# VARIABILITY OF PRECIPITATION IN SOUTH AMERICA FOR SHORT TERM FORECAST

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**ABSTRACT**

**This study investigated the behavior of the variability of precipitation in South America under different surface forcing and vertical diffusion, based on the assumption that the surface is an important reservoir of energy. It was used the Atmospheric General Circulation Model of the Center for Weather Forecasting and Climate Studies (AGCM-CPTEC/INPE) at the spectral resolution TQ0213L042 (~ 60 km and 42 vertical layers). It was implemented the SiB2 and IBIS-2.6 surface schemes and boundary layer parameterization of Holtslag Boville modified with different setting options of closure for the calculation of diffusion coefficient. It was performed for each day during the period of January 1, 2003 to January 10, 2003, several simulations (experiments) with forecasting up to 10 days and different physical combinations of surface and planetary boundary layer parameterizations. The initial conditions used were the analysis of the NCEP in the spectral resolution TQ0254L064 degraded to model resolution and the sea surface temperature in the resolution of 1 degree, interpolated to model grid. The analyses are based on the set of simulations produced by physical experiments, where each member of this group is compared to TRMM3b42 precipitation data and the average of the members. The modification of surface parameterization schemes showed results with significant dispersion of precipitation as expected, due to differences in the parameterization formulations. In relation to the closure options of the boundary layer it was not seen so much dispersion of precipitation with respect to the control experiment. To explain the dispersion of precipitation it was applied the wavelet analyses on the time series of net of energy on the surface obtained from the energy balance variables of the experiments. It was removed from the average of the diurnal cycle to verify the dispersion of the sign of the surface net of energy (ground, canopy). This method proved to be efficient because, it has shown qualitatively how the energy stored in surface dissipates for periods longer than one day. It also shows how the energy stored during the diurnal cycle may influence the maintenance of precipitation for a period of time longer. This behavior can be defined as a signal memory of the surface balance energy of the diurnal cycle. With the wavelet analyses of the surface balance energy and the dispersion of precipitation of the members in relation to control and TRMM3B42 it was concluded that although more simplified the SSiB scheme represents well the precipitation and the surface balance energy and does not presents a clear signal for periods of 2 to 3 days corresponding to the areas where precipitation occurs. The SiB2 scheme has the same pattern, but overestimates the precipitation in the Amazon region and presents a clear signal for periods of 2 to 3 days . The IBIS scheme maintains the standard underestimating the precipitation in the north region of Brazil and presents a clear signal for periods of 1 to 3 days .**

## OBJECTIVE

The motivation to undertake this work is related to the behaviour of rainfall variability in South America under different conditions of surface forcing and based on hypothesis that the surface is an important reservoir energy. Was used as tools (Integrated Biosphere Simulator), IBIS-2.6 (Foley et. Al. 1996), Simple Biosphere Model SiB2 (Sellers et. Al. 1986) and the Simplified Simple Biosphere Model SSiB (Xue, 1991) coupled to General Circulation Model Atmosphere of the Center for Weather Forecasting and Climate Studies (AGCM-CPTEC) (Paneta et al., 2007, Tomita et. Al. 2006 and Kubota et. al. 2006). The IBIS-2.6 model of vegetation dynamics can diagnose the loss of biomass, which is responsible for store significant amount of energy and water. This capability is very important in climate simulations, but in short simulations may have some impact in relation to other surface models.

## METHODOLOGY

The method adopted in this study was to use the Atmospheric General Circulation Model of the Center for Weather Forecasting and Climate Studies (AGCM-CPTEC/INPE) at the spectral resolution TQ0213L042 (~ 60 km and 42 vertical layers). It was implemented the SiB2 and IBIS-2.6 surface schemes and boundary layer parameterization of Holtslag Boville modified with different setting options of closure for the calculation of diffusion coefficient. It was performed for each day during the period of January 1, 2003 to January 10, 2003, several simulations (experiments) with forecasting up to 10 days and different physical combinations of surface parameterizations. The initial conditions used were the analysis of the NCEP in the spectral resolution TQ0254L064 degraded to model resolution and the sea surface temperature in the resolution of 1 degree, interpolated to model grid. The analyses are based on the set of simulations produced by physical experiments, where each member of this group is compared to TRMM3b42 precipitation data and the average of the members. The configurations of the model are described in table-1.

**Table – 1 Options Physical Parametrizations and dynamics of AGCM-CPTEC used during the simulations.**

| Scheme (Numerical e physical) | Type |
|---|---|
| Dynamics | Eulerian |
| Short Wave | Lacis and Hansen, 1974 |
| Long Wave | Hashvanadan, 1987 |
| Boundary Layer | Hostslag and Bovile, 1992 |
| Surface | SiB2,Sellers,1996; Foley; IBIS(dyn), Foley; SSiB, Xue, 1991 |
| Deep Convection | Grell, 1993 |
| Shallow Convection | Tiedke, 1983 |
| Gravity Wave | Alpert, 1988 |

## RESULTS

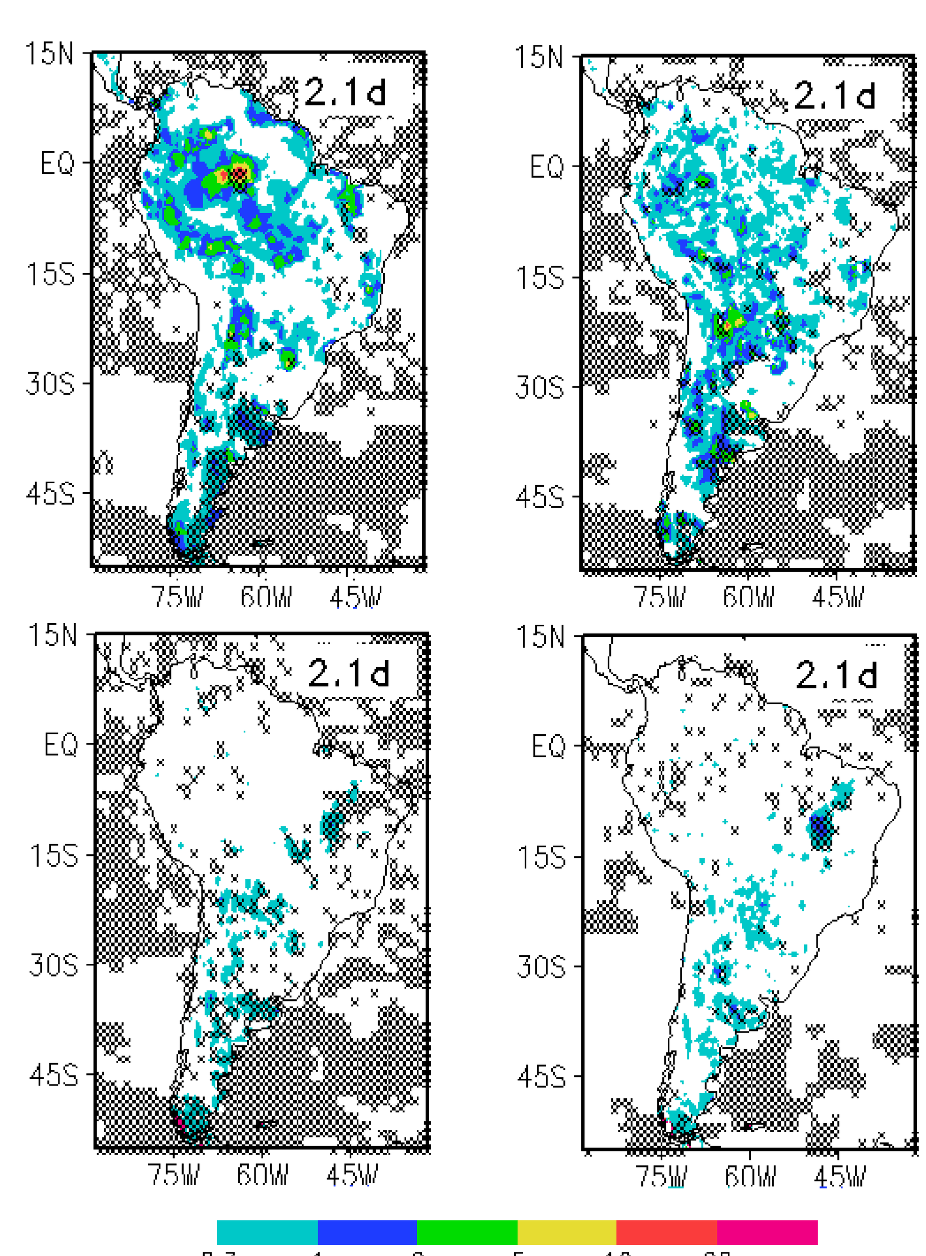


**Figure 1:** Anomaly propagating (2.1 days) sign of the square normalized variance of the balance of energy on the surface (W/m2) X represents regions with statistical significance above 95%. (A) experiment with the IBIS (b) experiment with SiB2, (c) experiment with SSiB (d) Ensemble of the experiment.

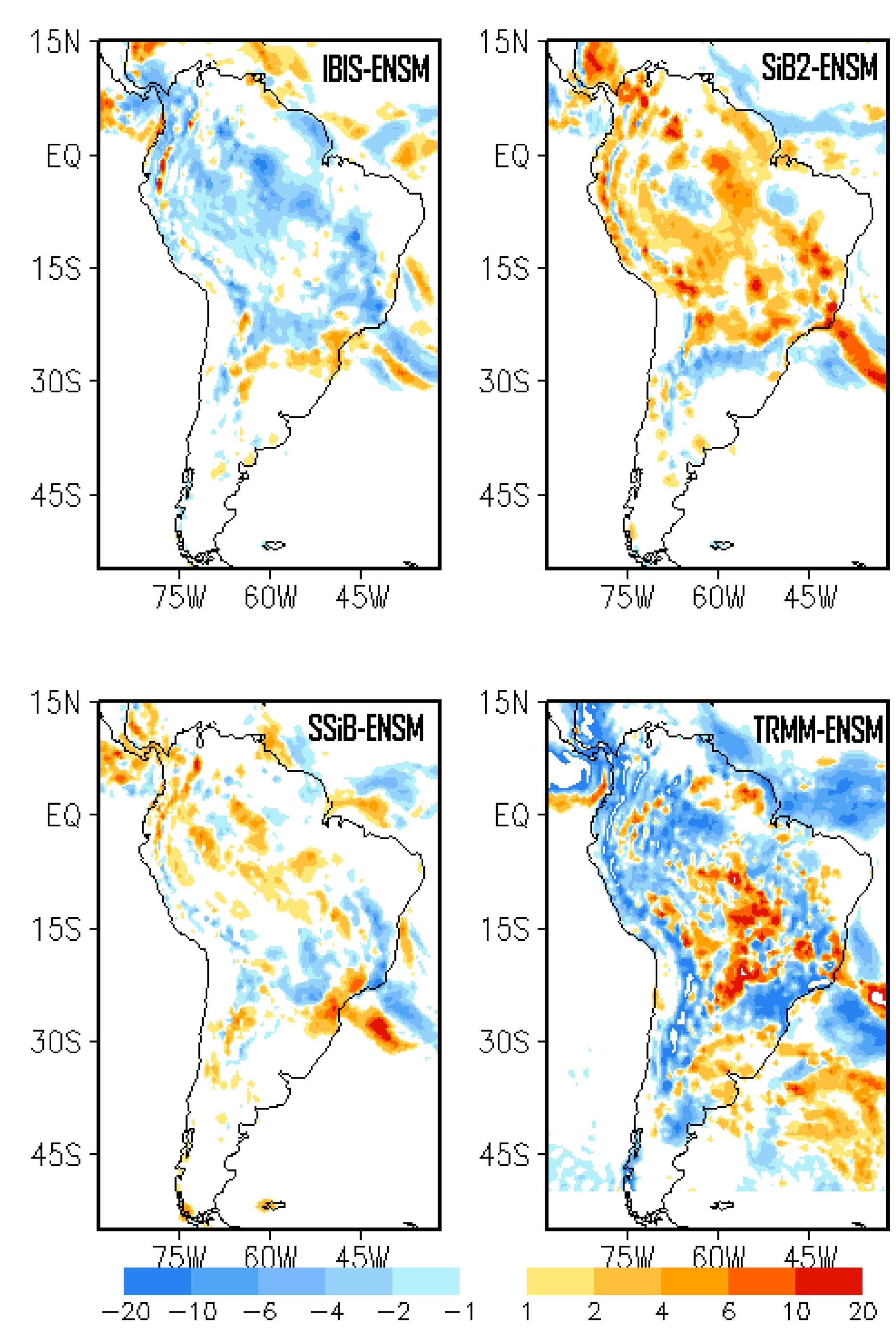


**Figure 2:** Average precipitation anomaly (mm / day) IBIS-ENSM (a) , SiB2-ENSM (b), SSiB-ENSM (c), TRMMS-ENSM (d).

In the figure 1 is showed the anomaly of the square of the normalised variance of the surface energy balance for the period of 2.1 days. It is observed that the signal is more evident when using the IBIS scheme in relation to other schemes, indicating that removing the diurnal cycle of the time series the signal is propagated for a period longer than two days.This may be related to precipitation, as can be seen in figure 2, where it is observed that the scheme IBIS forces in the reduction of precipitation in relation to other schemes. The scheme SiB2 despite the signal to propagate up period of 2.1 days occurs an overestimation of precipitation. The propagation of the signal for up period of 2.1 days in SiB2 may be related more to this overestimation of precipitation.

## CONCLUSIONS

The main conclusions obtained using these analyses are related to the behaviour of the variability of the precipitation regime. The analysis of the Morlet wavelet applied to the surface energy balance showed a significant memory behaviour of the balance of energy, because the signal persists for periods ranging from 0.5 to 2.1 days in three surface schemes. In IBIS scheme the signal appeared more intense, so it can be said that the characteristics of the spectrum of energy spreads for longer periods showing the pattern of memory of the balance of energy on the surface. The impact on precipitation variability due to signal propagation of the square of the variance in the range of 0.5 to 2.1 days is overridden by the value of the anomaly of the balance of energy on the surface, showing that there is a correlation between them.

**ACKNOWLEDGMENT:** Paulo Yoshio Kubota Thank to the CPTEC for granting the infrastructure for this work.

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