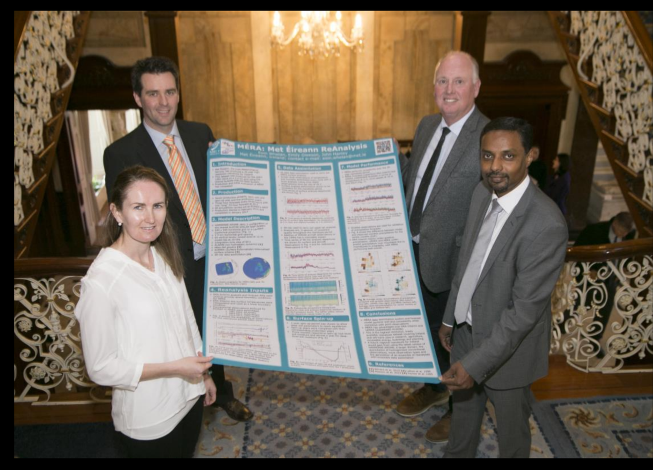
MÉRA: Met Éireann ReAnalysis

Emily Gleeson[1], Eoin Whelan[1], John Hanley[1]
[1]Met Éireann, Ireland. contact e-mail: emily.gleeson@met.ie



1. Introduction

- Met Éireann, the Irish Meteorological Service, has produced a very high resolution 35-year reanalysis dataset for Ireland **[1,2]**.
- This dataset was produced for the years 1981-2015 on a 2.5 km grid using the shared ALADIN-HIRLAM NWP System .
- Production and evaluation of MÉRA has been completed but we will continue to extend the dataset – currently up to May 2018.

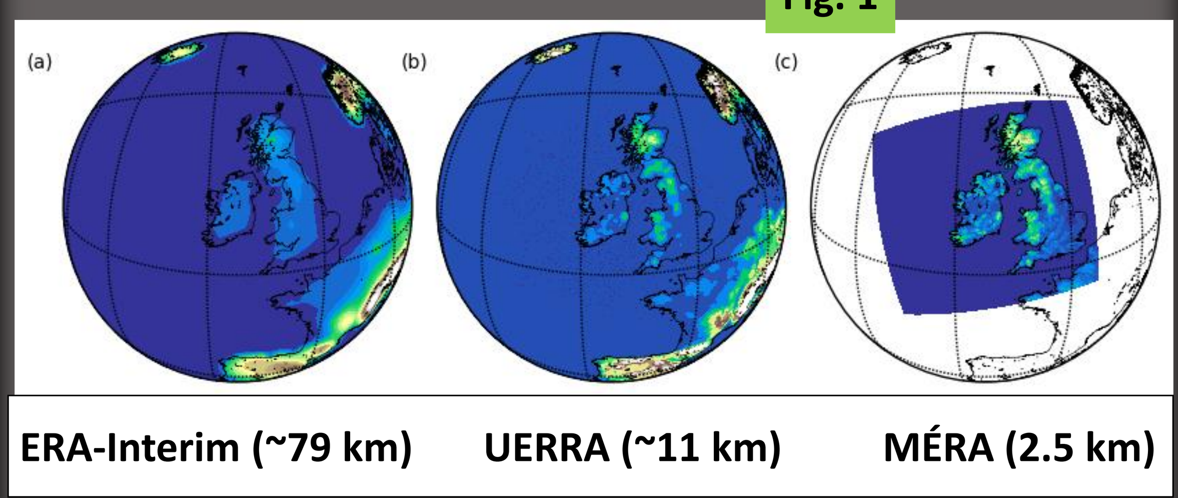
Production overview

- We had seven production streams, each with one spin-up year and five production years.
- Three hour forecasts every three hours with one "long" 33-hour forecast at 00 Z.
- All simulations carried out at ECMWF's HPCF.
- Production started in February 2015 and finished in January 2017.

2. Model Description

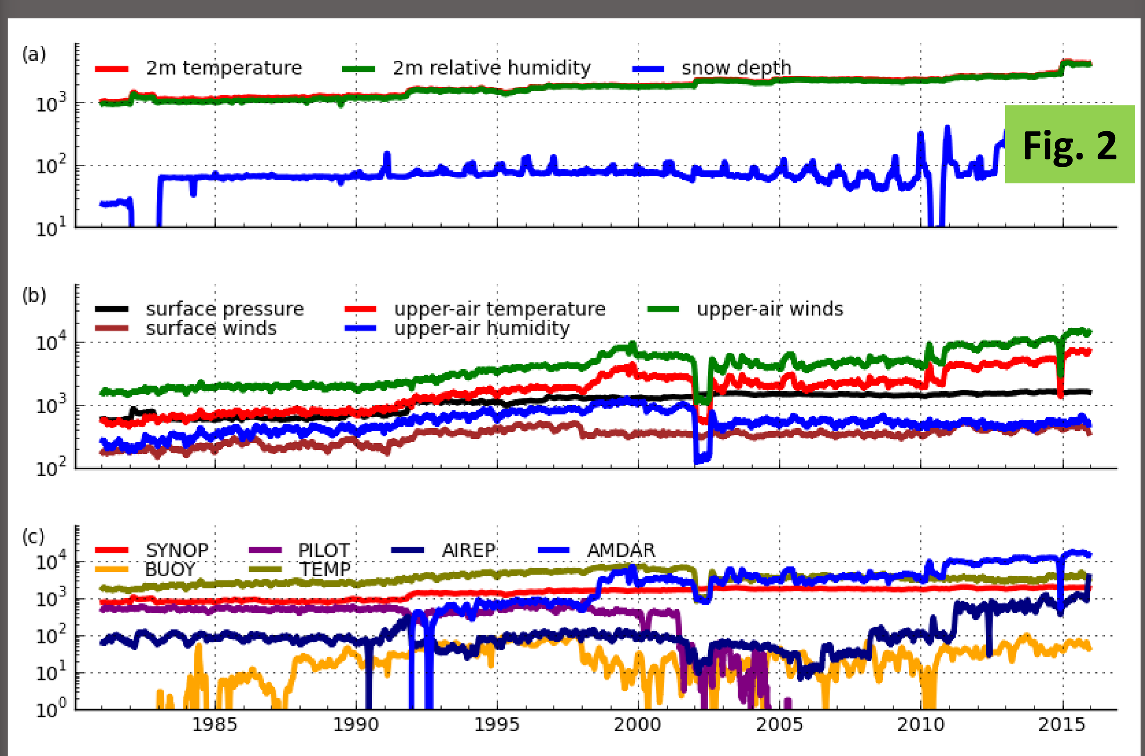
- HARMONIE-AROME 38h1.2 configuration of the shared ALADIN-HIRLAM NWP System.
- 540×500 horizontal grid on a Lambert Conformal projection (**Fig. 1c** - orography).
- 2.5 km horizontal grid-spacing.
- 65 vertical levels: lowest level at 12 m, model top 10 hPa
- Integration time step of 60 s.
- ALADIN non-hydrostatic dynamics **[3]**.
- Méso-NH physics **[4]**.
- SURFEX (Surface Externalisée) externalised surface scheme **[5]**.
- 3D-Var data assimilation **[6]**.

Fig. 1



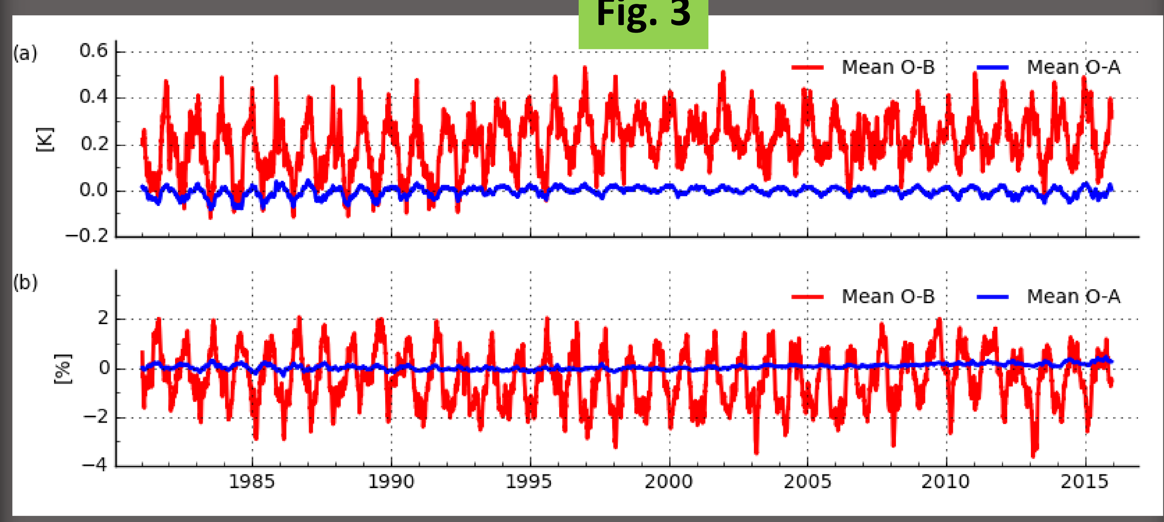
3. Reanalysis Inputs

- ERA-Interim analysis and forecast data were used to provide lateral boundary conditions for MÉRA.
- ERA-Interim SSTs were interpolated and used as a lower boundary condition.
- Conventional observations archived by ECMWF in MARS were assimilated
  - 1981-2004: DA stream
  - 2004-2013: DCDA stream
  - 2013-2015: LWDA stream
- **Fig. 2** shows the availability of observations for the reanalysis period 1981-2015.

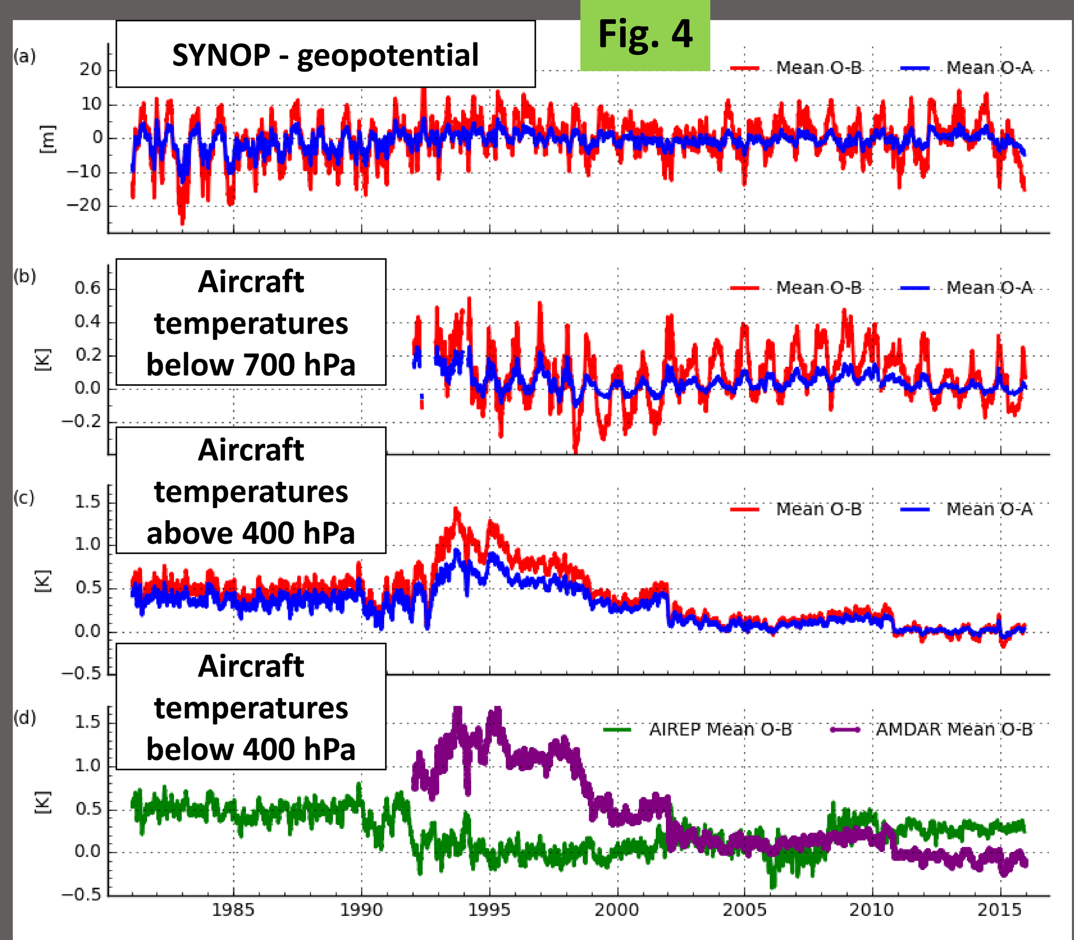


4. Data Assimilation

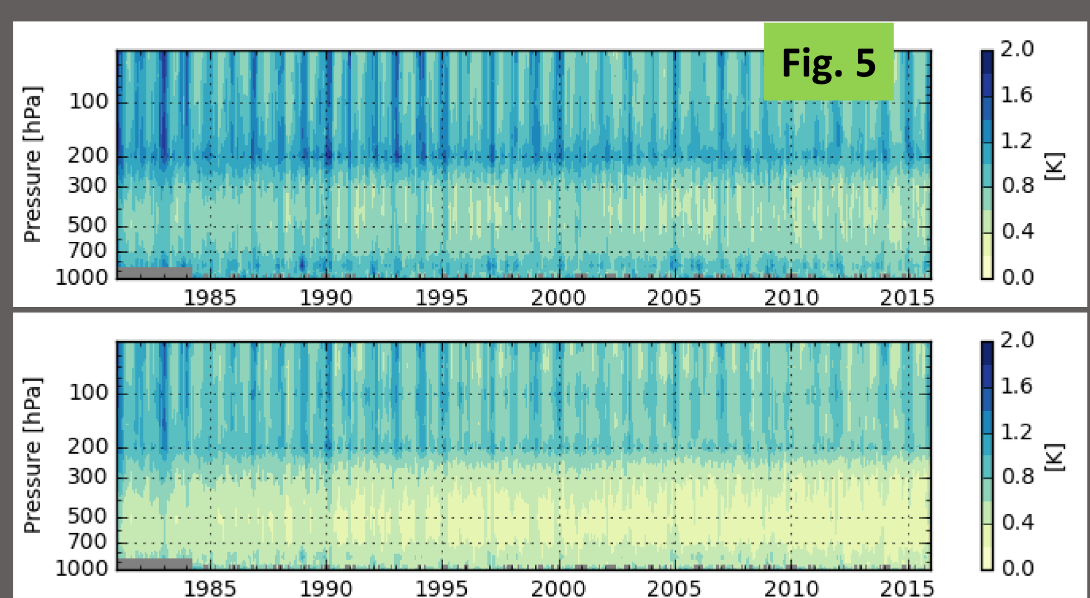
- Optimum interpolation (OI) data assimilation used to carry out MÉRA surface analysis.
- Screen level observations of temperature and humidity assimilated every cycle with a snow analysis (using snow depth observations) once per day at 06 Z.
- Surface analysis performance shown to be consistent for the reanalysis period - time-series of analysis and background departures for temperatures at 2 m and relative humidity at 2 m shown in **Fig. 3**.



- 3D-Var used to carry out upper-air analysis.
- Analyses are, in general, of consistent quality throughout the reanalysis period.
- Addition of AMDAR aircraft observations in the 1990s has a noticeable impact.
- Time-series of 3D-Var analysis (O-A) and background (O-B) departures are shown for surface and aircraft observations in **Fig. 4**.

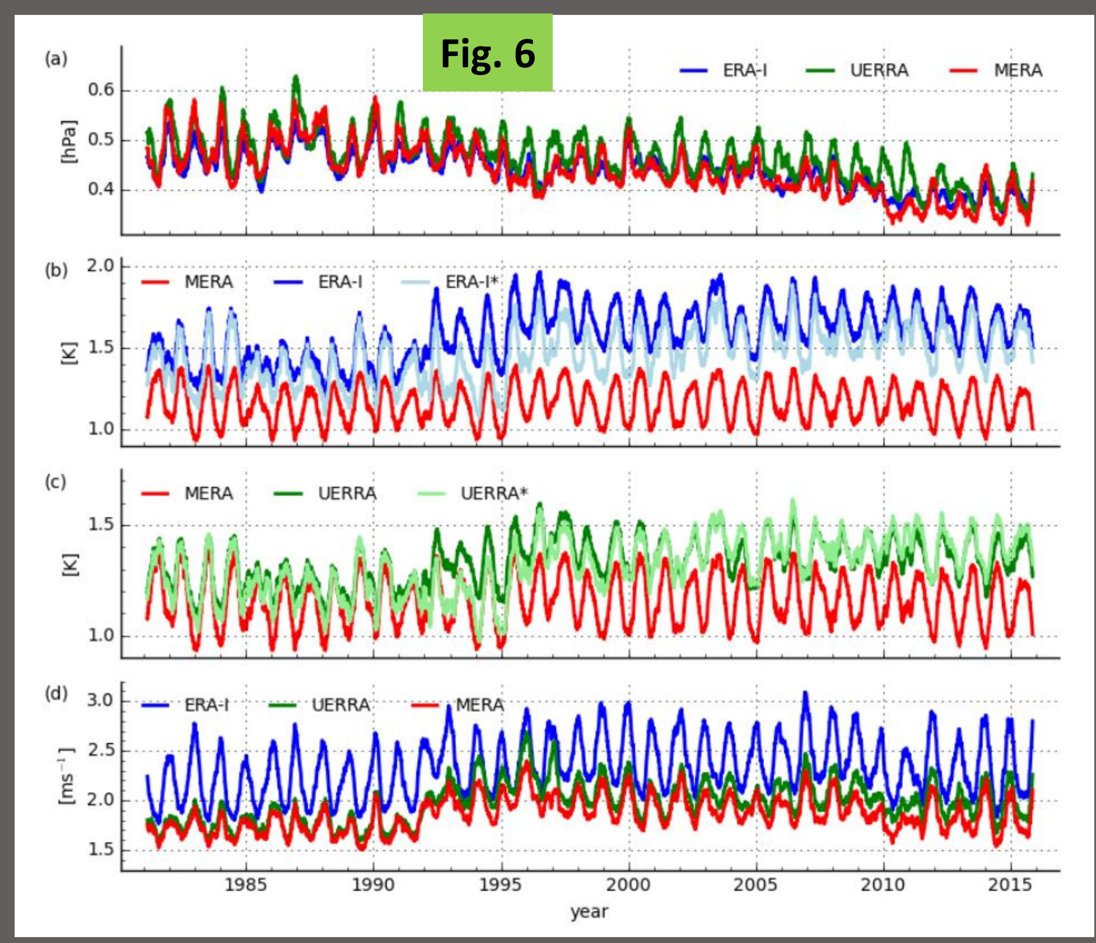


- Radiosonde temperature background (top) departures and analysis (bottom) departures at standard pressure levels are shown in **Fig. 5**. The lighter yellow colours indicate departure values closer to zero i.e. model temperature closer to observed temperatures.



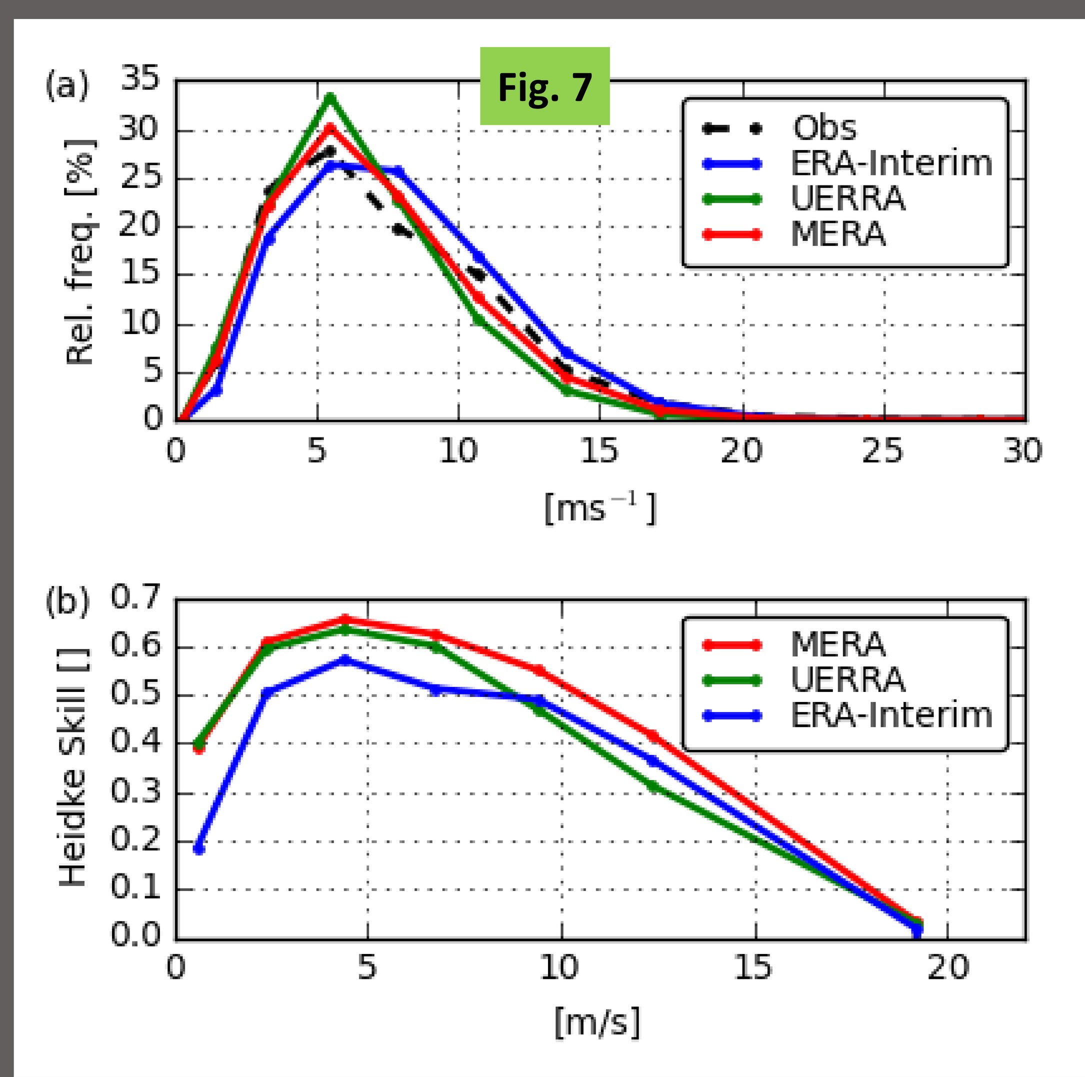
5. Model Performance

- MÉRA performs consistently over the 35-year reanalysis period with forecasts outperforming ERA-Interim and UERRA (HARMONIE-ALADIN) in terms of temperature at 2 m, wind speeds at 10 m and MSLP - see **Fig. 6** which shows standard deviations of 3-hour forecasts evaluated versus observations. Note that ERA-I* and UERRA* refer to height corrected data.

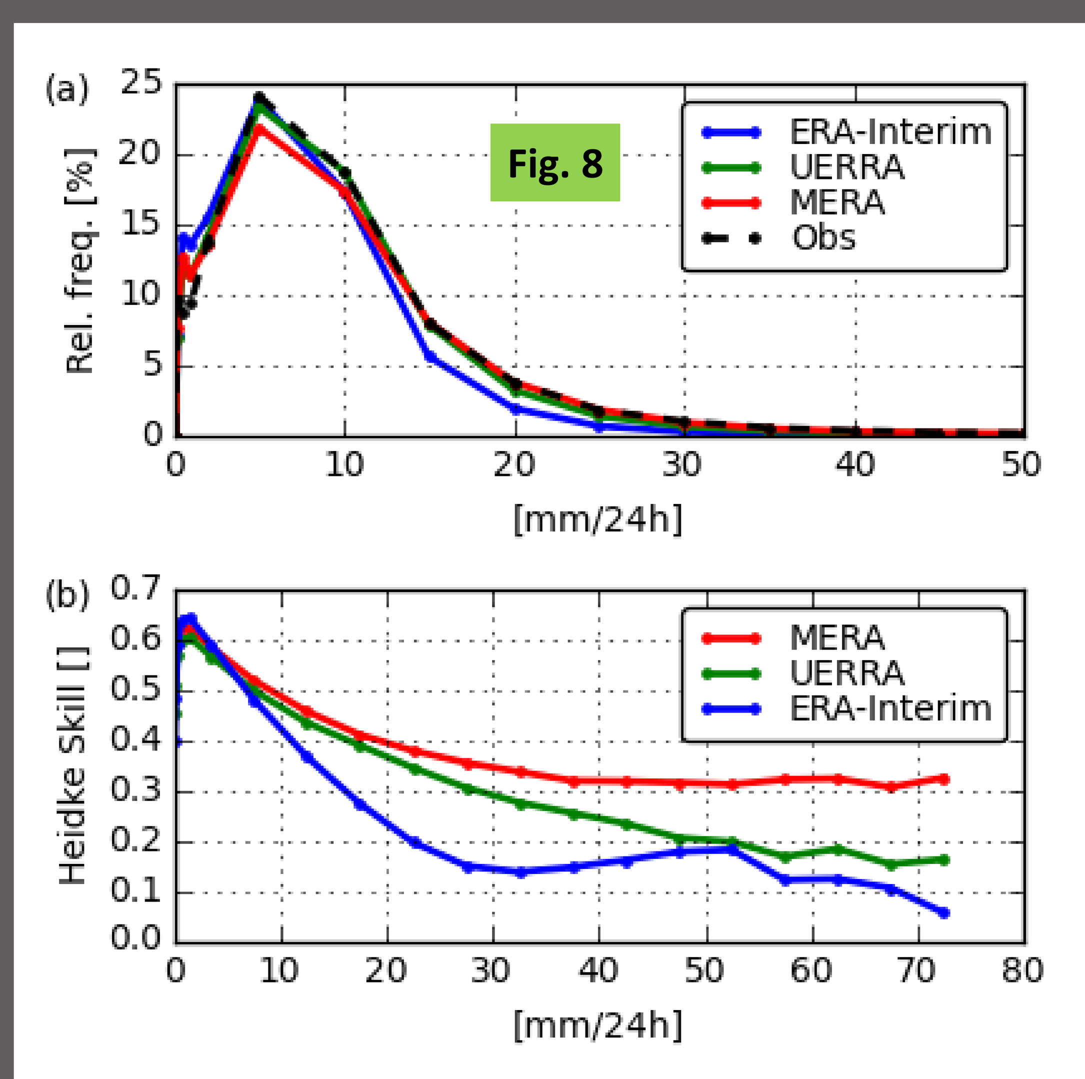


6. Wind & Precipitation Extremes

- **Fig. 7** (top) shows the relative frequency distribution of 10 m wind speeds compared to observations.
- The relative frequency of MÉRA wind speeds matches the observed wind speeds for all of the data bins.
- The Heidke Skill Score (HSS) is shown in **Fig. 7** (bottom).
- While there is little difference between the HSS values for MÉRA and UERRA for lower winds speeds, the forecast skill of MÉRA over ERA-Interim and UERRA can be clearly seen for higher wind speeds.



- **Fig. 8** shows the HSS for 24-hour accumulated precipitation forecasts.
- There is little difference in skill for lower accumulations (less than 10 mm) but MÉRA performs better than UERRA for more extreme (greater than 25 mm) precipitation accumulations.



References: **[1]** Gleeson et al., ASR, 2017; **[2]** Whelan et al., JAMC, 2018; **[3]** Bénard et al. 2010; **[4]** Lafore et al. 1998; **[5]** Masson et al. 2013; **[6]** Fischer et al. 1995.