# Newsletter 19

Measurements during the Winter Olympics

POM Sky Radiometers for the Italian Air Force

The Different Components of Solar Radiation

**The More Intelligent Way to Measure**

Net Radiometer Integrated into Spectral Instrument

KIPP & ZONEN
SINCE 1830

# Content

January 2012





## Contact

If you have a news item for the newsletter or want to share your experiences with Kipp & Zonen applications and contribute to our next issues, please e-mail the editor: kelly.dalu@kippzonen.com



# More Innovations on the Way

Welcome to 2012! With solar radiation from yesterday you cannot light or power tomorrow. This may seem obvious but, as with so many obvious things, it is sometimes necessary to give it a second look. I refer here to measurement technology, accuracy and quality; the core values that Kipp & Zonen stands for. It is important to invest today for better quality measurements tomorrow.

Solar radiation is the driving atmospheric parameter for weather and climate, their forecasting, many of the world's economic activities, and (of course) is directly related to solar energy. Accurate measurements determine the available solar energy budget and the operational performance of a power plant, and with that the financial results. The real costs of accurate measurement equipment are very modest compared to the total investment in solar energy or the effects of climate change on the public and economies.

At Kipp & Zonen we continue to invest today for better measurements tomorrow. In 2012 we will be launching more innovative products using the unique technology of the newly released SMP3 and SMP11 smart pyranometers. These feature digital interfaces and built-in intelligence, to reduce operational costs and provide easier interfacing to a wide range of data acquisition systems, whilst improving the measurement technology.

To be amongst the first to learn about our latest developments sign up on our website for our regular e-news bulletins.

Whilst being at the leading edge in new developments, we have not forgotten our long history. We have donated the Kipp & Zonen collection of historical instruments, including the first 'Kipp gas generator', to the Dutch National Museum for Science and Medicine, the Boerhaave Museum in Leiden. If you have some time to spend in the Netherlands go and see it!

Thank you and best regards,

Ben Dieterink, President
Kipp & Zonen B.V.

# Improved Calibration of CM 4 Pyranometer

**The CM 4 high temperature pyranometer is designed for use in climate chambers and other high temperature environments with temperatures ranging from -40 °C to +150 °C and irradiance up to 4000 W/m². Now, the calibration information has been optimized with sensitivity factors given for specific temperature intervals.**

Most customers use the CM 4 only in a certain temperature range without applying the temperature correction that is supplied with the calibration certificate. Because the CM 4 is calibrated in our test facility at +25 °C, this could lead to unnecessary errors at high (or low) temperatures. In order to increase the accuracy of the CM 4 irradiance measurements in typical use we have decided to optimize the available calibration information. This is now split into six operating temperature ranges with a sensitivity specific to each range.

In practice this means that a table is presented on the calibration certificate with the operating temperature ranges and the corresponding sensitivities. For a given measurement, the sensitivity that corresponds best to the middle of that range should be used. If this is done, the maximum percentage error in the measured irradiance value will be as shown in the example table below.

| Pyranometer CM 4 | | Serial number 110275 | |
|---|---|---|---|
| Calibration temperature | Sensitivity | Operating temperature | Maximum error |
| +2.5 °C | 9.50 µV/W/m² | -20 °C to +20 °C | <0.61 % |
| +25 °C | 9.56 µV/W/m² | +25 °C | <0.00 % |
| +50 °C | 9.47 µV/W/m² | +25 °C to +75 °C | <0.98 % |
| +62.5 °C | 9.26 µV/W/m² | +25 °C to +100 °C | <3.19 % |
| +87.5 °C | 9.17 µV/W/m² | +75 °C to +100 °C | <2.21 % |
| +125 °C | 8.83 µV/W/m² | +100 °C to +150 °C | <1.52 % |

If the requirement for the CM 4 is to measure over the full calibrated temperature range (-20 °C to +150 °C), the standard calibration value of 25 °C can be used, but then the error may be larger, depending on the actual pyranometer temperature. Because the CM 4 is fitted as standard with an integrated Pt-100 body temperature sensor, the appropriate temperature correction can still be applied afterwards ■

# International Sales Meeting 2011 - Partnering for Success

**The 2011 Kipp & Zonen International Sales Meeting was our third held in the Asia-Pacific region and the chosen location was Hong Kong, from 5th to 7th October. Hong Kong is a beautiful city and our partners from Asia, Europe, Canada and the United States had a great time together. The event was organized by our Singapore office and the agenda was interactive, informative and filled with activities. Everyone had a lot to share and went home motivated for the year ahead.**

During the three days, our partners shared the developments in their companies, the current market situation, the challenges they are facing in their respective countries and their best practices.

On the second day, we had a product hands-on session with experts from Delft. Everyone had the opportunity to get practical experience with the SOLYS 2 sun tracker, the new SMP smart pyranometers, the new LAS Mk II digital scintillometer, and to ask a lot of questions. Everyone is looking forward to getting started with the new products.

*Participants at the 3rd Kipp & Zonen Asian International Sales Meeting in Hong Kong*

It was a very successful and enjoyable meeting and we would like to thank everyone for their contributions. We look forward to seeing everyone again in 2012, when the meeting will be hosted in New York by our US office ■

# Solar Radiation Measurements during the 2010 Winter Olympics

*By Rosie Howard, MSc. and Professor Roland Stull, University of British Columbia, Canada*

**In 2003 the city of Vancouver won its bid for the 2010 Winter Olympic Games to be held in British Columbia (BC), Canada. As part of 'Own the Podium 2010', a winter sports initiative designed to help Canadian athletes win more medals, a research team from the University of British Columbia (UBC) built and deployed a sophisticated weather station on the men's Olympic downhill skiing course.**



The course is located in Whistler, two hours north of Vancouver in the Coastal Mountains and home to the 2010 Olympic Alpine skiing events. The Nordic skiing venue was the Callaghan Valley a few kilometers from Whistler. Cypress Mountain was the location for freestyle skiing and snowboarding, other events were hosted in Vancouver City.

Automated measurements and manual observations were taken over three winter seasons, 2008-2010. Data from the weather station served multiple purposes:

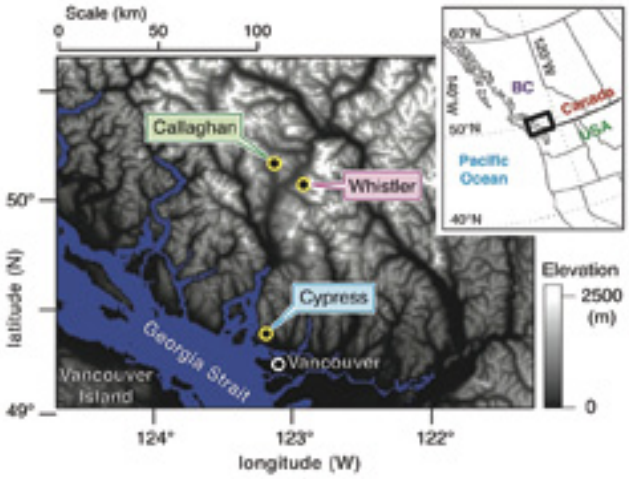



*Figure 1, the locations of the 2010 Winter Olympic and Paralympic venues, including Whistler where the weather station was deployed.*

1. Real-time use for Alpine Canada ski technicians, to aid them in choosing the fastest ski for current and forecast conditions;
2. Daily use for post-processing numerical weather prediction outputs from UBC models, to improve forecasts;
3. Daily use by the Vancouver Olympic Committee (VANOC) sports and operations managers, for their information and to provide a response if other Olympic teams inquired about the instrumentation, since it was for Canadian use only;
4. The creation of a large dataset (~16 GB) for research into snow surface conditions, mainly snow surface temperature.

The research aims to find relationships between the atmosphere and the snow surface by monitoring how each change with time, and by incorporating anthropogenic effects like grooming the ski run and skiing upon it. This way, ski technicians would have real-time and forecast snow surface conditions from simply knowing the current and forecast atmospheric conditions.

The Olympic downhill skiing course is in a high traffic recreational ski area that is groomed nightly. This presented a major challenge in capturing the effects of the skiers and grooming equipment, and in recording what was happening right at the snow surface, as closely and safely as possible. Therefore, most instruments were suspended directly over the ski run with the rest at the side of the run on a tower, as shown in Figure 2.

*Figure 2, the suspended instrument platform above the Dave Murray downhill course and instruments on a tower to the side of the ski run*



The CNR 1 net radiometer from Kipp & Zonen played a large part in this research. It was deployed on the suspended instrument carriage (Figure 3) over the snow surface to monitor the four important components of radiation, upwelling and downwelling short-wave and long-wave, with its two pyranometers and two pyrgeometers.

As expected, the surface energy budget is of utmost importance in evaluating the connection between the atmosphere and the snow surface. A preliminary look at the data confirms this, and further suggests that detailed knowledge of the radiation budget is also crucial. This requires all of the four radiation components, as measured by the CNR 1.

The instruments were removed from the site following the Olympic Games, however the study continues. A conceptual model is being created to represent the interaction between long-wave radiation emitted by the sky under different weather conditions, by the tall evergreen trees lining the Olympic course and by the snow surface itself.

This long-wave budget will be combined with solar heating of the snow, as well as other factors in the surface energy budget, to calculate snow surface temperature. Data used during the Olympics, as outlined earlier, was very well-received and feedback indicated that the information was helpful and in many cases improved team performance ■

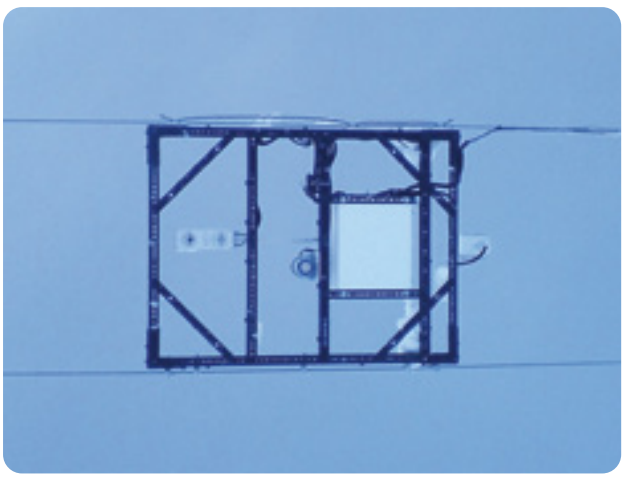


*Figure 3, under-side view of the suspended platform*

# Four POM Sky Radiometers for the Italian Air Force

*By Marco Mariano of Eurelettronica Icas and Franco Bassetto of Vitrociset SpA*

**With the increasing interest in climate change and global warming research, the effects of stratospheric aerosols are being studied with greater attention. Aerosols contribute to climate forcing through different mechanisms; on one hand, they interact with the incident solar radiation by reflecting it back to space or by absorbing it. On the other hand, they also act as condensation nuclei, modifying the properties of the clouds, which also affect precipitation efficiency.**

For studying the radiative forcing of aerosols, the sky-sun radiometry technique is the most accurate. Sky-sun radiometry is well established for measuring aerosol properties in the atmospheric column. It consists of measuring two variables at ground level; direct irradiance from the sun and diffuse radiance from the sky, in different spectral bands.

The Meteorological Service of the Italian Air Force, along with tasks which are strictly related to their missions of aviation and weather forecasting, is also making special observations such as ozone and solar radiation.

In 2010 the Italian Air Force issued a tender with the objective to procure systems to measure atmospheric turbidity (aerosol optical depth in the atmosphere), to complement their existing measurement network. As a result, four POM-01 Sky Radiometers (manufactured by Prede Co. Ltd. in Tokyo and distributed by Kipp & Zonen) were delivered in 2011 to Vitrociset SpA., the contractor for the procurement and installation. The systems will be installed in the near future at the Air Force sites located in:

Vigna di Valle (RESMA - Research Centre) by Lake Bracciano, north of Rome;
Monte Cimone (CAMM - Air Force Mountain Observatory), in the Appenine Mountains, south-west of Bologna;
Monte Paganella in the Dolomite Mountains; and
Messina, Sicily.

RESMA has been operating for a century with the task of studying and experimenting with meteorological instrumentation and of managing the data collected from special measurement networks; such as ozone, carbon dioxide, global solar radiation, sunshine duration and the chemical analysis of precipitation.

CAMM is established on Mount Cimone, at 2165 m altitude and has the task of carrying out environmental observations, in particular the values of background concentrations of atmospheric pollutants. Besides ordinary observations, special measurements are made of ozone, solar radiation, precipitation sampling and carbon dioxide.

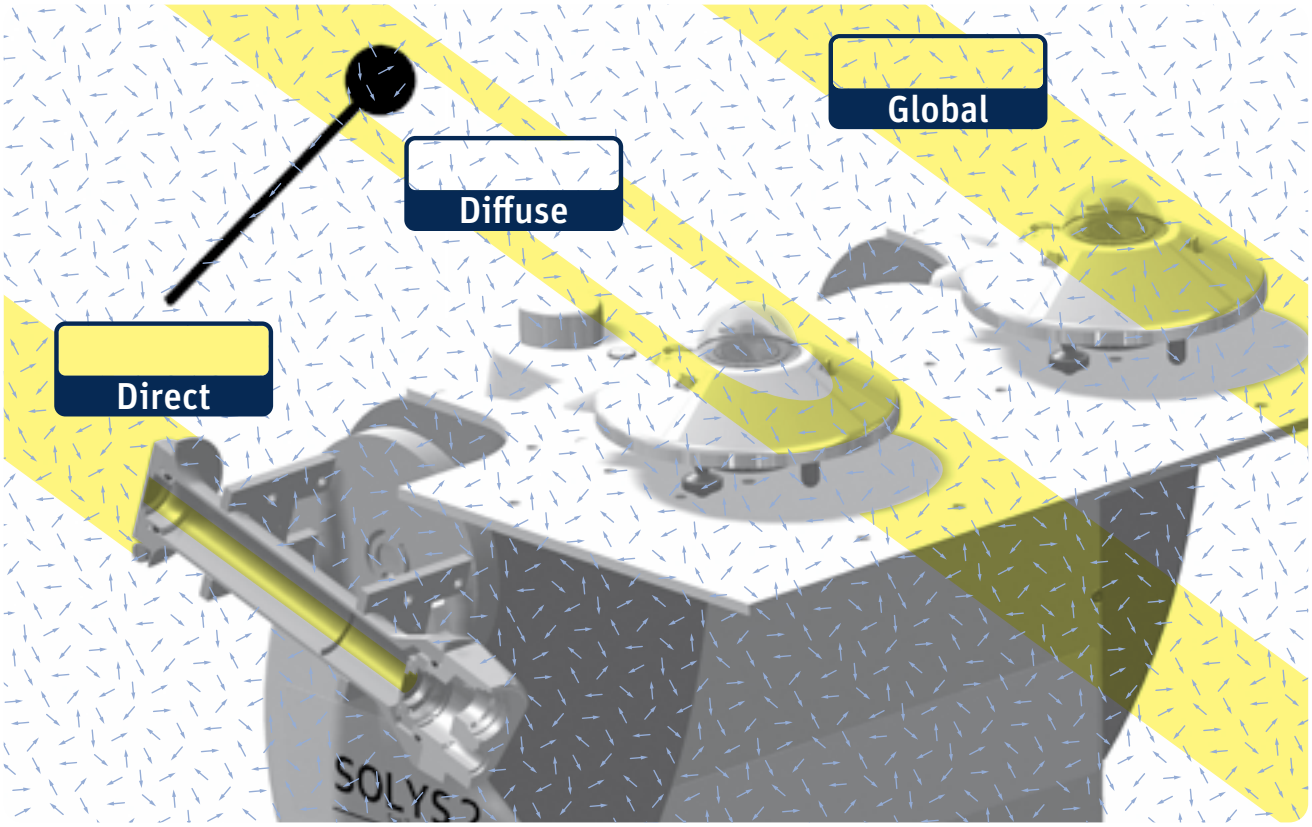
POM-01 and POM-02 are used in the Asia-Pacific SKYNET network, in the European Skyrad Users Network (ESR) and for aerosol monitoring and satellite ground-truthing around the world ■

Vitrociset SpA. **www.vitrociset.it**
Contact: Franco Bassetto

Kipp & Zonen is represented in Italy by Eurelettronica Icas Srl.
**www.eurelettronicaicas.com**
Contact: Maria Rita Leccese

# The Different Components of Solar Radiation

**Many people have asked us for an illustration that gives a simple overview of the three components of incoming short-wave solar radiation; direct, diffuse and global. We have now created a drawing that we hope will make this clear. We offer a range of instruments to measure each of these components.**






**Direct**

The basis is a SOLYS 2 sun tracker pointing a CHP 1 pyrheliometer at the centre of the sun. The CHP 1 has a full opening view angle of 5° and measures the normal incidence direct irradiance from the sun and its aureole - shown by the yellow beam.

Some of the direct radiation from the sun is absorbed in the atmosphere and some is scattered by clouds, aerosols, and molecules. This scattered component is the diffuse solar radiation, that comes from the sky in all directions, and is indicated by the blue arrows.

**Diffuse**

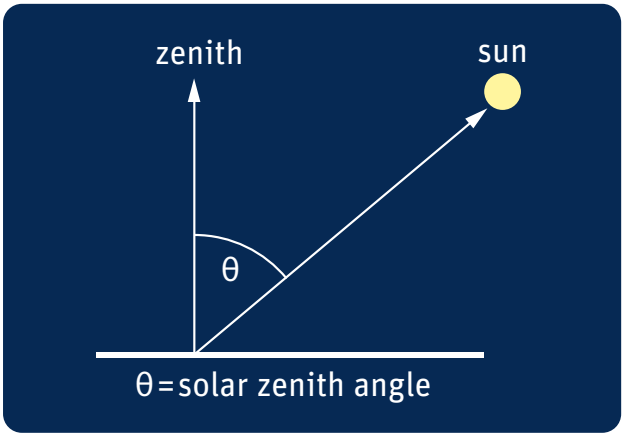
A CMP series pyranometer mounted on the SOLYS 2 can see the complete sky hemisphere, but the direct radiation from the sun (yellow beam) is blocked by a shading ball that moves with the tracker. Therefore, the pyranometer only measures the diffuse irradiance.

**Global**

The second CMP pyranometer can see both the direct and diffuse radiation and measures the horizontal global irradiance.

Irradiance is measured in W/m² and the World Meteorological Organisation (WMO) symbols for the three components of incoming short-wave solar radiation are given below ■

| | |
|---|---|
| Direct Solar Irradiance | $E$ |
| Diffuse Sky Irradiance | $Ed\downarrow$ |
| Global Irradiance | $Eg\downarrow = E.\cos\theta + Ed\downarrow$ |
| | (where θ is the solar zenith angle) |



# The More Intelligent Way to Measure Solar Radiation

**Smart is what we call our new range of pyranometers. Kipp & Zonen recently revealed the next generation of solar radiation measurement, the SMP3 and SMP11. The SMP series of smart pyranometers are intelligent and can communicate directly over a standard industrial RS-485 interface. They also have an amplified analogue output. More importantly response time is improved and accuracy is increased, thanks to smart algorithms and digital temperature compensation.**

The SMP series pyranometers are based on the well-known CMP 3 and CMP 11 and use the same sensor technology and housing design. Our smart pyranometers have been created to meet the requirements of industrial applications, such as solar energy monitoring, where a digital interface is a distinctive advantage.

**RS-485 Modbus®**

SMP's have a 2-wire RS-485 serial bus with Modbus® RTU protocol to communicate with PLC's, industrial data acquisition systems or computers. Real-time measurements of solar irradiance, body temperature and power supply voltage are available through the supplied software. Instrument-related information such as calibration history, instrument type and serial number can also be requested. Available settings are the Modbus® configuration, filtering, temperature compensation, scaling and firmware updates.

The RS-485 structure allows up to 247 devices to be connected in parallel to the 2-wire bus. Other meteorological sensors are already available with RS-485 interface, so with the addition of a SMP smart pyranometer a complete digital automatic weather station can be assembled without the need for traditional data loggers.

**Low power consumption and a built-in analogue amplifier**

The SMP's are available in two versions:
SMP3-V and SMP11-V have RS-485 Modbus® and a 0 to 1 V analogue output;
SMP3-A and SMP11-A have RS-485 Modbus® and a 4 to 20 mA analogue output.

Both versions consume very low power, 55 mW for -V and 100 mW for -A, and have a wide supply voltage range from 5 to 30 VDC. There is protection against reverse power polarity and short circuited outputs.



*SMP11 on display at Meteorology Technology World Expo: A halogen lamp over the pyranometer resulted in a display of more than 700 W/m²*

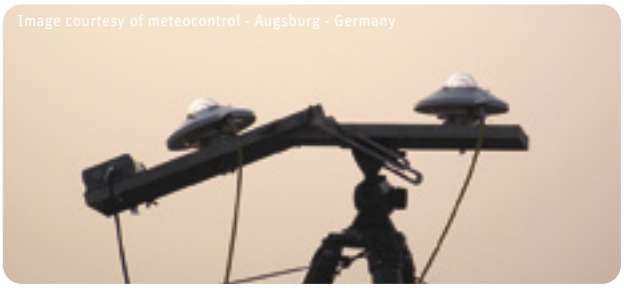


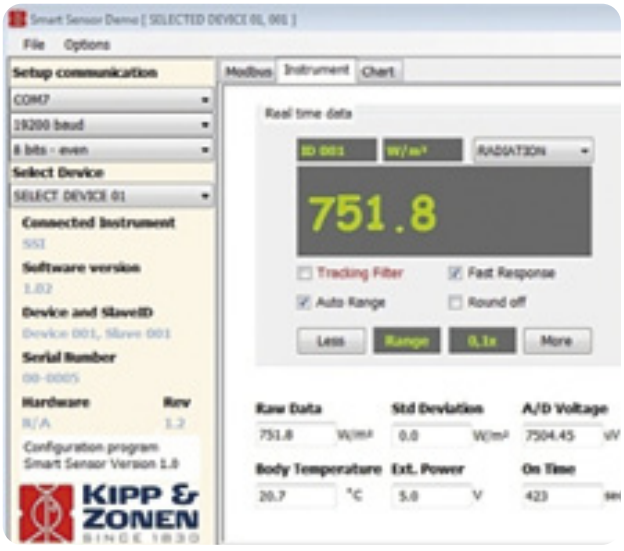
Image courtesy of meteocontrol - Augsburg - Germany

**Digital temperature correction and faster response**
An integrated temperature sensor and polynomial functions provide correction for the temperature sensitivity of the detector. A digital signal processing algorithm speeds up the response time.

**Interchangeable pyranometers**
All SMP's are programmed to have identical sensitivity and output levels, making them easily interchangeable for recalibration or service.

**First launch feedback**
The introduction of the new SMP pyranometers took place simultaneously in Europe and the USA; at the Meteorology Technology World Expo (MTX) in Brussels and at Solar Power International in Dallas. The new pyranometers were shown running off a 9 Volt PP3 battery, with a RS-485 to USB converter and a software program on a PC. The SMP11 at Brussels is shown in the picture.

A halogen desk lamp over the pyranometer resulted in a display of more than 700 W/m² (see screen shot below) and the enhanced response time could be easily demonstrated.




The new pyranometers drew a lot of attention from both solar energy and meteorology customers. They were quick to realize the advantages of the RS-485 Modbus® protocol, the digital signal processing and the ease of interfacing.

The SMP3-V and SMP11-V pyranometers are available from January 2012 with the -A versions following a few weeks afterwards.

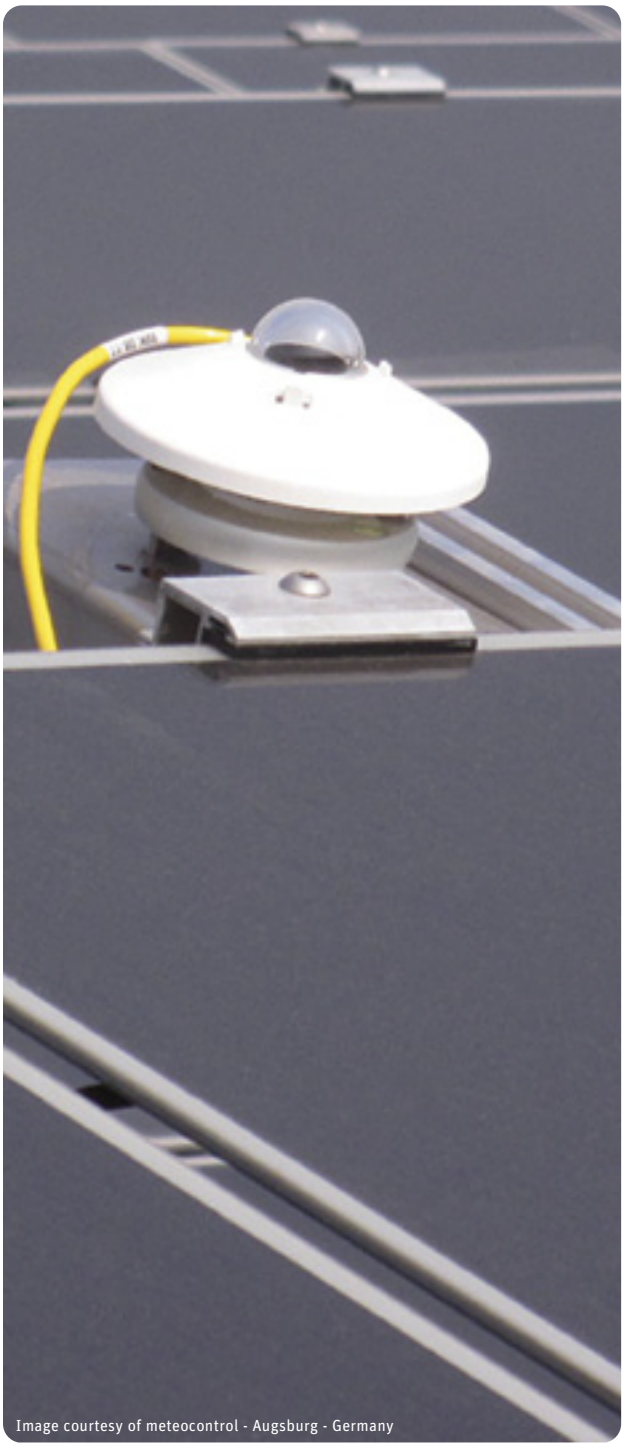


Image courtesy of meteocontrol - Augsburg - Germany

# Special Kipp & Zonen Net Radiometer Integrated into New Spectral Instrument

**One of the key ingredients that plants require to grow is light. It is well known that a specific range of wavelengths, named Photosynthetically Active Radiation (PAR), plays the most important role in the conversion of $CO_2$ into sugar (Photosynthesis). Now there is a new way to measure this radiation that is so critical to horticulture and agriculture.**




For the measurement of the total amount of PAR radiation available a PQS 1 sensor is often used. However, for certain applications, for example when LED's are used as the light source, more in-depth knowledge of the spectral composition of the radiation is required.

A second factor of importance is that many crops have an optimal yield at a specific ambient temperature. The temperature is driven by changes in solar radiation and the thermal infrared radiation exchange. This energy balance is measured by net radiometers.

In 2010 three Dutch companies - Croppings, Beemster Trading and Avantes - developed the HortiSpec+, a novel instrument combining both spectral and net radiation measurements. The instrument is based on a spectral radiometer sensitive to wavelengths between 200 nm and 1100 nm with a 0.5 nm resolution, and a single component broadband net radiometer with a measurement range between 200 nm and 100 µm. This HNR 1 net radiometer is based on the NR Lite2 and specially adapted for this application by Kipp & Zonen.

The HortiSpec+ provides spectral measurements of PAR, radiation intensity, several wavelength ratios and the total net radiation balance. The main benefit of combining spectral and net radiation measurements is that it gives vital information on several parameters for crop optimization, especially when growing fruit, vegetables and flowers in greenhouses. Lighting within greenhouses needs to be carefully controlled to achieve the best yield and quality.

Accurate measurements provide information on the amount of energy from both the sun and lamps that is received by plants inside the greenhouse and decisions can be made to close sun blinds or dim lights. If the net radiation changes significantly a temperature change can be expected to follow. This can then be anticipated by controlling the heating system.

For greenhouses energy is a major part of the total production costs. A study at the University of Applied Sciences Den Bosch has shown that by using the data from the HortiSpec+ as an input for greenhouse climate control systems, energy savings from 10 % to 20 % are achievable.

Spectral measurements of solar radiation, and PAR in particular, also have applications in the fields of agronomy and forestry. For example, accurate measurement of the spectral distribution of PAR and the ratio of blue to red, and red to far-red, wavelengths provides a deeper knowledge of the solar radiation available for plant development both above and below forest canopies.

For more information on the HortiSpec+ please contact Mr. Jos Beemster of Beemster Trading at www.hortispec.nl (in Dutch) or translated through Google ■

# Kipp & Zonen in European UV Research Project

**Kipp & Zonen is a partner in the new European Joint Research Project "Traceability for Surface Spectral Solar Ultraviolet Radiation". This project, EMRP ENV03, is a collaboration between National Metrology Institutes (NMI's), the research community in Europe and partners from industry.**

The aim of the project is to improve the reliability of spectral solar UV radiation measurements at the earth's surface by developing new techniques and instruments and by shortening the traceability chain to the fundamental SI unit. The target is to provide traceable solar UV measurements with an uncertainty of 1 % to 2 %; a factor of 5 improvement compared to the current situation. This is essential to quantify changes in solar UV radiation over decades that are expected to affect the global climate system.

Kipp & Zonen is involved in this three year project because the Brewer spectrophotometer is the most commonly used instrument for spectral solar UV measurements world-wide.

The National Metrological Institutes of the Netherlands, Germany and Switzerland (VSL, PTB and METAS) will develop new standard lamps for irradiance and wavelength calibrations. To test these new light sources, we will provide a Brewer MkIII spectrophotometer. Together with Aalto (NMI of Finland) and CMS-Schreder of Austria, we will develop an improved diffusor for the Brewer input optics to measure UV global radiation.

Participants in the EMRP ENV03 kick-off meeting

The project started in August 2011 and will run until July 2014. Several meetings and technical workshops are scheduled that also invite the end-users of UV instruments. The latest developments will be presented at several conferences. The project officially ends with an inter-comparison of UV spectroradiometers of about 10 days in May/June 2014 at the World Radiation Center, Davos, Switzerland. This will provide access to the tools and techniques developed during the project in order to significantly decrease current uncertainties in measuring spectral solar UV radiation ■

# French Office Expanded with Customer Support

**Kipp & Zonen is pleased to announce the arrival of a new team member, Pierre Simonneaud. He recently joined the French office as a Customer Support Technician. Pierre will be working on providing consultation, support and training to our French customers.**

With over 3 years of experience in laser servicing and diagnosis at Quantel, a Higher Technician Certificate in Optics & Photonics and a Bachelor of Electronics degree obtained with honors, we are confident he will quickly feel at home in the field of solar radiation monitoring.

"My goal is to progress in a leading company that serves fast growing and modern markets such as renewable energy and climate change investigation. I'm happy to be part of the opportunities for the French office to closely work together with our customers and provide them with technical support. I started on the 1st of December and already feel that it will be a long and good experience."

Please join us in warmly welcoming Pierre ■

# Fairs & Events

| | |
|---|---|
| 92nd American Meteorological Society Annual Meeting<br>New Orleans, Louisiana, USA | 23 - 26 January 2012 |
| European Geosciences Union General Assembly 2012<br>Vienna, Austria | 23 - 26 April 2012 |

# Passion for Precision

Kipp & Zonen is the leading company in measuring solar radiation and atmospheric properties. Our passion for precision has led to the development of a large range of high quality instruments, from all weather radiometers to complete measurement systems.

We promise our customers guaranteed performance and quality in; Meteorology, Climatology, Hydrology, Industry, Renewable Energy, Agriculture and Public Health.

We hope you will join our passion for precision.

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