# The French Alpine Lakes Observatory (ALO): a tool for assessing the effects of the global change on lake ecology

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SPECIAL SESSION « **Assessing the impacts of global change and anthropogenic pressures on freshwater ecosystems, a role for long term-ecological research.**

# The French Alpine Lakes Observatory (ALO): a tool for assessing the effects of global change on lake ecology.

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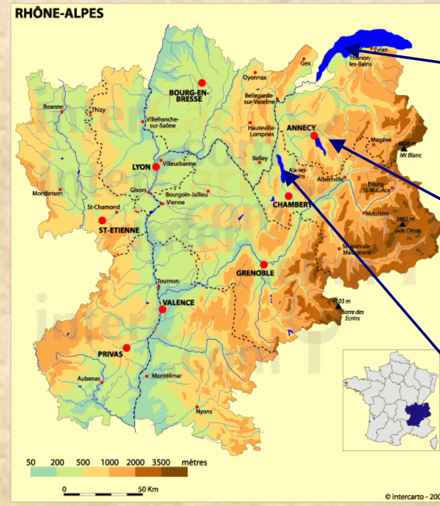
# The Alpine Lakes Observatory

- French part of the Alps
- 3 lakes







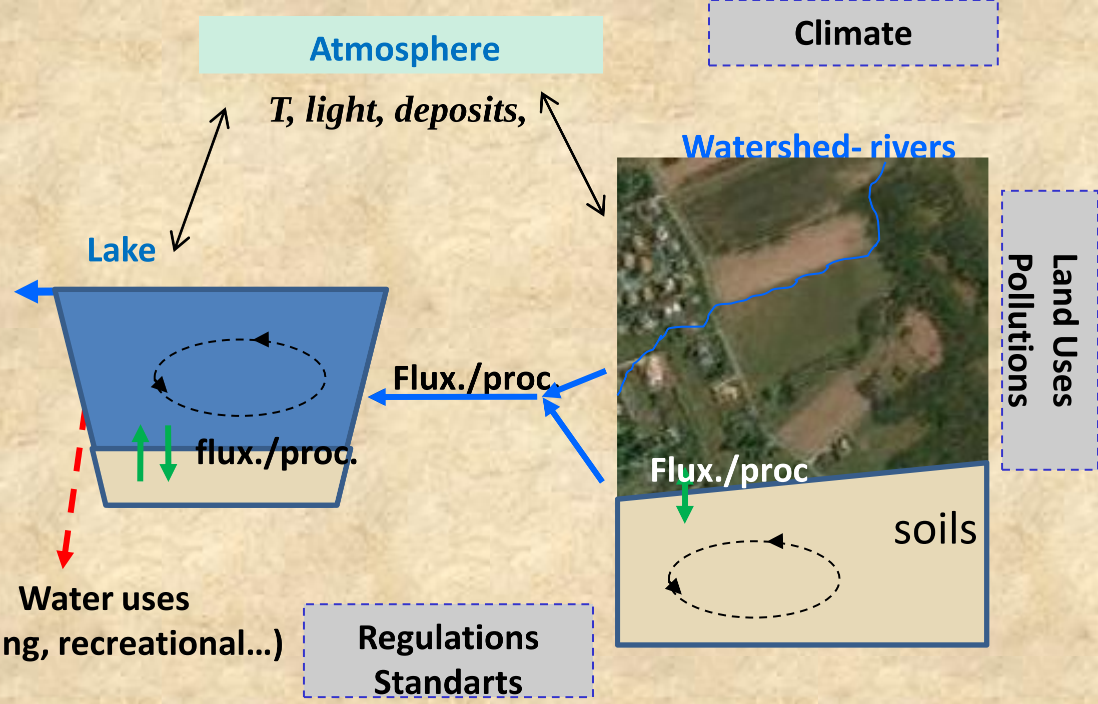
| LAC | Volume (km3) | Temps de séjour (an) | Profondeur max (m) | Surface BV ($km^2$) |
|---|---|---|---|---|
| LEMAN | 89 | 12 | 310 | 7395 |
| BOURGET | 3,6 | 8,5 | 145 | 560 |
| ANNECY | 1,12 | 3,8 | 82 | 251 |

**OBJECTIVES**

**« Scrutinizing, understanding and modelling the trajectories and the ecological mechanisms controling the lake systems exposed to changes in anthropic and climatic pressures, at a 10 years time steps ».**

# The ALO

- ***3 Sub systems and specific functionnings***
- ***Fluxes and internal exchanges***
- ***External drivers***




- Long term surveys (state variables)
- Biological and physicochemical processes controling water quality and productivity
- Ecological trends
- Global change consequences

**Long-term Limnology**

> 10 years

**ALO**

**Short and mid term processes**

- Functional ecology
- Fluxes assessment
- Trophic functionning and biodiversity

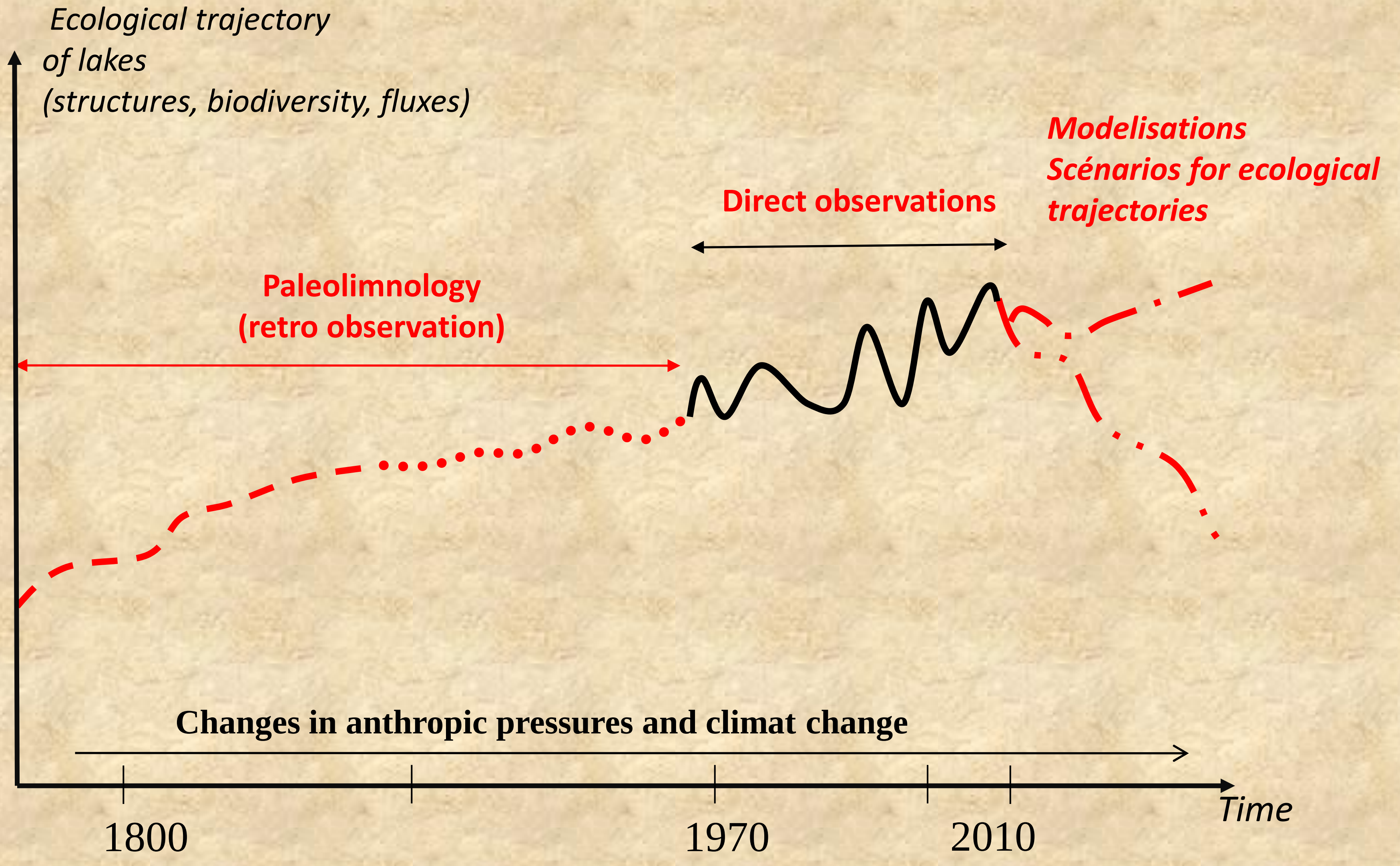
1< < 10 years

**Associated projects**

- small mountain lakes
- BPC ecodynamic

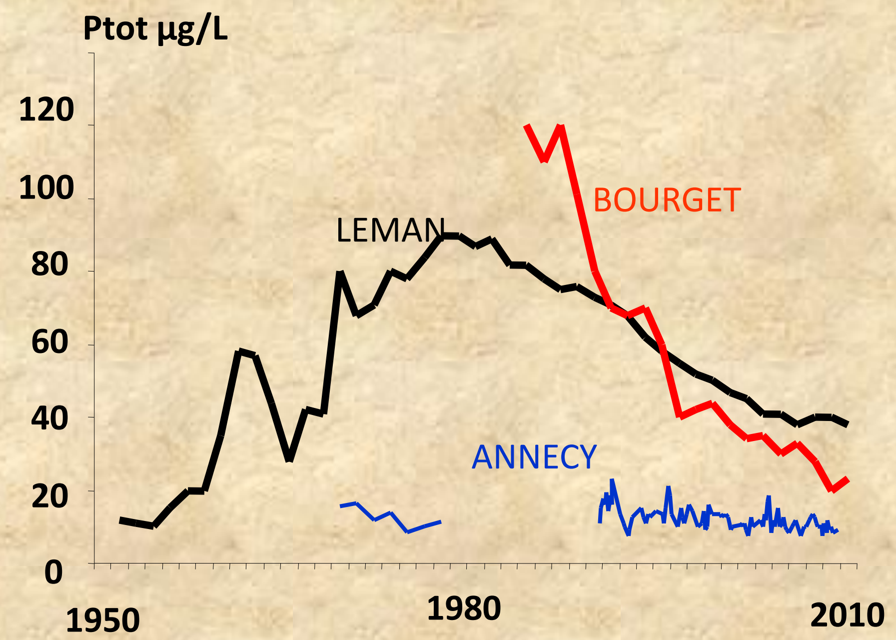
- Scientific knowledge
- Tools for lake managers

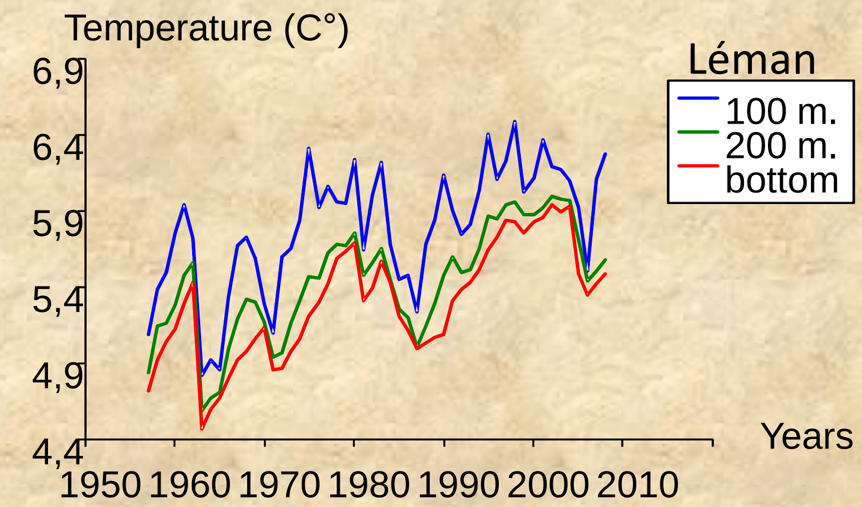
# 1/ Long term observations

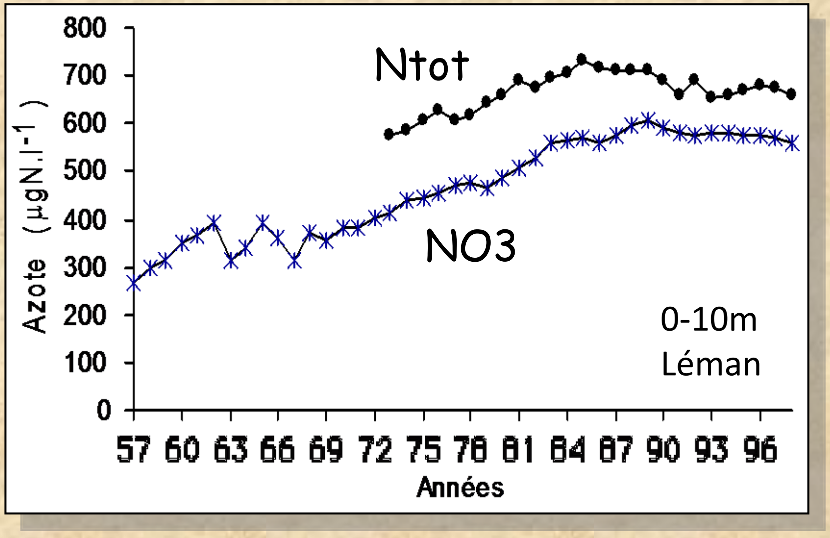


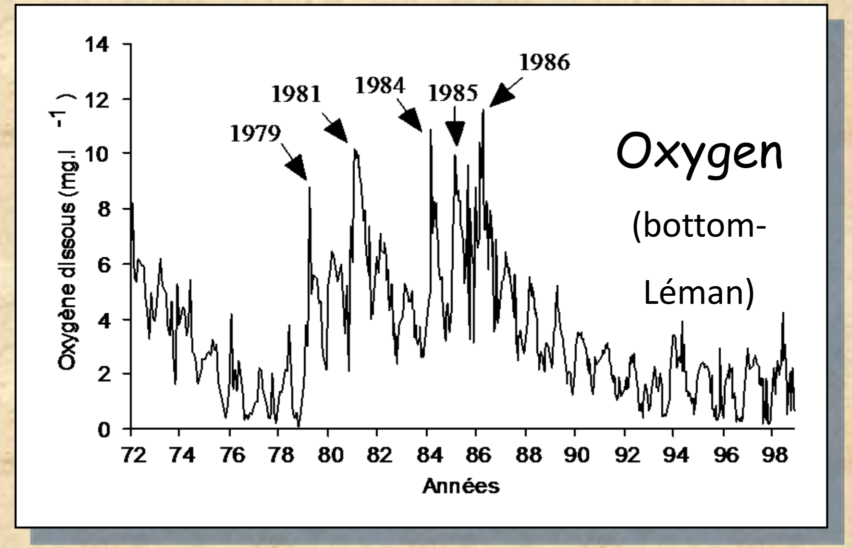
# 1/ Long term observations: the global physico-chemical changes

Anneville 2010, pers com



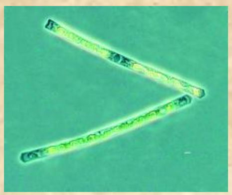



# 1/ Long term observations: trophic network dynamics (Leman)

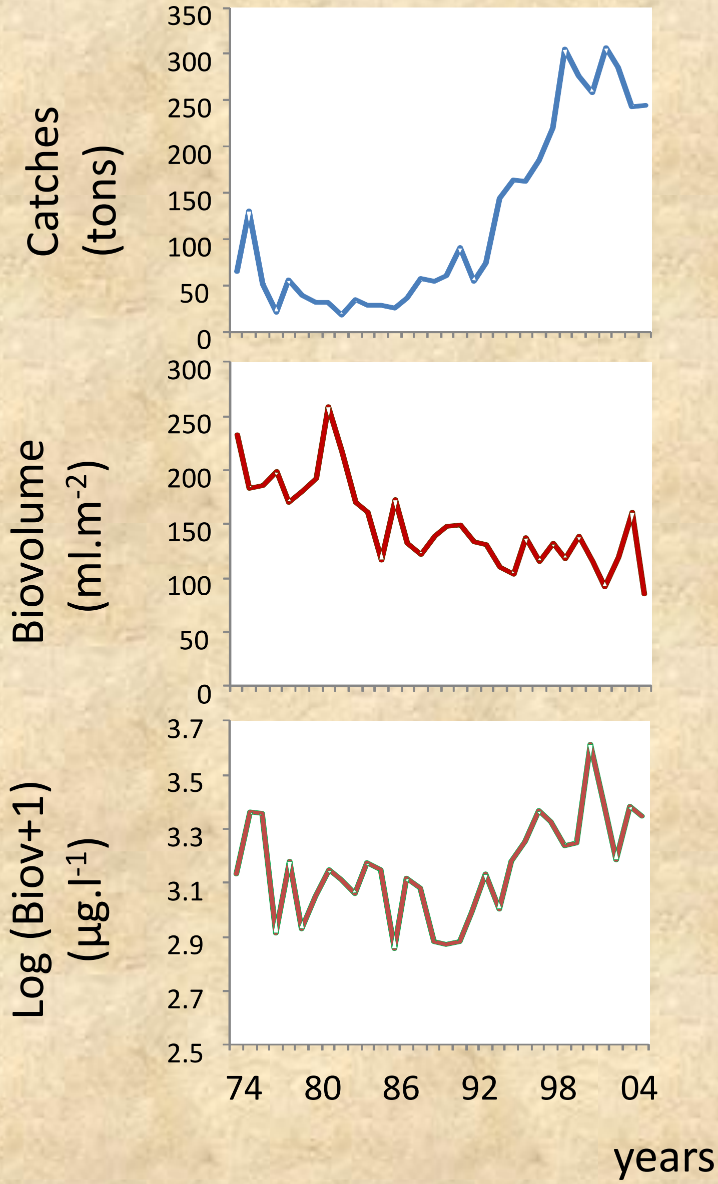
Anneville 2010, pers com

Whitefish

Zooplankton



Phytoplankton




Increasing predation

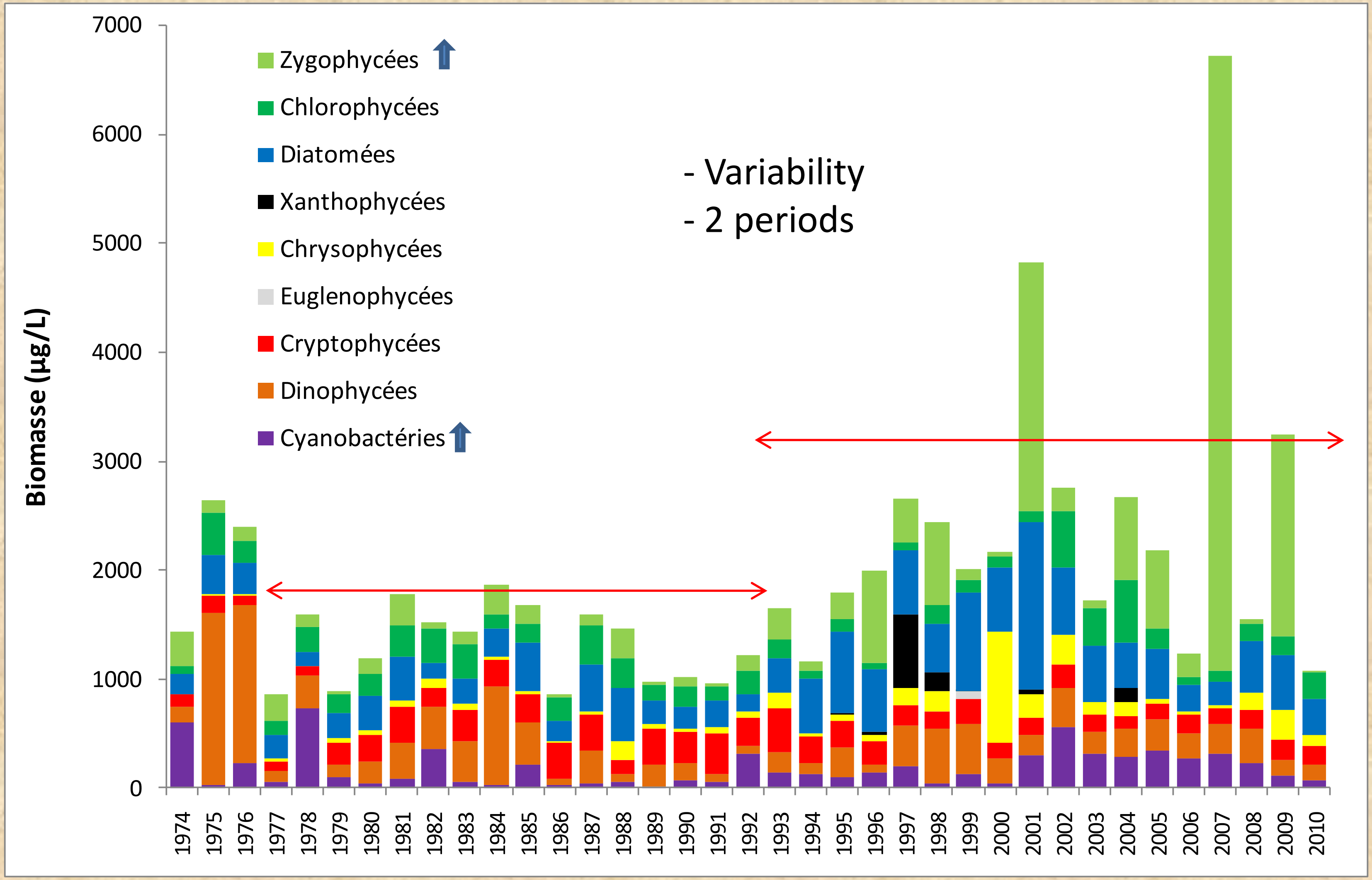
Decreasing ZoopK biomass

increasing PhytopK biomass

→ **Long-term changes in the functionning of the pelagic communities**

# 1/ Long term observations: algae diversity

Anneville 2010, pers com




→ **Long-term changes in the diversity of planctonic communities**

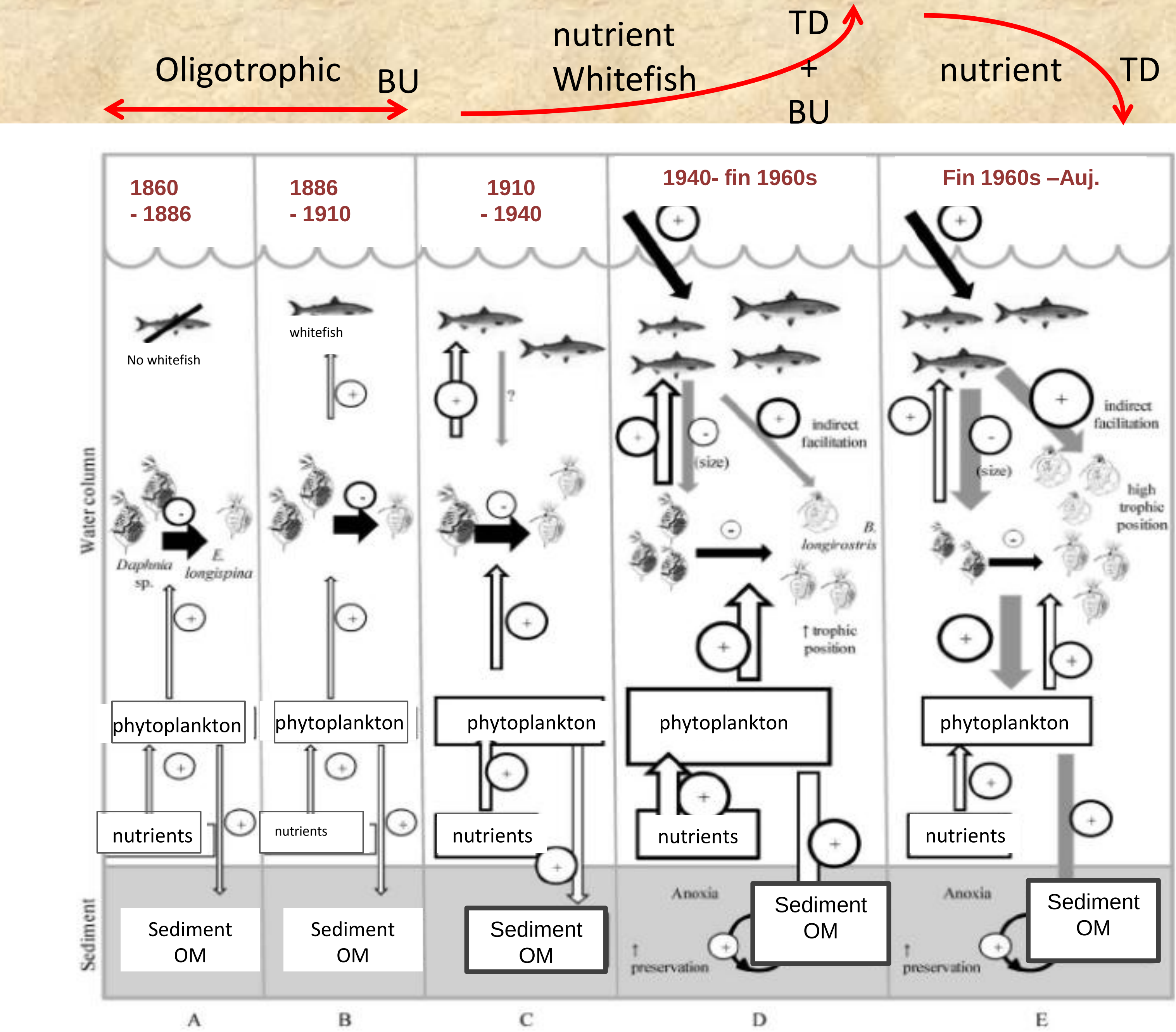
# 1/ Long term observations: Paleolimnology

Perga M-E, 2010, Limnol Oceanogr.

**Study of sediment cores:**
**- Macro remains of organisms**
**- Preserved macro-molecules (pigments)**
**- Isotopic characteristics of remains and OM ($^{13}C$ and $^{15}N$)**

**150 years of bottom-up and top-down response of trophic network (Lake Annecy)**

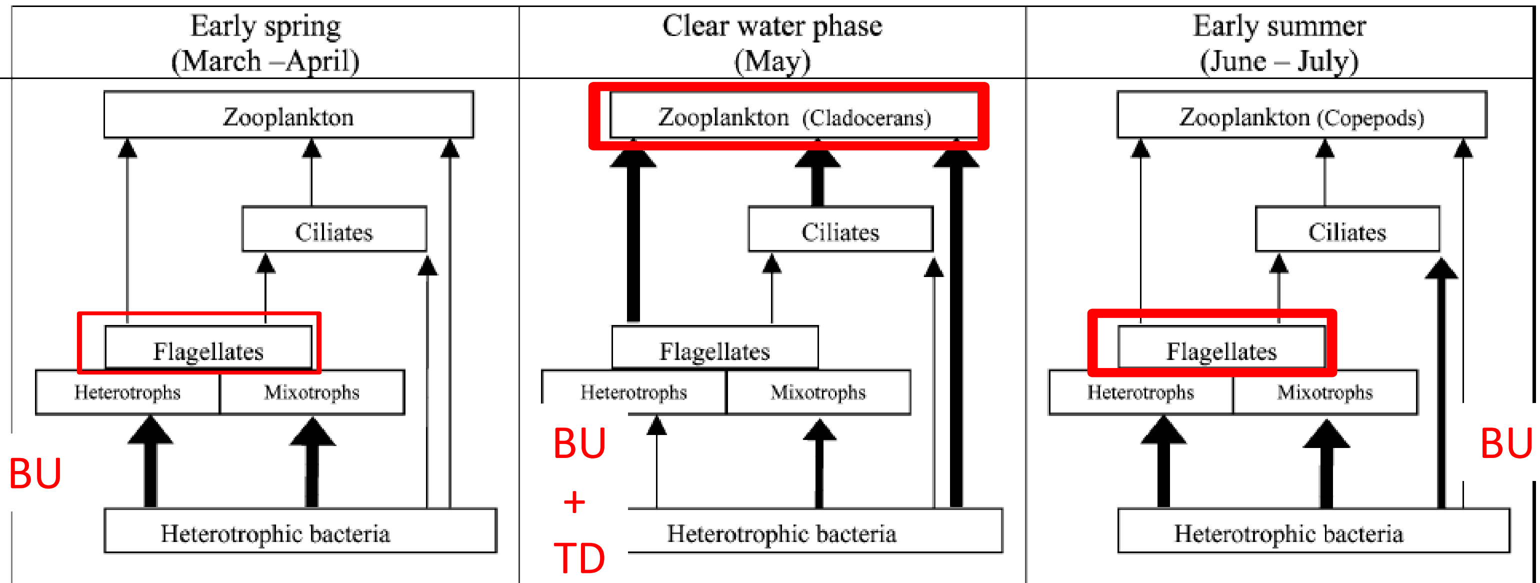
**Conceptual model on changes of trophic network**



# 2/ Short term observations: microbial loop changes (Le Bourget)

Domaizon & Comte , 2006

Conceptual scheme for upper layers (2, 6, 10 m depth)




| | Early spring (March –April) | Clear water phase (May) | Early summer (June – July) |
|---|---|---|---|
| [Chlorophyll *a*] | Peak on 2 April (2m) | Low values | Increase - peak on 3 July (6m) |
| [Heterotrophic Bacteria] | moderate values | Increase | high values |
| [Bacterial Filaments] | Peak on 22 April | Low values | Peak on 19 June |
| Bacterial groups proportion | Dominance of CF | Dominance of CF | Increase of α and β proteobacteria |
| % FDC (bacterial production) | highest values | lowest values | low values |
| Protozoan grazing | - Moderate to high flagellates grazing rates<br>- Low ciliates grazing impact | - Mainly mixotrophic flagellates predation<br>- Low ciliates and heterotrophic flagellates grazing impact | peak on 3 july<br>- Highest flagellates grazing rates<br>- Large increase in ciliates predation |
| Regulation pressure<br>*TD : Top Down control*<br>*BU : Bottom Up control* | Bacteria regulation : mainly BU (grazing rates lower than bacterial production)<br>Protozoan regulation : mainly BU, especially during April | Bacteria regulation : probably simultaneous BU control and TD control due to metazooplankton<br>Protozoan regulation : mainly TD | Bacteria regulation : mainly BU control although high protozoan predation<br>Protozoan regulation : mainly BU for flagellates (2 and 6m) and ciliates<br>Mainly predation for flagellates at 10m |

**High Predation pressure**

**Main C transfer pathway**

Conclusions:
- ALO has a large database (public access)
- long and short term studies
- paleolimnology and ecological trajectories
- drivers of changes in lake status : fish stocking, phosphorus


http://www.dijon.inra.fr/thonon

http://www.dijon.inra.fr/thonon/l_observatoire

Thank you for attention