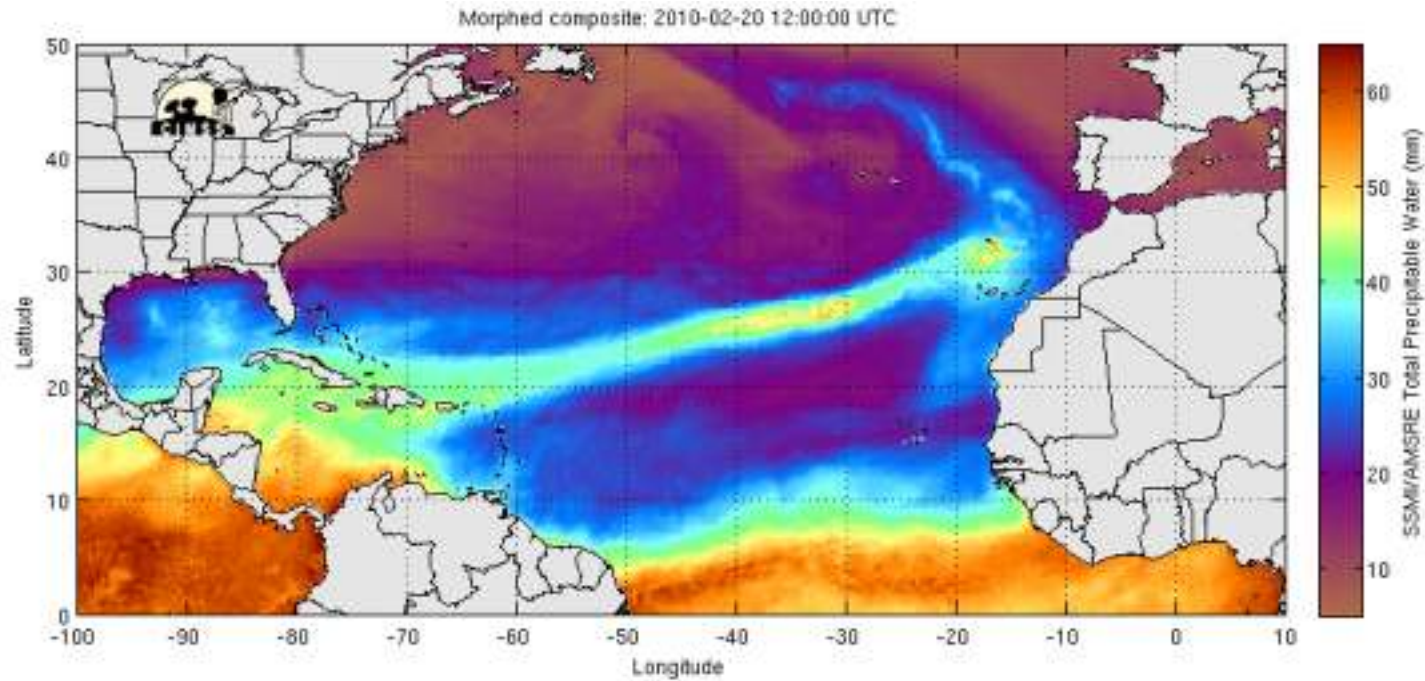


Predictability of Atmospheric Rivers in Europe



Pedro M. Sousa

ppsousa@fc.ul.pt

amramos@fc.ul.pt

Co-Authors

Alexandre M. Ramos⁽¹⁾, Ricardo M. Trigo⁽¹⁾, Ricardo Tomé⁽¹⁾, David Lavers⁽²⁾

(1) Instituto Dom Luiz (IDL), Universidade de Lisboa, Portugal

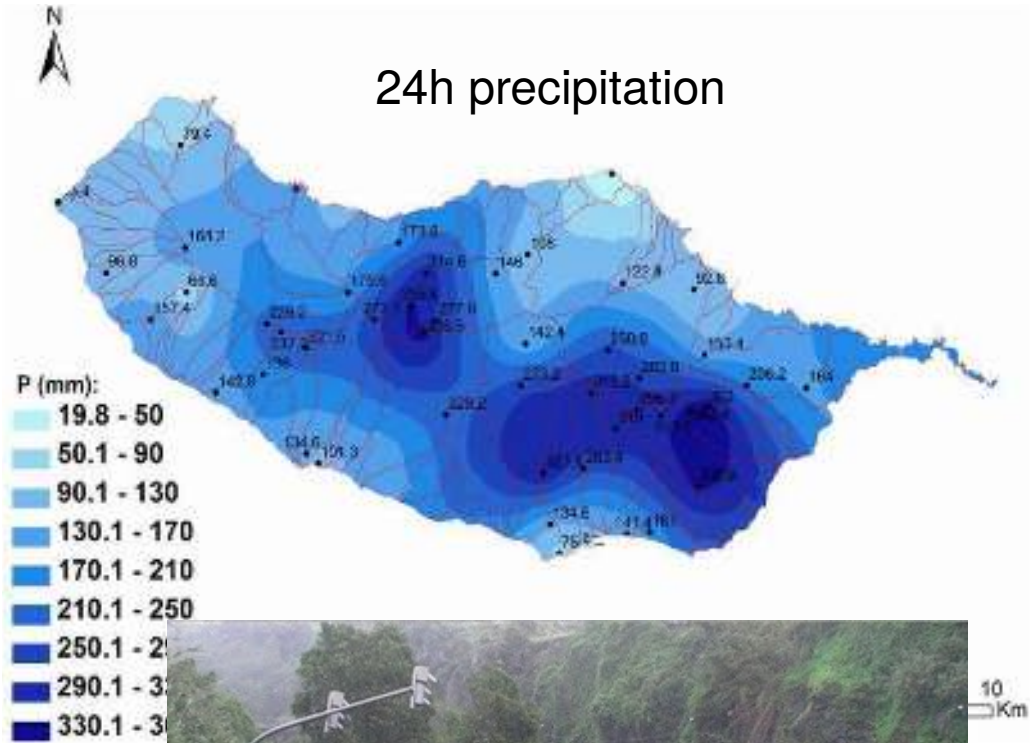
(2) European Center for Medium Range Weather Forecasting, Reading, United Kingdom

Motivation

- Heavy precipitation and floods along the west coast of Europe are largely caused by intense water vapor transport within the ARs
- Early awareness of extreme precipitation, can provide the time necessary to make adequate event preparations.

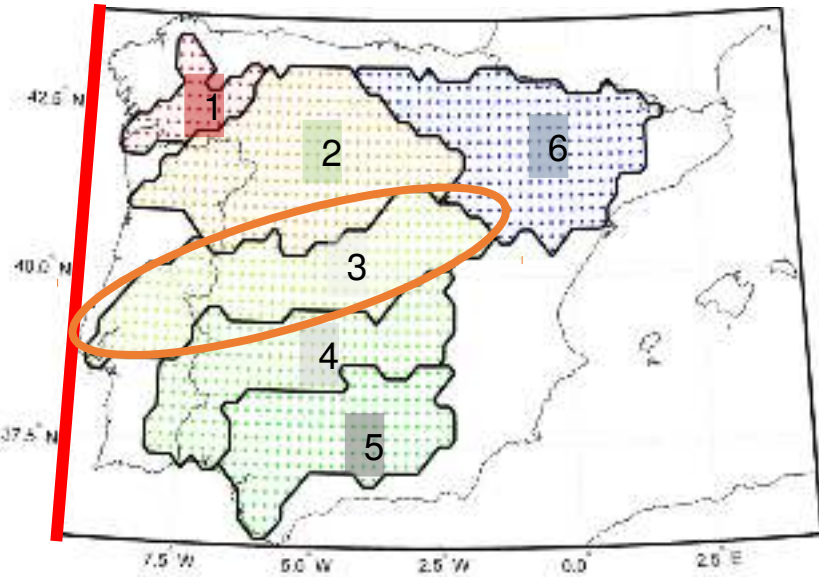
Motivation

Flash Flood Event in Madeira 20 February 2010

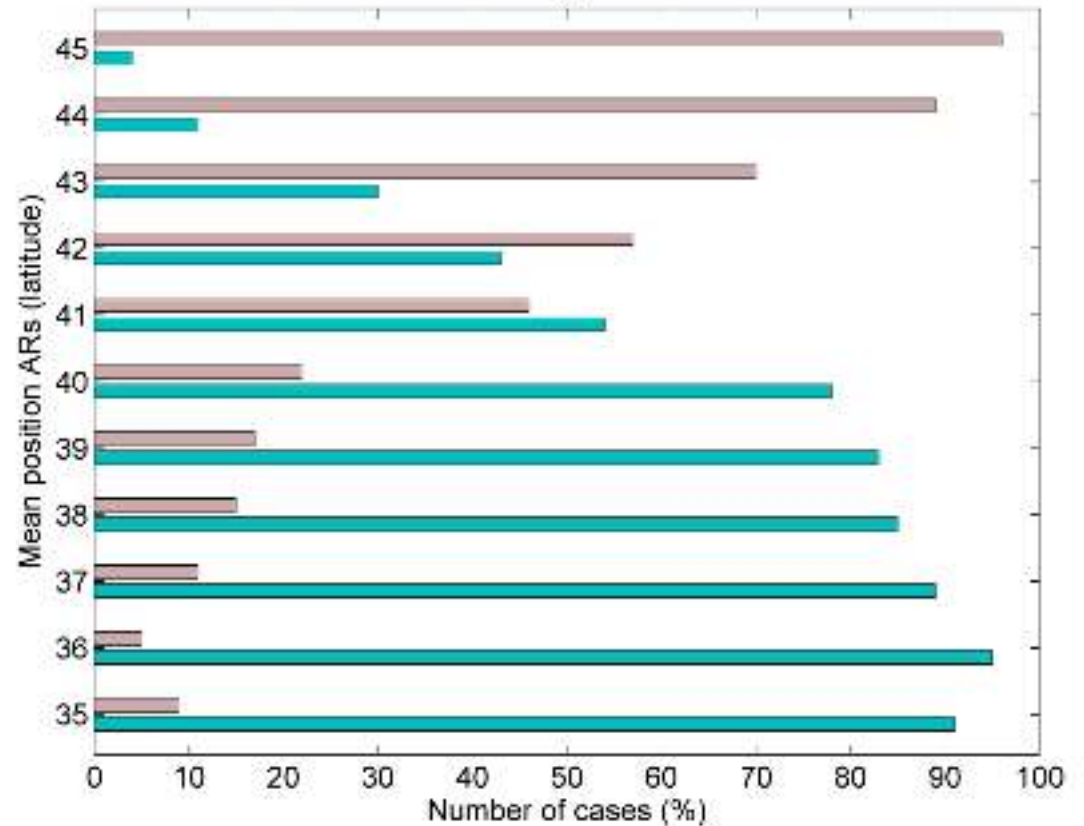


Motivation

Mean location of the ARs during *extreme precipitation days* (blue) and *non-extreme precipitation days* (light purple).



Tagus



The position of the ARs has influence in the extreme precipitation days!!

Objectives

Probabilistic forecast of the ARs that strike western Europe.

Focus on this presentation will be on:

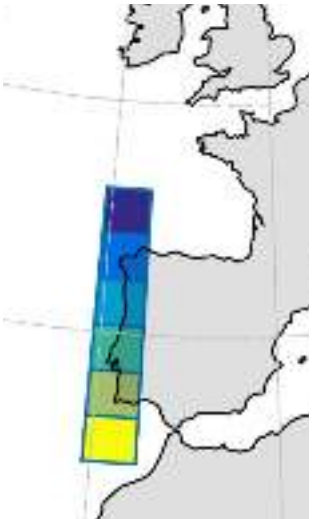
- Landfall Distance
- Intensity of the IVT
- Direction of the IVT

Dataset & Methods

Only interested in potential ARs events:

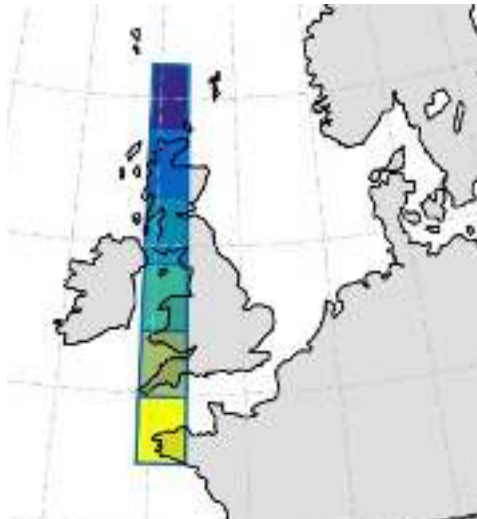
- Days with mean IVT value inside box > 450 kg/m/s;
- Iberian Peninsula and UK

Iberian Peninsula



(200 events)

UK

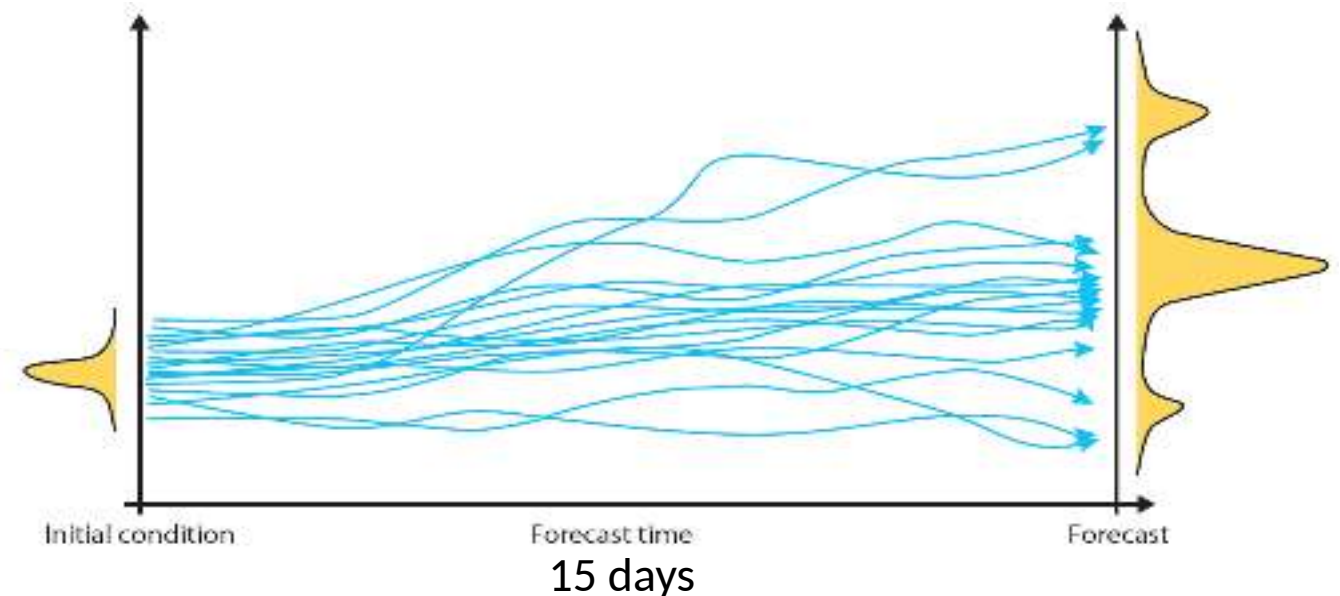


(240 events)

Dataset & Methods

The operational and 50 perturbed ensemble members (out to forecast day 15) from the ECMWF ensemble prediction system, were retrieved for the 00UTC and 12UTC initialization for:

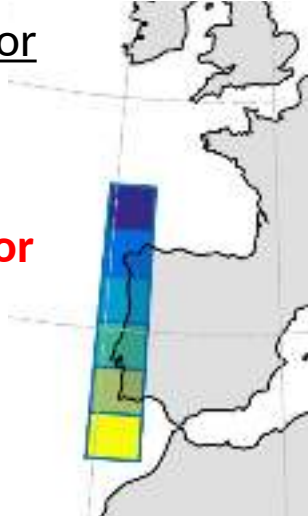
- Four extended winter seasons (October to March) of 2012/2013, 2013/2014, 2014/2015 and 2015/2016;
- **IVT (intensity and direction);**
- Horizontal resolution of $0.25^\circ \times 0.25^\circ$



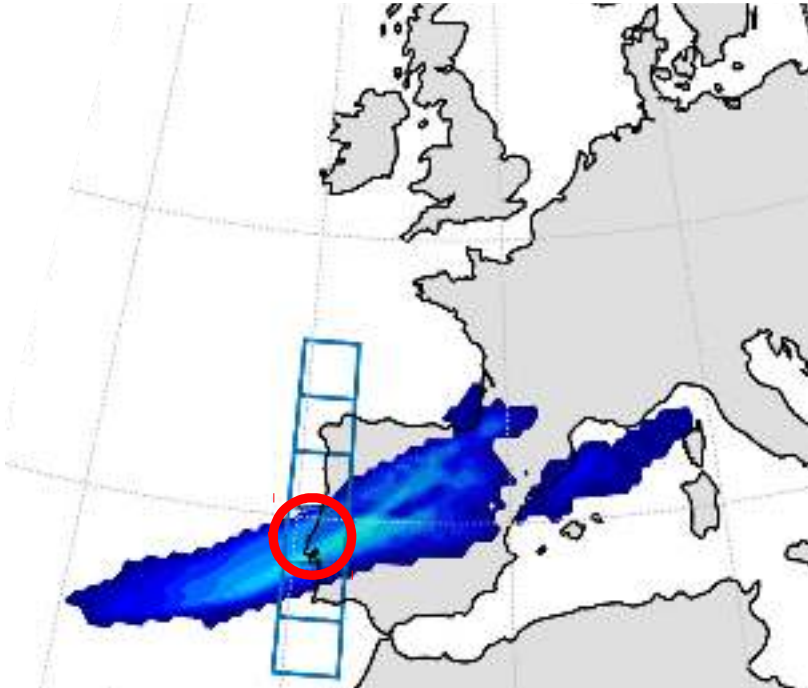
Dataset & Methods

For the days with mean IVT value inside a box $> 450 \text{ kg/m/s}$, we compared the analysis for AR events (at 00 UTC or 12 UTC) against the forecasts made in previous days (-24h, -48h,...-336h) using the following metrics:

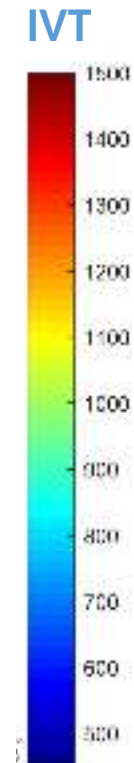
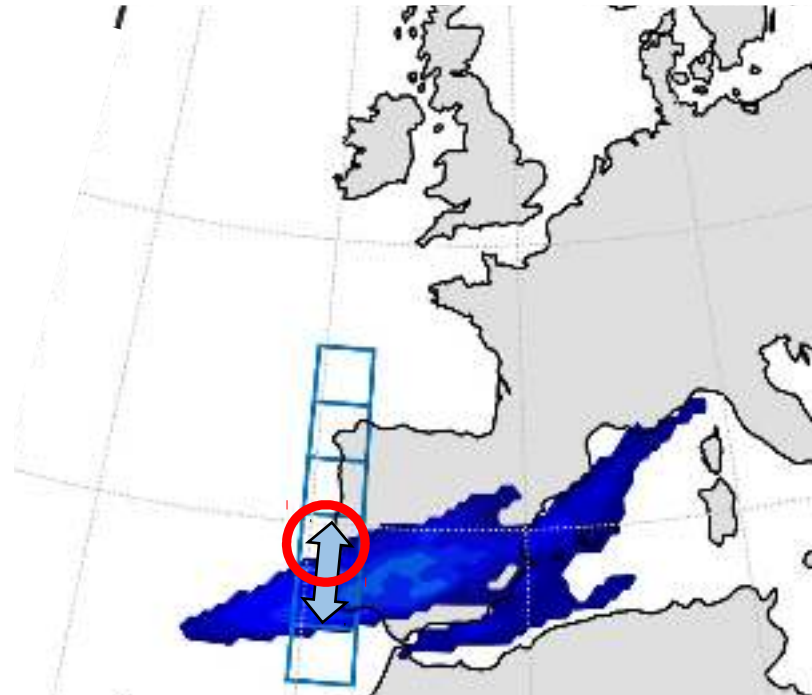
- the location (latitude) of the observed/predicted AR axis (maximum IVT) - Landfall distance
- the intensity (mean IVT in the box) at the latitude of observed/ should have been predicted - Landfall IVT Error



Analysis
11-Jan-2016 00UTC



Forecast (day -5)
6-Jan-2016 00UTC +120h



Example for
11-Jan-2016

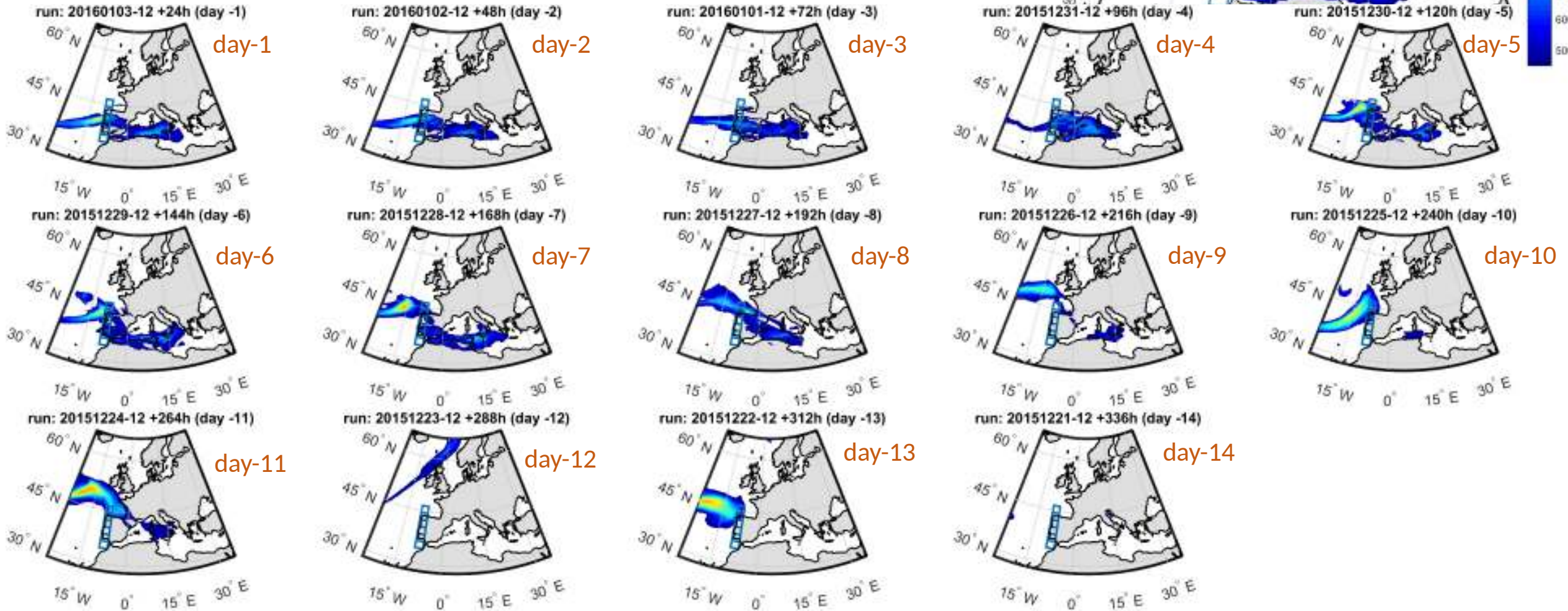
ARs Predictability Iberian Peninsula

IVT

Example

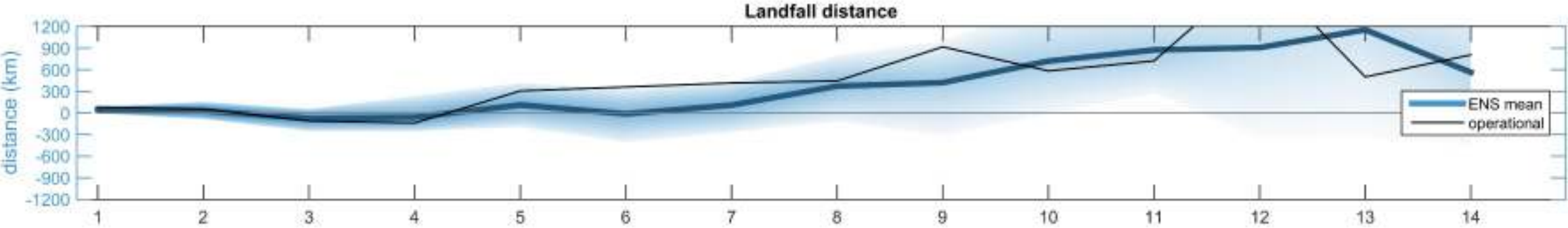
04 Jan-2016 12UTC - Analysis

Evolution of the Operational RUN Forecast



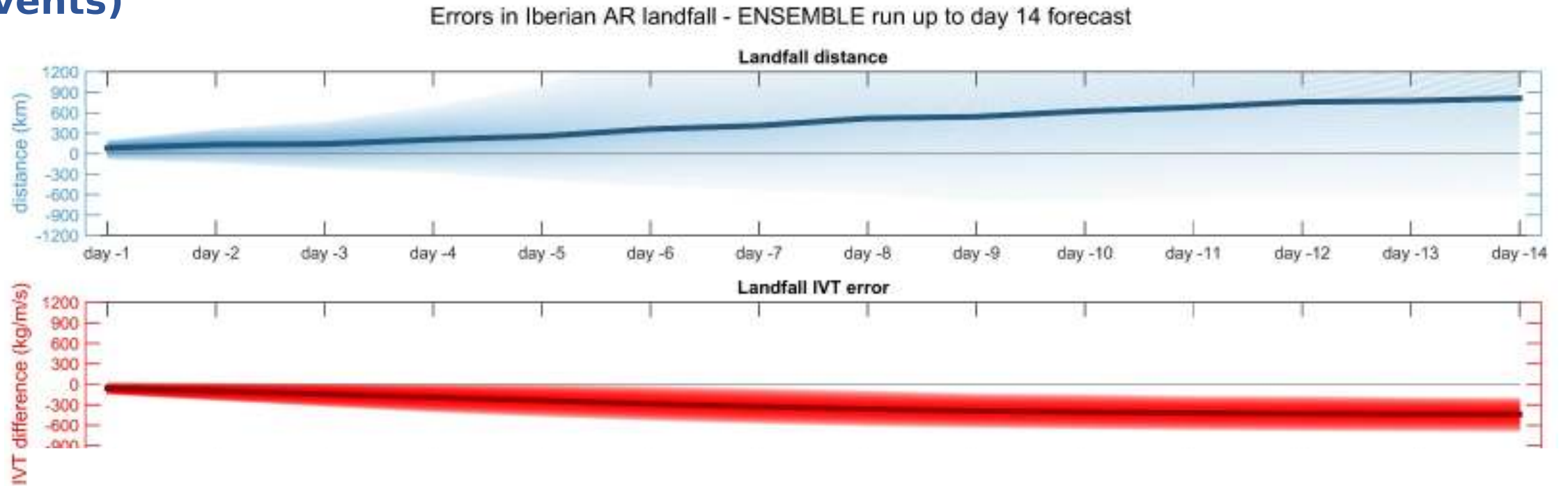
ARs Predictability Iberian Peninsula

04 Jan-2016 12UTC - Ensemble Forecast



ARs Predictability Iberian Peninsula

Mean of all operational forecasts
(200 events)



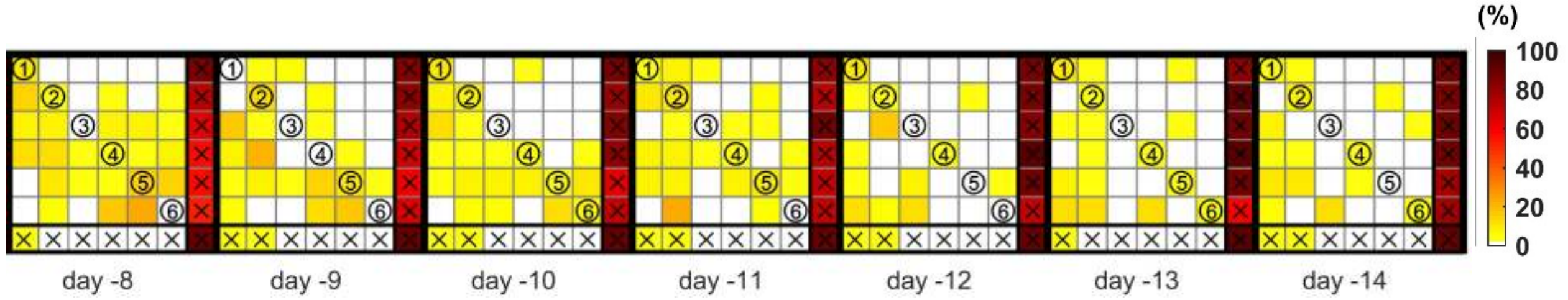
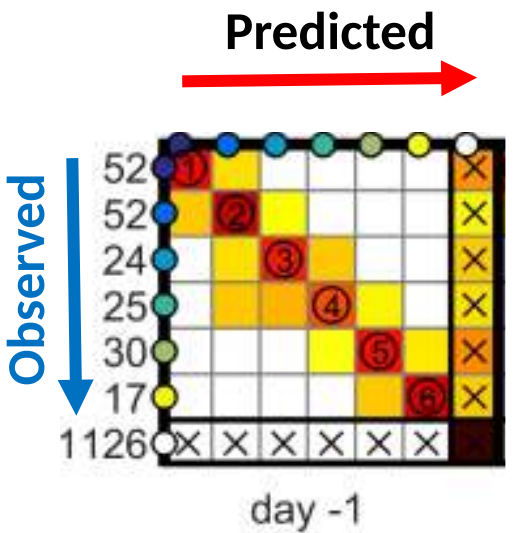
ENSEMBLE FORECAST – 200 cases x 50 Members

ARs Predictability Iberian Peninsula



All operational forecasts
(200 events)

Contingency Tables for Iberian Peninsula

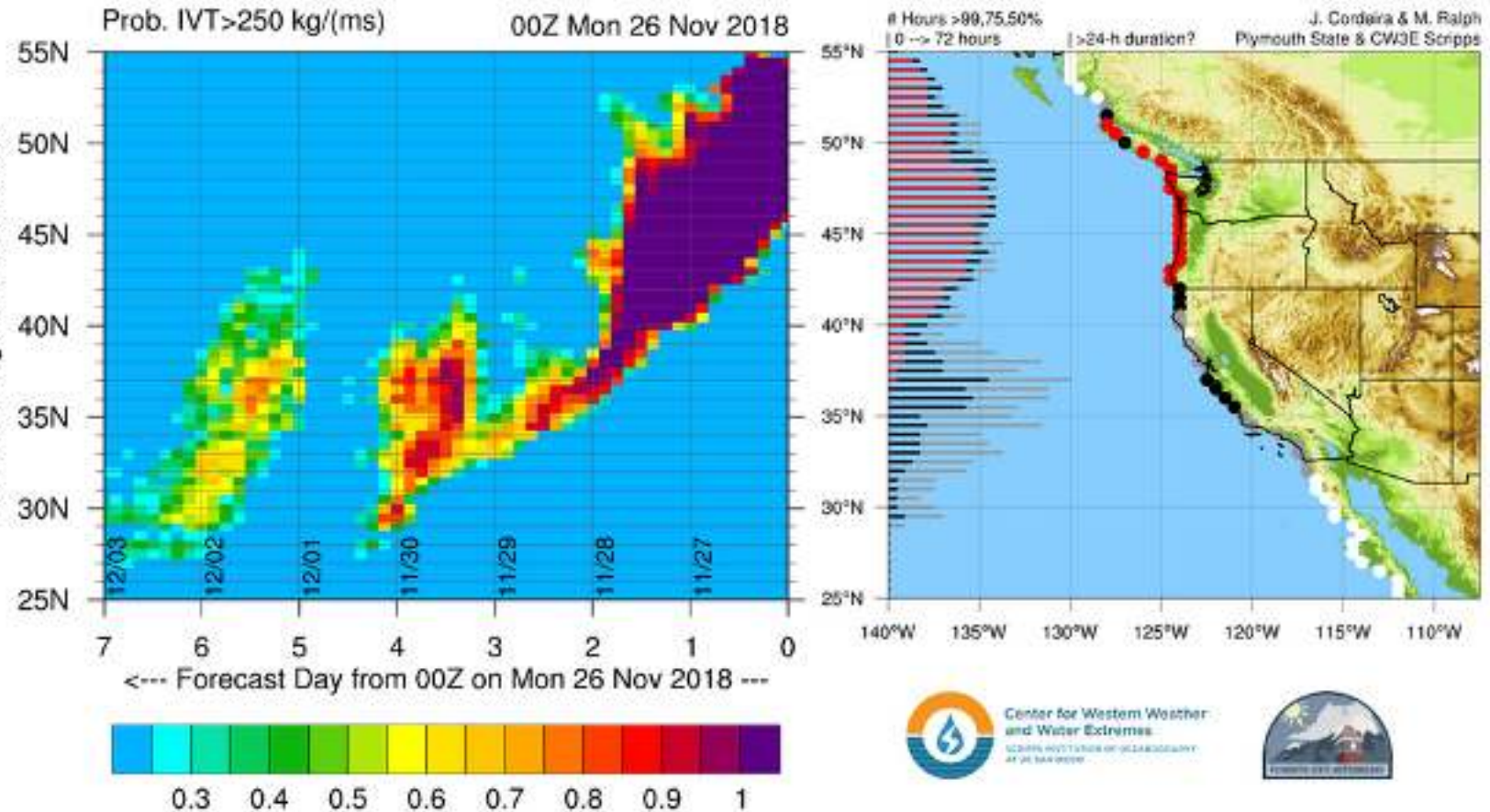
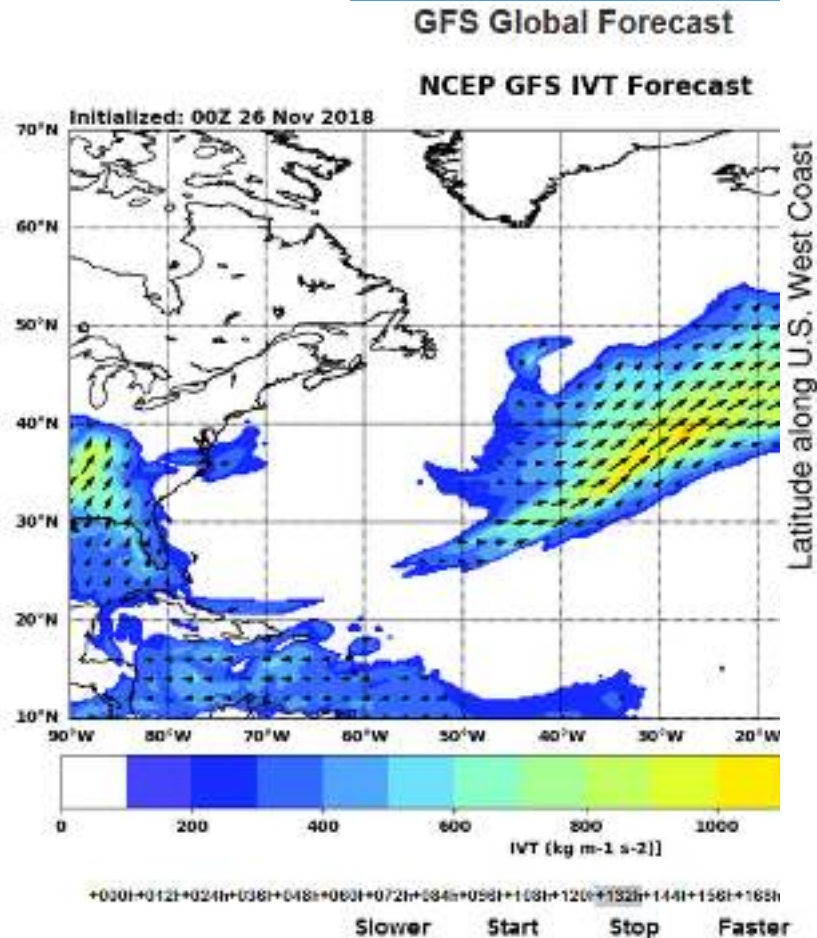


ARs Predictability Iberian Peninsula

Future work:

Example:

www.weather.uoi.pt



Final Remarks

- Ongoing work, but it seems that there is **some predictability on the characteristics of the ARs affecting the Iberian Peninsula and the UK**;
- The **location** and **intensity** of the **AR landfall** position, as well as the **angle** of incidence are **well predicted until forecast day 5** and lower when going to longer forecast periods;
- At longer forecast times detail is lost regarding the **specific latitude** of the landfall, but there is still **good predictability for potential ARs occurring in both areas** (Iberian/UK domains);
- ARs tend to be forecasted further north than observations in Iberia as forecast times increase;
- Mean IVT values tend to be underestimated for longer range forecasts in both domains;
- The use of **the ensemble forecast**, along with knowledge of systematic errors/biases, will be useful for the **probabilistic forecast of the location and intensity of the ARs**;

Acknowledgments

The financial support for attending this workshop was possible through FCT project UID/GEO/50019/2013 - Instituto Dom Luiz. The author wishes also to acknowledge the contribution the project IMDROFLOOD – Improving Drought and Flood Early Warning, Forecasting and Mitigation using real-time hydroclimatic indicators (WaterJPI/0004/2014) funded by Fundação para a Ciência e a Tecnologia (FCT) with the data provided to achieve this work. **I would also would like to thank Marty Ralph for the additional support for attending this conference.**

A. M. Ramos was also supported by a FCT postdoctoral grant (FCT/DFRH/ SFRH/BPD/84328/2012).



Thank you for your attention!



Motivation

10 December 2017

NCEP GFS IVT ($\text{kg m}^{-1} \text{s}^{-1}$; shaded), IVT Vector, and SLP (hPa; contours)
Initialized: 1800 UTC 12/10/2017 F-000: Valid: 1800 UTC 12/10/2017

