# Austria

- AROME-Nowcasting: Implementation of a 1.2km version of AROME with radar data assimilation and latent heat nudging.

- AROME-EPS: Implementation of stochastic perturbed partial tendencies (shallow convection, turbulence, microphysics) in AROME

- SEAMLESS: Integration of Ensemble INCA – AROME-EPS – and LAEF to a Seamless probabilitsic forecasting system.

# Belgium

- New HPC and model domain
- RMI-EPS: a prototype convection-permitting EPS for Belgium
- Monitoring the urban climate of the city of Ghent

# CROATIA

1. Operational suite:
   8 km 37 levels and 4 km 73 levels, both use LBC files from ECMWF, and run Alaro0 with 3Dvar and Canari with 3 hourly cycling
   additionally - dynamical adaptation of wind to 2km resolution
   full nonhydrostatic run in 2 km resolution.

2. Dvelopment and testing:
   new clim files are created for ISBA as in Noilhan and Planton from PGD fields from SURFEX and testing performed using Alaro0 and Alaro1.

3. Products :
   operational post-processing of forecasts to suite the needs of forecasting power production from the wind farms and solar power plants.

# Czech Republic

- Summary of changes in the operational status
- Recent research activities

# Danish Meteorological Institute
# NWP news 2016$_{(1)}$

## DMI participation in
## EU H2020 Project ESCAPE

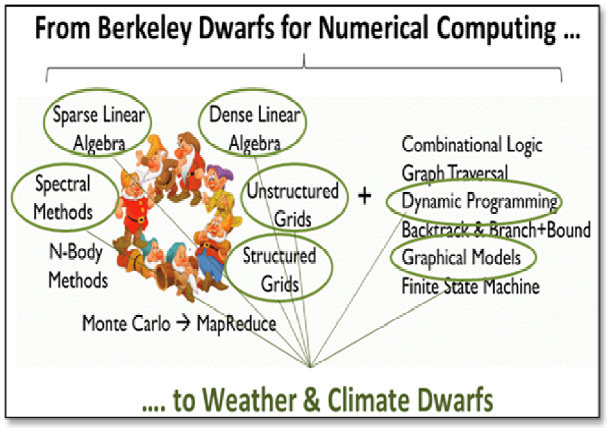
**Towards Energy-efficient Scalable Algorithms for Weather- and Climate prediction:**

**The EU-H2020 ESCAPE (www.hpc-escape.eu) project brings together numerical weather prediction (NWP) and climate high-performance computing (HPC) communities to develop world-class , extreme-scale computing capabilities for European operational NWP and future climate models. One of the challenges is to execute complex state-of-the-art models of the atmosphere within tight production schedules.**

**ESCAPE starts with the concept of Dwarfs that are building blocks of NWP or climate models. A Dwarf encapsulates a relevant characteristic or required functionality of a weather/climate prediction model, presented as a runnable and verifiable mini-application**

**WORK PACKAGES**

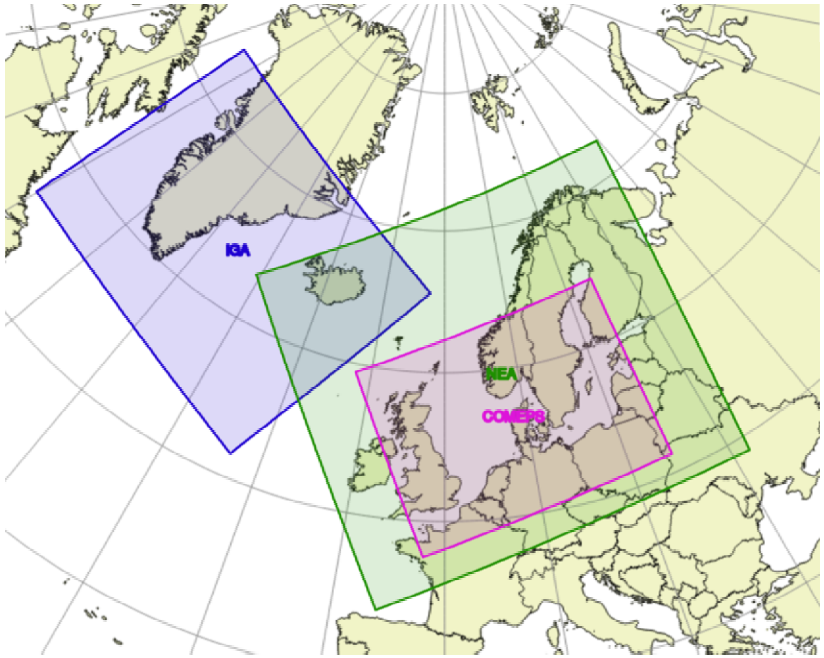
**WP1 : Weather and Climate Dwarfs**
**WP2 : Code adaptations for modern HPC architecture**
**WP3 : Hybrid computing**
**WP4 : Benchmarking and diagnostics**
**WP5 : Dissemination and training**
**WP6 : Project management**




**DMI participates in WP1,WP2 and WP5**

# Danish Meteorological Institute
# NWP news 2016$_{(2)}$

**New NWP setup** on DMI's Cray XC30 is expected to become operational before the end of 2016. HARMONIE IGA is developed in collamoration with IMO. HARMONIE NEA is replacing a HIRLAM model covering the same area.
A unique feature of the new model setup is the LAM –EPS system called COMEPS ( COntinuous Mesoscale Ensemble Prediction System) The new model systems are described in more details below.

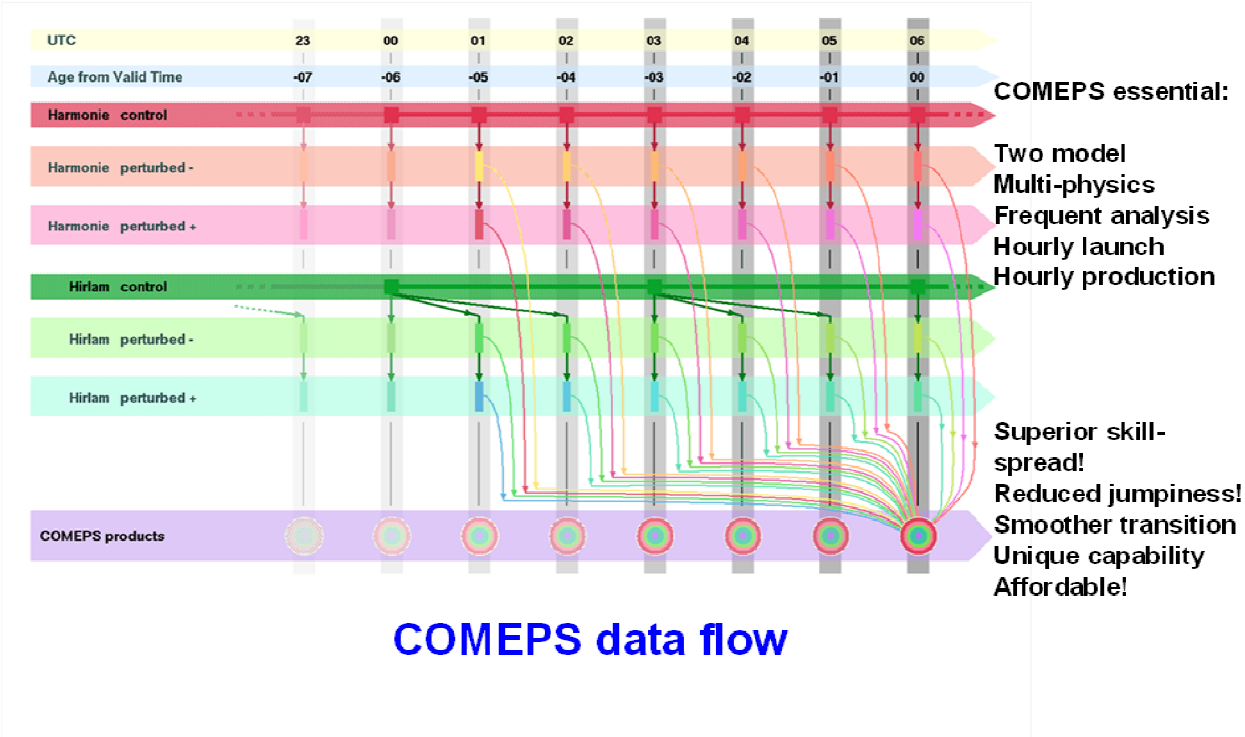



**New HARMONIE model domains :**
**IGA (blue), HARMONIE NEA (green), COMEPS (purple)**

# Danish Meteorological Institute
# NWP news 2016(3)

**COMEPS:**

**The most innovative part of the new operational setup of DMI is COMEPS . It combines multimodel concept (HARMONIE and HIRLAM) with frequently updated analyses and forecasts. Each hour a control + two perturbed forecasts is launched per model system from a fresh model analysis.**




COMEPS data flow

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

# 50 Years of Numerical Weather Prediction and High Performance Computing at DWD

## 1966 - 2016

D. Majewski (DWD)

$$
\begin{aligned}
\partial_t v_n &+ (\zeta + f)\, v_t &+ \partial_n K + w\, \partial_z v_n &= -c_{pd}\theta_v \partial_n \pi \\
\partial_t w &+ \vec{v}_h \cdot \nabla w &+ w\, \partial_z w &= -c_{pd}\theta_v \partial_z \pi - g \\
\partial_t \rho &+ \nabla \cdot (\vec{v}\rho) &= 0 & \\
\partial_t (\rho\theta_v) &+ \nabla \cdot (\vec{v}\rho\theta_v) &= 0 &
\end{aligned}
$$

# Nine NWP generations at DWD from 1966 until today

(1) 1966: **BTP**: Δ ~ **381** km (A ~ 145.161 km$^2$); 1 layer; barotropic (*Area of D: 357.000 km$^2$*)

(2) 1967: **BKL**: Δ ~ **381** km (A ~ 145.161 km$^2$); 5 layers; hemispheric model, barocl., dry

(3) 1978: **BKF**: Δ ~ **254** km (A ~ 64.516 km$^2$); 9 layers; hemispheric model, barocl., moist

(4) 1991: **GM**: Δ ~ **190** km (A ~ 36.100 km$^2$); 19 layers; global spectral model

(5) 1999: **GME**: Δ ~ **60** km (A ~ 3.114 km$^2$); 31 layers; icosahedral hexagonal grid

(6) 2004: **GME**: Δ ~ **40** km (A ~ 1.384 km$^2$); 40 layers

(7) 2010: **GME**: Δ ~ **30** km (A ~ 778 km$^2$); 60 layers

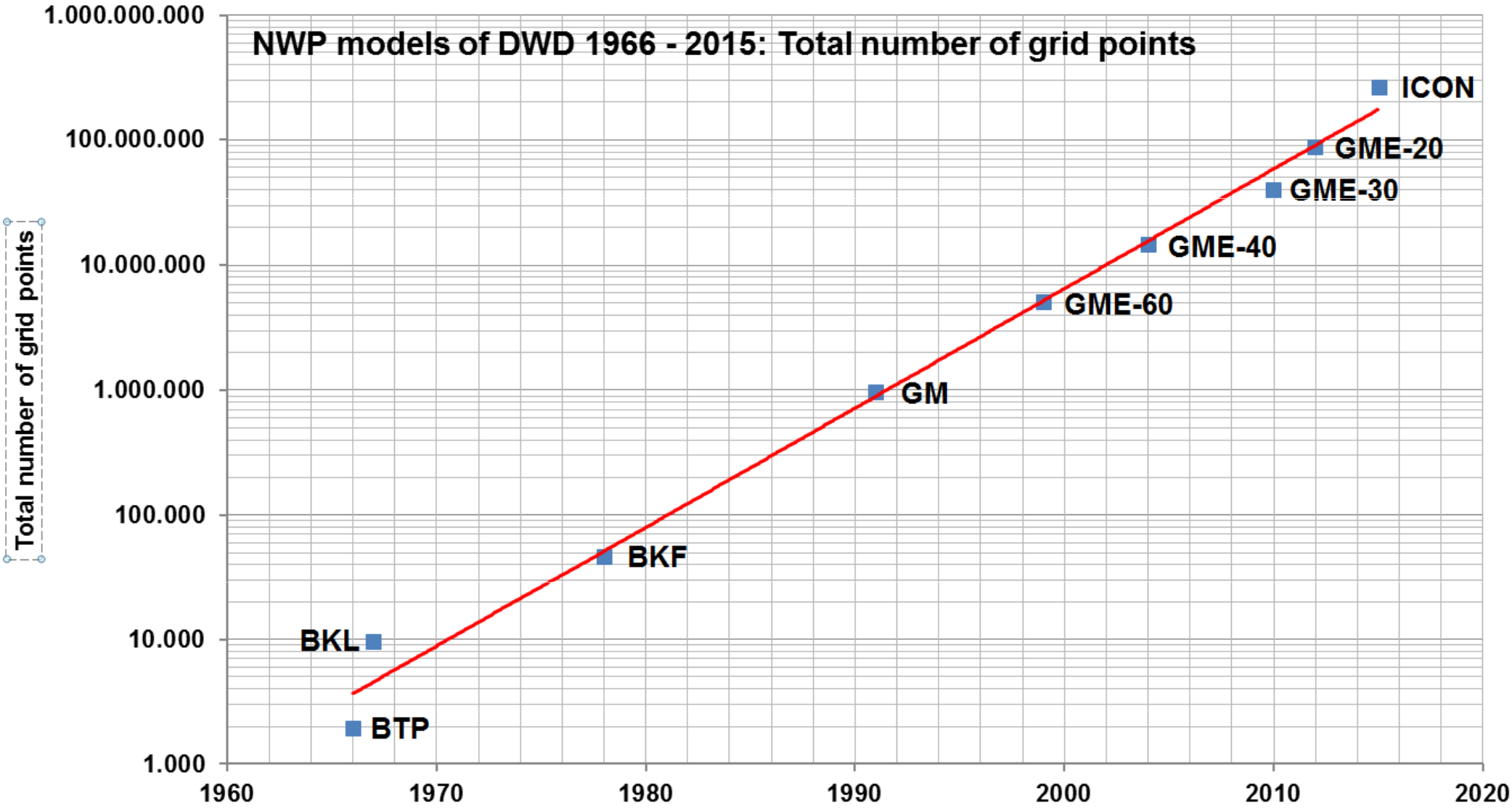
(8) 2012: **GME**: Δ ~ **20** km (A ~ 346 km$^2$); 60 layers

(9) 2015: **ICON**: Δ ~ **13** km (A ~ 173 km$^2$); 90 layers; nonhydrostatic model; triang. grid

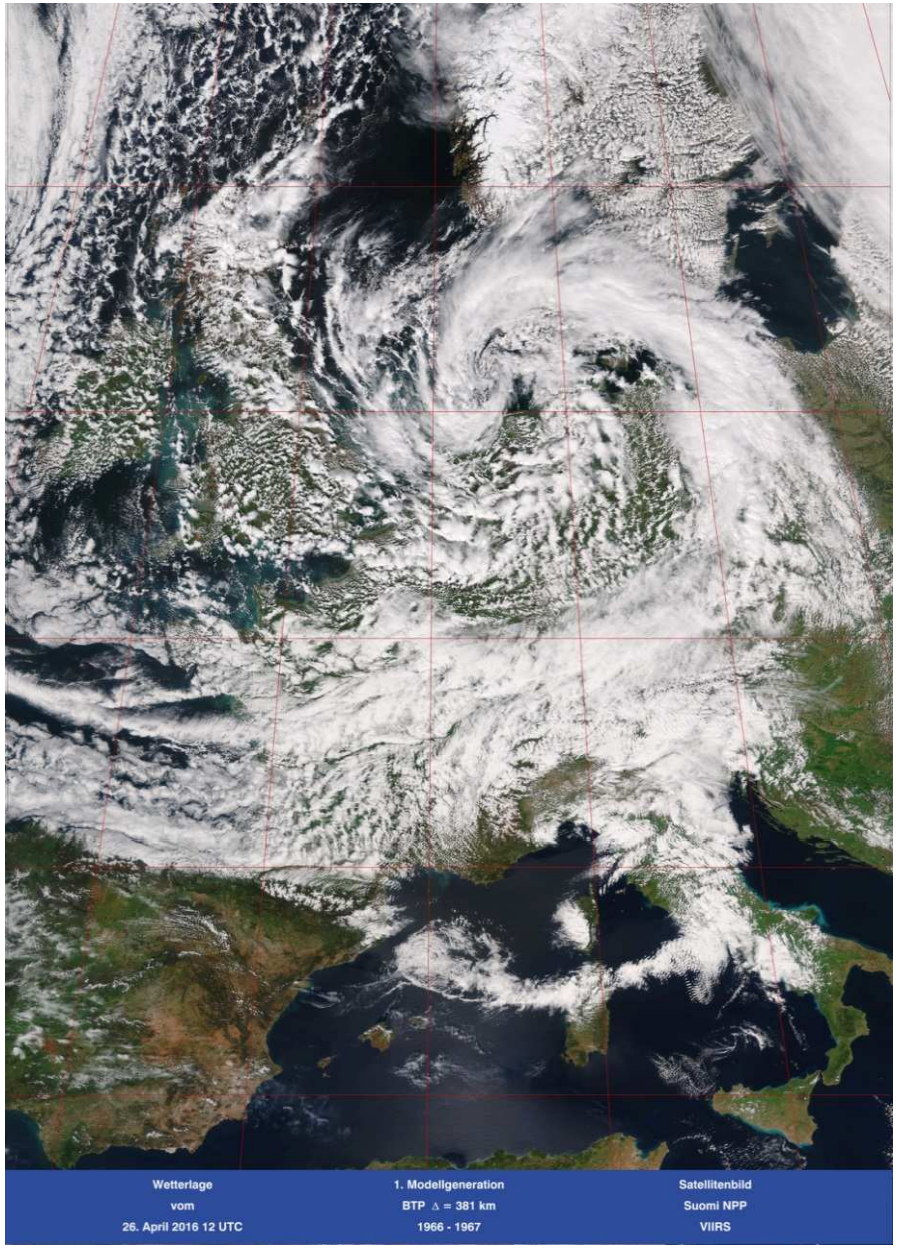
The NWP generations are also characterized by increasing complexity of the physical parameterizations, numerical methods and software design.

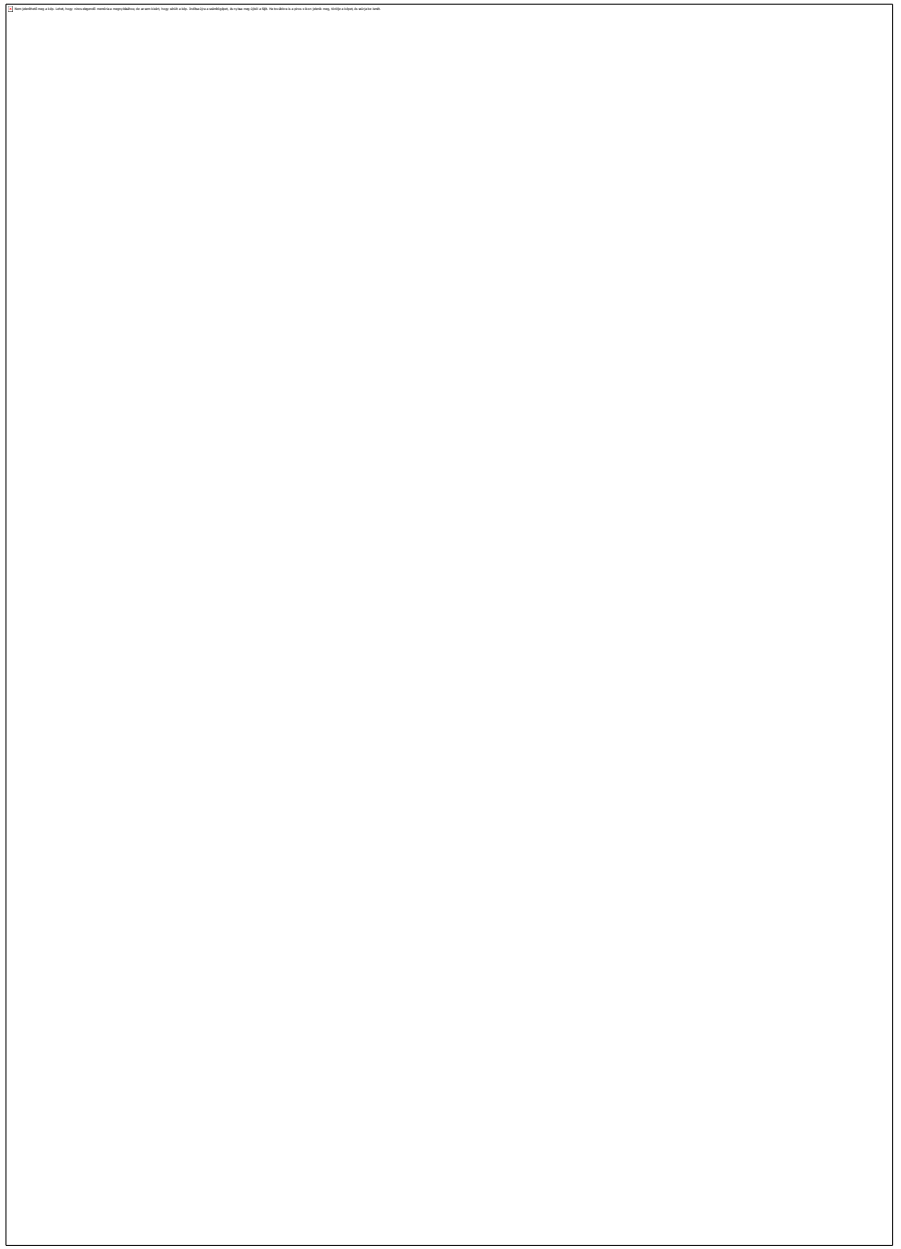
Moreover, the progress in data assimilation (algorithms as well as types of data used, esp. satellite data)

significantly contributes to the steady improvement of forecast quality.


NWP models of DWD 1966 - 2015: Total number of grid points
Total number of grid points
1.000.000.000
100.000.000
10.000.000
1.000.000
100.000
10.000
1.000
1960
1970
1980
1990
2000
2010
2020
ICON
GME-20
GME-30
GME-40
GME-60
GM
BKF
BKL
BTP

# 1st und 9th generation, 1966 vs. 2016

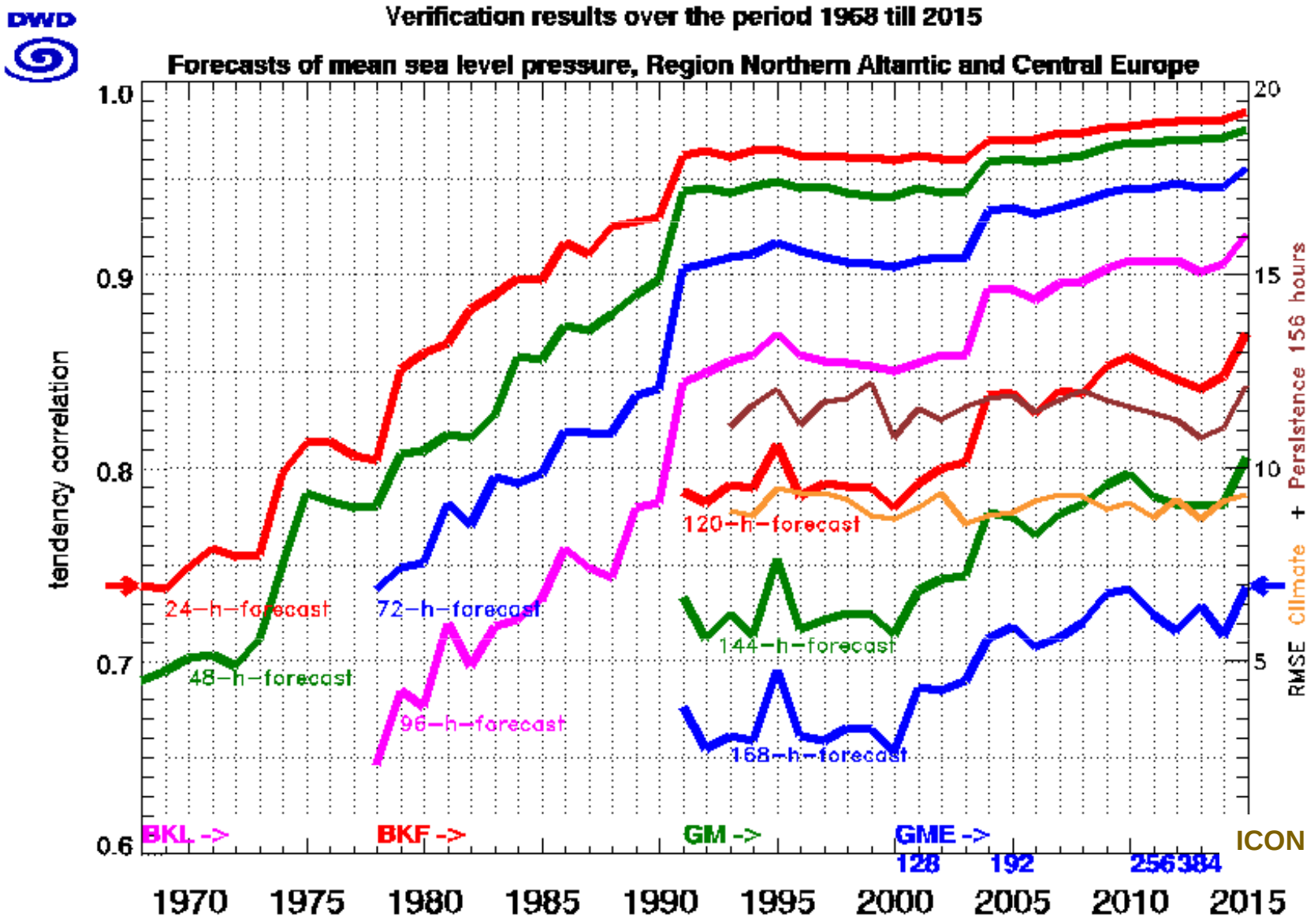


~ 3 - 4 grid points for Germany, 1 layer



~ 2000 grid points for Germany, 90 layers


DWD
Verification results over the period 1968 till 2015
Forecasts of mean sea level pressure, Region Northern Altantic and Central Europe
tendency correlation
RMSE Climate + Persistence 156 hours
1.0
0.9
0.8
0.7
0.6
20
15
10
5
24-h-forecast
48-h-forecast
72-h-forecast
96-h-forecast
120-h-forecast
144-h-forecast
168-h-forecast
BKL ->
BKF ->
GM ->
GME ->
128
192
256
384
ICON
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015


Thank you for
your interest!
Any questions?

# Finland

- Operational suites
- Snow observations from different sources from DA perspective: avaliability and errors
- New structure functions for Lake Water Surface Temperature (LWST) derived from observations

# France

- The NWP systems at Meteo-France :
  - The ARPEGE/AROME forthcoming parallel suite
  - AROME Overseas
  - AROME-PI : a high resolution model for nowcasting
  - AROME-France Ensemble Prediction System

# ALADIN

- 1991-2016 : ALADIN 25th Anniversary
  - from 4 to 16 Partners
  - people: the ALADINers
  - Events and achievements

# Hungary

- Operational NWP system (ALADIN, ALADIN-EPS, AROME)

- Recent developments
  - Data assimilation (surface EKF, AMDAR-q, Mode-S)
  - Turbulence in the grey zone
  - ALADIN-EPS with ECMWF ENS boundary conditions

# Italy

- The COMET Operational NWP System
  - The ensemble data assimilation system (COMET-LETKF)
  - The deterministic forecast system: operational configuration and upcoming updates
  - The probabilistic forecast system: description and performances

# The Netherlands

- Impact experiment (impact of observations in HARMONIE)
- Comparison of wind versus ASCAT observations
- Operational setup and new HPC plans

# Poland - ALADIN

- better control software for operational production - higher reliability, execution optimized
- new dedicated forecast products and www interfaces to view and analyze
- HARP verification implemented

# Poland - COSMO

- Operational Status of COSMO-PL and convective-scale ensemble.

- Recent results of Priority Projects: COSMO-EULAG operationalization (CELO), Intercomparison of spatial verification methods for COSMO terrain (INSPECT).

- EPS-forecasting of extreme weather events, including fog, thunderstorms and other convective phenomena.

# Portugal

- operational  suite status
- pre-operational suite: model upgrade (46 to 60 levels, 4 times a day)
- local OI_main implementation: preliminary validation studies

# Romania - ALADIN

- ALARO cy40t1_bf05 validation
- ALARO operational and research activities
- B-matrix computation for ALARO 3D-Var data assimilation

# 1. Operational *4 times per day* COSMO-Ru for 7 area

## Moscow:

- COSMO-Ru7 (7.0 km, for part of Europe), 78 h;
- COSMO-Ru2 (2.2 km, for area of Central region), **42** h;
- COSMO-Ru2 (2.2 km, for area of Sochi-2014), 42 h;
- COSMO-Ru2 (2.2 km, for area of Kazan-2013), 42 h;
- COSMO-Ru1 (1.2 km, Sochi-2014), 36 h,
- COSMO-Ru-ENA (13.2 km, **E**urope + **N**orth Asia), **120** h.

## Novosibirsk:

- COSMO-Ru-Sib-13 (13.2 km, Siberian region), 120 h

## Khabarovsk (end of 2016):

- COSMO-Ru-FE-13 (13.2 km, Russian Far East), **120** h

2. **Project SWFDP WMO for four countries of Central Asia.**

3. **Pollutions. COSMO-Ru7-ART runs every day in quasi-operational mode 48-hours forecast of air pollutant's concentration over center of the European part of Russia.**

4. **Preparing NWP system for megapolice (Moscow as example, grid size several hundred meters).**

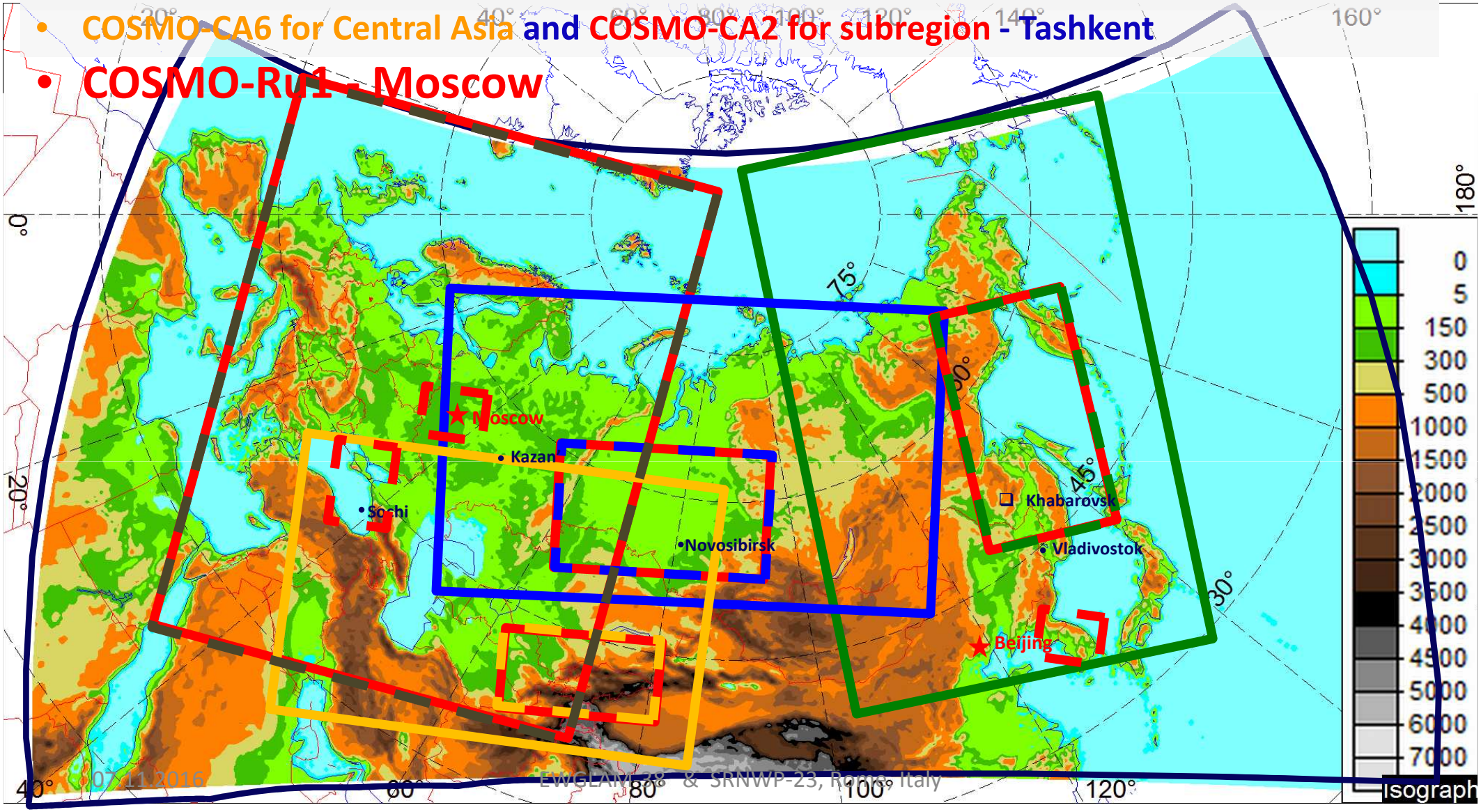
5. **The radiation block of the COSMO-Ru non-hydrostatic mesoscale model of the atmosphere and soil active layer was tested against a relatively new effective CLIRAD(FC05)-SW radiation model and radiative measurements at the Moscow State University Meteorological Observatory (MSU MO, 55.7N, 37.5E) using different aerosol datasets in cloudless conditions.**

# Roshydromet, Russia

**2017: Forecast activities**

**2017: New computer > 1 Pflops**

- COSMO-Ru6 (ENA) - Moscow
- COSMO-Ru2 for European part of Russia - Moscow
- COSMO-Ru6 for Siberia and COSMO-Ru2 for subregion - Novosibirsk
- COSMO-Ru6 for Far East and COSMO-Ru2 for subregion - Khabarovsk
- COSMO-CA6 for Central Asia and COSMO-CA2 for subregion - Tashkent
- COSMO-Ru1 - Moscow



# Serbia

- Operational running of NMMB global; providing Boundary Conditions for SEECOP members
- Regional NMMB installed and run operationally on ECMWF computer recources
- LETKF-NMMB, Hybrid EnVar-NMMB data assimilation (for 12km and 4 km model resolution)

# ALADIN and nowcasting activities @ SHMU

- operational system:
  **quasi-operational** status of the **ALARO-1vA** on new HPC (IBM)
  4.5km/63levels since August 2016

- R&D:
  - ALADIN/LAEF upgrade: 5km/60levels, preparation for EDA/3DVAR
  - ALARO-1 physics improvement: diagnostics of 2m variables in stable conditions
  - experimental AROME domain: basic installation in downscaling mode & sanity check

- Link with nowcasting:
  - Interface for hydrology
  - offline SURFEX initialized by INCA => snow
  - INCA4airports @100m resolution

# Slovenia

- study of the use and impact of local GPS ZTD observations
- ALARO-1 physics package validated for the operational use
- 2 way coupling of ALADIN model and ocean model - sensitivity studies

# Spain

- HARMONIE/AROME 2.5 km deterministic forecast is run operationally in the new AEMET's Bull computer.
  - These runs are Regular Cycle of Reference (RCR) for the HARMONIE System
  - 2 Domains H+48 forecasts
  - 3-hr cycles including assimilation of GPS/GNSS and ATOVS data.
  - Improved monitoring and verification of the system

- Research on
  - Radar data assimilation including correction for position errors (Field Alignment technique)
  - Assimilation of 'High Resolution' AMVs using NWC SAF software
  - Dynamics: Vertical Finite Elements for the vertical discretization
  - Configuration of a 2.5 km Ensemble System based on a multi-model approach

# Sweden

- MetCoOp will operationalize a mesoscale EPS on 1 Nov 2016.
- European reanalysis UERRA-ALADIN under production
- Improving mesoscale forecasts by utilizing MSG data, better microphysics, assimilating GNSS, surface DA, and high-resolution physiography.

# Switzerland

- New operational models COSMO-1 and COSMO-E
- Operations on Cray CS-STORM machines with high density of GPU
- Best members selection to drive nested ensembles

# Turkey

- Operational Activities at TSMS
- Comparison & verifications of the models
- Interactive pages developed by Turkish ALADINers

# Impacts of Increased Vertical Resolution in the Met Office UK Model

Anke Finnenkoetter, Kwinten Van Weverberg, Cyril Morcrette, Mike Bush

70 levels

120 levels

- We have tested the impact of increasing vertical resolution from 70 levels to 120 levels.
- The model cloud base lifts with increased vertical resolution, causing thinner cloud layers which are more prone to break up.
  → Better agreement with satellite observations
- Model cloud formation depends on a critical relative humidity. We tested how the choice of this critical threshold links to the lifted cloud base.