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A joint analysis of sea-level and meteorological data over the past 19th and 20th century on the Charente-Maritime French Atlantic coast

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A systematic survey of the historical French archives was initiated in 2004 to search for ancient sea level observations. Long term sea-level records are invaluable to study trends in sea level components in the context of climate change due to global warming. A large amount of records have been discovered, notably on the Charente-Maritime French Atlantic coast: fort Enet (1859-1873) and fort Boyard (1873-1909), a few kilometres apart. These two historical data sets include meteorological observations in addition to the sea-level heights: sea-level pressure, air temperature, wind direction and speed, and sometimes daily indications on the local climatic conditions. Sea-level heights were measured with a "Chazallon" type of float tide gauge and whereas the sea-level pressures were measured with a "Fortin" mercury barometer. The historical data sets are now in computer-accessible form. They were manually checked for consistency, and compared to nearby data sets (e.g. Brest, Hadley centre Sea Level Pressure data set HadSLP2).

We will present the data sets, the composite time series that were built for the period 1859-1909, and the joint sea level and meteorological data analysis which proved worthwhile. The pressure data were indeed of particular interest (7 observations per day, from 6.00am to 9.00pm between 1859 and 1909). First, examining the inverse barometer (IB) effect was demonstrated to be a good means to check the sea-level data sets (Woodworth 2006). If the data sets were of poor quality, then the sea-level height and air pressure monthly mean time series would show low or no correlation. Conversely, if both data sets were of good quality, there would be a high negative correlation between the local sea-level heights and sea-level pressure changes. Second, a linear regression between the two parameters (sea level and atmospheric pressure) would be giving a regression coefficient of approximately -1 cm/mbar under static assumption. Any departure from this relationship is indicative of wind-driven dynamical processes. As will be shown, the Charente-Maritime French Atlantic coast is a particular environment subject to westward winds with a complex coastline and bathymetry (islands, shallow waters). Last but not least, our data archeology exercise will provide additional evidence to the intriguing relation that was first noted by Miller and Douglas (2007) between sea level on the eastern boundary of the North Atlantic and the strength of the gyre-scale circulation, as represented by air pressure in the centre of the gyre, on multi-decadal and century-timescales.