Monitoring: the initial observing system

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- General Objectives
- 3 biogeographical areas
- Question of scales

Objectives

- **Provide operationally useful information on changes in the state of marine ecosystem.**

- Obtain from various sources relevant oceanographic and climatic data

- compile and analyse these data to describe the varying state of the ecosystem

- predict future states of the ecosystem on useful time scales

What is operational?

- the term 'operational' is used in the sense of being implemented widely and easily, using simple, inexpensive, standardised techniques operated automatically or by technicians rather then by scientists.

- Provide timely data for nowcast

Design considerations

- consider local objectives e.g. support to management, scientific activities, protection, fishery, ...

Particular objective of the Monitoring system

- A consequence of these efforts is the identification and implementation or development of more powerful and cost effective means for monitoring the marine ecosystem

- as well as more goal-oriented sampling strategies

The three biogeographical areas

Recognise the increasing heterogeneity of marine ecosystem from the open ocean to the shore (three biogeographical areas):

- **open ocean (basin or sub-basin),**
- **coastal ocean (large marine ecosystem scale)**
- **inshore (embayment or estuary scale)**

Considerations of scale

- **Temporal and spatial sampling frequency differs (e.g.) between coastal upwelling systems, boundary current systems, open seas, semi-enclosed seas**

- **It could be appropriate to define design principles for three nested monitoring systems**

Monitoring approach

- **Open ocean observations are minimalist, relying on ships of opportunity and remote sensing (important improvements are expected)**
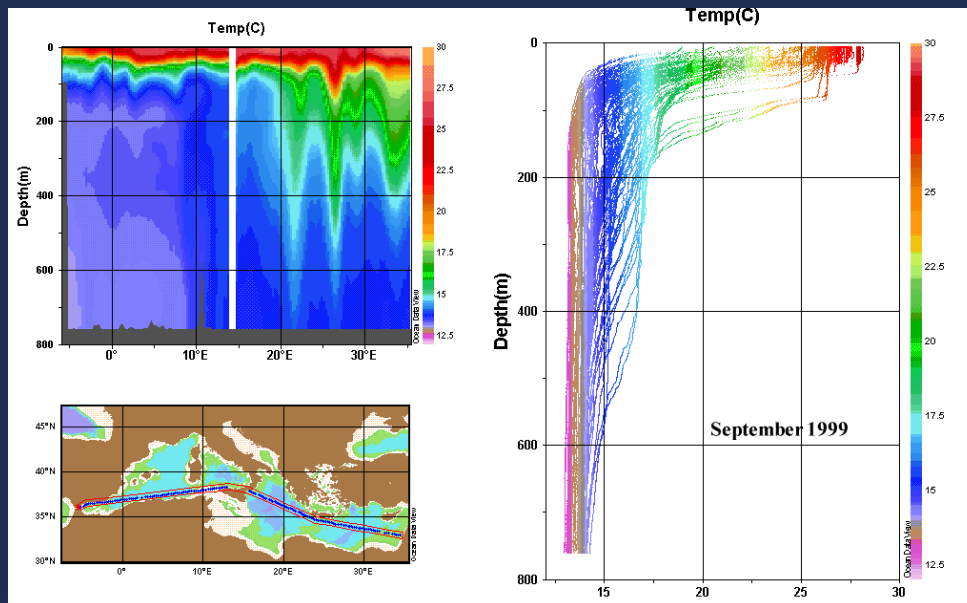
Monitoring approach

- **Coastal ocean observing system cannot be equal for all ecosystems and the design of specific observing plans are based on the knowledge of local scientists.**

Design considerations - Requirements

- **Identification of ecosystem components and conditions that should be monitored**

- **Prioritisation of elements to be observed**

- **Definition of sampling frequencies appropriate for the region**

- **Consideration of available and potential tools and opportunities**

Building the system

- **Monitoring system should evolve from existing observational programmes. Some of them can be identified as elements of the MedGOOS Initial Observing System.**

- **Others can contribute to the implementation of the global system as pilot projects.**

Requirements (An Example)
EU Directive 2000/60/EC - WFD

- **Contribute to pursuit of the objective of preserving, protecting and improving the quality of the environment (11)**

- **Environmental objectives for 'surface waters', 'transitional waters', 'coastal waters' : achieve the highest ecological and chemical status possible**

EU Directive 2000/60/EC - WFD - basic measures

- **Bathing Water Directive (76/160/EEC)**
- **Birds Directive (79/409/EEC)**
- **Drinking Water Directive (80/778/EEC) + (98/83/EC)**
- **Environmental Impact Assessment Directive (85/337/EEC)**
- **Sewage-Sludge Directive (86/278/EEC)**
- **Urban Waste-Water Treatment Directive (85/337/EEC)**
- **Nitrates Directive (91/676/EEC)**
- **Habitats Directive (92/43/EEC)**
- **Integrated Pollution Prevention Directive (96/61/EC)**

EU Directive 2000/60/EC - WFD - basic measures

- **The measurements required by Directives are including temperature, salinity, transparency, nutrients, microbacteria, heavy metals, …**

- **Some priorities must be defined for the development of an Initial Observing System**

- **Define the purpose of the programme**
- **Define the method of assessment in order to ensure the provision of appropriate information**
- **Define a limited number of parametres for the Initial Observing System)**
- **Choice the sampling locations**
- **Coordinate the national monitoring programmes**
- **Have common QC protocols**

Proposed objective of the Initial Observing System

- **Fill the gaps in knowledge of the spatial distribution and transport of nutrients and the effects on primary production**

- **Set a minimum number of parameters that will constitute the MedGOOS Initial Observing System**

- **Define additional parameters for each coastal area on the base of local requirements**

Can we prioritise from now the main themes of the initial system?

- **Water Quality is a good candidate?**

- **>> define local Water Quality indicators by using physical and chemical data (e.g. by means of the selection of the inter-related parameters)**

Proposed Basic Elements of the Initial Coastal Ocean Observing System

- **Phytoplankton**

- **Chemistry**

- **Hydrography**

- **Water samples**

- **ocean color**

- **Nutrients**

- **oxygen**

- **temperature**

- **salinity**

- **sea height**

- **coastal sea level**

Proposed Monitoring scheme

- **Satellite observations of boundary and frontal features on daily, weekly, seasonal and interannual scales**

- **Selected transects in 'key' areas at monthly or bimonthly time scales for oceanographic and chemical parameters**

- **Complementary biological information from seasonal surveys (more fitted to local problems).**
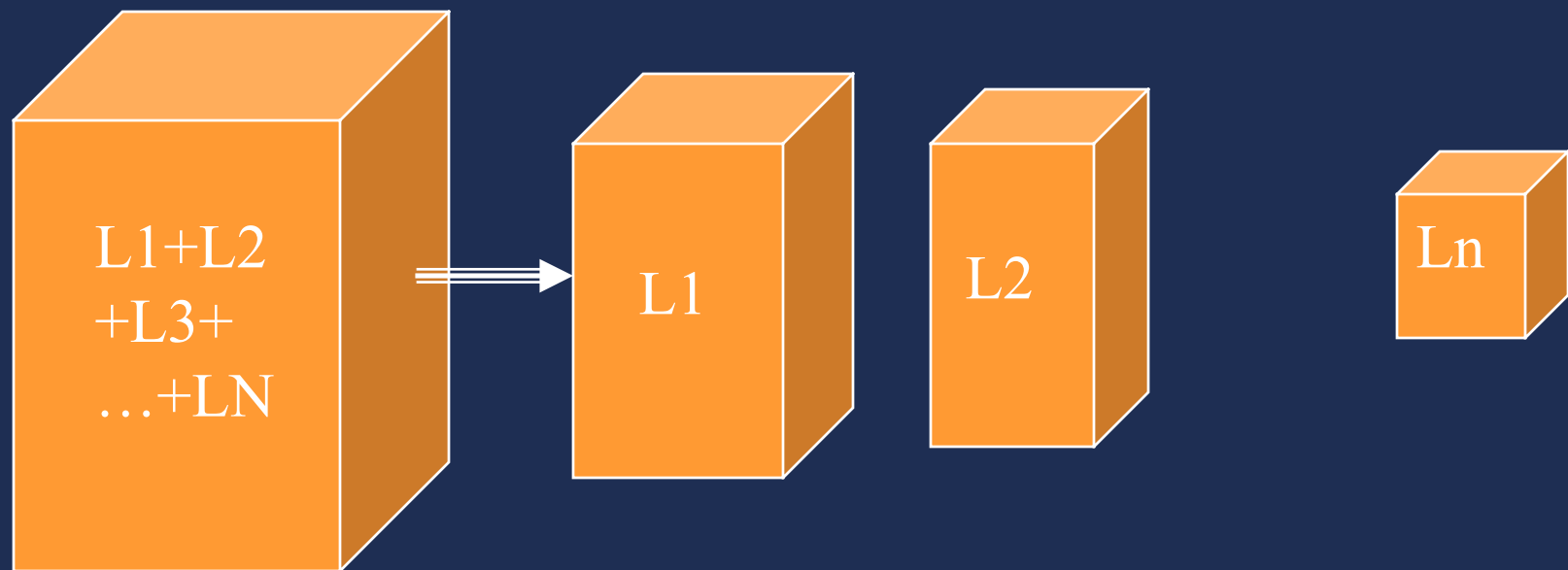
Testing the Initial Observing System

- **Diagnosis from models**
- **Retrospective analysis**

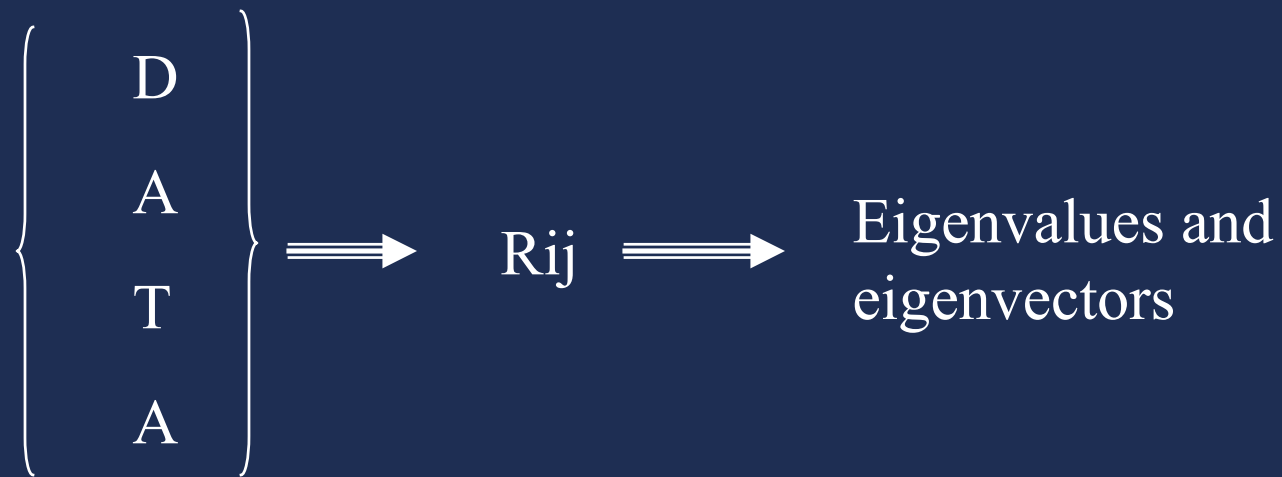- **Understanding the major scales**

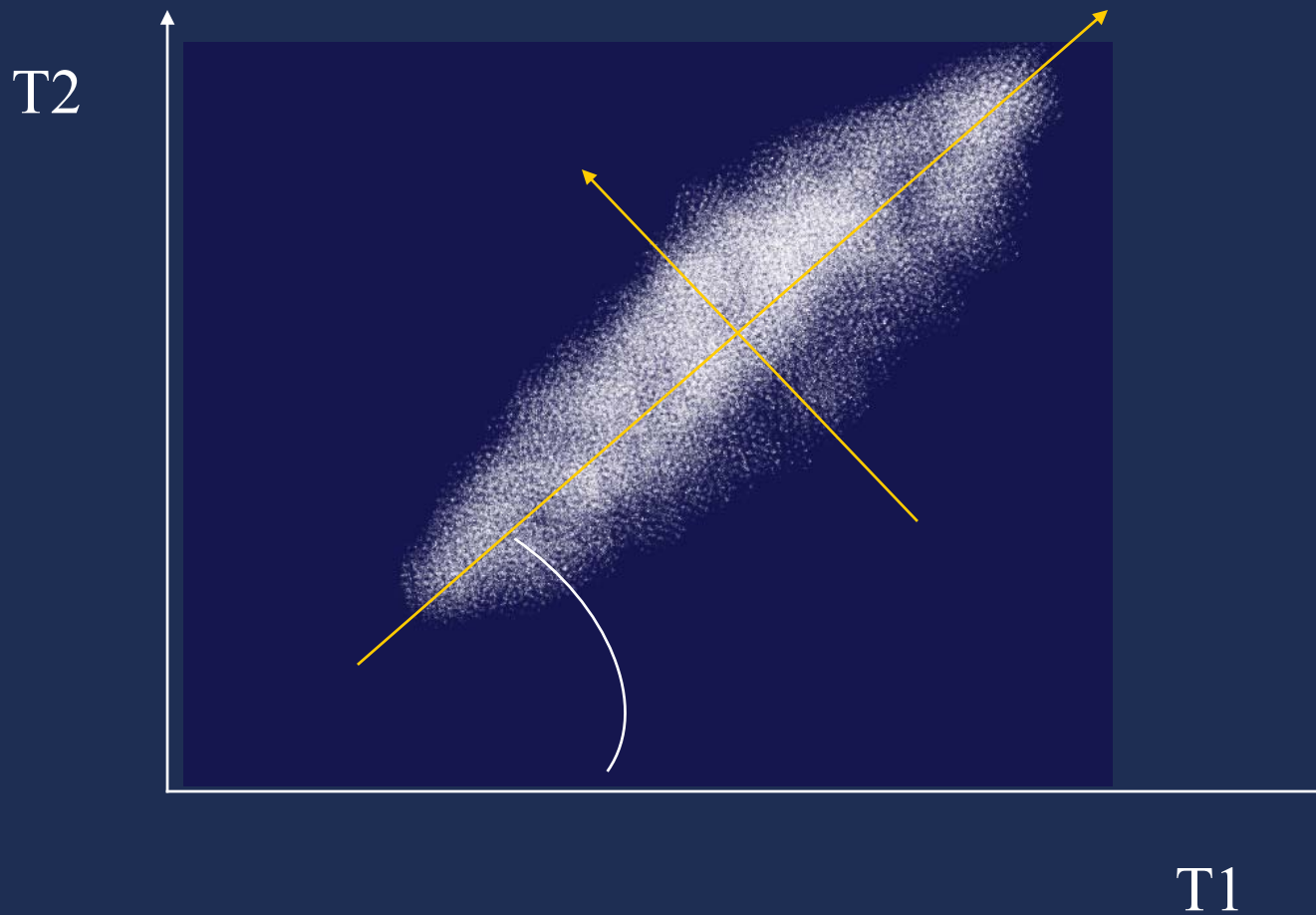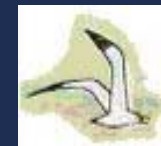# Question of scales

$$L1+L2+L3+ \ldots +LN \Rightarrow L1 \quad L2 \quad Ln$$

L1>L2>L3> … >LN   n<N

Extract scales from data

$$\left\{ \begin{array}{c} D \\ A \\ T \\ A \end{array} \right\} \implies R_{ij} \implies \text{Eigenvalues and eigenvectors}$$

Extract scales from data

Different modes

Different modes

$$\begin{bmatrix} T_{i,j} \\ S_{i,j} \end{bmatrix} \longrightarrow \begin{Bmatrix} T_{i,j} \end{Bmatrix}$$

$$\longrightarrow \begin{Bmatrix} S_{i,j} \end{Bmatrix}$$
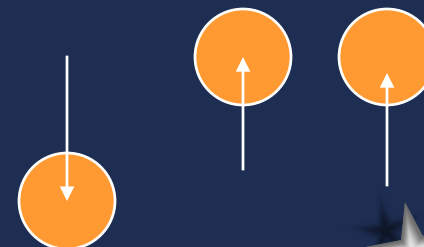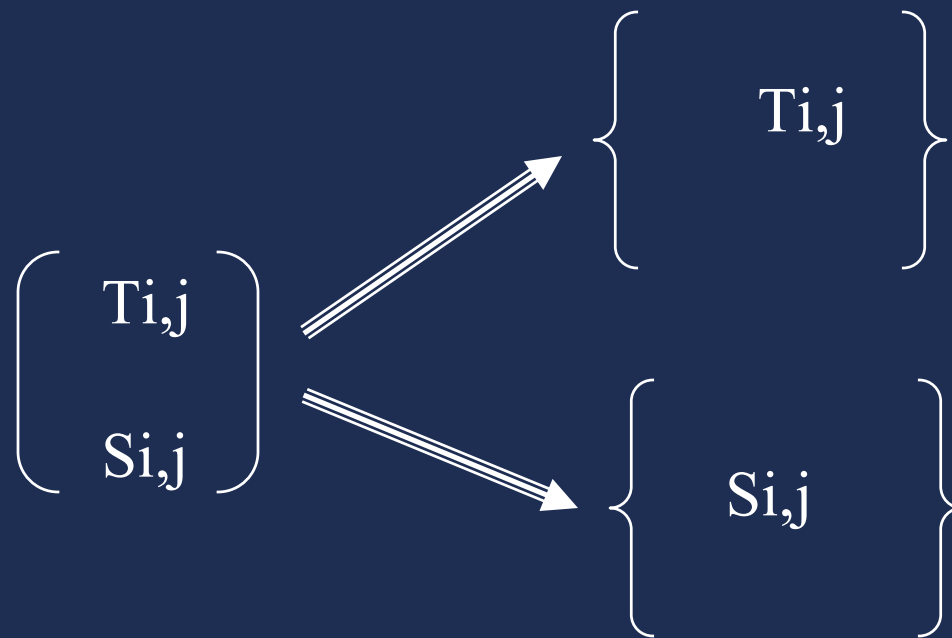
Results from decomposition

- Extract stations not significant in the representation of investigated phenomena

- Definition of along- and cross- shelf scales (by e.g. Fourier analysis)