



Effect of light pollution on sensitive animal species, ecosystems and landscape characteristics

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Prague acquired on March 21, 2022, with a Nikon D5 by ISS Crew

Project overview

- Impact of light pollution on wildlife species
- the impact of light pollution on the landscape
- Remote Sensing of Night Light Sources

VIIRS

On board NOAA-20 and Suomi NPP

Acquisition rate: Each Day

First image: March 1st 2012

Spatial Resolution: 750 m

Bit depth 14-bit



Data uncertainties

Surface albedo (effect of snow cover)

Phase of the moon

Aerosol loading

Cloud masking

Vegetation phenology

Geometry of observation

Airglow

Ephemeral aurora

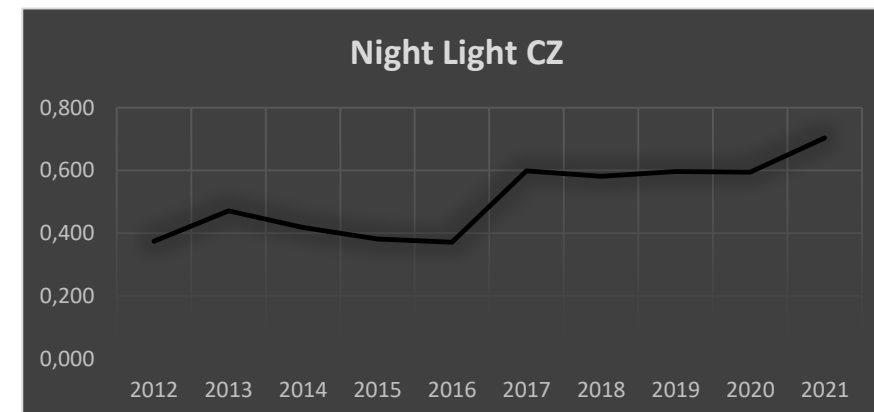


COLORADO SCHOOL OF
MINES
@ 150 | 1874-2024

Earth Observation Group (EOG)



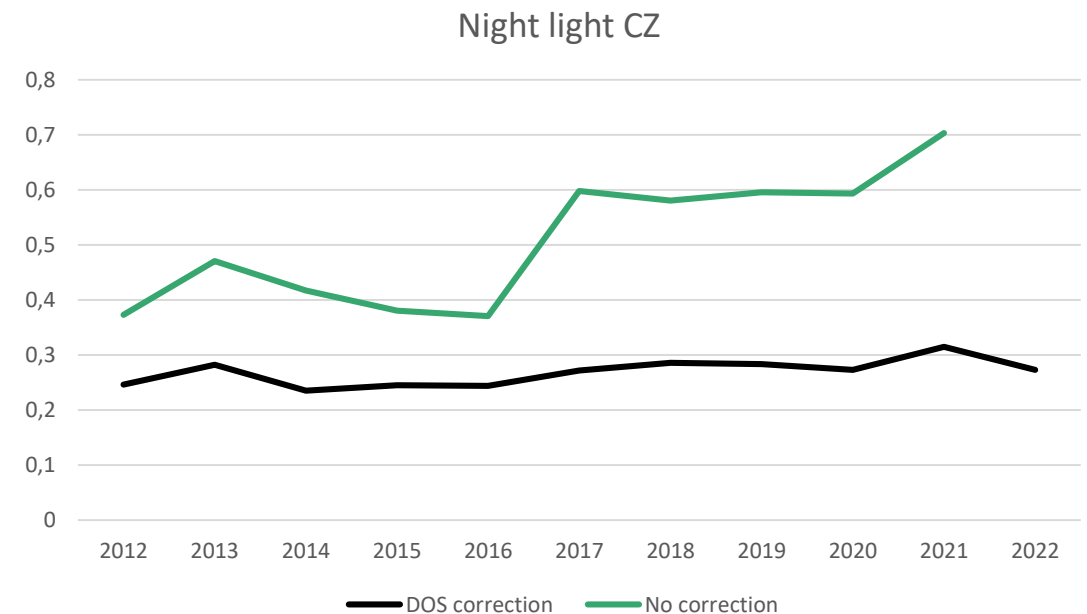
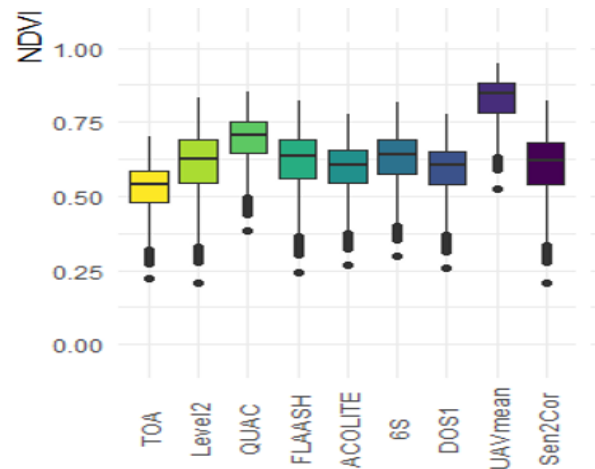
NASA's Black Marble



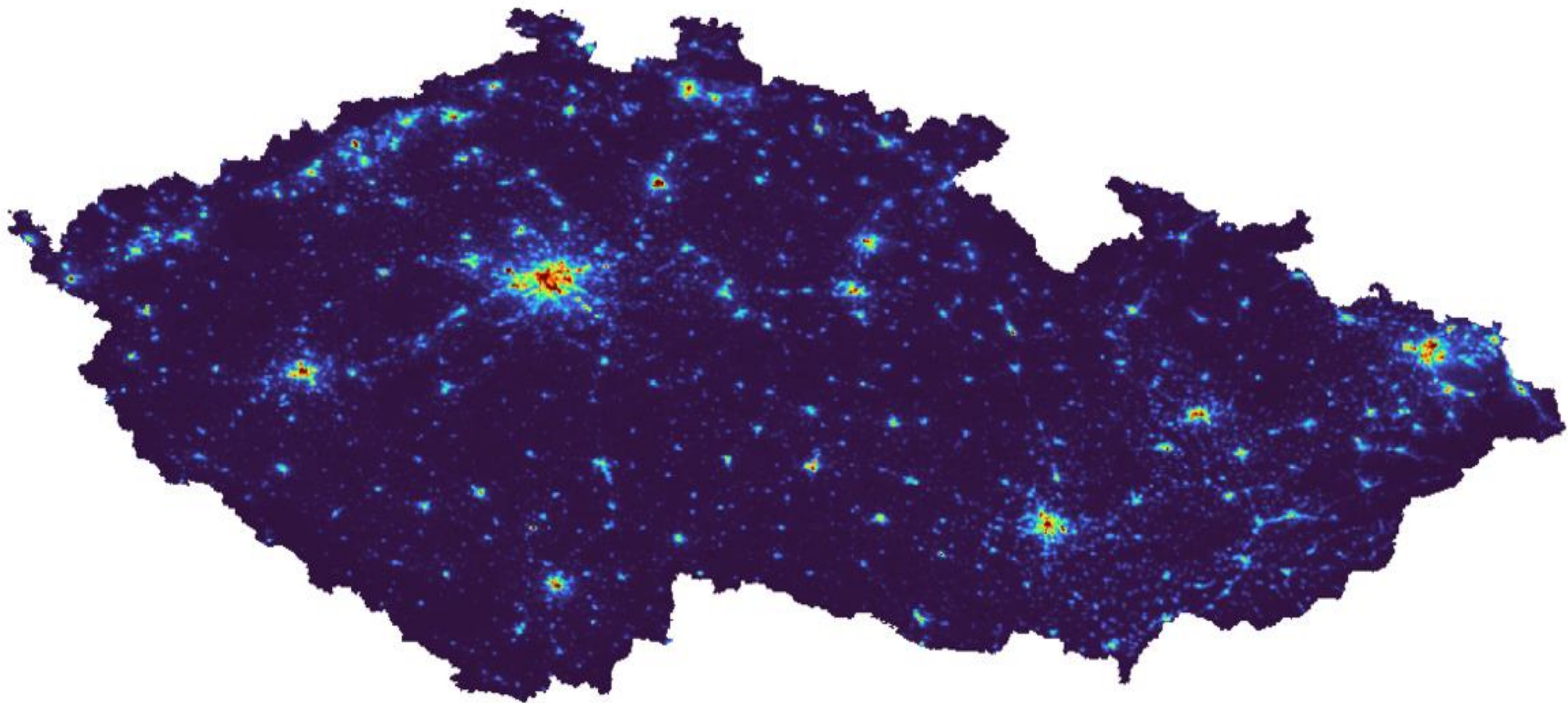
DOS

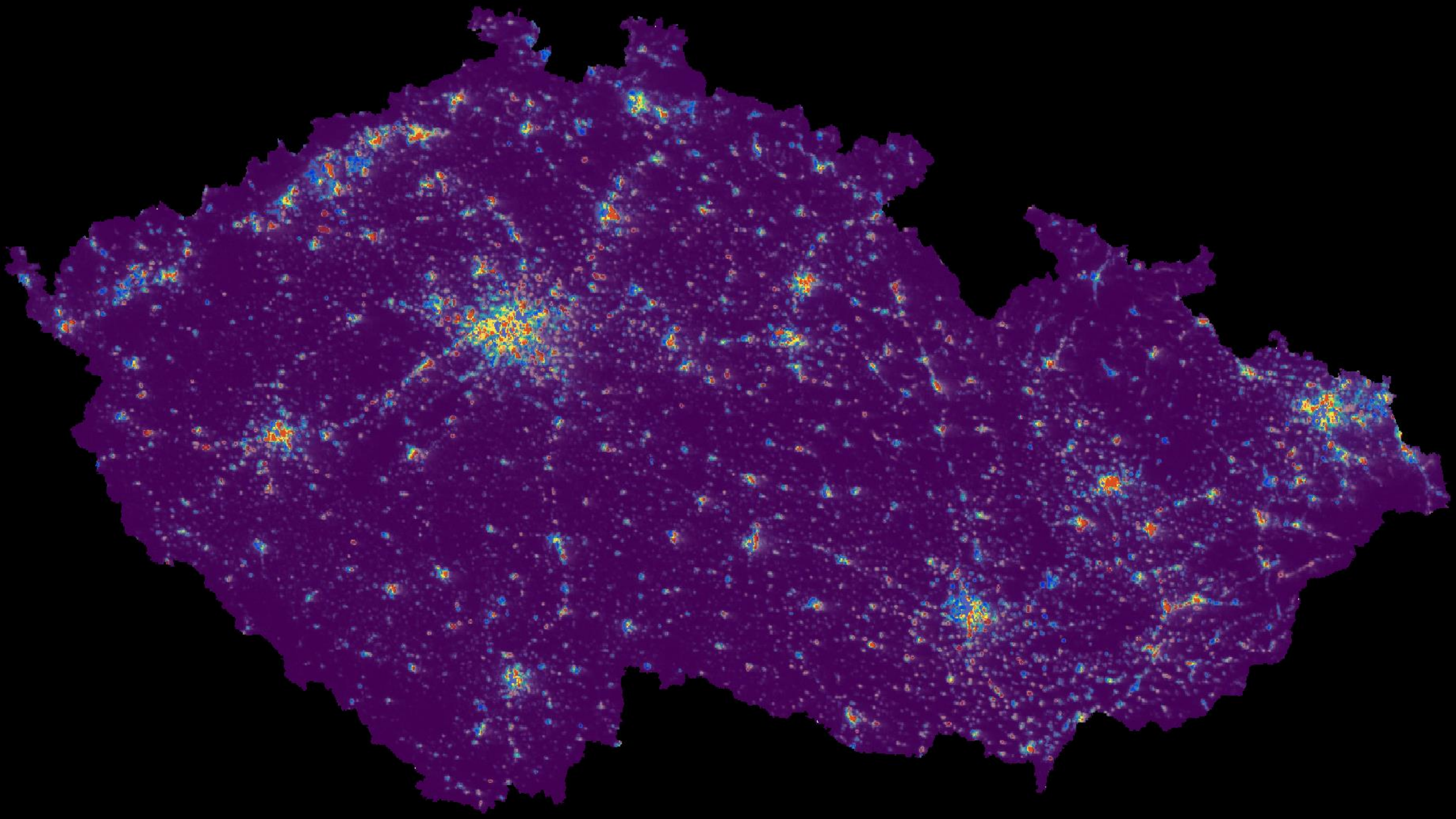
Premise: At least 1% of the surface in the image from which no signal should be coming.

If there is - it is noise, which we remove from the whole image.



Moravec, David, et al. "Effect of atmospheric corrections on NDVI: Intercomparability of Landsat 8, Sentinel-2, and UAV sensors." *Remote Sensing* 13.18 (2021): 3550.



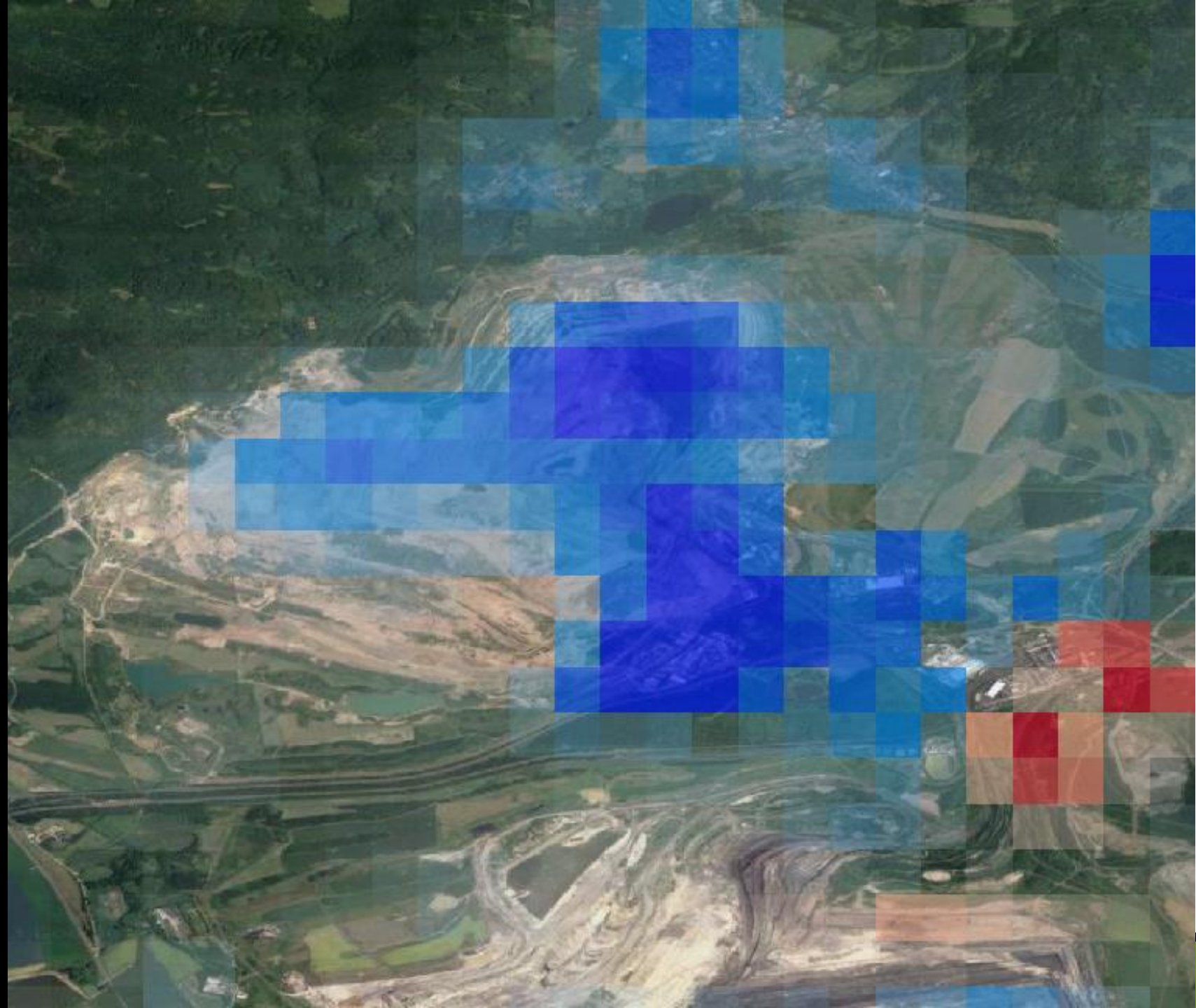


Increase in industrial areas

Industry areal Joseph,
Industry areal Triagnl

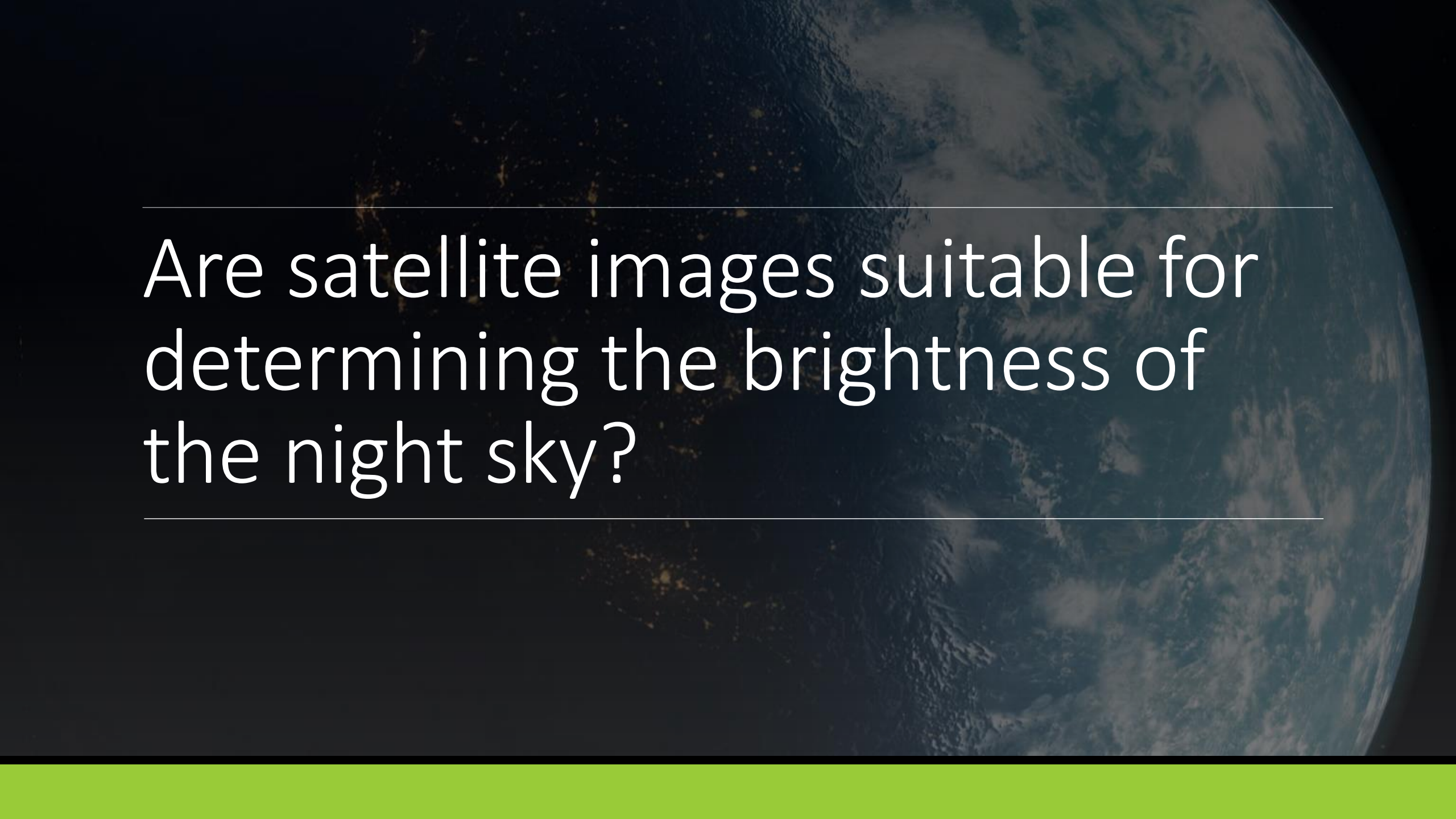


Declining trend
due to decline
in CSA
quarrying



Observed trend of night light in protected sites

CZECH	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
	0.247	0.282	0.235	0.245	0.244	0.272	0.286	0.284	0.273	0.315	0.273
National Parks	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
České Švýcarsko	0.102	0.071	0.088	0.085	0.072	0.106	0.090	0.101	0.122	0.124	0.098
Krkonošský národní park	0.111	0.227	0.102	0.160	0.137	0.125	0.169	0.163	0.132	0.212	0.174
Podyjí	0.078	0.100	0.080	0.074	0.059	0.067	0.105	0.084	0.095	0.110	0.089
Šumava	0.005	0.017	0.016	0.027	0.018	0.018	0.004	0.011	0.026	0.004	0.027
Protection Zones	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Krkonošský národní park	0.315	0.662	0.294	0.352	0.380	0.324	0.387	0.359	0.344	0.402	0.382
Podyjí	0.353	0.368	0.378	0.394	0.356	0.362	0.427	0.407	0.365	0.399	0.368
Protected landscape areas	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Beskydy	0.124	0.113	0.104	0.124	0.122	0.099	0.144	0.131	0.144	0.156	0.150
Bílé Karpaty	0.160	0.189	0.160	0.174	0.178	0.176	0.193	0.201	0.175	0.206	0.197
Blaník	0.129	0.117	0.123	0.085	0.108	0.123	0.142	0.151	0.133	0.163	0.142
Blanský les	0.196	0.166	0.142	0.161	0.160	0.164	0.197	0.142	0.159	0.152	0.135
Brdy	0.096	0.094	0.050	0.057	0.068	0.072	0.076	0.094	0.105	0.091	0.094
Broumovsko	0.179	0.313	0.165	0.211	0.172	0.194	0.212	0.226	0.186	0.285	0.205
České středohoří	0.349	0.455	0.372	0.385	0.357	0.454	0.442	0.441	0.437	0.491	0.429
Český kras	0.495	0.749	0.607	0.624	0.583	0.664	0.701	0.705	0.698	0.735	0.673
Český les	0.083	0.069	0.038	0.058	0.044	0.050	0.045	0.059	0.060	0.067	0.042
Český ráj	0.218	0.277	0.213	0.251	0.220	0.266	0.260	0.278	0.266	0.291	0.251
Jeseníky	0.090	0.122	0.073	0.105	0.092	0.057	0.097	0.100	0.077	0.126	0.121
Jizerské hory	0.183	0.405	0.183	0.283	0.272	0.246	0.281	0.283	0.306	0.323	0.301
Kokořínsko - Máchův kraj	0.164	0.141	0.142	0.159	0.121	0.158	0.179	0.169	0.178	0.192	0.188
Křivoklátsko	0.163	0.190	0.143	0.145	0.122	0.159	0.168	0.182	0.168	0.198	0.141
Labské pískovce	0.206	0.246	0.219	0.202	0.192	0.259	0.235	0.244	0.251	0.272	0.227
Litovelské Pomoraví	0.388	0.368	0.380	0.383	0.438	0.446	0.455	0.504	0.443	0.508	0.432
Lužické hory	0.173	0.236	0.173	0.189	0.173	0.209	0.221	0.204	0.223	0.235	0.197
Moravský kras	0.400	0.456	0.406	0.394	0.433	0.453	0.492	0.496	0.492	0.563	0.521
Orlické hory	0.044	0.100	0.056	0.079	0.073	0.054	0.085	0.098	0.078	0.122	0.112
Pálava	0.260	0.265	0.239	0.264	0.258	0.285	0.324	0.302	0.333	0.346	0.337
Poodří	0.552	0.558	0.537	0.557	0.515	0.537	0.600	0.556	0.611	0.631	0.570
Slavkovský les	0.150	0.269	0.149	0.126	0.125	0.167	0.164	0.181	0.160	0.150	0.168
Šumava	0.039	0.053	0.034	0.048	0.035	0.040	0.025	0.028	0.050	0.040	0.030
Třeboňsko	0.158	0.114	0.133	0.119	0.107	0.109	0.116	0.103	0.131	0.157	0.106
Žďárské vrchy	0.130	0.168	0.120	0.099	0.155	0.130	0.139	0.178	0.166	0.186	0.142
Železné hory	0.163	0.154	0.121	0.122	0.145	0.145	0.156	0.182	0.166	0.210	0.158



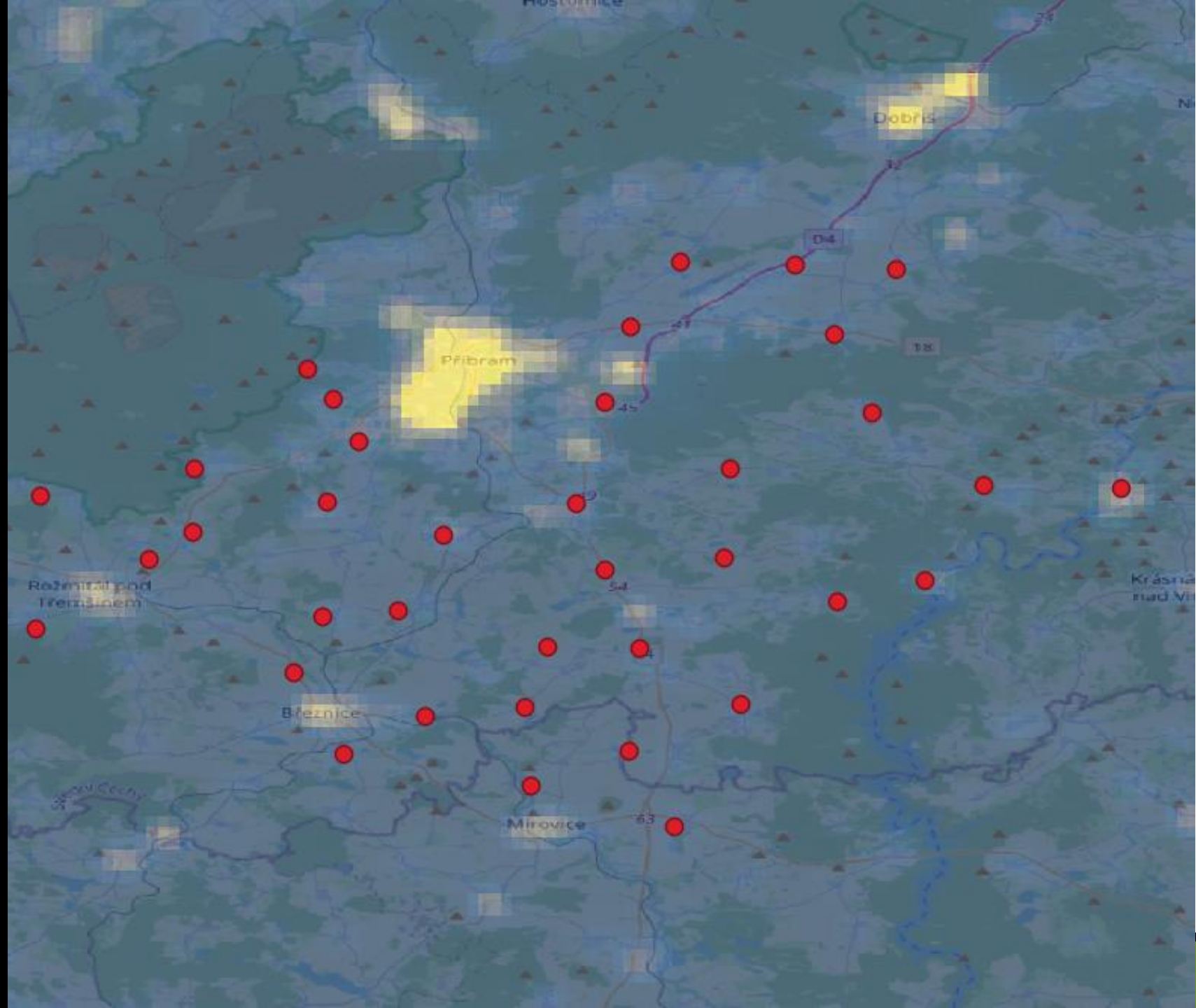
Are satellite images suitable for determining the brightness of the night sky?

Suitability test for night sky assessment

A total of 40 sites were selected in the vicinity of Přebram.

Each of these locations was then measured during the clear sky, cloudy sky and foggy weather three times

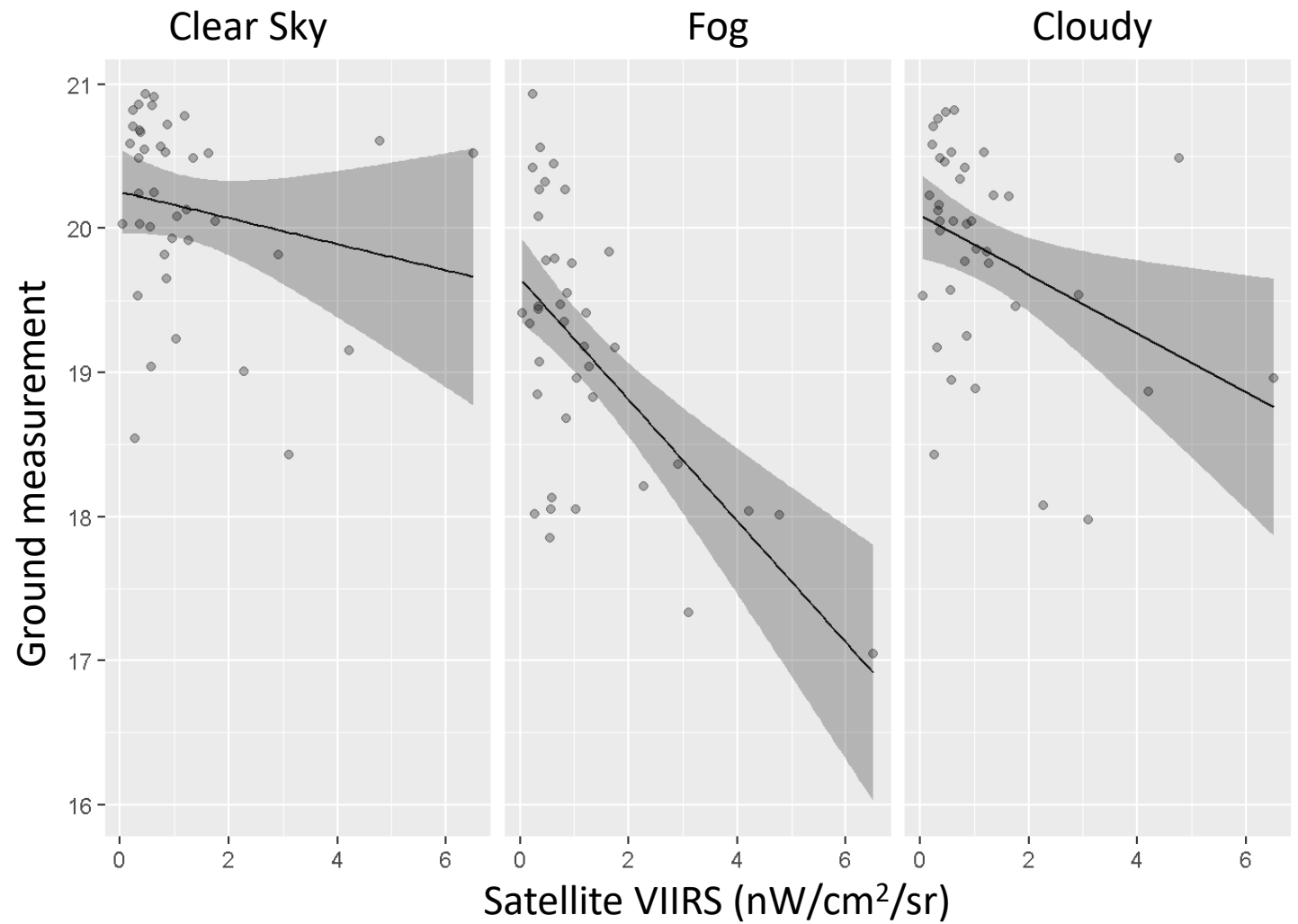
In total, 360 measurements were taken.



Linear regression

A statistically significant relationship between the satellite measurements and the ground measurements was demonstrated only in the case of foggy weather.

The model was able to explain 37% of the variability in the darkness of the night sky (Adjusted R-squared)



Explanation

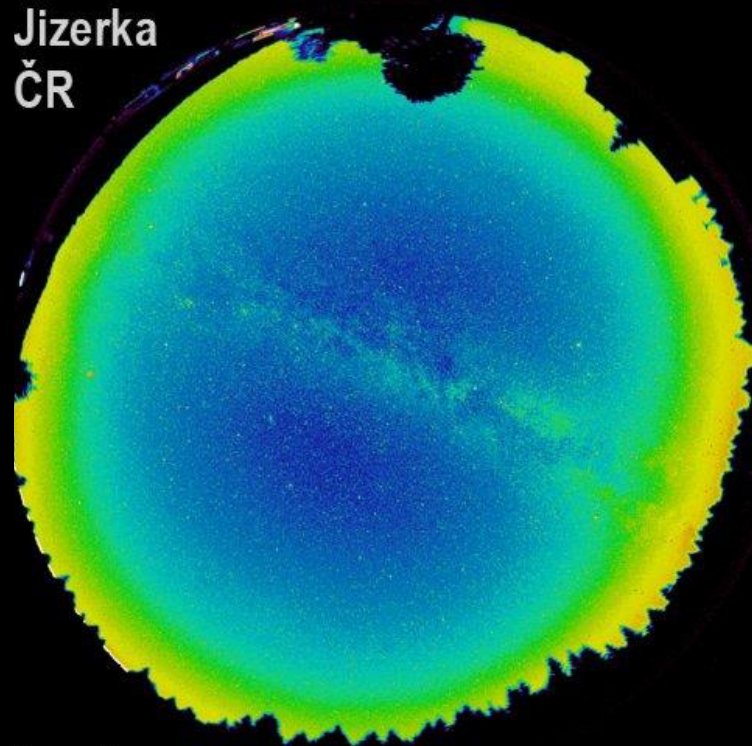
While a satellite only observes the light coming from a given location to it.

The darkness of the sky is affected by light coming from far away.

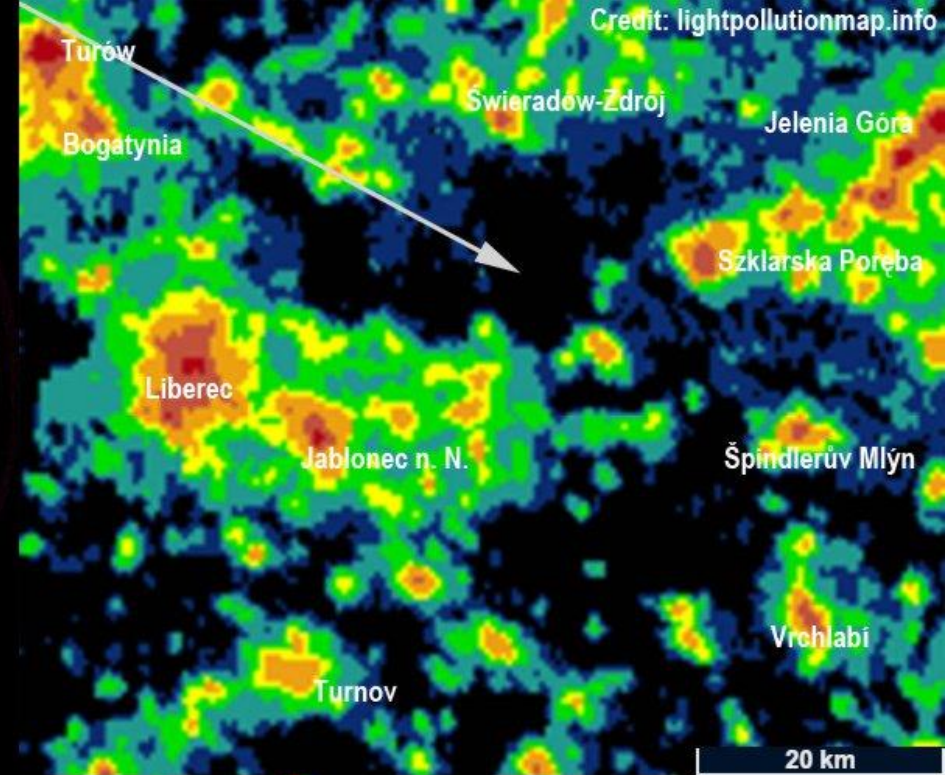
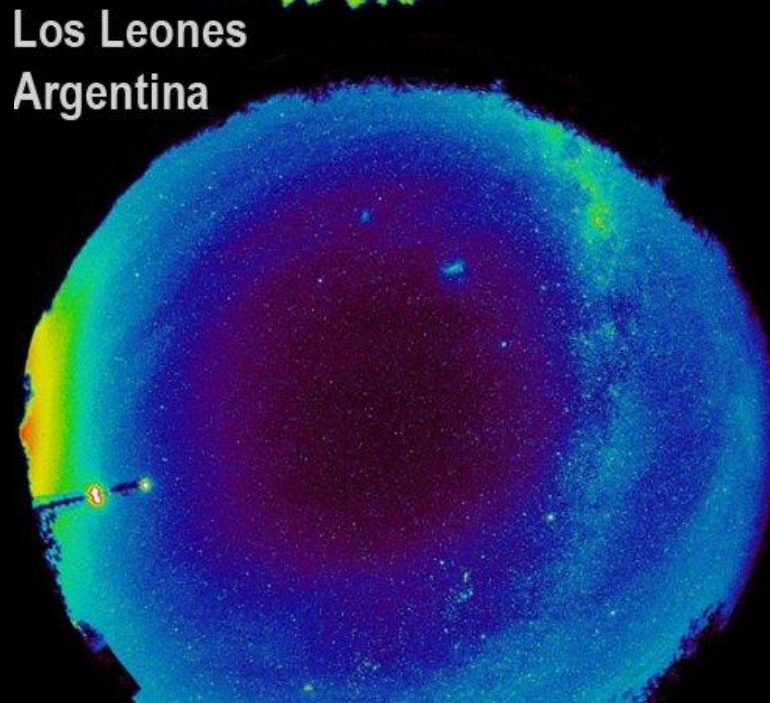
Example from:

<https://svetelnezncistenici.cz/mapovani-tmy/mapy-svetelneho-zncistenici/>

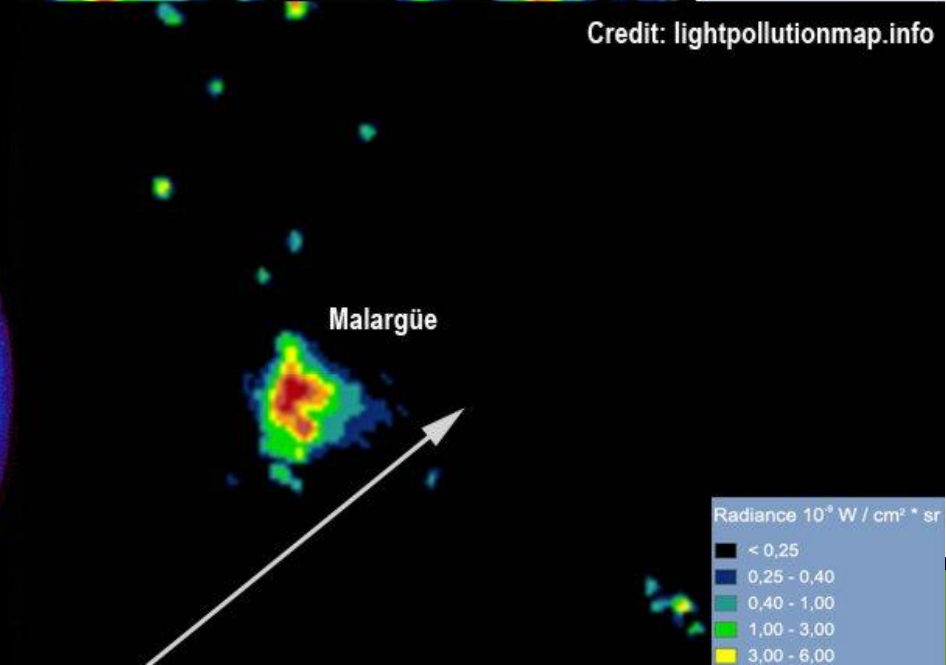
Jizerka
ČR



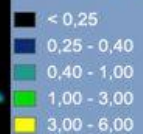
Los Leones
Argentina



Credit: lightpollutionmap.info



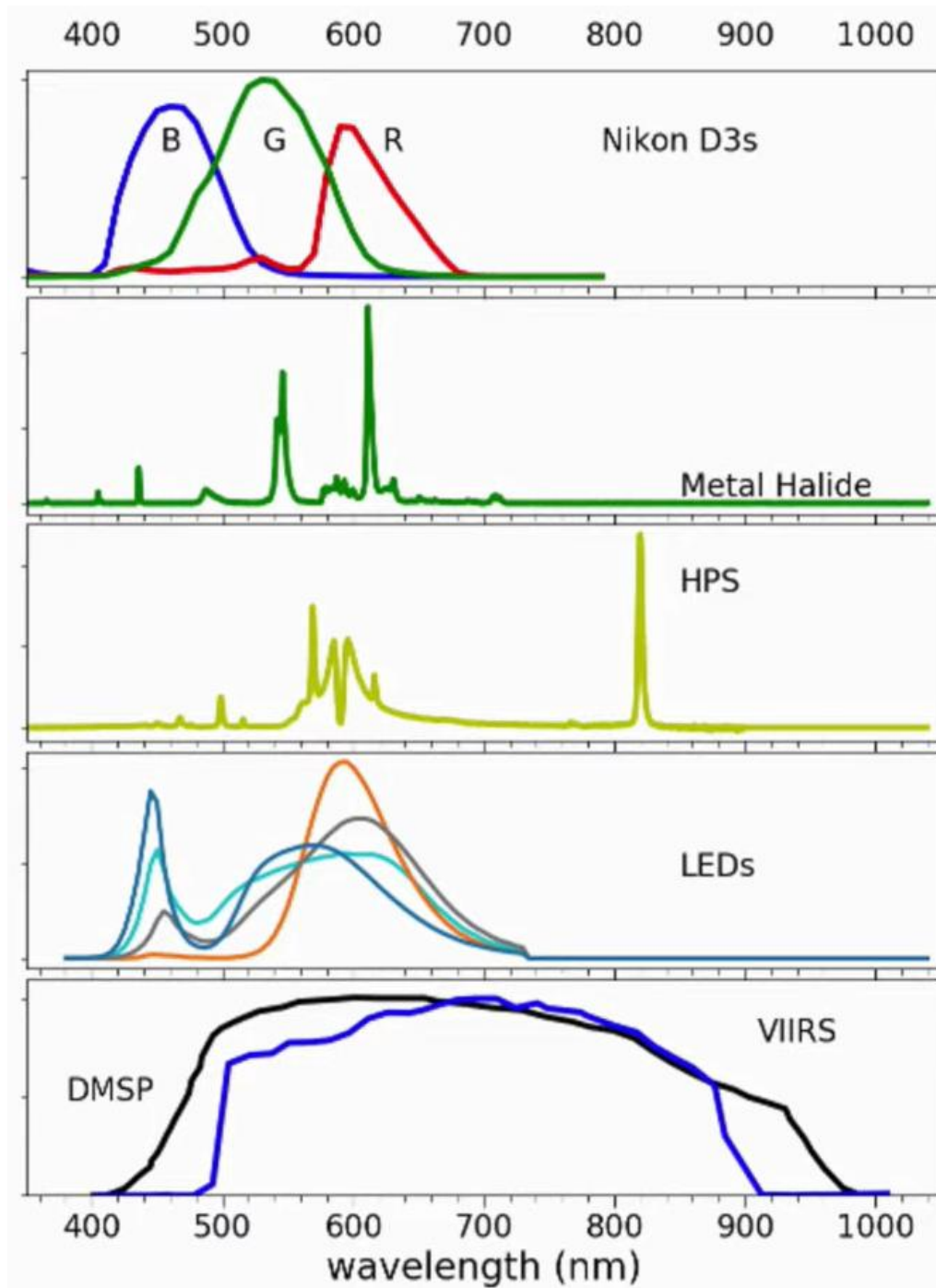
Radiance 10^{-8} W / $cm^2 \cdot sr$



The problem in the different spectrum

Emitted spectrum using Metal Halide (Halogenide lamp), HPS (Sodium lamp) and LED (5000K Blue, 4000K Turquoise, 2700K Grey and PC Amber Orange) illumination compared to the sensitivity of the DMSP (Black), VIIRS (Blue) and Nikon D3s (ISS camera) sensors.

Source NASA
ARSET.<https://appliedsciences.nasa.gov/>



How to use remote sensing of night lights

- Identifying light pollution sources and their sudden changes
- Caution to monitor long-term trends
- However, it is not suitable for monitoring the night sky

