

Possibilities of pulsation measurements in the Ecuadorian ocean/fishery ecosystem affecting by the Humboldt Current derived from the Antarctic Ocean

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[Background] El Niño / La Niña events (ENSO) occur in the Ecuadorian waters. El Niño affects the Antarctic ice sheet collapse (Paolo *et al.* 2018). The Humboldt Current derived from the Antarctic Ocean and the Panama Current from the northern part meet at the waters and the Equatorial Front is formed. Both ocean currents flow west as the South Equatorial Current with countercurrent. These dynamic oceanic environments strongly influence marine ecosystems and ultimately the fishery (Jiménez 2008; Ormaza-González *et al.* 2016). In Galapagos Islands, the Galapagos penguins decrease according to the El Niño (Boersma 1998). Pinchagua (Pacific thread herring, *Opisthonema* spp.), a coastal catch species, has a high correlation with PDO (Pacific Decadal Oscillation) (De la Cuadra 2010). The sustainably accumulated Ecuadorian fishery data are valuable for research on ecological changes in the waters (Alvaro *et al.* 2018). We devised Guayaquil - Galapagos Oscillation Index (GGOI), which is strength of surface winds determined from sea-level pressure differences between Guayaquil and Galapagos Islands focusing on atmospheric variation. Based on sustained data collection and analysis in the future, it can be expected that the effectiveness of GGOI will be clarified (Naganobu *et al.* 2018). We will take an integrated approach to measure key factors to understand changes in the Ecuadorian ocean/ ecosystem.

[Pulsation measurements] Many studies have been conducted at ENSO. In El Niño and La Niña events, the composition of the fish species changes significantly. Build a catch database and analyze it continuously. In addition, an innovative fish finder (AquaMagic, <https://www.youtube.com/watch?v=6TPlvopBtxE>) will be introduced to measure species composition and biomass in the sea. Emphasis is placed on the gradient of the equatorial front as an index of ocean environment change. In order to understand the predator ecosystem changes, emphasis is placed on understanding the changes in the habitat ecosystem of the Galapagos Penguin, which is connected to the Humboldt Current.

[Integrated approach] We will take an integrated approach by the selected priority indices. The Antarctic Ocean and the Ecuadorian Sea are connected by the South Pacific Gyre. There are many studies on ENSO scale. In contrast, environmental ecosystem data in the Ecuadorian Ocean field is extremely limited. Therefore, we first prepare and analyze the marine fishery database. Next, we will introduce innovative acoustic technology to grasp precise changes in resource ecology. In addition, changes in the habitat of Galapagos penguins connected to the origin of the Antarctic Ocean will be added as a predator ecosystem tracking. We monitor the equatorial front and associated atmospheric and ocean dynamics as marine environments related to ecological changes. The pulsation of the global environment changes in the Ecuadorian Ocean where ENSO is located. In other words, take an integrated approach step by step where possible.

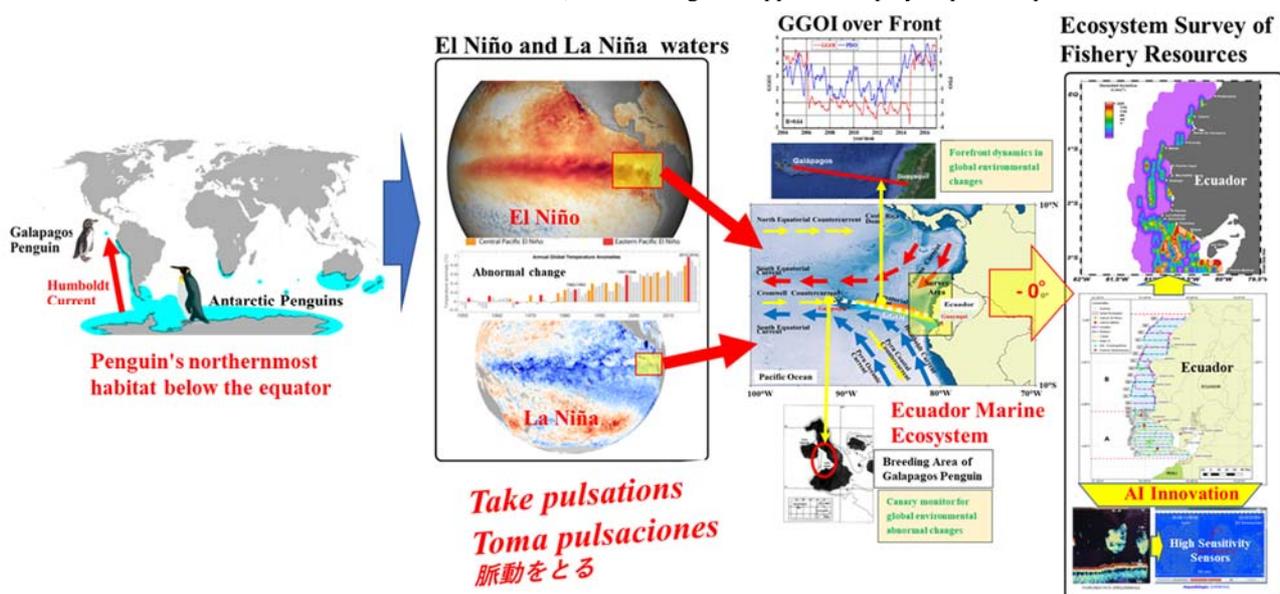


Figure 1: Take the pulsations of fishery environmental ecosystem by high digital instruments at hot spots of global climate change in the Ecuadorian Ocean including the Galapagos waters. The Galapagos waters with the penguin habitat are potentially influenced by the Antarctic Ocean through the Humboldt Current.