Impact of closing of the Agulhas leakage on tropical Atlantic climate in a coupled Ocean-Atmosphere simulation

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The response of tropical Atlantic climate to the closing of the Agulhas leakage is investigated with the coupled-ocean-atmosphere model SPEEDO. The initial as well as the equilibrium response are studied.

1. Introduction

The Agulhas leakage is formed by about 6 rings per year. Each ring transports 0.5-1.5 Sv. A northward shift in the zero wind stress curl line could interrupt the Agulhas leakage. Paleo data suggest that this has happened in the past.

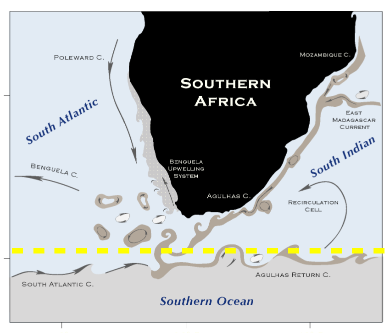

Figure A. *Agulhas leakage. The yellow line indicates the position of the present day zero windstress curl line*

2. SPEEDO

• Atmosphere: Speedy T30, global, 7 layers, simplified parameterizations

• Atlantic Ocean:(40S-50N) MICOM 22 layers, 1 degree resolution. Elsewhere: Climatological prescribed SST.

3. Experiment

Closing of the Agulhas leakage (NOAGU) is mimicked by imposing different boundary conditions in the south-eastern corner of MICOM at the region of the Agulhas leakage. They are colder and fresher in the upper ocean compared to the CONTROL run (Levitus) (Fig. B). NOAGU and CONTROL are run for 50 years.

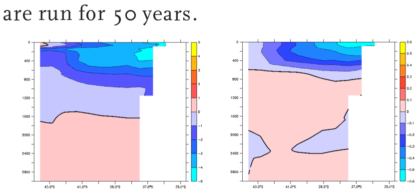

Figure B. *Difference between NOAGU and CONTROL boundary conditions in the south-east corner of the MICOM basin for (a) Temperature [K] and (b) Salinity [PSU]*

4. Initial response

The impact of the closing of the Agulhas leakage is advected in about 10 years to the tropical Atlantic. (Fig. C)

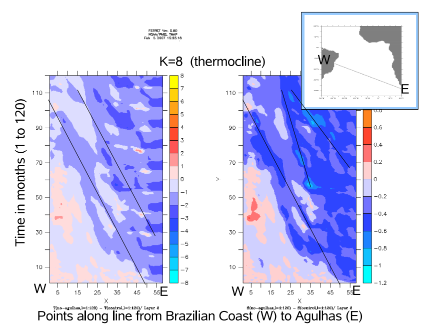

Figure C. *Hovmuller diagram of temperature (left) and salinity (right) in the $\sigma = 26.18$ layer*

5. Equilibrium response (last 20 years)

OCEAN

• Cooler and fresher surface waters in the South Atlantic. Slight warming at the equator. Cooling in Genuiea Dome (Fig. D).

• The cooling at the equator is confined to the thermocline and deeper layers. (Fig. E)

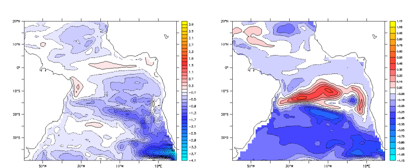

Figure D. *Difference in SST (left) and SSS (right) (NOAGU-CONTROL)*

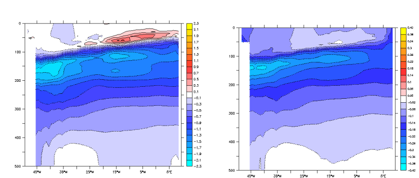

Figure E. *Difference in temperature (left) and salinity (right) along the equator (NOAGU-CONTROL)*

ATMOSPHERE

• Northward shift of ITCZ (Fig. F). This causes the local salinity maximum in Fig. D

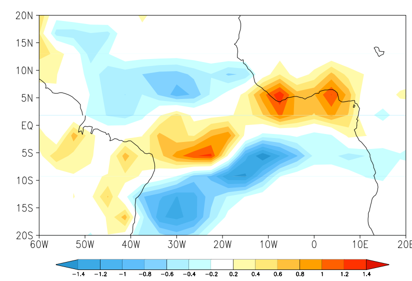

Figure F. *Difference in precipitation (NOAGU-CONTROL) [mm/day]*

• Shift in tradewinds reduces Ekman pumping in eastern tropical Atlantic (Fig. G). This causes the warming in that region (See Fig. D and E).

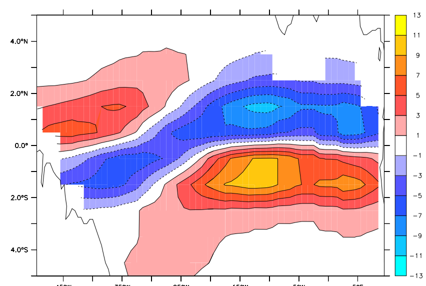

Figure G. *Difference in horizontal Ekman divergence (NOAGU-CONTROL).*

6. Conclusions

• **Impact on tropical Atlantic climate after about 10 years**

• **Cooling and freshening of South Atlantic**

• **No impact on temperature in equatorial mixed layer, only in deeper layers**

• **Cooling Guinea Dome region**

• **Northward shift of ITCZ**

• **Change in tradewinds and Ekman pumping**

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