The Indonesian Throughflow, its variability and centennial change

Ming Feng

CSIRO Oceans and Atmosphere

Indian Ocean Marine Research Centre, Crawley, Western Australia, Australia

The Indonesian Throughflow (ITF) is an important component of the upper cell of the global overturning circulation that provides a low-latitude pathway for warm, fresh waters from the Pacific to enter the Indian Ocean. Variability and changes of the ITF have significant impacts on Indo-Pacific oceanography and global climate. In this presentation, I discuss observed features of the ITF and its interannual to decadal variability. I will also discuss on its centennial change under the influence of the global warming.

The ITF mainly sources from north Pacific thermocline waters, with additional contributions from the lower thermocline waters of the south Pacific. The ITF waters experience insensitive mixing in the Indonesian Seas before exit to the Indonesia-Australian Basin in the Indian Ocean. The ITF affect the physical structure of the Pacific and Indian oceans, as well as the ocean boundary current systems in the two ocean basin.

The ITF passes across a region that comprises the intersection of two ocean waveguides – those of the equatorial Pacific and equatorial Indian Ocean. The ITF geostrophic transport is stronger during *La Niñas* and weaker during *El Niños*. The Indian Ocean wind variability associated with the Indian Ocean Dipole (IOD) in many years offsets the Pacific ENSO influences on the ITF geostrophic transport during the developing and mature phases of *El Niño* and *La Niña*, due to the covarying IOD variability with ENSO. Decadal and multi-decadal changes of the geostrophic ITF transport have been revealed: there was a weakening change from the mid-1970s climate regime shift followed by a strengthening trend of about 1 Sv every 10 years over the recent decades. These decadal changes appear mostly due to the ITF responses to decadal variations of the trade winds in the Pacific. Thus, Godfrey's Island Rule appears to be able to quantify decadal variations of the ITF.

Climate models project a weakening trend of the ITF under the global warming. Both climate models and downscaled ocean model show that this ITF weakening is not associated with the changes of the trade winds in the Pacific into the future, and the reduction of deep upwelling in the Pacific basin is mainly responsible for the ITF weakening. Because of the close coupling between the wind-driven circulation and the overturning circulation in feeding the ITF, there is a need to amend the Island Rule to take into account of the contributions from the overturning circulation.