Regional Cooperation for
Limited Area Modeling in Central Europe

LACE
nwp central europe

WGNE Grey Zone Experiment

ALARO Working Days, 12-14 May 2014

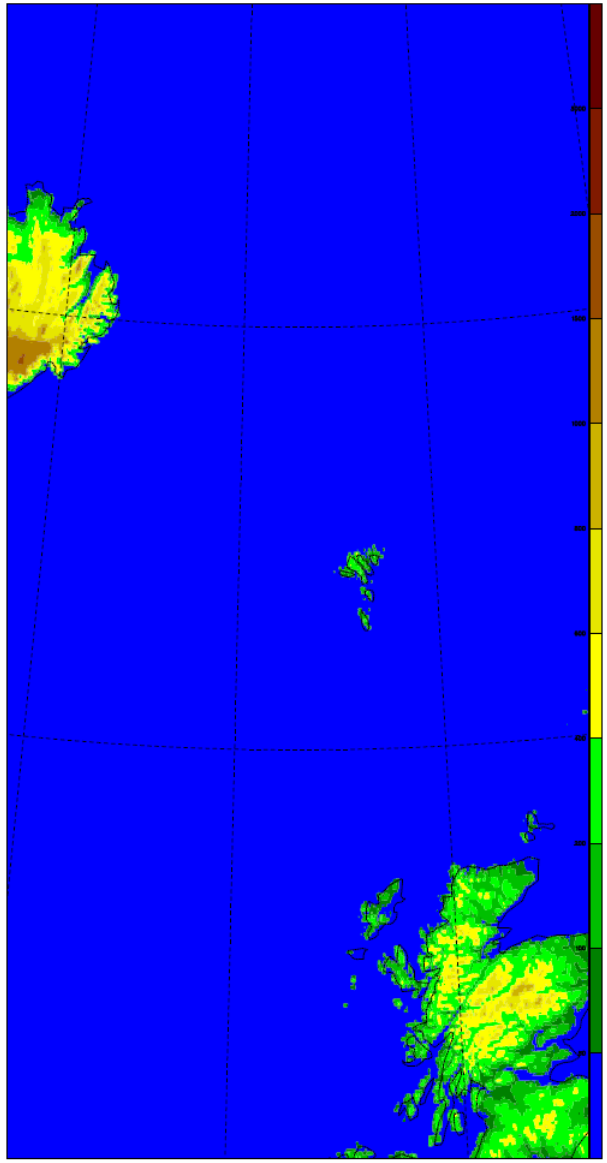
DHMZ SHMU OMSZ ZAMG ROMANIA ANM

Introduction

- To test the grey zone of convection, the JSC-CAS Working Group on Numerical Experimentations proposed “The Grey Zone Experiment”.
- Case study: Cold Air Outbreak over North Atlantic ocean:
  - Convection develops over warmer sea surface;
  - Not a big problem with orography.
- Exercise is proposed for:
  - LES
  - LAM
  - Global models

Conditions for LAM case

- Time period:
  - 30th January 2010, network time 12 UTC, run up to 36h.
- Model domain and resolutions to be run:
  - 16km
  - 8km
  - 4km
  - 2km
  - 1km (moist deep convection is considered as resolved)
- Parameterization switches:
  - Two basic permutations: Moist deep convection ON or OFF.



ALARO set up (1)

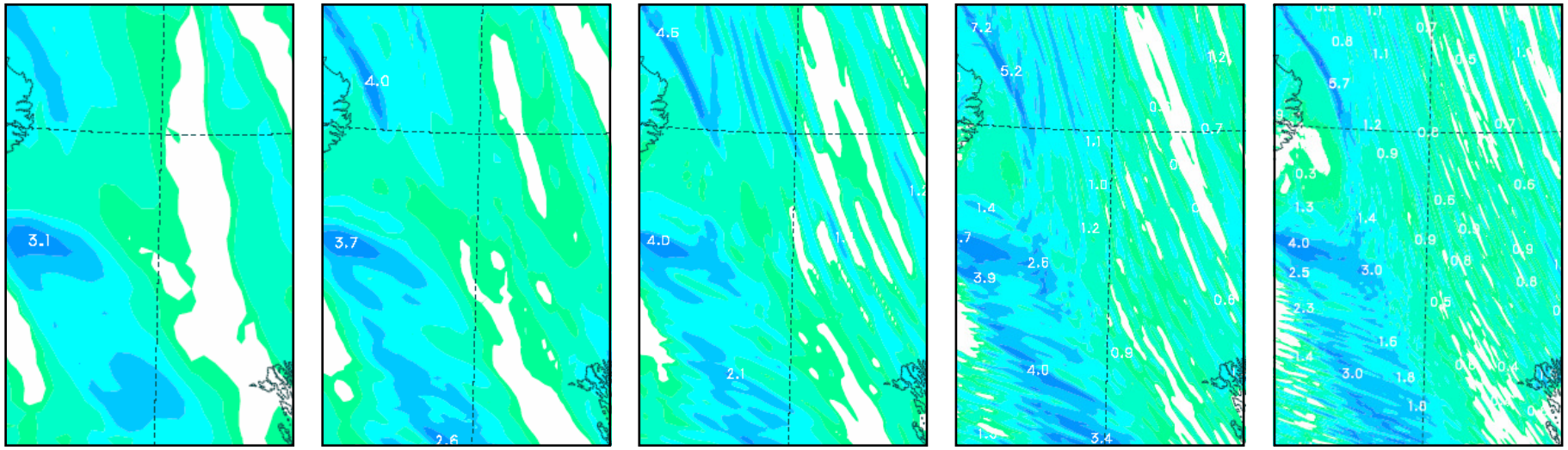
- Dynamics:
  - Non hydrostatic core at all resolutions
  - SLHD horizontal diffusion
- Physics:
  - ALARO-0 Base Line (with μ dependency on mesh-size) – first run - reference
  - ALARO-0 Base Line without 3MT but with LSTRAPRO (microphysics used in “resolved regime”) – modified run.
- Coupling
  - ARPEGE with 1 hour coupling interval
- Across resolutions, all runs of the same category are made with the identical setup.

ALARO set up (2)

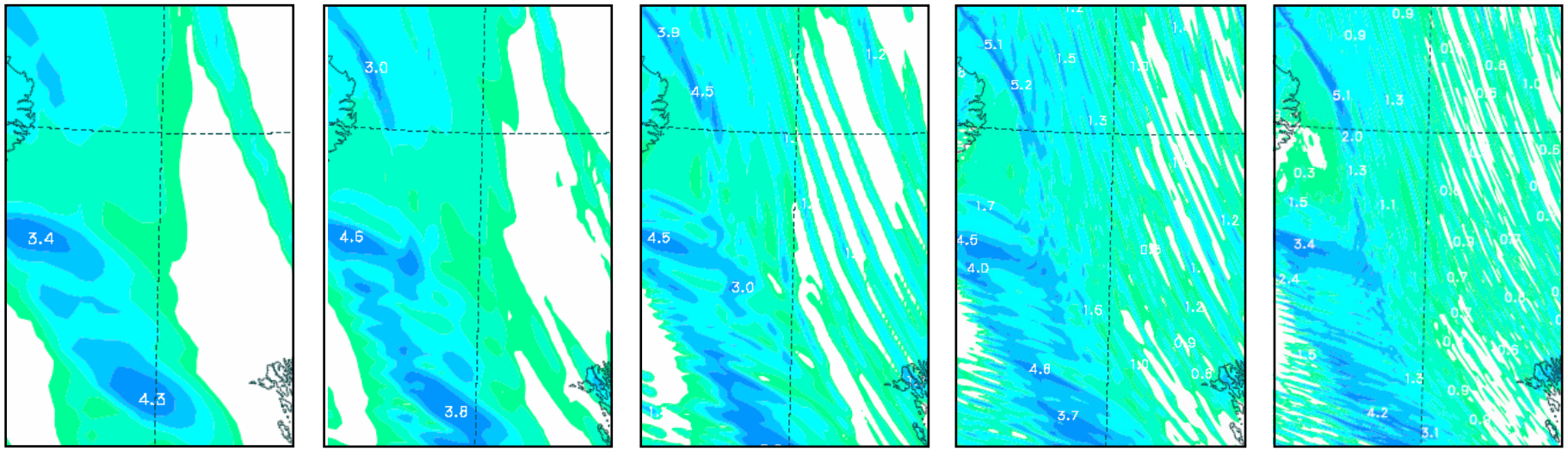
16km	8km	4km	2km	1km
75 x 125	125 x 216	216 x 405	405 x 800	800 x 1536
63 x 110	110 x 204	204 x 392	392 x 768	768 x 1520
87L	87L	87L	87L	87L
600s	300s	150s	75s	30s

Cold air outbreak; WGNE grey-zone test; 30-36 h precipitations (from 30/01/10 12UTC)

δx=16km **δx=8km** **δx=4km** **δx=2km** **δx=1km**



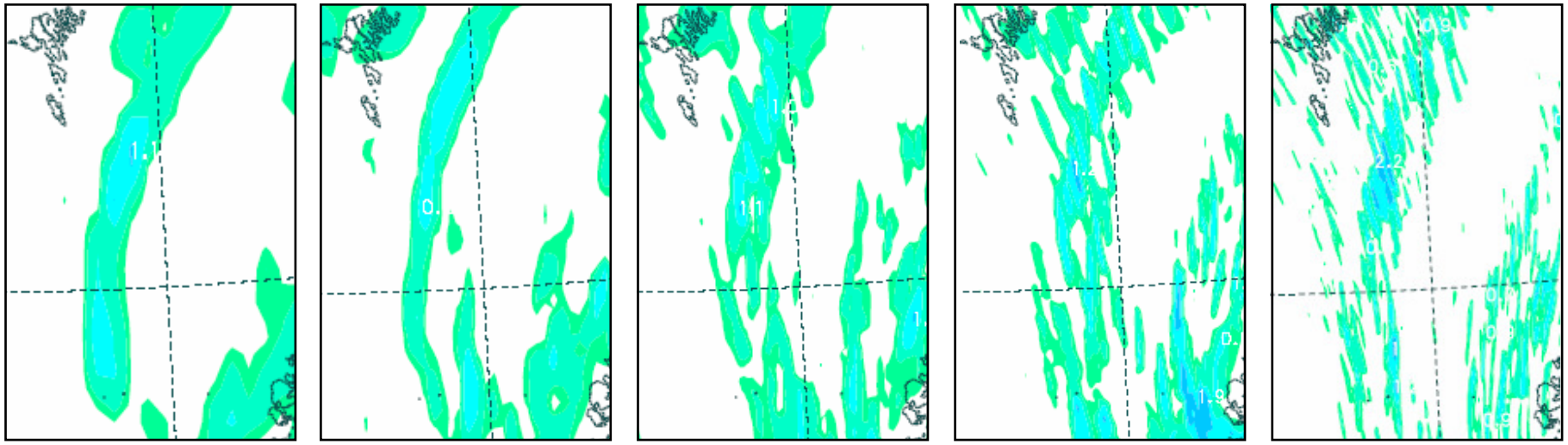
ALARO-0 physics (multiscale convective scheme '3MT' activated)



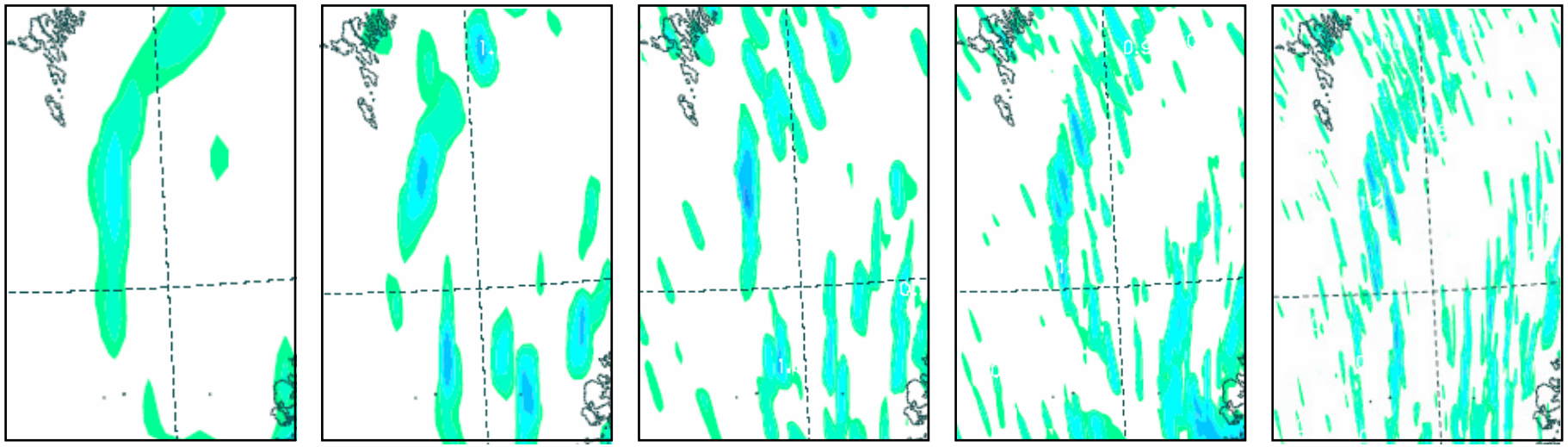
ALARO-0 physics (multiscale convective scheme '3MT' disabled)

Cold air outbreak; WGNE grey-zone test; 30-31 h precipitations (from 30/01/10 12UTC)

δx=16km **δx=8km** **δx=4km** **δx=2km** **δx=1km**



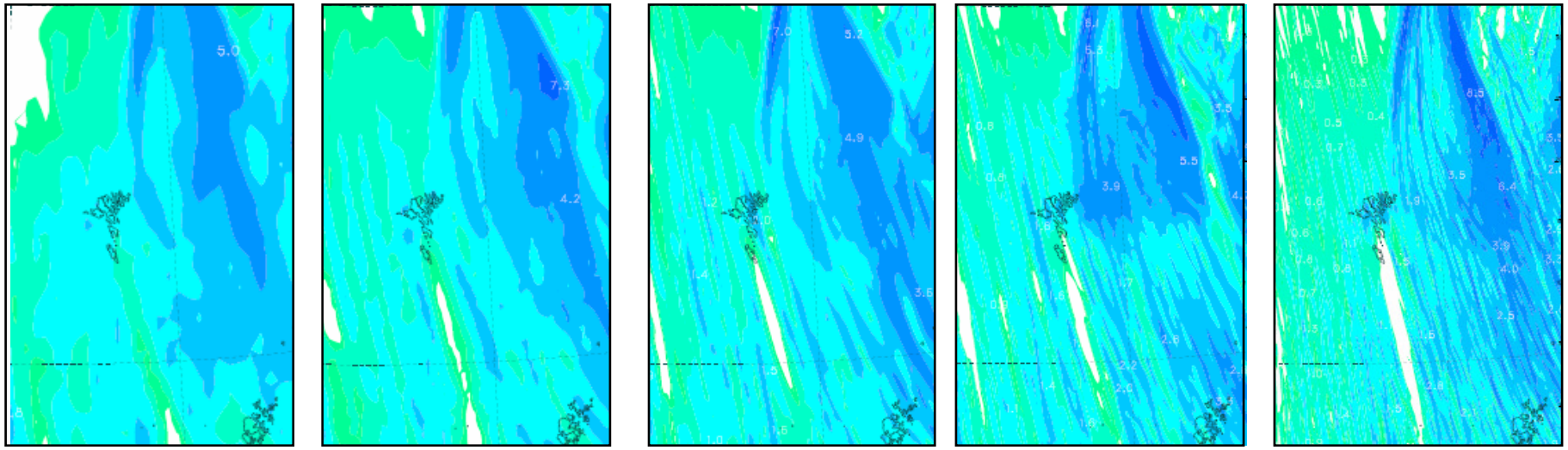
ALARO-0 physics (multiscale convective scheme '3MT' activated)



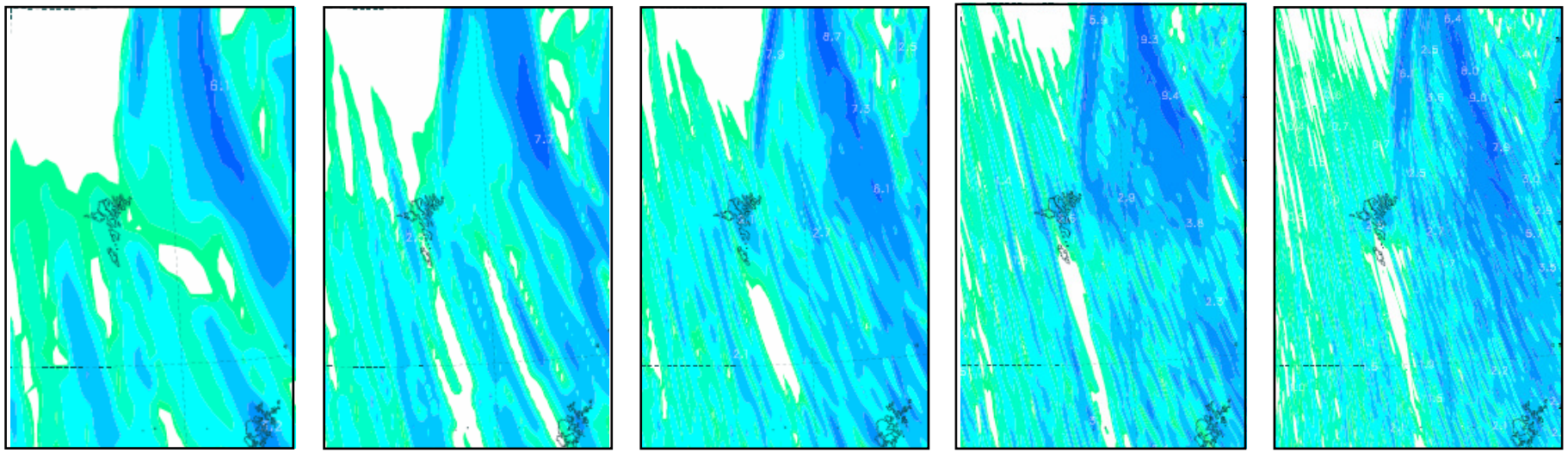
ALARO-0 physics (multiscale convective scheme '3MT' disabled)

Cold air outbreak; WGNE grey-zone test; 18-24 h precipitations (from 30/01/10 12UTC)

δx=16km **δx=8km** **δx=4km** **δx=2km** **δx=1km**



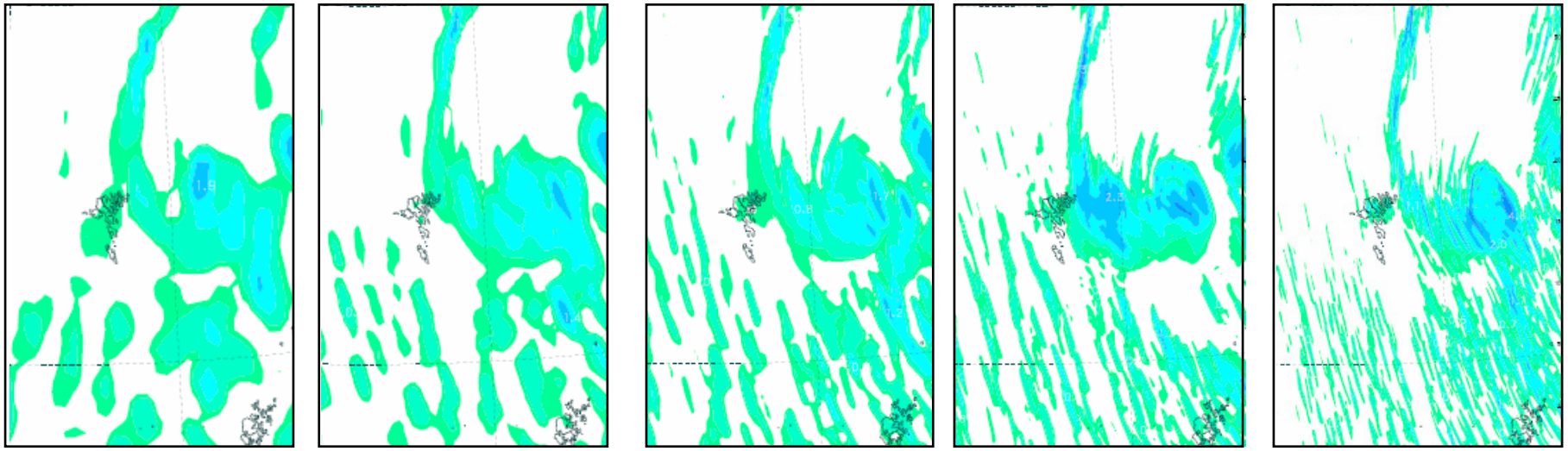
ALARO-0 physics (multiscale convective scheme '3MT' activated)



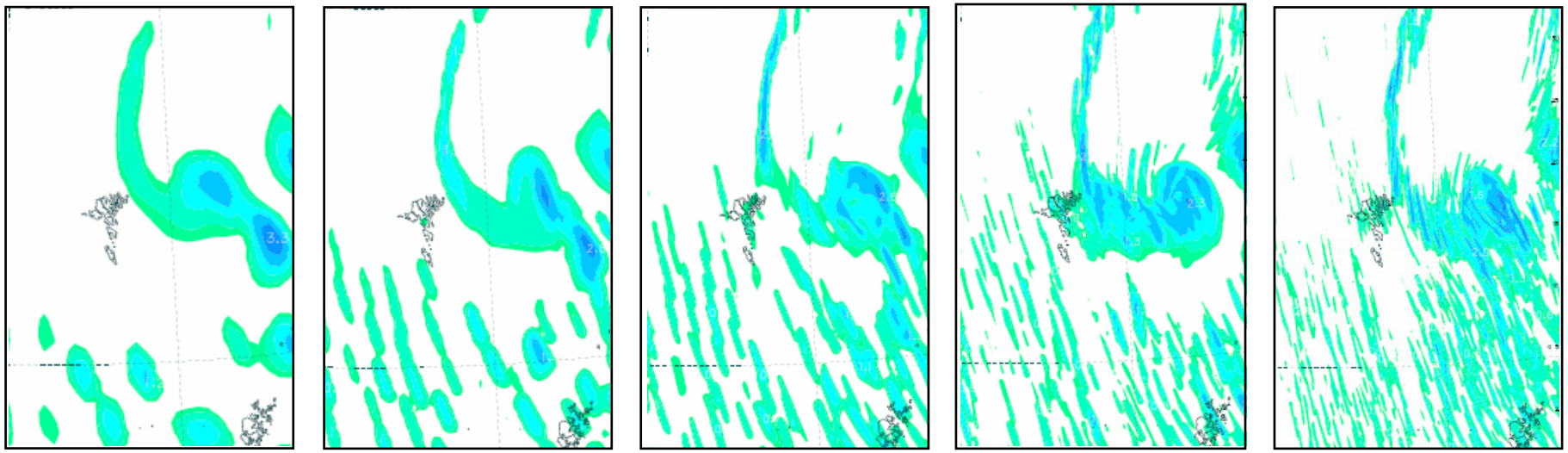
ALARO-0 physics (multiscale convective scheme '3MT' disabled)

Cold air outbreak; WGNE grey-zone test; 23-24 h precipitations (from 30/01/10 12UTC)

δx=16km δx=8km δx=4km δx=2km δx=1km



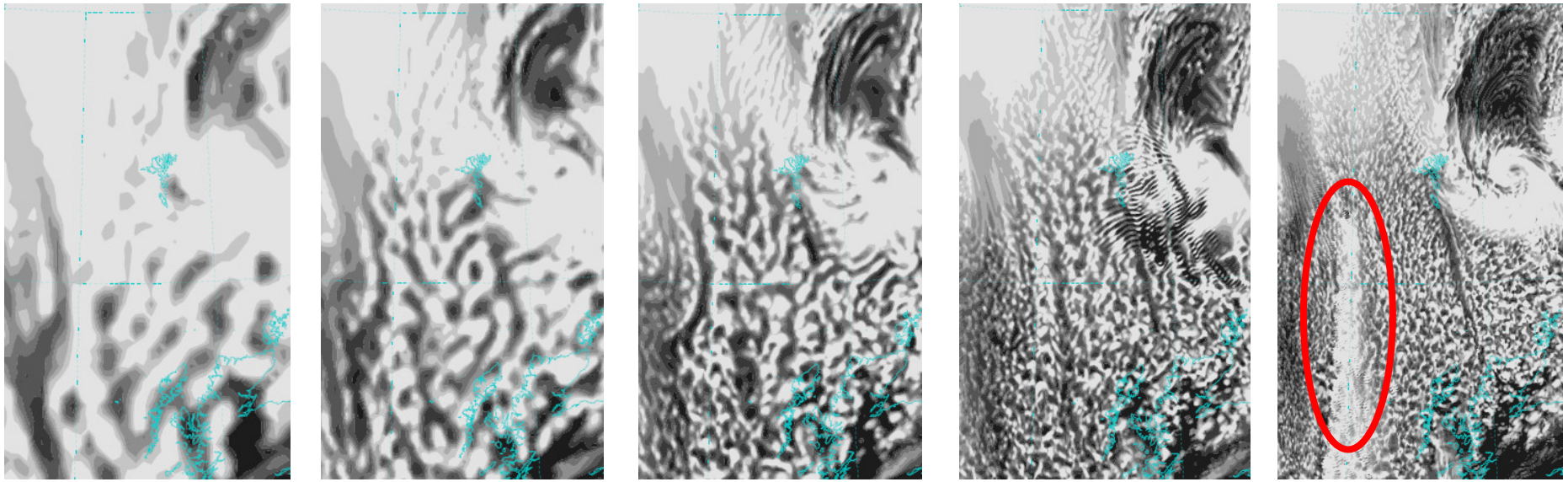
ALARO-0 physics (multiscale convective scheme '3MT' activated)



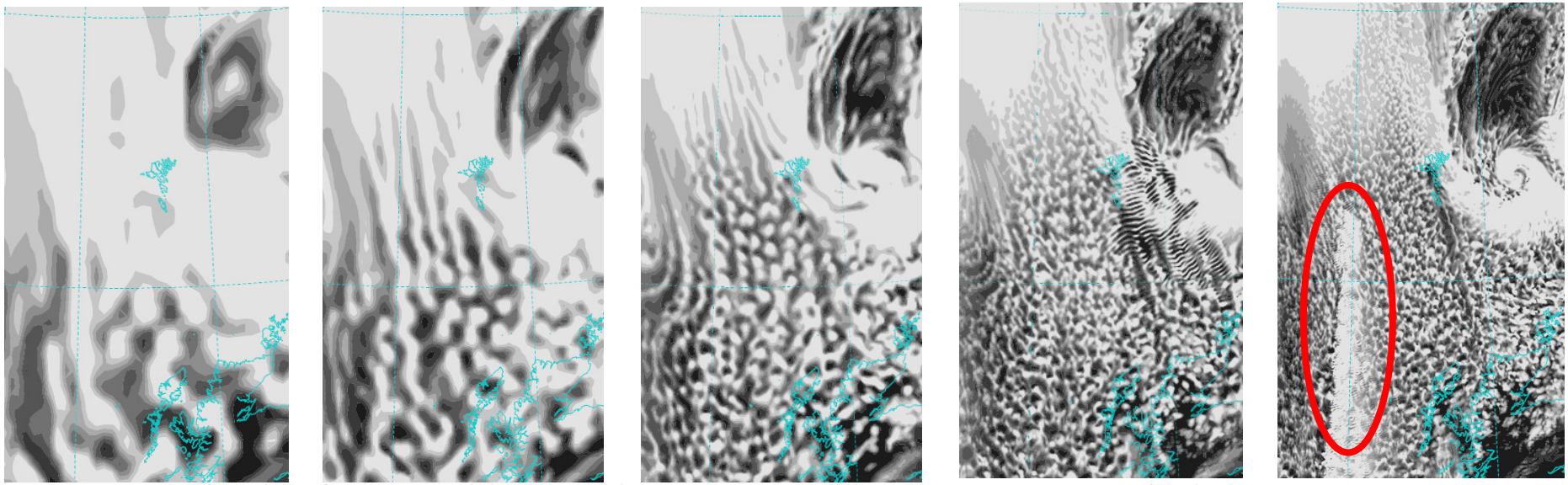
ALARO-0 physics (multiscale convective scheme '3MT' disabled)

Cold air outbreak; WGNE grey-zone test; 24h total cloud-cover

δx=16km δx=8km δx=4km δx=2km δx=1km



ALARO-0 physics (multiscale convective scheme '3MT' activated)



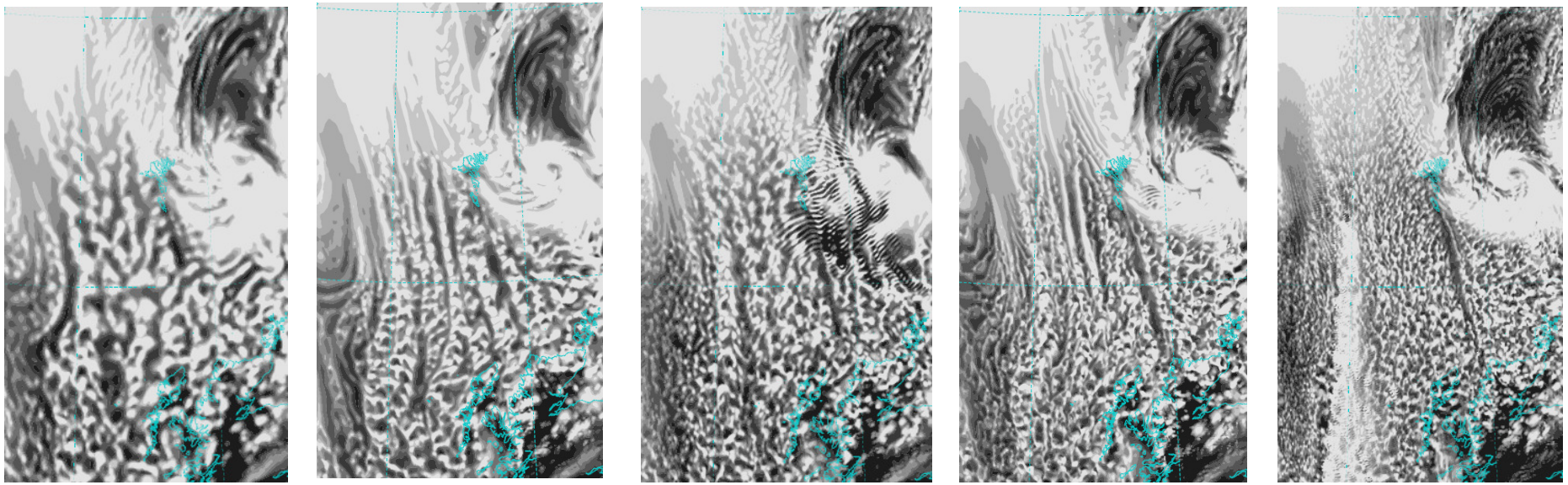
ALARO-0 physics (multiscale convective scheme '3MT' disabled)

Retuning horizontal diffusion

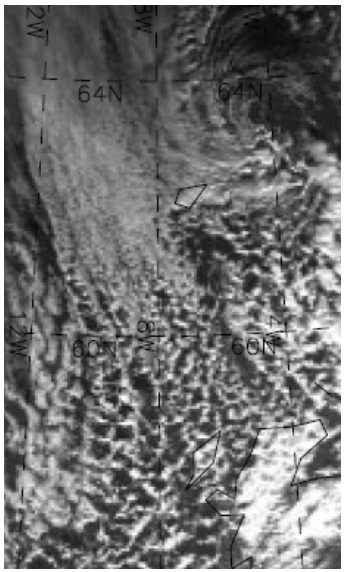
- Resolutions 2km and 1km : problem of energy accumulation nearby the model top (resolved buoyancy waves);
- Chosen Remedy:
  - Allow a small amount of horizontal spectral diffusion through the troposphere (the operational version of CHMI uses only SLHD below app 100 hPa);
  - Linear horizontal spectral diffusion should be used with moderation, because of the associated wavy patterns.
- The problem may be cured by other approaches (e.g. a kind of sponge – relaxation to LBC is applied at the top), research on a better solution is ongoing.

Cold air outbreak; WGNE grey-zone test; 24h total cloud-cover

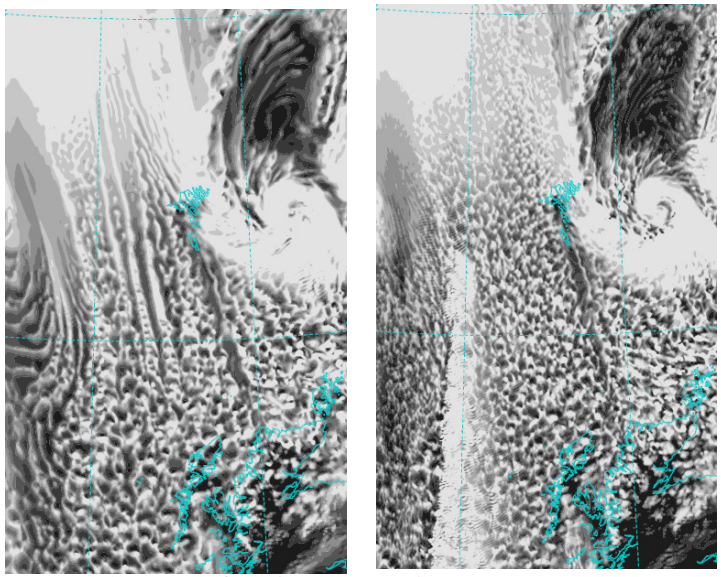
δx=4km | δx=2km (bis) | δx=2km | δx=1km (bis) | δx=1km



ALARO-0 physics (multiscale convective scheme '3MT' activated)



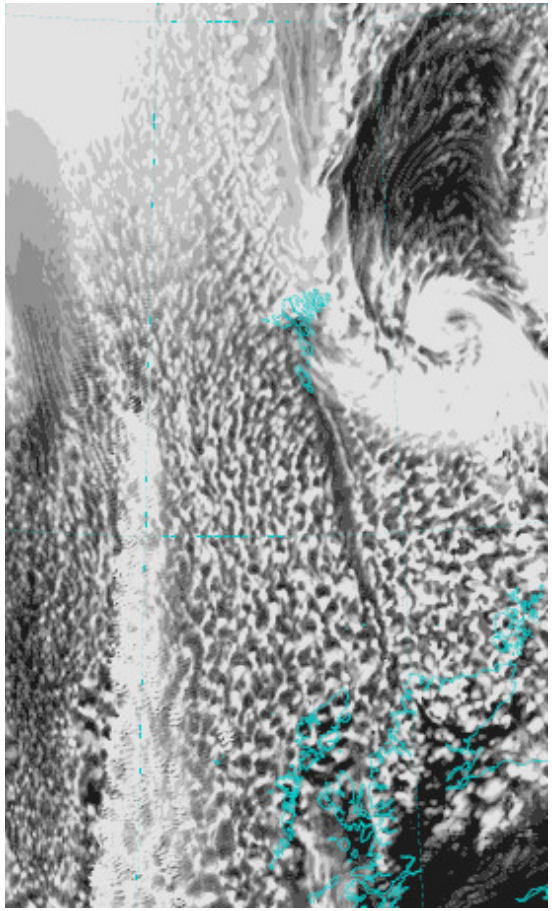
(MODIS Observation)



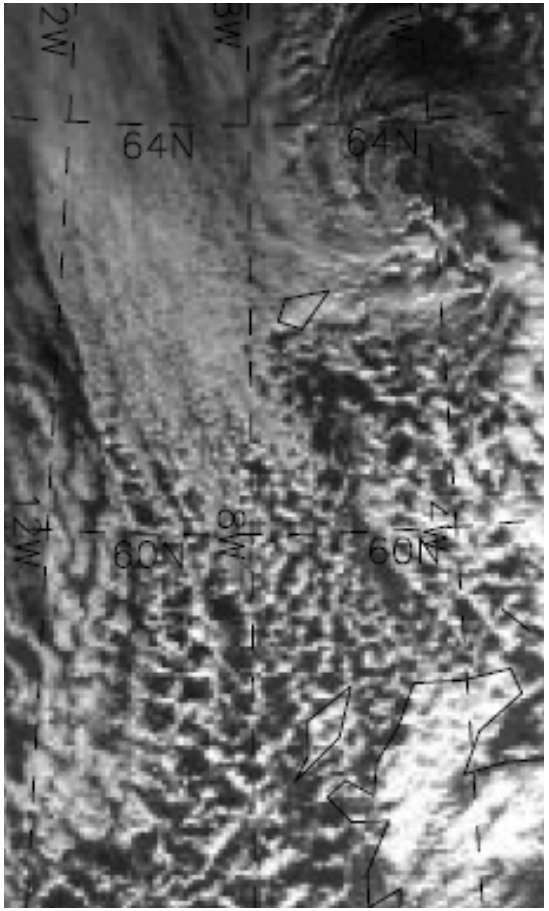
ALARO-0 physics (multiscale convective scheme '3MT' disabled)

Cold air outbreak; WGNE grey-zone test; 1-2-km schemes' validation

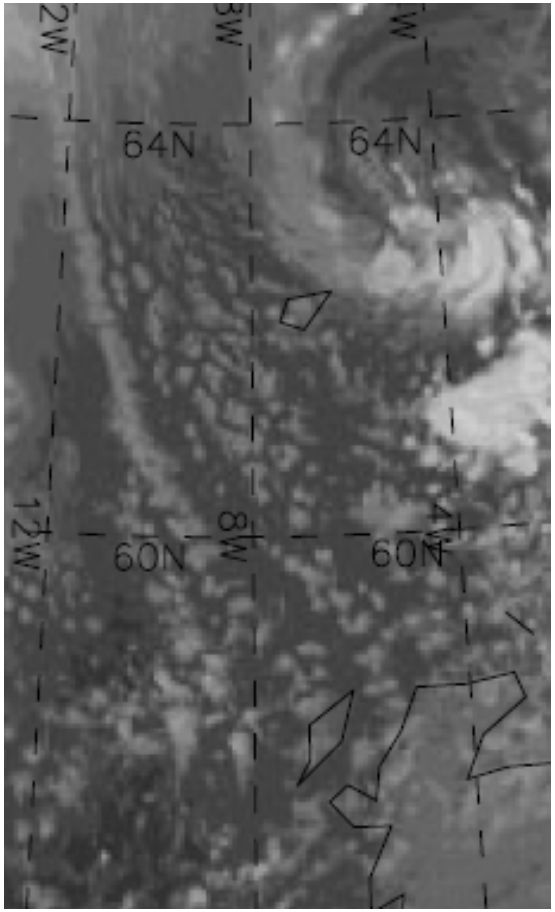
ALARO-0 with 3MT at 1 km



MODIS observation

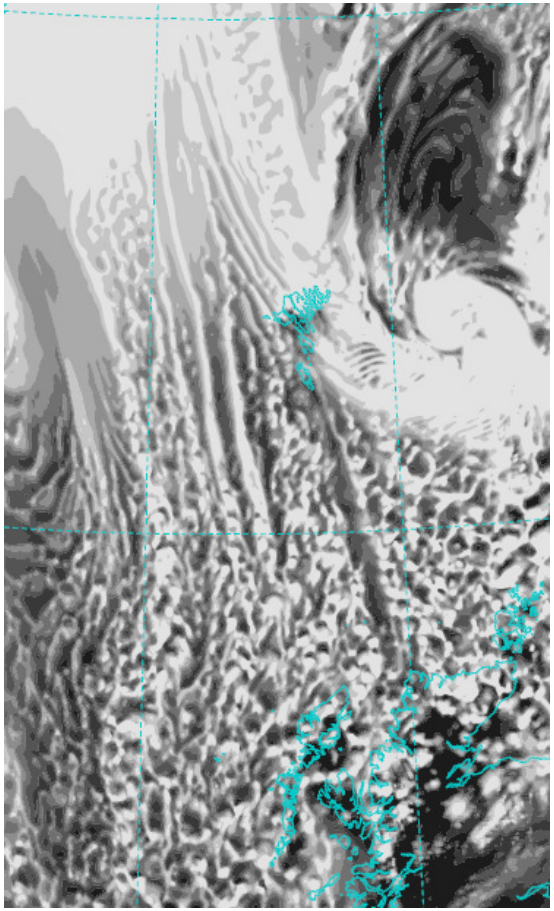


MO model (OLR) at 1.5 km



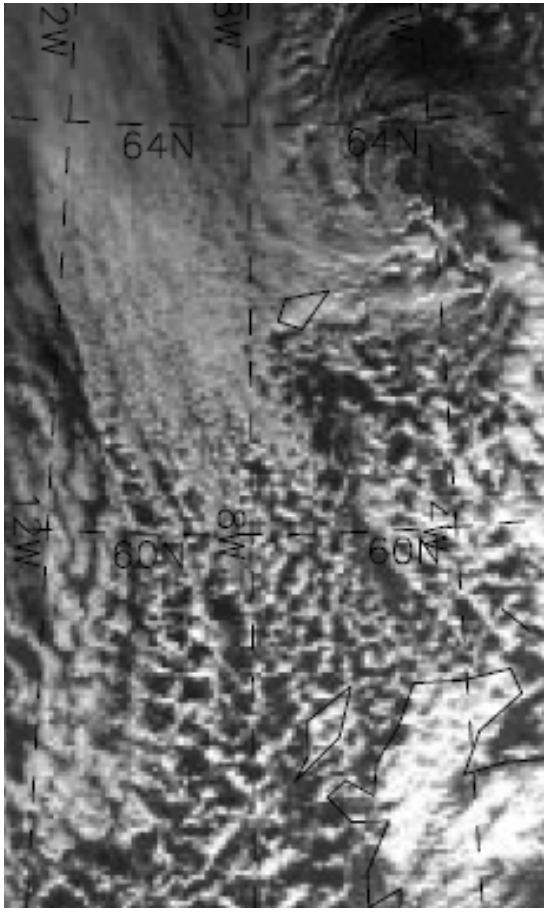
Cold air outbreak; WGNE grey-zone test; 1-2-km schemes' validation

ALARO-0 with 3MT at 1 km (bis)

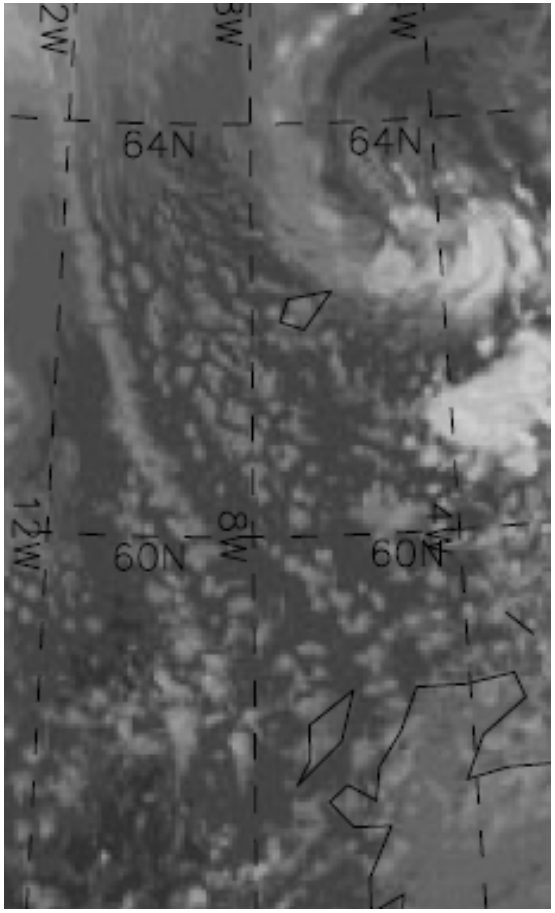


MODIS

observation

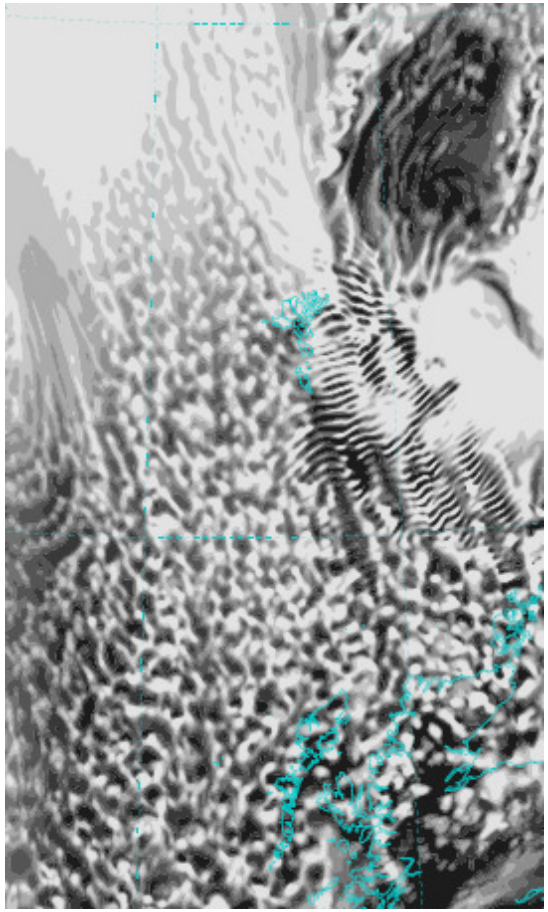


MO model (OLR) at 1.5 km

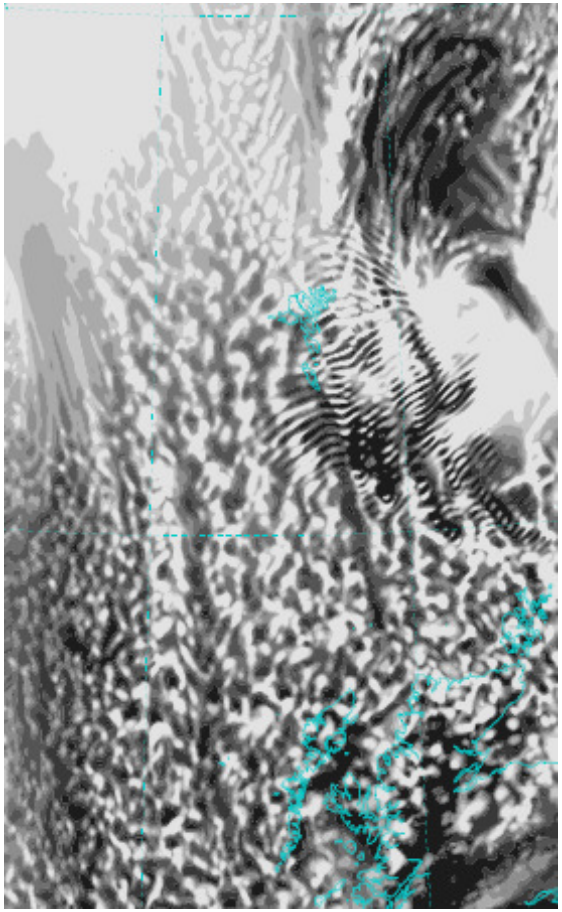


Cold air outbreak; WGNE grey-zone test; 2-km schemes' validation

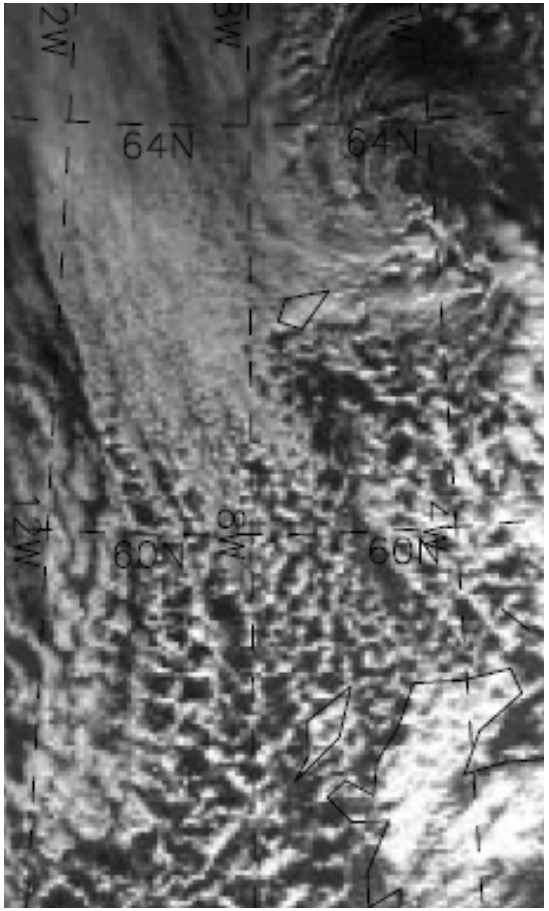
ALARO-0 without 3MT at 2 km



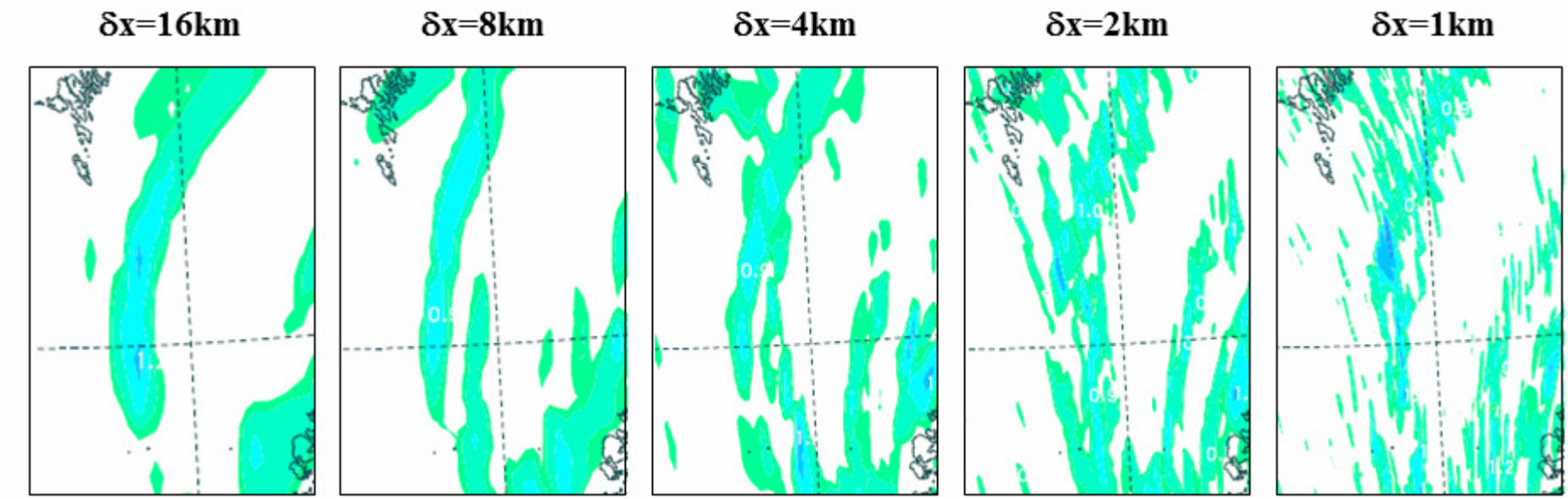
ALARO-0 with 3MT at 2 km



MODIS observation



ALARO precipitation with modified HDIF



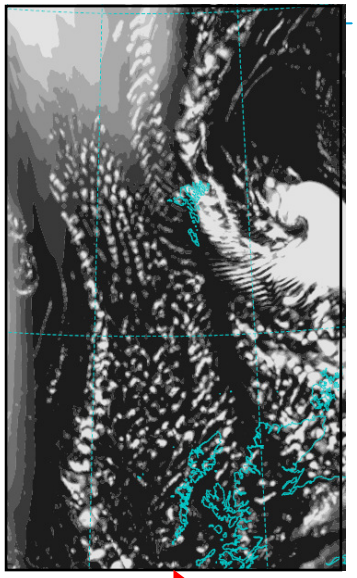
1h precipitation sum from +30h to 31h, forecast base 30 January 2010, 12h UTC
area between Faeroe and Orkney islands, case with 3MT.

Some results of 3MT in ARPEGE

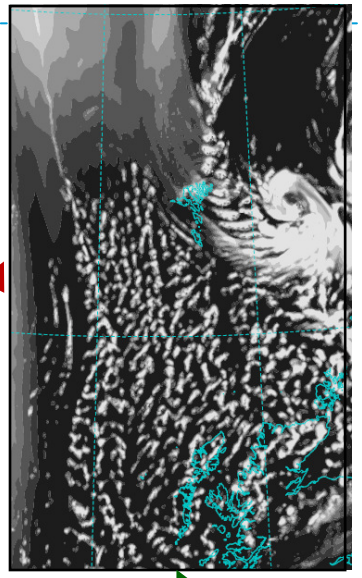
- The setup of the Cold Air Outbreak Case can be of course used to test the 3MT scheme in other configurations.
- Some runs using the “3MT in ARPEGE” were performed, also showing good results.
- Progressive change from the “3MT in ARPEGE” to ALARO-0 (with ACRANEB2) revealed interesting sensitivity (dichotomy).

Cold air outbreak; WGNE grey-zone test; parameterisation schemes' dichotomy

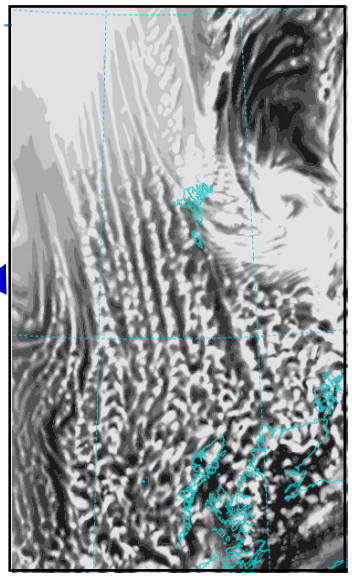
3MT-in-ARPEGE — **δx=2km - 24 h cloud-cover (from 30/01/10 12UTC)** — **ALARO-0 (A2Rad)**



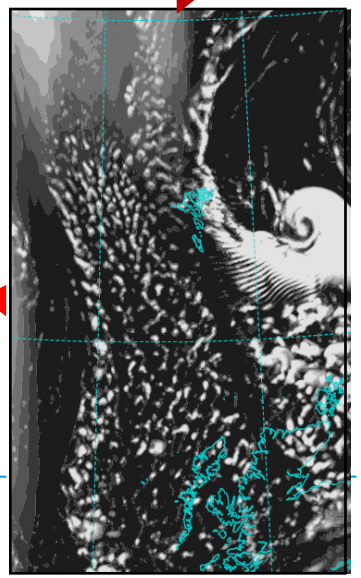
Δ = (moist) turbulence



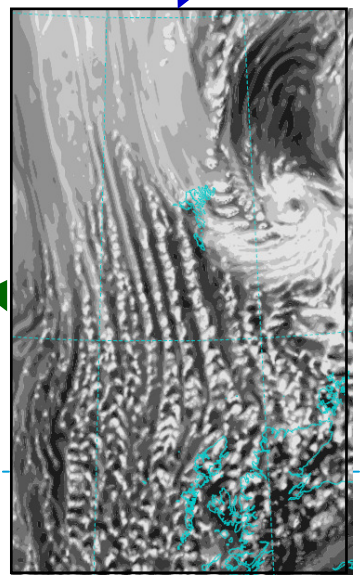
Δ = therm. adj. & miscellaneous



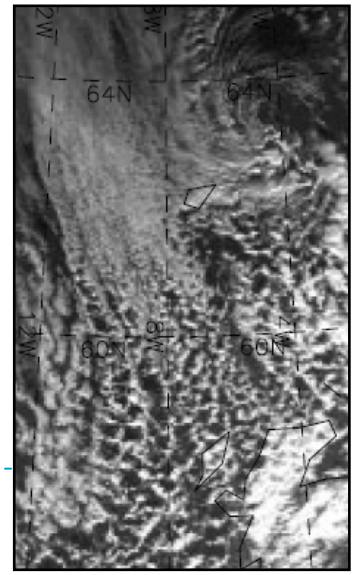
Δ = micro-physics



Δ = radiative cloud-cover

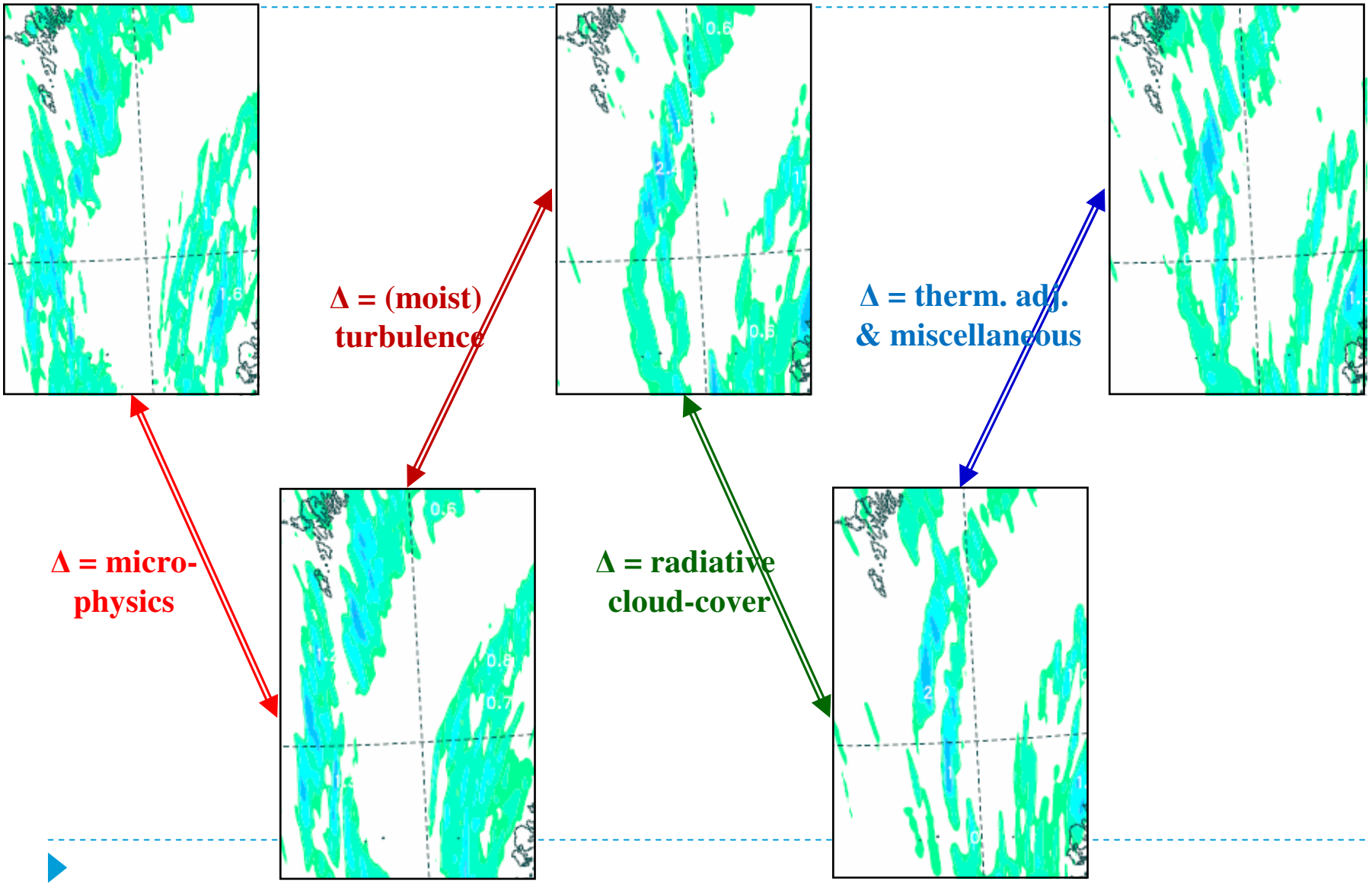


MODIS observation



Cold air outbreak; WGNE grey-zone test; parameterisation schemes' dichotomy

3MT-in-ARPEGE **δx=2km - 30-31 h precipitations (from 30/01/10 12UTC)** **ALARO-0 (A2Rad)**



Cold air outbreak; WGNE grey-zone test; parameterisation schemes' dichotomy

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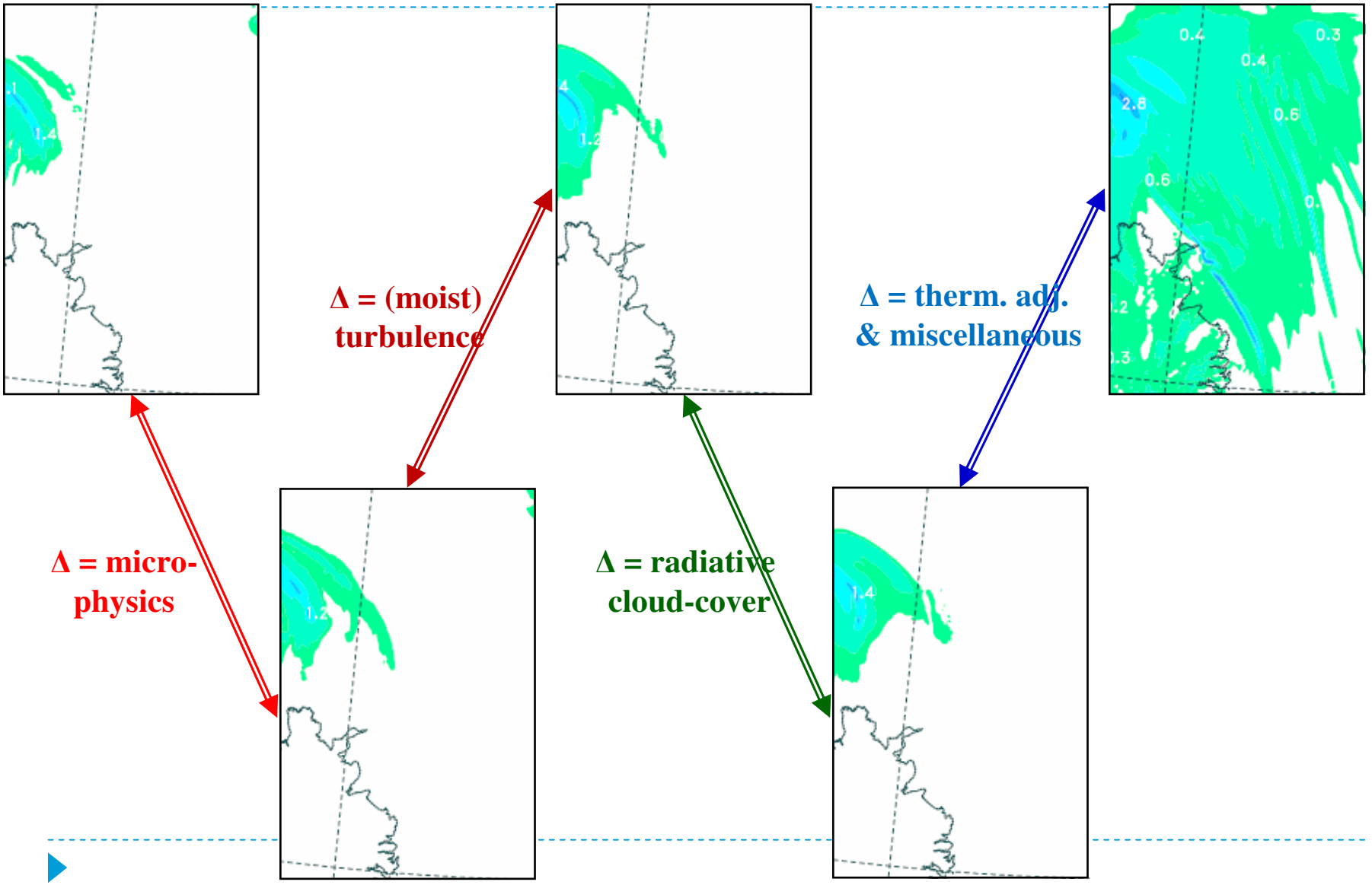

Conclusions

- The grey zone experiment is a quite valuable 3D real case test bed to compare solutions;
- ALARO-0 proves to provide a “seamless” forecast across the grey zone;
- We also could discover problems, like the one of accumulated energy of resolved buoyancy waves;
- ALARO-1 will be tested in this framework as well.