Upwelling Measurement Issues at the CERES Ocean Validation Experiment (COVE)

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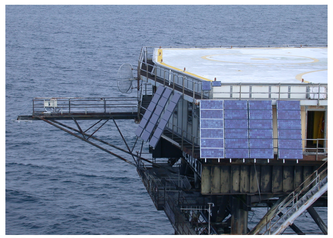
Introduction:

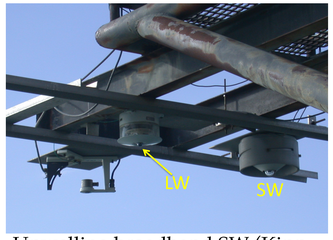
- The Clouds and the Earth's Radiant Energy System (CERES) Ocean Validation Experiment, or COVE, was established at Chesapeake Light Station as a validation site for CERES and other satellites.
- Pictures of COVE and the upwelling instrument locations are displayed.
- A 15 year monthly climatology of upwelling longwave (LW) and shortwave (SW) differences (Afternoon - Morning) are analyzed.
- Two measurement issues we attempt to understand are the upwell SW "tower shadow effect" and the other concern is the upwell LW "tower radiating effect". Both of these issues are presented.
- Analysis of Infrared Radiation Thermometer (IRT) data (which was used to measure sea surface temperature, or SST) to upwell Precision Infrared Radiometer (PIR) measurements are displayed and will attempt to make a case for using IRT measurements as upwelling LW.

COVE is ~25km off the coast of Southeast Virginia, USA. Depth of water is ~12m.

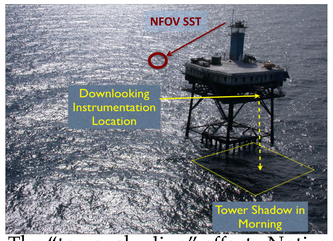
Map of COVE's location.



Upwelling instruments are at the end of the 8m catwalk on the west side of the structure.

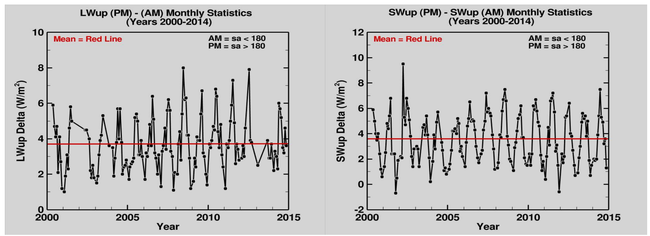


Upwelling broadband SW (Kipp and Zonen) pyranometer and LW pyrgeometer (Eppley PIR). Instrument elevation: 21m.

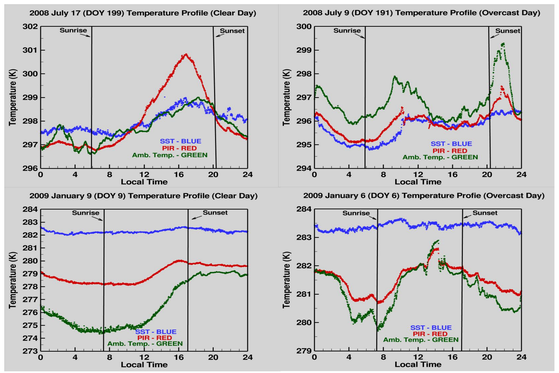


The "tower shading" effect. Notice the shaded area beneath the upwell instruments. This occurs primarily in the morning.

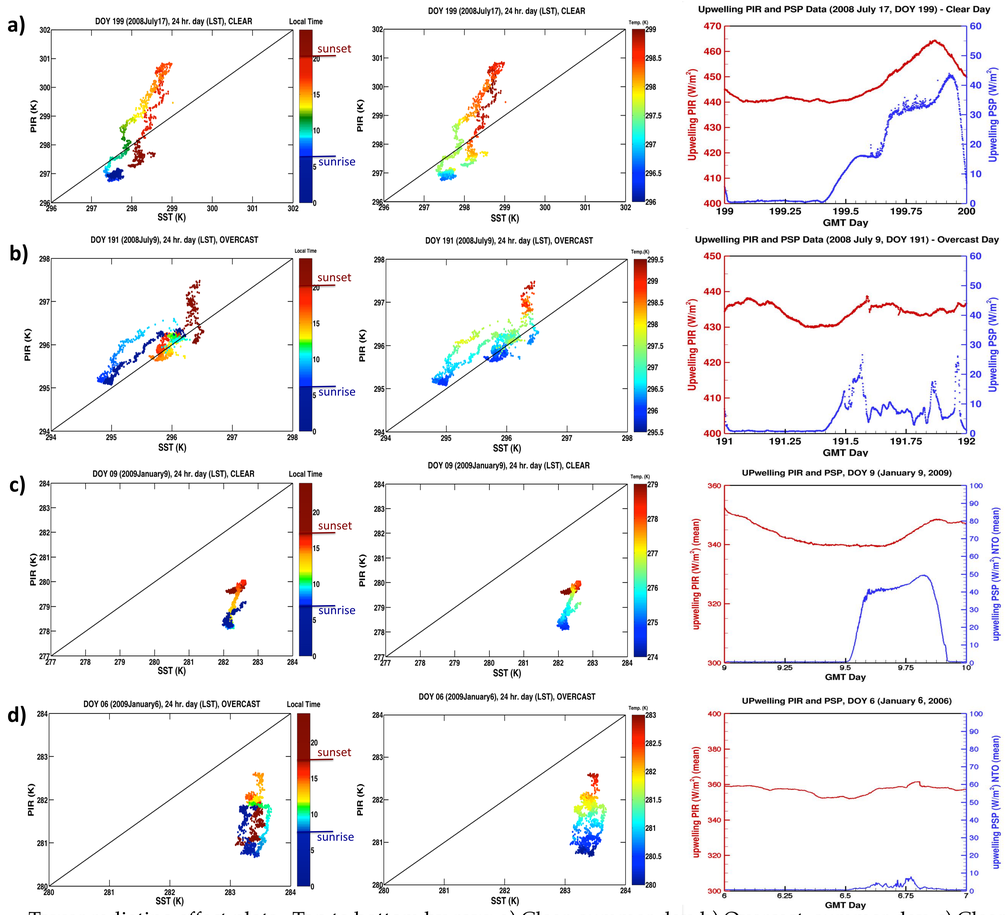
The "tower radiating effect". A fisheye lens picture shows the structure in the field of view of the upwelling instruments. The signal from the tower is an undesired quantity. As shown in the photo to the left, the narrow field of view (FOV) IRT does not have the tower in its view. IRT specifications: 2.8° FOV, 9.6-11.5μm range.



15 year monthly climatology of upwell LW and SW delta's (afternoon – morning). Solar azimuth (sa) was used to separate the data into morning and afternoon.



Upwelling LW measurements (PIR, red lines) are affected by the SST (IRT, blue lines), ambient air temps (green lines), and the tower temp. The red line should be in between the green and blue lines and this is usually the case. The influence of the tower signal is the most obvious on a sunny, summer day (upper left plot). This is less of a problem on overcast days, and the PIR tends to track the ambient air temps. On a clear winter day (lower left plot), the closing of the gap between the PIR and ambient temp (red and green lines) seems to indicate that the tower is heating up more slowly than the ambient air. The next set of 12 plots enhance this analysis.



Tower radiating effect plots. Top to bottom by row: a) Clear, summer day, b) Overcast, summer day, c) Clear, winter day and d) Overcast, winter day. The far right plots of each row depict the solar radiation result for that day. Note the greatest tower radiating effect is on a sunny, summer day, however, when ambient air temperatures increase, this appears to have an influence as well.

Summary:

- Upwelling radiation measurements commenced in May 2000 and were suspended in December 2014.
- Upwelling SW radiation data has the structure's shadow in its field of view primarily in the morning (the "tower shadow effect"). Therefore, SW data is likely good only in the afternoon. LW data should not be compromised by the shadow since the seawater's temperature should not change as it enters the shadowed area, due to it only occupying the shadowed area for only a few seconds.
- The "tower radiating effect" for LW measurements may be able to be resolved using IRT data since the IRT instrument does not have the structure in its field of view.

Acknowledgements:

- We thank the United States Coast Guard and the Department of Energy for allowing atmospheric and oceanic research at COVE.