Deterministic and fuzzy verification of the cloudiness of High Resolution operational models

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Summary

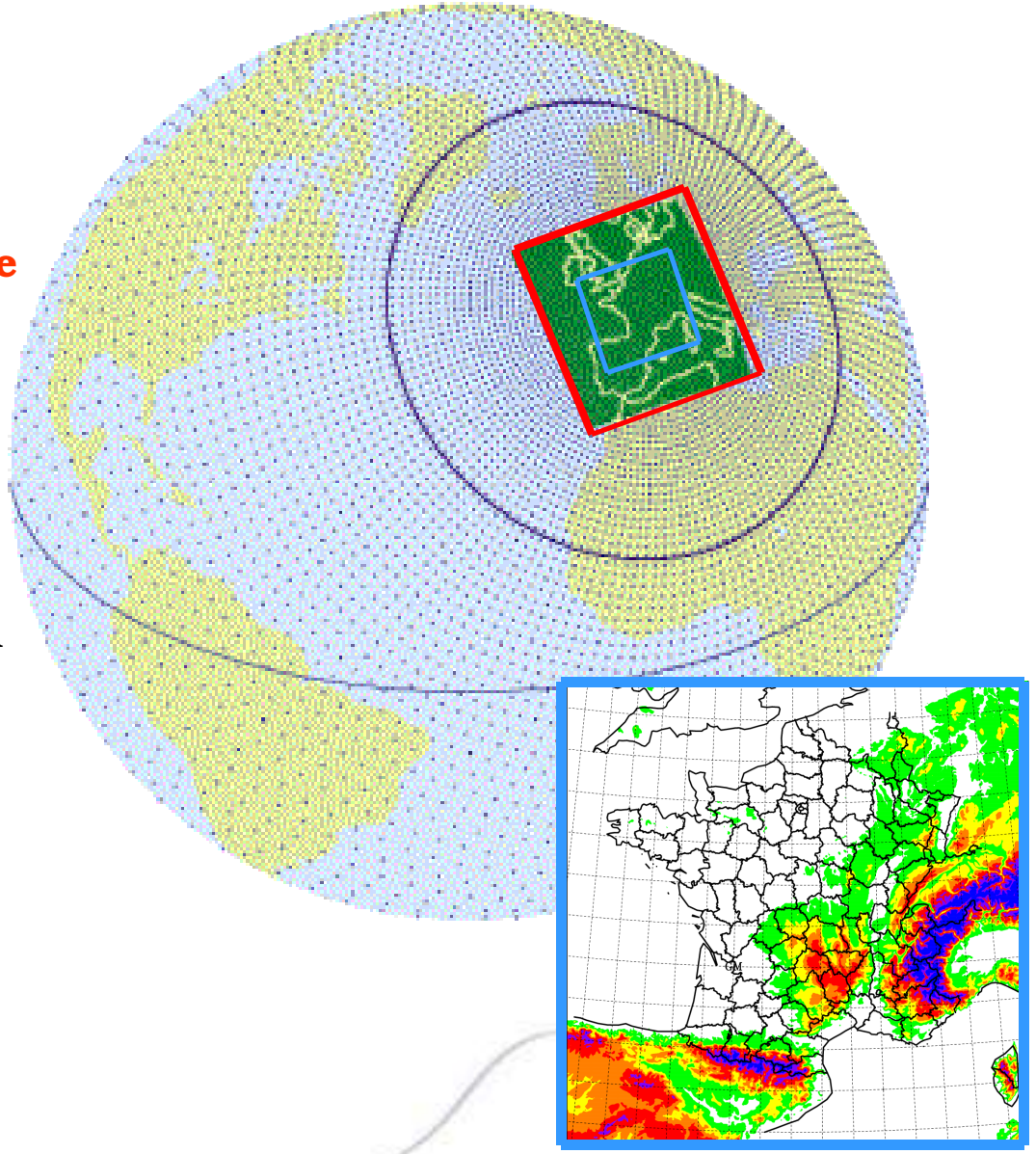
- Introduction
  - Verification against satellite data
  - Simulate satellite images
- Summer 2008 :
  - Illustrative example of SSI : June 11th
  - Deterministic scores
  - Probabilistic scores
  - Comparison with QPF
- Conclusion

Verification against satellite data

- **3 data types :**
  - **ALADIN-FRANCE 0.1 ° and mass flux convection scheme**
  - **AROME 0.025 ° and explicit convection**
  - SEVIRI METEOSAT 9

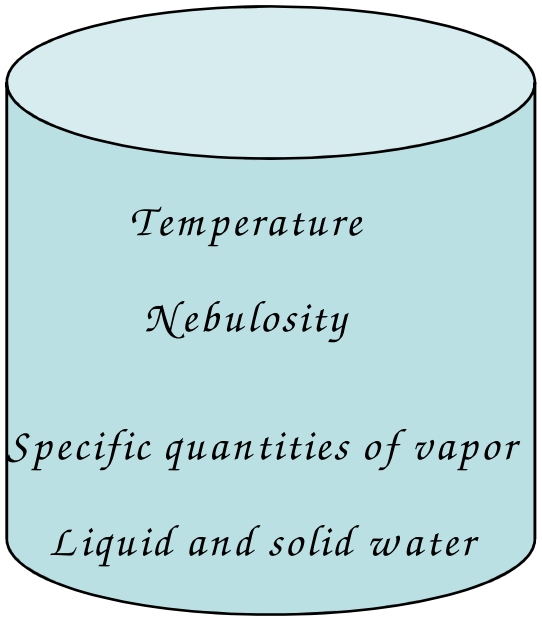
- **Verification domain**
  AROME domain with 0.1 ° grid

- **Verification time**:
  every 6 hours, instantaneous



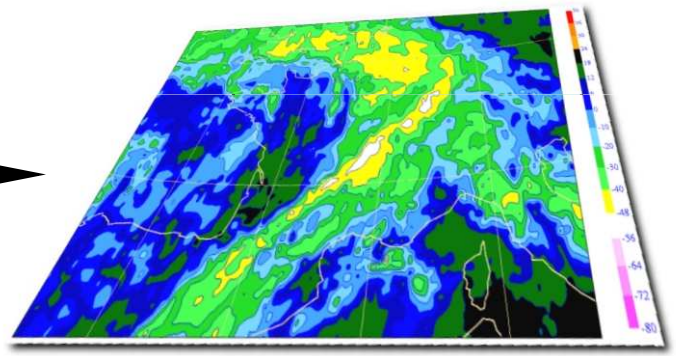
Simulated satellite images (SSI)

Output of the model forecasts



RTTOV_CLOUD 8

Two-dimensional SSI



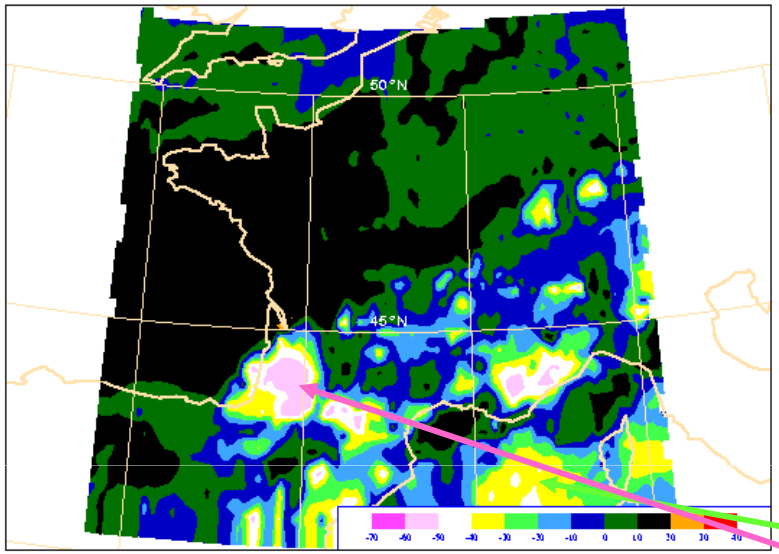
AROME : explicit clouds

ALADIN : explicit + subgrid clouds

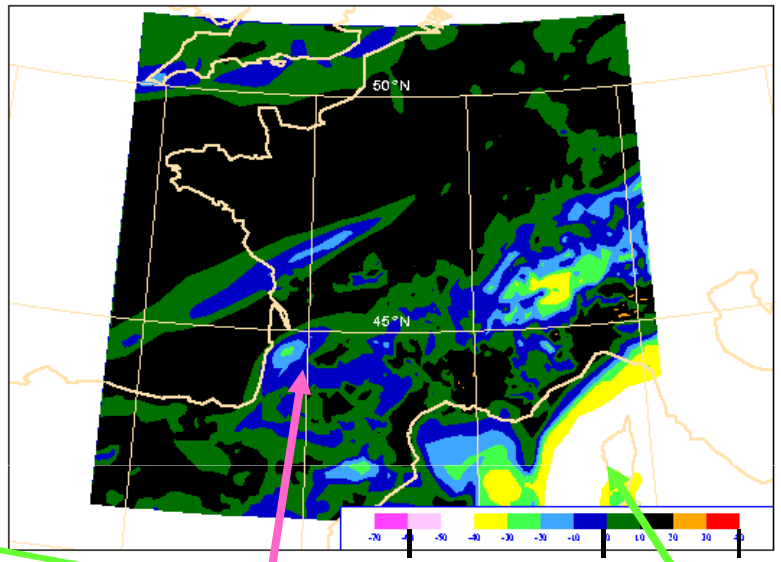
Wavelength of the Infrared channel is 10.8 micrometers

Simulated satellite images (SSI) 11 June 2008 18 UTC

Observation

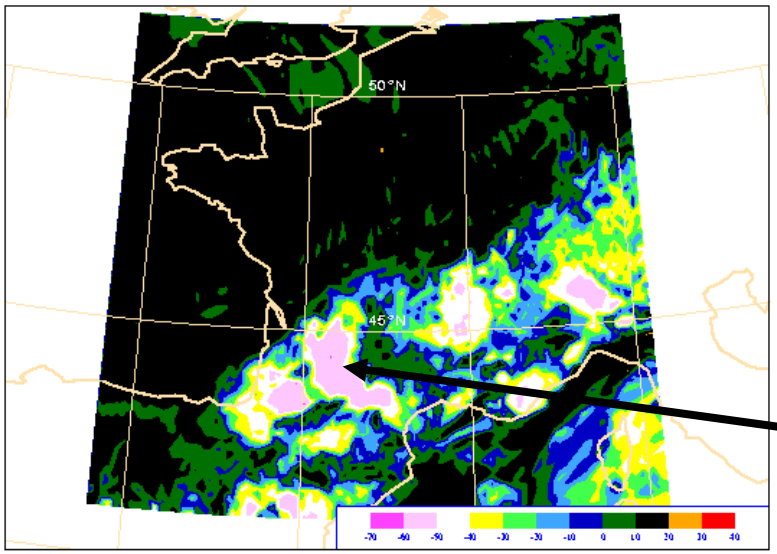


ALADIN



213 K 273 K 313 K

AROME



No convective subgrid clouds

Explicit clouds

Correct development of the convection

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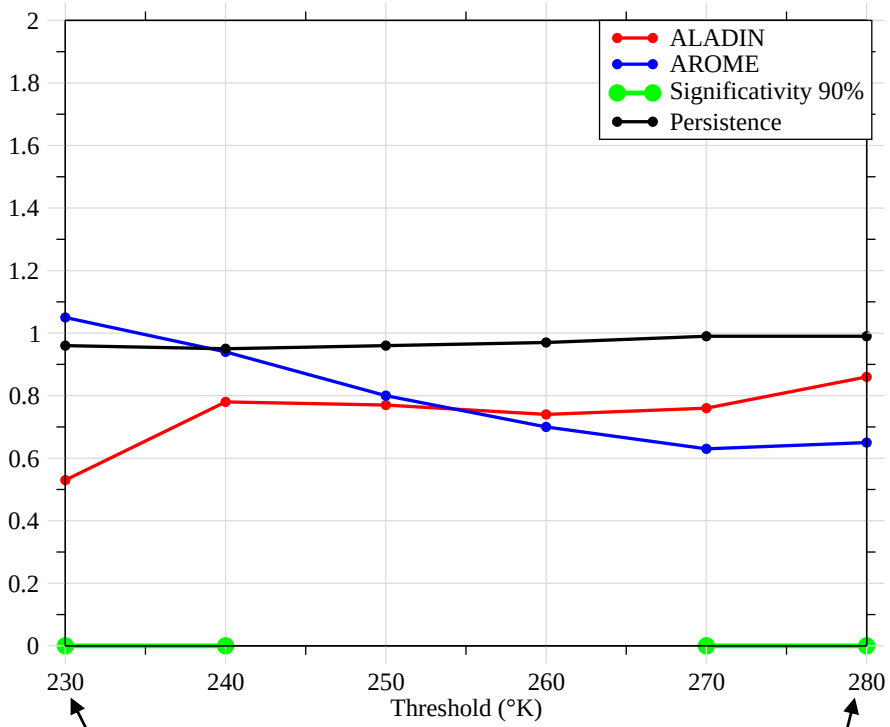
SUMMER 18 UTC

2 June – 10 September 2008

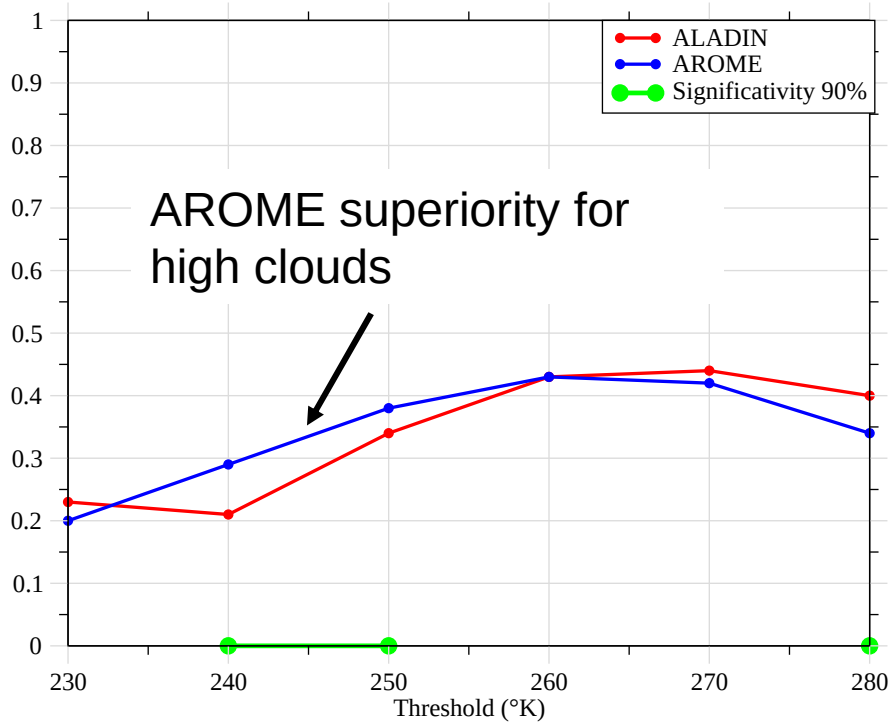
BIAS



3%
~5000 events

40%
~91000 events

Heidke skill score



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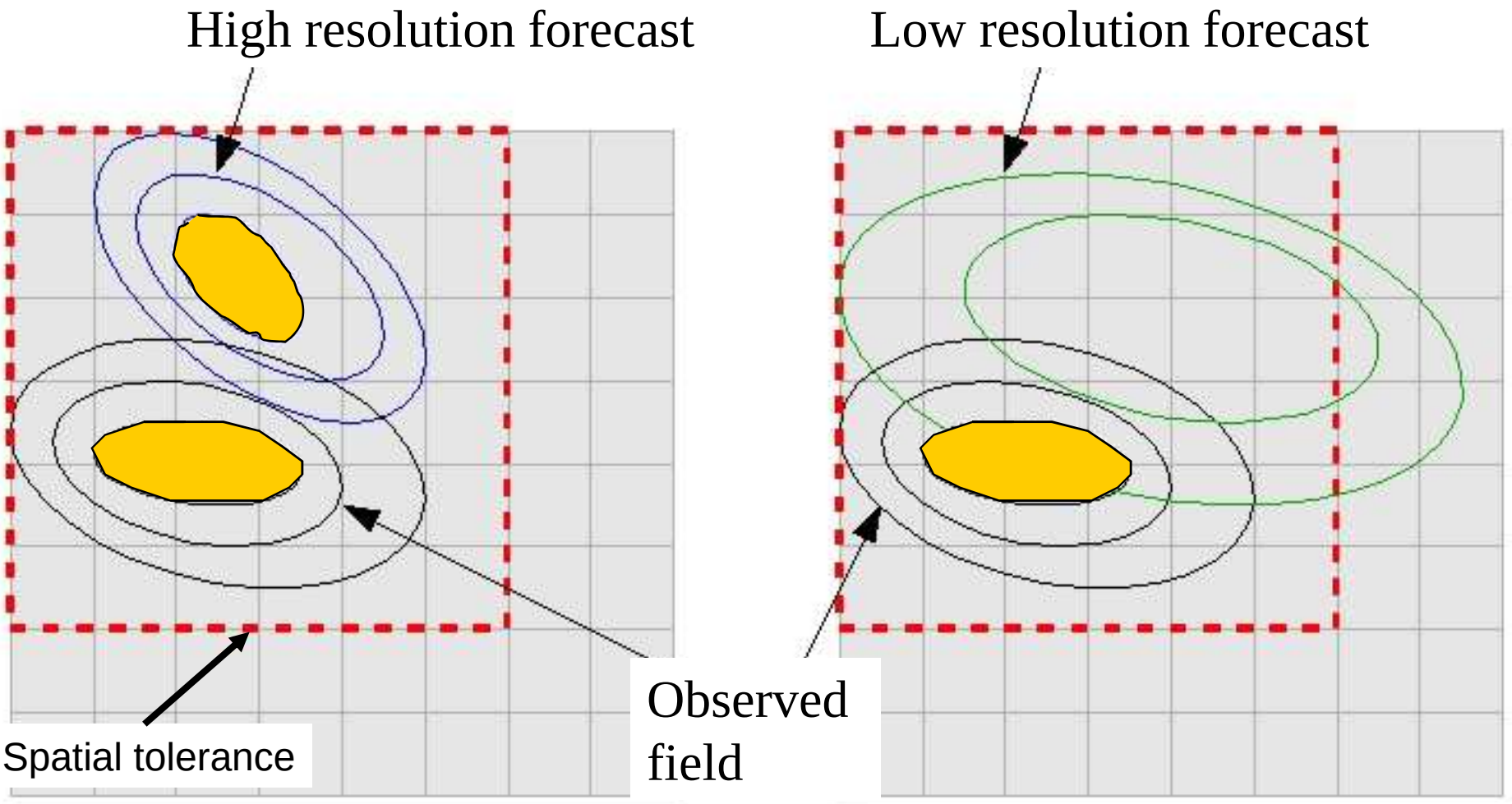
double-penalty and neighborhood



Deterministic forescast ⟹ Probalistic forescast

Fuzzy approach

- **Brier Score (BS):**

$$BS = \frac{1}{Nobs}\sum_{k=1}^{Nobs}(pk - ok)^2$$

- **Brier Skill Score(BSS):**

$$BSS = 1 - \frac{BS}{BSref}$$

Ref = persistence

- **2 interesting limits :**

1- Neighbourhood size = 0 :

$$BSS \xrightarrow[v \to 0]{} HSS$$

2- Neighborhood = simulation domain

$$BS \xrightarrow[v \to L]{} \frac{1}{Nday}\sum_{d=1}^{Nday}\alpha(d)\times(1 - BIAS\,(d))^2$$

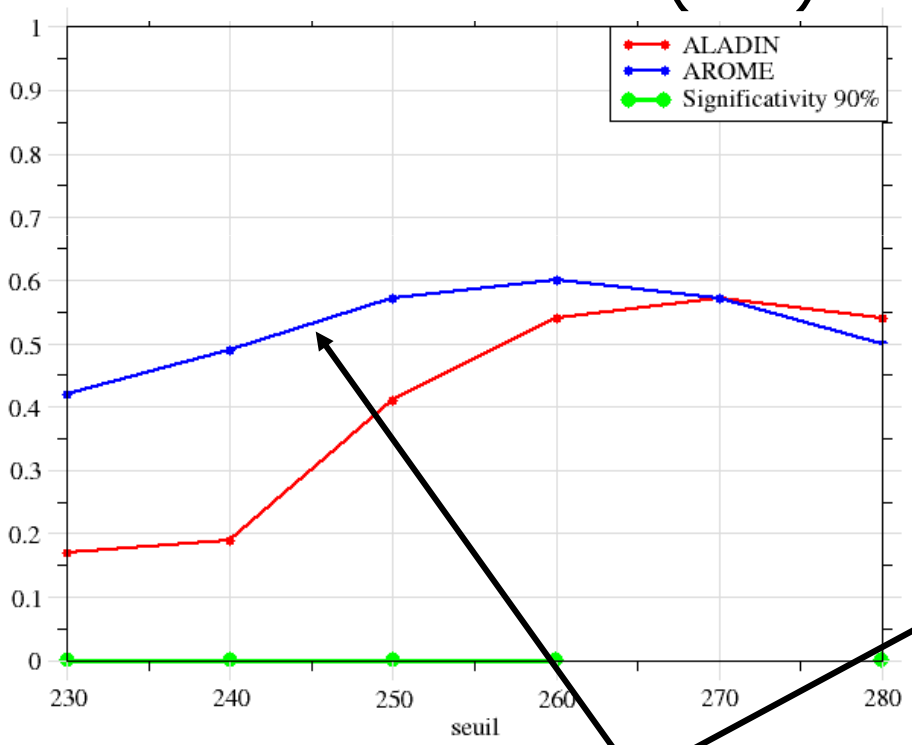
(further details in Amodei and Stein (2009))

SUMMER 18 UTC

2 June – 10 September 2008

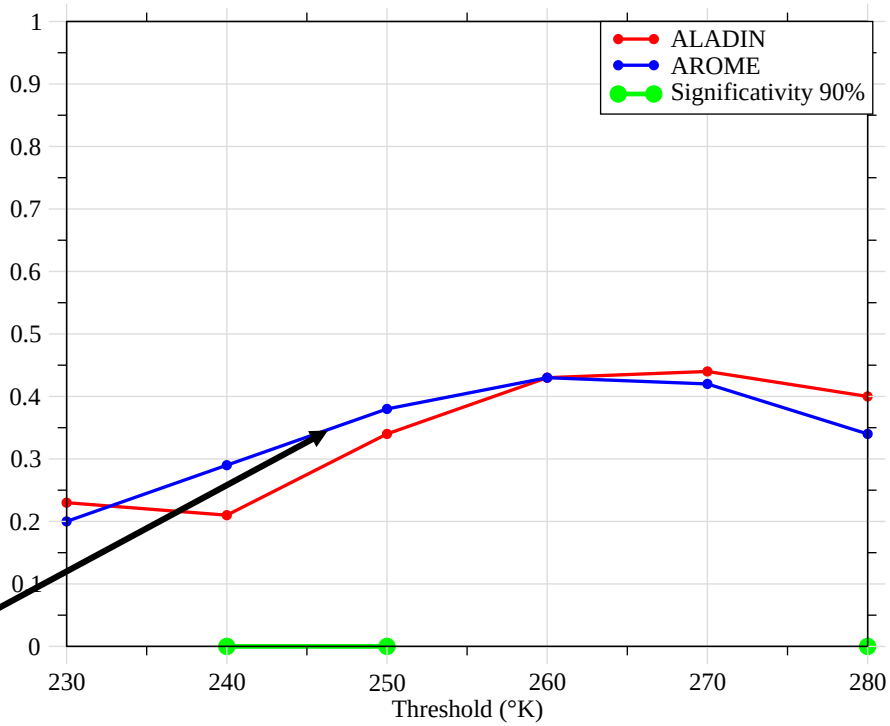
Neighborhood 76 Km

Brier skill score (NO)



HSS = BSS (10 km)

Heidke skill score



Removal of the double penalty for high clouds in AROME

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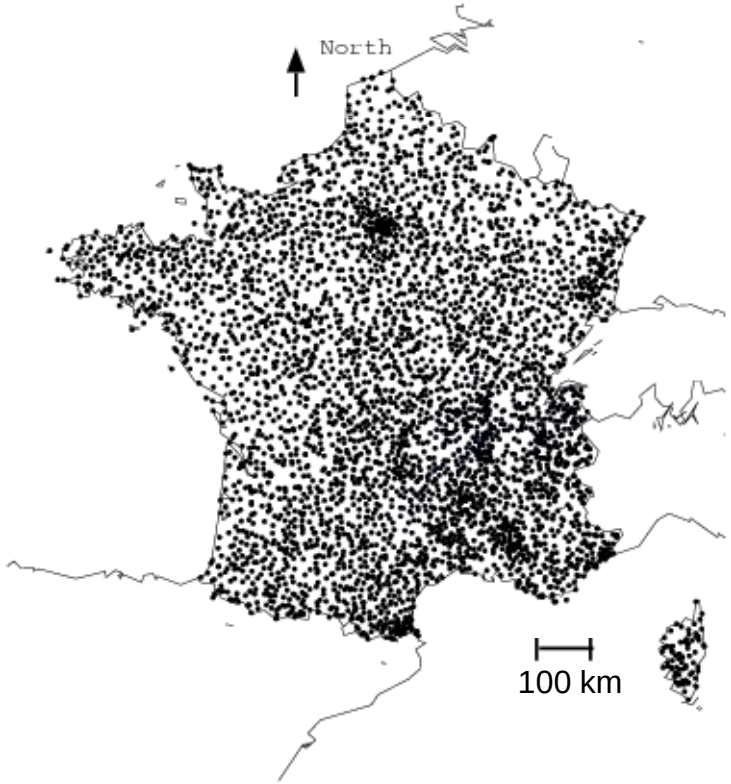
QPF verification

- Average the data and the models QPF at 0.2°x0.2°



Climatological state network

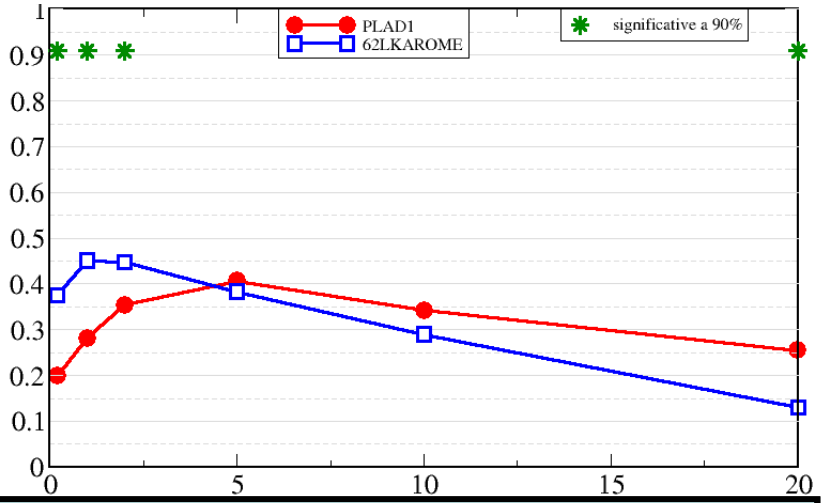
~4000 raingauges giving 24 hours accumulated rain every day

QPF verification during SUMMER 2008

2 June – 10 September 2008

24 hours accumulated rain

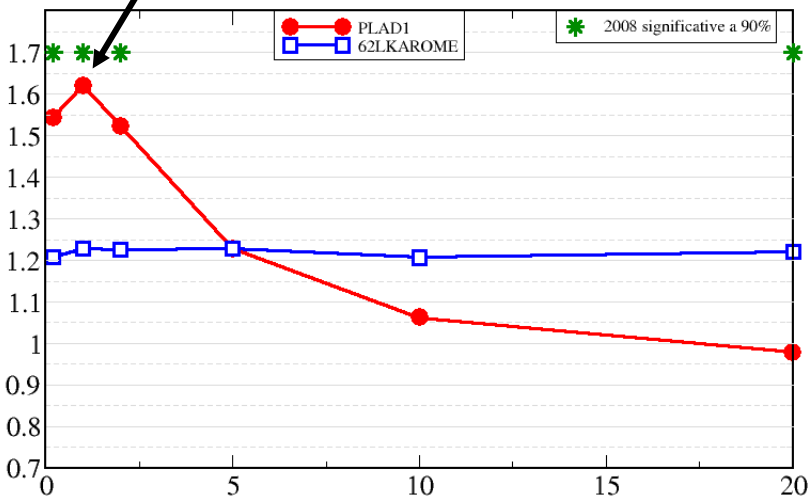
Heidke skill score



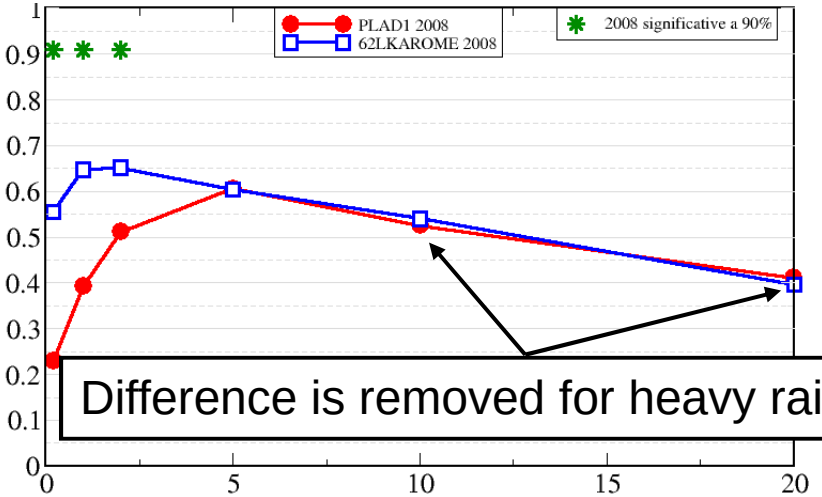
Known drawback of
A
s

Using a fuzzy approch removes the double penalty for heavy rains and cold SSI

Bias



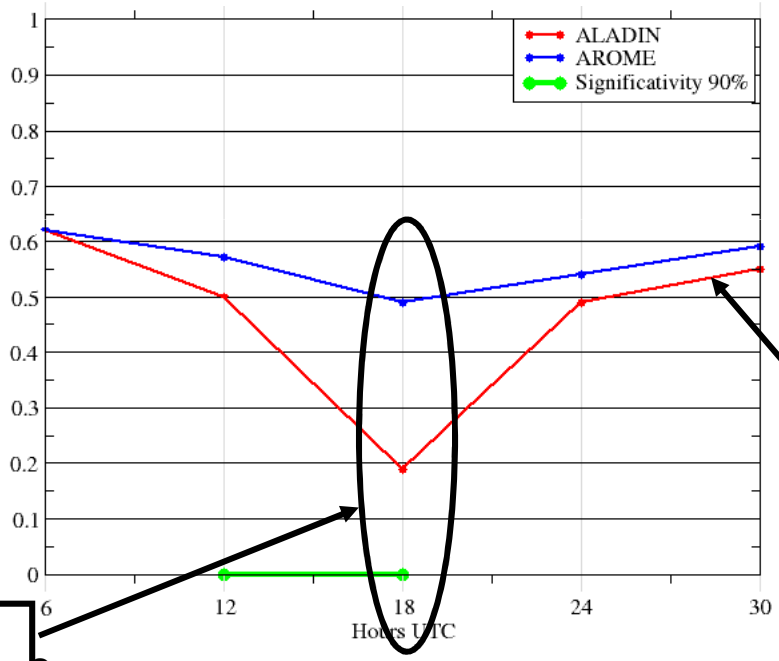
Neighborhood 76 km



Difference is removed for heavy rains

Daily evolution of SSI

BSS SSI every 6 hours
high clouds 240°K
Neighborhood 76 Km



During the night large scale cloudy phenomena replaces convective clouds

Difficulties to forecast convective clouds

6 18 30

Hours UTC

Conclusion

- SSI allow to document the forecast quality of the all types of clouds
- ALADIN and AROME under-estimate low and medium clouds.
- High-tropospheric clouds are quasi-absent in ALADIN forecasts.
- The fuzzy approach corrects the double penalty for the convection simulation for AROME but not for ALADIN.
- QPF and SSI verifications provide complementary information for convective events

Future plans

- Define a temporal tolerance (Theis *etal* 2005) to reduce the double penalty for temporal misplacement
- Perform the QPF verification for 6 hours accumulated precipitation.
- Compare both information provided by these new verifications for SSI and QPF
- Operational use of both verifications

The End