

Findings from Weather Rescue Phase 2: the Met Office Daily Weather Reports 1900-1910

Philip Craig* (philip.craig@reading.ac.uk) and Ed Hawkins

National Centre for Atmospheric Science, University of Reading

Introduction

There are many hand-written weather records stored in archives around the world. Transcribing these is very time consuming and can lead to frequent errors. To avoid these pitfalls, the citizen science project Weather Rescue was set up for volunteers to assist in digitizing such documents (Hawkins *et al.*, 2019).

In this part of the project, thousand of volunteers helped to recover 1.8 million observations of mean sea level pressure, dry/wet bub temperature, maximum/minimum temperature and rainfall from the 1900-1910 Met Office Daily Weather Reports (DWRs).

To show the usefulness of the recovered observations, three case studies of significant weather events in this time period are analysed with regards to how well these events are represented in current datasets such as the Twentieth Century Reanalysis Project version 3 (20CRv3; Slivinski *et al.*, 2019) and the Met Office's 1km gridded UK precipitation dataset (Had-UK Grid). This will highlight the current deficiencies in data coverage for this time period and give an idea how the representation of these weather events can be improved with new data.

February 1903 Storm

- Very destructive storm 27th February 1903 (Shaw, 1903)
- Ensemble mean overestimates cyclone pressure by about 10 hPa (Figure 1)
- Large ensemble spread around storm
- Z-scores fairly small as spread is so large
- Very few observations in the International Surface Pressure Databank (ISPD; Cram *et al.*, 2015) across UK & Ireland in 1903 (Figure 2)
- New observations give significantly better coverage & assimilation into 20CRv3 should lower cyclone's ensemble mean pressure and reduce ensemble spread

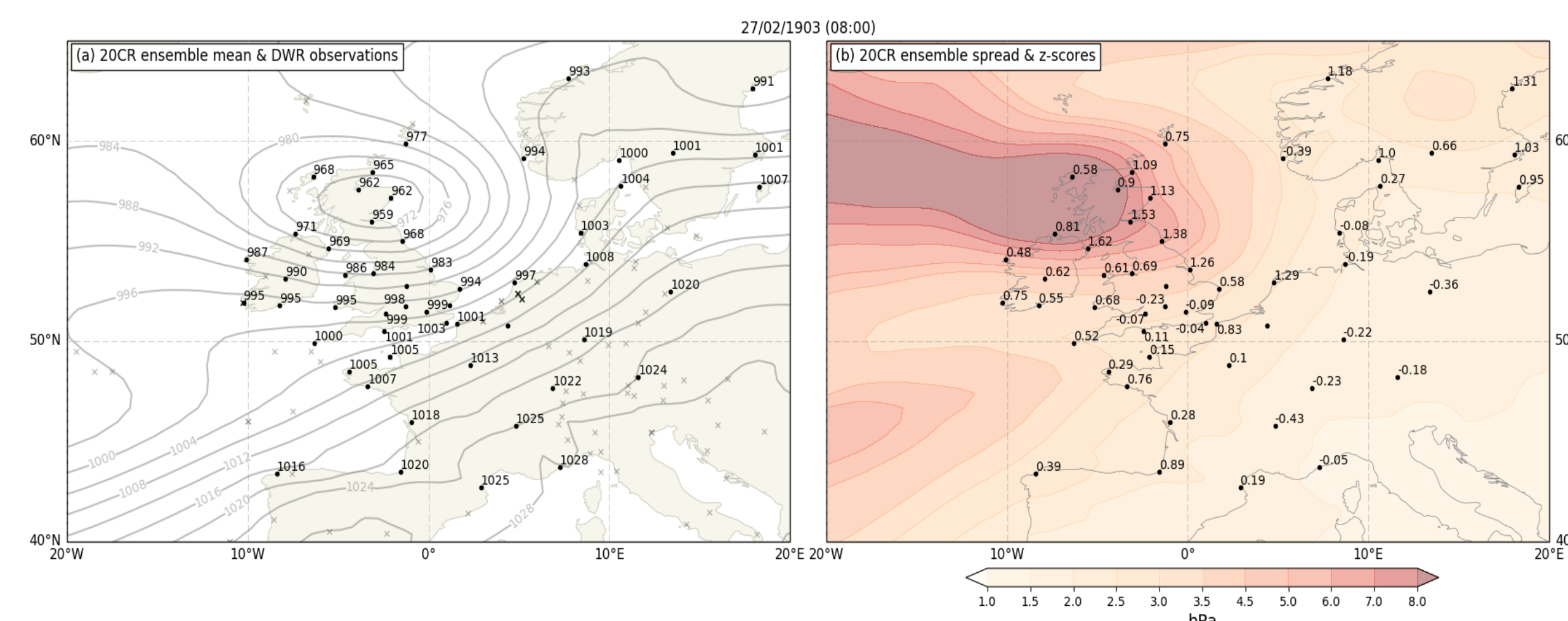


Figure 1: (a) 20CRv3 ensemble mean mslp and DWR observations; (b) 20CRv3 ensemble spread and z-scores at stations. Black dots are DWR stations and grey crosses are ISPD stations.

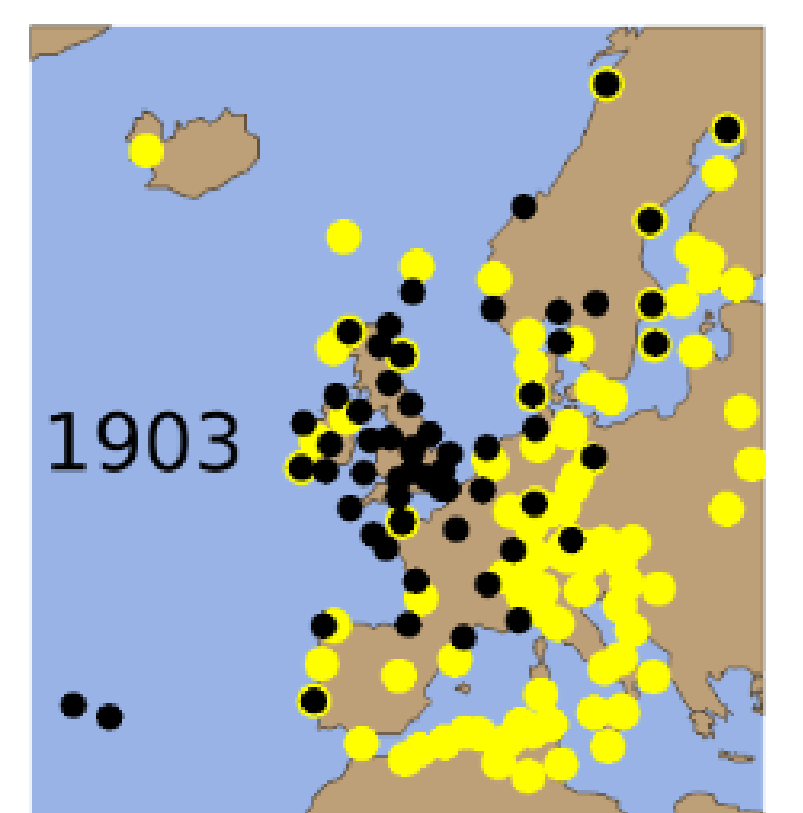


Figure 2: ISPD stations (yellow) & DWR stations (black) in 1903.

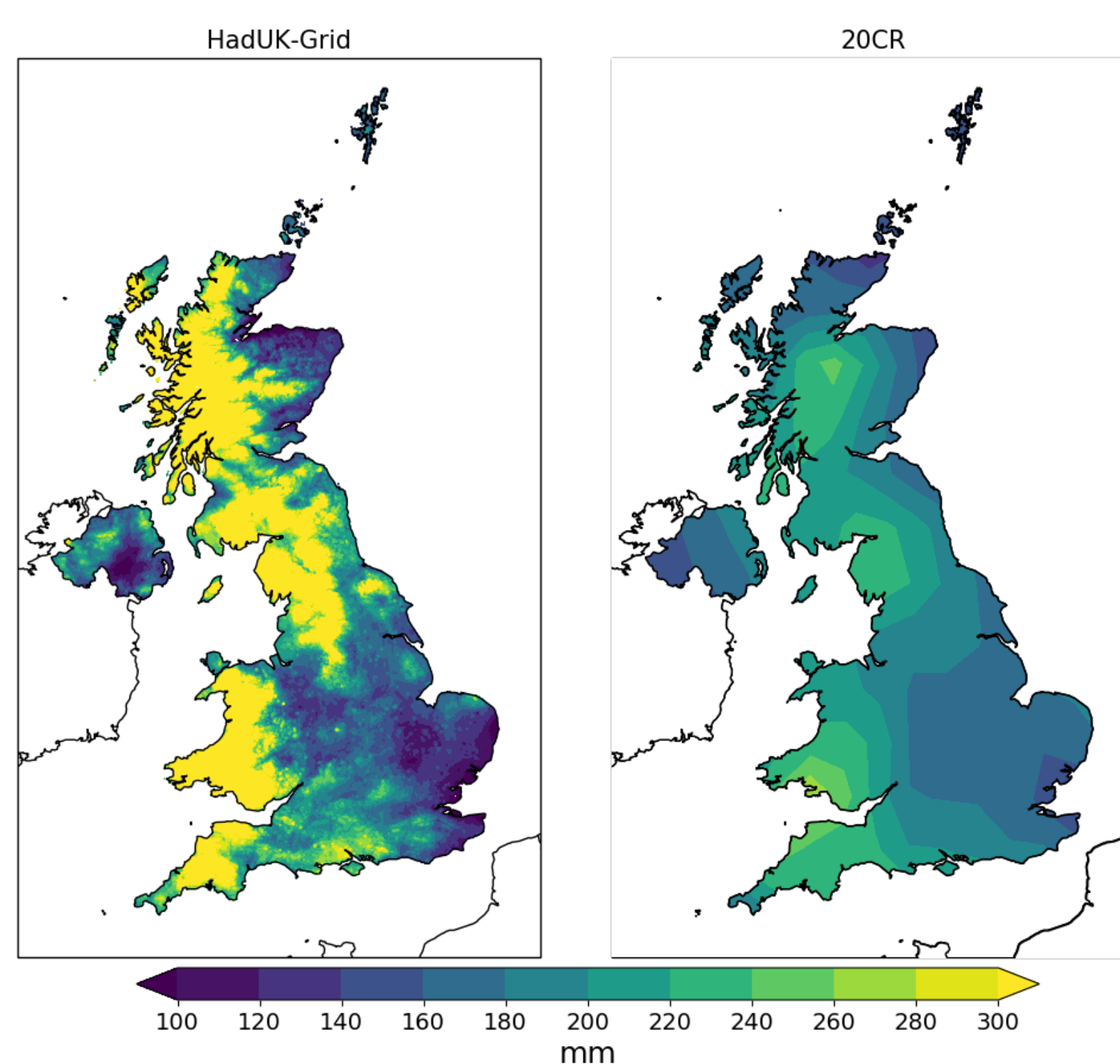


Figure 3: Total October 1903 precipitation for the Had-UK Grid (left) and the 20CR ensemble mean (right).

October 1903 rainfall

- Wettest month in England & Wales Precipitation dataset
- 20CR ensemble mean underestimates total rainfall compared to Met Office 1km gridded dataset
- Many stations not yet included in Met Office dataset (e.g. Stornoway, Donaghadee)
- Heaviest rainfall (~25% of the month's total) fell late in the month as a cyclone moved up from the Bay of Biscay across South-West England and Wales

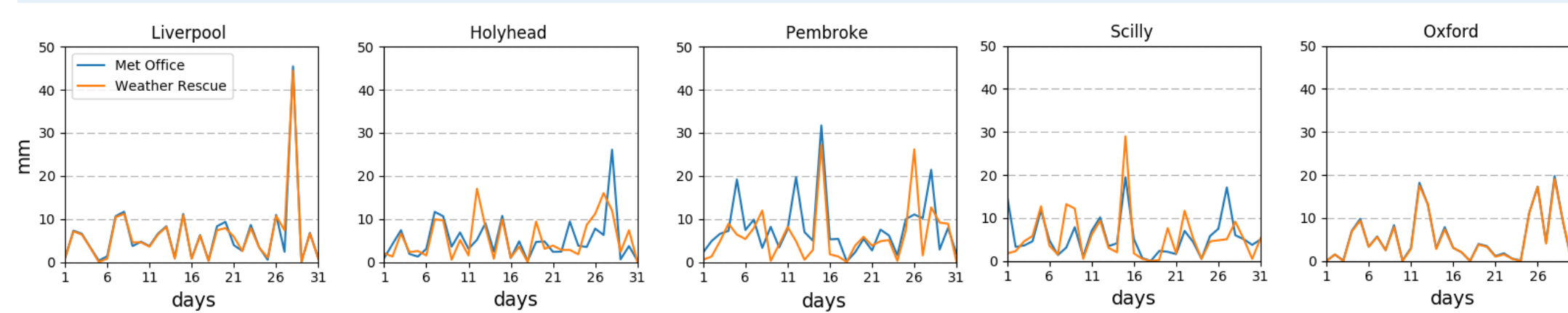


Figure 4: Daily rainfall from the Had-UK Grid (blue) and the DWRs (orange) for October 1903 at five stations.

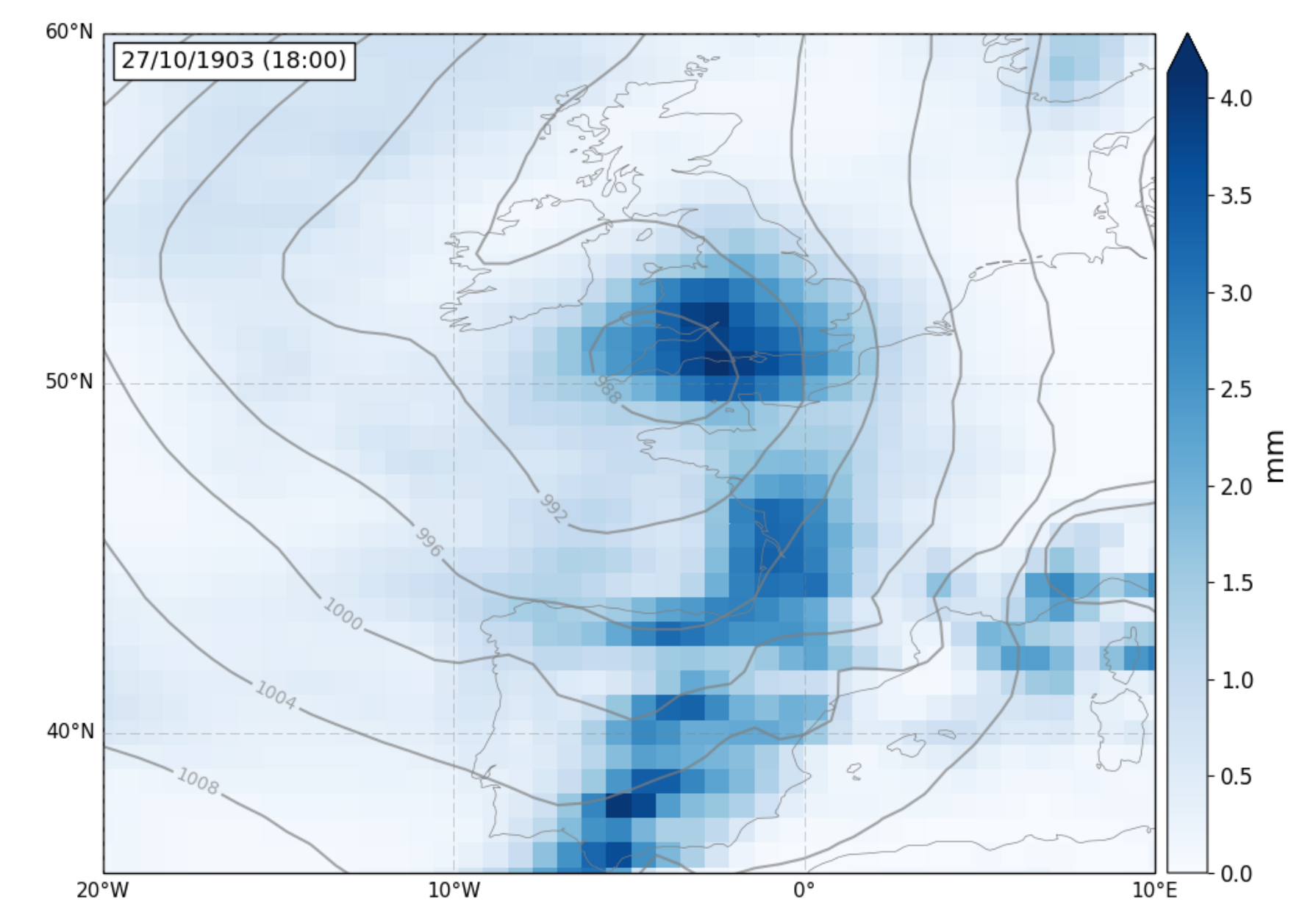


Figure 5: Ensemble mean 20CRv3 mslp (hPa, grey contours) and precipitation (mm, blue shading) for 27th October 1903 at 1800 UTC. Precipitation is the total rainfall over the previous 3 hour forecast window.

September 1906 heatwave

- Very high maximum temperatures across Europe
- 20CR underestimates British stations but performs remarkably well for some continental stations (Figure 5)
- Observations lie within ensemble spread at Paris & Berlin (Figure 6)
- Surprising that 20CRv3 performs so well at Paris as there is currently no ISPD data for Paris (Figure 2)

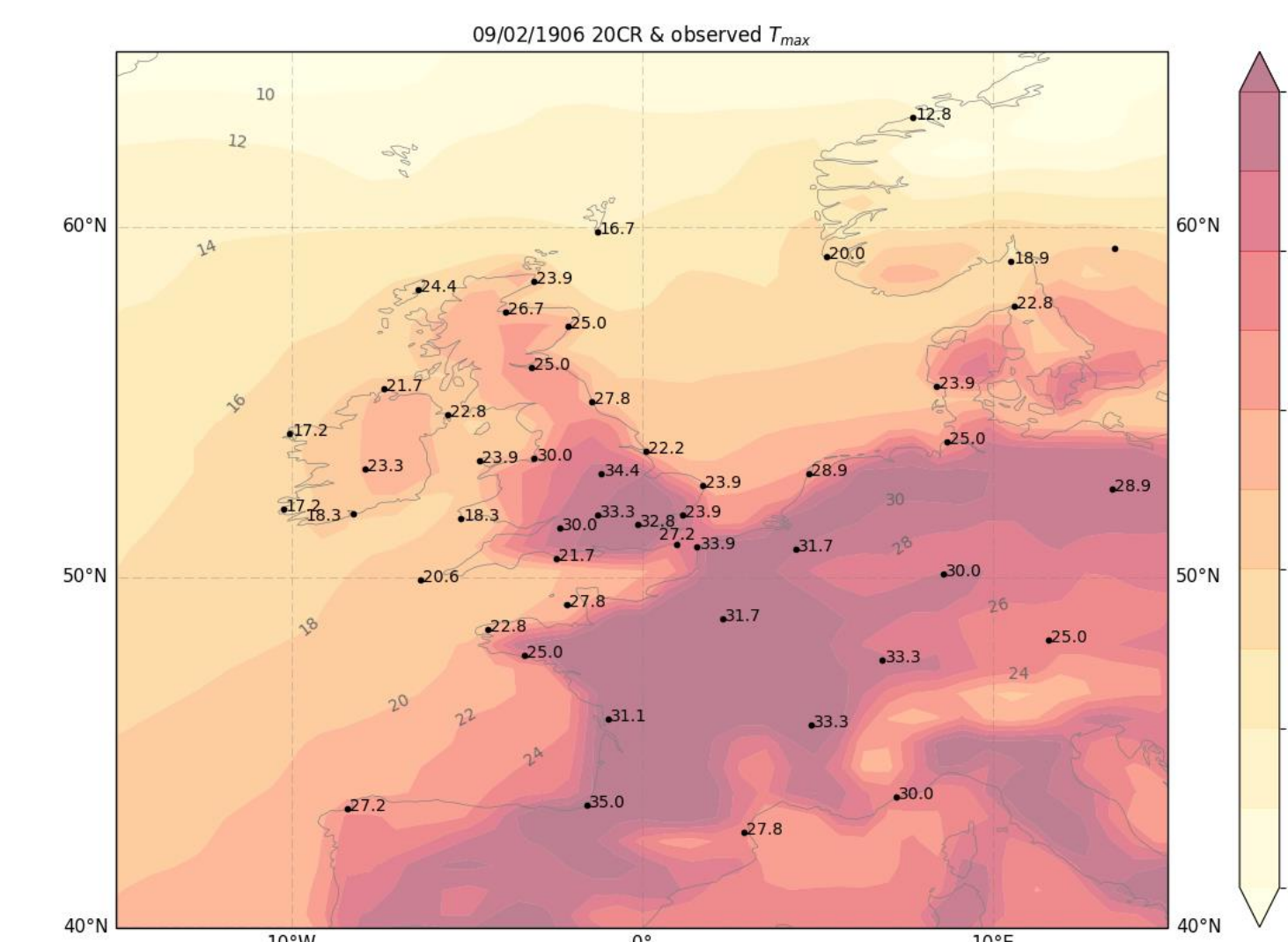


Figure 6: Ensemble mean 20CRv3 maximum temperatures (contours) and DWR observations at stations – all in °C. The reanalysis temperatures are taken between 0900 UTC on consecutive days, and between 0800 UTC on consecutive days for the DWRs.

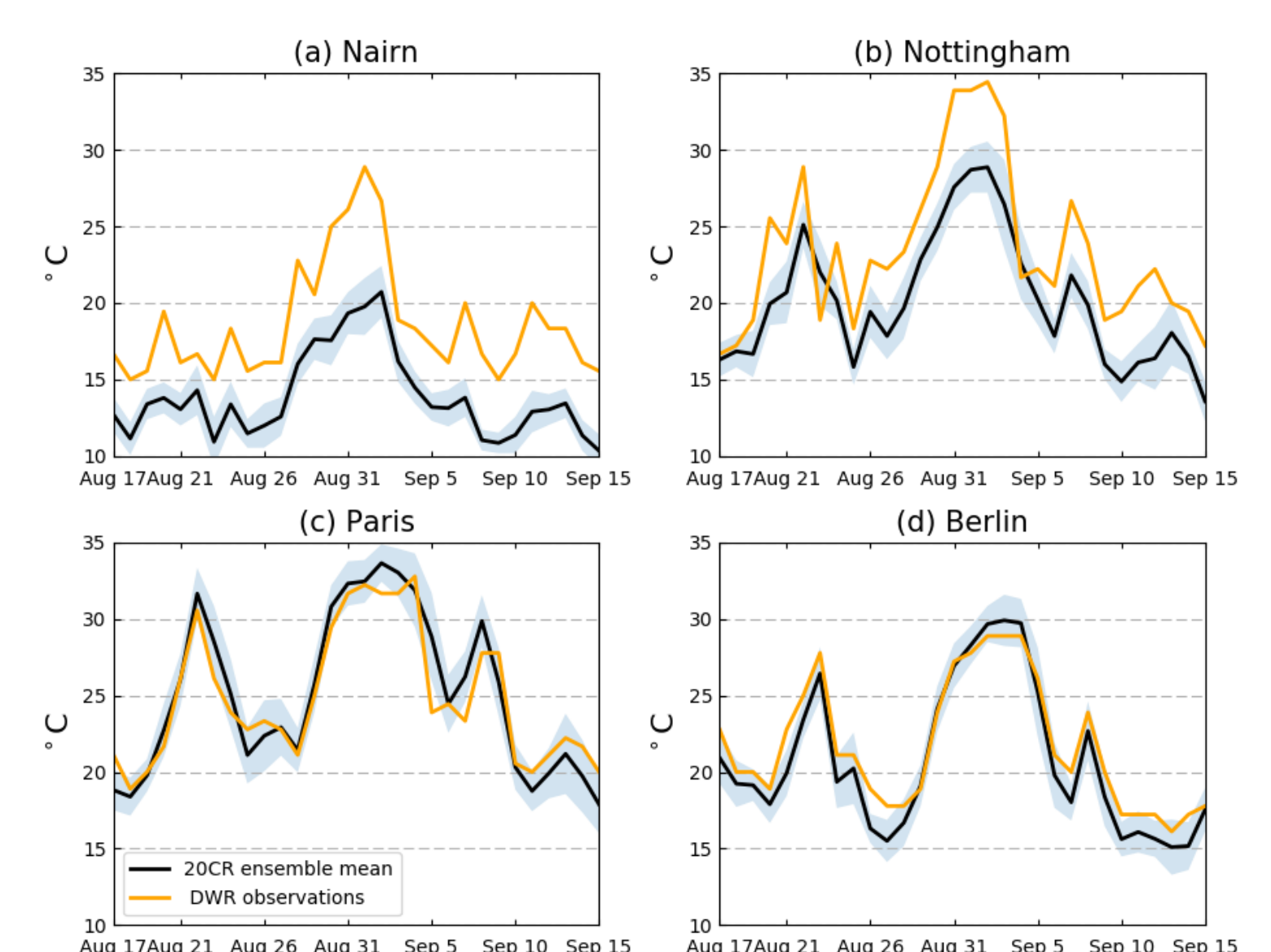


Figure 7: Ensemble mean 20CRv3 maximum temperatures (black) and DWR observations (orange) over the fortnight surrounding the heatwave with the ensemble spread (light blue shading).

Future work

Aim to re-run 20CRv3 on ARCHER supercomputer with new mslp observations and analyse improvements in the representation of these weather events (and others) and reductions in the ensemble spread.

Further Reading

1. Cram *et al.* (2015) The International Surface Pressure Databank version 2. *Geoscience Data Journal*, doi.org/10.1002/gdj3.25
2. Hawkins *et al.* (2019) Hourly weather observations from the Scottish Highlands (1883-1904) rescued by volunteer citizen scientists. (*in review*)
3. Shaw (1903) The Meteorological Aspects of the Storm of February 26-27, 1903. *Q. J. Roy. Meteor. Soc.*, doi.org/10.1002/qj.49702912801
4. Slivinski *et al.* (2019) Towards amore reliable historical reanalysis: Improvements for version 3 of the Twentieth Century Reanalysis system. (*in review*)

Acknowledgements

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