

# **The use of Ship-of-Opportunity measurements for marine environment monitoring**

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# Content

- **SOOP measurements**
- **Examples of data presentation**
- **Integration of SOOP data into environmental data analysis**
- **Conclusions**

# The benefit of SOOP measurements



**Operational (on-line data)**

**High frequency (in space and time)**

**Input data for operational hydrodynamic and ecosystem models**

**Relatively cheap**

**Fixed sampling depth**

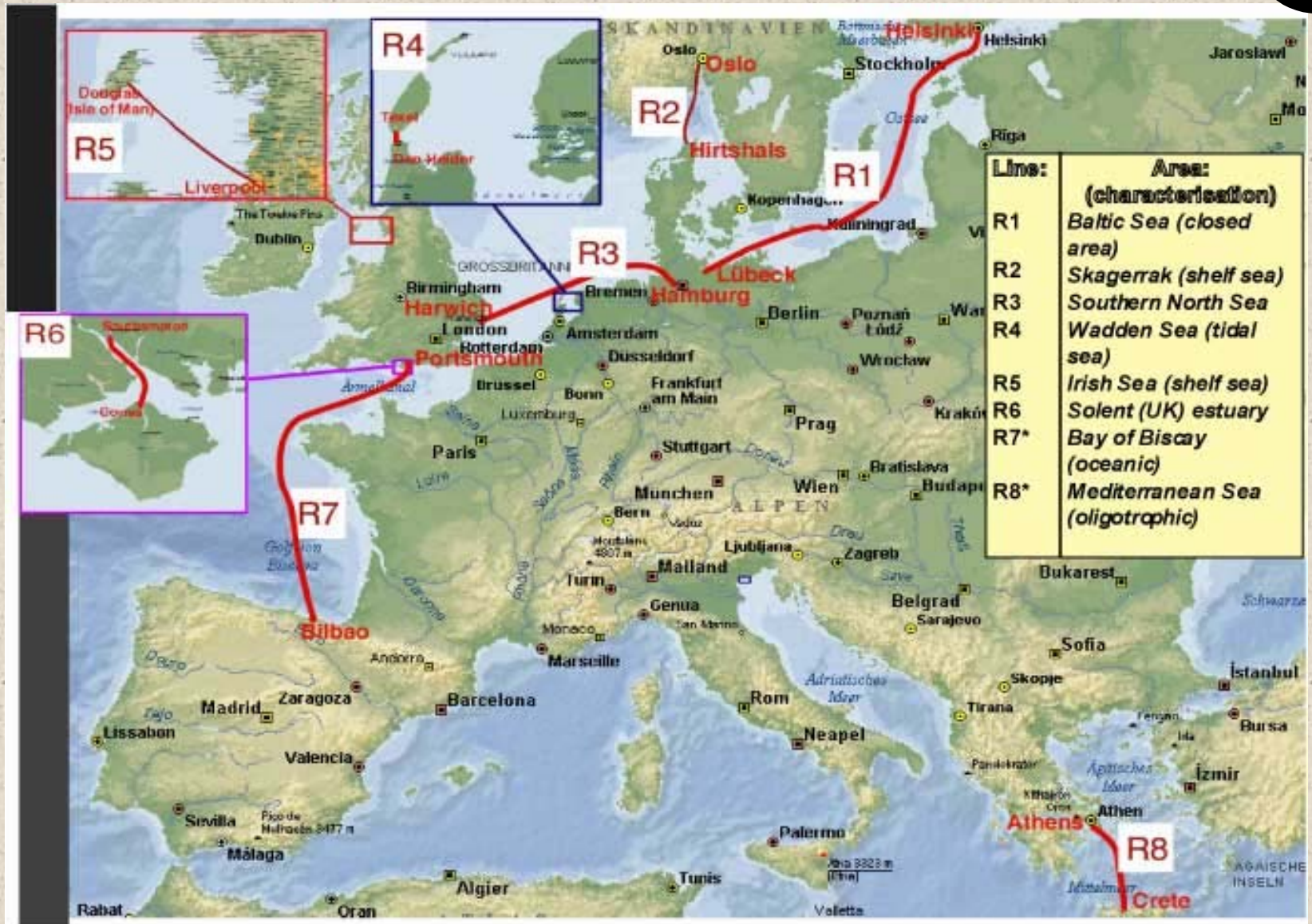
**! use in combination with other monitoring methods will rise the value of obtained data (remote sensing, COMBINE monitoring programme, open sea fish monitoring)**

# Ships and routes in the frame of Alg@line



- Silja Line **Silja Serenade:** Helsinki - Stockholm
- Silja Line **Silja Opera:** Helsinki - St. Petersburg
- Tallink **Romantika:** Helsinki - Tallinn
- Finnlines **Finnpartner:** Helsinki - Travemünde
- Kristina Cruises **Kristina Brahe:** Savonlinna - Vyborg - Helsinki - Mariehamn
- Transfennica **Transguard:** Hamina - Lübeck
- Coast guard vessel **Telkkä:** Archipelago Sea
- Coast guard vessel **Turva:** Bothnian Bay
- Coast guard vessel **Merikarhu:** Gulf of Finland

# FerryBox

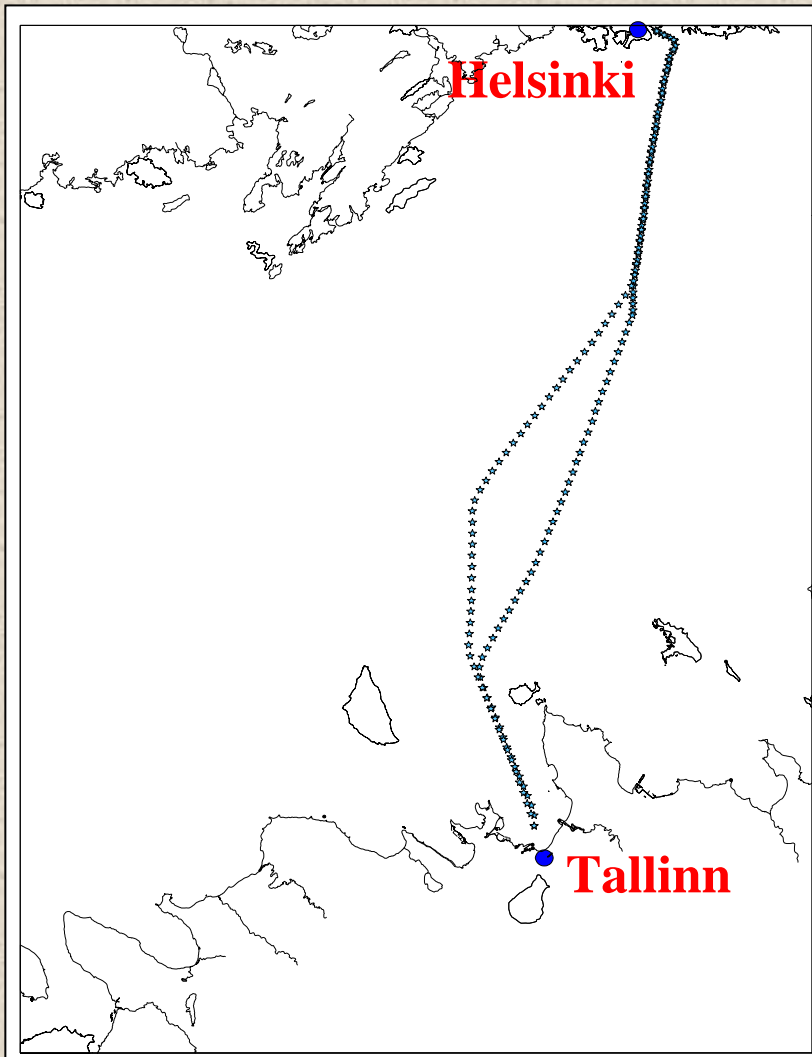


# FerryBox routes and tasks



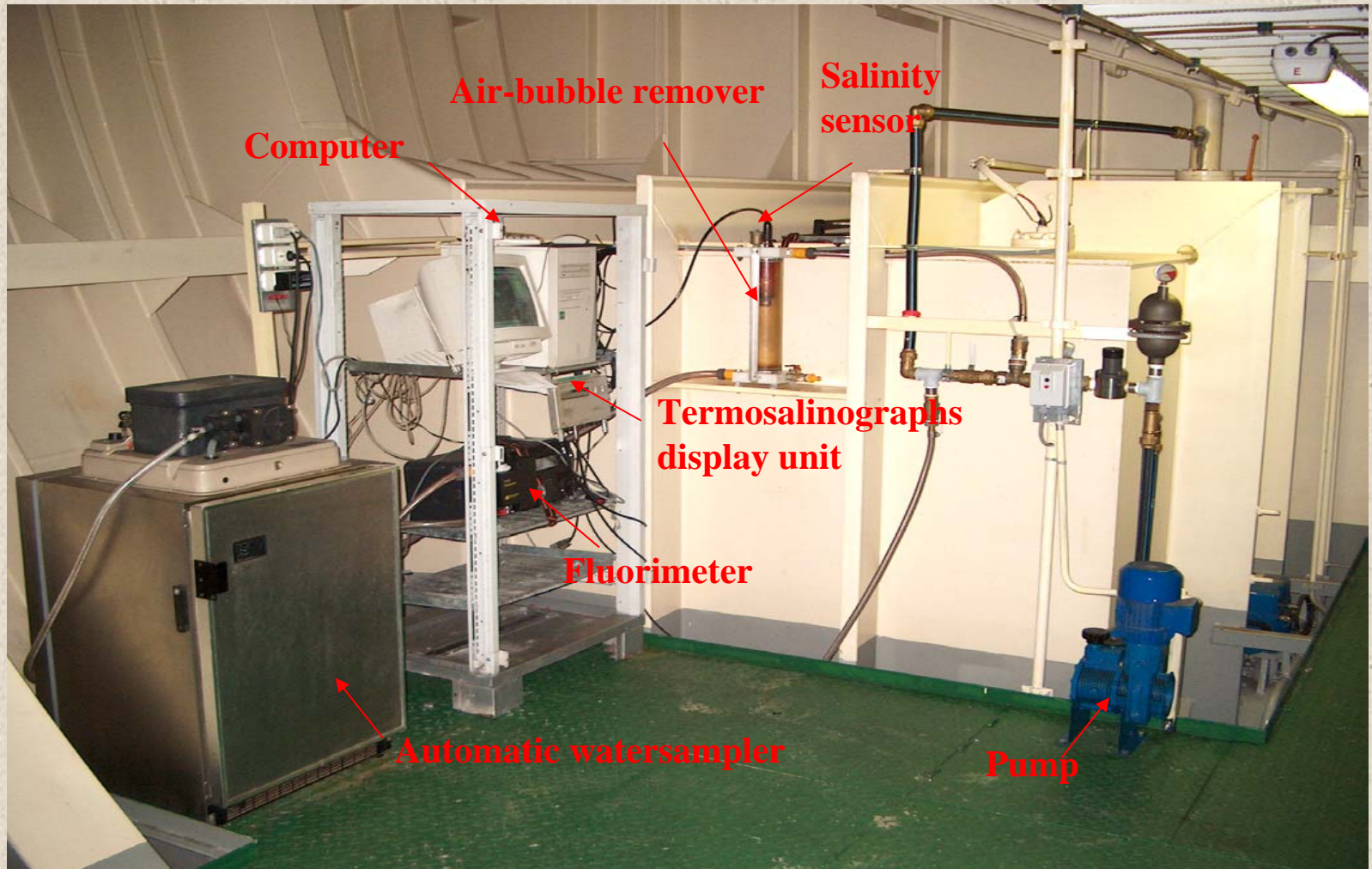
<b>Line</b>	<b>Area</b>	<b>Main study items and tasks</b>
<b>R1</b>	<b>Baltic Sea (closed area)</b>	<b>Eutrophication, algal blooms, sampling strategy</b>
<b>R2</b>	<b>Skagerrak (shelf sea)</b>	<b>Validation of satellite data, combination in situ and satellite data</b>
<b>R3</b>	<b>Southern North Sea</b>	<b>Nutrient input, Eutrophication, algal classification, ground truth</b>
<b>R4</b>	<b>Wadden sea (tidal sea)</b>	<b>Water currents, sediment transport</b>
<b>R5</b>	<b>Irish Sea (shelf sea)</b>	<b>Transport and mixing of Scottish shelf, algal growth</b>
<b>R6</b>	<b>Solent (UK) estuary</b>	<b>Transport from river to sea, estuarine Eutrophication</b>
<b>R7</b>	<b>Bay of Biscay (oceanic)</b>	<b>Water mass exchange shelf ocean, range of plankton environments</b>
<b>R8</b>	<b>Mediterranean Sea (oligotrophic)</b>	<b>Nutrient gradients, upwelling, data assimilation with buoy systems</b>

# SOOP measurements



- **Variables recorded on board:**
  - position (latitude, longitude) and time
  - *Chl a* fluorescence
  - temperature
  - salinity
- **Depth:**
  - 4-5 m
- **Spatial resolution:**
  - about 150 m
- **Frequency of measurements:**
  - highest - 4 crossings a day
  - lowest - 4 crossings a week
- **Time series since 1997**

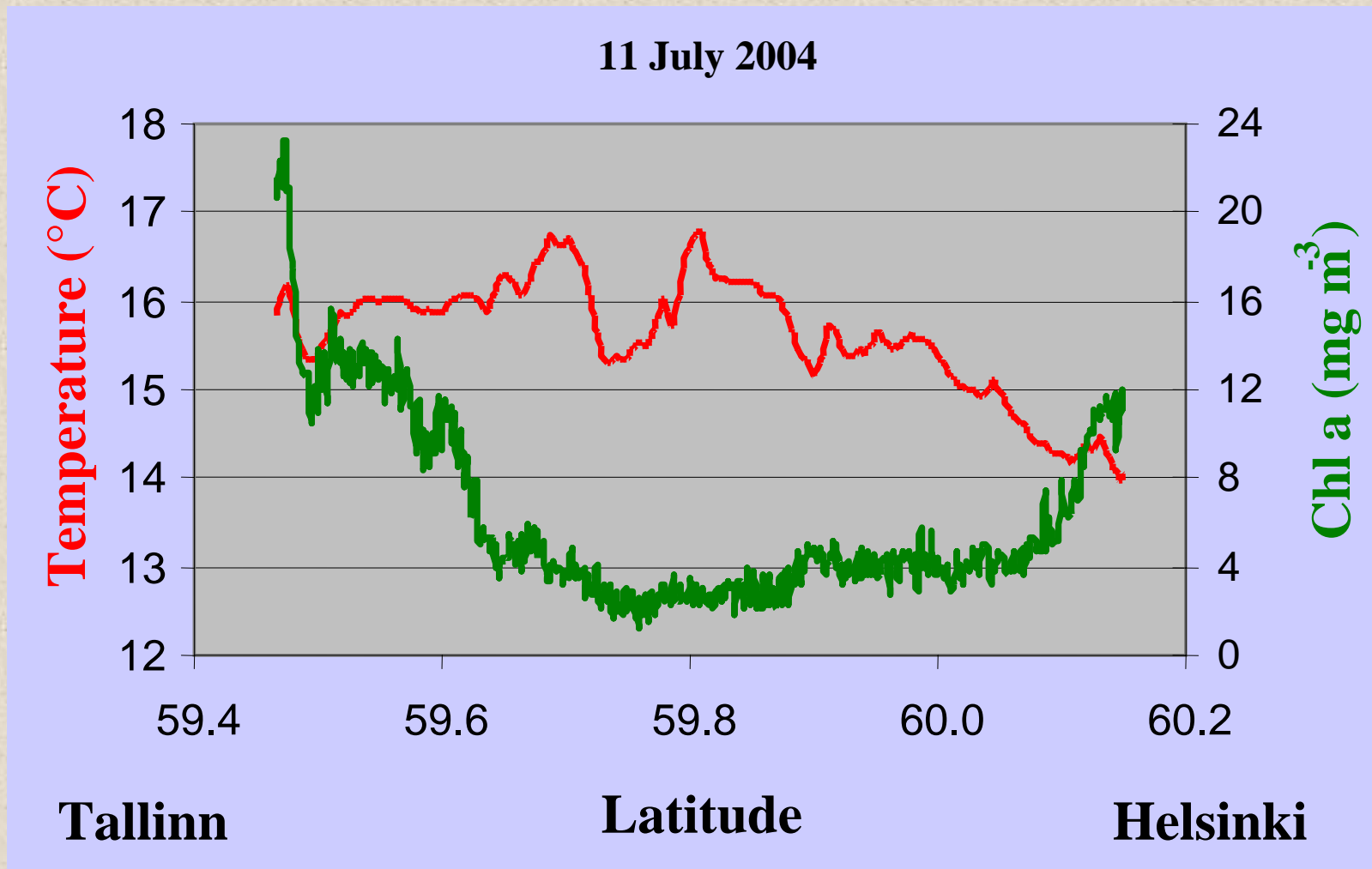
# Equipment onboard Romantika



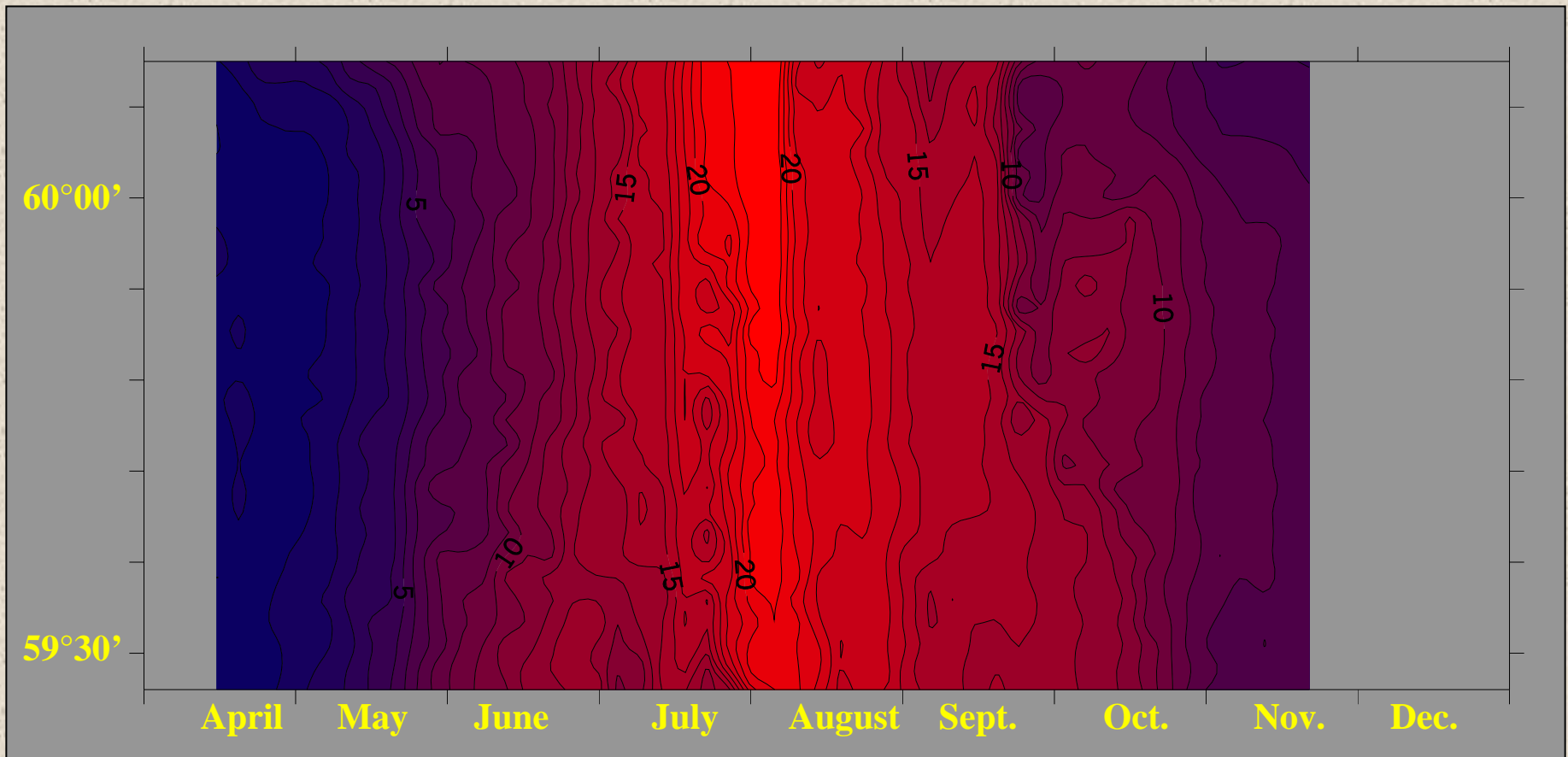


# Example of data

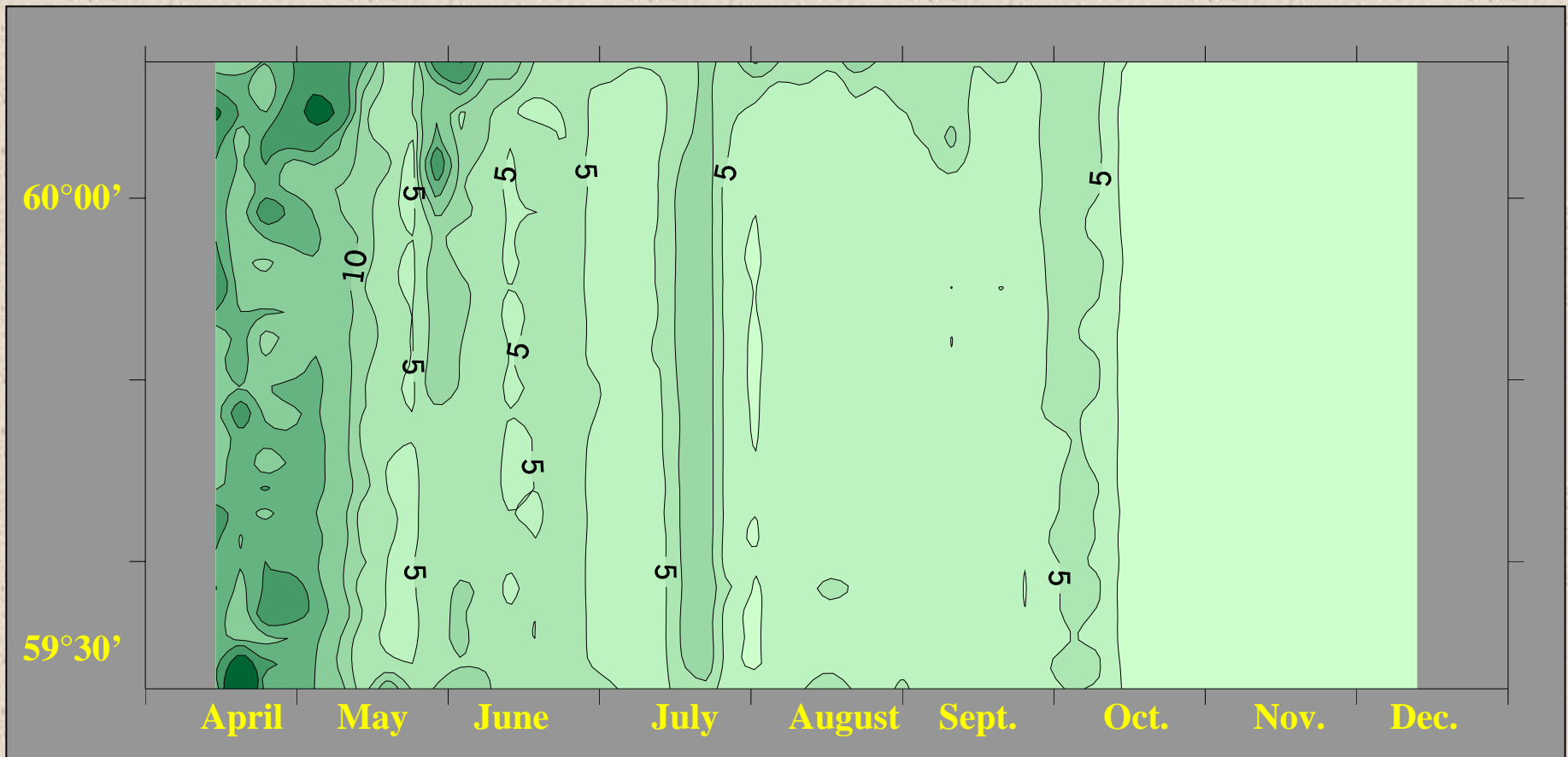
## Flow-through temperature and fluorescence measurements



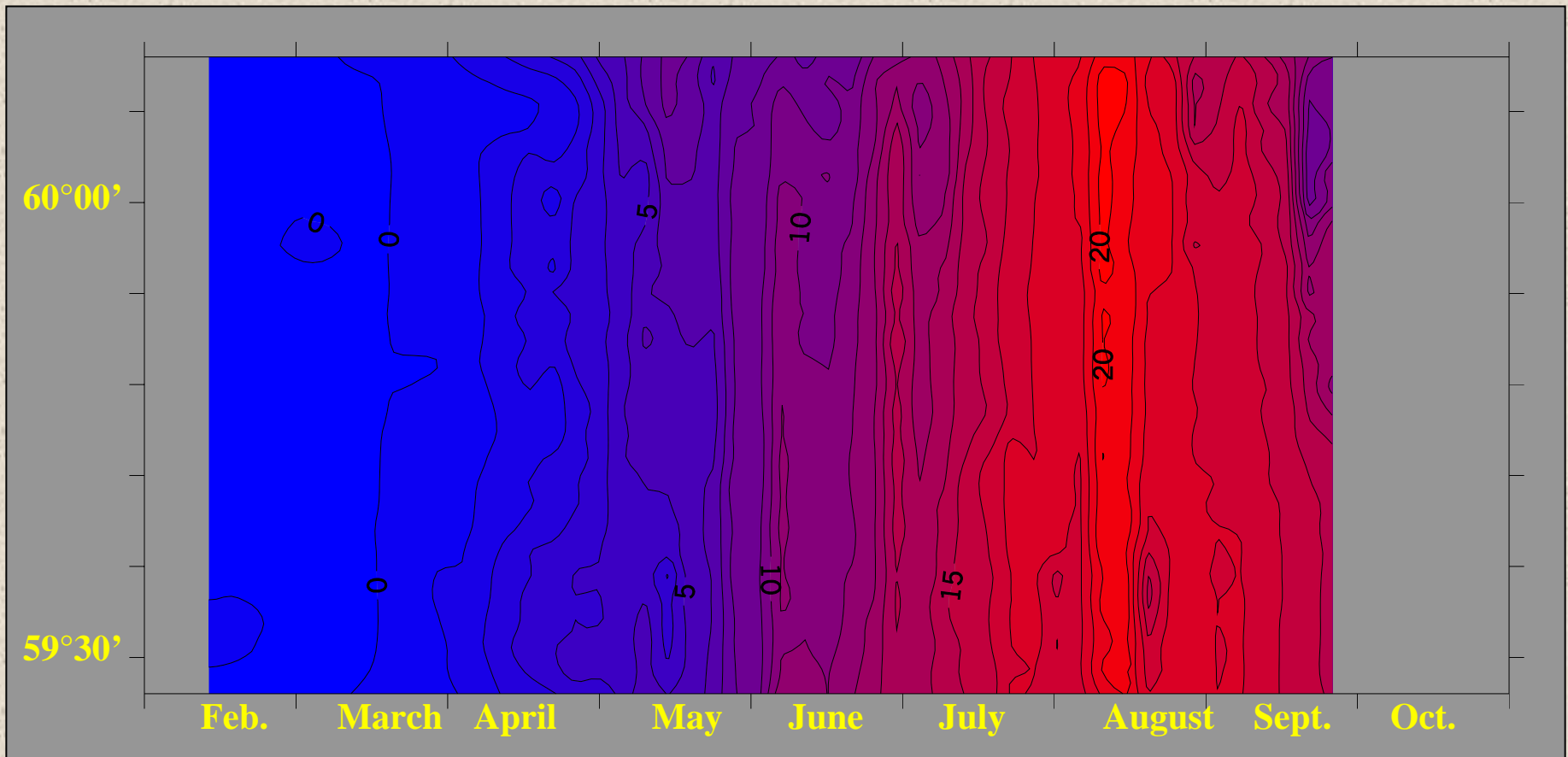
# Temperature variation (2003)



# Chlorophyll *a* fluorescence variation (2003)

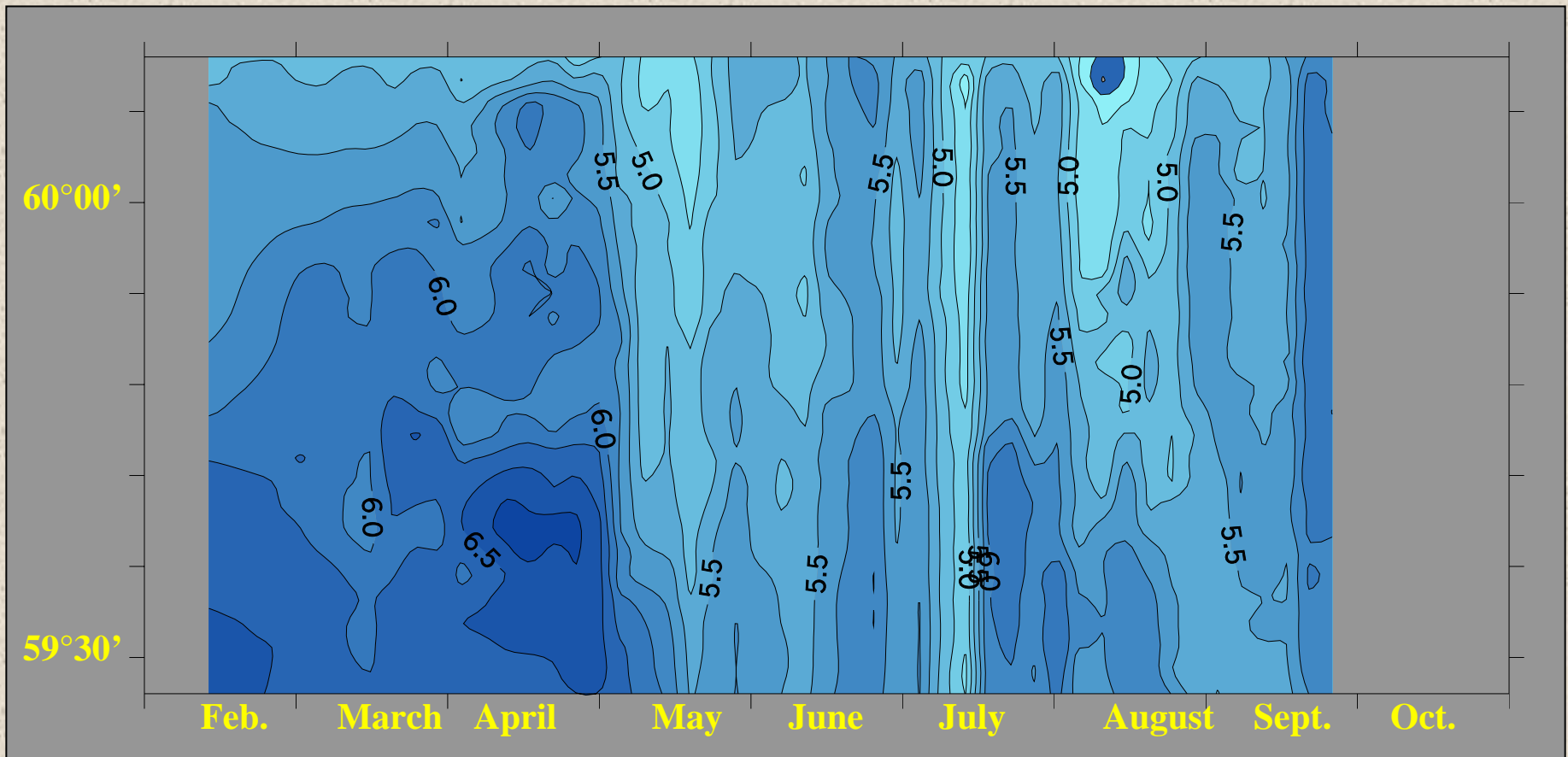


# Temperature variation (2004)

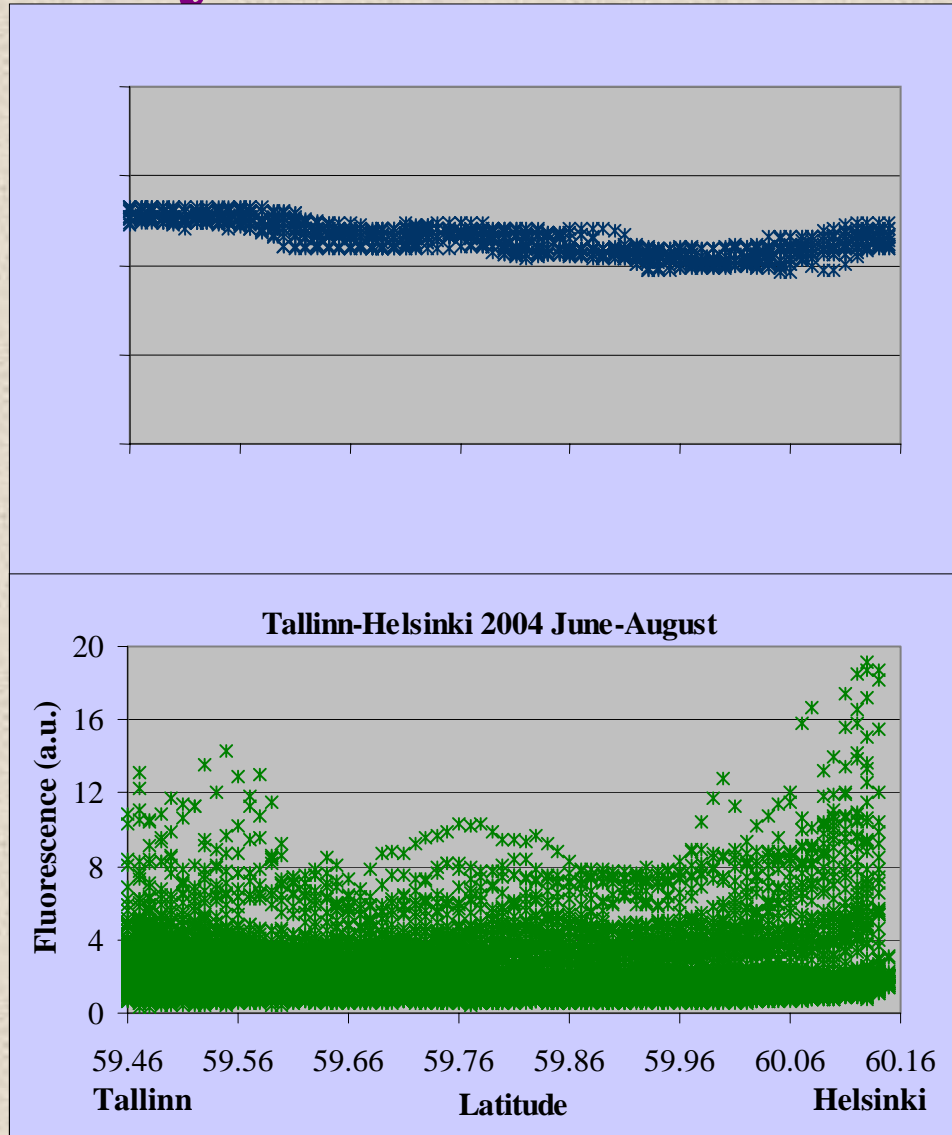




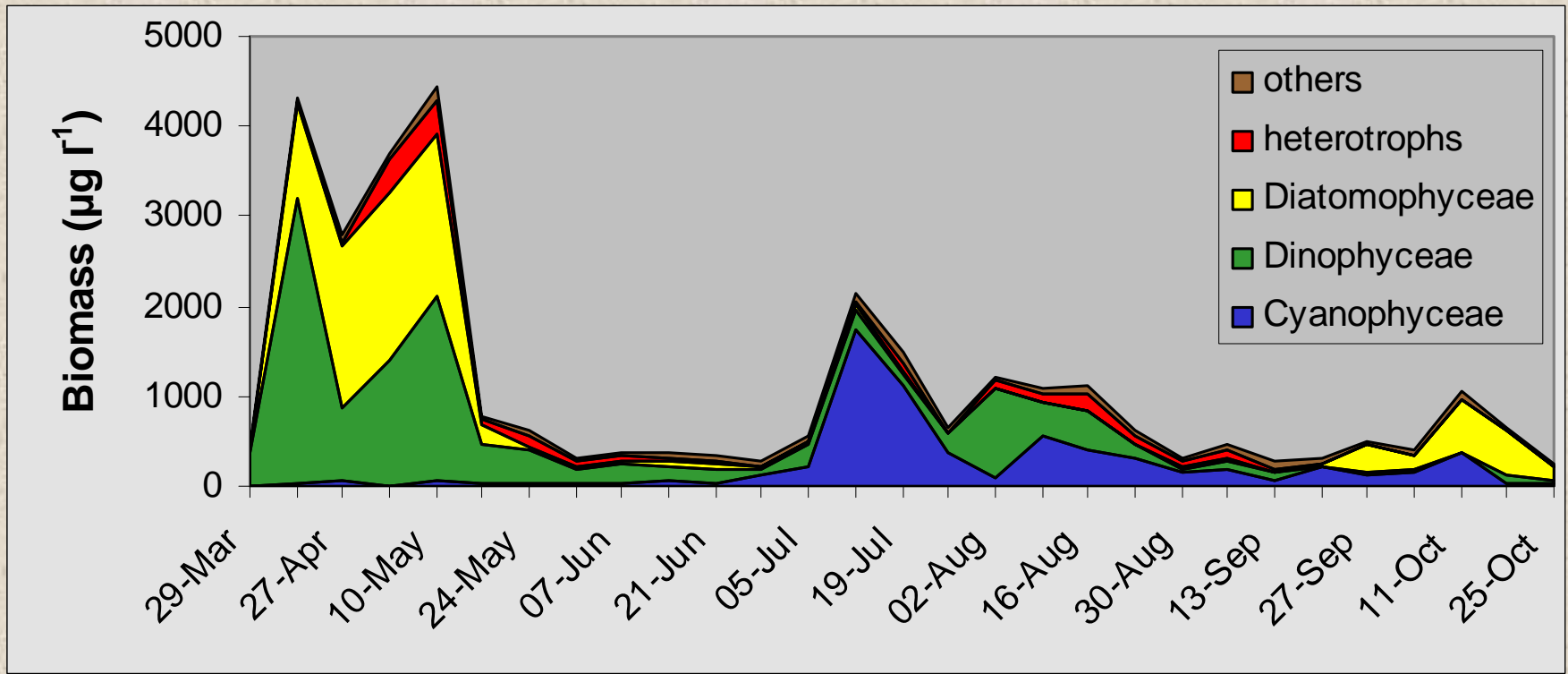
# Salinity variation (2004)



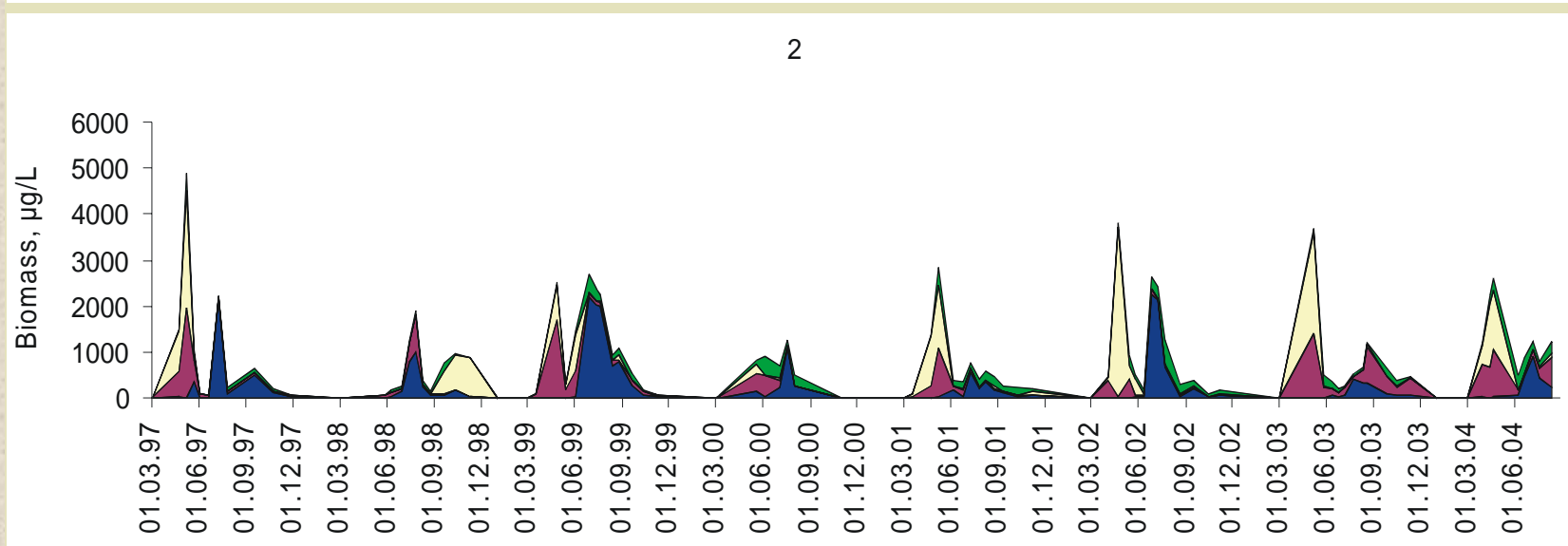
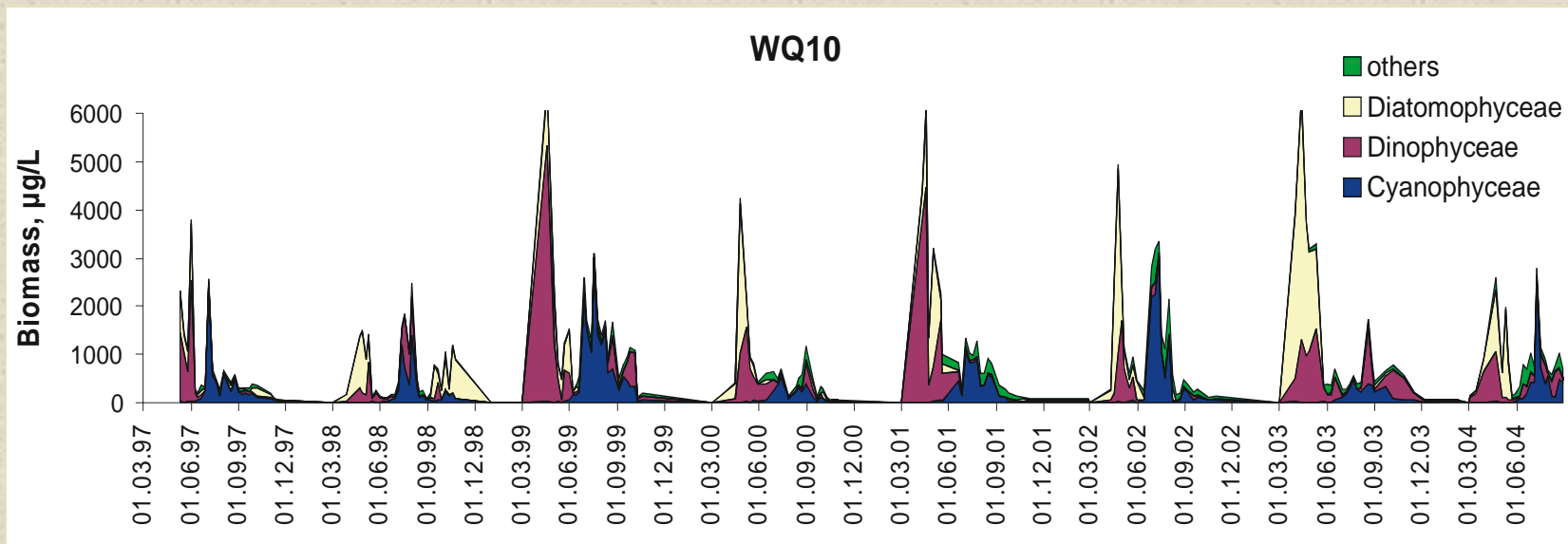
# Variations along the ferry line (salinity and fluorescence)



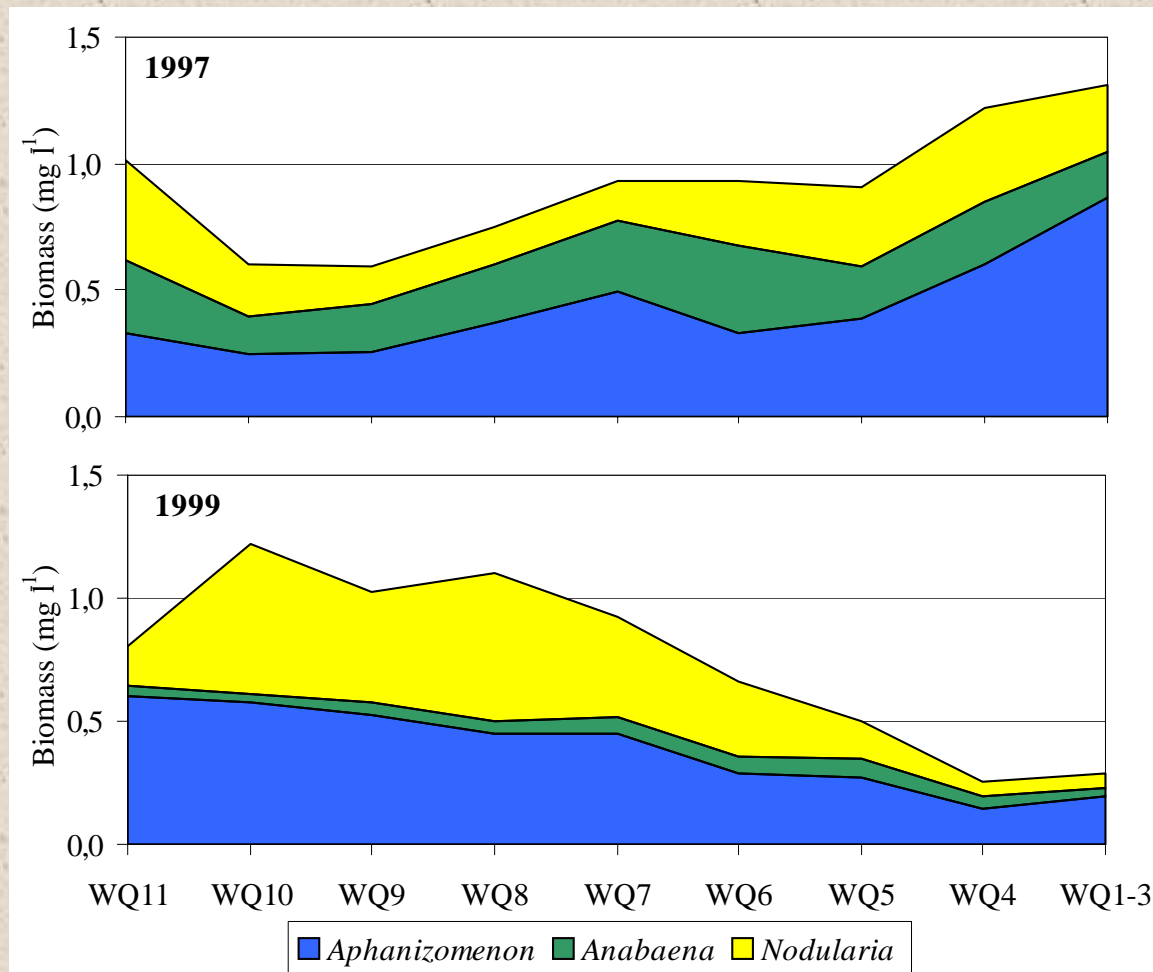
# Seasonal succession of phytoplankton in the Gulf of Finland (data from 1998)



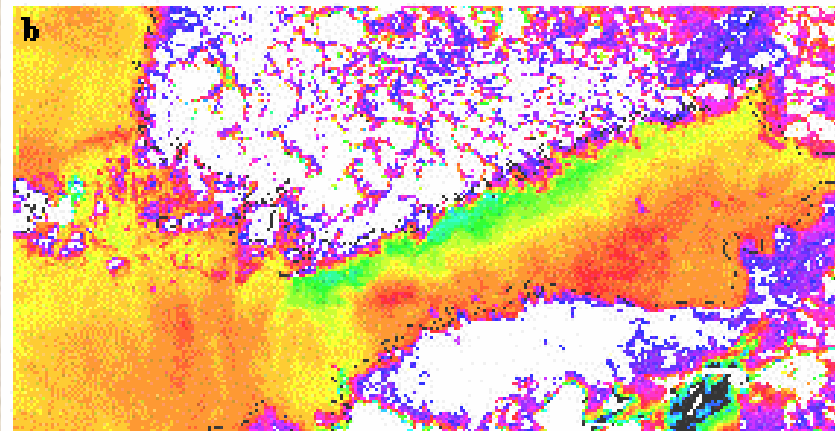
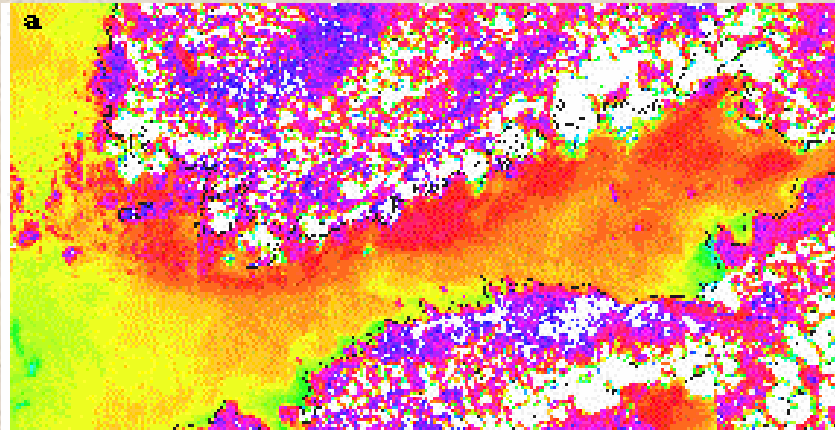
# SOOP versus traditional monitoring



# Time average biomass of cyanobacteria over the bloom period along the ferry route



# The NOAA/AVHRR images of the surface water temperature in the Gulf of Finland on 7 August 1997 and 3 August 1999

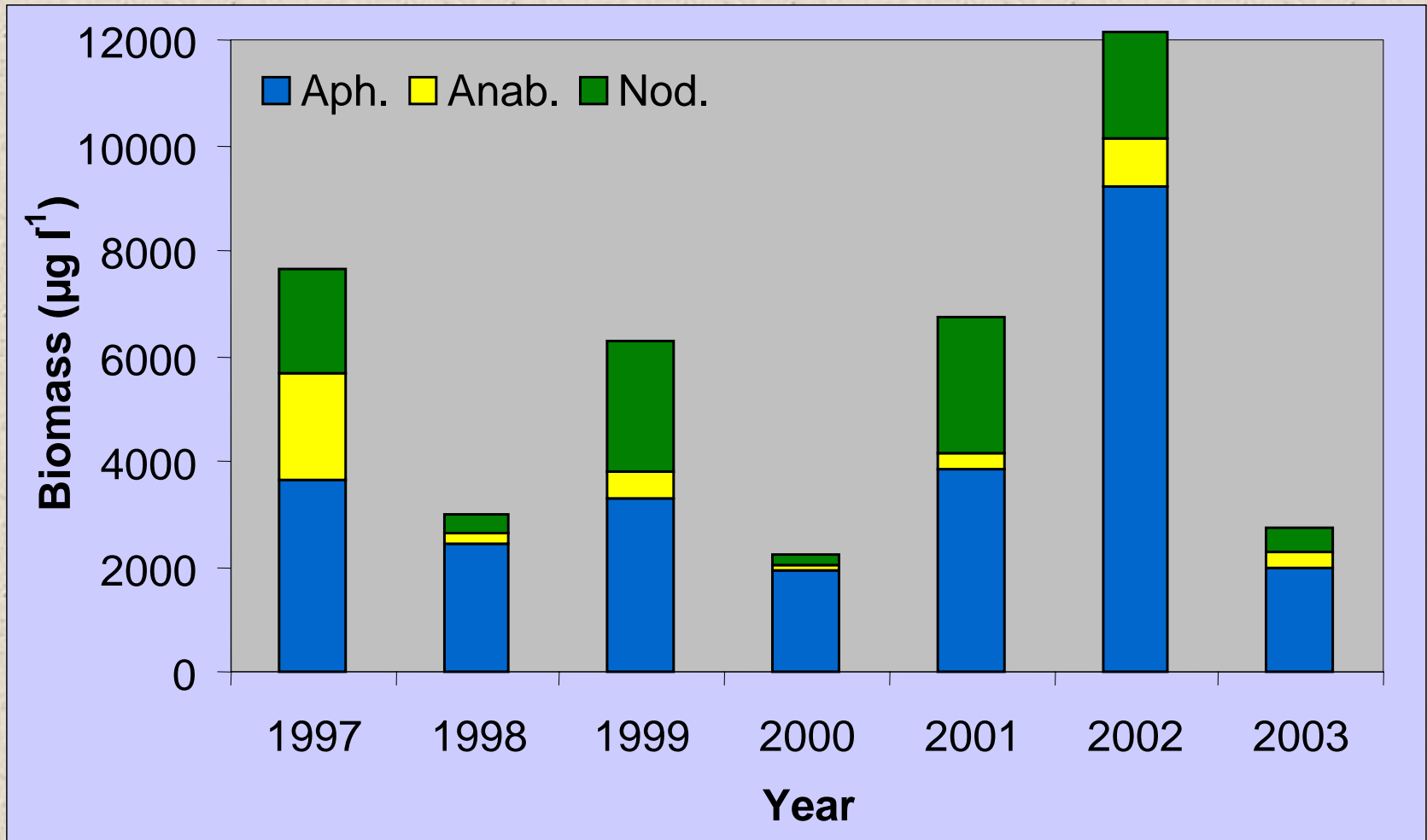


Pre-processed by the Finnish Meteorological Institute

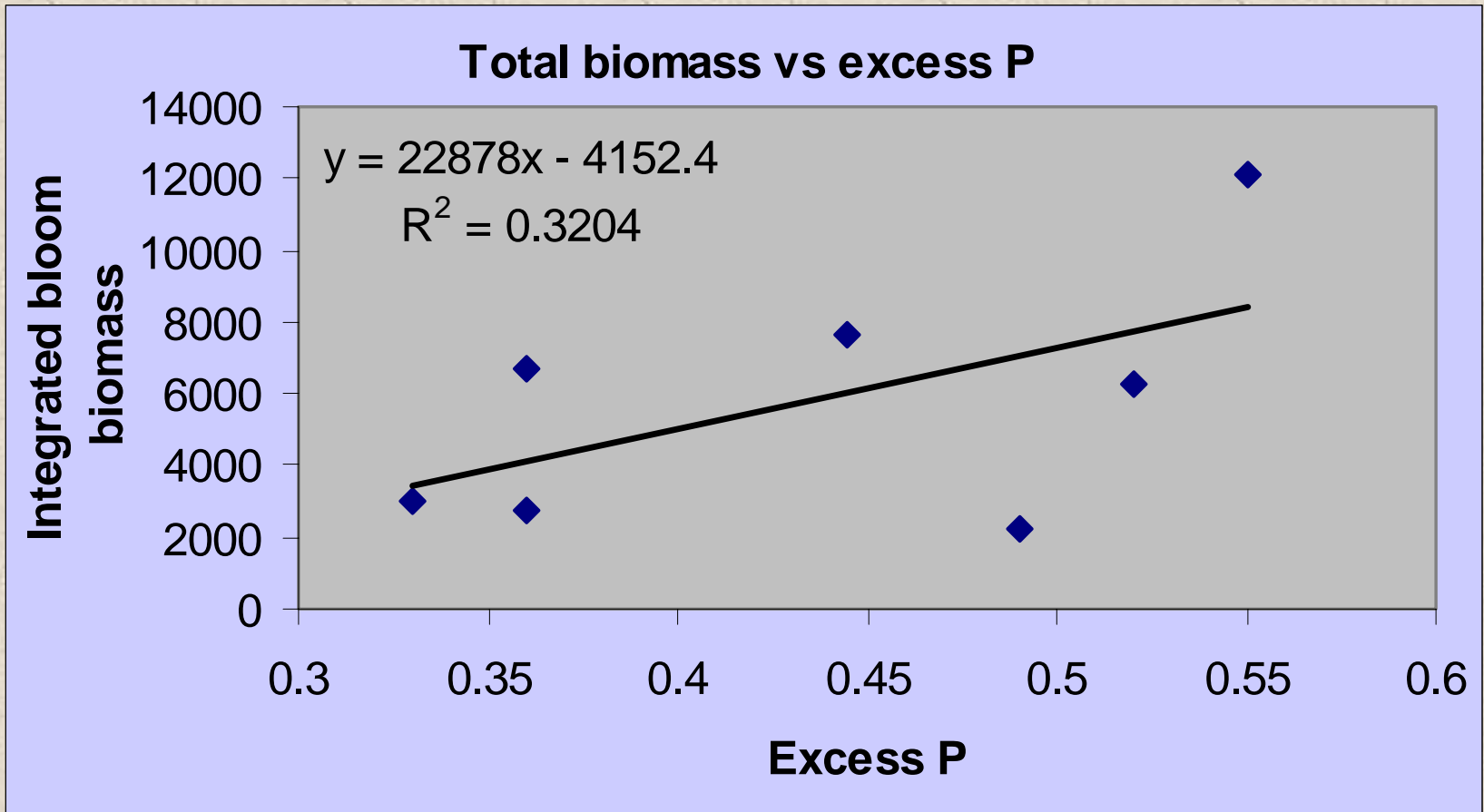
# Interannual variations



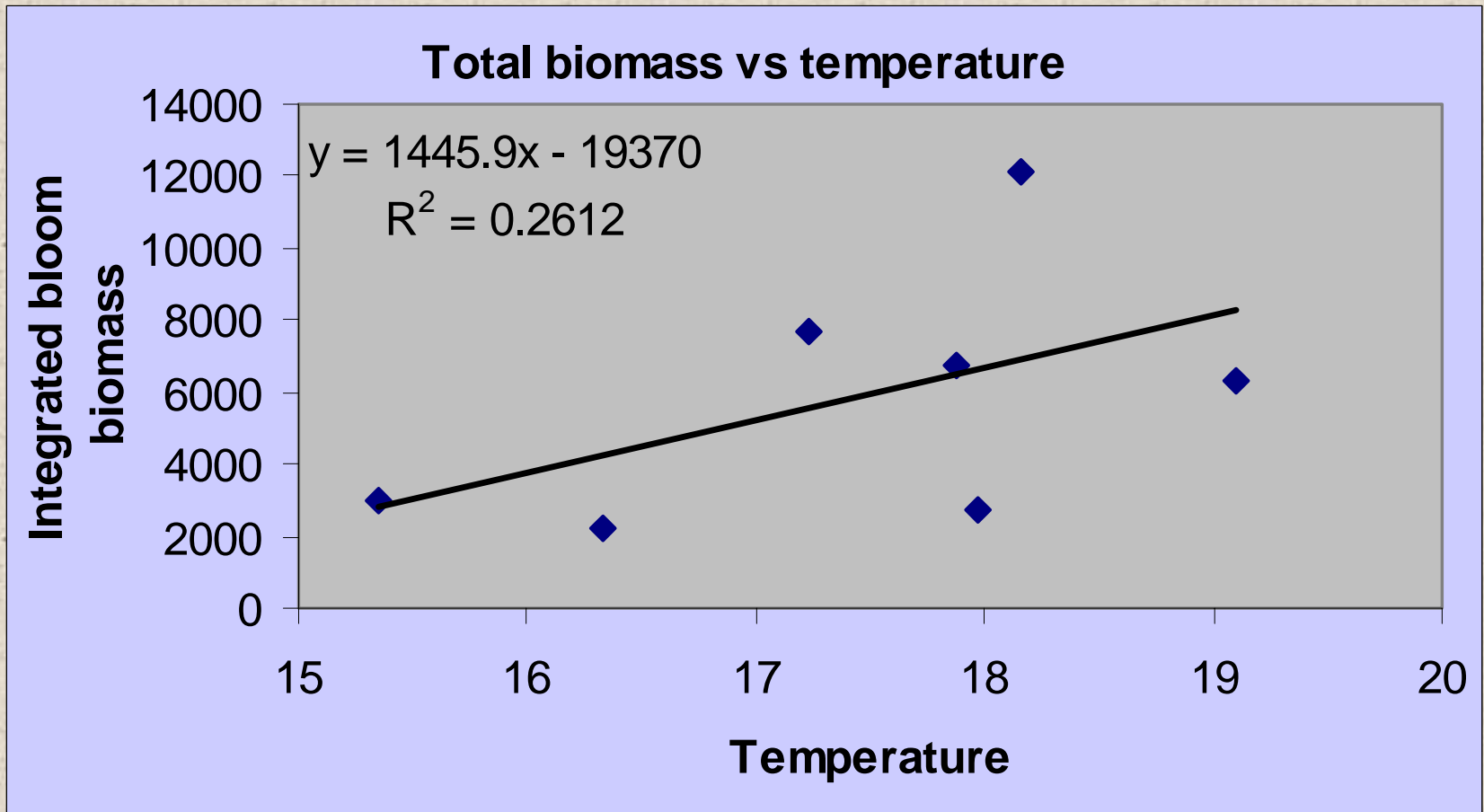
## Integrated bloom intensity



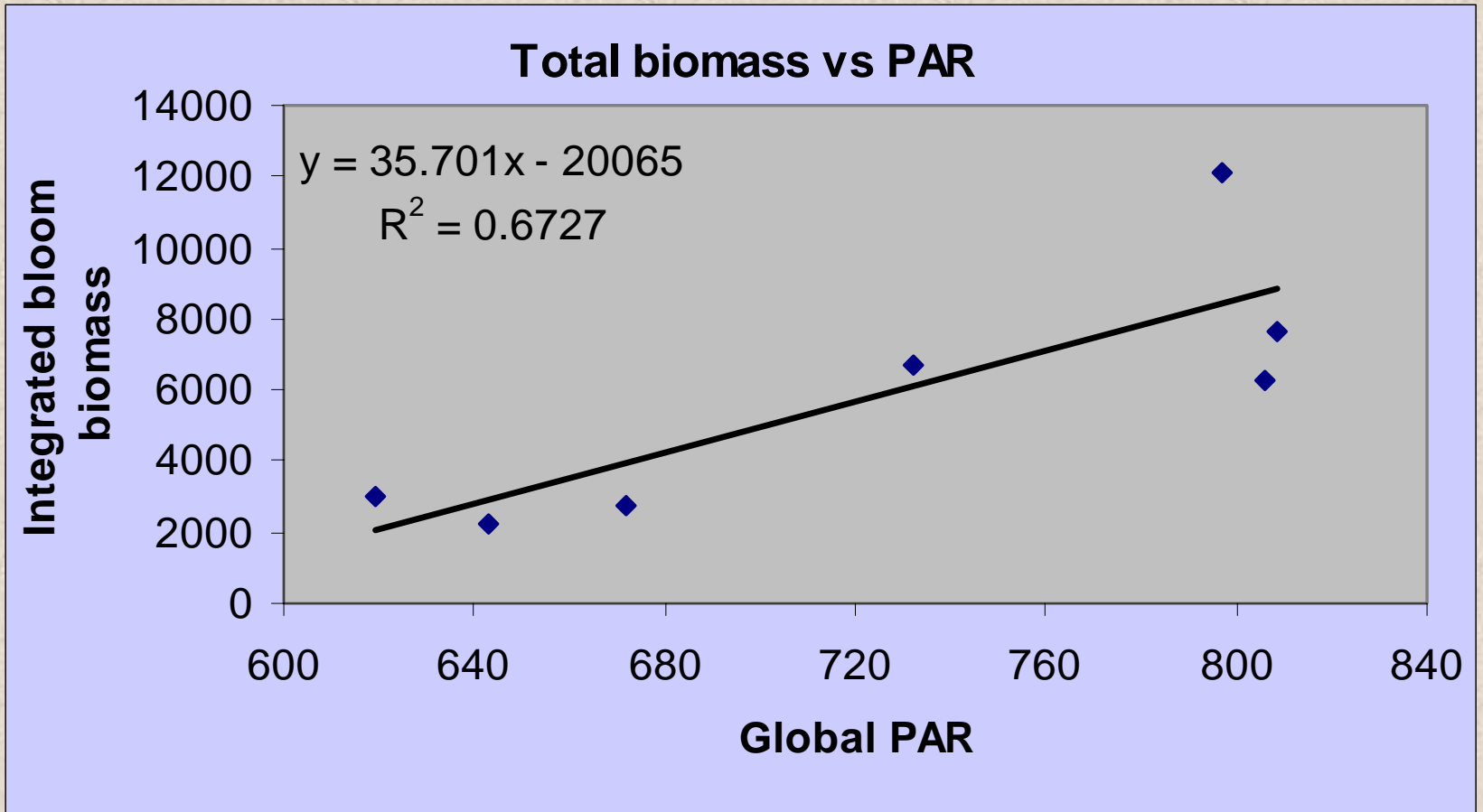
# Correlations



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# Conclusions

- SOOP is a proper method for operational monitoring of algae blooms (especially their initiation and development); data can be used i.a. for bloom forecasts
- details of temporal changes and regional peculiarities of hydrophysical and biological parameters can be monitored



# Conclusions

- high frequency of measurements is important for getting more reliable relationships between bloom parameters and forcing (controlling) factors



# ***Acknowledgements***

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***provided***

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