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Similarities between optimal precursors and optimally growing initial errors in onset prediction—ENSO, Blocking and Kuroshio Current

M. Mu (1,2), Z.N. Jiang (3), W.S. Duan (2), Y.S. Yu (1), and Q. Wang (1)

(1) Key Laboratory of Ocean Circulation and Wave, Institute of Oceanology, Chinese Academy of Sciences, Qingdao, China (mumu@qdio.ac.cn), (2) LASG,Institute of Atmospheric Physics, Chinese Academy of Sciences, Beijing, China, (3) State Key Laboratory of Severe Weather (LaSW), Chinese Academy of Meteorological Sciences, Beijing,China

In this work, we intend to investigate how precursors of some weather or climate events relate to the predictability of their onset when a conditional nonlinear optimal perturbation approach is used. Here we focused on links between the optimal precursor to the onset of ENSO, blocking and Kuroshio Current, and the optimally growing initial errors in their onset prediction.

Numerical results have shown that during the prediction of these weather or climate events, a type-1 optimally growing initial error bears the greatest resemblance to the optimal precursor. A type-2 optimally growing initial error is also characterized by a similar pattern, but with the opposite sign. Further analysis reveals that a type-1 optimally growing initial error has a similar growth behavior to that of the optimal precursor, and both develop into the weather or climate event. The evolutionary mechanism of a type-1 optimally growing initial error during the onset of weather or climate event can be explained in the same manner as that of optimal precursor triggering this weather or climate onset. This similarity between optimal precursor and optimally growing initial error also suggests that we may carry out the targeted observations over sensitive areas in advance to eliminate optimally growing errors as many as possible in the prediction of the onset of weather or climate event. Thus, the improved observation network will help us to better capture the spatial structure of precursors that trigger its onset and will increase our ability to predict these events.