Med Sea Re-analysis

The Mediterranean Sea long term reanalysis in the NextData project

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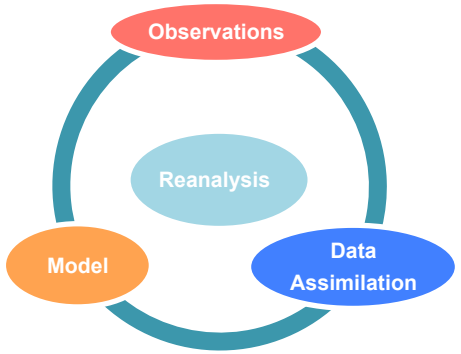
Outlines

1. What is a reanalysis?
2. System description
3. Validation protocols/results
4. Summary

Definition: A *reanalysis* is a retrospective data assimilative experiment that, using the same ocean model and data assimilation scheme throughout the simulation period, allows the production of a realistic and consistent four-dimensional description of the full (all physical, gap free) ocean state.

Requirements

- Same ("*frozen*") ocean model throughout the period (resolution, parametrizations etc)
- Same ("*frozen*") data assimilation scheme (formulation, background and observation error covariance etc)
- Avoid abroupt change in the quality of the boundary conditions (e.g. atmospheric fluxes)
- Use quality checked and corrected observational datasets (delayed mode dataset, when available)

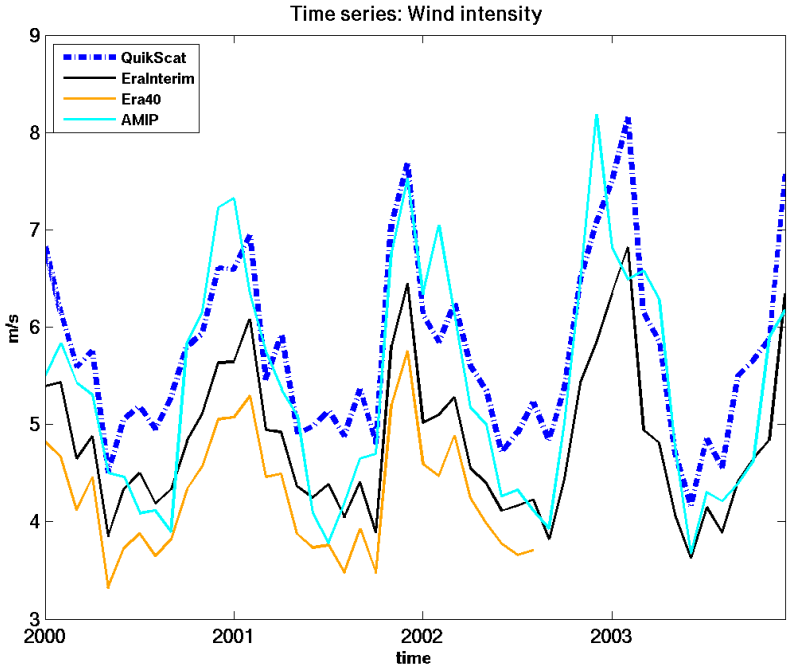


Atmospheric forcing analysis

Name	Source	Time range	Assimilation	Space resolution	Time resolution
AMIP	CMCC	1898 - 2015	None	1.125° x 1.125°	12-hourly fields
ERA-Interim	ECMWF	1979 - present	4D - VAR	0.75° x 0.75°	6-hourly fields
ERA-40	ECMWF	1958 - 2002	4D - VAR	1.125° x 1.125°	6-hourly fields

Parameters

- Mean sea pressure
- Total cloud cover
- Zonal wind component
- Meridional wind component
- 2m Temperature
- 2m Dew point Temperature



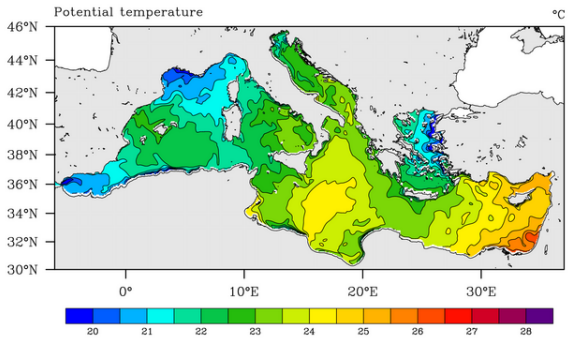
Satellite and In-situ Observations

Data Type	Source
SLA	AVISO-CMEMS SL TAC
ARGO	Coriolis and CMEMS INSITU TAC
XBT	MEDAR/MEDATLAS, MFS, CMEMS INSITU TAC
CTD	SeaDataNet, MEDAR/MEDATLAS, MFS, CMEMS INSITU TAC

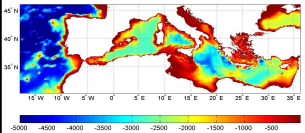
The core of the reanalysis system

In Situ Data:
XBTs, CTDs, bottles, ARGO
(Temperature and Salinity)

Forcing:
AMIP
(bulk formula)



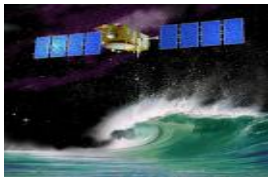
Ocean Model
NEMO (1/16°)



Assimilation schemes
3Dvar

Nudging to SST (Hadley)

Satellite Data
SLA Altimetry



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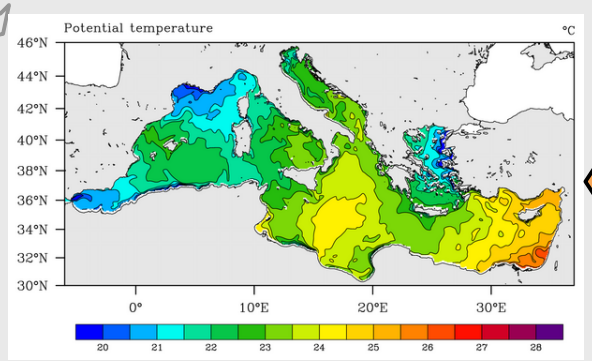

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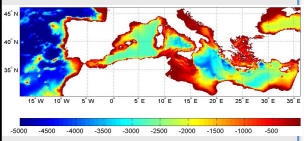

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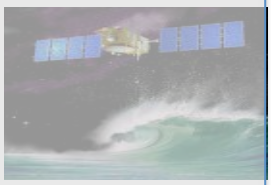

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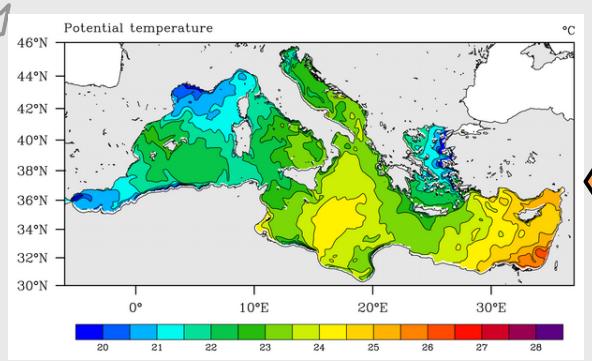

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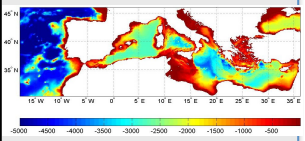

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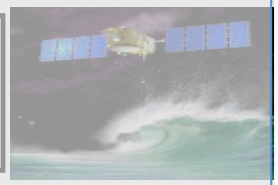

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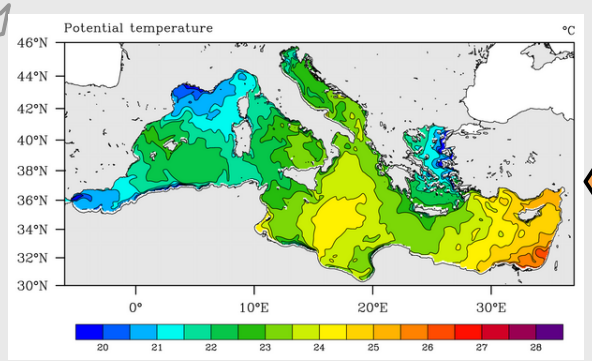

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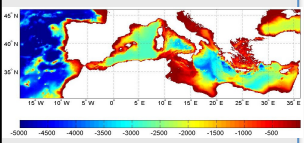

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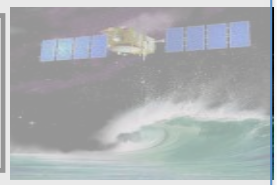

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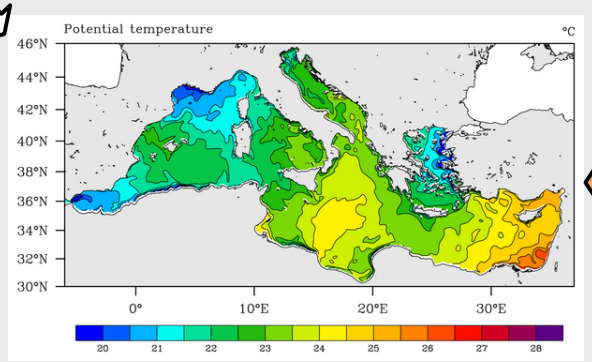

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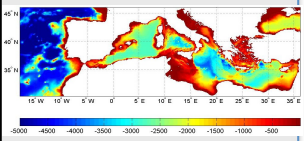

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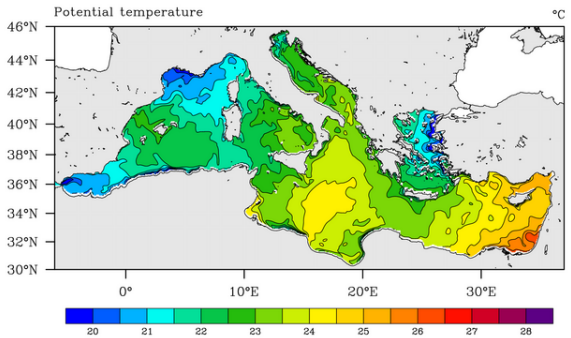

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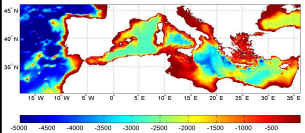

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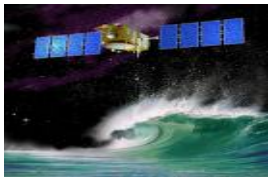
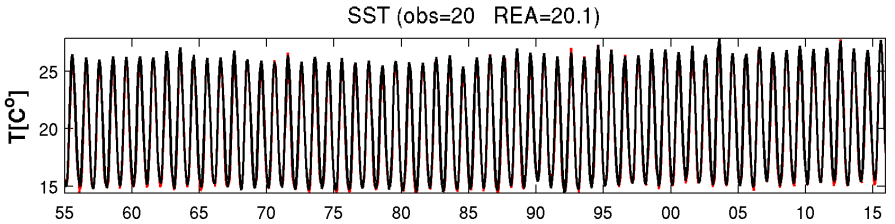


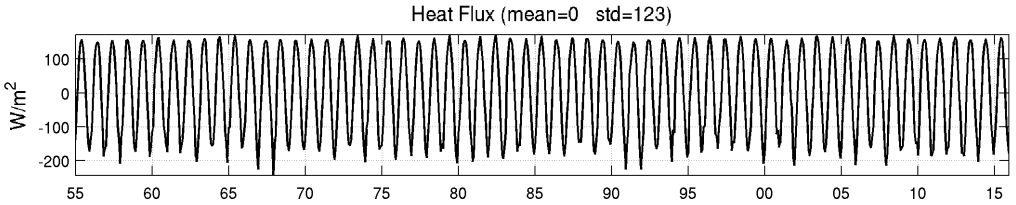
International standards: GODAE metrics

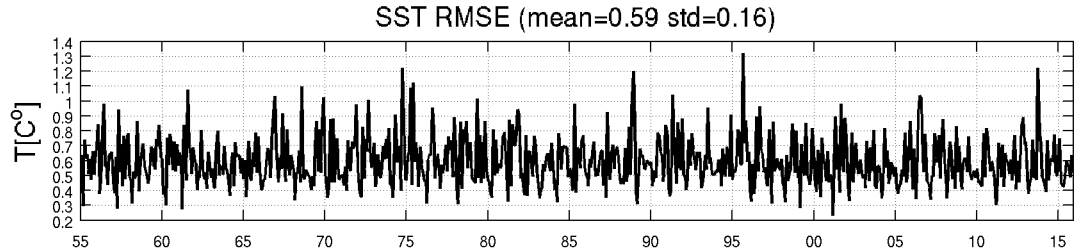
- **Consistency** (with current knowledge of ocean and climatologies)
- **Quality** (accuracy of analysis)
- **Perfomance** (accuracy of forecast)

- **Class1**: long term maps vs reference datasets (2D fields on standard grids)
- **Class3**: derived “integrated” quantities (T, S volume, fluxes)
- **Class4**: model values at location and time of observations (“in-situ point of view”)

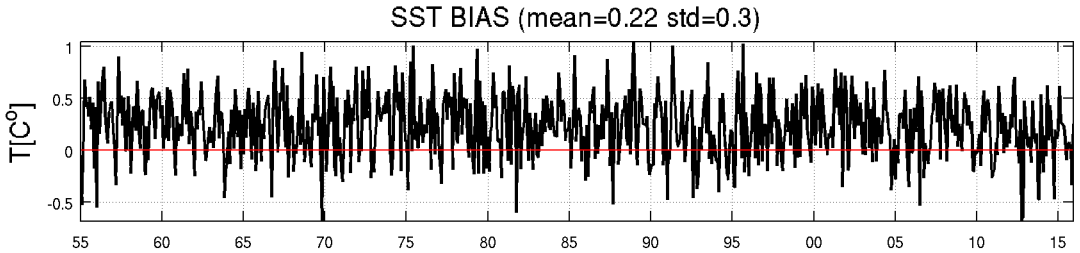
Sea Surface Temperature







Increased error during summer period



Warm bias

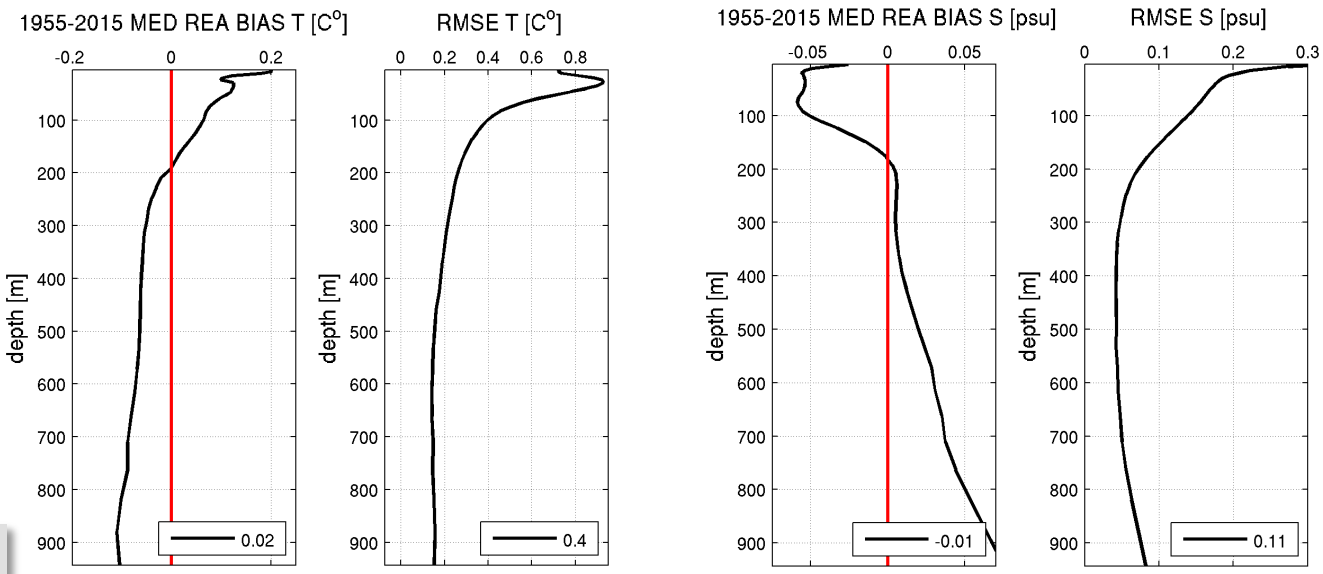
Insitu Data

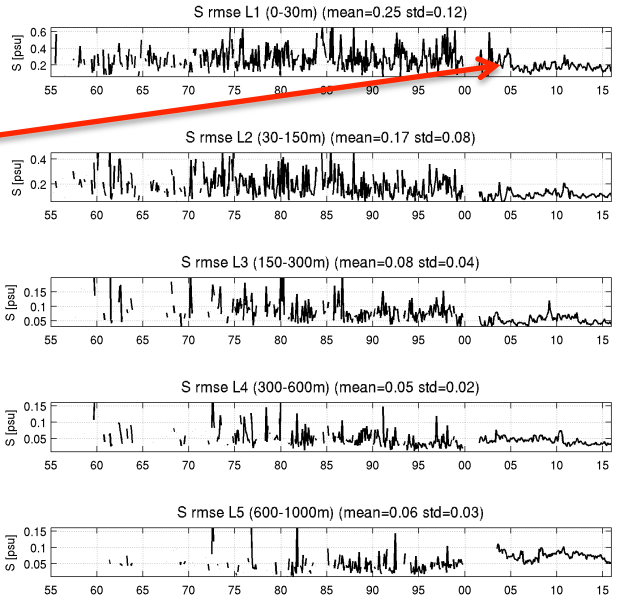
$m=[y-h(x^f)]$

T RMS peaks at ≈ 30m

S RMS maximum at surface

Less error with ARGO network

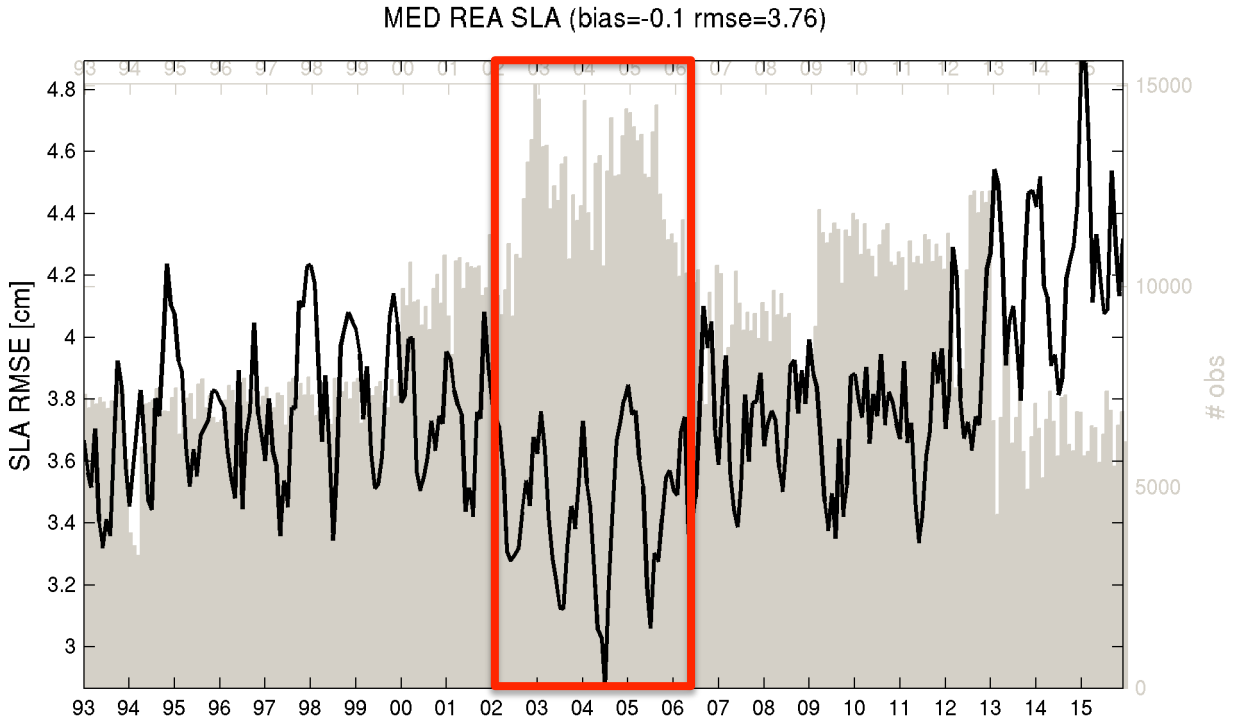




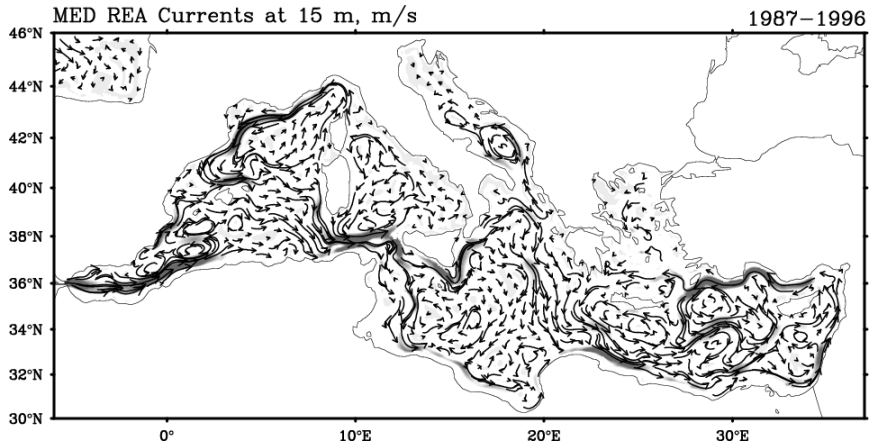
Sea Level Anomaly

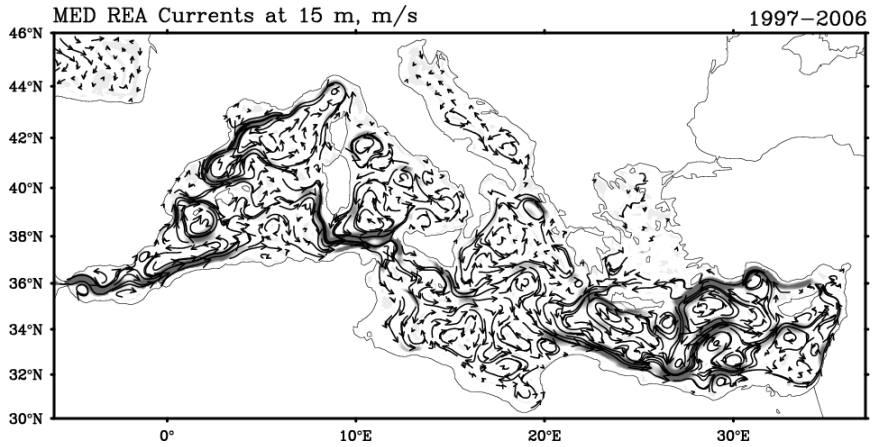
$m=[y-h(x^f)]$

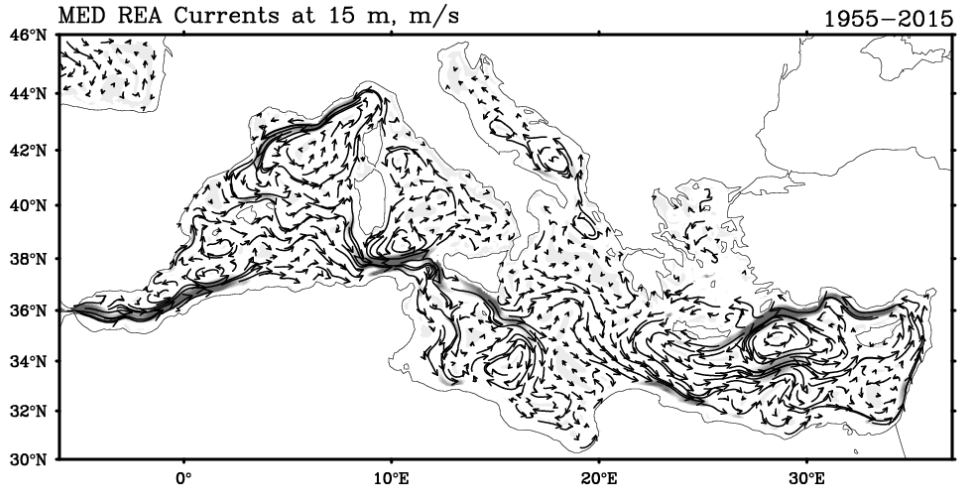
RMS <-> # Observations



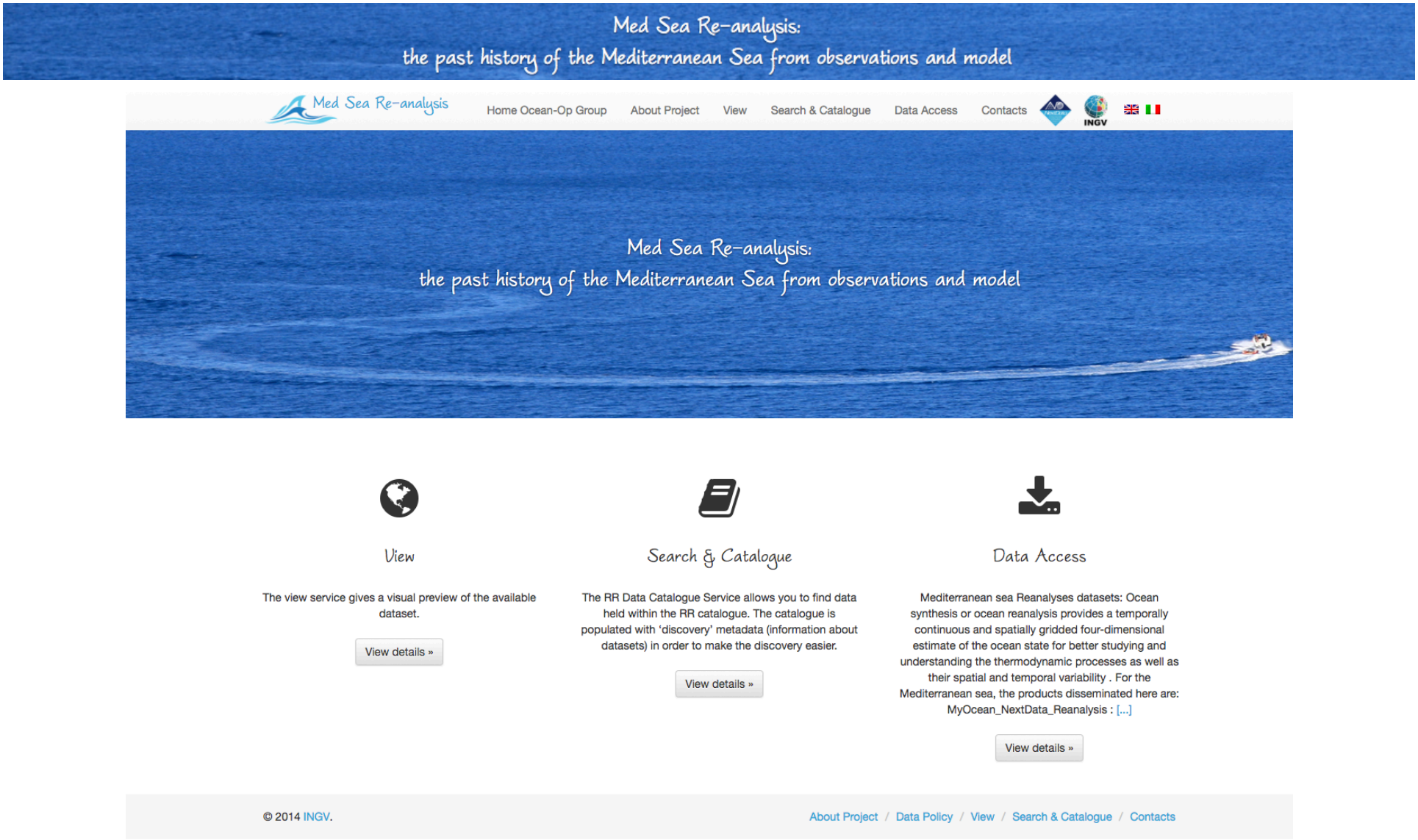
Currents







Pinardi et al., 2015



http://medsearr.bo.ingv.it/

Summary

- First 60 years reanalysis dataset has been produced and assessed for the entire time period 1955-2015
- It is a good quality time and space consistent reanalysis product which is a crucial characteristic of a reanalysis in order to provide the most coherent and consistent state of the ocean within the considered time period.
- It can be used to assess decadal variability of the Mediterranean Sea

Thanks