Weather predictability on a global scale is largely determined by periodic phenomena occurring in the tropics. This region is particularly important because latent heat of condensation released during formation of deep, convective clouds is a source of energy for a global atmospheric circulation. In other words: convective processes in the tropics – vertical movement of air and formations of clouds - as well as their variability, affect weather patterns on a global scale, including in mid latitudes (e.g. in Europe).

The Maritime Continent - a region composed of seas and lands, located between Australia and the South-East Asia, is the area with the highest global precipitation, on average exceeding 10 mm daily accumulation. This is why the Maritime Continent is considered as one of the most important area for the variability in atmospheric circulation and weather predictability on a global scale. Such a high average rainfall also means that extreme rain events, with floods and landslides as their consequences, occur much more frequently and regularly, than in other areas.

The Maritime Continent is composed of developing nations, such as Indonesia, Malaysia, Papua New Guinea and the Philippines. People living in this area are relatively poor, less protected by insurance against adverse effects of extreme weather phenomena and as a society – less able to predict hazardous weather conditions and adapt to them. Forecasts indicate that along with the climate change and the widespread human impact on the environment, extreme phenomena and their adverse effects will intensify in that region.

Rainfall in the Maritime Continent is characterized by a very strong diurnal cycle - it usually rains at the same time of the day: in the afternoon over land, while after midnight and in the early morning offshore. This is an effect of differences in diurnal warming of land and water areas during daytime and circulation that develops as a result of that imbalance. Furthermore, the amount of rain is modulated by variability of the diurnal cycle - higher daily rainfall means that the amplitude of the diurnal cycle was higher. This carries additional danger, because the short-term, rapid rain events can be by the order of magnitude higher than indicated by an average value.

The main goal of this project is to broaden our knowledge and understanding of the physical processes that govern multi-scale interactions between the diurnal cycle over the Maritime Continent and convective cloud systems organized in tropical waves (type of weather systems in the equatorial band). These interactions are important for extreme rainfall and associated floods. However, key physical mechanisms of those interactions remain unknown. In this project, we will calculate trajectories of tropical weather systems to analyze the variability of local atmospheric features associated with their propagation, including the diurnal cycle. During field campaign, which will in collaboration with a UK TerraMaris project, we will collect in-situ atmospheric data that will be used to study variability of the diurnal cycle, in the context of tropical weather systems' evolution.

The project involves novel theoretical and observational research at the frontiers of atmospheric physics and air-sea interactions. Project's scope, hypothesis and objectives are within interests of international community exemplified by the international Years of the Maritime Continent program. Identification of physical mechanisms triggering extreme rainfall will benefit the inhabitants of the Maritime Continent region. However, given global teleconnections, the project will improve the predictability of weather patterns in other areas of the globe, e.g. in Europe. This project will be executed in an international collaboration between scientists from the USA, Europe and Indonesia.