The comparison of convective parameterization schemes of Global Eta Framework (GEF) in simulating precipitation in a strong El Niño event

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O PAPEL DA METEOROLOGIA NA CONSTRUÇÃO DE UMA SOCIEDADE SUSTENTÁVEL

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1. INTRODUCTION

Global Eta Framework(GEF) is a global atmospheric model capable of working on various rectangular quasi-uniform grids, which eliminate the need for the polar filtering and thus offer an attractive alternative to the standard lat-lon spherical grids for application in global models for atmosphere and ocean. Thanks to nearly equally distributed grid points which these grids have, inconsistent increase of resolution around poles is avoided, as well as existence of strong singular poles, which is typical for any lat-lon based grid. The resulting exceptional computing efficiency of this model recommends it as one of the most useful tools for climate researches. In the preliminary testing, the model, operating on the smoothed cubic grid, showed capability in simulating extreme climate events, such is ENSO. While the spatial distribution of precipitation was simulated correctly, the amount of precipitation was not quite satisfying. The objective of this paper is to make a further investigation of possible causes of such behaviour of the model, testing it with the both convective schemes available in this model-Betts-Miller-Janjić scheme(BMJ) and Kain-Fritsch scheme(KF) for the case of one extreme El Niño event.

2. MATERIALS AND METHODS

This model uses cubic grid(**Fig. 1**) which consists of 6 tiles, which represent 6 sides of the cube. Applying a regional Eta model on each side of the cube, and allowing the interaction between them, the whole globe can be covered. In this way, a global model is obtained using regional model. This process is called "globalization" of regional models. Cubic grid allows any other regional model to be implemented on it, Eta model is taken only as a prototype. This is why this model is called Global Eta Framework, rather then Global Eta Model. Idea to use cubic grid instead of usually used lat-lon grid was mentioned for the first time by Sadourny(1972) in order to solve the problem of singularities on the poles, which was one of the main disadvantages of any lat-lon grid. Instead of 2 singularities, he got 8 singularities(corners of the cube) and 12 singular lines(sides of the cube)(**Fig. 2a**). With further improvements of Sadourny's gnomonic cube, smoothing the area around corners, Purser and Rančić(1998) developed smoothed conformal cube, with "weak" singularities, which is used in the first versions of GEF.

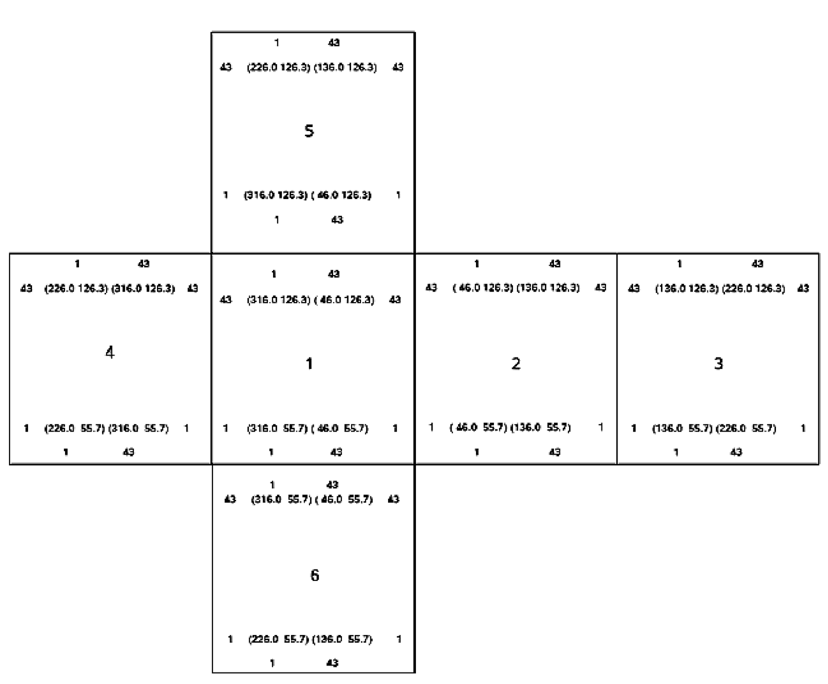

Figure 1: Cubic grid with 6 sides

Figure 2: Evolution of cubic grid from 1972 Sadourny's gnomonic cube(a) to 1998 Purser's and Rančić's smoothed conformal cube(b)(quasi-uniform grid)

The latest version of the model uses recently updated Purser's and Rančić's cubic grid(**Fig. 2b**), which allows a use of significantly larger time step.

BMJ is relatively simple, but computationally very efficient convective scheme which produces rain based on a comparison with pre-determined reference profile of temperature and humidity derived from climatology. The scheme adjusts the sounding toward a pre-determined, post-convective reference profile and produces precipitation from all the precipitable water available, preventing the microphysics scheme from triggering convection. There is only one reference profile available for the whole domain of the model, which is certainly one of limitations of the scheme. On the other hand, KF is more complex scheme, which produces rain based on a mass flux. It tends to leave unrealistically deep saturated layers in post-convective soundings, leaving the microphysics scheme to produce more stratiform precipitation, which may be overdone.

In order to make a comparison and evaluate the efficiency of both convective schemes which this model possesses(BMJ and KF), there will be two runs performed, both with the same initial conditions, taken from ERA INTERIM. The chosen date is a randomly selected date from February 1996, in order the analyze one of the most extreme El Niño events, the one from 1997. The model has relatively high horizontal resolution of approximately 25km, and it will be the first test performed with a new grid and such a high resolution. The model is forced by SST data taken from NCEP, and it is updated daily.

3. RESULTS AND CONCLUSIONS

It is expected that the runs performed with this upgraded version of the grid will contribute primarily in the computational efficiency of the model, while relatively high resolution will contribute to better presentation of meteorlogical processes. On the other side, it is expected that both of the convective schemes will show their characteristics on a global scale, as well as for some specific extreme events caused by El Niño, with the focus on precipitation in South America and some monsoon regions worldwide, where previous version of the model failed to represent the precipitation pattern well. All the results will be analyzed statistically using the standard tools like ETS(Equitable Threat Score), BIAS and spatial correlation.

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