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MONTHLY GRIDS OF CORRECTED PRECIPITATION

Many end-users, especially the one that work on water resources and water balance, need corrected precipitation grids as an input in their applications and models.

As the first step in grids calculation, daily precipitation is corrected. The procedure of the correction of the measured precipitation is adopted after F. Rubel and M. Hantel with their Dynamic Correction Model.. The corrected value of the measured precipitation amount is estimated through the wetting loss and the dynamic correction factor, depending on the type of precipitation and wind speed. Precipitation stations are classified according to the spatial distribution of mean wind speed. For liquid precipitation it is a function of wind speed and rain intensity. For solid precipitation dynamic correction factor is a function of wind speed and temperature.

In the next step 1 km grids of mean monthly corrected precipitation (period 1971-2000) are calculated. Precipitation is interpolated from measuring points in 100 m resolution grid (in order to consider variability of terrain variables in high resolution), using residual kriging method. The predictors in the deterministic part of the model are relative altitude in the NE direction, and different derived variables from longitude and latitude. Empirical variograms are fitted with anisotropic spherical or exponential variogram models, and on the basis of cross-validation procedure, influential surrounding for all 12 months are set to 35 km. Totalisor measurements are used for the mountainous region and precipitation measurements from stations near the border from Italy, Austria and Croatia are used for near border area.

Finally, grid for every separate month is calculated as deviation from long term monthly mean. Monthly precipitation deviations have usually much smaller spatial variability that is why ordinary kriging was used for spatial interpolation of deviations. Even if in some special cases the deviations from long term precipitation are clearly dependent on elevation or other geographical variables (summer month with convective precipitation), the introduction of deterministic model into spatialisation model could produce very large false signals in precipitation field, especially in the mountainous region.

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Monthly grids of corrected precipitation

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Outline

- Motivation
- Precipitation Correction procedure
- Spatialisation procedure
- Products

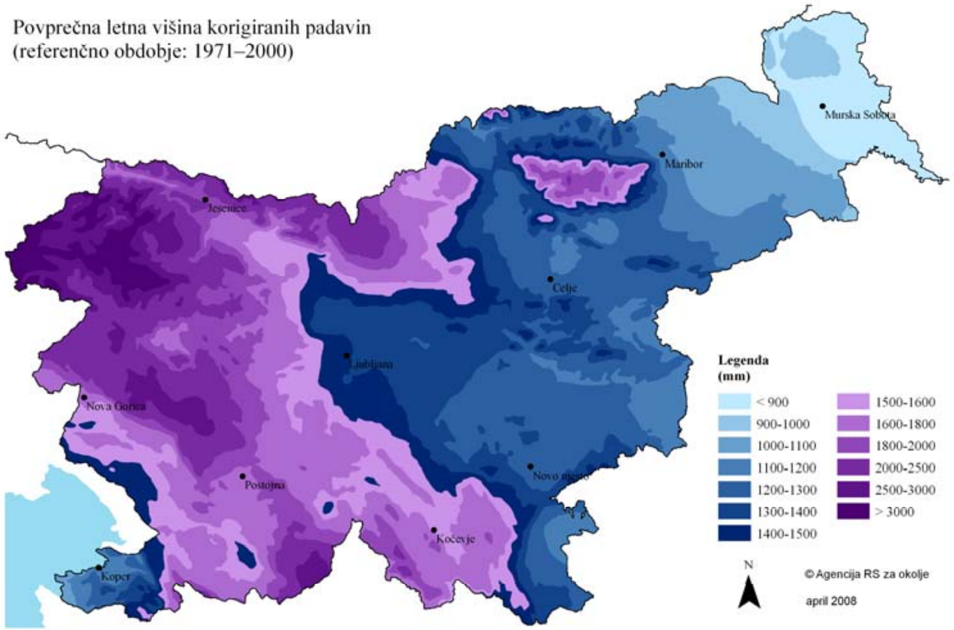
Motivation

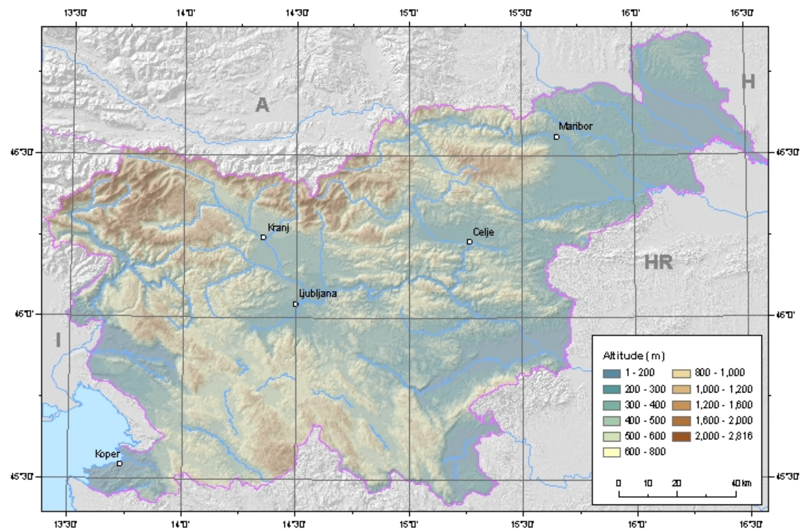
- Water balance (for reference period 1971-2000)
- Water balance monitoring
- Monitoring of underground water resources

- Security
- Agriculture
- Energy sector
- Tourism

Corrected precipitation

- High spatial variability of precipitation (annual mean: 800 – 4000 mm)
- Complex terrain (0 – 2864 m h.a.s.l.)
- High altitudes: high percentage of solid precipitation, wind exposed sites
- First study of precipitation corrections: water balance 1961- 1990
- New measurements technology (wind)



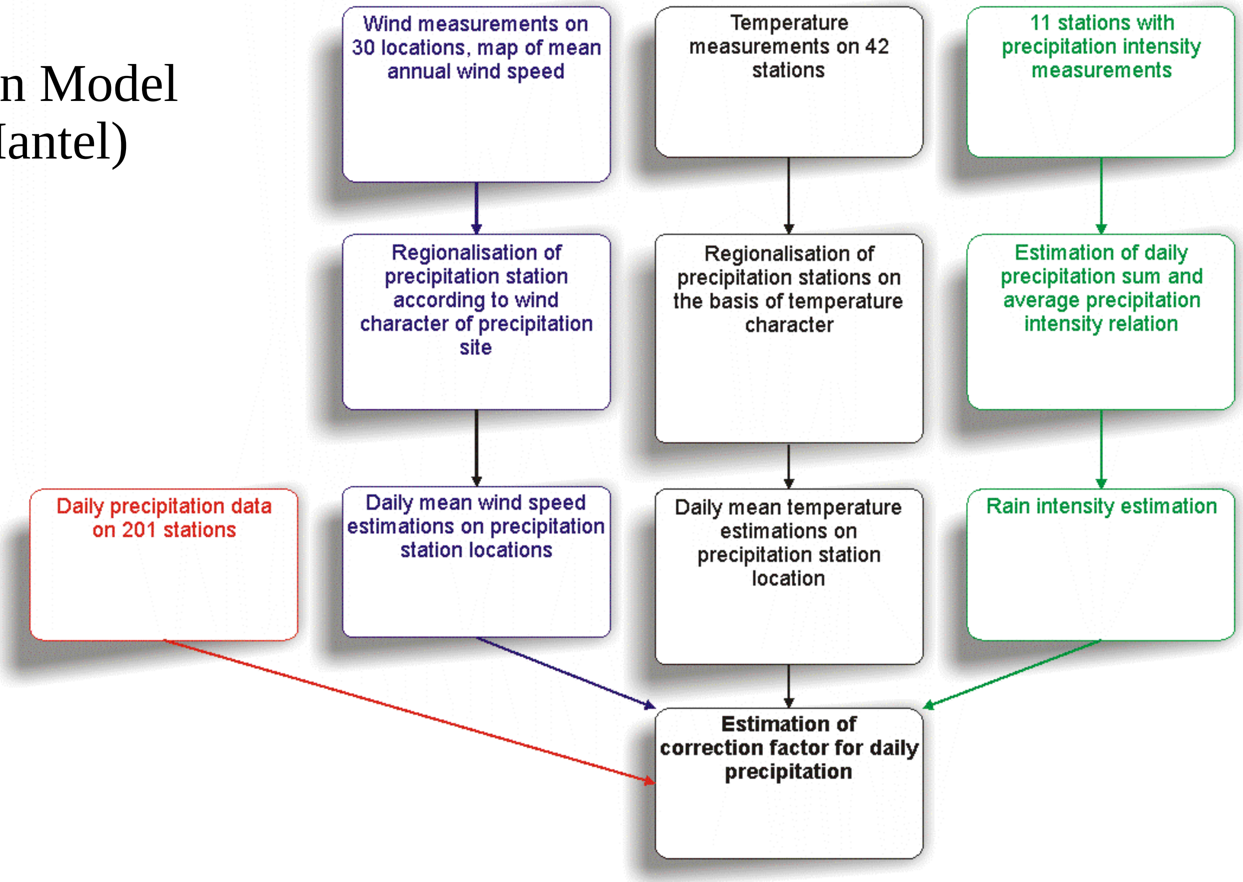


Precipitation corrections - algorithm

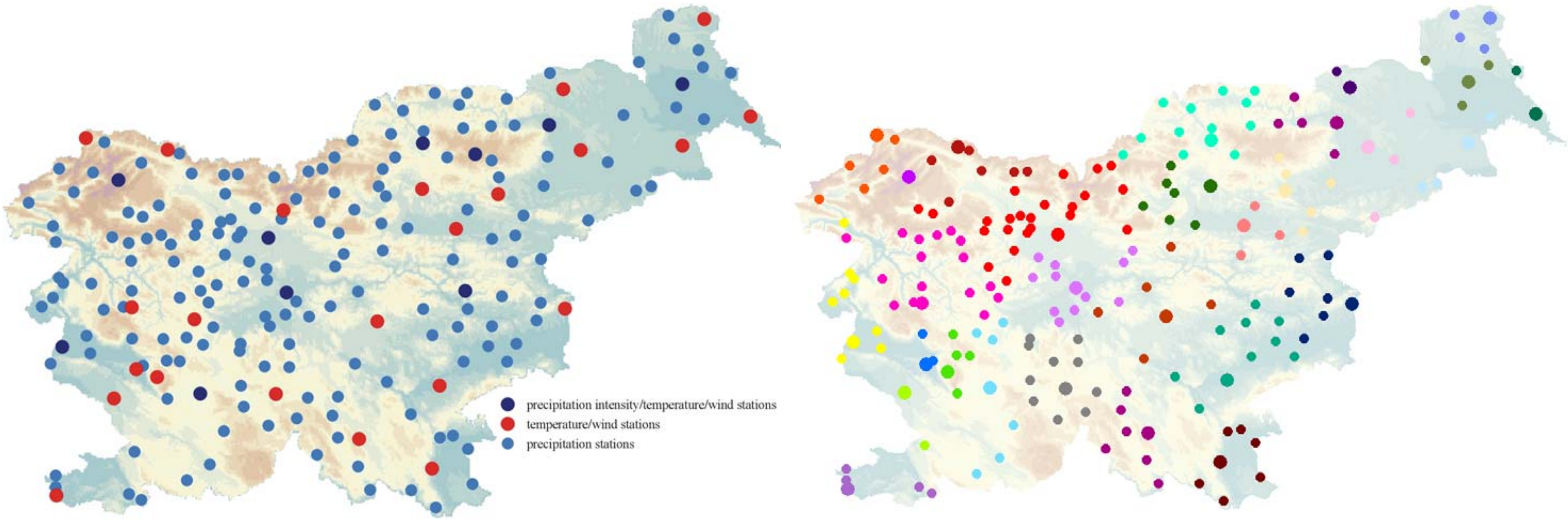
- Daily scale
- Dynamic Correction Model (F. Rubel and M. Hantel)
- Precipitation type
- Wind speed

Liquid precipitation:
- Wind speed
- Rain intensity

Solid precipitation:
- Wind speed
- Air temperature



Precipitation corrections - regionalisation



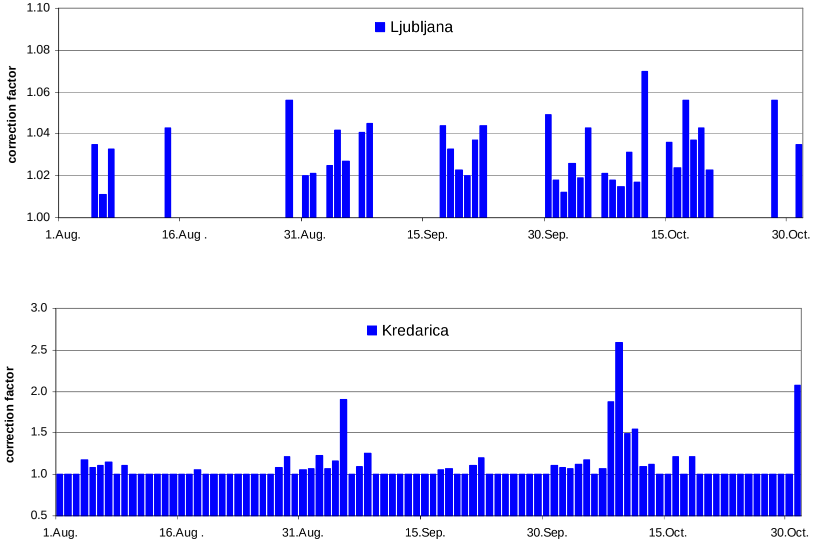
GIS based regionalisation:

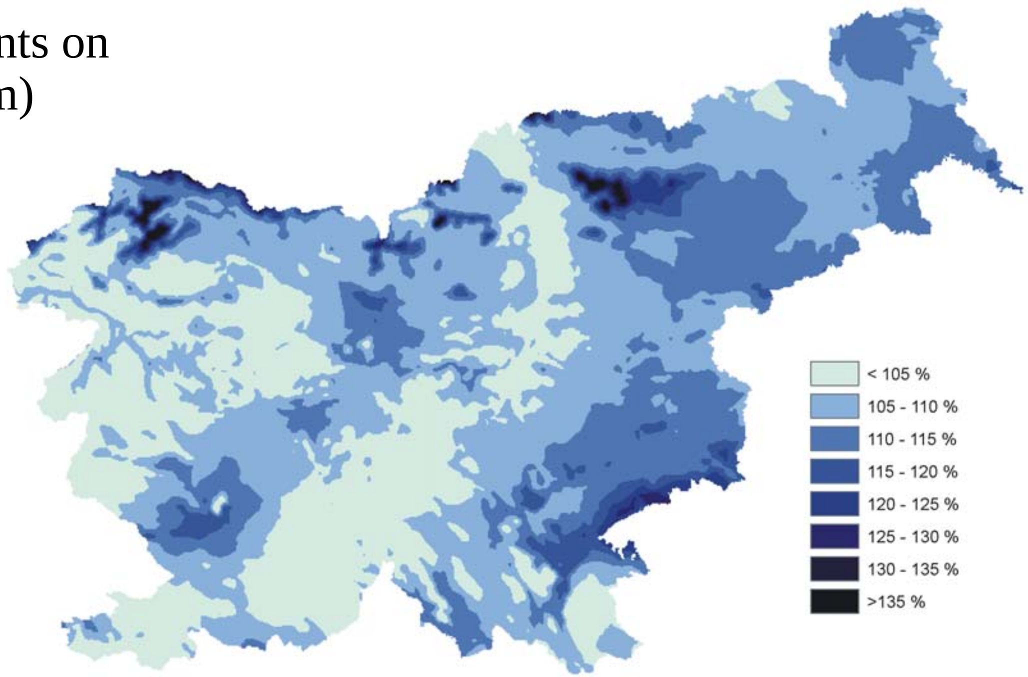
– Distance
– Wind climatology
– Temperature climatology
– Rain intensity climatology

Precipitation corrections - results

Validation of correction model:

- Snow water equivalent measurements on mountain station Kredarica (2514 m)
- Water balance 1971-2000





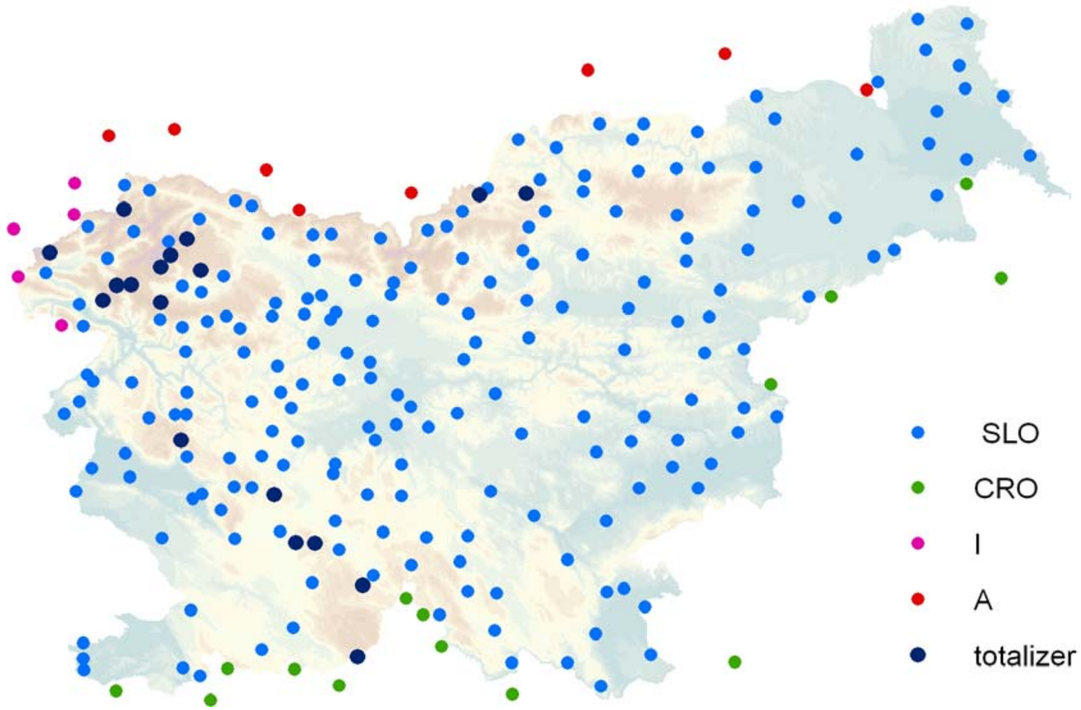
Mean annual precipitation corrections as percentage of measured value

Correction factor for daily precipitation values (period August to October 2000).
Kredarica is mountainous station (2514 m) and Ljubljana is urban basin station (299 m).

Spatial interpolation - methodology

Mean monthly precipitation for the reference period 1971-2000

– 201 measurement sites with daily precipitation measurements (up to 5 years missing data)
– 18 measurement sites with totalizers
– 29 measurement sites near border (Austria, Croatia, Italy)



Spatial interpolation - methodology

Spatialisation of mean monthly precipitation for the reference period 1971-2000

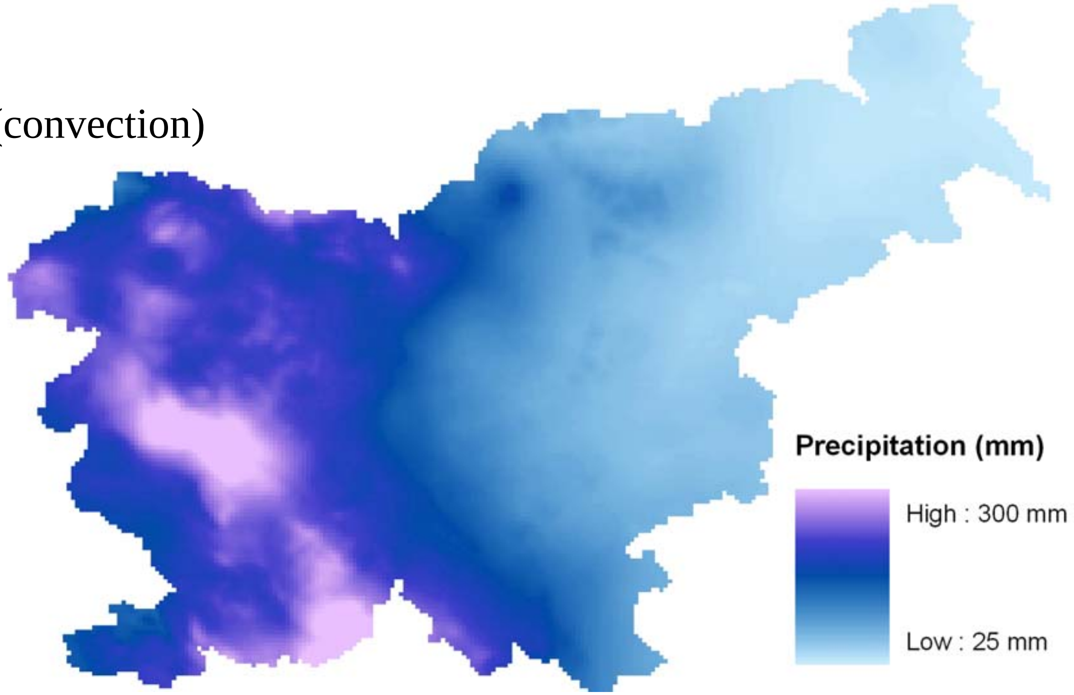
- **Multiple regression**
  - Derivatives of longitude and latitude (x, y, x2, y2 xy)
  - Elevation (z)
  - Relative elevation of closest mountain ridge in NE direction (zNE)
- **Residual kriging**
- **Influential radius: 40 – 50 km**
- **Cross validation**

	MULTIPLE REGRESION			**X-validation**
Month	Explanatory variables	R^2	Variogram model	R
January	x, x^2, xy, z, zNE	71,3 %	Nug	0.88
February	x, x^2, z	58,8 %	Nug	0.78
March	x, y, x^2, xy, zNE	68,6 %	Nug	0.83
April	x, y, x^2, y^2 xy, z	77,9 %	Nug	0.91
May	x, y, x^2, y^2 xy, z	76,2 %	Nug	0.92
June	x, y, x^2, y^2 xy, z	70,1 %	Nug	0.87
July	y, x^2, y^2 xy, z	73,1 %	Nug	0.87
August	y, y^2 xy, z	65,5 %	Nug	0.81
September	x, x^2, z, zNE	73,6 %	Sph	0.92
October	x, y, x^2, y^2 xy, z, zNE	75,8 %	Sph	0.90
November	x, y, x^2, y^2 xy, zNE	75,2 %	Sph	0.92
December	x, x^2, z, zNE	64,5 %	Sph	0.91

Spatialisation of monthly precipitation

Monthly multiplicative anomalies (from the reference period 1971-2000)

- All available precipitation measurements (including Austrian and Croatian near border daily measurements)
- Less measurements for higher elevations (no totalizers)
- Missing reference period values: from normals grids
- Universal kriging
- Influential radius: 40 – 50 km
- Cross validation R: 0.56 – 0.97
- Worst results: summer months (convection)
- Best results: autumn months



Results

- Database of corrected daily precipitation values
- Grids of monthly anomalies
  - 100 m
  - **1 km**
- Grids of monthly precipitation
  - 100 m
  - **1 km**
- Metadata files with representativity and error information

- Database of monthly grids (Oracle + ArcSDE)
- Distribution (web,EUMETGRID)

Thank you for your attention!