

Roles of the Brazilian Highland in the formation of SACZ

Part II: A statistical study using long term observational data

Tomoyuki SAGAWA,¹Yasu-Masa KODAMA,¹
e-mail: kodama@cc.hirosaki-u.ac.jpand Takao YOSHIKANE²

1. Department of Earth and Environmental Sciences, Hiroshima University, Aomori, Japan

2. Frontier Research Center for Global Change, Japan Agency for Marine-Earth Science and Technology, Yokohama, Japan

1. Purpose

SACZ (the South Atlantic convergence zone) is a predominant precipitation zone characterizing South America summer monsoon system (Zhou and Lau 1998). SACZ extends through Brazilian highland (BH) in its climatological position. SACZ is a convergence zone between northerly along the western periphery of Atlantic subtropical high and South American Low-level jet (SALLJ) from eastern foot of Andes. In this study, we remake a cyclonic circulation developed around the southwestern part of BH, which may intensify the low-level convergence along the SACZ.

2. Data

5-day averaged precipitation (CMAP) and reanalysis (NCEP-NCAR) data in austral summer (DJF) during 27-year period between January 1979 and February 2005 are utilized.

3. Correlation analysis

South-east extension of positive correlation in precipitation is largest when reference area is located around BH (Fig. 2). This suggests that BH is the most favorite area for developing the SACZ. Cross correlation between precipitation in reference area and 850 hPa height shows deep low-level trough appears in the southwestern part of BH when the reference area is located over BH. For the other reference areas, low-level trough does not appear (Fig. 3).

4. Lag-correlation analysis

Lag-correlation suggests that correlation between precipitation over BH and the low-level trough is weak before the maximum of precipitation (Fig. 4). The low-level trough appears at the precipitation maximum and remains one pentad after the maximum. Upper trough appears before the maximum. It becomes deepest at the maximum and then decays soon after the maximum (Fig. 5).

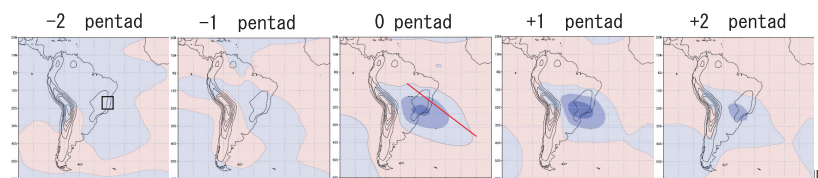


Fig. 4 Lag correlation between precipitation over reference area (box) and 850hPa height.

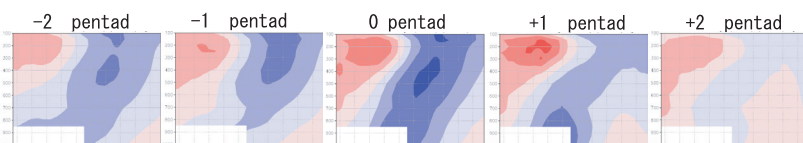


Fig. 5 As in Fig. 4 except cross section along red line in middle panel of Fig. 4.

5. Composite analysis

24 cases were selected when 5-day averaged precipitation was strong (>15mm/day) over BH. Time sequences of precipitation, wind and vorticity at 850 and 300hPa are examined using composite technique. Large rainfall over the South Atlantic remains 2 pentads after the maximum of precipitation over BH. At 0 and 1 pentads, a low-level cyclonic circulation is significant over the southwestern portion of BH and it intensifies low-level convergence with SALLJ and the sub-high circulation. Upper trough appears before the precipitation maximum. It may trigger the precipitation over BH. The trough is weak at the maximum of precipitation, but recovered again after one pentad. LH along the SACZ may contribute to form the trough and ridge system in the upper troposphere over the South Atlantic (Kodama 1999).

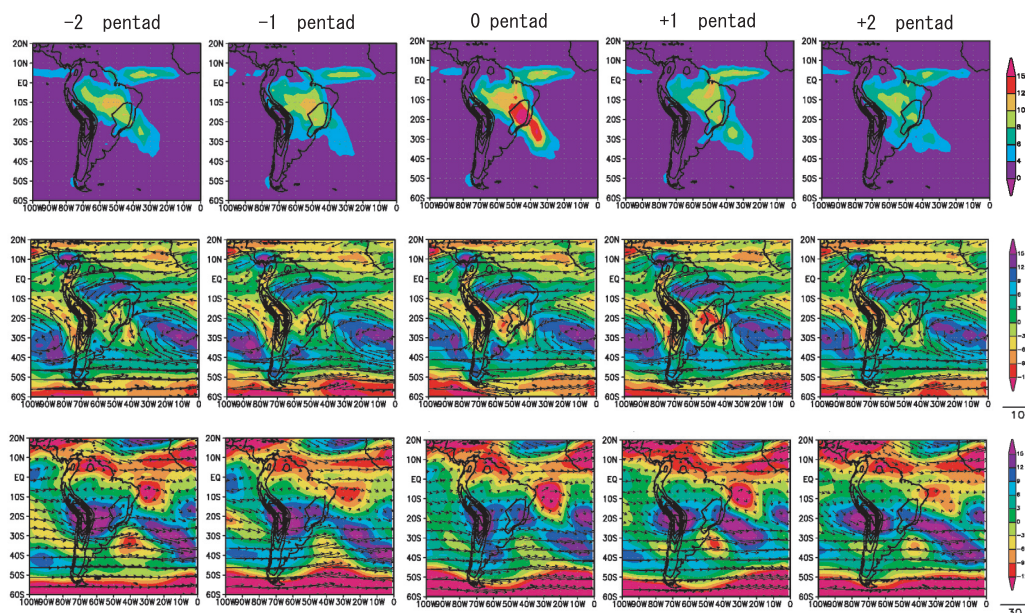


Fig. 6 Composite time-sequence of precip. (upper), wind and vorticity (*10e5) at 850hPa (middle) and 300hPa (lower).

6. Conclusion

Precipitation over BH is strongly related to the SACZ over the South Atlantic. Low-level cyclonic circulation developed over the south-western portion of BH. This circulation forms low-level convergence along the SACZ together with SALLJ and subtropical high circulation (Fig. 7). This result supports suggestions of numerical experiments (Part I) that BH contribute to the development of SACZ through intensifying the latent heating over BH.

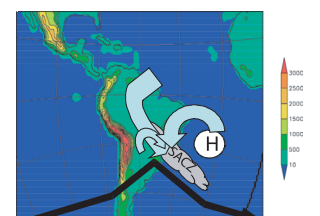


Fig. 7 Conceptual model of low-level circulation related to the SACZ.

References:

- Kodama, Y.-M., 1999: Roles of the atmospheric heat sources in maintaining the subtropical convergence zones -an aqua planet GCM study- J. Atmos. Sci., 56, 4032-4049.
Zhou, J., and K. M. Lau, 1998: Does a monsoon climate exist over South America? J. Climate, 11, 1020-1040.