**What's happening before and around the SSW onset?**
The stations **in the NH** show an **enhanced eastward GW forcing**. The **meridional wind fluctuates** with a **periodicity of** about **10 days**.

**Is inter-hemispheric coupling real?**
The **measurements in the SH** are **consistent with** the **inter-hemispheric coupling** hypothesis. The expected downward shift of GW drag [2] was reproduced by a downward travelling layer of enhanced GW activity.

# Superposed epoch analysis of coupling mechanisms captured by meteor radars during sudden stratospheric warmings

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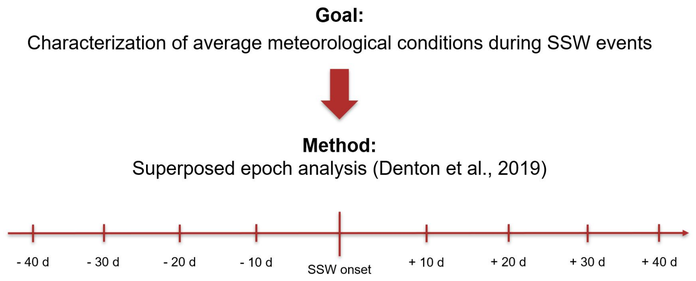
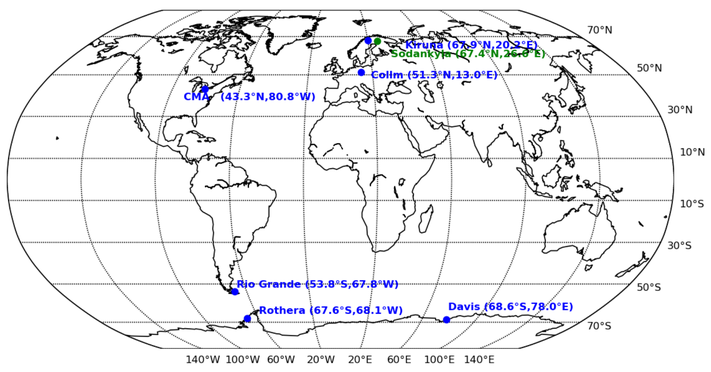
## Methods

- Adaptive spectral filtering [3]
- Superposed epoch analysis [1]




## Data

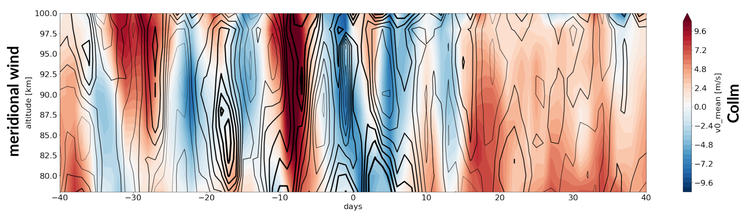
Meteor radar measurements for seven stations are used in this project.




- NH: Kiruna (Esrange), Sodankyla, Collm Observatory and the CMOR meteor radar at London, Ontario (CMA)
- SH: Rio Grande, Davis and Rothera

## Northern hemisphere (NH)

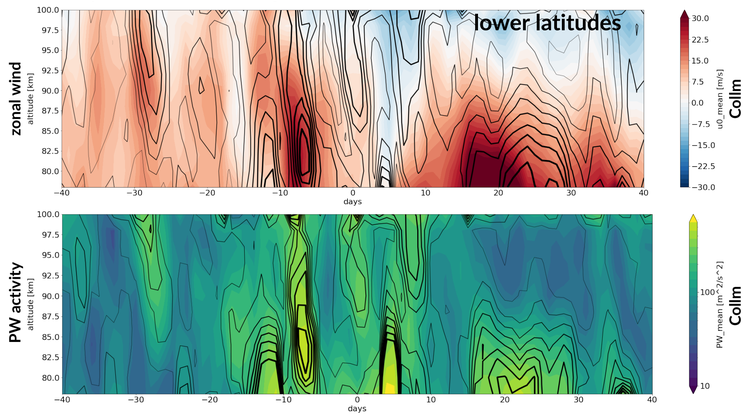
### Meridional wind



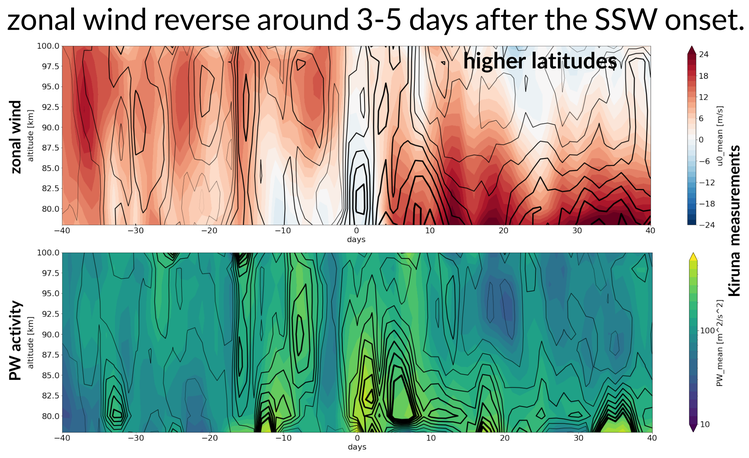

Fluctuating between positive and negative values, the **meridional wind** shows a **periodicity** of around 10 days. The strongest meridional wind speeds are found around 10 days before the sudden stratospheric warming (SSW) onset (northern) and around the SSW onset (southern direction). From about 2 weeks after the onset, the wind becomes mainly northerly.

## Latitudinal differences in zonal wind

In the NH, the **zonal wind** is decreasing from around two weeks before the SSW onset and onward. This corresponds to an increased planetary wave (PW) activity below and up to 80 km altitude at the same time.

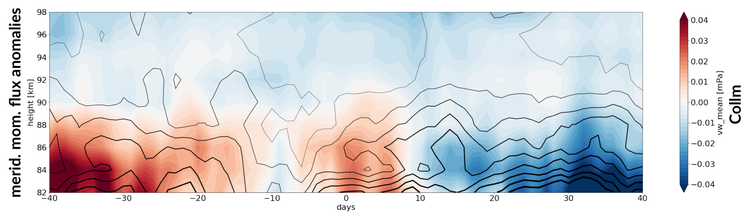



At Collm, this decrease is followed by a **strong increase in zonal wind and PW activity** around one week before the onset of the SSWs.
The stations at lower latitudes show a maximum of the zonal wind reverse around 3-5 days after the SSW onset.




At higher latitudes, the strongest zonal wind reverse is already apparent a few days earlier. Accordingly, the PW activity is enhanced earlier for Kiruna and later for Collm. This leads to the assumption that **latitudinal differences** are apparent in the PW activity as well.

## Momentum fluxes



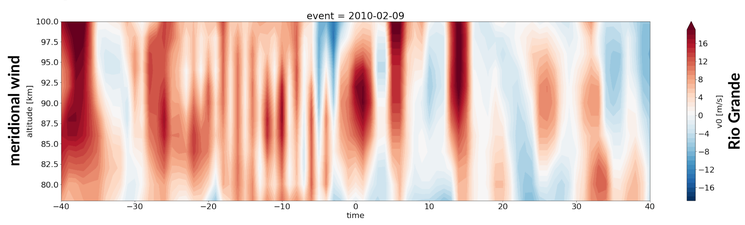

The meridional momentum flux shows positive anomalies before the SSW onset. At Collm, this is broken by negative anomalies around 10 days before the onset.

## Southern Hemisphere (SH)

### Zonal wind

In the SH, the zonal winds tend to decrease in magnitude after the SSW onset. Thus, the easterlies in around 80 km altitude weaken, which was also expected by the theory of inter-hemispheric coupling.


The meridional wind component shows multi-day fluctuations. These may indicate a quasi-multi-day wave propagation.
The climatologies for all events show a reversal of the meridional wind to southward direction around 10 days after the SSW onset. This agrees with the inter-hemispheric coupling theory, which also expected such negative anomalies in the meridional wind component.




## Outlook

Whether the zonal wind increase at Collm Observatory triggers the planetary wave activity or vice-versa needs further investigation. To identify a possible periodicity of the meridional wind fluctuations in the SH, a wavelet analysis needs to be accomplished.

## Acknowledgments

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