

The circulation and water mass (trans)formations in the Arctic Mediterranean Sea and their impact on the ocean deep circulation: a review

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Abstract. The Arctic Mediterranean is rapidly changing, a statement that is often made, but the follow-up statements: changing from what and towards what are often omitted. Hence its role in the global climate system, particularly regarding the Atlantic Meridional Overturning Circulations remains poorly constrained. This review of the oceanography of the Arctic Mediterranean Sea develops an unified perspective of how interacting components of the system evolve in space and time, and the processes that determine their evolution. To set the stage a succinct overview of the geographic setting and early explorations is given. We then follow the pathways of the principal water masses to describe inflows, inter-basin circulations, water mass transformations, and outflows of heat and salt to the bordering subpolar gyre and the global ocean. The fundamental connection to the global ocean, the Atlantic water, is traced along its route into and through the Arctic Mediterranean. Its transformations, driven by cooling, and by the freezing and melting of sea ice, lead to the creation of both denser and less dense waters that form and maintain the water column structures within the Arctic Mediterranean; the so-called double estuary. A second advective component to the Arctic, the low salinity water carried by the Pacific inflow, is concentrated into the Amerasian Basin and acts there to further isolate the denser waters derived from the Atlantic inflow. Hence, the waters return to the North Atlantic either as dense overflows or buoyant outflows. The water masses within diverse regions of the Arctic Mediterranean have changed over the past few decades, and this influences their exchanges with the world ocean east and

west of Greenland. That the water mass transformations in the Arctic Mediterranean take place beyond a ridge system that allows for the build-up of significant density differences that, through entrainment, can increase the impact of the Arctic Mediterranean on global overturning circulation.

1 Introduction

The mean surface temperature of the earth is rising and how this will influence the circulation of the atmosphere and in the oceans is largely unknown. The observed temperature increase is strongest in the high northern latitudes, which are primarily covered by ocean and one question then becomes: Does the presence of an ocean accelerate or mitigate the observed changes? To address this and related questions we review in Sect. 2 the global radiation balance and how the high north responds to the radiative and mechanical forcing generated by the sun and by the atmosphere. The focus is on the Arctic Mediterranean Sea, which comprises the Arctic Ocean and the Nordic Seas. We also describe the physical and geographical settings and the main bathymetric features of the Arctic Mediterranean and its connections to and communications with lower latitudes in the ocean and in the atmosphere.

Section 3 describes how our knowledge of the Arctic has evolved during the 500 years that have elapsed since the exploration of the high northern latitudes started. This section also reviews how the knowledge of the circulation and the water mass (trans)formations taking place in the Arctic