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working with the weather

S2S Forecast Skill in Europe

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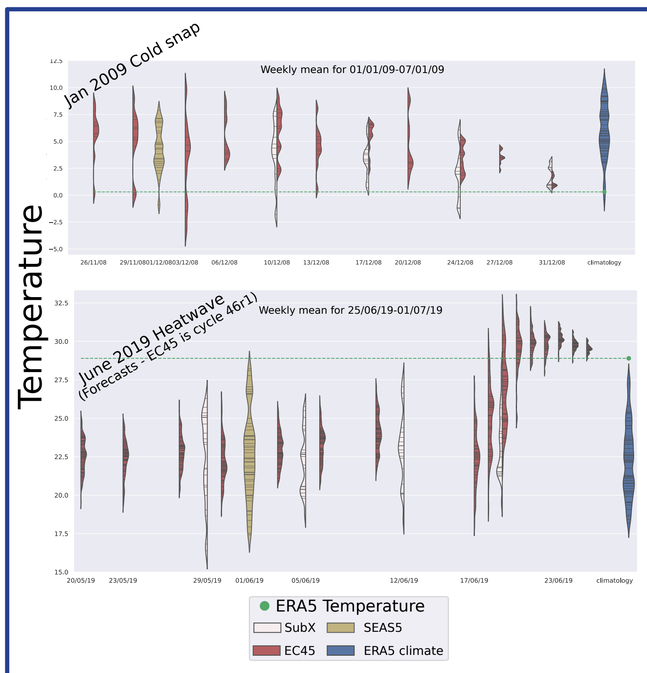
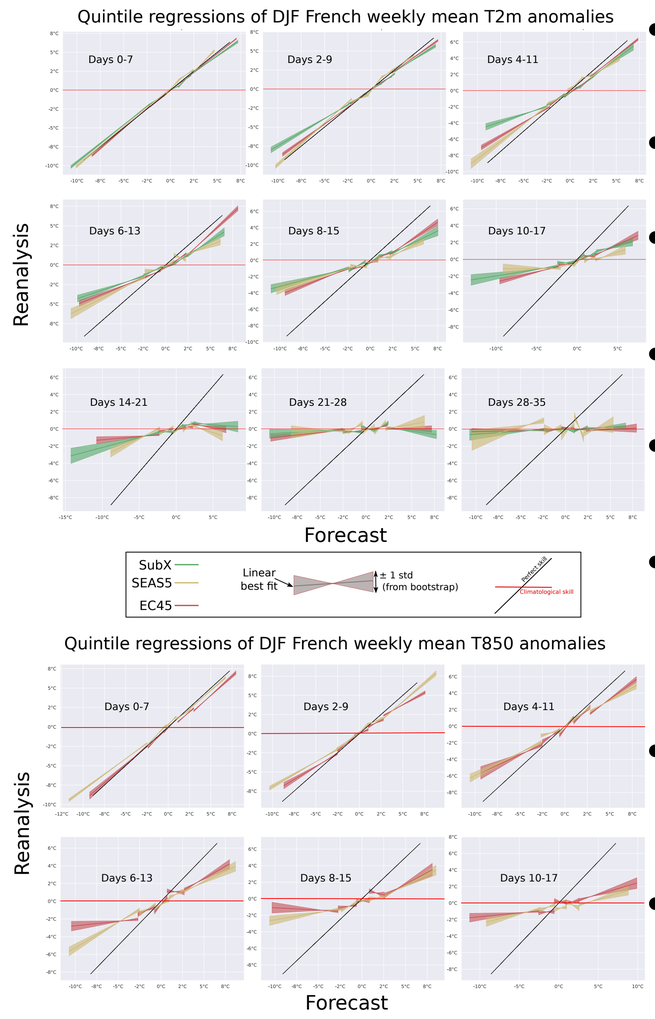
Predicting French surface temperature



- We can combine multimodel ensemble forecasts for a single event to understand the evolution of forecast skill
- We look at 2 metre weekly mean temperature over France - directly meaningful for users
- Extended range forecasts often seem little different to climatology
- Clear skill in these examples is limited to less than 2 weeks
- Some extended range forecast include the observed extremes - is there predictive skill at long lead times?



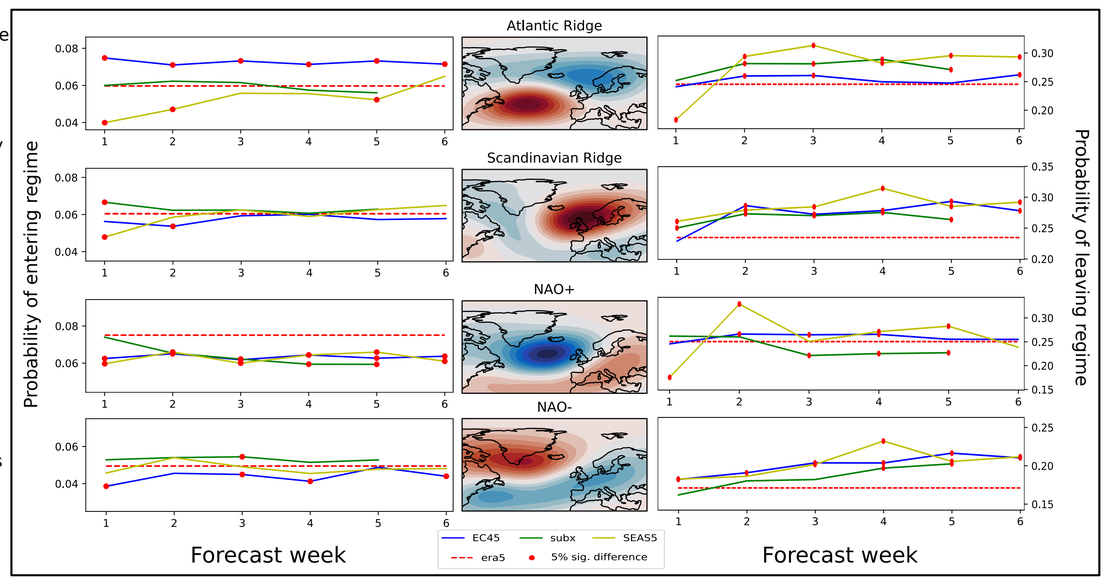
- We use 20 years (1999-2019) of debiased hindcast data to calculate bulk statistics
- Calculate a linear fit between quintiles of forecasts and corresponding reanalysis
- Prediction of DJF cold extremes drops rapidly between weeks 1 and 2, and no skill remains by week 4
- Skill deteriation in forecasts is not smooth!
- DJF warm extremes (mild weeks) lose predictability later, after week 2, but are unpredictable from week 3 onwards
- All models show rapid jumps in skill over periods of a few days

..and French T850

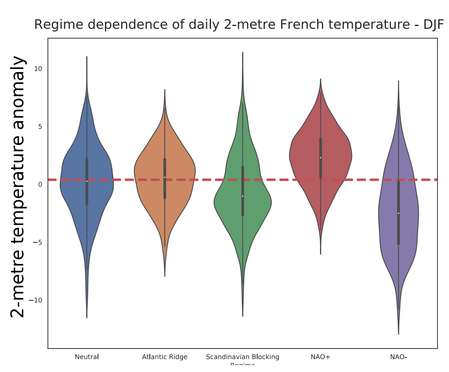
- Are these jumps a quirk caused by boundary layer interactions? No! We see the same behaviour in forecasts of T850
- Skill deteriates rapidly at 2 weeks for cold extremes

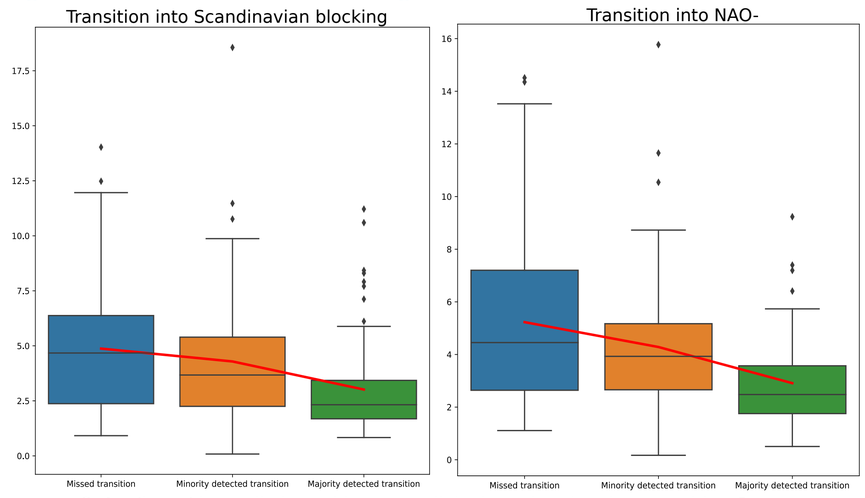
Drifts in DJFM circulation regime statistics

- How do the regime statistics of S2S forecast models change with lead time?
- We look at the probability of entering a regime each day and the probability of leaving a regime each day.
- EC45 enters Atlantic Ridge too often
- All models enter NAO+ too rarely
- SEAS5 shows much more transience in regime statistics than other models
- All models's regimes are generally underpersistent



Relating temperature and regimes

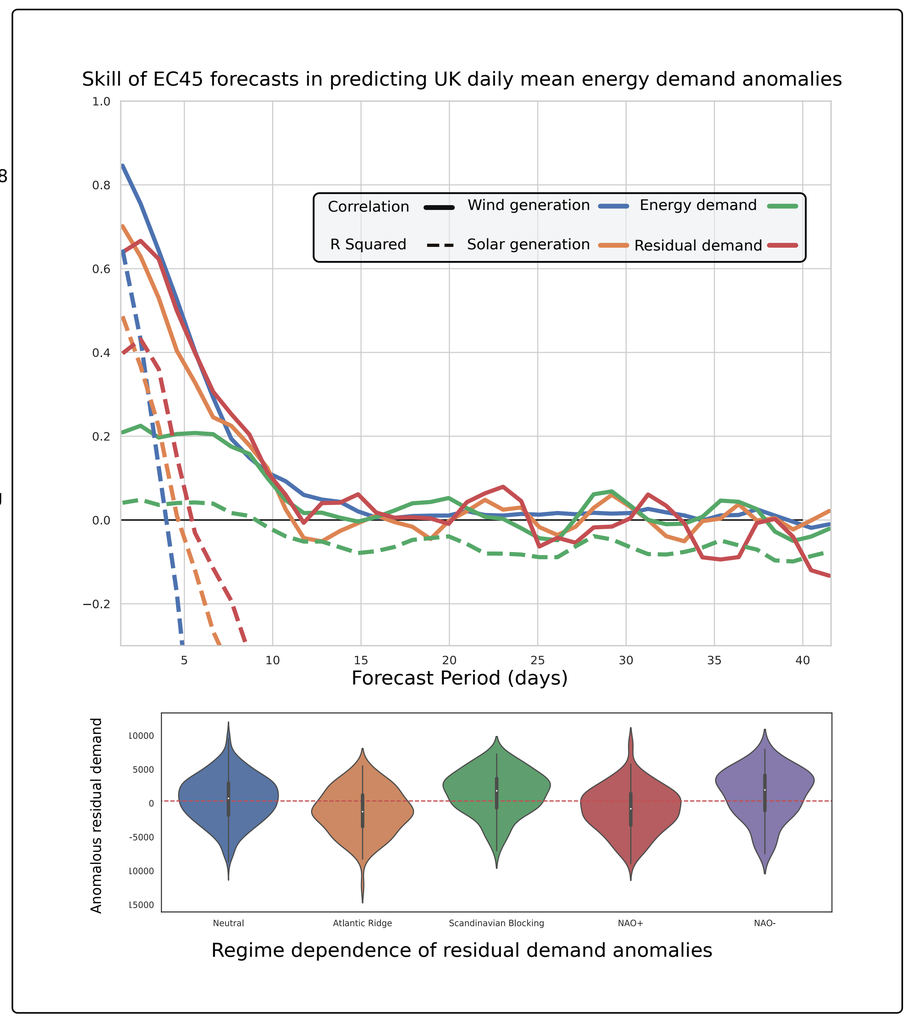




- French DJF temperatures are significantly affected by the active regime pattern
- Scandinavian blocking and NAO- make extreme cold more likely
- Are 'busts' in predicting cold extemes linked to missed regime transitions?
- Missed transitions lead to substantially more days with extreme RMSE
- We separated week 1 EC45 ensemble forecasts by how many members correctly predicted a regime transition and looked at the RMS error distribution

Predicting energy demand - an applied problem

- How useful are current S2S forecasts in an applied setting?
- We look at the predictability of UK daily averaged residual energy demand 2015-2018
- Residual demand= Total demand - renewable generation
- We use 2m temperature, 100m winds and surface solar flux downwards (SSRD) as predictors for energy variables
- Predicting demand is important for balancing power supply and can make the grid more efficient
- Residual demand is predictable only out to 6 days (albeit with a simple demand model)
- Can regime analysis provide longer range probabilistic information about demand?
- NAO- and Scandinavian blocking patterns correlate with anomalously high demand in DJFM
- The Atlantic Ridge pattern correlates with lower demand in DJFM



S2S Model Details

We have used three different operational forecasting systems in this work. These were chosen based on ensemble size, initialisation frequency and length of available hindcast data.

Name	Centre (source)	Forecast Duration	Initialisation frequency	Resolution	Time span	Ensemble size
			Utilised S2S forecasts			
EC45	ECMWF (MARS)C45r1	46 days	2 x week	0.5° / 6h	May 1999 -	11(hind), 51(fore)
SEA5	ECMWF (Copernicus CDS)	7 months	1 x month	1.0° / 12h	Jan 1992 -	25 (hind), 51(fore)
GEFS	EMC (SUBX project)	35 days	1 x week	1.0° / 24h	Jan 1999 - Dec 2016; July 2017	11(hind), 21(fore)

References

- **Violin plots originally developed in:**
  Hintze and Nelson, 1998, *Violin plots: a box plot-density trace synergism*, The American Statistician, May 1998, 52,2
- **Forecast bias correction based on:**
  Monhart et al, 2017, *Skill of Subseasonal Forecasts in Europe: Effect of Bias Correction and Downscaling using Surface Observations*, Journal of Geophysical Research: Atmospheres, 123, 7999-8016
- **Prior work on linking regimes to energy demand:**
  van der Wiel et al, 2019, *The influence of weather regimes on European renewable energy production and demand, Environmental Research Letters*, in press
- **Prior work on regime approaches to forecasting cold extremes:**
  Ferranti et al, 2018, *How far in advance can we predict changes in large-scale flow leading to severe cold conditions over Europe?*, Q J R Meteorol Soc, 144, 1788– 1802

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