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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

Quality of Calibrations

There are various classes of instruments for measuring solar radiation, the best being secondary standards such as the CMP10, CMP 11 and SMP11, CMP 21 and CMP 22. These are the finest instruments in the world, but that doesn't mean they will always provide the best measurements. To achieve that, proper maintenance of instruments in the field is critical, but in this column I want to emphasize the importance of good calibrations.

Outdoor calibrations at the site where the instrument is installed, is the best manner to calibrate pyranometers. The reference used for the calibration has to be the same or better than the instrument that is calibrated, or a pyrheliometer (absolute cavity) can be used.

Unfortunately, often it isn't possible to apply outdoor calibrations. An excellent alternative is an indoor calibration using a lamp, under highly controlled conditions, with the right equipment, with reference instruments calibrated by e.g the World Radiation center in Davos, executed by technicians with the required training, knowledge and skills. The calibration procedures are given in ISO 9847, and the implementation of the procedures at Kipp & Zonen is described in our Quality Manual as Kipp & Zonen is ISO9001:2008 certified. Our calibrations are the best possible and in the near future we are proud to add the ISO 17025 accreditation.

When we provide calibration equipment to customers, they are intending to calibrate Kipp & Zonen sensors. To guarantee the quality of the calibrations and the measurements, we never only provide the equipment, but always a package that includes training and a follow up audit after 2 years. This way we can support the customer in maintaining the highest quality of his calibrations, and therefore to maintain the highest quality of his measurements with our Kipp & Zonen sensors. Quality is key here.

We have seen competitors that are not even ISO certified, who are claiming to provide top quality sensors and equipment, who are offering calibration equipment without proper training, without follow up, without proper reference sensors, without proper support, just to be cheap. Just to be cheap...

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

Customer Services Expanding

We have greatly improved the regional coverage of our customer services in the past year. We can now support you directly from our offices in France, Singapore and the USA. Each office has a Customer Services Department specialised in the service, calibration and repair of our products. This is in addition to the fully comprehensive facilities at the factory in the Netherlands.

With the great expansion of our customer services worldwide, we saw the need for a dedicated coordinator. Therefore, Kipp & Zonen is pleased to announce the appointment of Ivo Groten as our new Coordinator Customer Services.

Ivo has a background in electronics and through his years of experience in service related jobs, we can call him an expert when it comes to Customer Services. He looks forward to learning the markets and the specific needs of our customers and will focus on building a professional services department that customers can rely on. Expanding our current services by offering service level agreements will be one part of our growing portfolio in the coming months. Check for updates on our new Customer Services webpage.

We congratulate Ivo on his new job and wish him all the best for his future career at Kipp & Zonen ■

Solar Radiation Station Monitors Pollutants in Taiwan

Taiwan is located downwind of sources in East Asia of acid pollutants and dusts, and of Southeast Asian biomass burning emissions. Regional meteorological conditions are favourable for the airborne transport of these, and other pollutants, to Taiwan. The high-elevation Lulin Atmospheric Background Station (LABS) was constructed in 2006 to study the trans-boundary transport of air pollutants and their impact on Taiwan.

LABS is located 2,862 meters above sea level atop Mount Lulin, at the boundary of the counties of Nantou and Chiayi, in central Taiwan. Because of its high altitude, the station's readings are not affected by local pollution from factories, traffic and other domestic sources. It is positioned downwind from the Asian landmass and is therefore ideally situated to monitor long-range air pollutants originating from that source.

There are two major objectives of LABS; to investigate the atmospheric chemistry of precipitation, aerosols, trace gasses, mercury, and atmospheric radiation; and, to study the long-term variability of regional atmospheric chemistry and radiation, as well as climate changes and their impacts on Taiwan.

In November 2008 a complete Kipp & Zonen scientific solar monitoring station was added to LABS. The basis of the station is a SOLYS 2 sun tracker that mounts a set of instruments of the highest accuracy. The SOLYS 2 is fitted with a CHP 1 pyrheliometer and two CMP 21 pyranometers to measure direct, global and diffuse solar radiation. A CGR 4 pyrgeometer is added to measure downward infrared radiation from the sky.

The ideal geographic location of LABS and the local climatic conditions have attracted much international notice. The station has therefore engaged in a number of collaborative projects with organizations from abroad. LABS is operated by the Taiwan Environmental Protection Administration ■

The Sunniest Province in Canada, Saskatchewan

By V. Wittrock, Saskatchewan Research Council, Canada.

Saskatchewan is known for being the sunniest province in Canada and the ability to measure and quantify that fact is important. A Kipp & Zonen CSD 3 Sunshine Duration Sensor installed at the Saskatchewan Research Council's new Climate Reference Station at the Conservation Learning Centre, just south of Prince Albert, assists in documenting this important feature of Saskatchewan.

CSD 3 at Conservation Learning Centre

Knowledge of when the sun was shining is used by various industries and sectors; including research, construction, agriculture, tourism, insurance and the legal communities. An example of insurance and legal interest is automotive accidents, which sometimes occur when the sun is shining squarely into the eyes of the driver, resulting in an inability to see properly. Knowing if the sun was shining at that particular moment can be critical if there is an insurance claim or a legal matter to be settled.

Knowing the long-term trend of how the amount of sunshine hours is increasing or decreasing is a key parameter in tracking climate change. It has been projected that the amount of cloud cover will increase and measuring the number of sunshine hours per day, season and year objectively (without the use of models) is critical to monitoring this important climate variable.

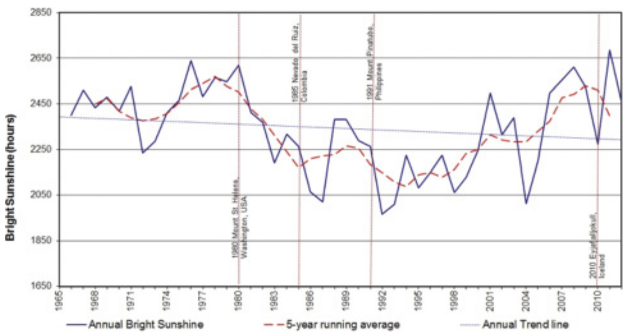
The Saskatchewan Research Council (SRC) has operated a principal Climate Reference Station (CRS) in Saskatoon, Saskatchewan since 1963 and bright sunshine has been one of twenty climate variables collected. Kipp & Zonen's CSD 1 Sunshine Duration Sensor was put into operation in January 2001 and it compared very well to the previous bright sunshine instruments utilised at the CRS.

In 2010 and 2011, SRC expanded its Climate Reference Station network to central Saskatchewan, at the Conservation Learning Centre (CLC) near Prince Albert. A Kipp & Zonen CSD 3 Sunshine Duration Sensor was installed at the new station in the spring of 2011.

‘Bright Sunshine’ is a rather loose and subjective term, largely based upon the Campbell-Stokes glass ball and paper strip instrument, where the length of the ‘burn’ on the paper caused by the focussed image of the sun is proportional to the number of ‘bright’ hours. However, this is highly dependent upon humidity (dampness of the paper), paper type and the observer’s interpretation of ‘burnt’. The instrument requires adjustment every few days to keep the sun’s image on the paper.

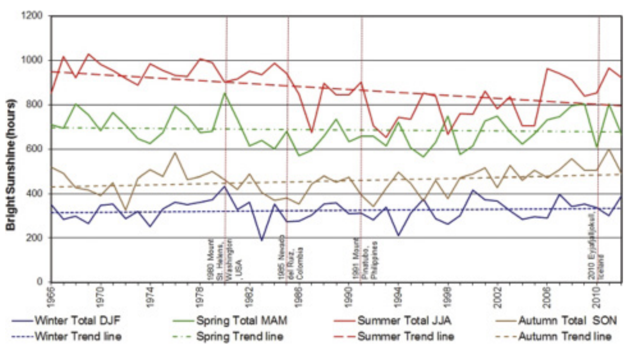
The availability of objective electronic instruments without all these drawbacks, and with real-time data available remotely, prompted the World Meteorological Organisation (WMO) to propose in 1981 that a direct solar irradiance of 120 W/m^2 best represented the threshold of historical ‘Sunny/Not Sunny’ measurements of hours of sunshine in a day. This was finally formalised in 2003 and defined as ‘Sunshine Duration’, with a required daily uncertainty in the number of sunshine hours of ± 10 %. The Kipp & Zonen CSD 1 and CSD 3 Sunshine Duration Sensors meet this requirement.

The Saskatoon Climate Reference Station began recording bright sunshine hours in 1966, and in the last 48 years has recorded some interesting variability and trends. It is possible for Saskatoon to receive up to 4490.6 hours of bright sunshine in a year, but the average was 2264 hours over the years from 1991 to 2010.



Annual sunshine hours in Saskatoon

The 1990s had the lowest number of bright sunshine hours for the period of record. The lowest year was 1992, recording 43.8 % of the actual to possible hours of bright sunshine. This drop was due to a downward trend during the summer season of June, July and August (JJA). Since the 1990s the trend has been towards more annual bright sunshine, increasing further between 2006 and 2012.



Seasonal sunshine hours in Saskatoon

Due to the northern latitude, the number of sunshine hours fluctuates markedly depending on the season. The other three seasons, while variable, do not have a strong upwards or downwards trend. The summer downward trend could have been due to various reasons, including three major volcanic eruptions around the globe, plus it is projected that the amount of cloud cover will increase with climate change.

Together with our distributor, Campbell Scientific Canada Corp., Kipp & Zonen supports the Saskatchewan Research Council with the service and re-calibration of their CSD 1 and CSD 3 Sunshine Duration Sensors.

As a Campbell Scientific Canada representative explains; “SRC operates two Climate Reference Stations that serve important roles in climate monitoring; in Saskatoon, which celebrated its 50th anniversary in 2013, and at the Conservation Learning Centre near Prince Albert, launched in 2011. Each station has a Kipp & Zonen Sunshine Duration Sensor.

The CRS in Saskatoon is a key site for both the Province of Saskatchewan and the Meteorological Service of Canada climate monitoring network. The CLC station serves as the main meteorological data resource for the many crop development and demonstration programmes at the Centre and also as a learning tool in climate monitoring. It is a regular showcase for numerous school tours, research organisations, and the general public.”

Find out more about the Saskatchewan Research Council Climate Reference Stations at **www.src.sk.ca/industries/environment/pages/climate-reference-stations.aspx**

CNR 4 on Top of Mount Kilimanjaro, Tanzania

By Dr. Douglas Hardy, Senior Research Fellow in the Climate System Research Center, University of Massachusetts Amherst

Kilimanjaro's shrinking glaciers have become an iconic symbol of climate change. Our climate measurements at the summit are demonstrating that variability of net radiation is the factor most closely controlling the 'health' of these glaciers. To increase the quality of our measurements, we recently added a Kipp & Zonen CNR 4 to one of the automatic weather stations (AWS).

Kilimanjaro is the highest free-standing mountain in the world with the peak at 5,895 m (19,341 ft) above sea level. The original station was installed in 2000 at an elevation of 5,775 m and includes a CM 14 albedometer and CG 1 pyrgeometer. A second station was added in 2010 and expanded with the CNR 4 and other instruments in 2012.

Together with collaborators at the University of Innsbruck (Austria), measurements and modeling are showing that Kilimanjaro glaciers are primarily sensitive to the variability of snowfall amount and timing. One obvious reason for this is because snowfall adds mass to the glaciers; more importantly, snow governs surface brightness (albedo) which controls the extent to which solar radiation is reflected rather than absorbed.

When radiation is absorbed at the glacier surface, this energy is available to drive melt and sublimation, both of which remove mass from the glaciers and are causing shrinkage. The changes in surface texture and albedo of the ice fields can be seen in the time-lapse pictures on the following page.

The principle objective of our automated stations on Kilimanjaro is characterizing the current summit climate. This knowledge is helping to interpret the long-term history of glaciers on the mountain, the ice-core records, and the larger-scale causal mechanisms driving environmental changes currently underway in east Africa. High-elevation climate in this region of the Tropics is currently not well understood, or linked to longer-term records at lower elevations.

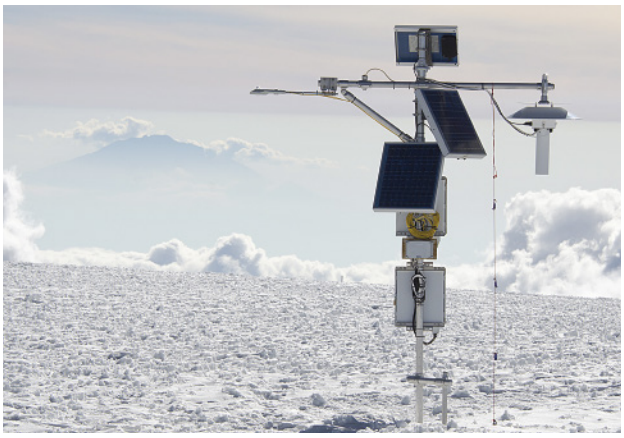
The summit glaciers on Kilimanjaro are ideally suited for radiation measurements, as low humidity combined with intense incoming solar radiation keeps instrument riming to a minimum. Time-lapse camera images demonstrate that instruments are quickly cleared of any snowfall or riming; an occasional issue, especially during the two seasonally-wet periods each year. Wind speed averages 6 m/s, which aids in the accuracy of radiation measurements without necessitating instrument ventilation.

Until our CNR 4 was installed in 2012, we measured each radiation component separately; engineering considerations required situating instruments close to the tower, which influenced measurements. Now, with the lightweight CNR 4, our measurements are being made further from the tower and better represent the four variables. During fieldwork at the site leveling adjustment consumes far less time than is required to level four different instruments.

During the first year with the CNR 4 at the site, median incoming short-wave radiation at mid-day, over all days of the year, was nearly 90 % of that at the top of the atmosphere, illustrating the intensity of radiation on Kilimanjaro. Surface albedo ranged widely, from 0.31 during the dry season to 0.90 following snowfall. Downward long-wave radiation exhibited a distinct seasonality, following the annual cycle of cloudiness and humidity. Upward long-wave radiation measurements are corroborated by surface temperature measurements made with an infrared transducer. In general, measurements reveal a close correspondence between the variability of snowfall, snow-surface age and net solar radiation.

Combined with high-accuracy air temperature and humidity measurements, the data from the CNR 4 on Mount Kilimanjaro are yielding a comprehensive new view of the summit climate. Upon retrieval of the second year of measurements in 2014, we hope to change out the instrument for calibration and make these data available.

Read the full article at: **www.kippzonen.com/kilimanjaro** ■



CNR 4 to left, temperature and humidity sensors to right
Mount Meru 70 km in the background

Northern ice field of Kilimanjaro in October 2012, January and February 2013 at 6 pm

Biography and acknowledgements

Dr. Douglas Hardy is a Senior Research Fellow in the Climate System Research Center at the University of Massachusetts Amherst. Collaborators at the University of Innsbruck include Thomas Mölg and Georg Kaser (Institute of Meteorology and Geophysics). Kilimanjaro climate research has been supported in part by the U.S. National Science Foundation (NSF).

Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author and do not necessarily reflect the views of the NSF.

We sincerely thank the Tanzanian governmental agencies who help make this research possible, particularly TAWIRI, TANAPA, and KINAPA.

Selected further reading

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Portable Apparatus Simplifies Albedo Measurements

By Ronnen Levinson, Ph.D., Staff Scientist, Heat Island Group, Lawrence Berkeley National Laboratory, Berkeley, California

Researchers in the Heat Island Group at Lawrence Berkeley National Laboratory (LBNL) use Kipp & Zonen first-class pyranometers to determine the albedo (solar reflectance) of roofs and pavements. Following ASTM Standard E1918-06 ('Standard Test Method for Measuring Solar Reflectance of Horizontal and Low-Sloped Surfaces in the Field'), albedo is measured as the ratio of reflected sunlight to incident sunlight.

In one configuration, a CMP 6 first-class pyranometer is fitted to a CMF 1 mounting fixture that is supported on the boom arm of a microphone stand, 50 cm above the test surface. A counterweight on the other end of the arm helps balance the pyranometer. A METEON data logger is used to record the measurements. The CMP 6 is faced up, then down, to measure incident and reflected solar flux; the process is repeated two more times to check repeatability. The technique is straightforward, but the pyranometer must be oriented and leveled six times in each measurement series.

Mounting rod has two cross-levels, one for the CMP 6 facing up, the other when facing down

In a second configuration, the CMP 6 is replaced by a CMA 6 first-class albedometer, which comprises two CMP 6 units integrated back to back and has an integral support rod. This permits simultaneous measurement of incident and reflected fluxes, and the instrument is oriented and leveled only once per measurement series. This makes the CMA 6 more convenient for measurement of albedo. Two METEONs are used to record the incident and reflected irradiance.

While it is common practice to mount an albedometer (or pyranometer) on a portable stand, the LBNL apparatus includes three convenient features. First, the mounting rod is joined to the boom arm of the microphone stand with a quick-release clamp, making it easy to attach and remove. Secondly, the two pairs of signal wires from the CMA 6 are terminated with color-coded banana plugs that connect to color-coded banana sockets on the two METEON data loggers. This reduces the likelihood of operator error.

CMA 6 with two METEONs, which are normally positioned out of view of the lower sensor

Third, and most helpfully, LBNL has added a pair of cross-levels to each mounting rod. These are fitted in an aluminium block that is aligned with the detector surface(s). It can be difficult with a portable apparatus to initially determine from the circular level built into the CMA 6 (or CMP 6) whether the instrument is close to, or far from, horizontal. The bubbles in the cross-level respond more gradually to tilt, making it easier to gauge how close the instrument is to horizontal. This is especially helpful when the CMP 6 is downward-facing, because the bubble level is not visible.

There is still room for improvement. For example, a stronger and more stable, but still lightweight, stand would permit the use of a longer boom arm. This would increase the accuracy of the albedo measurement by reducing the extent to which the stand is seen by the downward-facing sensor.

For more information on the Group's activities go to:
heatisland.lbl.gov

Lawrence Berkeley National Laboratory addresses the world's most urgent scientific challenges by advancing sustainable energy, protecting human health, creating new materials, and revealing the origin and fate of the universe. Founded in 1931, Berkeley Lab's scientific expertise has been recognized with 13 Nobel prizes. The University of California manages Berkeley Lab for the U.S. Department of Energy's Office of Science. For more, visit **www.lbl.gov**

Berkeley Lab Researchers Showcase Cool Pavement Technology

An example of LBNL's research that uses the CMA 6 albedometer configuration, is a study of cool pavement technologies. LBNL's Julie Chao describes the study in her article 'Parking Lot Science: Is Black Best?'

On those sweltering summer days - when it's too hot to play at the playground, when it seems like you could fry an egg on the pavement, when your car feels like an oven after a couple of hours parked at the mall - it's not just the beating sun that's driving up the temperature. It's our very urban environment, in which most of our paved surfaces are dark, absorbing almost all of the sunlight that shines down on them.

In a typical city, pavements account for 35 to 50 percent of surface area, of which about half is comprised of streets and about 40 percent of exposed parking lots. Most of these streets and parking lots are constructed with dark materials. "It's amazing how hot these pavements get and how we've let them cover most of our urban surfaces," said Haley Gilbert, a researcher in the Heat Island Group of Lawrence Berkeley National Laboratory (Berkeley Lab). "Because dark pavements absorb almost all of the sun's energy, the pavement surface heats up, which in turn also warms the local air and aggravates urban heat islands."

To combat this problem, Berkeley Lab scientists have been studying 'cool pavement' technologies. Like cool roofs, which are lighter-colored roofs that keep the air both inside and outside the building cooler by reflecting more of the sun's energy, cool pavements reflect as much as 30 to 50 percent of the sun's energy, compared to only 5 percent for new asphalt (and 10 to 20 percent for aged asphalt).

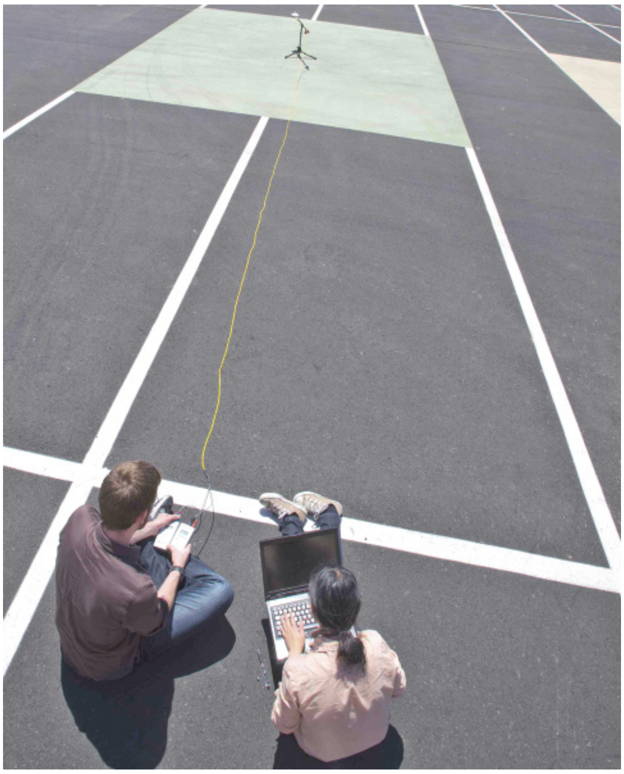
The Heat Island Group has converted a portion of a new temporary parking lot at Berkeley Lab into a cool pavement exhibit that will also allow them to evaluate the products over time. The parking lot provides an opportunity to feature cool pavement coatings that are applied directly to existing paved surfaces.

"An ideal design goal would be a pavement with solar reflectance of at least 35 percent," Gilbert said. "How you get there will vary by project."

With the exhibit now open at Berkeley Lab, the scientists will be collecting data to see how the coatings fare over time. A CMA 6 albedometer is used to measure incoming and reflected solar irradiance. The ratio of the two values gives the surface reflectance.

The benefits of cool pavements extend beyond just cooling the local ambient air. They can also impact global warming and energy loads. Dark roofs and dark pavements both contribute to global warming by absorbing large amounts of solar energy stored in sunlight, then radiating the energy back into the atmosphere in the form of heat. Gilbert added: "Across an entire city, small changes in air temperature could be a huge benefit as it can slow the formation of smog. Just a couple of degrees can also reduce peak power demand, by reducing the energy load from air-conditioning."

Read the full article at:
newscenter.lbl.gov/feature-stories/2012/09/13/parking-lot-science



Increase the Accuracy of Your Radiation Data

Ventilation of radiometers is recommended for the high quality measurement of solar and atmospheric radiation for applications in meteorology, climate research, and solar energy to improve the accuracy of data.

The BSRN (Baseline Surface Radiation Network) of the World Climate Research Programme (WCRP) is the highest quality network of stations for measuring the components of solar, sky and surface radiation. It states in its Operations Manual 'The recommended procedures for the measurement of global radiation require the use of a ventilated housing'.

International Standard ISO/TR 9901:1990 'Solar energy - Field pyranometers - Recommended practice for use' is a Technical Report of Technical Committee ISO/TC 180, Solar Energy. The scope is the measurement and recording of climatic data in relation to solar energy utilization. The Report advises the use of ventilation where high accuracy and reliability of data is required.

The Report requires that radiometers used for measurement in the plane of a solar collector must be installed parallel to the aperture area of the collector with a maximum deviation of 1° (preferably 0.5°). To ensure that the radiometer receives the same irradiance as the collector under test, the radiometer position must be chosen very carefully to avoid reflections and partial shading which do not reach the collector at the same time.

The radiometer housing must be shielded from irradiance and be thermally decoupled from the mounting surface as well as is possible, to avoid heating of the housing that may result in incorrect measurements. Ventilation devices are advised to further stabilize the housing and increase accuracy. More recommendations can be found in ISO/TR 9901:1990.

The Baseline Surface Radiation Network was conceived in the late 1980s as the radiation flux measurement network of the World Climate Research Program, which is jointly sponsored by the World Meteorological Organization (WMO), the International Council of Scientific Unions (ICSU) and the Intergovernmental Oceanographic Commission (IOC) of UNESCO. In 2004 it was also designated as the Baseline Surface Radiation Network of the Global Climate Observing System (GCOS).

The BSRN has two main objectives; to monitor the incoming and outgoing short-wave and long-wave radiation components, and their trends, between the atmosphere and the surface; and to provide data for the calibration of satellite-based estimates of the surface radiative fluxes. This is achieved using the best instruments, methods and practices currently available.

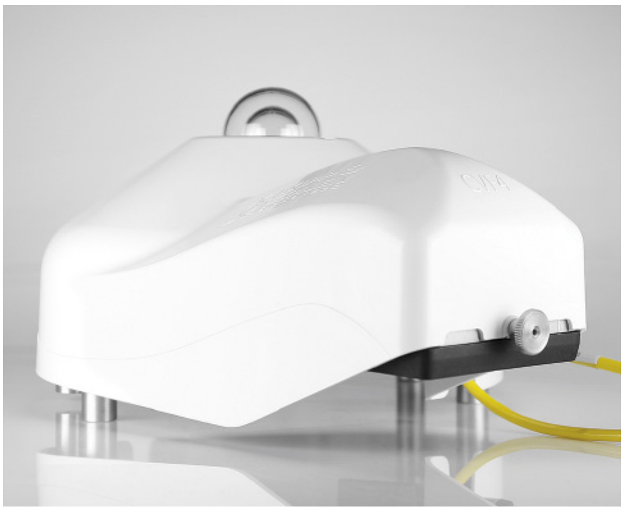
The BSRN Operation Manual states that ventilation is recommended:

- Where dew, frost or snow is prevalent
- Where natural ventilation is infrequent or variable
- Where there is significant radiative cooling during portions of the year, a ventilated housing may reduce thermal offsets
- Where the humidity is high during portions of the year a ventilator will reduce the possibility of water damage and reduce the frequency of desiccant changes

The recommended procedures for the measurement of global radiation require the use of a ventilated housing to improve the overall stability of pyranometer measurements by damping changes in the pyranometer body temperature due to solar loading and potentially reducing the thermal offsets. In some climates, the use of a ventilator also improves the amount of recoverable data by eliminating dew and reducing the number of occurrences of frost and snow on the instrument domes.

BSRN advises to check the ventilation fan on a daily basis. If the motor is not operating properly, the problem should be corrected or the fan replaced. On ventilators where the cover acts as a radiation shield, the top of the cover must be situated below the receiver surface of the radiometer so that it does not affect the field of view.

The BSRN Operations Manual version 2.1 can be found at: www.wmo.int/pages/prog/gcos/documents/gruanmanuals/WCRP/WCRP21_TD1274_BSRN.pdf



The new Kipp & Zonen CVF4 ventilation unit combines optimal performance and minimal power requirements to enable radiometers to provide the most accurate measurement data. It stabilizes the temperature of the radiometer near to that of the ambient air and suppresses the thermal offsets which are produced by cooling down of the domes under calm clear sky conditions, or by dome heating due to absorption of solar radiation. Heating of the air flow evaporates water droplets and melts frost, snow and ice.

The insulating moulded cover, raised resistors and radial ventilation fan make the power consumption low in comparison to competitive units. This reduces voltage drop and allows cable lengths up to 50 m. The cable fits to the CVF4 with a high quality waterproof connector. The radiometer bubble level is easily visible and the high-volume, spiral air-flow over the dome keeps it clean, even in windless conditions.

The CVF4 has as standard a fan speed output that can be logged with the radiation data. This allows for remote monitoring of the ventilator performance. Higher speed indicates filter flow restriction, while lower values indicate mechanical obstruction or wear of the fan. Five spare air inlet filters are supplied and these can be exchanged without removing the cover. When it is necessary to check the radiometer desiccant, the CVF4 cover can be easily removed by releasing two captive knobs, without the need to remove the radiometer cable.

We are convinced that the new CVF4 is the best ventilation unit available and will enable our radiometers to provide the best possible accuracy and availability of measurement data, combined with the longest maintenance interval.

CVF4 is compatible with all CM, CMP, SMP, CG, CGR and CUV radiometers. However with the CMP 3, SMP3 and CGR 3 the ventilation effect will be less due to the larger opening around the dome. It can also be fitted to the SOLYS 2 and 2AP sun trackers and the CM 121C shadow ring ■

Fairs & Events

CPV-10 • Albuquerque • NM • USA	7 - 9 April
EGU General Assembly • Vienna • Austria	28 April - 1 May
MENASOL • Dubai • UAE	6 - 7 May
SNEC 2014 PV Power Expo • Shanghai • China	20 - 22 May
InterMET Asia Expo • Singapore	2 - 3 June
Intersolar Europe • Munich • Germany	4 - 6 June
Renewable Energy Asia Expo Bangkok • Thailand	4 - 7 June
PV America • Boston • MA • USA	23 - 25 June

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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