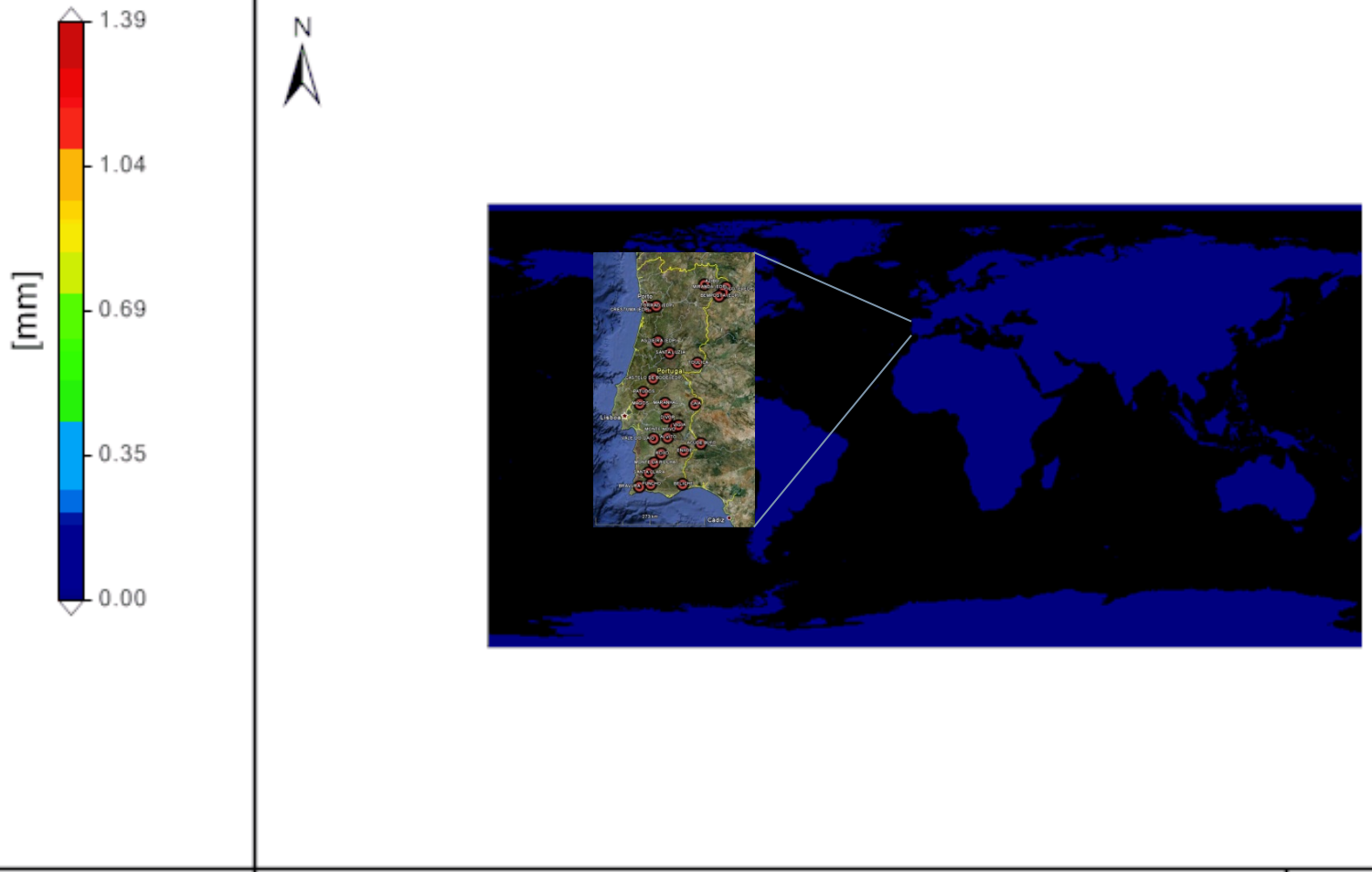
MANAGEMENT OF THE TROPHIC STATUS IN PORTUGUESE RESERVOIRS

Brito, D.; Chambel-Leitão, P.; Amaral, A., Campuzano, F., Malhadas, M., Mateus, M., Nunes, S., Pablo, H., Viegas, C., Neves, R.

Pedro Chambel Leitão

chambelpc@ist.utl.pt

INTRODUCTION



OVERVIEW

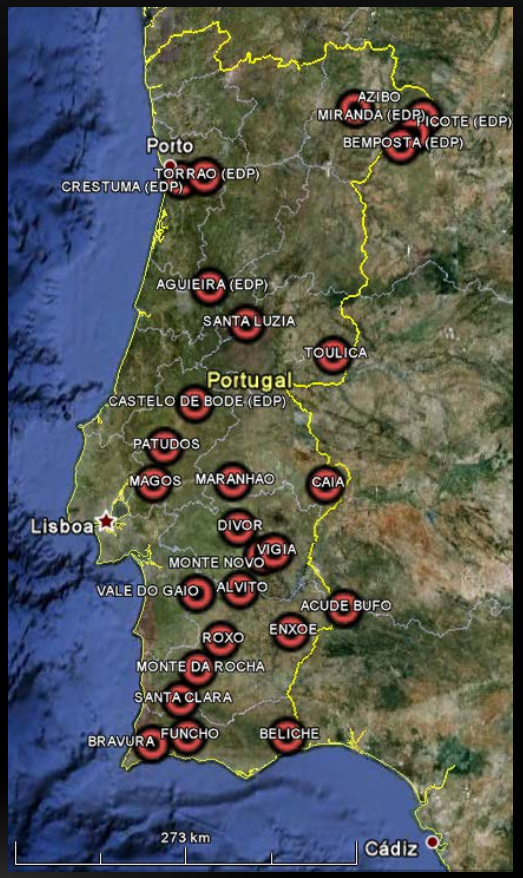
- Why is this work interesting for SWAT Conference
- The objectives of the study
  1. to evaluate the trophic status in 29 Portuguese reservoirs,
  2. to determine the TMDL for each of them
  3. to identify the catchment management policies that permit that TMDL.

WHY IS THIS WORK INTERESTING FOR SWAT CONFERENCE

- Estimation of TMDL and corrective actions with SWAT and CeQualW2
- Methodology applied to the all country (Portugal)
- Results showed you can rely on SWAT to get missing data
- Presently we are implementing a operational warning system on water quality

PORTUGUESE PROBLEMATIC RESERVOIRS

- European Commission was worried with the water quality of 29 Portuguese reservoirs
- How could we respond in a systematic way to the European Comission: Using DPSIR and models



DPSIR APPROACH

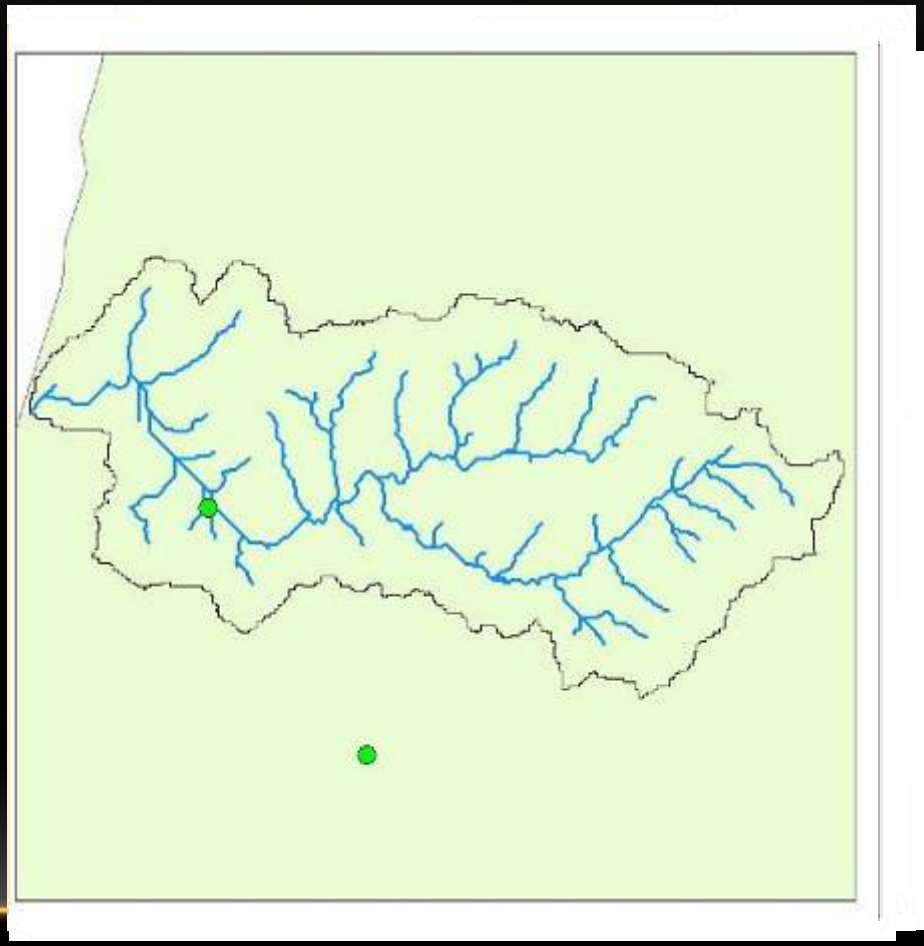
DRIVER	Pressure	State	Impact	Response
Agriculture	Diffuse loads of Nutrients and Organic Matter	Trophic Level	Nutrient enrichment, Biological enrichment (eutrophication), Species shift, Oxygen depletion, Fish kills, Toxic algal blooms.	Land use and crop redistribution, Improvement of agriculture practices
Industry	Point discharges of Nutrients and Organic Matter			Improvement of production process &/or End-of the pipe waste water treatment.
Urbanization	Mostly Point discharges of Nutrients and Organic Matter (WWTP) and some diffuse discharges			Improvement of sewer systems and wastewater treatment
Traffic	Atmospheric deposition of nitrogen			Limitation of individual car emissions and traffic management
Forest Fires	Enhanced soil erosion			Forest fire management

HOW TO KNOW IMPACT AND RESPONSE

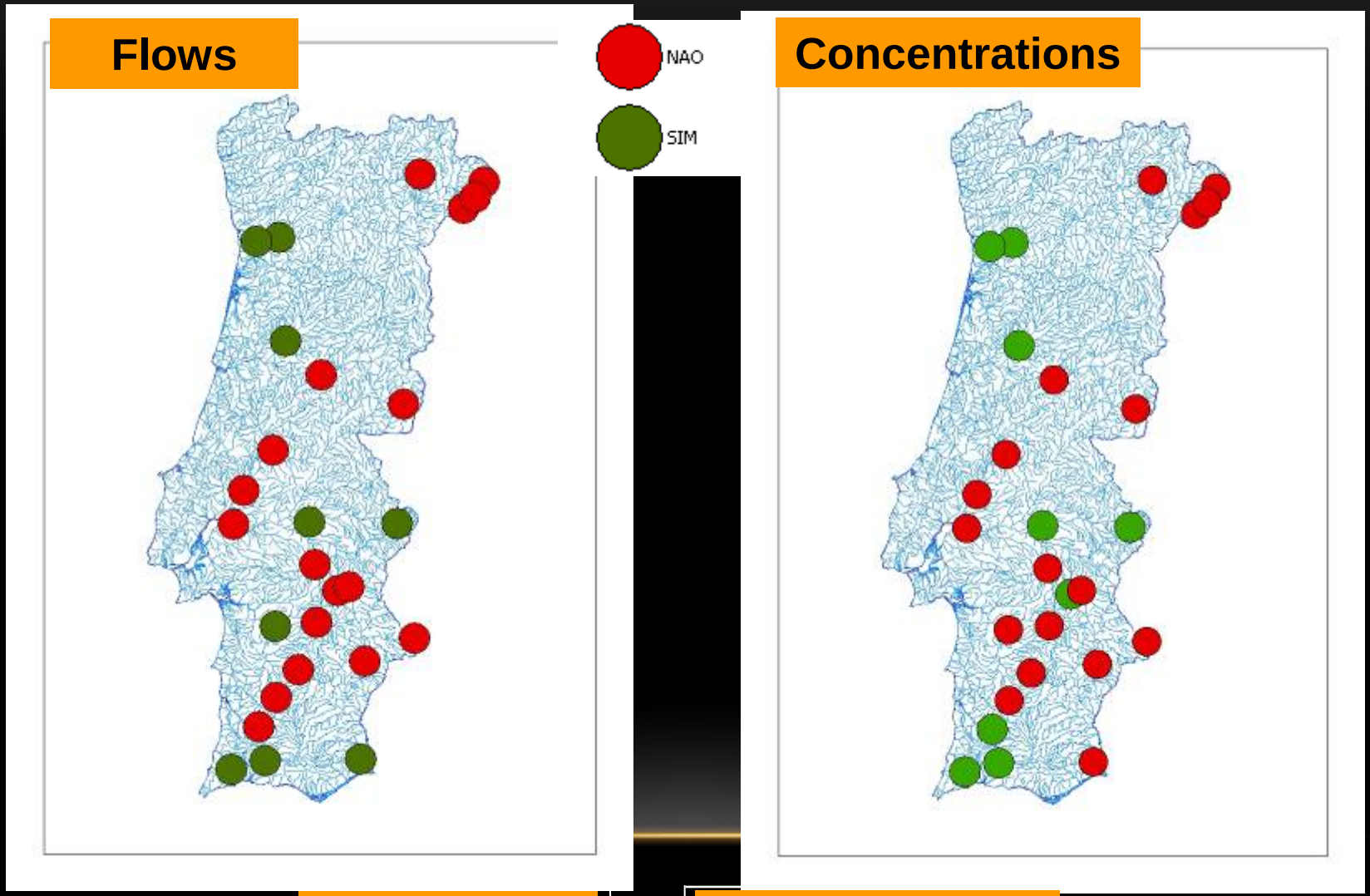
- Know the pressures – SWAT
- Estimate the trophic state – CeQualW2
- Compute impact (know the TMDL) – join SWAT and CeQualW2
- Respond with reduced inputs (SWAT) until reach TMDL (see CeQualW2)

PRESSURES PROVIDED BY SWAT

- SRTM DTM,
- Dailly precipitation and monthly for the rest,
- Few data on soils,
- Land Cover (corine 2000)
- Anual point Sources
- River measurments



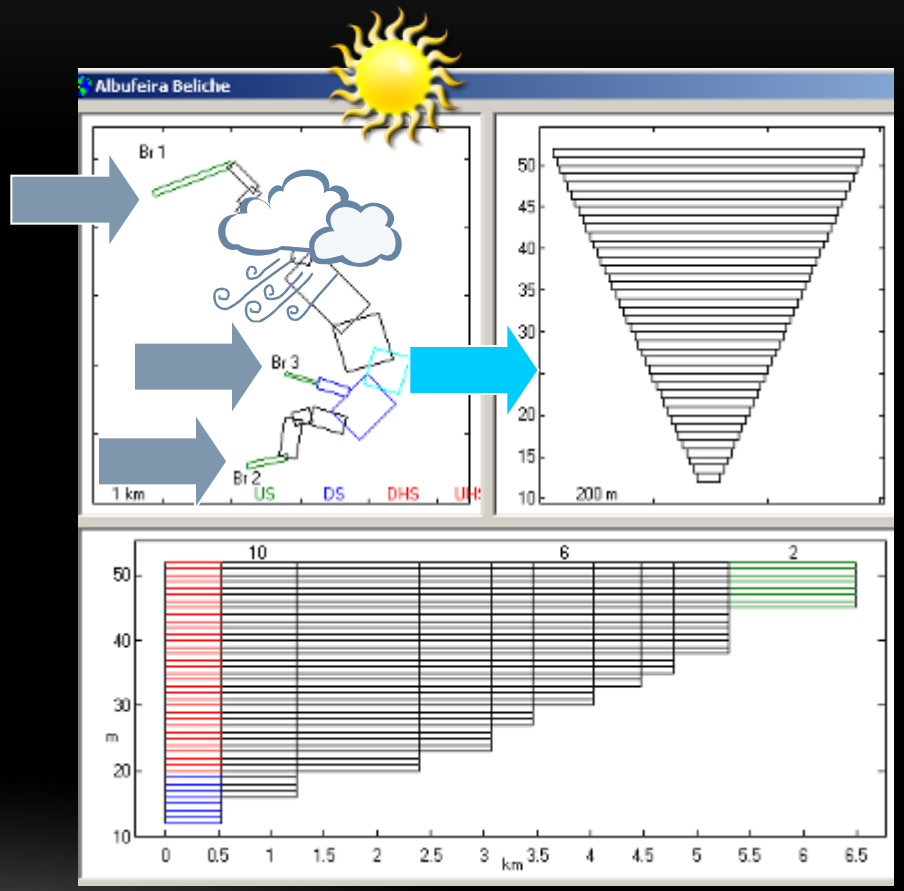
SWAT TO KNOW PRESSURES, UNDERSTAND IMPACT AND GET RESPONSE



Typical situation:

RESERVOIR MODEL: CEQUAL-W2

- State is provided by CeQualW2
- Impact can be understod with CeQualW2
- Input Data needed:
  - Bathymetry,
  - Water Discharges,
  - Inflow concentrations,
  - Atmospheric forcing.



OUTPUT

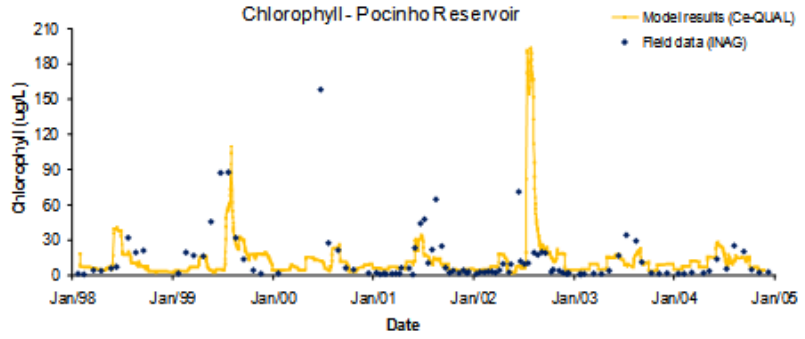


Figure 6 - Comparison between surface Chlorophyll-a measurements (blue dots, source: INAG[9]) and model results (yellow line) off dam wall in Pocinho reservoir.

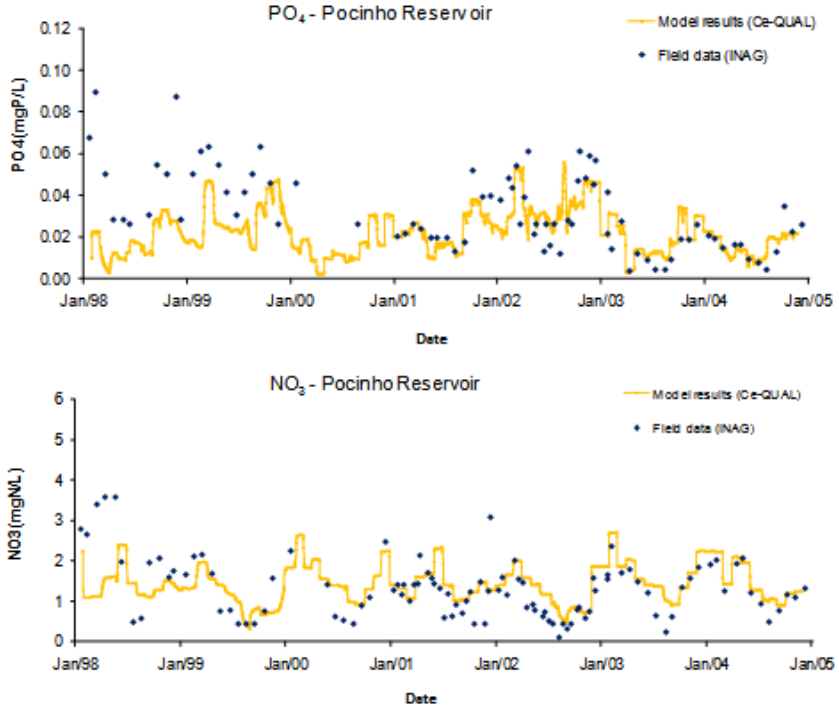
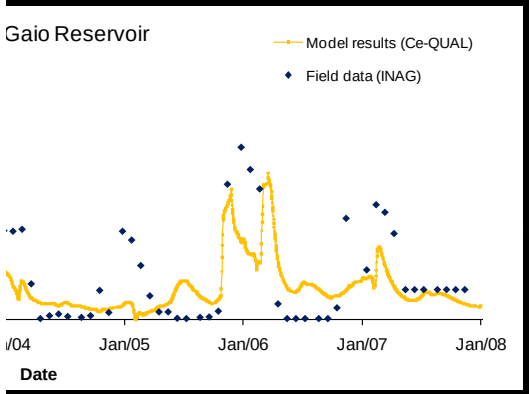


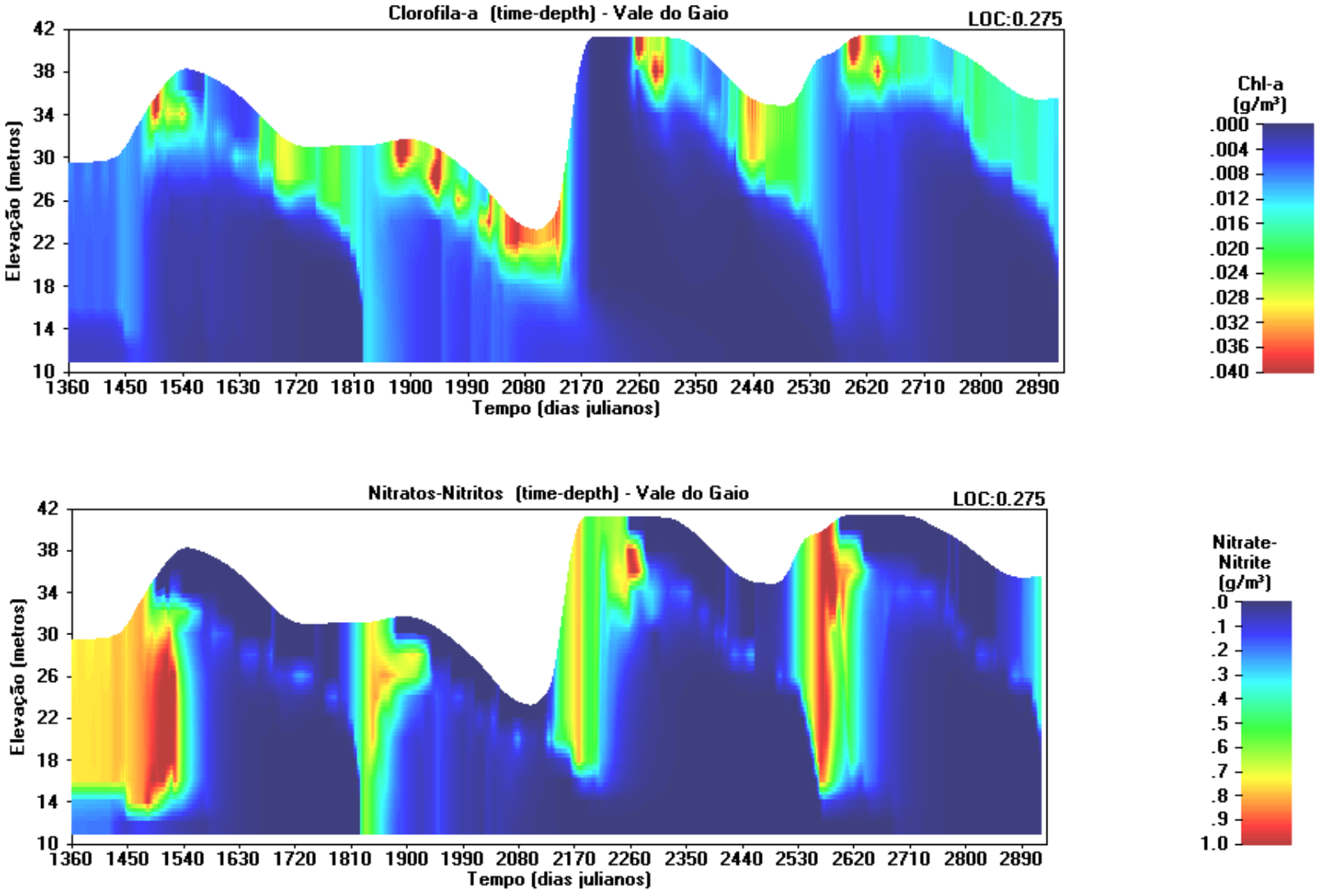
Figure 7 - Comparison between surface nutrient (top - orthophosphate and bottom - nitrate) measurements (blue dots, source: INAG) and model results (yellow line) off dam wall in Pocinho reservoir.



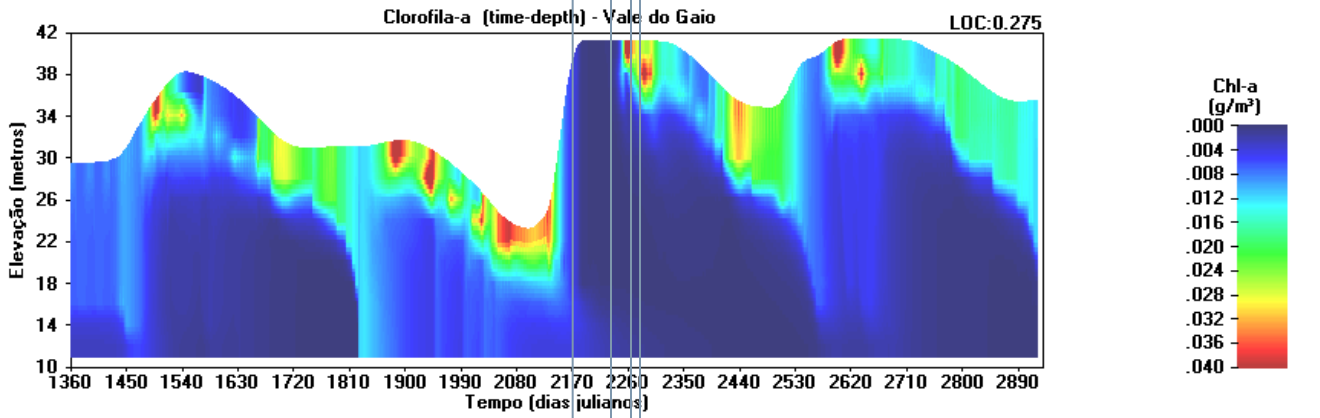
SOME DEFINITIONS

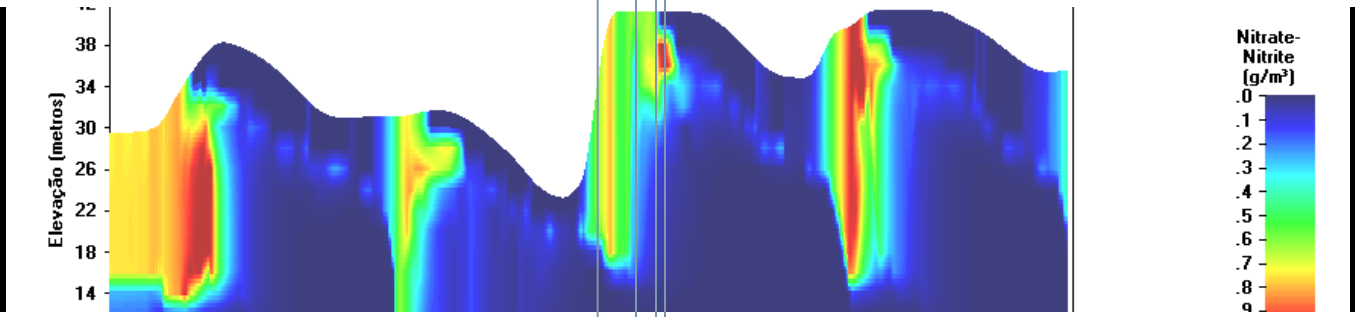
- Eutrophication is the process of biological enrichment of a water body.
- Trophic status is a measure of the biological activity in the water body.
- Eutrophication is a process and its measurement requires the temporal monitoring of the trophic status.
- The trophic status is a measure of the biological conditions in a yearly time frame.
- Eutrophication is the process of increasing the trophic status.

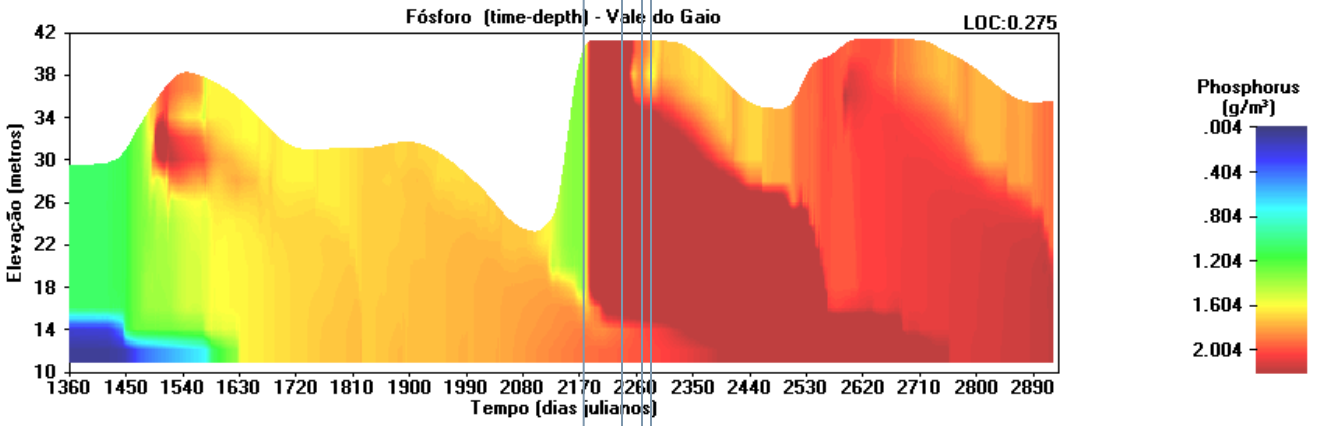
RESERVOIR MODELS



dates: 20 September 1993 (Julian day 1360) e 31 de December 1998 (day2920).







dates: 20 September 1993 (Julian day 1360) e 31 de December 1998 (day2920).

SO…

- Because the nutrient concentration is not enough to forecast the biological activity of a water body, it cannot be enough for assessing its trophic status.
- For the same reason nutrient concentrations cannot be used for comparing the trophic status or the eutrophication potential in different water bodies.

TROPHIC STATUS

Catchment/Reservoir (colour shows trophic status)		TSI Chlorophyll-a Threshold (TSI>53.2 – Chl-a>10µg/l)		TSI Total Phosphorus Threshold (TSI>55 – TP >35µg/l)	
		Last 5 years	Last 10 years	Last 5 years	Last 10 years
Douro	Bemposta	**	**	**	**
	Crestuma-Lever	100 % meso	86 % meso	100 % eut	100 % eut
	Picote	**	**	**	**
	Miranda-Paredão	60 % meso	58 % meso	100 % eut	100 % eut
	Azibo	100 % oligo	100 % oligo	100 % eut	100 % eut
	Pocinho	60 % eut	80 % eut	100 % eut	100 % eut
	Torrão	60 % eut	54 % eut	80 % eut	71 % eut
Guadiana	Açude do Bufo	100 % eut	80 % eut	100 % eut	100 % eut
	Monte Novo	60 % meso	50 % eut	100 % eut	100 % eut
	Enxoé	100 % eut	100 % eut	100 % eut	100 % eut
	Vigia	60 % meso	50 % eut	100 % eut	100 % eut
	Caia	60 % meso	56 % eut	100 % eut	93 % eut
	Beliche	60 % meso	50 % meso	60 % meso	73 % meso
	Alqueva	**	**	**	**
Mondego	Aguieira	60 % meso	67 % meso	60 % meso	67 % eut
Arade	Funcho	100 % oligo	100 % oligo	80 % eut	60 % eut
Sado	Monte da Rocha	100 % meso	86 % meso	100 % eut	100 % eut
	Roxo	80 % eut	80 % eut	100 % eut	100 % eut
	Vale do Gaio	100 % eut	86 % eut	100 % eut	100 % eut
	Alvito	60 % meso	57 % meso	60 % eut	60 % meso
Tejo	Santa Luzia	**	**	**	**
	Paul de Magos	100 % eut	89 % eut	100 % eut	100 % eut
	Divor	100 % eut	100 % eut	100 % eut	92 % eut
	Castelo de Bode	80 % oligo	83 % oligo	67 % eut	56 % meso
	Patudos	100 % eut	90 % eut	100 % eut	100 % eut
	Maranhão	60 % eut	50 % eut	100 % eut	100 % eut
	Toulica	**	**	**	**
Rib. Algarve	Bravura	100 % oligo	80 % oligo	100 % eut	70 % eut
Mira	Santa Clara	100 % oligo	100 % oligo	60 % eut	50 % eut

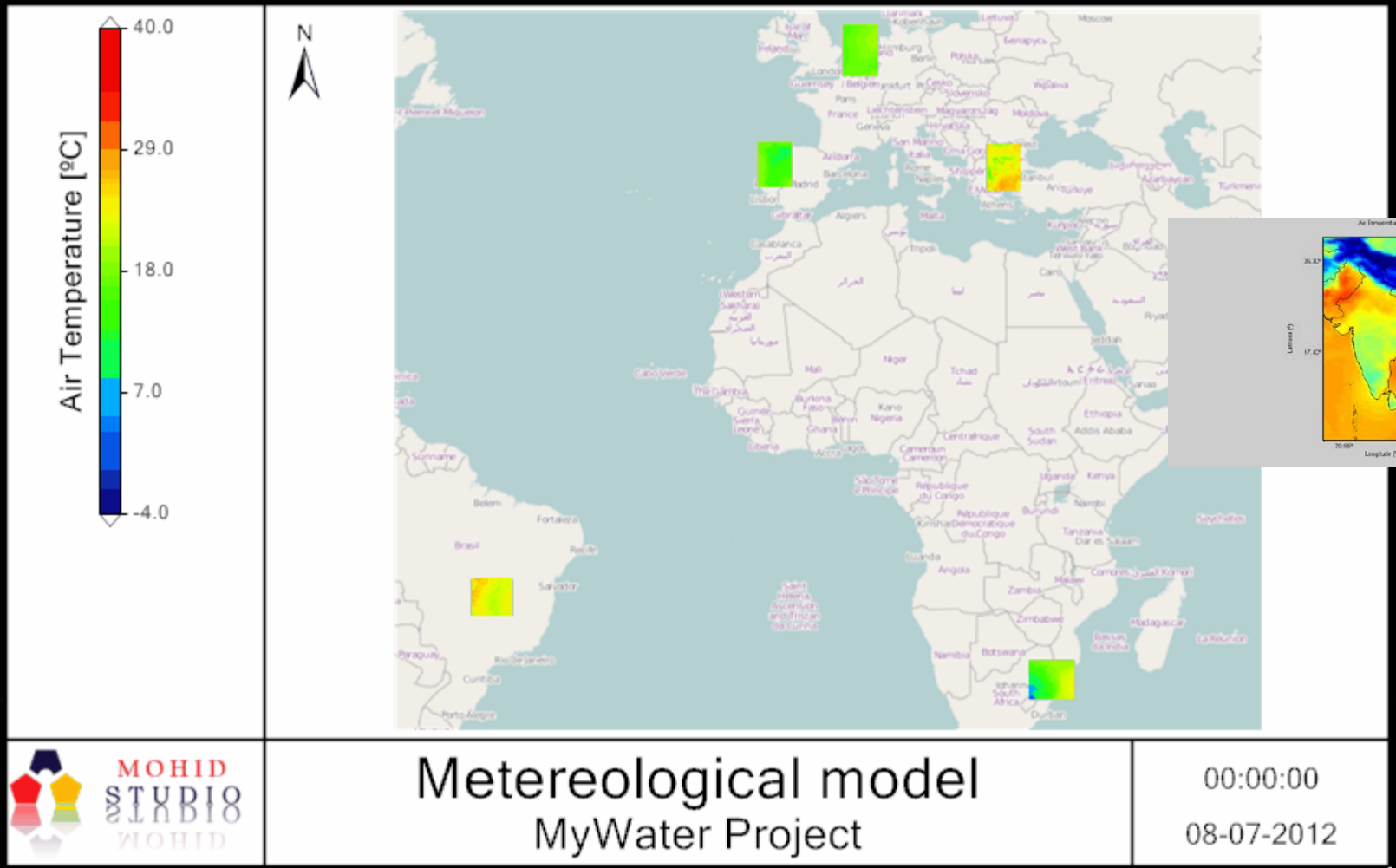
CONCLUSIONS

- This study has shown that in some catchments with the highest urban or animal occupation or with point sources near the reservoir (where summer urban loads can be an important part of the arriving load) were the main cause of the reservoir trophic status.
- For other reservoirs, reductions of the diffuse loads were computed. Typical reductions on the order of 10 to 20% are expected to be enough for shifting the trophic level. In two reservoirs load reduction effort got higher than 40% and further work should include a finer identification of the diffuse origins (e.g. agriculture practices, animal production, soil loss, etc) and the quantification of their weight on trophic level to sustain future management strategies.
- In reservoirs where input loads are low the reservoir geometry (usually with average depths lower than 10m) showed a factor that may consist an eutrophication risk. The continuous enrichment of the sediment (organic matter, nutrient) that occurs trough the years and the fact that light may arrive up to the sediments where nutrients usually are more available, creates a link to algal growth and eutrophication.

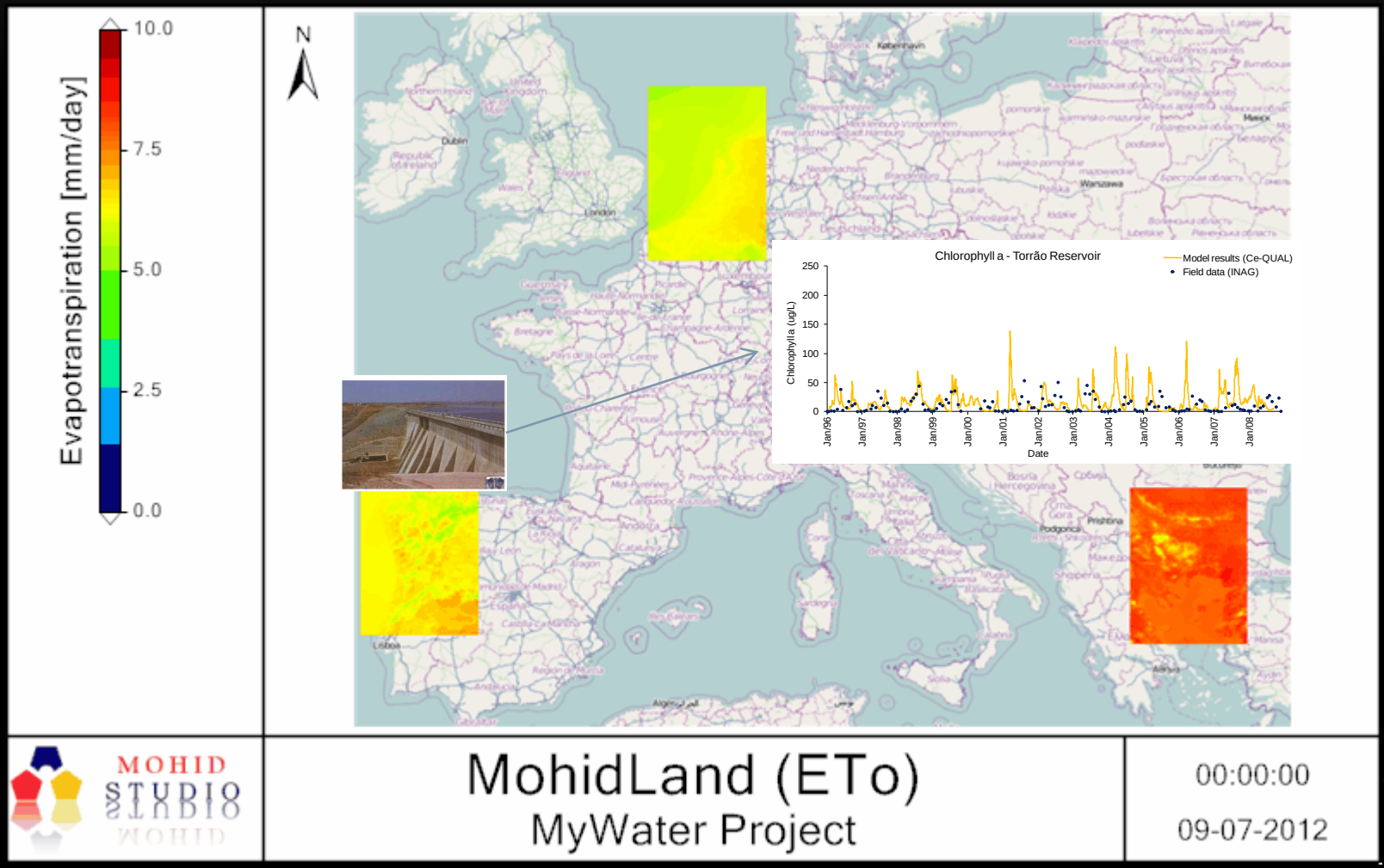
WHAT WE ARE DOING NOW…

MYWATER FP7 PROJECT

- MyWater at a glance



MYWATER


Evapotranspiration [mm/day]
10.0
7.5
5.0
2.5
0.0
N
Chlorophyll a - Torrão Reservoir
Model results (Ce-QUAL)
Field data (INAG)
Chlorophylla (ug/L)
250
200
150
100
50
0
Jan/96
Jan/97
Jan/98
Jan/99
Jan/00
Jan/01
Jan/02
Jan/03
Jan/04
Jan/05
Jan/06
Jan/07
Jan/08
Date
Kobenhavn
Dublin
London
Warszawa
Minsk
Bosna i Hercegovina
Pristina
Podgorica
Lisboa
Adriatic Sea
MOHID
STUDIO
MohidLand (ETo)
MyWater Project
00:00:00
09-07-2012