The Interrelation between the North Atlantic Oscillation (NAO) and the mean sea level at the Baltic Sea-North Sea coastlines

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Abstract

Large changes in the wintertime atmospheric circulation had occurred since the mid of 1970s over the Atlantic Ocean basin of the Northern Hemisphere (NH). The variations over the North Atlantic were related to changes in the North Atlantic Oscillation (NAO), in which, the (NAO) has accompanied by a northeast shift between the continents 40 oN – 70 oN and tended to remain in one extreme positive phase over Europe and downstream over Eurasia. These changes have pronounced effects on the regional distributions of the mean sea level at Baltic Sea – North Sea coastlines. Detecting the impacts of the (NAO) on the mean sea levels, have done by correlation coefficient. The relative mean sea level trends have estimated before and after removing the average seasonal cycle with correction for all series residuals. In this respect, Pearson correlation and standard ordinary univariate linear regression models have applied on 86 data stations series of the mean sea level in boreal winter months (December, January, February) and season DJF (average of December, January, February months) time scales over the period (1960 – 2010). The changes in the North Atlantic Oscillation over the periods (1977-1994, 1981-1994) in boreal winter season DJF condition have detected in the mean sea level anomalies. Each of the mean sea level anomalies is linked to the behavior of the (NAO) anomaly by using the standard ordinary bivariate linear regression models. Where, the averages of the mean sea level anomalies are the residual of strong regional patterns of changes, and the anomalies average for each data series have recomputed linearly related to the variations in (NAO+) indices. The formal regression models have estimated strictly by using high accurately methods for satisfying all regression assumptions absolutely, (i.e. for univariate regression: - the observed values of the dependent variable are subject to errors which have zero mean such: normality (if violated, the nonparametric method has used alternatively), and are independent from point to point, while, for bivariate regression: - the true relation between the variables is linear; the values of the independent variable are measured without error; the observed values of the dependent variable are subject to errors which have zero mean such: linearity, normality, finite common variance, and are independent from point to point; the errors do not depend on the independent variable). Changes in the mean sea levels anomalies, what have the positive phase of the (NAO+) origins, have separated statistically in the present study and estimated carefully. The estimated trends for the recomputed mean sea levels anomalies, referring to the presence of strong regional patterns of change associated with phenomena like the (NAO) in the context of global climate change that might influenced the positive phase continuity.

Figure 1. The Baltic Sea – North Sea coastlines study region in the continent between 40 oN – 70 oN latitudes.