Precipitation underestimated at inflow boundary in HCLIM-AROME

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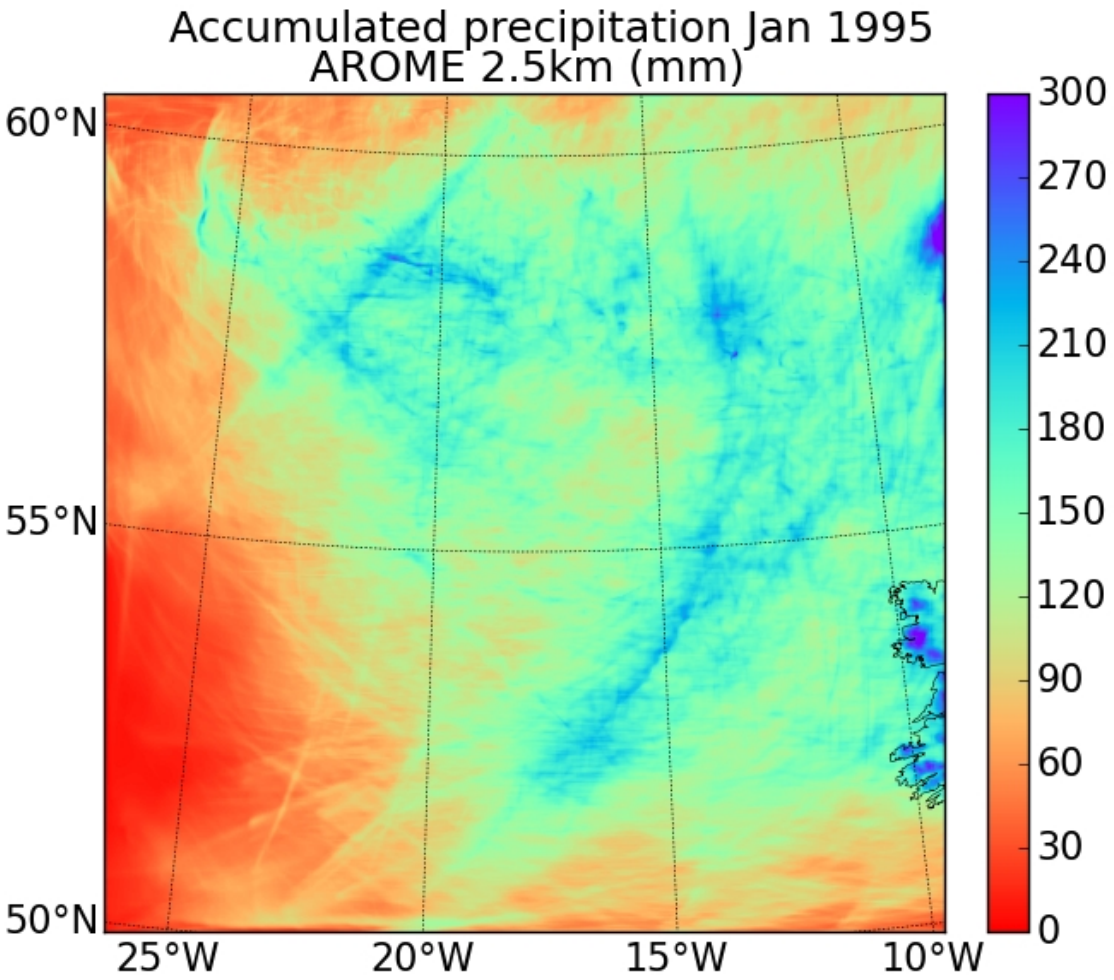
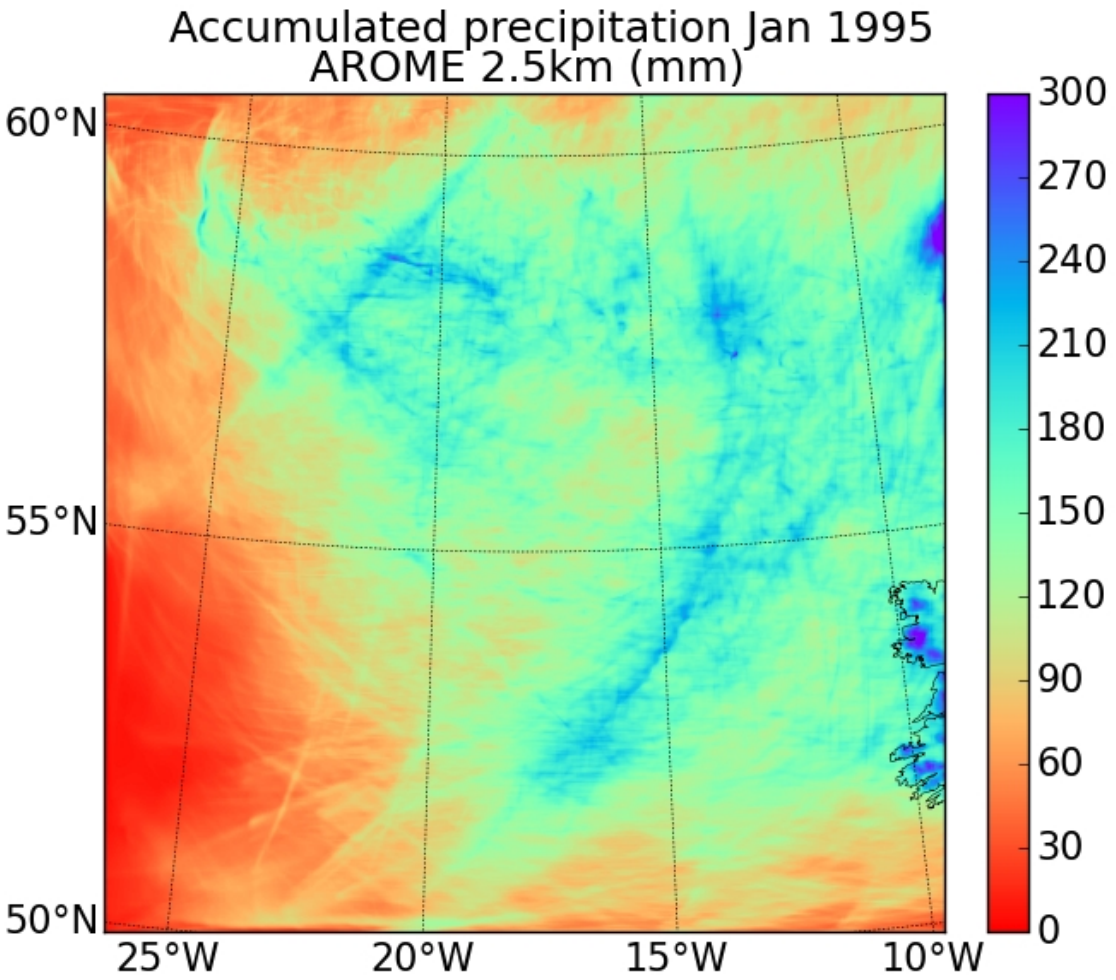
Thanks to: Ulf Andrae, Karl-Ivar Ivarsson, discussion with many other colleagues, persons who give a good comment at the end of this talk

HCLIM-AROME with ERA-I forcing

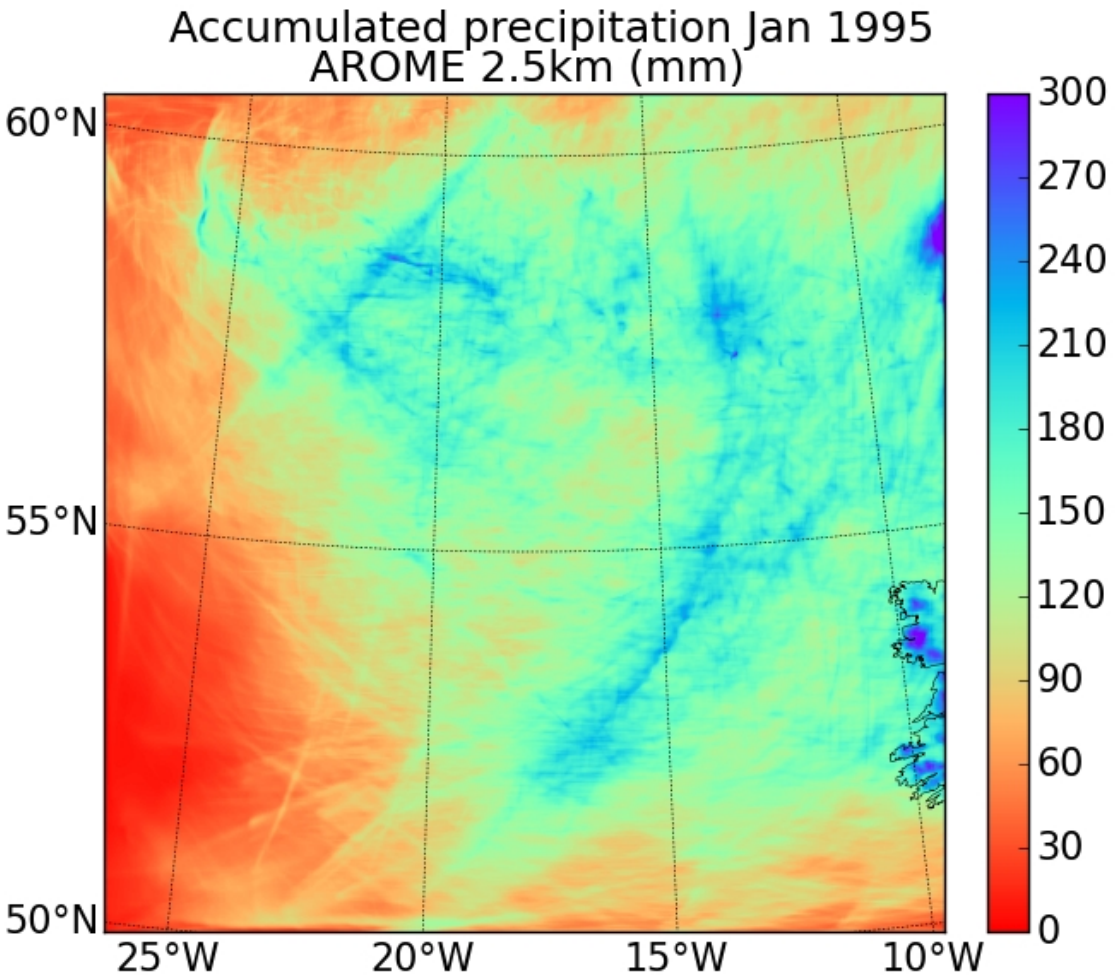


HCLIM-AROME with ERA-I forcing



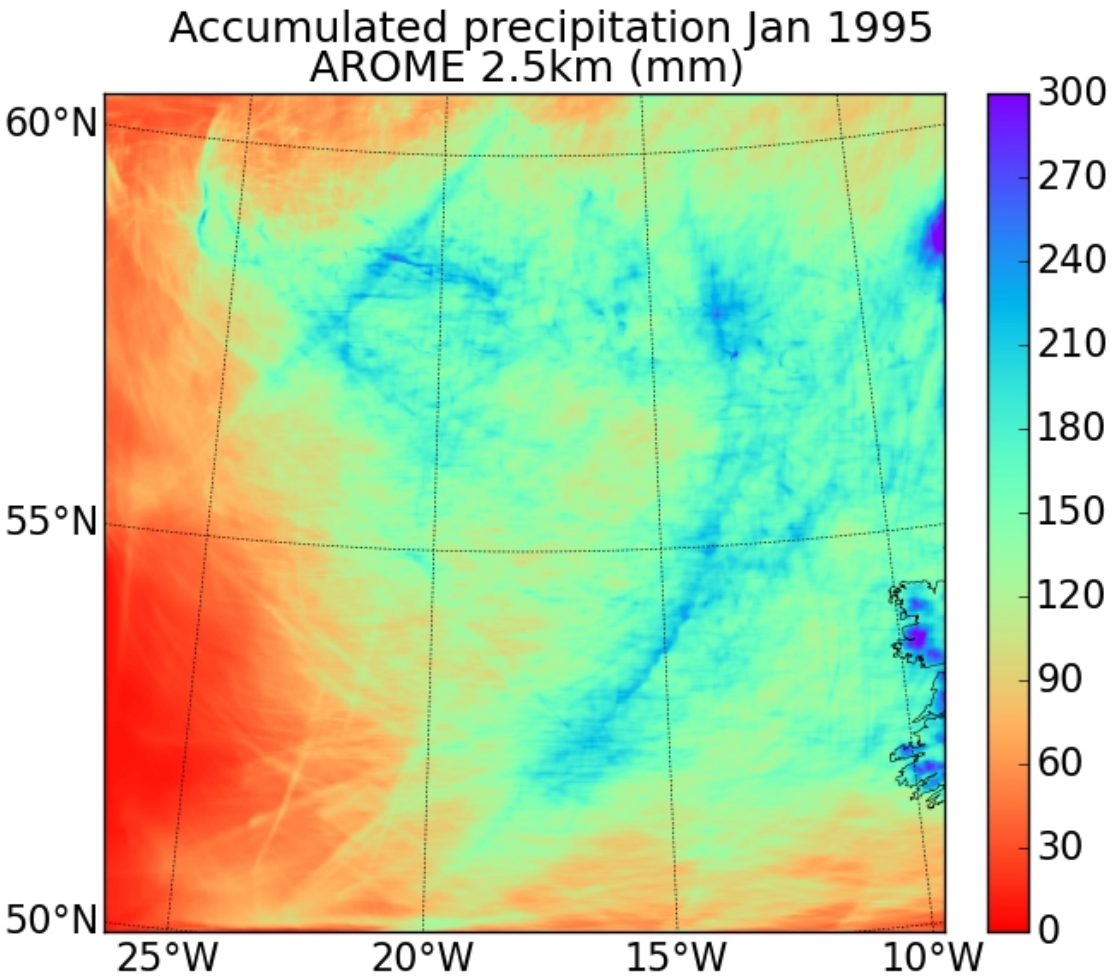
- Resolution jump?

HCLIM-AROME with ERA-I forcing



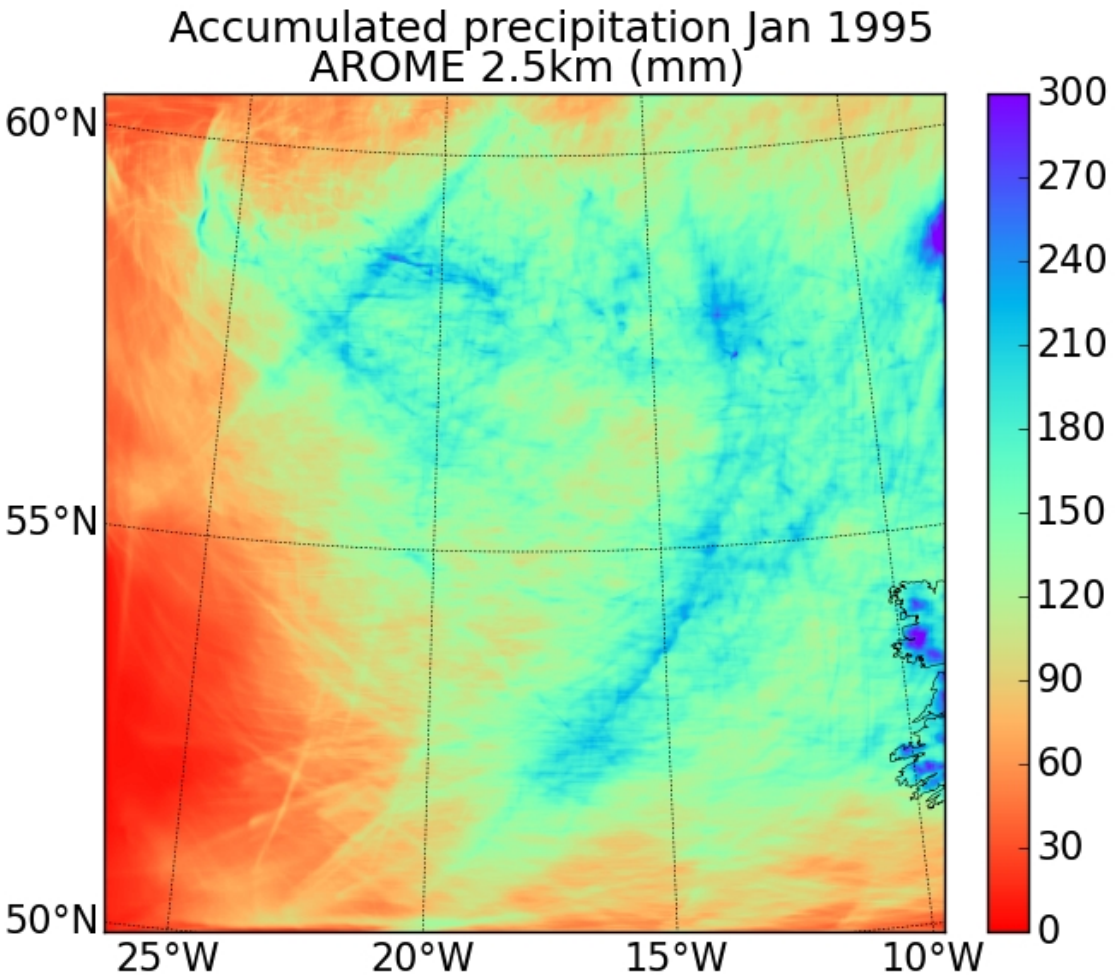
- Resolution jump?
- Different physics?

HCLIM-AROME with ERA-I forcing



- Resolution jump?
- Different physics?
- No HM/TKE coupling?

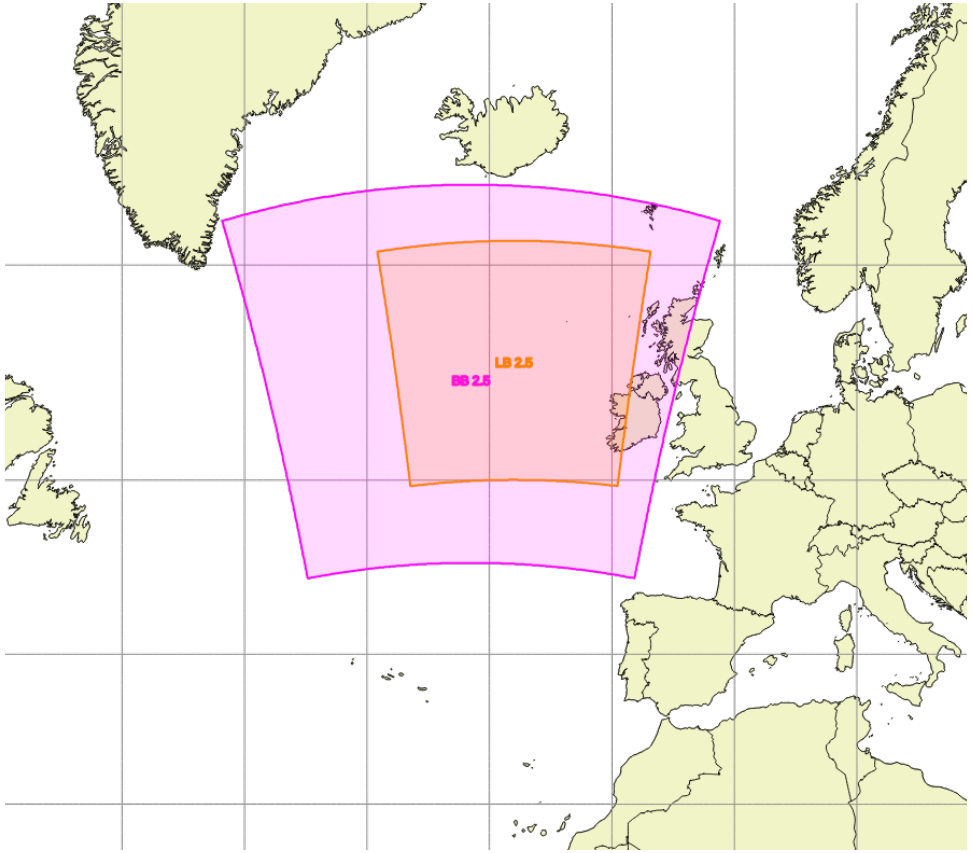
HCLIM-AROME with ERA-I forcing



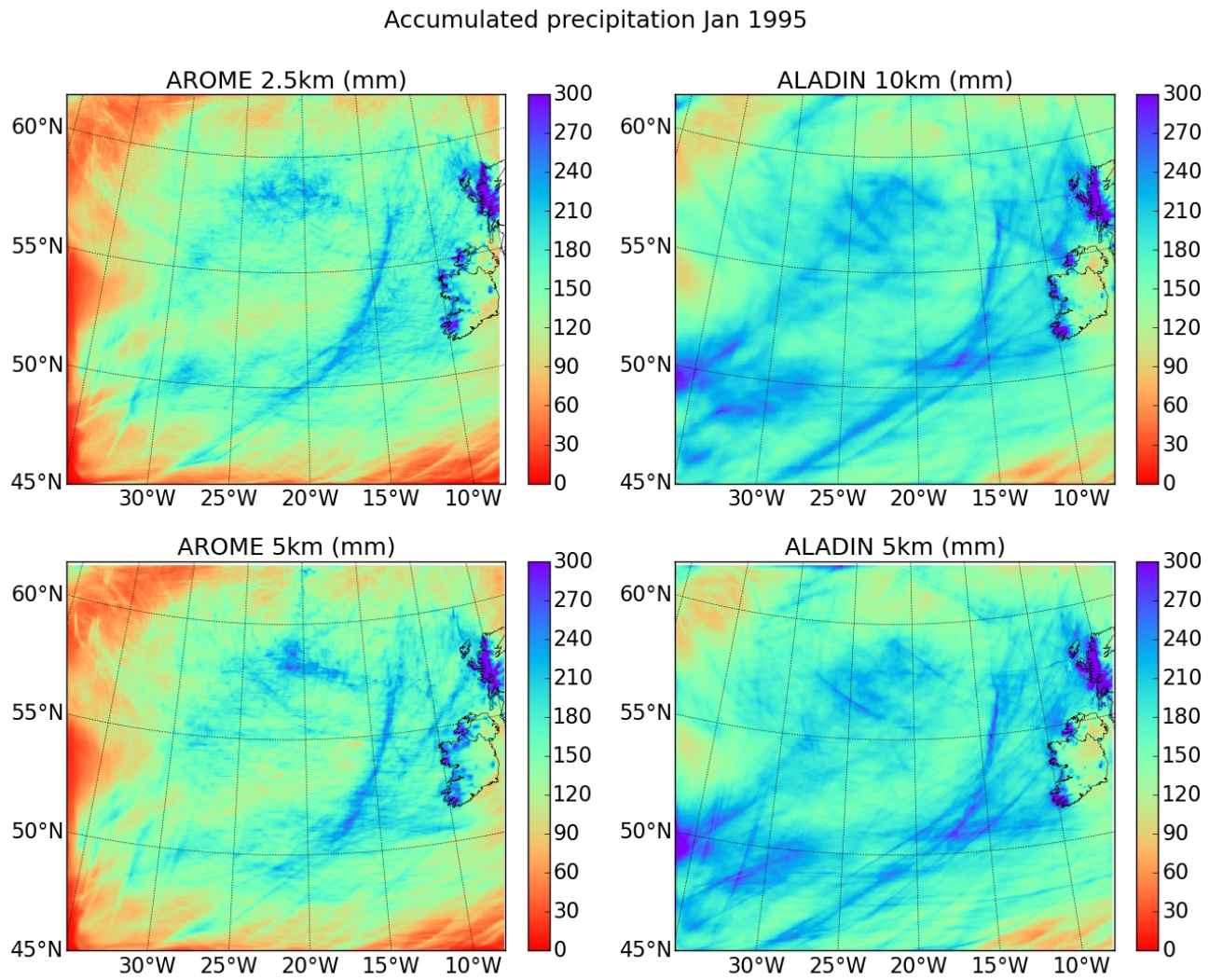
- Resolution jump?
- Different physics?
- No HM/TKE coupling?
- Problem with AROME?

Simulations

- HCLIM-AROME cy38
- dx = 2.5 km
- Domains:
  - Big Brother (BB): 864 x 800
  - Little Brother (LB): 500 x 500
- 1 month: Jan 1995
- Simulations:
  - ERA-I → LB
  - ERA-I → BB → LB
  - ERA-I → ALD → LB



BB's and ALD's (LBC's for LB)



BB

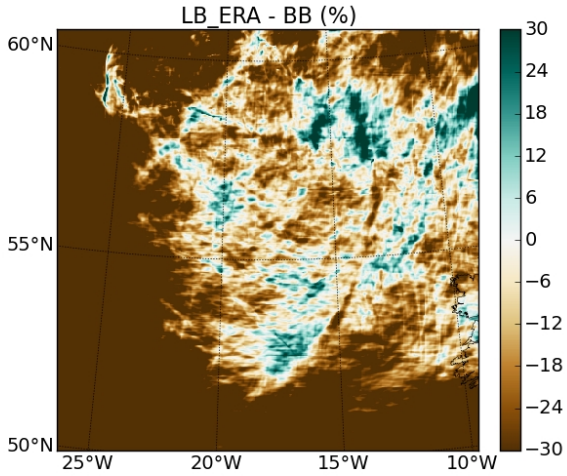
ALD10

BB5

ALD5

Resolution?

Accumulated precipitation Jan 1995



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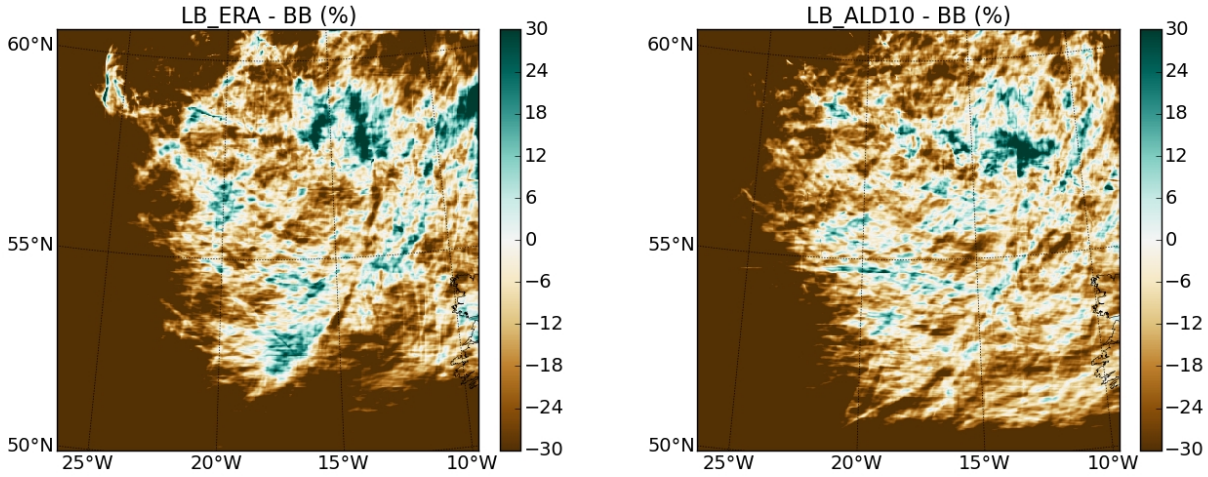

Resolution?

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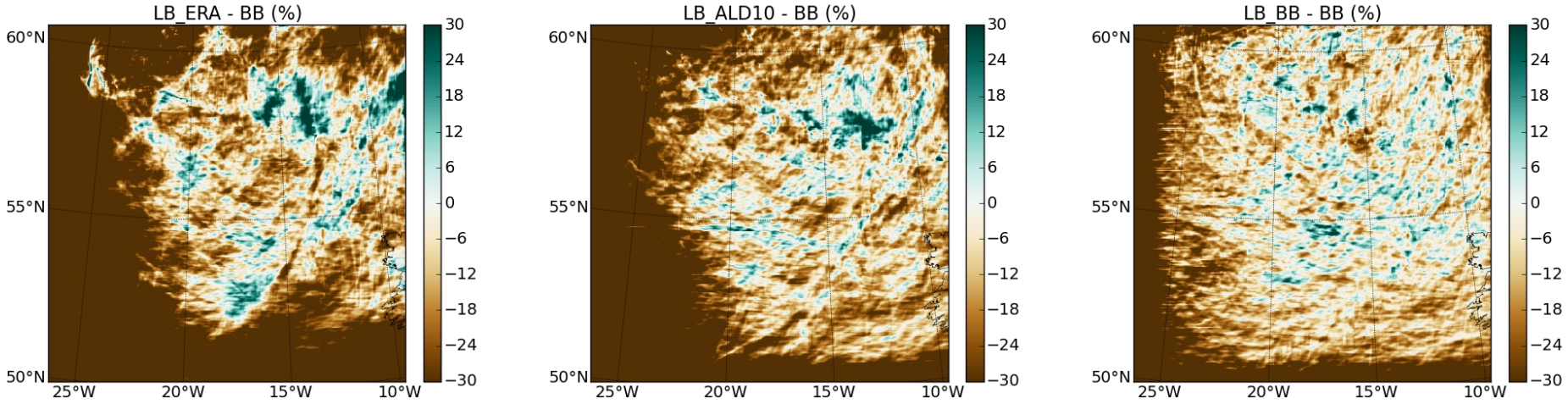
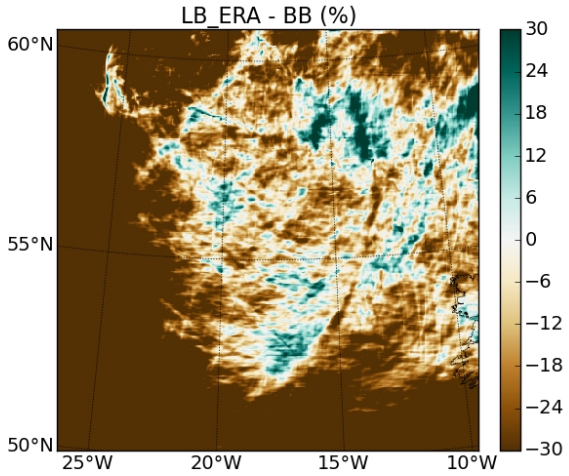
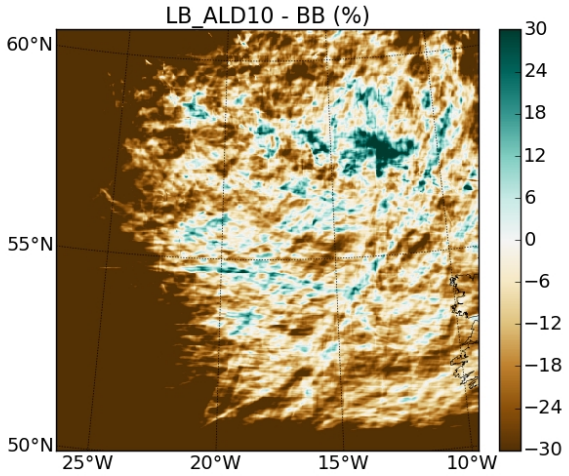
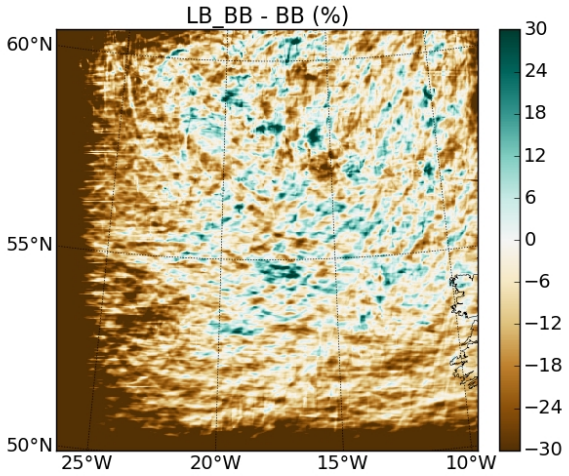


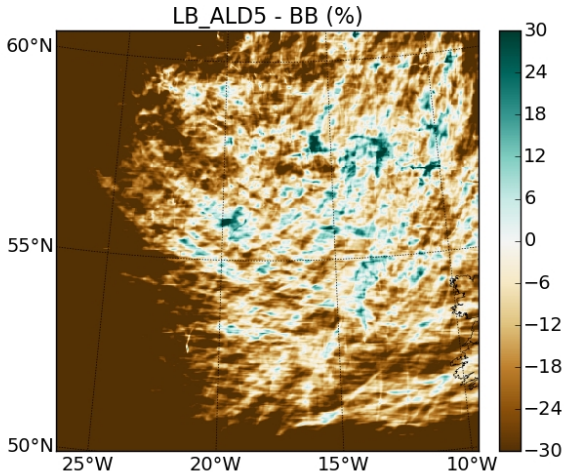
Resolution?

Accumulated precipitation Jan 1995









Resolution?

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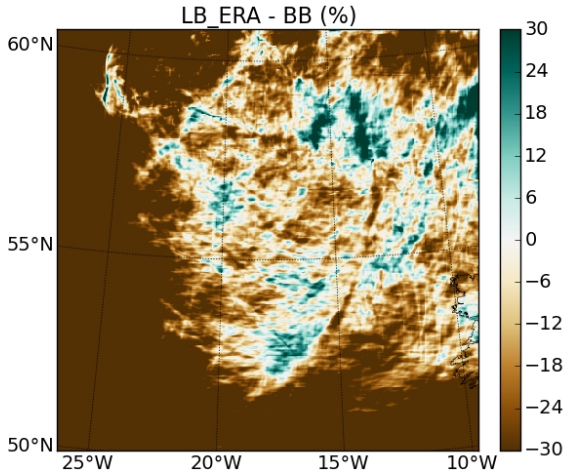
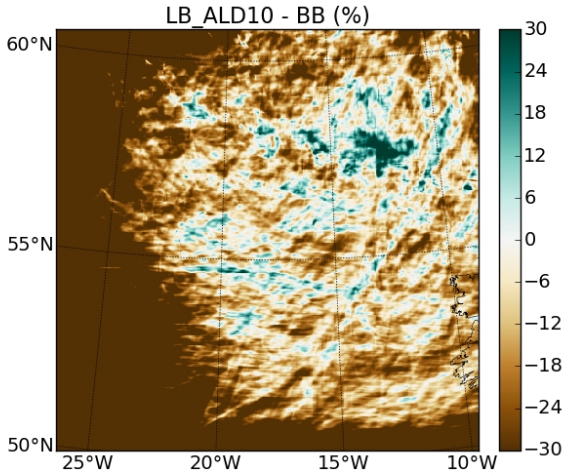
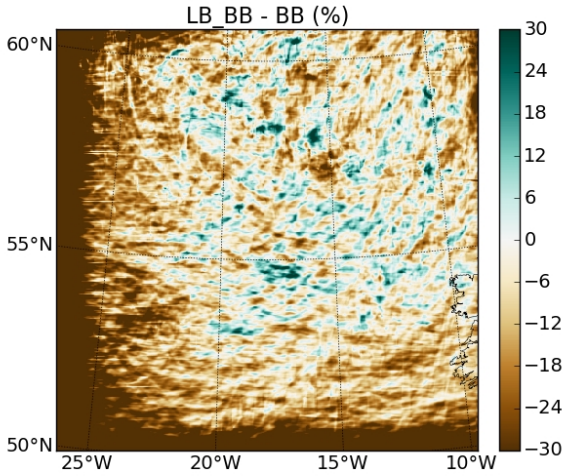
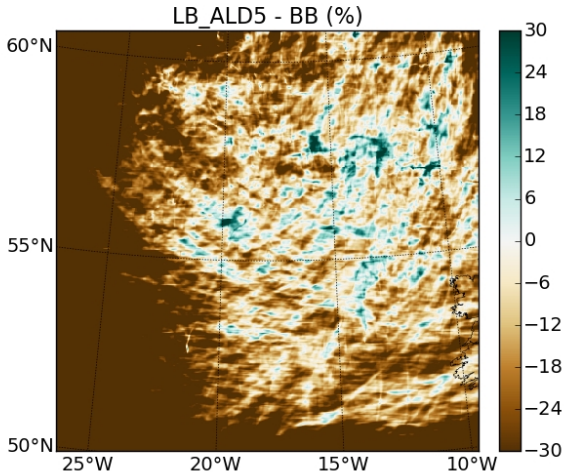
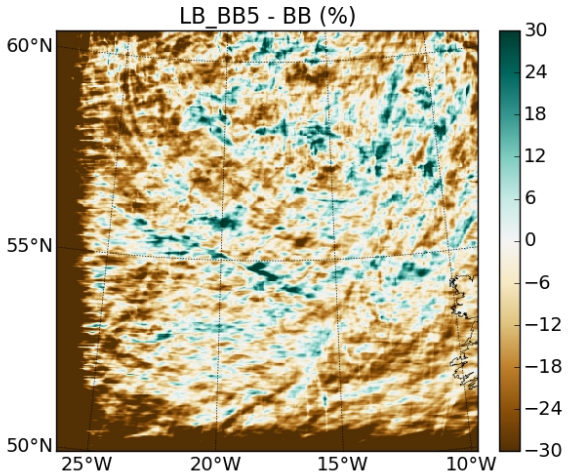






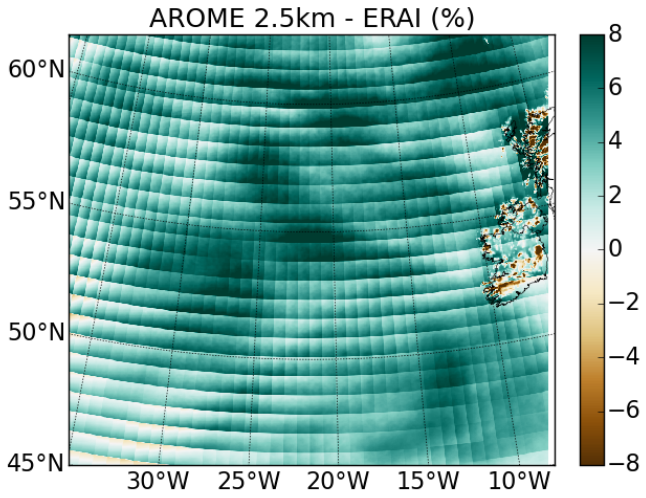


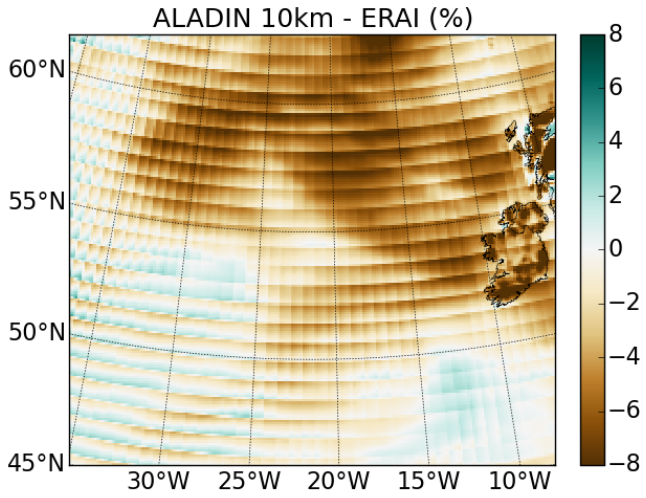


Physics?

Mean precipitable water Jan 1995

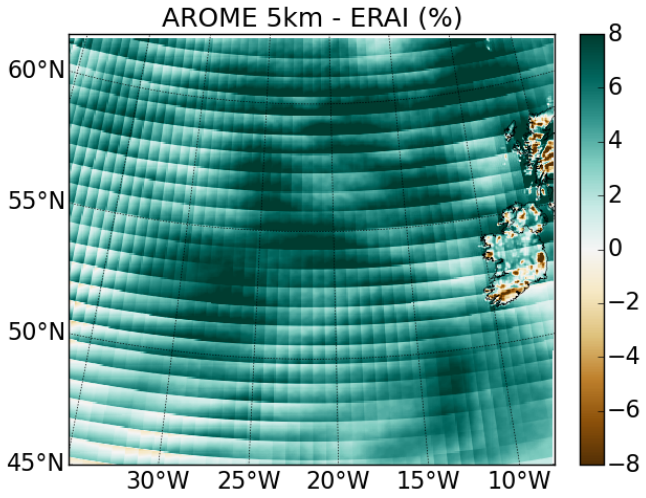
BB

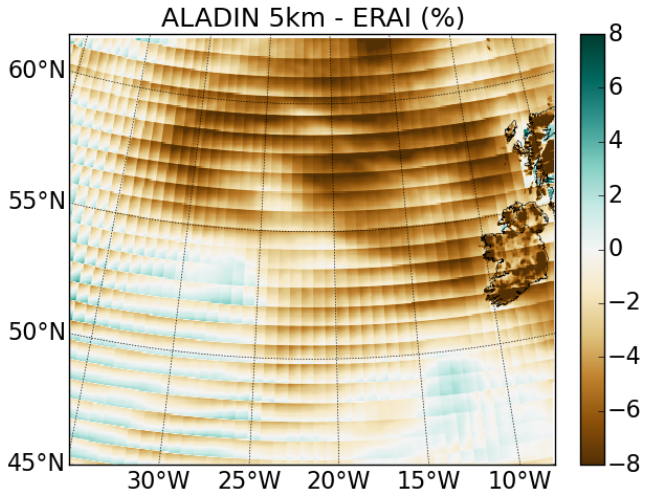




ALD10

BB5

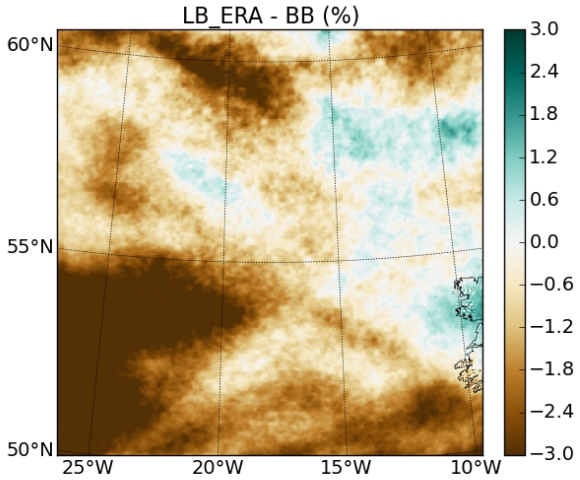


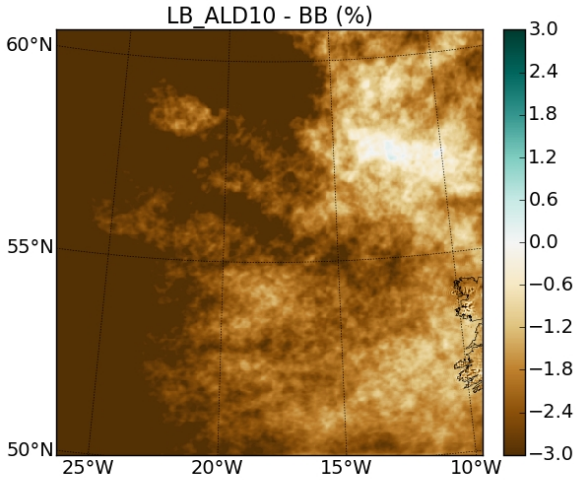


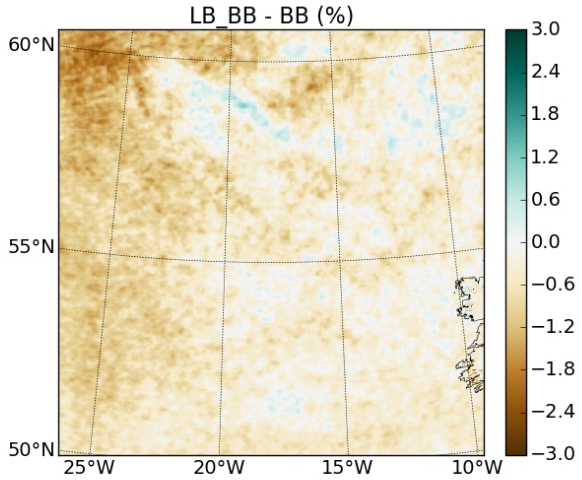
ALD5

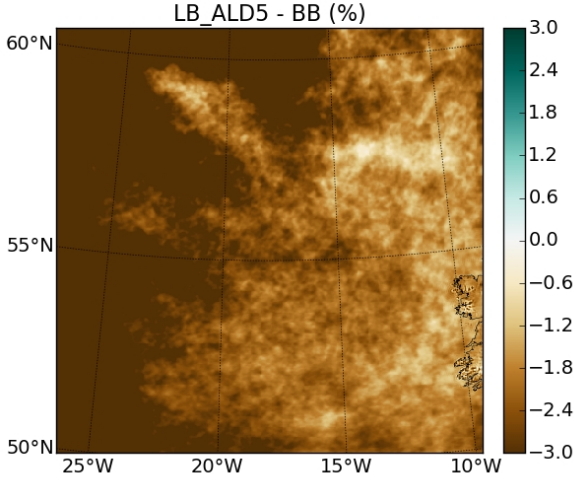
Physics?

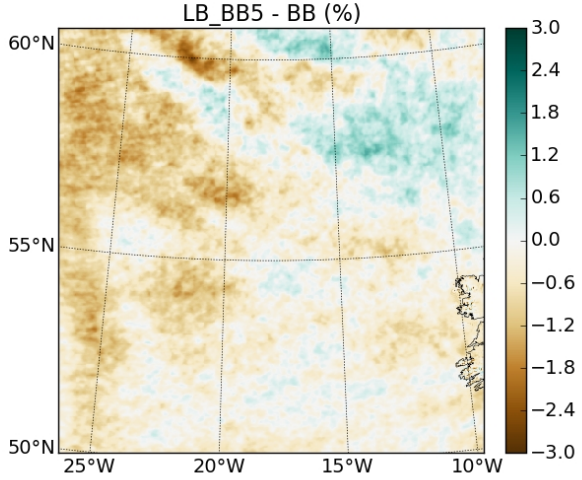
Mean precipitable water Jan 1995



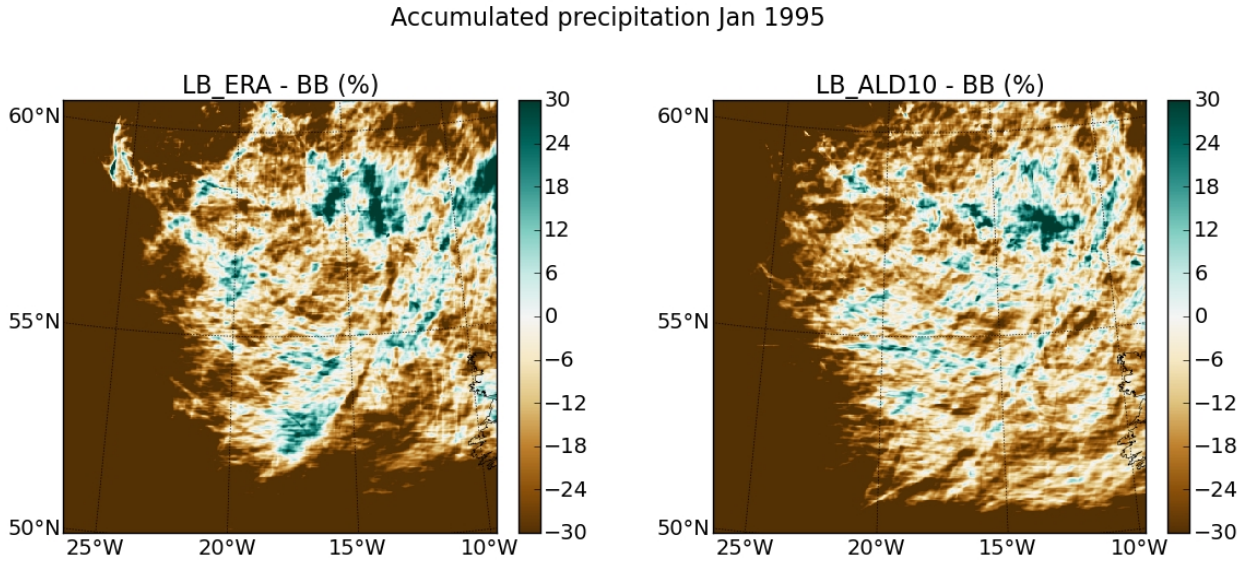






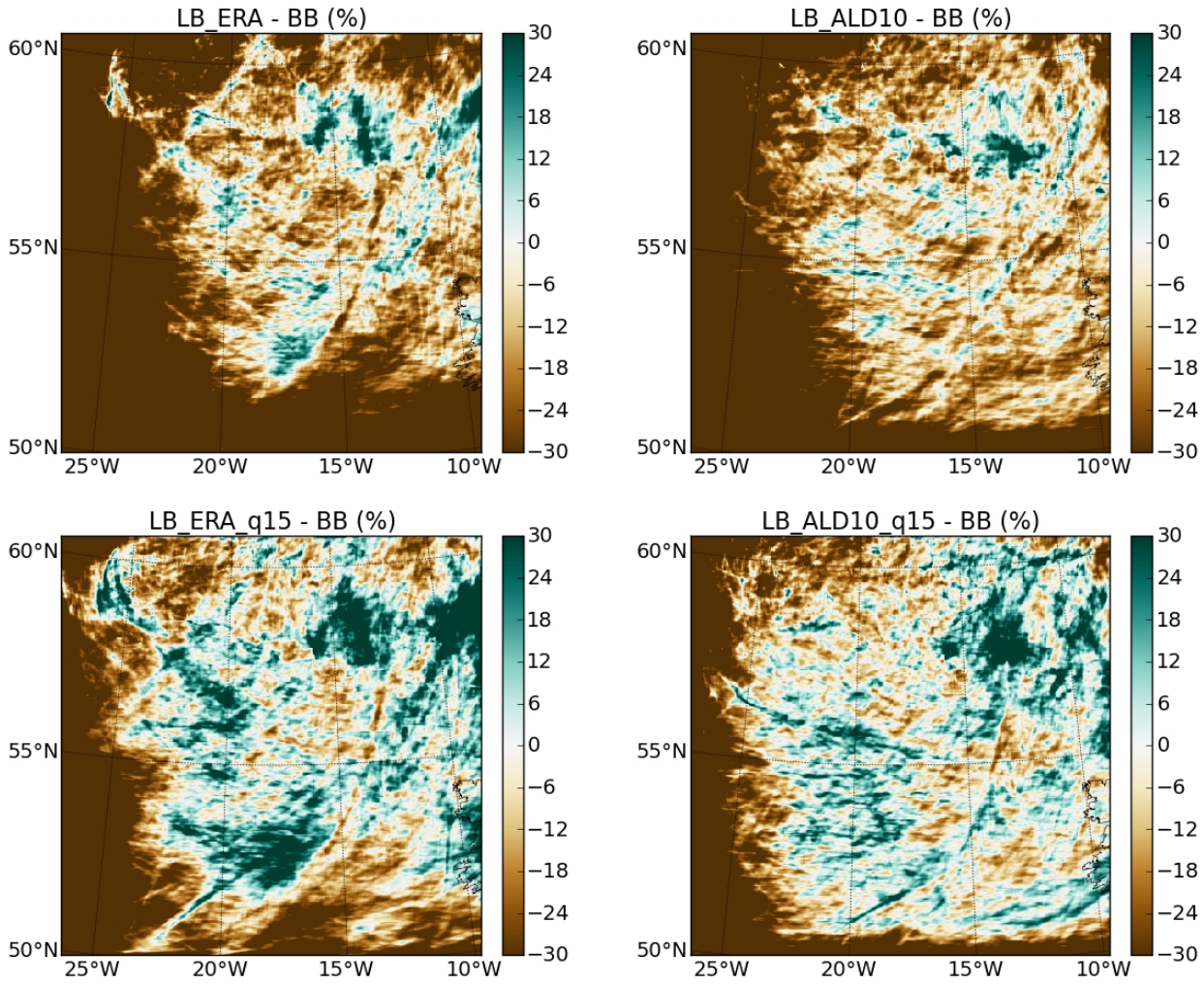


1.15q in parent domain



1.15q in parent domain

Accumulated precipitation Jan 1995



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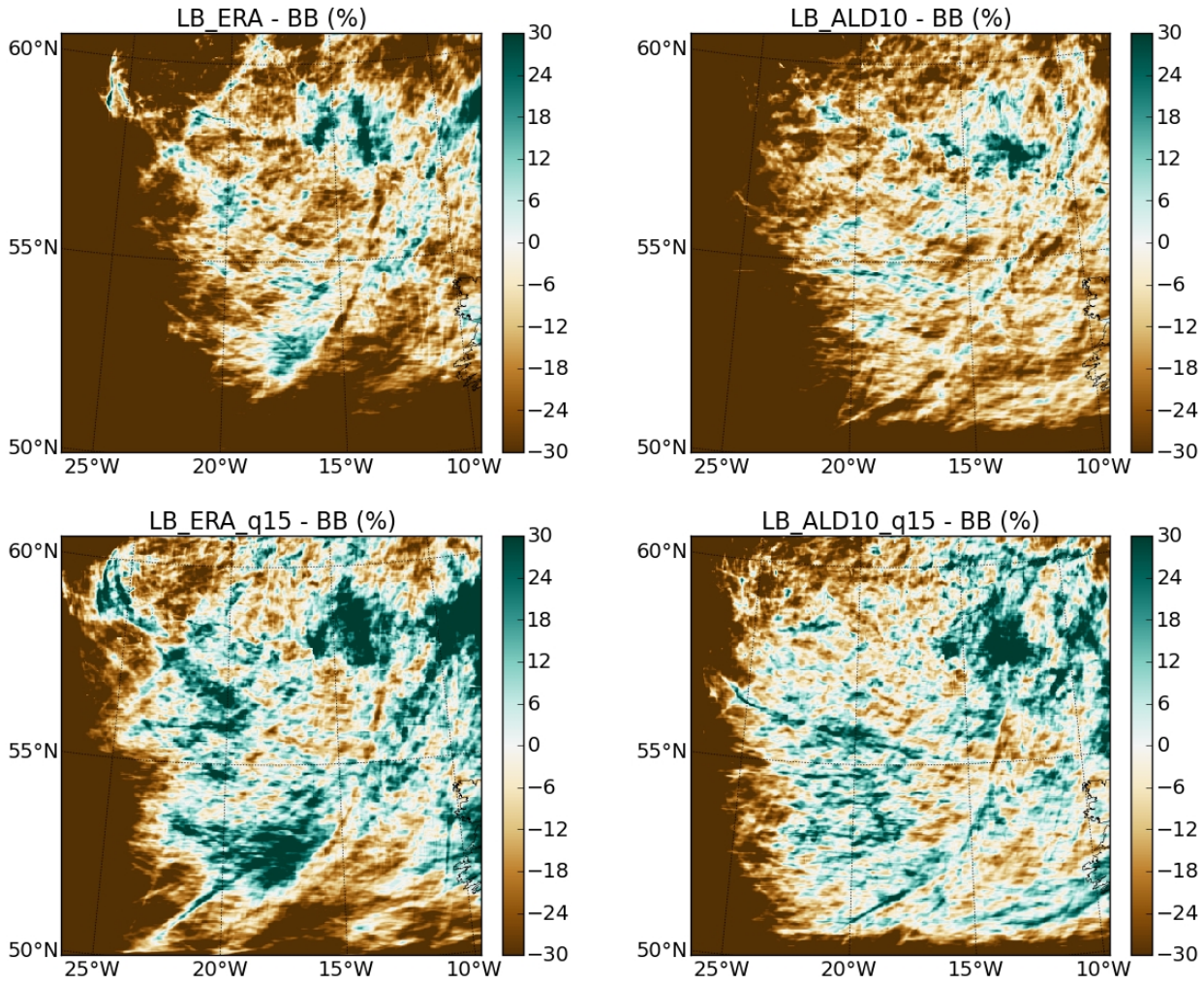
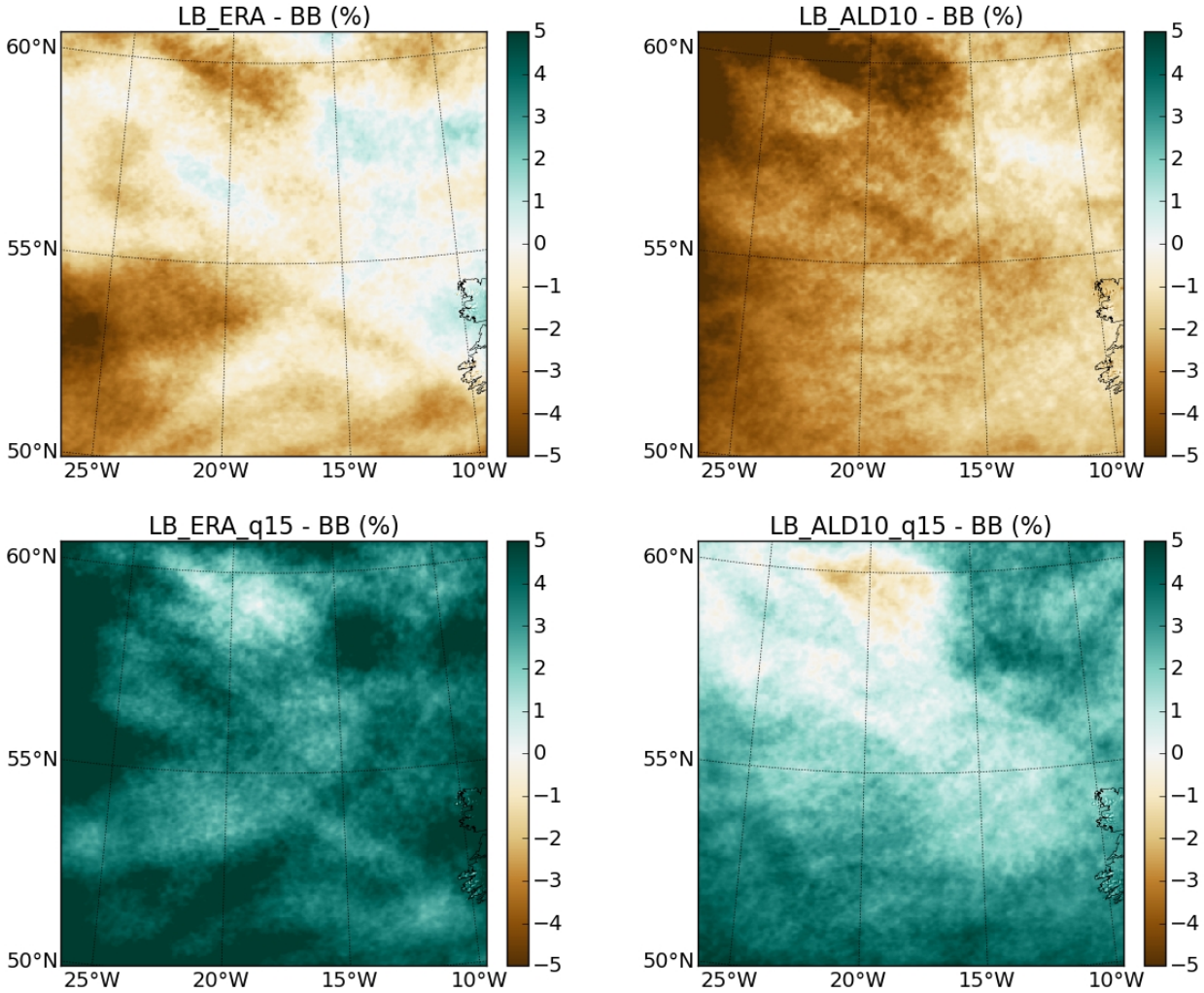
Accumulated precipitation Jan 1995



Not enough

1.15q in parent domain

Mean precipitable water Jan 1995



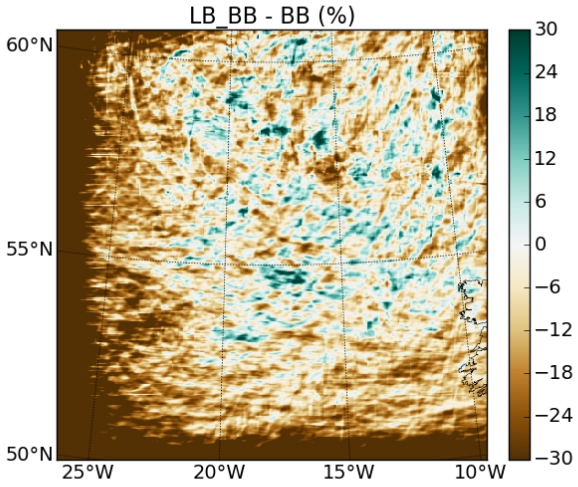
Not enough

+

Too moist

HM/TKE coupling?

Accumulated precipitation Jan 1995



HM/TKE coupling?

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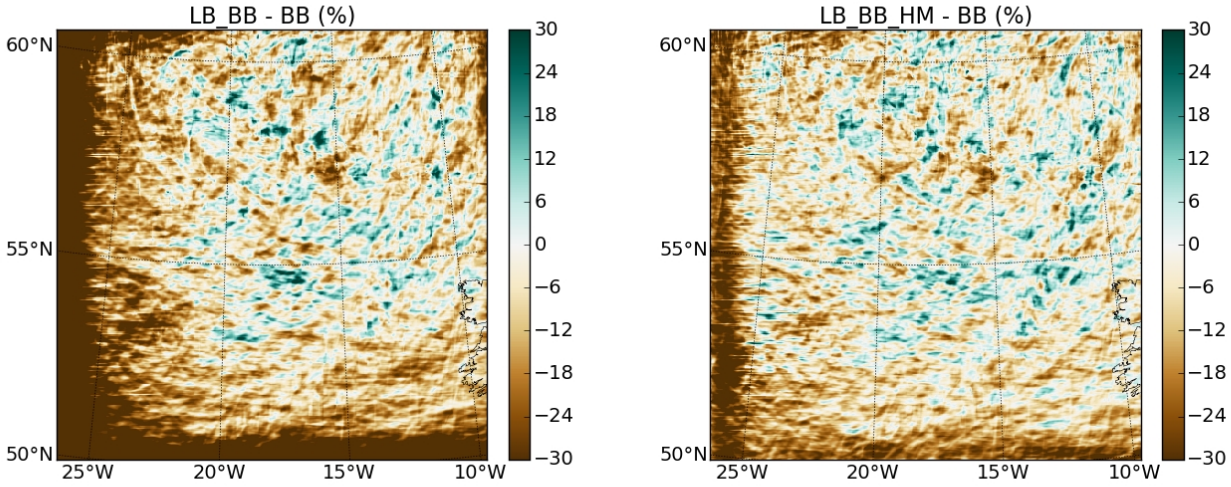

HM/TKE coupling?

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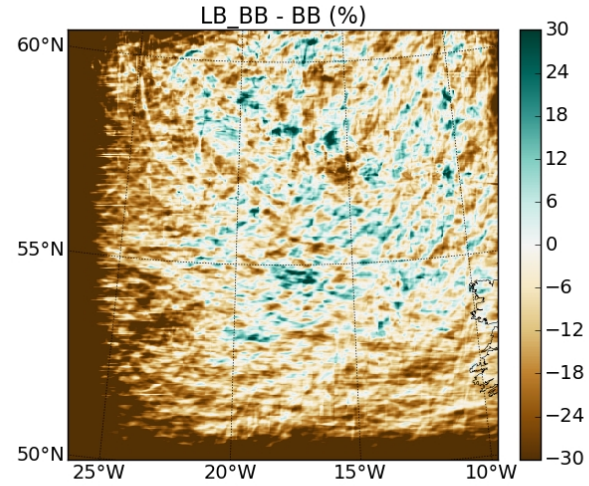
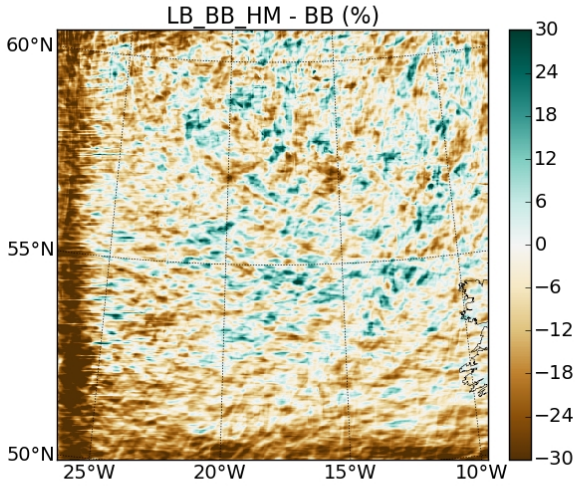
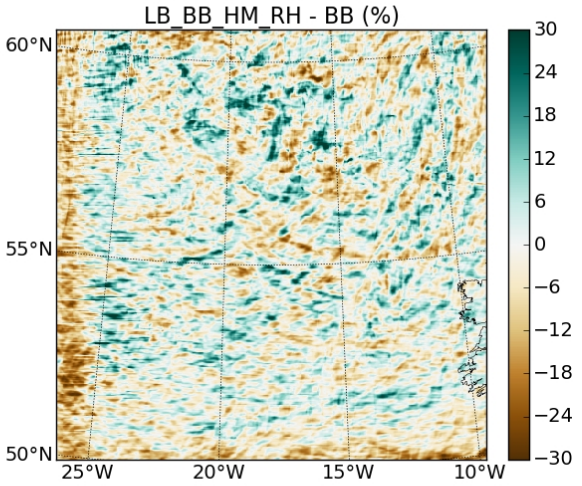
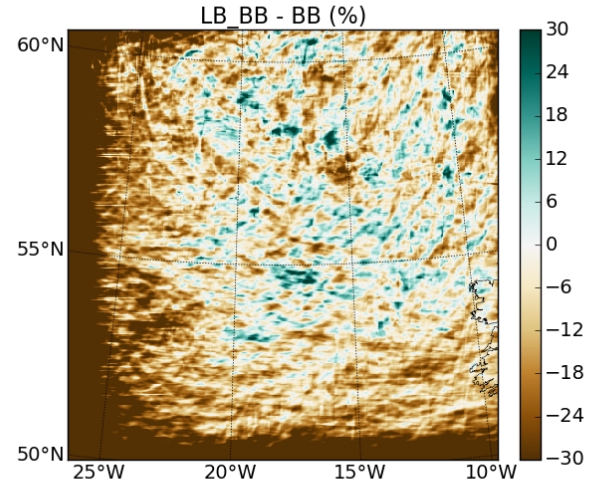


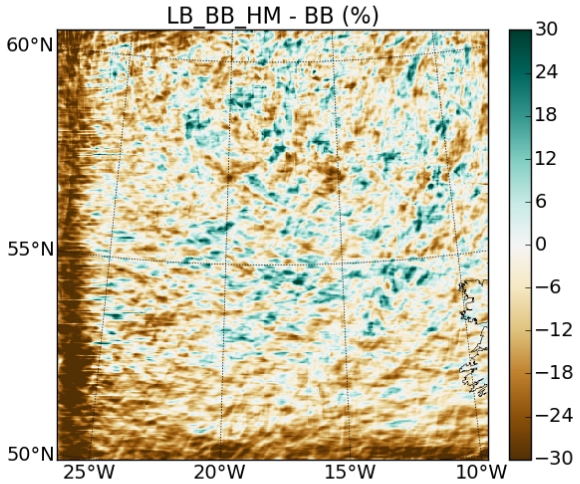


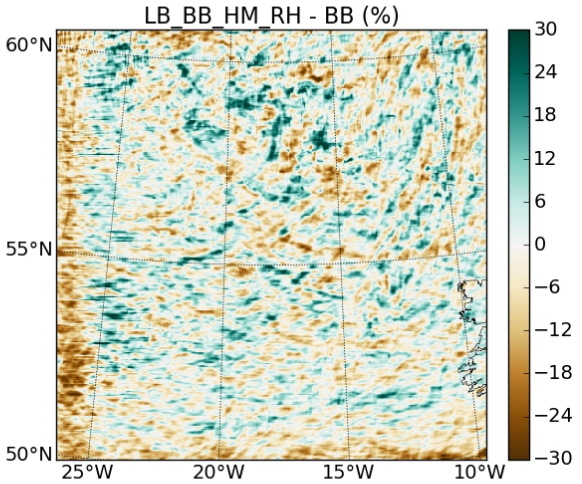


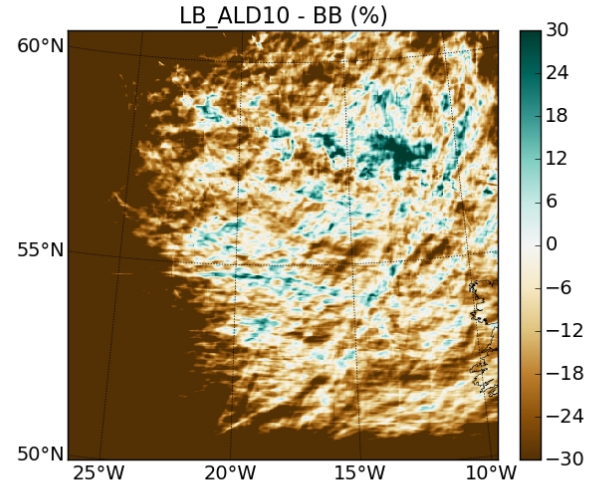
HM/TKE coupling?

Accumulated precipitation Jan 1995



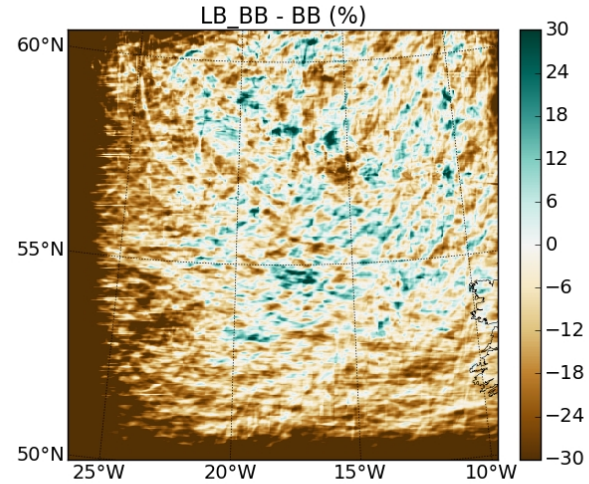


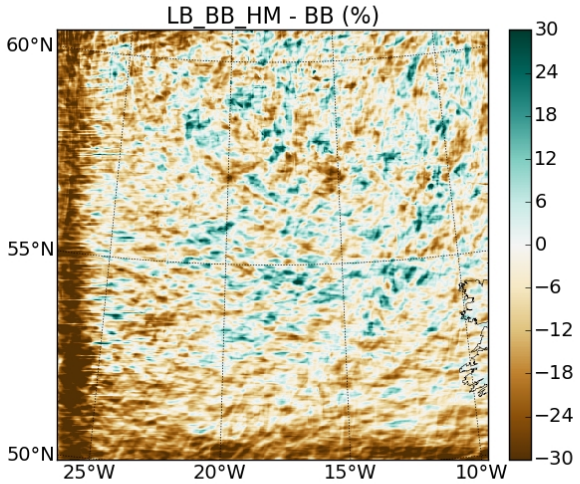


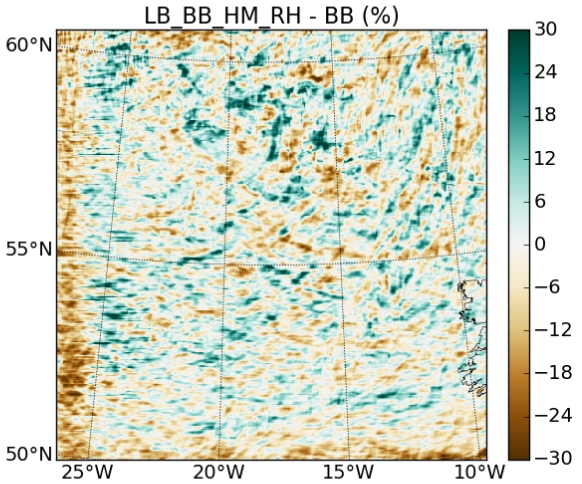


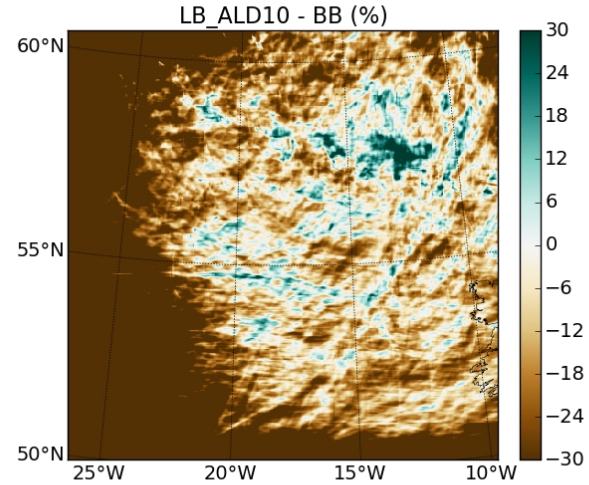
HM/TKE coupling?

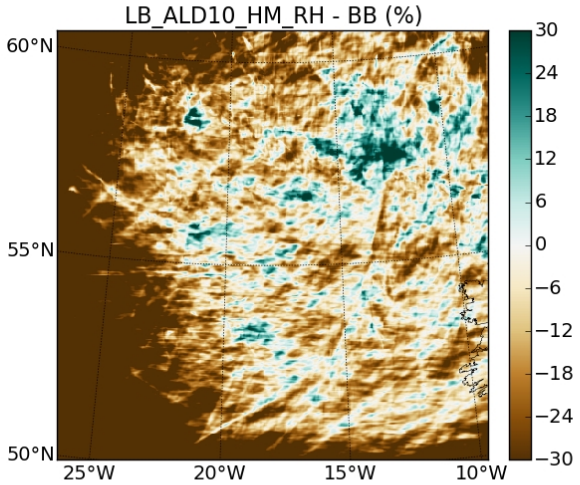
Accumulated precipitation Jan 1995





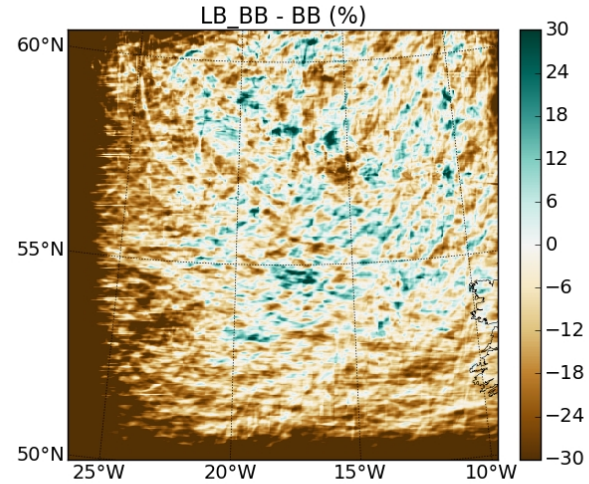


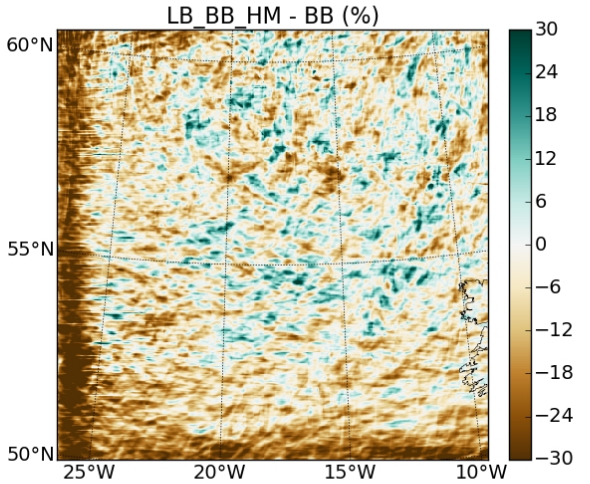


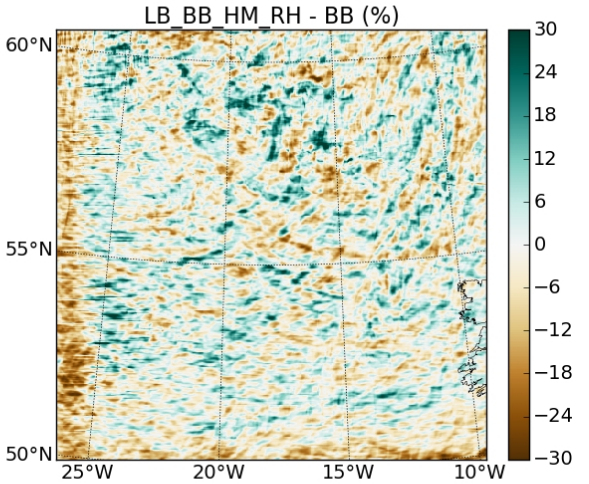


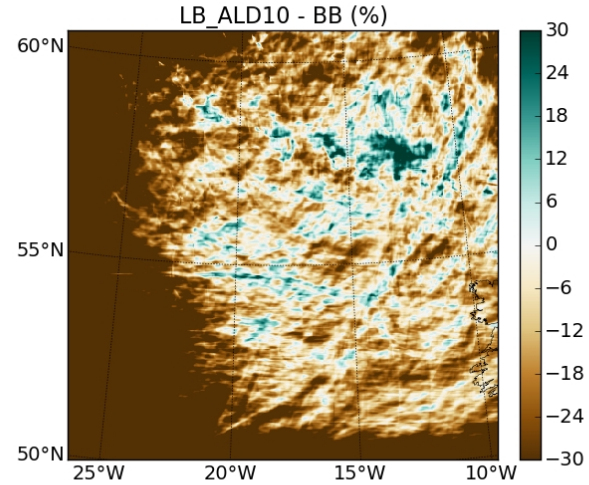
HM/TKE coupling?

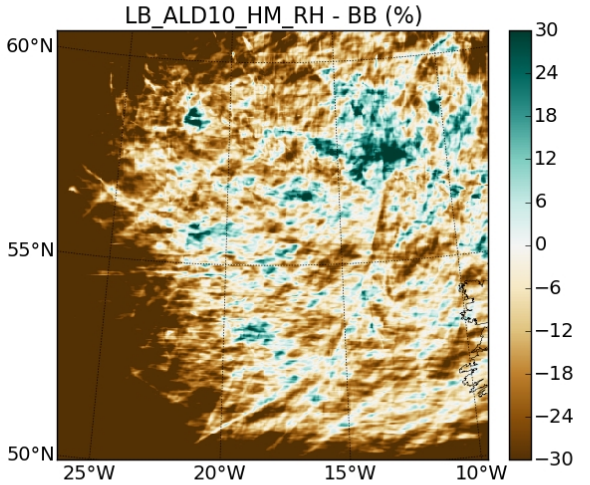
Accumulated precipitation Jan 1995

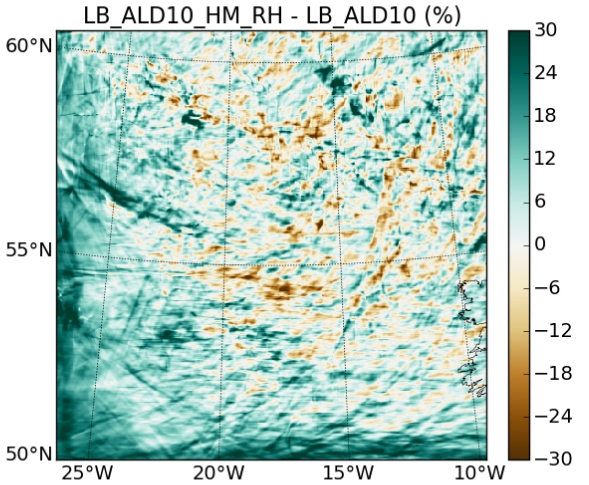






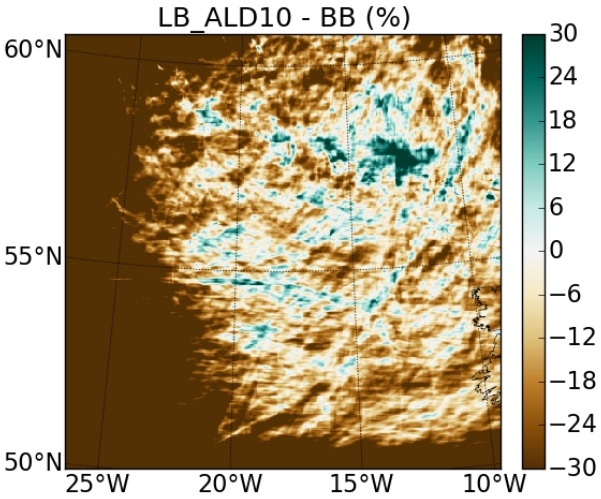


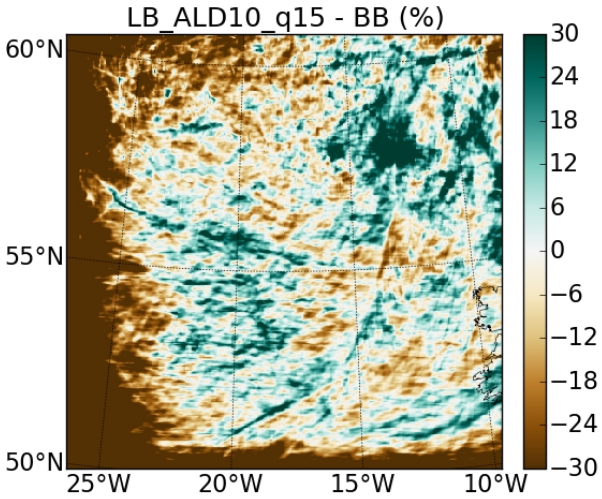


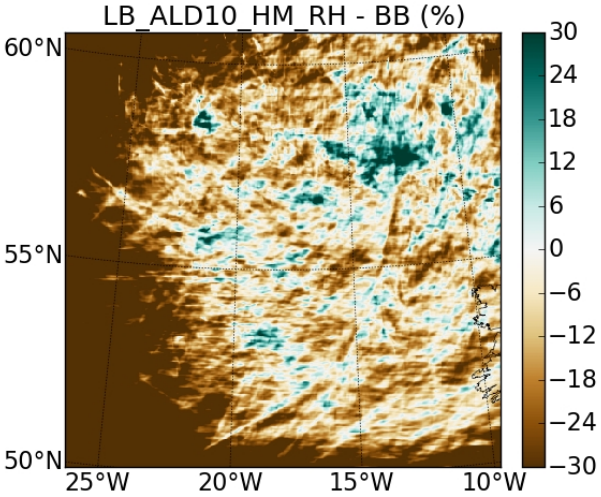


HM/TKE coupling & 1.15q?

Accumulated precipitation Jan 1995







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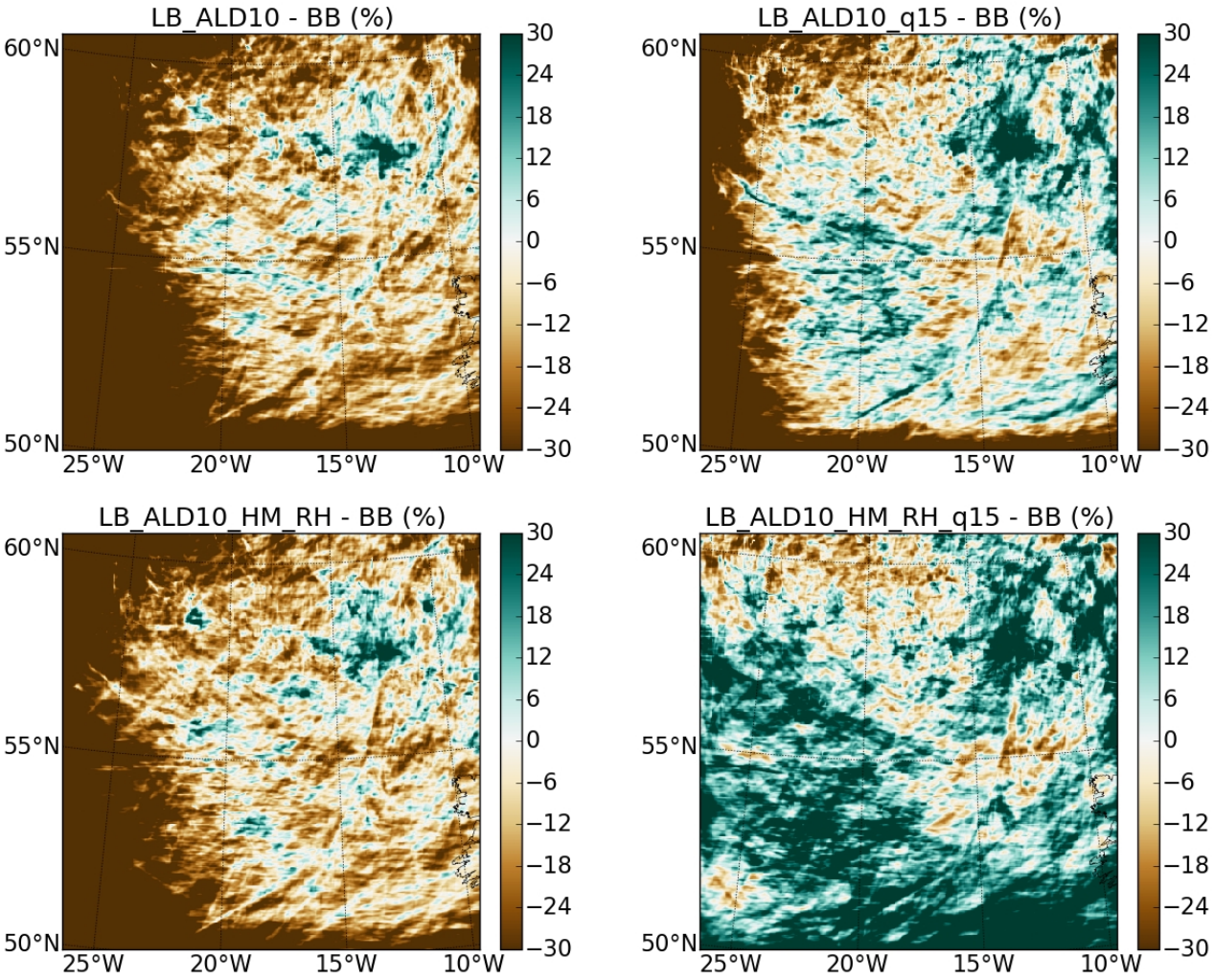
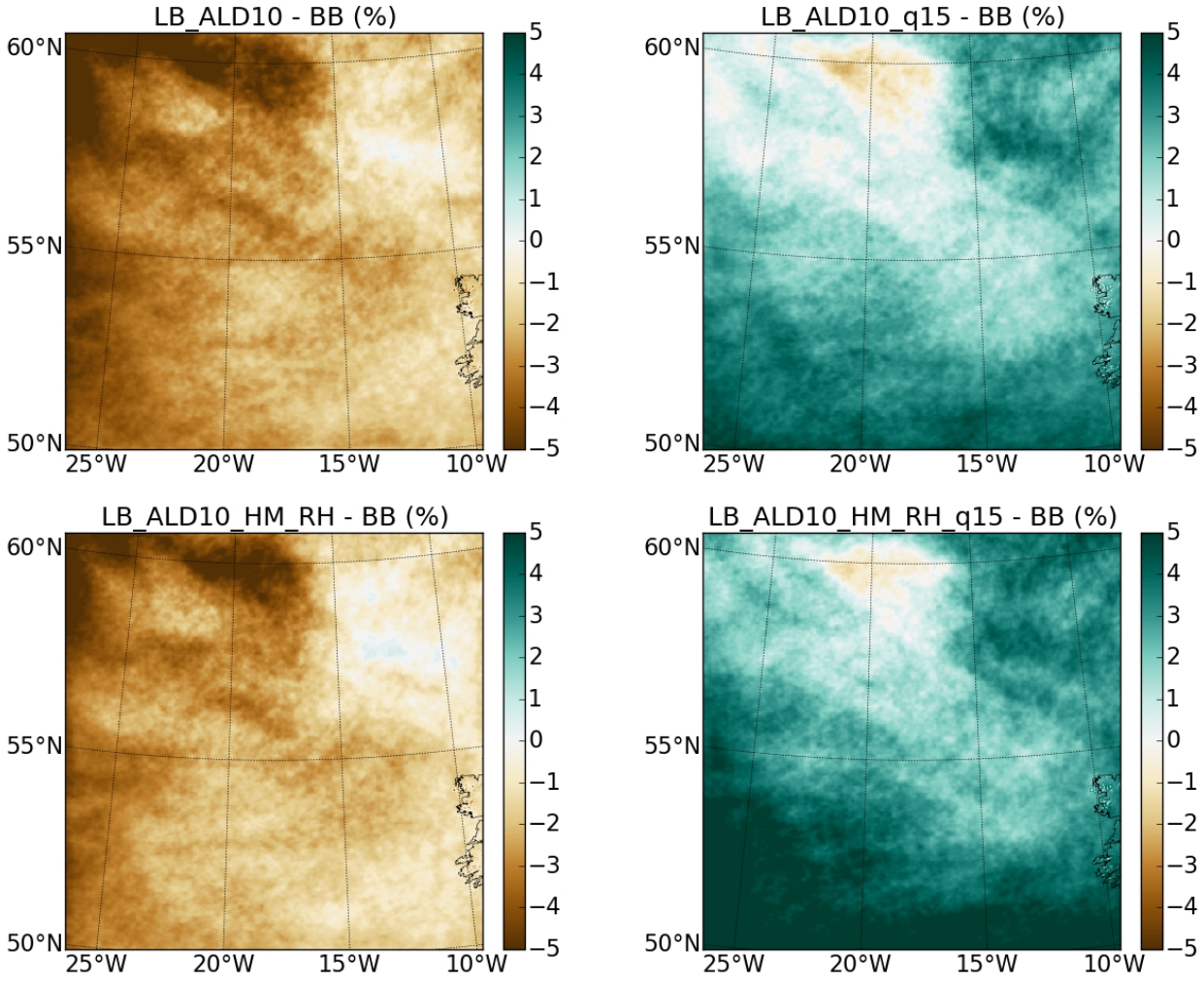


Finally!!!

HM/TKE coupling & 1.15q?

Mean precipitable water Jan 1995



Finally!!!

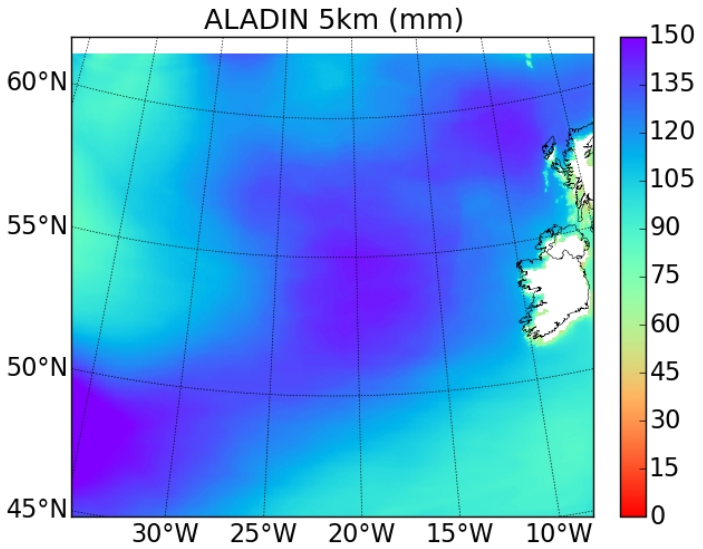
But unrealistic...

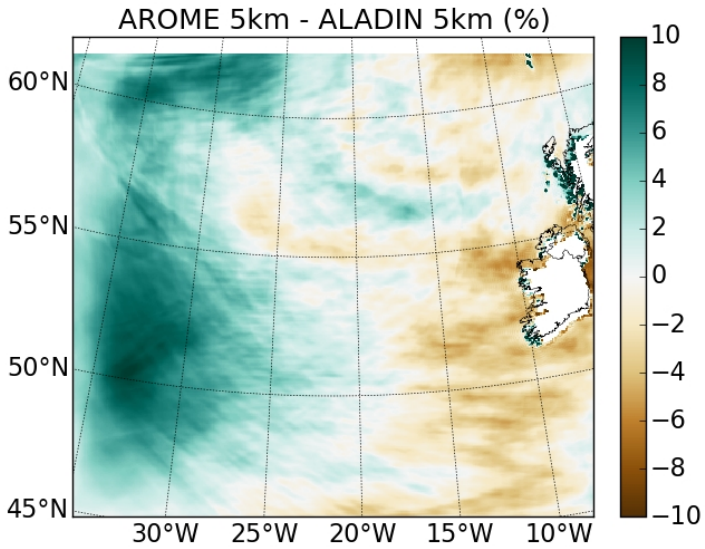
Conclusions

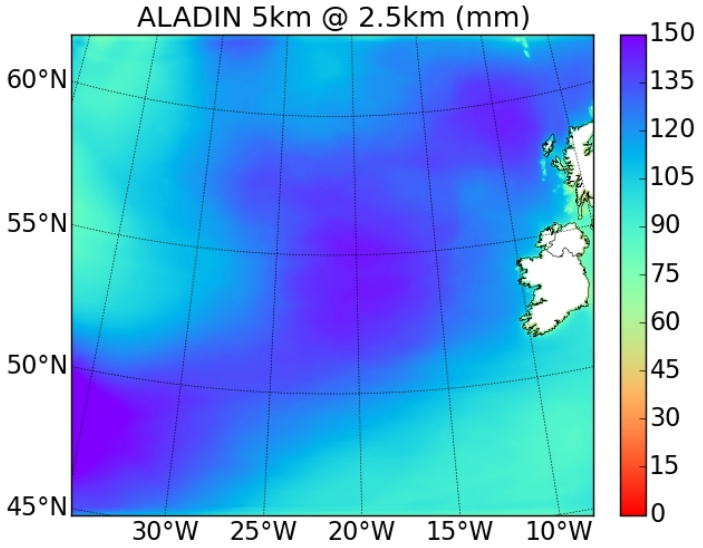
- Identified problem at inflow lateral boundaries in AROME (cy38):
  - Strong under-representation of cloud/precip over up to 500 km
  - Consistent with (long-standing) issue in NWP (so cy40 too!)
- Reasons:
  - AROME too moist and precipitates too little/slow?
  - AROME needs full LBC coupling
- Solution?
- Systematic errors obvious in climate mode → useful for NWP?

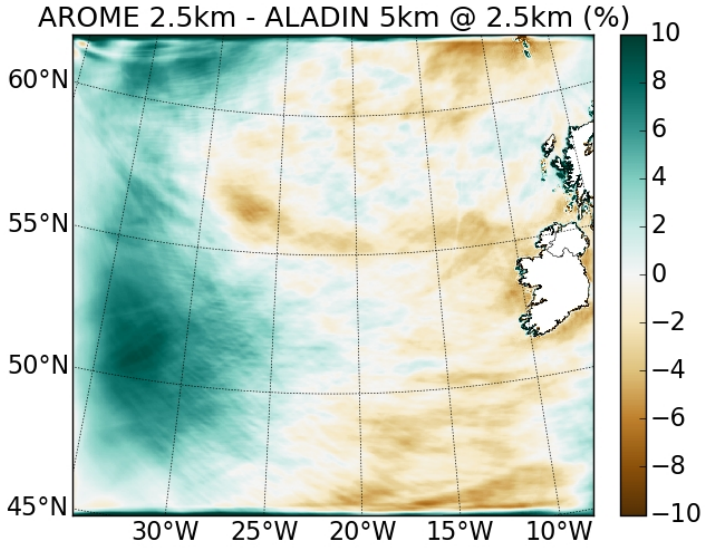
SMHI

Accumulated evaporation Jan 1995

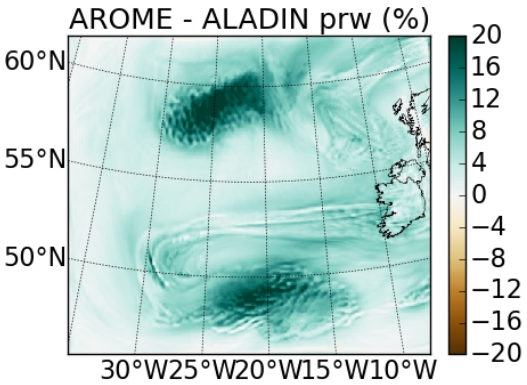


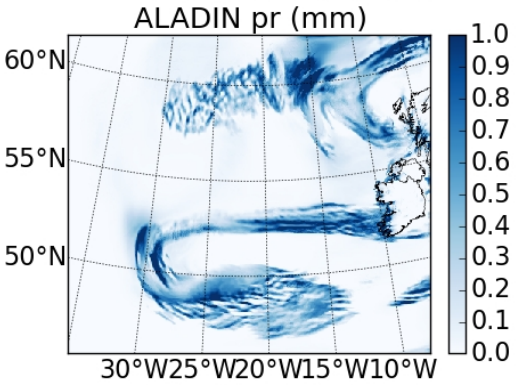


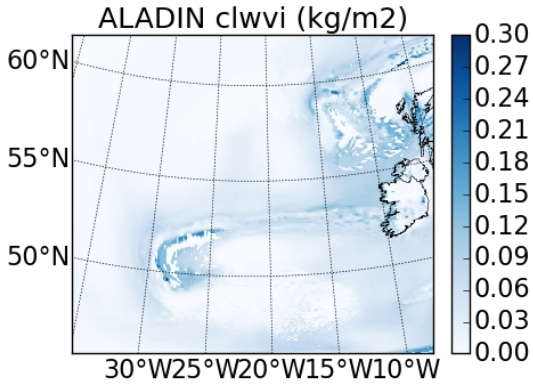


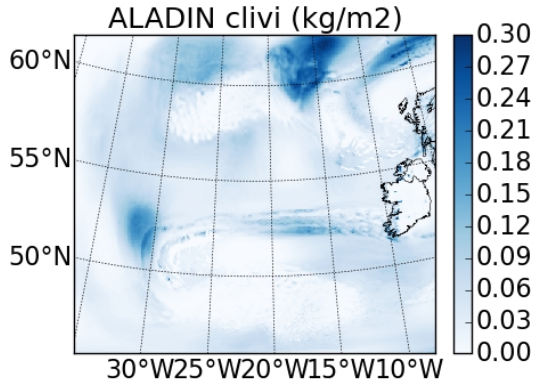


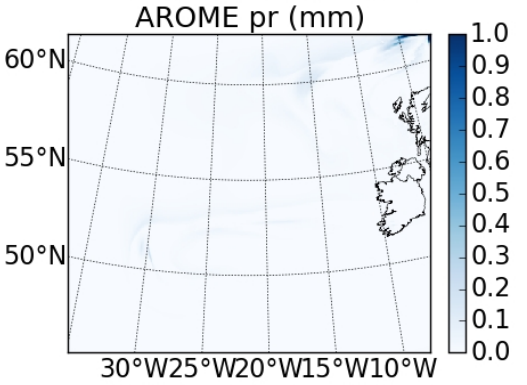
30 Dec 1994 00 + 3h

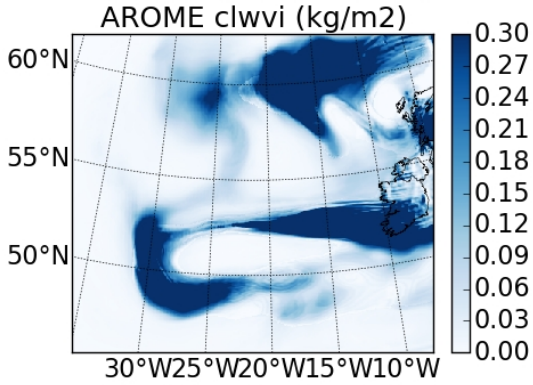


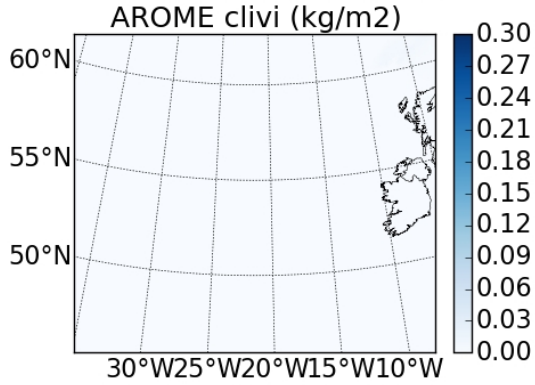




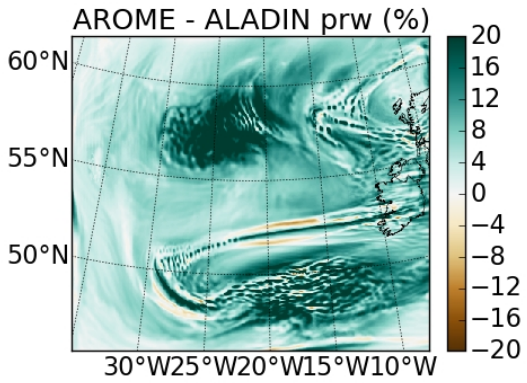


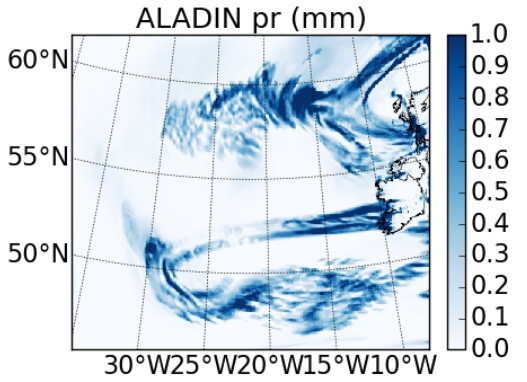


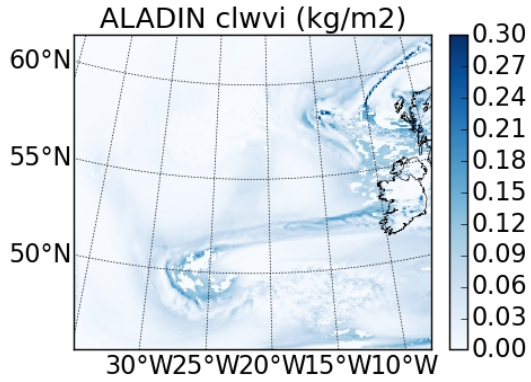


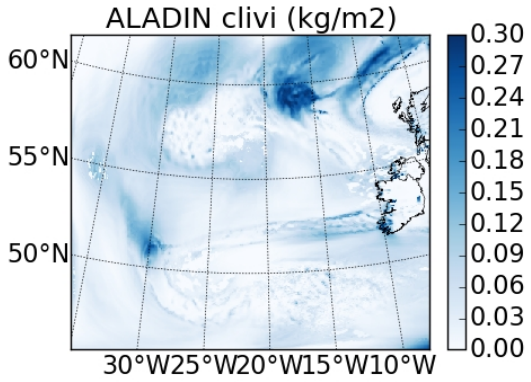


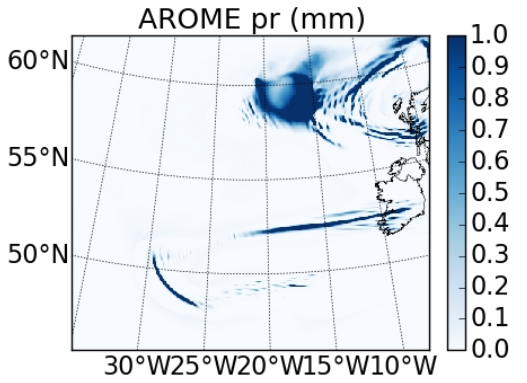
30 Dec 1994 00 + 6h

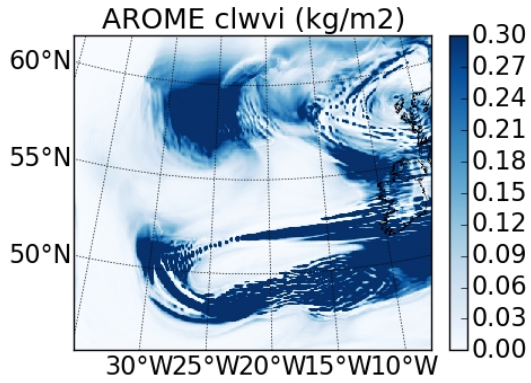


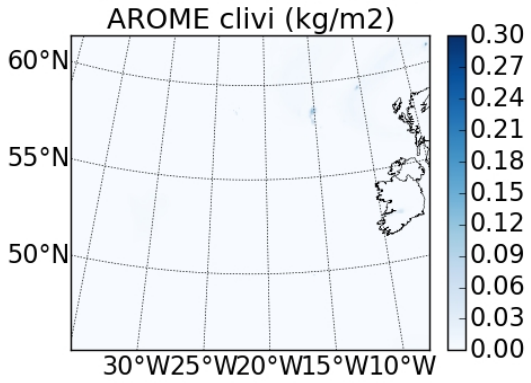












30 Dec 1994 00 + 10h