



Historical records from dated sediment cores unveiled the multidecadal dynamics of the toxic dinoflagellate *Alexandrium minutum* in the Bay of Brest (France)

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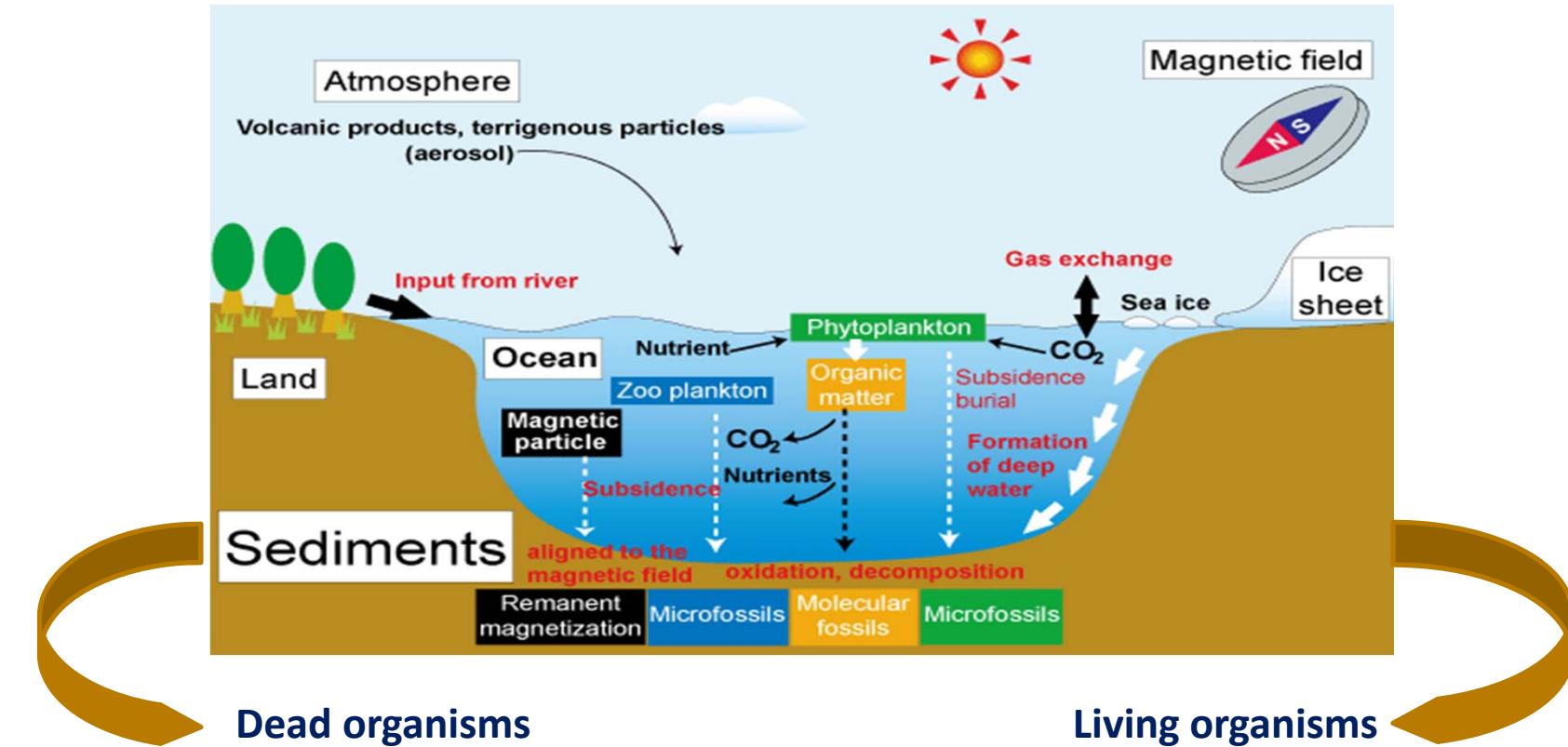
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The sediment record : archive of past communities



Dead organisms
Remains and organic molecules



DNA

shells, tests, skeletons

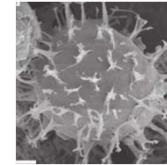


Coccolithophores

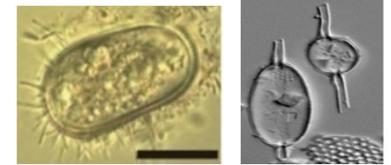


Foraminifera

Resting stages



Dinoflagellate cysts



Diatom spores

Indicators of past changes and communities

Sediment record : archive of past communities

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Ancient resting stages can be revived in the laboratory after up to 100 years of dormancy

Buried alive – germination of up to a century-old marine protist resting stages

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Using the sediment archive of living dinoflagellate cysts and other protist resting stages to study temporal population dynamics

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... and be used to study population temporal dynamics

... or population genetic structure



Hundred years of genetic structure in a sediment revived diatom population

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Geobiology (2011), 9, 377–393

DOI: 10.1111/j.1472-4669.2011.00290.x

Ancient Plankton DNA can be preserved in sediments ...

Preservation potential of ancient plankton DNA in Pleistocene marine sediments

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MOLECULAR ECOLOGY

Molecular Ecology (2012) 21, 1918–1930

doi: 10.1111/j.1365-294X.2011.05412.x

Hidden diversity in diatoms of Kenyan Lake Naivasha: a genetic approach detects temporal variation

KATHLEEN R. STOOF-LEICHSENRING,* LAURA S. EPP,† MARTIN H. TRAUTH‡ and RALPH TIEDEMANN*

... and be used to evaluate changes in biological communities

Paleoecological approach : an alternative to short time series

- Time series for plankton dynamics study are relatively short and early information on past communities are lacking...
- Few studies attempted to fill the gaps in time series ...

Biogeosciences, 10, 3817–3838, 2013
www.biogeosciences.net/10/3817/2013/
doi:10.5194/bg-10-3817-2013
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Estuaries and Coasts (2013) 36:1206–1218
DOI 10.1007/s12237-013-9623-2

DNA from lake sediments reveals the long-term dynamics and diversity of *Synechococcus* assemblages

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Evolution of the plankton paleome in the Black Sea from the Deglacial to Anthropocene

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Changes in the Abundance and Species Composition of Phytoplankton in the Last 150 Years in the Southern Black Sea

Erik Askov Mousing • Thorbjørn Joest Andersen •
Marianne Ellegaard

Harmful Algae 9 (2010) 449–457



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Harmful Algae

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A 100-year record of changing *Pseudo-nitzschia* species in a sill-fjord in Denmark related to nitrogen loading and temperature

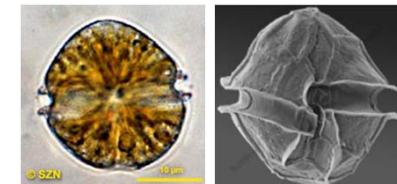
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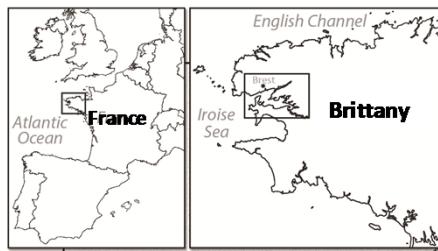
The case of *Alexandrium minutum*

- Toxic dinoflagellate ($\sim 20 \mu\text{m}$)
- First detection in 1960 (Alexandria, Egypt)
- Considered as an invasive species
- Detected in the Bay of Brest (Brittany, France) in 1990 in low concentrations
- July 2012 : Large bloom at Daoulas Estuary (~ 42 millions cells/l) with toxin production.

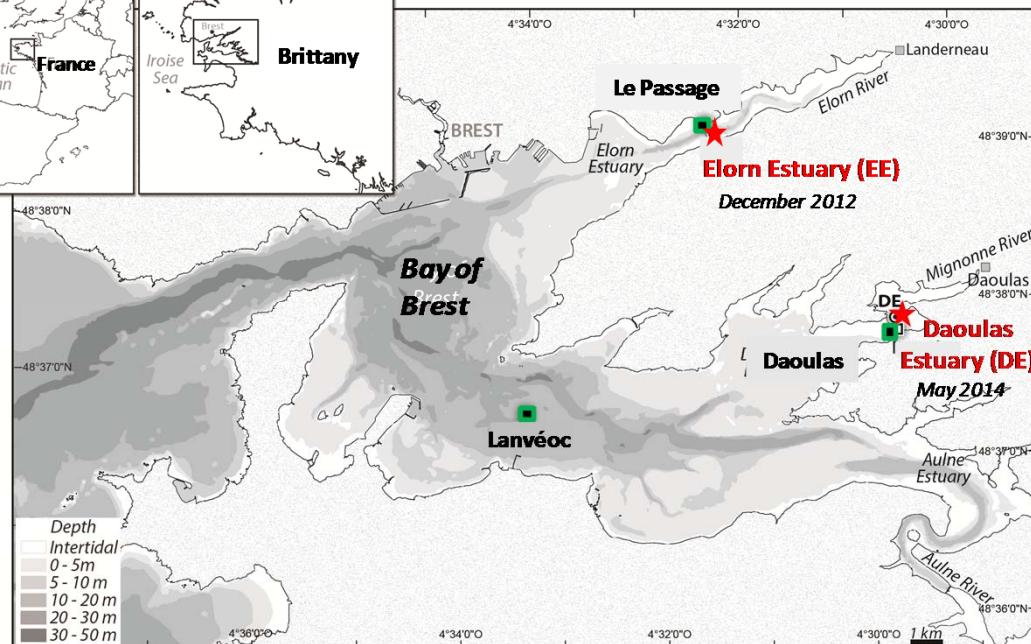


Aims of the study

- **What can we learn from paleoecology?**
 - Detect ancient traces of *A. minutum* from dated sediment cores
 - Reconstruct *A. minutum* multidecadal dynamics over time
 - Compare with *A. minutum* dynamics inferred from monitoring network (REPHY).
-
- As a control : Scrippsiella donghaiensis* (non toxic cyst-forming species).**



Core sampling



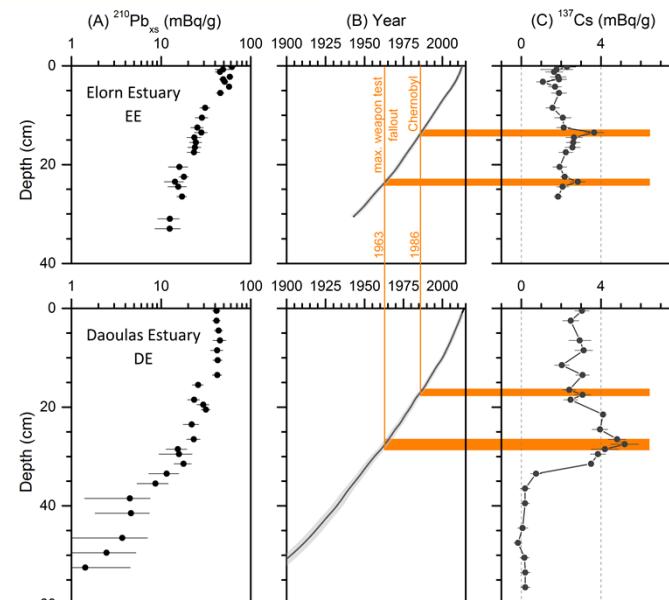
★ Sediment cores

■ Monitoring stations



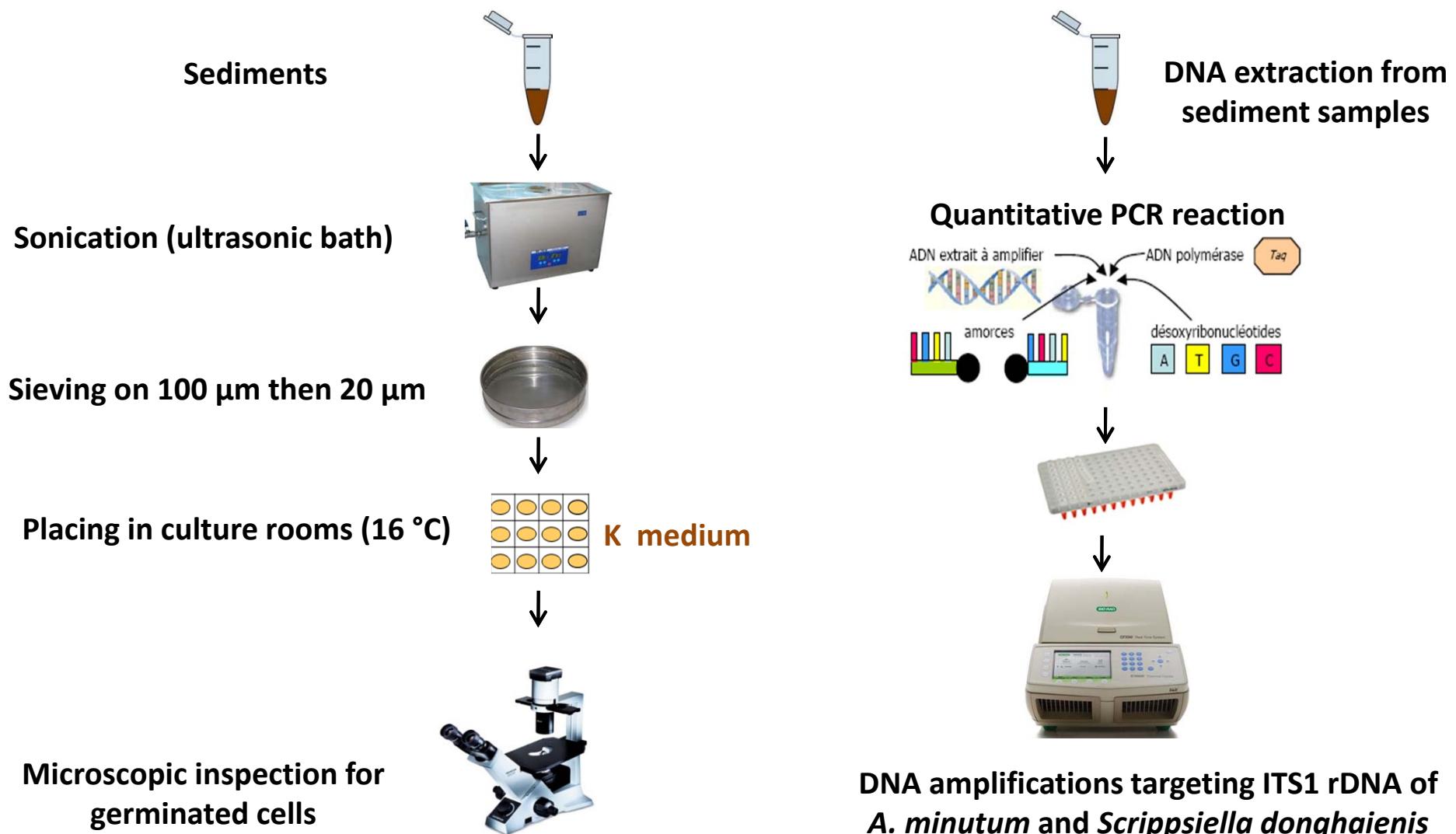
Sediment cores (≤ 58 cm)

Core dating

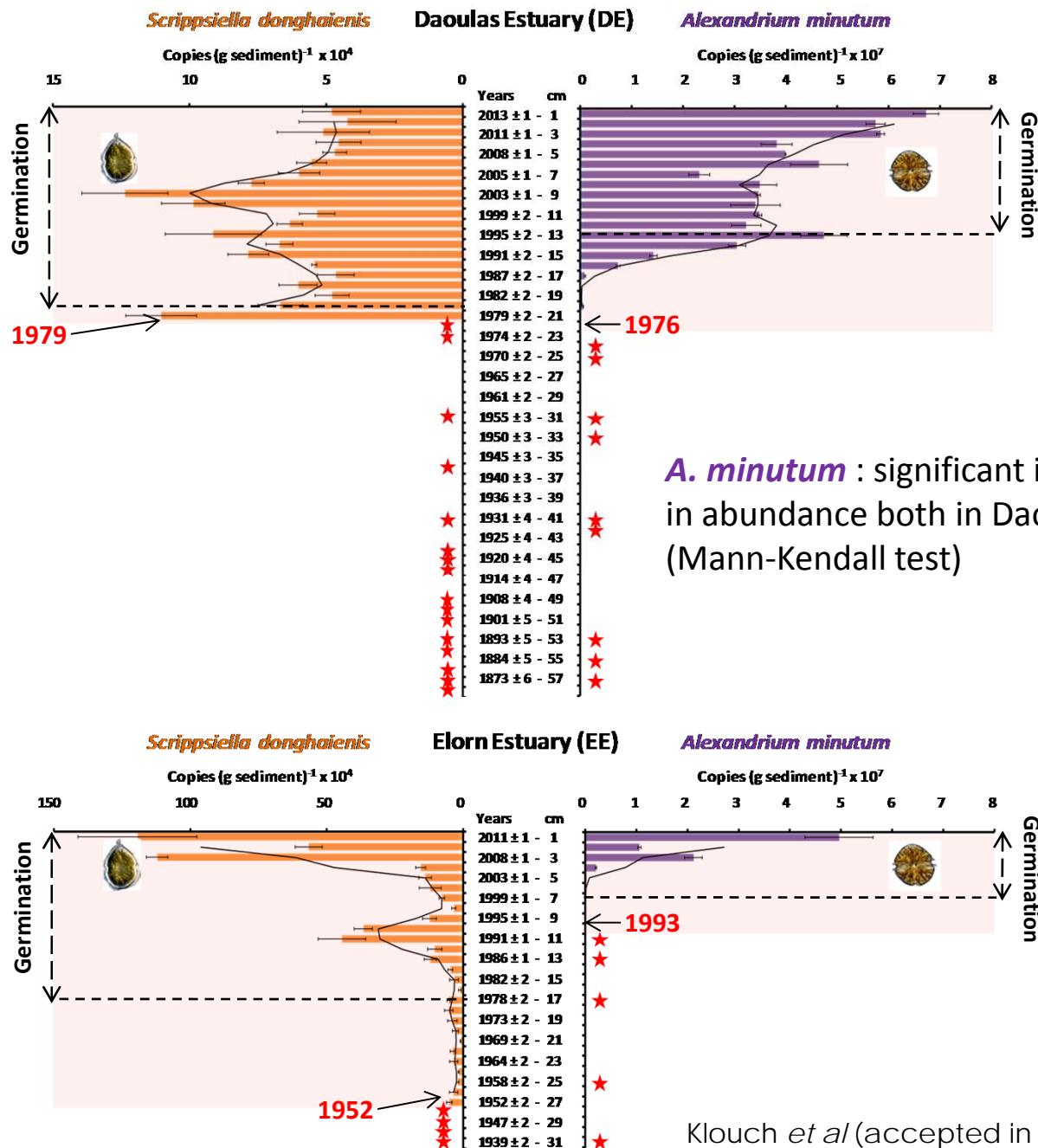


In collaboration with S. Schmidt (EPOC, Bordeaux)

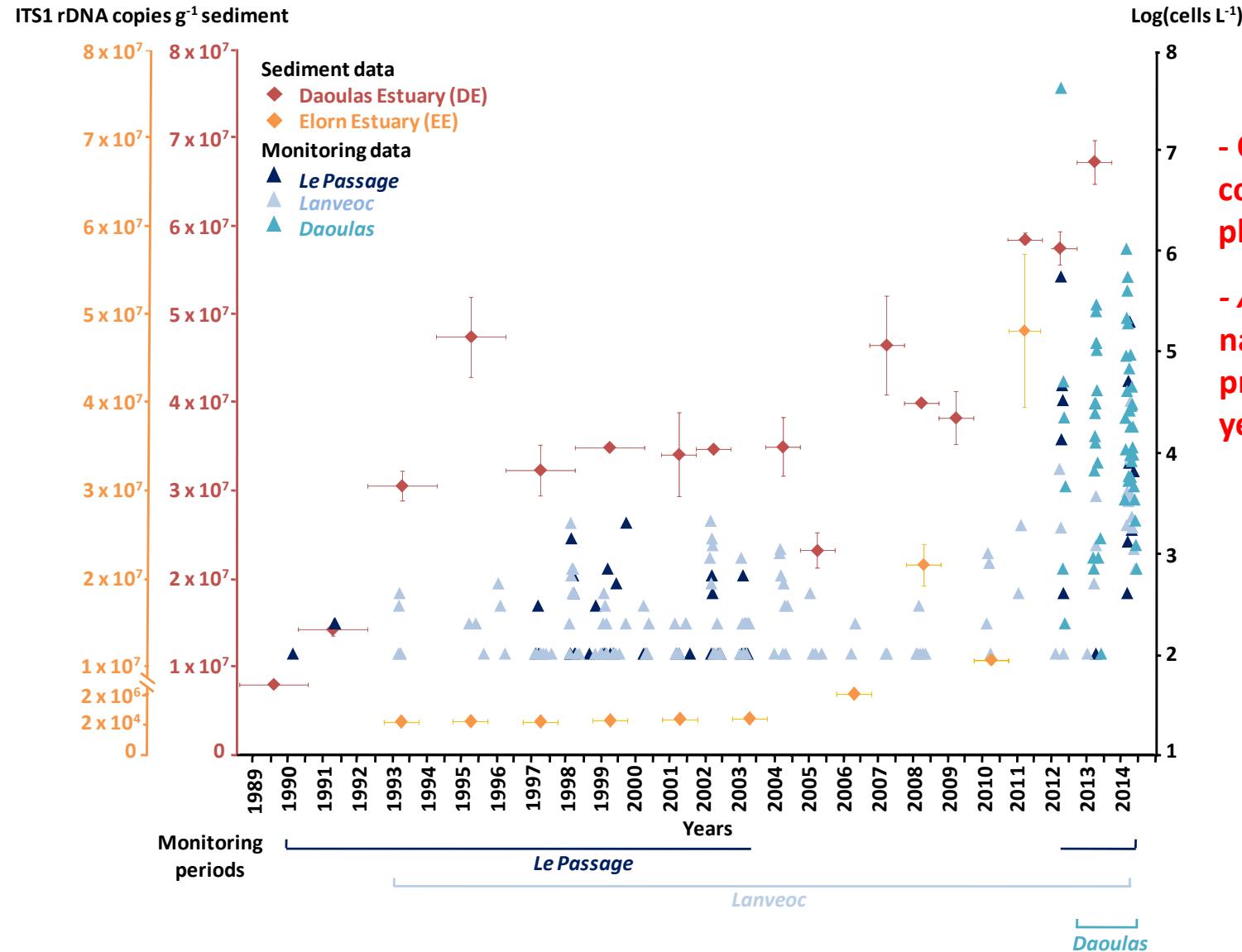
Cysts germination and real-time PCR amplification



Multidecadal dynamics of *A. minutum* and cyst germination

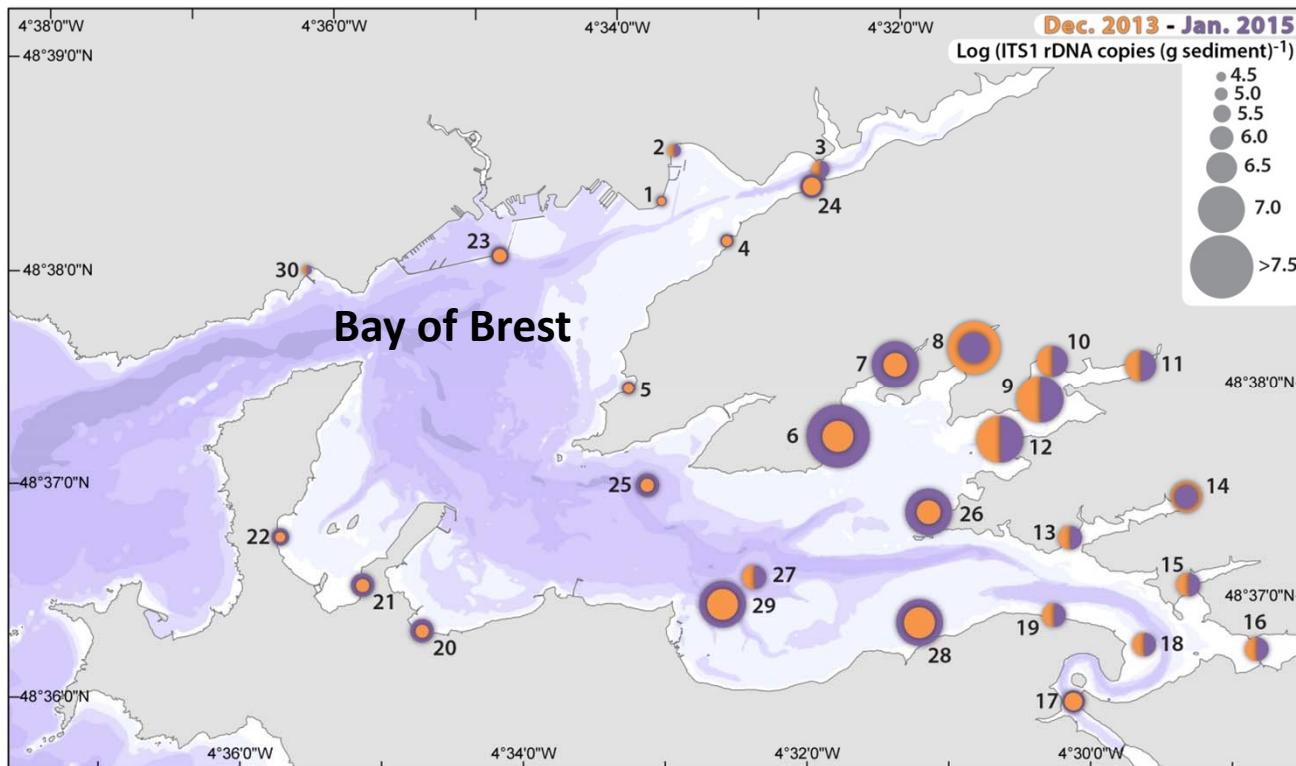


Alexandrium minutum abundances from sediment (copies/g) and water (cells/L)



- Quantitative PCR data corroborates monitoring plankton data (REPHY)
- *A. minutum* could be a native species which is proliferating in recent years...

A. minutum spatial distribution from superficial sediments



2 years sampling

Quantification of *A. minutum* DNA

DNA concentration in 2013

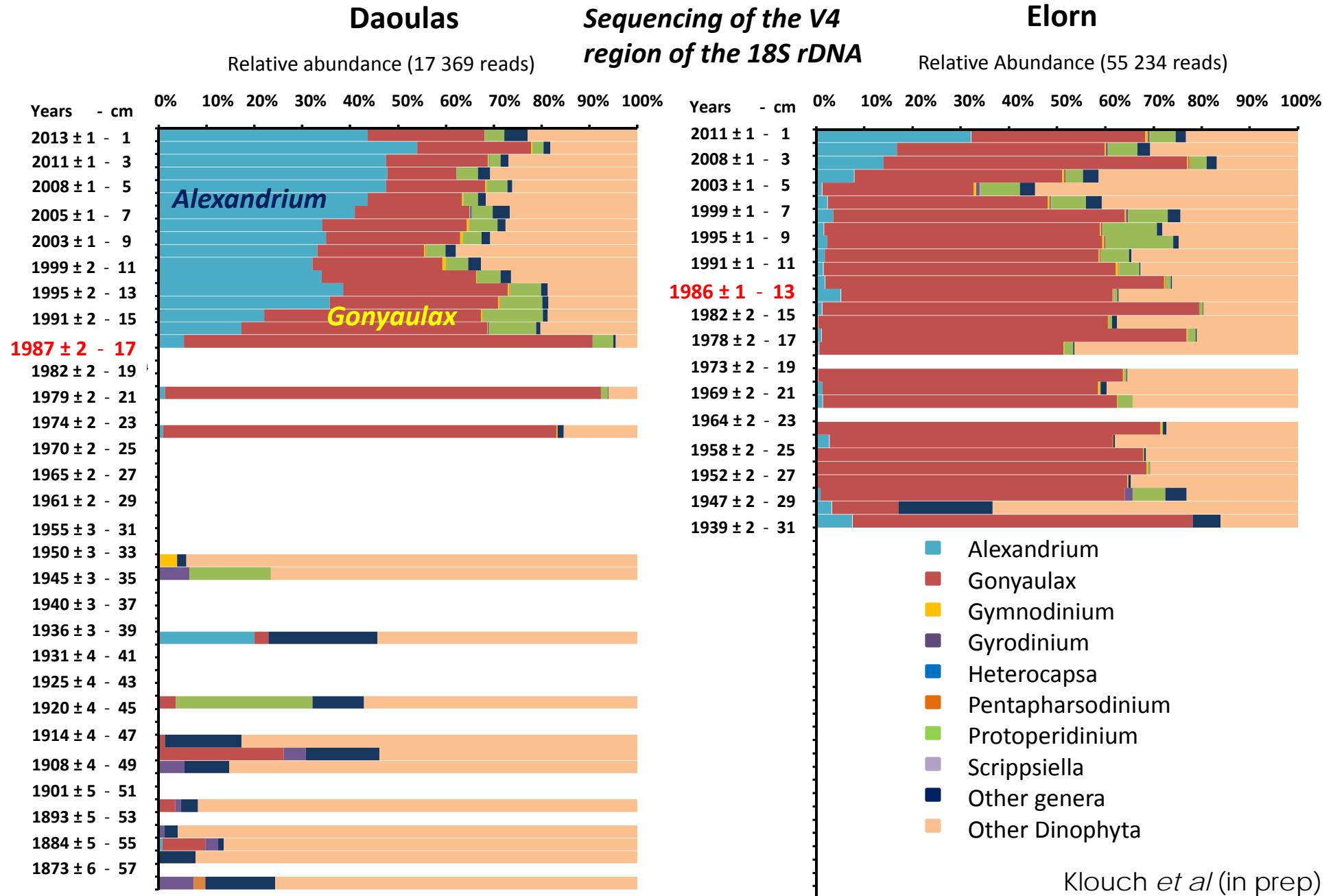
DNA concentration in 2015

A. minutum was detected in 30/30 stations

...and it germinated from all sediment samples of 2013

**From the study of specific taxa
to the analysis of the “global” diversity
(metabarcoding approach)**

Relative abundances of dinoflagellate genera over time



Conclusion

- The paleoecological approach allowed the study of species dynamics at a longer temporal scale than that of monitoring data, but have some limits (DNA degradation...).
- *A. minutum* was present in the Bay of Brest since at least 1873 ± 6 and now occupies the entire area.
- Paleogenetic data showed an increase trend in *A. minutum* abundances and corroborate plankton data
- *A. minutum* could be a native species which has proliferated recently in the Bay of Brest...but new different populations might have been introduced recently and contributed to the observed pattern.

→Need of paleogenetic population-based investigations when interpreting biological invasions.

Thank you for your attention.