WAVES TO WEATHER

Rossby wave packets associated with extreme precipitation events over Northern-Italy
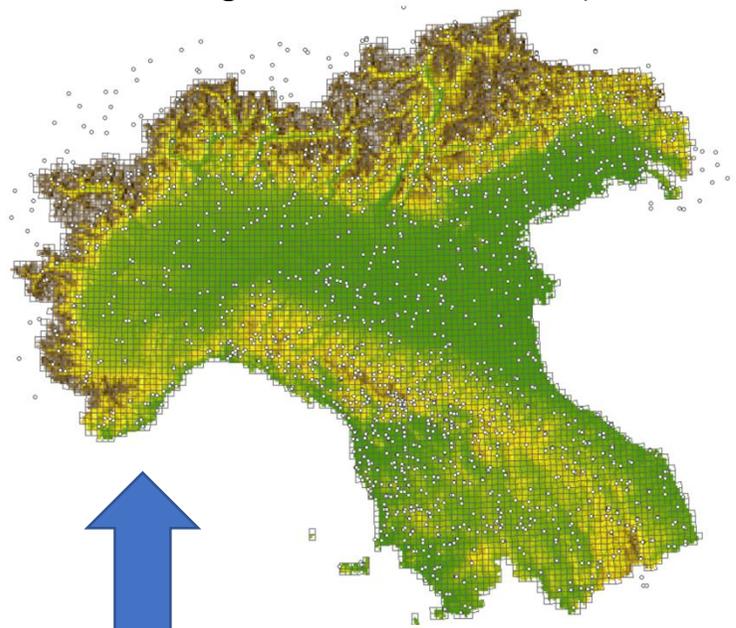
Federico Grazzini[1,3],Georgios Fragkoulidis[2], Franziska Teubler[2], Volkmar Wirth[2], George C. Craig[1]

1) Meteorologisches Institut München, Ludwig-Maximilians-Universität München

2) Johannes Gutenberg-Universität Mainz

3) Arpae regional weather service Emilia-Romagna, Bologna

LMU JG|U arpae emilia-romagna

T1 project partner
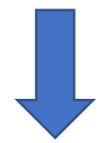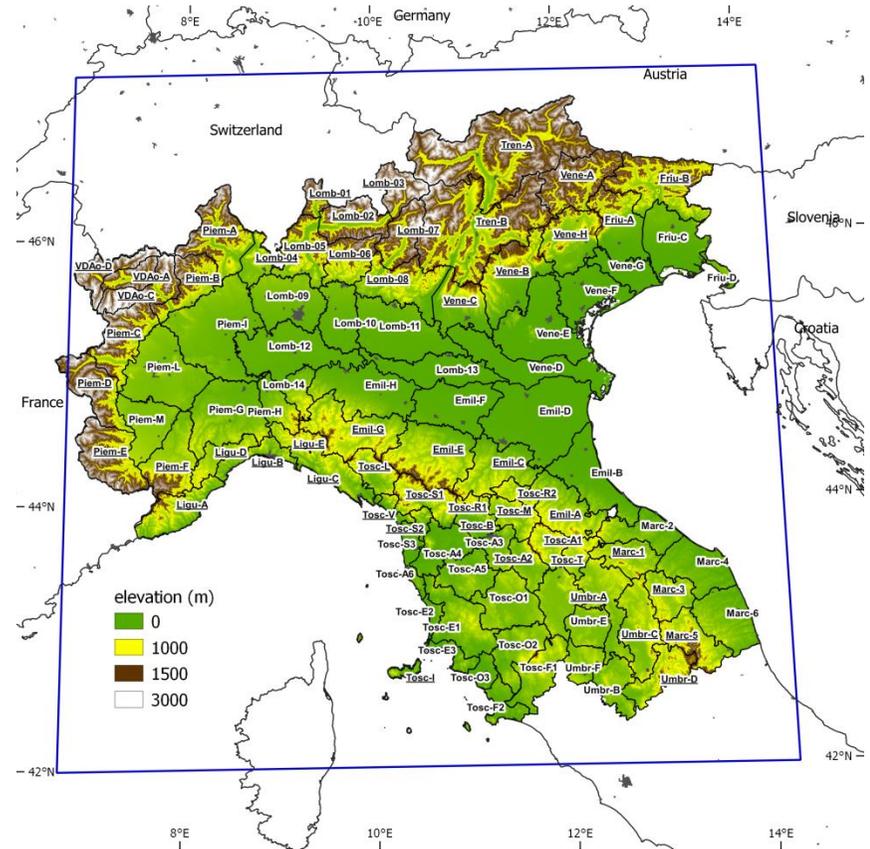
Creation of a catalogue of extreme precipitation events

WAVES TO WEATHER

ArCis dataset gridded obs 1961-2015 (Pavan et al. 2018)

Daily precipitation values averaged over Italian civil protection **warning areas**

11 regional observation networks

Extreme precipitation events (**EPE**) are defined as days with average rainfall, at least on one of the areas, exceeding 99° of climate distribution. We have found 887 days with EPE in the period 1979-2015.
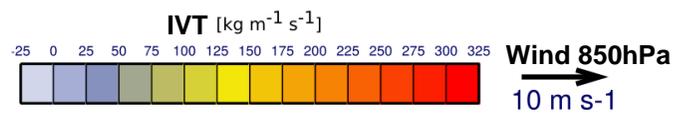
EPE distribution during the year

Strong seasonality prompt following research questions:
Are different processes generating EPEs?
Is recurrence linked to large-scale dynamics?
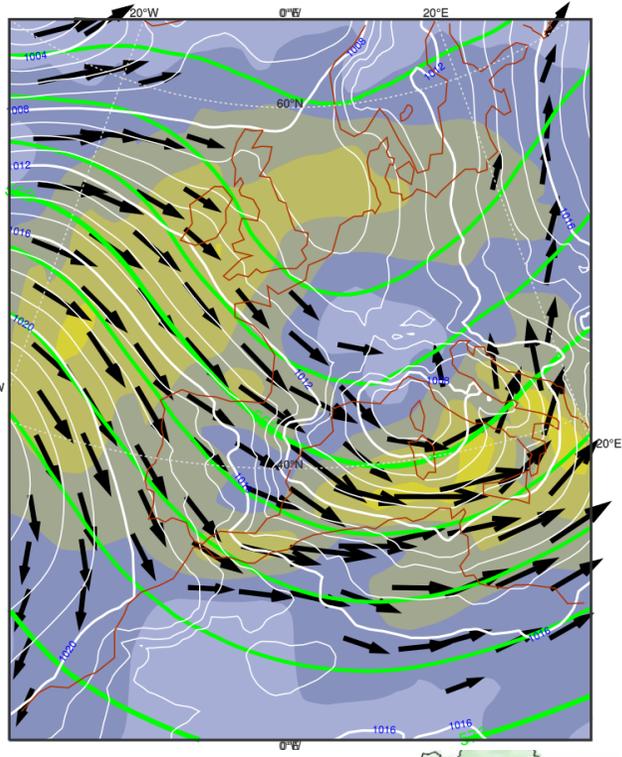Implications for predictability ?

Grazzini et al. 2020, QJRMS
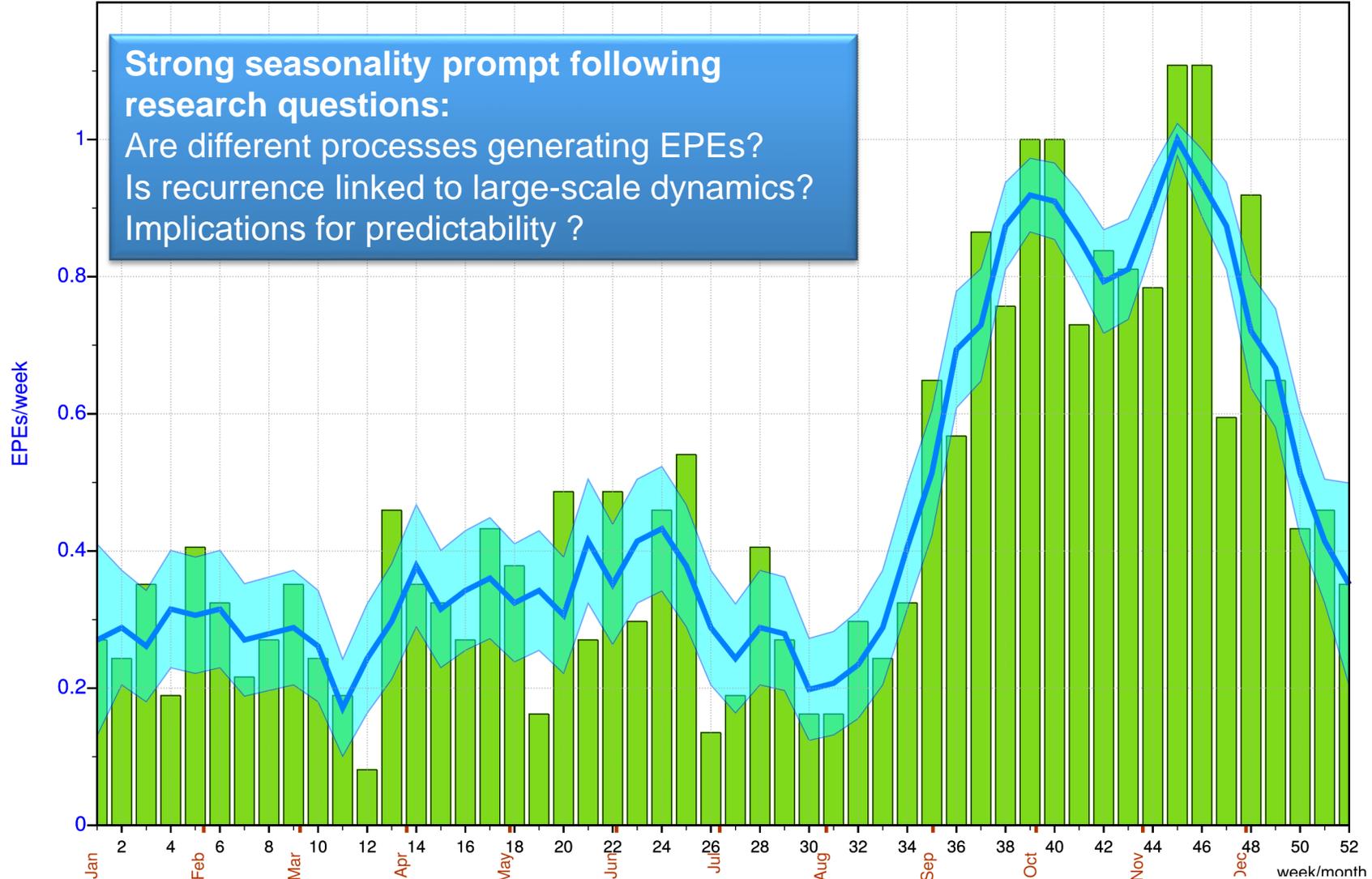
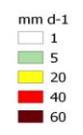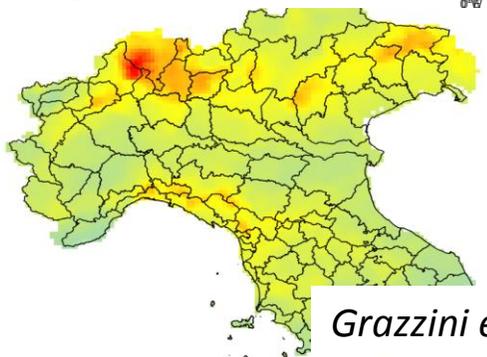# Classification of EPEs in 3 categories via machine learning

Synoptic composites

IVT [kg m⁻¹ s⁻¹]

Wind 850hPa
10 m s-1

Cat1

Cat2
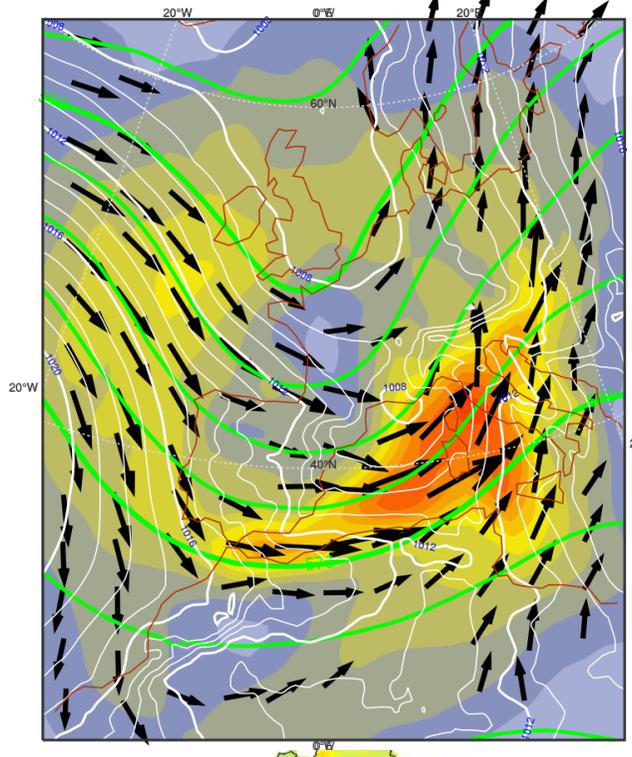
Cat3

Precip composites

mm d-1

homogenous sample #100

Grazzini et al. 2020, QJRMS
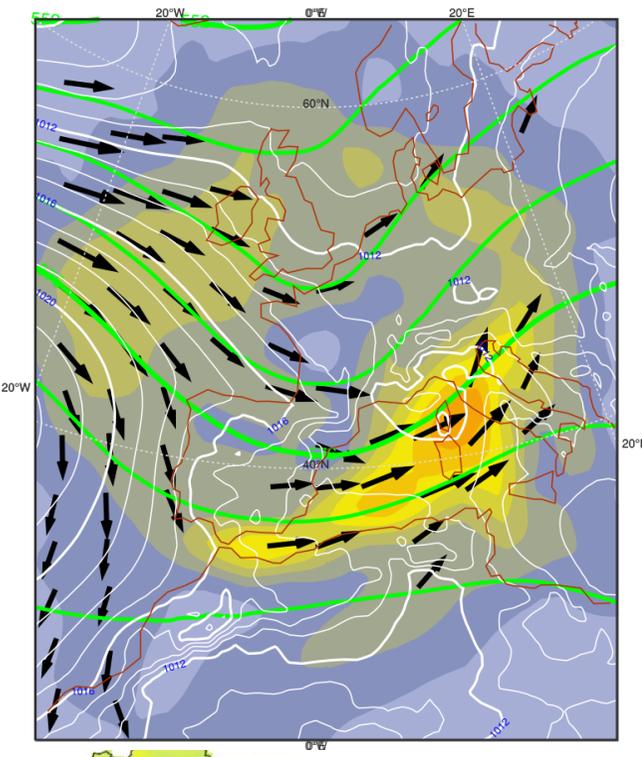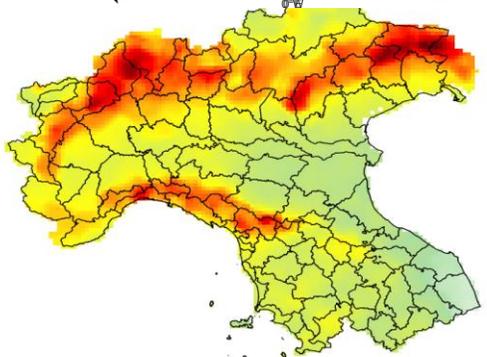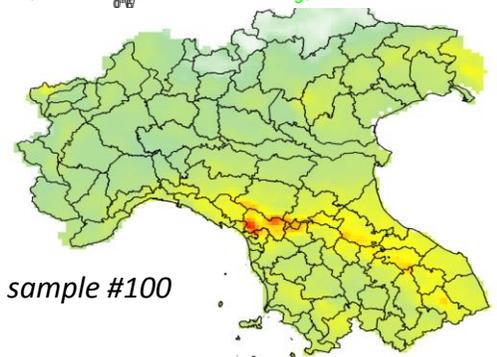
Hovmöller composites of EPE categories: v' and IVTn

hatches indicate statistical significance at the 0.10 level, based on a Monte Carlo approach

Grazzini et al. 2020 (part II), submitted
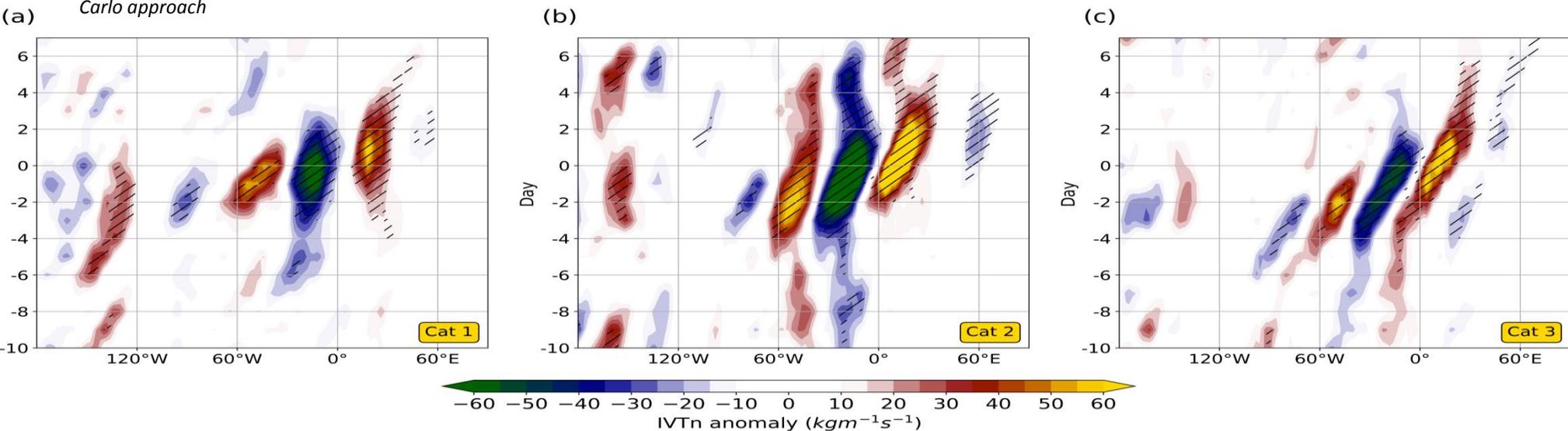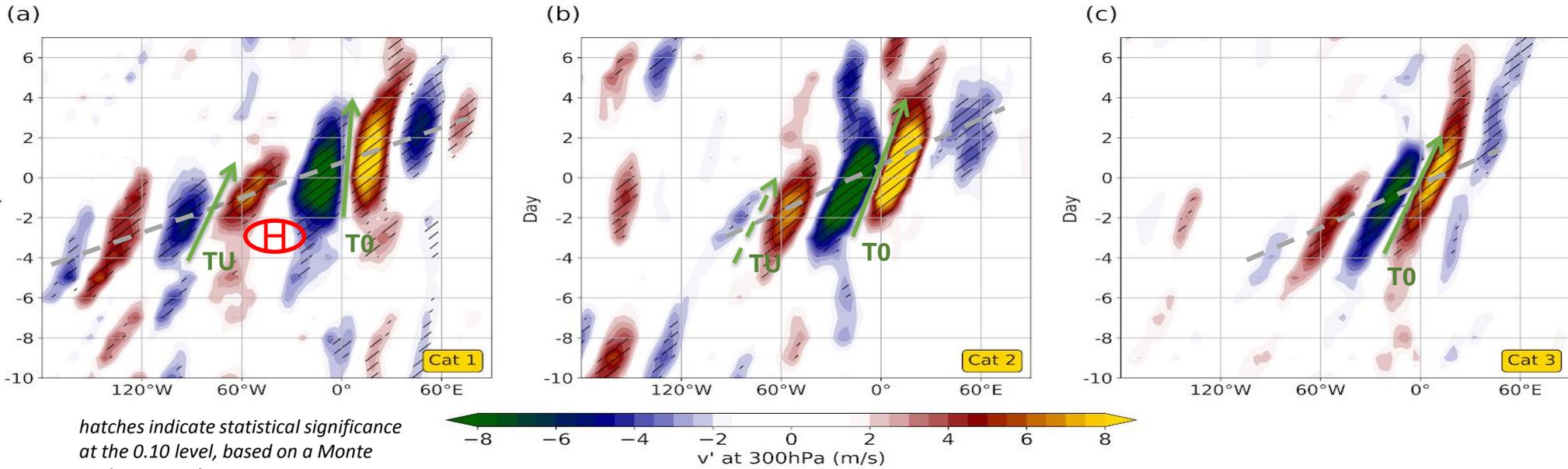
Evolution of precursors RWPs on November months only

EPE categories have different evolution, not explained by seasonality

(a) *51 cases*

(b) *35 cases*

Grazzini et al. 2020 (part II), submitted

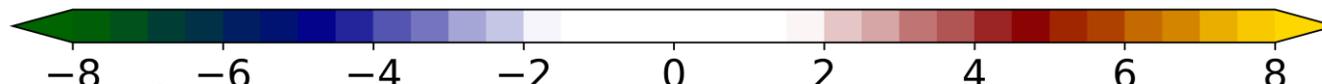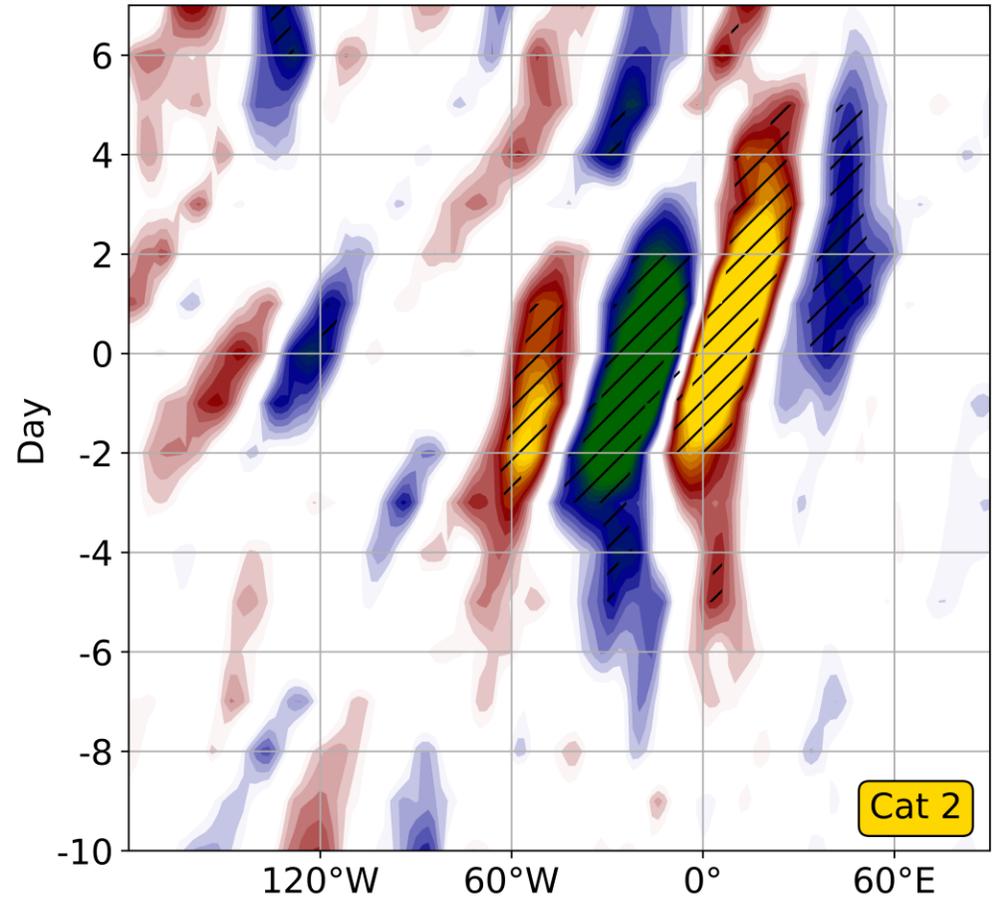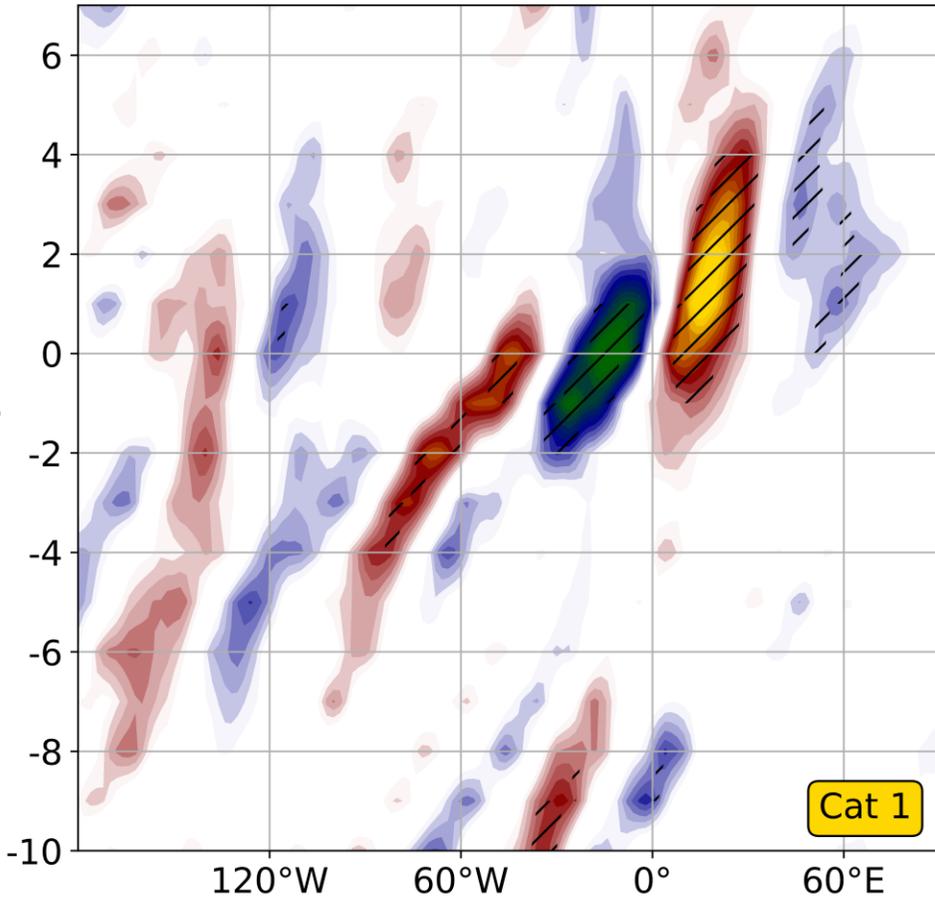# PV tendency framework* application to North-Atlantic ridge building, preceding EPEs during November months

In Cat1 the divergent outflow follows the baroclinic growth, while in Cat2 this is not true

* Following (Teubler and Riemer 2016)

Grazzini et al. 2020 (part II), submitted

Summary

Part I

- A large dataset of EPEs (1979-2015, **887 events**)
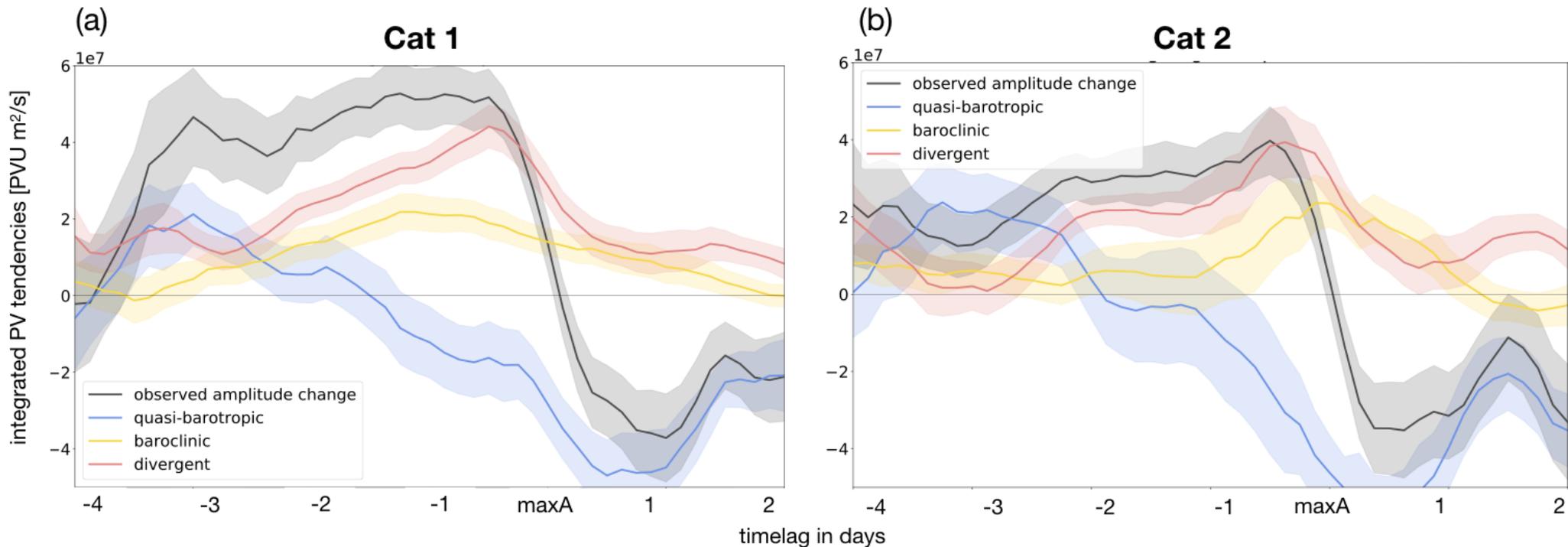- An objective method, based on *machine learning techniques,* to categorize EPE
- Well separated categories representing different physical processes
- Category 2 produces the largest effect due to a large-scale/convection synergy
- EPEs are usually associated with Rossby wave packets which mobilize water vapor plumes

Part II

- The probability of Cat1 and Cat2 EPE is proportional to the waviness in the upper-level flow
- Difference in RWP properties are evident and they are not exclusively related with seasonality
- An interplay between RWPs and moisture transport pathways is suggested
- In Cat2 we observe a larger divergent outflow in the initial phase of ridge amplification
- Enhanced RWP amplitude over NAtlantic likely leads to more vapour transport downstream (Italy)
- An increasing trend of moisture transport over the western N. Atlantic is likely associated with the observed increase in Cat2 and Cat3 events