Data Processing: Tara Mediterranean HyperPro (surface mode)

Name: Satlantic Free-Falling Optical Profiler (or Profiler II) deployed with two HyperOCR optical sensors.
Model and S/N for each:
MPR SN 136
HOCR ICSA SN 370
HOCR R08W SN 302
Purchase by Laboratoire d'Océanographie de Villefranche (LOV): December 2009

Alison Chase
University of Maine, Orono, ME
alison.p.chase@maine.edu
Document Version 1.0, January 8, 2016: "Tara_Med_HyperPro_Data_Processing.pdf"

Initial processing steps
Using Satlantic SatCon 1.5 software:
- Process *.raw files with appropriate *.cal files for each sensor.
- Process the Es files **without** the immersion coefficient (IC) applied, and Lu files **with** the IC applied (since the instrument is deployed in surface mode).
Using MATLAB:
- Lu and Es dark correction and time interpolation
- Select spectra where **both** the x and y tilt is less than 5 degrees
- Exclude spectra with -999 values
- Exclude Es and Lu spectra that fall outside of Es IQR. This eliminates anomalous Es spectra that appear to be in error. The Lu is not analyzed for the IQR range since there do not appear to be errors in the Lu spectra. However, it is still necessary to remove the Lu spectra that correspond to the removed Es spectra for consistency in Rrs calculations.
- Calculate Es and Lu mean and standard deviation (these Es and Lu mean and std dev are the ones printed in the final file)

Calculate Rrs:
- Determine water-leaving radiance (Lw) using:

$K\_Lu \sim (a\_w+a\_p)/0.5$; $\mu_u \sim 0.5$; K_Lu is the diffuse attenuation coefficient based on upwelling radiance; μ_u is the average cosine for upwelling radiance

$$Lu(\lambda, 0-) = Lu(\lambda, z)*\exp(-K\_Lu*z)$$

$$Lw(\lambda)=t^* Lu(0-, \lambda)/(n^2)$$

Where:
z=0.20; meters below surface of radiometer
n=1.34; refractive index of seawater
t=0.98; radiance transmittance of the surface (Chang et al. 2003)

a_w is absorption due to water, determined using Pope and Fry values.
a_p is the absorption by particulate matter, determined using the average spectrum of the Tara Med ac-s in-line deployment from the same day as the HyperPro data

collection (note that in some cases the same ac-s spectrum is used multiple times, since different HyperPro deployments from the same day are reported separately). In cases where no matching ac-s data is available, Lu is assumed to equal Lu(0-).

Finally:
$Rrs(\lambda)=Lw(\lambda)/Es(\lambda)$
(all Es and Lw spectra from a given deployment are used; average and std dev of Rrs can then be calculated)

- Average Es, Lu, and Rrs values are reported, as well as standard deviations of all three. Note that the Rrs is calculated using Lw, which is not reported (calculated with above description), therefore the reported Rrs value will be lower than Lu/Es since the attenuation of light from the sensor to the water surface and then across the water/air interface is being accounted for.

Other:
- Start time and end time printed in the text file are the beginning and end of the HyperPro deployment
- Latitude and longitude are the average latitude and longitude for the ac-s data file from the same time as the HyperPro deployment
- If there is no corresponding ac-s data, TSG data is used for latitude, longitude, temperature, and salinity information