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

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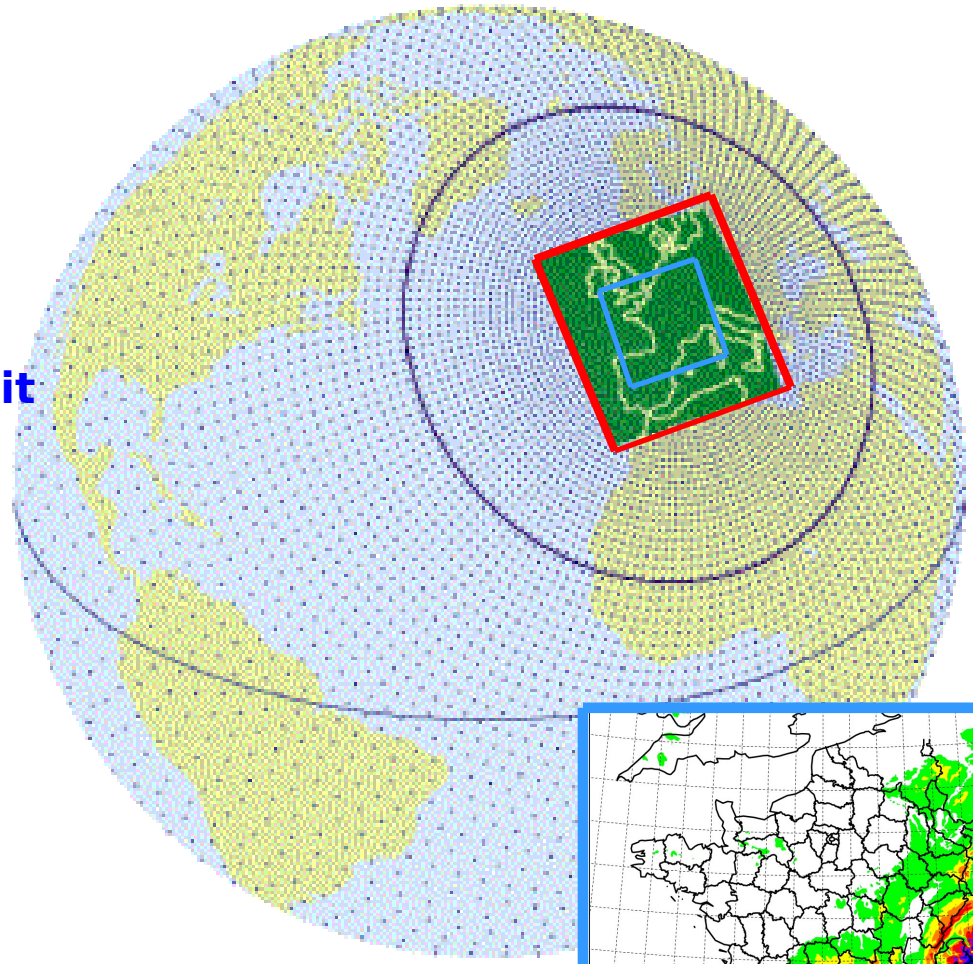
METEO FRANCE
Toujours un temps d'avance

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

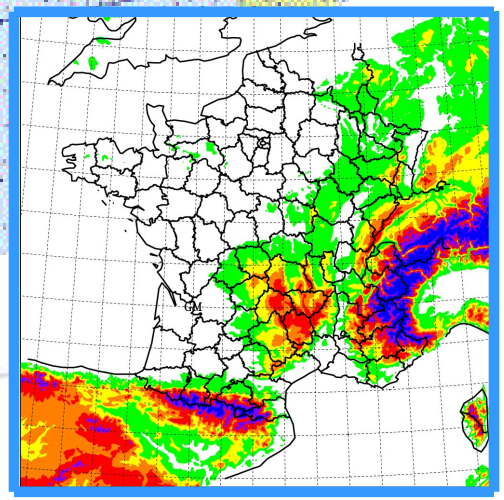


- **Verification time**:

every 6 hours, instantaneous

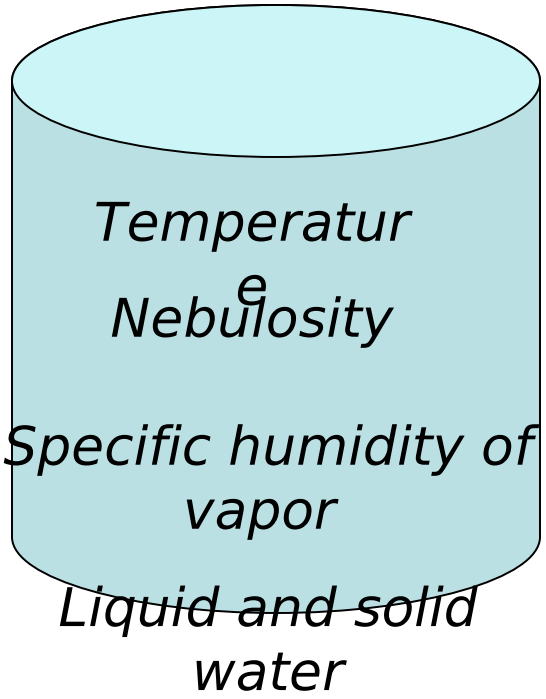
verification domain

AROME domain with 0.1 ° grid



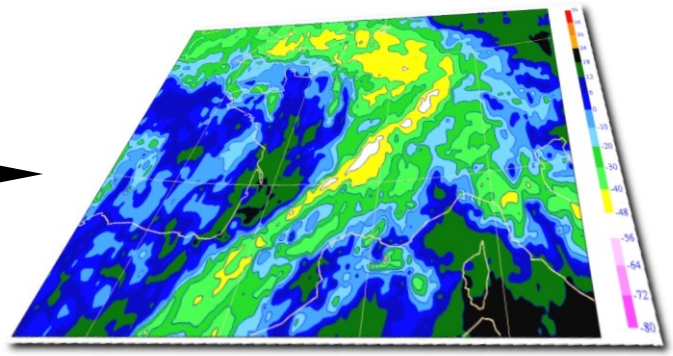
Simulated satellite images (SSI)

Output of the model forecasts



RTTOV_CLOUD 8

Two-dimensional SSI



AROME : explicit clouds

ALADIN : explicit + subgrid clouds

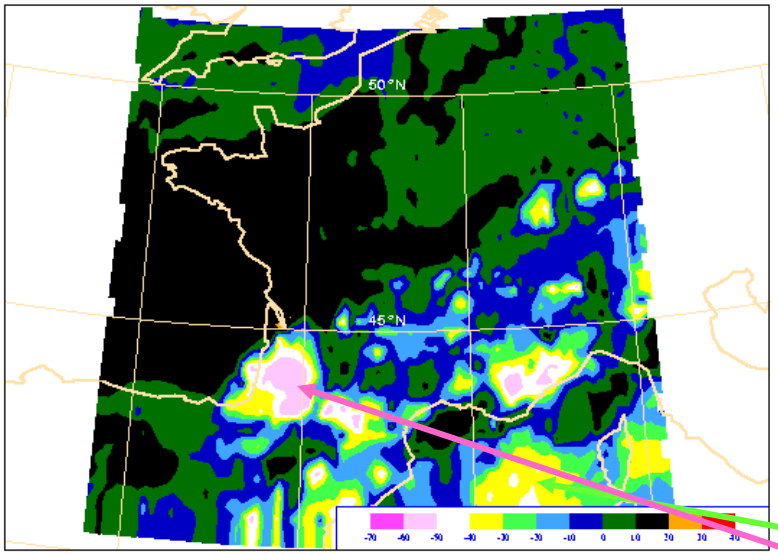
Wavelength of the Infrared channel is 10.8 micrometers

Summary

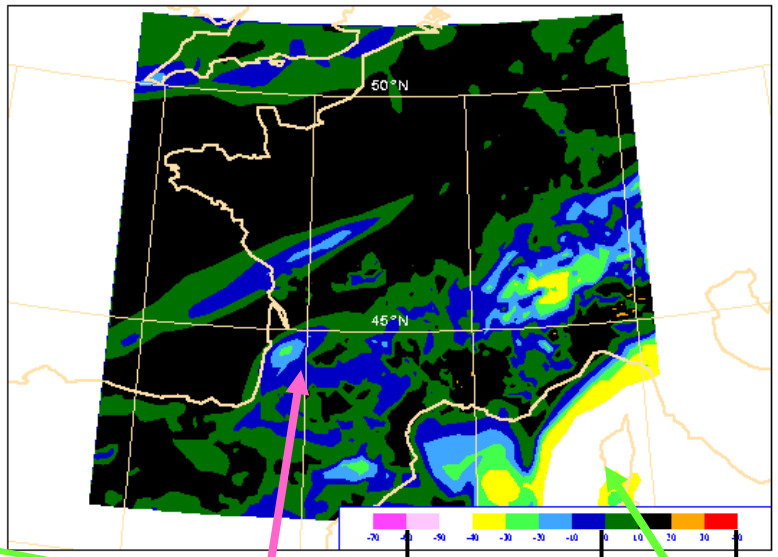
- Introduction
- Last Summer :
  - Illustrative example of SSI : 11 June 2008
  - Deterministic scores
  - Probabilistic scores
  - Comparison with QPF
- Conclusion

Simulated satellite images (SSI) 11 June 2008 18 UTC

Observation

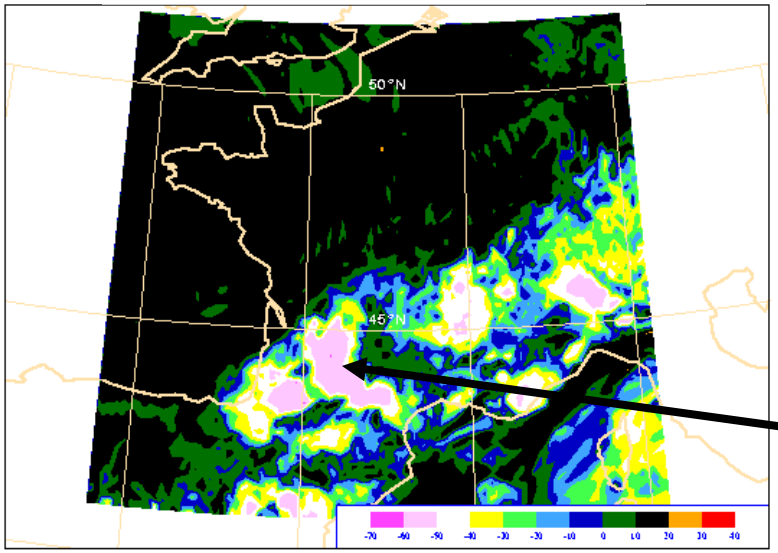


ALADIN



213 K 273 K 313 K

AROME



No convective subgrid clouds

Explicit clouds

Correct development of the convection

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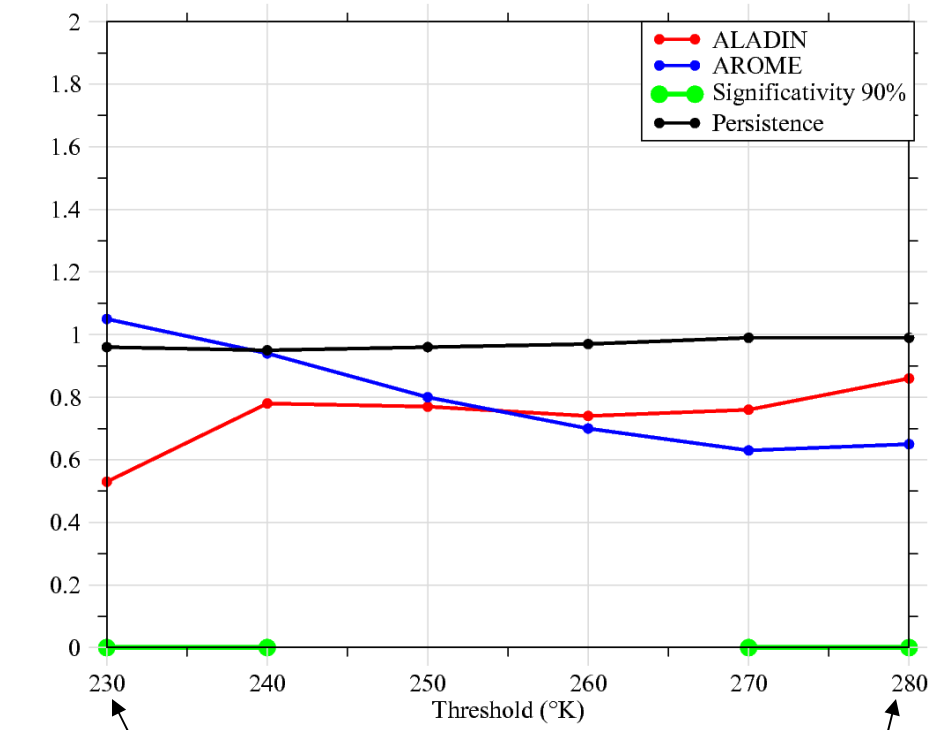
SUMMER 18 UTC

2 June – 10 September 2008

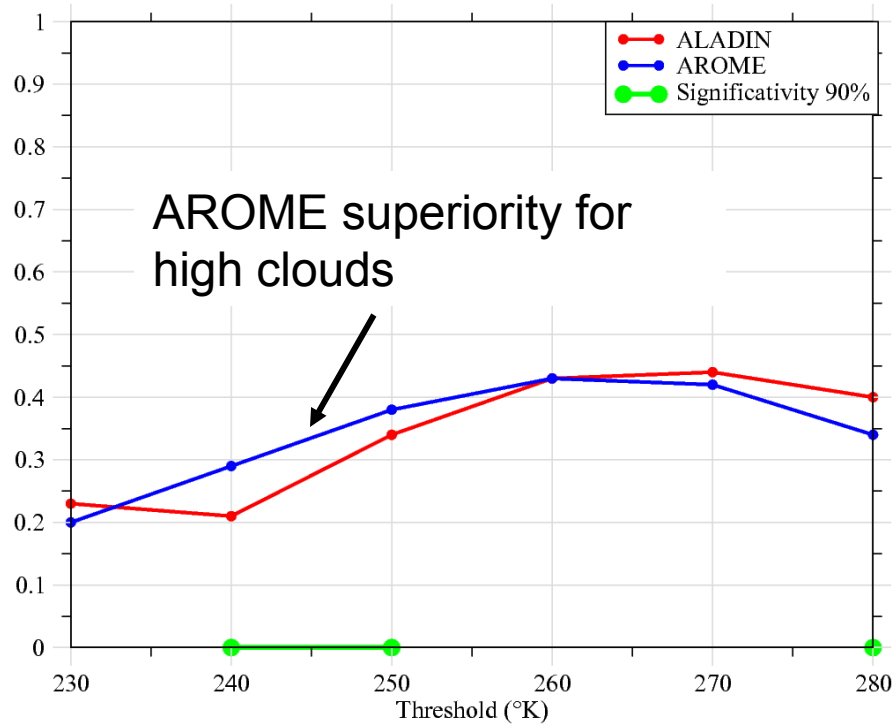
BIAS



3%
~5000 events

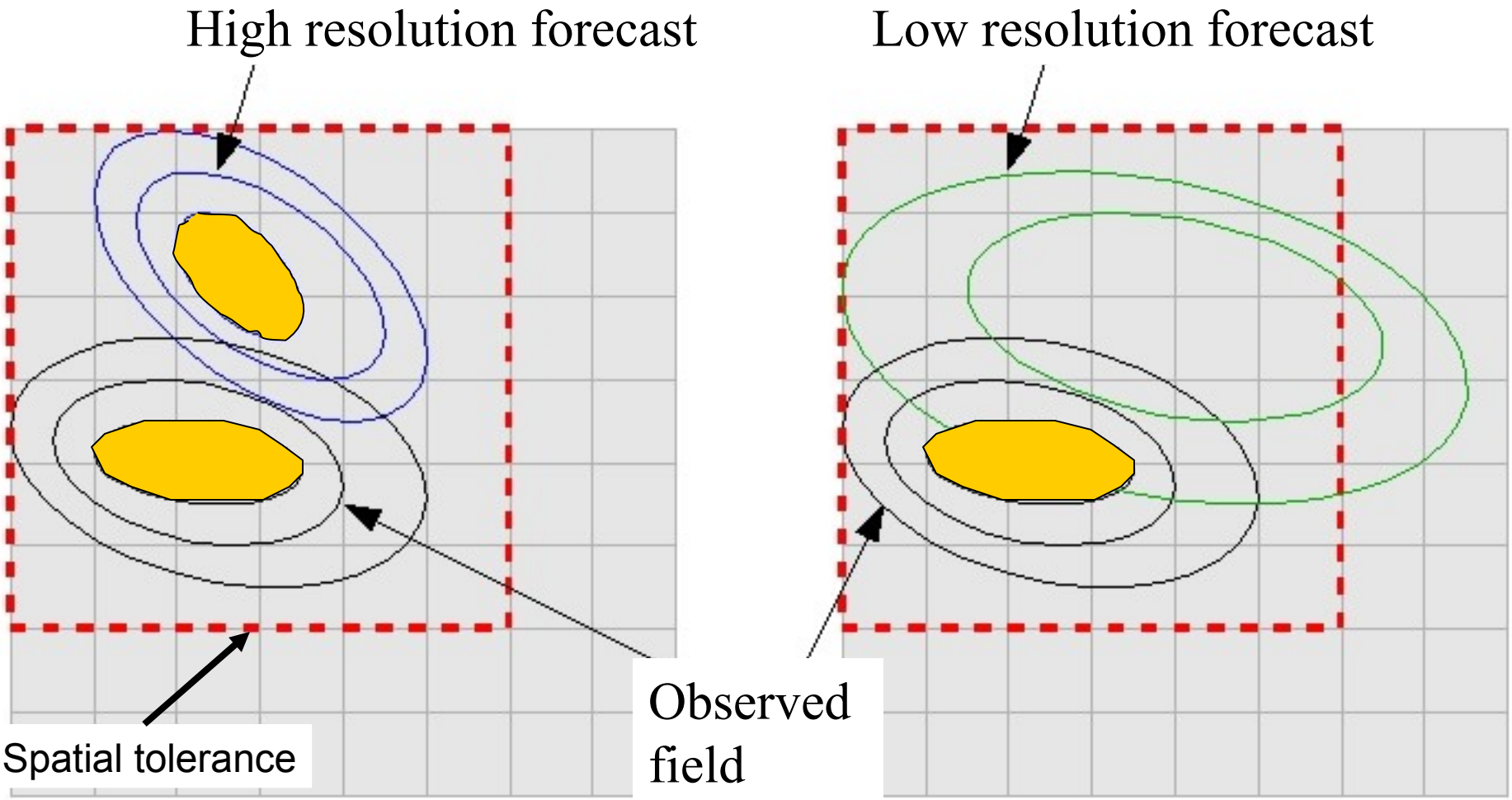
40%
~91000 events

Heidke skill score



METEO FRANCE
Toujours un temps d'avance

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

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

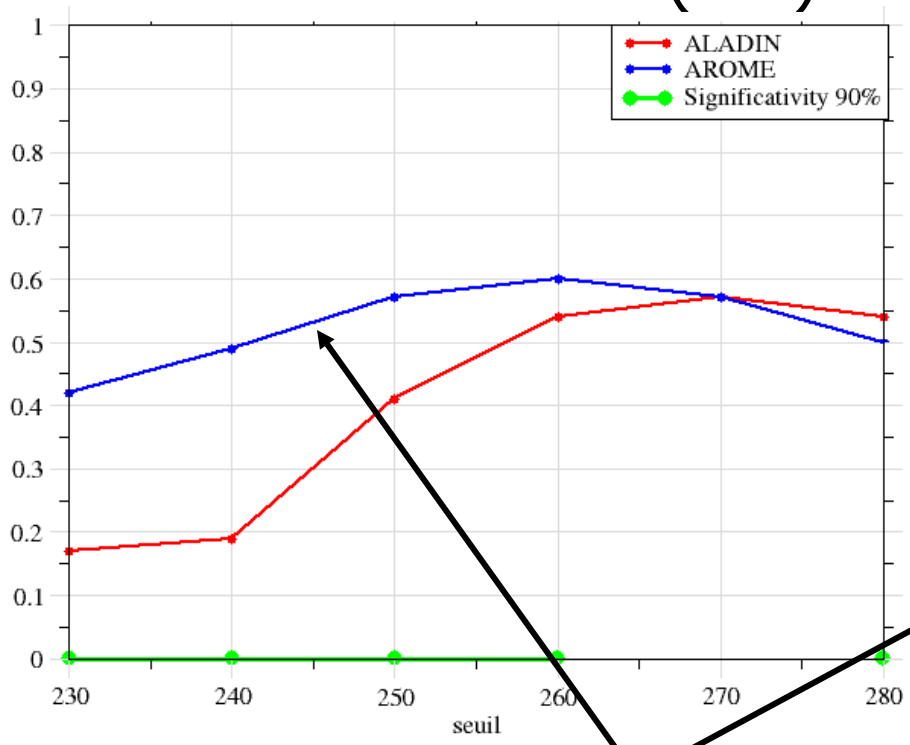
(further details in Amodei and Stein (2009))

SUMMER 18 UTC

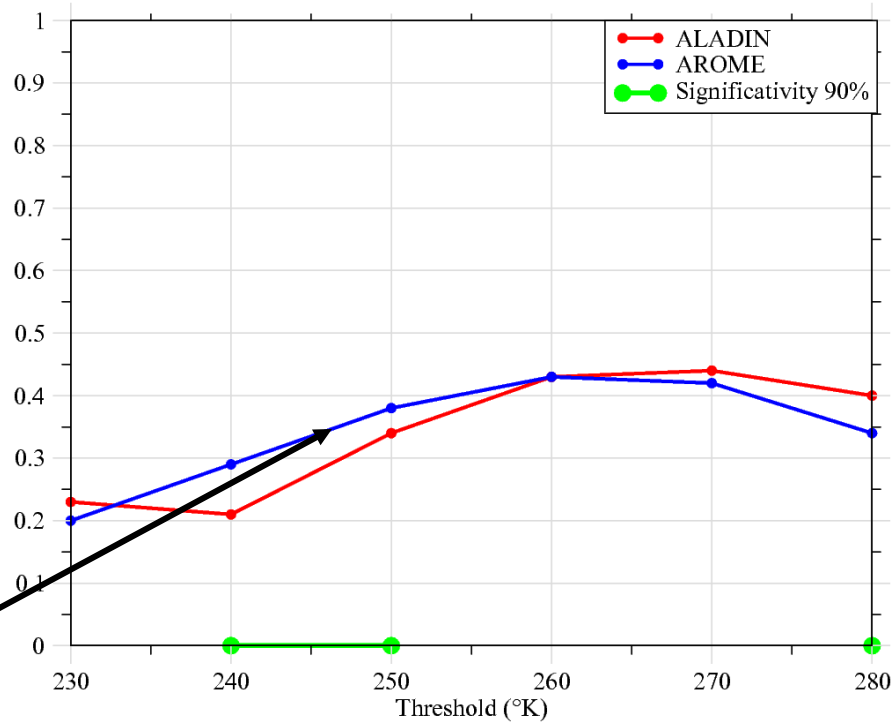
2 June – 10 September 2008

Neighborhood 76 Km

Brier skill score (NO)



Heidke skill score



More impact of the double penalty for high clouds in AROME

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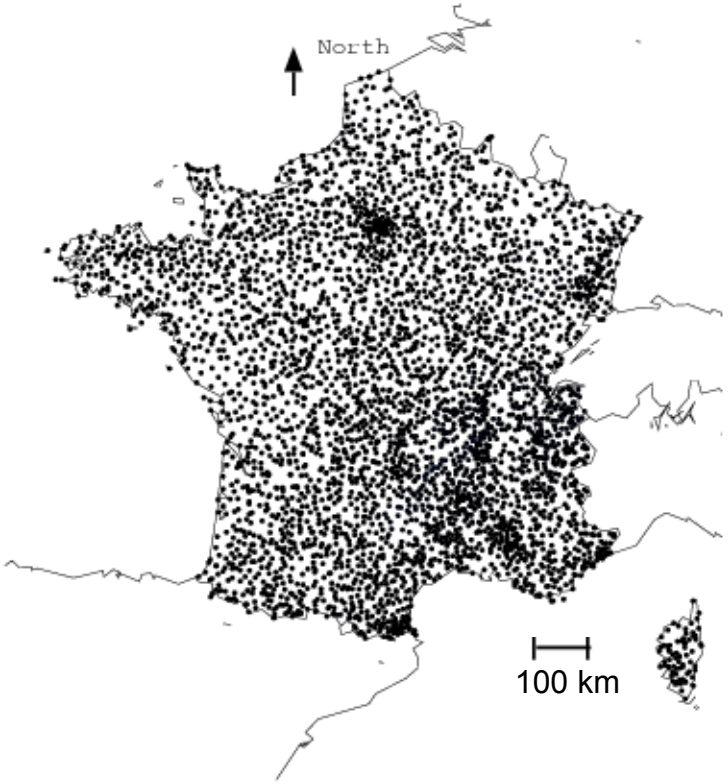
Toujours un temps d'avance

QPF verification

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



Climatological state network

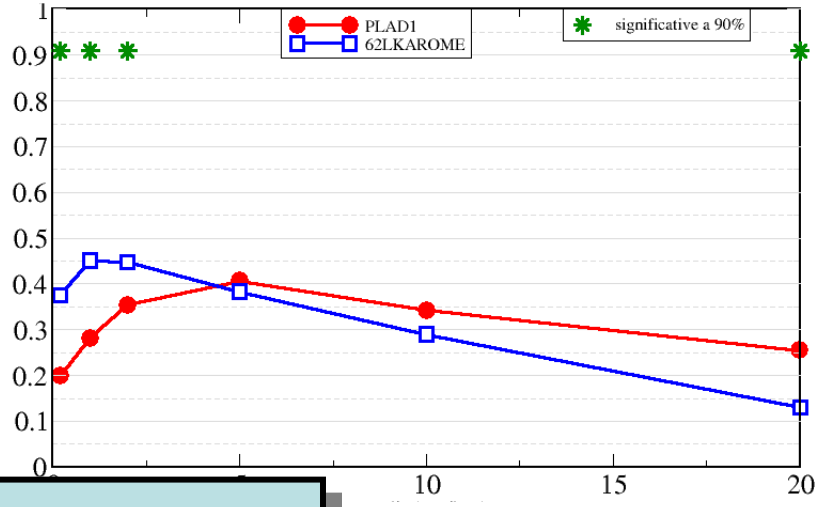
~4000 raingauges giving 24 hours accumulated rain every day

QPF verification during SUMMER 2008

2 June – 10 September 2008

24 hours accumulated rain

Heidke skill score

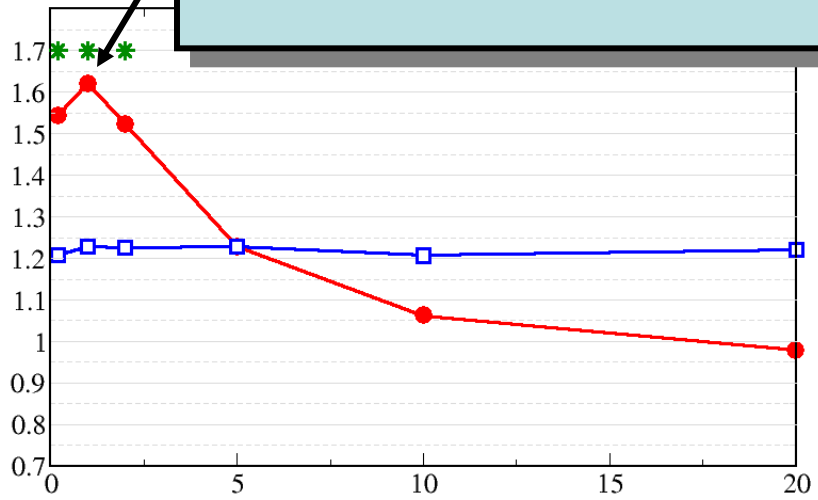


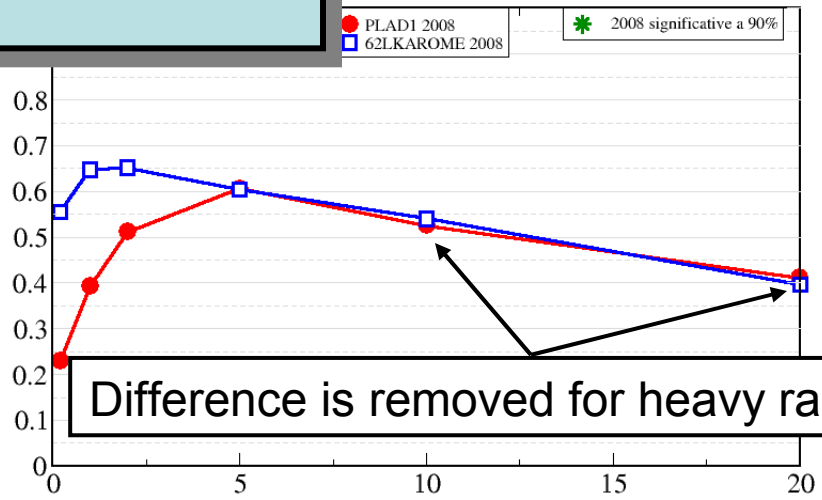
sholds (mm/day)

Known dra
ALADIN c
scheme

We recover the same improvement of the scores for heavy rains and cold SSI due to the removal of the double penalty

ill score (NO)
orhood 76 Km

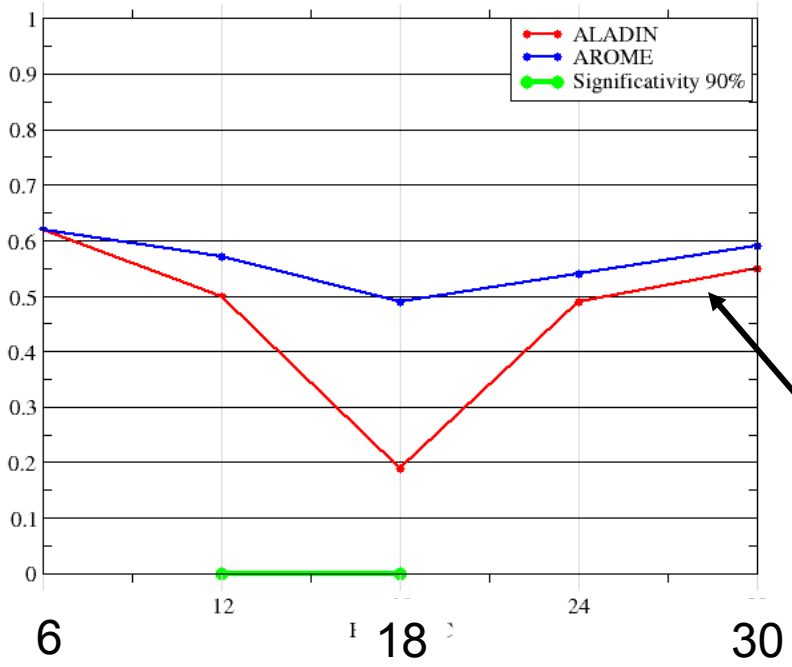




Difference is removed for heavy rains

Daily evolution of SSI

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



Difficulties to forecast convective clouds

During the night convective clouds are likely replaced by large scale cloudy phenomena

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

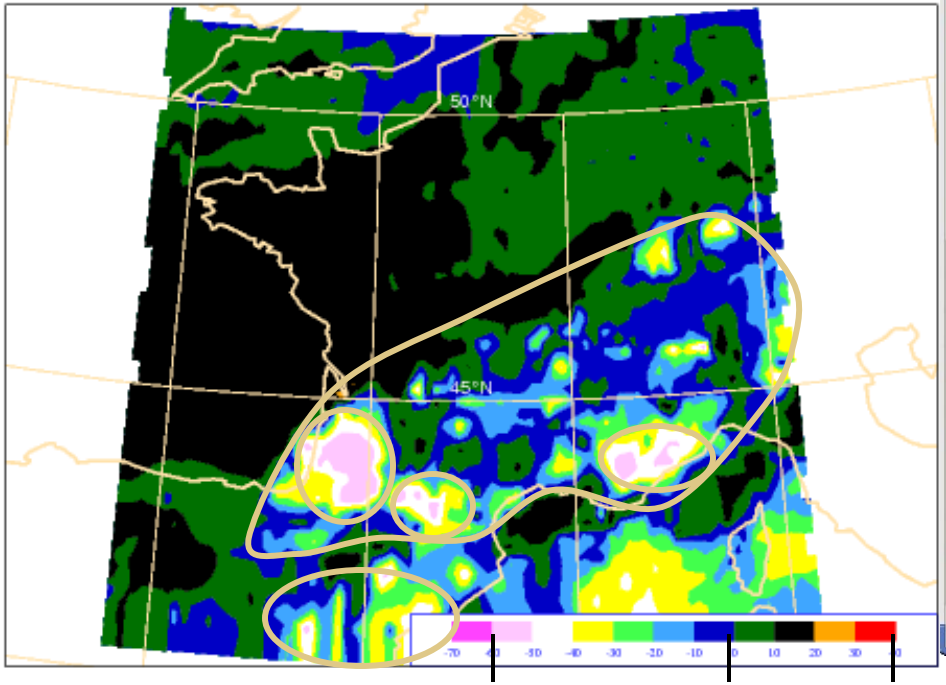
- Define a temporal tolerance (Theis *etal* 2005) to reduce the double penalty for temporal misplacement
- Perform the QPF verification for 6 hours accumulated precipitation.
- Compare both information provided by these new verifications for SSI and QPF
- Operational use of both verifications

The End

11 JUNE 2008 18 UTC

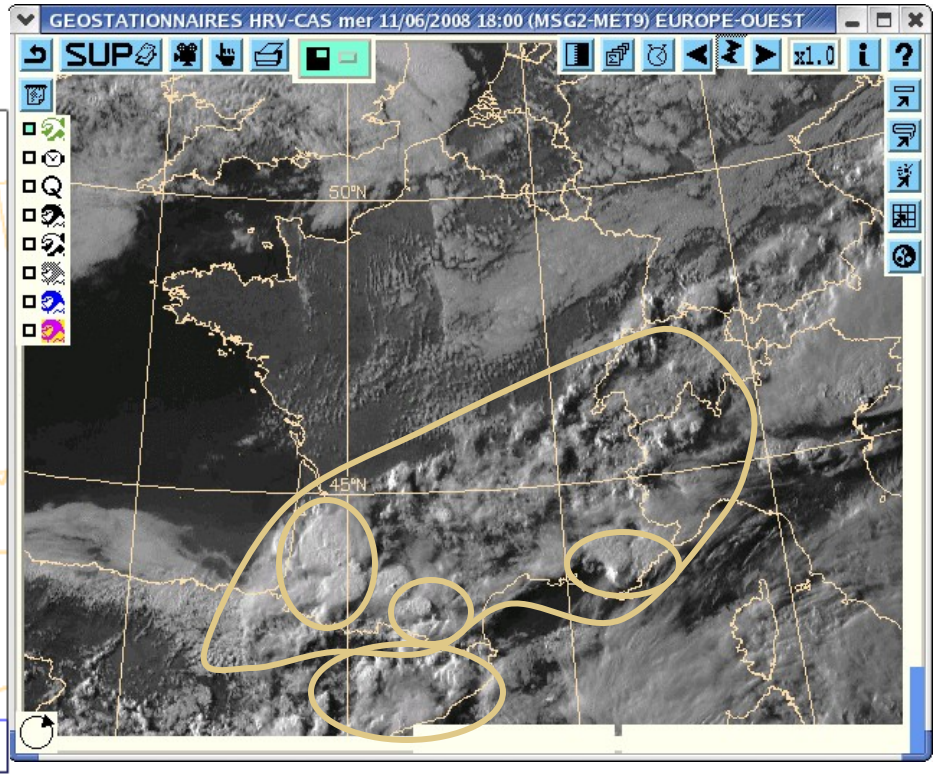
SEVIRI

10.8 micrometers



213 K 273 K 313 K

High-resolution visible image



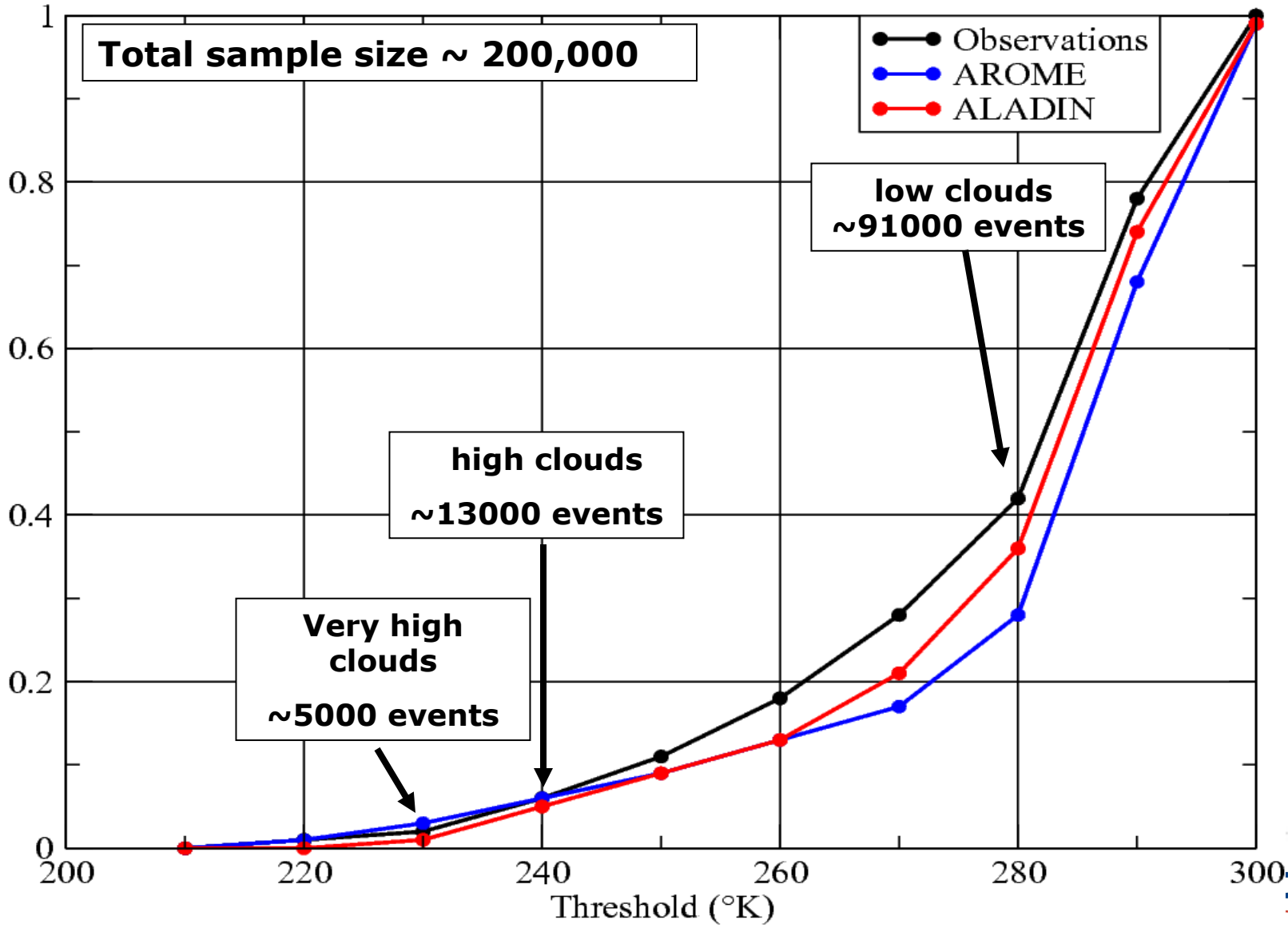
Different kind of clouds could be separated

SUMMER

Frequency of observed and forecasted events

2 June – 10 September 2008

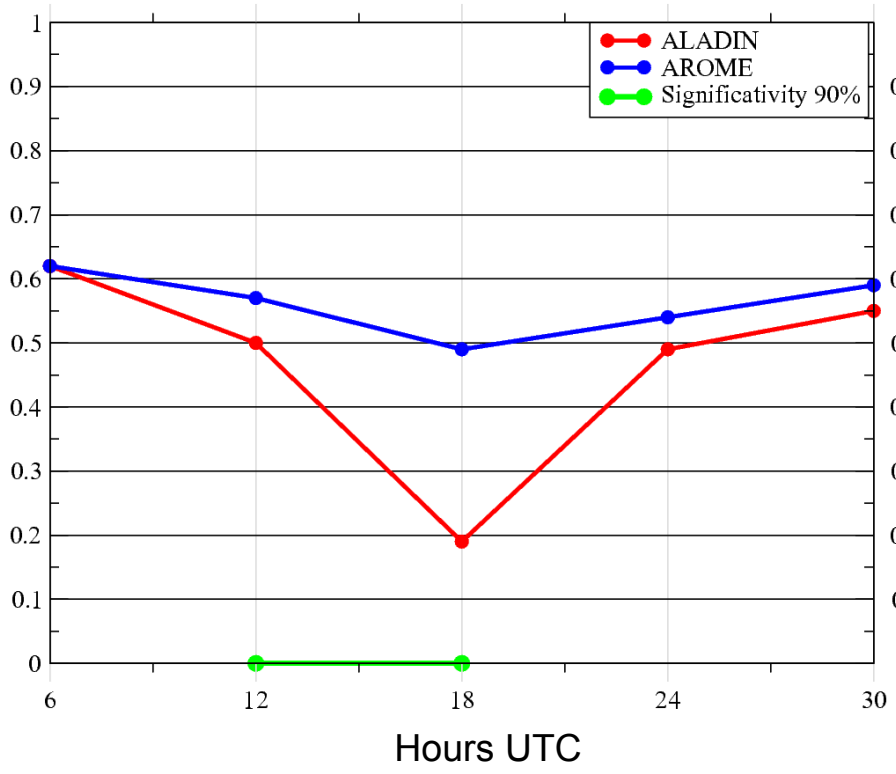
18 UTC



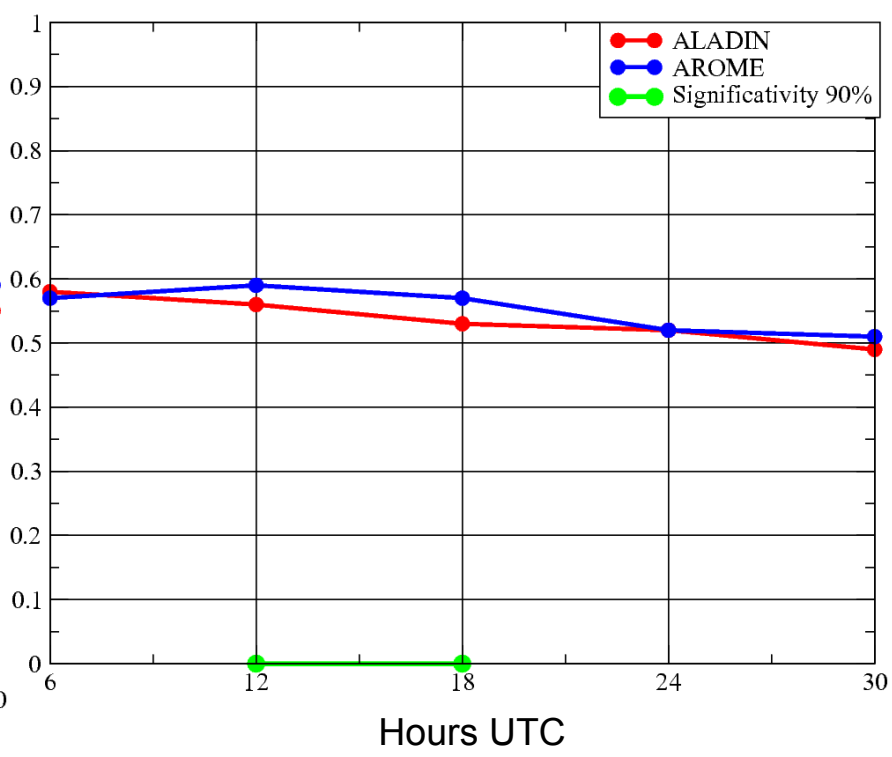
BSS SSI

every 6 hours for high clouds 240°K Neighborhood 76 Km

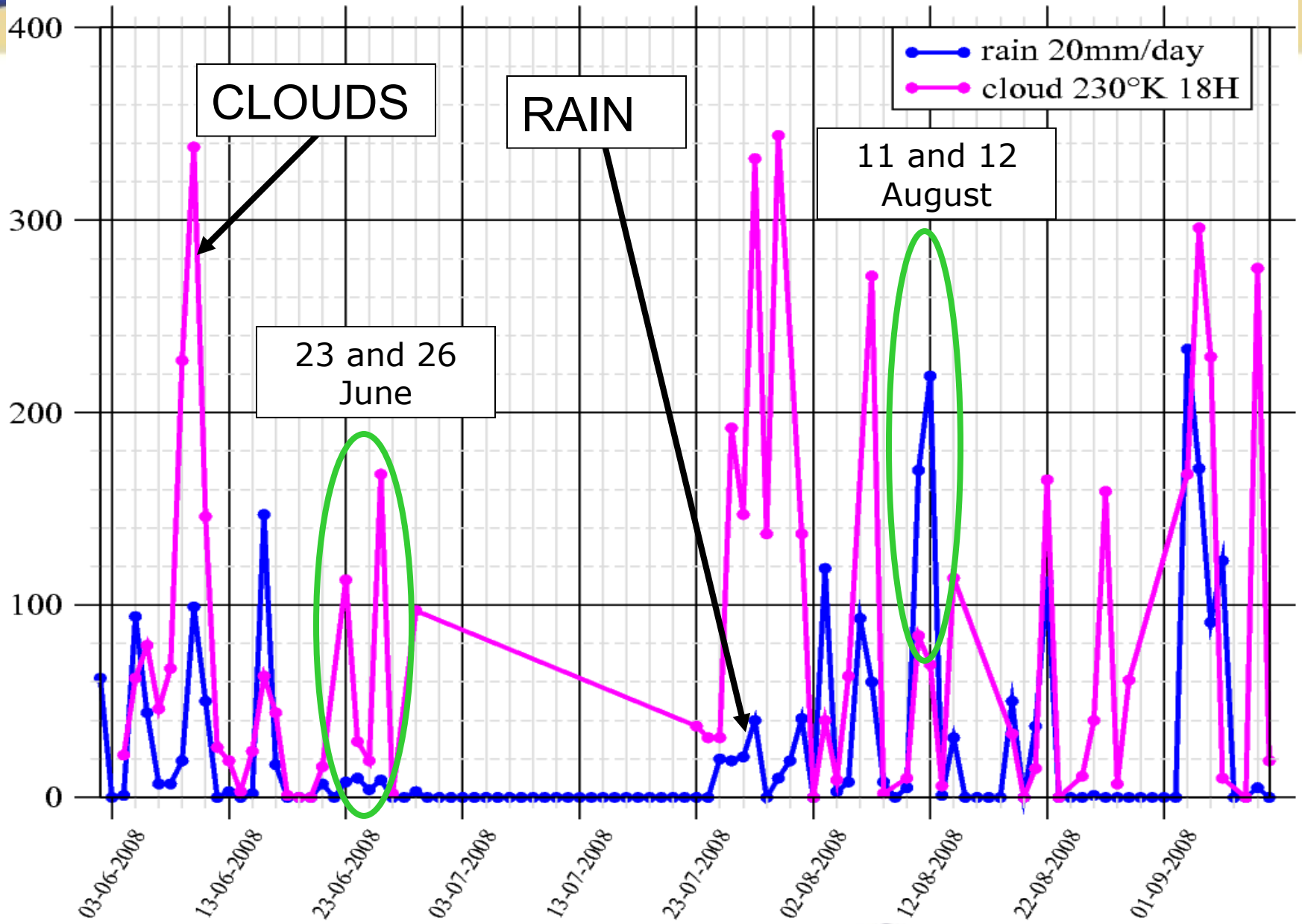
SUMMER 2008



AUTUMN 2008

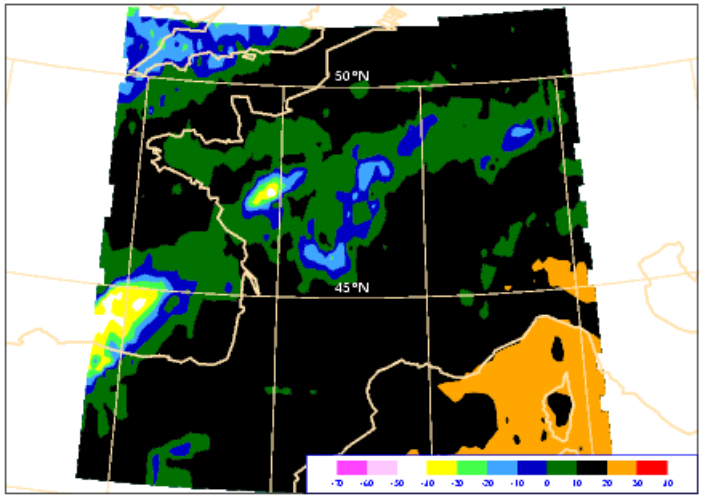


Number of observed events

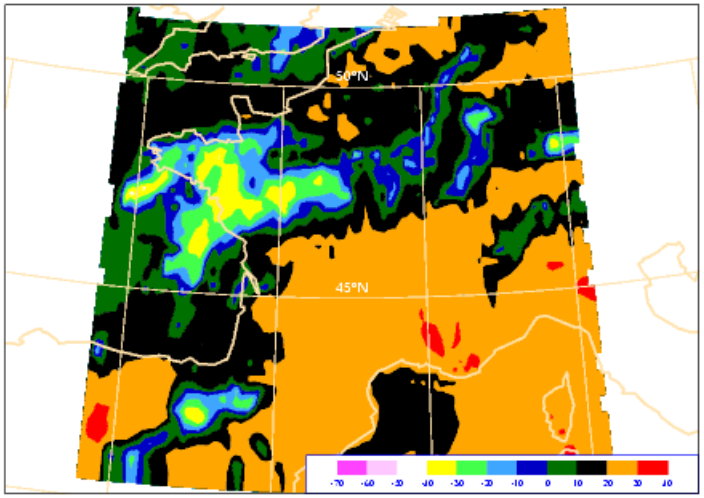


23 JUNE 2008 SEVIRI

6 UTC



12 UTC



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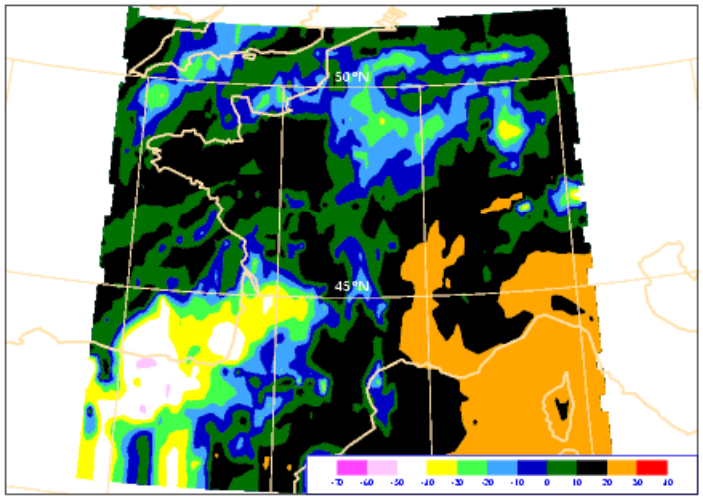
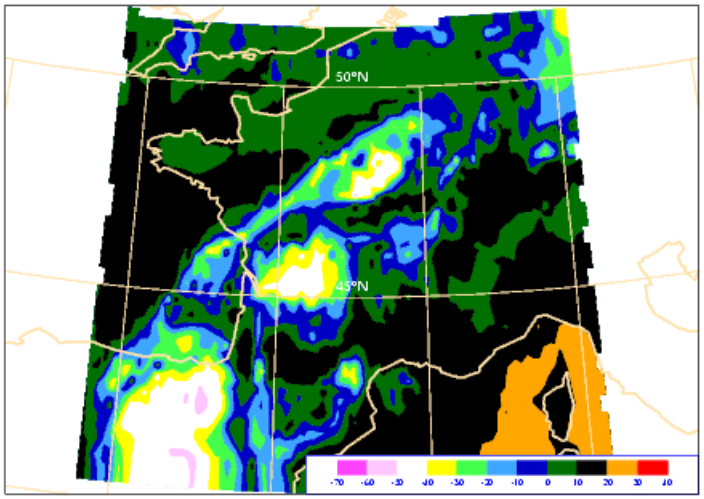
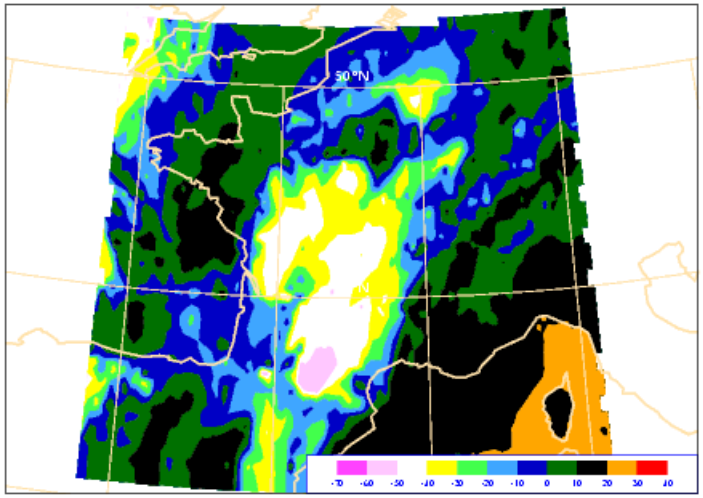


24 UTC

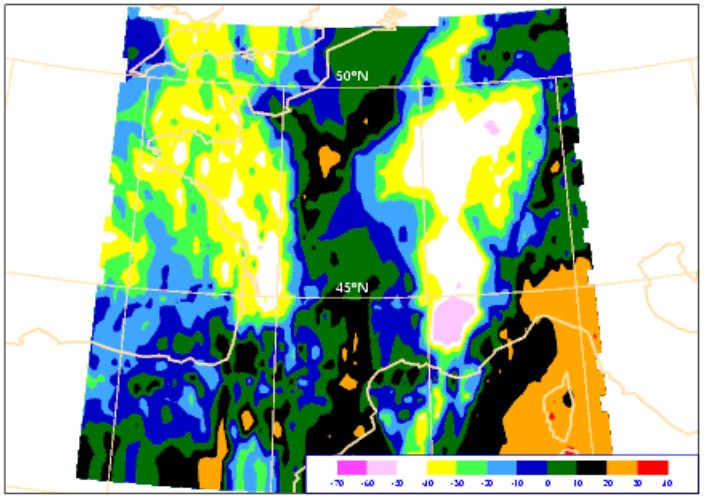


11 AUGUST 2008
SEVIRI

6 UTC



12 UTC



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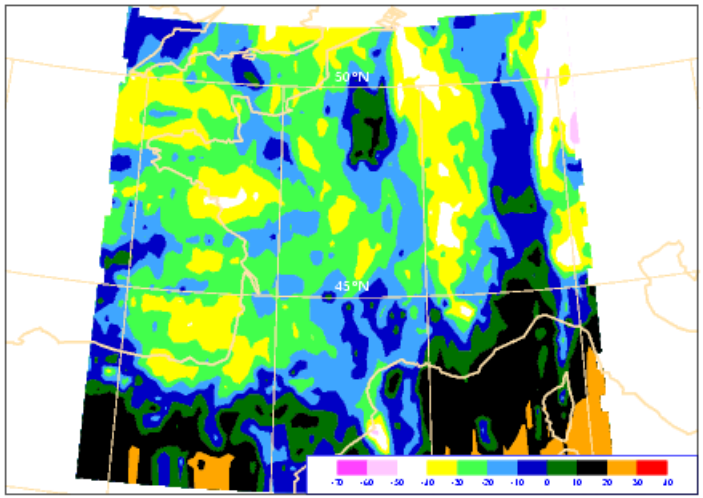

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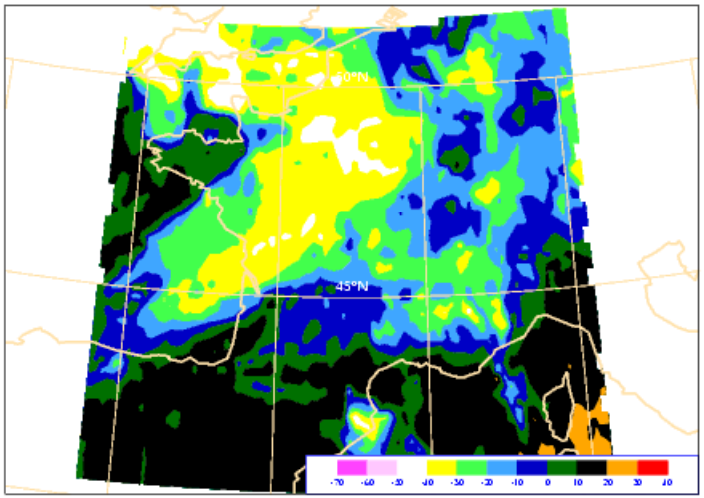
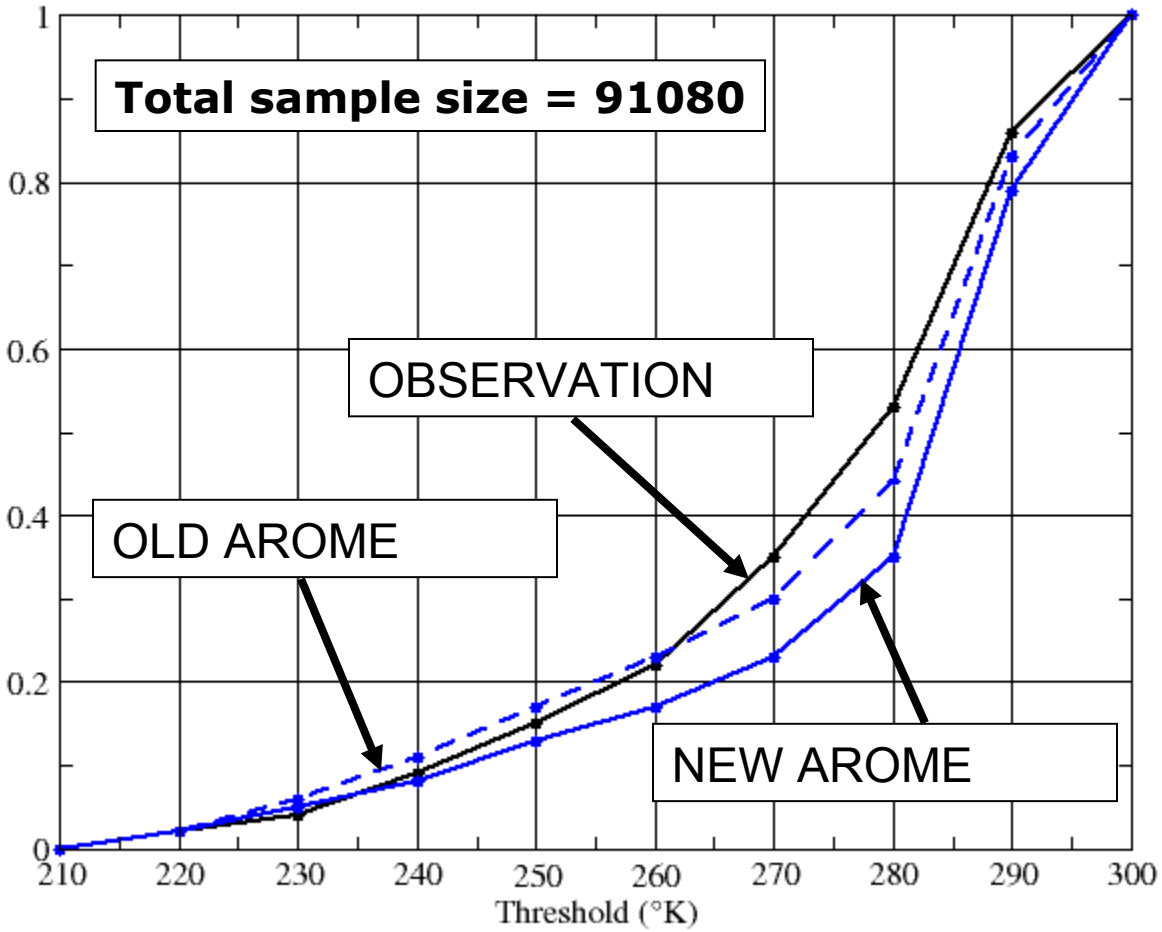


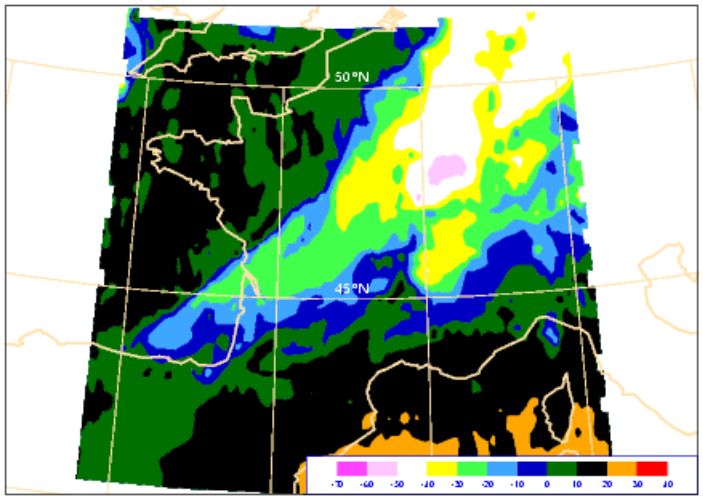
JUNE 2007 18 UHT

Base rate



12 AUGUST 2008
SEVIRI

6 UTC



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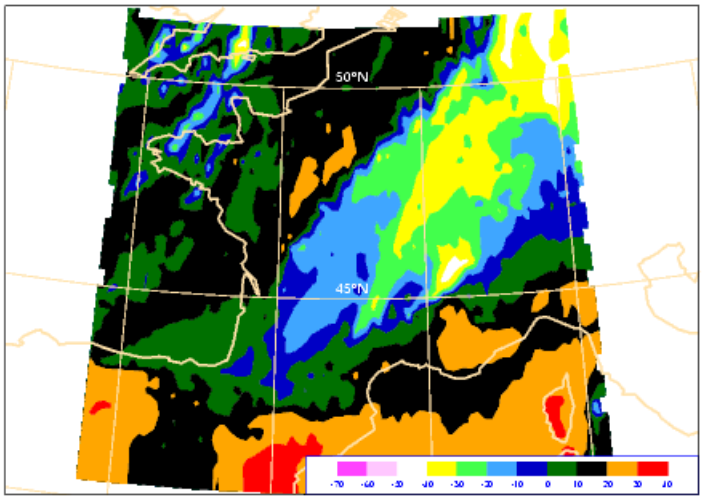
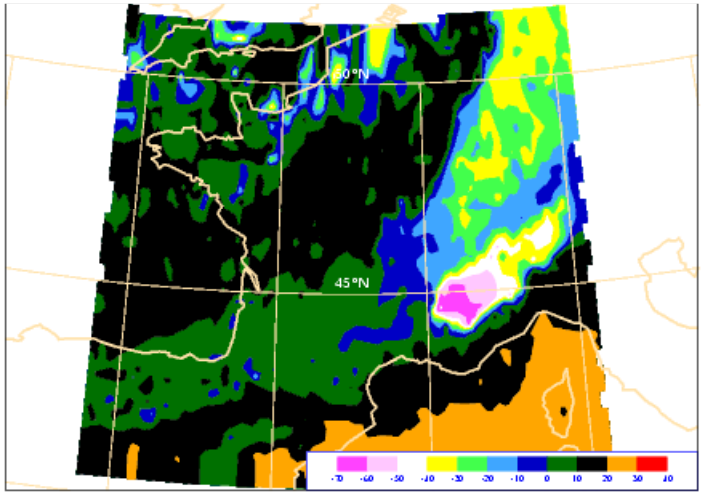
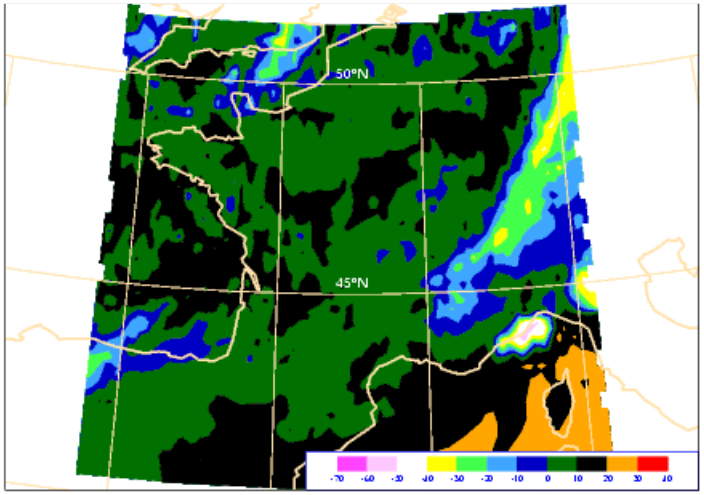


18 UTC

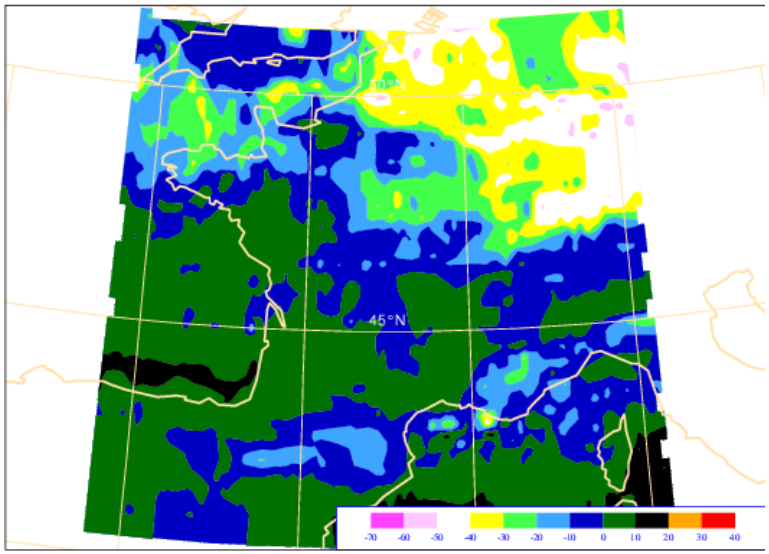


24 UTC

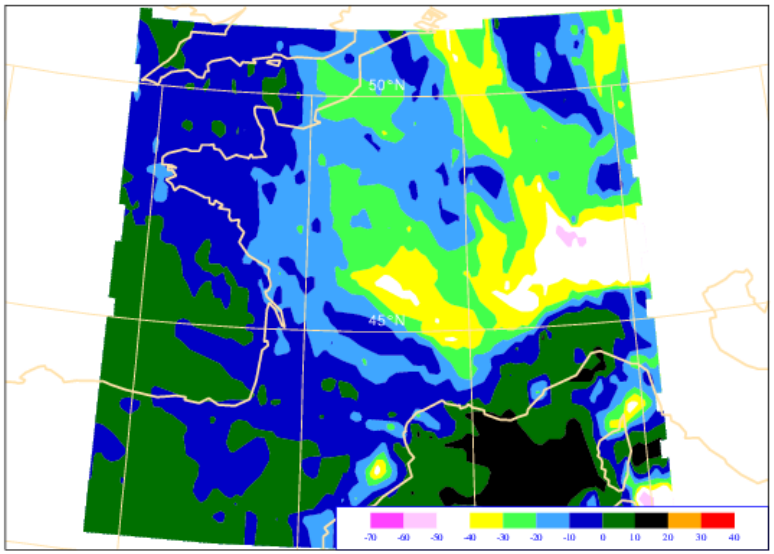


AUTUMN 2008 **SSI ALADIN** 10.8 micrometers

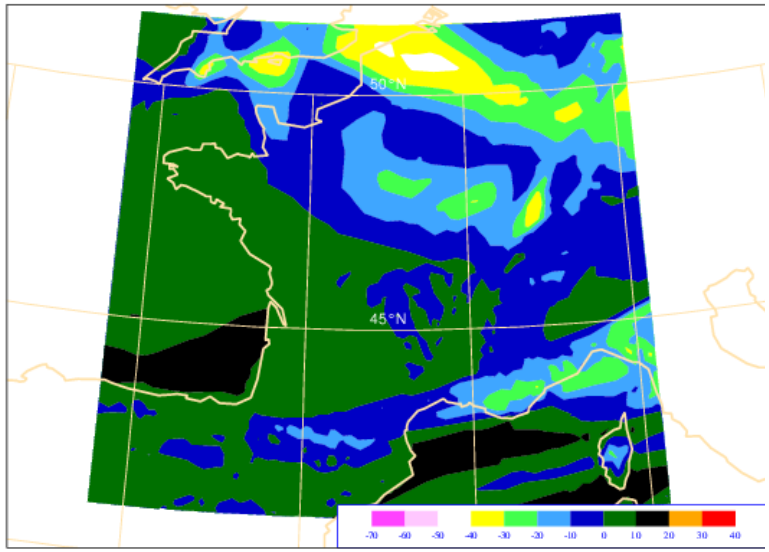
20 november 2008 18 UTC

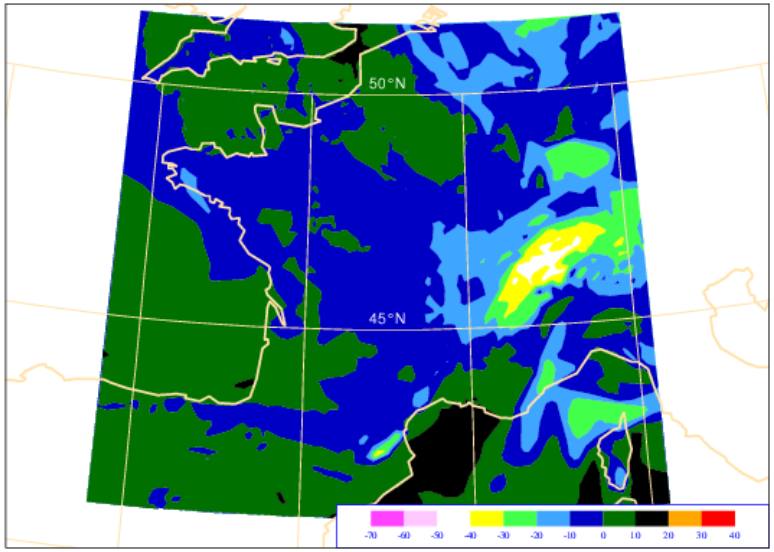


21 November 2008 18 UTC



Observation

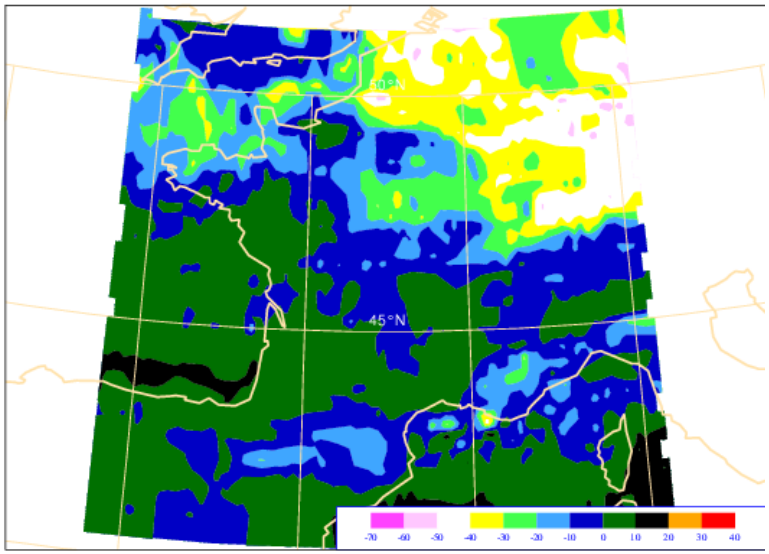




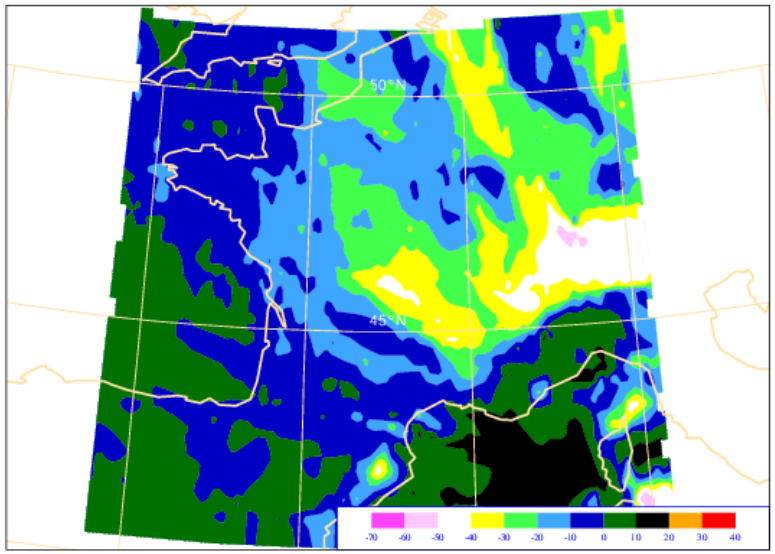
ALADIN

AUTUMN **SSI AROME** 10.8 micrometers

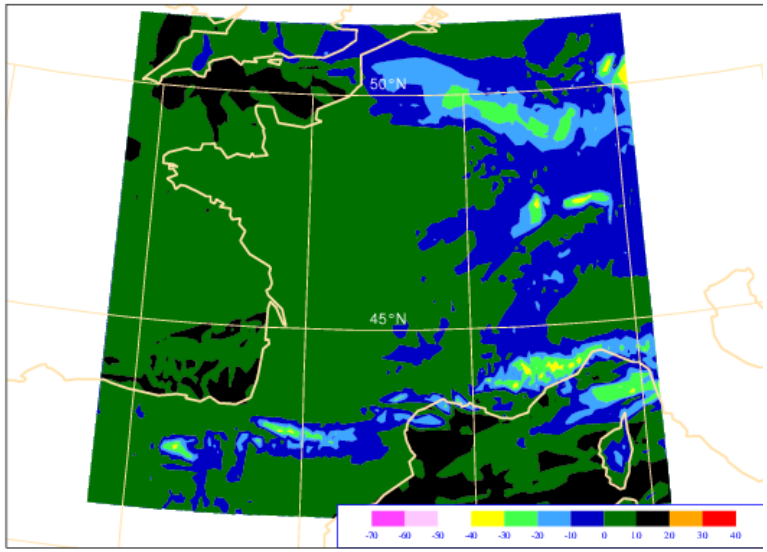
20 november 2008 18 UTC

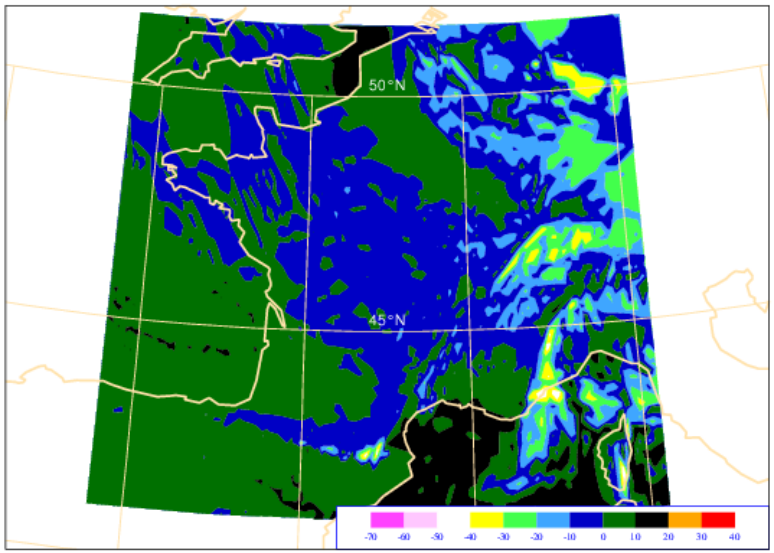


21 November 2008 18 UTC



Observation



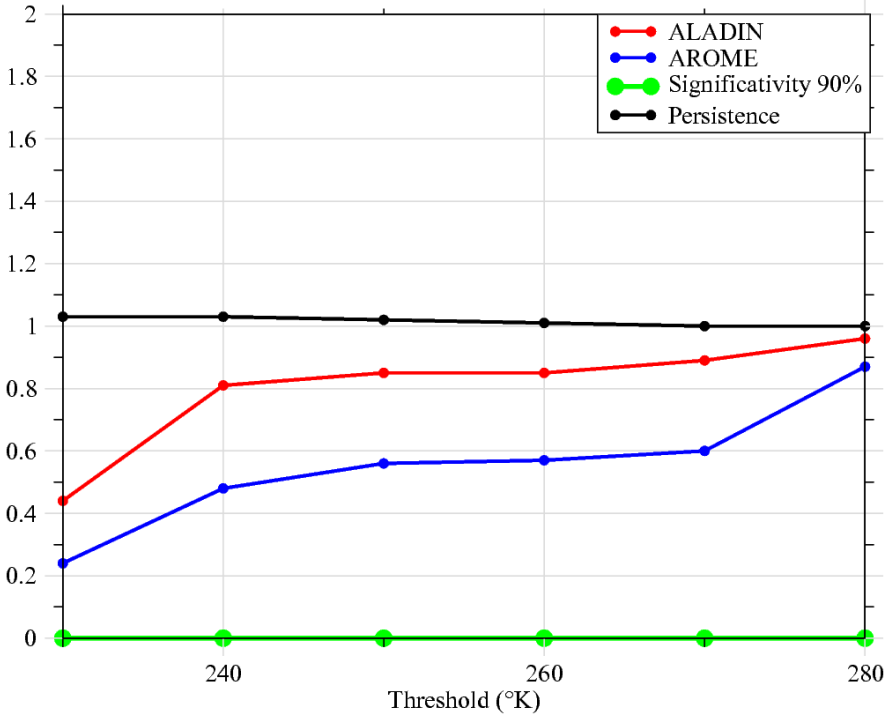


AROME

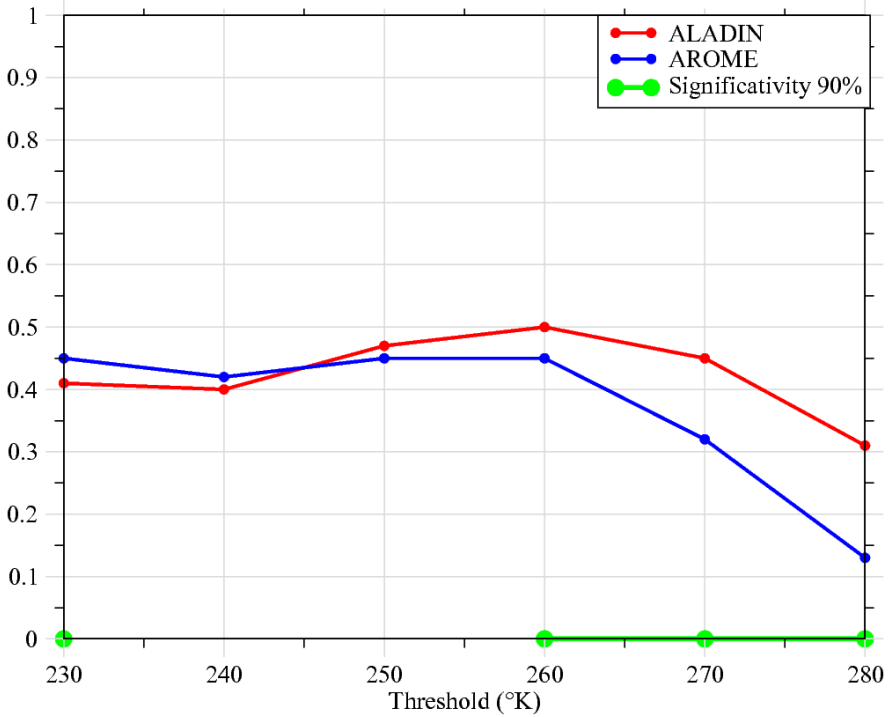
AUTUMN 18 UTC

2008

BIAIS



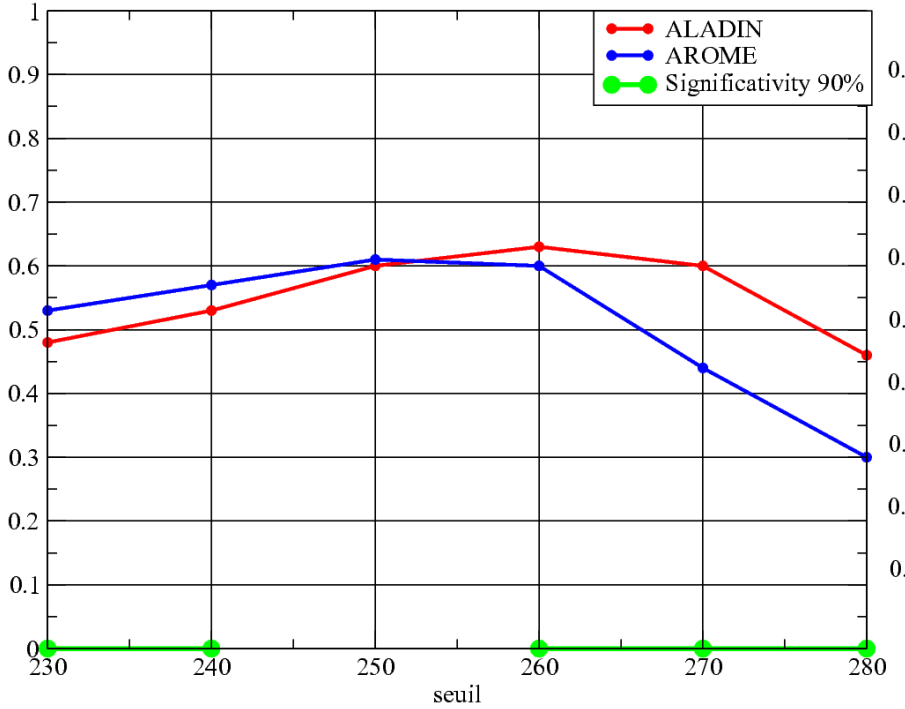
Heidke skill score



AUTUMN 18 UTC

2008

BSS 76 km



Heidke skill score