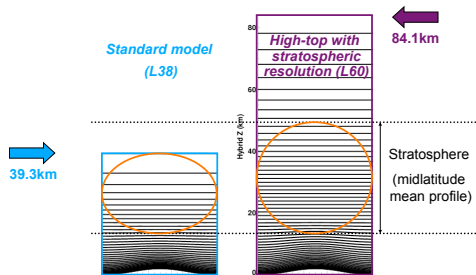


## Experimental Design



HadGEM2-A climate model:

N96L38 ('L38') with TOP ~3mb

N96L60 ('L60') with TOP ~0.004mb (full stratosphere)

Hindcast ensemble members: 15

Hindcast duration: December – April

Hindcast years: 15 winters within 1962 – 2002

Boundary / initial conditions:

Observed SST and sea ice (HadISST)

6-hourly ERA-40/ECMWF atmospheric data

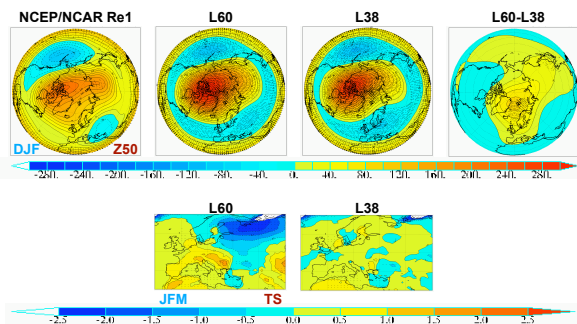
DJF surface temperature (TS) correlations over Europe, relative to ERA-40: **0.26** (L38), **0.31** (L60)

Correlation difference not significant over 15 winters

## Improved response to ENSO for L60

El Niño winters: 1968/69, 1982/83, 1987/88, 1991/92, 1997/98

La Niña winters: 1964/65, 1974/75, 1995/96, 1998/99



Response to ENSO (El Niño minus La Niña winters):

➔ **Negative AO / NAO signal better captured in L60**

## Improved predictability of SSWs for L60

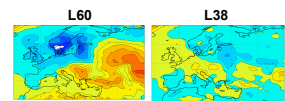
4 Sudden Stratospheric Warming (SSW) Events:

24 Feb 1984, 7 Dec 1987, 15 Dec 1998, 26 Feb 1999

Avg. maximum lead time for event capture: **12d** (L60), **8d** (L38)

Peak easterly strength (60N, 10mb): **0.6\*obs** (L60), **0.3\*obs** (L38)

➔ **Improved seasonal prediction of European winter cold spells**

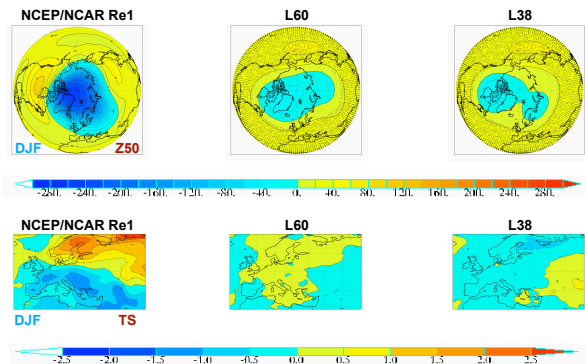


## Weak model response to volcanic forcing

(Post-)volcanic winters: 1963/64 & 1964/65 (Mt Agung)

1982/83 & 1983/84 (El Chichón)

1991/92 & 1992/93 (Mt Pinatubo)



Response to volcanic aerosol forcing:

- ➔ **Very weak positive AO / NAO in model**
- ➔ **Not improved by increasing the vertical**
- ➔ **Not improved by modifying the aerosol distribution**

## Summary

Increasing stratospheric resolution:

- ✓ Improves response to ENSO
- ✓ Improves SSW predictability (medium-range and seasonal)
- ✗ Does not improve response to volcanic aerosol