Lecture # 1 : Zooplankton Behaviour

Scaling and Scales in Oceanography

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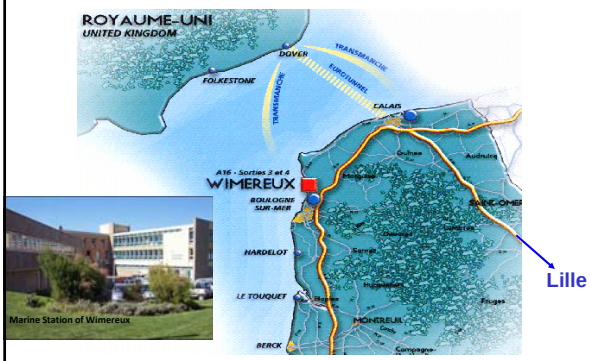


Introduction

Questions

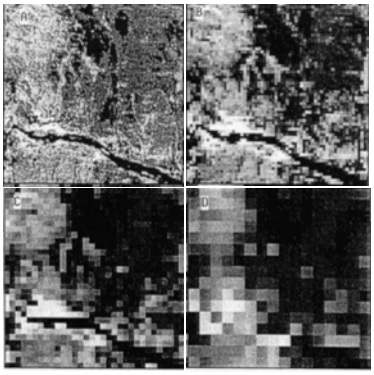
→ *How can-we define the notion of scale?*

The term 'scale ' is commonly used in the sens 'order of magnitude' for the observed units.

→ *Relations between 'scale' and ' discipline'?*

Each discipline can be characterized by a set of scales. For example ' Molecular Biology ' 'Biological Oceanography' and ' Paleontology' are not concerned by the same temporal scales.

→ *Relations between ' scale' and process?*



A problem of resolution

From Milne & Cohen (1999) Remote Sens. Environ. 70 :82-98

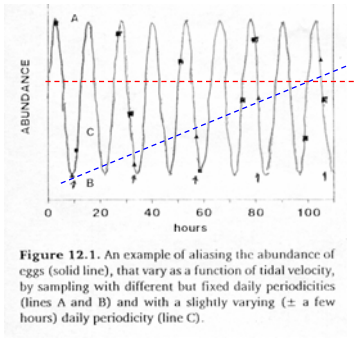


Figure 12.1. An example of aliasing the abundance of eggs (solid line), that vary as a function of tidal velocity, by sampling with different but fixed daily periodicities (lines A and B) and with a slightly varying (± a few hours) daily periodicity (line C).

One process is realized at a **real scale**

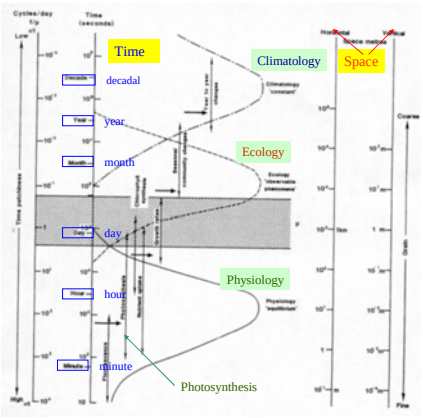
<==>

One process is **sampled** at a scale of observation

From Taggart & Frank (1989)

Un example: phytoplankton growth

Phytoplankton Ecology
Struture, function and fluctuation
Graham P. Harris
Chapman and Hall Ltd (1986)



Could we separate between all these scales?

In the ocean, could-we find clear frontiers between all processes: chemical-physical & biological?

According Haury *et al*. (1978) we can define:

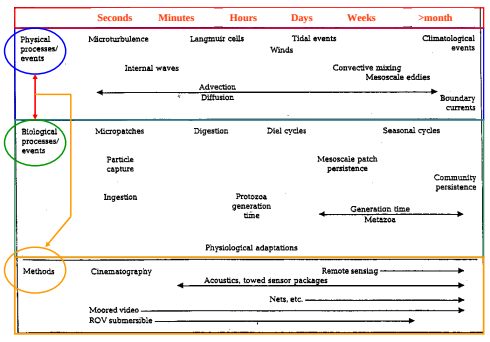
micro scale :	**1 cm -- 10 m**
Small scale :	**1 m -- 1 km**
Intermediate scale :	**100 m -- 100 km**
Meso scale :	**around 100 km**
macro scale :	**around 1000 km**
mega scale :	**around 10000 km**

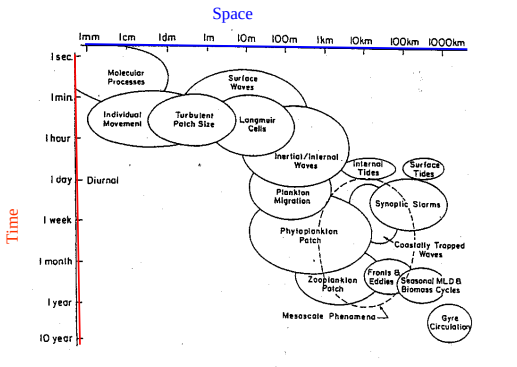
Size of planktonic organisms:

Picoplankton :	**0,2 -- 2 µm**
Nanoplankton :	**2 -- 20 µm**
Microplankton :	**20 -- 200 µm**
Mesoplankton :	**0,2 --20 mm**
Macroplankton :	**2 -- 20 cm**
Megaplankton :	**20 -- 200 cm**

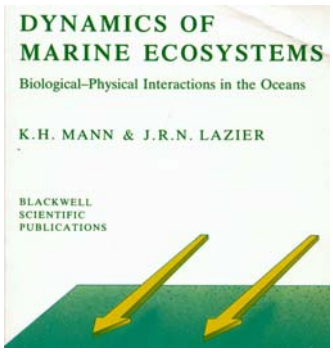
Bacteria
microplankton
Zooplankton
Nekton

Temporal scales and methods to study the principal interactions between physical processes (hydrodynamism) and the biological processes of zooplankton. From *Marine Zooplankton Colloquium I* (1989)





Schematic diagram representing spatial and temporal scales of bio-physical processes in the marine ecosystem. From *Dickey* (1991)



Process at a ascale:

A) < 1 km

Vertical structure

B) between 1 & 1000 km

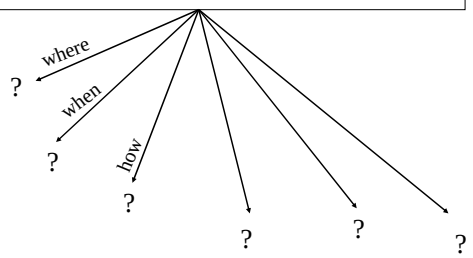
Tidal fronts

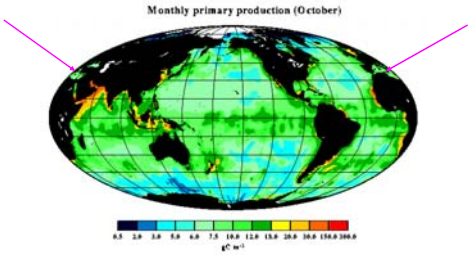
C) > 1000 km

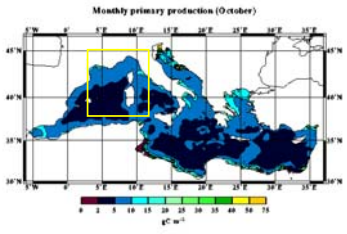
Ocean circulation

Exercice

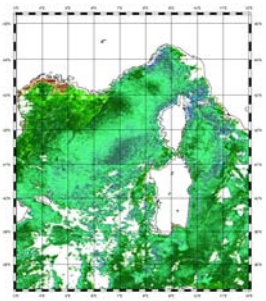
We would like to study the oceanic primary production



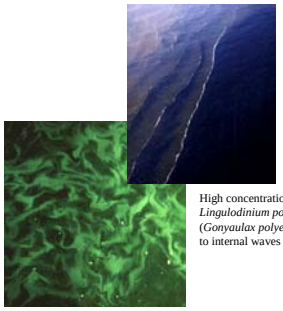




Map of chlorophyll in the western Mediterranean



Towards very small scales!!!!



High concentration of *Lingulodinium polyedrum* (*Gonyaulax polyedra*) due to internal waves

Accumulation of the production of *Noctiluca scintillans* in a geostrophic front

Bloom of *Anabaena flos-aquae*