Session: C4 Poster: TH181B

CLIVAR-SPAIN contributions - The Agulhas Current off South Africa as a pacemaker of North Atlantic and Southwest Mediterranean climate

Rainer Zahn[†]; GATEWAYS Project members
[†] ICREA, Universitat Aut_noma de Barcelona, Spain
Leading author: rainer.zahn@uab.cat

The Agulhas Current is the major western boundary current of the Southern Hemisphere. The Current transports about 70 sverdrups (1 sverdrup = 1 million cubic meters per second) of warm saline waters from the tropical Indian Ocean to the southern tip of Africa. This volume transport is comparable to the Gulf Stream and like its North Atlantic counterpart the Agulhas impacts climate on regional and global scales. South of Africa the current turns back into the South Indian Ocean, but up to 15 Sv of salt water enter the South Atlantic via so-called Agulhas Rings. Numerical models specifically highlight the possibility that this salt water transfer (also termed 'Agulhas Leakage') serves as a rheostat for buoyancy transports that, ultimately, modulate convective activity in the subpolar North Atlantic; this teleconnection carries direct implications for the stability of the Atlantic meridional overturning circulation (MOC) and northern hemisphere climate, including Mediterranean Europe. Despite its significance the Agulhas Current regime has long been neglected in ocean and climate research and has remained substantially underexplored. Hence, only few direct observations and even fewer modelling studies and paleo-reconstructions exist over the region. The 'GATEWAYS' project, funded by the European Commission and coordinated at the Universitat AutÚnoma de Barcelona, carries out multidisciplinary research into the Agulhas Current and its impact on the MOC. It combines physical oceanography, ocean and atmospheric modeling, and marine and terrestrial paleoclimatology. The aim is to (1) test the sensitivity of the Agulhas Current to changing climates, (2) assess the impact of the current on climates in southeastern Africa, (3) examine the sensitivity of the Atlantic MOC to Agulhas leakage, and (4) determine the influence Agulhas variability on North Atlantic and European climate. GATEWAYS offers interdisciplinary training and capacity building to 15 Early Stage Researchers and three Experienced Researchers. High-resolution numerical modelling demonstrates that the Agulhas salt water leakage influences the Atlantic's density stratification and hence its potential for deep convection; a persistent change in the leakage can shift the MOC to a new stable state in several hundred years. Direct observations indicate that the Agulhas leakage is increasing under current global warming. In conjunction with a progressive southward displacement of the ocean subtropical front south of Africa more rings are formed and travel to the South Atlantic. An increased leakage potentially compensates the impacts of warming and freshening of the North Atlantic, thereby possibly stabilizing the MOC. Initial paleoceanographic investigations into past variations of the Agulhas Current and leakage indeed confirm that a connection with the Atlantic MOC existed in the past. Salt water anomalies maximised episodically at the tip of Africa suggesting the existence of Agulhas Leakage maxima. The maxima coincided with a progressive strengthening of the MOC that is indicated by geochemical evidence, suggesting a direct connection between Agulhas Leakage and the MOC. Synchronizing the Agulhas paleo-records with similar records from the North Atlantic and Iberian margin indicates that climatic changes there coincided with Agulhas Leakage events in the past. The case is made that credible projections of future climate developments in the North Atlantic region and southwestern Mediterranean must include the dynamics and future development of the Agulhas Current off South Africa.