# Climate Velocity Over the 21<sup>st</sup> Century and its Implications for Fisheries Management in the Northeast U.S.

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## Abstract

A series of climate workshops recently held by the Mid-Atlantic Fishery Management Council (Council) identified the need to generate projections of future climate velocities (i.e., the rate and direction that isotherms shift across the seascape) in the region as explanatory mechanisms for the response of fish distributions to climate change. The purpose of the proposed research is to inform the Council about the rate, magnitude, and uncertainty surrounding future distributional changes for managed and other important species likely to occur as a result of climate change over the next several decades and for the remainder of this century.

In this proposal, we are proposing to project climate velocities and species distributions for a suite of species important to the Council in the Northeast U.S. Continental Shelf Large Marine Ecosystem (NE LME). We will downscale and bias-correct IPCC-class global climate model projections for 2020-2100, build species niche models from temperature and other environmental data, and develop an ensemble of species distribution projections. These ensembles will account for uncertainty more completely than has been done in the past, including uncertainty in greenhouse gas emissions, climate model formulation, climate variability, statistical niche model formulation, and niche model parameters. We will rank species by the rate and magnitude of range shift as well as the uncertainty in those values while also diagnosing the dominant source of uncertainty. In collaboration with the Council, we will identify potential priority species for adaptation of fisheries management to climate. Finally, we will expand an existing website to share these projections with the public, fishing communities, and other stakeholders.

The results of the proposed research will help the Council in the development of an adaptive fishery management framework that can deal effectively with shifting distributions of both managed and unmanaged fish stocks as part of its Ecosystem Approach to Fisheries Management (EAFM) Guidance Document. The Council proposes a novel, adaptive approach to conducting this work by utilizing its EAFM Working Group to help refine the analyses as the modeling work unfolds. EAFM WG oversight is expected to insure that the results of the proposed work will directly address the information and analytical needs required for inclusion in the Council's EAFM Guidance Document.

The research we propose directly addresses the primary focus of the COCA competition by seeking to understand and predict the future scope of distributional changes of fish stocks in the Mid-Atlantic as a result of climate change induced warming of the Atlantic Ocean. These analyses are critical to understanding future changes in the region and are a fundamental prerequisite to integrating these effects into fishery stock assessment and management efforts. The proposed research also supports the attainment of NOAA's long-term NGSP goal of climate adaptation and mitigation by improving our scientific understanding of the changing climate and its impacts on fisheries. Ultimately, the work will help the Council and Nation to prepare for and mitigate against the impacts of climate change with the goal of maintaining sustainable fisheries which support vibrant coastal fishing communities.