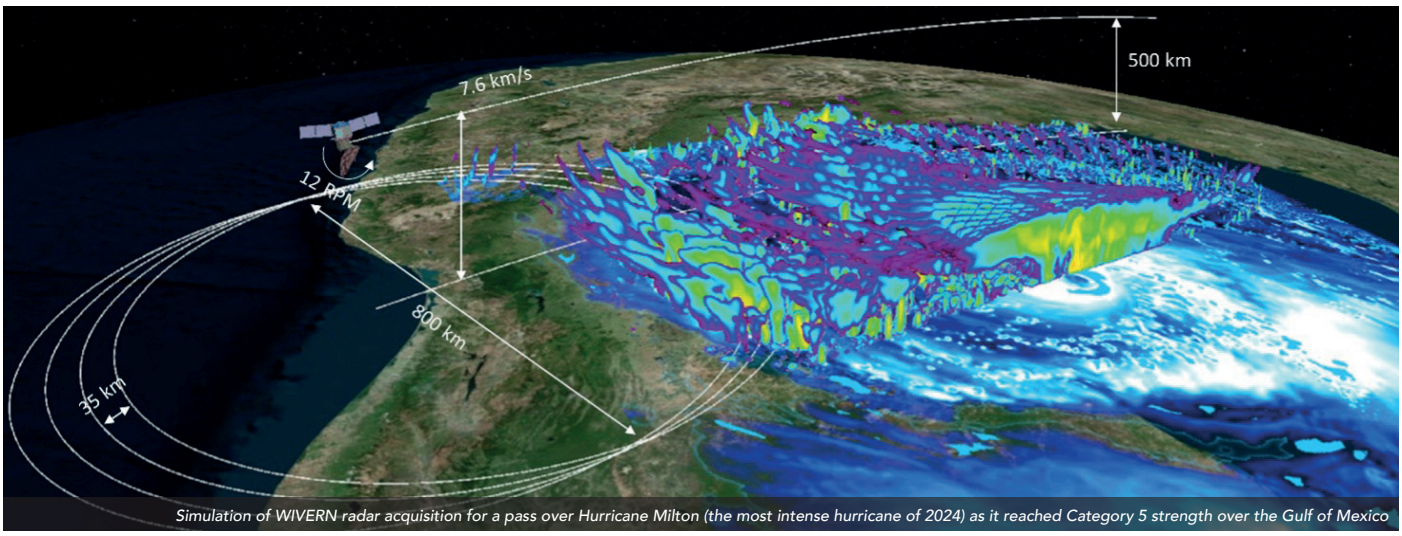
WIVERN
Wind velocity radar nephoscope

New wind monitoring satellite set to deliver 'huge societal impact'

A new satellite which measures in-cloud winds for the first time from space will significantly improve weather forecasts and provide new insights into storm dynamics, bringing societal benefits of an estimated £10 billion over the duration of the WIVERN mission (expected to be >= 8 years).

Wind is one of the most fundamental forces shaping Earth's weather and climate, and is the driving force behind where storms form, where rain falls, and how temperatures change from place to place. These wind-driven processes affect everyday life, from water supply and farming to power systems and extreme weather events.

Despite wind's key role, there is "major concern" among scientists that monitoring of wind is insufficient, especially within clouds. Windstorms in particular are among the most damaging phenomena, causing £18.5 billion of damage in Europe in 1999, £1.5 billion in 2009 and £1.3 billion in 2010.



Simulation of WIVERN radar acquisition for a pass over Hurricane Milton (the most intense hurricane of 2024) as it reached Category 5 strength over the Gulf of Mexico

ENTER WIVERN

WIVERN, short for wind velocity radar nephoscope, is a new satellite which measures, on a global scale, in-cloud winds and the internal structure of clouds for the first time from space. This fills a significant gap in the global satellite observing system.

The data it provides will be key in three ways: understanding storms, constraining the impact of clouds and precipitation on climate, and improving numerical weather prediction for better focusing of activities to limit damage and loss of life.

By orbiting the Earth, WIVERN can gather a significantly larger volume of data compared to the number of measurements that can be taken from the ground.

WIVERN is a dual polarisation, conically scanning, 94 GHz Doppler radar with an 800km swath. It provides wind observations at 50km horizontal and 1km vertical resolution, one visit per day on average at European latitudes, and accuracy better than 2m/s.

It is set to obtain approximately one million wind observations per day – data which should help to significantly reduce weather forecast errors, and will complement the cloud-free wind observations from the ESA Earth Explorer AEOLUS which launched in August 2018.

The background to WIVERN

WIVERN is a collaboration between the University of Reading, the University of Leicester and RAL Space, with grant funding from the Centre for Earth Observation Instrumentation (CEOI).
It began in 2013 with seed corn research which explored polarisation diversity for doppler radars on satellites (POLYDOROS) – the technology concept underpinning WIVERN.

Subsequent CEOI-funded studies demonstrated the observation and underpinning technology at Chilbolton Observatory, followed by mission concept studies with Airbus Defence and Space that strengthened its application to ESA's flagship Earth Explorer 11 mission.

Current status of this project

In September, ESA announced that WIVERN had been selected for its 11th Earth Explorer mission through the agency's prestigious FutureEO programme.
It followed ESA's Call for Ideas in 2020 for bold new missions that could push the boundaries of Earth science and satellite technology. From 15 proposals, four were shortlisted for detailed study before the list was narrowed down to two in 2023: WIVERN and CAIRT.
Both proposals were scrutinised by the scientific community and ESA's Advisory Committee for Earth Observation (ACEO) before it was announced in September 2025 that WIVERN has been selected for implementation as Earth Explorer 11.

ESA's Earth Explorer missions. Image credit: ESA

The impact of funding from CEOI

Cloudy regions cover nearly 70% of the Earth but without global in-cloud measurements, there has been a significant gap in the understanding and prediction of cloud and storm development and hazardous precipitation events.
The development of WIVERN will provide unique insights into storm dynamics and some of the most climatically significant cloud systems, leading to improved climate models, weather forecasts, and disaster preparedness.
The project has a £500m budget, with UK companies set to benefit from contracts for WIVERN in the coming seven years.

Beyond that, the team says there are "enormous" quantifiable societal benefits to better weather predictions, from planning for energy consumption during cold snaps and scheduling of outdoor construction work, to aircraft adapting their routes according to wind predictions.
Crucially, earlier weather forecasts allow for more timely interventions when it comes to knowing when and where a storm will land, so that support teams can be in place earlier.

At a glance

- Funding from CEOI: **£600,000 (when including POLYDOROS)**
- Other funding streams: ESA studies (**>£0.5m**)
- Total cost of the project: **>£500m**
- Number of people involved in the project: Estimated at **>200**
- Daily observations at **50km horizontal** and **1km vertical resolution**
- The 2.9 by 1.8m elliptical antenna rotates **once every five seconds**, sweeping out a broad swath on the ground.

Pictured below: Scaled models of the WIVERN satellite, as exhibited by the two industrial consortia at the User Consultation Meeting in Prague.

In the words of...

Dr Alessandro Battaglia, Associate Professor in the Department of Physics at the University of Leicester and DIATI at Politenico di Torino, Turin and **Professor Anthony Illingworth,** Emeritus Professor of Atmospheric Physics, University of Reading

"The wind observations and measurements from space we've had in the past have had an enormous effect in improving weather forecasts and providing better warnings to the public on windstorms. Further improving these observations would lead to more accurate forecasts with improved timing and location so that mitigation activities can be better focussed.

The benefits to the public and industry are huge – by ESA's calculations, there's a 20 to 1 cost benefit ratio from improving weather forecasts. This project also has huge potential for job creation among the UK industries involved in the development of the satellite.

We were all elated to hear WIVERN had been selected as ESA's 11th Earth Explorer. We have been involved in the project since 2013, working together through all the phases with scientists and industry specialists. It's been a long process but we're extremely delighted.

We put a large part of the success of our application down to the latest round of funding from the CEOI, as it enabled us to review, improve and sharpen our proposal before its submission."

WIVERN (WInd VElocity Radar Nephoscope) the mission selected as the eleventh mission of ESA's Earth Explorer program