UNIVERSITY OF TRENTO

Department of Civil, Environmental and Mechanical Engineering

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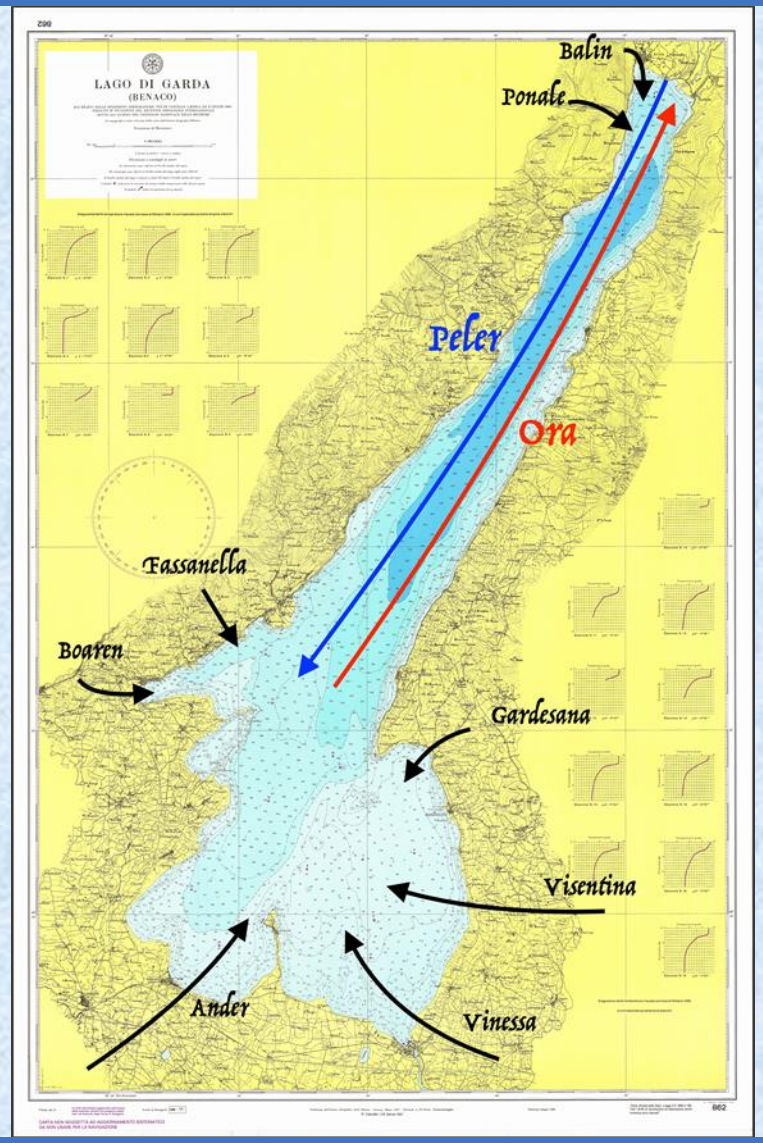
The use of Local Knowledge to reconstruct physical processes in Lake Garda

UNIVERSITÀ DEGLI STUDI DI BRESCIA

UNIVERSITÀ CATTOLICA del Sacro Cuore

Rocca di Manerba del Garda
RISERVA NATURALE
PARCO LACUALE
MUSEO ARCHEOLOGICO

INTRODUCTION



METEOROLOGICAL MODEL

WRF

HYDRODYNAMIC MODEL

DELFT3D

REMOTE SENSING

LOCAL KNOWLEDGE

FIELD MEASUREMENTS

VERTICAL PROFILE

VELOCITY

KEY POINTS

- Compare the information provided by the LK with the results of the numeric model
- Examine the surface flow field and transport processes with a Lagrangian model
- Evaluate the contribution of LK in a scientific approach

→

- Comparison between Delft3D output and LK information
- Realization of Lagrangian model for surface transport

WHY IS «LOCAL KNOWLEDGE» USEFUL ?

PNAS

Contributions of local knowledge to the physical limnology of Lake Como, Italy

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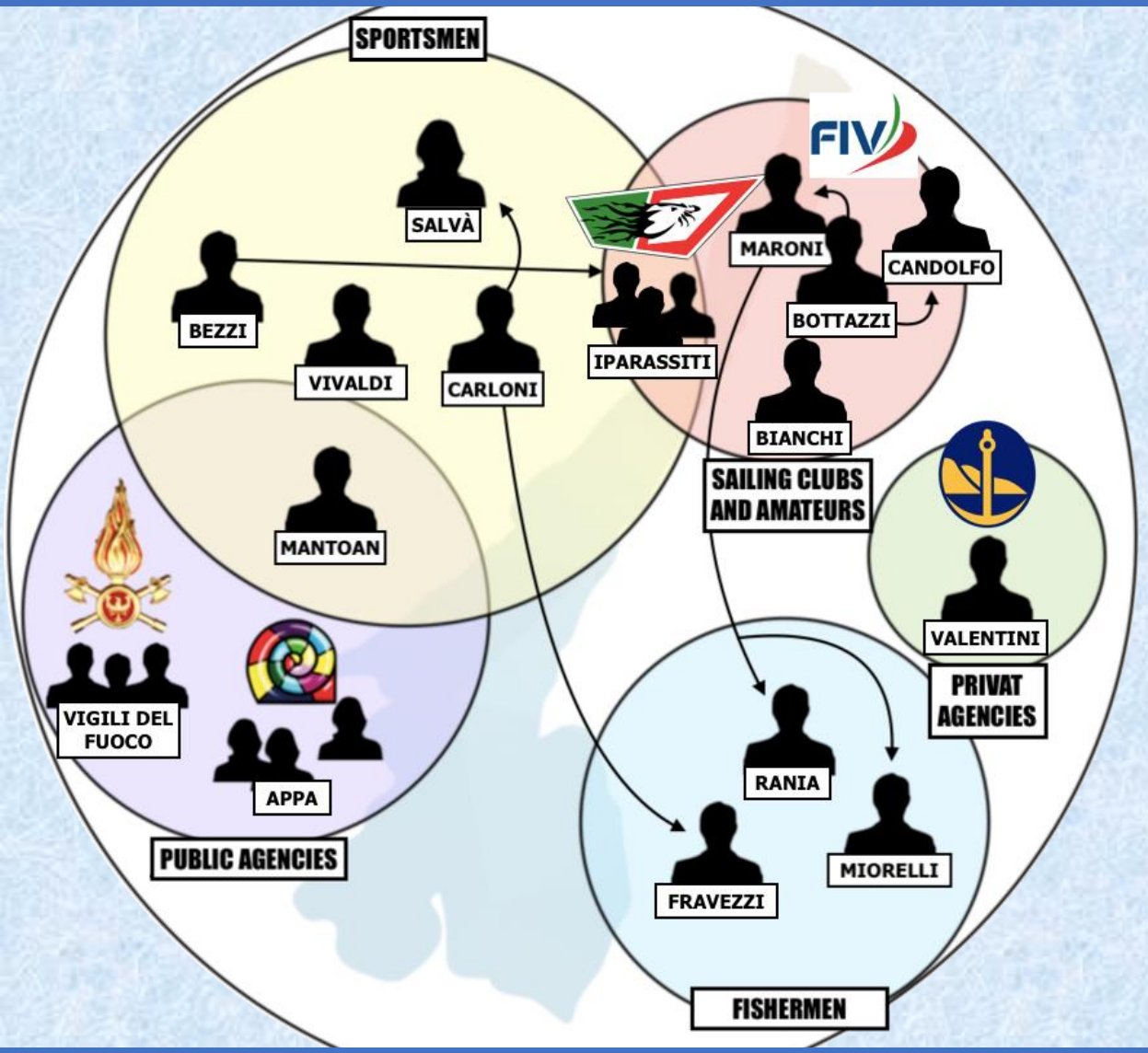
Edited by* E. Ronald Oxburgh, University of Cambridge, United Kingdom, and approved February 13, 2012 (received for review August 31, 2011)

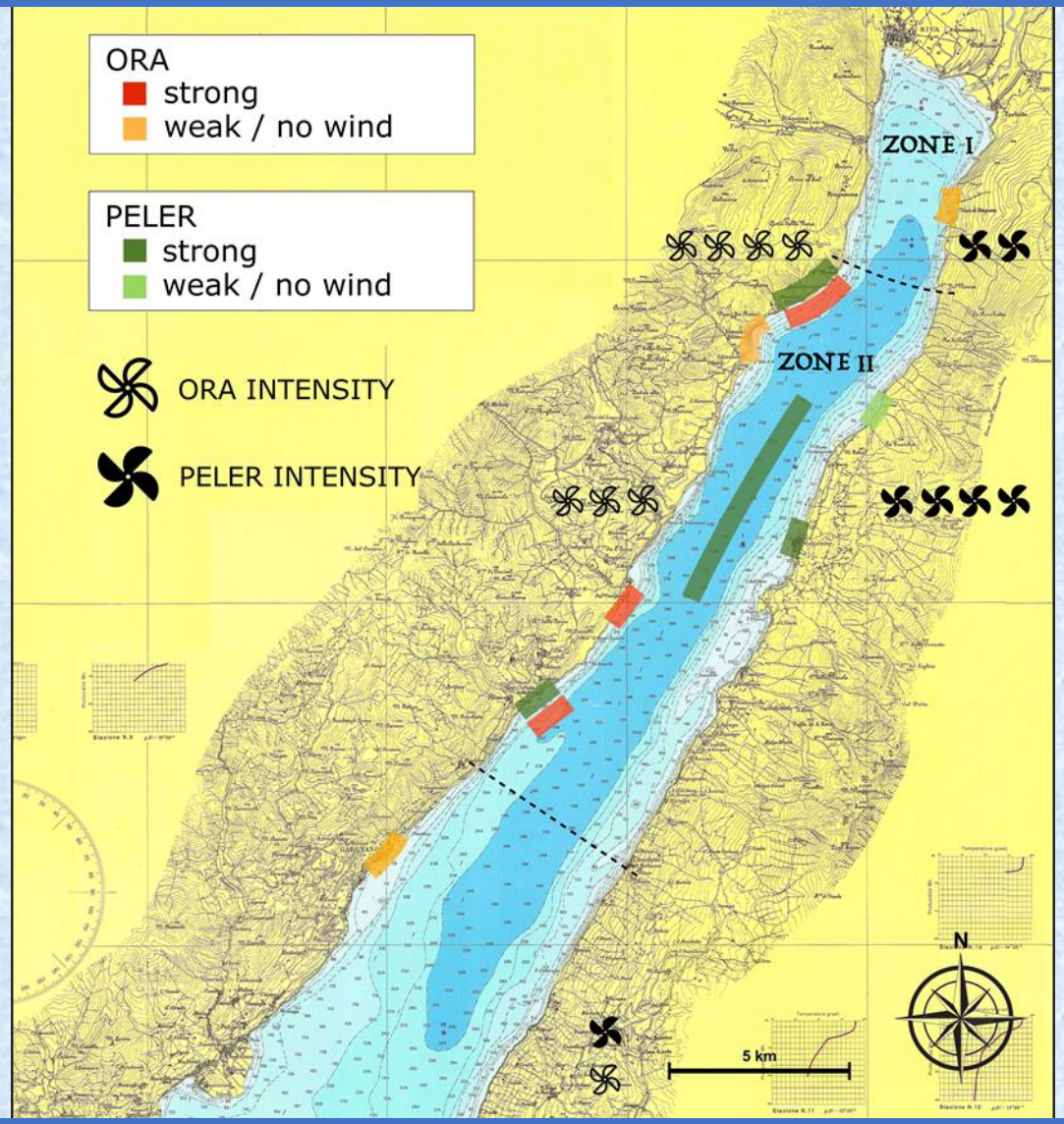
1. UTILITY PROVED IN PAST STUDIES
2. INFORMATION IS CONTINUOS IN SPACE AND TIME
3. NEW POINT OF VIEW: DISCOVERY OF UNKNOWN PHENOMENA
4. INDEX OF TERRITORY TRASFORMATION

METHODS

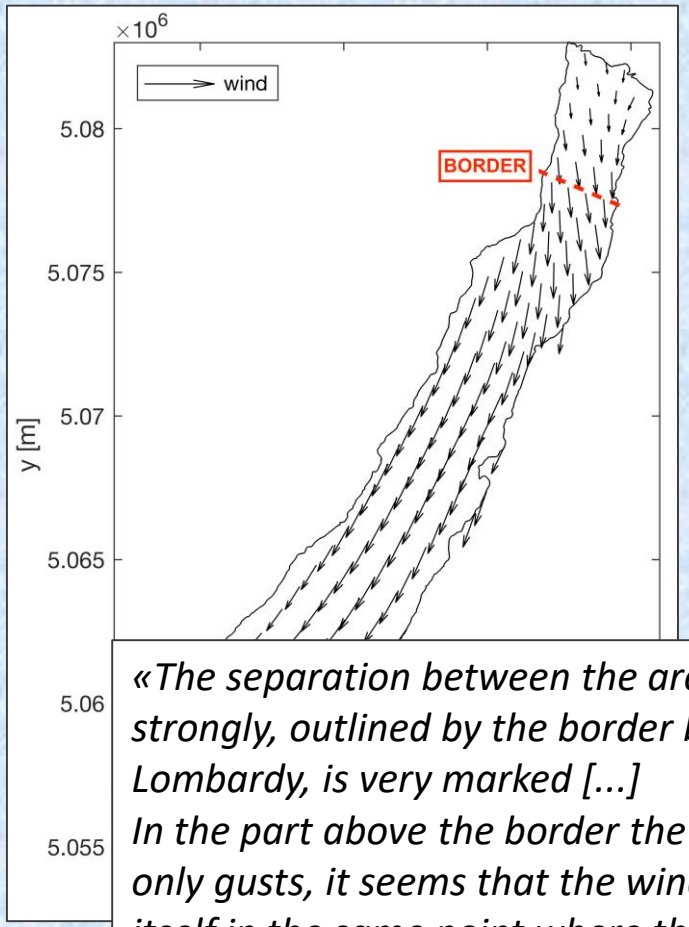


LOCALITY	NUMBER OF RESPONDENTS
TRENTO	7
RIVA	7
TORBOLE	1
CASTELLETTO	2
DESENZANO	2
TOTAL	**19**

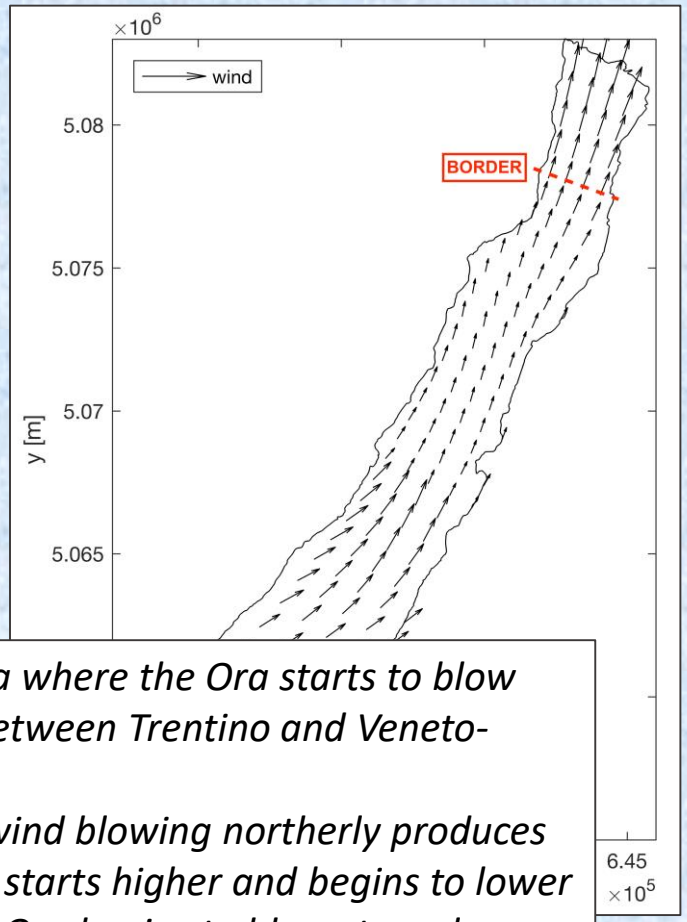
WIND FIELD



PELER

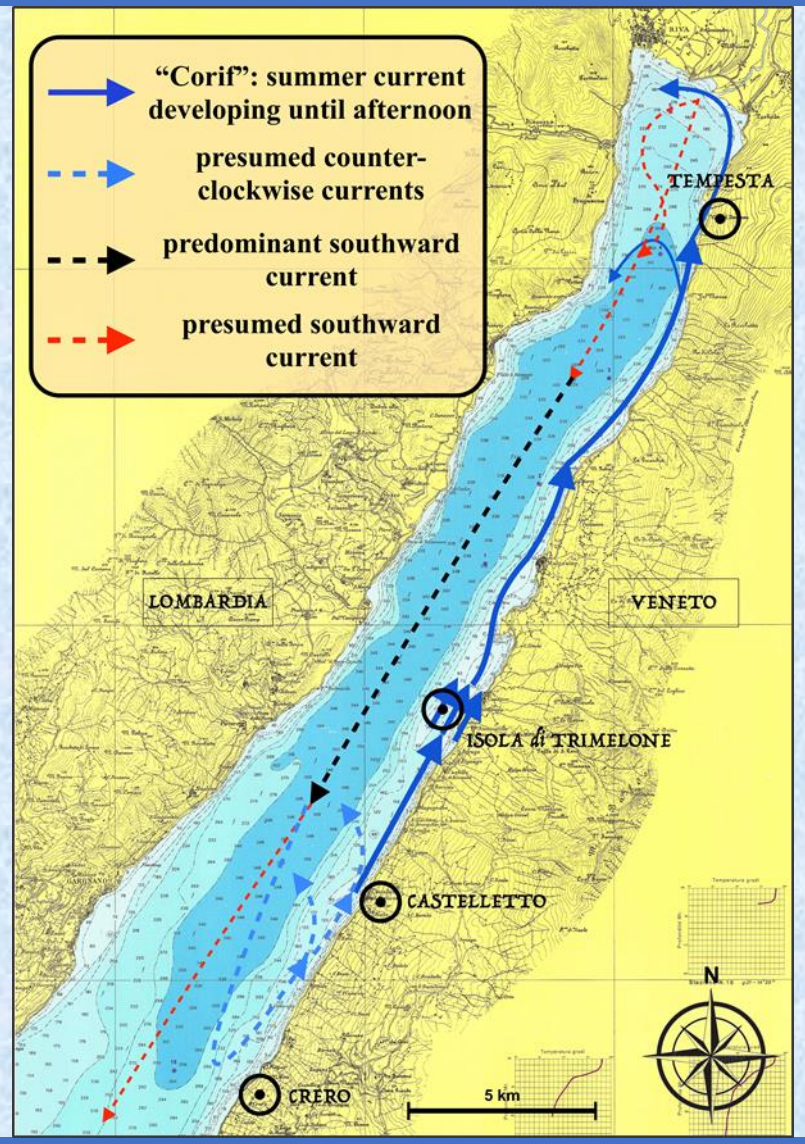


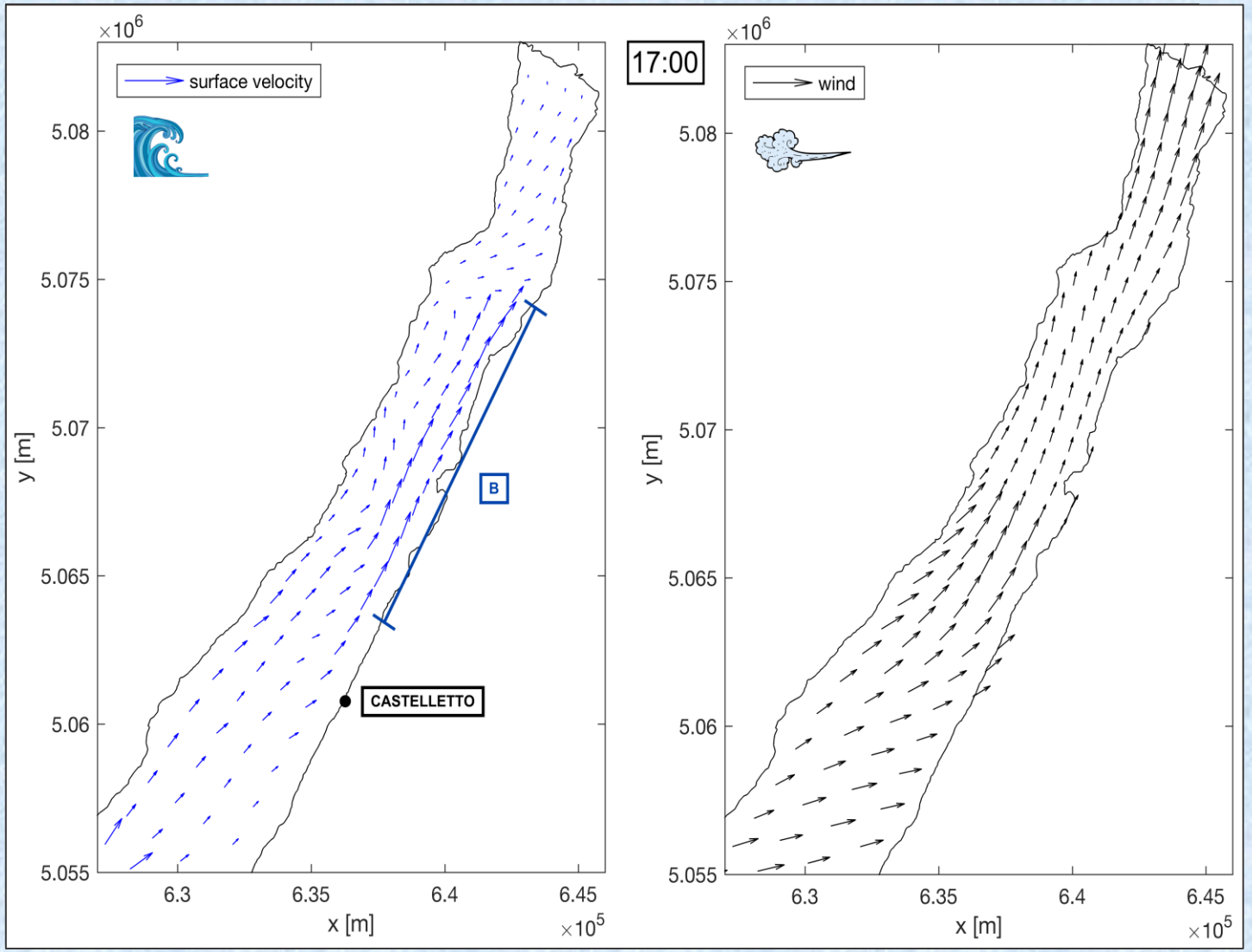
ORA



«The separation between the area where the Ora starts to blow strongly, outlined by the border between Trentino and Veneto-Lombardy, is very marked [...]
In the part above the border the wind blowing northerly produces only gusts, it seems that the wind starts higher and begins to lower itself in the same point where the Ora begins to blow strongly.

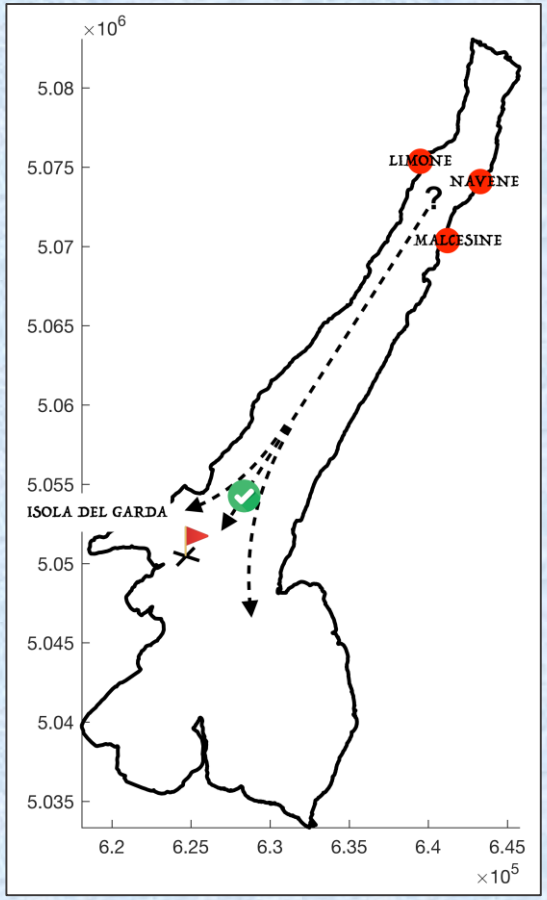
CURRENT PATTERNS





CASE STUDIES

1 VESSEL CAPSIZING

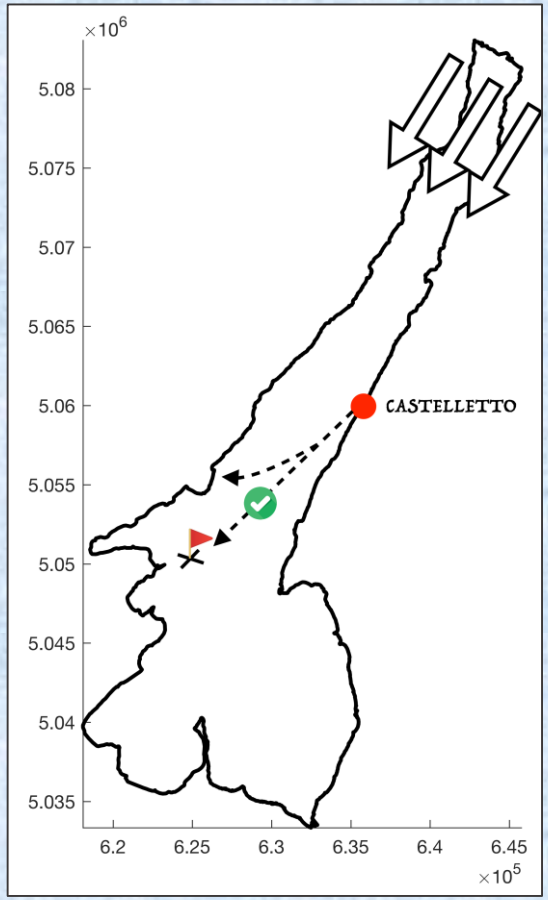


WHEN : 6.8.2017, 11.30-12.30

WHERE : LIMONE-NAVENE-MALCESINE

LOCATED ON «ISOLA DEL GARDA» 2 DAYS LATER

2 JOURNEY OF THE «VERONICA»



WHEN : NORTHERLY WIND > 10 m/s

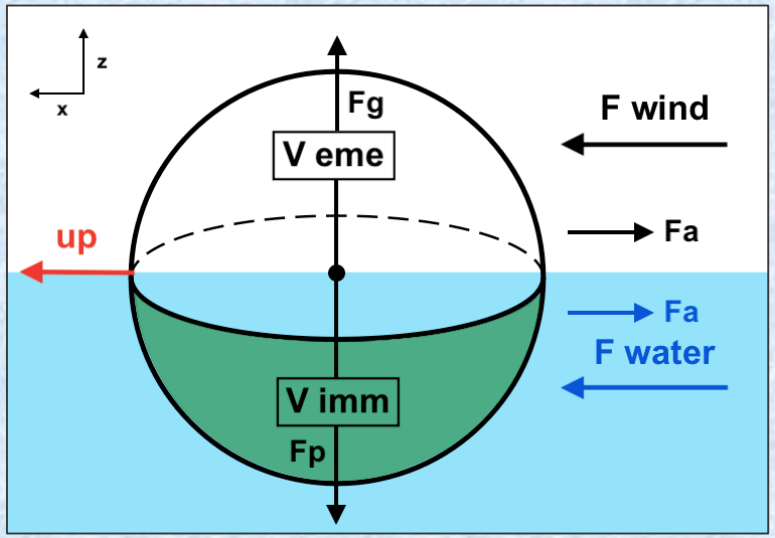
WHERE : CASTELLETTO DI BRENZONE

LOCATED ON «ISOLA DEL GARDA» 4-5 HOURS LATER

LAGRANGIAN MODEL

DELFT3D

MATLAB®



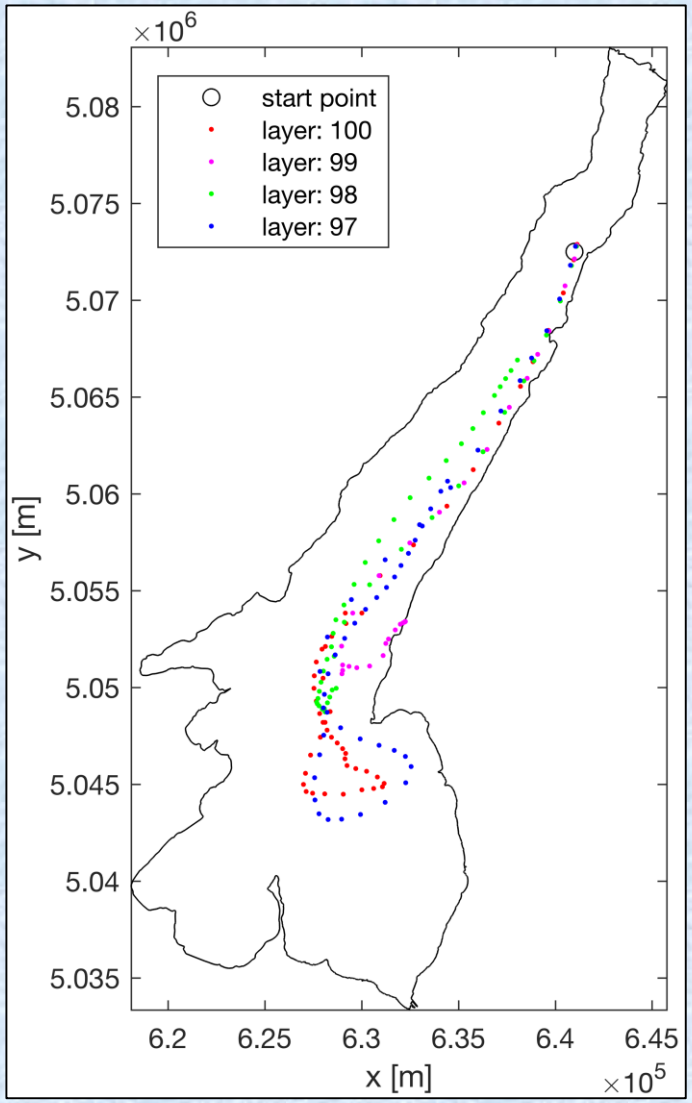
$$a = \frac{1}{m_s} \cdot (F_{water} + F_{air})$$

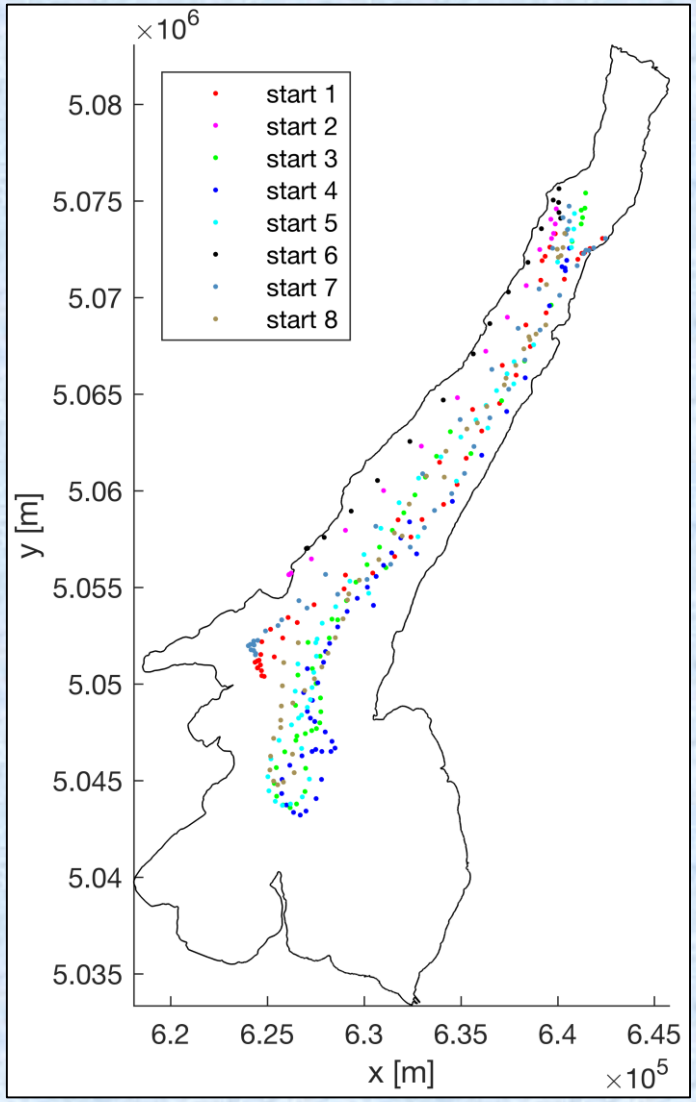
$$\begin{cases} \bar{F}_{water} = -m_s \cdot k_{water}(\bar{u}_p - \bar{u}_f) \\ \bar{F}_{wind} = -m_s \cdot k_{wind}(\bar{u}_p - \bar{u}_w) \\ k_{water} = -\frac{1}{2m_s} \cdot \rho_{water} \cdot C_{D,water} \cdot A_{imm} \cdot |\bar{u}_p - \bar{u}_f| \\ k_{wind} = -\frac{1}{2m_s} \cdot \rho_{air} \cdot C_{D,air} \cdot A_{eme} \cdot |\bar{u}_p - \bar{u}_w| \end{cases}$$

$$\frac{d\bar{u}_p}{dt} = -k_{water}(\bar{u}_p - \bar{u}_f) - k_{wind}(\bar{u}_p - \bar{u}_w)$$

INPUT
SIZE
IMMERSION RATIO
COEFFICIENT OF DRAG
LAYER
START POSITION
DEPARTURE TIME

SENSITIVITY ANALYSIS





High dependency on:

- **Immersion ratio**
- **Start position**

Low dependency on:

- **Size of the boat**
- **Departure time**

RESULTS OF THE LAGRANGIAN MODEL: CASE I

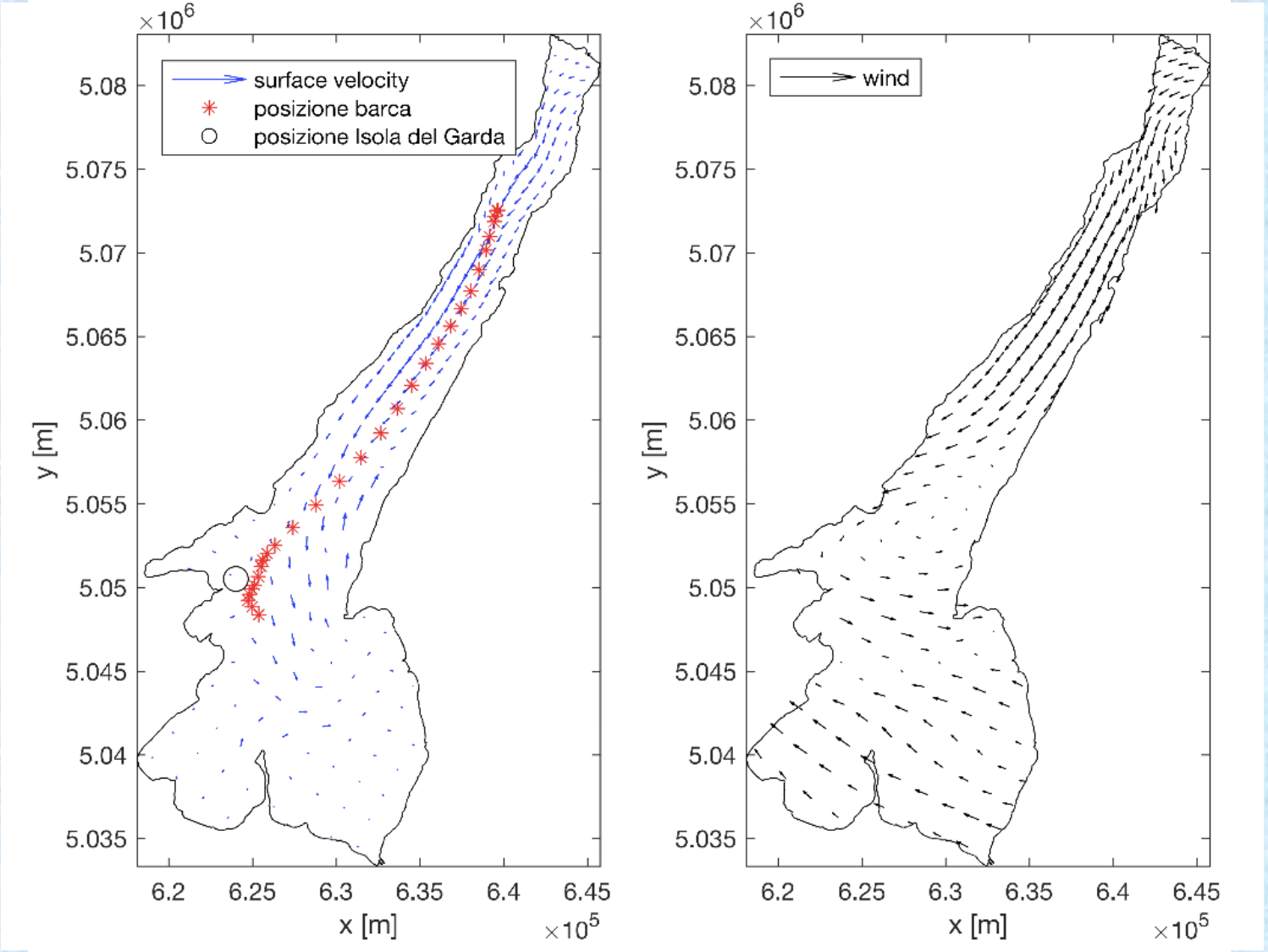
Departure time: 6.8.2017, 15:00

Radius	[m]	2
Drag coefficient	[-]	0.47
Immersion ratio	[-]	0.6

Velocity [m/s]	min	max	mean
Corrente	0.05	0.81	0.42
Vento	1.68	12.34	8.08
Barca	0.14	1.16	0.60

Distance: 27 km

Duration: 13 h



RESULTS OF THE LAGRANGIAN MODEL: CASE II

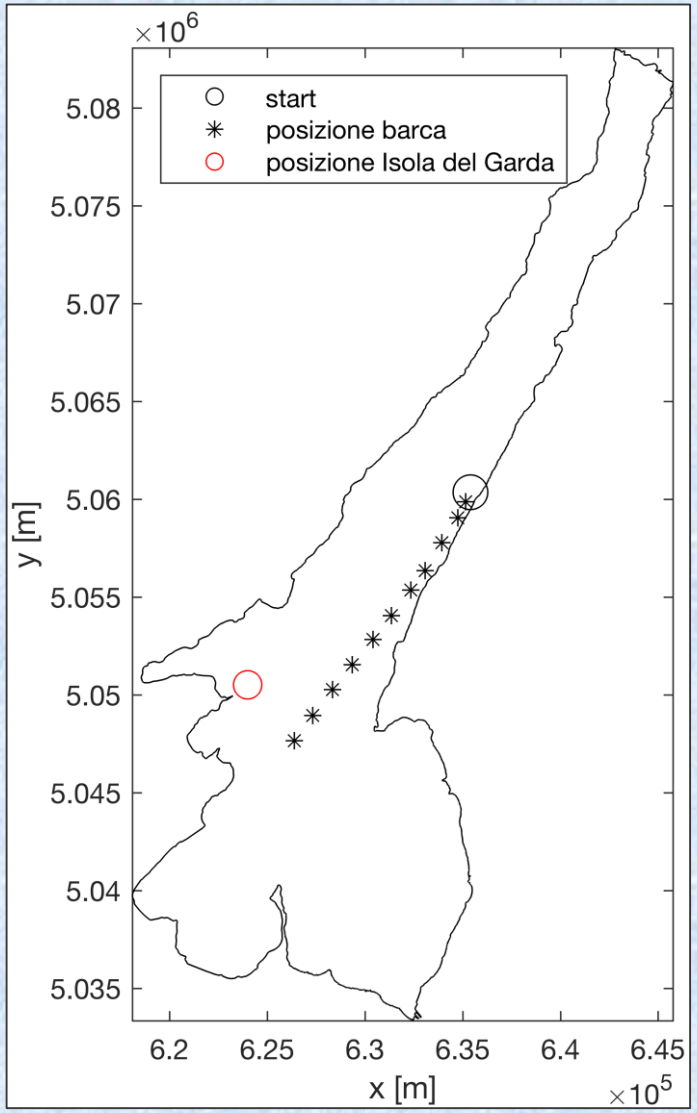
Departure time: 6.8.2017, 17:30

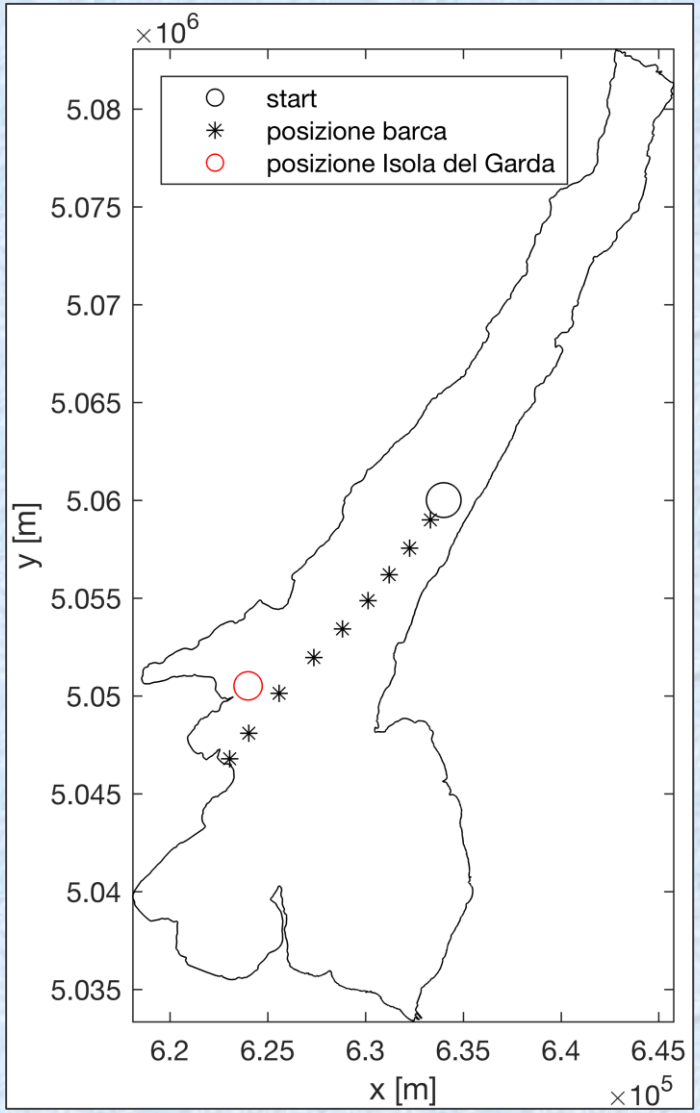
Radius	**[m]**	**2**
Drag coefficient	**[-]**	**0.47**
Immersion ratio	**[-]**	**0.6**

Velocity [m/s]	min	max	mean
Corrente	**0.26**	**0.65**	**0.53**
Vento	**9.41**	**14.92**	**11.71**
Barca	**0.49**	**1.23**	**0.90**

Distance: 16 km

Duration: 4-5 h





CONCLUSIONS

VALIDATION OF SUPERFICIAL FLOW (NORTH LAKE)

IMPLEMENTATION OF A SIMPLE LAGRANGIAN MODEL

COLLECTION OF NEW SUGGESTIONS FOR FUTURE INVESTIGATIONS


Thank you
for your attention !
Torbole, 6.12.2017