Strengthened Indonesian Throughflow Drives Decadal Warming in the Southern Indian Ocean

Ying Zhang (1,2), Ming Feng (3,4), Yan Du (1,2), Helen E. Phillips (5,6), Nathaniel L. Bindoff (5,6,7), and Michael J. McPhaden (8)

(1) State Key Laboratory of Tropical Oceanography, South China Sea Institute of Oceanology, Chinese Academy of Sciences, Guangzhou, China (zhangying@scsio.ac.cn), (2) College of Earth Science, University of Chinese Academy of Sciences, Beijing, China, (3) CSIRO Oceans and Atmosphere, Crawley, Western Australia, Australia, (4) Centre for Southern Hemisphere Oceans Research, Hobart, Tasmania, Australia, (5) Institute for Marine and Antarctic Studies, University of Tasmania, Hobart, Tasmania, Australia, (6) ARC Centre of Excellence for Climate Systems Science, Hobart, Tasmania, Australia, (7) CSIRO Oceans and Atmosphere, Hobart, Tasmania, Australia, (8) NOAA Pacific Marine Environmental Laboratory, Seattle, WA, USA

Remarkable warming of the Southern Indian Ocean during the recent two decades is assessed using a heat budget analysis based on the Estimating the Circulation and Climate of the Ocean version 4 release 3 model results. The annual mean temperature averaged in the upper-700 m Southern Indian Ocean during 1998-2015 has experienced significant warming at a rate of $1.03 \times 10^{-2} \degree C/\text{year}$. A heat budget analysis indicates that the increase is mostly driven by decreased cooling from net air-sea heat flux and increased warming from heat advection. Increased Indonesian Throughflow advection is the largest contributor to warming the upper 700 m of the Southern Indian Ocean, while the reduction of surface turbulent heat flux is of secondary importance. These results expand our understanding of the decadal heat balance in the Indian Ocean and of Indo-Pacific decadal climate variability.