

THE MAR MODEL PERFORMANCES OVER BELGIUM

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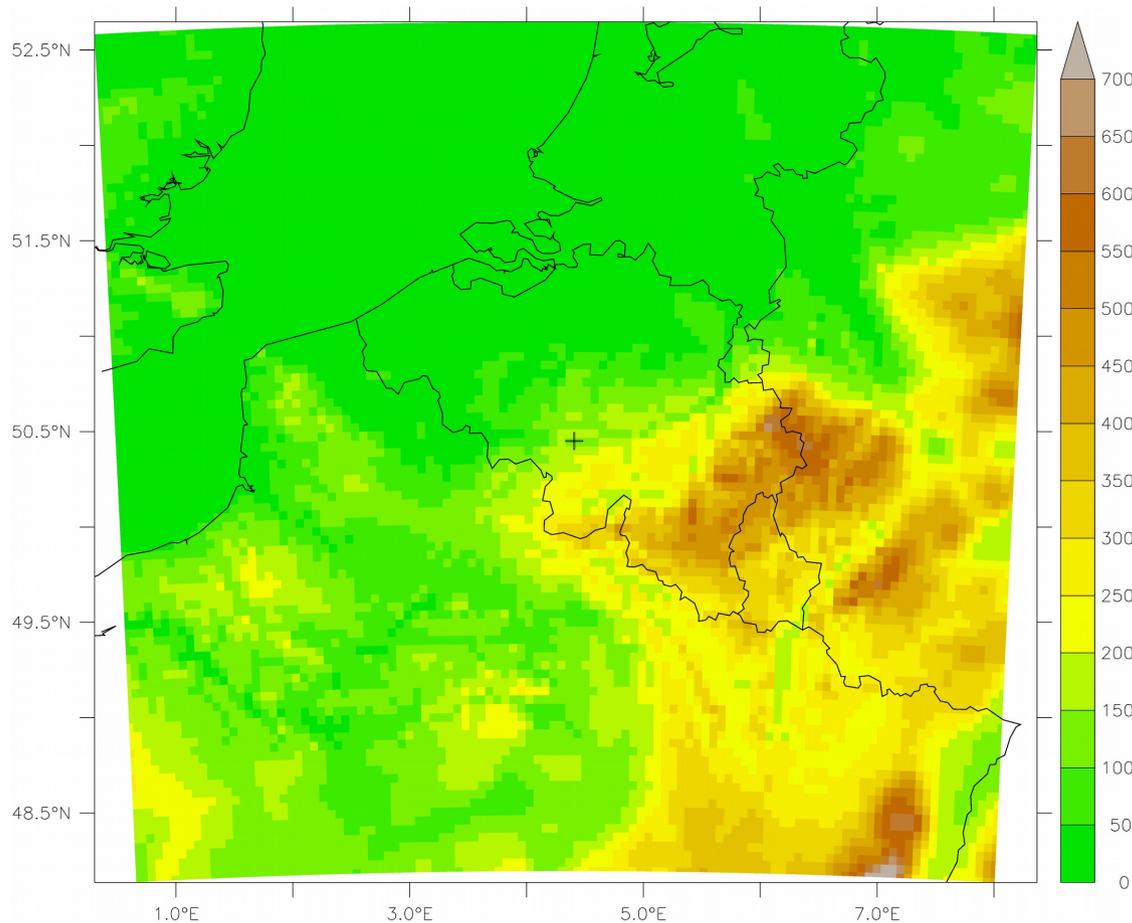
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Presented at the 1st MAR Workshop, ULg, Liège, Belgium

8 June 2016

- Funder: Fund for Research Training in Industry and Agriculture (FRIA) of Belgium
- Supervisors: Xavier FETTWEIS and Louis FRANÇOIS
- Objectives: Coupling MAR and CARAIB in order to assess the impact of the feedbacks between climate and vegetation on plant species exploited in Belgium and on climate extremes
- Involved in the CORDEX.be project
- Evolution of hydroclimatic conditions responsible for floods in the south-east of Belgium (snowpack melting + intense rainfall events)

First results and findings



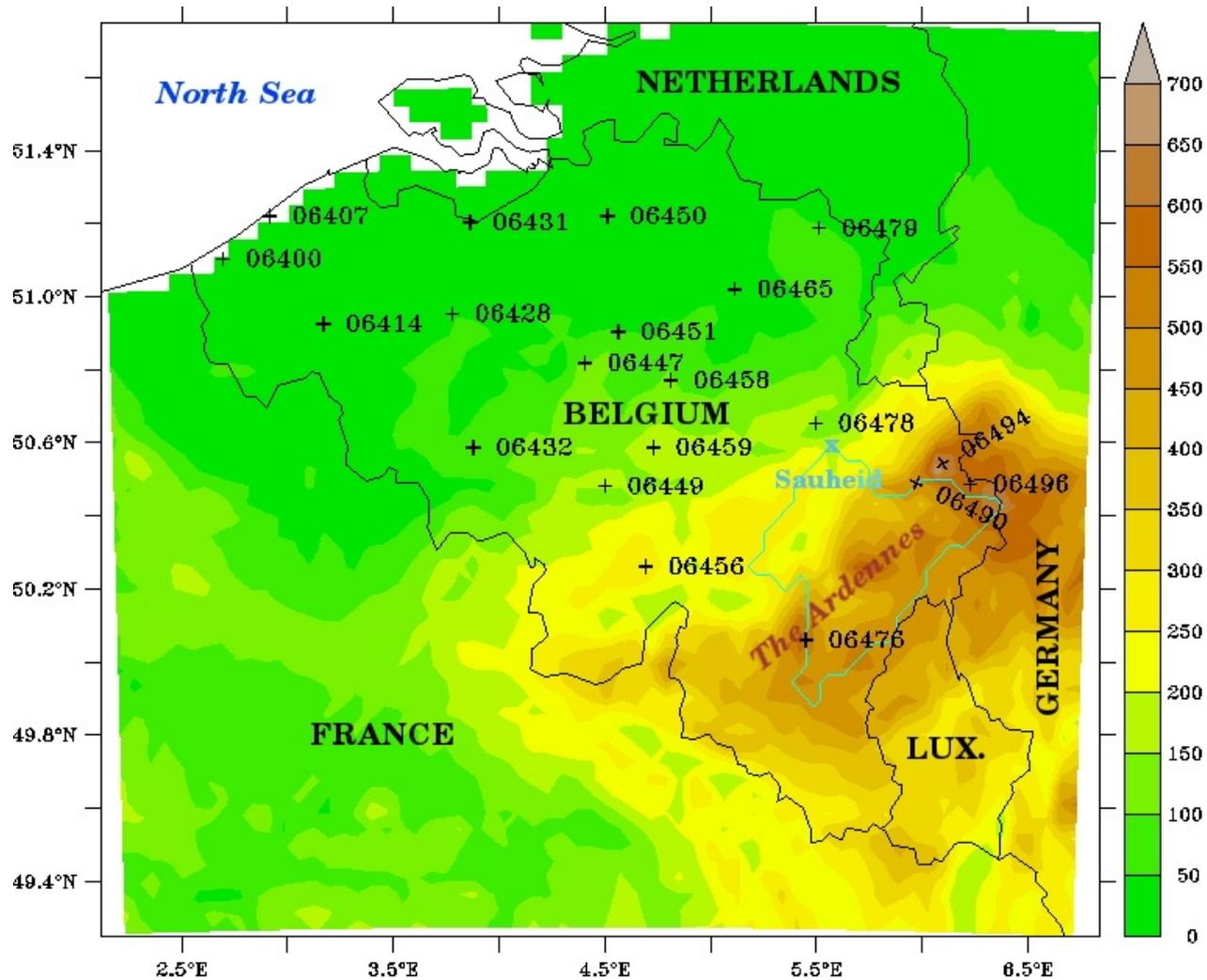
MARv3.5 — 5 km forced by ERA-Interim

- 110x100 pixels
- 23 vertical levels
- Centre (4,3°E;50,4°N)
- Time step: 30-40s
- NESTOR: Smoothing of topography on the eastern and southern boundaries (15 pixels)
- NESTOR: +10% of specific humidity
- NESTOR: Correction of the Mont Rigi elevation
- MAR: $RI0 = 0.97$
- MAR: $MZABSO = 4$ (11,781 m)
- MAR: $MZHYD = 5$ (10,270 m)

- Validation data

SYNOP code downloaded from www.ogimet.com

Period: 2008-2014

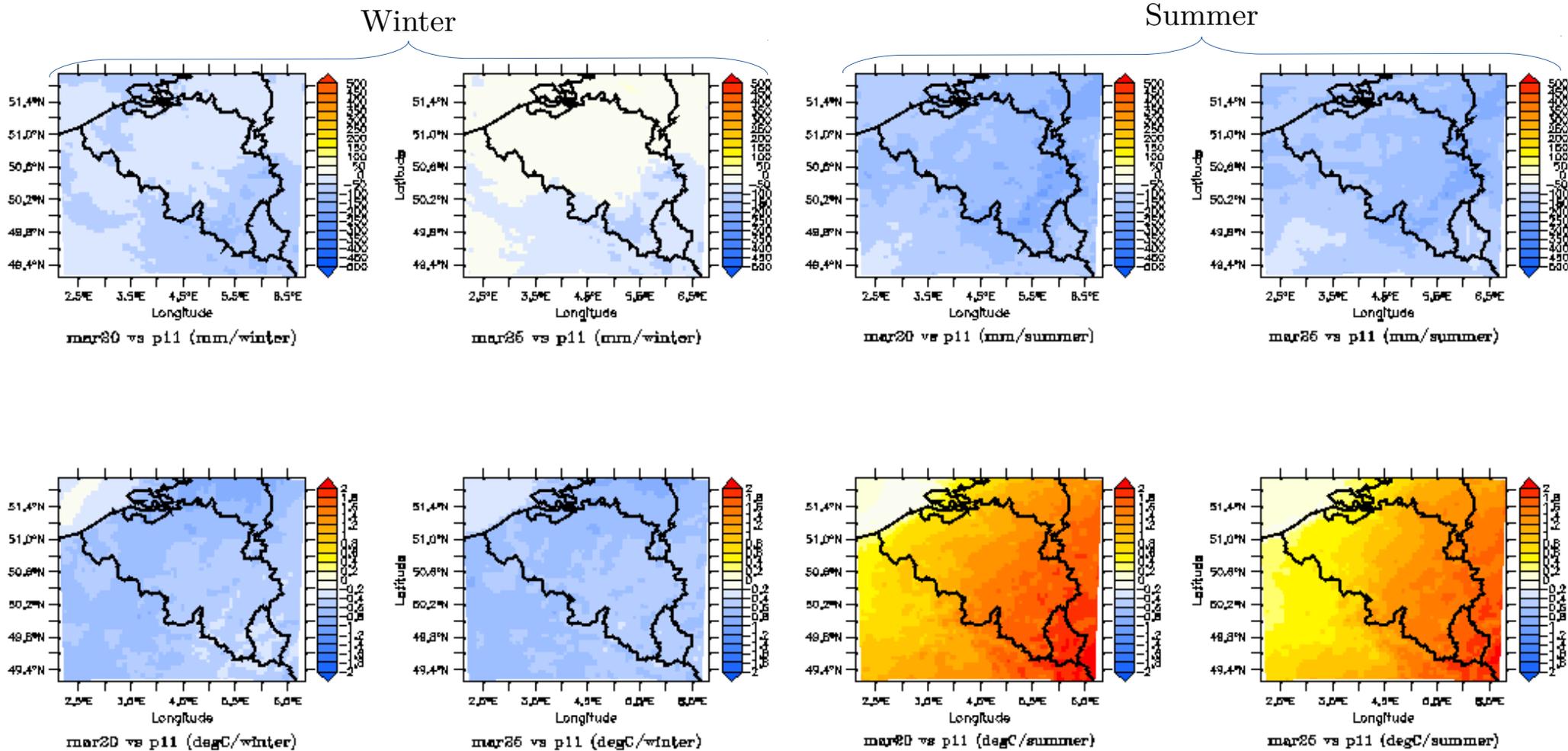


- First results and findings

Daily mean temperature	Winter	Summer
R	> 0.95	> 0.95
Bias	-0.47°C (-14%)	+1.62°C (+10%)
RMSE	~ 1.2°C (30%)	~ 2.1°C (70%)
Daily precipitation amount	Winter	Summer
R	0.70	0.52
Bias	-1%	-18%
RMSE	~3.3 mm (76%)	~5.2 mm (87%)
Daily snow depth	Winter	
R	> 0.85	
Bias	< -6 cm (-40%)	
RMSE	~ 9cm (60%)	

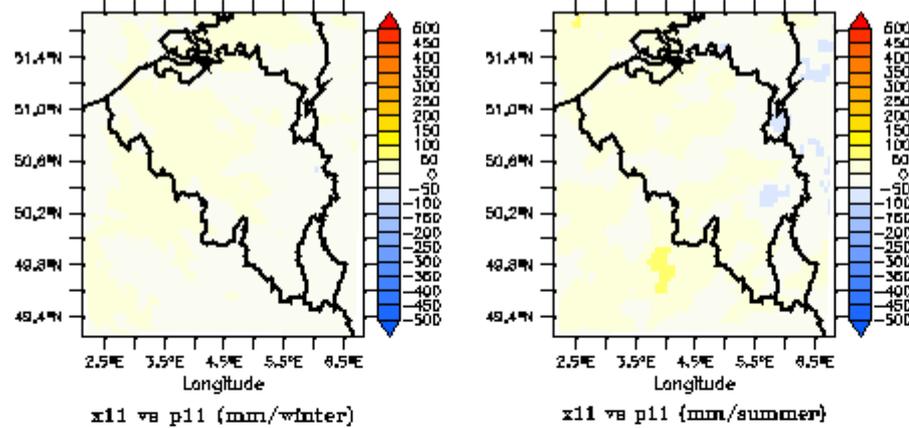
Biases correction attempts

x MAR forced by MAR → Amplification of biases

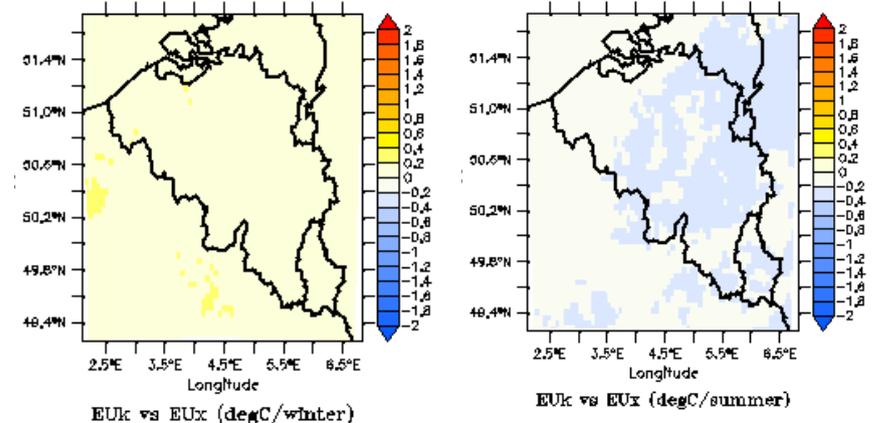
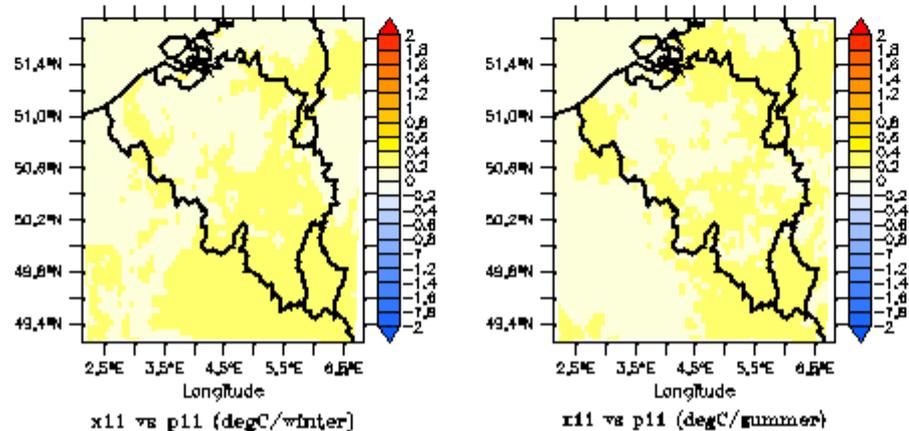
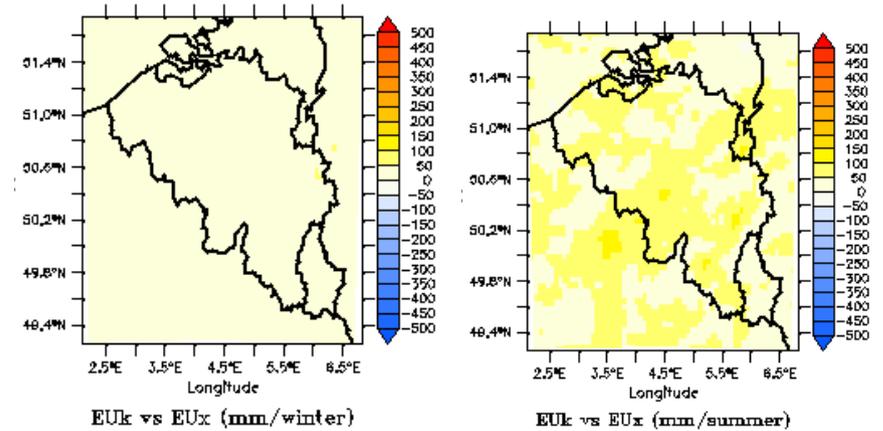


Biases correction attempts

✓ Enlargement of the integration domain



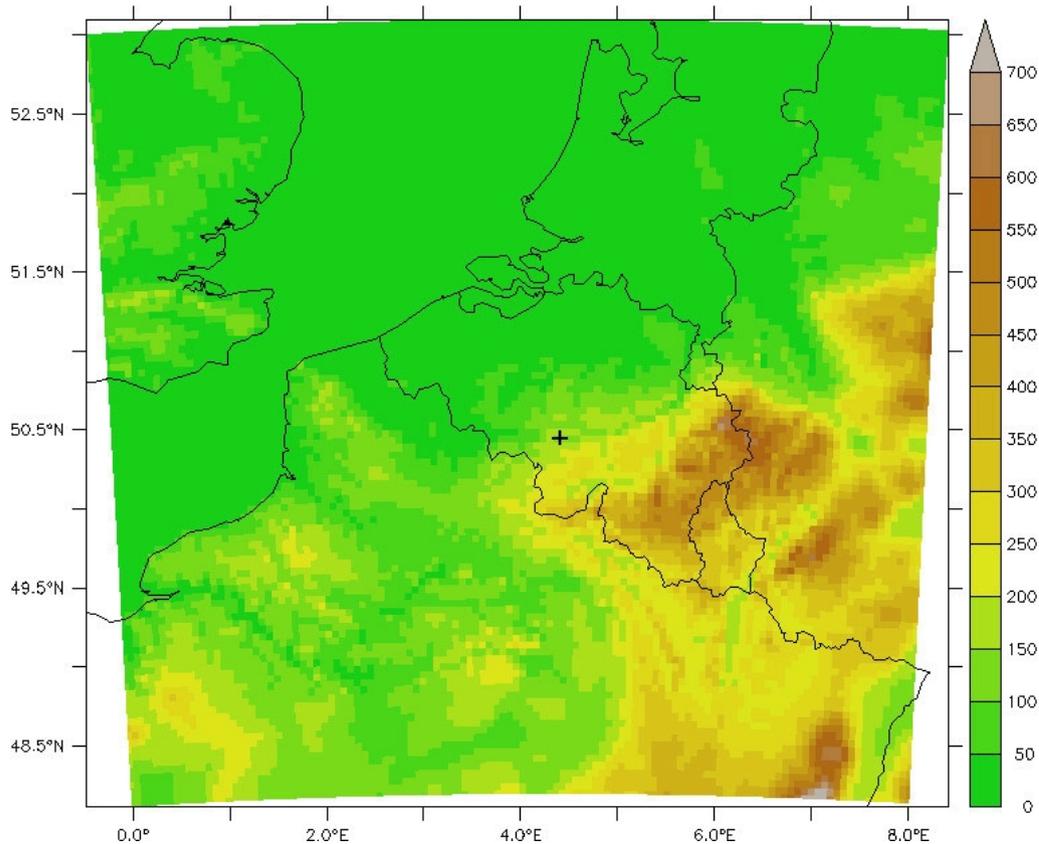
✓ Increase in specific humidity at the boundaries



Biases correction attempts

- ✗ **MAR forced by MAR** → Biases amplification
- ✓ **NESTOR: Enlargement of the integration domain** → Modification of PPN patterns
- ✓ **NESTOR: Increase in LSC_{qv} at the boundaries (specific humidity)** → Partial biases correction
- ✗ **NESTOR: Increase in NST_{dsa} (soil albedo)** → Colder and wetter results
- ✗ **MAR: Decrease in RIO (percentage of the solar constant at the top of the MAR atmosphere)** → Colder and wetter results
- ✗ **MAR: Decrease in sEX_{sv} (coefficient of solar energy vertically extinction in the snow layers)** → Colder and wetter results
- ✗ **MAR: Replacement of the Peter Bechtold convective adjustment by the Kerry Emmanuel convective adjustment** → Biases amplification
- ✗ **MAR: Removal of OdeepO and OshaO (deep and shallow convection)** → Warmer and dryer results
- ✓ **MAR: Decrease in RosMin (Minimum fresh snowfall density)** → Thicker snow accumulation
- ✓ **MAR: Limitation of Bros_N at 150 kg/m³ (Buffer snow layer density)** → Thicker snow accumulation
- ✗ **MAR: Decrease in FACFIK**
 (parameter which controls the filtering of initial properties at the boundaries) → Colder and wetter results
- ✗ **MAR: Decrease in MZHYD**
 (level above which there is no micro-physical processes, no clouds) → Colder and wetter results

Final MAR configuration



MARv3.6 — 5 km forced by ERA-Interim, ERA-20C, NCEP1

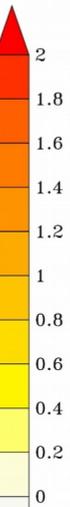
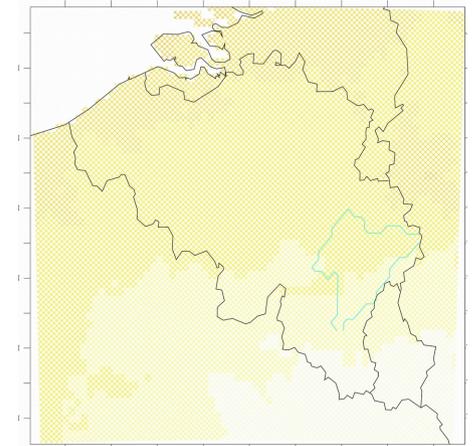
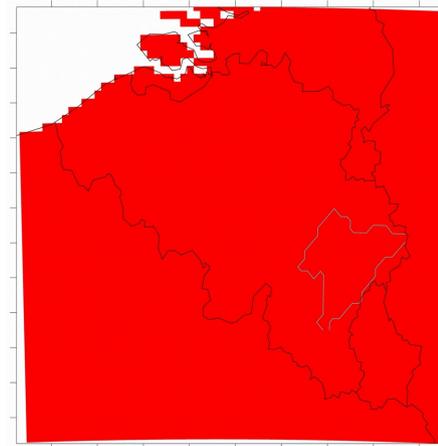
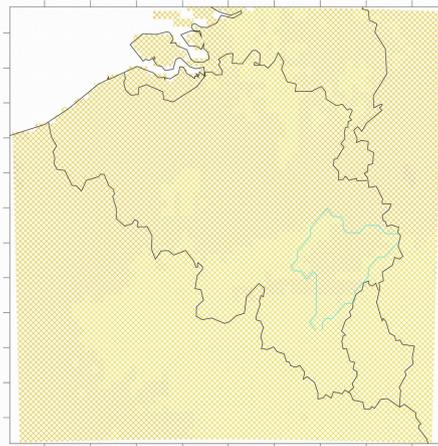
- 120x110 pixels
- 24 vertical levels
- Centre (4,3°E;50,4°N)
- Time step: 30 s
- NESTOR: Smoothing of topography on the eastern and southern boundaries (15 pixels)
- NESTOR: +11% of specific humidity
- NESTOR: Correction of the Mont Rigi elevation
- MAR: $RI0 = 0.97$
- MAR: $MZABSO = 4$ (11,781 m)
- MAR: $MZHYD = 5$ (10,270 m)

MAR-ERA

MAR-ERA20C

MAR-NCEP1

- Trend in the **daily mean temperature** in winter ($^{\circ}\text{C}/52$ winters)

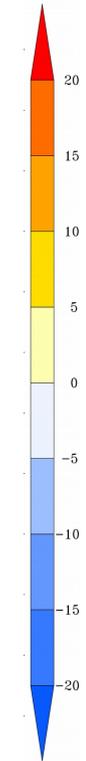
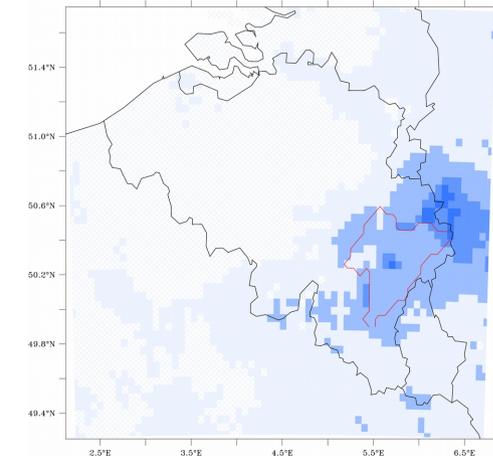
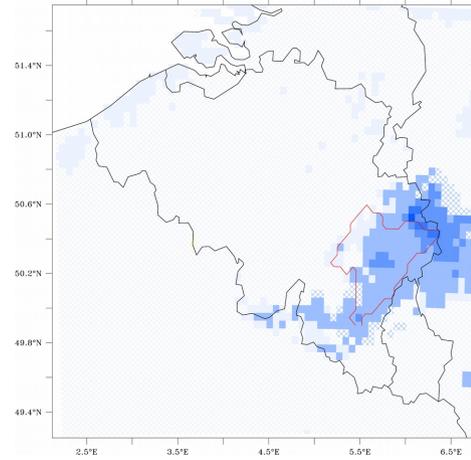
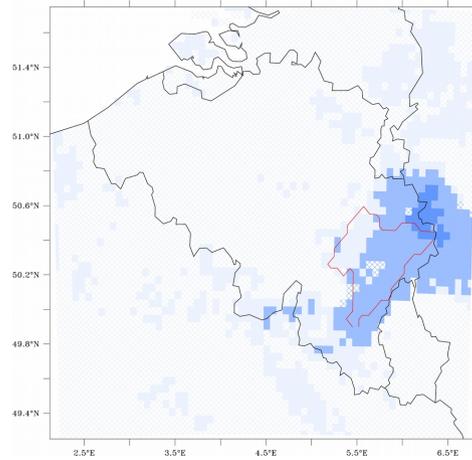


MAR-ERA

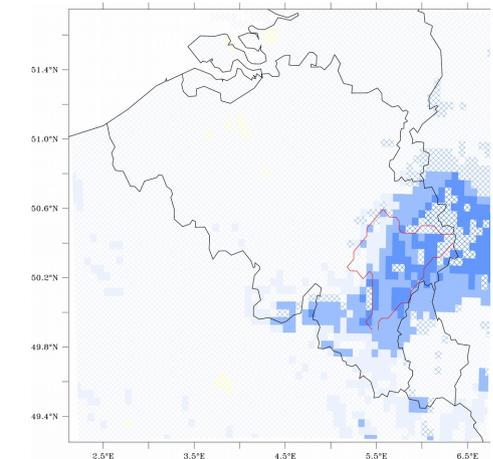
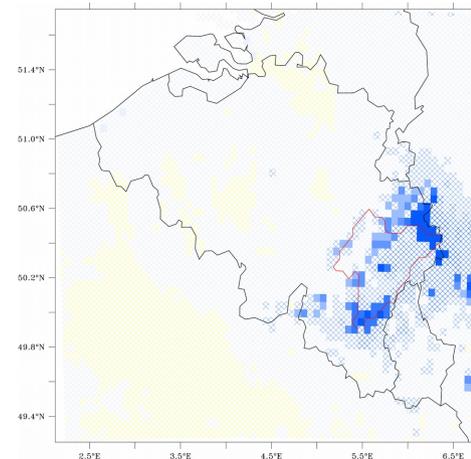
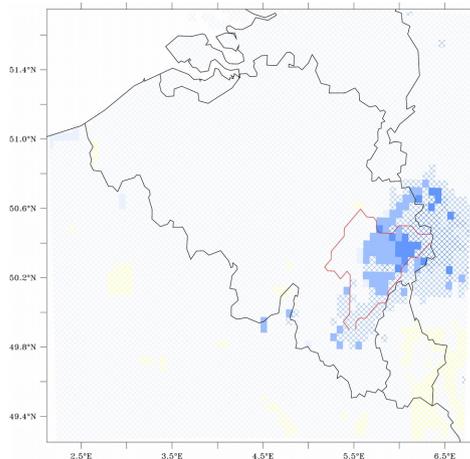
MAR-ERA20C

MAR-NCEP1

- Trend in the maximum snow depth in winter (cm/52 winters)



- Trend in the number of days with a snow cover of at least 5 cm (days/52 winters)

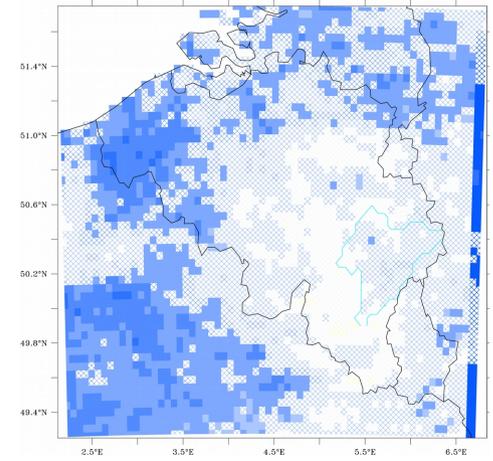
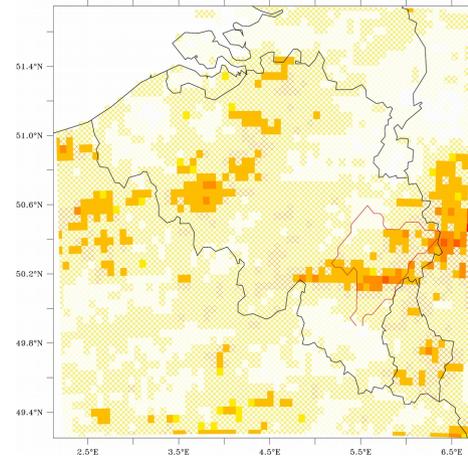
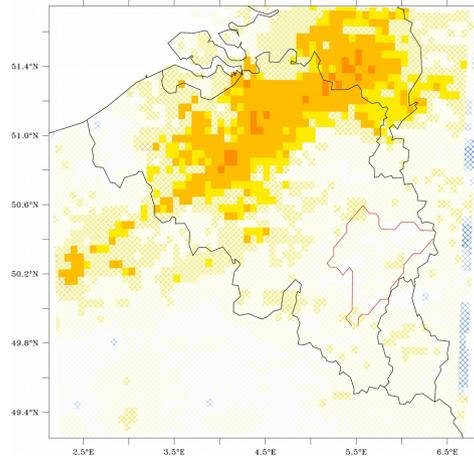


MAR-ERA

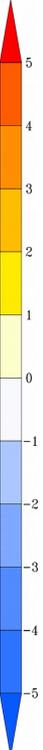
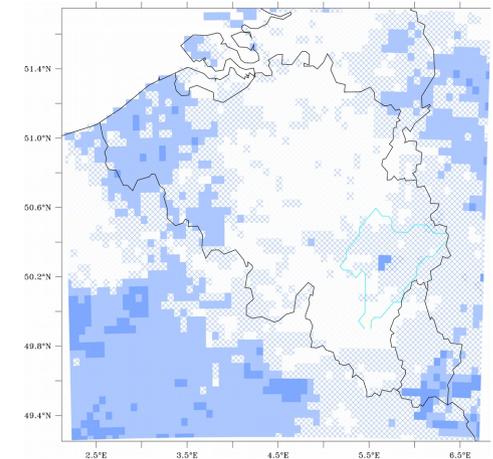
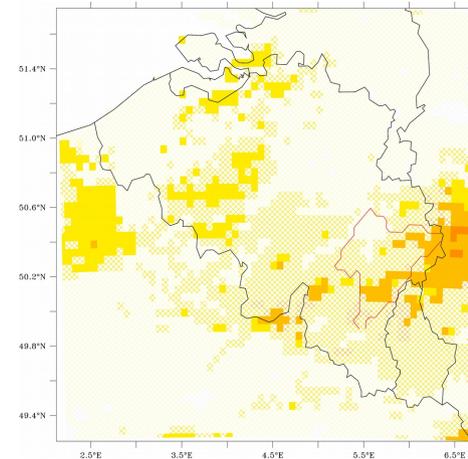
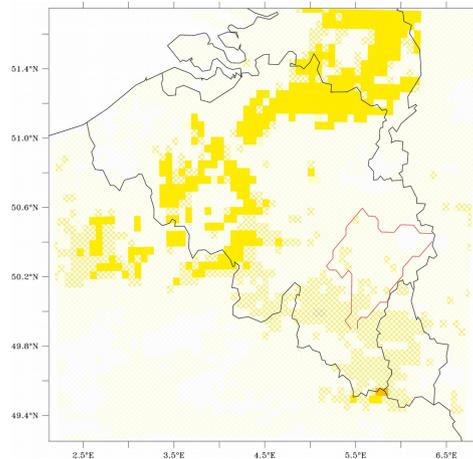
MAR-ERA20C

MAR-NCEP1

- Trend in the frequency of extreme precipitation events (events/52 winters)



- Trend in the intensity of extreme precipitation events (mmWE/52 winters)

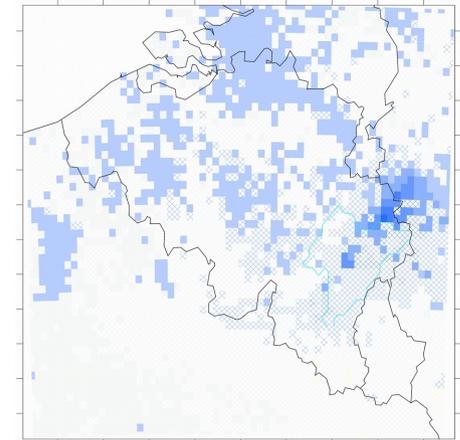
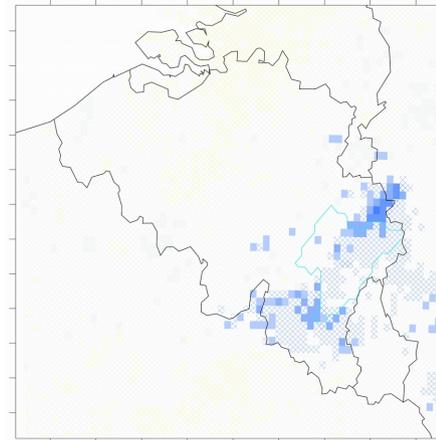


MAR-ERA

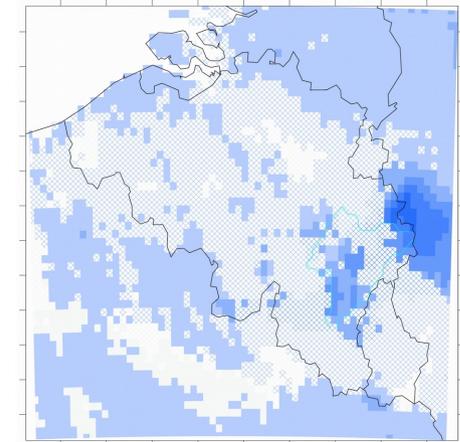
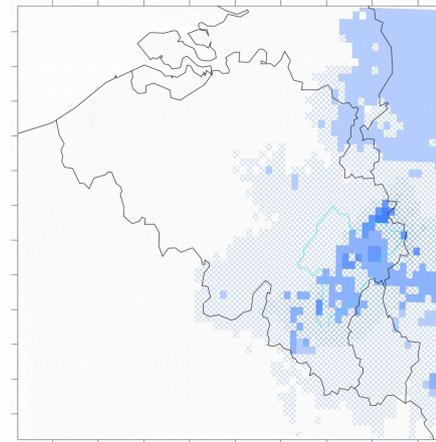
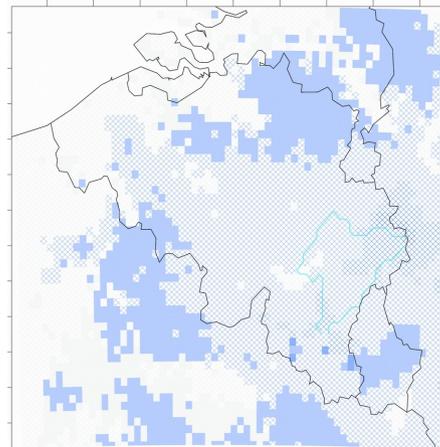
MAR-ERA20C

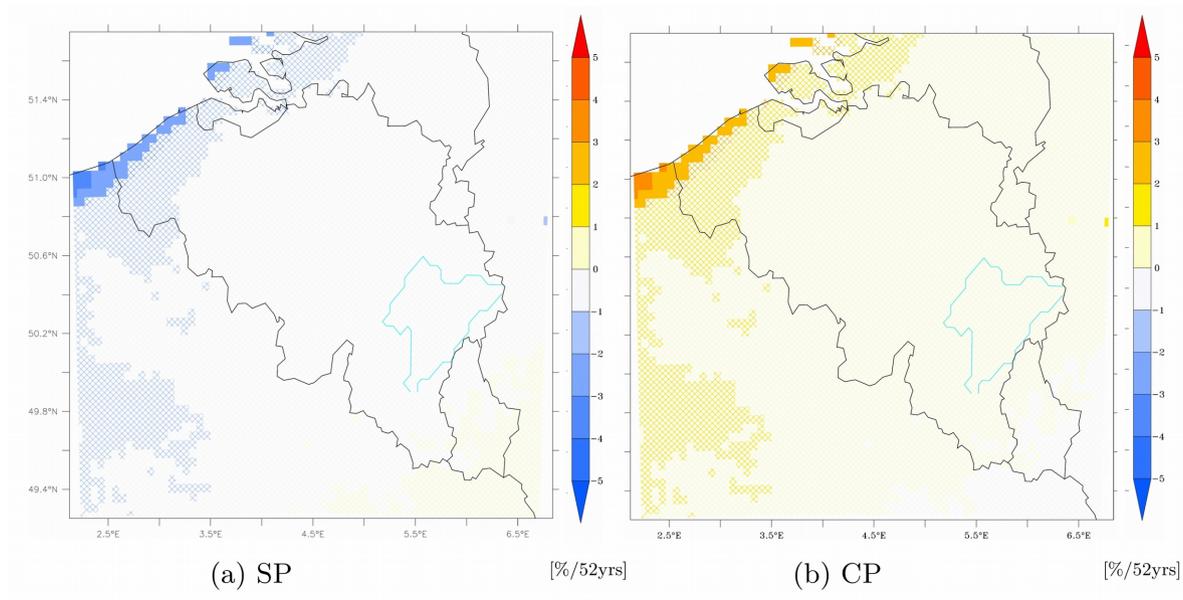
MAR-NCEP1

- Trend in **rainfall** amount in winter (mmWE/52 winters)



- Trend in **snowfall** amount in winter (mmWE/52 winters)





- Trend in the **percentage of stratiform precipitation** in winter (%/52 winters)
- Trend in the **percentage of convective precipitation** in winter (%/52 winters)

- MAR is able to represent the variability of the Belgian climate especially in winter
 - MAR computes a decrease in precipitation amount in winter over 1959-2010 while observations show an increase ...
 - The trends computed over 1959-2010 also depend on the reanalysis used as forcing
 - Trend in the daily mean temperature in winter (MAR-ERA-20C)
 - Trend in the frequency and the intensity of extreme precipitation events (MAR-NCEP1)
- MAR needs improvements: convection, nebulosity, surface properties

Thank you for your attention!

Questions?