Experiences with CM SAF data in the Czech Hydrometeorological Institute

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Introduction

- Czech Hydrometeorological Institute serves a network of stations with high quality climatological measurements
- This network is quite dense but data are more scarce in some parts of the Czech Republic
- Further, due to cuts in budget manual measurements are limited in last 10-15 years (especially problem for cloudiness)
- CM SAF can provide very useful supplement to get more precise picture of local climate conditions from two above mentioned reasosn
- This is especially true for the solar radiation and cloudiness data

Introduction

- Firstly, some comparison studies were done (for solar radiation (mainly SIS) and cloudiness) - how good are CM SAF data compared to surface observations?
- Overview of these results/applications will be given and benefits compared to the traditional climatological data discussed.
- Several possible ways of CM SAF data in the Czech Republic will be presented and discussed, too.

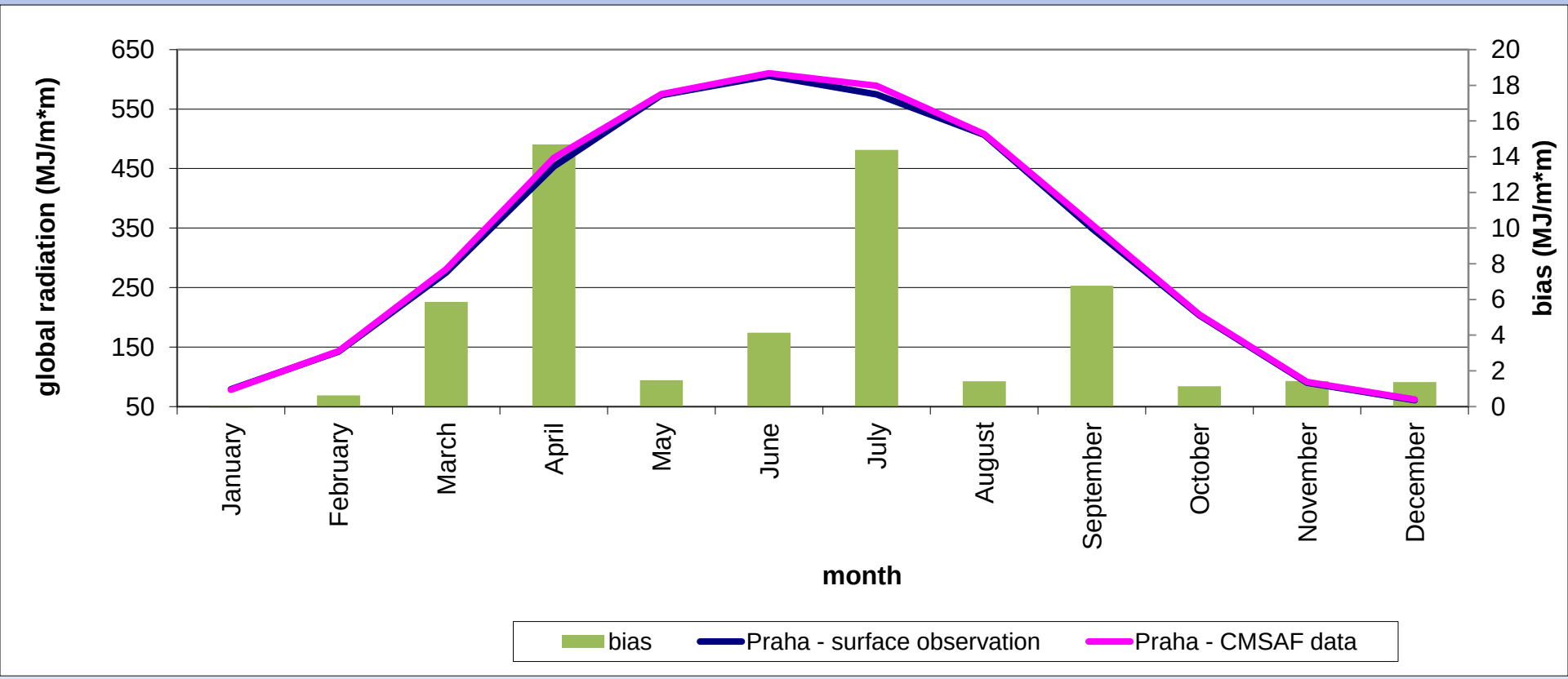
Solar radiation

- Surface incoming solar radiation (SIS) data from the CMSAF dataset for period of 1989–2009

- SARAH (Surface Solar Radiation Data Set-Heliosat) for period of 1983–2013
- Spatial resolution: 0,05x0,05 degree

- Surface data: stations with solar radiation and sunshine duration observations

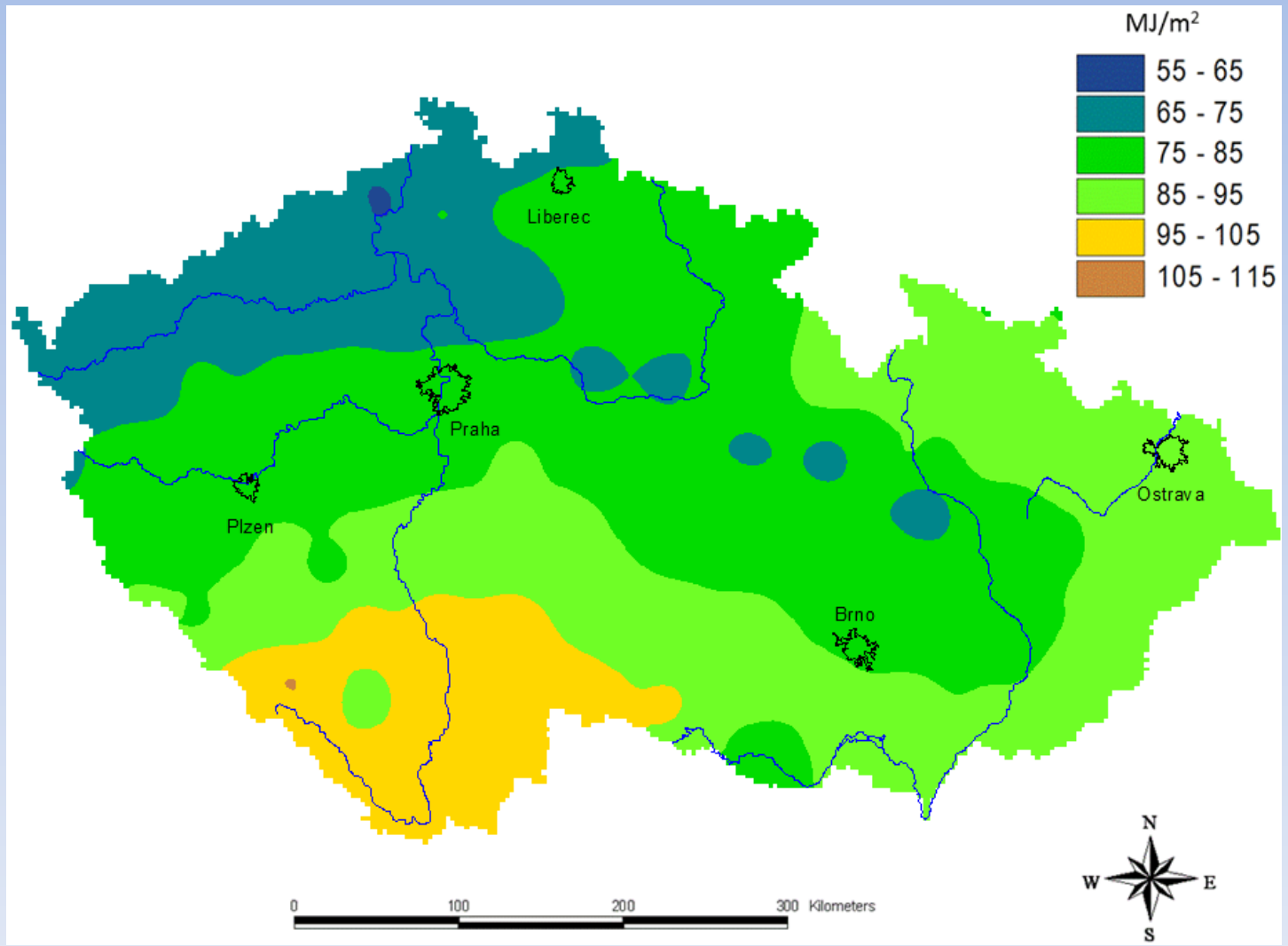
CM SAF vs. surface observation – global radiation (SIS), for Prague



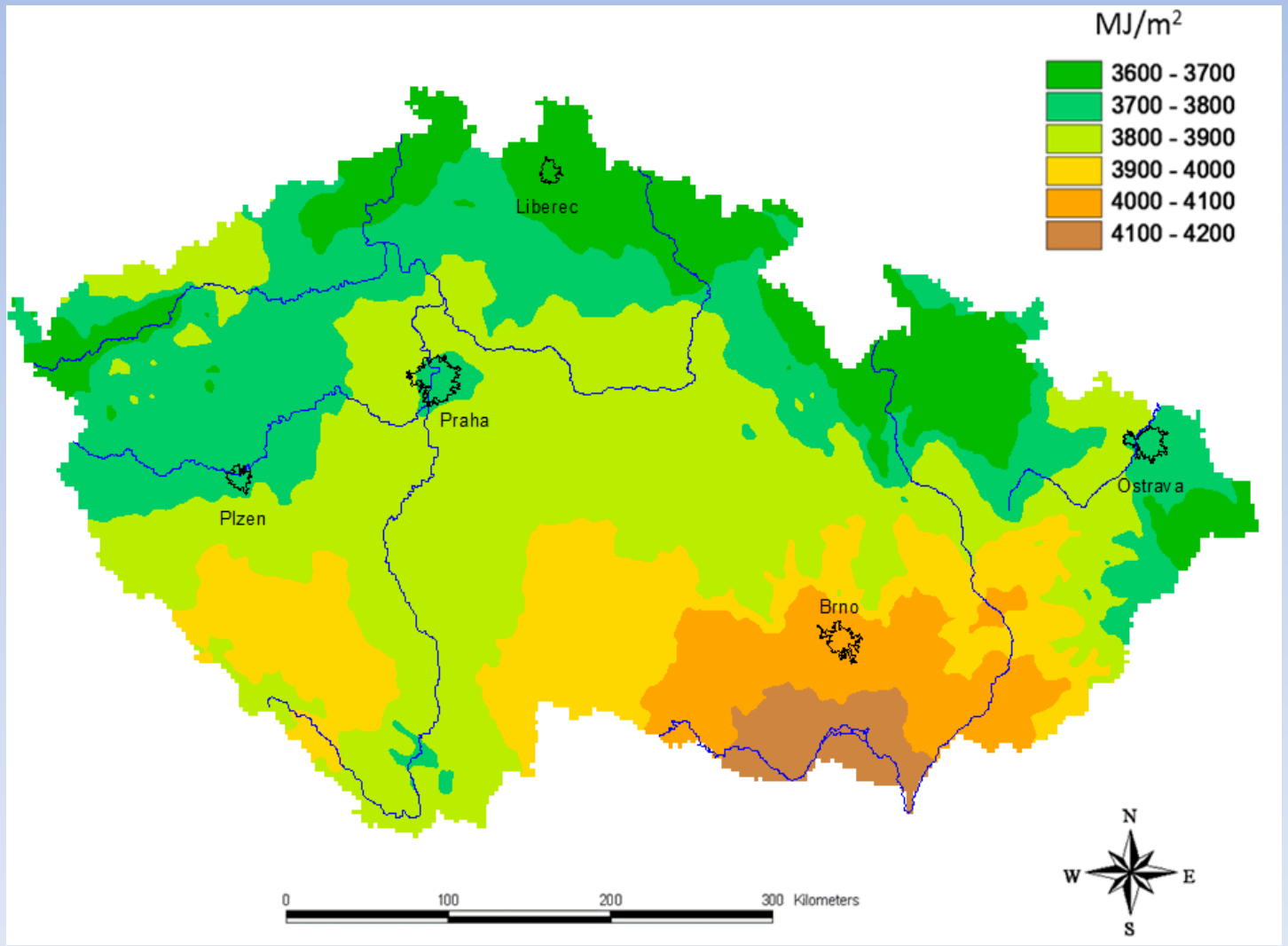
CM SAF vs. surface observation – global radiation (SIS), selected stations

Station (and Type)	Altitude (m a.s.l.)	Bias (W/m²)	Ratio of Months with Difference over 15 W/m²	Standard Deviation (W/m²)	Number of Cases
Hradec Králové (lowland)	285	4.1	10%	8.1	252
Churáňov (mountainous)	1122	4.7	14%	8.8	252
Kocelovice (hilly, countryside)	519	4.6	8%	8.8	252
Košetice (hilly, countryside)	470	4.4	9%	8.3	252
Kuchařovice (lowland, countryside)	334	4.5	10%	8.5	252
Luká (hilly, countryside)	510	4.5	9%	8.4	252
Mošnov (lowland, countryside)	242	4.2	9%	8.3	252
Praha-Karlov (city, centre)	254	4.3	11%	8.2	252
Svratouch (hilly, countryside)	737	4.2	10%	8.1	252
Tušimice (industrial region)	322	4.5	13%	8.6	252
Ústí nad Labem (industrial region)	375	4.6	12%	9.2	252

Monthly sum of SIS in December 2013. Example of a product combining the surface measured data and CMSAF data



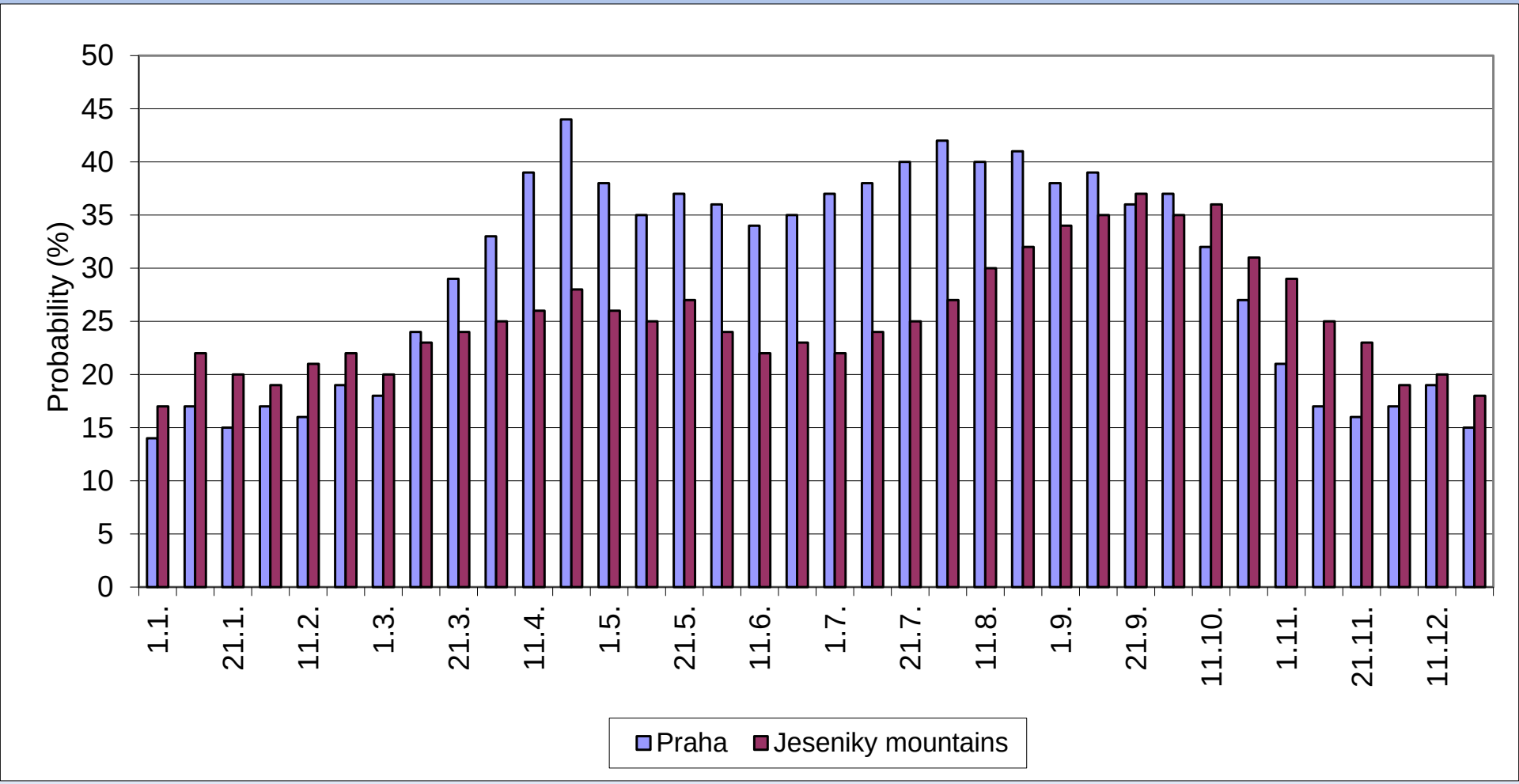
Long-term average of the annual sum of SIS constructed by the combination of measured and CMSAF data (1989–2009)



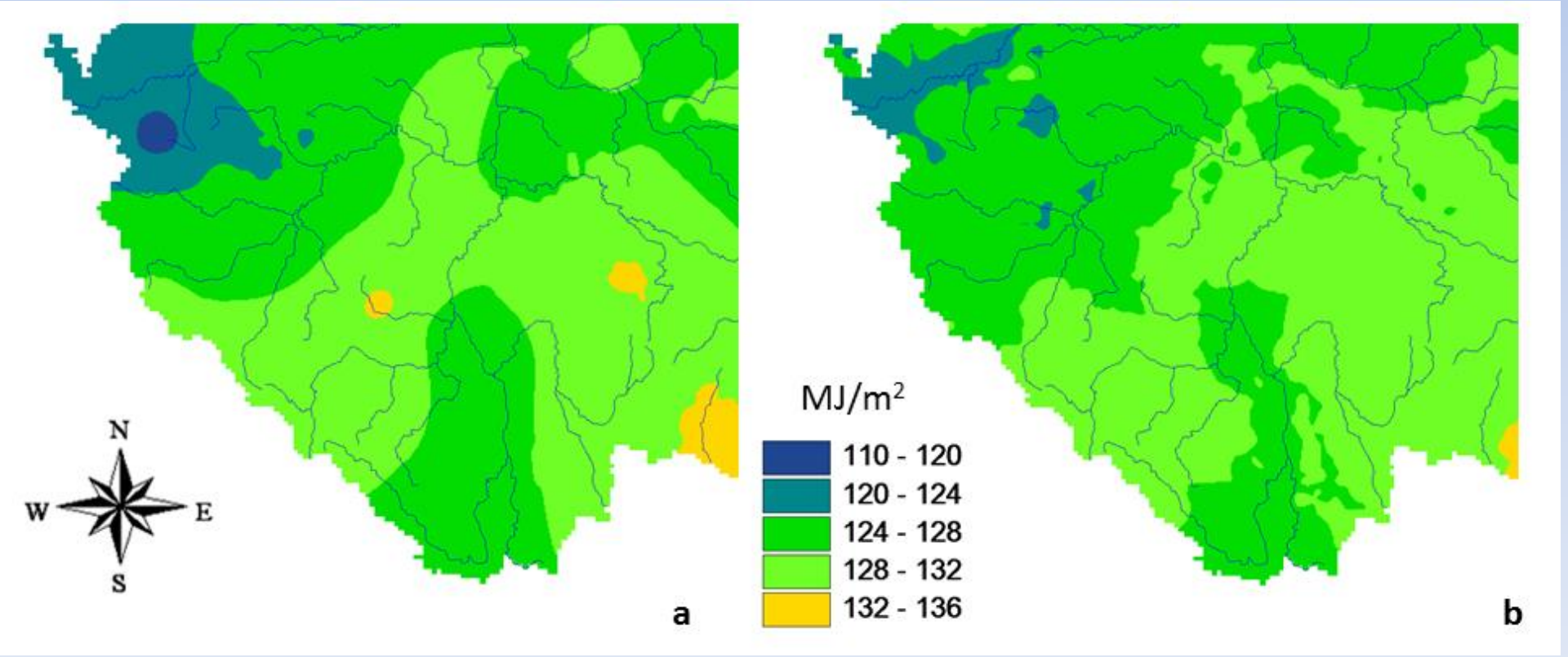
Trend of global radiation based on CM SAF and surface observation

Station (and its type)	Altitude (m a. s. l.)	Trend of surfaced data (W/m^2)	Trend of satellite data (W/m^2)
Hradec Králové (lowland)	285	*1.6*	*1.7*
Churáňov (mountainous)	1122	1.1	0.8
Ústí nad Labem (industrial region)	375	**4.8**	**4.0**
Ostrava (lowland, city)	242	**1.2**	0.9
Kocelovice (hilly, countryside)	519	0.6	0.4
Košetice (hilly, countryside)	470	**1.2**	**1.2**
Kuchařovice (lowland, countryside)	334	**1.3**	**1.1**
Luká (hilly, countryside)	510	**1.6**	**1.7**
Praha - Karlov (city, centre)	254	**1.5**	**1.9**
Svratouch (hilly, countryside)	737	**1.6**	**1.8**
Tušimice (industrial region)	322	**3.3**	**2.8**

Probability of sunny days (day with 80% or more of available clear-sky surface solar radiation for the given day) based on CM SAF data (for decades, for Prague and mountains in the NE of Czechia)



Example of SIS map used for Test Reference Year computation (SW part of Bohemia) for May *((a) based on station data only, (b) combination of both station and CMSAF data*



Cloudiness

- Fractional cloud cover (CFC) from January 1982 to December 2009
- (daily and monthly means)

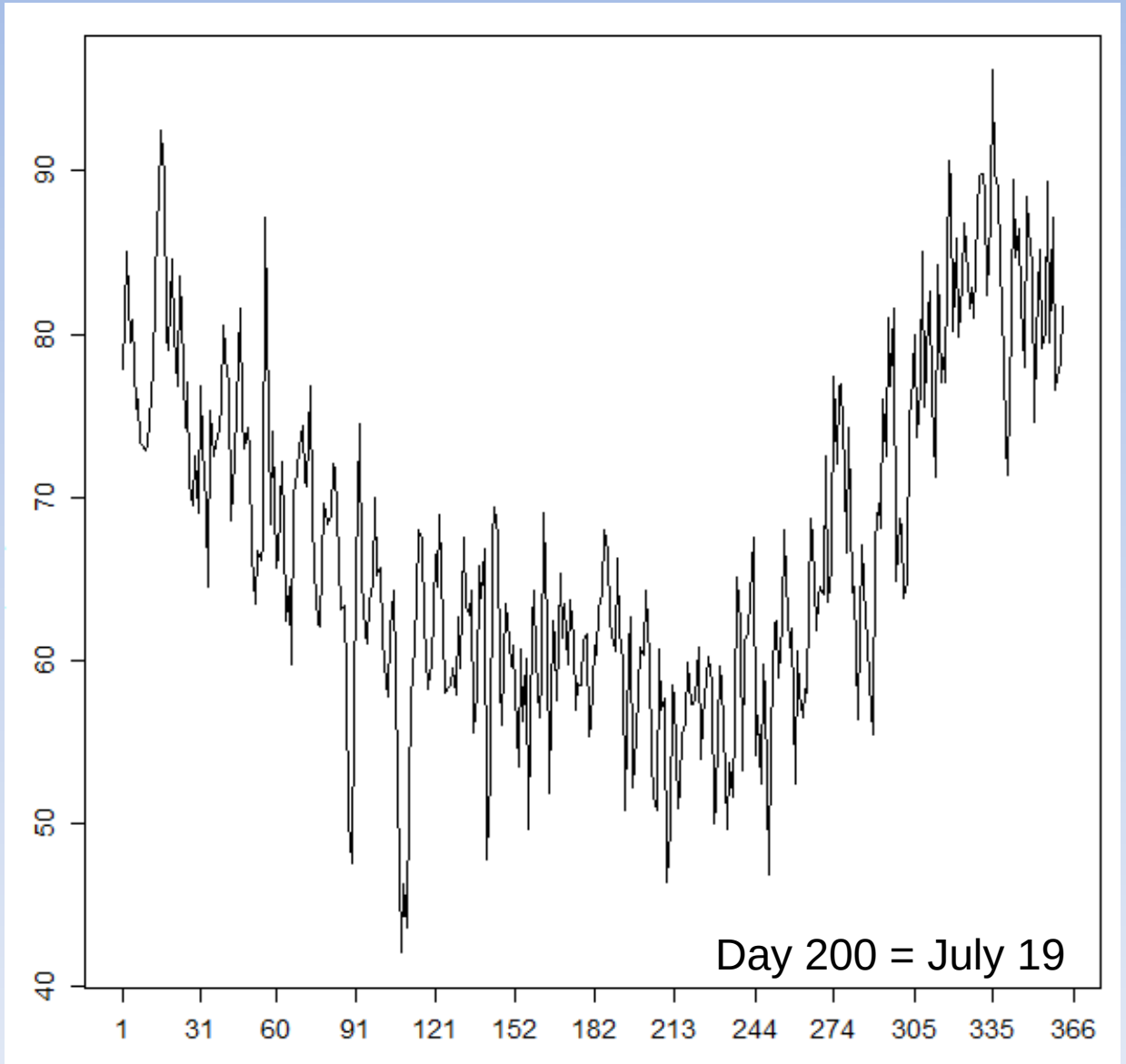
- Spatial resolution: 0,25x0,25 degree (sinusoidal projection)

- Surface data: stations with SYNOP observations

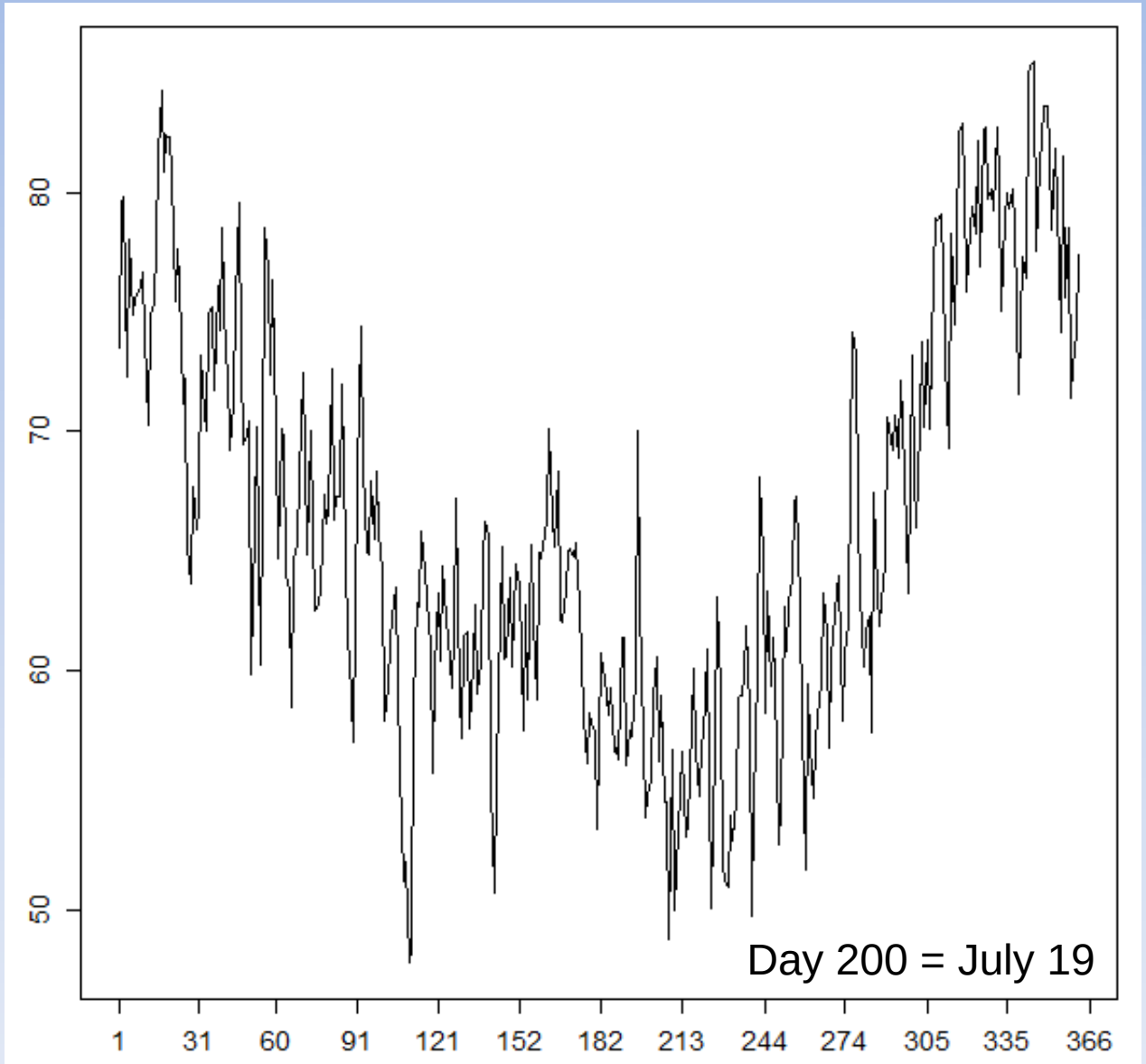
CM SAF vs. surface observation – cloud fractional cover (CFC)

Station (and its type)	Altitude (m a. s. l.)	Pearson's correlation coefficiten	Ratio of months with difference over 10 %	Number of cases
Brno (lowland, city)	285	0.63	18%	324
Doksany (lowland, countryside)	158	0.67	6%	324
Holešov (lowland, countryside)	222	0.64	19%	324
Cheb (hilly, town)	483	0.68	6%	324
Churáňov (mountainous)	1122	0.65	41%	324
Kocelovice (hilly, countryside)	519	0.62	21%	324
Kuchařovice (lowland, countryside)	334	0.62	25%	324
Liberec (hilly, city)	398	0.67	6%	324
Luká (hilly, countryside)	510	0.69	12%	324
Lysá hora (mountain peak	1322	0.72	11%	324
Milešovka (mountain peak)	831	0.7	7%	324
Praha - Ruzyně (airport)	364	0.66	18%	324
Svratouch (hilly, countryside)	737	0.68	26%	324
Tušimice (industrial region)	322	0.62	7%	324
Ústí nad Labem (industrial region)	375	0.63	8%	324

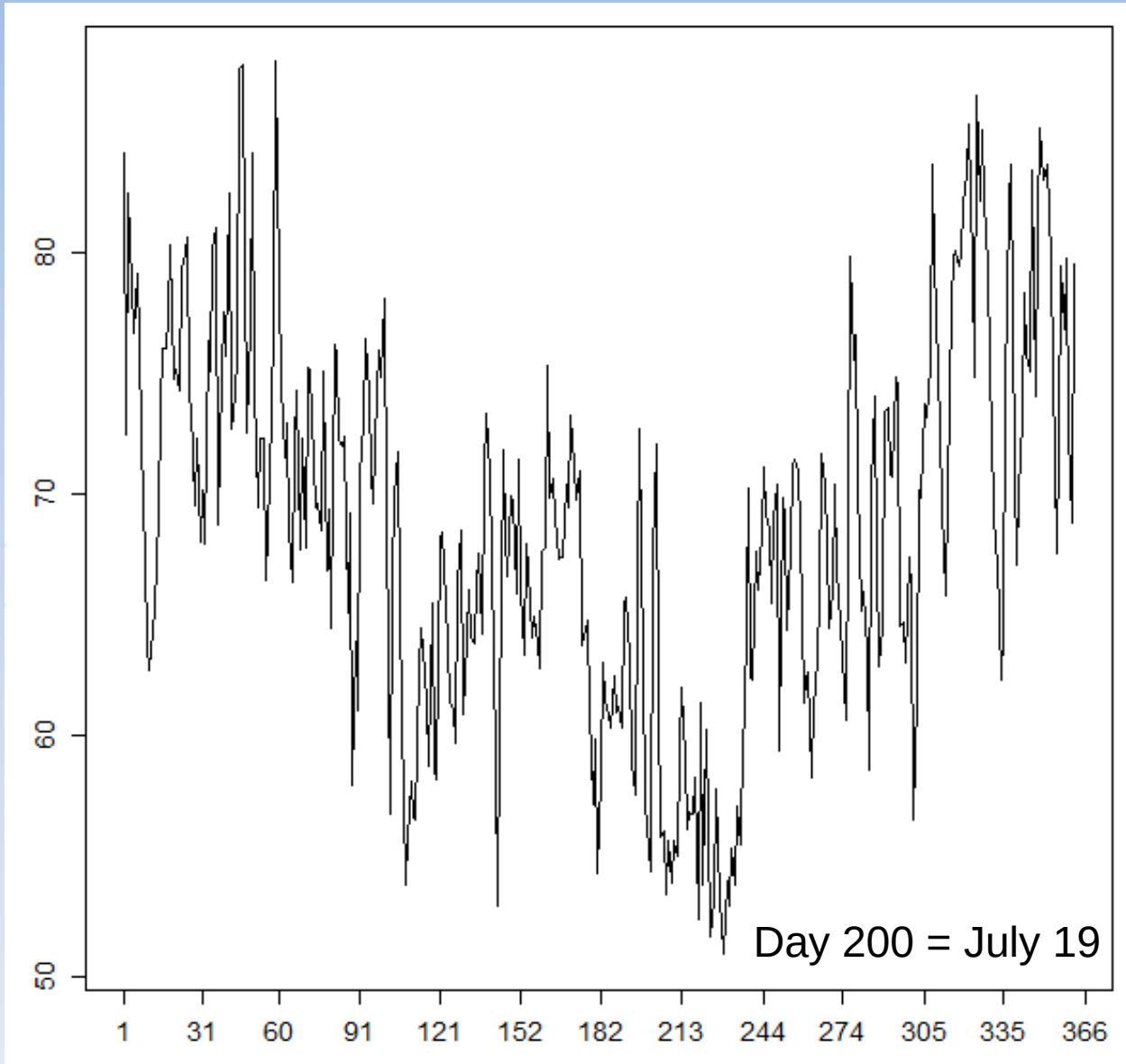
Annual course of 5day-moving average of cloudiness (in %) for station Cheb



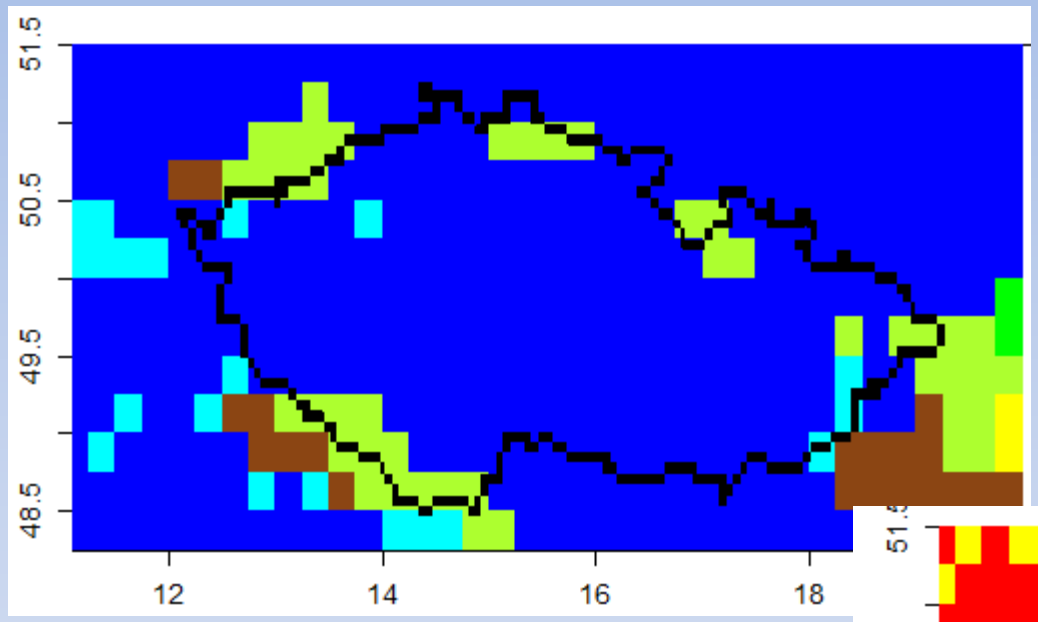
Annual course of 5day-moving average of cloudiness (in %) for station Prague

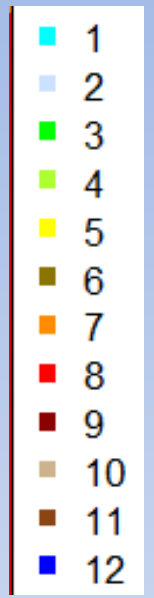


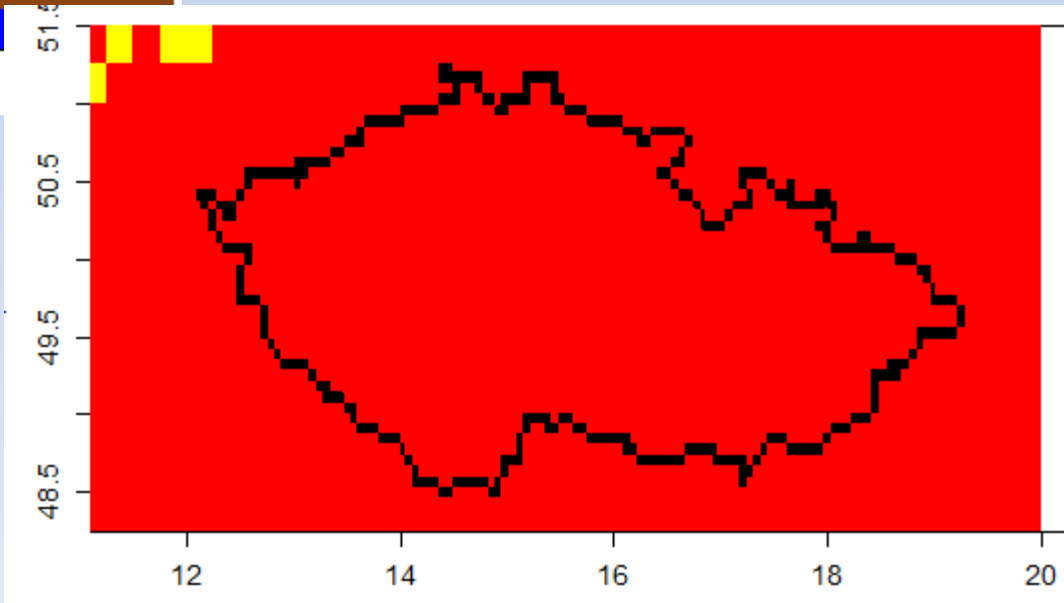
Annual course of 5day-moving average of cloudiness (in %) for station Lysá hora (mountain)



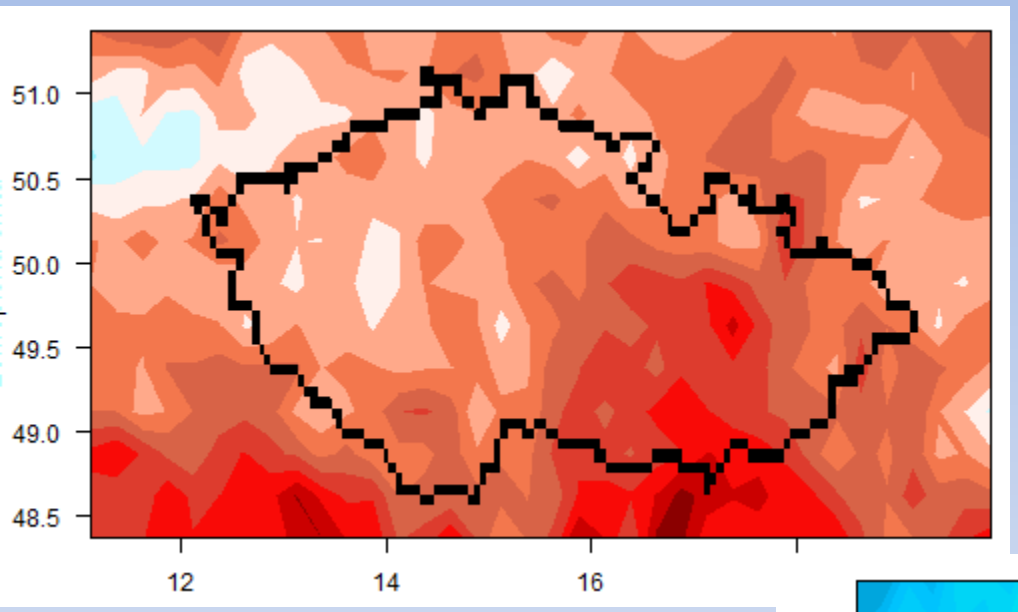
Month with highest (*up*) and lowest (*bottom*) average cloudiness

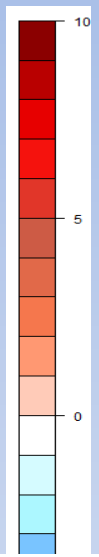


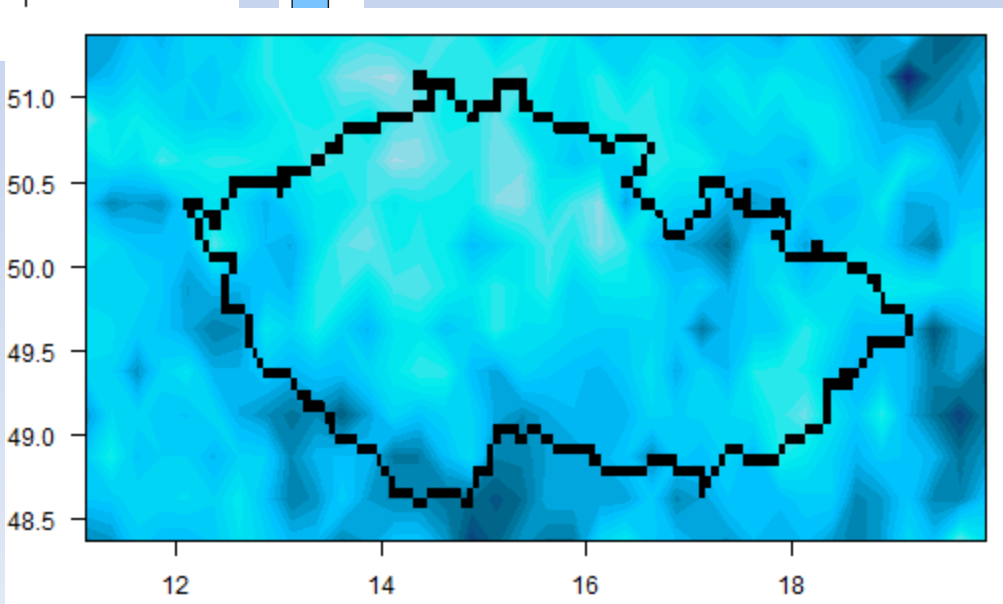




Trend of clear (*up*) and overcast (*bottom*) days per 10 years







Final remarks

- It is a bit problematic to use Cloud Fractional Cover (CFC) e.g. for direct replacement of the SYNOP observations *(at least on daily averages basis)*, but they can provide us with added information on clouds that can't be obtained by surface observation
- The problems are more „philosophic" – different ways of observations from surface and space (and besides, problems e.g. with fogs, C_L=8/8 …)
- In summertime, cloud elements are more cumuliform (and small-scale) while we have more of stratiform cloud types in the wintertime
- We believe that the surface observer has a tendency to report more of distant clouds in the summer (i.e. Cumulonimbus) for which the CMSAF grid point value will not be influenced
- Also geographical differences can lead to local deviations