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Wind-solar correlations and wind ramping events in reanalysis datasets over Ireland.

Seánie Griffin

17/05/2018

MÉRA workshop

UCD DUBLIN · DCU · ESRI · OÉ Gaillimh NUI Galway · Coláiste na Tríonóide, Baile Átha Cliath Trinity College Dublin Ollscoil Átha Cliath | The University of Dublin · ENERGY INSTITUTE UCD

EIRGRID · ESB · ervia · Glen Dimplex IRELAND · AIB

Energy Systems Integration Partnership Programme (ESIPP)

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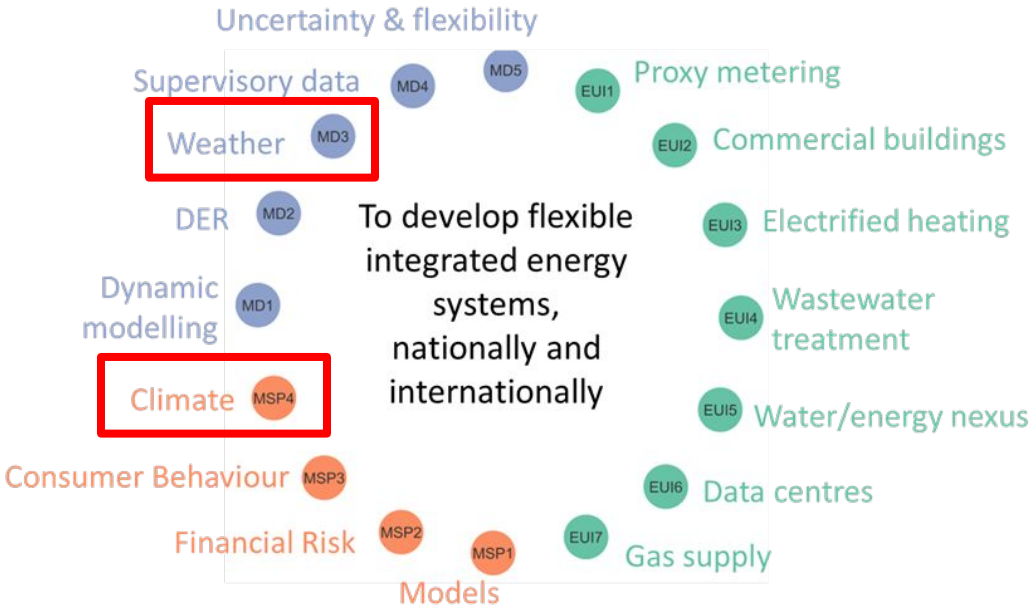
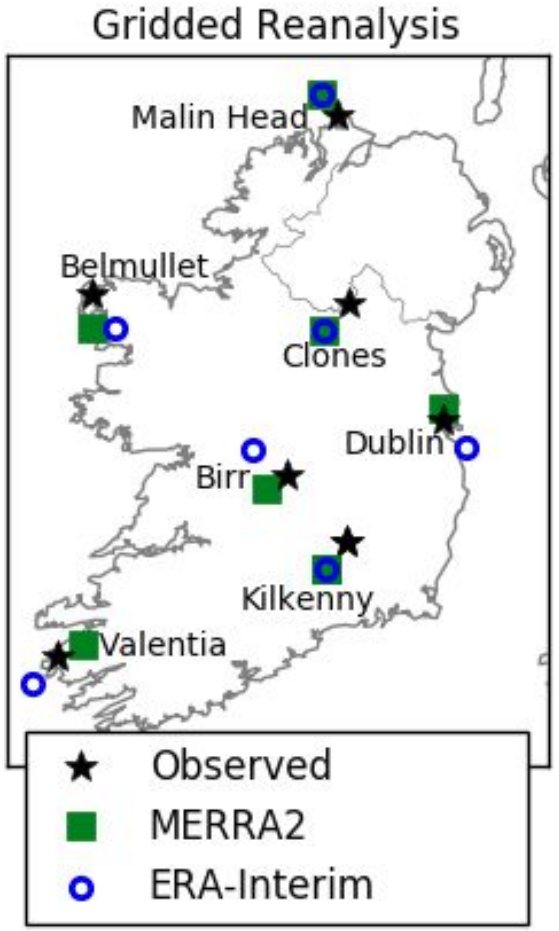
- Over 20 academics from 5 institutions (UCD, DCU, ESRI, NUIG, TCD)
- 16 interconnected Work Packages organised into three strands
- Three strands:
  - Modelling & Data (MD)
  - End Use Integration (EUI)
  - Markets & Strategic Planning (MSP)
- Funding €11M (SFI, industry funding, philanthropic donation)



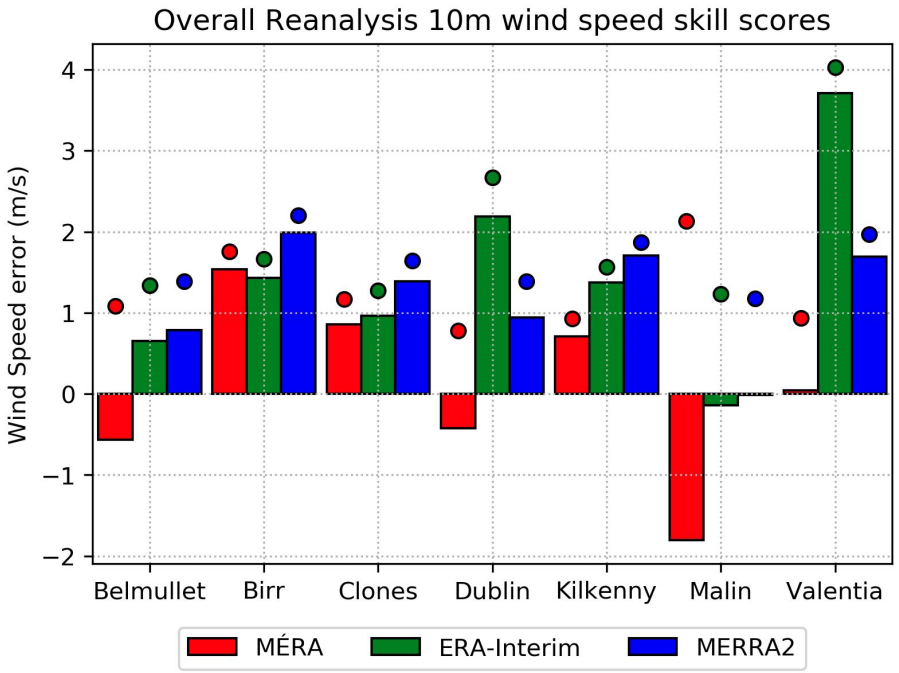
Data

Reanalysis product	Spatial resolution	Years covered
ERA-Interim	0.75° x 0.75° (78km)	1979 - present
MERRA-2	0.5° x 0.625° (50km)	1979 - present
MÉRA	2.5km x 2.5km	1981 - present

Common validation period: 1982-2007



Skill Scores



- Malin Head performance due to land-sea mismatch.

Skill Scores

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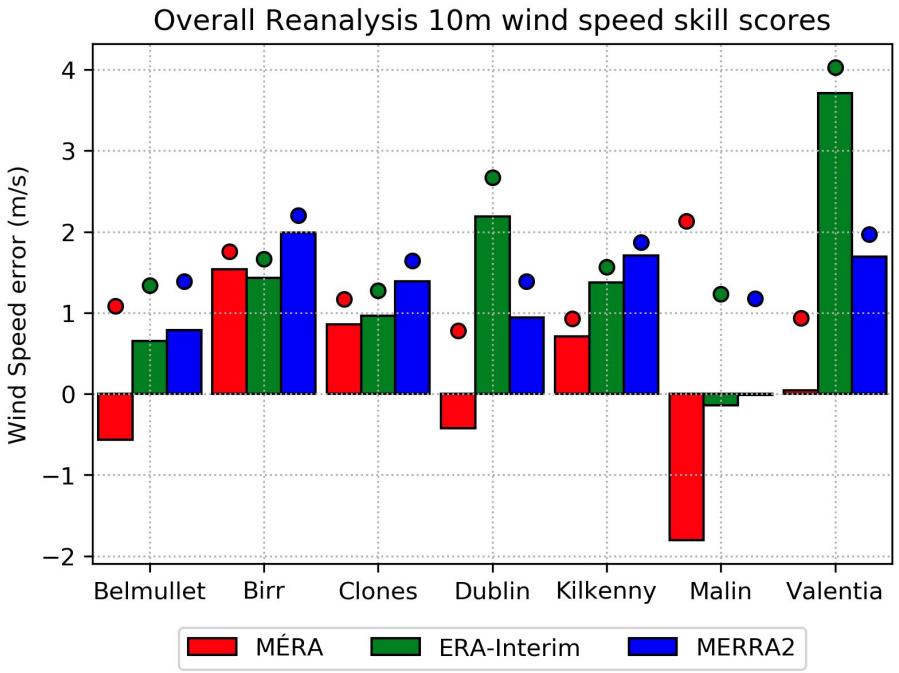

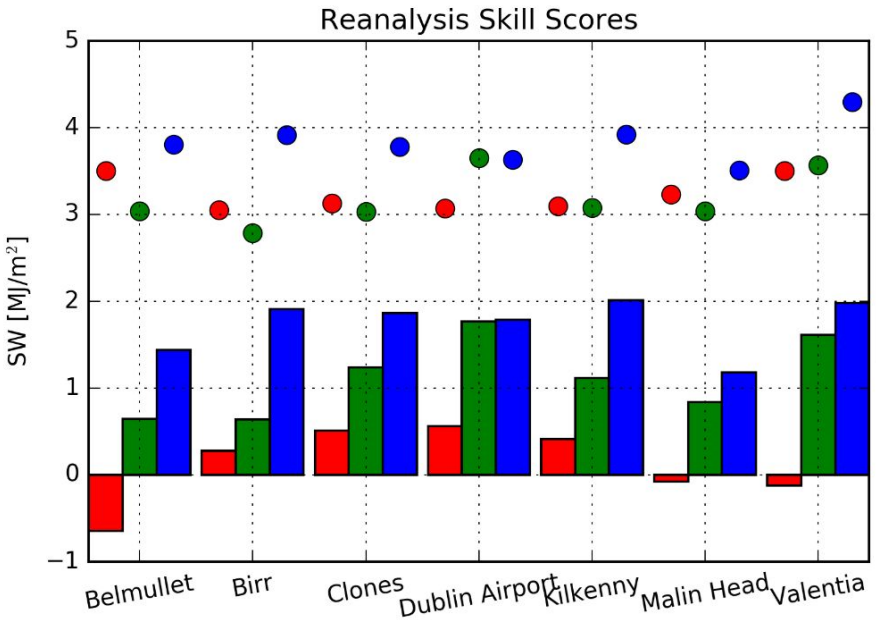

- Malin Head performance due to land-sea mismatch.

Wind speeds vs Solar radiation.

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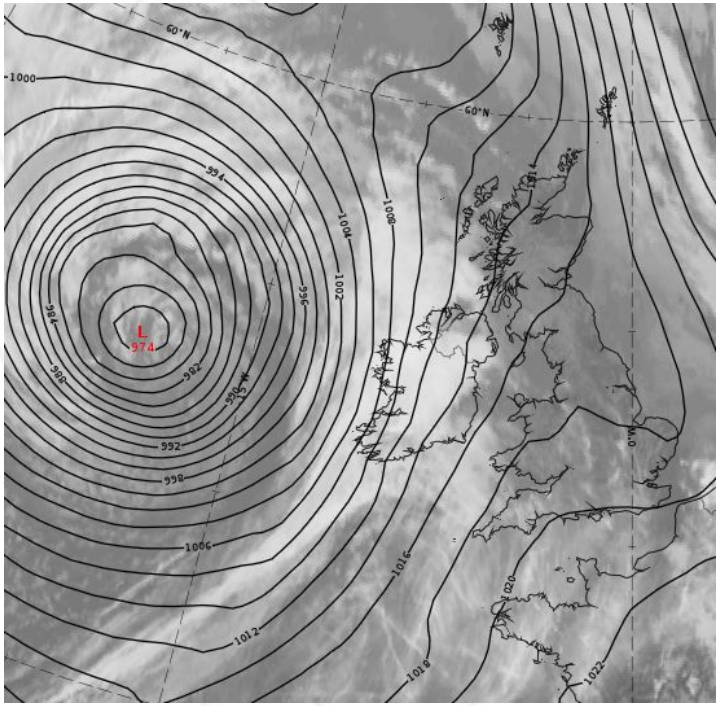
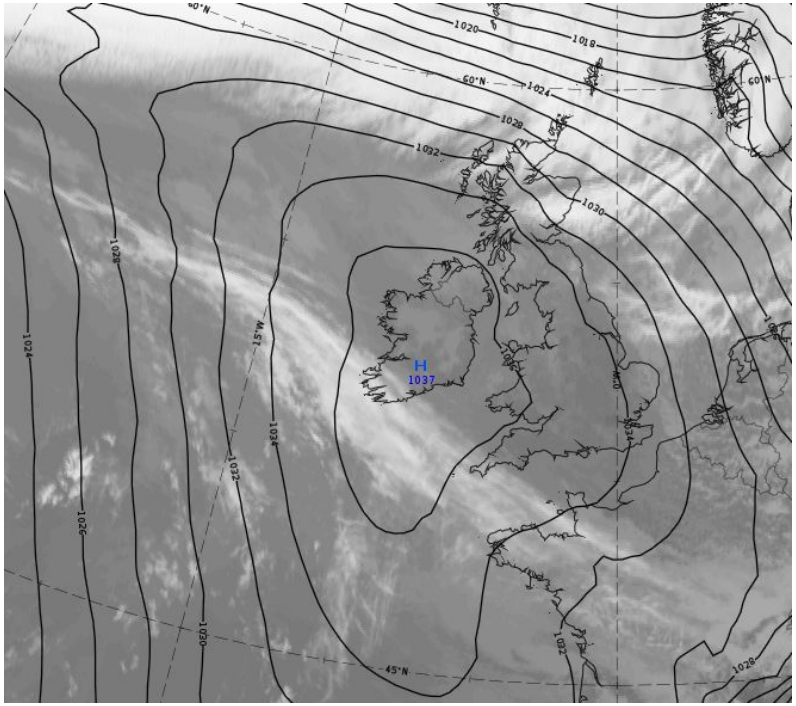


28/09/2017



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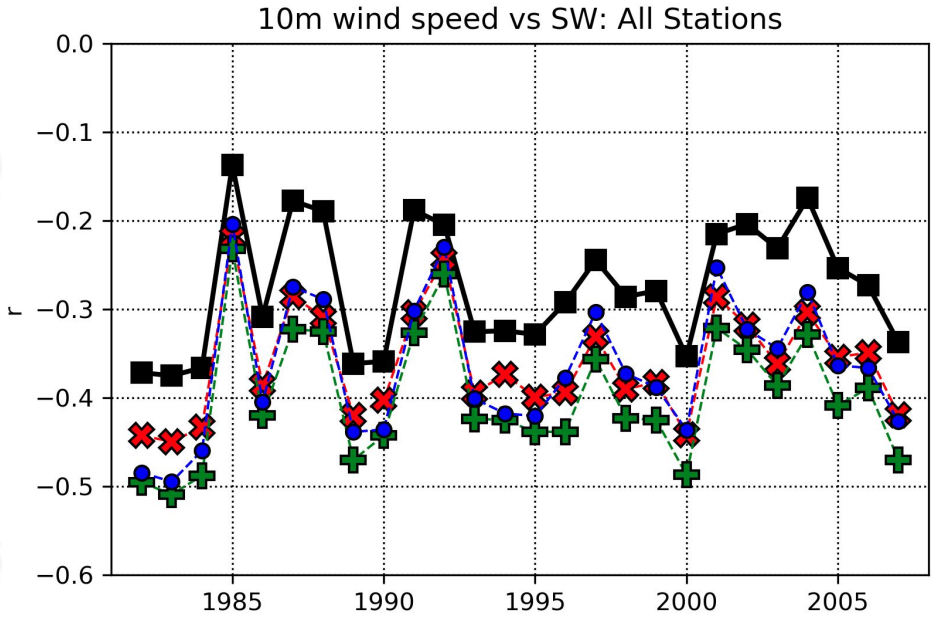
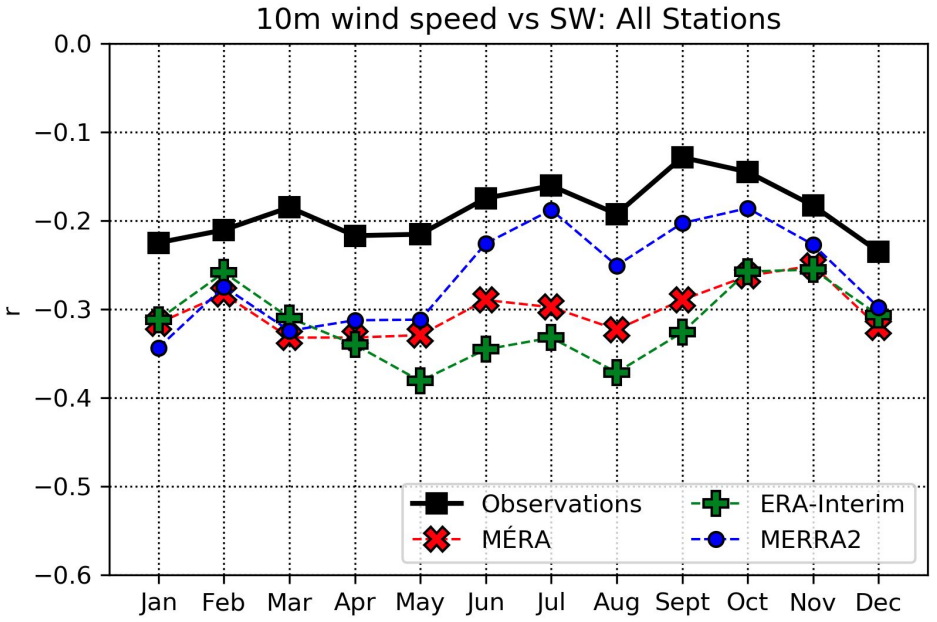
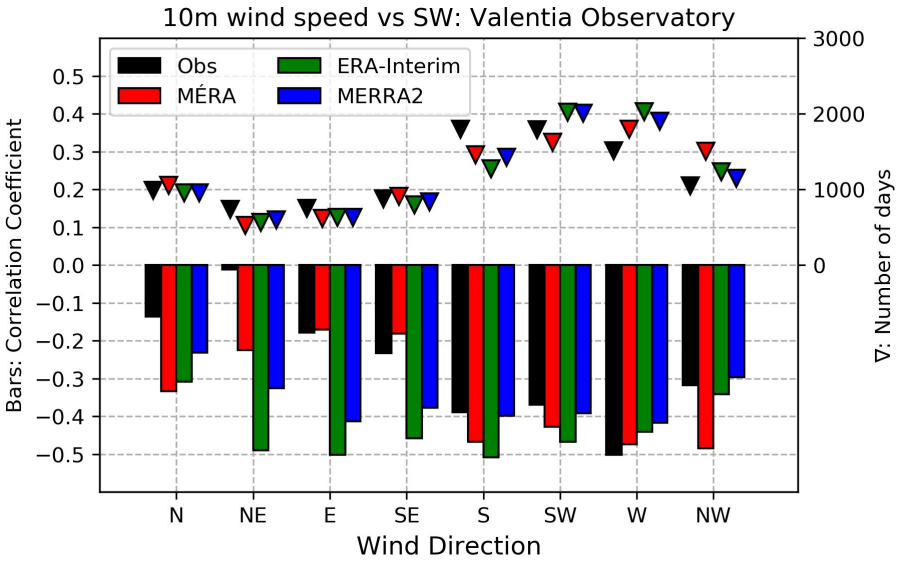
Wind-Solar Correlations

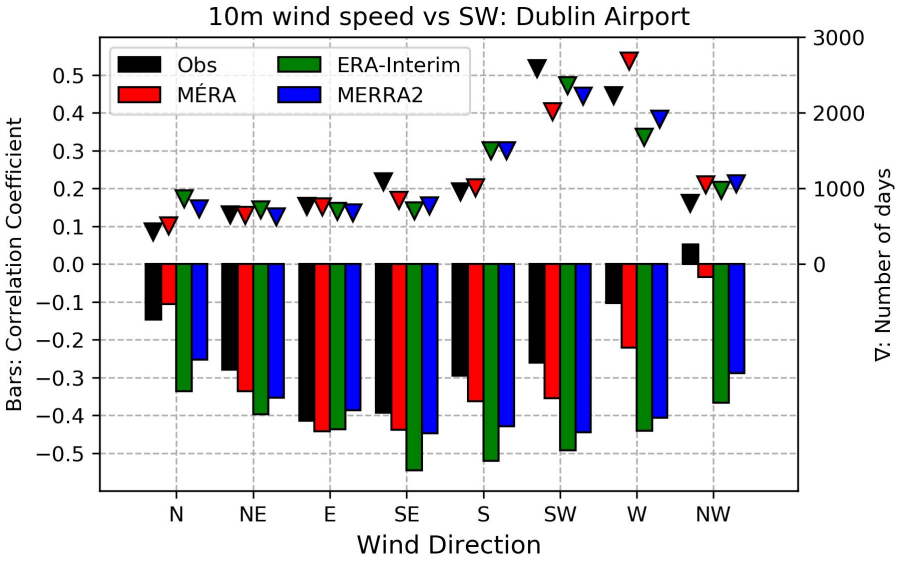




- Year-to-year variability
- Annual values contain seasonal cycle.
- Reanalyses overestimate both monthly and annual.

Wind direction variability.





- Correlations vary with wind direction.
- Westerly peak for west coast stations.
- Easterly peak for east coast stations.

Spatial Pattern of Correlations

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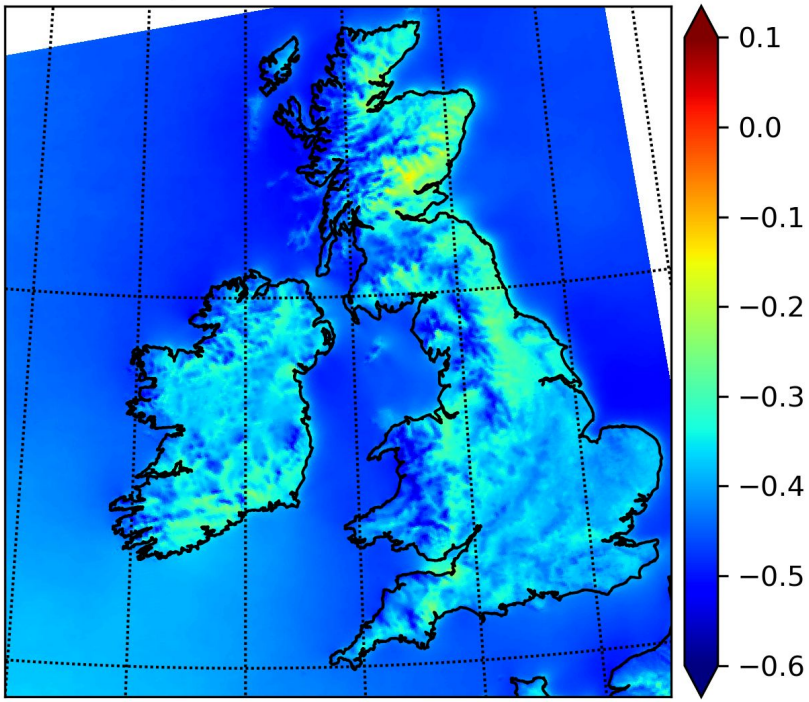
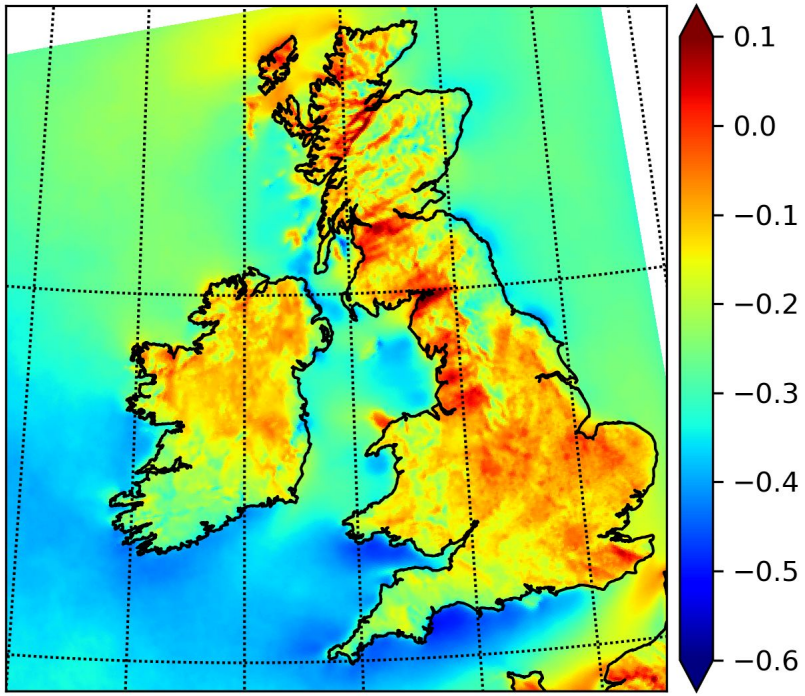
10m wind speed vs SW: 850hPa Westerlies



10m wind speed vs SW: 850hPa Easterlies



- Spatially averaged ERA-Interim 850hPa wind direction.
- Influence of orogaphy.
- Patterns not apparent in global reanalyses.

3 hour ramping: Kilkenny

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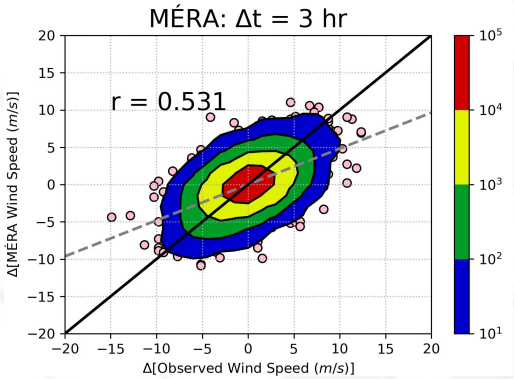
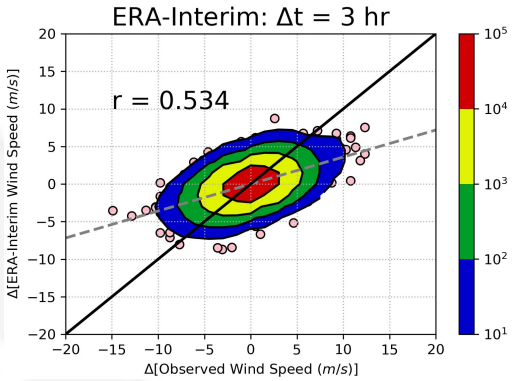
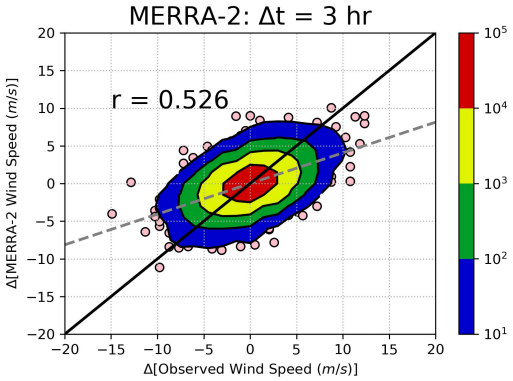
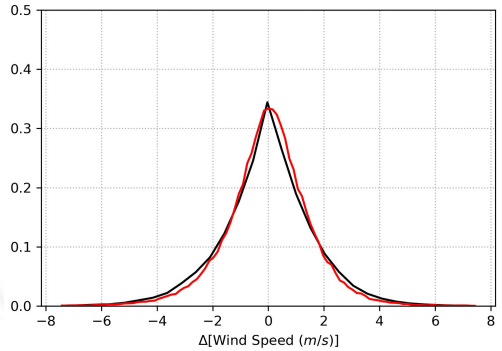
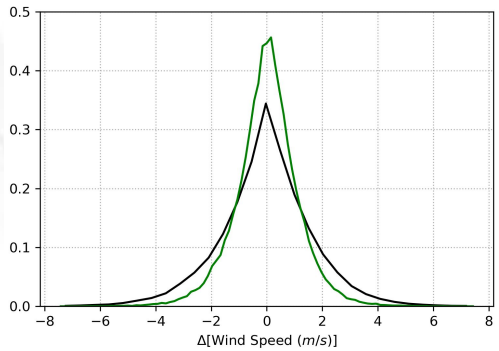
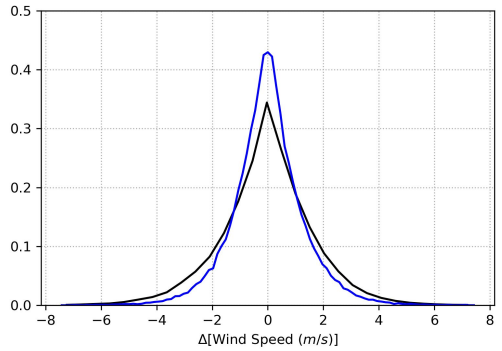






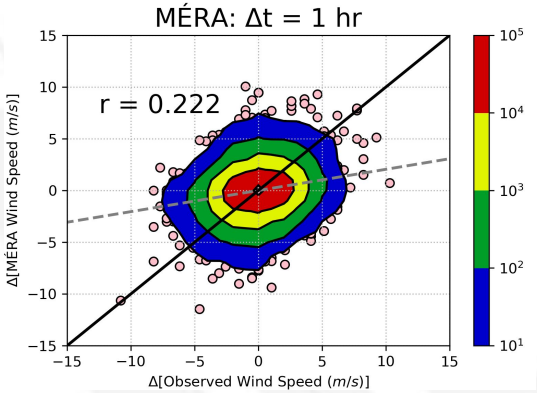


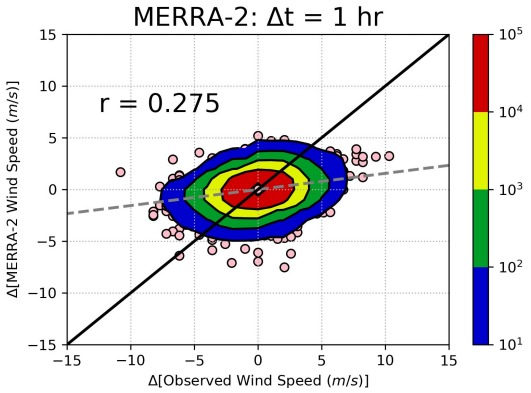


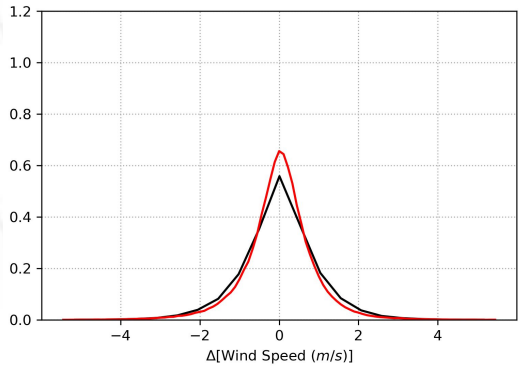


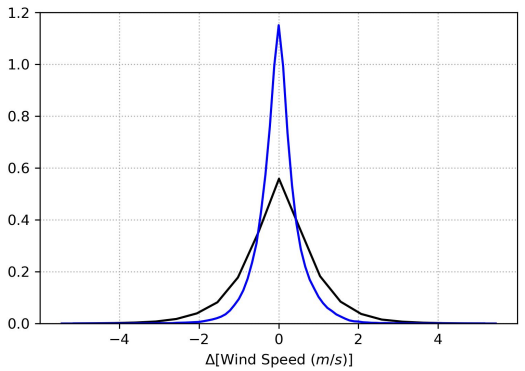
	Observations	MÉRA	ERA-Interim	MERRA-2
Standard Dev.	1.691	1.538	1.141	1.314
P05	-2.572	-2.533	-1.90	-2.091
P95	2.572	2.395	1.813	2.178

1 hour ramping: Kilkenny









	Observations	MÉRA	MERRA-2
Standard Dev.	0.983	0.908	0.556
P05	-1.543	-1.45	-0.87
P95	1.543	1.369	0.919

12 hour ramping: Kilkenny

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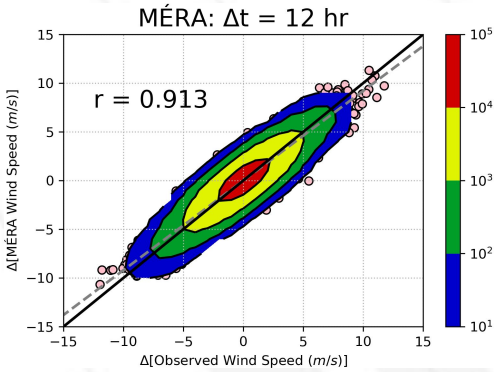

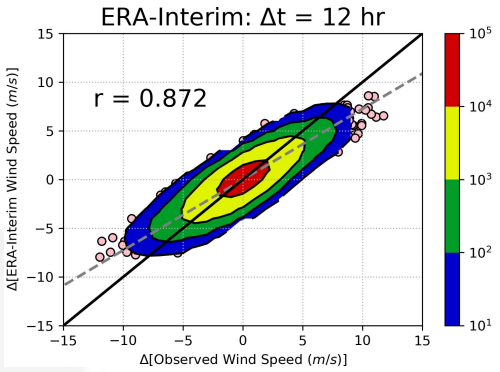

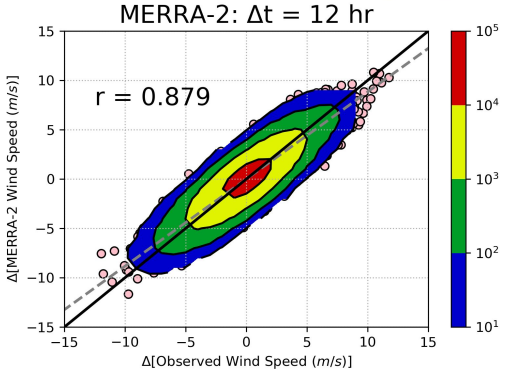

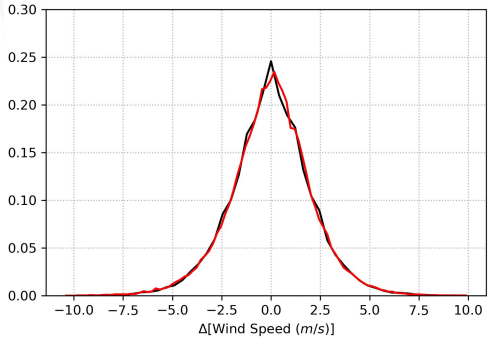

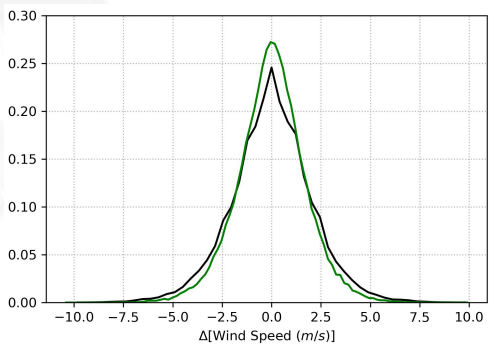

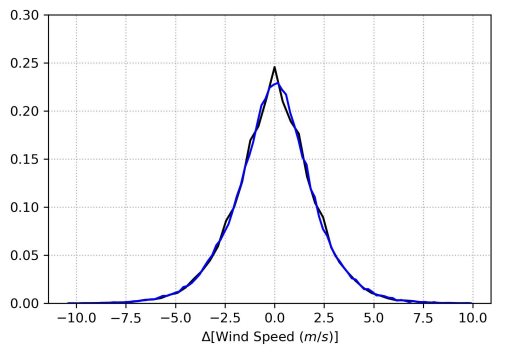

	Observations	MÉRA	ERA-Interim	MERRA-2
Standard Dev.	2.041	2.054	1.696	2.047
P05	-3.364	-3.433	-2.831	-3.390
P95	3.285	3.288	2.762	3.334

Conclusions

- MÉRA performs best for 10m wind speed at all but one station.
- All reanalyses appear to overestimate the strength of the inverse relationship between 10m wind speed and shortwave radiation.
- MÉRA outperforms global reanalyses at capturing temporal variability of 10m wind speed over shorter time periods.

Future work

- Assess MÉRA wind speeds at hub height using mast data or converting to power and compare to Eirgrid data.
- Analyse correlations further in the context of renewable power production.
- High-resolution NWP forecasting for renewable energy applications.

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