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Jun Ying

Sources of Uncertainty in the Tropical Pacific Warming Pattern under Global Warming Projected by Coupled Ocean-Atmosphere Models

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Doctoral Thesis accepted by
Institute of Atmospheric Physics,
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Supervisors' Foreword

The global mean temperature increase induced by the increased atmospheric CO_2 concentration has been a widely accepted conclusion in recent decades. However, the regional climate changes in a warmer climate are often controversial due to the complexity of climate systems. The zonal pattern of the tropical Pacific Sea surface temperature (SST) warming is one of the most controversial, and crucial, issues, because of its dominant impacts on the pan-Pacific climate systems. However, the models participating in the Coupled Model Intercomparison Projects (CMIPs) of generations project different warming patterns among each other.

In September of 2013, Dr. Jun Ying joined our group as a Ph.D. candidate in Center for Monsoon System Research, Institute of Atmospheric Physics, Chinese Academy of Science, led by Prof. Rong-Hui Huang and Prof. Ping Huang. His work focused on the formation of the tropical Pacific SST warming pattern in the CMIP5 models. Differing from the simple analyses on the model-projected SST warming, his work developed a framework to analyze the physical processes which can influence the SST warming pattern, including the cloud–shortwave-radiation–SST feedback effect, wind-induced evaporation cooling effect, background evaporation capability effect, ocean dynamical effect, etc. Based on these analyses, Dr. Ying studied the common formation mechanisms of the tropical Pacific SST warming pattern among CMIP5 models and revealed two leading sources of intermodel uncertainty in projecting the tropical Pacific SST warming pattern, the cloud radiation feedback, and ocean dynamical effect. When considering these two leading sources and the models' common climatological biases, Dr. Ying corrected the previous multi-model ensemble projections and suggested that the tropical Pacific SST warming is more likely to be an El Nino-like pattern. Dr. Ying published lots of high-quality papers in top journals in the fields of atmosphere and climatology research.

Dr. Ying's Ph.D. thesis suggests that improving our understanding of the tropical cloud system and equatorial ocean overturning circulation are the two effective ways to reduce the intermodel discrepancy in the projections of tropical Pacific SST warming pattern. This hint is crucial for the model developers to improve the state-of-the-art climate models more effectively. Moreover, this thesis

also provides an efficient framework to analyze the physical processes of tropical SST warming pattern under global warming, which can be used to study the various aspects—such as: features, formation mechanisms, and sources of uncertainty—of regional SST change pattern under global warming. I believe this thesis will make a long-standing and significant contribution to the regional climate change study.

Beijing, China
July 2019

Prof. Ping Huang
Professor of Climatology

Prof. Ronghui Huang
Professor of Atmospheric dynamics

The original version of the book frontmatter was revised: Modifications have been made to the Acknowledgement and affiliation. The correction to the book frontmatter is available at https://doi.org/10.1007/978-981-32-9844-6_7

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Contents