Experiences with snow level estimation for spatial analysis of new snow depth based on precipitation data

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Introduction 1

- Special routine application of Winter road maintenance index has been used since 2004-2005 winter season for roads/highways in about 100 regions of the Czech Republic by the Dept. of General Climatology
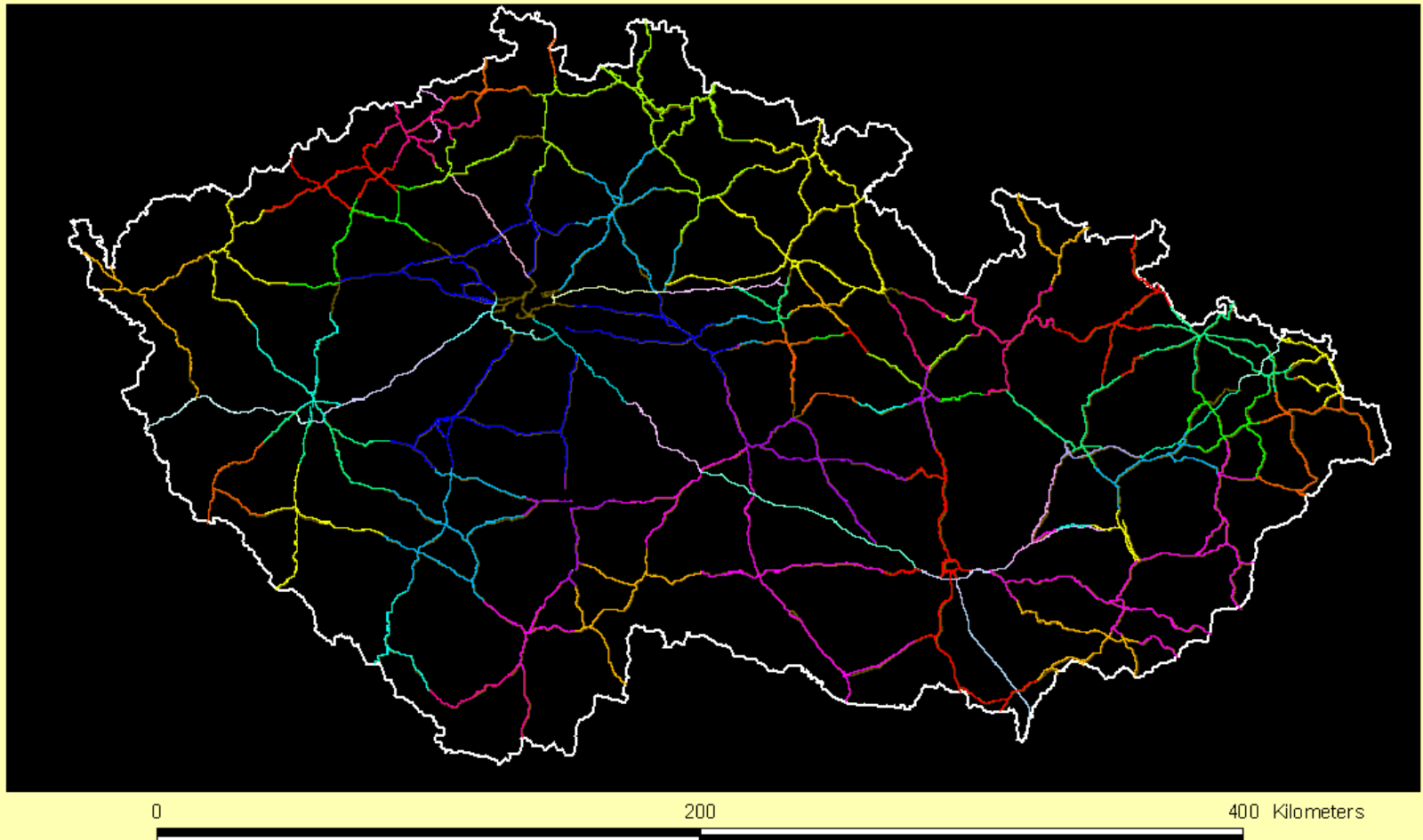
Introduction 2

- Winter road maintenance index is provided for CROSS company for processing and then delivered to Road and Motorway Directorate

- The Index is rated as an excellent instrument of objective indication both road maintenance winter severity and retrograde supervision of selected road winter maintenance performances adequacy

- It is very important for economic rating of winter maintenance centres

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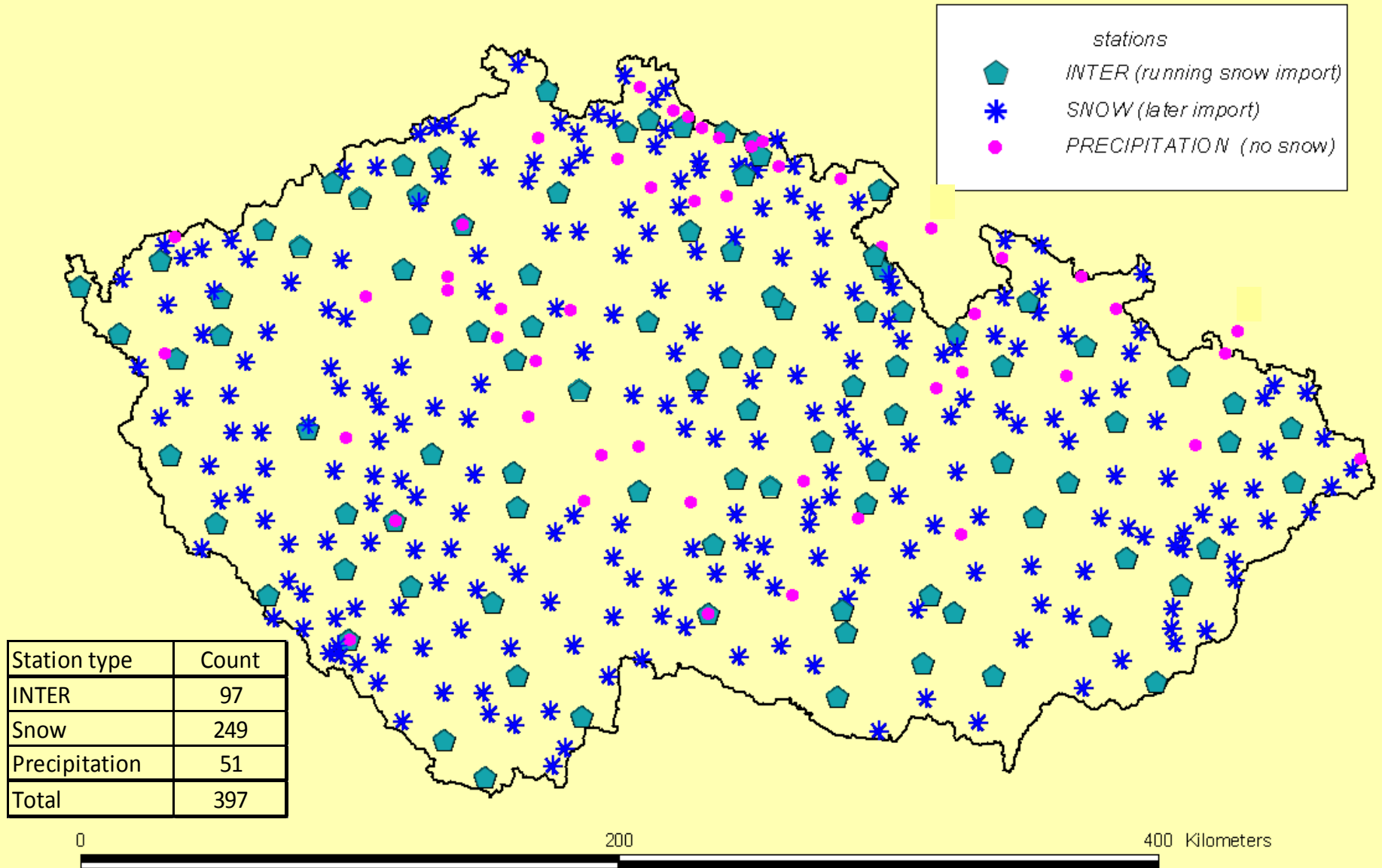in Climatol. and Meteorol., Budapest

Introduction 3

- Winter road maintenance index is based on daily values of selected meteorological parameters such as **snow, icy road conditions (black ice, glaze, frost deposit) and snow drifts**

- New snow depth values are essential parameter for computation of the index

- Computation of the index is based on spatial interpolation of station data

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Motivation I

- Only smaller part of stations send snow data every day to the CHMI's central database („INTER")

- The larger part of snow data is available with delay, usually around 10th of the next month („Snow")

- Furthermore, some precipitation stations don't measure snow data („Precipitation")

Station type	Count
INTER	97
Snow	249
Precipitation	51
Total	397

Motivation II – Station types

stations

- **INTER (running snow import)**
- **SNOW (later import)**
- **PRECIPITATION (no snow)**

Station type	Count
INTER	97
Snow	249
Precipitation	51
Total	397

0   200   400   Kilometers

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Motivation III

- Preliminary indices are issued every week with time resolution of 1 day

- These indices are based on accessible snow data in the current week

- Final indices are issued around 10th of the next month based on all climatological data (i.e. manual stations measurement, too**)**

- **This can lead to discrepancies between preliminary and final winter maintenance indices**

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Estimation of missing new snow values

- We've tried to estimate missing or questionable New Snow values based on following steps:

  - **Determination of snow level**

  - **Snow density estimation**

  - **New snow estimation**

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Step 1: Estimation of snow level

- SNOW level is specified as the altitude of the lowest station with SNO in defined surrounding (region)

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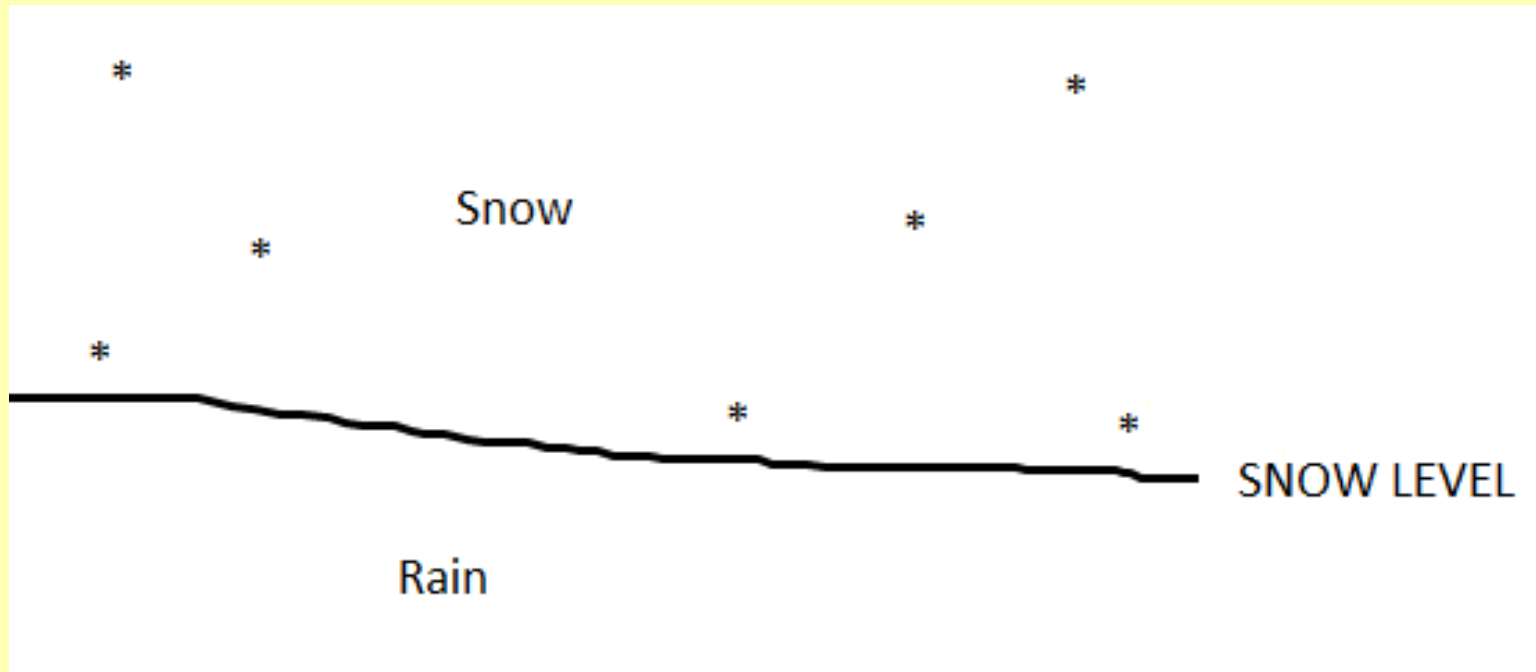
10 regions have been defined for snow level estimation depending on the orographic features in the frame of the Czech Republic

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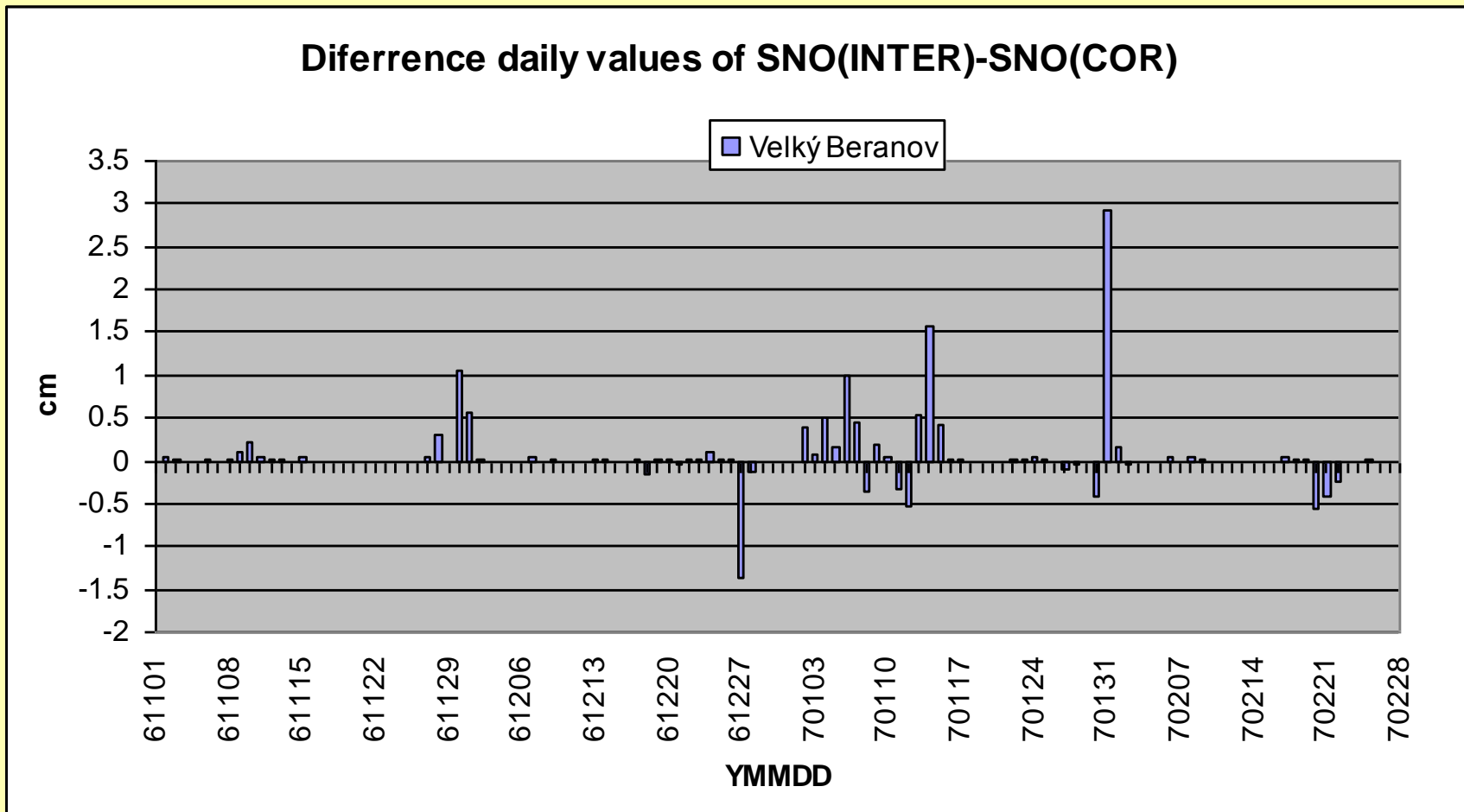in Climatol. and Meteorol., Budapest
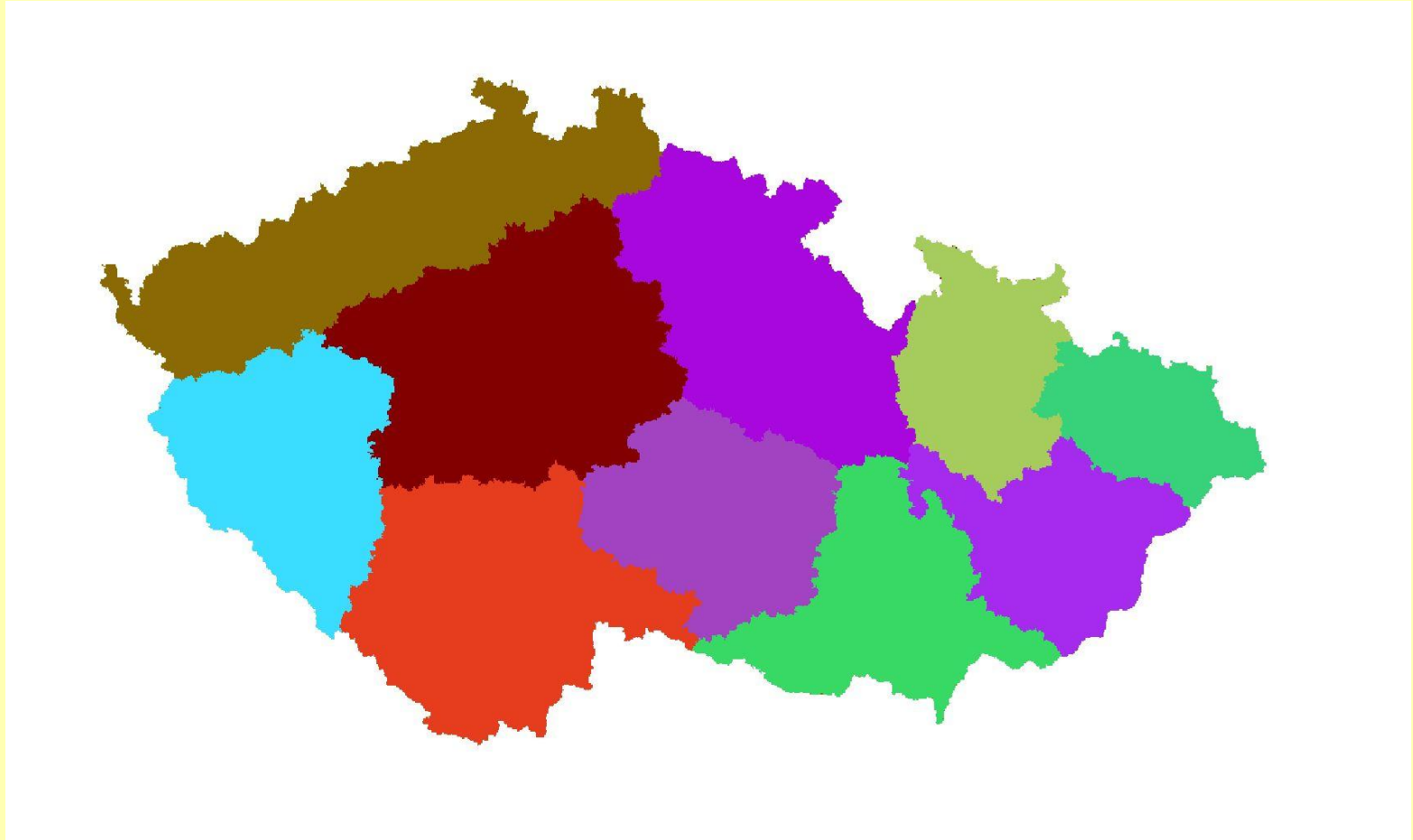
Step 2: Snow density estimation

- SNO density = SNOref/SRAref from the nearest station (refstation) with the least altitude difference but still situated above the snow level

- *(if SNOref<4 then SNO density =0.2 with respect to lower validity of SNO density in these cases)*

- Note: SNO density is important both from a view of maintenance difficultness and for estimation of NEW SNOW value based on SRA (daily precipitation sum)

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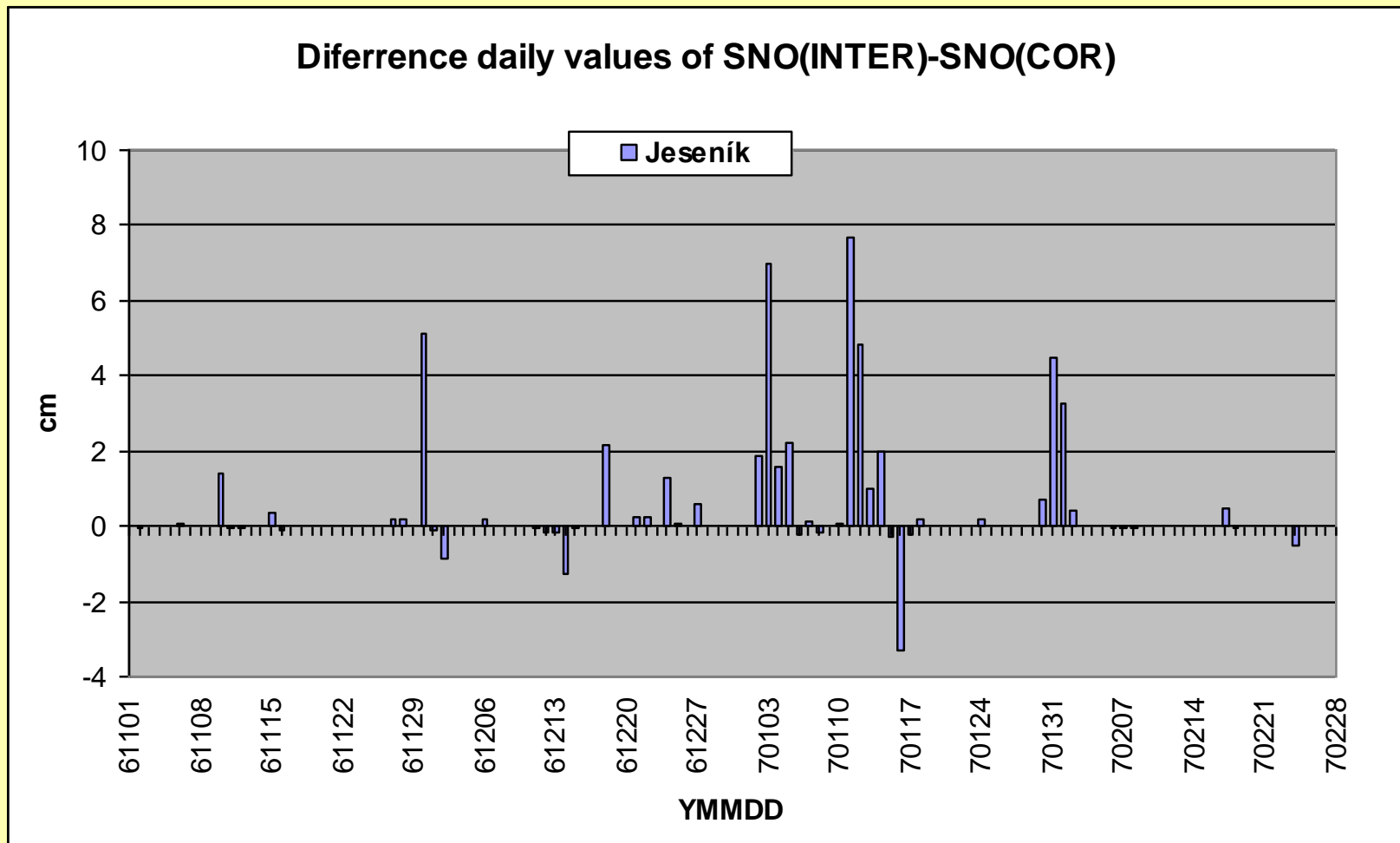in Climatol. and Meteorol., Budapest

Step 3: New Snow Estimation

Following steps are applied:

1) Spatial interpolation of SRA (daily precipitation sum)
2) Spatial interpolation of SNO (daily new snow depth)
3) Estimation of missing or questionable New Snow values in pixels:
   - If (SRA=0) then SNO=0
   - If SNO <= 0 in given pixel and SRA>0, then
     if (Altitude of pixel < Snow level) then SNO=0
     else SNO=SRA*SNOdensity
4) Daily averages over pixel values for each maitenance center were done

Results for winter maintenance centre Velký Beranov

Diferrence daily values of SNO(INTER)-SNO(COR)

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Results for winter maintenance centre Jeseník

Diferrence daily values of SNO(INTER)-SNO(COR)

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All roads and motorways

Diferrence daily values of SNO(INTER)-SNO(COR)

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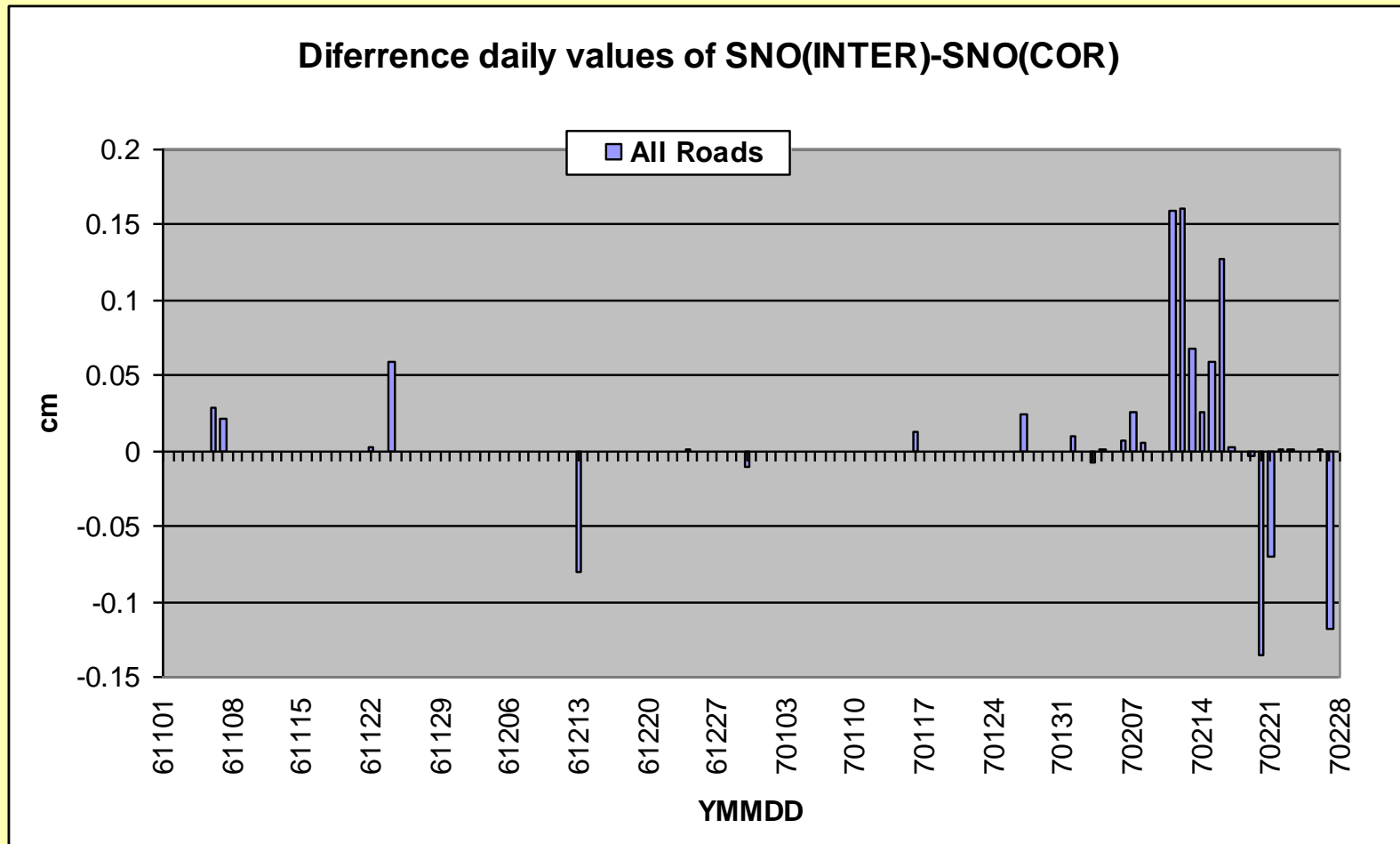
Conclusion

- According to CROSS company evaluation the Winter road maintenance index (preliminary values) based on corrected values of new snow cover provides better results than without this correction

- Further results verification is planned

- Based on this verification, further development of this method is underway

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Map of seasonal index of plowing
(period 1961-2010)

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0 - 5	40 - 50
5 - 10	50 - 60
10 - 15	60 - 80
15 - 20	80 - 100
20 - 30	100 - 150
30 - 40	150 - 300

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