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Decadal prediction of sea surface temperature off the Tunisian coast

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Target groups

- **Local/Regional Authorithies**
- **Private Stakeholders**
- **Regional met offices**

Relevance to the case-study requirements

Sea surface temperature (SST) changes have important impacts on the economy of coastal areas in the Mediterranean countries. Among other factors, SST changes influence the bathing water temperature, which is relevant for the coastal tourism sector. Here, near-term climate predictions performed with state-of-the-art initialised climate models are used to infer future changes in sea-surface temperatures off the eastern Tunisia coast, for coastal tourism applications. The relevant informative content, current limitations and future challenges for making valuable decadal SST predictions in the Mediterranean basin, are discussed.

The approach

Decadal predictions are a novel field of investigation, aimed at providing a statement on the future climate evolution over a temporal horizon ranging from a few years up to 20 years. Compared with climate projections, whose predictive capability is entirely related to prescribed changes in the atmospheric composition (i.e., changes in greenhouse gases, aerosols, ozone concentrations), dynamical decadal predictions benefit from the additional skill stemming from initializing the state of a climate model with a realistic reconstruction of the climate system. The purpose of the initialization is to make use of the predictability associated with the internal (non-anthropogenic) climatic variability, providing an additional (with respect to the atmospheric composition) source of predictability.

Here, we use the results from a multi-model ensemble of CMIP5-compliant decadal prediction experiments performed as part of the European FP7 COMBINE (Comprehensive Modelling of the Earth System for Better Climate Prediction and Projection) Project, to assess sea-surface temperature (SST) changes off the Tunisian coast, over the 1960-2015 period. The COMBINE multi-model ensemble consists of six decadal prediction systems, based on state-of-the-art European coupled general circulation models. Additional details on the individual prediction systems, and the associated predictive skill can be found in Bellucci et al. (2012; 2014). Due to the relatively coarse horizontal resolution featured by the oceanic components of COMBINE ensemble models (around 1-degree, corresponding to approximately 100 Km, at the Mediterranean basin latitudes; see Table 1 in Bellucci et al., 2012), coastal shelf topography and dynamics are very poorly represented. Therefore, no valuable information can be provided about the SST changes occurring at the local scale (e.g., Gulf of Gabes, Gulf of Hammamet and Gulf of Tunis are all grid-point scale features). Thus, we opted for a regional-scale assessment of the SST evolution over the wider [33N-38N; 10E-14E] region, which is broadly representative of the Mediterranean Sea waters off the eastern Tunisian coast.

References:

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TUNISIA SEA SURFACE TEMPERATURE: Tourism case study

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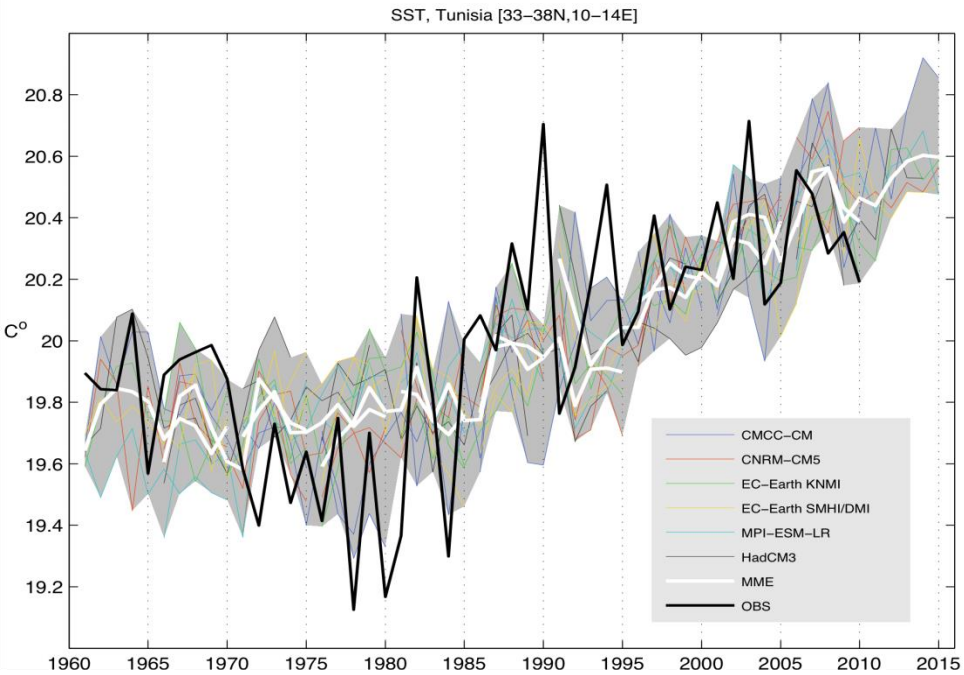
The product



Annual mean SST over the [33-38N; 10-14E] region for the 1960-2015 period, from model predictions (color), multi-model ensemble mean (white) and observations (black). The grey shading highlights the spread of the multi-model ensemble. Individual model biases were corrected following a standard procedure (ICPO, 2011).

The figure displays the evolution of the annual mean SST averaged over the [33N-38N; 10E-14E] region, for each individual decadal prediction system (color), the multi-model ensemble mean (MME; white) and HadISST (Rayner et al., 2003) observational data set (black). In the figure, the spread of the multi-model ensemble is also shown, with grey shading, providing a quantitative estimate of the uncertainty affecting the SST predictions.

The observed low-frequency SST changes are reasonably well reproduced by the hindcasts (retrospective predictions) for the 1960-2010 period. In particular, the observed 1960-1980 surface temperatures decline, and the following upward trend are both captured in the predicted signal. On the other hand, predictions under-estimate the observed interannual variability, leading to substantial departures between model results and observations, for individual years. The SST forecasts initialized on year 2005 indicate an expected multi-model ensemble mean temperature rise of about 0.4 ^{o}C over the 2006-2015 decade. The ensemble spread (grey shading in the figure) shows an uncertainty of approximately $\pm$0.2 ^{o}C around the multi-model mean.

Making the product usable

International efforts to set up a real-time multi-model decadal prediction system (similar to what is operational for seasonal forecasts worldwide) are currently ongoing (Smith et al., 2013).

Decadal predictions performed by several climate modelling groups as part of the IPCC WG1 activities have been archived on the CMIP5/ESGF facility, and are currently available to the international end-users community (see http://cmip-pcmdi.llnl.gov/cmip5/data_getting_started.html).

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