Attribution with Deep Learning-Based Analogues: A Heat Waves Scenario

Jorge Pérez-Aracil, Laura Cornejo-Bueno, Cosmin M Marina, Sancho Salcedo-Sanz, Ronan McAdam, Elena Xoplaki, Jürg Luterbacher

08-05-25

Table of Contents

What is Attribution?

1 Introduction

Attribution is the process of **determining** the likely **causes** of observed changes in the climate system.

It seeks to establish the principal factors, both **natural** and **human-induced**, that **explain** these changes and associated phenomena.

A significant **focus** of **climate attribution** is understanding the extent to which **human** activities contribute to observed **climate change or extreme event**.

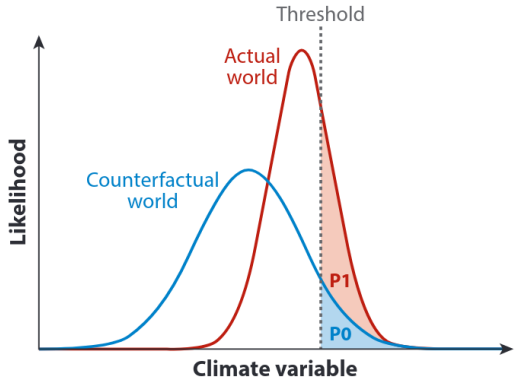
How to perform Attribution?

- Risk-based Attribution
- Impact-based
- Storylines
- Observational and Analogue

How to perform Attribution?

- Risk-based Attribution
- Impact-based
- Storylines
- Observational and Analogue

Risk-based Attribution



(a) Otto (2017).

Heat waves

- Extreme temperature
- Climatology reference period
- 90th percentile
- Extreme impact

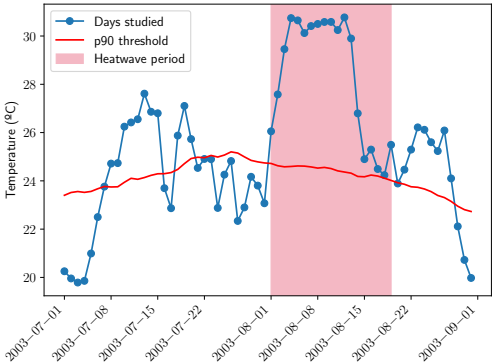
Definition

Heat wave identification based on Russo et al. (2015):

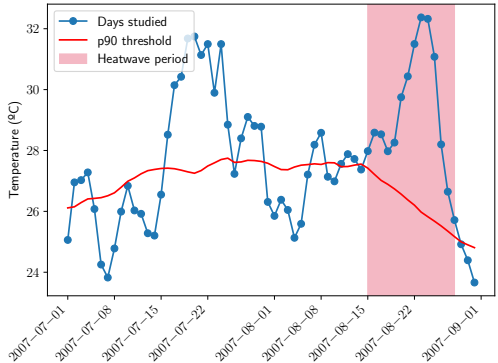
$$A_d = \bigcup_{y=1981}^{2010} \bigcup_{i=d-15}^{d+15} T_{y,i} \tag{1}$$

Examples

1 Introduction



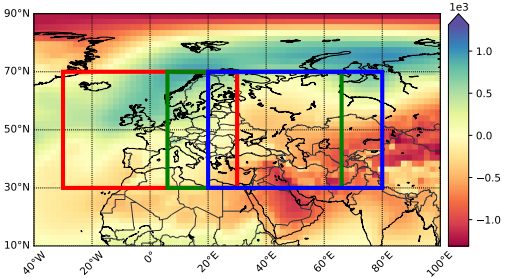
(a) **France 2003**.



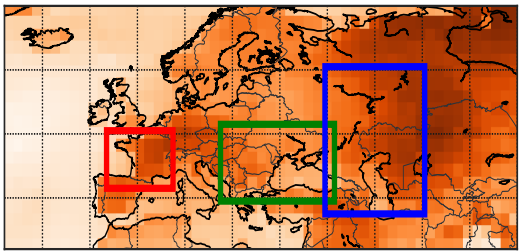
(b) **Balkans 2007**.

Data: Drivers

1 Introduction



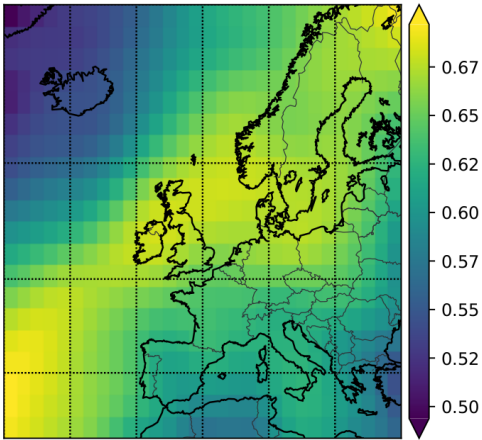
MSL.



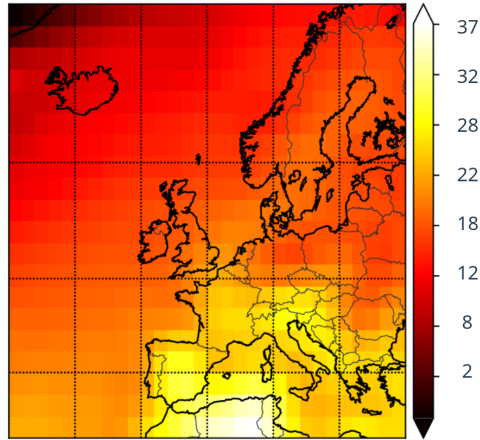
T2M.

Reconstruction of events

2 Methods



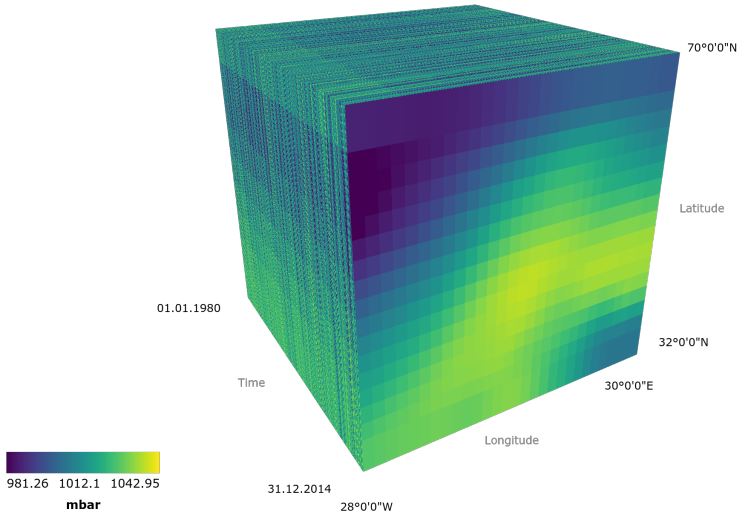
(a) MSL event of interest.

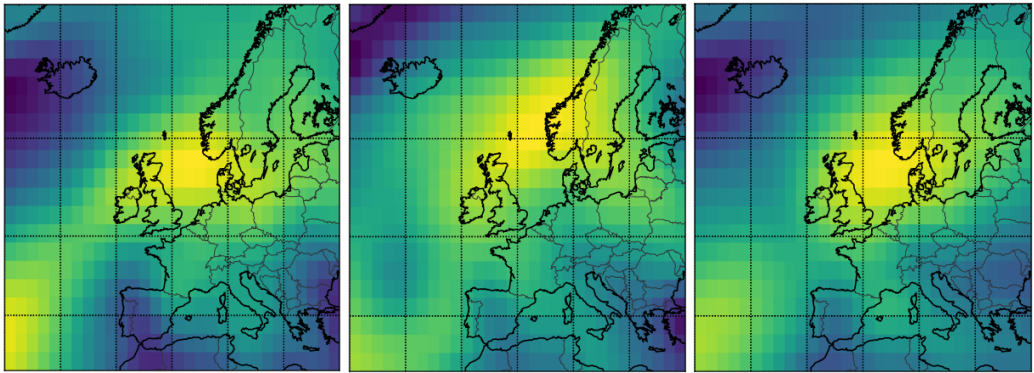


(b) T2M event of interest.

Reconstruction of events

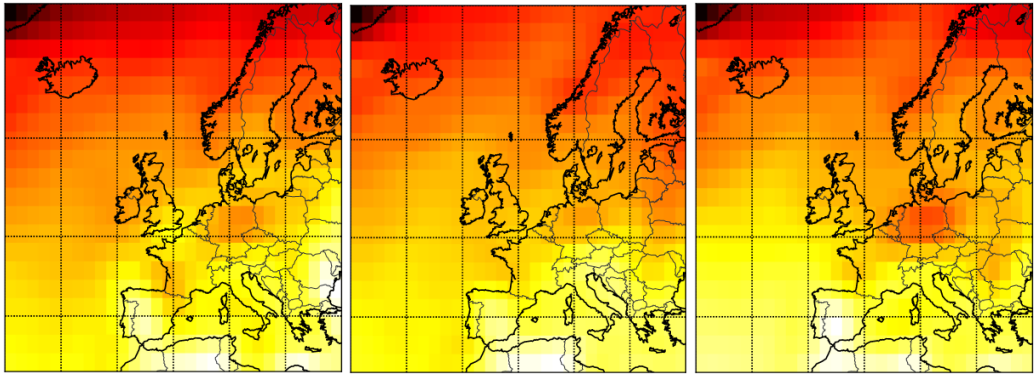
2 Methods





(a) Analogue 1. (b) Analogue 2. (c) Analogue 3.

Figure: MSL Analogues.

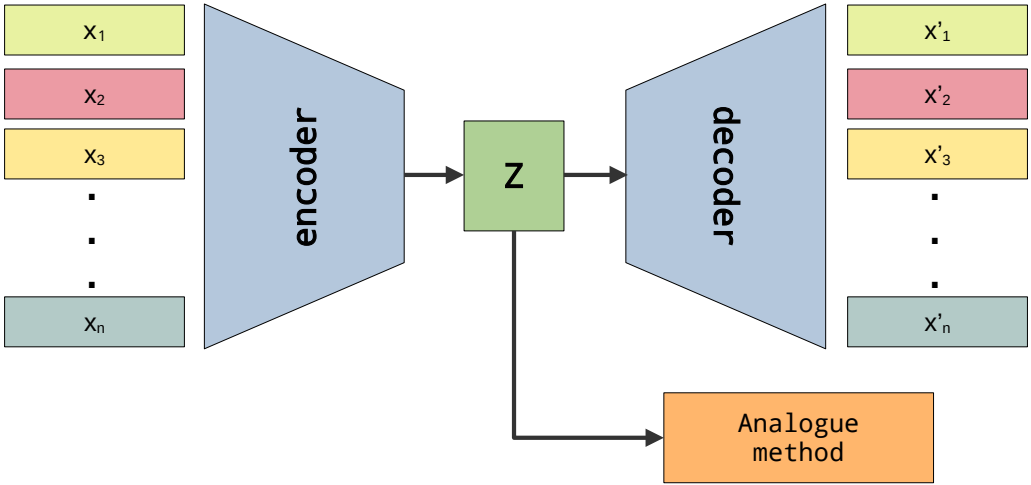


(c) Analogue 1. (d) Analogue 2. (e) Analogue 3.

Figure: T2M Analogues.

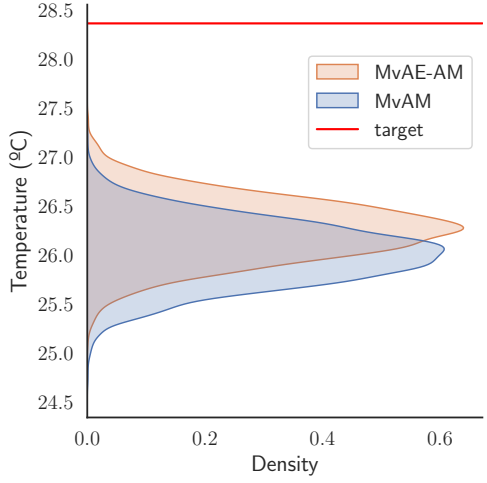
Multivariate Autoencoder AM (MvAE-AM)

2 Methods



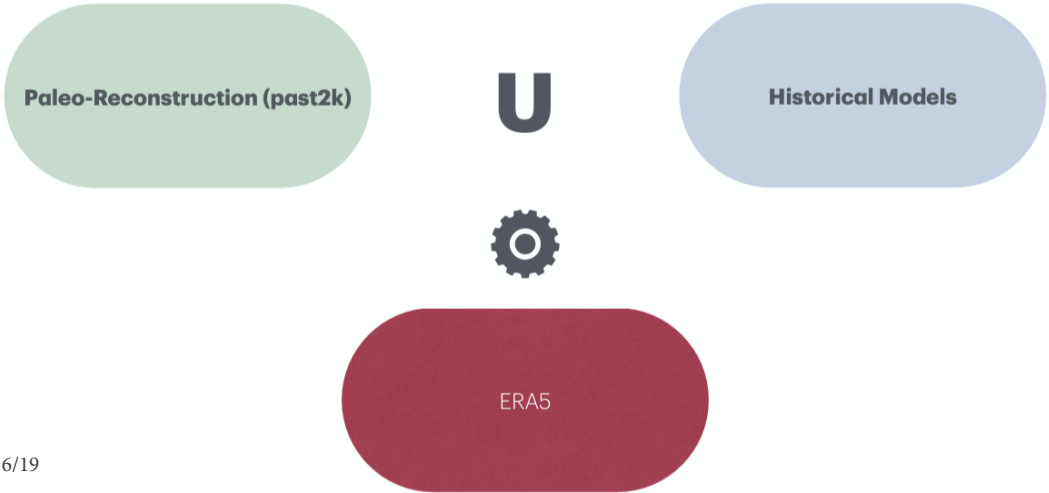
Results

3 Results



Pre-trained Model

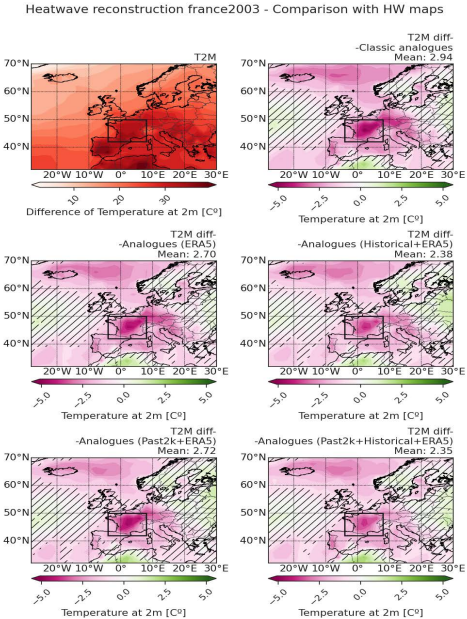
5 Future work



Pre-trained Model

5 Future work

- Data of past helps to improve the reconstruction



Attribution with Deep Learning-Based Analogues: A Heat Waves Scenario

Thank you for listening!

Any questions?

jorge.perezaracil@uah.es

References

RUSSO, S. et al. Top ten european heatwaves since 1950 and their occurrence in the coming decades. *Environmental Research Letters*, v. 10, 2015.

ZORITA, E.; STORCH, H. von. The analog method as a simple statistical downscaling technique: Comparison with more complicated methods. *Journal of Climate*, v. 12, p. 2474–2489, 1999.