El Nino affected by global warming

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The climatic event El Niño, literally “the Baby Jesus”, was given its name because it generally occurs at Christmas time along the Peruvian coasts. This expression of climatic variability, also called El Niño Southern Oscillation (ENSO), results from a series of interactions between the atmosphere and the tropical ocean.

It induces drought in areas that normally receive abundant rain and, conversely, heavy rainfall and floods in usually arid desert zones. Scientists term this phenomenon a “quasi-cyclic” variation because its periodicity, which varies from 2 to 7 years, shows no regular time pattern. Research conducted over the past 25 years, by oceanographers, climatologists and meteorologists has much improved knowledge on the mechanisms generating an El Niño event.

However, possible influence of other systems of climate variability on the ENSO regime is more difficult to fathom. More particularly, it is not known if the intensity and frequency of the event is susceptible to modification in a situation of global warming.

The research work recently published by a team of Chilean and IRD scientists sheds new light on El Niño’s variability. Several geochemical factors contained in a drill core sediment sampled from 80 m depth under the Bay of Mejillones, in northern Chile, were determined. Analysis of breakdown byproducts from diatoms, unicellular planktonic algae, yielded an accurate trace of this region’s trends in sea surface temperature between 1650 and 2000. Data for the period 1820-1878 showed a fall of over 2°C. This temperature decrease was also detected

in two cores collected near the South-American coasts, over 1000 km to the North and South of Mejillones.

These samplings confirmed that the decrease in ocean temperature observed from 1820 affected the whole Pacific seaboard, from central Chile up to the North of Peru. All the oceanic area situated on the path of the Humboldt current system was therefore the scene of significant cooling during this period. This conclusion brings a paradox, seeing that the beginning of the XIXth Century coincided with the end of the Little Ice Age which came at the same time as a warming of the Earth.

Complementary analyses on certain minerals contained in the sediment samples confirmed that these minerals were transported by the winds from the continent. Therefore the reinforcement of such prevailing winds, the trade winds, would have favoured the rise of colder waters up from deeper reaches, along the Pacific coasts of South America, by pushing the ocean surface layer westwards. Confirmation of this hypothesis came from measurement of the organic carbon flux which is directly linked to growth in nutrient concentration. The increase in this flux accords with the phase of falling sea temperatures between 1820 and 1878 which proves that the rise in nutrient concentration stems from a rising up of cold water by the process of upwelling.

The hypothesis the researchers postulate suggests that, in a situation of climate warming like the one that followed the end of the Little Ice Age, the large continent–ocean temperature (and hence thermal) contrast would be responsible for this accentuation of the trade wind regime. Whereas the Atacama, a coastal-zone desert, warmed rapidly during this period, the sea surface temperature would have risen much more slowly. The long-term persistence of a substantial temperature difference between ocean and continent would have caused an intensification of the prevailing winds. Then by pushing the surface water towards the west, these winds would have induced cooling of the coastal waters, changing

the normal feature of the El Niño regime which is a warming of the waters. Between the end of the Little Ice Age and the beginning of the global warming attributable to human activities the ENSO regime was modified. Historical climatology studies founded on chroniclers' accounts and descriptions of floods caused by these El Niño events also showed an abrupt change, around 1820, in the ENSO system along Pacific seaboard of South America. Since the beginning of the XIXth Century, in other words the final phase of the Little Ice Age, the characteristic feature of El Niño events was abnormal rainfall, both in central Chile during the southern winter and on the northern coast of Peru during the subsequent southern summer.

These results as a whole emphasize the complexity of the interactions at work between the global-scale climate changes, the diverse behaviour of the ENSO system and regional climate changes. It remains to be determined if the extreme intensity of the two events which occurred at the end of the XXth Century, in 1982-1983, then in 1997-1998, is effectively linked to recent intensification of global warming. If that turned out to be the case, the El Niño phenomenon could become more and more intense and destructive, not only on the South American coasts, but also in other regions of the world.

Source: Institut de Recherche Pour le Développement