ARPEGE and AROME : recent developments and plans

Joint ALADIN / HIRLAM Workshop, Madrid, April 3,2019

Jean-Marcel Piriou for Ingrid Etchevers and Yann Seity, CNRM/GMAP

Contents

- ARPEGE / AROME **diagnostic : visibility** (Ingrid Etchevers)
- ARPEGE / AROME **diagnostic : precipitation type** (freezing rain, dry snow, wet snow, etc) (Ingrid Etchevers and Yann Seity)
- ARPEGE : **wind gusts enhanced by convection** (Jean-Marcel Piriou and Laurent Descamps)
- AROME : horizontal and vertical **resolution impact on fog** prediction (Yann Seity)

Visibility diagnostic

- **Visibility** = - ln ε / β (Koschmieder, 1924)
  where ε is the contrast threshold (0.0**5** OMM, OACI and CIE), β extinction coefficient

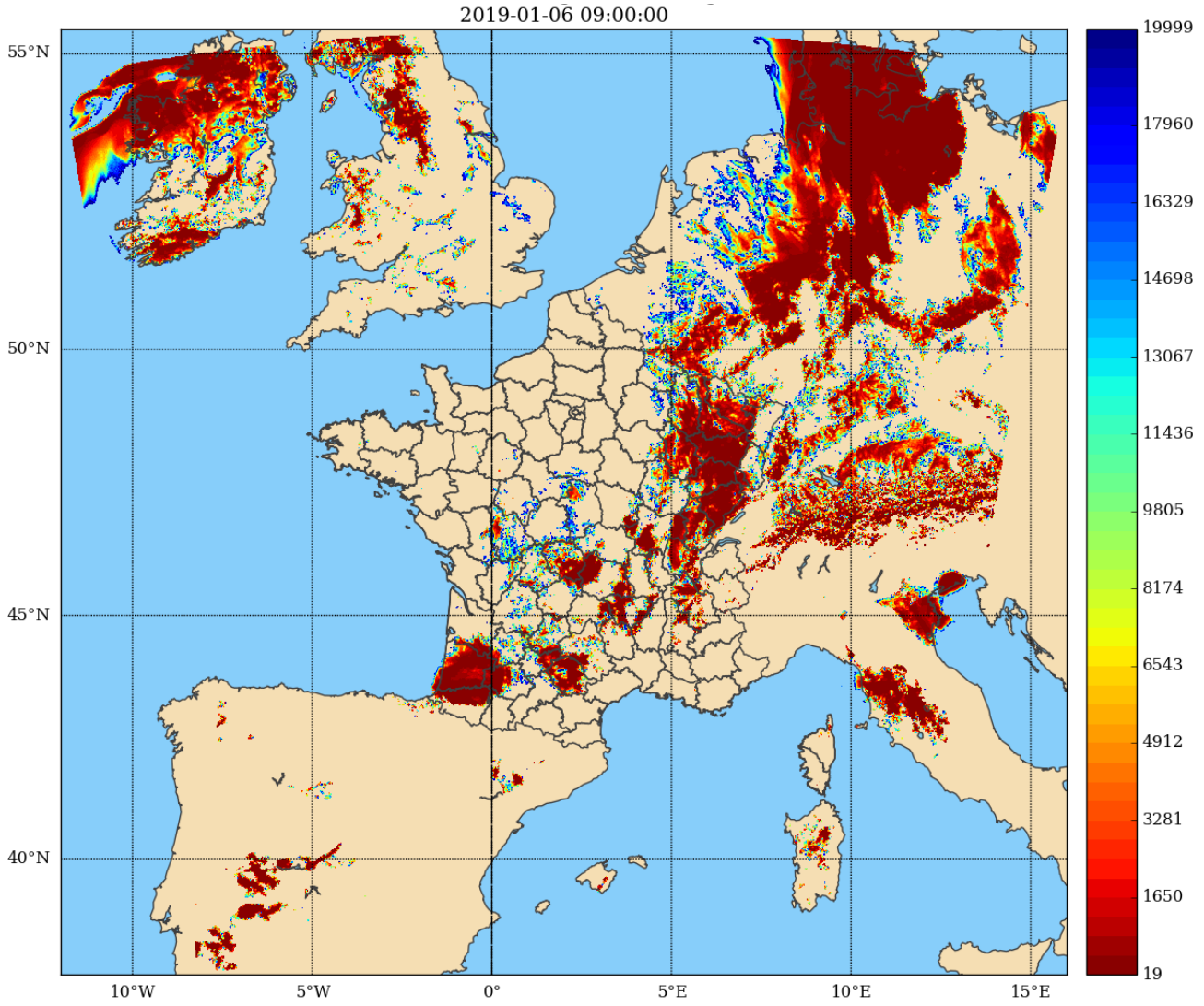
- **$Visi_{Cld}$ = - ln(0.05) / (βcld + βice)**
  *βcld = a*C^b*exp(c*(logC)^2)*exp(d*(logC)^ 3) (C=cloud liquid water content [g m-3])*
  (Olivier Mestre, Ingrid Etchevers)
  βice = 163.9 C^(1.0) (C = cloud ice water content [g m-3]) after *(Stoelinga, 1999)*

- **$Visi_{Hydro}$ = - ln(0.05) / (βrain + βsnow + βgraupel)**
  βrain = 2.5 C^(0.75) (C = rain water content [g m-3])
  after *(Niemelä, 2014), FMI*
  βsnow = 10.4 C^(0.78) (C = snow content [g m-3])
  after *(Stoelinga, 1999)*
  βgraupel = 2.4 C^(0.78) (C = graupel content [g m-3])
  after *(Niemelä, 2014), FMI*

- *No aerosol in the above formulas, because climatological aerosols in ARPEGE / AROME. Ongoing effort towards prognostic aerosols (Moktar, AROME dust)*

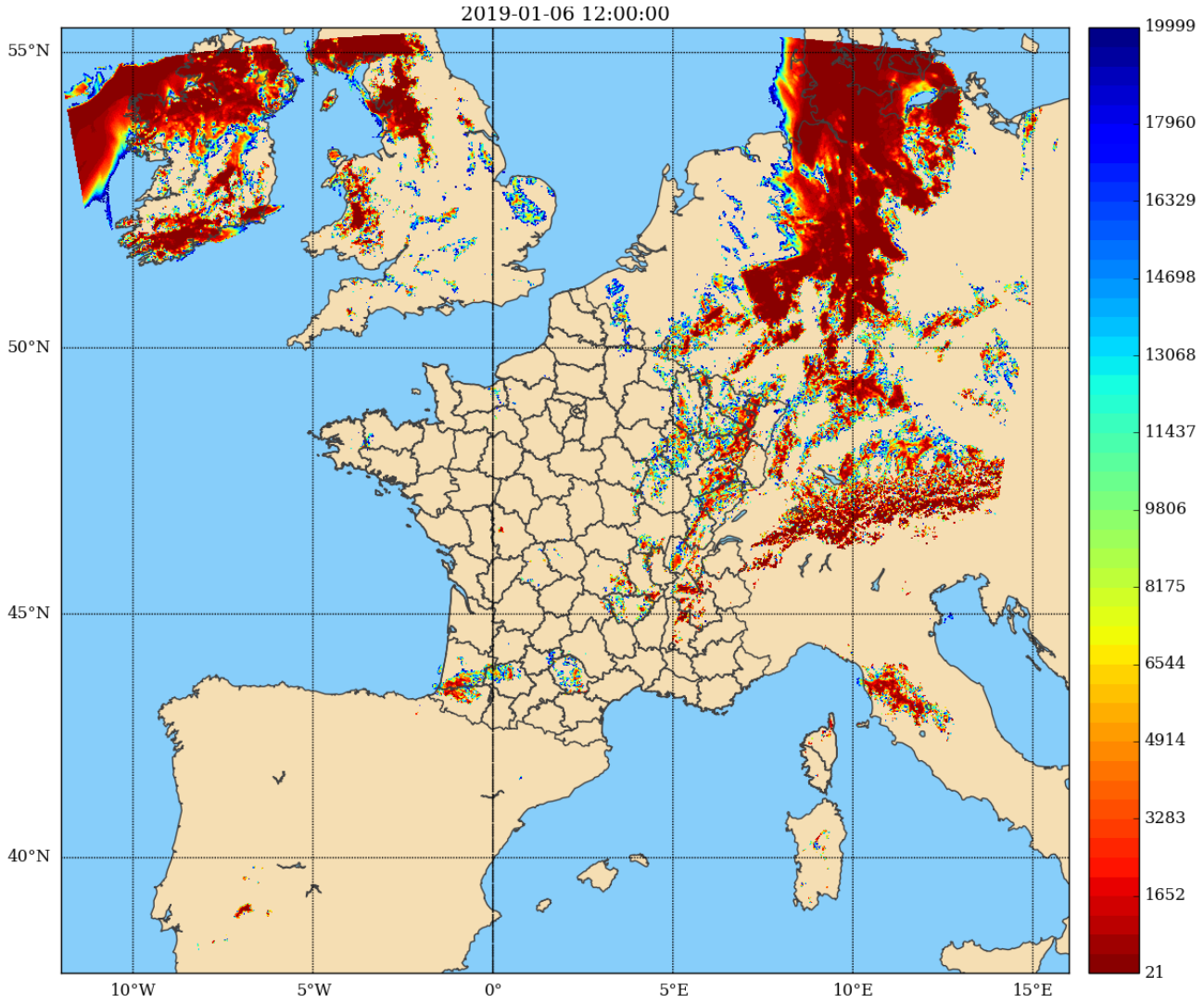
- Minimum 1h (**$Visi_{Cld}$**) et Minimum 1h (**$Visi_{Hydro}$**)

Visibility (min 1h), AROME 2019-01-06 00UTC + 09h



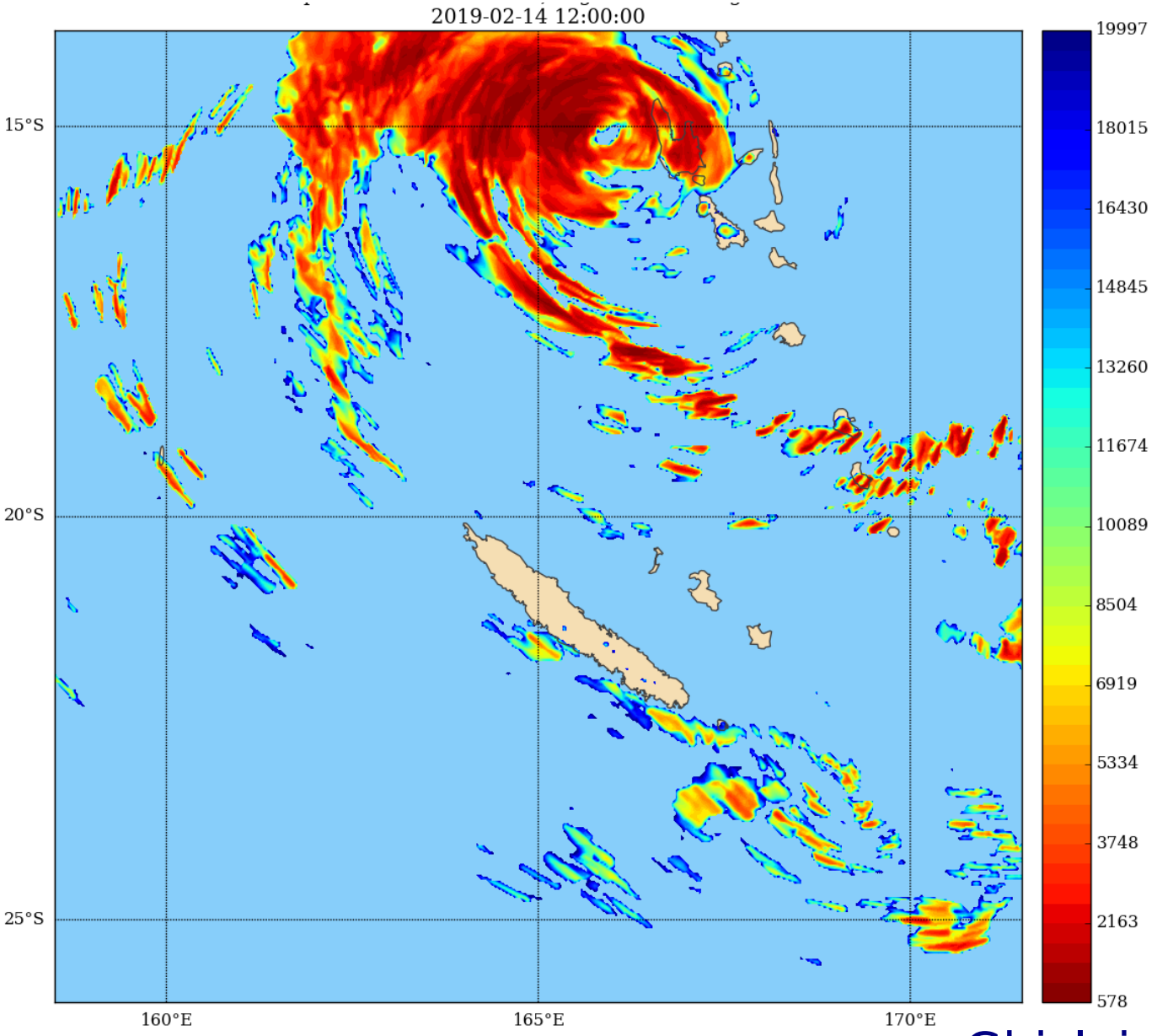
Ingrid Etchevers

Visibility (min 1h), AROME 2019-01-06 00UTC + 12h



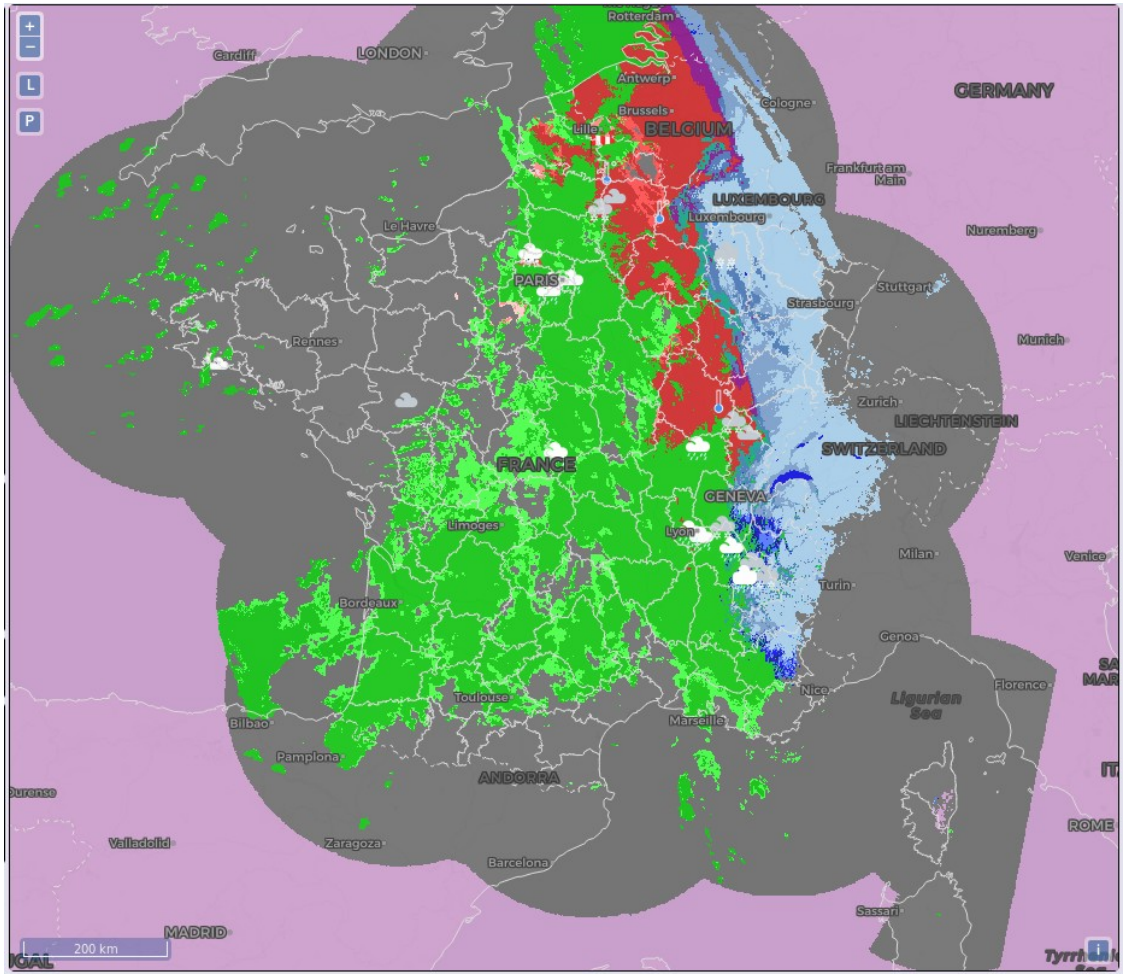
Ingrid Etchevers

Visibility (min 1h VisiHydro) AROME 2019-02-14 12 TU



Ghislain Faure

Precipitation types : HYDRE radar diagnostic

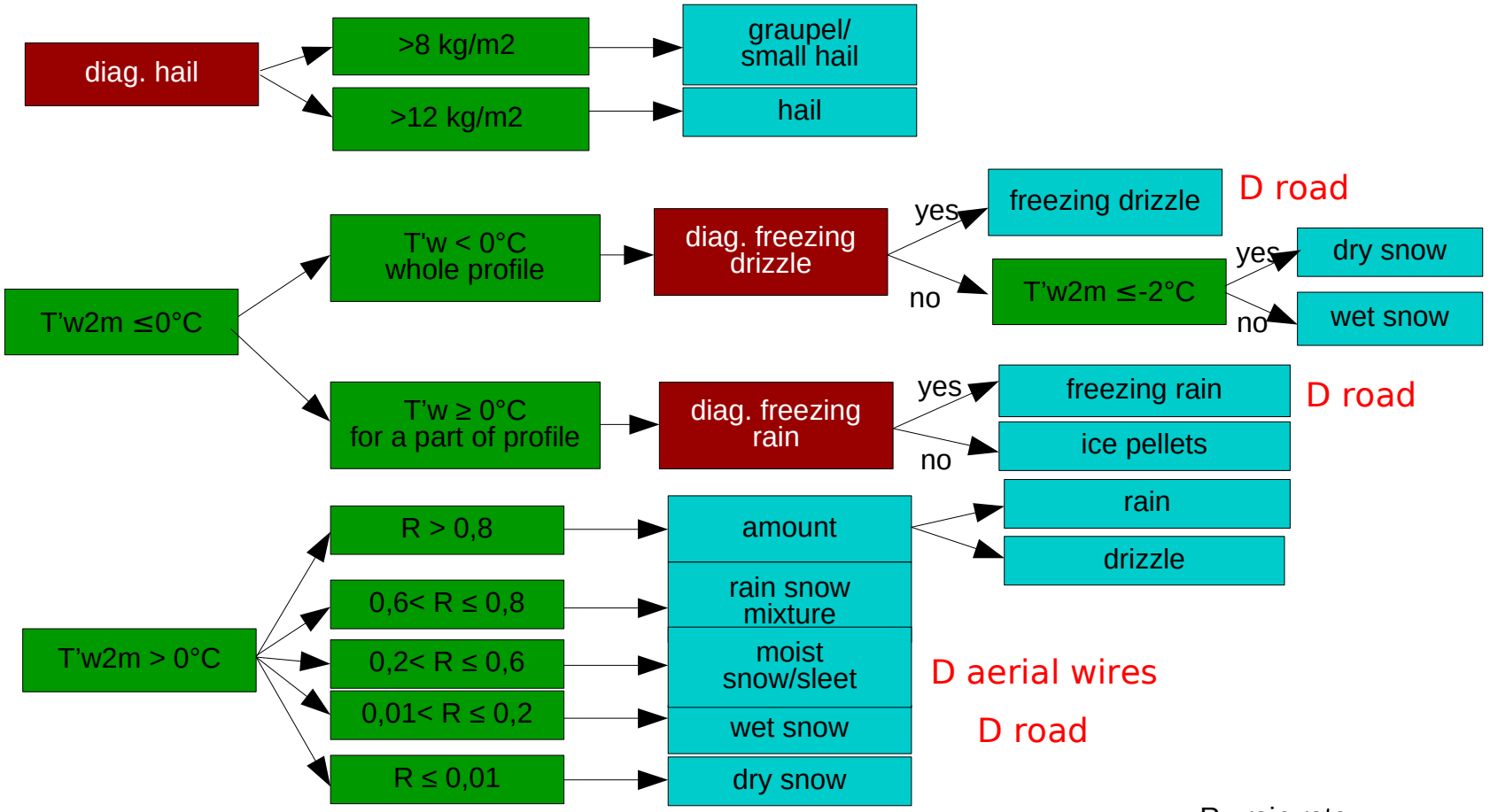


Rain	1	
Freezing rain	3	
Dry snow	5	
Wet snow	6	
Rain snow mixture	7	
Ice pellets	8	
Graupel/small hail	9	
Hail	10	
Drizzle	11	
Freezing drizzle	12	
Moist snow/sleet	193	
Intermittent rain	201	
Intermittent dry snow	205	
Intermittent wet snow	206	
Intermittent rain snow mixture	207	
Intermittent moist snow/sleet	213	

Real time analysis HYDRE : Radar data + T'w RH AROME

Ingrid Etchevers, Yann Seity

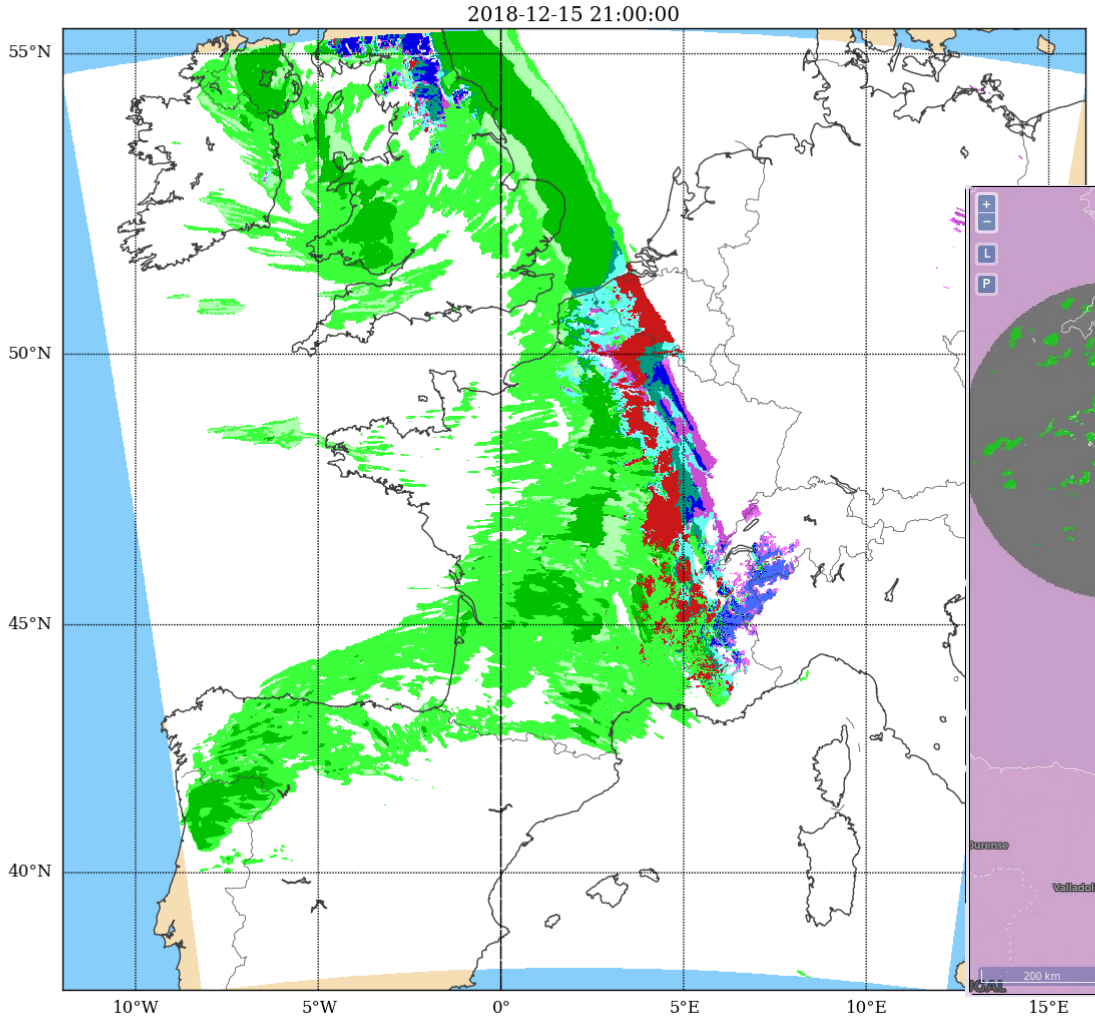
Precipitation types : AROME / ARPEGE diagnostic

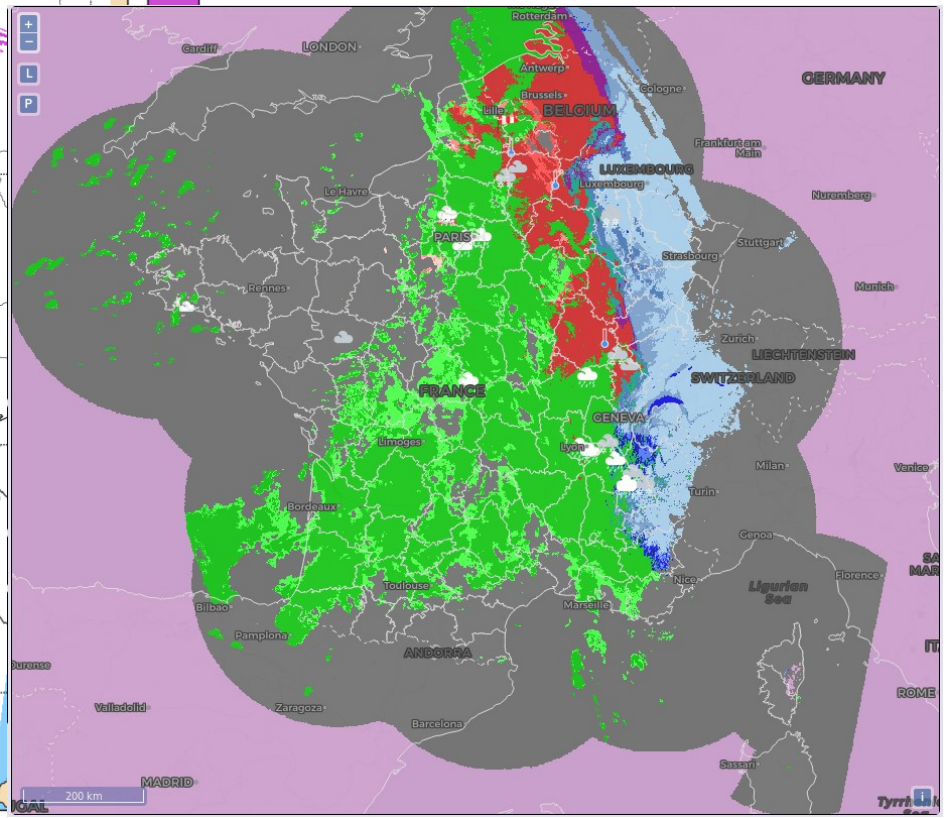


R : rain rate
total precipitation

Ingrid Etchevers, Yann Seity

Precipitation types : AROME vs HYDRE, 2018-12-15





AROME prediction range 18-21h

HYDRE

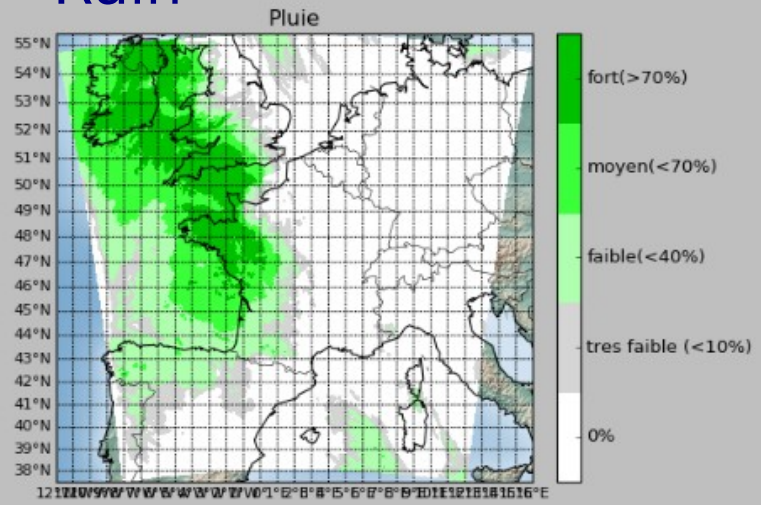
Integer type, written on GRIB real field. 2 fiels : (i) most frequent in 1h, (ii) most severe in 1h

Ingrid Etchevers, Yann Seity

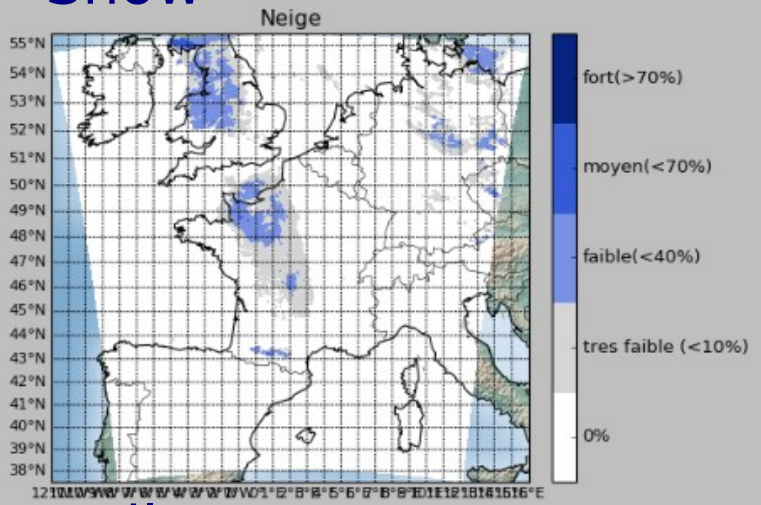
Precipitation types : prob. EPS (AROME / ARPEGE)

14-12-2018, run : 21h, echeance : +13h
Cartes de risques

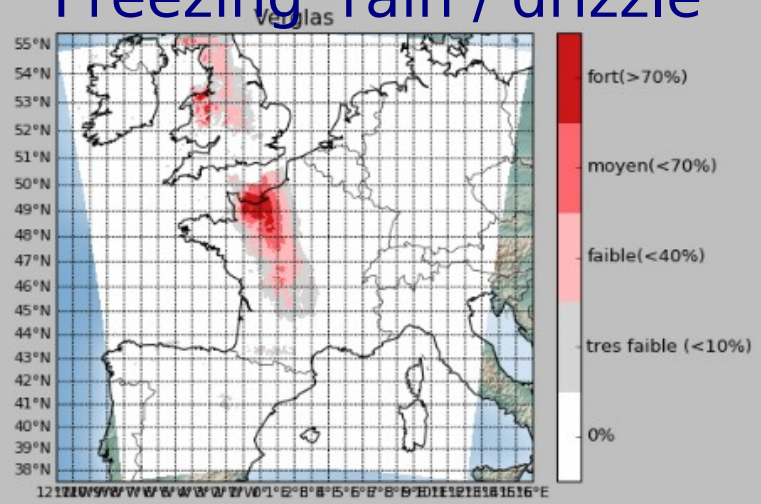
Rain



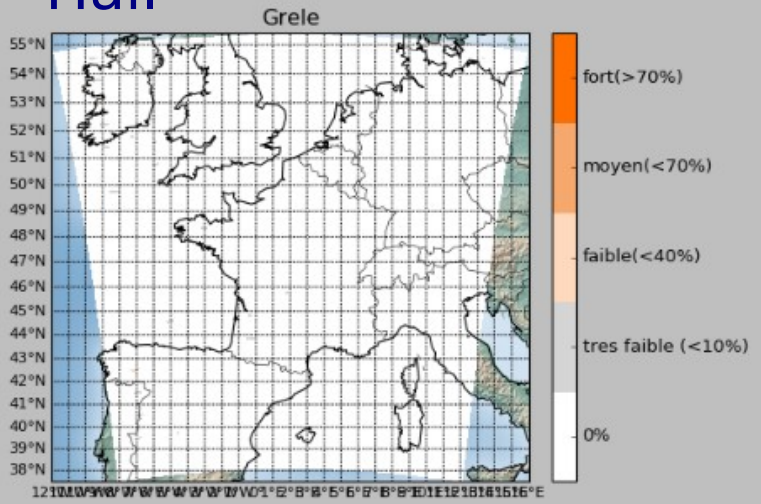
Snow



Freezing rain / drizzle



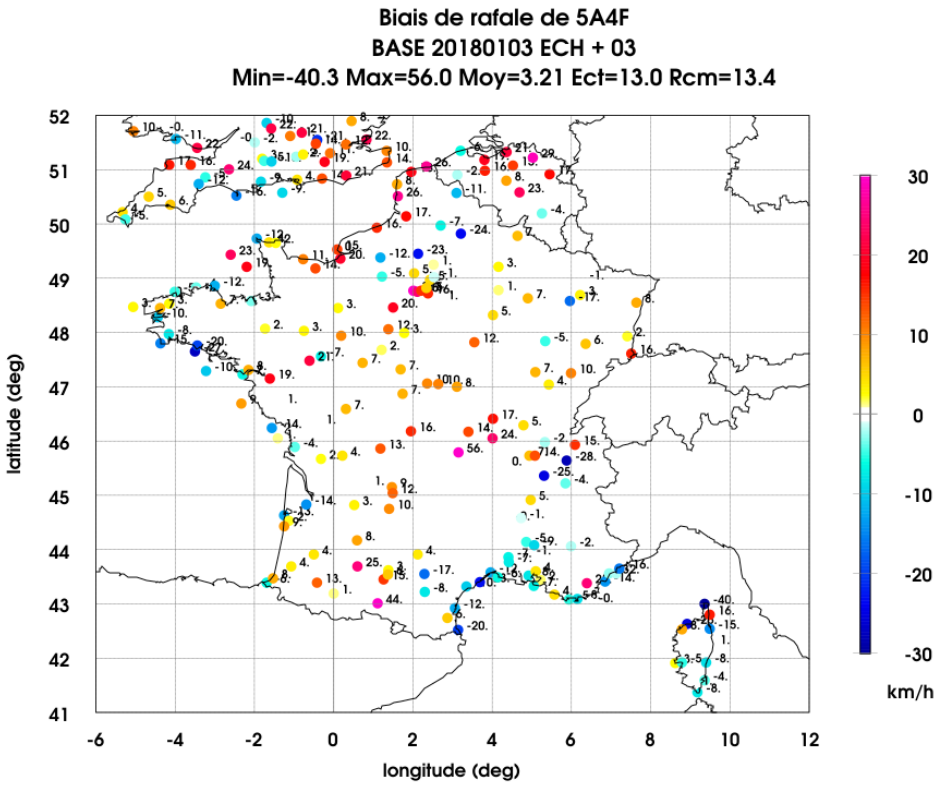
Hail



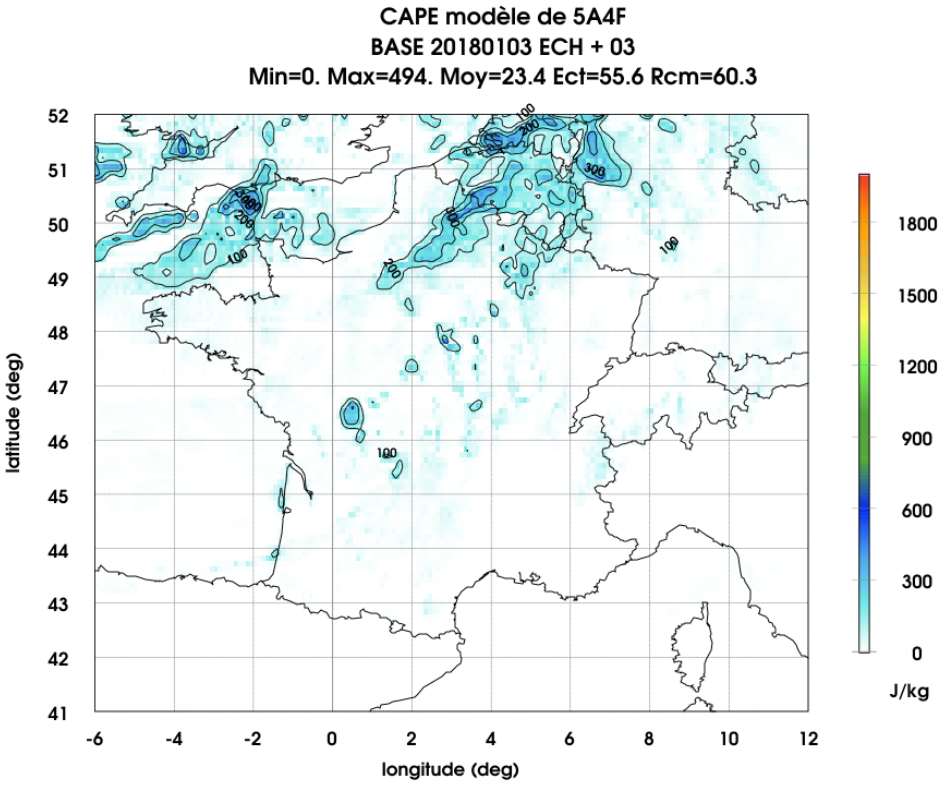
Ingrid Etchevers, Yann Seity

Convective gusts

Motivation : winter frontal events associated with CAPE :
Jean-Paul Tonnelier : Eleanor, 3 janvier 2018.



Gusts bias



Model CAPE

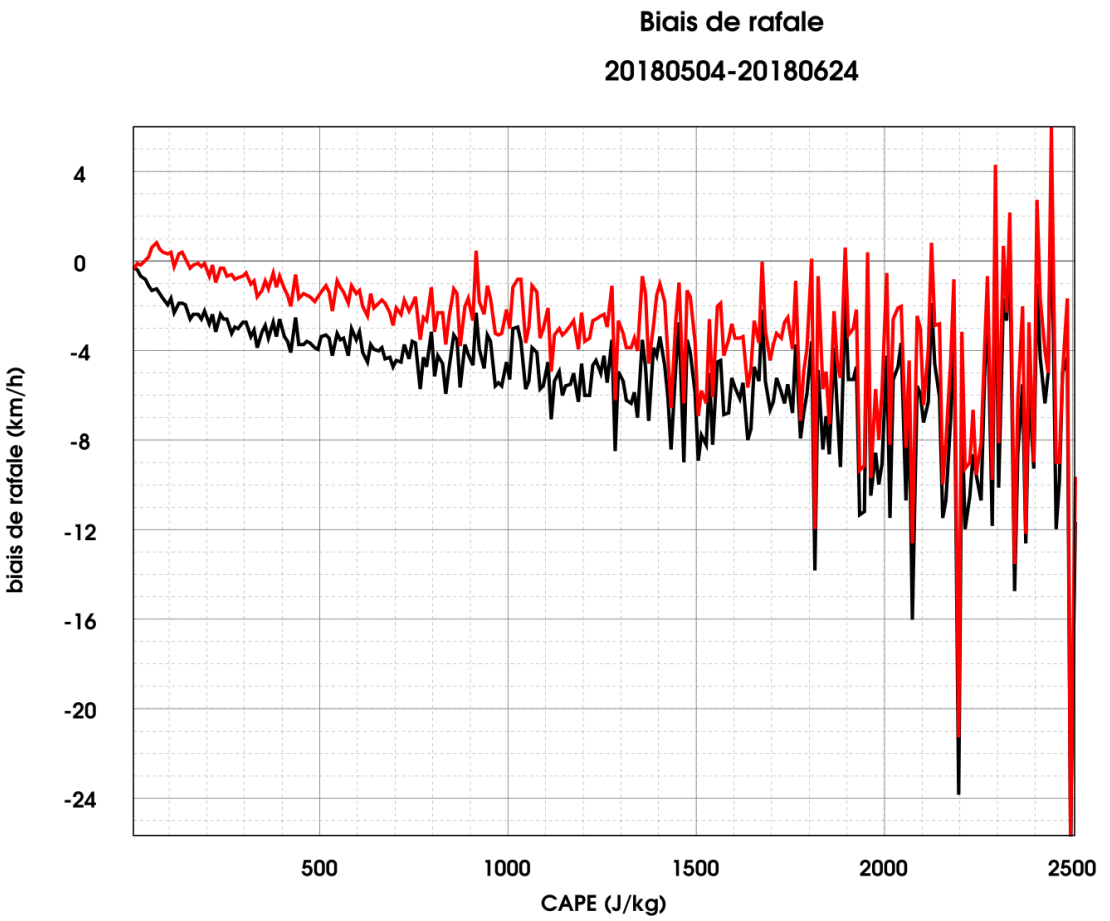
Jean-Marcel Piriou, Laurent Descamps

Convective gusts

$$U_{raf10m} = \alpha \ \max(0\ ,\ U_{850} - U_{950})$$

Bechtold and Bidlot 2009

si $CAPE > 100\ J/kg$

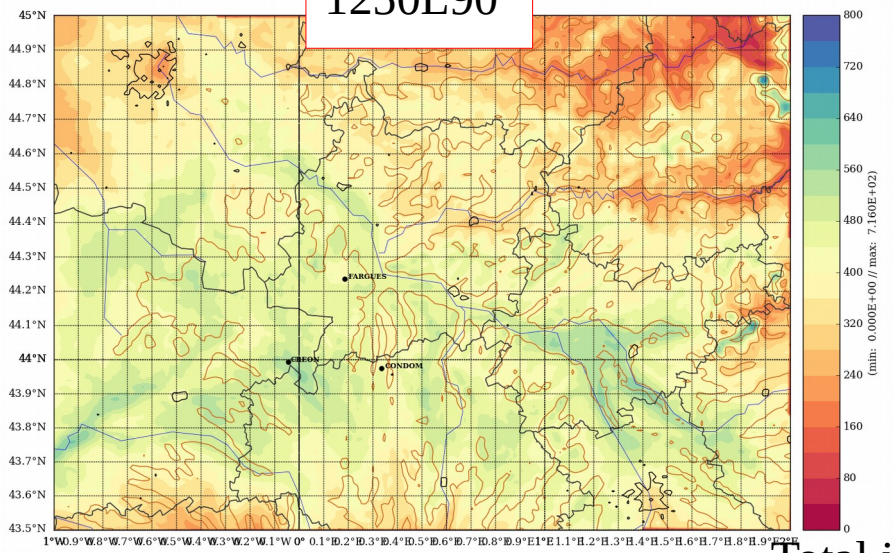


Black : control gusts (v10m+turb).
Red : with conv. gusts.

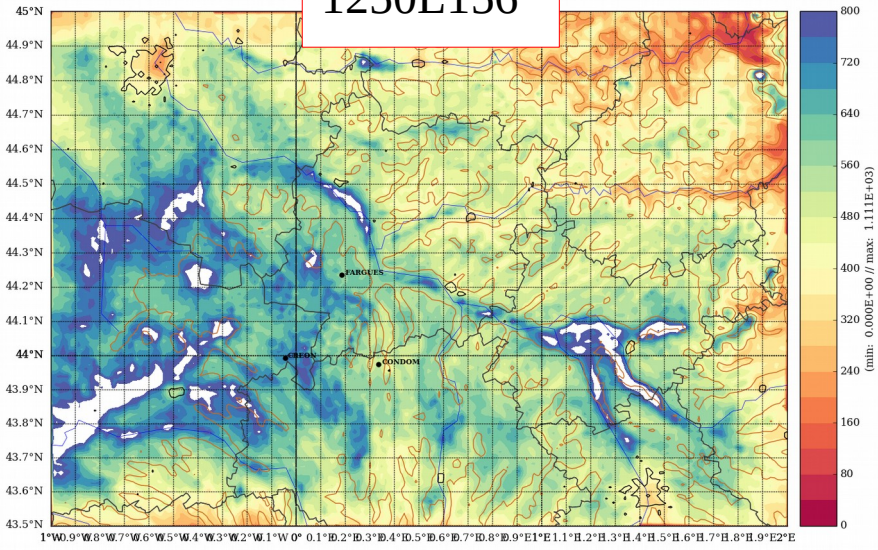
Jean-Marcel Piriou, Laurent Descamps

Fog SW France from Oct 2016 to March 2017

1250L90

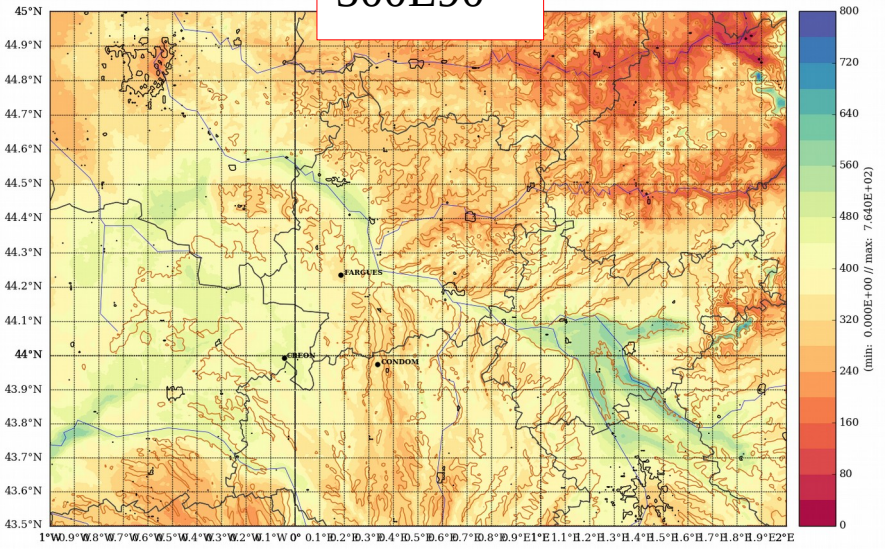


1250L156

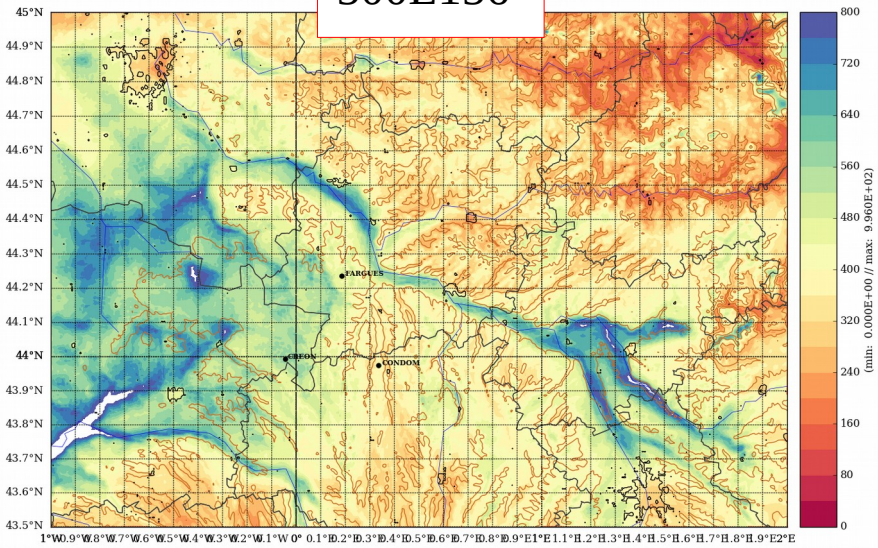


Total in hours

500L90



500L156



Yann Seity

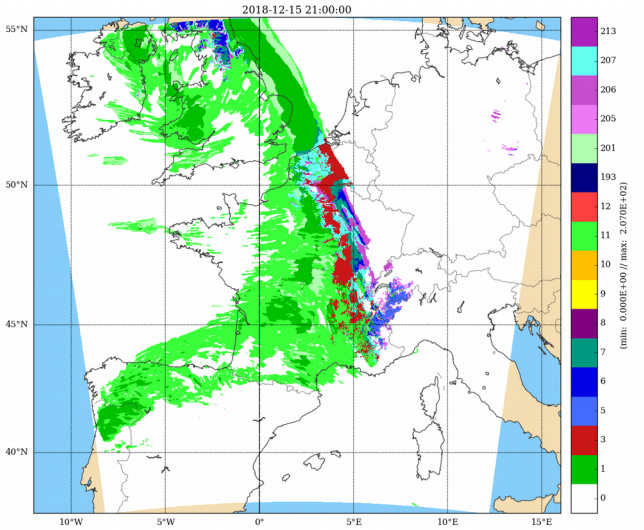
Fog scores : 4248h (177 days) x 10 observation sites

	1250L90	1250L156	500L90	500L156
Detection Rate (%)	43.9	54.0	40.4	47.8
FA Rate (%)	55.5	57.0	53.9	54.5
Bias	0.986	1.256	0.876	1.052
CSI	0.284	0.315	0.275	0.304

- 500L90 not better than 1250L90
- Stronger impact of vertical resolution (lowest level at 1m for L156)
- Ongoing tests with ECOCLIMAP-SG and LIMA

Yann Seity

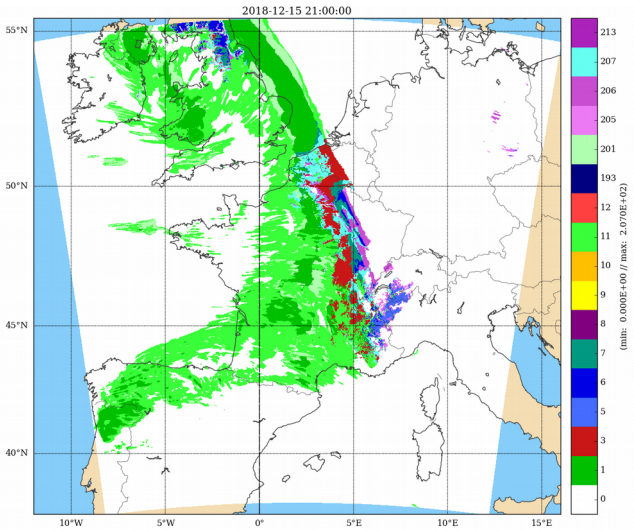
Conclusion / perspectives



Visibility, precipitation types, convective gusts :

- available in cy43t2_op1, phasing in progress > cy46
- Active in current parallel suite ARPEGE T1800 / AROME. May become operational next summer
- Precipitation types in probabilistic EPS, density currents inside convective gusts : planned for next year
- Ongoing effort on fog prediction in AROME

Ongoing topics at Météo-France/GMAP/PROC team



- Visibility, precipitation types, convective gusts
- Diag top convection, diag clear sky turbulence (Olivier Jarron)
- In AROME parallel suite : new ICE3 scheme (Sébastien Riette)
- AROME 500m sofog3d with LIMA scheme (Rachel Honnert)
- PhD interaction physics <> data assimilation (Antoine Hubans, Yves Bouteloup, Cécile Loo, Pascal Marquet), starts with GWD
- FLAKE, 1D GELATO (Adrien Napoly)