Ensemble forecasting at the RMI of Belgium

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Outline

1. Ensemble forecasting at the RMI of Belgium

2. Probabilistic storm forecasts for wind farms

3. RMI-EPS over Belgium and Madeira (Portugal)

Ensemble forecasting at the RMI

- ECMWF EPS (18km, operational, 2 runs per day)
- GLAMEPS (8km, still operational but phased out, 4 runs per day)
- RMI-EPS (2.5km, experimental and semi-operational, 2 runs per day)

Deterministic forecasting at the RMI

- ► ECMWF (9km, operational, 2 runs per day)
- ► ALARO (4km, operational, 4 runs per day)
- ► ALARO (1.3km, experimental, 4 runs per day)

⇒ operational products based on combination of ECMWF EPS and ALARO
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NOTE: in addition our forecasters also look at other models (GFS, UKMO, AROME-MF,...)

Probabilistic storm forecasts

- Wind farms in the North Sea
- Cut-out events (25 m/s and 30 m/s) for transmission system operator Elia
- ALARO (4km) wind speed (15min) at turbine height
- ECMWF EPS (18km) wind speed (1h) at 100m
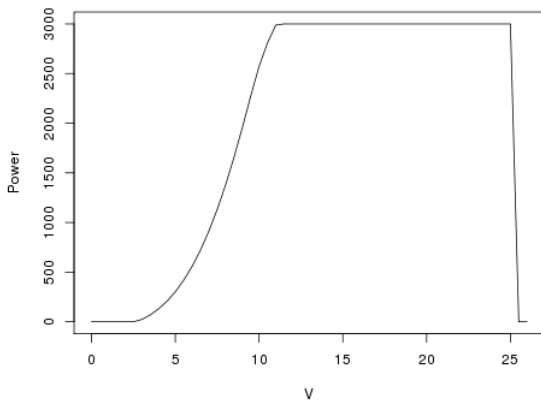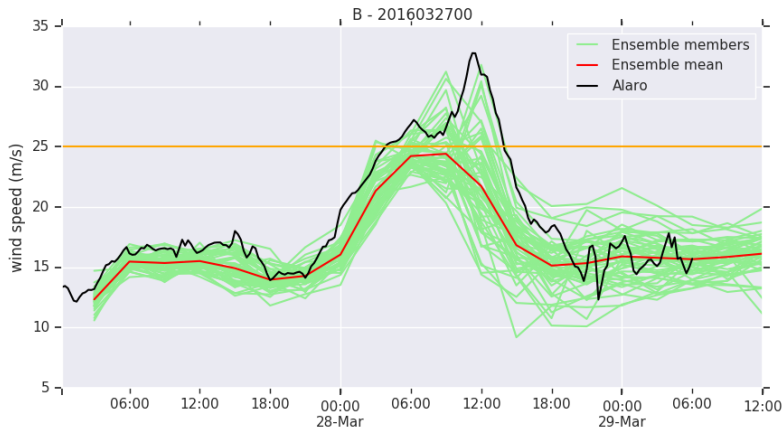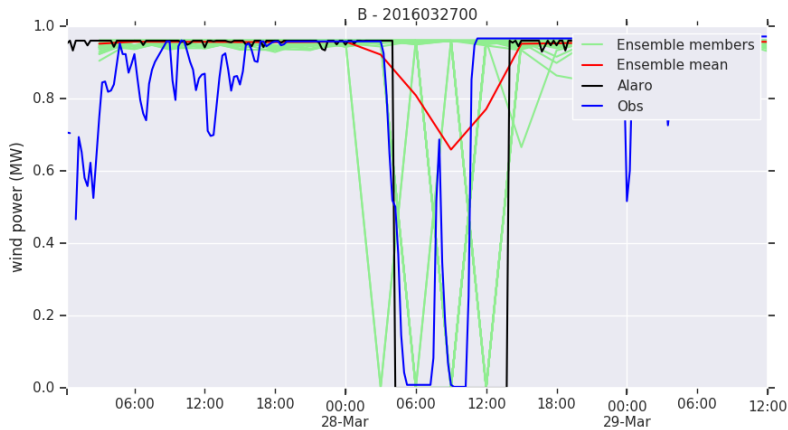 NOTE: only 3-hourly data before 23 Nov 2016.

Wind power model
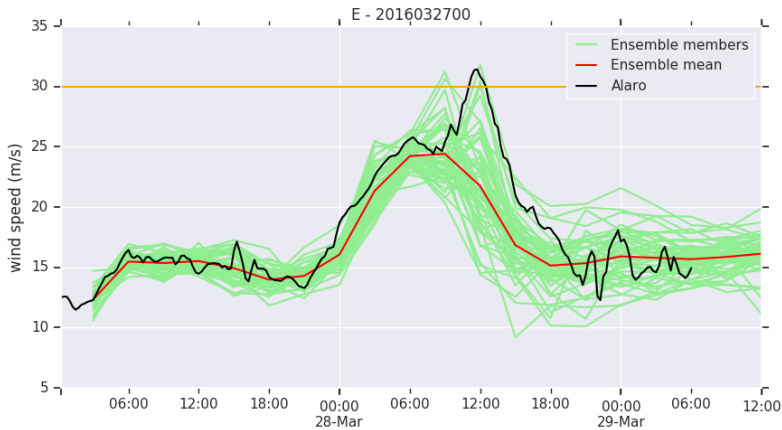

Figure: Wind power curve: a typical example
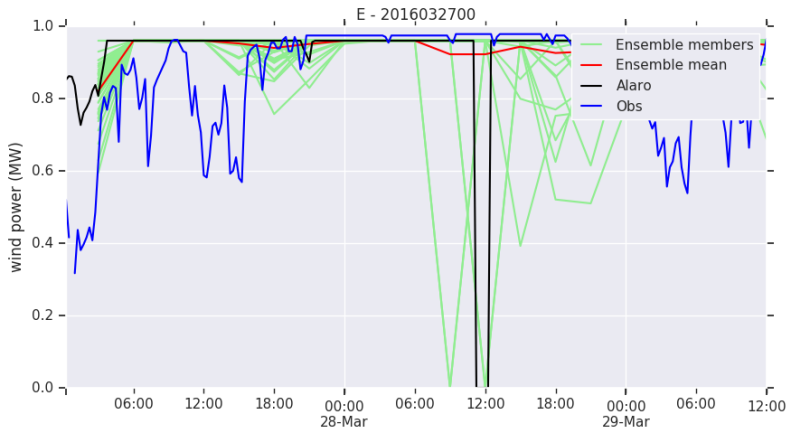
Cut-out event of 28 March 2016

Cut-out event of 28 March 2016

B - 2016032700

Legend:
- Ensemble members (green)
- Ensemble mean (red)
- Alaro (black)
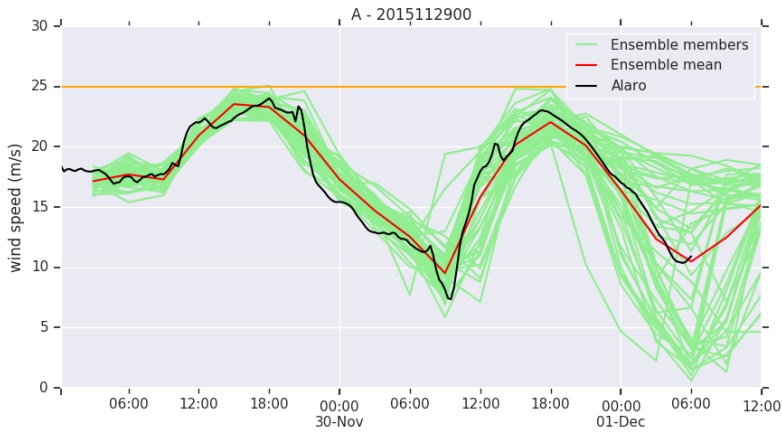- Obs (blue)

y-axis: wind power (MW)

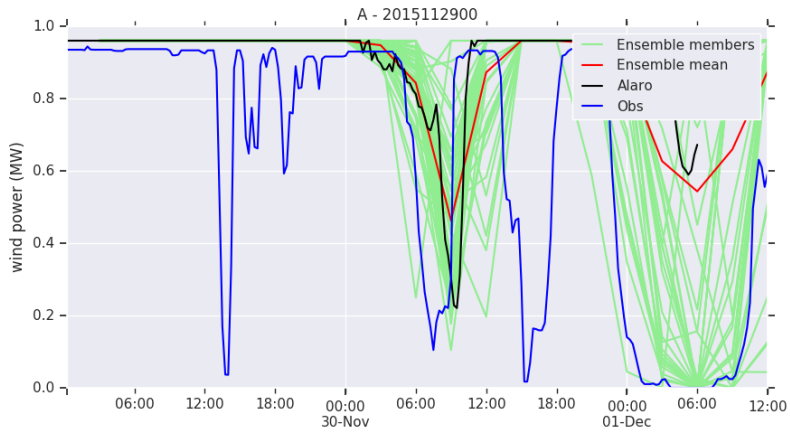# False alarm for 28 March 2016
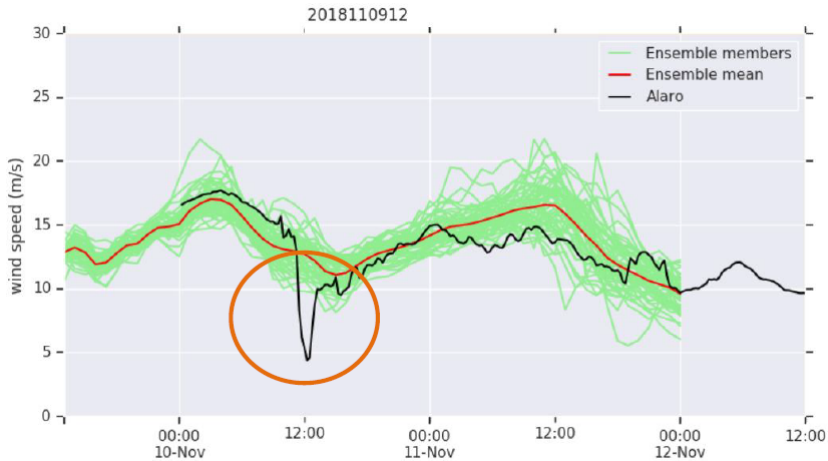
False alarm for 28 March 2016

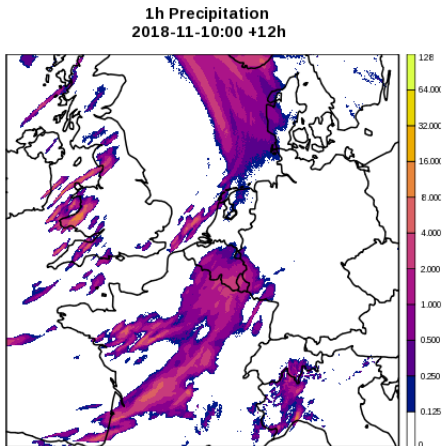# Near misses for 29-30 November 2015

Near misses for 29-30 November 2015

Occasional sudden wind drop

Occasional sudden wind drop

Seems to be related to precipitation (in ALARO)

1h Precipitation
2018-11-10:00 +12h

Alaro 4km

RMI-EPS current set-up

- AROME and ALARO models (both at 2.5km) are coupled to ECMWF ENS (vertical 65L).
- 22 limited area ensemble members: 10+1 from ALARO and 10+1 from AROME (cy38h1.1, both with SURFEX).
- Forecast range: 48 hours (at 00 and 12 UTC).
- Surface assimilation cycle (CANARI) + 3DVar upper-air data assimilation for control members.

Precipitation cases: Madeira (Portugal)

Convection permitting EPS on Madeira cases

- ▶ João Rio (IPMA) and Geert Smet (RMI)
- ▶ report on FR stay at RMI
- ▶ available at https://orfeo.kbr.be/
  new institutional Open Access repository for
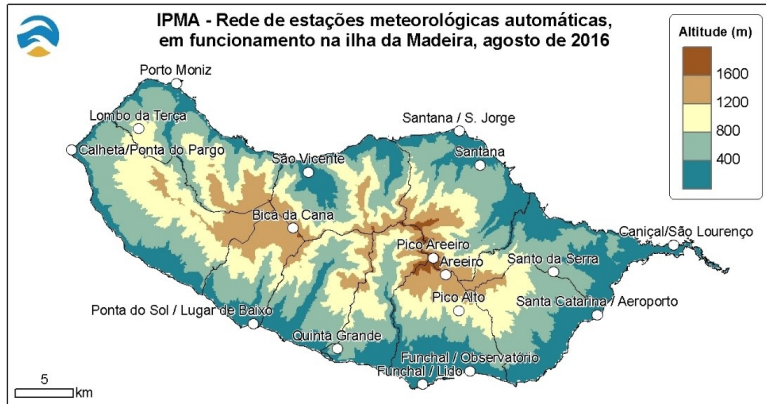 Federal Science Policy funded research

Figure: Orography and weather stations in Madeira

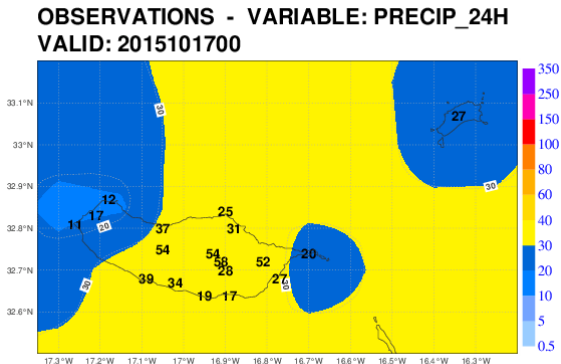# Heavy convective precipitation

16 October 2015

Figure: obs 24h precipitation (mm) in Madeira, on 16 Oct 2015

Heavy convective precipitation
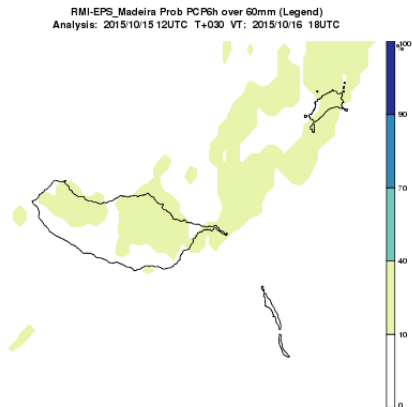
16 October 2015

Figure: Probability of precipitation above 60mm/6h, from the RMI-EPS run from 12 UTC of October 15th, valid at +30h.

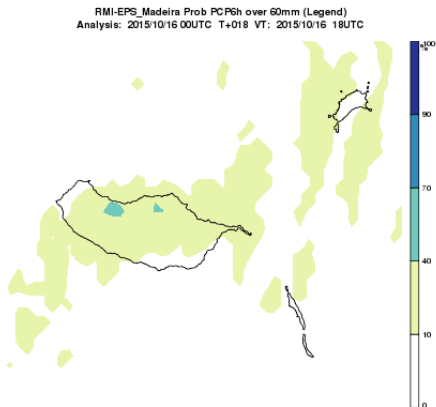# Heavy convective precipitation

16 October 2015

Figure: Probability of precipitation above 60mm/6h, from the RMI-EPS run from 00 UTC of October 16th, valid at 18 UTC.

Enhanced precipitation over mountains
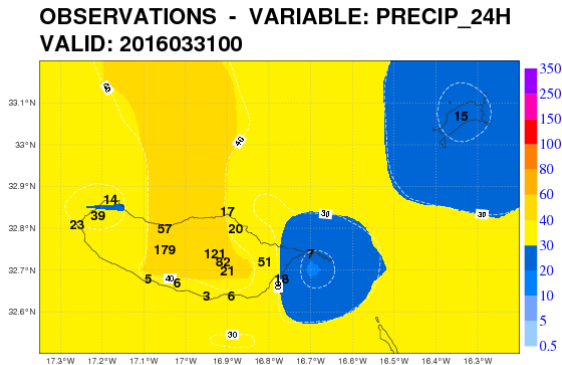
30 March 2016

Figure: obs 24h precipitation (mm) in Madeira, on 30 March 2016

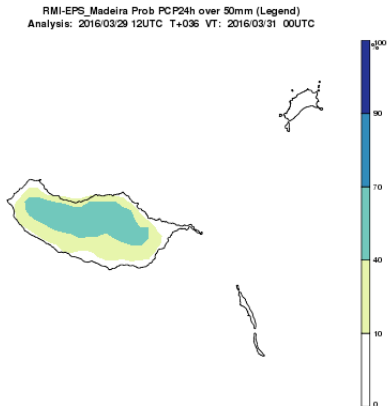# Enhanced precipitation over mountains

30 March 2016

Figure: Probability of precipitation above 50mm/24h, from the RMI-EPS run from 12 UTC of March 29th, valid at +36h.

Enhanced precipitation over mountains
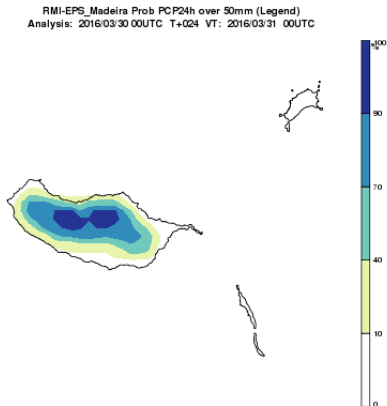
30 March 2016

Figure: Probability of precipitation above 50mm/24h, from the
RMI-EPS run from 00 UTC of March 30th, valid at +24h.
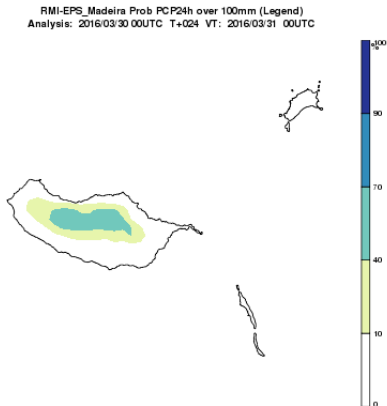
Enhanced precipitation over mountains

30 March 2016

Figure: Probability of precipitation above 100mm/24h, from the RMI-EPS run from 00 UTC of March 30th, valid at +24h.
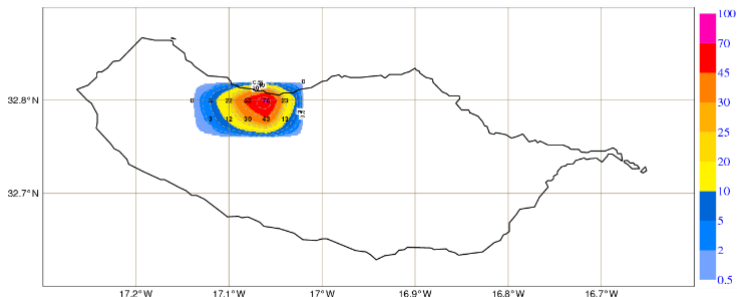
Over-active convection

Figure: AROME-MAD 3h precipitation, valid at 21UTC of 28 October 2016, from the 00 UTC run of October 28th.
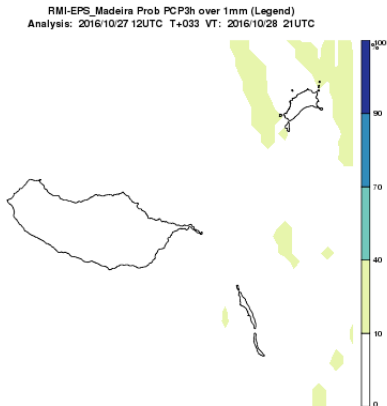
Over-active convection

28 October 2016

Figure: Probability of precipitation above 1mm/3h, from the RMI-EPS run from 12 UTC of October 27th, valid at +33h.

Over-active convection

28 October 2016

RMI-EPS_Madeira Prob PCP3h over 1mm (Legend)
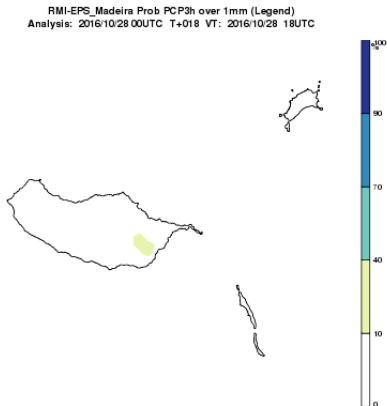Analysis: 2016/10/28 00UTC T+018 VT: 2016/10/28 18UTC

Figure: Probability of precipitation above 1mm/3h, from the RMI-EPS run from 00 UTC of October 28th, valid at +18h.

Over-active convection

28 October 2016

RMI-EPS_Madeira Prob PCP3h over 1mm (Legend)
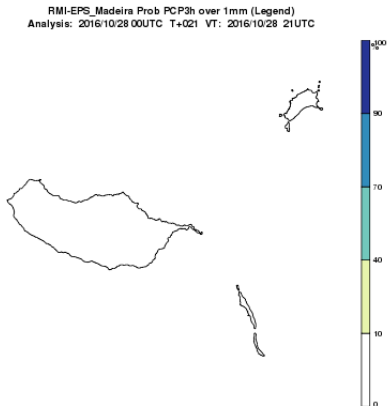Analysis: 2016/10/28 00UTC T+021 VT: 2016/10/28 21UTC

Figure: Probability of precipitation above 1mm/3h, from the
RMI-EPS run from 00 UTC of October 28th, valid at +21h.
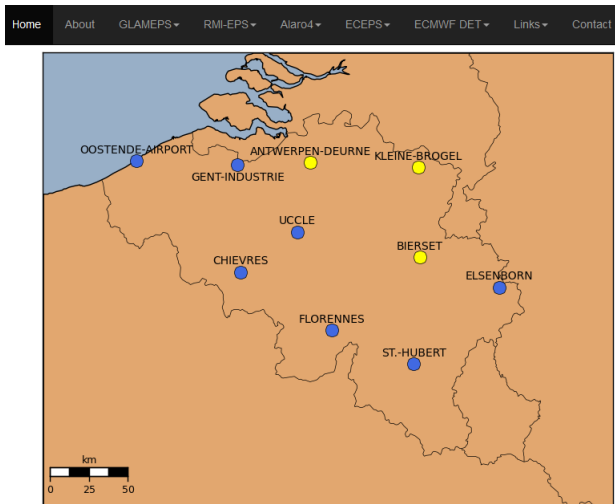
Verification scores: Belgium

Figure: INDRA synop stations.
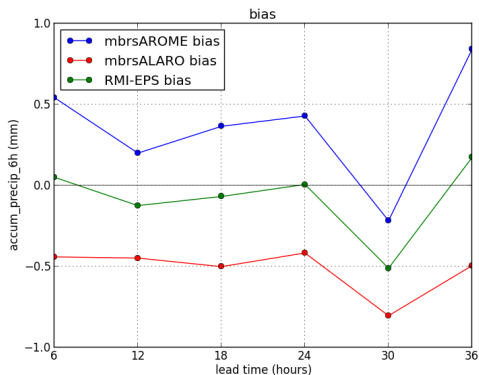
Verification scores: Belgium

Figure: Bias for 6h accumulated precipitation: thunderstorm cases of August 2015 (averages over 10 standard stations in Belgium).

Verification scores: Belgium
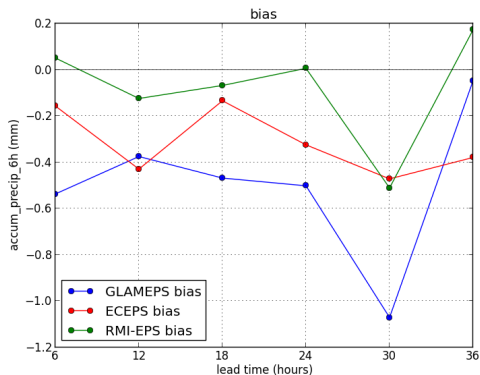

Figure: Bias for 6h accumulated precipitation: thunderstorm cases of August 2015 (averages over 10 standard stations in Belgium).
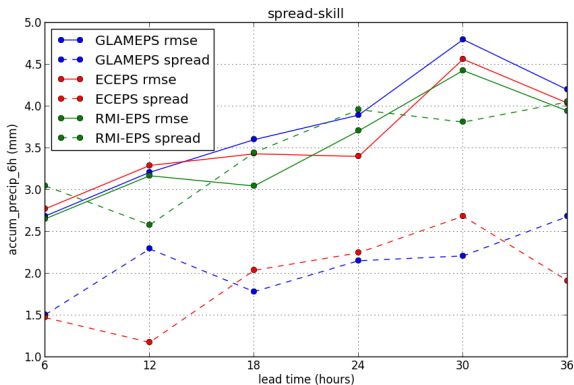
Verification scores: Belgium

Figure: RMSE and spread for 6h accumulated precipitation: thunderstorm cases of August 2015 (averages over 10 standard stations in Belgium).
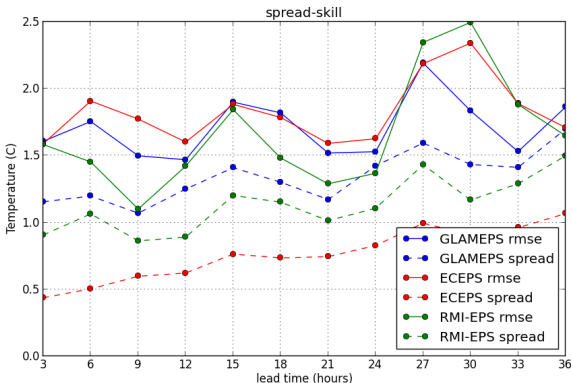
Verification scores: Belgium

Figure: RMSE and spread for T2M: thunderstorm cases of August 2015 (averages over 10 standard stations in Belgium).
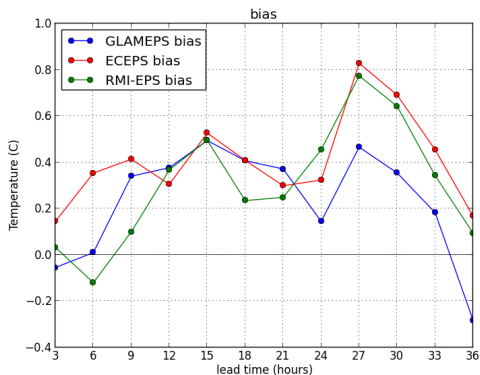
Verification scores: Belgium

Figure: Bias for T2M: thunderstorm cases of August 2015 (averages over 10 standard stations in Belgium).
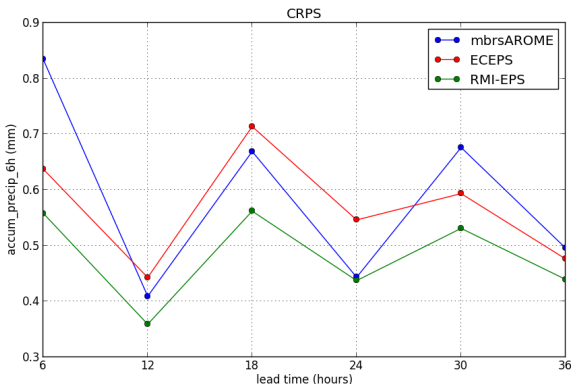
Verification scores: Belgium

Figure: CRPS for 6h accumulated precipitation: 15 May 2018 - 14 June 2018 (averages over 10 standard stations in Belgium).
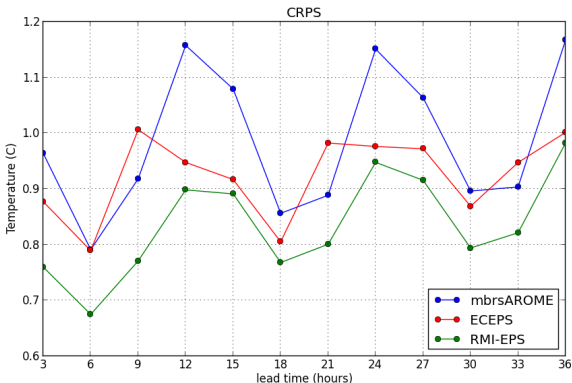
Verification scores: Belgium

Figure: CRPS for 2-meter temperature: 15 May 2018 - 14 June 2018 (averages over 10 standard stations in Belgium).

RMI-EPS future plans

Short term

- Additional surface perturbations.
  - Should improve T2m spread.
  - Influence on thunderstorm forecasts?
- An automatic monthly verification (of INDRA).

RMI-EPS future plans

Long term

Upper-air physics

- ▶ Multiphysics (e.g. different tunings).
- ▶ Tests with ALARO-1 (instead of ALARO-0).
- ▶ Perturbation of physical processes (parameter perturbation).