

A tool to identify large-scale dynamical precursors of European extreme precipitation

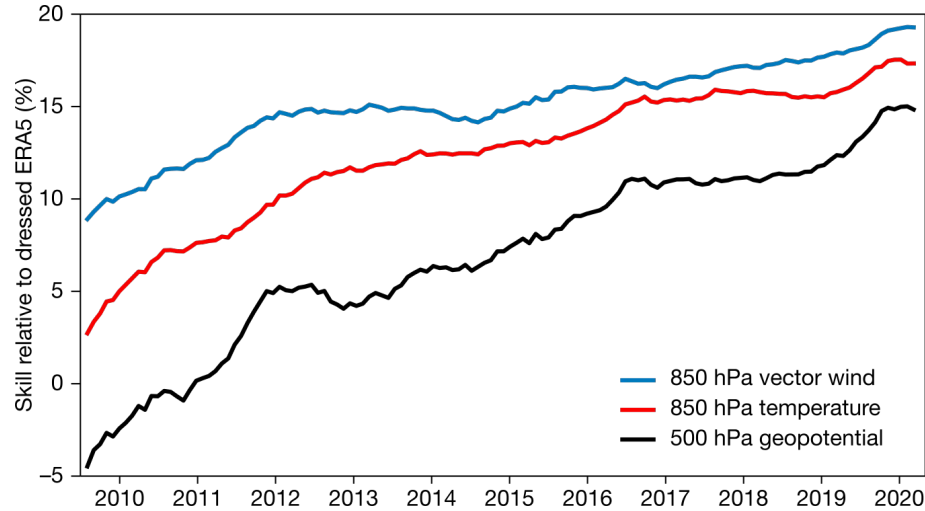
A W2W Transfer project in collaboration with ARPAE Bologna and ECMWF

- **Josh Dorrington** and Christian Grams (KIT IMK-TRO)
- Federico Grazzini (LMU)
- Laura Ferranti, Linus Magnusson, Frédéric Vitart (ECMWF)

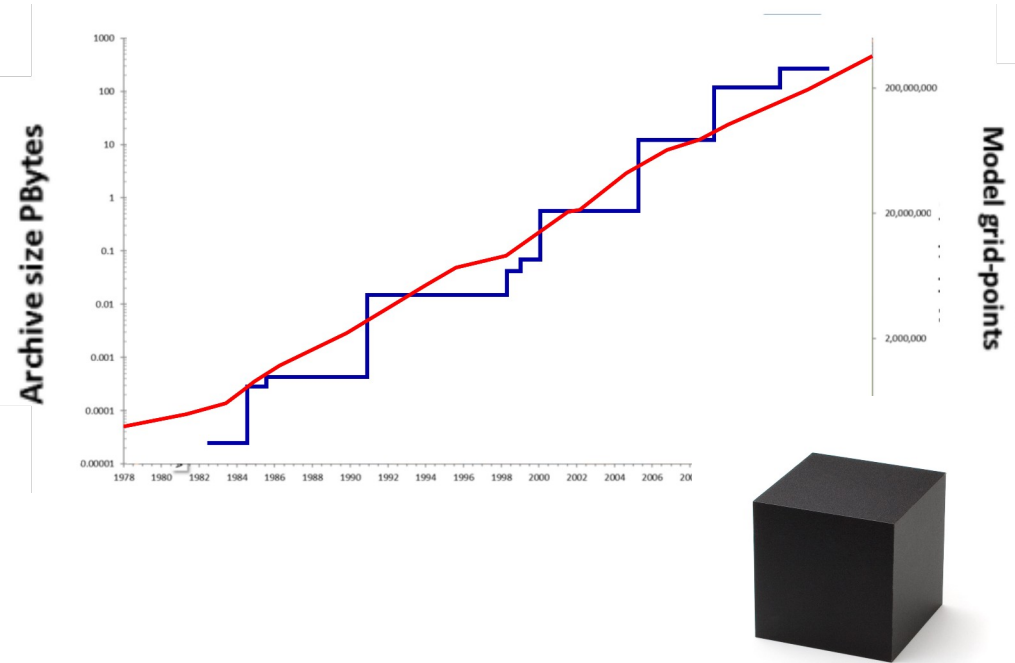


We are increasing skill but also data

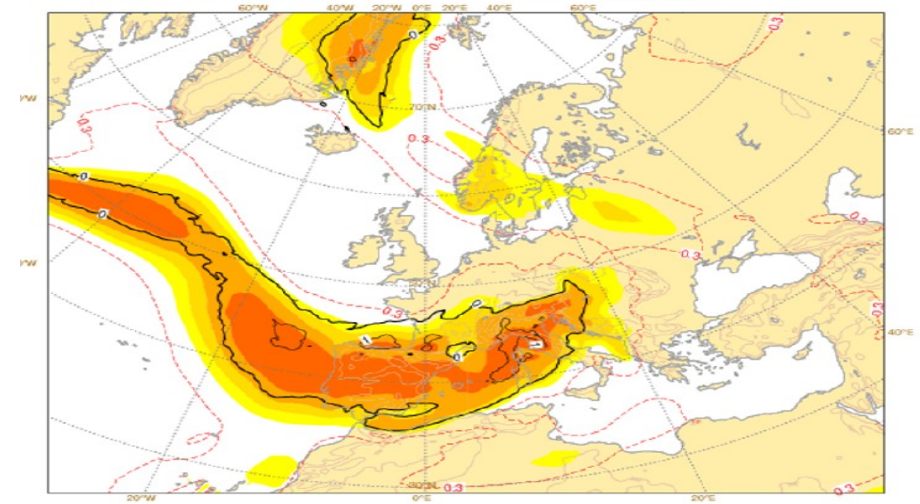
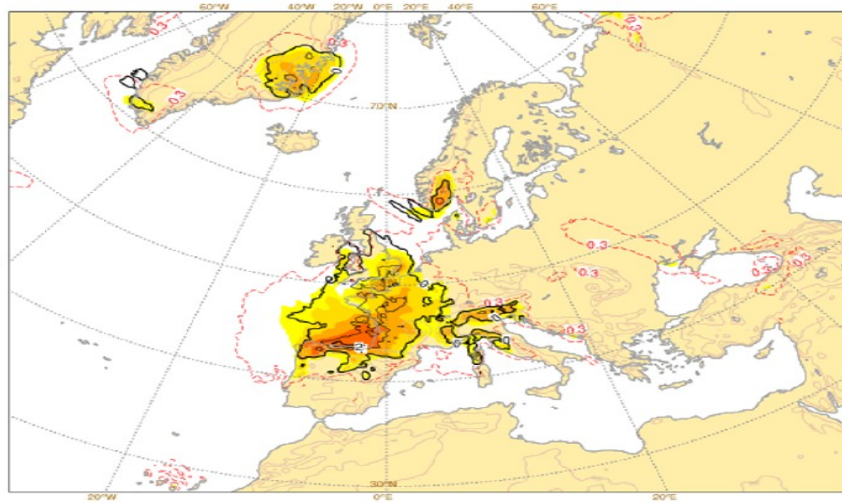
Linear skill increase



Exponential increase in data



As data volumes expand, models are becoming increasingly a black box



Direct precip forecast

Integrated vapour transport

Extreme Forecast Index, +96h forecast



Storm Alex,

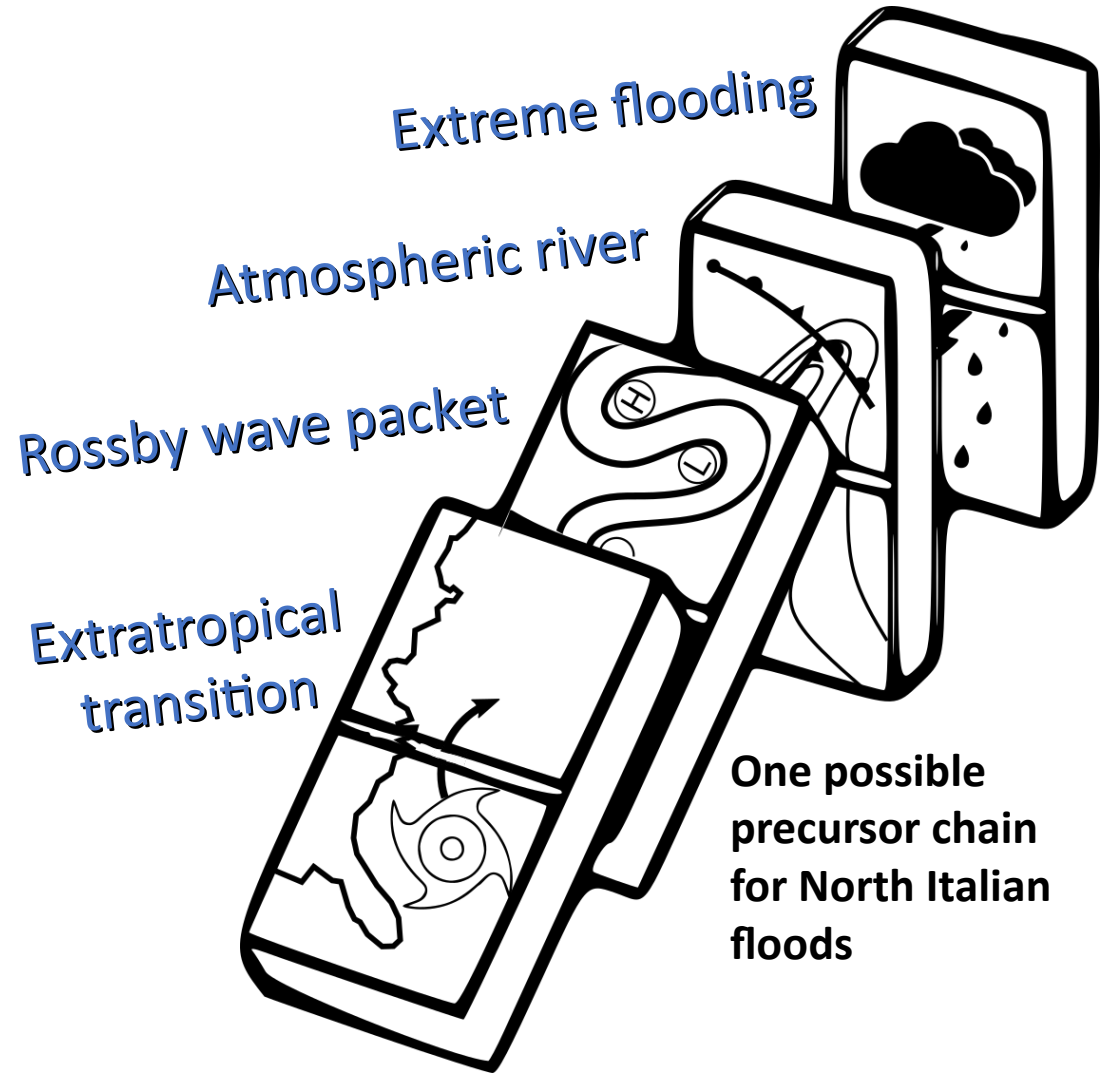
03.10.2020

500mm precip in 12 hr!



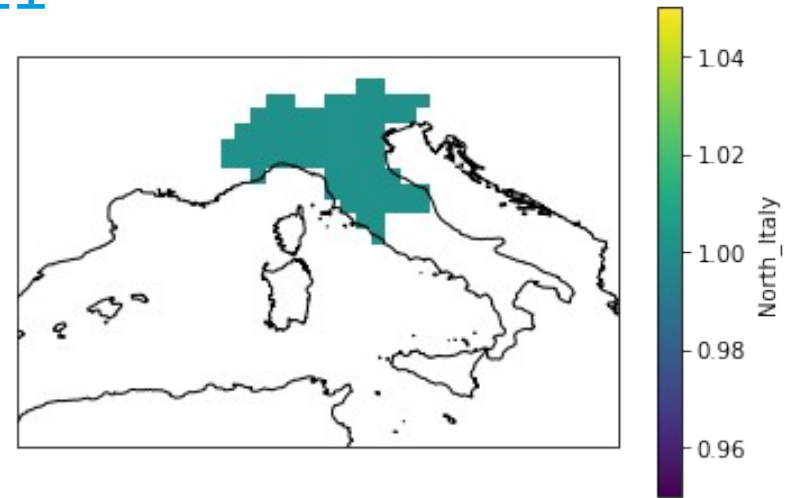
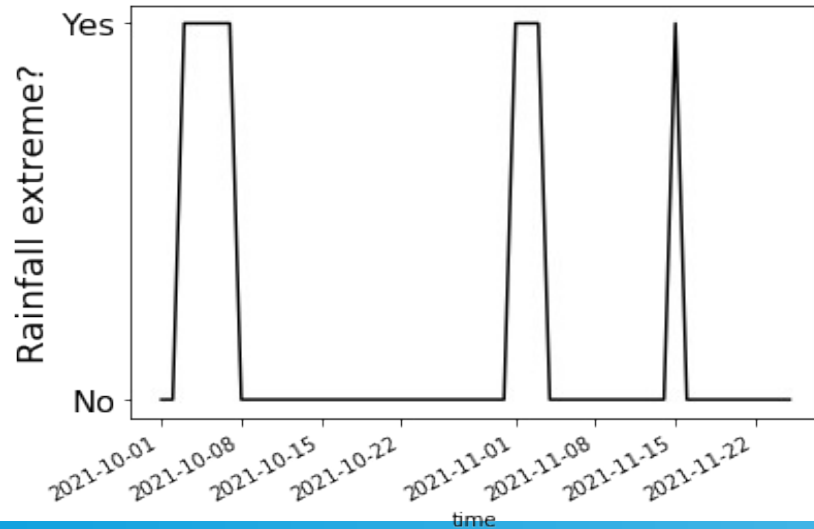
Every weather event
(and every forecast)
has a **story**

Mapping out the
large-scale precursors
of an event makes it
easier to understand
and predict



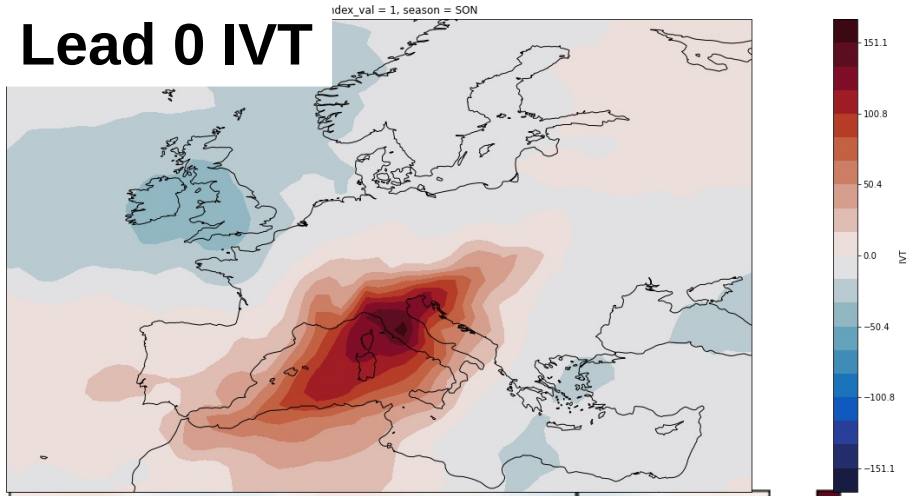
Extreme rainfall definition

- Looking at 90th percentile extremes relative to a monthly climatology in ERA5
- Looking only at 1st day of multi-day events – 6.5% occurrence
- For SON ~260 events between 1979-2021

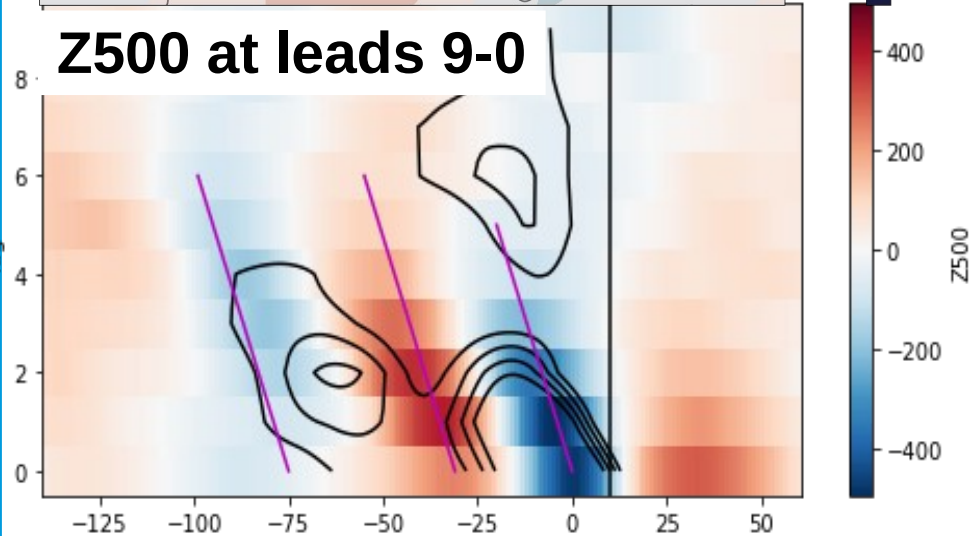


Dynamics of North Italian Rainfall

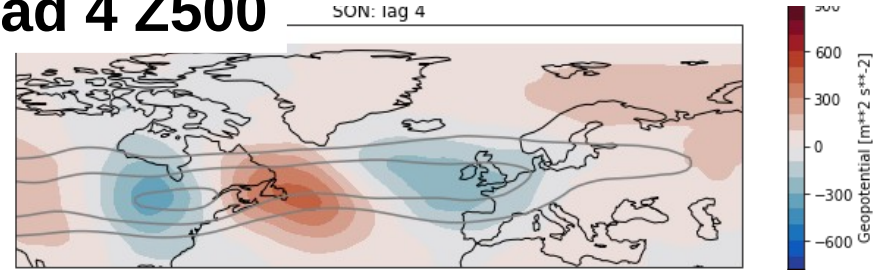
Lead 0 IVT



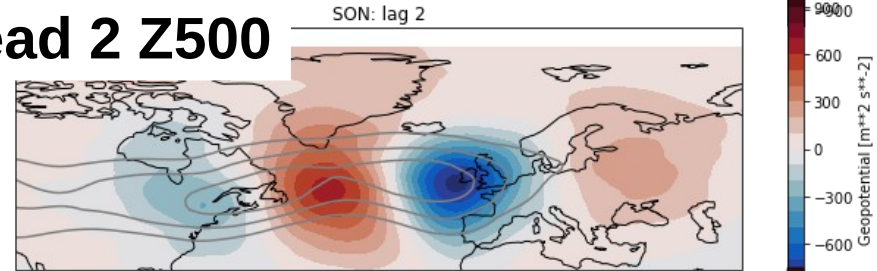
Z500 at leads 9-0



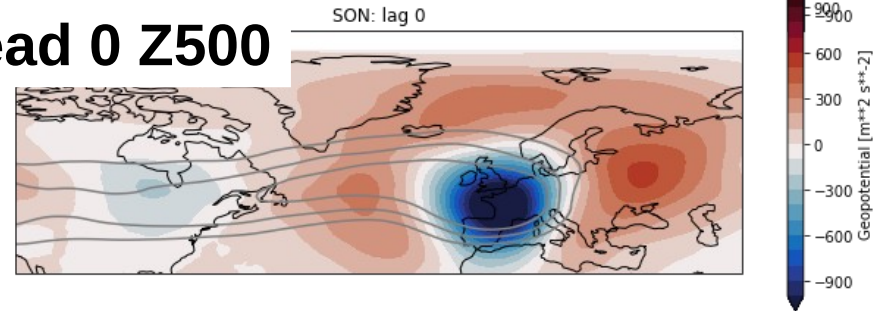
Lead 4 Z500



Lead 2 Z500

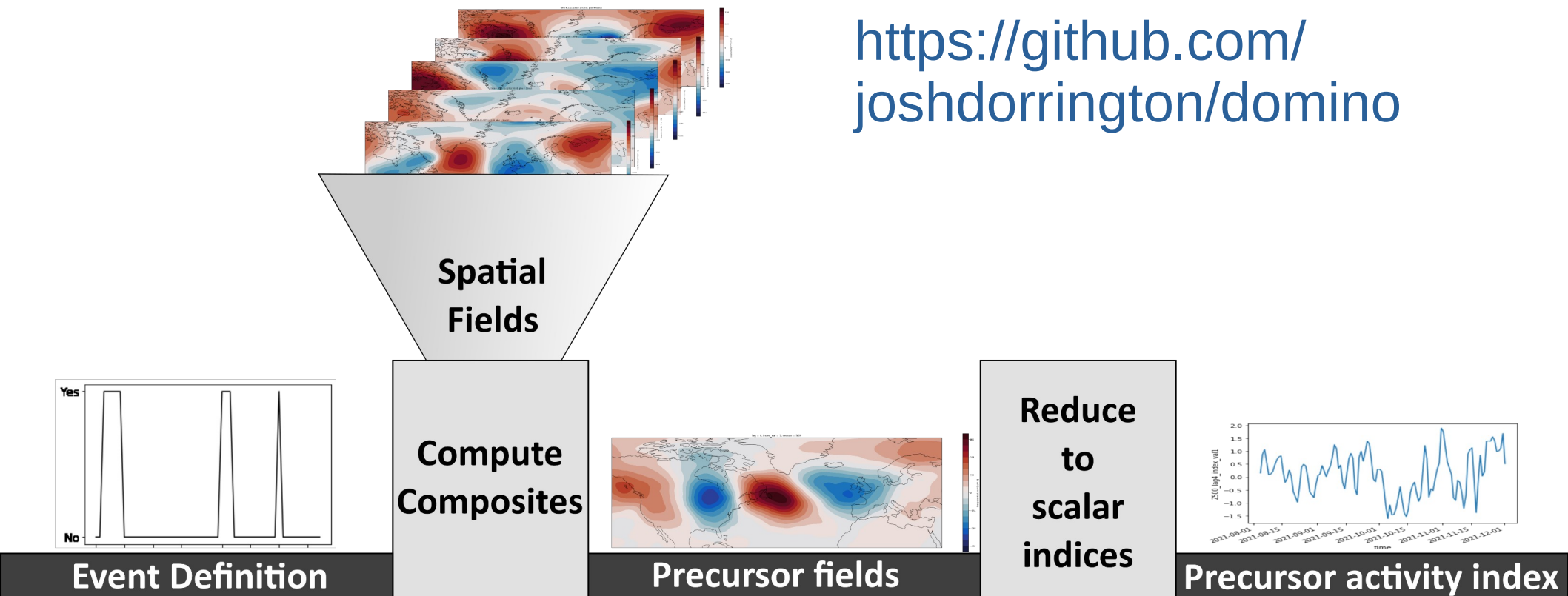


Lead 0 Z500

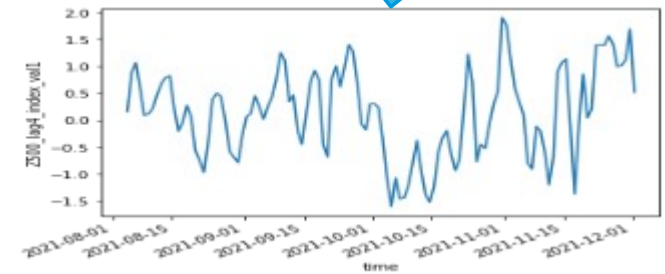
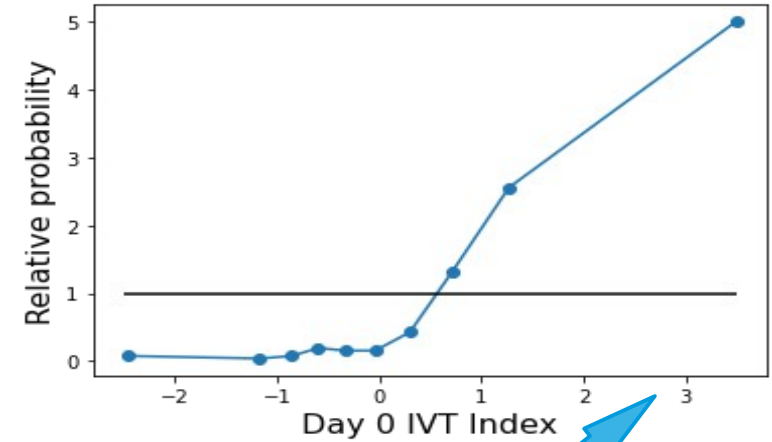
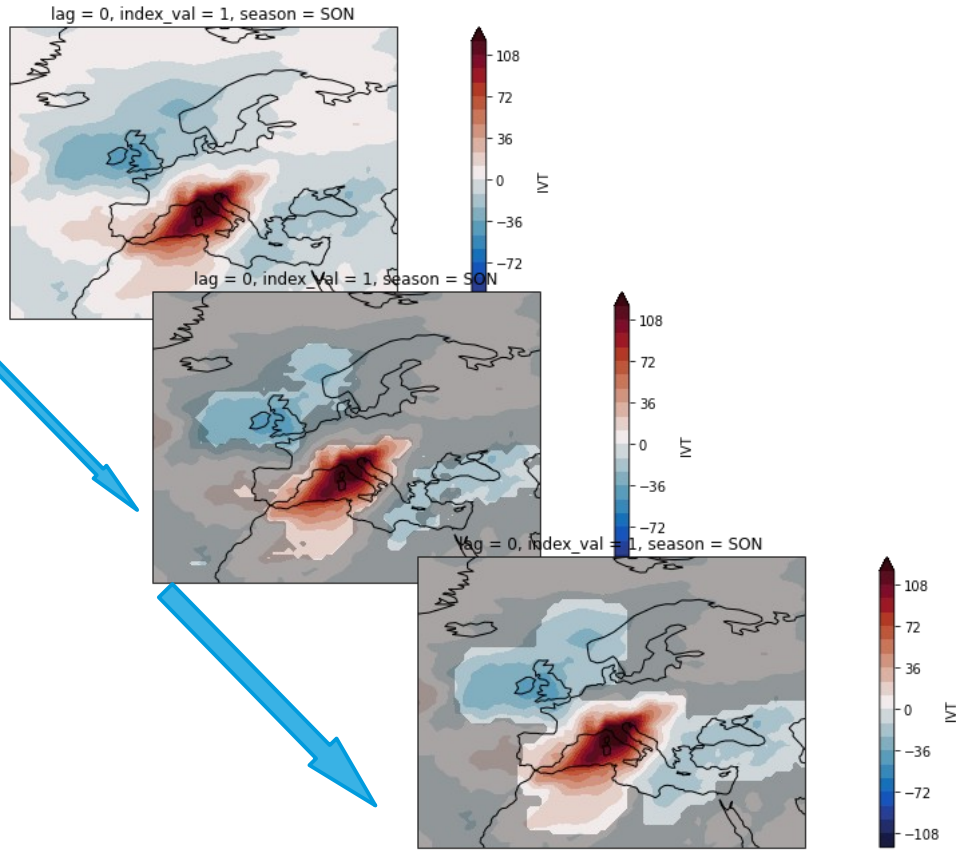


Domino: A Python package for compositing spatiotemporal data

<https://github.com/joshdorrington/domino>

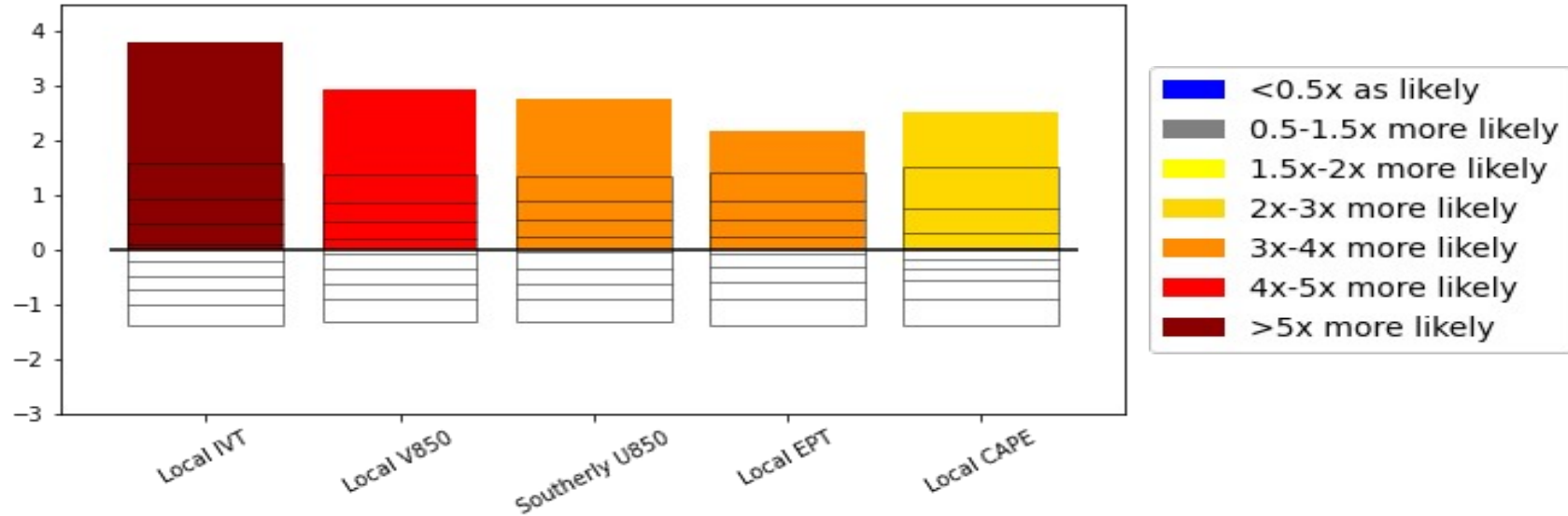


From composites to predictors



The Activity Monitor

Lag 0 Precursor activity for 2020-10-03 12:00:00

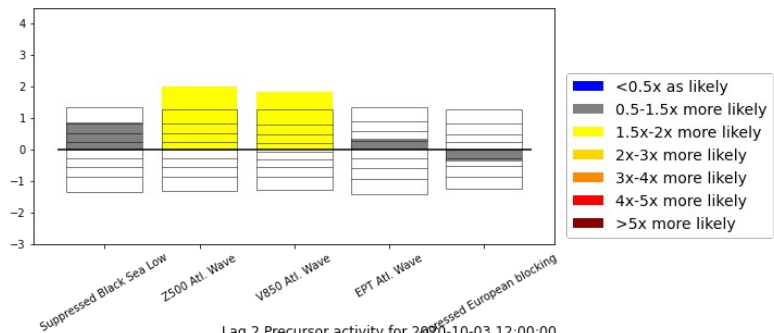


**Storm Alex,
03.10.2020**



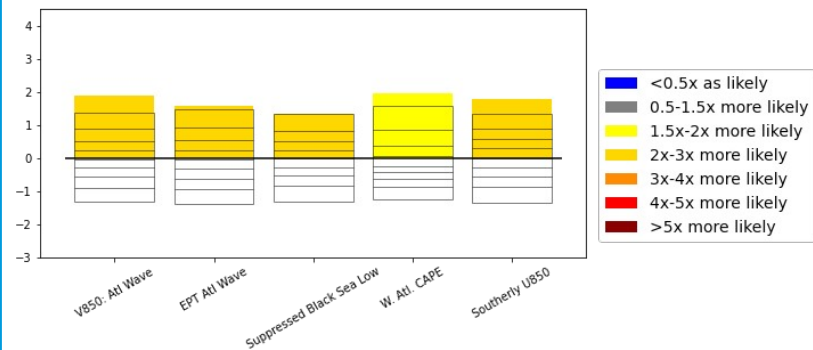
Precursors from different forecast days can be used together

Lag 4 Precursor activity for 2020-10-03 12:00:00



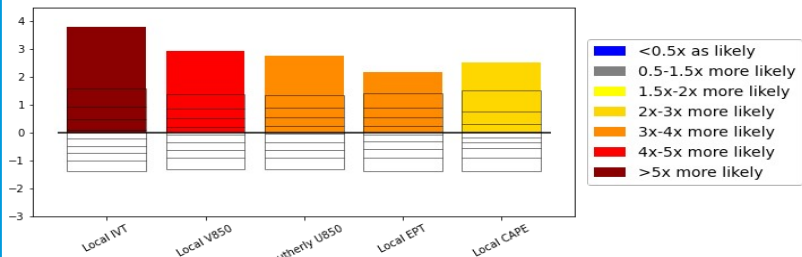
**4 days before:
Elevated wave activity**

Lag 2 Precursor activity for 2020-10-03 12:00:00



**2 days before: Strong
wave, high CAPE, low
pressure**

Lag 0 Precursor activity for 2020-10-03 12:00:00



**Day 0: Extreme IVT,
strong trough and CAPE**



Conclusions and future development

- We are working towards summarising the high dimensional atmospheric circulation in a data-efficient and application relevant way
- Our automated approach can be easily extended to different event definitions
- Integrate with IFS to track precursors in model output and ultimately develop hybrid system
- Report near-realtime precursor activity, computed from ERA5, as a public web-app