HCS098 - Spatial re-organizations in the coastal Humboldt Current ecosystem under oceanic climate forcing: portraying contrasted ecological scenarios

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One of the main sources of the climatic variability in the Humboldt Current system consists of the arrival of the coastal Kelvin waves, themselves being forced at the equator by the equatorial Kelvin waves (Pizarro *et al.*, 2002). The equatorial Kelvin waves are generated along the Equator, in the mid Pacific (180°W) by an anomaly of the wind flow and then propagate Eastwards across the oceanic basin. According to the kind of wind anomaly (under-pressure or over-pressure), the equatorial Kelvin wave may be of downwelling or upwelling type. When these waves hit the South-American continent, a portion of their energy is transmitted along the coast as 'coastal trapped' or 'coastal Kelvin' waves. Because these coastal waves introduce background energy for the turbulent flow in the coastal ecosystem, they are likely to produce deep impacts on a variety of components of the coastal ecosystem. On a physical point of view, a downwelling wave produces an intrusion of oceanic poor and warm waters in the coastal ecosystem and then a warm scenario (El Niño like scenario, Pizarro *et al.*, 2002). On the contrary, an upwelling wave favours cold and rich water resurgence and then the extension of the coastal water domain (a cold, La Niña like scenario).

In that context, the aims of this paper are (1) to describe the spatial re-organisations of living organisms in the Humboldt coastal ecosystem under the effect of the arrival of the costal Kelvin waves, (2) to formulate hypothesis on the particular processes that drive the re-distributions of the organisms, and (3) to build functional portraits of the scenarios of space occupation in the Humboldt coastal ecosystem. To characterise the equatorial Kelvin waves, we used an oceanic linear model of the tropical Pacific (Dewitte *et al.*, 2002). The model allows estimating the amplitude of the equatorial Kelvin waves in the eastern Pacific for the most energetic barocline modes, from wind data (QuickSCAT). The outputs of a high-resolution regional model (ROMS) simulation are also used to characterise the local mesoscale circulation. To describe anchovy distribution (*Engraulis ringens*, the main coastal pelagic resource), we analysed the distance to the coast, the depth and the size of the fish aggregations thanks to data collected both during scientific surveys and by observers at sea onboard fishing vessels. From these data, we also computed a spatial concentration index and a patchiness index (the fractal dimension) of the anchovy distribution. To describe fishers' spatial behaviour, we used positioning data from satellite vessel monitoring system. A synthetic index, calculated through a Lévy random walk modelling approach (Bertrand *et al.*, 2005), describes the sinuosity of the fishing trip trajectory and the area explored (diffusion). To explore the statistical connections between the dynamics of these different ecosystem components, we used linear statistics, GAM modelling and time series analysis.

Thanks to this approach, we could quantify and portray, on a spatial point of view, the ecological scenarios associated with the large scale climatic forcing. A downwelling wave generates in the coastal ecosystem a deepening of the thermocline and a reduction of the upwelled waters panache. Anchovy distribution concentrates in very coastal waters in dense and large aggregations. The high fish concentration allows fishers to explore smaller areas (high sinuosity, reduced diffusion). An upwelling wave, on the contrary, generates a rising of the thermocline in the coastal ecosystem, and an extension of the upwelled waters. Anchovy distribution is looser (less concentrated, patchier). Fishers need to explore wider areas to find enough anchovy (low sinuosity, high diffusion). Moreover, we evidenced a positive and significant correlation between the amplitude of the equatorial Kelvin waves and the fishers' spatial behaviour, with a 6 months lag. This last result may have important implications for management purposes as it could mean an ability to anticipate the dynamics of the coastal ecosystem.

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