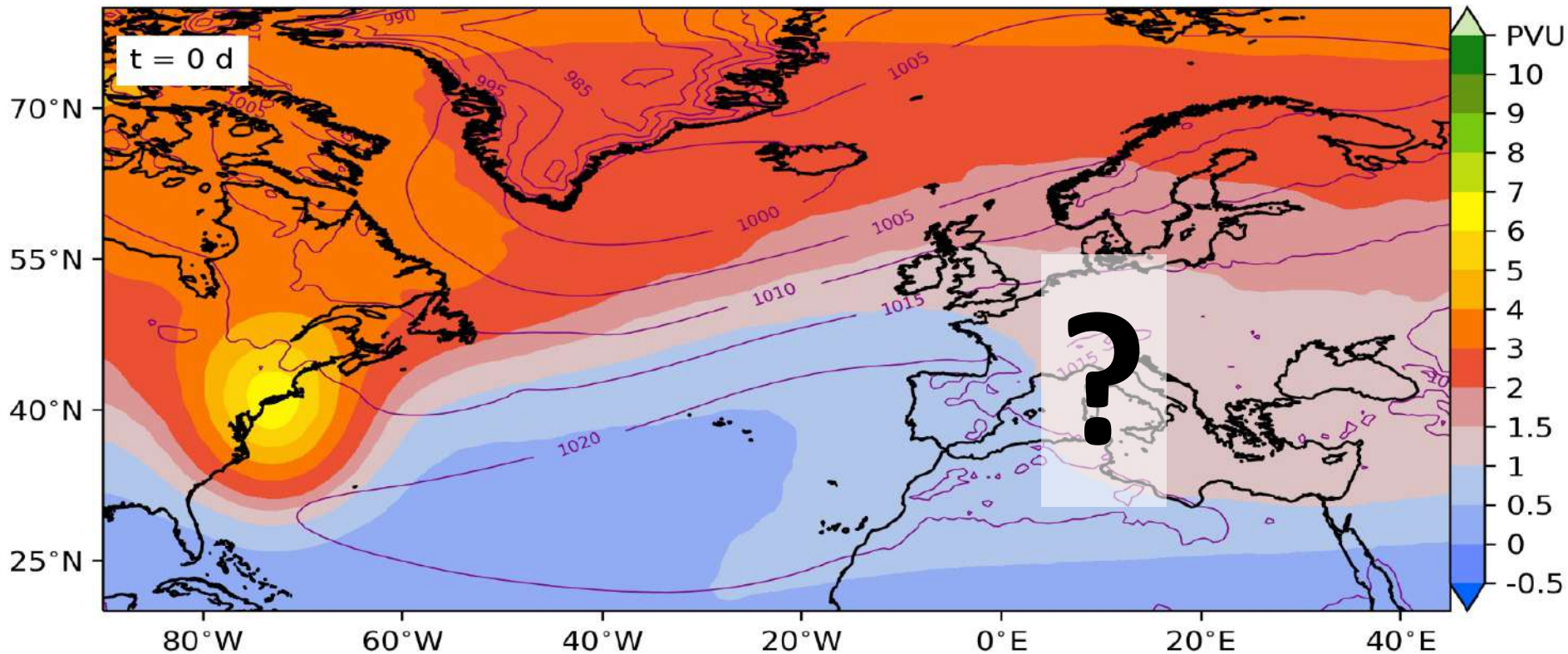


The upstream-downstream connection of North Atlantic and Mediterranean cyclones



MedCyclones & European Storm Workshop

Alexander Scherrmann*, Emmanouil Flaounas**

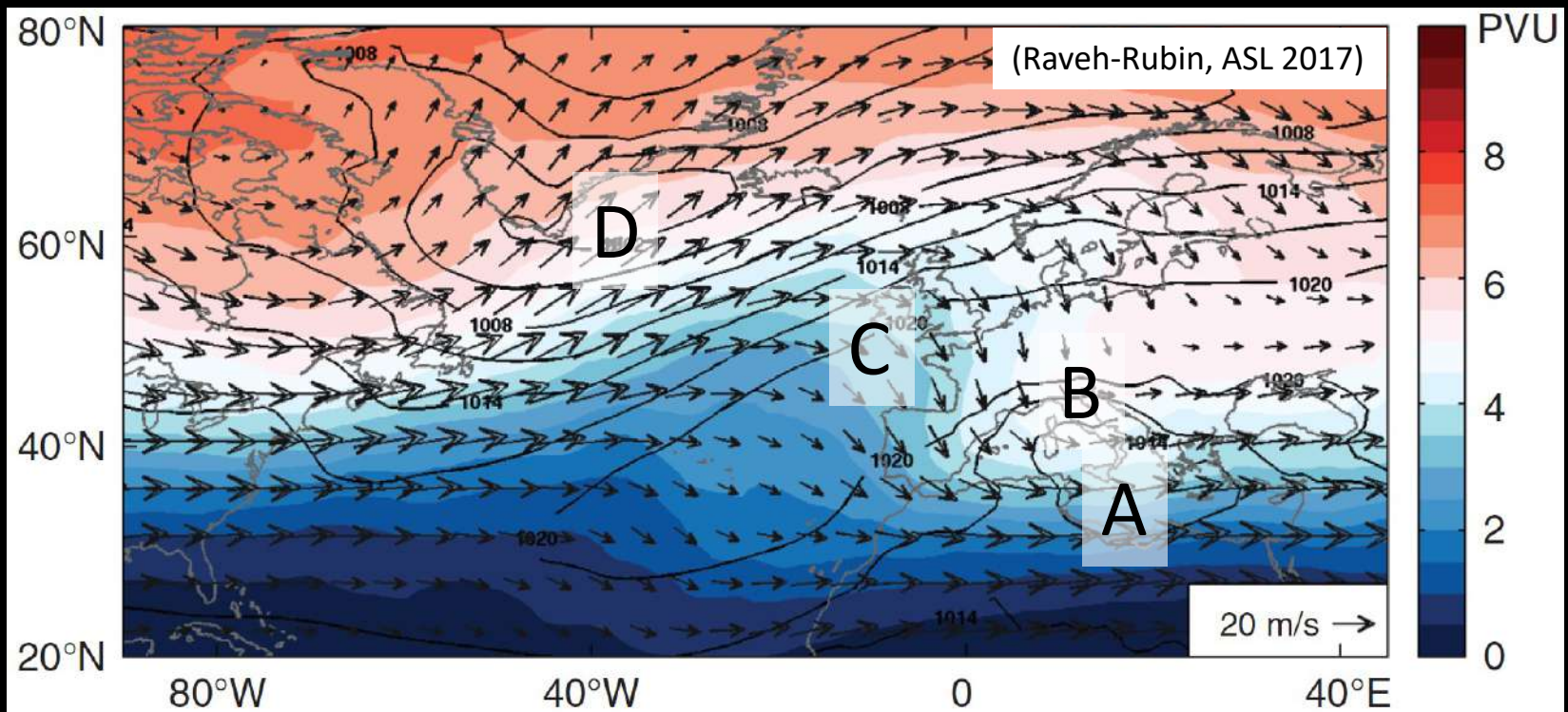
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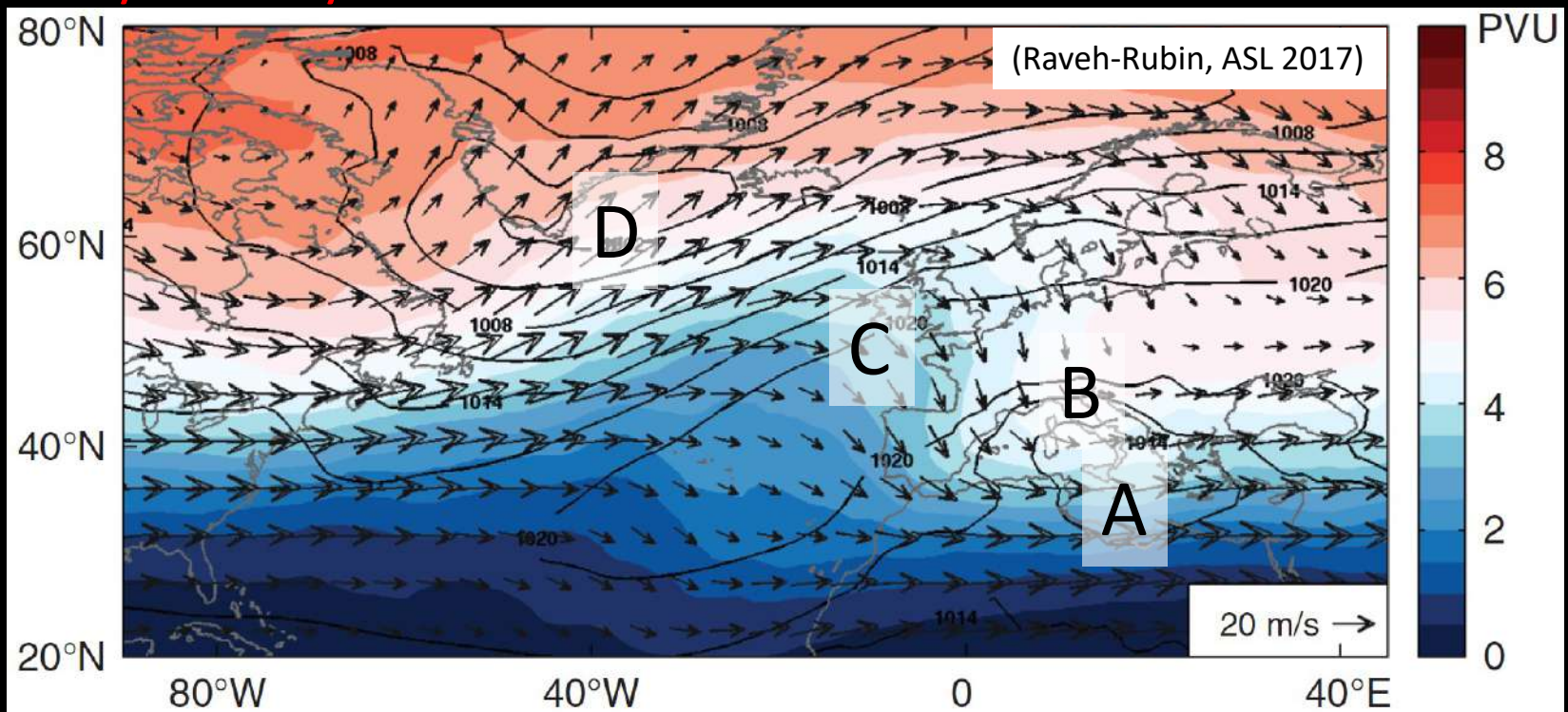
Why study the upstream conditions of Med cyclogenesis?

- Med cyclogenesis triggered by PV streamer (e.g. Massacand, GRL 1998)
- 4 ± 2 NA cyclones associated with intense Med cyclones (Raveh-Rubin, ASL 2017)
- Case studies show importance of upstream NA cyclone (e.g. Pantillon, QJ 2013)



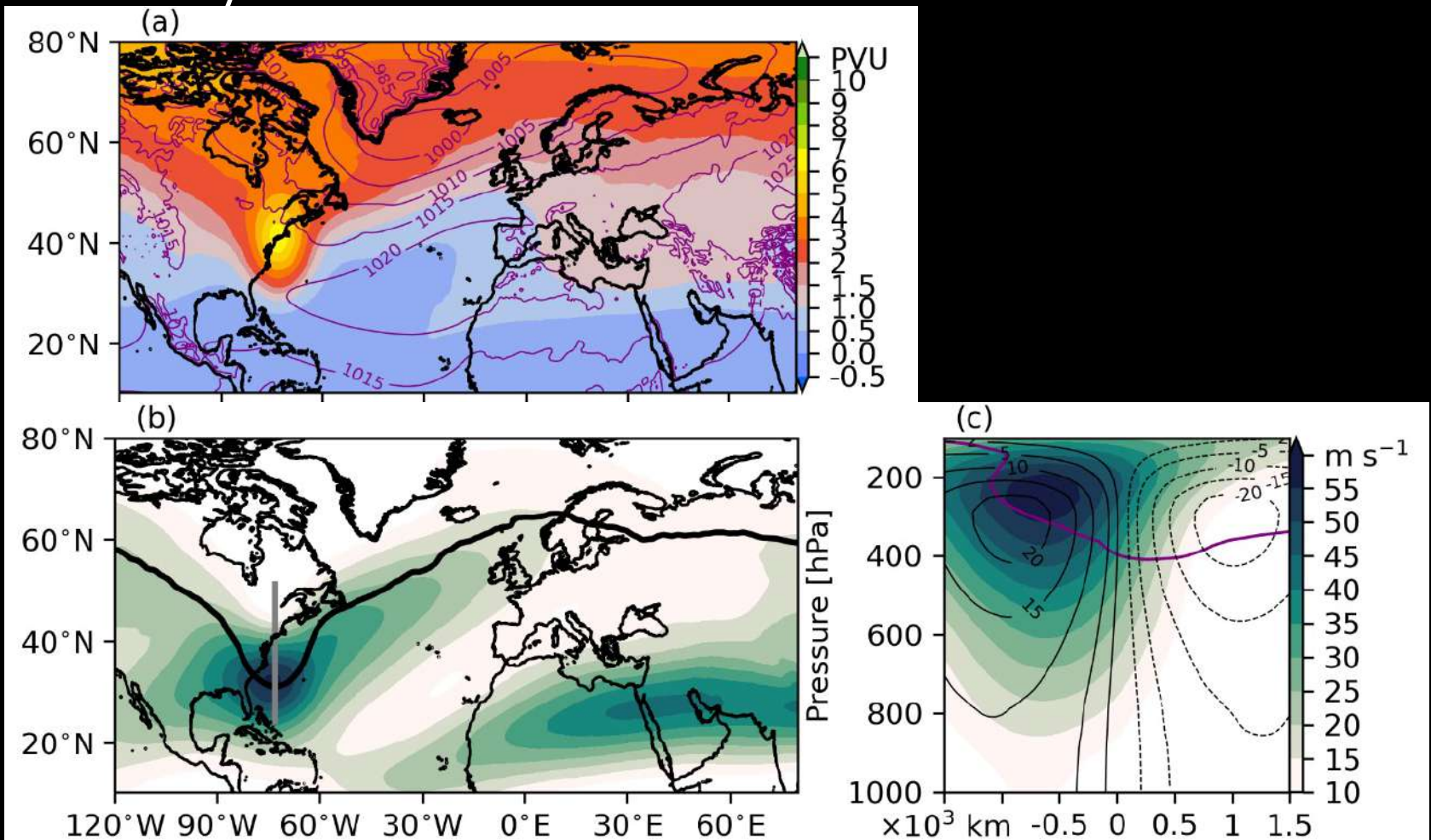
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- 4 ± 2 NA cyclones are associated with Med cyclones (Raveh-Rubin, ASL 2017)
- Case studies show importance of upstream NA cyclone (e.g. Pantillon, QJ 2013)
- How do intensity and location of NA cyclones affect the downstream Med cyclone dynamics?



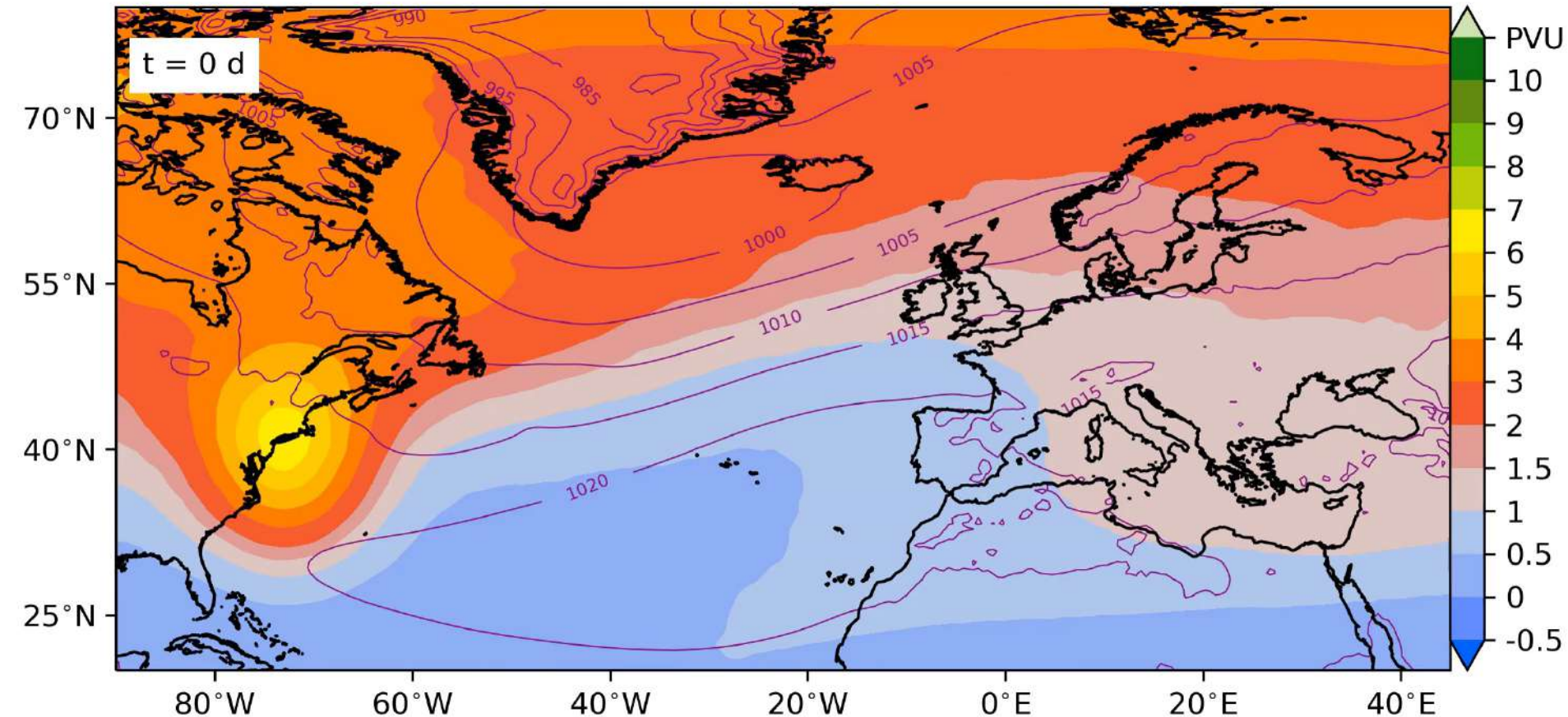
Methodology

- Seasonal 12h climatological conditions of 1980-2020 (ERA5, Hersbach, QJ 2020)
- WRF (Skamarock, NCAR 2021), Cyclone tracking (Sprenger, BAM 2017)
- Perturb zonal jet by quasi-geostrophic PV anomaly (Sprenger, ETH 2007)
- Sensitivity test of the mechanism to location (± 200 , ± 400 km) and intensity



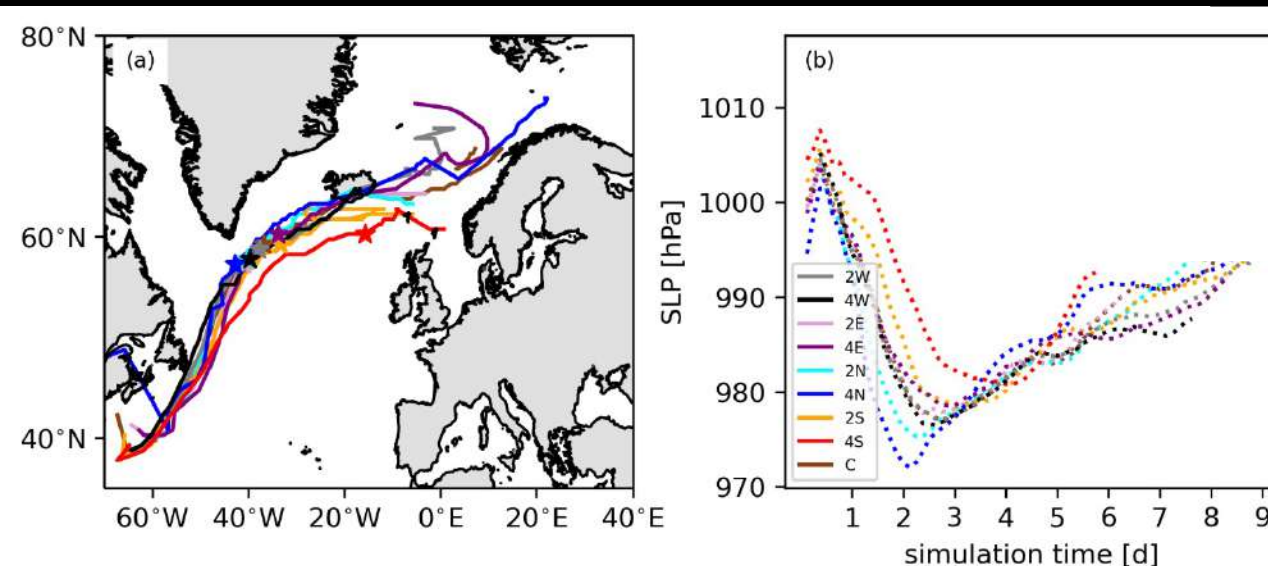
Cyclone development in a perturbed atmospheric state

- The upstream-downstream connection is triggered by perturbing the zonal jet.



Impact of the position of the perturbation

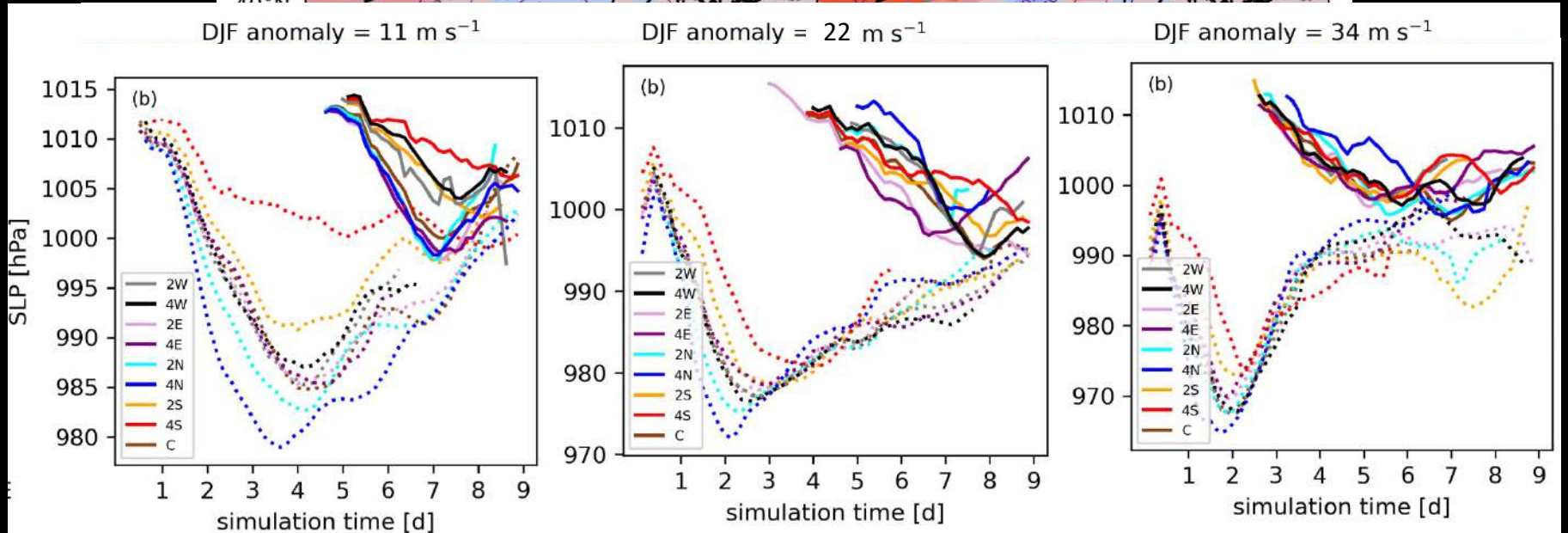
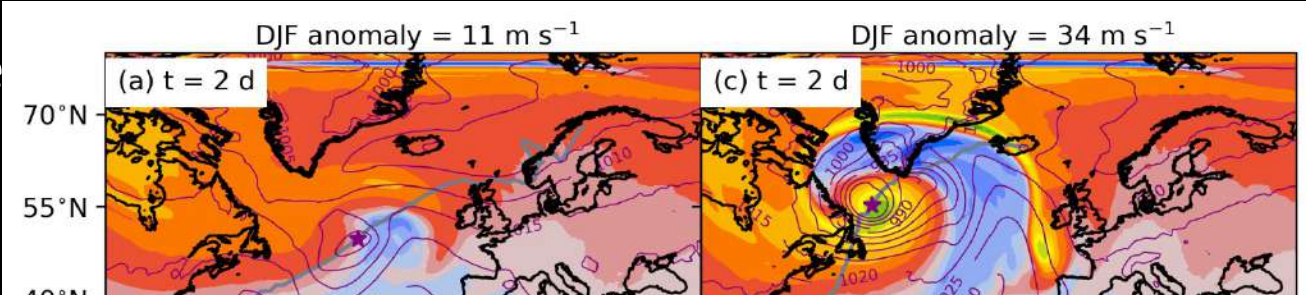
- Atlantic cyclone's intensity depends on horizontal position
- Streamers are similar and shift of perturbation is conserved
- Med cyclone dynamics sensitive to upper-level PV structure (e.g. Fehlmann, AMS 1997; Chaboureau, QJ 2012)



Impact of the intensity of the perturbation

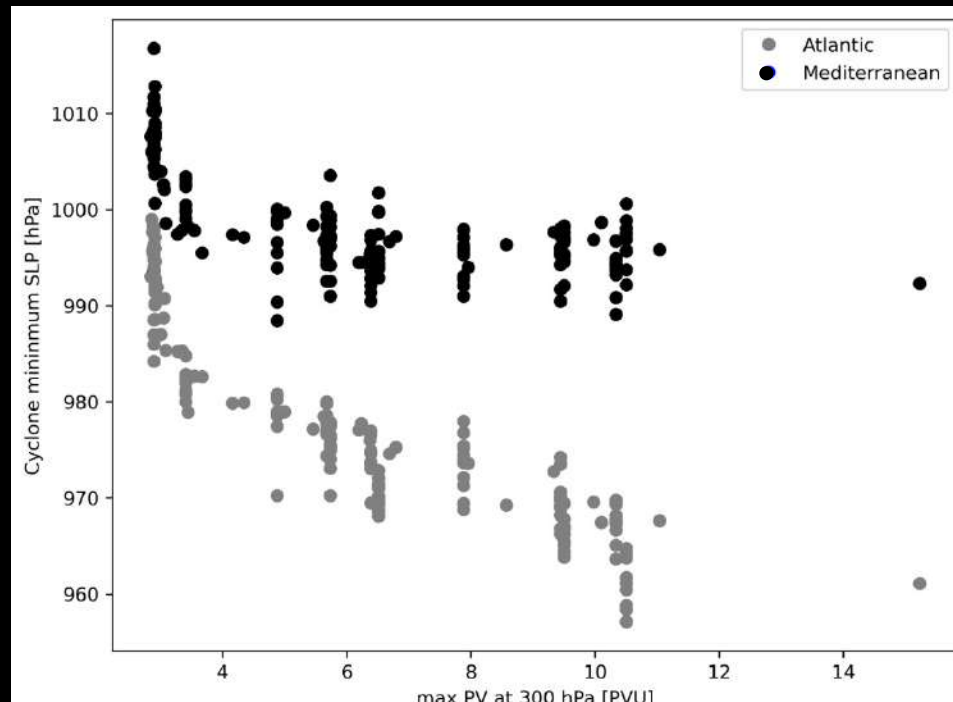
- Intensity of NA cyclone, ridge and streamer scale with intensity of perturbation
- Streamers are similar for same amplitude perturbation

• However



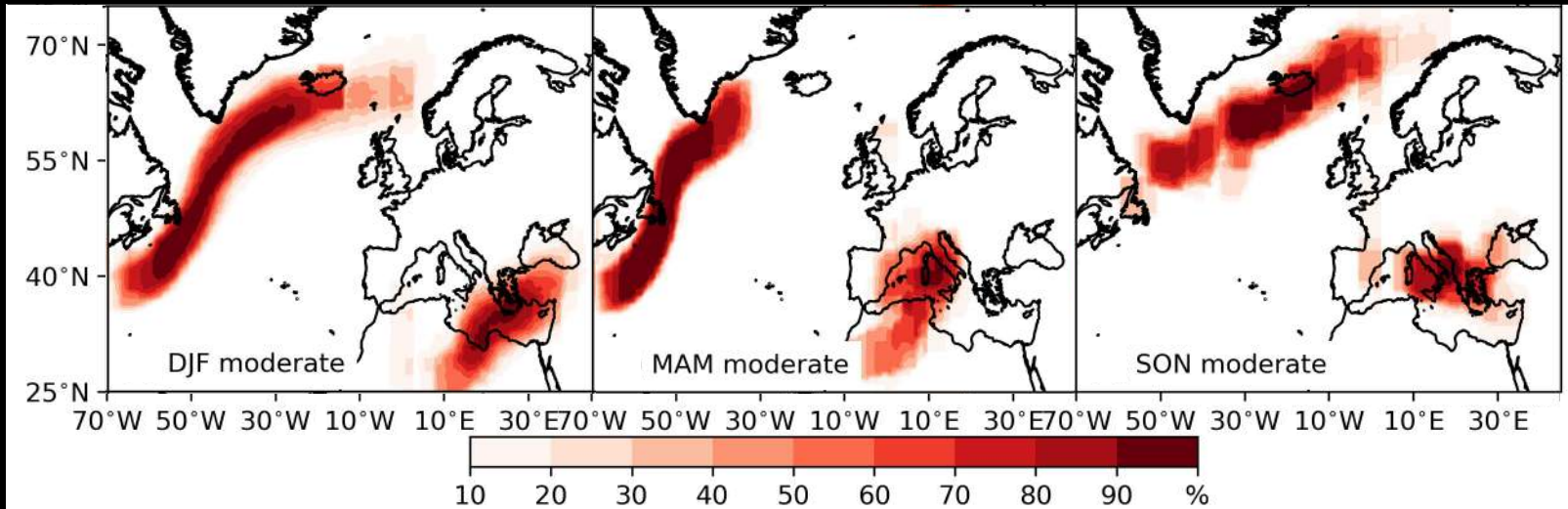
Connection between intensities

- NA cyclone intensity scales with perturbation strength
Med cyclone to certain extent
- No obvious connection between intensities



Seasonal variability

- Different upstream conditions lead to different NA and Med cyclone tracks



Conclusions

1. The downstream development is independent of intensity and position of perturbation.
2. PV streamers are robust, Med cyclone dynamics depend on upper-level PV structure and upstream conditions.
3. Different upstream conditions lead to different locations in the Med, but local conditions contribute as well.

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in preparation:

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