JUHO AALTO

Second, to foster creativity, we plan to support people who want to work in new areas — especially young researchers setting up their own labs. Most scientists do their most creative work at this early stage of their careers. But — understandably — it's often hard to obtain funding unless you can demonstrate expertise in a particular area. The Chan Zuckerberg Initiative could fill a niche by taking on more risks than other funders. That risk is worthwhile if it brings people into biomedical areas in which the need is great but current research is narrowly directed. Unfortunately, disease-relevant fields can be some of the hardest to break into for someone with a new idea or approach. Certain disease foundations, such as the Hereditary Disease Foundation for Huntington's disease or the Simons Foundation Autism Research Initiative, have done this well in the past. But we think that there is room to scale up this model to many other biomedical problems.

Finally, on openness. We believe that research advances when people build on each others' work. So our principles include making data, protocols, reagents and code freely available for other scientists to use. As an example of this approach, the HCA has committed to making its reference data publicly available after quality-control checks. Indeed, the Chan Zuckerberg Initiative engineering team and our HCA collaborators are building all of the software for the 'data coordination' arm of the project on the open-source platform Github.

We're also supporting external groups that share these values and goals. For instance, we're funding bioRxiv, the largest and fastest-growing preprint repository for the biological sciences — and a leader in bringing biology towards the level of sharing that's expected in the physical and computer sciences.

The Chan Zuckerberg Initiative is just starting, and we have a lot to learn. But I've been lucky to work in areas in which the free exchange of ideas and results is the norm. In my experience, such an approach creates the most dynamic fields. Now I have the chance to lead a new funding venture, and to explore whether openness or dynamism comes first. After all, as scientists we do experiments; as funders, we can do experiments too. ■

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**An enclosure for measuring gas exchange between plants and the atmosphere at a station in Finland.**

# Build a global Earth observatory

**Markku Kulmala** calls for continuous, comprehensive monitoring of interactions between the planet's surface and atmosphere.

Climate change. Water and food security. Urban air pollution. These environmental grand challenges are all linked, yet each is studied separately.

Interactions between Earth's surface and the atmosphere influence climate, air quality and water cycles. Changes in one affect the others. For example, increasing carbon dioxide enhances photosynthesis. As they grow, plants withdraw greenhouse gases from the atmosphere, but they also release volatile organic compounds such as monoterpenes. These speed up the formation of aerosol particles, which reflect sunlight back into space. Our actions — such as emission-control policies, urbanization and forestry — also affect the atmosphere, land and seas[1–5].

Satellites and stations on the ground track greenhouse gases, ecosystem responses, particulate matter or ozone independently of each other. Coupled observations are occasionally performed, but in intensive bouts. Vast areas of the globe — including Africa, eastern Eurasia and South America — are barely sampled.

The result is a cacophony of information that yields little insight. It is like trying to forecast weather in November with spotty measurements of rain, wind, temperature or pressure from June.

The answer is a global Earth observatory — 1,000 or more well-equipped ground stations around the world that track environments and key ecosystems fully and continuously. Data from these stations would be linked to data from satellite-based remote sensing, laboratory experiments and computer models.

Researchers could find new mechanisms and feedback loops[6] in this coherent data set. Policymakers could test policies and their impacts. Companies could develop environmental services. Early warnings could be provided for extreme weather, and quick responses initiated during and just after chemical accidents.

A global observatory has been discussed for more than a decade, but is only now feasible[7]. Instruments have matured; for example, today's mass spectrometers ▶