



Role of Interannual Kelvin wave propagations in the equatorial Atlantic on the Angola-Benguela current system.



Presented by: Rodrigue Anicet IMBOL KOUNGUE

With the Collaboration of: - Dr Serena ILLIG

- Prof Mathieu ROUAULT

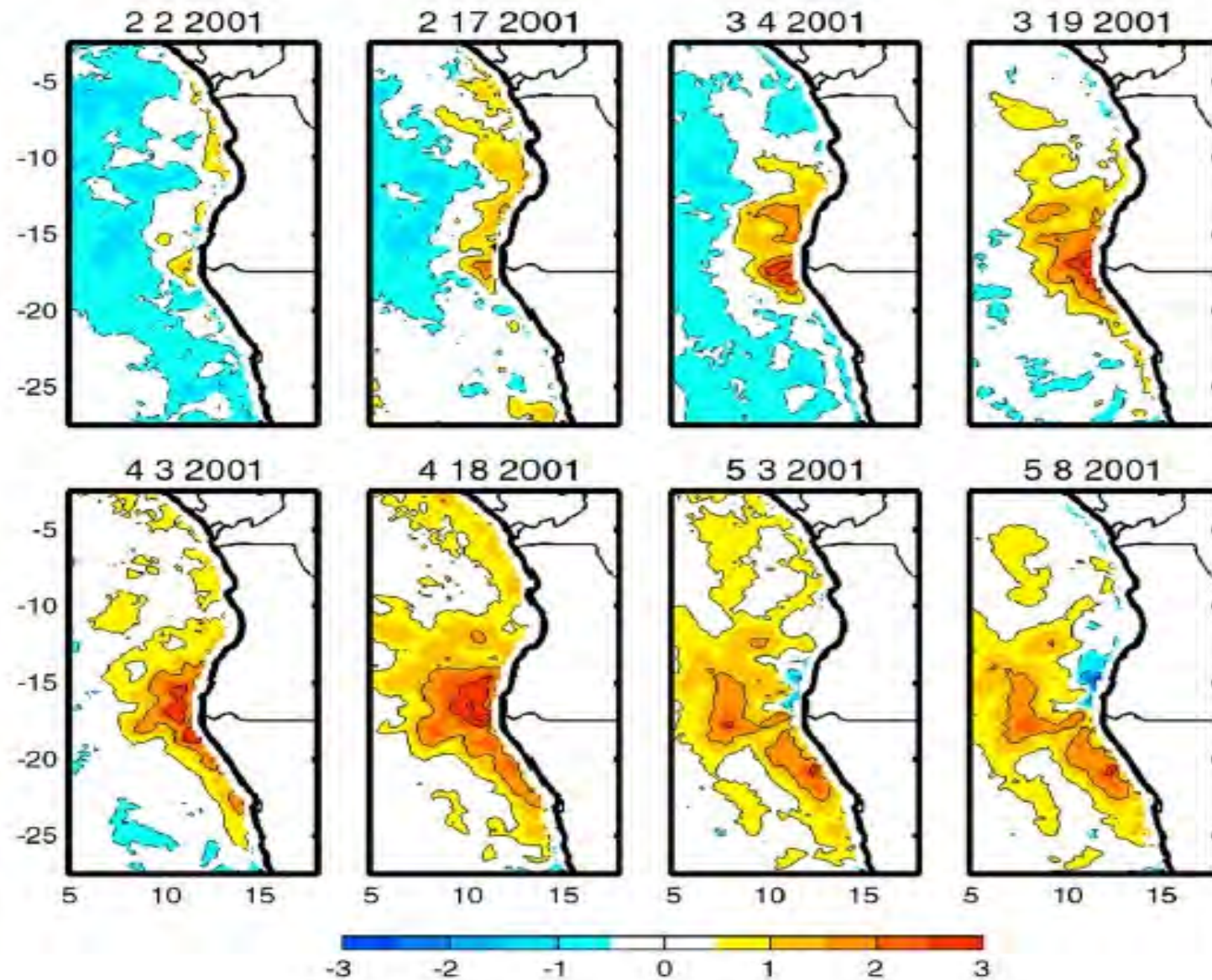
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ICEMASA
International Centre for Education,
Marine and Atmospheric Sciences
over Africa

Introduction / Signature of Benguela niños



Benguela Niños are intermittent, acute, extreme warm events near the border between Angola and Namibia.

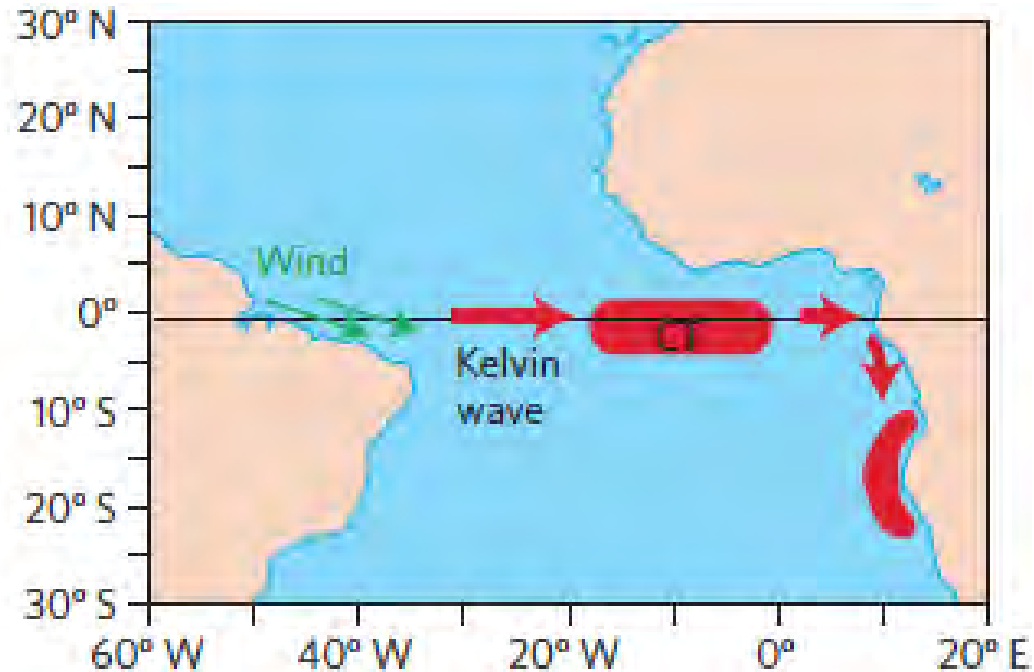
Weekly anomaly from the monthly mean TRMM TMI SST from 1998-2006 center on the date for February to May 2001 [*Rouault et al., 2007*].

Introduction / Forcing of Benguela Niños

2 theories have been discussed regarding the forcing of Benguela Niños and Niñas:

1) The local forcing [Richter et al., 2010]

2) The remote forcing [Rouault et al., 2007, 2009; Lübbecke et al., 2010, Bachèlery et al., 2016a, Rouault et al., 2017].



(Lübbecke, 2013)

- Are excited by anomalous surface winds in the western equatorial Atlantic.
- Equatorial Kelvin propagate eastwards.

2 types of Kelvin waves exist:

- **Downwelling Kelvin waves**
- **Upwelling Kelvin waves**

Aim of the study

Investigate the link between the linear equatorial Atlantic dynamics and the coastal variability in the region of Angola and Namibia during the 1998 – 2012 period.

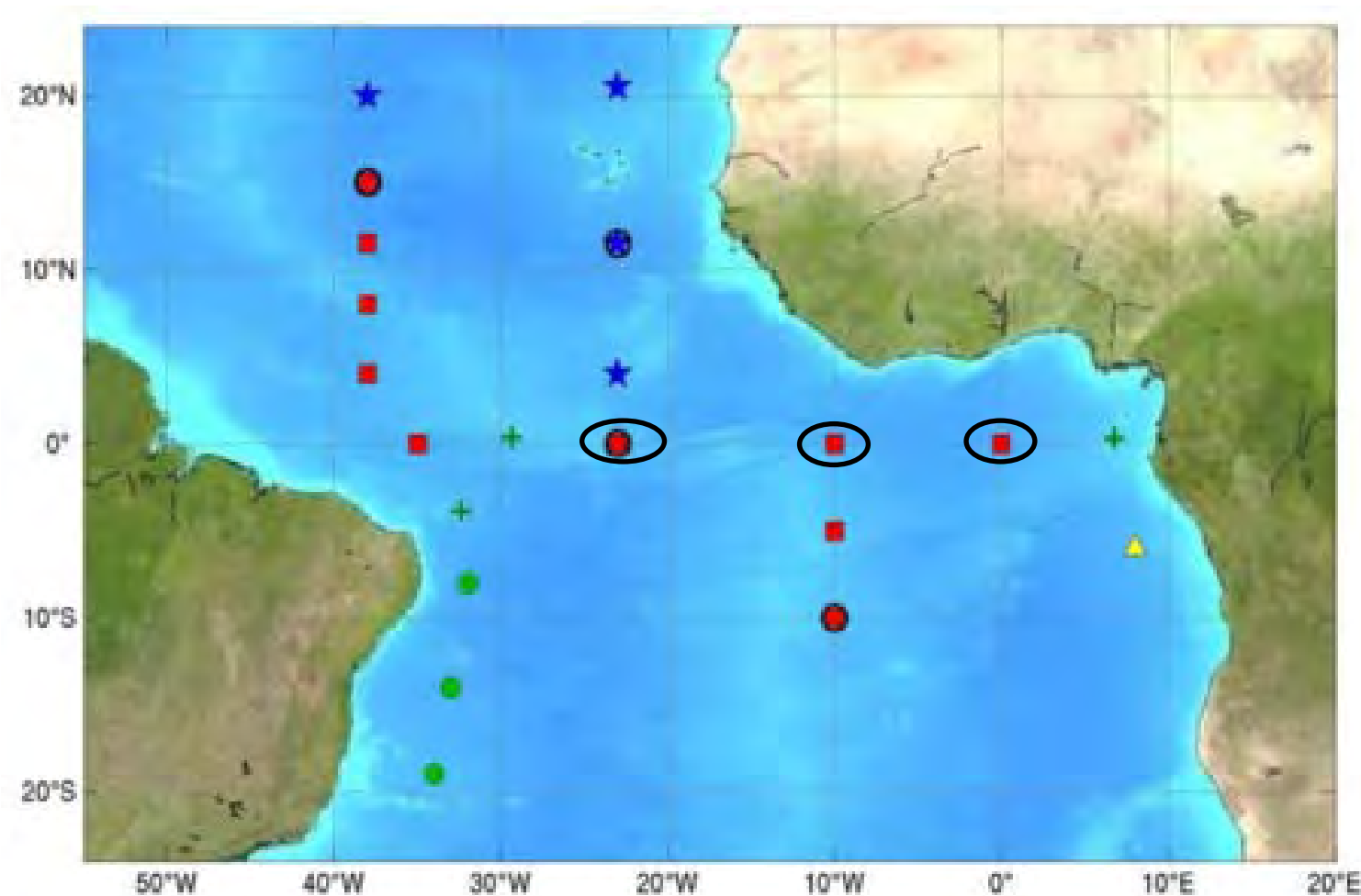


Research Questions

- How the Equatorial dynamics and Angola Benguela system variability are linked?
- Is there any possibility of Prediction of extreme warm and cold events in the Benguela upwelling system (BUS) using an index estimated based on the linear equatorial dynamics (IEKW)?

1) Source of Data

- **Monthly Dynamic Height** (Dyn ht) and **5 day mean D20°C** from Prediction and Research Moored Array in the Tropical Atlantic program (**PIRATA**) Atlas buoys located at [23°W; 0°N], [10°W; 0°N], [0°E; 0°N].



<http://www.pmel.noaa.gov/tao/disdell/>

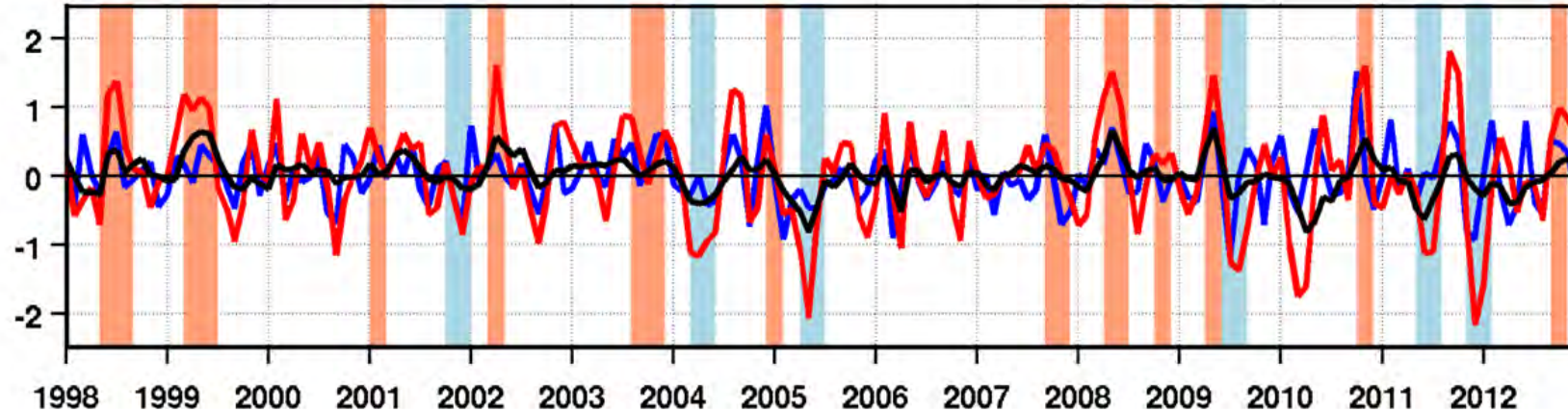
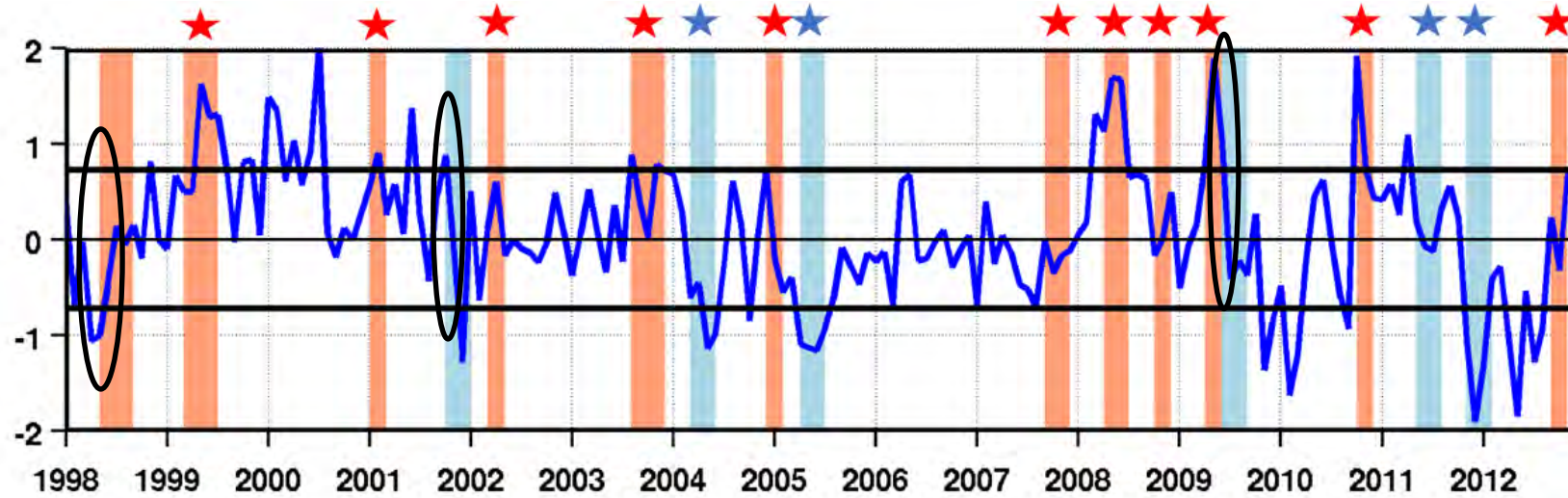
2) Source of Data

- Sea Surface Temperature (SST), from **OI-SST (Optimal interpolated-SST)**.
- Merged Sea Surface Height Anomaly (SSHA), from **AVISO**.
- An Ocean Linear Model (**OLM**) monthly outputs to investigate the Interannual Equatorial Kelvin Wave (IEKW) dynamics along the equatorial wave guide.
 - Domain **50°W to 10°E** from **28.875°S to 28.875°N**.
 - Horizontal resolution: $2^\circ(\text{longitude}) * 0.25^\circ(\text{latitude})$
 - Temporal resolution: 2 days
 - Drakkar Forcing Set version 5.2 (DFS5.2)

Results / Wind stress forcing and Kelvin wave contributions to SSHA

Most of equatorial positive and negative SSHA propagations match with anomalies of wind Stress.

Except for 1998, 2001 (end) And 2009.



Very good match between the IEKW and positive or negative SSHA propagations.

Top, detrended monthly anomalies of zonal wind stress (N/m^2) averaged over **ATL4 (50°W-25°W, 3°S-3°N)**. Bottom, OLM detrended anomalies of Kelvin wave monthly contribution to SSHA (cm : **1st baroclinic mode** in blue, **2nd baroclinic mode** in red, and **3rd baroclinic mode** in black, averaged over (20°W-0°E, at 0°N). Abnormal equatorial positive and negative SSHA propagation episodes identified in **Fig. 1** are represented by red and blue rectangles respectively.

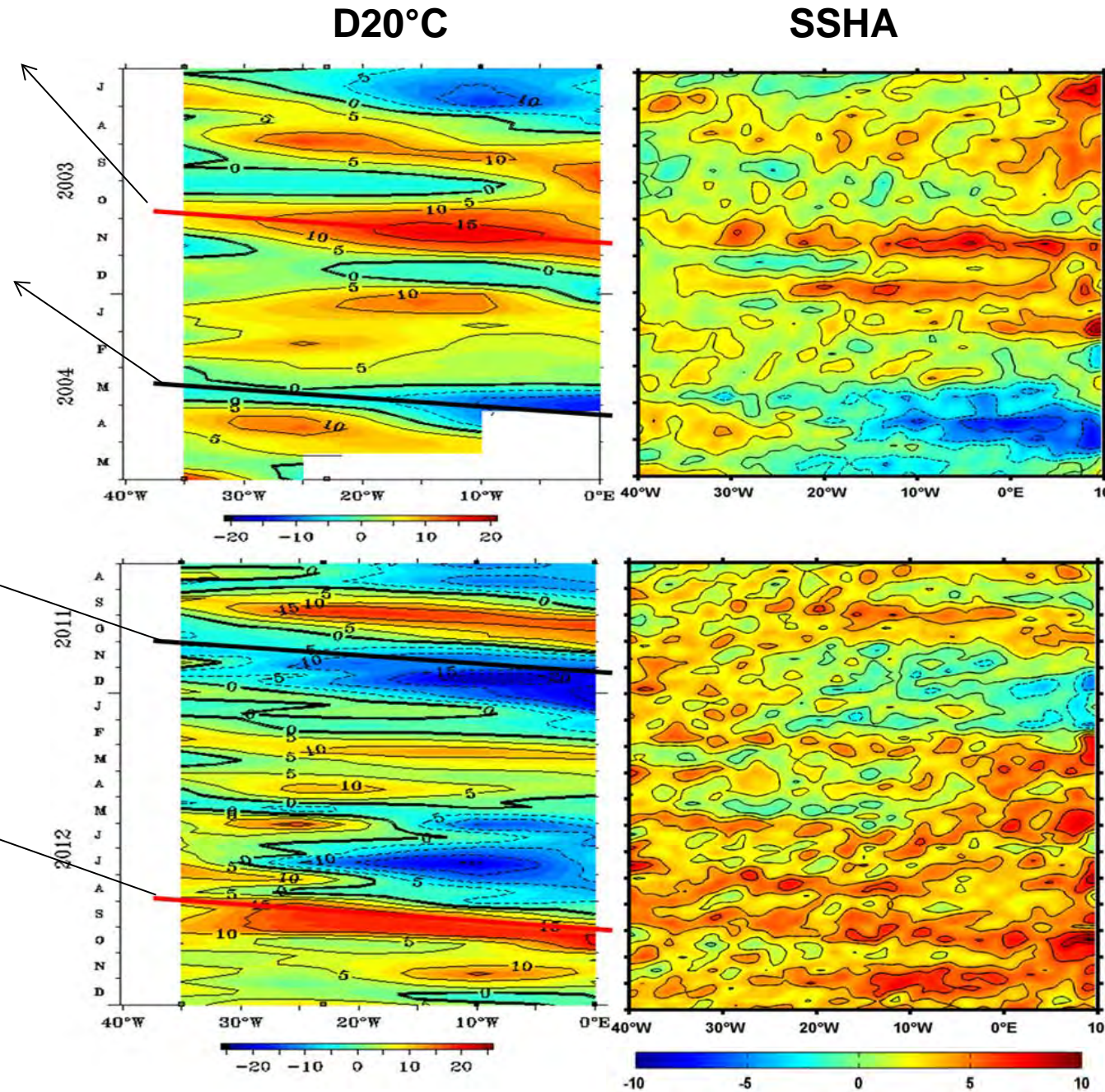
Results / Some specifics propagations

32days, 1.4m/s,
2nd mode

15days, 2m/s,
1st mode

32days, 1.4m/s,
2nd mode

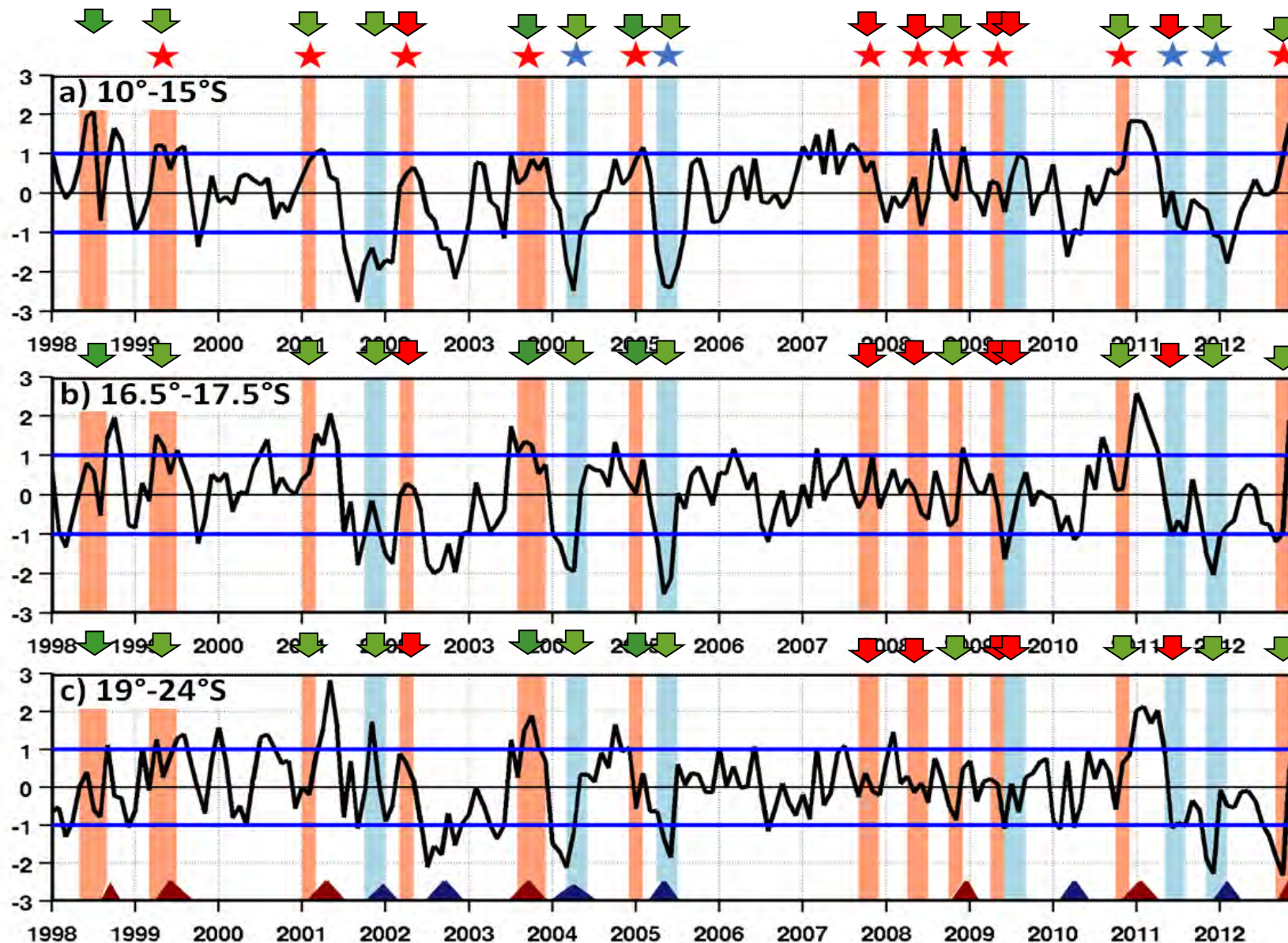
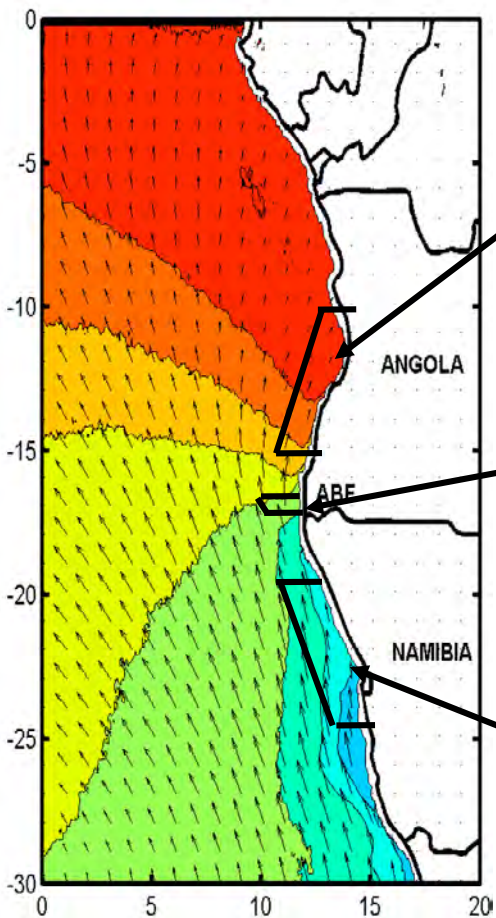
28days, 1.6m/s,
2nd mode



Results / Linked variability

Monthly detrended normalized anomalies of SST

Corr (IEKW2 - Southern A.)
= 0.4



Southern
Angola

Angola
Benguela
Front

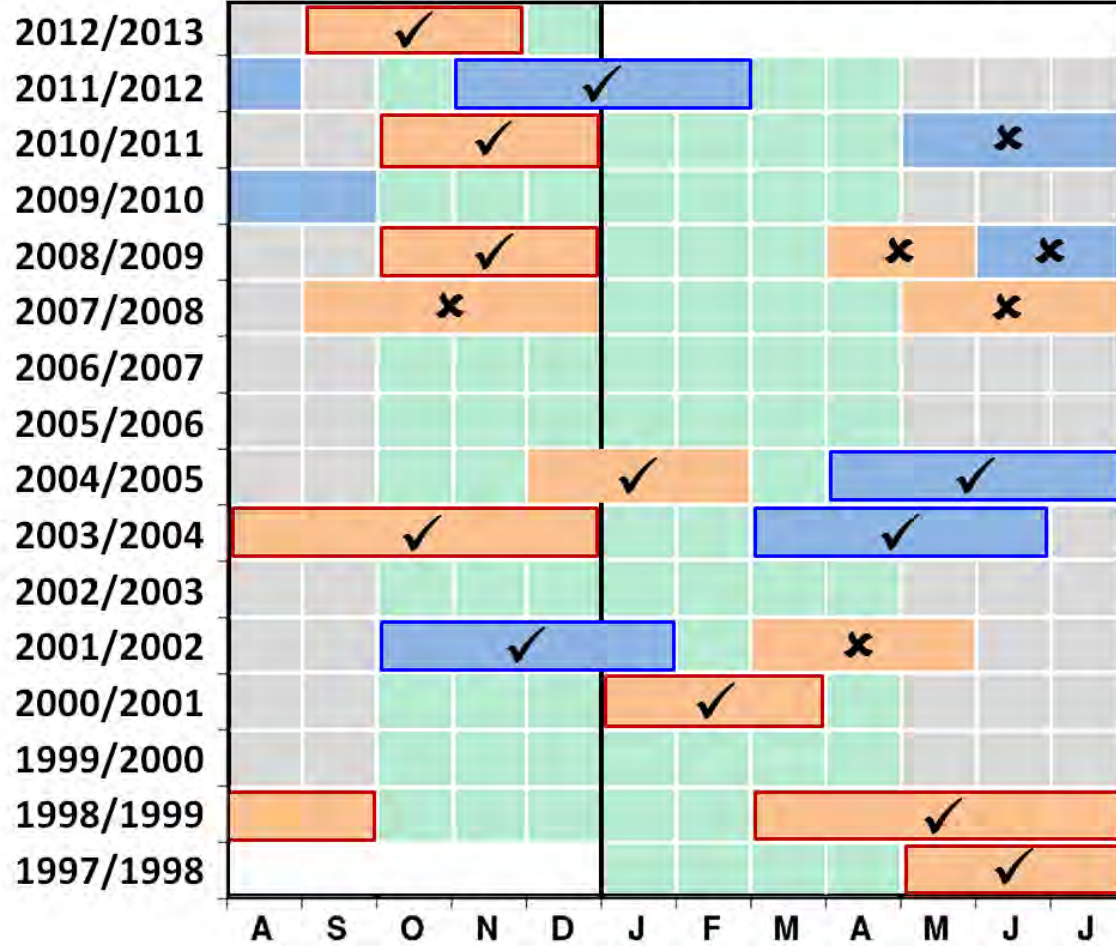
Northern
Namibia

Extreme warm and cold events when SSTA exceed 1 or -1 for at least 3 months and for at least 2 domains.

Results / Prior to the season

12/18

a) IEKW/coastal-SST matching diagram

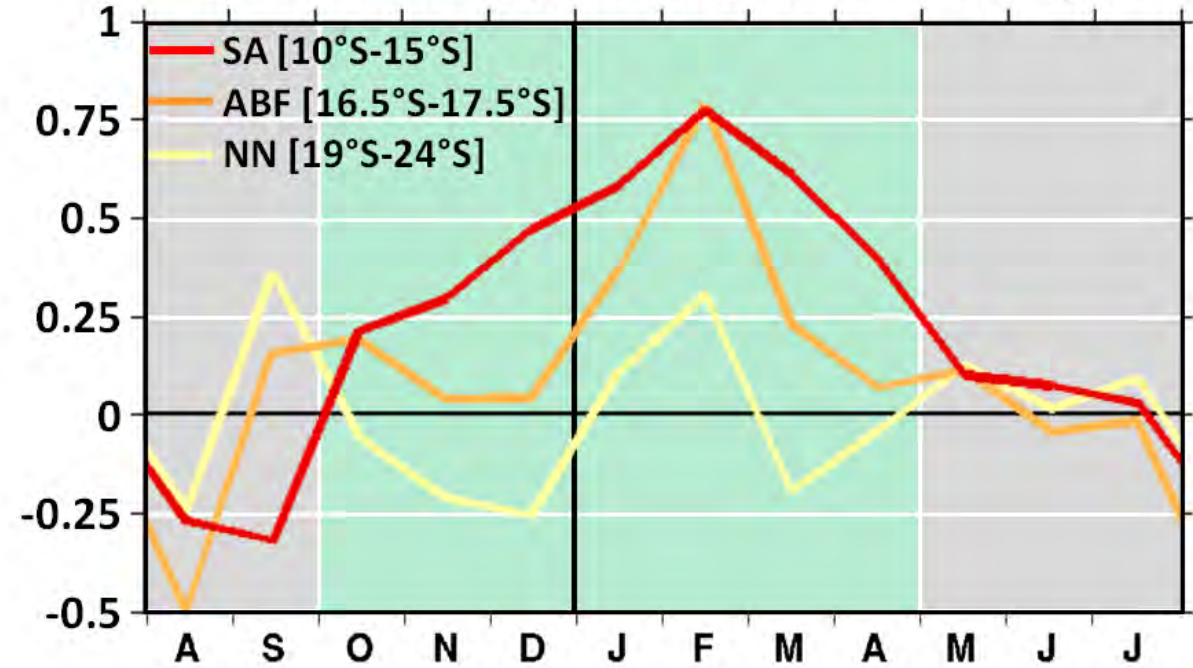


- ✓ Extreme coastal warm events which match with abnormal equatorial SSHA propagations.
- ✓ Major coastal warm events which match with abnormal equatorial SSHA propagations.
- x Major coastal warm events which do not match with abnormal equatorial SSHA propagations.

- ✓ Extreme coastal cold events which match with abnormal equatorial SSHA propagations.
- x Major coastal cold events which do not match with abnormal equatorial SSHA propagations.

67% of matches

b) Seasonal lagged correlation analysis



Summary

- Interannual Equatorial Kelvin Waves at the origin of these equatorial propagations are well monitored by PIRATA mooring and altimetry.
- Interannual Equatorial Kelvin Waves are linked to major warm and cold events in the Angola-Benguela Current system.
- Interannual Equatorial Kelvin Wave index is a skilful proxy to forecast these events by about one month between October and April.
- Some positive and negative propagations of SSHA are not seen in the Angola Benguela current system due to the effect of the local wind or stratification.



THANK YOU FOR YOUR ATTENTION !!!

