INTERACTIONS LAKE-ATMOSPHERE: THE ALEX 2014 FIELD CAMPAIGN AND NUMERICAL SIMULATIONS

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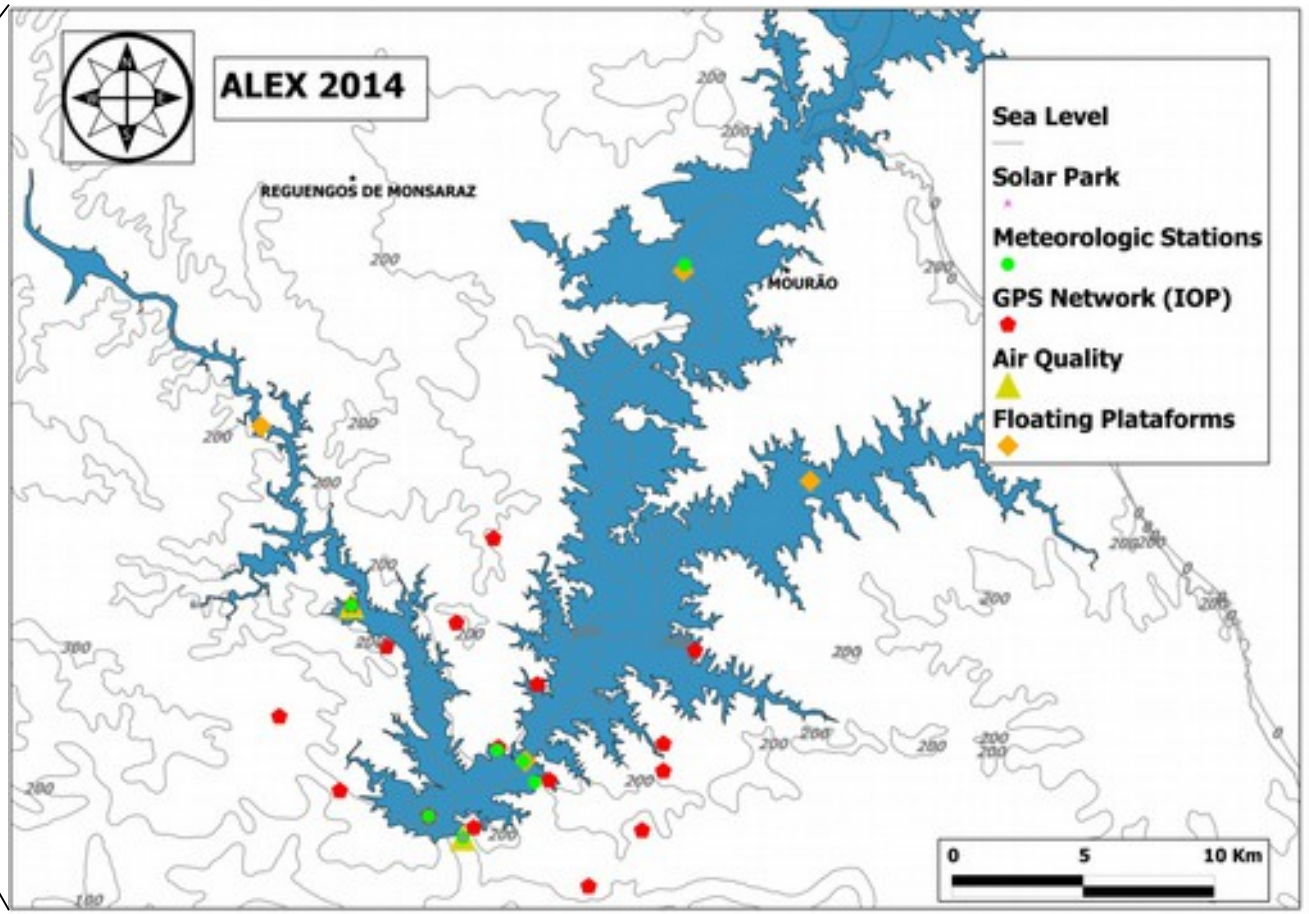
ALEX2014
ALqueva hydro-meteorological EXperiment
UNIVERSIDADE DE ÉVORA
EDIA

FCT Fundação para a Ciência e a Tecnologia
COMPETE
QREN QUADRO DE REFERÊNCIA ESTRATÉGICO NACIONAL
UNIÃO EUROPEIA
cost EUROPEAN COOPERATION IN SCIENCE AND TECHNOLOGY

The Alqueva and the region



Surface area of 250 km^2
Gates were closed in 2002

ALEX2014 field campaign

Understanding and predicting the complex interactions between climate, hydrology, ecosystem processes, water quality and biodiversity form the basis for a future sustainable management of Mediterranean systems and are important to:

- Improve the representations of lakes in NWP models (improve weather forecast and access climate impacts of man made lakes)
- Fulfil the requirements of the Water Framework Directive
- Improve the environmental management of the reservoir.

ALEX2014 field campaign

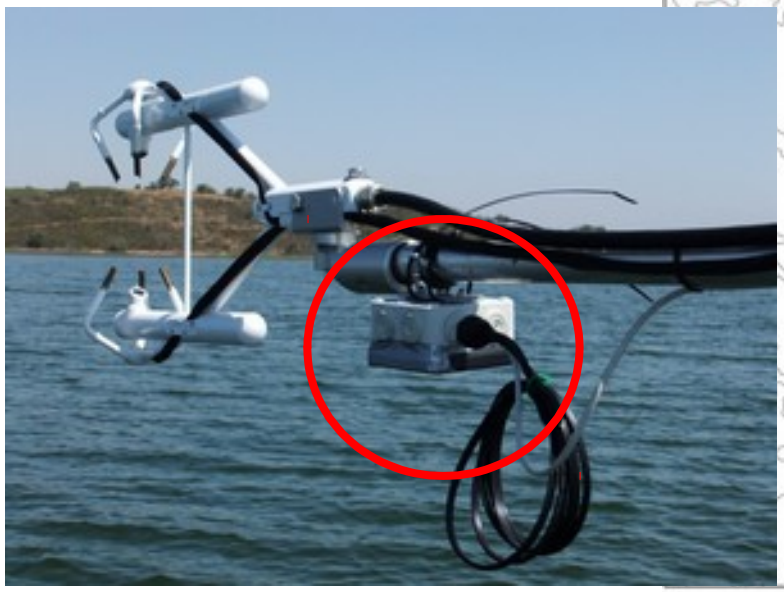
The ALqueva hydro-meteorological EXperiment, ALEX 2014

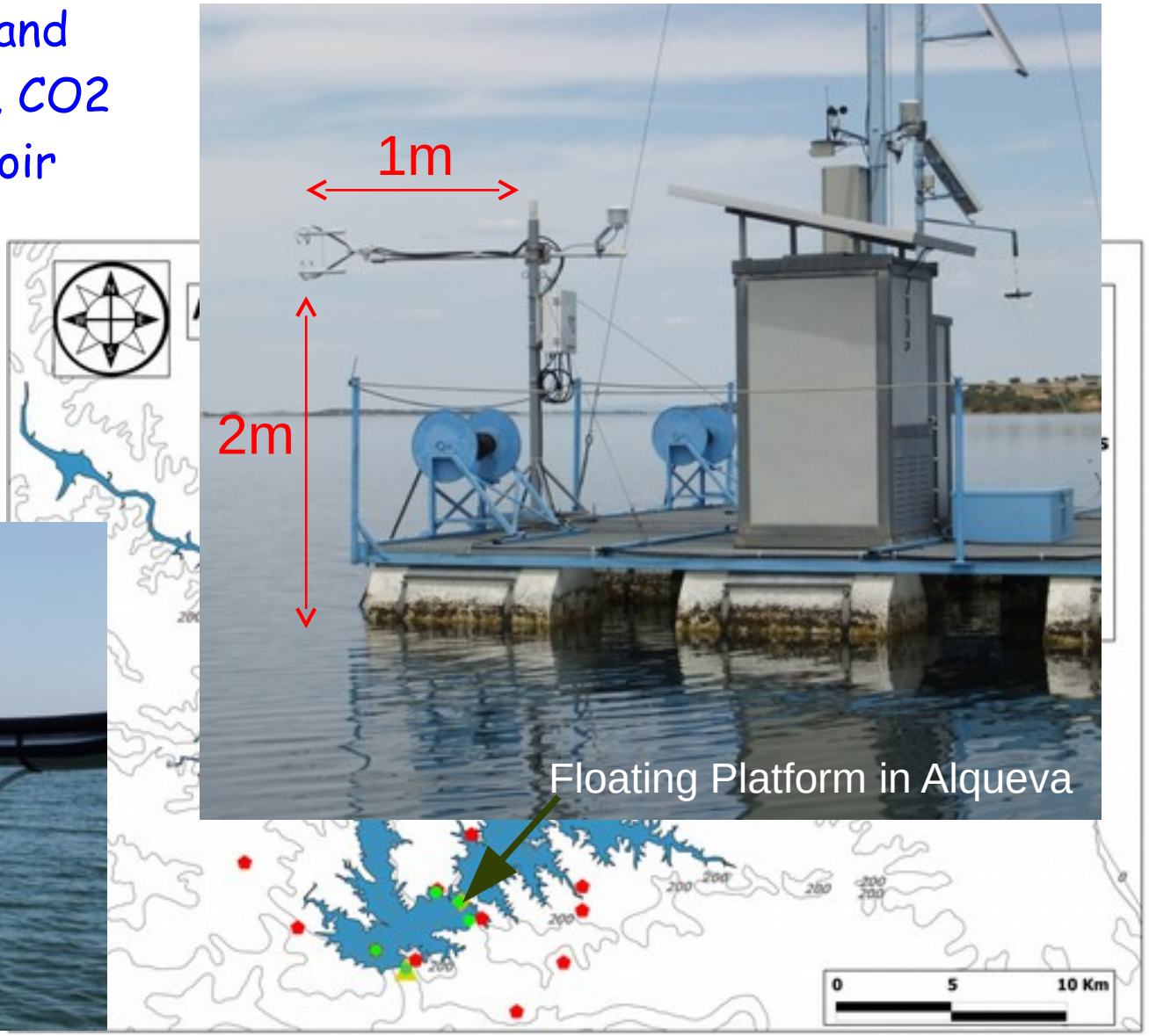
- An integrated field campaign with measurements of chemical, physical and biological parameters at different experimental sites in the Alqueva reservoir and in its surrounding region.
- With the purpose of studding the lake-atmosphere interactions
- From June to September and comprised a three days Intensive Observation Period (IOP) from 22 to 24 July.
  - Meteorological and flux measurements
  - Solar resource
  - Water quality – Chemical and phytoplankton composition
  - Inwater solar attenuation
  - Air quality - Atmospheric, aerosols and gases measurements
  - Water vapour mapping through GPS network (IOP)
  - Radiossondes with Meteorology and Atmospheric Electricity components (IOP)

Eddy covariance measurements

- Energy fluxes (radiative and sensible and latent heat), CO2 and H2O over the reservoir

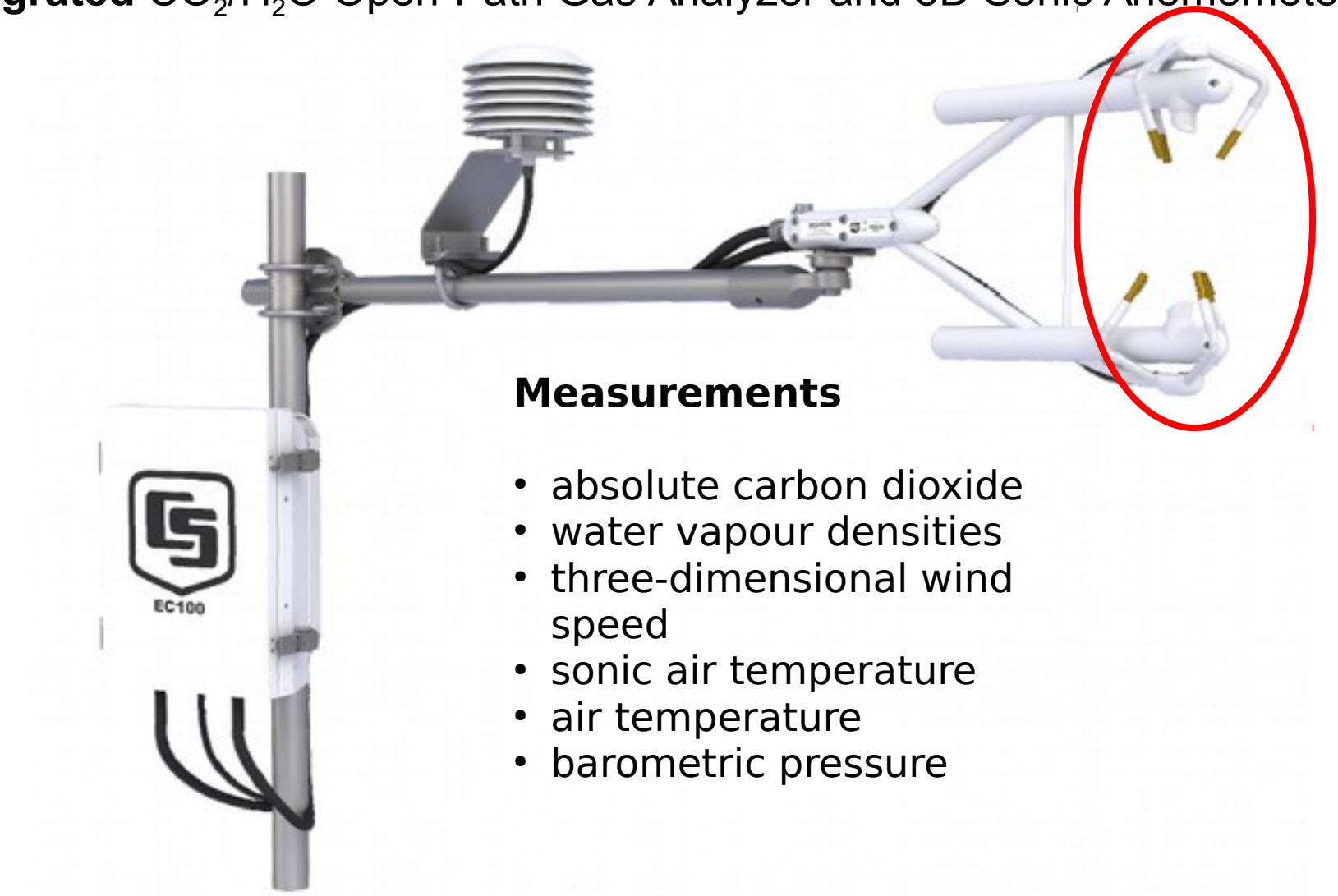
Built-in accelerometer in Waspmote board – Libelium to compute the vertical velocity of the arm





Eddy covariance system - IRGASON

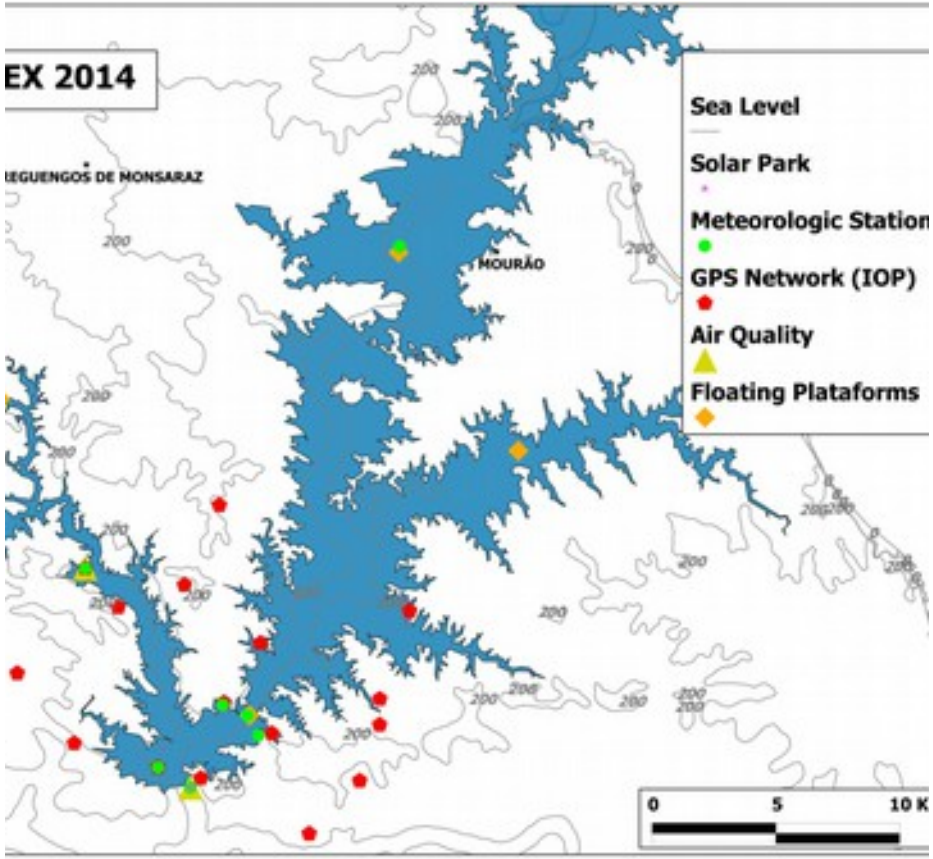
Integrated CO_2/H_2O Open-Path Gas Analyzer and 3D Sonic Anemometer



Measurements

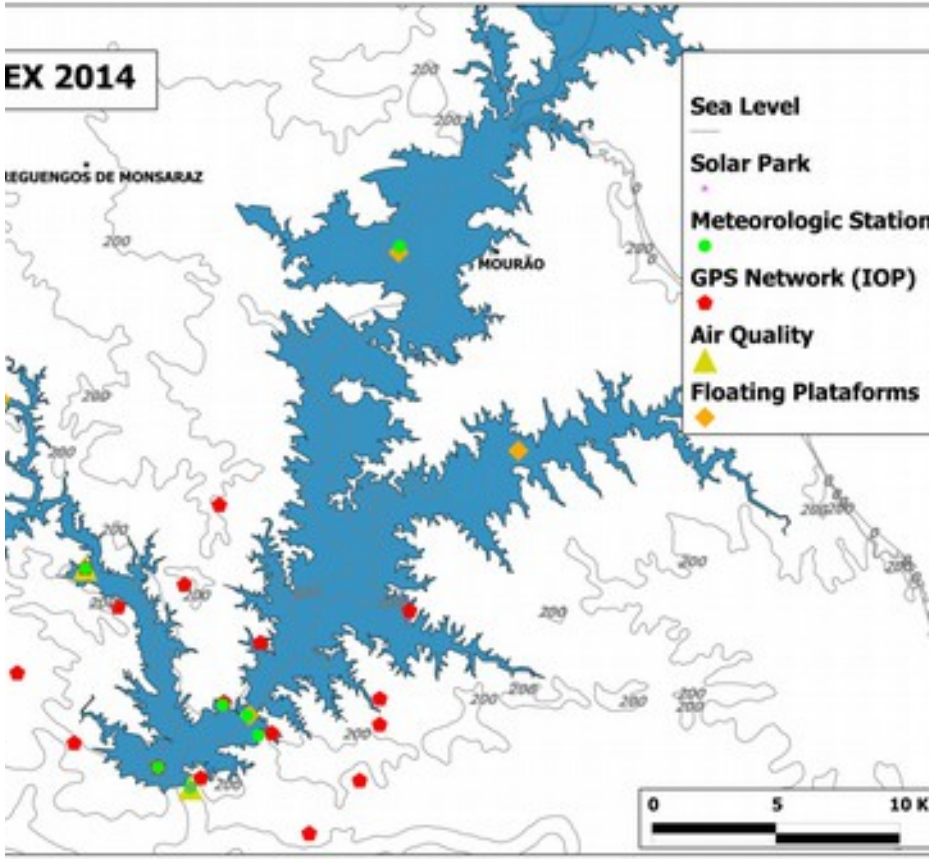
- absolute carbon dioxide
- water vapour densities
- three-dimensional wind speed
- sonic air temperature
- air temperature
- barometric pressure

Weather stations



- near surface meteorological stations: temperature, humidity, wind, precipitation and pressure.
- 7 automatic weather stations were in place
  - upwind and downwind

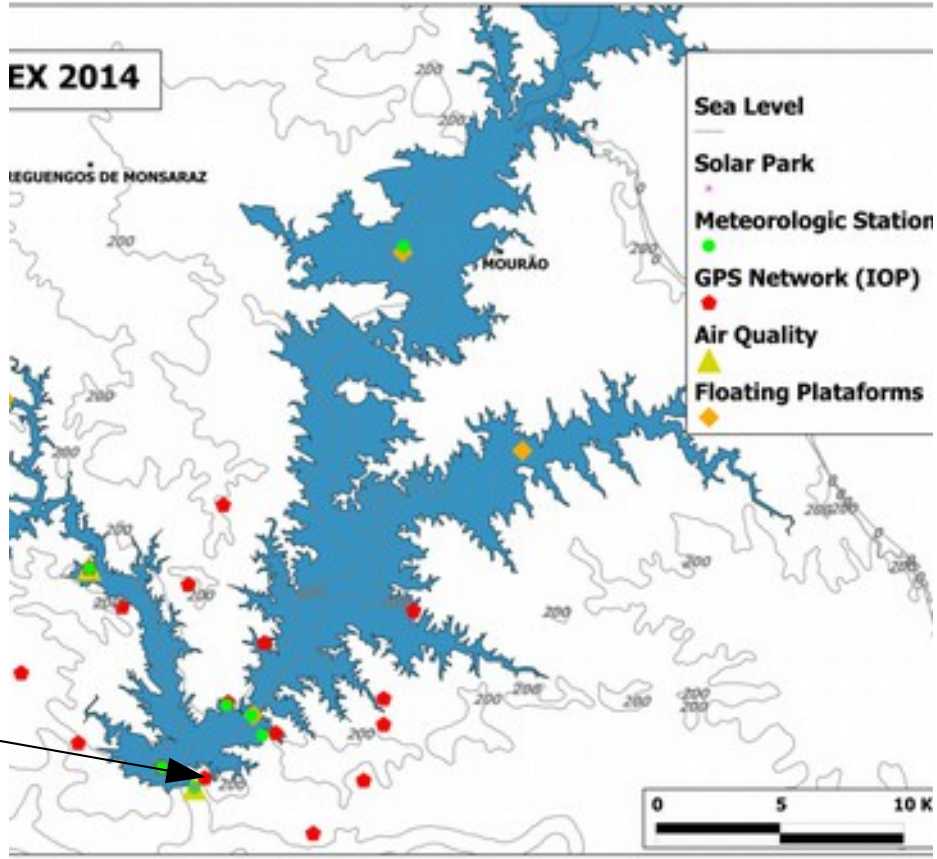
Air quality



To study the relationship between the air quality, meteorology and the electric field of the atmosphere, the Commission for Coordination and Regional Development of Alentejo (CCDR-A) provided a mobile unit with analysers of a set of gases.

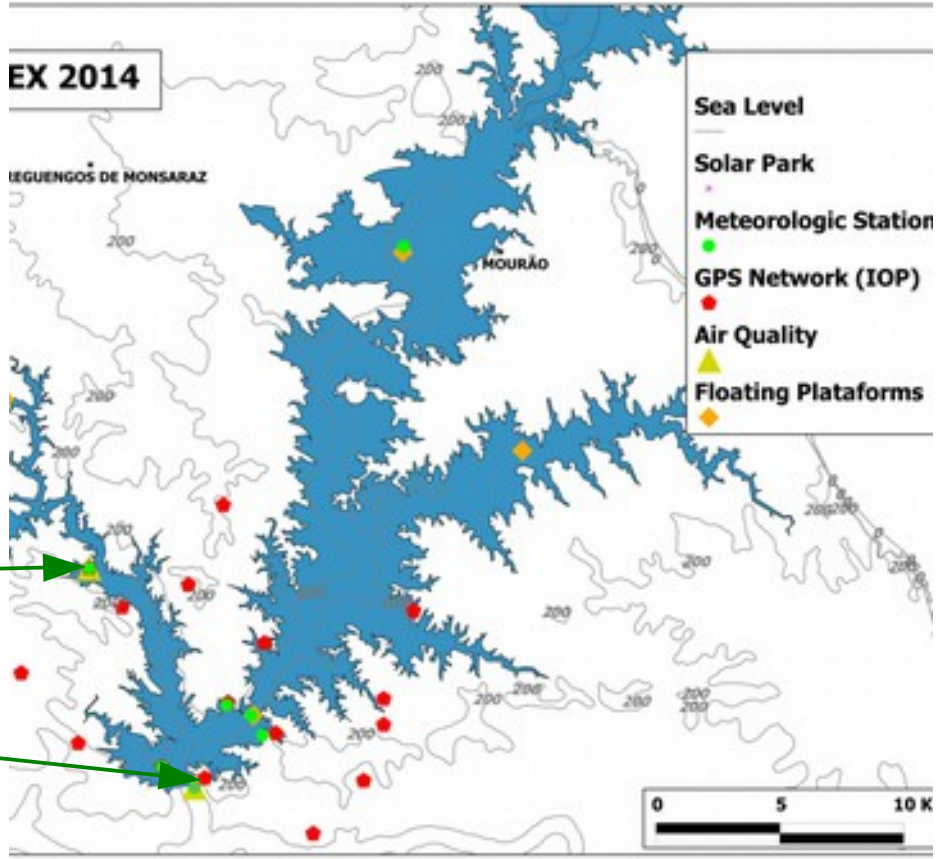
SO_2; NO; NO_2; NO_x; CO; O_3; BTEX

Solar resource: Global and Direct



Sun tracker with pyranometers:
Global, diffuse and direct solar radiation
→ Characterize the solar resource, in particular the DNI

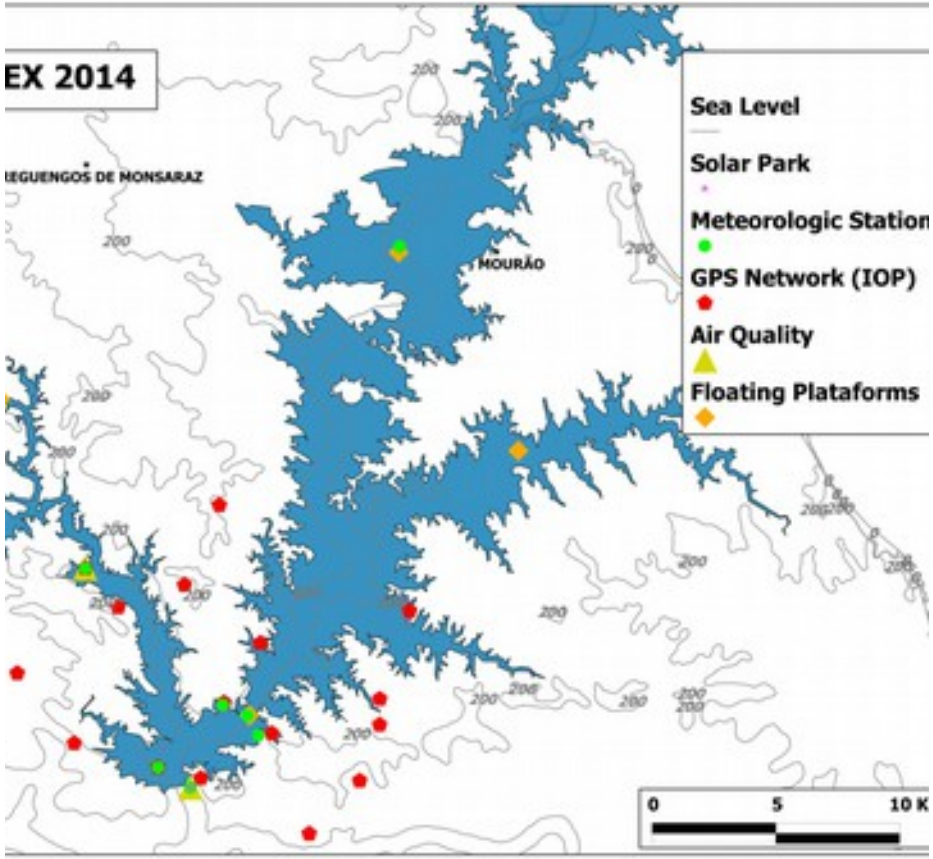
Atmospheric electric field



The ALEX2014 includes the study the Potential Gradient (PG) against the two principal ingredients influencing it at a local scale:

- ^{222}Rn: main Atmospheric-ions source
- aerosols and water droplet: main AI sink.

GPS network



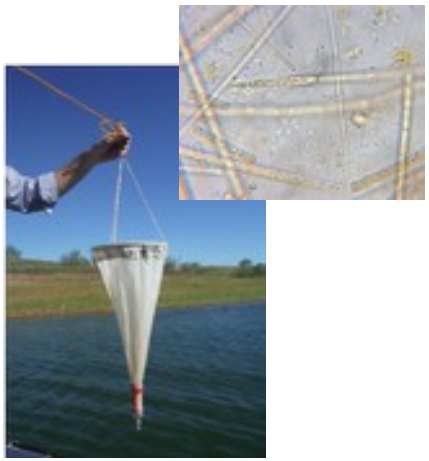
A GNSS network of 15 stations was installed, during 2 weeks campaign, in order to determine the water vapor distribution from GPS tomography

Biological Characterization

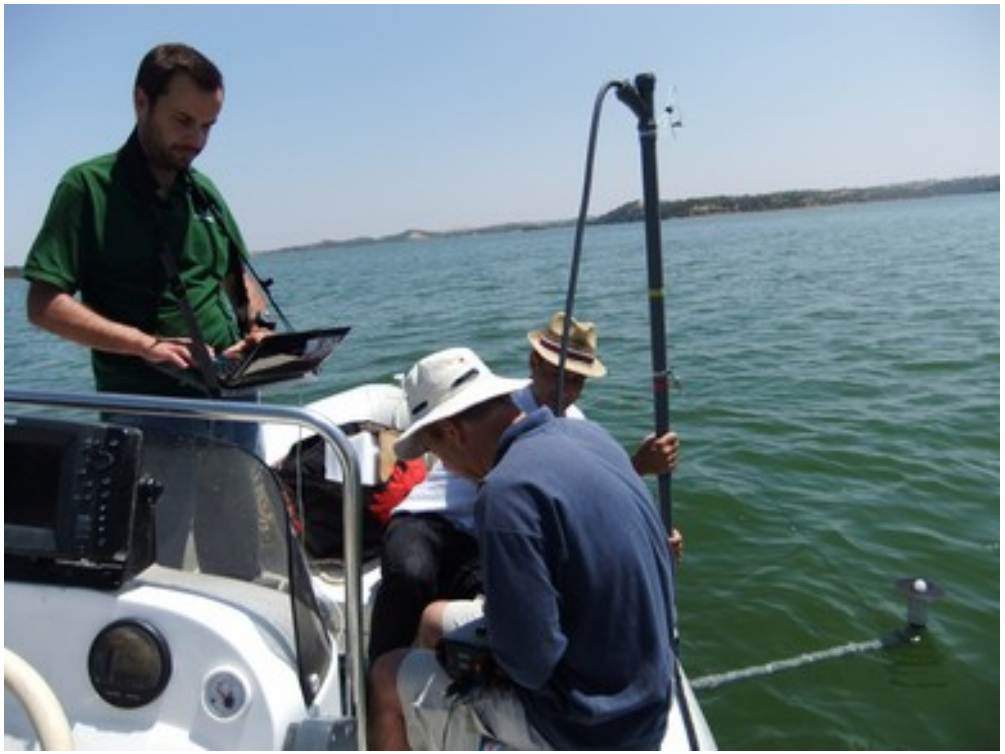
Sampling

Several observations were made on a monthly basis:

- water column profiles of dissolved oxygen (mg DO L-1 and %), pH, oxidation-reduction potential
- Biological Characterization close to lake margins: pupal exuviae collection of Diptera
- Diatoms on artificial substrates in depth + planktonic diatoms in the water column
- Microscopic and molecular characterization of cyanobacteria



Underwater irradiance system



FieldSpec UV/VNIR da ASD coupled to an optical cable and a cosine receptor

- Wavelengths between 325 – 1075 nm
- Spectral resolution of 3 nm
- 180º of FOV
- Maximum depth of 3 m

Turbidity measurements

Intensive Observation Period

ALEX2014

IOP: 22, 23 and 24 of July 2014, during which:

- 18 meteorological balloons with meteorological radiosondes were launched.
- every 3 hours

atmospheric ionization profile

- Geigersondes (Harrison et al., 2012, Reading University) were coupled to the meteorological radiosondes in order to obtain the atmospheric ionization profile
  - based on two miniature Geiger tubes
  - using a digital interface system, the radiosonde's meteorological data are also be retained.

Atmospheric characterization

- the Boundary layer were characterized with a Ceilometer

- The Vertical distribution of O3 and NO2 were obtained by the Spectrometer for Atmospheric Tracers Measurements

Sky Brightness

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DARK SKY alqueva

Alqueva is the first site in the world to receive the "Starlight Tourism Destination" certification, supported by UNESCO, UNWTO and IAC.

SQM-L model

measurements of the sky brightness with an Unihedron Sky Quality Meter

Foto: A Península Ibérica à noite, 26 de julho de 2014 ©NASA

Continuum Field Campaign

Continuum Measurements		Meteo	Radiation	Elect.	Air Qual.	Sism.	Radon	Radiosond	Hidrol.
Local									
Platform Alqueva		x	x						
Platform Mourão		x	x						
Solar Park		x	x	x	x				
Amieira Marina		x		x	x	x	x		
Herdade da Barbosa		x							
Herdade de Cid Almeida		x							
Alquilha		x	x						
Beja				x					
44 IPMA Stations		x	x						
3 ICT Stations		x							
Lisboa								x	
Hydro-electric Central EDP									x

IOP Data base

IOP Measurements	Water T. Profiles	Radiation Profiles	Water Qual.	GPS	Meteo	Ceilom	TSI (aeros.)	Radio sond	Lum.
local									
Solar Park						x	x	x	
Platform Alqueva	x	x	x						
Platform Mourão	x	x	x						
Platform Alcarrache	x	x	x						
Amieira Marina			x	x					
Herdade Barbosa				x					
Herd. Cid Almeida				x					
Amieira Village				x					
Monte das Areias				x					
Rest. Avestruz				x	x				
Canarinhos				x					
Herdade Catapral				x					
Herdade Alcarias				x					
Alquilha				x					
Monte da Pata				x	x				

Sampling

Measurements	Water quality profiles	Irradiative Profiles	Collection of water samples
local			
Platform Alqueva	X	X	X
Platform Mourão	X	X	X
Platform Alcarrache	X	X	X
Amieira			X

ALEX 2014 Database

Index of ftp://nas.cge.uevora.pt/alex2014_dados/

Up to higher level directory

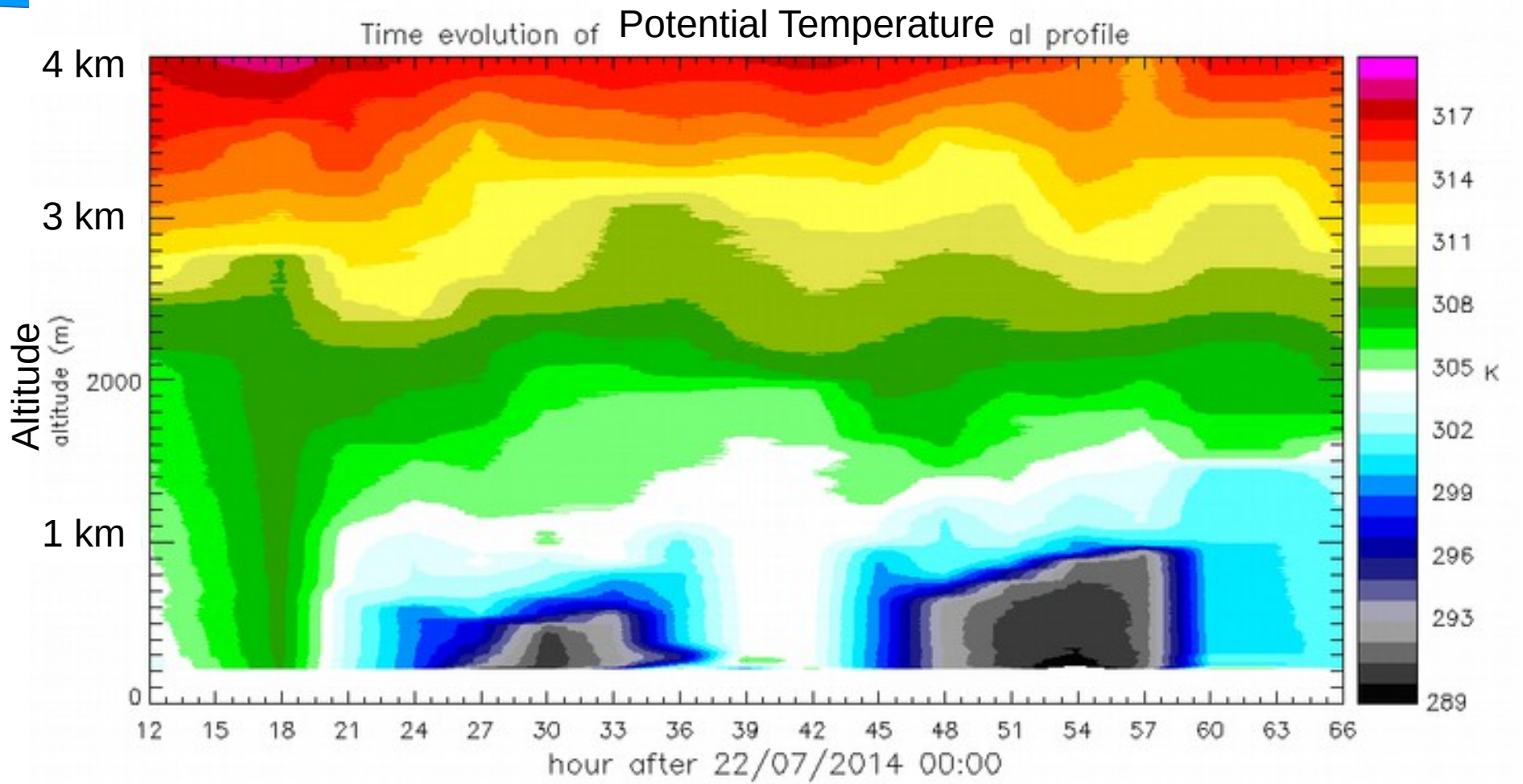
Name	Size	Last Modified
Coluna de Água		02/06/2015 03:32:00 PM
Composição da Atmosfera		02/12/2015 04:01:00 PM
Dados Espectrais (FieldSpec)		02/06/2015 02:52:00 PM
Dados Hidrológicos		02/06/2015 02:55:00 PM
Dados IRGASON		02/12/2015 03:56:00 PM
Dados Meteorológicos		02/06/2015 03:10:00 PM
Dados de Satélite		02/07/2015 03:35:00 PM
Electricidade Atmosférica		02/07/2015 03:33:00 PM
Luminosidade		02/06/2015 02:41:00 PM
Radiação Solar		02/07/2015 03:35:00 PM
Radiossondagens		02/06/2015 02:53:00 PM
Radão		02/07/2015 03:34:00 PM
Sismologia		02/06/2015 02:47:00 PM

Summary

- We presented the ALEX2014 field campaign
- More information and **Data** are available from: http://www.alex2014.cge.uevora.pt/

- **Some ongoing tasks**

IOP Atmospheric Radiosondes

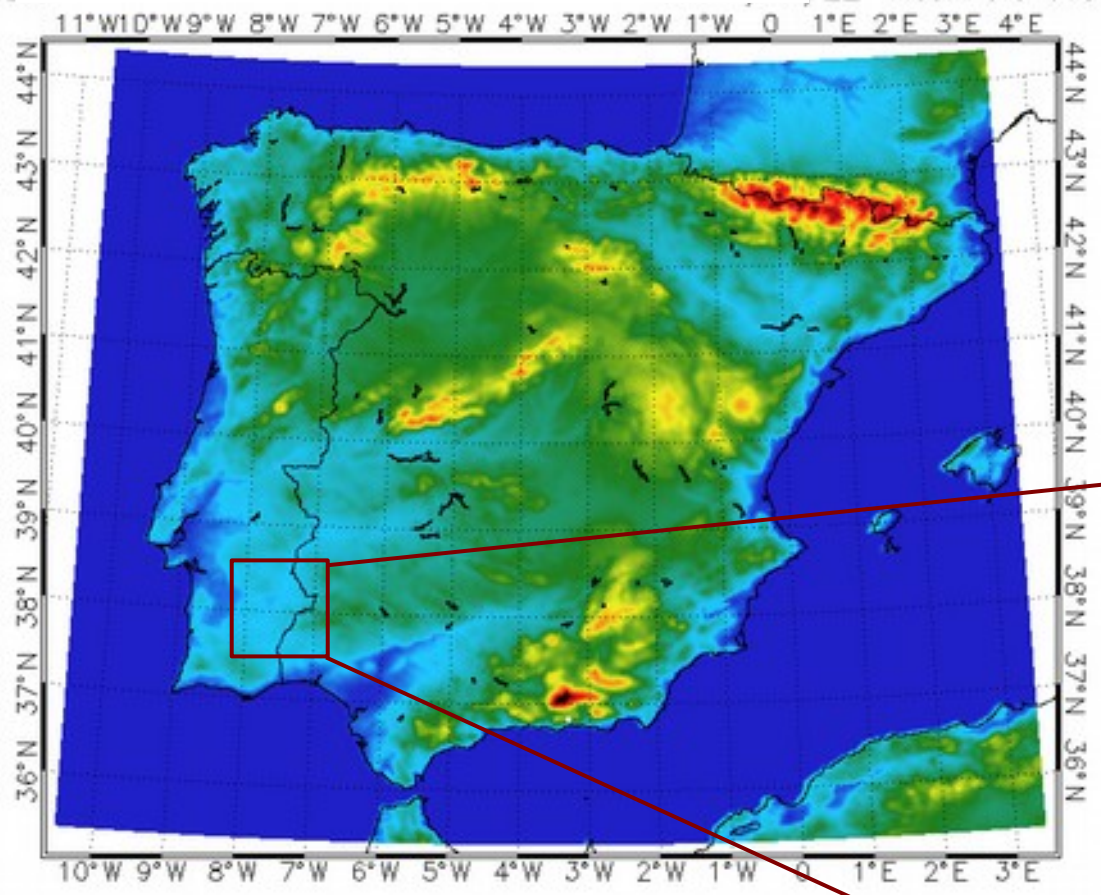


Characterization of the vertical structure and synoptic conditions

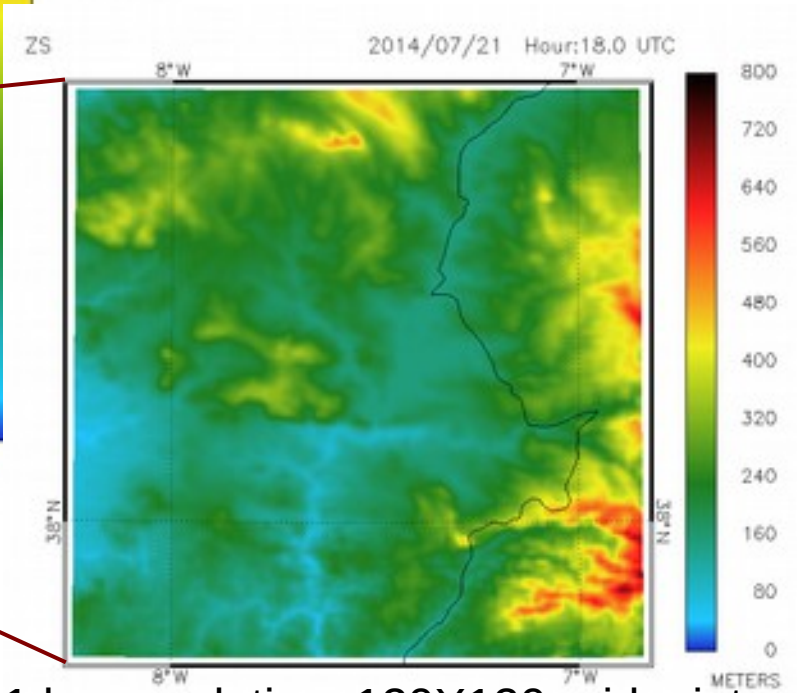
- Anticyclonic conditions
- Boundary layer well developed (more than 2500m deep in 1st day)
- Instable surface layer in the region (over land) with high values of sensible heat flux
- Near surface temperatures greater than 35ºC (1st day)

High resolution Meso-NH Simulations

4 km resolution, 300x250 gridpoints



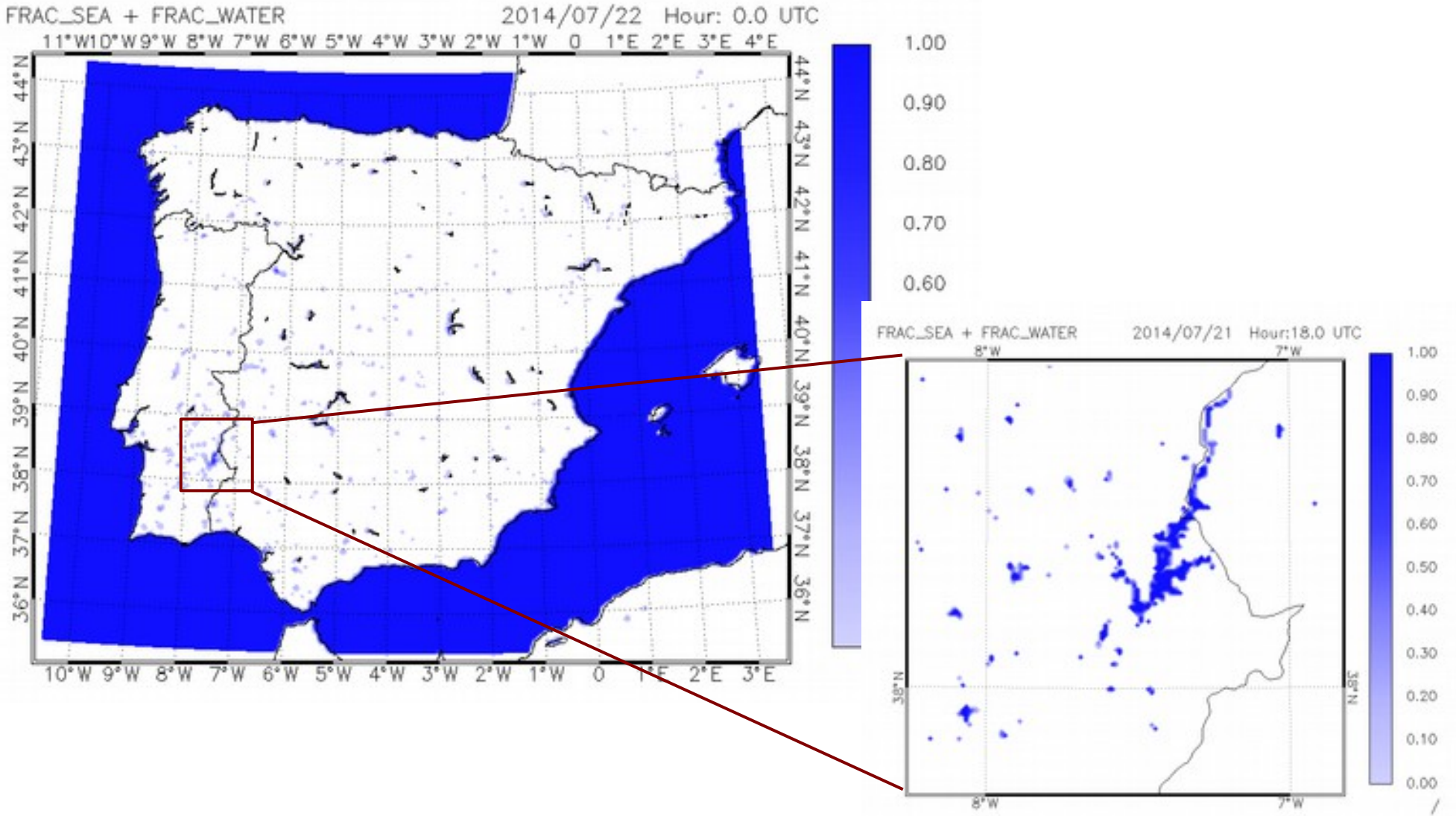
- ALEX IOP case: 22-24 July 2014
- Initialization and forcing: ECMWF
- 94 hours of simulation
- 54 vertical levels, concentrated in the BL



2 Nested Domains & Orography

1 km resolution, 120X120 gridpoints

Numerical surface water fraction



Simulation results: Examples

22/07/2014
18 TU

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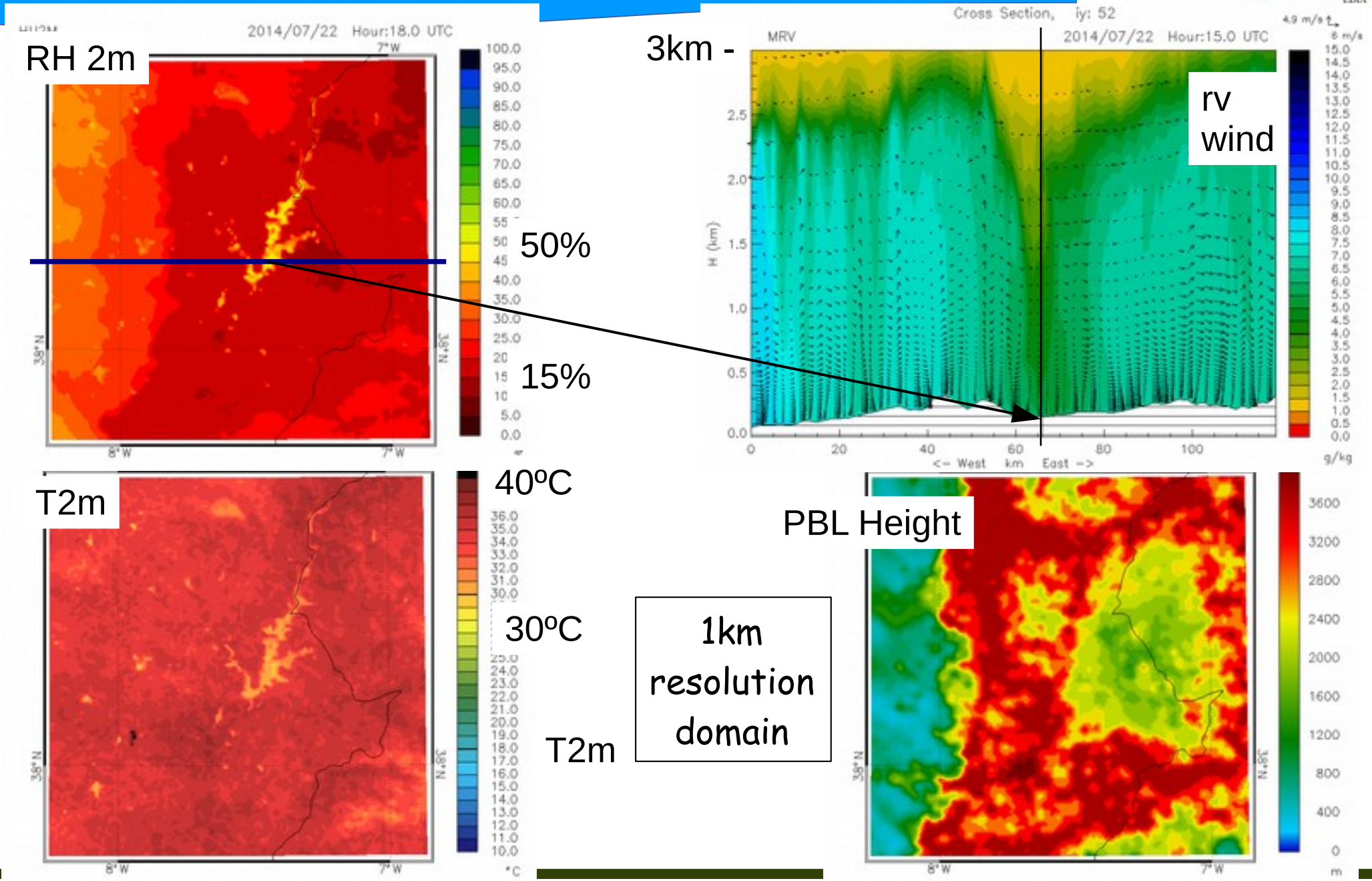

Thank you

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