Diagnostics in 48t1: Improvements and new products

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Which Diagnostics ?

- Lightning diagnostic improvement ⚡

- Precipitation type improvement ❄💧

- New storm helicity diagnostic 🌪

- Pressure of the top and base of deep convection ⛅

- Thermical vertical velocity (for gliding) ✈

- Snow depth diagnostic ⛄

Lightning diagnostic improvement

- Based on the McCaul (2009) parametrization, tuned by S. Radanovics for Arome (2021)

- Operationnal since summer 2022 (J-M. Piriou and Y. Seity)

  But ….

- Overestimation during the winter 2022/2023

  → Take into account updraft size

- Multiplication by $(\min(\text{zbase},1800)/1800)^2$
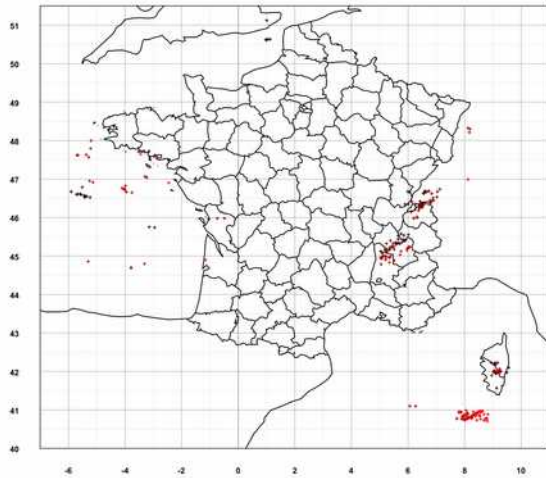
  zbase : altitude of cloud base

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Lightning diagnostic improvement

- 9 January 2023 3TU, cumul. 0-3h
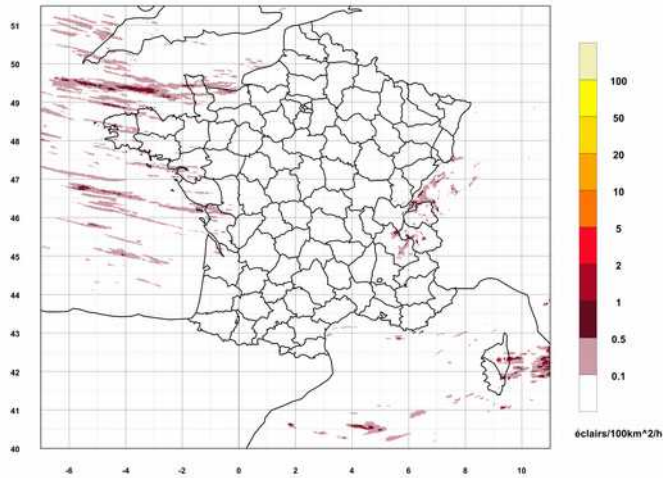- Cumulative amounts degrease and are closer to observations

Observation

New version

OPER
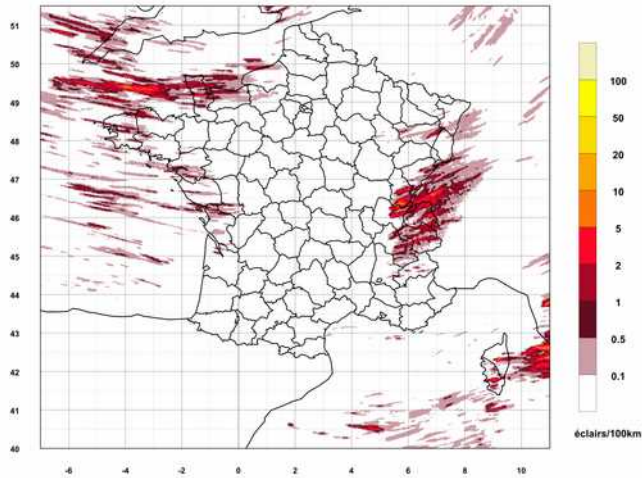
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Lightning diagnostic improvement

- 14 August 2022 21TU, cumulative 18-21h
- Not significant change in summer : Good !
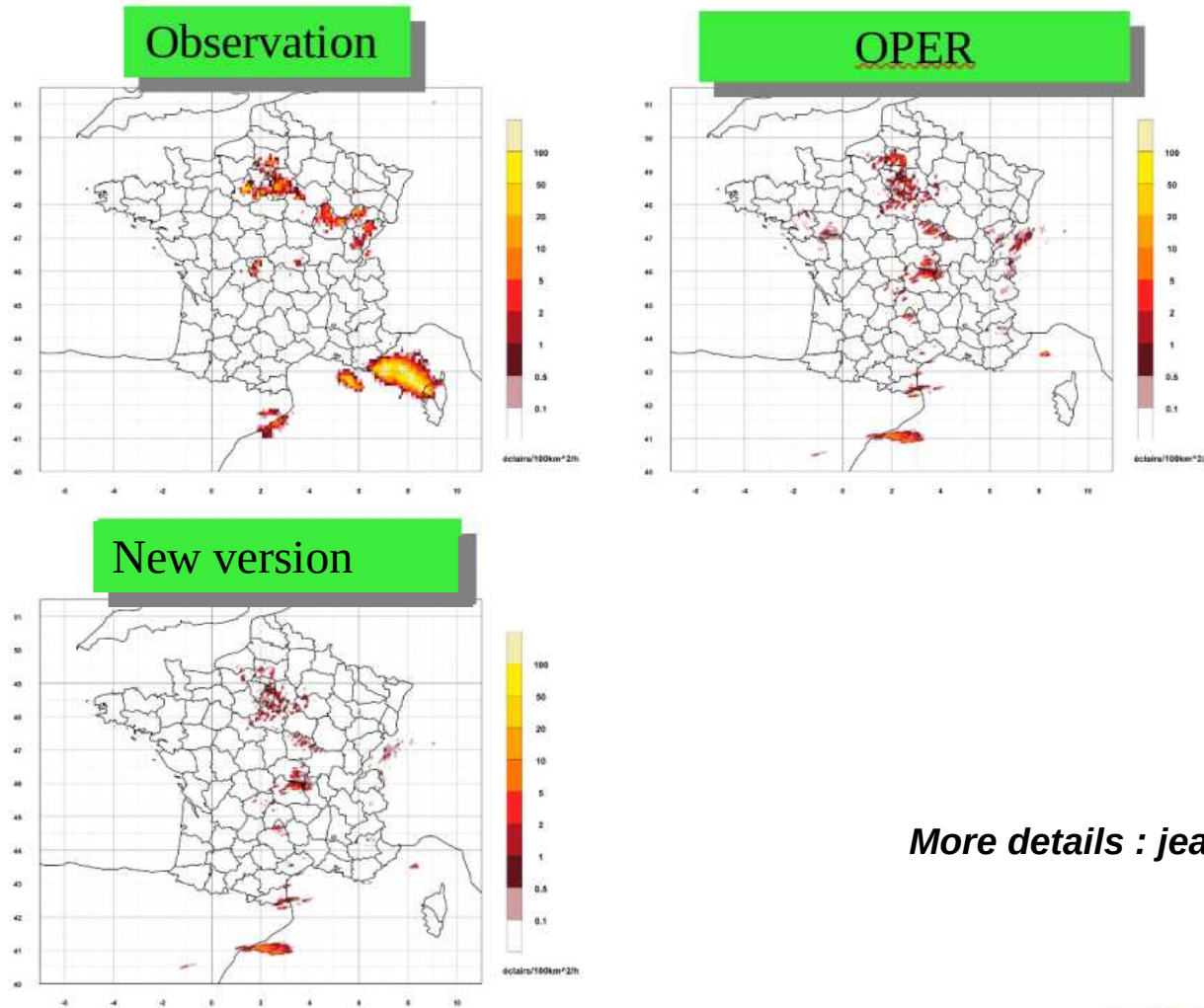
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Precipitation types improvement

- New thresholds added in the freezing rain algorithm
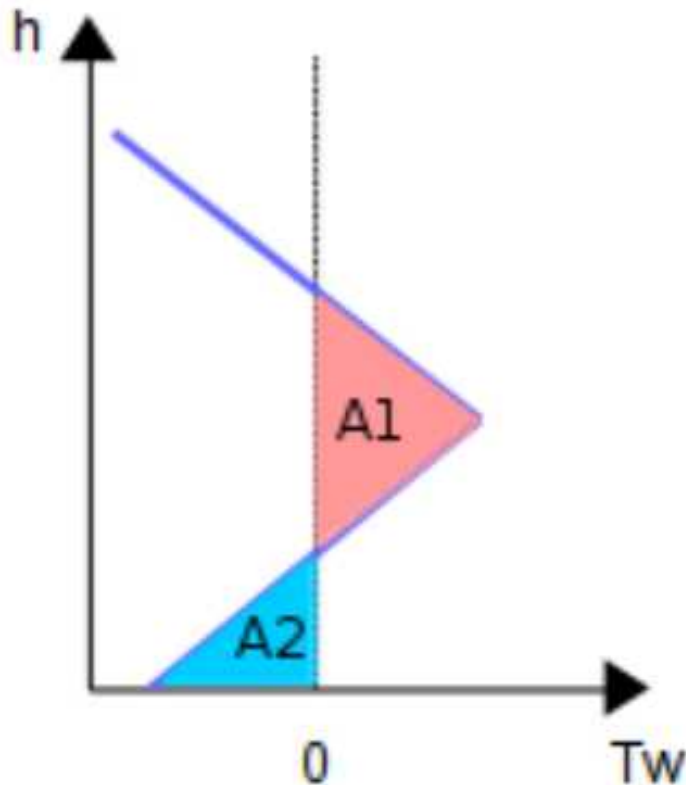
Before
A1 < RAWARM =>
Ice pellets or rain snow mixture (depending A2)

Now
A1 < RAWARM but A1 > RAWARM2
Ice pellets, rain snow mixture or **wet snow** (depending A2)

note: RAWARM2 < RAWARM

- Seamless forecast with observations and nowcasting
- Waiting for situation to observe/validate

New storm helicity diagnostic

- Based on the method ID (Bunkers et al, 2000)

- Introduced by M. Boisserie in fpstrmm.F90 (created by J. Cedilnik, thanks!)

- Key LSTRMMID=.TRUE. to compute this new storm helicity

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New storm helicity diagnostic

SRH 3km (m2/s2) - AROME pour mer. 01/06 à 01UTC
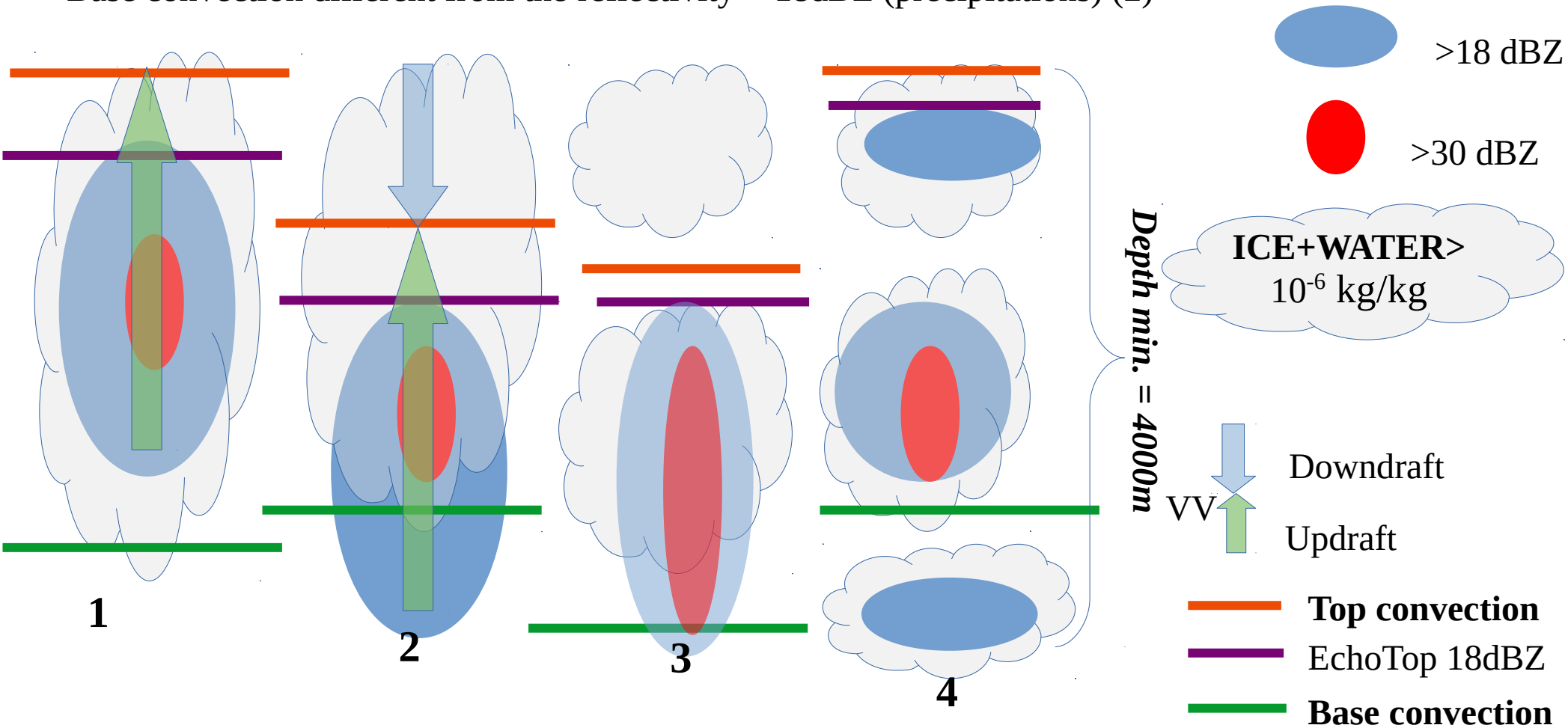run 20220601 00UTC ech 1h

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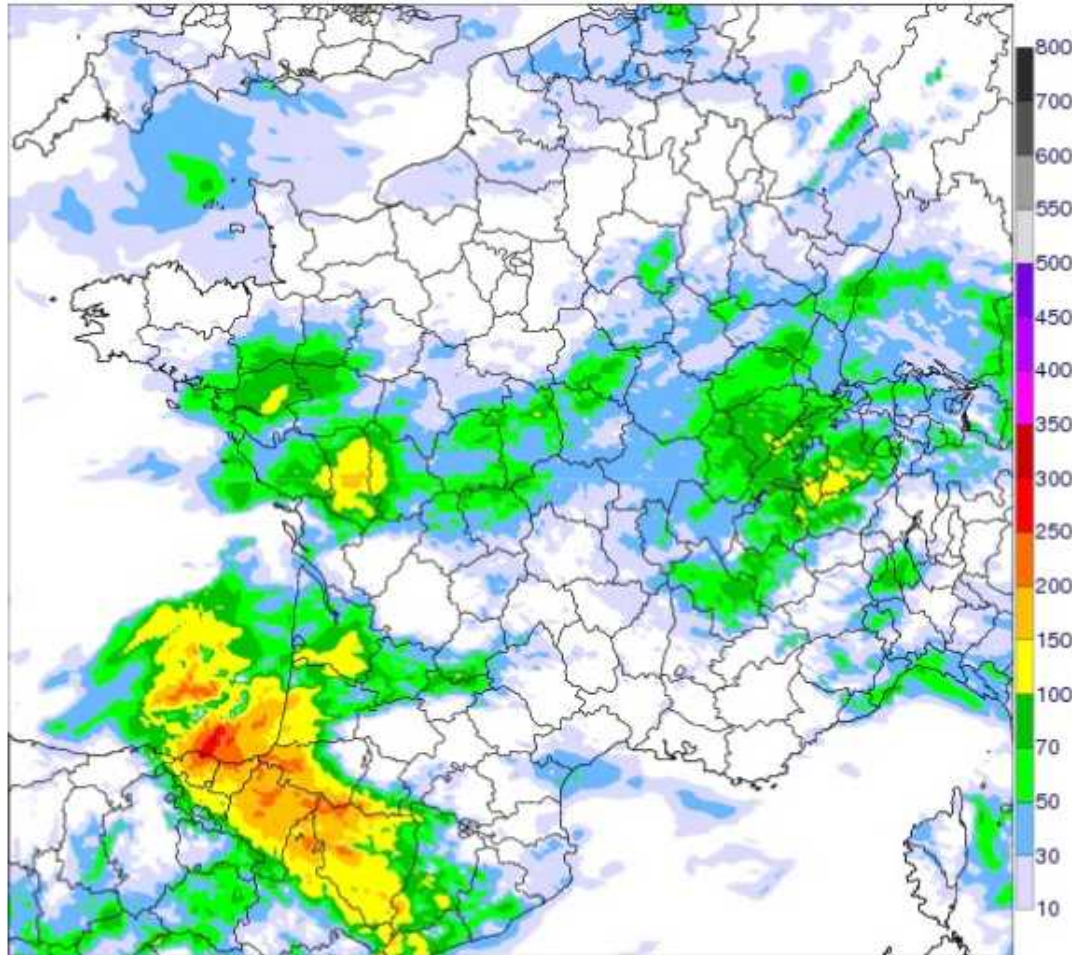
Pressure of the top and base of deep convection

Top convection always above reflectivity > 18dBZ (EchoTop)
Base convection different from the reflectivity > 18dBZ (precipitations) (2)

>18 dBZ

>30 dBZ

ICE+WATER> 10^{-6} kg/kg

Depth min. = 4000m

VV

Downdraft

Updraft

— **Top convection**
— EchoTop 18dBZ
— **Base convection**

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Pressure of the top and base of deep convection

Example PTOP
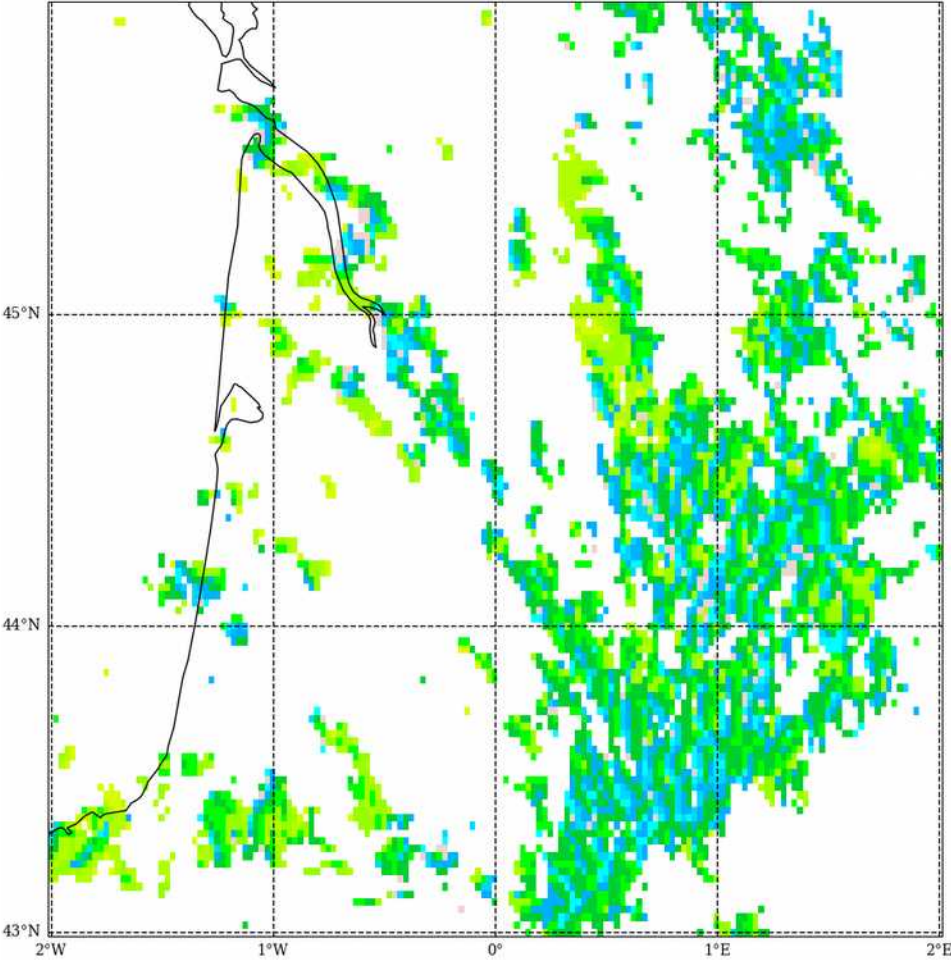
Example PBASE
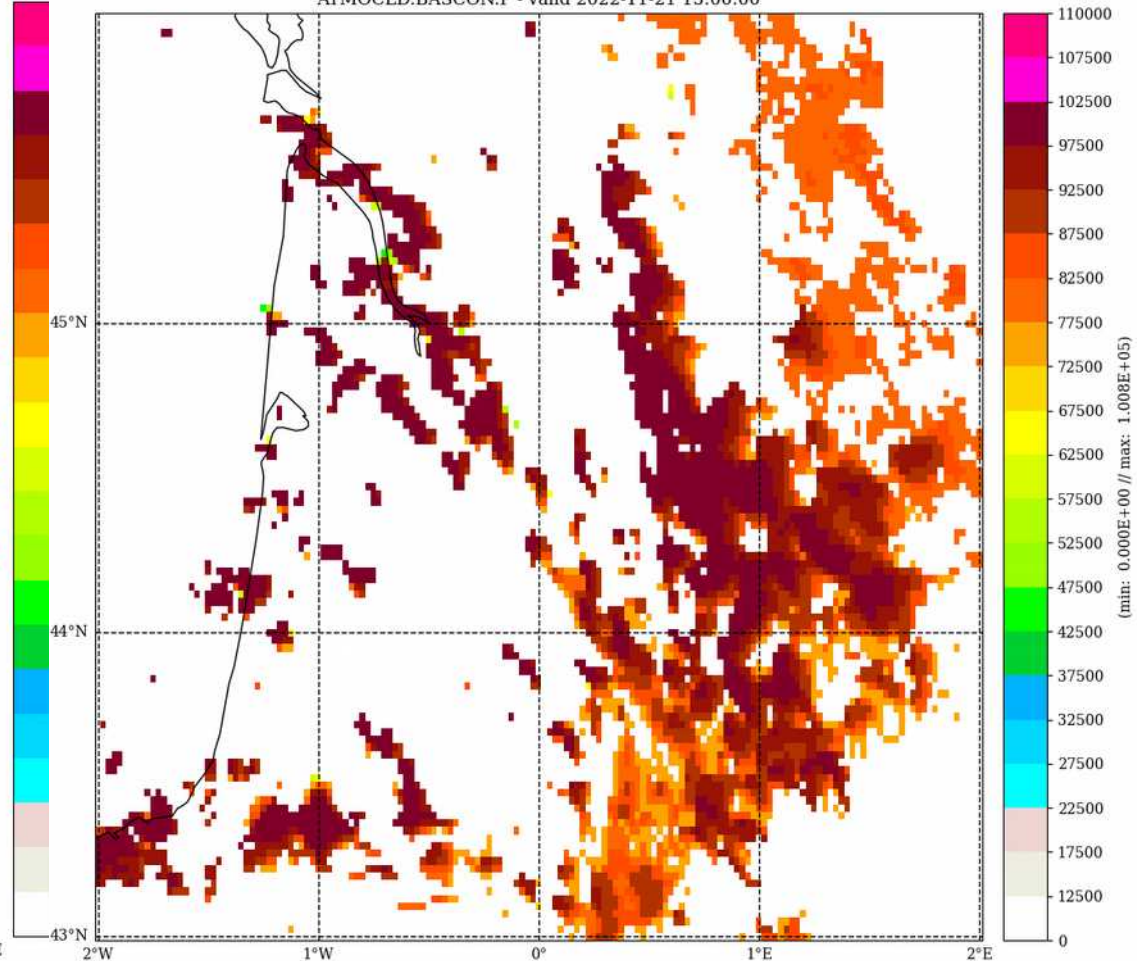
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Thermical vertical velocity

- Developed for gliding

$$V_z = \alpha\,(\beta\,Q_s\,H)^{1/3} \text{ (adapted from J. W. Glendening formula)}$$

- V_z : Thermical vertical velocity

- $\alpha = 1.9$ (tuned by V. Curat)

- β : Buoyancy constant = ratio of g (gravity)/ Ts (mean surface temperature)

- Q_s : Sensible heat flux

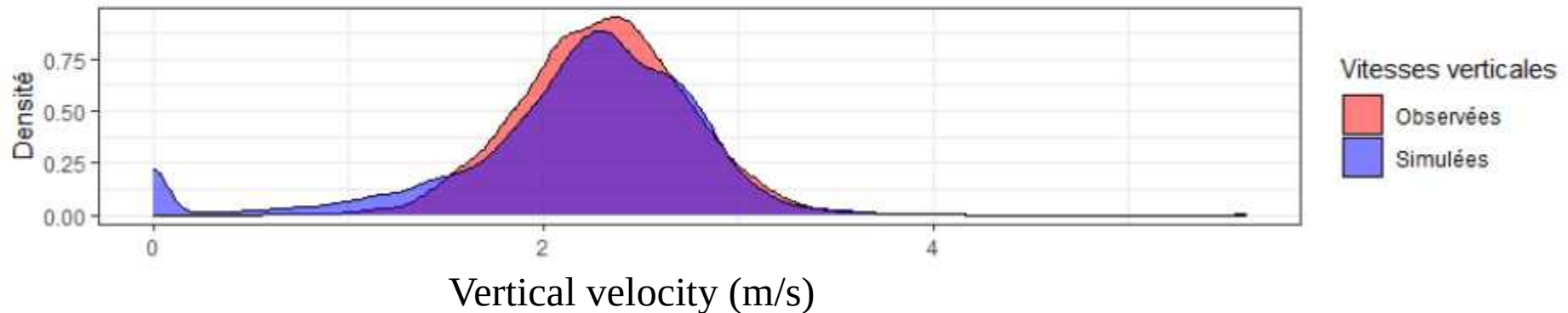- H : Boudary Layer Height

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Thermical vertical velocity
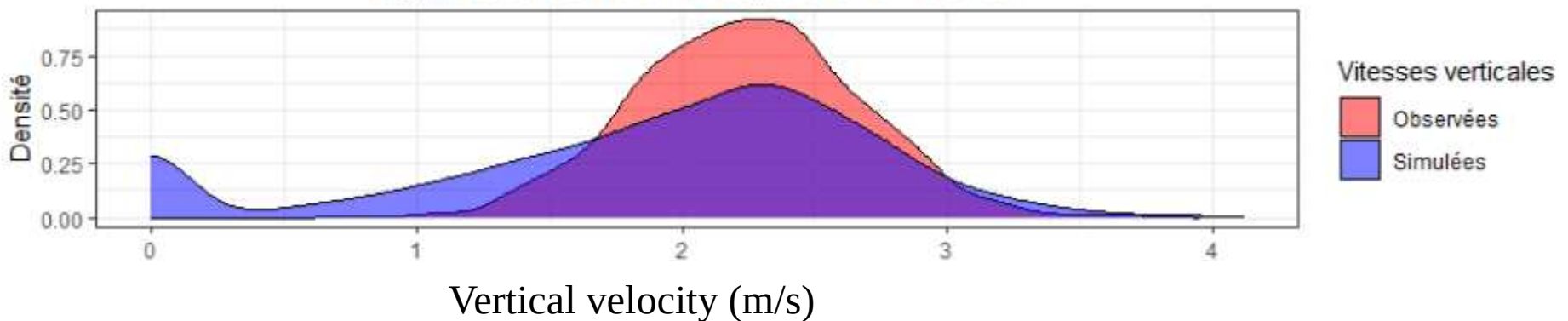
Density of observed and simulated vertical velocities

During several flights

Vertical velocity (m/s)

Only above complex terrain

Vertical velocity (m/s)

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Snow depth diagnostic

- In the code, the SWE is named GFP_SD and described « Snow depth »

- Misunderstanding between Snow Water Equivalent (kg/m²) and Snow Depth (m)

- Needs of forecasters, researchers and customers (trains, road management, etc)

- Snow Depth computed in SURFEX

  Subroutines of exchange between surface and physics are used to output the snow depth

Snow depth diagnostic

Snow Depth
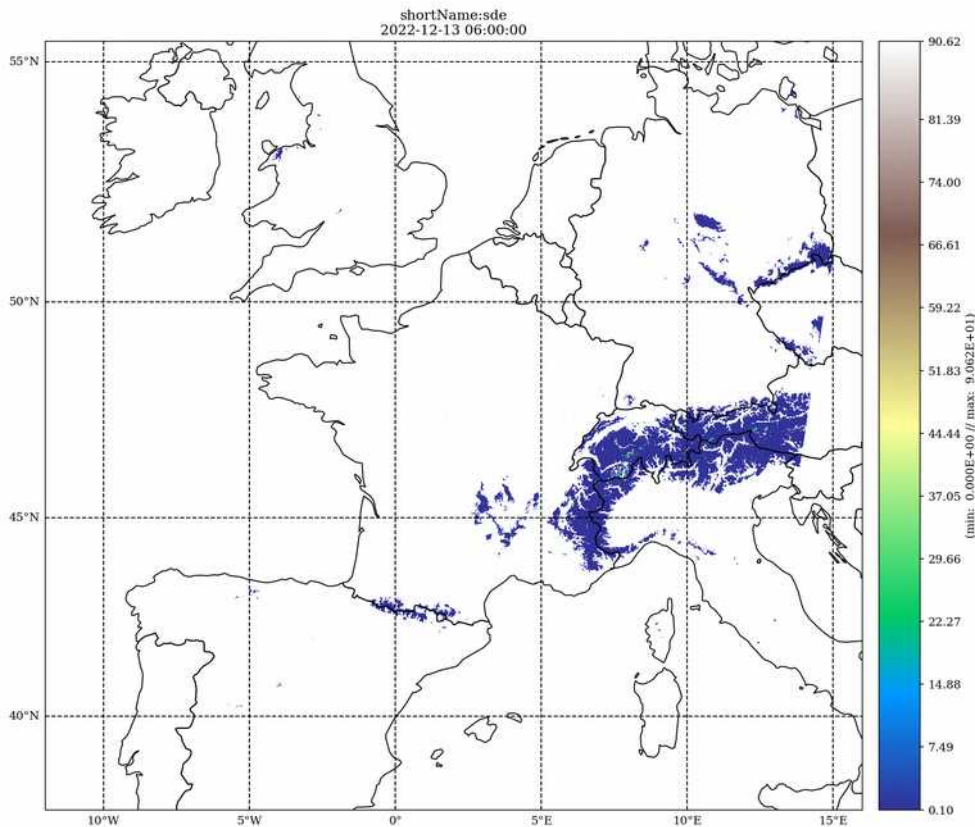
Snow Water Equivalent
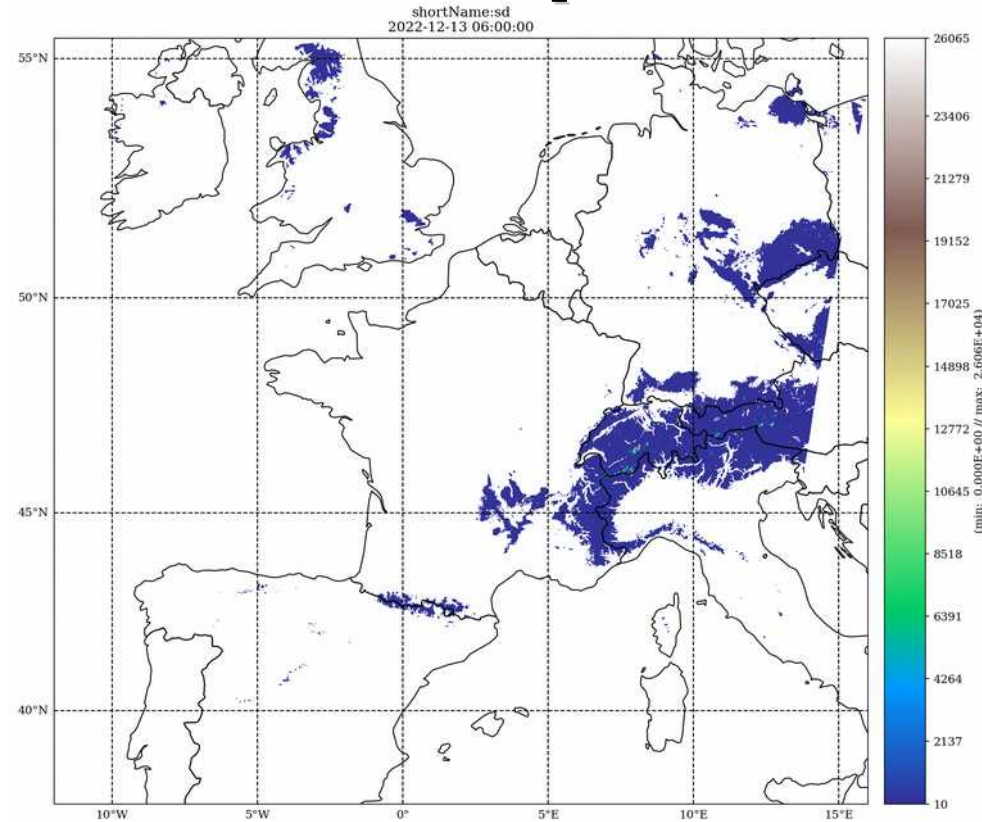
- Good agrement. Differences due to the densiti which varies
- Not trivial to output a SURFEX field via physics. Brainstorming on direct post-processing of SURFEX FA files

Thanks for your attention

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