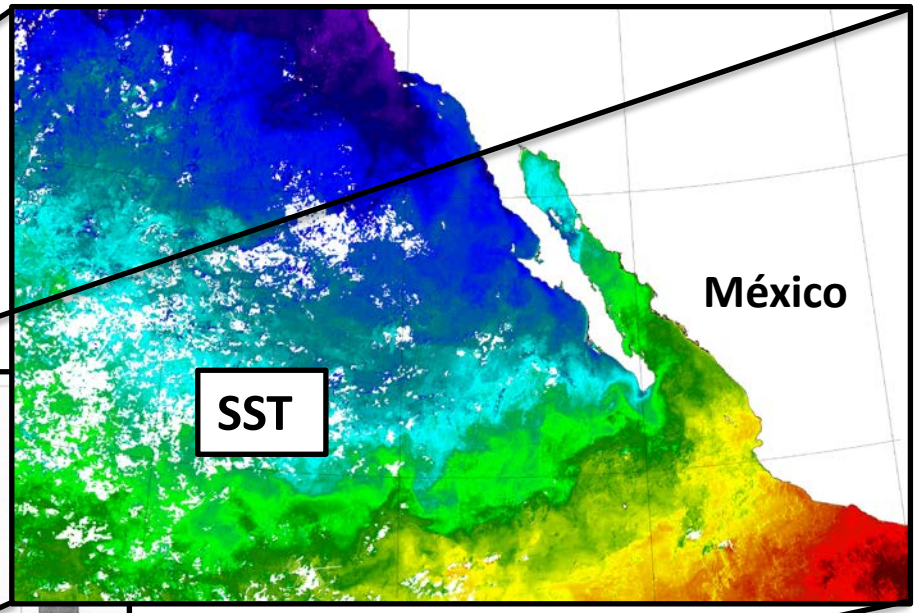
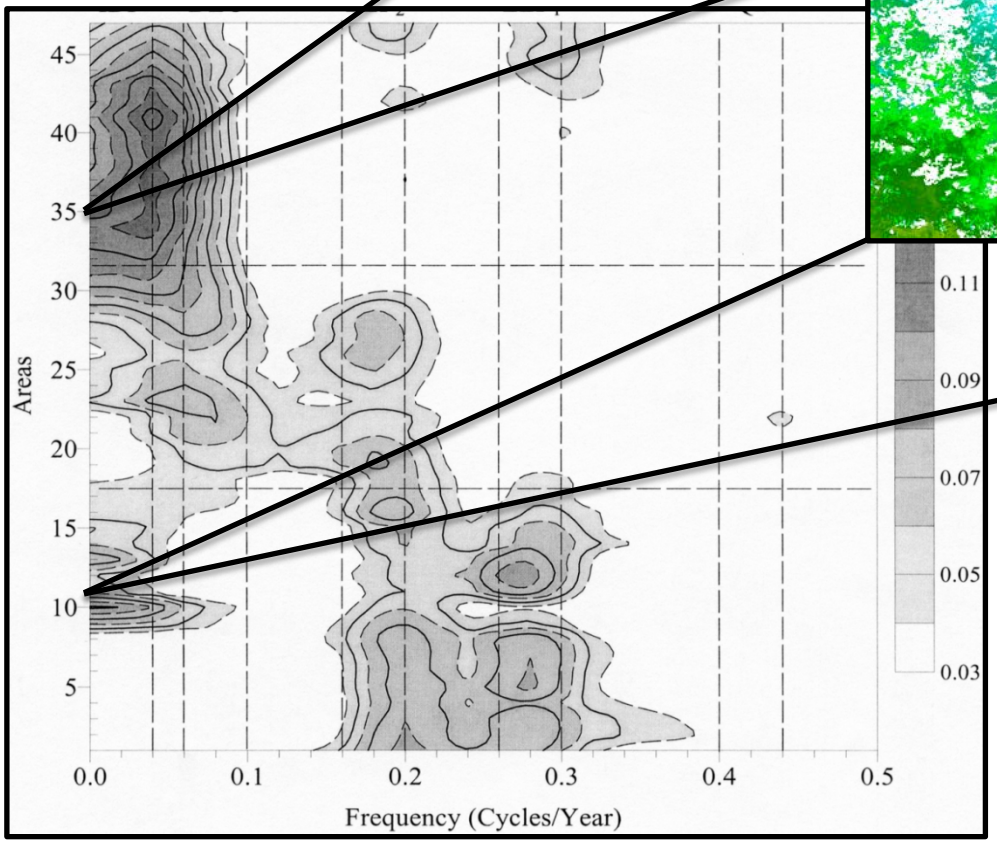
# Assessment of ocean climate and its associated physical-biological response at northwest Mexico

**Romeo Saldívar-Lucio**, C.J. Salvadeo, D. Lluch-Belda y H. Villalobos-Ortíz

# Northwest of Mexico




# Transitional zone

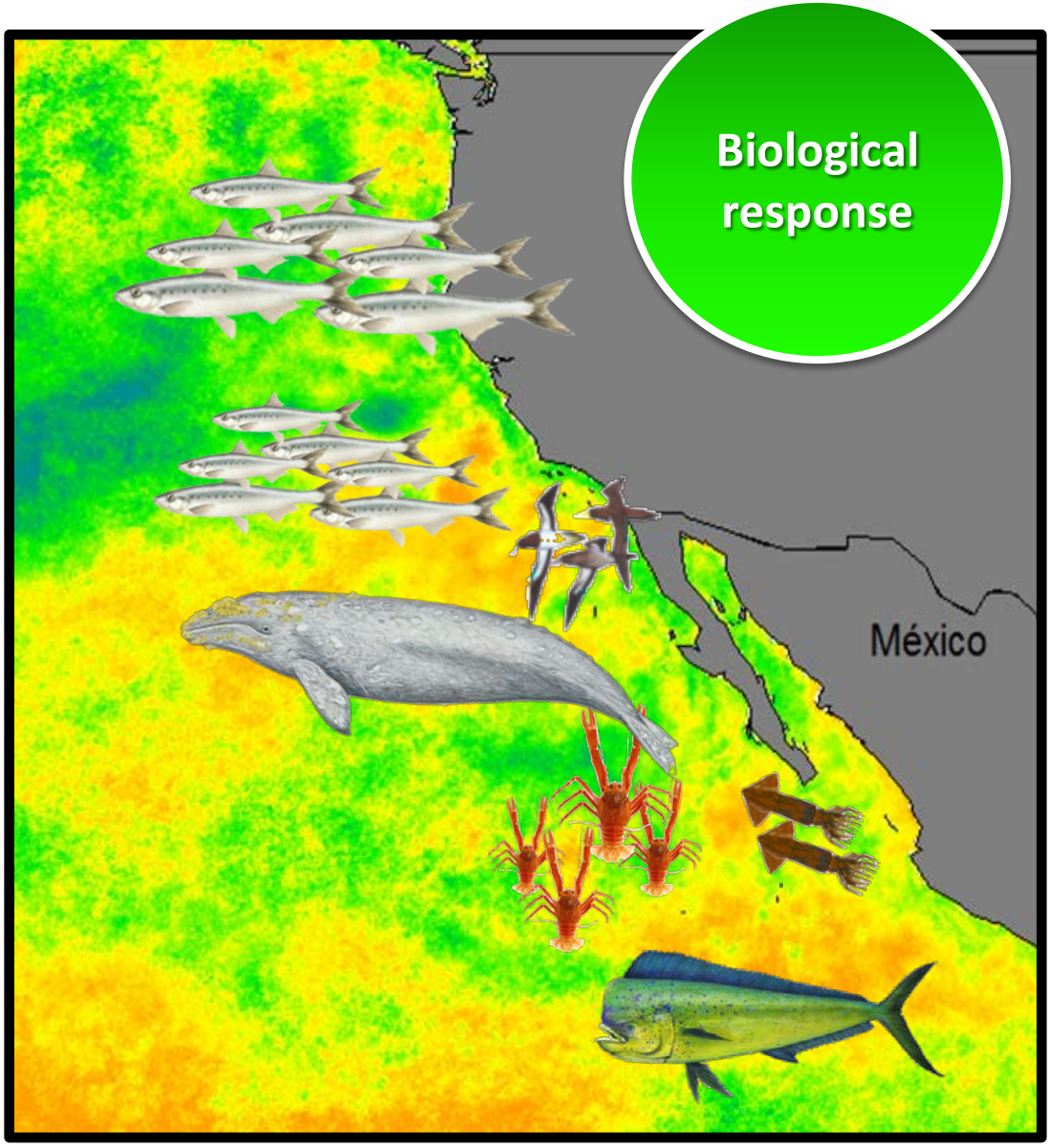
Seasonal

Interannual

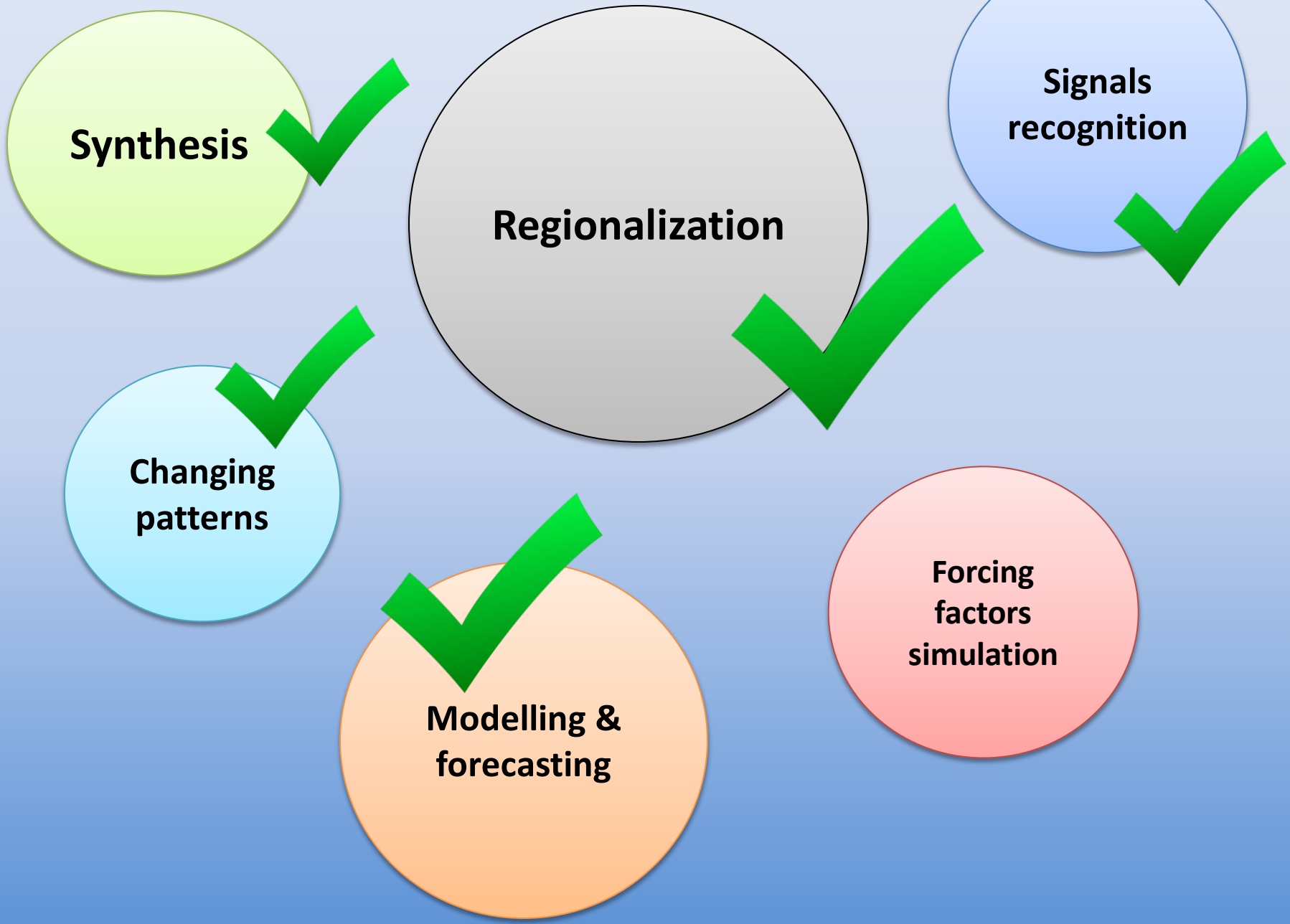
# Decadal

# Multidecadal

- **Geographic distribution**
- **Phenology**
- **Trophic relationships**

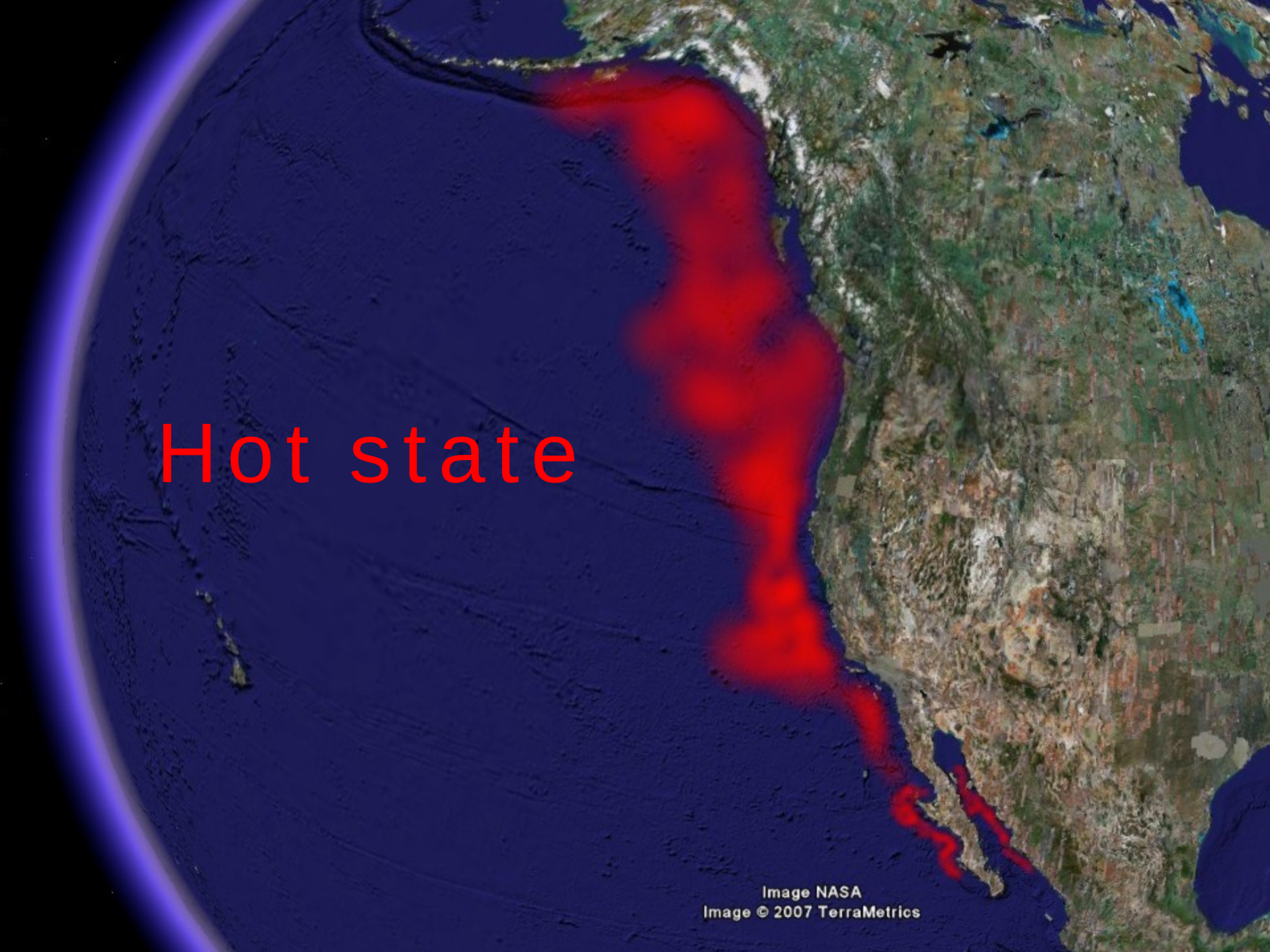



Lluch-Belda et al., 2003; 2005; Yamamoto et al., 2007; Del Monte-Luna P. and S. Lluch-Cota, 1013


Synthesis
Regionalization
Signals recognition
Changing patterns
Modelling & forecasting
Forcing factors simulation

# Sardine


Cool state
Image NASA
Image © 2007 TerraMetrics


Hot state
Image NASA
Image © 2007 TerraMetrics


Cooling
period
Contraction process
~30 years
Image NASA
Image © 2007 TerraMetrics


Heating
period
Expansion process
~30 years
Image NASA
Image © 2007 TerraMetrics

# Trinational sardine forum



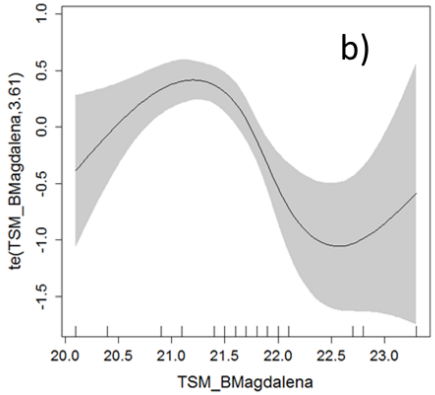

participants from government, academia, and industry


NOAA

| Modelos | Predictores | % D.E. | $R^2$ | GCV |
|---|---|---|---|---|
| Mod-1_BM | PDOcsum + TSM_BM | 81 | 0.8 | 4146 |
| Mod-2_BM | PDOcsum + TSM_BM + MEI | 88 | 0.88 | 3380 |
| Mod-3_ENS | PDOcsum + FEO1_ccs | 81 | 0.79 | 6308 |
| Mod-4_ENS | PDOcsum + FEO1_ccs + UW_30N | 90 | 0.86 | 4839 |



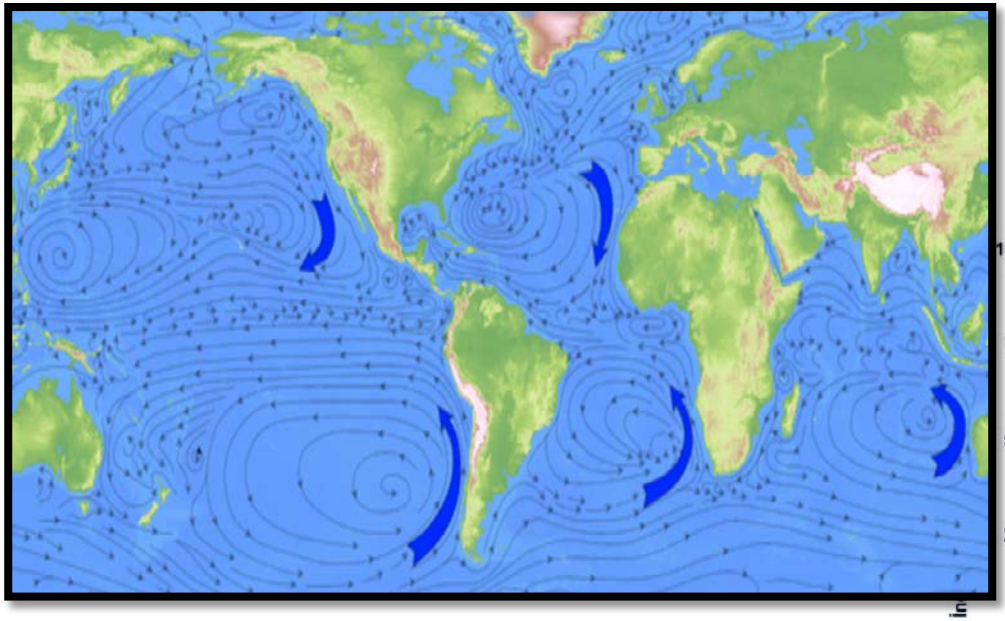


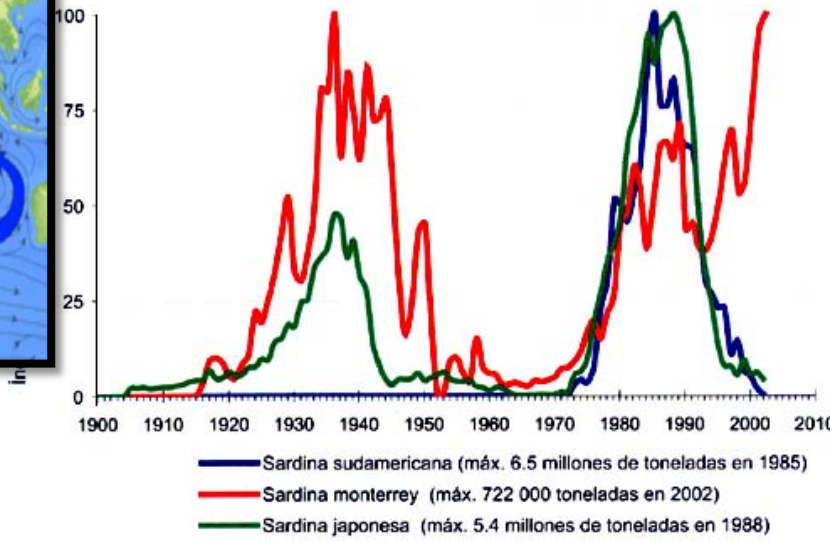


1)


# World-wide fluctuations of sardine and anchovy stocks: the regime problem

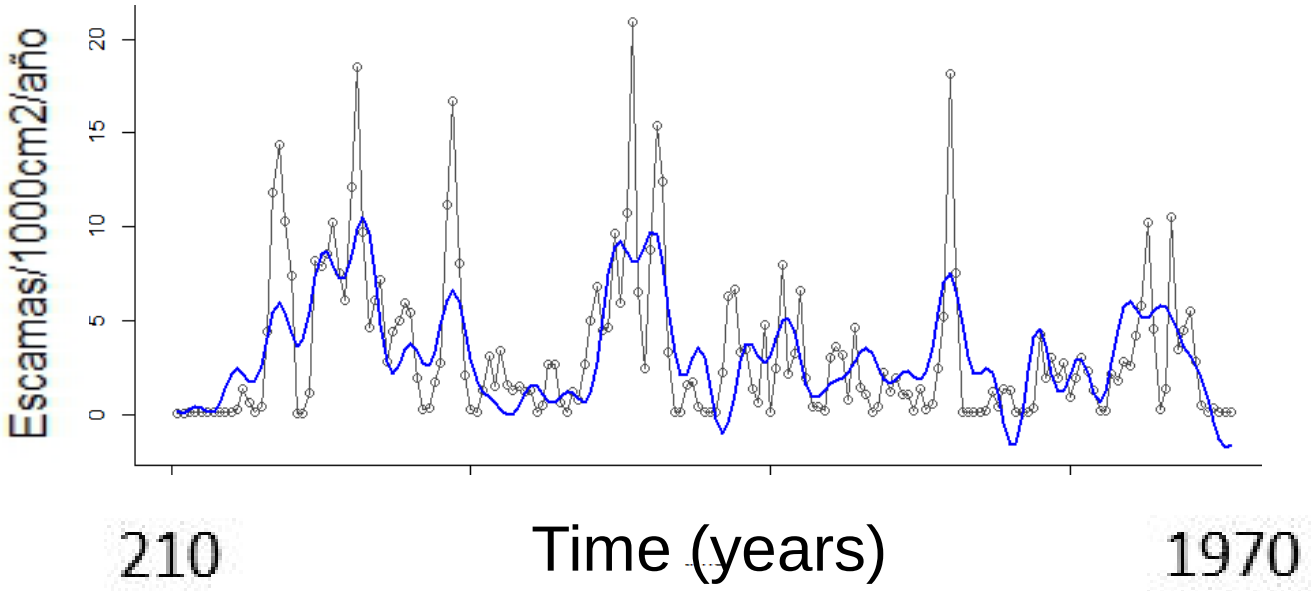
**Lluch-Belda *et al.*, 1989**





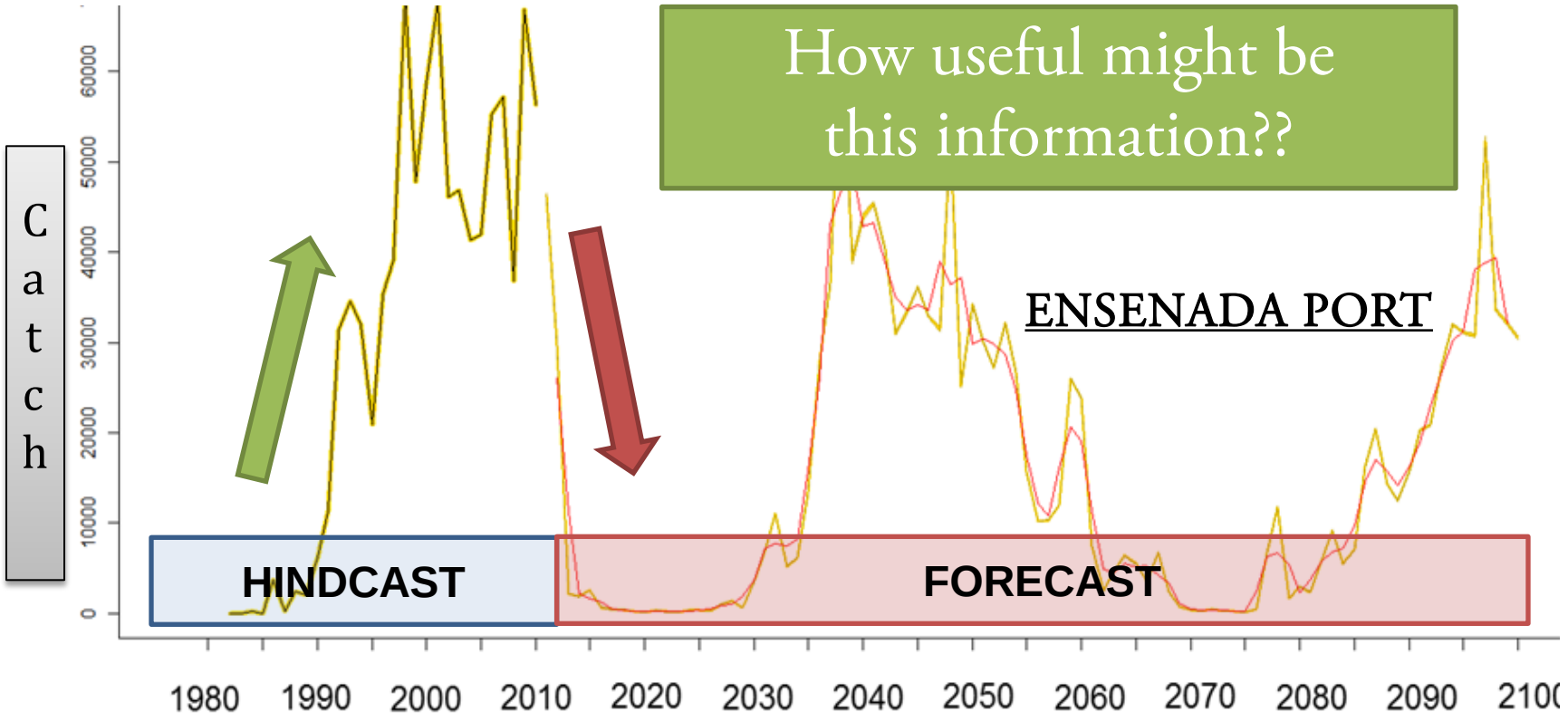
1) Synchronized increasing and decreasing periods

# 2) Sardine scales deposition rate



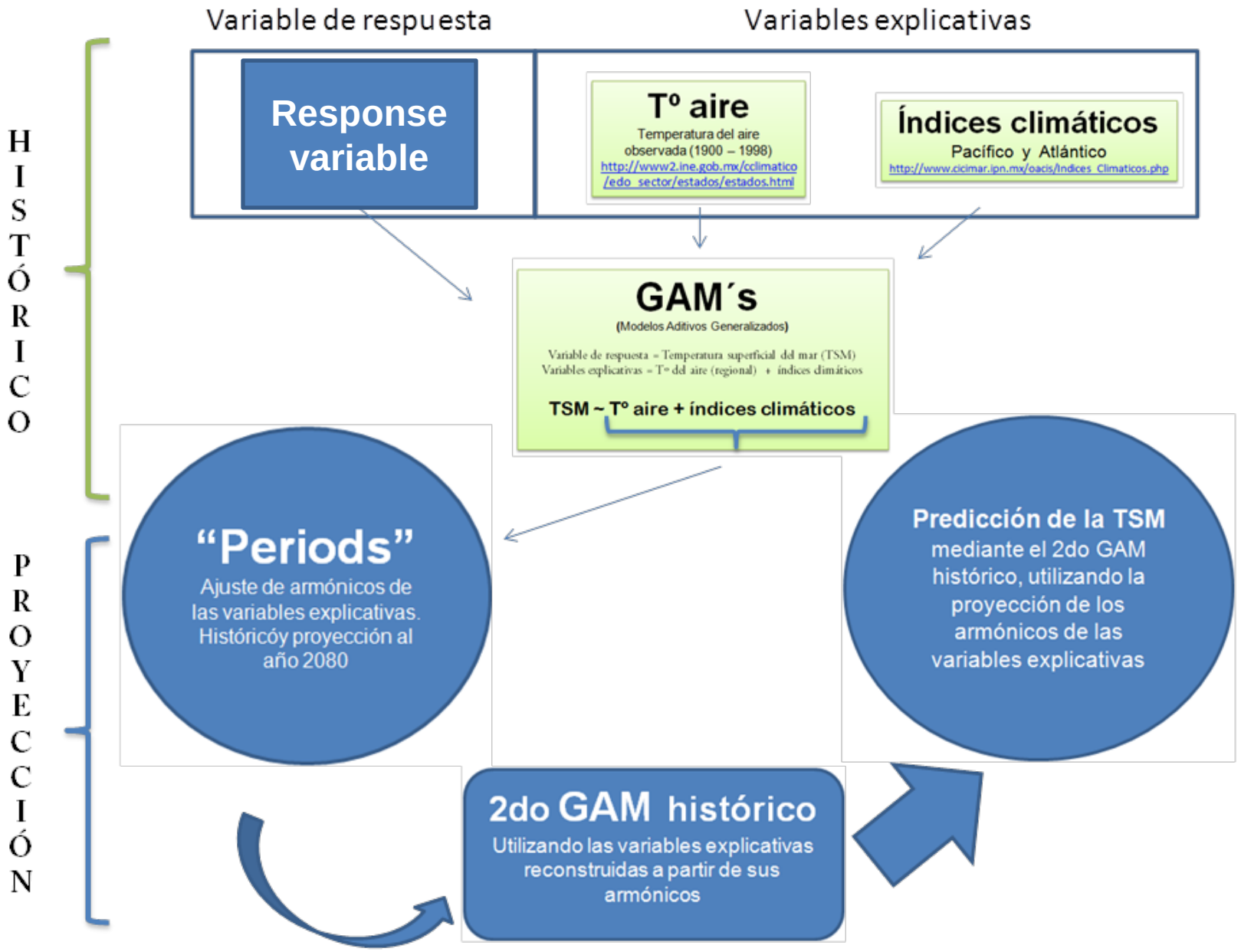

**~ 60 year** changing pattern present ~ 1800 años

/ Baumgartner *et al.*, 1992 / Kawasaki, 1994 /


How useful might be this information??
Catch
ENSENADA PORT
HINDCAST
FORECAST
0
10000
20000
30000
40000
50000
60000
1980
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100


COPYRIGHT: CHARLES MAXWELL

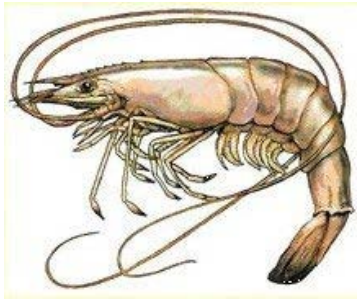
# MODELLING


Variable de respuesta
Variables explicativas
HISTÓRICO
PROYECCIÓN
Response variable
Tº aire
Temperatura del aire observada (1900 – 1998)
http://www2.ine.gob.mx/cclimatico/edo_sector/estados/estados.html
Índices climáticos
Pacífico y Atlántico
http://www.cicimar.ipn.mx/oacis/Indices_Climaticos.php
GAM´s
(Modelos Aditivos Generalizados)
Variable de respuesta = Temperatura superficial del mar (TSM)
Variables explicativas = Tº del aire (regional) + índices climáticos
TSM ~ Tº aire + índices climáticos
"Periods"
Ajuste de armónicos de las variables explicativas. Históricoy proyección al año 2080
Predicción de la TSM mediante el 2do GAM histórico, utilizando la proyección de los armónicos de las variables explicativas
2do GAM histórico
Utilizando las variables explicativas reconstruidas a partir de sus armónicos

# Shrimp

# Catch models

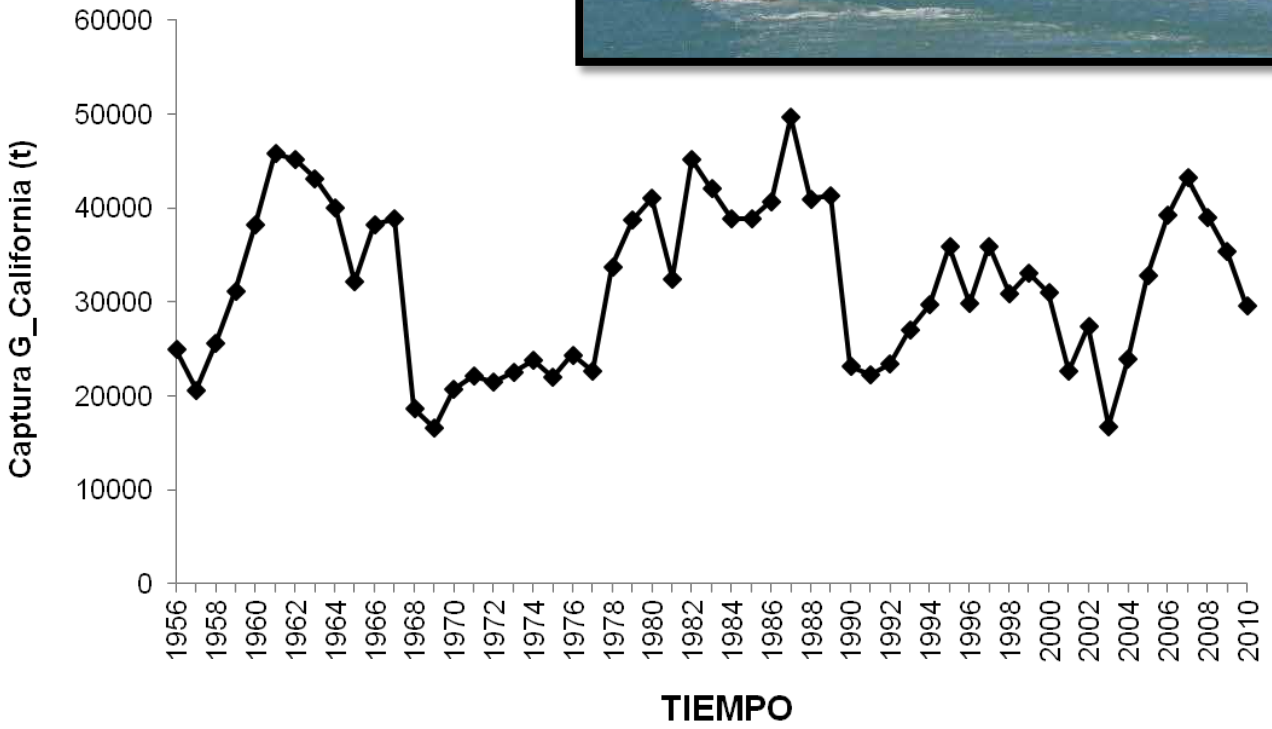
Golfo de California ($R^2$=0.785)



Baja California ($R^2$=0.667)

Sonora ($R^2$=0.726)

Sinaloa ($R^2$=0.694)



# unofficial corroboration . . .

Inicia pesca de camarón en

diariodelyaqui.mx/n/index.php?option=com_content&view=article&id=11833:inicia-pesca-de-c

Nueva pestaña | Google | Dirección de Bibliot... | Glo | RAE

Facebook/diarioyaqui

DIARIO DEL YAQUI.MX

INICIO | SECCIONES | COLUMNISTAS | CLASIFICADOS | PUBLICIDAD | FACTURACIÓN | IMPRESO | CORREO | ELECCIONES 2012

Inicia pesca de camarón en altamar

para darle su

De acuerdo

Acuicultura (

La temporada de pesca de cam

principal productor de este recurso marino.

da que inicia se espera superar la producción del pe

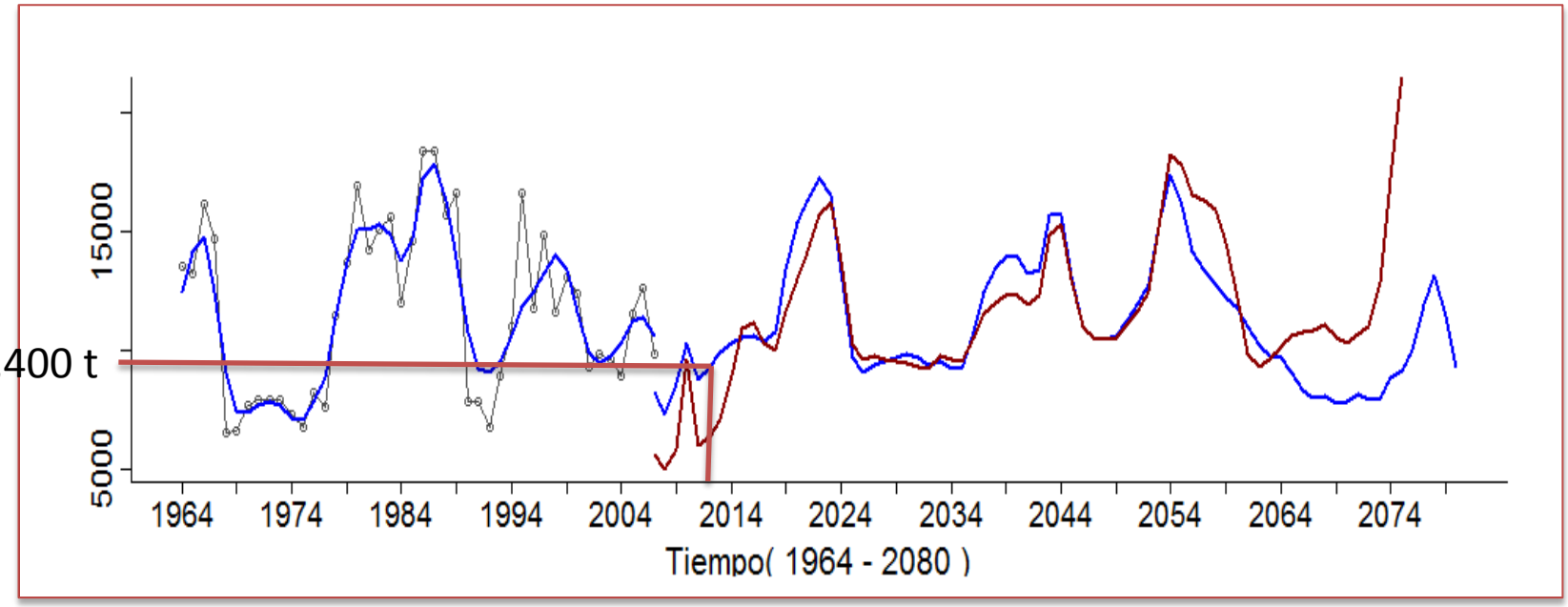
Gómez, indicó que al inic

superar las capturas del

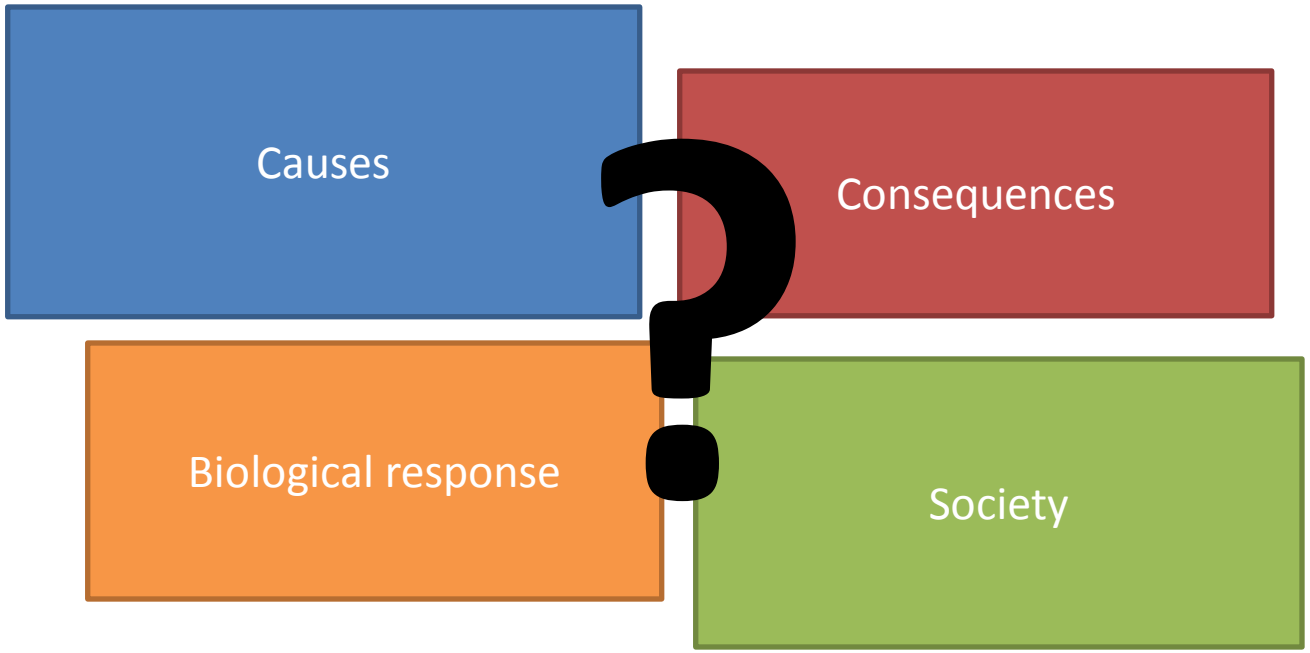
e pesca de camarón de altamar 2011-2012 arrojó una producc

una producción de siete mil 603 toneladas

7,400 t



# What we may learn from sardine and shrimp fisheries?

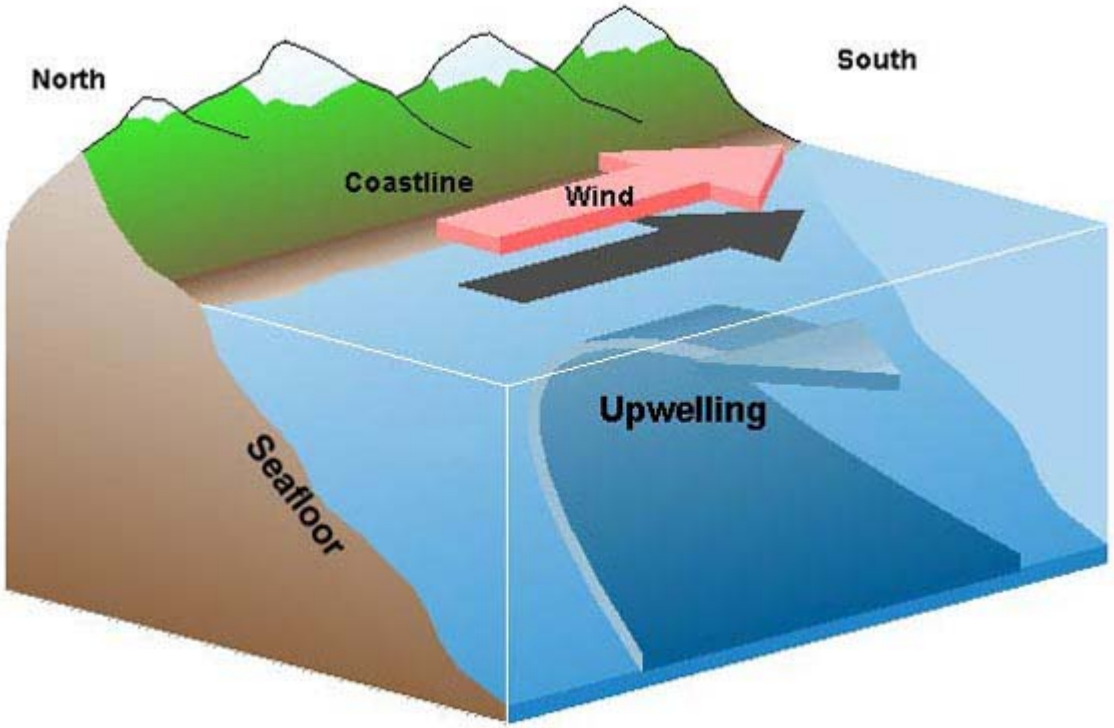



**Is it possible to develop a climatic basis for fisheries management? . . . when not?**

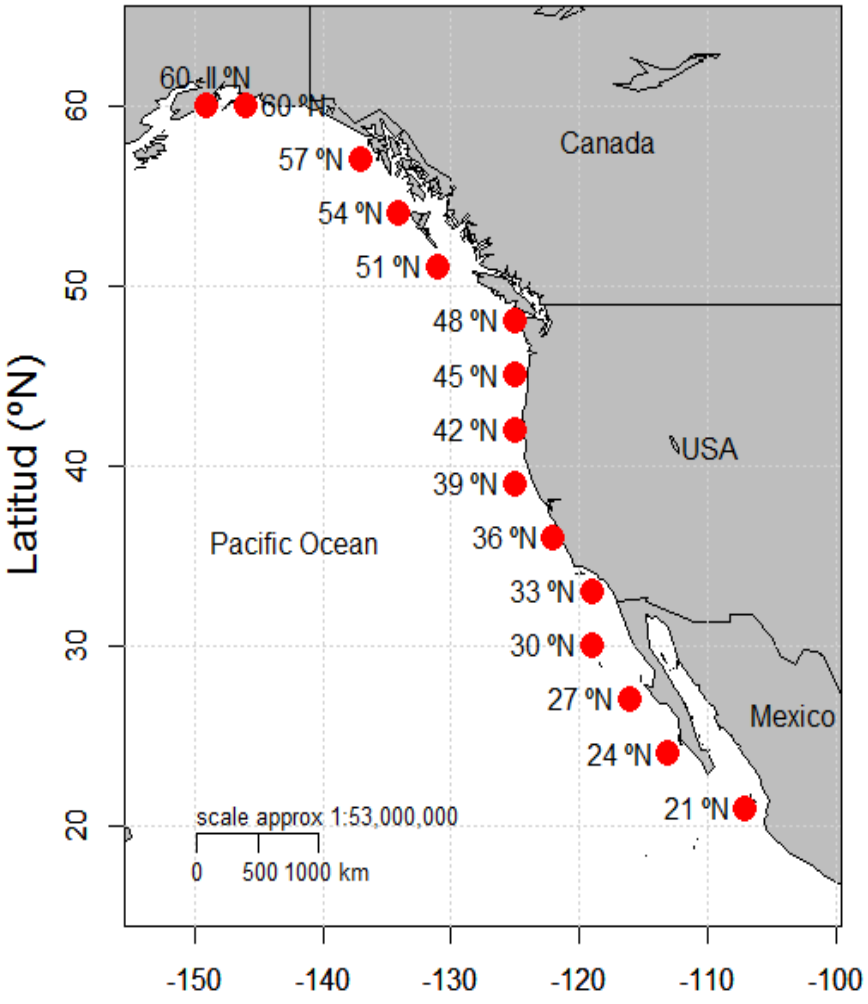
**Is multiannual management possible??**

**What if some decisions are build in the perspective of groups of years?**

# Upwelling



# Upwelling activity



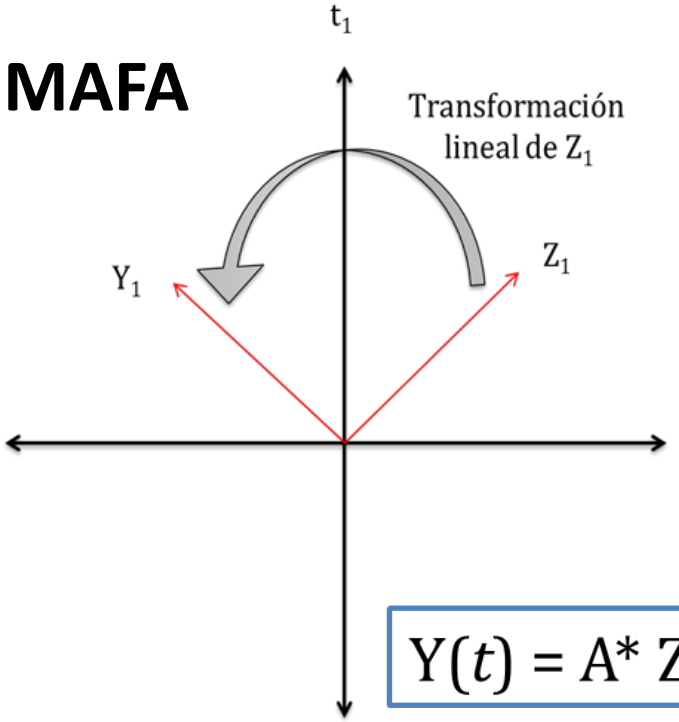

http://www.pfeg.noaa.gov/products/

**Geostrophic winds (PFEL)**

**15 stations** → 21 – 60° N

"Cleaning signals"

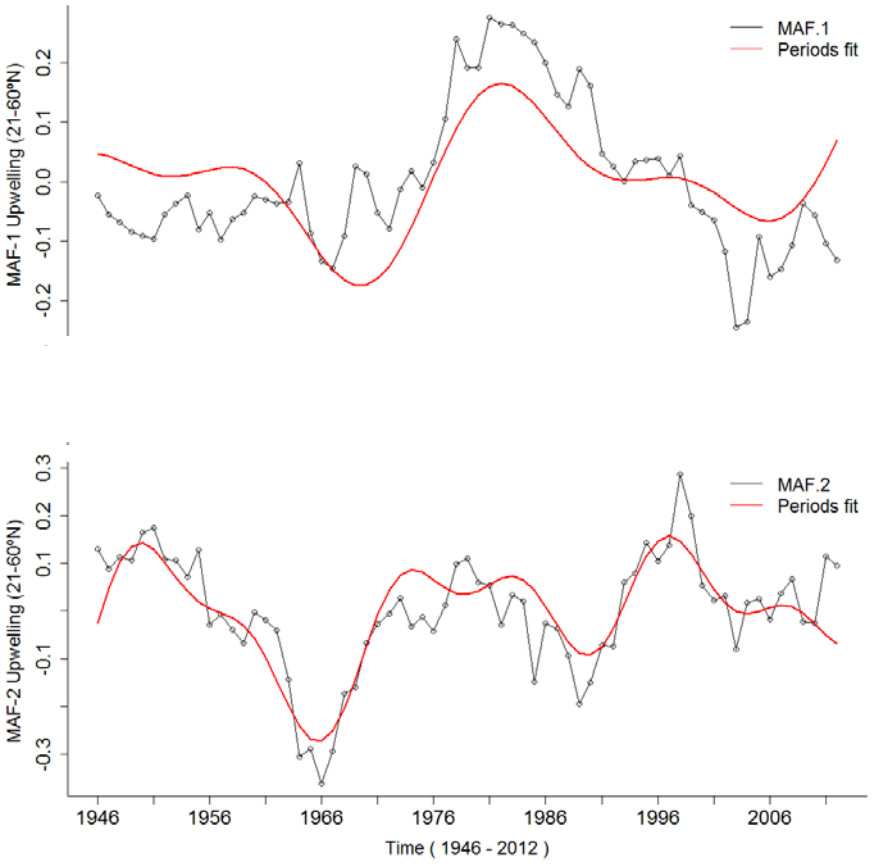
## MAFA



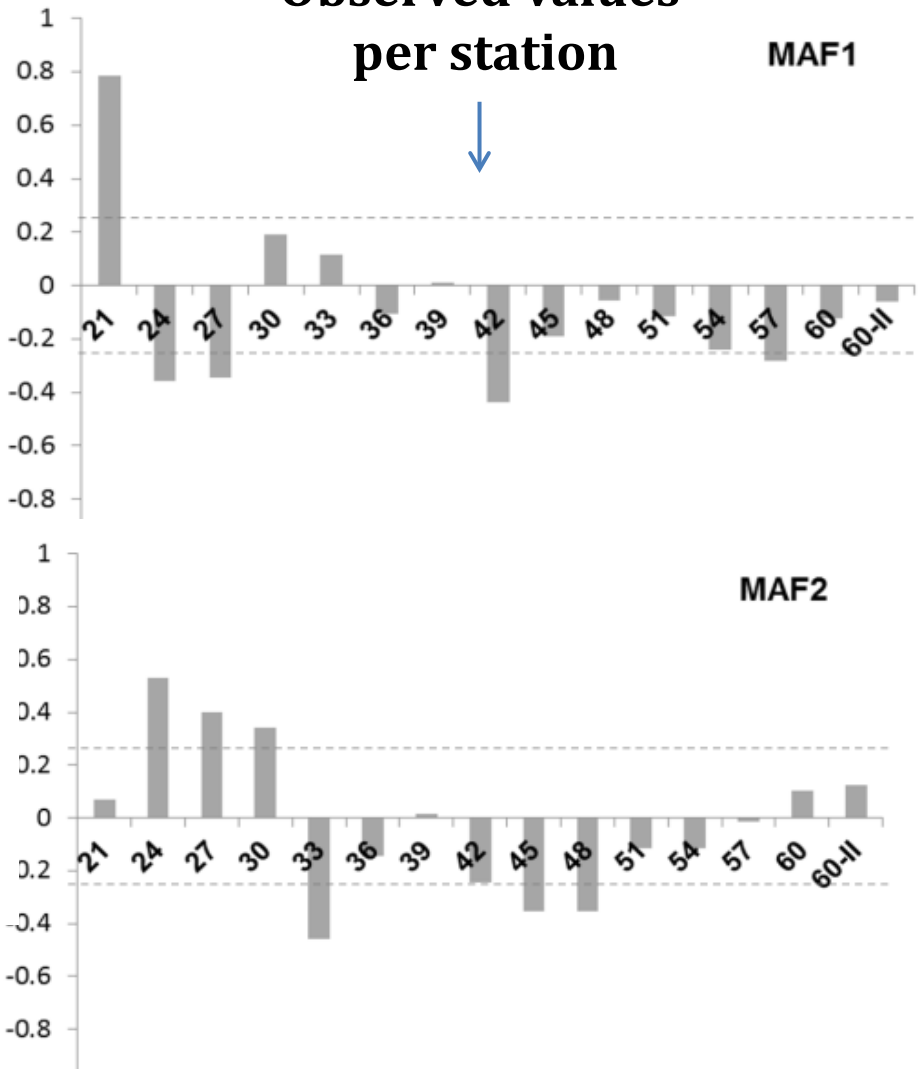

$$Y(t) = A^* Z(t)$$

Switzer y Green, 1984; Shapiro y Switzer, 1989

## Common signals → Correlation coefficients Vs:

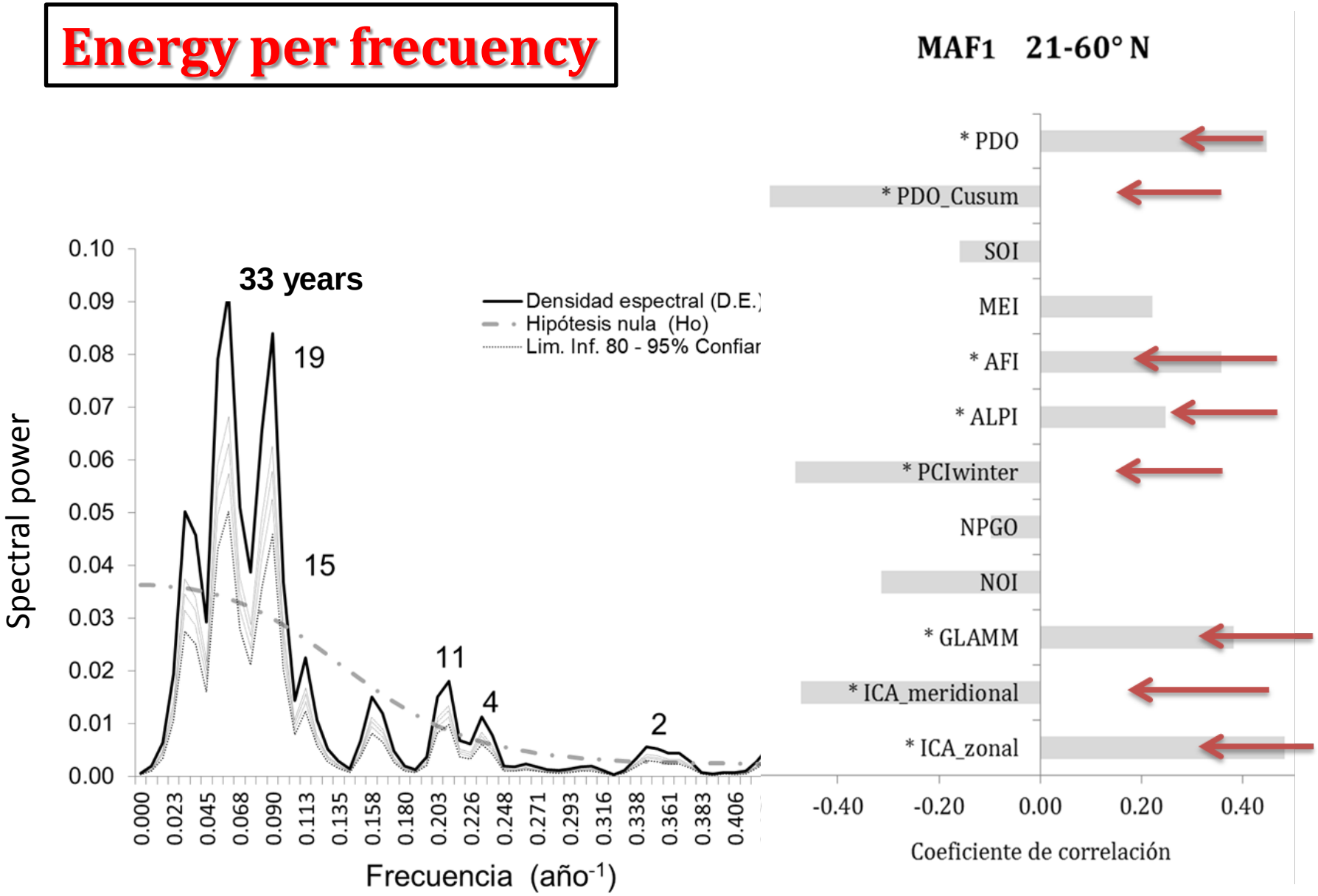



**Observed values per station**

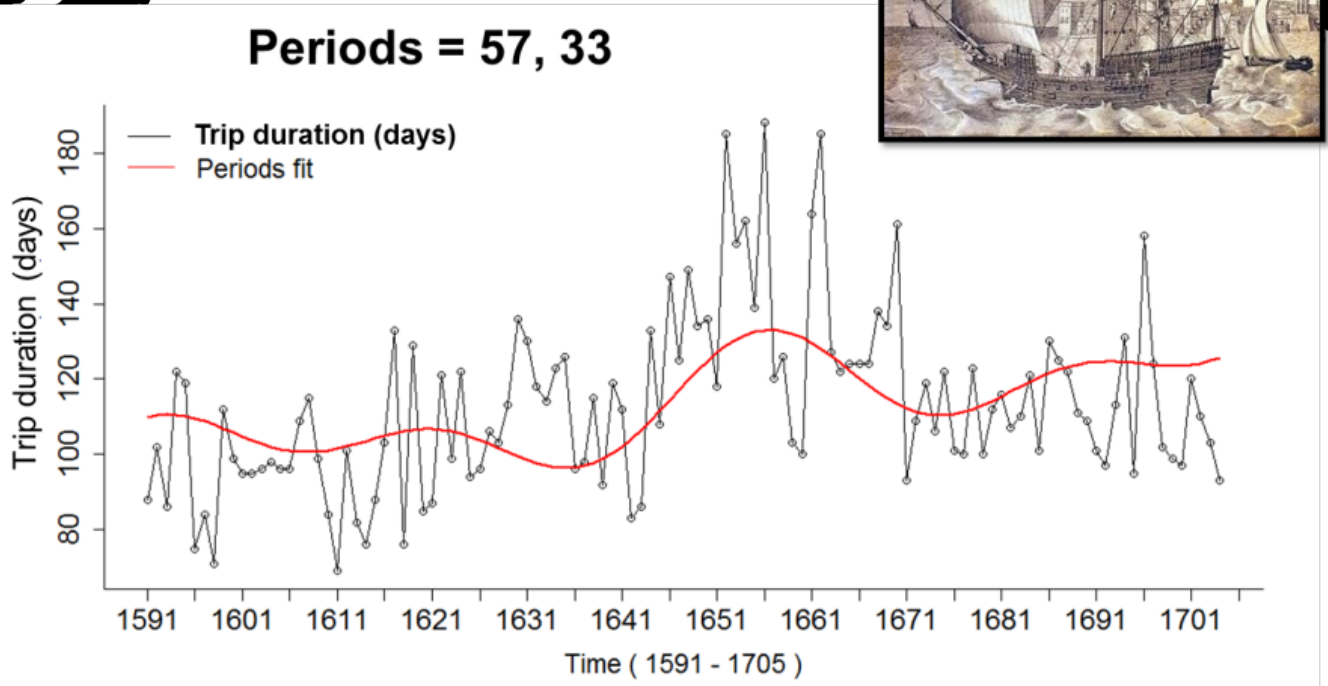



Saldívar-Lucio, R., *et al.*, *in prep*

# Energy per frecuency



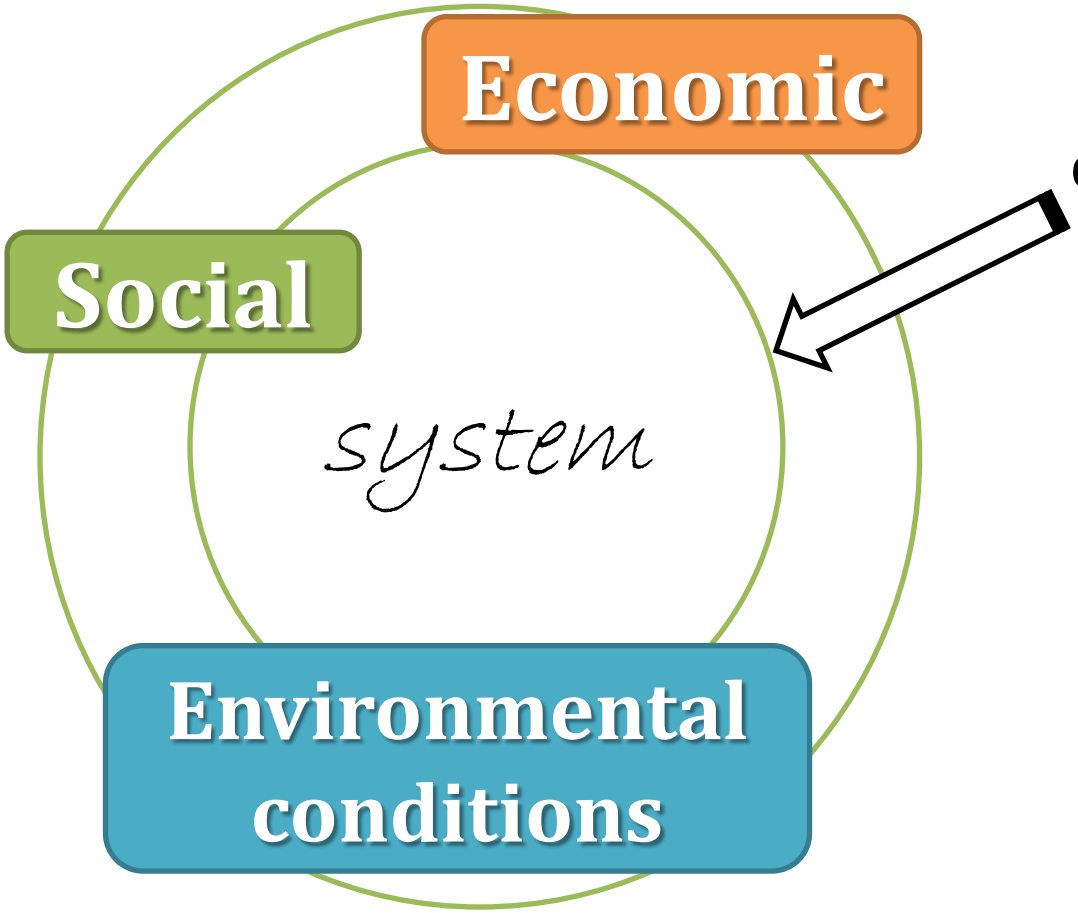
# Spanish ships (1591 – 1750)




García *et al*., 2001.
Atmospheric Circulation
Changes in the Tropical Pacific

The key while building
knowledge into this perspective:

# TRANSDISCIPLINARITY




## TECHNIQUES

development, adaptation and application

Seijo J.C., O. Defeo y S. Salas. 1998. Fisheries bioeconomics, Theory, modelling and management. FAO.

Increase **confidence** in **fisheries forecasting** . . . To assist and **consolidate** **their** **usefulness** for **economic** **planning** **and** **social development** of fishing activities in the **long term.**

# IN HONOR TO

## Ph.D. DANIEL LLUCH-BELDA

## 1942 - 2014

# GRACIAS!

**Assessment of ocean climate and its associated physical-biological response at northwest Mexico**

R. Saldívar-Lucio[1*], C.J. Salvadeo[1], D. Lluch-Belda[1] y H. Villalobos-Ortíz[1]