

The Sudden Stratospheric Warming Compendium

A51H-0175

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1. Background

- Sudden stratospheric warmings (SSWs) are first order dynamical events in the polar winter stratosphere
- SSWs influence surface weather on 10-60 day timescales; this is an active area of research
- We seek to simplify study of these events by producing a database of processed data around SSW dates

2. The Compendium

- Identifying SSWs and analyzing relevant fields requires significant computational costs (Fig. 1)
- We simplify this by providing processed data and underlying code to the public
- Intended to aid research by providing processed data and source code containing numerous useful functions
 - Researchers may also use code base to generate their own final product
- Intended to facilitate outreach by providing data and appropriate images for animations
- Components
 - 6 modern reanalyses (MERRA, JRA55, ERAi, ERA40, NCEP1, NOAA20CR)
 - Multiple event classifications (Charlton and Polvani [2007], Seviour et al. [2009])
 - Standard atmospheric fields (U, T, H, v'T', etc.)
 - Surface fields (Tsfc, MSLP, precipitation)
 - Timing diagnostics (wind reversal at all locations, maximum temperature at all locations, etc.)
 - Climate indices (extreme indices, QBO phase, ENSO phase, etc.)

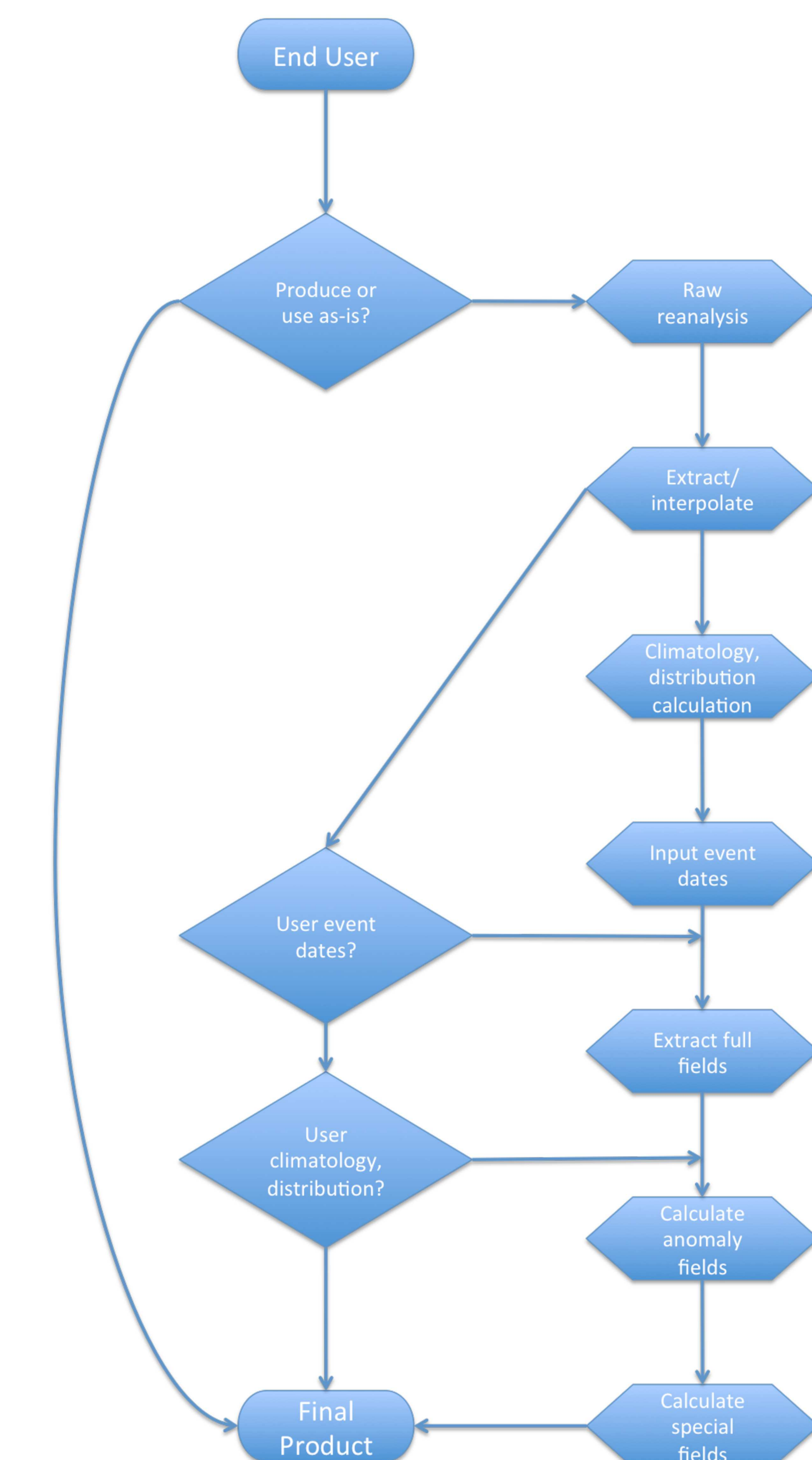


Fig. 1: Flowchart showing possible pathways for use of the Compendium. The primary way is along the left arc where the user immediately makes use of the final product. However, the open source nature gives options for the user.

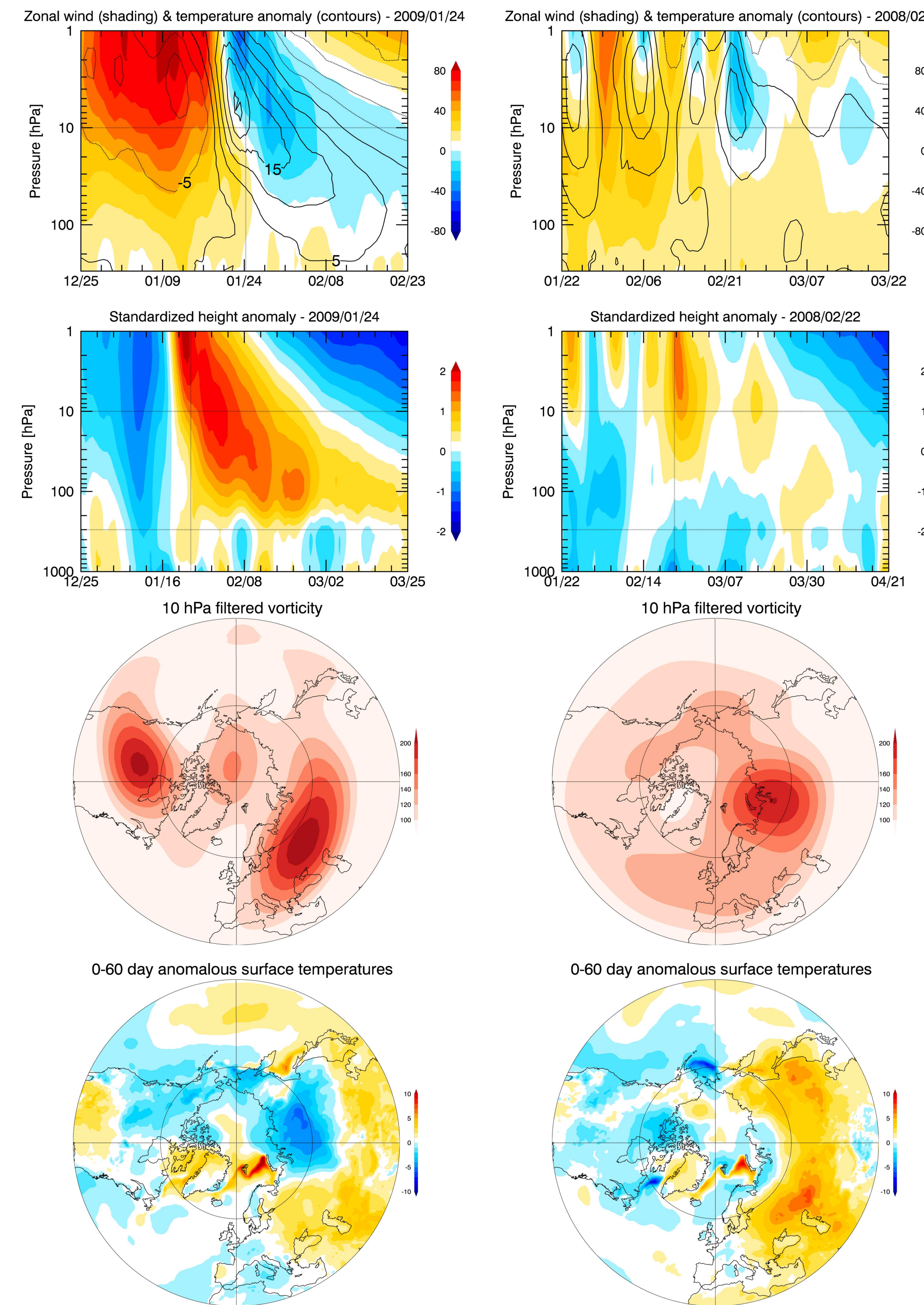


Fig. 2: JRA55 diagnostics for the 2009/01/24 split SSW (left column) and for the 2008/02/22 displacement SSW (right column). (Top) 60N zonal wind and 50-90N temperature anomalies. (Second row) 60-90N standardized height anomalies. (Third row) 10 hPa filtered absolute vorticity. (Bottom row) Mean surface temperature anomalies for the days 0-60 following the SSWs. Units are [m s-1] and [K], [standard deviations], [1E-6 s-1], and [K], respectively.

3. Applications

- Individual event analysis
 - Details range of variability for each event
 - Fig. 2: 2009/01/24 split event, 2008/02/22 displacement event
 - Note: events here are 60N, 10 hPa zonal mean zonal wind reversals
 - Note: classification is Charlton and Polvani (2007) method
- Composite analysis
 - Shows significant impacts and features of events
 - Differences between types of events?
 - Fig. 3: JRA55 all events composite
- Reanalysis intercomparison
 - Compare robustness amongst available data products
 - Fig. 4, Fig. 5, Fig. 6: JRA55 and NCEP1 split and displacement events composites

4. Summary

- Sudden stratospheric warmings are known to influence surface weather on short-term climate timescales
- To ease analysis of these events, we generate a new Compendium of data
- Compendium is a research-ready, available, and open source product
- Facilitates intercomparison and study of SSWs, in particular of the various surface fields which these events may impact
- Outreach products, such as Science on a Sphere animations, are produced and encouraged from others

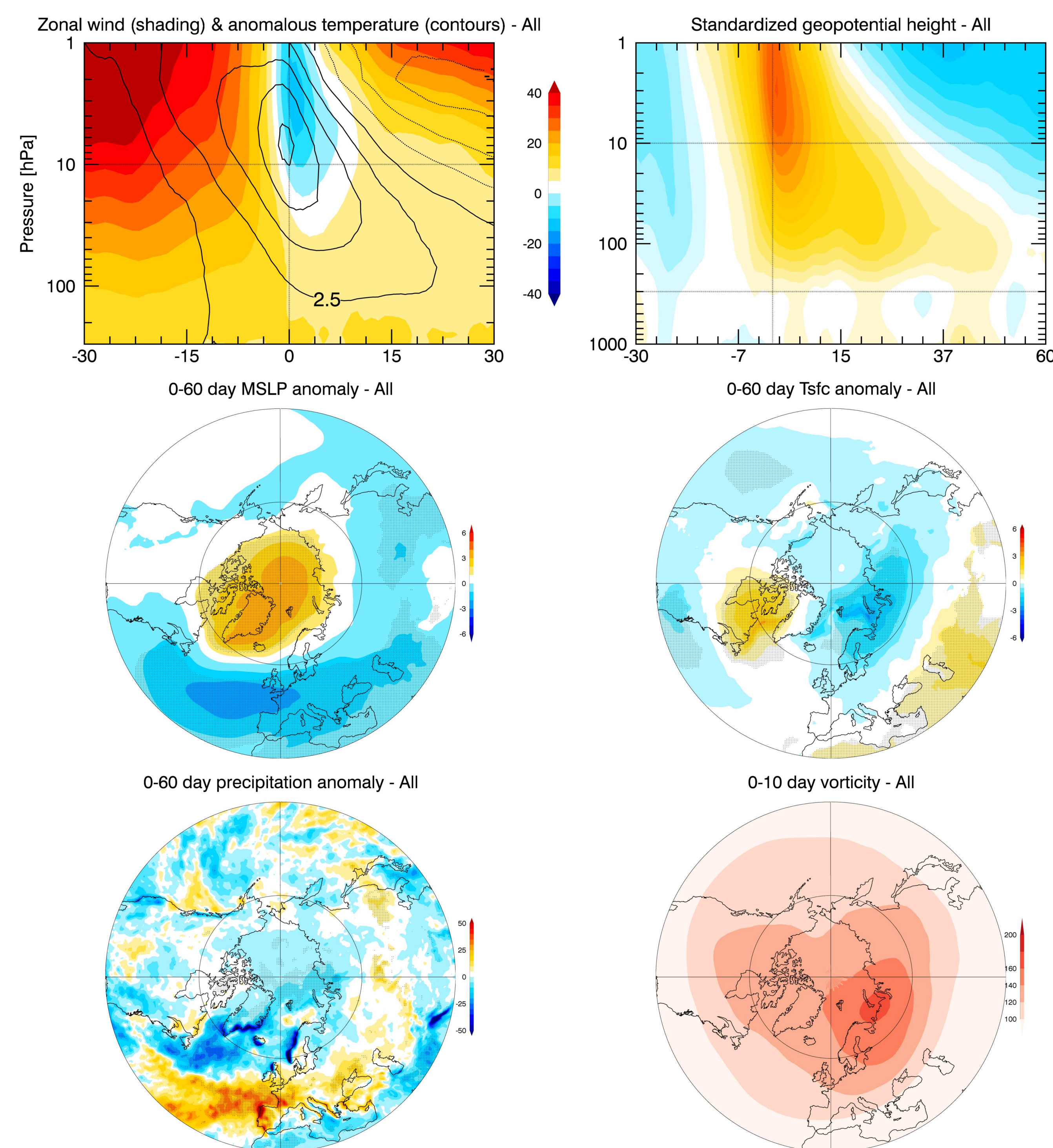


Fig. 3: JRA55 mean diagnostics for all SSWs. From top left to bottom right: 60N zonal wind and 50-90N temperature anomaly, 60-90N standardized height anomaly (note the change in both axes), 0-60 day sea-level pressure anomaly, 0-60 day surface temperature anomaly, 0-60 day total precipitation anomaly, 0-10 day filtered absolute vorticity at 10 hPa. Units are [m s-1] and [K], [standard deviations], [hPa], [K], [mm], and [1E-6 s-1], respectively.

Fig. 4: Composite sea-level pressure anomaly over days 0-60 following SSWs for NCEP1 and JRA55. Within each panel are composites for both split and displacement event. The event composites are over identical dates between each reanalysis. Units are [hPa].

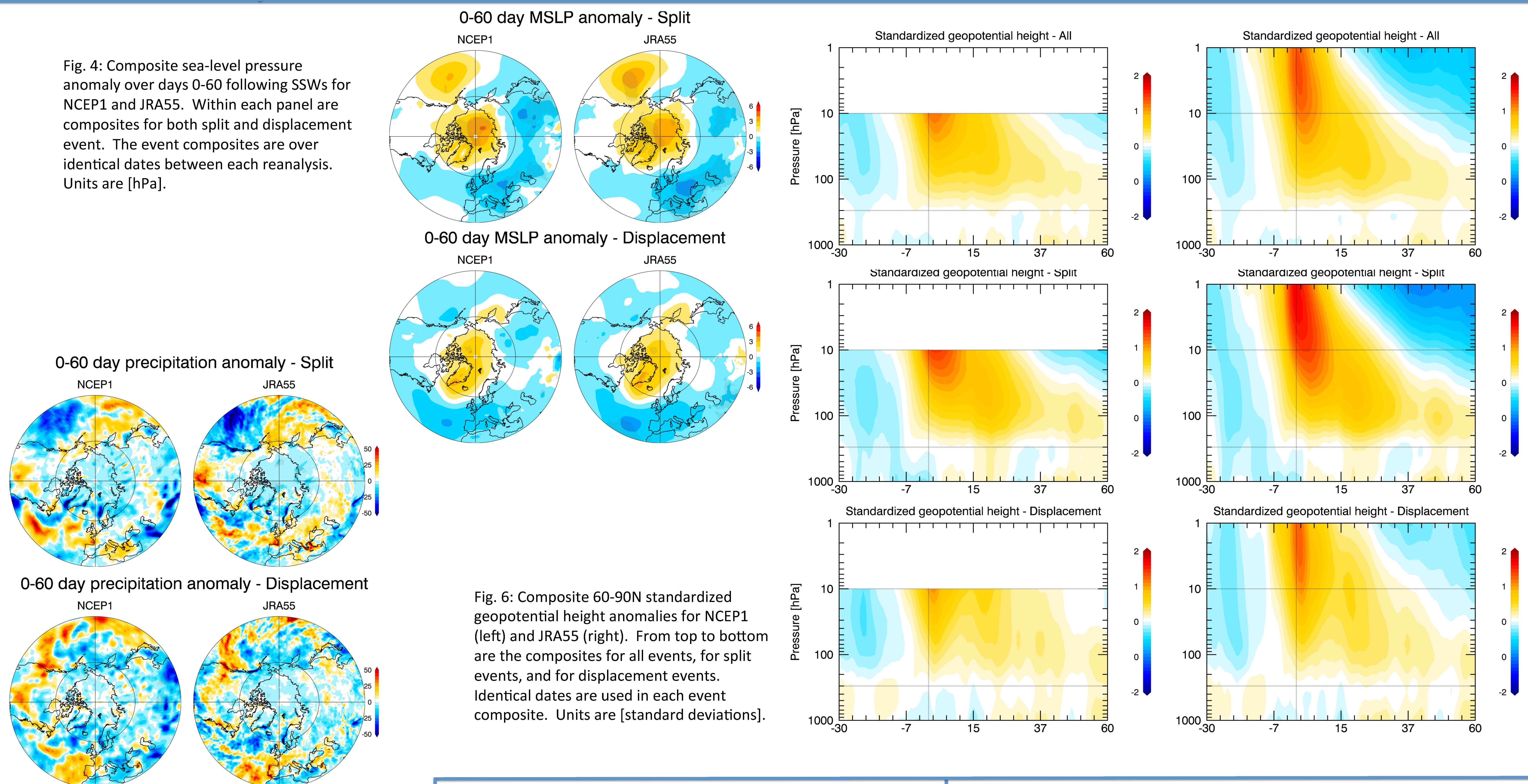


Fig. 5: As in Fig. 4, but composite total precipitation anomaly over days 0-60 following SSWs. Units are [mm].

References

- Charlton and Polvani (2007): A new look at stratospheric sudden warmings. Part I: climatology and modeling benchmarks. *J. Clim.*, **20**, 449-469.
- Seviour et al. (2013): A practical method to identify displaced and split stratospheric polar vortex events. *Geophys. Res. Lett.*, **40**, 5268-5273.

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