Collaborative scientific platforms for accessing, processing and validation of observation and biosensor data.

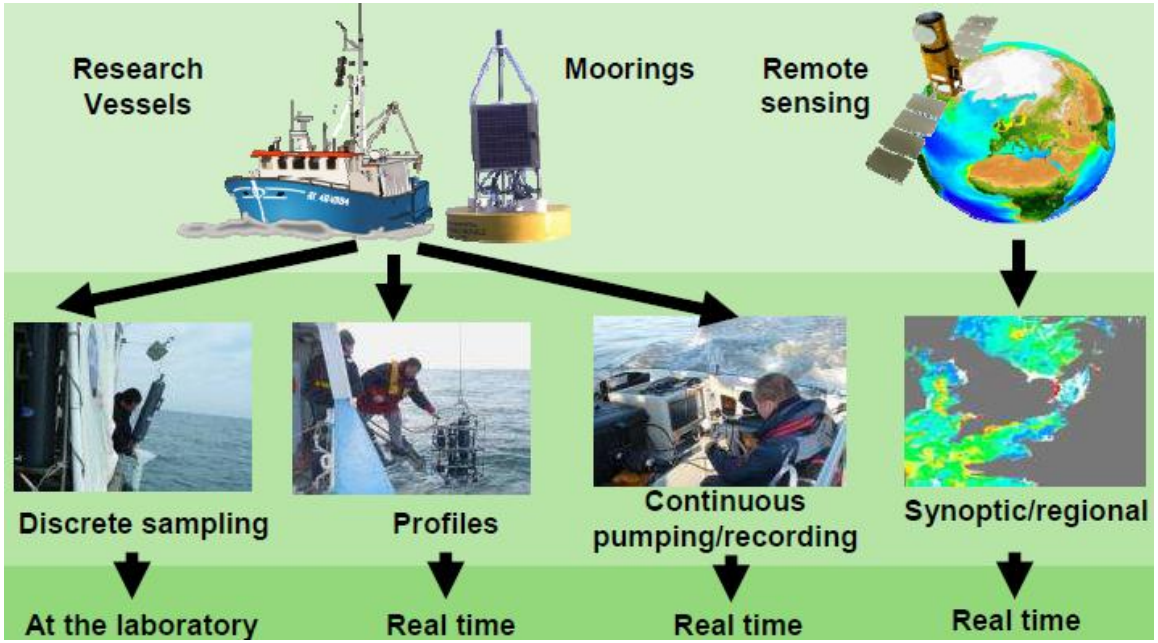
Lifewatch technical meeting 3-5 June 2014

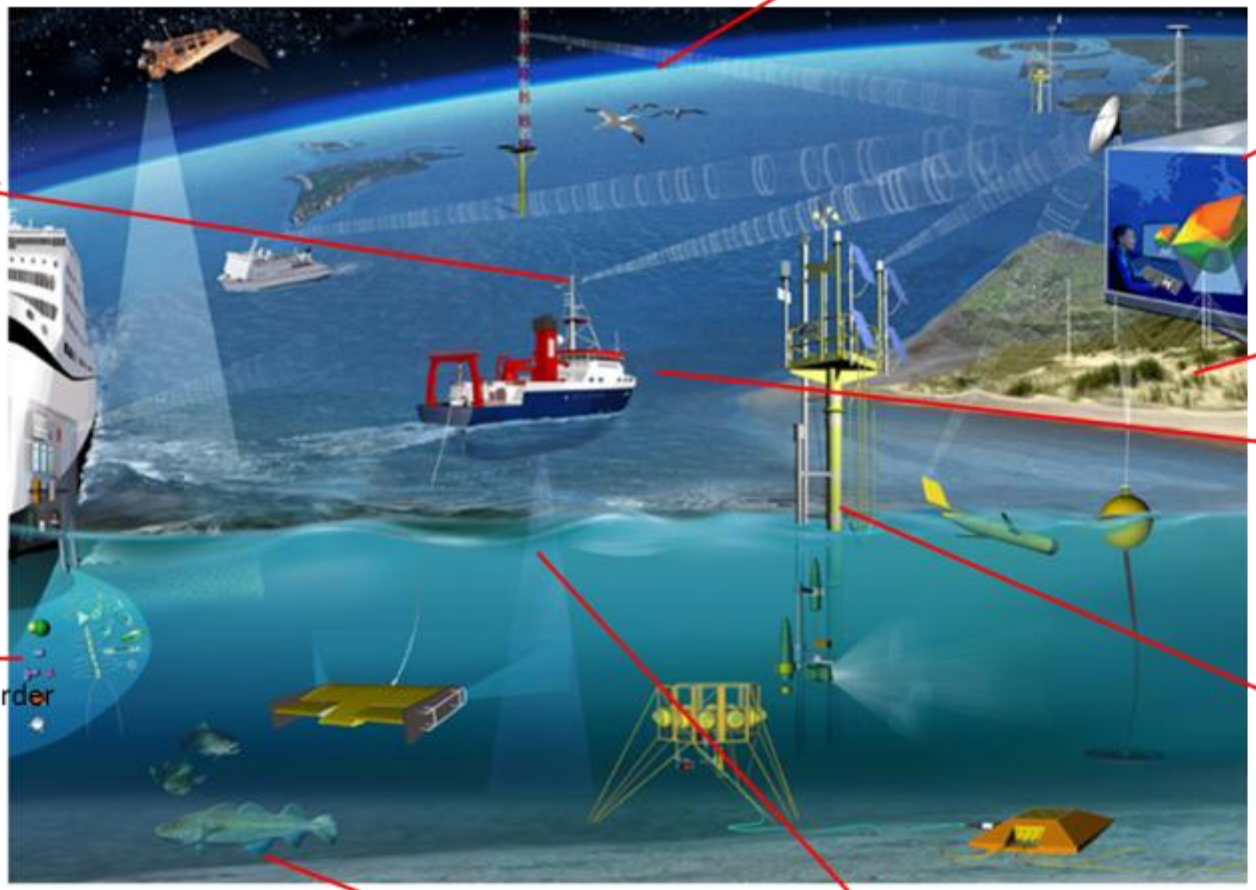
Outline

- Biosensors
  - What
  - Data generation
  - List of sensors in marine observatory
  - Status of sensor installation
  - Doctoral studies on sensor use and application
- Challenges
- Collaborative scientific platform
- Conclusions

Biosensors

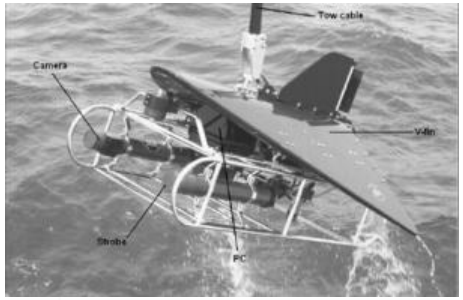
- Biological sensors that enable observations at space and time scales relevant to organisms behavior, fysiology and life history
  - Optics
  - Acoustics
  - Genetics
- Discrete => continuous
- Delayed mode => real-time

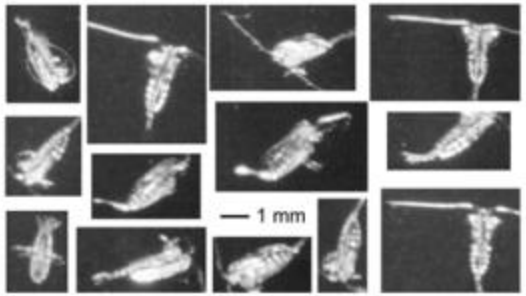


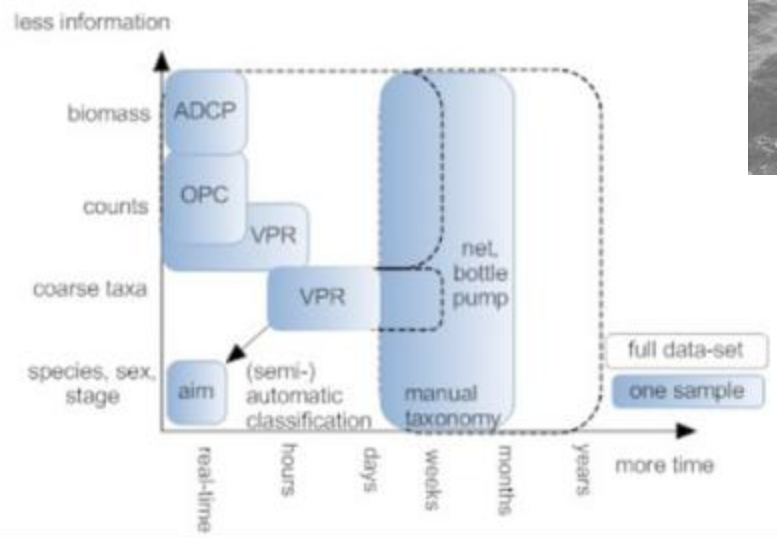

Bird tagging + web cams
Real-time access
And data services
for users
Data transfert
Internet connection
Bat acoustic recorder
Monthly surveys
- sample library
- continous sensor data
Flow cytometer
Video Plankton Recorder
Zooscan
Sensor platform (Lotto)
- CTD
- hydrophones
- under water camera
Fish tagging
Multi-beam recordings

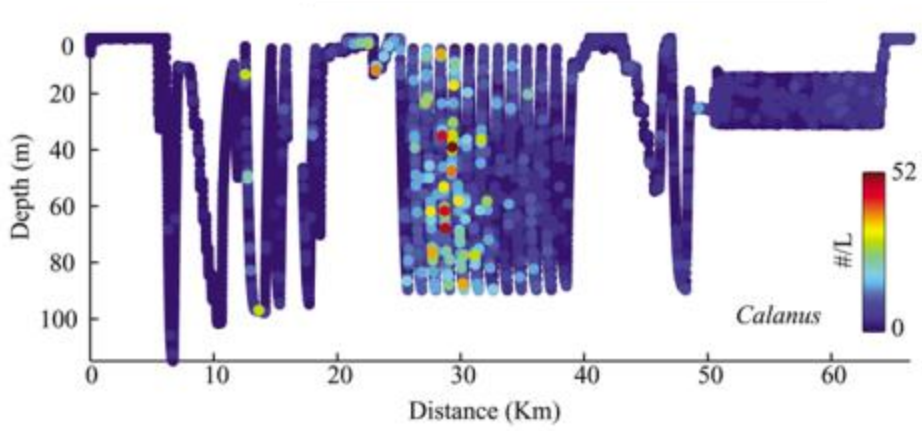
Video Plankton Recorder (VPR)

- Real-time underwater digital camera system + strobe
- Rapid quantification of plankton taxonomic composition and abundance
- Image acquisition: 30 frames/second of 7.2 ml image volume
- Data generation: +/- 10GB/hour (at 150kb/image)
- Analysis: pattern recognition software (Visual Plankton software [Matlab])









Zooscan

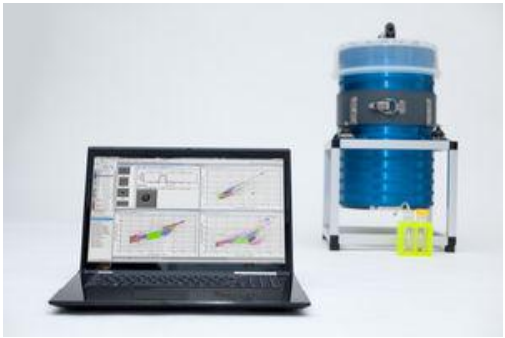
- High resolution flatbed scanner for water samples
- Digital storage and processing of zooplankton samples -> taxonomic composition and abundance
- Image acquisition: 2400-4800 dpi
- Data generation: +/- 4 GB/sample; 432 Gb/year
- Analysis: pattern recognition software (Plankton Identifier [Tanagra], ZooImage [R], …)

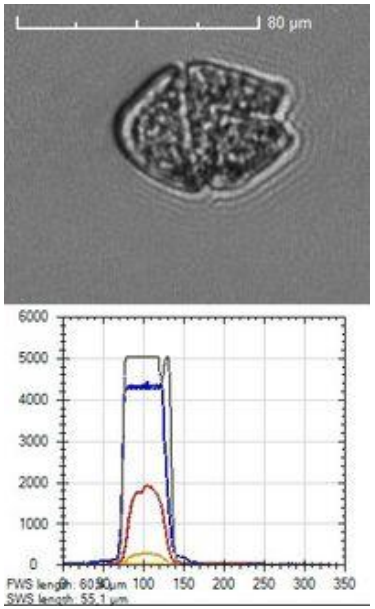
Distribution

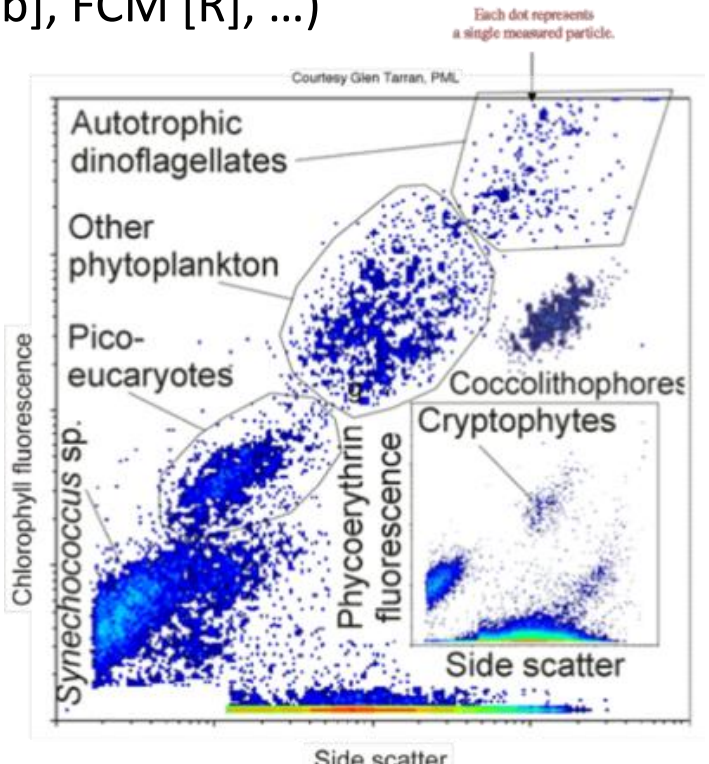
Values	Count	Percent	Histogram
Appendicularians	34	1.52 %	
Calanoids	405	18.08 %	
Chaetognaths	52	2.32 %	
Coscinodiscus	117	5.22 %	
Cyclopoids	84	3.75 %	
Harpacticoids	49	2.19 %	
_detritus	1390	62.05 %	
_fibres	109	4.87 %	

Flow cytometer

- Laser based instrument for particle detection and characterisation in fluids
- Counting and characterisation of phytoplankton particles -> taxonomic composition and abundance
- Image acquisition: particle scattering + fluorescence
- Data generation: +/- 200 MB/sample; 1Tb/year
- Analysis: clustering software (Easyclus [Matlab], FCM [R], …)

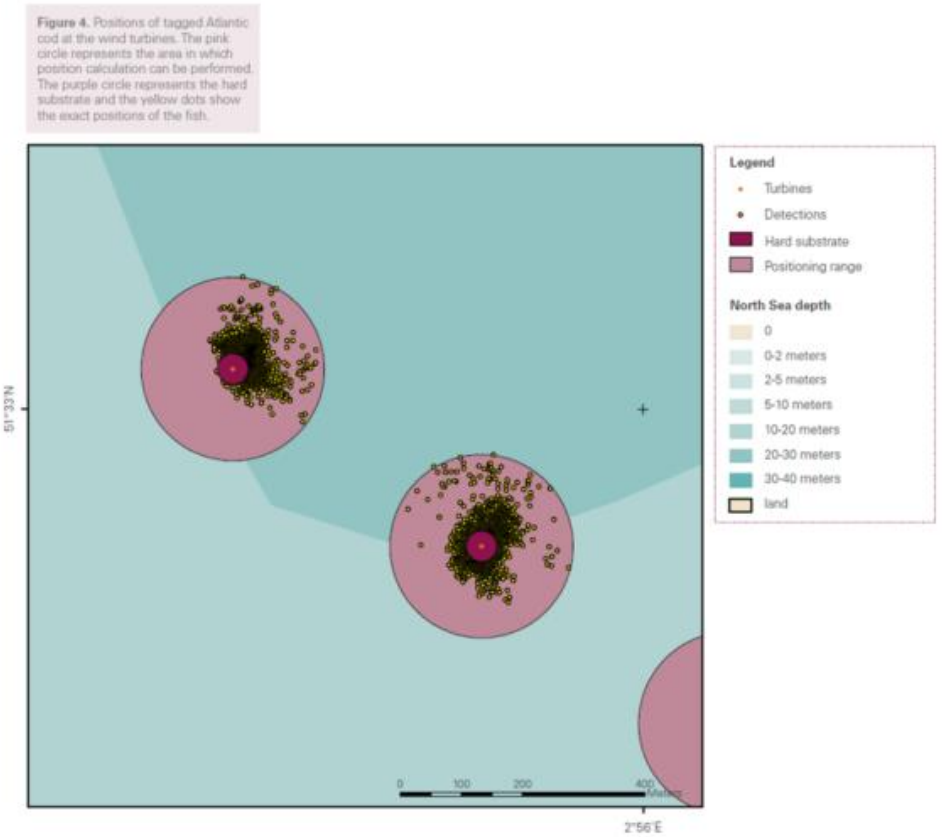






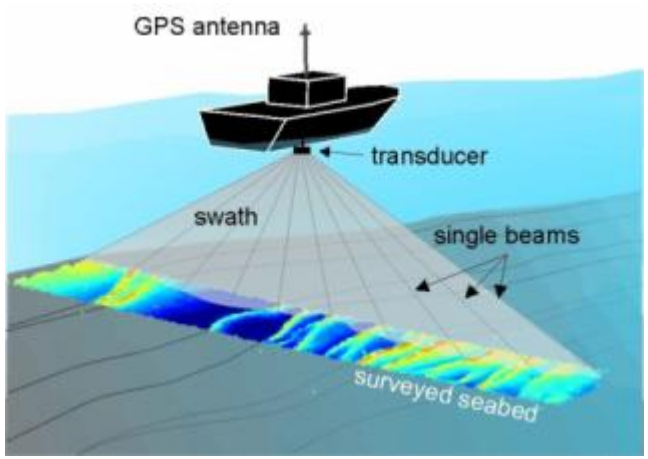
Acoustic fish telemetry

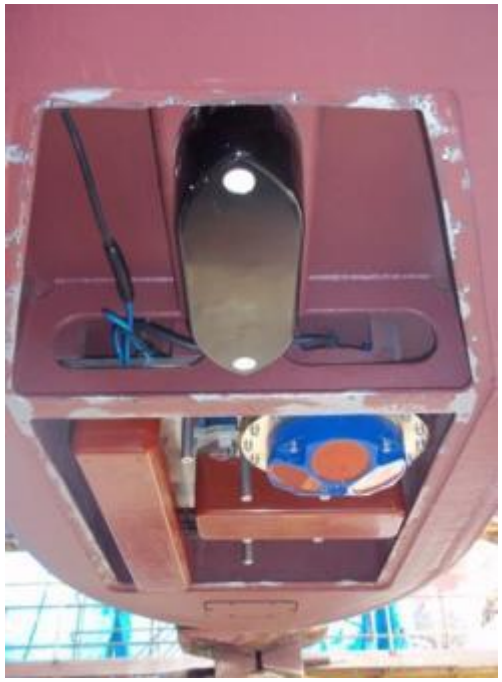
- Acoustic fish tag tracking
- Studying distribution, migration and habitat use
- Data generation: 25 MB/month
- Analysis: GIS mapping & visualization (CartoDB), behaviour analysis (Matlab, Python)

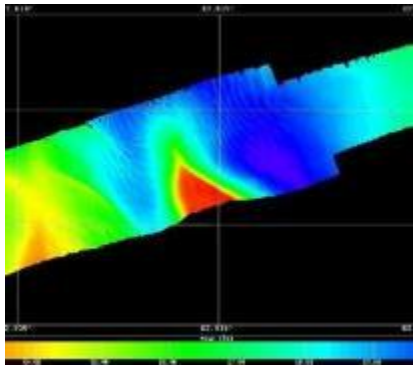


Multibeam echosounder

- Acoustic high resolution depth sounding sonar
- Bathymetry and sediment typology
- Data generation: sediment 10Gb; water column 100Gb/day
- Analysis: data cleaning and validation, chart creation, deriving sediment typology (CARIS, Fledermaus)

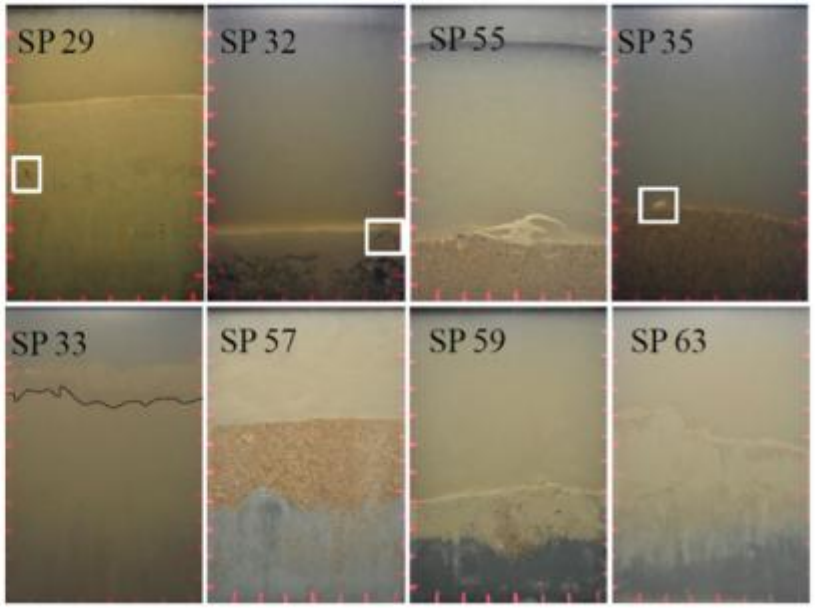






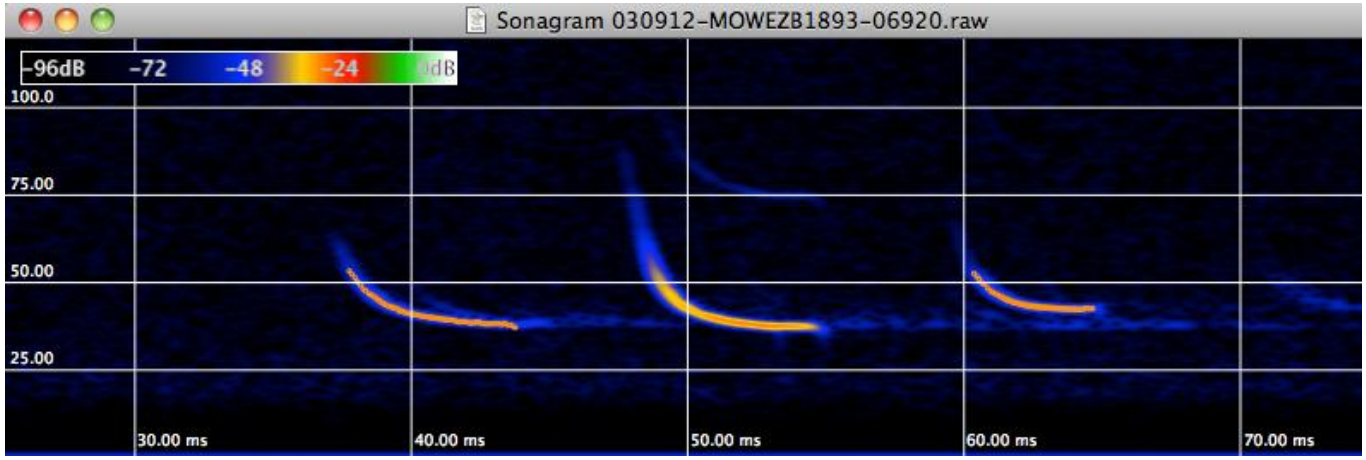
Sediment profiler imaging

- Digital Sediment Profiling Camera
- Vertical cross section of the sediment/water interface
- Image acquisition: 24.1 Mpixel images of 320 cm2 of sediment
- Data generation: 1Gb/image; 130 Gb/year
- Analysis: Image pattern recogition software, relating to benthic communities



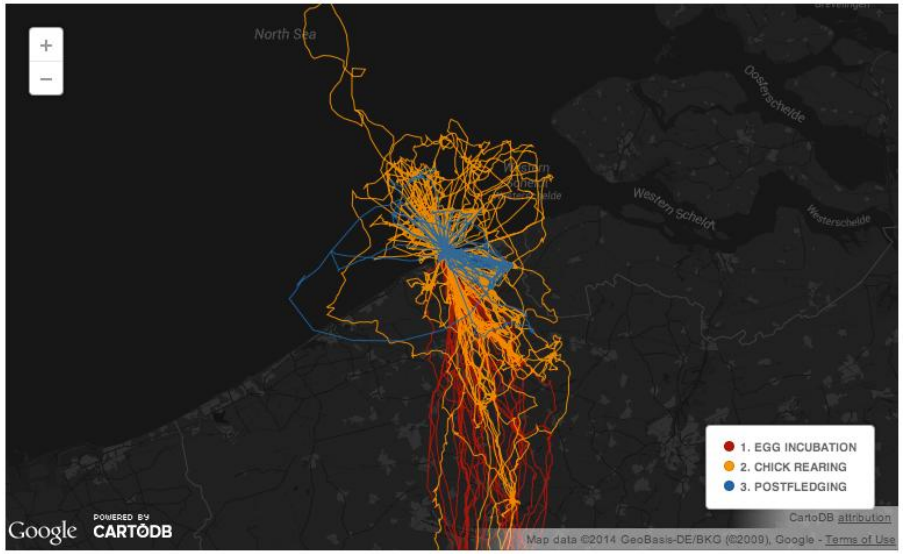
Acoustic bat recorder

- Ultrasound detection and recording
- Sound acquisition: 500 kHz with 16 Bit amplitude resolution
- Data generation: 1 MB/per second of sound recording; 0.5 Gb/night
- Analysis: Call detection and recogition software



Bird tracking with GPS

- Tracking of large birds with GPS tags developed by UvA-BiTS
- Studying migration and habitat use
- Data generation: 3G/year (Flemish LifeWatch), multiple GB/year (UvA-BiTS)
- Analysis: GIS mapping & visualization (CartoDB), behaviour analysis (Matlab, Python)

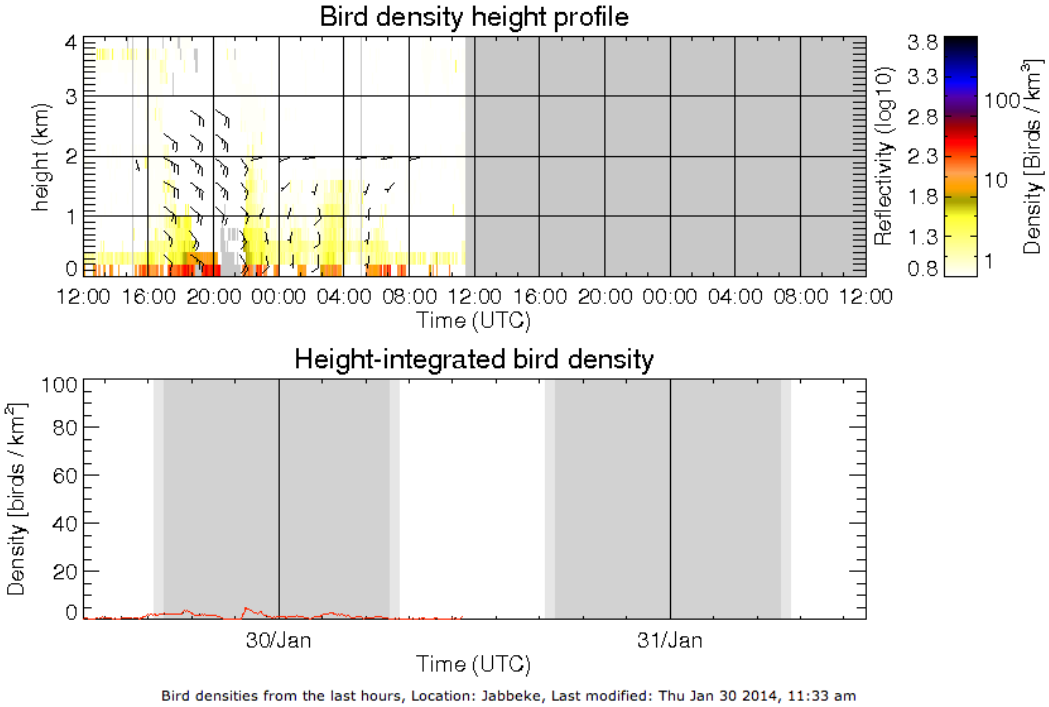


Bird radar

- 3D radar detection of bird movements and density
- Impact of wind turbines on birds, bird migration research
- Data generation: 1TB/year (radar images + flight tracks)
- Analysis: bird detection algorithms, GIS mapping & visualization (CartoDB), migration analysis

Weather radar: biological data

- Retrieval of biological data from European weather radars
- ENRAM - European Network for the Radar surveillance of Animal Movement (COST Action ES1305)
- Data generation: several TB/year
- Analysis: bird detection algorithms, GIS mapping & visualization, migration analysis



Infrastructure	Status
Bird GPS tracking network + web cams	3 base stations installed and operational
Flow Cytometer	Installed on RV Simon Stevin and operational
Multi beam	Installed on RV Simon Stevin and operational
Acoustic bat detectors	Test installation installed. Offshore installation in preparation
ZooScan	Installed in MSO lab and operational
Video Plankton Recorder	To be installed July 2014
Sediment Profile Imaging	Installed on RV Simon Stevin and operational
Bird radar	Purchased, awaiting approval
Environmental DNA	DNA lab under installation

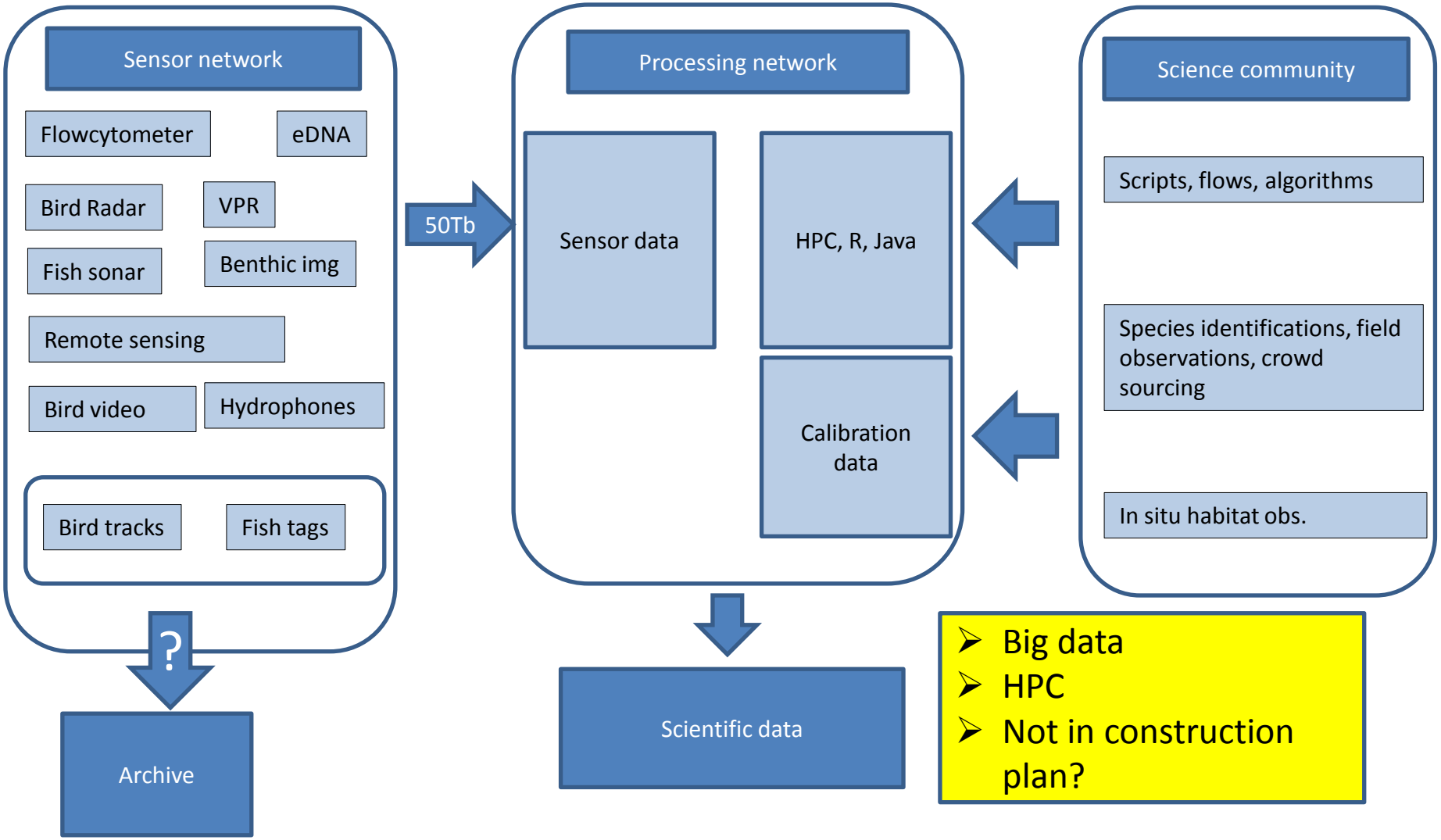
Doctoral studies on sensor use and application

- 4 PhD's at Ghent University
- Starting October 2014
- Work on :
  - Standard operation procedures
  - Algorithms for translation of sensor output to biodiversity parameters on abundance and distribution of taxa
  - Recommendations on optimization and upgrade of the infrastructure
  - Applications of the infrastructure in biodiversity and ecosystem studies

Challenges

- Sensor installation
- Technical calibration
- Linking instrument measurements
- Data transfer protocol and set-up
- Real-time data access, data storage, data processing
- Processing: sensor output -> biodiversity parameters
- Processing: quality control, aggregating, combine data, models & predictions, visualization, sharing, validation,…

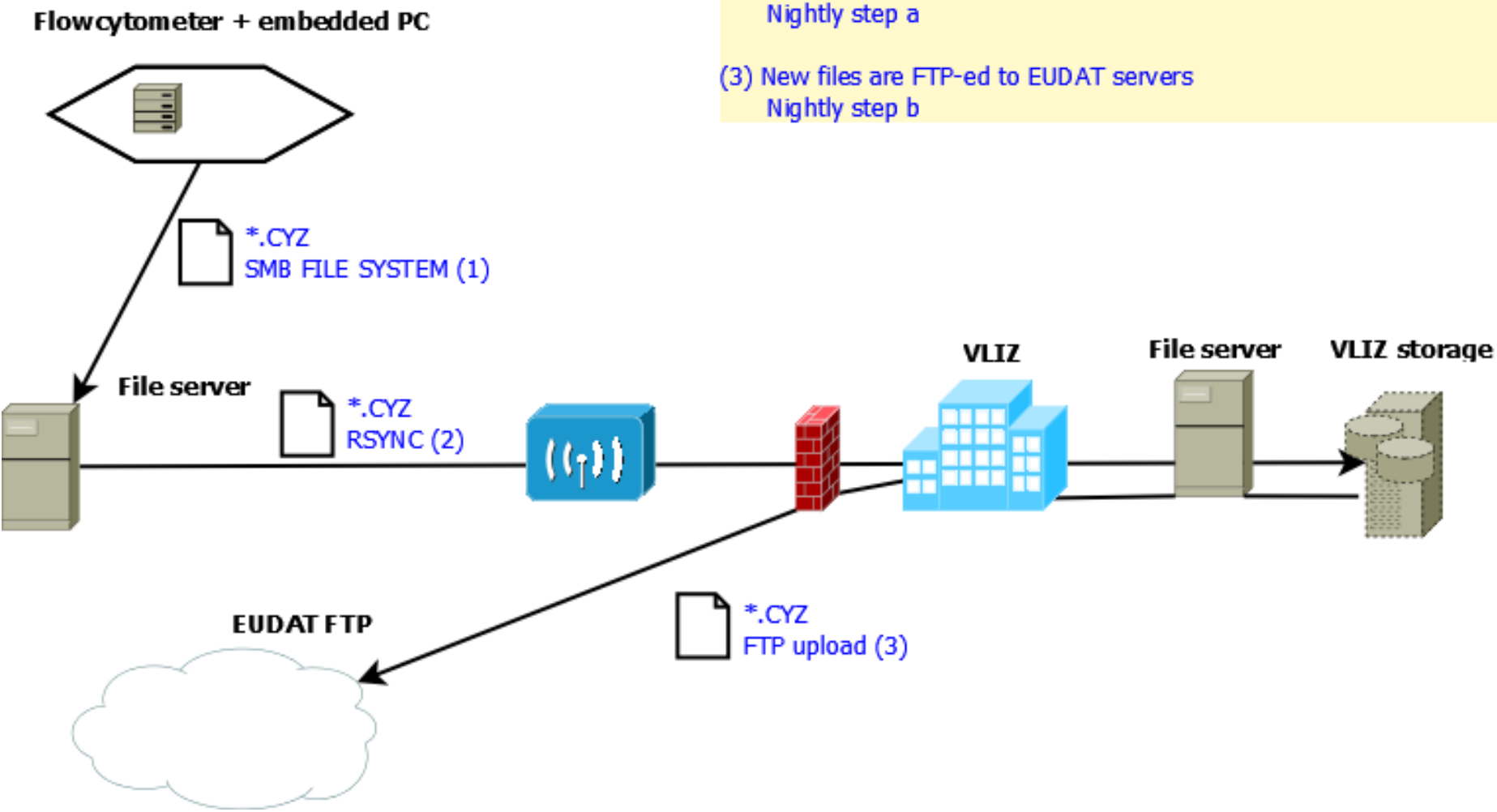
Collaborative platform for sensor data processing



(1) Flowcytometer + embedded PC write to shared SMB network filesystem
Realtime

(2) Rsync copies changed data to VLIZ servers
Nightly step a

(3) New files are FTP-ed to EUDAT servers
Nightly step b



Conclusions

- First users of LW infrastructure coming soon
- Need for defining data transfer protocols
- Need for shared collaborative environment
  - Storage
  - Processing capacity
  - Resources: data, algorithms, scripts, models, …
- Ongoing testing with ICT Core facilities: IFCA, EUDAT, EGI