Hydrological ensemble forecasts for Belgium

Emmanuel Roulin

Royal Meteorological Institute of Belgium

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Introduction

A hydrological ensemble forecast procedure has been simulated by using ECMWF-EPS precipitation forecasts as input of a water balance model

This procedure has been verified on two contrasted catchments in Belgium and with 6 years of archived forecasts

Method

- Water balance model “SCHEME”
  - conceptual model within 50 km^2
  - routing based on the width function
- ECMWF-EPS archives
  - N80 (~ 120 km): from December 1996 to November 2000
  - N128 (~ 80 km): from November 2000 to December 2002

Method

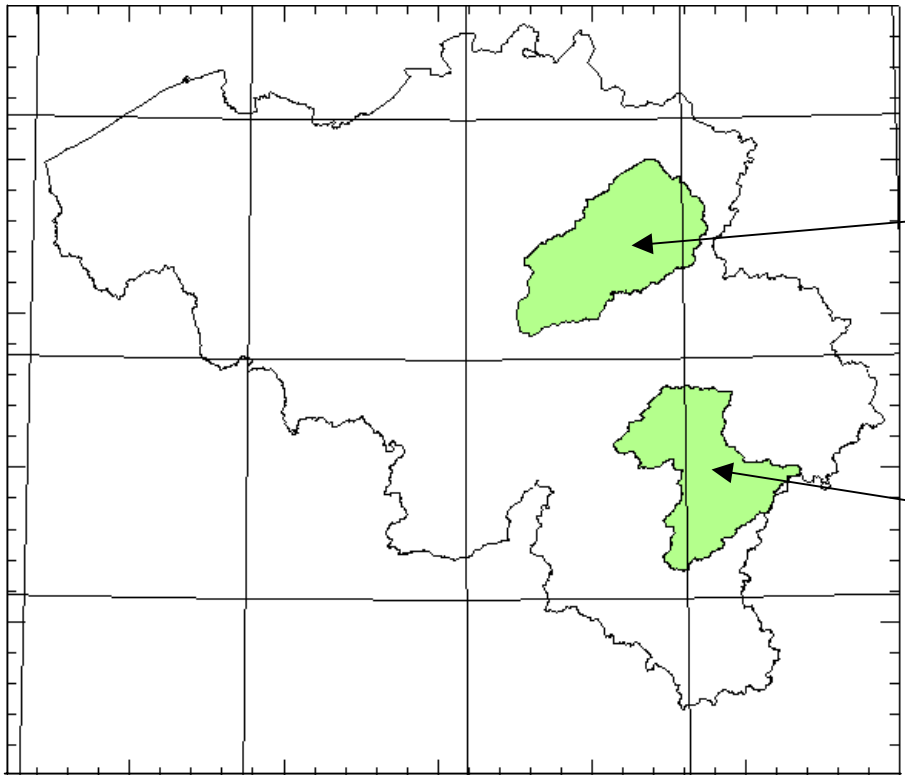
- Run with observed precipitation
  - reference streamflow
  - initial state of water balance model
- Run with EPS “control” forecast
- 50 runs with EPS “perturbed” forecasts
- Run with precipitation from climatology
  - in order to calculate skills

Two test catchments in Belgium

EPS

N128

~ 80 km



Demer

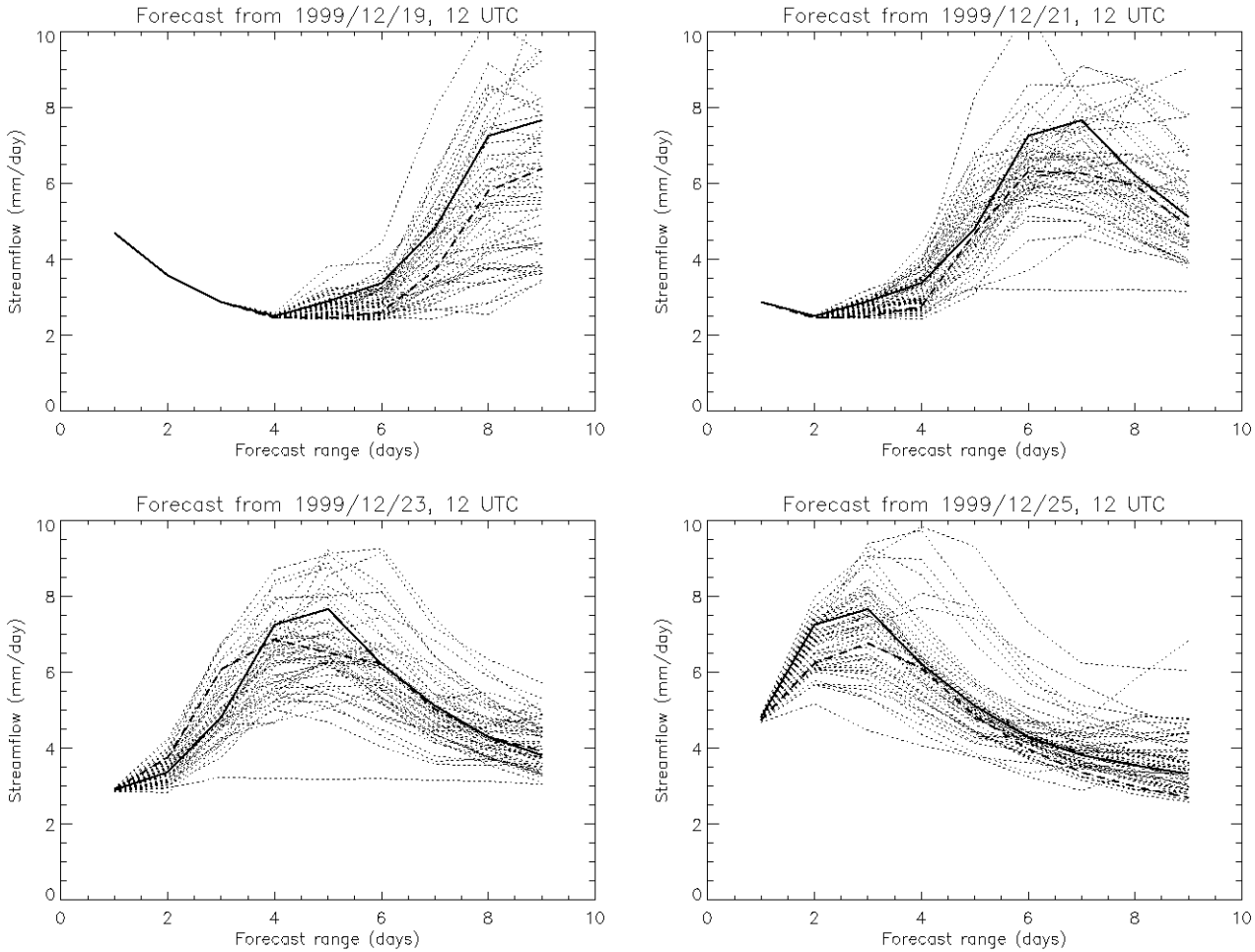
1800 km^2

Ourthe

1600 km^2

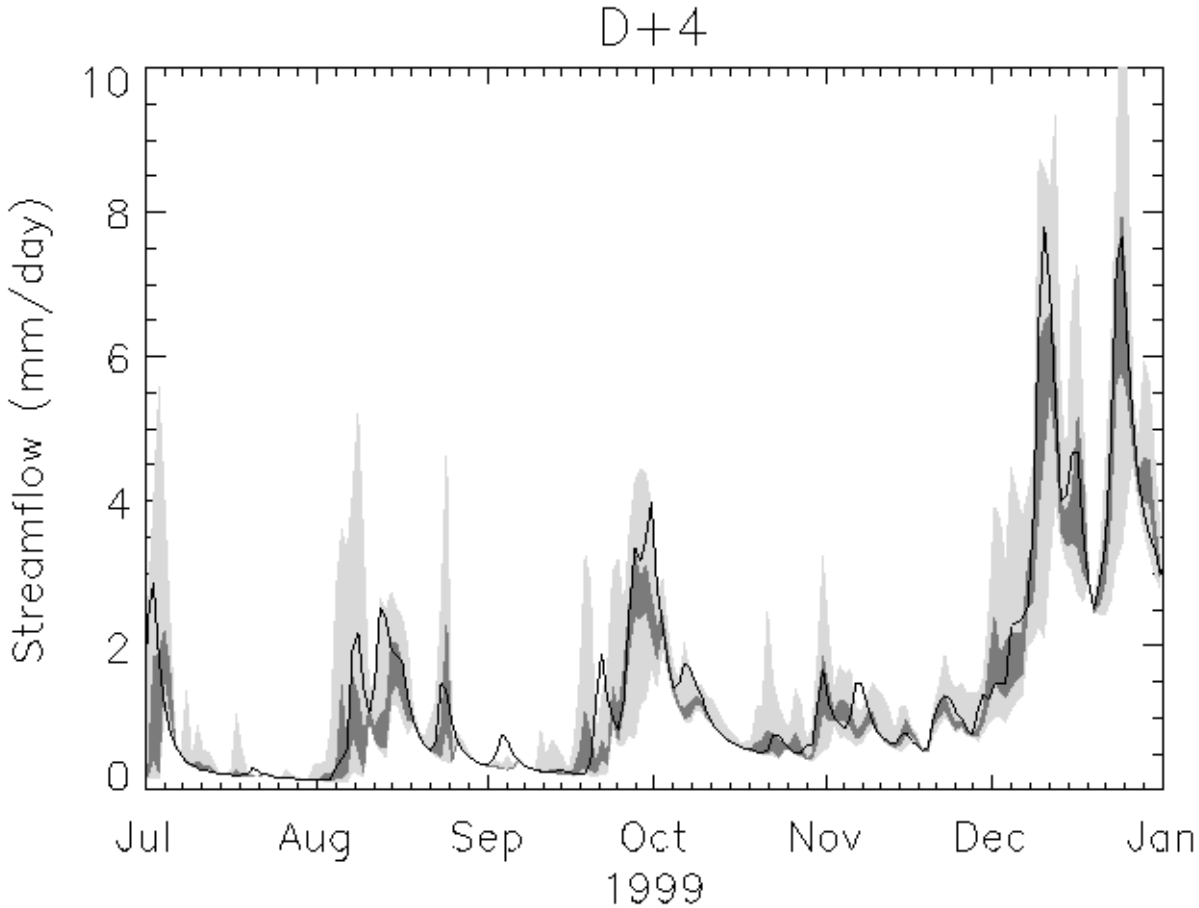
Example: Ourthe in December 1999

reference control ensemble

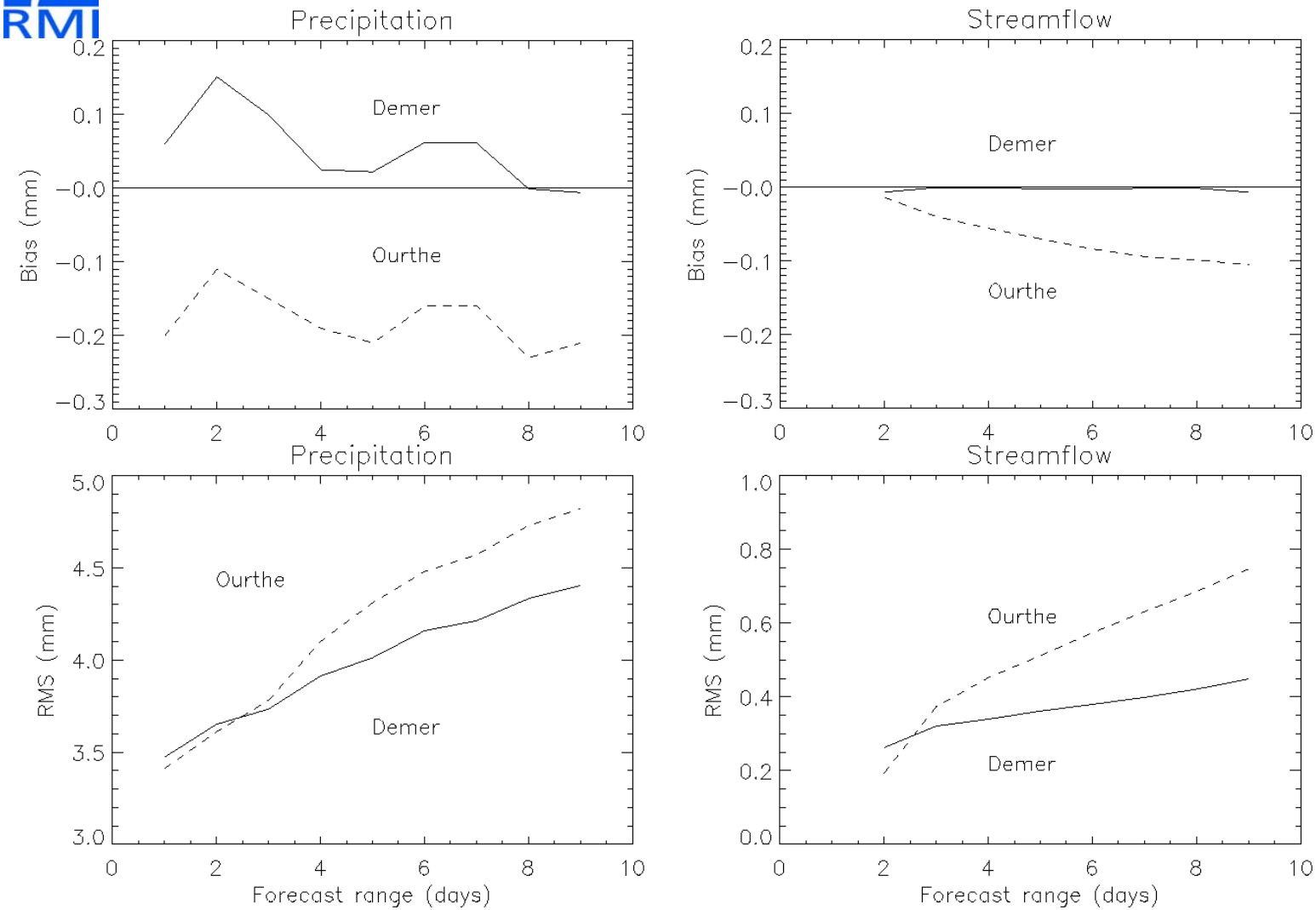


Example: Ourthe in December 1999

Light: min & max; dark: 25 to 75 % members



Verification: bias and rms (1996-2000)



Verification: probability forecasts

f : forecast = probability that P or Q > thresholds

x : observation = 1 if the event occurs, = 0 if not

Thresholds taken from the climatology (1971-2000)

in mm day^{-1}:	P80	P90	P95
Precipitation Demer	3.6	6.5	9.8
Precipitation Ourthe	4.7	8.3	12.2
Streamflow Demer	0.8	1.1	1.5
Streamflow Ourthe	1.8	2.8	3.9

Verification: probability forecast

Distribution-oriented verification: p(f,x)

Murphy and Winkler, 1987, 1992, … , Hashimo et al., 2002, ...

Calibration-refinement factorization: p(f,x) = p(x|f) p(f)

"attribute diagrams"

Decomposition of the mean square error:

$$MSE(f,x) = E(f - x)^2 = \sigma^2_x + E(\mu_{x|f} - f)^2 - E(\mu_{x|f} - \mu_x)^2$$

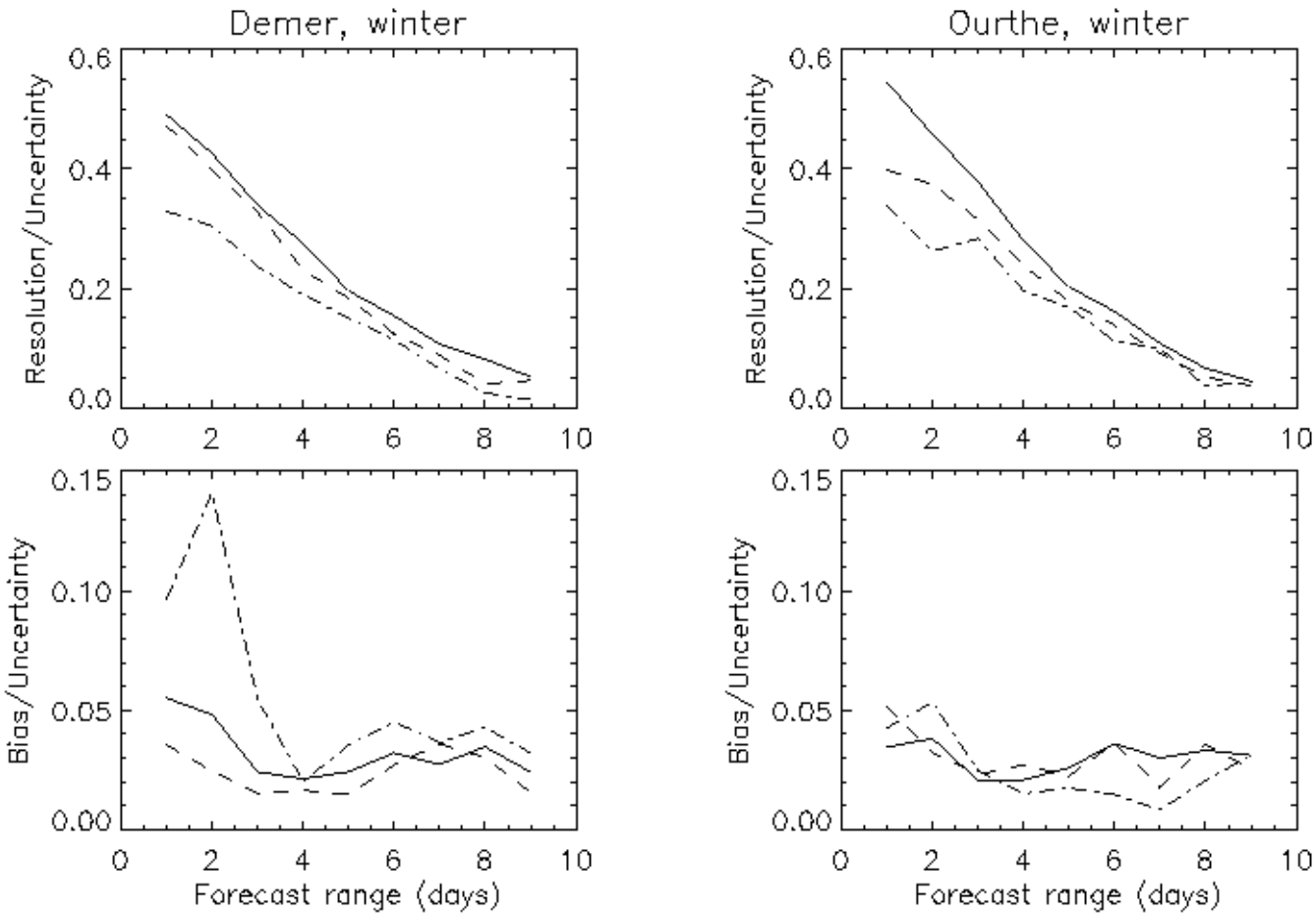
MSE(f,x) = uncertainty + reliability - resolution

Skill relative to the "sample climatology":

SS = resolution/uncertainty - reliability/uncertainty

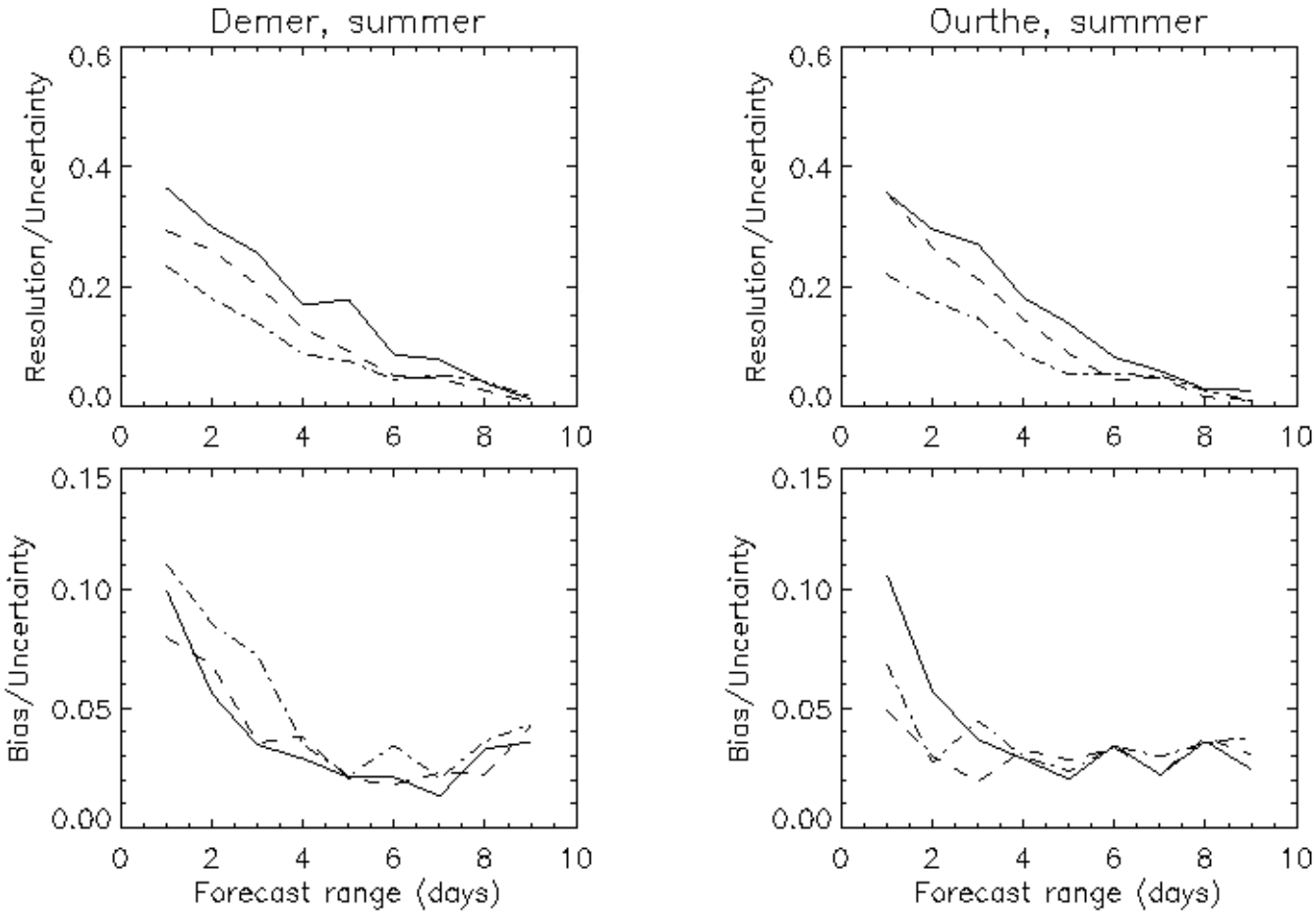
Precipitation winter (1996-2002)

P80 P90 P95



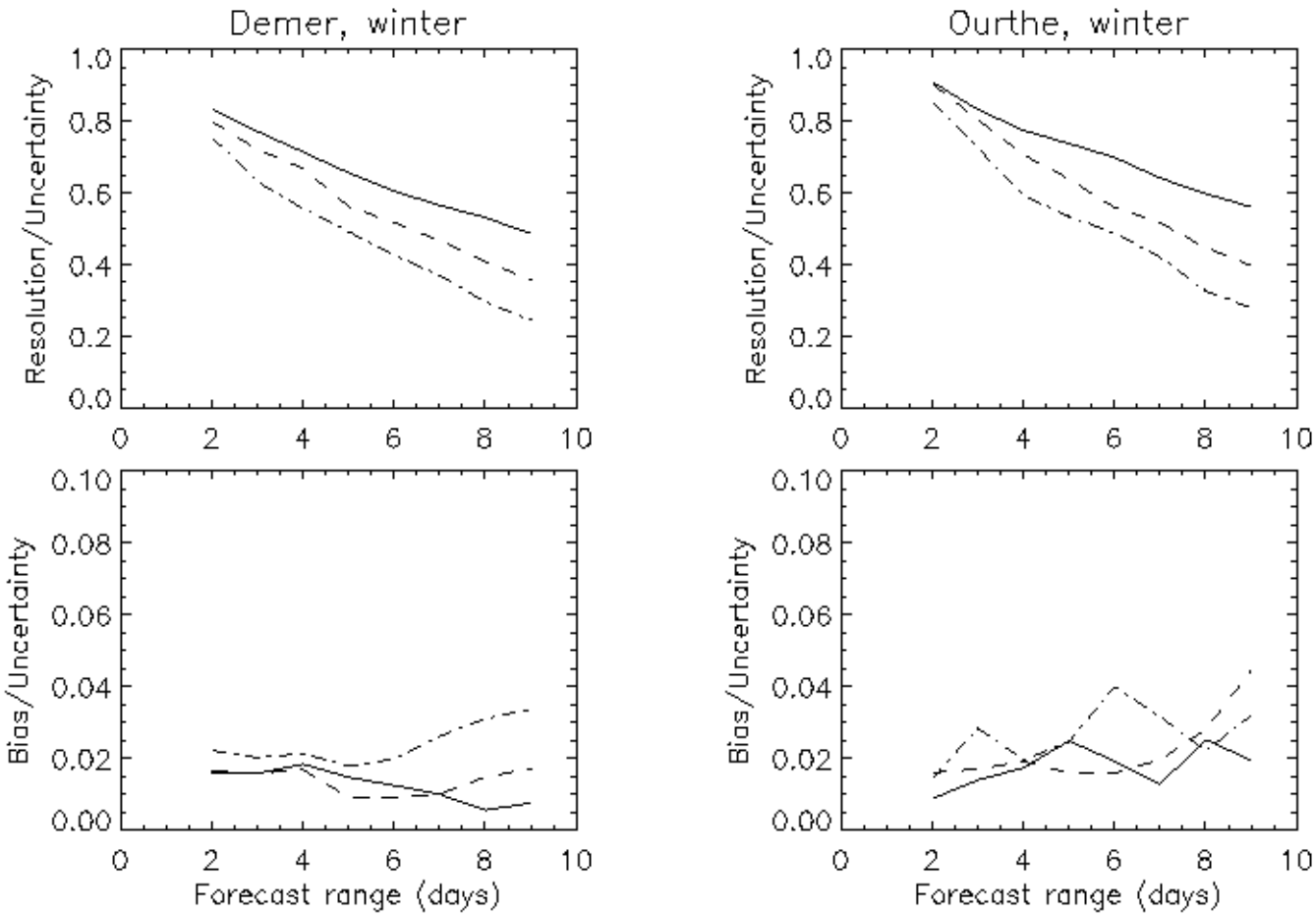
Precipitation summer (1996-2002)

P80 P90 P95



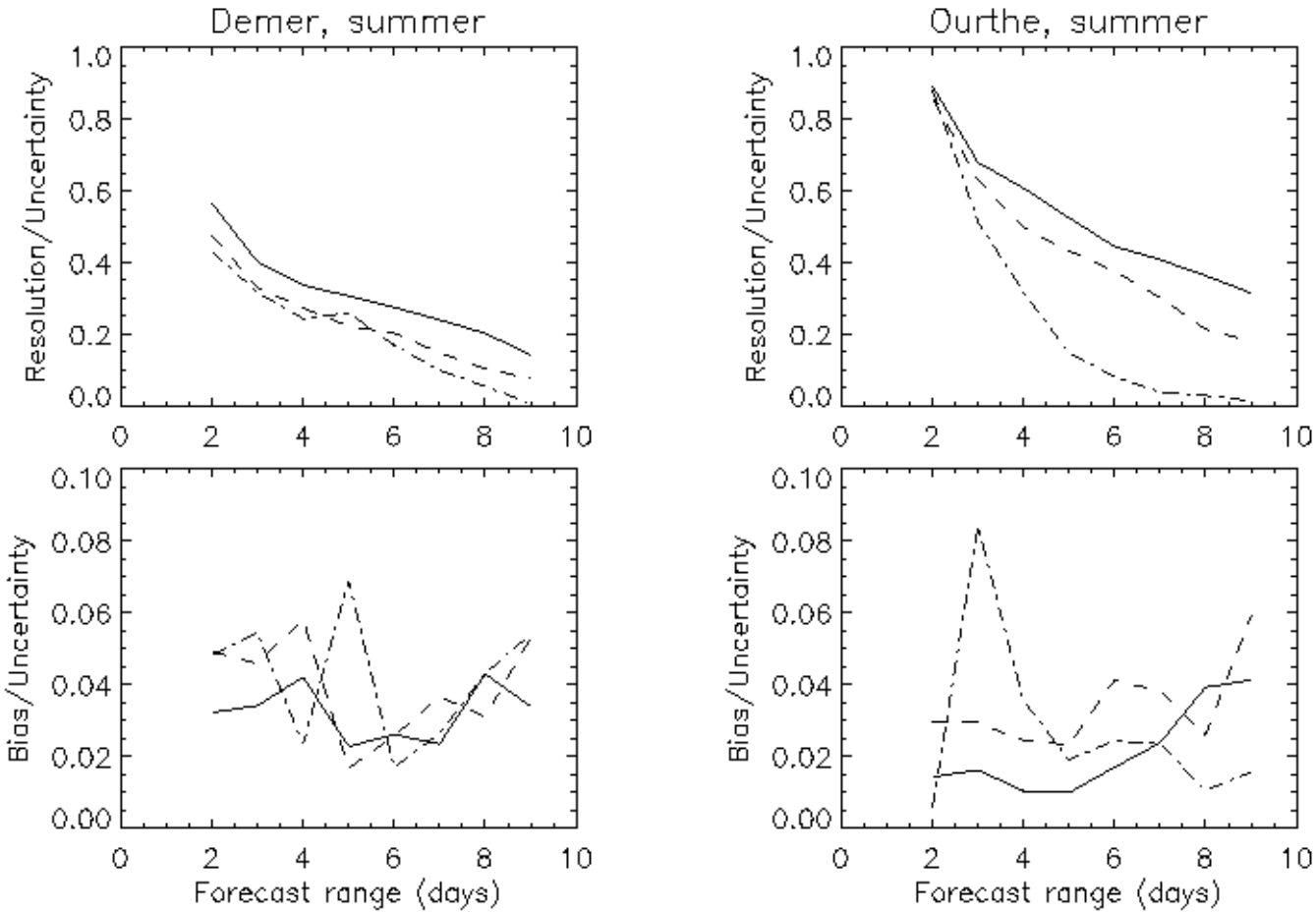
Streamflow winter (1996-2002)

P80 P90 P95



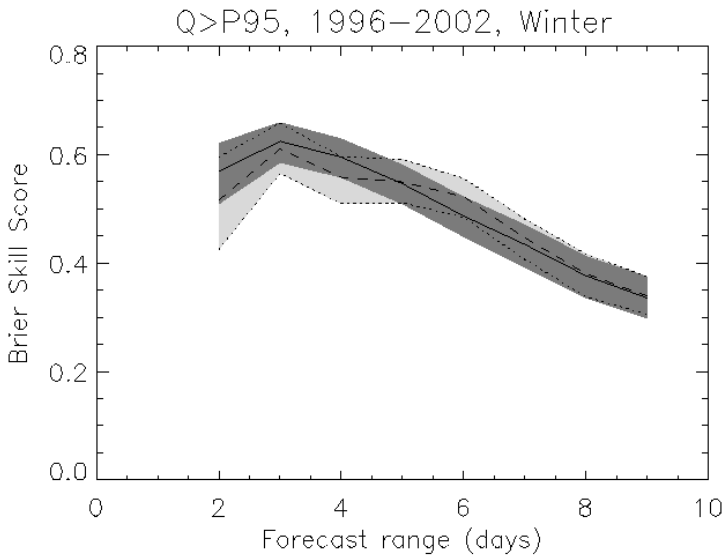
Streamflow winter (1996-2002)

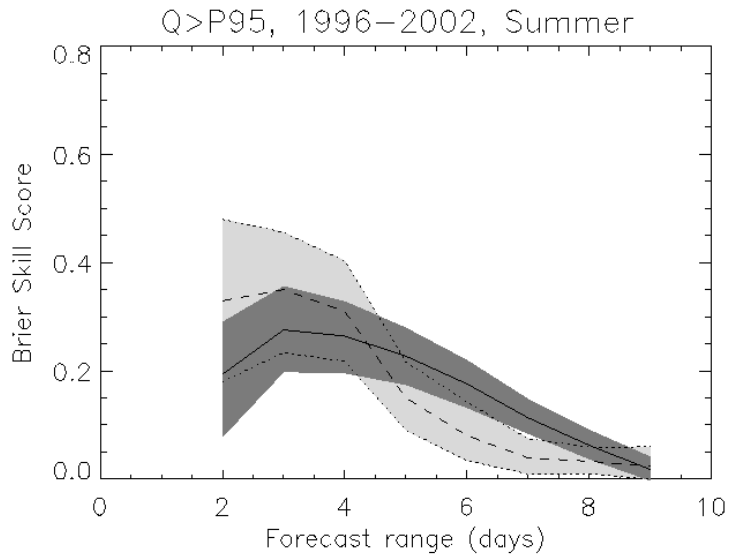
P80 P90 P95



Skills relative to the streamflow forecast using precipitation from climatology

Dark: Demer, light: Ourthe





Note: thresholds for the watch or alert operational modes are largely defined according to the current observed situation i.e. ~ twice the value in the table

Conclusions

- Skills of streamflow forecasts > skills of precipitation forecasts
- Skills of ensemble streamflow forecasts > skills of streamflow forecasts with the “control” precipitation forecasts
- Correction of bias in precipitation forecasts and downscaling methods will be tested
- The procedure will be complemented with decision models in order to evaluate the actual value for water management