Seamless approach for precipitations within the 0-3 hours forecast-interval

European Nowcasting Conference
April 2019
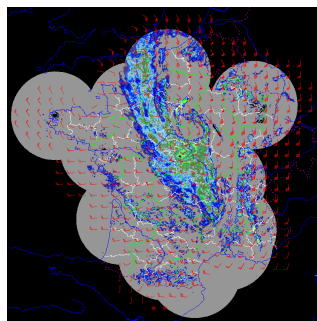Jean-Marc Moisselin, Cau, P., Jauffret, C., Bouissières, I., Tzanos, R.
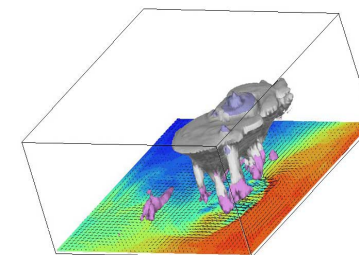
Outline

1) **Context** ⬅

2) The seamless components

3) PIAF: time and space seamless forecasts

Fusion between EXTRapolated observation and AROME-NWC

EXTRAPOLATION

PREDICTOR #1

NWP: Arome-NWC

PREDICTOR #2
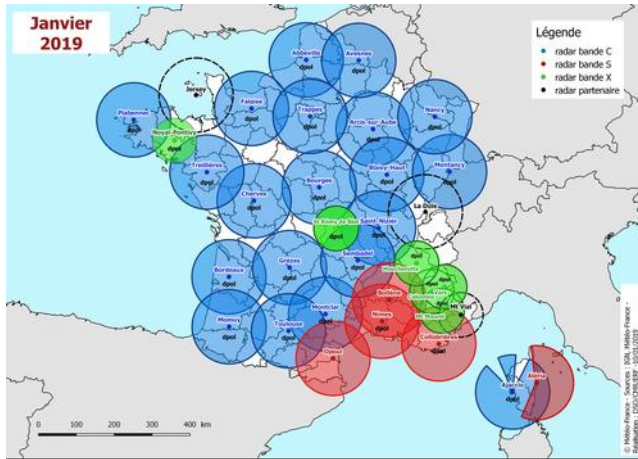
Initial State

t+180'

Outline

1) Context

2)The seamless components
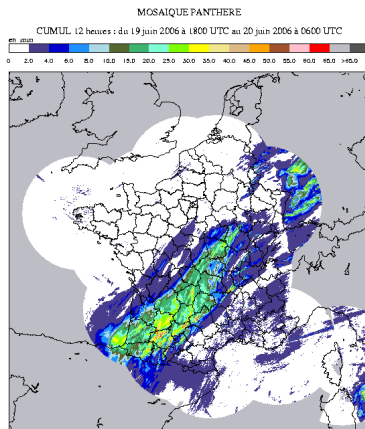
3) PIAF: time and space seamless forecasts

METEO
FRANCE

The EXTRAPOLATION method
Radar Products

The French radar **composite** image is processed with 30 conventional radars. The radar network has the following characteristics

- All Dopler

- C-band (majority)+S or X band

- 1km / 1dBZ / 5'

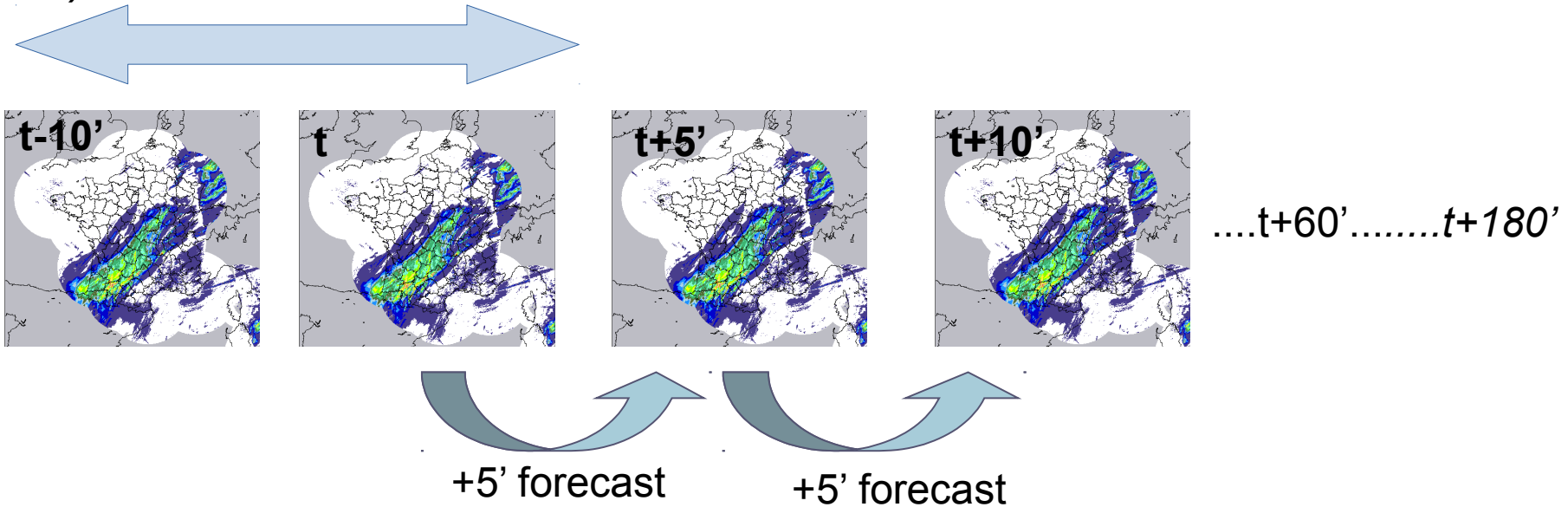QPE is then available every 5 minutes calibrated with rain gauge

Then QPE is extrapolated (next slide)

1km/1 dBZ /5', France coverage

The EXTRAPOLATION method
Main principle

1) Identification of cells displacement
2) Motion Field Calculation

t-10'   t   t+5'   t+10'   ....t+60'........t+180'

+5' forecast   +5' forecast

Traditional observation-based nowcasting technique

AROME-NWC characteristics

AROME-NWC=NWP AROME France built for **nowcasting**

Same Physics, dynamics, coupled model, domain, mesh and assimilation method

High-value of radar data in in AROME-NWC assimilation

	AROME	AROME-NWC
Assimilation	Cut off variable (1h30 for production)	Cut off 10 minutes
Update frequency	8 runs/day	24 runs/day
Max. Forecast range	up to 42h	6h
Forecast range sample	1h	15 minutes
Availability	H+2h to H+4h	H+30 minutes

Avalaible sooner + An added value of AROME-NWC up to 2-3 hours

ENC Madrid, April 2019 7/17

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Outline

1) Context
2) The seamless ingredients

3) **PIAF: time and space seamless forecasts**

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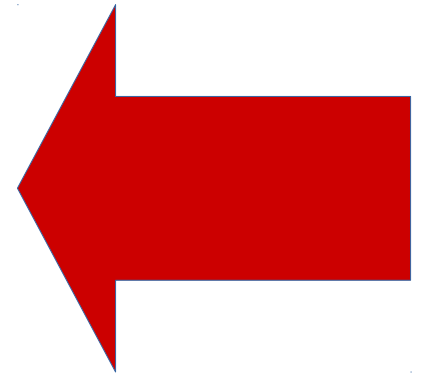
TIME SEAMLESS method PIAF overview

Fusion = α * EXTR + (1-α) *AROME-NWC

PREDICTOR #1   PREDICTOR #2

Weight α

1

Could be...in W-flux

...or could be
for convection

0

FCST Horizon

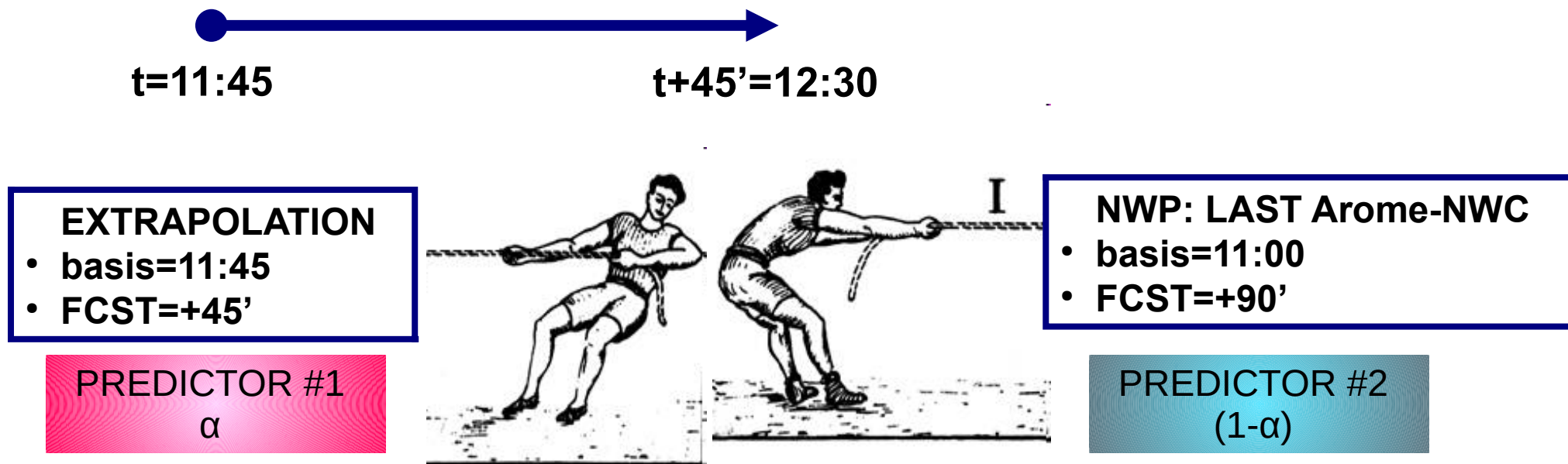0   180
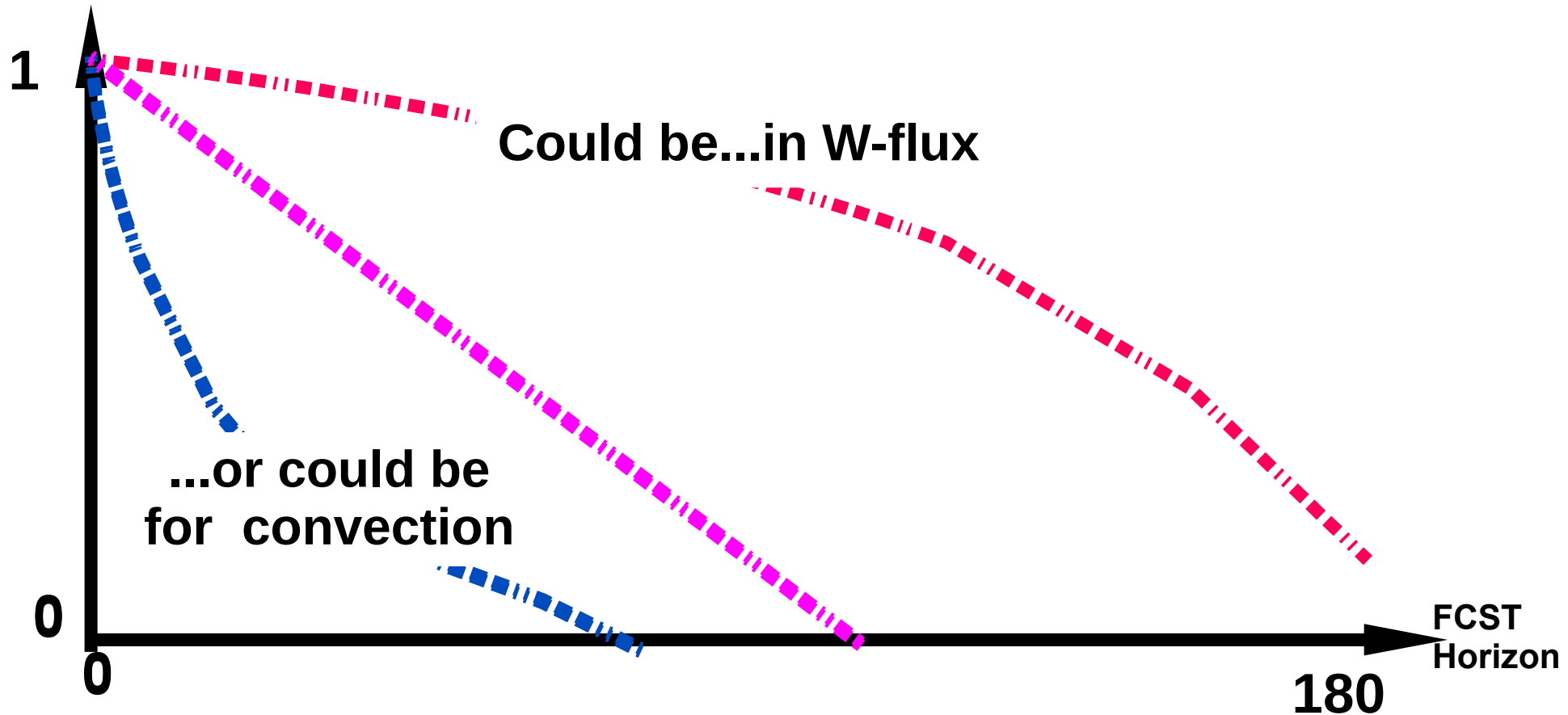
No preconceived idea of the decrease of the weight in PIAF

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TIME SEAMLESS method PIAF in detail

Weight of each predictor tuned in a past-window
Regret=when a predictor is better than PIAF. Aims: "minimize/limit the regret". Consequence of the criteria: fusion follows the best expert.
α depends on basis, forecast range and area **Updated every 5'**

t=11:45 → t+45'=12:30

EXTRAPOLATION
- basis=11:45
- FCST=+45'

PREDICTOR #1
α

NWP: LAST Arome-NWC
- basis=11:00
- FCST=+90'

PREDICTOR #2
(1-α)

To know more: Auer, P., Cesa-Bianchi, N., & Gentile, C., **2002**. *Adaptive and self-confident on-line learning algorithms*, J. of Computer and System Sciences, 64, p. 48-75.

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TIME SEAMLESS method PIAF in detail

Fusion=α * EXTR + (1-α) * NWP

Obs-extrapolation method and NWP data are merged
- Aggregation of expertise by exponential weight.
The ML-POLY version of the method provides a real choice of predictor rather than a mixture

- A cutting of French domain in 6 zones
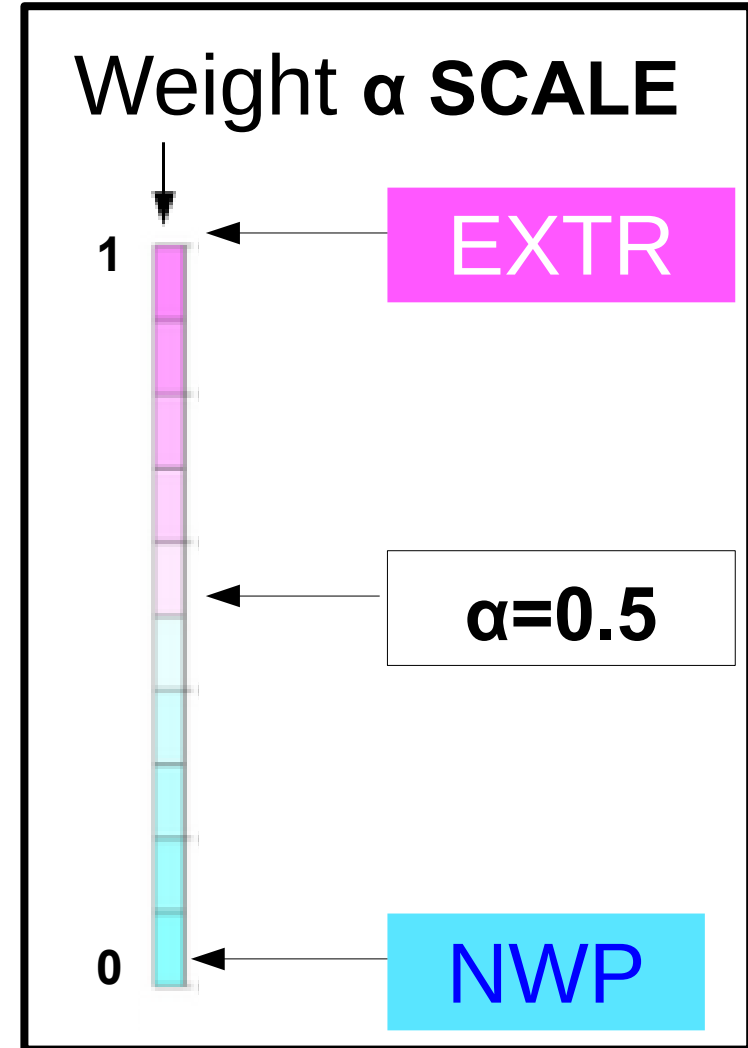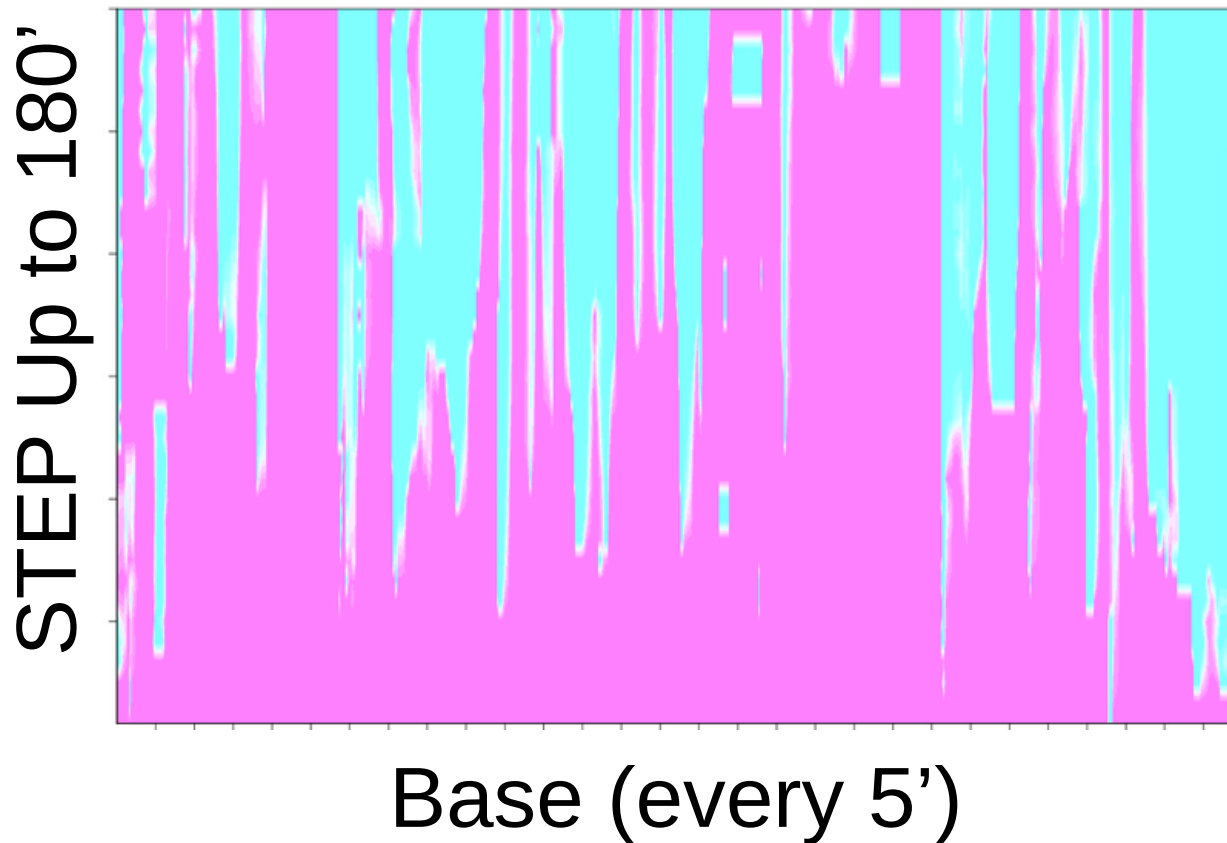- A loss calculation using a Gerrity score
- A 6-hours learning period

PIAF=Prévision Immediate Agrégée Fusionnée

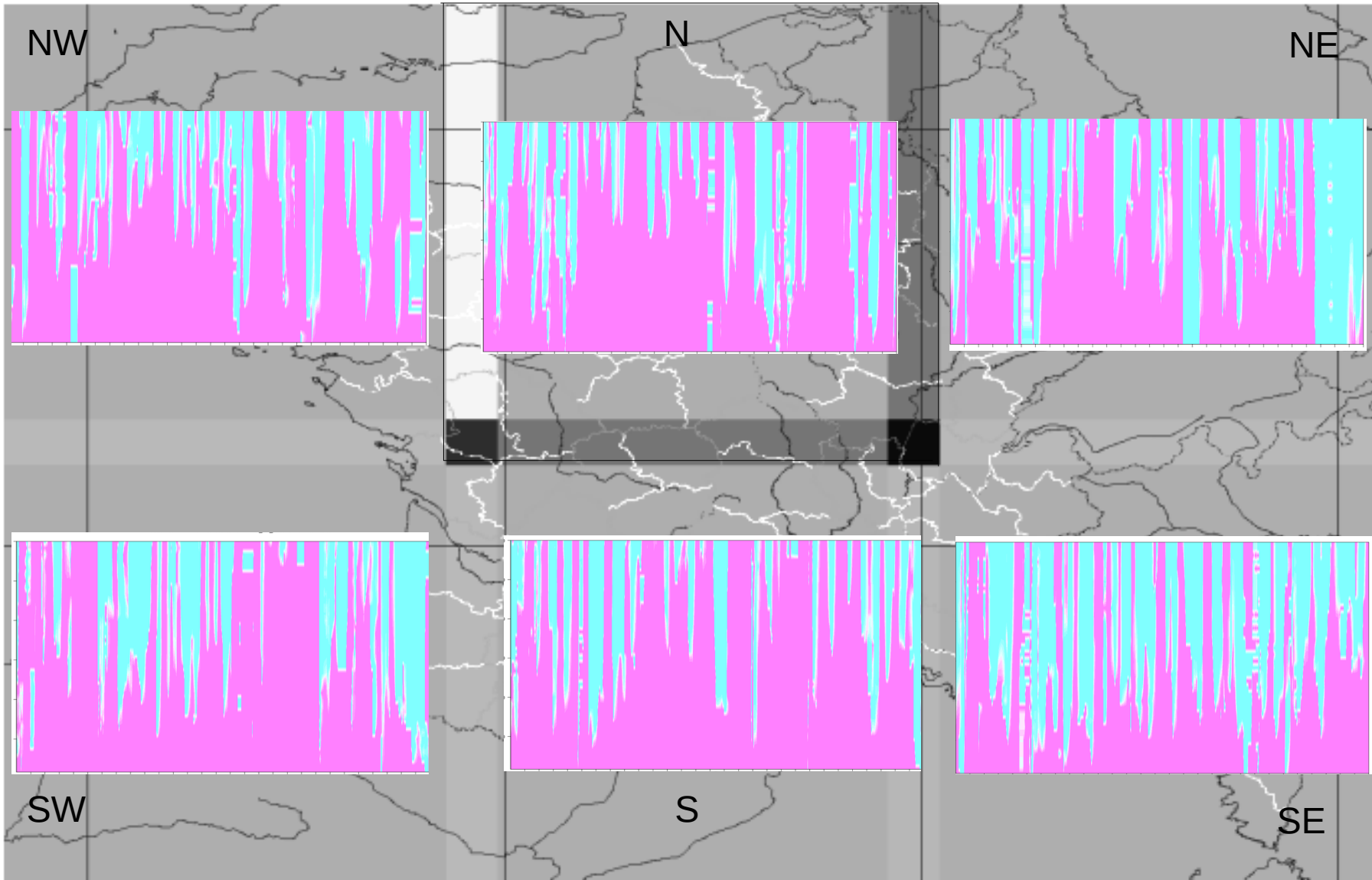**After 3 years of development level of maturity operational reached**

SEAMLESS method PIAF
Example for Area SW (South-West)

Fusion=α * EXTR + (1-α) * NWP

STEP Up to 180'

Base (every 5')

Weight **α SCALE**

1 — EXTR

α=0.5

0 — NWP

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SEAMLESS with PIAF - Weight dependency

NW

N

NE

alpha
2/2016

SW

S

SE

Difference between areas + Ratchet Effect

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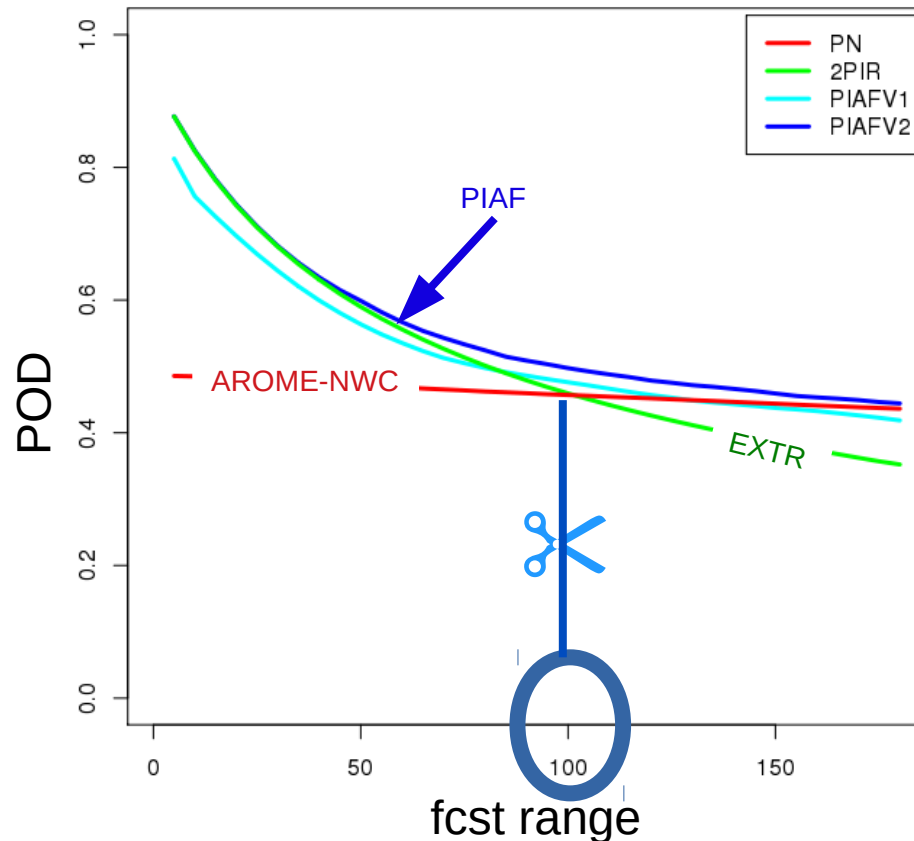
TIME SEAMLESS method PIAF
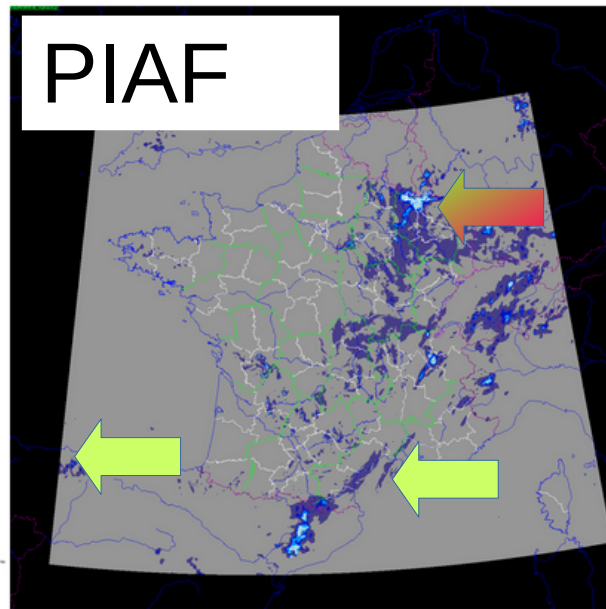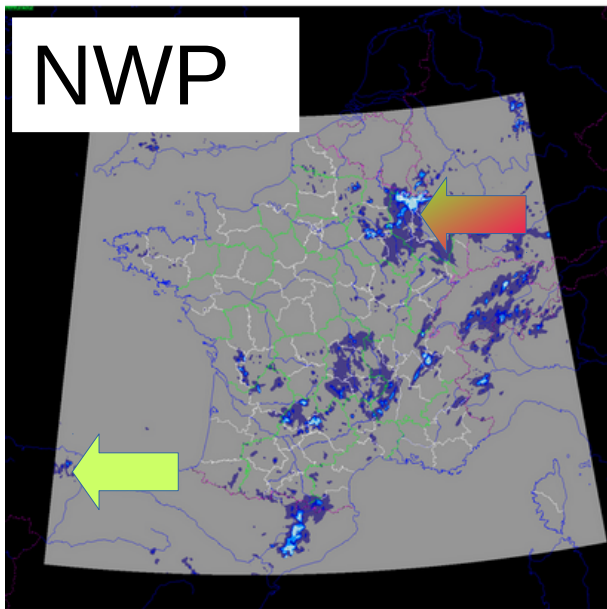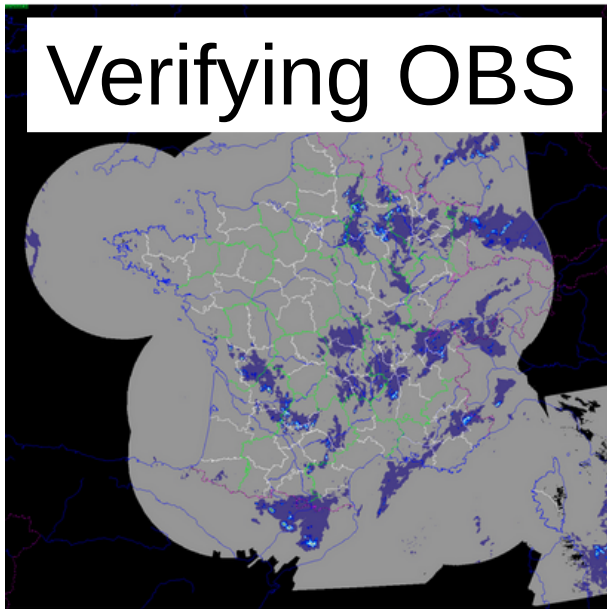
July 22, 2016 at 2 pm
FCST: +140 minutes step

Structures may be seen by a predictor or the other one in one of the 6 areas.
But they are all in PIAF

Quantitative Evaluation

Using criteria different from loss calculation (1 month)
POD for PIAF low threshold 0.05 mm/5' (0.6 mm/h)

PIAF is better than the best of EXTR and AROME-NWC

Conclusion

- NWP are now updated more frequently with higher forecast resolution
- PIAF **mixes** observations (EXTR) and modelling (NWP).
- PIAF **preserves** heavy rainfall events
- PIAF is fully **automatic** and **highly refreshed** forecast

- PIAF **Status**
  - OK for rainfall (operational 19/2/2019)
  - In progress for reflectivities
  - Hydrometeor version in test

- PIAF **Progress Potential**:
  - Input data:
    - Use of a data fusion rain-gauges/radar QPE instead of radar QPE
    - 5' AROME-NWC resolution of forecast (instead of 15')
    - Size decrease of learning window during convective season
  - Object approach / upscaling approach
  - Ensemble of input data for a future probabilist version of PIAF

- Possible use in future to enhance nowcasting of convection over Europe (see Sandra Turner lecture)
- Seamless meeting with FMI DWD MO and MF, Francfort 18/12/2018

Thanks for your attention