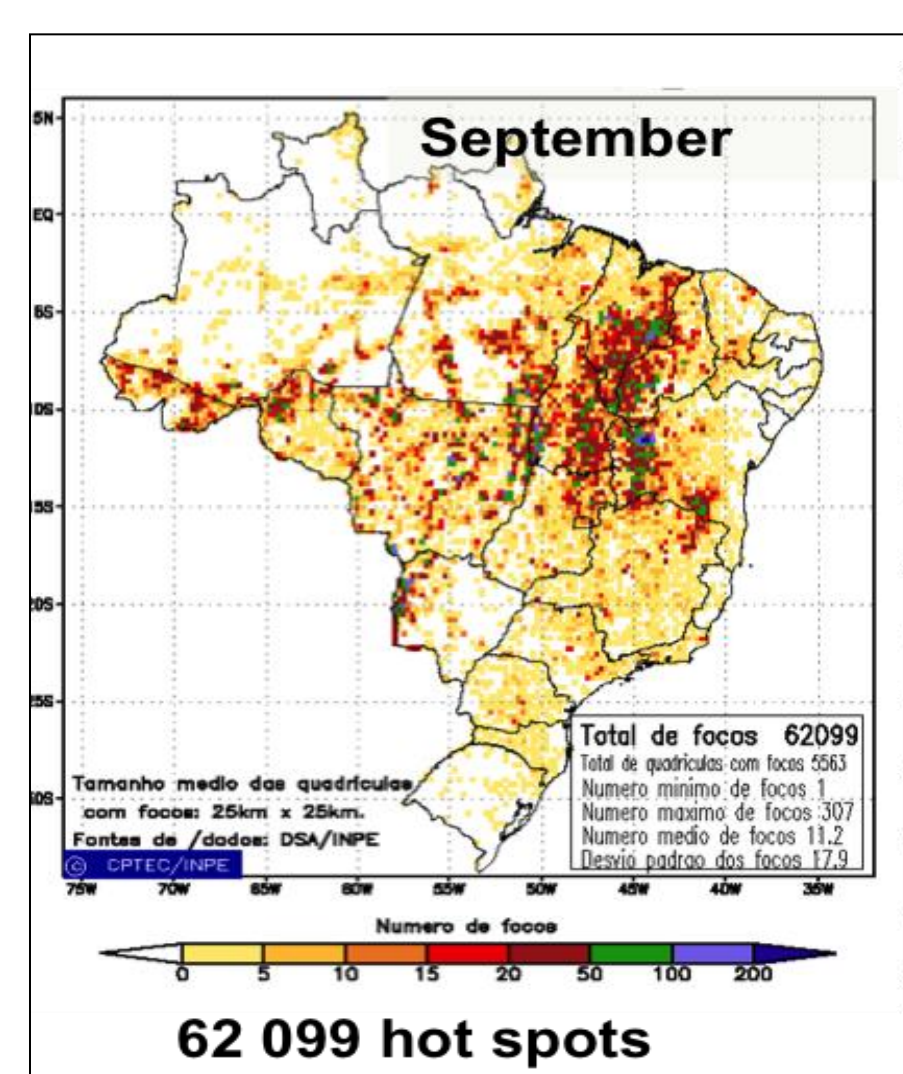
- How important are aerosols for predicting the physical system (NWP, seasonal, climate)?
- What are the current capabilities of NWP models to simulate aerosol impacts on weather prediction?

The general approach of the proposed work is:

- Select strong or persistent events of aerosol pollution worldwide that could be fairly represented in the current NWP model allowing the evaluation of aerosol impacts on weather prediction.
- Perform model runs both including and not including the feedback from the aerosol interaction with radiation and clouds.
- Evaluate aerosol impact on meteorology:
  - 2-meter temperature, precipitation

### 2. CASES STUDIES

Two cases were chosen for this exercise. A case of high biomass burning smoke concentration in Brazil on 5-15 of September 2012 and a case of extreme urban pollution in Beijing on 12-16 of January 2013. More detailed information can be found at the site <http://meioambiente.cptec.inpe.br/wgne-aerosols/>. The Panel 1 introduces the Weather Prediction Centers which are participating in this project.



1) Smoke in Brazil: 9/2012



2) Pollution in China: 1/2013

Panel 1- Participating NWP Centers

Participants	Case 1	Case 2	Type of model	Status of the data	People Involved
CPTEC	X		R	aerosol direct effect only	Saulo Freitas, Mauricio Zarzur, Juliana Freire
JMA		X	G	ind, dir, ind+dir, noaero	Taichu Tanaka, Chiasi Muroi
ECMWF	X	X	G	aerosol direct effect only	Angela Benedetti, Samuel Remy, Jean-Noel Thepaut
Météo-France/Met. Serv. Algeria			R	aerosol direct effect only	Morad Mokhtari, Bouyssel Francois
ESRL/NOAA	X		R	aerosol direct and indirect effect only	Georg Grell
NASA/Goddard	X	X	G	direct effect only	Arlindo da Silva
NCEP	X	X	G	direct effect only	Sarah Lu, Yu-Tai Hou, Shrinivas Moorthi, and Fanglin Yang
Barcelona Super. Ctr.			R	aerosol direct effect only	Oriol Jorba Casellas

### 3. RESULTS

The result for South America show a reduction in BIAS and RMSE for 2 meter temperature (Fig. 1) when considering the effect of the aerosol in the simulation. The models of the NASA/GSFC and the ECMWF were those with the largest difference. For precipitation (Fig. 2), the differences were not so expressive, except for the simulations with the CPTEC and ECMWF models. The results for Beijing that the Japan Meteorological Agency and the NCEP models presented a more significant reduction of RMSE and BIAS, temperature variable to 2 meters (Fig. 3). As for the precipitation (Fig. 4) variable, only the model NASA/GSFC showed a expressive difference when comparing the simulation with and without the presence of aerosols.

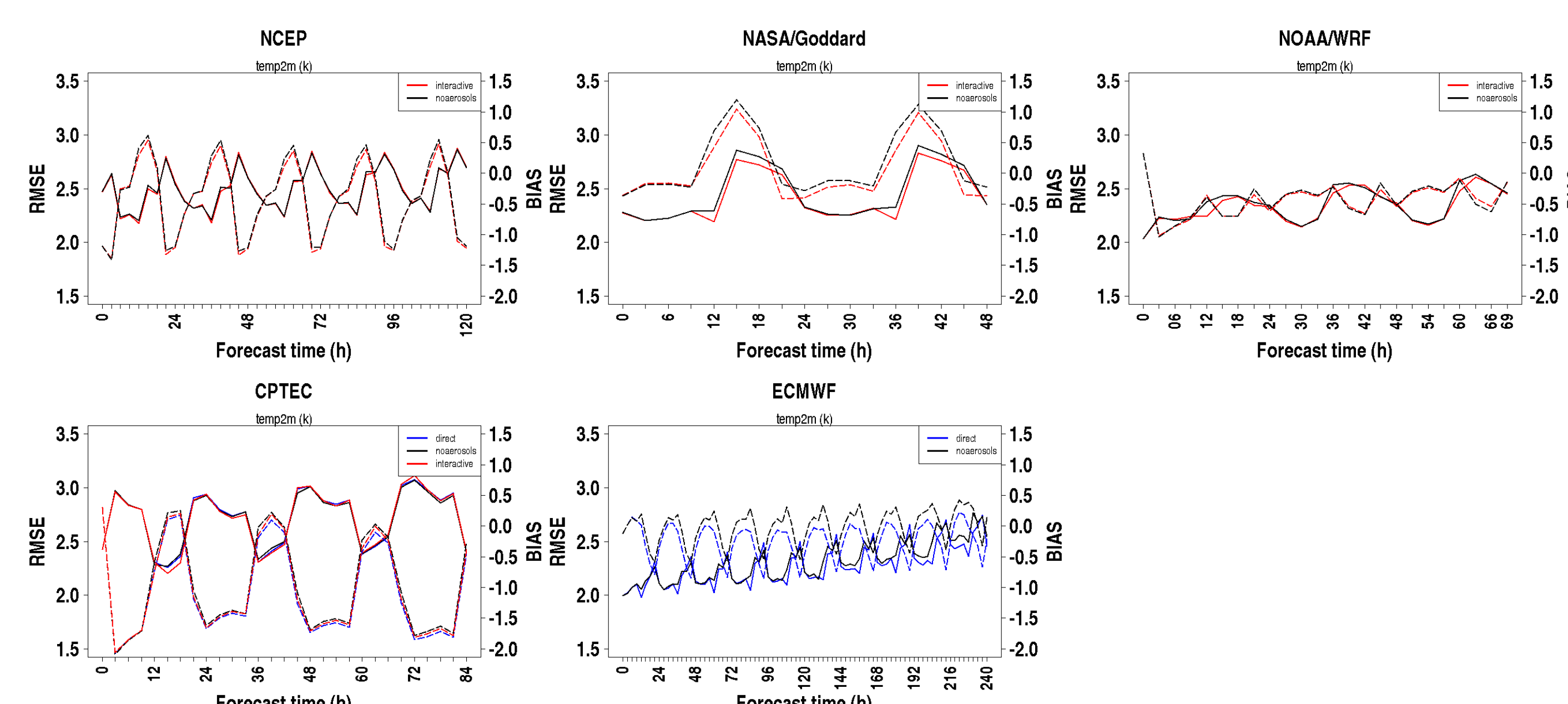


Figure 1 – Statistical evaluation (RMSE/BIAS) of the temperature 2meter to South America domain (35S-15N/90W-30W).

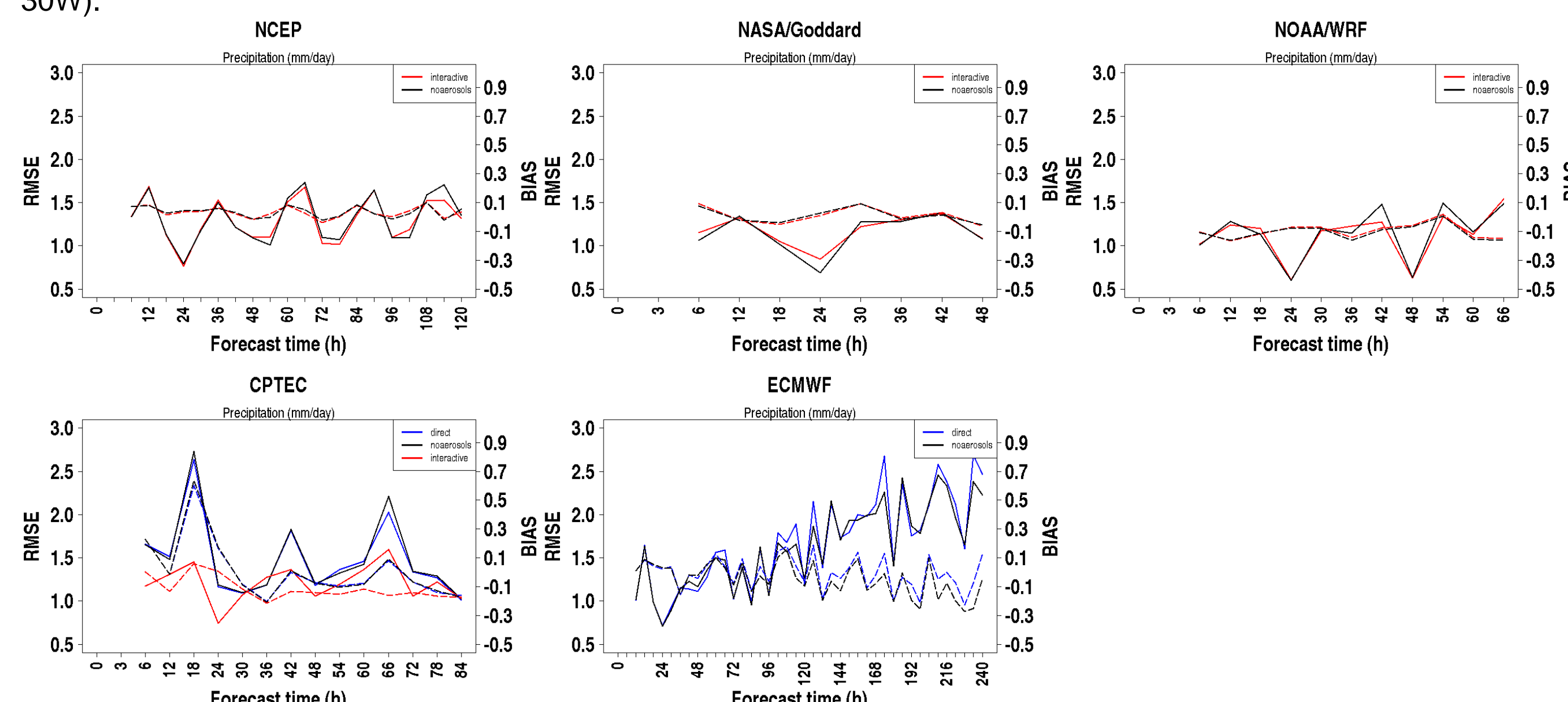


Figure 2 – Statistical evaluation (RMSE/BIAS) of the precipitation to South America domain (35S-15N/90W-30W).

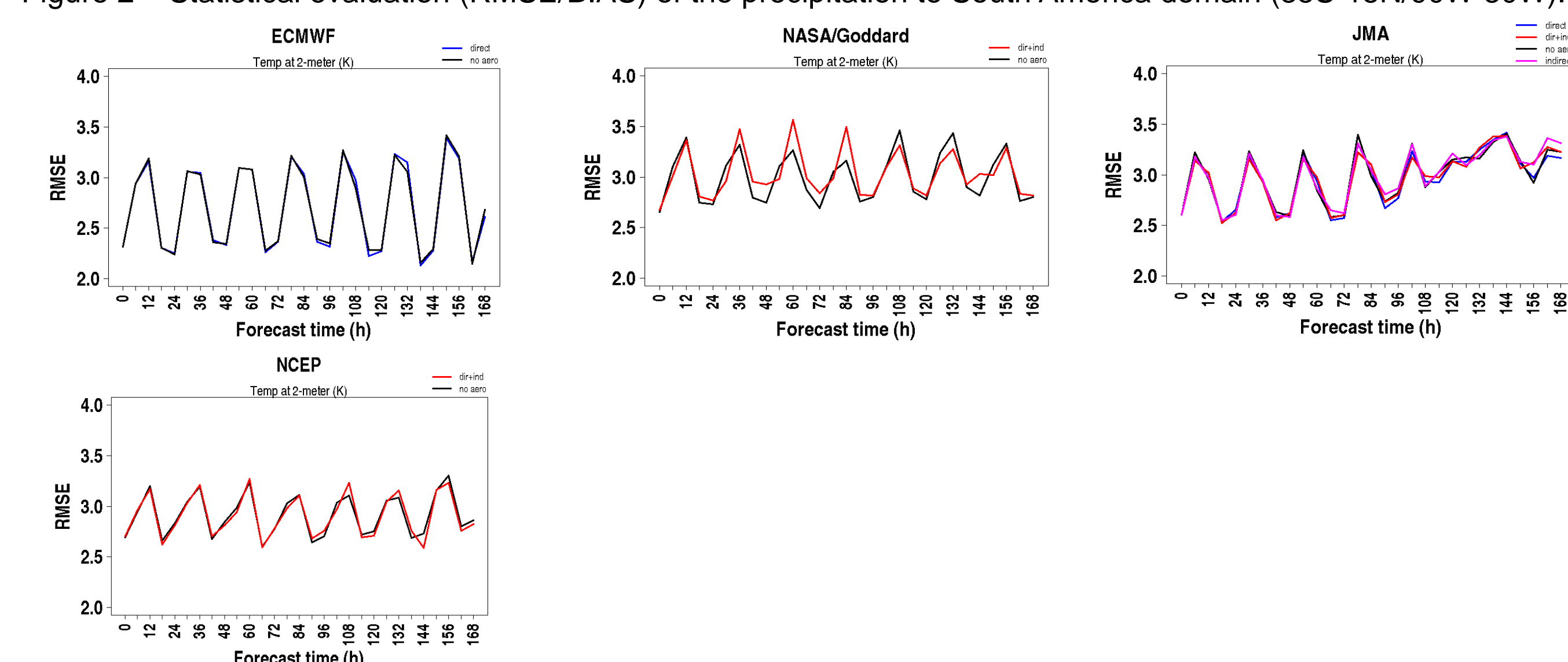


Figure 3 – Statistical evaluation (RMSE) of the temperature 2meter to Beijing domain (15N-40N/100E-140E).

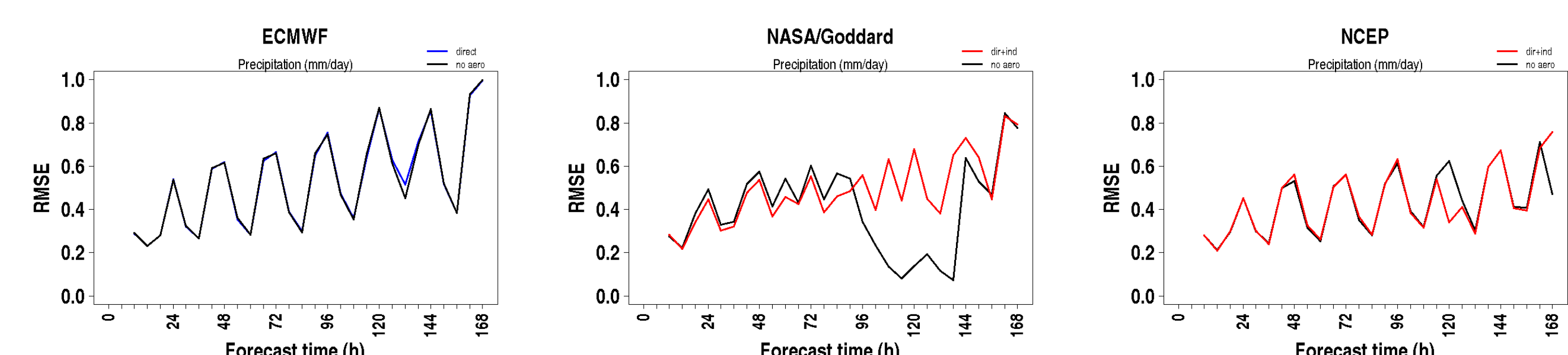


Figure 4 – Statistical evaluation (RMSE) of the precipitation to Beijing domain (15N-40N/100E-140E).

### 4. CONCLUSIONS

In general, all models showed a reduction in RMSE and BIAS when the effect of the aerosol was considered primarily for 2 meter temperature during the daytime simulations in both domains. However, more detailed with studies incorporating a greater number of extreme events are needed to improve the understanding of the response of the atmosphere when considering aerosol forcing. This work will continue to clarify questions raised by this study.

### ACKNOWLEDGMENTS

The Improvement of Higher Education Coordination (CAPES) and World Meteorological Organization (WMO) for the opportunity to carry out this study from research funding and grant funding.

