

# 12<sup>th</sup> International Living Lakes Conference

*Castiglion del Lago, 25 September 2008*

***Session 3: Culture, Landscape and Climate change***

Environmental evaluations of Umbria shallow lakes  
and support to Management Plans



ARPA  
umbria  
agenzia regionale per la protezione ambientale



PROGETTO AMBIENTALE  
OSSERVATORIO TRASIMENO



acqua 

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# Regional Environment Agency

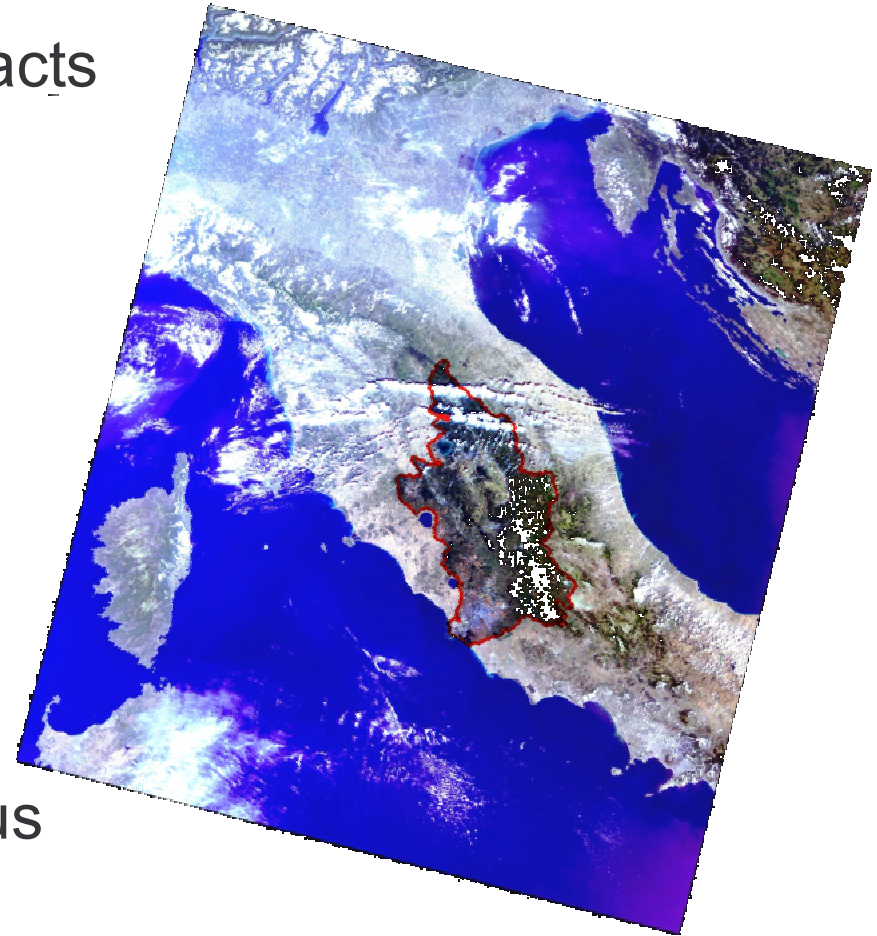
1. Our Agency, public institution, recently born in 1998, would like enforce his role for the regional community for to be:
  - The reference for environmental aspects, promote the information collection and diffusion;
  - the support to institutions, associations and citizens;
  - The pole of attraction for merging scientific researches and results with field observations, monitoring, data collection and practical application;

We want to build capacity for environmental assessment and management proposal.

This conference, give us an opportunity to stimulate even local interaction with institutions and civil society

## The presentation sketch

1. General and local scale elements on climate impacts for Italian lakes
2. Trasimeno and Piediluco overview
3. Lakes monitoring and ecological status
4. The Project Trasimeno: objectives, activities and perspectives
5. Lakes management status and proposals



# Climate effects on Italian Lakes

- Climate change causes thermoenergetic increase in surface and deep water
- Influences the annual and long-term circulation and mixing of water, especially in late winter when the thermal inversion occurs (see graph).
- Less mixing of water decreases the availability of oxygen in the deep water.:  
Anoxic conditions → anaerobic processes → increasing release of methane and CO<sub>2</sub>
- → mobilization of metals and nutrients (e.g. phosphorus) → algal growth, cyanobacteria and eutrophic problems.

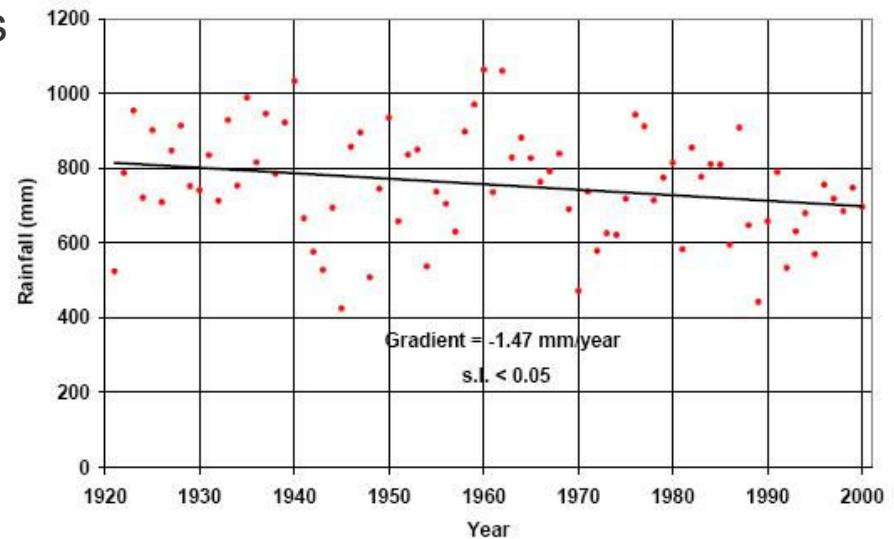
(From Ambrosetti and Barbanti, 1999). Climate impact in the Depth of vertical mixing of Lake Maggiore at the end of winter (years 1951-1998).



# Climate effects on Italian Lakes

- Reduction of total rainfall and increasing of water scarcity are observed in Italy
- Moreover, changes in precipitation intensity and distribution, dry and wet days occurrence, are also important because of implications for soil erosion, nutrients and pollutants transport.

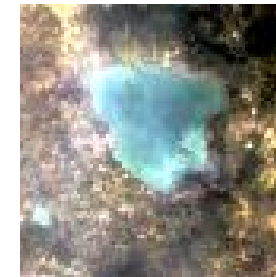
Shallow lakes, as the Umbrian Lakes Trasimeno and Piediluco, are in different way affected by anthropic pressures and climate change, causing more difficulties to recover their ecological equilibrium and a good ecological status according to DIR 200/60CE.



**Graph:** Trend of the yearly rainfall on the lake Trasimeno surface from 1921 to 2001. (From Burzigotti, et al., 2003)

# Lake Trasimeno

- Trasimeno: shallow lake, fed by rainfall, small catchment
- Recent negative rainfall trend generates an “endoreic” behaviour focusing the pollution on the lake
- Annual charge: organic carbon (500t), nitrogen (550t), phosphorus (30t)
- Tourism, agriculture and livestock breeding
- Cultivated lands 70% of the hilly territory, intensive agriculture 28%.
- Irrigation uses are regulated, not the uptakes from wells
- Phosphorus → pig livestock breeding units → agricultural spreading of slurries of about 40 to 70.000 pigs; civil wastewater treatment plants → 30.000 e.i. (+ tourism)



	WWTP	Overflow in WWTP	Untreated loads	Flood discharger	Industry	From soil	Agriculture	Breeding	Total
	(t/y)	(t/y)	(t/y)	(t/y)	(t/y)	(t/y)	(t/y)	(t/y)	(t/y)
BOD	38,5	7,3	56,4	176,4	88,3	6,4		150,8	524,1
Phosphorus	2,1	0,2	1,5	5,9	0,2	0,12	16,0	5,2	31,2
Nitrogen	28,7	1,5	11,6	19,0	2,7	5,92	390,7	97,2	557,3

Table: Estimated annual loads discharged to Lake Trasimeno (from Proposal of Regional Water Protection Plan)

# Lake Trasimeno

- Lacustrine ecosystem: area of exceptional value for flora and fauna richness and species diversity. (Nature 2000 site)
- Vegetation: partially compromised, external band of humid prairie, an internal one made of reeds and of root-fixed hydrophytes.
- Lake has from mesotrophic to eutrophic conditions, quality of water is classified as poor (moderate polluted).
- Principal critical parameters: phosphorus and chlorophyll,
- Ecological constraints are algal blooms of cyanobacteria, reducing conditions of sediments, modification and decrease of fish community and plankton, recession of common reeds.



# Lake Piediluco

- Piediluco: 1,5 km<sup>2</sup> wide, fed by two man-made channels, artificial catchment (Nera and Velino) more than 2.000 km<sup>2</sup>.
- Used for Hydropower; 2.000.000m<sup>3</sup> of water daily flowing through the lake;
- Identified two complete different water bodies
- Environmental status is eutrophic and poor, defining a situation of Heavily Modified Water Body according to DIR2000/60CE.
- Seasonal stratification; lack of oxygen in depth, mobilization of phosphorus from sediments and eutrophic problems.

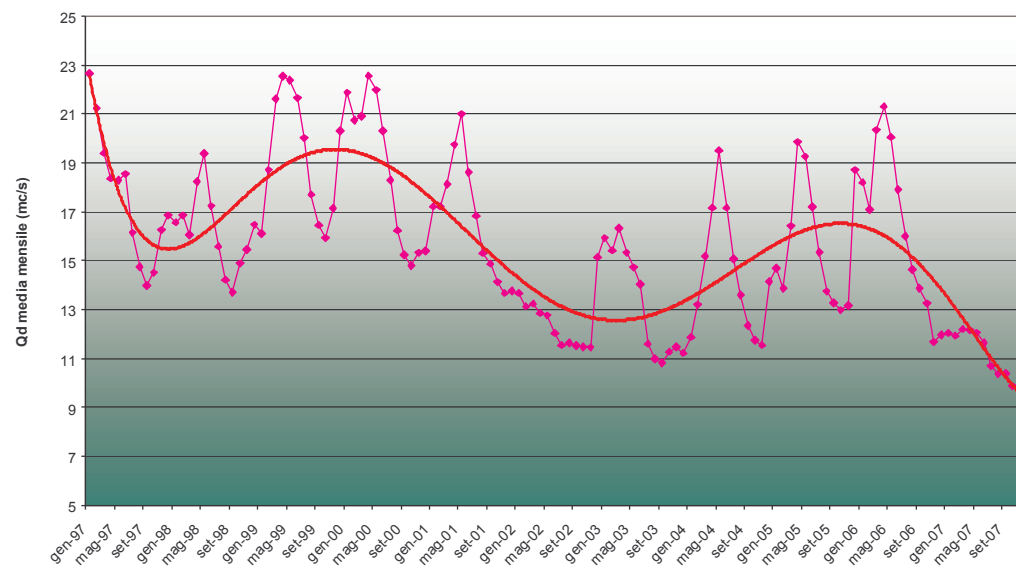


Figure: 10 years discharge rate of Medio Nera Channel: monthly average and trend. The Upper Nera (and the channel) is fed by linear groundwater sources. The trend evidenced is due to climate impacts.



# Umbria Lakes monitoring: Piediluco

- In the Piediluco basin ARPA Umbria realises the lake water/sediments quality monitoring and evaluates the evolution of the anthropic charges transported to the lake by artificial channels (Canale Medio Nera and River Velino): suspended solids, nutrients and organic matter specially from fish farms and WWTP.

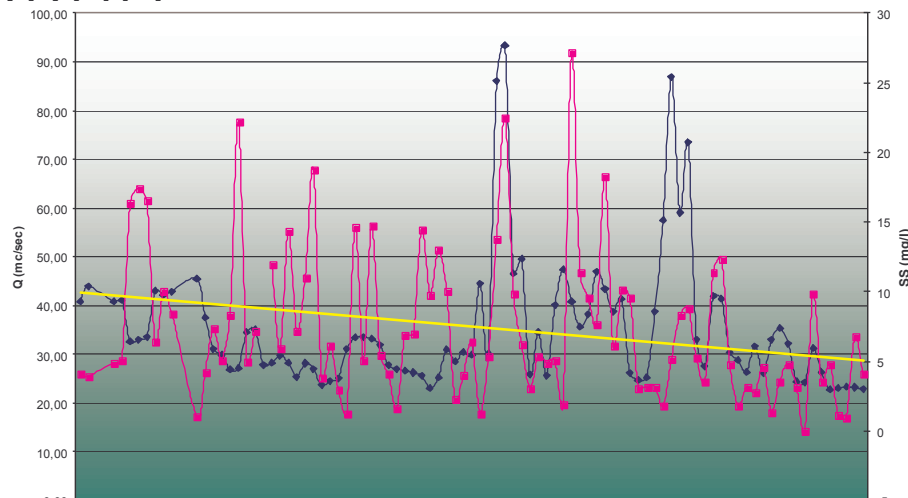
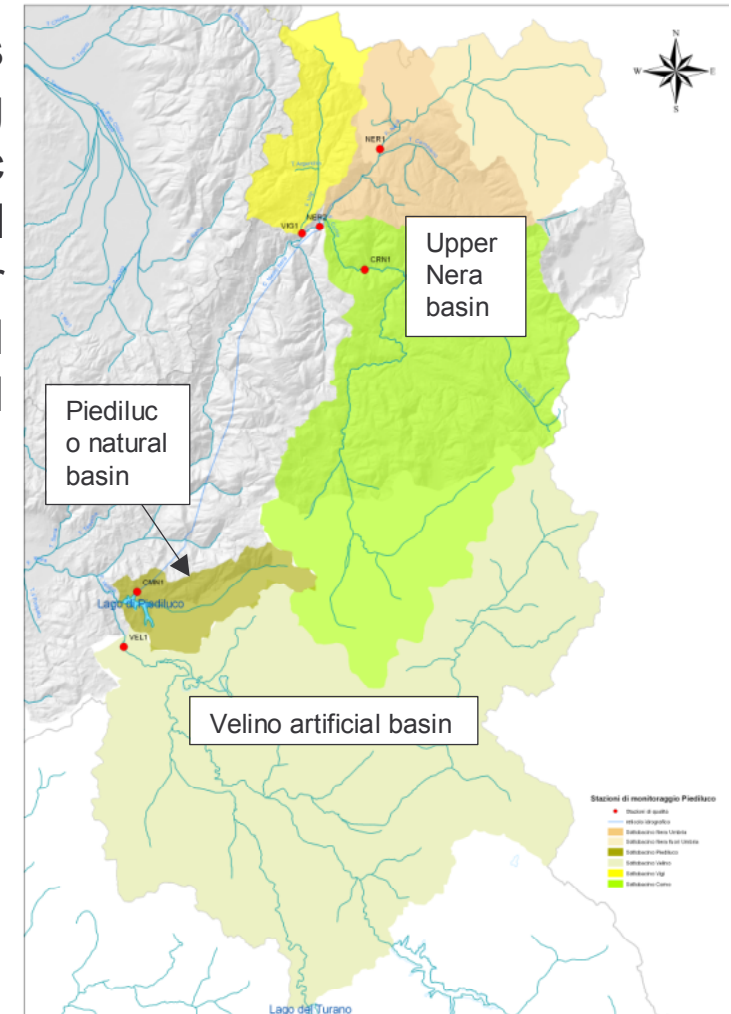


Figure: Discharge rate (blue) and suspended solids (pink) of Velino River – from year 2000



# Umbria Lakes monitoring: Trasimeno

- Lake water quality monitoring, control of anthropic factors, nitrates monitoring of groundwater, control of WWTP, estimation of loads discharged by small watercourses.
- Parameters: physic & chemical parameters, cyanobacteria, faecal pollution and other bio-indicators as phytoplankton, diatoms and macroinvertebrates.

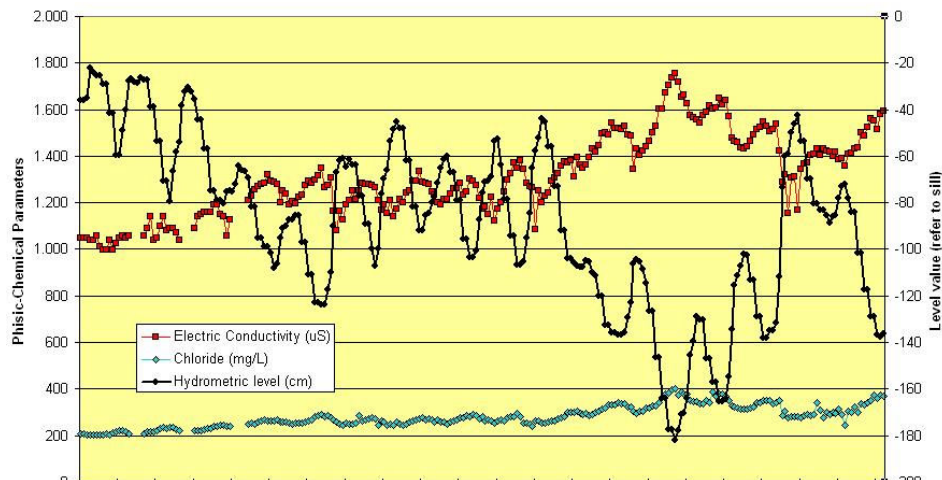


Figure: Decreasing water level (black), increasing El. Conductivity (red) and Chloride (light blue) – from year 1992



Figure: Map of monitored basins and watercourses

# Observatory and project Trasimeno

- 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.



# Main features of the project

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

The ARPA project has the five following objectives, assured by 12 specific tasks:

1. **Integration and development of knowledge** and anthropic pressures-environment interaction
2. **New investigations on sediments** status and remote sensing assessment of the environment
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**

- The aim is to re-open the discussion on the lake management starting from shared multidisciplinary analysis of the ecosystem.
- Operational activities will be achieved at the end of 2008; participation process, development of proposal and diffusion of results are planned for 2009.

# Operational activities of the project

- Specific activities of sampling are developed for the **sediments** due to their important role in relation to impact on water transparency, on vegetation growth and on nutrients-pollutants exchange with the water body.
- 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 vegetation.



Figure: exemple of images chromatic variability

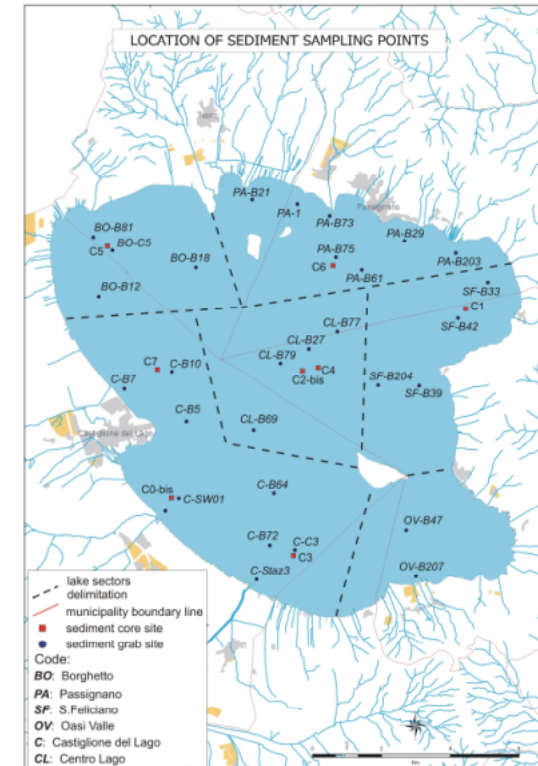
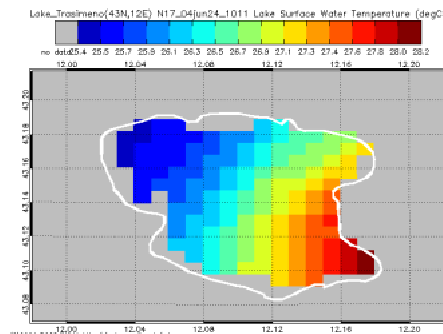
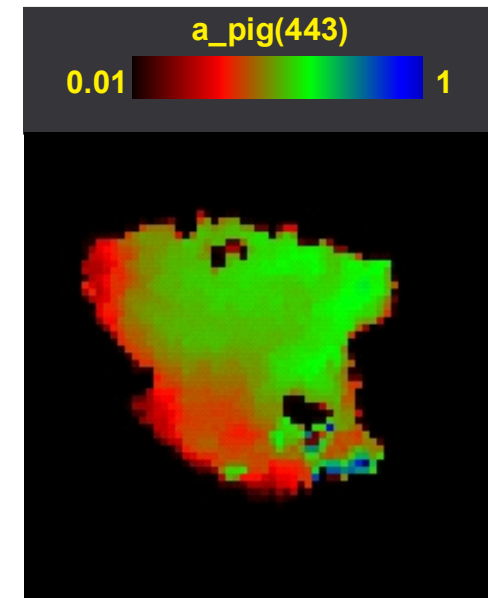


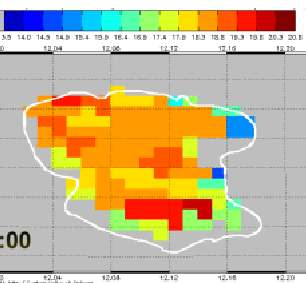
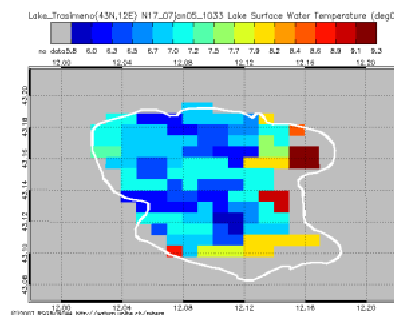
Figure: Projected and realised sampling sites for lake sediments

# Remote sensing activities

- Different satellite sensors have been considered:
  1. MERIS and MODIS for coarse scale regular monitoring of water;
  2. Higher spatial resolution satellite as Landsat and ASTER for intermediate/fine scale studies on aquatic vegetation and surrounding lands;
- Water quality mapping is performed using physically based approaches and bio-optical modelling.
  1. Dedicated fieldworks activities started in May 2008 for water components concentrations and apparent optical properties.
  2. Spectroradiometric measurements on aquatic vegetation.



24 June 2004 MODIS Temperature output



9 May 2008

MERIS-derived map of the absorption coefficient due to pigments at 443 nm, which is correlated to chlorophyll-a concentrations. The image was acquired on 26 August 2007

# Reference conditions for the Trasimeno and management plan

- Defined the environmental problems and relations (public participation)
- Established the reference condition
- **Project will involve the institutions to define measures for the Management plan.**
- **Resulting proposal will be released to decisors and to the public opinion.**
- Several important measures concerning the existent pressures are already identified and proposed in the Regional Water Protection Plan:
  1. Transformation of slurries from pig farms into manure for a better agricultural use as fertiliser
  2. Optimisation of sewage systems and wastewater treatment, with re-use of effluents in agriculture
  3. Adoption of a Balance of nutrients in the nitrates vulnerable area
  4. Enhancement of adequate buffer strips along watercourses and lake coastal zone

# Piediluco management plan

- 2006: The Tevere River basin Authority approved the Piediluco Basin management Plan.
- Umbria Region activated the operational plan for his territory
- Principal measures concern the Upper Nera River catchment, source of external pressures:
  1. Sediment and phosphorus removal from fish farms effluents
  2. Optimisation of wastewater treatment plants
  3. Monitoring of organic and nutrients loads on rivers network
  4. Lake water and sediment monitoring, balance of input-output loads
- The same measure have to be adopted by Lazio Region in the Velino River catchment.
- More specific measures are defined on the Lake area (land use, sewage network, WWTP outlet out of lake basin, etc...)





# Conclusions

- Activities of **Project Trasimeno** are realised in collaboration with IREA-CNR Milano for remote sensing.
- Trasimeno and Piediluco monitoring are managed by Arpa Laboratory Unit
- Data elaboration and specific studies are carried out by ARPA Department of Perugia and Department of Terni
- More info are displayed in Posters at Trasimeno Desk
- Documents and info are distributed via Web at [www.arpa.umbria.it](http://www.arpa.umbria.it) (acque)
- Project and public participation:  
<http://www.arpa.umbria.it/canale.asp?id=1308>

*THANKS to all collaborating people!  
...and institutions too.*



Thanks for contribution to this presentation: C.Giardino, M. Bresciani – IREA CNR  
F. Charavgis, N. Morgantini – ARPA Umbria

# Late Questions

- Ecological footprint indicate that in Italy, every citizen consume in general more than 4 times the available resources, so the territory demand needs to be roughly multiplied for 4.
- This is the Trasimeno situation.
- Each economic sector asks and operate for whole lake potentiality:
  1. Tourism (bathing waters and beaches)
  2. Agriculture – cattle breeding
  3. Fishery
  4. Civil and urban uses
  5. Moreover there's the Nature 2000 protected area.

# Late Questions

- Where found all this place?
- Which is the solution?
- 1 lake for each one?
- 1 slice of water (until will be present) for each one?
- **We have (still) only 1 lake!**

