

Evolution of tropical coastal triple boundary zone as biosphere and anthroposphere

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Based on regional specific observations during GAME and MAHASRI, we may integrate the knowledges interregionally and interdisciplinarily during AsiaPEX.

Globally speaking, precipitation has been keeping the Earth's water amount and the ocean-continent ratio for 600 Myears after the last icehouse climate ("snowball Earth"). The coastline (the triple boundary among lithosphere, hydrosphere and atmosphere) has been changed with ceaseless plate-tectonic activities and an asteroid impact event 66 Myears ago, but provides the most suitable zone for evolution, diversification and population of organisms. Recent studies (Ogino et al., 2016, 2017) reveal that precipitation is concentrated in the coastline, which is indeed suitable for them.

Boundary layers are generated in the atmosphere (both over the land and sea surfaces) and ocean (both near the surface and the bottom) around the coastline, in order to mitigate the gradients of energy, momentum and constituents. Mathematically speaking, there are singular perturbation problems of which solutions include the Ekman friction (pumping or upwelling), the Sverdrup-Stommel wind-driven poleward ocean current (Kuroshio and Gulf Stream), and the monsoon and sea-land breeze circulations. They transport energy and water (sensible and latent heat). They are important also to generate cloud and precipitation, because the atmosphere is "conditionally unstable" only when any ascending motion and/or moisture convergence are forced.

Even without land ("aqua planet"), cloud and precipitation should be uniquely centered at the equator (ITCZ), due to Hadley-cell ascending motion induced by the annual-mean highest insolation (overheating). Therefore the tropical coastlines such as around the Indonesian maritime continent (IMC) produce the largest rainfall and biodiversity. It is interesting that the equator is dynamically similar to a coastline (e.g., Kelvin waves and oceanic upwelling).

Under AsiaPEX. I shall study the evolution and stability of biosphere and anthroposphere in the tropical coastal zones, (i) observationally over IMC-peatland plantations, and (ii) theoretically by boundary-layer dynamics.