



Educational Materials on the subject

# Earth by Night – Light Pollution in Central Europe

Form 11

Student Materials

## Tasks

**1. Marker 1 shows a so-called false colour image in which the red recording channel has been replaced with the infrared one. Locate the image section in Germany and elaborate on the advantages of this type of visualization.**

Tip: additional information on the subject can be found under [fis.uni-bonn.de/researchtools/info-box](https://fis.uni-bonn.de/researchtools/info-box)

**2. Use the App “Earth by Night” together with marker 1 (page 2). Describe the distribution of the light spots in the video by identifying the structures and patterns. What can be found out about natural conditions and patterns of settlement? Also consult the false colour image itself**

Have you lost your orientation? This symbol will help you to find it again:

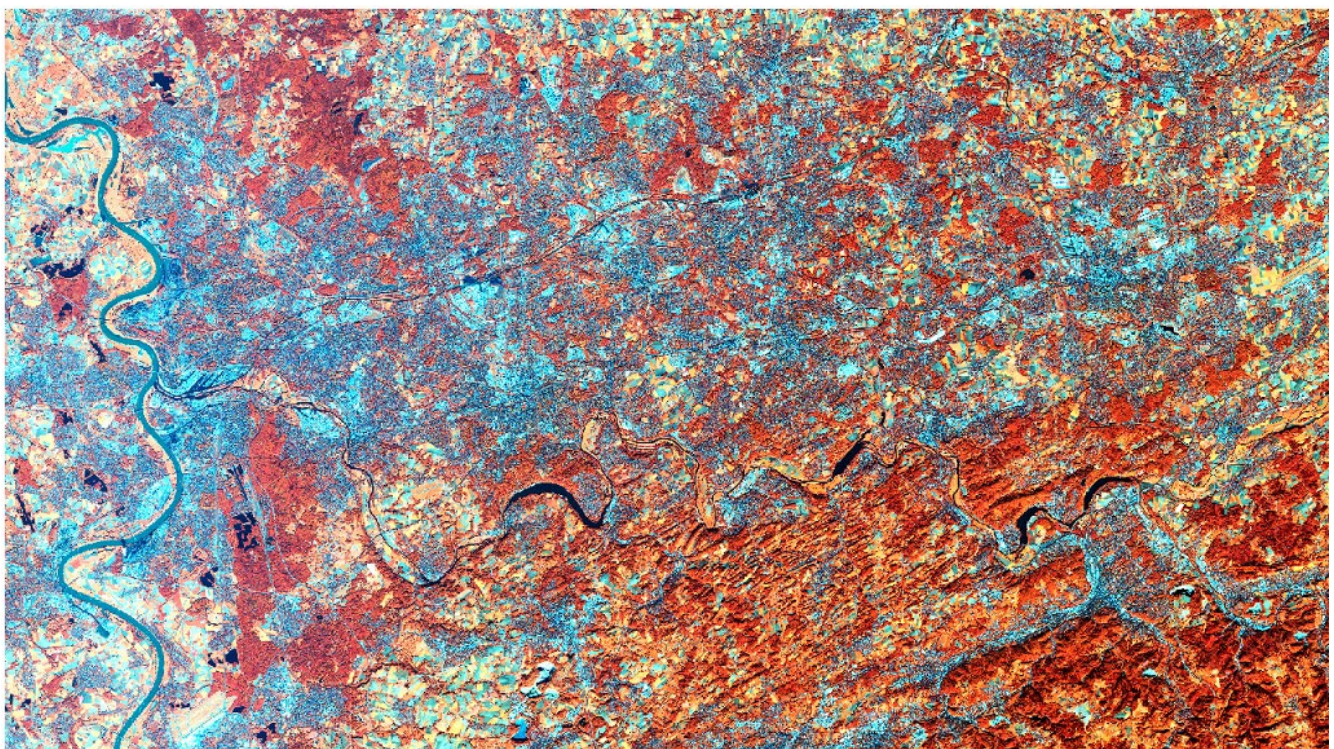
Simply cover this object and other objects which cast a shadow with your hand.



**3. Use the App “Earth by Night” together with marker 2 (page 3). Compare the video with the map. Are the areas which appear dark in the first video really dark? What effect do the light sources have in the distance?**

The light pollution map can be found on [www.lightpollutionmap.info/](http://www.lightpollutionmap.info/). Compare your place of residence to the two survey areas.

**4. Read the attached newspaper article and discuss the necessity and the problems of constant night lighting. How can these problems be solved or reduced?**



 **sentinel-2**    Infrared   Green   Blue

0   5   10   20 km



**Marker 1** Sentinel-2B-image from 15/10/17 in the colour channels infrared (B8, 833nm), green (B3, 559nm), blue (B2 492 nm).



## Translation of the newspaper article Das Ende der Nacht from SPIEGEL ONLINE, 13/06/16:

### New data regarding light pollution

## The End of the Night

**A new atlas shows how artificial lighting makes the nightly starry sky disappear in many places. One third of the human race cannot see the Milky Way any longer.**

The realm of darkness begins at 38 degrees northern latitude. Literally. From space you can clearly see where the South Korean territory ends and where North Korea begins: The south is sparkling brightly; the north is dark. Progress and prosperity on one side of the border; retrogression and poverty on the other.

But Christopher Kyba of the German Geo Research Centre (GeoForschungsZentrum-GFZ) in Potsdam knows that this symbolism has a problem: on the border between Belgium and Germany

darkness also encounters glistening light every night. Belgium shines, Germany does not – without the clash of two totally different economic systems.

So apparently there is no direct connection between economic capability and night lighting – even if the first glance at Kyba's atlas might suggest otherwise. "In the biggest part of Europe, the night does not occur any longer. Only day and twilight remain", the scientist warns.

The lighting maps discussed in the trade journal "Science Advances" show: By now one third of the human race cannot see the Milky Way any longer – because in many places the night sky is outshined by the light of the cities, industrial areas and motorways.

The new publication replaces an atlas from 2001. An important tool for the new version was a special measuring instrument aboard the US weather satellite "Suomi NNP". Its data was calibrated through measurements on the ground – countless scientists and volunteers helped with an app installed on their mobile phones.



**Marker 2** Abstufungen von Lichtverschmutzung im Umfeld von Städten. In hell erleuchteten Innenstädten überstrahlt die künstliche Beleuchtung den Nachthimmel vollständig (Quelle: mnn.com).

“The satellite is great for the light which is emitted upwards”, Kyba explains. “But there is also light emitted downwards”. And that is where the measurements from the volunteers come into play. “About 20% of the calibration data came from the ‘citizen scientists’. “Without them, we would not have any data from outside Europe and North America”, the scientist says.

Amongst the 20 major industrial countries - considering the affected area - Italy and South Korea have the biggest problem with light pollution. Sparsely populated countries such as Canada and Australia, in contrast, come off better.

The scientists also performed a different, very practical evaluation of their data, asking the question: How likely is it that a person can still see the Milky Way from his home? Here Saudi Arabia and South Korea perform badly. India and surprisingly Germany perform well.

Last year Kyba and his colleagues calculated that German cities with more than 100.000 inhabitants only give off one fifth of the light per capita that is emitted by American cities of comparable size. Since city lights are reflected by clouds, they also illuminate the cities’ hinterland – so this effect has an impact on vast areas.

People who are specifically looking for darkness in Europe will most likely be able to find it in Scotland, Norway or Sweden, also in parts of Austria and Spain. Some regions in Germany also promote themselves as retreats for stargazers – e.g. the Rhön, the Eifel and the Havelland.

While the concrete consequences of air pollution are well understood, respiratory diseases and strokes etc., the effects of light pollution need further research. However, the loss of the night has a heavy impact on eco systems, that much becomes apparent even through the little research there is: zooplankton’s

movement e.g. is not stimulated by the rhythm of the day as it used to be - and this might cause fundamental changes for whole food chains. Also some plants develop fewer blossoms under artificial light.

### **Problem threatens to double or triple**

A different study proved that the migration of young tortoises is disturbed by lighting, a further study deals with the negative impact of lighting on pollen transportation through moths. And yet another paper examines how the mass coral spawning in the Great Barrier Reef is disturbed through the light pollution. But altogether scientists do not know much about what negative consequences the end of darkness will bring.

In any case, the aimed use of technology could alleviate the problems caused by light pollution, the authors of the atlas believe. Streetlamps which are aimed downward and switched on by a motion sensor could be a part of the solution.

Should such solutions not be applied, the problem is likely to worsen further. This is because in many places gas discharge tubes are replaced with LED lamps. This may be a good idea with regards to saving energy – but not so much when it comes to light pollution: the white LED light could make unclouded nights even brighter.

Therefore, scientist Fabio Falchi warns: “If we do not pay close attention to the LED spectrum and the lighting intensity, sky illumination during clear nights could double or even triple.”