Long term and spatial plankton monitoring with the ZooScan and the UVP:

-Insights from a 6 years project at the Laboratory of Villefranche sur Mer and - Perspectives for a global network

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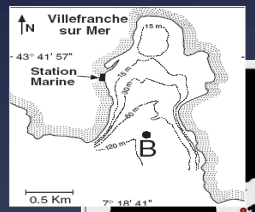
Point B zooplankton time series is one of the longest and most complete in Europe

TS1: 1966-2011, Regent Net (680µm mesh), oblique hauls, daily sampling
TS2: 1966-2003, Juday Bogorov net (330 µm mesh), vertical hauls, daily sampling
TS3: 1995 – 2006, WP2 net (200µm mesh), vertical hauls, weekly sampling
TS4: 2003-2011, WP2 net (200µm mesh) , vertical hauls, daily sampling



More than 20 000 net samples but pooled in weekly jars (>5000 jars).

→ too many samples to analyse in a traditionnal way

State of the collection in early 2004

- Partially analysed for target species until 1993
- Degradation of the samples (formaldehyd leackage)

RADEZOO service proposed 3 complementary solutions for long term preservation and analysis.
- digitalization
- re-conditionning
- semi-automatic analysis

RADEZOO Service : the team since 2005

L. Stemmann, Responsible data analysis

C. Garcia-Comas (PhD 2005-2010)

G. Gorsky Expert, Taxonomist

C. Desnos Technician Zooscan operator

M. Picheral Engineer, database , Zooscan maintenance

F. Prejger Technician Zooscan operator, taxonomist

L. Berline PostDoc (2008-2010)

P. Vandromme (PhD 2007-2010)

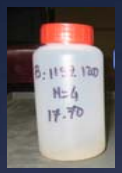
Philippo Dos Santos (PostDoc 2008)

+ several Master students

non permanent
permanent

RADEZOO Service : Digitalization and analysis of current and past zooplankton samples (since 1966)

10 WP2
5 Regent
10 JB



3 samples/week
and more than 5000
in collection

Digital Archives

Image analysis

Archiving the jars
(bat Jean Maetz)

Publication

Web site
http://www.obs-vlfr.fr/Rade/Radezoo
.
Databases: NODC/IODC

RADEZOO Service : Semi automatic analysis

① TRAINING SET

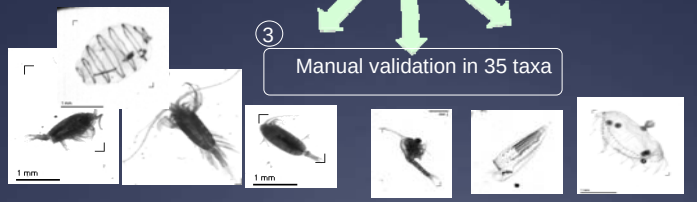
Defining groups
Cross-validation
(confusion matrix)

Prediction by the model (Random Forest)
Accuracy (confusion matrix)

SAMPLES
WP2 Time Series

② PREDICTION in 15 groups

③ Manual validation in 35 taxa

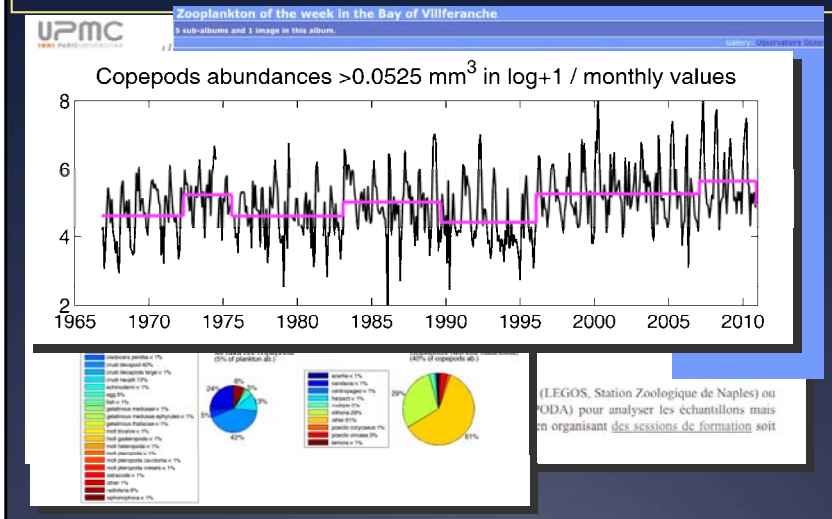


RADEZOO Service : Number of samples par day treated semi- automatically

	Villefranche time series (WP2 200µm 2008)	Dune mesocosm (WP2 june 2009)	Tetiaroa experiments (Bongo 13 locations)	North Atlantic (LHPR 200µm)
Samples (#)	136	12	25	22
Images (#)	272	12	25	37
Frame (type)	Narrow	Narrow	Large	Narrow
Objects (#)	171000	17650	32600	29340
Plancton predicted categories (#)	15	6	12	11
Misc predicted categories (#)	5	4	4	2
Plancton validated categories (#)	35	15	26	14
Error rate (effort)	28%	17%	27%	20%
Learning set preparation and improvement (day)	1.5	0.5	0.5	0.5
Validation (day)	14	2.5	4.5	3
Scanning (day)	32	2	5	4
Total (days)	47.5	5	10	7.5
Objects/day	3600	3530	3260	3912

On average, 3-5 samples/day are digitalized and processed (such as all objects (3600 objects) are classified in 40 taxa) and text files are available

RADEZOO Service : Quasi Real time monitoring of zooplankton



Imaging systems, GREAT PERSPECTIVES

Provide Indicators of ecosystem status (abundance, biomass, taxa, size spectra), numerous presentations or posters on this issue in Pucon

Can be obtained using lab and in situ instruments, they provide high frequency data

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

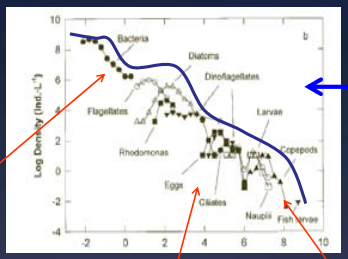
- zooplankton size spectra to get information on physiological rates (Platt & Denman 1978, ... Baird et al., 2004, 2010, Zhou 2006, Maury et al.,2007).
- vertical distribution of appendicularian and effect on vertical fluxes (Lombard et al., 2009).
- appendicularians in recent PFT models (Berline et al., 2010).
- vertical distribution of particle fluxes (Stemmann et al., 2004).

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

Size spectra and taxa

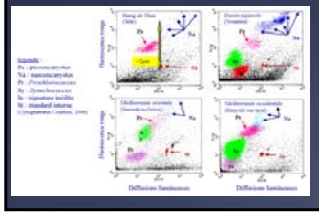
Pilot study at Point B

Common software for image analysis and data management for Flowcam, Zooscan and UVP



4 UVP, LISST

1: Fowcytometer



2: FlowCam

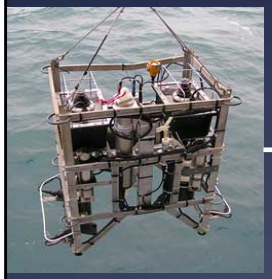
3: Zooscan

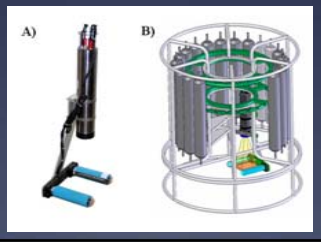
In situ observation with the Underwater Vision Profiler

1996 : The UVP 4 is based on :

1. Camera
2. Specially design lighting system
3. Computer
4. Software

A CTD is associated on the frame
The UVP 4 was a real innovative system but it is heavy and limited to 1000 m.





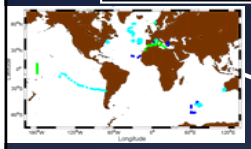
New 2007 version :

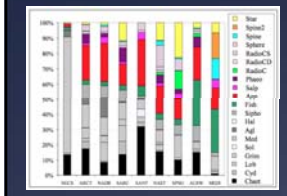
- 30 Kg
- Red light system
- Increased autonomy
- Real time processing
- Optional telemetry
- 6000 m range
- Rosette-AUV-adaptable

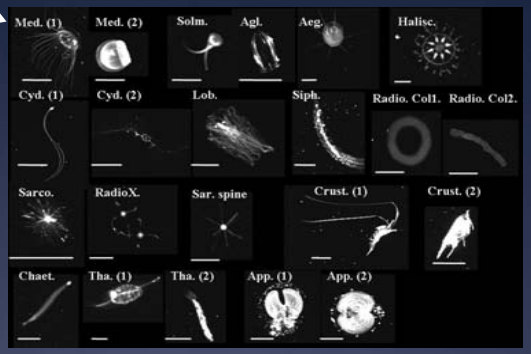
Picheral et al., 2010

Application: Global biogeography of mesopelagic macrozooplankton

200 profils of the UVP







Definition of 9 provinces that fits Longhurst biogeochemical regions

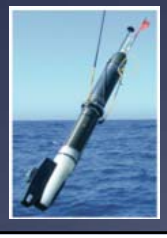
Stemmann et al., 2008a and b

Perspectives: Strong development of imaging systems and also their miniaturization for in situ monitoring

1) Laboratory instruments
FLOWCAM, ZOOSCAN, ...

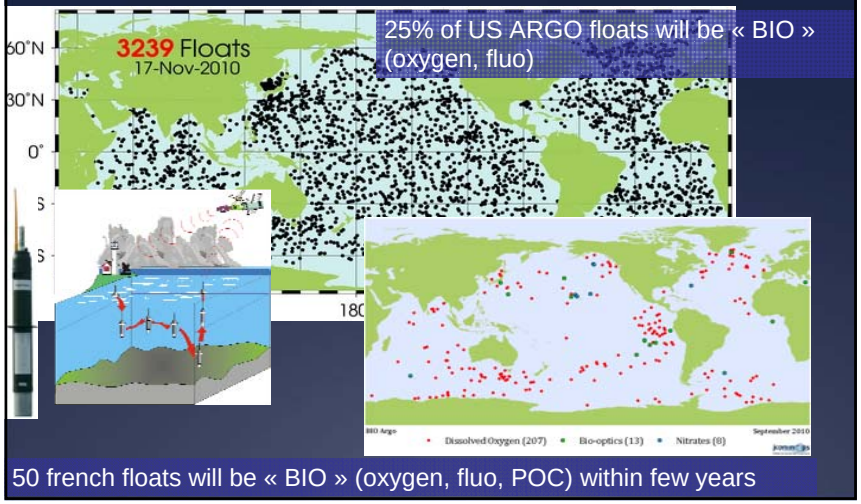
2) In situ instruments used from ships
UVP, VPR, SIPPER, Underwater Digital Holocamera , ...

In situ instruments on autonomous vehicles
SOLOPC
Checkley et al., 2008



Benfield et al., 2007

Toward a biological network (BIOARGO)



25% of US ARGO floats will be « BIO » (oxygen, fluo)

50 french floats will be « BIO » (oxygen, fluo, POC) within few years

In 20 years: global network for *in situ* global monitoring

Global network of observations
- ARGO-> BIOARGO+vision
- fixed stations + vision

Oceanographic data center for QC and large diffusion

macro and mesoplankton (Taxa size spectra)

Particulate Organic Carbon (size spectra)

Pico and microplankton (taxa, size spectra)

CTD and geochemical data

-Ecosystem monitoring

- Data assimilation in models for Carbone fluxes and marine ressources.

- **THE KEY OF THE SUCCESS:**

Follow BIO ARGO recommendation (biogeochemist community)

- **AGREED PROCEDURES (image format, treatment, semi-automatic recognition, intercalibration)**
- **AGREED DATA MANAGEMENT**
- **AGREED DATA DISTRIBUTION**
- **AGREED MODELING FRAMEWORKS**
- **SUMMER SCHOOLS FOR THE USERS**

These are propositions that we could discuss now... and dream

By the way, do you know what they are ???