



# LTER-MC Data Report

Version I JULY, 2014

**1984-2013**

**W**elcome to this illustrated Data Report that presents most of the variables collected at LTER-MC station in the Gulf of Naples from 1984 to 2013.

This report represents the first step towards a complete data mining and organization of LTER-MC time series.

The storage and management of the whole dataset and related information are available on <http://szn.macisteweb.com>. The website hosts also the internal Quality Assurance procedures, the analytical methods and protocols. The dataset will be continually updated over the coming years.

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We are grateful to:

- Stazione Zoologica Anton Dohrn for funding the LTER-MC Program
- Progetto Bandiera RITMARE and ENVeurope for support in funding
- University of Genova for implementation of the information system MACISTE



## ILTER-MC



**The research Program MareChiara** was launched by SZN in 1984 for the study of the coastal pelagic system in the Gulf of Naples with the aim of investigating the structure and functioning of planktonic communities in relation to the environmental variability and climate change.

The sampling site LTER-MC is located 2 miles offshore the city of Naples, on the 75 m isobath, at the border between the coastal eutrophic system influenced by land runoff and the offshore oligotrophic waters with characteristics of the southern Tyrrhenian Sea.

## The long-term ecological research MareChiara

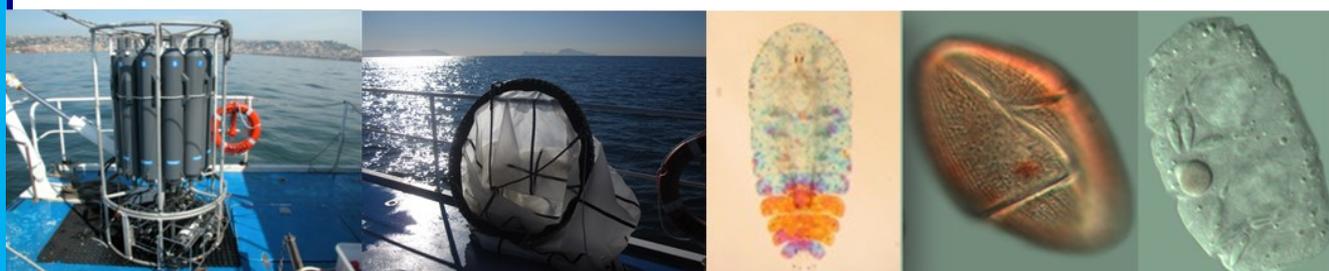


Station LTER-MC belongs to the Italian (LTER-Italia), European (E-Europe) and international (I-LTER) networks of Long Term Ecological Research and is one of the few Mediterranean sites for the regular monitoring of marine plankton.

The sampling and observational activities at station LTER-MC raise questions and hypotheses that are addressed through *ad hoc* field and laboratory experiments whose results are then used to interpret observations, with particular attention to the possible impact of climate change on marine ecosystems.

**We are presently addressing the following main research topics:**

- **Carbon and nutrient dynamics in the water column**
- **Chemotaxonomy and photophysiology of phytoplankton communities**
- **Biodiversity**
- **Phenology**
- **Succession of congeneric species**
- **Structure and functioning of plankton communities**
- **Long-term variability of plankton communities in relation to climate change**
- **Metagenomics**



# Data Report

## LTER-MC

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### Reading notes for the graphical representation of the environmental and biological variables

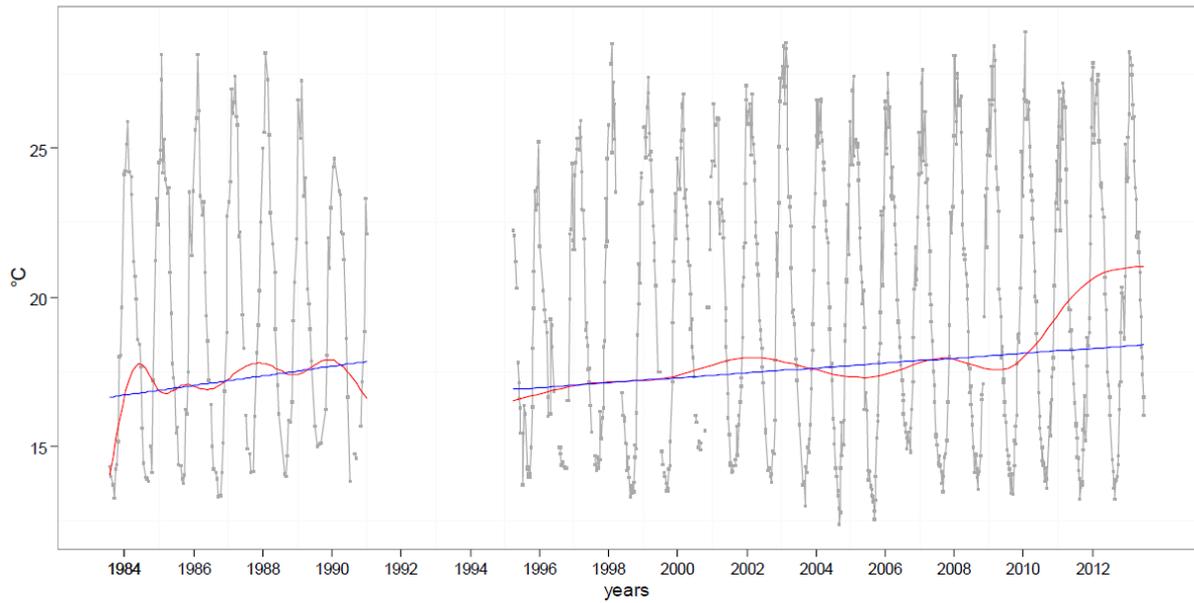
Figures (a) show the temporal distribution of the variables. Filters based on local linear smoothing were applied: the blue line is the regression line, the red line is the local polynomial regression curve. A test for linear deterministic trend (T-test) for the sub-periods 1984-1990 and 1995-2013 (for microzooplankton 1997-2010) was performed: values for the estimated coefficients and the p values are reported below the figure. The significance level  $\alpha$  was set to 5%.

Box and whiskers plots show the distribution of data at weekly (Figures b), monthly (Figures c), and annual (Figures e) scale. Reported information concern the minimum, the lower quartile Q1 (bottom line of the box), the median (thick line at the middle of the box), the upper quartile Q3 (upper side of the box) and the maximum. Data points beyond the whiskers are considered as possible outliers.

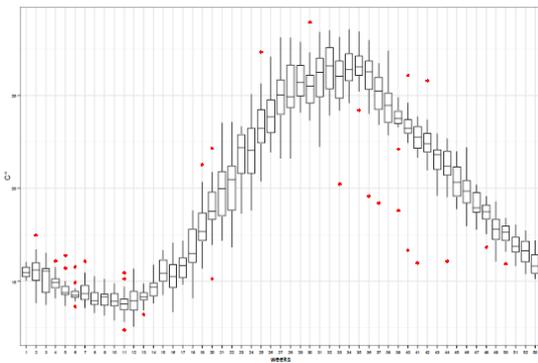
Figures (d) report the heatmaps with the weekly (x-axis) and annual (y-axis) distribution of the variables. Plankton abundances were log-transformed.

# Environmental variables

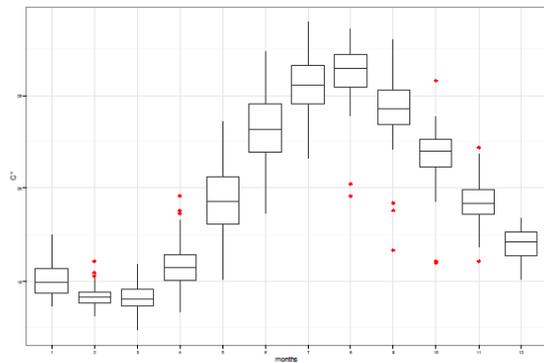
## TEMPERATURE 0m



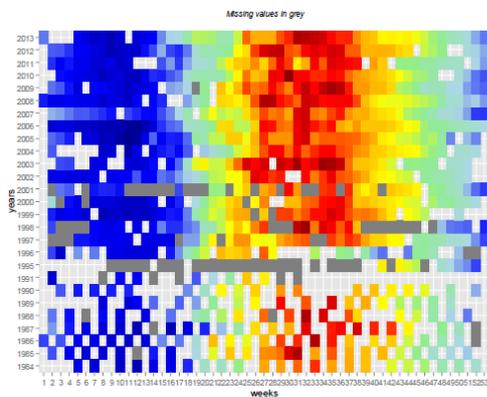
(a) Trend test 1984-1990  $\text{coef} = 0.0004404479$ ,  $\text{pvalue} < 0.001$ ; 1985-2013  $\text{coef} = 0.000000000000002745639$ ,  $\text{pvalue} < 0.001$ .



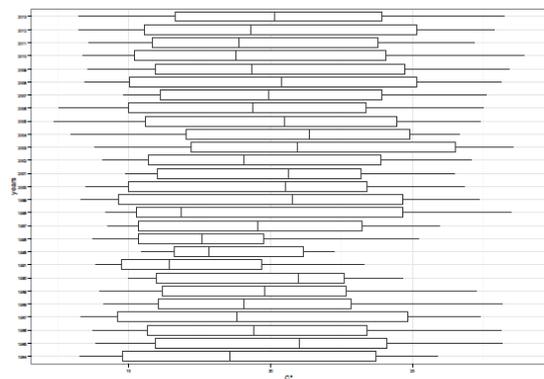
(b) Weekly distribution



(c) Monthly distribution

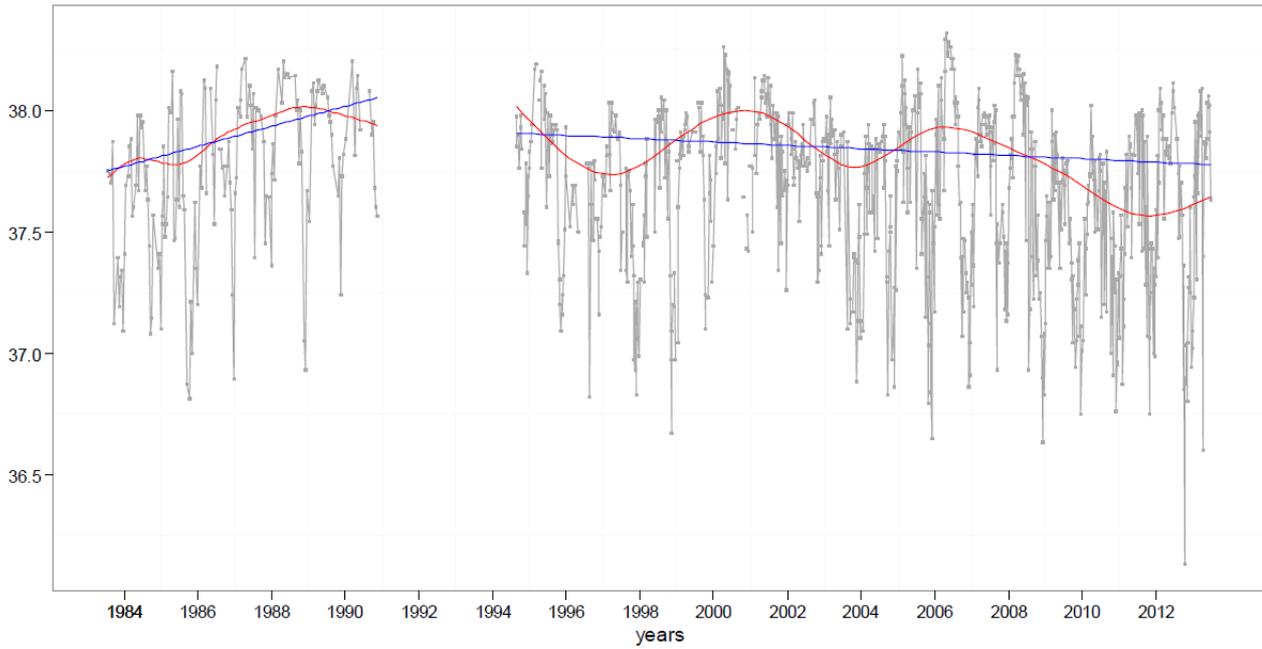


(d) Heatmap

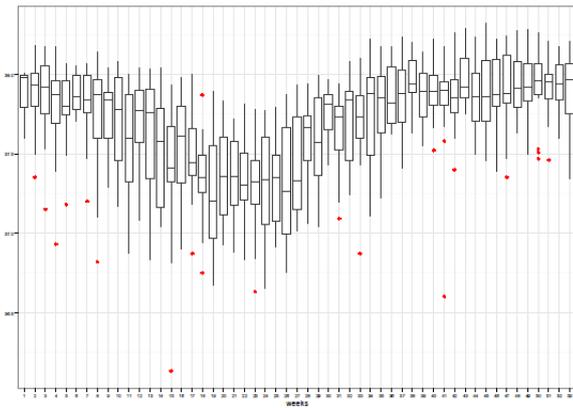


(e) Annual distribution

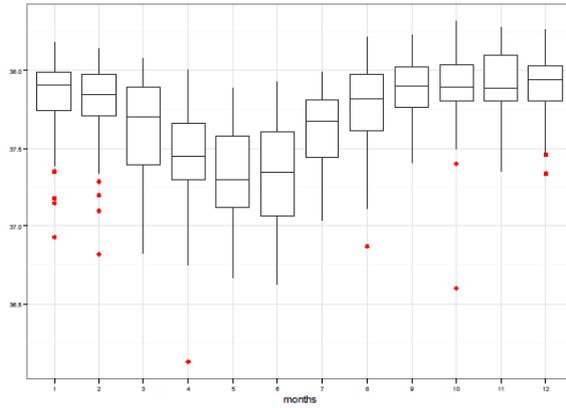
## SALINITY 0m



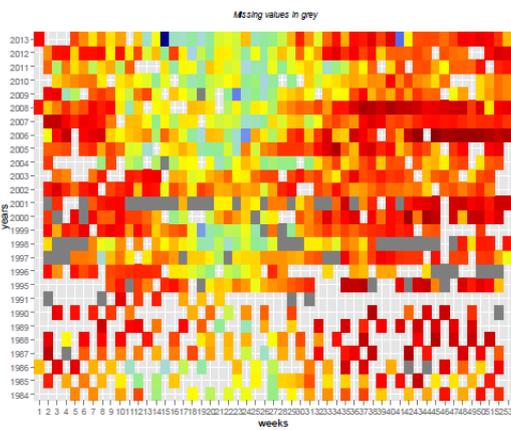
(a) Trend test 1984-1990 coef= 0.0001129056, pvalue<0.001; 1995-2013 coef= -0.00001887571, pvalue <0.001.



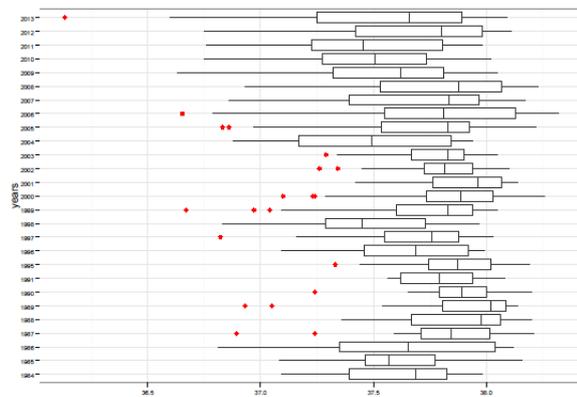
(b) Weekly distribution



(c) Monthly distribution

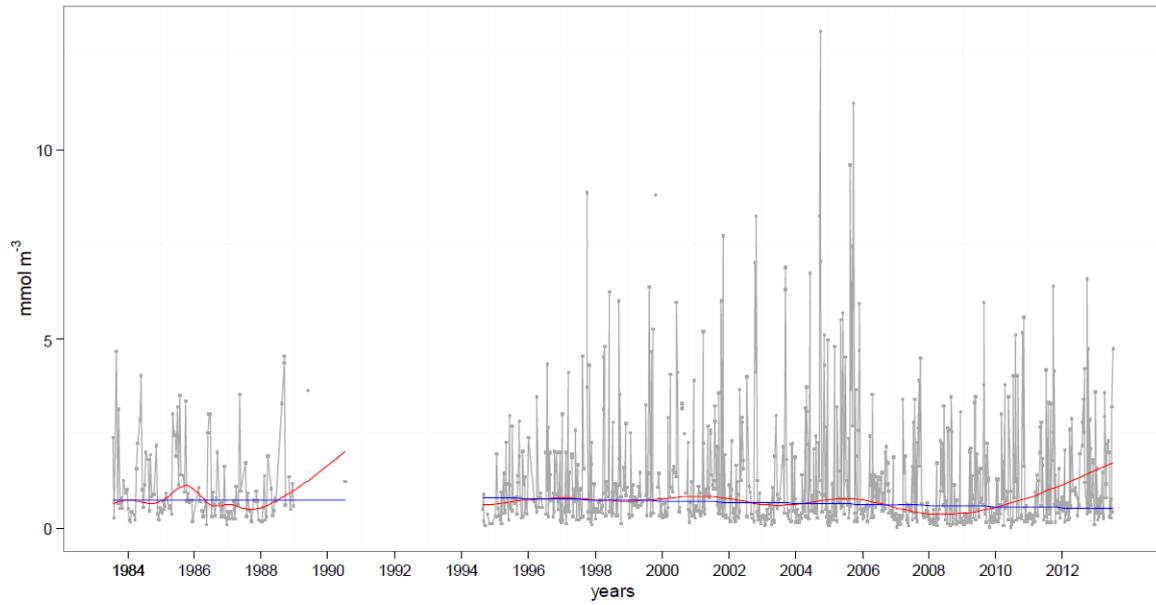


(d) Heatmap

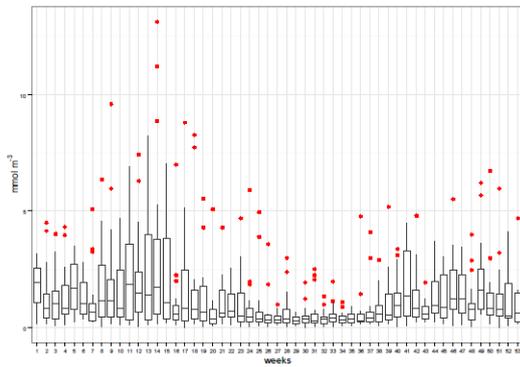


(e) Annual distribution

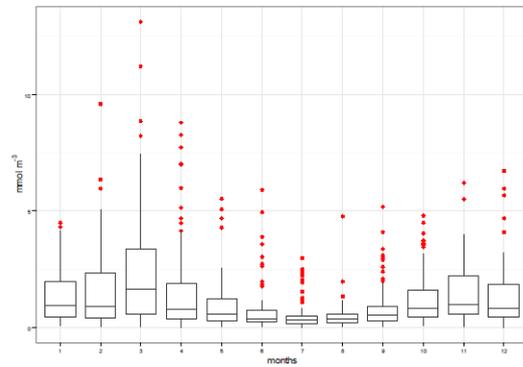
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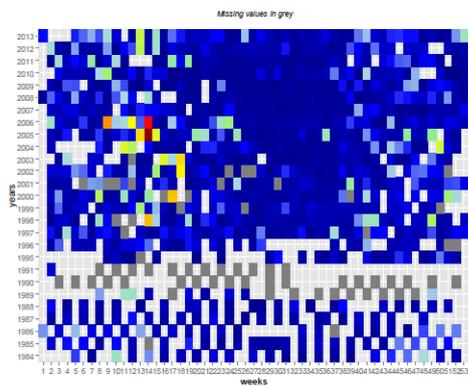
(a) Trend test 1984-1990 coef= 0.00007496872, pvalue= 0.8188216; 1995-2013 coef= -0.00004177313, pvalue <0.001.



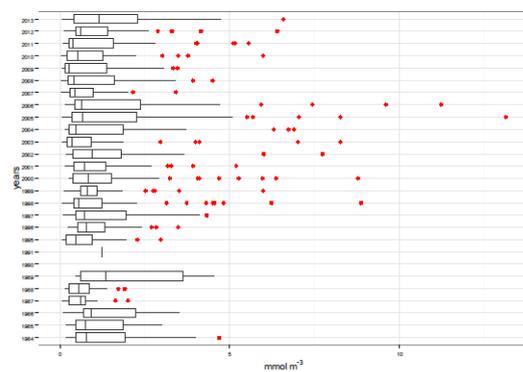
(b) Weekly distribution



(c) Monthly distribution

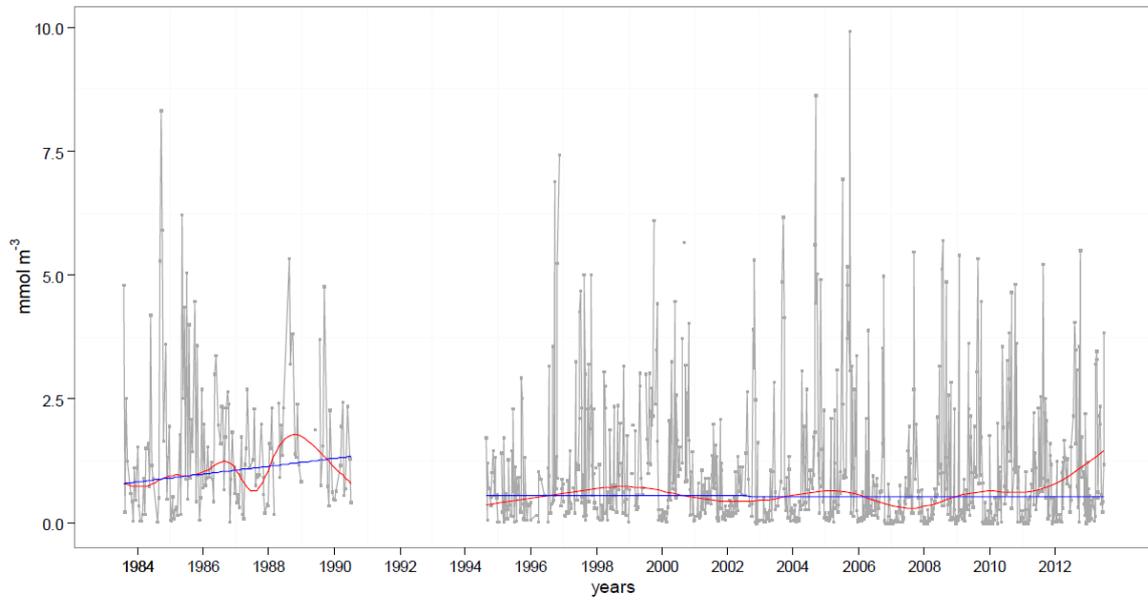


(d) Heatmap

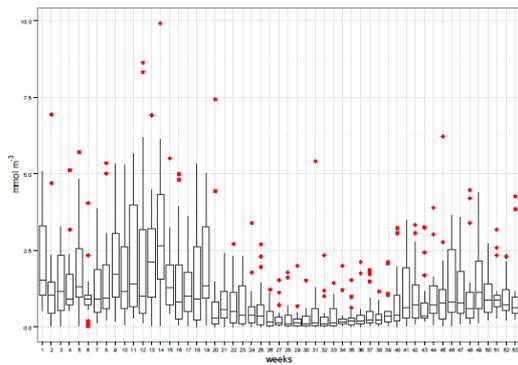


(e) Annual distribution

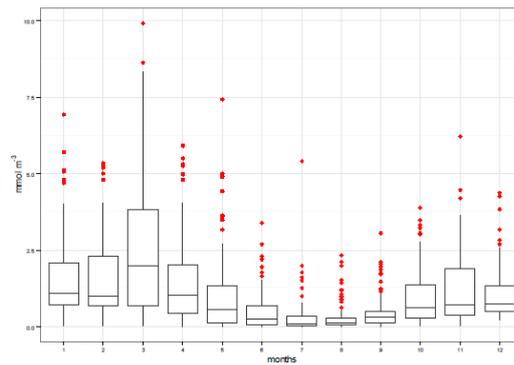
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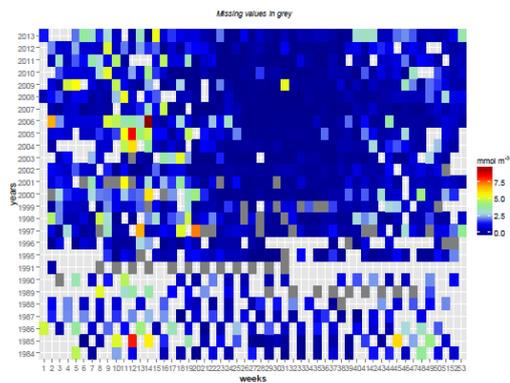
(a) Trend test 1984-1990 coef = 0.0002161714, pvalue < 0.001; 1995-2013 coef = -0.000002976603, pvalue = 0.5764665.



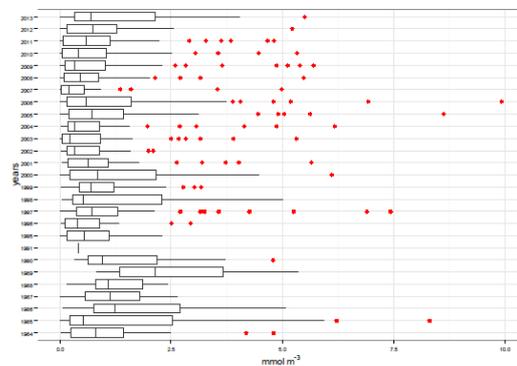
(b) Weekly distribution



(c) Monthly distribution

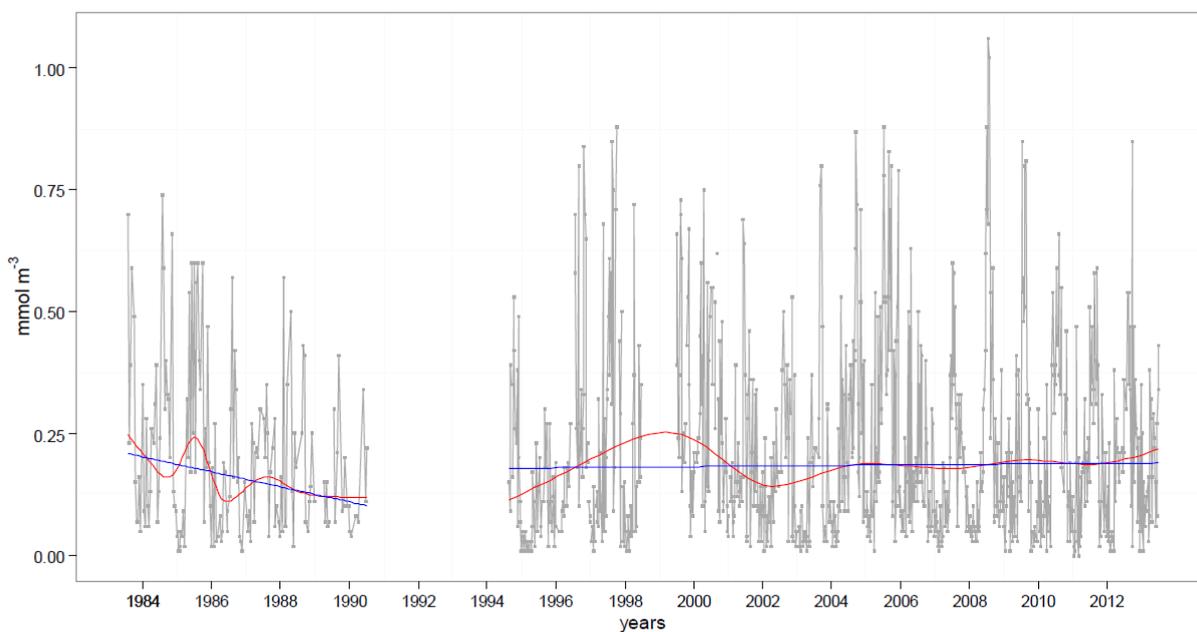


(d) Heatmap

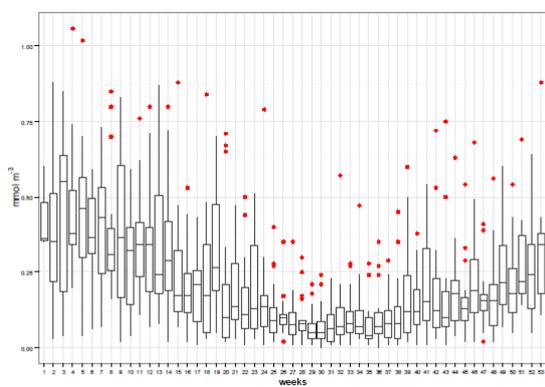


(e) Annual distribution

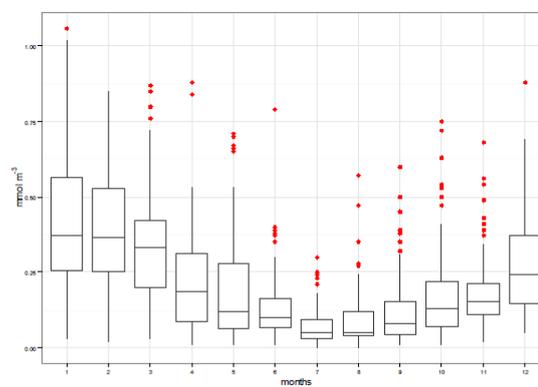
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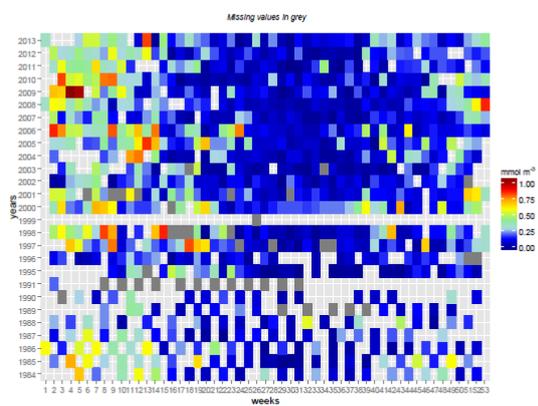
(a) Trend test 1984-1990 coef = -0.00004210593, pvalue < 0.001; 1995-2013 coef = 0.000001568784, pvalue = 0.191334.



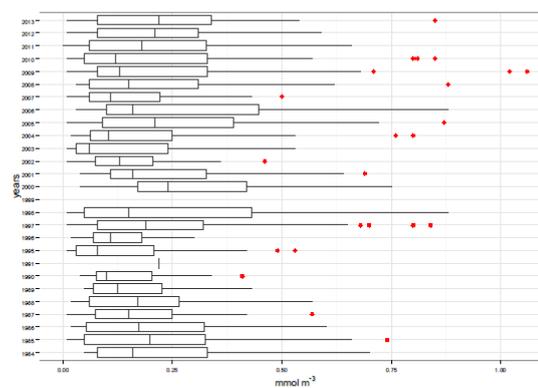
(b) Weekly distribution



(c) Monthly distribution

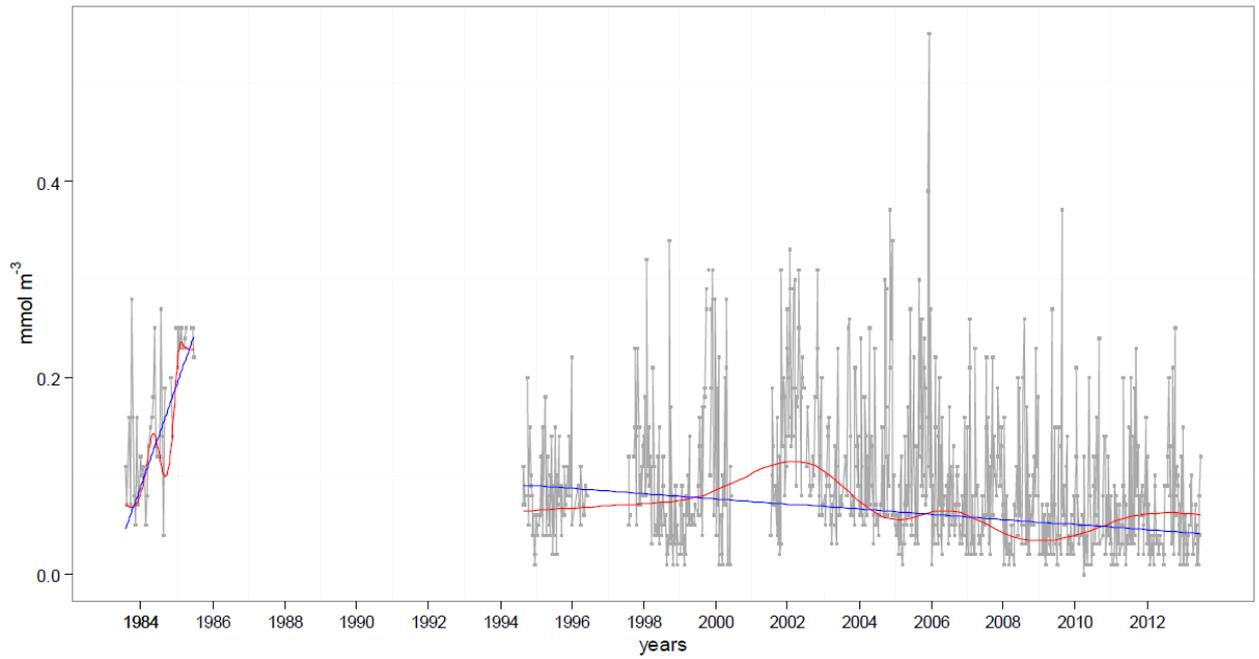


(d) Heatmap

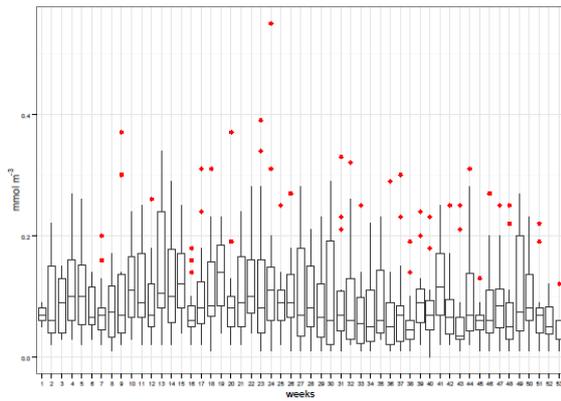


(e) Annual distribution

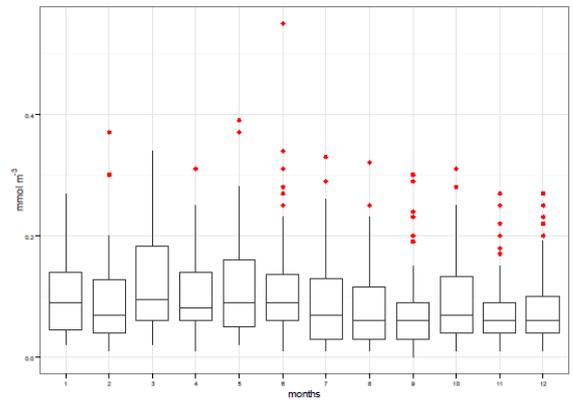
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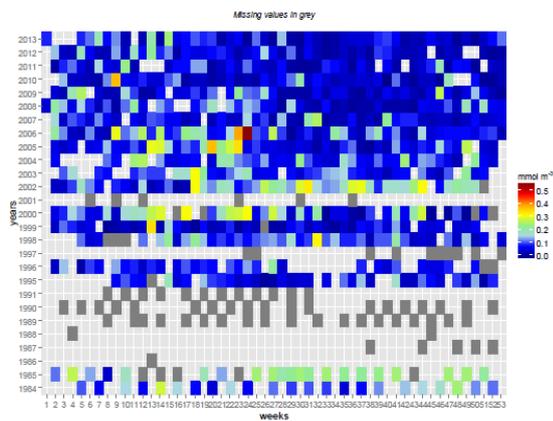
(a) Trend test 1984-1990 coef = 0.0002825847, pvalue < 0.001; 1995-2013 coef = -0.000007181128, pvalue < 0.001.



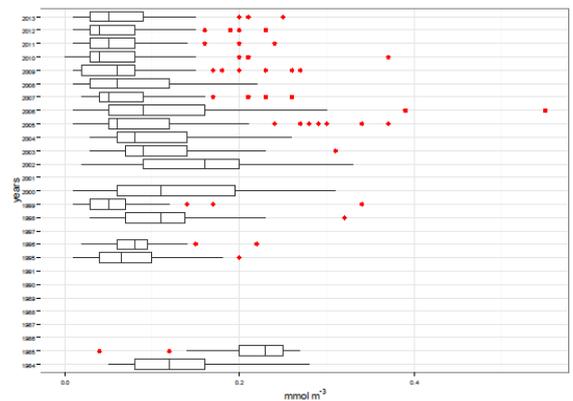
(b) Weekly distribution



(c) Monthly distribution

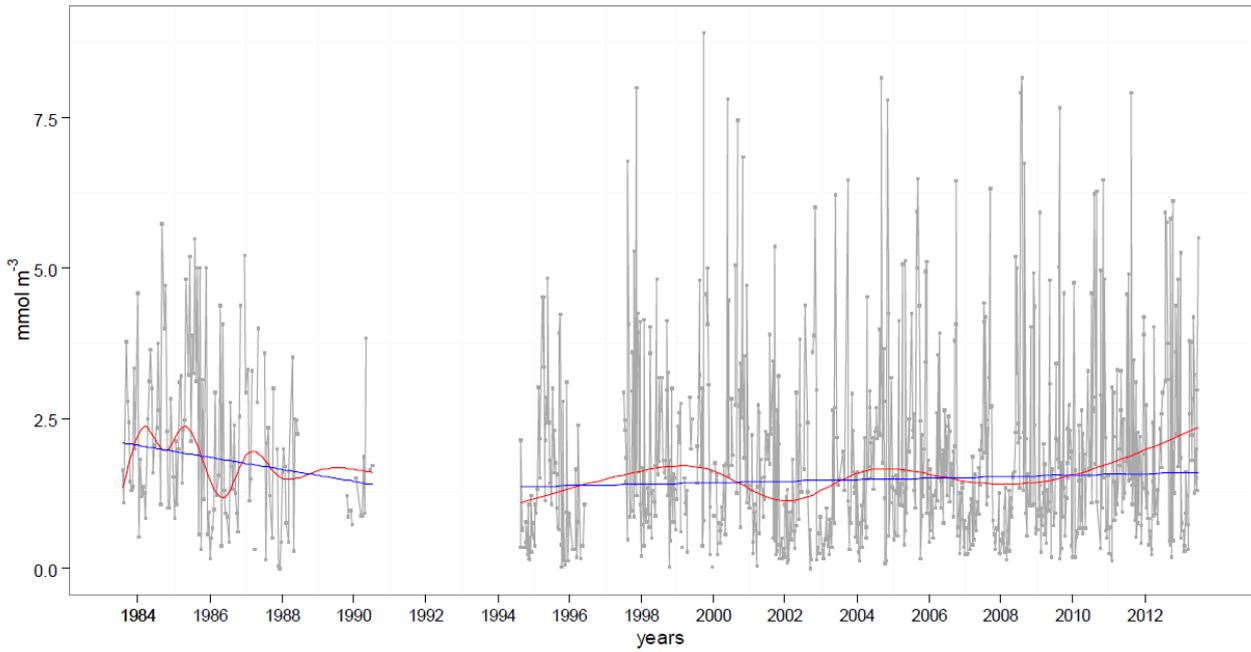


(d) Heatmap

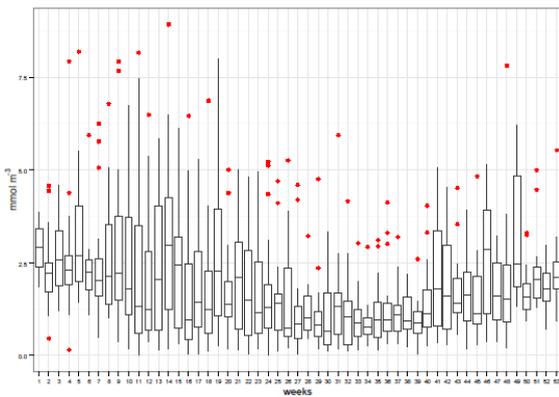


(e) Annual distribution

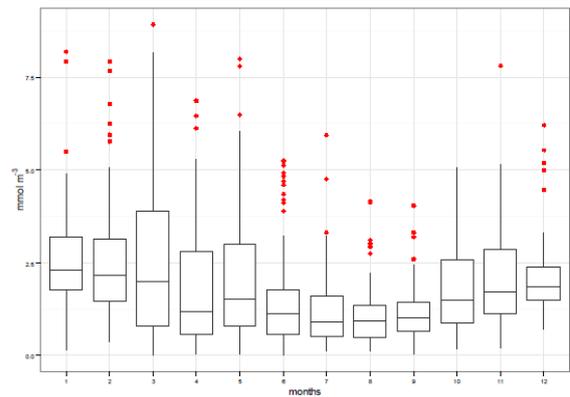
### SiO<sub>4</sub> 0m



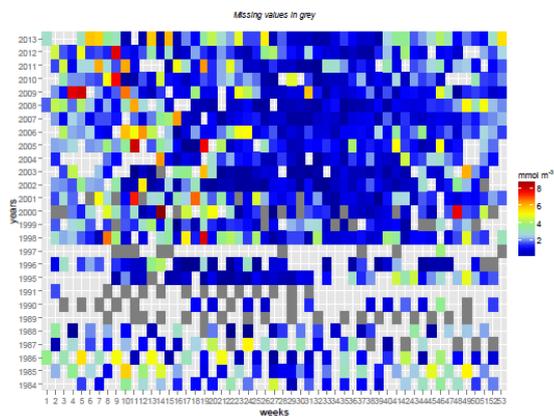
(a) Trend test 1984-1990 coef = -0.0002738482, pvalue <0.001; 1995-2013 coef= 0.00003458323-, pvalue <0.001.



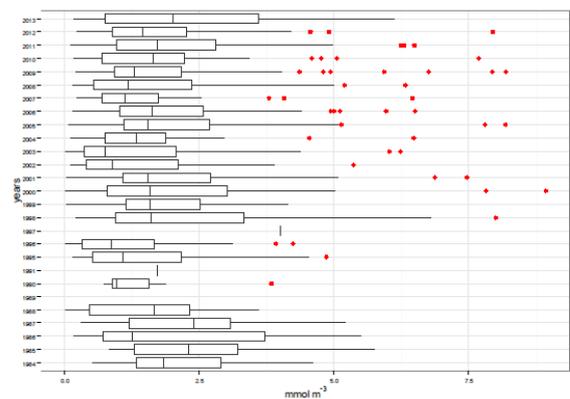
(b) Weekly distribution



(c) Monthly distribution

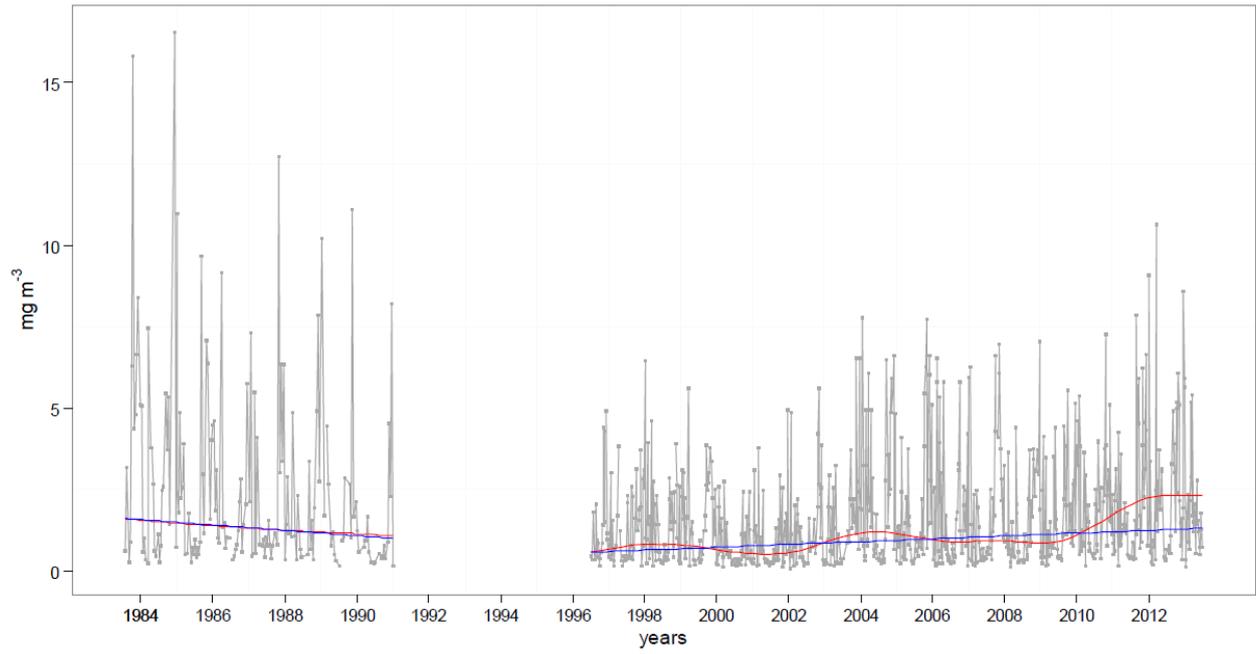


(d) Heatmap

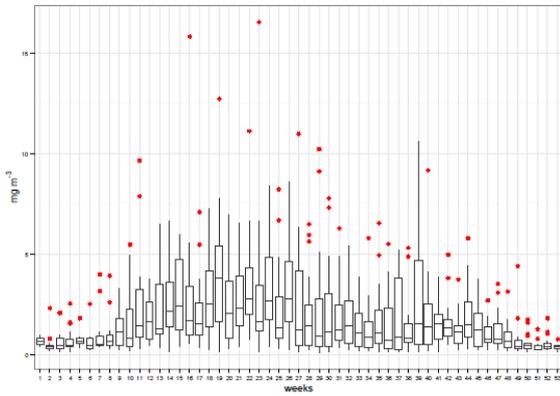


(e) Annual distribution

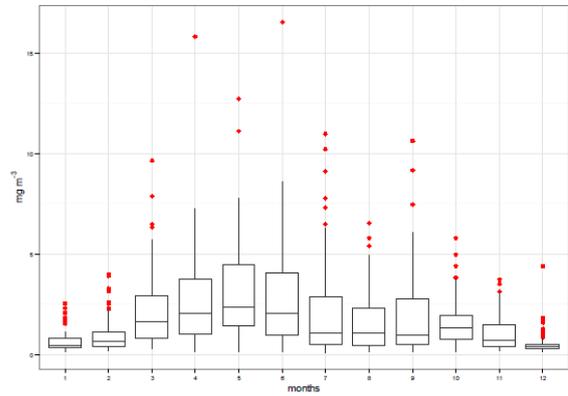
# Chl a 0m



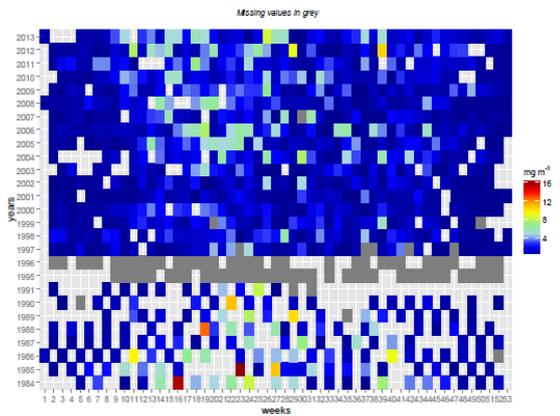
(a) Trend test 1984-1990 coef = -0.000226555, pvalue = 0.002352366; 1995-2013 coef 0.0001188536, pvalue <0.001.



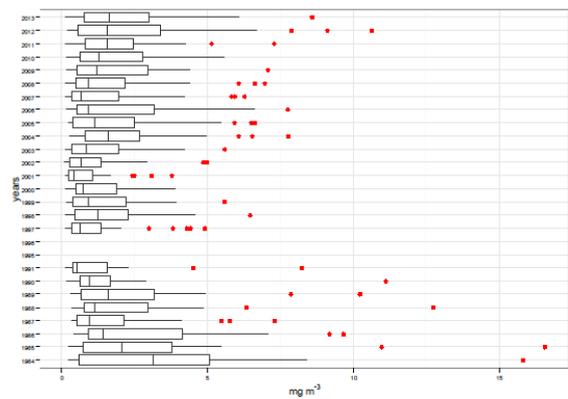
(b) Weekly distribution



(c) Monthly distribution



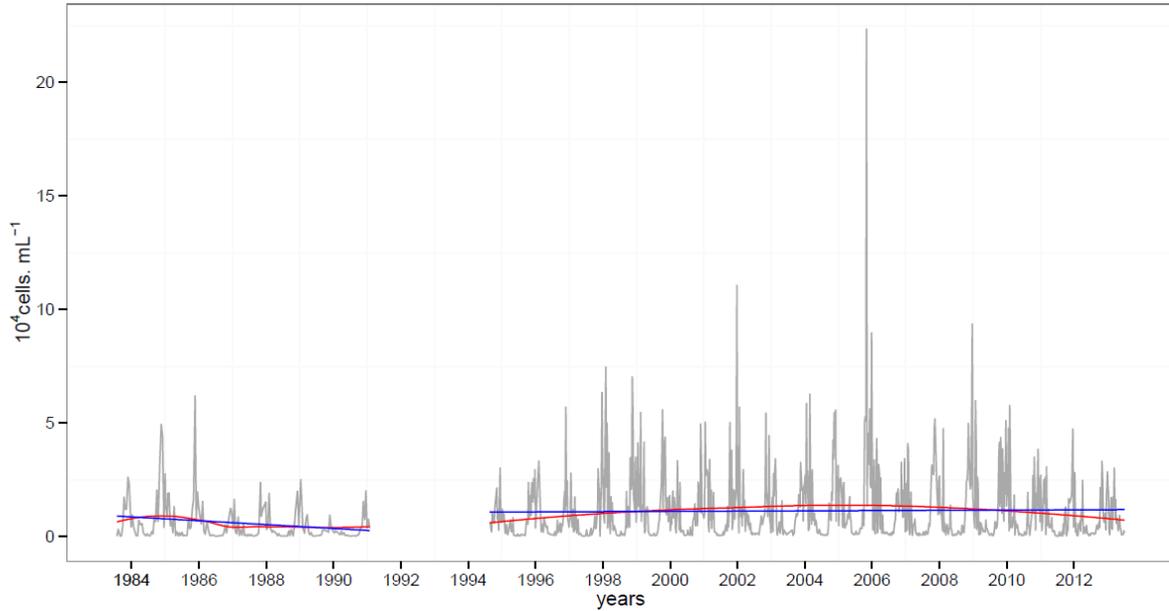
(d) Heatmap



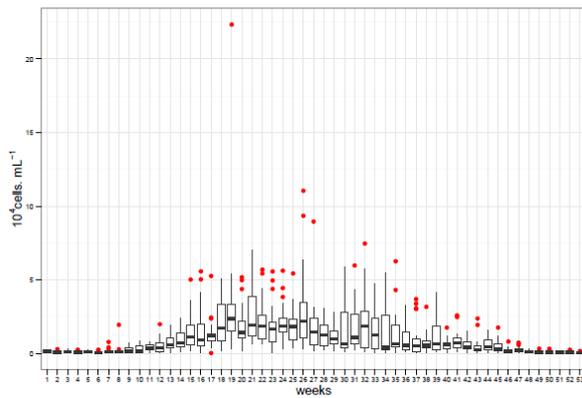
(e) Annual distribution

# Phytoplankton

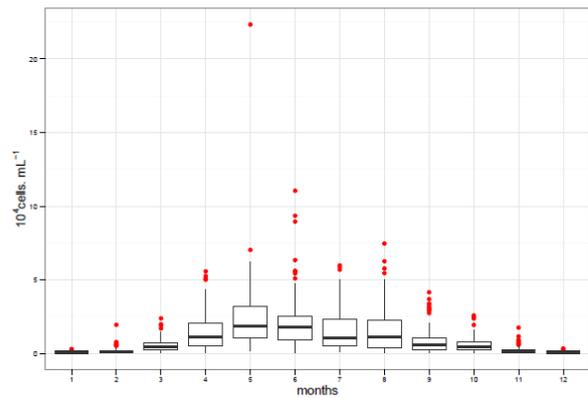
## TOTAL PHYTOPLANKTON



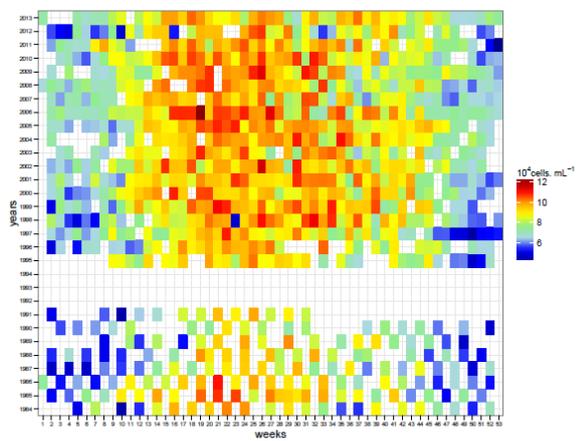
(a) Trend test 1984-1990 coef= -2.3253, pvalue= 0.0067; 1995-2013 coef= 0.1556, p-value= 0.5635



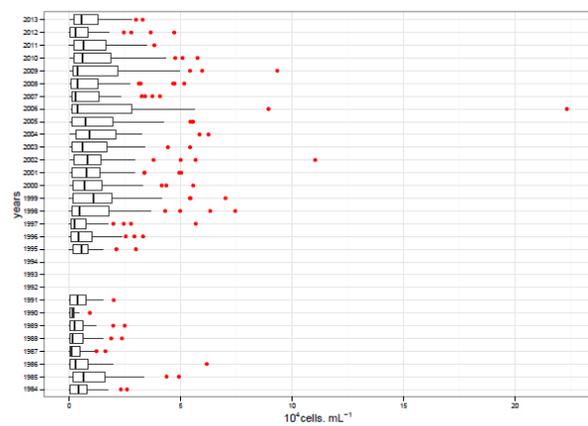
(b) Weekly distribution



(c) Monthly distribution

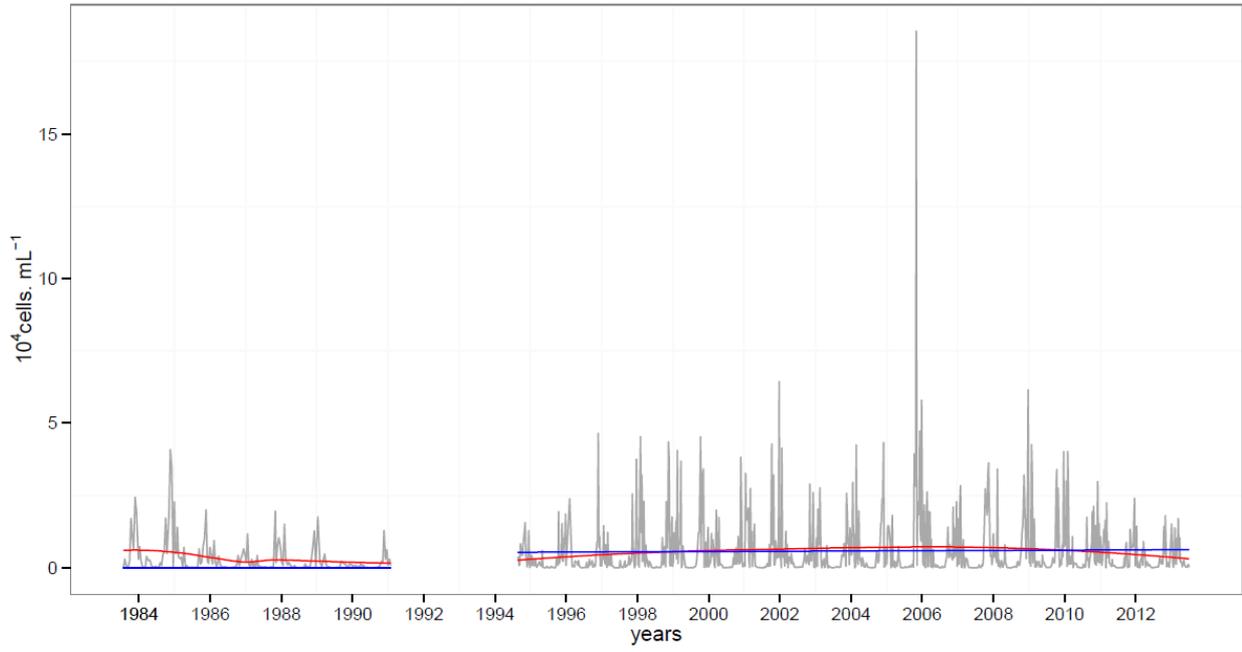


(d) Heatmap

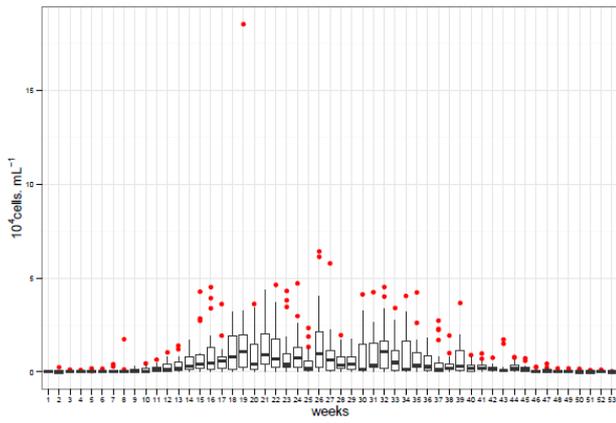


(e) Annual distribution

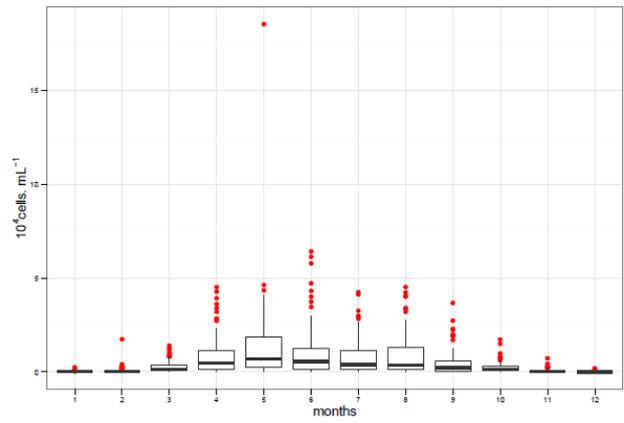
# DIATOMS



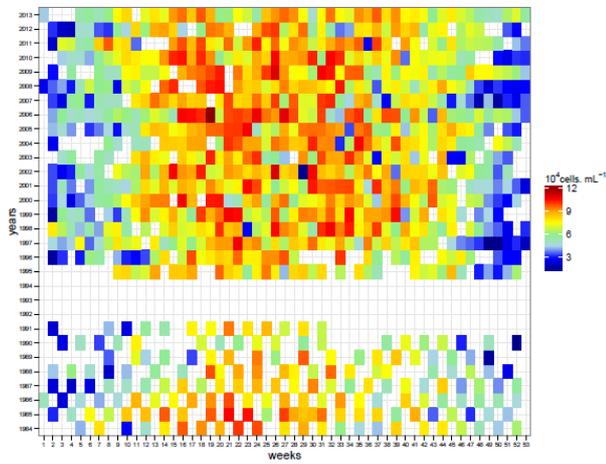
(a) Trend test 1984-1990 coef= -1.9355, pvalue= 0.0009; 1995-2013 coef= 0.1287, p-value= 0.4997



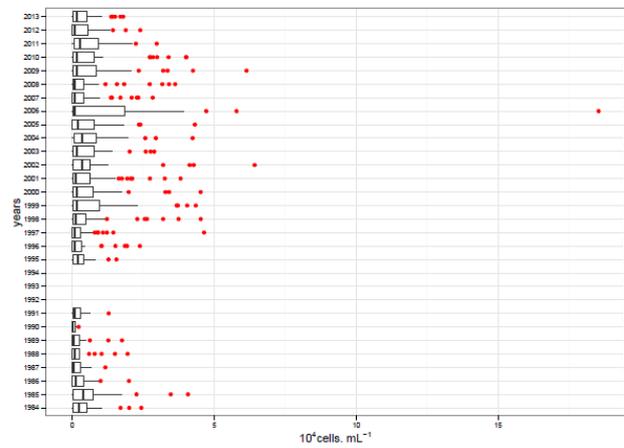
(b) Weekly distribution



(c) Monthly distribution

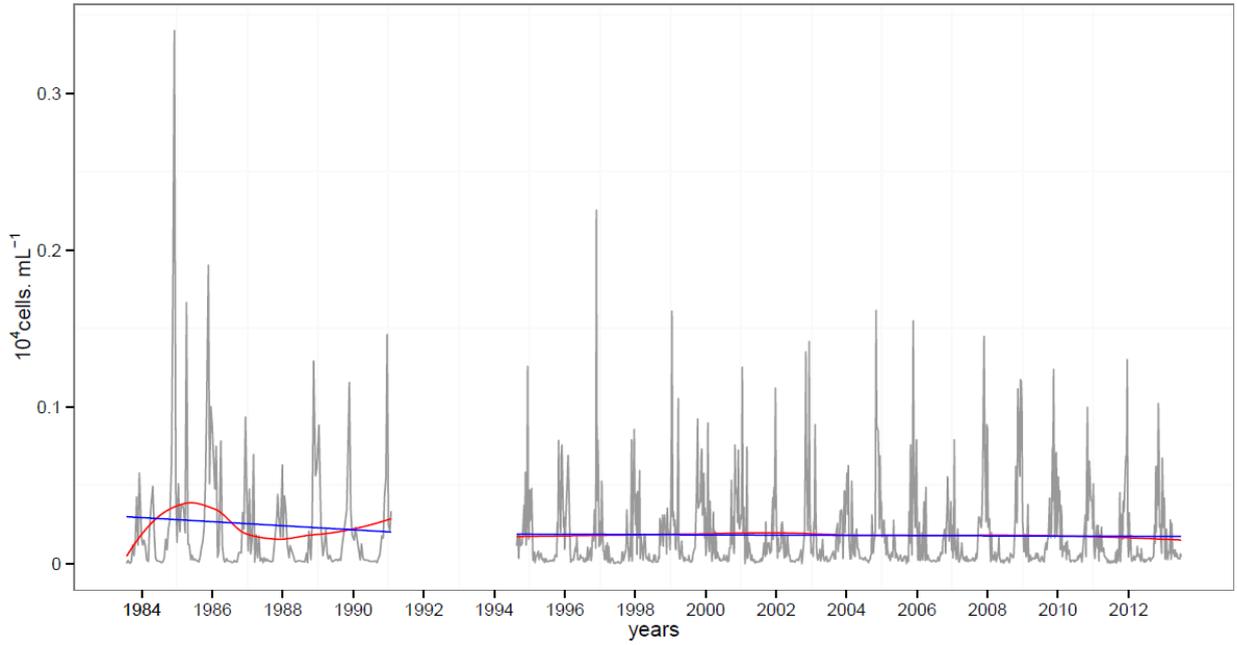


(d) Heatmap

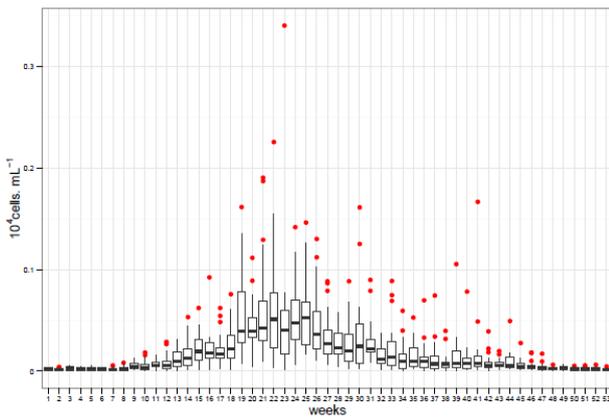


(e) Annual distribution

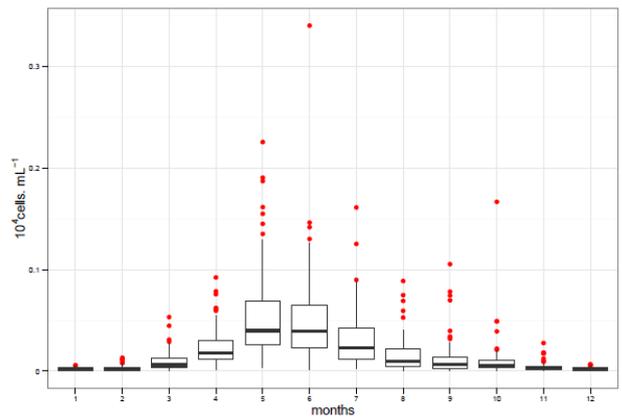
# DINOFLAGELLATES



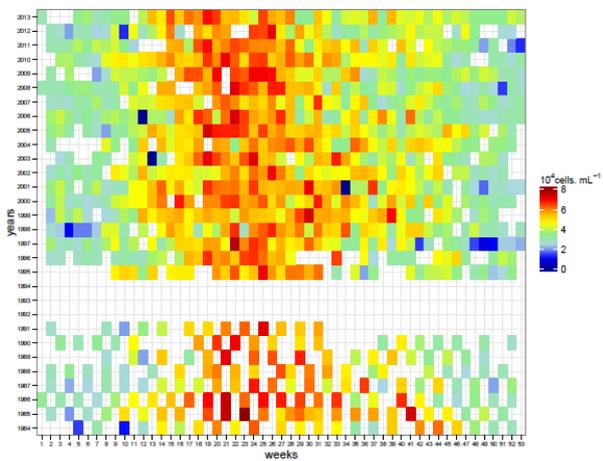
(a) Trend test 1984-1990 coef= -0.0355, pvalue= 0.377; 1995-2013 coef= -0.0021, p-value= 0.6265



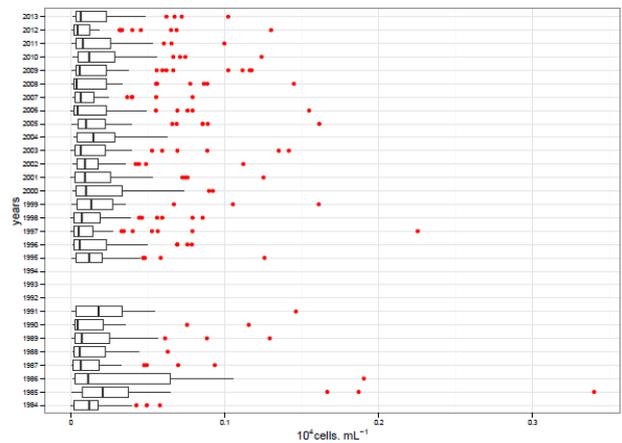
(b) Weekly distribution



(c) Monthly distribution

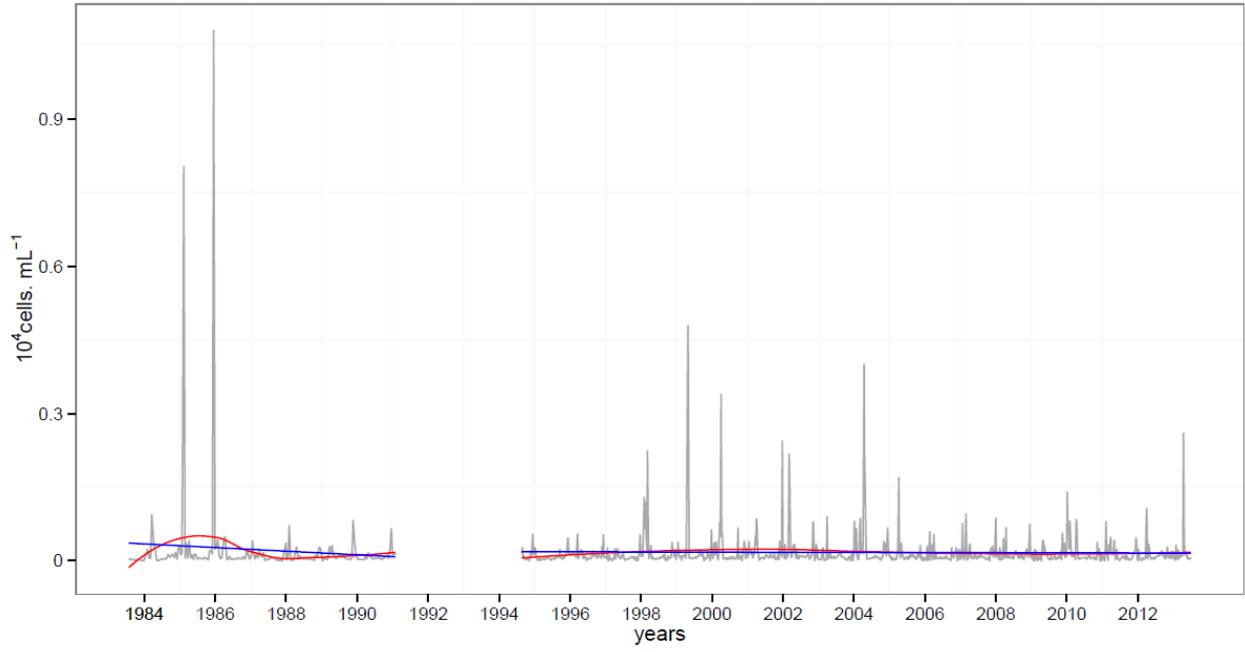


(d) Heatmap

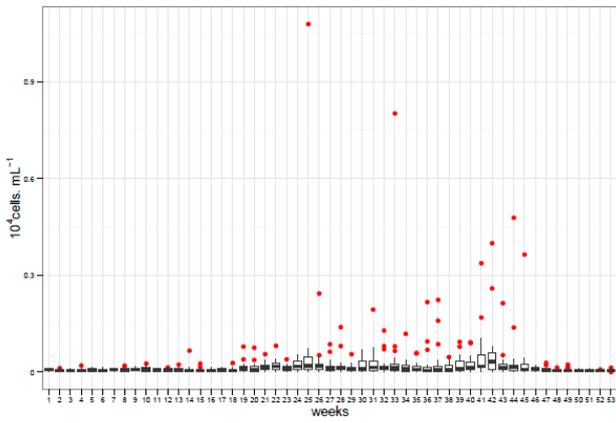


(e) Annual distribution

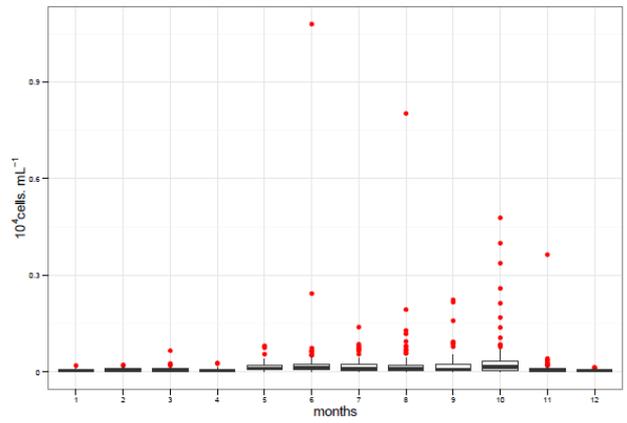
# COCCOLITHOPHORES



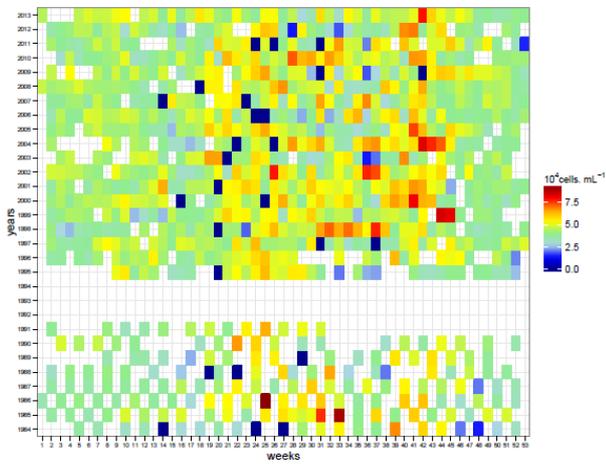
(a) Trend test 1984-1990 coef= -0.1011, pvalue= 0.3028; 1995-2013 coef= -0.004, p-value= 0.5141



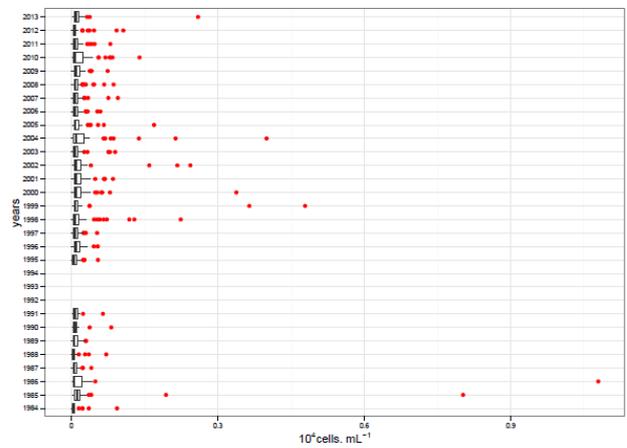
(b) Weekly distribution



(c) Monthly distribution

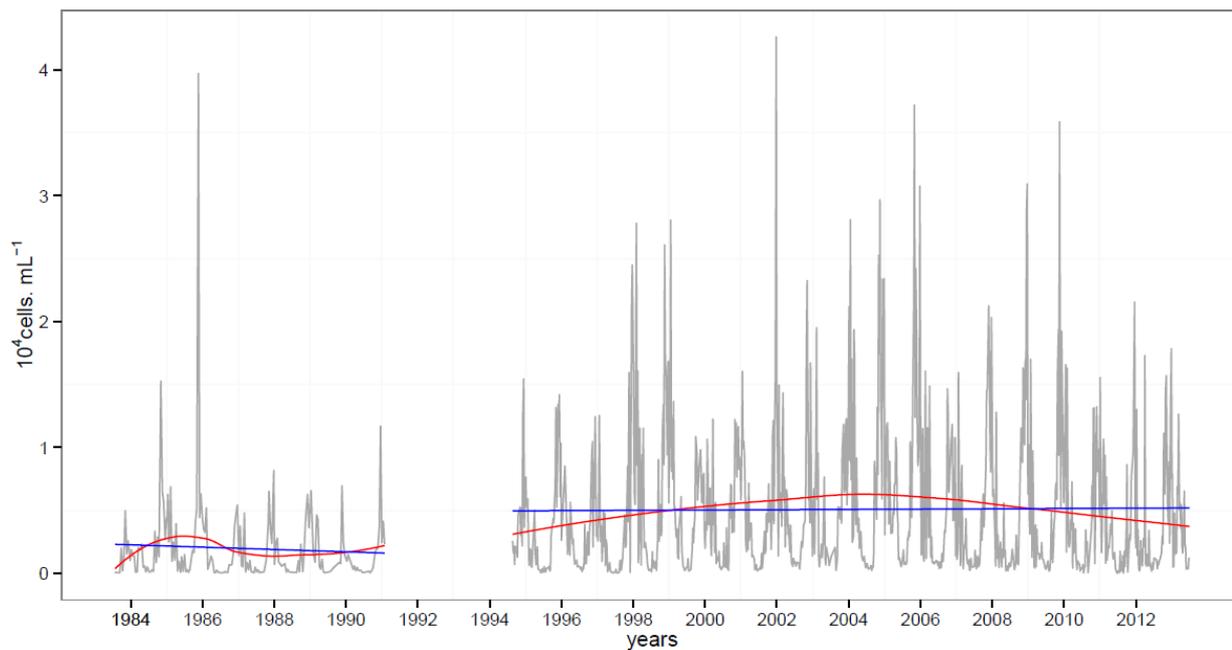


(d) Heatmap

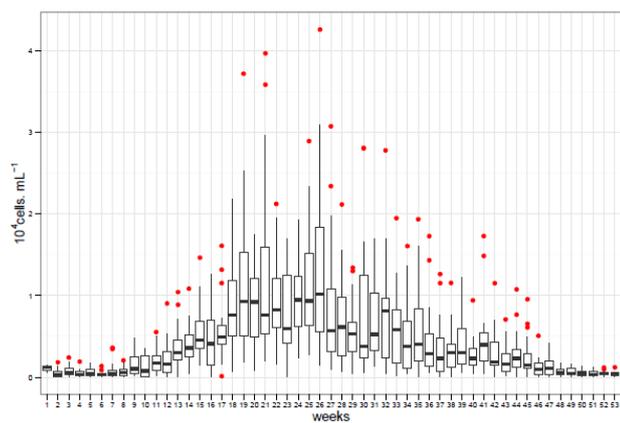


(e) Annual distribution

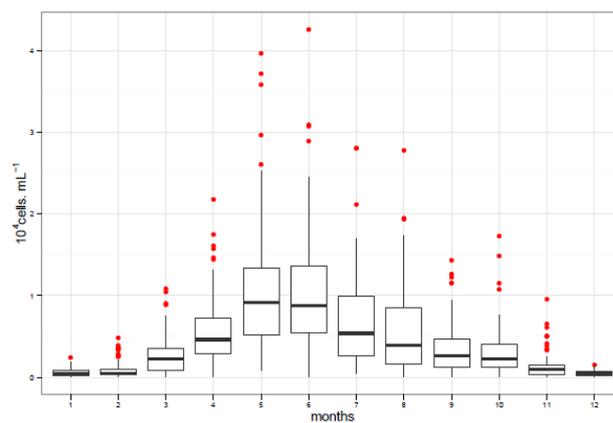
## OTHER FLAGELLATES



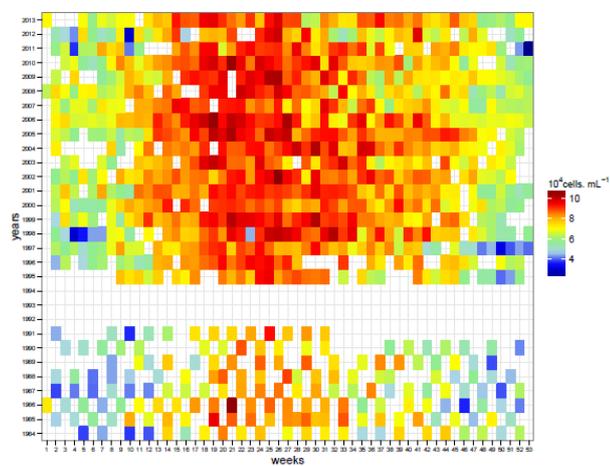
(a) Trend test 1984-1990 coef= -0.2532, pvalue= 0.4719; 1995-2013 coef= 0.033, p-value= 0.7404



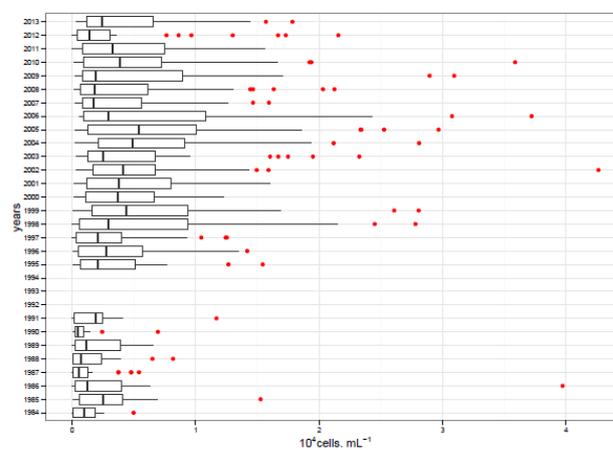
(b) Weekly distribution



(c) Monthly distribution



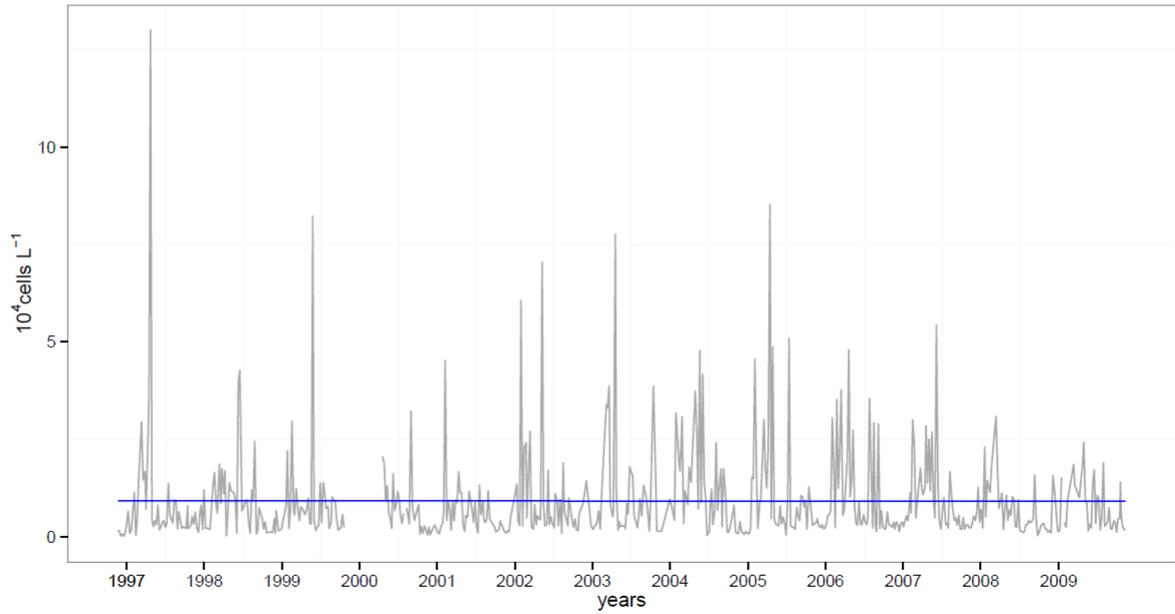
(d) Heatmap



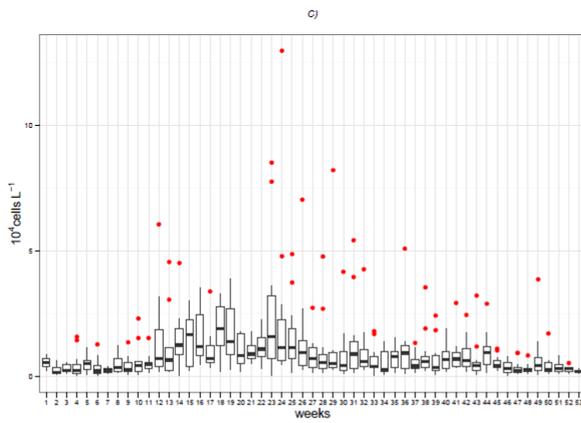
(e) Annual distribution

# Microzooplankton

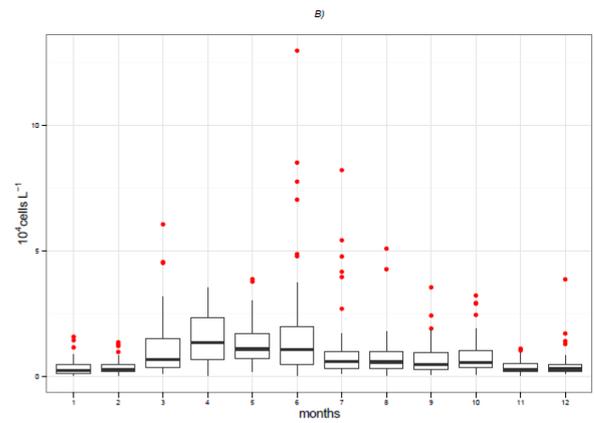
## Ciliates



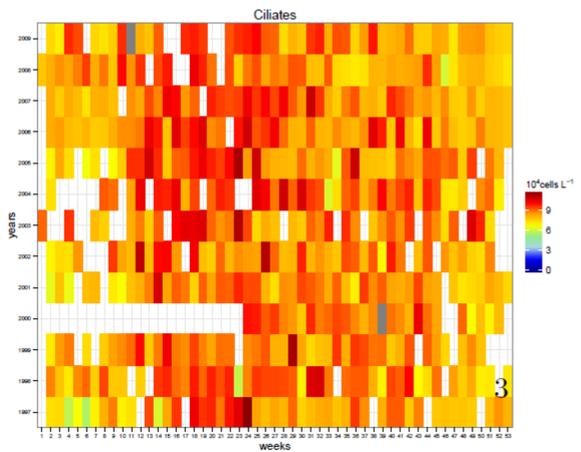
(a) Trend test 1997-2009 coef= -0.0204, pvalue= 0.9541



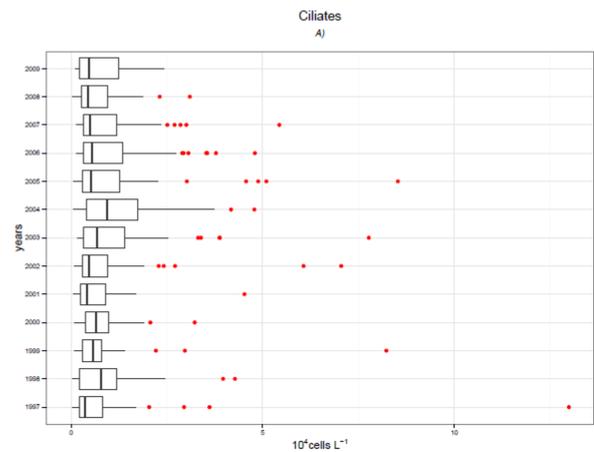
(b) Weekly distribution



(c) Monthly distribution

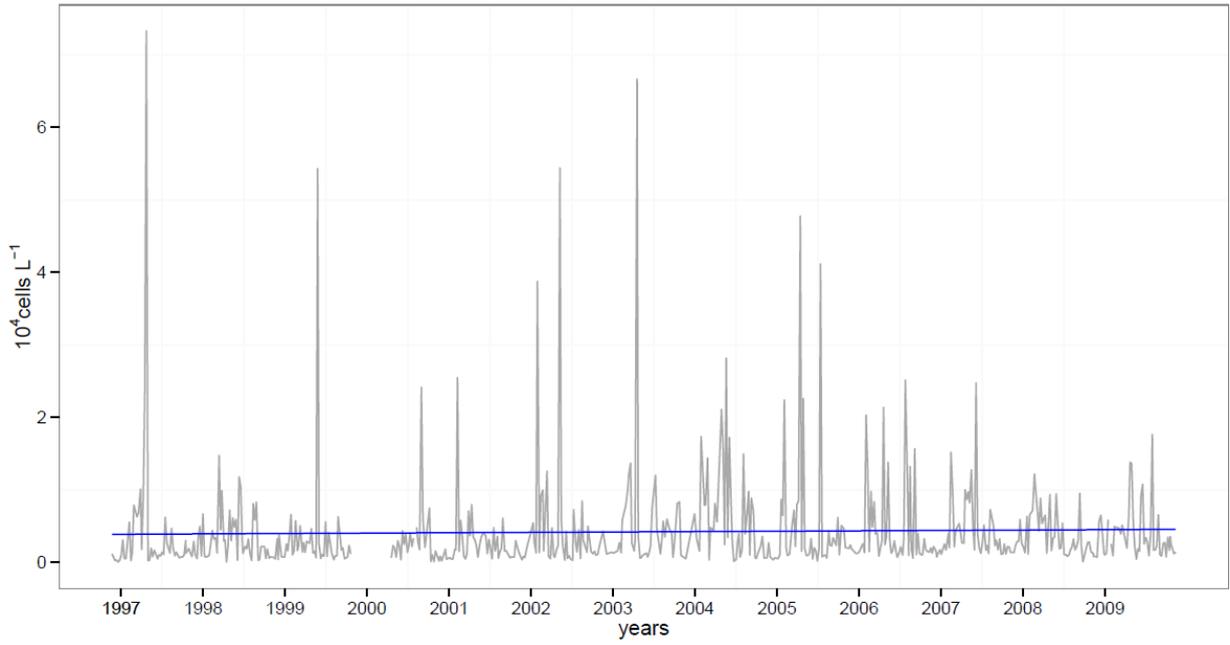


(d) Heatmap

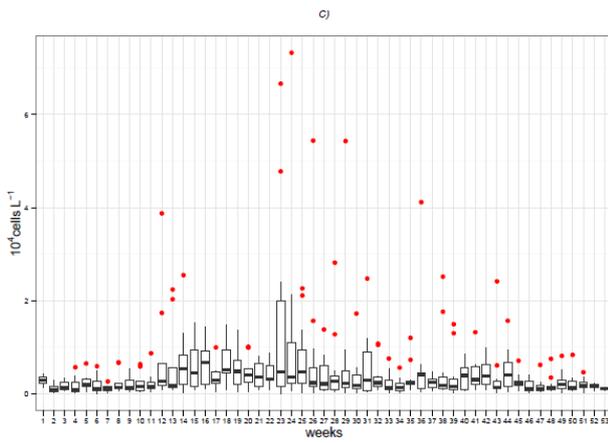


(e) Annual distribution

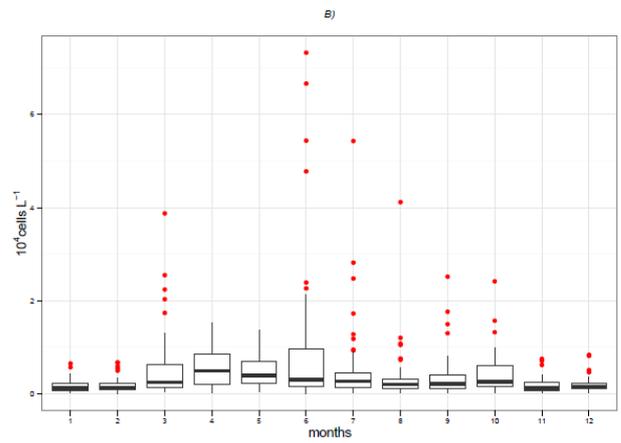
# Nanociliates



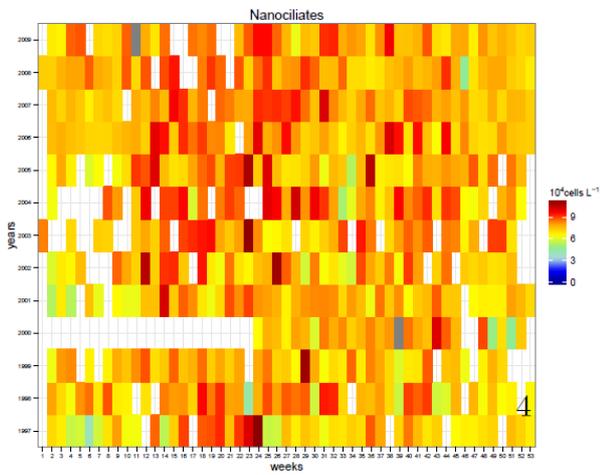
(a) Trend test 1997-2009 coef= 0.1447, pvalue= 0.4863



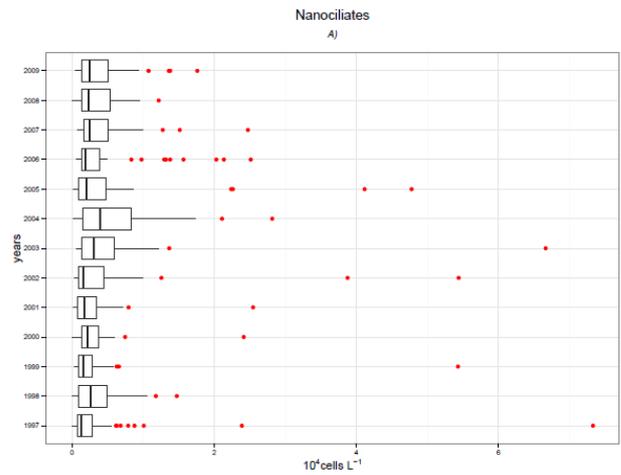
(b) Weekly distribution



(c) Monthly distribution

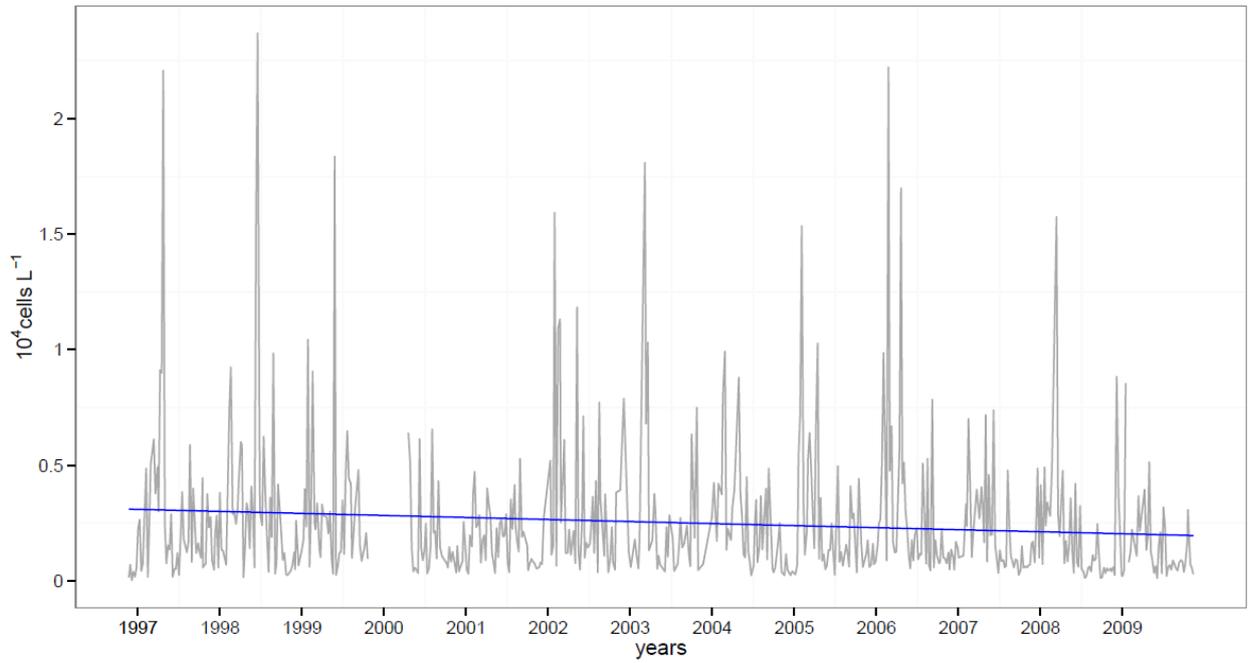


(d) Heatmap

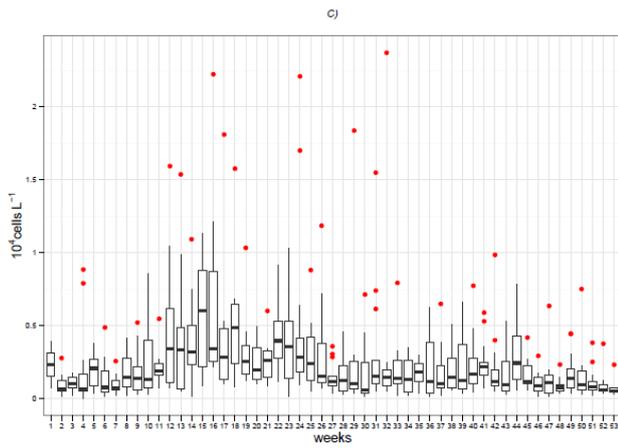


(e) Annual distribution

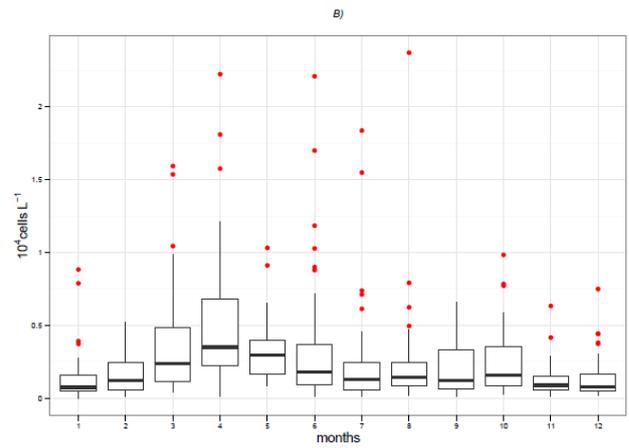
### Ciliates Heterotrophs



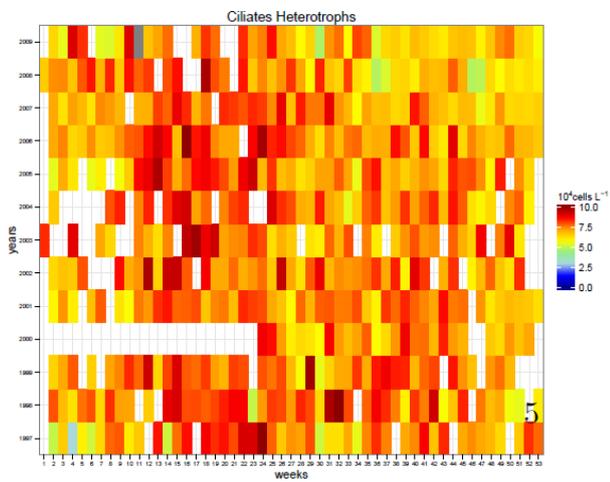
(a) Trend test 1997-2009 coef= -0.2413, pvalue= 0.0069



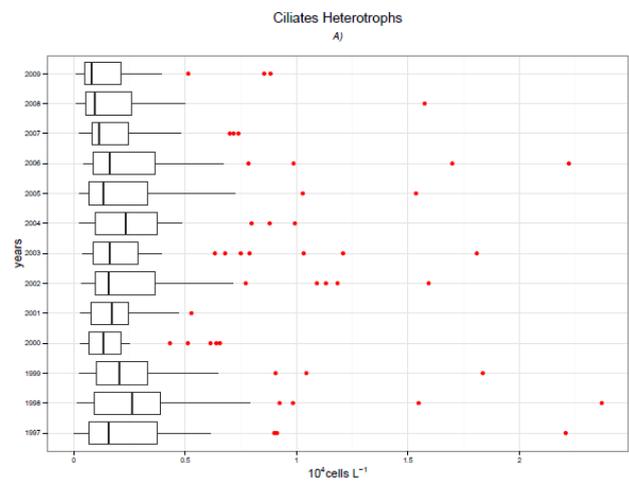
(b) Weekly distribution



(c) Monthly distribution

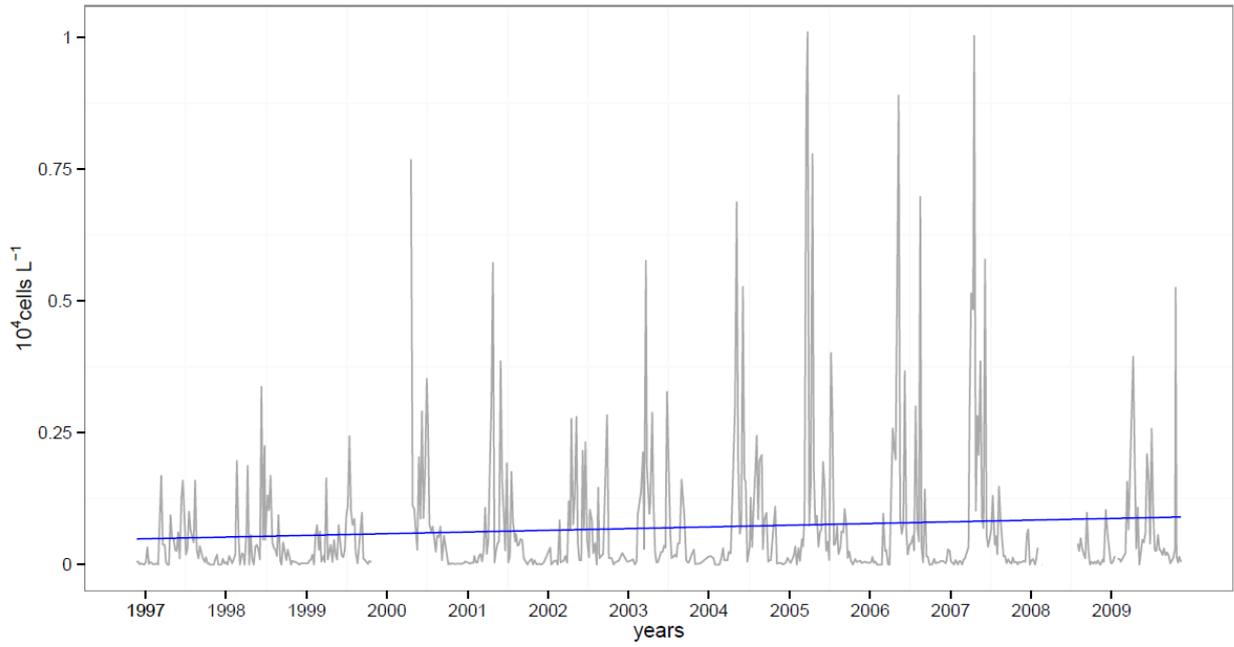


(d) Heatmap

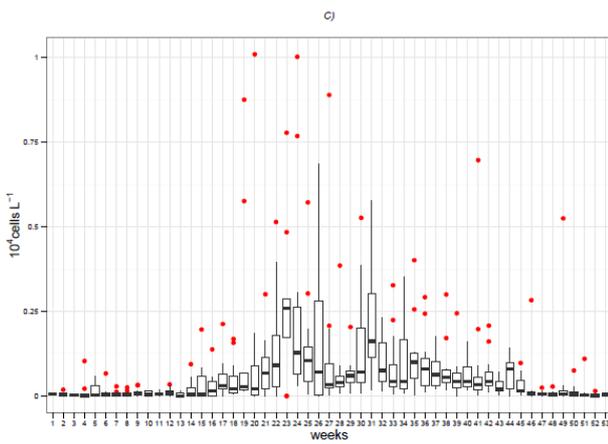


(e) Annual distribution

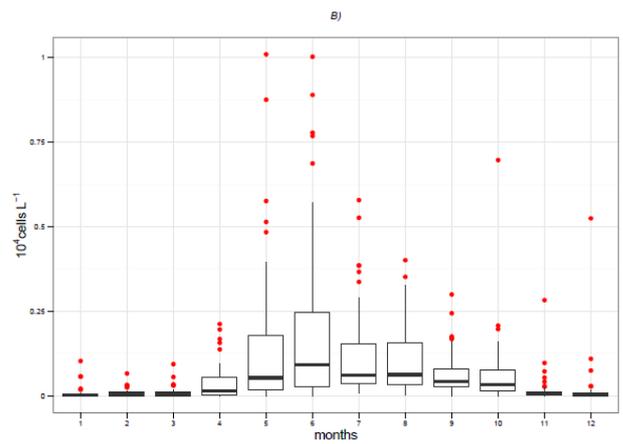
# Mixotrophs



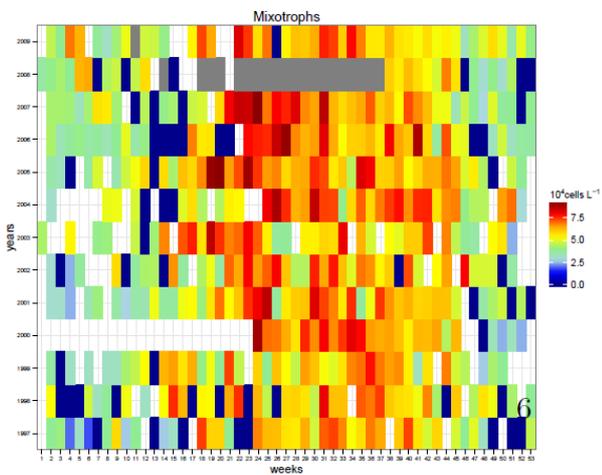
(a) Trend test 1997-2009 coef= 0.0878, pvalue= 0.0289



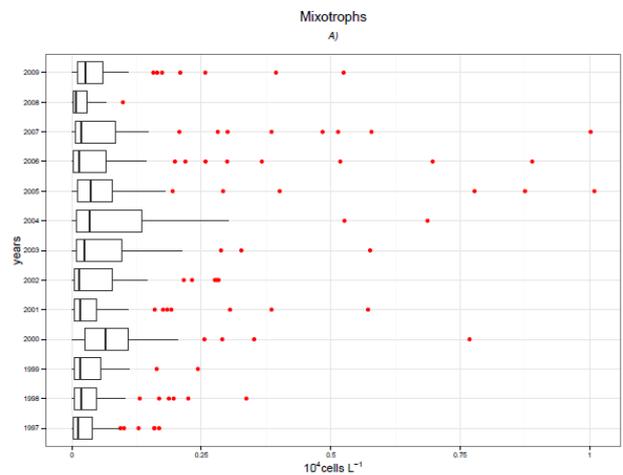
(b) Weekly distribution



(c) Monthly distribution

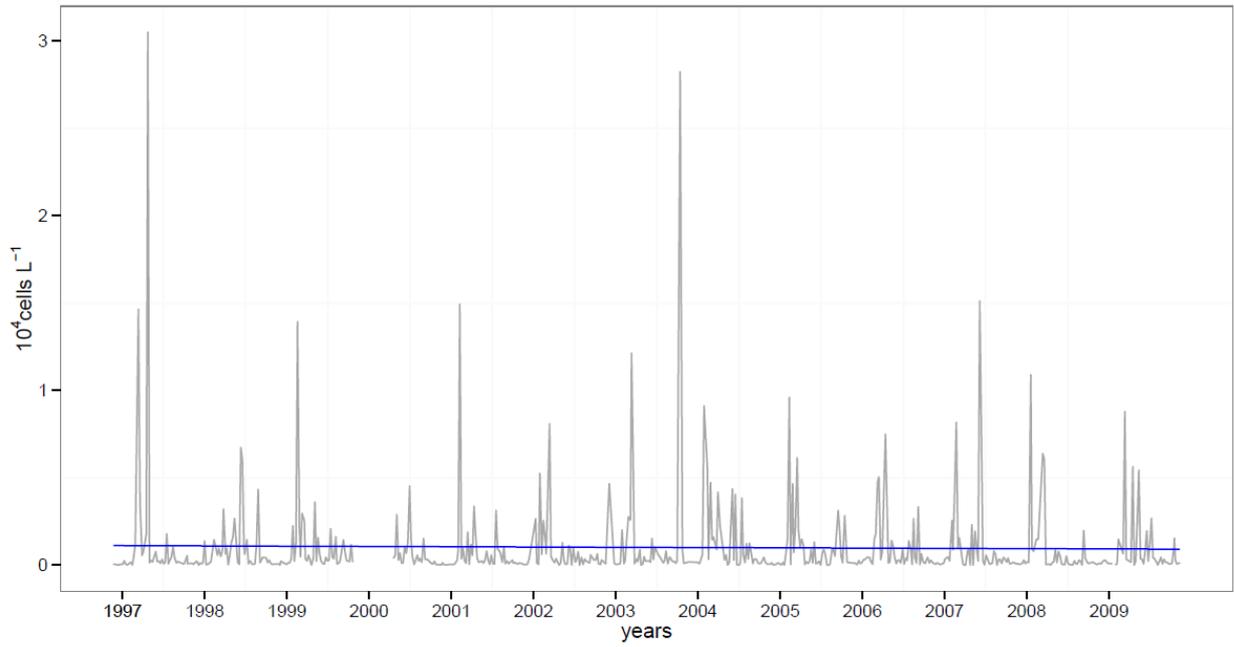


(d) Heatmap

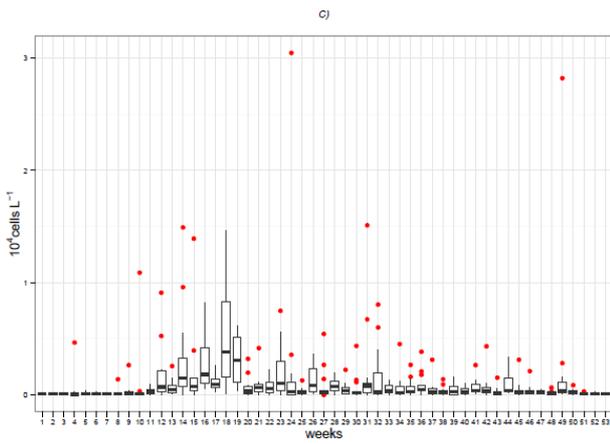


(e) Annual distribution

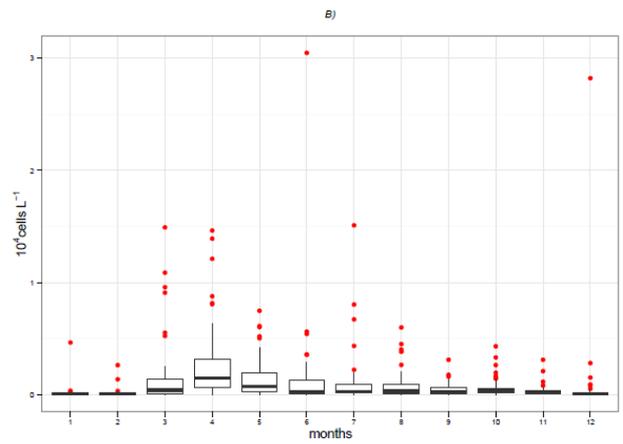
# Tintinnids



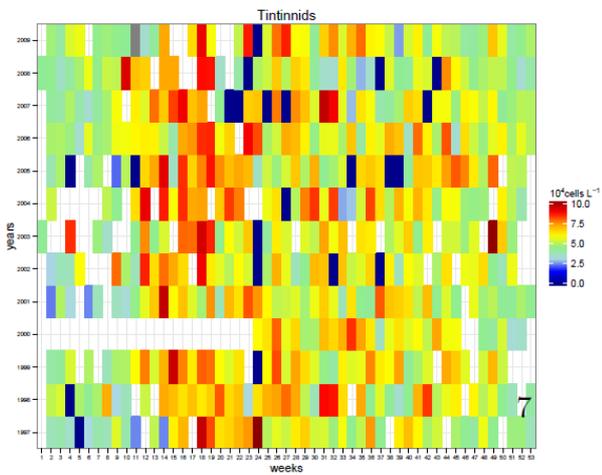
(a) Trend test 1997-2009 coef= -0.0428, pvalue= 0.5679



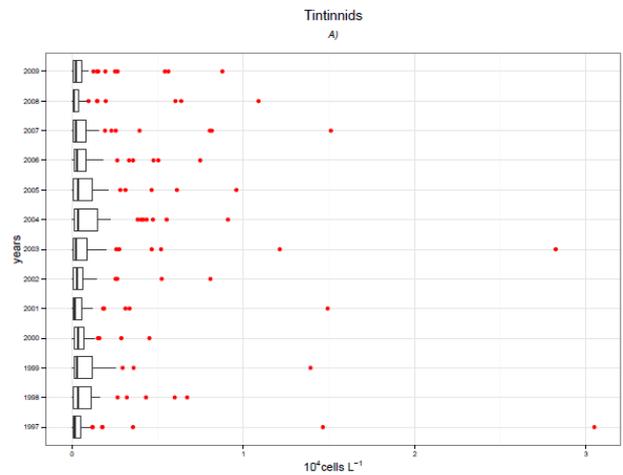
(b) Weekly distribution



(c) Monthly distribution

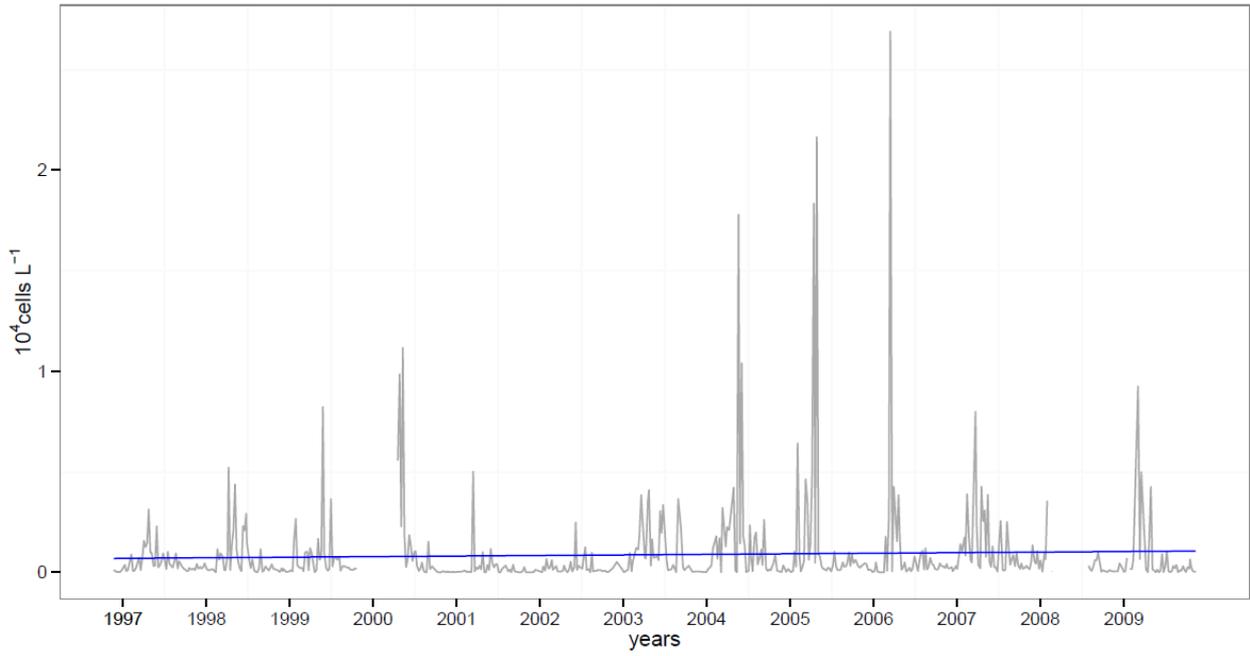


(d) Heatmap

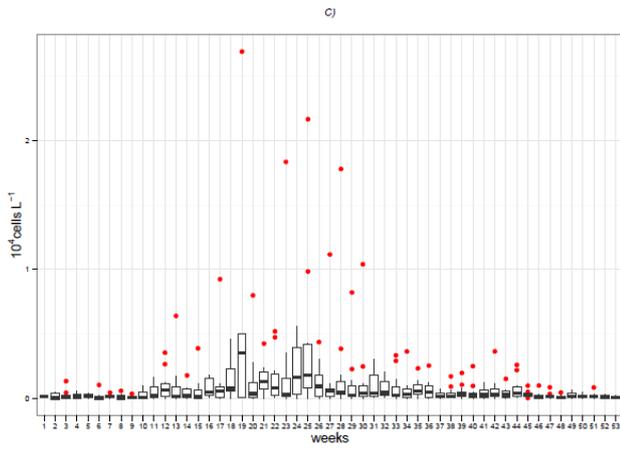


(e) Annual distribution

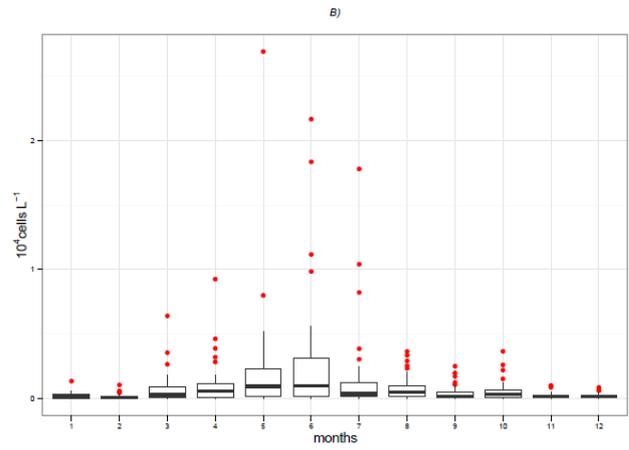
# Prostomatids



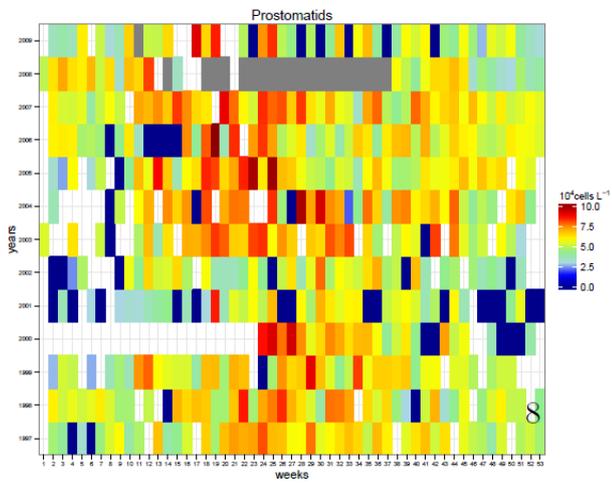
(a) Trend test 1997-2009 coef= 0.0771, pvalue= 0.2487



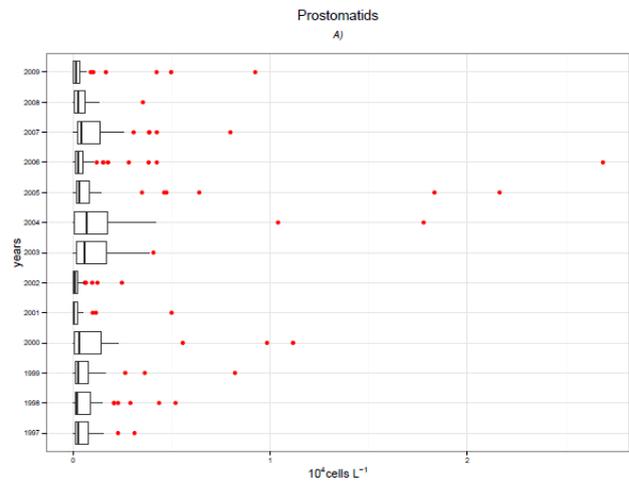
(b) Weekly distribution



(c) Monthly distribution

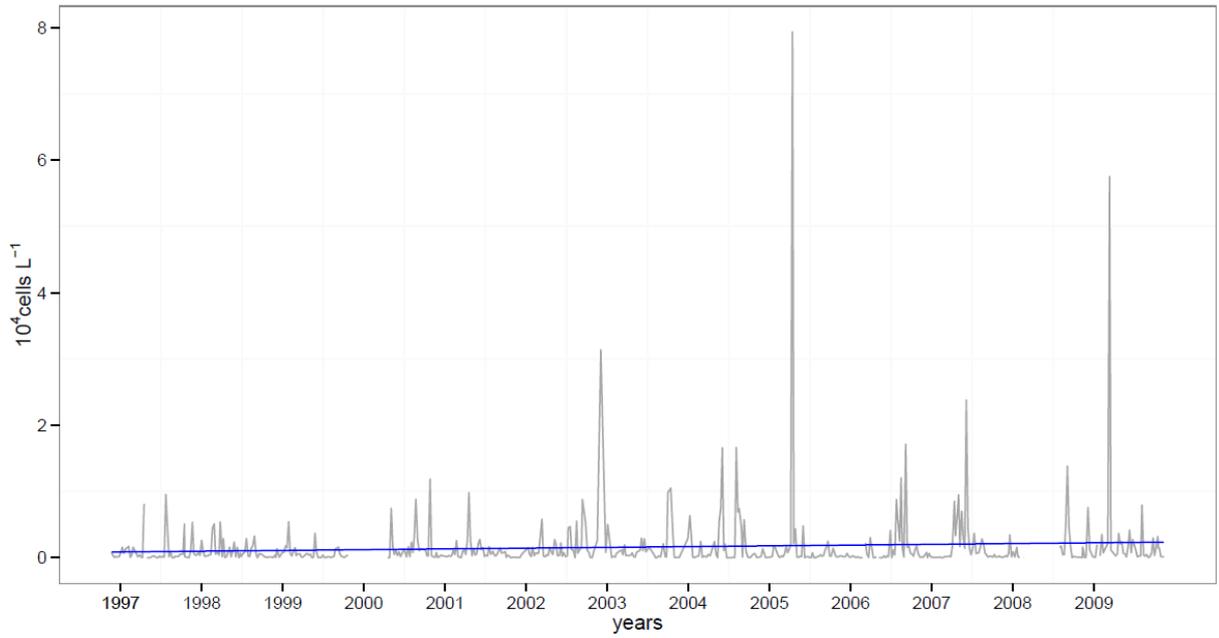


(d) Heatmap

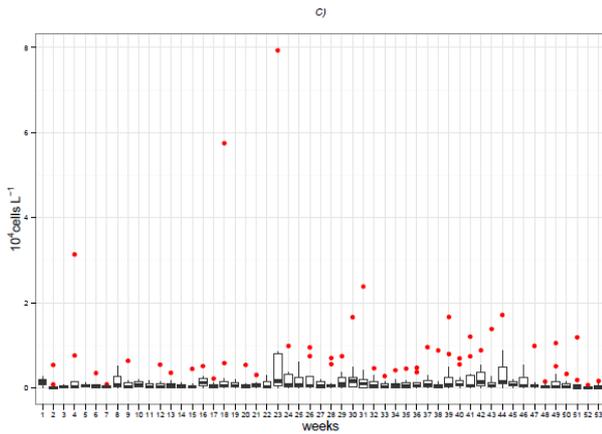


(e) Annual distribution

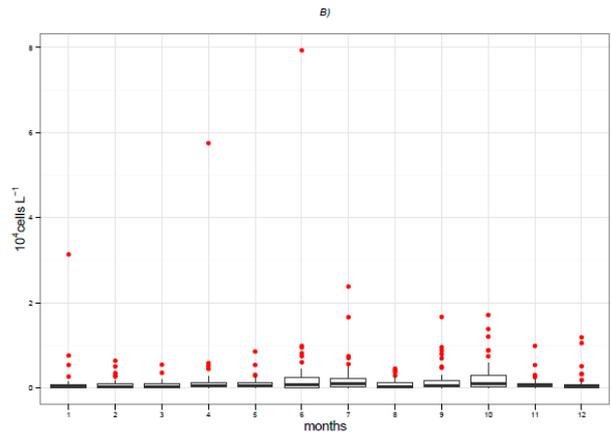
Mesodinium rubrum



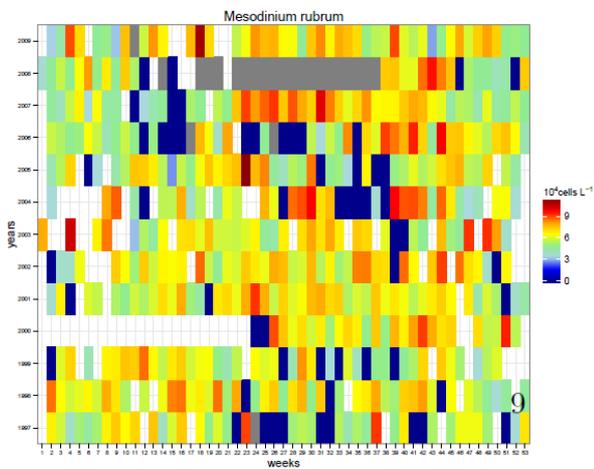
(a) Trend test 1997-2009 coef= 0.3145, pvalue= 0.0356



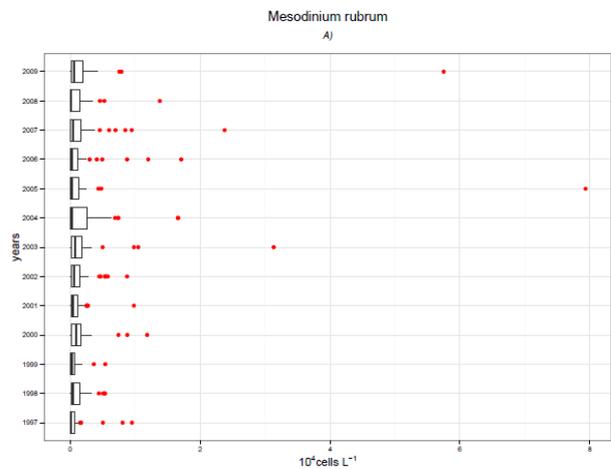
(b) Weekly distribution



(c) Monthly distribution



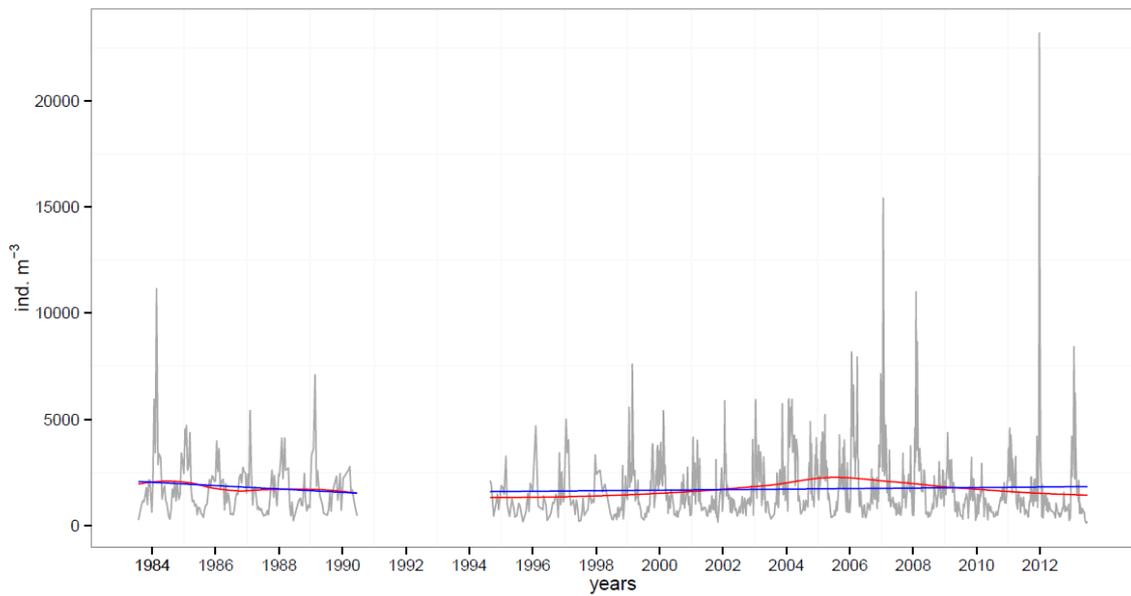
(d) Heatmap



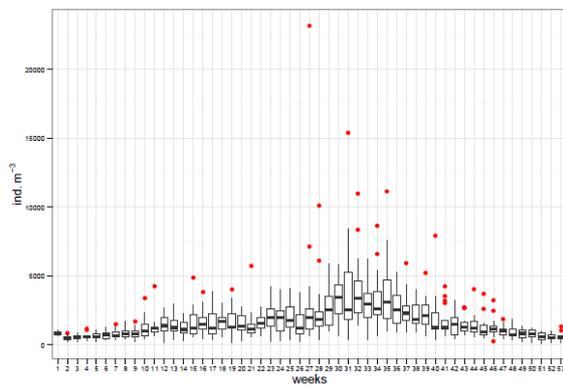
(e) Annual distribution

# Mesozooplankton

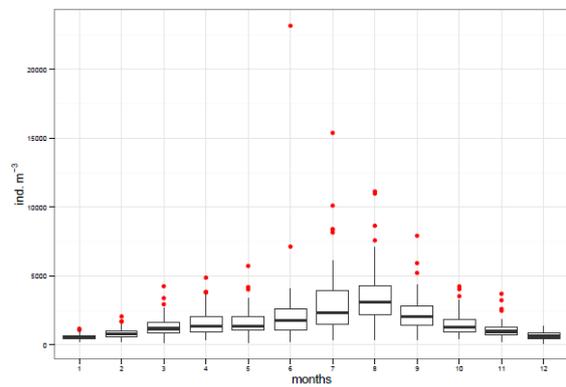
## TOTAL MESOZOOPLANKTON



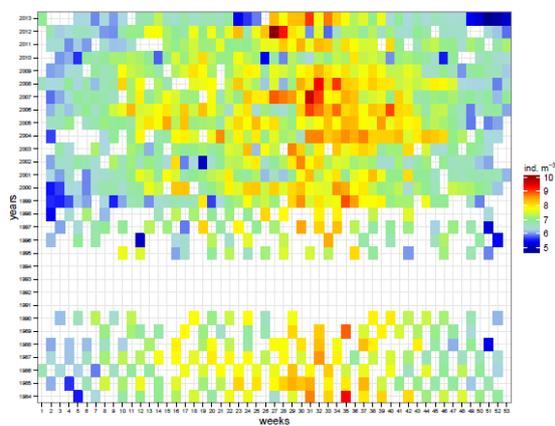
(a) Trend test 1984-1990 coef= -0.2166, pvalue= 0.1585; 1995-2012 coef= 0.0343, p-value= 0.2941



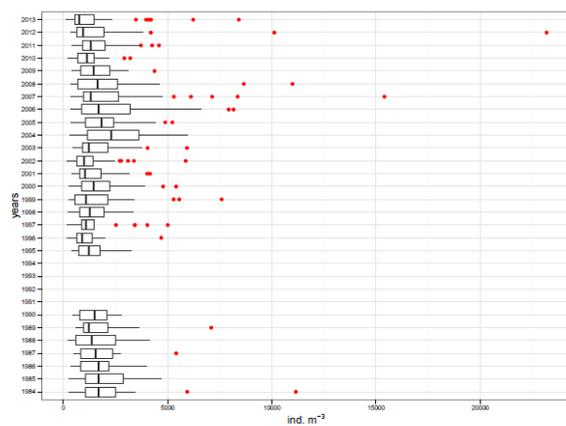
(b) Weekly distribution



(c) Monthly distribution

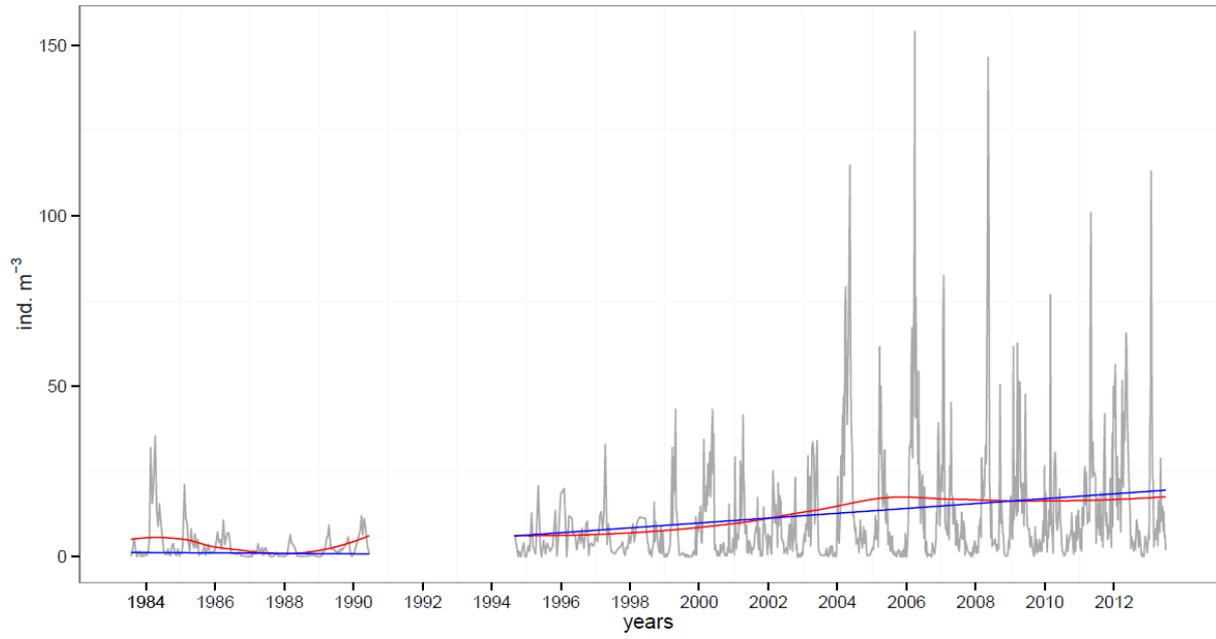


(d) Heatmap

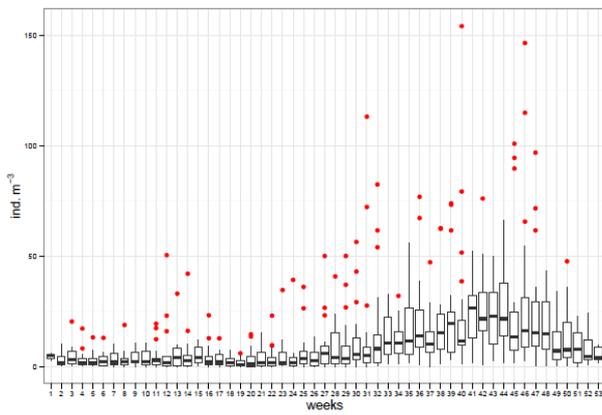


(e) Annual distribution

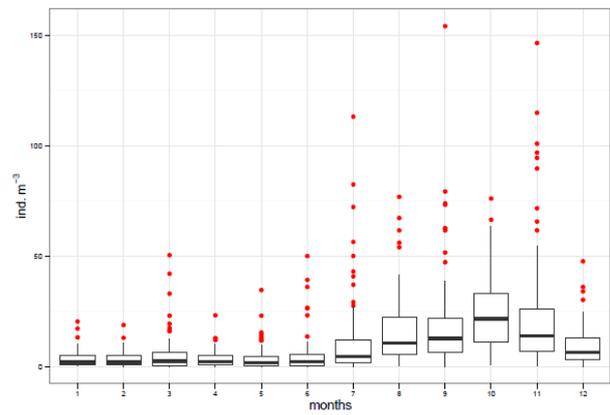
# CHAETOGNATHS



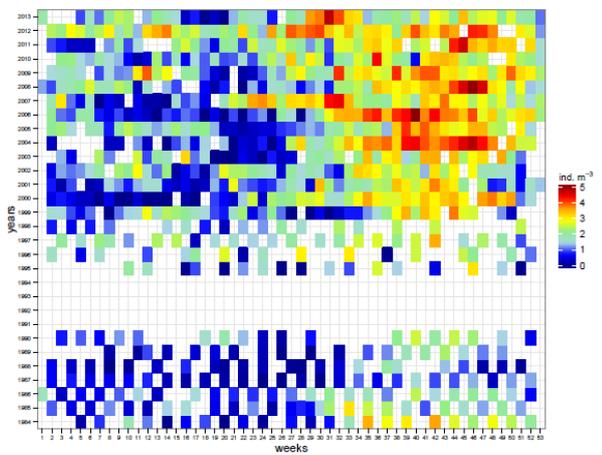
(a) Trend test 1984-1990 coef= -0.0014, pvalue= 0.0106; 1995-2012 coef= 0.002, p-value= 0



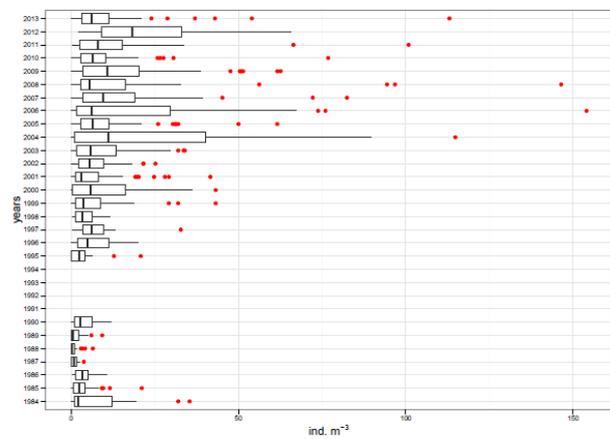
(b) Weekly distribution



(c) Monthly distribution

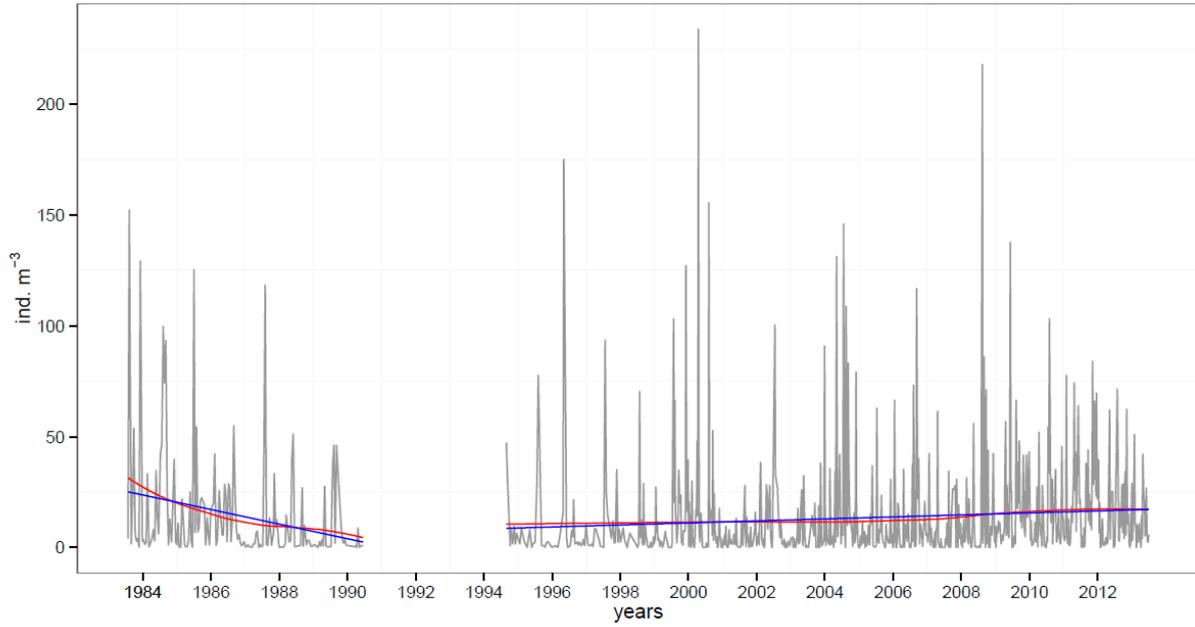


(d) Heatmap

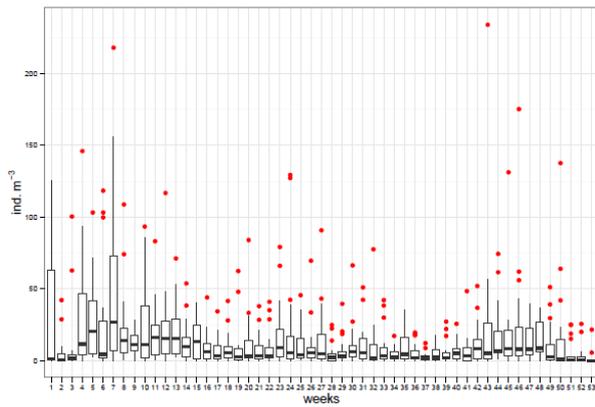


(e) Annual distribution

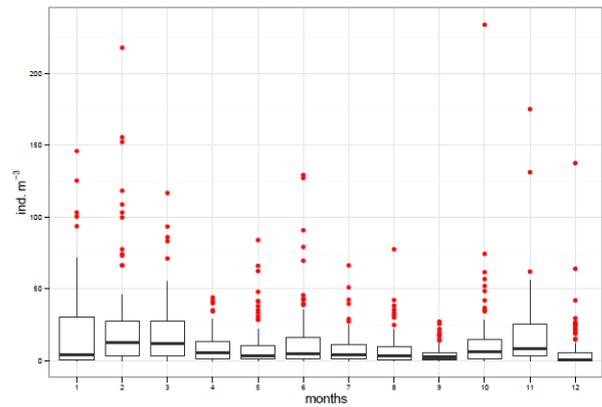
# CIRRIPED LARVAE



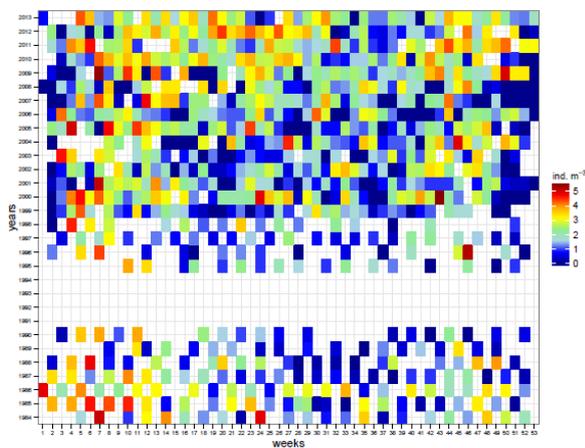
(a) Trend test 1984-1990 coef= -0.009, pvalue= 0.0014; 1995-2012 coef= 0.0012, p-value= 0.0072



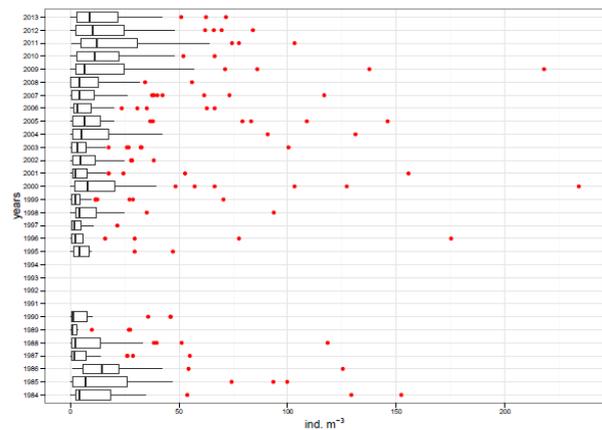
(b) Weekly distribution



(c) Monthly distribution

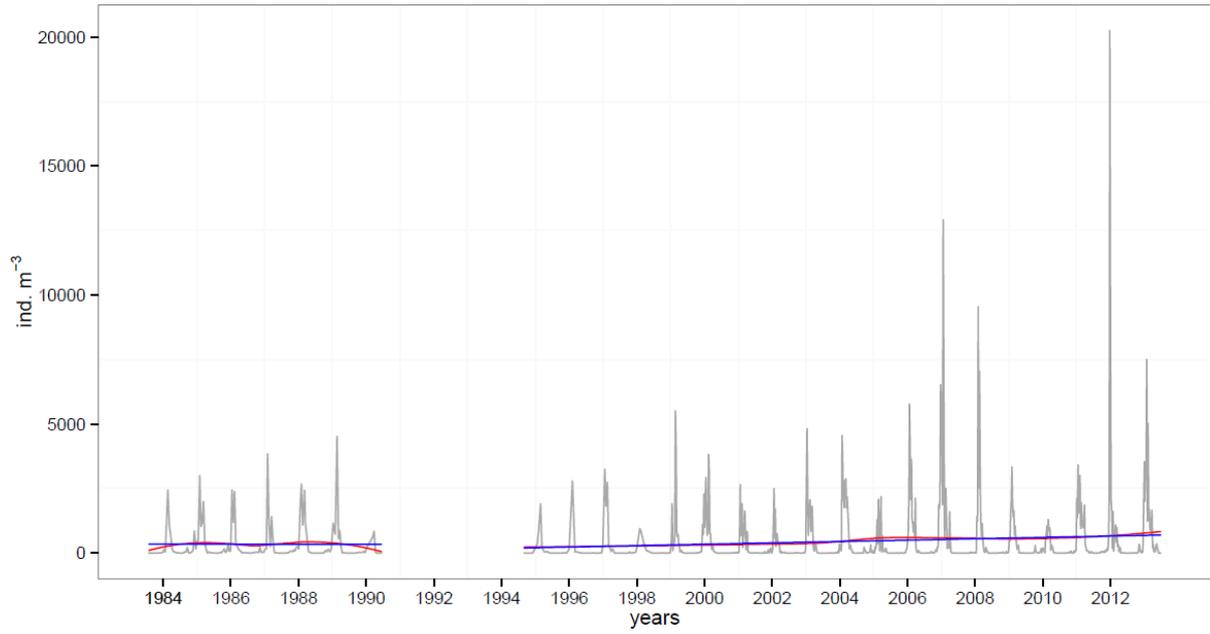


(d) Heatmap

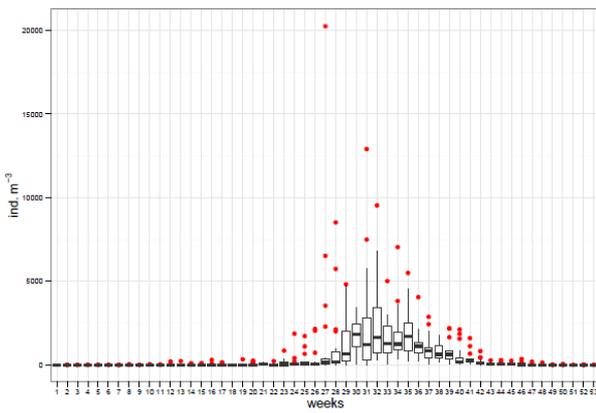


(e) Annual distribution

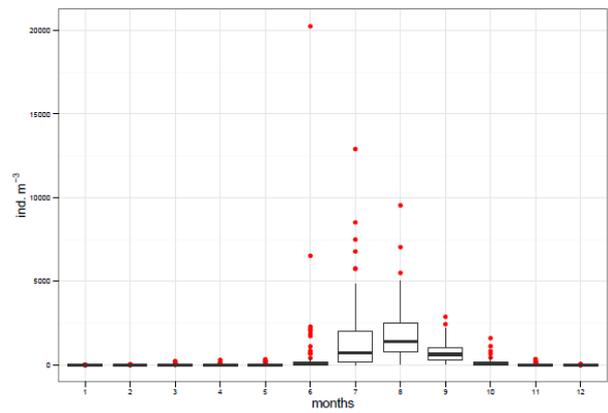
# CLADOCERANS



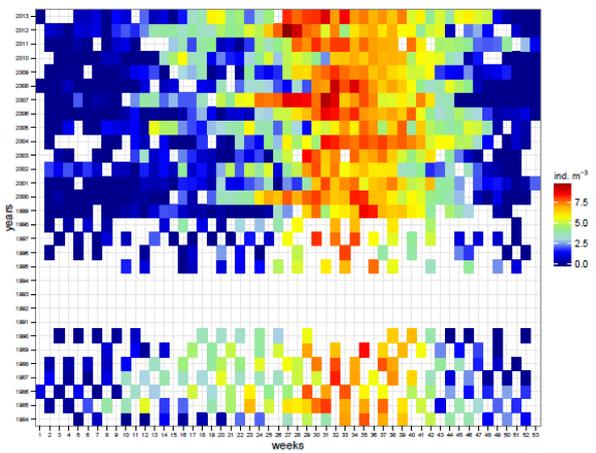
(a) Trend test 1984-1990 coef= -0.0015, pvalue= 0.985; 1995-2012 coef= 0.0727, p-value= 0.0057



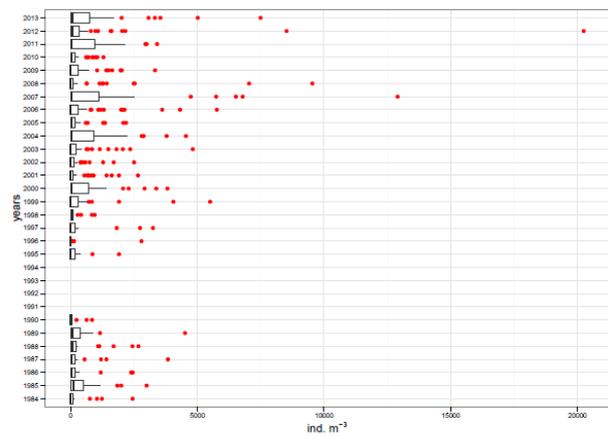
(b) Weekly distribution



(c) Monthly distribution

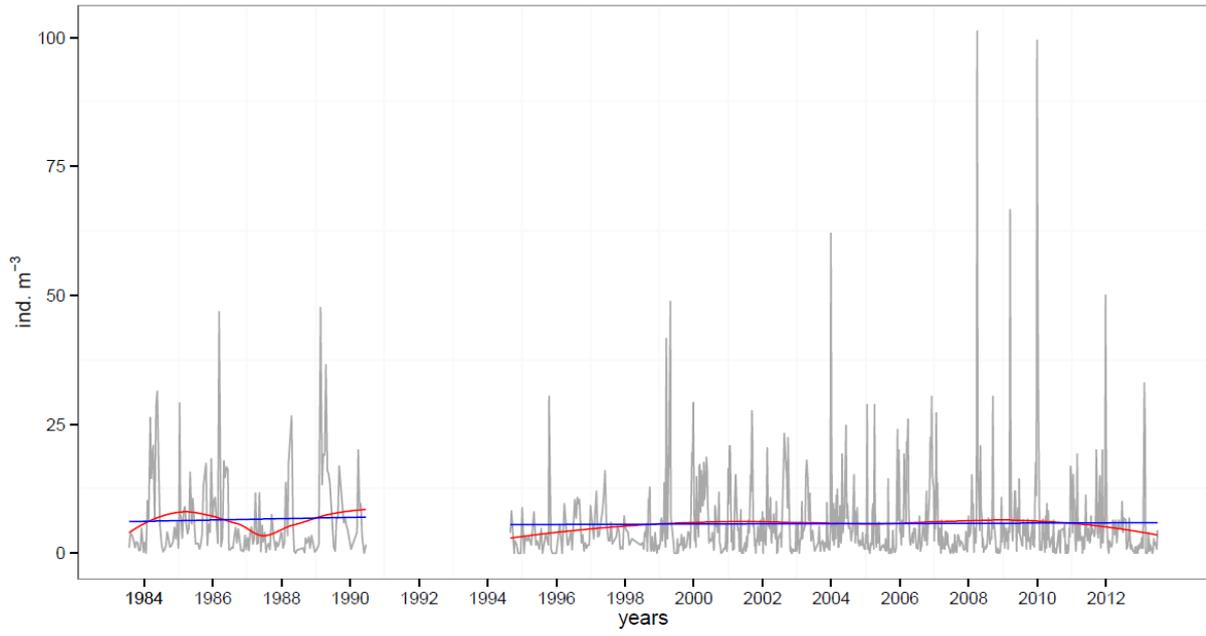


(d) Heatmap

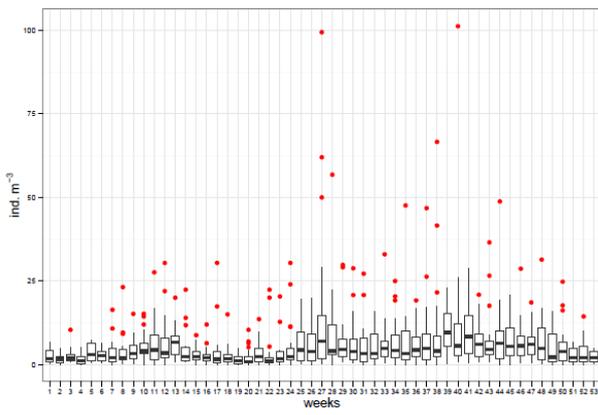


(e) Annual distribution

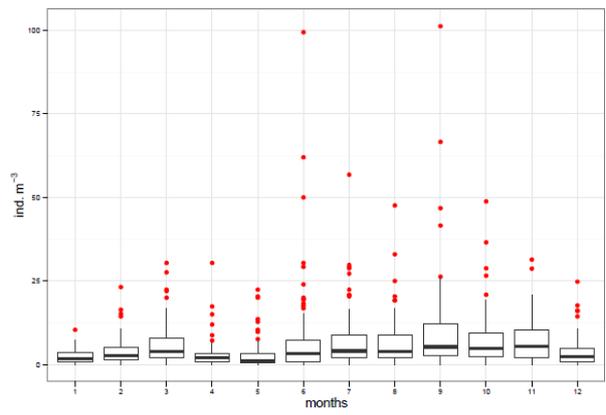
# CNIDARIANS



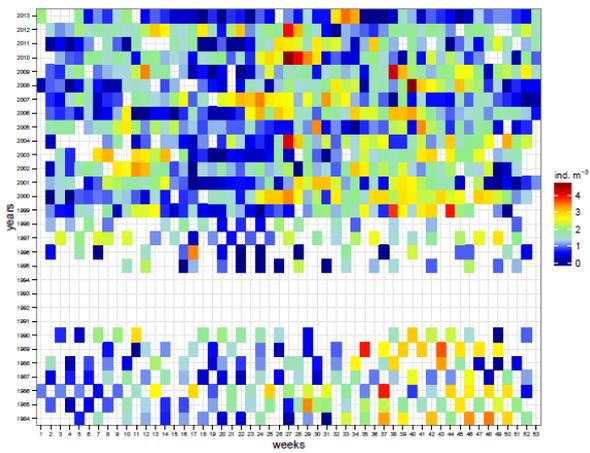
(a) Trend test 1984-1990 coef= 0.0003, pvalue= 0.7097; 1995-2012 coef= 0.0001, p-value= 0.7611



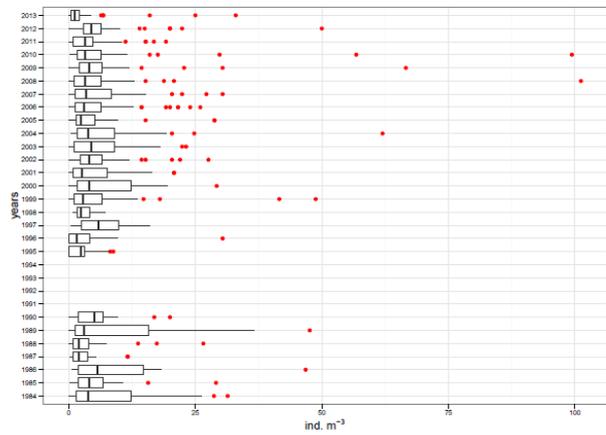
(b) Weekly distribution



(c) Monthly distribution

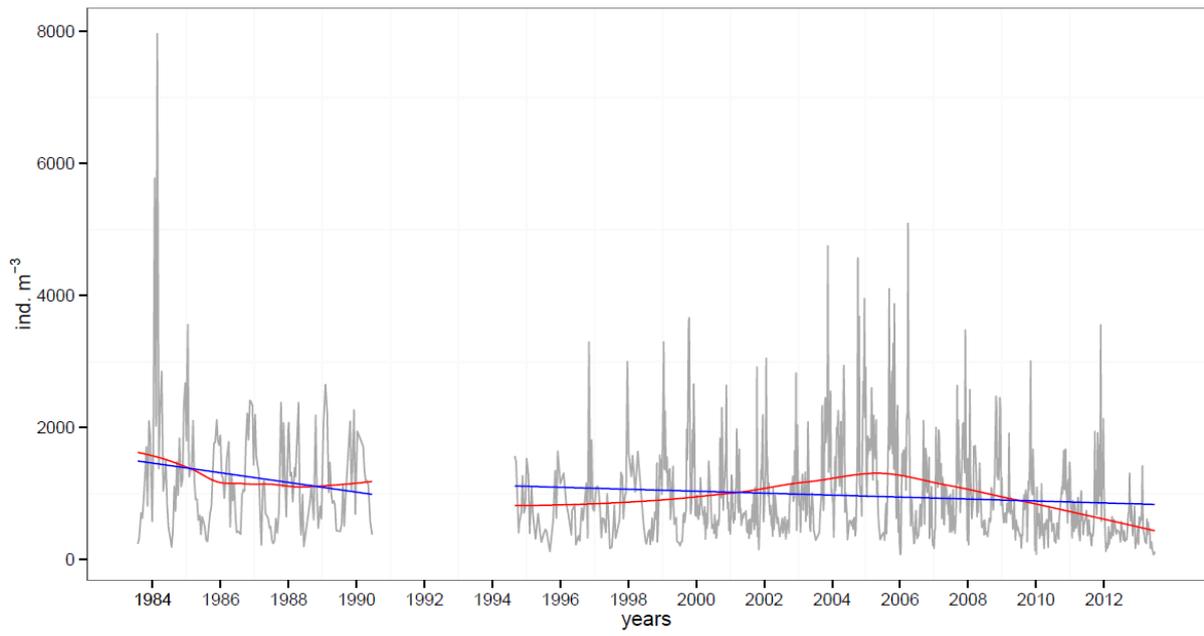


(d) Heatmap

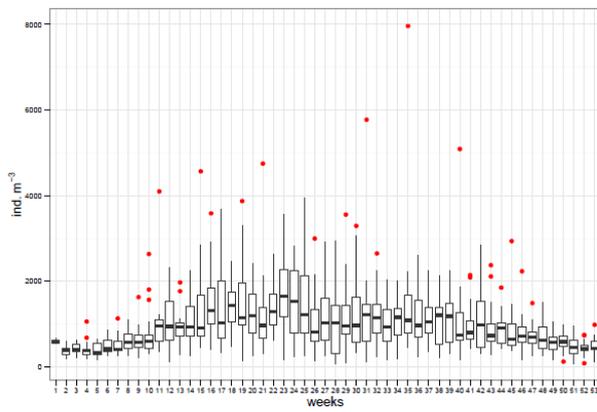


(e) Annual distribution

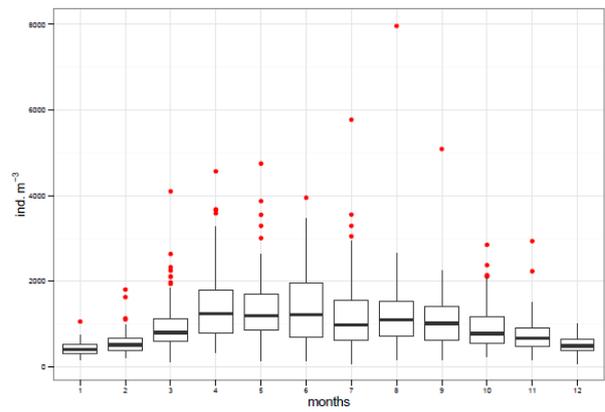
# COPEPODS



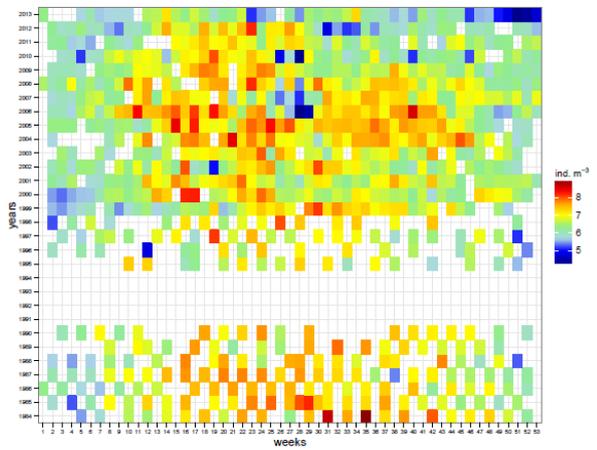
(a) Trend test 1984-1990 coef= -0.2005, pvalue= 0.0536; 1995-2012 coef= -0.0406, p-value= 0.0032



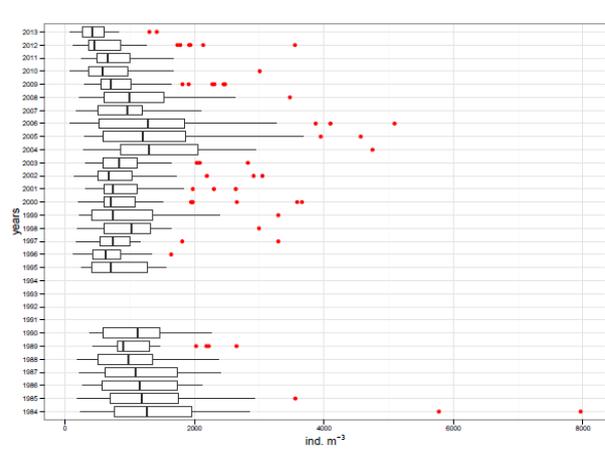
(b) Weekly distribution



(c) Monthly distribution

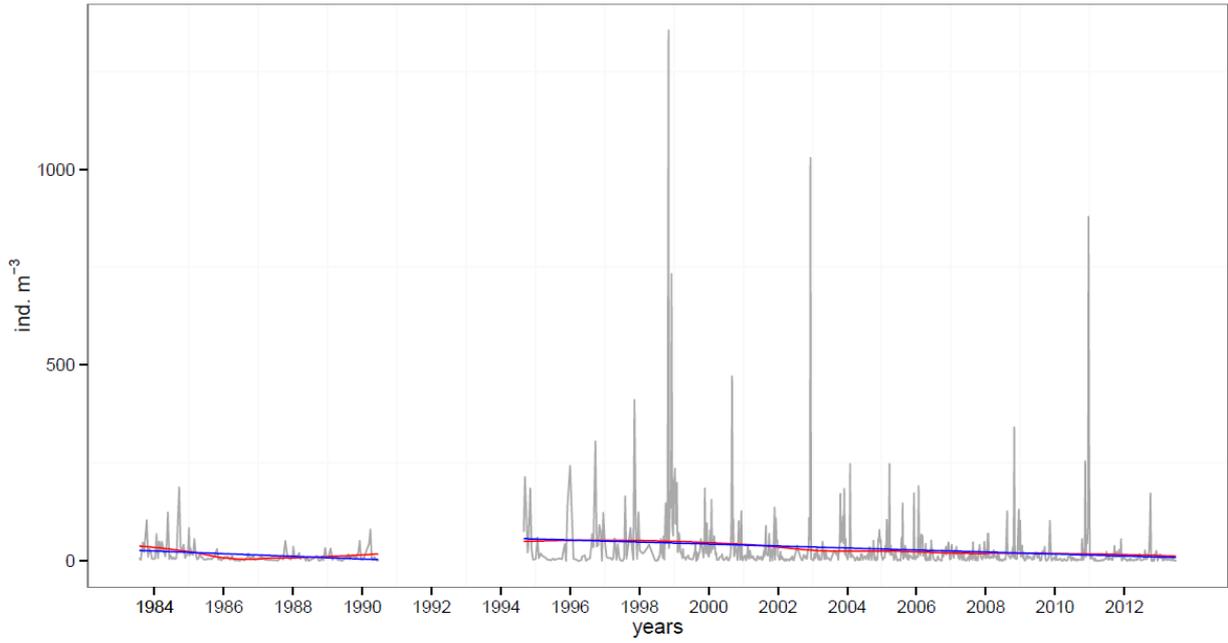


(d) Heatmap

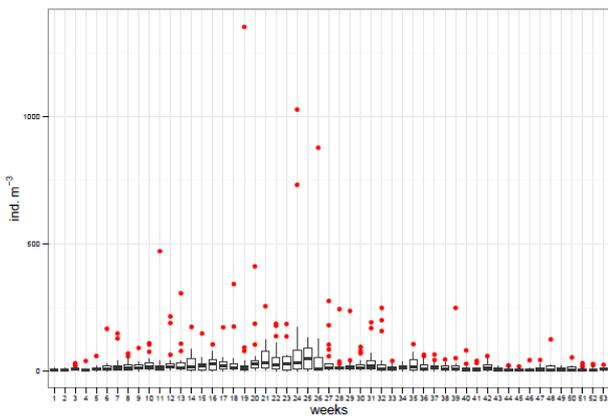


(e) Annual distribution

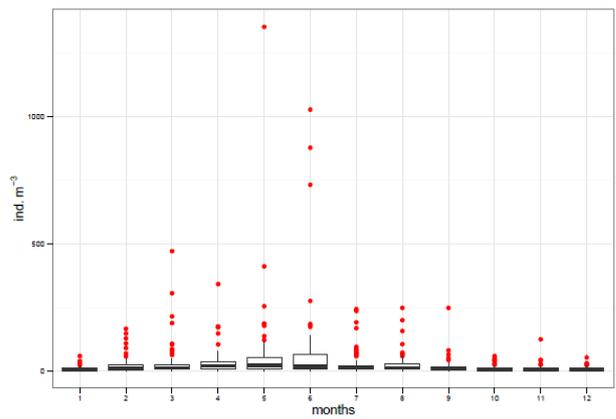
# MALACOSTRACAN LARVAE



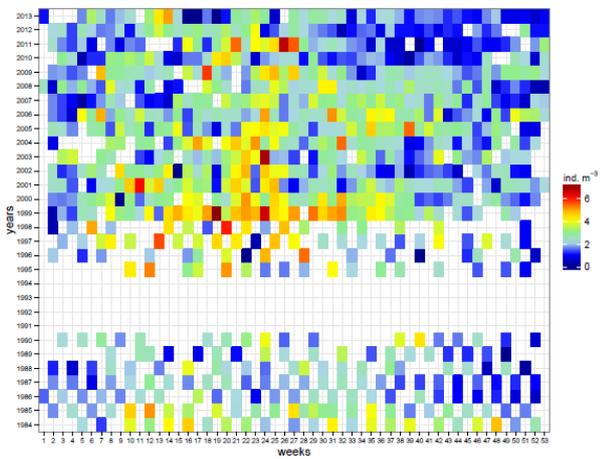
(a) Trend test 1984-1990 coef= -0.0093, pvalue= 0.0006; 1995-2012 coef= -0.007, p-value= 0



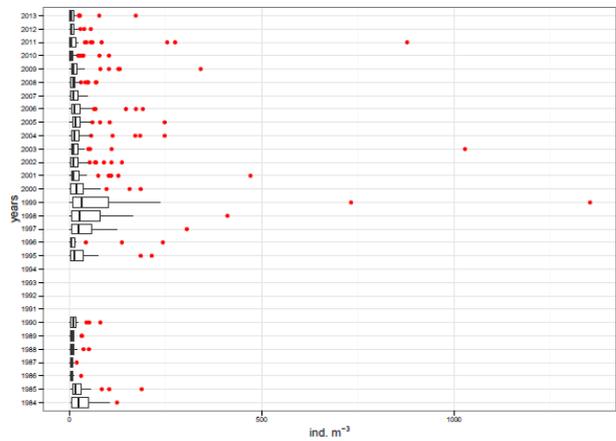
(b) Weekly distribution



(c) Monthly distribution

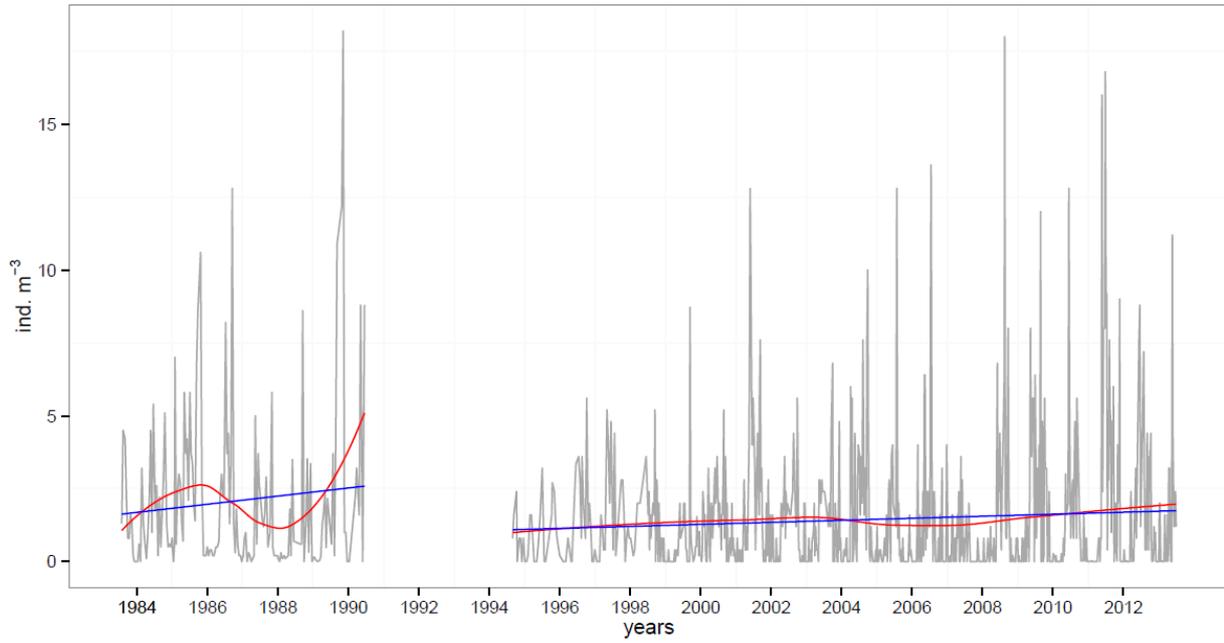


(d) Heatmap

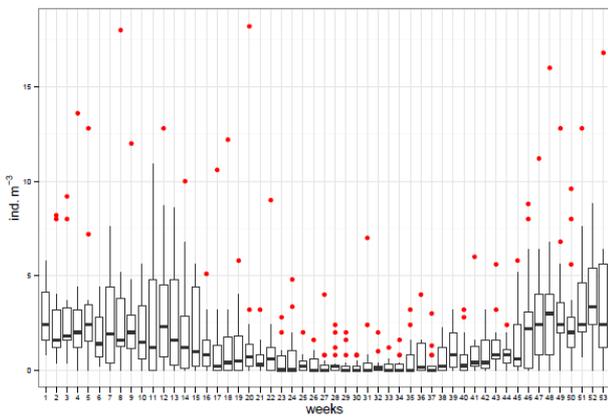


(e) Annual distribution

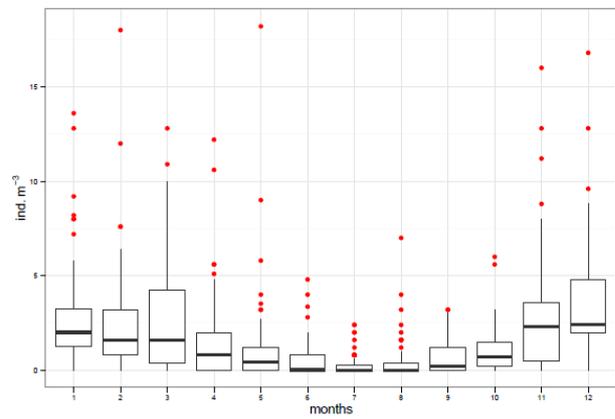
# OSTRACODS



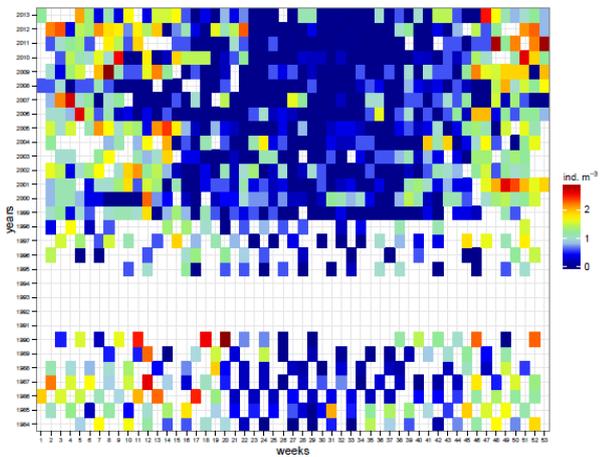
(a) Trend test 1984-1990 coef= 0.0004, pvalue= 0.2268; 1995-2012 coef= 0.0001, p-value= 0.0315



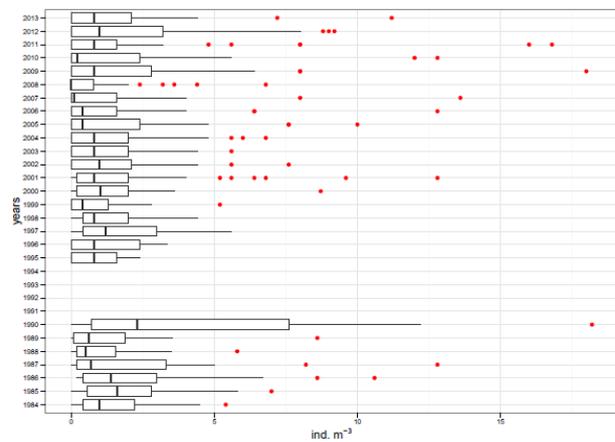
(b) Weekly distribution



(c) Monthly distribution

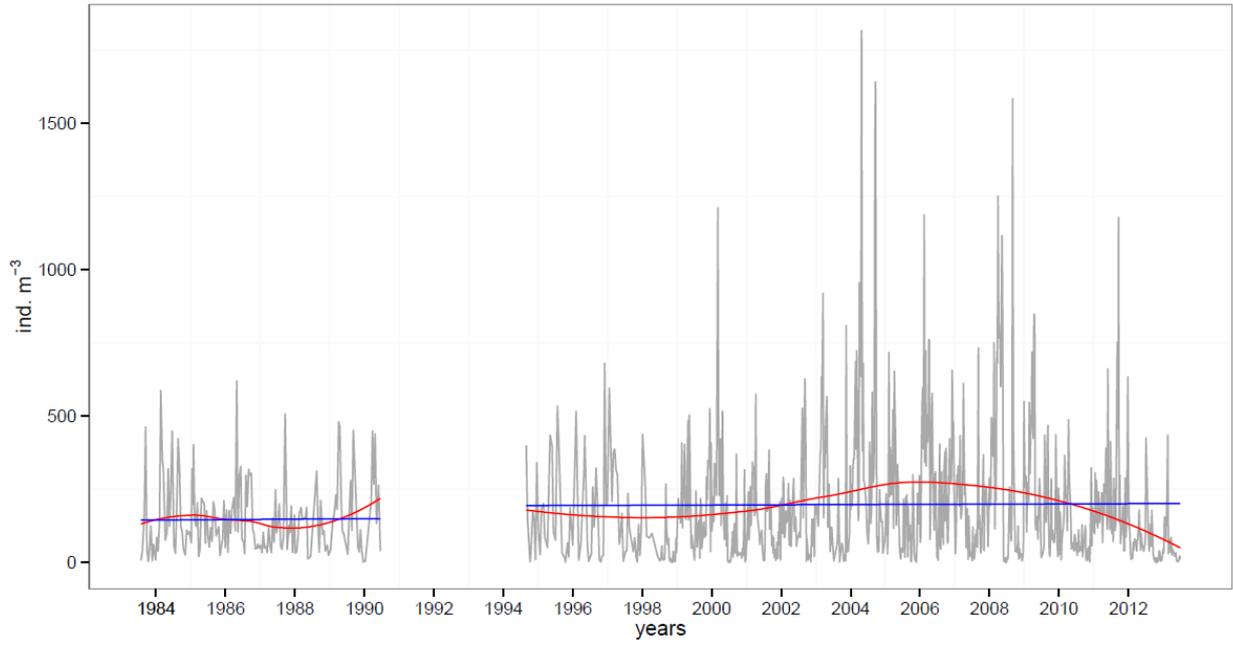


(d) Heatmap

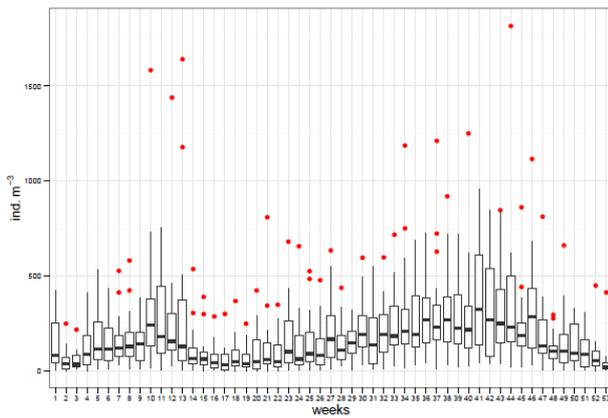


(e) Annual distribution

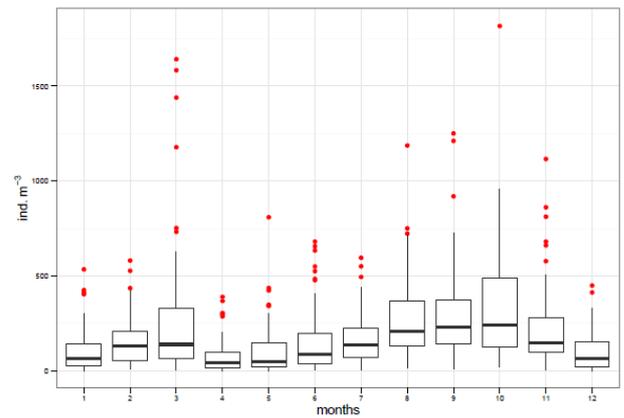
# TUNICATES



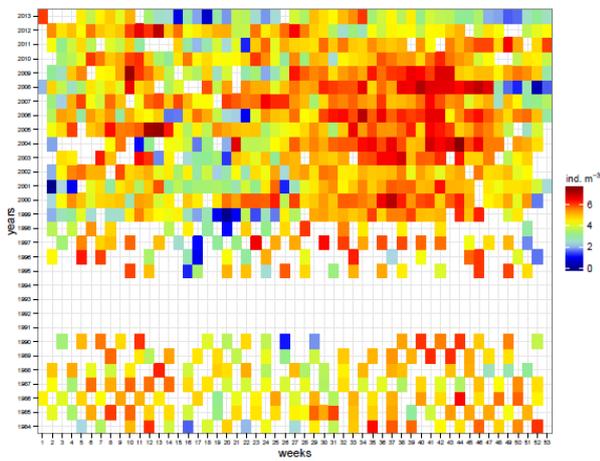
(a) Trend test 1984-1990 coef= 0.002, pvalue= 0.8863; 1995-2012 coef= 0.001, p-value= 0.8155



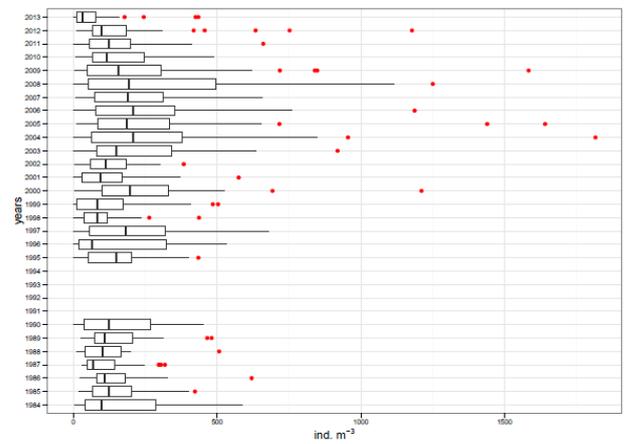
(b) Weekly distribution



(c) Monthly distribution



(d) Heatmap



(e) Annual distribution

# LTER-MC Team

[http://www.macisteweb.com/  
maciste\\_szn/gruppo-di](http://www.macisteweb.com/maciste_szn/gruppo-di)



**Adriana Zingone** (LEEP – Scientific coordinator)



**Raffaella Casotti** (MECA/FEEL – Logistics and sampling)

**Staff presently involved in the Project (LTER-MC): research, sampling, laboratory analyses and data processing.**



**Fabio Conversano** (MECA) He studies physical dynamics and geochemistry. His activities include sampling.



**Daniele Iudicone** (LEEP) Physical oceanography and plankton biodiversity models. He is an expert in physical oceanography and plankton bio-physical coupling.



**Francesca Margiotta** (MECA/LEEP) Nutrients and carbon dynamics. Her research activity is focused on the dynamics of N, P and C in the dissolved and particulate pools (in terms of concentration, partition and stoichiometry) as related to the physical forcing and microbial communities. Person in charge of TN e TP, POC and Chl a analyses.



**Maria Grazia Mazzocchi** (LEEP) Ecology, biology and behavioural traits of mesozooplankton. She studies the biodiversity, phenology and long term trends of zooplankton communities and populations in relation to abiotic and biotic variability of the system.



**Augusto Passarelli** (MECA) Field operations and chemical analyses. He is responsible for sampling of abiotic and biotic parameters for organic and inorganic nutrient analyses and acquisition and processing of CTD data.





**Marina Montresor** (LEEP) Life history strategies of marine phytoplankton. She studies the life strategies of phytoplankton organisms, their role in population dynamics, the role of endogenous and exogenous factors in regulating transitions between different stages and phases of life cycle. The study includes both experimental work in the lab as well as *in situ* observations.



**Maurizio Ribera d'Alcalà** (LEEP) Biological Oceanography. His research focuses on the study of the interactions between internal and external factors related to the biology and evolution of plankton. He also deals with the dynamic biogeochemistry of the Mediterranean Sea.



**Maria Saggiomo** (MECA) Chemotaxonomy and photoacclimation of phytoplankton communities. Her research activity is focused on chemotaxonomy and temporal variability of phytoplankton communities in the water column and of their photoacclimation as related to abiotic factors. She is responsible for HPLC analyses.



**Raffaella Casotti** (MECA/FEEL) Logistics and sampling coordinator. She studies bacteria and phytoplankton < 5  $\mu\text{m}$  in size using flow cytometry and molecular methods such as CARD-FISH and metagenomics. Experiments to estimate growth and grazing rates and reactions to biotic and abiotic stresses (mainly light and natural algal products).



**Diana Sarno** (TIMP) Phytoplankton biodiversity and ecology. She coordinates the activities related to identification and counting of phytoplankton samples in the context of national and international projects. She is also involved in the development of tools for collection and dissemination of taxonomic information. She is in charge of the phytoplankton time series data of LTER-MC.



**Ferdinando Tramontano** (LEEP) Sampling of the main biotic and abiotic parameters, treatment of samples on board, filtrations for the determination of Chl  $a$ , pigmentary spectrum, and analysis of dissolved oxygen.



**Adriana Zingone** (LEEP) Scientific coordinator. Biodiversity, phenology and long term trends of planktonic microalgae in relation to abiotic and biotic variability of the system. Her research is based on data obtained with traditional and advanced methods, including metagenomics.

## Contract researchers:



**Iole Di Capua** (LEEP) Mesozooplankton taxonomy and ecology. Taxonomic identification and quantitative analysis of zooplankton samples of LTER-MC with light microscope and image analysis (ZooScan) techniques. She studies the coexistence and succession of zooplankton species at different temporal scales.



**Isabella Percopo** (LEEP) Phytoplankton taxonomy and ecology. She studies the phytoplankton biodiversity with microscopical and molecular methods. She is involved in the taxonomic identification and quantitative analysis of the phytoplankton time series data of LTER-MC.



**Cecilia Balestra** (LEEP) Composition and dynamics of autotrophic and heterotrophic picoplankton. Her main research interest is microbial ecology, with a focus on the abundance and distribution of autotrophic and heterotrophic picoplankton, on bacterial community composition and metabolic activity of heterotrophic bacteria.

LEEP : Ecology and Evolution of Plankton

MECA: Environmental Management

TIMP: Taxonomy of Marine Phytoplankton

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