Assessment of multiple daily precipitation statistics in ERA-Interim driven Med-CORDEX and EURO-CORDEX experiments against high resolution observations

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A. Fantini[1,2] , F. Raffaele[1], C. Torma[1],
S. Bacer[3], E. Coppola[1], F. Giorgi[1], B. Ahrens[4],
C. Dubois[5], E. Sanchez[6], M. Verdecchia[7]

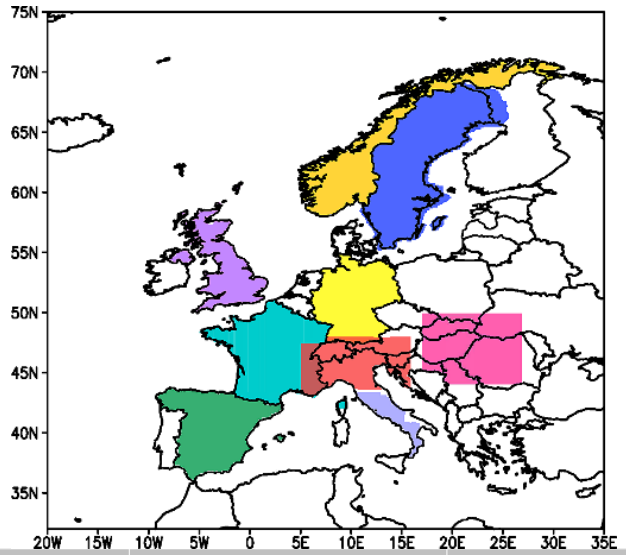
1 - Abdus Salam ICTP, Trieste, Italy
2 - University of Trieste, Italy
3 - Max Planck Institute for Chemistry, Mainz, Germany
4 - Goethe-Universitaet Frankfurt a.M., Frankfurt/Main, Germany
5 - Météo-France and Mercator Océan, France,
6 - Universidad de Castilla-La Mancha, Toledo, Spain
7 - CETEMPS and University of L'Aquila, Italy

Assessment of multiple daily precipitation statistics in ERA-Interim driven Med-CORDEX and EURO-CORDEX experiments against high resolution observations

- Assessing the performance of an ensamble of RCMs over various EU regions against HR observations using both Med- and EURO-Cordex, with focus on extremes
- Does increased resolution (0.44 → 0.11 deg) provide real benefits compared to HR OBS?
- Do modelled precipitation climate extremes show significant Added Value?

DATASETS AND SETUP

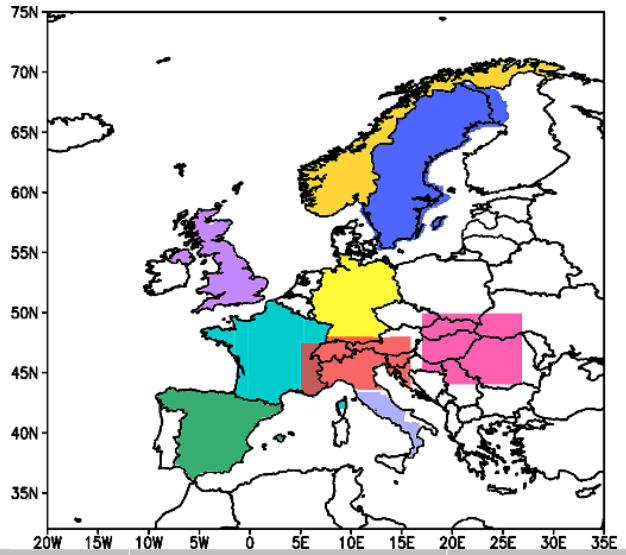
- 9 ERA-Interim driven, double nested Med- and EURO-CORDEX Regional Climate Models
- 3 common analysis grids at 0.11, 0.44, 1.50 degrees resolution
- HR observation datasets over 9 different European regions
- Precipitation undercatch correction with UDEL dataset (Matsuura and Willmott 2010, UDEL V3.01) when applicable



Dataset	Institution	Region	Period	~Res	Reference
EURO4M-APGD +	MeteoSwiss	Alps	1971-2008	5km	Isotta et al. (2013)
Spain02 +	Santander Meteorology Group	Spain	1971-2010	0.11 deg	Herrera et al. (2010)
SAFRAN	Meteo-France	France	1958-2013	8km	Vidal et al. (2010)
UK gridded dataset o+	UK Met Office	United Kingdom	1990-2010	0.11 deg	Perry et al. (2009)
KLIMAGRID o	METNO	Norway	1957-2013	1km	Mohr (2009)
PTHBV o	SMHI	Sweden and part of Finland	1961-2010	4km	Johansson (2002)
CARPATCLIM +	Hungarian Met Service	Carpathians	1961-2010	0.10 deg	Szalai et al. (2013)
REGNIE o+	DWD	Germany	1961-2009	1km	Rauthe et al. (2013)
CETEMPS gridded dataset +	CETEMPS, University of L'Aquila	Italy	2000-2014	0.11 deg	Not released yet

o = covered by EURO-CORDEX only

+ = undercatch-corrected with UDEL data



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9 Regional Climate Models @ 0.11 and 0.44 deg resolution

Model	Institution	
CCLM4-8-17	CLMcom	EURO-CORDEX
HIRHAM5	DMI	
INERIS-WRF331F	IPSL	
RACMO22E	KNMI	
RCA4	SMHI	
ALADIN5.2	CNRM	Med-CORDEX
RegCM4.4	ICTP	
CCLM4-8-18	GUF	
PROMES	UCLM	

Analysis period: 1989-2008; 1990-2008 (UK); 2000-2010 (Italy)

Precipitation performance indices with emphasis over extremes

Index	Description
RMSE, mean, bias	Standard statistics.
TAYLOR	Taylor diagrams: spatial correlation, std.dev. and centered RMSE.
PDF, KL	Symmetrized Kullback-Leibler divergence for PDFs *. (>1mm / day)
SDII *	Mean daily precipitation intensity. (mm / day)
DDF *	Mean frequency of dry days. (%)
CDD95 *	95th percentile of dry spell length. Replaces CDD. (No. days / year)
Psum>R95 obs *	Total precipitation above the reference 95th percentile of observed daily precipitation. Replaces R95p. (mm / year)

* = daily precipitation indices

Example for mean precipitation (DJF)

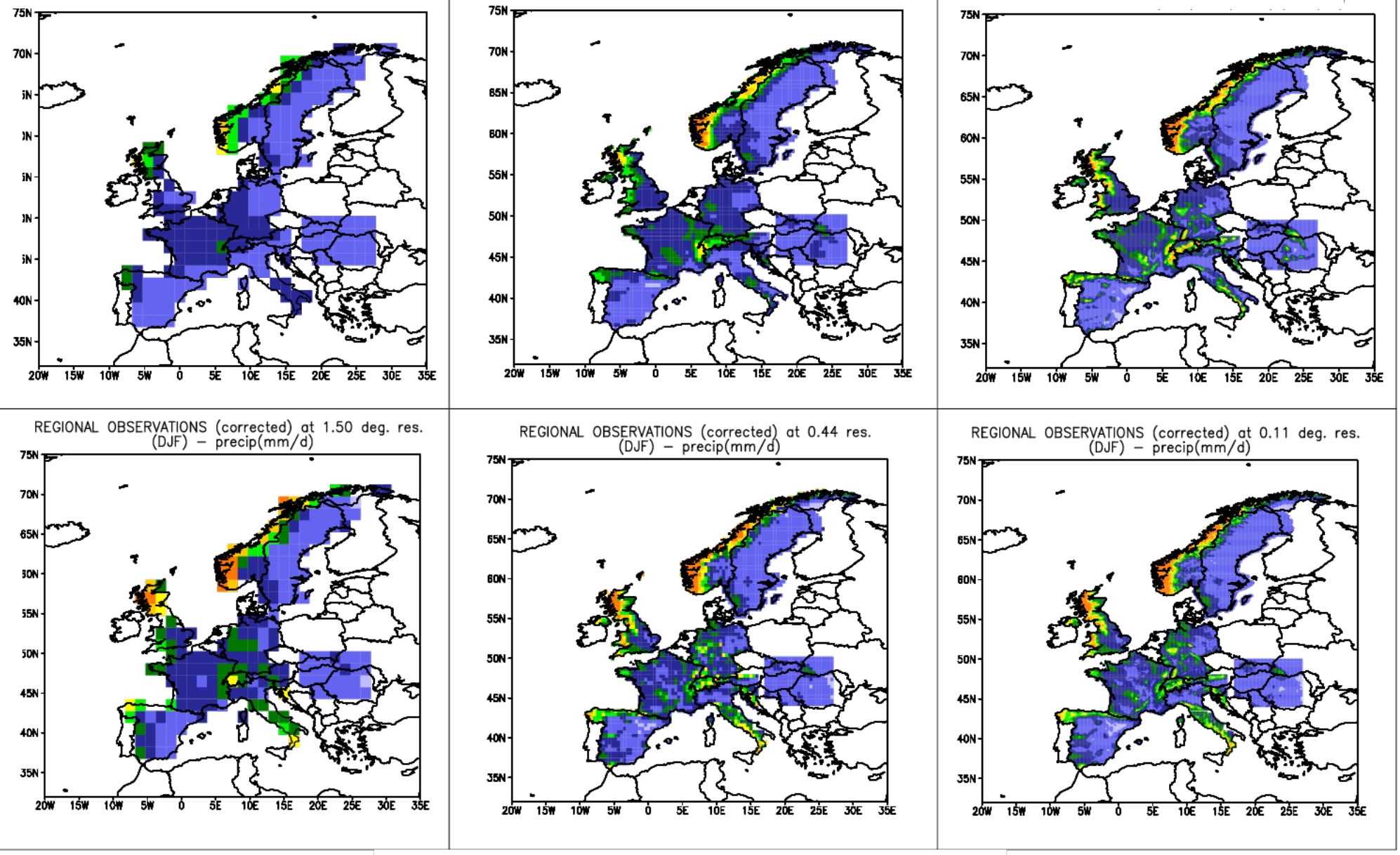
ERA-Interim

0.44 ensemble

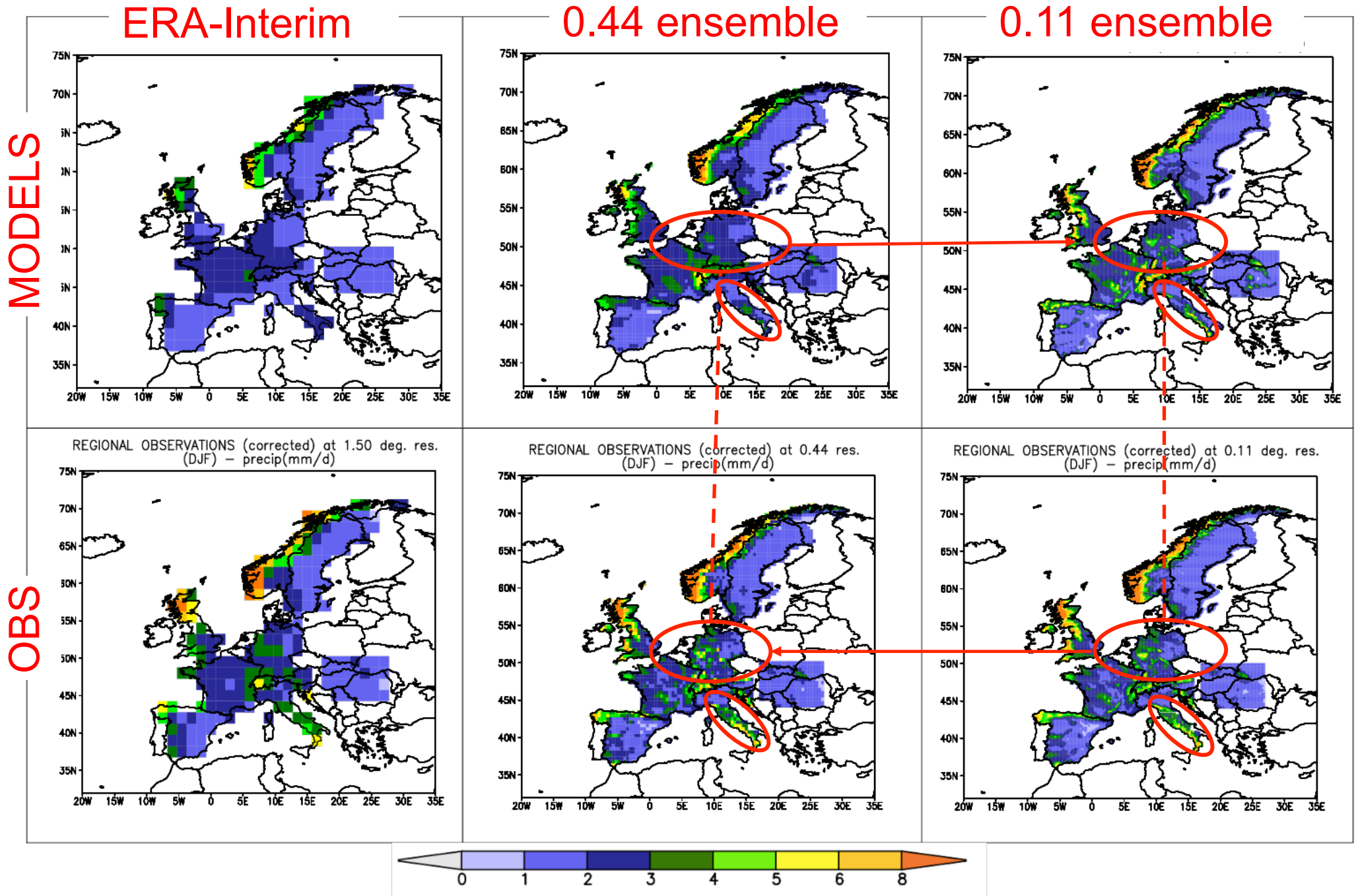
0.11 ensemble

MODELS

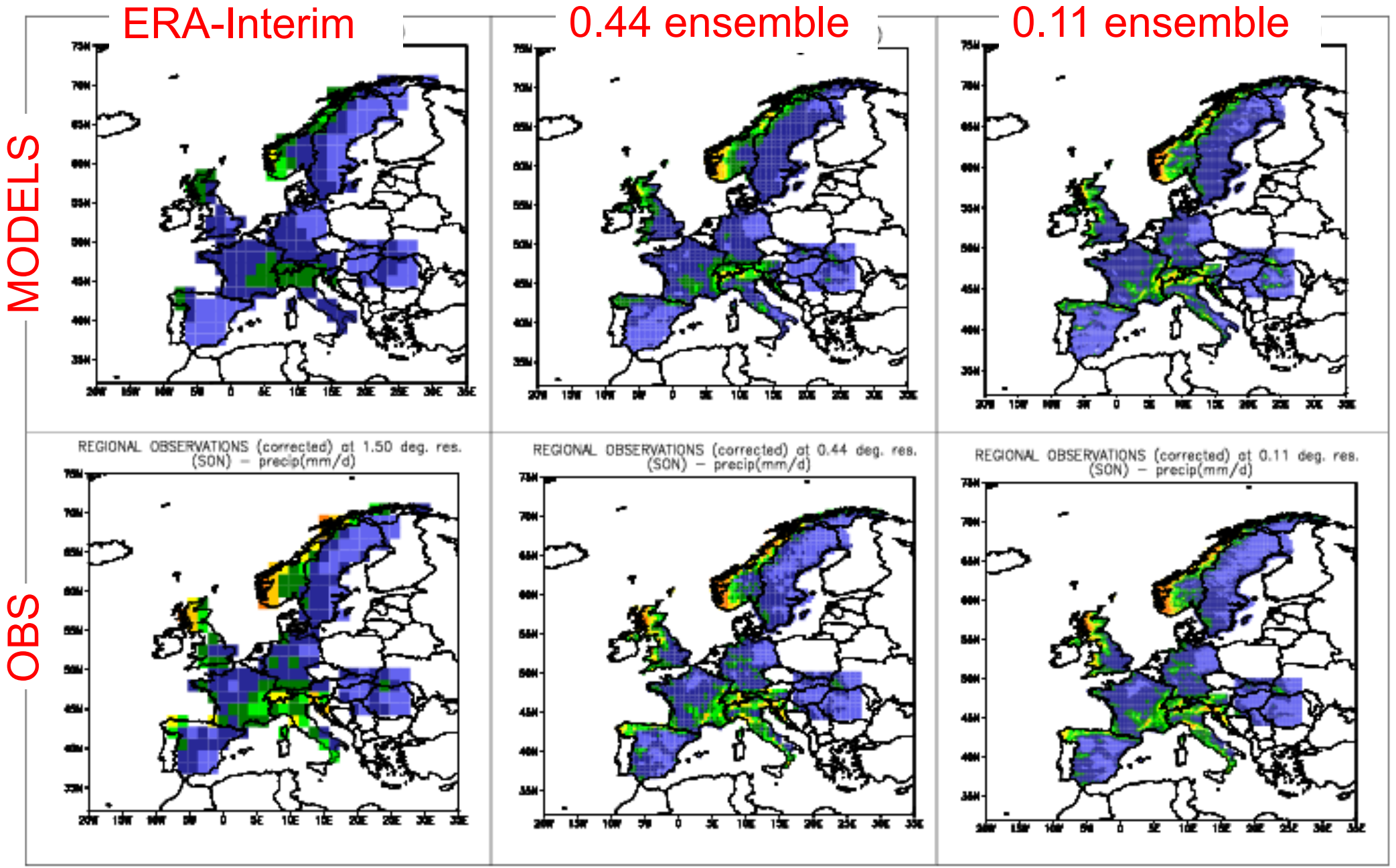
OBS



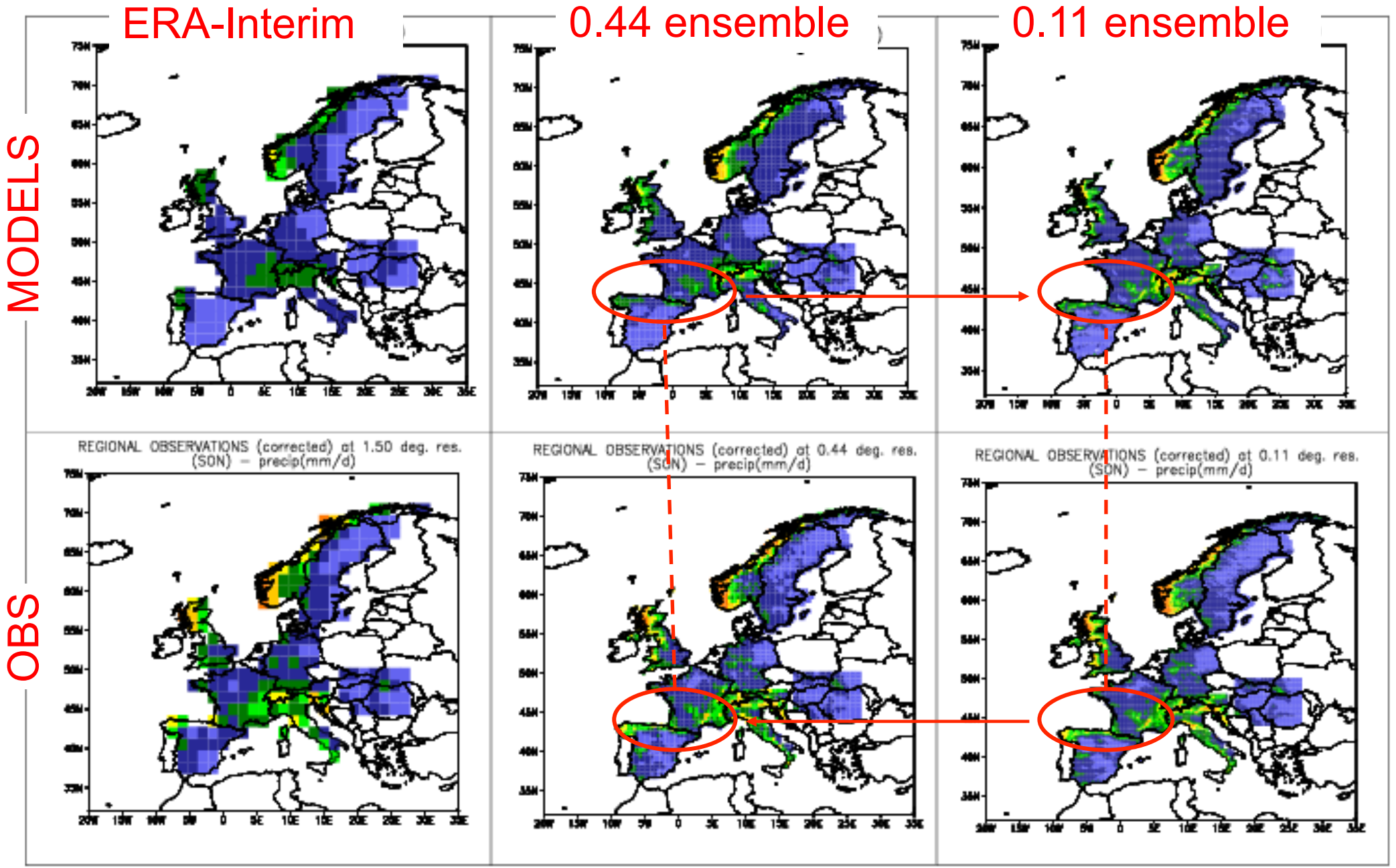
Example for mean precipitation (DJF)



Example for mean precipitation (SON)

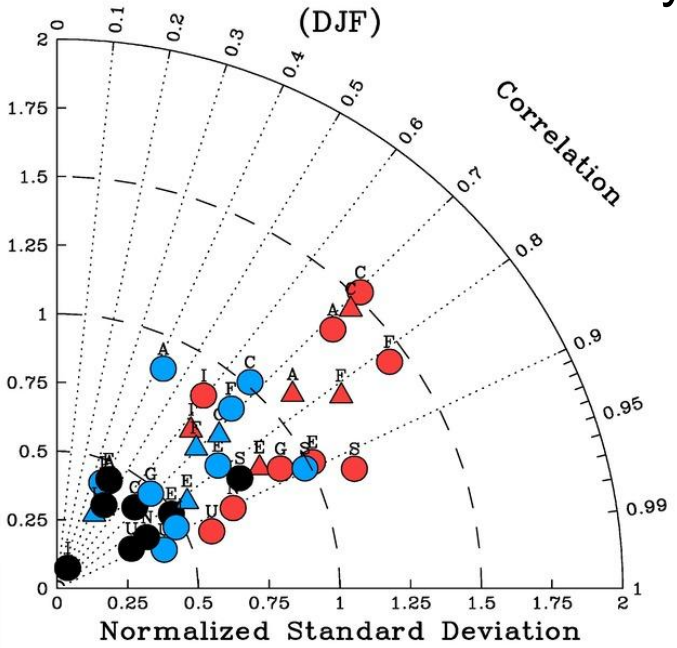


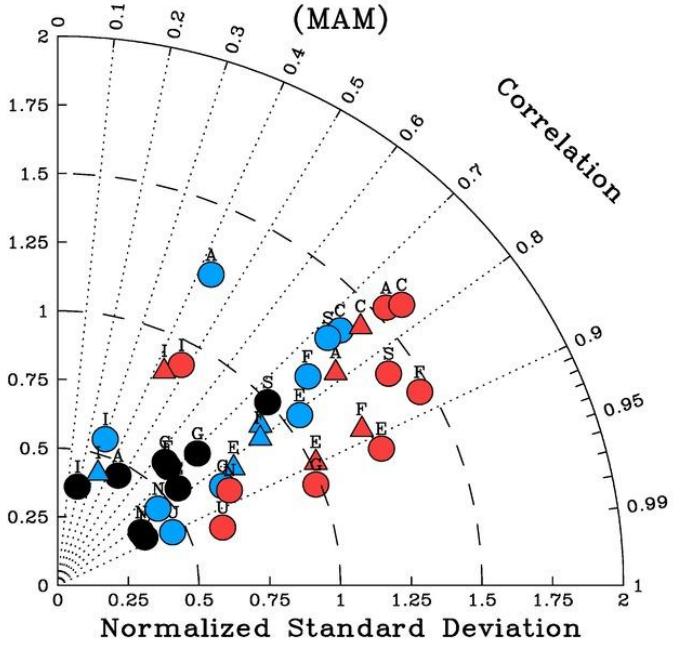
Example for mean precipitation (SON)



Results for mean precipitation

Taylor plots



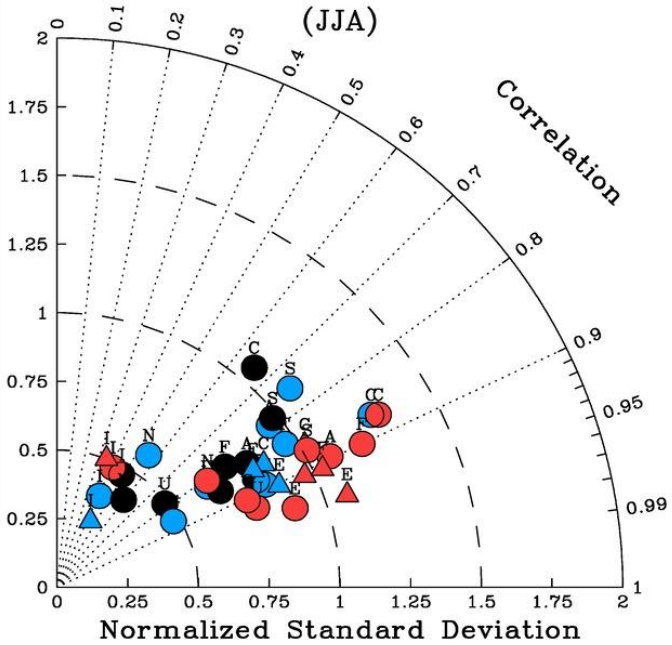


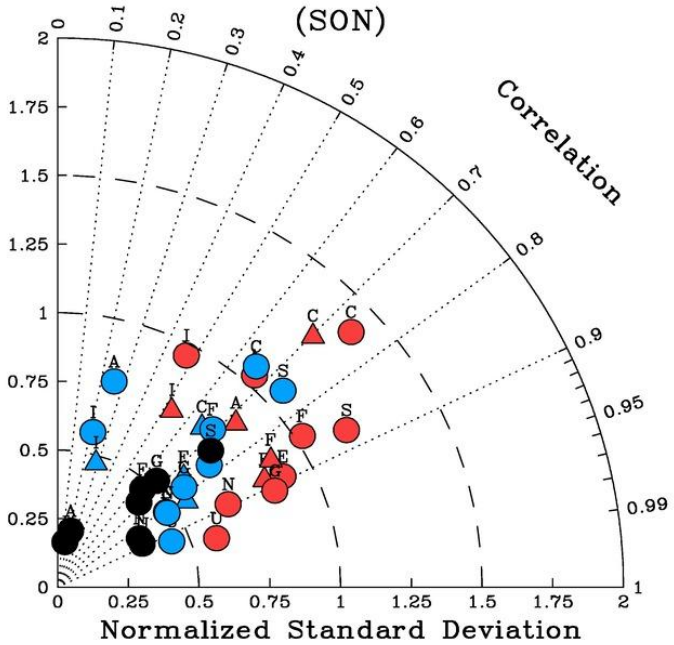
0.11

ERA−Interim
RCM44−EUR
RCM11−EUR
RCM44−MED
RCM11−MED

Regions

A Alps
C Carpathians
F France
G Germany
I Italy
N Norway
E Spain
S Sweden
U UK





Results for mean precipitation

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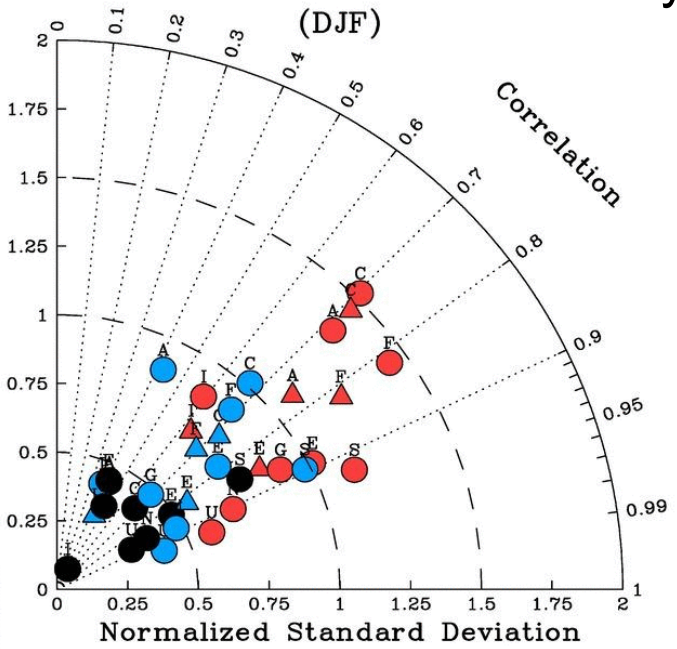

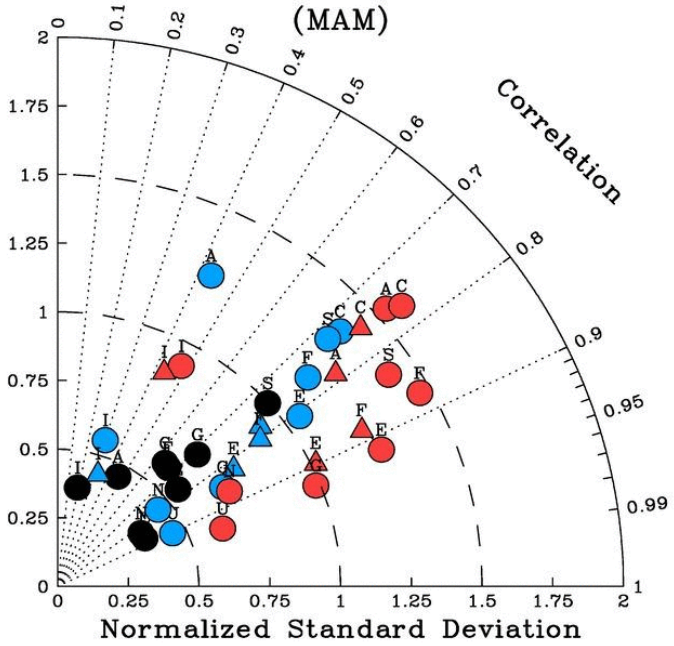

0.11

ERA−Interim
RCM44−EUR
RCM11−EUR
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RCM11−MED

Regions

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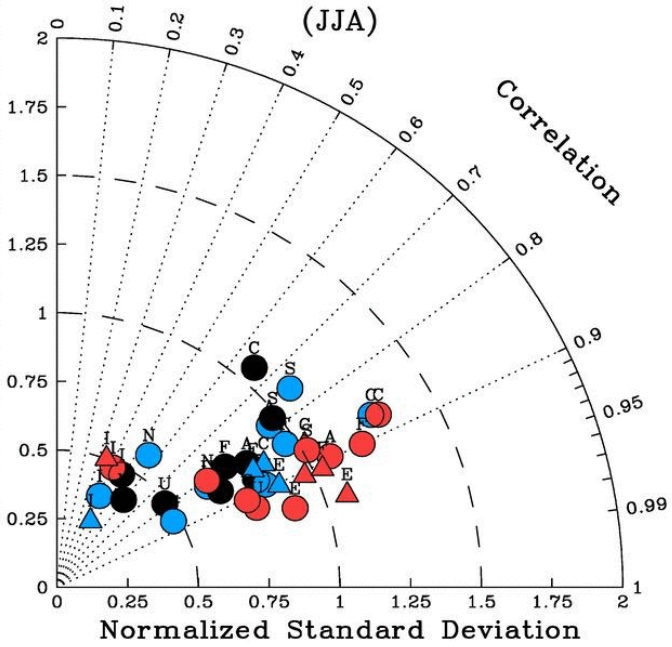
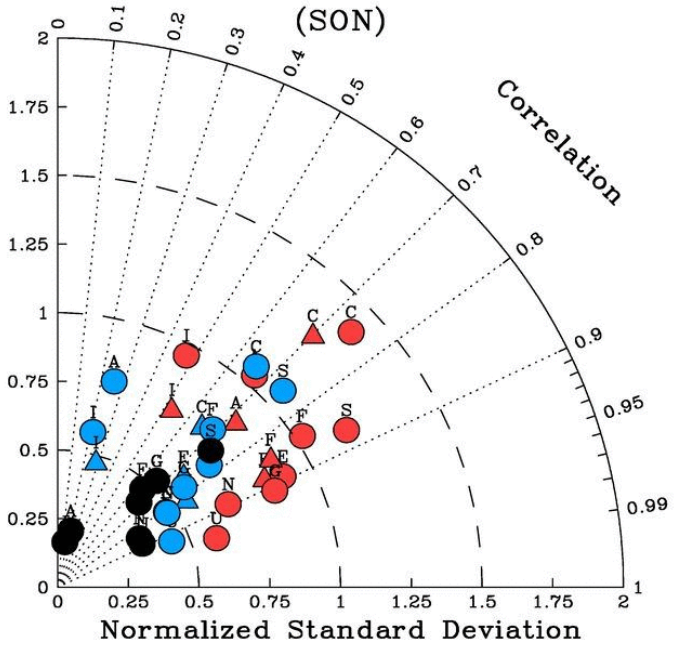
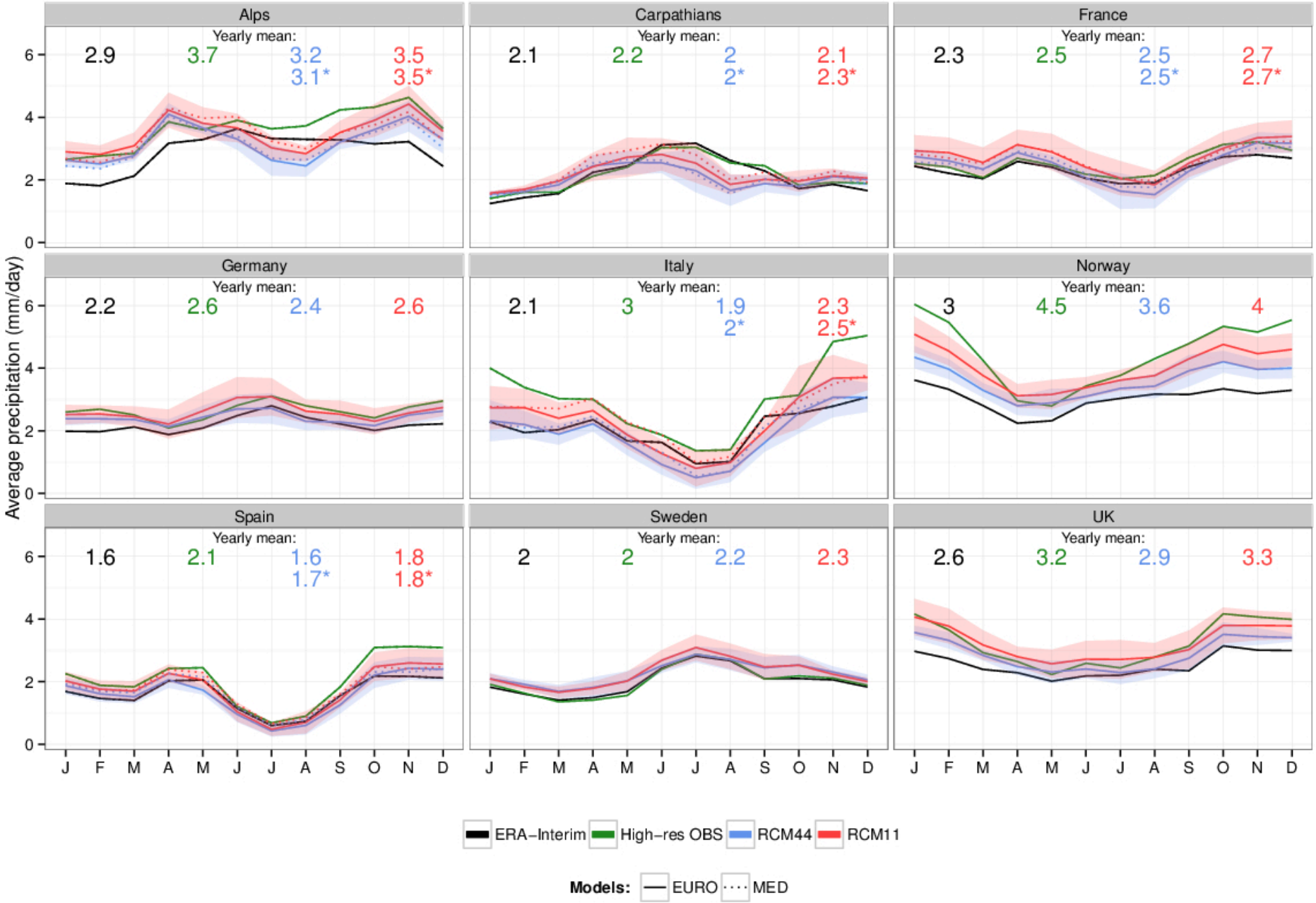


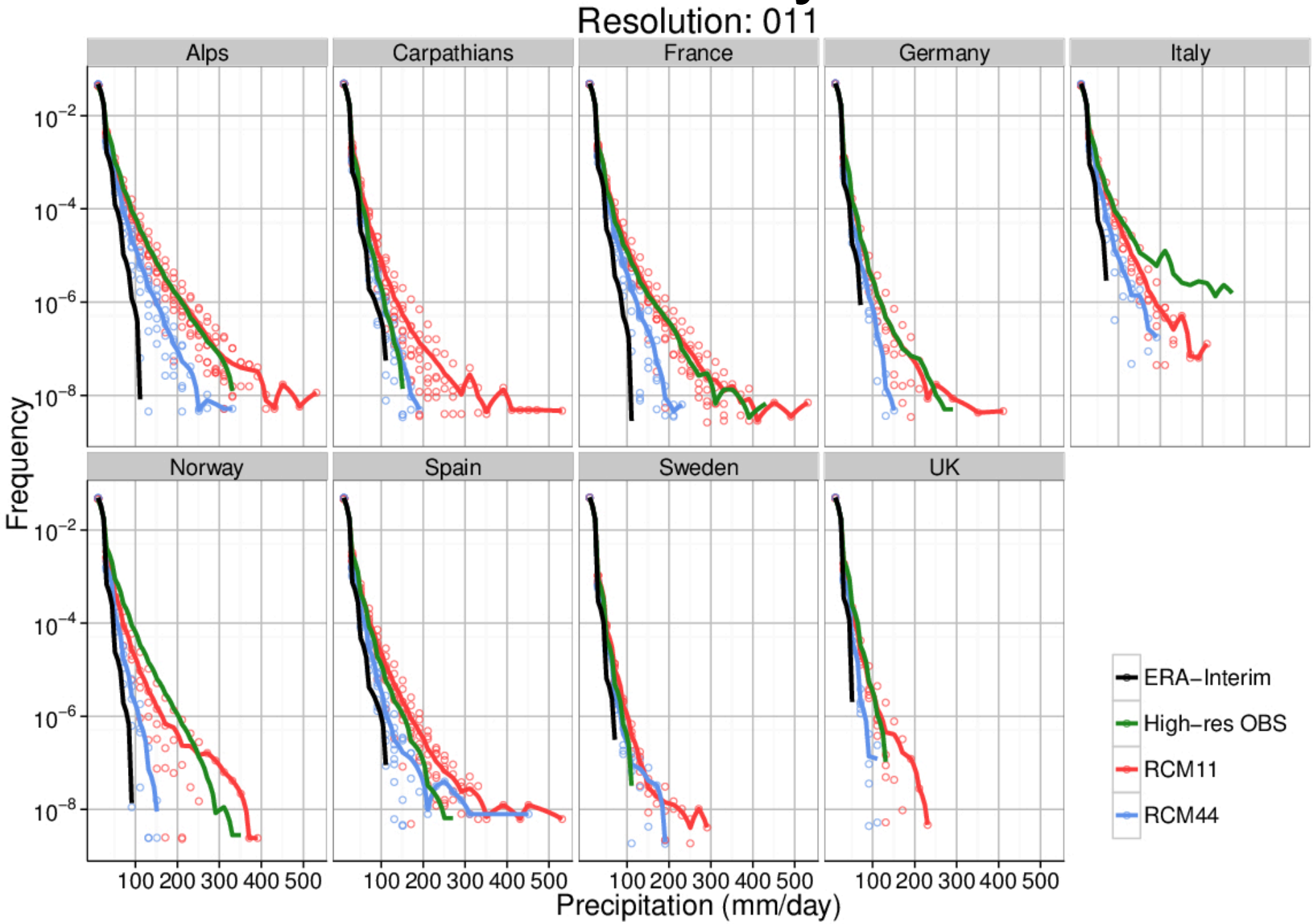


Results for mean precipitation

Annual cycle



Results for daily PDFs



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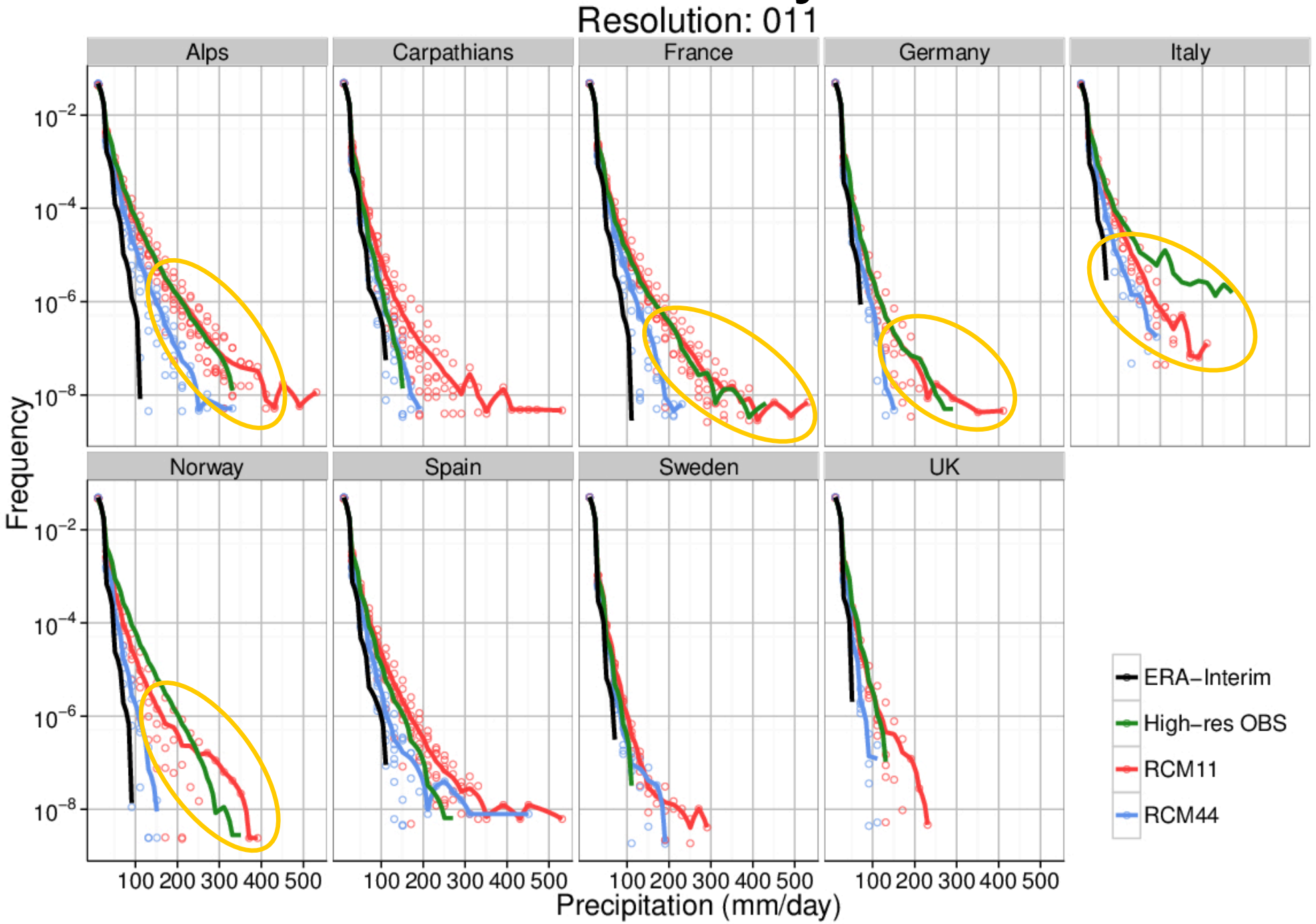
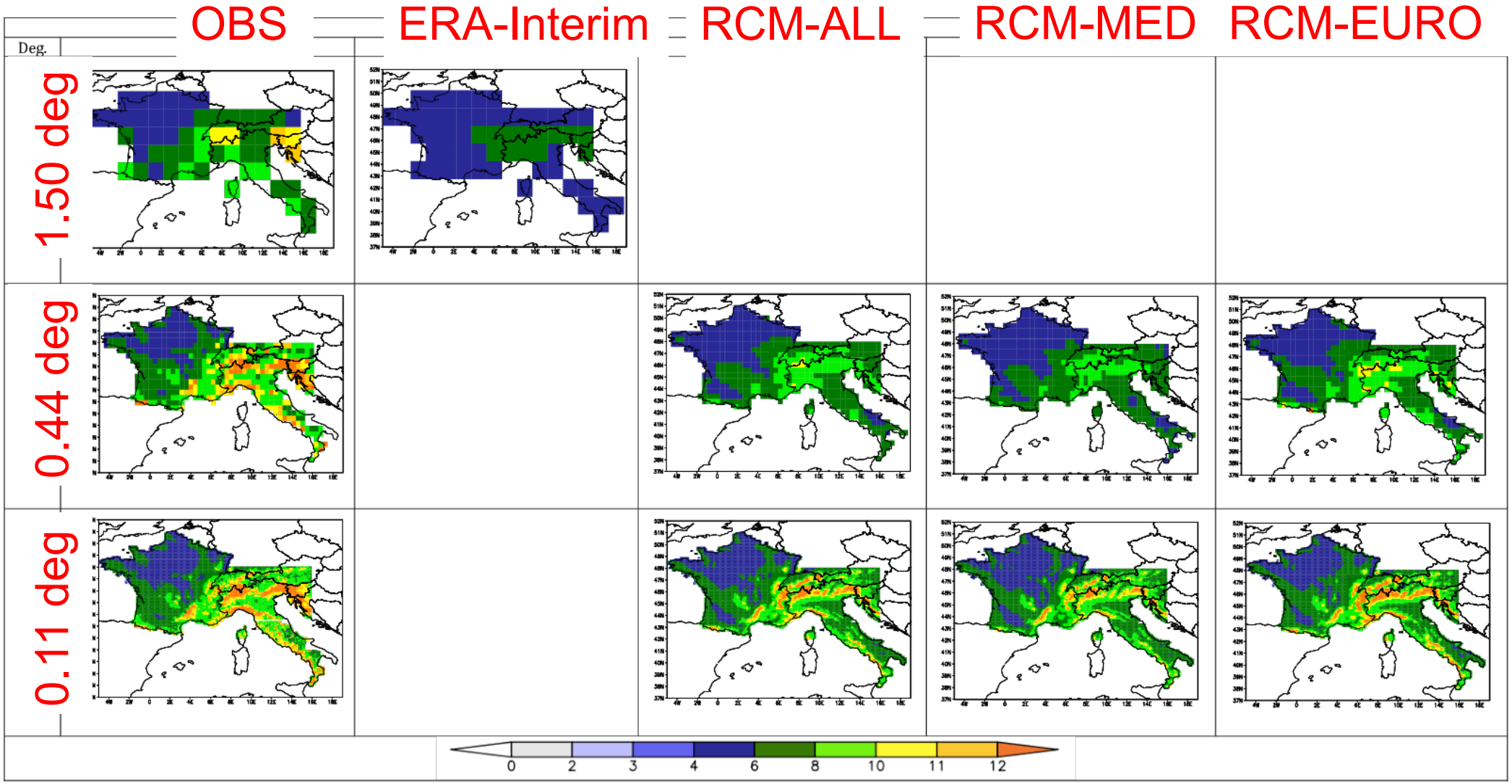


Results for daily precipitation indices

Selected maps: SDII



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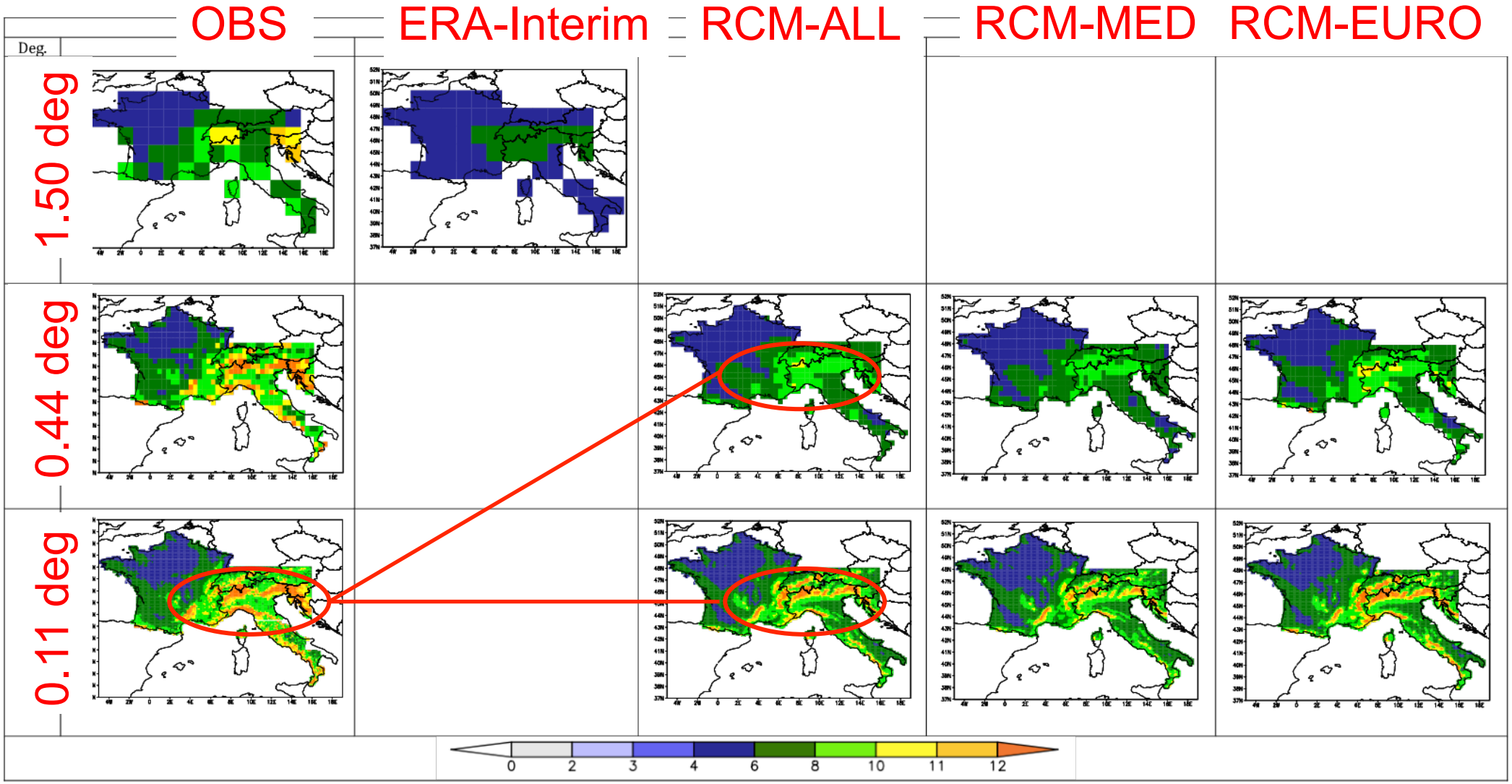

Results for daily precipitation indices

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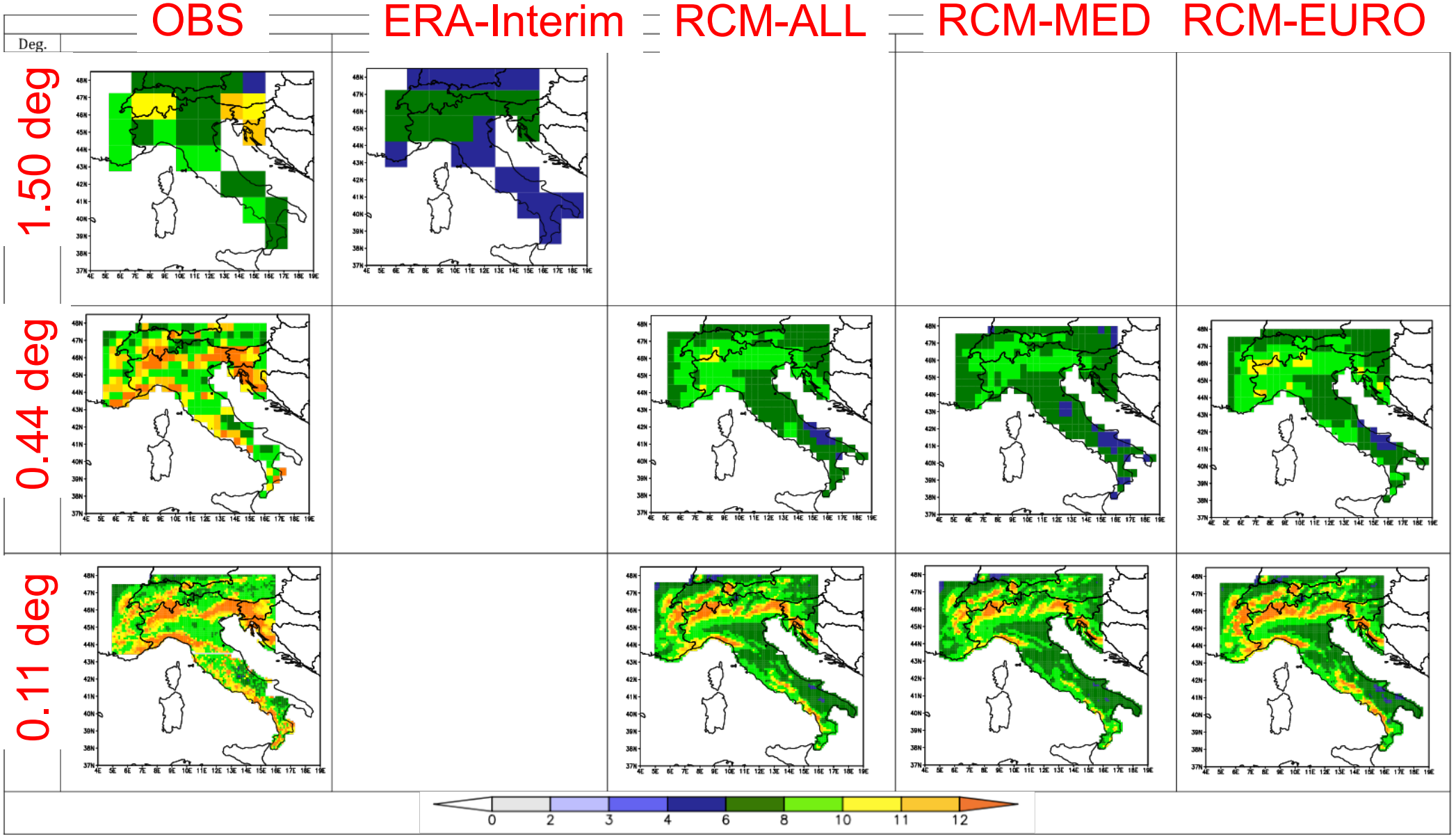

Results for daily precipitation indices

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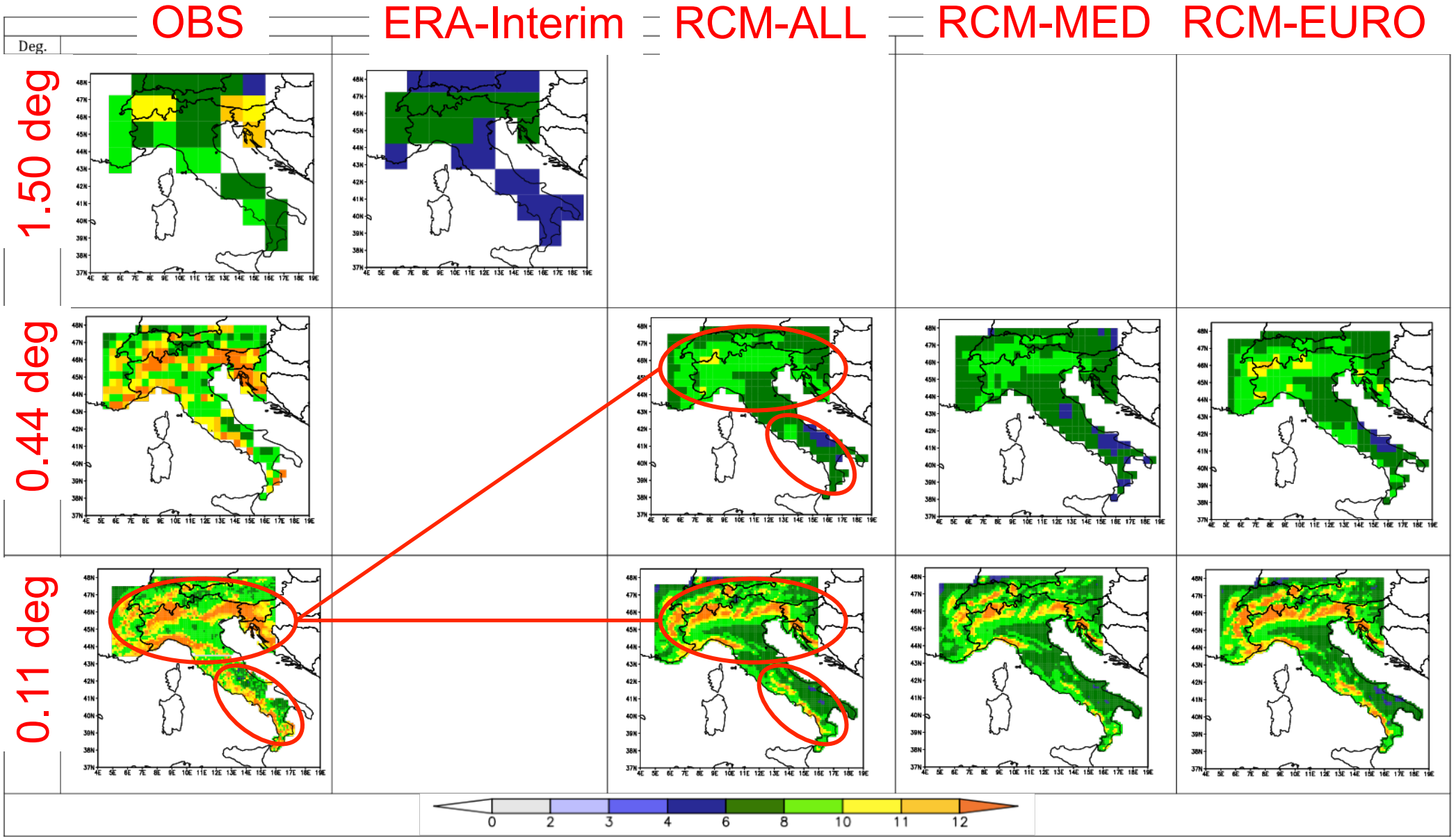
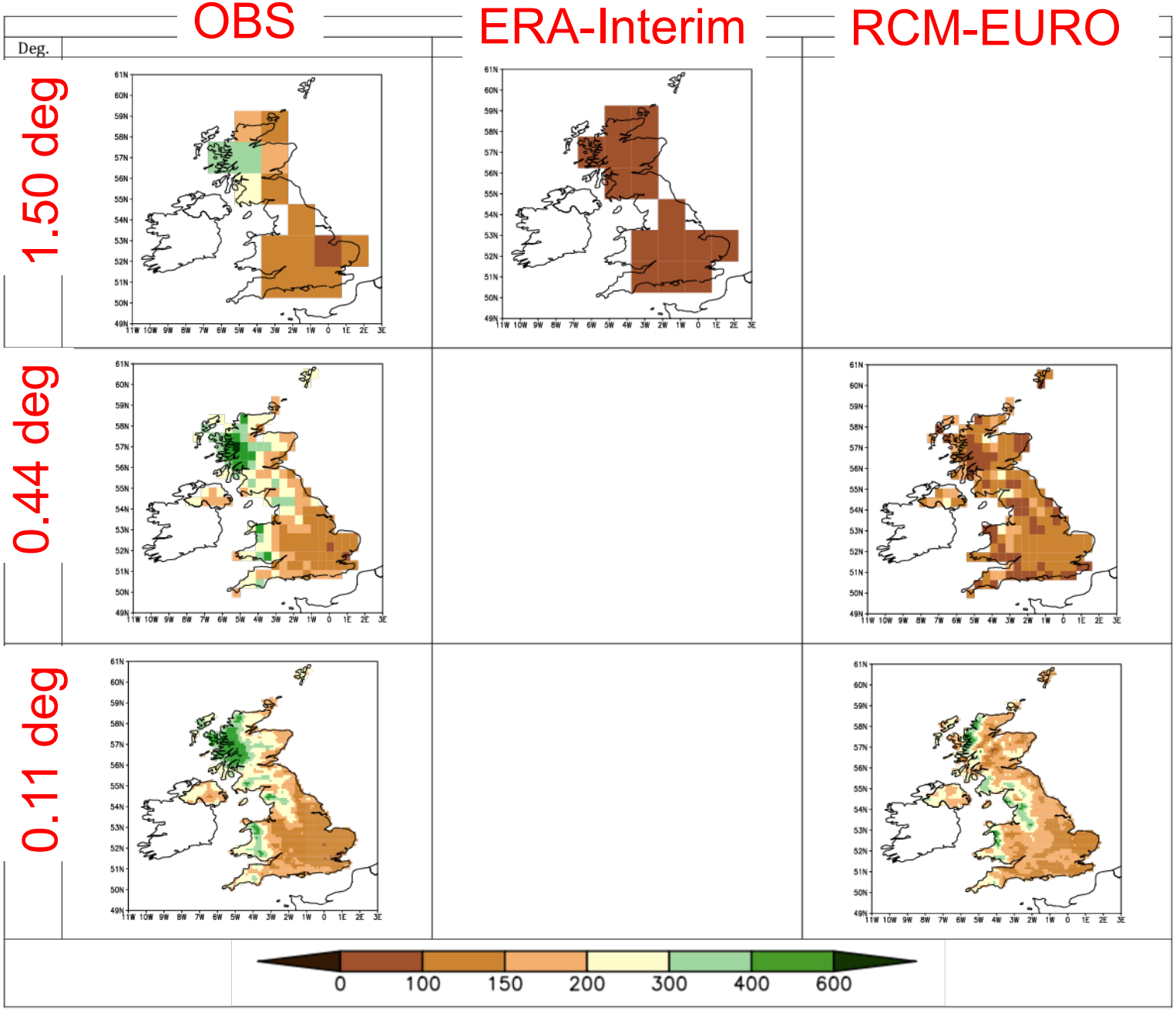


Results for daily precipitation indices

Selected maps: Psum>R95obs



Results for daily precipitation indices

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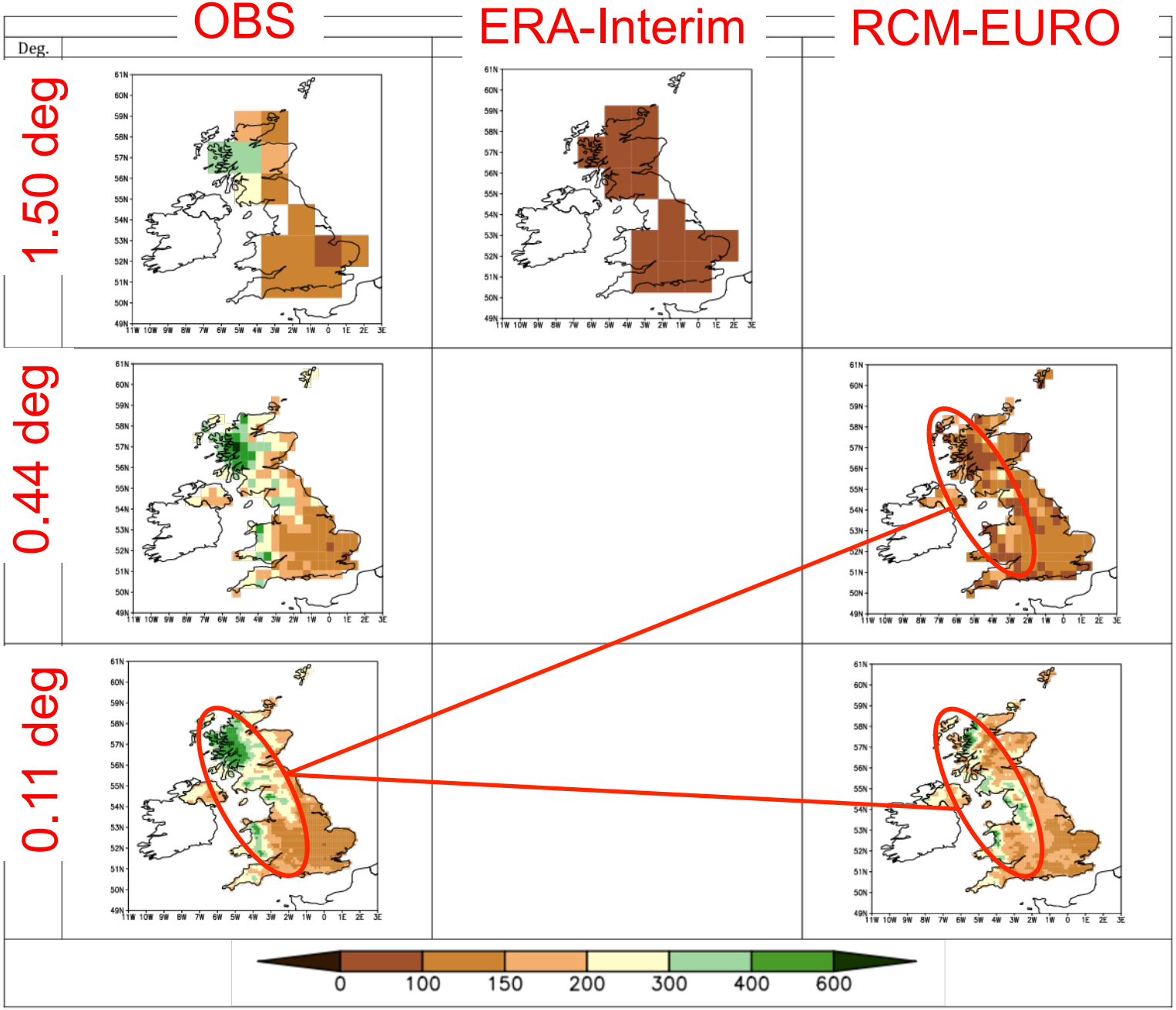
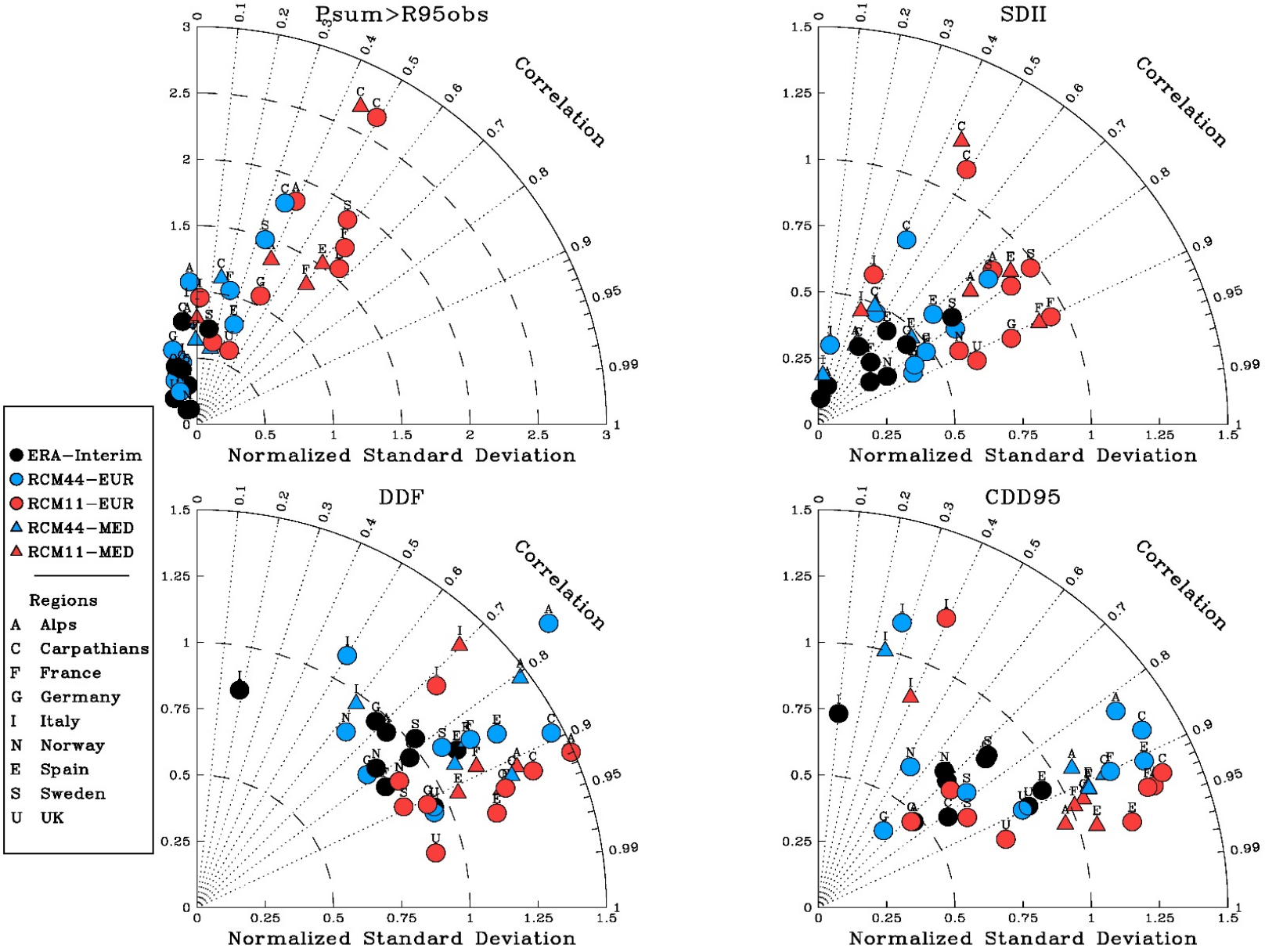


Results for daily precipitation indices

Taylor plots (0.11deg)

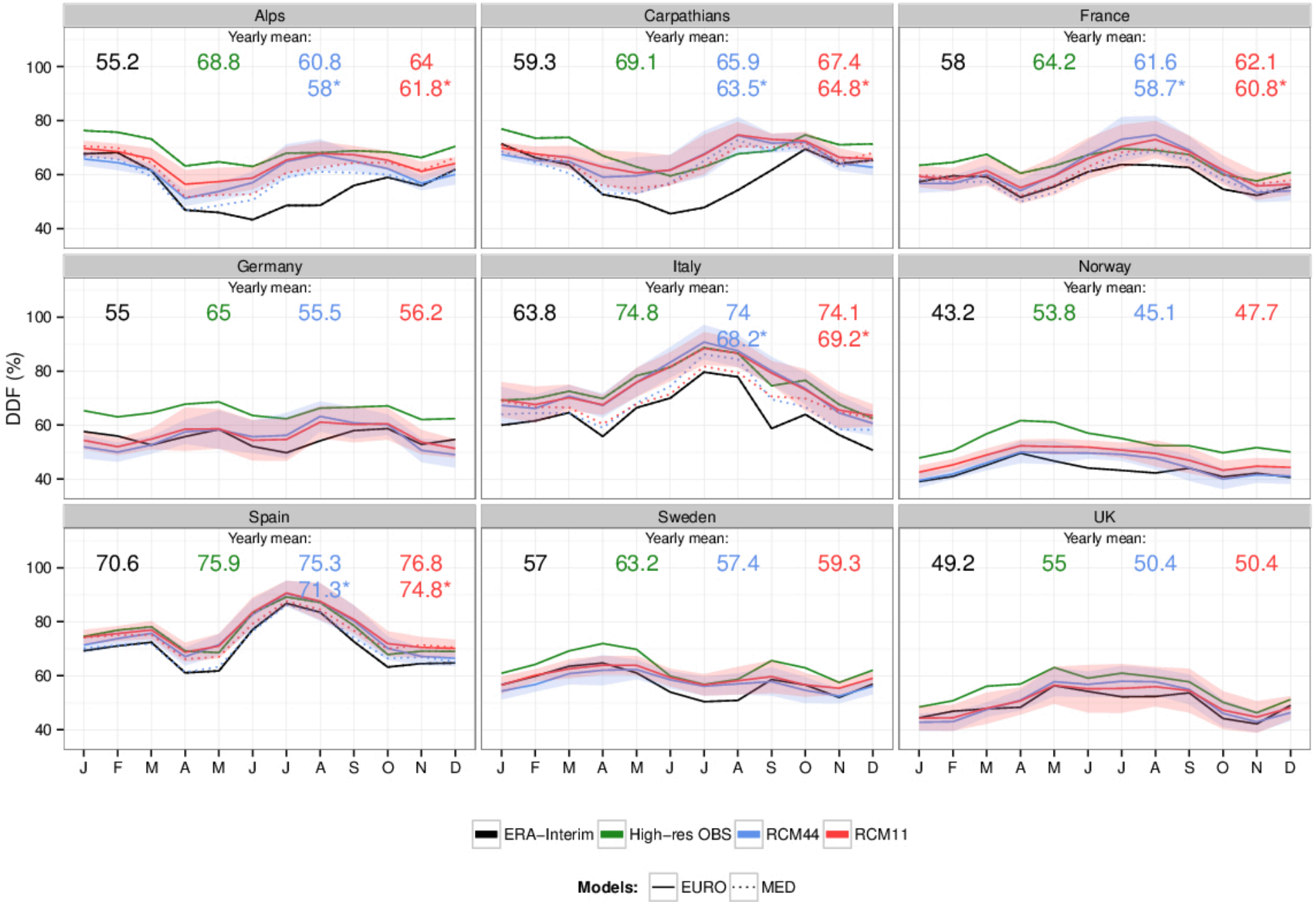


Results for daily precipitation indices

Psum > $R95_{obs}$

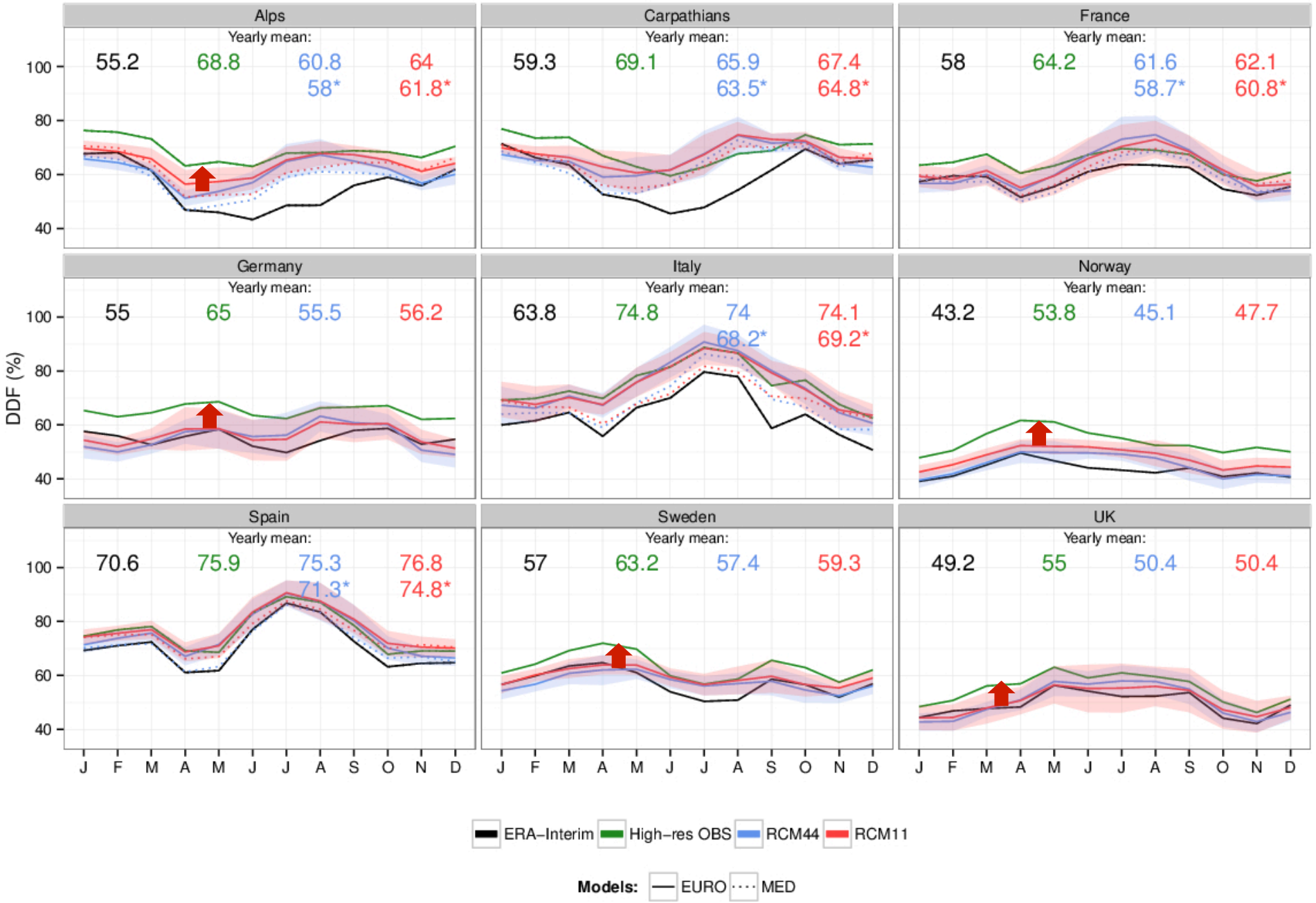
Results for daily precipitation indices

DDF

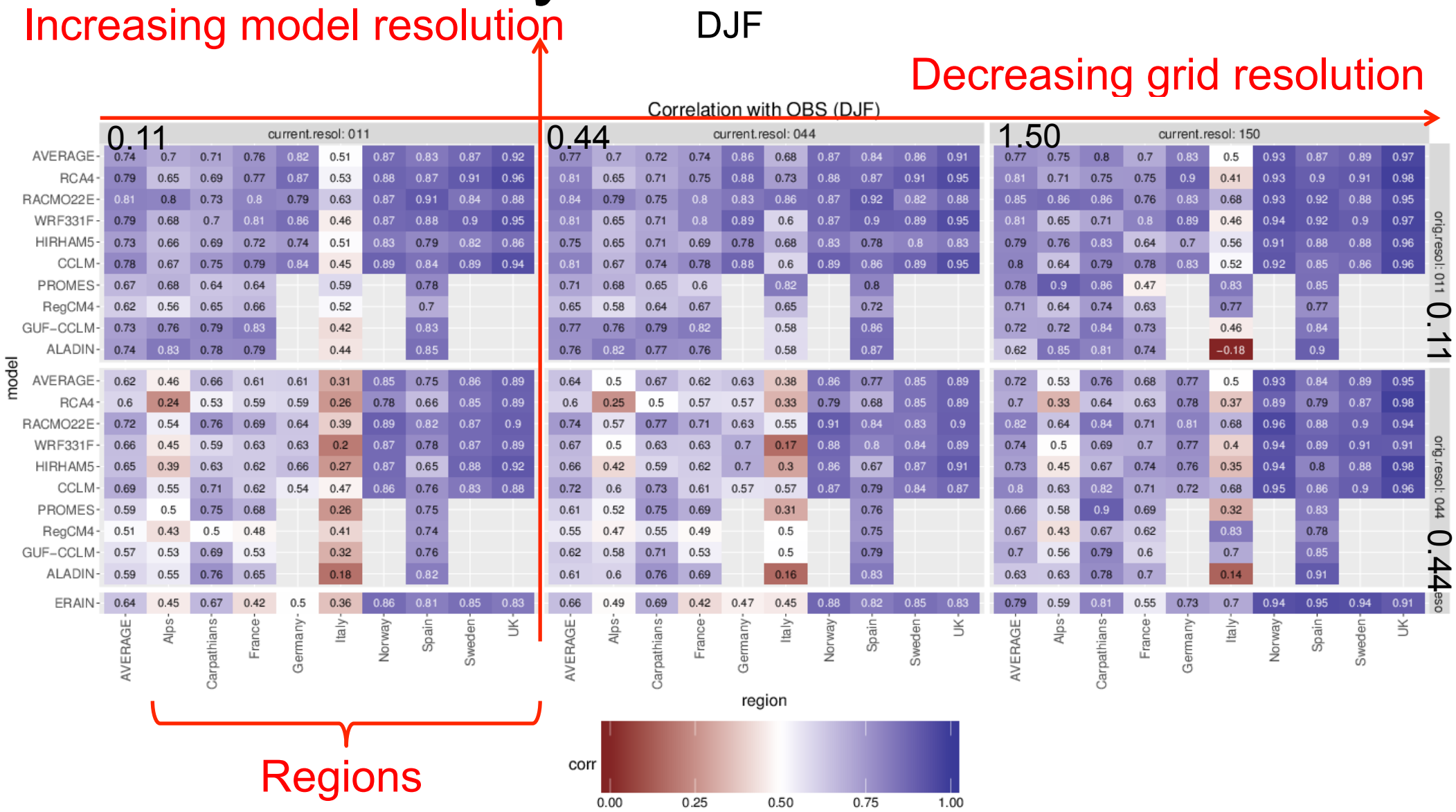


Results for daily precipitation indices

DDF



Model by model correlation



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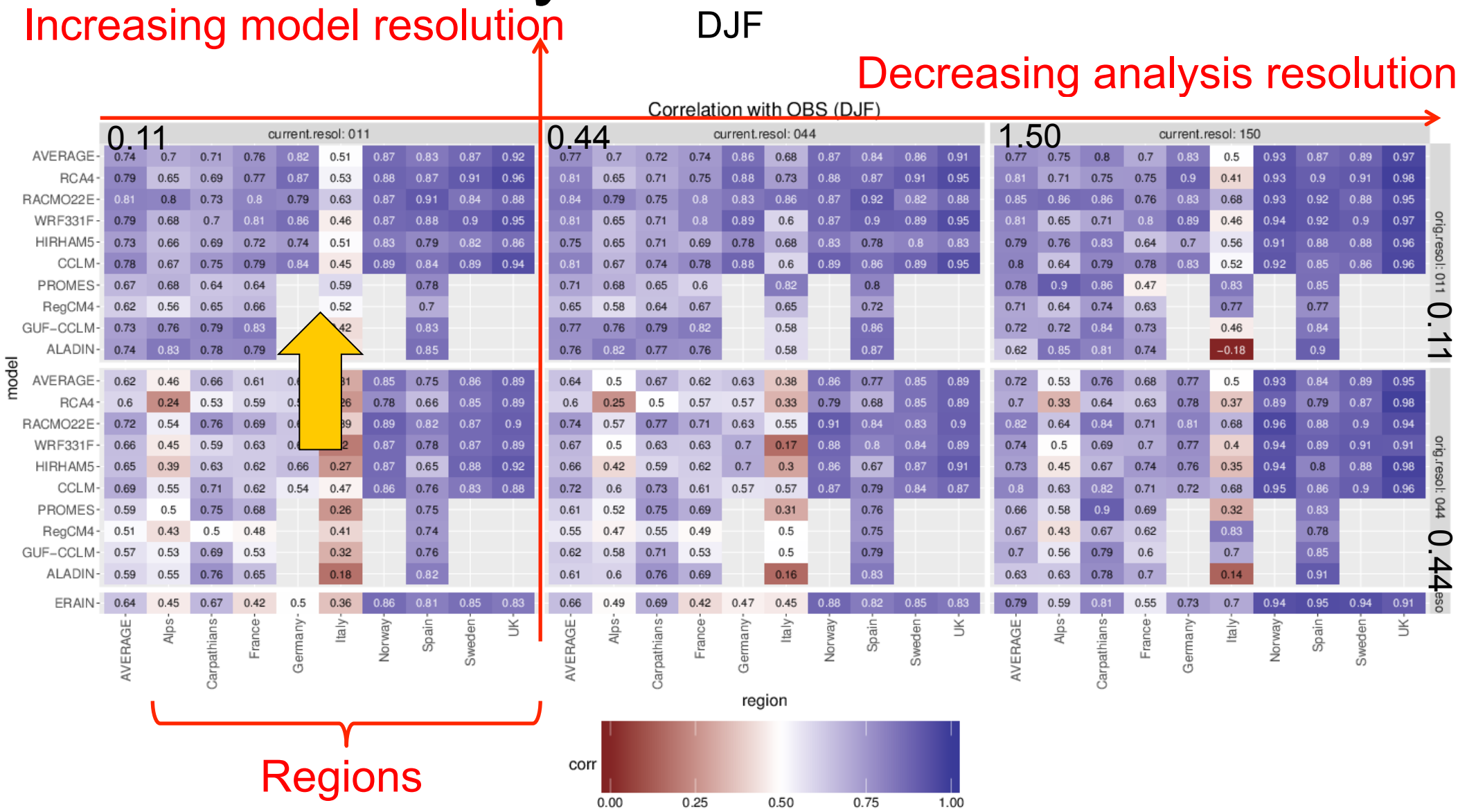

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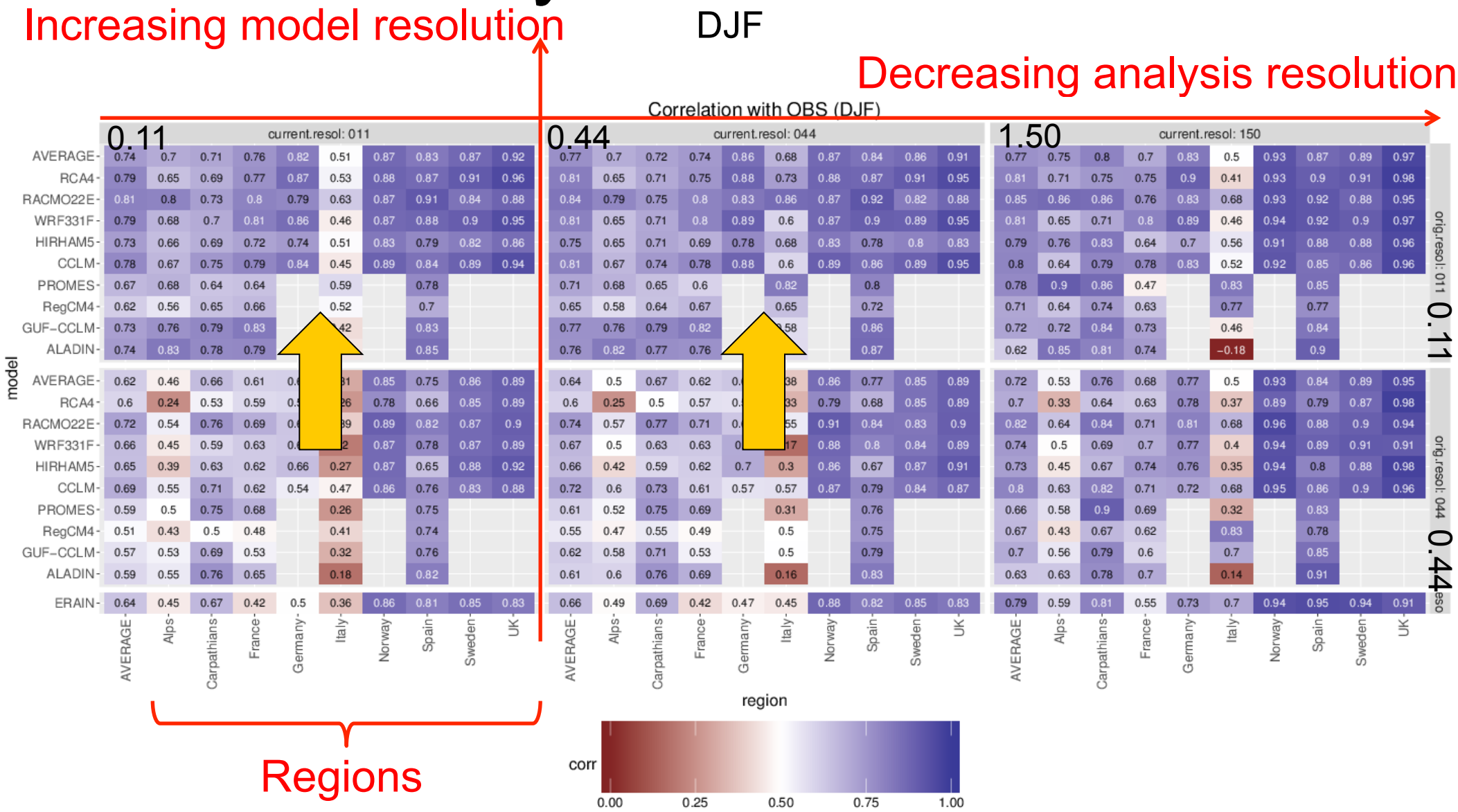

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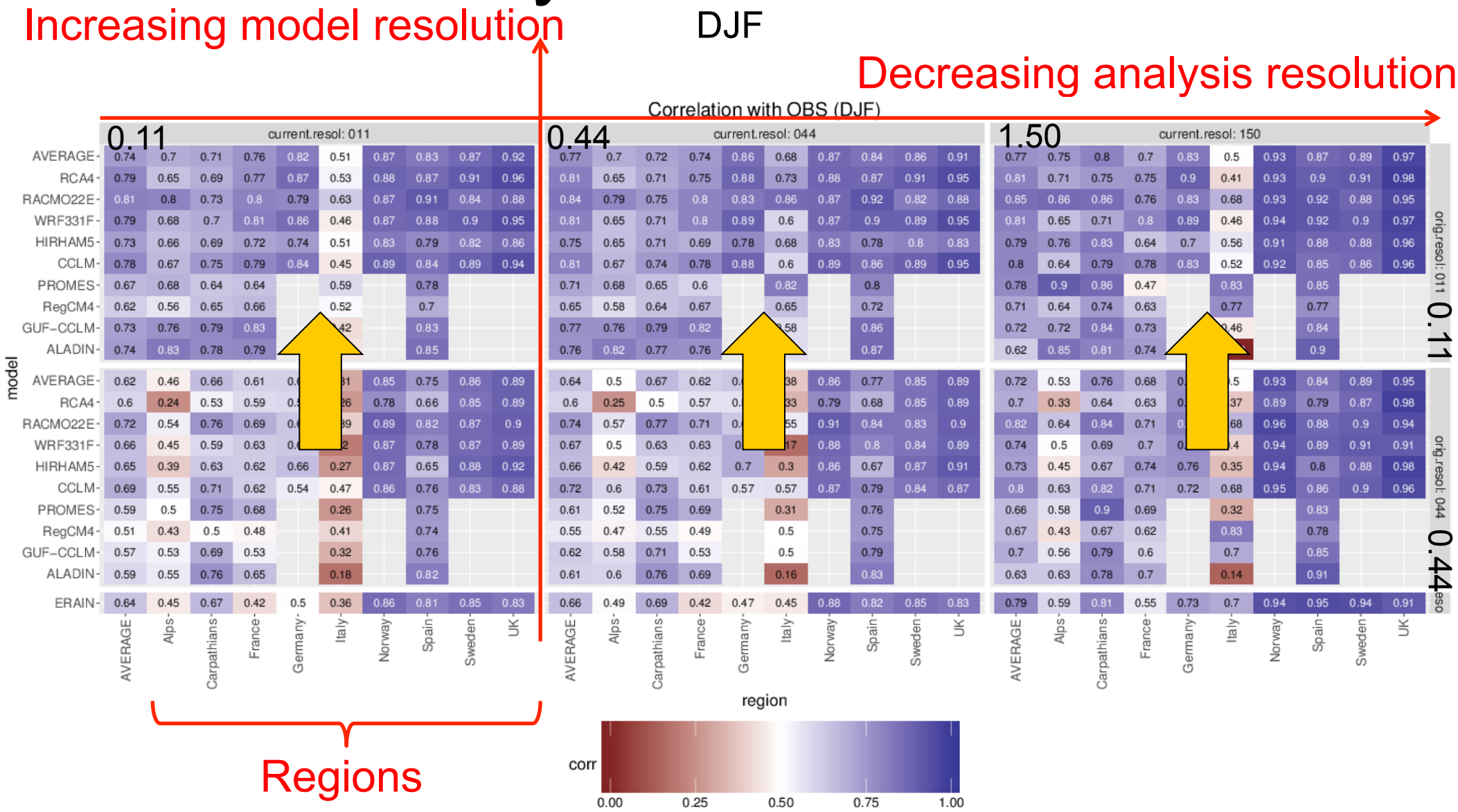

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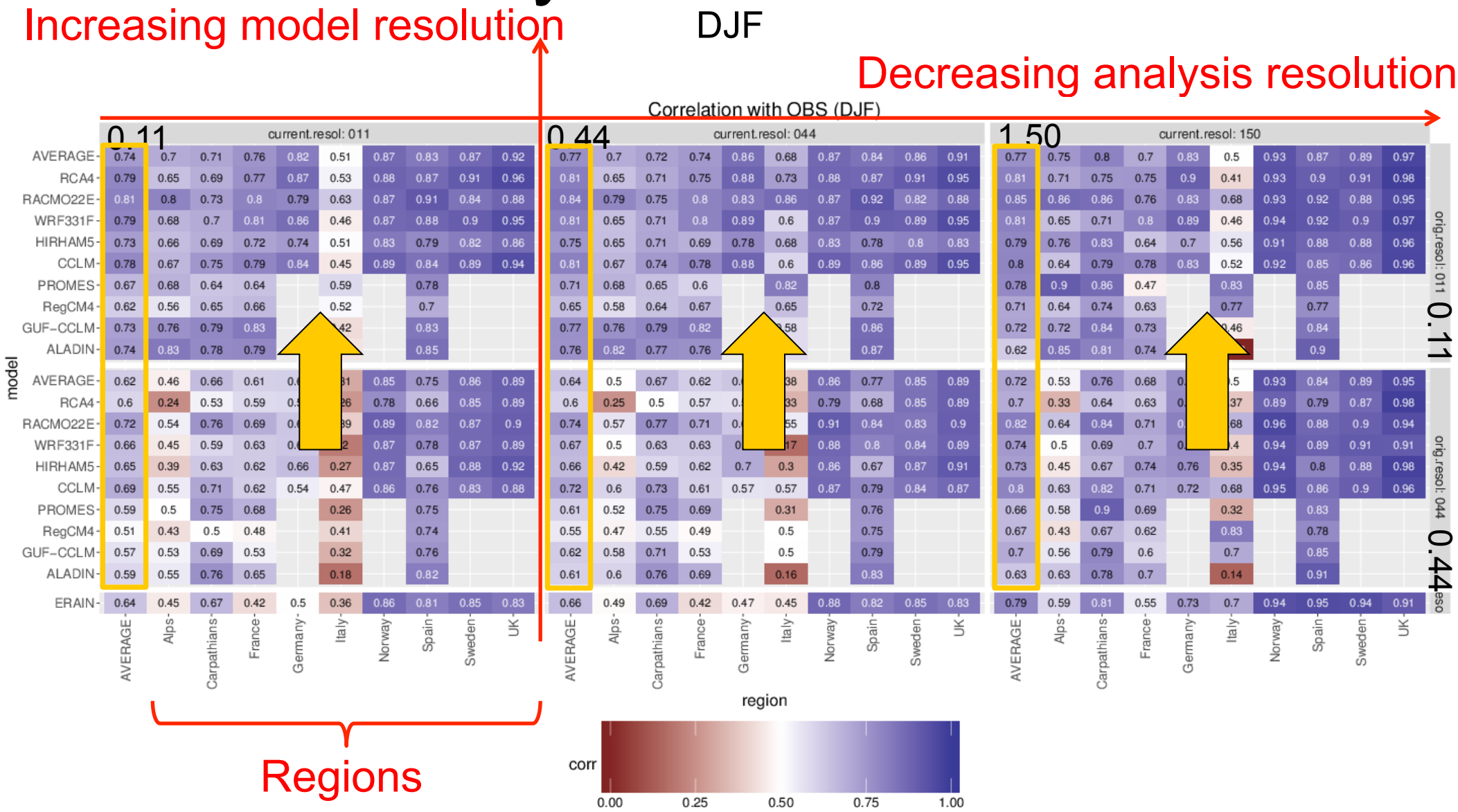


CONCLUSIONS

The model ensembles show **remarkable performance** in simulating the **spatial patterns and annual cycle of all metrics analyzed**, with a substantial improvement going from the low resolution of the ERA-interim data to the medium resolution RCM44ensemble and the high resolution RCM11. This conclusion is **retained** even when the data are **upscaled** to the lower resolution (confirms Torma et al., 2015)

EURO-CORDEX and Med-CORDEX models **have similar performance**; both ensembles are of **sufficient quality** to be applied in **climate projections**

Some metrics (e.g**. DDF and CCD95** in some regions) still indicate **deficiencies** in the model's description of precipitation processes mainly due to the **drizzle phenomenon** that is **not solved** only by **increasing resolution**, but there are indications that this problem might be ameliorated which cloud and **convection** processes are **explicitly described**.

Need to develop a homogeneous and internally consistent **high resolution, quality checked, observation dataset** for the entire European territory which can be used for future development of very high resolution, European-wide models.

THANKS!

Paper reference:

Fantini A., Raffaele F., Torma C., Bacer S., Coppola E., Giorgi F., Ahrens B., Dubois C., Sanchez E., Verdecchia M. **Assessment of multiple daily precipitation statistics in ERA-Interim driven Med-CORDEX and EURO-CORDEX experiments against high resolution observations**.

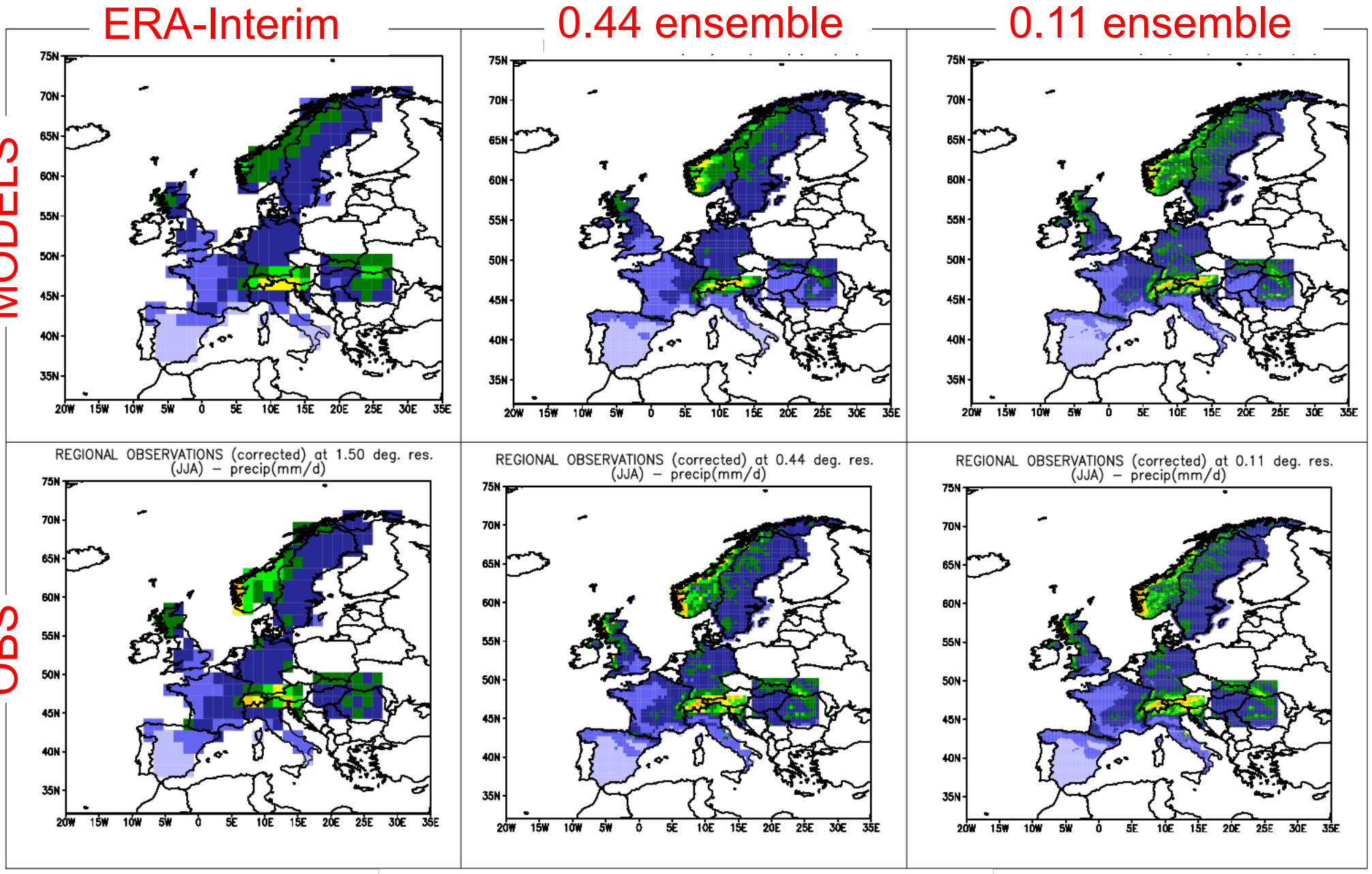
Submitted to Climate Dynamics, 2016

Speaker: Adriano Fantini, 1st year PhD, University of Trieste

Supervisor: Erika Coppola, ICTP, Trieste

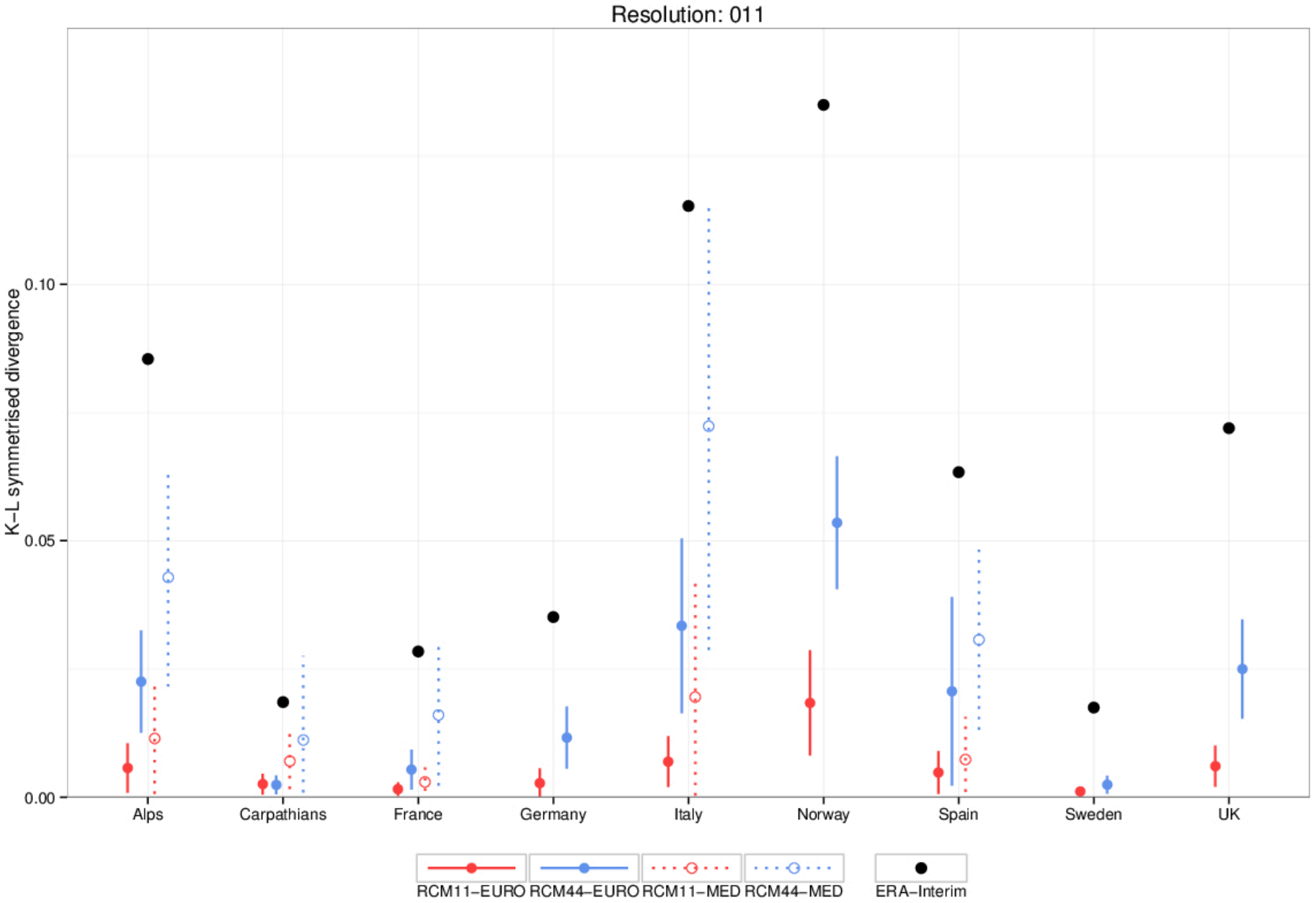
Contact: afantini@ictp.it

Results for mean precipitation (JJA)



Results for daily PDFs

Kullback-Leibler divergence



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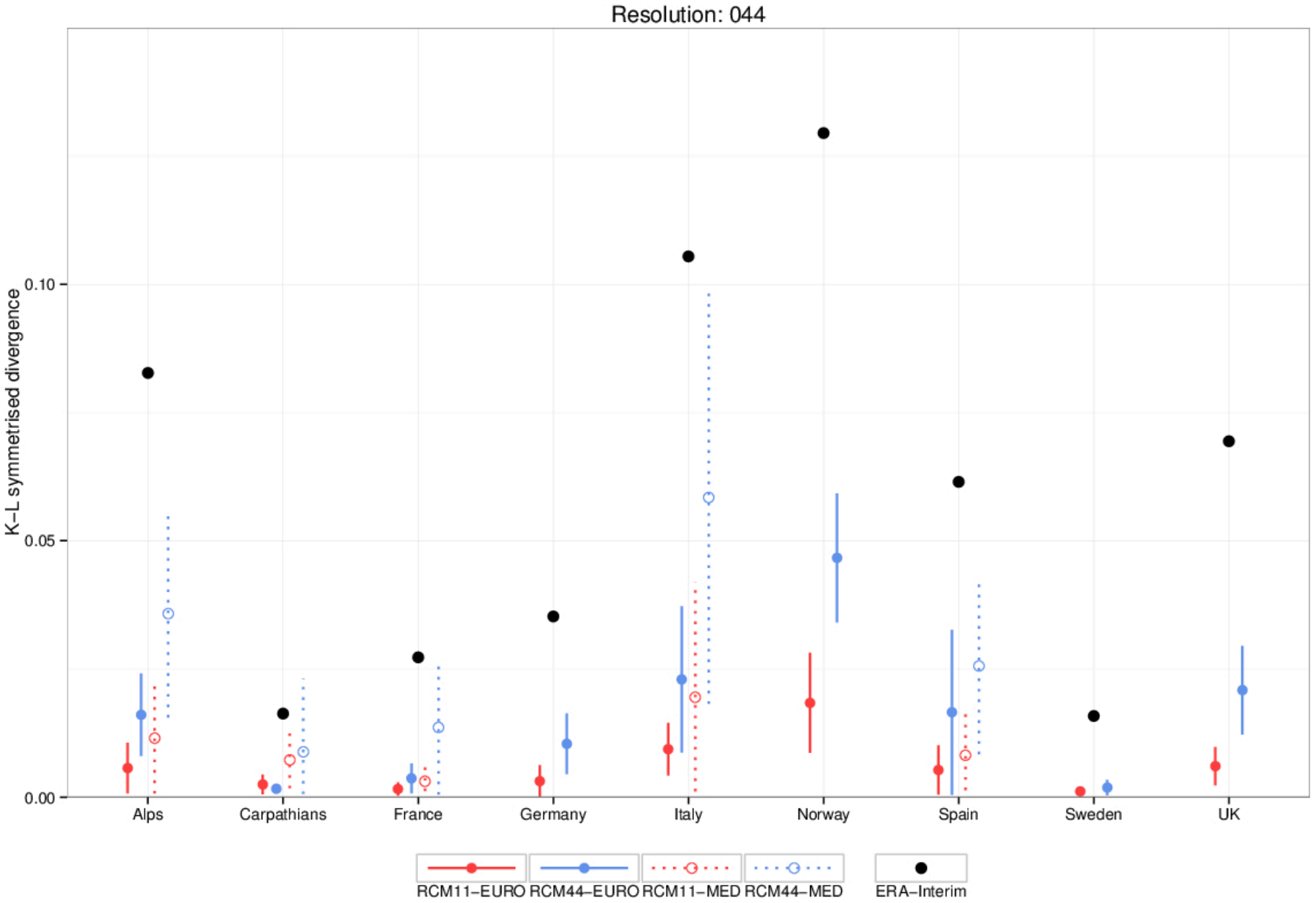

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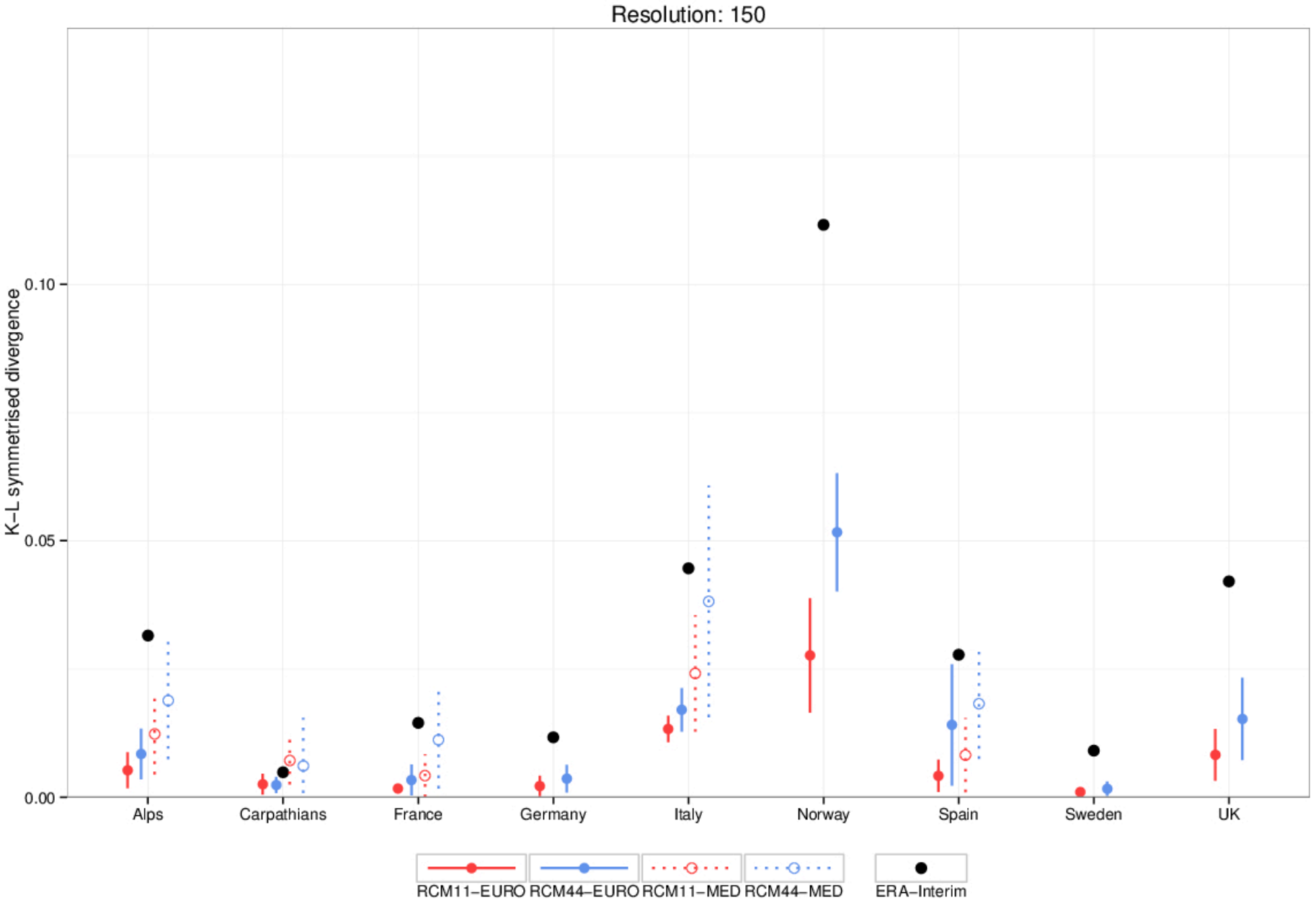
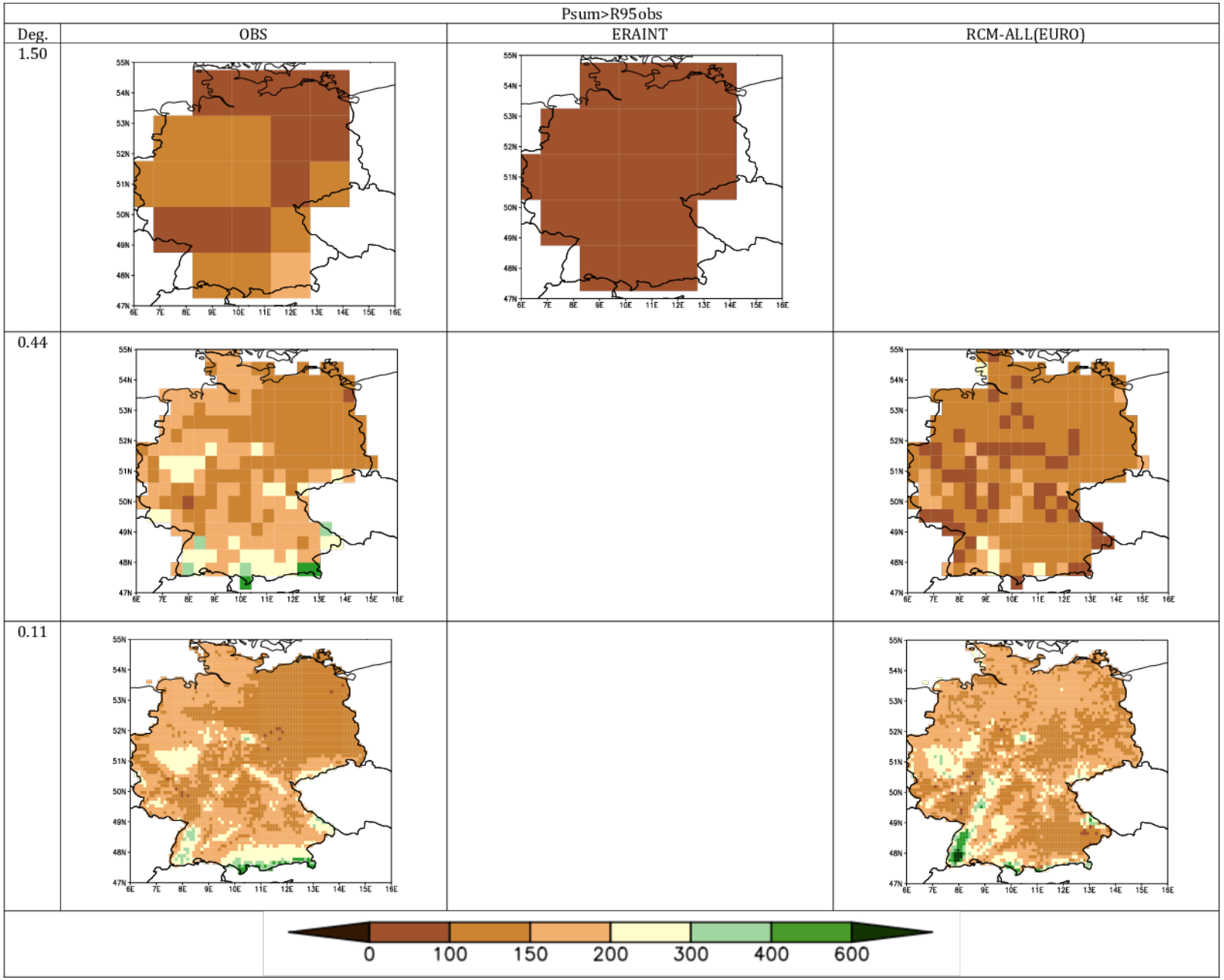


Results for daily precipitation indices

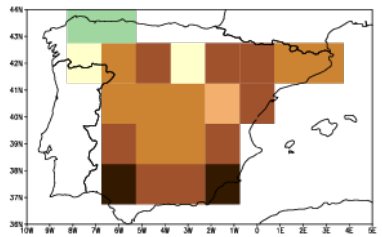
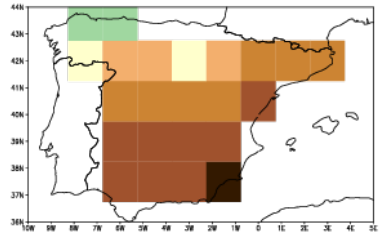
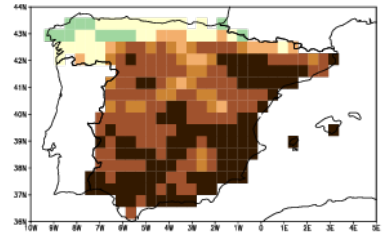
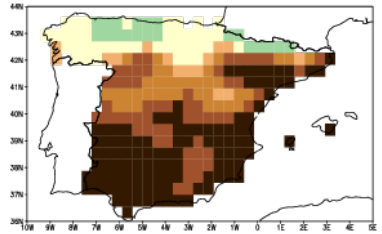
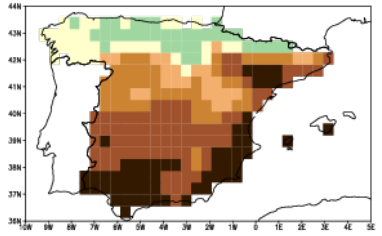
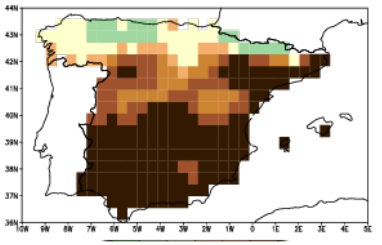
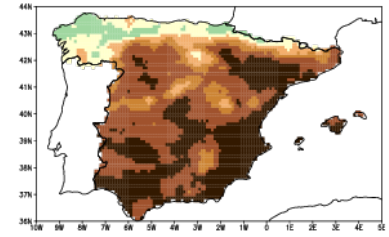
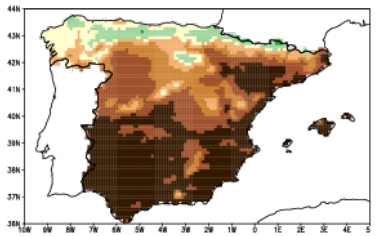
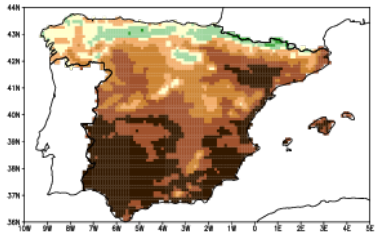
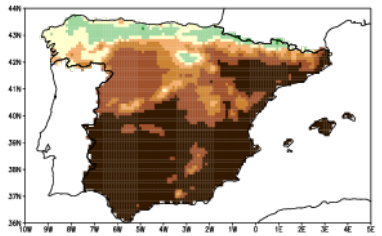
Selected maps: Psum>R95obs

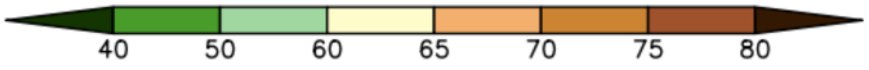


Results for daily precipitation indices

Selected maps: DDF

DDF

Deg.	OBS	ERAINT	RCM-ALL	RCM-MED	RCM-EURO
1.50					
0.44					
0.11					

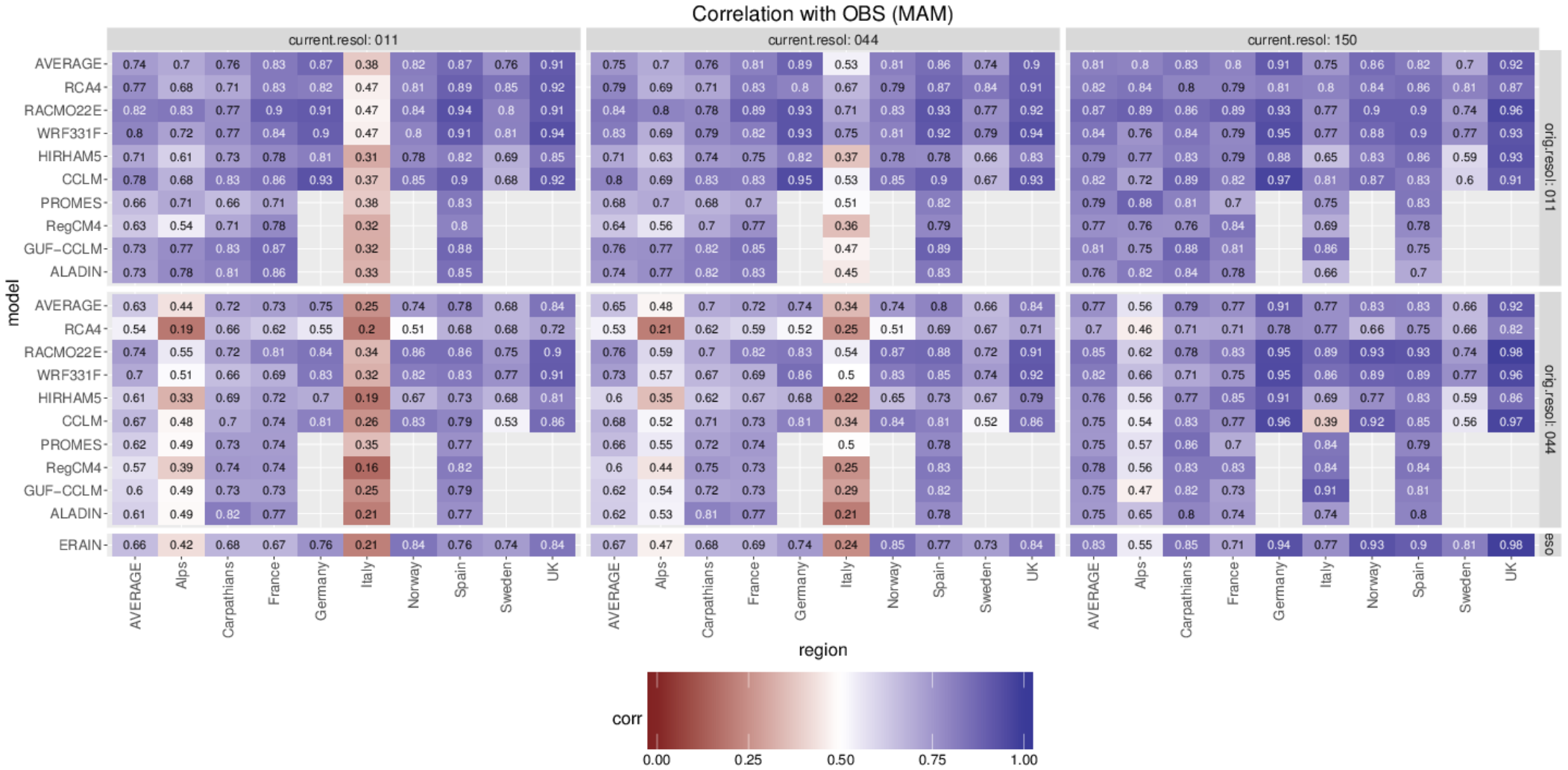


Results for daily precipitation indices

SDII

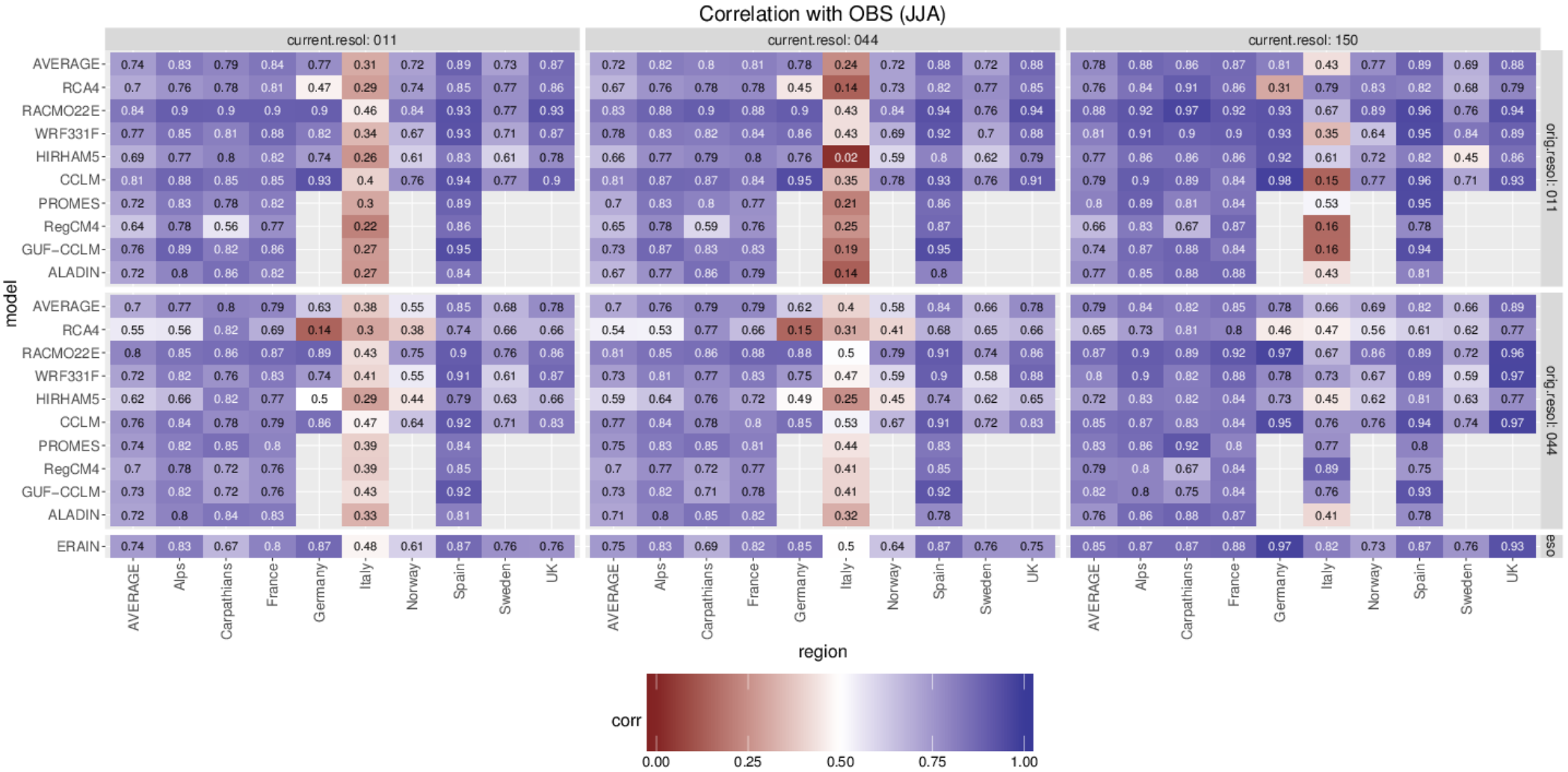
Model by model correlation

MAM



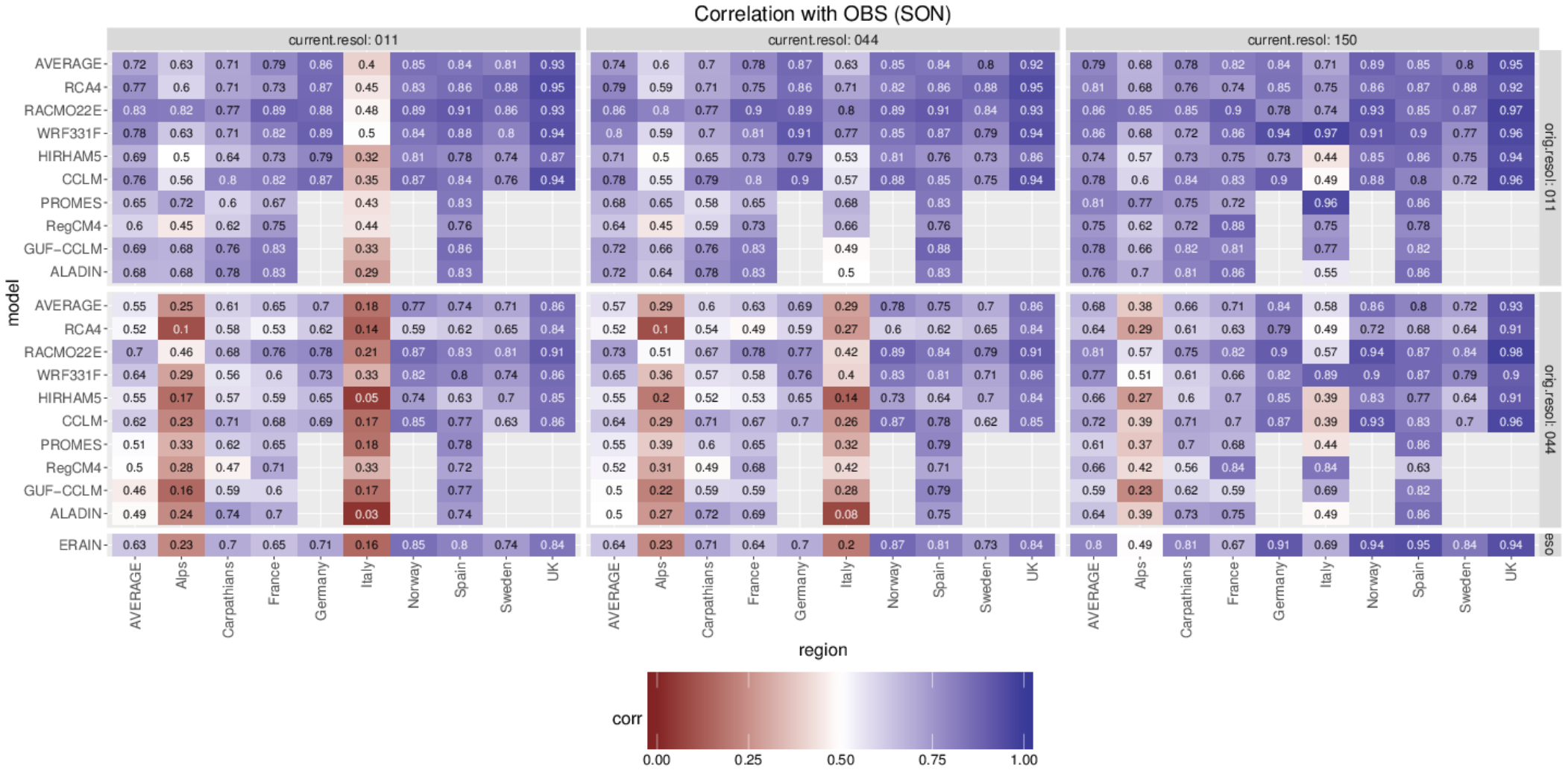
Model by model correlation

JJA



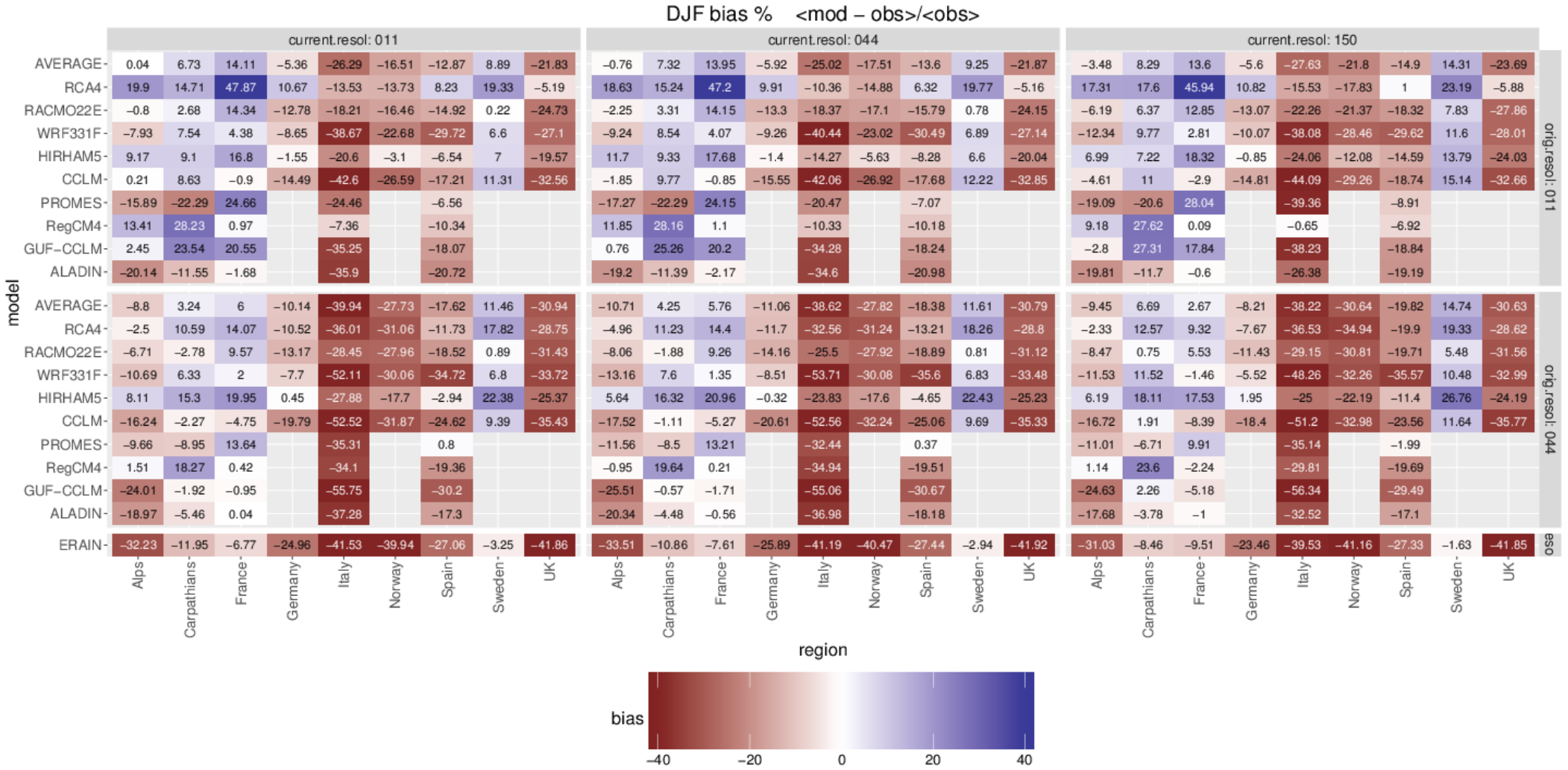
Model by model correlation

SON



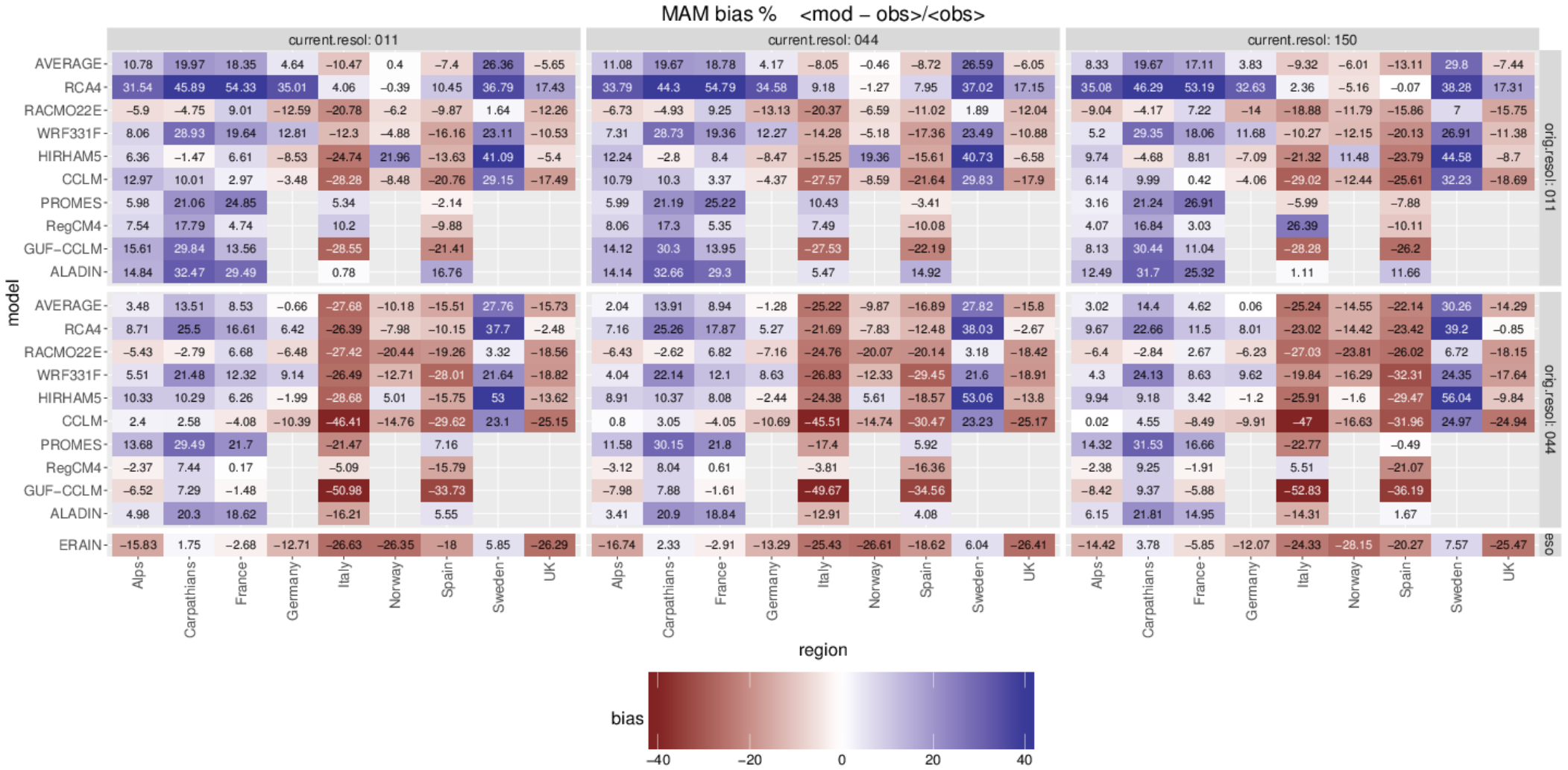
Model by model bias

DJF



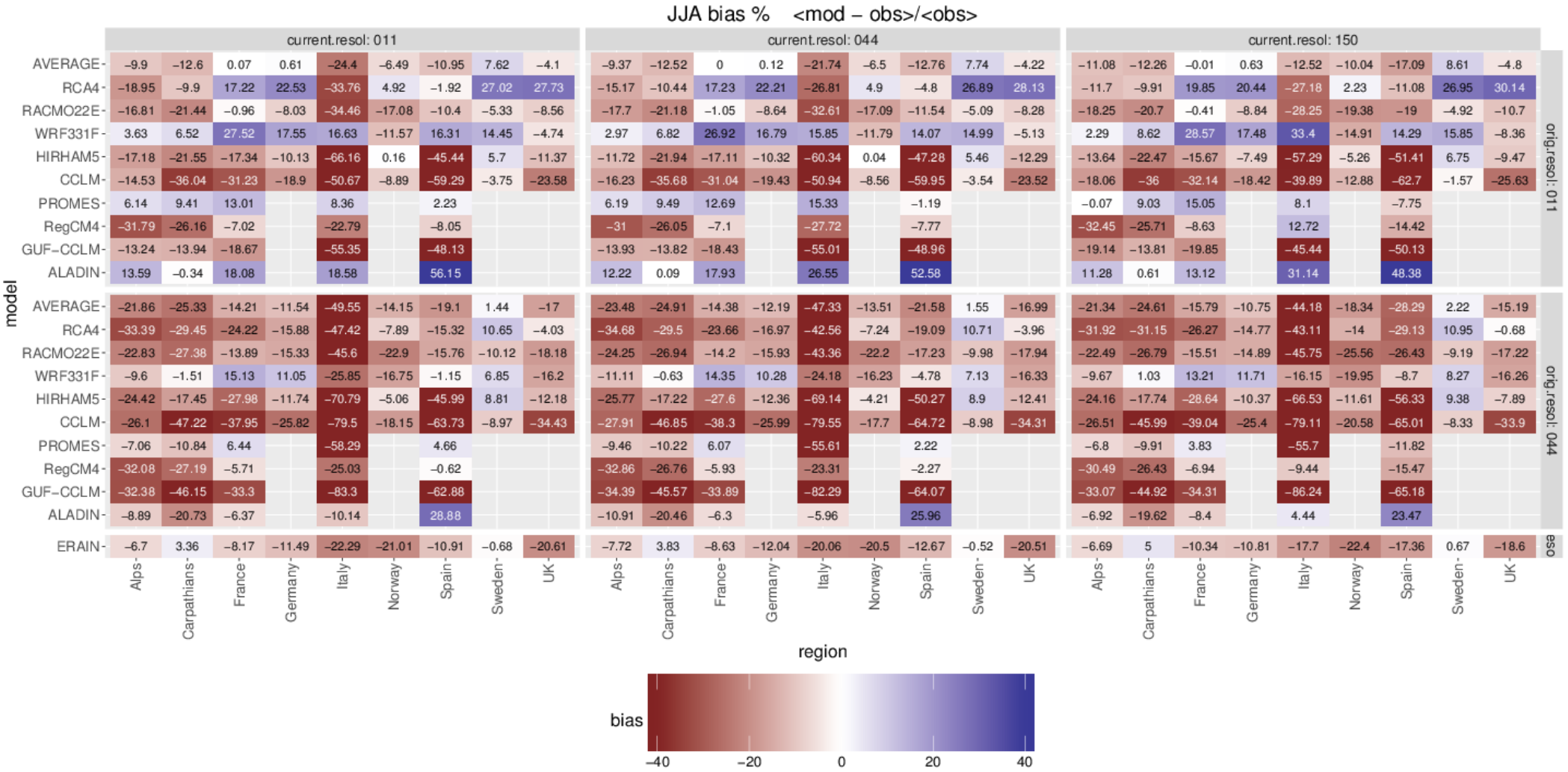
Model by model bias

MAM



Model by model bias

JJA



Model by model bias

SON