Ocean and climate: The new theory

October 14 2013

© IRD / C. Costantini

Is this the end of a scientific paradigm on the effects of climate change? It would seem that global warming is not intensifying the rise of cold deep water, a phenomenon known as 'upwelling', characteristic of certain coastal zones. For over twenty years, specialists have believed that climate change is reinforcing the trade winds at the origin of these phenomena, thereby cooling the surface water. A new study, led by a team from the IRD and its partners, off the coast of West Africa, has

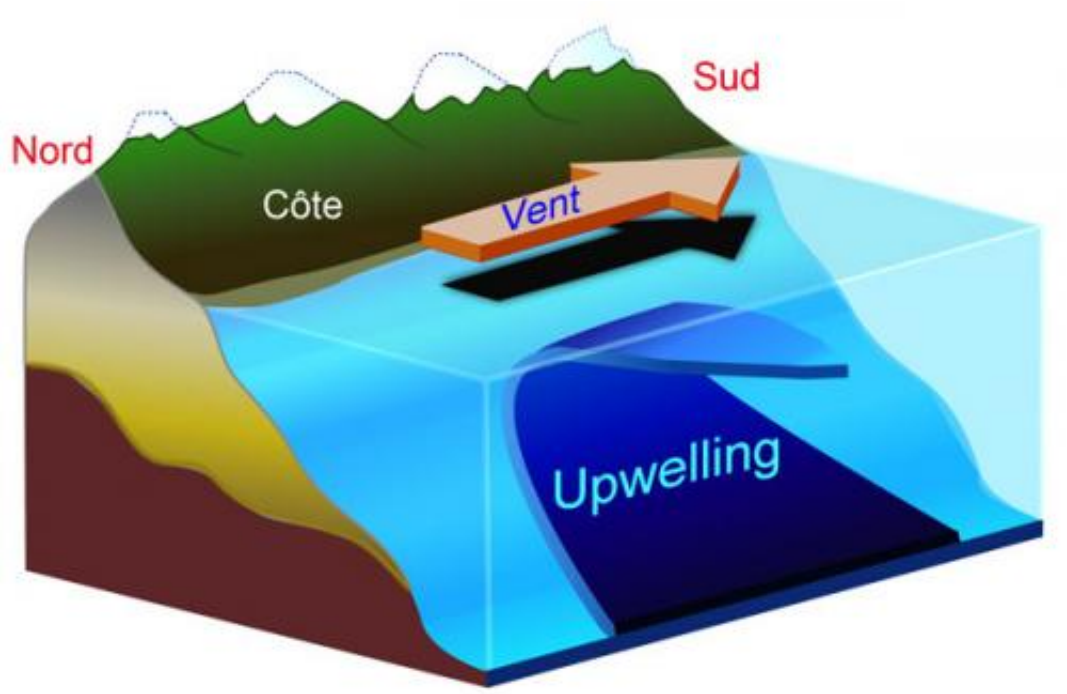
shown that this is not the case for the ecosystem of the 'Canary Current'. On the contrary, it reveals that the coastal waters from Morocco to Senegal have been getting warmer for the past 40 years.

Ecosystems at the heart of concerns

Assessing the effect of climate change on upwelling ecosystems is essential to be able to predict the future of marine resources. The zones concerned by this upwelling of cold deep water, which is very rich in nutrients, provide up to 20 % of global production of fish. Since the 1990s, the theory adopted by the majority of the scientific community affirmed that these phenomena were intensifying. The rising temperatures of the air masses above the continents were expected to quicken the trade winds, which would in turn increase the upwellings, thereby cooling the surface water. But this theory has been contradicted by the recent work of researchers from the IRD and its partners.

Coastal waters are getting considerably warmer

In their new study, led off the coast of North and West Africa, the scientists reviewed the wind measurements taken over the past 40 years and the data of the meteorological models along the Spanish and West African coastline, and discovered that they do not show an acceleration of the wind on a regional scale that would be likely to significantly cool the coastal waters. In fact, quite the opposite is true, since the satellite images and *in situ* measurements of the surface water temperature show a distinct upward trend in the temperature for the entire zone, at a rate of 1°C per century. These new findings contradict the hypothesis that the upwelling of the Canary Current is intensifying.



Credit: © Lichtspiel-IRD

A reinterpretation of the paleoclimatic data

Until now, the study of this ecosystem focused primarily on paleoclimatic reconstructions based on samples of marine sediments. According to the geochemical analysis of these samples, planktonic organisms have evolved in an increasingly cold environment over the last few decades. This led scientists to conclude that the temperature of the surface water was dropping. But in view of the new findings, the oceanographers have put forward another explanation: the thermal signal deduced from the paleoclimatic data is due to a progressive migration of plankton towards the depths because, on the contrary, the surface water is getting warmer!

The reaction of the coastal ecosystems to climate change remains complex, because it depends greatly on local specificities – other

upwelling systems, such as that of the California Current, clearly show a trend of intensification and cooling of the water in recent decades. At the level of the ecosystem itself, the effects of the warming of the surface waters can be antagonistic: it can for example encourage the growth of fish larvae, but also increase the temperature gradient between the surface water and the deeper water and thereby modify the food chain, etc. Researchers will now have to address all these questions.

More information: E.d. Barton, d.b. Field, Claude Roy. Canary current upwelling: More or less? *Progress in Oceanography*, 2013, 116, 167–178. dx.doi.org/10.1016/j.pocean.2013.07.007

Provided by Institut de Recherche pour le Développement