HOT HyperPro Deployment Protocols

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The protocols in this document override any previous HOT HyperPro protocols.
Why have the protocols changed?

Surface products, such as normalized water-leaving radiance, can be derived by extrapolation from profiles of light measurements to the sea surface. Changes to the protocols are needed to improve the accuracy of these surface retrievals. These hyperspectral surface measurements are invaluable data for cal/val of satellite data products.

From the HyperPro II manual (Rev K):

A new technique for deploying the profiler in free fall was developed by Dr. Giuseppe Zibordi of the Joint Research Centre, particularly for coastal waters to improve the retrieval of normalized water leaving radiances. The technique was adopted by a NASA cal/val project, SORTIE (Spectral Ocean Radiance Transfer Investigation and Experiment) to lower uncertainties in water leaving radiances and specialized processing to take advantage of this new technique has been implemented in ProSoft 8.0. By using the technique described in this section, investigators can easily achieve regressions for diffuse attenuation coefficients and water leaving radiances with over 100 samples/m even with hyperspectral systems. This leads to significant improvements in derived parameter precision and accuracy in both Case-I and Case-II waters.

Changes to existing protocols are highlighted in yellow throughout the document.

The protocols in this document override any previous HOT HyperPro protocols.
The protocols in this document override any previous HOT HyperPro protocols.

### Summary of protocol changes

<table>
<thead>
<tr>
<th>Protocol element</th>
<th>Old protocol</th>
<th>New protocol</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Personnel</strong></td>
<td>No protocol</td>
<td>Include all personnel on all HOT HyperPro</td>
<td>Open communication about HyperPro issues and calibrations is needed to keep everyone on the same page.</td>
</tr>
<tr>
<td><strong>communication</strong></td>
<td></td>
<td>correspondence</td>
<td></td>
</tr>
<tr>
<td><strong>Calibration</strong></td>
<td>No protocol, but usually every two years</td>
<td>Annual with stray light and thermal corrections</td>
<td>Frequent calibrations are necessary to ensure accuracy of the derived products. A specific request must be made to Satlantic to include coefficients for stray light and thermal corrections in the calibration files.</td>
</tr>
<tr>
<td><strong>requirements</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>ProSoft version</strong></td>
<td>No protocol, but version 7.7.16 was in use</td>
<td>Version 8.1.1 (multicast) or higher</td>
<td>Version 8.1.1 (multicast) applies stray light and thermal responsivity corrections, can process yo-yo data, and yields more accurate surface products.</td>
</tr>
<tr>
<td><strong>Equipment</strong></td>
<td></td>
<td>Accurate ruler, tape measure or calipers</td>
<td>The sensor offset distances must be measured at the start of each cruise.</td>
</tr>
<tr>
<td><strong>required</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Sensor distance</strong></td>
<td>Constant value assumed</td>
<td>Measure the sensor distance offsets at the start of each cruise</td>
<td>The sensor distance offsets may vary between deployments and after calibration or reconfiguration.</td>
</tr>
<tr>
<td><strong>offsets</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Time of</strong></td>
<td>13:00 – 13:30 HST</td>
<td>14:00 – 14:30 HST</td>
<td>This time maximizes the likelihood of matching an AQUA or SNPP satellite overpass with low sunglint.</td>
</tr>
<tr>
<td><strong>deployment</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Cloud cover text</strong></td>
<td>Old example: “2/8 clouds”</td>
<td>New example: “2/8 clouds, clear sun”</td>
<td>Satellite cal/val can only be made when the sun is not obscured by clouds during the cast.</td>
</tr>
<tr>
<td><strong>Comments text</strong></td>
<td></td>
<td></td>
<td>The sensor distance offsets must be recorded in the metadata for each cast.</td>
</tr>
<tr>
<td><strong>Pressure tare</strong></td>
<td>In water at surface</td>
<td>Vertically upright on deck</td>
<td>Recommended by Satlantic and the cal/val team.</td>
</tr>
<tr>
<td><strong>orientation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Cast sequence</strong></td>
<td>1) profile 1  2) profile 2  3) profile 3</td>
<td>1) profile 1  2) profile 2  3) yo-yo</td>
<td>A yo-yo cast provides additional data points near the sea surface, improving the accuracy of surface retrievals.</td>
</tr>
<tr>
<td><strong>Yo-yo cast</strong></td>
<td></td>
<td>Yo-yo</td>
<td>A series of 5 short casts to 20 meters depth collected in a single file. Duration 10 minutes.</td>
</tr>
<tr>
<td><strong>Depth of profile</strong></td>
<td>200 m</td>
<td>180 m</td>
<td>The pressure sensor saturates at approximately 190 m. Saturated values cause processing issues.</td>
</tr>
</tbody>
</table>
The protocols in this document override any previous HOT HyperPro protocols.

Personnel

HyperPro S/N 120 is owned by the HOT program. It is stored, maintained, and operated by HOT personnel at the University of Hawaii under the direction of Ricardo Letelier (Oregon State University). The data are processed and analyzed by personnel at Oregon State University. The processed data are made available via the HOT program website and Oregon State University. Calibrations are performed by the instrument manufacturer (Satlantic). The table below lists all relevant contacts and their roles.

<table>
<thead>
<tr>
<th>Role</th>
<th>Name</th>
<th>Affiliation</th>
<th>e-mail address</th>
</tr>
</thead>
<tbody>
<tr>
<td>HOT director</td>
<td>Matt Church</td>
<td>University of Hawaii at Manoa</td>
<td><a href="mailto:mjchurch@hawaii.edu">mjchurch@hawaii.edu</a></td>
</tr>
<tr>
<td>PI</td>
<td>Ricardo Letelier</td>
<td>Oregon State University</td>
<td><a href="mailto:letelier@coas.oregonstate.edu">letelier@coas.oregonstate.edu</a></td>
</tr>
<tr>
<td>co-investigator</td>
<td>Angel White</td>
<td>Oregon State University</td>
<td><a href="mailto:awhite@coas.oregonstate.edu">awhite@coas.oregonstate.edu</a></td>
</tr>
<tr>
<td>operator</td>
<td>Benedetto Barone</td>
<td>University of Hawaii at Manoa</td>
<td><a href="mailto:bbarone@hawaii.edu">bbarone@hawaii.edu</a></td>
</tr>
<tr>
<td>operator</td>
<td>Lance Fujieki</td>
<td>University of Hawaii at Manoa</td>
<td><a href="mailto:fujieki@hawaii.edu">fujieki@hawaii.edu</a></td>
</tr>
<tr>
<td>data processor</td>
<td>Jasmine Nahorniak</td>
<td>Oregon State University</td>
<td><a href="mailto:jasmine@coas.oregonstate.edu">jasmine@coas.oregonstate.edu</a></td>
</tr>
<tr>
<td>calibrations</td>
<td>Darrell Adams</td>
<td>Satlantic</td>
<td><a href="mailto:darrell@satlantic.com">darrell@satlantic.com</a></td>
</tr>
</tbody>
</table>

Correspondence regarding the HOT HyperPro (issues, calibrations, etc.) should be sent to all personnel in the above table (except the Satlantic rep., unless appropriate). This will ensure that everyone is on the same page at all times.

Calibration requirements

An annual calibration of each HyperPro is necessary to ensure accurate output products.

Recent versions of ProSoft (8.1.1 and higher) are capable of correcting the data for stray light and thermal responsivity. To apply these corrections, calibration files containing stray light and thermal coefficients are needed. The calibration files sent from Satlantic may or may not include these coefficients. If not, a revised calibration file may be obtained on request from Satlantic.

Copies of new calibration files should be posted ASAP to the HOT ftp site (ftp://ftp.soest.hawaii.edu/dkarl/hot/light/hyperpro) where they can be downloaded by Oregon State University for use during data processing.
Deployment protocols

A summary of HyperPro deployment protocols is given below. More details can be found in:
Operation Manual for the Profile II, revision K, 10 December 2012

A. Equipment required

1. HyperPro (profiler, reference sensor, cables, deck unit, battery, sensor covers)
2. Accurate ruler / tape measure / calipers (at least 3’ long, for measuring the sensor distance offsets; preferably metric)
3. Black electrical tape (for dark count measurements)
4. Kim Wipes (for cleaning the sensors)
5. Computer with SatView, the latest calibration files, and ProSoft 8.1.1 or higher (optional)
6. Radios (if out of hearing range from the second operator during deployment)
B. Sensor distance offsets

To correct for the different vertical locations of the various sensors on the profiler, several distance measurements are required. Since the positions of the Ed and Lu sensors can be variable, these distance measurements should be made once per cruise before the first deployment; if the instrument configuration is changed between deployments, the distance measurements must be re-made.

In units of meters, make and record the four measurements illustrated in the figure:

1. **PRESS**: Top of Ed clamp to the lower face of the pressure sensor
   
   The lower face of the pressure sensor can be seen through the holes in the lower part of the instrument; see figure. This distance value should stay constant for a given instrument.

2. **ED**: Top of Ed clamp to the face of the Ed sensor
   
   This distance value may vary between deployments, calibrations, and configuration changes.

3. **LU**: Top of Lu clamp to the window on the Lu face
   
   This distance value may vary between deployments, calibrations, and configuration changes.

4. **PUC**: Top of Ed clamp to the center of the ECO PUC window
   
   This value should stay constant for a given instrument.

These values must be recorded in the **COMMENTS** field of the “Station Setup” window in SatView for every deployment. Use the format “**PRESS 0.726 m, ED 0.118 m, LU 0.145, PUC 0.152 m**”.

The protocols in this document override any previous HOT HyperPro protocols.
Measurements required to derive the sensor distance offsets. This is an edited version of a figure from the Operation Manual for the Profile II, revision K, 10 December 2012.
C. Time of deployment

Ideally, deployments will occur within an hour of the overpass time of ocean color satellites. Satellite overpass times depend on the orbit; approximate time ranges when Station ALOHA is in view are listed in the table below. The center times are best avoided since these are the times when sunglint occurs.

<table>
<thead>
<tr>
<th>Priority</th>
<th>Satellite-Sensor</th>
<th>Overpass time (GMT)</th>
<th>Overpass time (HST)</th>
<th>Maximum Glint (HST)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SNPP-VIIRS</td>
<td>22:45 – 00:45 GMT</td>
<td>12:45 – 14:45 HST</td>
<td>13:30 HST</td>
</tr>
<tr>
<td>2</td>
<td>AQUA-MODIS</td>
<td>23:00 – 00:45 GMT</td>
<td>13:00 – 14:45 HST</td>
<td>13:50 HST</td>
</tr>
<tr>
<td>3</td>
<td>TERRA-MODIS</td>
<td>20:30 – 22:00 GMT</td>
<td>10:30 – 12:00 HST</td>
<td>11:15 HST</td>
</tr>
</tbody>
</table>

For daily overpass predictions, please visit [http://www-air.larc.nasa.gov/tools/predict.htm](http://www-air.larc.nasa.gov/tools/predict.htm). This predictor provides the time, satellite elevation, and percent likelihood of glint for each overpass.

It is recommended that the HyperPro deployments occur from 14:00 – 14:30 HST.

In the past, the optics casts (ac-s, LISST) and HyperPro casts were made back-to-back. The optics casts are made at noon. The timing of the optics casts will not change, hence the two casts will no longer be back-to-back.

D. Reference sensor

Mount the reference sensor (Es) with cable ties and tape to a high spot on the vessel away from shading.

E. Cables

Surface sensor

1. Connect the surface sensor to the computer COM port (COM4) via the serial to USB converter cable.
2. Connect the surface sensor to the power supply with the power/telemetry cable.

Profiler

1. Connect the sensor cables on the profiler.
2. Connect the power/telemetry cable from the profiler to the MDU-200 deck unit.
3. Connect the RS-232 cable from the deck unit to the computer COM port (COM1).
4. Connect the deck unit to the battery.
5. Secure all mechanical connections (shackles).

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F. Computer startup

1. Turn on the computer.
2. Launch SatView.
3. Turn on the power to the profiler power supply. Instruments will start automatically.
4. Instruments should be sending data to the COM ports in use.
5. **COM port settings should be: 57,600 bps baud, 1 start bit, 8 data bits, 1 stop bit, no parity.**
6. Edit the following station metadata (Log – Station Setup).

<table>
<thead>
<tr>
<th>Metadata</th>
<th>Example</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRUISE-ID</td>
<td>HOT-254</td>
<td></td>
</tr>
<tr>
<td>OPERATOR</td>
<td>BB, LF</td>
<td>operator initials</td>
</tr>
<tr>
<td>CLOUD_PERCENT</td>
<td>1/8 clear sun</td>
<td>fraction of cloud cover, plus a note whether the sun is clear or obscured</td>
</tr>
<tr>
<td>WAVE_HEIGHT</td>
<td>0.25 m</td>
<td></td>
</tr>
<tr>
<td>WIND_SPEED</td>
<td>9 kts from West</td>
<td></td>
</tr>
<tr>
<td>COMMENT</td>
<td>PRESS 0.726 m, ED 0.118 m, LU 0.145, PUC 0.152 m</td>
<td>sensor distance offsets</td>
</tr>
<tr>
<td>STATION_ID</td>
<td>Kahe</td>
<td></td>
</tr>
</tbody>
</table>

G. BB2F dark counts

1. Place black electrical tape on the face of the BB2F, covering the entire surface. Do not use the cap in place of the tape (the cap is reflective).
2. Use the filename convention h250_dark_01.raw
3. Click “Start Logging” in SatView.
4. Collect data for 2 minutes.
5. Click “Stop Logging” in SatView.
6. Remove the tape and make sure the BB2F window is clean.

H. Pressure tare

1. **Orient the HyperPro vertically upright on the deck of the ship.**
2. In the SatView software, right-click on the instrument package (MPRO120).
3. Select “View List …”.
4. Select “Ancillary View”.
5. Click on the “Pressure Tare” button when ready.
6. Repeat this procedure if either the power is cycled to the instrument or SatView is restarted.

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I. Cast sequence

Two operators are required – one to deploy the HyperPro and the other to man the computer.

1. Remove the sensor caps.
2. Deploy the profiler a minimum of 20 m from the vessel.
3. Perform two profiles followed by one yo-yo cast as detailed below.

PROFILE 1
   a. Use the naming convention h250_aloha1.raw for the file.
   b. When then instrument starts to free fall, hit the “Start Logging” button in SatView.
   c. When the instrument reaches 180 m depth, hit the “Stop Logging” button in SatView.
   d. Do not log data deeper than 180 m depth as the pressure sensor saturates.
   e. Pull the HyperPro back to the surface.

PROFILE 2
   same as PROFILE 1

YO-YO

The entire yo-yo cast will be logged to a single file. It should take about 10 minutes total.
   a. Use the naming convention h250_aloha_yoyo1.raw for the file.
   b. When the instrument starts to free fall, hit the “Start Logging” button in SatView.
   c. When the instrument reaches 20 m depth, pull the HyperPro back to the surface but do not stop logging.
   d. Immediately repeat this 20 m cast a total of 5 times, continuing to log to the same file.
   e. When the HyperPro has reached the surface after the fifth cast, hit the “Stop Logging” button in SatView.
J. Computer shutdown

1. Exit SATView.
2. Backup data to a thumb drive.
3. Shutdown the computer.

K. Cleaning the HyperPro

1. Pull the profiler back onto the ship.
2. Power down the instrument and disconnect the cables.
3. Rinse the instrument and cables with fresh water.
4. Dry sensor heads and BB2F with Kimwipes.
5. Replace the sensor caps.

L. Processing (optional)

Use ProSoft 8.1.1 (multicast mode) or higher. Earlier versions of ProSoft will not process yo-yo data. See the HyperPro data processing instructions for details.

M. Data distribution

After the cruise, place the collected raw HyperPro data and any new calibration files on the HOT ftp site:


These data will be downloaded and processed at Oregon State University.

Raw and processed HyperPro data are available online from both the HOT program and Oregon State University at the following locations:

<table>
<thead>
<tr>
<th></th>
<th>raw</th>
<th>processed</th>
<th>OSU raw &amp; processed</th>
</tr>
</thead>
<tbody>
<tr>
<td>HOT</td>
<td>raw</td>
<td>processed</td>
<td>OSU raw &amp; processed</td>
</tr>
</tbody>
</table>

fin

The protocols in this document override any previous HOT HyperPro protocols.