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Anyone Can Be an Explorer

Modern technologies are enabling vast amounts of research data to be stored and processed. Moreover, advancements in computing are opening up unprecedentedly broad access to this data.

Dominik Lis

Institute of Ocenology,
Polish Academy of Sciences, Sopot, Poland

Observing the world around us has always been a source of fascination and a way to connect more deeply with nature. From the weather and vegetation to animals and sea tides, our ancestors meticulously monitored their surroundings. This careful observation enabled them to understand the current state of affairs, identify patterns, and predict future events. Early weather forecasting attempts are evident, for instance, in such folk sayings as "Red sky at night, sailor's delight; red sky in the morning, sailor's warning" or "March winds and April showers bring forth May flowers." Even back then, people recognized that various phenomena were interconnected.

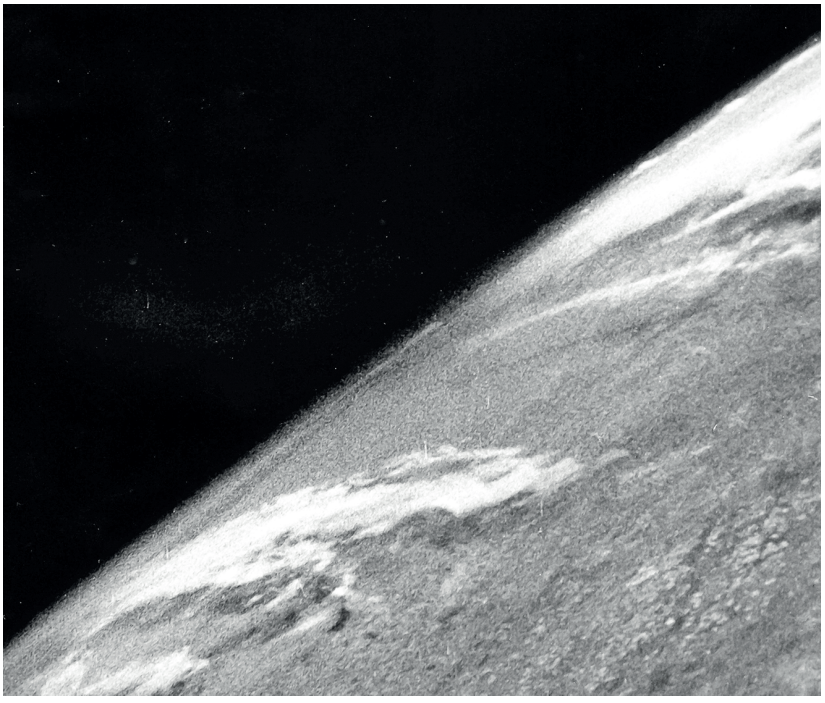
However, personal impressions of what the daily weather was like were not very precise. Research instruments have expanded the scope of observation and made measurements more independent of human factors. One of the first measuring devices was the thermoscope – a kind of prototype thermometer described in 210 BCE by the Greek writer and engineer Philo of Byzantium. However, it was not until the sixteenth century that a device similar to today's thermometer was created, enabling systematic recording of temperature data.

Air temperature measurements in Europe began in 1654–1655 in large cities (including Warsaw). This marked the creation of the first global network of meteorological stations operating on standardized principles, known as the Florentine network, which initiated the development of air temperature measurements. Over the years, more initiatives emerged, increasing the volume of environmental data. In addition to air temperature, other environmental parameters were also measured. The consistency of taking each measurement in the same, well-documented way and location paved the way for the study of environmental variability over many years. As time passed, similar measurement programs became standard, with more organizations formed to collect environmental data. Measurements became more precise, frequent, and took more and more parameters into account.

Eternal curiosity

A large portion of our planet is covered by water – vast oceans stretching to the horizon have always

Dominik Lis
is studying mathematical modeling and data analysis at the University of Gdańsk. He works at the Sea Remote Sensing Laboratory at the Institute of Oceanology, Polish Academy of Sciences, where he oversees the SatBaltyk.pl service. He also develops satellite algorithms for the Baltic Sea, particularly focusing on algorithms that describe chlorophyll concentrations based on satellite data.
dolis@iopan.pl



The first photo of Earth ever taken from space, by the V-2 rocket in 1946 from an altitude of 105 km

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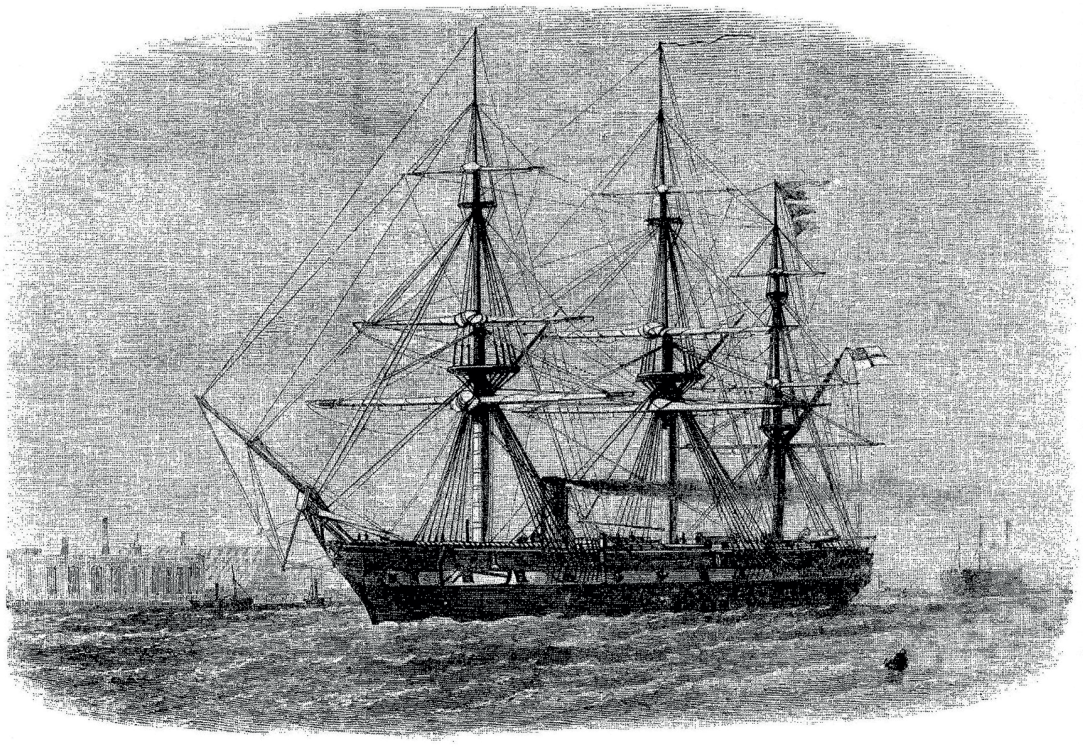

The HMS Challenger, the British vessel that undertook the very first oceanographic voyage

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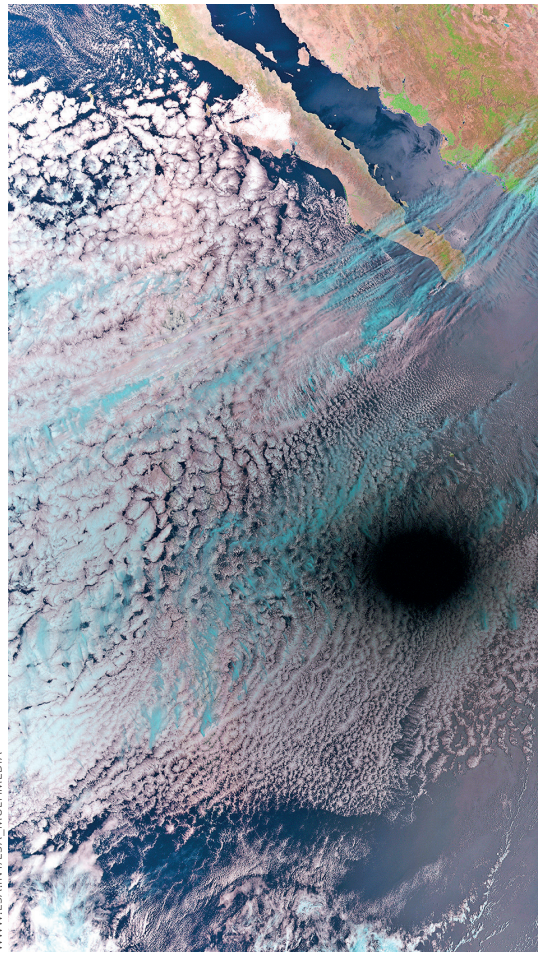

A photograph taken by the Sentinel-3 satellite during a total solar eclipse over North America

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sparked curiosity. The first voyage aimed at studying the oceans in a comprehensive way is considered to have been the British expedition aboard the HMS Challenger, which was launched in 1870 and lasted over three years. During this time, data was collected from 362 measurement locations, where information on the temperature, sea currents, the chemical composition of seawater, and seabed sediments was gathered. The collected data was published in over 50 volumes. This expedition marked the beginning of oceanographic research, which has now become much more common, with many research voyages conducted annually, bringing back vast amounts of information about the sea. However, such voyages are expensive, time-consuming, and the collected data covers only relatively small areas along in the expedition route.

Satellites have come to aid in the study of seas and oceans, and satellite imaging of Earth is becoming increasingly important for understanding changes on our planet. The very first photo of Earth from space was taken on 24 October 1946, during a suborbital flight of a ballistic missile equipped with a camera that snapped photos every 1.5 seconds. Current research satellites are very advanced – for example, the modern Earth observation satellite Sentinel-3, operated by the European Space Agency, is equipped with many sensors that record information about water color, temperature, wave height, and sea currents movement. Satellite images are crucial in monitoring the marine

environment, as they are able to cover vast areas compared to ship-based research.

Satellites undoubtedly have many advantages, but their findings need to be calibrated with *in-situ* data – in other words, data gathered aboard research ships. Without such points of reference down here on Earth, we could not be sure that satellite sensors are providing accurate information. The Institute of Oceanology, Polish Academy of Sciences, also contributes to such *in-situ* research of marine areas with its research vessel Oceania, which has been conducting voyages since 1985. It is the only ship in Poland adapted for Arctic research, serving not only for Baltic Sea studies but also making regular voyages to polar northern areas. Onboard, measurement devices operate, some continuously throughout the voyage and others only at measurement stations. For example, at each measurement station, water temperature and salinity at a certain depth are measured using a device called a CTD (conductivity, temperature, depth) sensor. The voyage-related work does not end when the ship pulls into dock; rather, the collected data must be organized and samples examined in the lab.

Giving data a second life

All the data so collected is documented and stored. Not all this information can be used immediately; some may lie overlooked for long years. New research ideas, fresh perspectives, or new technologies can later give such data a second life. For this, however, the data must be openly accessible. This was the idea that inspired the creation of the eCUDO.pl Electronic Center for Sharing Oceanographic Data. This project was carried out by a consortium of Polish institutions including the Institute of Oceanology, Polish Academy of Sciences, the Institute of Marine Sciences in Gdynia, the National Marine Fisheries Research Institute, the Polish Geological Institute – National Research Institute, the University of Gdańsk, the University of Szczecin, and the Pomeranian University in Słupsk. Through the collaborative efforts of these institutions, over 7 million sets of oceanographic data are now openly available on the platform. Everyone can try their hand at discovering new correlations, as the data is free and publicly accessible.

A good example of data being given such a new lease on life is the "Old Weather" project. This initiative involves volunteers transcribing ship logs from the nineteenth and early twentieth centuries. The logs are rich in valuable information about the weather, sea ice extent, and extreme conditions experienced by ship crews. Although the logs were created to document the conditions at the time, today they can help us better understand climate change and glacier melting.

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The Oceania – the research vessel of the Institute of Oceanology, Polish Academy of Sciences

Thanks to the combined efforts of specialists from various fields, we can piece together a more complete picture of our environment and better describe it using mathematical parameters. This allows us not only to predict future events but also to proactively address emerging challenges. We have a duty to diligently observe, meticulously record, and thoroughly document the present, ensuring that future generations can build upon our insights and discoveries. ■

Further reading:

www.satbaltyk.pl

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