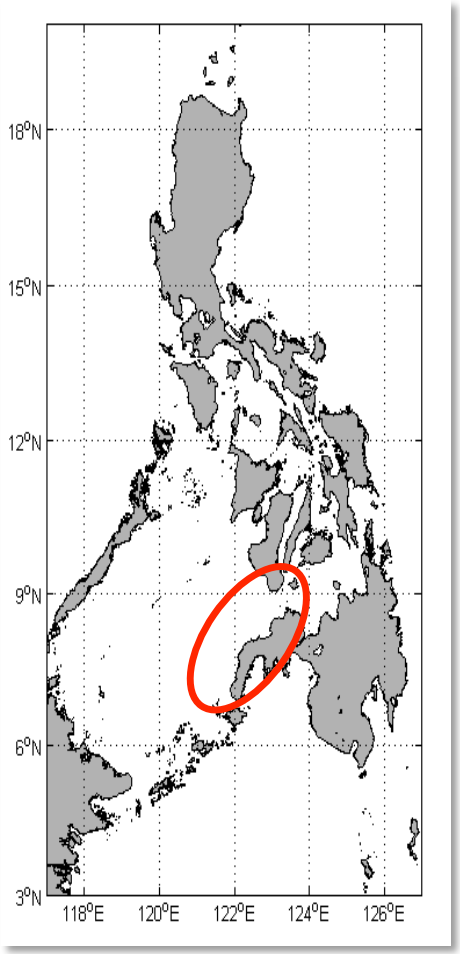
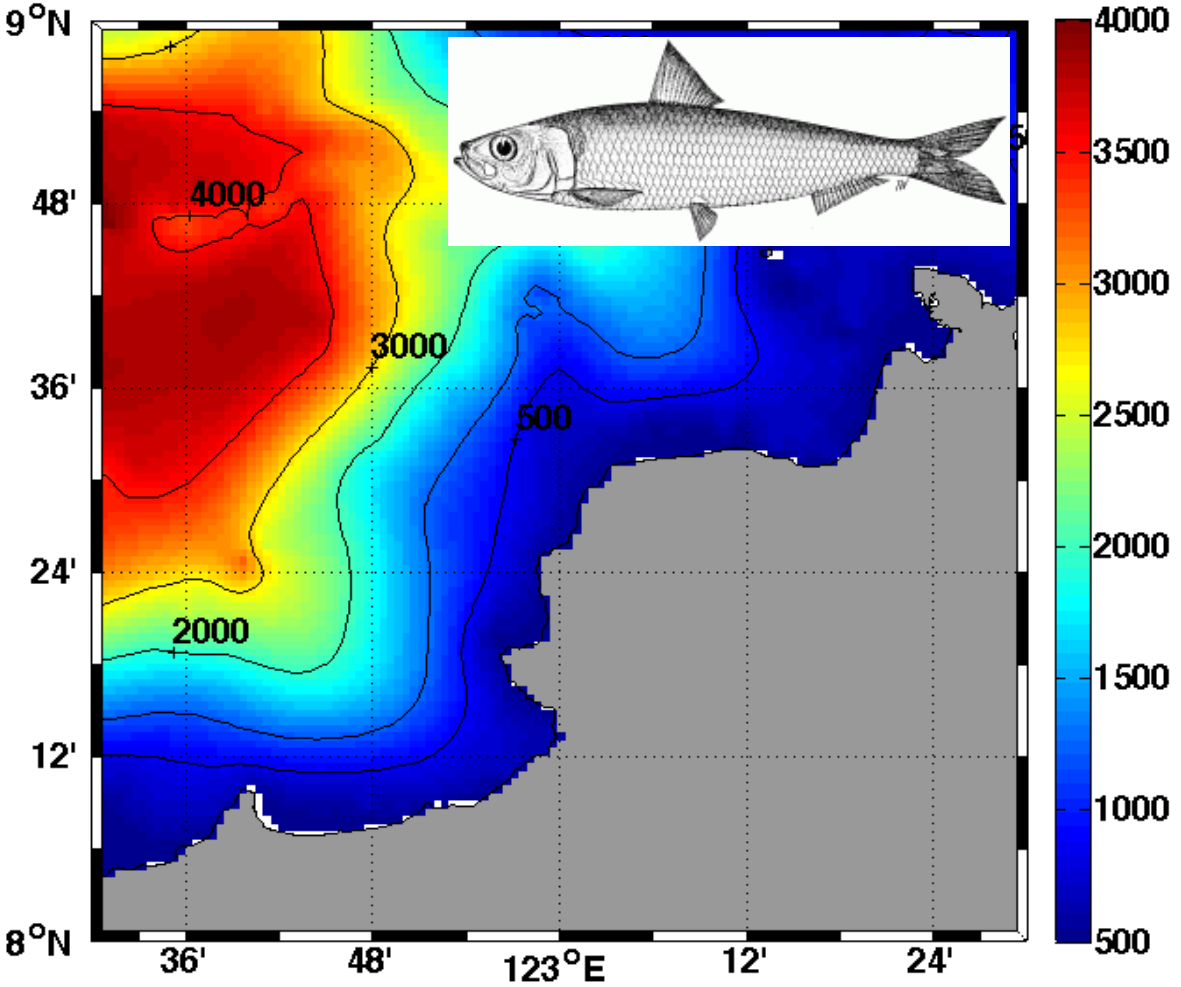
Temporal variability of upwelling parameters in the Zamboanga Peninsula, Philippines and its relationship with sardine production

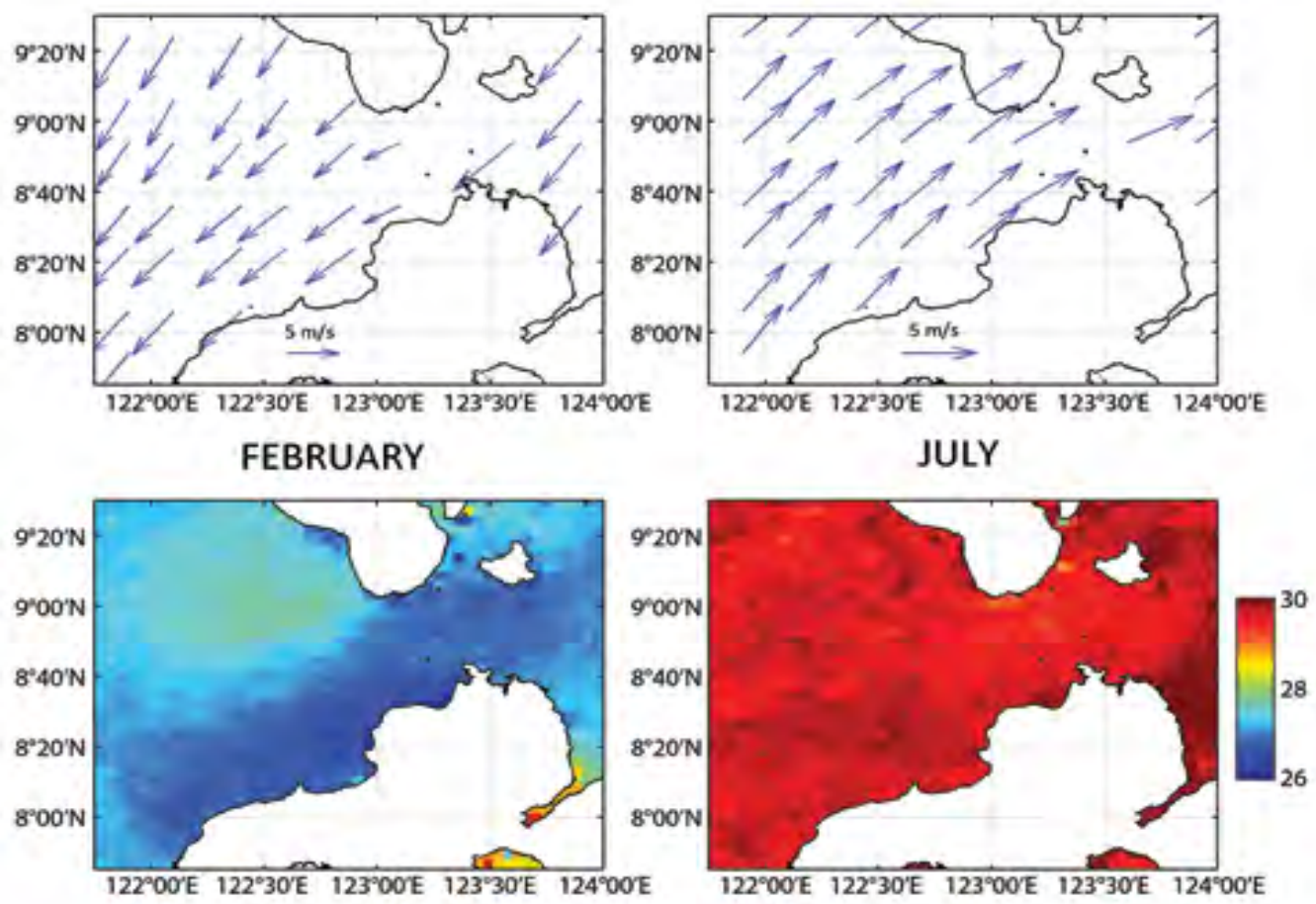
Josephine Dianne Deauna, Olivia Cabrera, Patrick Pata, Cesar Villanoy, Roselle Borja, Laura David, Asuncion de Guzman

Zamboanga Peninsula



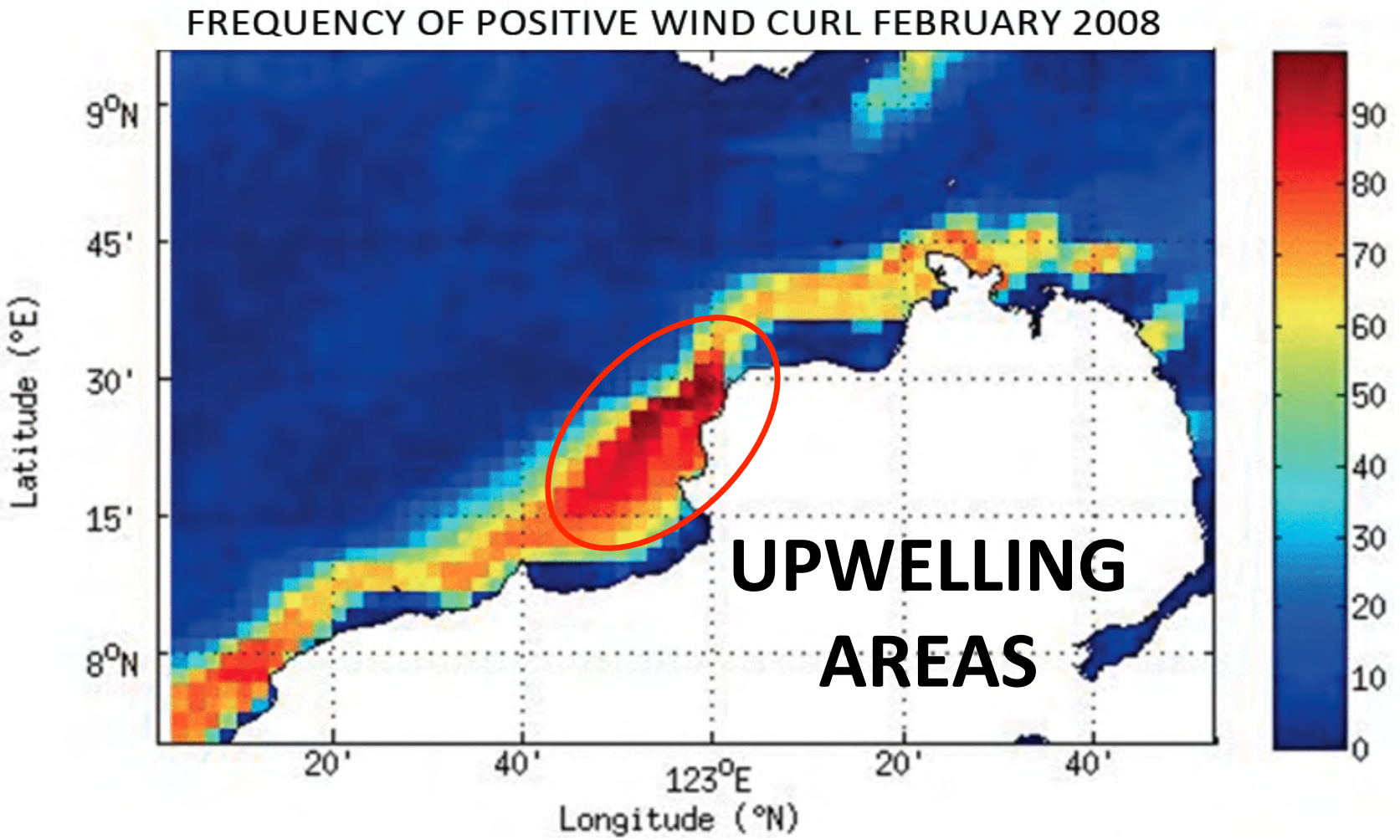


Seasonality of upwelling



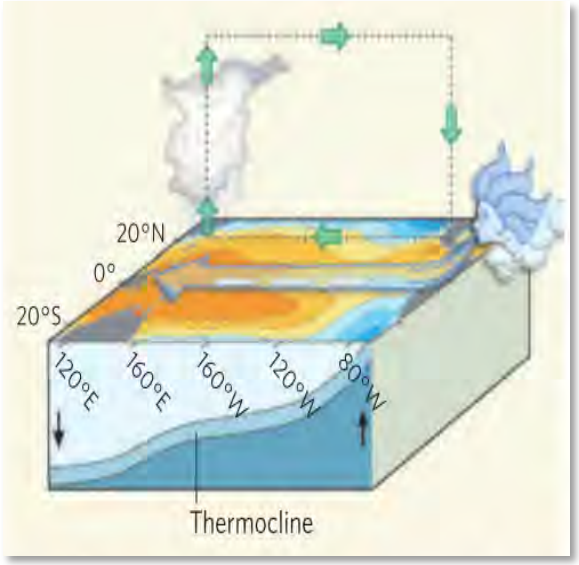
Villanoy et. al., 2011

Wind stress curl

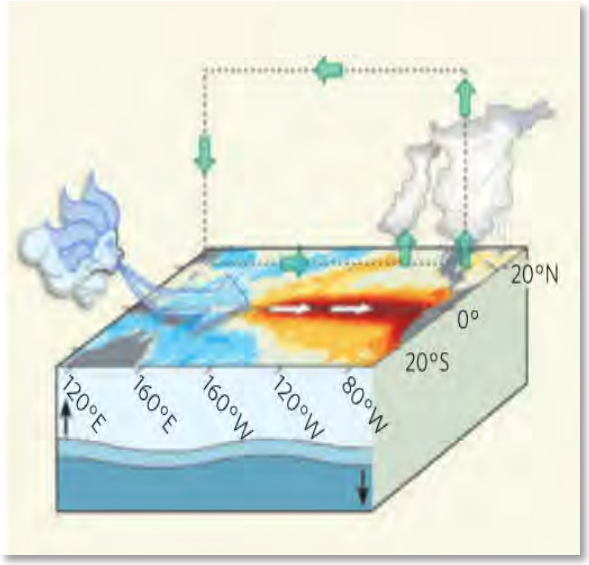


El Niño Southern Oscillation

NORMAL



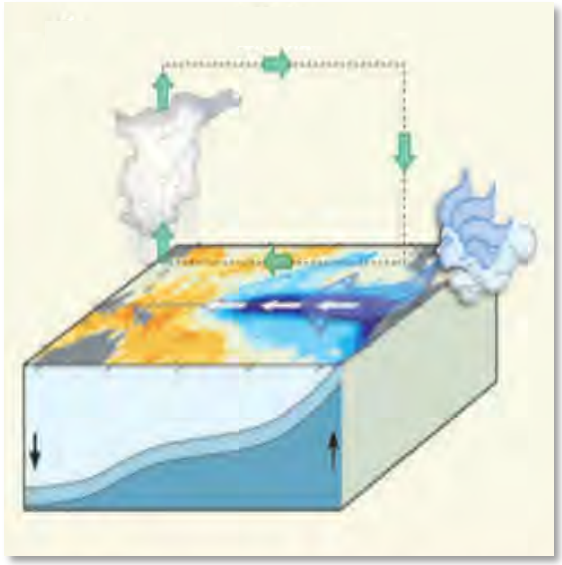
EL NIÑO



Weak easterlies
Less rain
Low SST
LOW STRATIFICATION

UPWELLING

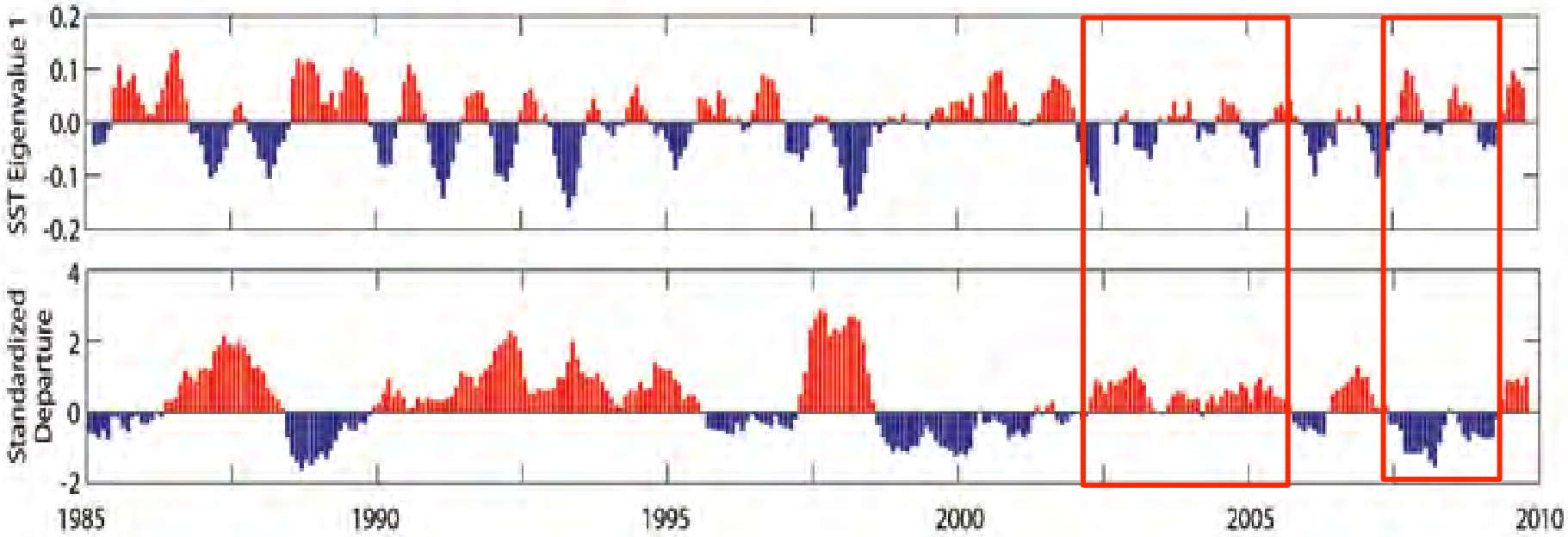
LA NIÑA



Strong easterlies
More rain
High SST
HIGH STRATIFICATION

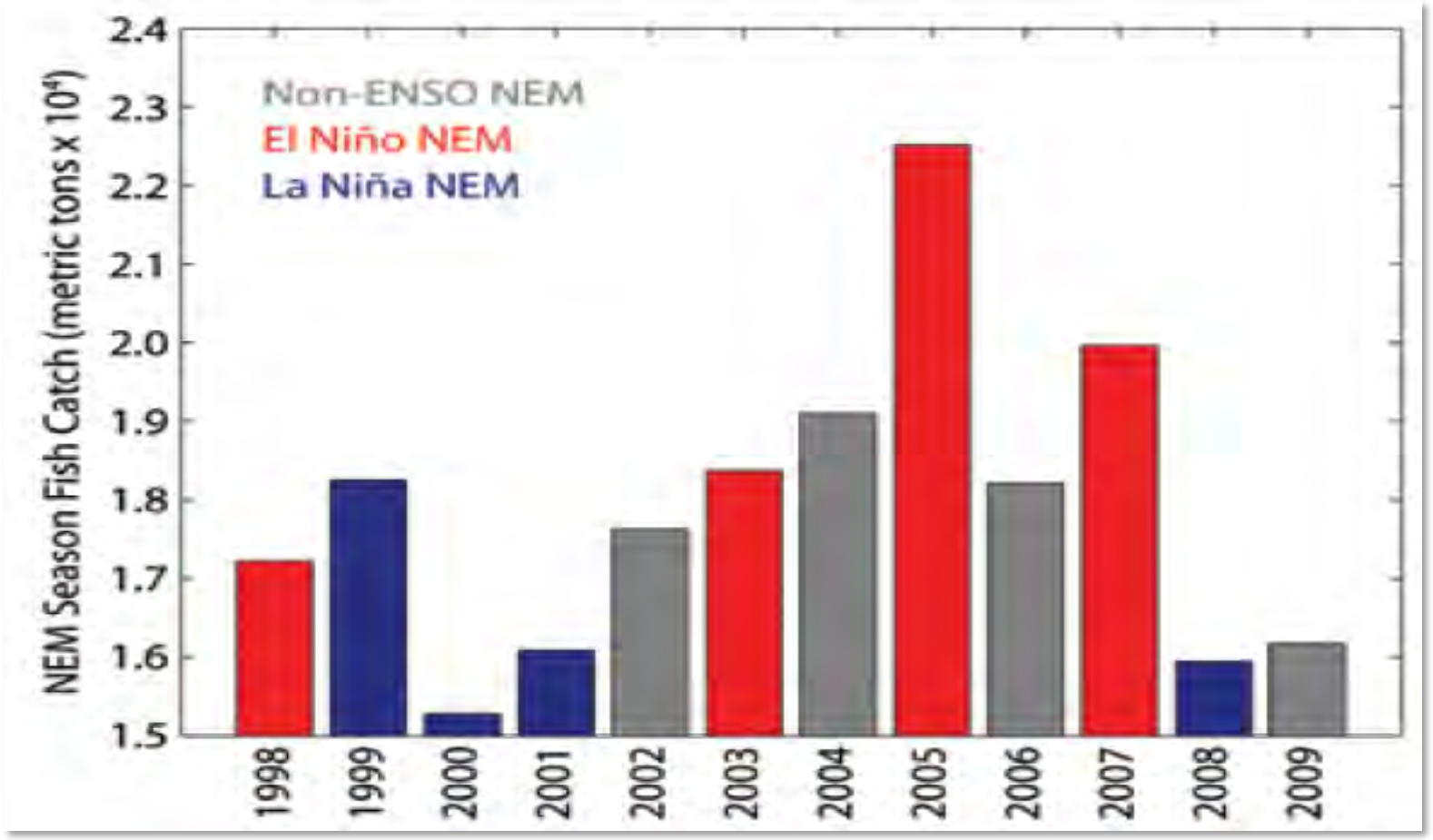
Ashok et. al., 2009

Pathfinder SST vs ENSO 3.4 Index



Villanoy et. al., 2011

Sardine catch vs ENSO



Villanoy et. al., 2011

OBJECTIVES

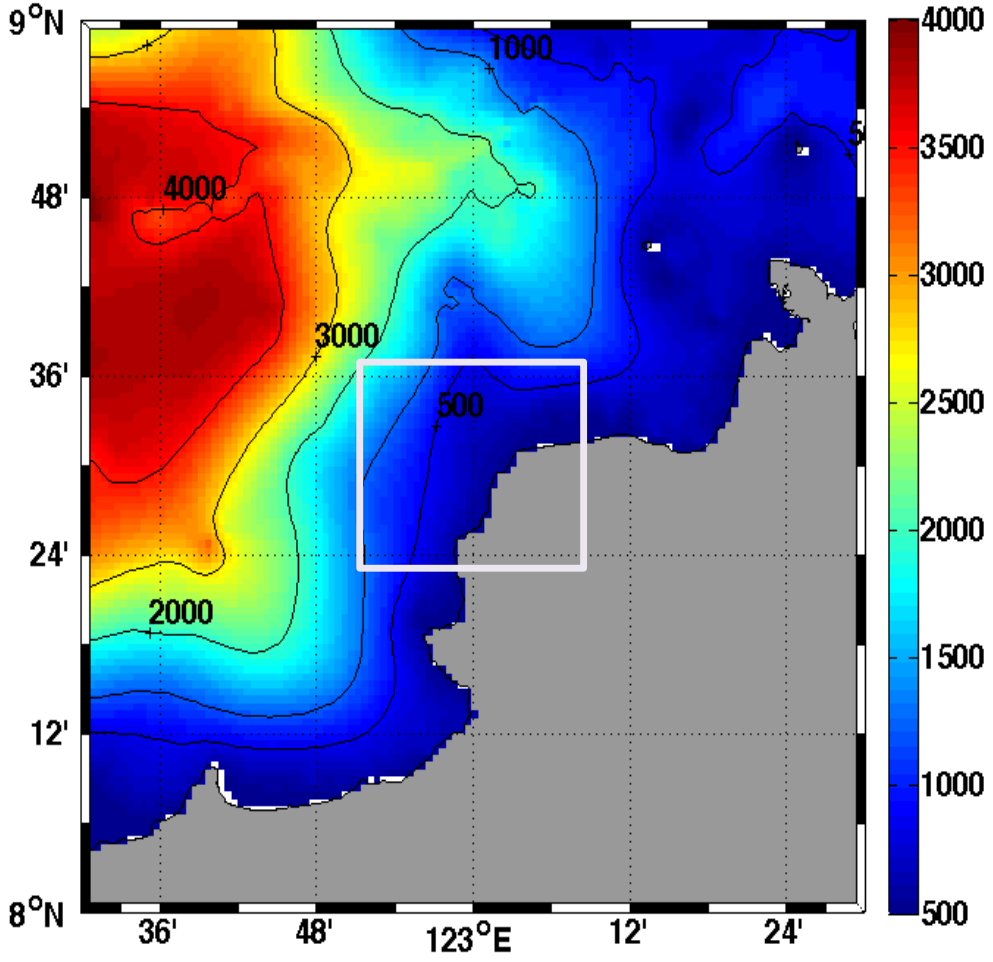
- To describe the temporal variability of upwelling parameters in the Zamboanga Peninsula
- To relate this variability to climate indices
- To determine the possible relationships between sardine volume production and environmental factors in the study area

METHODOLOGY - WINDS

ASCAT (U component)
www.apdrc.soest.hawaii.edu
July 1999 to January 2015

FOURIER TRANSFORM

LOW FREQUENCY SIGNALS
Signals with period > 365 days
Compare with climate indices



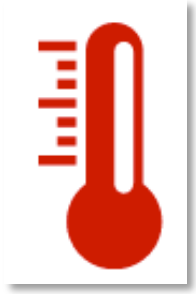
METHODOLOGY – CHL, SST and RAINFALL

ENSO 3.4 INDEX
www.cpc.ncep.noaa.gov

MODIS SURFACE CHLOROPHYLL
oceancolor.gsfc.nasa.gov

INDIAN SARDINE VOLUME PRODUCTION
countrystat.bas.gov.ph

TRMM RAINFALL
apdrc.soest.hawaii.edu



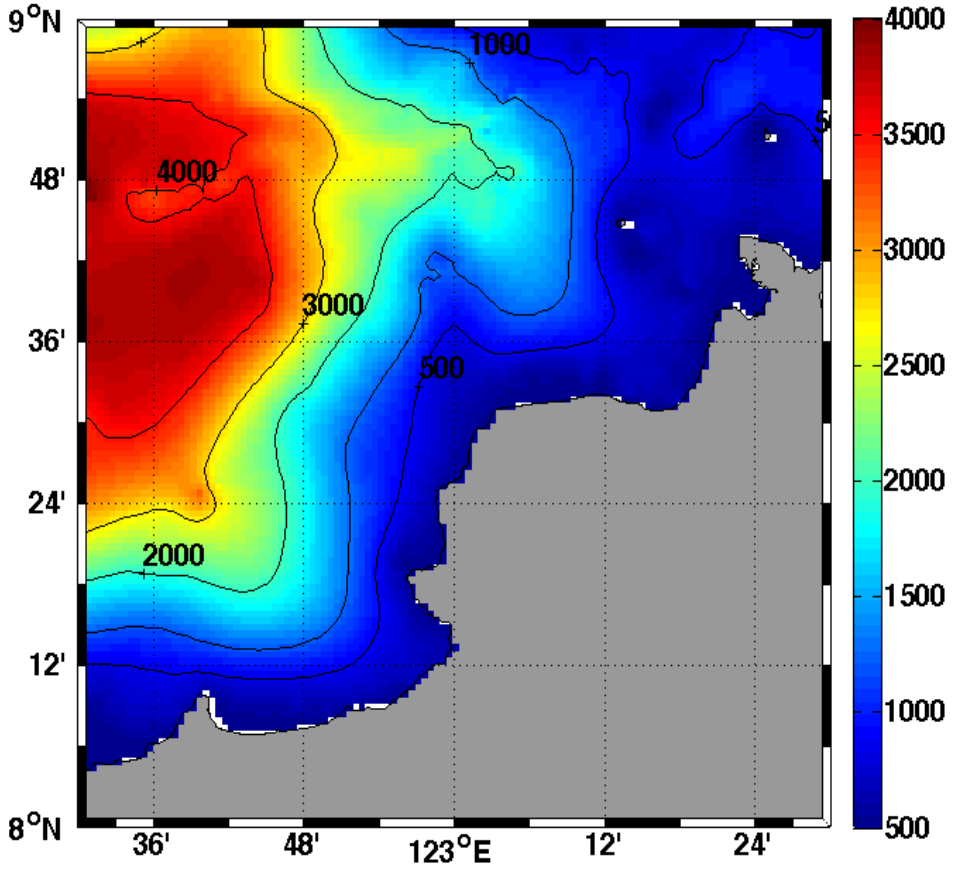
MODIS SURFACE TEMPERATURE
oceancolor.gsfc.nasa.gov

METHODOLOGY – CHL, SST and RAINFALL

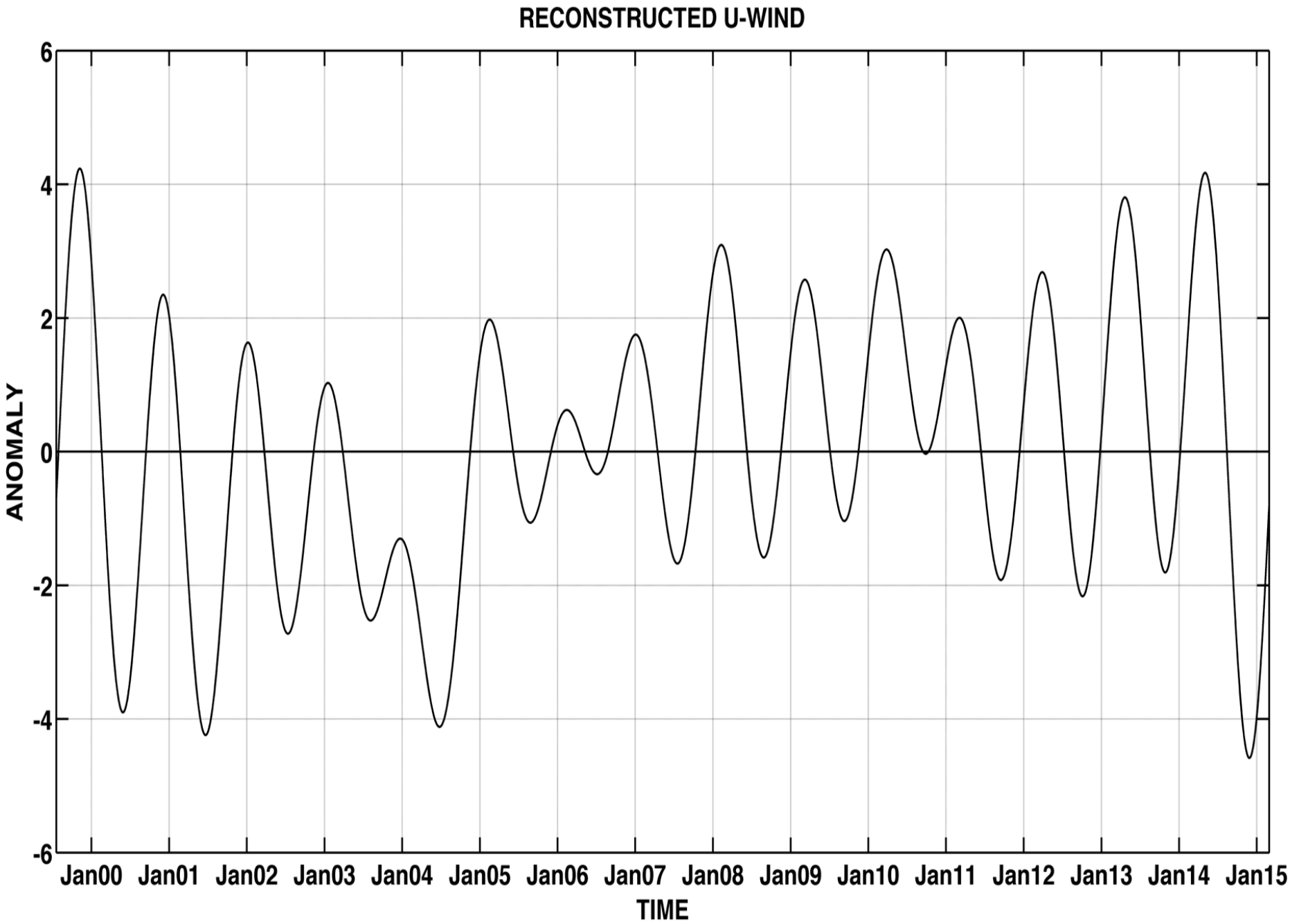
SPATIAL LIMITS
Dipolog–Sindangan Bay
Longitude: [122.5 123.5] Latitude: [8 9]

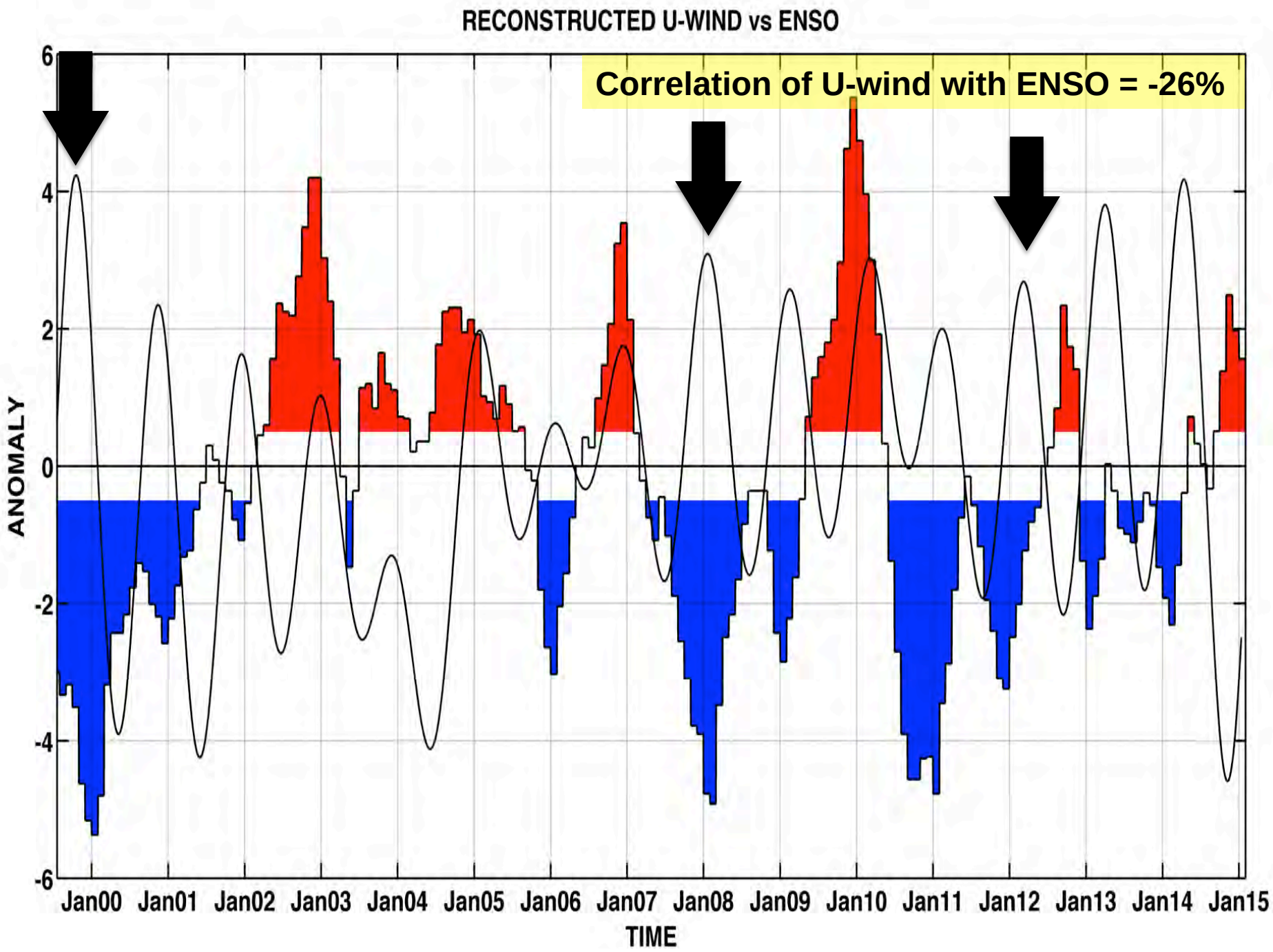
TEMPORAL LIMIT
July 2002 to March 2014

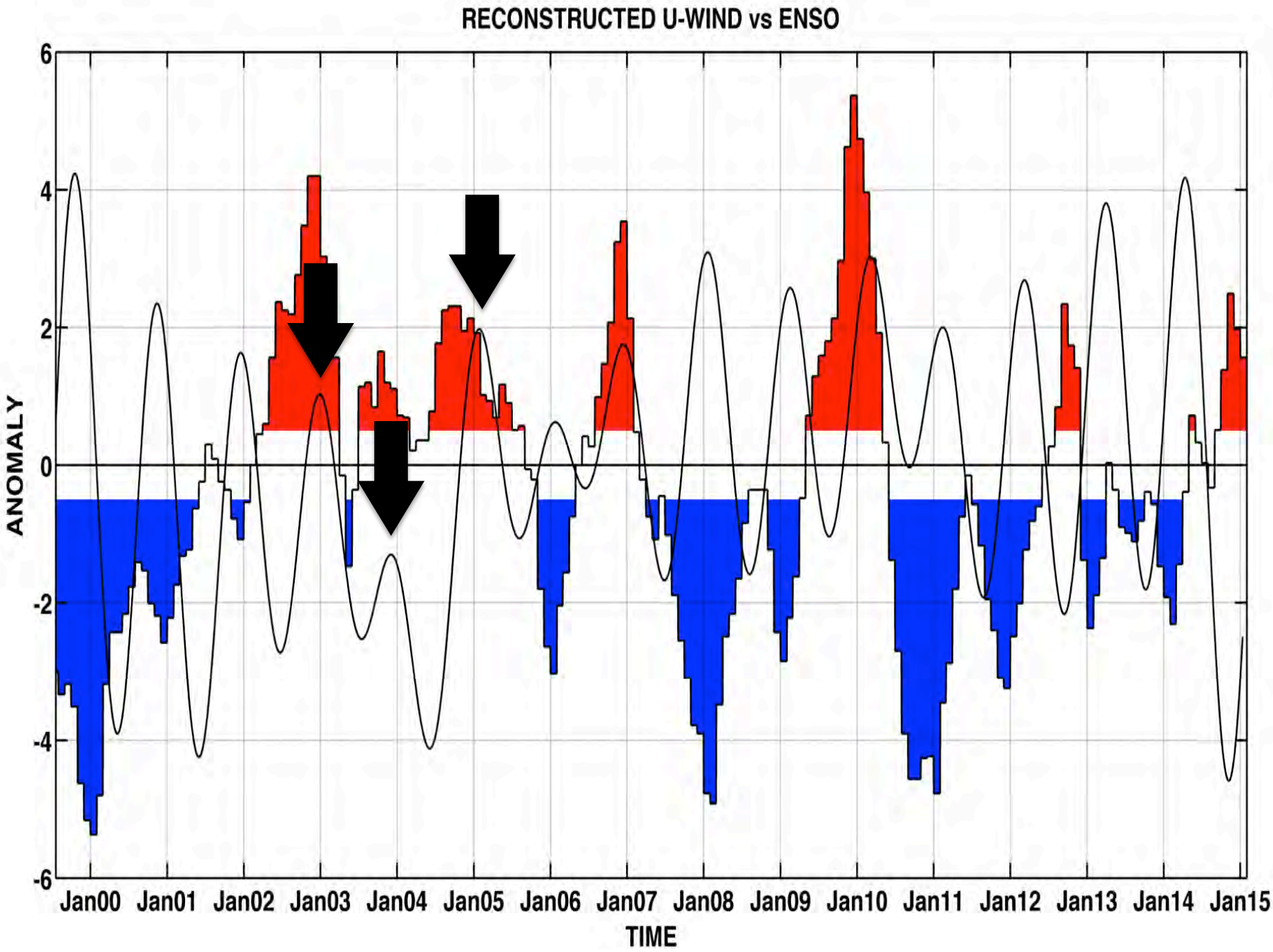
DATA PROCESSING
Spatially–averaged
Monthly mean
Monthly climatological signal removed
5–month running mean applied

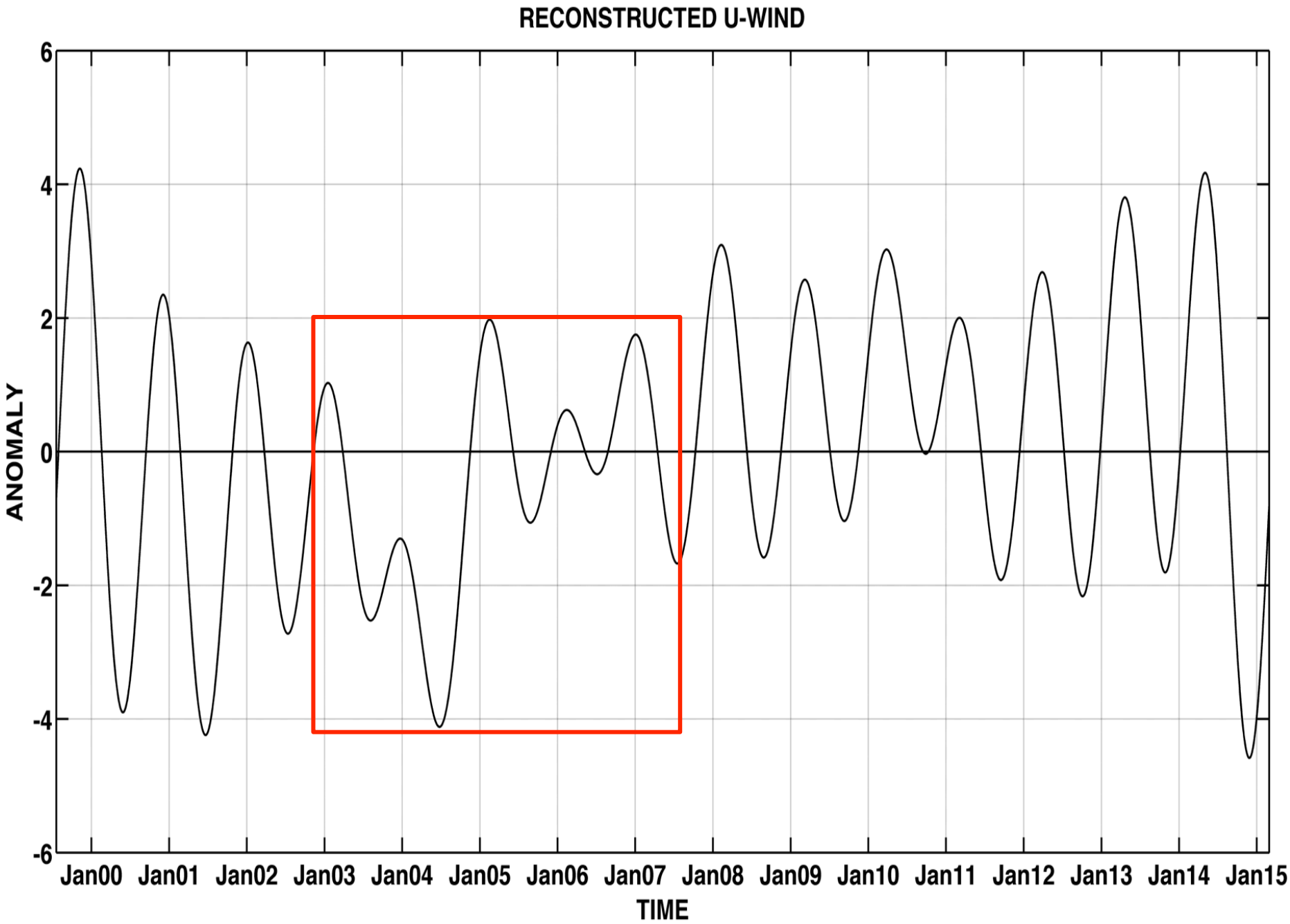


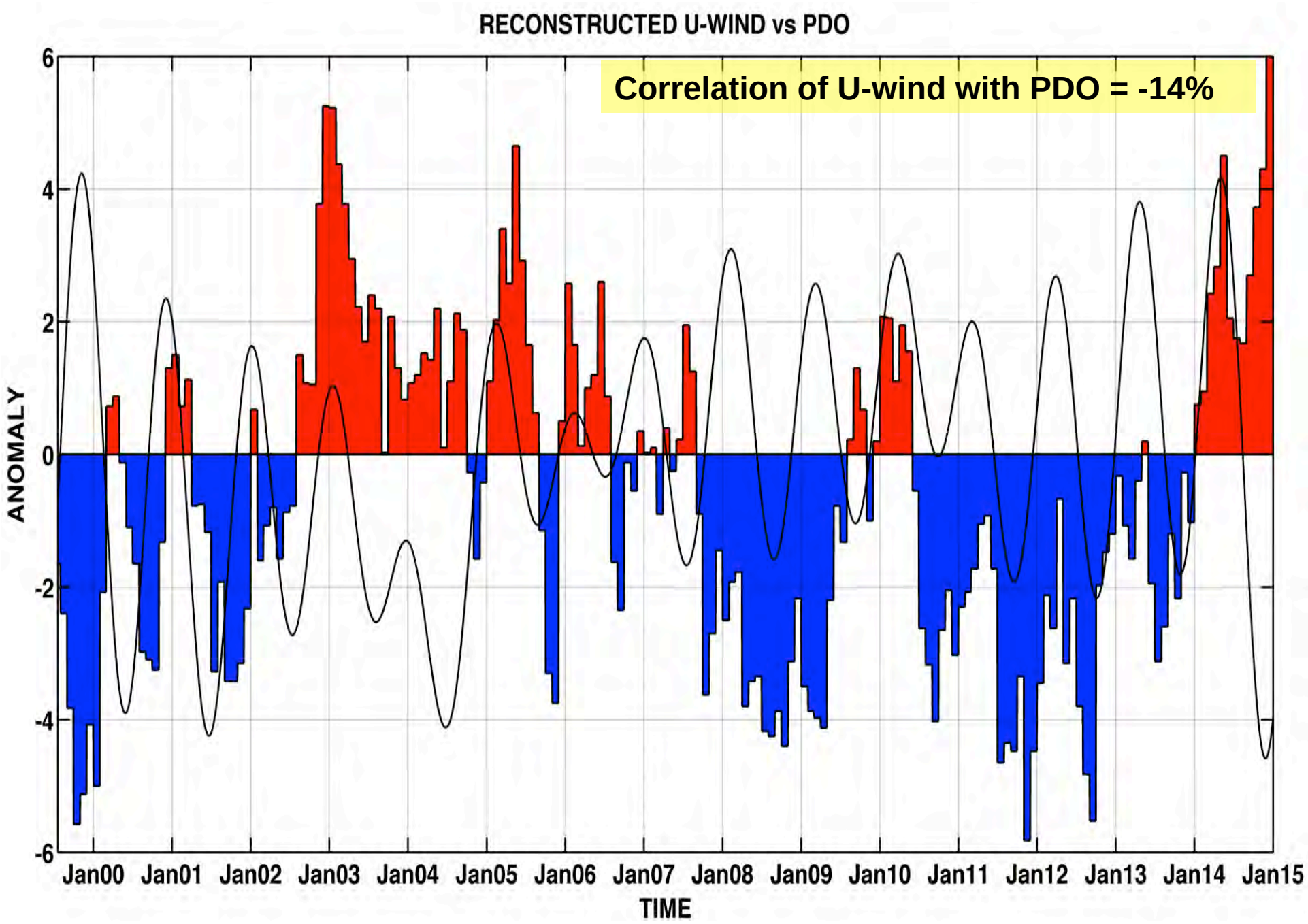
FOURIER TRANSFORM OF WIND DATA


RECONSTRUCTED U-WIND
ANOMALY
6
4
2
0
-2
-4
-6
Jan00
Jan01
Jan02
Jan03
Jan04
Jan05
Jan06
Jan07
Jan08
Jan09
Jan10
Jan11
Jan12
Jan13
Jan14
Jan15
TIME


RECONSTRUCTED U-WIND vs ENSO
Correlation of U-wind with ENSO = -26%
ANOMALY
6
4
2
0
-2
-4
-6
Jan00
Jan01
Jan02
Jan03
Jan04
Jan05
Jan06
Jan07
Jan08
Jan09
Jan10
Jan11
Jan12
Jan13
Jan14
Jan15
TIME

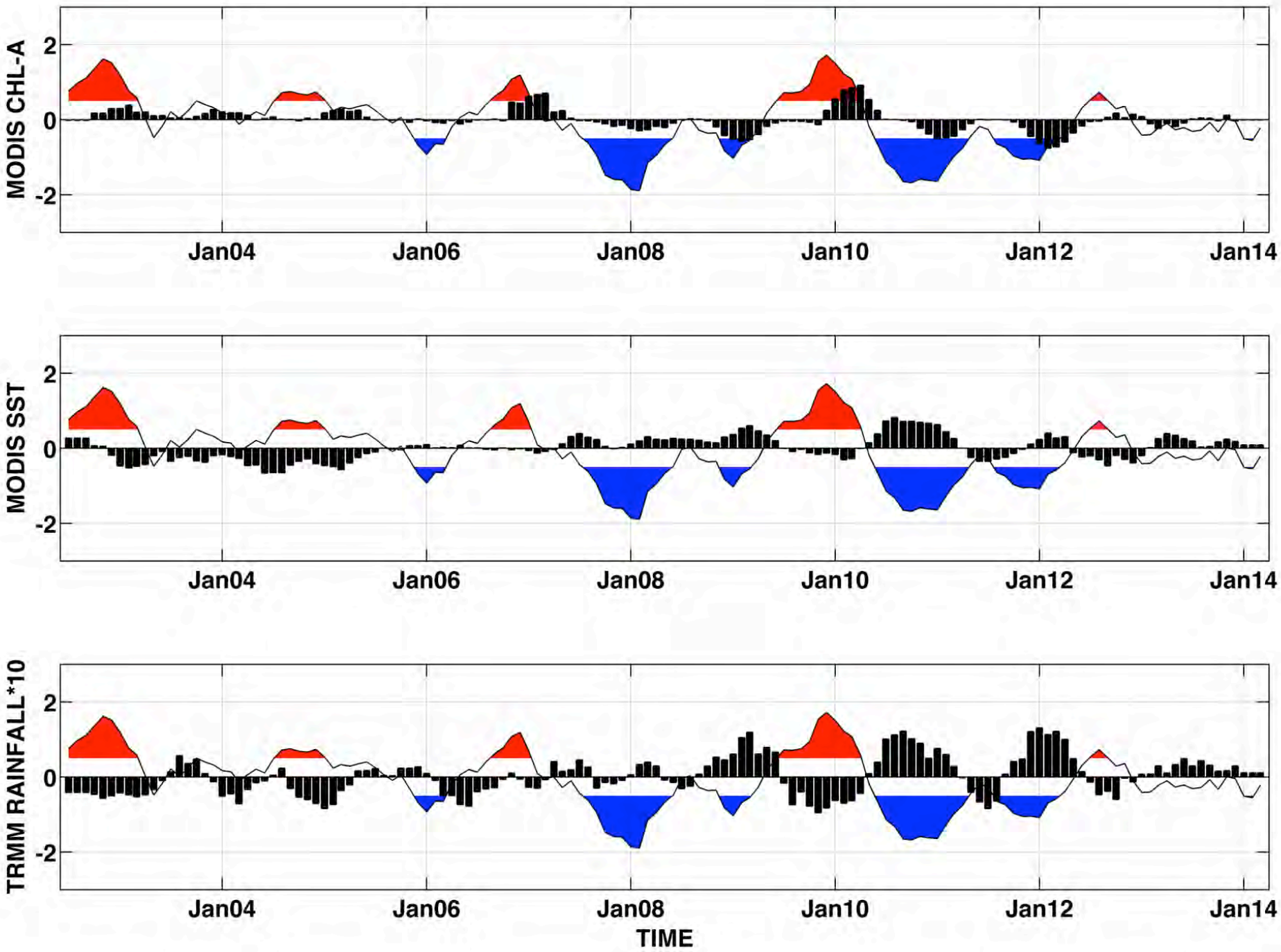

RECONSTRUCTED U-WIND vs ENSO
ANOMALY
6
4
2
0
-2
-4
-6
Jan00
Jan01
Jan02
Jan03
Jan04
Jan05
Jan06
Jan07
Jan08
Jan09
Jan10
Jan11
Jan12
Jan13
Jan14
Jan15
TIME

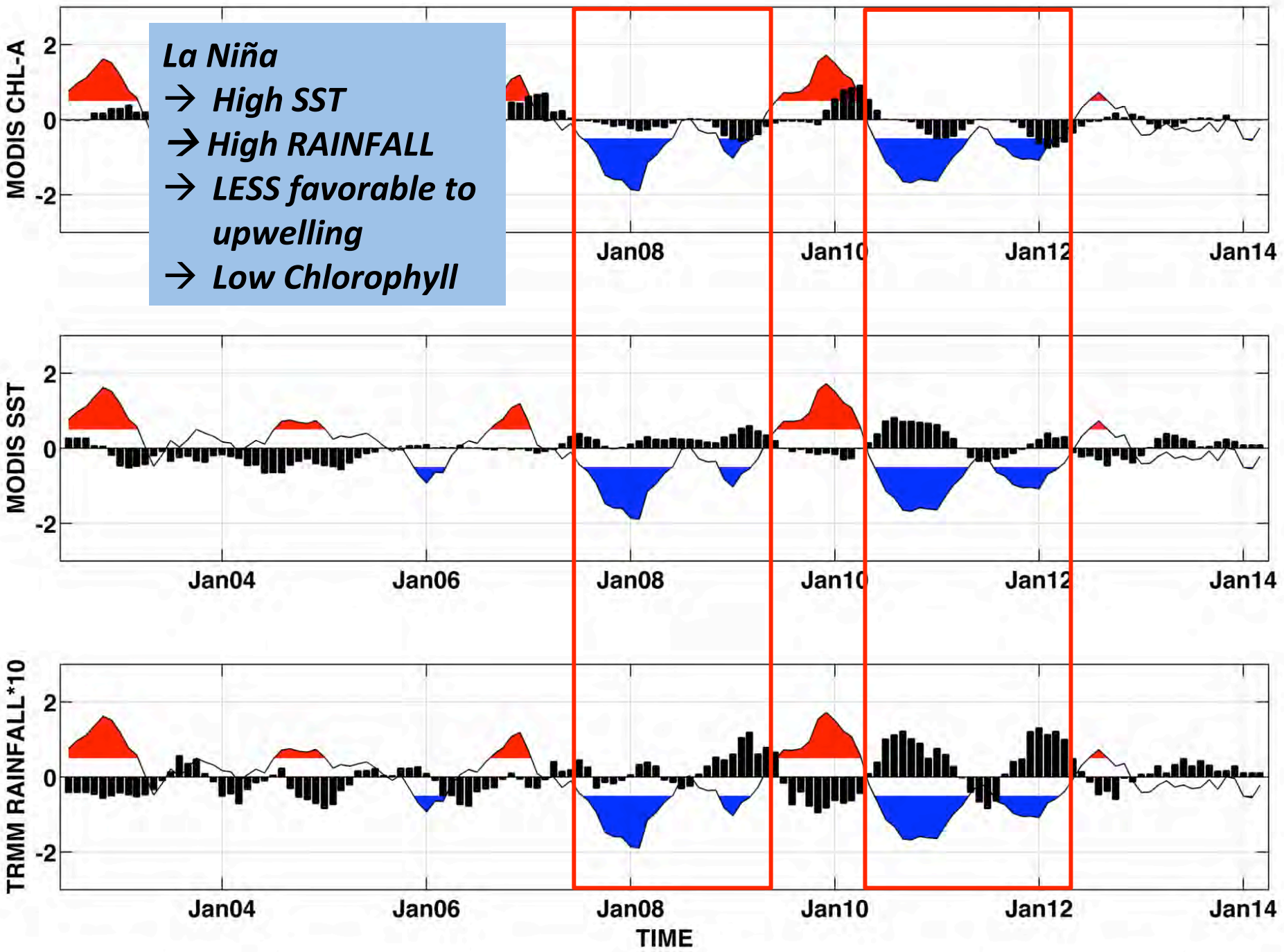

RECONSTRUCTED U-WIND
ANOMALY
6
4
2
0
-2
-4
-6
Jan00
Jan01
Jan02
Jan03
Jan04
Jan05
Jan06
Jan07
Jan08
Jan09
Jan10
Jan11
Jan12
Jan13
Jan14
Jan15
TIME

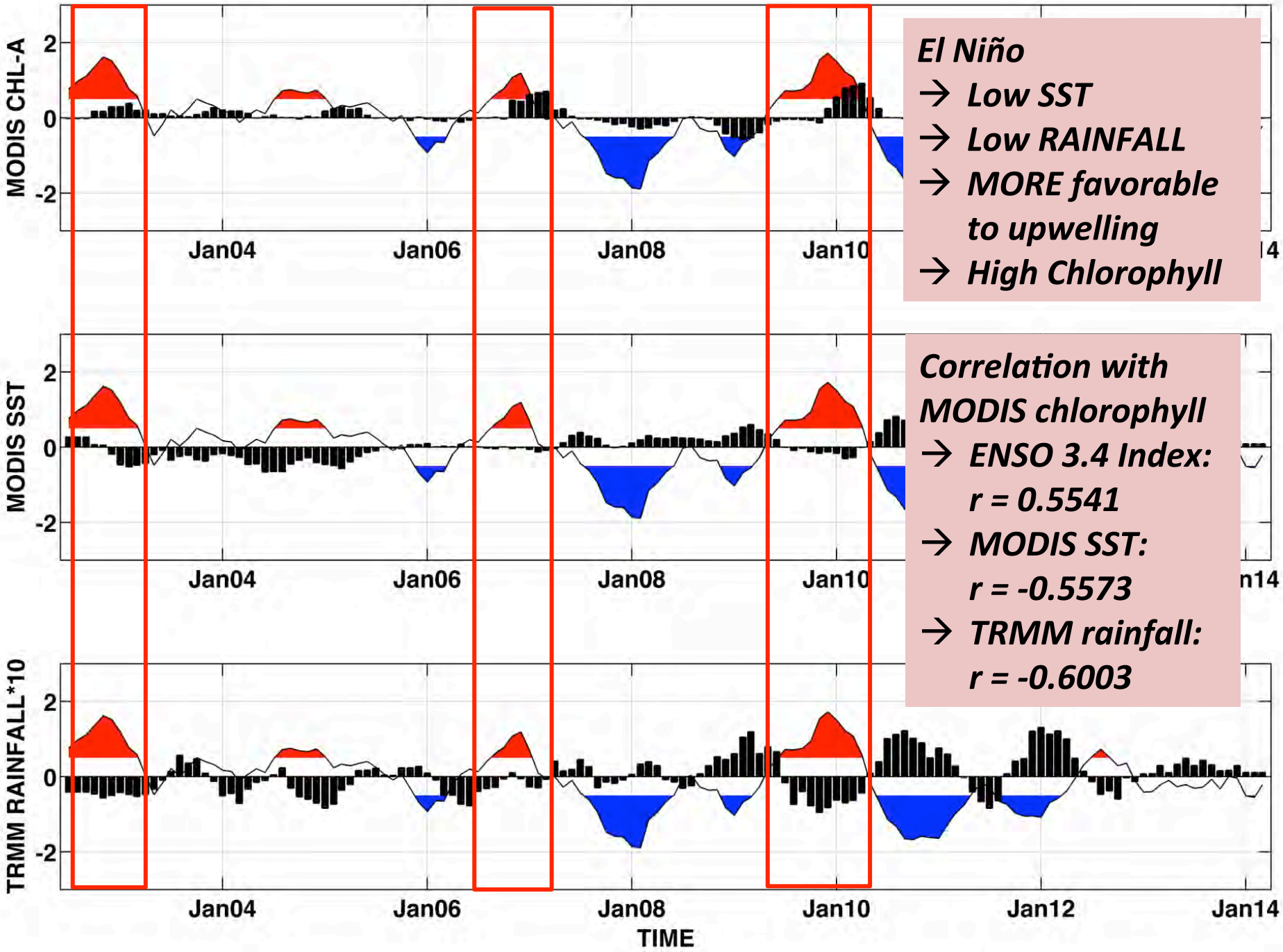

RECONSTRUCTED U-WIND vs PDO
Correlation of U-wind with PDO = -14%
ANOMALY
6
4
2
0
-2
-4
-6
Jan00
Jan01
Jan02
Jan03
Jan04
Jan05
Jan06
Jan07
Jan08
Jan09
Jan10
Jan11
Jan12
Jan13
Jan14
Jan15
TIME

RESULTS

CHLOROPHYLL, SST and RAINFALL


MODIS CHL-A
2
0
-2
Jan04
Jan06
Jan08
Jan10
Jan12
Jan14
MODIS SST
2
0
-2
Jan04
Jan06
Jan08
Jan10
Jan12
Jan14
TRMM RAINFALL*10
2
0
-2
Jan04
Jan06
Jan08
Jan10
Jan12
Jan14
TIME


La Niña
→ High SST
→ High RAINFALL
→ LESS favorable to upwelling
→ Low Chlorophyll
MODIS CHL-A
MODIS SST
TRMM RAINFALL*10
2
0
-2
Jan04
Jan06
Jan08
Jan10
Jan12
Jan14
TIME

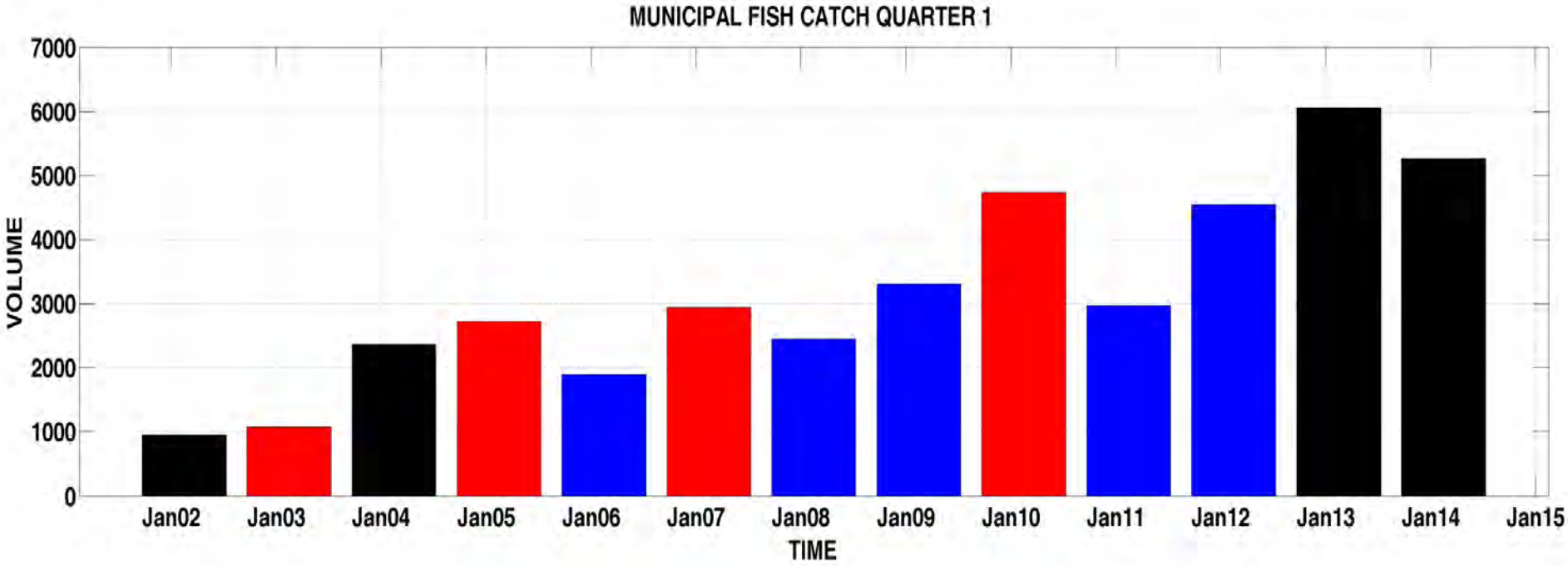


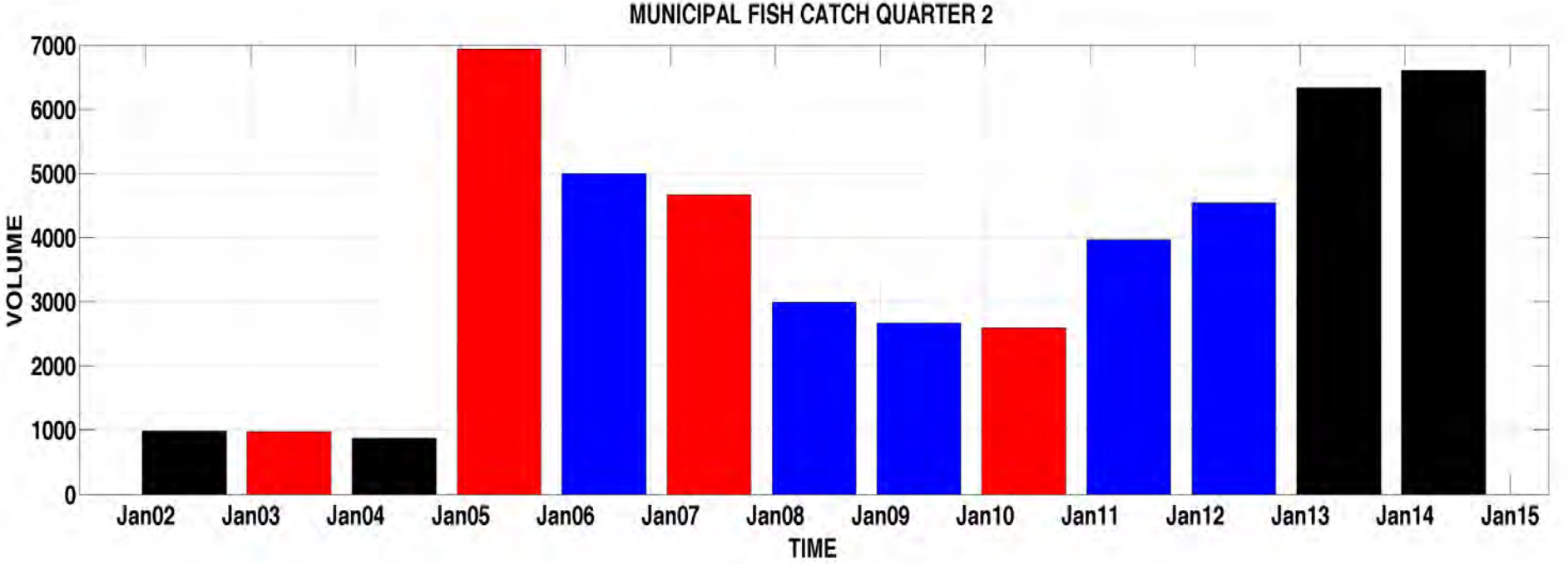
El Niño
- → *Low SST*
- → *Low RAINFALL*
- → *MORE favorable to upwelling*
- → *High Chlorophyll*

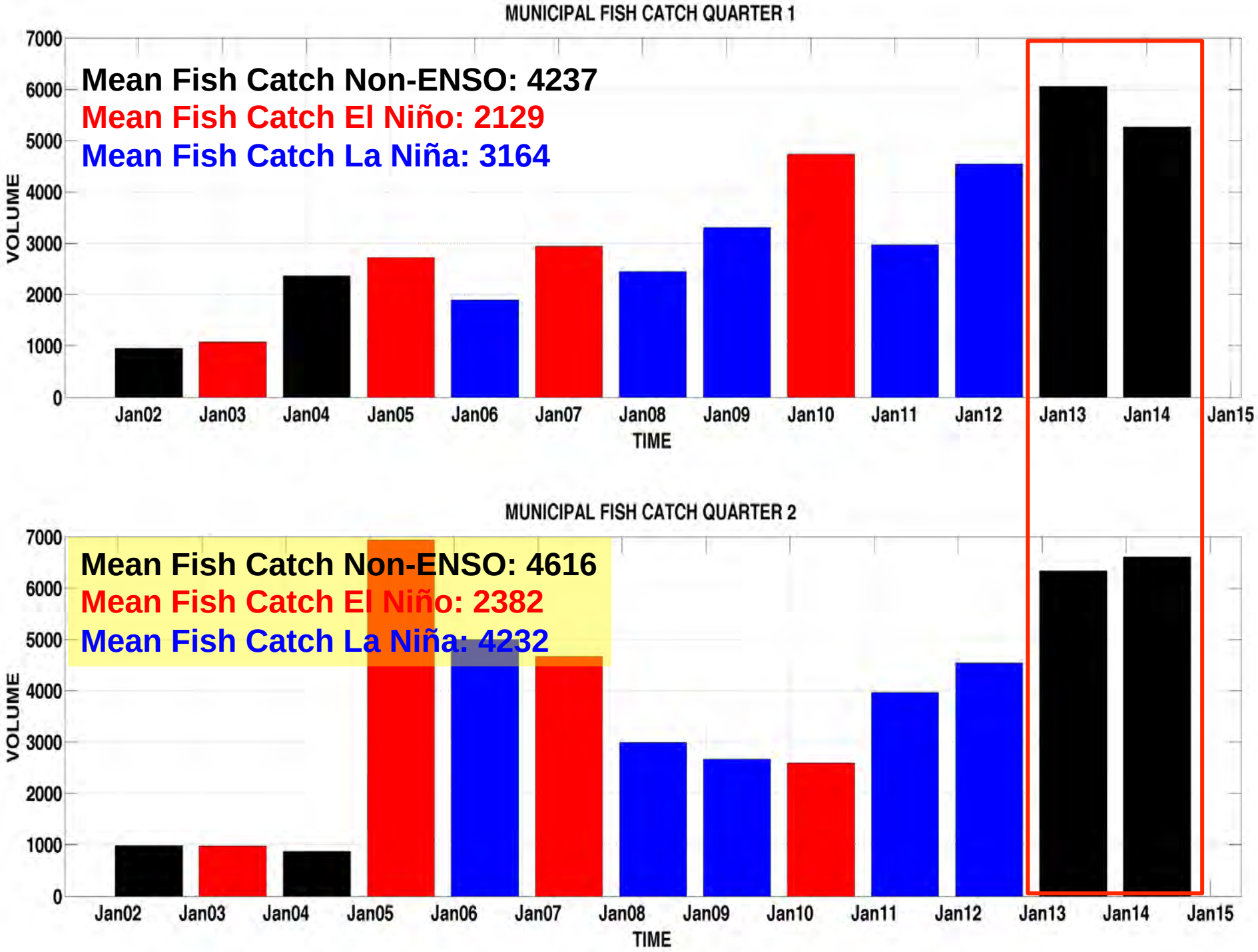
Correlation with MODIS chlorophyll
- → *ENSO 3.4 Index: r = 0.5541*
- → *MODIS SST: r = -0.5573*
- → *TRMM rainfall: r = -0.6003*

RESULTS

VOLUME OF SARDINE CATCH

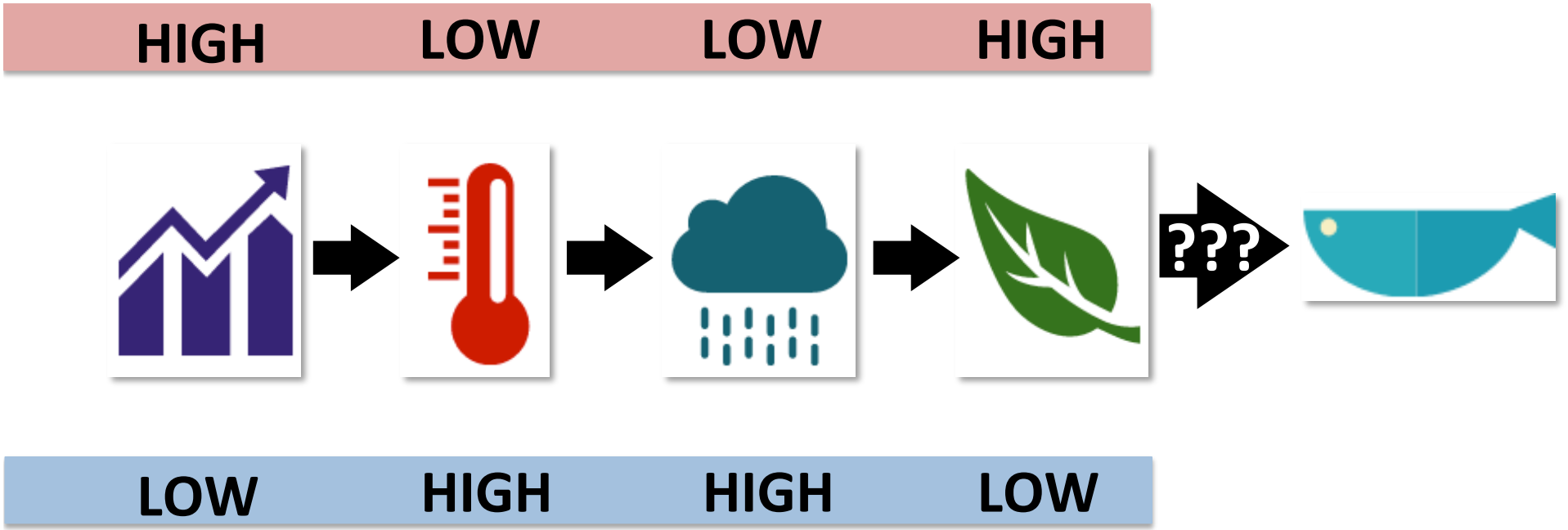

MUNICIPAL FISH CATCH QUARTER 1
VOLUME
7000
6000
5000
4000
3000
2000
1000
0
Jan02
Jan03
Jan04
Jan05
Jan06
Jan07
Jan08
Jan09
Jan10
Jan11
Jan12
Jan13
Jan14
Jan15
TIME


MUNICIPAL FISH CATCH QUARTER 2
VOLUME
7000
6000
5000
4000
3000
2000
1000
0
Jan02
Jan03
Jan04
Jan05
Jan06
Jan07
Jan08
Jan09
Jan10
Jan11
Jan12
Jan13
Jan14
Jan15
TIME


MUNICIPAL FISH CATCH QUARTER 1
Mean Fish Catch Non-ENSO: 4237
Mean Fish Catch El Niño: 2129
Mean Fish Catch La Niña: 3164
VOLUME
TIME
MUNICIPAL FISH CATCH QUARTER 2
Mean Fish Catch Non-ENSO: 4616
Mean Fish Catch El Niño: 2382
Mean Fish Catch La Niña: 4232
VOLUME
TIME

SUMMARY

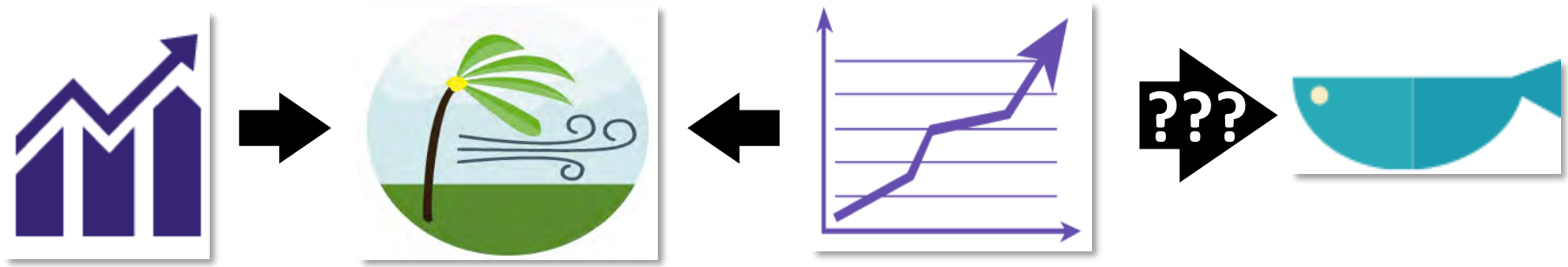
Variability of upwelling parameters is influenced by ENSO



SUMMARY

Wind variability could be influenced by ENSO and PDO

HIGH **FAVORABLE** **HIGH**



LOW **NON FAVORABLE** **LOW**

ACKNOWLEDGMENTS

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University of the Philippines

Marine Science Institute

Intergovernmental Oceanographic Commission

UNESCO

REFERENCES

- Ashok K and Yamagata T. 2009. The El Nino with a difference. Nature. Vol 461. pp. 481–484.
- Villanoy CL, Cabrera OC, Yniguez AT, Camoying MG, De Guzman A, David LT and Flament P. 2011. Monsoon–driven coastal upwelling off Zamboanga Peninsula, Philippines. Oceanography Vol 24 No 1 pp 156 – 165.