New sensors and techniques for in situ measurements at fixed points: image analysis and pH-pCO2 sensors (WP10.1 & 10.2)

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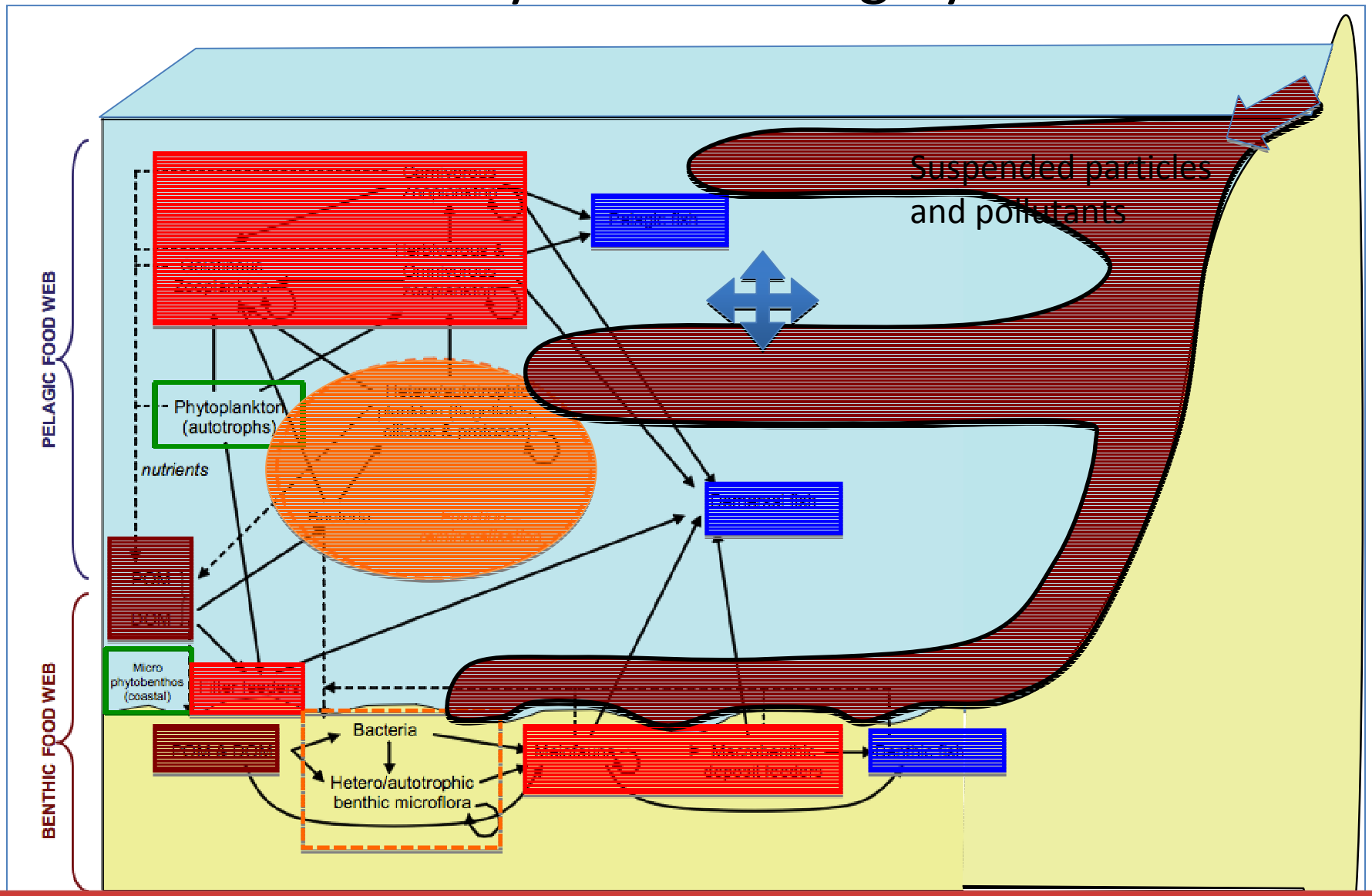
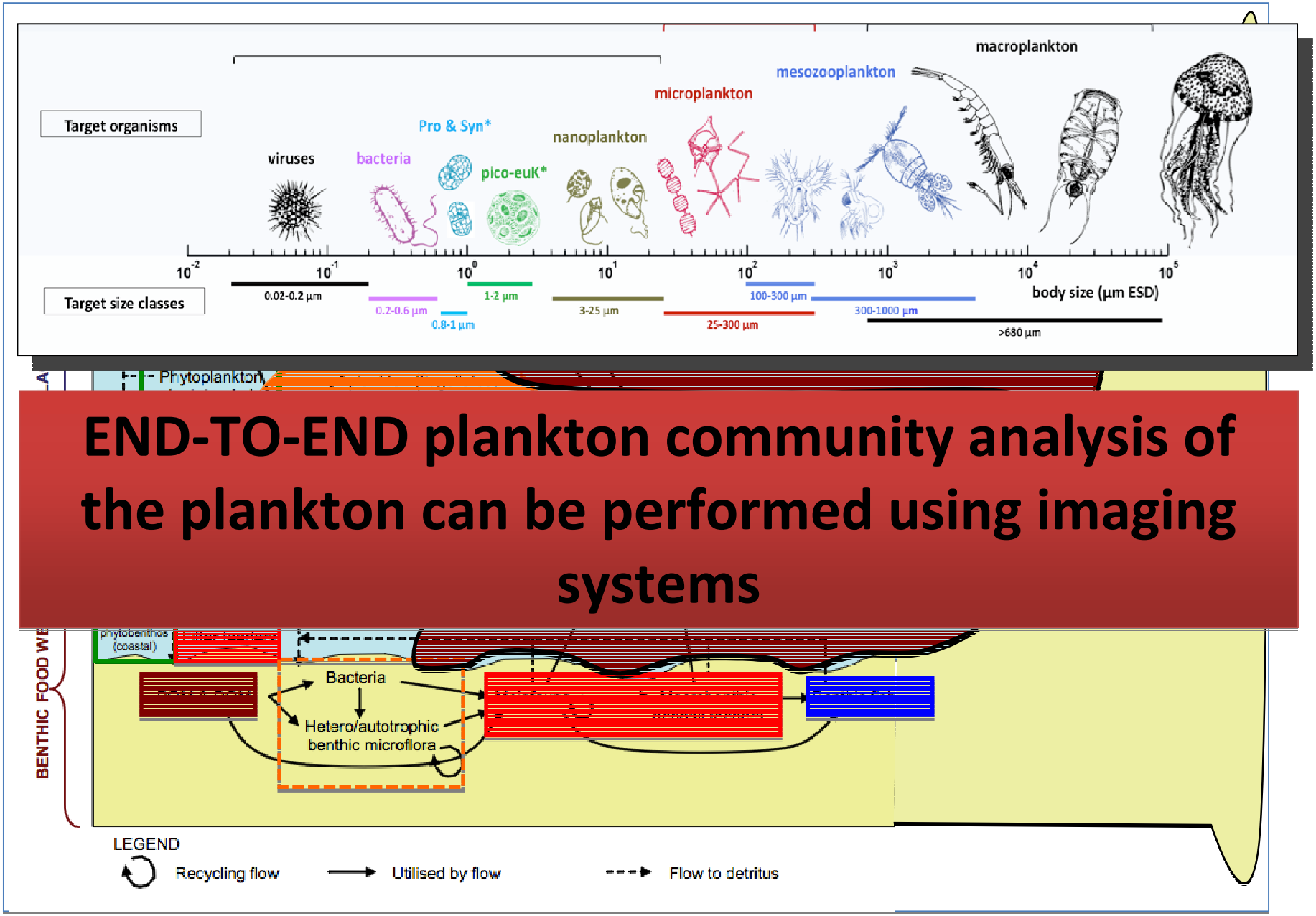
Coastal ecosystems are highly variable



the monitoring of all living and dead ‘particles’ requires integrated (all trophic levels) and rapid methods



END-TO-END plankton community analysis of the plankton can be performed using imaging systems

Imaging systems, GREAT PERSPECTIVES

Provide indicators of ecosystem status (abundance, biomass, taxa, size spectra) from lab measurements and **in situ instruments** (provide high frequency data)

These indicators can be used to develop mathematical models for systems where size is important:

-zooplankton size spectra to get information on physiological rates (Platt & Denman 1978, ... Baird et al., 2004, 2010, Zhou 2006, Maury et al.,2007)

-vertical distribution of appendicularian and effect on vertical fluxes (Lombard et al., 2009)

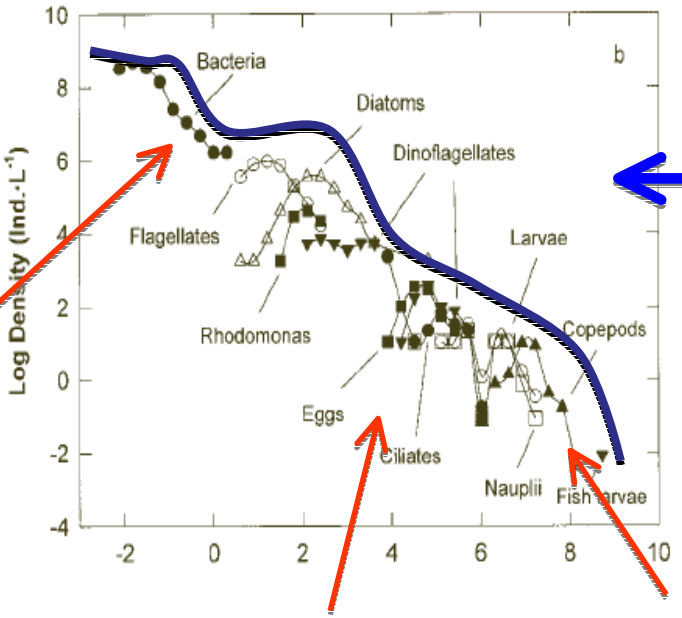
-appendicularians in recent PFT models (Berline et al., 2010)

- vertical distribution of particle fluxes (Stemmann et al., 2004)

NOW and in the future: Pelagic ecosystem « end to end » monitoring

DELIVERABLE:
Common software for image analysis and data management for Flowcam, Zooscan.

We try to take into account other instruments (for other size ranges)



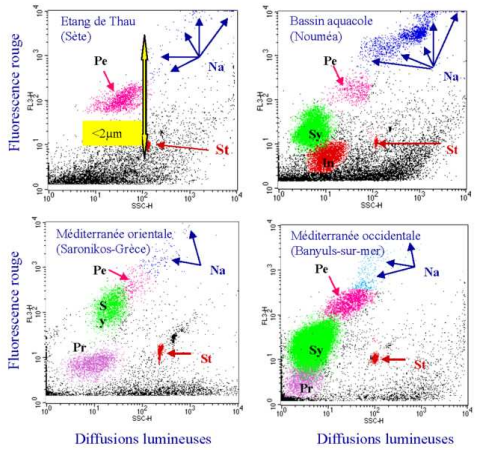
4 UVP, LISST

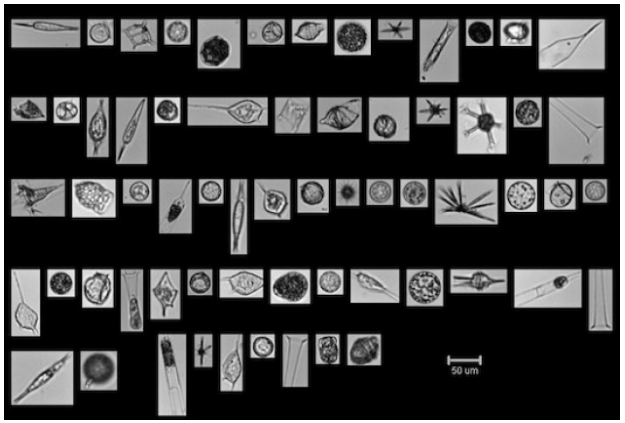
1: Flowcytometer

2: FlowCam

3: Zooscan

légende :
Pe : picoeucaryotes
Na : nanoeucaryotes
Pr : *Prochlorococcus*
Sy : *Synechococcus*
In : signature inédite
St : standard interne
(Cytogrammes Courties, 2006)





Task 10.1 Development of new tools and strategies for the monitoring of key biological compartments and processes.

- Develop a sampling and an analytical protocol for the end to end pelagic ecosystem monitoring based on sample collection

- Use image analysis for the semi-automatic recognition of different plankton groups that could be used as indicators (bottles and net samples): FlowCam (for microplankton) and the Zooscan (for meso and macrozooplankton).

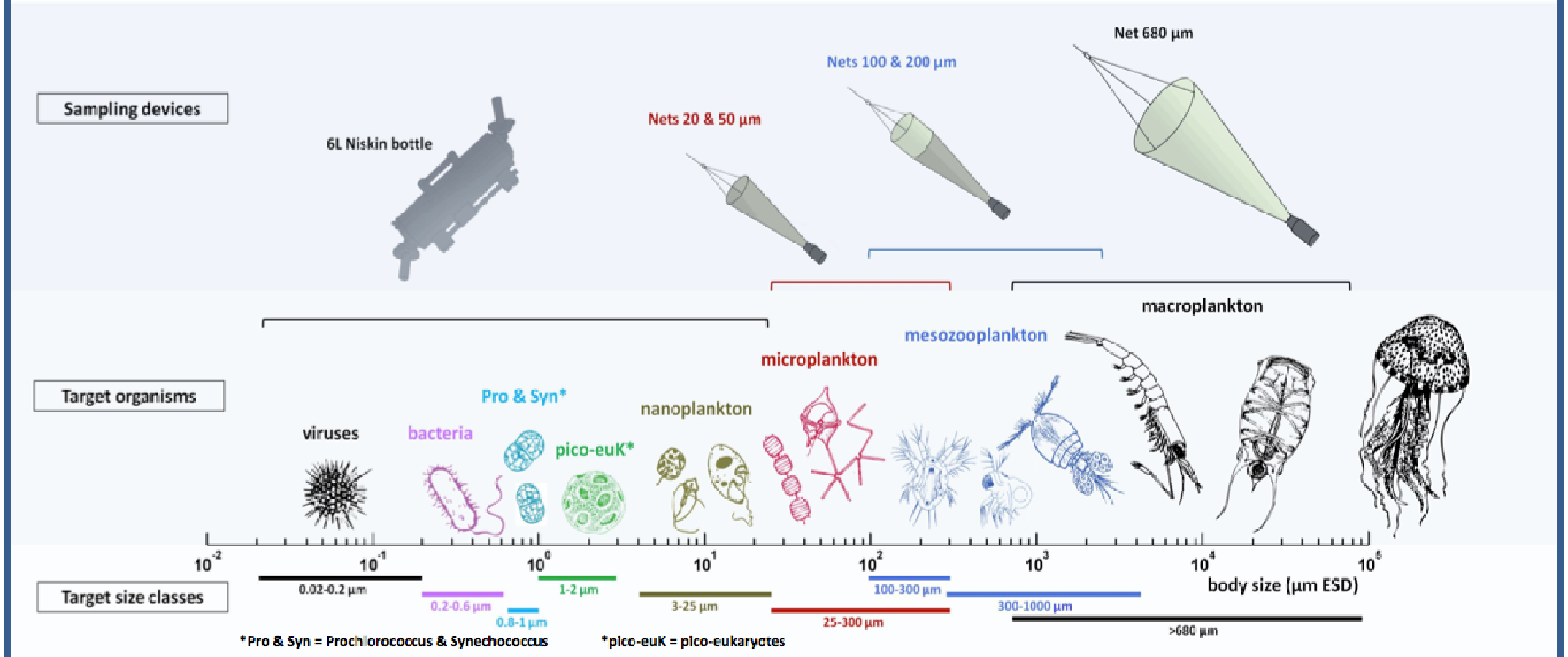
- Currently each instrument works with it's suite of softwares (Zooprocess/Plankton Identifier for Zooscan and ZooImage for Flowcam) while operational deployment requires an integrated and compatible methodologies.

- Today, software is still an early version and does not include any features for automatic recognition.

OPERATION PILOTE POINT B: started in 2011

1-SAMPLING

Romagnan et al., 2011



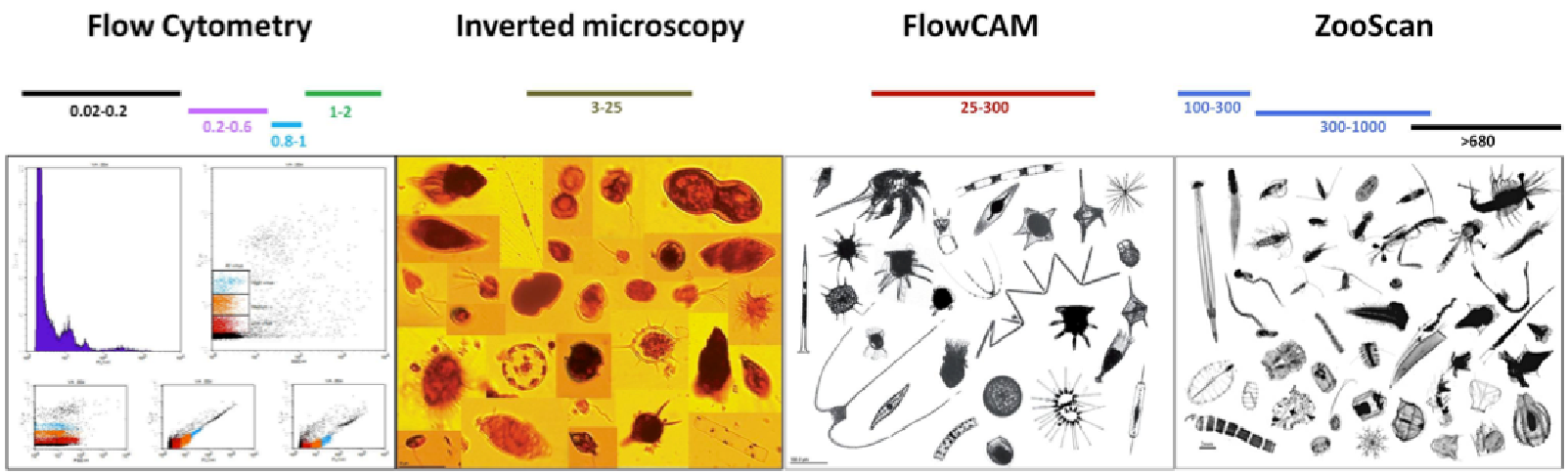
➔Sampling in every size fraction, across trophic levels, from viruses to the largest gelatinous organisms : **END-TO-END**

Nets and bottles for organisms 5 to 2000µm at VLFR (Point B site) during spring bloom and potentially in the Arcachon Lagoon

Sampling started and full analysis will be completed in spring 2012

OPERATION PILOTE POINT B: start in spring 2012

2-ANALYSES : IMAGING



➔ 3 imaging instruments

➔ 1 single consistent method to **measure** & **identify** organisms > 3 µm, associated with Flow Cytometry for smaller objects

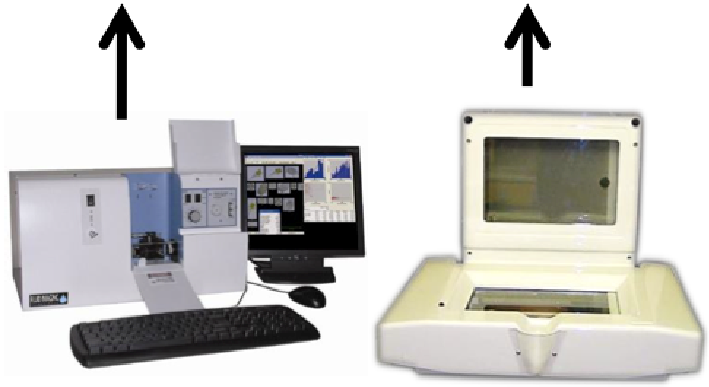
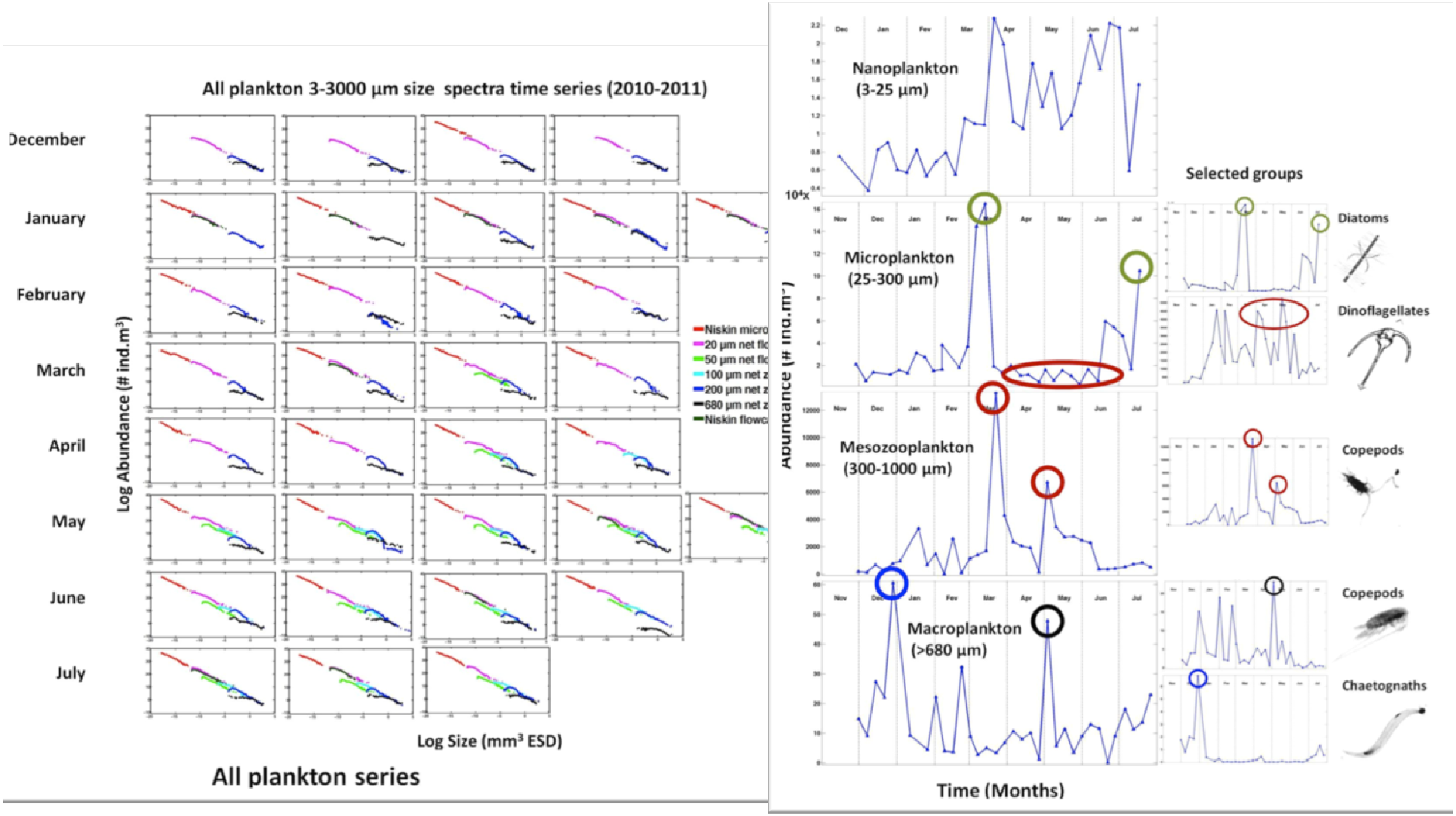


Image data base from FLOWCAM and ZOOSCAN exists and is used for image developing image analysis software

Develop an integrated suite of software for image analysis, automatic recognition, predictions validation and images and results management for both instruments

OPERATION PILOTE POINT B: started in 2011



Merging data from the different imaging systems works but requires adaptation for the software (in progress, should be finished early 2013)

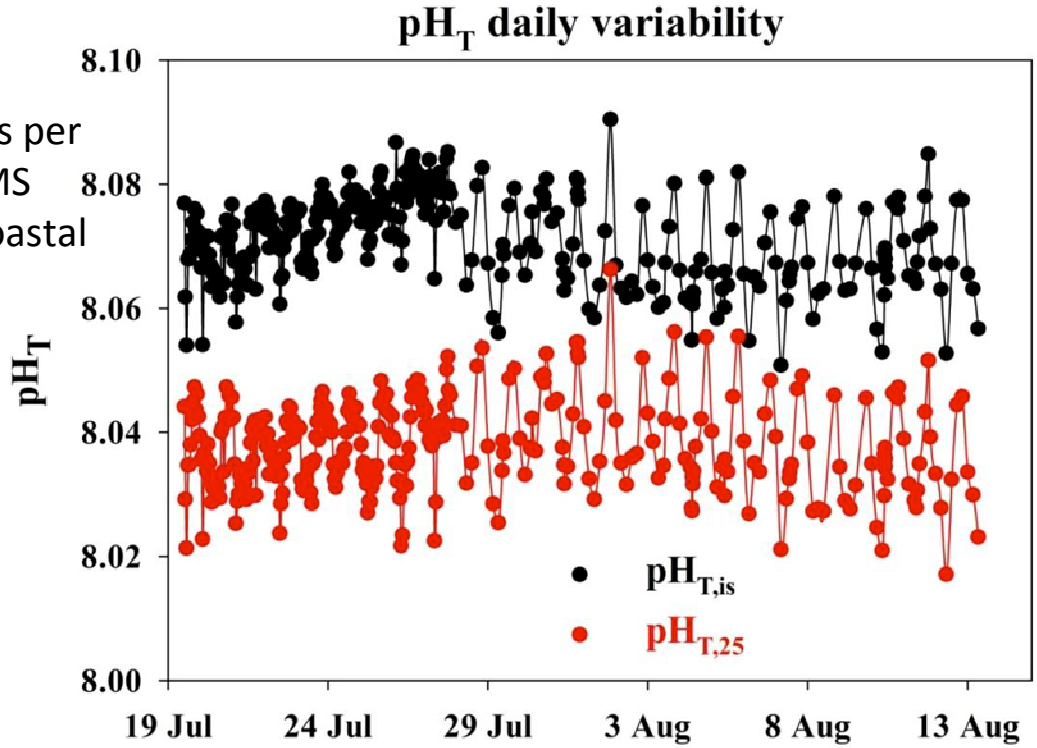
Existing pH sensor: example of pH sensor developed by ULPGC (Melchor González Dávila mgonzalez@dqui.ulpgc.es)

EuroSITES European Ocean Observatory Network

A pH sensor has both been developed and trialed at ESTOC site (EUROSITES)

SP100-SM Submarine pH Sensor
Based on spectrophotometric methods to measure pH removing dye effect in each determination

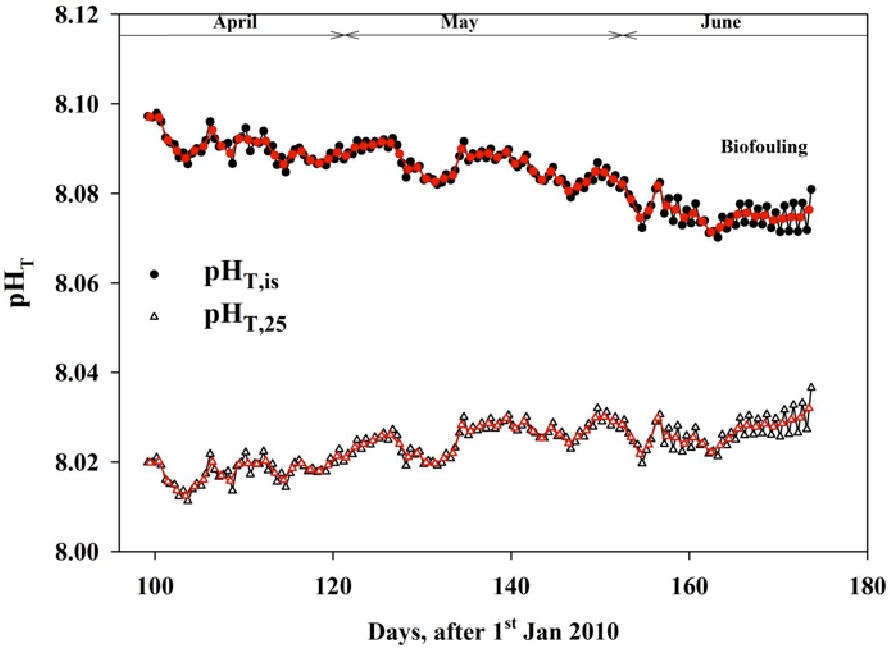
4 measurements per day and with SMS transmission (coastal buoy in 2009)

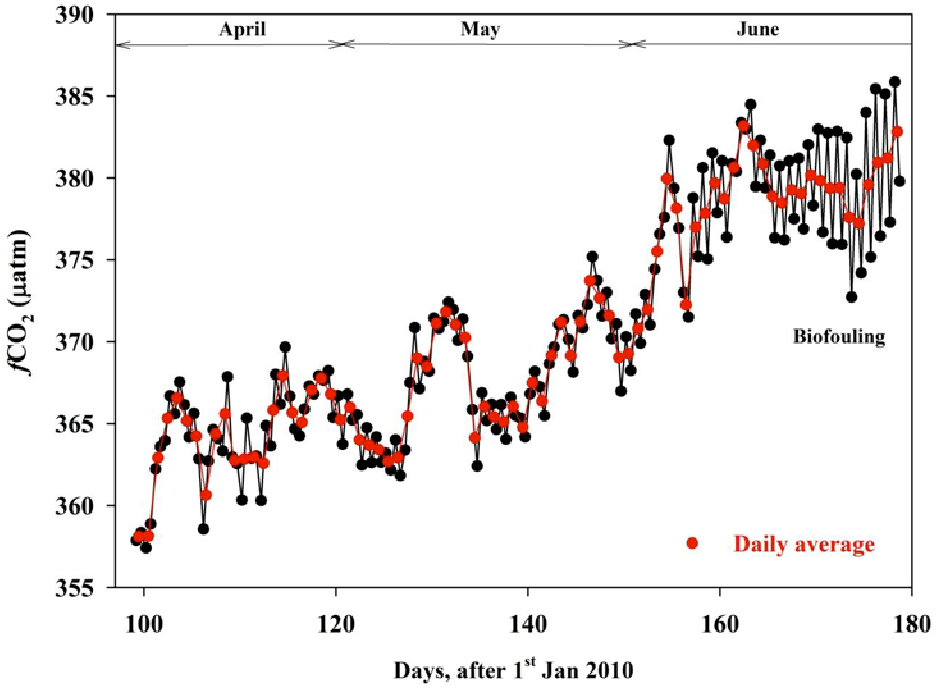


Range 0-20m. Work for 24 months with a pH reading every hour. Extremely stable pH sensor: precision < 0.002 pH units, accuracy ±0.005 pH units

Sensor deployed in 2011 on ESTOC site, including pCO2 from Pro-Oceanus

New design for E1-WM3A (HCMR)





EuroSITES
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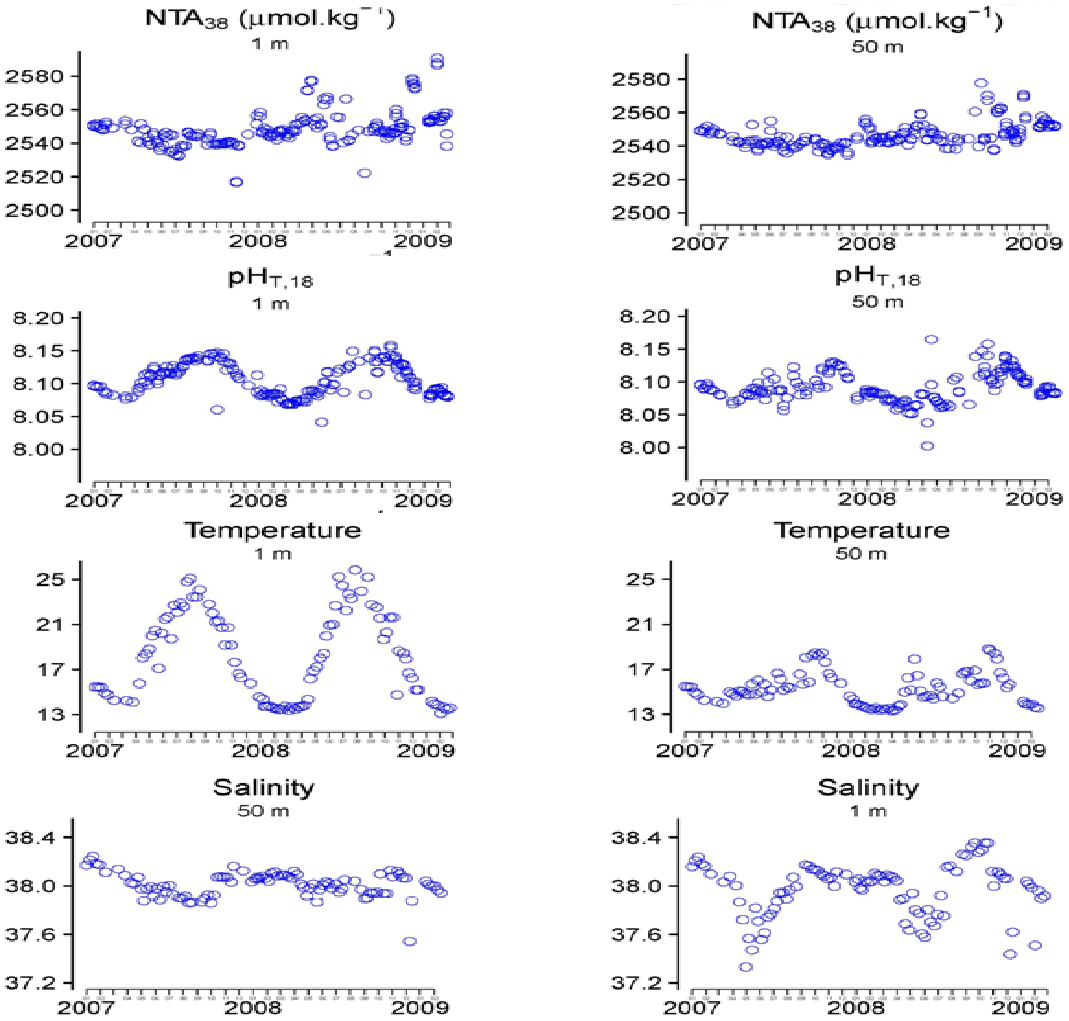
WP10.2: Integration of pCO2 and pH sensors on EOL coastal buoy in Villefranche/Mer (near Nice)

Present pH time series record in the Villefranche Bay (by using water sampling every 2 weeks) are not enough to understand the pH variability and the reason of such variability (EPOCA, MedSea)



EOL buoy: possibility to cross-validate data (in situ sampling), to transmit data by GSM and to check biofouling issues (10 min from lab)

OPEN ACCESS Freely available online

PLoS one

High-Frequency Dynamics of Ocean pH: A Multi-Ecosystem Comparison

Gretchen E. Hofmann[1], Jennifer E. Smith[2], Kenneth S. Johnson[3], Uwe Send[2], Lisa A. Levin[2], Fiorenza Micheli[4], Adina Paytan[5], Nichole N. Price[2], Brittany Peterson[2], Yuichiro Takeshita[2], Paul G. Matson[1], Elizabeth Derse Crook[5], Kristy J. Kroeker[4], Maria Cristina Gambi[6], Emily B. Rivest[1], Christina A. Frieder[2], Pauline C. Yu[1], Todd R. Martz[2]*

Since 2009, the Martz lab (SIO) has constructed 52 **SeaFET pH** sensors for 13 different collaborators (see http://martzlab.ucsd.edu) working in a broad range of settings (9,850 US $)

Autonomous indicator-based sensors for measurement of seawater pH. pH range 7.5-8.5; Accuracy 0.002; precision <0.001. Accomodates up to 3 additional sensors such as PAR, O2 optodes, beam-c transmissometers, and chl-a fluorometers.

CO2Pro160611.jpg

Pro-Oceanus sensor:
pCO2 by IR detection featuring automatic zero point calibration. High sampling rate; pumped interface; low cost; long term stability