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On the coupling between atmospheric and oceanic temperature time series

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We consider here simultaneous temperature time series both recorded in Boulogne-sur-mer (France): (i) a marine temperature time series recorded every 20 minutes in the surface of the sea from the MAREL automatic monitoring system and (ii) an atmospheric temperature time series recorded every hour by Meteo France.

The overall superposition of both time series is quite good, but atmospheric data present as expected a much larger variability. The coupling between these time series is studied for measurements between 24 March 2004 and 27 September 2007, with a total duration of 1098 days. There are about 26,000 data points at 1h resolution. Spectral, cospectral and probability density function analyses are performed on each series and on flux data, revealing couplings and scaling ranges. This shows that oceanic temperature may be modeled as a fractional integration of order 0.3 of atmospheric data, over a period of 40 days. As a test of this model, a synthetic oceanic temperature time series is generated as the sum of a constant and the fractional integration of the atmospheric measurements over a running period of 40 days. The synthetic series is compared to the oceanic temperature time series and it is found that there is a rather good superposition; the probability density function of the difference between the synthetic and the measured oceanic time series is estimated and shown to be rather narrow, being characterized by a standard deviation of about 0.7 degree C.