Günther Zängl, on behalf of the ICON development team

COSMO General Meeting, Offenbach, 07.09.2016

Outline

➔ **Status of limited-area-mode (ICON-LAM) and basic evaluation tests**

➔ **Progress in forecast at DWD: ICON-EU vs. COSMO-EU and WMO verification of ICON (global) against other global NWP models**

Status of ICON-LAM (limited-area mode)

a) technical aspects

➔ **Model grid needs to be precomputed with grid generator**

➔ **Preprocessing tool 'remapicon' executes only horizontal interpolation from source data to ICON grid**

➔ **Initial and boundary data from ICON, COSMO and IFS are supported**

➔ **Vertical interpolation is done within ICON; thus, changing the setup of the vertical grid does not require rerunning remapicon**

➔ **Boundary data can be read asynchronously with prefetching on a dedicated processor**

Status of ICON-LAM (limited-area mode)

a) technical aspects

➔ **Boundary data can be restricted to stripes along the lateral boundaries, covering the interpolation and nudging zones (COSMO model always requires data for full domain)**

➔ **Apart from boundary data supply, the limited-area mode is technically nearly identical to one-way nesting, where boundary data are updated at each model time step**

➔ **This implies that no physics parameterizations are active in boundary interpolation zone; model output can be masked there**

➔ **Nesting (one-way or two-way) can be combined with limited-area mode**

➔ **Unlike the COSMO-model, no built-in nudging data assimilation is available (3D-Var / EnKF DA is separate code package)**

# Status of ICON-LAM (limited-area mode)

b) exemplary functionality test

➔ **Case study for 72h-forecast starting on 11 July 2016, 00 UTC (frontal passage with heavy precipitation in the Alpine region)**

➔ **Initial and boundary conditions taken from operational ICON-EU forecast (6.5 km)**

➔ **Mesh size of limited-area grid 3.25 km; 60 levels up to ~ 22 km**

➔ **Comparison between limited-area run with two-way and one-way nesting in ICON-EU**

➔ **Reference experiment with convection scheme, limited-area experiment also conducted without convection scheme**

Model orography

geometric height of the earths surface above sea level
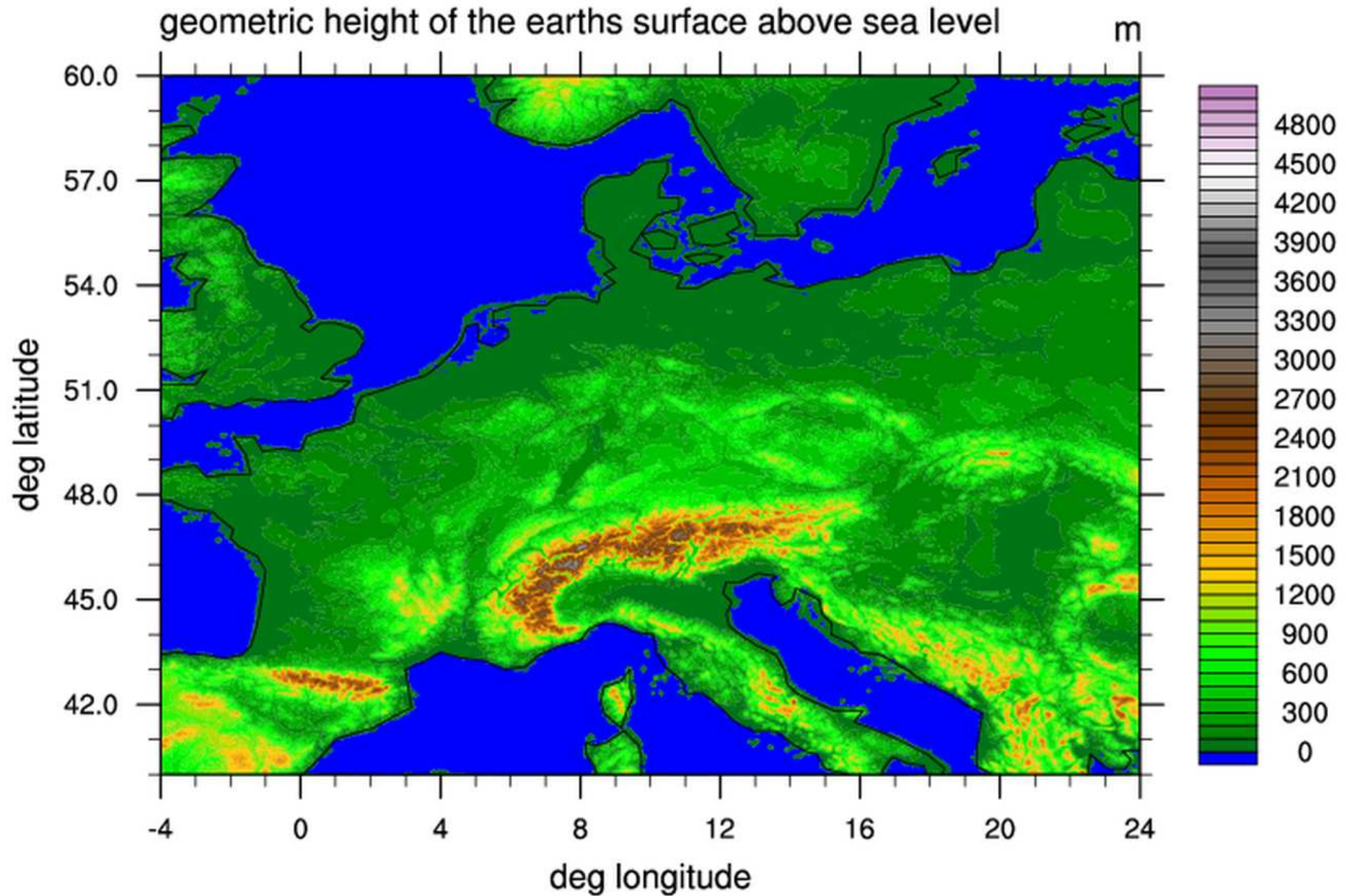
Sea-level pressure, 72h-forecast
2-way nested expt.
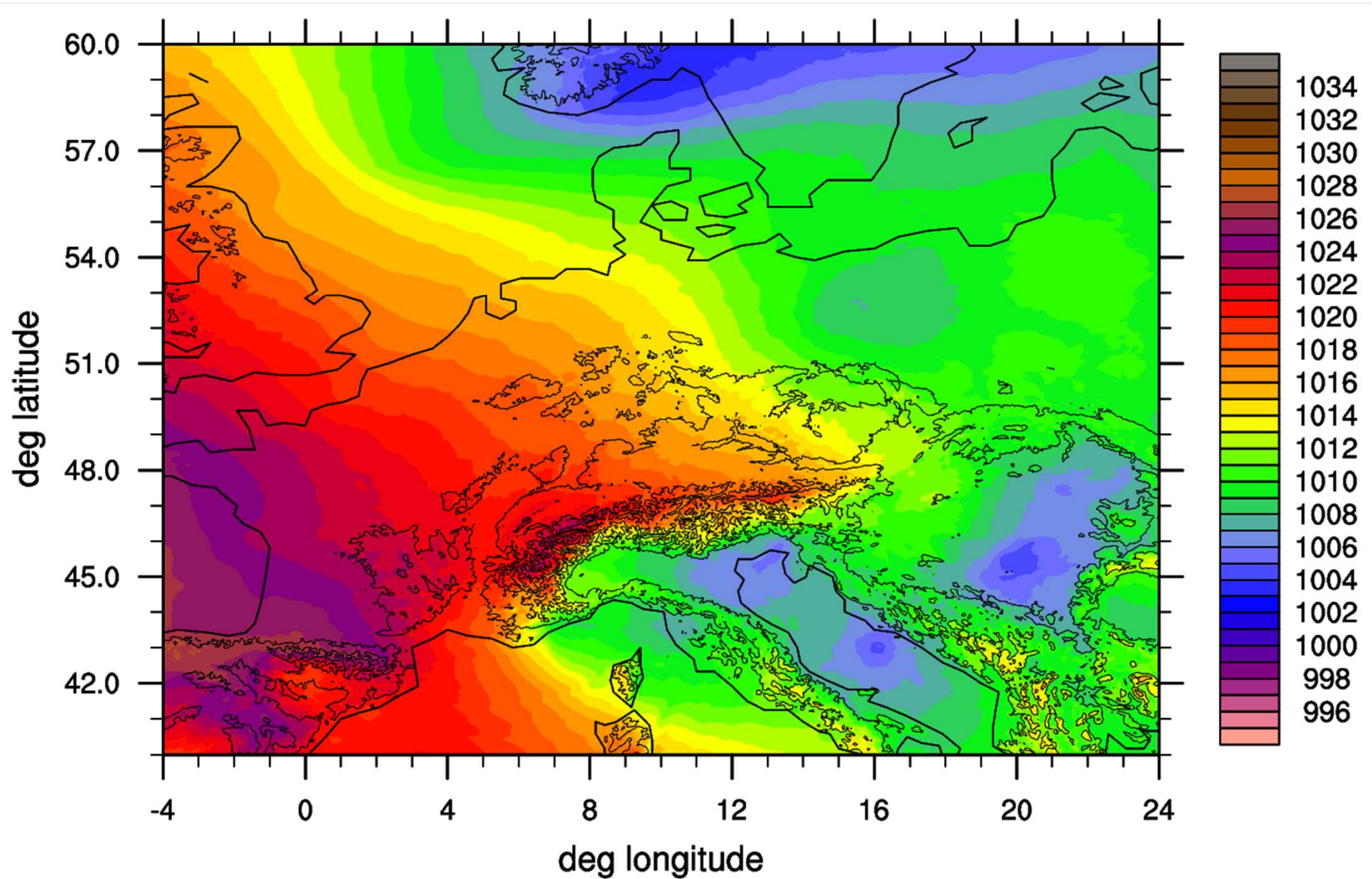
Sea-level pressure, 72h-forecast
1-way nested expt.
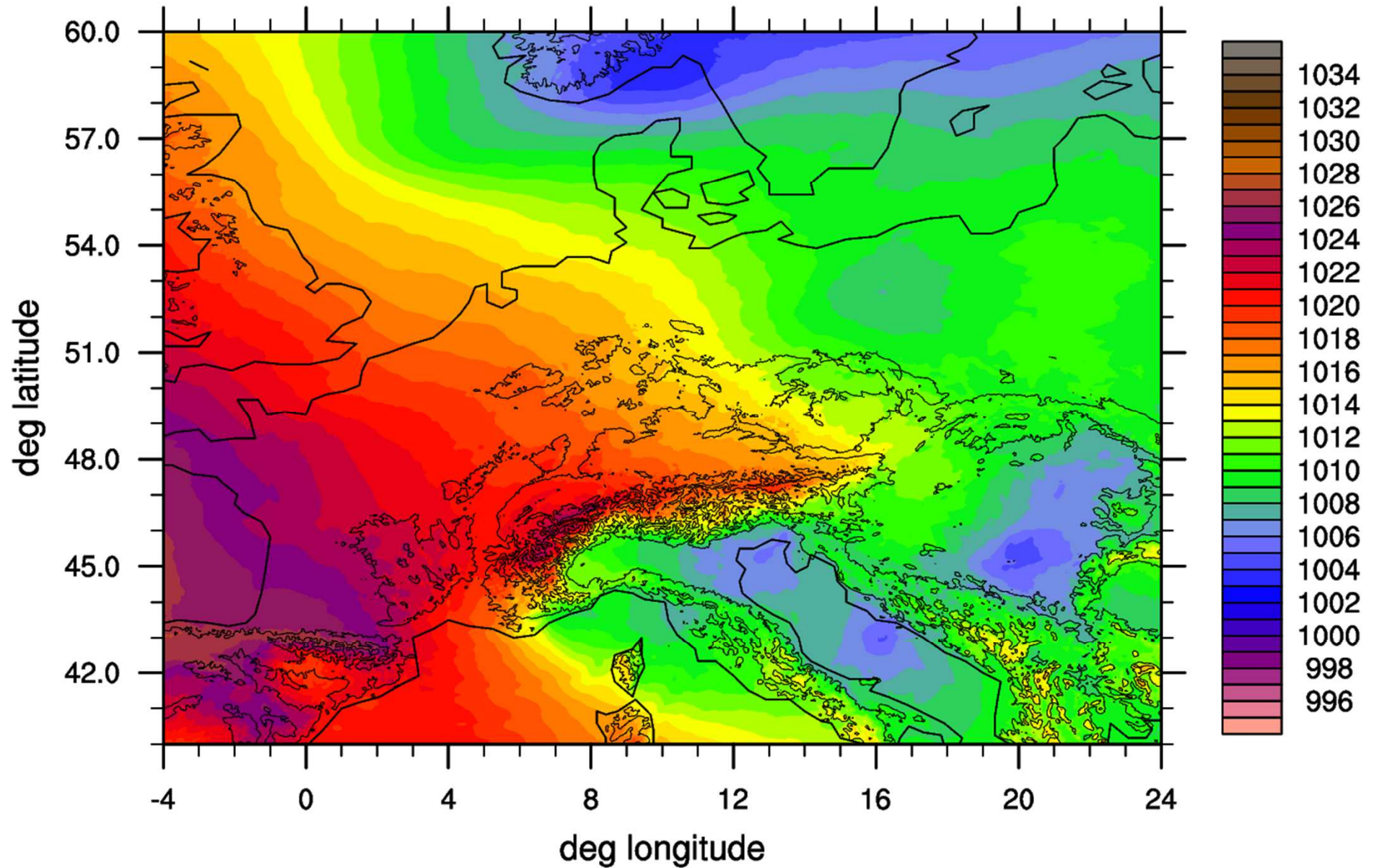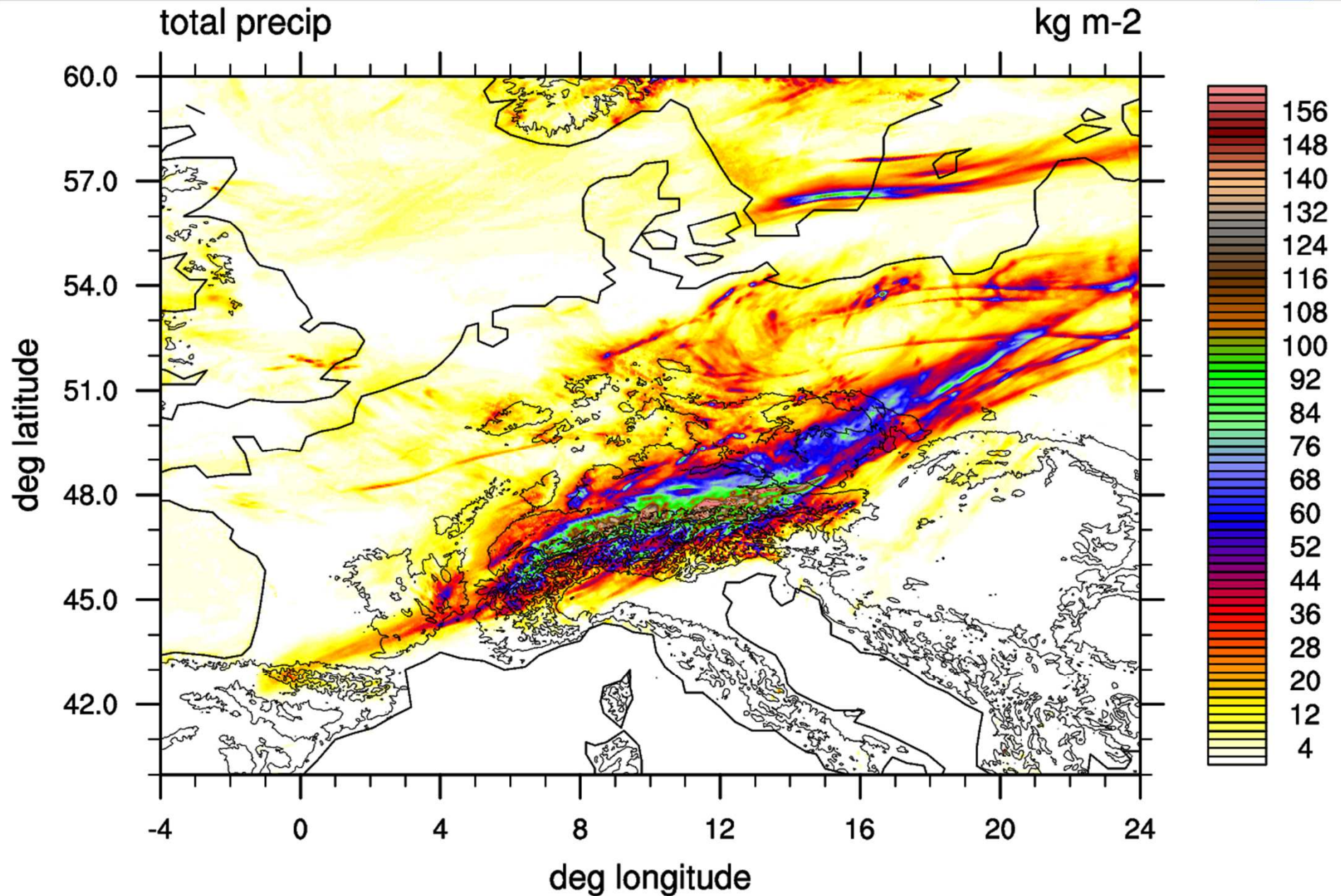
Sea-level pressure, 72h-forecast limited-area expt.
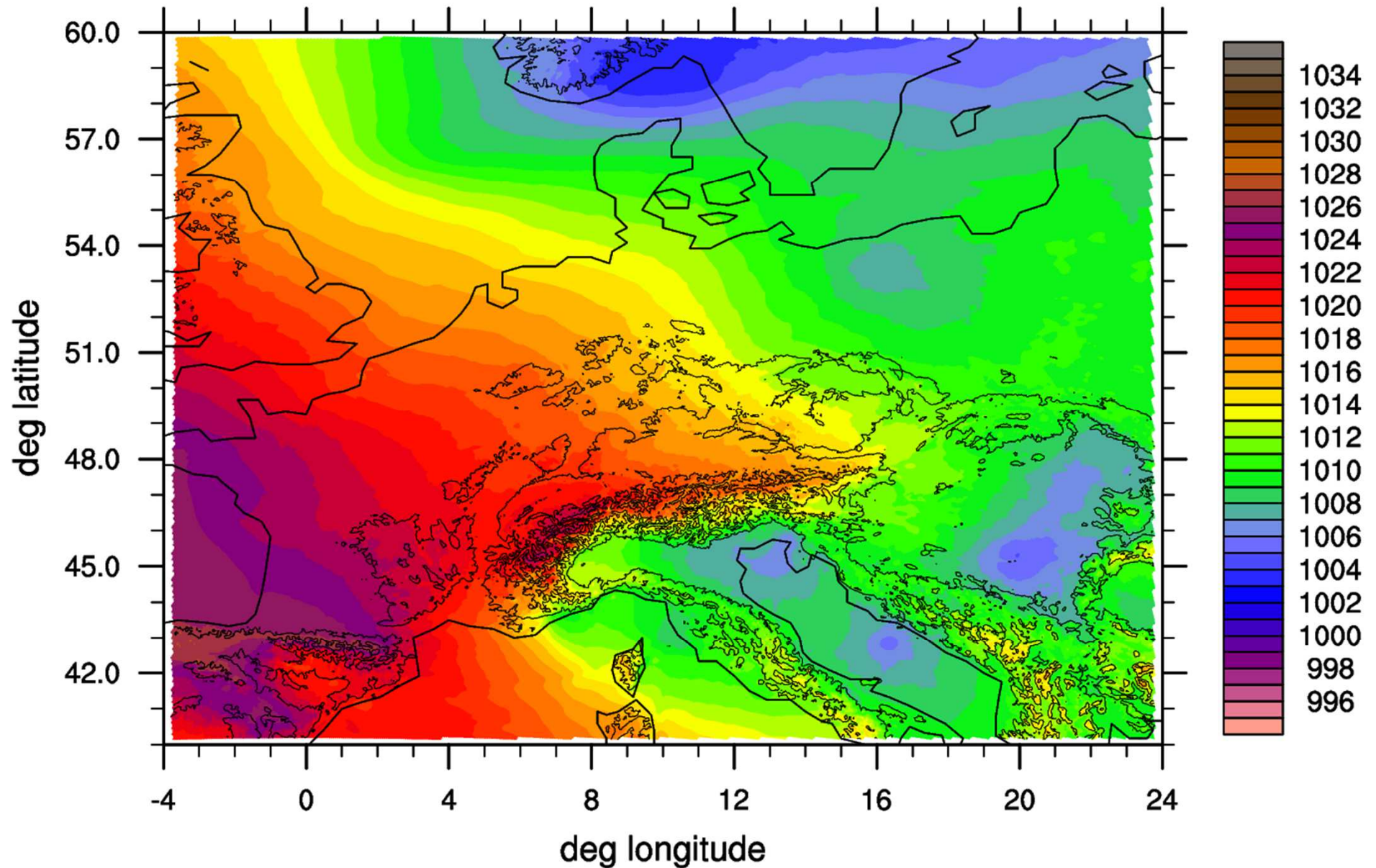
**Sea-level pressure, 72h-forecast
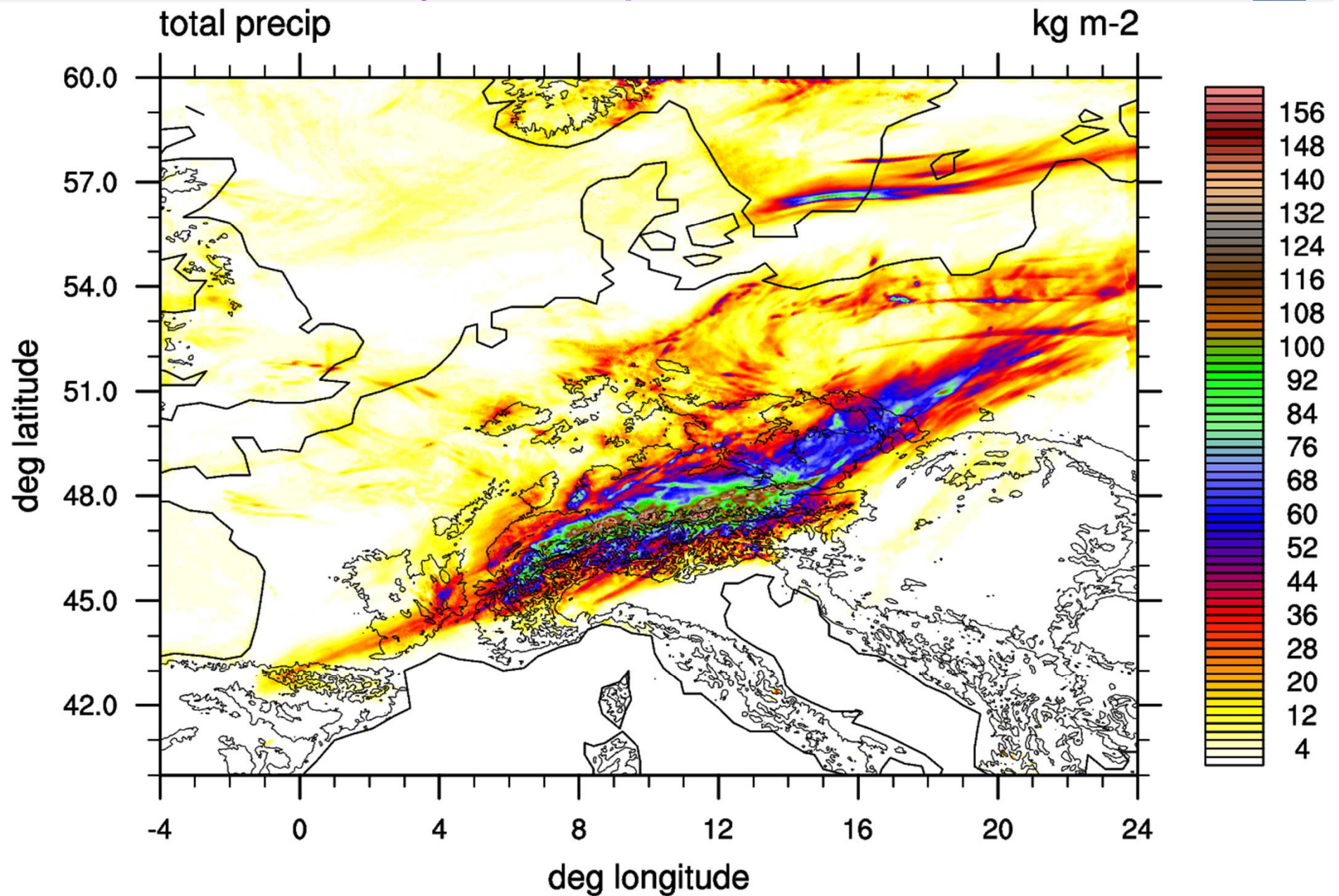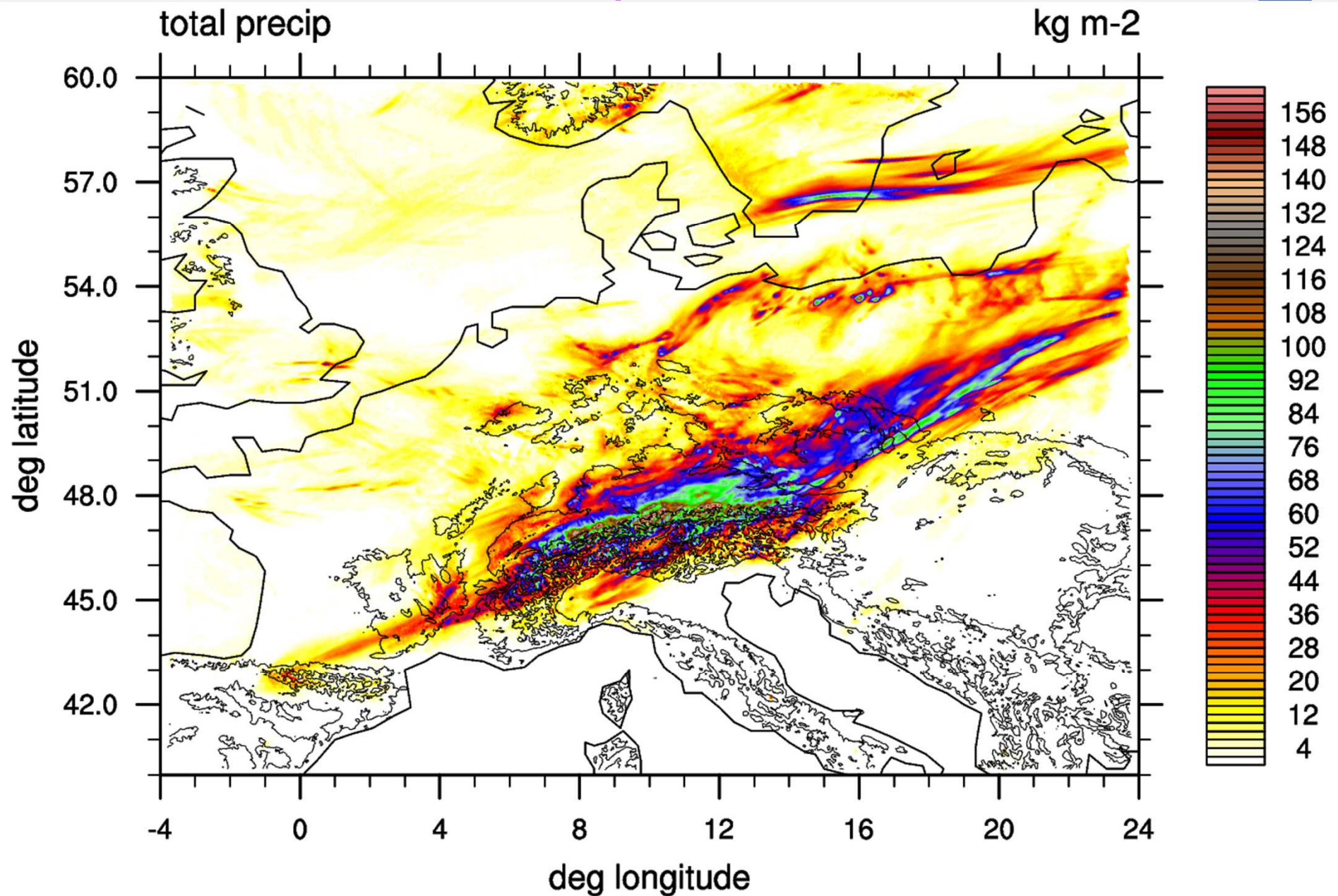limited-area expt. without convection scheme**
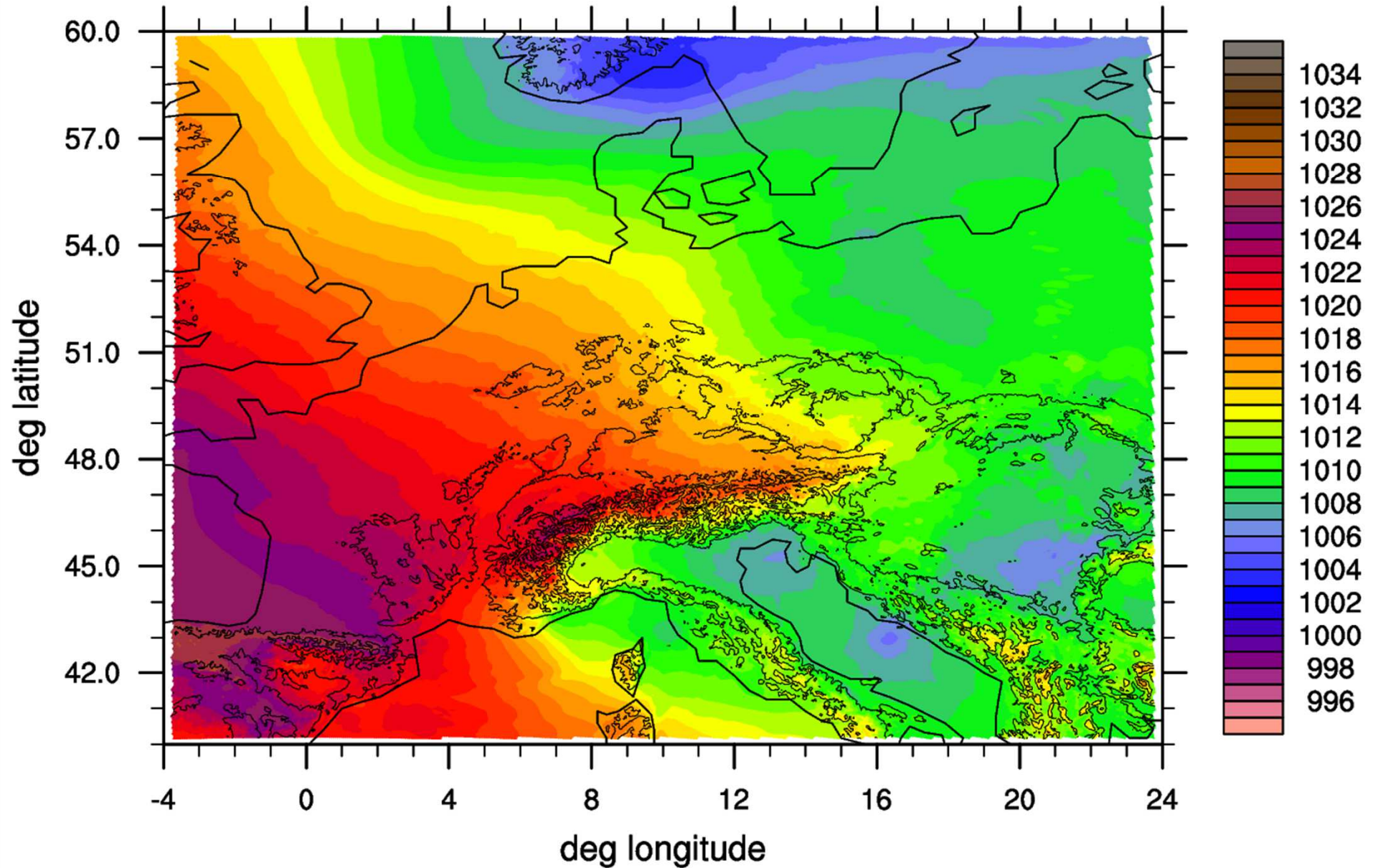
Deutscher Wetterdienst
Wetter und Klima aus einer Hand
DWD

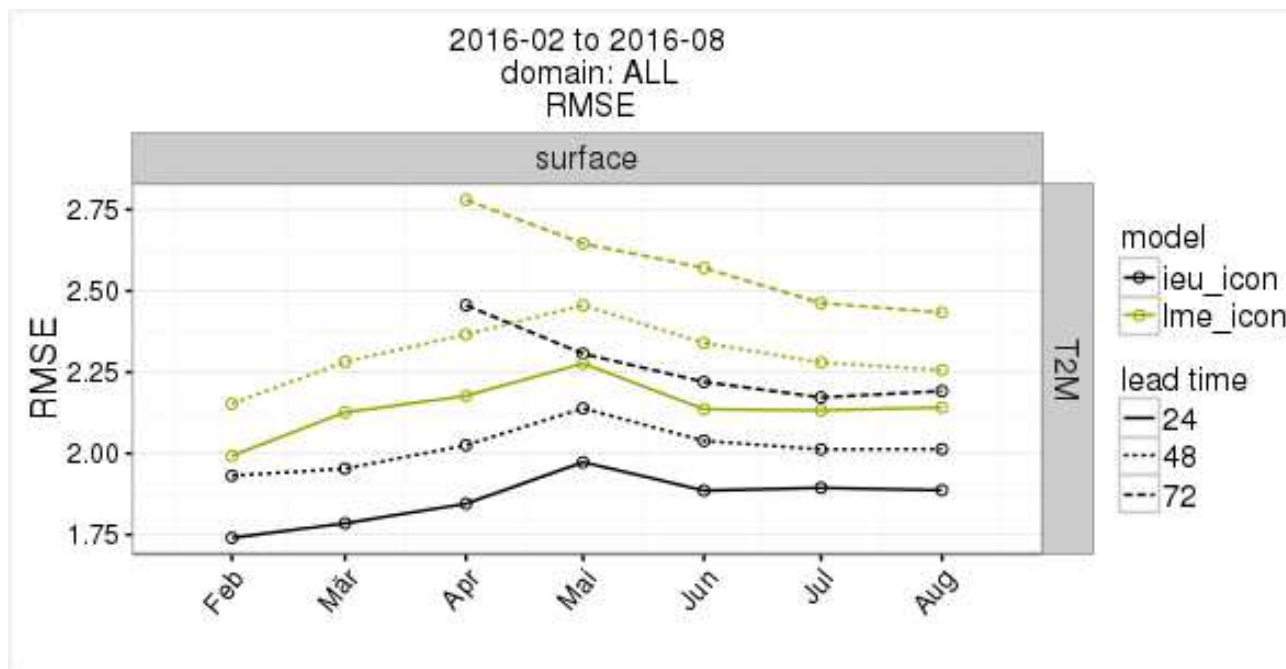**Accumulated precipitation, 72h-forecast 2-way nested expt.**

Accumulated precipitation, 72h-forecast 1-way nested expt.

Accumulated precipitation, 72h-forecast limited-area expt.

Accumulated precipitation, 72h-forecast limited-area expt. without convection scheme
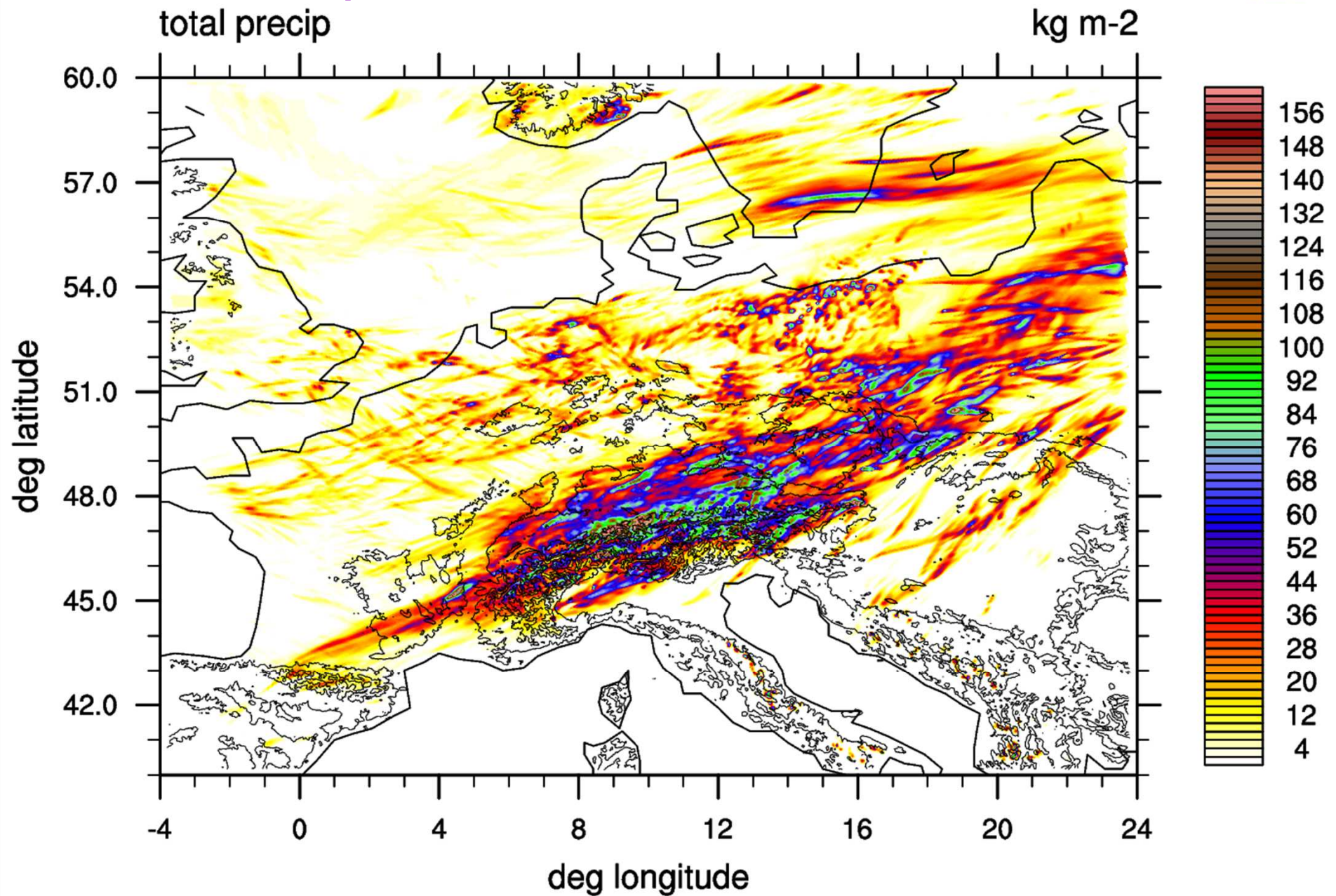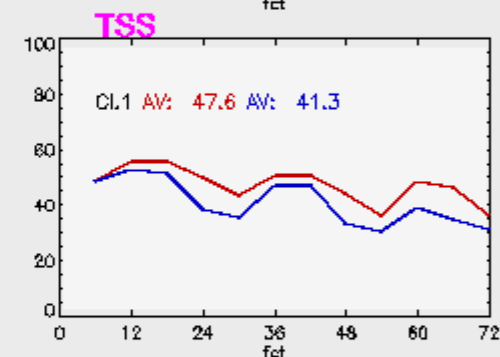
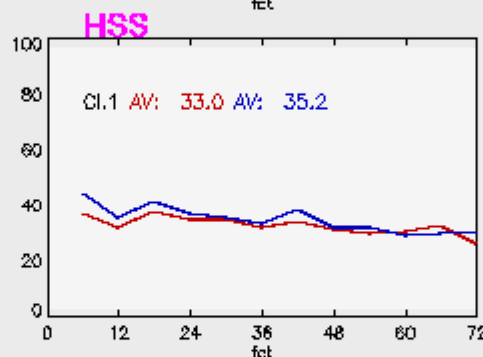# Verification results COSMO-EU vs. ICON-EU
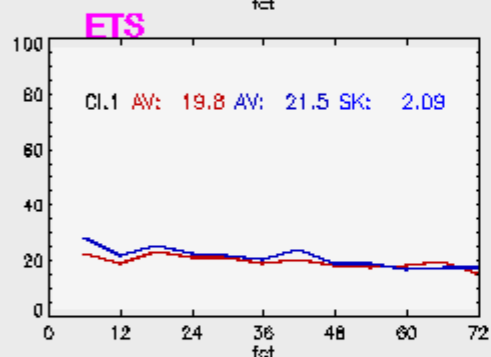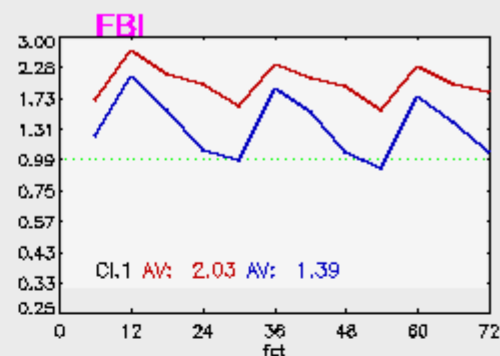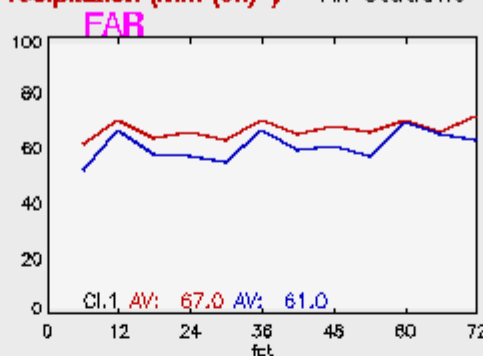# monthly RMSEs of 2m-temperature

2016-02 to 2016-08
domain: ALL
RMSE

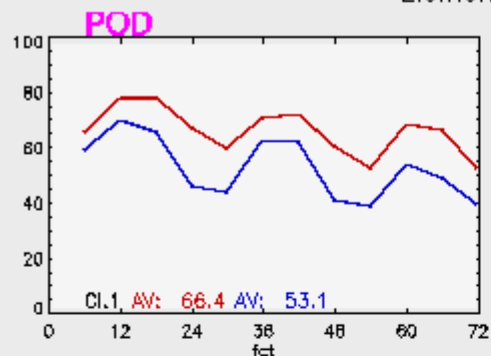**green: COSMO-EU; black: ICON-EU**

Results of verification of forecasts for local weather elements at surface stations
Element: Precipitation (mm (6h)⁻¹)   All stations
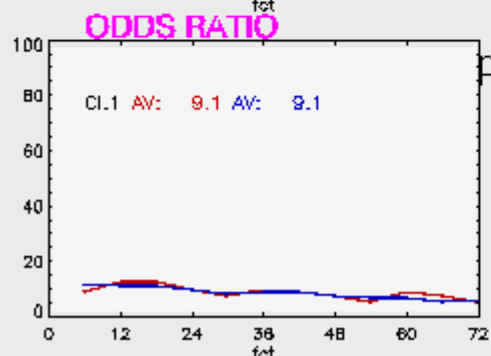
precipitation above 0.1 mm (6h)⁻¹
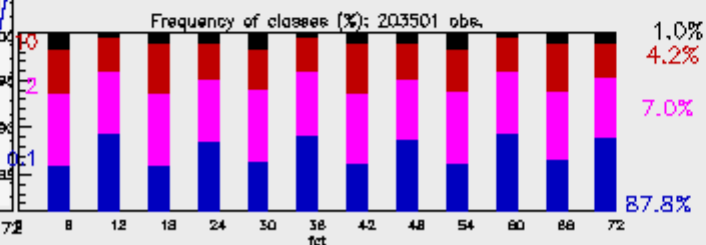
ICON_EU_NEST regular grid 29.07.2016 — 28.08.2016
COSMO—EU (run 00 UTC) — Region of COSMO—EU

blue: COSMO-EU; red: ICON-EU

Precipitation > 2 mm/6h

Deutscher Wetterdienst

blue: COSMO-EU; red: ICON-EU
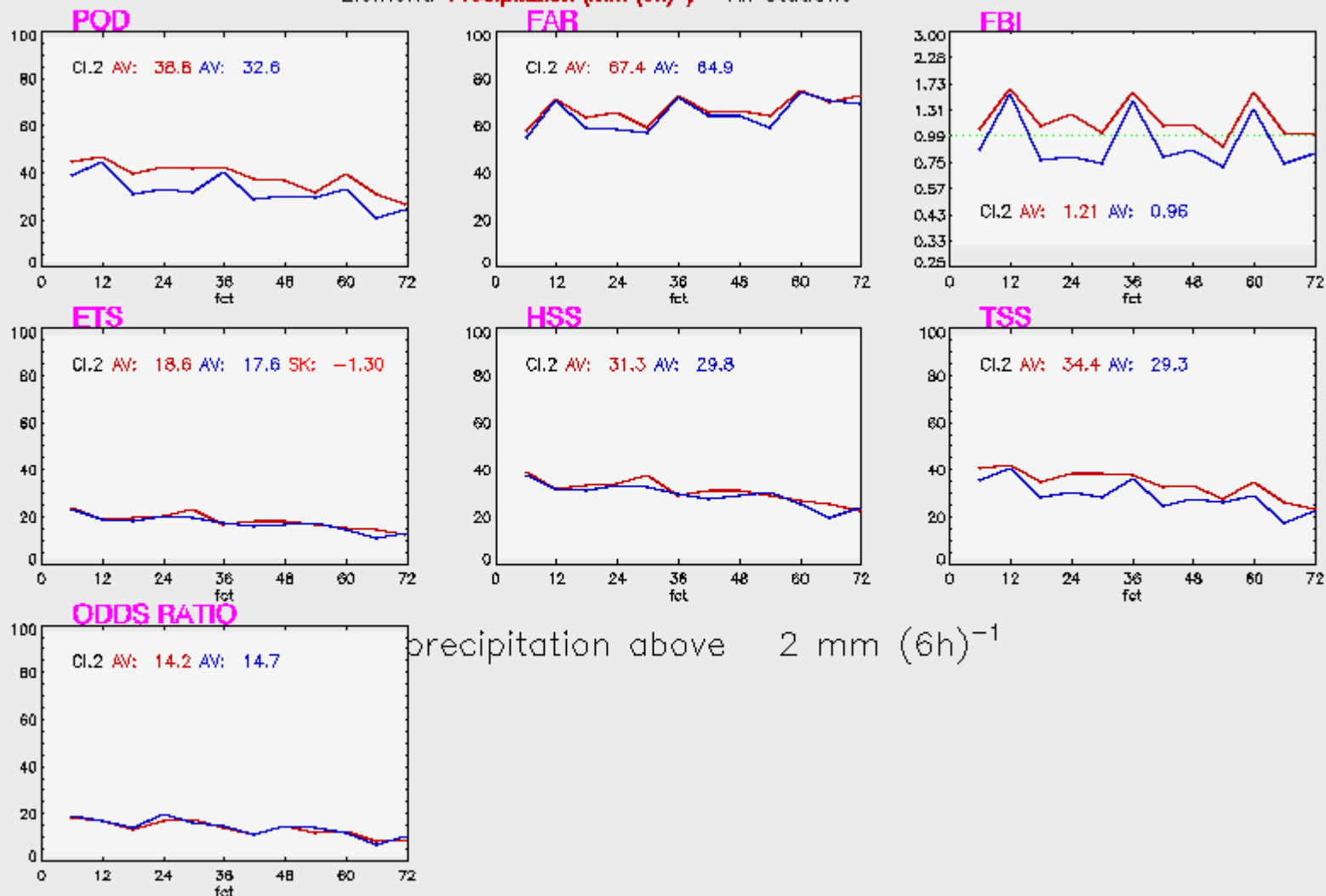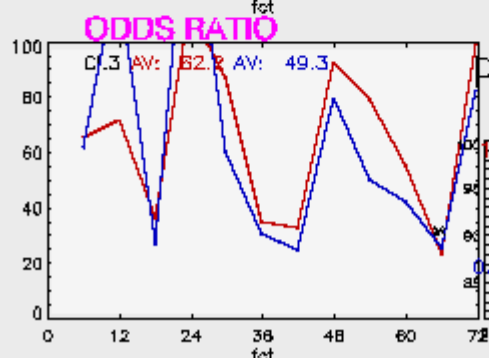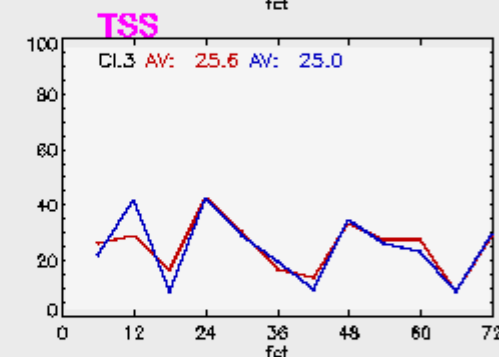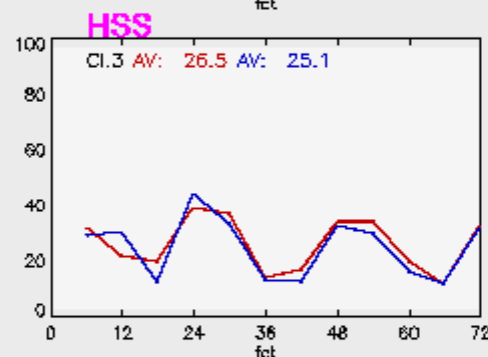
Precipitation > 10 mm/6h

Results of verification of forecasts for local weather elements at surface stations
Element: **Precipitation (mm (6h)$^{-1}$)**   All stations

ICON_EU_NEST regular grid 29.07.2016 – 28.08.2016
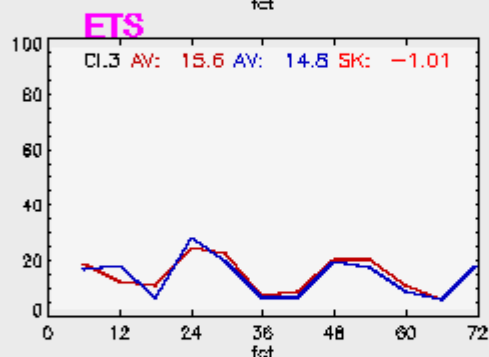COSMO–EU (run 00 UTC) – Region of COSMO–EU

blue: COSMO-EU; red: ICON-EU

Verification results COSMO-EU vs. ICON-EU wind direction, relative humidity, temperature and geopotential against radiosondes
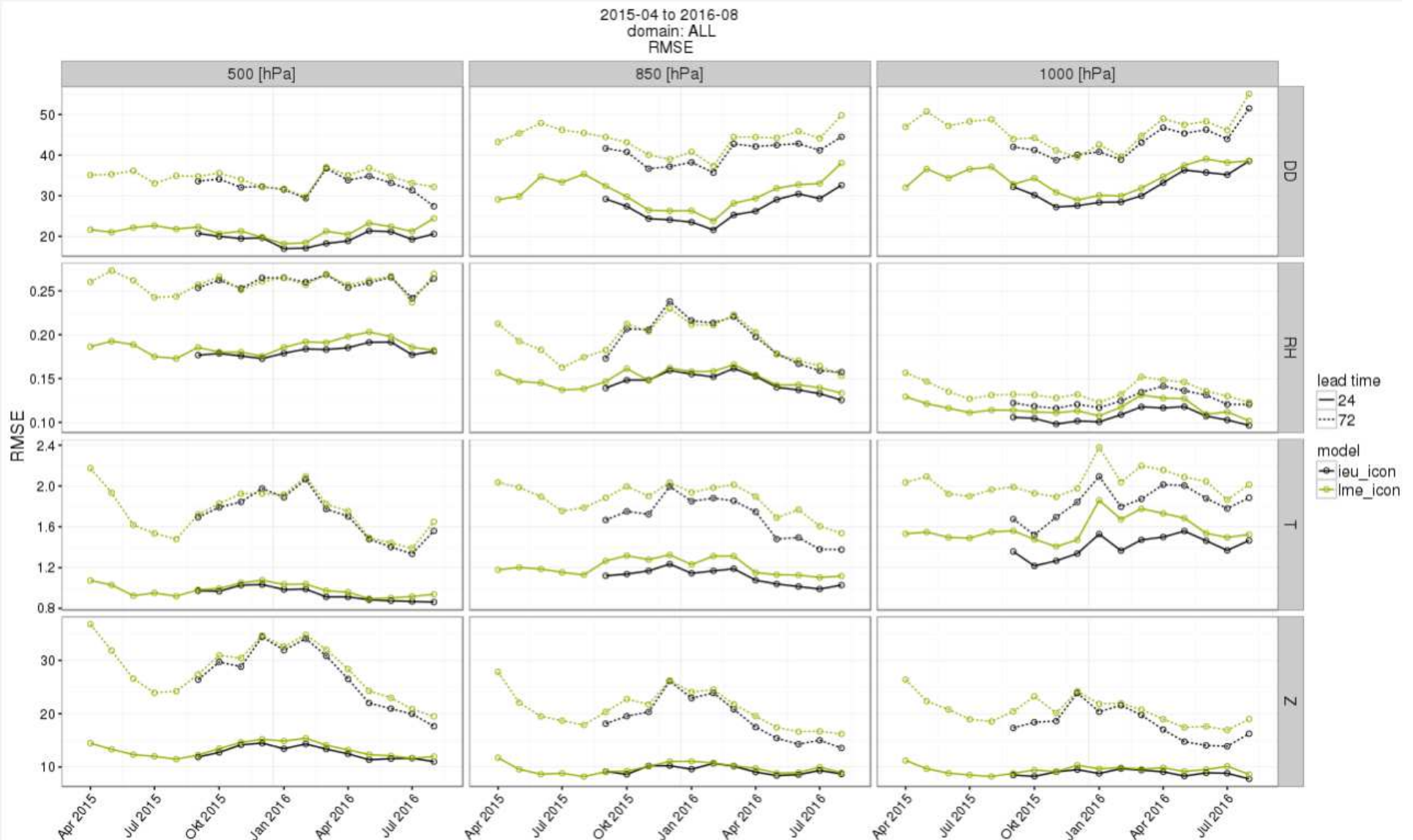
green: COSMO-EU; black: ICON-EU

WMO verification against observations
lead-time: 72h
valid-time: 12UTC
level: 850hPa

↓ ICON   ↓ EDA

WMO verification against radiosondes:

Temperature, wind speed and geoptential at 850 hPa, northern hemisphere, RMSE, lead time 72 h

WMO verification against observations
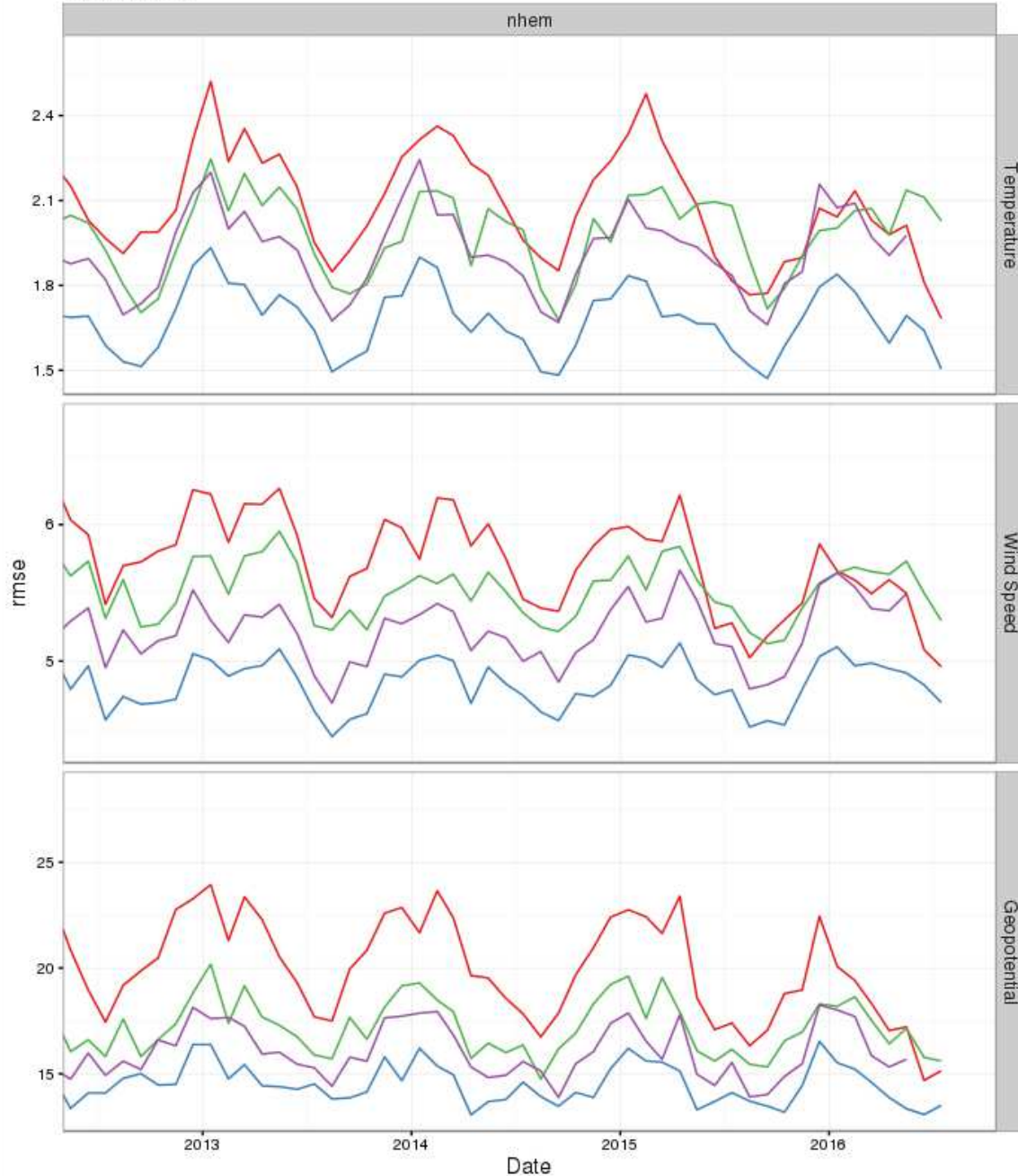lead-time: 72h
valid-time: 12UTC
level: 850hPa

↓ ICON   ↓ EDA

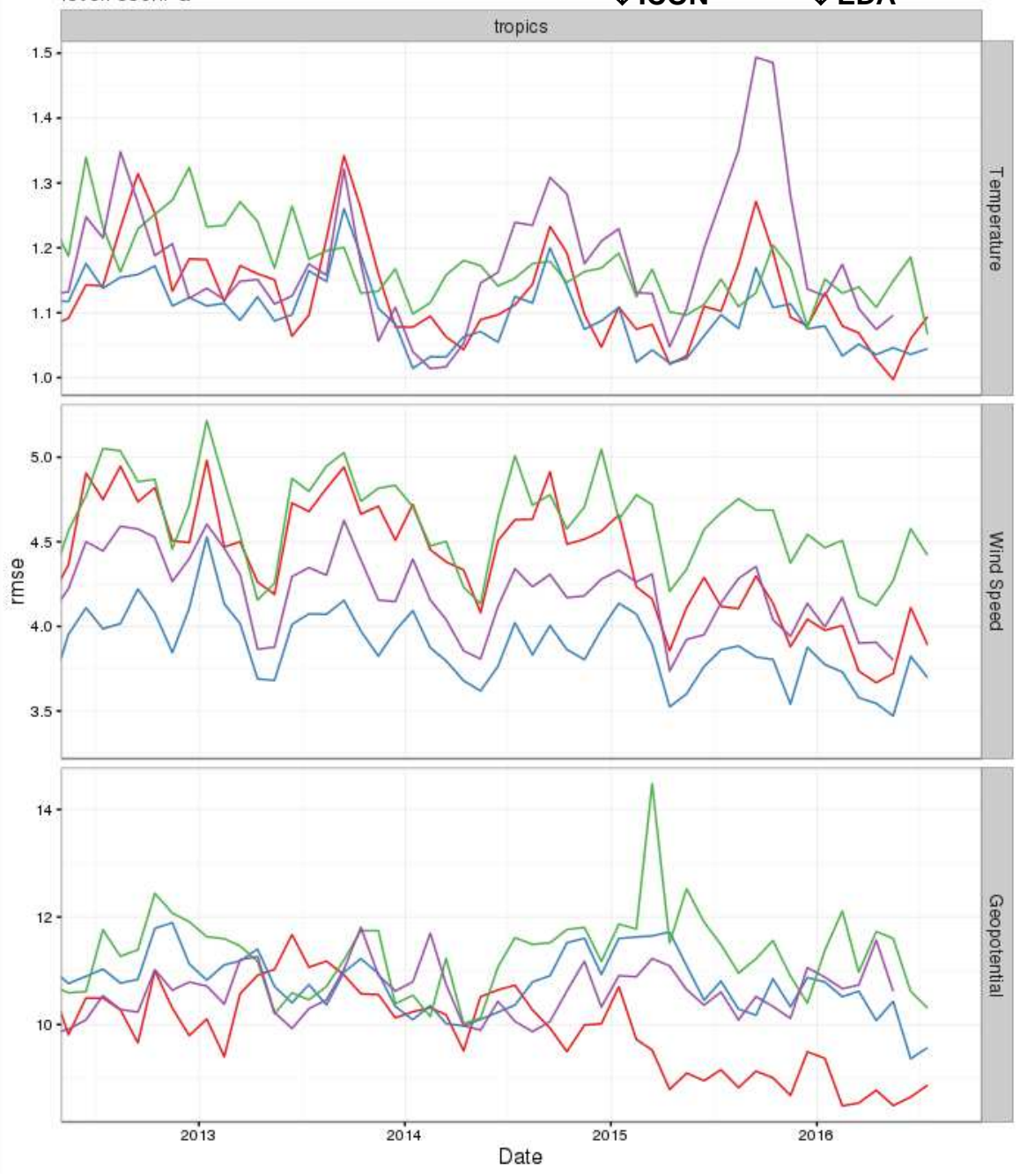**WMO verification against radiosondes:**

Temperature, wind speed and geoptential at 850 hPa, tropics, RMSE, lead time 72 h

DWD
Deutscher Wetterdienst
Wetter und Klima aus einer Hand

Summary

limited-area mode (ICON-LAM)

➔ **Boundary artifacts are very small although there have been no tuning efforts for boundary nudging zone so far**

➔ **Differences between limited-area mode and 1-way nesting are somewhat larger than between 1-way and 2-way nesting due to less accurate (hourly) boundary data supply, but changing physics parameterizations makes a much larger difference**

verification results

➔ **ICON-EU shows better verification scores then COSMO-EU for most variables, particularly large improvements are found for T2M**

➔ **WMO verification scores against UKMO, Météo-France and ECMWF demonstrate substantial improvement of ICON (global) over GME**