

Immersion Coefficients

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Question: □ The PRR800 we were using has an immersion coefficient so that it can be used for both a surface and aquatic radiometer. The reviewer asked "how is it derived, and does the instrument in fact have a different field of view in or out of the water? If it has a 2π (pi) diffuser how does the FOV of that change?"

Answer: □ It is more accurate say that the PRR800 has an immersion coefficient to correct the response of the instrument for the effects of being immersed in water. All of our instruments are calibrated in air, but underwater instruments like the PRR800 will change their response (the amount of light entering the collector is different when the refractive index changes) when immersed. We measure that change in response (the immersion coefficient) and provide that in the calibration data. A reference describing how this is done is found in Hooker and Zibordi, "Advanced Methods for Characterizing the Immersion Factor of Irradiance Sensors," <http://journals.ametsoc.org/doi/abs/10.1175/JTECH1736.1>

The PRR800 is designed to have a very good cosine response in water and the PRR810 is designed to have a very good cosine response in air — each is optimized for the environment for which they are intended to be used. By "very good" I mean $\pm 2\%$ from 0° to 65° , and $\pm 10\%$ from 65° to 85° . Both sensors have a "field of view" of 180° . A good discussion of this cosine response is found here: <http://ieeexplore.ieee.org/Xplore/login.jsp?url=http%3A%2F%2Fieeexplore.ieee.org%2Fiel5%2F7067%2F19068%2F00882233.pdf%3Farnumber%3D882233&authDecision=-203>. In your case, I believe you do not have the normal PRR810 or PUV2510 surface ("deck") versions, so you are using the underwater version without the immersion coefficient. The accuracy of the cosine response will be less than optimum in this case, and the loss of accurate cosine correction will probably not be significant when the Sun is high in the sky. At lower solar angles, you will begin to see the effects of the cosine response error. Typically the measured values will be somewhat higher than should be as the Sun is lower. This effect will be more pronounced in the long wavelengths, and minor in the UV.

In addition, when using the underwater version of the instrument in air, you need to switch calibration data and use calibration without the immersion factor.