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Climate change effects on environment (marine, atmospheric and terrestrial) and human perception in an Italian Region (Marche) and the nearby northern Adriatic Sea.

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An integrated analysis of recent climate change, including atmosphere, sea and land, as well as some of the impacts on society, has been conducted on the Marche Region in central Italy and the northern portion of the Adriatic Sea. The Marche Region is one of the 20 administrative divisions of Italy, located at a latitude approximately 43° North, with a total surface area of 9,366 km2 and 1,565,000 residents. The northern Adriatic Sea is the northernmost area of the Mediterranean Sea, and it has peculiar relevance for several aspects (environment, tourism, fisheries, economy).

The collected environmental data included meteorological stations (daily maximum and minimum air temperature, daily precipitation), oceanographic stations (sea temperature, salinity, dissolved oxygen, nutrient salts concentration, chlorophyll) and river flows, over the last 50 years. The collected social data include 800 questionnaires and interviews carried out on selected samples of residents, decision-makers and emergency managers. These questionnaires and interviews aimed at highlighting the perception of climate change risks.

The trend analysis of air temperature and precipitation data detailed an overall temperature increase in all seasons and rainfall decreases in Winter, Spring and Summer with Autumn increases, influencing river flow changes. Marine data showed a relevant warming of the water column in the period after 1990 in comparison with the previous period, particularly in the cold season. Surface salinity increased in Spring and Summer and strongly decreased in Autumn and Winter (according with the precipitation and river flow changes). These last mentioned changes, combined with anthropogenic effects, also influenced the marine ecosystems, with changes of nutrient salts, chlorophyll and dissolved oxygen. Changes in nutrient discharge from rivers influenced the average marine chlorophyll concentration reduction and the consequent average reduction of warm season hypoxic conditions. Indeed, all these changes influence several other aspects of the North Adriatic marine environment, such as coastal erosion, ecosystems, biological productivity, mucilage phenomena, harmful algal blooms, etc.. These impacts in the coastal areas are also evident inland. For example, the analysis of agro-meteorological extreme indices (aridity index, potential water deficit) suggests negative impacts in terms of soil deterioration and agricultural productivity, particularly evident in the area close to the coast. Finally, the analysis of social data revealed awareness among local residents of these impacts and associated risks connected to climate change. Yet, this awareness does not appear translated into long term adaptation plans.

Apparently, the inability to define shared collective strategies is the result of a feeble sense of individual and institutional responsibility about climate matters, and ineffective information exchange among citizens, public administrators and the scientific community.