

# *The Payne Institute* for Public Policy



COLORADO SCHOOL OF MINES

PAYNE COMMENTARY SERIES: **BRIEFS**

## **Ukraine Power Outages Viewed From the NASA/NOAA Visible Infrared Imaging Radiometer Suite at Night**

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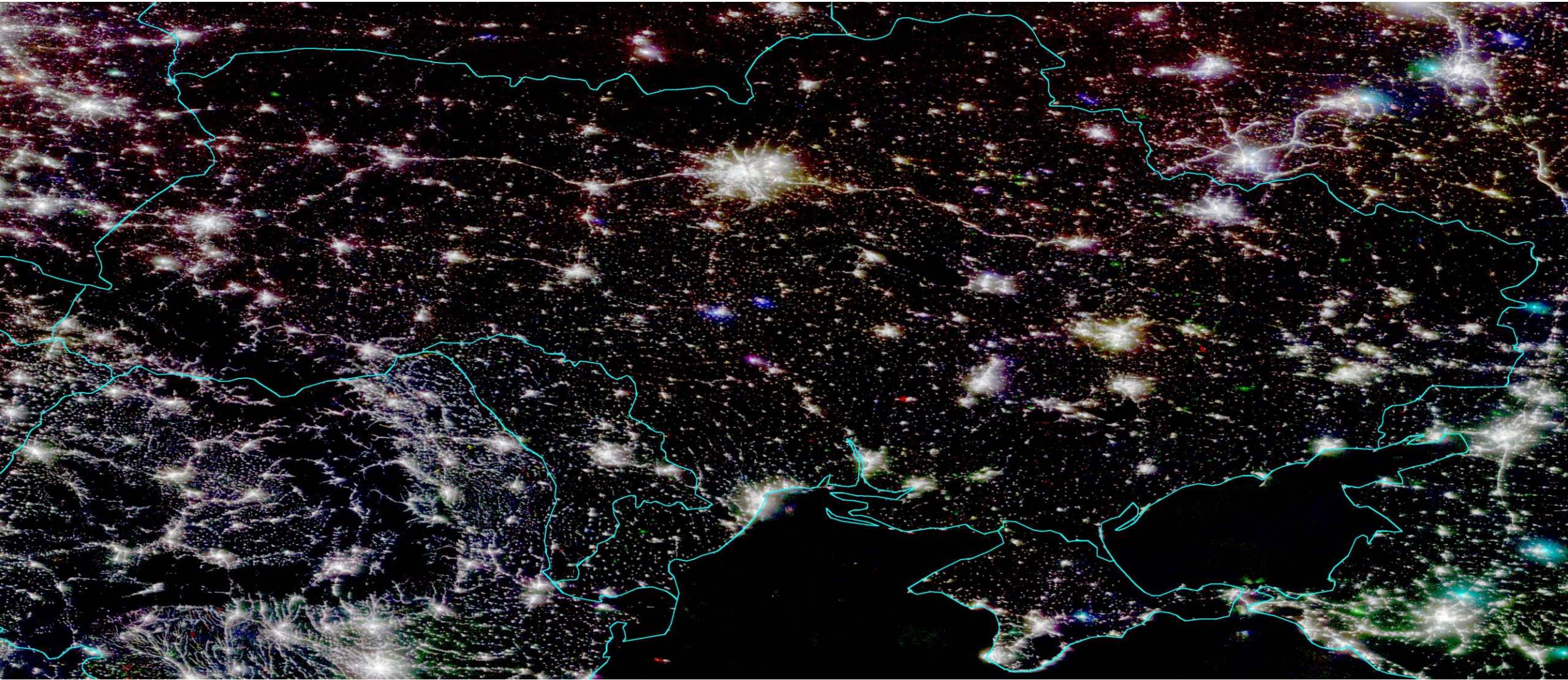
Earth Observation Group

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As the Russia-Ukraine war approaches the 1 year mark the electrical grid in Ukraine has taken devastating damage. Russia has hit more than 200 targets in the electrical infrastructure. This has left millions of Ukrainian citizens without power in the cold winter months. In the early days of the war Russia captured the Zaporizhzhia nuclear power plant, which is the largest nuclear power plant in Europe. Russia has now militarized the facility installing several Grad rocket launchers around the dry storage for spent nuclear fuel. Protective structures were erected to defend the launchers, but these structures violate international nuclear and radiation safety regulations.

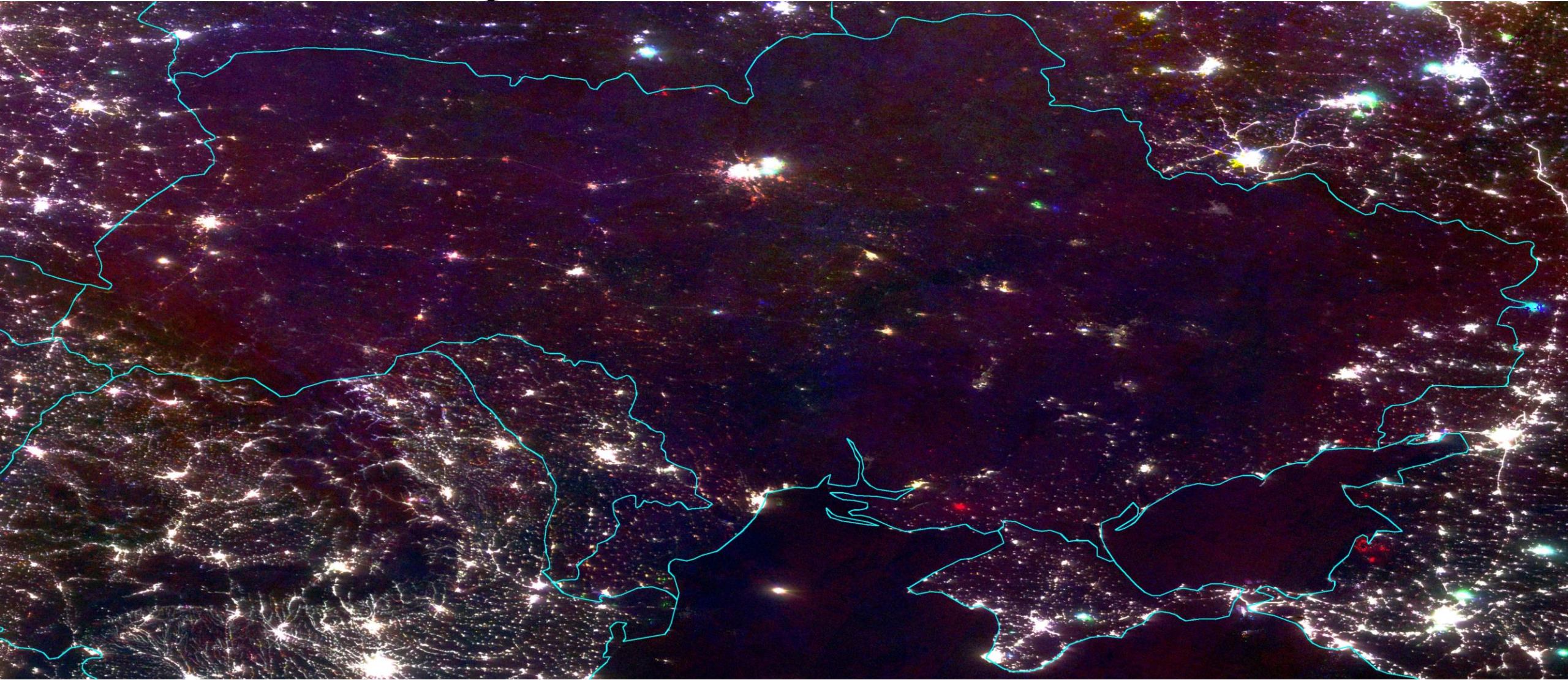
The International Atomic Energy Agency (IAEA) has been criticized of having a slow reaction to the takeover of the civilian run facility. The IAEA specializes in peace-time policy and training. However, they are now taking a proactive approach to the issues and have sent operation teams to the now Russian controlled Zaporizhzhia facility. With the frequent shelling across the country a high voltage backup power line has been severed to the plant. This leaves the station with one remaining offsite backup power line. Large capacity diesel generators have been installed to provide additional power to the station and the neighboring city of Enerhodar. Ukraine's massive demand for electrical supplies is competing with an international shortage. Slow production and high demand have made the large transformers and other equipment needed by Ukraine hard to come by. With the power generation down 45% since the start of the war Ukraine has had to rely on EU grid hookups and increase the power supplied from their uncaptured power stations.

# 2021 Pre-war Condition



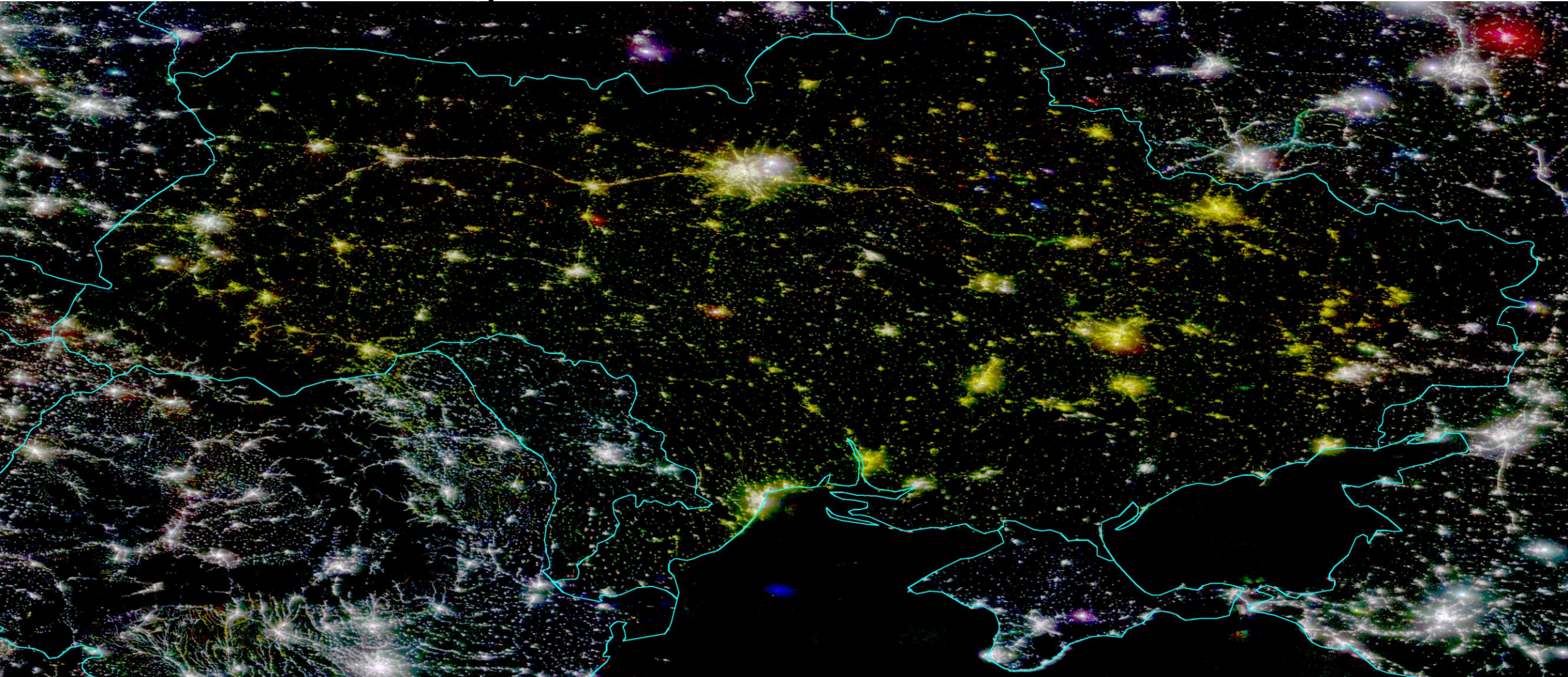
The image shows three months of 2021 VIIRS nighttime lights as red, green, and blue. September 2021 = red. October 2021 = green. November 2021 = blue. The white tones indicate the brightness of lighting is near equal in all three months.

# 2022 War Impacted Condition



The image shows VIIRS nighttime lights as red, green, and blue. September 2022 = red. October 2022 = green. November 2022 = blue. The white tones indicate the brightness of lighting is near equal in all three months. Most of the 2021 lighting features have been lost in the Ukraine in 2022. Note that lighting is still present in the center of Kyiv and Lviv. Lights are on in portions of Russian controlled Donbas and Crimea.

# 2022 War Impacted Condition



The image shows VIIRS nighttime lights from three Octobers as red, green, and blue. October 2020 = red. October 2021 = green. October 2022 = blue. The white tones indicate the brightness of lighting is near equal in all three months. Most of the lighting features in Ukraine are a golden-yellow, indicating that lighting was not detected in 2022. Note that lighting is still present in the center of Kyiv and Lviv. Lights are on in portions of Russian controlled Donbas and Crimea.

## Sources

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## ABOUT THE AUTHORS

### **Christopher Elvidge**

**Senior Research Associate, Director of Earth Observation Group**

Christopher D. Elvidge has decades of experience with satellite low light imaging data, starting in 1994. He pioneered nighttime satellite observation on visible lights, heat sources including gas flares and wild fires, as well as bright lit fishing vessels. He led the development of these nighttime remote sensed products with images from DMSP, JPSS, and Landsat satellites. These data are very popular and used globally in both public and private sectors. As of February 2018, he has more than 11,000 scholarly publication citations.

### **Tilottama Ghosh**

**Research Associate, Earth Observation Group**

Tilottama (Tilo) completed her PhD in geography from the University of Denver. Her training and educational background in geography, demography, economics, remote sensing, and Geographic Information Systems (GIS) helped to shape-up her interests, career and passion. Her research interests include nighttime lights, remote sensing, sustainable science, human geography, and spatio-temporal research using remote sensing, and Geographic Information Systems (GIS). She has about fourteen years of experience working with low light imaging data from the U.S. Air Force Defense Meteorological Satellite Program (DMSP), and Visible Infrared Imaging Radiometer Suite (VIIRS) data, from 2013 onwards. She is responsible for creating the nightly, monthly, and annual, VIIRS nighttime lights products, and the other two flagship products, VIIRS Boat Detection (VBD), and VIIRS Nightfire (VNF), as well as the processing of the DMSP monthly and annual cloud-free composites. Along with her team members she is responsible for conceptualizing, and testing of the processing algorithms, creating metadata documenting generated data products, fulfilling data requests related to the nighttime lights products and the DMSP archive, providing training in the use and implementation of nighttime lights software to scientists and researchers, documenting DMSP and VIIRS algorithms and accomplishments through manuals, conference proceedings, and journal submissions. She conducts socio-economic research using nighttime Earth Observation Group (EOG) products and official socio-economic data at local and global scales. She publishes such work in peer -reviewed journals, conference proceedings, and book chapters.



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### **Mikhail Zhizhin**

#### **Research Associate, Earth Observation Group**

Zhizhin Mikhail Nikolaevich, M.Sci in mathematics from the Moscow State University in 1984, Ph.D. in computational seismology and pattern recognition from the Russian Acad. Sci. in 1992. Research positions from 1987 to 2012 in geophysics, space research and nuclear physics at Russian Acad. Sci., later at NOAA and CU Boulder. Currently he is a researcher at the Earth Observation Group at Colorado School of Mines. His applied research fields evolved from high performance computing in seismology, geodynamics, terrestrial and space weather to deep learning in remote sensing. He is developing new machine learning algorithms to better understand the Nature with Big Data.

### **Elijah Mt. Castle**

#### **Satellite Modelling Researcher, Earth Observation Group**

Elijah is a master's student studying algorithmic robotics at the Colorado School of Mines. He specializes in data interpretation and presenting use cases for VIIRS nighttime lights products, VIIRS Boat Detection (VBD), and VIIRS Nightfire (VNF). His interests include GIS automation and cartography.

## **ABOUT THE PAYNE INSTITUTE**

The mission of the Payne Institute at Colorado School of Mines is to provide world-class scientific insights, helping to inform and shape public policy on earth resources, energy, and environment. The Institute was established with an endowment from Jim and Arlene Payne, and seeks to link the strong scientific and engineering research and expertise at Mines with issues related to public policy and national security.

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