

# Una panoramica su prodotti e infrastrutture oceanografiche. Integrazione dati / modelli e modelli / modelli

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Torino, 14-15 Ottobre 2015



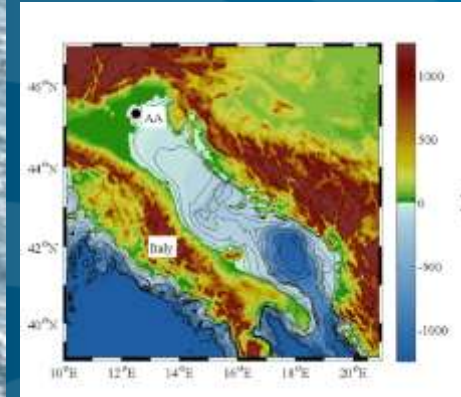
# Per un buona caratterizzazione dell'ambiente marino

- Schema classico: i modelli numerici (a scala ampia) hanno bisogno di dati per essere calibrati / valutati.
- Use dei dati “2.0”: Data assimilation!
- Inversione: le osservazioni (a scala locale / istantanea) hanno bisogno di modelli (numerici e non) per essere interpretati
- Necessità di
  - esplorare scale diverse (p.e. Mediterraneo, Adriatico, Laguna di Venezia) con misure / dati e modelli appropriati
  - far “comunicare” i modelli, eliminando la frammentazione tra comparti (p.e. atmosfera, circolazione oceanica, onde)
  - Chiedere ai modelli nuove “variabili” (prognostiche / diagnostiche)

# Osservazioni a mare. ISMAR & La piattaforma oceanografica "Acqua Alta"

## Misure

- Parametri atmosferici
- Idrologia
- Correnti
- Onde
- Bio-Geochimica



### RETI OSSERVATIVE

#### Piattaforma "Acqua Alta"

Previsione onde - Sistema Nettuno

Previsione onde - Sistema Henetus

Kassandra Storm Surge System

Dati meteo dalla nave Urania

Rete meteomarina Trieste

S1 Meda CTD/Meteo Po di Goro

E1 Boa CTD/Meteo Rimini EMMA/LIFE

Rete meteomarina Ancona

Rete meteomarina Lesina

Condivisione dati: progetto CIGNo

Dati in tempo reale: Canale di Corsica

Correnti in tempo reale: HF Radar -

Manfredonia

LTER-Italia Alto Adriatico

LTER-Italia Laguna di Venezia

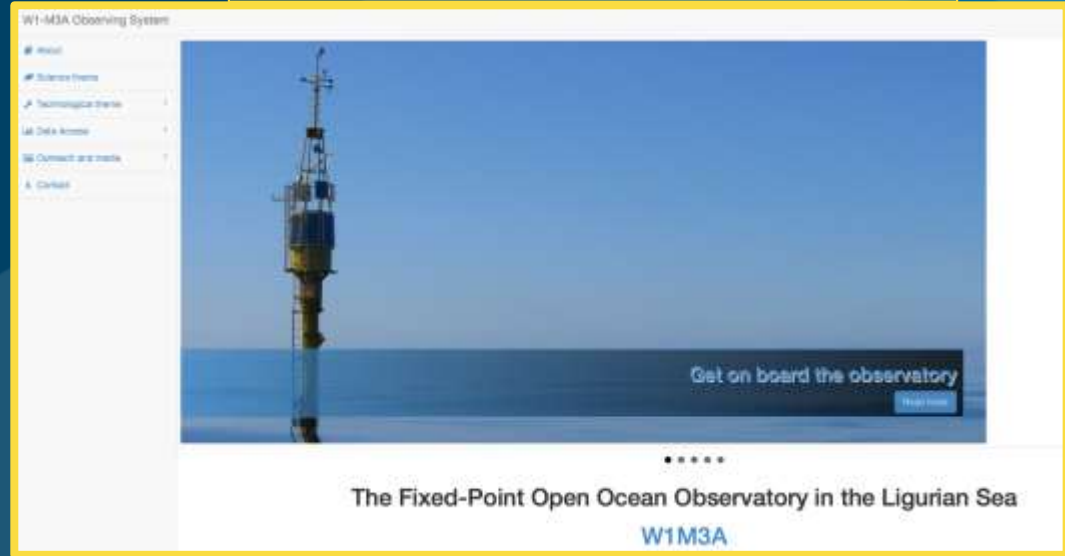
- LTER (Long Term Ecological Research) network
- Link with other coastal observatory sites
- The platform is partner of JERICO (FP7 Project Towards a joint European research infrastructure network for coastal observatories, <http://www.jerico-fp7.eu/tna>)

# Osservatori marini in-situ (altri esempi)



EMODnet

ODAS Italia 1 buoy (mar Ligure)



Rete mareografica / ondametrica

# Osservazioni da remoto (misure satellitari)





# Modelli: alla scala globale a quella “ingegneristica” (Risoluzioni / Fenomeni / Parametrizzazioni)

## Fornitori di dati globali (Forecast & Reanalysis)

- Centro meteorologico Europeo: ECMWF <http://www.ecmwf.int/en/forecasts/accessing-forecasts>
- National Weather Service (USA): NCEP <http://www.ncep.noaa.gov>



Alcuni prodotti gratuiti, altri a pagamento (ECMWF diverse licenze)



# A scala Mediterranea (modelli operativi)

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SEARCH

AREA

- All areas
- Mediterranean (0)
- Atlantic Ocean (0)
- Black Sea (0)
- European North-West Shelf Sea (10)
- European North-East Shelf Sea (0)
- Mediterranean Sea (0)
- Black Sea (0)

PARAMETER

of all parameters

- Ocean Temperature (10)
- Ocean Salinity (0)
- Ocean Currents (0)
- Sea Ice (0)
- Sea Level (0)
- Wave (0)
- Ocean Depth (0)

**MEDITERRANEAN SEA PHYSICS ANALYSIS AND FORECAST**  
 Marine Sea Model, Temperature, Salinity, Currents, Sea Level, Near-Real Time, Forecast, Mediterranean Sea

The physical component of the Mediterranean Forecasting System (MFS) consists of a nested hydrodynamic sea model implemented over the whole Mediterranean Basin. The model horizontal grid resolution is 1/3° (ca. 37 km) and the sea 12 vertically stacked isopycnals.

The hydrodynamic are coupled for sea level and for wave forecasting, at the Ocean BATHY, while the wave component is provided by WaveWatch3. The model outputs are coupled to the ecological assessment (based on a 2000000 volume of temperature and salinity remote sensing sea-ice data available on-line within Copernicus).

**MEDITERRANEAN SEA BIOGEOCHEMISTRY ANALYSIS AND FORECAST**  
 Marine Sea Model, Ocean Chemistry, Ocean Chlorophyll, Ocean Biology, Ocean Sea-Phase Data, Mediterranean Sea

The biogeochemical analysis and forecasts for the Mediterranean Sea are produced by the CO2M Prediction Unit by means of the CO2M-FM model (Ocean Chemistry Forecast, coupled to physical forcing by the MFS). The model outputs are coupled to the ecological assessment (based on a 2000000 volume of temperature and salinity remote sensing sea-ice data available on-line within Copernicus).

**Previsioni meteorologiche CNR-ISAC**  
**GLOBO - BOLAM - MOLOCH forecasts**  
 CNR-ISAC, Bologna

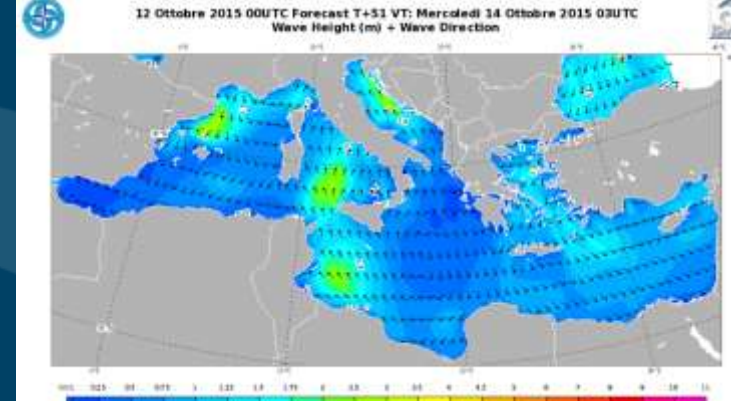
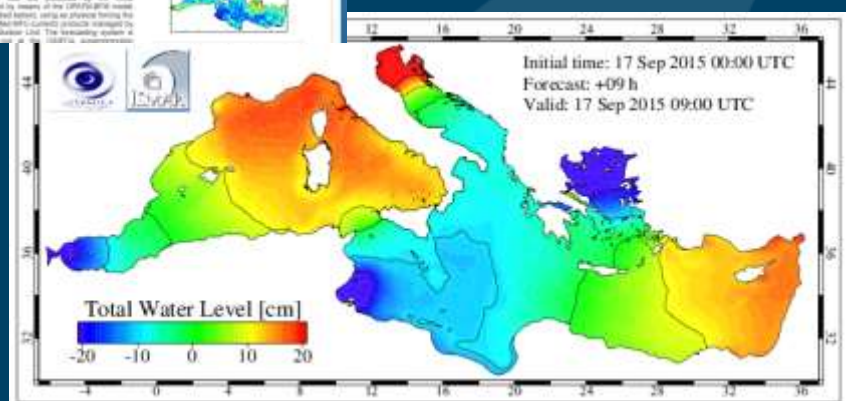
**CONSORZIO LaMMA**

METEO TERRITORIO MAP CLIMA & ENERGIA DIDATTICA CONSORZIO

**Codice Alerta Mete**

**Consorzio LaMMA** WW3 (0.5m) - WRF GFS (12m) T=1h

12 Ottobre 2015 00UTC Forecast T+51 VT: Mercoledì 14 Ottobre 2015 03UTC Wave Height (m) + Wave Direction





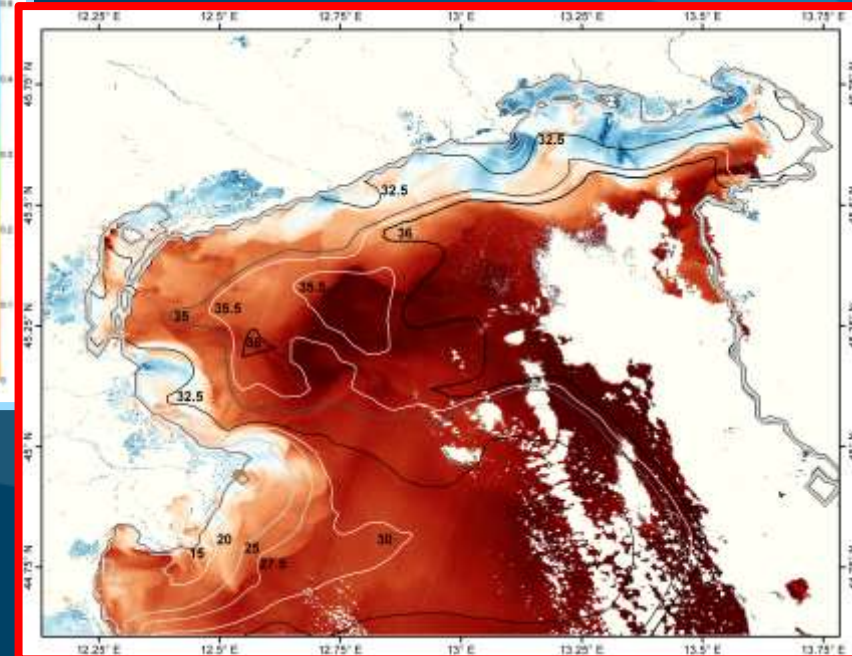
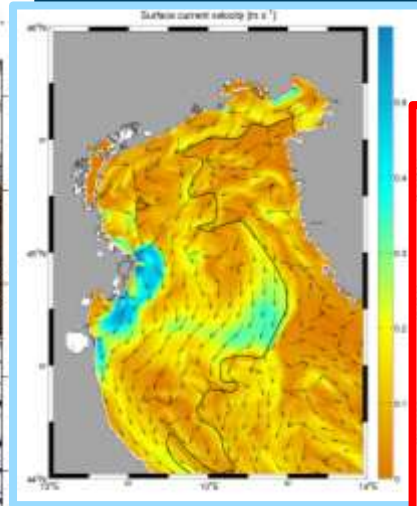
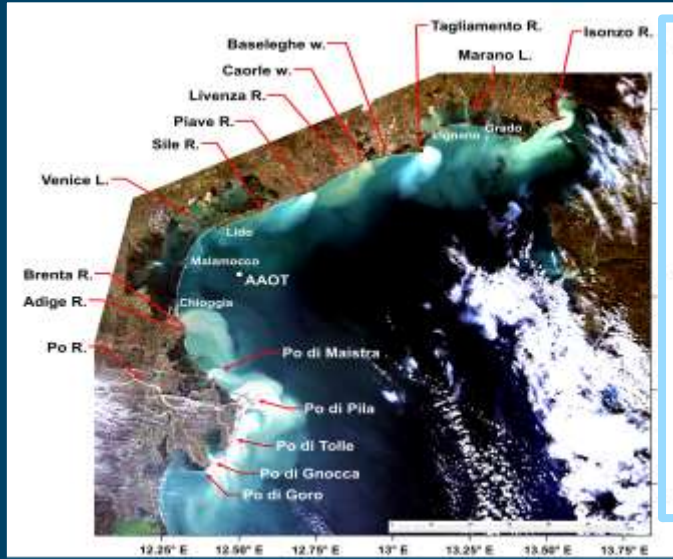


# Valorizzazione dei dati osservativi con output modellistici (Landsat-8 data e Modello oceanografico)

Osservazione

Modello

Merging (Obs: Temp.; Model: salt)

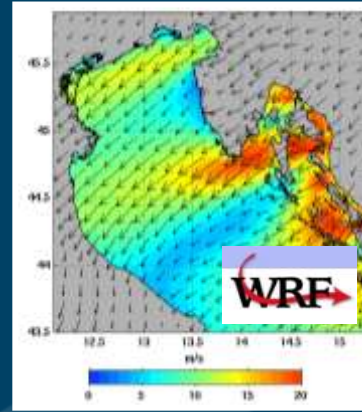
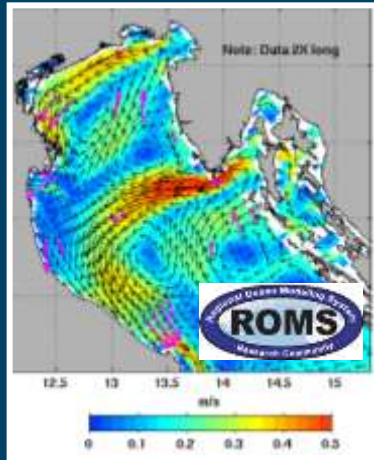


Brando, et al., 2015: High resolution satellite turbidity and sea surface temperature observations of river plume interactions during a significant flood event, *Ocean Sci. Discuss.*, 12, 1669-1692.

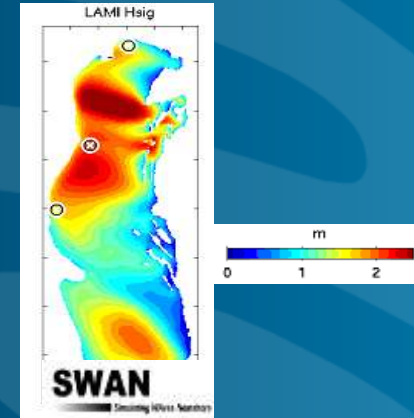
# Accoppiamento tra modelli

## ATMOSFERA

## CORRENTI



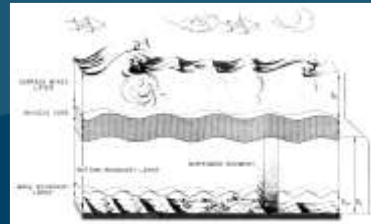
## ONDE



Parametri ondosi (altezza, periodo, etc.)

Velocità, livello...

(Warner et al., 2008. OM)



## SEDIMENTI

Stress al fondo

Variazioni batimetriche

Forcings  
Temperatura superficiale

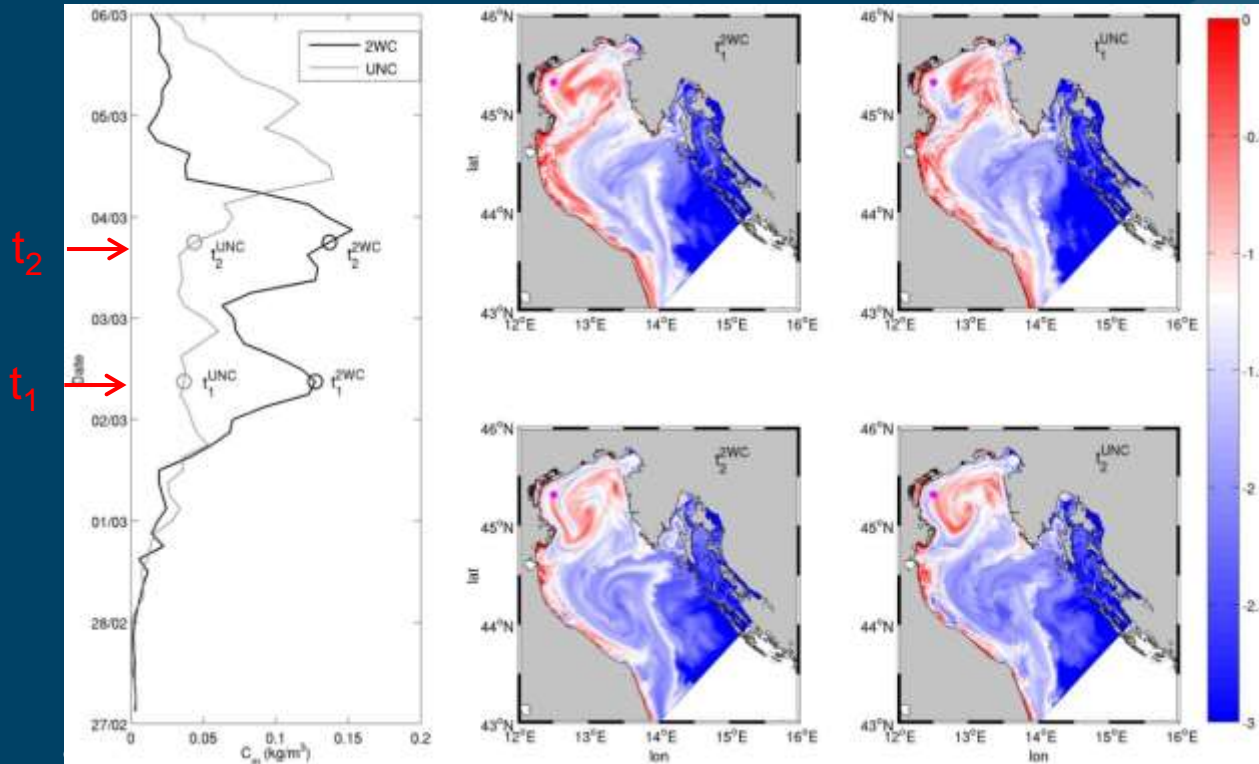
Rugosità  
Vento

Risospensione e trasporto

# Wave-Current interaction (2WC)

## Effetto sul trasporto di materiale in sospensione

SSC(kg/m<sup>3</sup>)

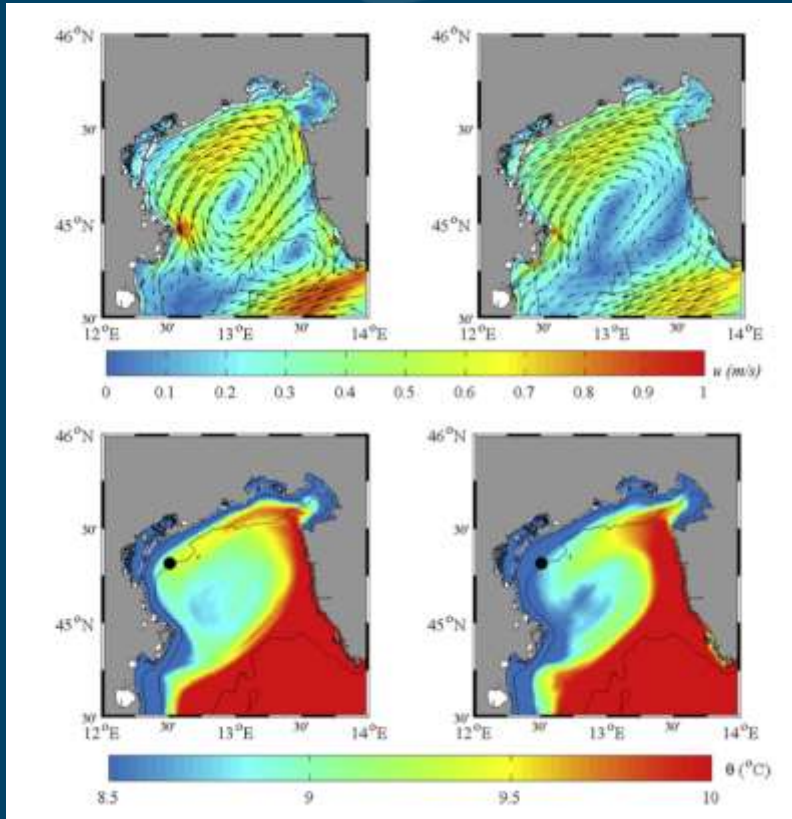


L'interazione onde-correnti può essere determinante nel delineare i patterns di erosione / trasporto / deposito

- 2WC: 2 picchi;
- UNC: 1 solo picco + diverso timing

(Sclavo et al., 2013. JCR)

# Wave-Current interaction Effetto sulla circolazione termohalina



- L'interazione onde-correnti può essere determinante nel delineare i patterns di corrente e di trasporto di traccianti (passivi e non) anche inquinanti
- Durante il Cold-Air-Outbreak del Febbraio 2012, tale interazione sembra essere stata determinante nel trasporto di masse d'acqua dal nord al sud dell'Adriatico

(Benetazzo et al., 2014. PIO) Italian DHI Conference 2015

Torino, 14-15 Ottobre 2015

# Nuove teorie, nuove variabili e nuove misure...eventi estremi

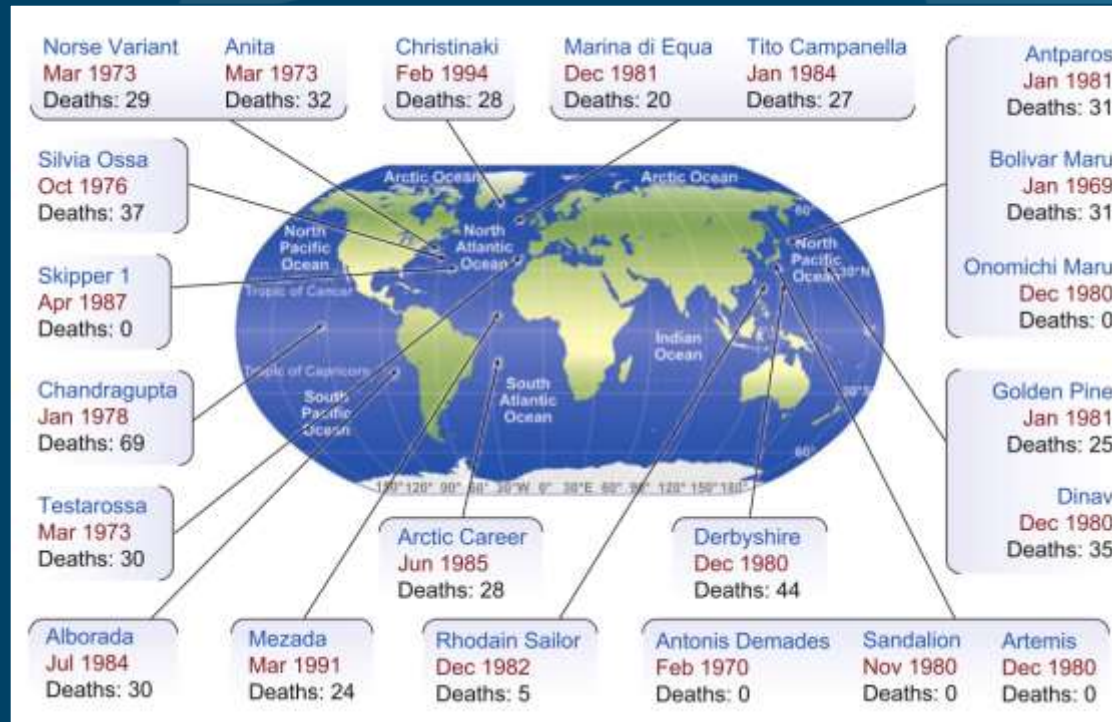
## Freak waves



Italian DHI Conference 2015

# Nuove teorie, nuove variabili e nuove misure...eventi estremi

## Freak waves



Locations of 22 supercarriers assumed to be lost after collisions with rogue waves between 1969 and 1994. (Figure copyright C. Kharif and E. Pelinovsky, 2003).

# Nuove teorie, nuove variabili e nuove misure...eventi estremi

## Freak waves



### Rescue for stricken cruise ship

A cruise liner with 732 people on board - most of them Spanish - has been crippled by a severe storm in the western Mediterranean.



A French-led rescue operation is under way to reach the stricken Voyager, now about 100km (60 miles) from Menorca.

The ship was battered by 10-metre waves

Several people suffered minor injuries and the ship has lost all engine power, a spokesman for its owner, V Ships of Monaco, told the BBC News website.

It was sailing from Sardinia, on a voyage from Tunis to Barcelona.

The spokesman said the crew were battling to restore engine power and a liquefied gas tanker, the Gimi, was on the scene after receiving the distress call.

### Battered by storm

A high wave smashing through the windows of the bridge and damaging electronics is thought to have caused the power cut.

Movie 1

Movie 2

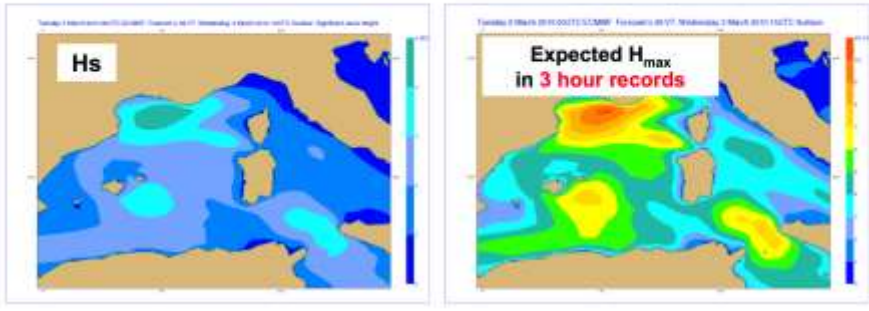
(Cavaleri et al., 2012. JGR)



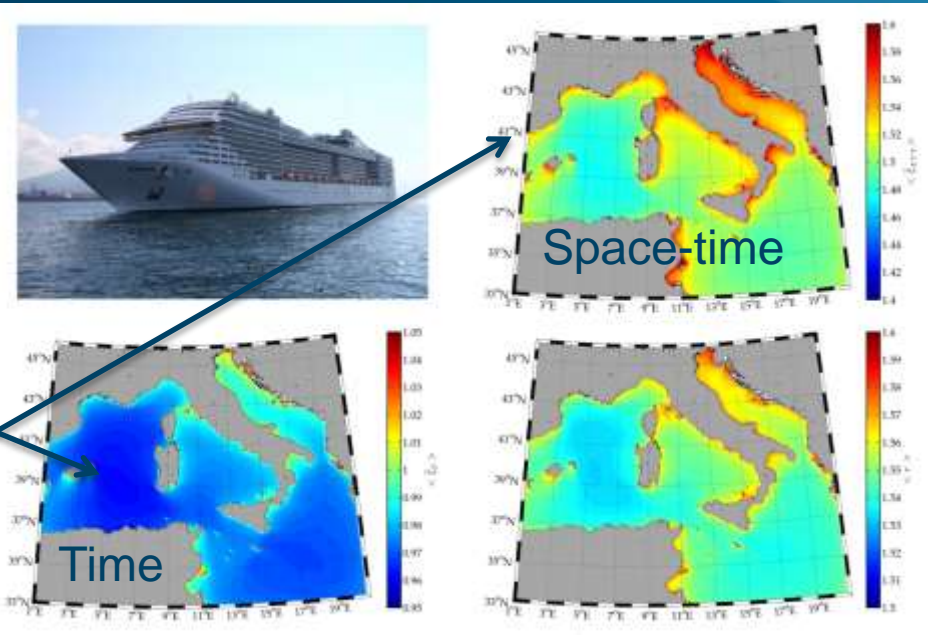
# Nuove teorie, nuove variabili e nuove misure...eventi estremi

## Onde estreme: modelli

We have recently introduced a new parameter to estimate the height of the **highest individual wave ( $H_{max}$ )** one can expect. Its value can be derived from the 2d wave spectrum:



ECMWF: Altezza d'onda massima ( $H_{max}$ )



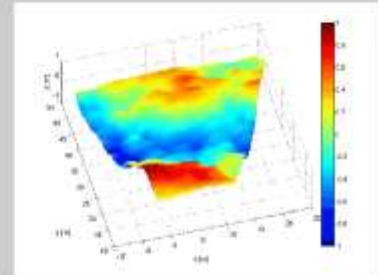
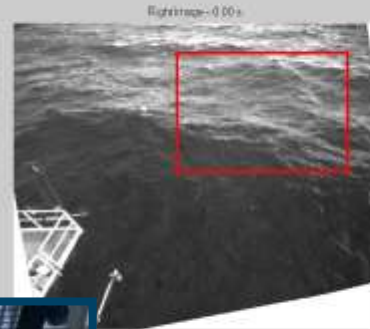
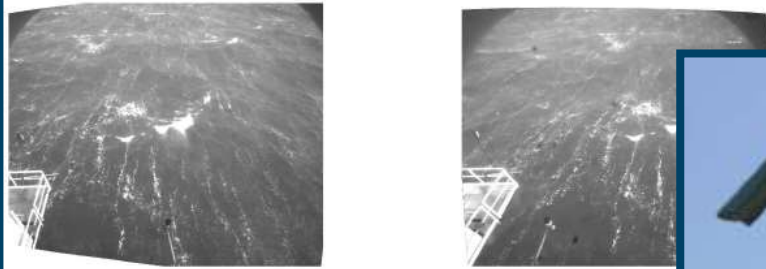
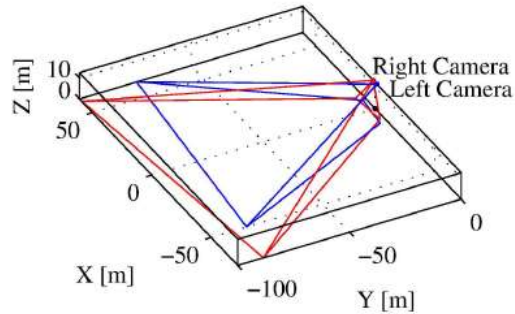
Onda massima (Space-time extreme)

(Benetazzo et al., 2015. JPO)



# Nuove teorie, nuove variabili e nuove misure...eventi estremi

## Onde estreme: misura



(Benetazzo et al., 2012. CENG)



# Grazie

Alvise Benetazzo (in collaborazione con Sandro Carniel, Mauro Sclavo, Francesco Barbariol, Davide Bonaldo, Francesco Falcieri, Filippo Bergamasco)

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**Torino, 14-15 Ottobre 2015**

