



Universitat
de les Illes Balears

Impact of Rapid Scan Atmospheric Motion Vectors on the predictability of a medicane case

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1. INTRODUCTION: Brief overview of the 7 November 2014 medicane

Qendresa medicane:

Visible MODIS image at 16 UTC 7 November 2014



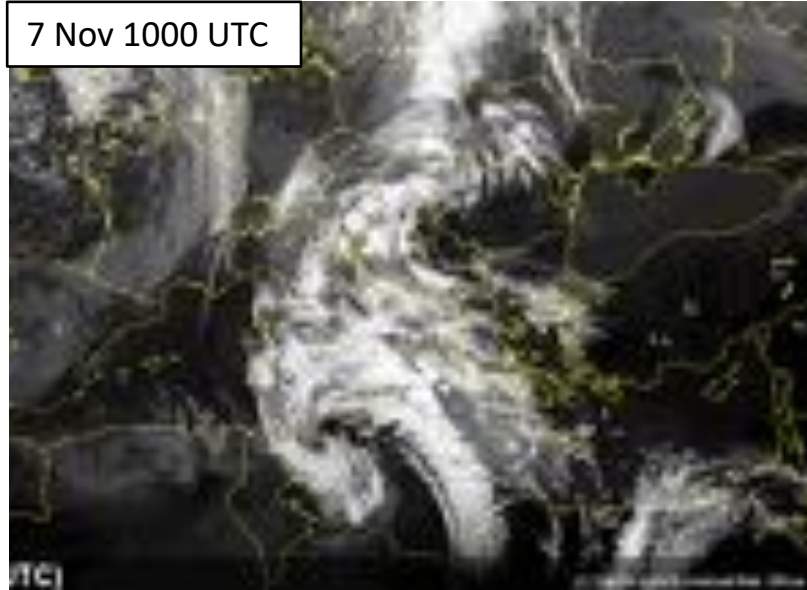
1. INTRODUCTION: Brief overview of the 7 November 2014 medicane

Overview case study:

7 Nov 0700 UTC



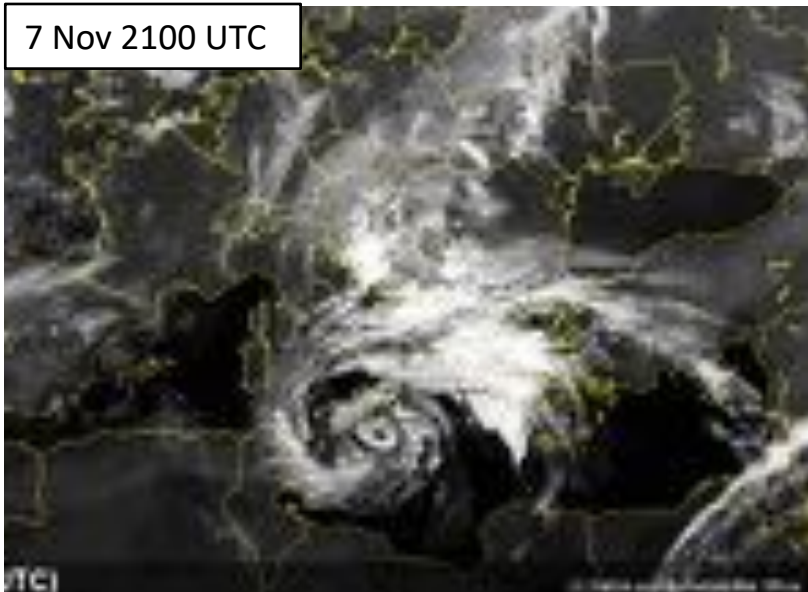
7 Nov 1000 UTC



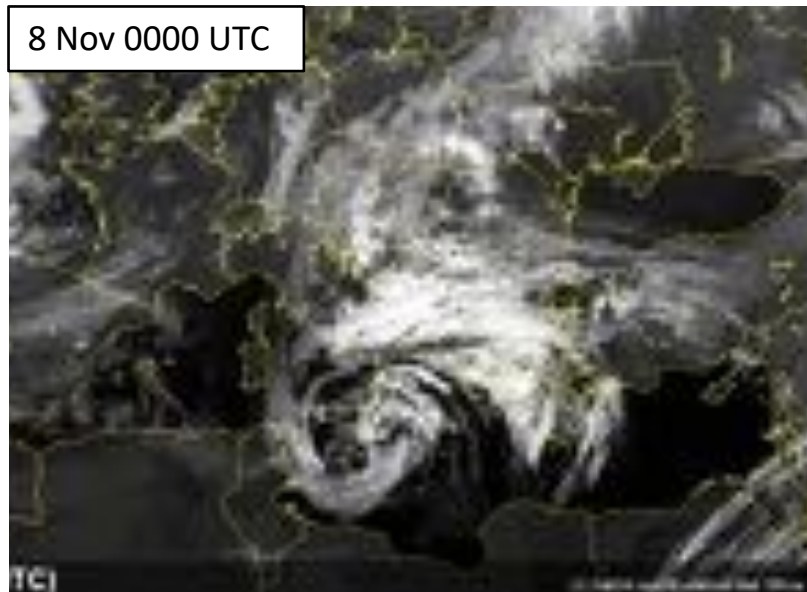
7 Nov 1300 UTC



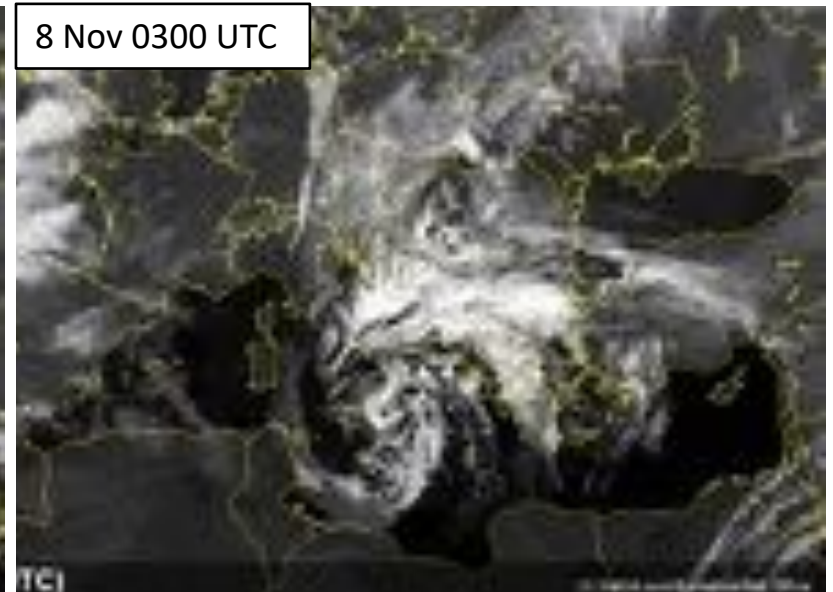
7 Nov 2100 UTC



8 Nov 0000 UTC

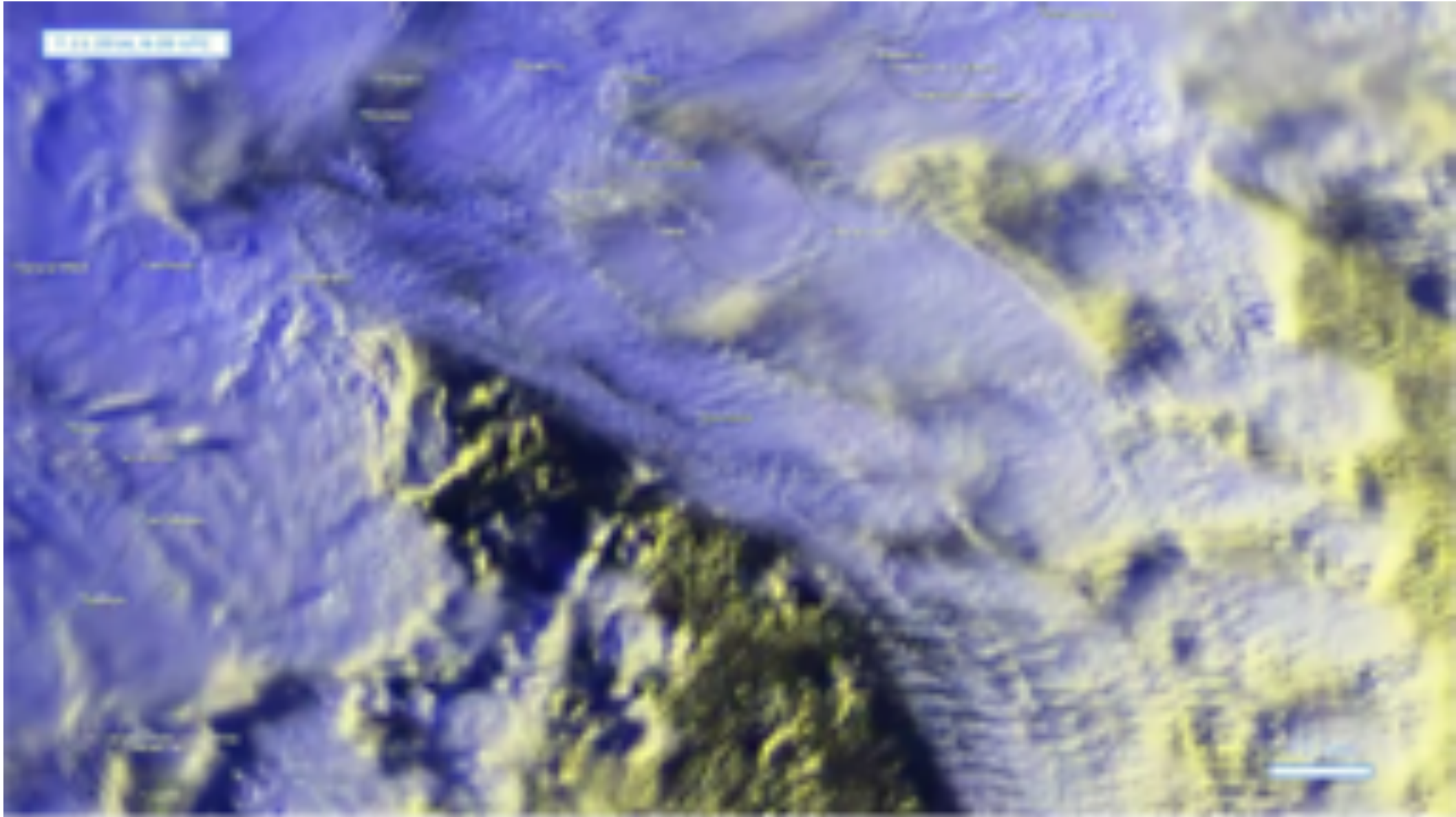


8 Nov 0300 UTC



1. INTRODUCTION: Brief overview of the 7 November 2014 medicane

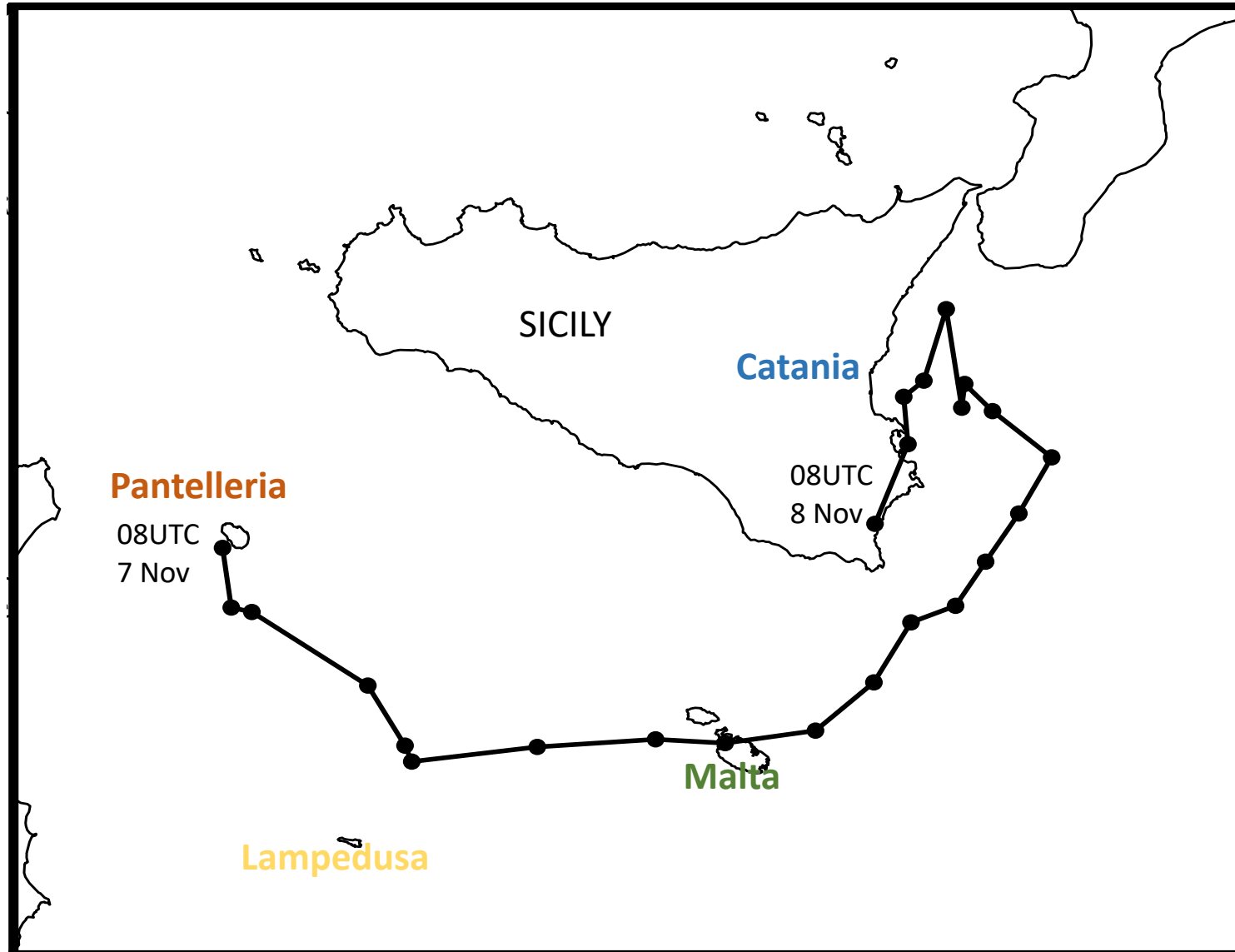
Overview case study:



1. INTRODUCTION: Brief overview of the 7 November 2014 medicane

Overview case study:

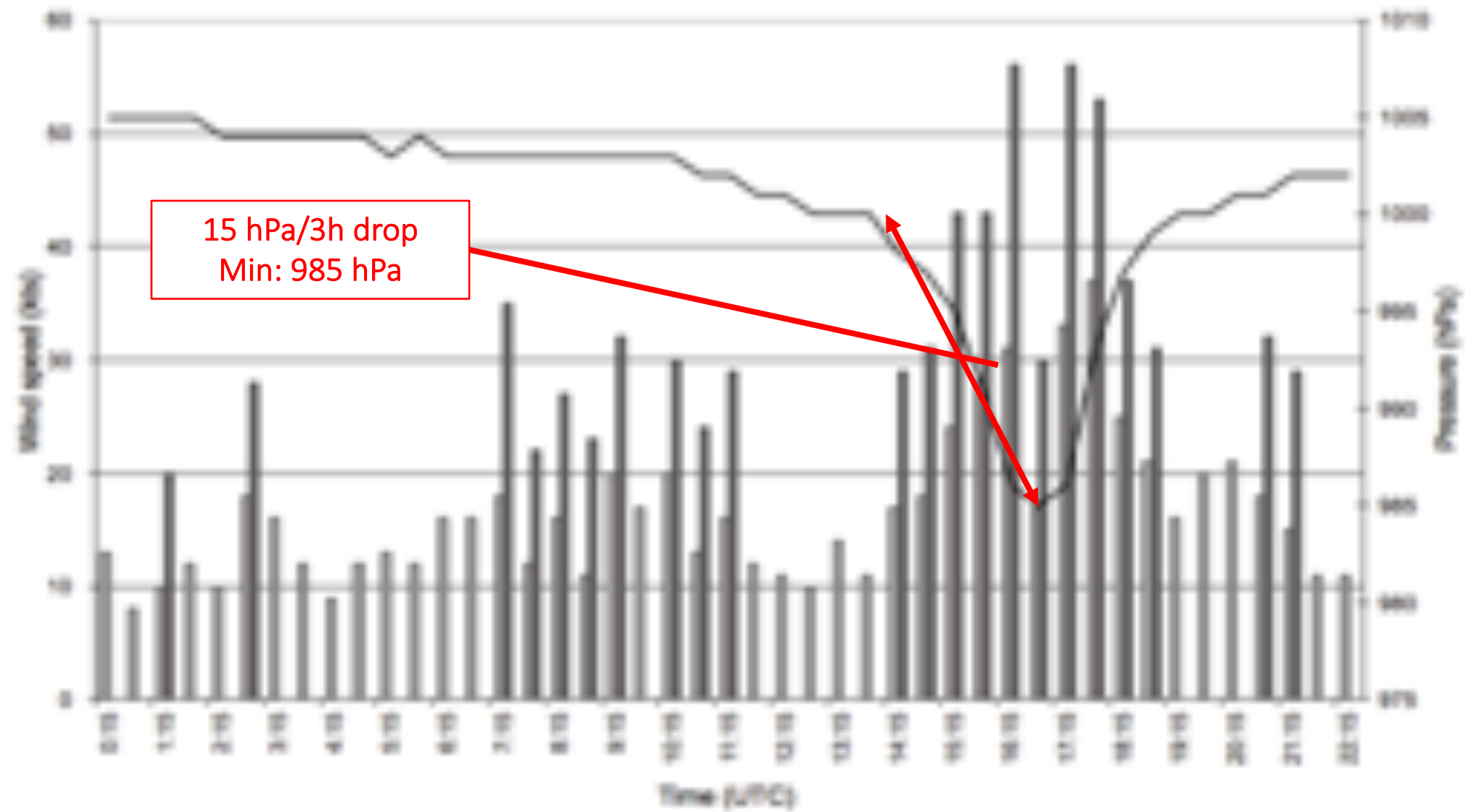
Quendresa 1h track



1. INTRODUCTION: Brief overview of the 7 November 2014 medicane

Overview case study:

METAR from Luqa Airport (Malta) during 7 November 2014

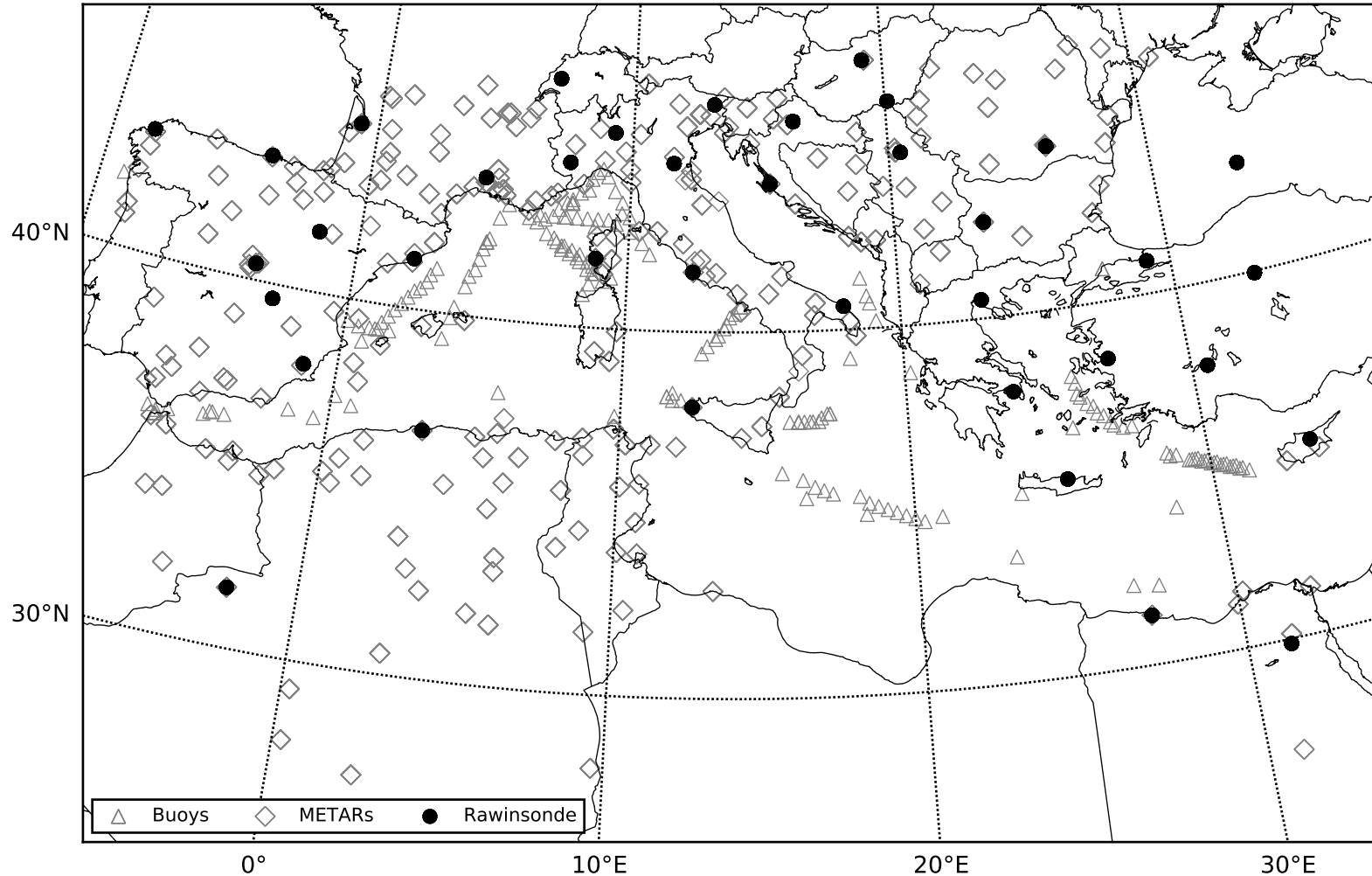


2. ASSIMILATED OBSERVATIONS: *In-situ* Conventional (SYN)

Observations to be assimilated:

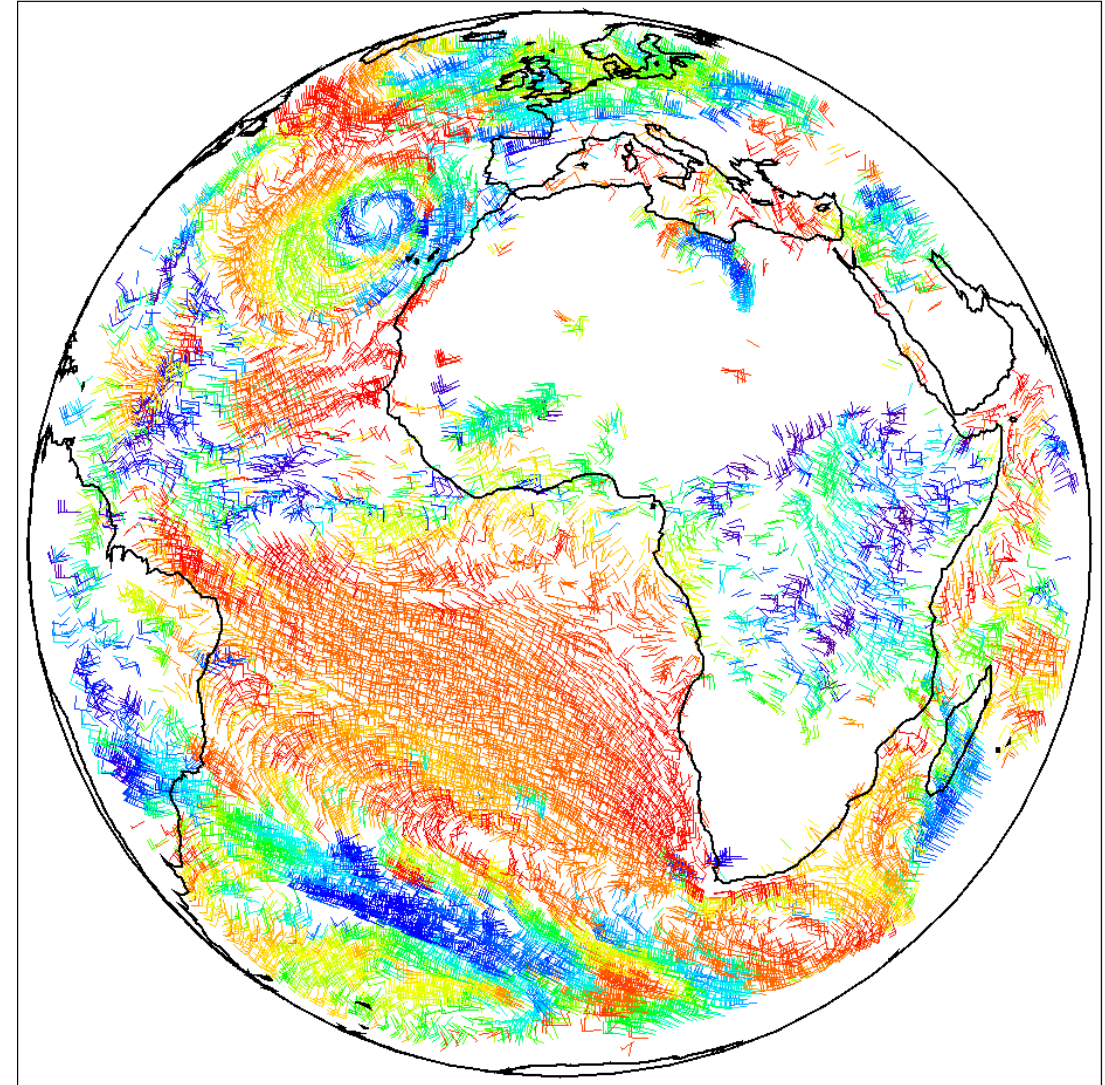
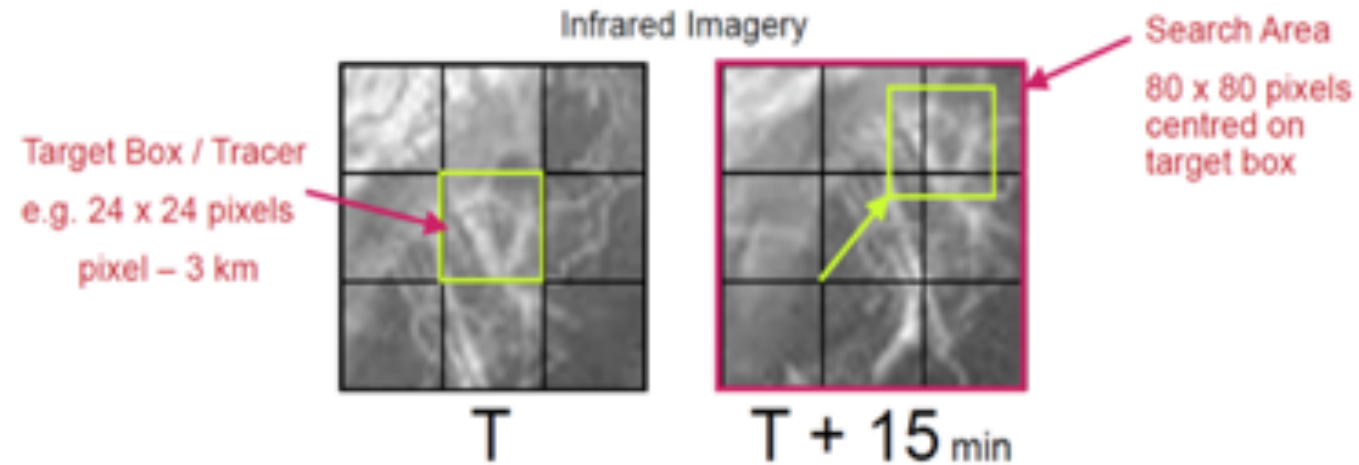
- Hourly QC *in-situ* conventional DA from MADIS database:

Observations available on **7 November 2014 at 12 UTC ($\pm 6h$)**



2. ASSIMILATED OBSERVATIONS: *MSG SEVIRI AMVs*

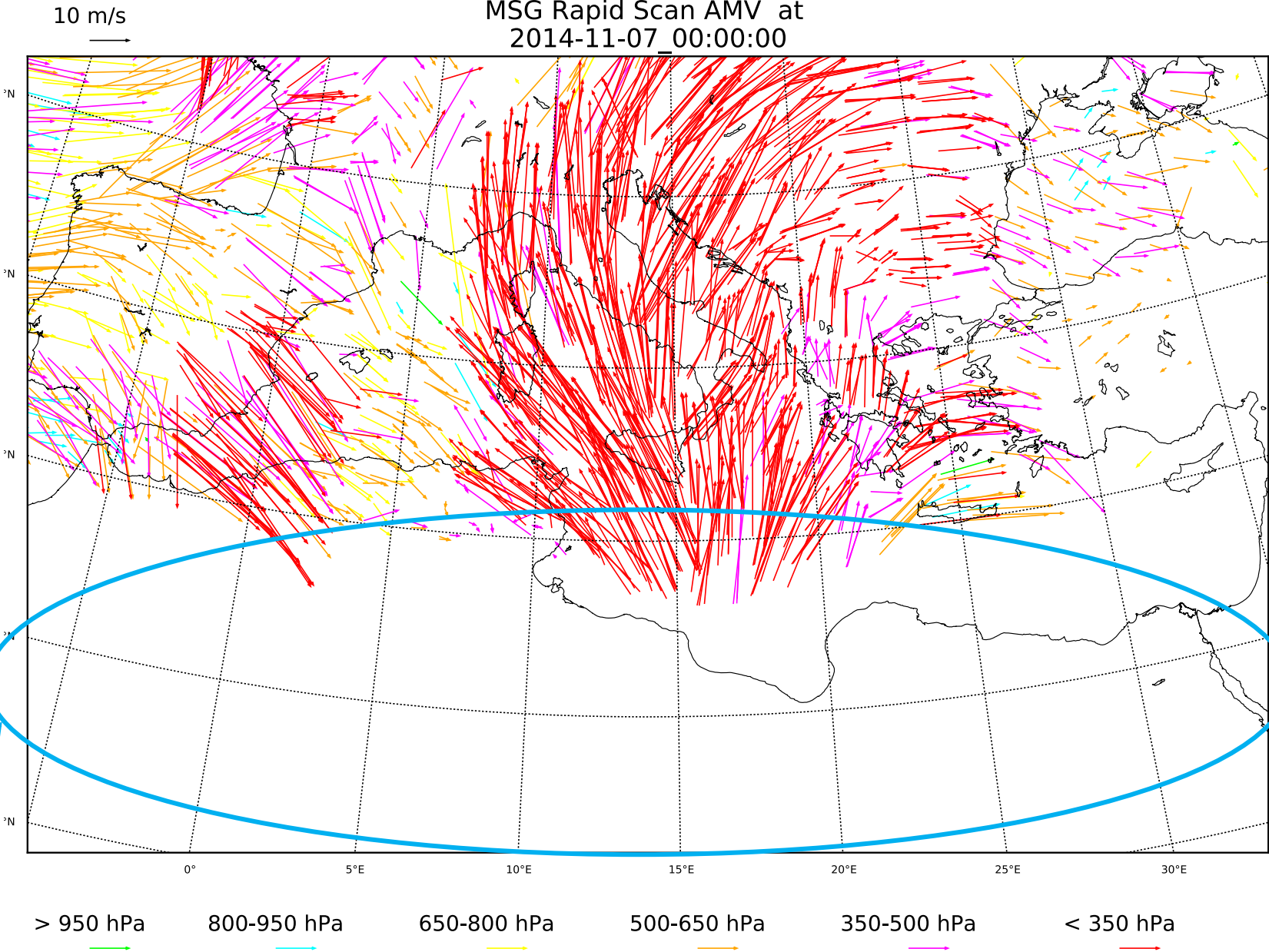
- Satellite data from **SEVIRI instrument** onboard MSG
- 20-minutes **Rapid Scan Atmospheric Motion Vectors** (RSAMV)
- **Wind field** information at multiple vertical levels
- These observations are obtained identifying a certain cloud pattern and following its evolution



2. ASSIMILATED OBSERVATIONS: MSG SEVIRI RS-AMVs

Rapid Scan Atmospheric Motion Vectors:

MSG Rapid Scan AMV at
2014-11-07 00:00:00

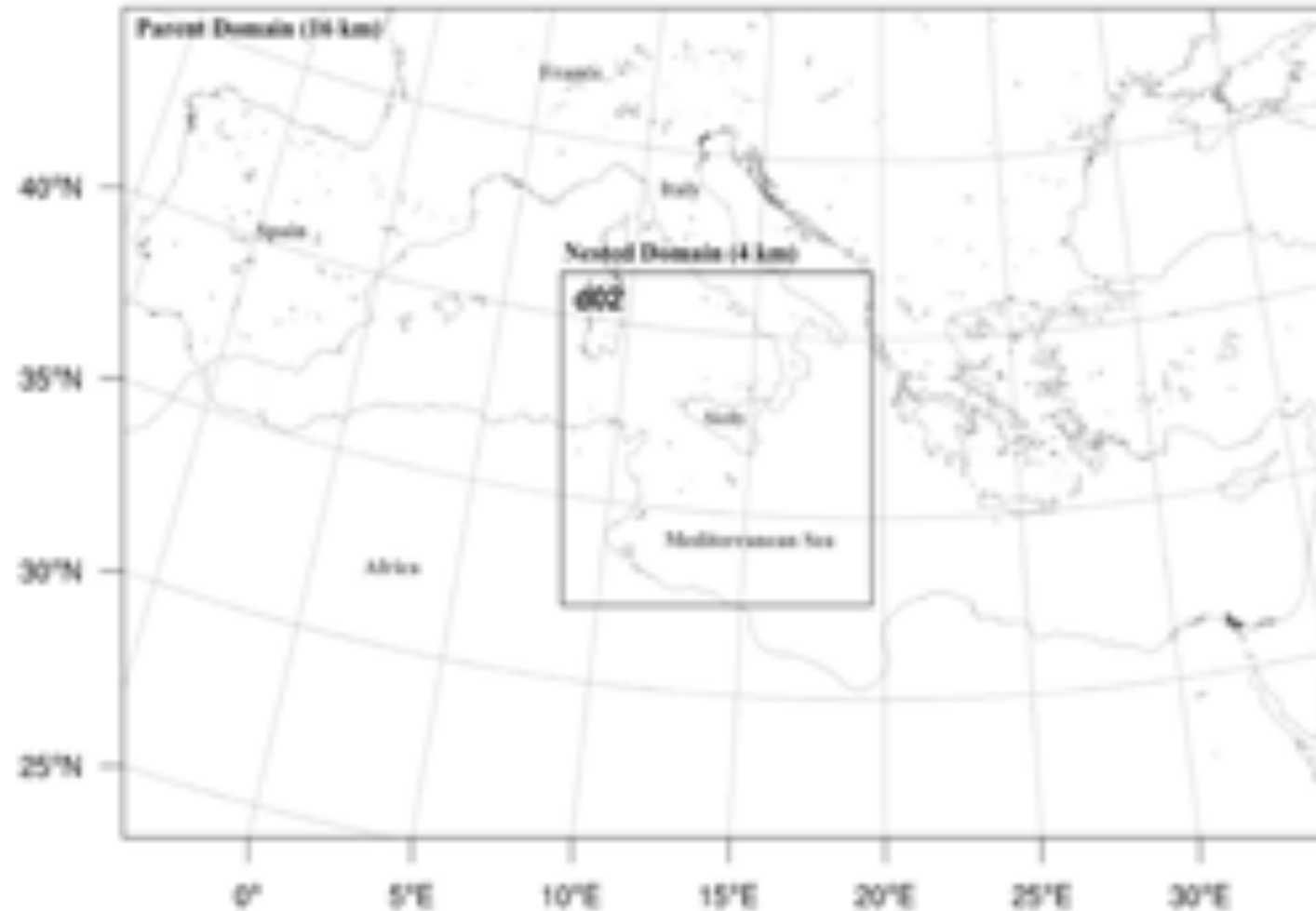


Southern part of parent domain
not covered by RS-AMV
observations!!!!

3. METHODOLOGY: Numerical Model

Numerical Model Configuration:

- **WRF-ARW** model V3.7.1: Fully compressible, non-hydrostatic model
- Initial and Boundary Conditions from **EPS-ECMWF** (~16 km)
- **One way-nesting:**
 - D01: $\Delta x = \Delta y = 16 \text{ km}$ (245x253x51)
 - D02: $\Delta x = \Delta y = 4 \text{ km}$ (253x253x51)
 - 51 terrain-following eta levels
- Forecast initialization time: 00 UTC 7 Nov 2014



3. METHODOLOGY: Numerical setup

Numerical setup:

- Multiphysics EnKF with 36 members initialized from best WM ECMWF members:

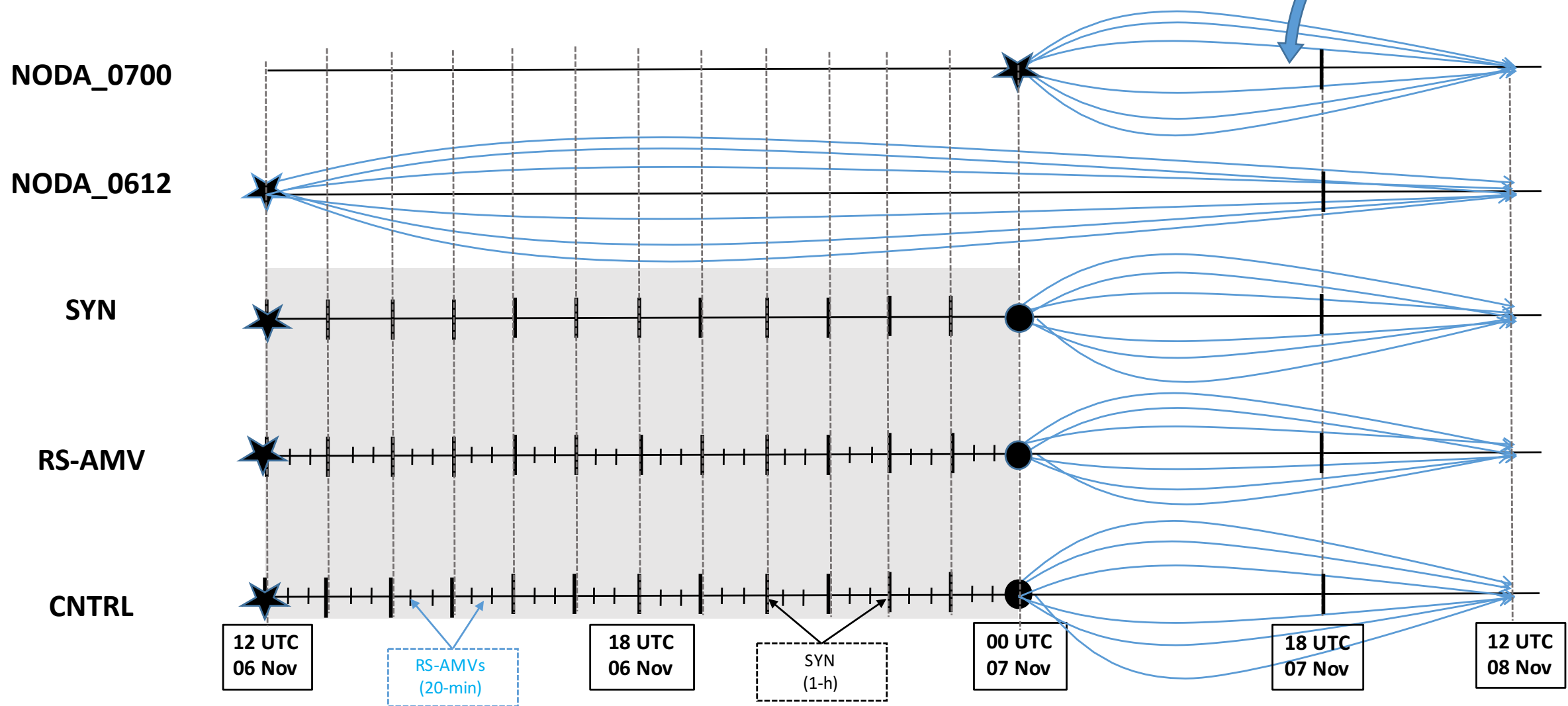
Multiphysics Configuration					
Ensemble Members	Microphysics	Clouds	PBL	Land Surface	SW/IR radiation
1	Thompson	KF	YSU	Noah	Dudhia
2		KF	YSU		RRTMG
3		KF	MYJ		Dudhia
4		KF	MYJ		RRTMG
5		KF	MYNN2		Dudhia
6	Thompson	KF	MYNN2	Noah	RRTMG
7		GF	YSU		Dudhia
8		GF	YSU		RRTMG
9		GF	MYJ		Dudhia
10		GF	MYJ		RRTMG
11	Thompson	GF	MYNN2	Noah	Dudhia
12		GF	MYNN2		RRTMG
13		Tiedke	YSU		Dudhia
14		Tiedke	YSU		RRTMG
15		Tiedke	MYJ		Dudhia
16	Thompson	Tiedke	MYJ	Noah	RRTMG
17		Tiedke	MYNN2		Dudhia
18		KF	MYNN2		RRTMG
19		KF	YSU		Dudhia
20		KF	YSU		RRTMG
21	Thompson	KF	MYJ	Noah	Dudhia
22		KF	MYJ		RRTMG
23		KF	MYNN2		Dudhia
24		KF	MYNN2		RRTMG
25		GF	YSU		Dudhia
26	Thompson	GF	YSU	Noah	RRTMG
27		GF	MYJ		Dudhia
28		GF	MYJ		RRTMG
29		GF	MYNN2		Dudhia
30		GF	MYNN2		RRTMG
31	Thompson	Tiedke	YSU	Noah	Dudhia
32		Tiedke	YSU		RRTMG
33		Tiedke	MYJ		Dudhia
34		Tiedke	MYJ		RRTMG
35		Tiedke	MYNN2		Dudhia
36		Tiedke	MYNN2		RRTMG



3. METHODOLOGY: Experimental Design

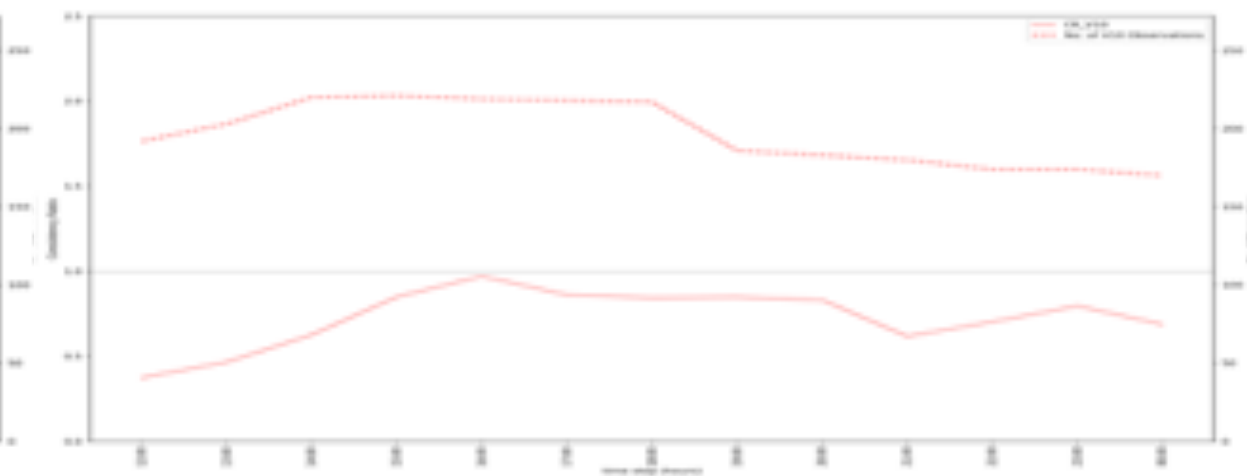
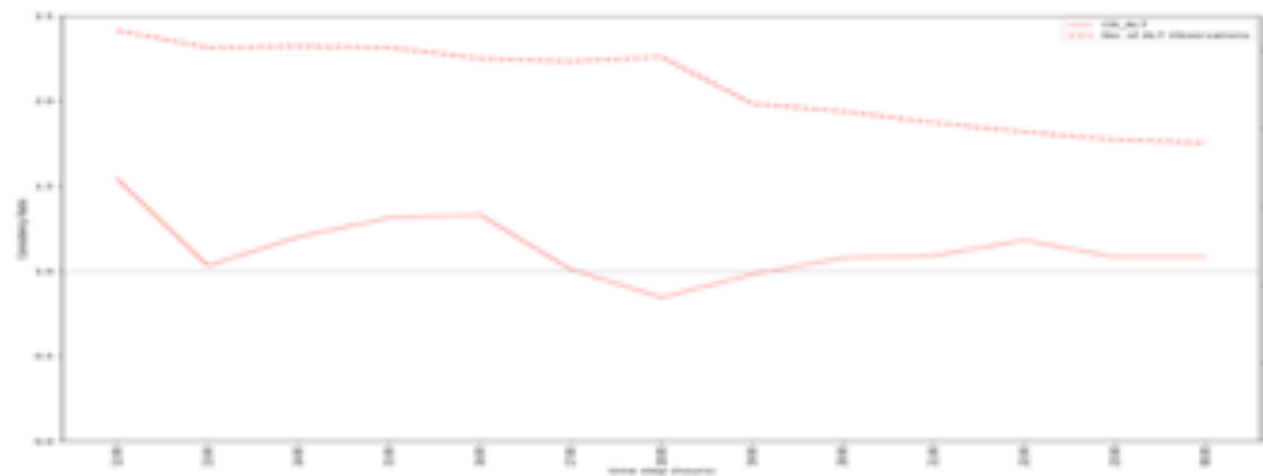
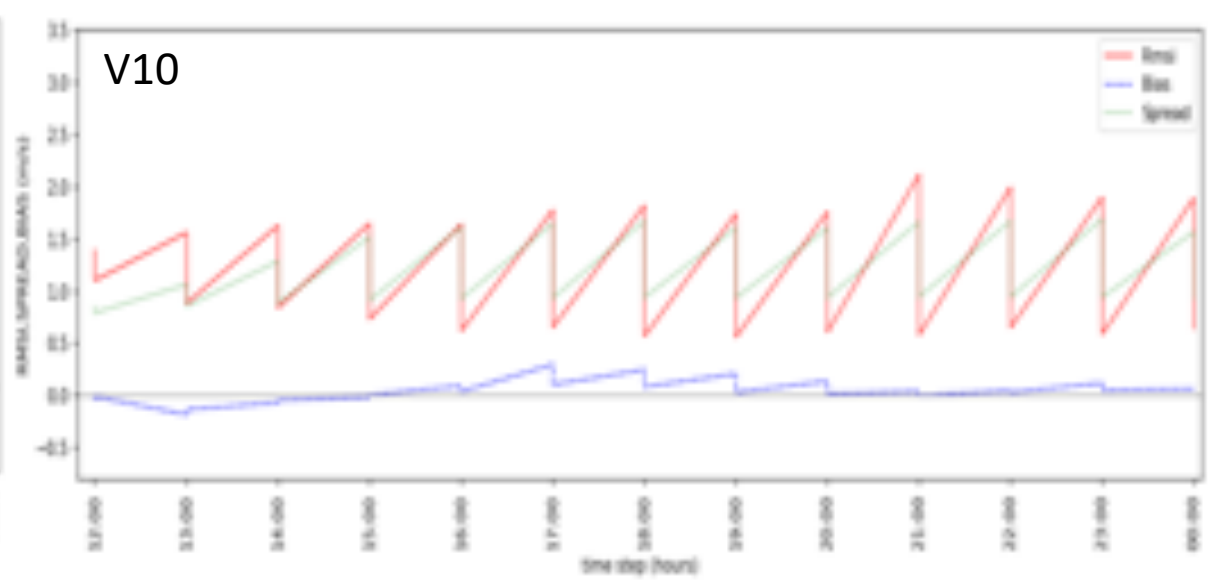
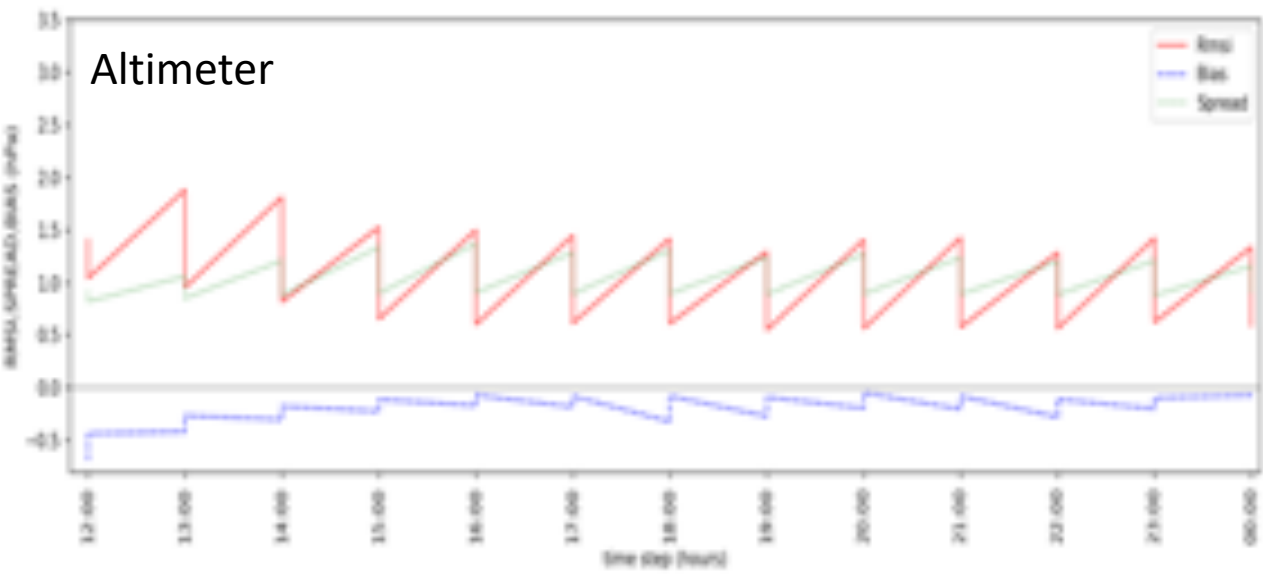


Experimental Design:



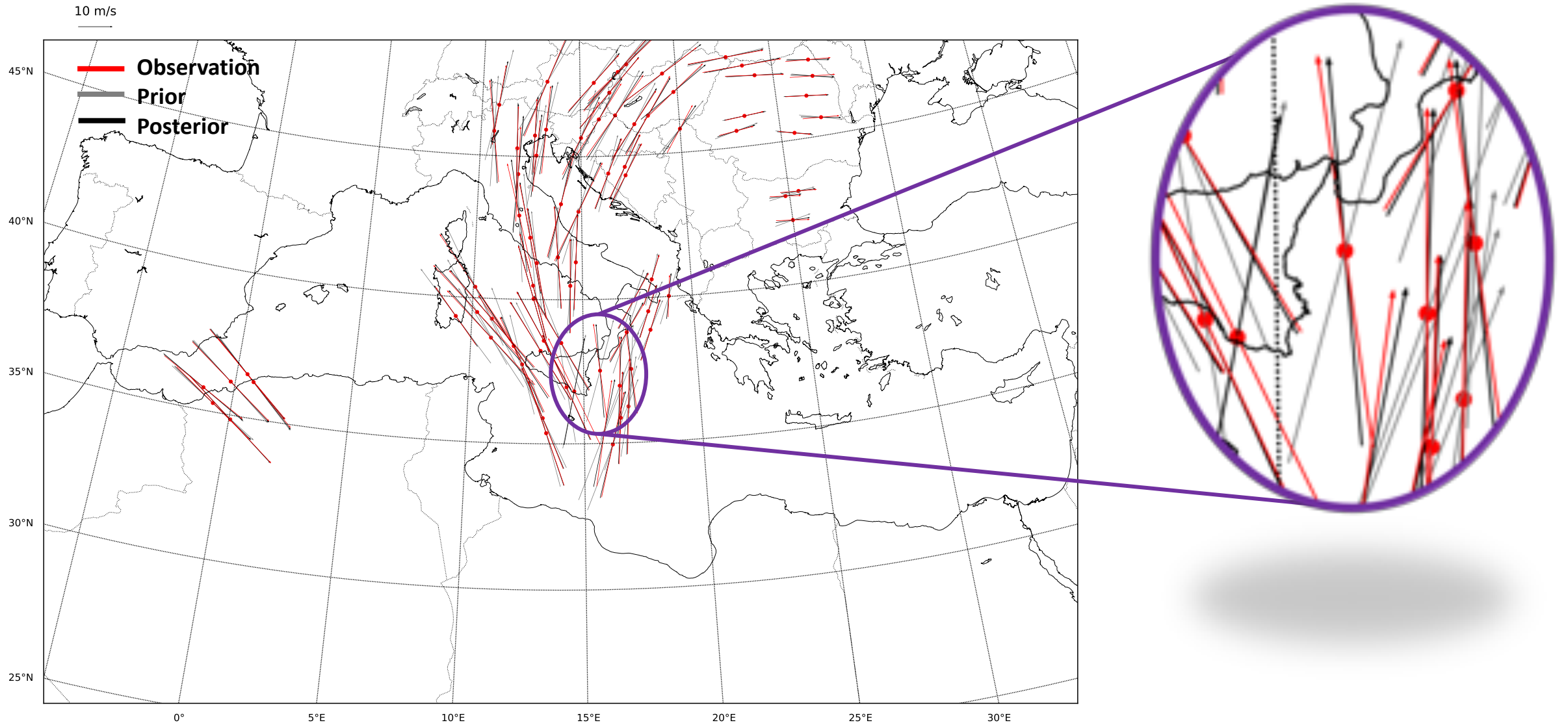
3. METHODOLOGY: Experimental Design

Observation-space Diagnostics:



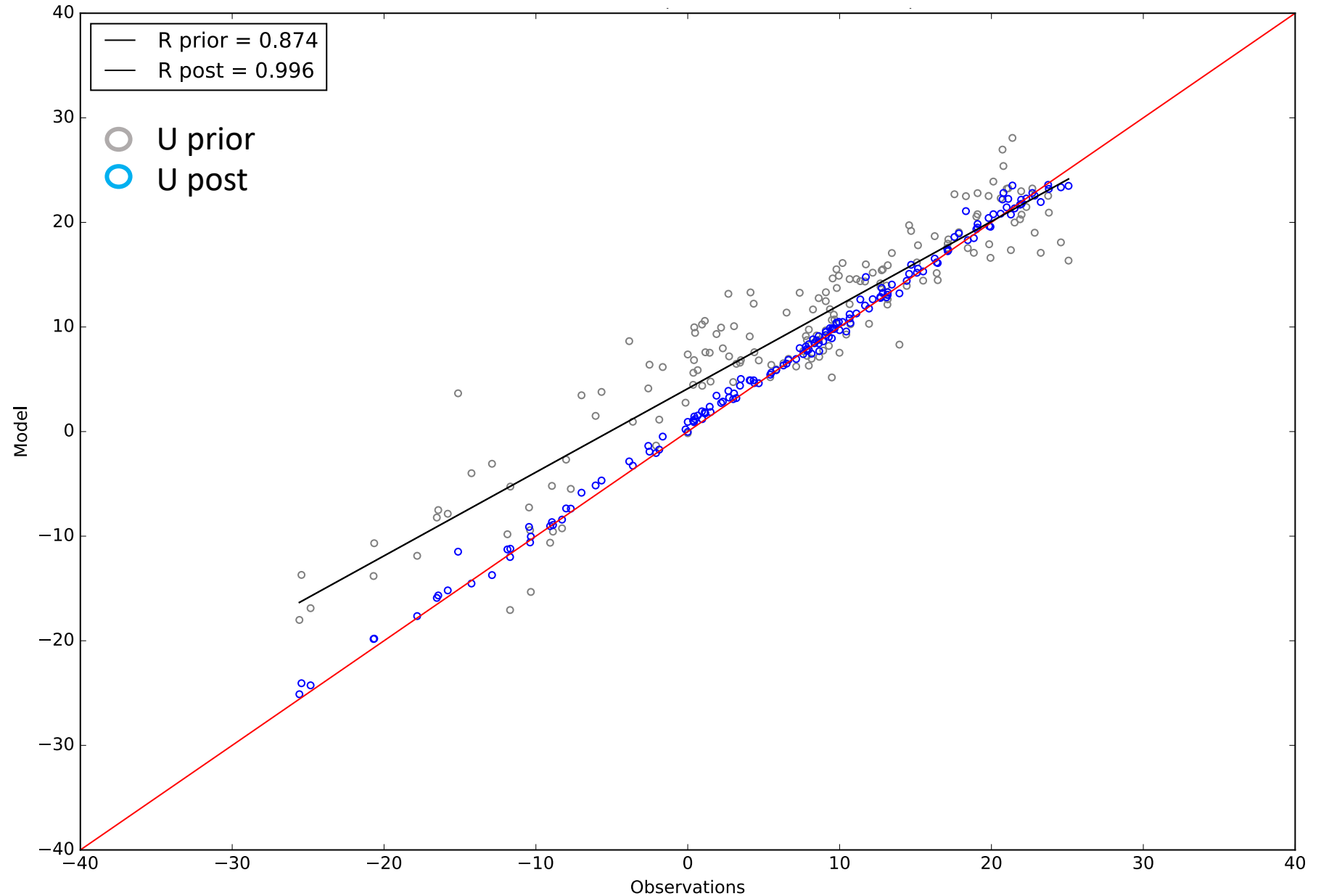
3. METHODOLOGY: Experimental Design

Observation-space Diagnostics:



3. METHODOLOGY: Experimental Design

Prior vs Posterior Correlation

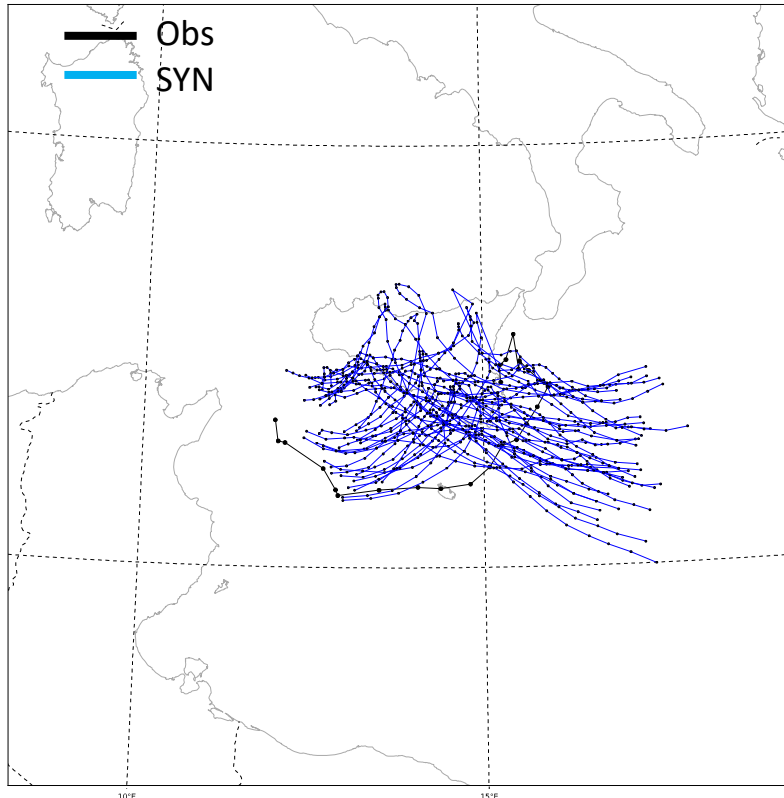


4. RESULTS

MEDICANE ensemble track:

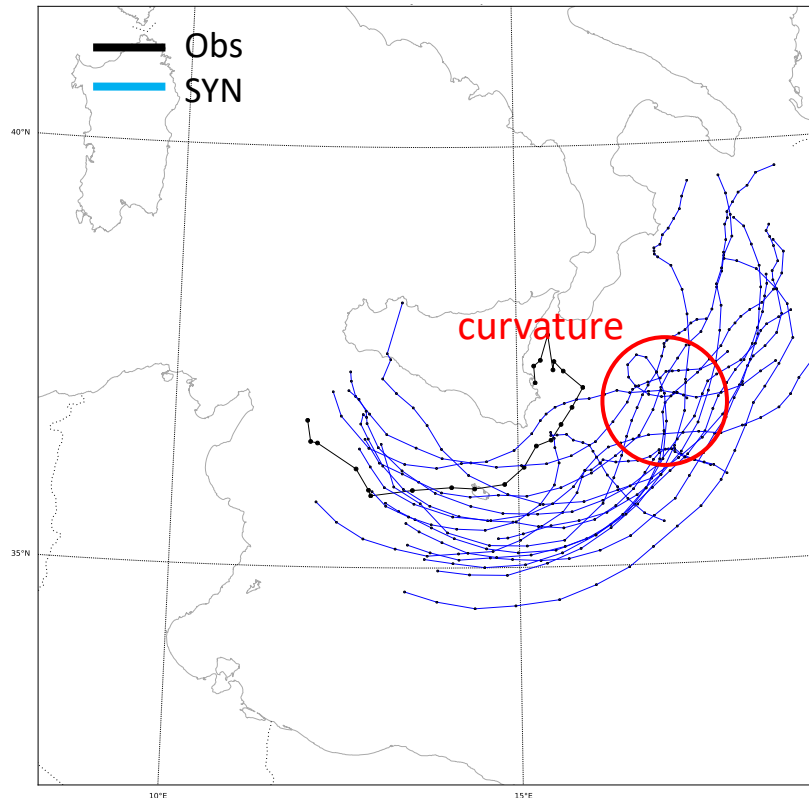
NODA's Tracking

- **23/36** ensemble members can depict a **medicane** signature
- **NO member is able to reproduce curvature** cyclone



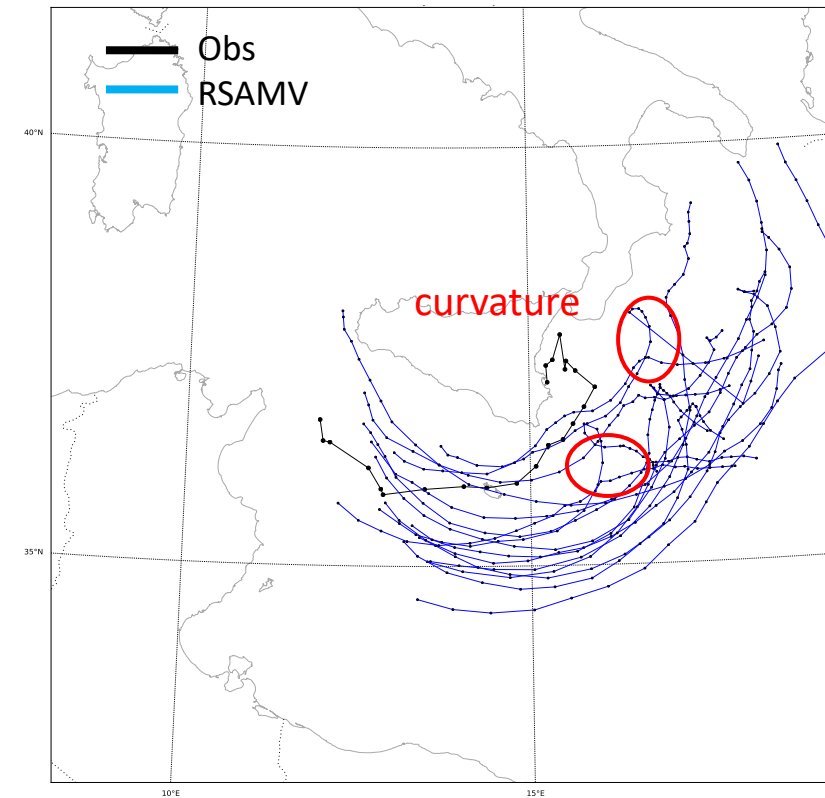
SYN's Tracking

- **17/36** ensemble members can depict a **medicane** signature
- **Some members reproduce curvature** (spatial shift)
- Most cyclone's tracks shifted towards the south



CNTRL's Tracking

- **21/36** ensemble members can depict a **medicane** signature
- **Some members reproduce curvature** (spatial shift)
- Most cyclone's tracks shifted towards the south

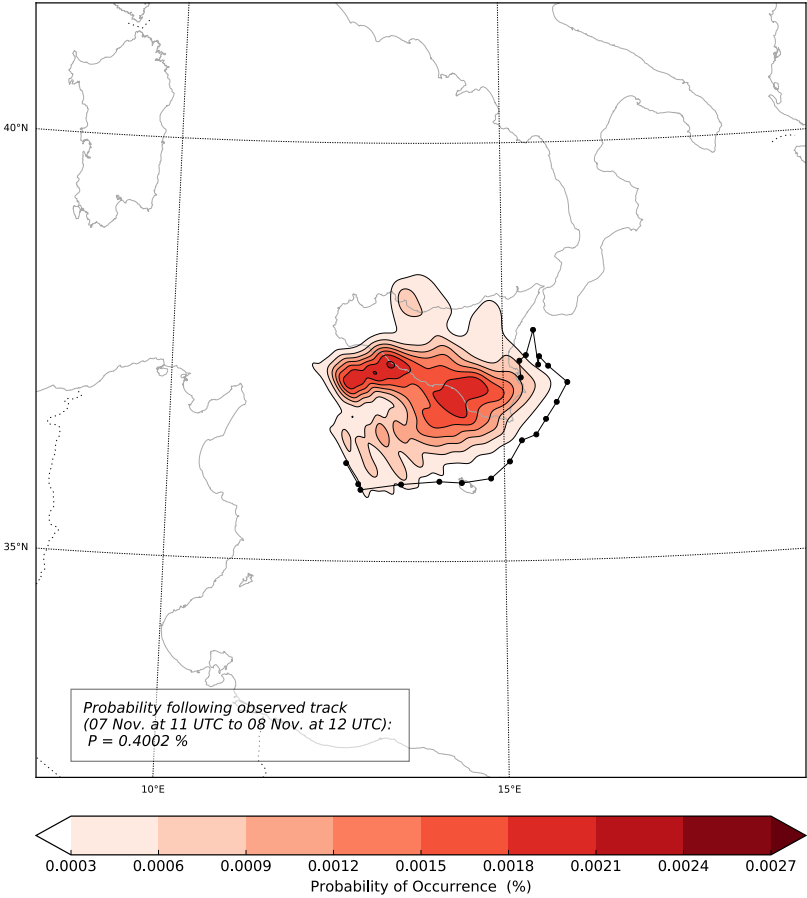


4. RESULTS

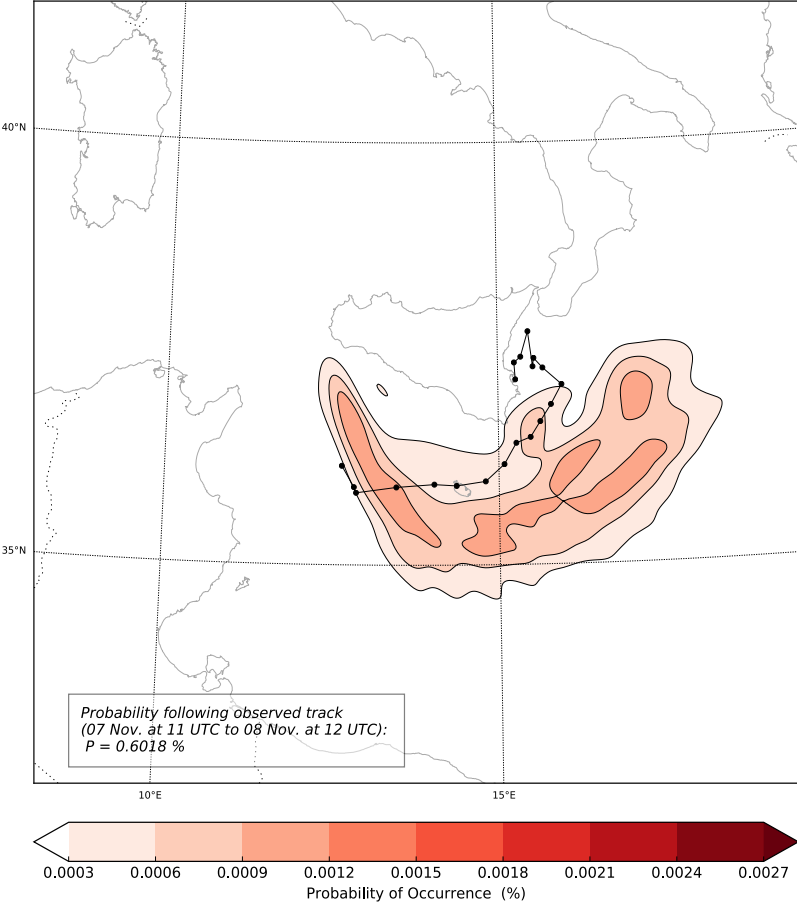
MEDICANE probability track:

Quantitative verification: **Probability of being hit by the cyclone center** from 00 UTC 7 November to 00 UTC 8 November

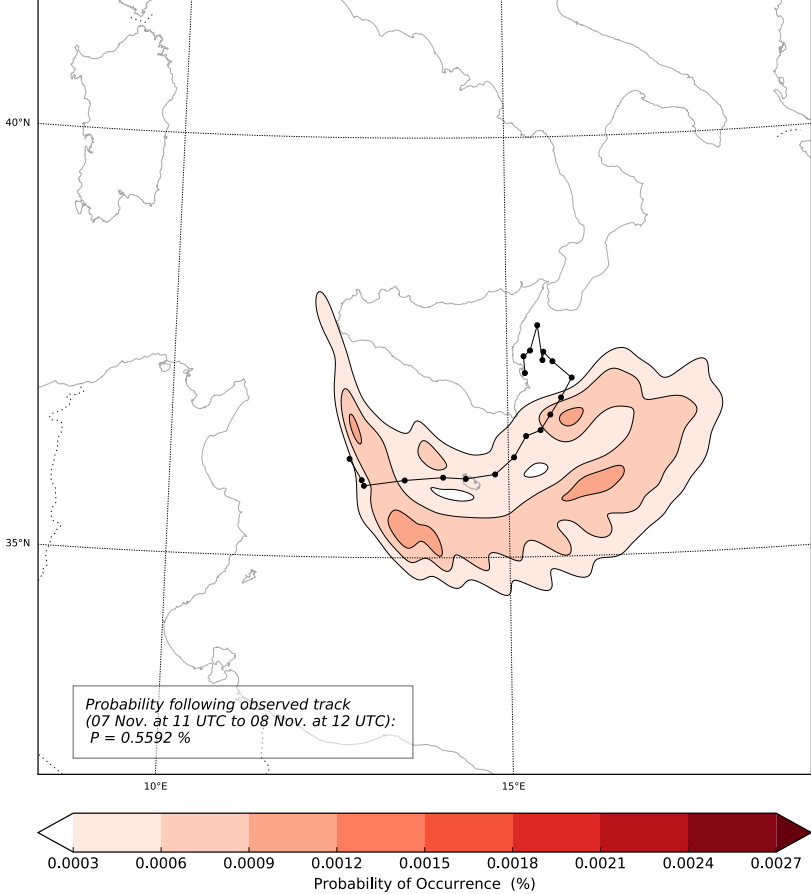
NODA ($P = 0.4002 \%$)



SYN ($P = 0.6018 \%$)



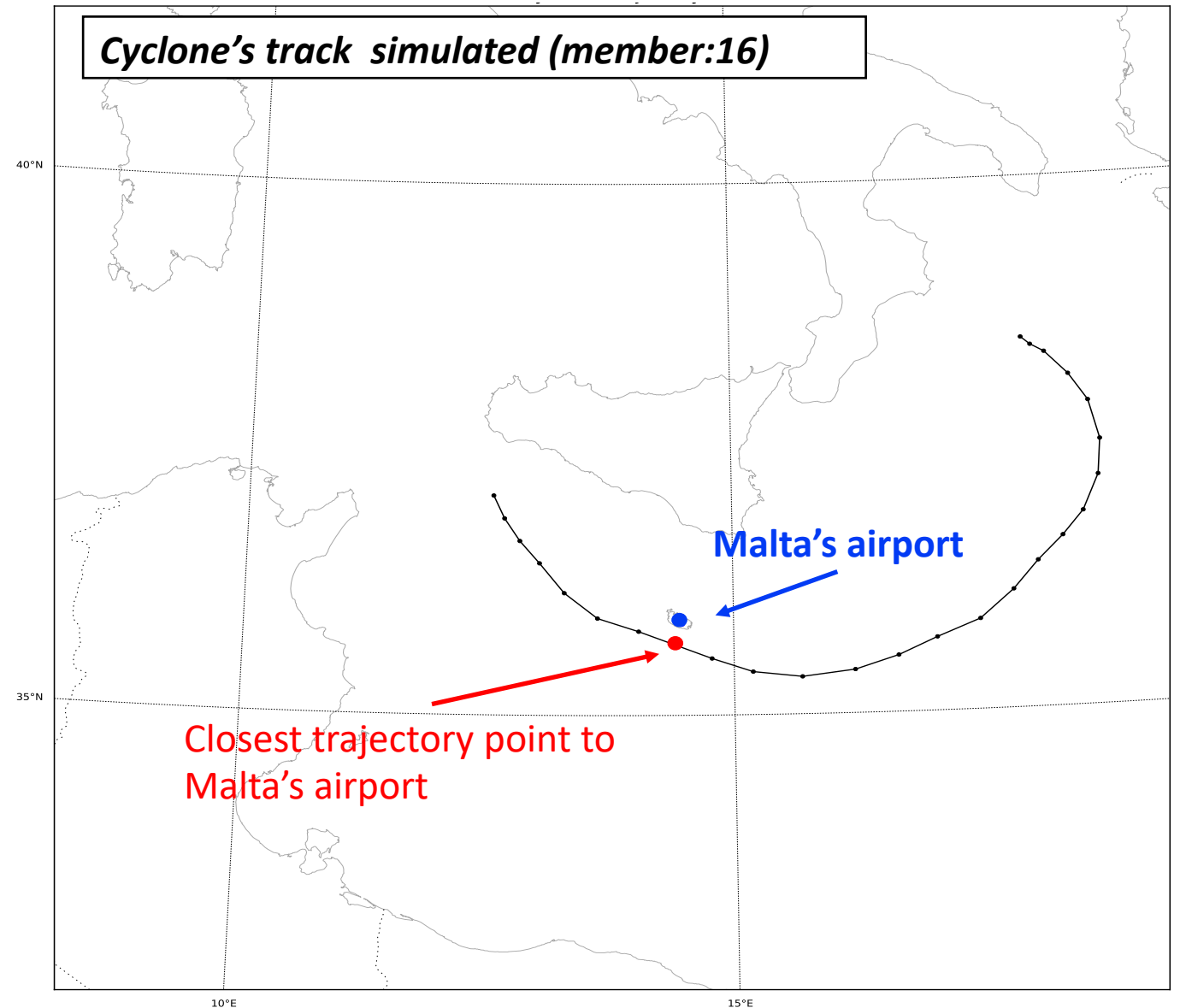
CNTRL ($P = 0.5592 \%$)



4. RESULTS

Cyclone Intensity:

- **Quantitatively assess** the skill forecast of each numerical experiment
- Compare **MSLP** measured over Malta's airport against ensemble members
- We evaluate the **time-evolution of the MSLP** of the **closest trajectory point** for each ensemble member

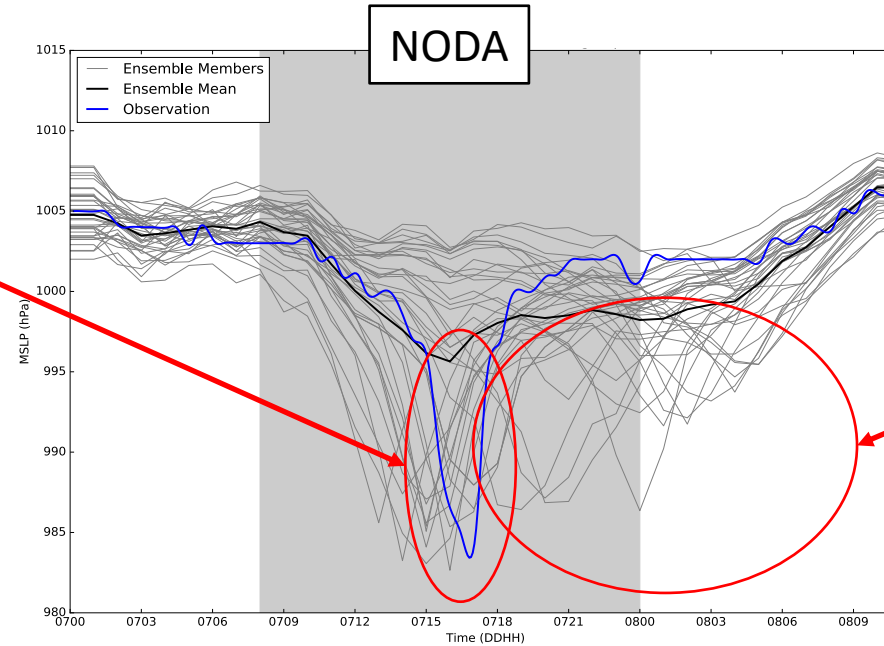


4. RESULTS

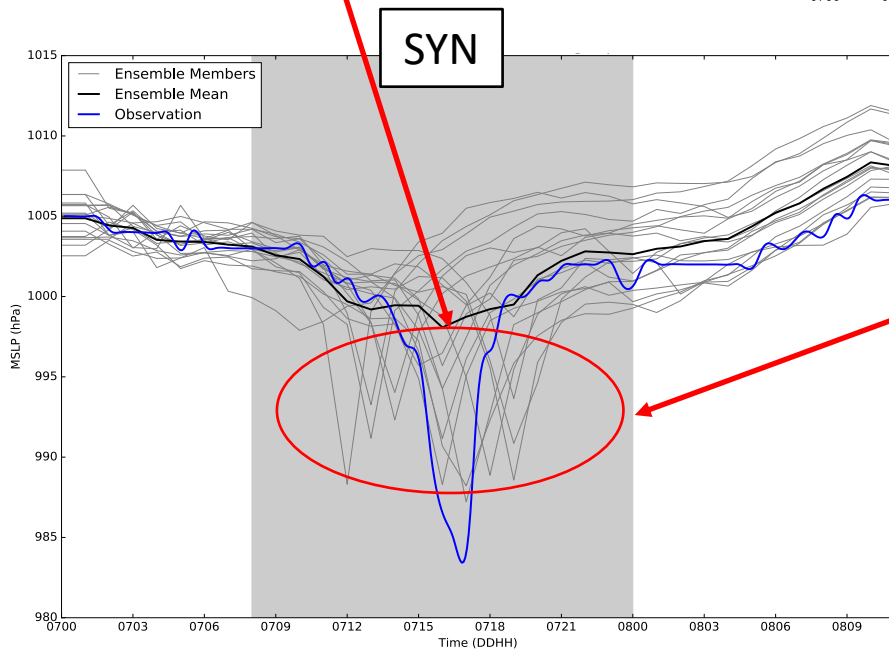
Cyclone Intensity:

Only few members depict MSLP drop centered at the time it was observed in Malta

Assimilation of conventional data reduces spread and some of the ensemble members are correctly located

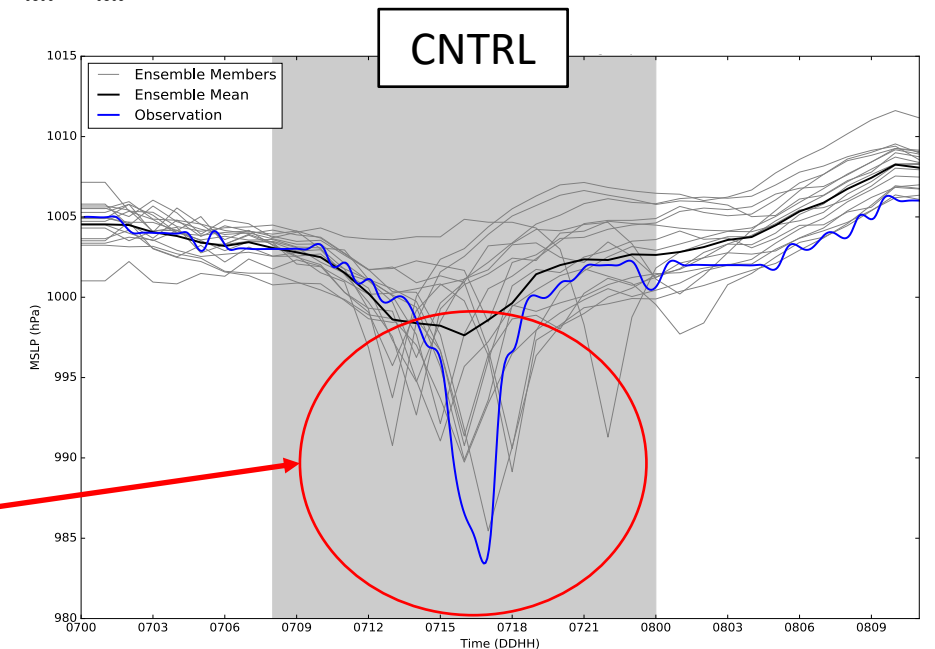


Most of the ensemble members perform a shallow cyclone which is also shifted from observations (large spread)



Ensemble members do not depict observed intensity

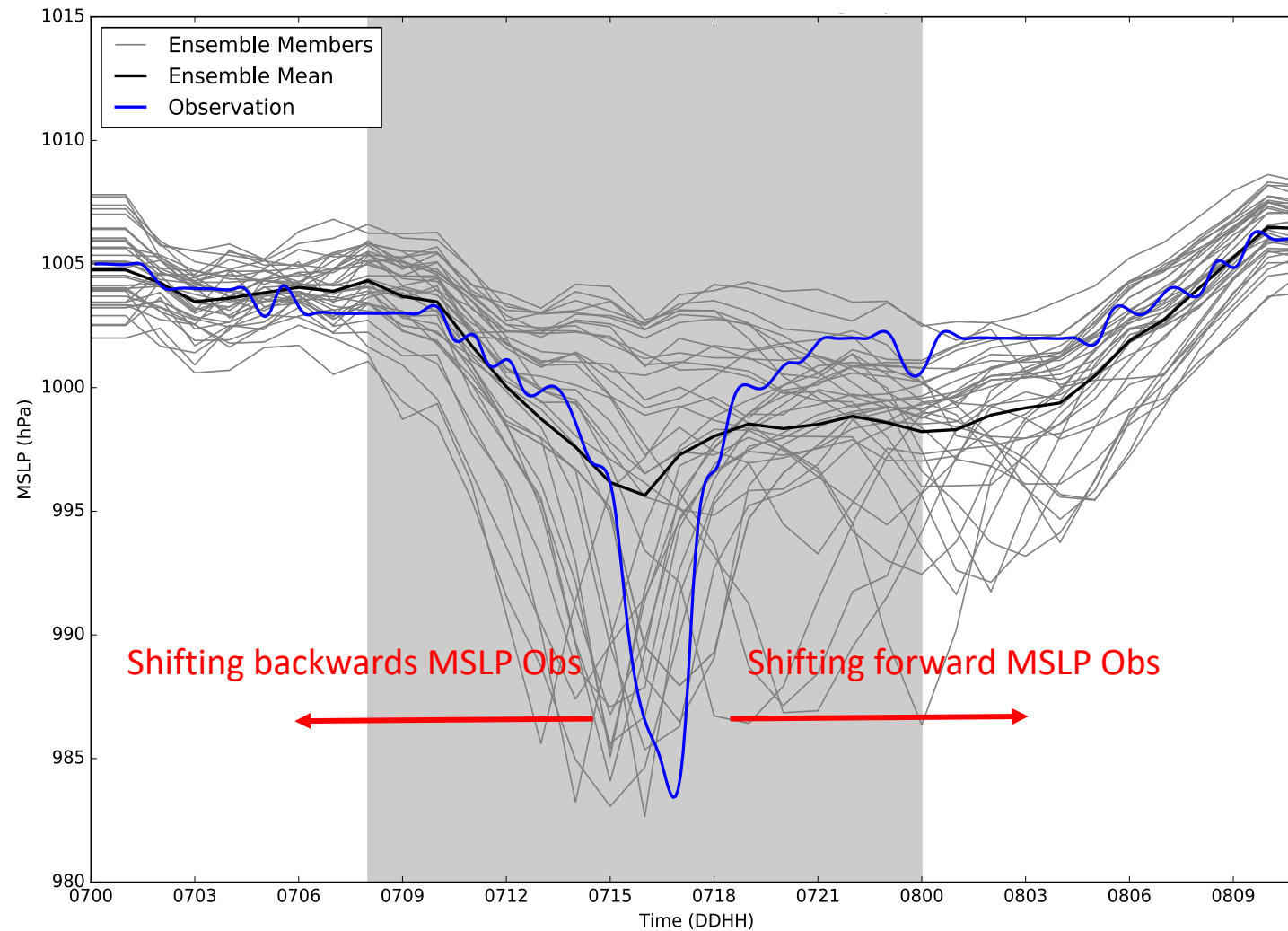
Assimilation of RSAMV help to push some members towards observations



4. RESULTS

Cyclone Intensity:

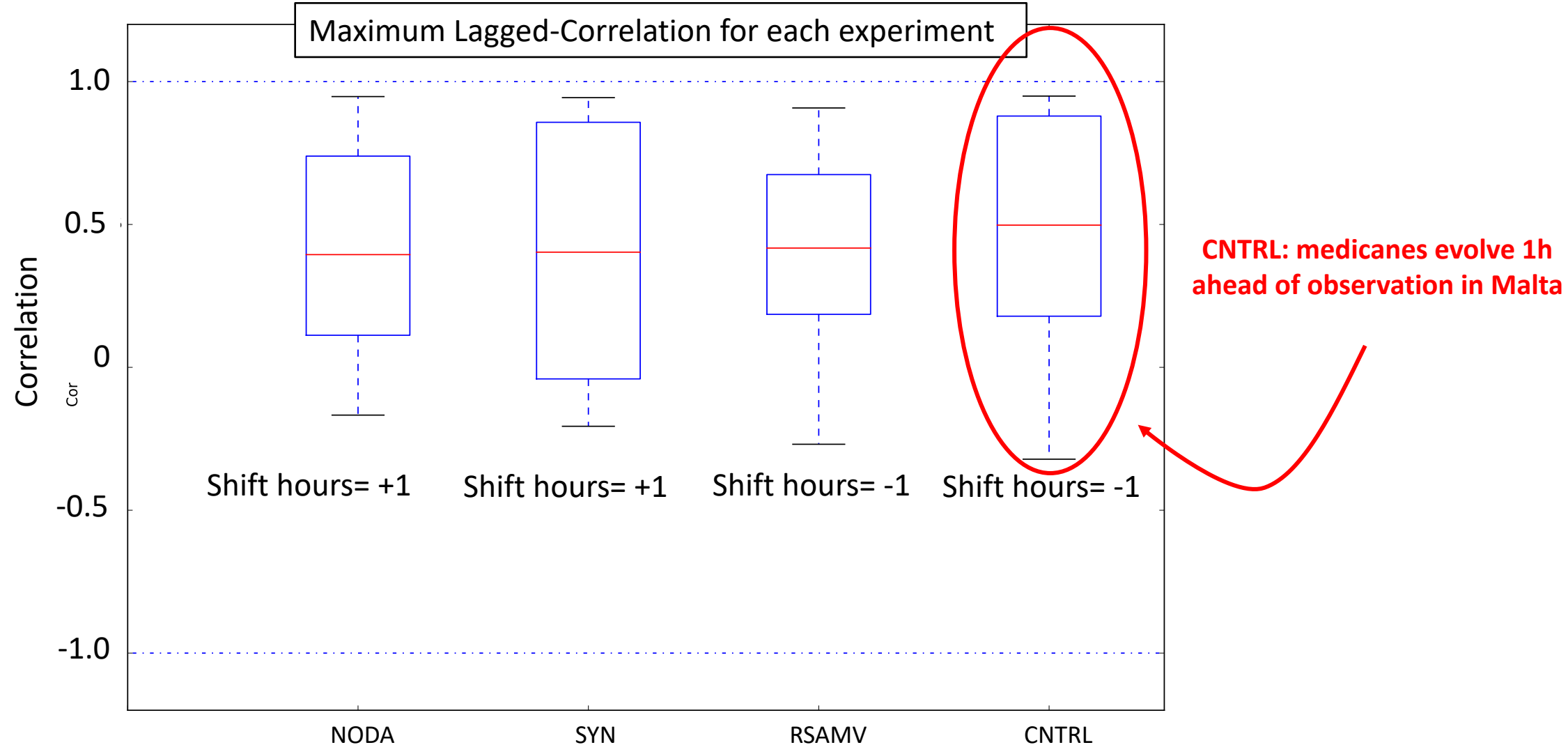
- Quantitative verification through time Lagged-Correlation



4. RESULTS

Cyclone Intensity:

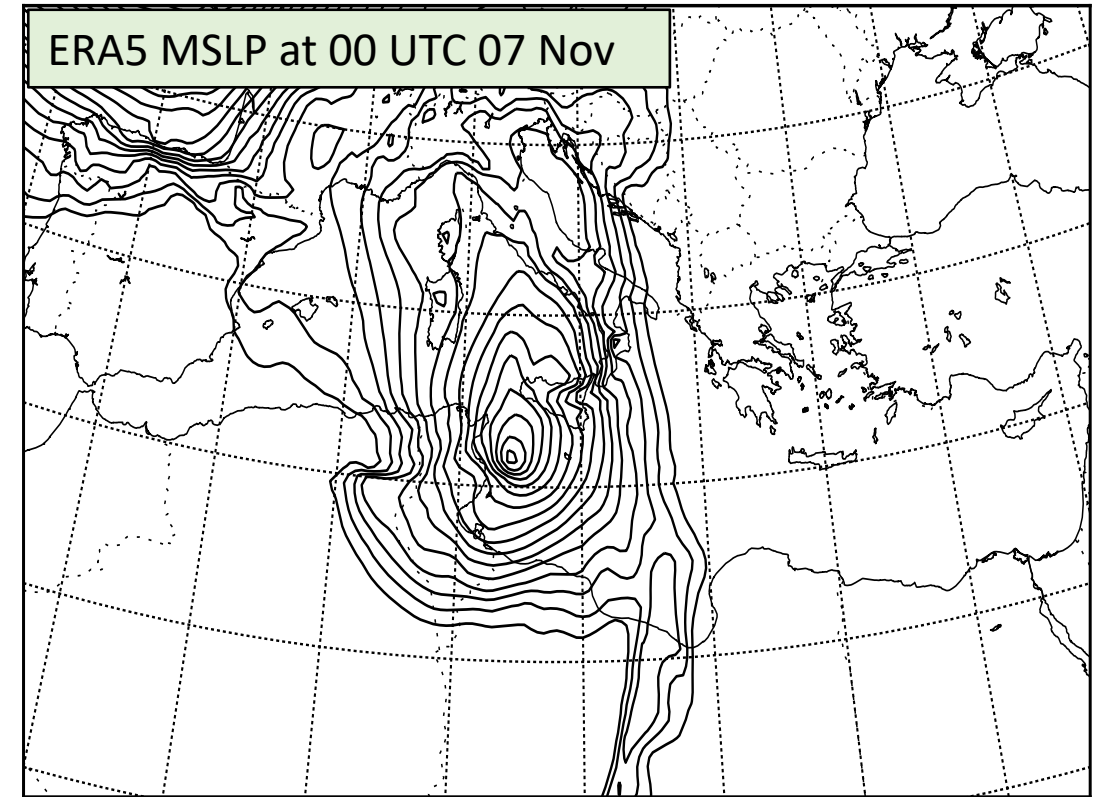
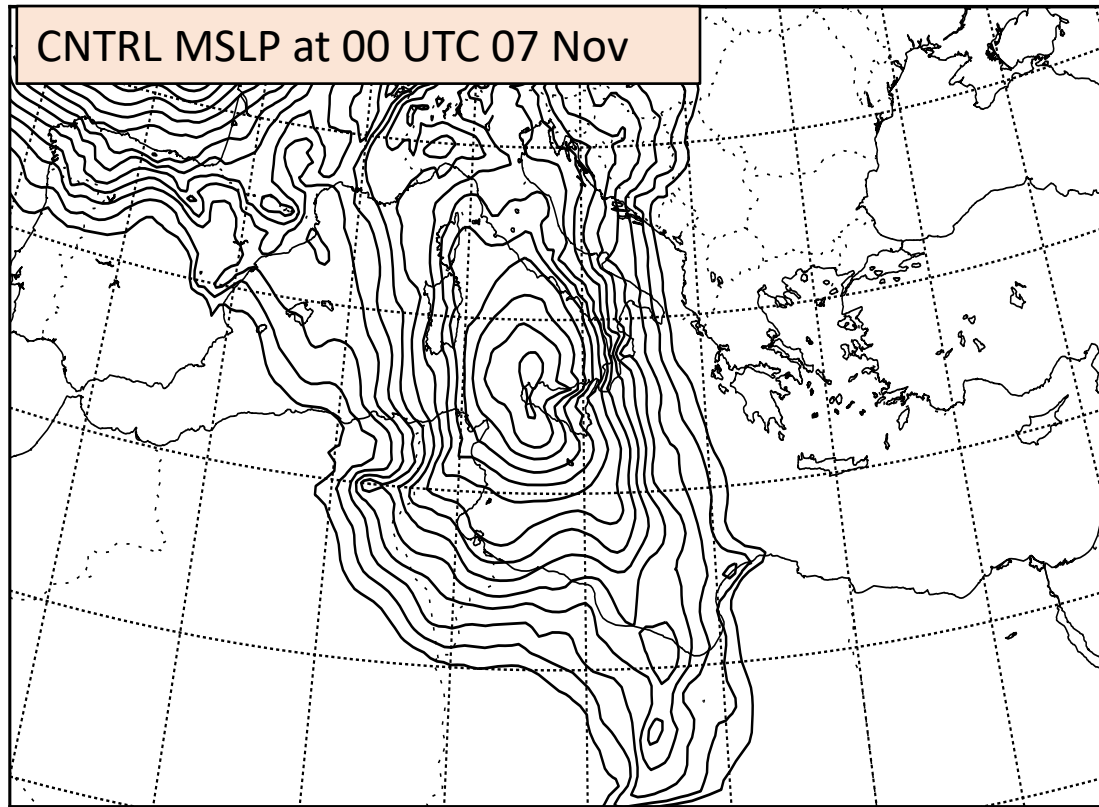
- Quantitative verification through time Lagged-Correlation



4. PRELIMINAR RESULTS

Limited Predictability Improvements: Main Reasons

- **Poor analysis** (new IC) estimation in comparison with reanalysis **ERA5**



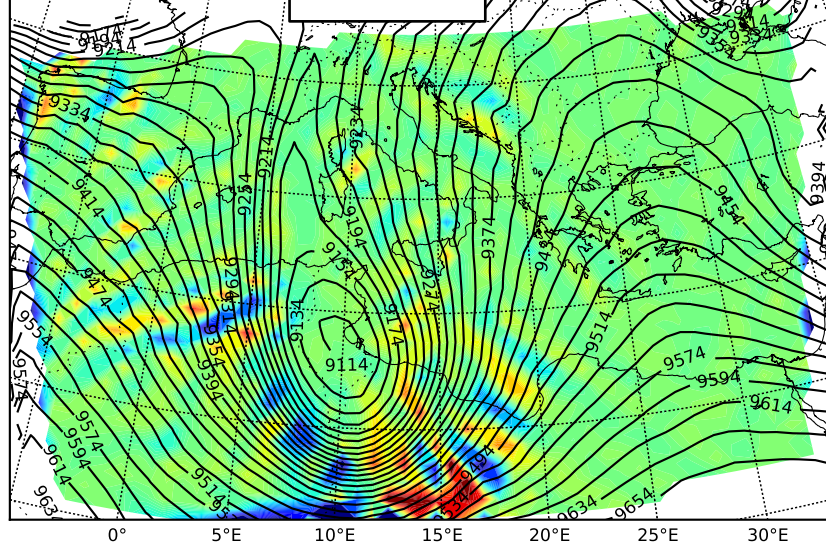
4. PRELIMINAR RESULTS

Limited Predictability Improvements: Main Reasons

- Poor analysis (new IC) estimation in comparison with reanalysis ERA5
- Influence of **upper-level dynamics**
- **Vorticity advection at 300 hPa at 00 UTC 7 November**

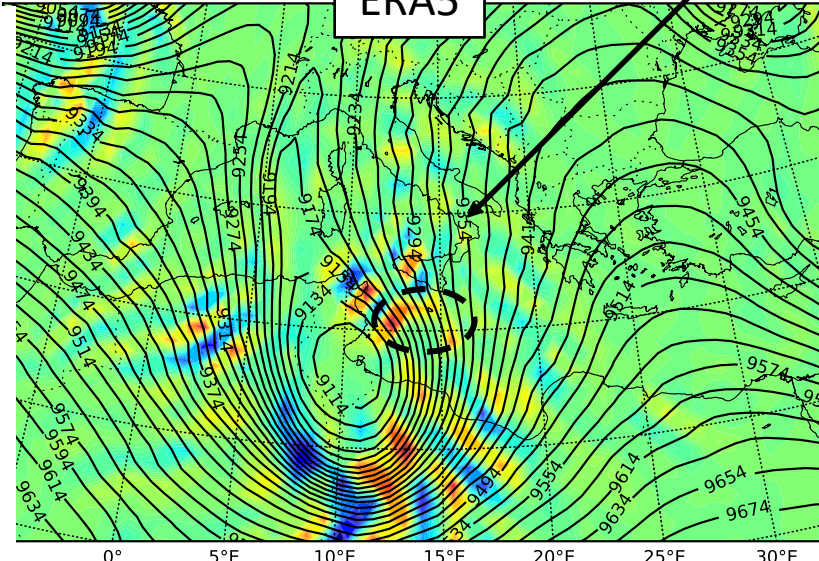
Positive vorticity advection
over region where center of
the cyclone develops

RSAMV



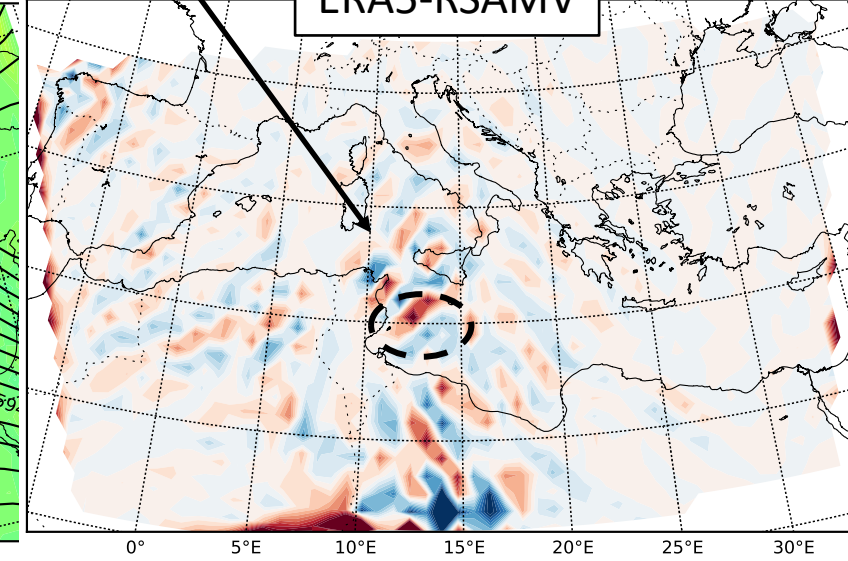
Vorticity (s^{-1})

ERA5



Vorticity (s^{-1})

ERA5-RSAMV



Geopotential (gmp)

CONCLUSIONS

- Assimilating conventional data and RS-AMVs in high resolution EnKF system improves the prediction of the track and intensity of the Mediane Qendresa.
- Room for improvement with respect to ERA-5, due to the insufficient spatial sampling of RS-AMV for this case
- OSSEs with ERA-5 prove the potential of this EDA system to forecast with warning value the Mediane of 7 Nov 2014. Higher spatial, vertical and temporal resolution is needed.

COASTEPS CGL2017-82868-R (MINECO/AEI/FEDER, UE)

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