

VAISALA

NEWS

Meteorology Edition - Spring 2017

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VAISALA NEWS

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Vaisala in Brief

Vaisala is a global leader in environmental and industrial measurement. Building on 80 years of experience, Vaisala contributes to a better quality of life by providing a comprehensive range of innovative observation and measurement products and services for chosen weather-related and industrial markets. Headquartered in Finland, Vaisala employs approximately 1,600 professionals worldwide and is listed on the NASDAQ Helsinki stock exchange.

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Publishing Information

Published by: Vaisala Oyj
P.O. Box 26
FI-00421 Helsinki
FINLAND
Phone (int.): + 358 9 894 91
Internet: www.vaisala.com

Editor-in-Chief: Tiina Kiianlehto
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Cover photo: Shutterstock
The image Schiaparelli Lander Model at ESOC by Gerbil on page 15 is licensed under the Creative Commons Attribution-Share Alike 4.0 International license.
https://commons.wikimedia.org/wiki/File:Schiaparelli_Lander_Model_at_ESOC.JPG
Design, Layout: Grapica Oy
Printed in Finland by: Grano Oy
ISSN 1238-2388

Subscriptions

For subscriptions, cancellations, feedback and changes of address, please email:
vaisala.news@vaisala.com

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Getting Ready for Changing Weather

Extremes of weather are becoming more prevalent. Since the work done to curb the rise in global temperature will prove its efficacy only with time, there is a more urgent need to adapt to the impact of tropical storms, lightning storms, and floods.

What does that require? Since weather cannot be changed, deflected or mitigated, we need to have warning systems in place, making it possible to protect people and property. They, again, cannot work properly without reliable observations.

Hurricanes are a good example. Knowing where they will land and how strong they are, is literally a matter of life and death.

Evacuating people from the path of a major hurricane can save thousands of lives. Evacuating people from the wrong place incurs unnecessary costs and eats at people's confidence in forecasts, which can lead to tragedies later on.

So they, like other types of weather, need to be studied and observed over long periods of time, to be able to see slowly occurring changes and trends. Decisions need to be driven by data and science.

United States already has its Weather-Ready Nation program, bringing together government organizations, private enterprises and academia to build communities that are ready and resilient to severe weather events.

However, extreme weather often occurs in regions that are highly vulnerable to its effects – in developing countries where the infrastructure is not as advanced.

This is one of the reasons why the World Meteorological Organization wants to build meteorological capacity in the least developed countries. In

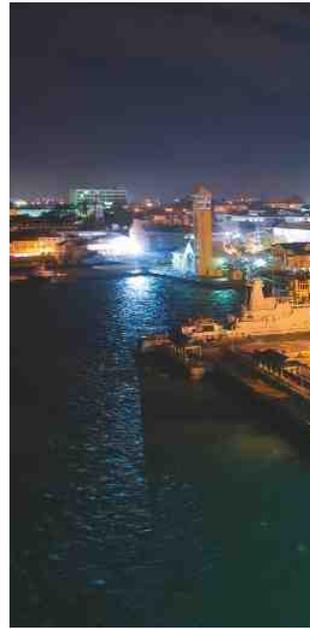


addition to mitigating extreme weather impacts, they can then use relevant weather information in order to eradicate poverty and achieve internationally agreed development goals.

Vaisala is gradually getting more involved in this work, too, helping nations get weather-ready.

Helping save lives and minimize damages to property makes our work relevant to the whole humankind and motivates us to keep looking for new ways to improve our operations and solutions.

Kjell Forsén
President and CEO



Improved Weather Forecasting Capabilities for the Bahamas

The Bahamas is investing in a new nation-wide meteorology network to keep its citizens and visitors safe from extreme weather.

Over recent years, severe weather has become more frequent in the Caribbean. So improving the weather forecasting capabilities of the Bahamas Department of Meteorology will help improve warnings and preparedness for severe weather and will assist in minimizing loss of life and property from the ravages of tropical cyclones (hurricanes, tropical storms, and tropical depressions) affecting the country.

“The Bahamas is called the ‘Jewel of the Caribbean’ because of its beauty, and because of its geographical location to the United States of America it is envied by many. But this comes at a price. From the beginning of June to the end of November, is the official hurricane season,” says **Trevor Basden**, Director of the Bahamas Department of Meteorology.

The Bahamas is an archipelago of some 700 islands scattered over 100,000 square miles of ocean. The weather in the northern islands can be completely different from that in the southernmost islands. Moreover, the islands are low and flat, prone to any rise in sea level, and in particular to flooding from heavy rains and to storm surge from hurricanes.

Equipment to Cover all Islands

Currently, The Bahamas has only one Doppler Weather Radar installed at the Lynden Pindling International Airport, in the capital city Nassau, on the island of New Providence. It covers the Northwest Bahamas but only a portion of the Central Bahamas. The Southeast Bahamas is completely without coverage.



After Hurricane Joaquin caused widespread destruction in the Central Bahamas and the Southeast Bahamas in 2015, the Government of The Bahamas heeded the cry of the meteorology department and decided to invest in a network of Doppler Weather Radars that will cover the whole country whose land and sea area is on par with that of Cuba.

When looking for the best suitable provider, the Department of Meteorology soon turned to Vaisala.

“We have over 40 years of history with Vaisala, and Vaisala has provided the most robust and reliable equipment. In this case, it was also important that Vaisala thought of the whole picture for The Bahamas – not just trying to make the deal. Training, for example, was an essential part of the contract for us,” Mr. Basden points out.

The contract was signed with Vaisala partnering with FMI on October 26th 2016. Vaisala will provide The Bahamas with four Doppler Weather Radars, nine Automatic Weather Observation Systems (AWOS) for airports, sixteen Automatic Weather Stations (AWS), one Direct Readout Ground Station (DRGS), and related services. FMI will provide meteorological software and training.

The deliveries will start at the beginning of 2017, to be completed by the end of 2019.

Keeping People Safe

“Thanks to the weather radars, we will be able to see more accurately the current weather and when tropical cyclones are in The Bahamas – how fast they are moving and how severe they really are.”

The radars will help in building a more reliable early warning system in order to alert the population of significant or severe weather conditions

The AWOSes will assist the airports to operate more efficiently and

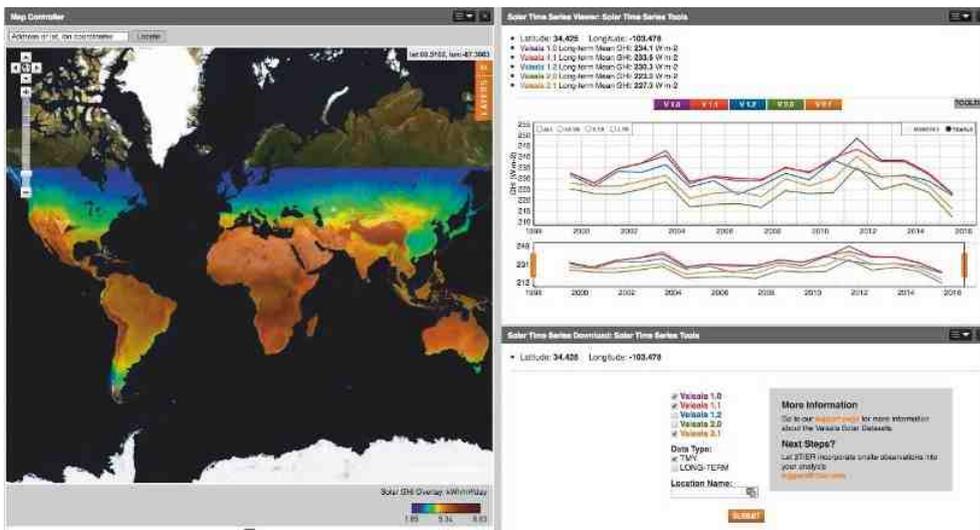
thus improve aviation safety as operators are more accurately advised of the weather parameters over and in the vicinity of the airports.

“The Bahamas has some five million visitors annually, and we have 28 government owned airports on our islands. The heavy rains, lightning, thunderstorms, low visibility and wind shear associated with severe weather events are definitely a hazard to aviation, so we need to be able to service the airports better as well as meet International Civil Aviation Organization (ICAO) and World Meteorological Organization (WMO) standards and regulations.”



Electronics Manager Byron Bain (on the left) and Director Trevor Basden from the Bahamas Department of Meteorology visited Vaisala’s factory and headquarters in Finland in late 2016.

Helping the Sun Shine Brightly on the Global Solar Industry



Vaisala Solar Time Series Tools offer easy access to bankable solar resource records at any location around the world.

It's no secret that solar technology is presenting major opportunities for the energy sector and all sorts of businesses around the world. In 2016 global solar capacity is expected to reach 64.7 GW, up from 57.8 GW in 2015.

To put that in perspective this incremental 6.9 GW increase is larger than the total 2008 installed capacity worldwide – a ten-fold increase in only eight years – and there are no signs of a slowdown in sight.

While this growth is driven by the leading markets of China, the United States, Japan and India, new markets frequently emerge. And when opportunity strikes it is critical for global

energy players to act quickly and make investments at the right time.

Latin America is a prime example. In the last few years there has been a great deal of focus on solar development in Chile and Brazil, but now Argentina is the market to watch. At the end of 2015 the Argentine government announced a renewable energy goal, stating that it would get 8 percent of its energy from renewables by 2017 and 20 percent by 2025.

After signing this into law, policymakers spent the first half of 2016 putting the framework in place to help drive the development and investment required to meet the

aggressive new target. The initial result of this work was the country's first renewable energy auction, held in September 2016 with the results announced in early October.

To submit a project bid in the auction, developers are required to provide a long-term energy estimate. To be competitive, this estimate must be as accurate as possible, demonstrating a strong solar resource and low uncertainty around projected performance. In this aspect of the auction, Vaisala played a key role, supporting 30 percent of the solar auction bids with due diligence services and helping both local and global com-



Vaisala Solar Weather Station SP12 is an all-in-one system specifically designed for the solar industry to help collect reliable ground measurements.

panies act quickly to enter the new market.

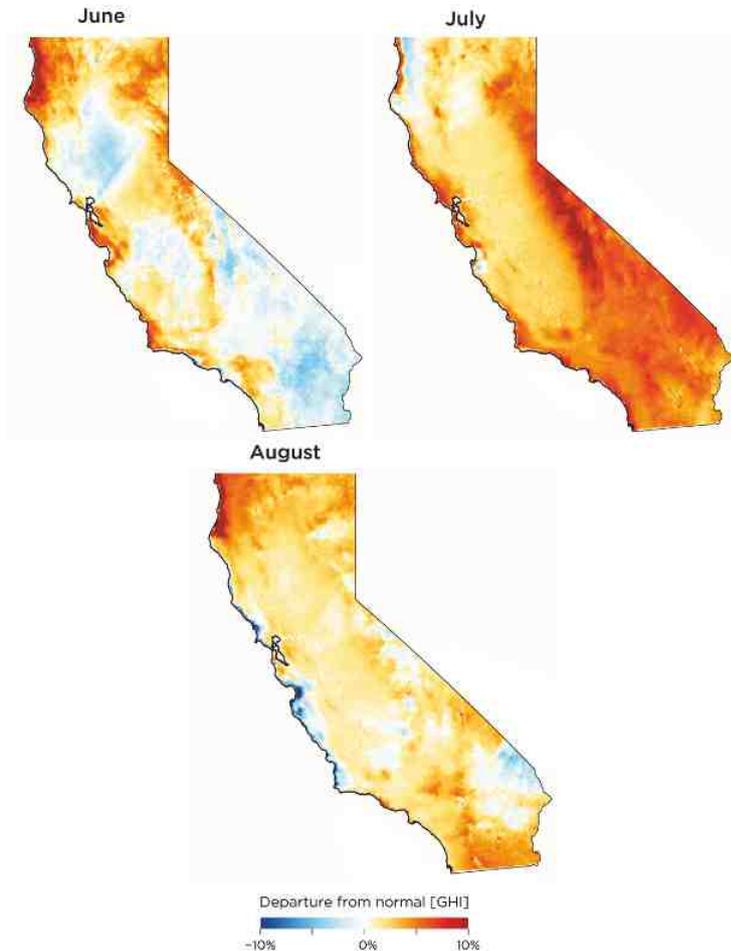
In the solar industry, weather is both the project's fuel and operating environment and as the leader in applied weather science, Vaisala is uniquely positioned to help the industry adapt and mitigate weather risk while making informed decisions that reduce costs and increase profitability.

Through its 3TIER consulting services, Vaisala has been active in the solar space since 2009, assisting customers in translating weather conditions into long-term solar energy estimates in the pre-construction phase and observing and forecasting real-time performance in the operational phase. Vaisala was also the first to map the world's solar energy resource potential through a

high-resolution dataset that continues to be used today by developers, project owners, policymakers and governments to make high-level financial, infrastructure and operational decisions.

Recently Vaisala partnered with IRENA, the International Renewable Energy Agency, to make portions of this dataset publicly available through its Global Atlas platform.





These California Solar Performance Maps show departures from average solar irradiance in GHI (or Global Horizontal Irradiance, the key variable for PV projects) and highlight the effects of recent wildfires. Vaisala conducted the study by comparing 2016 data with long-term averaged values from its continually updated global solar dataset.

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The aim of the partnership is to increase access to high-quality resource data for large-scale planning and remove information barriers for countries trying to promote renewable energy.

Vaisala's significant data capabilities are also put to work in the operational space. For example, we often monitor the impact of large-scale weather trends on wind and solar performance. Last fall we published a study illustrating the impact of California's summer wildfires on energy production in areas with a high con-

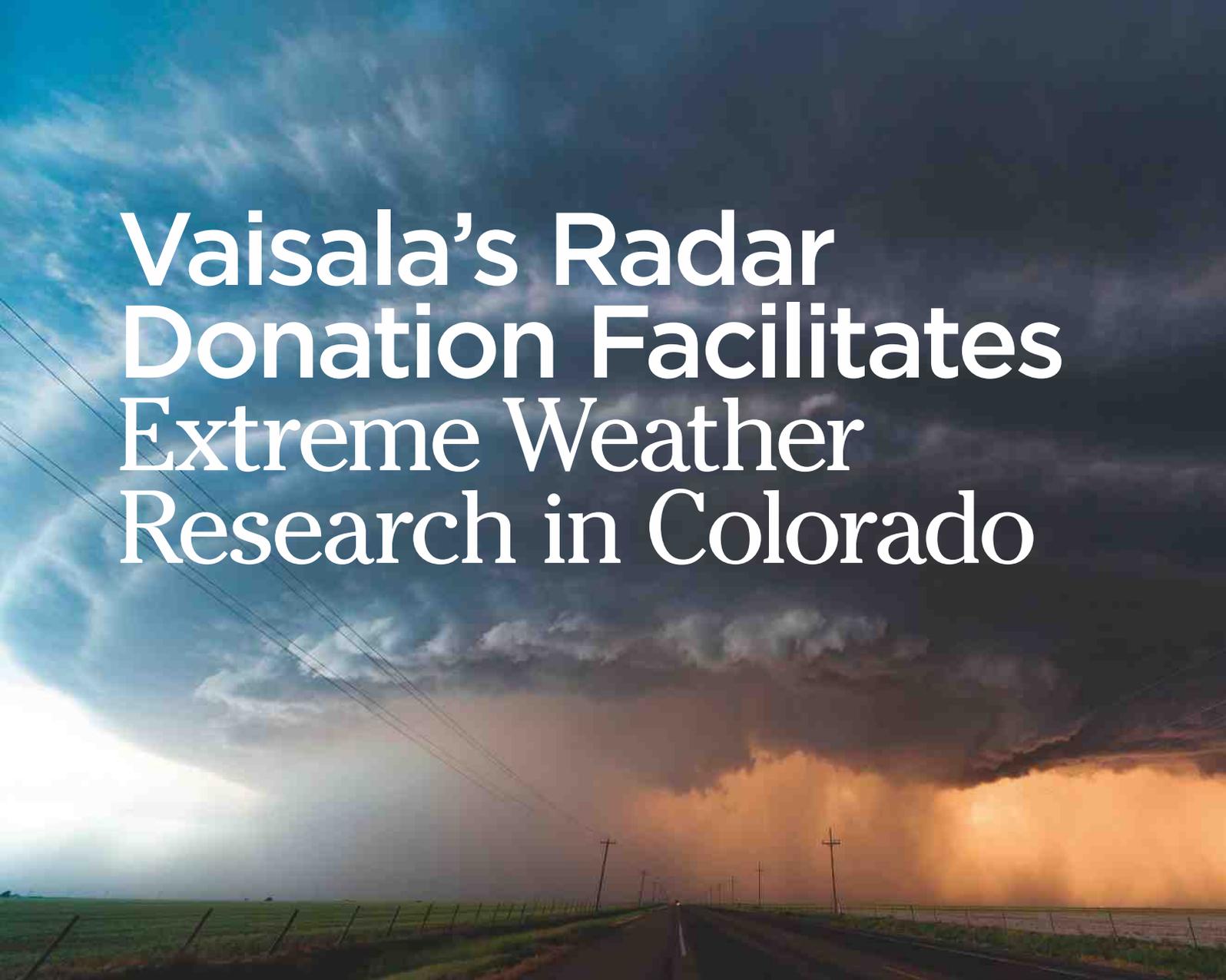
centration of solar capacity due to the resulting smoke and haze.

In the spirit of continuous improvement, Vaisala is always looking for ways to innovate in the solar measurement and consulting services field to better support clients who must respond quickly in a challenging and ever-changing industry. These customers need a partner who can deliver both on speed and accuracy to help them enter new markets and put forward only the most competitive and profitable projects for auction or investor consideration.

It is with these customers in mind that we recently introduced two new products that help developers better evaluate potential projects. Our new Solar Time Series Tools offer easy access to bankable solar resource records at any location around the world at a low annual subscription cost. These dynamic online tools allow developers to visualize, compare and order up to five global datasets and receive data files within 24 hours to meet tight deadlines while reducing project performance uncertainty.

We have also launched our new Vaisala Solar Weather Station SP12, an all-in-one system specifically designed for the solar industry to help collect reliable ground measurements. This station is rugged and ready-to-install, equipped with state-of-the-art sensors and a data logger proven to withstand extreme conditions.

Solar has a bright future and Vaisala plans to remain a leader in the solar resource assessment, measurement and forecasting area as the industry grows and matures. With more and more opportunities clearly on the horizon, Vaisala is making solar a strategic company focus and will continue investing in practical innovations that provide value to customers around the world.



Vaisala's Radar Donation Facilitates Extreme Weather Research in Colorado

Vaisala donates a brand new, state-of-the-art C-band radar to Colorado State University (CSU) for the study of weather in previously unreachable places.

The new radar will be used by the students of University Distinguished Professor **V. Chandrasekar** in the research of extreme weather.

“Due to the radar’s small size, it can travel with us to international areas where we haven’t been able to bring radars to before, opening important possibilities to measure weather-related phenomena in new locations. It’s an exciting opportunity to teach my students and further our research,” says Professor Chandrasekar.

Professor Chandrasekar has contributed significantly to the development of weather radar science and technology and is one of the world’s leading researchers in this area. He

is an avid experimentalist conducting special experiments to collect in-situ observations to verify new techniques and technologies.

Vaisala’s compact C-band radar uses dual polarization to locate precipitation, calculate its motion, intensity, and determine the type of precipitation, and is able to classify targets into categories such as hail, snow pellets, snow or rain.

Unlike traditional collegiate gifts that are typically donated only after initial use, the equipment is being developed specifically for the university.

Advancements in Airline De-icing

The importance of airline de-icing cannot be overstated, with the lives of passengers and flight crews at stake.



When it comes to airline de-icing, there is little room for error. According to the International Air Transport Association (IATA), more than eight million people travel by aircraft every day on average. These people have to be kept safe, and a huge factor in that is de-icing.

Another very significant issue to airlines is the potential for time delays when working to de-ice aircraft. Especially at busy international airports the flights are often taking off less than a minute apart. Winter weather causes delays to aviation particularly from the process of receiving deicing, and from landing/

taking off capacity reduction during reduced visibility that occurs during a storm. Vaisala CheckTime provides the confidence in the application and thus lead to fewer treatments.

Airlines are also concerned about environmental practices. Sustainability is becoming more important all the time because of the damage being inflicted on the earth. Using a more reliable system to establish holdover (HOT) time will allow pilots to work out exactly how long they have before it will have to be reapplied. Effectively calculating holdover time can ensure that there is no unnecessary use of these fluids,

which will go towards reducing the environmental impact of airline de-icing.

There have been a number of organizations working together to harmonize de-icing procedures globally. Regulators including the US' Federal Aviation Administration, the European Aviation Safety Agency, Transport Canada and the International Civil Aviation Organization can implement their own de-icing guidelines or refer to recommended practices established by others.

Different mixes of fluids are used to ensure that ice does not form on vital aircraft parts before takeoff. These fluids must be chosen depending on various circumstances and play an important part in establishing holdover time for pilots, which is the time a fluid will prevent the formation of ice.

There are two main problems with the formation of ice or snow on aircraft. Firstly, the additional weight of the ice or snow adds to the total weight of the aircraft, increasing the lift required for the aircraft to take off. Secondly, the formation of frost, ice or snow also changes the airflow over the wing, reducing the overall lift it can produce.

It is the pilot's responsibility to determine the holdover time by taking into account the outside temperature, which fluid mix will be used, precipitation and an estimate of fluid failure based on visibility.

Holdover time is calculated using tables, which can often become burdensome and inconvenient. They could prove distracting and rely on estimates, rather than up-to-date information. holdover tables can be inaccurate as they do not take into account the changing weather conditions.

Pilots in colder countries should therefore be relieved to hear about Vaisala CheckTime, which makes the process of de-icing aircraft more streamlined and efficient.

CheckTime uses precision weather measurement equipment positioned at the airfield the pilots are taking off from, to measure the Liquid Water Equivalent, the amount of water in the precipitation, and uses that to calculate the de-icing and anti-icing fluid saturation point.

As the techniques for de-icing airlines evolve and become more effective, so should the processes for determining holdover time. This is why CheckTime is recommended as the best option for ensuring safety during takeoff during winter weather.

All this information, and more, is detailed in our webinar, which is presented by **Pasi Piirainen**. He has 25 years' experience in airline operations, including managing winter operations around the world. Please visit vaisala.com/webinars to learn more about Vaisala CheckTime, as well as other interesting topics covered in Vaisala webinars.





Using Fire Weather Outlooks to Identify Areas of Concern and Help Reduce Incidents

The National Oceanic and Atmospheric Administration (NOAA) Storm Prediction Center (SPC) shared their story with Vaisala about the risks and rising costs of wildfires, and how lightning data is helping the United States identify high-risk areas and provide better forecasts.



Rising Costs and Concern

In the United States, Federal costs for suppressing wildfires routinely exceed \$1 billion and exceeded \$2 billion last year (2015) for the first time. Suppression expenditures continue to increase and now account for more than 50% of the Forest Service's annual budget. According to the National Interagency Fire Center (NIFC), while human caused wildfires account for 80-90% of all wildfires, lightning ignited wildfires account for more than half of acres burned on federal lands. In addition to costs for suppression, each year wildfires cause millions of dollars of property loss with property at risk totaling in the billions of dollars across the United States due to wildfires (<http://www.iifc.org/issue-update/wildfires>).

Lightning caused wildfires occur more frequently in the western

United States due to the drier climate. Drier thunderstorms and longer periods with lower atmospheric moisture prime the forests and rangelands of the western U.S. for lightning wildfire ignitions. Lightning ignited wildfires are dependent on a combination on the amount, type, and dryness of fuels and atmospheric moisture (relative humidity and rainfall). The vast majority of lightning strikes do not ignite wildfires, with less than 1% to about 10% of lightning strikes resulting in a wildfire. This percentage depends on a number of factors including fuel type and dryness, land surface characteristics, and atmospheric moisture.

Keeping the Public Informed

The SPC is part of the National Weather Service's National Centers for Environmental Prediction. The SPC mission is to provide timely and accurate forecasts and watches for severe thunderstorms and tornadoes over the contiguous United States. The SPC is also responsible for monitoring fire weather events across the continental United States and issuing Fire Weather Outlooks.

In addition to severe thunderstorm and tornado forecasts, the SPC also produces Day 1, Day 2, and Day 3 Fire Weather Outlooks that identify areas of elevated, to extremely critical, fire weather conditions and dry thunderstorm potential, and of increased probability of critical fire weather conditions during days four through eight. The Fire Weather Outlooks are intended to delineate areas of the contiguous U.S. where pre-existing fuel conditions, combined with forecast weather conditions during the next eight days, will result in a significant threat for the ignition and/or spread of wildfires (read more at <http://www.spc.noaa.gov/misc/about.html>).

The Fire Weather Outlooks are designed for the NWS, as well as other federal, state, and local government agencies. "However, we encourage the public to be aware

of severe and fire weather forecasts especially in their area," comments **Nick Nauslar**, Research Scientist at the University of Oklahoma Cooperative Institute for Mesoscale Meteorological Studies, working at the Storm Prediction Center. SPC fire weather forecasters coordinate with state and federal land agencies and NWS Weather Forecast Offices when producing Fire Weather Outlooks. FEMA also uses SPC fire weather outlooks for daily briefings and situational awareness.

SPC publishes all of its outlooks to its websites and also uses social media (i.e., Twitter and Facebook) to reach a greater audience. SPC forecasters coordinate with the local NWS Weather Forecast Offices across the country to provide a clear, consistent, and accurate message. Weather information and forecasts, such as the Fire Weather Outlook, allows the public to plan and helps explain why some restrictions, such as burn bans, are in place.

SPC's forecasts and research directly align with the NWS Mission and Vision. The NWS Mission is to provide weather, water, and climate data, forecasts and warnings for the protection of life and property and enhancement of the national economy, and the NWS Vision for a Weather-Ready Nation is to have a society prepared for and responds to weather-dependent events. The NWS has teamed with many well-respected agencies, including Vaisala, who are Weather-Ready Nation Ambassadors and share the mission for being well informed and prepared for weather events.

Behind the Scenes

Scientists around the world never stop researching and experimenting to determine the best methods or solutions in their field of study. This is true for scientists working at Vaisala and at the Storm Prediction Center. Weather, and specifically





lightning, has been a highly studied phenomena for decades. There is a vast amount of research about lightning physics (how it works), detection, and lightning safety. And while scientists have figured out how to detect lightning, forecasting lightning is difficult. Forecasting conditions leading to lightning ignited wildfires is even more difficult and complex. SPC fire weather forecasters have to synthesize a lot of weather and fuels information on multiple temporal and spatial scales to provide accurate Fire Weather Outlooks.

SPC utilizes Vaisala's quality controlled and archived historical lightning data to help formulate, calibrate, and verify the probabilistic thunderstorm and lightning models while monitoring real-time lightning data during forecast shifts. Data from Vaisala and other private sources are critical to the SPC's understanding

and input into these weather models, as well as thunderstorm and lightning prediction, and research.

Results and Future Plans

SPC provides probabilities of dry thunderstorms and probabilities of various thresholds for lightning, relative humidity, and rainfall. SPC is currently examining lightning prediction tools (calibrated thunder probability, for example), and researching ways to improve probabilistic lightning guidance.

The verification of SPC's outlooks and forecast tools demonstrate accurate and reliable forecasts. "It is very difficult to quantify any reduction of incidents or costs, but land agencies do use our outlooks and forecast tools as input to pre-position and move

wildfire suppression resources to more efficiently and safely suppress wildfires," notes Nauslar.

SPC will continue to improve its outlooks and forecast tools through research and verification while integrating weather, fuels, and wildfire occurrence data to provide comprehensive Fire Weather Outlooks. "We will also continue to work with the fire community and public to better understand how to address their needs," adds Nauslar.

Space-Proof Sensors

Thanks to their stability and high quality, Vaisala's humidity and pressure sensors were again sent to the demanding conditions of Mars, this time on board the ExoMars 2016 mission.



Model of Schiaparelli, Lander of ExoMars Trace Gas Orbiter Project 2016, at ESOC in Darmstadt, Germany

The ExoMars mission 2016 consists of two modules, the Trace Gas Orbiter and the Schiaparelli lander. The lander was equipped with a suite of science instruments for recording the wind speed, humidity, pressure and temperature at the landing site.

This suite included the DREAMS instrumentation built by the Finnish Meteorological Institute, a long-time partner of Vaisala. It was based on one Vaisala humidity sensor and two Vaisala pressure sensors.

The humidity sensor is a standard product, and the smaller pressure sensors are the same ones used in Vaisala's RS92 radiosondes, but specially customized and verified at Vaisala to be able to measure the extremely small pressures on Mars.

The humidity sensor and the smaller pressure sensor are used in radiosondes, while the larger pressure sensor is used in process mea-

surements, for example, in condition monitoring of high-voltage assets at power transmission industry.

"The Finnish Meteorological Institute has been using Vaisala sensors for space research thanks to their stability," says CEN principal scientist **Tomi Salo**.

"Users can trust that the changes indicated by our sensors are real changes in the measured environmental conditions."

Valuable Experience for the Future

The main objective for the Schiaparelli lander was to test its entry, descent and landing capabilities to better prepare for the next ExoMars mission in 2020.

After a successful separation of the orbiter and the lander on October 16, the Schiaparelli lander

started its three-day descent towards Mars. Contact was lost with the lander about 50 seconds before the expected landing time. It was discovered that the landing had not been successful, and that the lander had fallen from too high, destroying it.

Had the landing been successful, the lander would have gathered more information and possibly unveiled more secrets about the Martian environment.

Despite the unsuccessful landing, the Finnish Meteorological Institute received important information about the functionality of the new technology used in the instrumentation: the instruments can survive a trip to Mars, as they worked perfectly until the crash.

This proves that the same technology can also be used in ExoMars 2020 mission and NASA's Mars 2020 rover.



Flying into the Eye of the Storm

Hurricane Hunters fly into hurricanes to save lives. Accurate data about hurricanes helps get people out of their way and understand their behavior.

If you live inside a hurricane zone, knowing a storm is coming your way can be a matter of life and death. NOAA's Hurricane Hunters fly into hurricanes to gather data and to help weather forecasters determine how strong the storm is and where it is heading.

Best Data from Inside the Hurricane

There are all kinds of ways to gather information about a storm: satellites, buoys offshore, balloon radiosonde launches and surface weather observations.

Ultimately, the most accurate information you can gather about a hurricane is by flying into it.

"It may seem a bit old-fashioned, but it is the best way to determine exactly how strong the storm is and whether it is gaining or losing strength," says **Richard Henning**, Flight Director at NOAA Aircraft Operations Center. He has been a Hurricane Hunter for 21 years now, the last seven with NOAA.

Dropsondes Show Strength and Trend

The Hurricane Hunters have two P-3 Orion turboprop planes to do the dirty work, bounced around in the hurricane at 5,000–10,000 feet above the ocean surface.

Scientists aboard deploy Vaisala's dropsondes as the P-3 flies through



the hurricane. They continuously transmit measurements of pressure, humidity, temperature, and wind direction and speed as they fall, providing a detailed look at the structure of the storm and its intensity.

“Probably some of the most important dropsondes are dropped from the P-3 into the eyewall of the storm to determine the strongest winds,” Richard Henning says.

Sondes dropped in the eye of the storm are also very critical to the forecasters in determining the pressure inside the eye. The lower the pressure, generally the stronger the storm is.

Data from Above the Storm

A Gulfstream jet is used to gather data from above the hurricane, at an altitude of 40,000–45,000 feet.

“The best way to describe it is to compare the hurricane to a block of wood floating on a stream: on the jet, we are gathering information about the stream carrying the block,” Henning says.

Even more dropsondes are used per mission than on the P-3 – usually

30–35 – to see what the atmosphere is doing. The data enables forecasters to map the steering currents that influence the movement of hurricanes.

“Dropsonde data is critical to what we do. We have a very good relationship with Vaisala, and as a team, we are always striving to make dropsonde data as precise and dependable as possible,” Richard Henning points out.

Richard Henning Flight Director at NOAA Aircraft Operations Center on a hurricane mission

Becoming a Hurricane Hunter

“I had been flying in the Navy, and I had a Master’s in meteorology. The combination provided me an opportunity to fly with the Air Force Reserve hurricane hunters. This qualified me for my job in NOAA.”

“We have only about 100 people in the Aircraft Operations Center, so the hiring process is very competitive. Pilots, scientists and technicians are usually highly educated and experienced before coming here.”

“The qualification process takes up to three years, and many flights with someone instructing you before you get to fly into a storm on your own.”



NOAA Hurricane Hunters

National Oceanic and Atmospheric Administration is US environmental intelligence agency, focusing on the oceans and atmosphere. In Florida, NOAA has a fleet of nine aircraft at its Aircraft Operations Center, which is also the base for the Hurricane Hunters.

Why aren't Hurricane Hunter planes torn apart in storm?

Planes are generally not destroyed by strong winds while in flight. It is the shear, or sudden change in horizontal or vertical winds, that can destroy an aircraft.



Saving Lives

The data from both planes is streamed to the National Hurricane Center in Miami, in seconds. There it is combined with other weather data. Computer models are run many times a day to predict the storm's movements and strength, several days in advance.

The Hurricane Hunters are at times the first people to know if the storm has turned or intensified.

"One storm I remember more than any other in this regard is Katrina in 2005. We were inside the storm, when it intensified from a category 3 to 5," Richard Henning remembers.

This was early on a Sunday morning, and based on Hurricane Hunters' data, the residents of Louisiana and Mississippi were warned of the category 5 hurricane heading their way.

"Tens of thousands of people evacuated from the coast that morning. Had they not left, many would have died, as it was such a severe storm."

Rollercoaster with Speed Bumps

Flying in the storm is not always as turbulent as you would expect; sometimes it is no worse than being on a

commercial airliner in rough weather. Sometimes it is much worse.

"At times it is like being on a rollercoaster with speed bumps. Going through the eyewall, it can be raining so hard that you can

barely see the tips of the wings. It is like going through a car wash, on a rollercoaster."



NOAA Aircraft Operations Center technician, Mr. Damon Sans Souci, preparing to launch an expendable into a storm from the WP-3D Orion Hurricane Hunter.

Vaisala's Corporate Science Advisor Knighted

Dr. **Walter Dabberdt**, Vaisala's former Chief Science Officer and Corporate Science Advisor, has received one of the highest honors bestowed by the Finnish government.

Dr. Dabberdt has been made Knight, First Class, of the Order of the Lion of Finland for promoting the knowhow and export of Finnish environmental technology. The honor is given based on exceptional personal merit, gained in his own field of profession.

Building Collaboration

As a renowned scientist in the area of meteorology, Dr. Dabberdt has initiated and increased Vaisala's cooperation with world-leading research institutes, especially in the USA.

The ensuing research has led to commercial products and strengthened Vaisala's position as the technology leader and primary partner for environmental observations.

"Close collaboration with research institutes is critical for our business and future success. Walt's role in building our networks has been extremely important. He is a well-known and respected scientist not only in USA but also in China and Germany. In Washington D.C., he has even contributed to environmental legislation," says **Kjell Forsén**.

Eminent Meteorologist

Dr. Dabbert has a long career in the field of meteorology. Prior to joining



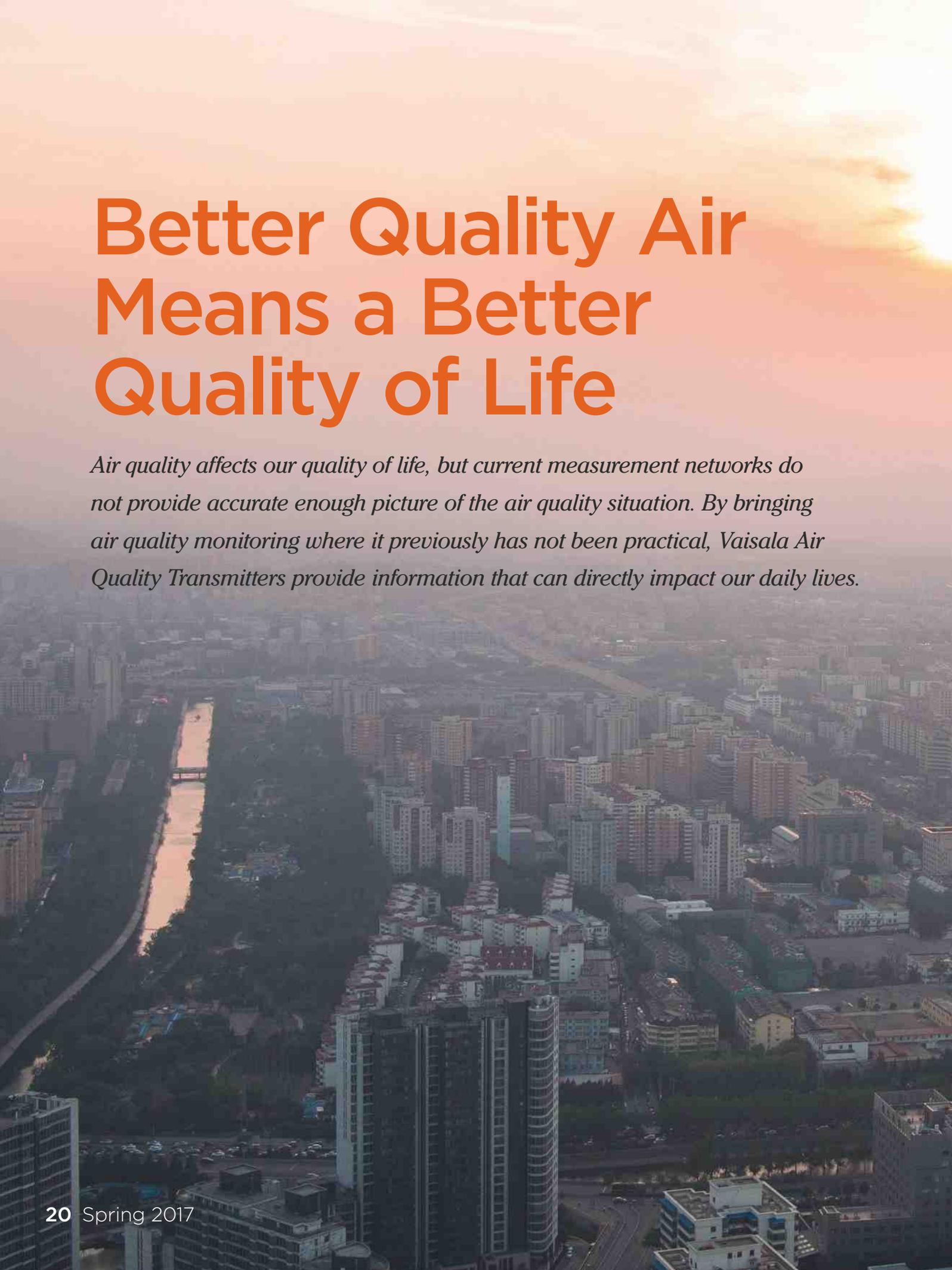
Dr. Walter Dabberdt, Kirsti Kauppi, the Ambassador of Finland to the United States and President and CEO of Vaisala Kjell Forsén

Vaisala, he spent 15 years at the National Center for Atmospheric Research (NCAR) as scientist, facility manager, and Associate Director.

He has served on numerous regional, national and international panels and committees. He is also a Fellow and past President (2008) of

the American Meteorological Society and is a Fellow of the Royal Meteorological Society.

Dr. Dabberdt retires from Vaisala in early February 2017, after 16 years with the company.

An aerial photograph of a city at sunset. The sky is a mix of orange, yellow, and light blue. A river flows through the city, reflecting the sunset. The city is densely packed with buildings of various heights and colors. The overall atmosphere is hazy and warm.

Better Quality Air Means a Better Quality of Life

Air quality affects our quality of life, but current measurement networks do not provide accurate enough picture of the air quality situation. By bringing air quality monitoring where it previously has not been practical, Vaisala Air Quality Transmitters provide information that can directly impact our daily lives.

Since the London smog incident in the 1950s, ambient air monitoring has developed into a globally adopted public task. It is performed to ensure the health and safety of citizens as well as to minimize adverse environmental effects due to pollutants.

Providing Local Air Quality Information

In today's statutory air quality networks, measurements are made with fixed air monitoring stations using standard reference methods. Analysers using these methods are well established and accurate, but are costly to operate and maintain, so the number and spatial density of these stations is typically relatively low. Typically, stations are several kilometres apart even in cities.

However, due to the localized nature of pollution sources and micro-climatic effects, the air quality in cities inevitably varies on much smaller scale, making current networks inad-

equately for providing real-time localized air quality information.

Vaisala Air Quality Transmitters provide a new type of a cost effective solution for monitoring ambient air, providing a real-time picture of the local air quality situation. Quick and easy to deploy, they are ideal for complementing an analyser-based network for a more accurate picture of the air quality situation.

They are also an easy way to establish a monitoring network around industrial sites, like petrochemical facilities, power plants or mines, where air quality is of particular interest.

Vaisala also offers software solutions for managing a network of instruments and making the measurement data easily accessible for users and applications. The data can also be used to support air quality forecasting.

Weather Conditions Impact Air Quality

The accumulation of air pollution also depends on local meteorological

conditions. For example, wind can move pollutants distances of hundreds of kilometres, and under low level inversion conditions, pollutants accumulate to generate high ground level concentrations. Wet deposition due to rainfall clears the air from pollutants but can also pollute the environment in the form of acid rain.

Understanding local weather conditions is therefore important in fully understanding air quality conditions.

To this end, the Vaisala Air Quality Transmitters can seamlessly be connected to the Vaisala Weather Transmitter family of products. These products measure the essential weather parameters (wind, rain, PTU) in a compact and easy to deploy format.

Also a solar irradiation sensor can be added to provide data on local photochemical conditions. Vaisala also offers ceilometer instruments for 24/7 monitoring of boundary layer height and conditions.



Belgium's Air Quality Tracked with Vaisala Lidar Ceilometers

In Belgium, volcanic eruptions of the early 2010s proved the need to follow pollutants in the boundary layer in the atmosphere to better understand air quality in all weather conditions.

Air quality is not only affected by emissions in the atmosphere. How quickly pollutants are dispersed is determined by the weather as well as the thickness of the boundary layer where emissions are diluted vertically.

Monitoring the boundary layer, also known as the mixing layer height, is critical for estimating the nature, transformation, and removal of pollutants in the air.

In Belgium, the need for this monitoring was brought home by the volcanic eruptions of Eyjafjallajökull and Grimsvötn in 2010 and 2011, leading to closing of large parts of European airspace.

The ozone, aerosol, and UV research group at the Royal Meteorological Institute of Belgium (RMI) decided to track the vertical profile of aerosols using Lidar (Light Detection And Ranging), and installed its first Vaisala Lidar Ceilometer CL51 monitor

in Uccle, Brussels in 2011. In 2014, the monitoring was expanded with the installation of three additional monitors in Zeebrugge, Diepenbeek, and Humain.

Remote sensing with a Lidar ceilometer is a cost-effective and accurate way to measure the boundary layer and to improve atmospheric research and air quality monitoring.

"Lidar ceilometers have improved in recent years and now offer the opportunity to continuously monitor the vertical profile of aerosols and the mixing layer height," says Dr. **Hugo De Backer**, who is responsible for ozone and UV observations and data maintenance at the RMI.

The raw data gathered by the sensors is analyzed to determine the maximum vertical gradient and the temporal variant of the backscatter profile, while also comparing boundary-layer models over time.

The collected data is sent continuously to the Belgian Interregional Environment Agency, where it is integrated with other air quality measurements – such as data on particles and gas – to improve understanding of current and near-future weather conditions.

Data on the boundary layer is also useful for verifying numerical simulations of air pollution and predicting ozone formation.



Vaisala Expands to Africa

Vaisala is setting up a new subsidiary in Nairobi, Kenya, to be close to its current and prospective clients in a rapidly developing market.

“We want to grow our business in Eastern and Southern Africa. Several countries there are seeing rapid economic growth, so their ability to invest in meteorological systems is improving,” says **Panu Partanen**, Head of Weather APAC&MEA.

“At the same time, climate change and urbanization are increasing the importance of weather data in Africa.”

A local presence is needed to be within easy reach for Vaisala’s African clients and to be able to monitor the market and develop operations there. In Africa, Vaisala focuses primarily on meteorology and airport clients.

Kenya was selected at the subsidiary’s location, as it is the one of the most advanced economy in Eastern and Central Africa, an important business hub with many Western companies already established there. It is also one of the regional meteorological centers.



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