LIC – Laboratorio di Ingegneria Costiera (Coastal Engineering Laboratory)

Michele Mossa

POLITECNICO DI BARI
DICATECh - Dpt. of Civil, Environmental, Building Engineering and Chemistry
Professor of Hydraulics
Chief Scientist of the LIC (Coastal Engineering Laboratory)
michele.mossa@poliba.it
www.michelemossa.it
www.iahrmedialibrary.net

LIC – Coastal Engineering Laboratory of the DICATECh - Dpt. of Civil, Environmental, Land, Building Engineering and Chemistry of the Polytechnic University of Bari (Italy)

Coastal Engineering Laboratory funded by Programma Operativo Plurifondo Puglia

D.R. 29/10/90 n. 6155, cofinanced with structural funds CEE-REG.

CEE n. 20522/68 e 4253/88, Sottoprogramma 6, Misura 6.3

3D WAVE BASIN

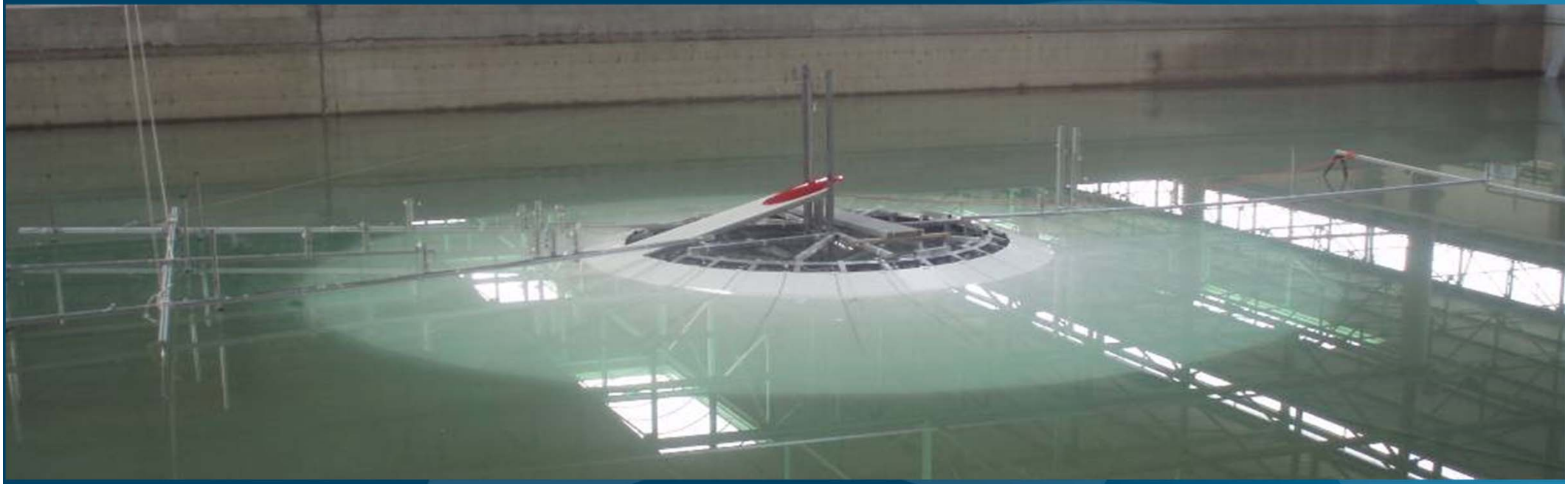
Width=50 m; length=100m; depth=1.2 m.

3D wavemaker:

- Number of modules = 6
- Number of paddles = 8
- Paddle width = 60 cm
- Max wave front length = 28.8 m
- Hmax=30 cm

OFF-SHORE PHYSICAL MODEL BASIN

Width=50 m; length=30 m; depth=3 m



National Interest Research Program approved with D.M. N. 174/2004.
TSUNAMI WAVES GENERATED BY LANDSLIDES IN WATER: MECHANICS OF WAVE GENERATION AND PROPAGATION, DEVELOPMENT OF FORECASTING TOOLS AND REAL-TIME WARNING SYSTEMS BASED ON TIDAL MEASUREMENTS. The photo shows a tsunami scenario generated by landslide at Sciarra del Fuoco (Stromboli island). The physical model was constructed at the LIC of the Technical University of Bari.

OFF-SHORE PHYSICAL MODEL BASIN

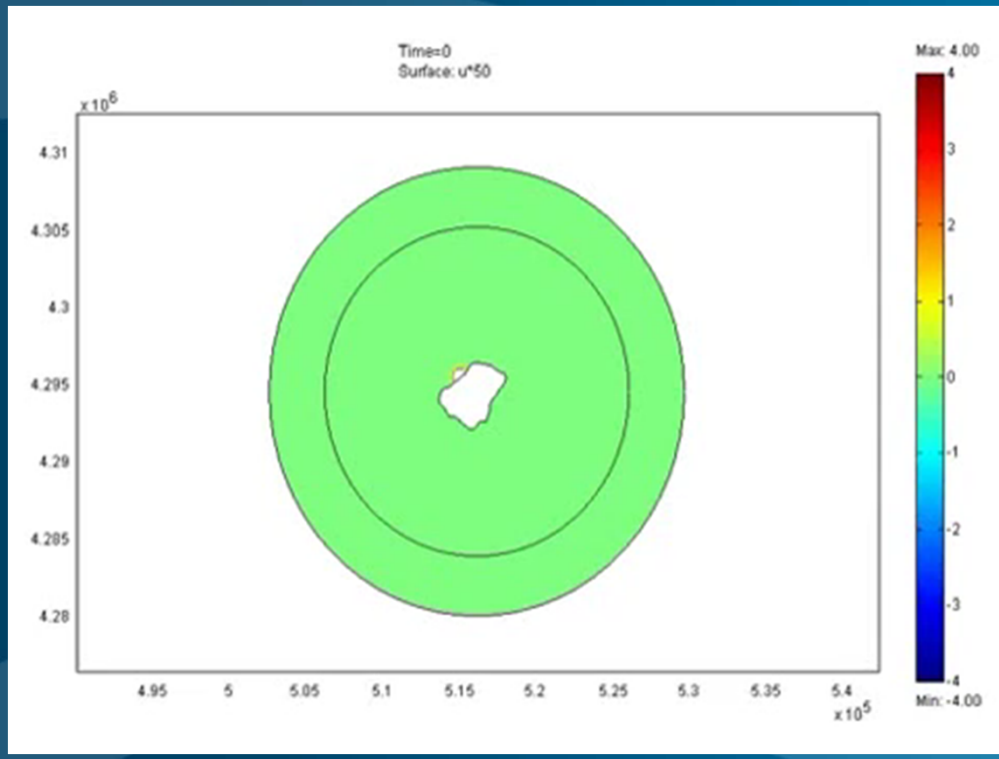
The movies show the tsunami of December 2002 around the Stromboli island and then its physical model at the Coastal Engineering Laboratory (LIC) of Bari technical University (Italy). The research program was aimed at improving the knowledge of tsunami waves hydraulics generated by landslides. The generation process, the wave propagation, the interaction with the boundary of the domain of interest, focusing on wave run-up and overtopping will be studied in details.

OFF-SHORE PHYSICAL MODEL BASIN

For further details, please visit the web site IAHR MEDIA LIBRARY http://www.iahrmedialibrary.net

The IAHR Media Library is a web resource for the storage and dissemination of photographic, animated and video material relating to hydraulics, hydrology and water resources including: photos of technical interest, films of technical interest, other similar material, with brief technical descriptions, an adequate classification system, an identification of technical areas. All these materials are analyzed, categorized and archived.

OFF-SHORE PHYSICAL MODEL BASIN



For further details, please visit the web site IAHR MEDIA LIBRARY http://www.iahrmedialibrary.net

The generation process, the wave propagation, the interaction with the boundary of the domain of interest, focusing on wave run-up and overtopping will be studied in details. Tsunami waves are non periodic water free surface perturbations of high period; they are able to produce disasters when reaching the coast or the structures. Focusing on what happened in Italy in the last 100 years three occurrence of tsunami are worth to be mentioned. These are the tsunami that in 1908 killed 120.000 people at Messina, the Vajont dam disaster (2.000 people killed) and the very recent tsunami (December 2002) around the Stromboli island. Vertical landslide generated wave SPH numerical modeling The forecasting of tsunami and of their effects need joint efforts in the fields of geophysics, geology, geothechnics and hydraulics. As far as the Italian research is concerned only few, although valuable, contributions have been provided in the last years in the field of hydraulics. To improve the knowledge on this important topic, since 1998, thanks to the funding of the National Dams Authority of the Italian Government, researchers of the University of L'Aquila, University of Roma TRE, Tor Vergata and "La Sapienza", started to study tsunami waves. Experimental, numerical and analytical studies have since now been carried out in order to provide practical tools for wave parameters forecasting. The present program originates from the experience on this important field and from the need of further developing the studies carried out until now. More specifically the research will aim at developing simple formulae based on experimental results, able to forecast wave parameters, wave run-up and wave overtopping. Numerical models shall be developed in order to simulate the hydrodynamics of the near-field (using a three-dimensional SPH model) and the flow in the far-field (three depth-integrated models shall be developed).

Two wave channels

Width=2.4 m; length=50 m; depth=1.2 m.

2D wavemaker:

- Number of modules = 1
- Number of paddles = 4
- Paddle width = 60 cm
- Wave front length = 2.4 m
- Hmax=30 cm

WAVE MECHANICS AND COASTAL DEFENSE

Experimental research of different regular and irregular waves breaking on a sloping bottom. The investigation refers particularly to the surf zone, with the aim to develop two themes: the study of velocity and Reynolds shear stress distributions in the shoaling zone of regular and irregular wave fields and the study of turbulence in the breaking region, observing that these two aspects greatly influence many coastal processes, such as undertow currents, sediment transport and action on maritime structures. The experimental data are compared with numerical results obtained with codes such as FUNWAVE and SPH.

Some references:

De Serio F, Mossa M (2016). Assessment of classical and approximated models estimating regular waves kinematics. OCEAN ENGINEERING, vol. 126, p. 176-186, ISSN: 0029-8018

De Padova D, Dalymple R A, Mossa M (2014). Analysis of the artificial viscosity in the smoothed particle hydrodynamics modelling of regular waves. JOURNAL OF HYDRAULIC RESEARCH, ISSN: 0022-1686

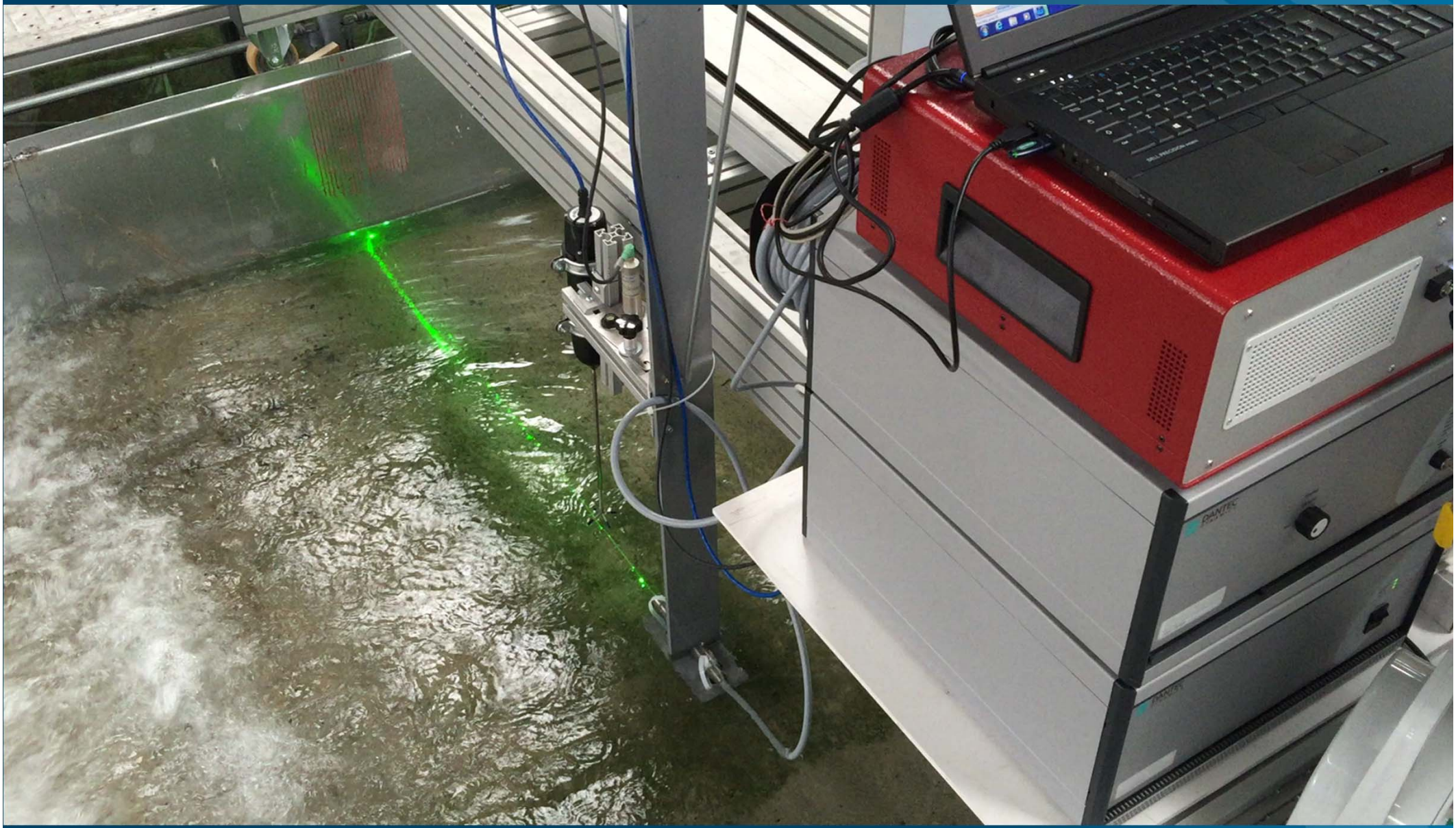
De Serio F, Mossa M (2013). A laboratory study of irregular shoaling waves. EXPERIMENTS IN FLUIDS, ISSN: 0723-4864, doi: 10.1007/s00348-013-1536-0

De Serio F, Mossa M (2006). Experimental study on the hydrodynamics of regular breaking waves. COASTAL ENGINEERING, vol. 53, p. 99-113, ISSN: 0378-3839.

THE SECOND WAVE CHANNEL

Analysis of the coherent structures due to the wave breaking using LDA and PIV, in cooperation with the University of Marche and the network Hydralab+

Awarded with a fellowship **Gii Placement** in Water Engineering. Call of 23rd October 2015



VERY LARGE FLUME

Channel with a very large aspect ratio used for the study of the jet diffusions, in cooperation with prof. Peter Davies (University of Dundee, UK).

A part of the very large channel of the LIC is the buoyant jet thermal-hydraulic system. The discharged heated water generating the turbulent buoyant jet is pumped into the channel through a round steel tube mounted at the bottom of the channel in the central longitudinal section.

JET DYNAMICS AND VEGETATED FLOWS

This study is devoted to experimental results of a turbulent neutrally-buoyant jet vertically discharged in a stagnant ambient and of the same jet discharged in a flow field of regular waves.

Thermal buoyant jets in a very large channel with a vegetated bottom. The channel base covered a surface of 15 m by 4 m and the depth of the channel was 0.4 m.

Environmental problems have assumed an increasingly pivotal role in recent years. While there are several studies in the literature on nonbuoyant and buoyant jets and their interaction with currents, few deal with jet-wave interaction. Also the effects of both a corrugated and a vegetated channel bed on buoyant or momentum turbulent jets, vertically discharged into a crossflow, have been investigated. The major objective of this study has been the background turbulence, generated by the corrugated or vegetated channel bed surfaces, which affects the jet behavior (i.e. jet penetration, spreading, mixing performance, turbulent structures, etc.).

Some references:

Ben Meftah M., Mossa M. (2016). Partially obstructed channel: Contraction ratio effect on the flow hydrodynamic structure and prediction of the transversal mean velocity profile. JOURNAL OF HYDROLOGY, ISSN: 0022-1694

Ben Meftah M, De Serio F, Mossa M (2014). Hydrodynamic behavior in the outer shear layer of partly obstructed open channels. PHYSICS OF FLUIDS, vol. 26, p. 065102-1-065102-19, ISSN: 1070-6631

Ben Meftah M, Mossa M (2013). Prediction of channel flow characteristics through square arrays of emergent cylinders. PHYSICS OF FLUIDS, p. 045102-1-045102-21, ISSN: 1070-6631

Cuthbertson A.J.S, Malcangio D, Davies P.A, Mossa M (2006). The influence of a localised region of turbulence on the structural development of a turbulent, round, buoyant jet. FLUID DYNAMICS RESEARCH, vol. 38, p. 683-698, ISSN: 0169-5983

HYDRAULIC JUMPS

In this research we describe the main characteristics of the velocity field of hydraulic jumps in a very large channel where lateral shockwaves occur.

Extensive flow velocity measurements were investigated in order to have a clearer understanding of both hydraulic jump development and lateral shockwave formation in a very large channel. Experiments are performed in a 4m wide rectangular channel; the experiments differ in the inlet Froude number and the jump type. The flow velocity and the flow free surface measurements have been taken using a two-dimensional Acoustic Doppler Velocimeter (ADV) and an ultrasonic profiler, respectively.

In this research topic we have investigated also the oscillating characteristics and cyclic mechanism of hydraulic jumps, analyzing the vortex roll-up process and the fluctuations of the longitudinal jump toe.

Some references:
De Padova D, Mossa M, Sibilla S., Torti E (2013). 3D SPH modelling of hydraulic jump in a very large channel. JOURNAL OF HYDRAULIC RESEARCH, vol. 51, p. 158-173, ISSN: 0022-1686
Ben Meftah M, Mossa M, Pollio A (2010). Considerations on shock wave/boundary layer interaction in undular hydraulic jumps in horizontal channels with a very high aspect ratio. EUROPEAN JOURNAL OF MECHANICS. B, FLUIDS, vol. 29, p. 415-429, ISSN: 0997-7546
Mossa M (1999). On the oscillating characteristics of hydraulic jump. JOURNAL OF HYDRAULIC RESEARCH, vol. 37, p. 541-558, ISSN: 0022-1686

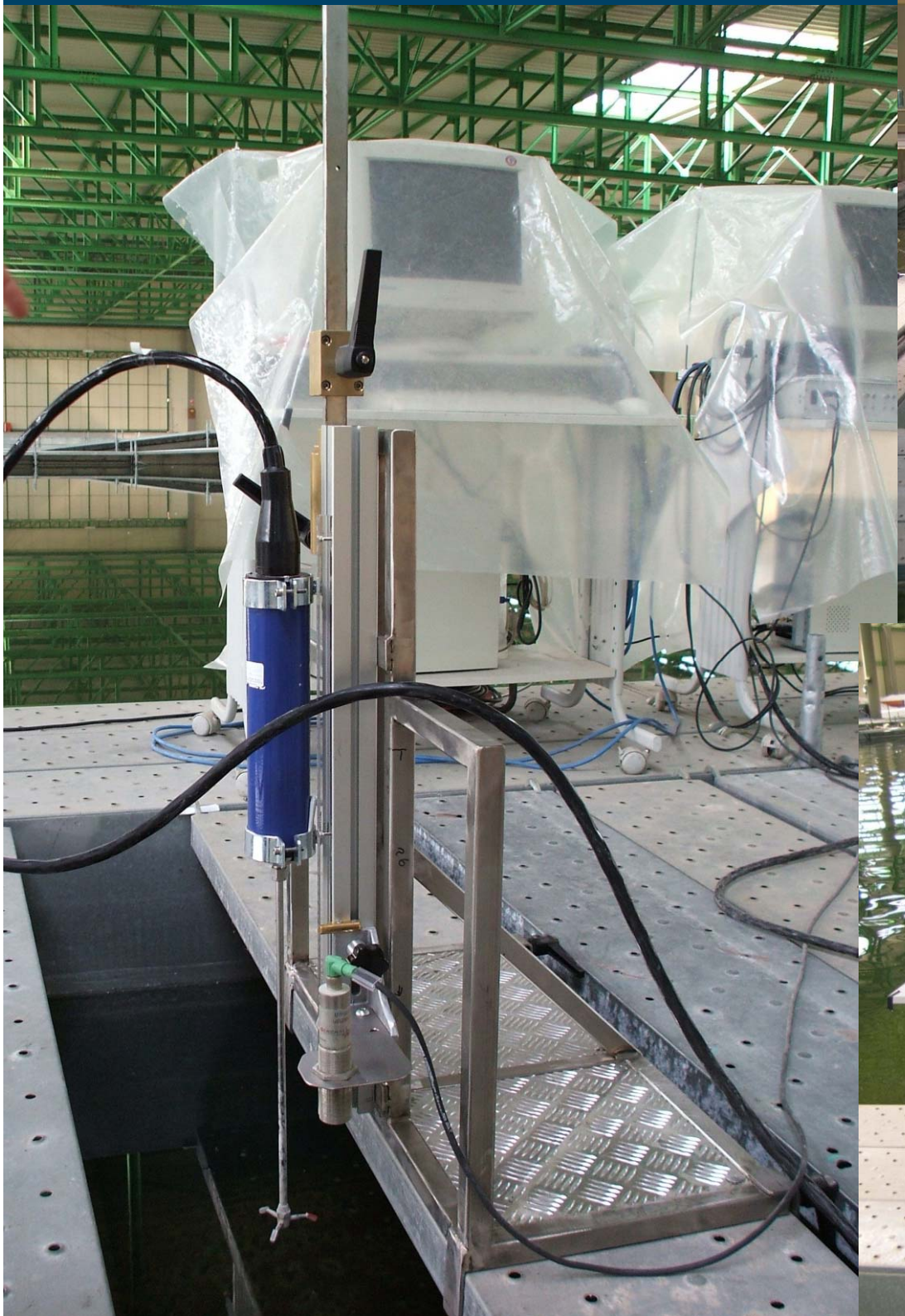
Support structures

Carpentry

Tool and machine work

Other images of the LIC

Water treatment station



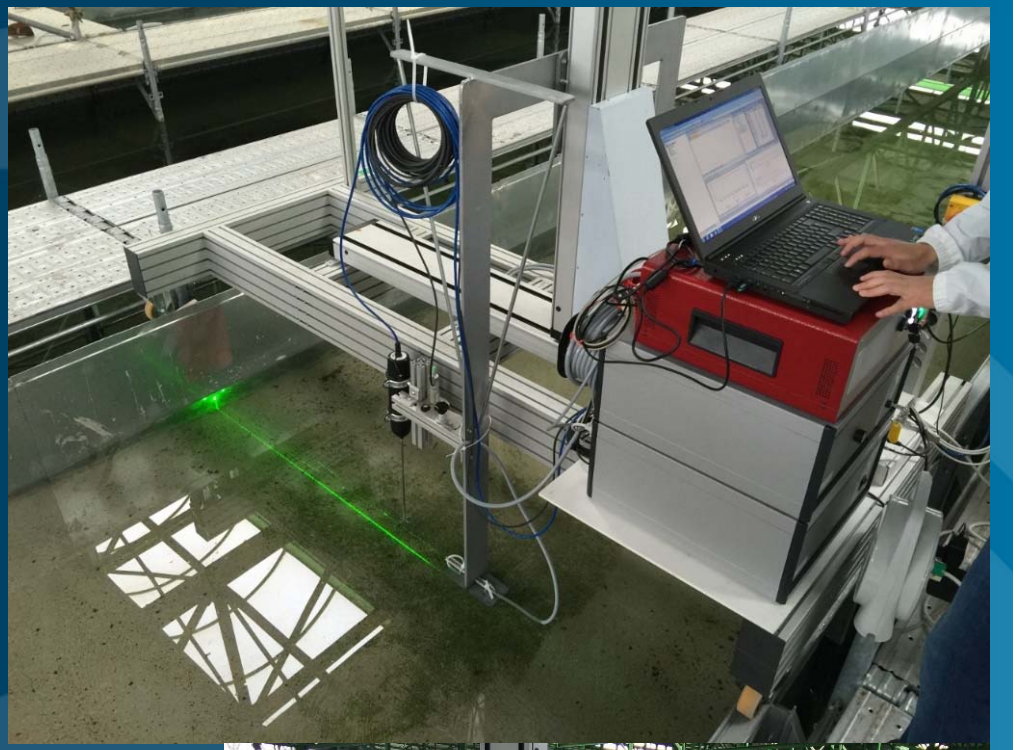
MEASUREMENT TOOLS

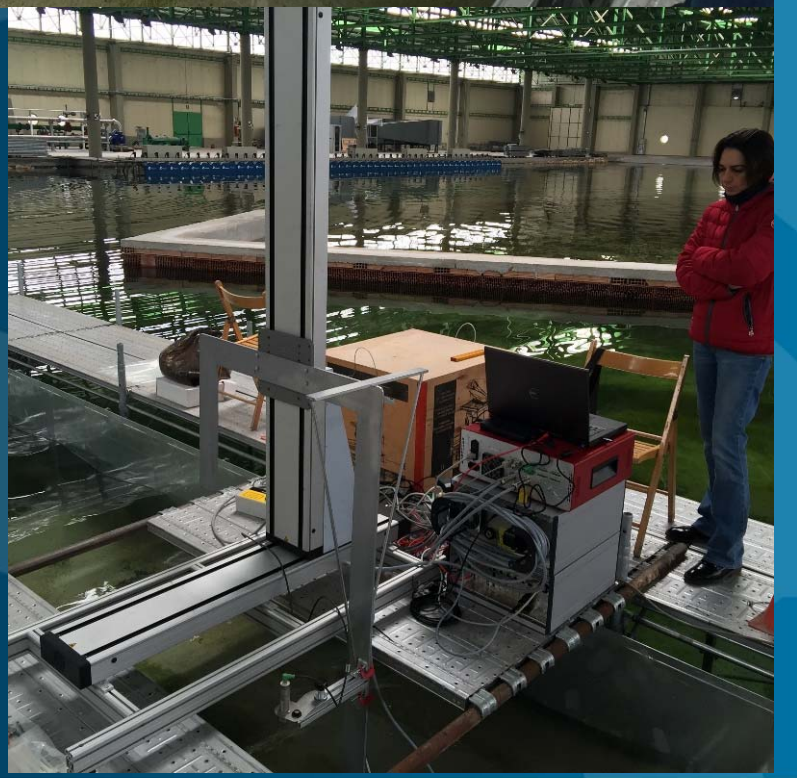
- process computers
- bottom profiler
- density-meters
- wave gauges
- spectrum analyzer
- 3D velocitymeters (ADV) and profilers
- micro turbine meters
- hydrometers
- pressure transducers
- vessel mounted acoustic Doppler current profiler (VM-ADCP)
- LDA and PIV
- numerical models

LDA

Laser Doppler Anemometry (LDA), also known as Laser Doppler Velocimetry (LDV), is an optical technique ideal for non-intrusive 1D, 2D and 3D point measurement of velocity and turbulence distribution in both free flows and internal flows. Science and industry apply LDA systems to gain a clearer understanding of fluid mechanics. The measurement results are important steps in fine-tuning product designs to improve aerodynamic efficiency, quality and safety.

Features: Non intrusive. No calibration required. Velocity range 0 to supersonic. One, two or three velocity components simultaneously. Measurement distance from centimeters to meters. Flow reversals can be measured. High spatial and temporal resolution. Instantaneous and time averaged.
Characteristics of our 2D Dantec LDA:
01 FlowLite 2D High Power 1,35mm beam, 532/561nm, 27 mm probe, 2 x 200 mW 532/561 nm laser
02 Front Lens for water, 27mm, f=160mm Stainless Steel
03 5 m cable Extension for 2D probe 1.35 mm Beams
04 Window for 27 mm Optics for Use in Water
05 FlowLite 1D LDA detection unit Inc. Photomultiplier for 532nm
06 Flowlite 2D LDA detection unit upgrade. For 532nm and 561nm
07 BSA F60 Flow Processor ready for internal PMT
08 BSA F60 Additional Velocity Channel for internal PMT
09 Analog Input Option for BSA F/P Processors
10 BSA Flow Software for 62Nxx Processors
11 Advanced Graphics Add-on for 62S10 BSA Flow
12 2D Traversing Mechanism Range XZ 1010mmx1500mm
13 2-D Traversing Controller, line voltage 100-250V
14 PC Sistema informatico portatile dedicato, 17”, processore serie I7, 16GB RAM, HD 750 GB
15 Front Lens, 60mm, f=400mm
16 2x Beam Expander for 27 mm 61X40 probe, compatible with 60 mm front lenses





PIV

Particle Image Velocimetry (PIV) is a whole-flow-field technique providing instantaneous velocity vector measurements in a cross-section of a flow.

Features:
• The technique is non-intrusive and measures the velocities of micron-sized particles following the flow.

• Velocity range from zero to supersonic.

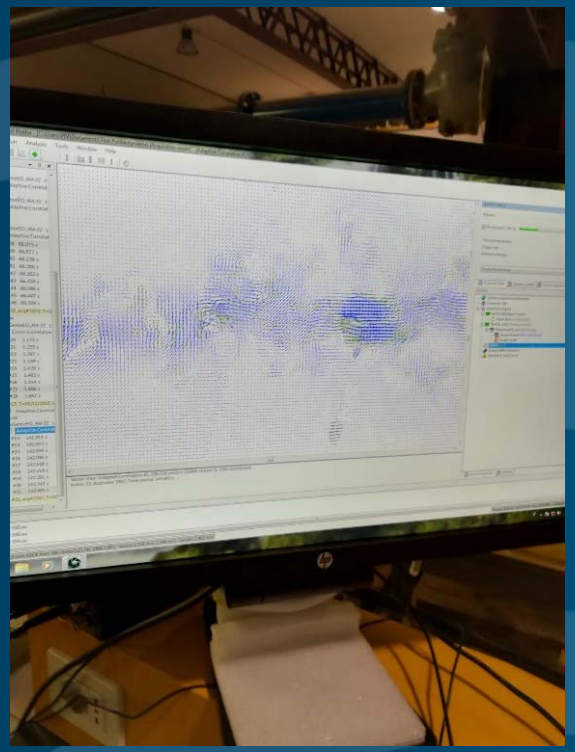
• Instantaneous velocity vector maps in a cross-section of the flow.

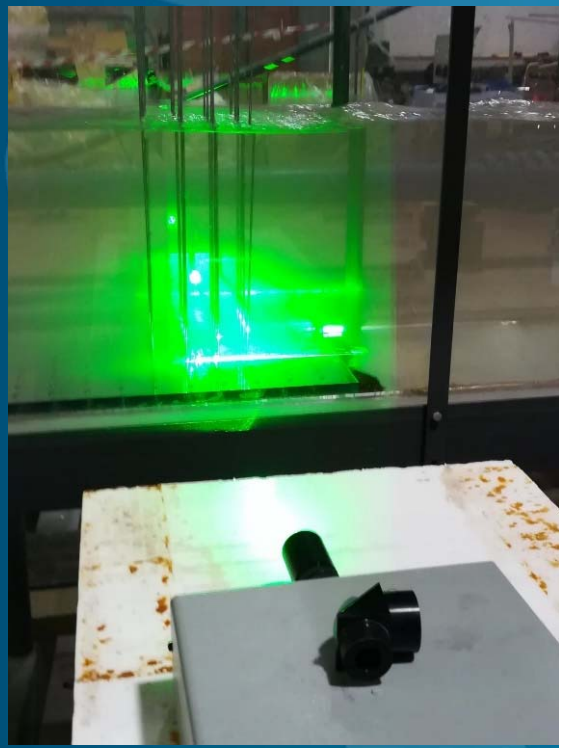
• All three components may be obtained with the use of a stereoscopic arrangement.

• With sequences of velocity vector maps, statistics, spatial correlations and other relevant data are available.

Instrumentation:

Dynamic Studio Base Package (codice Dantec 9080S0571).
2D PIV Add-on (codice Dantec 9080S0581).
FlowSense EO 4M-32 (codice Dantec 9081C0141).
Obiettivo Nikon 60 mm.
High performance dual-channel (codice Dantec 9138A0617).
Timer Box, incl. Timer Card Cable Box and 4x10m BNC (codice Dantec 9080N0772)



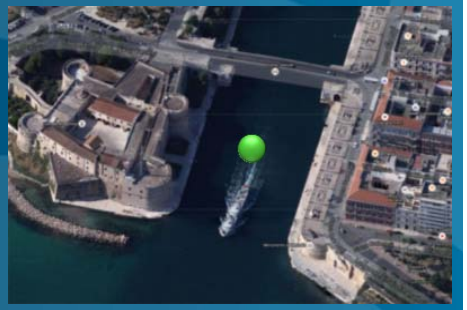


Measurement stations installed and operated in the Gulf of Taranto by the Research Group of the LIC

The area in analysis is in southern Italy and is composed by two basins, an inner one named **Mar Piccolo and an external one named Mar Grande**

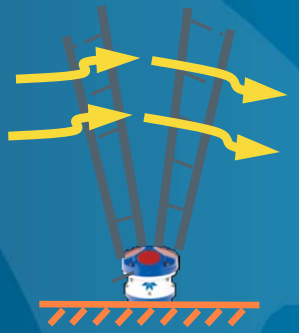
This study area is highly vulnerable, because exposed to a strong anthropic pressure, to urban and industrial discharges as well as to an intense naval traffic. For all these reasons, at present, it is enclosed in the so-called SIN (site of national interest) list and is under the control of the Special Commissioner appointed by the Italian Government to evaluate and dispose urgent measures of **remediation and environmental requalification of Taranto city**.

Automatic Monitoring of the Sea - Mar Piccolo - Taranto (Italy)



RITMARE is the Italian leading national marine research project for the period 2012-2016 (overall project budget amounts to 250 million euros, co-funded by public and private resources). In this frame, we installed a system in the Navigable Channel of the Mar Piccolo of Taranto (Italy) for the monitoring of sea currents and waves.

ADCP installed in the Navigable Channel

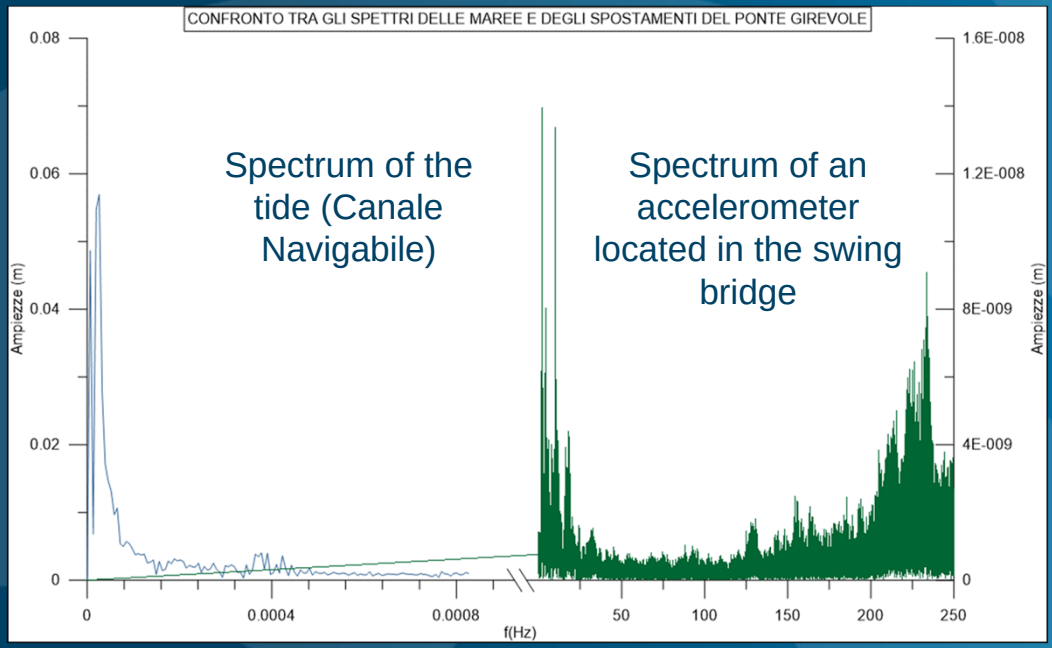


The real time data are available from this web site:
http://www.michelemossa.it/stazionemeteo2.php

Ultrasonic tide gauge in Navigable Channel of Mar Piccolo (Taranto)

- Installed on August 2015
- Acquisition frequency: 5Hz

Spectral analysys of the sea currents and the tide in the Navigable Channel



Some references:

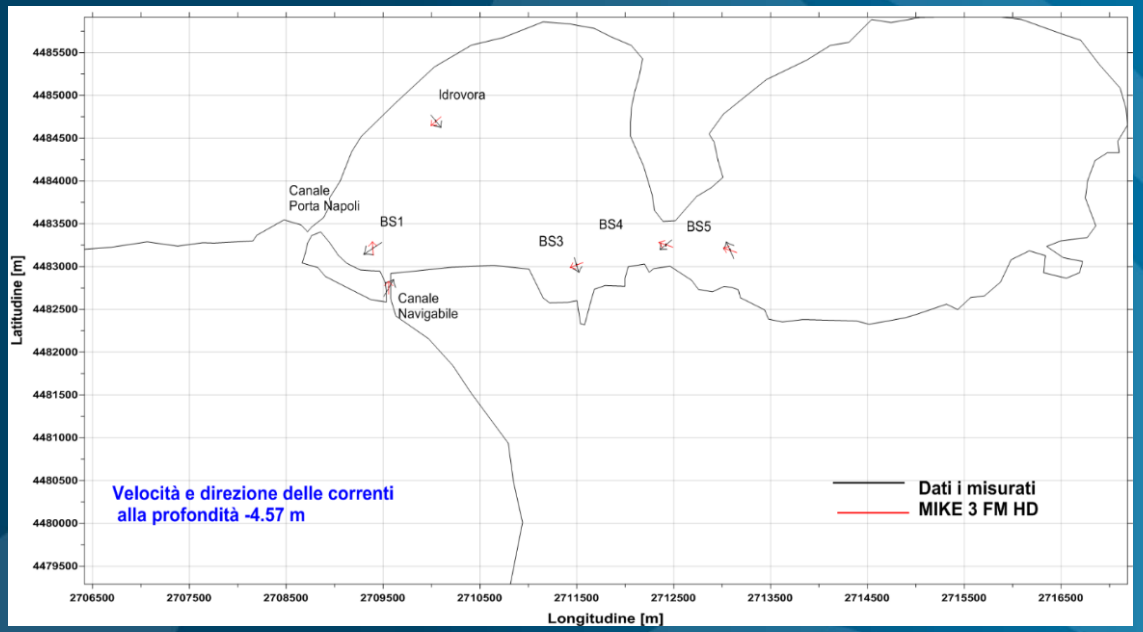
De Serio Francesca, Mossa Michele (2016). Assessment of hydrodynamics, biochemical parameters and eddy diffusivity in a semi-enclosed Ionian basin. DEEP-SEA RESEARCH. PART 2. TOPICAL STUDIES IN OCEANOGRAPHY, ISSN: 0967-0645.
De Serio Francesca, Mossa Michele (2016). Environmental monitoring in the Mar Grande basin (Ionian Sea, Southern Italy). ENVIRONMENTAL SCIENCE AND POLLUTION RESEARCH INTERNATIONAL, ISSN: 0944-1344.
Mossa M (2006). Field measurements and monitoring of wastewater discharge in sea water. ESTUARINE, COASTAL AND SHELF SCIENCE, vol. 68, p. 509-514.

Automatic Monitoring of the Sea - Mar Grande - Taranto (Italy)

System in the Mar Grande Taranto (Italy) for the monitoring of sea currents (ADCP) and waves. Also a meteo station, a CTD, a combined fluorometers, turbidity meters and a C3 Submersible Fluorometer for CDOM, Crude Oil and Refined Fuels have been installed.

The real time data area available from this web site:
http://www.michelemossa.it/stazionemeteo.php

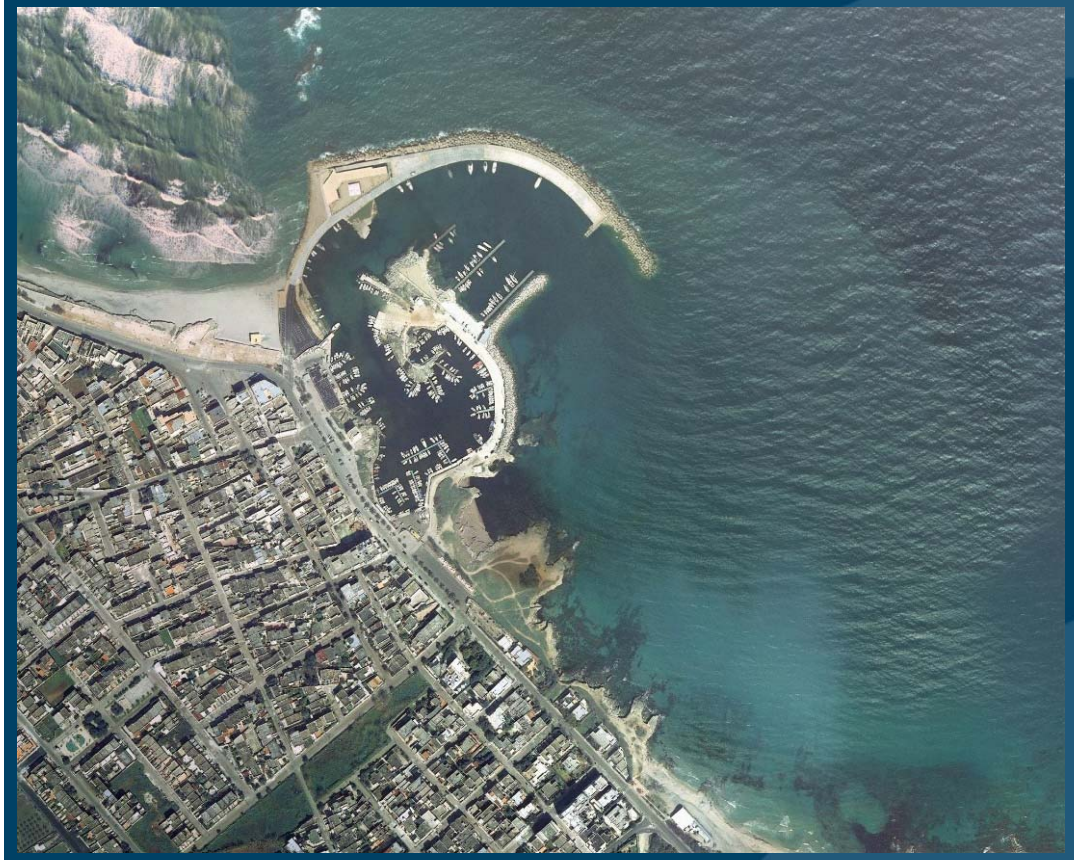
FIELD MEASUREMENTS OF THE SEA CURRENT WITH A VM-ADCP (VESSEL-MOUNTED ACOUSTIC DOPPLER CURRENT PROFILER) for the comparison between the field mesurements and the numerical codes

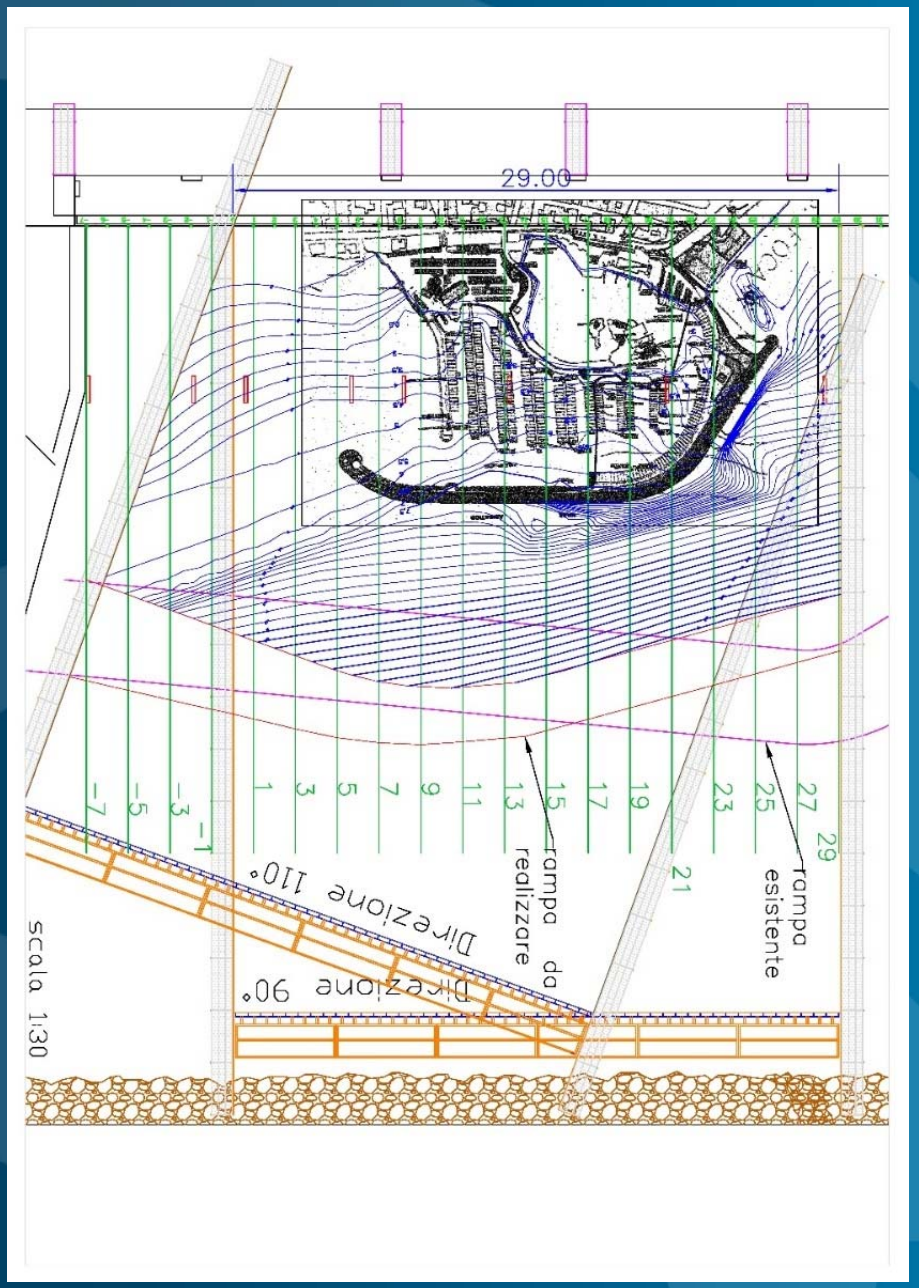


Sea current measurements: **VM-ADCP** with GPS receiver (the accuracy of the GPS velocity should be 0.05 m/s or better (DGPS)
Gyro: with serial output and accuracy better than 1°. It is also possible to use combined gyro and GPS system
Computer: The survey computer needs at least 3 serial ports and it is advisable to use an intelligent multi-port card.

Simultaneous measurements of water temperature and salinity with a CTD

Case study: Study with a 3D physical model of the PORT OF SAN FOCA – MELENDUGNO (LE)



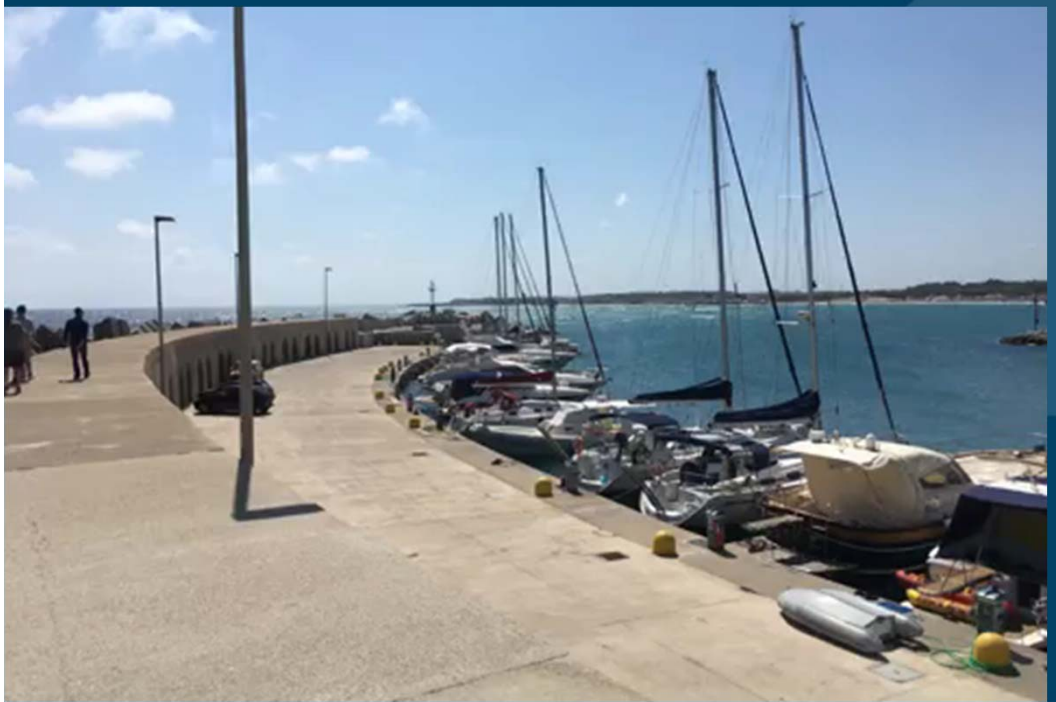


Aims of the model:

Model in analogy of Froude with a length scale of 1:30. Hydrodynamic simulation of both the present and new designed situations for two wave directions (from East and East-South-East).

The project mainly involves an increase of the length of the outer pier towards the south direction and an arrangement of the port basin.

Study with a 3D physical model of the PORT OF SAN FOCA– MELENDUGNO (LE)



Study with a 3D physical model of the PORT OF SAN FOCA – MELENDUGNO (LE)

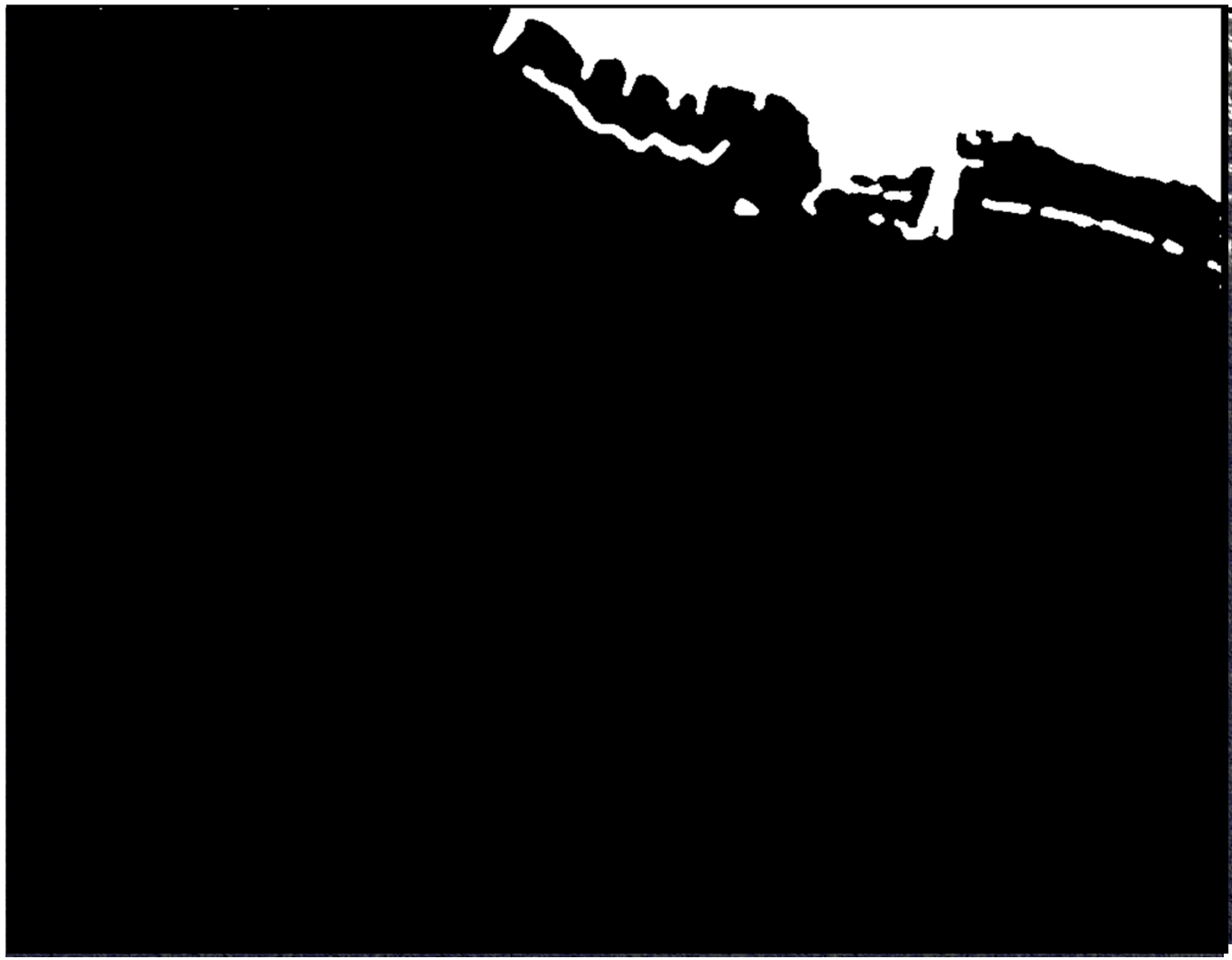
Study with a 3D physical model of the PORT OF SAN FOCA – MELENDUGNO (LE)

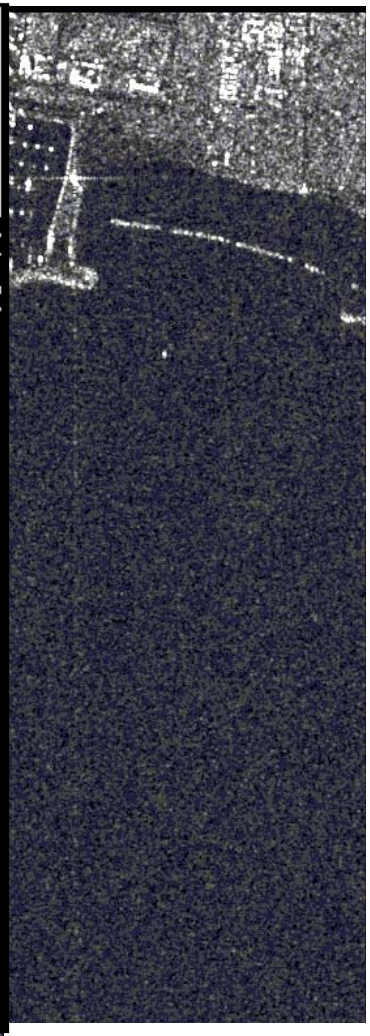
Coastal line detection and monitoring

Immagine SAR

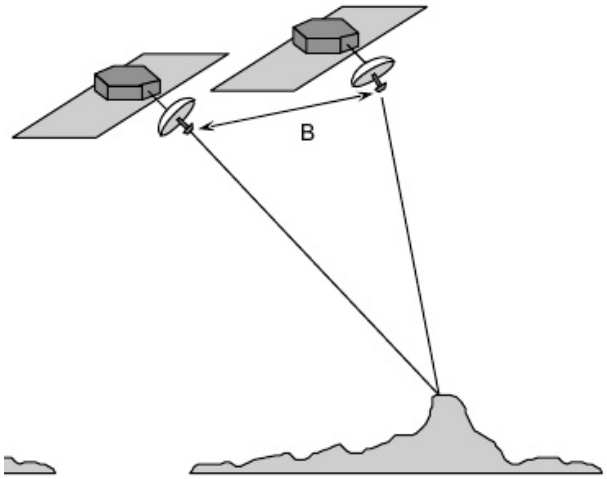
Costa estratta dal DB GSHHG e sovrapposta all'immagine

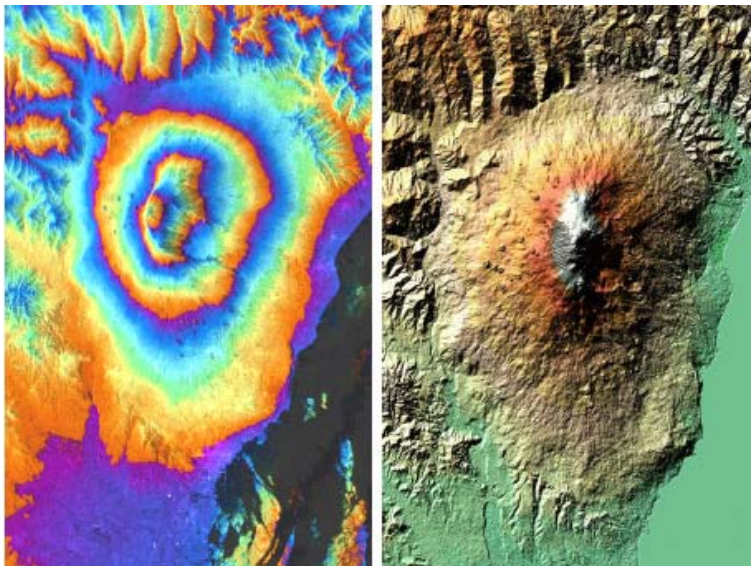
Costa ricavata dall'elaborazione dell'immagine SAR





Interferometria SAR

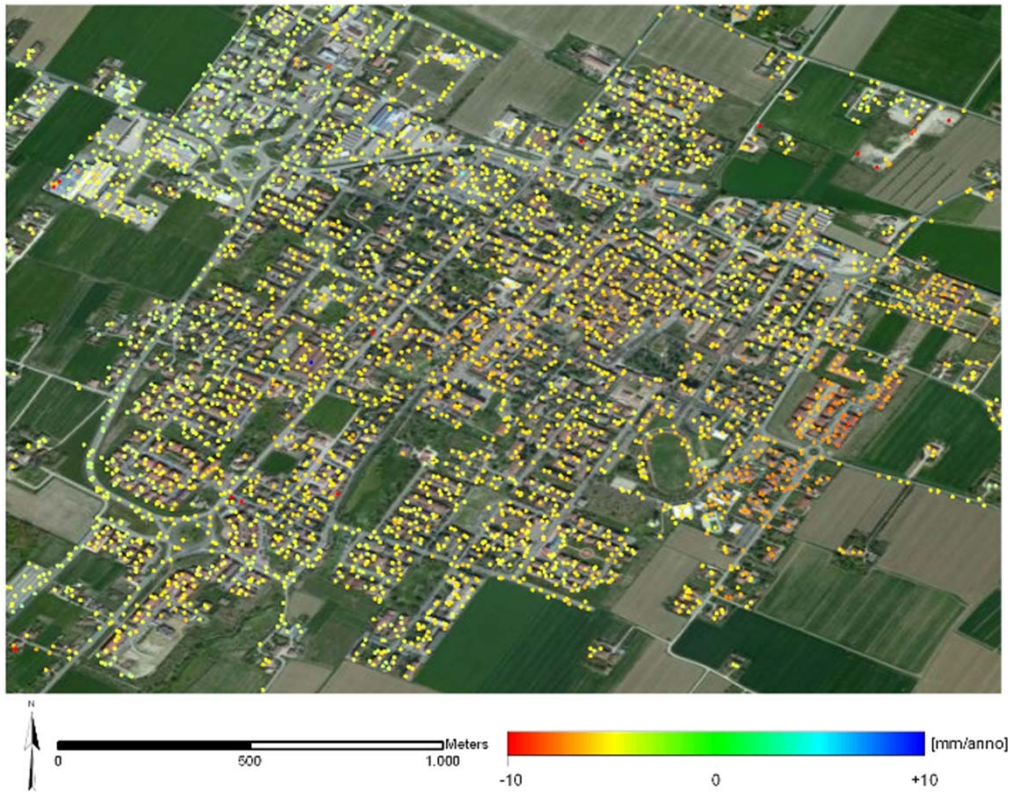




L’acquisizione di immagini con due satelliti sia contemporaneamente che dopo un breve intervallo (sino ad un paio di giorni) consente di ricavare il DEM dell’area ripresa

Monitoraggio della Subsidenza

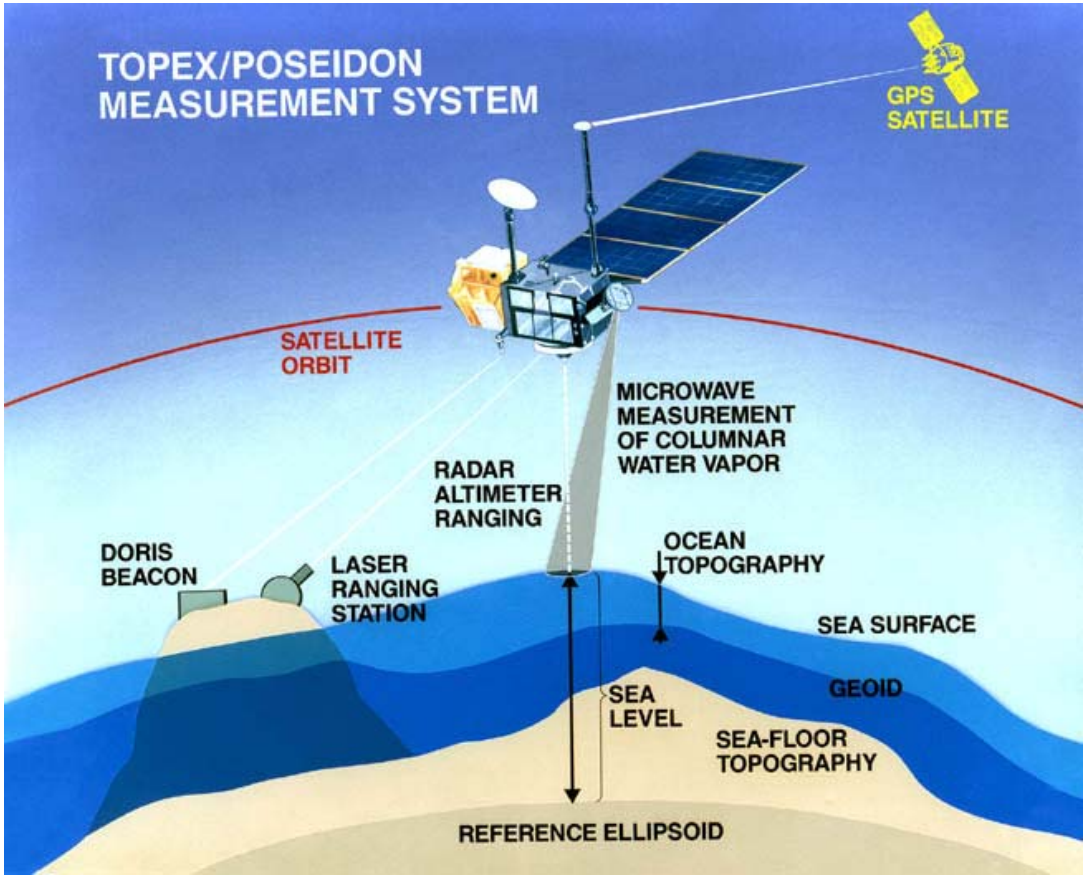
Se la zona di interesse è ripresa molte volte nel tempo è possibile elaborare i dati con la tecnica dei PS. Tale tecnica consente di rilevare movimenti verticali di pochi mm all'anno.



Dalla conoscenza dell'orbita del satellite, dal tempo di andata e ritorno del segnale radar si ricostruisce il profilo della superficie del mare e la sua variazione nel tempo.

Da questi dati si possono ricavare anche le correnti marine.

Rif. Missioni altimetriche ERS, ENVISAT, Topex-Poseidon, Giason



https://www.star.nesdis.noaa.gov/sod/lsa/SeaLevelRise/LSA_SLR_rads.php

«[…] La Terra è l'unico mondo che abbiamo, e contiene qualcosa di estremamente prezioso: il futuro. Ogni futuro è grande come il mondo intero. Il futuro, così come il mondo, non vi appartiene, ma è nelle vostre mani. È unico, ma non è mai uguale. Sembra infinito, ma è solo infinitamente fragile.»

(Dalla lettera dell'astronauta Luca Parmitano alle sue figlie)

Prof. Ing. Michele Mossa
Professore Ordinario di Idraulica - POLITECNICO DI BARI
Dottore di Ricerca in Ingegneria Idraulica per l'Ambiente e il Territorio
Responsabile Scientifico del LIC – Laboratorio di Ingegneria Costiera
Componente direttivo del Co.N.I.S.Ma. per il Politecnico di Bari

www.michelemossa.it
e-mail: michele.mossa@poliba.it
skype name: michele.mossa

DICATECh - Dipartimento di Ingegneria Civile, Ambientale,
del Territorio, Edile e di Chimica
Via E. Orabona, 4 - 70125 Bari
tel.: 080 596 3289
fax: 080 2209969
www.dicatech.poliba.it

LIC – Laboratorio di Ingegneria Costiera
Area Universitaria di Valenzano
Strada Provinciale Valenzano - Casamassima, Km 3
70010 Valenzano, BA
tel.: 080 4605 204
fax: 080 4605 243
www.poliba.it/lic

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MENDELEY:
https://www.mendeley.com/profiles/michele-mossa/
RESEARCHER ID:
http://www.researcherid.com/rid/A-4420-2016
IMPACTSTORY:
https://impactstory.org/u/0000-0002-6477-8714

Grazie per la vostra attenzione