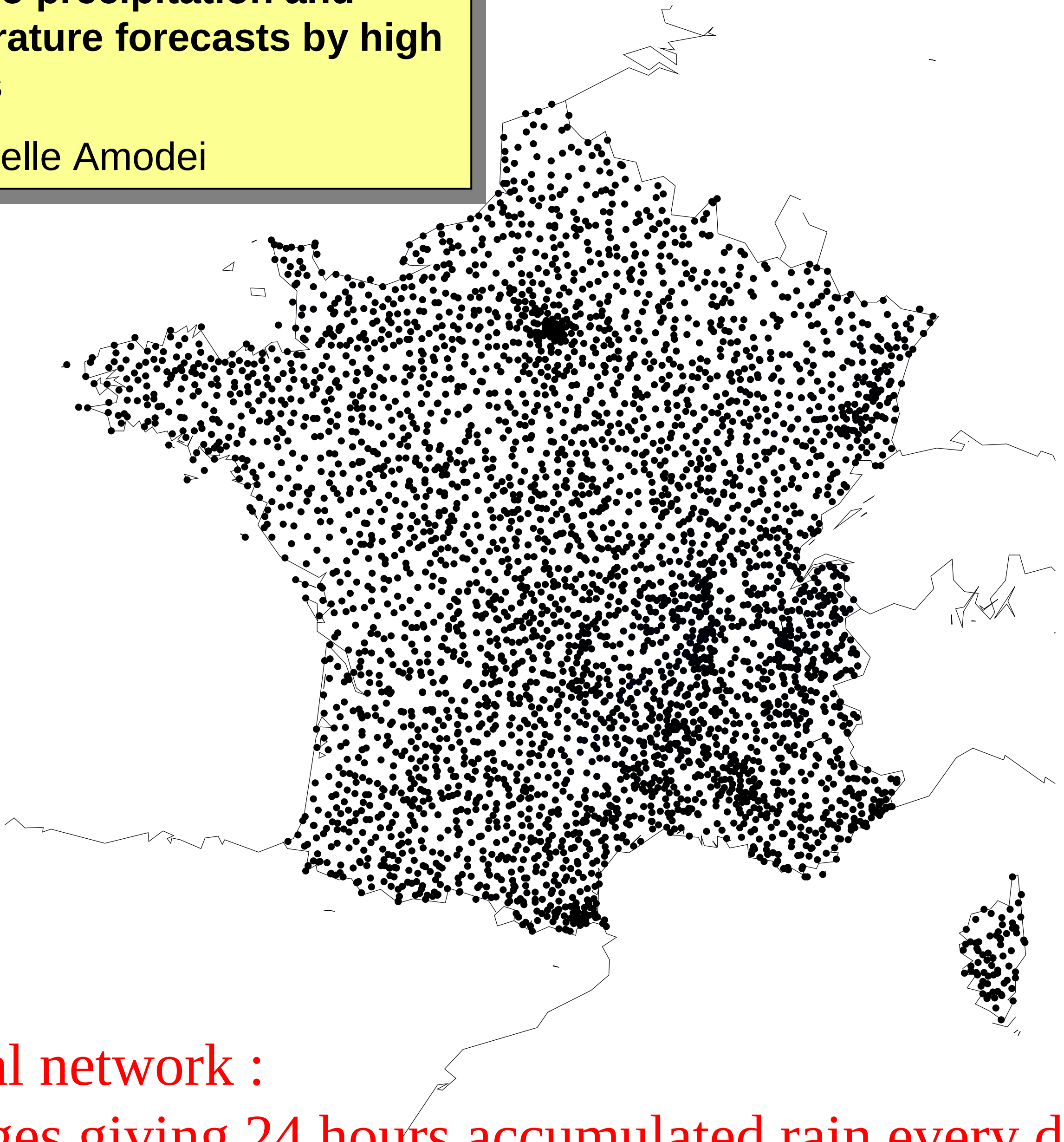
Deterministic and fuzzy verification methods applied to precipitation and brightness temperature forecasts by high resolution models

Joël Stein and Marielle Amodei



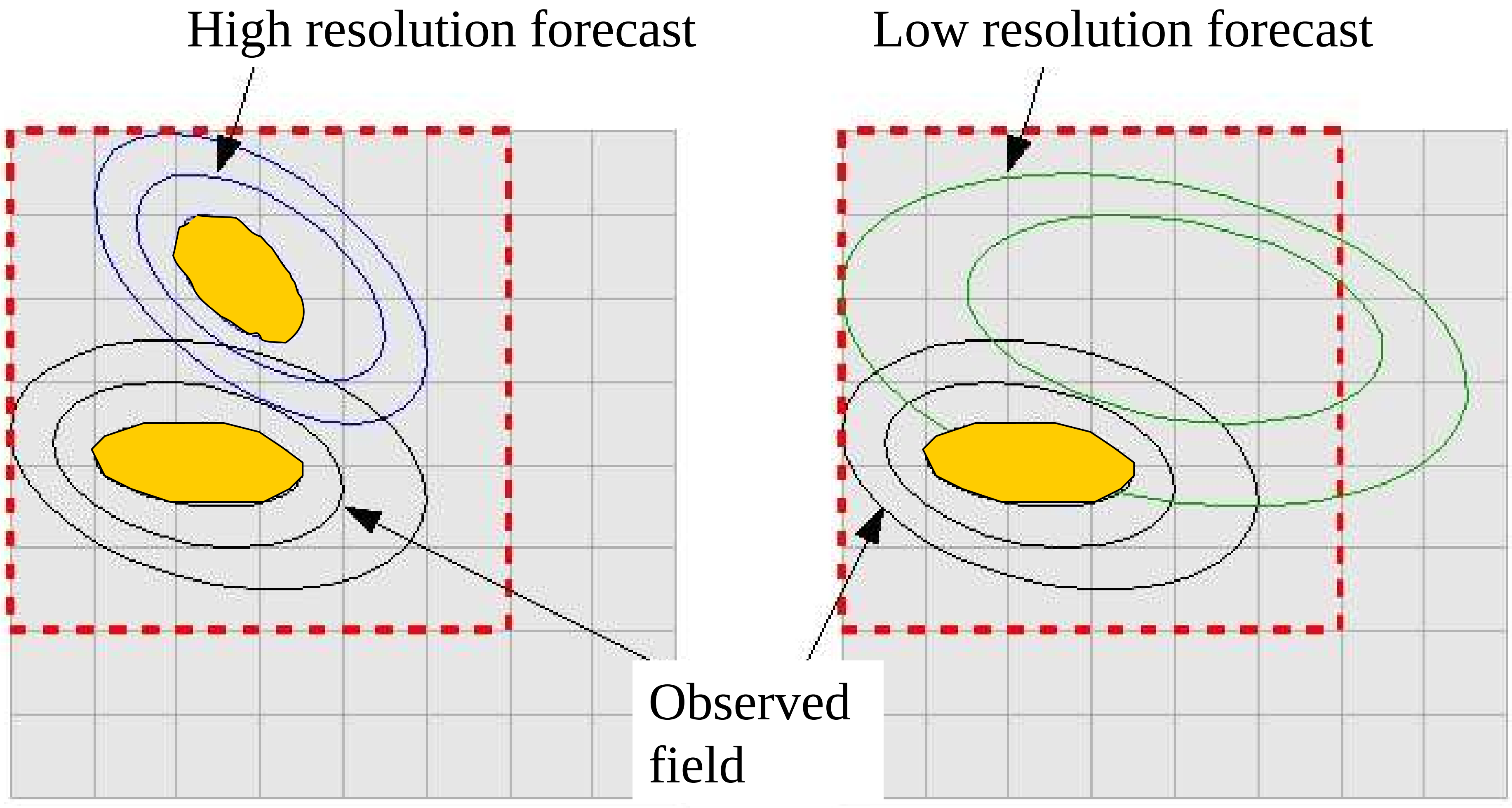
Climatological network :

4000 raingauges giving 24 hours accumulated rain every day

QPF verification

- Average the data at 0.2°x0.2°
- Average the models QPF at the same grid: ALADIN 0.1→ 0.2 or AROME 0.025→0.2
- Compute the classical and probabilistic scores:BIAS, HSS, BSS… and if their difference is significant

double-penalty and neighbourhood



Fuzzy approach

- Brier Score (BS): $BS = \frac{1}{n}\sum_{k=1}^{n}(pk - ok)^2$ with $BSperf = 0$

- Brier Skill Score(BSS): $BSS = 1 - \frac{BS}{BSref}$

- 2 interesting limits :

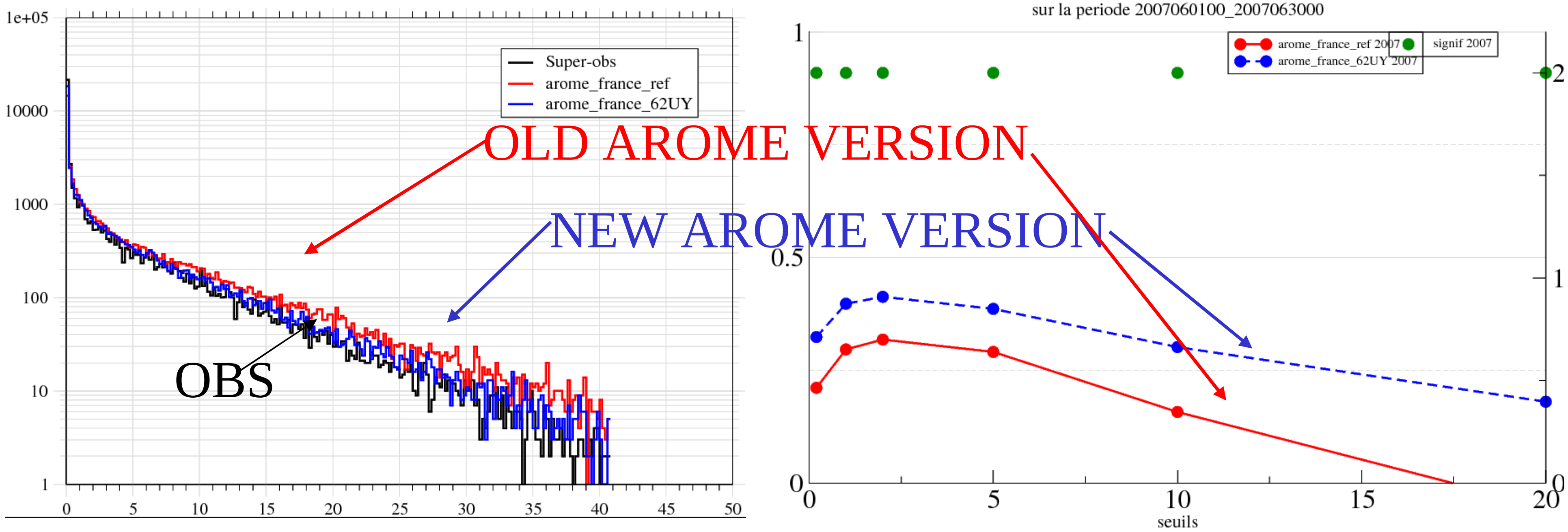
1- Neighbourhood size = 0 : $BSS \xrightarrow[v \to 0]{} HSS$

2- Neighbourhood = simulation domain $BS \xrightarrow[v \to L]{} \frac{1}{n}\sum_{j=1}^{n}\alpha(j) \times (1 - BIAS(j))^2$

QPF verification during June 2007

Rain histogram every 0.2 mm

Heidke skill score against persistence

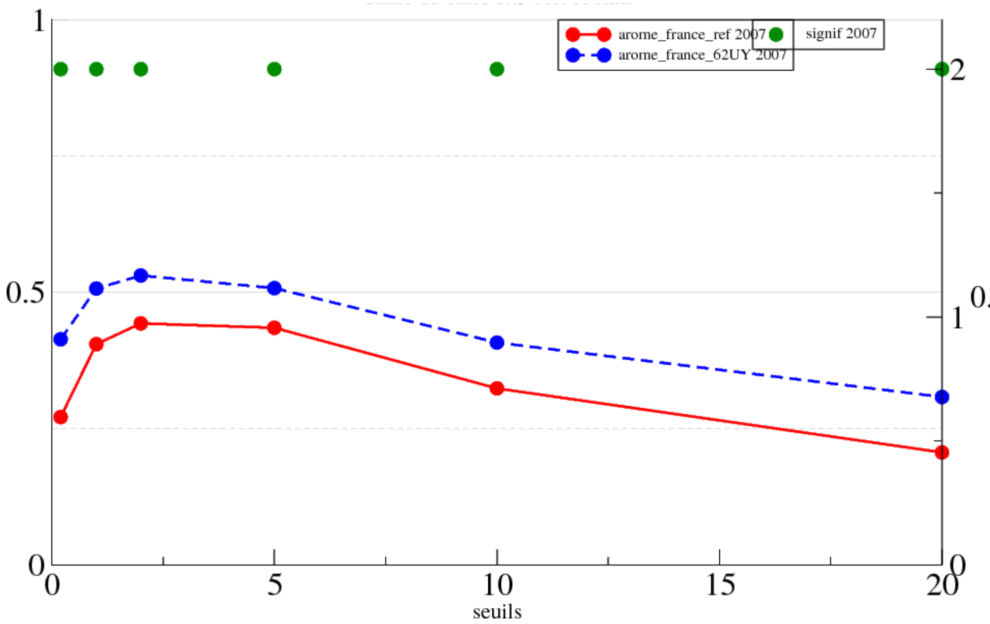


QPF verification during June 2007

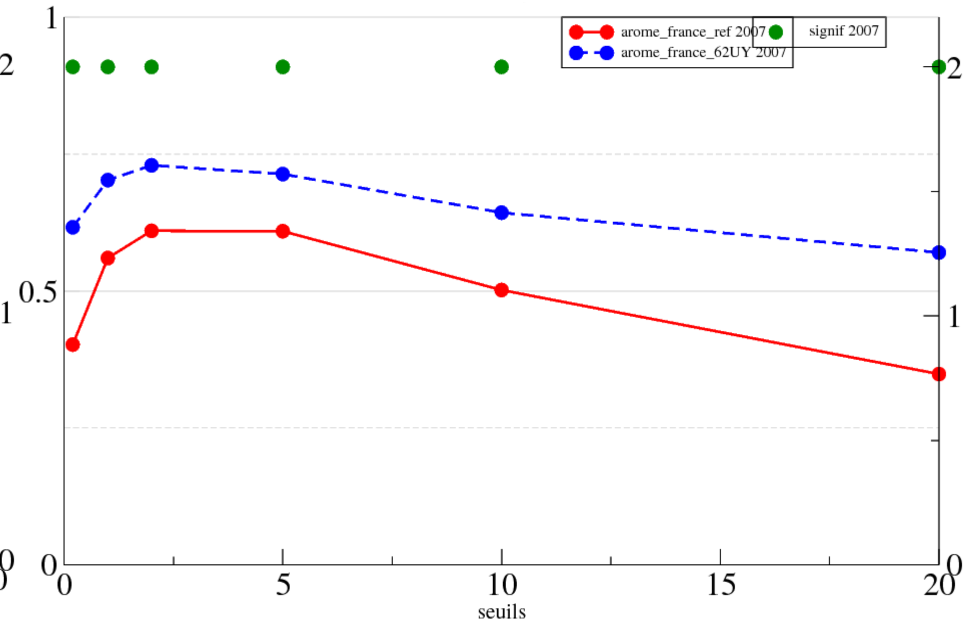
OLD AROME VERSION

NEW AROME VERSION

Brier skill score (SO) against persistence

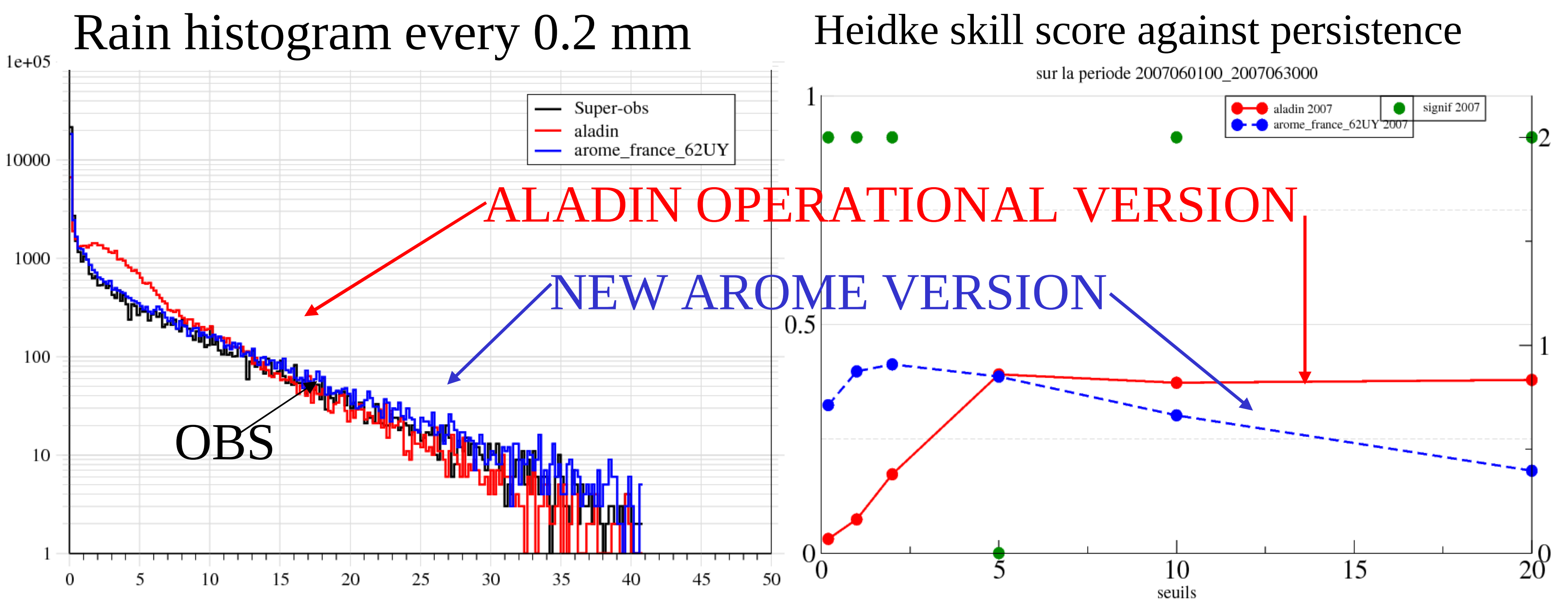


Brier skill score (NO) against persistence



The size of the neighbourhood is 130 km

QPF verification during June 2007

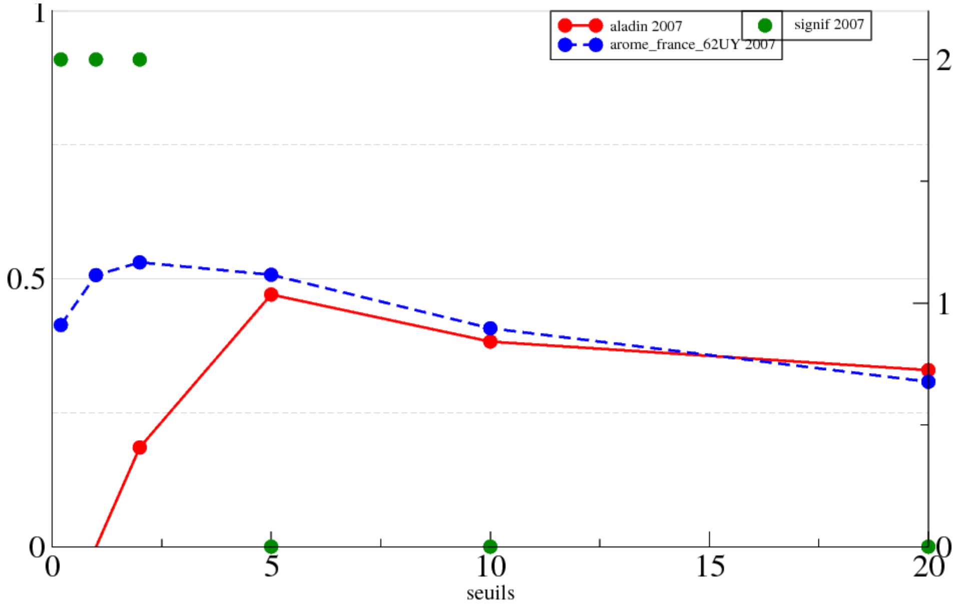


QPF verification during June 2007

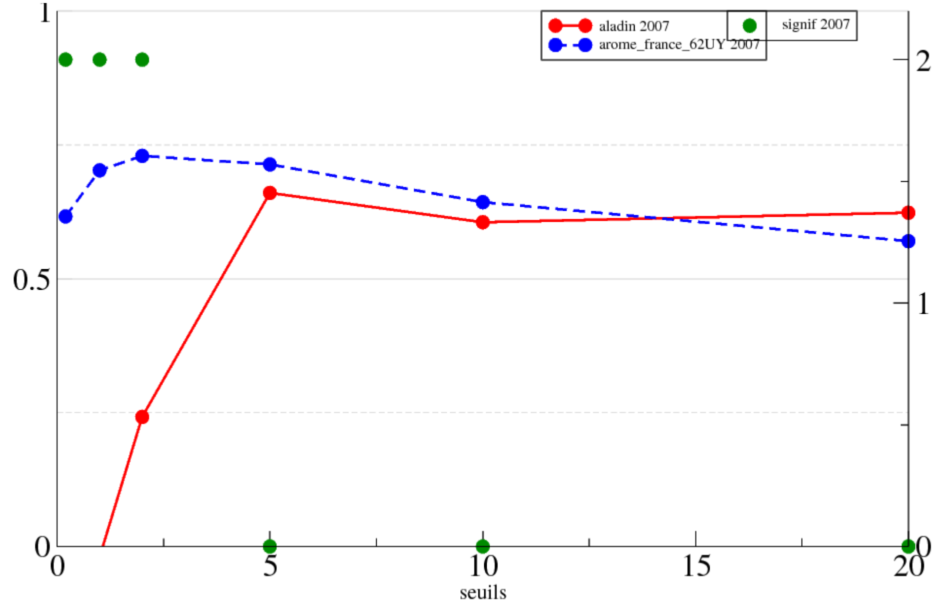
ALADIN OPERATIONAL VERSION

NEW AROME VERSION

Brier skill score (SO) against persistence



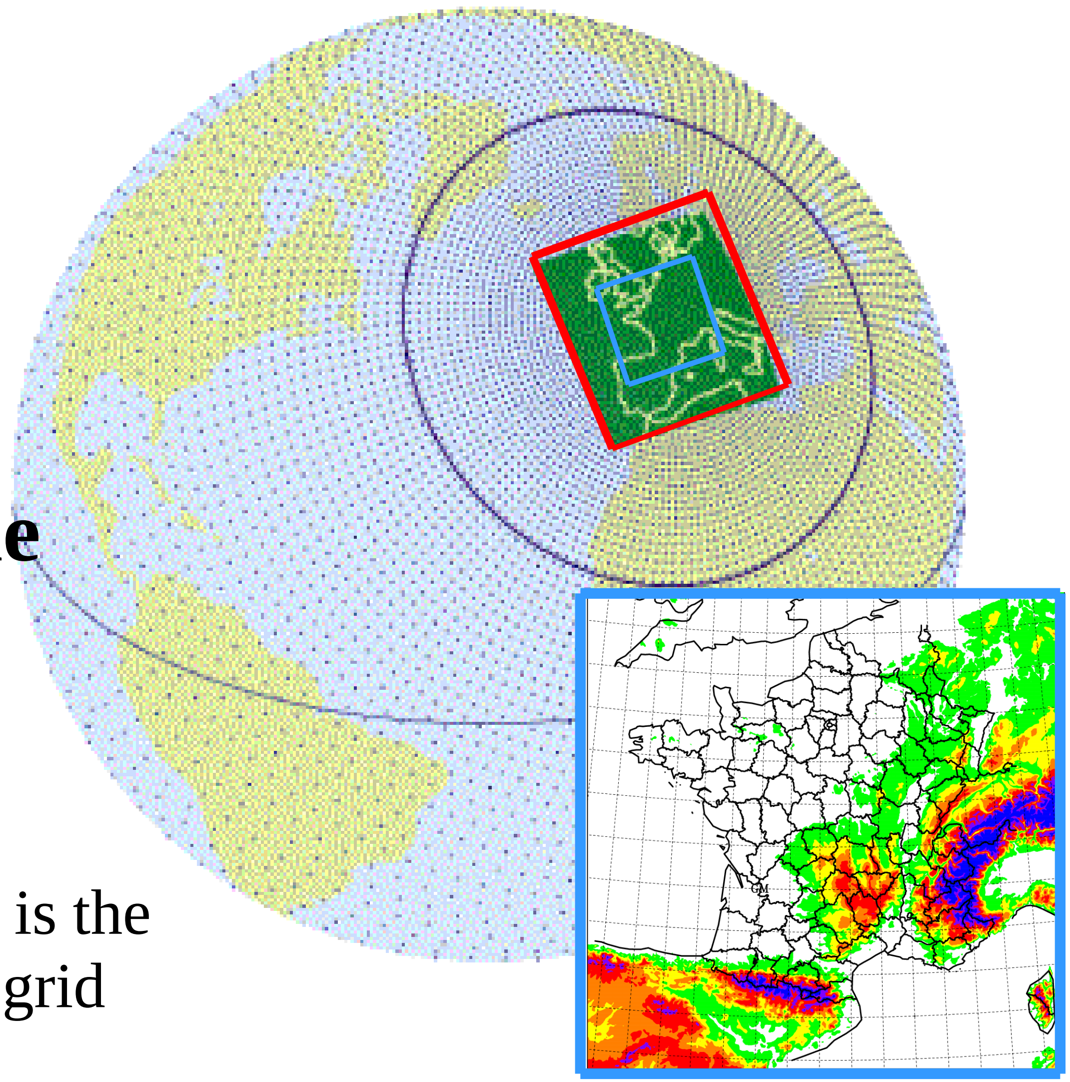
Brier skill score (NO) against persistence



The size of the neighbourhood is 130 km

Verification against satellite data

- **3 data types :**
  - **ALADIN-FRANCE**
  - **AROME**
  - SEVIRI METEOSAT 9



- **Time interval for the verification** :

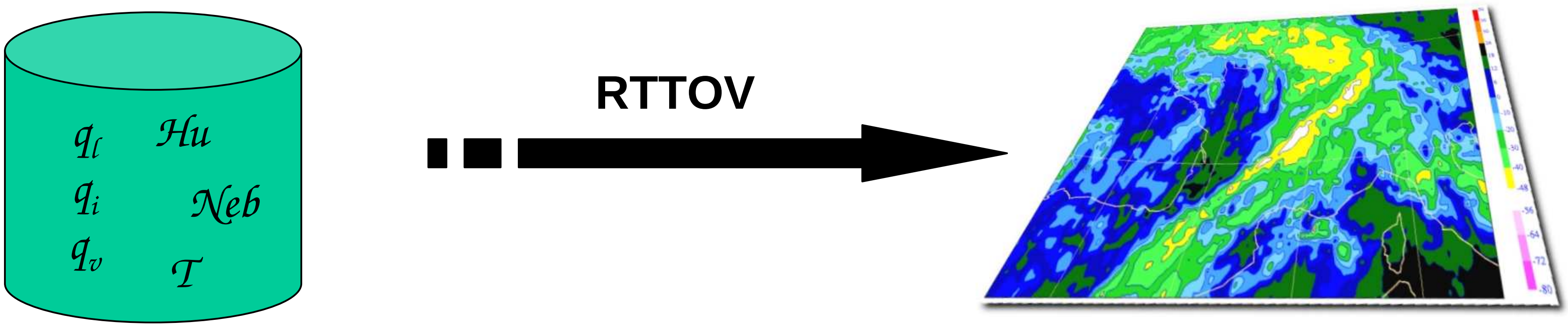
  6 hours

verification domain is the AROME domain with 0.1 ° grid

Simulated satellite images

Output of the model forecasts

SSI



Infrared images 10.8 micrometers

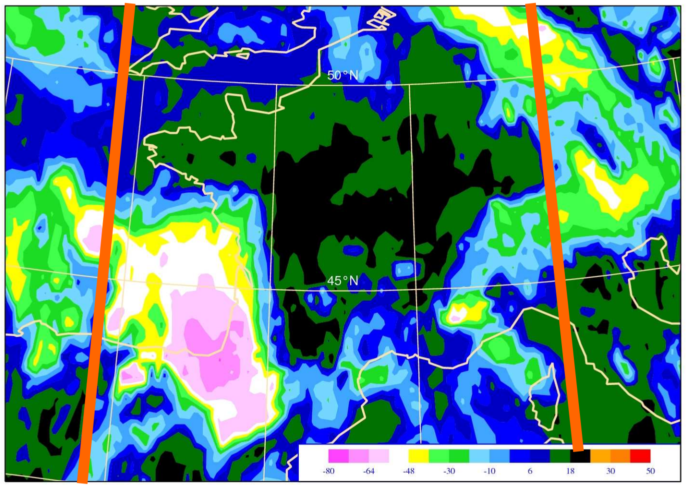
10,8 micrometers

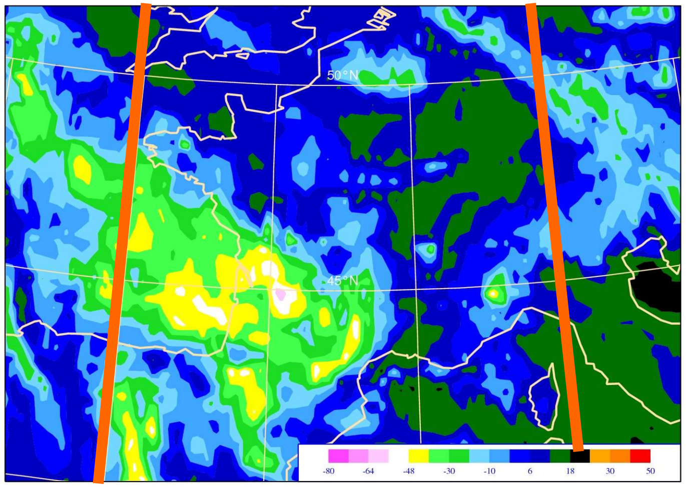
9 june 2007 : SSI AROME

9/06 at 18 UTC

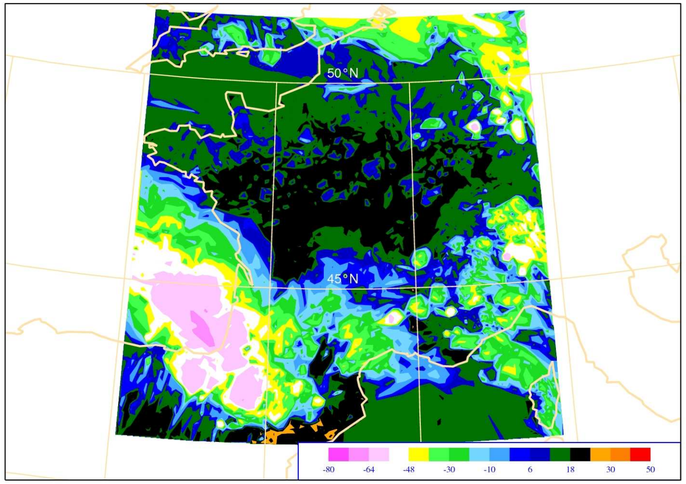
10/06 at 0 UTC

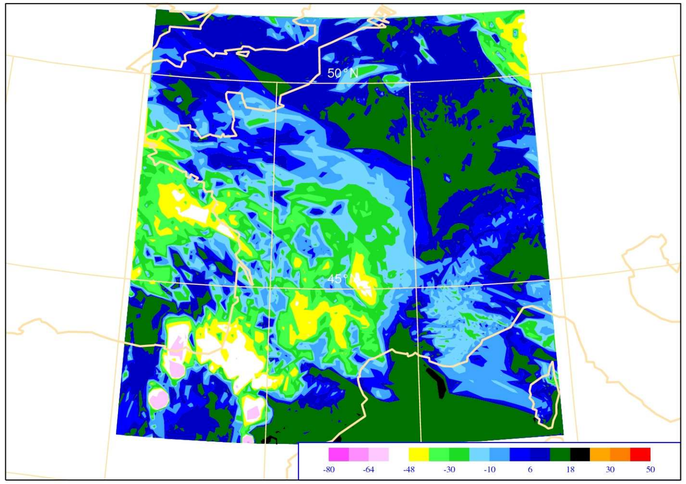
Observation





AROME

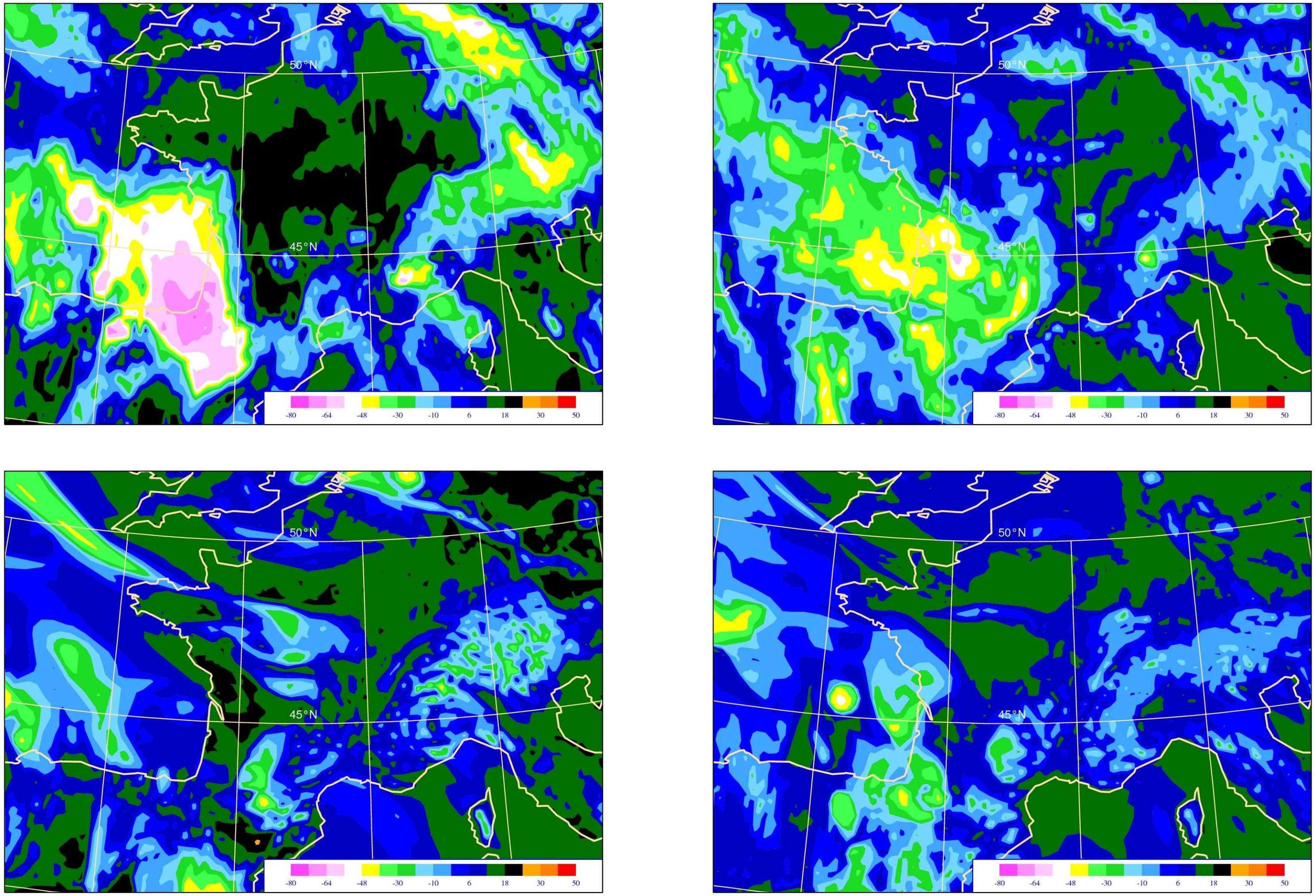




10,8 micrometers

9 june 2007 : SSI ALADIN

9/06 at 18 UTC | 10/06 at 0 UTC



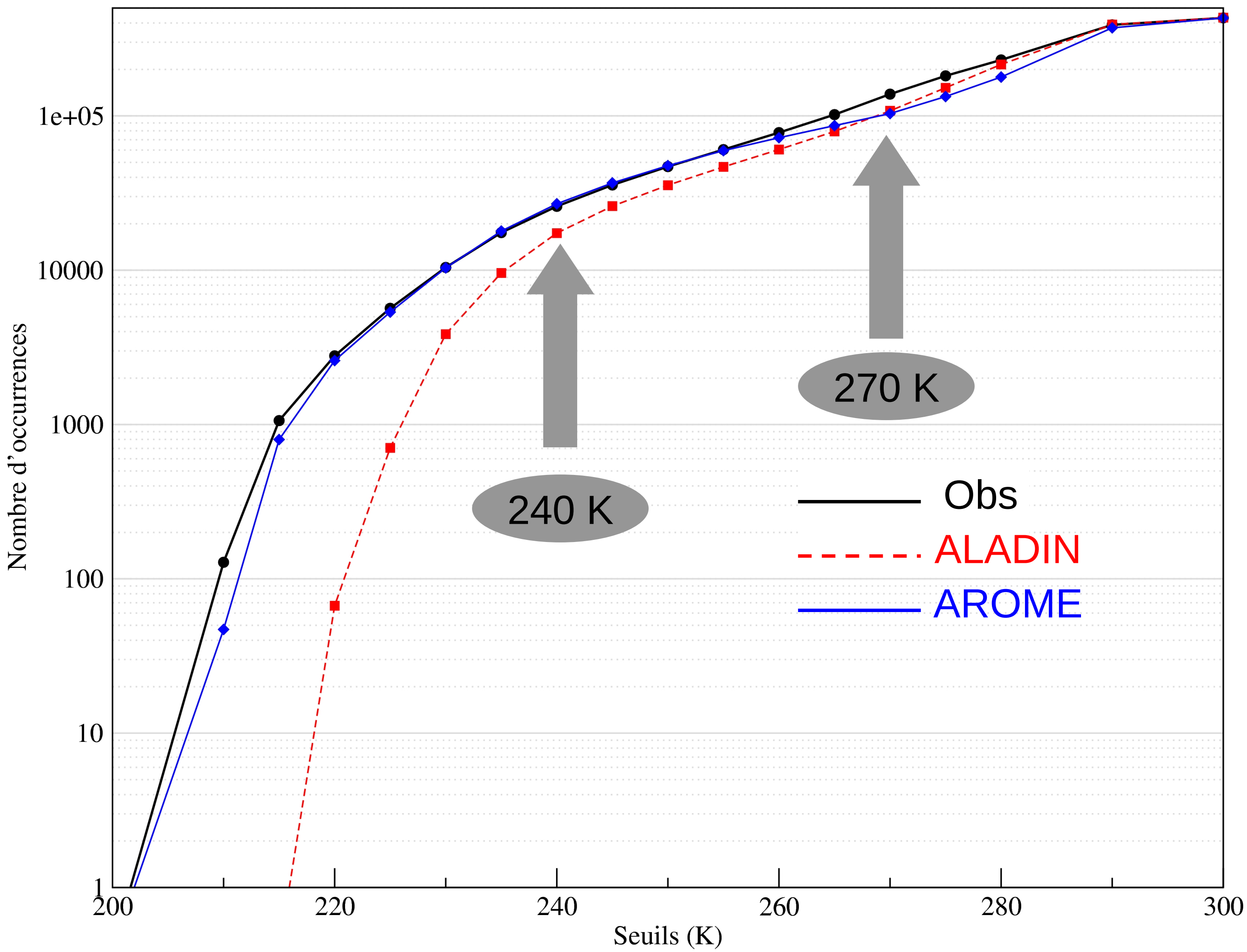
Observation

ALADIN

10,8 micrometers

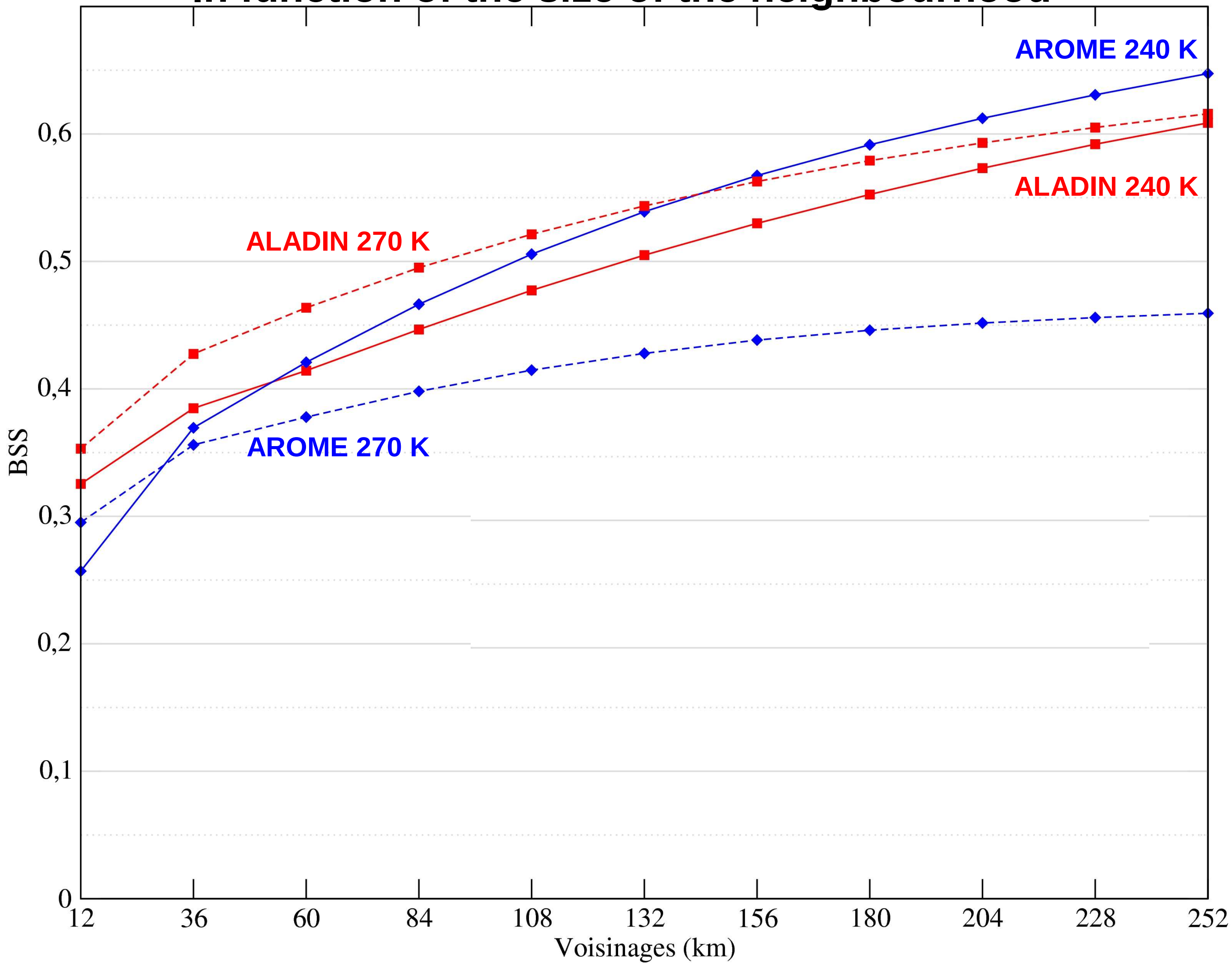
Verification during June 2007

Histogram of observations and forecast BT



Canal 10,8 micromètres

BSS for 2 different thresholds of brightness temperature
In function of the size of the neighbourhood



The end

Brier score - $BS = \frac{1}{N}\sum_{i=1,N}(p_i - o_i)^2$

Answers the question: What is the magnitude of the probability forecast errors?

Measures the mean squared probability error. Murphy (1973) showed that it could be partitioned into three terms: (1) reliability, (2) resolution, and (3) uncertainty.

Range: 0 to 1. Perfect score: 0.

Characteristics: Sensitive to climatological frequency of the event: the more rare an event, the easier it is to get a good BS without having any real skill. Negative orientation (smaller score better) - can "fix" by subtracting BS from 1.

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Brier skill score - $BSS = \frac{BS - BS_{ref}}{0 - BS_{ref}}$

Answers the question: What is the relative skill of the probabilistic forecast over that of climatology, in terms of predicting whether or not an event

occurred?

Range: minus infinity to 1, 0 indicates no skill when compared to the reference forecast. Perfect score: 1.

Characteristics: Measures the improvement of the probabilistic forecast relative to a reference forecast (usually the long-term or sample climatology), thus taking climatological frequency into account. Not strictly proper. Unstable when applied to small data sets; the rarer the event, the larger the number of samples needed.