Tropical Pacific and Indian Oceans Climate Indicators: warm water volume, subtropical cells, Indonesian throughflow indices

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Abstract

The tropical Pacific and Indian Oceans play important roles in climate variability and change in the Indo-Pacific sector and have global ramifications. In particular, Indo- Pacific upper ocean heat content regulates sea surface temperature (SST) to control ocean-atmosphere coupling. To a large extent, the upper ocean heat content is controlled by the shallow meridional overturning circulation cells that connect the tropical and subtropical regions, often referred to as the subtropical cells (STCs). The Pacific and Indian Ocean STCs linked by an atmospheric bridge (through the Walker Circulation) and oceanic tunnel (via the Indonesian throughflow, i.e. ITF). Our previous studies suggest that the STCs of the Pacific and Indian Ocean play opposite roles in regulating upper ocean heat content of the Indo-Pacific region on interannual and decadal time scales (at least since the early 1990s). A routine monitoring of upper ocean heat content, STCs, ITF, the relationships among these elements, and their relationships to climate mode indices and parameters are therefore important to the diagnostics, understanding, and prediction of climate variability and change in the Indo-Pacific domain.

Despite the important need for monitoring these oceanic features, there has been a lack of systematic effort to produce an inter-connected set of indicators for these features in a routine manner. The proposed effort aims to systematically develop and routinely produce a set of observation-based indicators to monitor the tropical upper oceans in the Indo-Pacific sector to facilitate ocean and climate research and to enhance the public's awareness of the societal relevance of ocean observations. Specifically, we will produce indicators to describe the state, variability, and trend of (1) upper ocean heat content using the well-established index of warm-water volume (WWV), (2) various branches of the Pacific and Indian Ocean STCs, and (3) the ITF. We will also develop indicators that describe the relationships among these indicators as well as their relationships to climate mode indices for the Indo-Pacific region. With NOAA/PMEL, we will work with various NOAA organizations and international programs to disseminate these ocean climate indicators to the research community and the general public through web/data services along with the corresponding description of societal relevance.

The proposed effort is highly relevant to 2014 NOAA FFO competition "1. Climate Observations and Monitoring (COM) – Data Sets and Indicators", specifically, "b) Ocean Climate Indicators". That element of competition solicits proposals to "produce meaningful, authoritative climate-relevant and observation-based diagnostic indicators describing the status, trends, extremes, and variability of ocean physical properties over time scales of weeks to decades". This is because the proposed effort aims to produce well-established, physically important, societally relevant, observation- based ocean indicators to monitor upper ocean heat content and circulation that have strong implications to climate variability and changes. The proposed effort directly contributes to the first two objectives of NOAA's long-term climate goals as described in NOAA's Next-Generation Strategic Plan (NGSP): 1) Improved scientific understanding of the changing climate system and its impacts; 2) Assessment of current and future states of the climate system that identify potential impacts and inform science, service, and stewardship decisions.