Etesian winds after major volcanic eruptions

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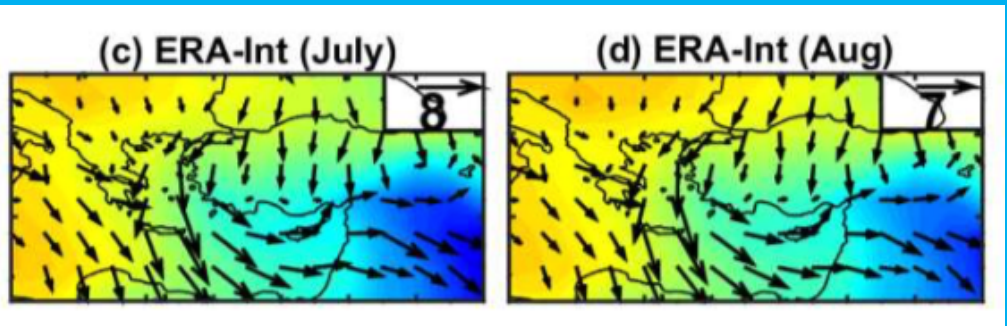
Etesians are northerly winds in the lower atmosphere, blowing over the Aegean sea from early summer to early autumn. They result from a high-pressure system over central Europe/North Balkans and a low pressure centre over south East Mediterranean (Hoskins and Rodwell, 1995; Anagnostopoulou et al., 2014b).

They are an important circulation component for the East Mediterranean area as they

- moderate the summer heat and control the appearance of heat wave events
- contribute to socio-economic activities
- viewed as a very effective way to produce low-cost renewable energy

Wikipedia

July and August shows maximum persistence, intense and frequency



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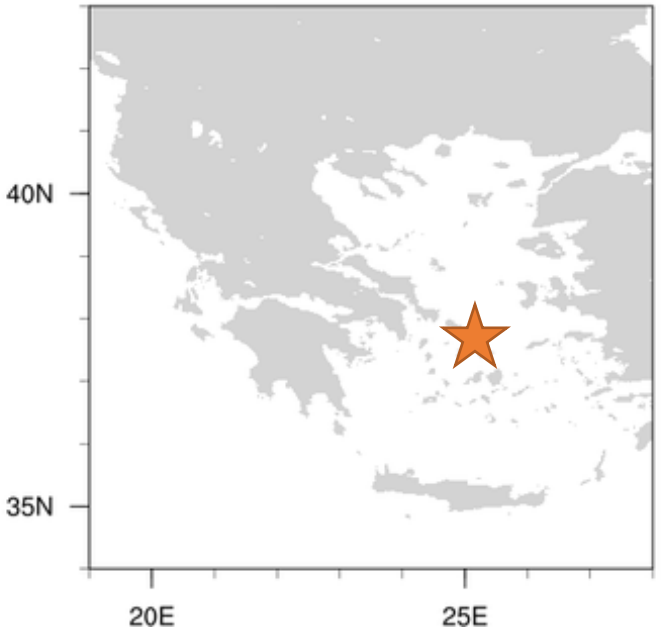
Methods and data

The reference point for classifying Etesians is placed at the central Aegean (37.5 °N, 25.0 °E, red star).
We calculate wind speed and count Etesian days during July and August. A day is classified as Etesian when the wind speed is larger than/equal to the median of its distribution and the wind direction is northerly (NE to NW or 315° to 45 °N). These days are generally characterized as moderate to intense Etesian days.



Volcanic Eruptions

Samalas, Kuwae, Huaynaputina, Laki, Tambora, Krakatoa, El Chicon, Pinatubo

Last Millennium Ensemble

We analyse the 13 member ensemble of last millennium (850-2005) considering all known forcings (Otto-Bliesner et al., 2015).
We use daily average time series.

Do Etesians respond to strong volcanic forcing?

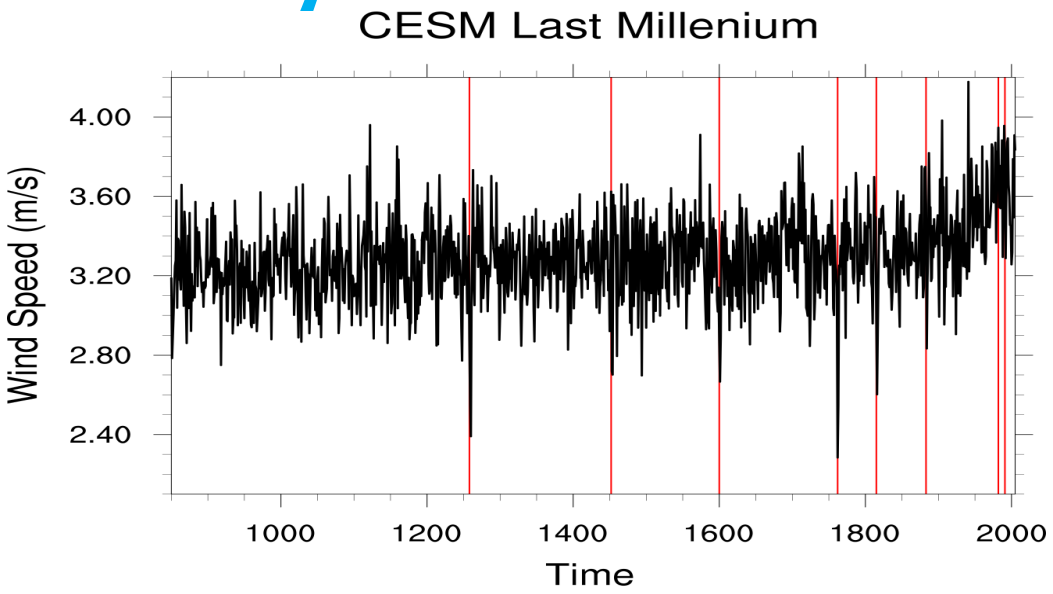
Wind speed and Etesian days

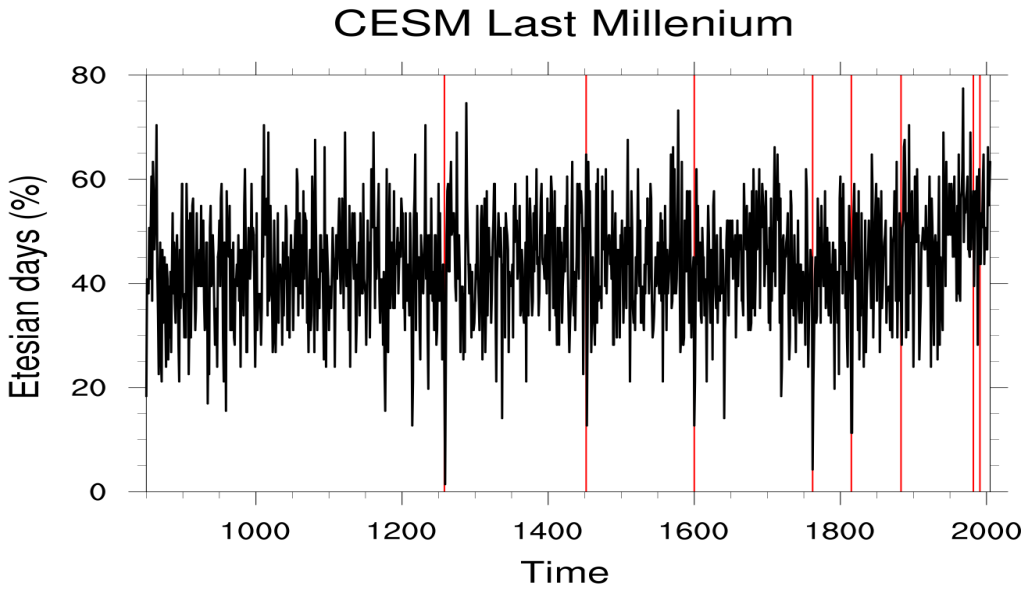
The Last Millennium Ensemble shows a positive trend towards higher wind speed in the 2nd half of the 20th century.

Pronounced spikes of weakened wind speed is associated with Volcanic Eruptions.

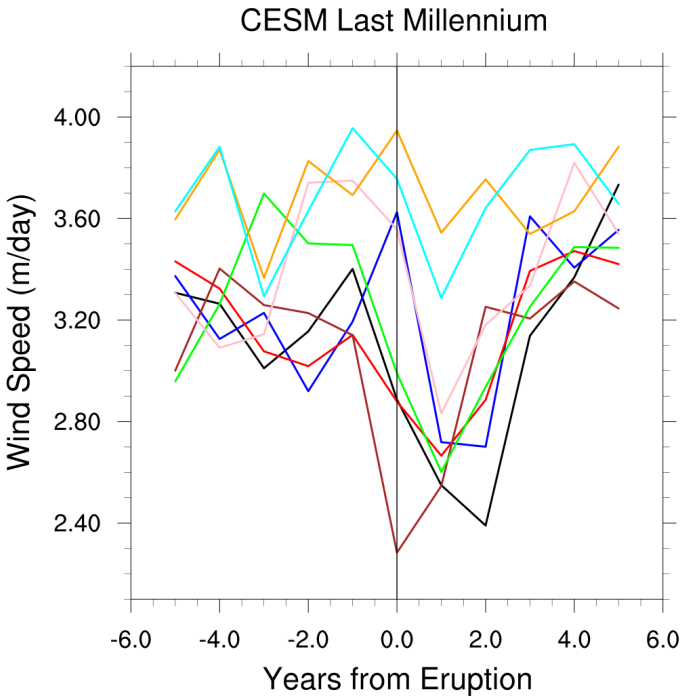
Volcanic eruptions reduce the number of Etesian days (expressed in % of total days in Jul-Aug). The summer of Samalas eruption it was a "summer without Etesians"

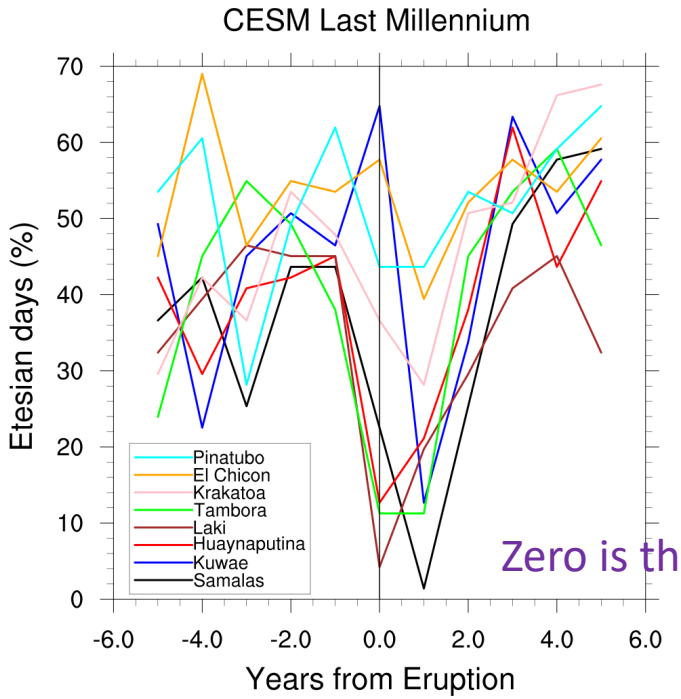
Etesians weaken after strong Volcanoes





Composites of wind speed and Etesian days





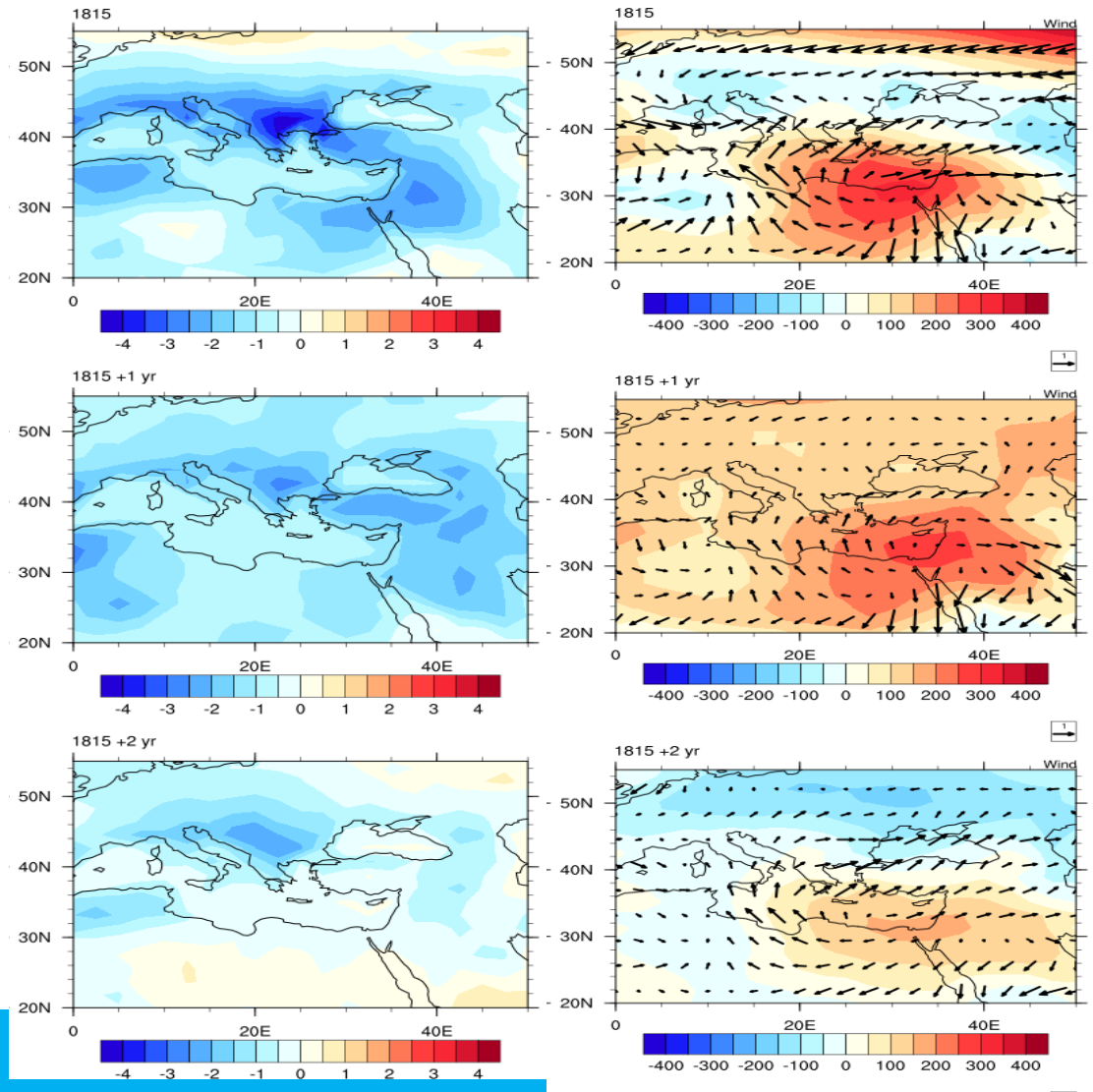
Zero is the eruption year.

In many cases the strongest reduction is simulated in the following year. Samalas and Kuwae shows the strongest weakening at lag +1.

It is interesting that Laki in Last Millennium Ensemble shows an equally strong response. This prompts of a detailed analysis to understand the mechanisms influencing Etesians.

An example: the summer time circulation after Tambora

Weakened circulation in the South Eastern Mediterranean



A possible mechanism

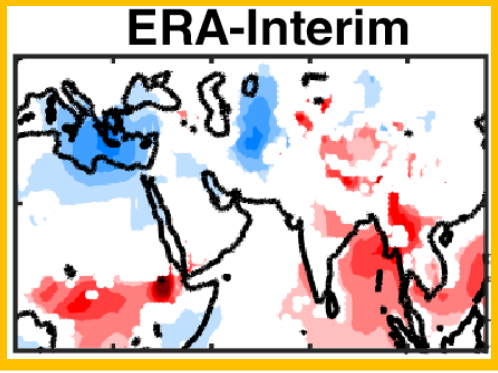
Volcanic cooling → Indian Monsoon → Etesian flow

Tropical volcanic eruptions decrease the Monsoon activity.

Indian Monsoon activity impacts the Eastern Mediterannean tropospheric circulation (see box, Logothetis et al. 2019).

However,
this mechanism may not be applicable to high-latitude eruptions.

Nr. Of Etesians regressed on Ω500



Future research
Compare with reanalysis and reconstructions
Investigate on the mechanism