The importance of Atmospheric Rivers in the Development of Explosive Cyclogenesis in the North Atlantic and North Pacific Basins.

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Introduction

- Explosive cyclogenesis (EC) is one of the major natural hazards in mid-latitudes.
- EC results from different mechanisms related to vorticity, advection and **latent heat** release.
- Atmospheric Rivers (ARs) are responsible for most of the latent heat poleward transport.
- The role of the ARs in certain EC developments has been previously analyzed (e.g. Ferreira 2016), but no climatology periods were considered.
- This study analyzes the role of the ARs in the explosive deepening of North Atlantic and North Pacific cyclones from a climatological point of view.

Methods

Three different databases have been considered in the analysis:

① - Cyclone database for the Northern Hemisphere, ad hoc generated, based in Trigo (2006).
② - ARs detection database from Eiras et al. (2016).
③ - ARs detection database from Guan et al. (2015).

EC have been identified from ①*1. ① has been independtly crossed with ② and ③ in a time period covering 1979-2012 to analyze the presence of ARs in a 1000 km radius surrounding the EC and non-EC events.

Finally, a composite of the Integrated Vapor Transport surrounding the EC and non-EC, has been obtained crossing ① and ③ from a time-dependent point of view.

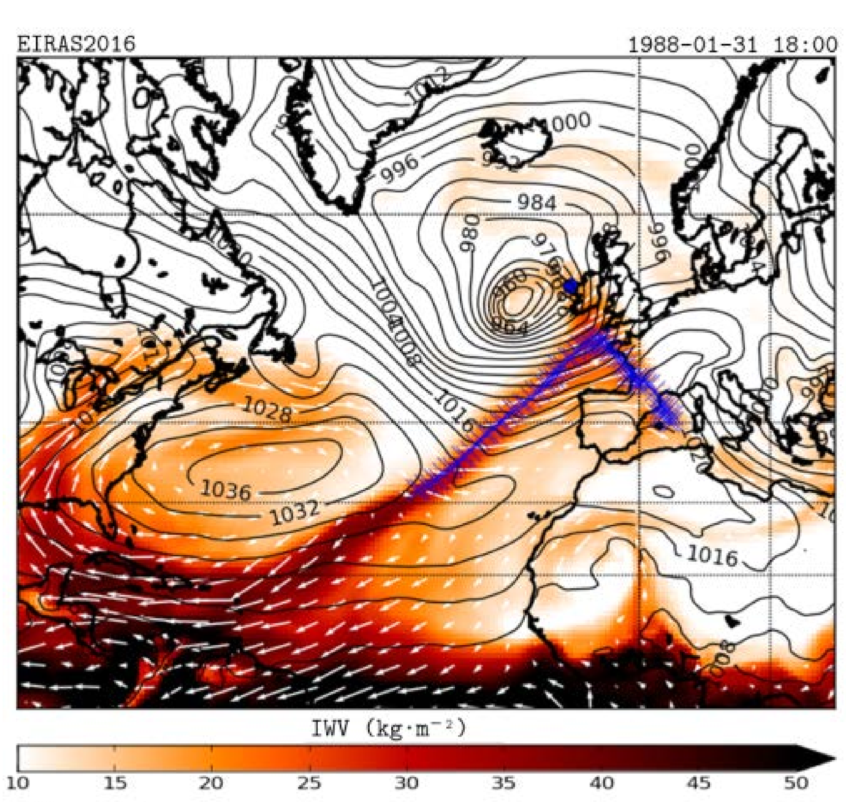

Figure 1: *Example of interaction between a very well defined AR and an EC. Blue crosses identify the central axis of the Atmospheric River detected by the EIRAS2016 algorithm.*

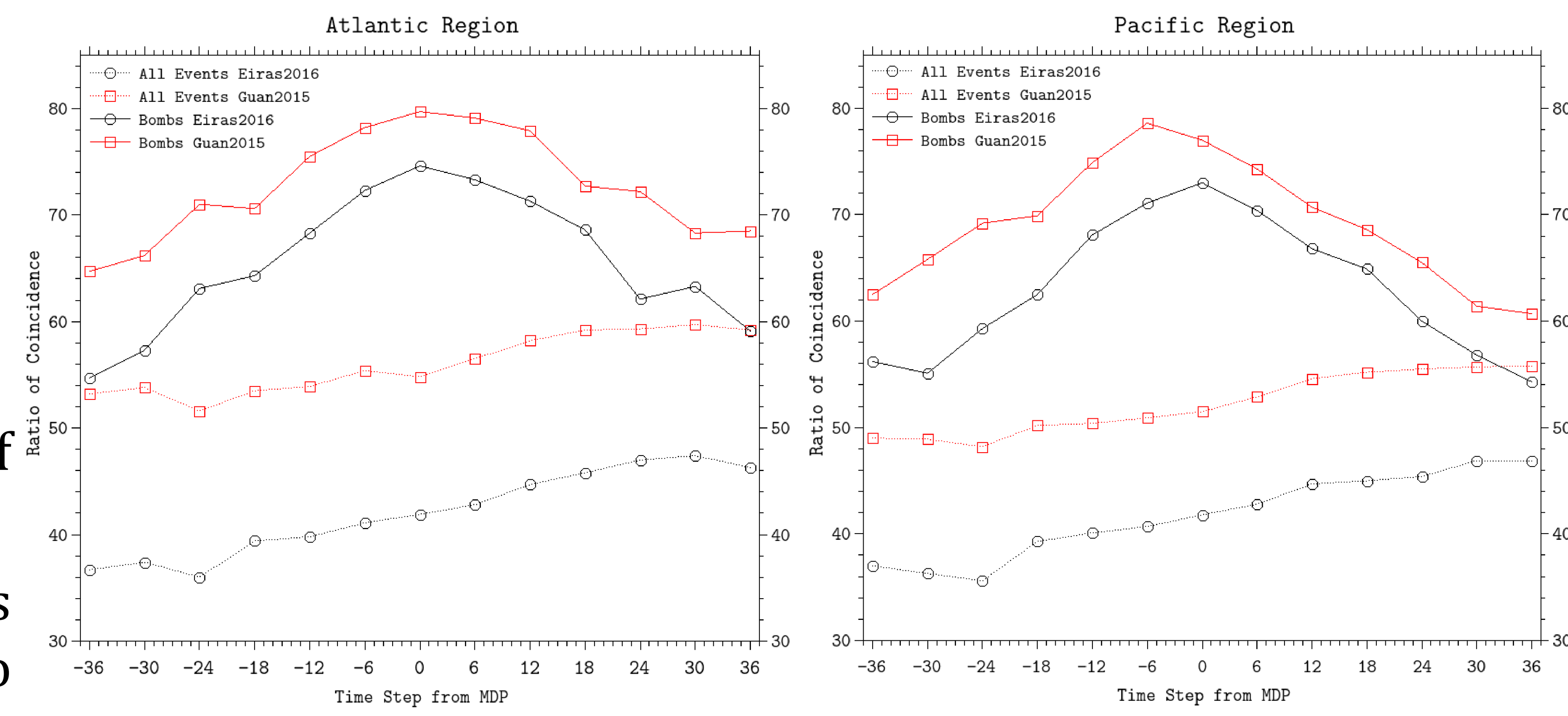

Figure 2: *Ratios of coincidence between the proximity of an AR and the development of EC (bombs, in solid lines) and OC (in dashed lines). The Maximum Deeping Point (MDP,) was selected as time reference. <u>Example of interpretation</u>: for the Atlantic Ocean, considering the MPD, and according to the EIRAS2016 algorithm; ARs were present in the 75% of the Ecs but only in the 41% of all the events (EC+non-EC).*

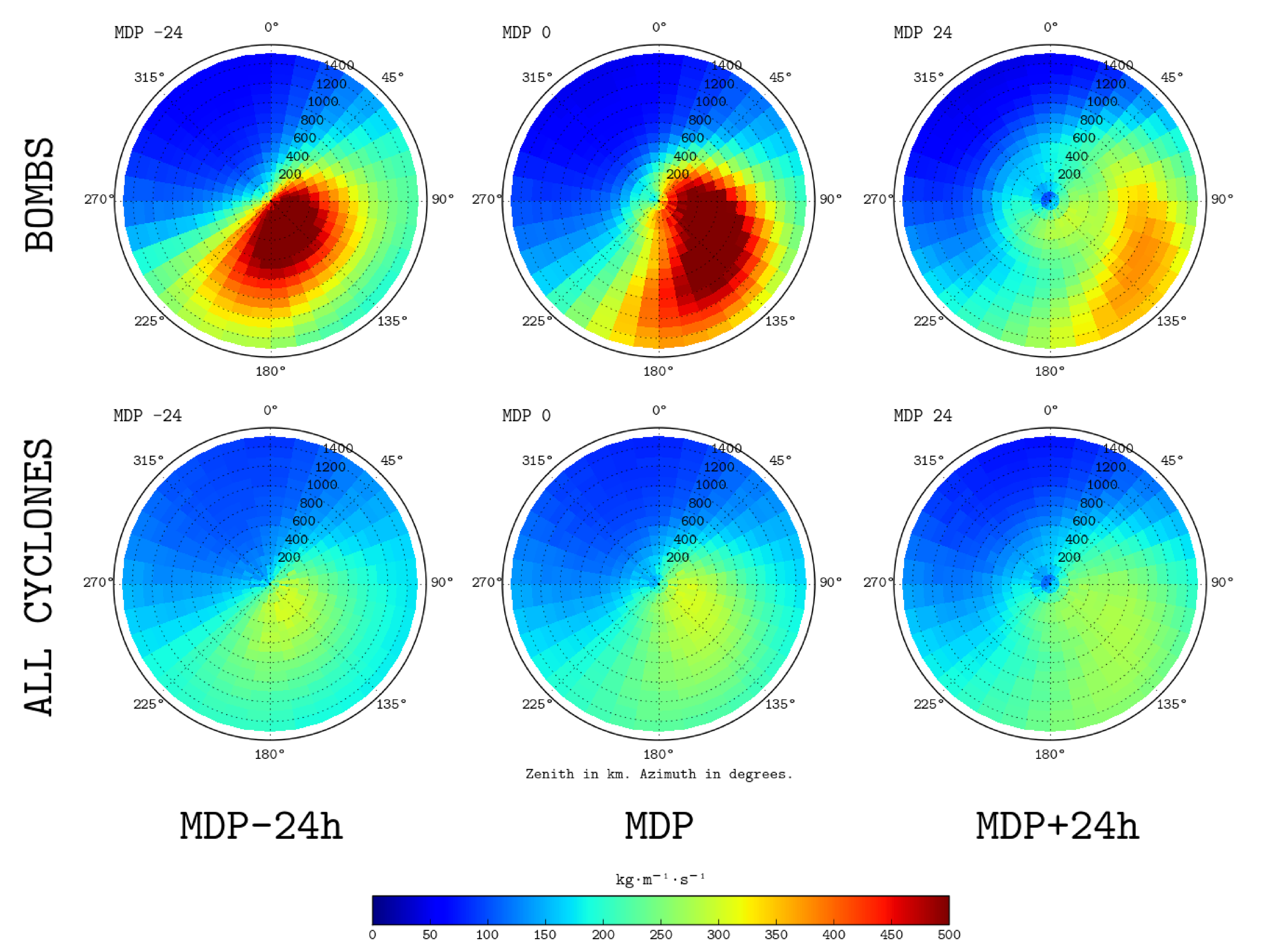

Figure 3: *Integrated Vapor Transport (IVT) composites surrounding the cyclone center in a 24h time-frame from the Maximum Deepening Point (MDP *2), for the North Atlantic basin.*

Conclusions

- ❑ High ratios of coincidence between explosive ciclogenesis developments and ARs can be observed.
- ❑ Much lower ratios of coincidence with ARs are found if non-explosive cyclogenesis events are considered.
- ❑ From analysis of IVT composites around the center of cyclones, we hypotheseze that hte relationship betwee explosive cyclogenis and ARs exists not only in terms of STATISTICAL CORRELATION but also of CAUSALITY.

Bibliography and Notes:

*1- EC were computed based on cyclone deepening rates of at least (24·sinφ/sin 60) hPa in 24h. *2- The Maximum Deepening Point is defined as the point with the maximum deepening in the pressure values when compared to previous time-step.

Ferreira et al. (2016). On the relationship between atmospheric water vapour transport and extra-tropical cyclones development.

Trigo (2006). Climatology and interannual variability of storm-tracks in the Euro-Atlantic sector: a comparison between ERA-40 and NCEP/NCAR reanalyses.

Eiras-Barca et al. (2016). Seasonal Variations in North Atlantic atmopsheric river activity and its association with anomalous precipitation over the Iberian Atlantic Margin.

Guan et al. (2015). Detection of Atmospheric Rivers: Evalueation and application of an algorithm for global studies.