



## Night Watch, a New Earth Observation Mission Idea Theme: Technology and Design

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## Night Watch, a New Earth Observation Mission Idea

Theme: Technology and Design

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Night Watch is a new concept for a night-time visible band observation satellite that received European Space Agency (ESA) support through the inaugural round of its New Earth Observation Mission Ideas (NEOMI) program. This new initiative from ESA aims to expand the Earth Observation (EO) community, attract more ambitious and bolder mission proposals, mature science and technology missions to reduce risk for selected missions, and to grow and diversify the community of EO scientists and leaders.

The NEOMI projects are not linked directly to an actual mission, rather it is an enabler to develop and design a new mission idea. The duration of the NEOMI is one year, at the end of which the design of Nightwatch will be completed. However, the intention of both ESA and our group is to use the knowledge gained to apply for ESA satellite missions - even before the NEOMI is over. In particular, our group hopes to lead the development of an Earth Explorer proposal for the next call.

Our project addresses the very limited number of satellites specifically designed for measuring the nocturnal radiance of Earth in the visual band. Although not designed specifically for night-time observation, the only current satellite sensor with daily near-global coverage is the Day/Night Band (DNB) of the Visible Infrared Imaging Radiometer Suite [1]. However, its data is far from ideal for most night-time studies. Fine details about lighting configuration and location are lost due to a spatial resolution close to 750 m per pixel. Also, it does not provide any spectral information (colors), as it has only a single band. Unfortunately, that band extends from 500-900 nm, which means it has no sensitivity to the critical blue part of the visual range (400-500 nm). This is a major problem at the moment, because it misses the blue peak of LED lights that typically is between 420 and 460 nm. A small number of other satellites are able to acquire night light data (including astronaut photographs from the ISS [2]), but this data is typically uncalibrated, not regularly acquired, with

major gaps in many regions of the world (particularly the Global South), and (especially in the case of commercial satellites, such as the Jilin-1 series or CESAT by Canon) not freely available.

While the Nightwatch concept is still in development, we anticipate that it would obtain high spatial resolution images (10-100 m), in a multiband approach (R, G, B and broadband), covering the spectral band from 400 to 900 nm to allow comparison to VIIRS DNB. Depending on final decisions regarding resolution, it may be possible to obtain near global coverage with a revisit time shorter than one month. The duration of the mission is expected to be at least five years, although the development team has a strong preference for a longer duration (approaching 10 years) in order to allow observation of lighting change over time.

The list of possible applications for this satellite concept is long. Our group has so far conducted interviews with representatives from 13 different groups or application areas, with further interviews planned. These interviews have indicated a great interest across diverse fields, including urban planning and development, socio-economic research, ecology, energy, human health, legislation, light pollution modeling, meteorology, building stock and material flows. We expect this list of application fields to grow even before the construction of the actual satellite, for example via outreach activities such as discussions at the ALAN conference.

One of the main challenges for the collaboration is in selecting a single, or at most a small number, of science applications which will drive the instrument technical requirements from among the diverse set of possible applications. While the mission concept will eventually focus narrowly on these specific science applications, it is our expectation that the satellite will deliver data that benefits many or most of the diverse application areas.

## References

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