MOBY245 Deployment Revision Date: August 25, 2011
12 Jan 2010 - 15 Jun 2010 Stephanie Flora

Overview of problems:

- Problems were first noticed around the 9th of February 2010. Stephanie noticed the LuMid and Bot radiances were getting closer to each other. This continued until around 25 Feb when it became very difficult to get any good data. After the 5th of April all data were marked bad. Later analysis determined that LuMid was decreasing during the deployment, until in early March LuMid was below LuBot much of the time.

- To complicate matters it appears there was a "fouling event" between Julian days ~80 and 125 (21 Mar - 5 May). This could explain the largish dip seen around Julian day 120 for the Mid and Bot arm.

- LuMid anomalies were observed during Post-Calibrations. Mike found that the LuMid response decreased by ~15% vs preCal. Also, when LuMid post-cal was repeated (10 days later) it's resp had decreased another 10% BSG, 20% RSG. LuTop was also repeated for comparison - LuTop resp decreased ~3% B, 7% R, or just outside estimated uncertainties. During post cal Mike noticed the LuMid collector window looked to have some condensation/crystals on inside surface.

- EdSfc was the only other sensor to fall outside the expected uncertainties during post calibrations. EdSfc response increased by ~5% at Blue Spectrograph, and ~10% at RSG When Es post-cal was repeated (5 days later) it's resp had increased another 5% BSG,10% RSG. Next day Es was repeated again: Es response remained stable @ B/R 10/20% above preCal - plus EdTop was repeated for comparison: EdTop resp remained stable & close to pre-cal.

- Mike could not find an explanation for the variability in the LuMid and EdSfc post calibrations. He looked at temperature differences, engineering explanations, MUX position changes and lamp stability.

Other issues:

- 12 - 21 Jan 2010: 20 hour files: EdTop and LuTop have the incorrect int time and bin factors, also the order of data taking is not correct. When Mark corrected the order the LuTop time changed. This effect will show up as sharp changes in zenith angles etc.

- 21-Jan-2010 to 25-Jan-2012 : MOBY broke loose from the mooring sometime on the 21st. 21 hours later (21 Jan 21:21 GMT) it was around 15 miles West of the mooring site. MOBY then followed a clockwise loop which took it a few miles South of the mooring and then North to Molokai. Hawaii Rafting Adventures found MOBY at 6 Pm HST on the 24th it had anchored itself on the South side of Molokai. MOBY was towed back to the mooring overnight. It was reconnected with flopper stoppers attached by 1 PM on the 25th.

So after a MOBY team telcon it was decided to mark all the LuMid data from 9 Feb 2010 to the end of the deployment as bad. Mike's post calibration data showed a large change in the pre-post calibrations which confirms that LuMid died during the deployment.

Originally when processing the deployment, after 9 Feb more and more data were marked questionable or bad and all the data after 6 Apr was marked bad. Once we decided LuMid had died, this means there will be no Lw1 (LuTop, KL(top,mid)) or Lw7 (LuMid, KL(mid,bot)) data after 9 Feb. So a lot of Lw2 (LuTop, KL(top,bot)) data that were marked bad or questionable should be remarked as good. The deployment needed to be reassessed to determine which days after 9 Feb are really good.

Normally I have used the GOES images, the 3 KL's/Lu's and Es data to decide. In this case I used the GOES images to mark obvious cloudy days as bad. These data were automatically excluded from the processing detailed below. Because of the problems with LuMid, we are left with LuTop, LuBot, KL(top,bot) and Es data to determine which days after 9 Feb are really good.

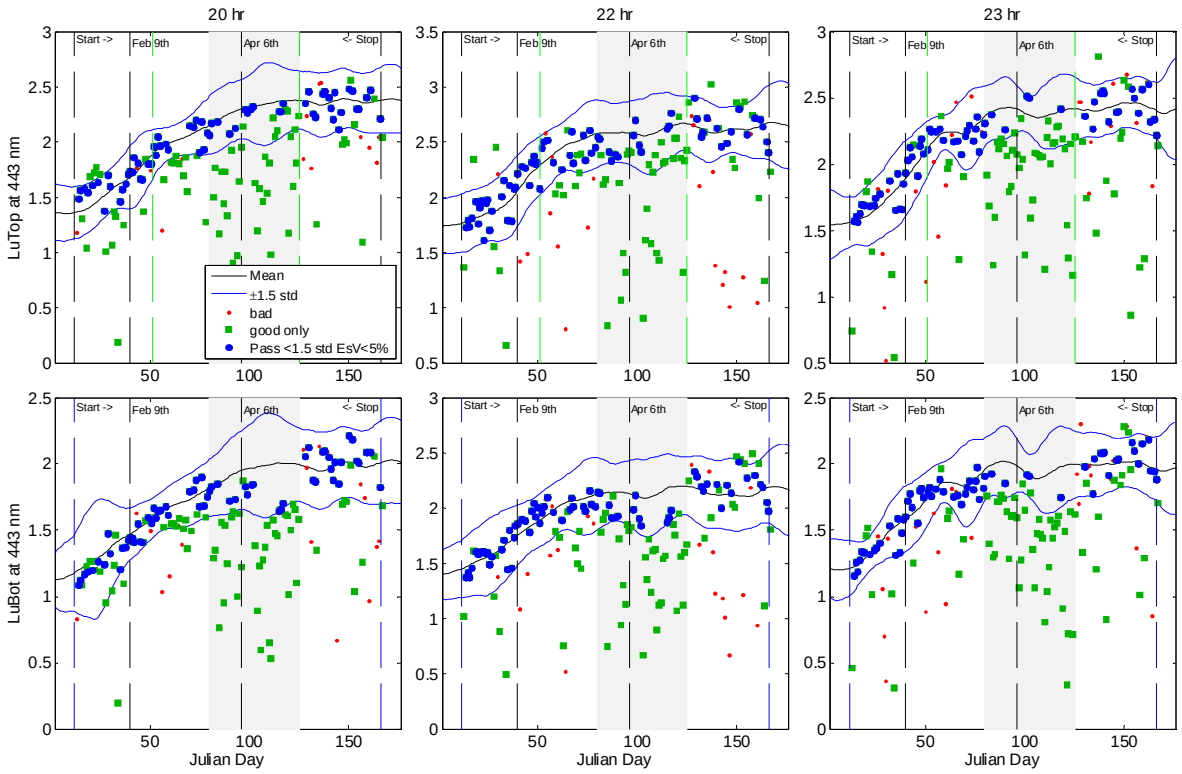

Figure 1. Shows the process used to determine which LuTop and LuBot data were good. The top panels show the LuTop data and the bottom are for LuBot. The black and blue lines are the standard deviation and mean calculated from all the good LuTop or Bot data (all deployments). The red dots are the M245 Lu data marked bad because of clouds. Green dots (some covered by the other dots) are the data which are not cloud contaminated and the blue squares are all the good data left which were run through the two filters. The grey shaded area is the fouling event.

In the figure above and following figure the first dashed black line is when I first noticed the LuMid having problems, the second is the last day I marked data good/questionable during

deployment processing. The two dashed green lines are the cleanings performed by divers. The dashed red lines are the lower limit from clear water Kl and the upper limit set at 0.06.

I decided to look at all old LuTop and LuBot data (good data only, even and odd deployments) by hour and calculate the mean and standard deviation (std) by Julian day, at 443 nm (black and blue lines, Figure 1). The values of the standard deviations used to remove the M245 LuTop and Bot data were a function of Julian day and 20, 22 or 23 hour. For the data to pass this filter both the LuTop and LuBot data needed to be within 1.5 std of the mean. I also looked at all the good Es data (443 nm) over time and calculated the std/mean for all the Es data and found that most good days had a relative standard deviation (normalized by the mean) value less than 0.05. This was added as an extra filter to remove any data that might be cloud contaminated.

I then looked at the KL time series just for M245 and found that a few KL's were below clear water (at 412 and 443 nm) and above 0.06 (dashed red lines, Figure 2). Using all Kl data from all deployment I found most good KL data are below 0.04, so 0.06 is a very safe upper limit, only bad KL's are greater than 0.06. So the data was filtered again to removed KL outside these limits. Also all data from 21 Mar - 5 May were marked bad due to the fouling of the Lu collectors.

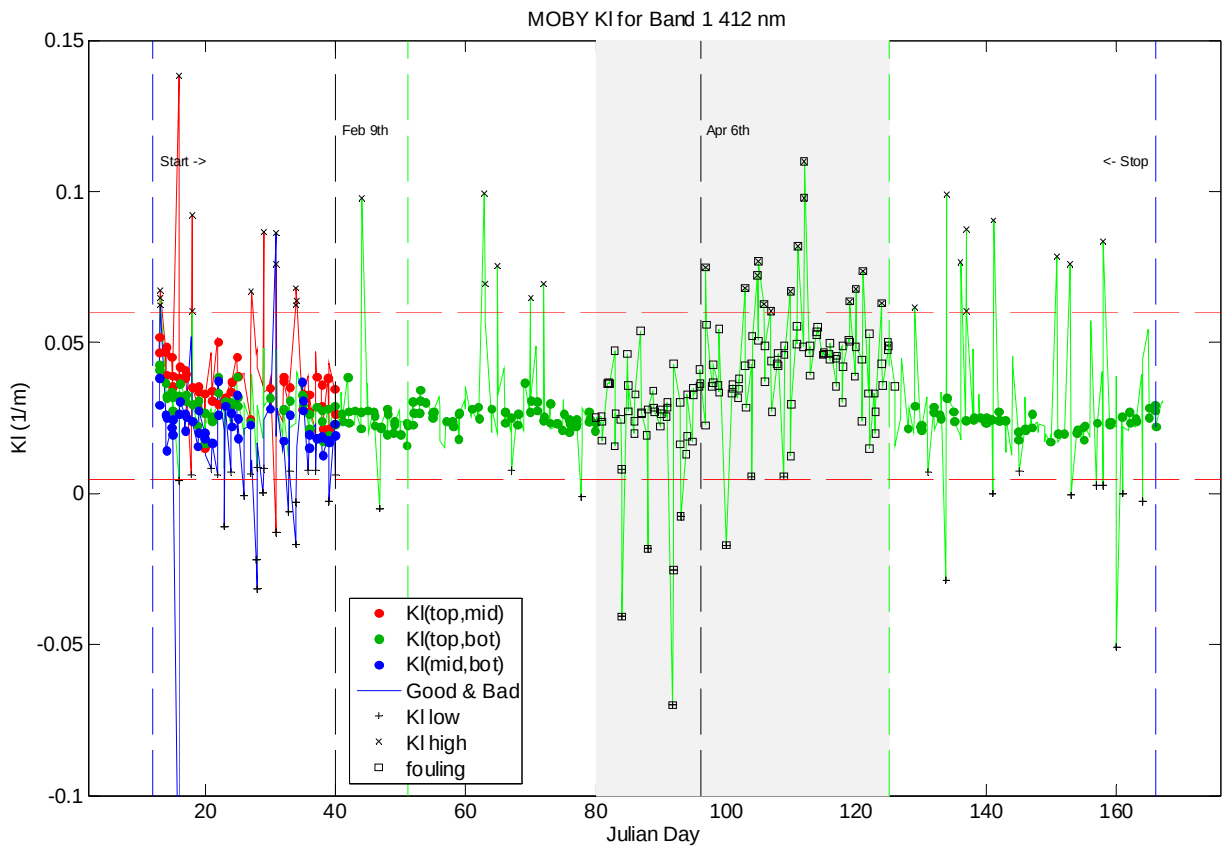

Figure 2. KL time series for M245 showing decision making process to filter the KL's. The dashed red lines are the upper and lower limits used as a second filter on the KL data.

In the figure above the circles are the KL's which are good, the lines show all the KL's (good, bad and questionable). The black symbols show the data which were removed from the KL's.

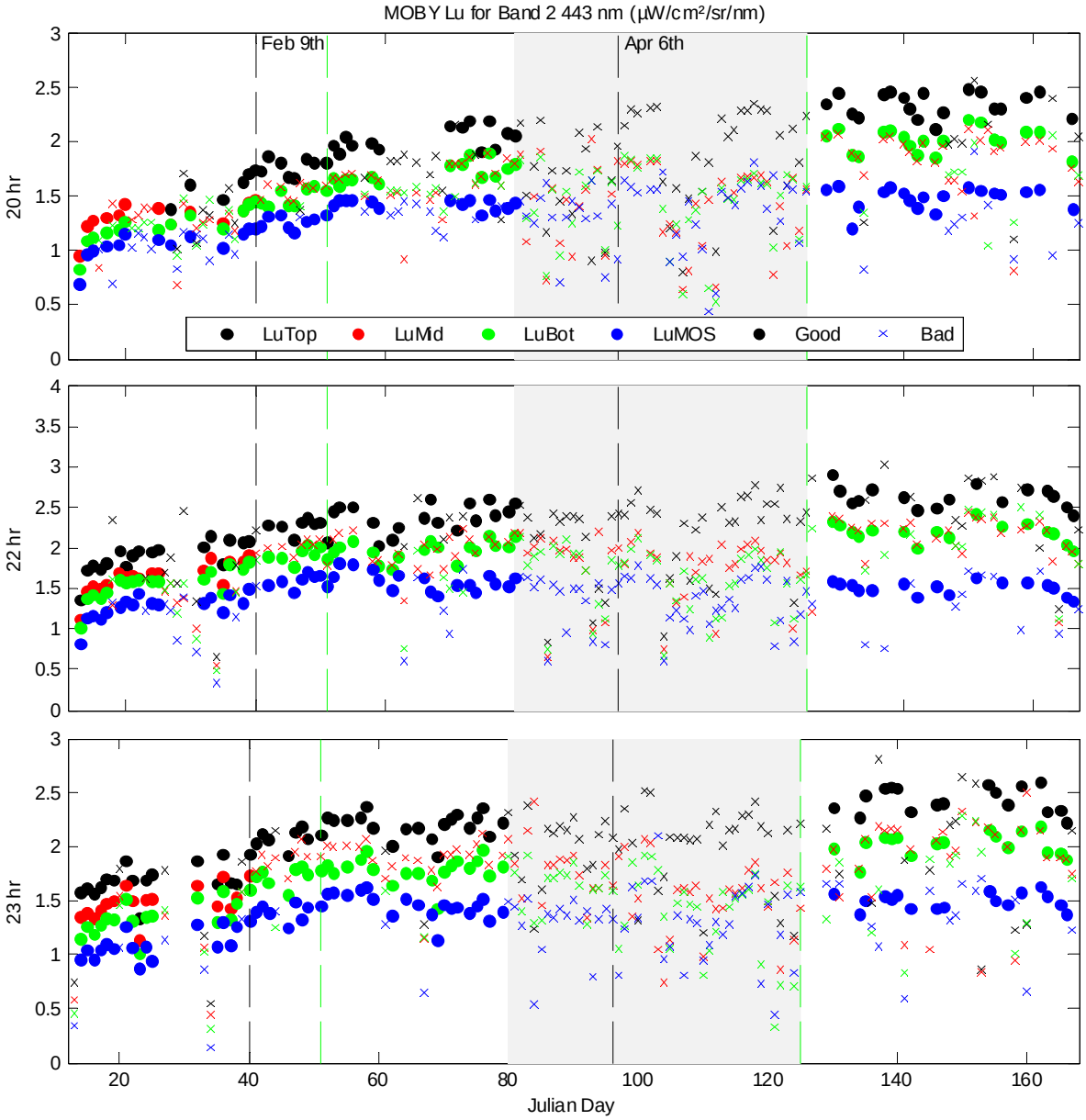

Figure 3. A time series of 4 Lus for band 2 443 nm. Dashed green lines are cleanings and the gray box is the suspected fouling event see in the Kl time series.

The above Lu time series shows the 4 Lu's so you can see how they vary relative to each other. All the LuMid data are marked bad from Feb 9th to the end of the deployment. Feb 9th is where I started seeing a change in LuMid and Mike's post cals confirmed LuMid's response had changed by ~15% during the deployment. Also because of the fouling event, there are no good data from any arm between 21 Mar and 5 May.

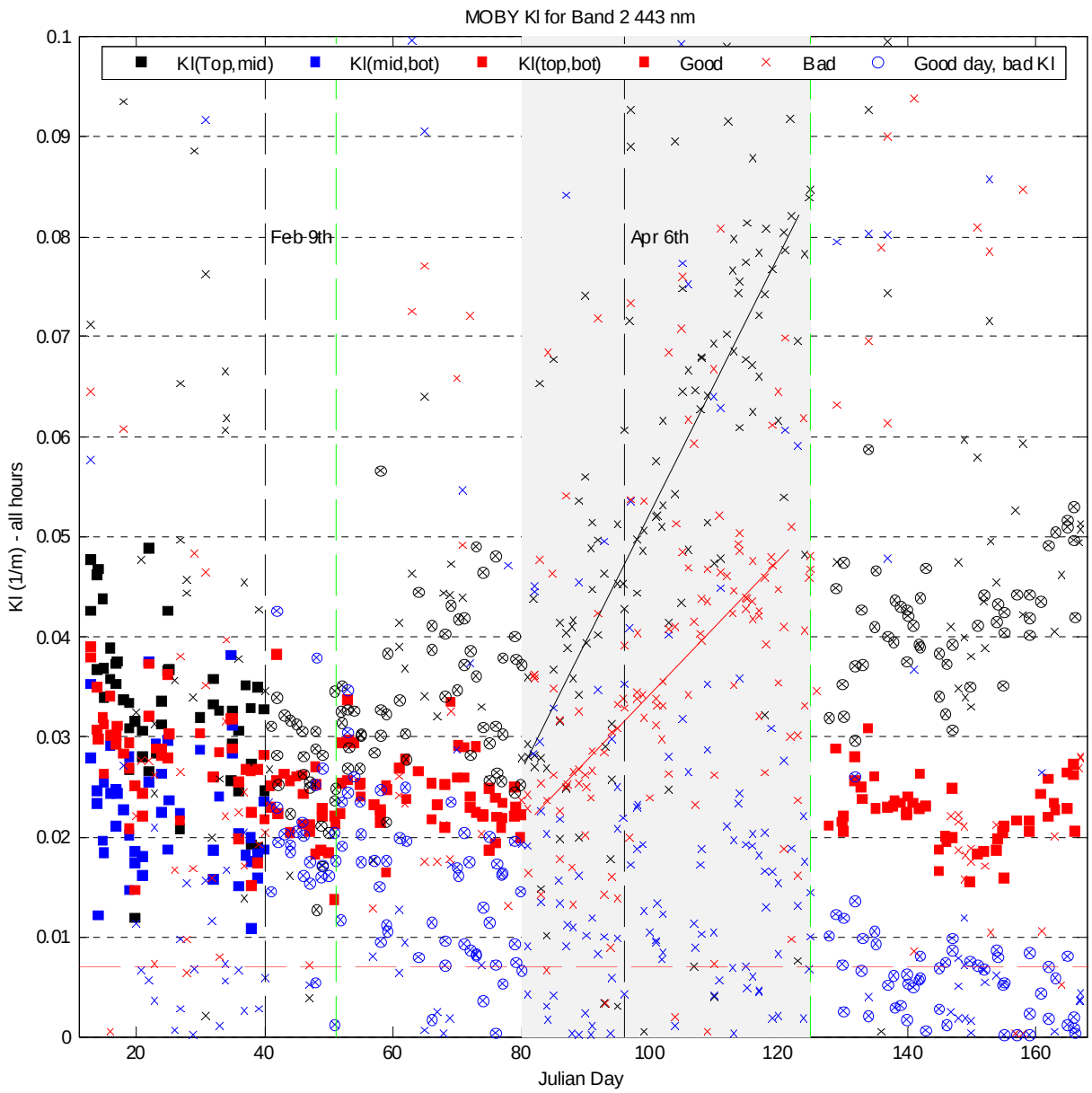

Figure 4. Kl time series for M245 at 443 nm, note the fouling event in the middle of the deployment.

The Kl's are a much more sensitive to small changes. The time series above clearly shows a fouling event. The event is characterized by a rise in two of the KL's followed by a sharp decline after a cleaning. The open circles are the KL(top,mid) and KL(mid,bot) data which are bad because of LuMid but the day was marked good. This way you can see the trends in each KL.

The final Lw derived from this deployment is Lw2 (LuTop, Kl(top.bot)) data. Lw2 data is not a normal product of MOBY, usually only Lw1 and Lw7 are put in the gold dir. The next graph will compare the Lw1, Lw2 and Lw7 data, to see how different the Lw2 will be.

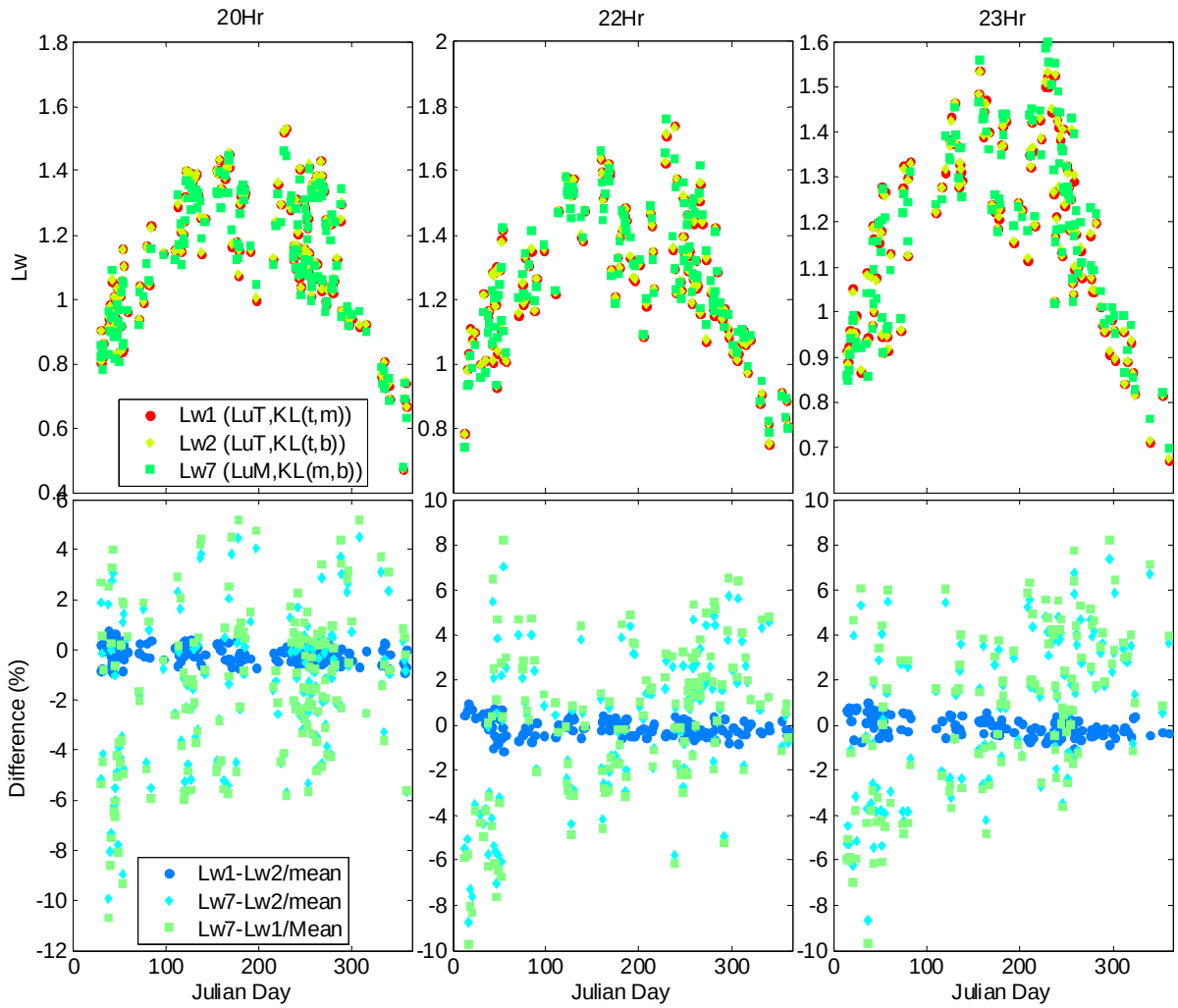

Figure 5. Comparing Lw1, Lw2 and Lw7 for all good data all deployments.

The graph above shows the difference between Lw2, which is not normally given out, and Lw1 and Lw7 the standard MOBY products. Lw2 was clearly very similar to Lw1, which makes sense since they use the same Lu. The only difference is the KL used.

Both M245 was reprocessed and all the data were satellite weighted and uploaded to the MOBY website and Coastwatch gold directory. For MOBY245 Lw2 data will be added to the gold directory.