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The spatial patterns of initial errors related to "winter predictability barrier" of Indian Ocean dipole and sensitive areas in targeted observations

Rong Feng (1,2), Mu Mu (3), and Wansuo Duan (1)

(1) LASG, Institute of Atmospheric Physics, Chinese Academy of Sciences, Beijing, China (friap@hotmail.com), (2) University of Chinese Academy of Sciences, Beijing, China, (3) Key Laboratory of Ocean Circulation and Wave, Institute of Oceanology, Chinese Academy of Sciences, Qingdao, China (mumu@lasg.iap.ac.cn)

With the Geophysical Fluid Dynamics Laboratory (GFDL) CM2p1 coupled model, the “winter predictability barrier” (WPB) phenomenon of the Indian Ocean dipole (IOD) events is revealed from the view of error growth. Quite a few initial errors exhibit significant season-dependent evolutions with maximum growth rate in winter, finally inducing a significant WPB phenomenon. These initial errors can be classified into two groups. In one group, the initial errors tend to present positive sea surface temperature anomalies (SSTA) in the western Indian Ocean and negative SSTA in the eastern Indian Ocean; while in the other group, the initial errors are inclined to have patterns almost opposite to the former. Furthermore, the anomaly signal in the subsurface temperature component of initial errors is more notable than that in the surface temperature. For the initial errors that don’t show considerable season-dependent evolutions, it is difficult to identify a common characteristic of the patterns. Besides, numerical experiments demonstrate that there is no season-dependent evolution with the random initial errors, and WPB phenomenon disappears. All these indicate that the WPB of IOD events is closely related to the particular spatial patterns of initial errors.
The two types of initial errors feature that the large errors concentrate a localized region; the benefits from reductions of initial errors in this localized region are quite larger than those in other regions. This region may therefore represent the sensitive areas of IOD predictions. If we increase observations in these areas and then the accuracy of initial fields, the IOD forecast skill may be greatly improved.