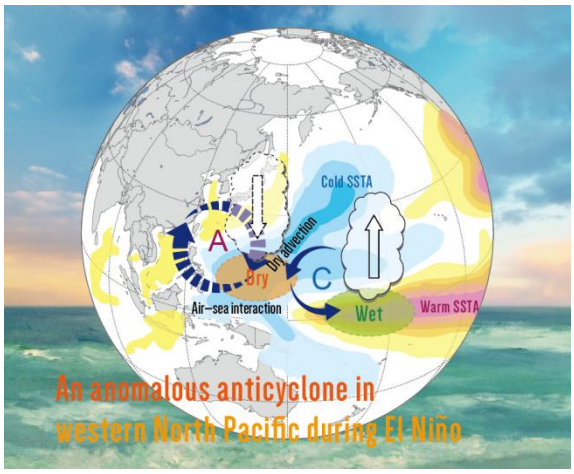
Li, Tim, B. Wang, B. Wu, et al., 2017: Theories on formation of an anomalous anticyclone in western North Pacific during El Niño: A review. *J. Meteor. Res.*, **31**, 987-1006, doi: http://dx.doi.org/10.1007/s13351-017-7147-6.

西北太平洋异常反气旋（WNPAC）是 El Niño 影响东亚-西北太平洋气候的主要环流系统。在最新一期《气象学报（英文版）》（Journal of Meteorological Research;JMR），夏威夷大学和南京信息工程大学的李天明教授与夏威夷大学的王斌教授，中科院大气物理所得吴波博士、周天军研究员，美国海军研究生院的 C.-P. Chang 教授以及复旦大学的张人禾教授，合作发表了一篇综述文章，题目是“对 El Niño 期间西北太平洋异常反气旋形成机理的回顾”。

文章总结和讨论了过去 20 年关于 WNPAC 的研究进展和各种理论，以及这些理论的局限性。与西北太平洋反气旋形成相关的理论包括：**暖池区大气-海洋相互作用，印度洋电容器，ENSO 和年循环非线性相互作用所导致的 combination mode，风-湿焓平流，以及中太平洋海温强迫**。分析表明，**局地海-气相互作用以及风-湿焓平流机制是 El Niño 成熟冬季 WNPAC 发展和形成的最主要过程**，它们对 WNPAC 在次年春天的维持也很重要。印度洋电容器机制对于 WNPAC 的早期发展没有作用，但在 El Niño 衰减年夏季可帮助 WNPAC 维持。同时，西北太平洋的局地海温异常也起一定作用。跨越印度洋-西太平洋暖池的大气-海洋耦合模态是一个新的可能机制，常常发生在一个强的 El Niño 的衰减年夏季。中太平洋冷 SST 异常强迫是北半球夏季的另一个重要影响机制，经常发生于 El Niño 快速衰减位相或 La Niña 发展/维持位相。Combination mode 理论预测的近年周期在观测中很难发现，因此它对于 WNPAC 的形成不起作用。文章最后提出一个新的热带大西洋的电容器机制。



The western North Pacific anomalous anticyclone (WNPAC) is an important circulation system that conveys El Niño impact on East Asian climate. In the latest JMR issue, Prof. Tim Li of University of Hawaii (UH) and Nanjing University of Information Science & Technology, co-authored with Prof. Bin Wang at UH, Dr. Bo Wu and Prof. Tianjun Zhou at Institute of Atmospheric Physics, Prof. C.-P. Chang at Naval Postgraduate School, and Prof. Renhe Zhang at Fudan University, wrote a review paper

entitled “Theories on formation of an anomalous anticyclone in western North Pacific during El Niño: A review”.

The paper summarizes research progress made in the past 20 years regarding this important issue. Various theories on the formation and maintenance of the WNPAC, including the warm pool atmosphere-ocean interaction, the Indian Ocean capacitor, the combination mode that emphasizes nonlinear interaction between ENSO and annual cycle, the moist enthalpy advection/Rossby wave modulation, and the central Pacific SST forcing, as well as the limitation of the theories, are discussed in details.

Table 1. Major mechanisms operating in different phases of ENSO

ENSO phase	Key processes responsible for formation and maintenance of WNPAC
El Niño developing fall SON(0) El Niño mature winter DJF(1) El Niño decaying spring MAM(1)	Local atmosphere–ocean interaction (Wang et al., 2000); Moist enthalpy advection/Rossby wave modulation (Wu et al., 2017a, b)
El Niño decaying summer JJA(1)	IO capacitor (Wu et al., 2009; Xie et al., 2009); Local SSTA forcing (Wu et al., 2010a); A self-sustained IO–WNP mode (Wang et al., 2013)
La Niña developing or persisting summer JJA	Central Pacific SSTA forcing (Wang et al., 2013; Xiang et al., 2013)

The authors concluded that the local atmosphere-ocean interaction and the moist enthalpy advection/Rossby wave modulation mechanisms are the essential processes for the initial development and formation of the WNPAC prior to and during El Niño mature winter. These two mechanisms are also critical for the maintenance of the WNPAC throughout the subsequent spring. The Indian Ocean capacitor mechanism does not contribute to the earlier development but helps maintain the WNPAC in El Niño decaying summer. The local SST anomaly in the western North Pacific, although damped in the decaying summer, also plays a role. A self-sustained inter-basin coupled mode across the Indo-western Pacific warm pool emerges as a new mechanism, and often occurs during the decaying summer of a strong El Niño. The central Pacific cold SST anomaly acts as an additional mechanism for the WNPAC formation in boreal summer, and it often occurs during either a rapid El Niño decaying phase or a La Niña developing/persisting phase. The near annual periods predicted by the combination mode theory are hardly detected from observations and thus do not contribute to the formation of the WNPAC. A new possible mechanism, with an emphasis on tropical Atlantic capacitor effect, is proposed.

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