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Meteorology Division

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Insights for Experts

# Weather Station Sensor Technologies


**Bernard Kalaani**

**Regional Manager**

**OTT MEA**

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# Table of Contents

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- Brief introduction about who we are
- Basics of Weather monitoring
- Main sensors used in weather stations
- Different technologies pros and cons
- Compact weather stations
- Questions and Answers

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# OTT HydroMet

## Hydrology

### OTT

Hydrology monitoring and data management for surface and groundwater.

### SUTRON

Hydro-meteorology monitoring, data collection and management for water, weather, and renewable energy.

### HYDROLAB

Environmental water quality monitoring for surface and groundwater.

### ADCON

Plant disease monitoring and agricultural meteorology for smart farming and irrigation management.

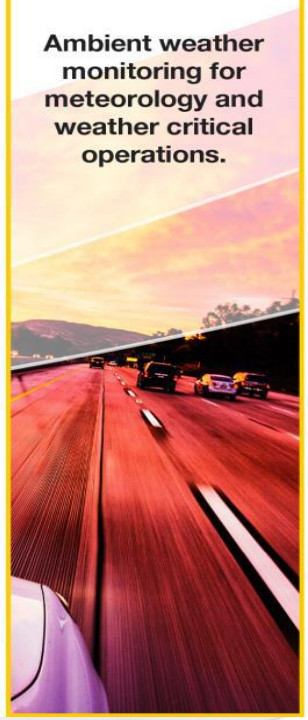
## Meteorology

### KIPP & ZONEN

Solar radiation and atmospheric properties for meteorology and solar energy.

### Lufft

Ambient weather monitoring for meteorology and weather critical operations.



### METEOSTAR

Software for real-time weather forecasting and meteorological operations.

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# Typical Weather Station

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# Components

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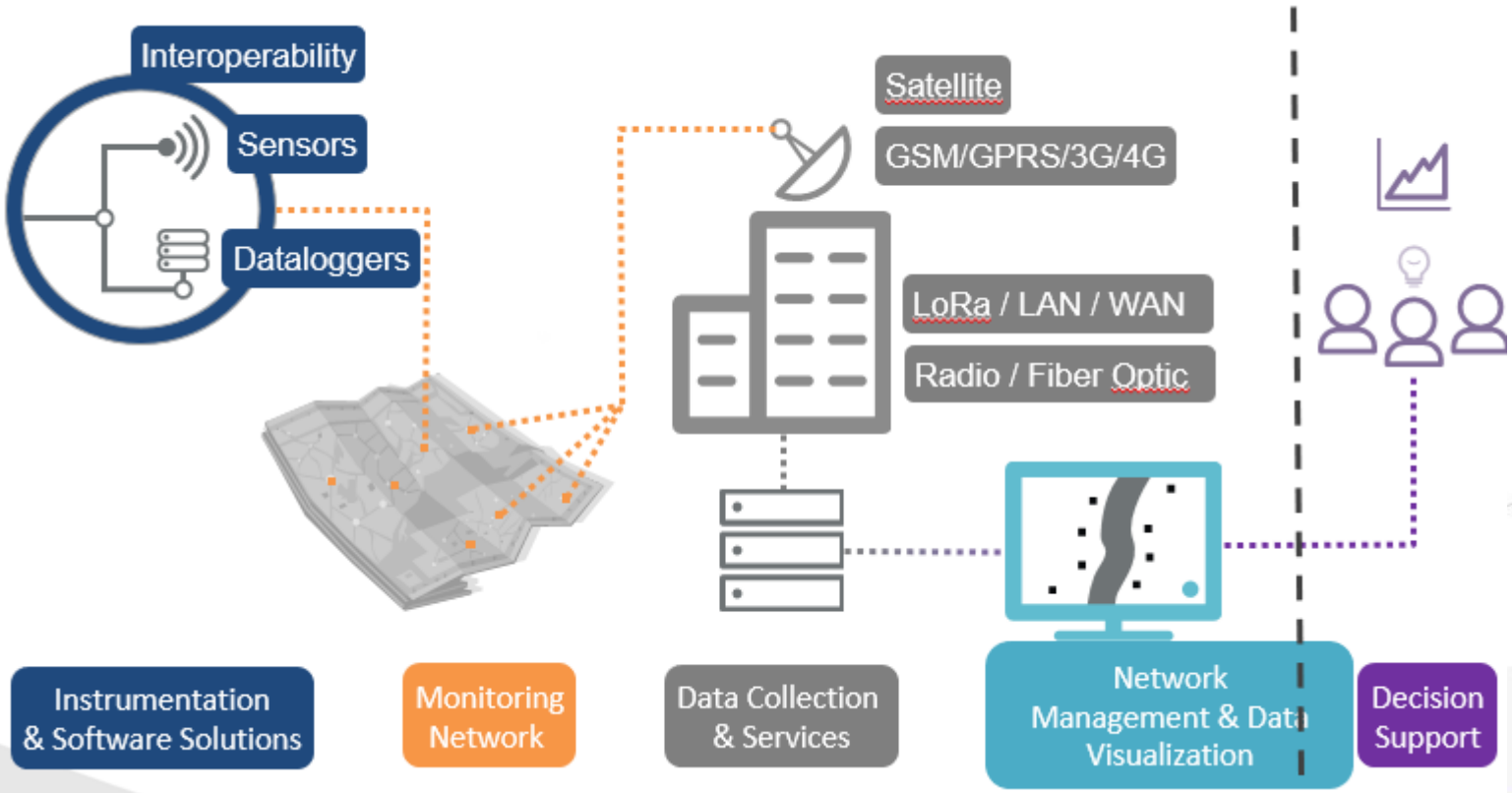
- Mountings
- Sensors
- Power Supply
- Data transmission
- Data collection

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# Sensors

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- Ambient temperature
- Humidity / Dew Point
- Barometric pressure
- Precipitation
- Wind Speed / Wind Directio
- Solar Radiation

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# Thermometers

- Thermocouples, **resistive temperature devices (RTDs, thermistors)**, infrared radiators, bimetallic devices, liquid expansion devices, molecular change-of-state and silicon diode
- **NTC: Negative Temperature Coefficient Thermistor:** Reduce their resistance as the temperature increases. They are very accurate

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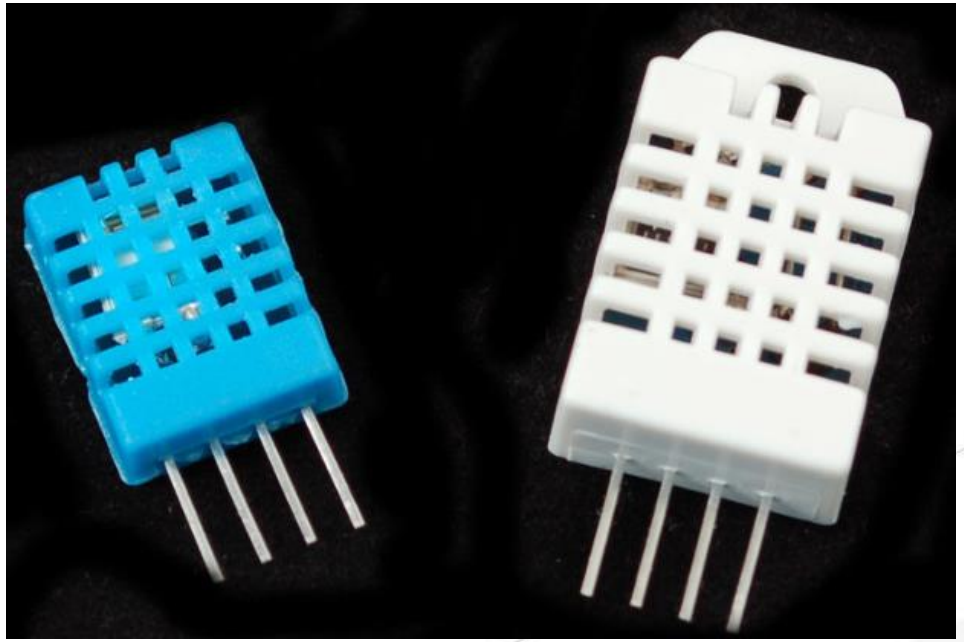
# Hygrometers

- Resistive: makes use of the change in the resistivity measured between two electrodes to establish a value of relative humidity
- Capacitive: uses capacitive measurement, which relies on electrical capacitance



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# Barometric Pressure

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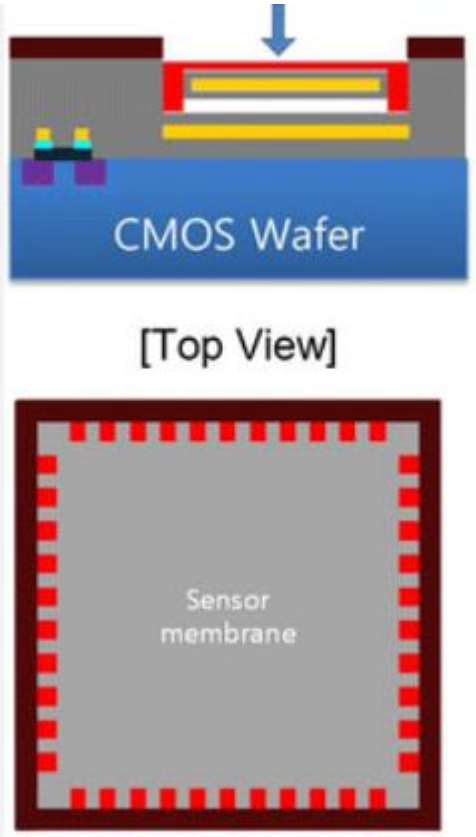
- MEMS capacitive pressure sensor: microelectromechanical systems (MEMS) is formed on a CMOS chip by using a post-CMOS MEMS processes. The proposed device consists of a sensing capacitor that is square in shape, a reference capacitor and a readout circuitry based on a switched-capacitor scheme to detect capacitance change at various environmental pressures



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# Precipitation

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- Tipping bucket
- Weighing bucket
- Tipping and weighing
- Laser
- Radar

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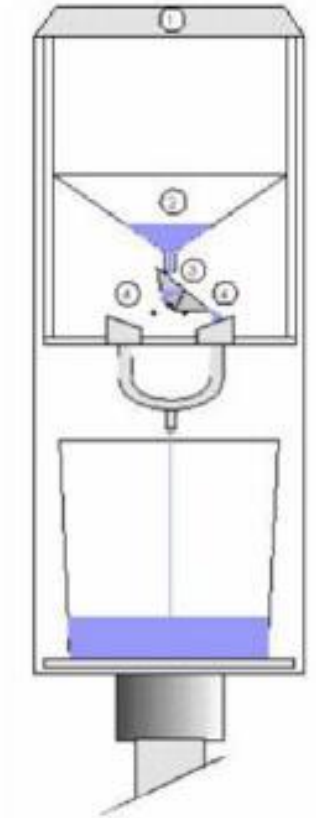
# Precipitation

- Tipping bucket



Standard
tipping bucket

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# Precipitation

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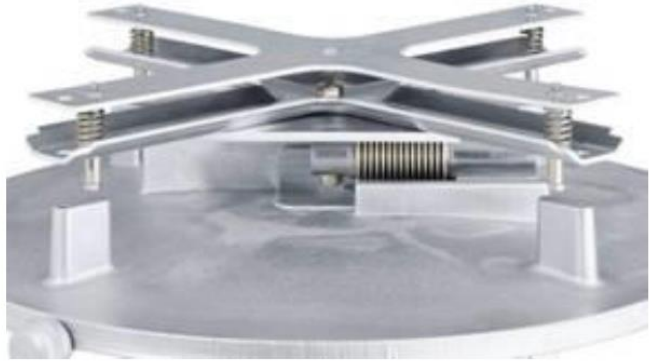
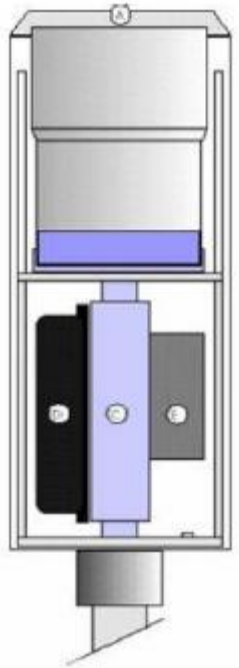
- Weighing bucket





Weighing principle

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# Precipitation

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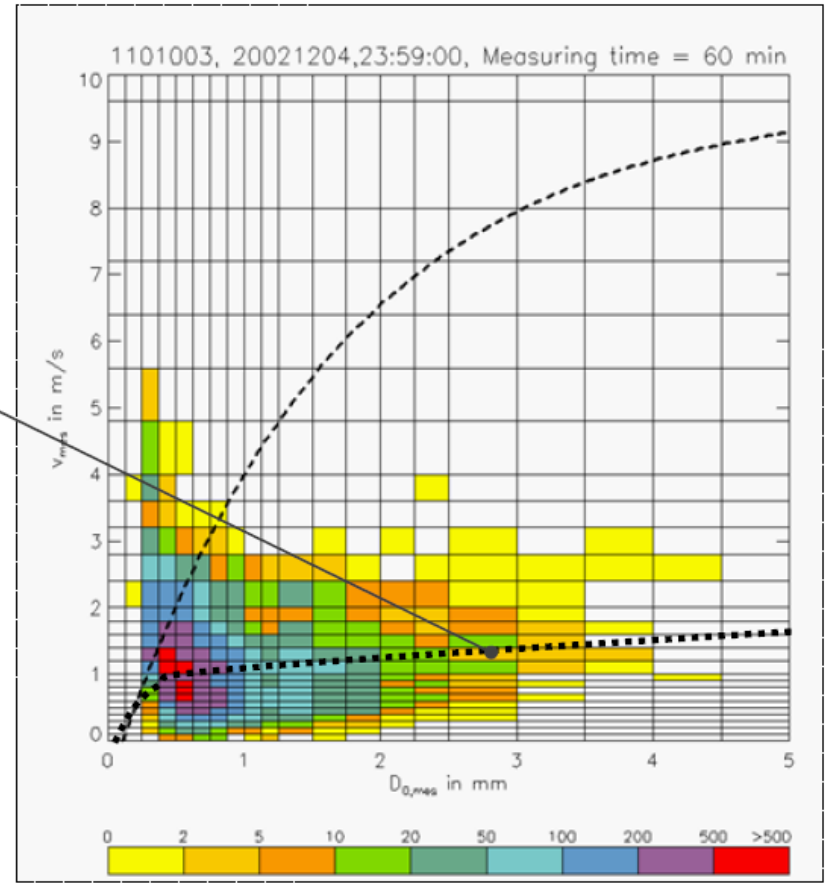
- Laser disdrometer
- Particle velocity according to Locatelli and Hobbs distribution

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# Precipitation - Radar

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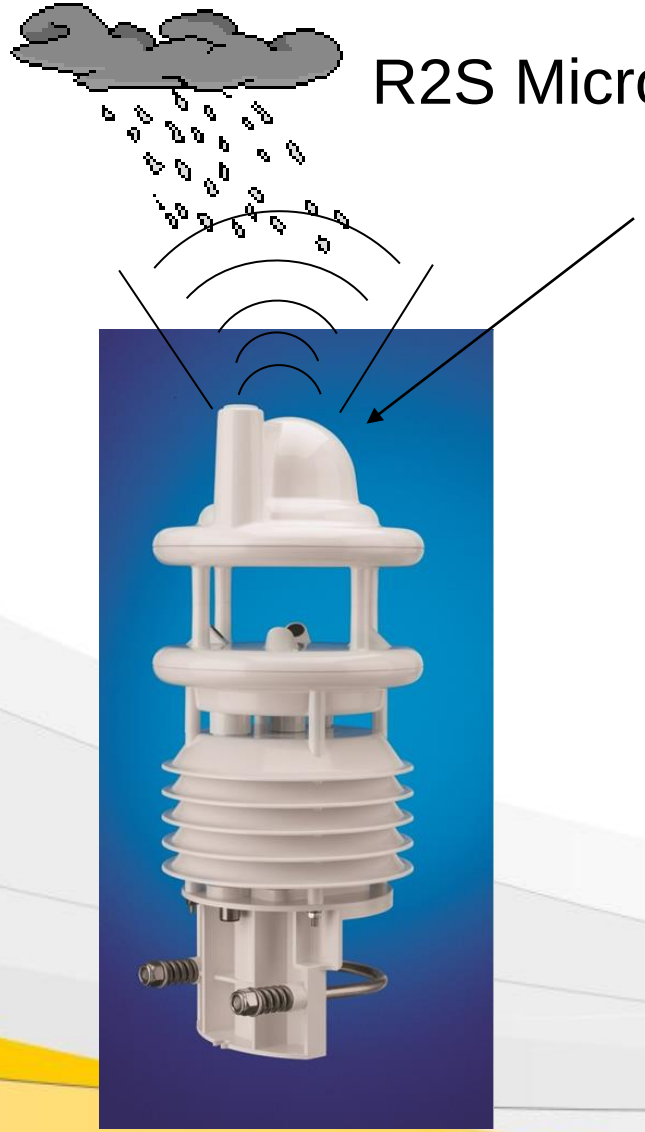
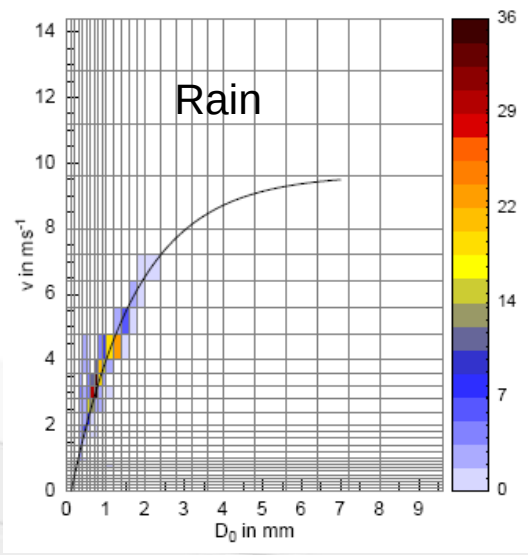
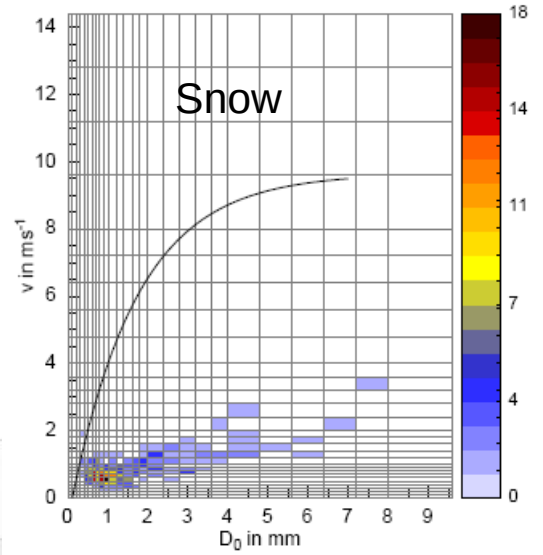
## R2S Microwaves-doppler radar principle = Present Weather Detector



24 GHz microwaves-doppler radar measures precipitation type and precipitation intensity by correlation of drop size and drop speed

Examples of distribution on drop size and drop speed at different precipitation types

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# Wind Speed and Direction

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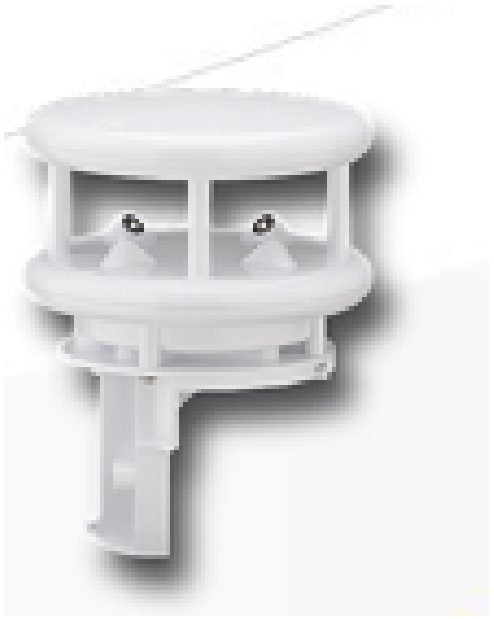
- Mechanical cup & vane
- Ultrasonic 2D and 3D



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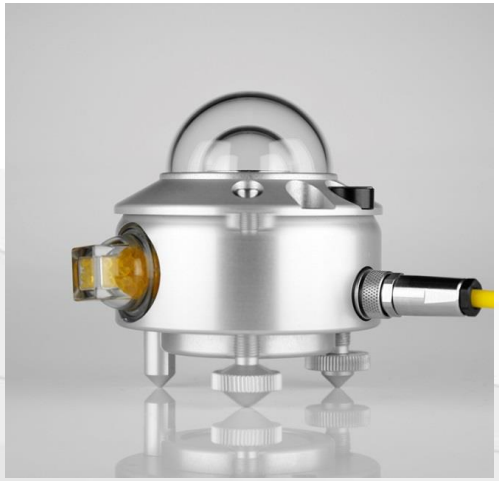
# Solar Radiation

- Pyranometer
- Pyrheliometer
- Pyrgeometer
- UV-Radiometer

→

- Thermopile
- Silicon Photodiode



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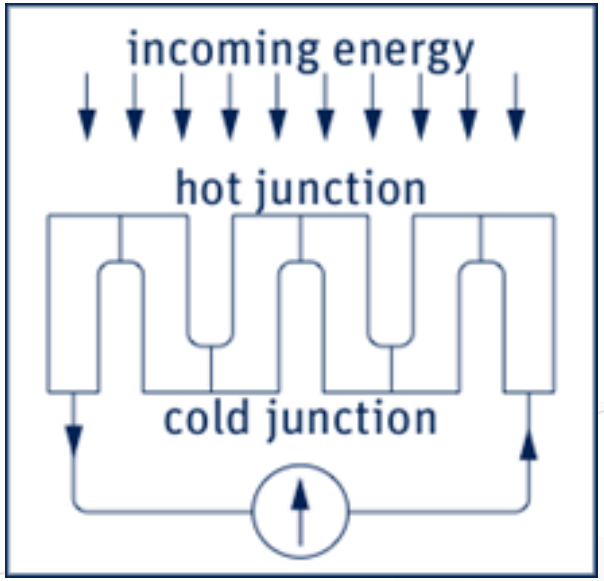
# Solar Radiation

- Incoming radiation is almost completely absorbed by a horizontal blackened surface, over a very wide wavelength range.
- The resulting increase of temperature is sensed via a large number of thermocouples connected in series, or series-parallel.
- The active (hot) junctions are connected together beneath the receiver surface and are heated by radiation absorbed in the black coating. The passive (cold) junctions are joined together and in thermal contact with the pyranometer housing, which serves as a heat-sink and thermal stabilizer.
- The temperature difference / heat flow generates a small proportional voltage.

## HOW THE THERMOPILE WORKS

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# Solar Radiation

## Sun Trackers

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# Compact Stations

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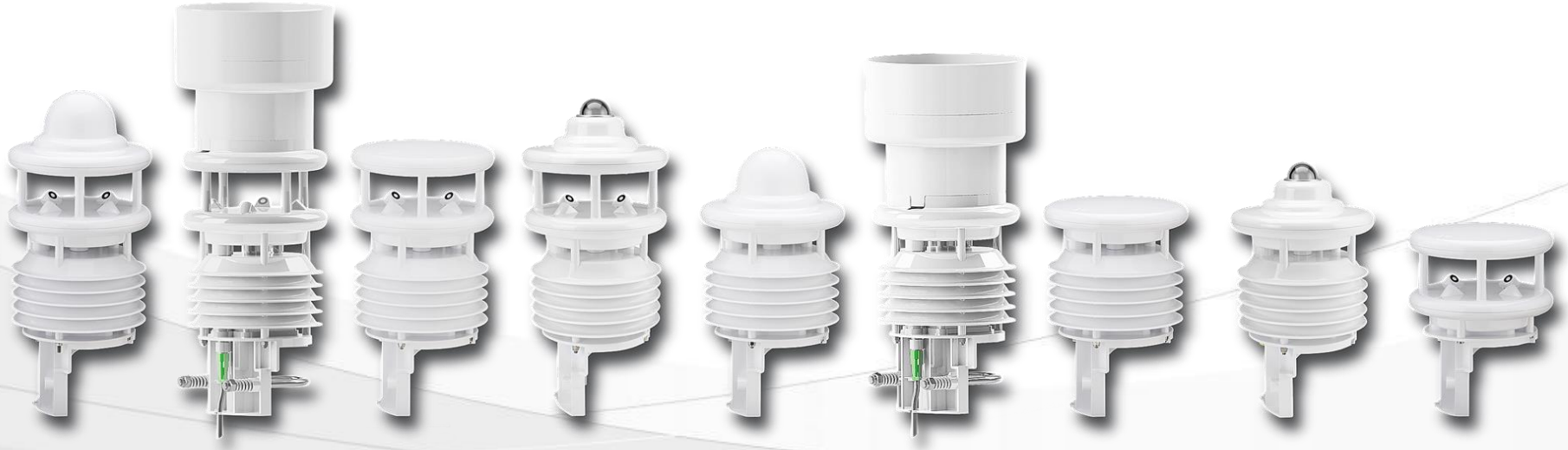
## Wind & Weather: Smart Weather Sensors

**Intelligent sensors with many different interfaces (protocols)**

WS Series Compact Weather Station, low-power-low-voltage-operation, analog output



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# WS800-UMB

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**Innovative method: R²S microwaves**–doppler radar

**Precipitation type** (rain, snow) / precipitation intensity (mm/h)

**Global radiation measurement** via **Pyranometer 0…1400 W/m²**

**Lightning detection by an integrated sensor** analyzing **the radio wave emission** of lightnings. (sum of events)

**Measurement of wind speed and wind direction**

By ultrasonic sensors. Very precise, low start-up value, maintenance-free

**Air pressure sensor**

**Measurement of air temperature and rel. humidity**

Including ventilated/aspirated radiation shield

**Data transmission and power supply in one cable**

RS485-interface up to 1200m

Digital communication of data via open ASCII, SDI-12, MODBUS or UMB protocol

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# Questions?

# Thank you for your attention

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