What if quantum sensors predicted disasters and protected lives?

14 Planet Pulse

Within Reach | Transitional | **Visionary**

A global quantum sensor network monitors air, land and sea environments in real time, providing instant environmental data analysis and disaster prediction enabled by advanced machine intelligence and international collaboration.

UNCERTAINTIES

Nature, Technology

MEGATREND (Most significant)

Boundless
Multidimensional Data

TRENDS

Cross-Sectoral Partnerships
ESG & Beyond GDP
International Collaboration
New Materials
Open Data

TECHNOLOGIES

Edge Computing
Artificial Intelligence
Internet of Things (IoT)

SECTORS IMPACTED

Agriculture & Food
Communication Technologies & Systems
Data Science, AI & Machine Learning
Energy, Oil & Gas, & Renewables
Government Services
Health & Healthcare
Infrastructure & Construction
Insurance & Reinsurance

KEYWORDS

Climate Change
Disaster Prediction
Environmental Monitoring
Quantum Sensors
Real-Time Data

WHY IT MATTERS TODAY

Climate change is intensifying extreme weather events, **making accurate prediction more crucial than ever**, as the frequency and severity of disasters such as hurricanes, floods and wildfires are expected to rise

Climate change is intensifying extreme weather events, making accurate prediction more crucial than ever. According to the insurance company Swiss Re, in 2022, natural disasters had nearly 102 million victims and caused 10,500 fatalities globally, and economic losses from natural disasters increased to $275 billion.[710] As the global climate continues to warm, it is expected that the frequency and severity of natural disasters, such as hurricanes, floods and wildfires, will increase.[711] Comprehensive environmental data can help governments and businesses make more informed decisions, reducing the risks associated with climate change and environmental degradation.[712]

Public awareness and concern about climate change and natural disasters are increasing. The Peoples' Climate Vote is the world's largest standalone public opinion survey on climate change. In the 2024 survey, covering 77 countries and representing 87% of the world's population, 80% of the respondents wanted stronger climate action and over half (53%) said that they were more worried about climate change than they had been in 2023.[713] Environmental monitoring is emerging as a powerful tool for diplomatic collaboration.[714]

Quantum technologies are expected to disrupt applications across sectors, such as finance, healthcare and defence. With the potential to generate economic value surpassing $2 trillion by 2035,[715] quantum sensing could reach $2.7 billion by 2035.[716] Quantum sensors that use nitrogen-vacancy centres in diamond can measure numerous properties, including magnetic or electric fields,[717] temperature and rotational motion, with preciseion.[718,719] While many quantum sensors are at the proof-of-concept stage, some are commercially available for various purposes, including leak detection in underground pipes and volcano monitoring.[720]

THE OPPORTUNITY

A real-time environmental monitoring system built on a multilayered, globally distributed quantum sensor network improves environmental monitoring, weather forecasting accuracy, and disaster prediction. The network includes atmospheric sensors (e.g. in high-altitude weather stations, satellite-based remote sensing platforms, mountain observatories, and polar research stations),[721,722] ground sensors (e.g. in forest stations, agricultural research centres, national parks, urban environmental nodes, and geological research sites),[723,724] and oceanic sensors (e.g. in deep-sea sensor networks, coastal stations, marine research vessels, underwater sensor arrays, and coral reef monitoring points).[725,726,727]

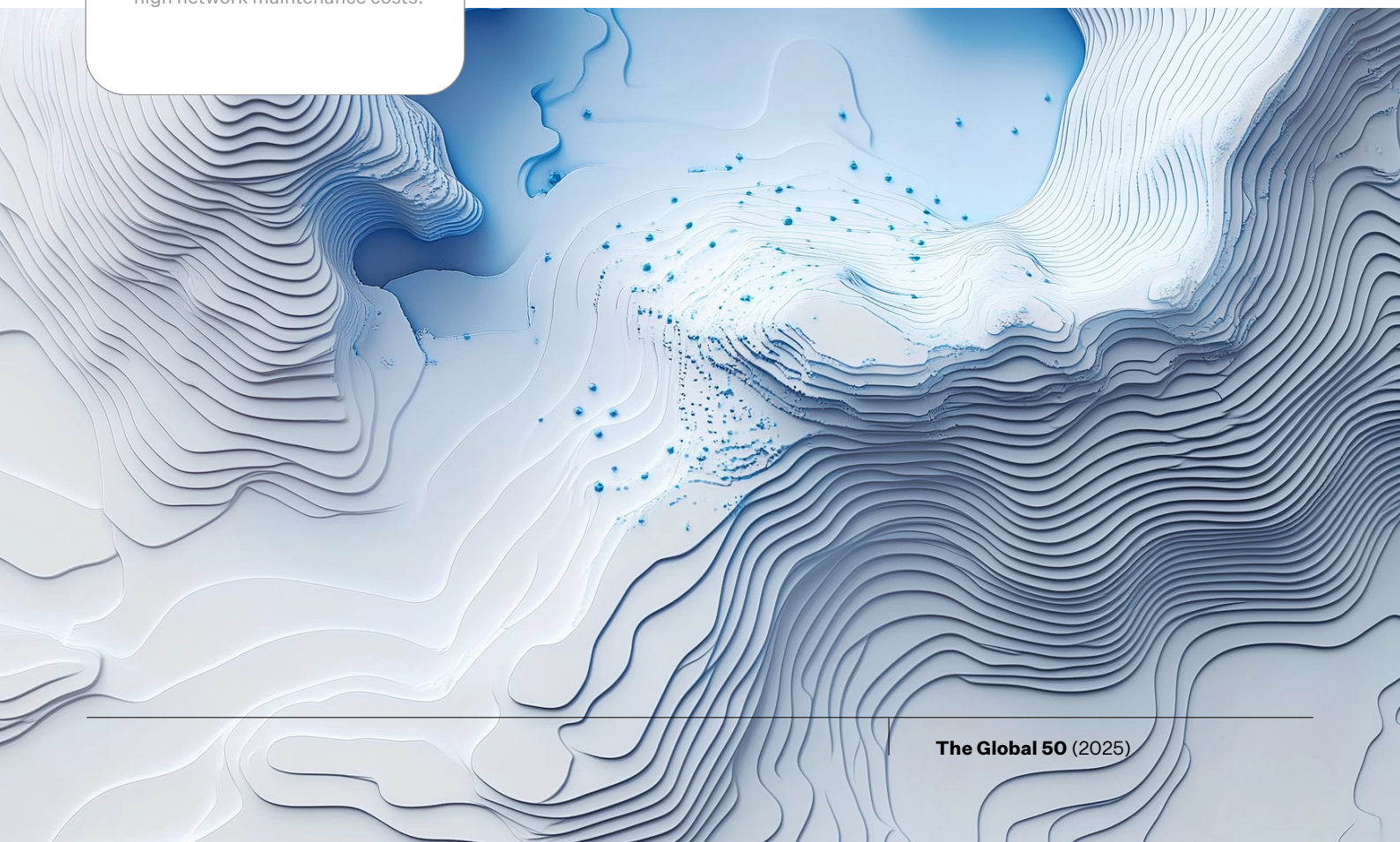
Advanced machine intelligence optimises sensor placement in critical environmental zones, including seismically active regions, mountain ranges, coastal areas, urban centres, and agricultural areas. Self-contained sensor nodes, powered by solar or advanced battery micropower systems and edge computing,[728] provide real-time data analysis and sharing.

BENEFITS

Better forecasting and climate decision-making from live data on oceans, marine life, and forests; open data for research; unprecedented precision in environmental monitoring and action; proactive measures to protect people from natural disasters.

RISKS

Unequal access to data; data manipulation; inconsistent measurement methodologies; wear and tear of sensor network; high network maintenance costs.



Optimising sensor placement in critical zones such as seismically active regions, coastal areas, and urban centres, these **self-contained sensor nodes provide real-time data analysis and sharing**