Roles of the Brazilian Highland in the formation of SACZ
Part I :Numerical experiments using RAMS

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1. Purpose

SACZ (the South Atlantic convergence zone) is a predominant precipitation zone charactering South American summer monsoon system (Zhou and Lau 1998). SACZ extends through Brazilian highland (BH) in its climatological position. This suggests some contribution of BH for maintaining SACZ. This study investigates the influence of BH for SACZ by numerical experiments.

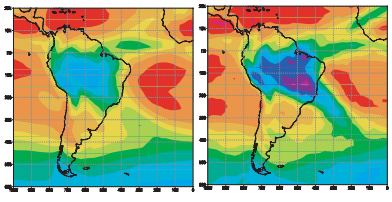

Fig. 1 Climatology of OLR (January, 1975-2005) (left) and OLR in January 1985 (right)

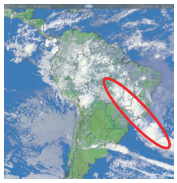

Fig. 2 Snapshot of GOES-IR image of SACZ.

2. Model and design of experiments

Model: TERC (Terrestrial Environment Research Center, Tsukuba Univ. Japan) -RAMS
Grid number: 250*200 (30 layers)
Horizontal grid: 50 km and 25 km
Initial and Boundary condition: NCEP-NCAR reanalysis
SST: NCEP NHC oisstv2
Simulated period: January 1985
Spin-up time: 10days
Convective parameterization scheme: Arakawa-Shubert (Numaguti et al. 1997)
Radiation scheme: Nakajima et al. (2000)

Table 1. Conditions of sensitivity experiments

	t0	t50	Cntl	t200	High_reso	stop rain over BH
Height of BH	0%	50%	100%	200%	100%	200%
Resolution	50km	50km	50km	50km	25km	50km

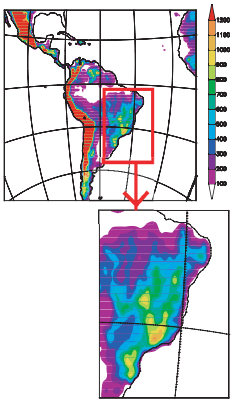

Fig. 3 Area of simulation(upper) and area for modifying resolution in high_reso run (lower)

3. Performance of Control run

Precipitation: Position of SACZ is good, but rainfall intensity is weakly simulated.

Wind: Cyclonic circulation near BH in the real atmosphere is not simulated in the lower troposphere. Bolivian High and trough of subtropical jet over the South Atlantic is properly simulated.

Cross sections of potential temp. and mixing ratio: Properly simulated.

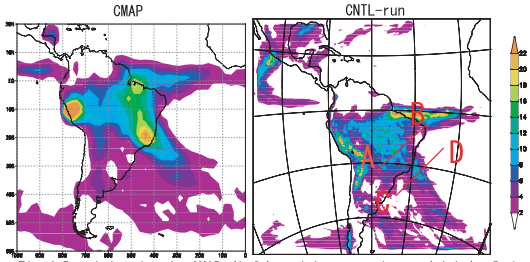

Fig. 4 Precipitation in CMAP (left) and in control run (right). Red lines indicate the position of cross section in Fig. 6.

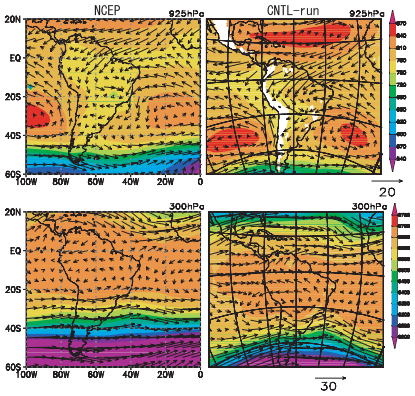

Fig. 5 Geopotential height (shad) and wind at 925 hPa in NCEP-NCAR reanalysis(left) and control run (right).

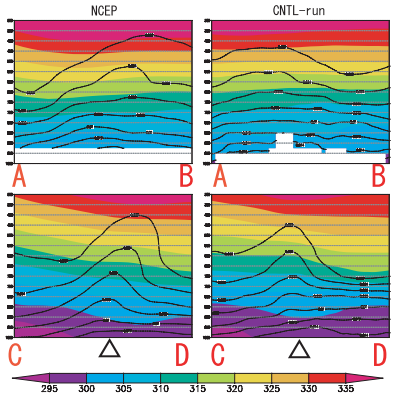

Fig. 6 Cross section of potential temperature (shade) and mixing ratio (contour).

4. Results of sensitivity experiment

(a) BH is higher and low-level convergence and precipitation along the SACZ are stronger. The cyclonic circulation in the southwestern protion of BH is simulated in t200 run.

(b) Precipitation along the SACZ and the low-level cyclonic circulation near BH are well simulated in high-resolution run. This indicates that expression of complex terrain of BH is important to simulate precipitation over the BH.

(c) Low-level cyclonic circulation near BH is disappeared in stop rain run, in which precipitation around BH is artificially stopped.

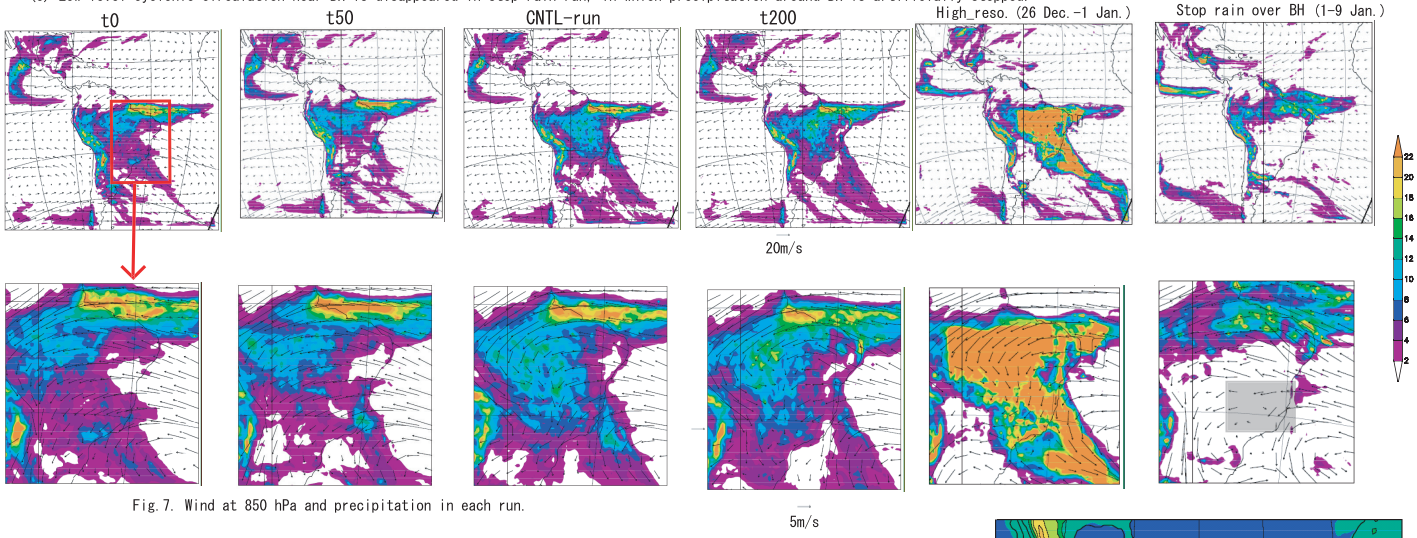

Fig. 7. Wind at 850 hPa and precipitation in each run.

5. Conclusion

SACZ was simulated in control run, although rainfall of SACZ was weak and the low-level cyclonic flow over BH was not simulated. In t200 run and high-resolution run, precipitation over the BH becomes strong and cyclonic circulation over the southwestern part of BH was simulated. The cyclonic circulation was not simulated in rain_cut run. This indicates BH maintains precipitation near the BH and the precipitation generates the low-level cyclonic circulation. The circulation contributes to maintain SACZ, because it intensifies the low-level convergence of SACZ along with northerly in the western periphery of Atlantic subtropical high and South American Low-level jet (SALLJ) from the eastern foot of Andes.

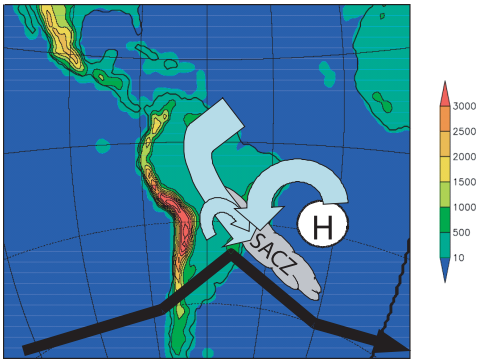

Fig. 8. Conceptual model of low-level circulation related to the SACZ.

References :
Nakajima, T., M. Tsukamoto, Y. Tsushima, A. Numaguti and T. Kimura 2000:Modelling of the radiative process in an atmospheric general circulation model, Appl. Opt., 39, 4869-4878.
Numaguti, A., M. Takahashi, T. Nakajima and A. Sumi, 1997:Description of CCSR/NIES Atmospheric General Circulation Model,CGER's Supercomputer Monograph Report, Center for Global Environmental Reserch,National Institute for Environmental Studies,No.3, 1-48.
Zhou, J., and K. M. Lau, 1998: Does a monsoon climate exist over South America? J. Climate, 11, 1020-1040.