



# What can we expect from MUSC after the winter (Dec. 2016) working days ?

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# Outline

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- Brief history of MUSC
- Status of MUSC and problem of validations
- Available cases for the MUSC common version & some results
- Other interesting case ?
- 1D testbed on several sites observations



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# Brief history of MUSC

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- MUSC exists since the cy32 (developed by S. Malardel) but since her departure the maintenance and the development have been postponed or done for specific 1D intercomparison GABLS3 or physics validation (TKE+KFB)
- The main advantage of MUSC should be “to be fully integrated“ in the 3D model but unfortunately for several reasons (time, manpower, surfex version, forcing options etc .. ) it is not the case
- 78 routines in src/local for MUSC !

From ASM 2011 E. BAZILE et al



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## Possible perspectives:

- Phase the modifications on a CY37T2 or CY38
- Put all the modifications for SURFEX in V7
- Add a logical (LMUSC) for the specific diagnostics used in 1D in the physics subroutine.
  - IF (LMUSC) CALL WRSCRM or WRAROM
- Add new cases: deep convection,...
- Thanks to the LES results and/or observations → an improved understanding of the behaviour of our physical packages → That's in fact the main GOAL of this tool !

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- Phase the modifications on a CY37T2 or CY38 **NOT DONE!**
- Put all the modifications for SURFEX in V7 **NOT DONE!**
- Add a logical (LMUSC) for the specific diagnostics used in 1D in the physics subroutine.
  - IF (LMUSC) CALL WRSCRM or WRAROM **OK**
- Add new cases: deep convection,...**PARTLY**
- Thanks to the LES results and/or observations → an improved understanding of the behaviour of our physical packages → That's in fact the main **GOAL** of this tool !

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# Status of MUSC and validation problems

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1. Cy38t1 op1 (MF) et cy38h1.1 (HIRLAM) with SURFEX 7.2
  1. Problem : cycle “op” is not an export version
  2. Cy38h1.2 contains already some modifications compared to the export version:
    1. radiation modification
    2. OCND2
    3. HARATU
    4. Surfex
- For each cycle MUSC is validated only on ARM-Cu but without SURFEX and with only soimple constant forcing → partial validation
1. Additional modifications for more cases and specific 1D modification:
  1. in mse: read\_surfx1\_aro.F90 read\_surfx2\_aro.F90
  2. in Surfex for surface forcing : fluxes, prescribed Ts over land or over sea
  3. In arp for new type of atmospheric forcing such as variable nudging , variable geos. Wind. Etc ..



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# Status of MUSC and validation problems

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- Cy41t1op1 (MF) with SURFEX 7.3
  - contains already OCND2 and HIRLAM radiations modifications but not HARATU
- Less (!) additional modifications for more cases and specific 1D modification:
  - in surfex for surface forcing : fluxes, prescribed Ts over land or over sea . Technical aspect for the date coding
  - In arp for new type of atmospheric forcing such as variable nudging , variable geos. Wind. Etc ..
- For cy43 with SURFEX V8 : all the 1D modifications should be included BUT not yet validated (only in mitraille). Potential problem with SURFEX due to the removal of lfi file format → recreate or convert all the PGD and PREP files to FA format and run all the 1D cases !
- For the next validated MUSC version at MF, probably cy42op1 will be used
- For HIRLAM 40h1.1 contains HARATU, OCDN2 update, radiation update & SURFEX 7.3. No “h” created on version cy41 and cy42 → directly to 43h1.2 based on 43t1



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# 1D Case available in the common MUSC

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## Common validated case in MUSC cy38t1 and cy38h1 (?)

- “Validated” means exactly same results in both side t and h for :
  - basic configuration such as AROME/ARPEGE
  - HARMONIE config so : EDMF, OCND2, RADIATION modset and HARATU
- GABLS1 (dry case:  $Q_v=0.$ , no rad) **Validated** still a problem (both side) with HARATU due to probably the vertical discretization or the top model (400m)
- GABLS4 (ideal case  $Q_v=0$ , no rad) **Validated**
- GABLS4 (real case) **Partly Validated = OK for EDMF & Radiation modset BUT very small differences with HARATU**
- **ASTEX\_Lag & COMPOSITE : Partly Validated = OK for EDMF & Radiation modset BUT very small differences with HARATU**
- The back phased OCND2 not yet validated in MUSC cy38t1op1 (MF version)
- **ARM-Cu OK for AROME and EDMF and very small differences with HARATU**



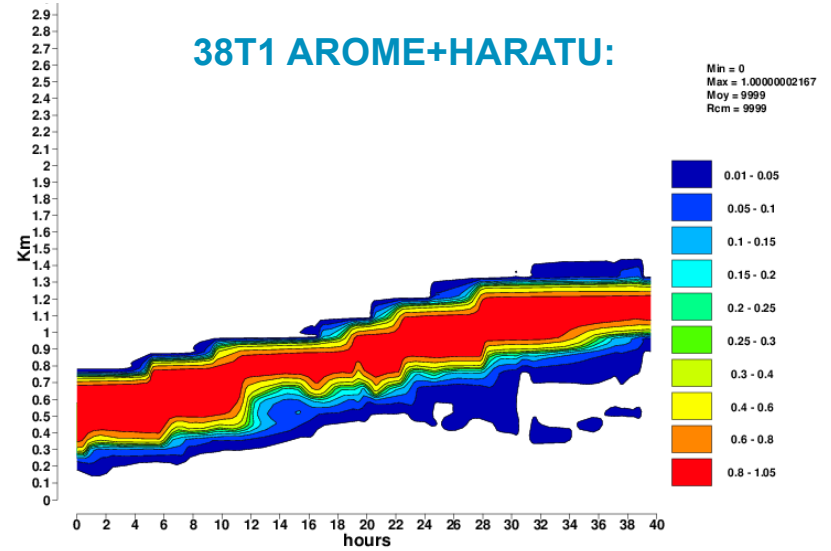
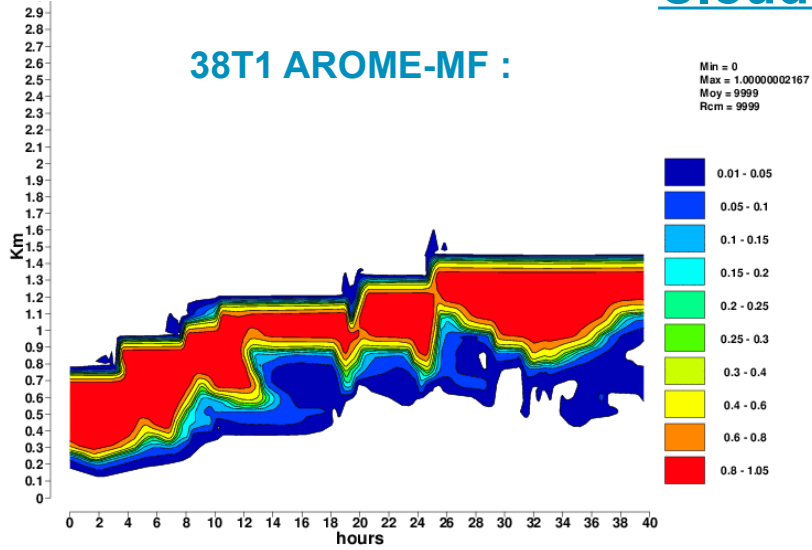
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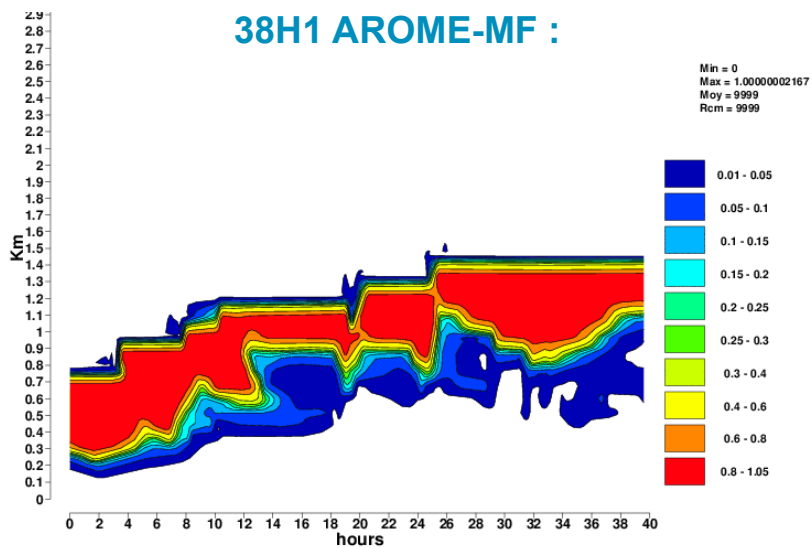


# ASTEX Case in CY38

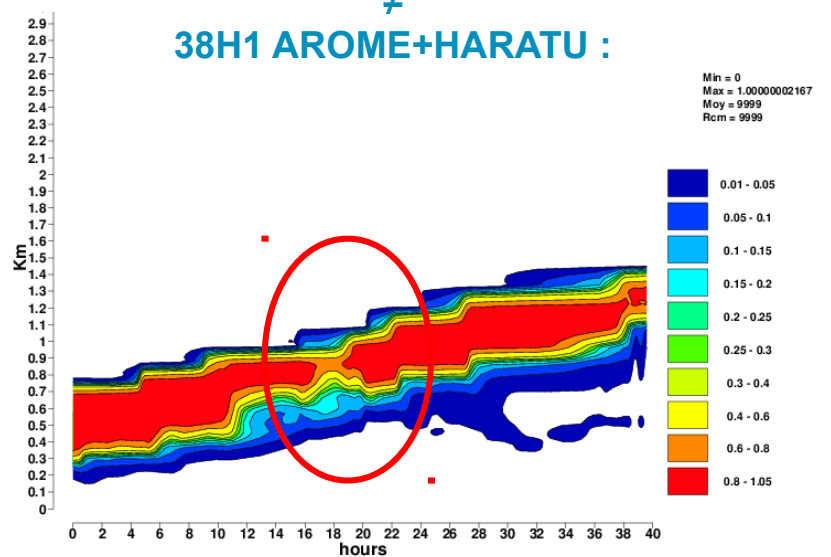
## Cloud cover :



=

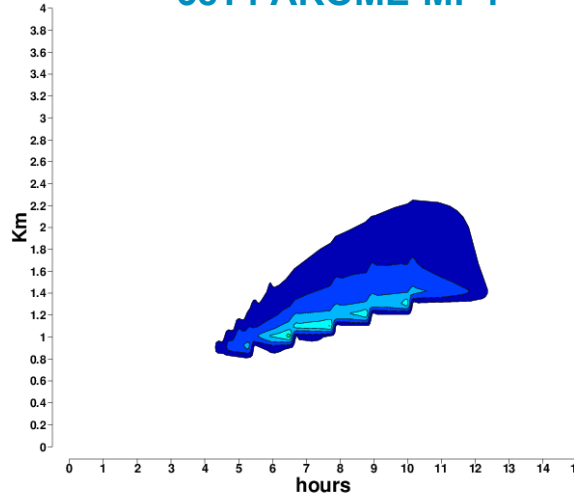


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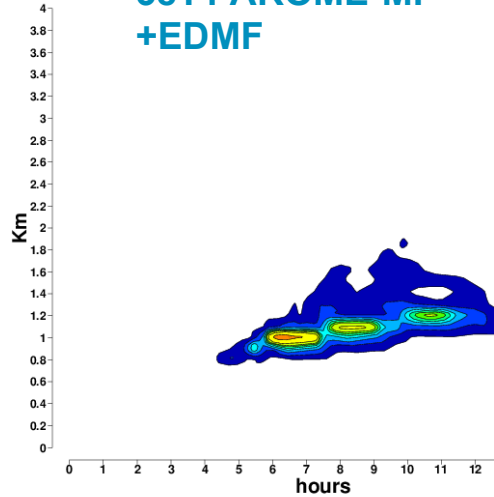


# ARM-Cu Case in CY38: Cloud Cover

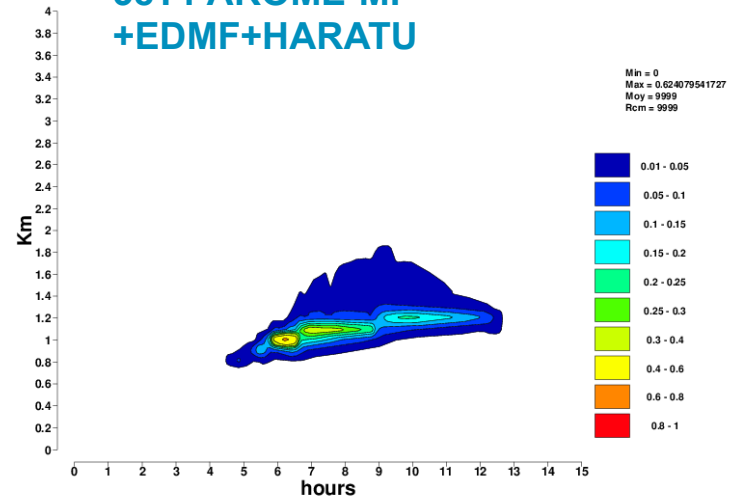
38T1 AROME-MF :



38T1 AROME-MF  
+EDMF

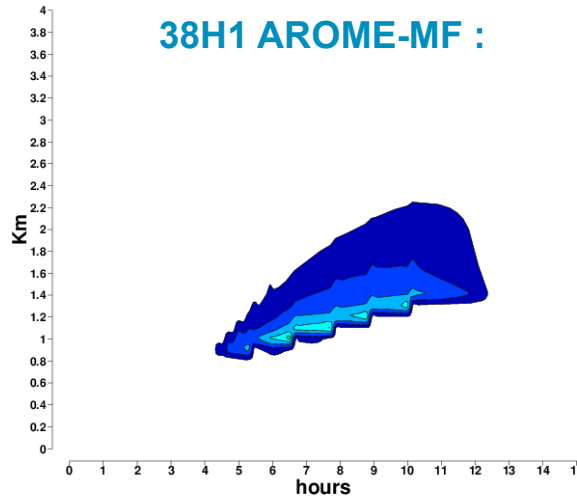


38T1 AROME-MF  
+EDMF+HARATU



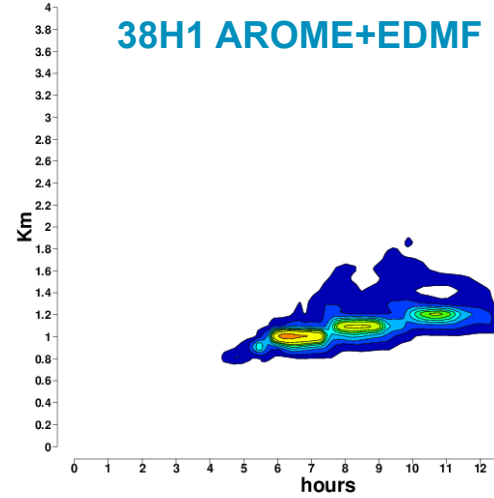
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38H1 AROME-MF :



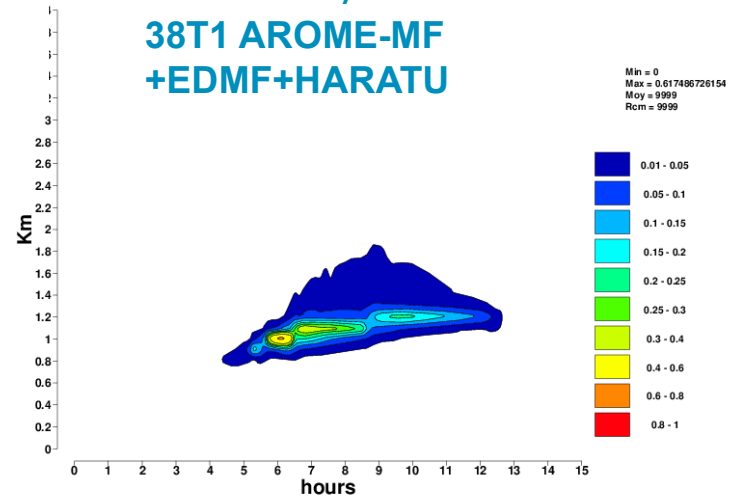
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38H1 AROME+EDMF :



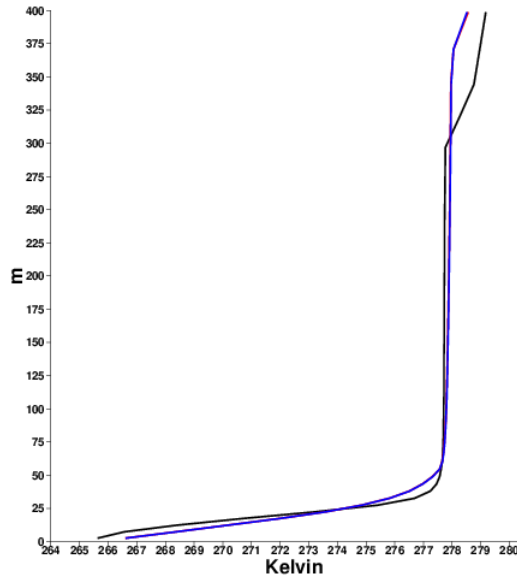
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38T1 AROME-MF  
+EDMF+HARATU

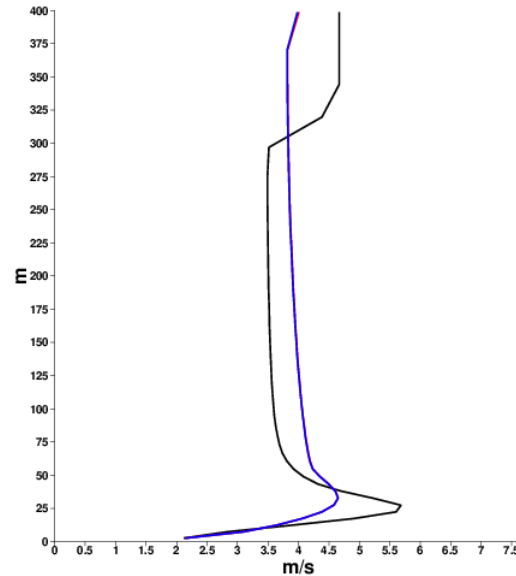


# GABLS4: ideal Case stage 3 in CY38

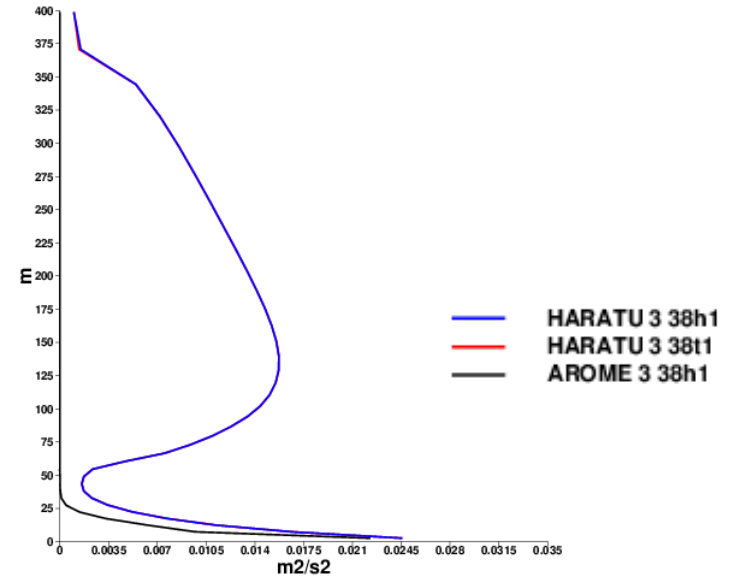
THETA at +18TU



Wind at +18TU



TKE +18TU



- Suspicious results with HARATU on GABLS4 ideal case but in both side (!) with a residual TKE above the LLJ

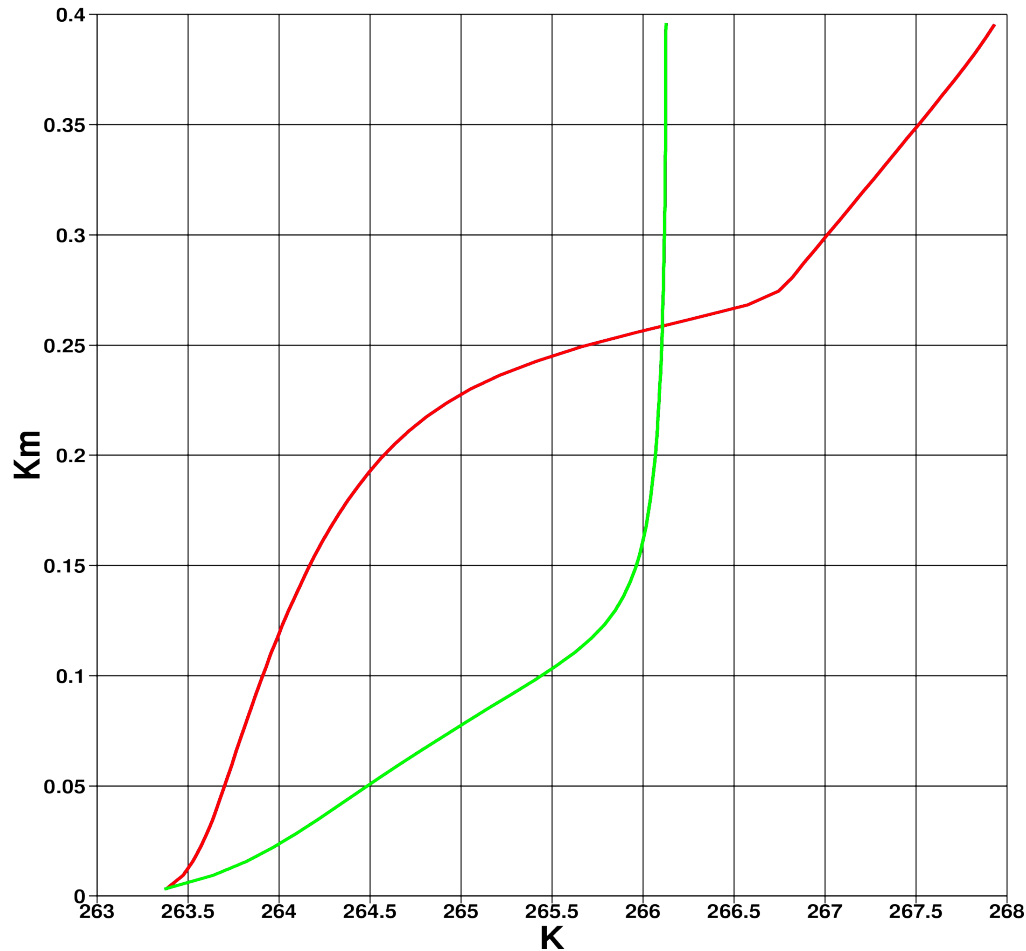


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# GABLS1 Case in CY38

THETA at +9TU :



•“Crazy” results results with HARATU on GABLS1 (again in both side) probably due to a weaknesses in the code related with the model top or with  $Q_v=0$ .

— 38t1/38h1 HARATU  
— 38t1 AROME-MF  
— 38h1 AROME-MF



# Other interesting case ....

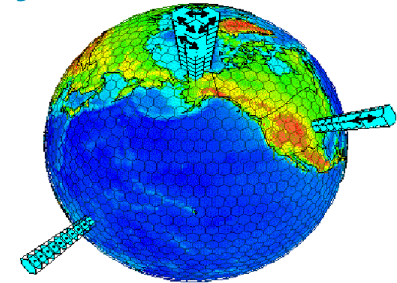
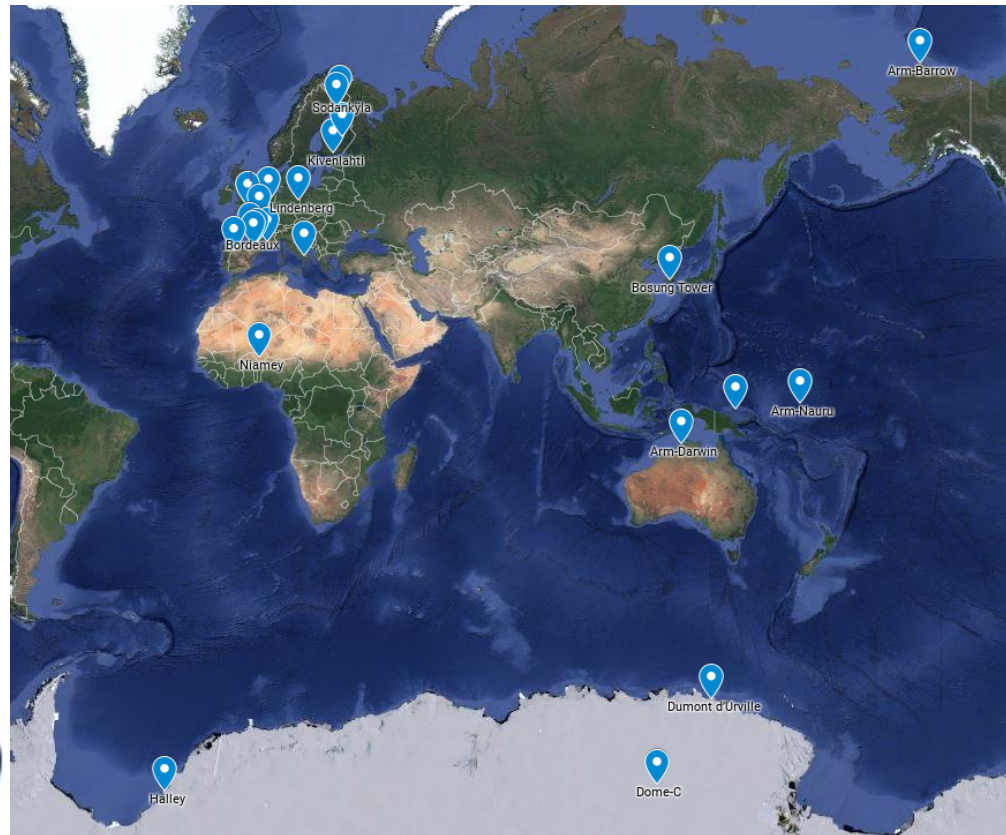
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- **Never implemented in MUSC:**
  - **Convective Boundary Layer without condensation: IHOP (2002), Wangara, Ayotte, AMMA 5/06/2006**
  - **Cumulus: SCMF over land new case (Florida) (more details in F. Couvreux's talk )**
  - **Stratocumulus : DYCMONS2 (night)**
  - **Oceanic Deep Convection : TOGA-COARE**
- **Used in some old versions of MUSC:**
  - **Cumulus over sea :**
    - **BOMEX (now available in MUSC cy41t1op1) ,**
    - **RICO-composite (Climate group in MUSC cy37 + Surfex 7.3)**
  - **Stratocumulus : FIRE-I (juillet 1987) Continental Deep Convection :ARM (27-28/06/1997) , AMMA 10/07/ 2006 (project FP7/EMBRACE; ANR/DECAF), CINDY-DYNAMO, Eurocs-Idealized humidity case (Climate group in MUSC cy37 + Surfex 7.3)**
  - **Stable Boundary Layer : GABLS cases 2 et 3**



# Operational output and tools for diagnostics :

- From the global model ARPEGE (since 2005) : several profiles (25) on site observation are saved with all the variables and the fluxes from the physics on the model levels (hourly)  $\diamond$  compute budget, advection (useful for 1D or LES simulation) etc ....up to 78h (since 12/2015). Long time series, available in NetCDF.
- Comparison on site observation: Cabauw, Lindenberg, Sodankyla, Chilbolton ARM-site : Barrow, SGP used for the CAUSES intercomparison



- Cabauw, Sodankyla, Sirta since June 2004
- Arm-Barrow, Lindenberg since 2005, Eureka since 2007
- Dome-C since 09/2011



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# Next ....

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- **1D Cases are very useful to develop AND VALIDATE physical parametrization**  
→ reduce the risk of compensating errors. Easier to compare with other models, LES results are essential to validate in deep the parameterization
- **Can we use MUSC more ?**
  - to better understand the low level cloud formation sensitivity due to the different PBL ?
  - to validate new options against super site observations for a long time period ? A Generalized Testbed by using ARPEGE-forcing ?
- **How to proceed to :**
  - **Validate on a new cycle MUSC on all the existing cases ? It is not an easy task ...never done**
  - **Have a common repository between “h” and “t” for MUSC ? May be first with cy38 and next which version cy43(th)1 ?**



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