Abstract

The hypothetical increase in the intensity of storms is one the most important consequences related to the climate change. This is a critical issue in coastal engineering since it directly concerns the design and safety of maritime works. From the information recorded at Palamós buoy from 1988 to 2003, we have studied if it turns out to be credible to conclude that a climate change is taking place.

We have defined several categories of storms, in such a way that the climate change detection has become a problem of estimation and homogeneity of proportions. The estimation of proportions by means of the classical operations of the ordinary Euclidean geometry can lead to inaccurate results, specially when some of the probabilities are close to zero. The vector of probabilities we want to estimate belongs to the simplex, a sample space where the Euclidean geometry is not the appropriate one and must be replaced by the so called Aitchison geometry. Their desirable properties turn Aitchison geometry into the natural scale of the simplex. Therefore, we have raised our problem according to Aitchison geometry.

The use of Bayesian statistics makes possible to describe the uncertainty about the proportions by means of a joint probability distribution. All inferences about the multinomial probabilities have been carried out using the Gibbs sampler, a simulation technique belonging to the the Markov chain-Monte Carlo methods (MCMC). We have proposed a method of climate change detection that combines Bayesian statistics with Frequentist tools.

The results show that a significant increase in the intensity of storms takes place around 1995. Moreover, this increase has the same shape as the global climate change: there is an increase in the probability of extreme events whereas the distribution of the average climate remains relatively stable. Nevertheless, due to the short available record (only 16 years) the conclusions about the results must be considered as preliminary. The method we have used to the detect possible changes in the intensity of storms can also be used in any categorical data problem as a tool to estimate multinomial probabilities or to detect possible changes of trend.