

Significance of incompleteness as an aqua planet: Earth's climate with land-sea coexistence

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Our planet Earth is in a habitable zone in the Solar System, but is not entirely covered by liquid water, because its crust has separated into higher (continental) and lower (oceanic) parts. Such a planet of land-sea coexistence has a climate different from so-called aqua-planets or land planets.

Firstly, because oceans cannot flow beyond lands, the zonal vortical motion dominant generally in rotating planetary fluids must turn poleward near coasts in the oceans and contribute to meridional heat transport. Secondly, because of heat capacity contrast between ocean and land, the periodical variability of solar irradiance on a planet with rotation and revolution induces striking horizontal temperature gradient and wind in the bottom of atmosphere. Thirdly, the atmospheric mechanical forcing may be balanced (interacted) with the oceanic thermal forcing, whereas the rapid maritime water vapor transport must be balanced with the slow river flow on land. The coastline is just like a triple point among three geophysical phases of atmosphere, ocean and crust, maintained by an erosion-orogeny balance.

The land-sea coexistence is essentially important in equatorial climate, where the dominant motion is convective and governed by the temperature contrast and water budget between land and sea. Thus the longest coastlines in the Indonesian maritime continent (IMC) generate the largest rainfall on Earth. A super cloud cluster coupled with warm ocean water may circulate eastward with an intraseasonal period along the equator on an aqua-planet, but must be modified by reflection of ocean water (waves) at the coasts of IMC and American/African continents with an interannual time scale. Therefore, IMC is an important region in which we can study the climate of a land-sea planet based on observations.

The coastlines and rivers important climatologically as mentioned above are also zones in which human population, infrastructure and hence observations are concentrated. This is partly why we could start climatology even in an early history of the human beings. The leadership of climate observations in IMC is being transferred to the new G20 country, and we are entering into a new era for truly global observation of our planet Earth.

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