Numerical Weather Prediction at IMGW-PIB

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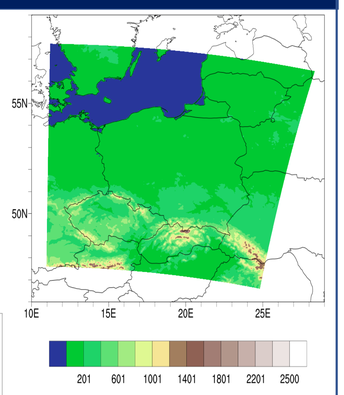
Status of the operational suite

COSMO-CE PL (COSMO-EULAG)

- 2.8 km mesh size
- Domain size [grid points]: 380 x 405
- 4 x per day up to +60 hours (00, 06 12,18 UTC)
- Time step: dt=20s
- LBCs: COSMO-PL 7, update interval 1h
- Nudging Assimilation scheme
- version 5.05

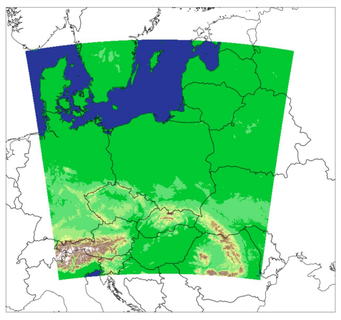
COSMO PL – TLE-MVE (ensemble)

- 20 members at 2.8 km mesh size
- Domain size [grid points]: 380 x 405
- 4 x per day up to +60 hours (00, 06 12,18 UTC)
- Time step: dt=20s
- LBCs: COSMO-PL 7, update interval 1h
- No data assimilation scheme
- version 5.05



ICON PL

- Equivalent Surface resolution ~2.5 km
- icon-2.6.2.2+icontools-2.4.12, R2B10,
- 14x14deg, NP -161.0, 38.0
- 65 vertical levels
- Time step dt=24s
- 4 x per day up to +48 hours (00, 06 12,18 UTC)
- Nested in R3B7 ICON Global (~13km equivalent)
- No data assimilation scheme
- 3h LBC update interval
- version 2.6.2.2



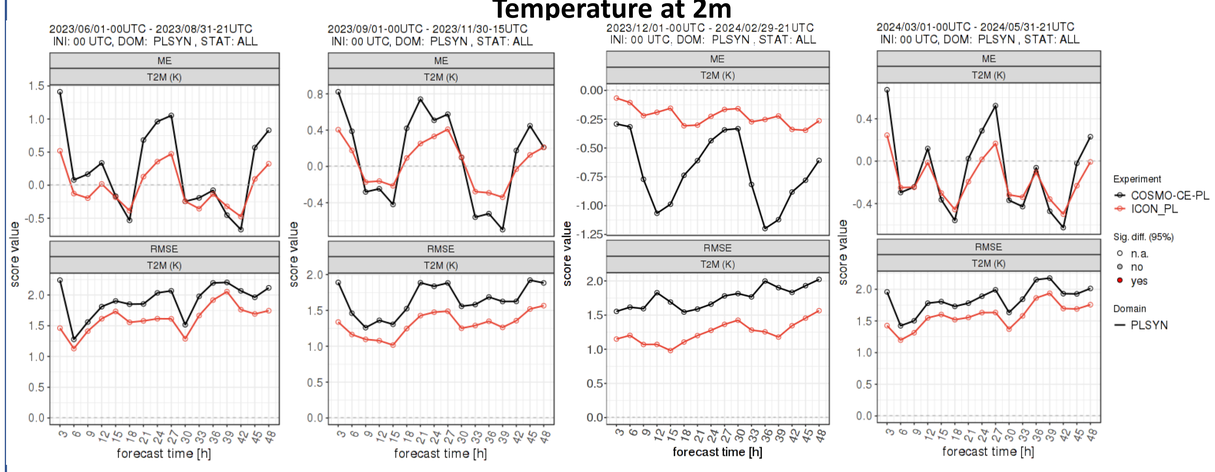
Input/output data for nowcasting forecasting systems

Products (forecasts)	Spatio-temporal resolution	Input to systems:
10-min precipitation sums (RUC mode)	10 min/2.8 km/upto 2 hrs	**SCENE**: nowcasting forecasts of precipitation field with high spatio-temporal resolution
Height of the 0°C isotherm	1 hour/2.8 km/upto 2 hrs	**HAIL**: hail detection (hail probability and size)
Vertical distributions of pressure, temperature & spec. humidity	1 hour/2.8 km/upto 2 hrs	**SPT** (Surface Precipitation Type): detection and nowcasting forecasts of precipitation type

Operational Comparison – ICON-PL vs. COSMO-CE-PL

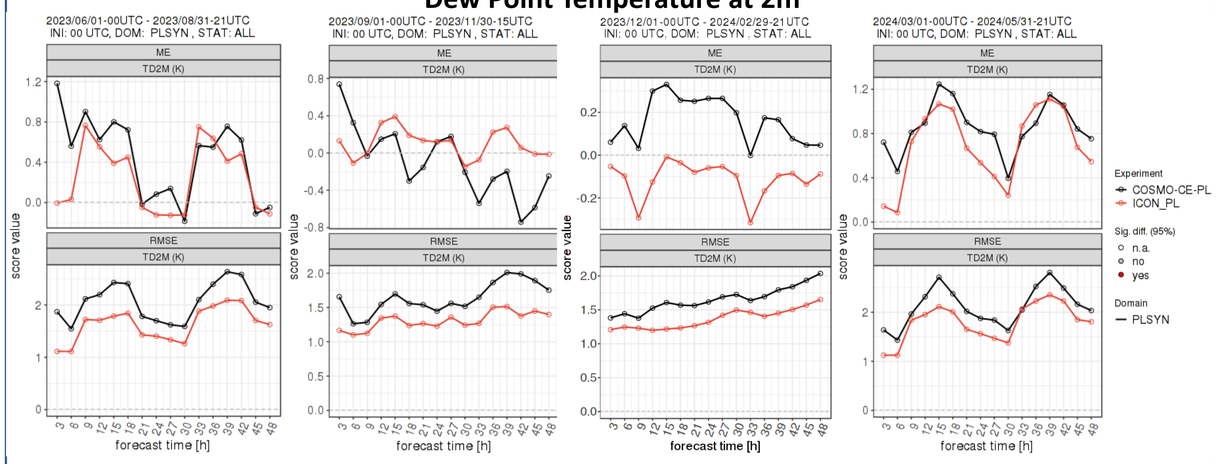
ICON-PL 2.6.2.2 (includes cp/cv bug fix, the RRTM radiation scheme) vs. **COSMO-CE-PL** v 6.01
Verification using MEC/Rfdbk. Verification period: JJA2023-MAM2024.
Comparison with Polish SYNOP stations (Poland domain) and Polish TEMP stations

Temperature at 2m



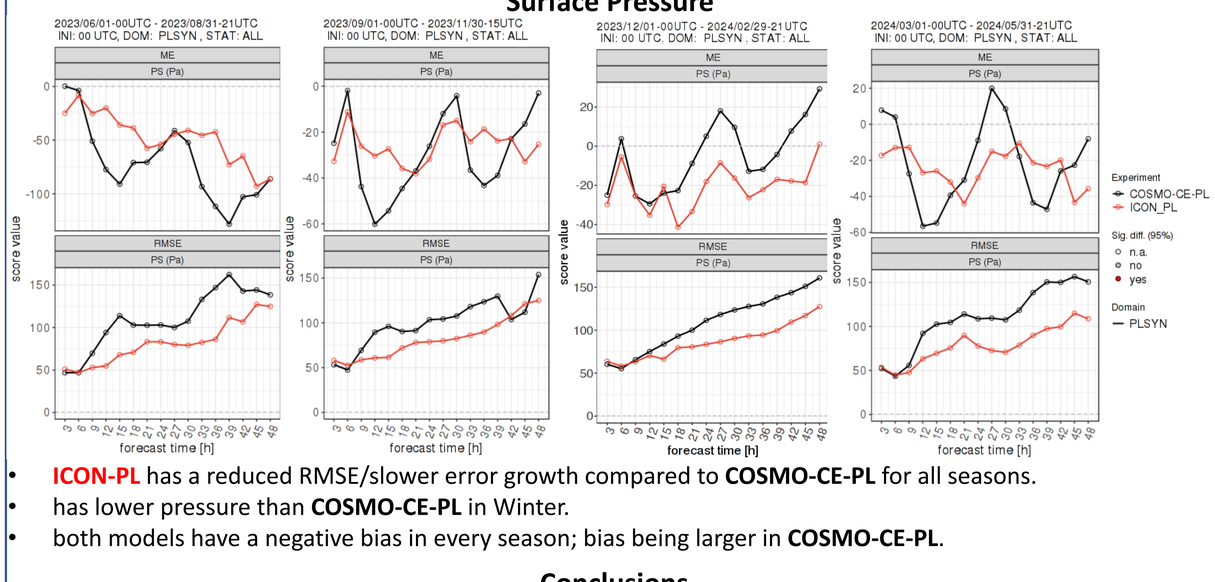
- **ICON-PL** has much reduced RMSE compared to **COSMO-CE-PL** for the all seasons;
- cooler than **COSMO-CE PL** in Summer and Spring and reduces the warm bias, esp.at nighttime.
- warmer than **COSMO-CE-PL** in Winter and reduces the cold bias, particularly during daytime.
- a reduced bias in the diurnal cycle compared to **COSMO-CE PL** in Autumn with a reduced warm bias at nighttime and a reduced cold bias during daytime.

Dew Point Temperature at 2m



- **ICON-PL** has reduced RMSE compared to **COSMO-CE-PL** for all seasons;
- is cooler than **COSMO-CE-PL** in Winter up to T+39, T+30 in Spring, T+18 in Summer and T+6 in Autumn.
- is warmer than **COSMO-CE-PL** in Autumn after T+12.

Surface Pressure



- **ICON-PL** has a reduced RMSE/slower error growth compared to **COSMO-CE-PL** for all seasons.
- has lower pressure than **COSMO-CE-PL** in Winter.
- both models have a negative bias in every season; bias being larger in **COSMO-CE-PL**.

Conclusions

- In terms of surface parameters, ICON-PL overall performs better than COSMO-CE-PL.
- In all seasons and for all parameters and lead times (except for surface pressure in the first few hours of the forecast) ICON-PL has a reduced or similar RMSE compared to COSMO-CE-PL.
- 6-hourly precipitation is more skillful in ICON-PL at drizzle and light rain thresholds than COSMO-CE-PL. For the 10mm threshold the results are less consistent.
- In terms of upper air verification, ICON-PL overall performs better than COSMO-CE-PL.
- ICON-PL generally has a reduced or similar RMSE compared to COSMO-CE-PL for temperature and wind speed and relative humidity in all seasons.
- ICON-PL is generally less accurate than COSMO-CE-PL at the top of the atmosphere for all analyzed parameters and for wind speed at 1000hPa in Summer and Autumn.

Research & Development

City Induced Temperature change Through Advanced modelling
CITTA Priority Project

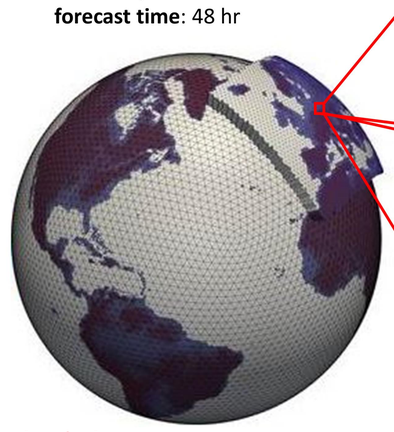
1. Introduction

This work presents the results of evaluating NWP hindcasts scales for Warsaw agglomeration in the frame of the PP CITTA. Warsaw is the capital of Poland, located at the Vistula River in the greater North European Plain. Its population is estimated at 1.8 million residents within a greater metropolitan region of 3.1 million. An observed temperature increase is attributed to urban development and is intensifying during this century. Land use changes lead to a rise in the UHI effect and urban ventilation, triggering flash flood hazards.

2. Model configuration

The COSMO and ICON-LAM models are tested at about 100 km^2 domain at 1 km and 600 m resolutions, respectively. GLOBCOVER and ECOCLIMAP-SG are used for COSMO simulation, and ICON-LAM is run with GLOBCOVER. The models have implemented a bulk urban canopy parameterisation, TERRA_URB (Wouters et al. 2016, 2017), which uses spatially variable urban canopy fields based on the Local Climate Zones (LCZ) approach and ECOCLIMAP-SG for the COSMO. In the GLOBCOVER case, the urban parameterisation utilises one artificial class that characterises impervious urban areas in cities.

ICBC
IC: ICON global analysis daily
2022-06-22:2022-07-02@00UT
BC: every 3 hr
forecast time: 48 hr



COSMO
Resolutions:
❖ 1 km
Landuse:
❑ GLOBCOVER
❑ ECOCLIMAP-SG

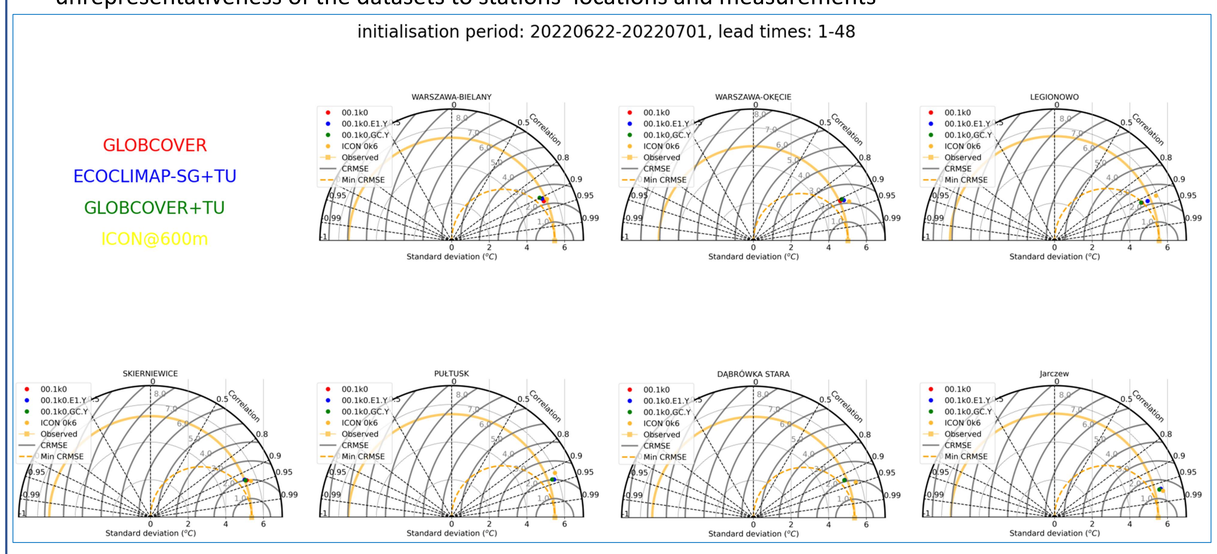
ICON
Resolution
❖ 600 m
❖ no TERRA_URB
Landuse:
❑ GLOBCOVER

3. Case simulation

For the test simulation, a period of heat wave and strong convection in the city area was selected, covering the end of June and the beginning of July 2022. The National Hydrological and Meteorological Service's measurement and observation data were used. During this period, on 26-28 June, the maximum temperature in urban areas exceeded 30°C, and on 30 June and 1 July, the highest monthly temperatures of 34°C and 36°C, respectively, were observed. On 1 July, the front passed through with heavy, followed by rapid cooling.

4. Evaluation results

- Using TERRA_URB and ECOCLIMAP-SG has a slight impact on better reproduction of observed temperature in urban areas
- In rural areas, simulated COSMO results differ slightly, which follows the expectations
- GLOBCOVER based ICON-LAM simulations without TERRA_URB mostly reproduce the worst observed temperatures
- The obtained results are possibly affected by different characteristics of the sites in landuse datasets and the unrepresentativeness of the datasets to stations' locations and measurements



Evaluation results for individual stations employing Taylor diagrams.

Evaluate Personal Weather Station and Opportunistic Sensor Data CrowdSourcing
EPOCS Priority Task

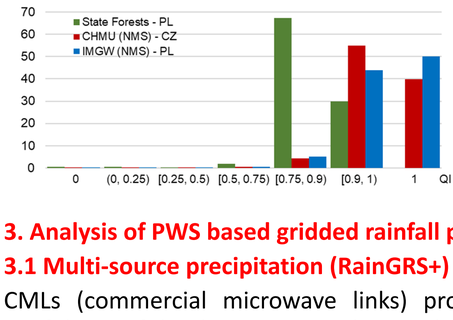
1. Introduction

The aim of this task is to design a new version of gridded dataset called RainGRS+. This data set will use additional data inputs, such as the radar data from OPERA, data from Personal Weather Stations (PWS) and other Opportunistic Sensors (OS). All input data of RainGRS+ will pass quality control. The combining method of these data will be selected to give the optimal quality of the final RainGRS+ product.

2. Development and testing automatic QC methods based on the RainGaugeQC algorithms

The rainfall analysis (RainGRS) is a combination of different sources of available observations (rain gauges, radar and satellite observations) using a conditional merging approach and quantitative information about the quality of individual input data. The below sub-algorithms have been designed and are in the process of verification:

1. Comparison of the agreement of time series of rain gauge data with radar observations
2. Unbiasing the unprofessional rain gauge data by comparison of long-term accumulations from the rain gauge and radar data (from the last 10 days).



$$bias = \frac{\sum_{10\ days}(R)}{\sum_{10\ days}(G^{unprof})}$$

The professional measurements have bigger percentages for higher quality indices: mainly between 0.90 and 1, whereas for unprofessional State Forest network, data with lower quality indices: from 0.75 to 0.9, are more numerous.

3. Analysis of PWS based gridded rainfall products

3.1 Multi-source precipitation (RainGRS+) CML-based data

CMLs (commercial microwave links) provide precipitation estimates based on attenuation on the links. Usefulness of the data was tested in Opole region. CML-based precipitation was estimated, and statistics of their reliability were determined. PT finished, applied for the extension in the Priority Project form.

Early warninG and AnaLysIs sysTEm for release and dispersion of contaminants
EGALITE Priority Task

The aim of the task is gathering/exchange the experience available among COSMO partners on the connection: numerical weather forecasts – pollutant dispersion modeling in favor of new- and/or of existing EWAS (Early-Warning Systems) that respond to the threat(s) related to releases of contamination, dangerous due to its nature (i.e., radioactive, toxic…) and/or emission intensity. Work in progress. For more information – see the separate poster on Early Warning systems (EWAs) – operational use of results of meteorological model(s) to provide information on the atmospheric dispersion of contaminants and pollutants.