Impact of mixing on the seasonal variations of productivity and phytoplankton communities of Lake Edward (East Africa)

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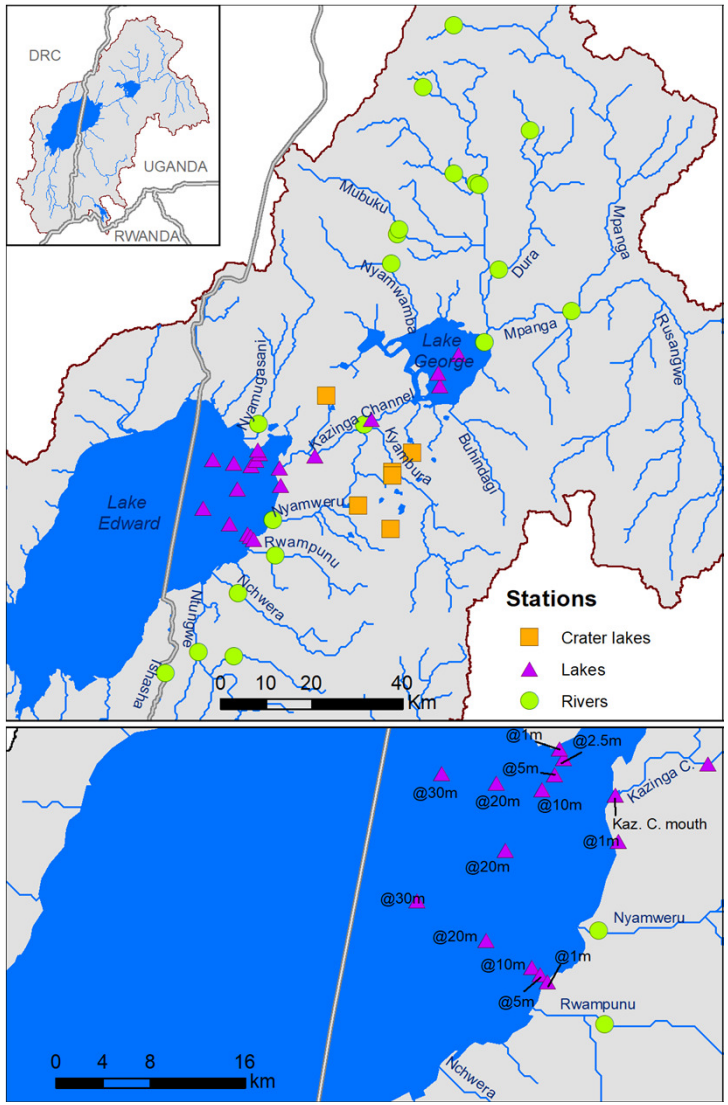
Back ground: Lake Edward

- African Rift valley Great Lake
- Drains into the River Nile Basin
- Home to about 81 fish species
- Employs around 2000 fishers
- Bordered by 2 National Parks



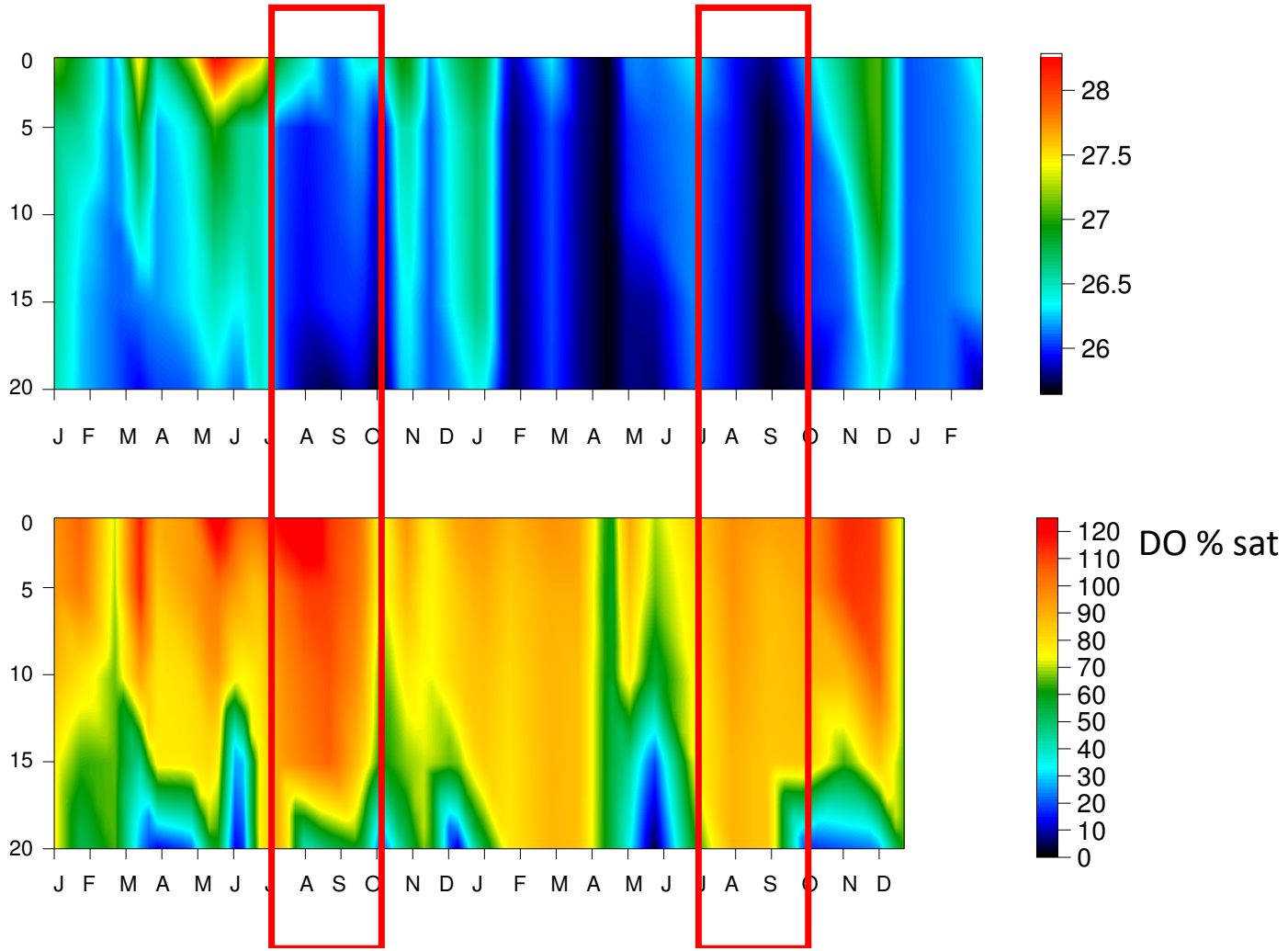
- All these benefits are threatened by the increasing human activities i.e. agriculture, poaching, encroachment on Parks
- **HIPE:** to test the causal relationship between the recent environmental changes and the drastic reduction of fisheries productivity using innovative paleo-proxies, coupled to a study of the present functioning of Lake Edward
- **This study:** Mixing and impact on seasonal variations of productivity and phytoplankton communities

Methodology



- Monthly sampling from January 2017 to October 2018
- YSI multi-probe: Physico-chemical parameters
- Chlorophyll-a and phytoplankton
- High performance liquid chromatography (HPLC): Marker pigment analysis
- CHEMTAX: processing for estimating abundance of phytoplankton groups

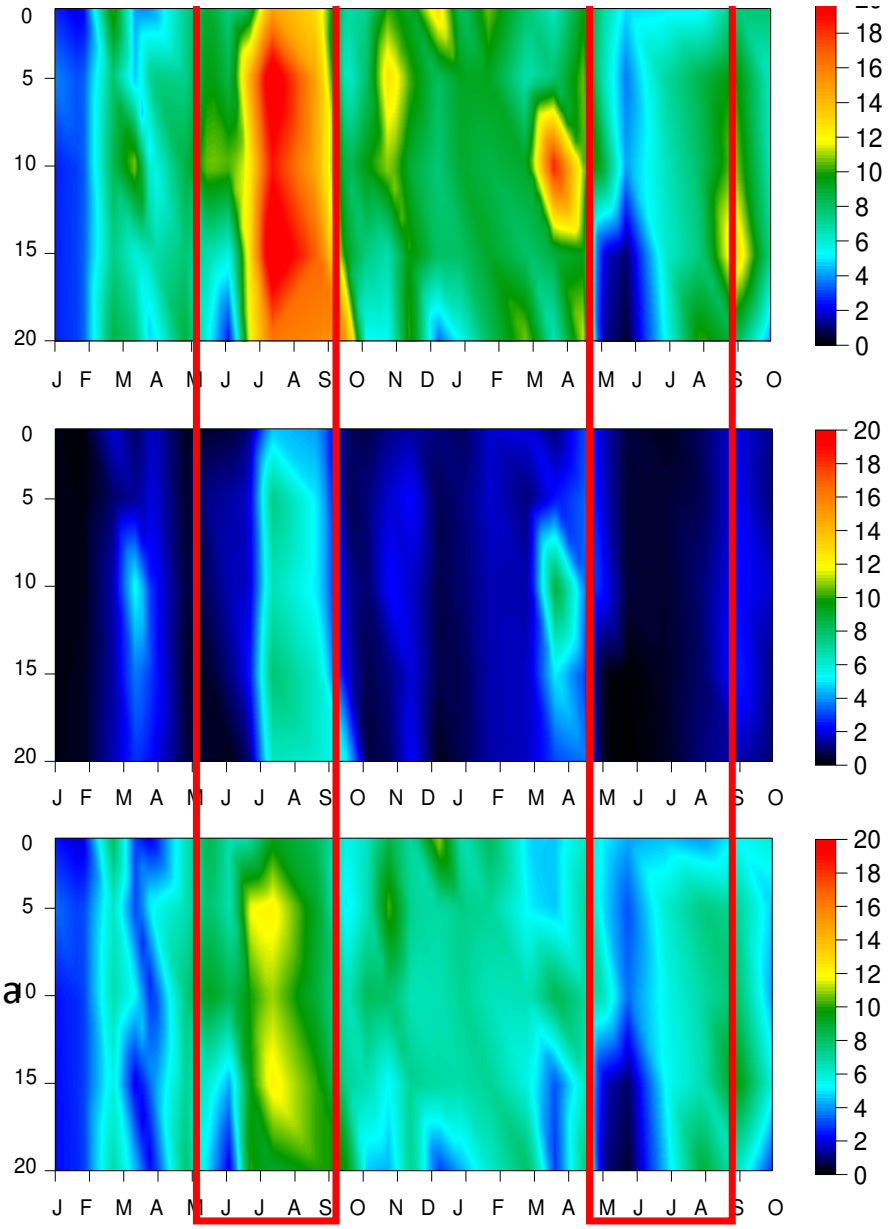
Results: Temperature (°C)



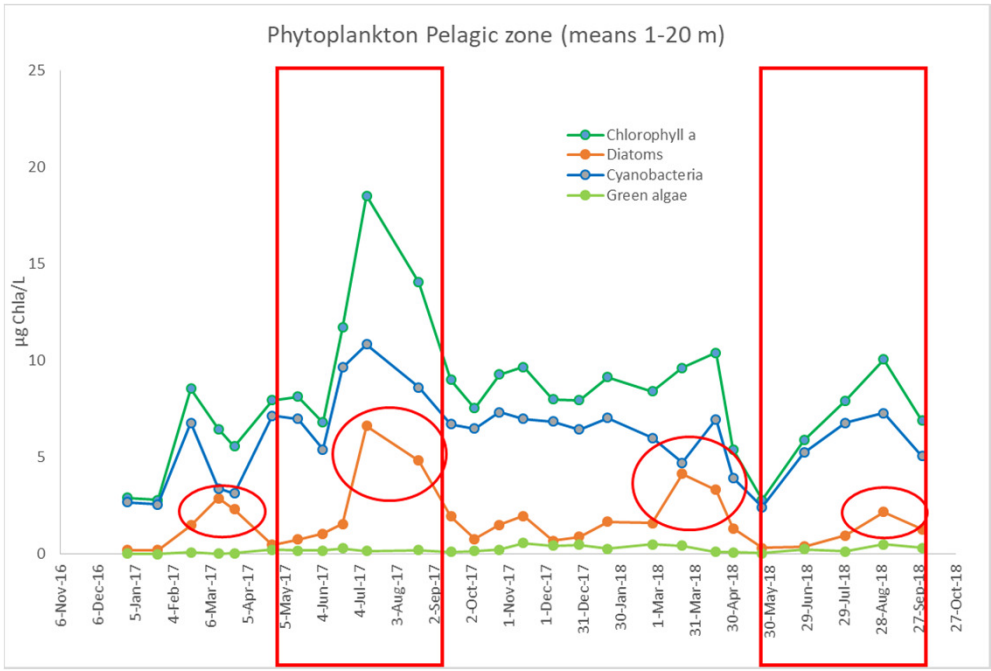
Chlorophyll a

Diatoms

Cyanobacteria

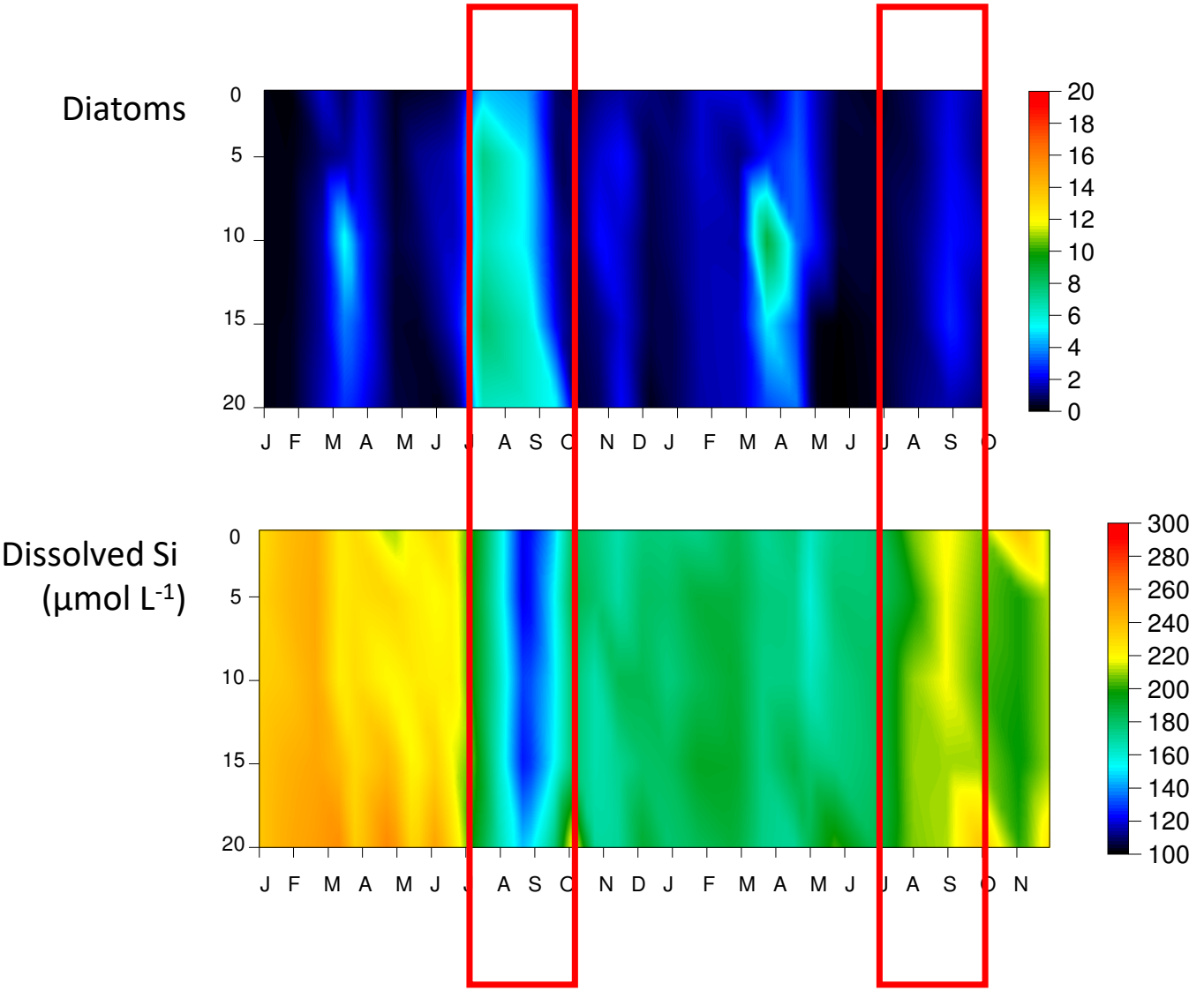


Rectangles : dry season (May-Sep)



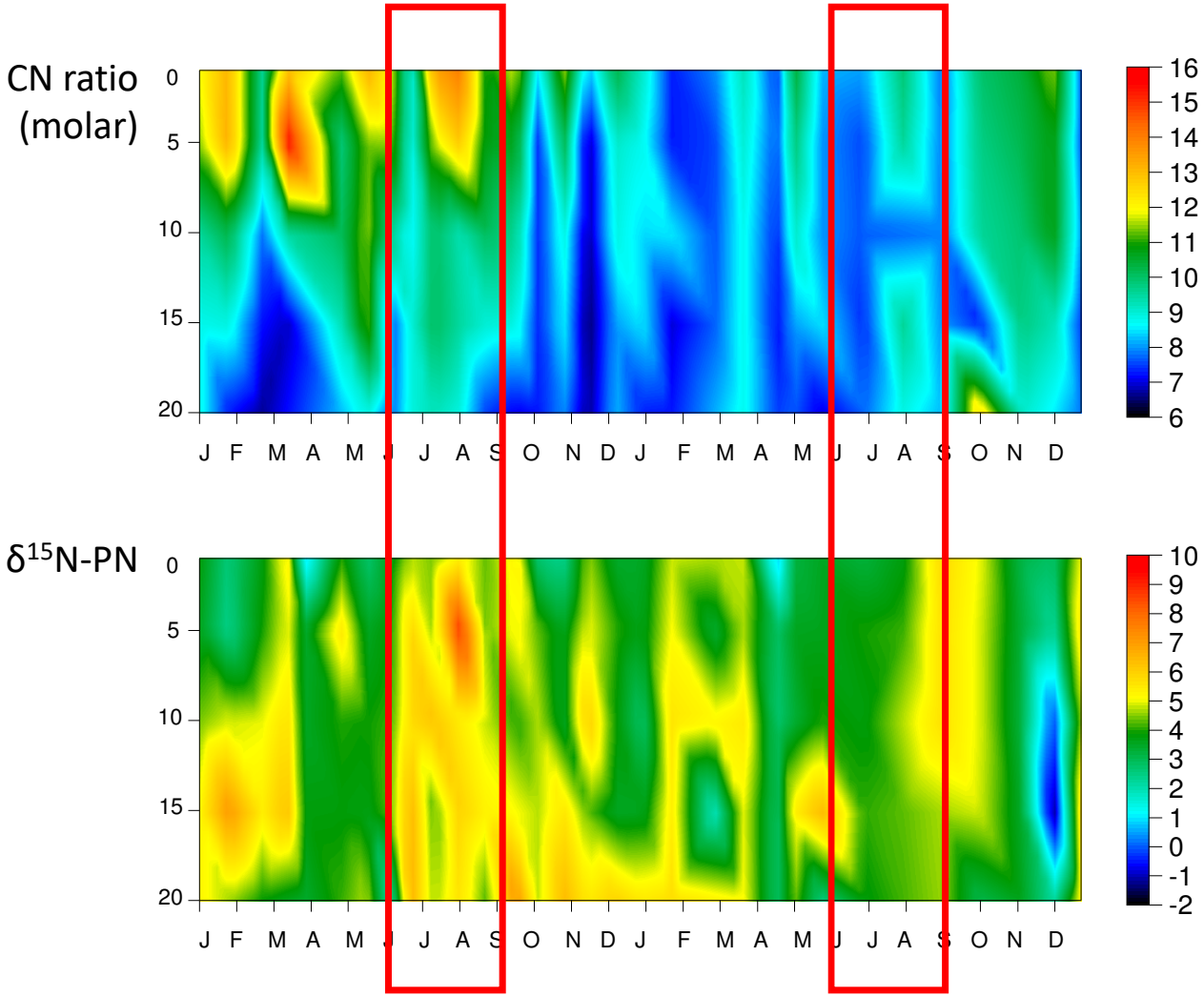
- DS diatom peak in 2017, none in 2018
- Note smaller diatoms peaks in March both years
- Cyanos dominant at all times, peaking also in DS

Why no biomass peak in DS in 2018? In 2017, both cyanos and diatoms increased; in 2018, diatom peak did not occur : some limitation must be involved



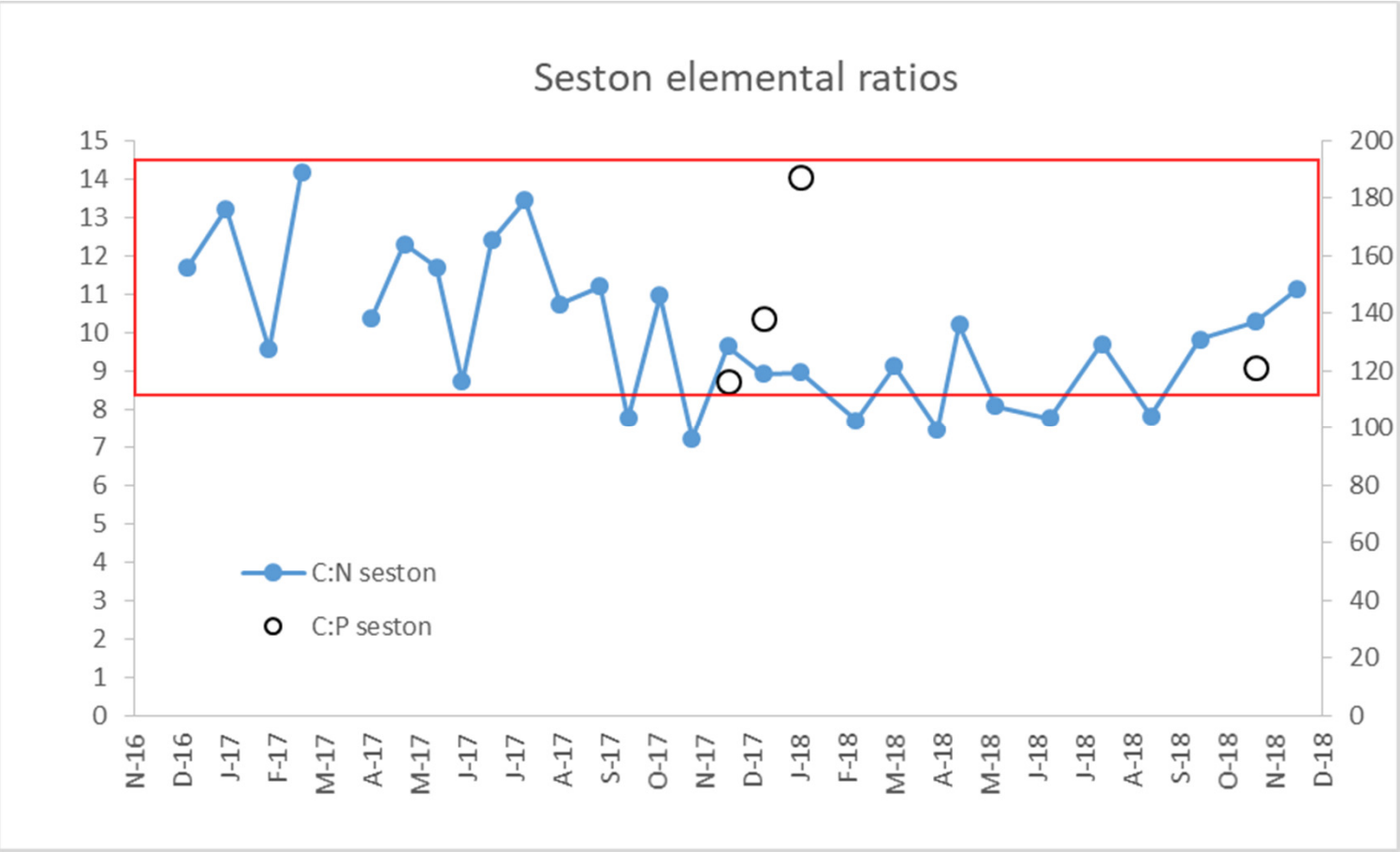
Si limitation unlikely above 4 µmol L^{-1}

Si variation resulted (partly) from diatom uptake (but likely also from Si inputs from the watershed)

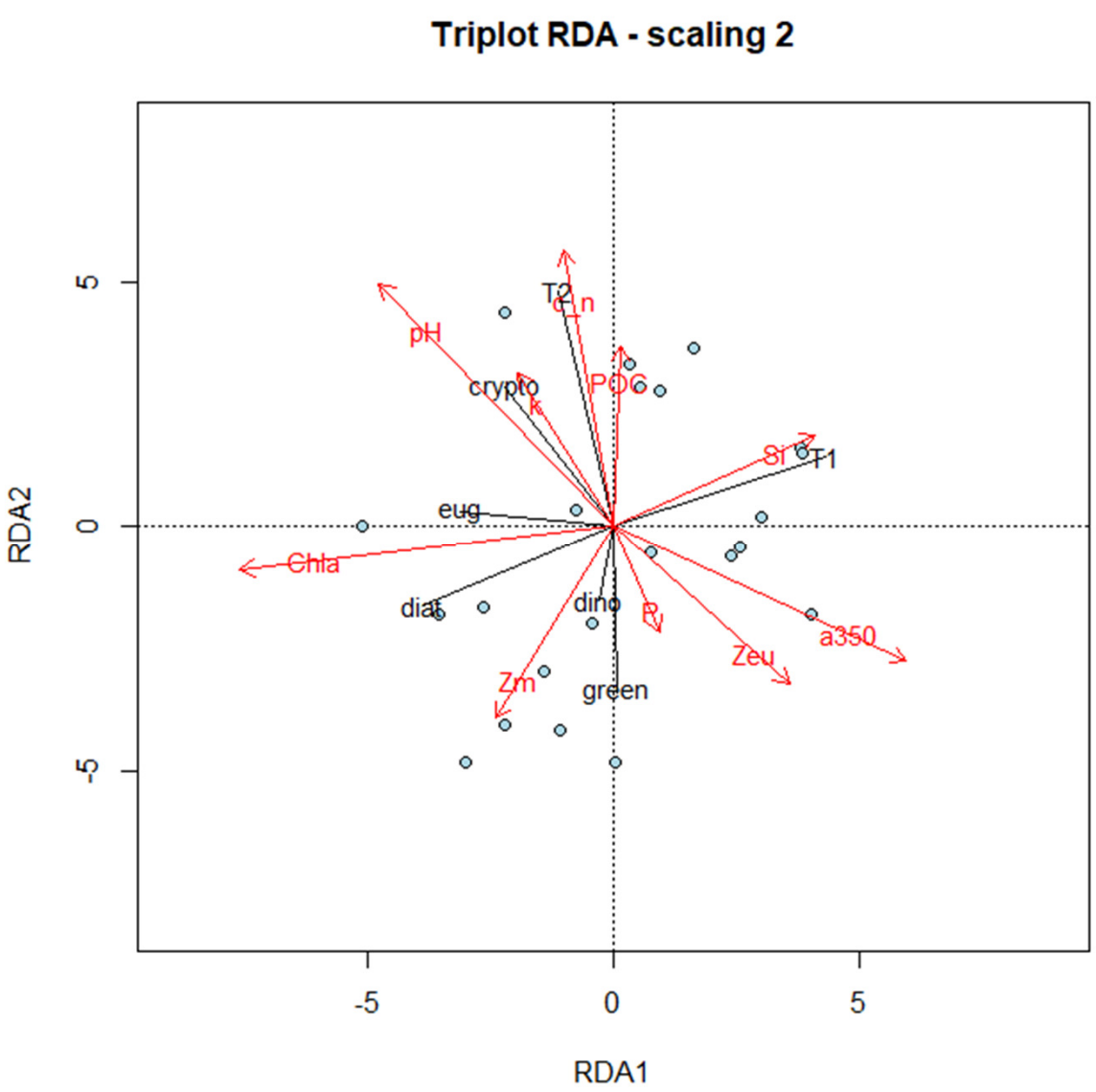


See next slide : moderate N limitation, especially in Jan-Sep 2017

high δ^{15}N-PN resulting from N2 fixation ???



- Red box indicates moderate N limitation (C:N 10.1 ± 1.9)
- P limitation unlikely (SRP 1.1 ± 0.5 µmoles L^{-1})



RDA1=48%
RDA2=19%

- Chlorophyll a correlated to diatom biomass, which is driven by Zm
- Cyanobacteria, especially T2, favoured by stratification, high pH and high C:N (high capacity to take up CO_2 at low concentration and use of HCO_3^- as DIC source) + N_2 fixation
- Cyano T1 succeed when the water column is stratified and when euphotic zone is greater
- No influence of P, as concentration usually > 1 µmole/L (result of frequent mixing down to the bottom)
- Green algae dependent on resuspension from the sediment?

Conclusions

- Two mixing events were observed in the dry season (July to September) of 2017 and 2018, with temperature of about 26 – 26.5°C along a total depth of 20 m
- Despite substantial seasonal variations of limnological conditions such as photic and mixed layer depths, cyanobacteria represented on average 60 % of the phytoplankton biomass.
- The high proportion of heterocystous cyanobacteria, along with a relatively high particulate organic carbon to nitrogen (C:N) ratio, suggest N limitation (and perhaps a light limitation)

Acknowledgment

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THANK YOU