

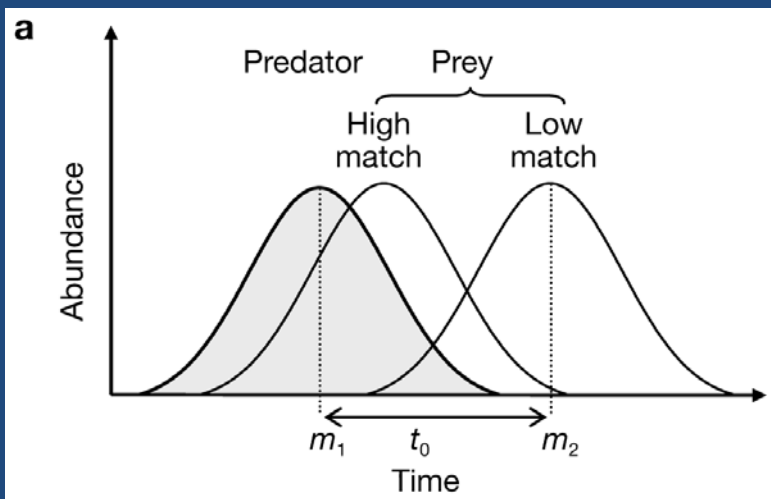
From large scale climate variability to individual character changes in coastal invertebrates: NAO, reproduction and daily growth of the scallop, *Pecten maximus*

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1. Telecom Bretagne Brest France
2. LEMAR/IUEM UBO/CNRS/Ifremer Brest France
3. LOS Ifremer
4. CERFACS-Toulouse France

The question !

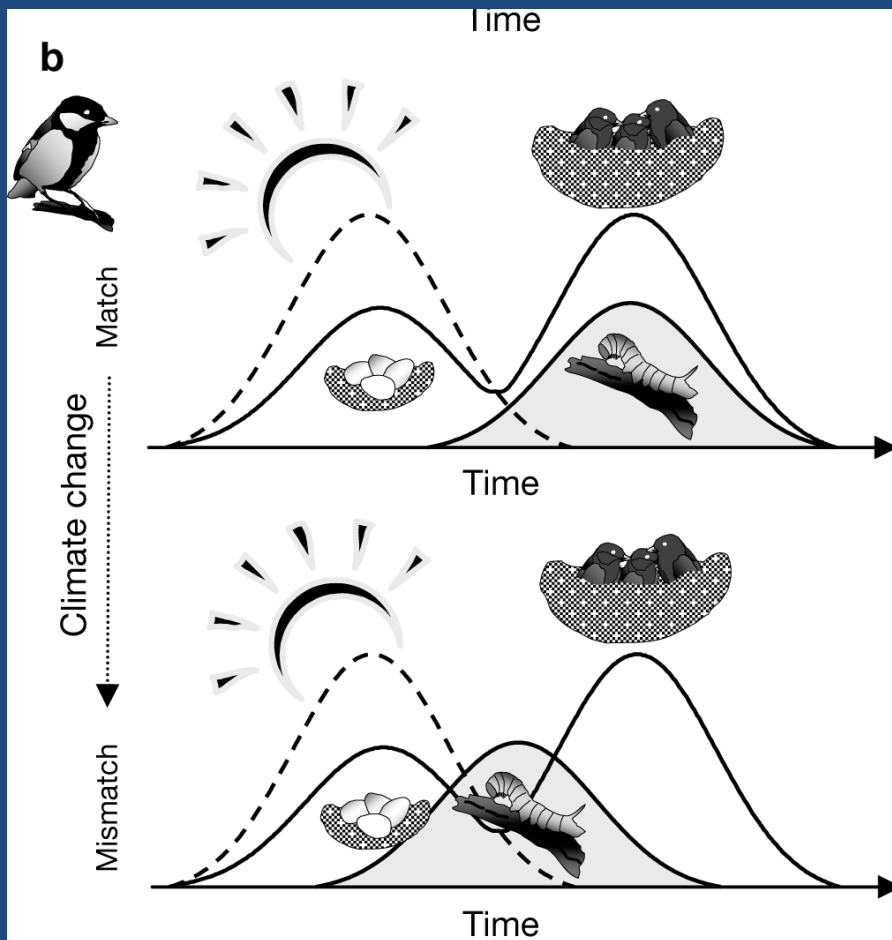
Temporal dynamics of growth and reproduction processes are fundamental keys of our understanding of population and community variability. Phenologic changes impact largely biologic interactions.



(in Durant *et al.*, 2007)

Since Cushing works (1969), the Match-Mismatch Hypothesis (MMH) has proved its relevance.

It is based on phenological coincidence between predators and preys. Largely confirmed for meroplanktonic species with planctroptoph larvae.



For terrestrial systems, Visser et al. publish in 1998 a founding paper on mistimed reproduction in great tits relative to caterpillar abundance.

Bird nesting mainly controlled by photoperiod determine hatching dates,

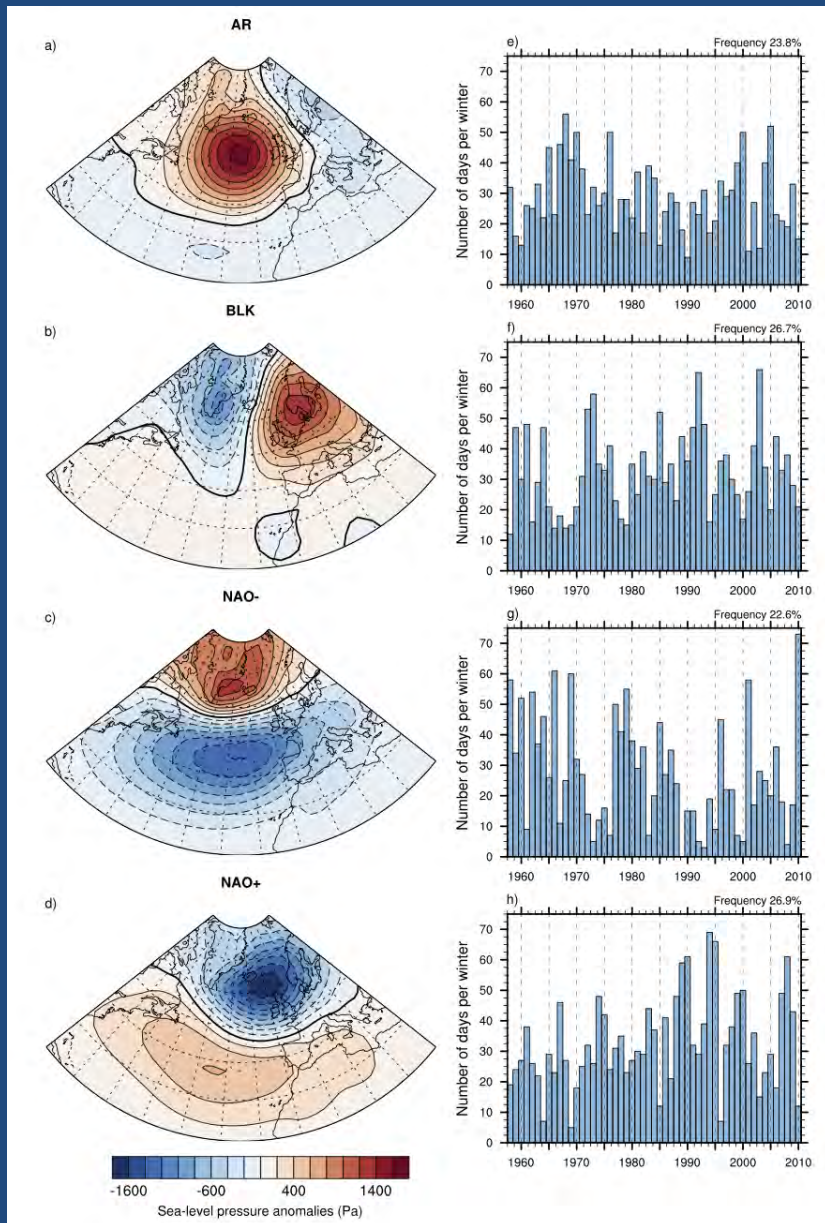
In CC context, warming springs can induce mismatch between nestling and caterpillar bloom more dependant from température.

In marine environments

- Climate change less easy to characterized
- Life traits variations more difficult to tackled
- Scarcity of time series of reproduction and growth

In this study we have try to link climate variability at the North Atlantic Scale, using NAO and derivate indicators,

With a marine mollusk biology, the great scallop *Pecten maximus*, one of the most studied and finely knew of the marine benthic species.



AR
Anticyclonic ridge over the Atlantic

North West flux, dry and cool

BLK
High pressure over Scandinavia

Est winds, dry and cold

NAO –
Iceland high pressures and low on Acores

Nort Est winds, humid and cold

NAO+
Iceland low pressures and high on Acores
South West Flux, mild temperatures

(from Vautard, 1990, Cassou et al., 2010)



The model :

A Coastal invertebrate, the great scallop, *Pecten maximus*.

Living on soft bottom, from circalittoral to 200 meters depth.

Reproduction and growth intensively studied in the Bay of Brest (Brittany, France) since the eighties.



Scallop stock historically exploited
Aquaculture development
A marine megatidal system with two quite small tributaries
Data series on physico-chemical and biological/ecological parameters

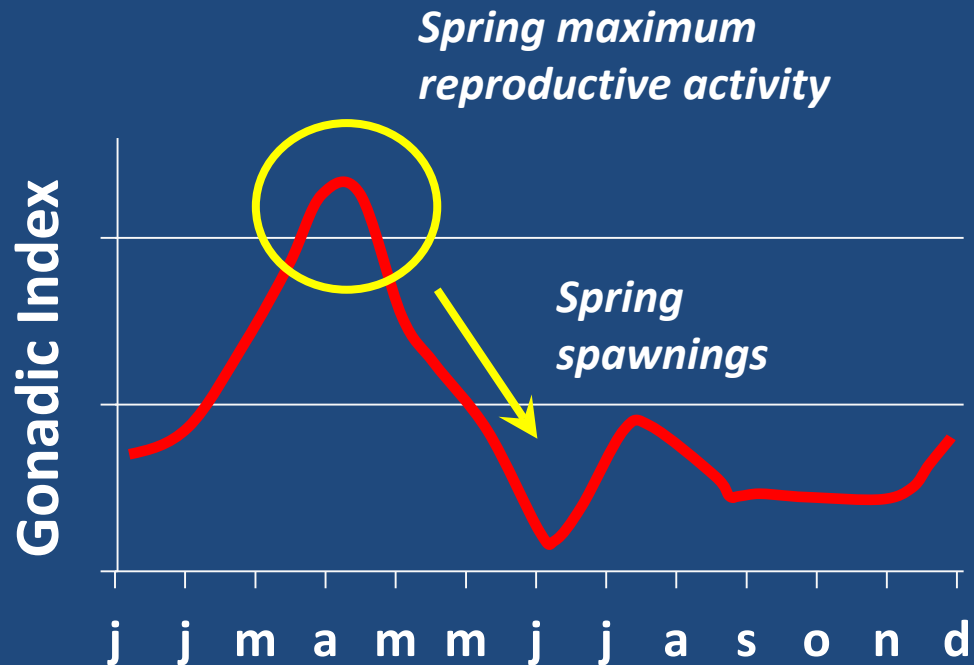
1. Reproduction

Scallop reproductive activity in a nutshell / 16 years of acute survey

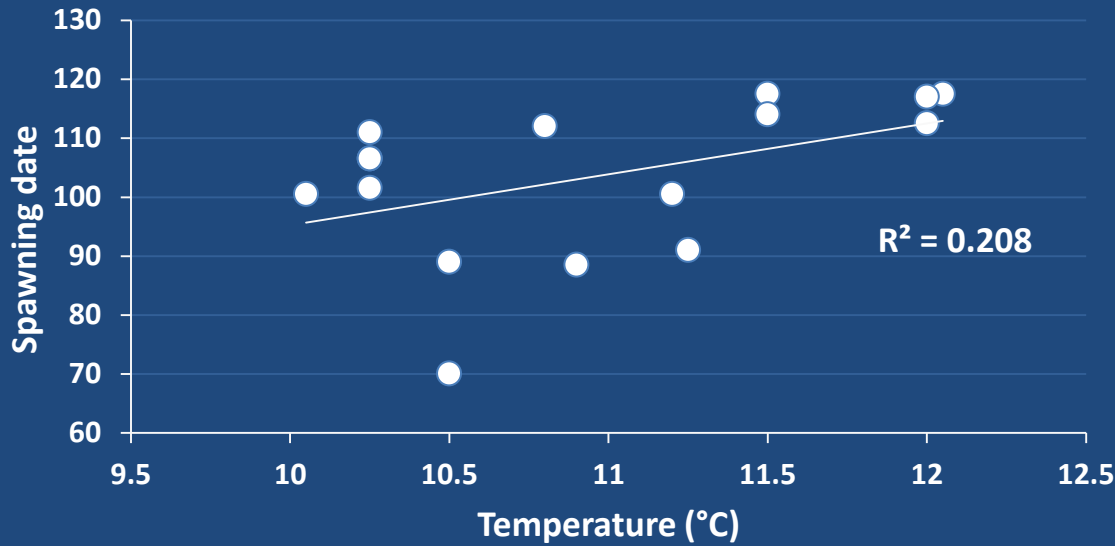
A major point of the annual reproductive cycle : the date of the first annual spawning



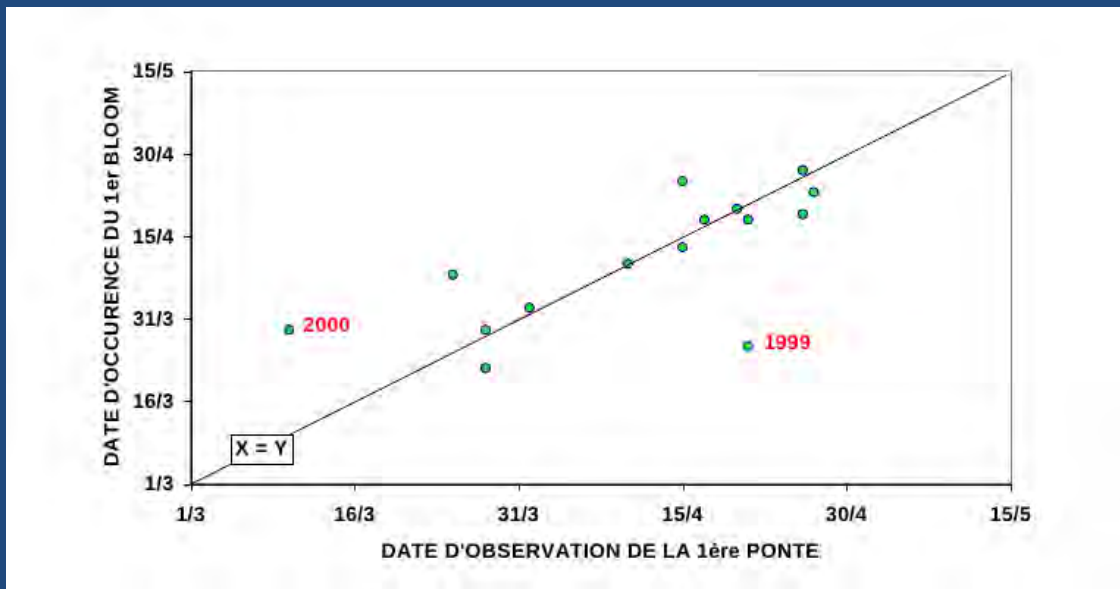
Reproductive organ



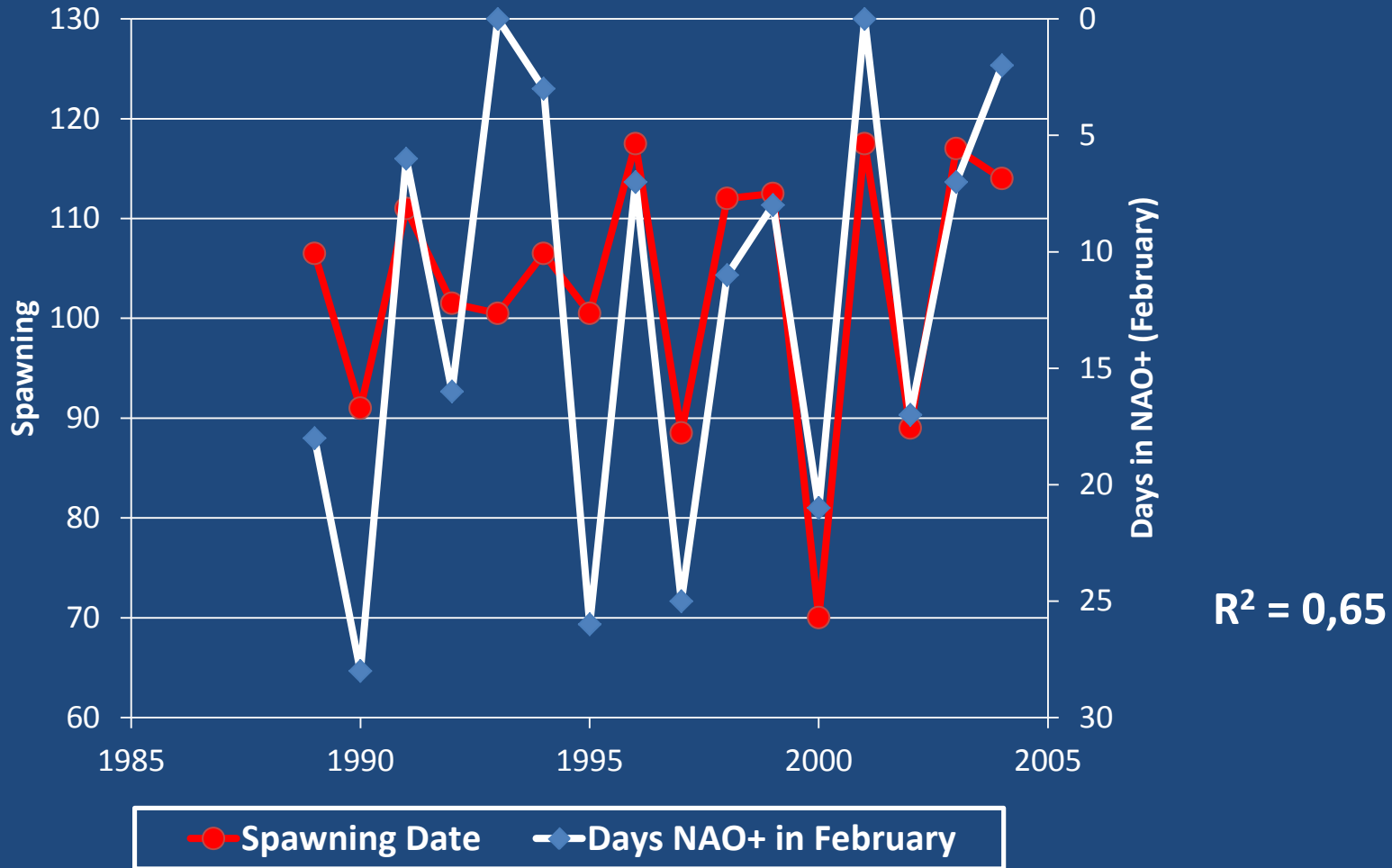
Spawning Date vs Temperature



A triggering temperature ?



Spring algal bloom...
under an adaptive
hypothesis ?



Spawning time is a very adaptive live traits.

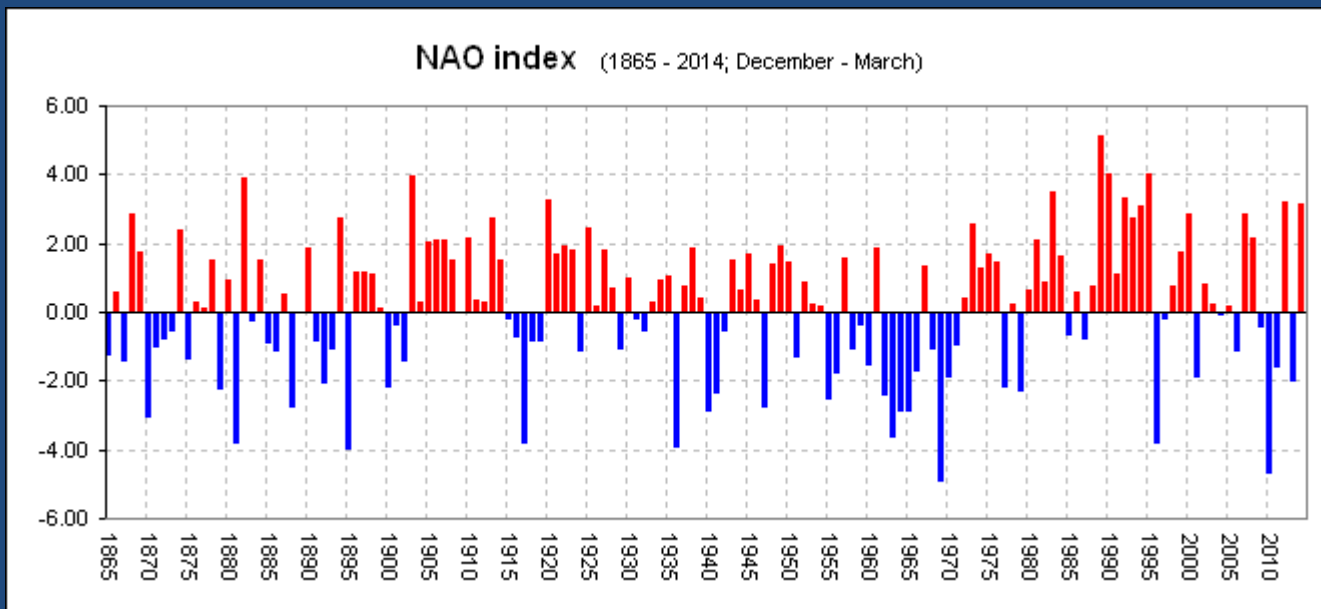
Rarely caused by a simple factors as it must integrate several constraints :

In phase with egg and sperm maturity (a gonadic processes initiated weeks and months before)

The best survival of the propagules in the marine medium

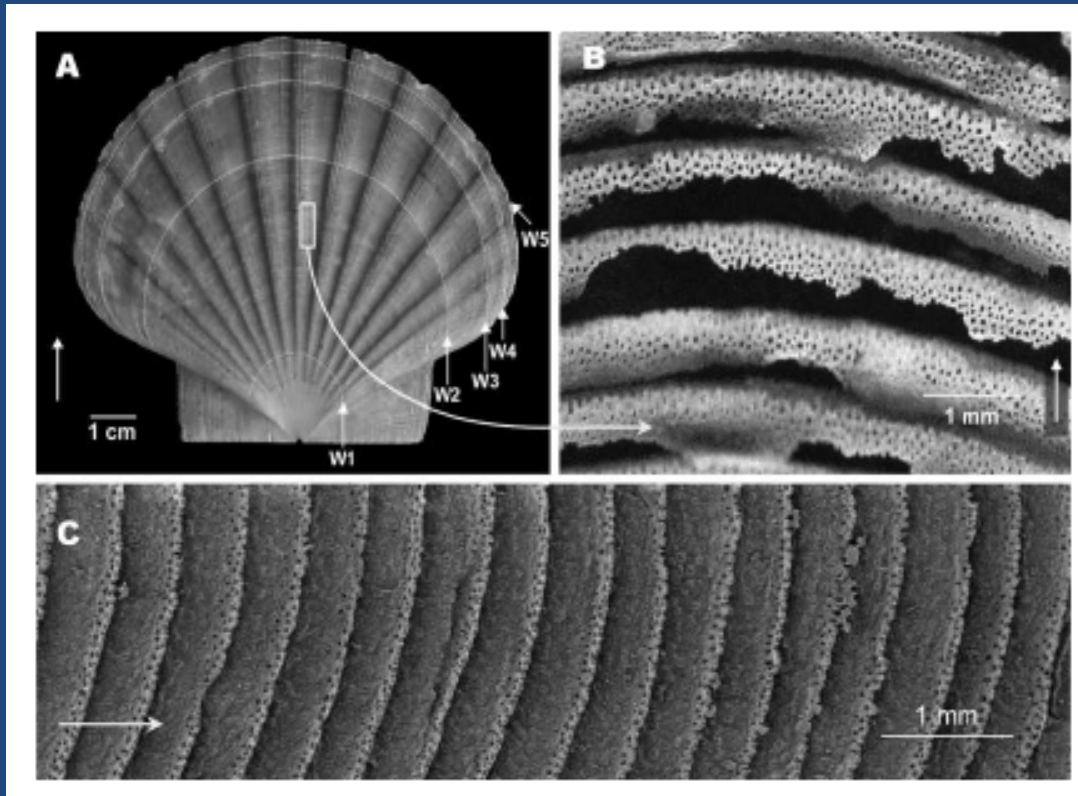
The best conditions for larval development (mainly food availability)

The best timing correspond to a general « atmosphere/ambiance » that weather regime at the basin scale seems the best « proxy ».

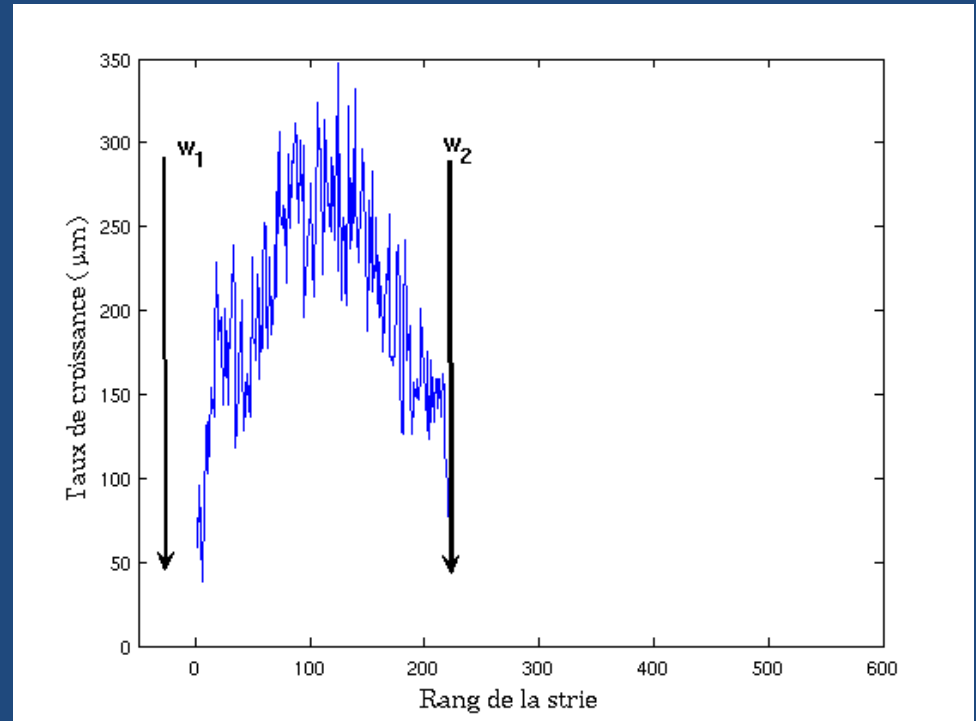
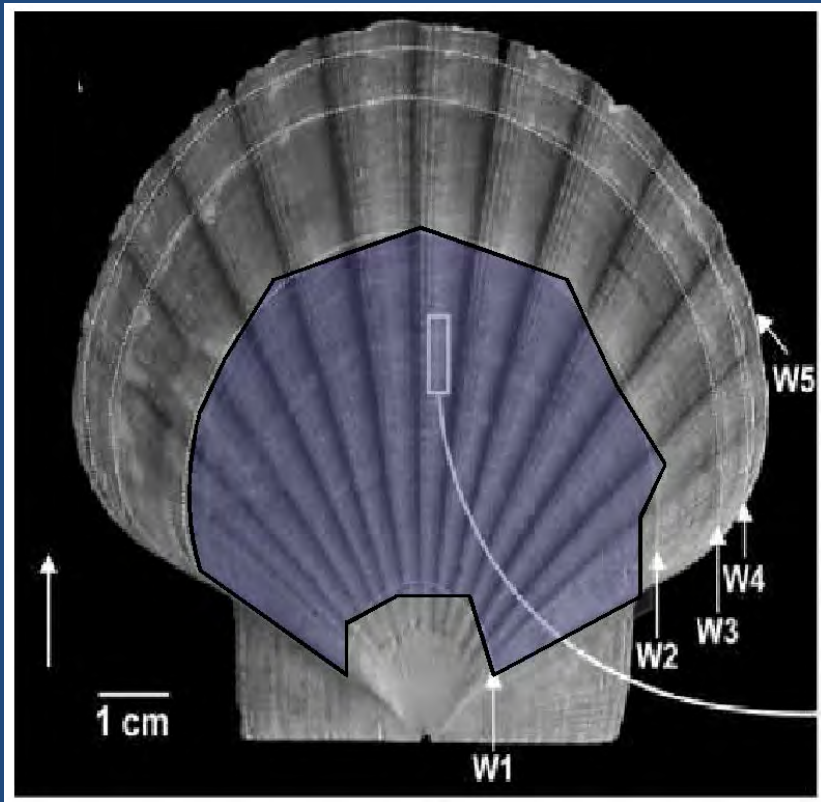


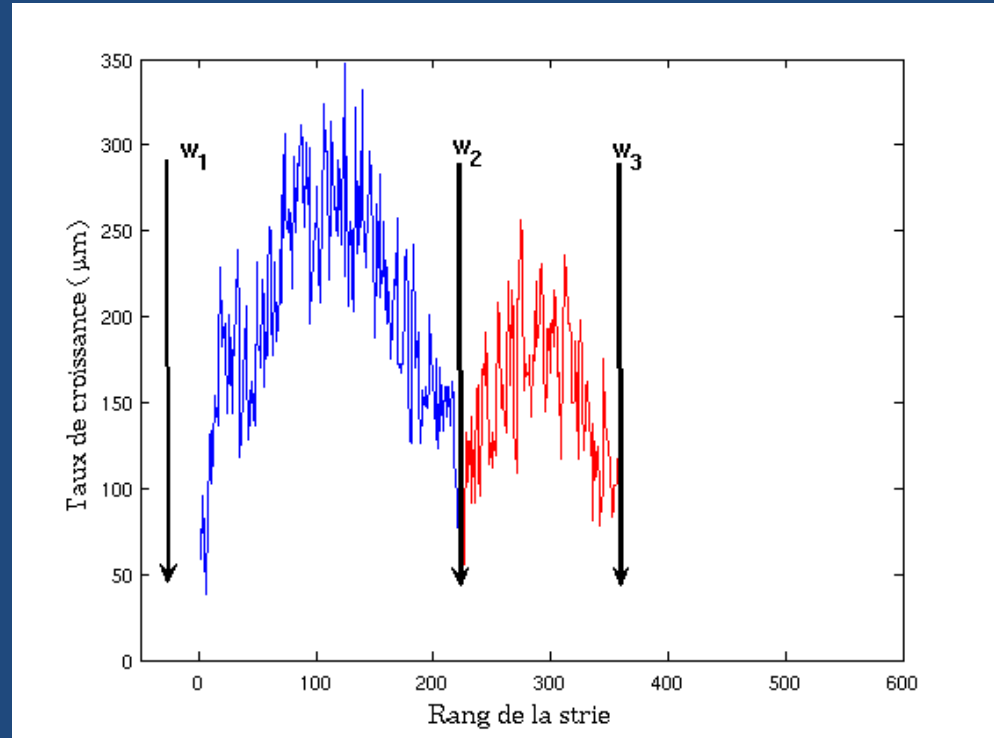
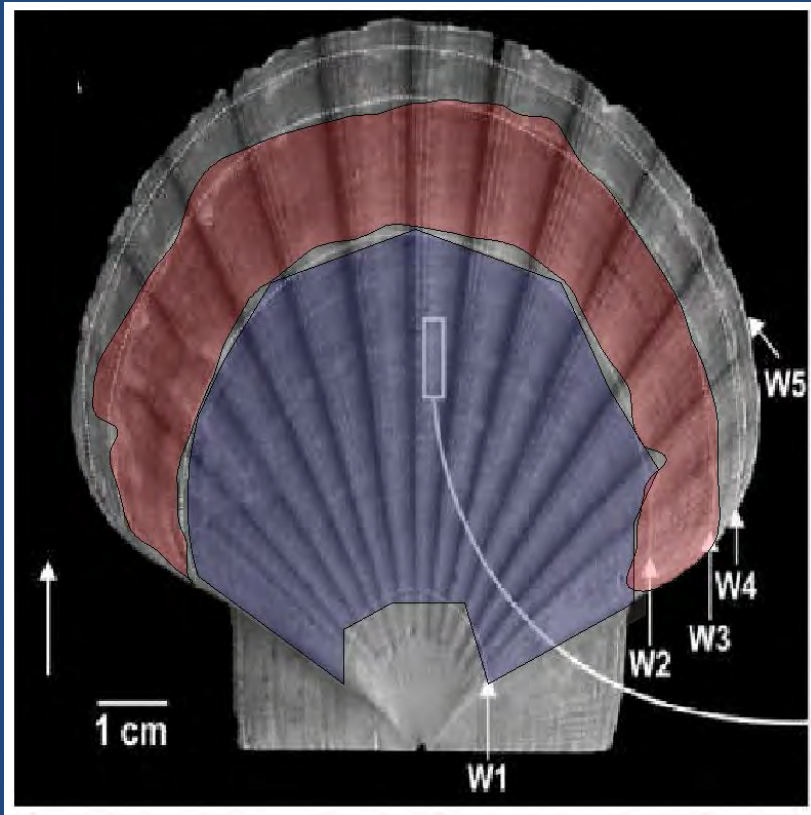
2. Growth

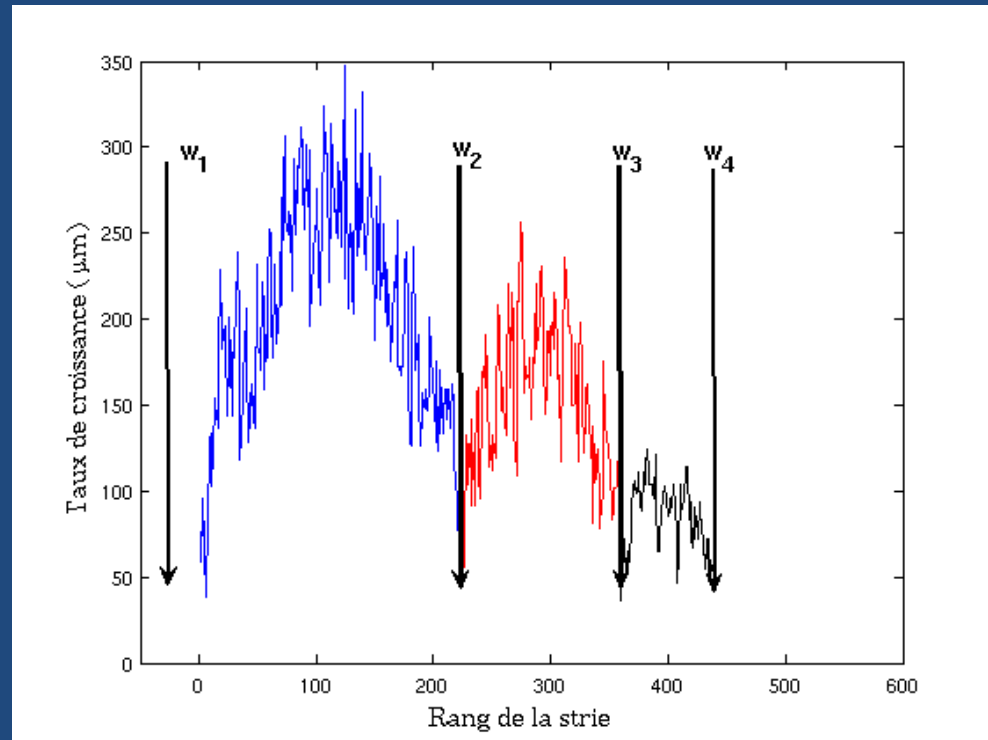
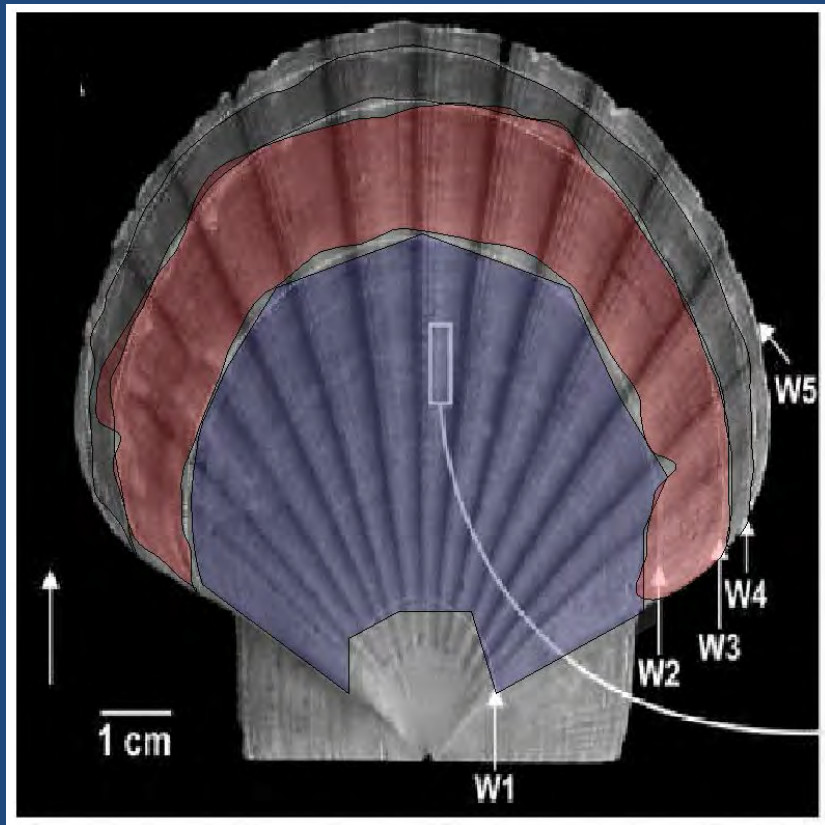
Scallops, an exceptional model to access daily growth



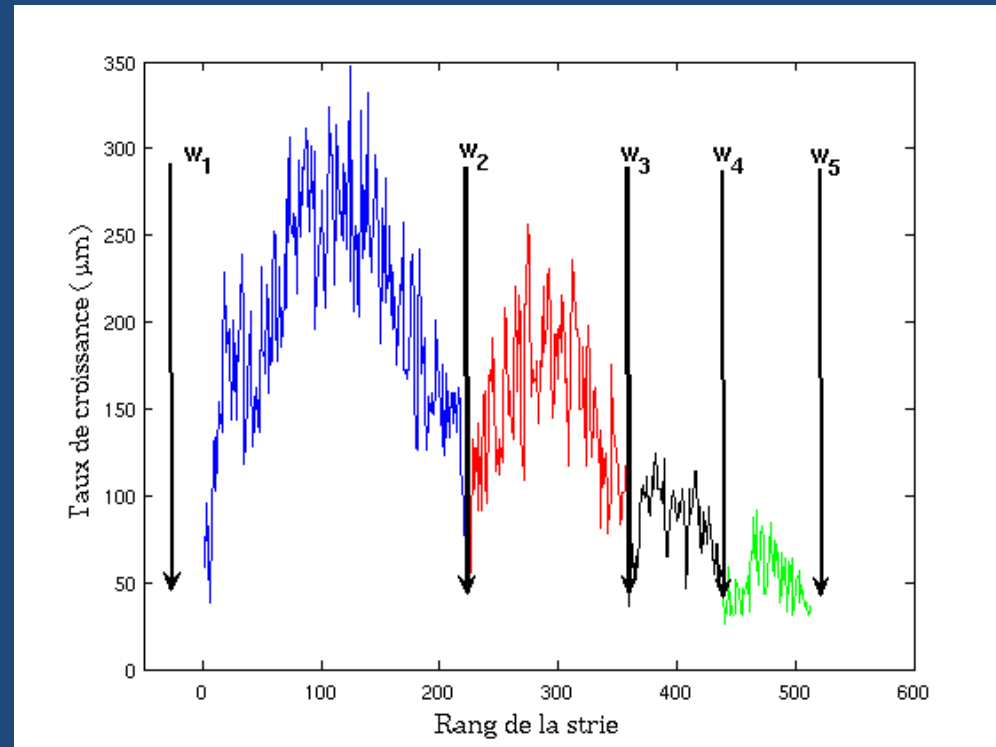
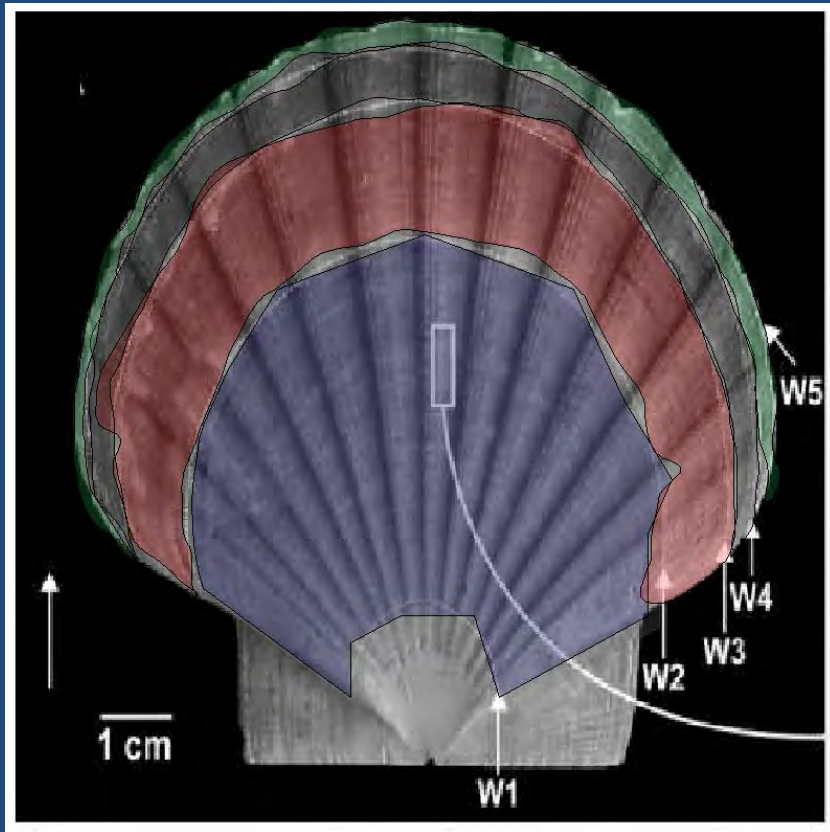
Outer surface of flat valve (left valve) of *Pecten maximus*. Winter marks are well defined, and using magnification some tiny daily striae appear (from Chauvaud *et al.*, 2005)







Effects of Climate Change on the World's Oceans - Santos City Brazil March 2015



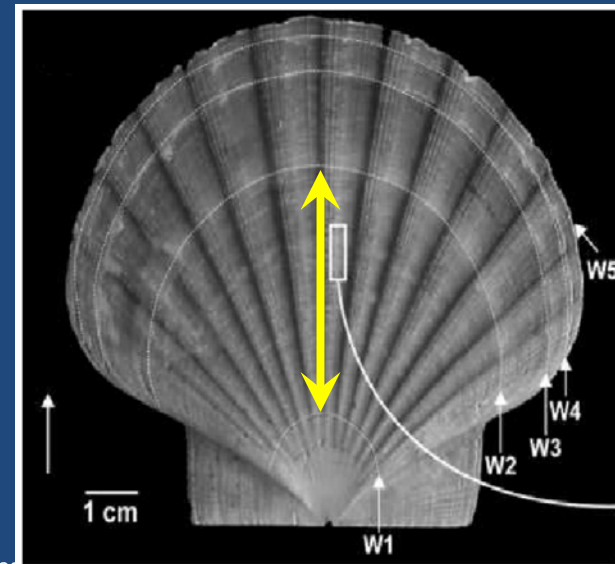
Effects of Climate Change on the World's Oceans - Santos City Brazil March 2015

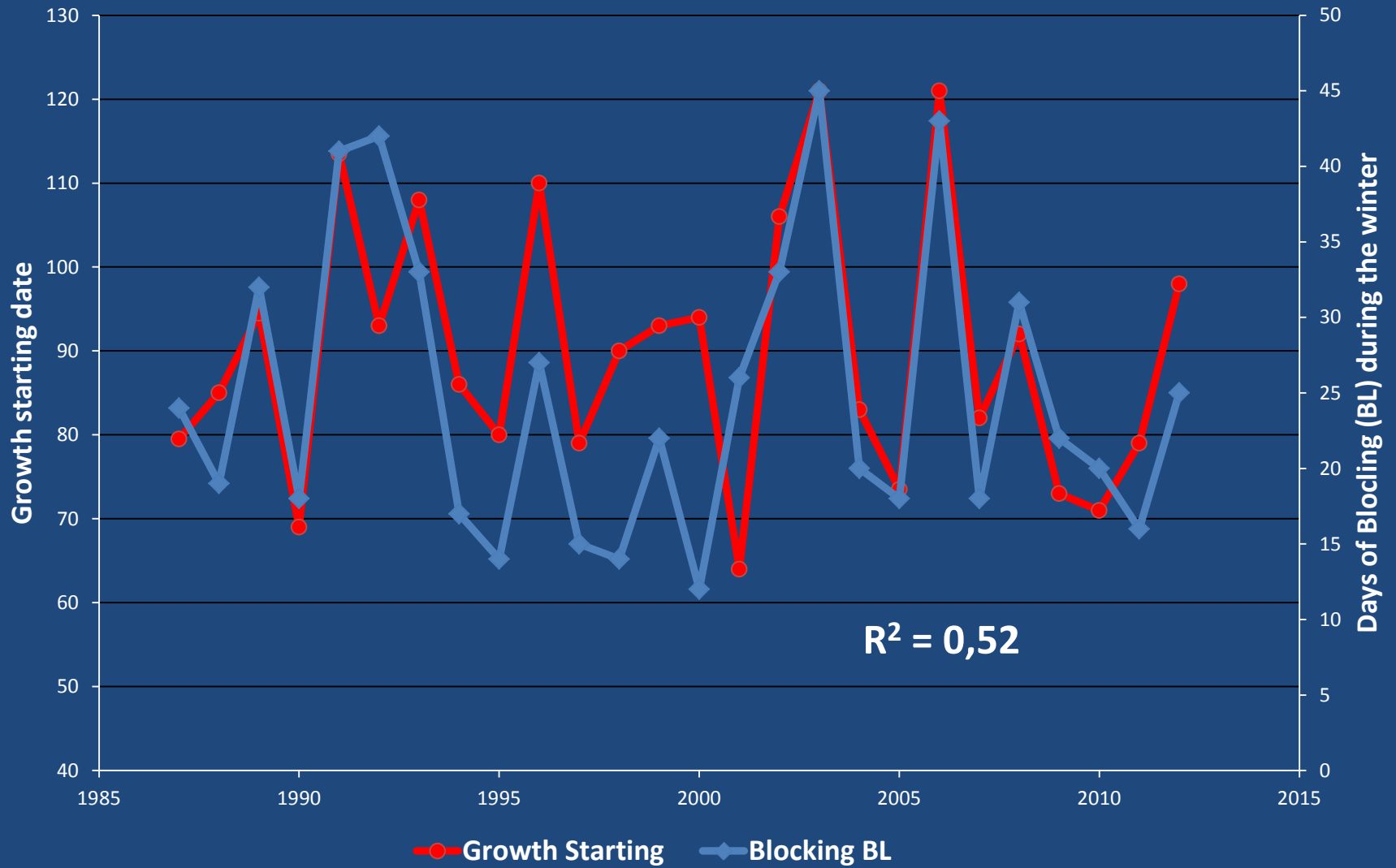
Growth descriptors retained :

Growth observed during the second year of life = between the first and the second winter.

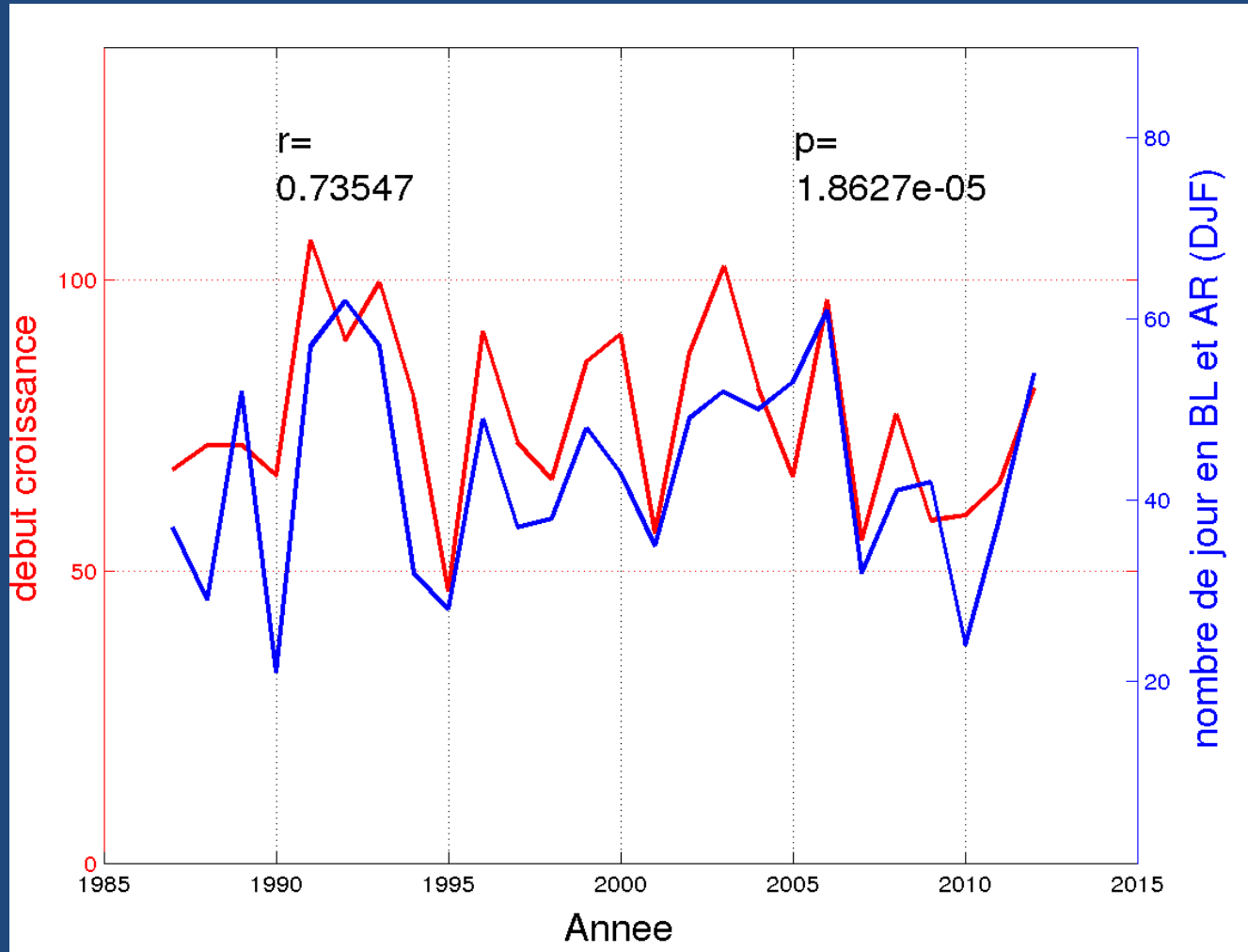
No or weak interference with reproduction process
A year of fast growing

- Date of Growth resumption occurrence
- Lasting (in day number per year) of the growth window period.

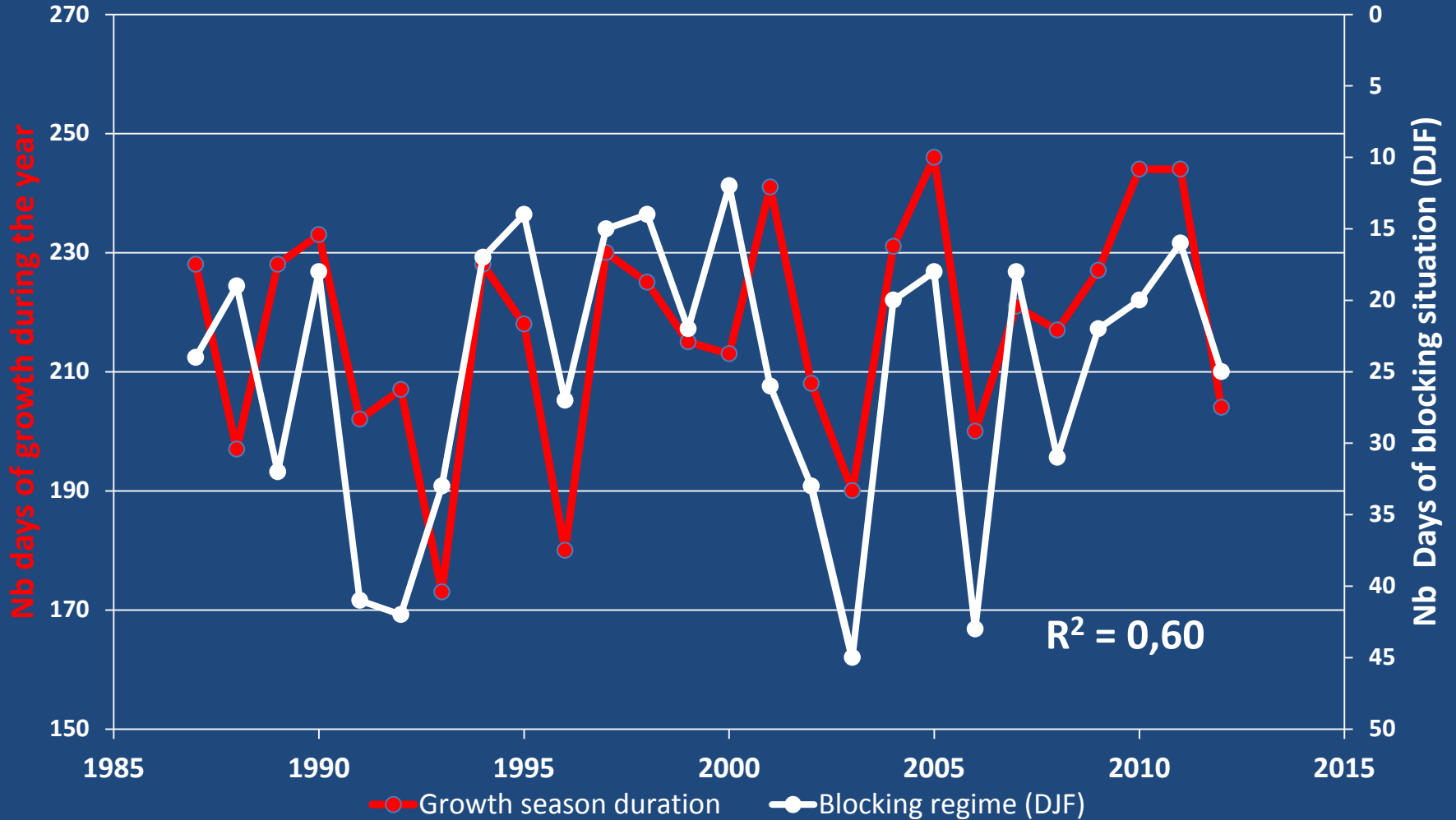




If we cumulate Blockage and Atlantic ridge, we significantly enhance the correlation level



Lasting of the annual growth period



Main outcomes

- Individuals of a population of bivalve (located in a middle position of their distribution area) show phenologic traits more related to a global « ambiance » change than to more local and isolated clues ;
- Spawning time is largely affected by weather regime in the North Atlantic. Thus spawning in the scallop is largely advanced in NAO+ situations (up to 50 days) ;
- Growth appears to respond also to weather regime through a modulation of the date of spring growth resumption. Consequently the yearly growth window can be affected by more than 30%.

Perspectives

Deepens studies using the scallop model that gives inestimable datas on reproductive and growth phenology ;

Integrate theses scientific advances in population models ;

Extend the work to populations at the south limits of the species distribution.



Muito obrigado !