

Ensemble weather forecast for ESP

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HEPEX WORKSHOP

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ECMWF

Reading, UK

Topics

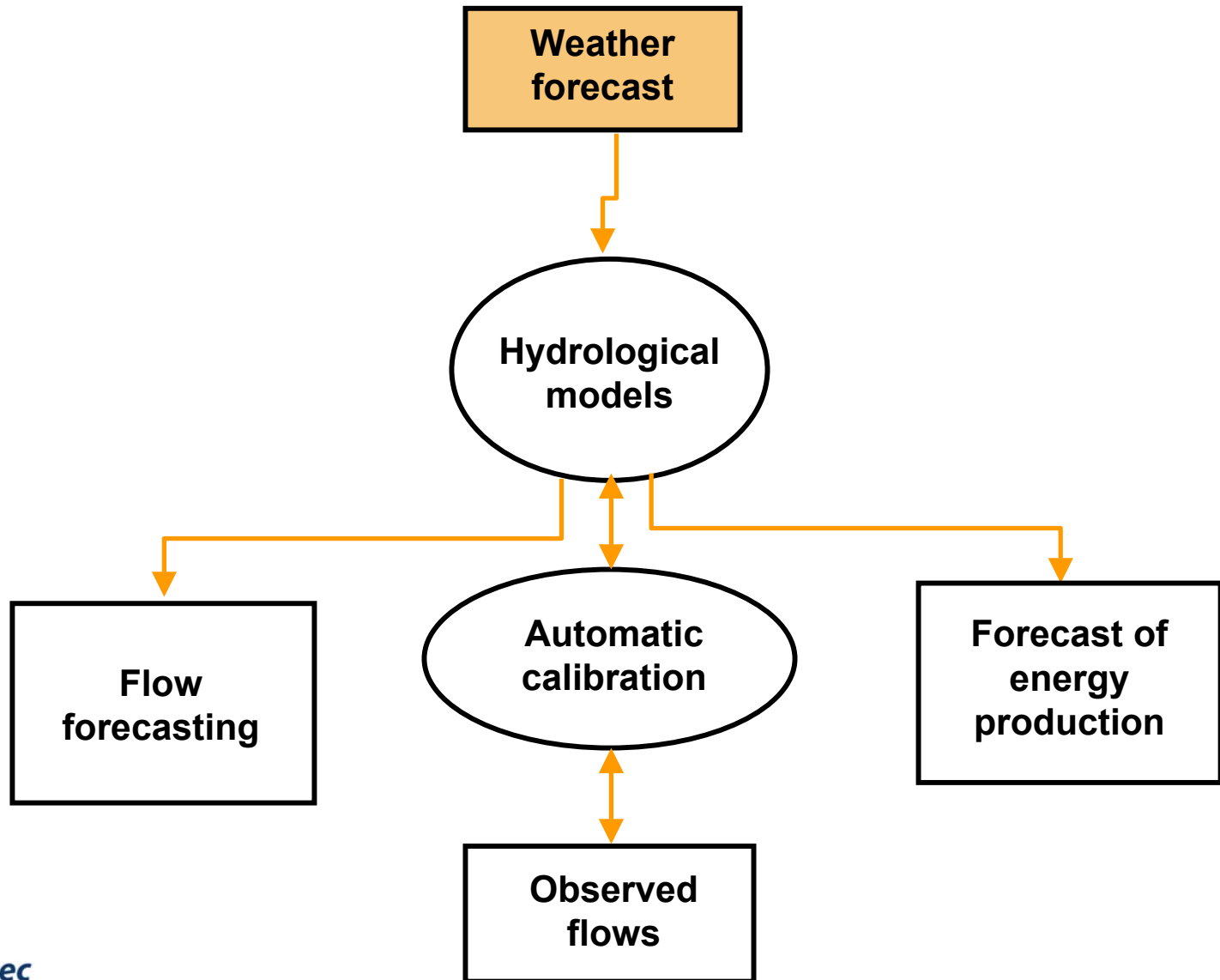
- ❑ Preliminary and exploratory results
- ❑ Issues to address in order to use ensemble forecast for flow prediction at Hydro-Quebec

Ensemble forecast benefit for Hydro-Quebec

- ❑ Take into account uncertainty in hydrological forecasting due to short term meteorological events (1 to 10 days)**
 - Provide an estimate of the most probable flow
 - Provide a range of possible outcomes

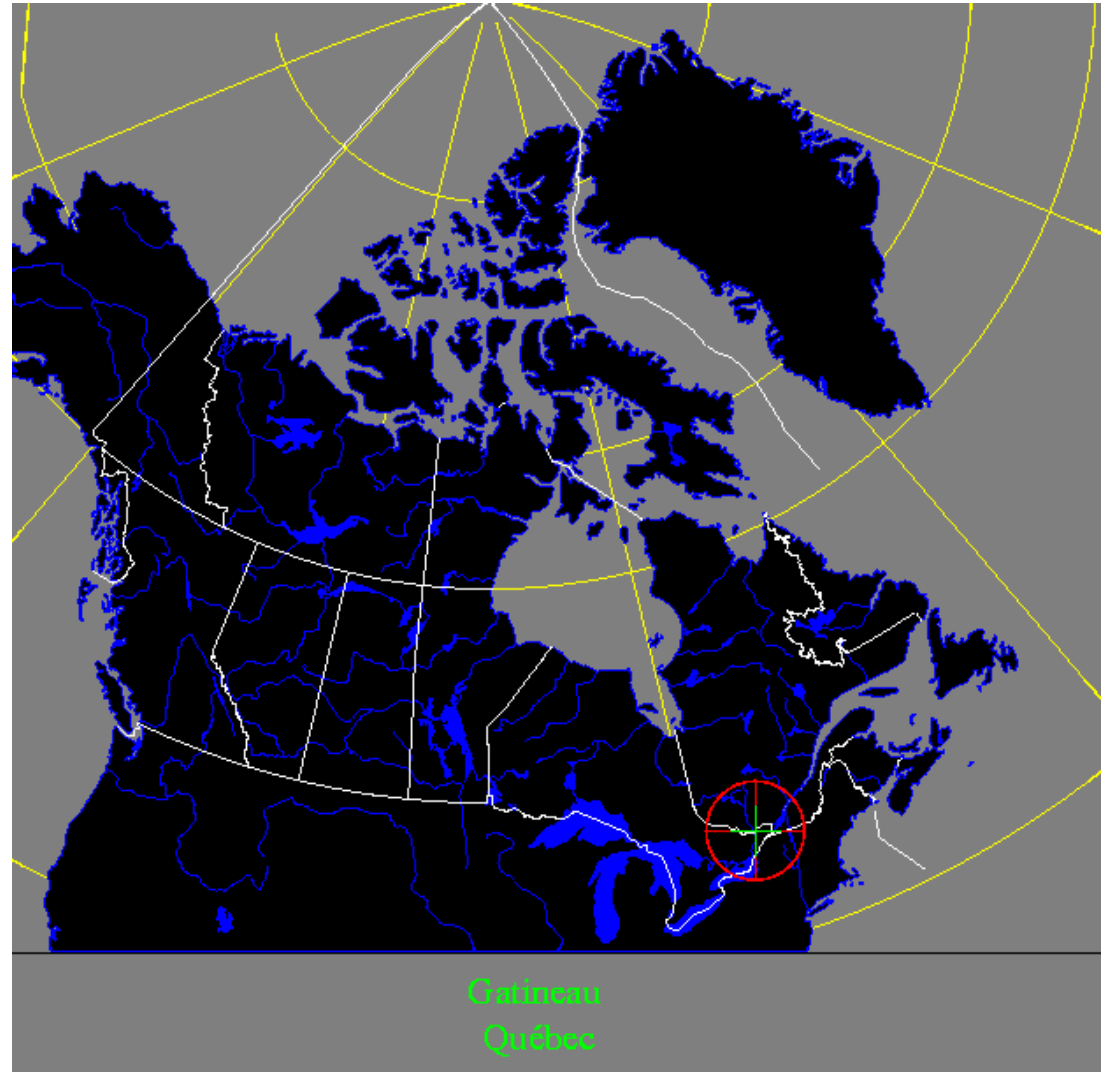
- ❑ Impact on water resources management**
 - Uncertainty on flow forecasting
 - Flood forecasting and control
 - Dam safety
 - Secure supply of electricity

Forecast process



Experimental water resources system

- Southwestern Quebec province (Outaouais region), Canada



Experimental water resources system



Baskatong reservoir
Cabonga reservoir
3 generating stations

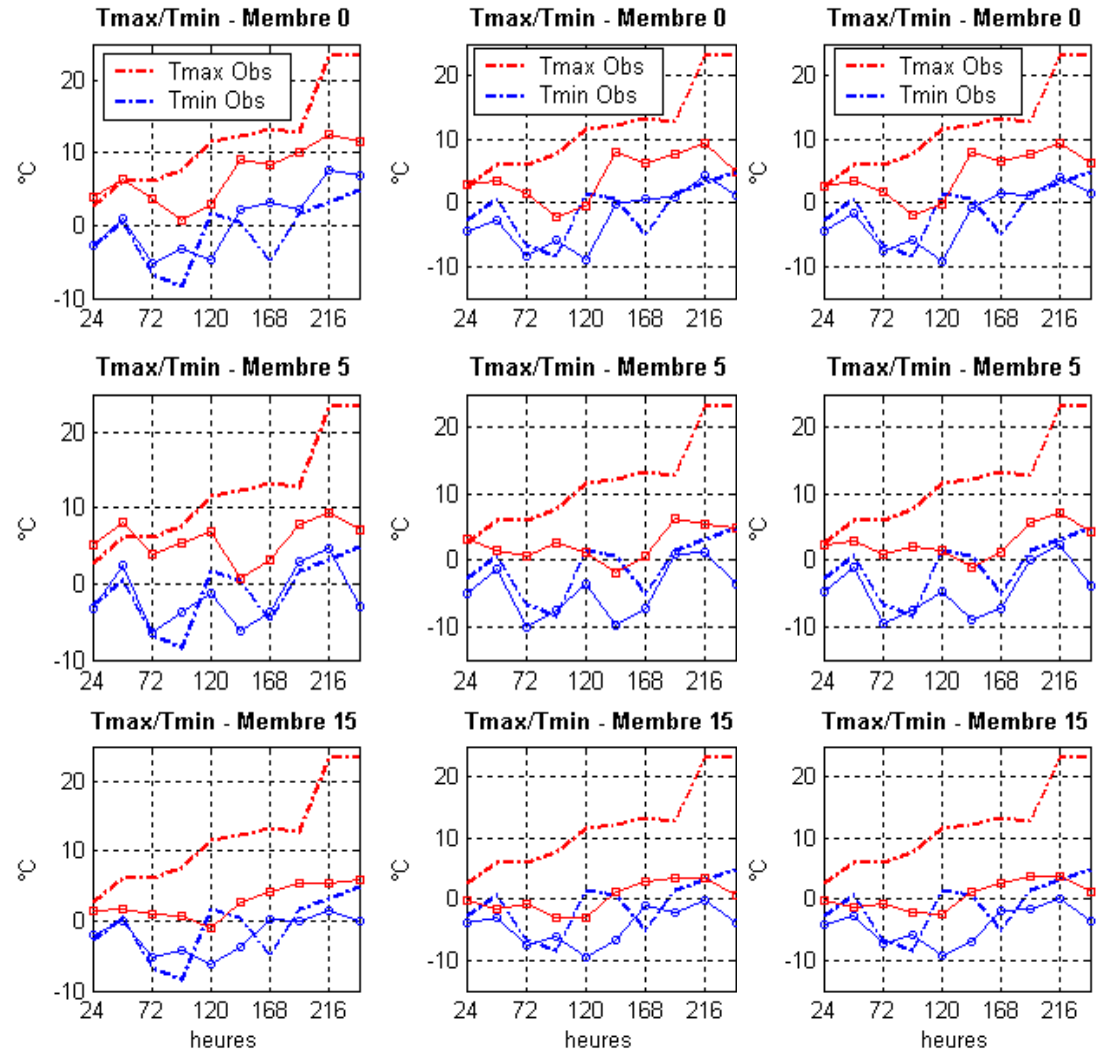
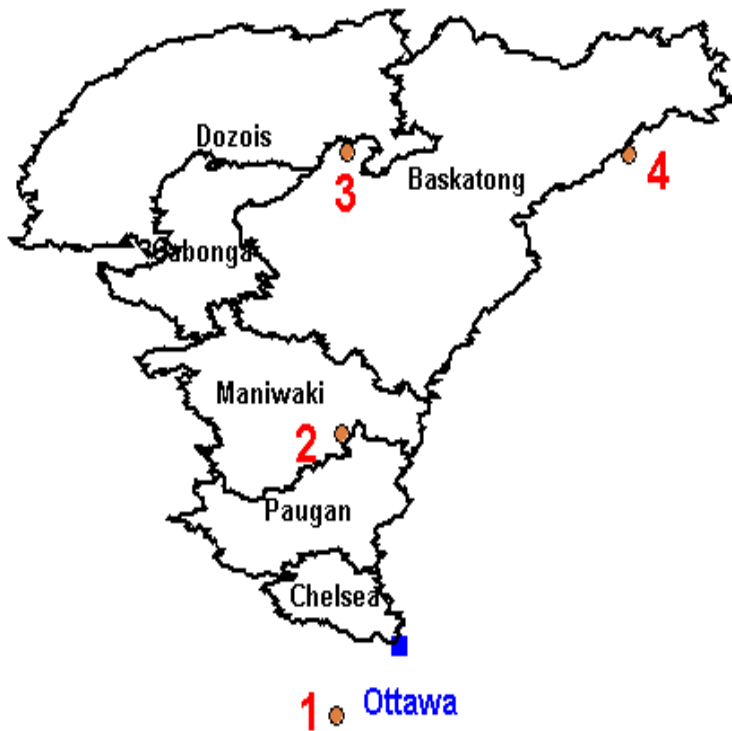
Ensemble forecast data

- ❑ 2 models from Environment Canada: SEF and GEM**
- ❑ Grid resolution: 150 km resolution**
- ❑ 16 members and the control run**

Issues

- Different space scales or resolutions (ensemble forecasts scale versus watershed/station scale)**
- Is the uncertainty of ensemble forecast representative of important meteorological uncertainties?**
- Ensemble bias**
- Same probability of occurrence for each member**
- Independence of ensemble members**

Bias on temperature: Baskatong basin

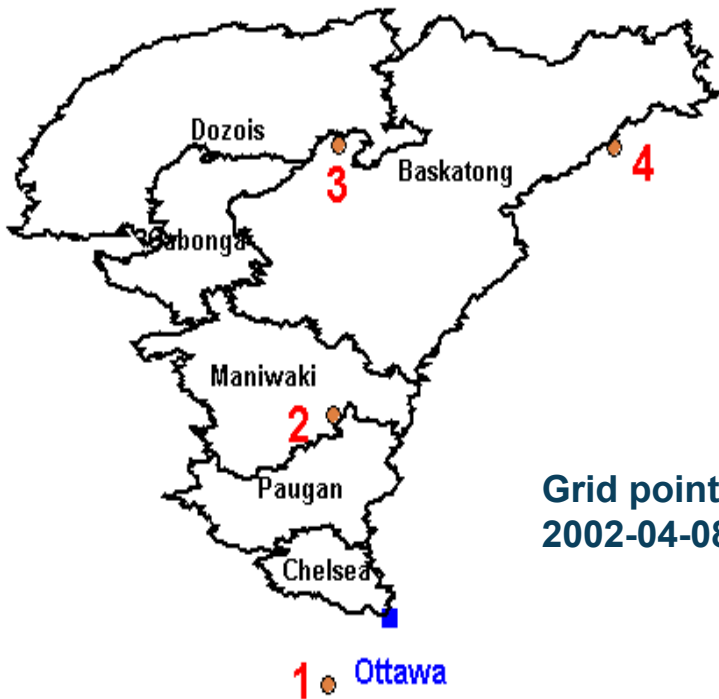


Grid point 2
2002-04-08

Grid point 3
2002-04-08

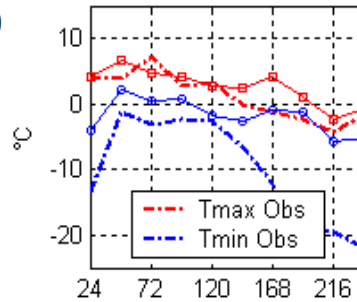
Grid point 4
2002-04-08

Bias on temperature: Baskatong basin

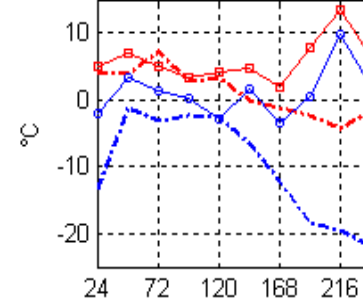


**Grid point 2
2002-03-29**

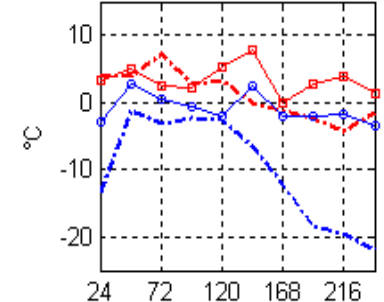
Tmax/Tmin - Membre 0



Tmax/Tmin - Membre 5

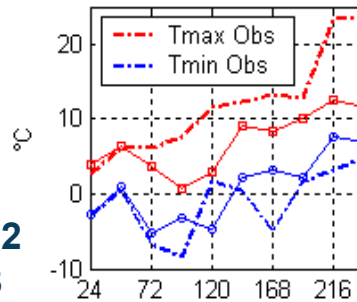


Tmax/Tmin - Membre 10

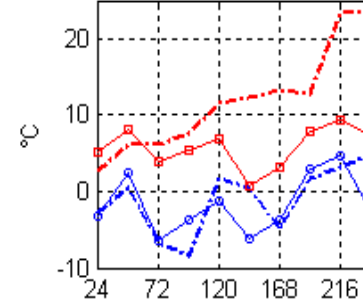


**Grid point 2
2002-04-08**

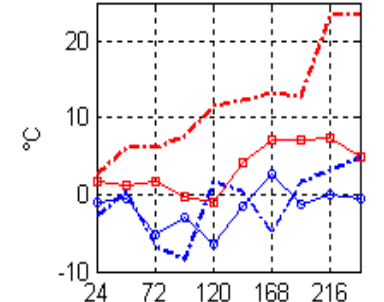
Tmax/Tmin - Membre 0



Tmax/Tmin - Membre 5

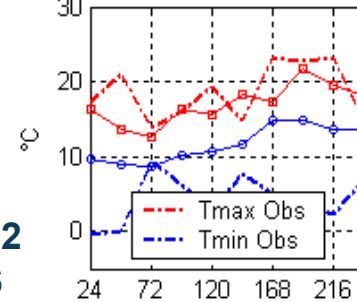


Tmax/Tmin - Membre 10

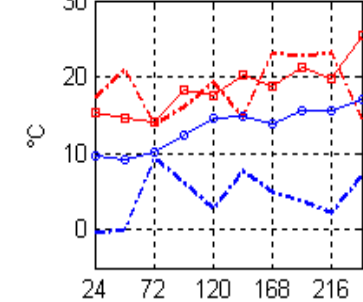


**Grid point 2
2002-06-06**

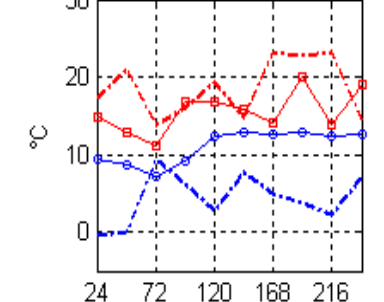
Tmax/Tmin - Membre 0



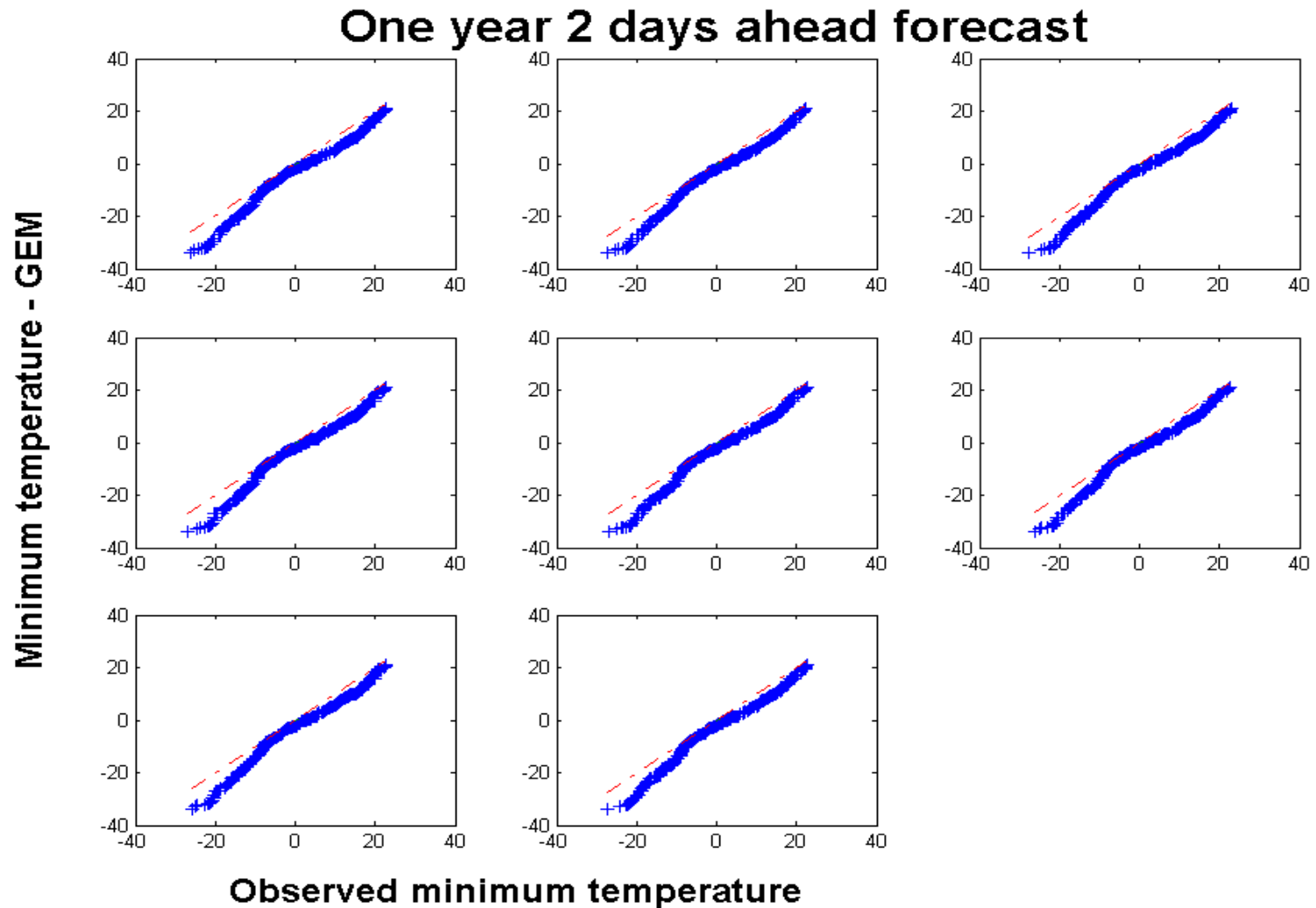
Tmax/Tmin - Membre 5



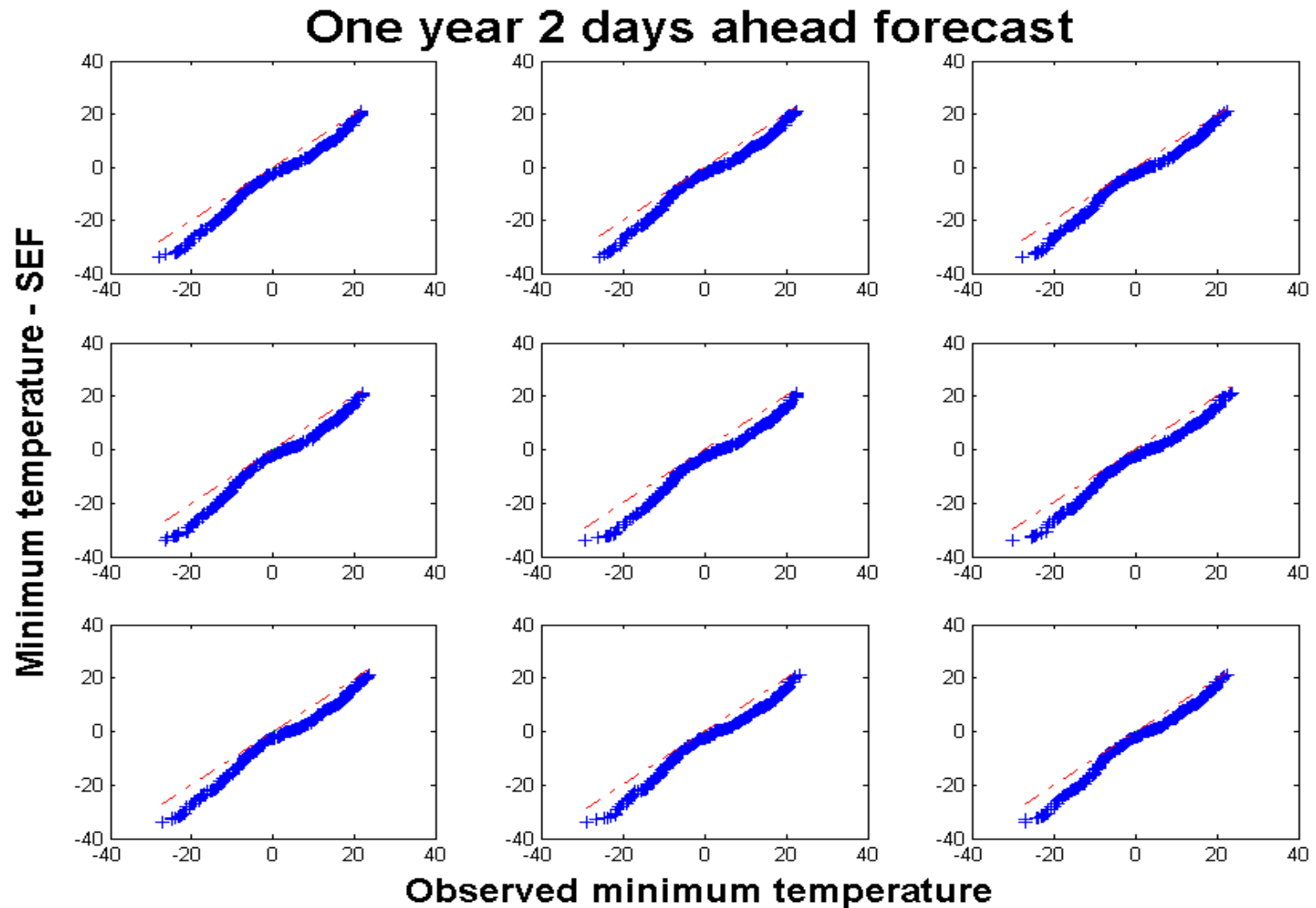
Tmax/Tmin - Membre 10



Bias on minimum temperature: Chelsea

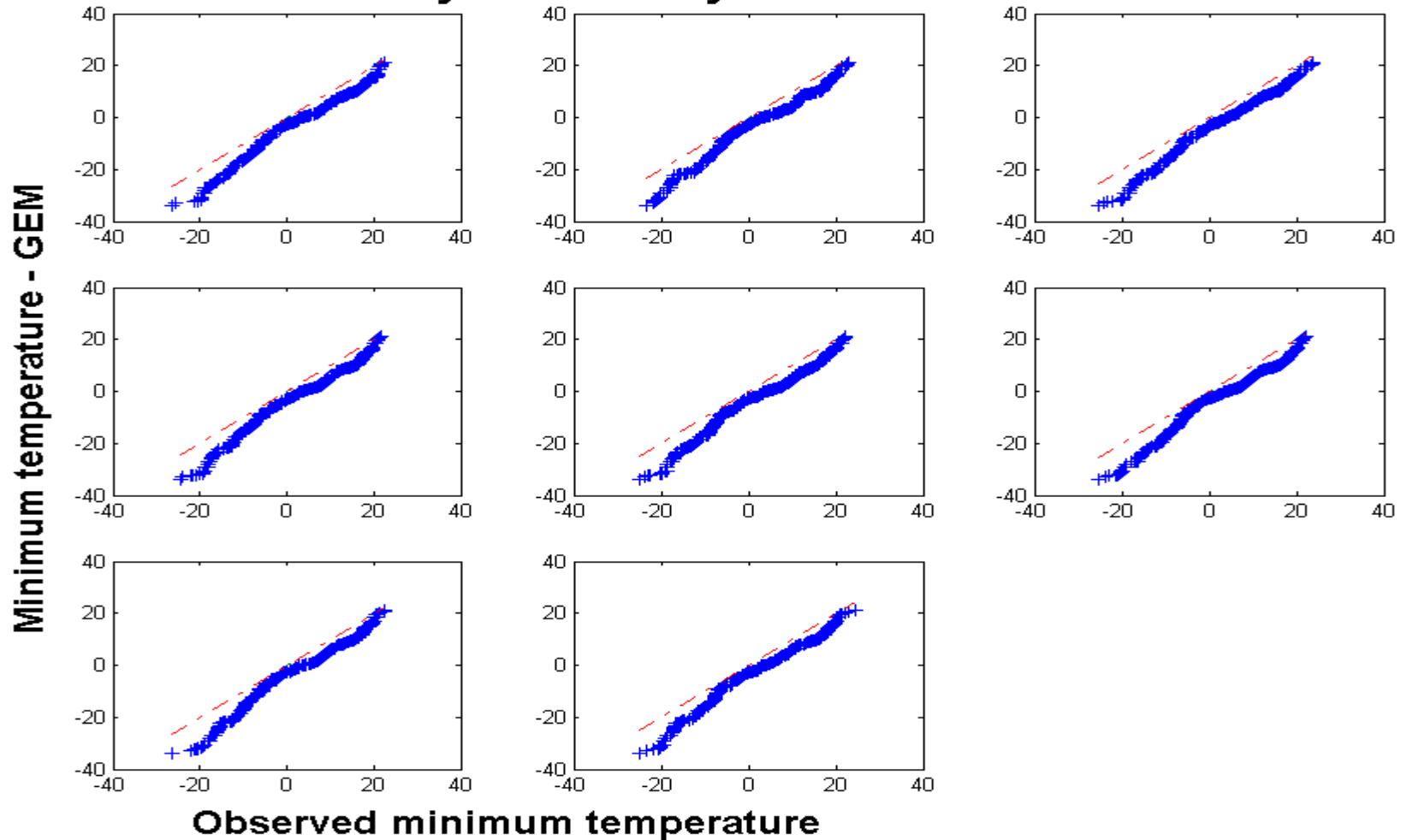


Bias on minimum temperature: Chelsea



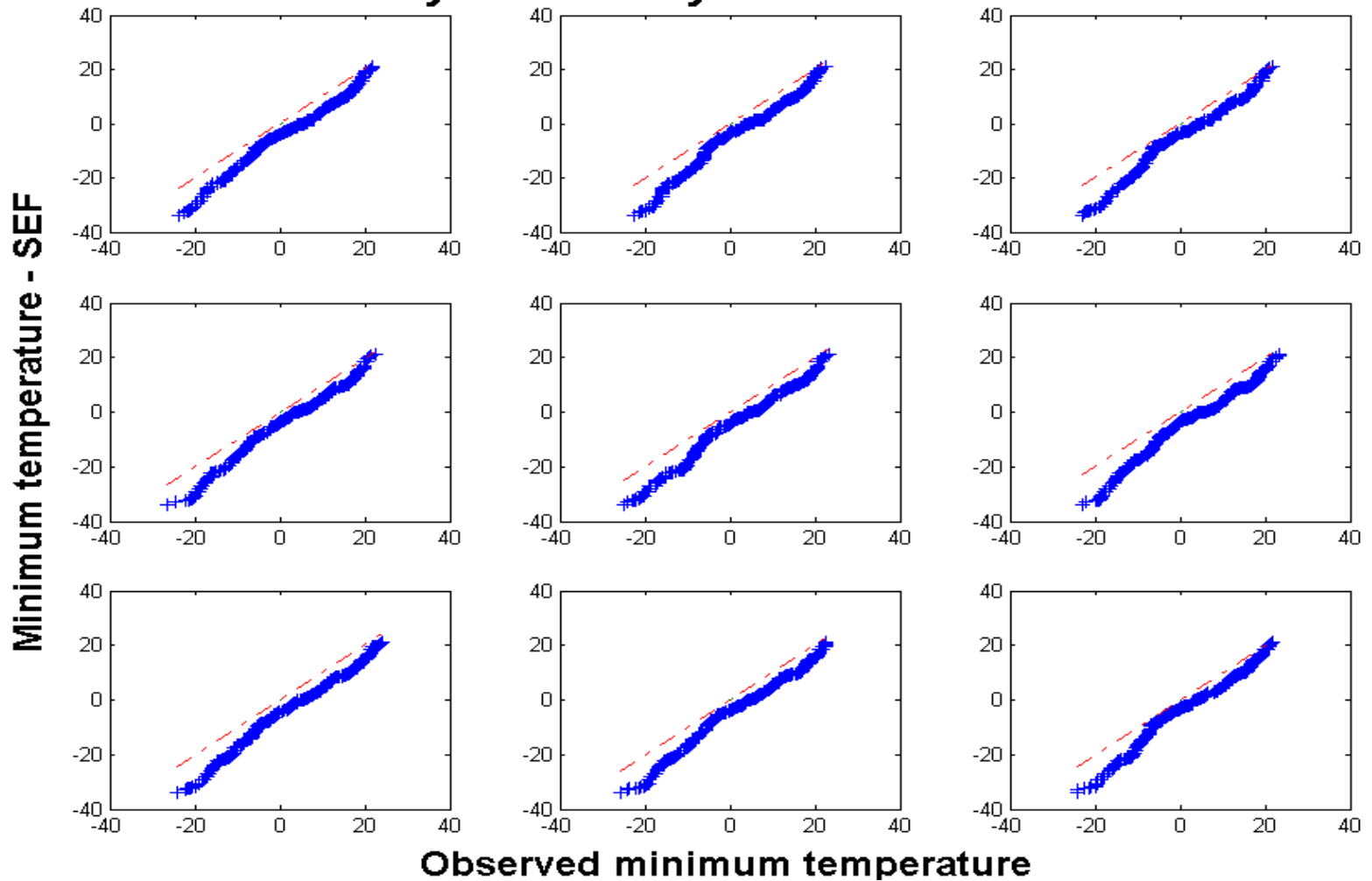
Bias on minimum temperature: Chelsea

One year 10 days ahead forecast

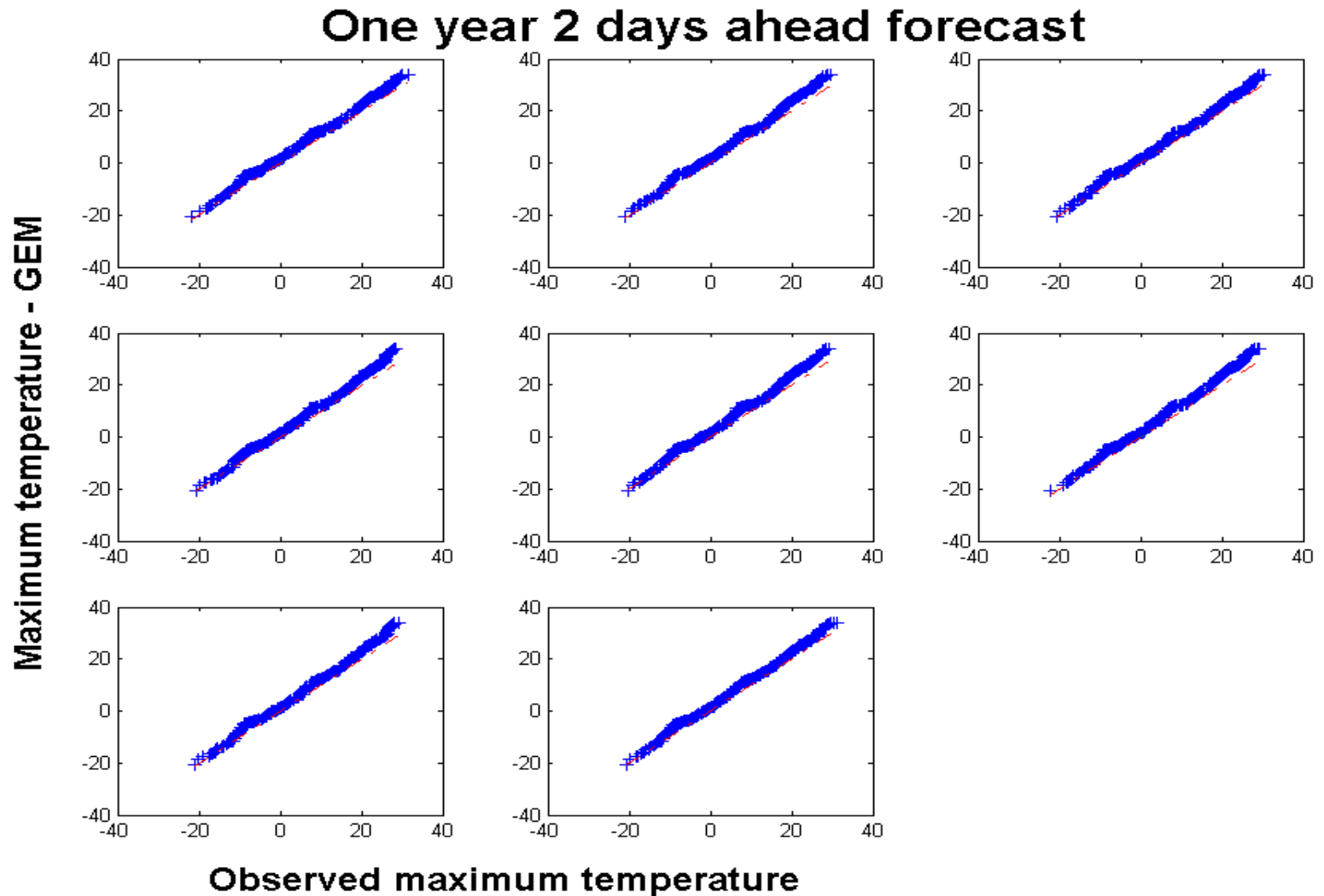


Bias on minimum temperature: Chelsea

One year 10 days ahead forecast

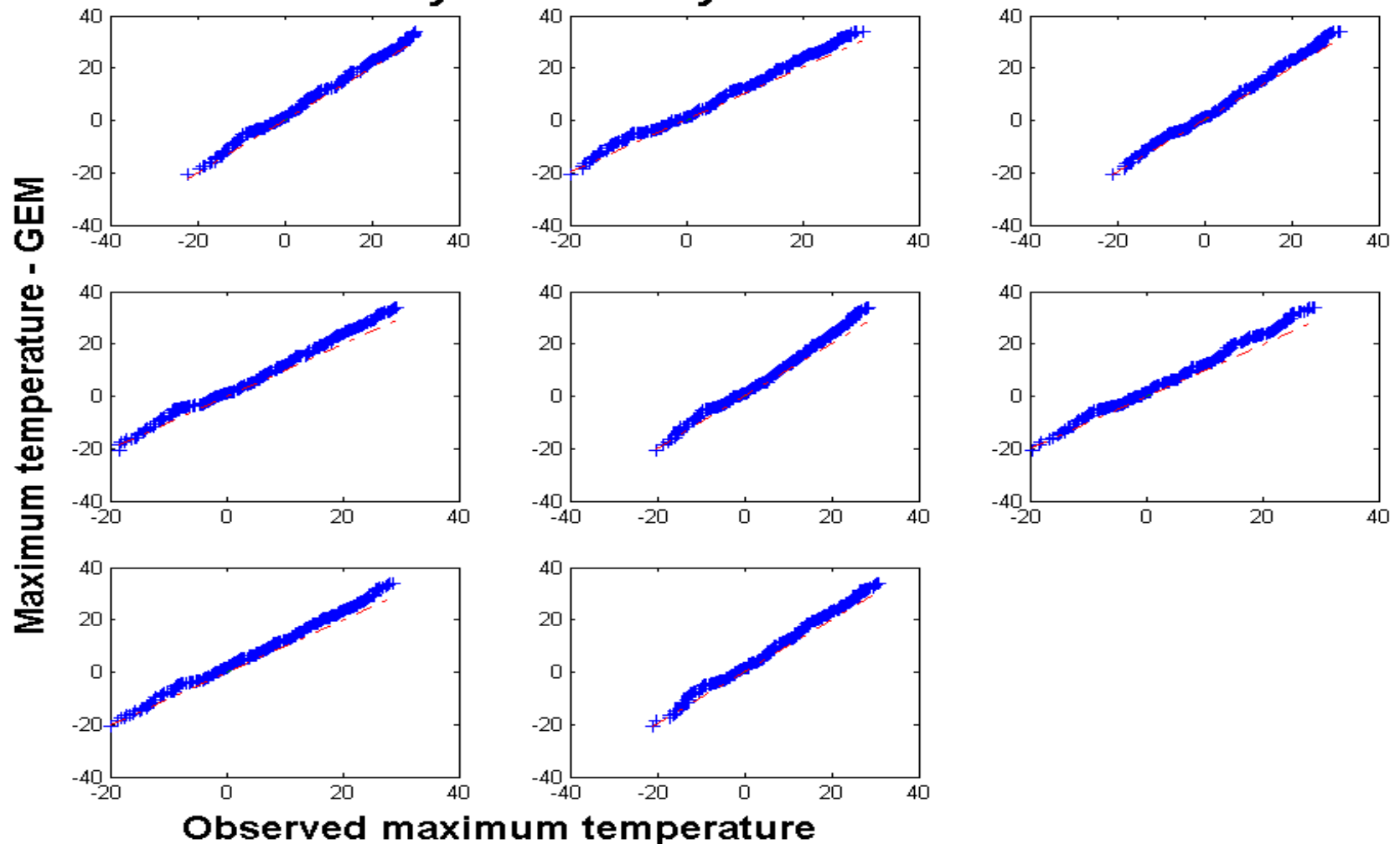


Bias on maximum temperature: Chelsea



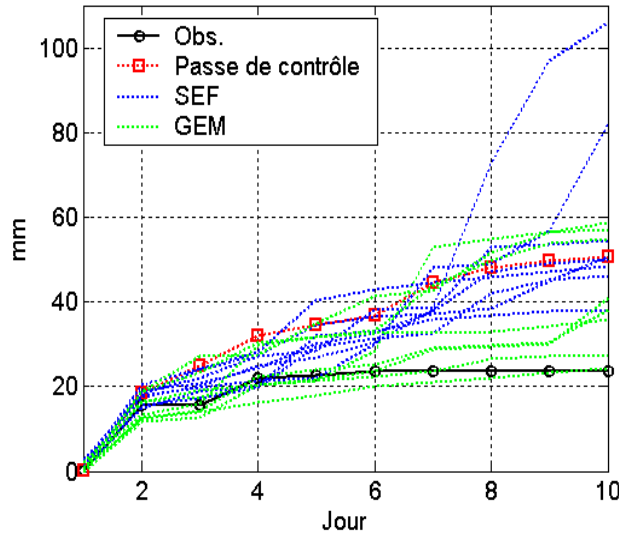
Bias on maximum temperature: Chelsea

One year 10 days ahead forecast

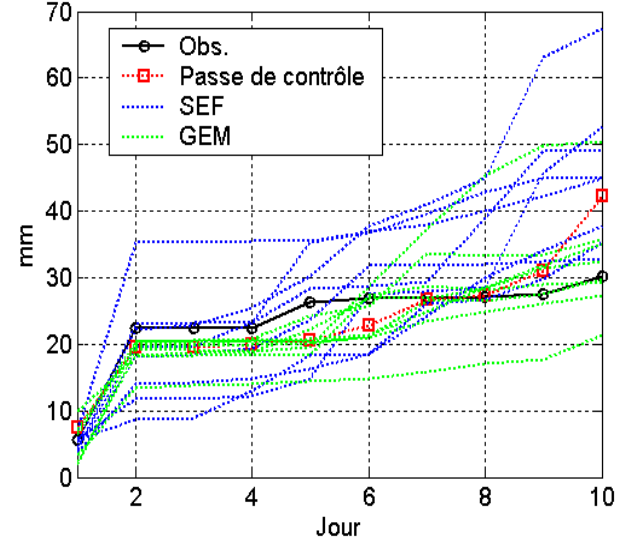


Bias on cumulative precipitation: Baskatong basin

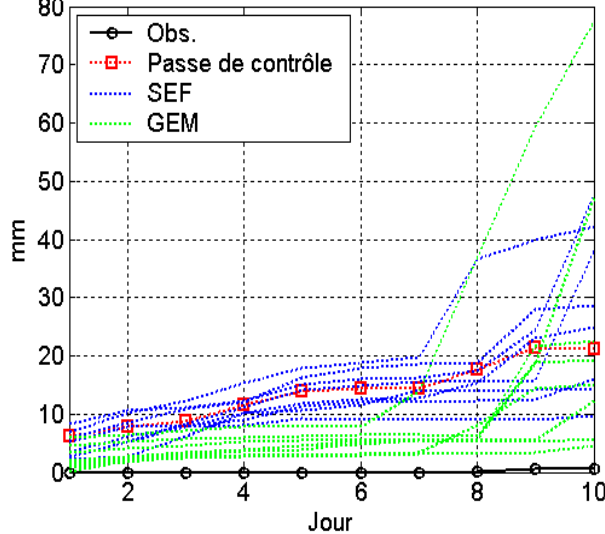
Précipitation cumulée prévue le 2002-03-29



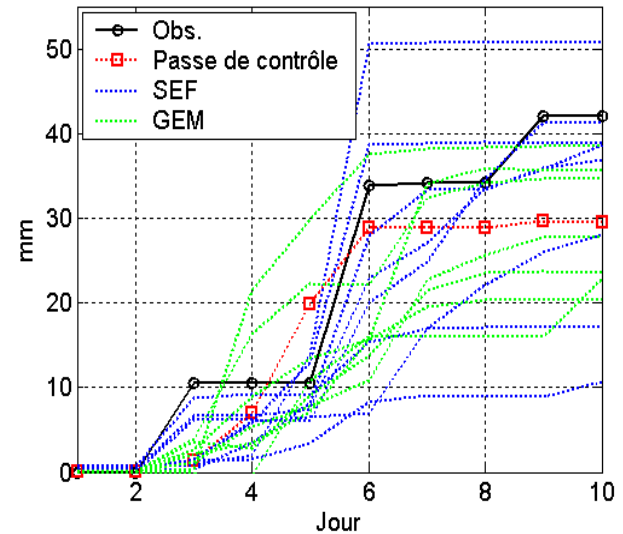
Précipitation cumulée prévue le 2002-04-08



Précipitation cumulée prévue le 2002-05-16

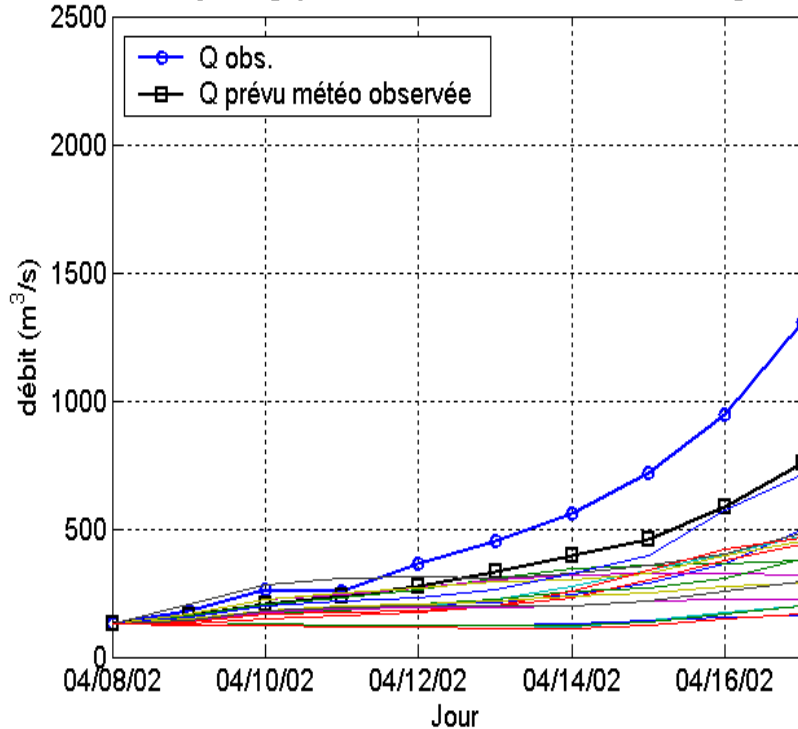


Précipitation cumulée prévue le 2002-06-06

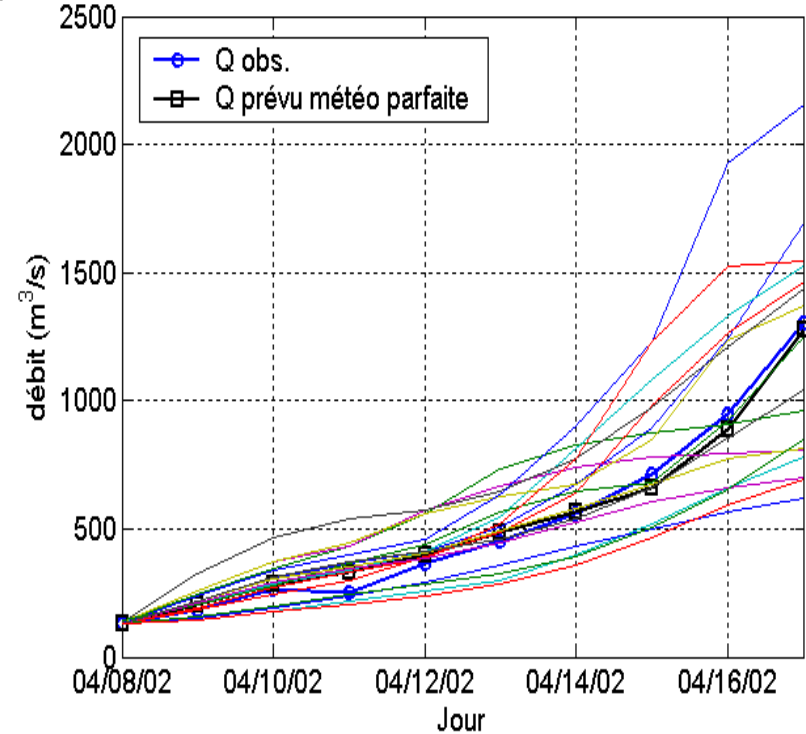


Flow forecasting with HSAMI rainfall-runoff model

Prévision hydrologique avec HSAMI / 2002-04-08 / Point de grille (3,6)



Prévision hydrologique avec HSAMI / 2002-04-08 / Point de grille (3,6)



Model uncertainty :

Snow cover (+50 %)

Uncertainty on input data :

Precipitation (+50 %) - Temperature (+2 °C)

Ensemble bias :

Precipitation (N/A) - Temperature (+10 °C)

Conclusion

❑ Bias correction procedure taking into account:

- Hydrological model uncertainty
- Uncertainty on input data
- Ensemble bias

❑ Bias correction methods

- Bayesian approach
- Downscaling (neural nets or other)

Conclusion

- Do ensemble members have the same probability of occurrence**
 - **Weighting or not**

- Independence of the ensemble members**