
# Newsletter 22

Solar Carports Monitored with Pyranometers

New Insights into the Greenhouse Effect

**High Accuracy of SMP3 Makes a Big Difference**

KIPP & ZONEN
SINCE 1830

# Content

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## 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



# Solar Energy and Science

India is the third largest economy in the world. The total population is 1.22 billion, with approximately 300 million people in rural areas without connection to the electricity grid. Since 2007, 18,000 of these villages have been connected to some form of solar powered electricity source.

On Sunday 29th July a big power failure struck the northern India grid and 370 million people lost their electricity. The following Tuesday three of the five high voltage networks broke down and 684 million people lost access to electricity. This was the biggest power failure in human history.

The northern part of India has some of the sunniest locations in the world and India is developing solar energy technology rapidly. The Sun is the ideal energy source for an enormous number of people in India. Let's hope that the implementation of solar energy in India will go fast and smoothly, it can raise the standard of living for many to a higher level.

In the second week of August international scientific experts convened in Berlin for the International Radiation Symposium (IRS) 2012. The program was impressive; radiation budget and forcing, particle radiative properties, radiative transfer modeling, radiation and weather, environment and climate, surface measurements, field experiments, molecular radiative properties, remote sensing, and UV radiation. Kipp & Zonen exhibited there and we had many excellent discussions with the scientific community.

The roots of Kipp & Zonen's solar radiation measurements lie in atmospheric sciences. We will never forget these roots and we intend to keep supporting this community with our top quality instruments, and we are looking forward to new challenges in cooperation with scientific institutes. We are continuously looking for the innovative developments that the scientific community is asking for.

We have recently employed a full-time scientist, to further these aims, and you can read more about him in this Newsletter.

Enjoy reading the 22nd issue of our newsletter.

Foeke Kuik -
Business Development Manager
Kipp & Zonen B.V.

# Solar Carports Monitored with CMP 11 Pyranometers

**Every rooftop can be turned into a source of power. “So why not the rooftop of a carport?” is what the City of Industry thought when developing a new solar facility at the Metrolink public train station in Southern California, U.S.A.. Thanks to Trimark Associates Inc. this 1.5MW (AC) power generating project uses two CMP 11 pyranometers to monitor the energy produced.**

To show their commitment to renewable energy, the City of Industry, Los Angeles, took the opportunity to convert the Metrolink station parking lot into a state-of-the-art solar power generating facility that provides energy to the grid, along with individual charging stations for electric vehicles. Trimark Associates was part of a design and build construction team and provided two CMP 11 pyranometers, and a Lufft WS501 weather station to the City of Industry. Other team members were Oltmans Construction, Gregg Electric and Panelized Structures.

The Lufft WS501 weather station features an integrated Kipp & Zonen CMP 3 pyranometer that measures the global horizontal irradiance for this project. The two CMP 11’s measure the plane of array (POA) irradiance; one of the key factors to predict solar power production and critical in this project because of its connection to the power grid maintained by CAISO (CA Independent System Operator). CAISO requires reliable and accurate radiation data to predict the expected energy generation and to confirm the power produced. The real-time data from the CMP 11 pyranometers and the Lufft unit are collected by a Data Acquisition System (DAS) and automatically relayed to CAISO.

**About Trimark Associates Inc.**

Trimark provides technology based systems to electric power producers. These systems include meteorological data collection, power production monitoring, and revenue metering. Trimark is a supporter of the California Solar Initiative (CSI), and is proud to have its meters and meteorological equipment installed at hundreds of commercial and utility sites throughout the state, as well as across the country.

“We have many years of experience with Kipp & Zonen instruments. We’ve used them extensively in our meteorological monitoring systems.” says Trimark’s Dean Schoeder, Director of Engineering. “They are the industry standard and the usual choice for a project like the City of Industry’s solar carports.”

Find out more at **www.trimarkassoc.com**



# New Insights into the Greenhouse Effect

*By Dr. Rolf Philipona, Senior Scientist, MeteoSwiss, Aerological Station Payerne, Switzerland*

**In September 2011, a Kipp & Zonen CNR 4 net radiometer was used to make the first high quality measurements of radiative flux profiles through the atmosphere from the Earth's surface to above 30 km in the stratosphere. During two-hour balloon flights, the solar short-wave and thermal long-wave radiation was measured, both downward and upward.**

*Figure 1*

*CNR 4 mounted between two Meteolabor radiosonde packages*

Solar short-wave and thermal long-wave radiation at the Earth's surface and at the top of the atmosphere is commonly measured at surface stations, from aeroplanes and from satellites. However, upper-air observations for climate have recently been given more attention with the initiation of the Global Climate Observing System (GCOS) Reference Upper Air Network (GRUAN) to provide climate-quality measurements of variables in the upper troposphere and lower stratosphere (UTLS).

The primary objectives are to monitor changes in temperature profiles and to characterise water vapour. Temperature and water vapour changes in the atmosphere alter radiative fluxes; so in-situ measurements of the fluxes through the atmosphere, and particularly the UTLS, provide valuable information.

Of greatest importance with regard to climate change are the upward and downward long-wave radiation profiles, which are directly related to radiative forcing through the atmosphere. Measurement of these profiles would provide greater understanding of radaitive forcing and the Earth's greenhouse effect.

Researchers from MeteoSwiss used two Meteolabor SRS-C34 radiosondes, which measure air temperature and humidity, and are equipped with additional channels measuring the four thermopile signals and several instrument temperatures from a Kipp & Zonen CNR 4 net radiometer. The CNR 4 was mounted between the two radiosondes as shown in figure 1.

All the body and dome temperatures of the radiometers are measured with the same type of thermocouples as used for air temperature measurement in the SRS-C34. Precise body and dome temperature measurements are crucial to enable corrections for the differential thermal emissions between the radiometer domes and the thermopiles. These result from large temperature gradients caused when the instrument cools from +20 °C at the surface to -60 °C in the stratosphere.

A new technique is used to lift the equipment, consisting of two balloons with carefully adjusted lifting capacities and a GPS-controlled mechanism to automatically release the 'carrier' balloon at a pre-set altitude.

The two balloons lift the payload at a constant climb rate of about 5 m/s. After release of the carrier balloon, the payload descends at a similar rate using the 'parachute' balloon. The balloon arrangement is shown in figure 2.

*Figure 2*

Figure 3 shows the radiation components at ground level at the Payerne Baseline Surface Radiation Network (BSRN) station. Short-wave downward *(SDR)*, upward *(SUR)* and net *(SNR)* radiation; and the corresponding long-wave radiation, *(LDR)*, *(LUR)* and *(LNR)*. These are 1 minute averages over 24 hours on 23 September 2011.

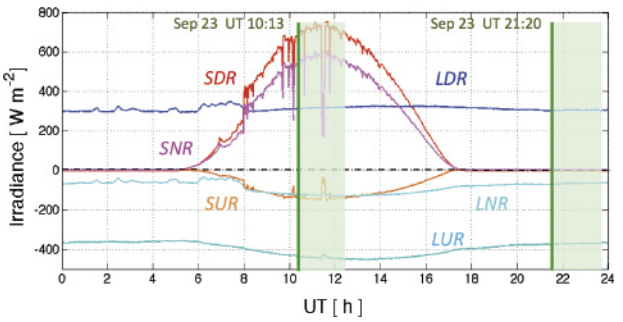


*Figure 3. Surface radiation measurements at Payerne BSRN station*

The daytime upper-air radiometry sounding was launched from Payerne at UT 10:13. The payload was recovered in the afternoon and launched again at UT 21:20, nighttime. Upper-air radiation profiles for the day and night flights are shown in figure 4.

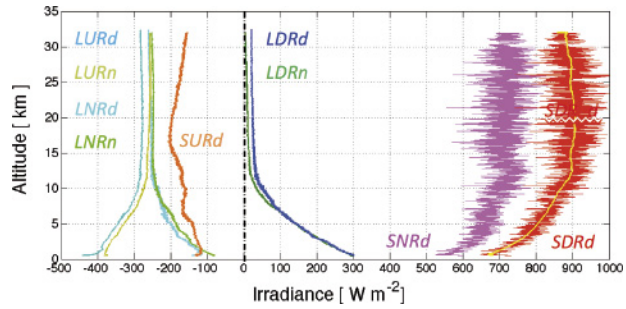


*Figure 4. Day and night radiation profiles above Payerne*

The daytime short-wave downward radiation *(SDRd)* shows about 680 W/m² at the surface and 880 W/m² at 32 km. This altitude was reached at UT 12:30. The solar height at the sonde's location was 40.92 degrees, resulting in a direct solar component of 1344 W/m². This is more than 99 % of the direct solar irradiance of 1352 W/m² above the atmosphere on 23 September.

The measured *SDRd* signal is rather noisy due to rotation of the payload, and to fit a smoothing curve to the dataset a locally weighted least squares regression technique is used (yellow line). The short-wave upward radiation *(SURd)* shows about -130 W/m² at the surface and -160 W/m² at 32 km. The short-wave net radiation *(SNRd)* is 550 W/m² at the surface and 720 W/m² at 32 km.

The surface-emitted long-wave upward radiation is about -445 W/m² during the day *(LURd)*, but only -380 W/m² during the night *(LURn)*. However, *LURd* shows a strong decrease during the first 1,000 m and then decreases to about -280 W/m² at the tropopause. *LURn* decreases similarly. Above the tropopause *LURd* and *LURn* stay fairly constant, with the night emission about 20 W/m² lower.

Long-wave downward radiation in the day *(LDRd)* is similar to nighttime *(LDRn)* in the lower troposphere, decreasing from about 300 W/m² at the surface down to about 15 W/m² at the tropopause. Above the tropopause, *LDRn* decreases steadily down to 4 W/m² at 32 km. However, *LDRd* is always about 15 W/m² higher even at 32 km.

This difference, which is observable above 7 km, is due to thermal long-wave radiation from the Sun. *LNRd* at the surface is about -140 W/m², whereas during the night *LNRn* is only about -80 W/m². However, the difference decreases with height and at 32 km the day and night net emissions are -270 W/m² and -260 W/m², respectively.

Consistency observed between different flights, with measurements of more than 99 % of direct solar irradiance at 32 km and long-wave downward radiation down to 4 W/m² at 32 km, show that upper air solar and thermal radiation can be reliably measured through the atmosphere.

The radiation profiles shown were all measured under cloud-free conditions, which is normally necessary for greenhouse effect studies. However, future measurements through clouds, aerosols or other atmospheric constituents will allow the investigation of short-wave and long-wave radiative effects, and the climate forcing at different altitudes which is directly related to greenhouse effects ■



**References**

Rolf Philipona, Andreas Kräuchi, and Emmanuel Brocard. 'Solar and thermal radiation profiles and radiative forcing measured through the atmosphere'. Geophys. Res. Lett., 39, L13806, doi:10.1029/2012GL052087, 2012.

# The Ease of Use and High Accuracy of the SMP3 Smart Pyranometer Makes a Big Difference

**One of the first companies to work with the SMP3 smart pyranometer introduced last year is Advanced Green Technologies (AGT) of the United States. Now that they have finished their initial tests and have applied the SMP3 in six live Photovoltaic (PV) projects, they report back with their experiences. The accuracy of the instrument is extremely important because slight errors can have a huge impact on the data.**



AGT is an International, full service Engineering, Procurement and Construction (EPC) contractor specializing in rooftop solar arrays from 100 KW to more than 5 MW. Working cooperatively with local utilities and inspection authorities is one of their key values to getting projects connected to the grid and maximizing the return on investment for their clients. AGT Solar works closely together with two leaders in renewable energy financing and investment; Moose Power in Canada and Nautilus Solar in the United States

Marcelo Lorenzo, Project Manager at AGT Solar explains: “A large part of our job is measuring the production and efficiency of the systems we install. The accuracy of the devices we use for that is extremely important. Even slight variations can have a huge impact on the data. Kipp & Zonen pyranometers are unmatched in their level of accuracy and performance and are vital to our company for insuring each installation is performing at or above specification.

We have specified the SMP3 smart pyranometer for its Modbus output. Our systems are closely monitored through the use of Modbus RS-485 and Modbus TCP devices. Having a pyranometer that does not require an additional piece of equipment to translate the incoming millivolt and/or milliamp signals was the decisive factor.

We have now installed the instruments on 6 live projects. We left the irradiance sensor from a different supplier, which was originally installed on the projects, in place for comparison to the SMP3. We are extremely impressed with the results. While the competitor is fairly accurate in higher irradiance conditions, it is on the lower end of the scale (below 300 W/m²) that we are seeing a significant difference. The level of accuracy in these conditions has improved anywhere from 10 to 40 %. When contract value is tied to performance results, you can understand how much of an effect this might have on the bottom line.

We are very satisfied with the service and support we have received from Kipp & Zonen and the US sales office. With that in mind, and the unrivaled accuracy of the measurement and the ease of use, we decided to choose Kipp & Zonen.” ■

# Welcoming our new Scientist

**To maintain and increase our expertise in both research and customer support, we are delighted to welcome Keith Wilson to Kipp & Zonen. He is our new scientist within the Research & Development team, expanding our scientific and technical capacity for present and future products, and will be our main representative in the scientific community.**

We will let Keith explain what he will be doing:

"Initially I will focus on knowledge regarding the Brewer spectrometer and maintaining the high quality of the instrument as an Ozone and UV measurement reference worldwide. I will also be studying the scientific principles behind the Large Aperture Scintillometer (LAS), and setting up a reference instrument for improved LAS calibrations. This will be measuring over a 1 km path close to Kipp & Zonen and will also provide insights into the urban heat island effect above Delft.

I have 19 years' experience in instrument development and research, in the field of atmospheric measurements and climate studies. This has involved diverse field measurements such as trace gases in the troposphere measured on aircraft, solar radiation interacting with snow or clouds, pollution from poultry and vehicles, and remote sensing from the ground.

I studied and worked in England until 10 years ago when I emigrated to the Netherlands with my family. My previous position involved optical design of new encoders and spectrometer products with Anteryon in Eindhoven. Prior to that, I developed the multi-wavelength Raman LIDAR system, Caeli, initially at the National Institute for Public Health and the Environment (RIVM) and then at the Royal Netherlands Meteorological Institute (KNMI).

I look forward to meeting Kipp & Zonen customers around the world to see their diverse applications and installations in the field and helping them to solve problems and find new applications" ■

*Keith Wilson and David Godoy*

# Please meet our new Brewer Engineer

**Kipp & Zonen is proud to introduce you to David Godoy, our new Brewer Engineer. He will be dedicated to our Brewer activities full time and joins the team at the head office to strengthen our service and support to the global Brewer community.**

Could you describe your activities at Kipp & Zonen?

"My main job consists of adjusting, testing and calibrating new MkIII Brewers at the factory and ensuring that our clients get the best service. Another important duty is the maintenance, service and repair of customers' Brewers of all types, and performing UV and Ozone calibrations; either on-site or in Delft. I will also provide assistance and support to Brewer users when they need it."

David has a background in electronics and gas analysers. For the past three years he has been maintaining the Brewer network and the National Radiometric Laboratory (LRN) of AEMET in Spain (Agencia Estatal de Meteorología), the National Agency of Meteorology.

"Moving to the Netherlands was not a difficult choice. It is a great opportunity to progress in my career and there is no better place to learn about the Brewer instrument than at the factory itself. Besides, Delft is a lovely small city to live in."

David has already been busy during his first month in the job. He has visited the KNMI (Royal Netherlands Meteorological Institute) in De Bilt and the RMI (Royal Meteorological Institute of Belgium) in Brussels, to calibrate their Brewers.

"My impressions after the visits are very positive; everyone I met in the Brewer community, both in Brussels and in De Bilt, was charming and made me feel very welcome. They were very friendly and helpful whilst performing the calibrations."

Please join us in warmly welcoming David to Kipp & Zonen ■

# Fairs & Events

| | |
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| Meteorology Technology World Expo Brussels, Belgium | 16 - 18 October 2012 |
| PV Asia Pacific Expo & Conference Singapore | 22 - 24 October 2012 |
| Intersolar India - Mumbai, India | 6 - 8 November 2012 |
| AGU Fall Meeting - San Franciso, USA | 3 - 7 December 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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