

## Weather types, beach recreation and tourism potential along the coast of the Gulf of Biscay

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Beach recreation is one of the most weather-sensitive leisure activities. Coastal regions around the Gulf of Biscay possess a long tourism tradition, initiated almost a century and a half. Today, tourism is a fundamental economic resource, although the oceanic climate of the northern coast of Spain and Western France, characterized by wet and mild summers, do not offer the same potential than the Mediterranean shorelines.

Several methods (from weather typing to weather indices) have been devised to analyze the impact of weather conditions on beach tourism potential. However, how the different weather/climate variables influence beach visitation remains a controversial issue.

This study applies a novel approach to study the relationship between weather and beach use and to define weather thresholds, useable as an input in a weather typing analysis of tourism potential, based on the comparison between webcam images and onsite real-time weather data. Over a period of 5 years (2006-2010), images taken at 12 UTC from June to September, in El Sardinero Beach (Santander), were analyzed and classified in different occupation classes, and later compared to the specific weather conditions from a nearby weather station. Based on those insights, the interannual variability of two tourist weather indices, a modified Besancenot's weather index typology and the Physiological Equivalent Temperature (PET), were calculated from several weather stations along the northern and western coast of France, and linked to the large scale atmospheric circulation over western Europe, reproduced as a synoptic daily pattern circulation catalogue and seasonally indices of relevant teleconnection pattern indices such as the North Atlantic Oscillation.

Precipitation and cloudiness became the dominating weather parameters affecting beach occupation. Wind speed and temperature seem to have a minor effect, conditioned to the previous ones, as well as air temperature. Sea surface temperature seems to exert an important role establishing the beginning and the end of the season, but its day-to-day impact is not relevant.

The most favourable period for the development of tourist activities takes place during the core summer months (July and August). The latitude, governing the temperature field, is the geographical factor that determines the length of that period. Some singularities exist, for example, the lower aptitude of the northern Spanish littoral during the heart of the summer, but the prolongation of summer season towards the beginning of the autumn in comparison with nearby areas such as Galicia or Aquitaine. The explanation rests on the orographic effects on the movement of the air masses crossing the mountains of northern Spain.

During the analyzed period, and in spite of a notable inter-annual variability, no detectable trend was deduced neither for the regional evolution of the most relevant parameters (sunshine, precipitation frequency) nor the frequency of suitable conditions obtained from the weather typing. However, the regional increase of summer temperatures has improving the thermal comfort during the optima days.

The most suitable summers for the tourist activities are characterized by persistent blocking highs on the British Isles. Such circulation pattern favours cloudless skies, relatively high temperatures and a wind regime characterized by breezes. On the contrary, unfavourable conditions are the result of the passage of atlantic disturbances over the region, bringing cloudy skies, high probability of rainfalls and moderate to strong westerly winds.

In terms of large scale circulation patterns, years of high potential were associated with negative summer NAO index, characterized by enhanced regional mid-tropospheric ridging over Central Europe and low pressures off the western coast of the Iberian Peninsula. Conversely, enhanced regional westerlies over Central Europe and a stronger Azores High were linked to unfavourable summers and a positive summer NAO index.

Finally, the preliminary results show that the regional evolution, in case of persisting on time, will increase the capacity of attraction of the region in comparison with other tourist destinations. Additionally, webcam-based research is a promising field that can provide important information for coastal planning and climate change research.