

DATA FUSION

NOWCASTING AND NWP

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WSN12 Rio, August 2012



METEO FRANCE
Toujours un temps d'avance

Outline

- Quick look at existing nowcasting system
 - CONO objects
 - SIGOONS system
 - And an example of data fusion

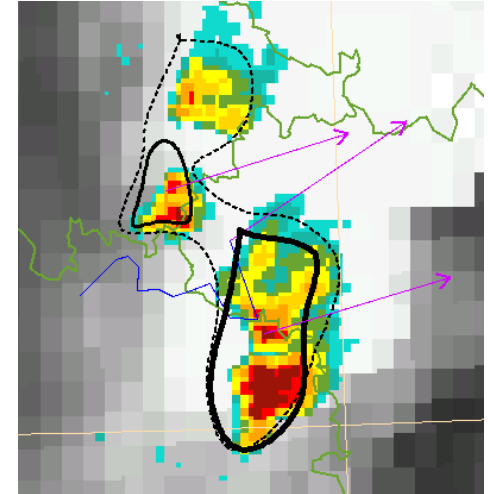
- Data fusion in progress with AROME-NWC
 - Overview of AROME-NWC
 - First results with simulated convective objects

- Outlook
 - **Focus on nowcasting of convection**



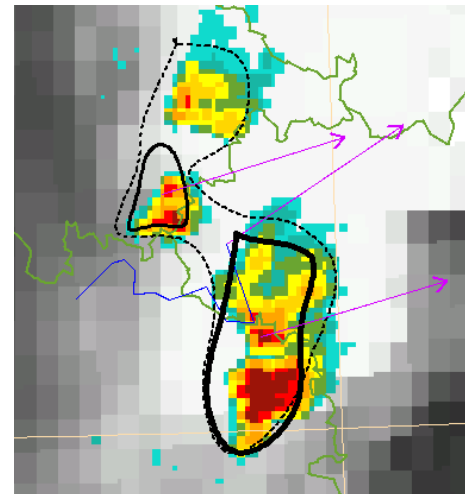
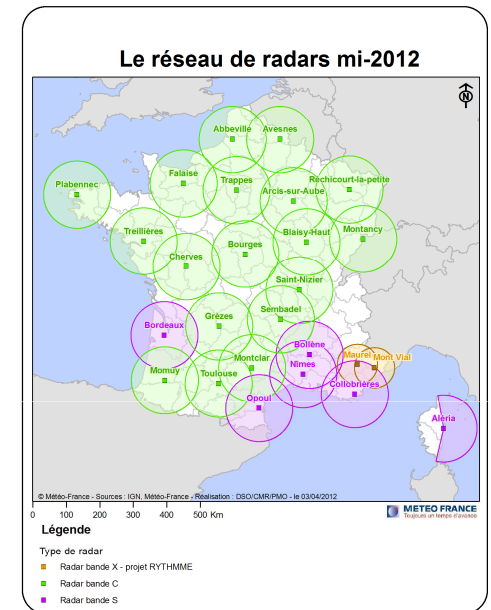
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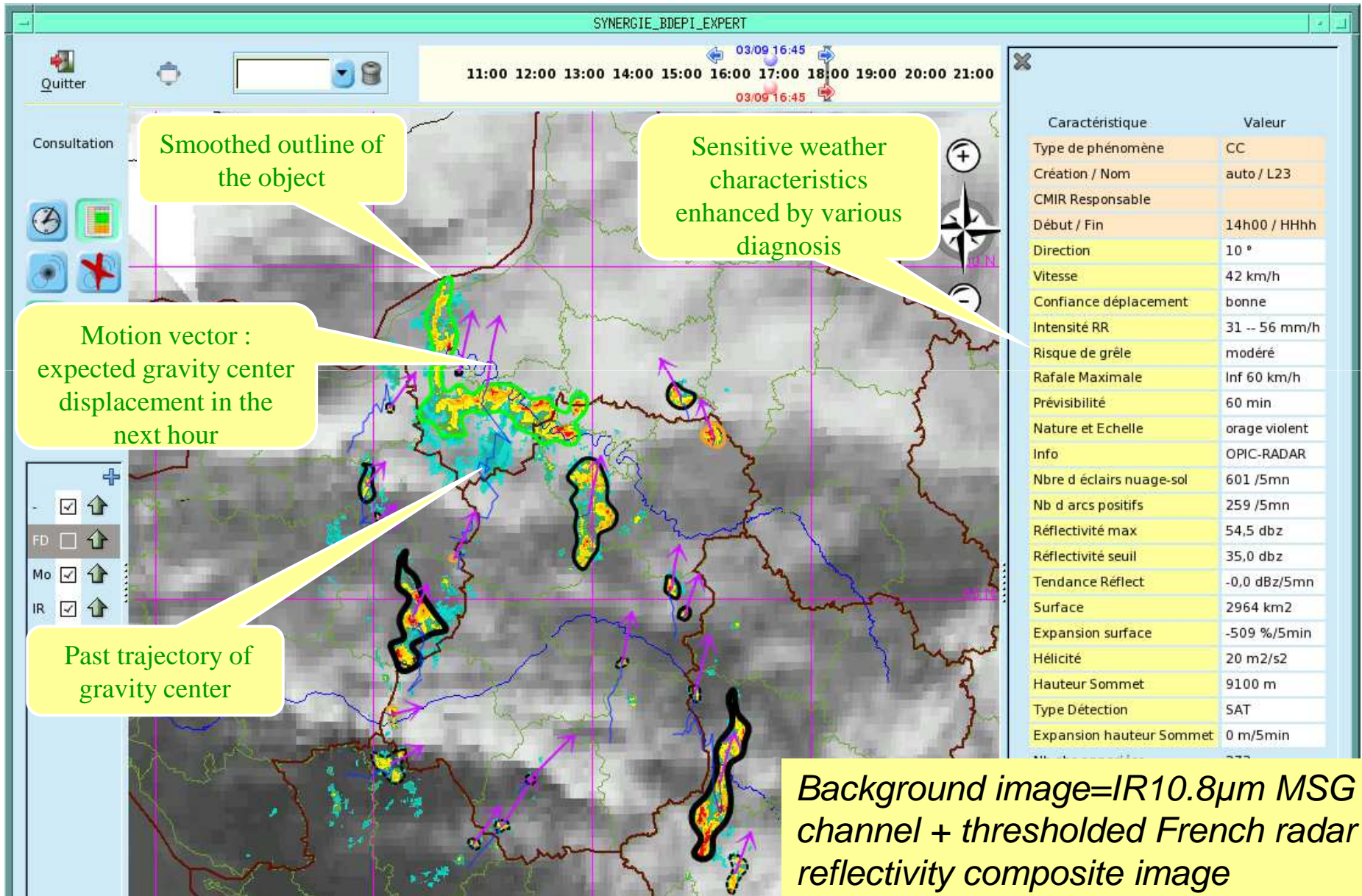
NOWCASTING of CONVECTION: CONO

- CONO Objects : COnvective Nowcasting Object
- Based on radar data:
 - The French radar **composite** image is processed with 26 conventional radars. The radar products have the following characteristics
 - 1km spatial resolution
 - 5 mn time resolution
 - 1dBZ reflectivity resolution
 - Lightning data from Meteorage network
- Cell detection and tracking in radar reflectivity in order to identify convective severity areas below cloud anvils.
 - 2 thresholds: 35 and 41 dBZ,
 - Object approach
- Operational since the Summer of 2005



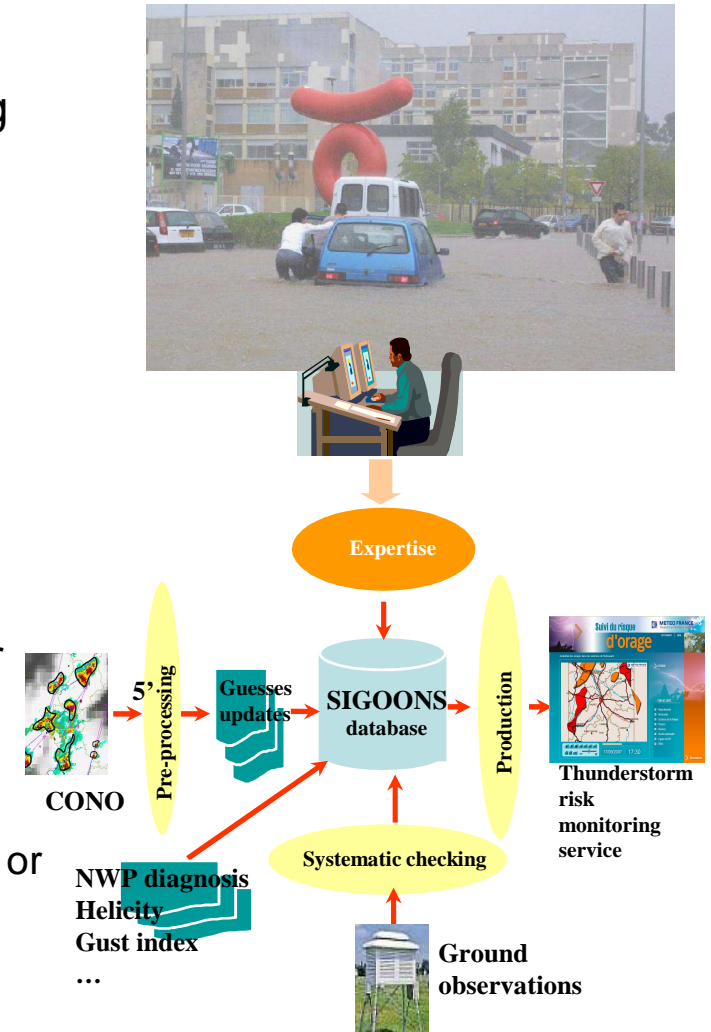
Visualization of CONO objects

with SYNERGIE (MF forecasters' workstation)



NOWCASTING of CONVECTION: SIGOONS

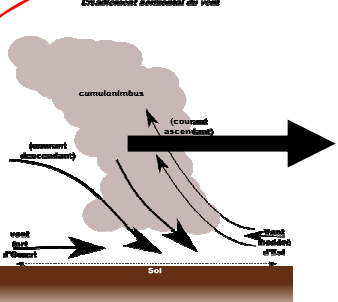
- SIGOONS : Significant Weather Object Oriented Nowcasting System
 - Focus on convection
- CONO are injected into the object management system SIGOONS
 - With other diagnosis : data fusion approach
 - Possibility to include forecaster's expertise
 - **CONO + data fusion = SIGOONS**
- SIGOONS advantages:
 - to make forecasters' analysis of meteorological situations easier
 - to merge different kinds of information
- SIGOONS challenges:
 - to **take into account** measurements at various time resolutions or geographical scales and to merge them
- Operational since the Summer of 2008



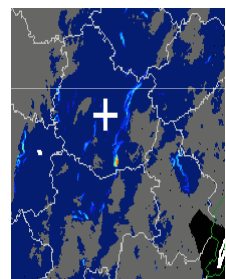
Combined diagnosis for thunderstorm gust risk estimation

Overview

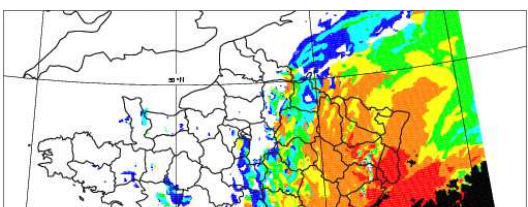
Criteria 2 : empirical rule gathering



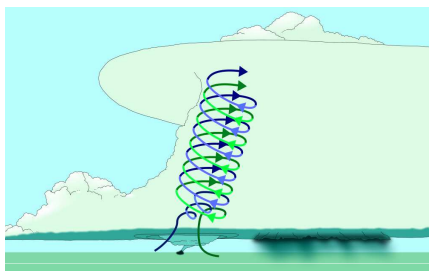
Cell Motion vector



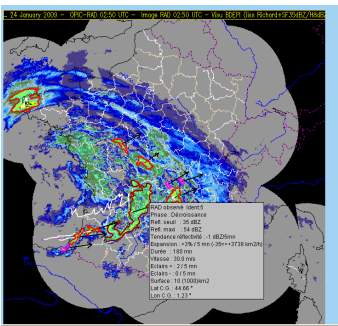
Wind Shear



Estimation of energetic potential of density currents



Relative helicity



High reflectivity

Criteria 1: gust observation below CONO
risk maintained at least one hour

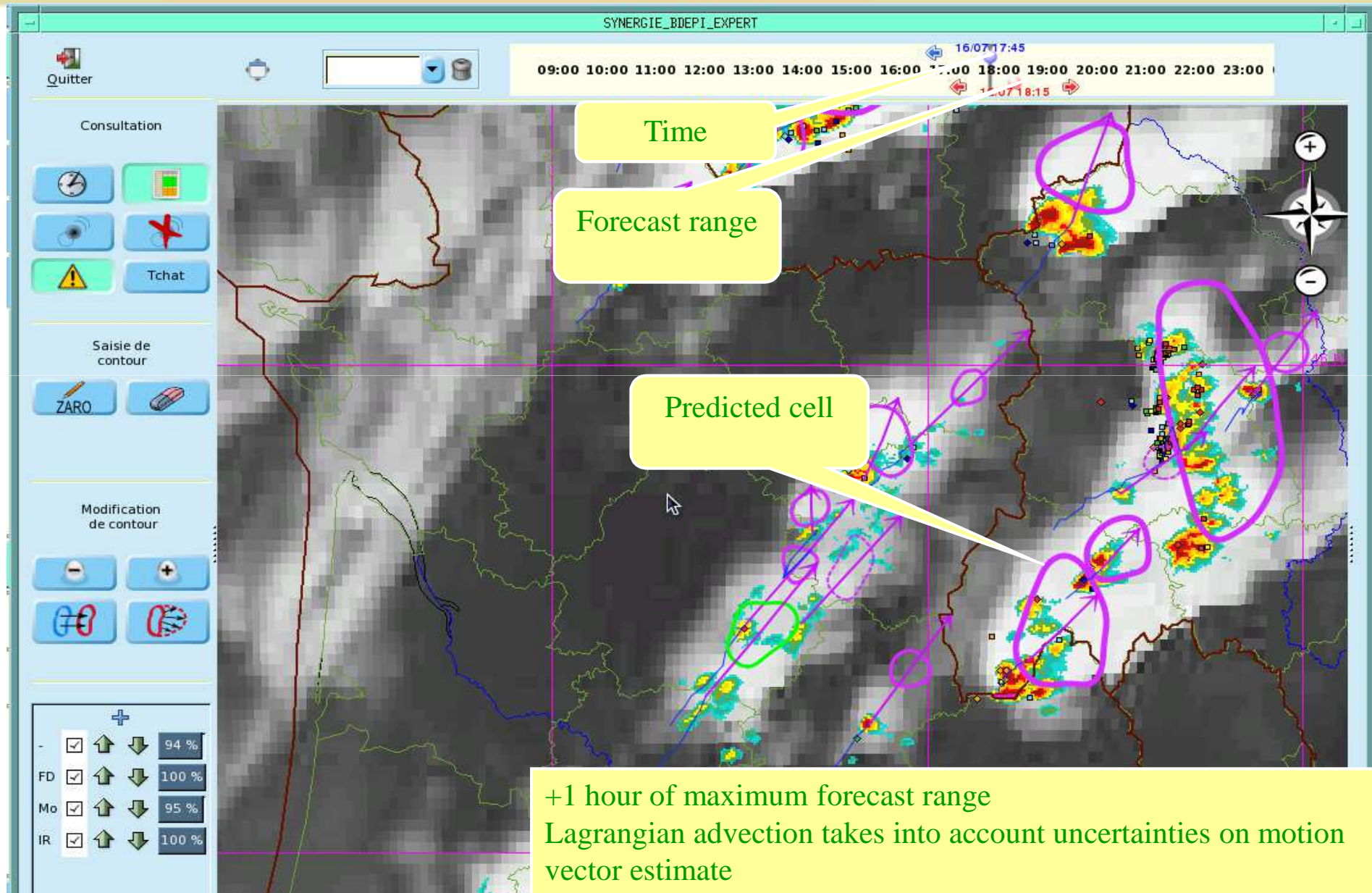


Observations



Thunderstorm gust estimation = maximum of {criteria1, criteria2}

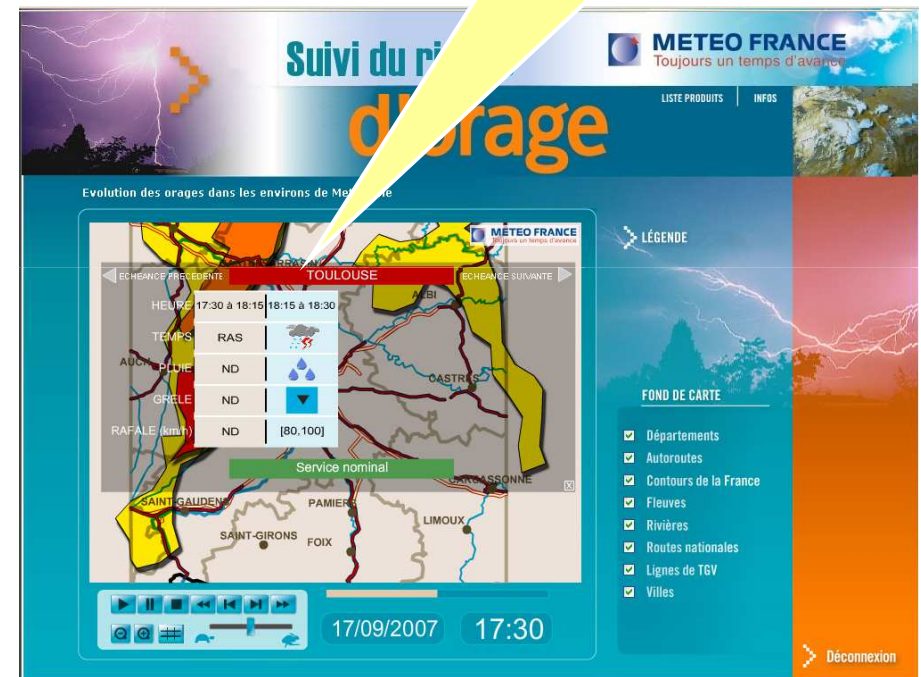
Thunderstorm nowcast: Lagrangian advection



Thunderstorm warnings for end users

- Warning at a given place, up to one hour before the phenomena
 - End users: place, thunderstorm severity level,
 - Warning: beginning, monitoring, end.
 - Email or SMS distribution
 - Web access with graphics
- Commercialisation since 2008

Weather conditions for a warning on Toulouse



Discussion

- Efficient product in case of well-established flow with low impact of orography.

- One hour of maximum forecast range => numerous warning refreshes



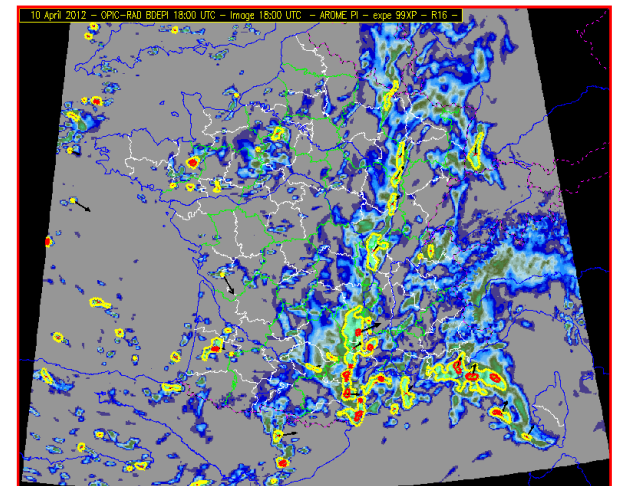
- Limitation linked to lagrangian advection :

- Constant intensity, no change of direction
- Few non detections but some difficulties to anticipate rapid cell development
- False alarm rate due to uncertainty of cell motion
- Stationary phenomena difficult to capture



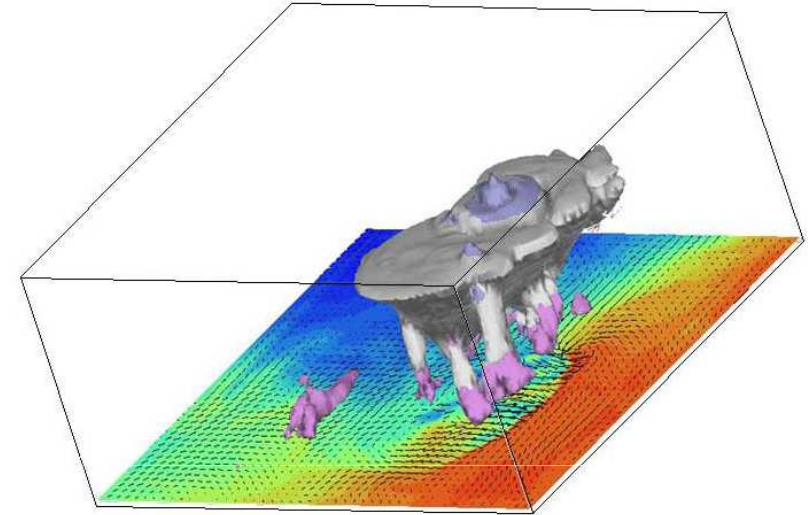
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New field of development: AROME – NWC

- New opportunities :
 - NWP compliant with mesoscale and resolved convection
 - Special work on spin-up, data assimilation, assimilation cycle
 - Increase of computer power
- A specific version of AROME for nowcasting
 - Under test phases
 - Operational 2014/2015
- AROME - NWC goals
 - Extend the maximum forecast range
 - Provide trends on phenomena
- Forecast of several parameters : wind, temperature, humidity, but also reflectivities, precipitation, kind of hydrometeors
 - hourly refreshed
 - available within 30 minutes after the latest observations
- Application to :
 - Public Weather Services
 - Hydrometeorological applications
 - Aeronautical domain like SESAR project
- See also L. Auger presentation in WSN12 conference

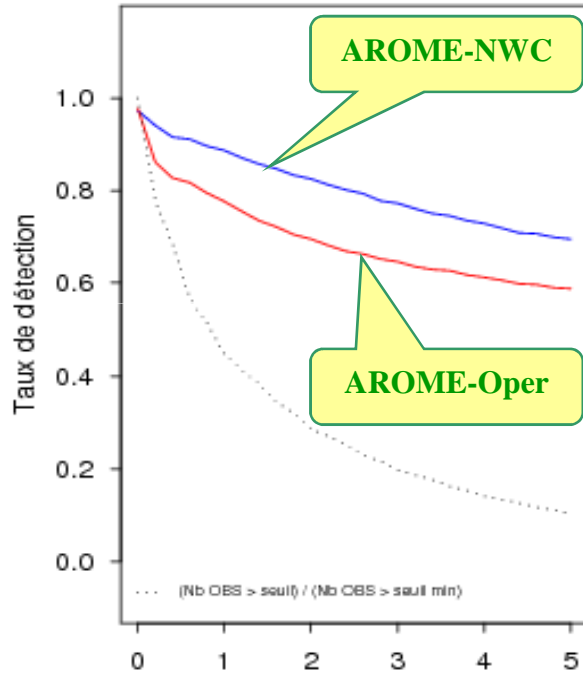


AROME-NWC vs AROME-Oper

asynchronous scores – QPF (HH+1h)

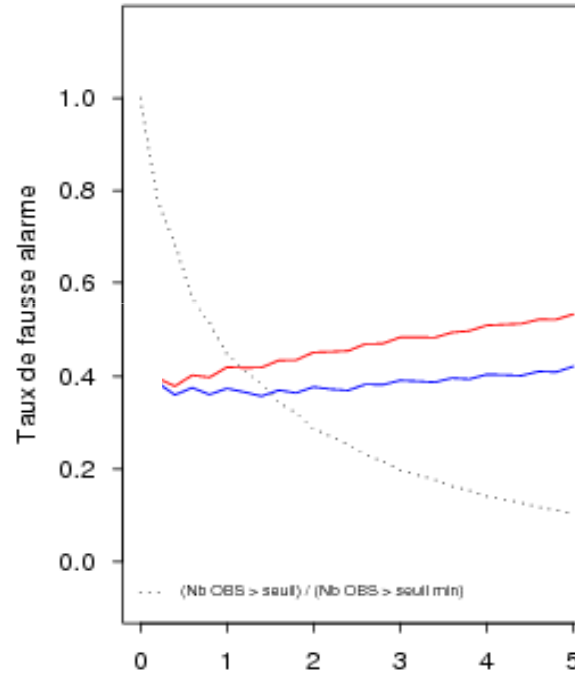
range : HH+1h

POD Cumul 1h Ech. +60



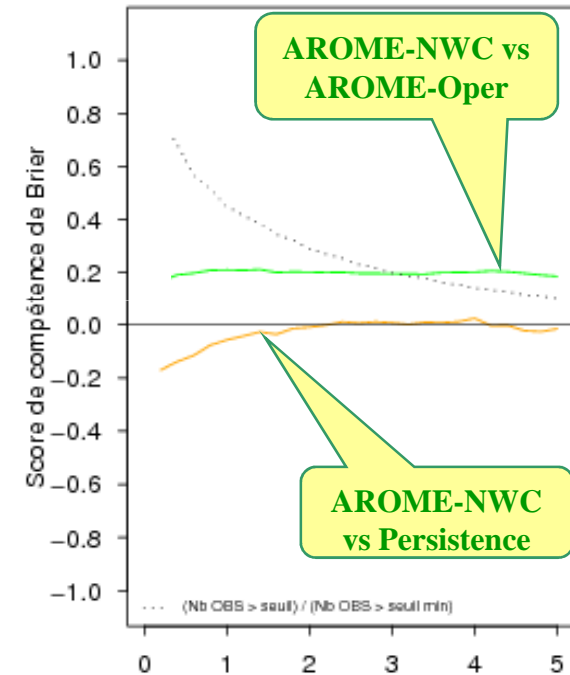
141 simulations du 20111101 au 20111106 sur FRANXL

FAR Cumul 1h Ech. +60



141 simulations du 20111101 au 20111106 sur FRANXL

BSS_NO Cumul 1h Ech. +60



141 simulations du 20111101 au 20111106 sur FRANXL

— AROME-NWC
— AROME-Oper

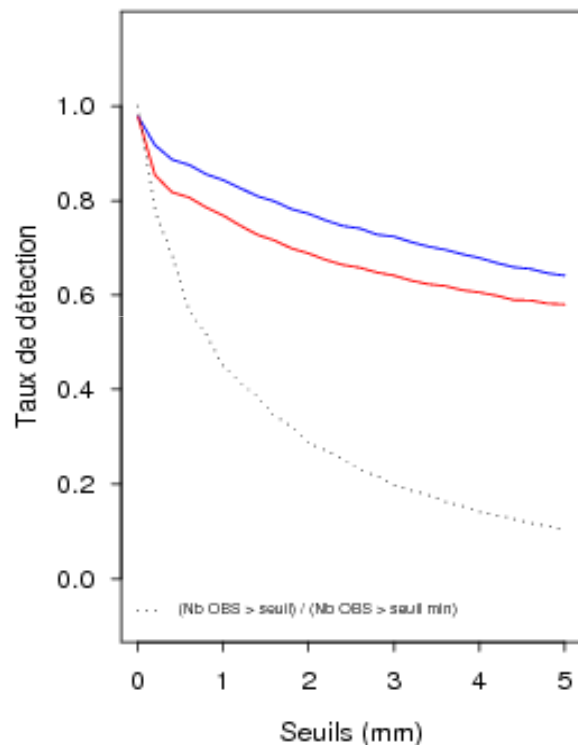
— BSS AROME-NWC vs Persistence
— BSS AROME-NWC vs AROME-Oper

AROME-NWC vs AROME-Oper

asynchronous scores – QPF (HH+2h)

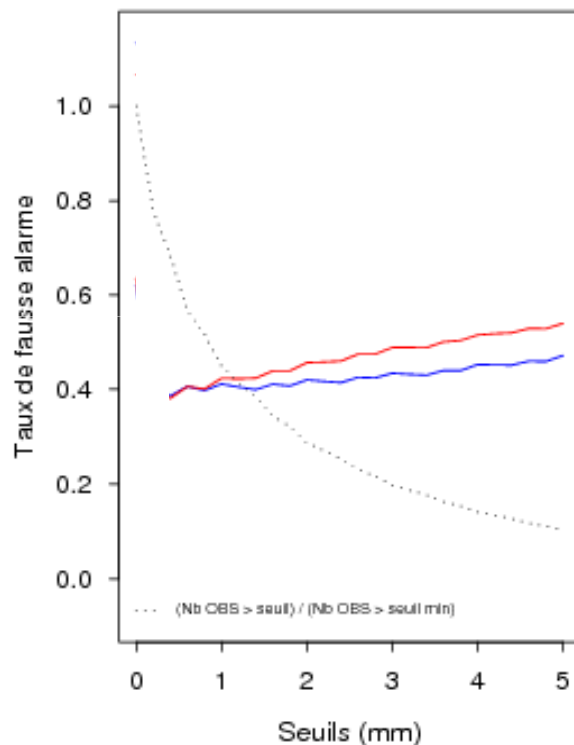
range : HH+2h

POD Cumul 1h Ech. +120



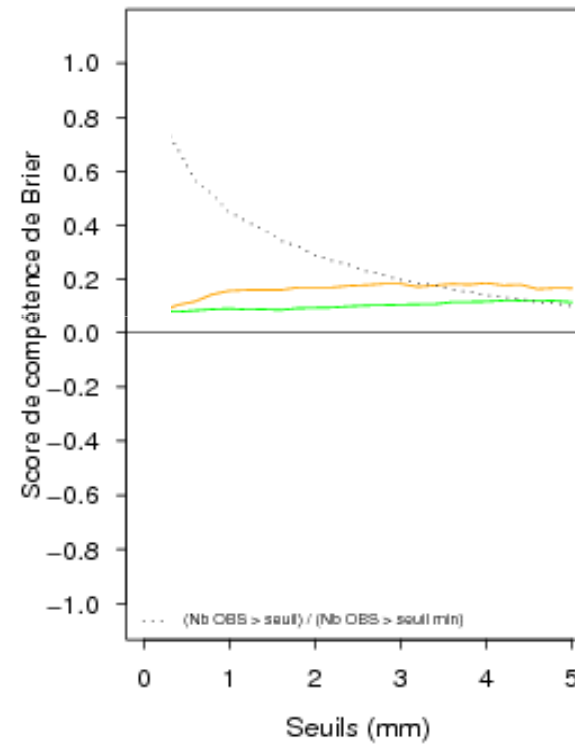
141 simulations du 20111101 au 20111106 sur FRANXL

FAR Cumul 1h Ech. +120



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BSS_NO Cumul 1h Ech. +120



141 simulations du 20111101 au 20111106 sur FRANXL

— AROME-NWC
— AROME-Oper

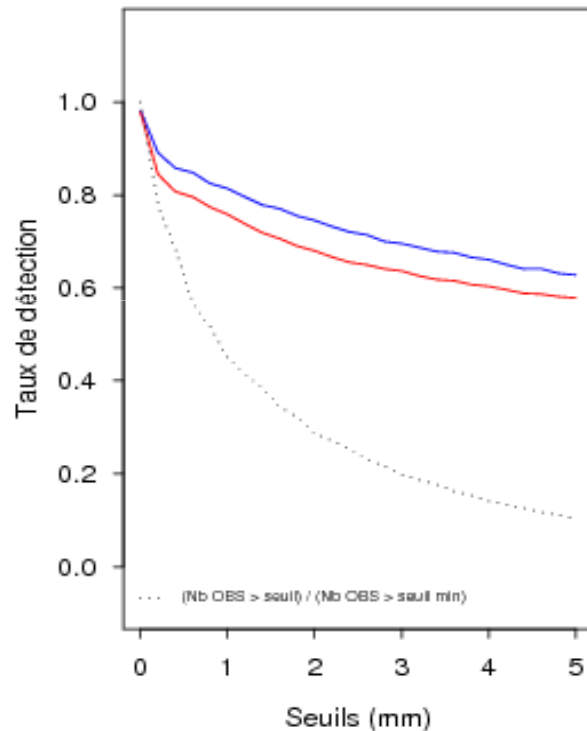
— BSS AROME-NWC vs Presistence
— BSS AROME-NWC vs AROME-Oper

AROME-NWC vs AROME-Oper

asynchronous scores – QPF (HH+3h)

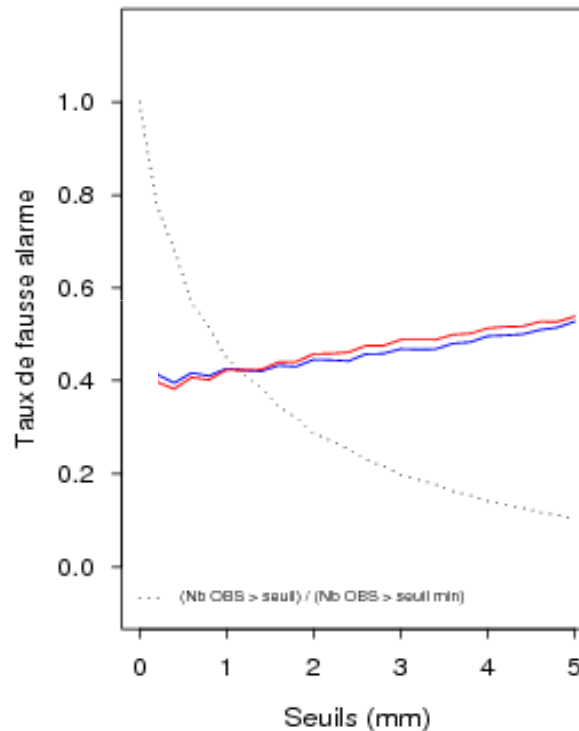
range : HH+3h

POD Cumul 1h Ech. +180



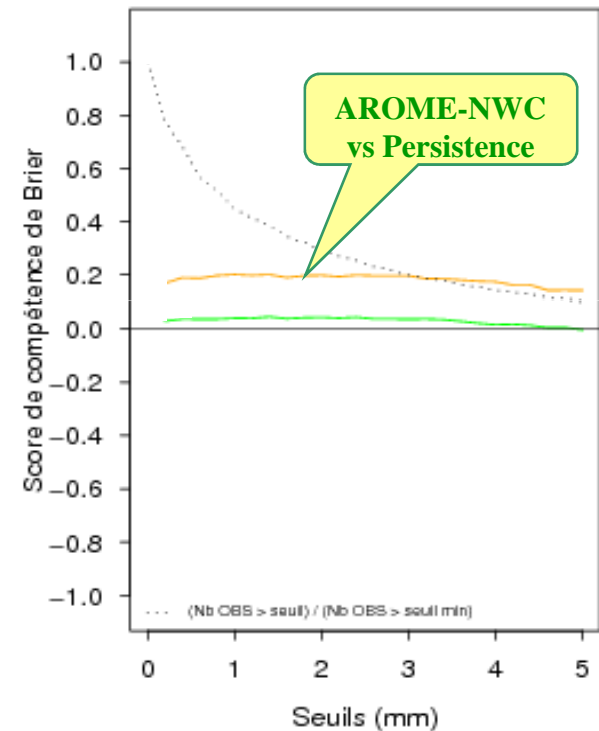
141 simulations du 20111101 au 20111106 sur FRANXL

FAR Cumul 1h Ech. +180



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BSS_NO Cumul 1h Ech. +180



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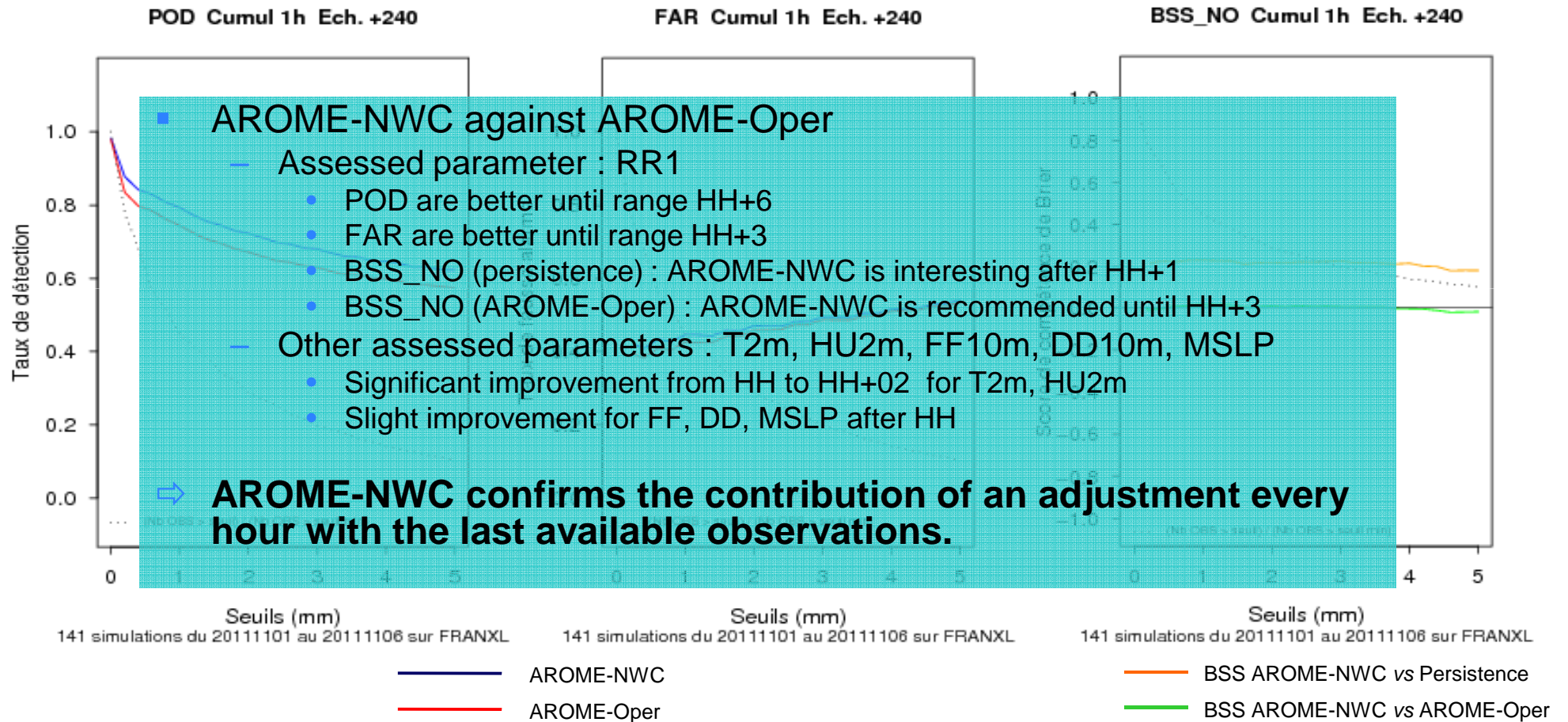
— AROME-NWC
— AROME-Oper

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AROME-NWC vs AROME-Oper

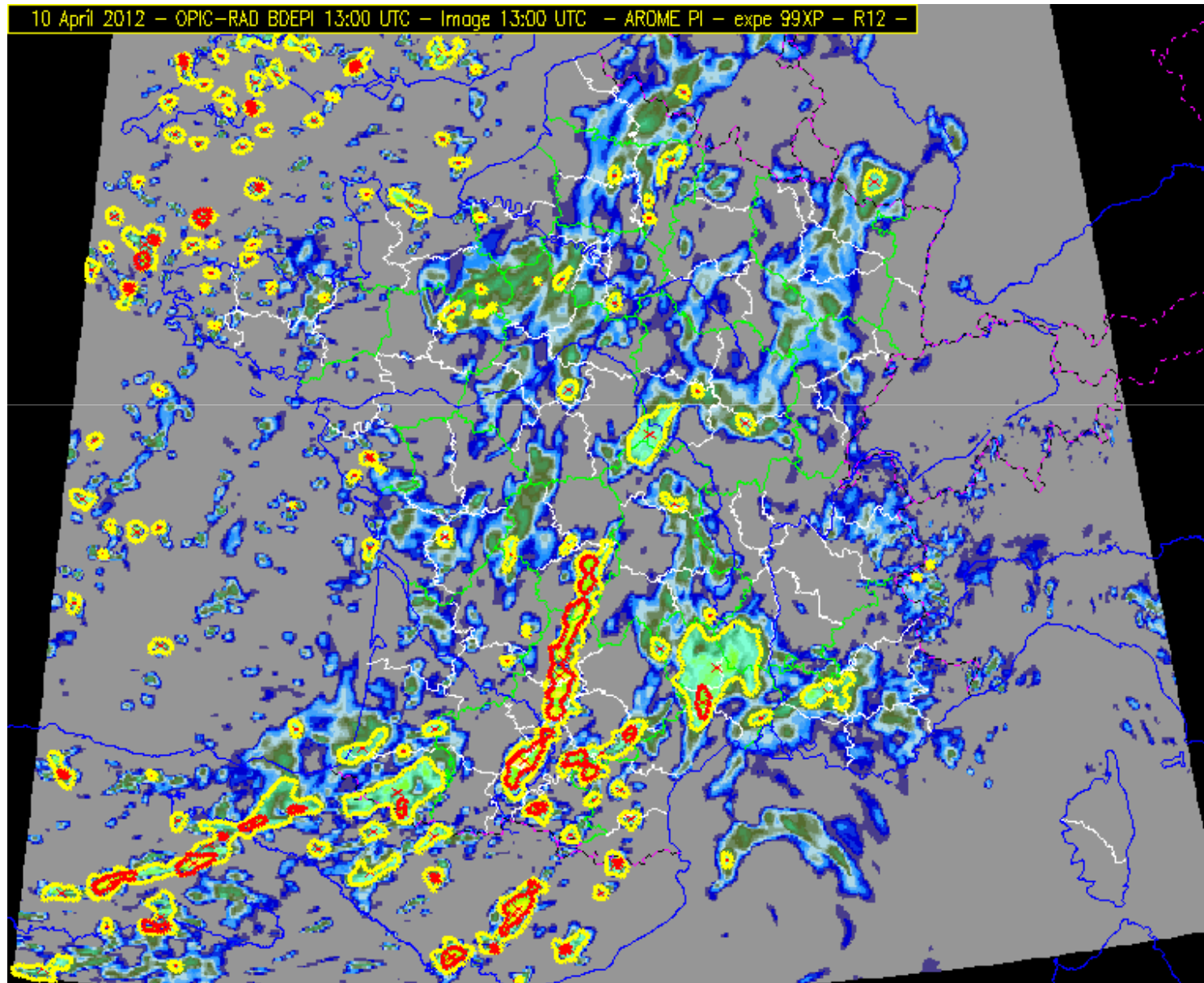
asynchronous scores – QPF (HH+4h)

range : HH+4h



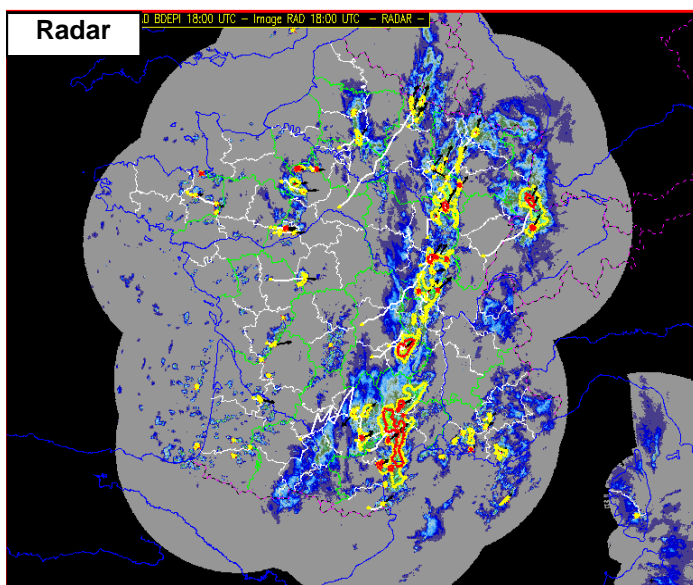
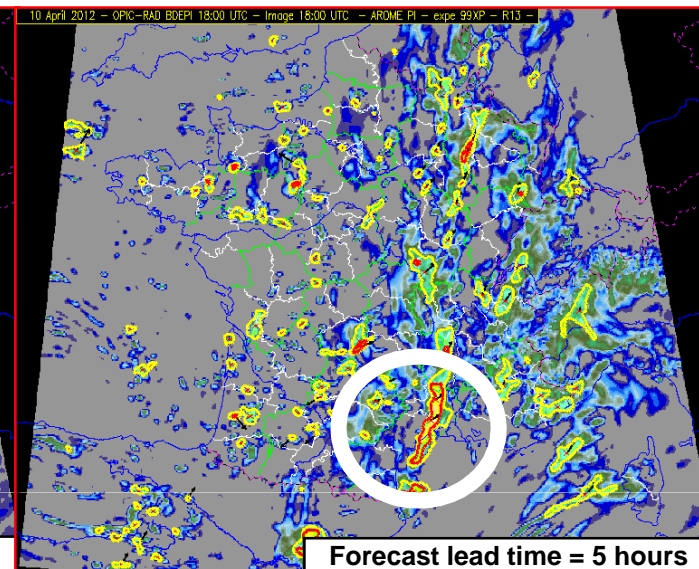
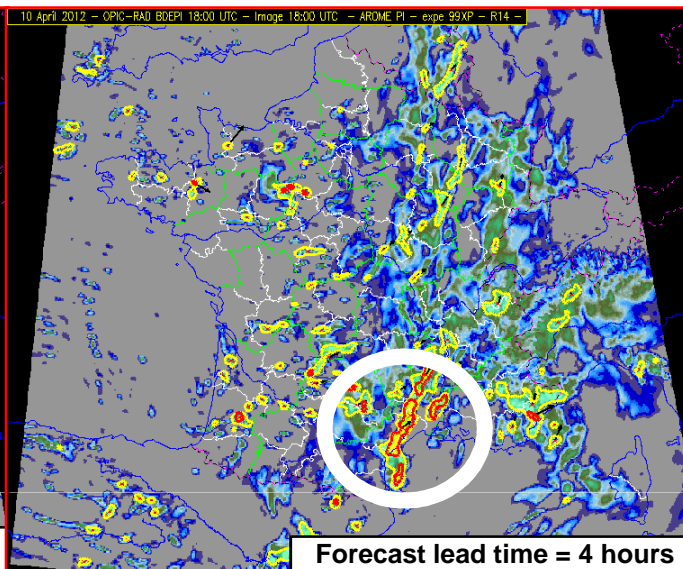
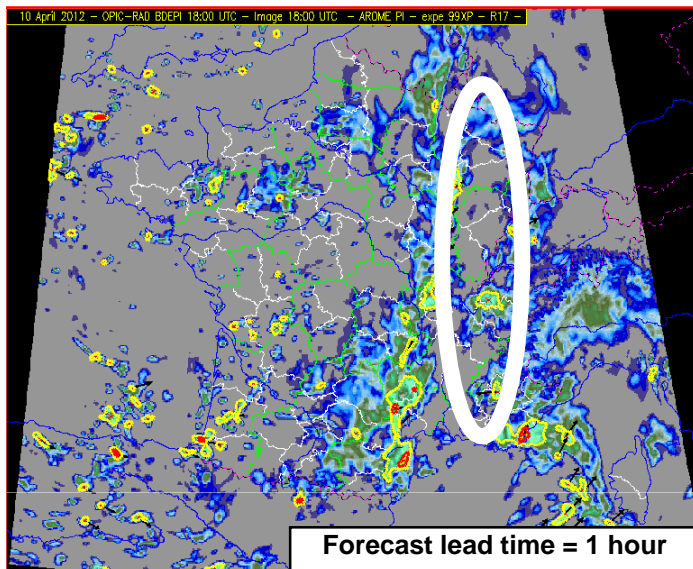
CONO with AROME-NWC reflectivities

April 10, 2012, forecast loop between 13 and 18 UTC



CONO with AROME-NWC reflectivities

same validity time 2012 April 10, 18 UTC

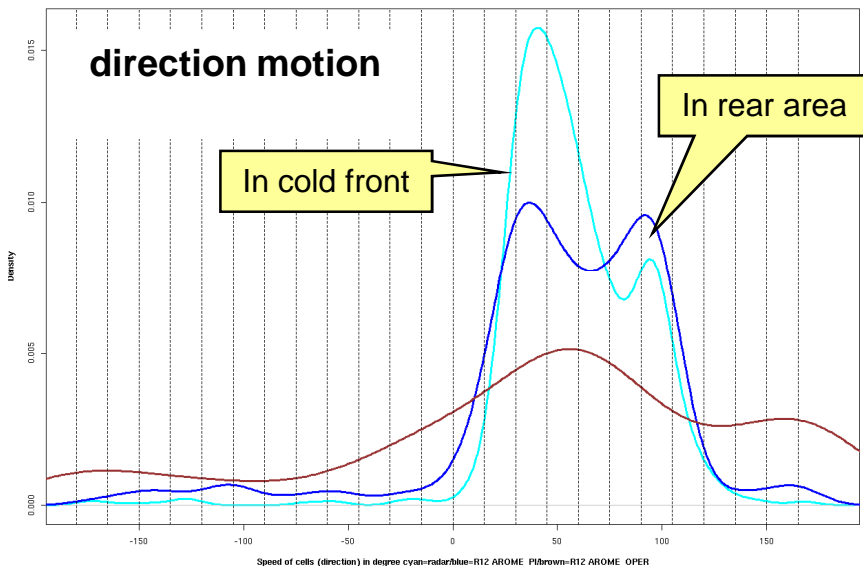
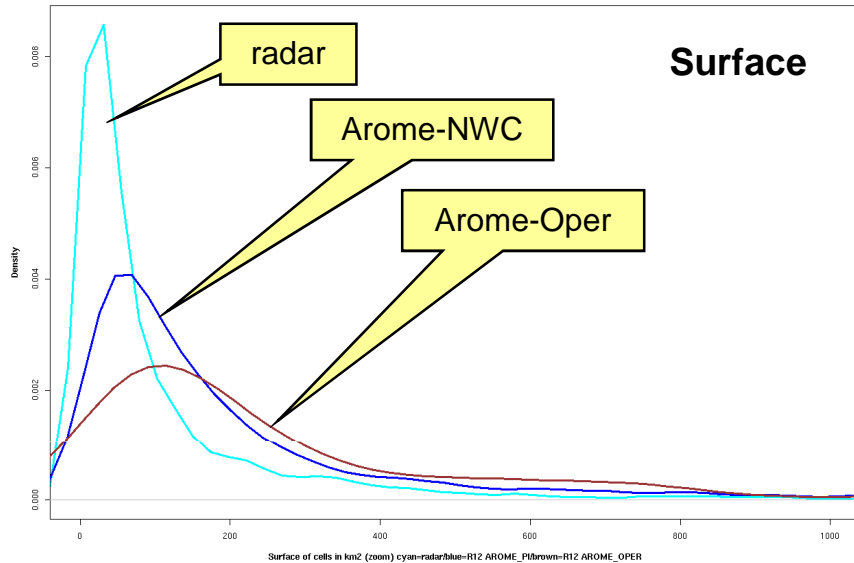


- ✓ Correct forecast of general features of reflectivity fields
- ✓ +1 hour: correct dry area eastward high reflectivity line
- ✓ +4 and +5 hours: correct high reflectivity patterns in the South

⇒ **The choice of the last issue of AROME-NWC is not necessarily/systematically the best option**

Comparison between observed and simulated CONO

April 10, 2012, between 13 and 18 UTC



- CONO detected with simulated AROME-NWC reflectivity are more numerous and more spread out than CONO-radar
 - Difference increases with range especially after 2 hours range
 - AROME-NWC is better than AROME-Oper
 - ⇒ **Positive impact of hourly assimilation**
- CONO motions in simulated reflectivity AROME-NWC are reasonably correct even if it is more difficult to build simulated trajectories
 - ⇒ **High frequency output is very useful (but perhaps not enough)**
- First results. Sample to enlarge. In progress...

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➤ Outlook



AROME-NWC applications



- **2012-2014** : To develop a non linear nowcasting scheme of thunderstorms based on fusion of CONO trajectories (observed, extrapolated and simulated)
- **2012-2014** : To develop synthetic diagnosis downstream AROME-NWC
 - To adapt existing diagnosis concerning convection, fog, winter conditions like snow or freezing rain
 - To organize case studies with forecasters to assess
 - AROME-NWC forecasts reliability
 - Diagnosis skills
 - To prepare the operational usage of hourly refreshed forecasts by our forecasters and in our automatic productions
- **2013-2016** : To improve our high resolution precipitation nowcasting method
 - Diagnosis of motion and trend fields in simulated reflectivities and rainfall
- **2015** : To operate AROME-NWC in real time on FABEC domain
- **2012-2016** : To operate an experimental AROME-Airport system at 500 meters resolution during SESAR experimentations (WP12.2.2 concerning wake vortex prediction)
 - on Paris CDG airport (2012 and 2014 with additional information about uncertainty of forecasts),
 - and Frankfurt (2016)

Thanks for your attention!



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