

# Lipidomics comes of age:

## The role of lipids in cells' response to environmental challenges

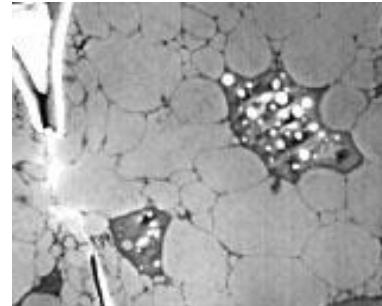
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Equipe EBMP « Environment, Bioenergies, Microalgae and Plants »  
BIAM Institute  
CEA Cadarache

# Lipids play essential biological functions

- Structural components of membranes
- Energy and carbon storage
- Signaling and developmental role

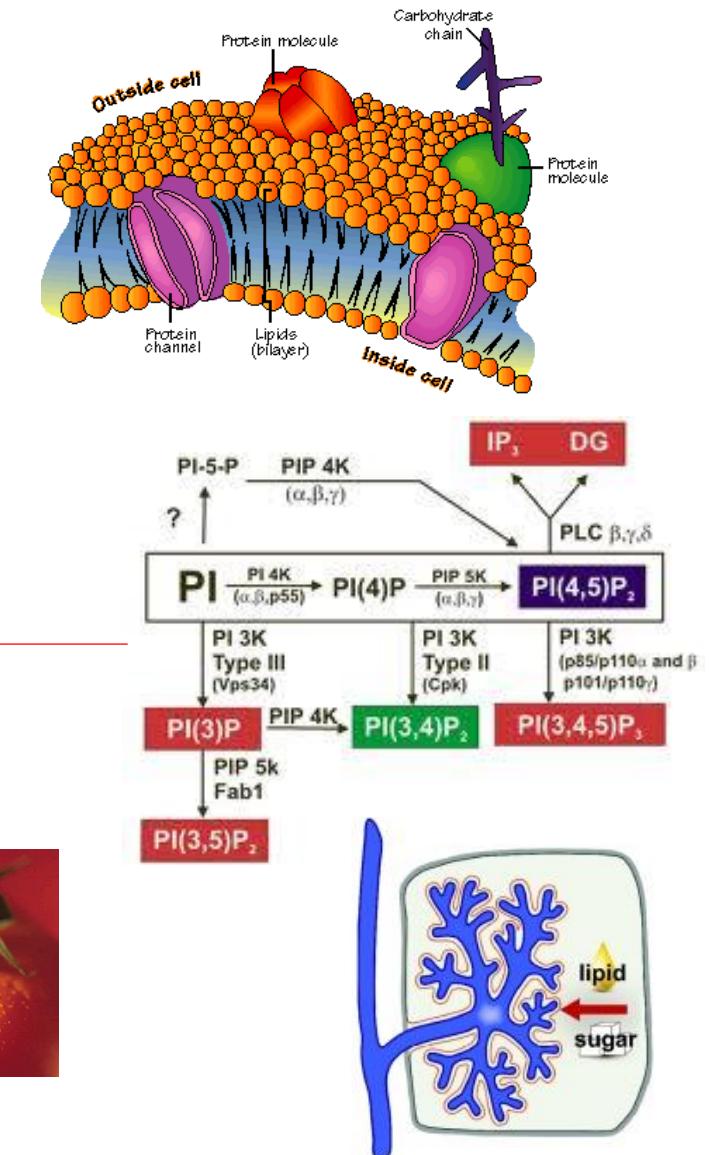
Lipid droplet



Intra-cellular

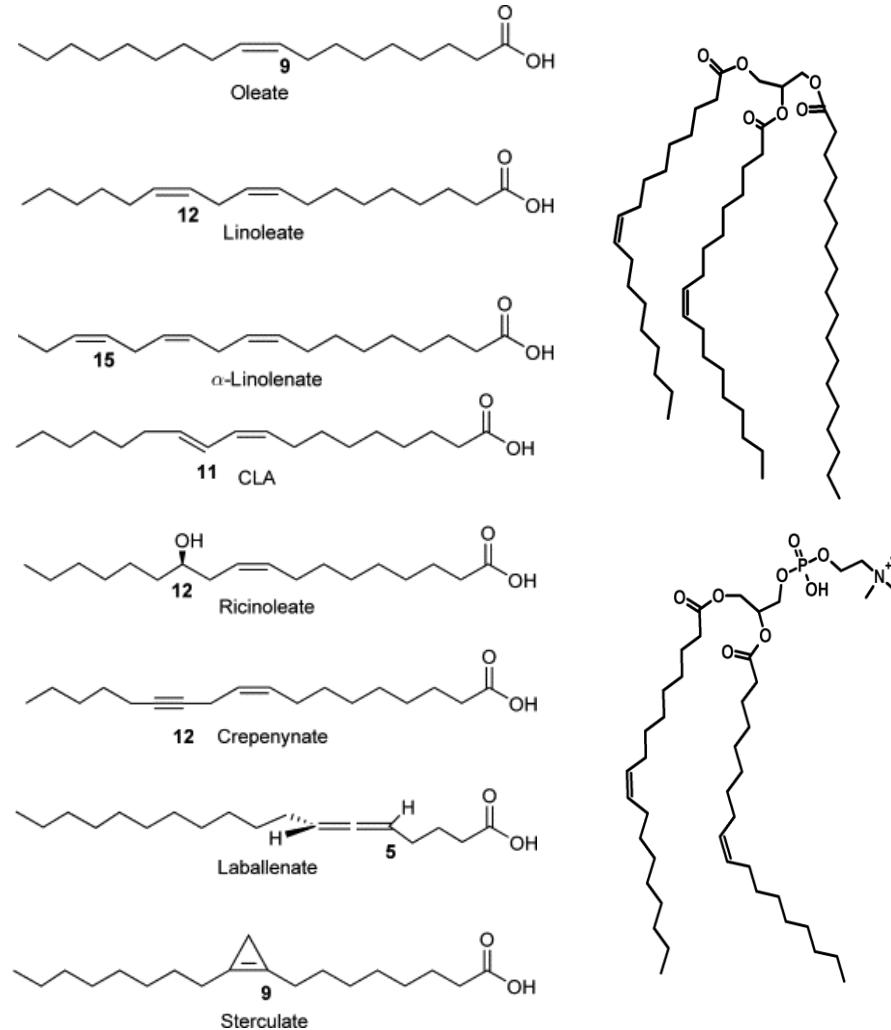
Extra-cellular

- Waterproof enveloppe and UV resistance
- Evolutionary role  
establishment of plant-fungal symbiosis

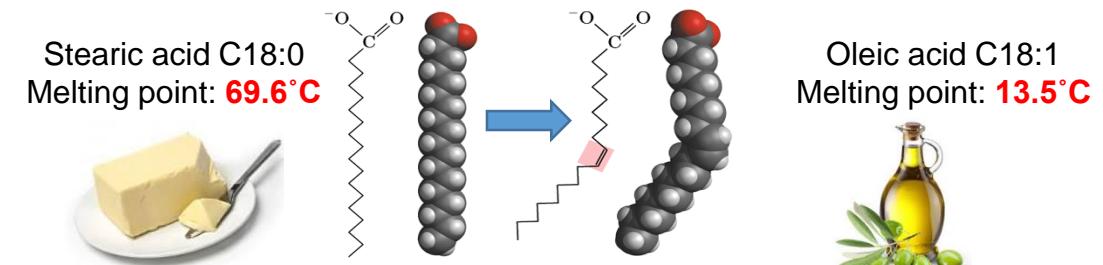


# Its physical-chemical properties determine its utility and function

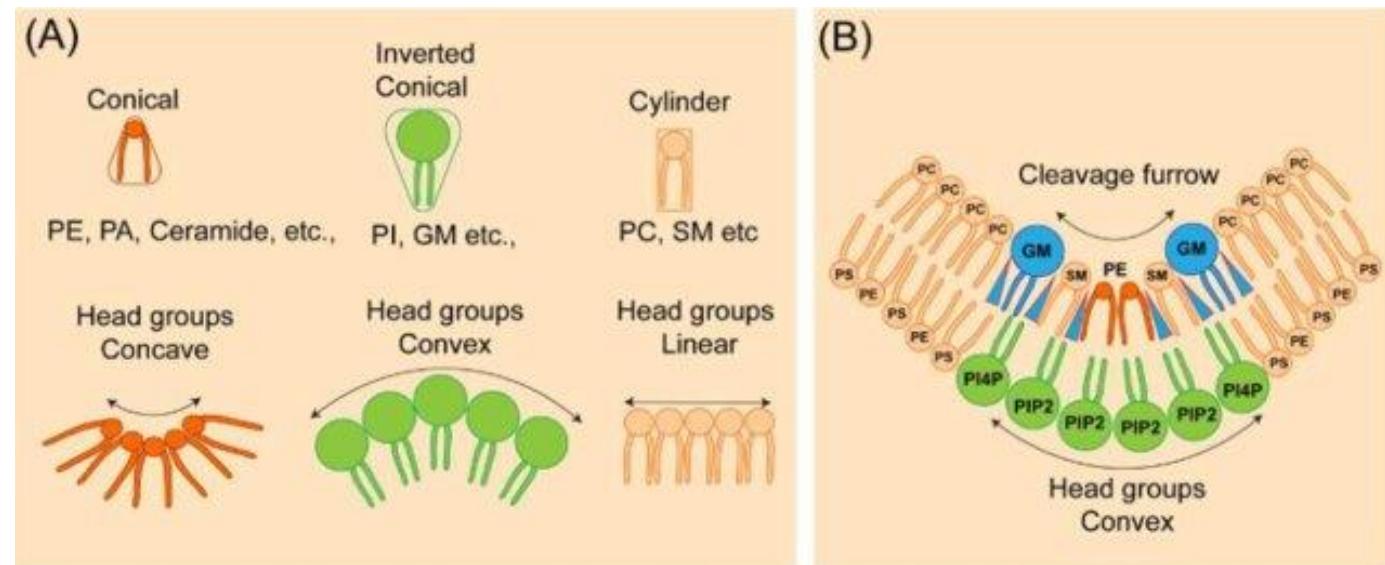
*Over thousands in nature:*



*Fatty acid structure*



*Head group*



(Kunduri et al 2022)

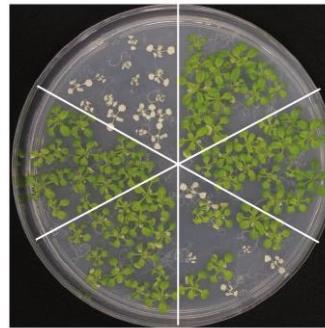
# From land to ocean: some examples in acclimation to environmental challenges

- Salt stress:**



(Desaturase: Zhang et al 2012 Plos One)

- Heat tolerance:**



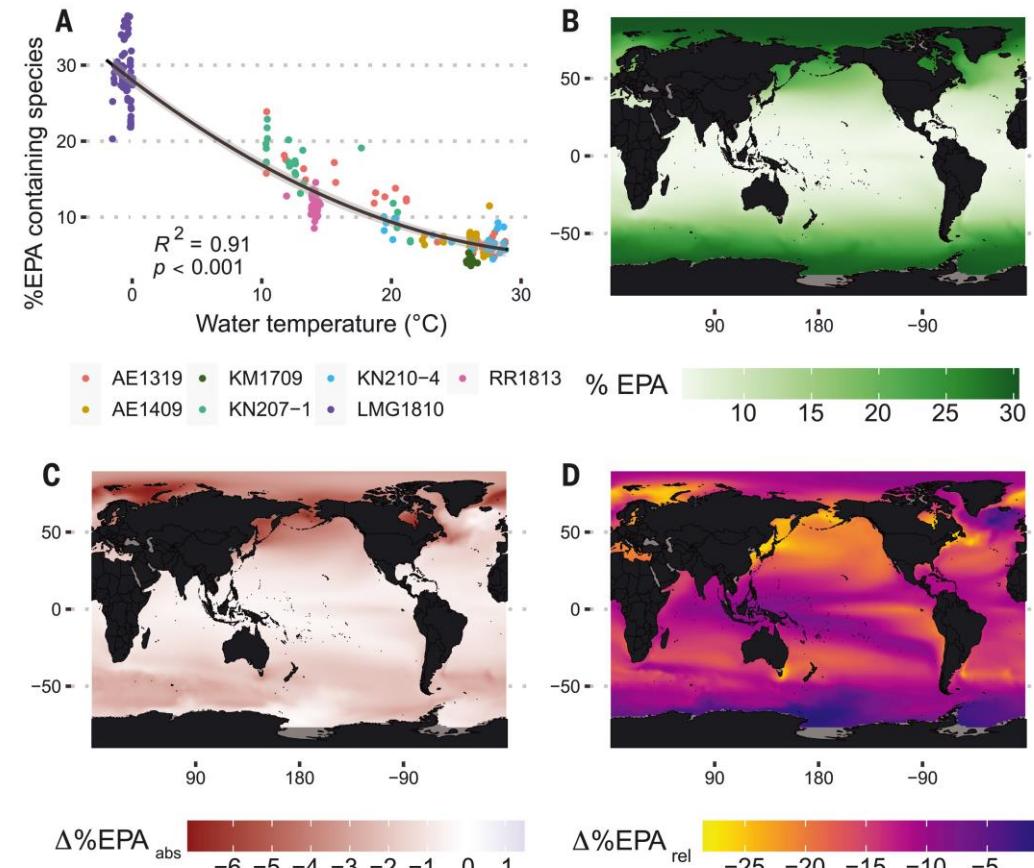
(Lipase: Higashi et al. 2018 Plant Cell)

- Cold:**



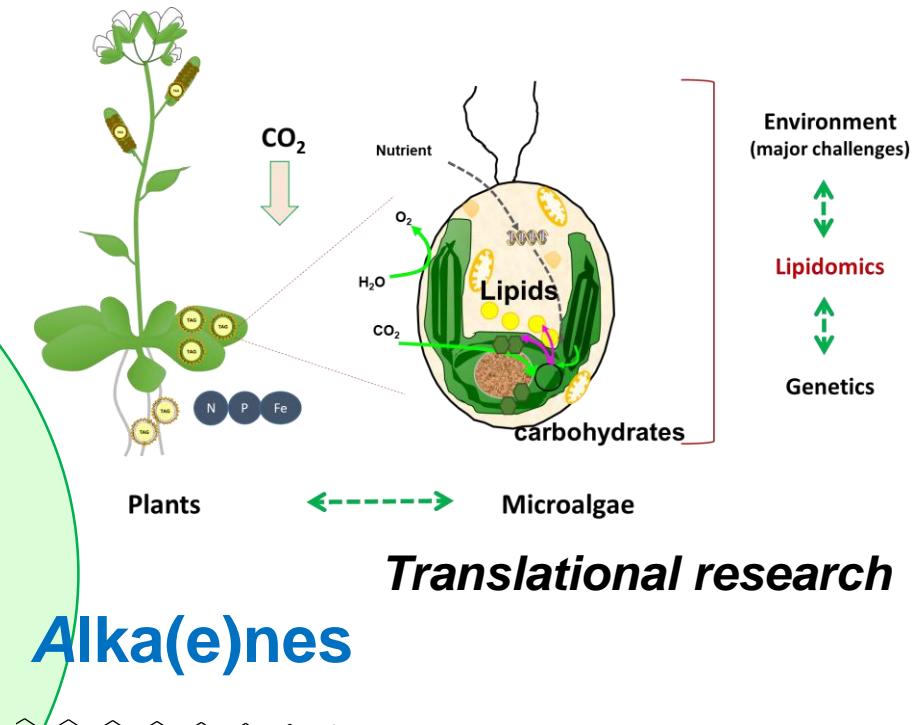
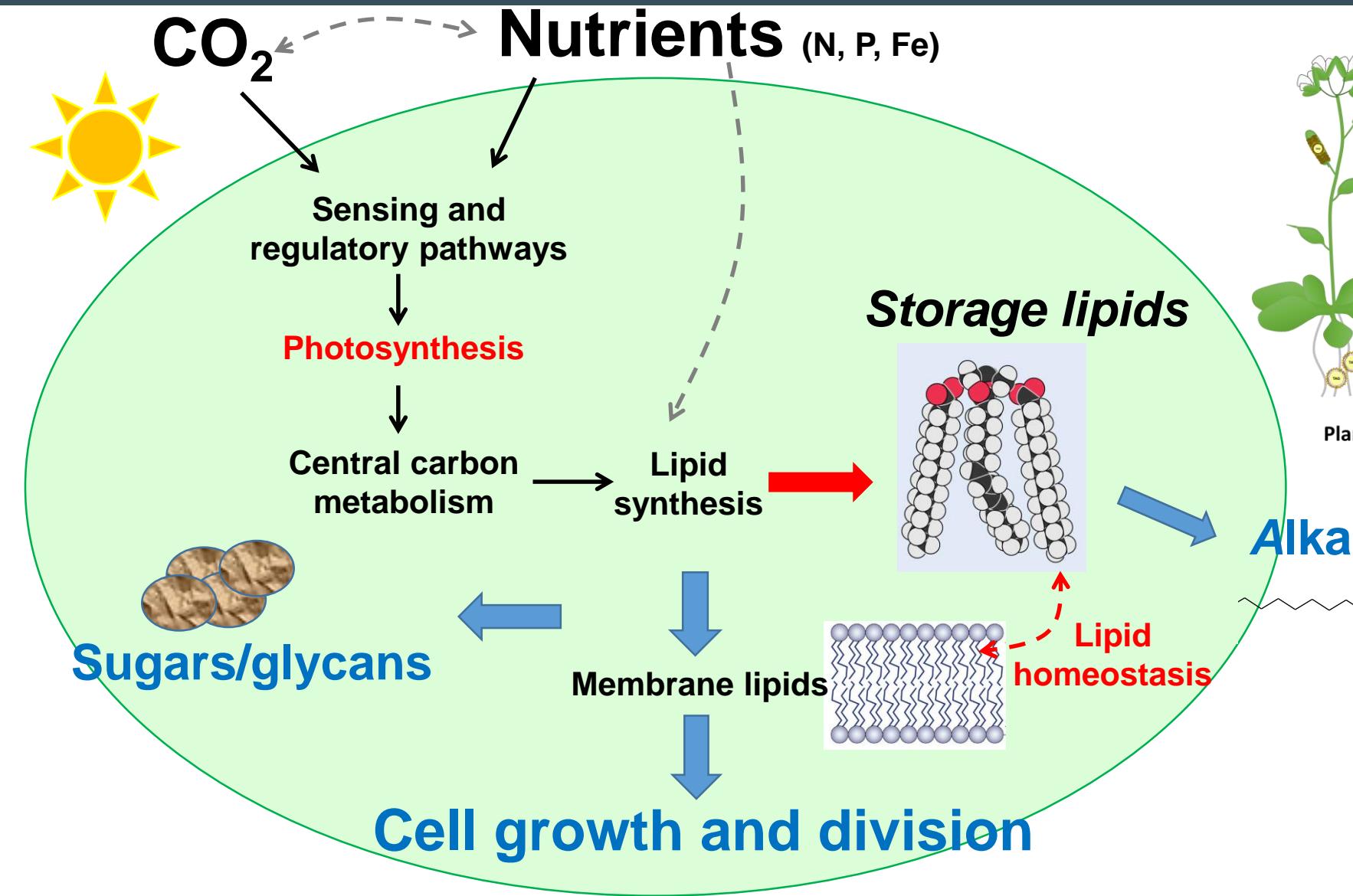
(Galactosyl-transferase: Moellering et al 2010 Science)

- Global ocean lipidomes show a universal relationship between temperature and lipid unsaturation:**



(Holm et al Science 2022)

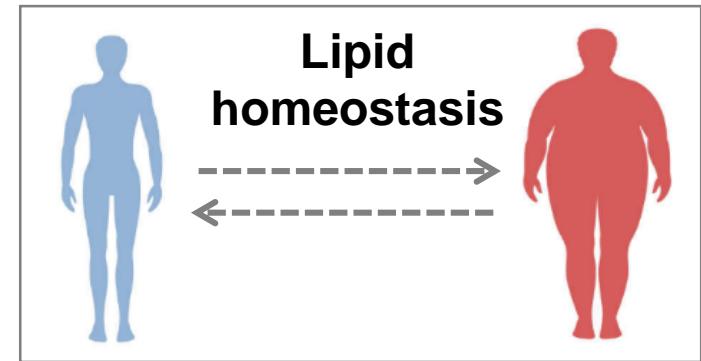
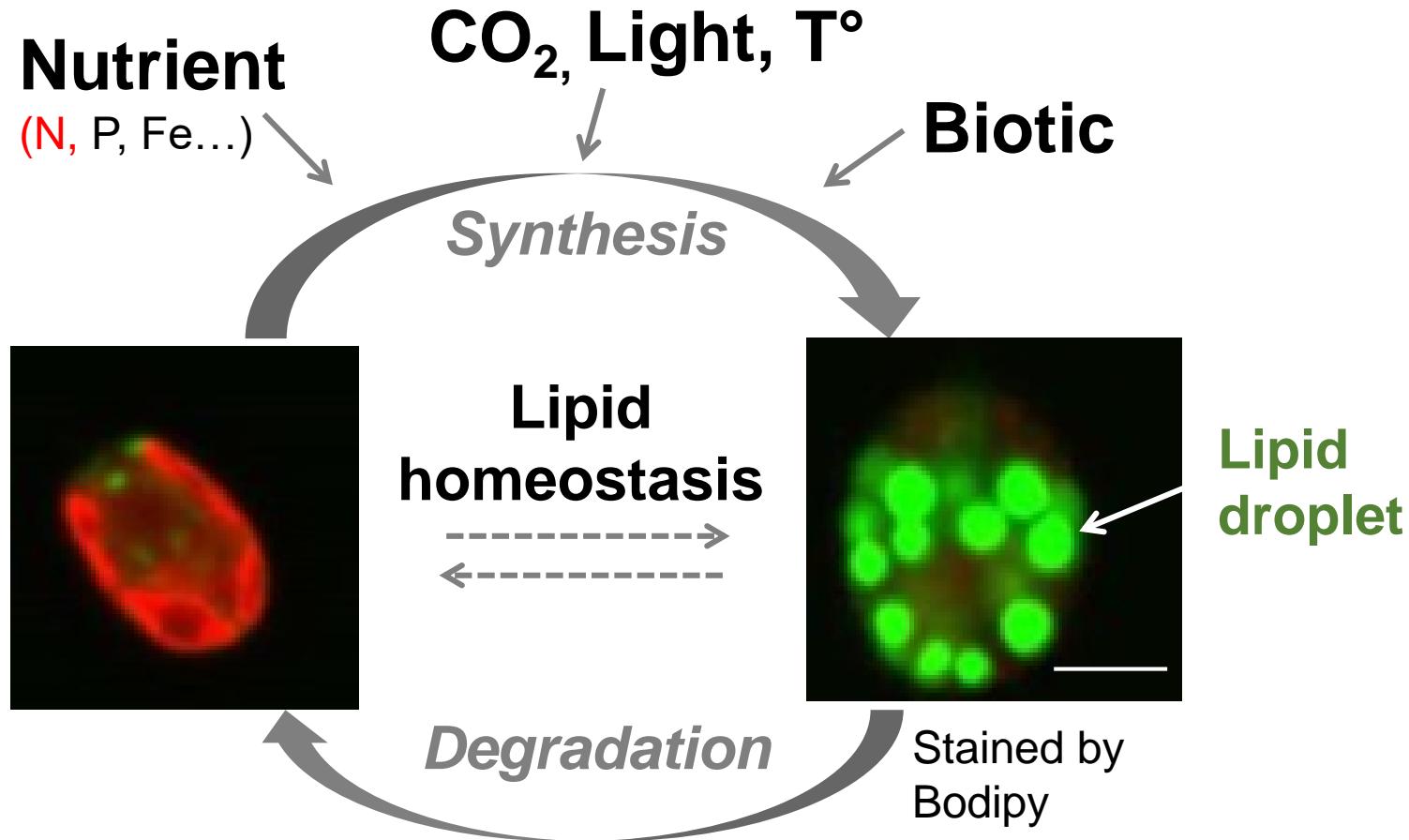
# Research focus: from environmental acclimation to bioenergy production



**Major issues:**

- Metabolic regulation
- Scale up

# Lipid homeostasis in microalgae



→ **« Forward genetic screen »**

- Kong et al 2018 *Plant Cell*
- Lee et al 2020 *PNAS*

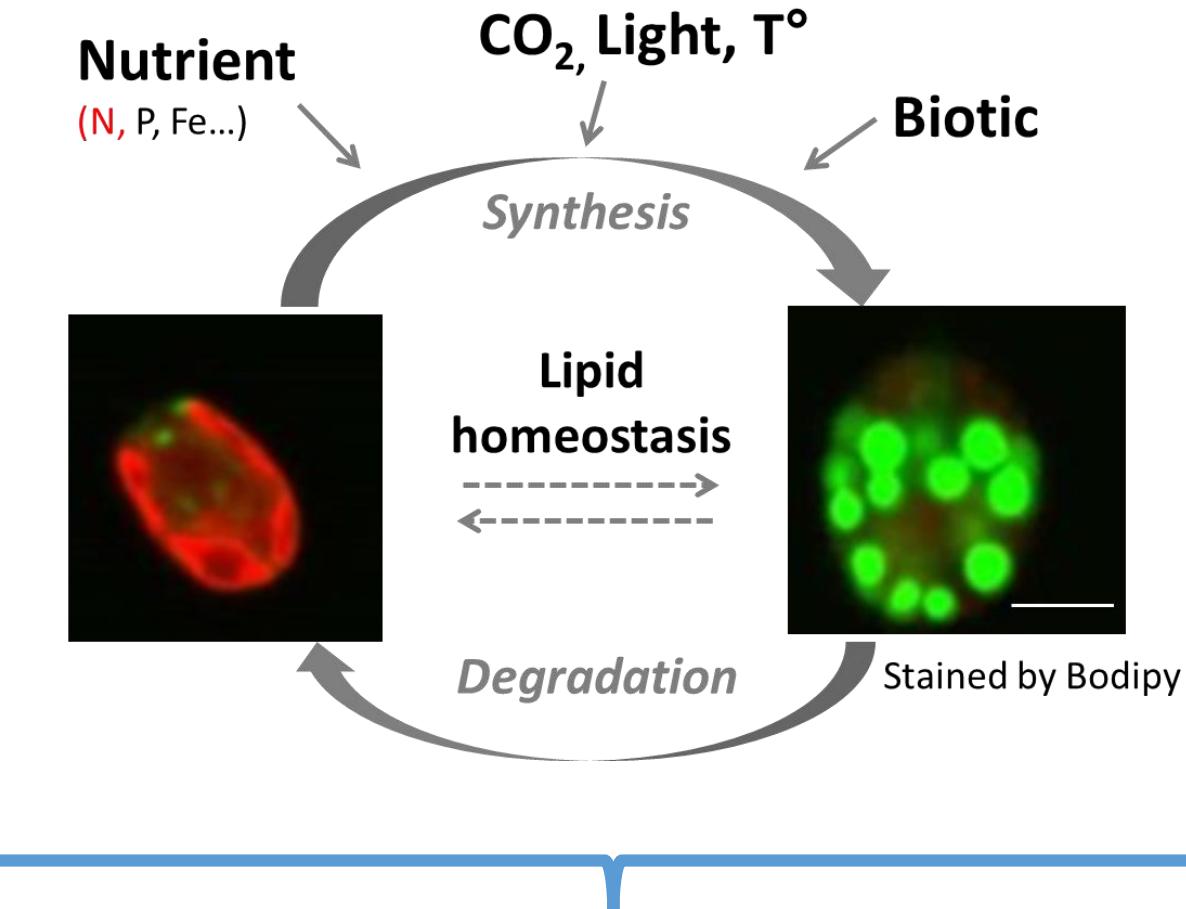
→ **Lipid content is determined by interplay between environmental factors and genetic make-up**



« PEPR B-BEST »

# Redox is a key messenger in connecting environmental signals to “genetic regulation” to metabolic acclimation

Malate shuttle  
Regulators  
Kinases  
Lipases  
....



PEPR  
« AlgAdvance »

Genetic, Omics, Physiology and Genome editing tools

# From lab to field.....



Nutrient (N, P, Fe...)

CO<sub>2</sub>, Light, T°

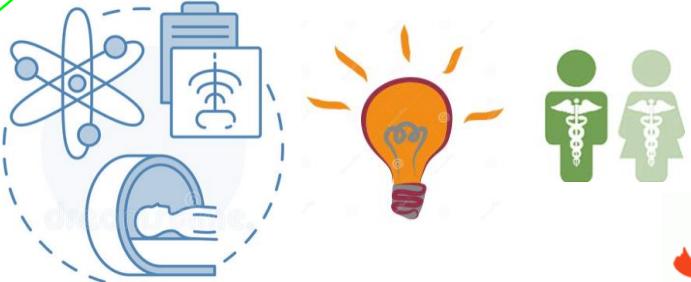
Biotic/Abiotic



PEPR  
« AlgAdvance »

# A couple of ongoing collaborative projects: The role of lipids in cells' adaptation to environmental challenges

Radiation resistance



Collaboration: L. Blanchard & A. de Groot

Acclimation to marine heat waves

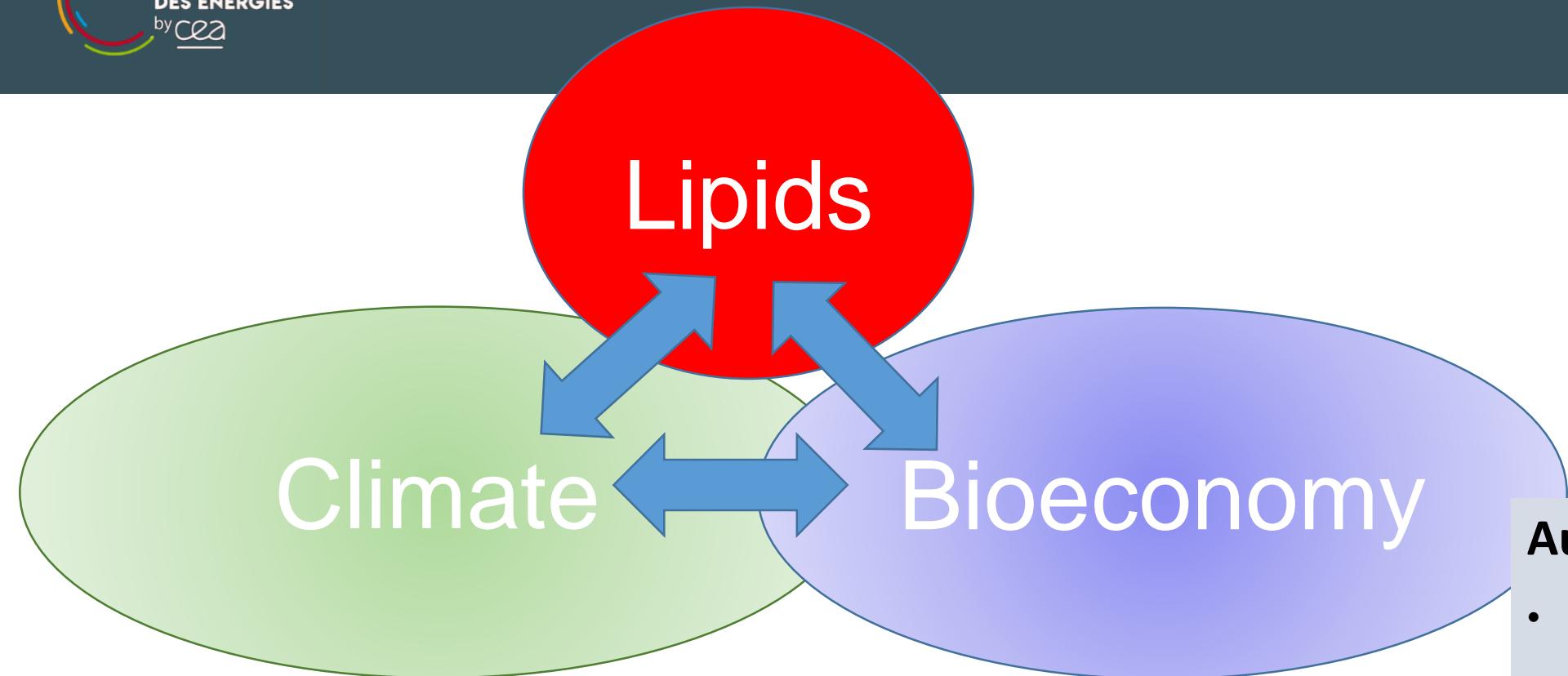


Collaboration: A. Atteia & R. Van Lis

## Submitted grant applications:

- ERC-Synergy (nutrient and light)
- Marie Curie Training Networks (metal stress)
- Marie Curie individual fellowships (nutrient sensing)
- IRSN (ECCOREV application) (radiation...)

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## Au sein du CEA:

- Maille « NET: nouvelles technologies de l'énergie »
  - L'économie circulaire du carbone – ECC
- Maille « Recherche fondamentale en sciences du vivant »
  - Sciences et technologies pour l'adaptation au changement climatique

# Acknowledgement

*All members of the EBMP team: (Noel 2022)*



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