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SIMULATIONS OF THE MID HOLOCENE CLIMATE IN SOUTH AMERICA USING THE CPTEC AGCM

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1. INTRODUCTION

The climate of 6000 years ago represents a good test bed for evaluating atmospheric general circulation model (AGCM) performance for several reasons. It is a relatively recent paleoclimate period and consequently data records (Turcq *et al.*, 1998; Behling *et al.*, 2000; Turcq *et al.*, 2002) of climate indicators are available. It is possible to model the climate Mid-Holocene with simple changes to model boundary conditions, especially changes in orbital parameters (Hall and Valdes, 1997), and this was the case of various model intercomparison projects, such as the Paleoclimate Model Intercomparison Project (PMIP) results, as well as papers from various modeling centers, such as Braconnot *et al,* (2000) using the ISPL model..

The objective of this study is to analyze the climate and climate variability in the Mid-Holocene (6000 years before present, hereafter referred to as 6k) for South America. The past mechanisms and feedbacks of the climate have a great importance in its variability understanding in the present and in future climate change simulations using global climate models.

2. DATA AND METHODS

In this paper we use the CPTEC AGCM (Centro de Previsão de Tempo e Estudos Climáticos), with a resolution of T062L28. In order to simulate the climate of Holocene, the orbital parameters and carbon dioxide concentration (CO_2) are changed to make them more representative to Mid-Holocene (6k). Using the set of climatologic sea surface temperature (SST) for present times as representative of the Mid-Holocene (Ruddiman and Mix, 1993; Morley and Dworetzky, 1993), the effect of the orbital parameters and carbon dioxide concentration by forcing in the simulations, the climate resulting is analyzed on present times context.

Two sets of ensemble simulations have been carried with 40 years and five members (control and MH). The first three years of integration had been rejected, because they have been considered as spin-up model, and the 37 years later, these simulations are compared with the Mid-Holecene simulations of a suite of AGCMs from the PMIP. The analysis is focused on circulation, temperature and rainfall.

3. RESULTS AND CONCLUSIONS

Simulation of short wave radiation (SW) on the top of the atmosphere (Figure 1) is shown as the difference between the Mid Holcene simulation and the control run (present climate), and suggests that a larger amount of radiation arrives during the austral spring (August-September) in the Mid-Holocene. It agrees with previous simulations by the PMIP models.

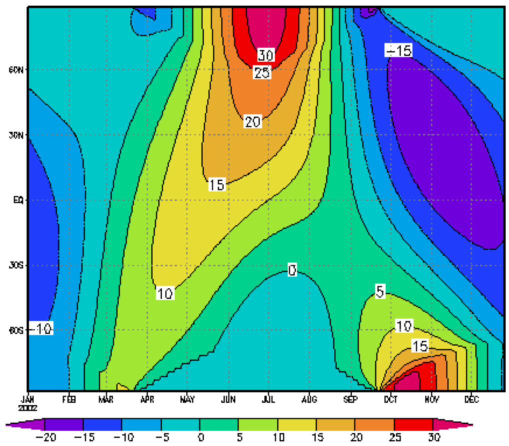

Figure 1 – Difference of short waves radiation on the top of the atmosphere, in the Mid-Holocene (6k) and the present (0k).

The temperature difference fields (Figure 2) show the cooling in the 6k in most of South America, except for south and Southeastern regions, where the model shows warming.

The precipitation difference field (Figure 3) suggests that Northeast Brazil and Amazonia were slightly more humid during the Mid-Holocene while Southeastern Brazil was a bit drier as compared on present climates. The near surface circulation fields show that the Intertropical Convergence Zone was located to the south of its present climatological position.

From the analysis of two simulation sets, with the same contour and initials conditions, it was concluded that the CPTEC AGCM captures the general circulation large features. The results were compared to paleoclimatic indications and to other models results. Simulations from the CPTEC T062L28 agree with paleoclimatic data, and with the simulations from PMIP, but it is hard to say if the model simulates the synoptic variability from the Mid-Holocene. The results suggest that Northeast Brazil was colder and more humid in the 6k period while southern and southeastern South America was warmer and drier, in agreement with results by Valdes (2000), In fact, they analyzed simulations from the Holocene of 19 AGCMs run with the same boundary conditions. In the mean, the seasonal average wind's field at the 850 hPa level (not show here) exhibits a large southward displacement of the ITCZ and a shifting of the wind variability during summer and winter in the Amazon region, suggesting that a South American Monsoon circulation also existed in the Mid-Holocene. The results, in a general sense, agree to the PMIP simulations and to paleoenvironmental studies using paleoclimatic indicators. It suggested that the CPTEC AGCM captures a general way the atmospheric circulation features of the Mid Holocene climate, and this is supported by the analyses of paleoclimatic indicators. The CPTEC AGCM model is considered suitable for the purposes of paleoclimatic simulations. The imposition of the sea surface temperature (SST) must be considered as an advantage and a limitation. Therefore, as a continuation to this study, it will be verified the necessity to run the Mid-Holocene simulation experiments from coupled ocean-atmosphere model, or from AGCMS forced by the SST generated by the oceanic component of coupled models.

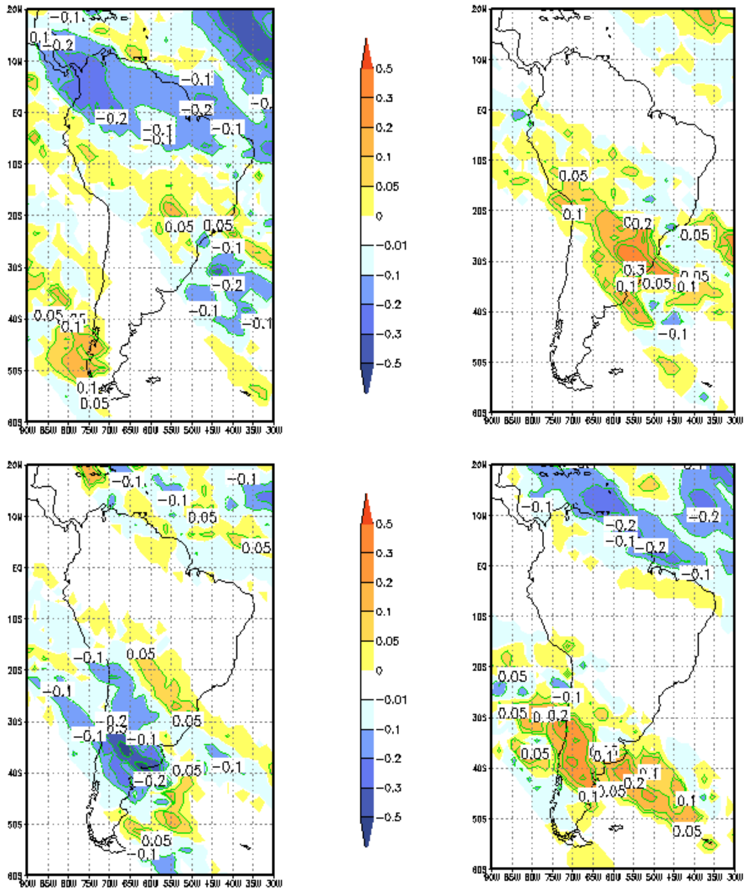

Figure 2 – Temperature difference between the Mid-Holcene simulation and the control run a) DJF; b) MAM; c) JJA e d) SON

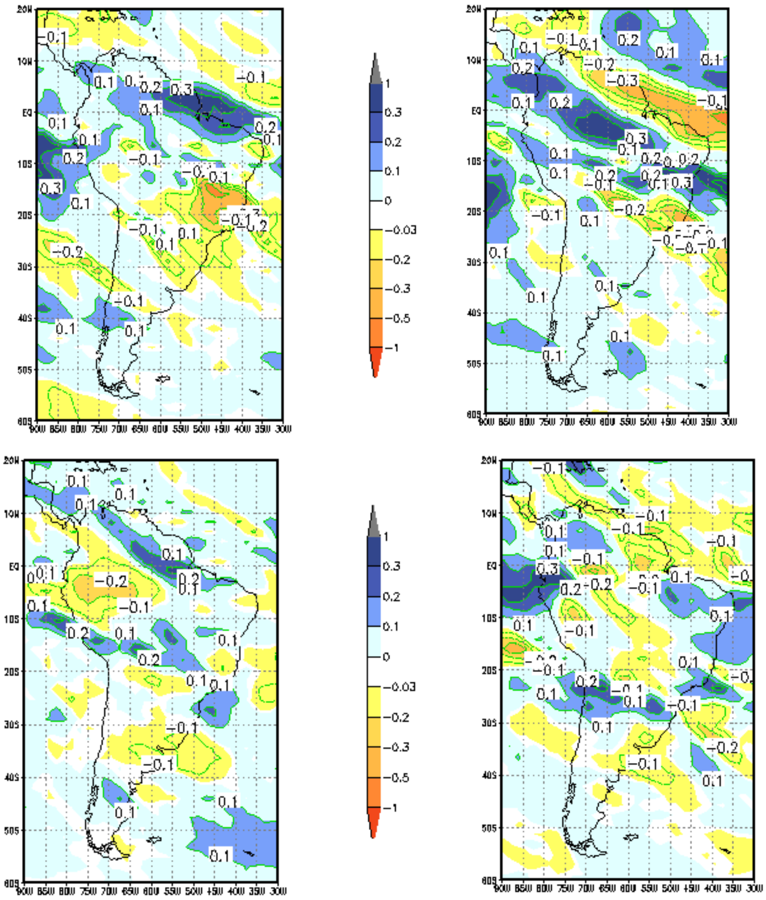

Figure 3 – Preciptation difference fields between Mid-Holcene simulation and the control run a) DJF; b) MAM; c) JJA e d) SON

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