Deeper understanding of the intrinsic variability and stability properties of the main climate variability modes is needed to assess confidence in the detection, attribution and prediction of global and regional climate change, to improve seasonal predictions, and to understand the shortcomings of current prediction systems. DYNAMITE will explore the fundamental dynamical mechanisms of two of the most important modes of climate variability: the North Atlantic Oscillation/Arctic Oscillation (NAO/AO) and the El Niño-Southern Oscillation (ENSO). The project will elucidate key theoretical and practical aspects of the NAO/AO and ENSO through analyses of available observations, application of classical and new theory, and use of idealised and state-of-the-art numerical models of the atmosphere, ocean, land-surface, sea-ice, marine biology, and the coupled climate system.