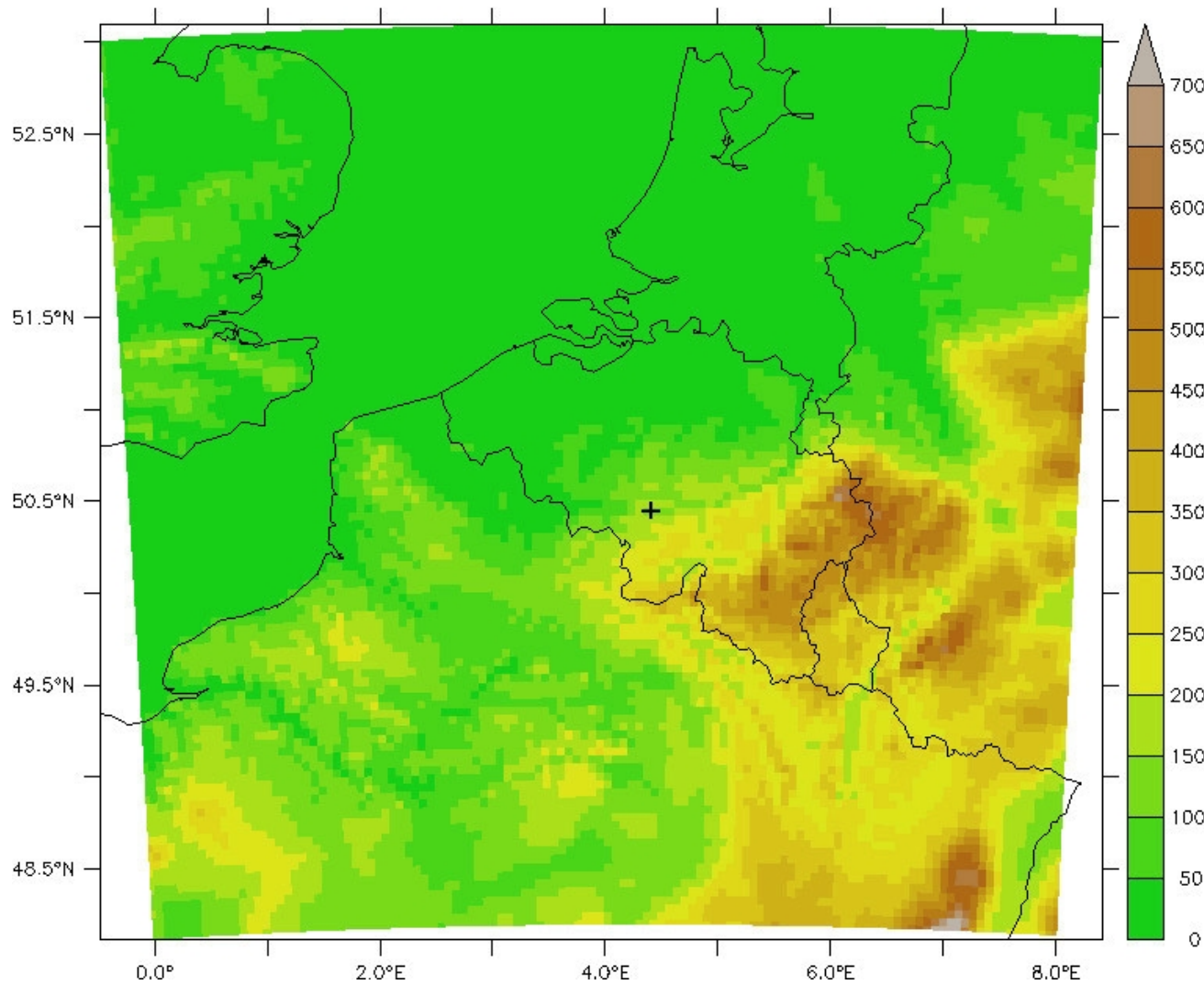# The MAR model:
CORDEX.be and EURO-CORDEX results

Coraline WYARD

Sébastien DOUTRELOUP

Xavier FETTWEIS

1. **MAR sensitivity to forcing reanalyses**

2. MARv3.6 vs MAR3.7

3. Detection of hydroclimatic conditions favourable to floods

4. MAR results over the EURO-CORDEX domain
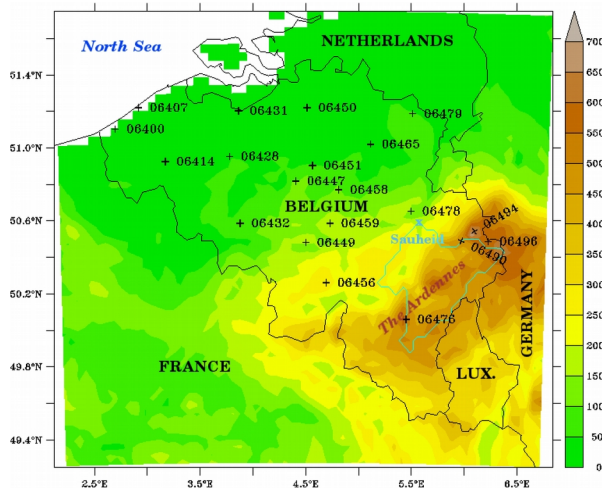
- # CORDEX.be simulations

- · Forcings :
  - · ERA40(1958−1978)/ERA-Interim (1979−2015)
  - · NCEP/NCAR-v1 (1948−2015)
  - · ERA-20C (1900-2010)
  - · 20CRV2C (1900-2010)
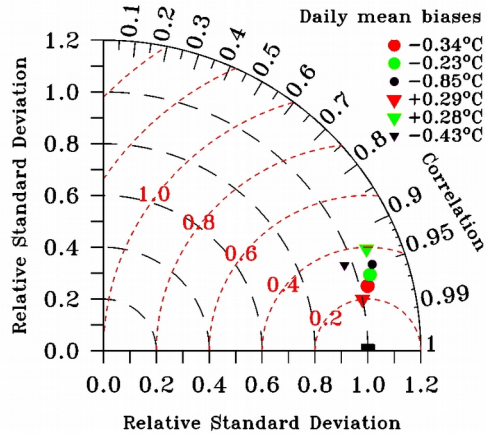
- · Horizontal resolution :
  - 5 km − 10 km − 20 km
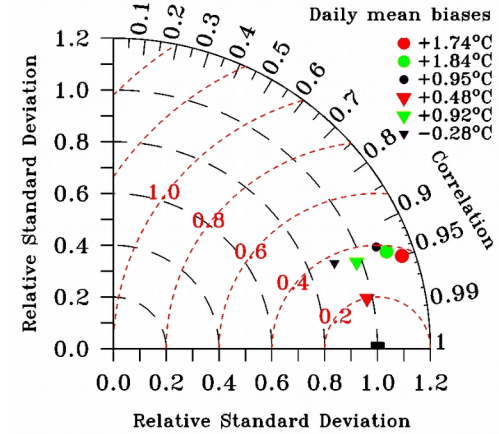
- Sensitivity to **forcing reanalyses** : temperature
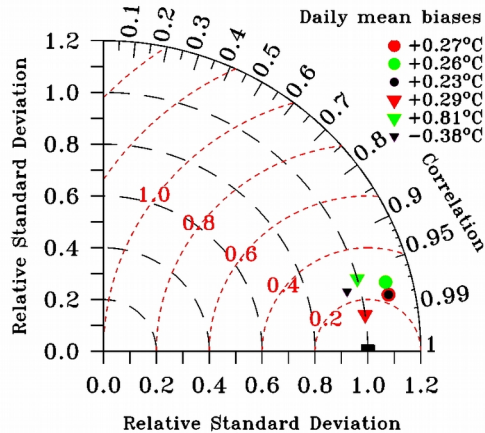

SEASONAL DAILY MEAN TEMPERATURE

(a) DJF

Daily mean biases
- ● −0.34°C
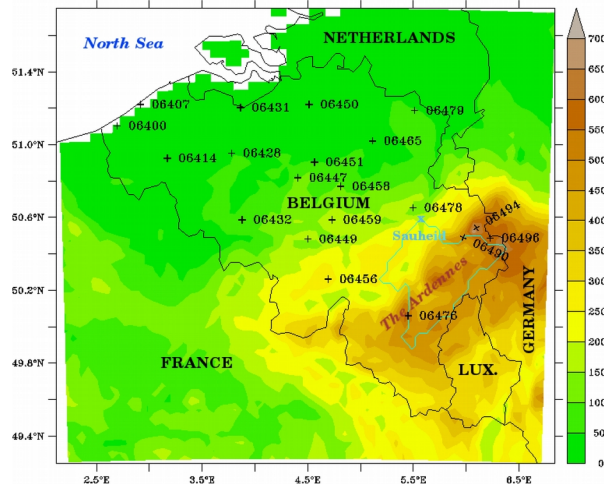- ● −0.23°C
- ● −0.85°C
- ▼ +0.29°C
- ▼ +0.28°C
- ▼ −0.43°C

(c) JJA

Daily mean biases
- ● +1.74°C
- ● +1.84°C
- ● +0.95°C
- ▼ +0.48°C
- ▼ +0.92°C
- ▼ −0.28°C

(b) MAM

Daily mean biases
- ● +0.27°C
- ● +0.26°C
- ● +0.23°C
- ▼ +0.29°C
- ▼ +0.81°C
- ▼ −0.38°C

(d) SON

Daily mean biases
- ● +0.70°C
- ● +0.92°C
- ● +0.12°C
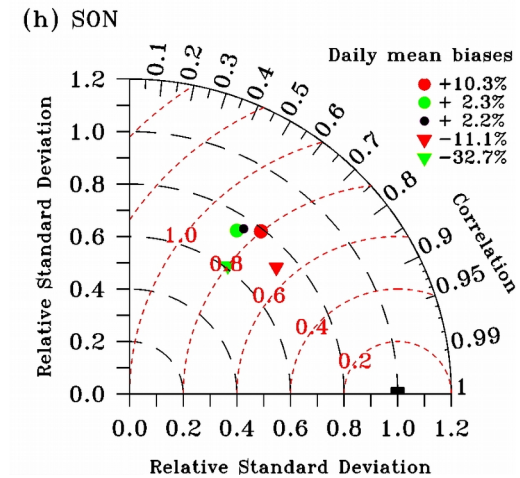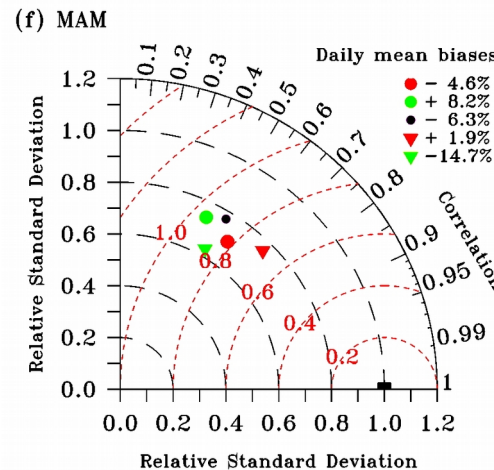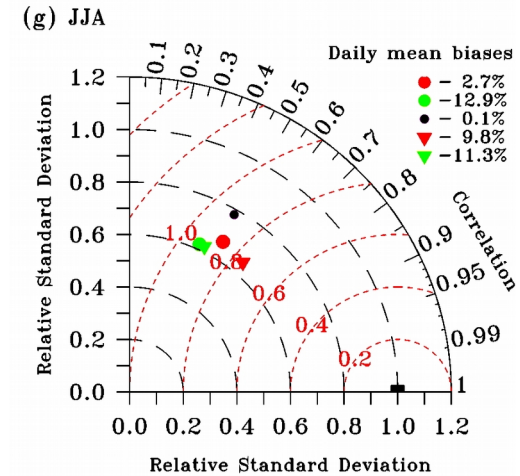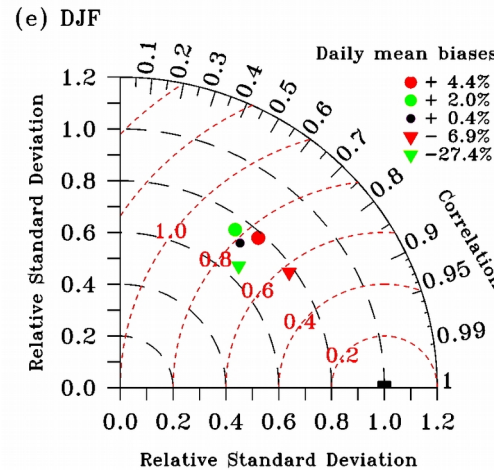- ▼ +0.21°C
- ▼ +0.79°C
- ▼ +0.14°C
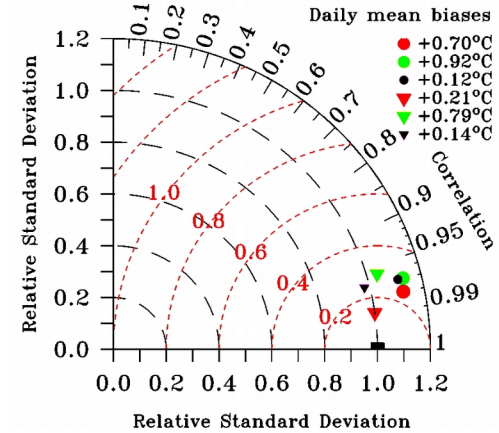
- ■ Observation
- ● MAR−ERA 5km
- ● MAR−NCEP1 5km
- ● MAR−ERA−20C 5km
- ▼ ERA−interim
- ▼ NCEP/NCAR v1
- ▼ ERA−20C

- ## Sensitivity to **forcing reanalyses** : precipitations
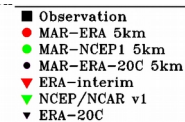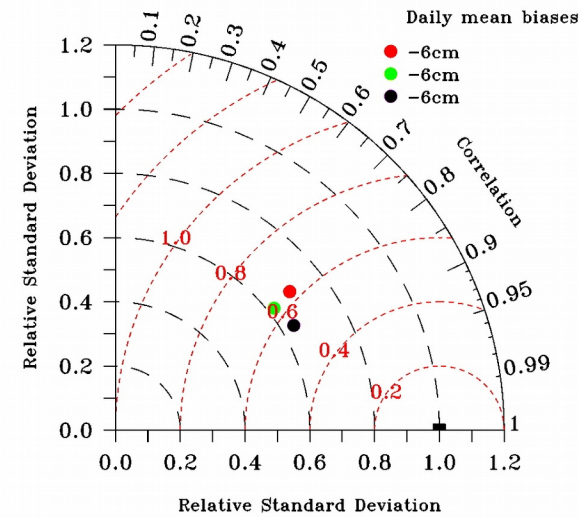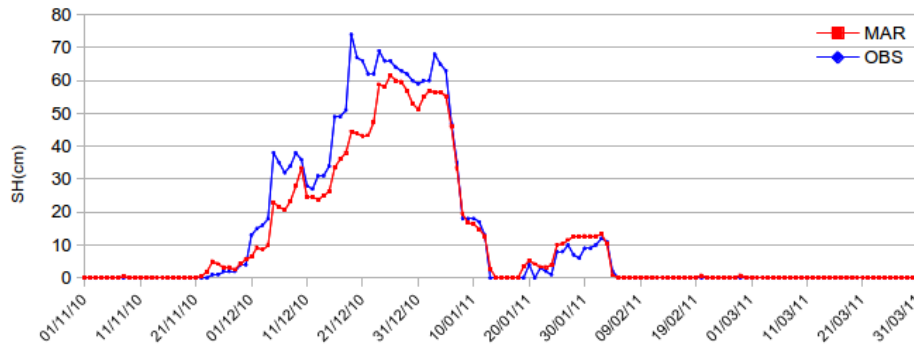
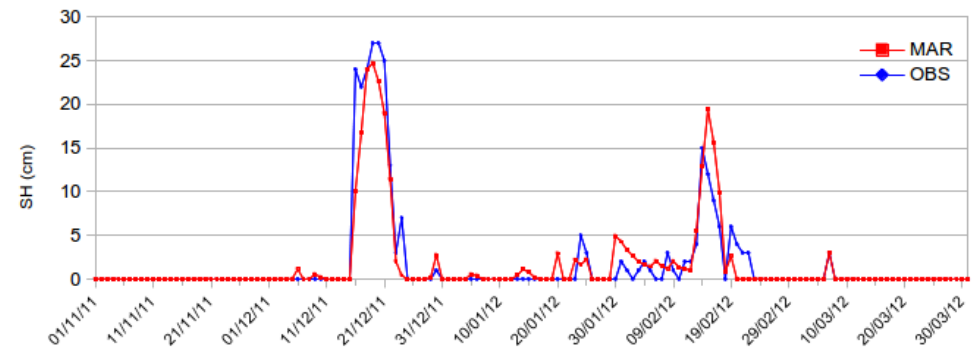- Sensitivity to **forcing reanalyses** : snow height
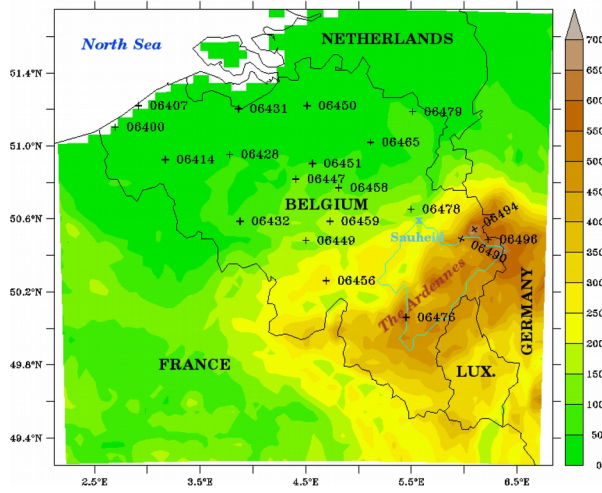
(c) WINTER DAILY SNOW HEIGHT

Snow height (Mont Rigi) Winter 2010-2011

Snow height (Mont Rigi) Winter 2011-2012

1. MAR sensitivity to forcing reanalyses
2. **MARv3.6 vs MAR3.7**
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- ## MARv3.6 vs MARv3.7 : temperature

MARv3.6

2008-2014	DJF	MAM	JJA	SON	*Annual mean*
R	0.97	0.98	0.95	0.98	0.97
RMSE (°C)	1.08	1.11	**2.07**	1.35	1.47
MB (°C)	-0.34	0.27	**1.74**	0.70	**0.59**
STD (°C)	5.56	4.61	3.10	4.12	4.35
Daily mean T (°C)	4.06	10.56	16.48	10.10	10.30
				Percentage of usable observations : 98,9 %	

MARv3.7

2012	DJF	MAM	JJA	SON	*Annual mean*
R	0.96	0.98	0.95	0.98	0.97
RMSE (°C)	1.51	1.25	**1.52**	1.11	1.39
MB (°C)	-0.85	-0.19	**1.09**	0.07	**0.03**
STD (°C)	5.56	4.61	3.10	4.12	4.35
Daily mean T (°C)	4.06	10.56	16.48	10.10	10.30
				Percentage of usable observations : 98,9 %	

- ## MARv3.6 vs MARv3.7 : precipitations

MARv3.6

2008-2014	DJF	MAM	JJA	SON	*Annual mean*
R	0.67	0.58	0.52	0.61	**0.59**
RMSE (mm/jour)	3.34	3.17	5.21	3.98	4.03
MB (mm/jour)	0.11	-0.08	-0.36	-0.06	-0.10
STD (mm/jour)	4.34	3.77	5.98	4.85	4.85
Daily PPN amount (mm/jour)	2.48	1.69	2.68	2.36	2.30

Percentage of usable observations : 95,6 %

MARv3.7

2008-2014	DJF	MAM	JJA	SON	*Annual mean*
R	0.75	0.60	0.56	0.67	**0.64**
RMSE (mm/jour)	3.29	3.01	4.91	3.58	3.80
MB (mm/jour)	0.25	-0.14	-0.43	-0.49	-0.20
STD (mm/jour)	4.34	3.77	5.98	4.85	4.85
Daily PPN amount (mm/jour)	2.48	1.69	2.68	2.36	2.30

Percentage of usable observations : 95,6 %

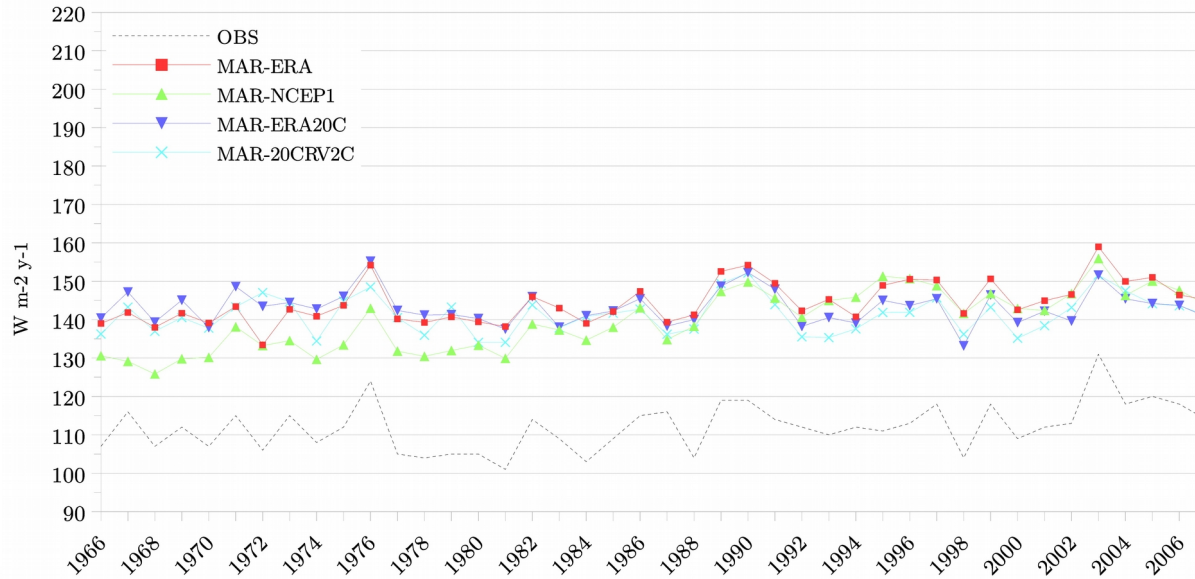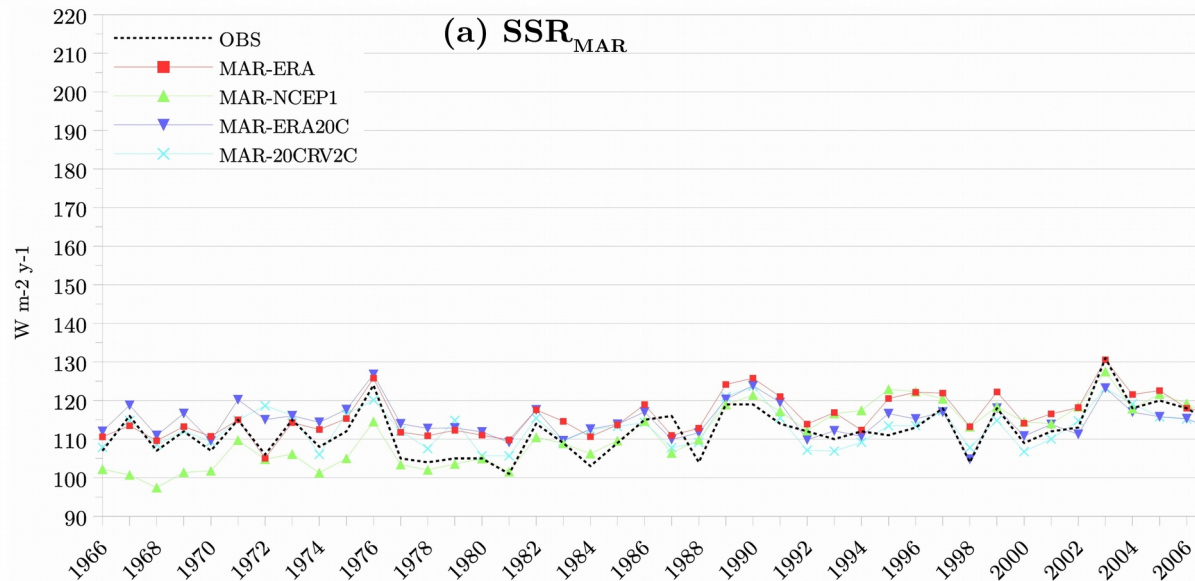- ## MARv3.6 vs MARv3.7 : cloudiness

MARv3.6

MARv3.7

(a) TCC_MAR
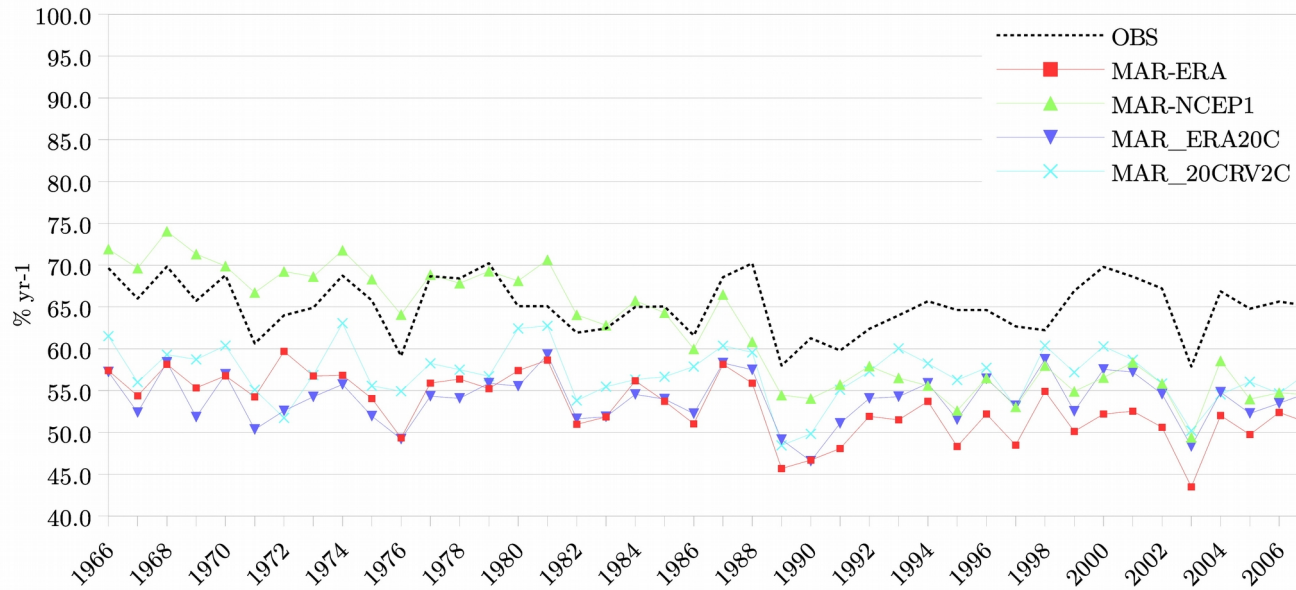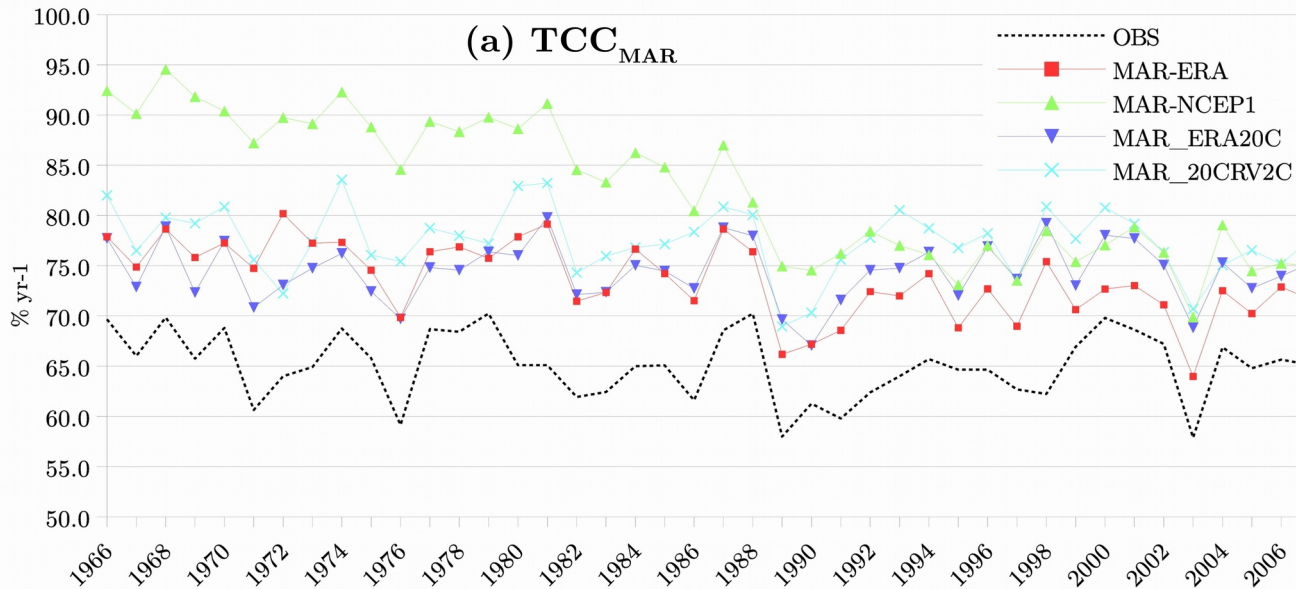
- ## MARv3.6 vs MARv3.7 : global radiation
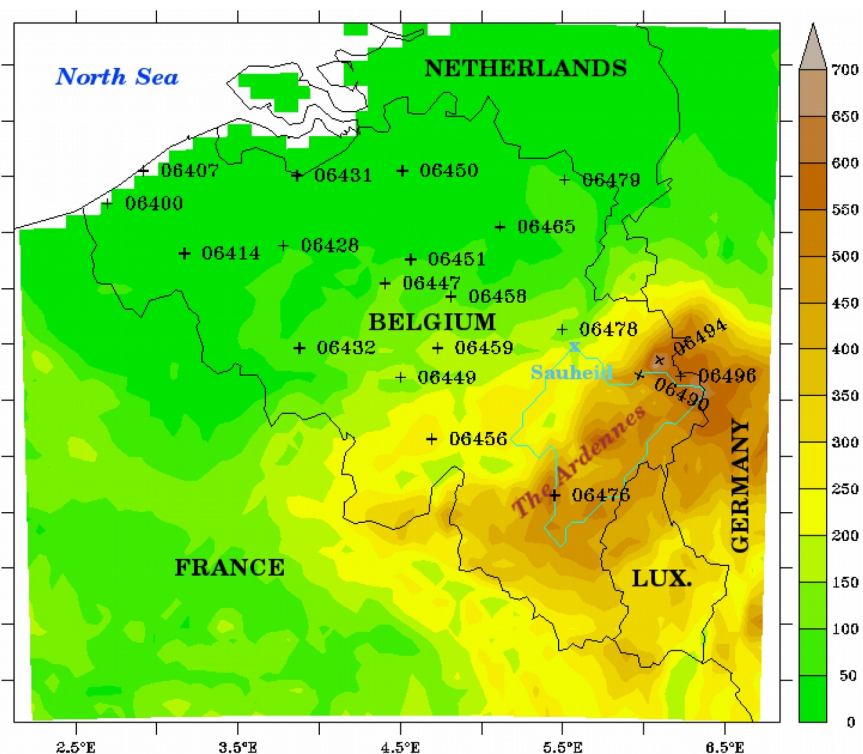
MARv3.6

MARv3.7

(a) SSR_{MAR}

1. MAR sensitivity to forcing reanalyses

2. MARv3.6 vs MAR3.7

3. **Detection of hydroclimatic conditions favourable to floods**

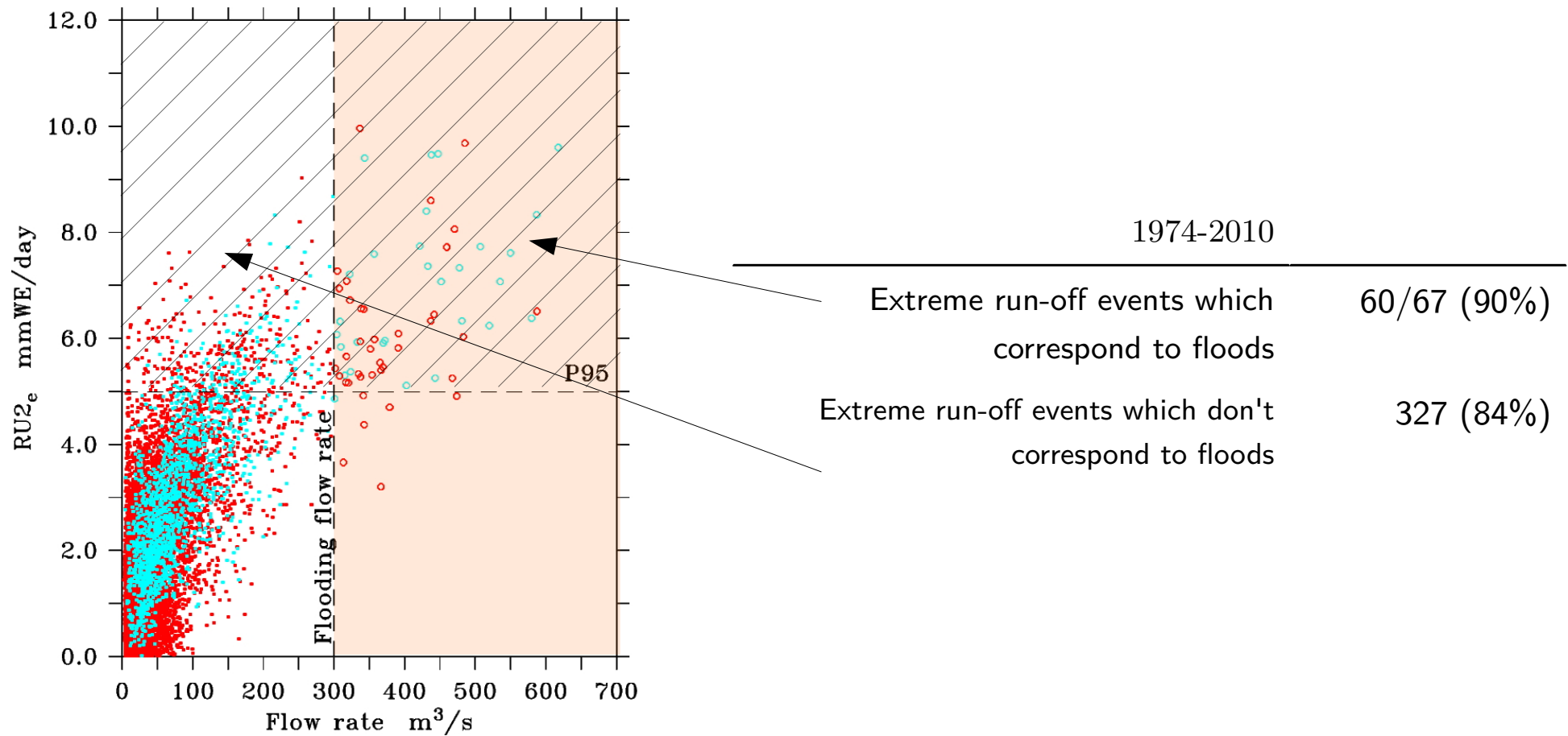4. MAR results over the EURO-CORDEX domain

- # Hydroclimatic conditions favourable to floods

- **Floods** :
  - 70% in winter
    - 50% caused by PPN
    - 50% caused by snow melting + PPN
  - Observed floods → flow rate > 300 m³/s
  - MAR (conditions favourable to floods) → run-off > P95

- ## Hydroclimatic conditions favourable to floods

1974-2010

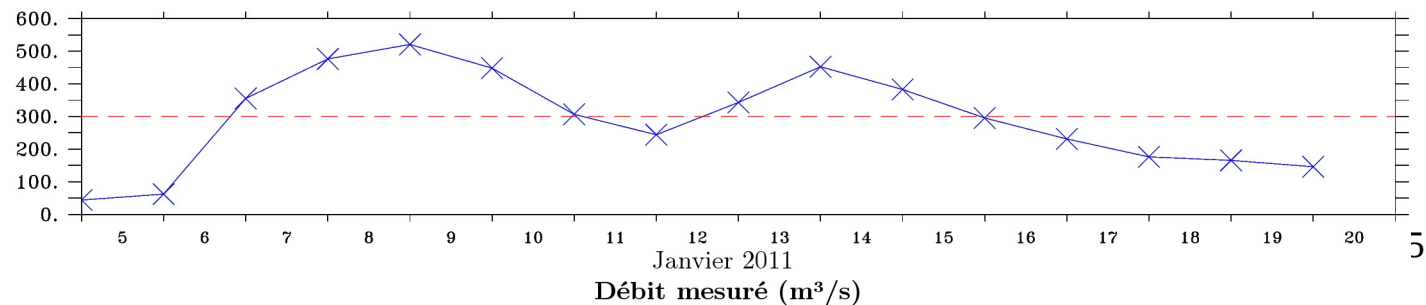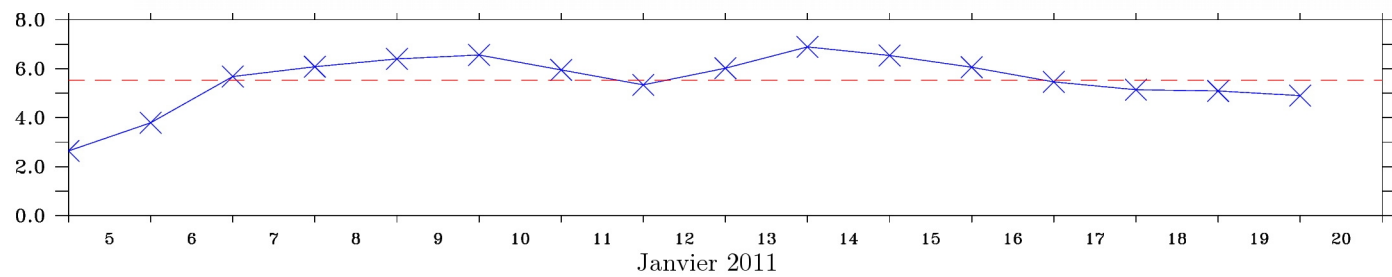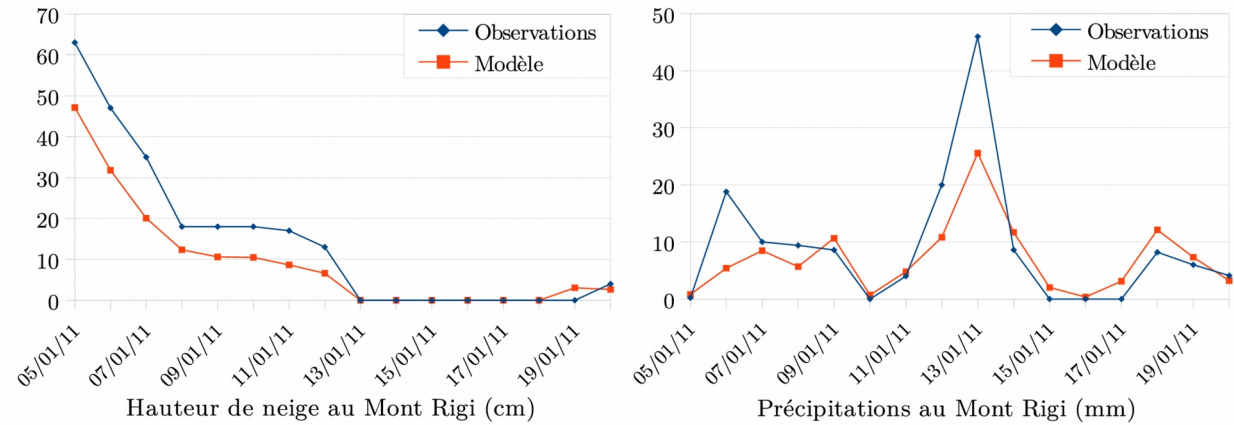|	
Extreme run-off events which correspond to floods	60/67 (90%)
Extreme run-off events which don't correspond to floods	327 (84%)

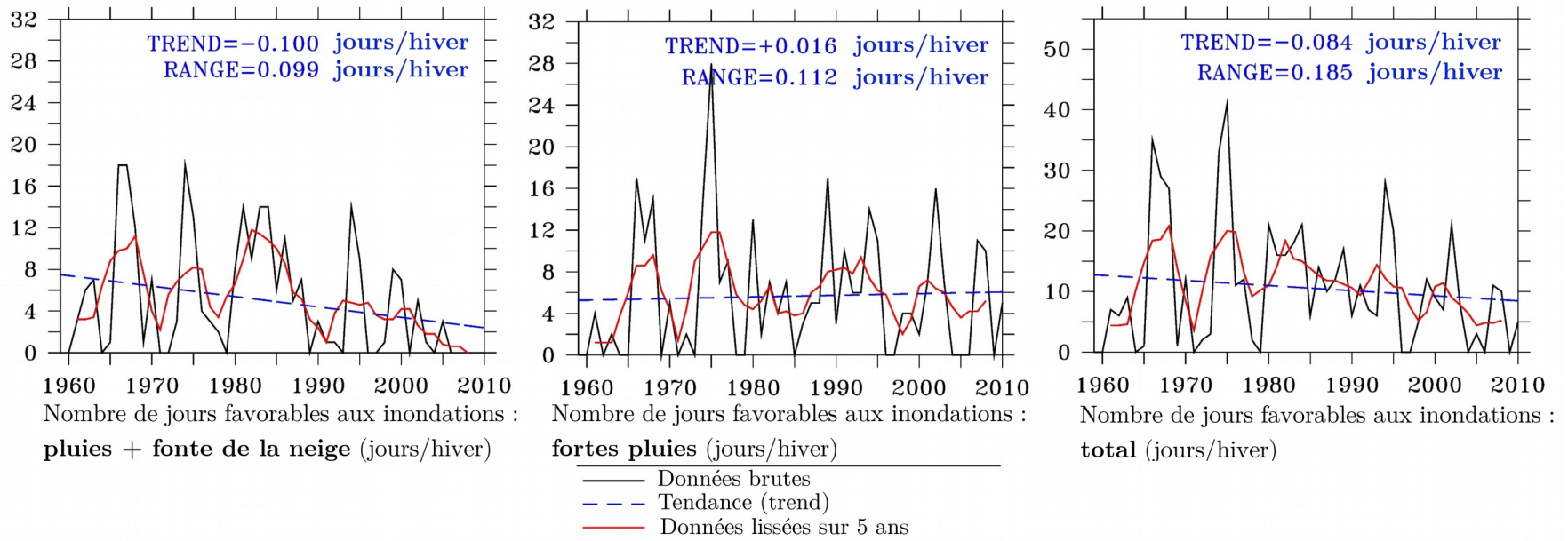- ## Hydroclimatic conditions favourable to floods

Double flood of January 2011

Mery

Hauteur de neige au Mont Rigi (cm)

Précipitations au Mont Rigi (mm)

Janvier 2011

Run-off modélisé (mmEE/jour)

Janvier 2011

Débit mesuré (m³/s)

- ## Hydroclimatic conditions favourable to floods

Trends

1959-2010

- ## Hydroclimatic conditions favourable to floods
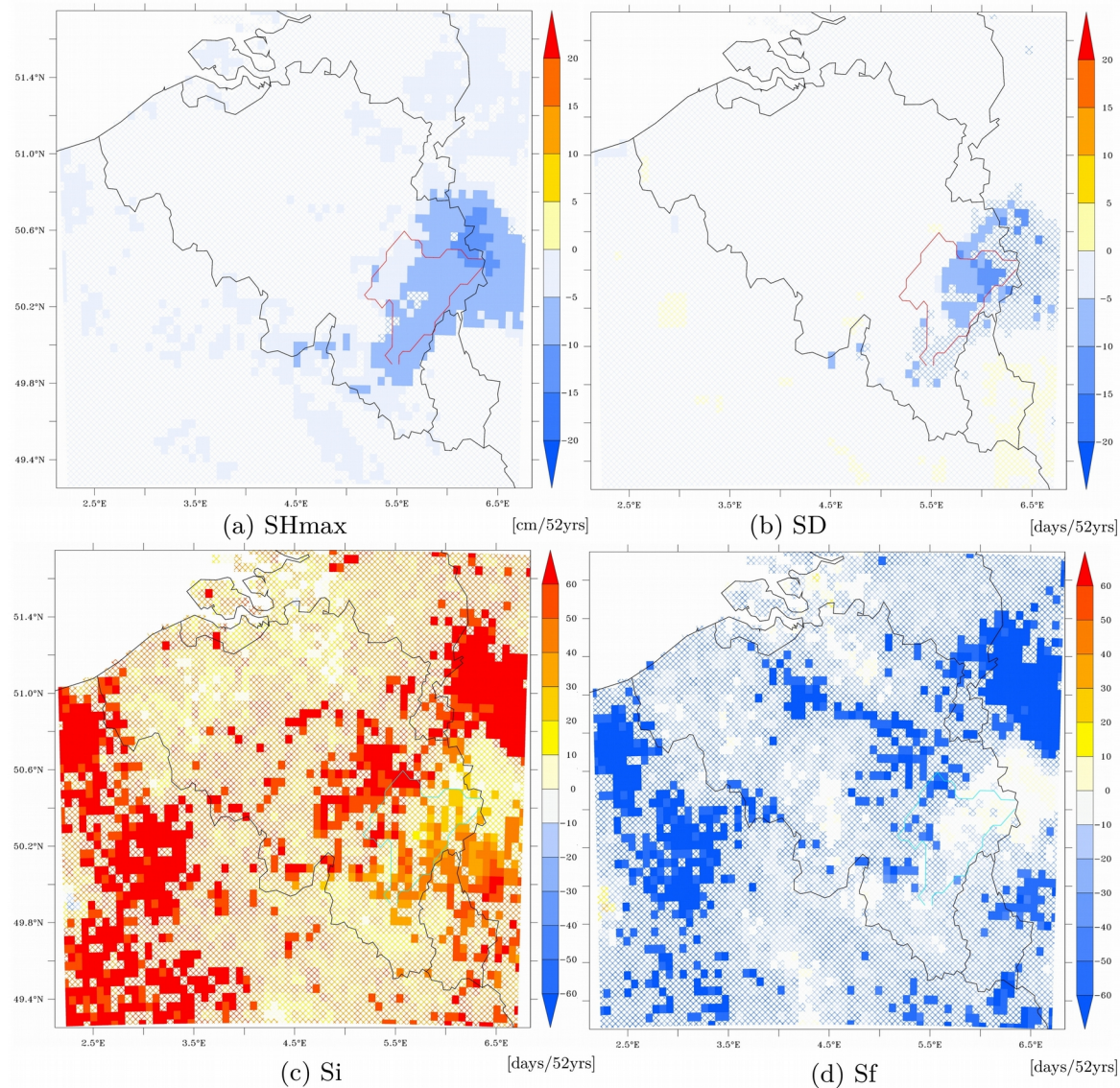
Trends
1959-2010

(a) SHmax [cm/52yrs] (b) SD [days/52yrs]

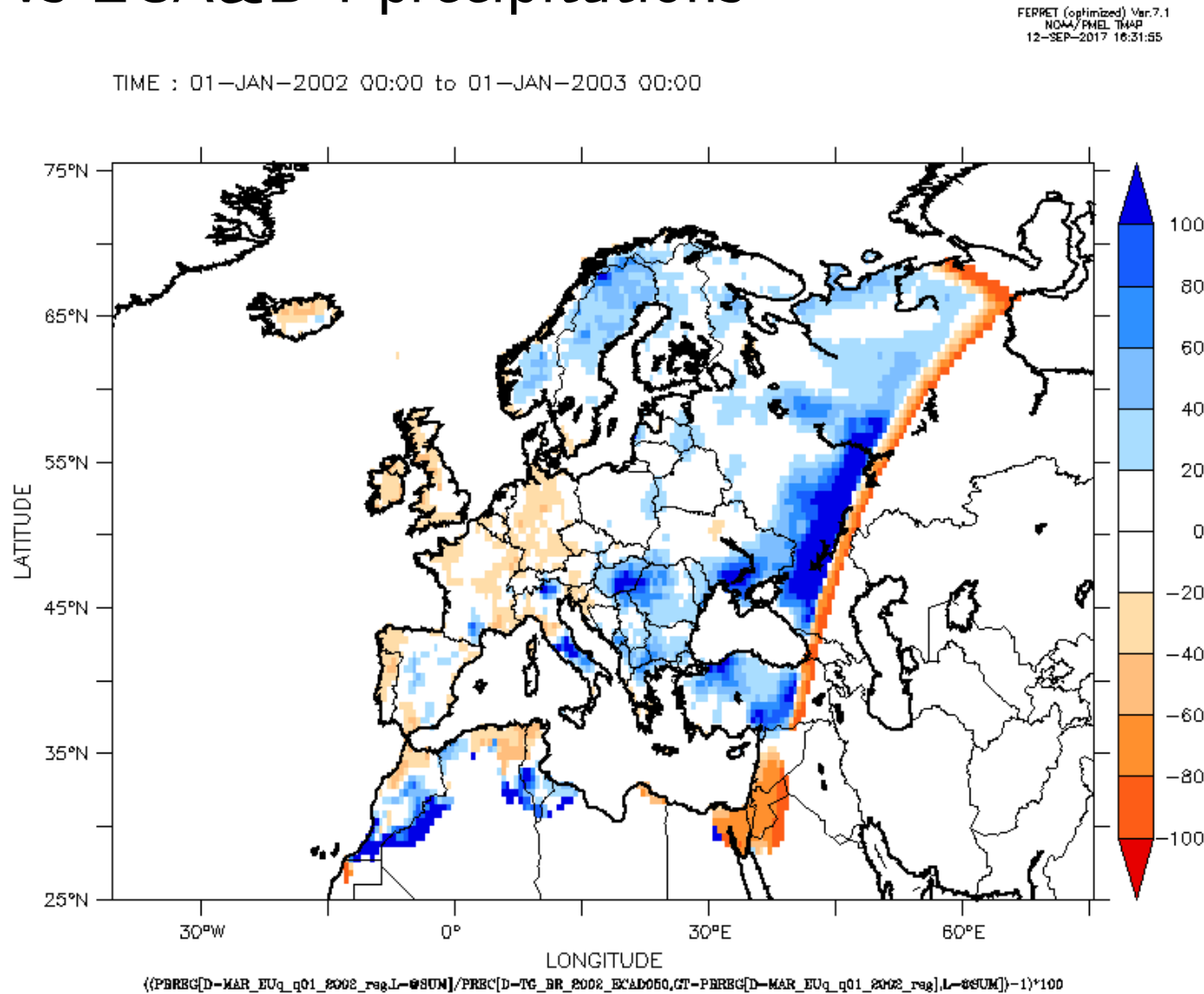(c) Si [days/52yrs] (d) Sf [days/52yrs]

1. MAR sensitivity to forcing reanalyses

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3. Detection of hydroclimatic conditions favourable to floods

4. **MAR results over the EURO-CORDEX domain**

- ## MAR vs ECA&D : temperature
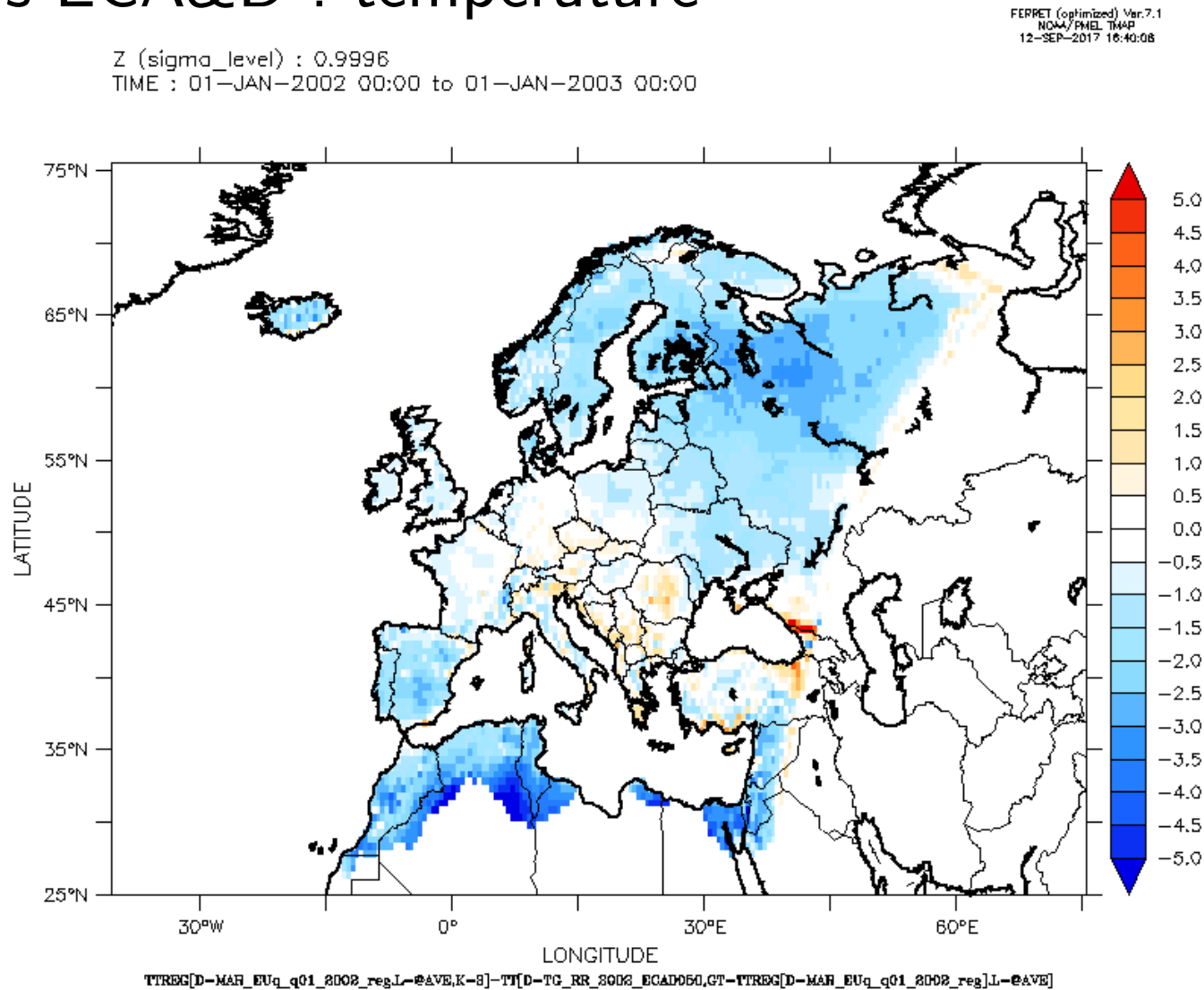
- ## MAR vs ECA&D : precipitations

Summary and prospects

1. MAR sensitivity to forcing reanalyses

- MAR forced by ERA-interim provides the best results
- MAR provides better results in winter
- Improvements in the convection scheme are required
    - → non-hydrostatic MAR?

2. MARv3.6 vs MAR3.7

- MAR is highly sensitive to vegetation properties especially in summer
    - → MAR-CARAIB coupling

3. Detection of hydroclimatic conditions favourable to floods

- → Coupling MAR with a hydrological model or forcing a hydrological model by MAR

4. MAR results over the EURO-CORDEX domain

- MAR provides good results especially in Western Europe