Meteorološki izazovi 2:
"Meteorologija u fokusu javnosti"

Oborina u kompleksnoj topografiji simulirana regionalnim klimatskim modelom RCA3

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DHMZ
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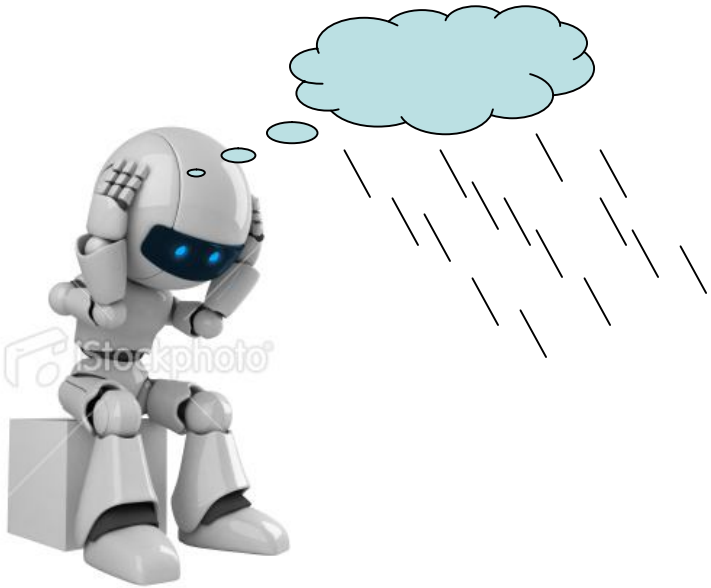
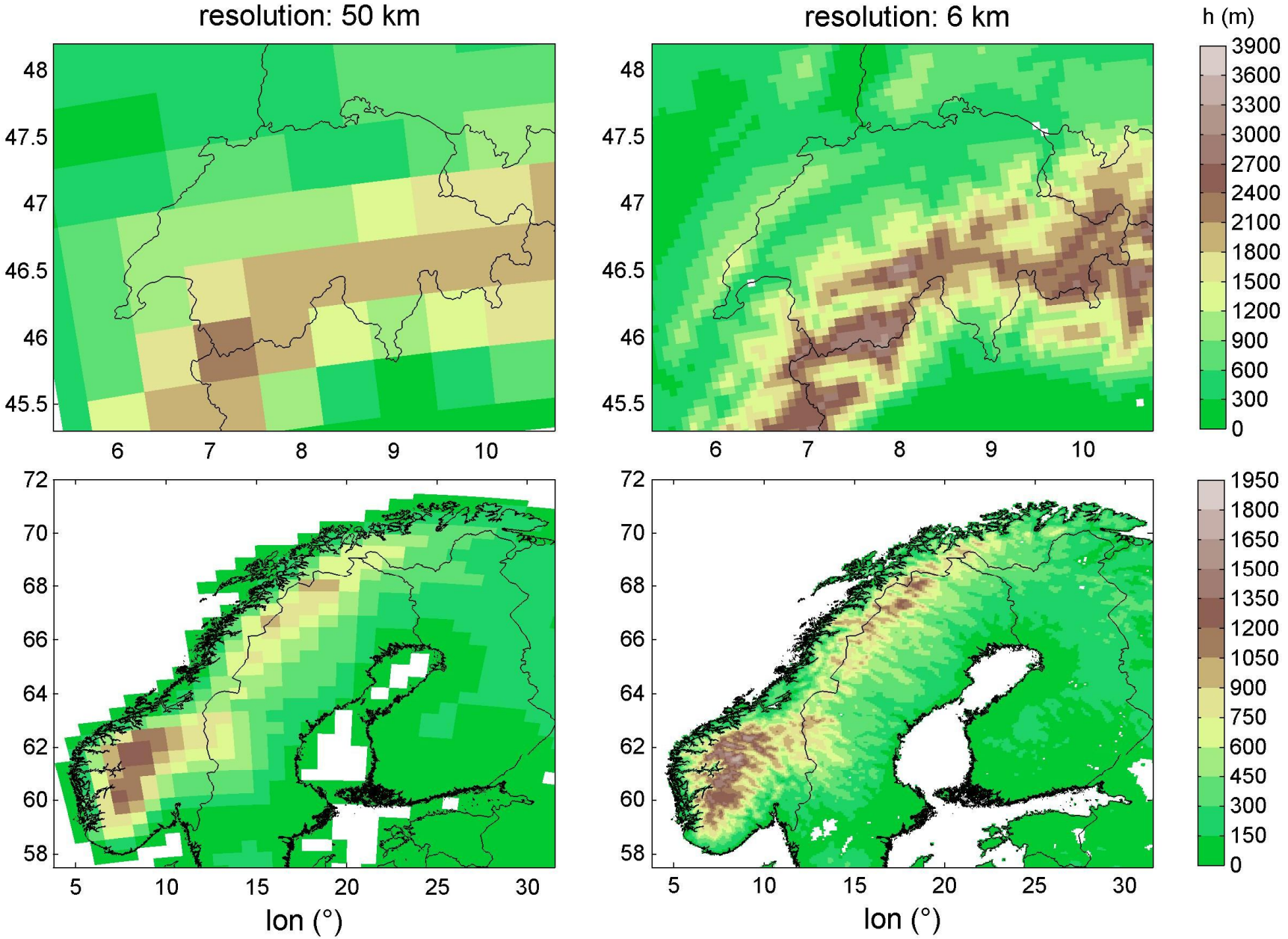
SMHI

Opis eksperimenta:

Mjerenja	EOBSv4, EOBSv5 (**50 km**, **25 km**) Haylock et al. (2008) METEOSWISS RhiresD (**2.2 km**) www.meteoswiss.admin.ch/web/en/services/data_portal/grided_datasets.html METNO KLIMAGRID (**1 km**) Mohr (2007)
Model	RCA3 (**~50 km**, **~25 km**, **~12 km**, **~6 km**) Samuelsson et al. (2011)
Vremenski period	1987-2008.

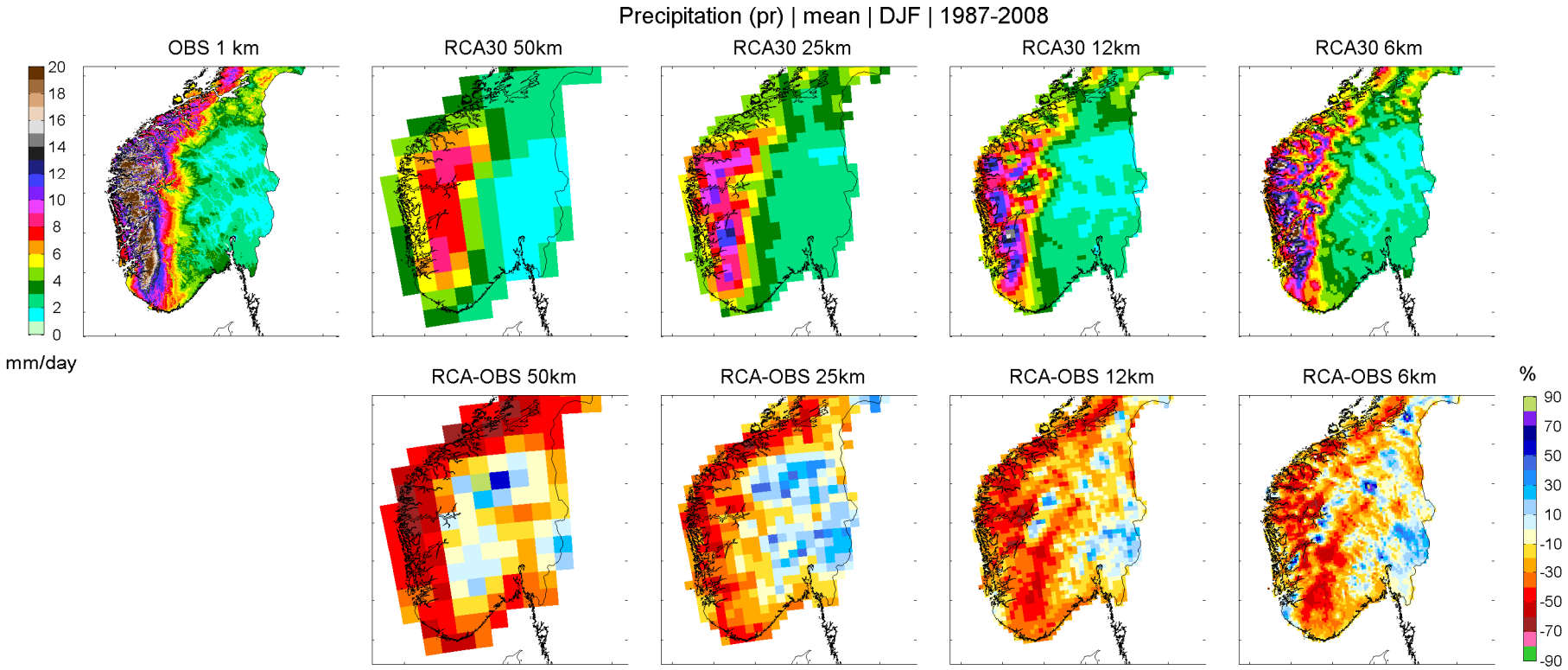
vs.





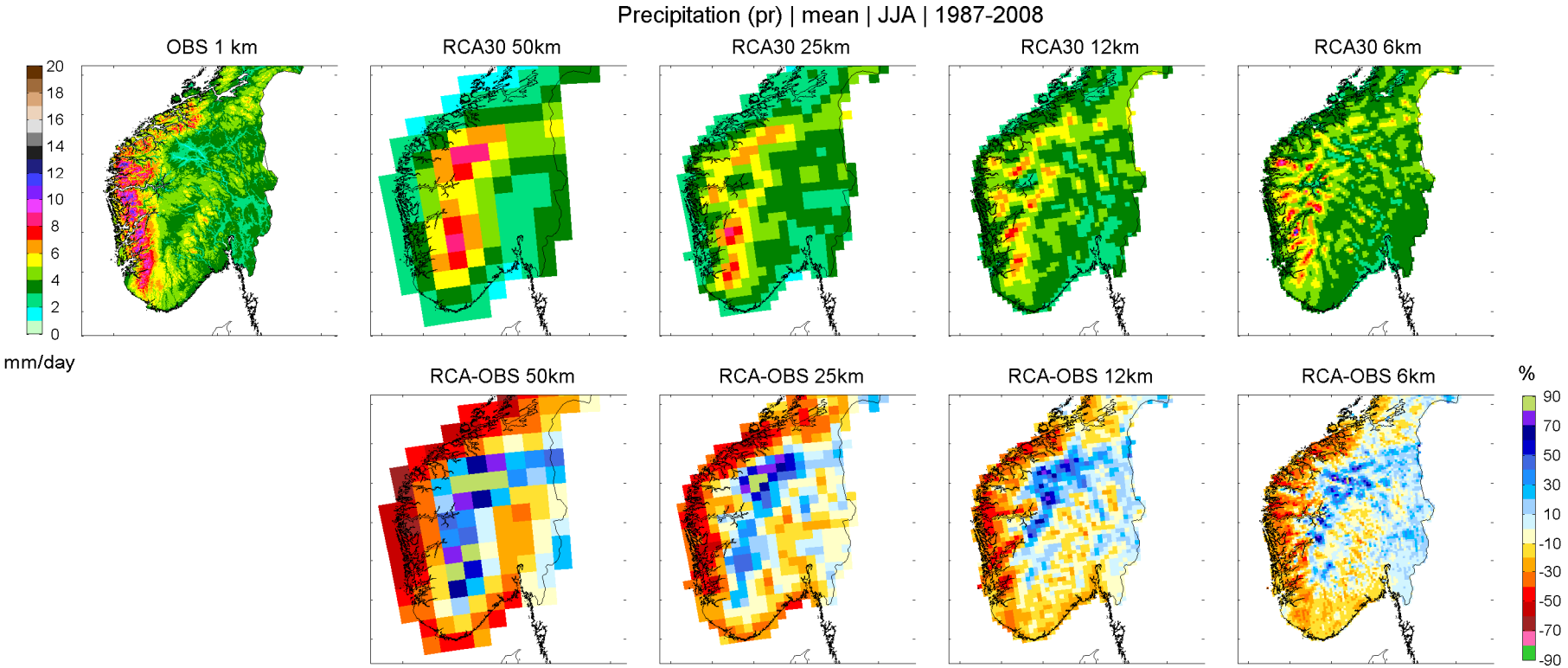
Visina topografije iznad Švicarske i Norveške u modelu RCA3 na rezolucijama 50 km i 6 km.

Srednja ukupna količina oborine: **DJF**

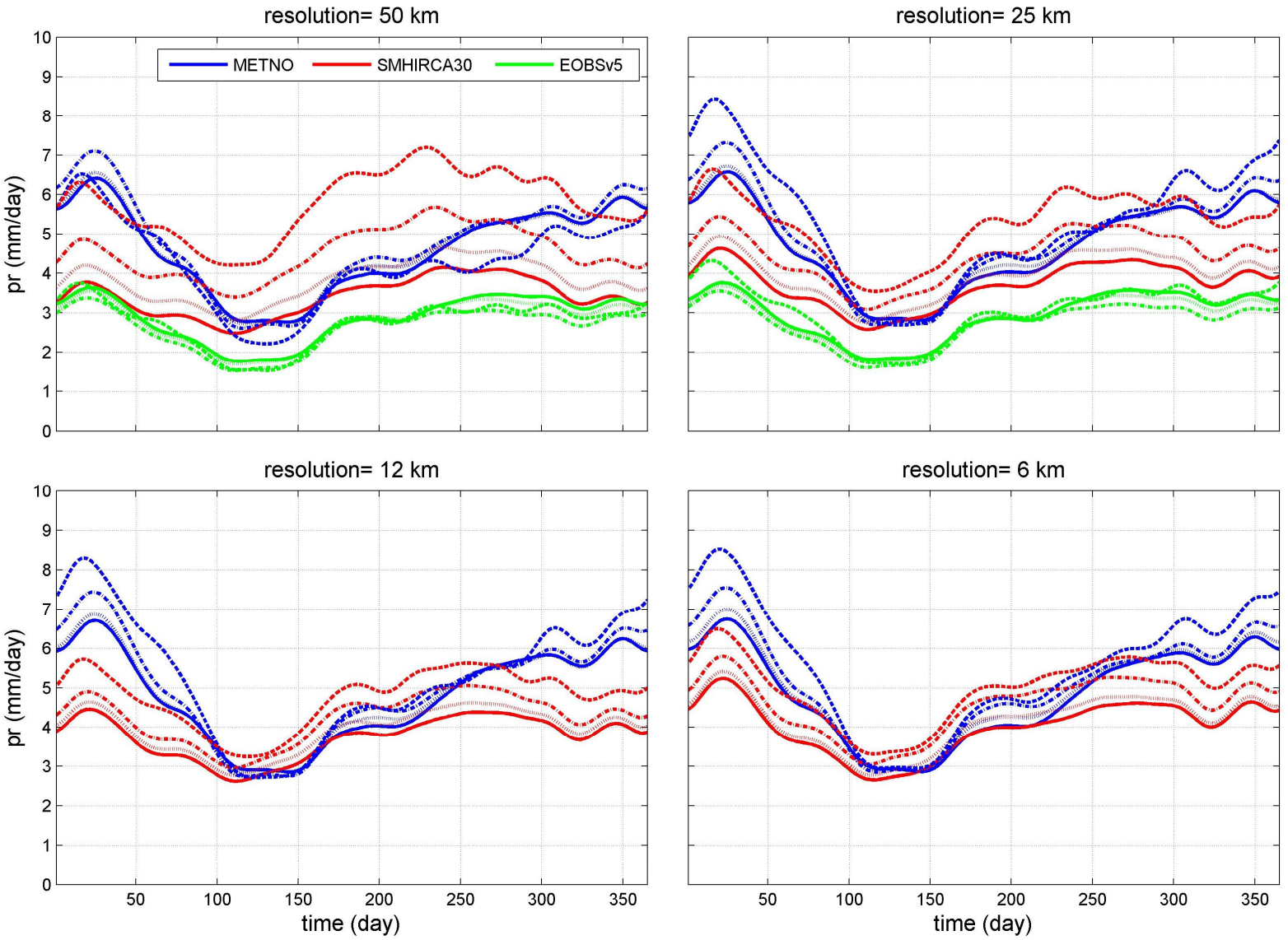


Srednja ukupna količina oborine zimi. Prikazana su puna polja u mjerenjima i modelu (prvi red) te razlike između modela i mjerenja (drugi red).

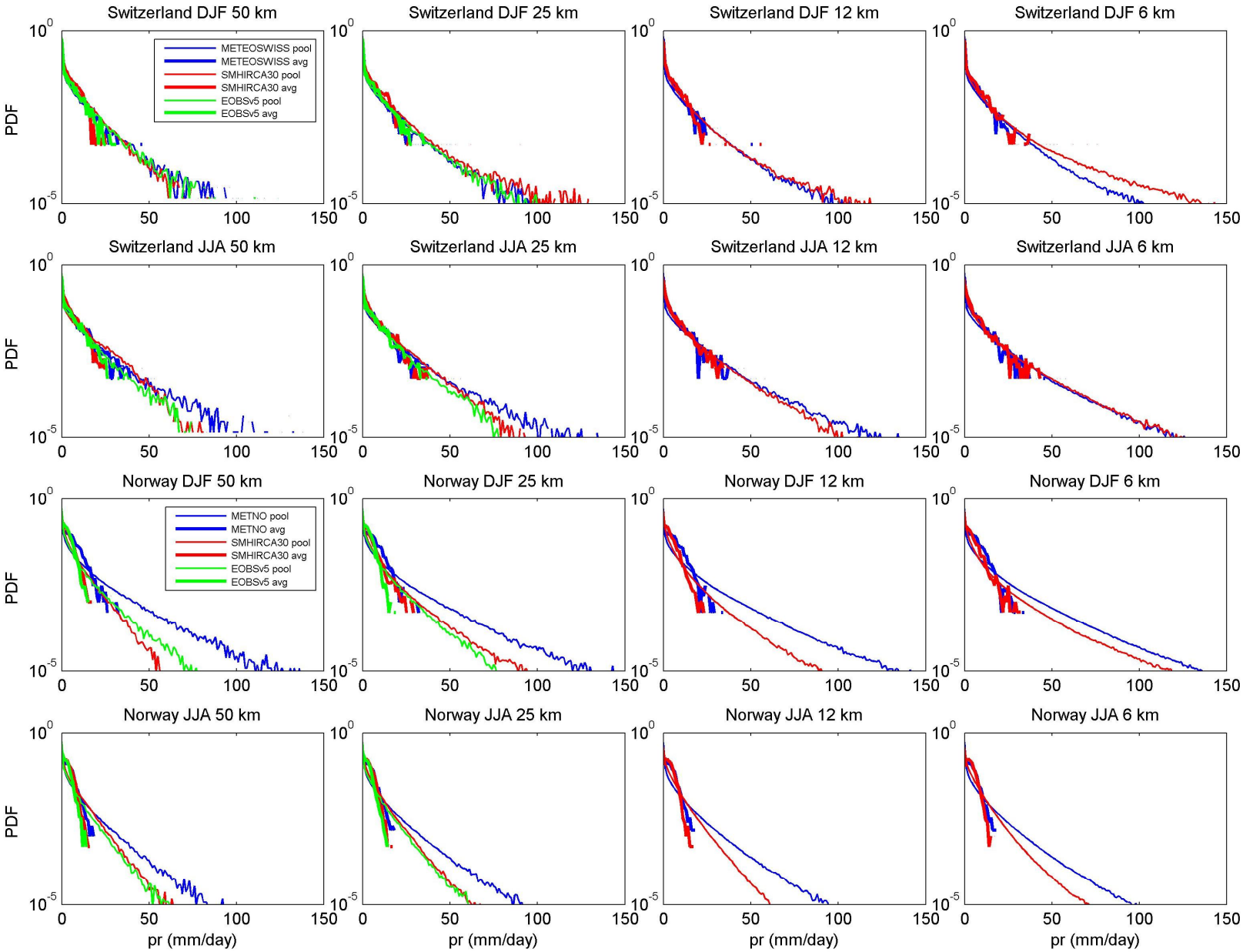
Srednja ukupna količina oborine: **JJA**



Srednja ukupna količina oborine ljeti. Prikazana su puna polja u mjerenjima i modelu (prvi red) te razlike između modela i mjerenja (drugi red).

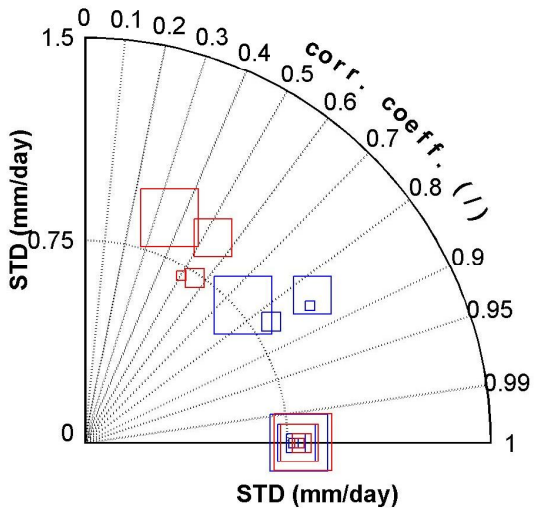


Srednji godišnji hod ukupne količine oborine iznad Norveške za simulacije na različitim rezolucijama (__ sve ćelije; ... ćelije iznad 300 m; _._. ćelije iznad 700 m; --- ćelije iznad 1000 m). Na godišnjem hodu je primijenjen niskopropusni filter.

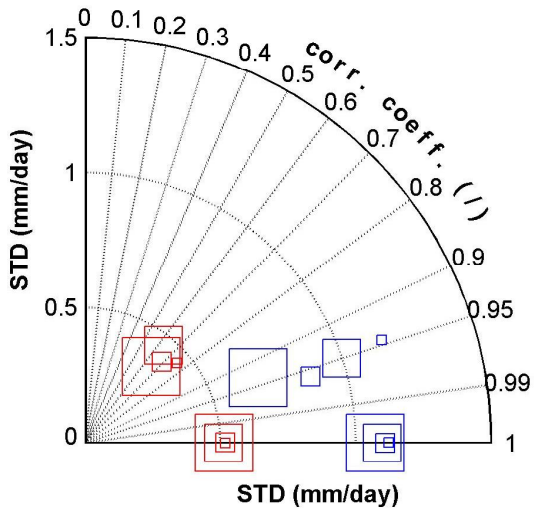


Empiričke gustoće vjerojatnosti ukupne količine oborine iznad Švicarske (prvi red DJF, drugi red JJA) i Norveške (treći red DJF, četvrti red JJA). Prvi stupac predstavlja rezultate na 50 km, a četvrti stupac na 6 km.

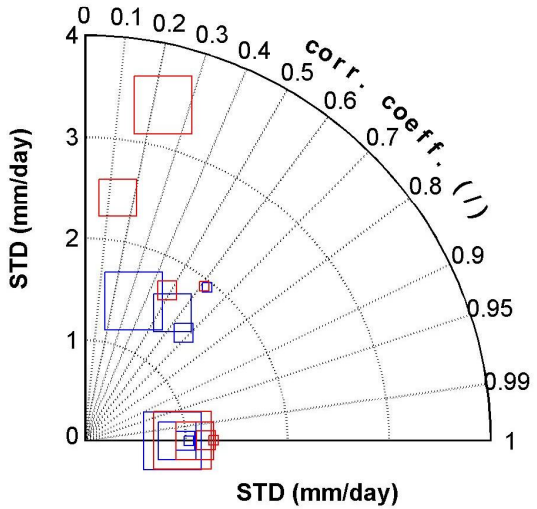
Temporal variability, DJF (blue) /JJA (red), Switzerland



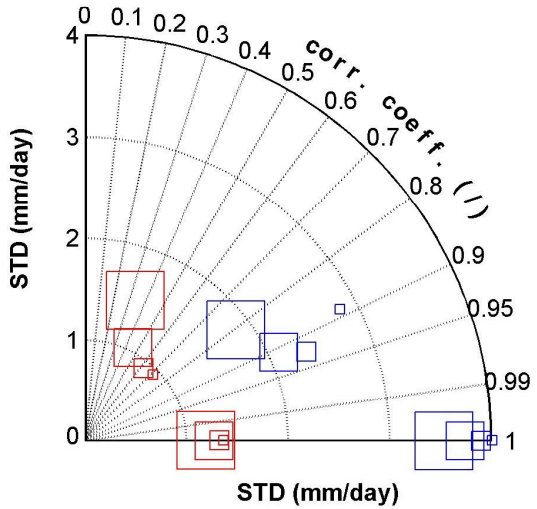
Temporal variability, DJF (blue) /JJA (red), Norway



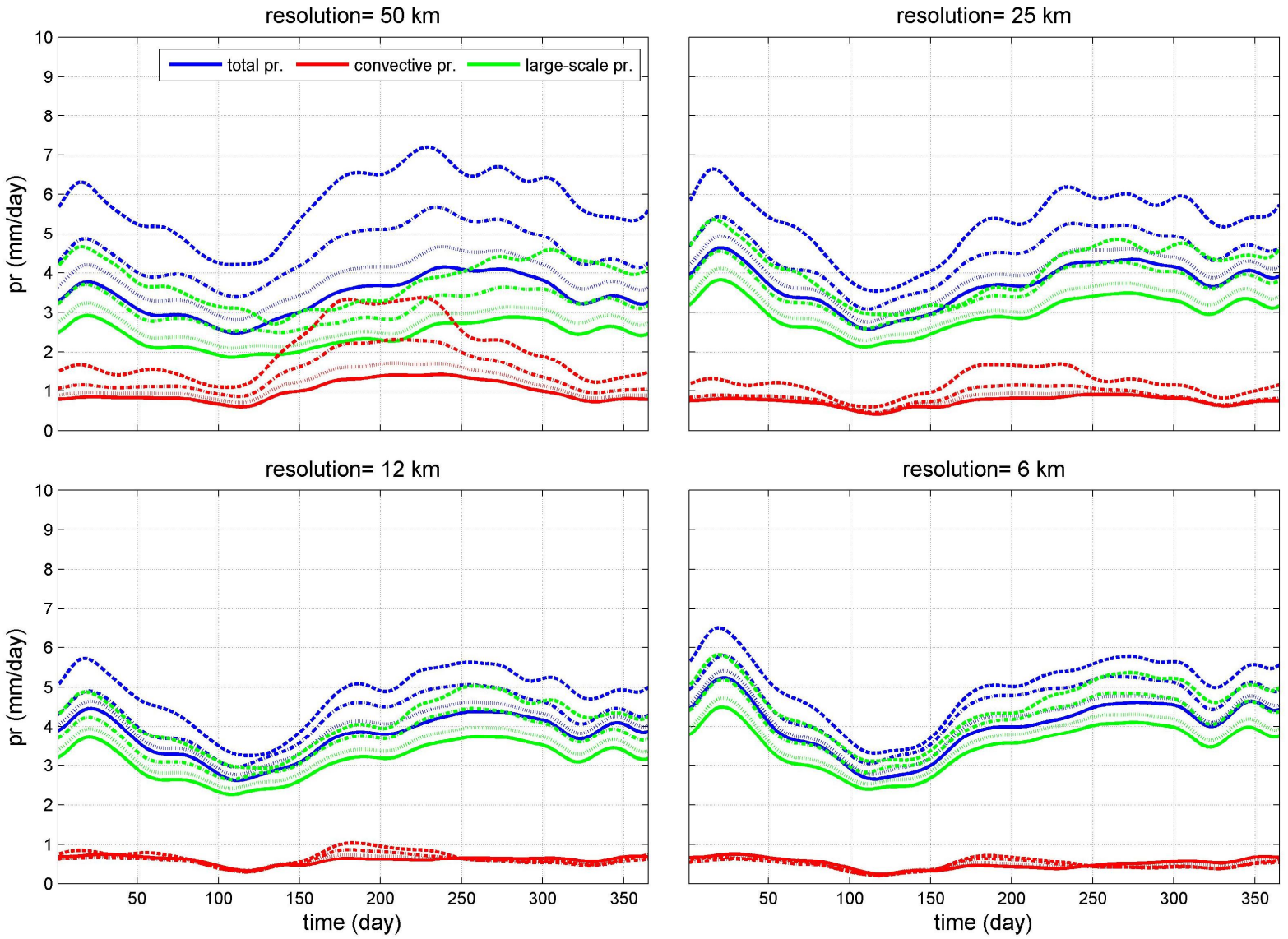
Spatial variability, DJF (blue) /JJA (red), Switzerland



Spatial variability, DJF (blue) /JJA (red), Norway



Taylorovi dijagrami ukupne količine oborine zimi i ljeti iznad Švicarske (prvi stupac) i Norveške (drugi stupac). Najveći kvadratić predstavlja rezultate na 50 km, a najmanji rezultate na 6 km.

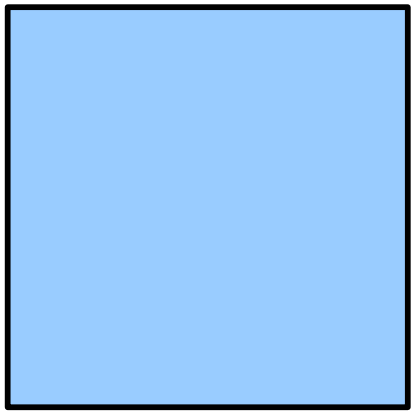


Srednji godišnji hod ukupne količine oborine iznad Norveške te konvektivne oborine i oborine zbog kondenzacije na velikoj skali za simulacije na različitim rezolucijama (__ sve ćelije; ... ćelije iznad 300 m; _._. ćelije iznad 700 m; --- ćelije iznad 1000 m). Na godišnjem hodu je primijenjen niskopropusni filter.

Oborina velike skale vs. konvektivna oborina

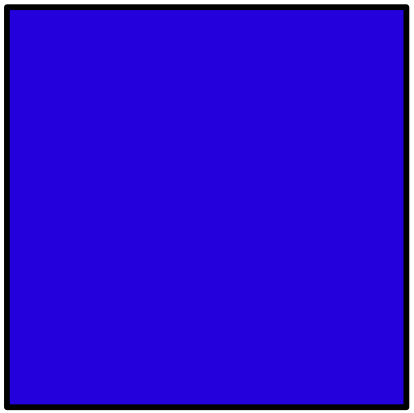
"Nezasićena" ćelija

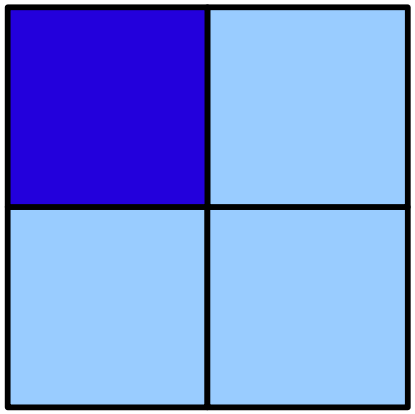
a) uz prisutnu nestabilnost moguća konvektivna oborina



"Zasićena" ćeija

a) uz prisutnu nestabilnost moguća konvektivna oborina
b) oborina zbog kondenzacije na velikoj skali





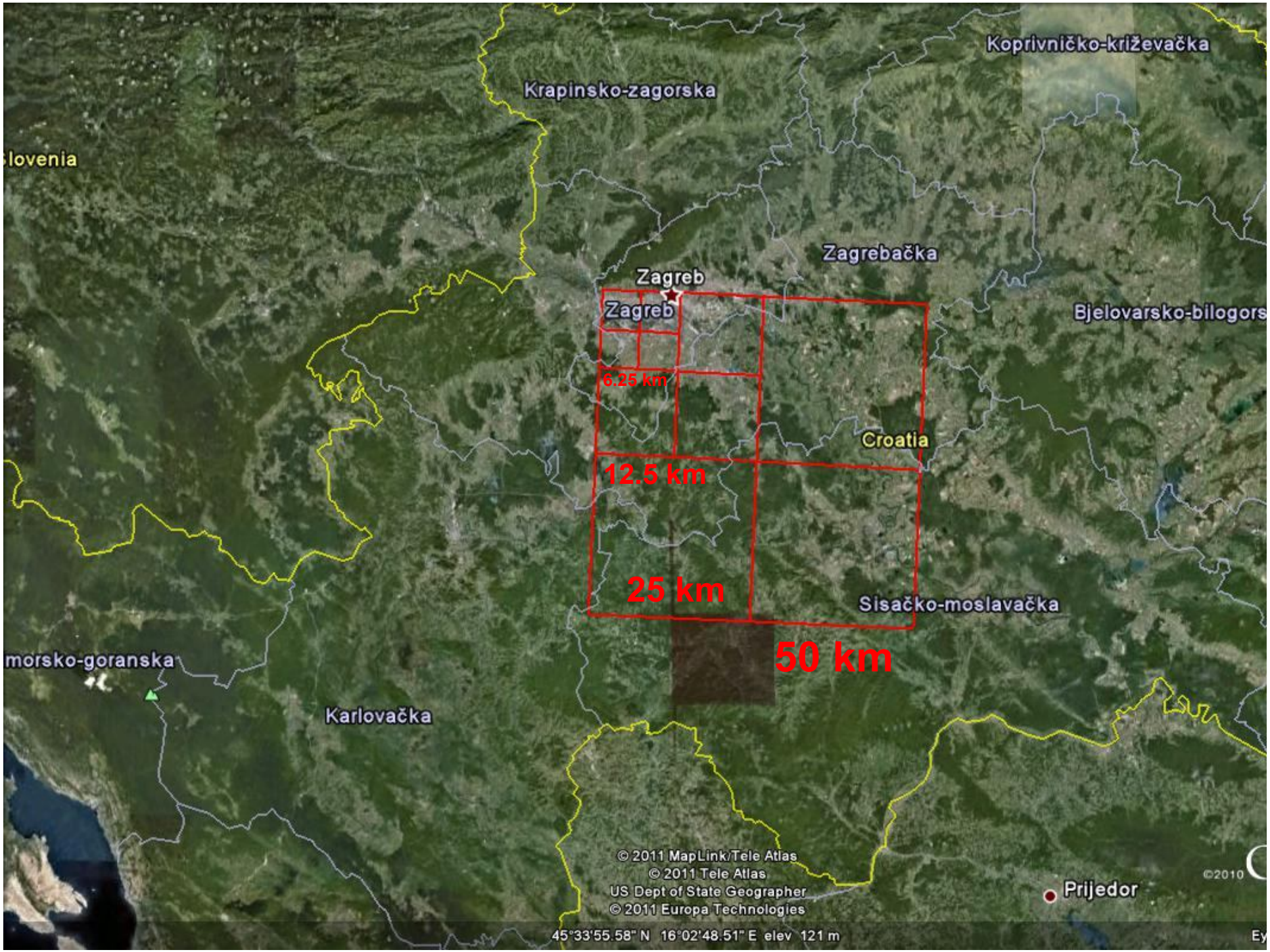
Porast u rezoluciji > smanjenje konvektivne oborine i povećanje oborine velike skale.

Dodatno promjene u cirkulaciji.

Sažetak

1. RCA3 model općenito precijenjuje (podcijenjuje) ukupnu količinu oborine u visinskim (nizinskim i obalnim) područjima.
2. Povećanjem horizontalne rezolucije poboljšavaju se razna svojstva ljetne oborine: višegodišnji srednjak, prostorna i vremenska varijabilnost i ekstremna oborina.
3. Dodana vrijednost pri povećanju rezolucije se uočava u prijelazima od 50 km do 12 km. Simulacije na 6 km nisu bitno kvalitetnije u smislu oborine od 12 km.
4. Odnos između konvektivne oborine i oborine na velikoj skali je bitno ovisan o rezoluciji.

Hvala na pažnji!


Koprivničko-križevačka
Krapinsko-zagorska
lovenia
Zagrebačka
Zagreb
Zagreb
Bjelovarsko-bilogors
6.25 km
Croatia
12.5 km
25 km
Sisačko-moslavačka
50 km
morsko-goranska
Karlovačka
© 2011 MapLink/Tele Atlas
© 2011 Tele Atlas
US Dept of State Geographer
© 2011 Europa Technologies
Prijedor
©2010
45°33'55.58" N 16°02'48.51" E elev 121 m

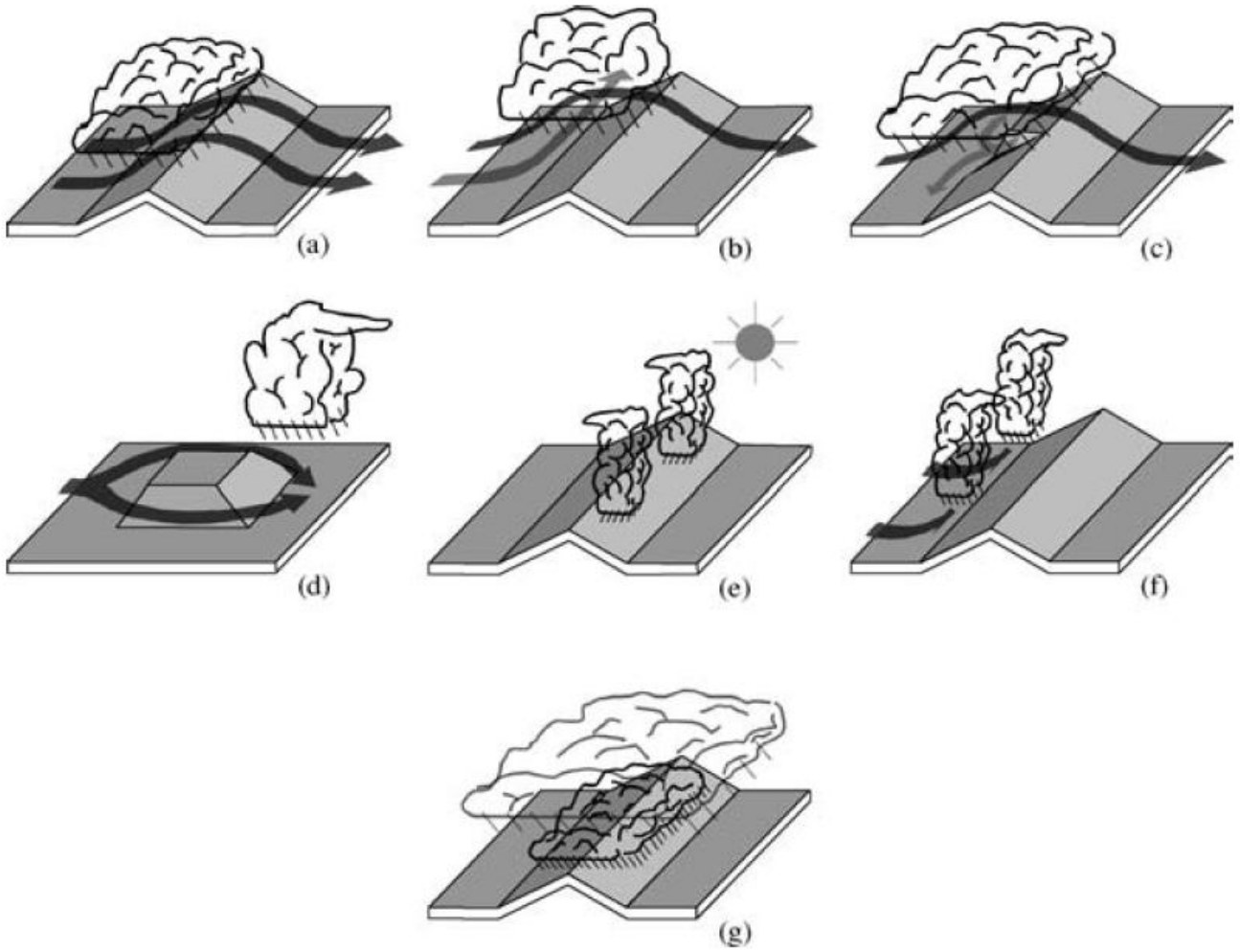
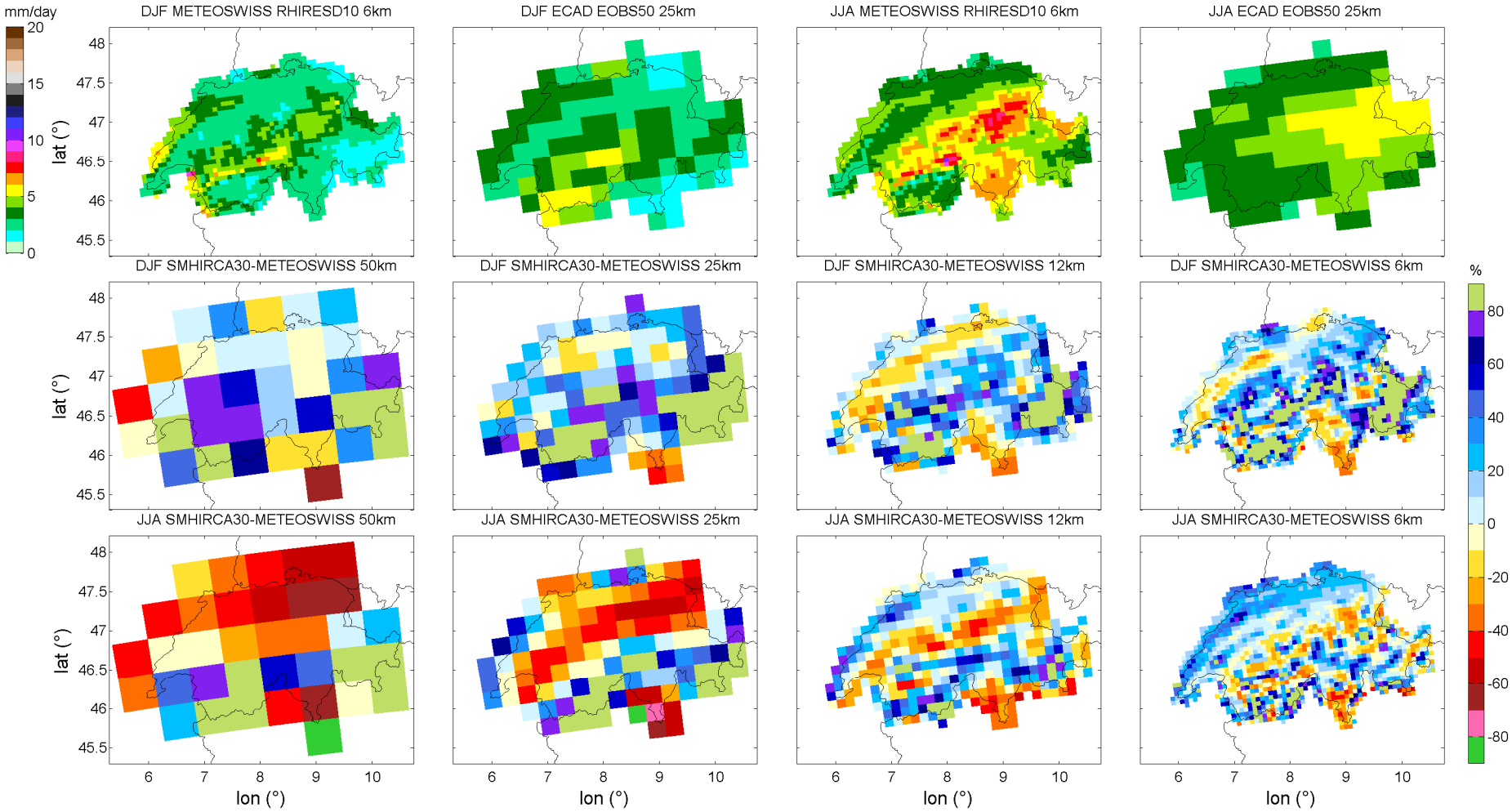


Figure 6 Schematic illustrations of different mechanisms of orographic precipitation. (*a*) stable upslope ascent, (*b*) partial blocking of the impinging air mass, (*c*) down-valley flow induced by evaporative cooling, (*d*) lee-side convergence, (*e*) convection triggered by solar heating, (*f*) convection owing to mechanical lifting above level of free convection, and (*g*) seeder-feeder mechanism. See text for more details.

Roe GH, 2005: Orographic Precipitation, Annu Rev Earth Planet Sci, 33:645-671, doi: 10.1146/annurev.earth.33.092203.122541


mm/day
20
15
10
5
0
DJF METEOSWISS RHIRESD10 6km
DJF ECAD EOBS50 25km
JJA METEOSWISS RHIRESD10 6km
JJA ECAD EOBS50 25km
DJF SMHIRCA30-METEOSWISS 50km
DJF SMHIRCA30-METEOSWISS 25km
DJF SMHIRCA30-METEOSWISS 12km
DJF SMHIRCA30-METEOSWISS 6km
JJA SMHIRCA30-METEOSWISS 50km
JJA SMHIRCA30-METEOSWISS 25km
JJA SMHIRCA30-METEOSWISS 12km
JJA SMHIRCA30-METEOSWISS 6km
lat (°)
48
47.5
47
46.5
46
45.5
lon (°)
6
7
8
9
10
%
80
60
40
20
0
-20
-40
-60
-80

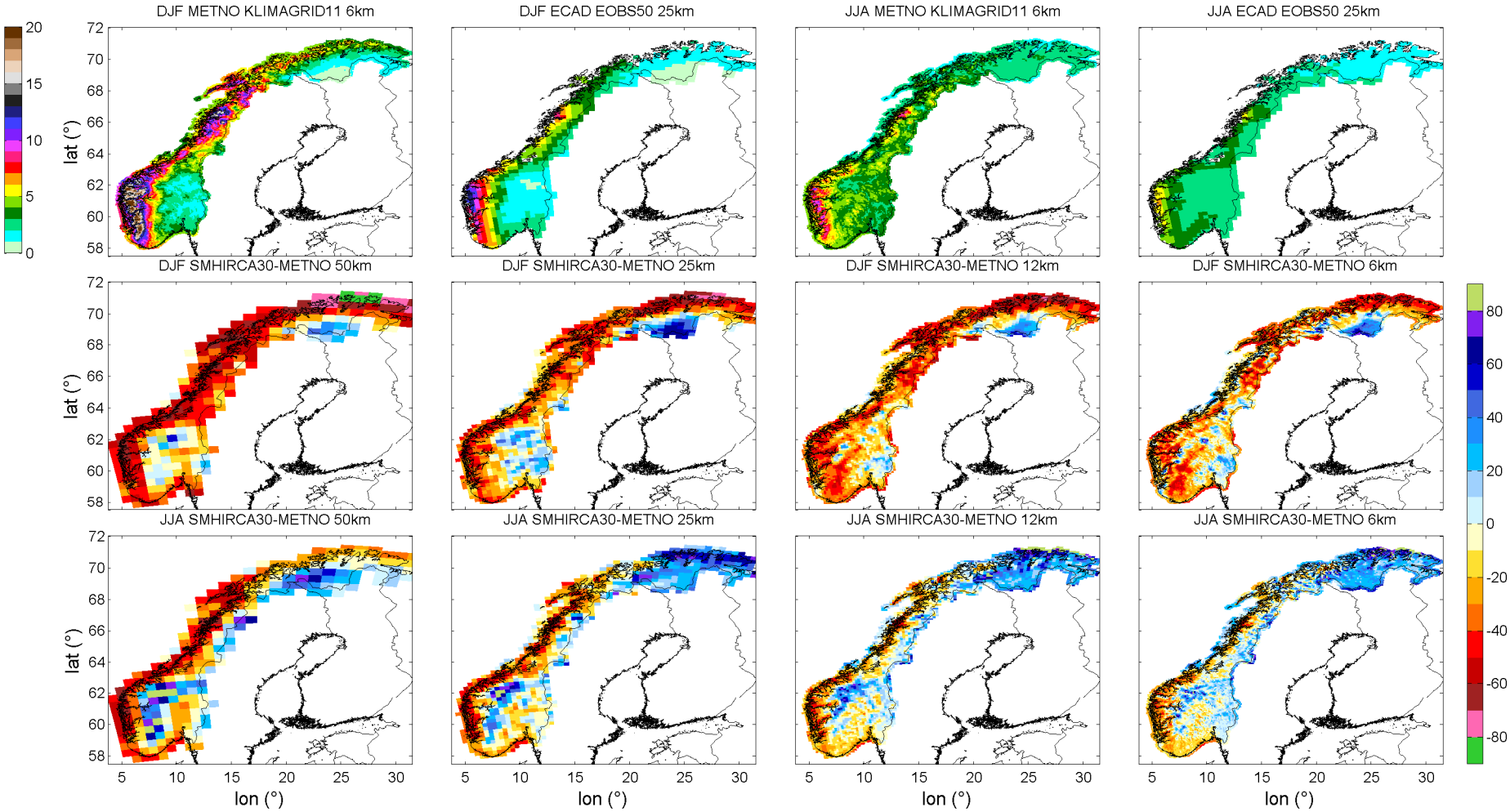

DJF METNO KLIMAGRID11 6km
DJF ECAD EOBS50 25km
JJA METNO KLIMAGRID11 6km
JJA ECAD EOBS50 25km
DJF SMHIRCA30-METNO 50km
DJF SMHIRCA30-METNO 25km
DJF SMHIRCA30-METNO 12km
DJF SMHIRCA30-METNO 6km
JJA SMHIRCA30-METNO 50km
JJA SMHIRCA30-METNO 25km
JJA SMHIRCA30-METNO 12km
JJA SMHIRCA30-METNO 6km
lat (°)
lon (°)
72
70
68
66
64
62
60
58
5
10
15
20
25
30
20
15
10
5
0
80
60
40
20
0
-20
-40
-60
-80

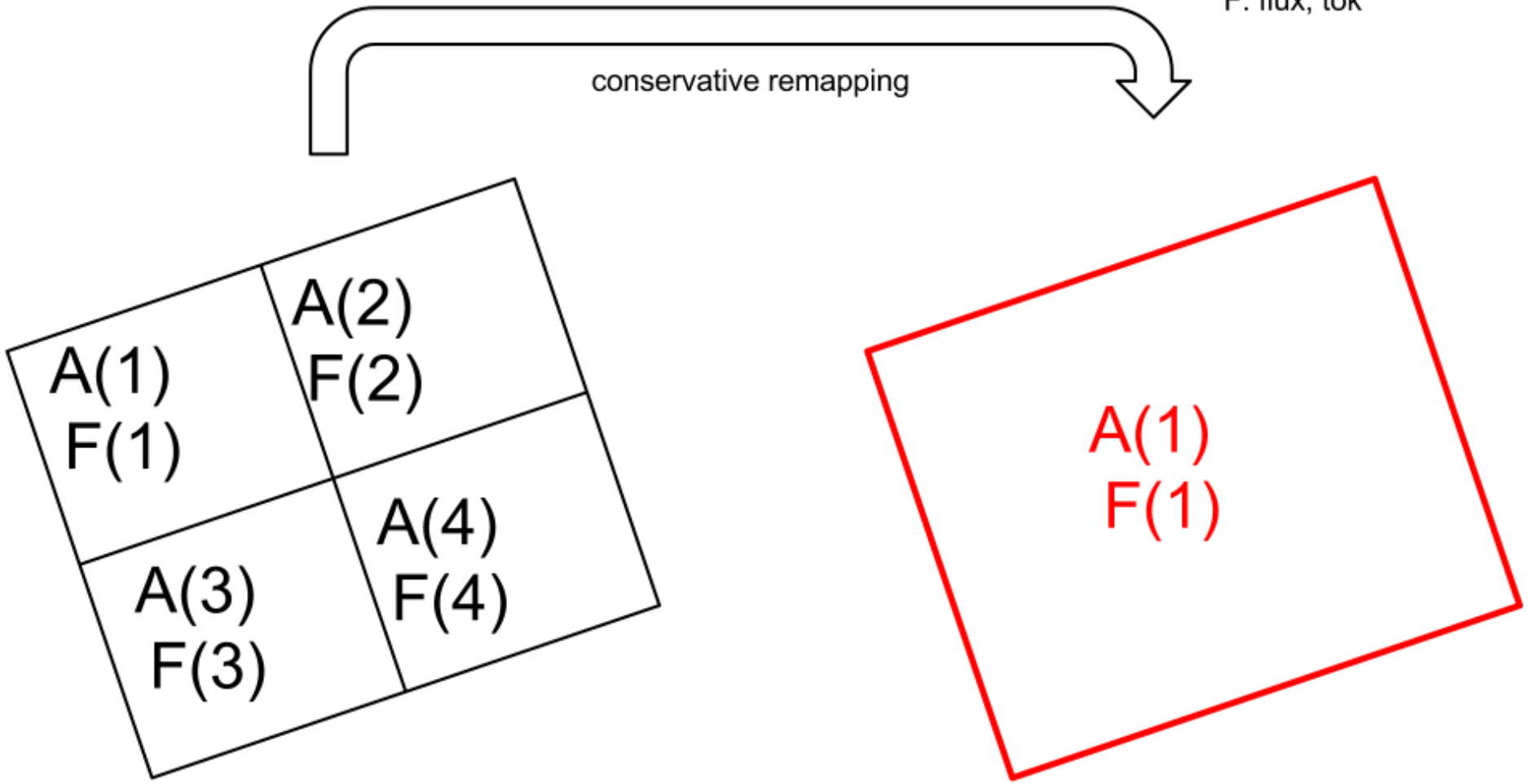
Table 1: Differences between area mean of mean seasonal precipitation in E-OBS v4, E-OBS v5 and RhiresD (KLIMAGRID) over Switzerland (Norway).

		Switzerland: E-OBS v5 - RhiresD (mm/day)	Switzerland: E-OBS v5 - v4 (mm/day)	Norway: E-OBS v5 - KLIMAGRID (mm/day)	Norway: E-OBS v5 - v4 (mm/day)
DJF	50 km	0.03	0.015	-2.36	-0.008
	25 km	0.13	0.029	-2.34	-0.007
MAM	50 km	-0.27	-0.009	-1.27	-0.007
	25 km	-0.18	-0.005	-1.24	-0.006
JJA	50 km	-0.66	-0.020	-0.93	-0.014
	25 km	-0.58	-0.021	-0.96	-0.011
SON	50 km	-0.44	0.001	-1.89	-0.007
	25 km	-0.36	0.008	-1.85	-0.005

Table 2: Area mean of mean seasonal precipitation observed in Switzerland (RhiresD data) and Norway (KLIMAGRID data) and error of RCA3 model.

		Switzerland: obs (mm/day)	Switzerland: bias (mm/day)	Norway: obs (mm/day)	Norway: bias (mm/day)
DJF	50 km	2.97	0.84	5.65	-2.42
	25 km	2.98	1.19	5.68	-1.76
	12.5 km	2.96	0.60	5.73	-1.89
	6.25 km	2.95	0.88	5.76	-1.41
MAM	50 km	3.56	1.25	3.27	-0.80
	25 km	3.62	1.14	3.28	-0.54
	12.5 km	3.62	0.85	3.30	-0.55
	6.25 km	3.61	0.80	3.31	-0.48
JJA	50 km	4.50	0.36	3.72	-0.47
	25 km	4.63	0.28	3.76	-0.31
	12.5 km	4.68	0.21	3.81	-0.19
	6.25 km	4.70	0.63	3.84	-0.11
SON	50 km	4.00	0.68	5.17	-1.67
	25 km	3.98	0.87	5.19	-1.29
	12.5 km	3.97	0.47	5.23	-1.29
	6.25 km	3.93	0.47	5.25	-1.06

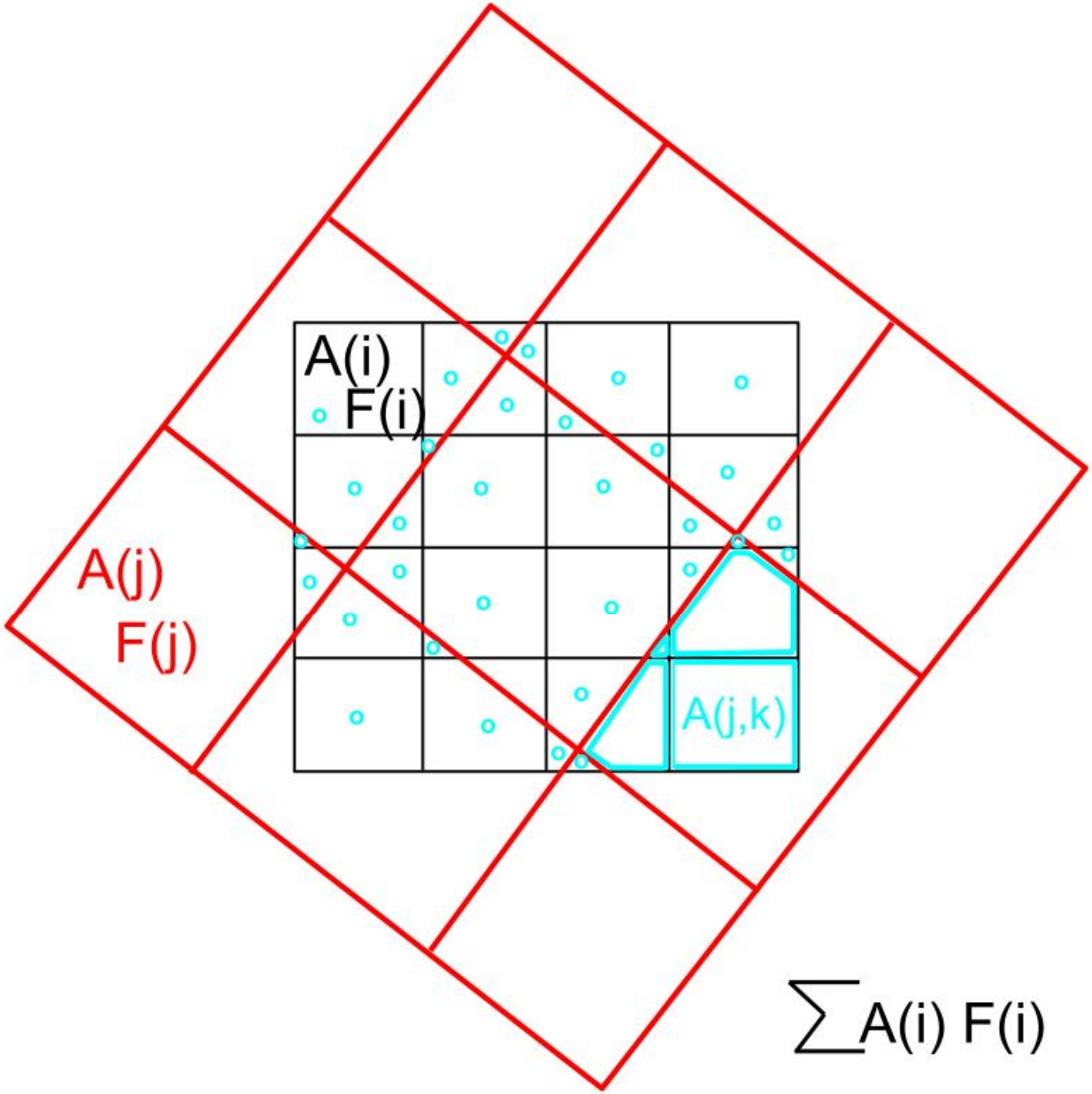
A: area, površina
F: flux, tok



$$\sum A(i)\,F(i) \;=\; A(1)\,F(1)$$

I.G. 2012

A: area, površina
F: flux, tok



$$\sum A(i)\,F(i) = \sum\sum A(j,k)\,F(j)$$

I.G. 2012