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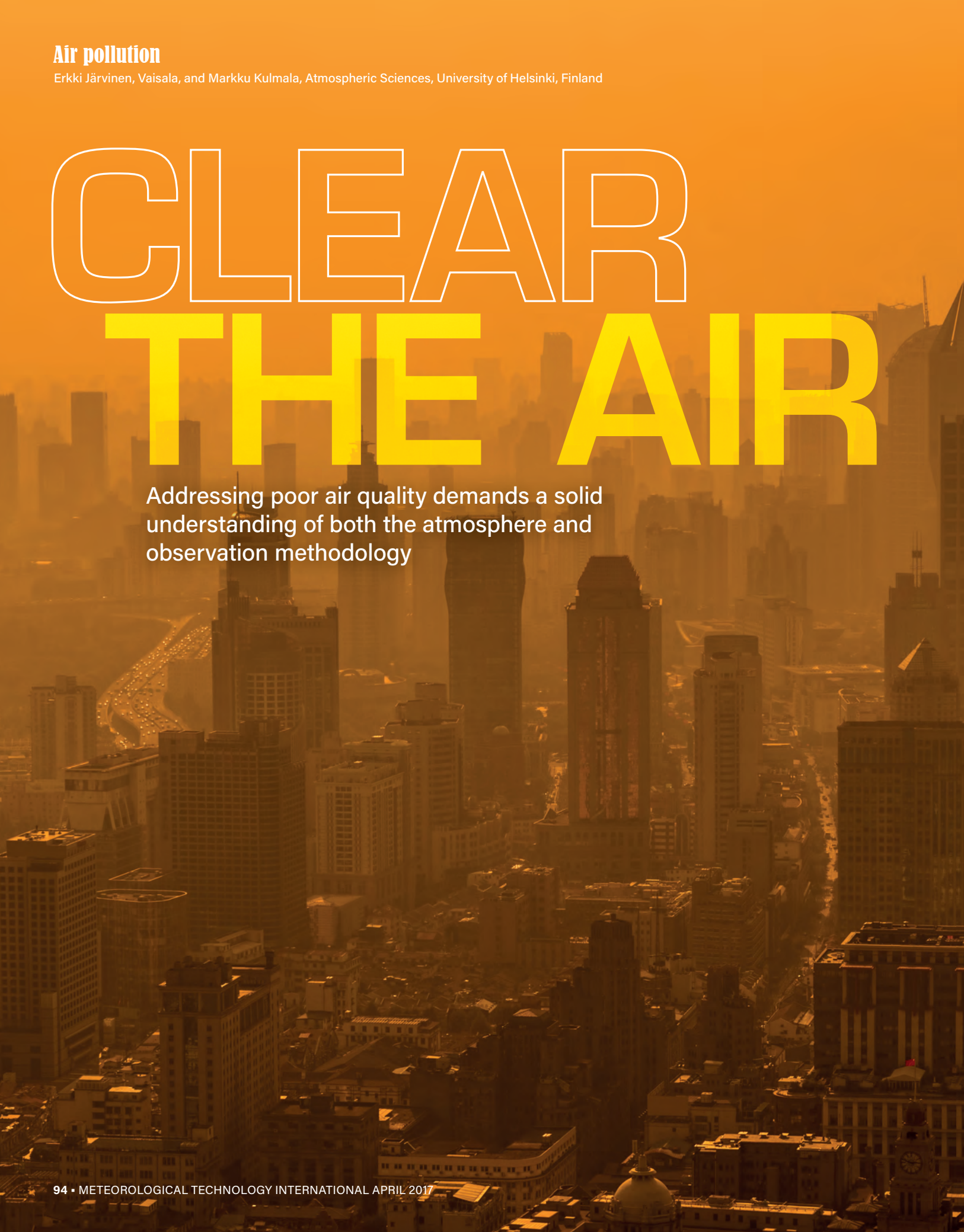
CLEAR THE AIR

Addressing poor air quality demands a solid understanding of both the atmosphere and observation methodology



The Vaisala Air Quality Transmitter AQT410

Air pollution exposure is a global issue – 87% of the world's population lives in countries where the ambient pollution level exceeds World Health Organization (WHO) guidelines. Poor air quality contributed to the deaths of some seven million people in 2012, accounting for one in eight deaths worldwide that year, said a 2014 WHO report.

According to *The Cost of Air Pollution: Strengthening the Economic Case for Action,* by the World Bank and the Institute for Health Metrics and Evaluation (IHME) at the University of Washington, Seattle, the health risk posed by air pollution is the greatest in developing countries. In 2013, 93% of deaths and non-fatal illnesses attributed to air pollution worldwide occurred in these countries, where 90% of the population was exposed to dangerous levels of air pollution.

Developed countries are not immune to problems, either. Major cities such as London, Paris and Madrid experience days of extremely high air pollution levels. While air quality is generally better controlled in the western world, there is growing awareness of the health hazards posed by pollution gases and particulate matter in the air.

ECONOMIC DRAIN

There are also significant financial implications that result from the health problems and premature deaths caused by air pollution. Diseases associated with poor air quality – among them lung cancer, heart disease and chronic bronchitis – are a considerable drain on resources. Loss of labor because of these diseases means that air pollution is also hampering economic growth.

The World Bank and IHME study found that in 2013 premature deaths due to air pollution cost the global economy US$225bn in lost labor income, or US$5.11tn in welfare losses worldwide – about the size of the gross domestic product of India, Canada and Mexico combined. The study found that air pollution costs have grown considerably since 1990, with welfare losses almost doubling and labor income losses up by 40% by 2013.

Agricultural productivity can also be stunted, with air pollution cutting crop yields

The Air Quality Transmitter measures up to four pollutants

Cost-effective monitoring

Vaisala provides a broad range of technologies and products for the monitoring of air quality and weather conditions, including weather stations, wind sensors and lidar ceilometers for boundary layer profiling.

The latest addition to Vaisala's offering is a range of air quality transmitters that provide a cost-effective solution to monitoring conditions locally. The transmitters measure up to four of the most common gaseous pollutants, including nitrogen oxides, sulfur dioxide, carbon monoxide, hydrogen sulphide and ozone, as well as particles (PM2.5 and PM10).

Quick and easy to install and maintain, they are well suited for extensive and dense air quality monitoring networks and can be connected seamlessly to Vaisala weather transmitter products.

and changing conditions in the natural environment. Poor air quality can hinder businesses relying on tourism, and has a direct impact on the generation of solar power, affecting the economy and the environment.

Governments are trying to improve air quality with cleaner fuels and more efficient vehicles, but this will take time. While pollution control should be at the top of the political agenda, it still competes with other policy objectives. Progress will be slowest in developing countries – for example, the use of solid fuels for cooking is the biggest cause of air pollution-related welfare losses in south Asia and sub-Saharan Africa.

WEATHER AND AIR QUALITY

It is widely known that weather affects air quality. Rain, for instance, can wash away air pollutants and improve air quality. Wind can either bring in pollutants or remove them, depending on their source and its location.

The impact of air quality on the weather is also considerable. Air pollutants are mostly created and spread in the planetary boundary layer, which varies in thickness according to location, season, time of day, weather – and pollutants. The thinner the boundary layer is, the higher the concentration of pollutants, intensifying their impact on us all.

Usually the air near the ground is warmer than the air above it. Solar radiation heats the Earth's surface, which heats the air above. When the air has high concentrations of pollutants, they reflect radiation, which leads to the ground and the air near it cooling. This creates a warmer or inversion layer that suppresses convection between layers and traps the pollutants in the boundary layer, raising their concentration.

The enhanced pollution can even lead to rains being transported to other locations or not occurring at all, having a major impact on agriculture. For these reasons, weather phenomena should be monitored alongside air quality, to determine their interaction both locally and in general.

LOCAL STATIONS

To reduce the impact of air pollution, we need to better understand its components and their interactions, so we need to measure what is going on in the atmosphere.

Air quality is monitored using stations that measure 10-20 parameters and cost a few hundred thousand dollars. A megacity may have a few dozen of these stations, while a smaller city might have just two or three.

These stations are good at providing information in the long term, but their monitoring parameters are too few to give a good picture of the atmosphere. Moreover, they tend to be so far apart that they cannot provide local air quality information. Pollution in cities is highly local, made worse by traffic, weather phenomena and buildings.

In an ideal world there would be a global network of 1,000 accurate and versatile 'flagship' stations, monitoring up to 1,000 parameters, from common air pollutants, to trace gas concentrations and fluxes, as well as particle composition and optics. The data would help us understand the chemistry and physics in the atmosphere.

Measurements in Nanjing, China, for example, have shown that reducing NO_X emissions could cause a tenfold increase in summer ozone concentrations. Therefore, understanding the chemical reactions between air pollutants would be invaluable in designing air quality improvement measures.

This flagship station network should be supported by smaller units to provide information locally and help find hot spots, making it possible to warn residents of air quality problems.

Naturally, the smaller units do not need to be as sophisticated or accurate as the flagship stations; their power lies in their numbers and locality. They complement the existing air quality observation stations.

DECISION-MAKING SUPPORT

When a network of air quality observation stations is dense enough, it can provide relevant information for decision makers. Local data can be used to redirect traffic, temporarily shut polluting manufacturing plants located upwind, or switch them from coal power to other sources of electricity.

In the long term, observations can help achieve a better understanding of the interplay between the weather and air pollution. The observations can start modeling the presence and spread of pollutants in a way similar to weather modeling – essential if we are to solve air quality problems and mitigate their impact. ▮