WORLD
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INSTRUMENTS
Instrumenting scientific ideas

UltraPath™

A unique multiple long pathlength sample cell for absorbance spectroscopy

Appearance of instruments presently in these systems differ from those pictured here.

- ***Process Control & Oceanography***
- ***Rugged system for laboratory and onboard measuring***
- ***Portable & easy to use***
- ***User-selected optical path lengths: 2, 10, 50 & 200 cm***
- ***Highly sensitive and stable***

UltraPath™ is a unique high-performance spectrophotometer system offering user-selectable optical path lengths of 2, 10, 50 and 200 cm. The instrument operates in the wavelength range of 250 to 730 (**UPUV**) or 380 to 730 nm (**UPVIS**) and has an exceptional dynamic range. Designed for the detection of low absorbing species in aqueous solutions, UltraPath is an ideal tool for any study requiring precise and highly sensitive spectroscopic determination of analytes, either in the lab or in the field.

Background

UltraPath was developed by WPI under a collaborative agreement with NASA (Stennis Space Center) for the spectroscopic determination of colored dissolved organic matter (CDOM) in seawater and fresh water environments. It can be used in the laboratory and in the field (*i.e.*, at sea). CDOM concentrations vary significantly between open ocean samples with low CDOM (*e.g.*, 0.007 m^{-1} at 380 nm), and high CDOM freshwater

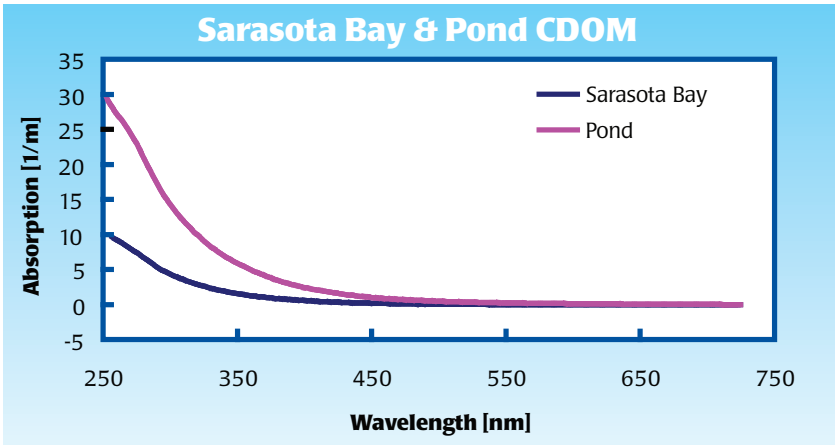


Fig. 1 — *Two typical absorption spectra measured using UltraPath. The sample labeled "Sarasota Bay" is a CDOM sample with 34 PSU salinity collected from Sarasota Bay (Nov. 2007), and the sample labeled "Pond" is a highly concentrated CDOM sample collected from a local pond in Sarasota, Florida (Nov. 2007).*

environments (*e.g.*, 10-20 m^{-1} at 380 nm). To address these problems the design requirements of UltraPath mandated the development of a rugged portable system capable of high sensitivity measurements across a wide dynamic range. The UltraPath system meets these stringent design criteria and enables reliable measurement of CDOM in the range of 0.002 m^{-1} to 200 m^{-1} (250 to 730 nm).

Design

UltraPath has four optical pathlengths contained within a single sample cell (*i.e.*, 2 cm, 10 cm, 50 cm and 200 cm). The pathlengths are user-selectable, offering a very high sensitivity and an extended dynamic range for UV and VIS absorbance measurements. The fluid path of the sample cell is optimized to produce a laminar flow that is virtually free of interference from trapped air bubbles and adherence of dissolved substances to the cell wall. In particular, the design greatly minimizes the problems commonly found with flow cells of long optical pathlengths: the risk of trapping dust particles, fibers or particulate matter inside the cell. The UltraPath system includes a low noise photodiode array-based spectrometer module (TIDAS I: FWHM = 5 nm, noise <0.2 mAU) and a light source (**D4H** with UPUV; **FO6000** with UPVIS) to measure sample absorption. Light is coupled from the light source to the sample cell and from the sample cell to the detector via two fused silica fibers. A peristaltic pump (**PeriPro-4LS**) is utilized to draw the sample into the UltraPath sample cell.

A standard PC or laptop (not included) is connected to the TIDAS E via a RJ-45 Ethernet interface. For spectrometer requirements and software options, see **TIDAS-E**.

Mobility

The system is designed for mobility. The components of the UltraPath system are designed to function over a broad range of laboratory and field environments.

Samples

Two typical absorption spectra recorded with an UltraPath (UPUV) of a seawater and a fresh water sample collected in November 2007 are shown in Fig. 1. Due to their high absorbance, both samples were analyzed in the 10 cm pathlength. The CDOM sample labeled Mayagüez Bay in Fig. 2 is from oligotrophic, low productive waters with high salinity collected off the west coast of Puerto Rico in the Mayagüez Bay. Special attention should be drawn to the exceptional sensitivity of UltraPath enabling detection of CDOM absorption below 0.03 m-1. To exemplify the

performance of the UltraPath in Laboratory Chemistry and Process Control, Ponceau S absorbance was measured with the 200 cm pathlength of an UltraPath. Normalizing the Ponceau absorbance graph to AU/cm, the range of this measurement is 150 µAU with a noise level below 2 µAU peak to peak. Sub-nanomolar concentration of this dye can clearly and reliably be detected, which is a novelty in absorbance based spectroscopy.

Particulate Absorption

Particulate absorption can be measured by the well established Quantitative Filter Technique (QFT). WPI now offers a fiber optic filter holder for Glass Fiber Filters (**QFT1**, page 206) which can be used with the spectrometer (**TIDAS E**) and light source (**D4H** or **FO6000**) supplied with the **UltraPath**. With this accessory, particulate absorption can be measured on site, avoiding loss of spectral information due to freezing and shipping particulate samples to a laboratory.

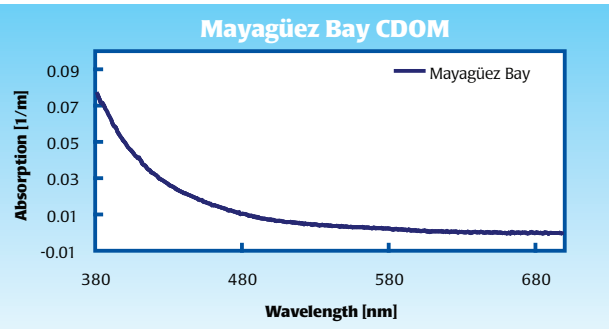
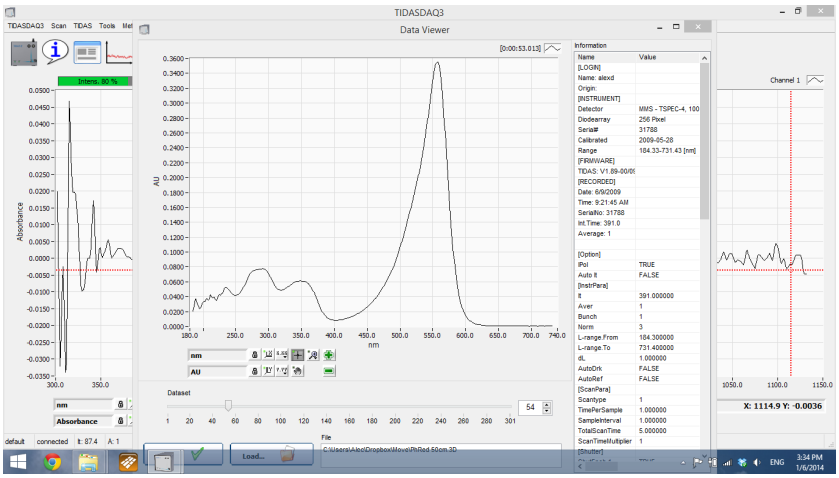


Fig. 2 — *CDOM Sample "Mayagüez Bay" was collected from the high salinity oligotrophic waters of Mayagüez Bay on the west coast of Puerto Rico (2001). Data courtesy of NASA Stennis Space Center.*



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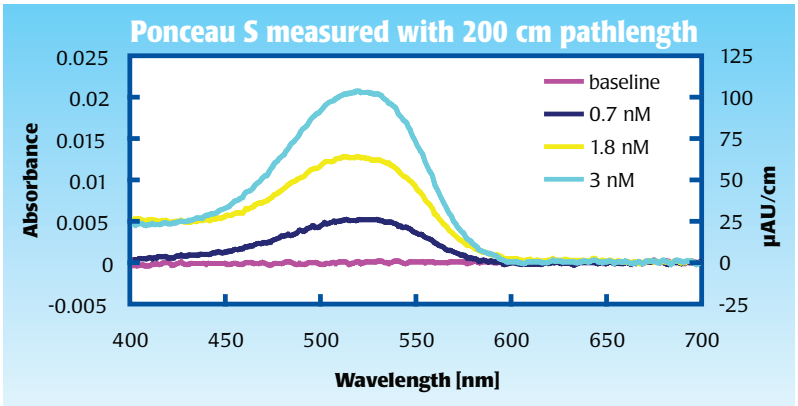

Fig. 3 – *Ponceau S absorption measured with UltraPath (200 cm cell). Ponceau S was dissolved in Millipore water.*

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SPECIFICATIONS

DYNAMIC RANGE	5 µAU/cm to 1 AU/cm 0.002 m^{-1} to 200 m^{-1}
WAVELENGTH RANGE	250 nm – 730 nm (UPUV) 380 nm – 730 nm (UPVIS)
WAVELENGTH RESOLUTION (FWHM)	5 nm
NOISE (PEAK TO PEAK)	< 0.2 mAU
DRIFT	< 1 mAU/h
OPTICAL PATHLENGTH	2, 10, 50 & 200 cm (user selectable)
SAMPLE CELL INNER DIAMETER	2 mm
CELL VOLUME	10 mL (at 200 cm pathlength)
SAMPLE INLET / OUTLET	1/8"
FIBER INPUT/OUTPUT	600 µm
SOLVENT RESISTANCE	Most organic and inorganic solvents
SHIPPING WEIGHT	UPUV: 44 lb (20 kg) UPVIS: 33 lb (15 kg)

WORLD PRECISION INSTRUMENTS

USA: International Trade Center, 175 Sarasota Center Boulevard, Sarasota FL 34240-9258 USA **Tel:** 941-371-1003 • **Fax:** 941-377-5428 • **E-mail:** wpi@wpiinc.com • **Internet:** www.wpiinc.com

UK: 1 Hunting Gate, Hitchin, Hertfordshire SG4 0TJ England • Tel: 44 (0)1462 424700 • E-mail: wpiuk@wpi-europe.com
Germany: Zossener Str. 55, 10961 Berlin, Germany • Tel: 030-6188845 • Fax: 030-6188670 • E-mail: wpide@wpi-europe.com
China & Hong Kong: Rm 29a, No8 Donfang Rd., Pudong District, Shanghai 200120 PRC • Tel: +86 688 85517 • E-mail: ChinaSales@china.wpiinc.com
Brazil: Conselheiro Nabias, 756 sala2611, Santos-Sao Paulo 11045-002 Brazil • E-mail: info@brazil.wpiinc.com