



**Storm surge network forum
ISMAR – Venice 18-20 November 2013**

**Storm surge forecast activities
in the Northern Adriatic Sea and in the lagoons**

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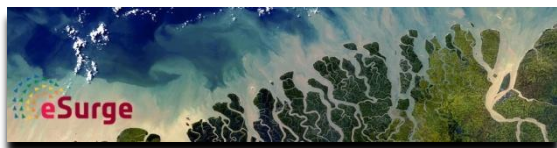


Storm surge network forum

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Summary

- 1) [Tide modelling](#) at ISPRA
- 2) [Operational tide forecast models](#)
- 3) [Forecast evaluation](#)
- 4) [Case study](#)
- 5) [Future challenges](#)



1) Tide modelling: statistical approach

INPUT DATA

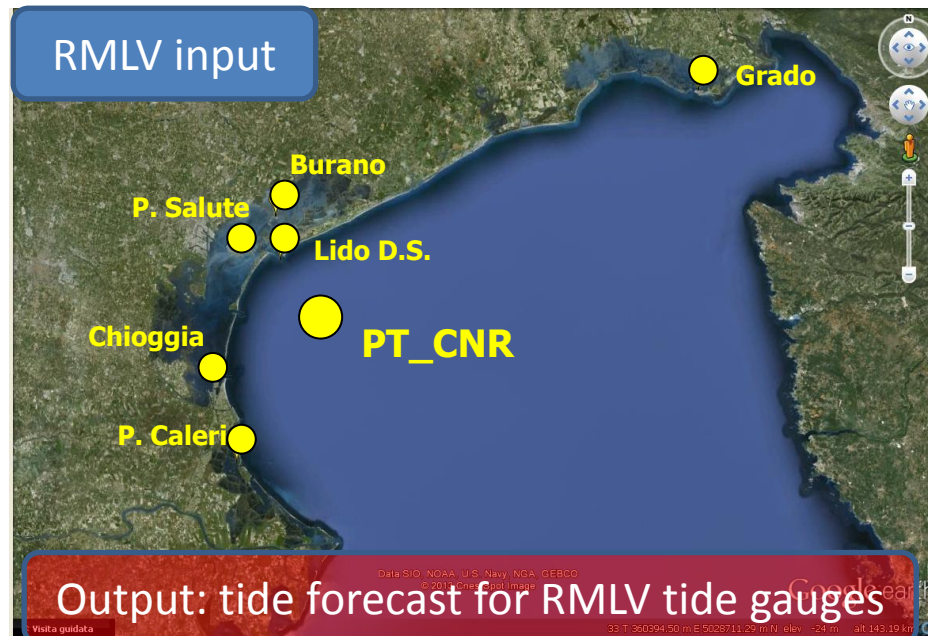
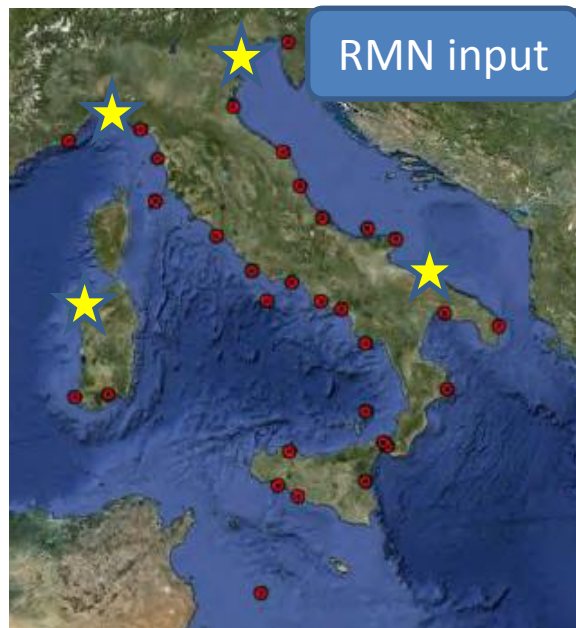
Observed values (every hour):

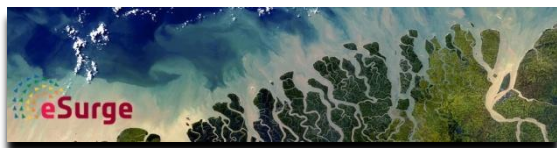
- **atmospheric pressure** at Porto Torres, Genova, Bari, Venezia (RMN) ★
- **wind speed** from SE/NE sectors at Piattaforma (RMLV) ●
- **tide** at RMLV stations ●

Forecast (every 24 hours):

ECMWF (6 hours) or BOLAM (1 hour):

- **wind speed** at Piattaforma (SE/NE sectors)
- **atmospheric pressure** at Porto Torres, Genova, Bari, Venezia (RMN)





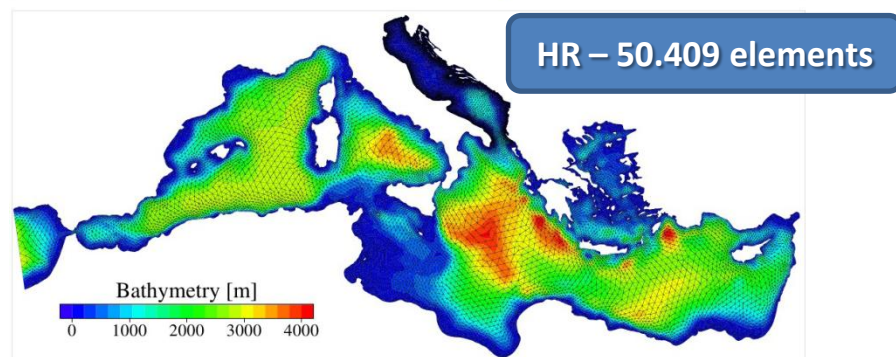
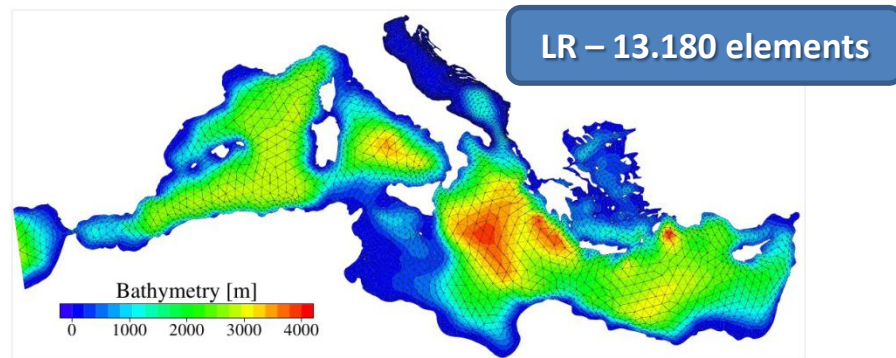
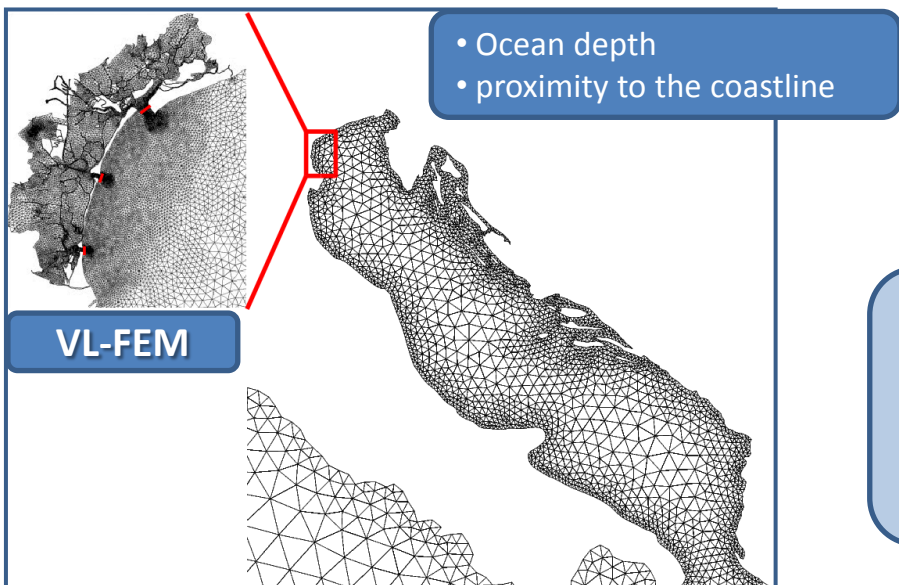
1) Tide modelling: Deterministic approach

The model

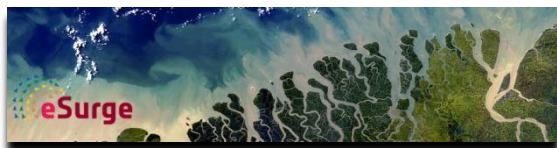
Simplified version of SHYFEM 2D (Shallow Water Hydrodynamic Finite Element Model)

Forcings

- Wind and pressure forecast (ECMWF – resolution: 0.5 degrees, every 6 hours)
- Wind and pressure forecast (BOLAM – resolution: 0.1 degrees, 1 hour)



The Mediterranean sea grid provides surge forecast for each node at hourly time steps. The Venice Lagoon grid is forced by the Mediterranean one.



2) Operational models running at ISPRA

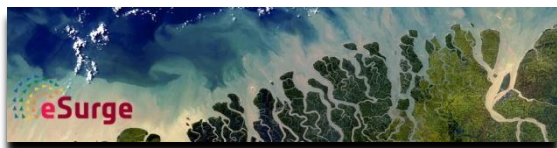
Running models

Weater Forecast/ Model	ECMWF (55 km)	BOLAM (11 km)
Statistical	1	2
Deterministic Low Resolution (LR)	4*	6*
Deterministic High Resolution (HR)	5*	7*

Models ID Nr.

ECMWF (4*, 5*)		
	Standard	Data assimilation
LR grid	4s	4a
HR grid	5s	5a

BOLAM (6*, 7*)		
	Standard	Data assimilation
LR grid	6s	6a
HR grid	7s	7a



2) Models scheduling

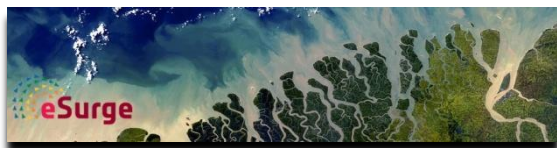
Nr. of forecasts	ECMWF/ day	BOLAM/ day	Sites of forecast	Nr. of daily forecasts	Nr. of yearly forecasts
Statistical	8	8	7	112	40.880
Deterministic Low Resolution (LR)	2	2	9	36	13.140
Deterministic High Resolution (HR)	2	2	9	36	13.140

Number of daily and annual forecast output currently running at ISPRA

Total number of forecasts per year: ~ 67.000

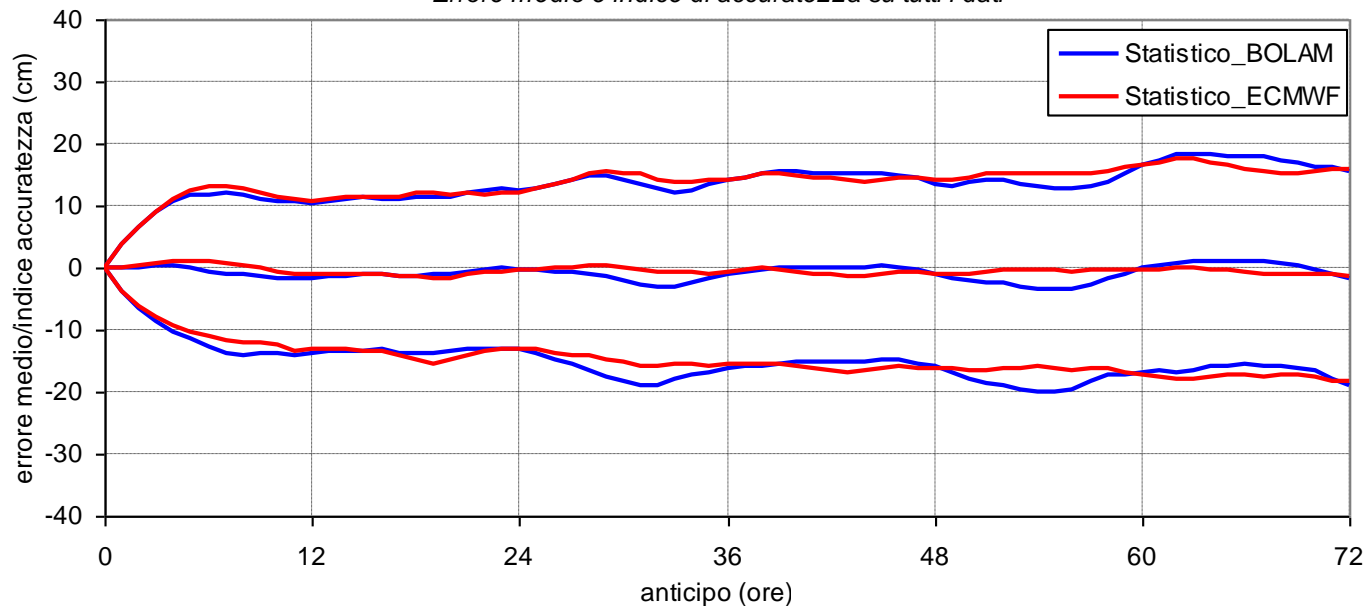
Model #	Operational since
1	Feb 2009
2	Oct 2012
4, 5	Mar 2011
6, 7	Oct 2012
Data Assimilation	Aug 2012

Operational models and starting period



3) Forecast evaluation: stat models

Punta Salute - operativo 18/3/2012 - 30/6/2013
 Errore medio e indice di accuratezza su tutti i dati

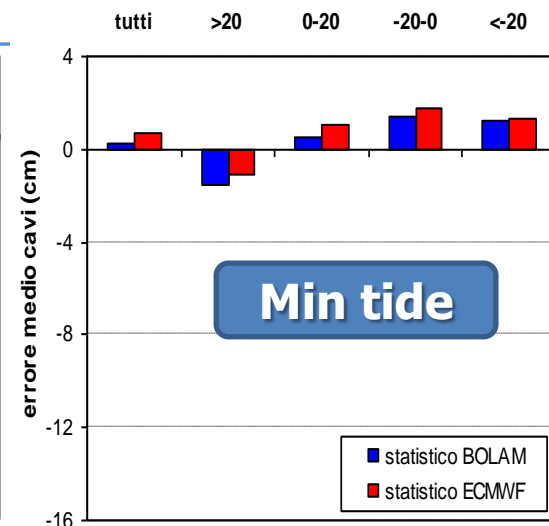
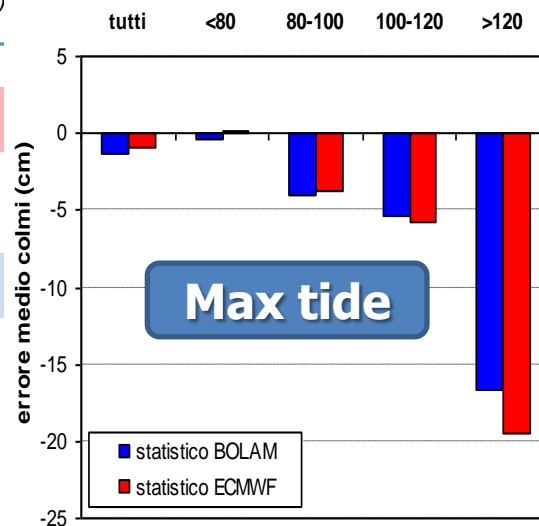


Mean error (ϵ) and accuracy index ($\epsilon \pm 2\sigma$) at different times.

ECMWF —
 BOLAM —

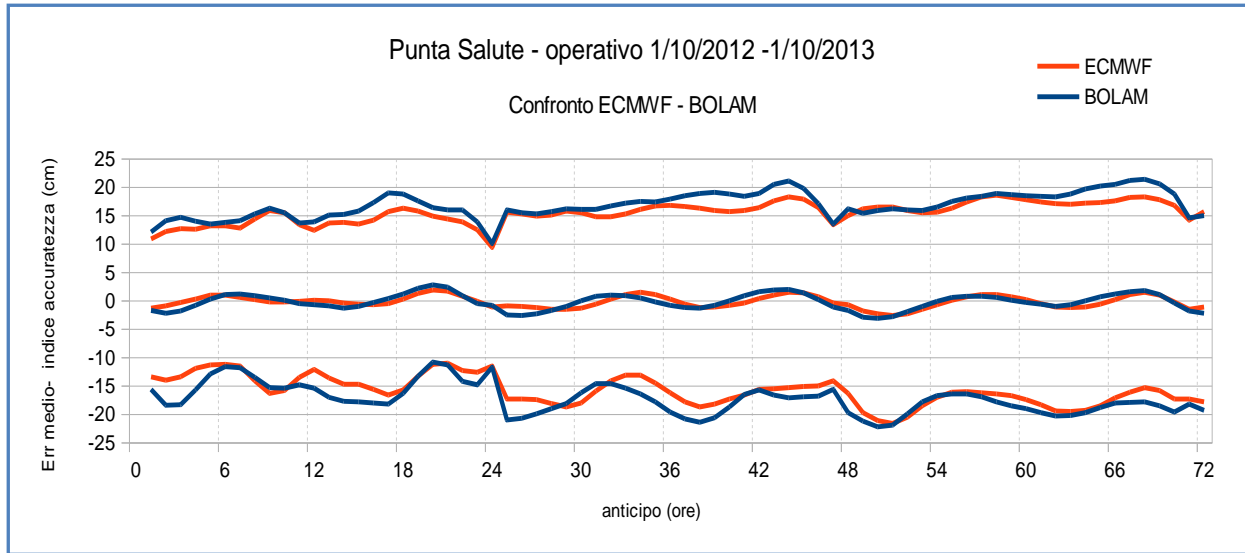
Mean error per tide classes – ECMWF forcing

Mean error per tide classes – BOLAM forcing





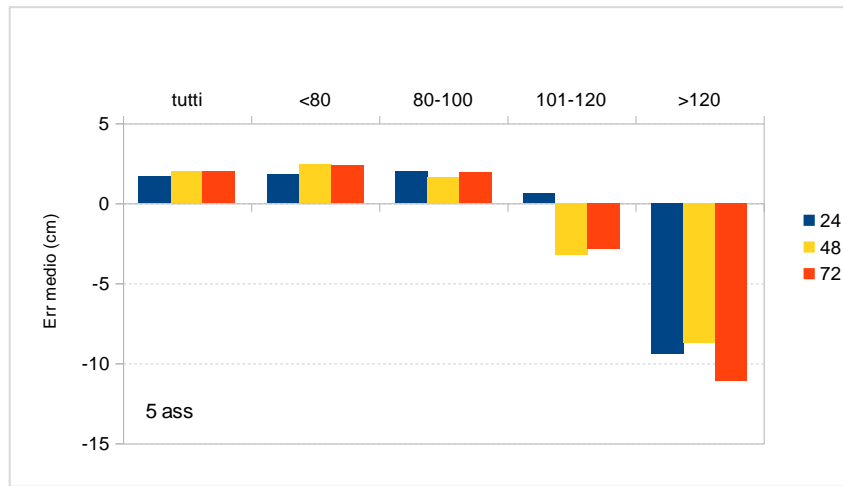
3) Forecast evaluation: det models



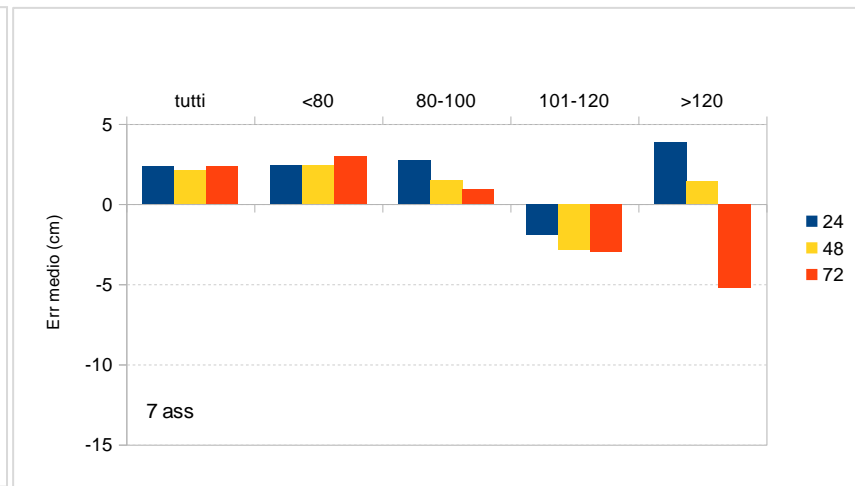
Mean error (μ) and accuracy index ($\mu \pm 2\sigma$) at different times.

ECMWF

BOLAM



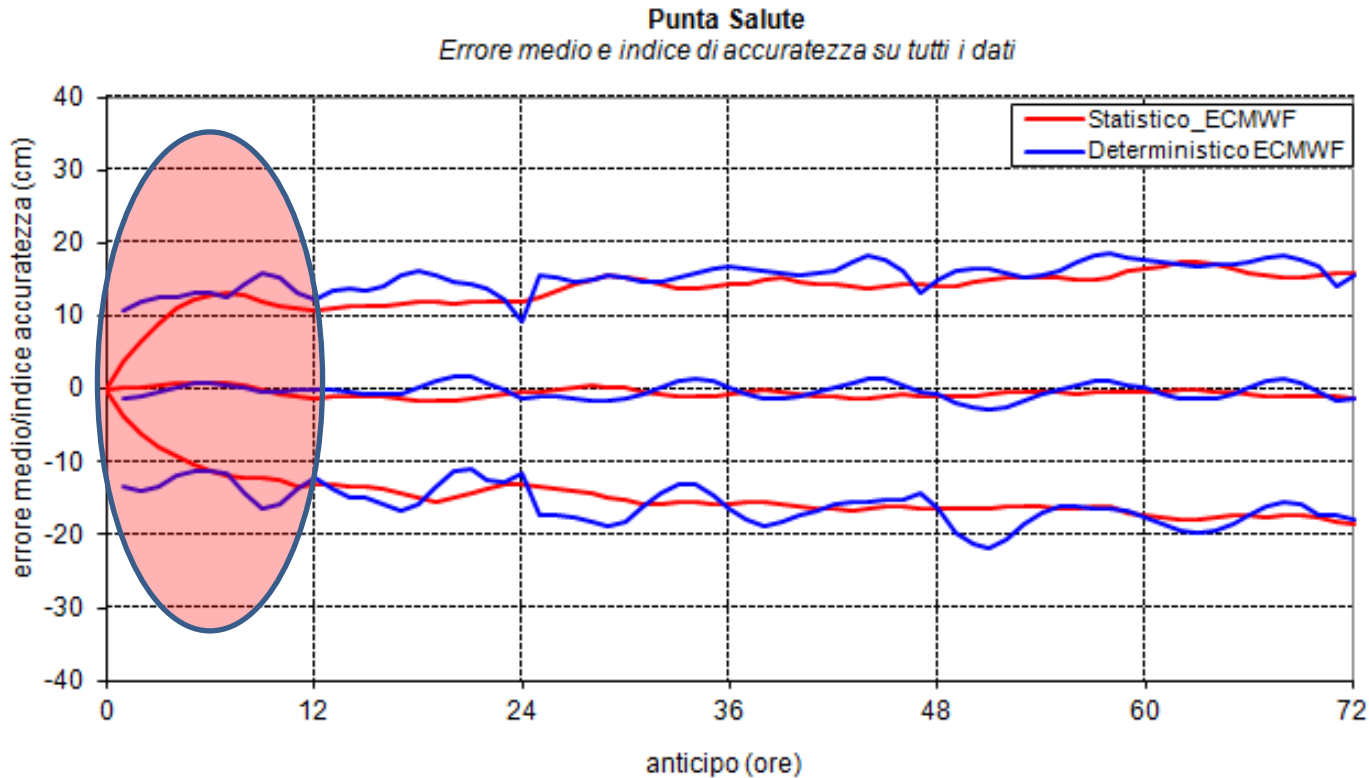
Mean error per tide classes – ECMWF forcing



Mean error per tide classes – BOLAM forcing



3) Forecast evaluation: comparison



Statistical and deterministic models: a comparison

The first 12 hours are better evaluated by the statistical approach. In the following hours the quality is comparable.

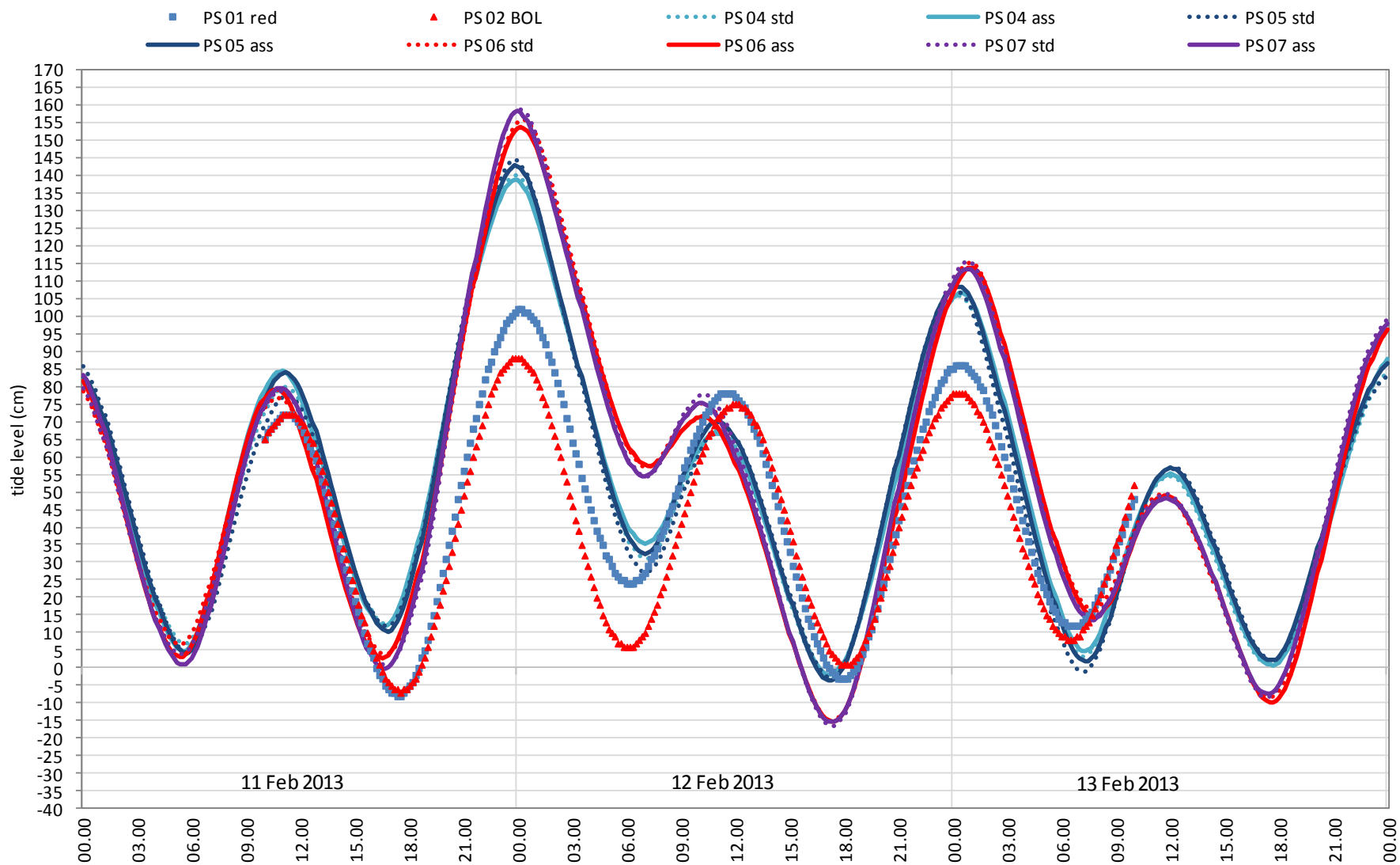
Note that for tide classes > 100 cm the deterministic approach fits better the observed tide.

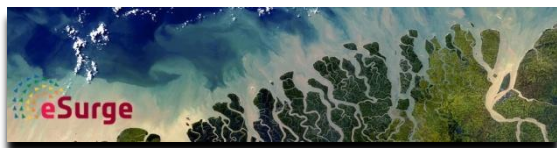
4) **A case study**:
**when the choice
becomes difficult**



4) Case study: 11th Feb 2013: forecast

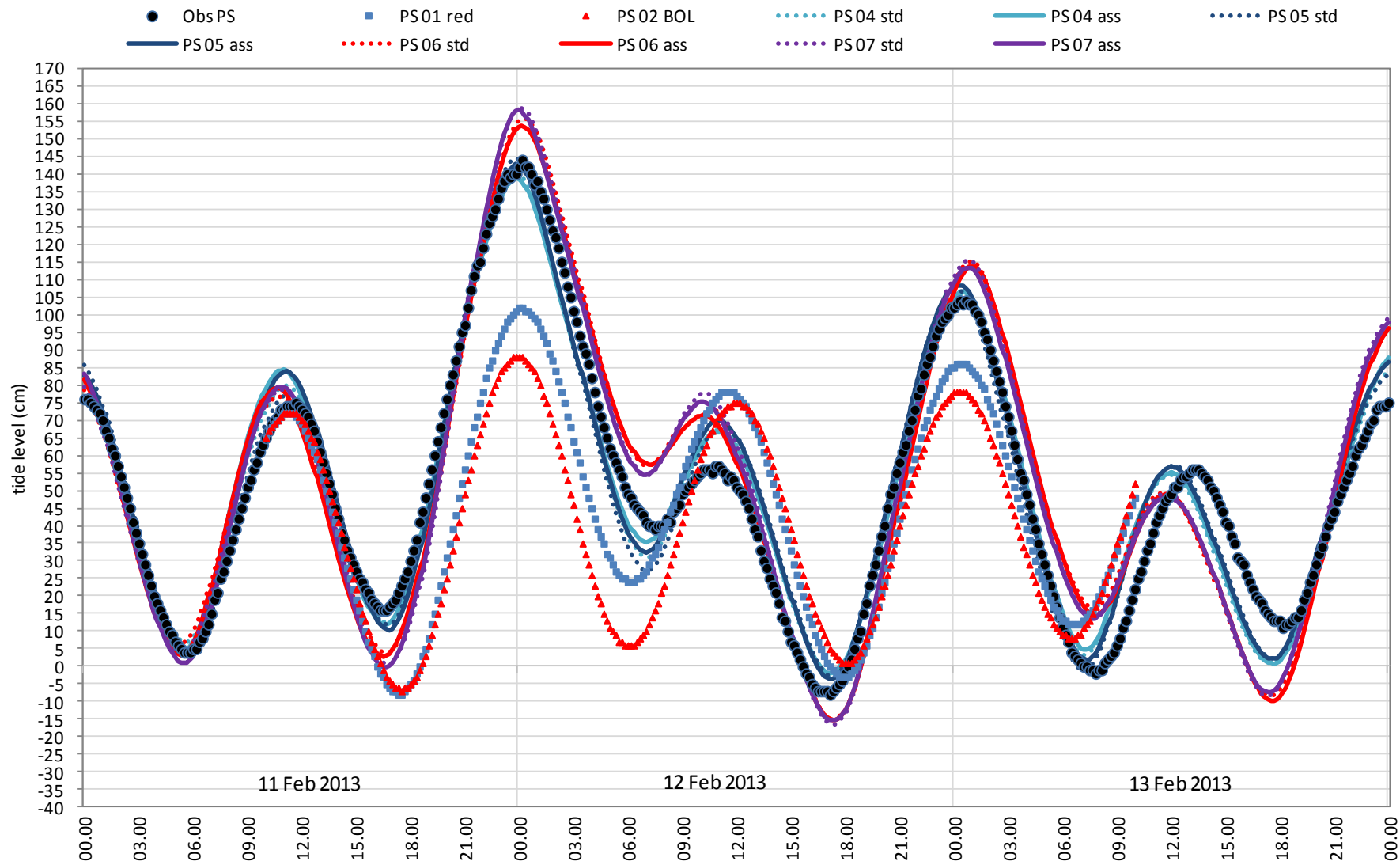
Venice Punta Salute - forecasts of the 11th Feb 2013

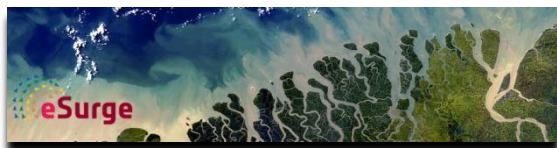




4) Case study: 11th Feb 2013: observations

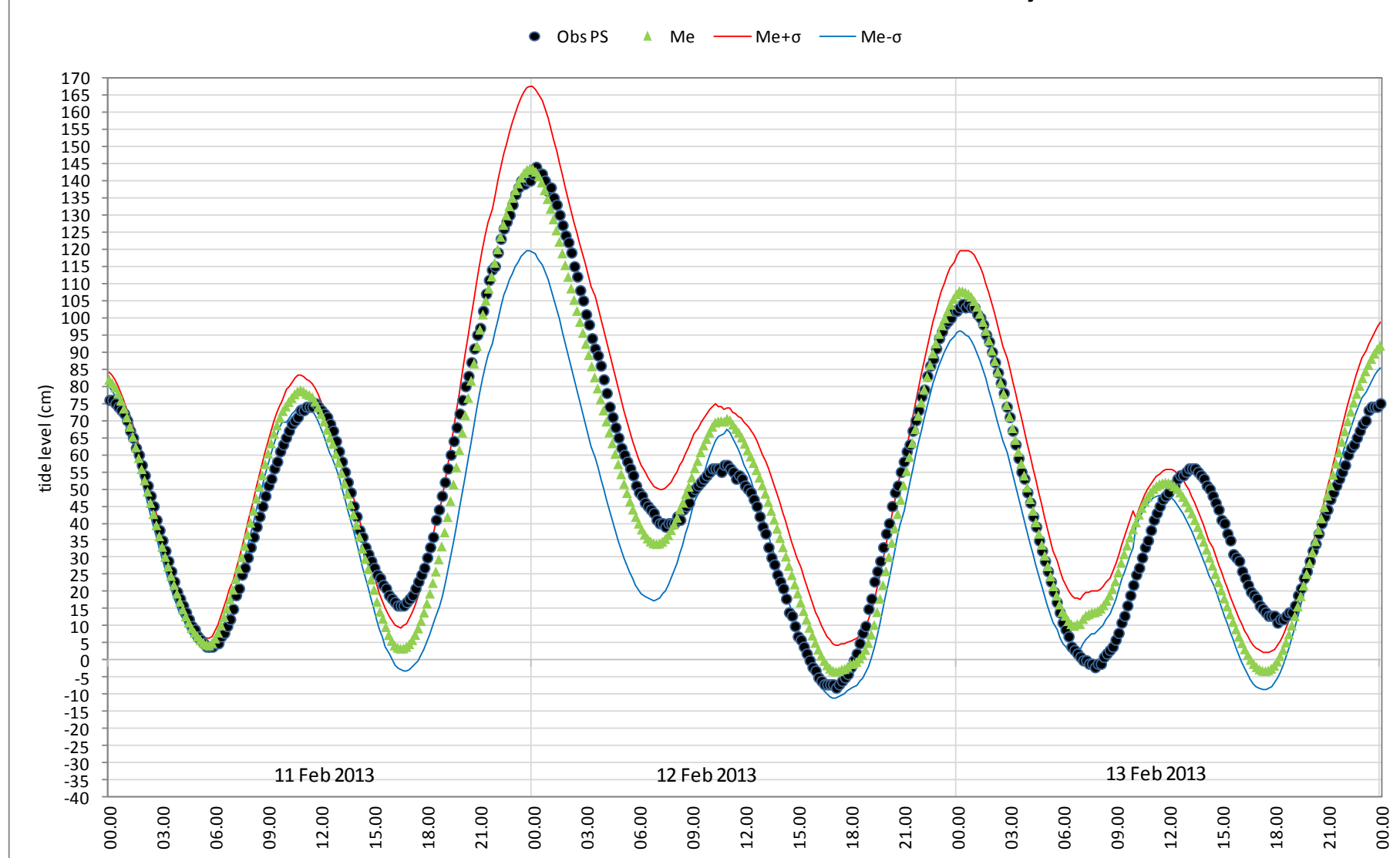
Venice Punta Salute - forecasts of the 11th Feb 2013





4) Case study: 11th Feb 2013: solved?

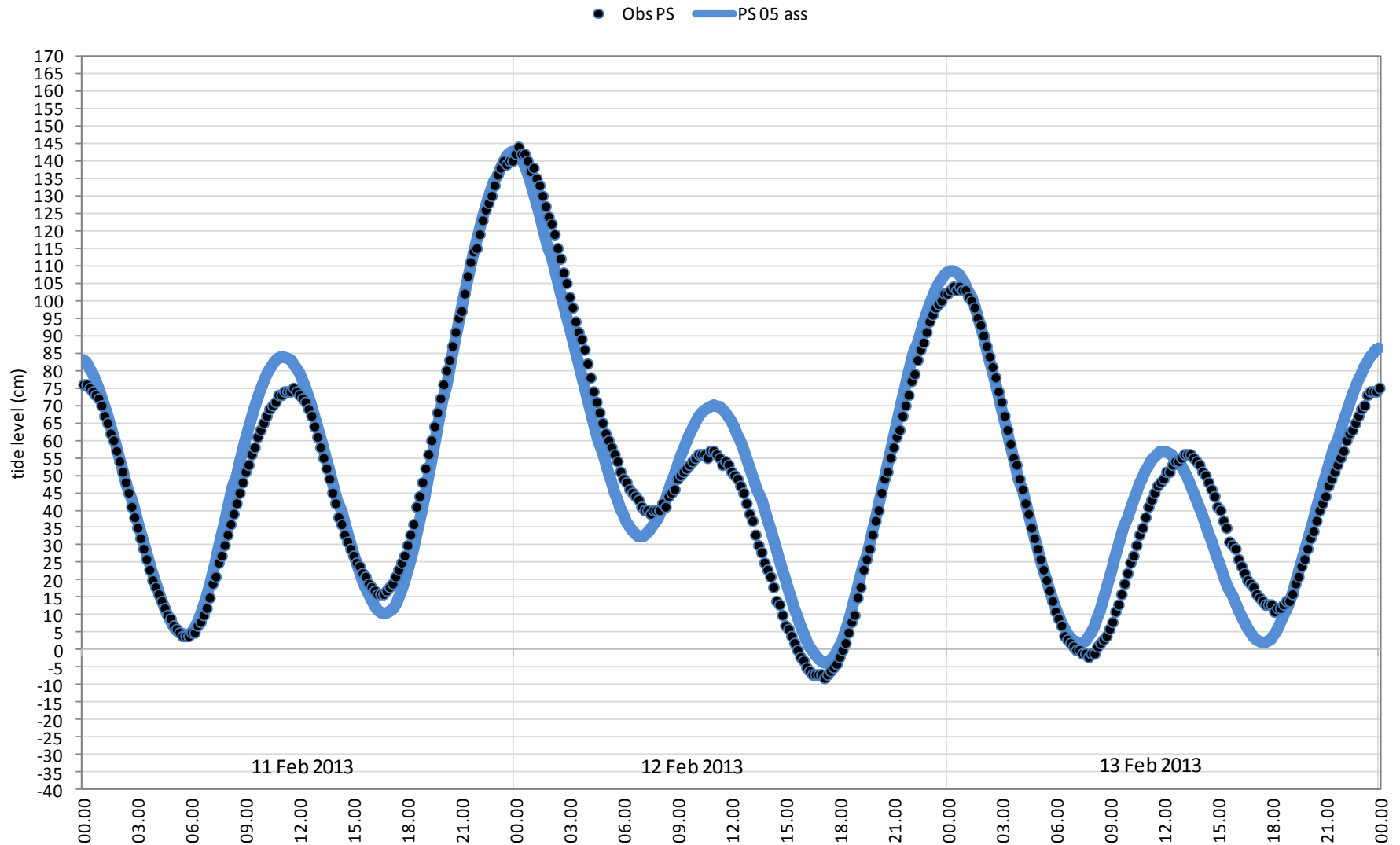
Venice Punta Salute - forecast of the 11th Feb 2013: synthesis





4) Case study: 11th Feb 2013: the choice

Venice Punta Salute - forecast of the 11th Feb 2013: the adopted choice



5) FUTURE CHALLENGES



To do list

INPUT IMPROVEMENTS

• New observation sites:

- RON buoys in the Adriatic (wind, pressure, wave obs data)
- Tide gauges in the eastern shores (tide, pressure, wind)

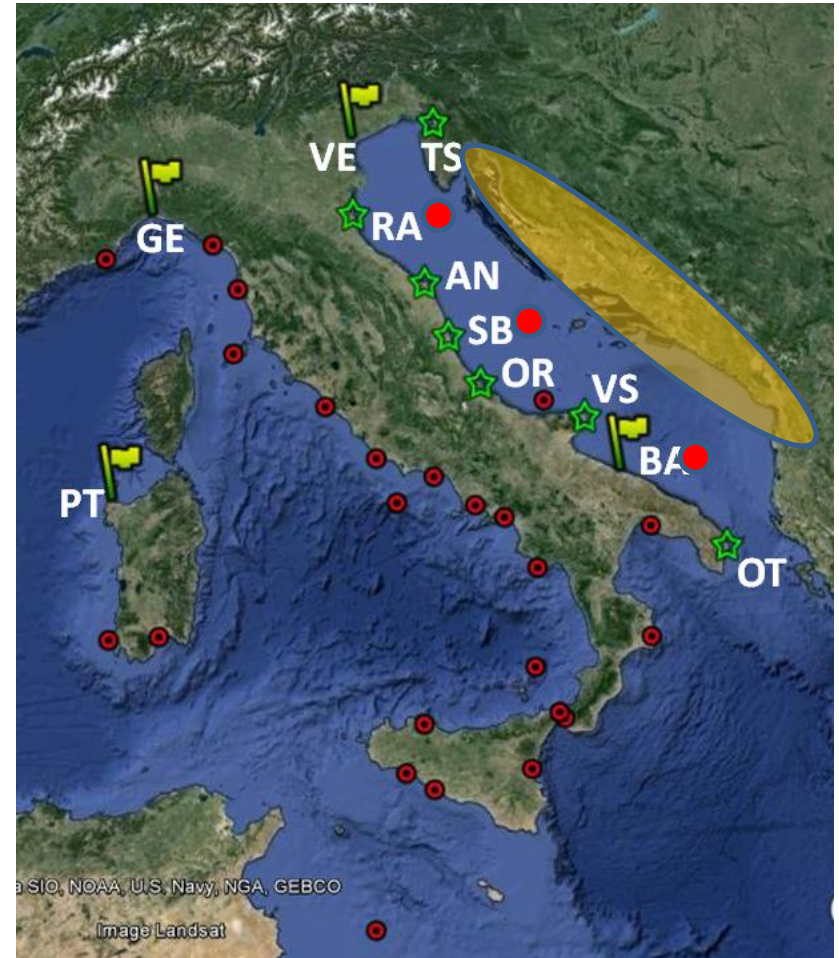
- **New weather forecasts** (e.g. Bolam at 7.8 km and Moloch at 2.5 km grid)

OUTPUT IMPROVEMENTS

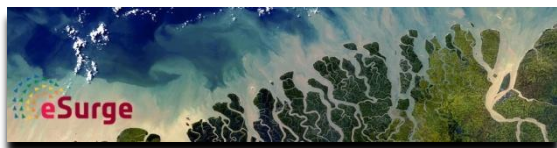
- **New forecast sites:** all Venice Lagoon inlets, River Po Delta;
- **Surge maps** for the entire Northern Adriatic Sea;

5) What's next? Open issues

Observed data

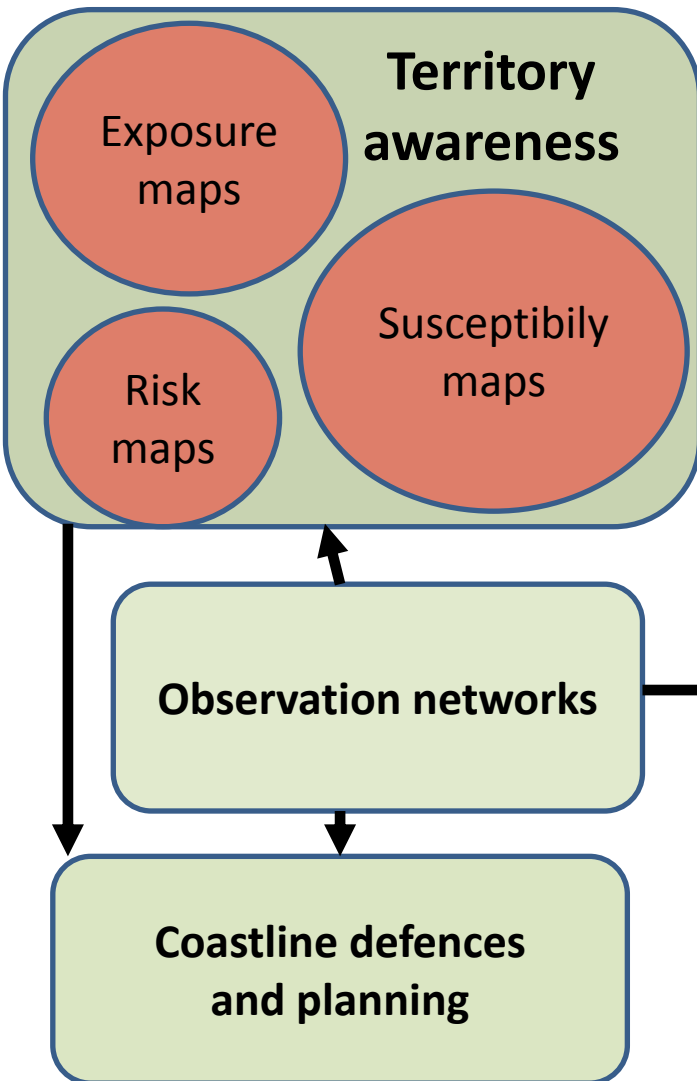


Obs need for a better forecasting

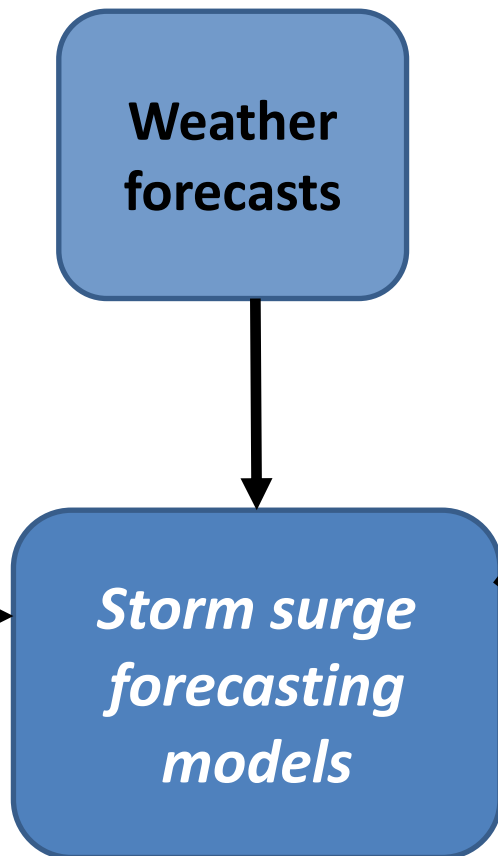


What for?

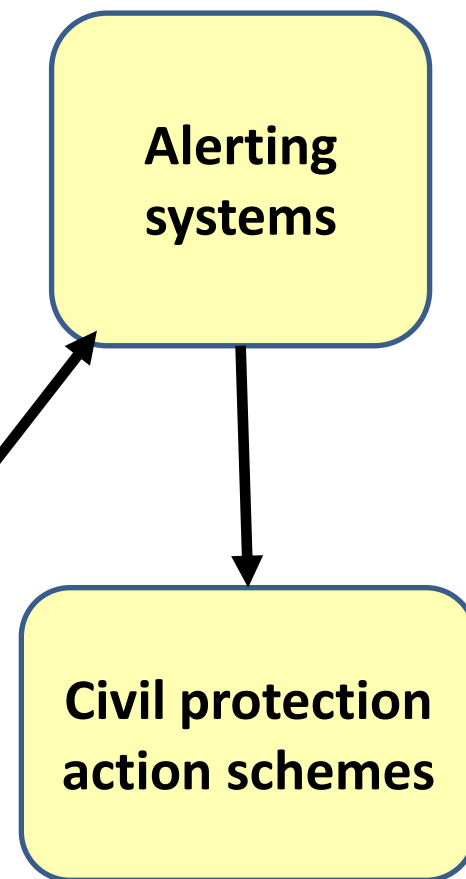
ANALYSIS AND PLANNING



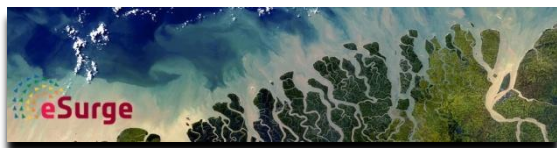
FORECASTING



DECISION



The debate is open.....



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THANK YOU

Real time data

Tide forecast

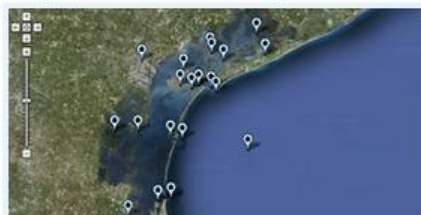
Laguna di Venezia



Il Servizio Laguna di Venezia è inserito nel Dipartimento Tutela Acque Interne e Marine dell'Istituto Superiore per la Protezione e la Ricerca Ambientale (ISPRA). Il Servizio gestisce la **Rete Mareografica della Laguna di Venezia e del litorale Nord - Adriatico (RMLV)**. Le attività principali riguardano la divulgazione di dati ed elaborazioni delle osservazioni RMLV, la previsione della marea e delle acque alte e la promozione di attività di ricerca che riguardano l'ambiente lagunare.

Rete Mareografica Laguna di Venezia

Mappa della Rete Mareografica



Mappa interattiva delle stazioni

Dati in tempo reale

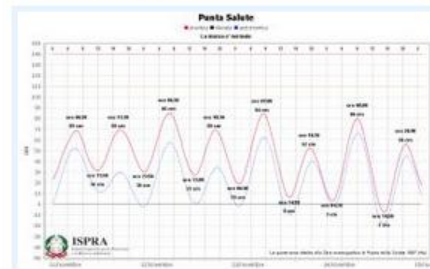


Istantanea sulla laguna di Venezia

Previsioni - Bollettino della marea in alto Adriatico

Le previsioni di marea sono riferite allo Zero Mareografico di Punta Salute (1897).

Punta della Salute



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Consorzio per il
Coordinamento delle
attività di ricerca inerenti
il sistema lagunare
(C.O.R.I.L.A.)