

Environmental monitoring and studies on Lake Trasimeno

ARPA Environmental Monitoring activities on Lake Trasimeno

Environmental investigations on Lake Trasimeno was developed in the past century concerning biology, water quality, sediments status, hydrology: several monitoring activities and data collection was activated by research institutions and local administration. Meteorologic and hydrologic stations supplies data over the lake and its basin, whereas some physico-chemical parameters was determined by automatic systems on lake and principal tributaries. Regular monitoring activities on lake water are developed from the 80's according to three different objectives: environmental quality, bathing, eutrophication control. Until 2004 quality controls involved the water supply station of Castiglione del Lago, an uptake of about 50 L/s from the lake

Biological quality elements

From March to September Chlorophyll "a" and algal community are determined on 7 stations every 15 days focusing the attention on those species that may be potentially toxic (cyanobacteria).

Physical-chemical elements

Regional Environment Agency provides regular water and sediments monitoring: three quality stations are utilised for environmental status, 7 for eutrophication control and 15 for bathing control. Principal parameters analysed available for long time series are: Temperature, pH, El. Conductivity, Transparency, Dissolved Oxygen, Alkalinity, Sulphates, Silica, Suspended solids, BOD, COD, NO₃, NH₄, N total, PO₄, P total. Tensioactive compounds, Phenols, Fecal and Total Coliform bacteria, Streptococchi, % sat. D.O., Chlorides, Dissolved solids. Characterisation of aquifers in the basin was realised in 2003-4 and a two years monitoring study was conducted in 2004-5 over the 10 majors watercourses and rills, analysing monthly the basic parameters, macroinvertebrates and pesticides.

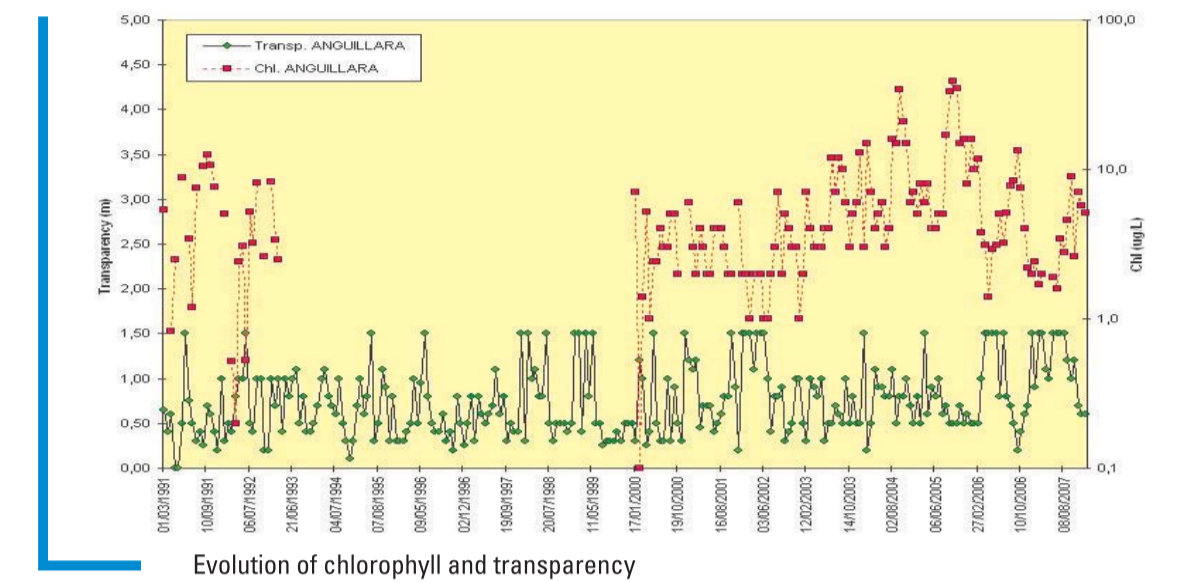
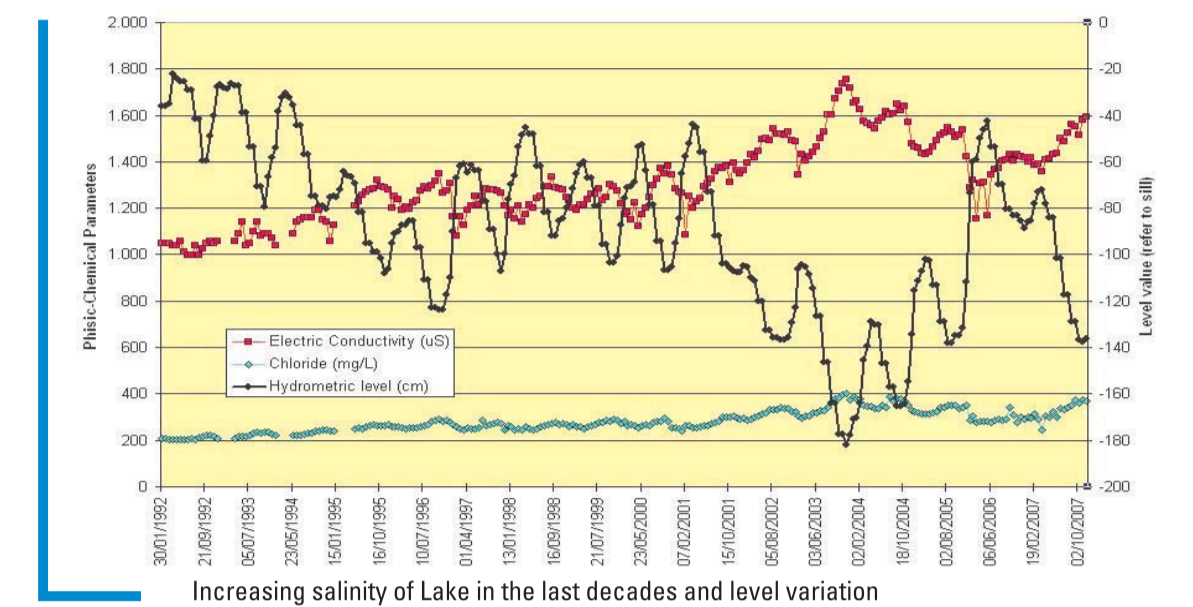
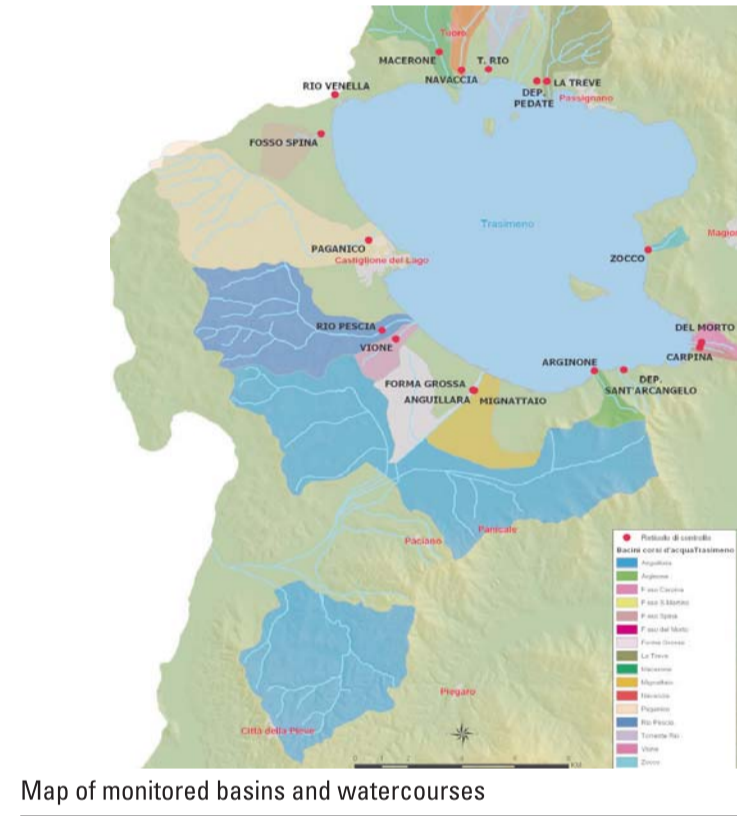
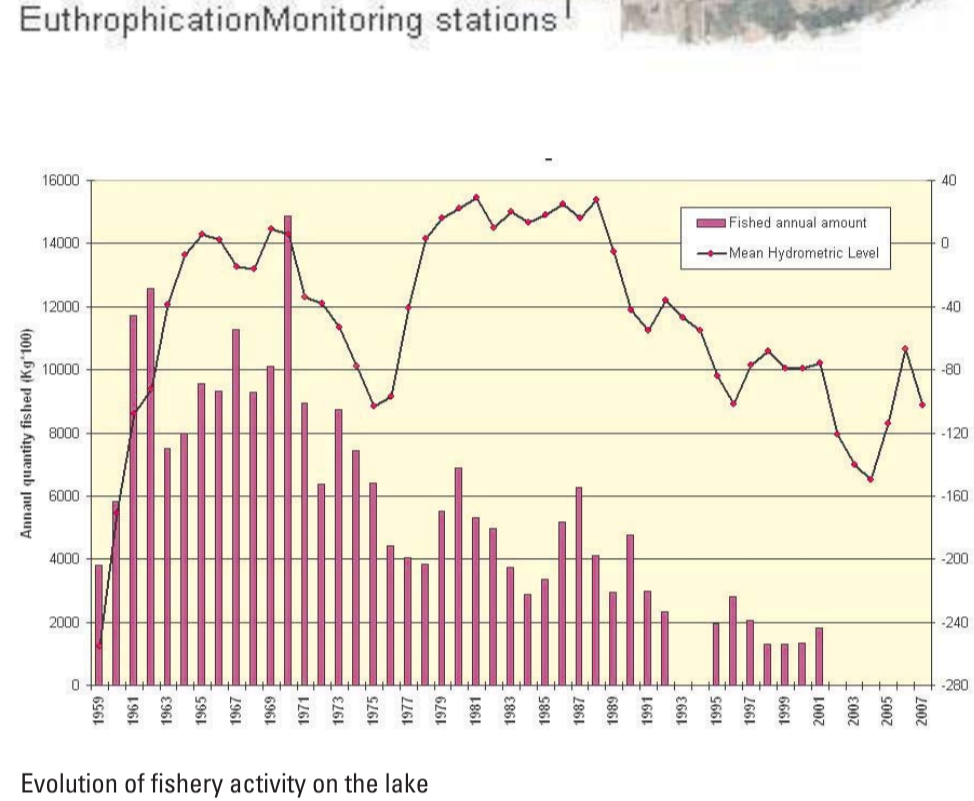
Data and environmental state

After the crisis of the 50's, aided by basin enlargement the Lake maintained a quantitative equilibrium around Level zero (257,33 m.a.s.l.) until the late 80's: negative climate and anthropic impacts produced a progressive depletion of water storage, with absence of outflow and negative records in 2003 (-1.8 m below sill) and 2008 (-1.6 m). The polluting pressures increased at the same time, especially in term of slurries from pig farms, fertilisers and pesticides from agriculture, wastewaters from civil and industrial uses, flowing into the lake water body. Evidence of such effects are documented by Chloride/Electric conductivity data, by chlorophyll fluctuation, by Redox sediments evolution, increase of pH and temperature in summer season, and so on.

The ecological impact in the Lake has evidenced a fish community negative evolution, characterised by lowering results in fishery, crisis of autochthonous species and introduction of new ones, changes in planktonic composition (loss of species and size reduction), explosion of algal blooms and cyanobacteria, other species invasion (shrimps, mussels, nutrias), insect invasion for larval colonisation of bottom lake with reduced sediments (Chironomids). The submerged vegetation evolved toward eutrophic association and reed coastal band is disappearing in the wet area, meanwhile humid prairies are substituted by cultivated crops. The lost of a natural buffer strip modified the anthropic impact on coastal lake ecosystem.

The environmental status of Lake, defined for the period 2000-2007 according to national legislation DLgs. 152/99 considering some water macro-indicators, is poor: transparency, Chlorophyll, dissolved Oxygen, Nitrogen and Phosphates, have medium low indicator values. The quality status is determined by phosphates and transparency values (even if transparency has a partially natural origin). Until 2004, water was uptaked for drinking use and its status was classified at lower level of potabilising surface waters. Recreational use for bathing is authorised during all the time the national legislation was applied (from DM 470/1982), even if with regular derogation for transparency and pH. Evaluation of groundwater quality status indicates nitrates pollution in the western zone of the basin; quantitative features and water extraction estimation shows a weak aquifer, easily modifiable in its relation with hydrographic network.

The monitored small water courses present an elevate pollution level: organic and nutrients charge, presence of four pesticides in spring season: Metholachlor, Terbutylazine, Terbutylazine desetil, Chlortorulon. The Umbria Regional Government has declared the Lake basin vulnerable by nitrates and pesticides according to River basin Plan and European Union Directives.



Parameter (Year 2004)	Watercourse							
	Paganico	Rio Pesca	Anguillara	La Treve	Macerone	Formaggiara	Mignattino	R. Vesula
CO ₂	Bad	Poor	Poor	Sufficient	Poor	Bad	Bad	Bad
CO ₂	Bad	Poor	Good	Good	Sufficient	Bad	Bad	Bad
NO ₃	Bad	Bad	Sufficient	Sufficient	Good	Bad	Bad	Poor
Ortho-phosphates	Bad	Sufficient	Excellent	Good	Sufficient	Bad	Poor	Poor
Watercourse code	Poor	Sufficient	Excellent	Poor	Poor	Poor	Bad	Sufficient
CO ₂	Poor	Poor	Poor	Sufficient	Poor	Poor	Bad	Poor
NO ₃	Poor	Poor	Sufficient	Good	Good	Poor	Poor	Poor
Ortho-phosphates	Bad	Poor	Excellent	Good	Good	Bad	Poor	Bad
Watercourse code	Poor	Sufficient	Sufficient	Sufficient	Sufficient	Poor	Poor	Poor
BOD ₅	Poor	Poor	Sufficient	-	-	Poor	Poor	Poor
Extended Biotic Index	Poor	Poor	Sufficient	-	-	Poor	Poor	Poor

Monitored watercourse	Estimated annual discharged volume (m ³)	Annual Discharged loads - year 2005			
		CO ₂	NH ₄	NO ₃	PO ₄
Paganico	6.031.844	133.146	4.128	49.997	3.668
Rio Pesca	3.711.831	116.318	4.179	46.438	2.164
Anguillara	17.126.678	337.507	9.203	34.073	2.173
La Treve	2.437.644	42.613	349	8.243	413
Formaggiara	2.442.171	58.986	2.791	20.940	3.167
Macerone	3.632.970	67.963	286	6.558	564
Mignattino	1.588.597	48.164	898	7.423	833
TOTAL	38.971.752	804.708	21.834	195.678	12.983

Environmental main parameters evaluation of Trasimeno basin watercourses

Main loads discharged by basins of principal watercourses (loads from civil wastewater treatment plants are not included, as they are directly discharged to the lake)

Development of monitoring according to Water Framework Directive and Bathing Directive

The adoption of Water Framework Directive, DIR 2000/60, recently developed at regional level, introduce biological indicators and new chemical/hydro-morphological criteria into evaluation of environmental condition of Lake: phytoplankton and fishes, macrophytes and macro-invertebrates, parameters from pressure analysis, frequencies and monitoring sites, coastal situation and quantitative elements. The most important aspect of new approach is the quality assessment related to a specific reference condition for the lake typology: a shallow lake as Trasimeno will be compared and parametrised in relation to a similar good-excellent status reference Lake (homogeneous definition criteria). The more wide-sense and suitable environmental lake assessment (including trophic aspects) will be concluded in 2009: first monitoring activity recently started in July 2008. By 2009 the new Bathing Directive (DIR 2006/7) will be implemented, as indicated by the new national legislation DLgs. 116/08, previewing microbiological parameters and pressure-related risk elements.

The ARPA project "Refining the environmental knowledge and reference conditions for the Lake Trasimeno, definition of a conceptual model for a basin management plan"

In 2004 Italian Ministry of the Environment and Tevere River Basin Authority, with the participation of local administrations, activate a Trasimeno Observatory in order to sustain the realisation of environmental measures proposed in 2002 by Trasimeno Basin Plan. Within its activities, the Observatory adopted a technical proposal of APAT-ARPA Umbria concerning an integrated approach for the lake, a new ecological assessment derived from the DIR 2000/60CE and a public participation for the revision of planned measures. In such context is born the project **Refining the environmental knowledge and reference conditions for the Lake Trasimeno, definition of a conceptual model for a basin management plan** committed at Regione Umbria and ARPA.

Umbria Regional Offices provide the investigation on bottom topography, sediments mapping and dating; ARPA develops all the environmental aspects.

The ARPA project, will be completed in 2009, has the five following objectives:

1. Integration and development of environmental knowledge and anthropic pressures-environment interaction
2. New investigations on sediments status and remote sensing assessment
3. Creation of an integrated electronic archive for documents and data
4. Definition of conceptual environmental framework and reference conditions for the lake
5. Proposal of a management plan (involving institutions and citizens)

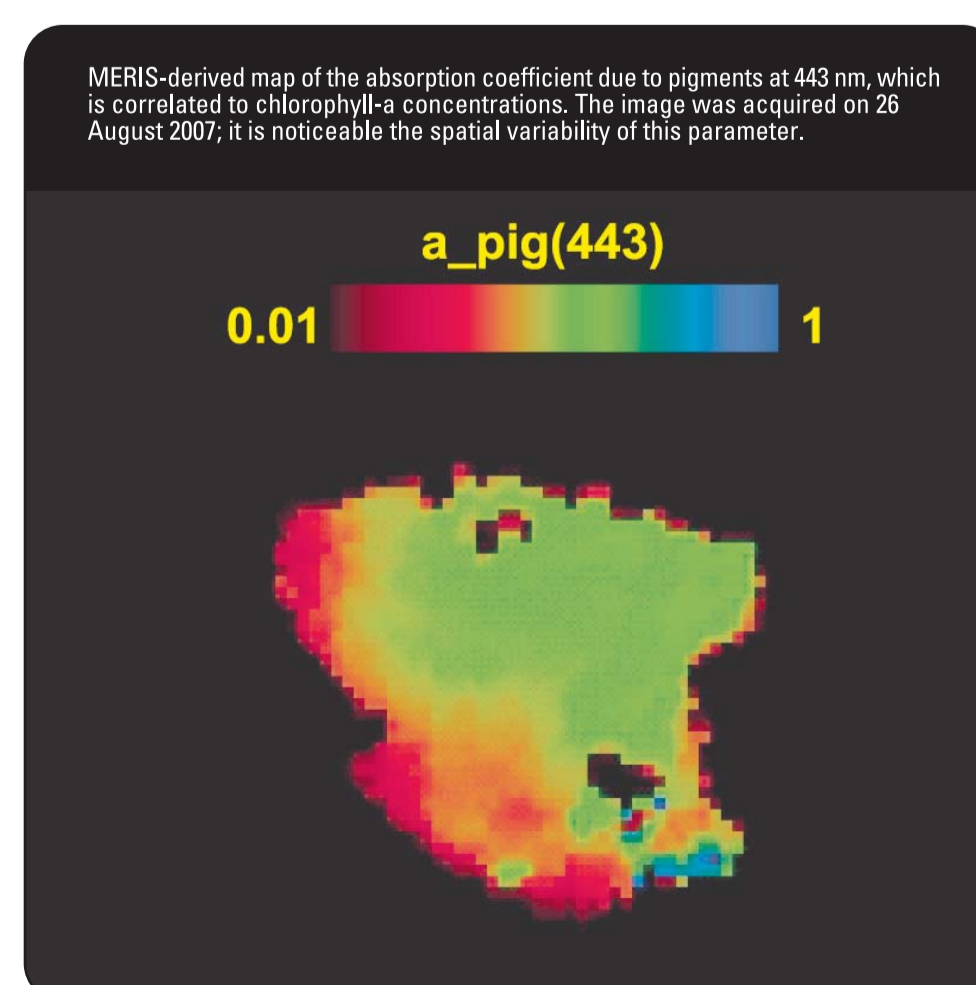
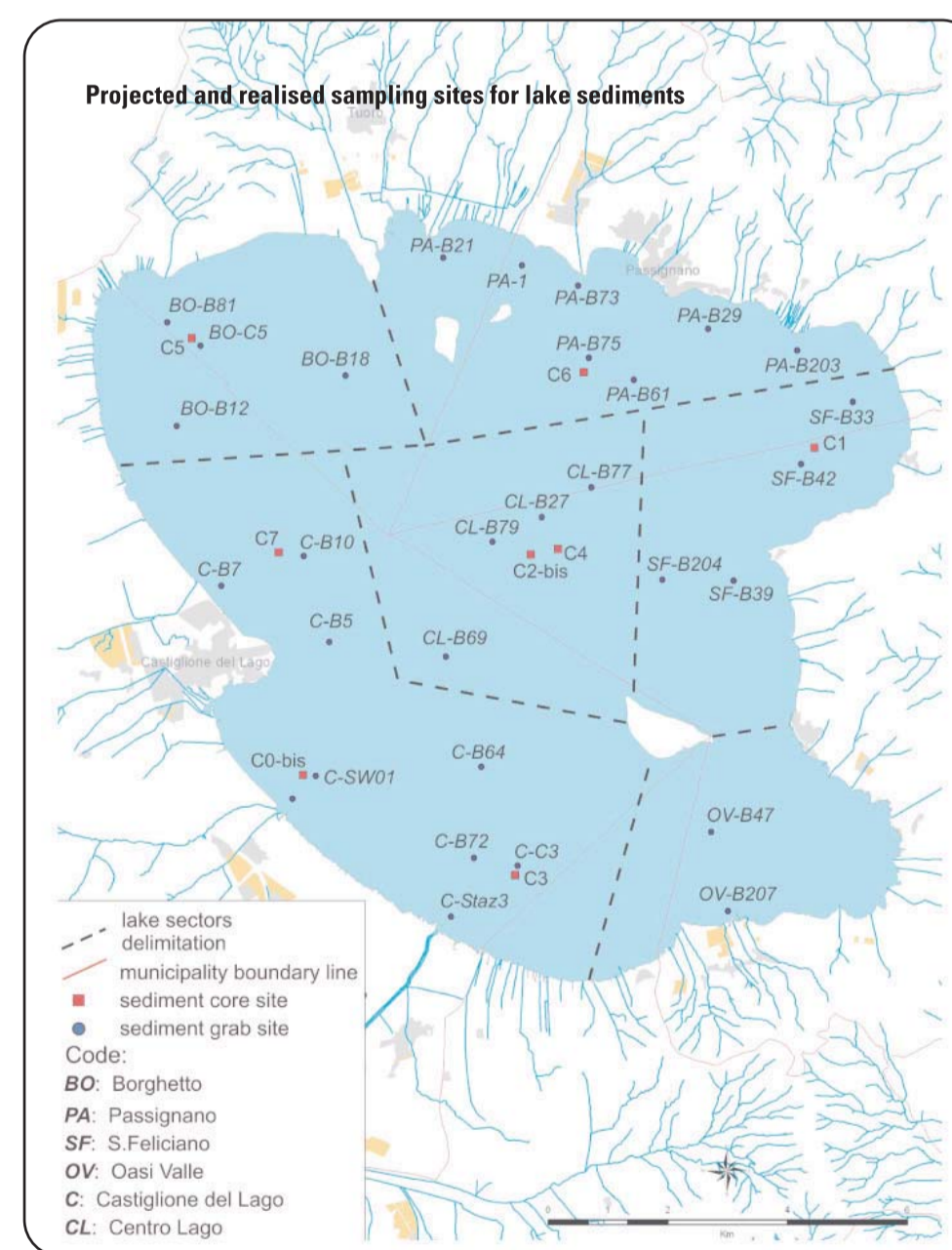
Status of the art is periodically upgraded at web site www.arpa.umbria.it/canale.asp?id=1308

Integration and development of knowledge

The aim is to re-open the discussion on the lake management starting from shared multidisciplinary analysis of the ecosystem. The first step of this project consists in collecting and reviewing the scientific and technical bibliography about Lake Trasimeno. ARPA is making a summary of the contents for the most important documents, redact a specific overview for the principal environmental aspects (such as water quality and quantity, fishes, submerged and coastal vegetation, sediments, micro-organisms), in order to give a complete environmental framework of the lacustrine system. All those elements will be distribute on the Web to administrators, policy makers and citizens.

Investigations on sediments

Specific activities of sampling are developed for the sediments due to their important role in relation to water transparency, vegetation growth and nutrients-pollutants exchange with the water body. In particular, nutrients exchange (P, N) between lake water and bottom sediment is a very complex mechanism, influenced by geochemical and biological processes as well as hydrological and environmental parameters. The sediment's study will be completed during autumn 2008, by collection of cores and shallow samples sediment. About thirty shallow samples and eight core sediment will be collected in several lake zones, considering the main environmental characteristics and the anthropogenic "pressures" of the lake basin. The Umbria Regional part of the project has defined the recent sedimentation rate of the lake, ranging fro 3 to 6 mm per year in the pelagic zone: chemical log on cores will evaluate pollution elements and natural trends.



Remote sensing assessment of the environment

The objective of the activity on remote sensing observation, supported by researchers of IREA-CNR from Milan, is to investigate the evolution in time and space of both water quality, mainly in relation to seasonal and climatic evolution of algal blooms, turbidity and water temperature, and the coastal submerged vegetation.

The first phase of work has been focused on fieldwork activities for the calibration of the satellite data and on image processing of time-series of medium resolution images. Preliminary results are indicating a good agreement between water quality products derived from MERIS and MODIS and in situ data on chlorophyll-concentrations, Secchi disk depth and water temperature. Simultaneously, the multispectral images from Landsat/ASTER have been archived and pre-processed for studies on vegetation and land use-land cover change at catchments scale.

The availability of images from different sensors give us the opportunity to perform studies at different temporal and spatial scales, we expect that Remote Sensing will provide useful information for the purposes of the Lake Trasimeno project.

Reference conditions for the lake and management plan

Achieved the definition of environmental problems and relations, established the reference condition for a peculiar shallow lake as Trasimeno in Mediterranean area, the project will involve to define the framework of measures for in the Management plan.

Several important measures concerning the existent pressures are already identified and proposed in the Regional Water Protection Plan:

- Transformation of slurries from pig farms into manure for a better agricultural use as fertiliser
- Optimisation of sewage systems and wastewater treatment, with re-use of effluents in agriculture
- Adoption of a Balance of nutrients in the nitrates vulnerable area
- Enhancing of adequate buffer strips along watercourses and coastal zone