No evidence for climate change in the unprecedented Summer 2018 flow over Europe

Carley Iles[1], Robert Vautard[1] (Carley.Iles@lsce.ipsl.fr)

1: Laboratoire des Sciences du Climat et de l'Environnement, Institut Pierre Simon Laplace, CNRS, Paris, France

Summer 2018

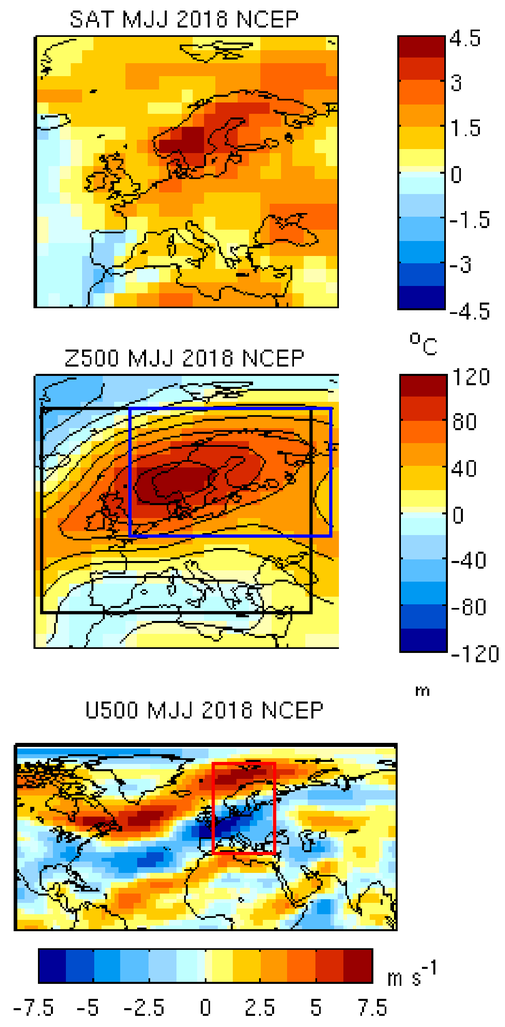
- **Prolonged heat waves in Northern Europe**
- **Persistent atmospheric blocking over Scandinavia**
- **Unusually far North jet stream**

Has climate change made this kind of atmospheric flow pattern more likely?

- Most attribution studies focus on the temperatures themselves

-However atmospheric circulation plays an important role in heatwave generation

- Changes in atmospheric circulation constitute a large source of uncertainty in future climate projections



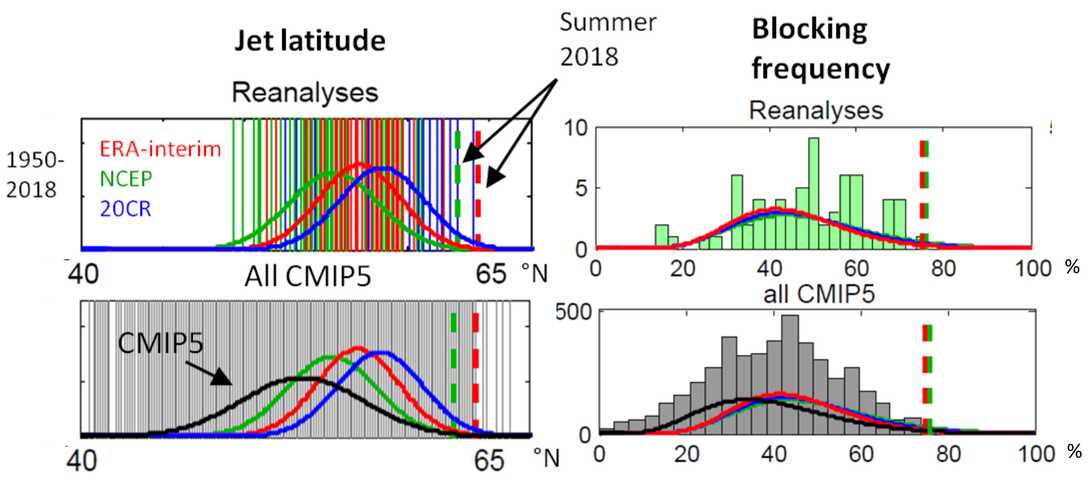
Right: Summer 2018 anomalies of May-July a) surface air temperature, b) 500hPa geopotential height showing a blocking pattern and c) 500 hPa zonal wind showing a northward displaced polar jet

Methods

3 circulation indices:

- **Blocking index:** Stationary large scale blocking (similar to Davini et al. 2014 and Tibaldi and Molteni 1990) in Scandinavian region denoted by blue box above.
- **Jet latitude index:** Latitude of maximum zonal wind at 500 hPa is found for each longitude within the red box above for each day. Then the zonal mean and seasonal mean are calculated.
- **Circulation analogues:** Pattern correlation for geopotential height at 500 hPa in black box above is used to compare observed summer 2018 days with summer days in other years. Good analogues are those with r > 0.85.

How unusual was this circulation pattern?

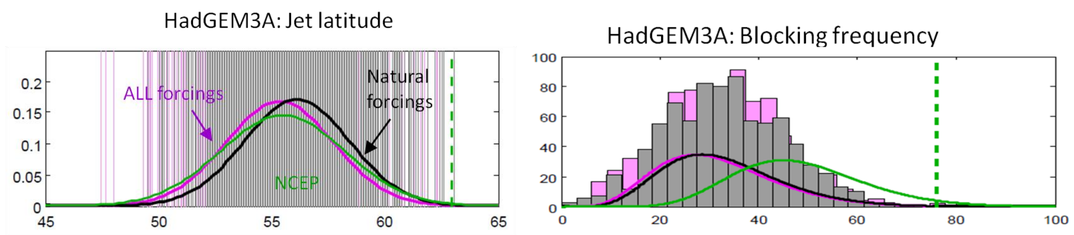


Above: Distributions of summer (May-July) mean jet latitude and blocking frequency in reanalysis and CMIP5 simulations since 1950. For the jet stream each vertical line donates a summer. Summer 2018 values from NCEP and ERA Interim are shown with thick dashed lines.

Summer 2018 had the most northerly average jet position and highest percentage of blocked days over Scandinavia seen in reanalysis records. Equivalent circulation states are also rare in CMIP5.

Human Influence?

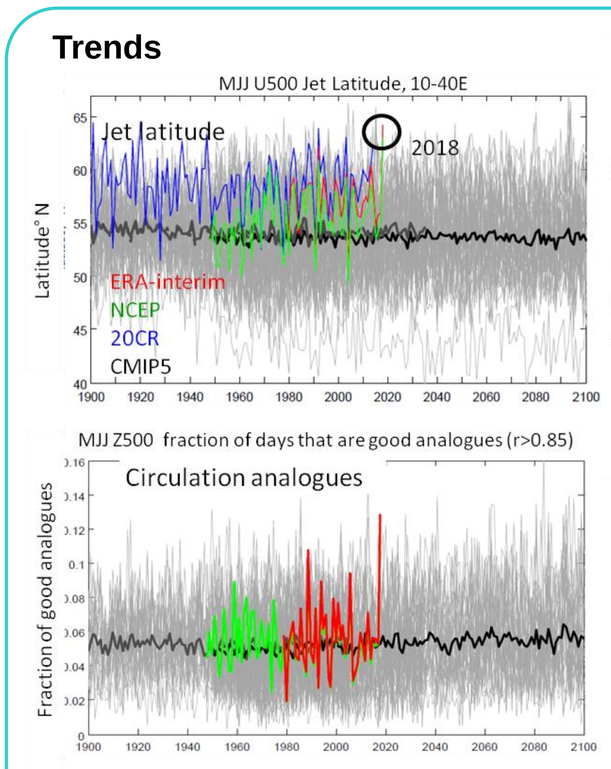
2 x 15 member ensembles of HadGEM3A (N216) with and without human forcing



-The jet stream resides a little further south with anthropogenic forcing

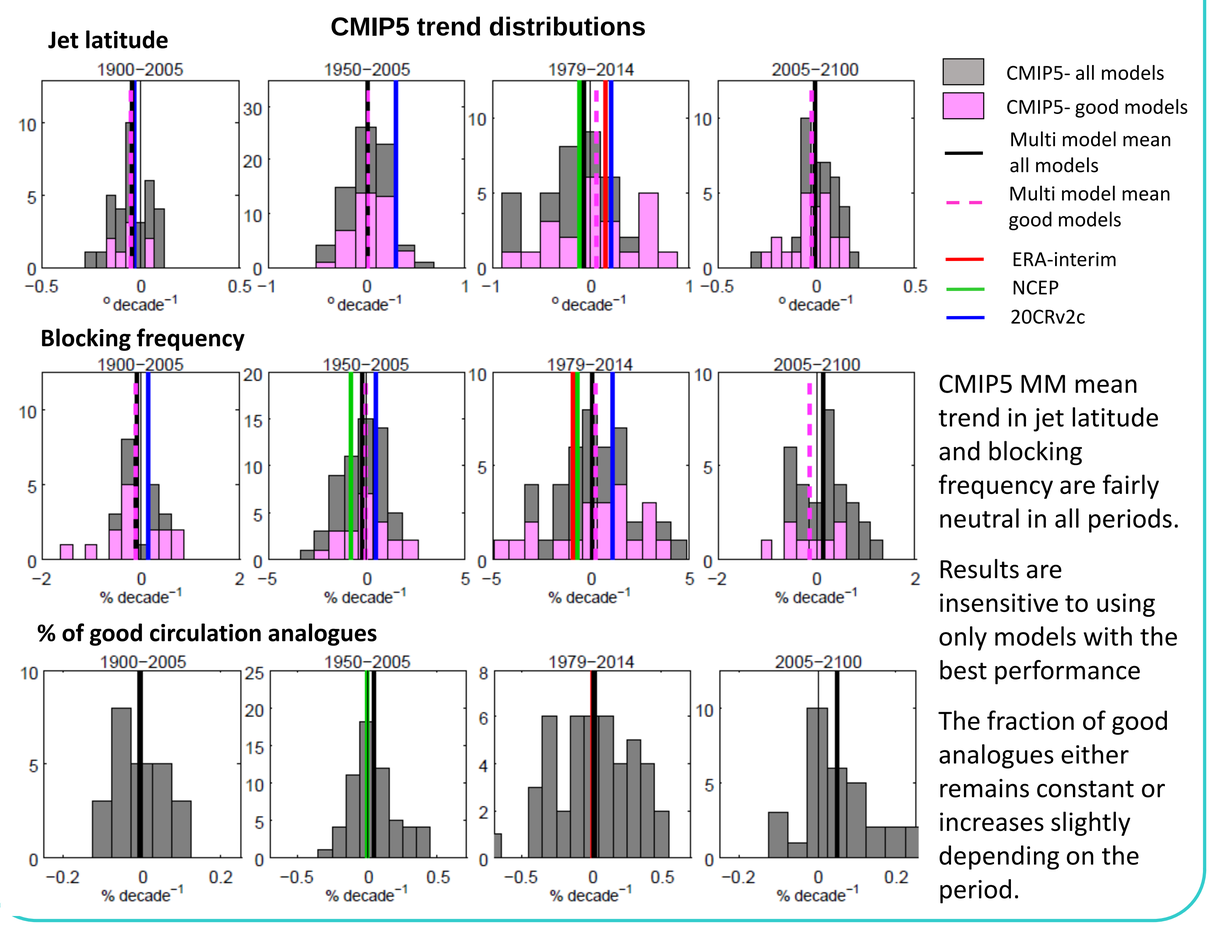
-No difference in blocking between the two ensembles (although Scandinavian blocking frequency is underestimated in this model)

Trends



-Reanalyses show much interannual to multi decadal variability in all circulation indices.

- CMIP5 multi model mean trends are fairly flat.
  - Slight southward trend in jet latitude
  - A small positive trend in the fraction of summer days that are good analogues of summer 2018 days

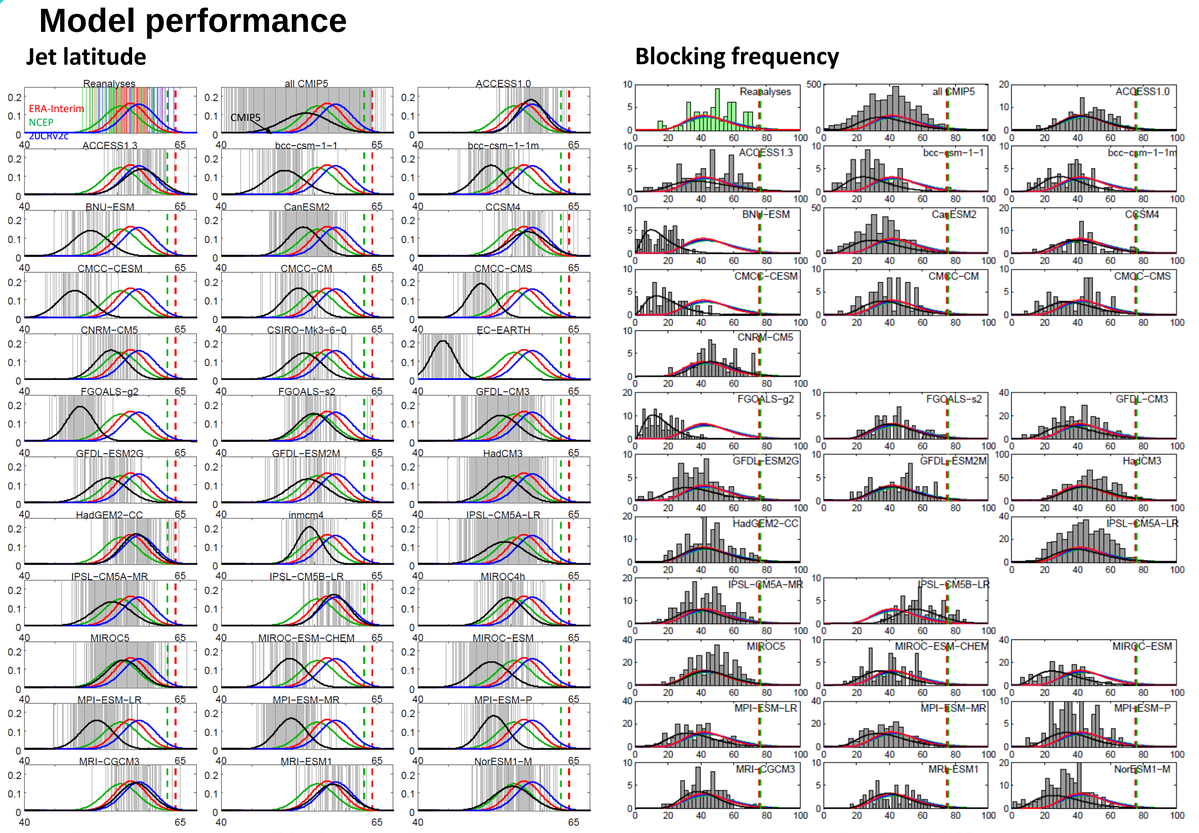


CMIP5 MM mean trend in jet latitude and blocking frequency are fairly neutral in all periods.

Results are insensitive to using only models with the best performance

The fraction of good analogues either remains constant or increases slightly depending on the period.

Model performance



Above: Distributions of summer (May-July) mean Scandinavian jet latitude (left) and blocking frequency (right) for CMIP5 models compared to reanalyses. For the jet stream each vertical line donates a summer. Summer 2018 values from NCEP and ERA Interim are shown with thick dashed lines.

Some CMIP5 model simulate realistic Scandinavian summer blocking and jet latitude distributions. Others underestimate blocking frequency or have the jet too far south.

Conclusions

- The prolonged summer 2018 heatwave in Northern Europe was associated with the most northerly average jet position and highest blocking frequency over the Scandanavian sector seen in reanalysis records.

- Such features are also very unusual in CMIP5 simulations.

- There is little evidence for human influence increasing the likelihood of this circulation pattern