BRAZILIAN SARDINE (*Sardinella brasiliensis*) LANDING AND ITS RELATIONSHIP WITH THE MARINE VARIABILITY IN THE SOUTHEAST BRAZILIAN BIGHT.

Walter Hugo Diaz PINAYA [1], Ronald Buss de SOUZA [1]
[1]Southern Regional Center for Space Research, National Institute for Space Research - CRS/INPE, Santa Maria, RS, Brasil
wpinaya@ig.com.br

INTRODUCTION

The Brazilian sardine (*Sardinella brasiliensis* - Steindachner, 1879) is considered a traditional specie in the fish captures of the South and Southeast coastal region of Brazil. It is a coastal pelagic specie and easy to capture, being fished between 10 m and 100 m depth. The dynamic of populations of coastal species is highly correlated with long term climatic variability established with the oceanic circulation. An optimum between physical and biological aspects favors the fish grow and survival.

MATERIAL AND METHODS

Remote Sensing data was used to obtain time series of sea surface temperature (SSTA) and chlorophyll-a anomalies in the Southeast Brazilian Bight (SBB). The fishery data is available by Sao Paulo Fishery Institute, as Brazilian sardine landing during the period from January of 1998 to August of 2014. In order to evaluate the relationship between these variables the methods of wavelets, cross-wavelets and cross-correlation were applied.

RESULTS AND DISCUSSION

The results show that the main catches of the Brazilian sardine are related to the SSTA from -1 to +1 and chlorophyll-a anomalies from 0.3 to 1. In the years 2006 and 2008 the anomaly values were low and from -0.3 to +0.1 for the SSTA and from +0.35 to +0.45 for the chlorophyll-a. The maximum and minimum values of SSTA and the minimum value of chlorophyll-a anomaly occurred mainly at the spawning season. The maximum chlorophyll-a anomaly was found during the recruitment phase of the Brazilian sardine. The distribution of Sardinella brasiliensis practically follow the SST variability along the study area in association with the effects of coastal upwelling with shallow and seasonal SACW intrusions reaching the inner continental shelf, especially in spawning and nursery grounds, located in the southern center region of SBB (MORAES et al., 2012). The cross-correlation between sardine catches and SSTA showed two peaks, one at 2.8 years (0.30) and another annual (0.25). For the chlorophyll-a anomaly, a peak was found at 1.5 years (0.36).

The power spectrum (wavelet) of the Brazilian sardine catch showed two main power centers: semiannual observed almost throughout the analyzed time period and annual for 2004-2009 values (Fig. 3a). The SSTA in the SBB shows three peaks as quasi-annual (2007 to 2009), annual (2004-2007) and inter-annual power peaks of 4 years, observed in the all time period analyzed (1998 to 2014) (Fig. 3b). The chlorophyll-a anomaly showed the annual power nuclei for all period considered (Fig. 3c). At the annual cycle, most power happened during 2006-2008, which coincides with the period of the largest sardine catches. The variability common to the sardine catch and the SSTA observed in the cross-wavelet showed two power peaks (Fig. 4a). The first power peaks (semi-annual period) were in phase, the second was an annual cycle especially strong during 2003-2006 and 2007-2009. During the 2003-2007, the phase difference was 135°, meaning that the catch responded within 4 months of the SSTA variations. During the 2007-2009 period, the phase had a 90° difference, that is, the catch responded within 3 months of the SSTA variations. The cross wavelet between the sardine catch and chlorophyll-a anomaly showed three peaks of higher power. One semi-annual for the period of 2006-2008 and 2011-2013, where the phase was 90°, or the catch responded in ¼ of the period (1.5 months) of the variability of chlorophyll-a concentration. The second peak was annual from 2002-2009, being predominantly out of phase (Fig. 4b). The third peak was centered at 1.5 years from 2005-2009 and was in phase.

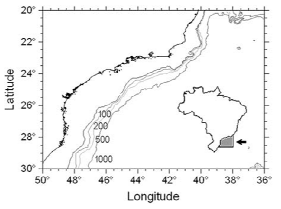

Figure 1: Map of the study area (the Southeastern Brazilian Bight)

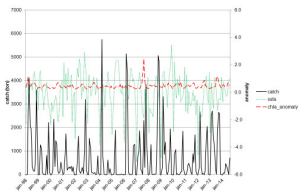

Figure 2: Time series of catch of Brazilian sardine (black), STTA (green) and chlorophyll-a anomaly (red) in the SBB, from 1998 January to 2014 August.

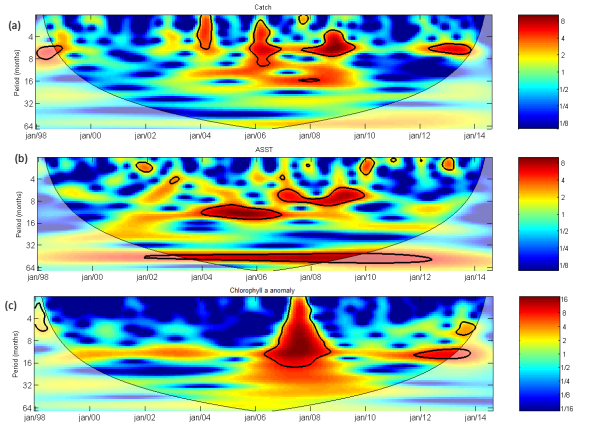

Figure 3: Power spectrum of WT of (a) catch of Brazilian sardine, (b) SSTA and (c) chlorophyll a anomaly in the SBB. Period 1998 to 2014. The thick black contour designates the 95% confidence level against the red noise and the cone of influence (COI), the areas where the edge effects might distort the picture are shown by the lighter shade.

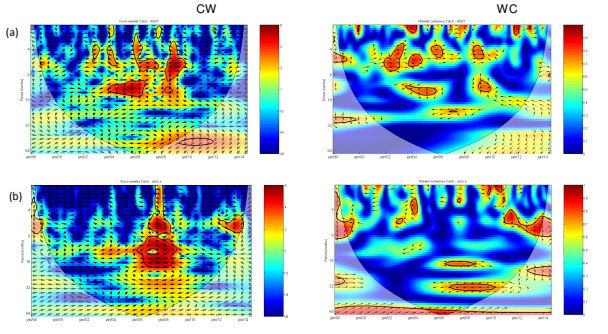

Figure 4: Cross-wavelet time series of catch of Brazilian sardine x SSTA and chlorophyll-a anomaly. (CW) Energy of the cross wavelet. (WC) wavelet coherence. The contours are for units of the variance. The 5% significance level against red noise is shown as a thick contour. The relative phase is shown as vectors.

CONCLUSION

The warming of the oceans should commit the reproductive success of the Brazilian sardine, while the variability in chlorophyll-a concentration regulates the success of recruitment of this species to the adult and fishing stock. Factors such as the sea surface temperature, wind, Ekman transport and the concentration of chlorophyll-a govern the abundance and distribution of the Brazilian sardine, as they determine the amount of food that will ensure successful reproduction and recruitment of this species. All aspects should be considered when aiming at a coherent and sustainable fishing policy.

AKNOWLEGDEMENT

The authors thank the State Institute of Fisheries of São Paulo, NASA by the release of the data sets and the INCT for financial assistance to attend the Congress. INPE / CNPq for scholarship to the first author.