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North Atlantic explosive cyclones and large scale atmospheric variability modes

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Extreme windstorms are one of the major natural catastrophes in the extratropics, one of the most costly natural hazards in Europe and are responsible for substantial economic damages and even fatalities. During the last decades Europe witnessed major damage from winter storms such as Lothar (December 1999), Kyrill (January 2007), Klaus (January 2009), Xynthia (February 2010), Gong (January 2013) and Stephanie (February 2014) which exhibited uncommon characteristics. In fact, most of these storms crossed the Atlantic in direction of Europe experiencing an explosive development at unusual lower latitudes along the edge of the dominant North Atlantic storm track and reaching Iberia with an uncommon intensity (Liberato et al., 2011; 2013; Liberato 2014). Results show that the explosive cyclogenesis process of most of these storms at such low latitudes is driven by: (i) the southerly displacement of a very strong polar jet stream; and (ii) the presence of an atmospheric river (AR), that is, by a (sub)tropical moisture export over the western and central (sub)tropical Atlantic which converges into the cyclogenesis region and then moves along with the storm towards Iberia.
Previous studies have pointed to a link between the North Atlantic Oscillation (NAO) and intense European windstorms. On the other hand, the NAO exerts a decisive control on the average latitudinal location of the jet stream over the North Atlantic basin (Woollings et al. 2010). In this work the link between North Atlantic explosive cyclogenesis, atmospheric rivers and large scale atmospheric variability modes is reviewed and discussed.

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