Downscaled extremes based on NCEP reanalysis data (1958–2000): Secondary Region — United Kingdom

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Introduction

The purpose of deliverable D12 is to compare different downscaling methods based on the NCEP reanalysis. This partner report describes the results for six UK stations from the FIC station data set.

Method

A description of the method can be found in the partner report for the primary region.

Data

This evaluation is based on six UK stations rom the FIC station data set, and NCEP data interpolated onto HadAM grid points (see Fig. 1). For each station the grid point with the highest correlation with the corresponding daily station data is selected (see Table. 1).

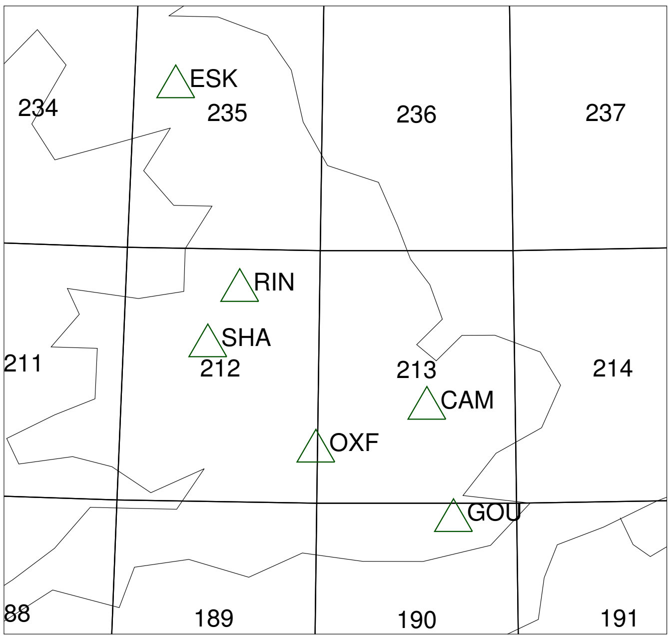

Figure 1: The 12 HadAM grid points and the 6 UK stations from the FIC station data set (see Table 1).

The downscaling methods are calibrated using the data from 1958–1978 and 1994–2000 and validated for the ERA-15 period 1979–1993. Seasonal values of all STARDEX indices were calculated for every year for the downscaled data. The present analysis is, however, restricted to the indices listed in Table 2.

Table 1: The six UK stations from the FIC station data set. The column GP indicates the HADAM grid point used for downscaling.

Station	lon	lat	height	GP
Cambridge	0.13	52.20	12	213
Goudhurst	0.46	51.08	85	189
Oxford	-1.27	51.77	63	189
Eskdalemuir	-3.20	55.32	242	234
Ringway	-2.28	53.35	69	211
Shawbury	-2.67	52.80	72	212

Table 2: STARDEX Diagnostic Extreme Indices considered in the present analysis.

name	description
AV	mean climatological precipitation
FRE	precipitation frequency
INT	simple daily intensity
Q90	90th percentile of rainday amounts
X3D	greatest 3-day total rainfall
XCWD	max no consecutive wet days
PDD	mean dry-day persistence
XCDD	max no consecutive dry days

Results

Mean annual cycle

The mean annual cycle for the indices AV, FRE, INT, and Q90 for the NCEP and downscaled data is shown in Fig. 2-5. The deviations from the observed annual cycle represent the bias of the data.

The results for the bias for the UK are similar to those for the Alps. Overall, the intensity scaling methods (LOCI and DYNI) perform better than the standard methods (LOC and DYN). However, the differences between the methods are not as large as for the Alpine region. Yet, for the UK, the advantage of dynamical downscaling is seen more clearly (see, for example, the annual cycle for CAM, OXF, RIN in Fig. 2).

Interannual variations

The skill in reproducing the correct interannual variability is illustrated for two typical stations in the Taylor diagrams shown in Fig. 6-7. Note the large differences in the skill from one index to another, and from one season to another, but also from one station to another. Generally higher skills are obtained for AV, FRE, and PDD, while generally lower skills are found for INT and Q90. Comparing the results for the two stations, a better performance is found for Eskdalemuir than for Oxford. As for the primary region, the main difference between the methods lies not in the correlation skill, but in the magnitude of the interannual variations (e.g. standard devation ratio).

Fig. 8 shows a a direct comparison of the dynamical intensity scaling method (DNYI) with the raw NCEP data. As was already found with the Taylor diagrams, the main improvement of the downscaled data is its magnitude of interannual variability (Fig. 8-11. As can be seen, for most stations and most indices the standard deviation ratio is closer to one for the downscaled data than for the raw NCEP data. However, the signal is less clear than for the primary region.

The mean skill obtained for the six UK stations for the raw NCEP and downscaled data is summarized in Table 3.

Conclusion

It has been found, that the downscaling skill varies considerably from station to station, from season to season, and from index to index. These variation are often larger than the differences between the different downscaling methods. The overall skill of the NCEP and the downscaled data is clearly higher for the secondary region (UK) than for the primary region (Alps). Because of the higher skill of the raw NCEP data for the UK, the improvements from downscaling are smaller than for the Alpine stations.

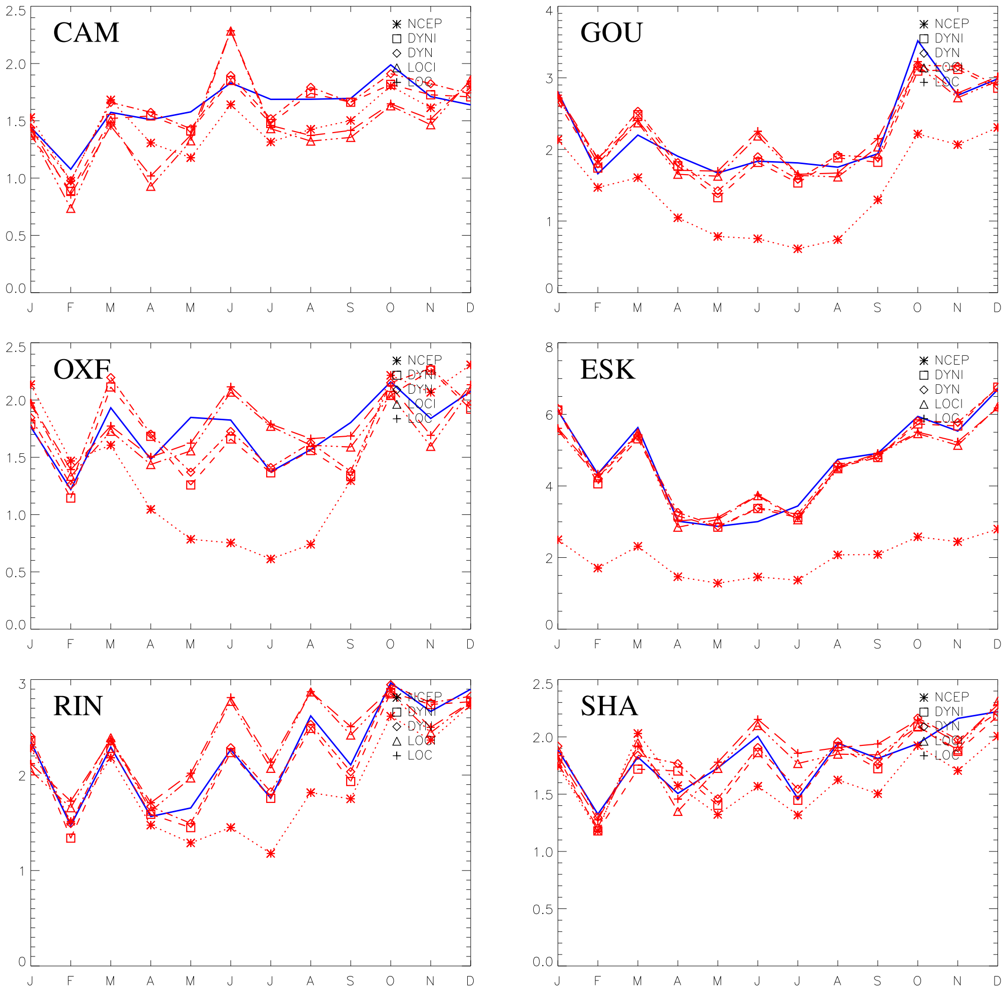

Figure 2: Mean annual cycle of AV for the six UK stations deduced from observations (solid line), NCEP, and downscaled data.

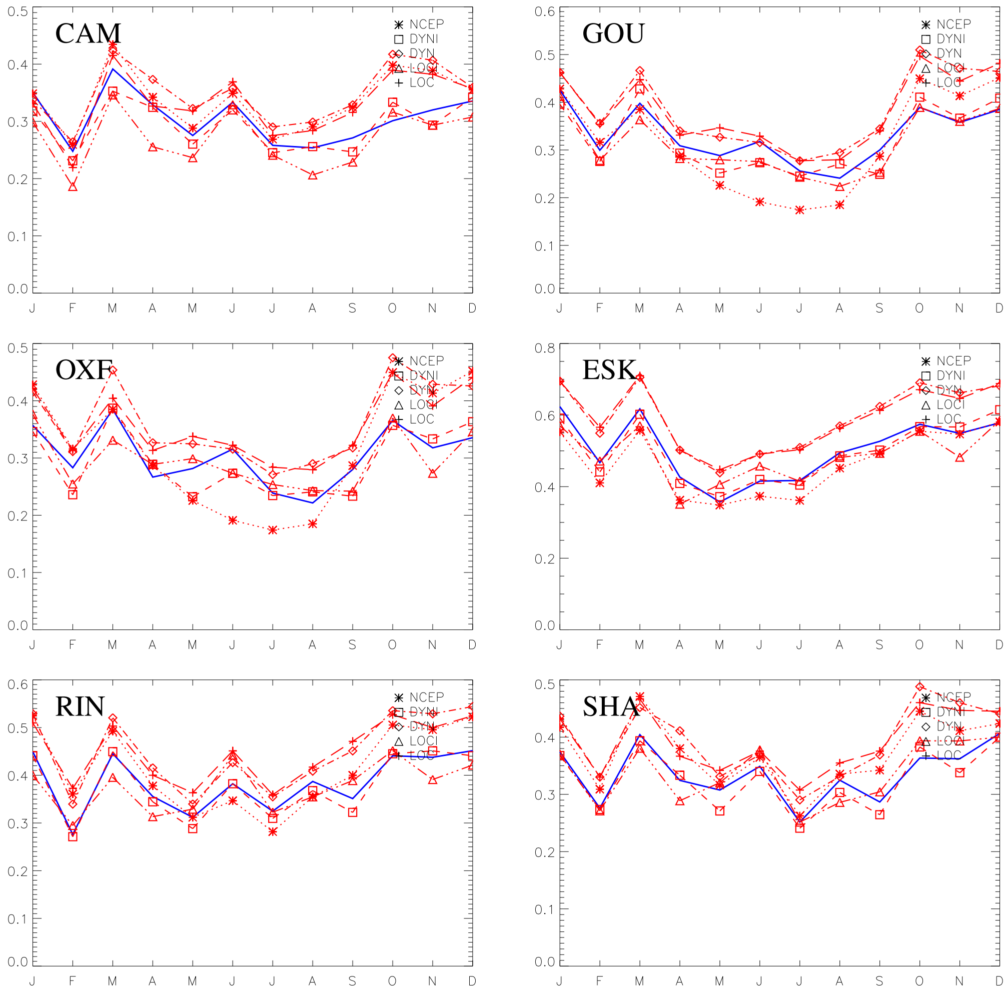

Figure 3: As Fig. 2, but for FRE.

Table 3: Mean skill for the six UK stations for the ncep and downscaled data.

model	Correlation				RMSE			
	wi	sp	su	au	wi	sp	su	au
				AV				
(NCEP)	0.80	0.88	0.68	0.82	0.98	0.81	1.07	1.01
(DYNI)	0.74	0.84	0.59	0.79	0.54	0.36	0.60	0.47
(DYN)	0.80	0.86	0.61	0.81	0.47	0.33	0.58	0.43
(LOCI)	0.81	0.87	0.69	0.81	0.49	0.38	0.60	0.48
(LOC)	0.81	0.88	0.69	0.81	0.48	0.36	0.60	0.45
				FRE				
(NCEP)	0.76	0.87	0.78	0.83	0.07	0.07	0.08	0.07
(DYNI)	0.75	0.88	0.83	0.82	0.06	0.06	0.05	0.05
(DYN)	0.78	0.88	0.82	0.83	0.08	0.09	0.07	0.11
(LOCI)	0.75	0.87	0.83	0.80	0.06	0.06	0.05	0.06
(LOC)	0.77	0.88	0.83	0.84	0.09	0.08	0.07	0.09
				INT				
(NCEP)	0.69	0.23	-0.00	0.53	1.99	2.09	2.80	2.67
(DYNI)	0.63	0.27	0.06	0.43	0.96	1.06	1.81	1.12
(DYN)	0.68	0.33	0.10	0.54	1.20	1.19	1.72	1.74
(LOCI)	0.67	0.19	-0.03	0.48	1.00	1.17	1.77	1.07
(LOC)	0.69	0.27	0.01	0.57	1.24	1.27	1.61	1.75
				Q90				
(NCEP)	0.59	0.38	0.08	0.35	5.14	5.18	7.39	7.08
(DYNI)	0.46	0.42	0.10	0.20	3.09	2.86	5.36	3.91
(DYN)	0.56	0.43	0.13	0.43	3.32	2.98	5.07	4.88
(LOCI)	0.54	0.32	-0.10	0.32	2.93	3.09	5.03	3.90
(LOC)	0.58	0.33	-0.10	0.38	3.41	3.23	4.85	5.02
				X3D				
(NCEP)	0.55	0.45	0.28	0.45	19.94	16.66	22.39	19.60
(DYNI)	0.42	0.46	0.09	0.50	13.42	11.72	22.09	11.15
(DYN)	0.47	0.47	0.12	0.50	13.55	10.93	21.06	11.74
(LOCI)	0.50	0.49	0.33	0.45	12.70	10.42	18.99	12.82
(LOC)	0.51	0.49	0.33	0.43	13.75	10.83	18.25	13.63
				PDD				
(NCEP)	0.66	0.71	0.63	0.82	0.06	0.09	0.09	0.06
(DYNI)	0.67	0.75	0.68	0.79	0.06	0.09	0.08	0.07
(DYN)	0.66	0.77	0.67	0.79	0.06	0.07	0.07	0.07
(LOCI)	0.61	0.75	0.68	0.79	0.07	0.09	0.07	0.07
(LOC)	0.66	0.69	0.67	0.80	0.06	0.09	0.07	0.07
				XCWD				
(NCEP)	0.33	0.44	0.13	0.23	4.35	3.68	3.24	5.14
(DYNI)	0.39	0.40	0.31	0.16	3.65	3.40	3.08	4.23
(DYN)	0.37	0.41	0.33	0.23	5.07	4.68	3.76	5.82
(LOCI)	0.43	0.47	0.43	0.08	3.47	2.83	3.23	4.18
(LOC)	0.36	0.43	0.30	0.18	4.69	4.92	4.34	5.82
				XCDD				
(NCEP)	0.64	0.60	0.49	0.74	4.32	8.04	8.56	5.36
(DYNI)	0.60	0.61	0.50	0.73	4.75	7.65	7.56	6.77
(DYN)	0.69	0.62	0.44	0.72	4.18	6.28	6.70	5.08
(LOCI)	0.64	0.55	0.56	0.73	4.45	8.22	7.31	6.64
(LOC)	0.70	0.52	0.38	0.75	4.00	7.07	6.72	4.84

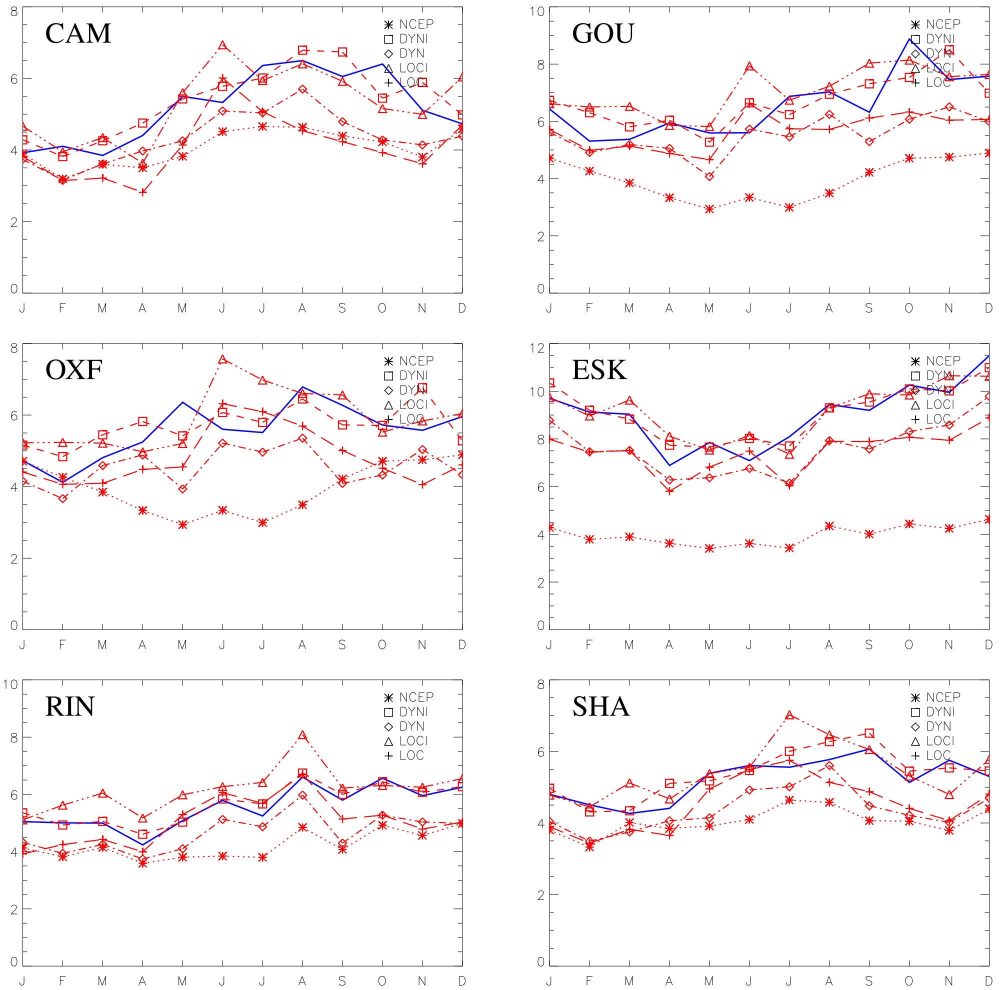

Figure 4: As Fig. 2, but for INT.

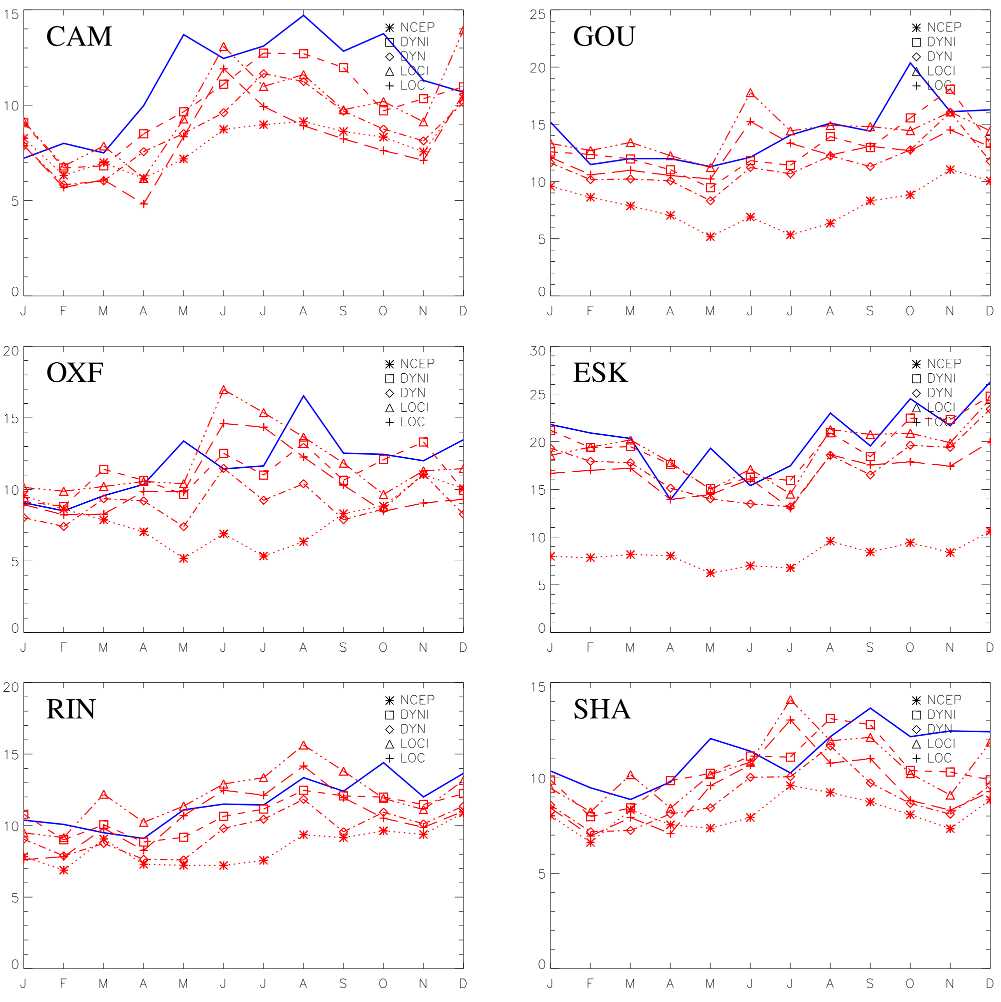

Figure 5: As Fig. 2, but for Q90.

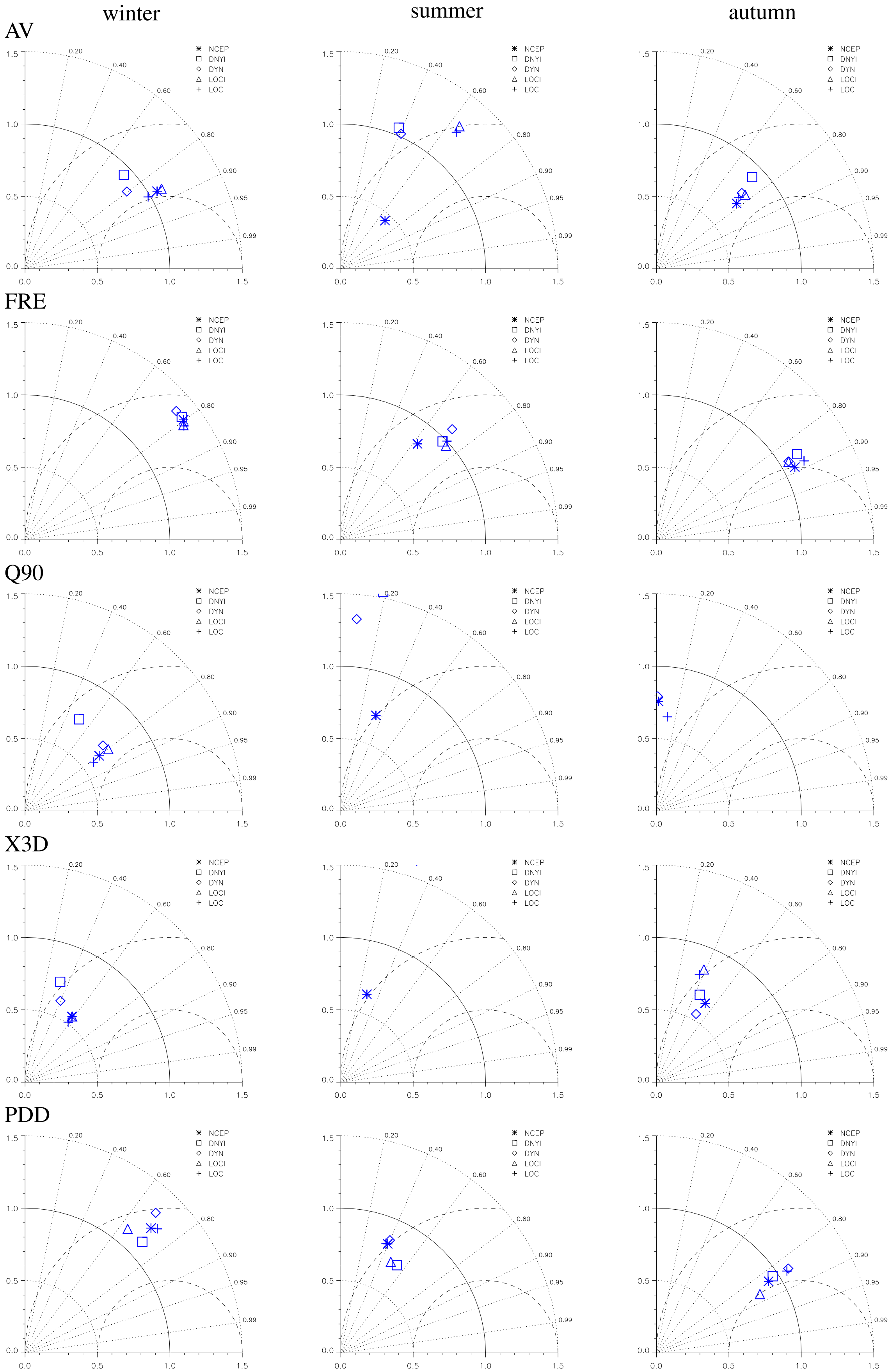

Figure 6: Taylor diagrams of interannual variability for Oxford.

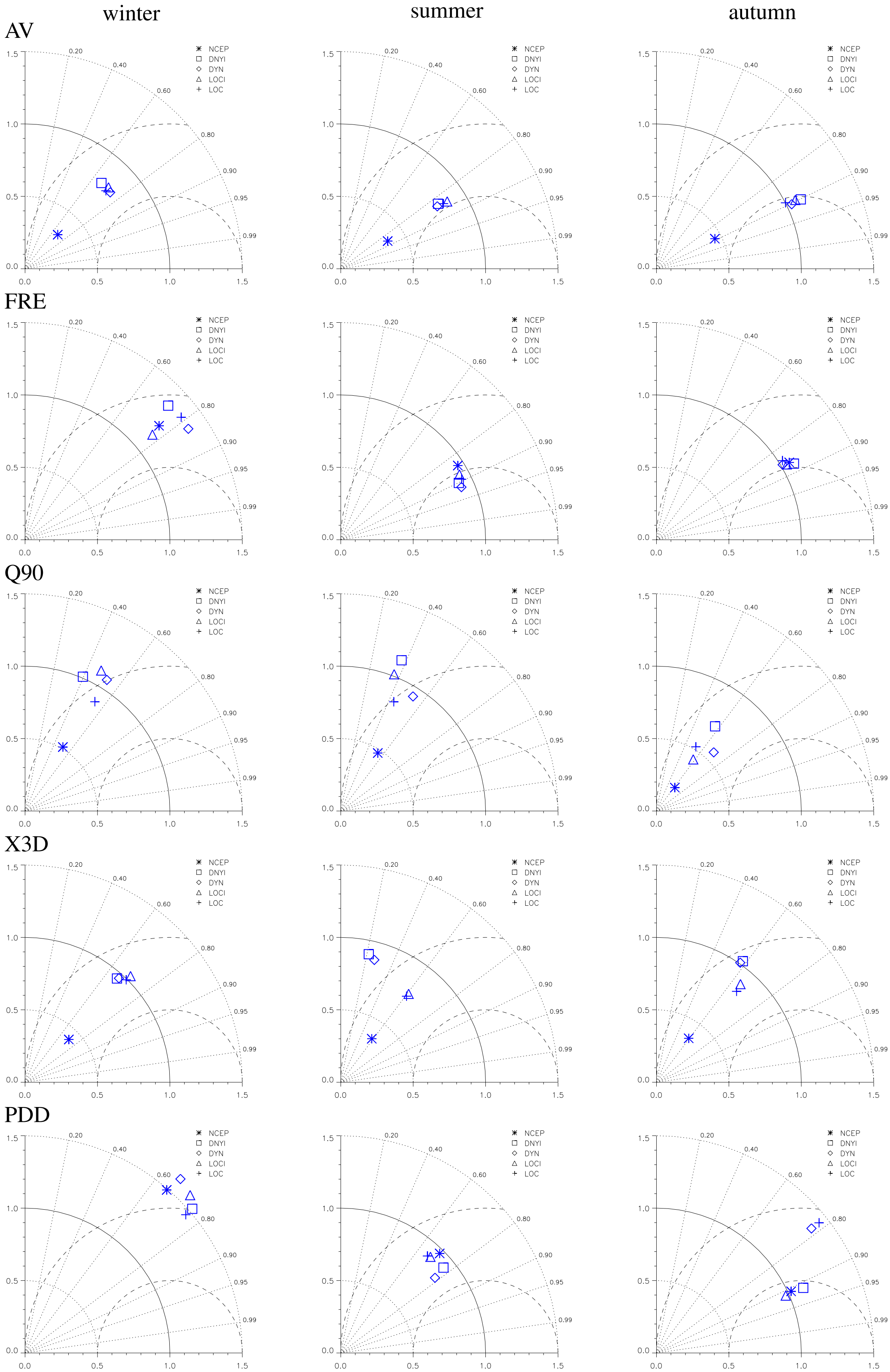

Figure 7: Taylor diagrams of interannual variability for Eskdalemuir.

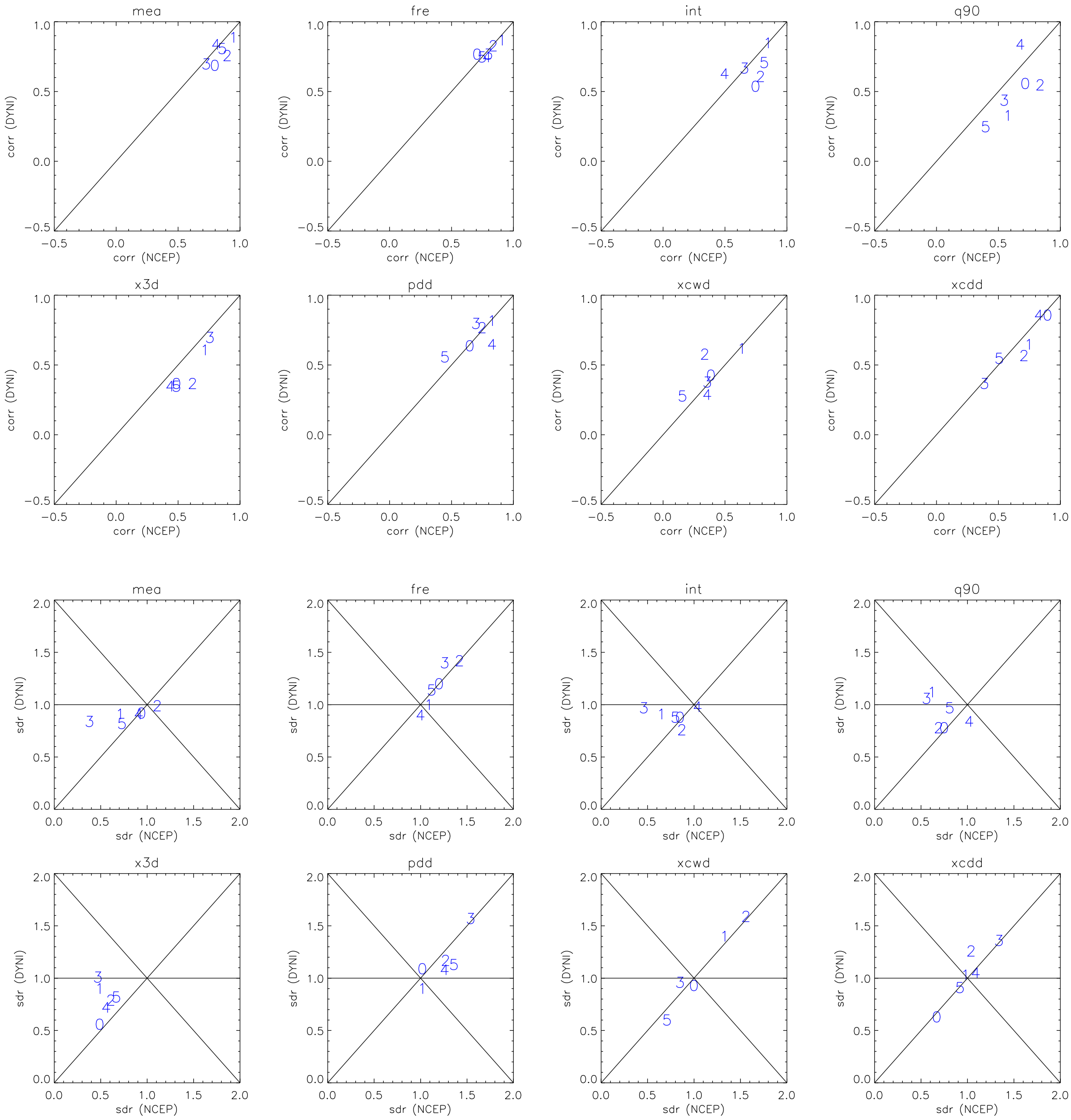

Figure 8: Skill of dynamical intensity rescaling (DNYI) versus raw NCEP reanalysis for the winter season. Correlation (top eight panels) and standard deviation ratio (lower eight panels).

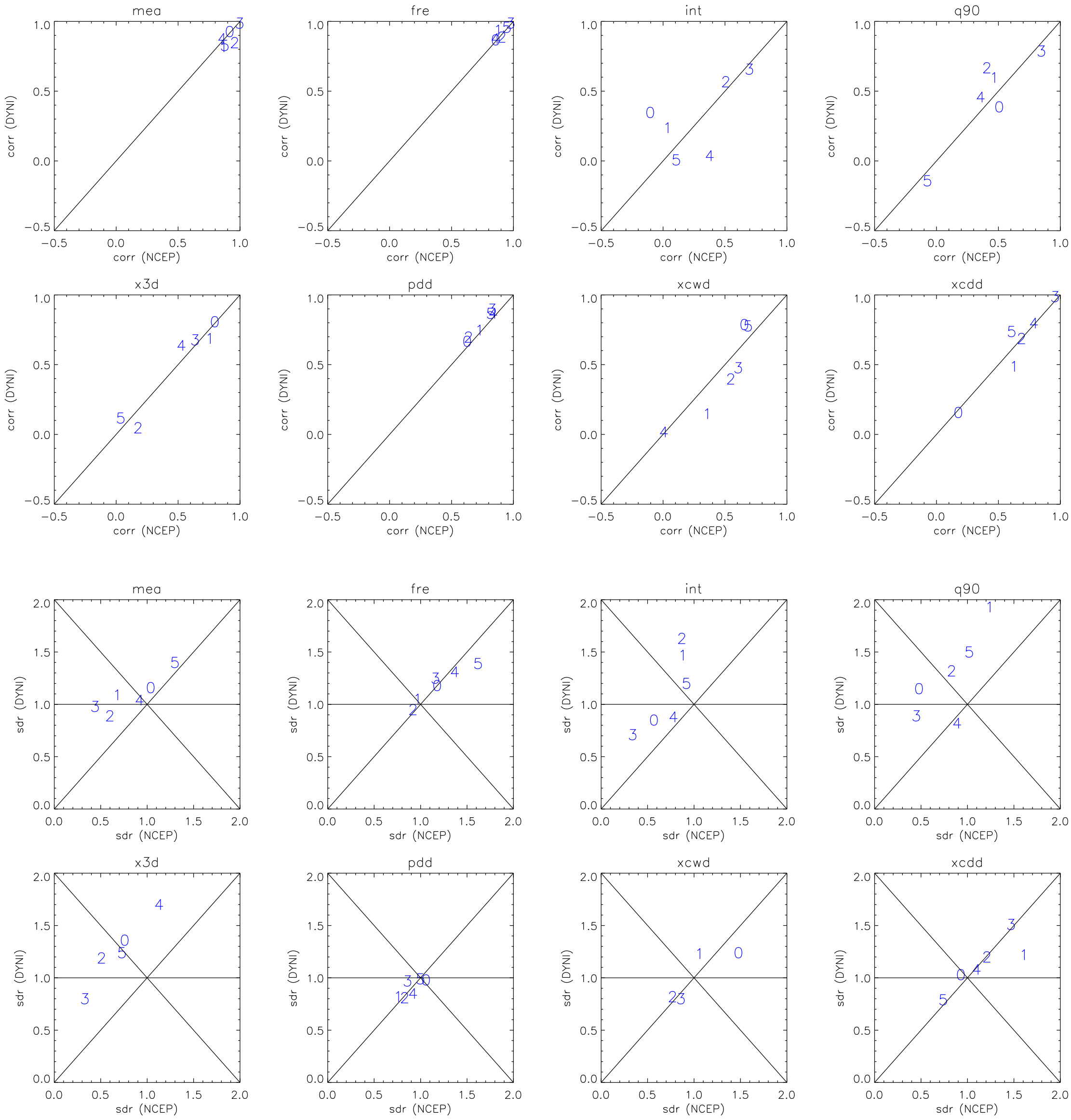

Figure 9: As in Fig. 8, but for spring.

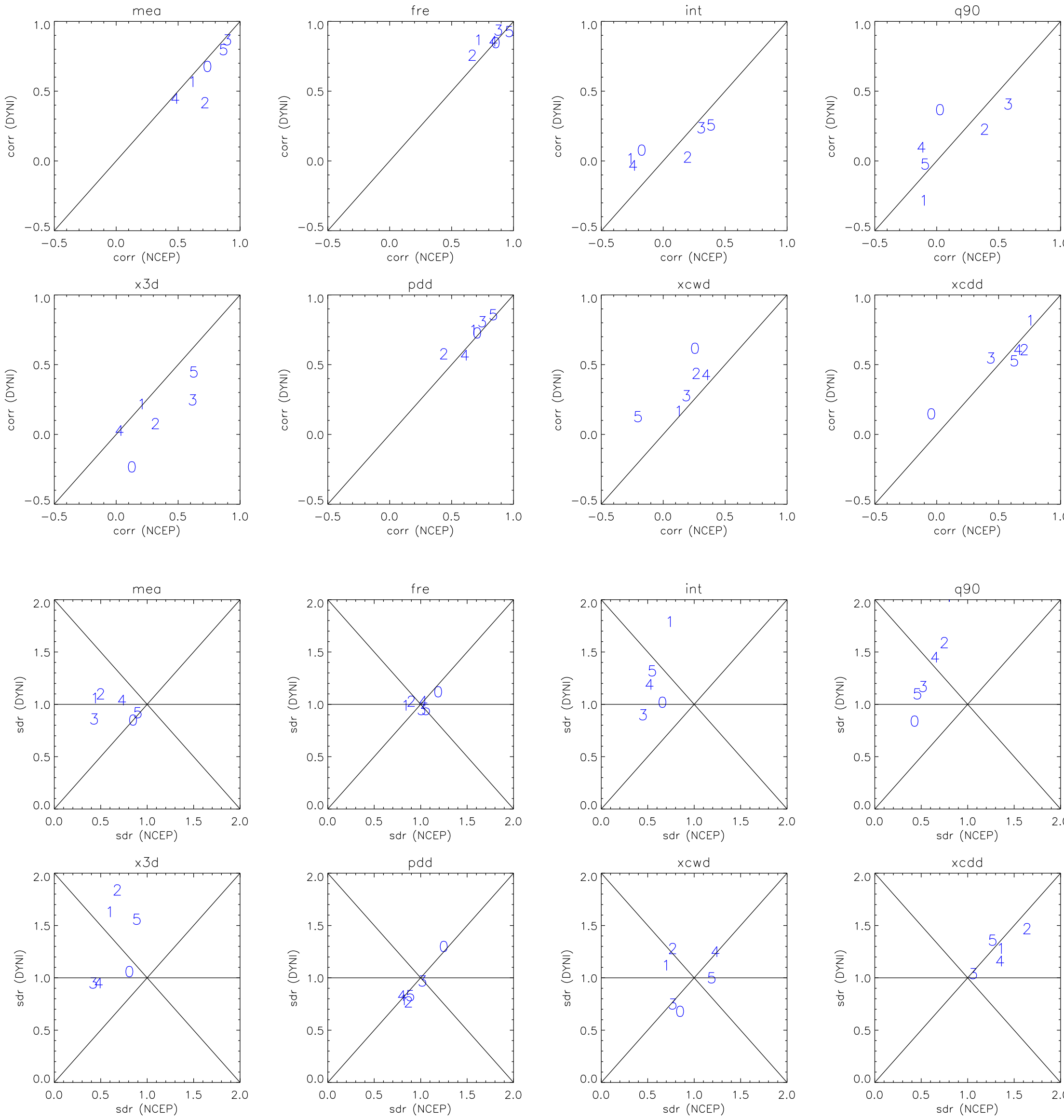

Figure 10: As in Fig. 8, but for summer.

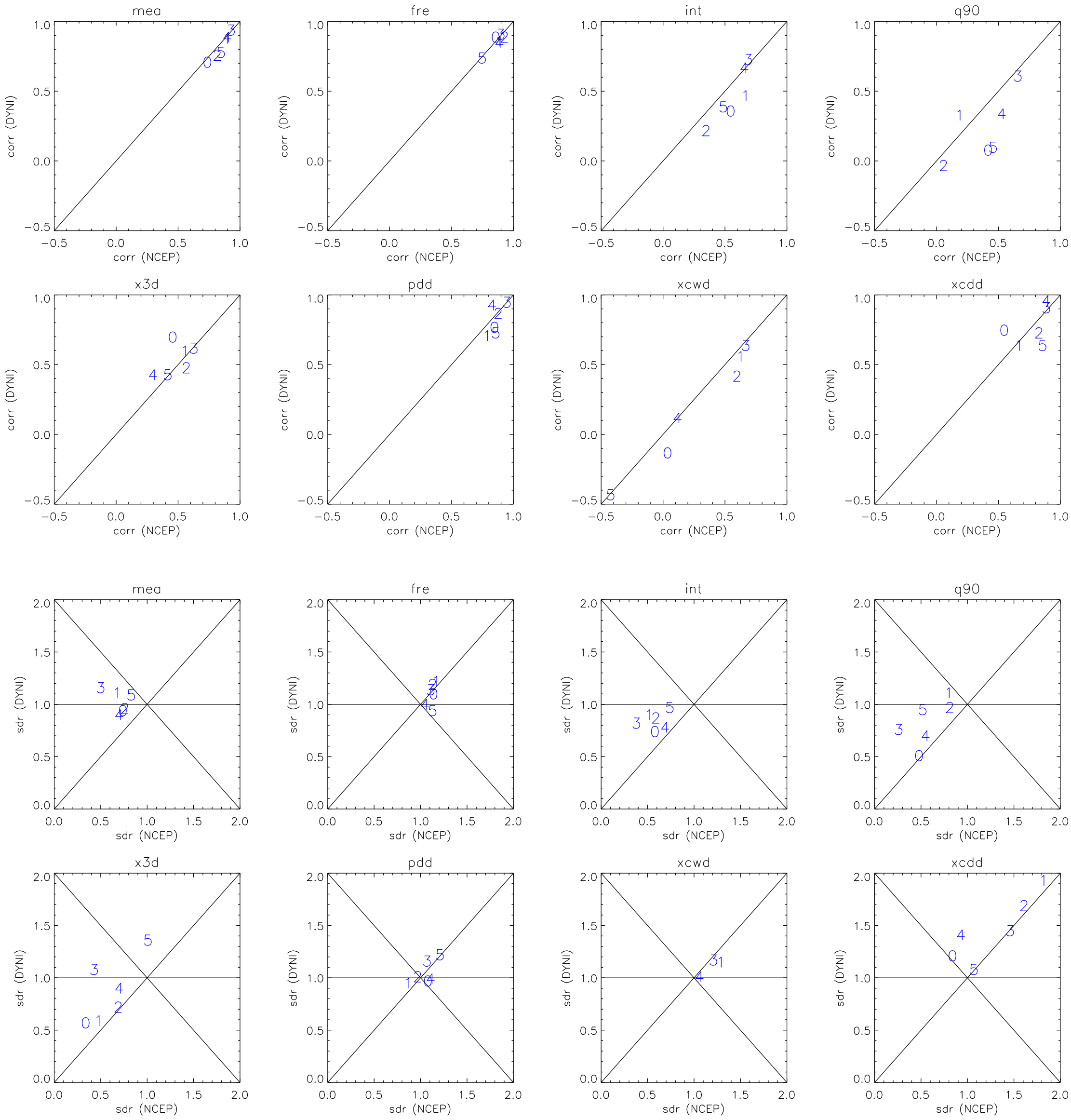

Figure 11: As in Fig. 8, but for autumn.