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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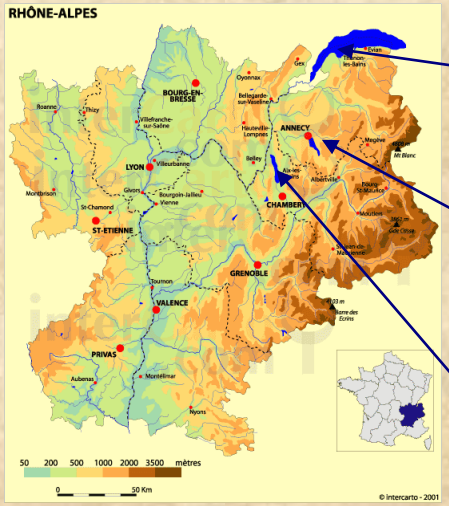
The Alpine Lakes Observatory

- French part of the Alps
- 3 lakes



LAC	Volume (km3)	Temps de séjour (an)	Profondeur max (m)	Surface BV (km²)
LEMAN	89	12	310	7395
BOURGET	3,6	8,5	145	560
ANNECY	1,12	3,8	82	251

OBJECTIVES

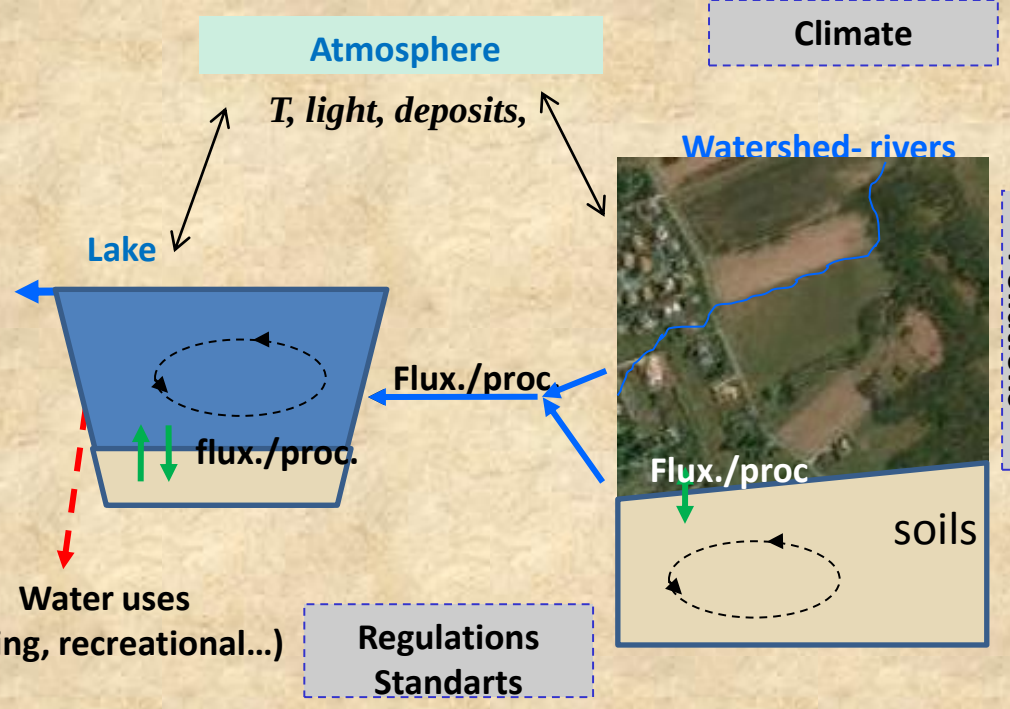
« Scrutinizing, understanding and modelling the trajectories and the ecological mechanisms controling the lake systems exposed to changes in anthropic and climatic pressures, at a 10 years time steps ».

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

- Functional ecology
- Fluxes assessment
- Trophic functionning and biodiversity

ALO

Short and mid term processes

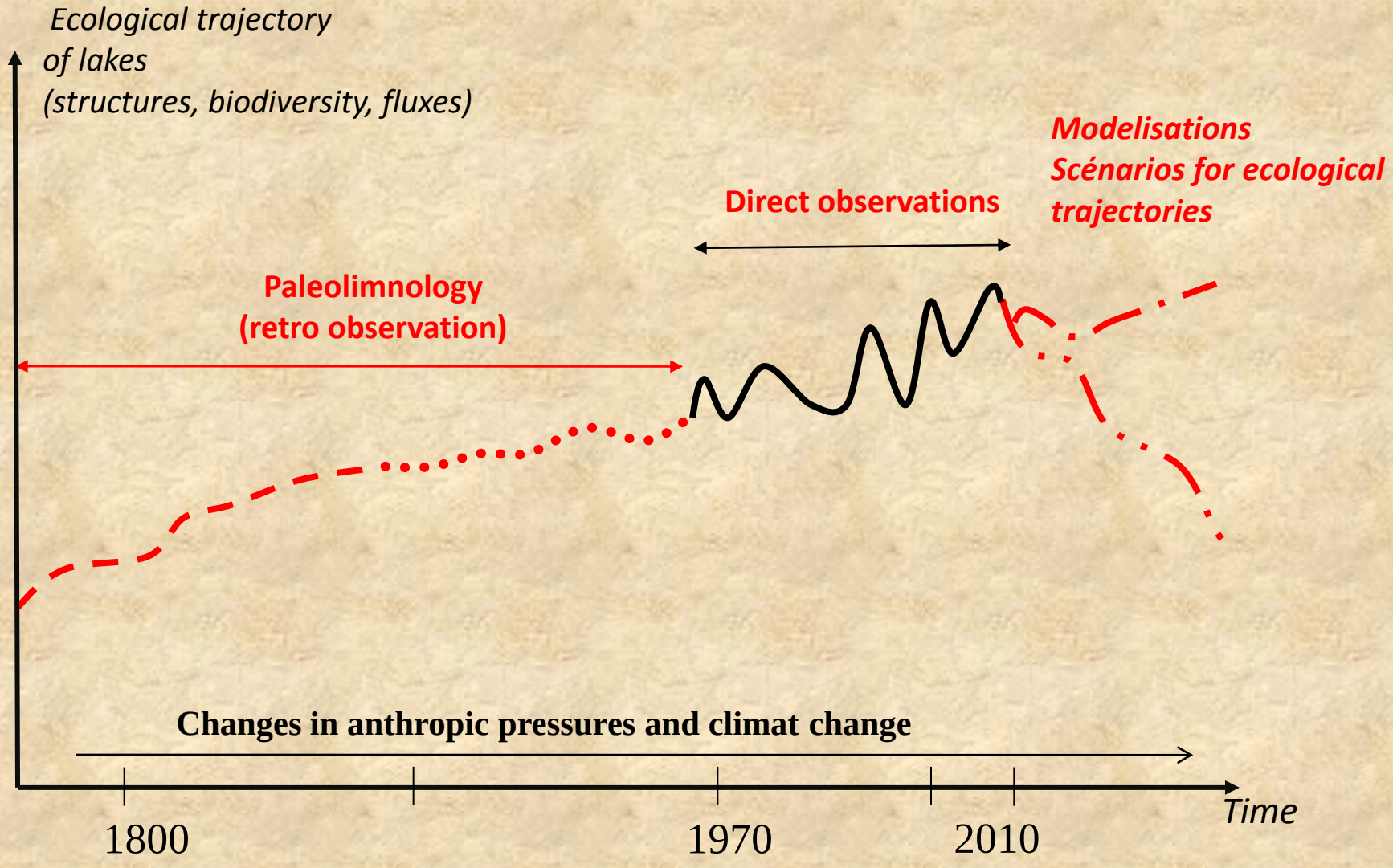
1< < 10 years

Associated projects

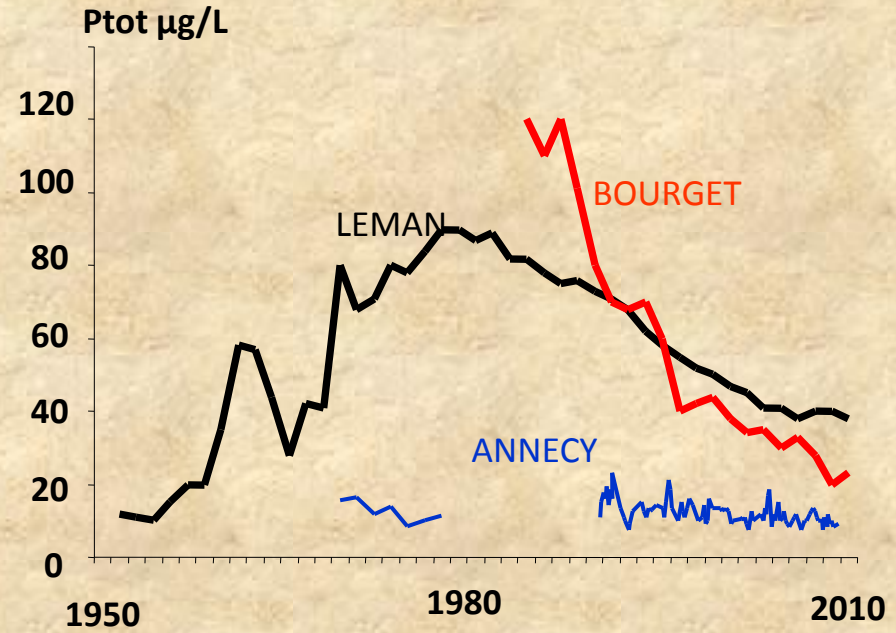
- small mountain lakes
- BPC ecodynamic

- Scientific knowledge
- Tools for lake managers

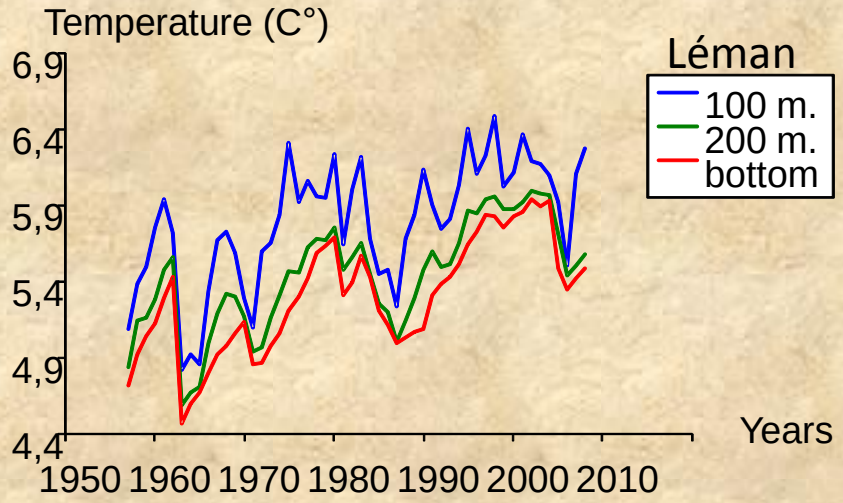
1/ Long term observations

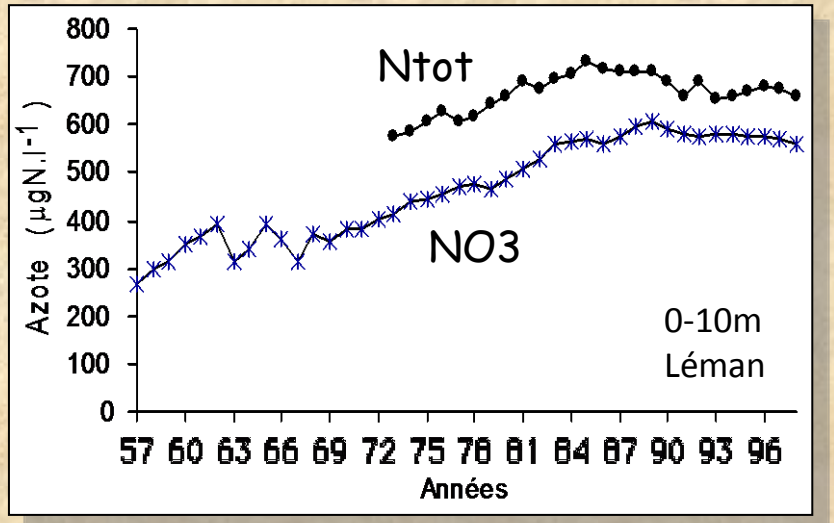


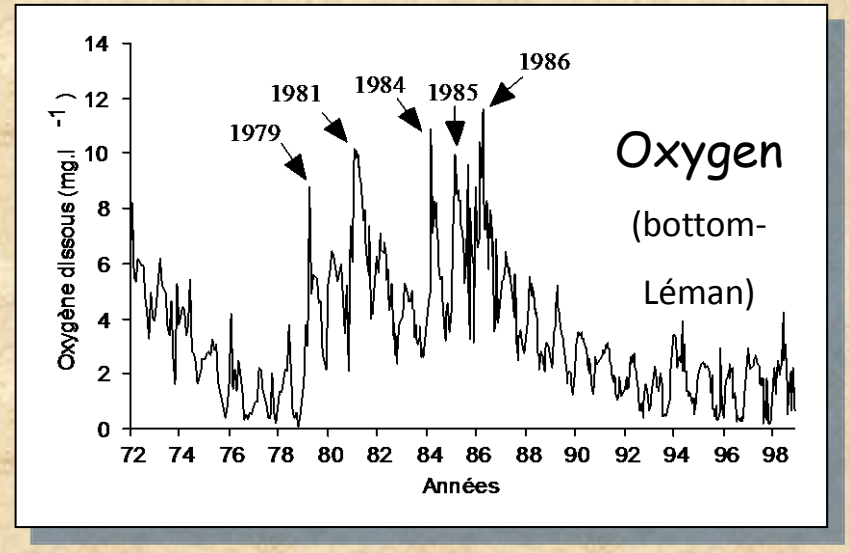
1/ Long term observations: the global physico-chemical changes



Anneville 2010, pers com





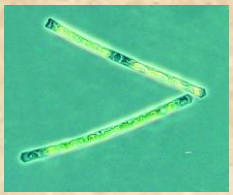


1/ Long term observations: trophic network dynamics (Leman)

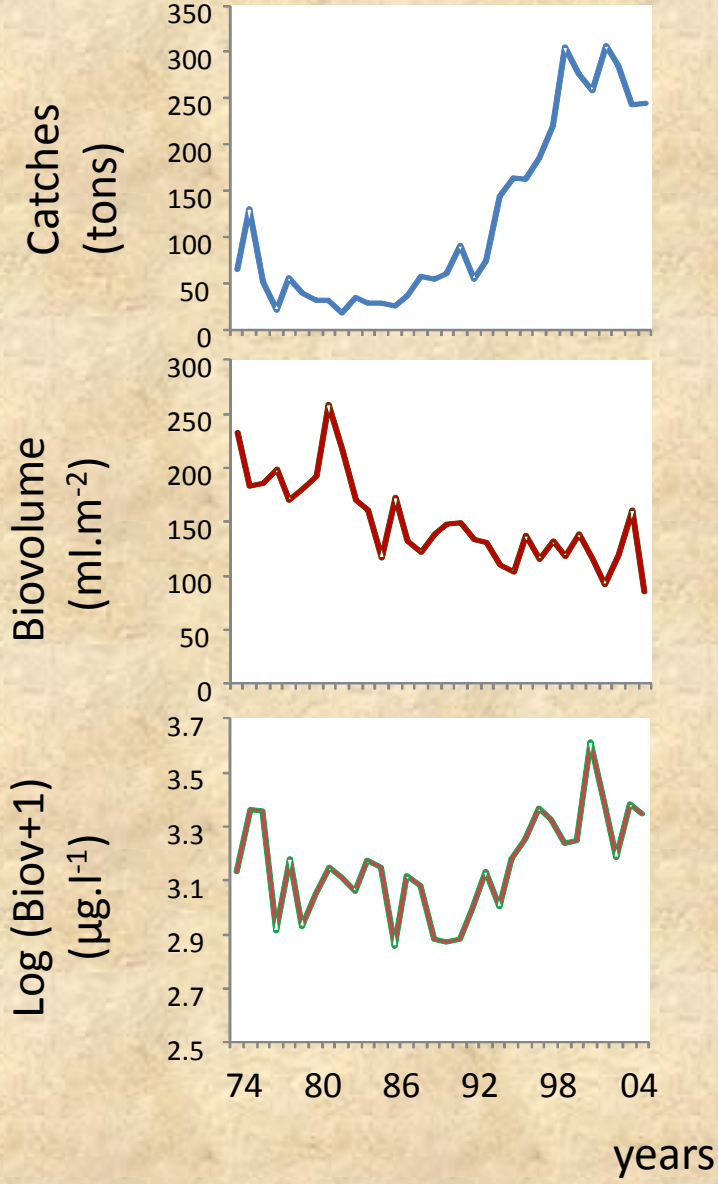
Anneville 2010, pers com

Whitefish

Zooplankton



Phytoplankton



Increasing predation

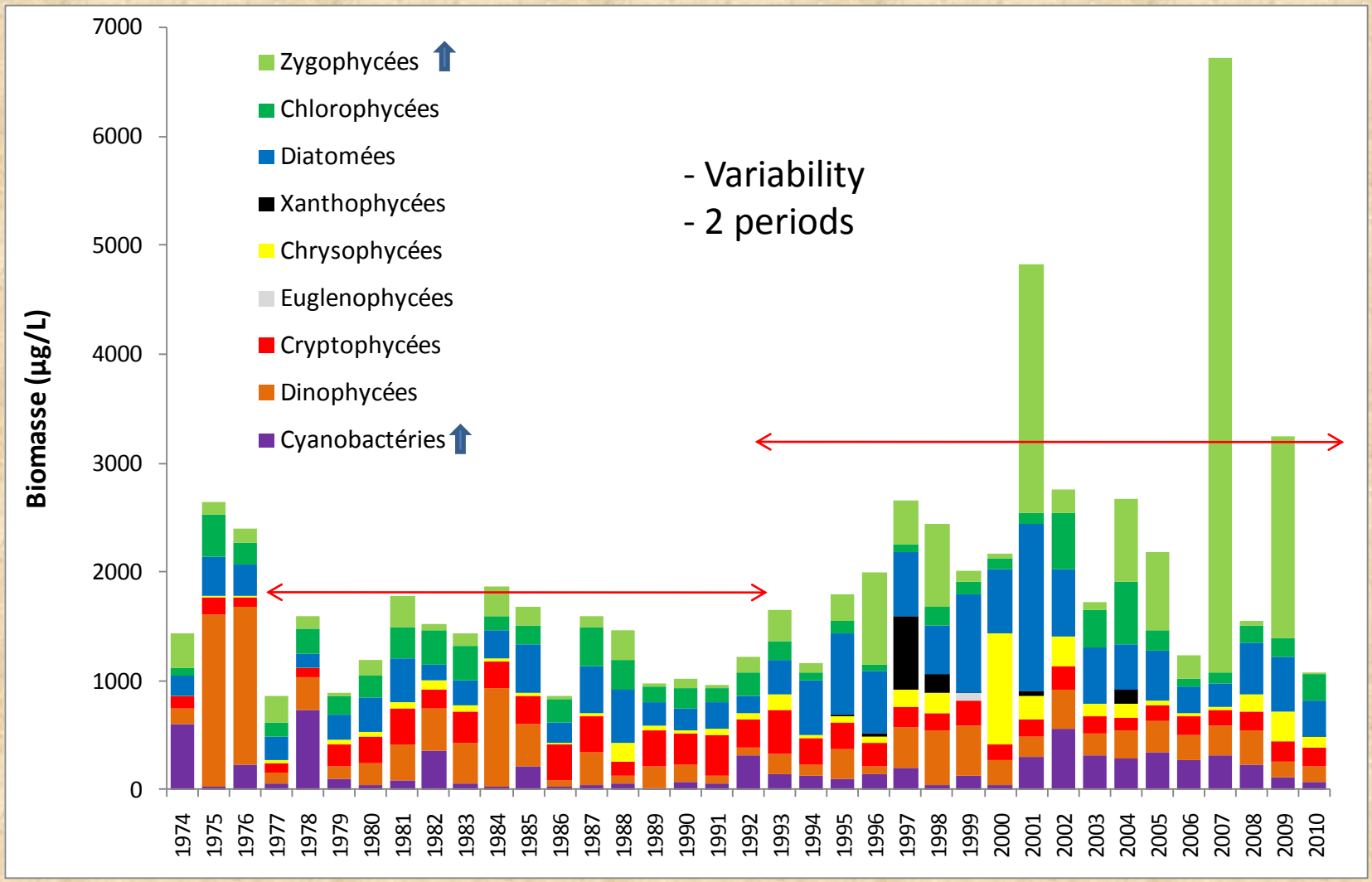
Decreasing ZoopK biomass

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**

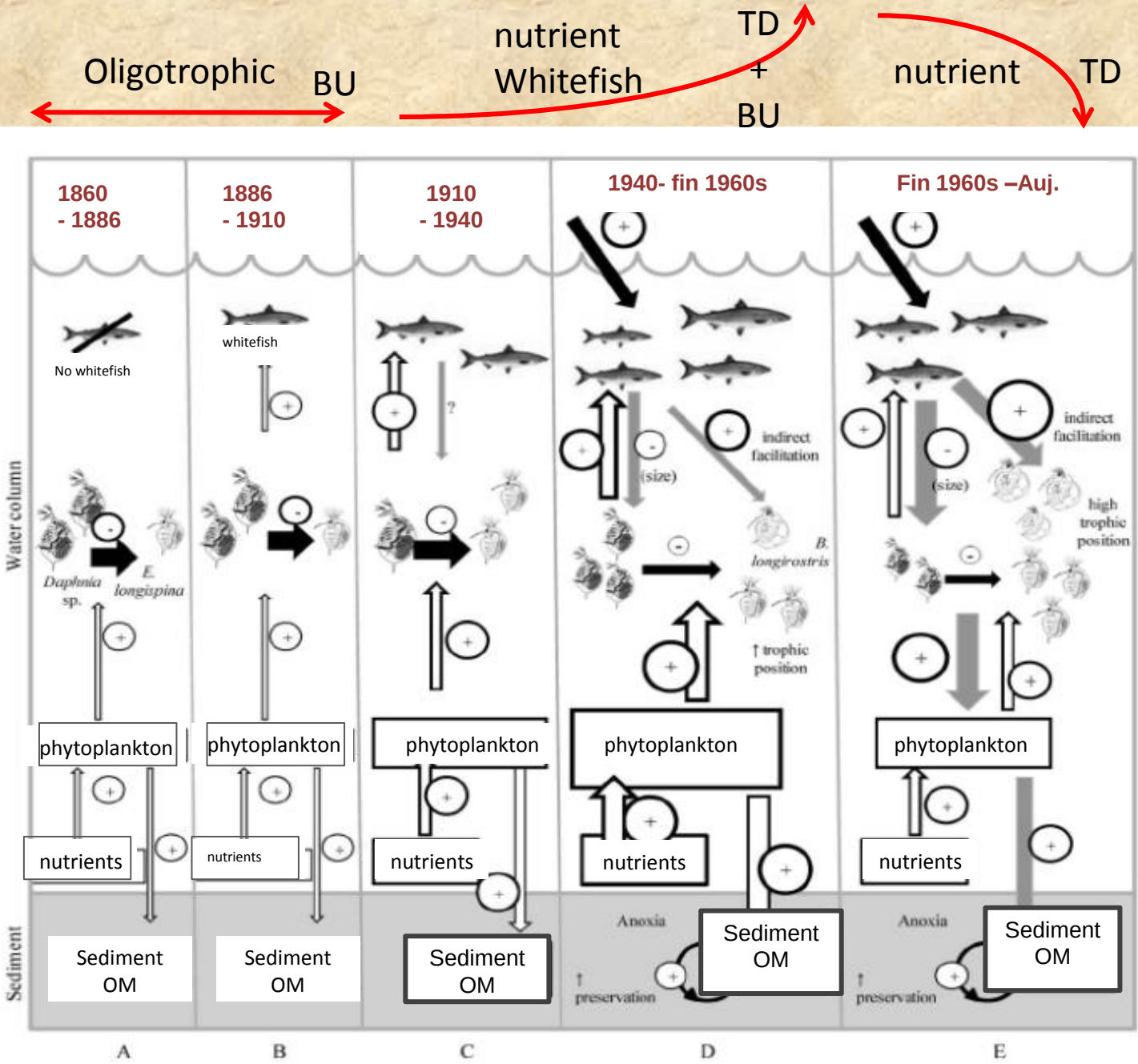
1/ Long term observations: Paleolimnology

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)**

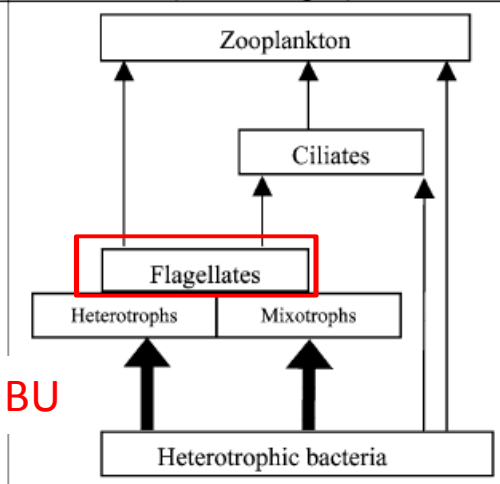
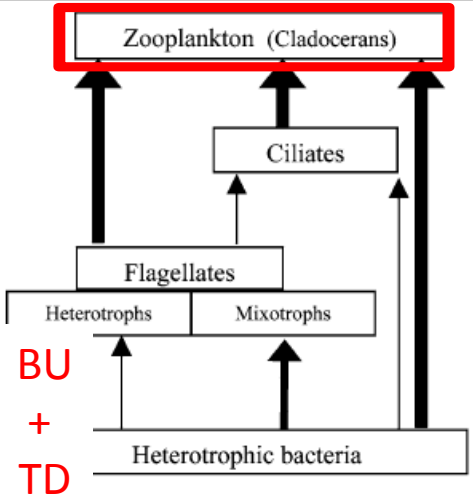
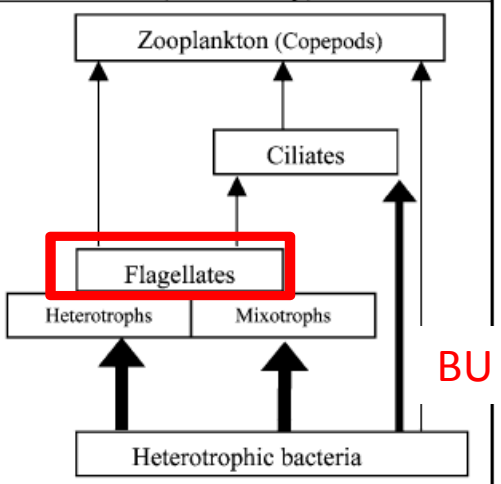
150 years of bottom-up and top-down response of trophic network (Lake Annecy)

Conceptual model on changes of trophic network



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

Domaizon & Comte , 2006

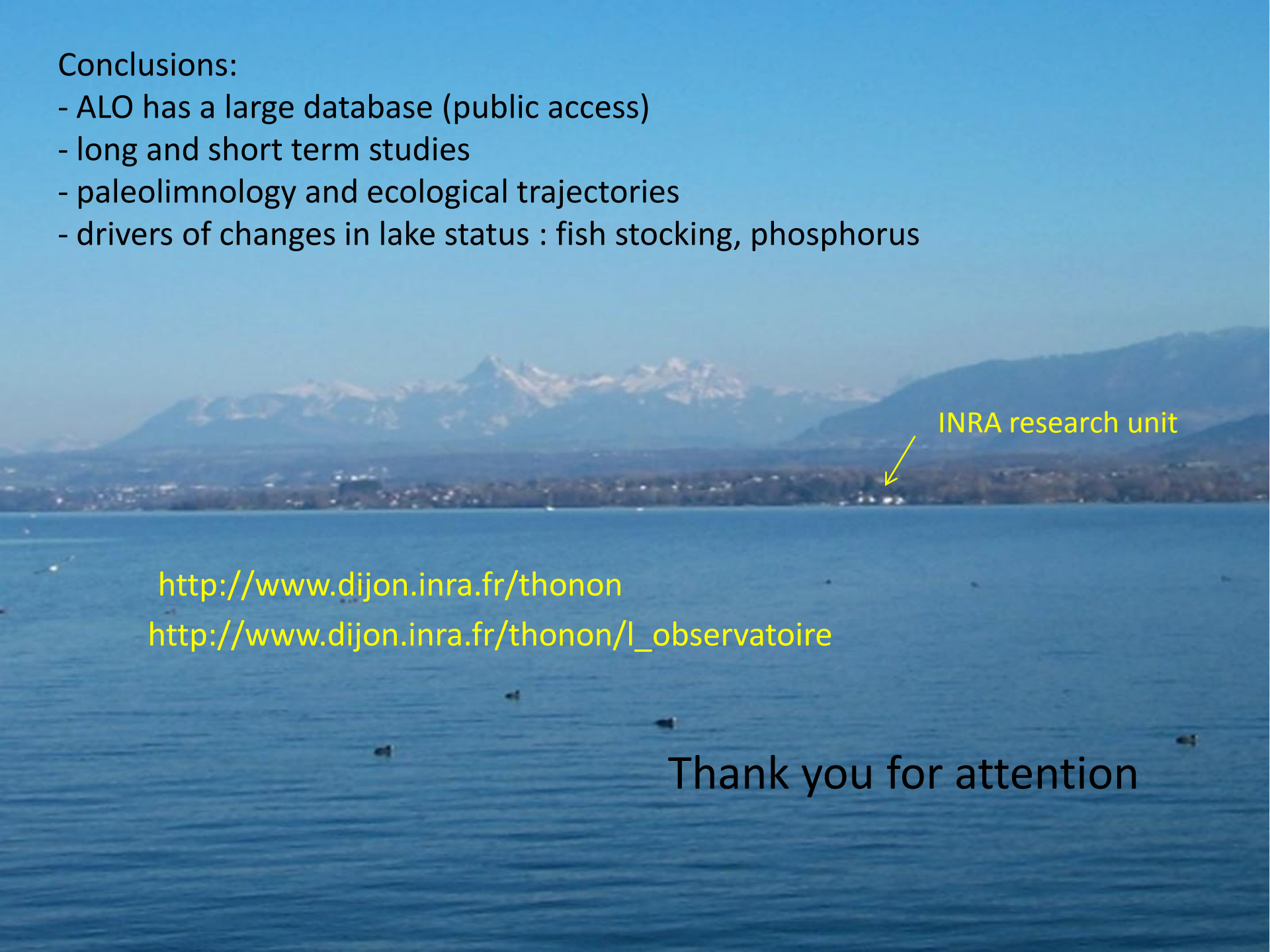
	Early spring (March –April)	Clear water phase (May)	Early summer (June – July)
Conceptual scheme for upper layers (2, 6, 10 m depth)			
[Chlorophyll *a*]	Peak on 2 April (2m)	Low values	Increase - peak on 3 July (6m)
[Heterotrophic Bacteria]	moderate values	Increase	high values
[Bacterial Filaments]	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 - Low ciliates grazing impact	- Mainly mixotrophic flagellates predation - Low ciliates and heterotrophic flagellates grazing impact	peak on 3 july - Highest flagellates grazing rates - Large increase in ciliates predation
Regulation pressure *TD : Top Down control* *BU : Bottom Up control*	Bacteria regulation : mainly BU (grazing rates lower than bacterial production) Protozoan regulation : mainly BU, especially during April	Bacteria regulation : probably simultaneous BU control and TD control due to metazooplankton Protozoan regulation : mainly TD	Bacteria regulation : mainly BU control although high protozoan predation Protozoan regulation : mainly BU for flagellates (2 and 6m) and ciliates 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



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Thank you for attention