LIMA: Evaluation and recent developments
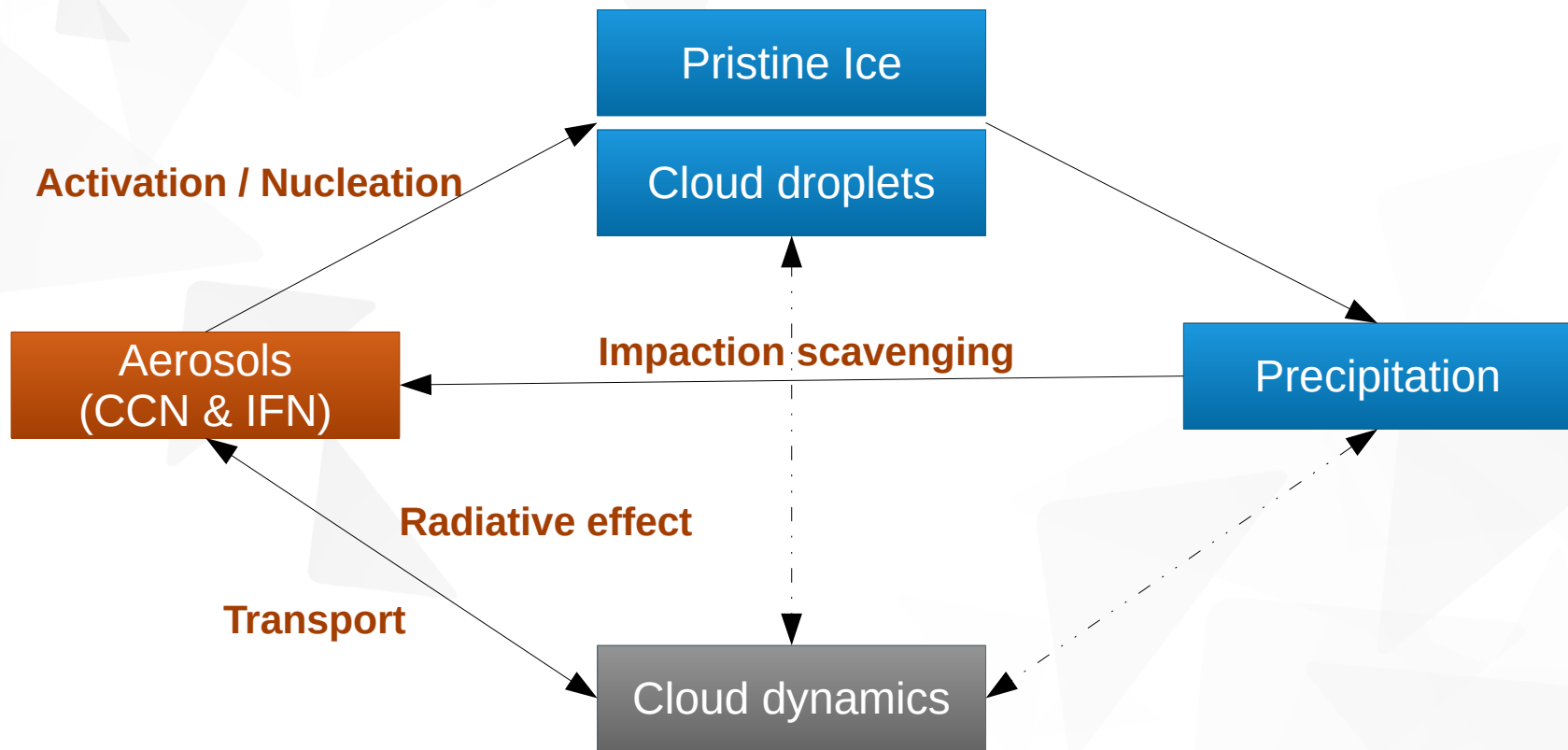
- <u>B. Vié</u>, , M. Taufour, Y. Seity, L. Ducongé, C. Lac
- CNRM, Météo-France/CNRS, Toulouse

Motivations

- Complex aerosols – clouds – precipitations interactions

LIMA: Liquid Ice Multiple Aerosols

◥ 2-moment, mixed-phase microphysical scheme

Droplets	Drops	Ice	Snow	Graupel	Hail
r_c N_c	r_r N_r	r_i N_i	r_s	r_g	r_h

r: mass mixing ratio (kg.kg^{-1})   N: number conc. (#.kg^{-1})

◥ Prognostic aerosol population

    ◥ Interaction with clouds (nucleation …)

    ◥ Resolved and subgrid transport

Vié et al., 2016: LIMA (v1.0): a two-moment microphysical scheme driven by a multimodal population of cloud condensation and ice freezing nuclei, GMD, doi:10.5194/gmd-9-567-2016.

Current implementation of LIMA

- LIMA was integrated in AROME (cycle 42 and 45+)

- Recent developments

  - Revised CCN activation properties, using the "κ-Köhler theory"

  - Internal time-splitting technique

  - Optimization of the splitted sedimentation scheme

  - Improvements and bug fixes

- Aerosol initialization from MACC or MOCAGE data

  - In test for various situations
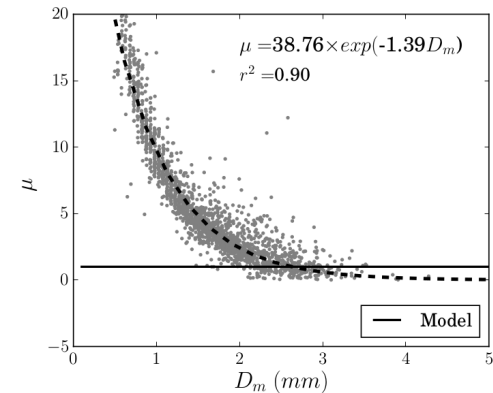
Evaluation for HyMeX deep convection

▾ LIMA represents the cloud composition better than ICE3, but produces too large raindrops

Taufour et al., 2018: Evaluation of the two-moment scheme LIMA based on microphysical observations from the HyMeX campaign, QJRMS, DOI: 10.1002/qj.3283
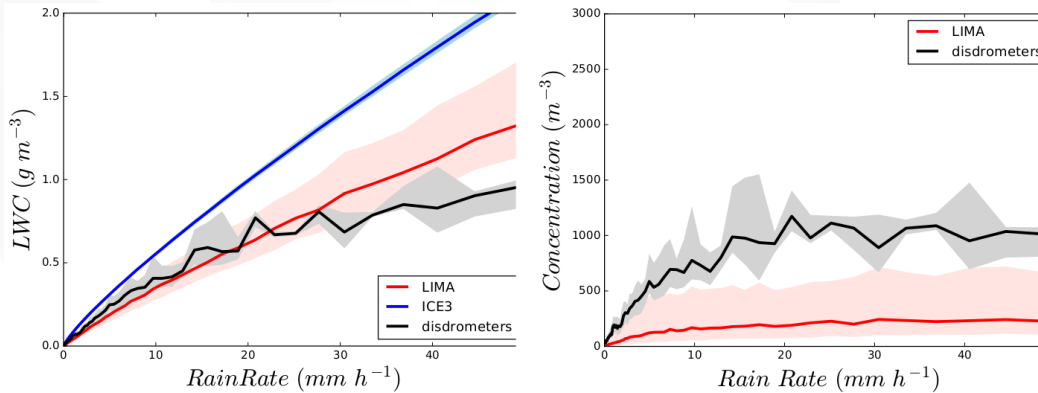
Observed (disdrometers) and simulated rain characteristics, HyMeX IOP 16, 2012/10/26

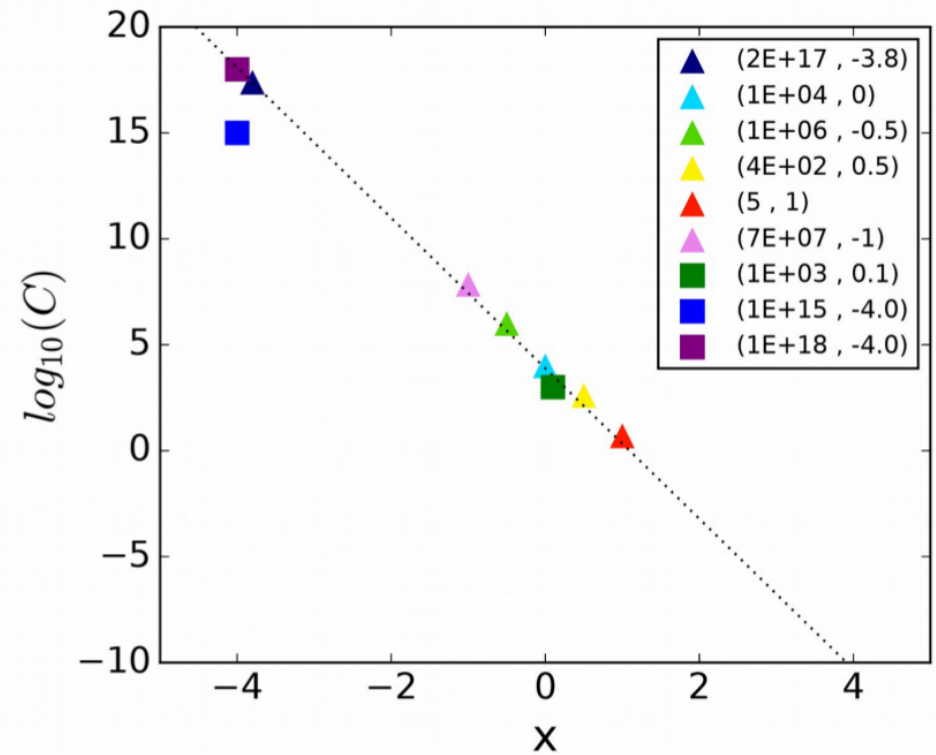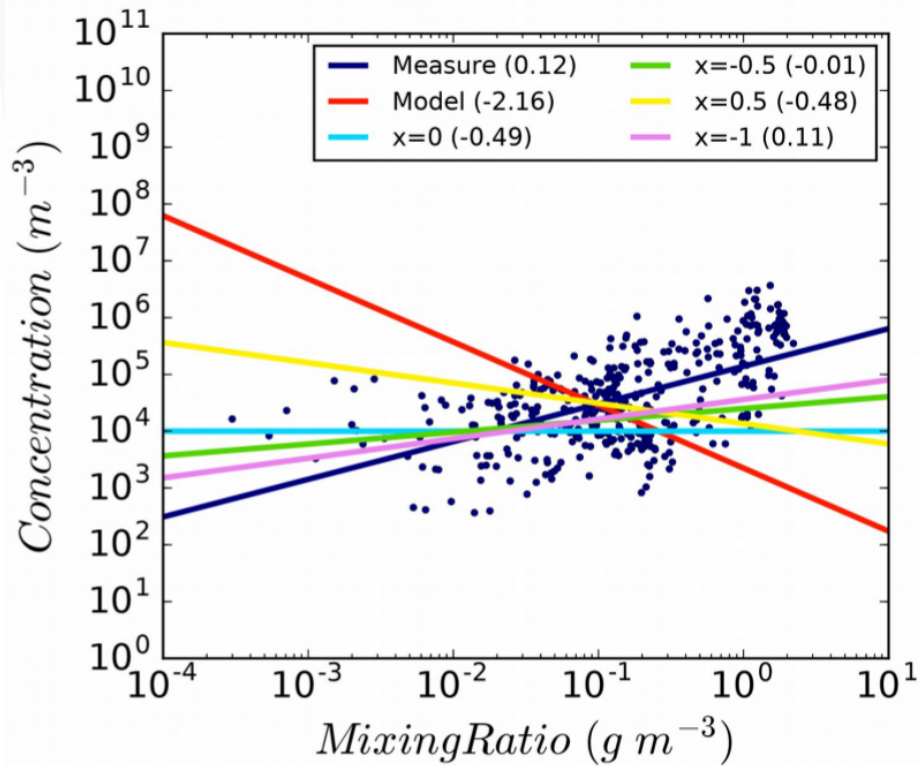*Observed (disdrometers) rain μ-Dm relationship during HyMeX SOP 1*

▾ Improvements (under evaluation)
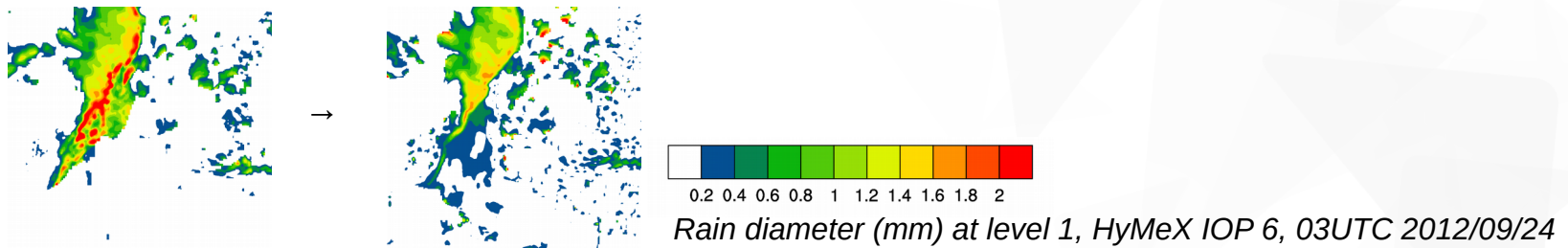
Rain diameter (mm) at level 1, HyMeX IOP 6, 03UTC 2012/09/24
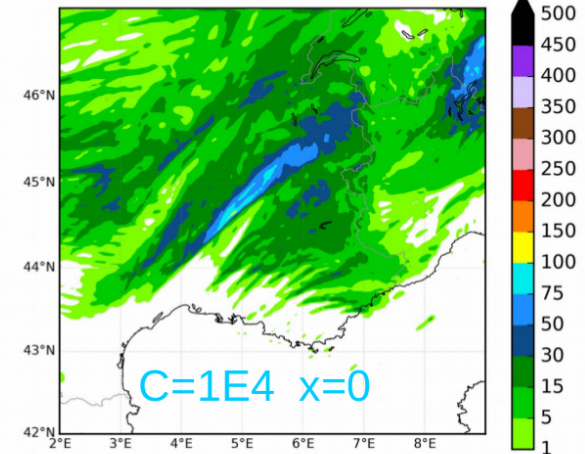
LIMA: Evaluation for deep convection
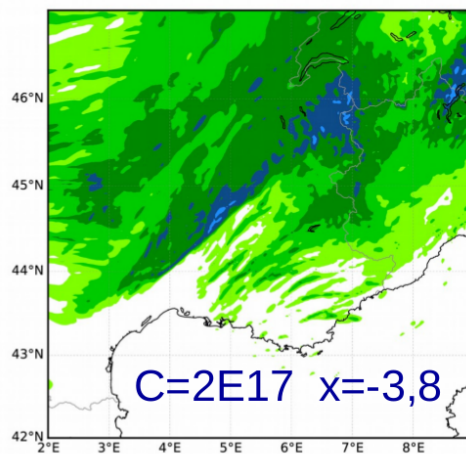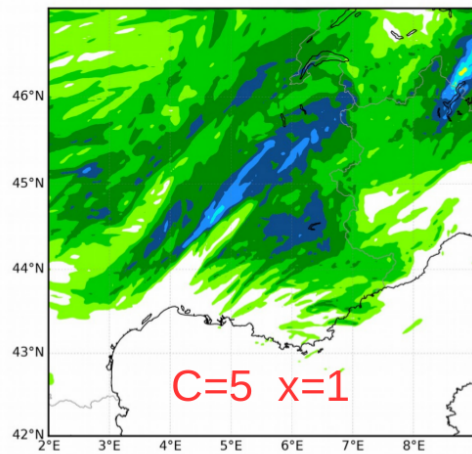
◥ Snow diagnostic number concentration

◥ Ns = C · λˣ

LIMA: Evaluation for deep convection

HyMeX IOP 6: 12-h accumulated precipitation, 2012/09/24, 12UTC
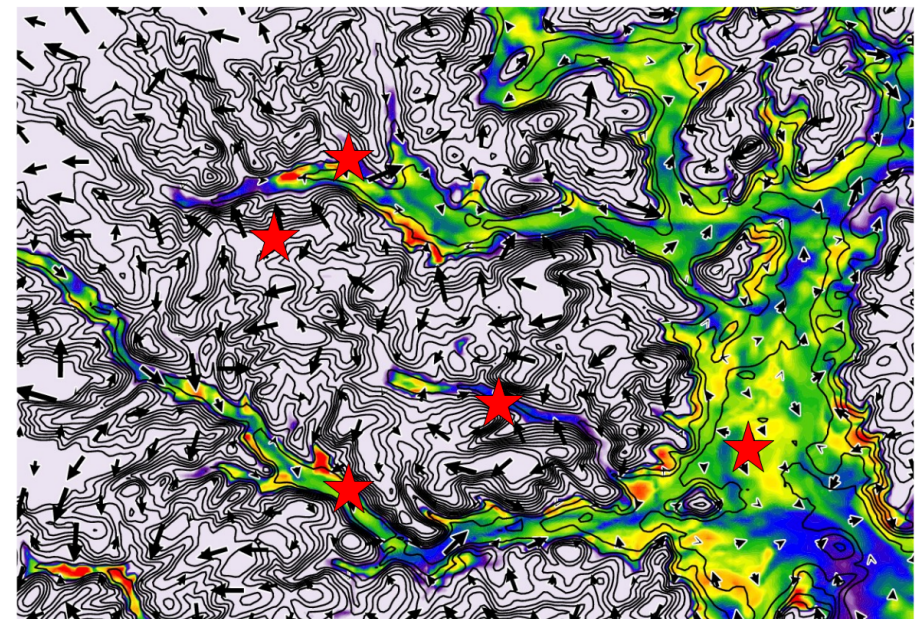

Two-moment microphysics for AROME
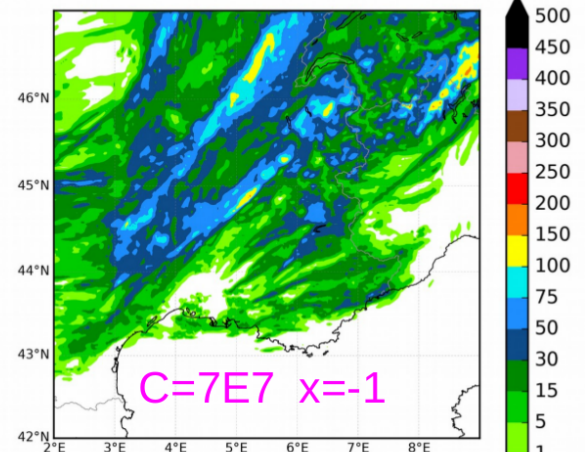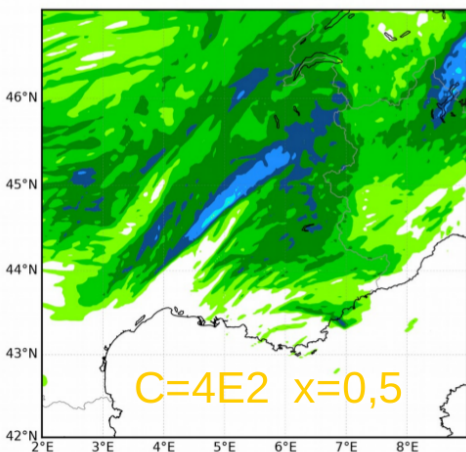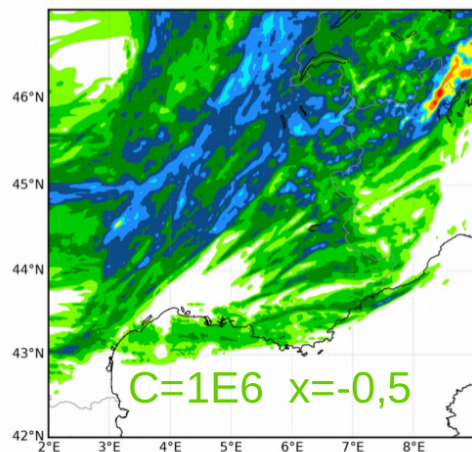
LIMA: Evaluation for deep convection
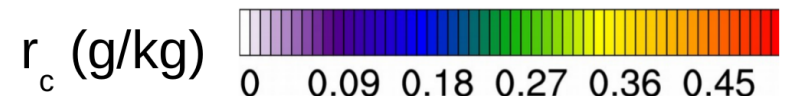
HyMeX IOP 16: 24-h accumulated precipitation, 2012/10/27, 00UTC
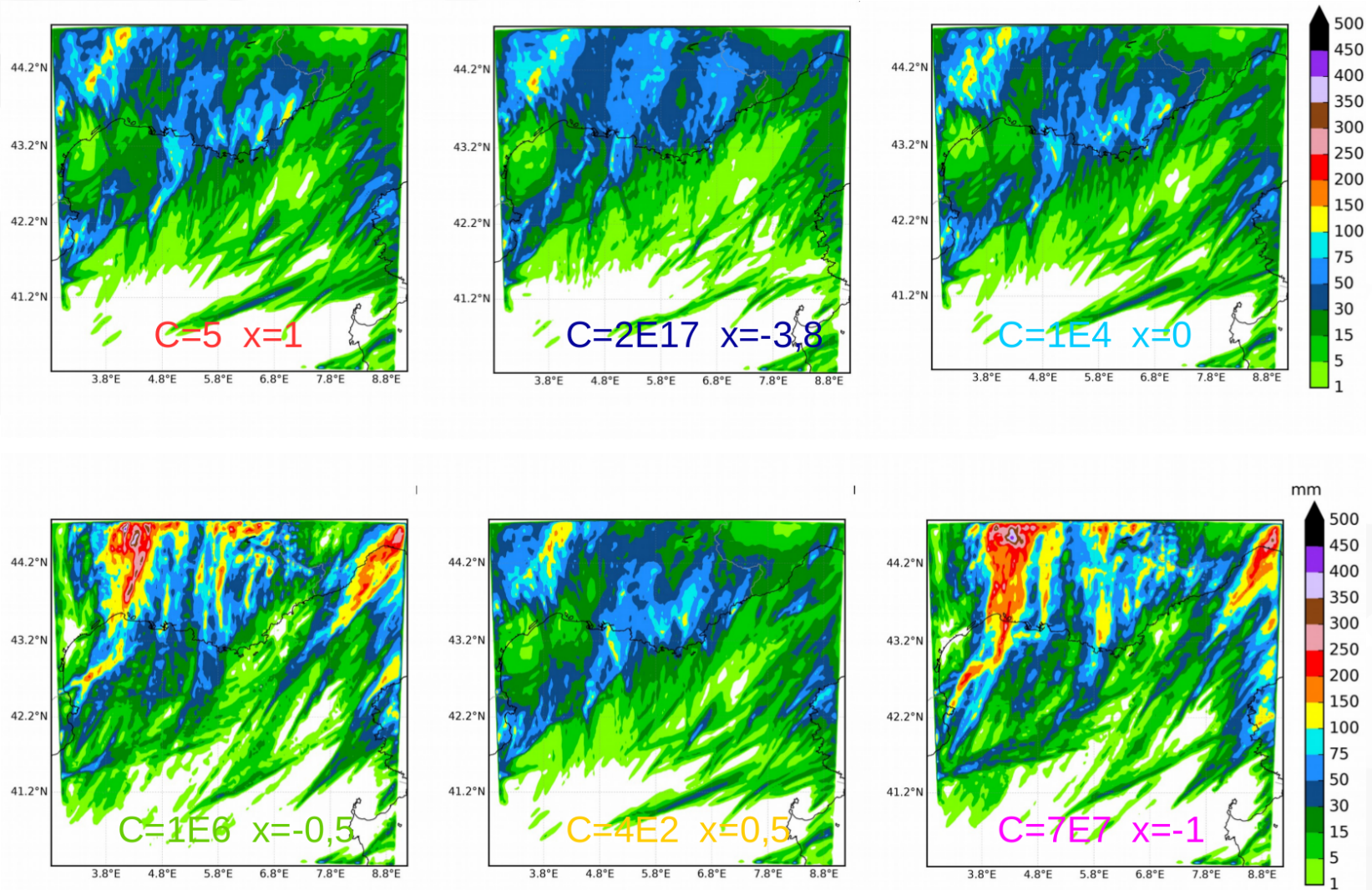
LIMA: Evaluation for fog situations

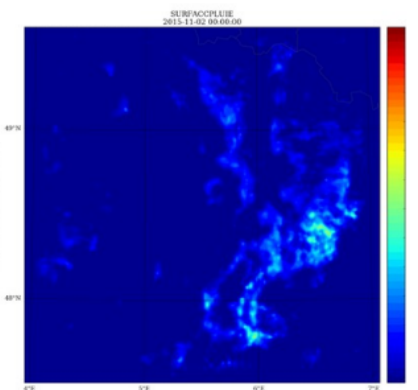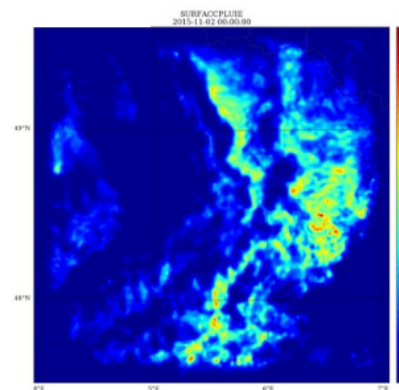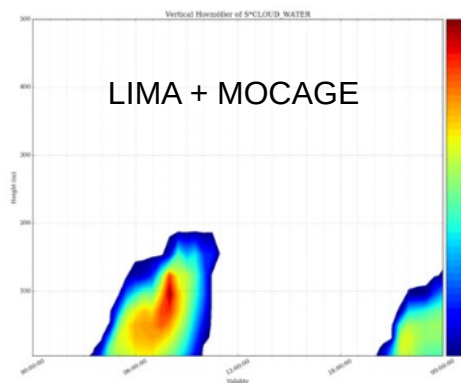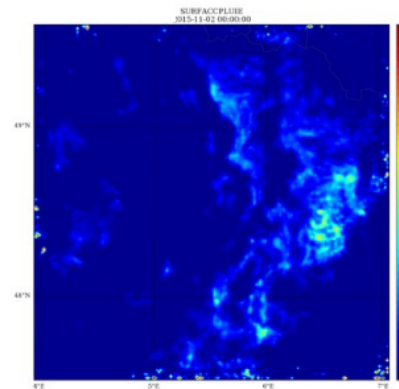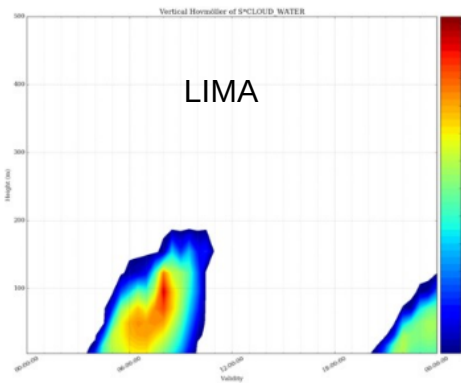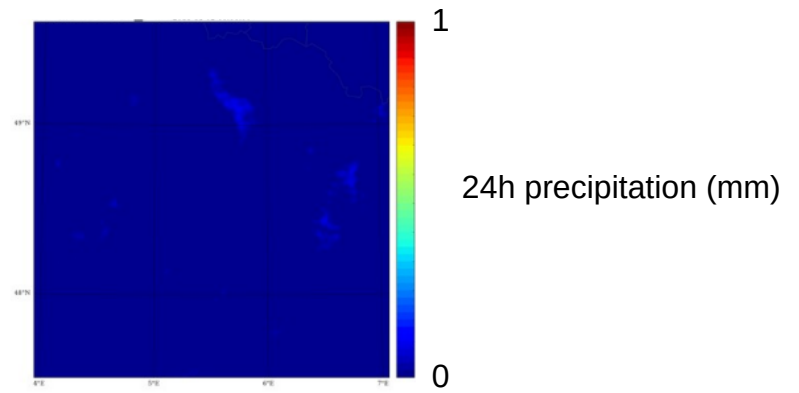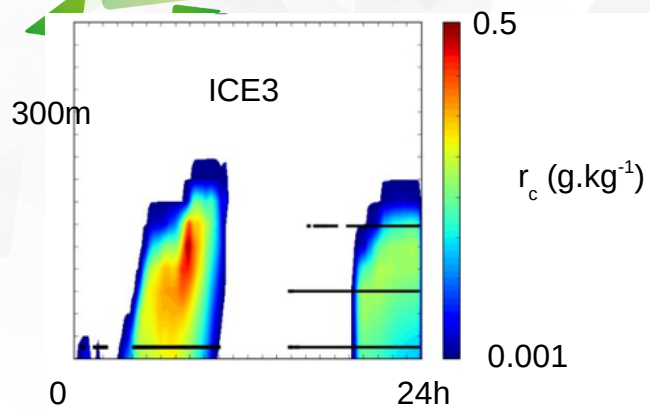- LES of fog at SIRTA
  - Droplets sedimentation
  - Droplets deposition
  - Account for cooling in the diagnostic supersaturation

- LES of fog for Lanfex cases →

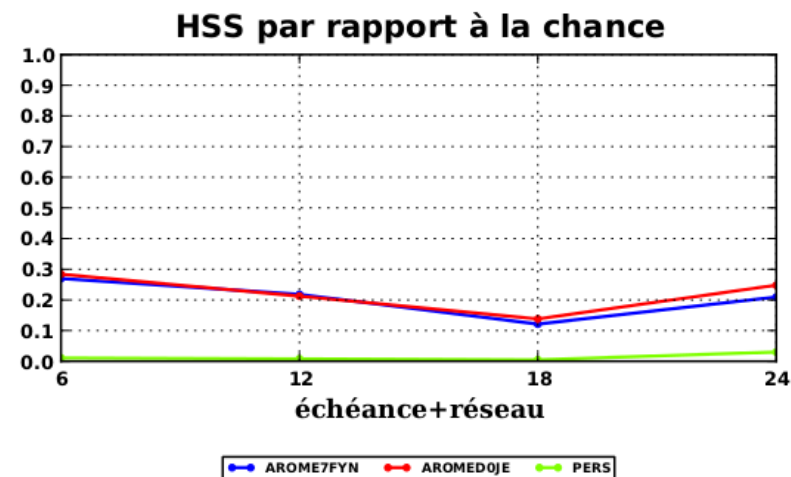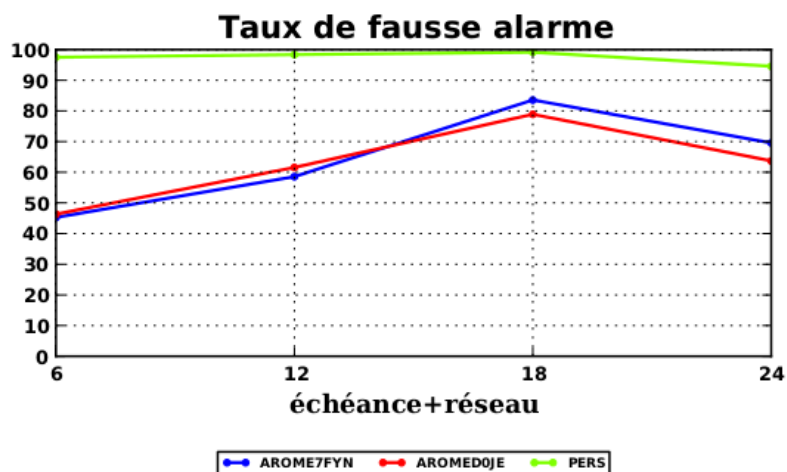*Lanfex IOP 12: 2-m cloud water mixing ratio at 01UTC, 2015/10/02*

r_c (g/kg)

0   0.09 0.18 0.27 0.36 0.45

Aerosol initialization: Bure, 2015/11/01

ICE3

300m

r_c (g.kg^{-1})

0.5

0.001

0

24h

24h precipitation (mm)

1

0

LIMA

LIMA + MACC

LIMA + MOCAGE
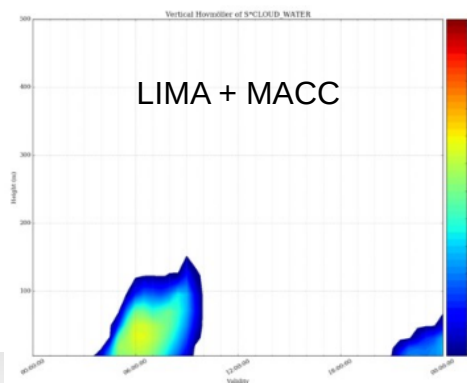
LIMA (old version): 1-month scores

LIMA

ICE3

20160316-20160417, 6-h accumulated precipitation, 10mm threshold
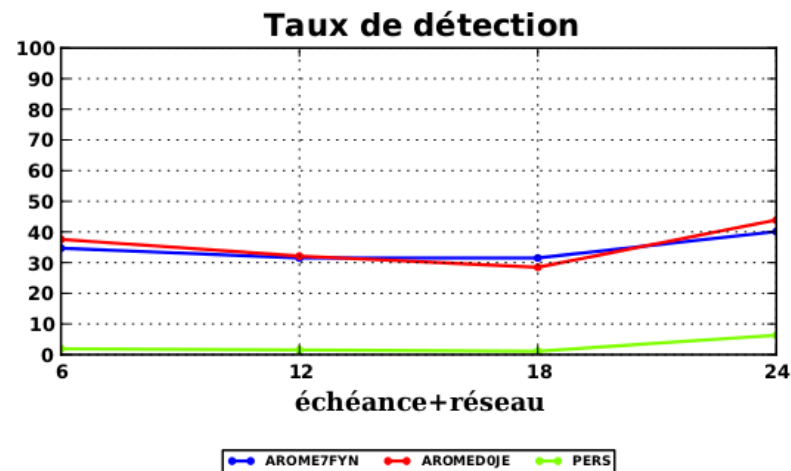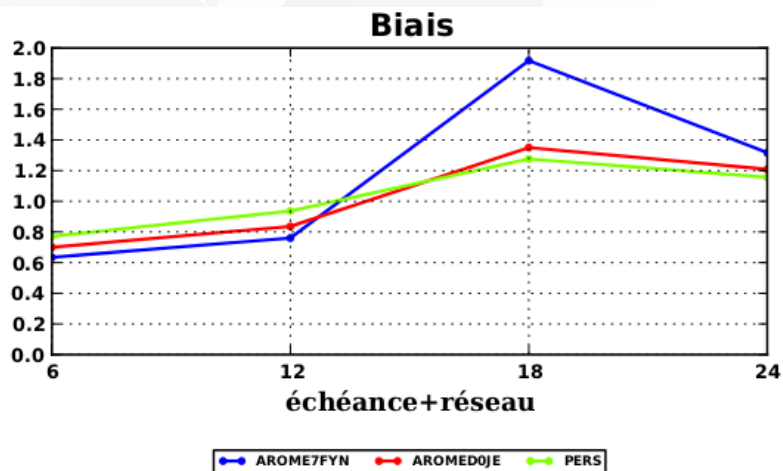
DPREVI/COMPAS 11-January-2017

Two-moment microphysics for AROME

Conclusion & prospects

- Thorough evaluation of LIMA (convection, fog, cyclones…)
  - Input from Karl-Ivar and Daniel will be interesting

- Be careful when changing parameters !

- Scheme efficiency
  - Currently, 8 new prognostic variables result in +30% computing time

- Subgrid cloud fraction

- Aerosol initialization from MACC and MOCAGE

To be continued…

2016 05 12, Low clouds in front of the Pyrénées