Climate change impacts on benthic ecosystems in Marine Protected Areas of the NW Mediterranean Sea: assessing potential risk from field, laboratory and numerical experiments

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The Mediterranean Sea is extremely responsive to climate change and dramatic impacts are expected to occur in benthic coastal ecosystems which are among the most exposed to the current trends and extreme events [1]. In this semi enclosed microtidal sea with seasonal stratification up to 15°C, the influence of (sub)meso scale dynamics (eg. upwelling, downwelling) is crucial in modulating local thermal regimes and potential impacts of climate change at local scale [2,3]. Developing more precise/realistic scenarios of coastal habitats warming and potential impact on ecosystems is crucial for setting up sound management and conservation plans of the rich Mediterranean biodiversity and thus recognized as a priority theme of international programs (eg. CIESM, MEDPAN, MERMEX). Within the CLIMCARES project (http://climcares.medrecover.org), we specifically addressed the risk of mass mortality outbreaks driven by thermal stress in rocky benthic ecosystems of the NW Mediterranean (NW Med) [4,5]. This was achieved by combining high resolution numerical simulations under IPCC scenarios with field observations and thermotolerance experiments. Temperature profiles (5-40m) have been monitored hourly over the past 10 years in different MPAs of Spain, France and Corsica (T-mednet initiative, http://www.t-mednet.org). Observations from 10 MPAs were compared with simulations for the last decade for two different models: the high resolution hydrodynamical model addressing (sub)mesoscale processes MARS3D/MENOR (horizontal resolution 1.2 km) and NEMO-MED8 (ca. 13 km resolution) [6]. Forecasts run were performed under IPCC scenarios to explore changes in stratification. Both approaches - local correction of regional model and high resolution downscaling with MENOR - were considered complementary and used to explore respectively long term trends in stratification and extreme events by the end of the century. These simulations were qualified with species distribution and thermotolerance functions to explore present risk level and potential impacts of climate change by the end of the century, providing new insight on areas of high conservation concern.