Wind and Weather

e · a passion for precision · passion pour la précision · pasión por la precisión · passione per la precisio

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Lufft

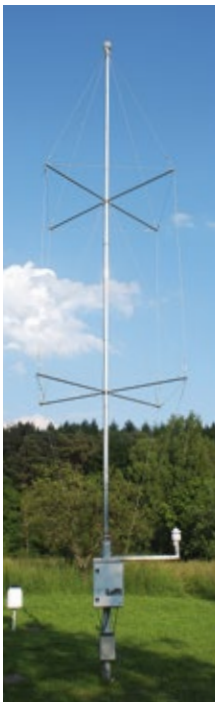
Hydro-Meteorology

Climate change makes for more extreme weather. The main reasons for this are wind and precipitation.

That is why an increasing number of meteorological and hydrological monitoring networks are coming together. Global coverage with hydro-meteorological measuring technology is varied. Very old and very modern (new) measuring networks are used for climate monitoring worldwide. And there are still large gaps, for example on the oceans.

Sample Applications in (Hydro-) Meteorology

Climate research, reliable short, medium and long-term forecasts and timely alarms in extreme weather are classical tasks of weather monitoring. This requires dense monitoring networks and accurate measurement data in real time. The applications vary. The budgets are also different world-wide. Open technologies are therefore required: modularity, variant diversity and simple plug and play installations.



In the cooperation between users and producers of environmental measuring systems, the technical installation must correspond to the needs of the user.
To this end, the system supplier needs to know the exact requirements.
This can be achieved by means of a detailed tender document, performance specification or so-called design qualification.
As technology is constantly being improved, in the applications it is recommended to focus on the costs / results of the system and to allow different technical solutions that facilitate these results.

Prior to delivery of the system, measurement certificates can prove that the components used comply with the requirements.
After installation of the system(s), a so-called functional qualification can be requested, to ensure that the system works as expected under real conditions.
Maintenance and calibration intervals can be defined in conjunction with the supplier based on the availability requirements of the user (performance qualification).

Smart sensor technology for long-term use.

Metrology

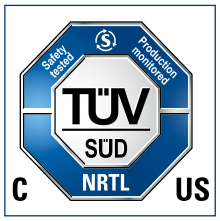
Sustainability

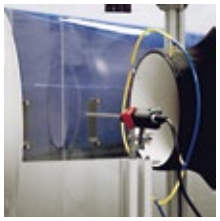
Building environmental monitoring networks is complicated and expensive. When planning, therefore, it is important to consider the service life of the entire system. And since this typically should be more than 10 years, the system must allow permanent modernization and improvements.

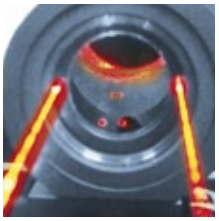
> High long-term stability of the sensor technology
> Very long service life
> Extreme robustness
> Precise measurements
> Calibration capability of the sensor
> Reliable measurement even under extreme conditions
> Software upgrades

You know your application and take the decisions...

...we supply the measurement data that you need for this purpose. We deal with the measurement of all environmental data. Smart sensors allow not only reliable measurement with advanced technology, but also computing and diagnostic functions. And, via the serial interfaces of the smart sensor, the information can also be forwarded for post-processing in various languages (protocols). Whether cloud, datalogger or "smart communicator". Smart sensors facilitate streamlined hardware architecture in the entire measurement setup.







Applications

> Climate research / Science Weather forecasting
> Extreme weather warnings
> Airport weather monitoring
> Air quality monitoring networks
> Agro-meteorological monitoring networks

System Concept

Individual sensors or modular-designed all-in-one sensors supply data for further processing via an open interface. Whether GPRS, LAN, WLAN or satellite transmission, the necessary infrastructure to provide real-time data for decision-making is available worldwide.

Reliable Measurement Data

Big data provides ever increasing amounts of environmental data. Which sources can you use for decision-making? Which data can you trust? For this, in every measurement network in the future there needs to be a number of reference stations, which always measure correctly. Guaranteed.

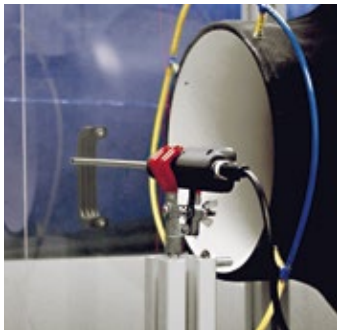
Our technology is designed to bring you benefits.

Our Customer is King

User First

Reliable Measurement Data Verification and Calibration

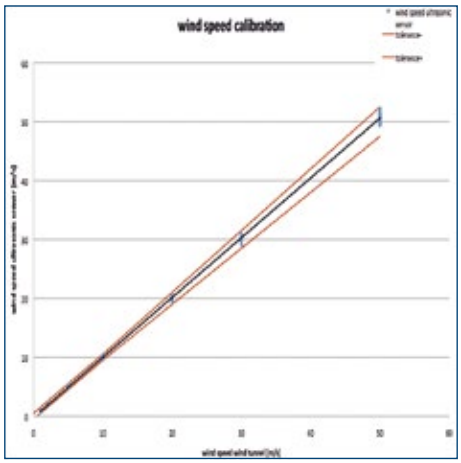
What type of maintenance do you want for your monitoring network?
Reactive (in case of faults) with regular maintenance intervals? Or proactive with timely replacement of critical components? Predictive, taking account of probabilities of failure? Or availability-based, i.e. you expect data delivery, for example, in 99.5% of all possible cases? On this basis, verification and calibration activities can be performed on your measuring systems.



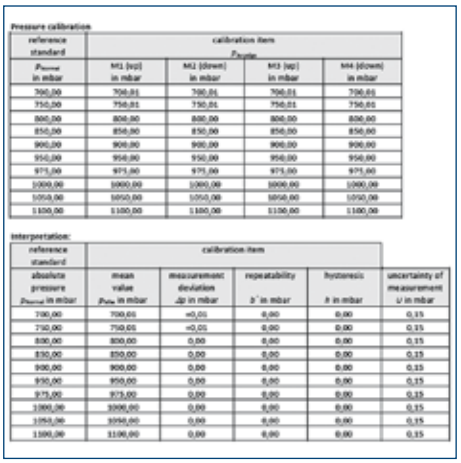
Calibration (traceability)
Environmental sensors can be laboratory tested, including traceability. In the best case, the characteristic curve of the sensor can also be corrected (adjustment). And the date of the next verification can then be set.

Verification
The measurement point is compared with a reference. Ideally, not only at a given time, but over a period of about one hour. A decision can then be taken regarding adjustment or replacement.

Reference Sensor WS3000
> Exchangeable sensor
> Redundant air pressure sensor
> Excellent ventilation
> Metal housing

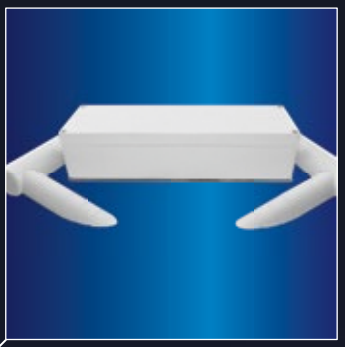


Characteristic Curve of a Wind Sensor
> Target / actual comparison over the entire measuring range
> Optimization of measurement accuracy by storing the characteristic curve in the sensor
> Secondary calibration by the user during use



Meteorology and Metrology:
> Verification of accuracy, e.g. air pressure, traceable to primary standards (NIST, DKD, etc.).

Trust the measurement data whose origin you know.



Platforms and Variants

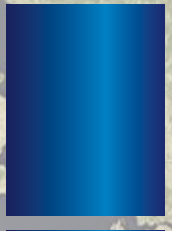
Modern sensor technology based on platform concepts. As a result, new variants required by our users can be developed faster.

Platforms can be realized with replaceable or hardwired sensors.

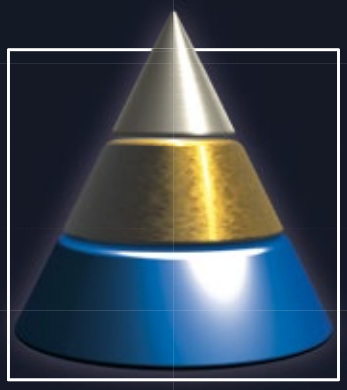
Different platforms allow us to meet the respective requirements in the best possible way.

THE REFERENCE
WMO-STANDARD
METEO-SMART

The WMO (World Meteorological Organization) places high demands on the sensors to be used. The reference class must not only meet these requirements, but exceed them. The WMO standard sensor is intended to ensure that weather observation takes place worldwide on the basis of identical principles. And though WMO accuracies are not always required, a professional environmental sensor is still needed. That's why we developed the "Meteo-Smart" series.

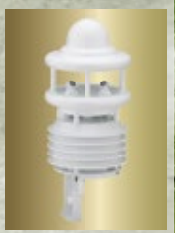
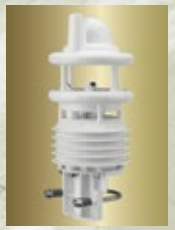
	Cloud height	Snow depth	Current weather	Visibility
The Reference				
	 CHM 15k	 SHM 51	 Parsivel	
WMO-Standard				
	 CHM 8k	 SHM 31	 WS100	 V20k
Meteo-Smart				
		 SHM 30	 R2S	 V2k

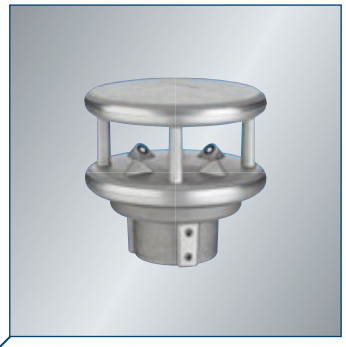
Matrix Overview
WS Series



Wind	Temperature	Temperature Rel. humidity Air pressure Precipitation	Temperature Rel. humidity Air pressure Irradiation
Lufft WS Sensors: The Reference			
Ventus			WS3000 / WS3100
Lufft WS Sensors: WMO-Standard			
WS200 / V200	WS300	WS400	WS301/303
Lufft WS Sensors: Meteo-Smart			
		WS401	WS302 / WS304

THE REFERENCE
WMO-STANDARD
METEO-SMART

	Temperature Rel. humidity Wind speed and direction	Temperature Rel. humidity Air pressure Wind speed Wind direction Irradiation			Temperature Rel. humidity Wind speed Wind direction Precipitation		Temperature Rel. humidity Wind speed Wind direction Precipitation Irradiation
							
	WS310			**WS510**			**WS800**
							
	WS500	**WS501**	**WS503**			**WS600**	**WS700**
							
		WS502	**WS504**		**WS601**		



The Reference

- > High long-term stability of the sensor
- > Very long service life
- > Extreme robustness
- > Precise measurements
- > Calibration capability of the sensor
- > Reliable measurement even under exreme conditions
- > Software upgrades

Applications

Every application is different. The common factor is that each application is based on measurement data. Reference measurements in the laboratory and in the field guarantee reliable information. And reference sensors must not only provide highly accurate data, but also work in all extreme weather conditions.

Environmental sensors made of metal are more robust and have a longer service life.
For particularly important applications, dual sensors are installed (redundancy).

Laboratory accuracies are the prerequisite for high accuracy in the environment, but no guarantee.
Comparisons of environmental sensors under real conditions show differences in the detail. And this is what matters.

Until now, sensors were developed for stationary applications.
However, a stationary sensor can be made "portable".
We distinguish between stationary, portable and mobile sensors.

The rapid "turning-in-the-wind" of the turbine protects this from damage due to wind loads on the blades while simultaneously ensuring the best possible energy yield. The accuracy and speed of the wind direction measurement is the basis for this.
If the wind sensor fails to provide data, the turbine has to be shut down.

There are extreme conditions in every country. Our sensors have to prove their viability in such locations.
If a sensor functions at an extremely cold, hot or damp measurement point, it will usually also measure reliably everywhere else. And more and more measurement points are now found in extreme offshore conditions.

So-called all-in-one sensors are increasingly used for the densification of meteorological networks. The accuracy of the individual sensors corresponds to the requirements of the WMO.
And a wind measurement at a height of 2 m can be converted to a meteorological height of 10 m.

Referenz

WS3000

- > **Accuracies:**
  Air pressure: 0.1 hPa (-40 … 60°C)
  Air temperature: 0.1°C (-40 … +60°C)
  Relative humidity: 2%, fastest possible response time on drying by heated sensor
- > **Interfaces: WLAN, RS485**
- > **Protocols: UMB, NMEA, ASCII**
- > **Protection class: IP66**
- > **Exchangeable sensor**
- > **Traceability**
- > **Metal housing**

Meteorological measuring networks: reference for other synoptic systems.

Optionally, two high-precision air pressure sensors can be provided (redundancy for airport applications).

Optional: WS3100 with pyranometer (secondary standard).

1 To avoid the effects of wind in high precision air pressure measurement. Attachment for additional sensor, e.g. pyranometer or precipitation radar.

2 Microprocessor unit (CPU) with built-in fan.
Integrated MEMS air pressure sensor. The ventilation ensures that the accuracies are observed in all environmental conditions.

3 Exchangeable sensors for air temperature and relative humidity.

4 Radiation protection

Aluminum housing construction for extreme conditions

When only the best is good enough.

Extreme Wind measurement

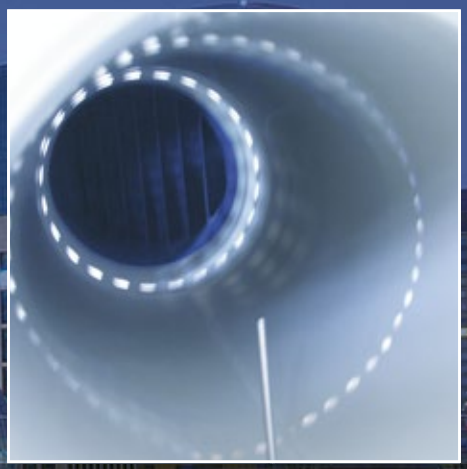
> Measuring range: Up to 100 m/s (360 km/h)
> Interface: Analog and digital
> Housing: Seawater-resistant aluminum
> Protection class: IP68
> VentusX for extreme ambient conditions
> Factory calibration in traceable wind tunnel with measurement certificate
> Secondary calibration during useful life by qualified laboratory, including measured value correction, if necessary

Blackcomb-Peak, Canada. Reliability test in the skiing region.

Offshore application in meteorology. Wind measurement takes place on oceans to densify the weather observation measuring networks.

Ice-free test in Ostankino, Moscow. The television tower is 600 m high and in the winter often stands in an ice cloud.

Ice usually forms first on the measuring mast. In critical applications, therefore, the mast mount is heated. The wind sensor is heated on the upper and lower plates.
In the X-version, the measuring heads are also directly heated.



Due to the escalation of extreme weather conditions, the measuring range requirements in meteorology have also increased. Originally, a measuring range of up to 65 m/s was typical, then 75 m/s. As typhoons and tornadoes reach wind speeds of over 300 km/h, users ideally want to measure up to 100 m/s.

In the field, typically only two measuring points can be verified: calm and the current wind speed.
In the laboratory, the sensor is calibrated and adjusted over the entire relevant measuring range. The measurement certificate for each sensor provides information about the actual accuracy, which is generally significantly better than the technically specified minimum accuracy.

To prevent damage in extreme weather.
And for timely evacuation in case of typhoons and tornadoes.

Cloud Height

Aerosol profiles

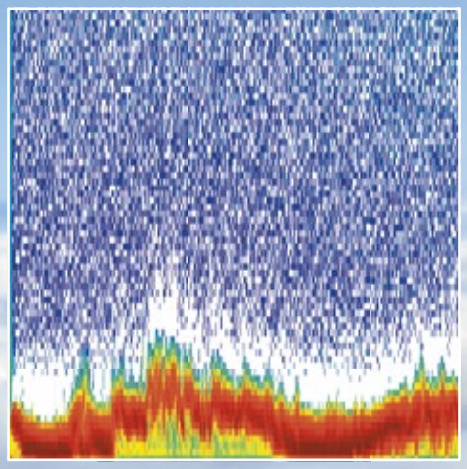
> Measuring range: Up to 15,000 meters
> Extremely high sensitivity of the measurement signal with excellent reproducibility in identical conditions
> Detection of up to 9 cloud layers with simultaneous thickness measurement
> Degree of coverage (Sky Condition Index)
> Cloud penetration depth
> Height of the aerosol and boundary layers
> Vertical visibility (VOR)
> Aerosol backscatter profile
> In preparation: Differentiated aerosol detection, depolarization:
> Fine dust, sand, volcanic ash, “chemical weather”
> Verification with cloud height simulator

Ceilometers help to investigate the impact of climate change.
These findings are incorporated into future forecasting models.

Equipment is required on location to check the functionality. The Lufft cloud height simulator allows the testing of ceilometers even under a cloudless sky.

Ceilometers are often of dual use - for airport weather information and meteorology.

The building of international monitoring networks for cloud and aerosol observation has begun.
Currently, there are significant gaps worldwide. Through the complete automation of the observation networks, ceilometers will take on a very important role in the future, and the intention is also to automatically detect the cloud type.



Ceilometers that are used for both airports and meteorology / climate research must provide precise measurement of all air layers.
Very high cirrus clouds, e.g. over the equator, are over 10 km high.

The extremely stable laser sensor produces raw data for all heights, which are converted into the different results.
Signal processing by means of microprocessors is critical to the quality of the output.
Cooperation with climate and meteorology researchers worldwide allows constant improvement of the data output and ensures application-specific use.

Cloud and aerosol measurement for precise forecasting of air pollution.

Snow Depth

Laser Technology

> Single or multipoint laser
> Low power consumption
> Automatic angle correction
> Accuracy: Better than +/- 5 mm, temperature-compensated
> Interfaces: UMB, SDI12, ASCII (RS485)

The measurement method of the SHM31 is based on a combination of phase comparison and time of flight.
The platform-independent UMB Config Tool allows the configuration of the sensor according to the individual requirements.

Despite long-term warming, snowfall intensity is actually increasing.
Snow depth measurements are an integral part of meteorological measuring networks.

Winter services and ski regions need precise information on snow depth, whether for slope preparation or proactive clearing.

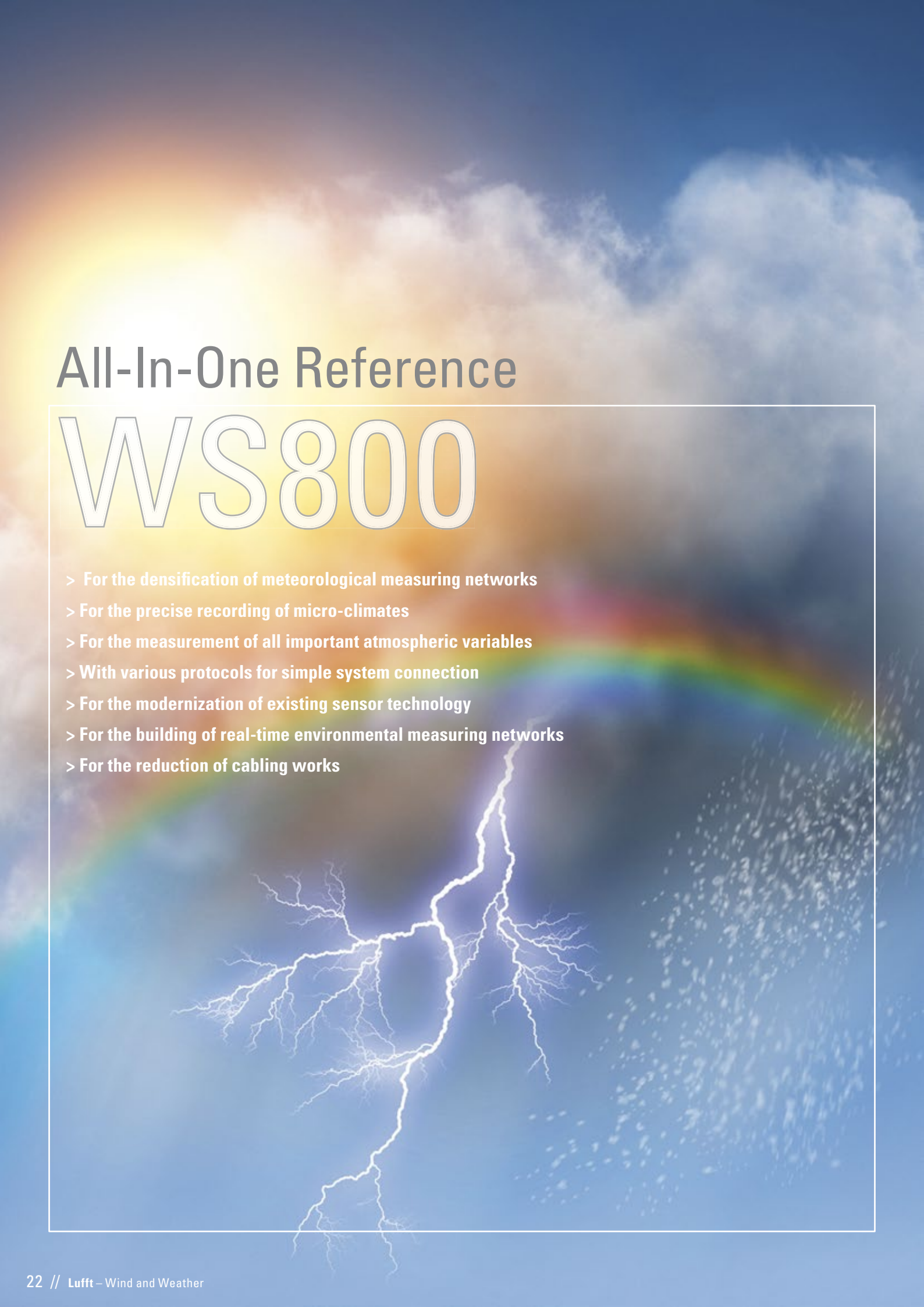
In most cases, the point measurement with a single laser is sufficient.
Independent of temperature, wind and relative humidity, the measurement result is highly accurate in all conditions.

The point or surface measurement for a winter without surprises.

All-In-One Reference

WS800

> For the densification of meteorological measuring networks
> For the precise recording of micro-climates
> For the measurement of all important atmospheric variables
> With various protocols for simple system connection
> For the modernization of existing sensor technology
> For the building of real-time environmental measuring networks
> For the reduction of cabling works

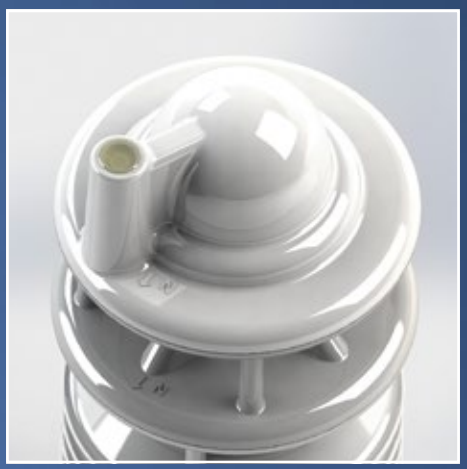


Simultaneous measurement of precipitation and radiation.

Lightning detection for proof of damage.

The wind sensor is heated and has no mechanical moving parts (static wind sensor).
The sensor measures 16 times per second.
The quality value in the measurement output shows the number of valid measurements that are within the permitted measurement interval.

Temperature measurement takes place under ventilated conditions. This improves the response time of the sensor in case of rapid temperature changes.
The built-in microprocessor converts the analog sensor signals into a digital output protocol.
The configuration software allows application-specific parameterization of the required sensor outputs.



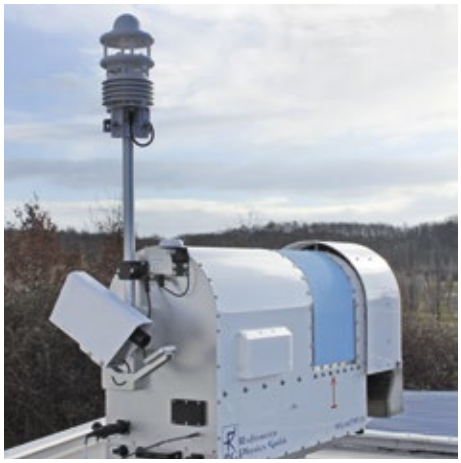
Maintenance-free measurement and differentiation between rain and snow.
The output of intensity takes place every minute.

State-of-the-art sensor technology for intelligent solutions.

WMO-Standard

Meteorological Instruments and Observation Methods

For the continuous improvement of short, medium and long-term forecasting, accurate data are required. More good data are needed in order to fine-tune the resolution of the forecast. „More" and „improved" require advanced sensor technologies, whose measurement results can be made available in real time in any meteorological cloud.



Individual sensor or all-in-one measuring transducer? The answer depends on the installation location. In the high mountains, measurement data are needed - but a 10 m mast can not be installed. Nevertheless, the measurement data must be fed into the databases in a WMO-compliant manner.

In synoptic meteorology, analysis takes place in step 1 (what is the weather like), diagnosis in step 2 (why is the weather like this) and the forecast in step 3 (what will the weather be like).
We have specialized in step 1 and leave the other two steps to other experts.

Weather stations for climate research and meteorological data collection have been in use for more than 100 years.
Newer areas are smart agriculture, air quality monitoring networks, smart grids, smart cities, smart homes and the optimization of artificial snow.
Our sensors are used in all these applications in relation to meteorology.
And we are constantly discovering new applications that require modern environmental sensor technology.

More measurement data with greater accuracy lead to more accurate forecasts.

Precipitation

WS100

> Maintenance-free detection of precipitation
> Differentiation between rain and snow
> Excellent precision
> Fast response time in case of extreme rain showers

The WS100 is typically mounted on the top of the pole.

The WS100 can be used as a single or All-in-one-sensor.

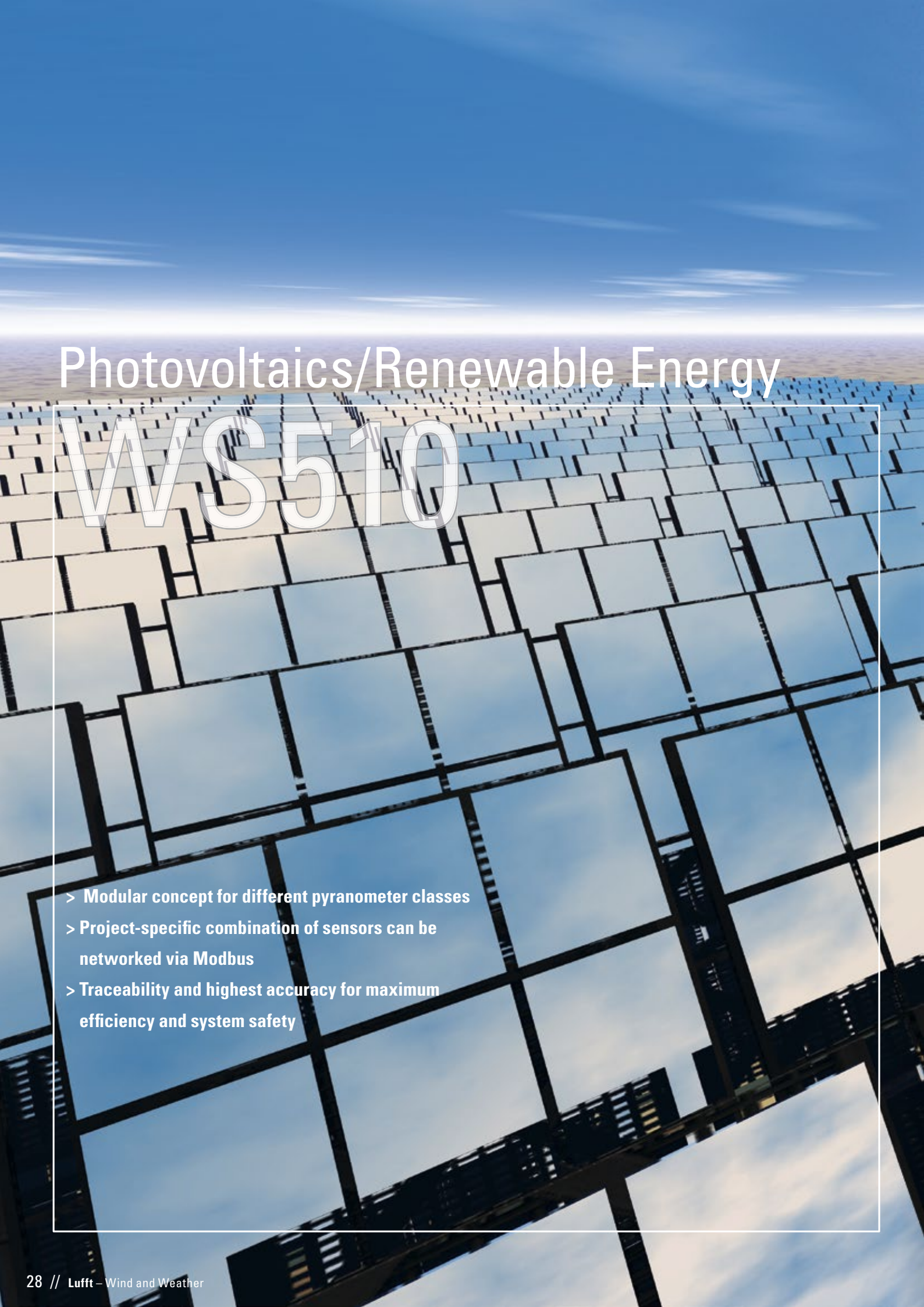
All UMB-sensors use the same output protocol. This allows easy integration into any new or existing system design.

Each minute counts in case of extreme rain.The intensity output each minute allows immediate decision making.

With traffic applications, the WS100 output is used to display the according speed limits on variable message signs.

Today, meteorological systems use both, a present weather sensor and a precipitation gauge. In future, the WS100 can replace both sensors.

A unique rain gauge which does not need cleaning.



Photovoltaics/Renewable Energy

WS510

> Modular concept for different pyranometer classes
> Project-specific combination of sensors can be networked via Modbus
> Traceability and highest accuracy for maximum efficiency and system safety

The most important measurement parameter is irradiation. Since PV systems are becoming ever larger, the accuracy of the irradiation measurement is increasingly important for the efficiency of the system.

Wind cools the temperature of the module and must therefore be included in the efficiency calculation. Precipitation leads to contamination or covering (snow).

With increasing temperature, the performance of the solar module decreases. Therefore, it is important to measure the temperature of the solar module in addition to the air temperature.

Many photovoltaic system providers throughout the world use our sensors. In general, MODBUS interfaces are used to transfer measurements to the PV controller. On request, we integrate manufacturer-specific protocols as a plug & play interface.

Secondary standard for safe operation.

Why is the WMO standard required in such applications?
Because the large measuring range is necessary for irradiation, in order to measure the actual efficiency of the PV system. And because the service life of the system is intended to be more than 10 years. This requirement also applies to the sensor technology.

Which alternative sensor technologies are useful?
GHI: Global irradiation on the horizontal surface GTI: Global irradiation, tilted. And thus aligned to the irradiation angle of the sun
DHI: Diffuse Horizontal Irradiation
Together with the WS600, these sensors are transmitted via a Modbus interface to the data acquisition unit / controller of the PV system.

Air Quality

WS500/600

> Immission measurement:
Fine dust, gases, Atmospherics
WS500 captures all atmospherically important weather data
Integration into the overall system via various digital interfaces:
(UMB, ASCII, Modbus, SDI12)

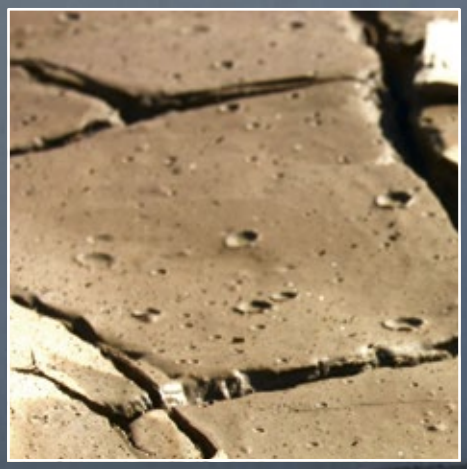
> Traceable measurement certificate option

For meteorological applications the WS 500 is combined with a tipping bucket for precipitation measurement.

WS600: Radar technology is used for maintenance-free recording of precipitation. WS700 measures irradiance in addition.

WS sensors have standard interfaces and can be installed at different heights in accordance with WMO requirements.

Forest fires destroy large areas and threaten human lives. The measurement of wind speed and wind direction in real time, in particular, help to limit the damage.



Extreme weather leads to periods of drought. Maintenance-free radar precipitation sensors detect very fine droplets and prevent evaporation effects.

Emission and immision measurements require different technologies and measuring ranges. Our atmospheric sensors are used in both applications.

We want to help to protect our blue planet.

Visibility

VS20k

- > Measuring range up to 20 km
- > Active defense against spiders
- > Contamination detection
- > Anodized housing

Fog is caused by large temperature differences between day and night and is a micro-climatic event.

Verification in the field is carried out using a calibration disc. As a further control point, the zero point is checked ("in the dark").

The degree of contamination of the sensor is transmitted together with the measured values and serves to alert proactive maintenance.

Sensors with different measuring ranges are available for different applications. Up to 100 km.

Saturated air, fine dust and sand cloud the atmosphere and lead to reduced visibility. Meteorological networks and airport applications require a large measuring range. If the VS20k returns the maximum measurement value, the visibility can be identified as clear.

In future, spiders will have to find another place for their webs.

Meteo-Smart

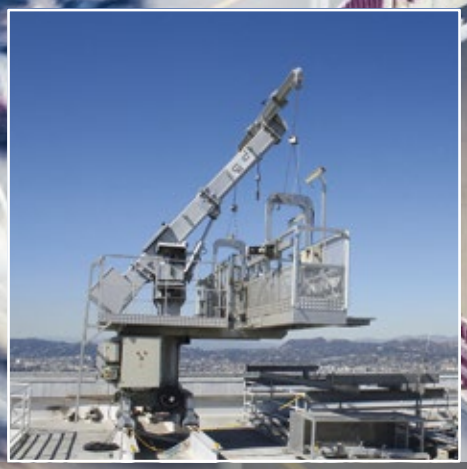
Intelligent environmental sensors for a digital age

Measurement data help decision-makers to optimize resources.
Energy efficiency only works on the basis of accurate data on the specific building microclimate.
Building and mobility control lead to "smart cities".
Even agricultural production must be as environmentally friendly as possible. Pesticides, if necessary, must be kept to an absolute minimum.
With the aid of environmental monitoring technology, the change can be made from "maximum" to "optimal".
Big data applications in conjunction with clouds lead to new algorithms and decision-making aids.
Many new data from unknown sources require qualification and the automatic disqualification of bad or inaccurate data.

Big data applications require data – but it must also be good data.

Smart Homes = Smart Cities

> Optimization of energy consumption
> Protection against material damage
> Automatic building management



The WS700 collects all measurement data for optimal weather-dependent building control.

Rain / snow differentiation and maintenance-free intensity measurement of all types of precipitation.

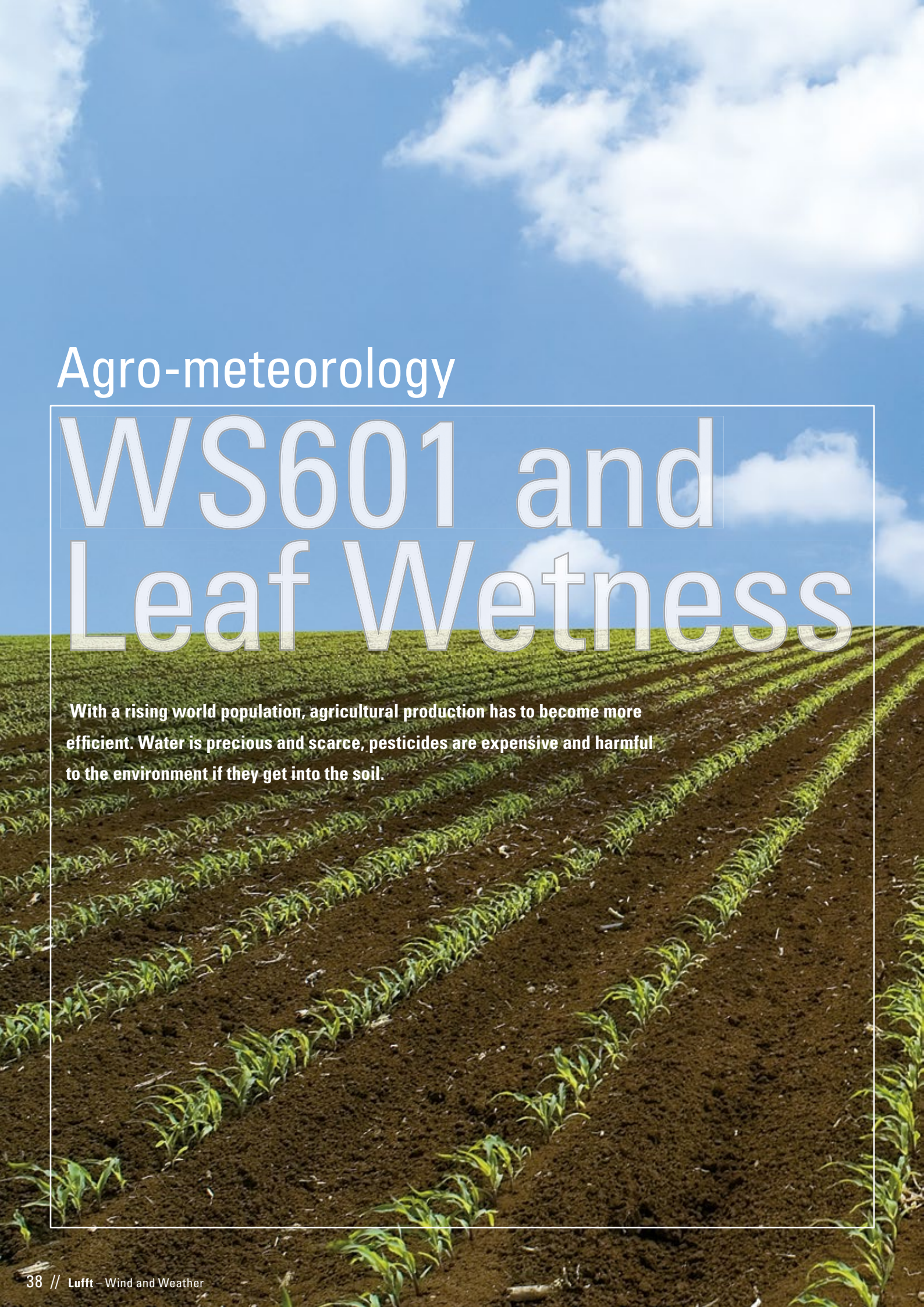
As an option, lightning detection can be integrated into the WS800. Insurance companies require proof in case of building damage.

Travel time calculation, in accordance with the current weather conditions.

Smart homes need a professional weather sensor that controls watering, closes the windows when it rains and optimizes the energy requirement (heating / cooling), depending on the external conditions.

The better the weather information the megacities collect, the better the traffic management.

Environmental measurement technology for our digital age.



Agro-meteorology

WS601 and Leaf Wetness

With a rising world population, agricultural production has to become more efficient. Water is precious and scarce, pesticides are expensive and harmful to the environment if they get into the soil.

To determine the duration of action of the plant protection product, the amount of precipitation must be recorded that falls after application.

Lean hardware: All-in-one sensor technology in combination with a logger / communicator, solar-powered.

Optional: Soil humidity and soil temperature at various depths.

Smart agriculture is based on precise knowledge of fungal diseases and insect development.
In addition to leaf wetness measurement, temperature, relative humidity and precipitation measurement are important for proactive action and secure returns.

Every fungal disease on plants develops step-by-step. The decisive factor is to stop it spreading in time.
If the risk of disease is known, curative and preventive action can be taken alternately.
This prevents resistance.

Every year insects develop at different rates, depending on the air temperature. As a correlation of insect development, daily temperature sums are calculated on different levels in order to identify the stage of development.
In this way, the threat can be combated "just in time".

Optimization instead of maximization!

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MARWIS wins the Industry Award 2015 and is thus regarded as one of the greatest innovations in the SME sector.

In the Anniversary Edition of the Brand Lexicon, Lufft was proclaimed "Brand of the Century".

The Prism Awards are also known as the Oscars of Photonics. An eminent panel of experts distinguished MARWIS as a finalist.

**G. Lufft belongs to the TOP 100 innovators.
By winning this coveted prize awarded by the TOP 100 mentor Ranga Yogeshwar, we once again successfully demonstrated our innovative strength in a scientific selection process. This encourages us to continue on our chosen path of innovation and quality.**

MARWIS helped us to win the 2015 Innovation Award of the State of Baden-Württemberg – also known as the Dr. Rudolf Eberle Award.

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