Ozone recovery effects in the SH stratosphere **influence** the **dynamics in MLT via GW** coupling. This is **fairly reproduced** in **GAIA** and **WACCMX-SD**.

Long-term changes in mesospheric wind and wave estimates based on radar observations in both hemispheres

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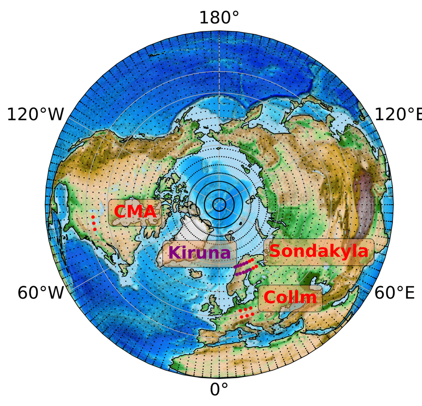
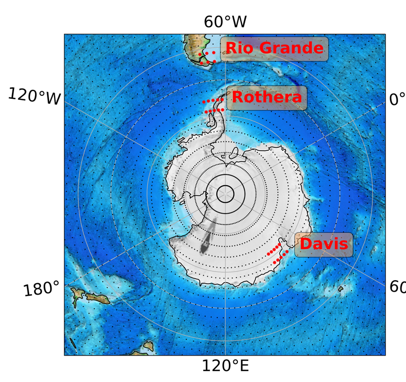
Introduction

Several studies [1, 9] found a trend reversal between winter and summer circulation in the southern hemisphere around 2000 in the middle atmosphere. The analysis of WACCM6 simulation confirmed that ⊖ trend in the stratosphere after 2000 can be attributed to ozone recovery [6]. Here we investigate how **stratospheric trends relate to trends in the mesosphere and lower thermosphere** (MLT) dynamics.

Datasets

- Meteor radar (MR) zonal and meridional wind (ZW,MW) measurements for 7 stations (2005–2019)
- MERRA2 reanalysis [5]
- models nudged in the stratosphere
  - WACCMX-SD (1980–2017) [2]
  - GAIA (1996–2017) [4]





Methods

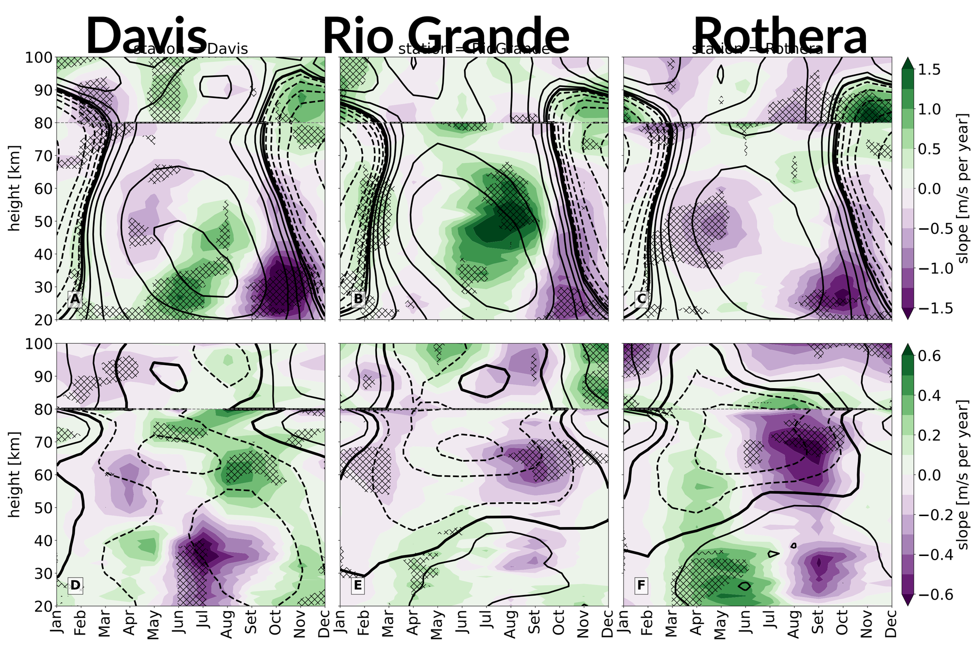
- adaptive spectral filtering [8] to decompose winds in daily means, diurnal and semidiurnal tides etc.
- trend analysis based on Theil–Sen estimator using the modified Mann-Kendall test [10, 7]
  - Hatching \\\\ and //// for p-values < 0.05 and < 0.01
  - compared with OLS (t-test, bootstrap), GLSAR, and GLS using measurement error

Future outlook

Use of the FDR methodology [11]. Comparison with ERA5. Temperature trends in GAIA. Ideas?

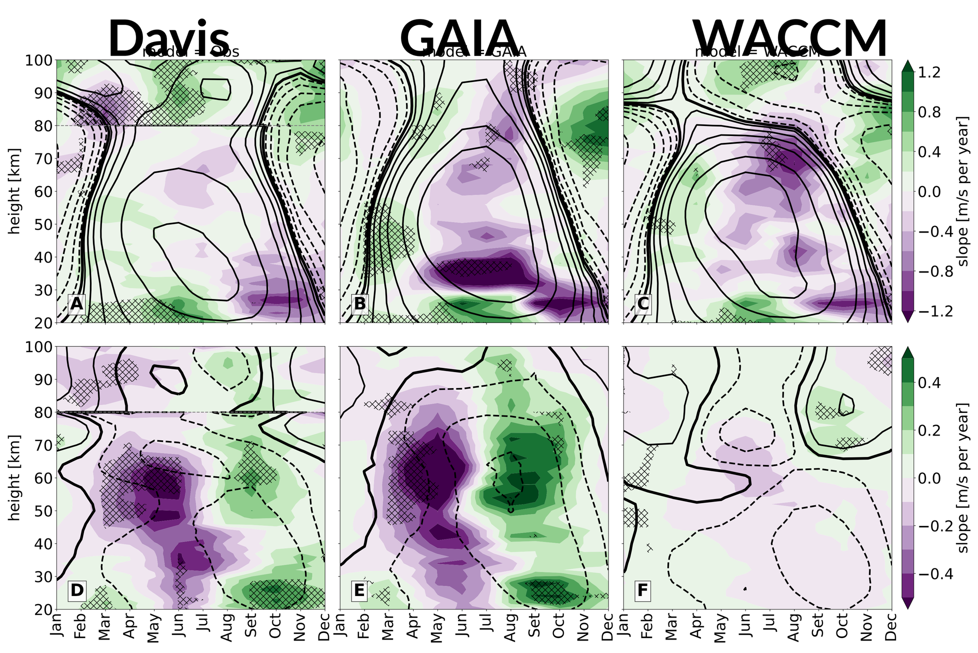
Comparison among SH stations

Trends in MERRA2 (70–80 km) compatible with trends revealed above by MRs. The common ⊖ trend in ZW starting in Sep switches to ⊕ trend weakening easterlies (70–90 km).

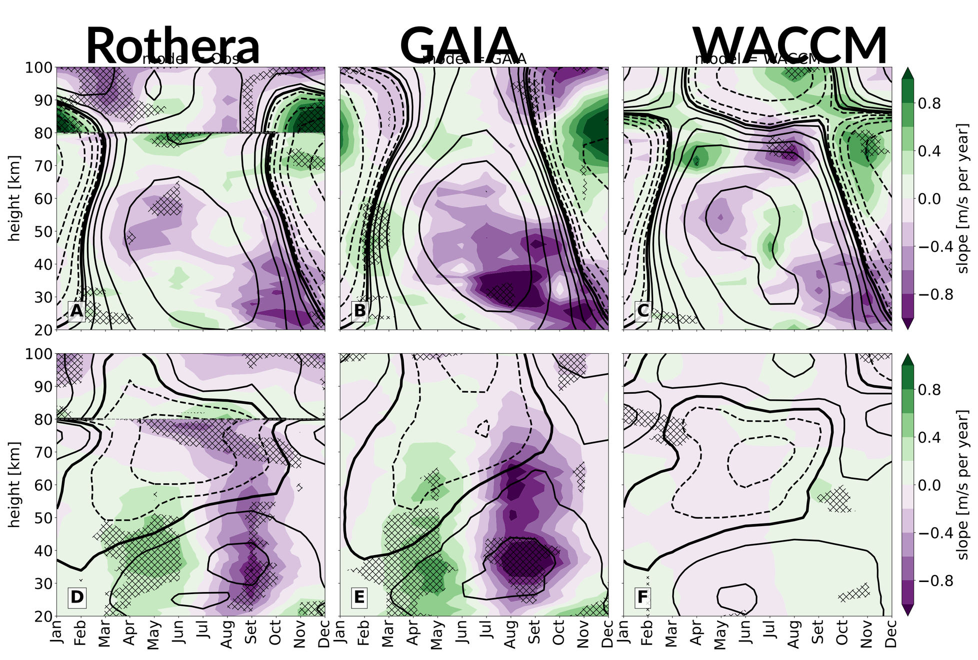


Comparison w. reanalysis & models

Both models are able to reproduce ⊕ ZW trend in Nov/Dec around 80 km.

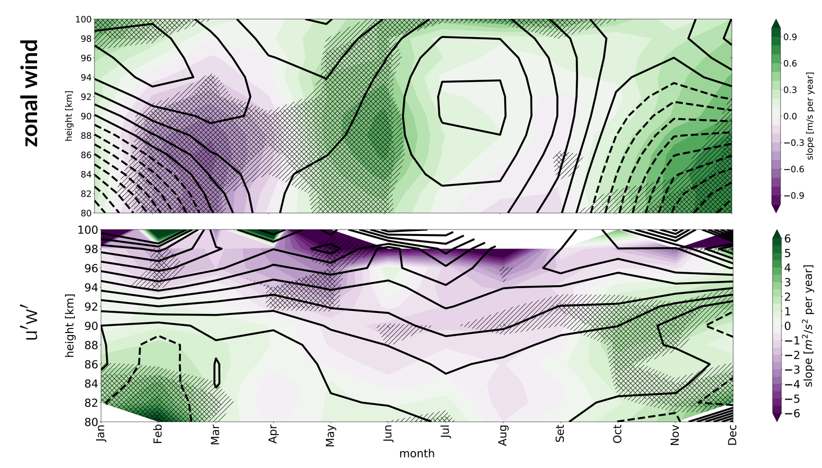


Too weak trends in MWs reproduced by WACCM. Even stratospheric trends not comparable with MERRA2.

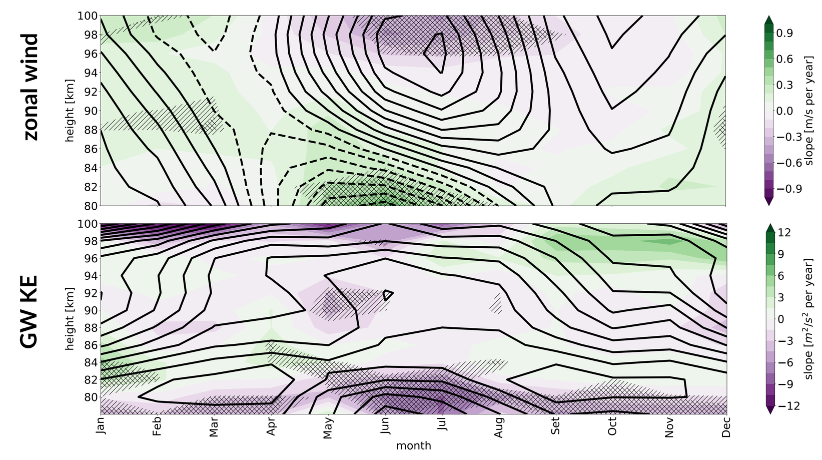


Trends related to GWs

Strengthening of easterly winds in Oct/Nov/Dec connected with a weaker westward drag in the same months as documented **at Davis**.

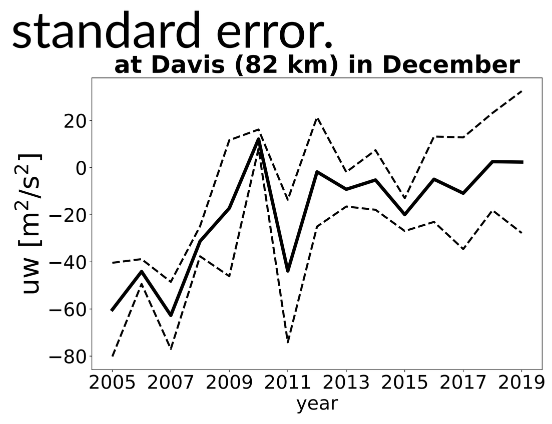


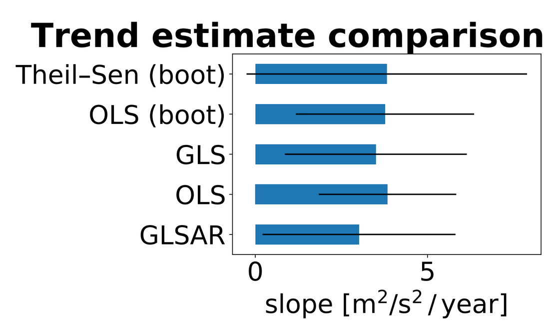
At Collm summer trends in ZW as opposed to previous studies [3], associated with decreased GW kinetic energy. No significant signal in u′w′.



Robustness of fitting method

Alternative methods offer a substantially lower standard error.





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