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

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Sébastien DOUTRELOUP
Xavier FETTWEIS

2d MAR Workshop, 13-15 September 2017, IGE, Grenoble
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:**
    - ERA-20C (1900-2010)
    - 20CRv2C (1900-2010)

  - **Horizontal resolution:**
    - 5 km – 10 km – 20 km
• Sensitivity to **forcing reanalyses**: temperature

![Graph showing seasonal daily mean temperature with different biases and correlations for different seasons.](image-url)
Sensitivity to forcing reanalyses: precipitations
• **Sensitivity to forcing reanalyses**: snow height
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
• MARv3.6 vs MARv3.7 : temperature

<table>
<thead>
<tr>
<th>MARv3.6</th>
<th>2008-2014</th>
<th>DJF</th>
<th>MAM</th>
<th>JJA</th>
<th>SON</th>
<th>Annual mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>0.97</td>
<td>0.98</td>
<td>0.95</td>
<td>0.98</td>
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<td>0.97</td>
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<tr>
<td>RMSE (°C)</td>
<td>1.08</td>
<td>1.11</td>
<td>2.07</td>
<td>1.35</td>
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<td>1.47</td>
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<tr>
<td>MB (°C)</td>
<td>-0.34</td>
<td>0.27</td>
<td>1.74</td>
<td>0.70</td>
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<td>0.59</td>
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<tr>
<td>STD (°C)</td>
<td>5.56</td>
<td>4.61</td>
<td>3.10</td>
<td>4.12</td>
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<td>4.35</td>
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<tr>
<td>Daily mean T (°C)</td>
<td>4.06</td>
<td>10.56</td>
<td>16.48</td>
<td>10.10</td>
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<td>10.30</td>
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Percentage of usable observations : 98.9 %

<table>
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<th>JJA</th>
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<th>Annual mean</th>
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Percentage of usable observations : 98.9 %
• MARv3.6 vs MARv3.7: precipitations

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<td>RMSE (mm/jour)</td>
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<td>Daily PPN amount (mm/jour)</td>
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<td>1.69</td>
<td>2.68</td>
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Percentage of usable observations: 95.6%

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Percentage of usable observations: 95.6%
• **MARv3.6 vs MARv3.7**: cloudiness

![Graph showing comparison between MARv3.6 and MARv3.7](image)

- **MARv3.6**
- **MARv3.7**

**EURO-CORDEX results**

**Sensitivity to forcing reanalyses**

**Flood detection**
• **MARv3.6 vs MARv3.7**: global radiation

![Graph showing comparison between MARv3.6 and MARv3.7 for global radiation sensitivity to forcing reanalyses](image-url)

**MARv3.6**

**MARv3.7**
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
Hydroclimatic conditions favourable to floods

Trends
1959-2010
• **Hydroclimatic conditions favourable to floods**
1. MAR sensitivity to forcing reanalyses
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• **MAR vs ECA&D : temperature**

Z (sigma_level) : 0.9995
TIME : 01—JAN—2002 00:00 to 01—JAN—2003 00:00
• 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