2 Deforestation in the Amazon basin is changing its climate system.

3 Greenhouse-gas measurements in Siberia will help to reveal the effects of melting permafrost.

4 Megacities such as Lagos need better data on air quality.

SOMALIA: SIEGFRIED MODOLA/REUTERS; AMAZON: UESLEI MARCELINO/REUTERS; SIBERIA: JEREMY NICHOLL/EYEVINE; LAGOS: PIUS UTOMI EKPEI/AFP/GETTY

to €20 billion for the whole thing. This is comparable to the construction cost of the Large Hadron Collider near Geneva, Switzerland, or that of US President Donald Trump's proposed Mexican wall.

Stations should be constructed or upgraded using a modular approach. The different modules would target atmospheric chemistry, micrometeorology and soil chemistry, for example. Each block would cost around €500,000 to €2 million to develop and install. Annual servicing would add about 3–6% per year to these costs.

The instruments will need to be harmonized, calibrated and standardized. They must be developed and upgraded as techniques improve. Data sharing must be considered — information must be reliable and open. Data scientists will be needed to analyse data and develop products that flow from the stations to users and archives. Professional staff will be needed to run the stations.

Existing networks need to coordinate their practices. These include scientific programmes such as PEEX, the DBAR initiative and FLUXNET; global organizations such as the WMO and Future Earth; private global foundations and companies; and municipal, governmental and UN bodies.

Complementary infrastructures such as the following should be combined: the Integrated Carbon Observation System (ICOS); the WMO's Global Atmosphere Watch; the Aerosols, Clouds, and Trace gases Research Infrastructure network (ACTRIS); Europe's Long-term Ecosystem Research (LTER); and the infrastructure for Analysis and Experimentation on Ecosystems (AnaEE). The first step would be the open exchange of data between them, which is already starting to happen in Europe. Next, the networks should establish joint stations across other continents, especially in the hot spots mentioned. SMEAR II proves that this is feasible and need not be expensive.

Once we establish the global observatory, we will have the tools to understand how the Earth system works. ■

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