An observing system simulation experiment for an operational model of the Iberian SW Coast

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UAlg UNIVERSIDADE DO ALGARVE
fct Fundação para a Ciência e a Tecnologia
CiMA Centre for Marine and Environmental Research
ARNET AQUATIC RESEARCH NETwork

NAUTILOS

Revolutionising ***underwater sensing*** and ***sampling technology*** for **ocean observation**

Cost-effective **marine** instrumentation targeting a range of **Essential Ocean Variables** that can be integrated within existing, **low-energy consumption** platforms

13 types of cost-effective **sensors & samples**

70% biological & biogeochemical EOVs (Essential Ocean Variables covered

Scan Me for more information

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 101000825 (NAUTILOS).

Objectives

1. Design an OSSE System for the operational model SOMA.

   → Article manuscript

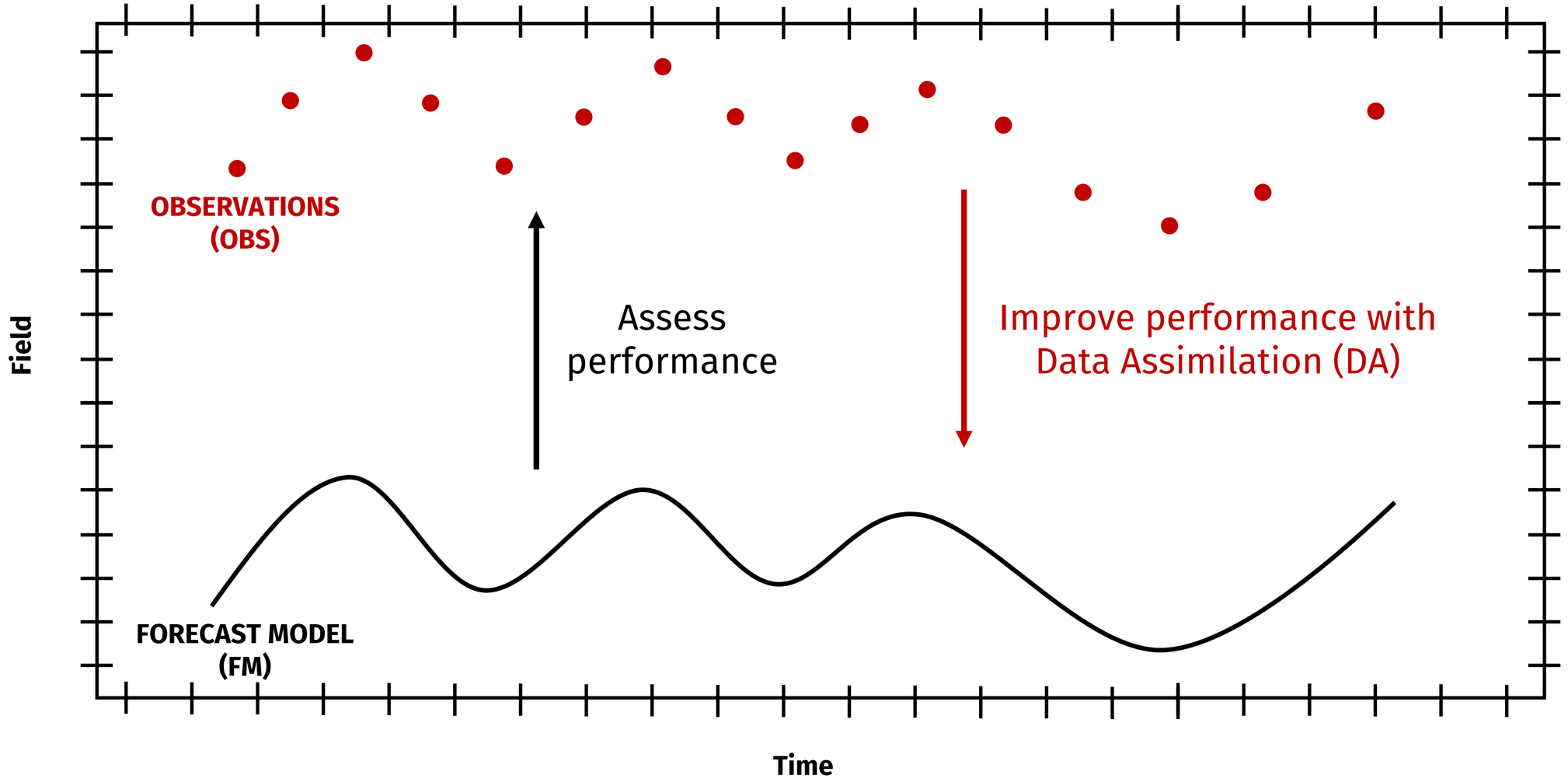
2. Use the OSSE System to test different observation scenarios.

   → Article planned (preliminary results)

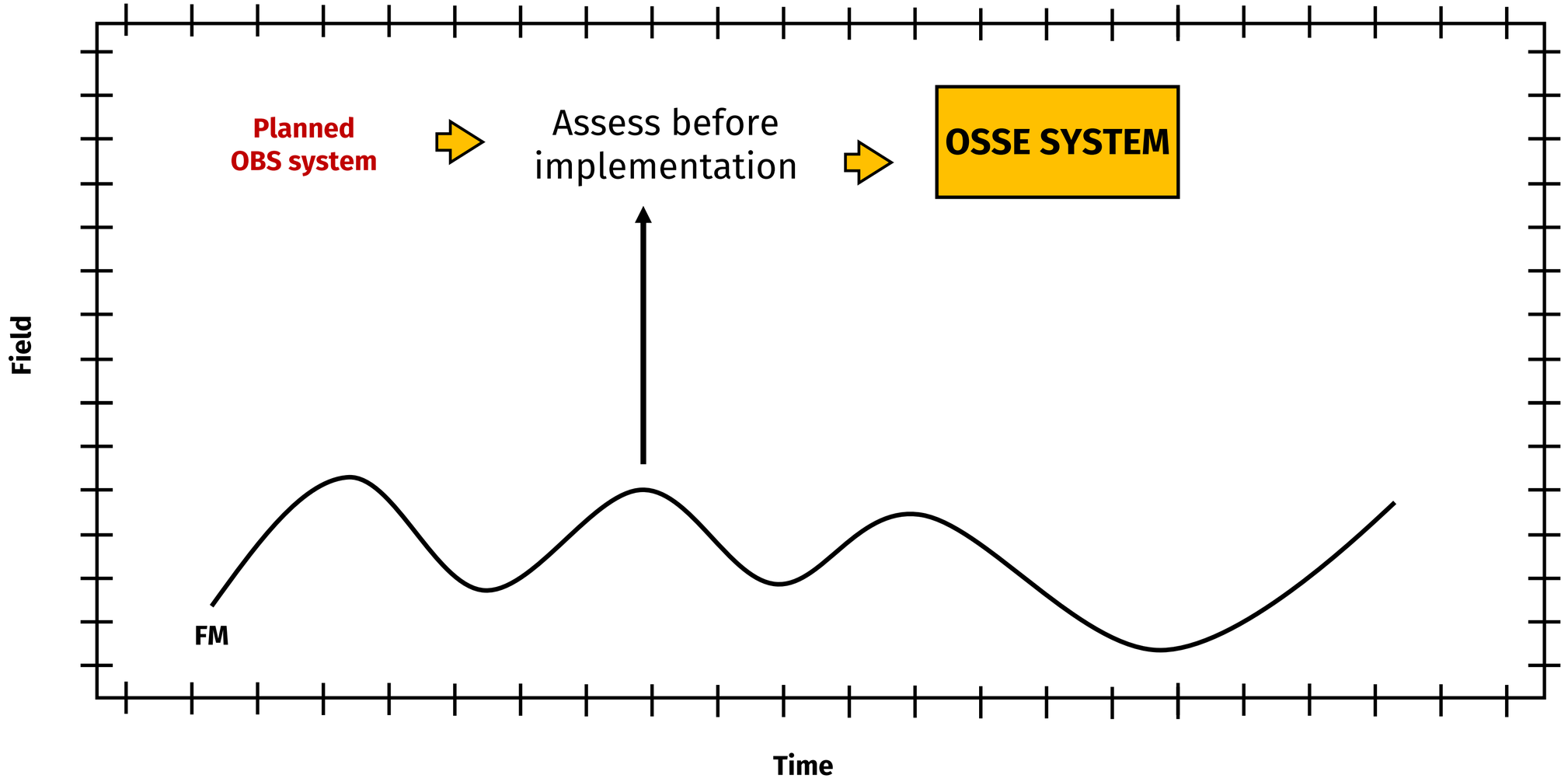
3. Apply the Data Assimilation System used in the OSSE to improve SOMA's forecasting capabilities.

   → Article planned (operational application)

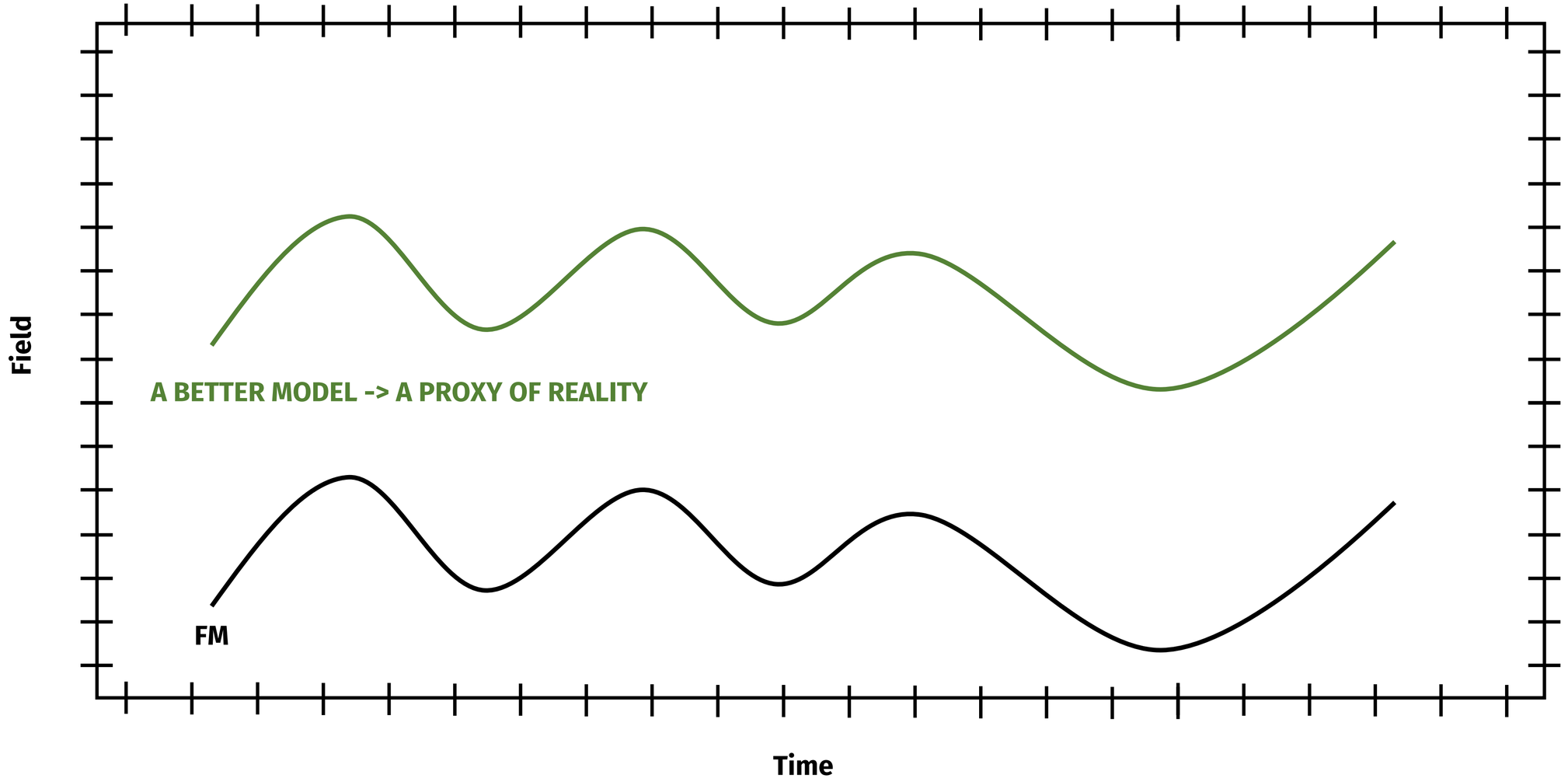
OSSE Concept



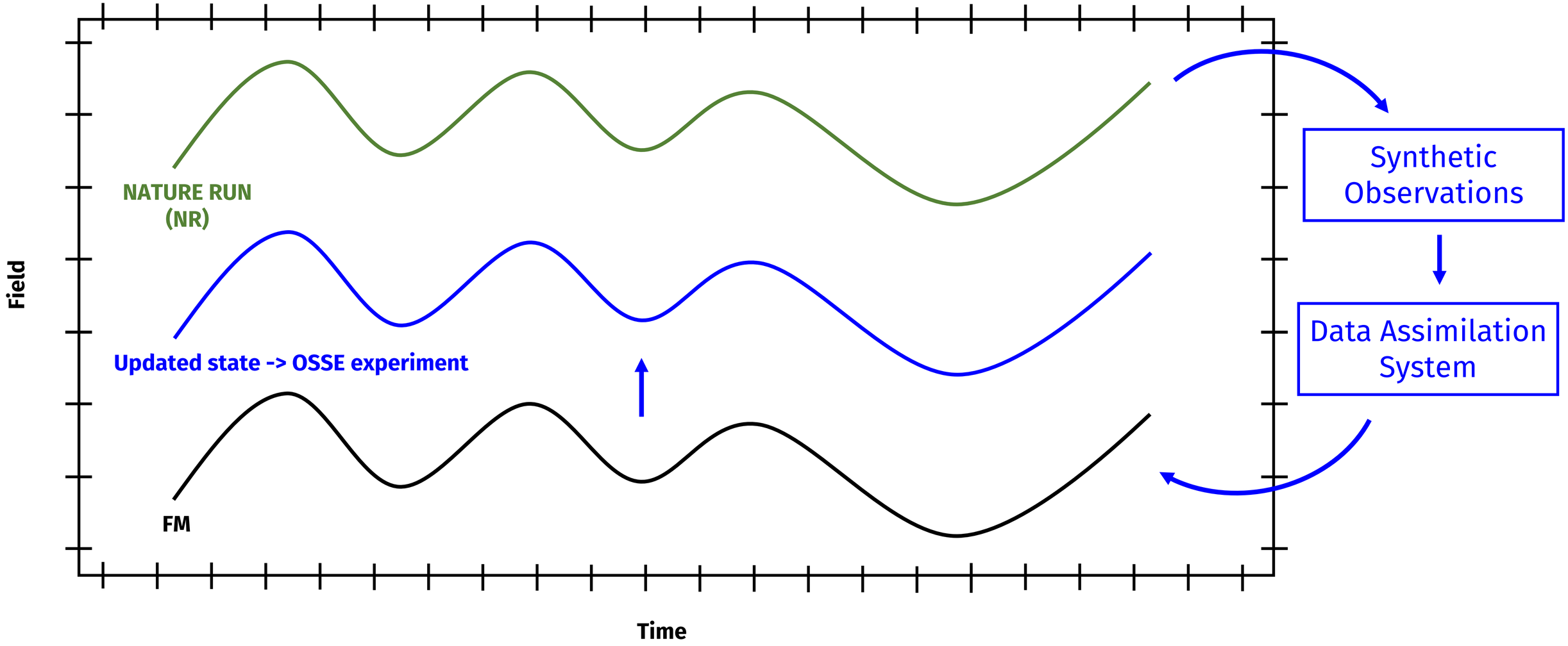
OSSE Concept



OSSE Concept



OSSE Concept



OSSE Concept

Synthetic Observations

1. Modulate realistic observation errors
2. Compare with a corresponding Observing System Experiment (OSE)

Real observations

OSSE validation

Avoids overestimating or underestimating the value of proposed observational systems, which leads to biased decision-making in sensor deployment.

SOMA OSSE System Components

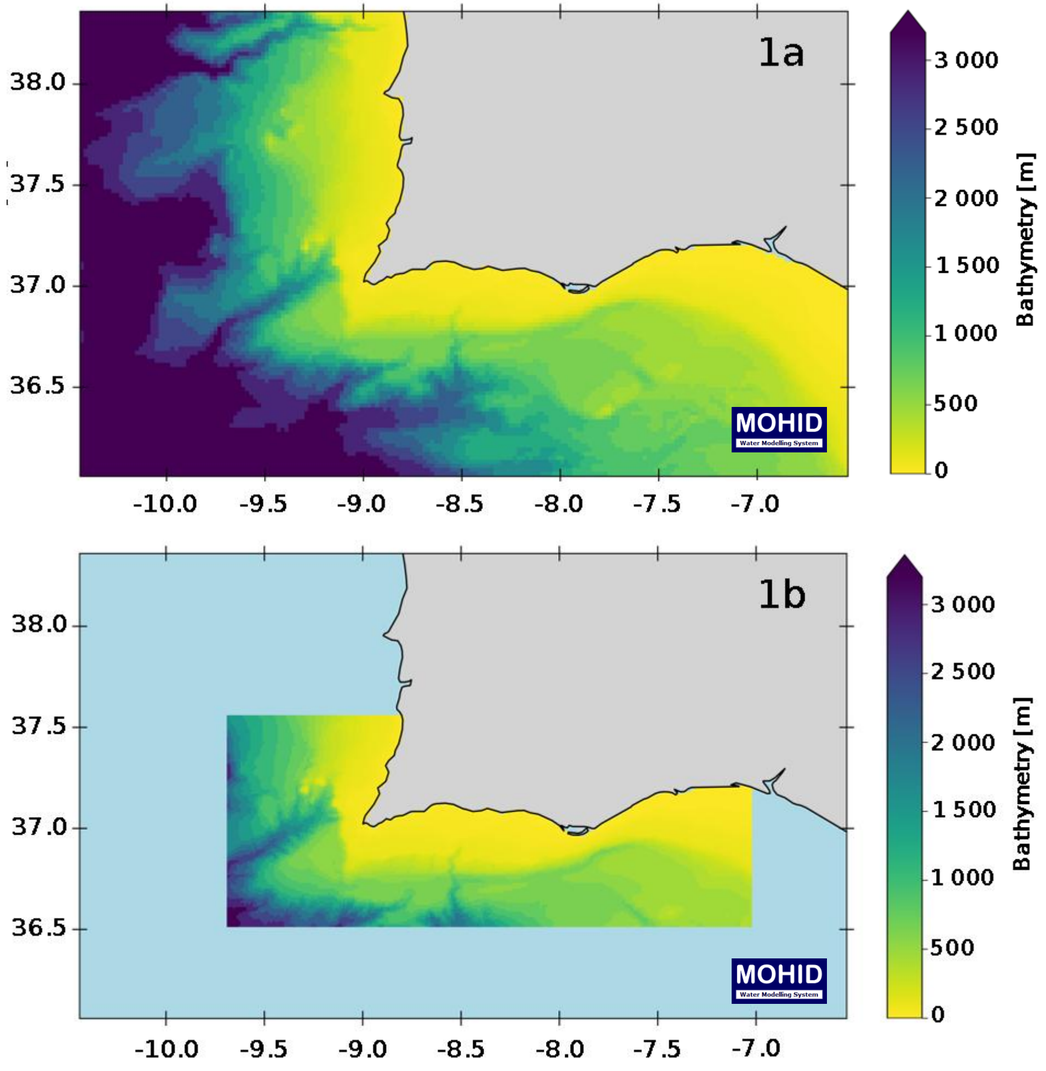
Algarve Operational Modelling and Monitoring System (SOMA)

Specifications

- MOHID-based
- Bathymetric data from EMODNET
- Downscaling domains:
  - 2 km resolution grid in Level 1
  - 1 km resolution grid in Level 2
- 50 cartesian coordinates layers

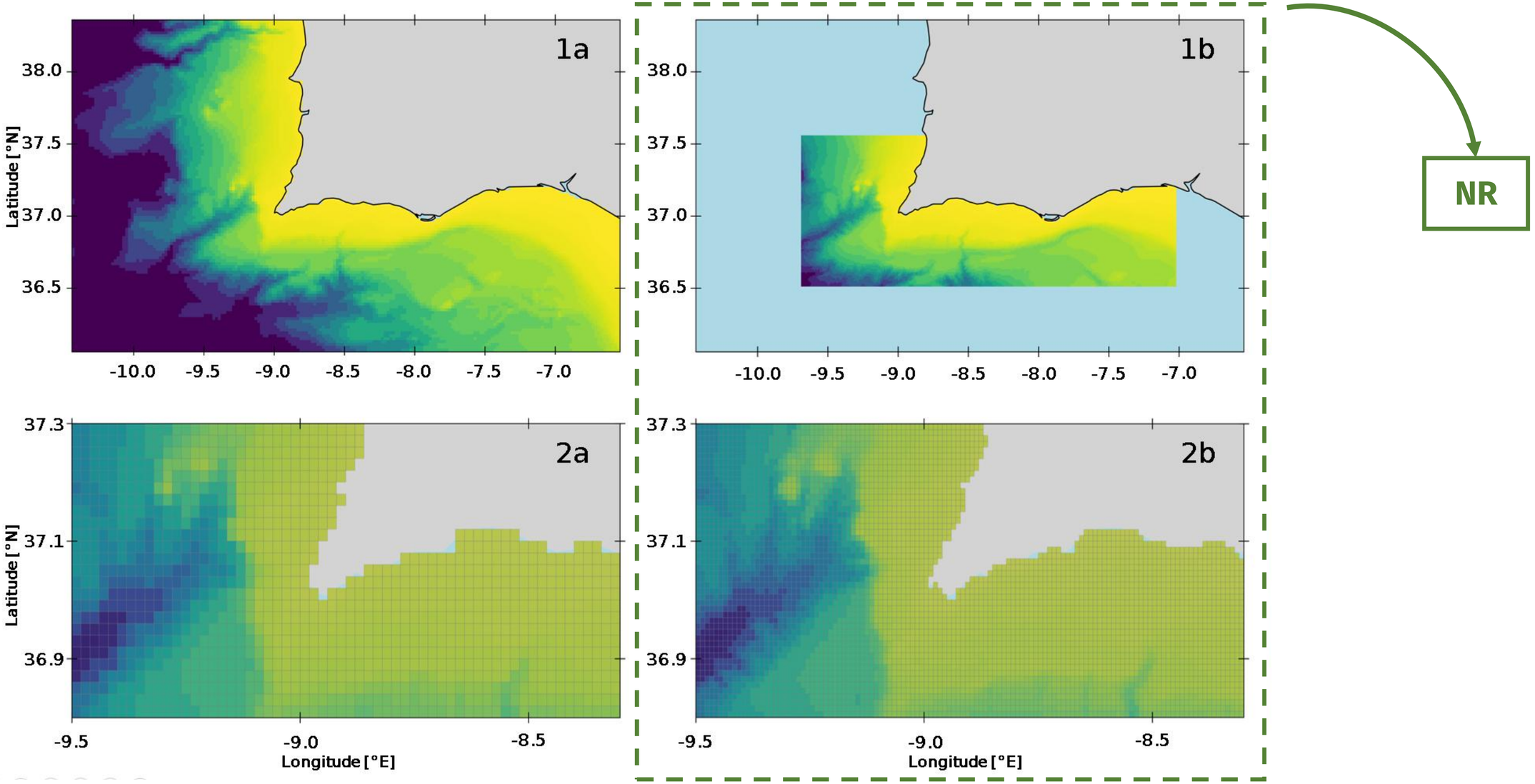
Boundary forcing

- Ocean : CMEMS Global solution → Weekly restart
- Atmosphere : SKIRON
- Tide : FES2014



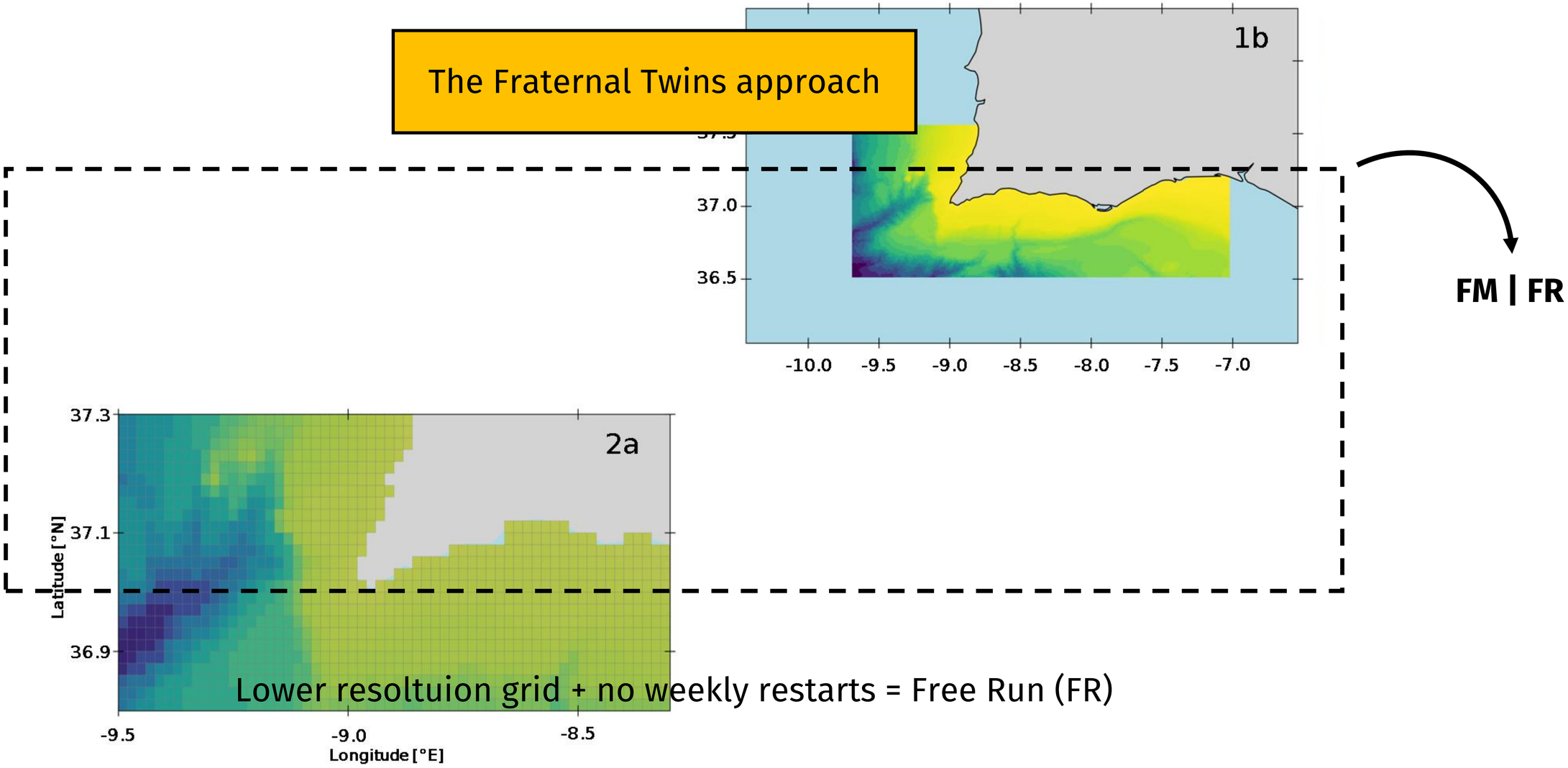
Forecast access and visualization: https://soma.ualg.pt

SOMA OSSE System Components



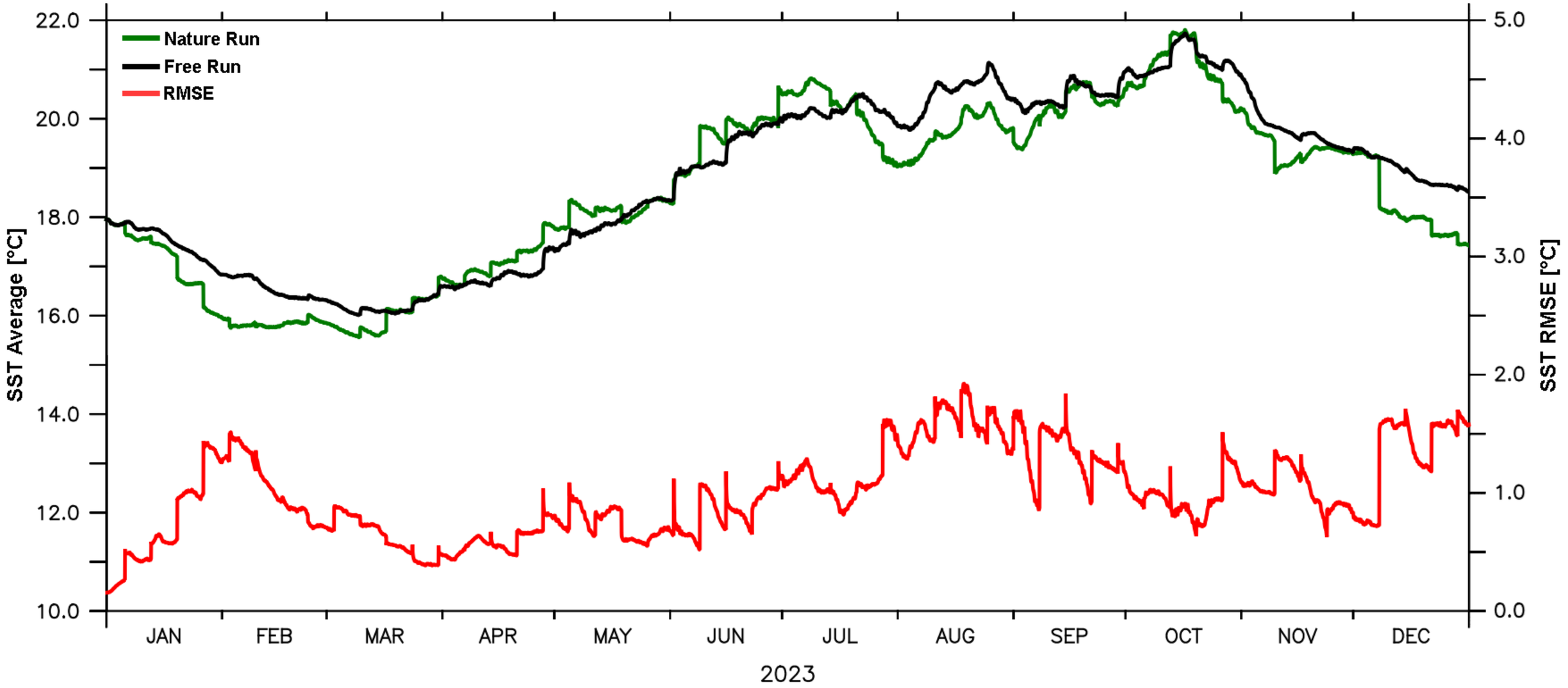
SOMA OSSE System Components

The Fraternal Twins approach



Lower resoltuion grid + no weekly restarts = Free Run (FR)

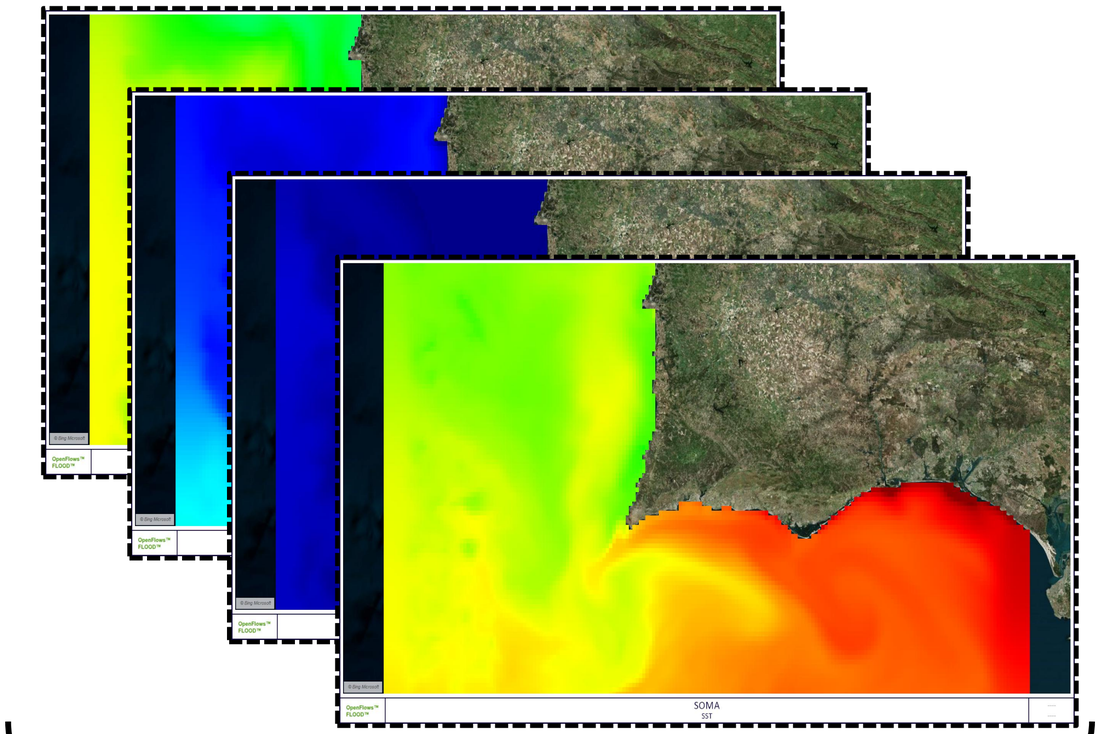
SOMA OSSE System Components



SOMA OSSE System Components

Data Assimilation (DA) System

- Ensemble Optimal Interpolation (EnOI) scheme.
  - Computationally cheap.
  - Time-invariant error statistics: model error is obtained from a fixed ensemble of the model anomalies.



1 model state for every 25h over a 1-year integration

Catch system variability

354 ensemble members

OSSE Experiments Design

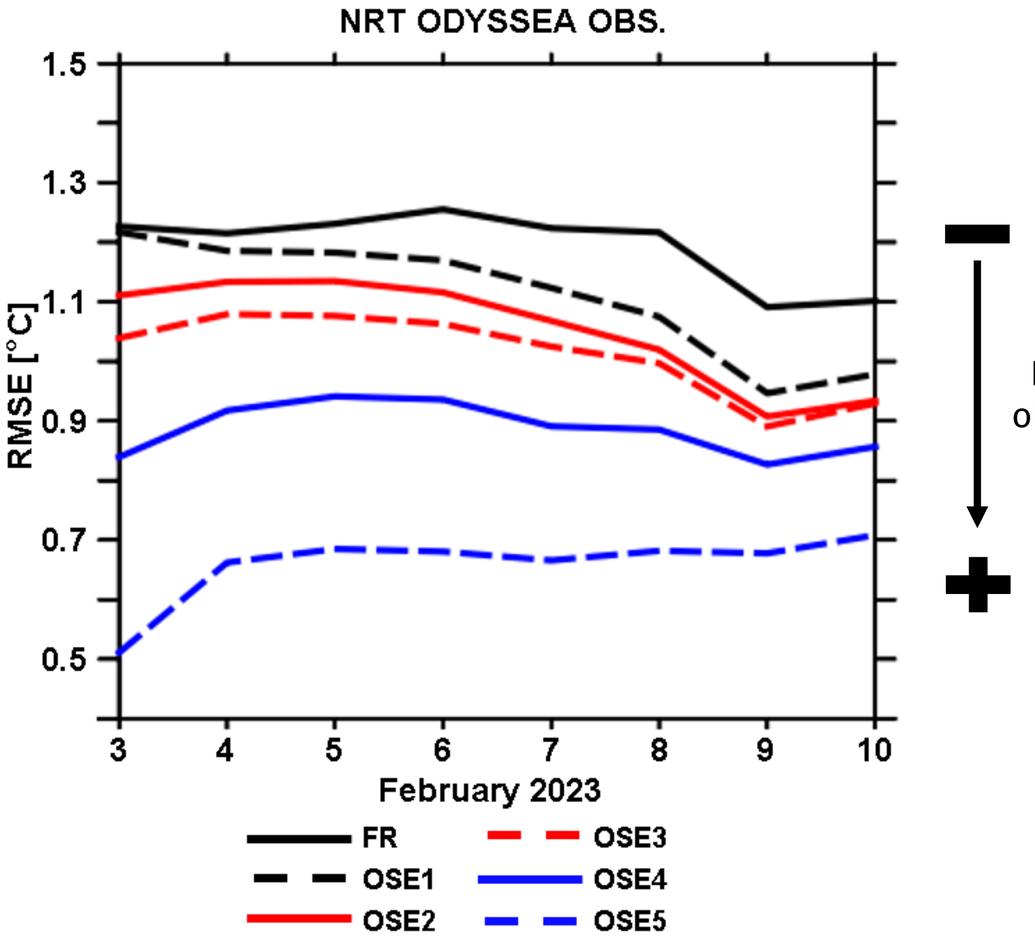
Experiment	Number of Points	Data Source	Observation Error
OSE_1	10	CMEMS NRT ODYSSEA	from data source
OSE_2	50		
OSE_3	100		
OSE_4	200		
OSE_5	500		
$OSSE_1$	10	SOMA Natue Run	$NRT\_ODYSSEA \times random\_field_1$
$OSSE_2$	50		$NRT\_ODYSSEA \times random\_field_2$
$OSSE_3$	100		$NRT\_ODYSSEA \times random\_field_3$
$OSSE_4$	200		$NRT\_ODYSSEA \times random\_field_4$
$OSSE_5$	500		$NRT\_ODYSSEA \times random\_field_5$

Random points

Modulated error

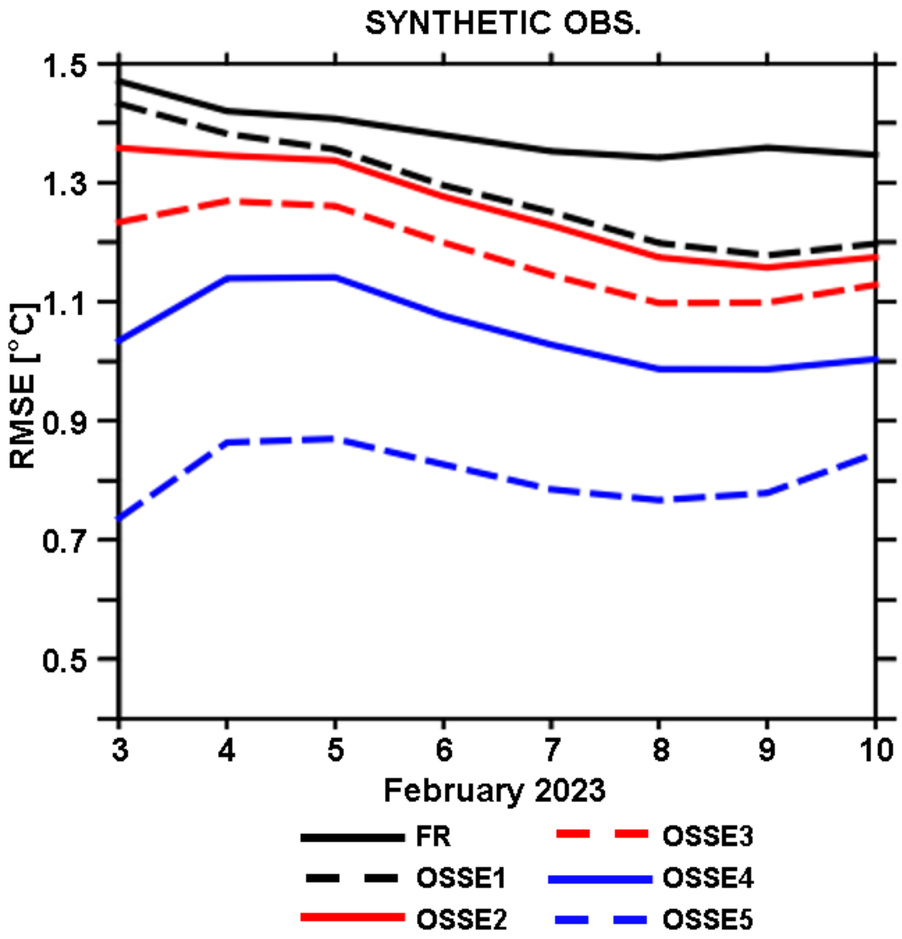
OSSE System Results

RMSE against Satellite



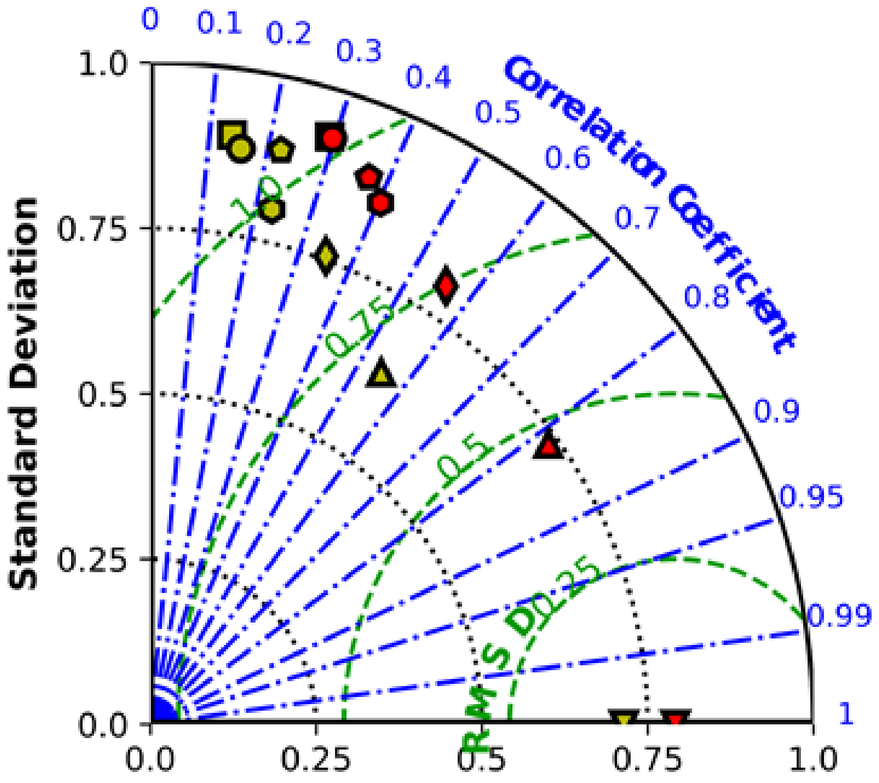
Number of observations

RMSE against NR

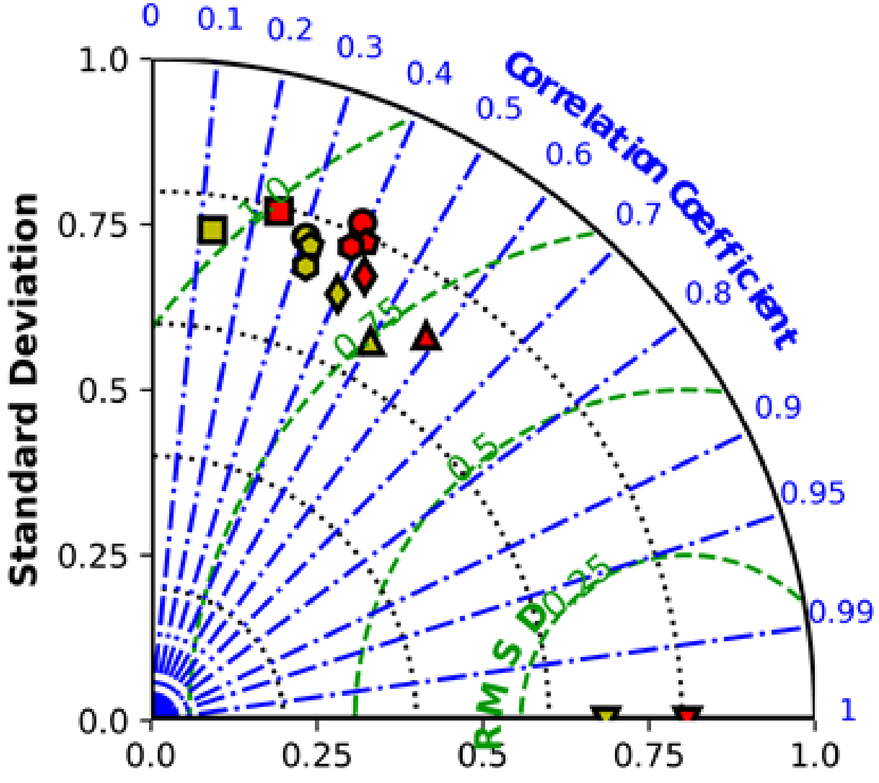


OSSE System Results

D+0 after the update



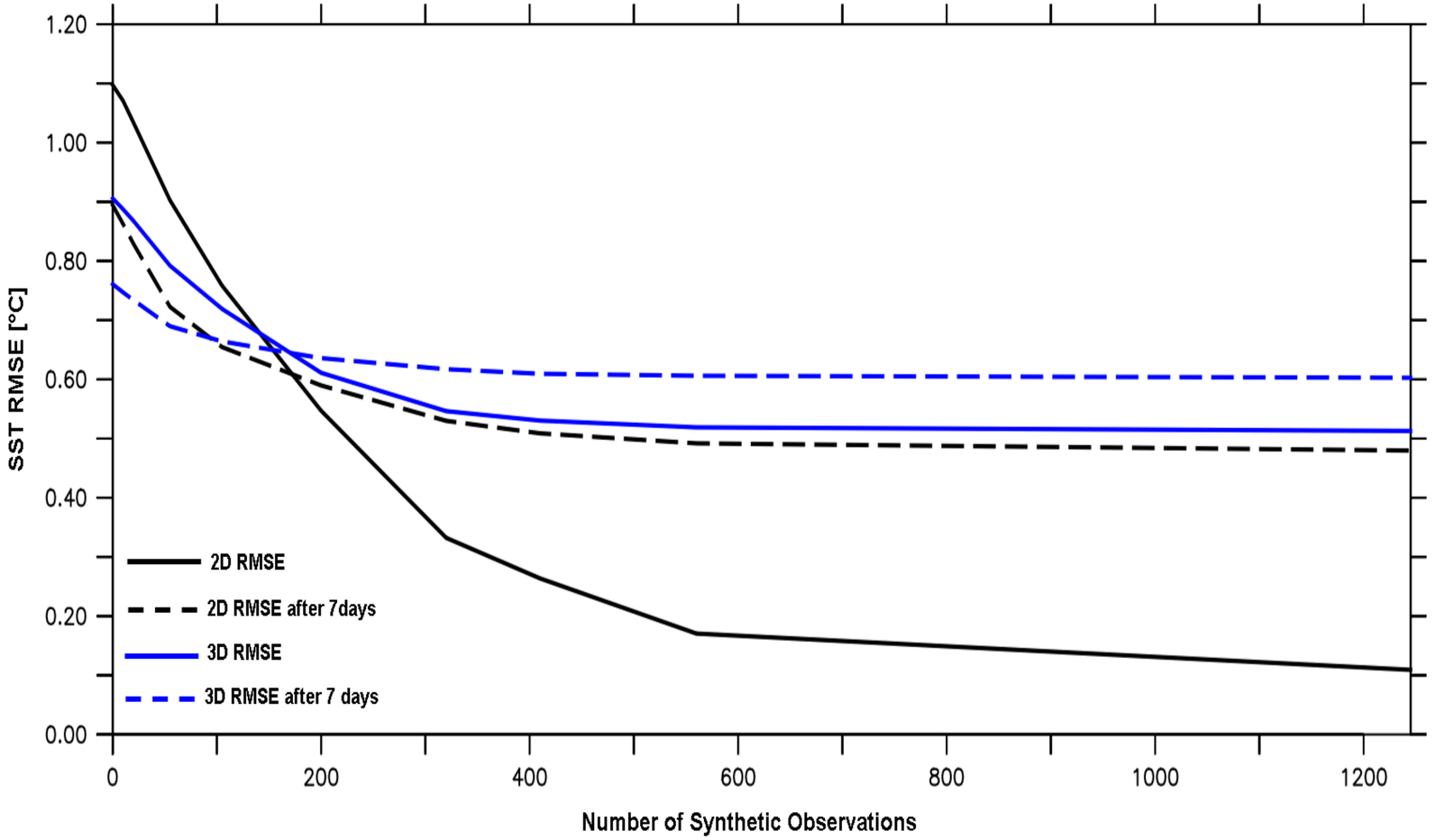
D+7 after the update

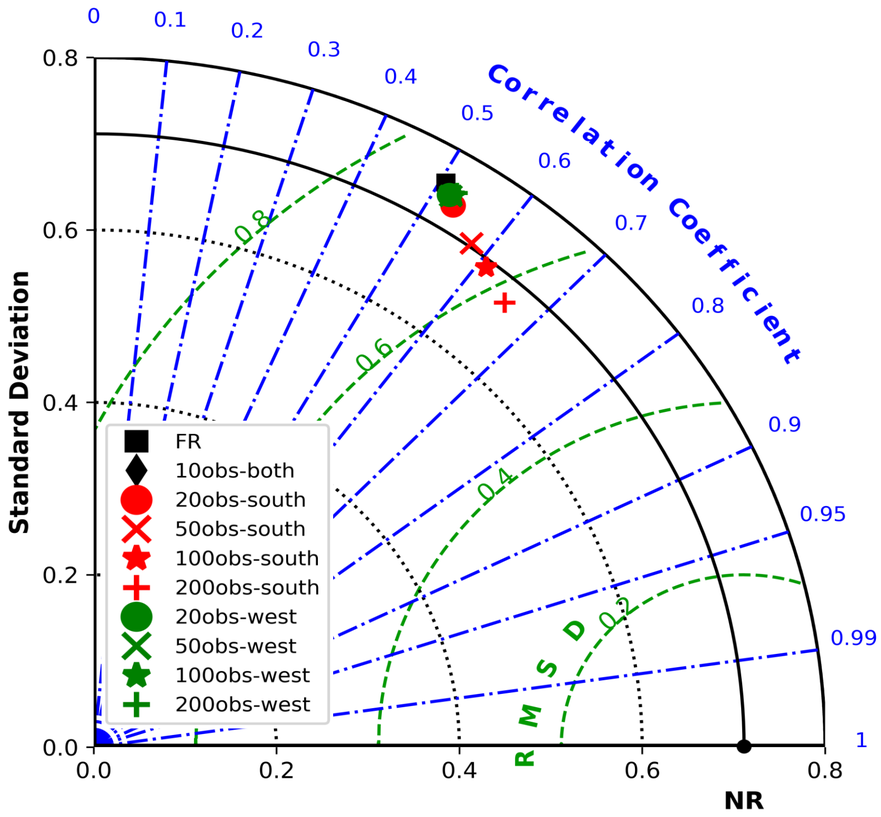


SATELLITE **FR** **OSE1** **OSE2** **OSE3** **OSE4** **OSE5**

NR **FR** **OSSE1** **OSSE2** **OSSE3** **OSSE4** **OSSE5**

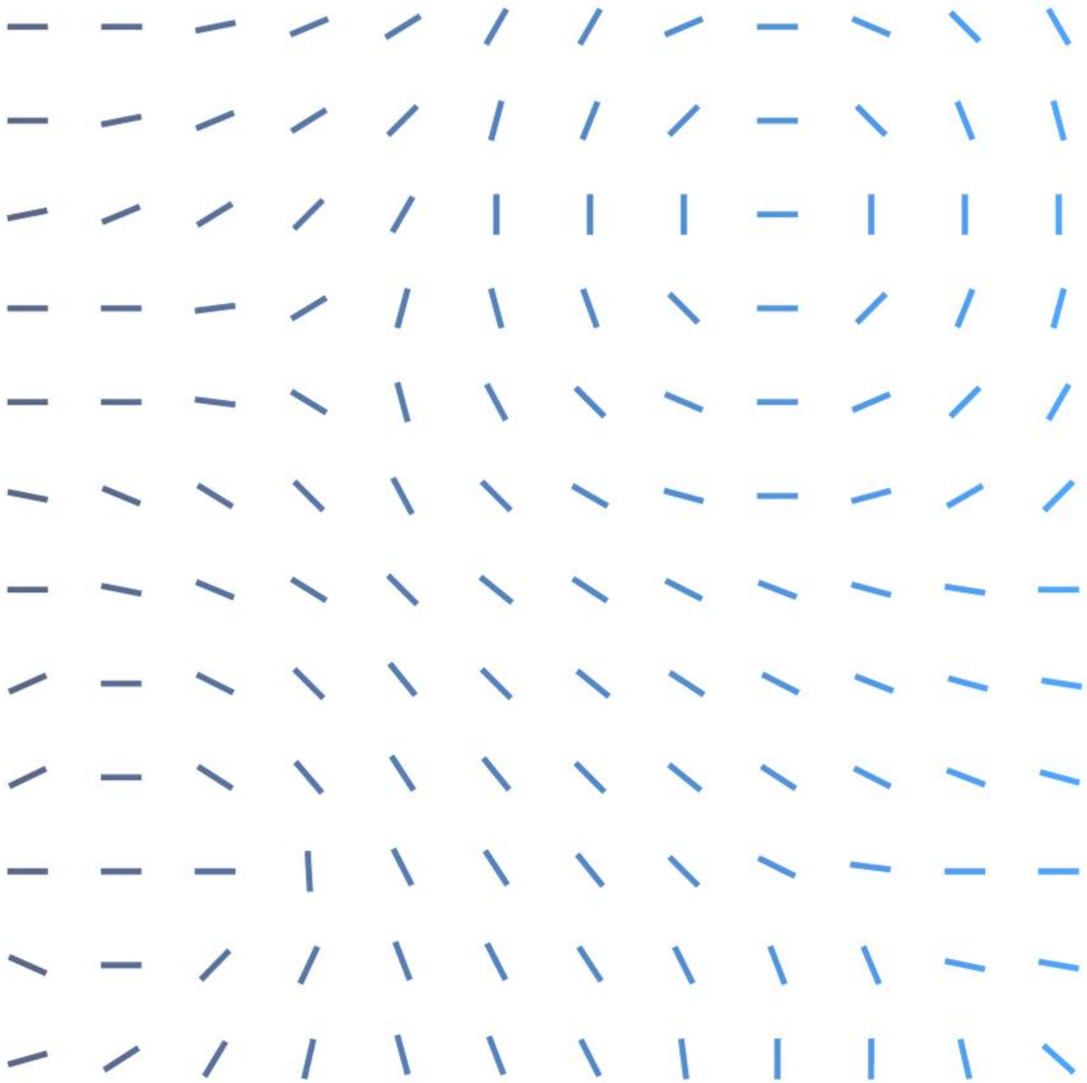
Observations Scenarios





Conclusions

- Similar results when the OSSE system was tested against another data product which provides the same variable (SST).
- OSSE system is already being used to test different observation scenarios.
- The development of this work led to the adaptation of a DA system for SOMA, which will later be integrated in its operational forecast.



Thank you!

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