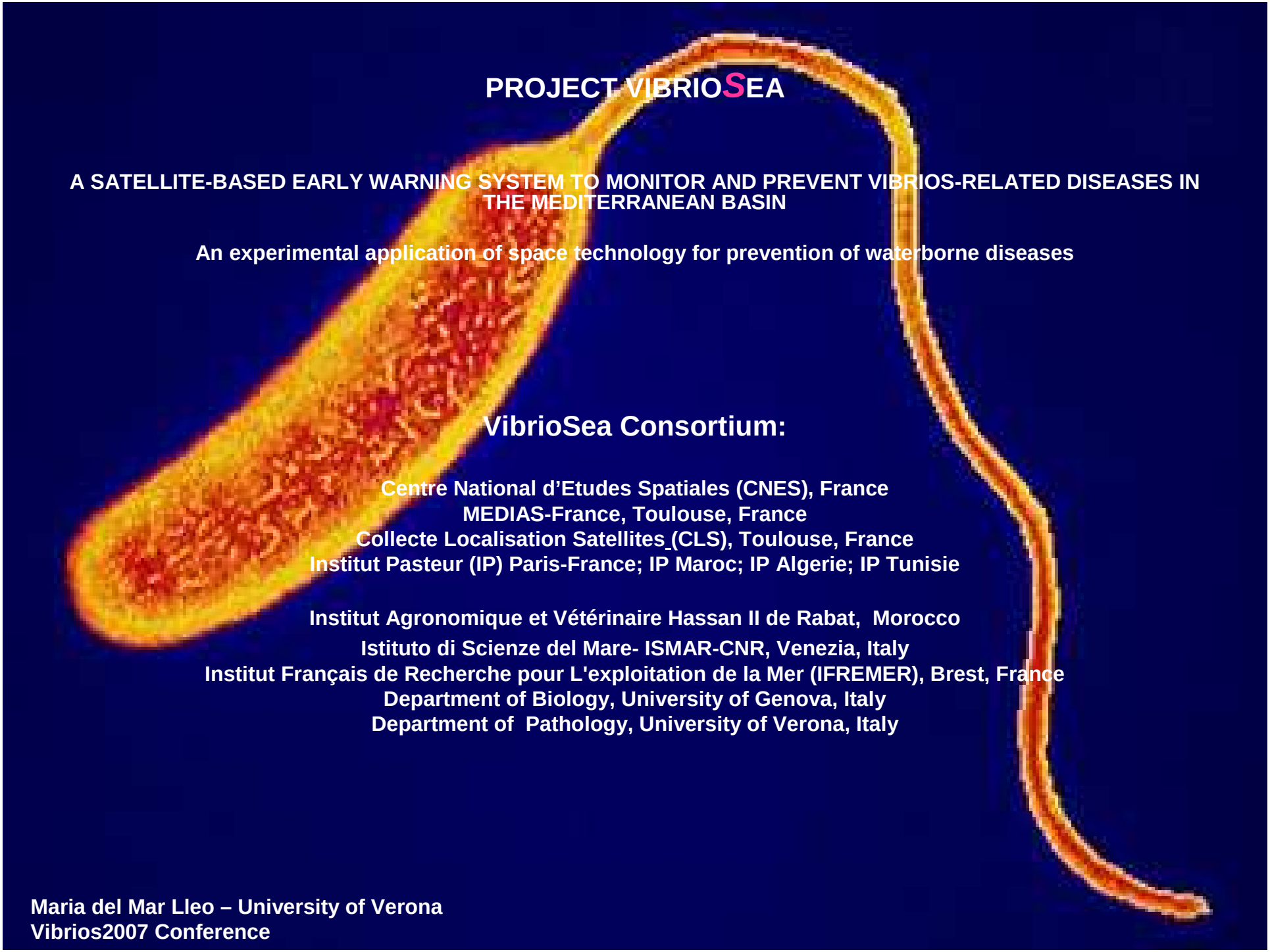


PROJECT VIBRIOSEA

A SATELLITE-BASED EARLY WARNING SYSTEM TO MONITOR AND PREVENT VIBRIOS-RELATED DISEASES IN THE MEDITERRANEAN BASIN

An experimental application of space technology for prevention of waterborne diseases

VibrioSea Consortium:

Centre National d'Etudes Spatiales (CNES), France
MEDIAS-France, Toulouse, France
Collecte Localisation Satellites (CLS), Toulouse, France
Institut Pasteur (IP) Paris-France; IP Maroc; IP Algerie; IP Tunisie

Institut Agronomique et Vétérinaire Hassan II de Rabat, Morocco
Istituto di Scienze del Mare- ISMAR-CNR, Venezia, Italy
Institut Français de Recherche pour L'exploitation de la Mer (IFREMER), Brest, France
Department of Biology, University of Genova, Italy
Department of Pathology, University of Verona, Italy

Maria del Mar Lleo – University of Verona
Vibrios2007 Conference

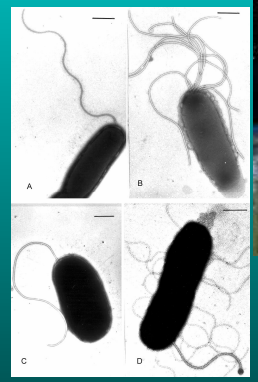
OBJECTIVE OF THE PROJECT

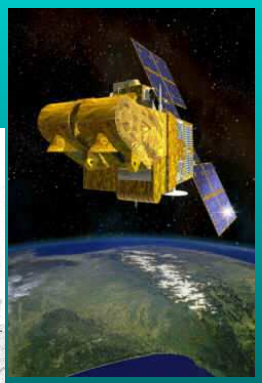
To evaluate the added value and complementary role of remote sensing in the prediction of vibrios-related risks in the Mediterranean Basin as a model for preventing waterborne diseases

….on the basis of two ongoing studies:

1) **Environmental parameters influencing the presence, concentration and distribution of vibrios in different areas of the Mediterranean marine environment**

2) Level of correlation between measurements of key environmental parameters obtained by in situ methods and by remote sensing





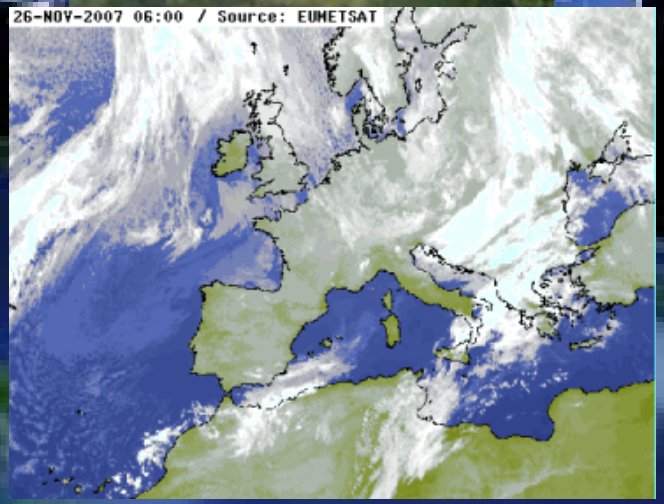
CONTRIBUTION OF SPACE TOOLS

- **Satellites provide:**

- Wide geographical covering
- Good spatial and time resolution
- Permanent availability
- Independency from extreme weather events

- **Parameters measured my satellite:**

- Sea surface temperature
- Chlorophyll
- Turbidity (total suspended matter)



- **Satellite data used**

- NASA Aqua satellite, Modis sensor
- ESA Envisat satellite, Meris sensor

FIRST YEAR OF ACTIVITY - MAIN ACHIEVEMENTS

1) Extended network covering different representative areas of the Mediterranean Basin

Sampling areas and sites

COUNTRY	ANALYZED AREA	MONITORING STATION	SAMPLING SITES
Italy	Tyrrhenian coast (Gulf of La Spezia)	2	2
	Adriatic coast (Venezia lagoon)	3	6
France	Gulf of Lions, near Séte	5	5
Morocco	Tanger Bay and Nador lagoons	3	6
Algeria	Algers Bay, Tipaza port	3	6
Tunisia	Gulf of Tunis	2	4

Mediterranean network monitoring environmental and microbiological parameters

Environmental parameters monitored	Sea surface temperature (SST) Chlorophyll A and pheopigments Phyto- and Zooplankton Turbidity and suspended matter Salinity Conductivity pH [O2] Total Bacterial Counts in water and shellfish [proteins] in water
Microbiological parameters monitored	Total vibrios concentration in water, plankton, sediment, shellfish Presence of pathogenic Vibrio species (V. cholerae, V. parahaemolyticus, V. vulnificus) in all the samples
Type of samples examined	Water Plankton Sediment Shellfish

FIRST YEAR OF ACTIVITY - MAIN ACHIEVEMENTS

2) Definition and standardization of sampling methods, in situ environmental measurements and microbiological protocols.

Global comparison and evaluation of results

Setting of metadata repository

Sampling methods, Environmental parameter monitoring systems, Microbiological protocols have been defined and standardized among all the partners of the consortium.

CALERI 1

Sampling sites :			
Sampling sites	Distance from the coast	Depth	Comments
sampling site1	500 meter	1 meter	Close to river
sampling site 2	3000 m		
sampling site 3	500 m		
sampling site 4	3000 m		
sampling site 5	500 m		Control site
sampling site 6	3000 m		Control site

Measured parameters for all sites								
Physical parameter influencing vibrios concentration	Parameter	Sampling protocol	Sampling frequency	Instrument / Method	Unit	Accuracy	Analysis methods	Data examples
	Sea Surface Temperature (SST)	Measured at 1 m depth	once/month during winter twice/month during summer	Probe CTD Idronaut	℃	± 0.003		
	Water temperature	whole water column	once/month during winter twice/month during summer	Probe CTD Idronaut	℃	± 0.003		
	Salinity	Measured at 1 m depth	once/month during winter twice/month during summer	Probe CTD Idronaut	Practical salinity units (psu).	± 0.01	Calculated on the basis of conductivity (mS/cm)	
	pH	Measured at 1 m depth	once/month during winter twice/month during summer	Probe CTD Idronaut	pH units	± 0.01		
	Turbidity	Measured at 1 m depth	once/month during winter twice/month during summer	Probe CTD Idronaut	NTU (nephelometric turbidity units)	< 2%		

Measured parameters for all sites								
Biological parameter influencing vibrios concentration	Parameter	Sampling protocol	Sampling frequency	Instrument / Method	Unit	Accuracy	Analysis methods	Data examples
	Chlorophyll A	At 1 m depth	once/month during winter. Twice/month during summer	Probe CTD Idronaut	µg/l	± 0.02 µg/l		
	Chlorophyll A	At 1 m depth	once/month during winter. Twice/month during summer	Water filtration and Fluorimeter	µg/l	0,1		
	Other cloro-pigments and CPE	At 1 m depth	once/month during winter. Twice/month during summer	Water filtration and Fluorimeter	µg/l	0,1		
	Quantity of phytoplankton	At 1 m depth	once/month during winter. Twice/month during summer	Optical microscopy	Cells/l	Average number ± SD		
	Quantity of zooplankton	At 1 m depth	once/month during winter. Twice/month during summer	Optical microscopy	Cells/m^3	Average number ± SD		
	Concentration of zooplancton in water	At 1 m depth	once/month during winter. Twice/month during summer	Plancton weighing	g/l			
	Organic substance (protein concentration)	At 1 m depth	last 7 campaigns (once/month)	BioRad method + fluorimeter	µg/l	0,001 *µg		
Vibrio measurements	Vibrios concentration in water	At 1 m depth	In the laboratory the day after the sampling.Twice a month (summer), once a month (winter)	Most Probable Number in enrichment medium. Confirmation in selective medium	MPN/ml	Sensitivity: 1 cell/ml	Standard microbiological methods	
	Vibrios concentration in plankton	At 1 m depth	In the laboratory the day after the sampling.Twice a month (summer), once a month (winter)	Most Probable Number in enrichmentmedium.Confirmation in selective medium	MPN/g of plancton	Sensitivity: 1 cell/ml	Standard microbiological methods	
	Vibrios concentration in sediments	At 1 m depth	In the laboratory the day after the sampling.Twice a month (summer), once a month (winter)	Most Probable Number in enrichment medium. Confirmation in selective medium	MPN/g of sediments	Sensitivity: 1 cell/ml	Standard microbiological methods	
	Vibrios pathogenic species presence (Water, Plankton, sediment)	In samples resulting positives for vibrios detection.	In the laboratory the day after the sampling.Twice a month (summer), once a month (winter)	Growth on selective media; growth on different salt percentage; biochemical characteristics. PCR		accuracy: 10 pg (for PCR)	PCR and biochemical methods	Presumptive identification

FIRST YEAR OF ACTIVITY - MAIN ACHIEVEMENTS

3) High number of marine samples (more than 1000 and increasing) : statistically significant correlations, incidence of pathogenic Vibrio species in the marine environment

Data record summary

Country	Morocco	Italy Adriatic	Italy Genova	France Ifremer	Algeria	Tunisia	Total
Starting date	05/10/06	13/06/06	14/06/06	03/07/06	18/02/07	18/07/07	
Last date	29/08/07	27/08/07	29/08/07	20/06/07	11/09/07	25/09/07	
Sites number	6	6	2	5	6	2	27
Parameter	Number of records / parameter						
SST	115	126	37	55	66		399
pH	115	126	0	15	66		322
Salinity	115	126	37	55	66		399
Chlorophyll A (ChloA)	87	96	41	12	0		236
Turbidity	115	126	37	37	65		380
Conductivity	115	0	0	0	0		115
Suspended matter	115	0	0	0	0		115
[O]%	0	114	0	0	0		114
[Protein in water]	0	26	0	0	0		26
TBC_Water	0	0	0	54	0		54
TBC-Shellfish	0	0	0	22	0		22
Vibrios Concentration in marine samples:							1023
VC_Water	115	126	41	46	66	10	404
VC_Plankton	55	125	41	0	0	0	221
VC_Sediment	61	84	41	0	66	4	256
VC_Shellfish	35	0	21	20	66	0	142
V. cholerae	266	319	144	66	198	14	1007
V. parahaemolyticus	266	319	144	66	198	14	1007
V. vulnificus	266	319	144	59	198	14	999
V. alginolyticus	266	0	0	66	198	14	544

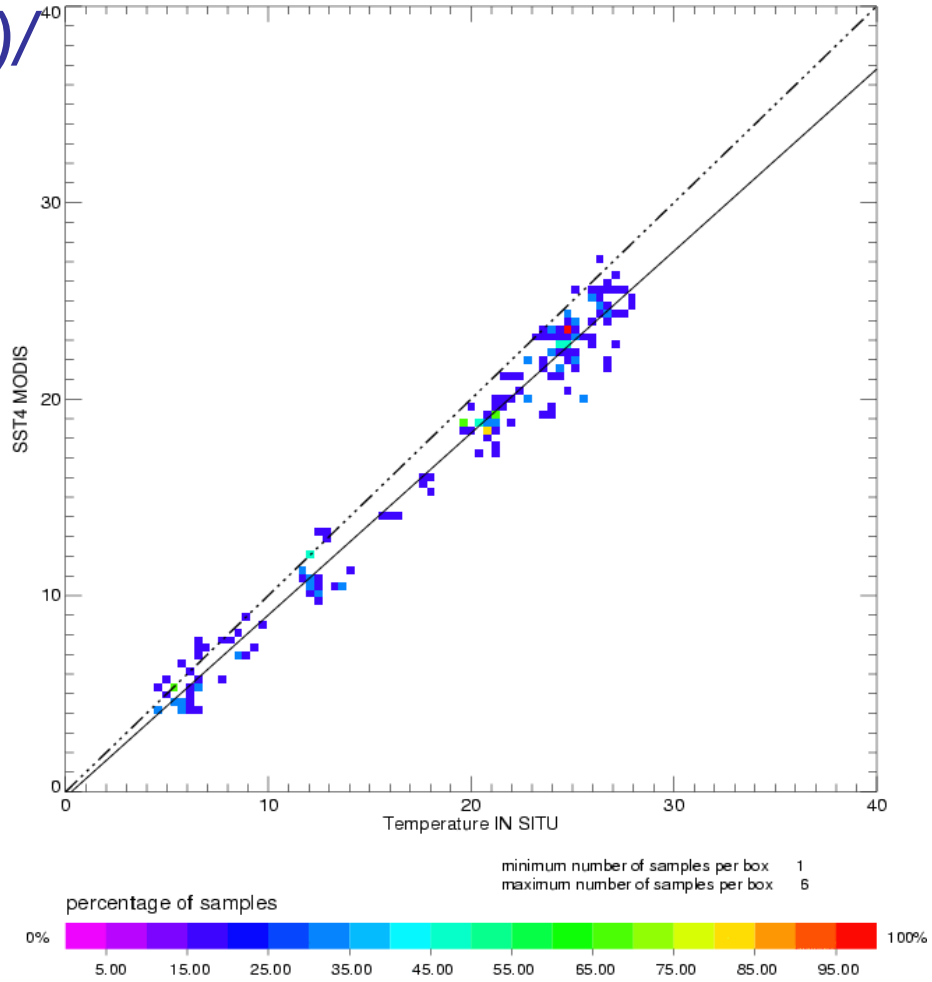
FIRST YEAR OF ACTIVITY - MAIN ACHIEVEMENTS

4) Optimal level of correlation between in situ and remote measurements as regards Sea Surface Temperature: possibility of SST monitoring by satellite also close to the coast

Corrélations mesures In Situ / Spatiales

Température SST4 (Nuit)/ In Situ (Jour)

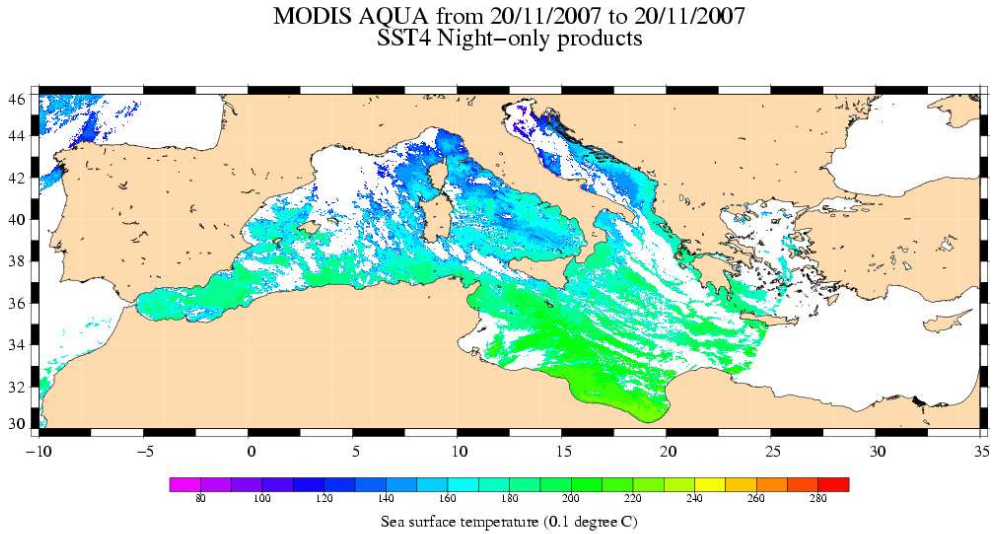
Statistiques de corrélation	
Coefficient de corrélation	98.7%
Nombre de points	192
Biais ± Ecart type (in situ – MODIS)	-1.61 ± 1.25 ℃
Régression linéaire y = ax+b	a = 0.93 b = - 0.25 ℃

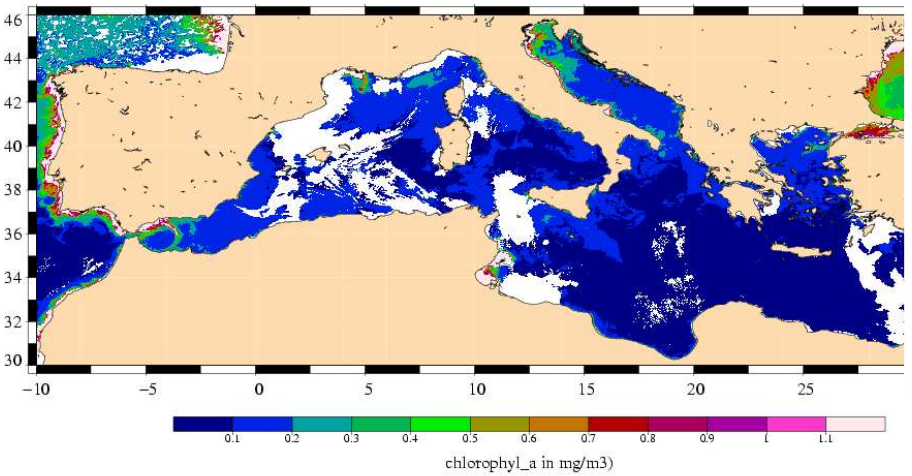


Data from CLS

FIRST YEAR OF ACTIVITY - MAIN ACHIEVEMENTS

5) Access from PC via Internet to remote sensing daily data on SST, ChloA and other environmental parameters





Station : Aresquiers Latitude : 43.43867 Longitude : 3.85783

Date	SST4	CHL_NASA	CHL_IFREMER
2007-01-01	NODATA	0.612681	0.308179
2007-01-02	123.672722	NODATA	NODATA
2007-01-03	129.315000	1.114539	0.324101
2007-01-04	NODATA	1.236945	0.328185
2007-01-05	127.909861	1.123324	0.308419
2007-01-06	120.993861	1.387957	0.364576

FIRST YEAR OF ACTIVITY - MAIN ACHIEVEMENTS

6) Development of:

1. **Metadata catalogue and project information on www.redgems.org**
2. **Project database visible to all the partners**

FURTHER ACTIONS…….

- **Through a statistical study, to highlight the environmental parameters that are correlated with vibrios presence**
- **To include all the validated results on the database and make it available to the scientific community**
- **To involve other partners and add other Mediterranean areas**
- **To look for other satellite-measurable parameters**
- **To correlate to microbiological parameters also climatic factors (temperature, rainfall, wind) and clinical data**