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AN EVALUATION OF THE INTER-HEMISPHERIC MASS AND HUMIDITY TRANSPORT AROUND SOUTH AMERICA

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1. INTRODUCTION

The Inter-Tropical Convergence Zone (ITCZ) works as a natural barrier that blocks the mass exchange between the two hemispheres. However, the Indian Monsoon region is a known opening where there is substantial mass transport from the Southern to the Northern Hemisphere during the boreal summer. One can formulate the question: Are there other ways for inter-hemispheric exchange in the globe? The present work has the objective of evaluating the meridional tropospheric transport of mass and humidity in South America and surroundings.

2. METODOLOGY

To make this evaluation, mean monthly data of meridional wind component and specific humidity from NCEP/NCAR reanalysis (Kalnay et al., 1996; Kistler et al., 2001) was used. Initially the tropical belt was divided in three regions, the first one between 120° W and 0° (here named region I), the second one from 0° to 160° E (region II), and the third one between 160° E and 120° W (region III). In those regions it was plotted the mean monthly fields of meridional wind, specific humidity and meridional advection of humidity.

3. RESULTS

The results present a flow from the Northern to the Southern Hemisphere in South American region during the austral summer (here represented by January) as in figure 1. This passage is not observed during the austral winter (here represented by July) as in figure 2.

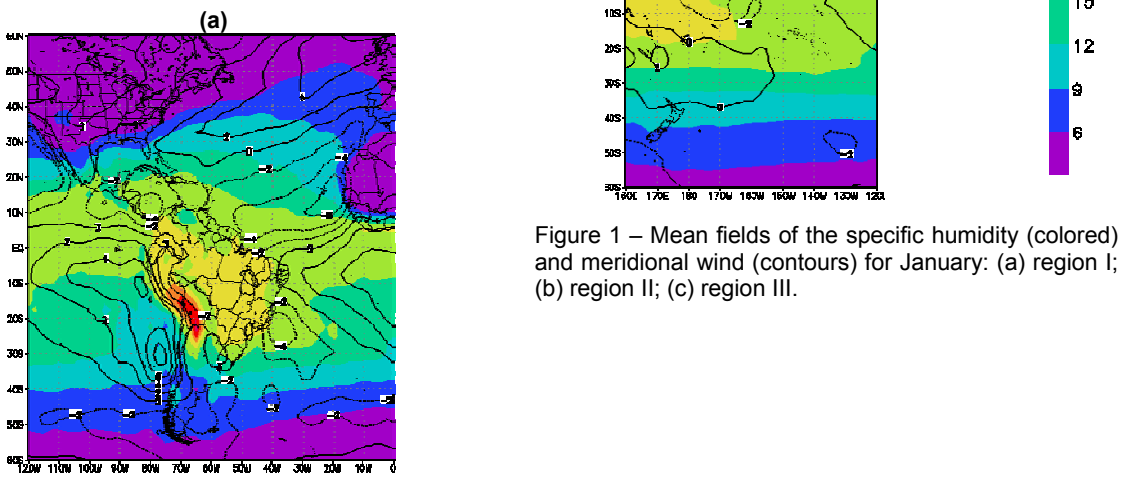

Figure 1 – Mean fields of the specific humidity (colored) and meridional wind (contours) for January: (a) region I; (b) region II; (c) region III.

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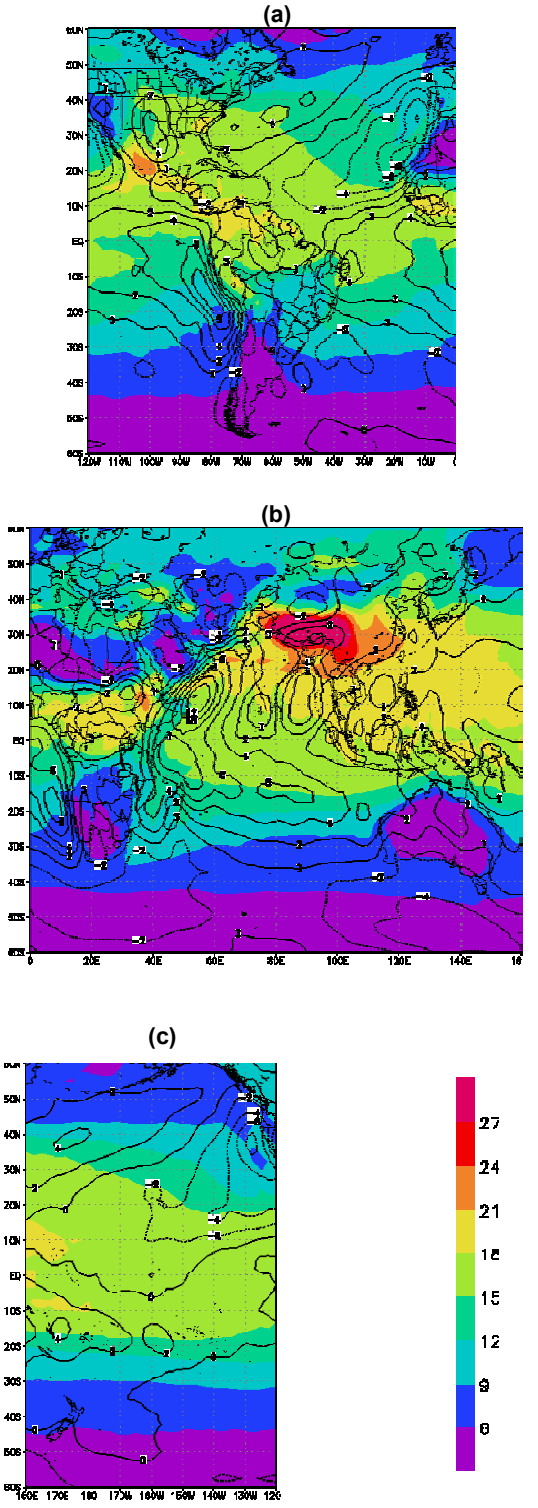
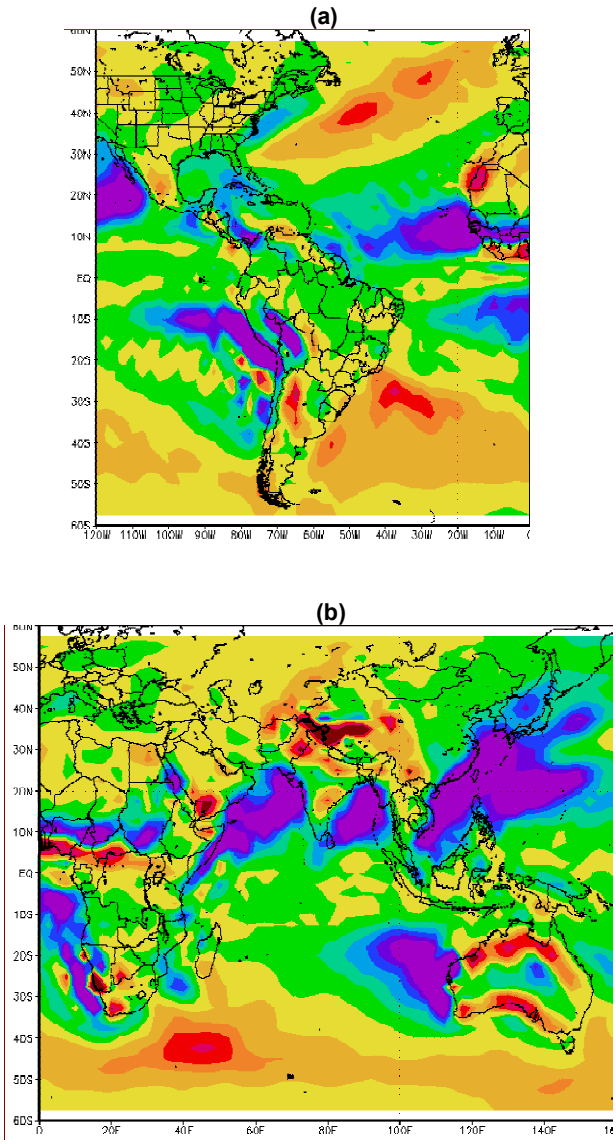


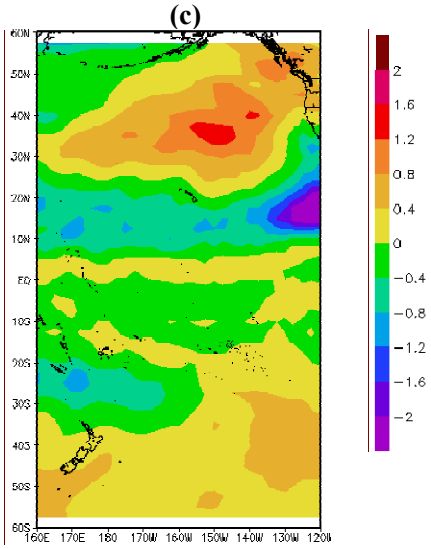
Figure 2 – Mean fields of the specific humidity (colored) and meridional wind (contours) for July: (a) region I; (b) region II; (c) region III.

Figures 1a and 2a allow inferring that the humidity extends from the Amazon region to the South American subtropics during the austral summer and to the North American subtropics during the boreal summer.

Figures 1b and 1c show other way in the inter-hemispheric barrier during austral summer east of the African tropics, east of Australia and in Central Pacific. As expected, during the boreal summer there is a great inter-hemispheric way for humidity in Asia that is the Asiatic Monsoon.

Figures 3 and 4 represent the mean fields of the meridional advection for January and July, respectively.





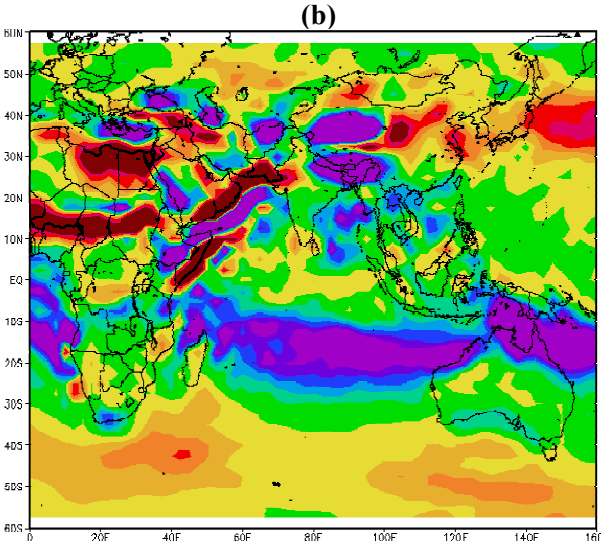
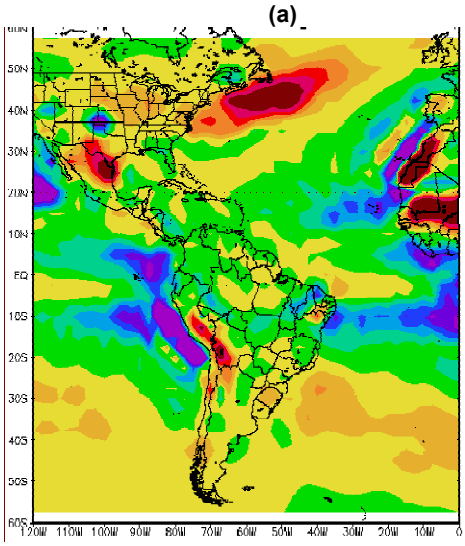


Figure 3 – Mean fields of humidity meridional advection for January: (a) region I; (b) region II e (c) region III.



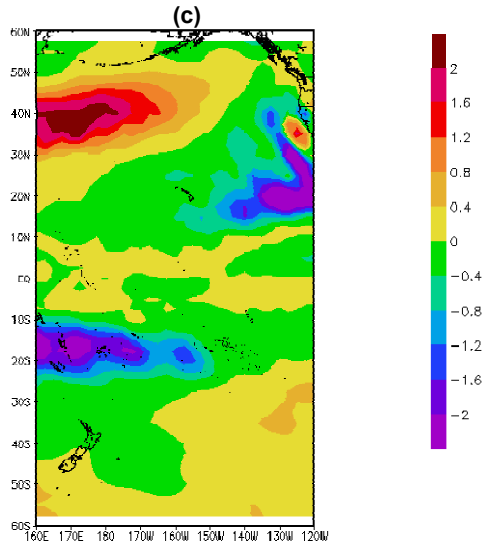


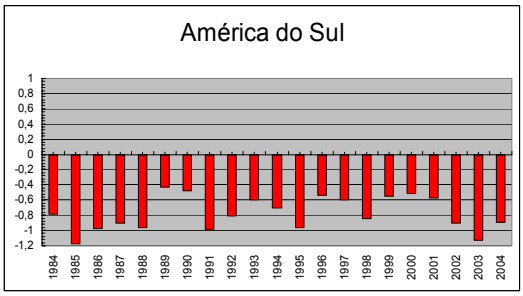
Figure 4 – Mean fields of humidity meridional advection for July: (a) region I; (b) region II e (c) region III.

Figure 3a shows the presence of humidity advection southward from the Amazon region to Southern of Brazil, Northern Argentina, Uruguay and Paraguay during the austral summer. Figure 3b shows positive (northward) humidity advection east of Africa and east of Australia. Figure 4b shows strong humidity advection from the Indic Ocean toward the Monsoon region.

Figure 5 represents the mean meridional flow in the troposphere (from surface to 200 hPa) in the tropical belt between 20° S to 20° N, during the period of southward humidity flow in South America (January, figure 5a) and northward humidity flow in Asia and Oceania (July, figure 5b). A comparison between these two figures suggests that the southward flow over South

America in January is stronger then the northward flow over Asia in July. A possible explanation for this surprising result is that the Monsoon northward wind is strong in few days in July, while the southward South American flow occurs every day in January. Another possible explanation is that the Monsoon wind remains northward above 200 hPa.

(a)



(b)

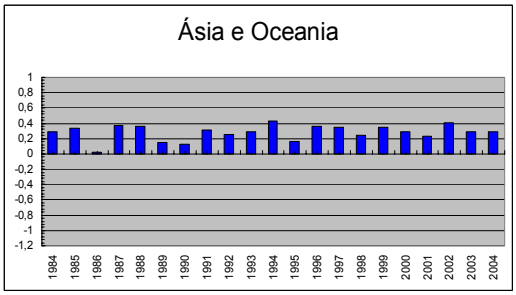


Figure 5 – Mean meridional flow in troposphere: (a) South America in January; (b) Asia and Oceania in July.

4. CONCLUSIONS

Some conclusions can be obtained from this study:

- There is a flow from the Northern to the Southern Hemisphere over South America continent during the austral summer, but this is not observed during the austral winter.
- Humidity extends from equatorial South America to southern subtropics during austral summer and to northern subtropics during austral winter.
- During austral summer, there is southward inter-hemispheric exchange east of Africa, east of Australia and in Central Pacific.
- During austral winter, there is northward inter-hemispheric exchange over Asia (Asian Monsoon) and also over Mexico region.
- Significant humidity advection occurs during austral summer, bringing water vapor from Amazon region to Southern Brazil, Northern Argentina, Uruguay and Paraguay.

5. REFERENCES

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