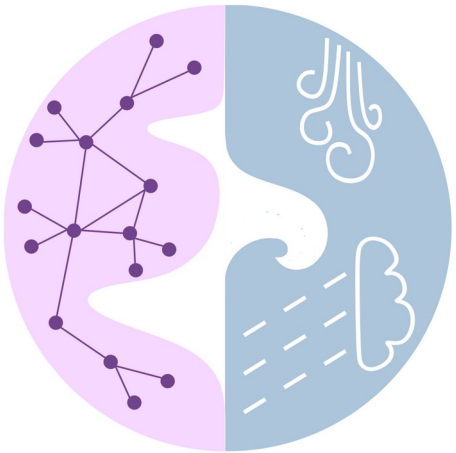


machine learning in climate science

# Sudden Stratospheric Warming Events

Bedartha Goswami

Journal Club

13 Apr 2021

Weather Clim. Dynam., 1, 373–388, 2020
https://doi.org/10.5194/wcd-1-373-2020


Weather and Climate Dynamics
Open Access
EGU

# The role of North Atlantic–European weather regimes in the surface impact of sudden stratospheric warming events

**Daniela I. V. Domeisen**[1,★], **Christian M. Grams**[2,★], **and Lukas Papritz**[1,★]

[1]Institute for Atmospheric and Climate Science, ETH Zürich, Zurich, Switzerland
[2]Institute of Meteorology and Climate Research – Department Troposphere Research (IMK-TRO), Karlsruhe Institute of Technology (KIT), Karlsruhe, Germany
★These authors contributed equally to this work.

**Correspondence:** Daniela I. V. Domeisen (daniela.domeisen@env.ethz.ch)

Received: 13 December 2019 – Discussion started: 9 January 2020
Revised: 10 July 2020 – Accepted: 18 July 2020 – Published: 11 August 2020

Bedartha Goswami

## Sudden Stratospheric Warming (SSW)

- Reversal of winds  (from westerly to easterly)
- 10hPa & 60N
- Between 1 Dec & 31 Mar
- Must return to a westerly wind for more than 10 consecutive days

Bedartha Goswami

## Sudden Stratospheric Warming (SSW)

- Reversal of winds  (from westerly to easterly)
- 10hPa & 60N
- Between 1 Dec & 31 Mar
- Must return to a westerly wind for more than 10 consecutive days

https://youtu.be/VnlFFaF_l7I

Bedartha Goswami

## Weather Regimes

- From Grams et al. (2017)
- *k*-means clustering of data in EOF space
- 10 day low-pass filtered 500 hPa gph
- Consider only seven leading EOFs (76% explained variance)



## Identified weather regimes

- “Cyclonic”
  - Atlantic trough (AT)
  - Zonal regime (ZO)
  - Scandinavian trough (ScTr)
- “blocked”
  - Atlantic ridge
  - European blocking
  - Scandinavian blocking
  - Greenland blocking

## Identified weather regimes

- “Cyclonic”
  - Atlantic trough (AT)
  - Zonal regime (ZO)
  - Scandinavian trough (ScTr)
- “blocked”
  - Atlantic ridge
  - **European blocking**
  - Scandinavian blocking
  - **Greenland blocking**

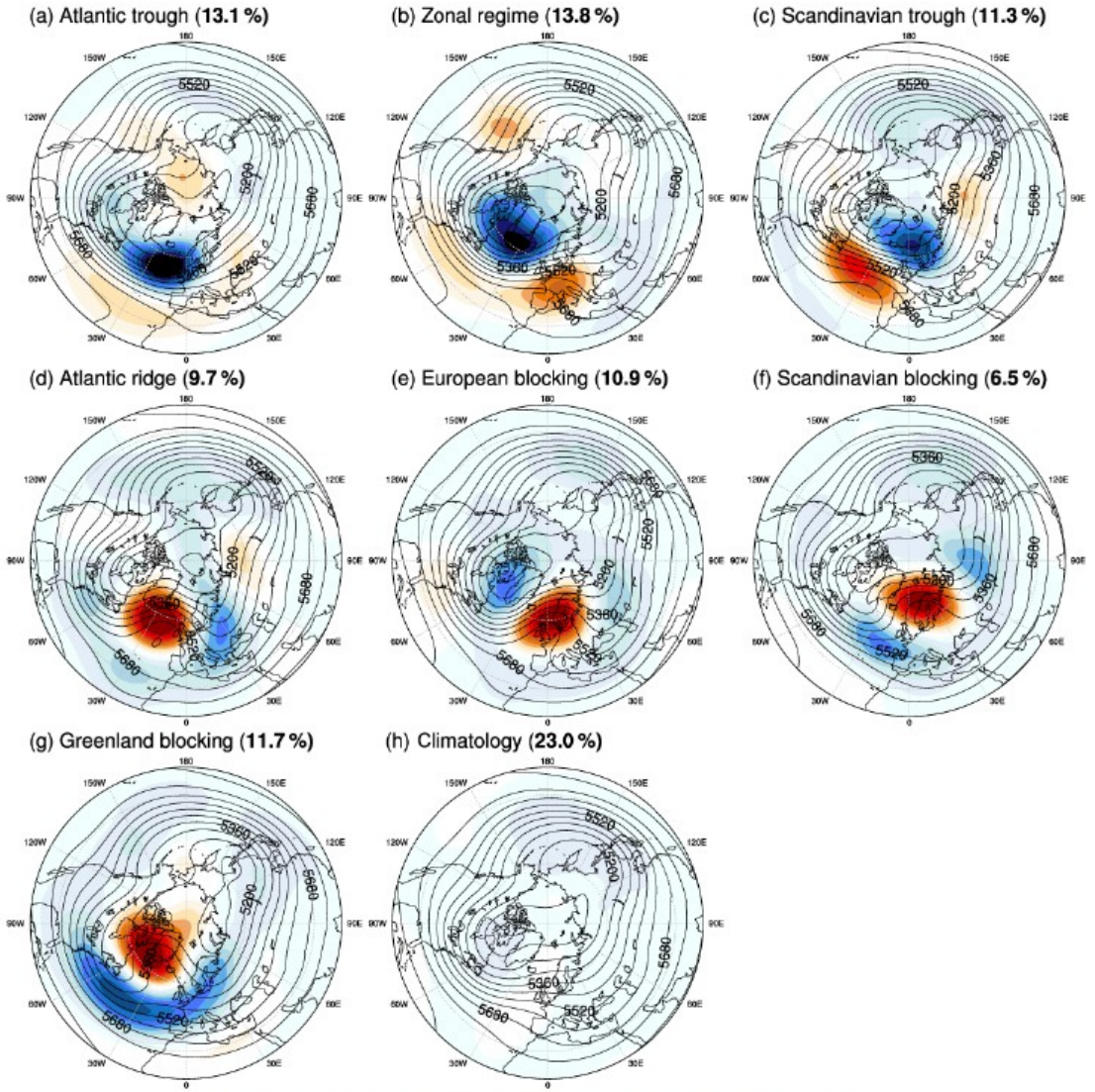


## Identified weather regimes

- "Cyclonic"
  - Atlantic trough (AT)
  - Zonal regime (ZO)
  - Scandinavian trough (ScTr)
- "blocked"
  - Atlantic ridge
  - European blocking
  - Scandinavian blocking
  - Greenland blocking

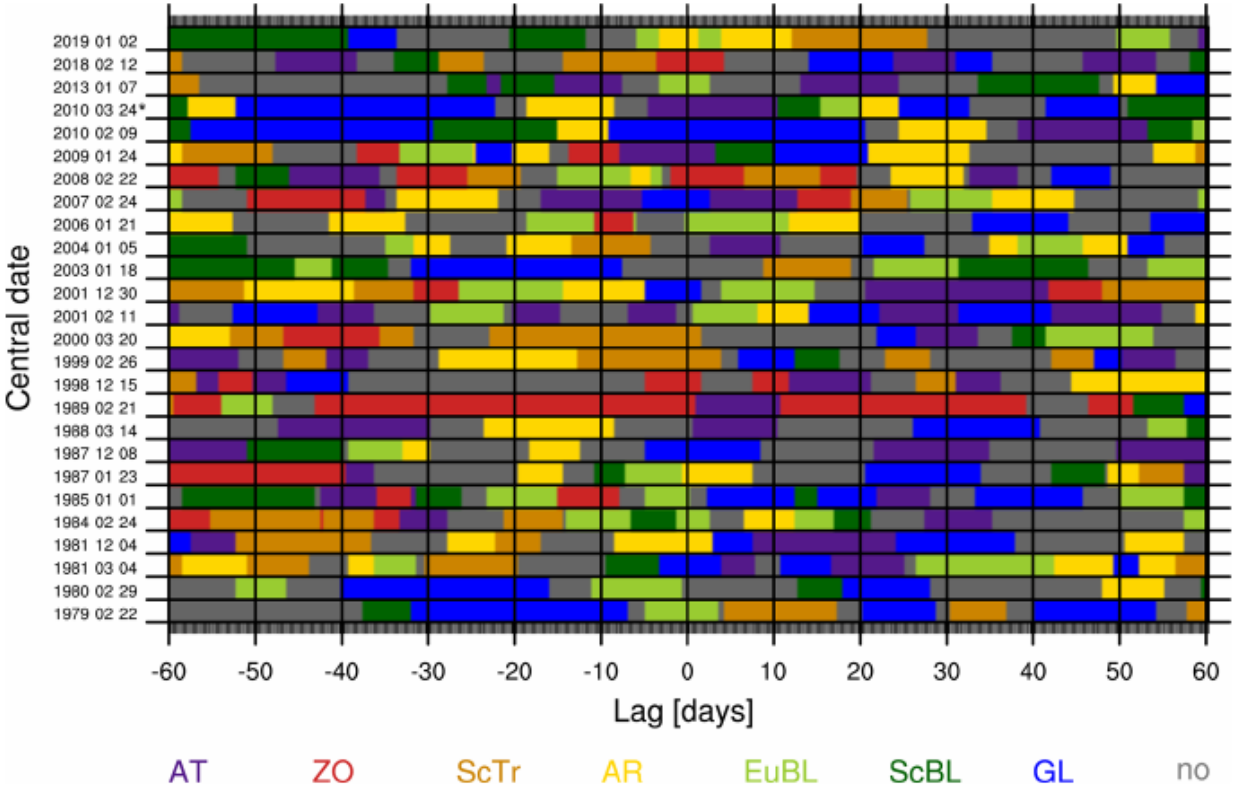
**Table 1.** Weather regime attribution around the onset of SSW events: SSW date, attributed regime, and mean weather regime index ($\overline{I}_w$, with $w \in$ AT, ZO, ScTr, AR, EuBL, ScBL, GL) for the attributed regime for the period $\pm 5$ d around SSW onset. Asterisks (*) indicate that the event has been excluded from the subsequent analysis; for details see Sect. 2.1.

| SSW central date | attributed regime | $\overline{I}_w$ |
|---|---|---|
| 22 Feb 1979 | EuBL | 1.41 |
| 29 Feb 1980 | EuBL | 0.91 |
| 04 Mar 1981 | GL | 1.82 |
| 04 Dec 1981 | AR | 2.18 |
| 24 Feb 1984 | EuBL | 1.01 |
| 01 Jan 1985 | EuBL | 0.74 |
| 23 Jan 1987 | AR | 1.52 |
| 08 Dec 1987 | GL | 1.56 |
| 14 Mar 1988 | AT (cyclonic) | 0.48 |
| 21 Feb 1989 | ZO (cyclonic) | 1.74 |
| 15 Dec 1998 | ZO (cyclonic) | 1.01 |
| 26 Feb 1999 | ScTr (cyclonic) | 1.37 |
| 20 Mar 2000 | ScTr (cyclonic) | 0.91 |
| 11 Feb 2001 | EuBL | 0.47 |
| 30 Dec 2001 | GL | 1.31 |
| 18 Jan 2003 | no regime | – |
| 05 Jan 2004 | no regime | – |
| 21 Jan 2006 | EuBL | 1.14 |
| 24 Feb 2007 | GL | 1.36 |
| 22 Feb 2008 | ZO (cyclonic) | 1.32 |
| 24 Jan 2009 | AT (cyclonic) | 1.86 |
| 09 Feb 2010 | GL | 2.46 |
| 24 Mar 2010* | AT (cyclonic) | 1.20 |
| 07 Jan 2013 | EuBL | 1.09 |
| 12 Feb 2018 | ZO (cyclonic) | 1.48 |
| 02 Jan 2019 | AR | 1.52 |

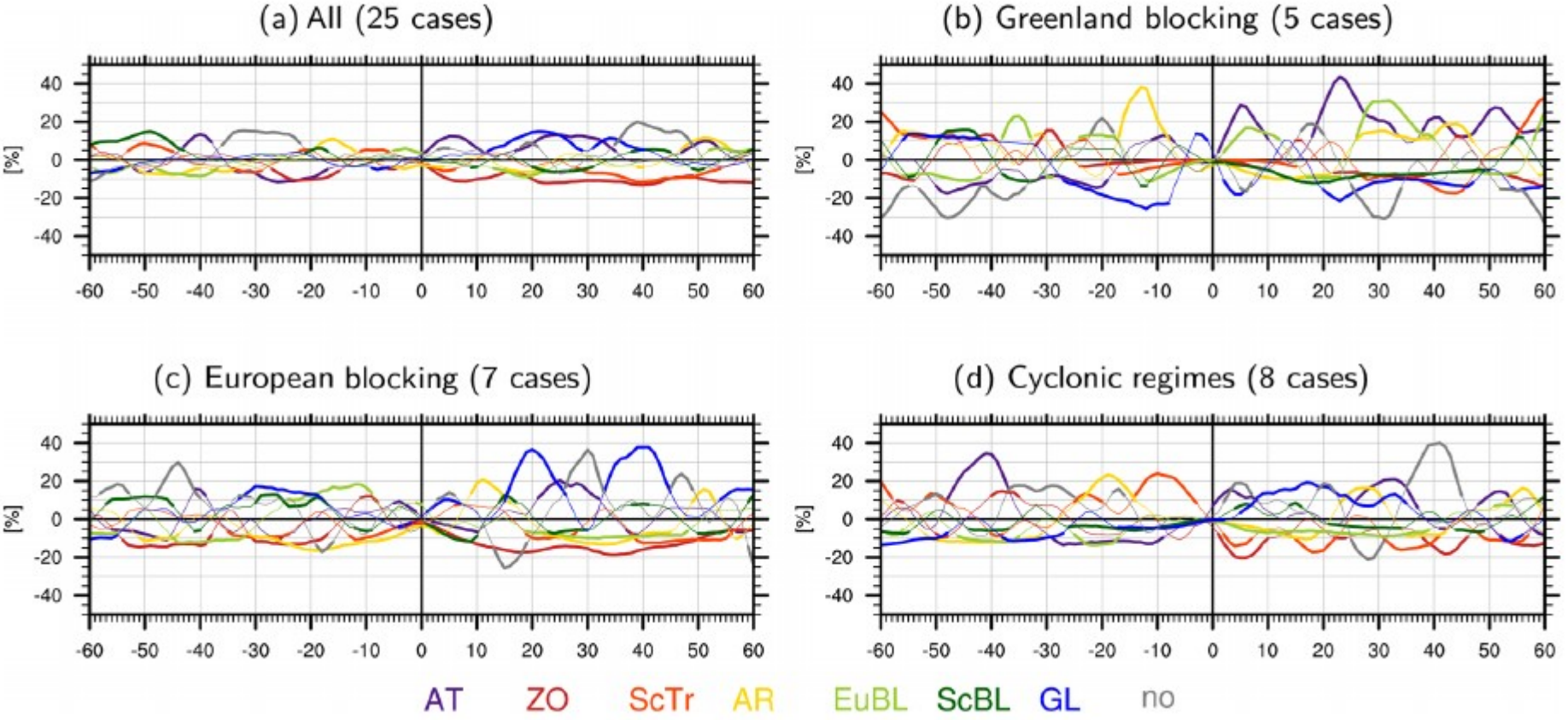



## Definitions

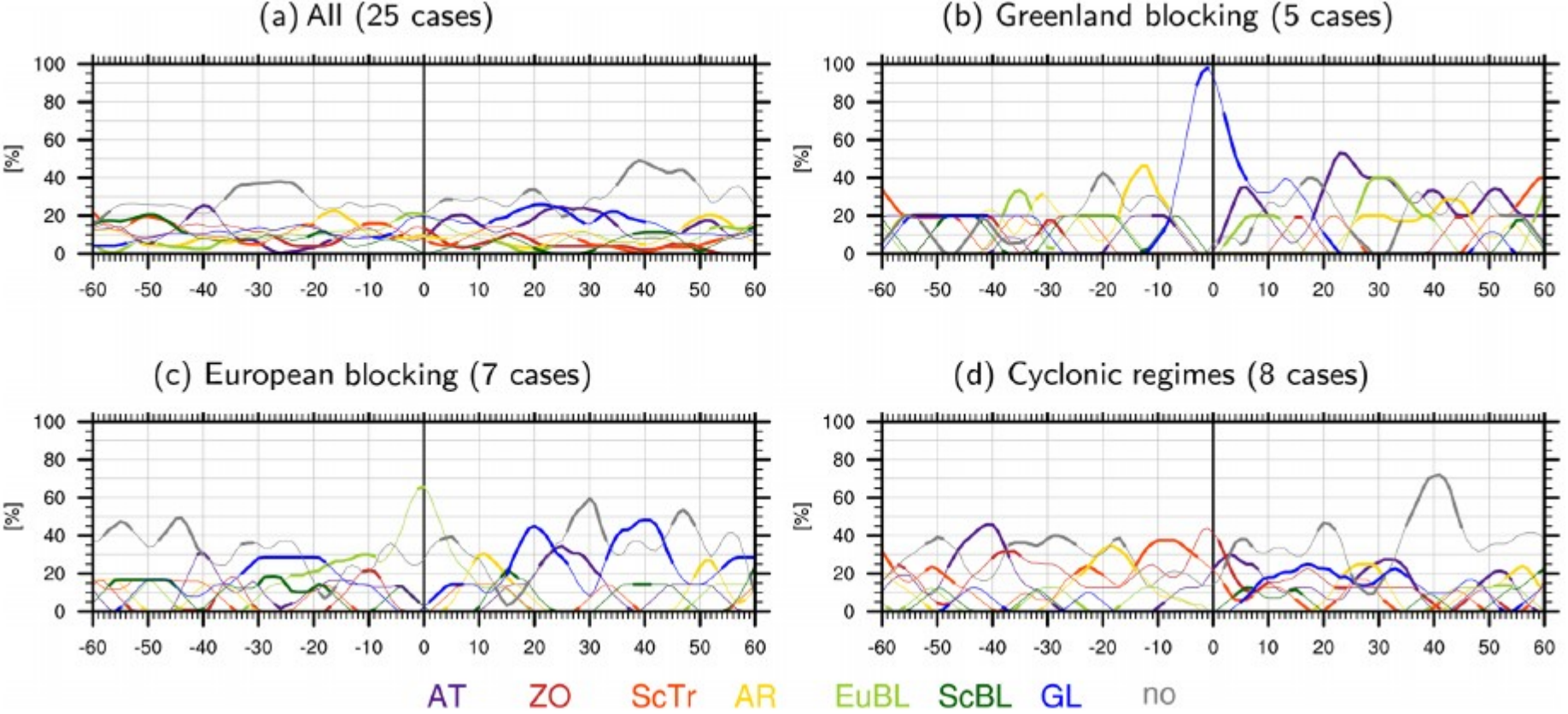
Bedartha Goswami



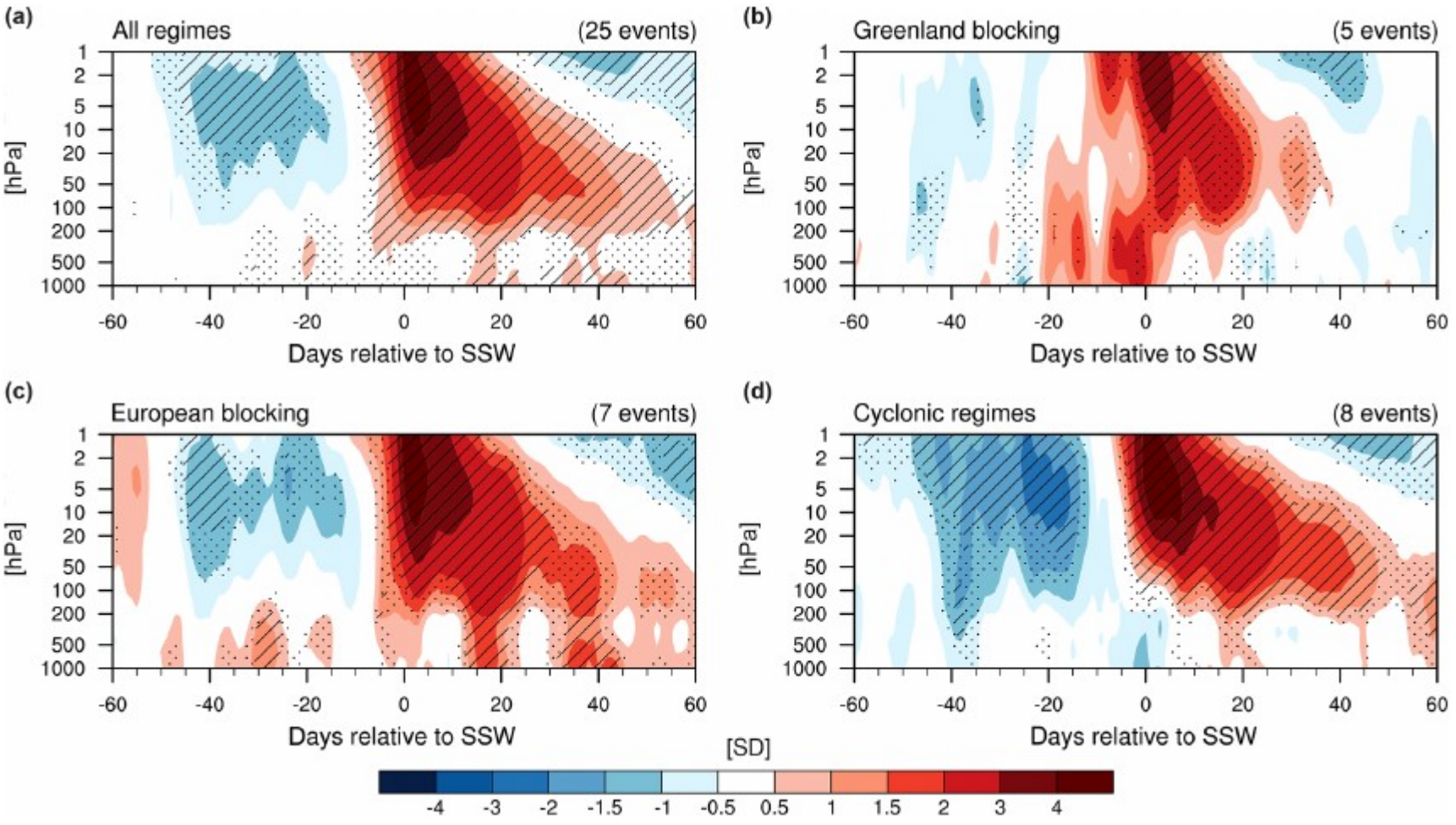

## Time Evolution



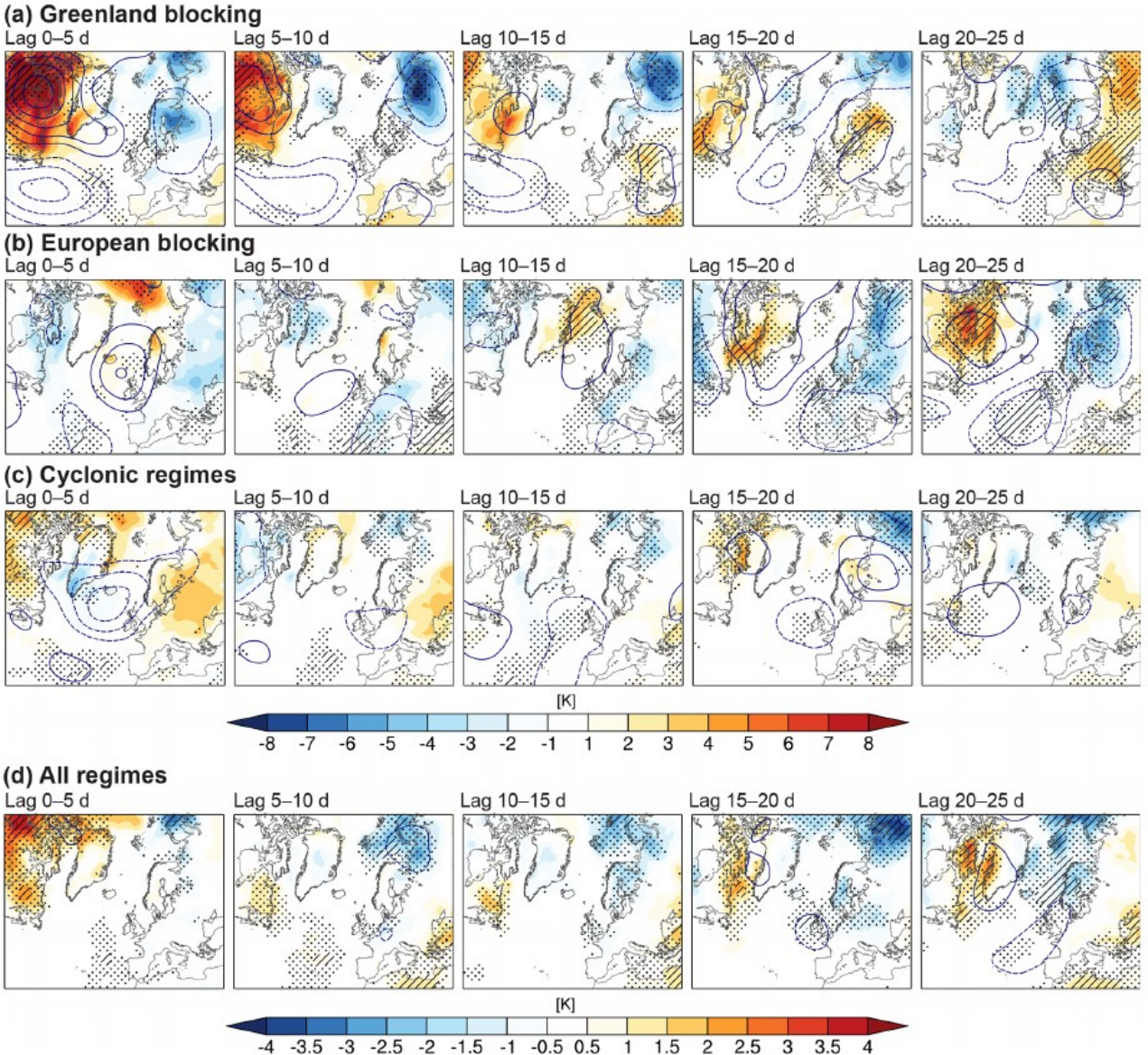

## Time Evolution




## Time Evolution




## Tropospheric impact




## Surface impact

## Summary

- GL and EuBL result in surface impacts
- SSW results in the preferred occurrence of certain weather regimes over others
- Cyclonic weather regimes have less impact
- Low sample size