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Supporting Information for

Modulation of western South Atlantic marine heatwaves by meridional ocean heat transport

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Introduction

The **Text S1** of this Supplementary Material describes the concept of the Bayes' Theorem and the methodology used to calculate probabilities of MHWs and CSs conditional to the CEOF mode. The **Figure S1** shows the result of the posterior conditional probabilities described in Text S1, and Table S1 shows the values of the individual probabilities used to calculate the posterior probabilities. **Figure S2** shows the seasonal cycle of the mixed layer heat budget (in W/m^2) the average mixed layer depth (in meters) averaged in the western subtropical South Atlantic (46W-35W/33S-27S). The mixed Layer heat budget is calculated using the monthly ORAS5 reanalysis.

Text S1. Conditional Probability

The probability of an event occurring based on prior knowledge of the conditions that might be relevant to the event is described by the Bayes' theorem. The Bayes' theorem is expressed in the following formula:

$$\boldsymbol{P(A|B) = \frac{P(B|A).P(A)}{P(B)}}$$

Where P(A|B) is the posterior probability that event A occurs given that event B has occurred, P(B|A) is the likelihood that both events A and B occur, and P(A) and P(B) are the observed independent probabilities of the events A and B occurring, respectively.

In our particular case, we assume that the variables A and B are binary, in which A represents the MHW (A+) and CS (A-) events, and B represents the CEOF+ (B+) and CEOF- (B-) events. The occurrences of these events are treated as mutually exclusive, thus P(B) can be defined as the sum of all factors affecting B:

$$\boldsymbol{P(B) \ = \ P(B|A+)P(A+) \ + \ P(B|A-)P(A-)};$$

therefore, P(B) can be regarded as a normalization factor for the posterior probabilities. Thus, in agreement with the main mechanism examined here, we are interested in analyzing if the alternative hypothesis (P(MHW,CEOF+), P(CS,CEOF-)) is significantly higher than the null hypothesis (P(MHW,CEOF-), P(CS,CEOF+)), and in this case we can reject the null hypothesis.

The events are analyzed over 9681 days, from which MHW events occurred during 1000 days and CS events occurred during 1166 days. The CEOF+ events occurred during 4986 days, from which 811 MHW events and 302 CS events occurred, and CEOF- events occurred during 4695 days, from which 864 CS and 189 MHW events occurred. The individual probabilities are given in Table 1.

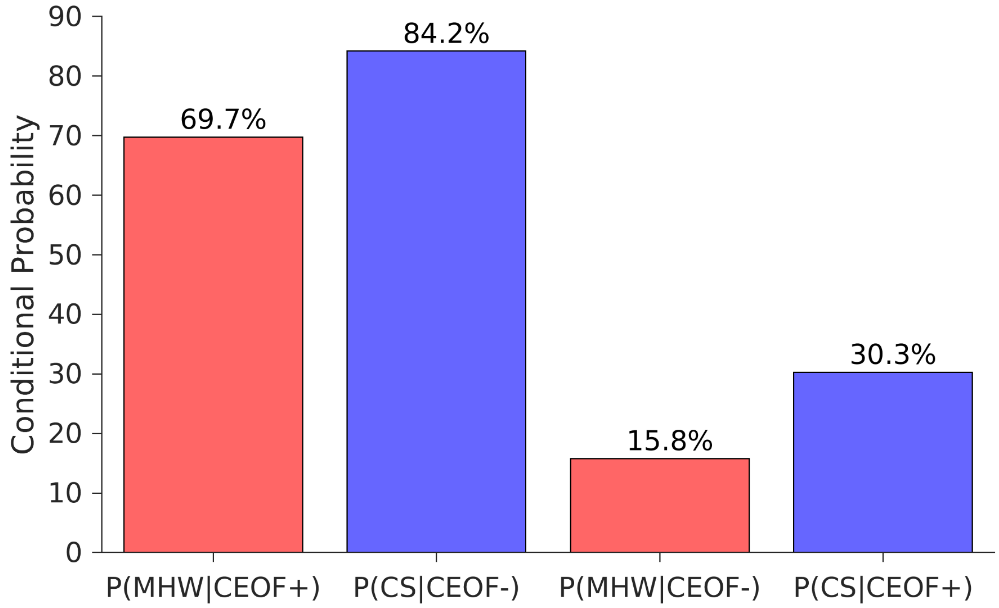

Figure S1. Conditional probabilities (%) of MHW and CS events given a particular phase of the SLA reconstructed in the western South Atlantic using the CEOF1 mode. Conditional probabilities are calculated using the Bayes' theorem (see Text S1), and values are shown in Table S1.

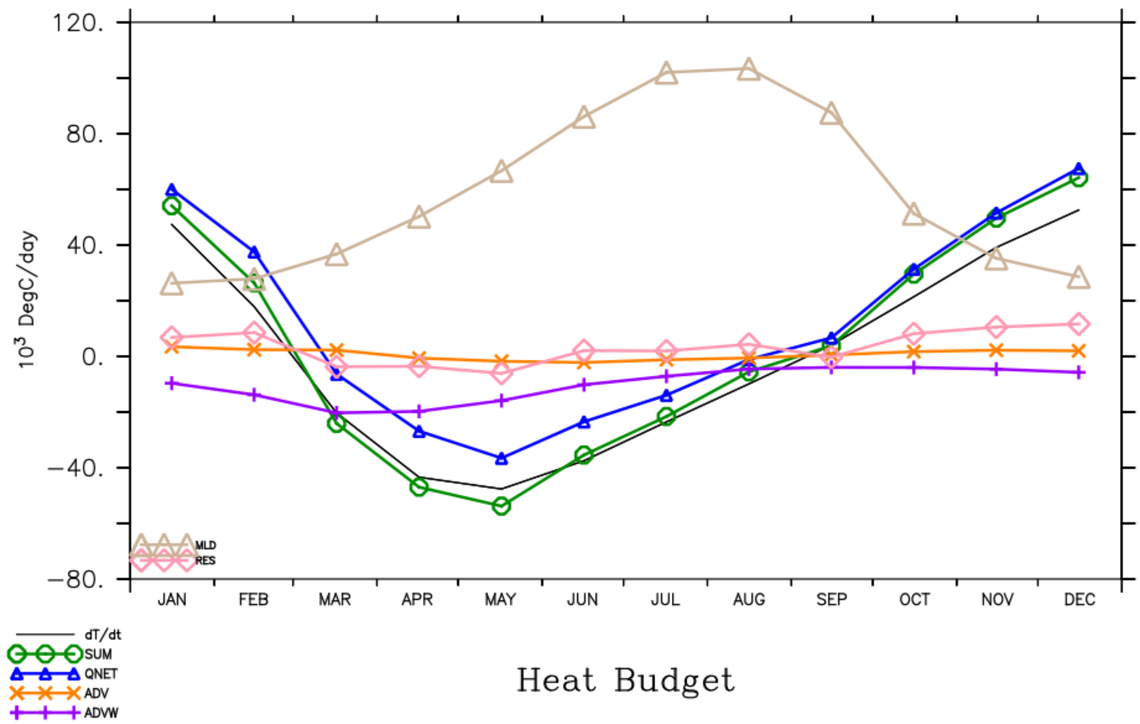

Figure S2. Seasonal cycle of the mixed layer heat budget terms in the box of **Figure 6c**. Deepening of the MLD during fall (Feb-Jun) provides cooling to the mixed layer due to vertical entrainment. A rapid warming due to net heat heating occurs when the mixed layer is shallow during late spring and summer.

Probabilities	
P(MHW)	0.103
P(CS)	0.120
P(CEOF+)	0.012
P(COEF-)	0.013
P(COEF+ | MHW)	0.084
P(COEF+ | CS)	0.031
P(COEF- | MHW)	0.019
P(COEF- | CS)	0.089
P(MHW | COEF+)	0.697
P(CS | COEF+)	0.158
P(MHW | COEF-)	0.303
P(CS | COEF-)	0.842

Table S1. Individual probabilities used in the Bayes' theorem estimation of conditional probabilities.