

## Solar Radiation Methodology

(Last rev. 07/10/2024)

The Parque Natural Metropolitano (PNM) station (Figure 1) is located on the north edge of Panama City. It is attached to a large construction crane.

The original 42m crane was dismantled in 2021 and a new crane, located approximately 10m away, was put into operation in January of 2022. The new crane is taller (~70m) compared to the original crane (~60m). No difference in precipitation is expected because of the change (Figure 2).

Incoming solar radiation was originally measured electronically using LiCor Model Li200s Pyranometers located at 25m at the ends of a metal cross bar located below the tipping bucket (see figure 3).

New LiCor sensors were install on the top of the crane in March of 2012 (Figure 4). The 25m sensors were discontinued in March of 2018. A comparison of the overlapping data is shown in Figure 5. Unsurprisingly, the sensor at the top of the crane always registered more than the 25m sensors. The difference between the two sets of sensors varied throughout the year due to the seasonal movement of the sun and the resulting shading of the 25m sensors.

Two top-of-the-crane pyranometers are designated as Back (b) and Front (f). The reported values in summary statistics based on the larger values of both sensors for any given reporting interval.

On June 14, 2016 the 'Front' sensor was replace with a Kipp&Zonen CMP11 pyranometer. On July 31, 2018 the 'Back sensor was also replaced with a Kipp&Zonen CMP3 pyranometer (Figure 6). A comparison of daily average solar radiation between the two sensors is shown in Figure 5. However, a comparison of the last 5 years of Kipp&Zonen sensor data with the previous data seems to indicate that the K&Z sensors are recording approximately 7% more solar radiation. Adjusted monthly totals are provided in the Excel summary files.

Incoming solar radiation is sampled once every 10 seconds. The average, minimum and maximum values are recorded every 15 minutes.

On Feb. 24, 2022, sensors were installed on the new crane. We do not anticipate any change in solar radiation due to the change in cranes.

Sensor elements are replaced with newly recalibrated sensors every year according to the manufacture's recommendations.

Figure 1



Location of PNM cranes

Figure 2



PNM Cranes (new crane left, old crane right)

Figure 3



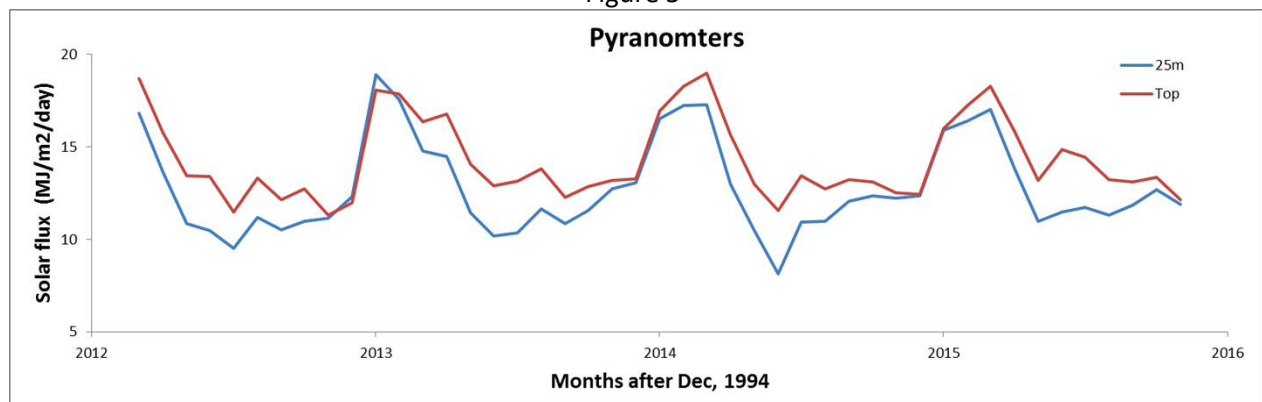
PNM tower showing met. station approximately at the middle of the tower

Figure 4



Tipping bucket on top of the PNM crane.

Figure 5



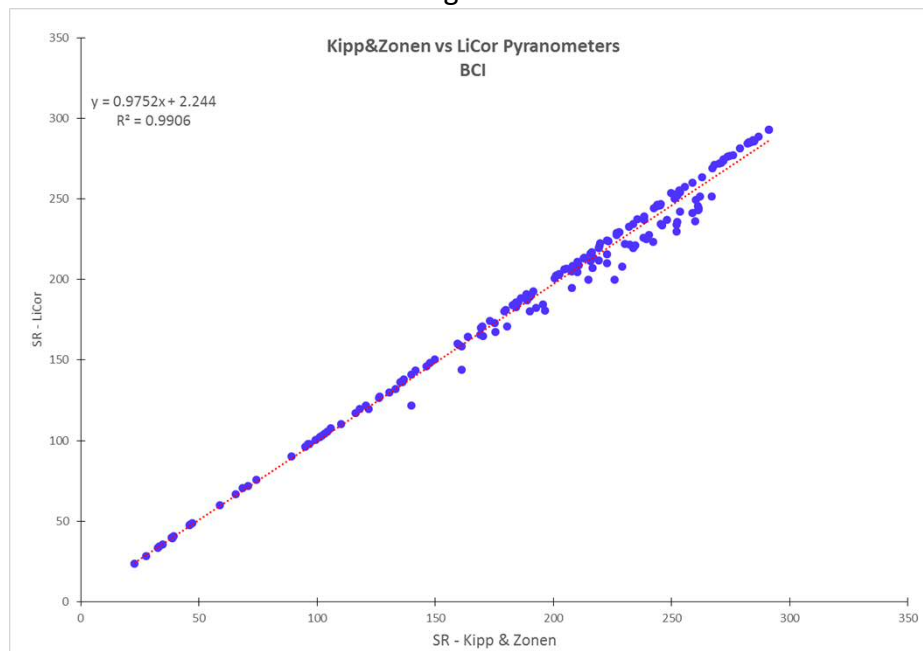
Monthly total Solar flux as measured at the 25m and Crane Top locations

Figure 6



Kipp & Zonen CMP11 (left) and CMP3 (right)

Figure 7



Comparison of Daily average solar radiation between LiCor Li200SB and Kipp&Zonen SPLite2 Pyranometers

## Recent Sensor History

Feb 4th, 2022 @ 12:42 pm - Deployment of metparktop station on new crane

Installed **Back pyranometer CMP3** SN209126

Feb 4th, 2022 @ 12:42 pm - Deployment of metparktop station on new crane

Installed **front pyranometer CMP10** SN197175

March 24, 2021 @7:43 am

Reconstruction of the crane - all sensors were removed - Removed: CR1000 logger SN79866, **CMP10 SR SN19568, CMP3 SR SN164730**, TB3 rain gauge SN17152

Sept 18, 2020 Metpark Cranetop - Back

-Removed back pyranometer **SPLite2** SN183706

-Installed back pyranometer **CMP10** SN19568

Station powered up at 11:30 am

Sept. 18, 2020 – Metpark cranetop - Front

Metpark cranetop

-Removed front pyranometer **CMP3** SN:176134

-Installed front pyranometer **CMP3** SN:164730

July 31st, 2018 – Metpark cranetop- Front

Station down between 9:32 am and 10:39 am

Removed pyranometer **F SPLite2** SN151574

Installed pyranometer **F CMP3** SN176134 M=14.44 microV

July 31st, 2018 – Metpark cranetop – Back

9:32 am to 10:39 am

Removed **B pyranometer LI200S** SN86902

Installed **B pyranom SPLite2** SN183706, M67.7 microV

June 14, 2016 – Metpark cranetop – Back

Logger shutdown at 10:12 am

-Removed back facing LI-200S PY80608

-Installed back facing LI-200S PY86902

June 14, 2016- Metpark cranetop – Front

Logger shutdown at 10:12 am

-Removed Forward facing SR LI-COR pyranometer PY80605

-Installed Forward facing SPLite pyranomter SP151574

April 2nd, 2014 – Metpark cranetop – Front facing SR – LI-COR sensor in use

Turn power off at approx 12:56



Replaced front SR Sensor PY71463(F) with PY80605

April 2nd, 2014 – Metpark cranetop – Back facing -LI-COR sensor in use

Turn power off at approx 12:56

Replaced back SR sensor PY71464(B) with PY80608.