ELO (Equatorial Line Observations)

Contact points:

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Overview:

In this project, the interactions within atmospheric equatorial convectively coupled Kelvin waves (CCKWs), the leading modes of eastward moving convection on time scales between several days and three weeks, will be investigated. CCKWs and other equatorial waves form the "building blocks" of the active phase of MJO. The main effort will be to organize and execute the Equatorial Line Observations (ELO) field campaign during the winter of 2018/2019 – as a component of the International Years of the Maritime Continent (YMC) program. Based on collected in-situ data as well as other observational, remote sensing and modeling datasets, the key physical mechanisms responsible for multi-scale interactions associated with the propagating atmospheric convection over the Maritime Continent will be analyzed.

Field Campaign description

We propose to organize ELO as part of the international YMC program, to study convective-dynamical atmospheric systems and their land and ocean interactions over the MC.

Approach: The ELO experiment is proposed to take place between 1 November 2018 and 28 February 2019 during the international YMC program. ELO is designed to fill in critical gaps in observations of multi-scale interactions between propagating and stationary modes of convection. The main objective is to collect atmospheric and oceanic data that characterize diurnal cycles of atmospheric convection and upper ocean temperature during CCKW and MJO propagation across the MC region. The observational network will consist of three land-based and two ocean-based stations (Figure 1). We will deploy meteorological and oceanographic instruments to measure upper ocean dynamics and thermodynamics, surface fluxes and precipitation and atmospheric stratification to characterize their intraseasonal variability.

The experimental design of the ELO field campaign is to comprise of four components along the equator, which will allow for coherent observations of dynamical and thermodynamical properties of the atmosphere and ocean during CCKW and MJO events across the MC.

The first component, west of the Sumatra coast in the eastern Indian Ocean (Figure 1), will measure the oceanic upper layer temperature and salinity using two autonomous Seagliders that will act as virtual moorings at stations on the equator at 95°E and 97°E. These locations are both within the range of the atmospheric convective systems that propagate westwards offshore from Sumatra as part of the diurnal cycle (Love et al., 2011). The goal is to understand the variability in the development and evolution of the warm layer and diurnal cycle before the CCKW approaches the land. The Seagliders will continuously dive to 1000 m and ascend to the surface, approximately every 3 hours, taking high vertical resolution (~0.5 m) measurements of temperature, salinity, pressure, dissolved oxygen and chlorophyll concentration, along with dive-average currents.

Figure 1: Map of the location of the ELO field campaign ocean stations (yellow squares) and land stations (orange circles) in the Maritime Continent.

Two land-based meteorological stations in Western Sumatra serve as the second component: they include an Indonesian government meteorological office (BMKG) station in Padang and a nearby Earth Atmospheric Radar (EAR) mountain station. The two stations are separated by only a short distance (100 km), but have a large vertical displacement that will enable a better characterization of the diurnal evolution of convection during its propagation away from the mountain range. Atmospheric measurements will include upper level soundings, precipitation, continuous local remote sensing profiles of atmospheric temperature, humidity and water vapor, cloud base and cloud cover, evolution of convection and vertical structure of rainfall, solar and infrared radiation, wind speed and turbulent fluxes from meteorological masts. We will work with BMKG, as well as Kyoto University researchers (who have relevant instrumentation at the EAR station), to obtain access to their observations and we will augment these observations with several instruments (flux tower, MPL Lidar, Ceilometer, microwave radiometer, wind profiler).

The third component has been submitted separately to NSF Ocean by Dr. Janet Sprintall. It consists of a moored thermister chain that will be deployed within the shallow waters of Karimata Strait that are unsuitable for Seaglider operations. The mooring will have high vertical resolution near the surface with thermistors at 10 cm, 50 cm and 1 m depths, and 1 m vertical resolution down to 15 m, and 5 m resolution below 15 m. The purpose is to study evolution of the upper ocean temperature warm layer associated with the diurnal convection and its variability during the propagation of the CCKWs and MJOs.

The final and fourth component is the land station on the west coast of Borneo in Pontianiak. This station has similar instrumentation to that of the Sumatra stations. The purpose of this station is to study the dynamical and thermodynamical properties of the diurnal cycle of the convection over relatively flat topography, and compare its variability associated with enhanced convection expected over Sumatra and its relationship to CCKW activity.

Expected Outcomes: The ELO field campaign will create a unique dataset of atmospheric and oceanic in-situ and remotely sensing measurements targeted at multi-scale interactions between the propagating convection and the local environment. The data will greatly advance our understanding of the non-linear processes and feedbacks responsible for convection propagation blocking in the MC region, along the equator from the eastern Indian Ocean to Borneo within the MC. During the four-month deployment period we expect (based on climatology) to measure approximately 14 CCKW and 2 MJO events. The collected data will include about 2000 ocean stratification profiles from the Seagliders, 700 atmospheric soundings along with a continuous 4-month record of surface fluxes, remotely sensed atmospheric profiles as well as the upper ocean temperature profiles from Karimata Strait. The quality controlled observations will be analyzed using time series statistical analysis and data-model comparisons. All data will be made publically available to the community in a timely fashion.