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Bio-Optical Profile Data Report

Joint Global Ocean Flux Study
Hawaii Ocean Time-Series
HOT-3
R/V Moana Wave
January 6–10, 1989

Donald J. Collins
W. Joseph Rhea
An Van Tran

September 1, 1990

NASA

National Aeronautics and
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Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

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ABSTRACT

Time-series measurements of the incident surface downwelling irradiance and vertical profiles of the bio-optical properties of the ocean have been measured during the third cruise of the Hawaii Ocean Time-Series to the ALOHA site, 22° 56.4′ N, 157° 54.6′ W, north of the island of Oahu, Hawaii, during the period January 6-10, 1989. A summary of these data is presented to permit investigators an overview of the data collected. The data are available in digital form for scientific investigators. Requests for the data should be addtessed to D. Collins
(D.Collins/OMNET: (818)-354-3473).

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INTRODUCTION

The Joint Global Ocean Flux Study (JGOFS) is an international program to study the flux of carbon through the ocean and the ocean's role in the global carbon cycle. The JGOFS Hawaii Ocean Time-Series (HOT) (cf. Karl, et al., 1990 and Winn, et al., 1990) has been established to examine the time variability of the hydrography and of the flux of carbon through the upper ocean at the ALOHA site, 22° 56.4′ N, 157° 54.6′ W, in the oligotrophic ocean north of Oahu in the Hawaiian Islands. The goal of the study is to survey the ALOHA site using monthly cruises to produce a time-series of the hydrographic and biological data and to understand the physical and biological processes which combine to produce the flux of carbon through the oligotrophic system. This goal has been approached with an intensive sampling of the hydrographic data surrounding the ALOHA station and the deployment of a floating sediment trap array for the determination of the flux of carbon to the deep ocean at this site. We participated in the third cruise of this effort, HOT-3, collecting bio-optical data from the R/V Moana Wave, during the period January 6-10, 1989. This cruise was conducted in heavy seas, with overcast skies, with Dr. Christopher Winn as the chief scientist. This report describes in graphical form an overview of the bio-optical data collected.

DATA DESCRIPTION

The downwelling scalar photosynthetically available irradiance (PAR) was measured continuously during the cruise using a Biospherical Instruments QSR-240 integrating scalar radiometer. These data are shown in Figure 1 as a time-series plot. The mean scalar irradiance for the period of the cruise was 62.9 Ein/m^2-day, with the individual daily values shown in Table I. During each vertical cast of the spectroradiometer, the downwelling vector irradiance at the surface was measured in four spectral channels to provide a surface normalization for the in-water measurements.

The in-water optical data was collected with a bio-optical profiling system (BOPS), an updated version of the BOPS originally developed by Biospherical Instruments and reported by Smith et al. (1984). The heart of the instrument was a Biospherical Instruments MER-1048 Spectroradiometer, which measured the downwelling spectral irradiance in 13 channels and the upwelling spectral irradiance and the upwelling spectral radiance in eight channels each. The MER-1048 also had sensors for photosynthetically available radiation (PAR), depth, tilt and roll. In addition, temperature and conductivity were measured with a Sea-Bird CTD, chlorophyll fluorescence was measured with a Sea Tech fluorometer and beam transmission with a Sea Tech 25-cm transmissometer. The channel assignments for the radiometer and the units for each measurement are given in Table II. The MER-1048 acquired data 16 times per second, formed four averages per second and transmitted the resulting averages to a deck receiving unit. A Compaq-286 computer stored the data on a hard disk and provided an analysis capability. The spectroradiometer casts were interspersed between the CTD casts using the stern A-frame and are limited in number. The starting time for each of the casts is listed in Table I. Because working conditions did not permit the operation of the spectroradiometer on January 9, 1989, data is not available for that day.

The results of the optical profiles are presented as separate downcast and upcast results for the same operation to give insight into the short-term variability of the data. The profile data was filtered to remove obvious data spikes, binned into one-meter averages and stored in the form of ASCII comma-separated files.

INDIVIDUAL STATION DATA PROFILES

For each downcast and upcast, vertical profiles of the measured temperature, salinity, fluorescence, beam transmission, and PAR are presented in Figures 2 through 13 to give a graphical overview of the data. Spectra of the downwelling irradiance, E_d, the upwelling irradiance, E_u, and the upwelling radiance, L_u, are presented in these figures as an overview of the optical data available from the cruise. The spectral plots represent the data at 3 m depth and at 5 m intervals, beginning at 5 m to the maximum depth of the spectroradiometer, approximately 160 m, depending on the cast. The minimum depth of 3 m has been chosen for this overview because of the difficulty in the interpretation of data at the surface for rough seas.

The data files are identified by a filename of the format:

H389**ddnc** ,

where H389 identifies the JGOFS HOT-3 cruise data from the R/V Moana Wave, January 6-10, 1989. **dd** is the Julian day, **n** is the cast number during the day, and **c** identifies either the downcast or the upcast.

The radiance, irradiance, and PAR data are presented in calibrated units based on a laboratory calibration conducted by Biospherical Instruments on October 19, 1988. A second calibration after the cruise showed no significant deviation from these values. No corrections for ship shadow or other artifacts have been made to the data presented in this report, although we have developed routines for correcting such artifacts, calculating K, etc., following the guidelines of Smith and Baker (1984, 1986) and Gordon (1985). The reader is referred to the references for a discussion of these problems.

The salinity is calculated from the temperature and conductivity measurements using the standard equations for practical salinity units (psu) as discussed by Millero, et al. (1980). The occasional spikes in salinity that are observed at the surface and at the thermocline result from an artifact caused by differences in the response time of the conductivity sensor and the temperature sensor.

Data from the Sea Tech fluorometer are presented in fluorescence units. The fluorometer has been calibrated using extracted chlorophyll and phaeopigment values from water samples taken on this cruise. These calibration results are not used in the figures in this report.

Data from the Sea Tech transmissometer are presented as percent transmission, where the vacuum transmission value is 100%. The interpretation of these results in terms of the beam transmission coefficient, **c**, as reported by Zaneveld, et al. (1979), has been accomplished. These results have not been included in this report.

The data are available in digital form for use by scientific investigators. Requests for the data should be addressed to D. Collins (D.Collins/OMNET: (818)-354-3473).

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TABLE I

PROFILE SUMMARY

DATE	E_o (Ein/m^2-day)	CAST No.	START TIME
1/ 6/89	--	--	--
1/ 7/89	57.6	H389071	15:15
1/ 8/89	65.2	H389081	10:40
		H389082	14:16
		H389083	16:27
		H389084	19:02
1/ 9/89	66.8	--	--
1/10/89	61.8	H389101	11:46

TABLE II

DATA CHANNELS

CHANNEL	DESCRIPTION
0	Number of data points averaged per bin
1	410 nm Downwelling Irradiance ($\mu W/cm^2/nm$)
2	441 nm Downwelling Irradiance ($\mu W/cm^2/nm$)
3	488 nm Downwelling Irradiance ($\mu W/cm^2/nm$)
4	520 nm Downwelling Irradiance ($\mu W/cm^2/nm$)
5	550 nm Downwelling Irradiance ($\mu W/cm^2/nm$)
6	560 nm Downwelling Irradiance ($\mu W/cm^2/nm$)
7	589 nm Downwelling Irradiance ($\mu W/cm^2/nm$)
8	633 nm Downwelling Irradiance ($\mu W/cm^2/nm$)
9	656 nm Downwelling Irradiance ($\mu W/cm^2/nm$)
10	671 nm Downwelling Irradiance ($\mu W/cm^2/nm$)
11	683 nm Downwelling Irradiance ($\mu W/cm^2/nm$)
12	694 nm Downwelling Irradiance ($\mu W/cm^2/nm$)
13	710 nm Downwelling Irradiance ($\mu W/cm^2/nm$)
14	Depth of averaged data (m)
15	Tilt (deg)
16	Roll (deg)
17	410 nm Upwelling Radiance ($\mu W/cm^2/nm/sr$)
18	441 nm Upwelling Radiance ($\mu W/cm^2/nm/sr$)
19	488 nm Upwelling Radiance ($\mu W/cm^2/nm/sr$)
20	520 nm Upwelling Radiance ($\mu W/cm^2/nm/sr$)
21	550 nm Upwelling Radiance ($\mu W/cm^2/nm/sr$)
22	633 nm Upwelling Radiance ($\mu W/cm^2/nm/sr$)
23	656 nm Upwelling Radiance ($\mu W/cm^2/nm/sr$)
24	683 nm Upwelling Radiance ($\mu W/cm^2/nm/sr$)
25	410 nm Upwelling Irradiance ($\mu W/cm^2/nm$)
26	441 nm Upwelling Irradiance ($\mu W/cm^2/nm$)
27	488 nm Upwelling Irradiance ($\mu W/cm^2/nm$)
28	520 nm Upwelling Irradiance ($\mu W/cm^2/nm$)
29	550 nm Upwelling Irradiance ($\mu W/cm^2/nm$)
30	589 nm Upwelling Irradiance ($\mu W/cm^2/nm$)
31	671 nm Upwelling Irradiance ($\mu W/cm^2/nm$)
32	694 nm Upwelling Irradiance ($\mu W/cm^2/nm$)
33	25 cm Transmissometer (% transmission)
34	Fluorometer (fluorescence units)
35	PAR (quanta x $10^{17}/cm^2/s$)
36	Temperature (deg C)
37	Conductivity (mmho/cm)
38	Salinity (ppt)
39	Density (g/cm^3)
40	410 nm Surface Irradiance ($\mu W/cm^2/nm$)
41	520 nm Surface Irradiance ($\mu W/cm^2/nm$)
42	589 nm Surface Irradiance ($\mu W/cm^2/nm$)
43	683 nm Surface Irradiance ($\mu W/cm^2/nm$)

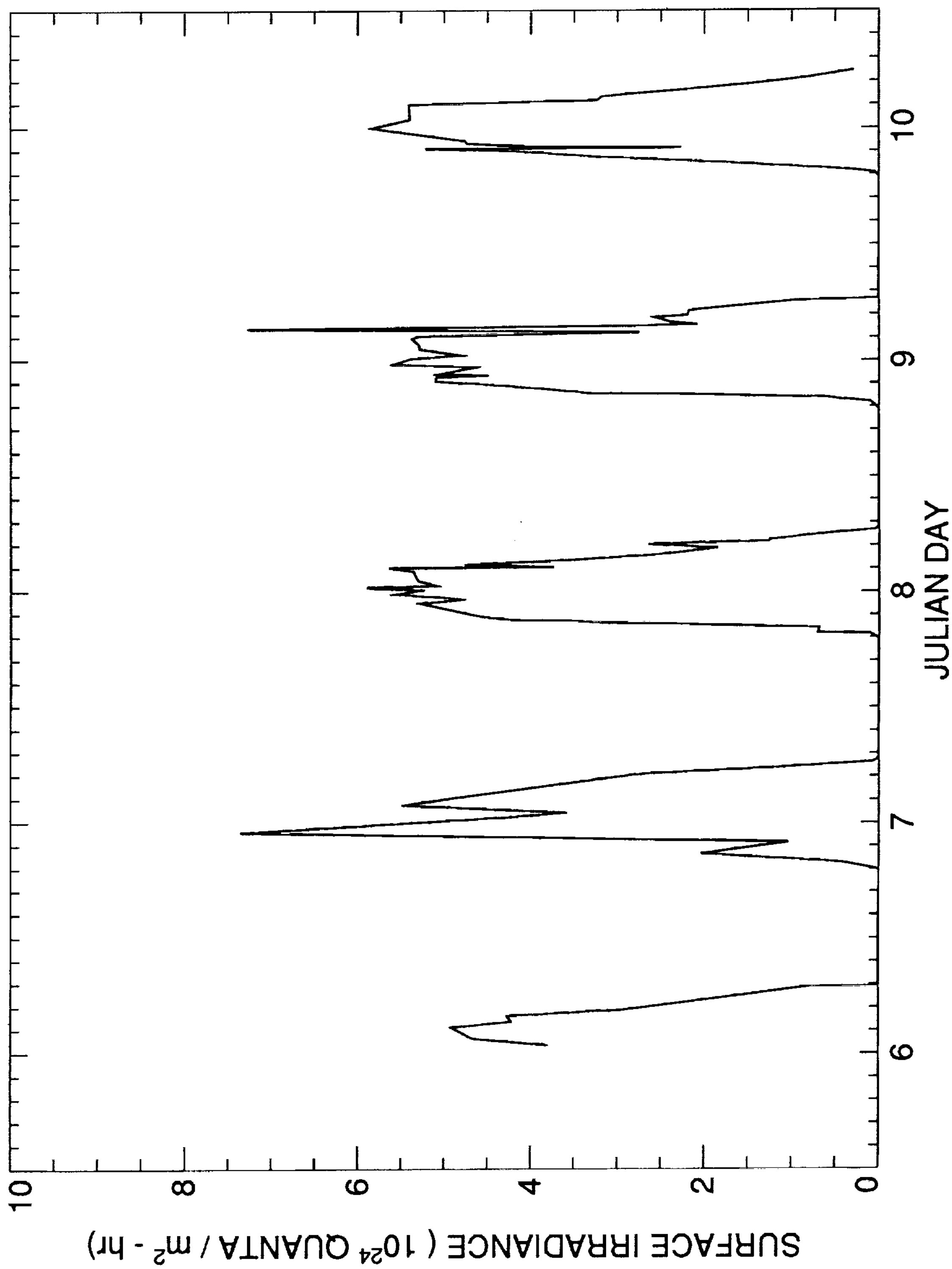
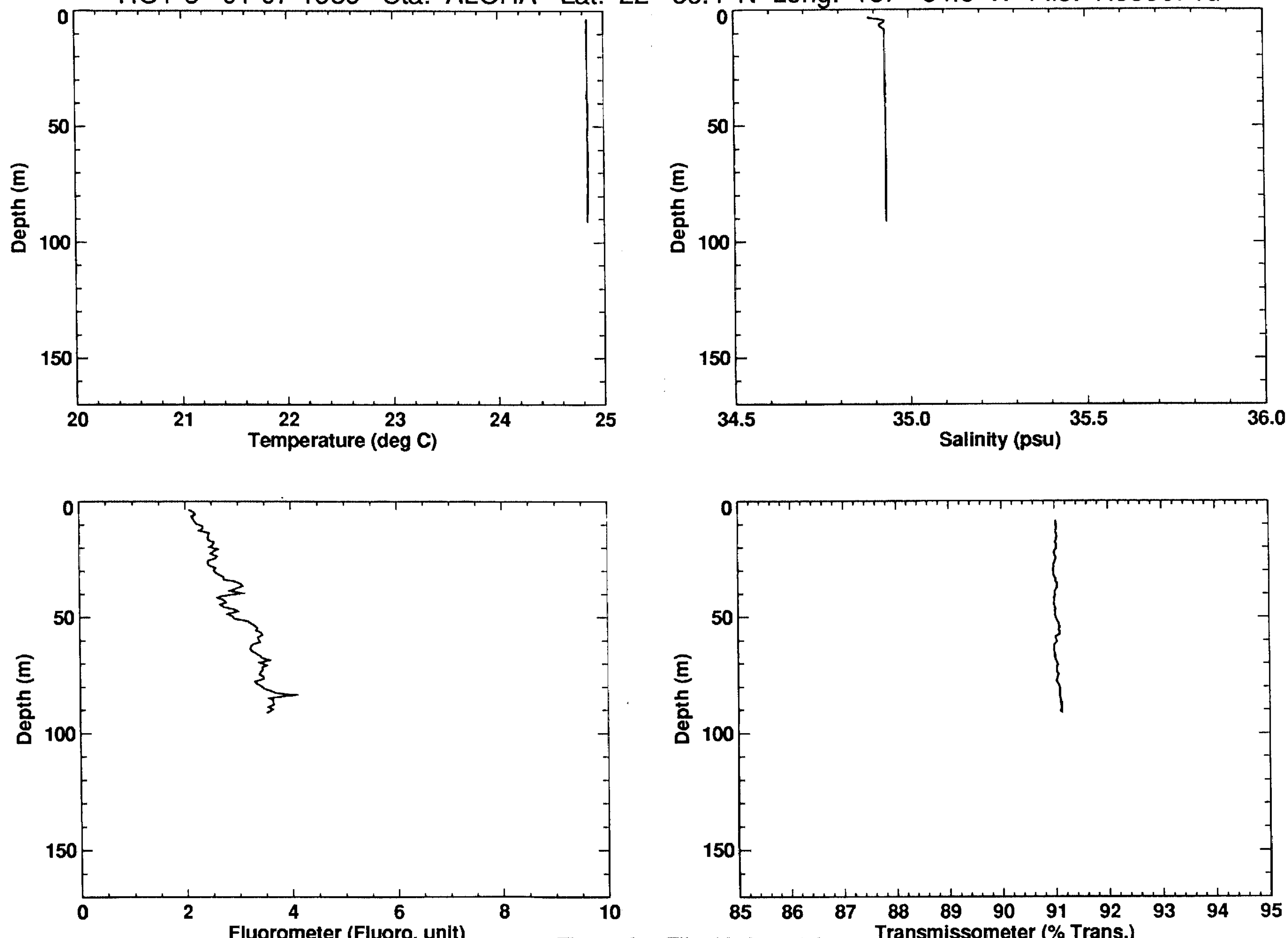


Figure 1. Time Series of Surface irradiance

HOT-3 01-07-1989 Sta: ALOHA Lat: 22° 56.4' N Long: 157° 54.6' W File: H389071d



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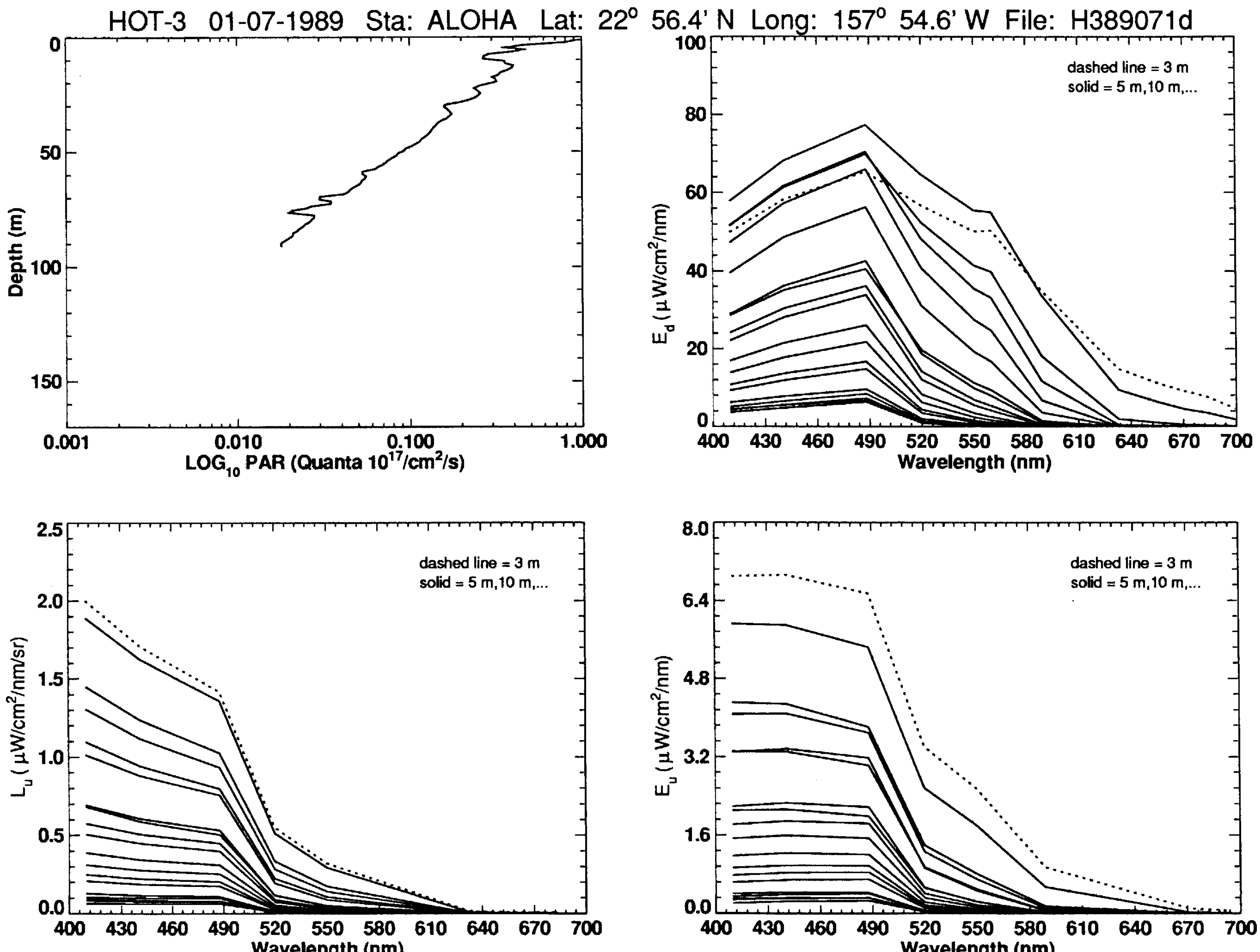

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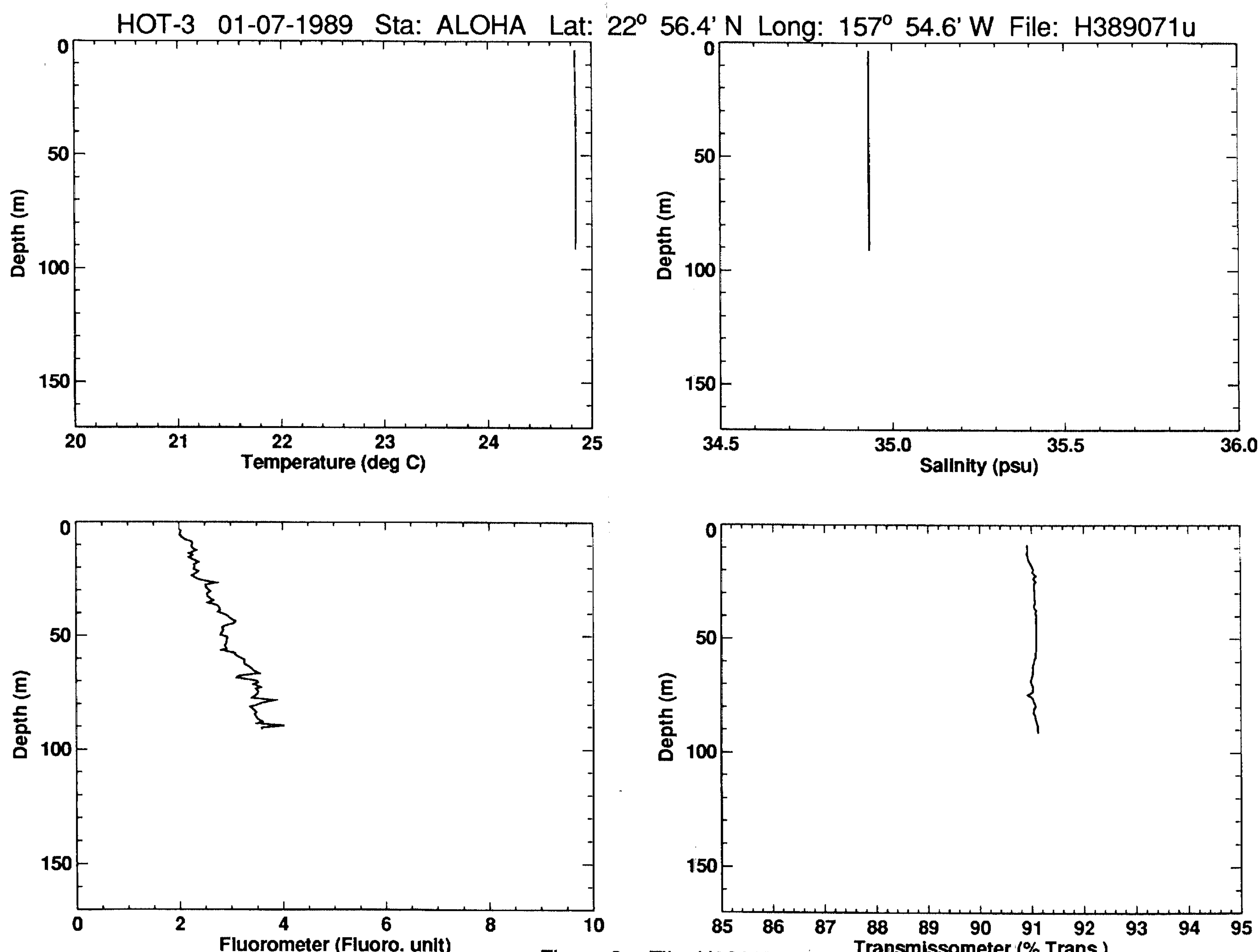

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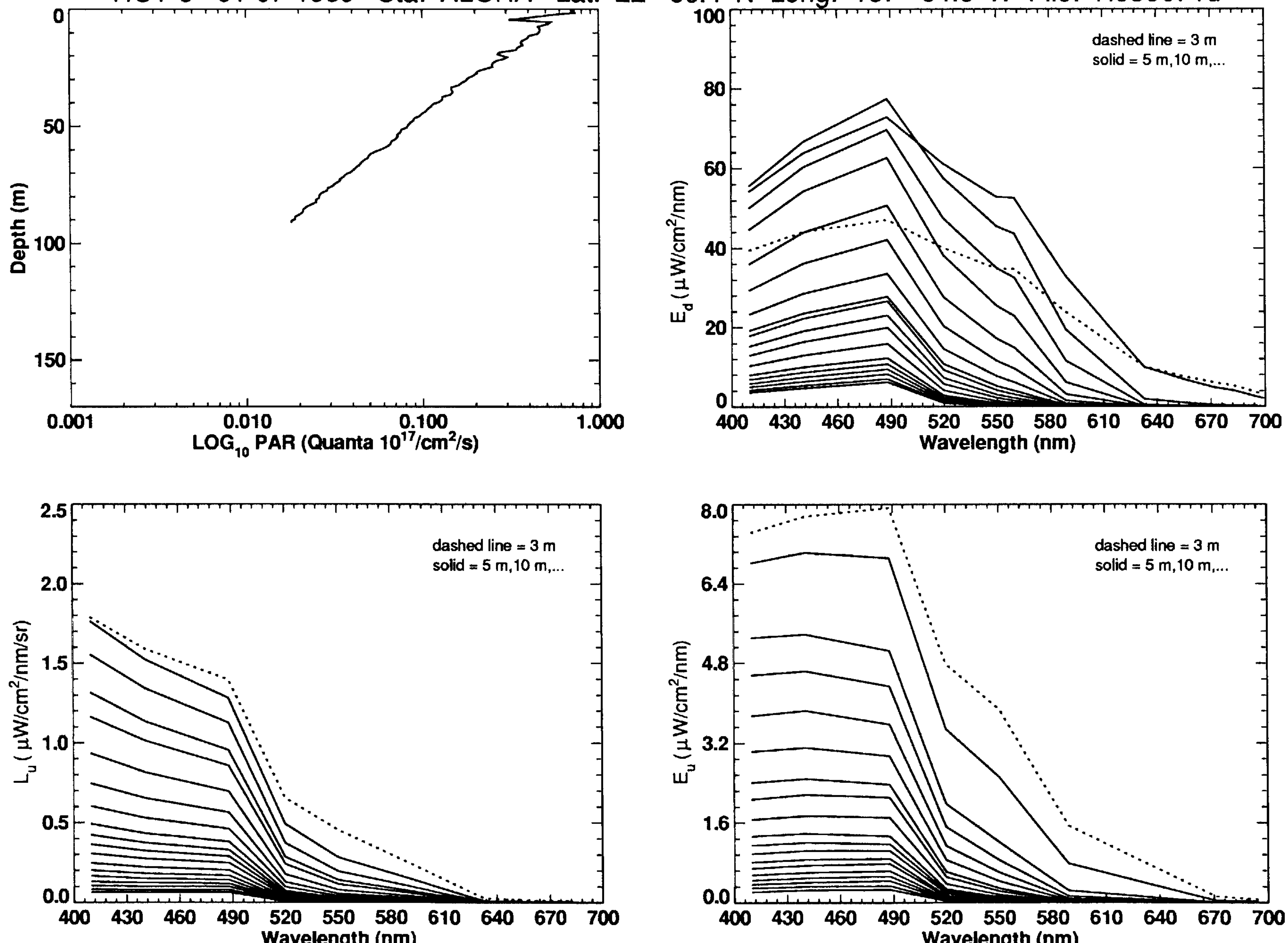

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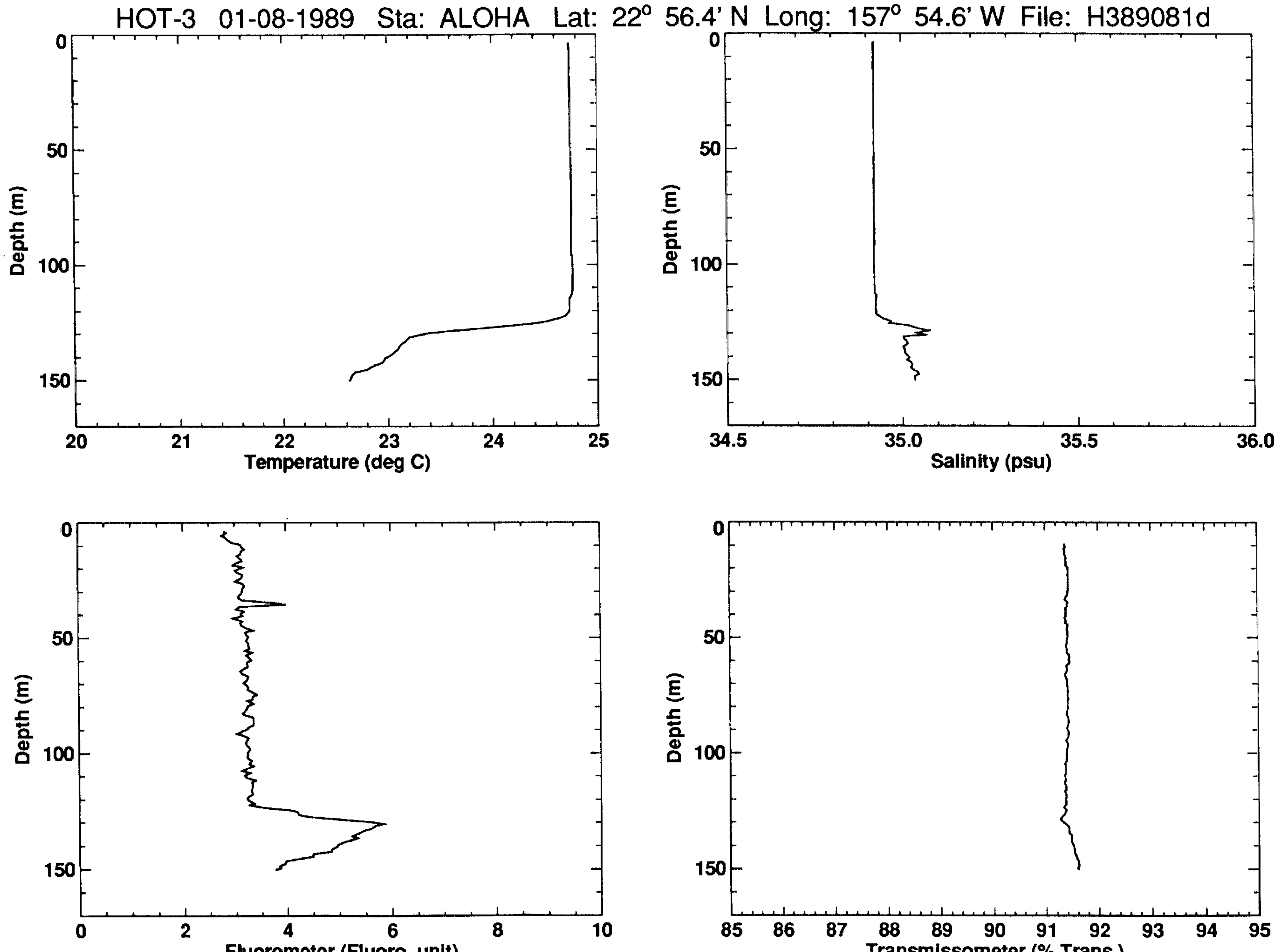

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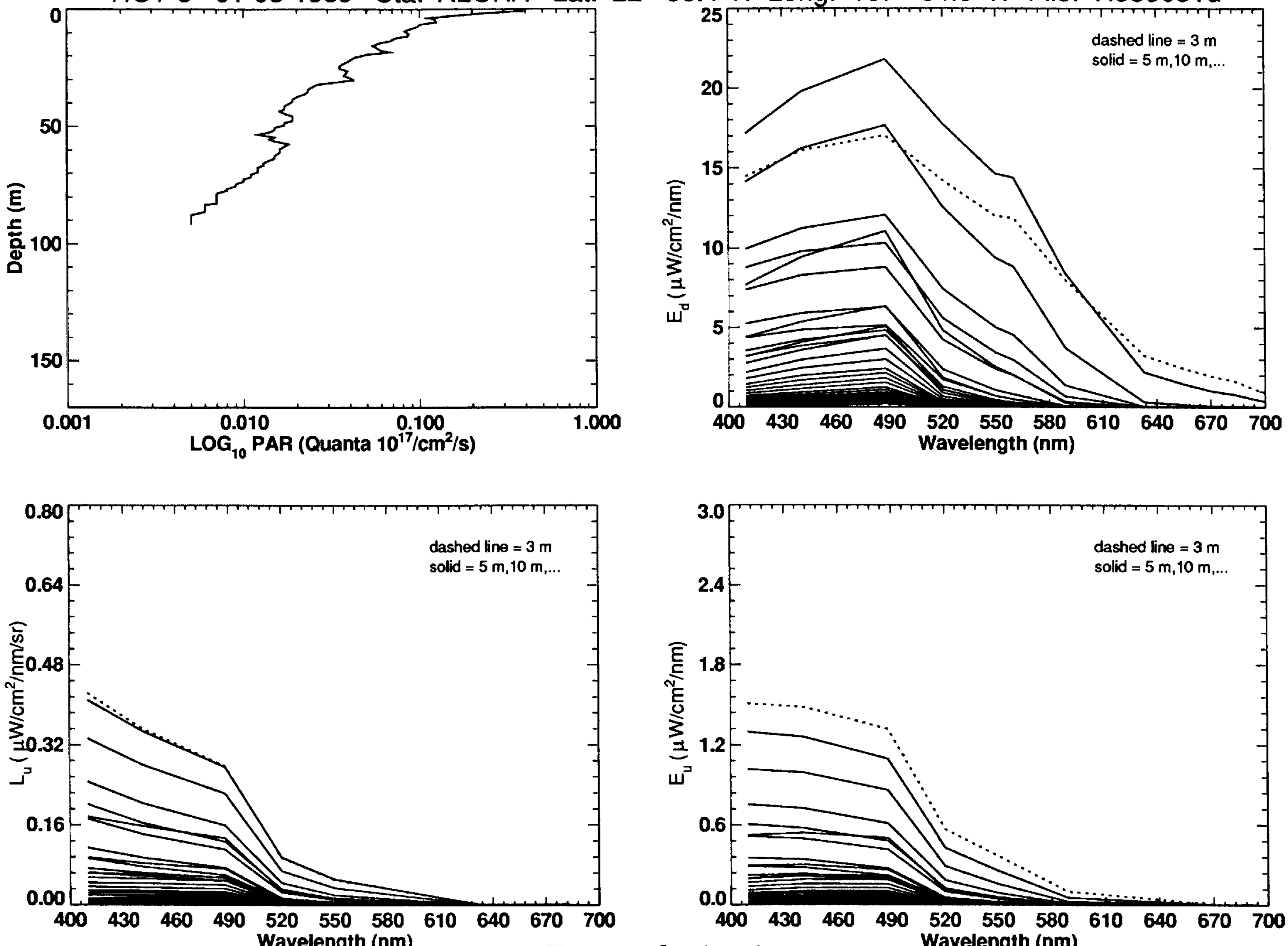

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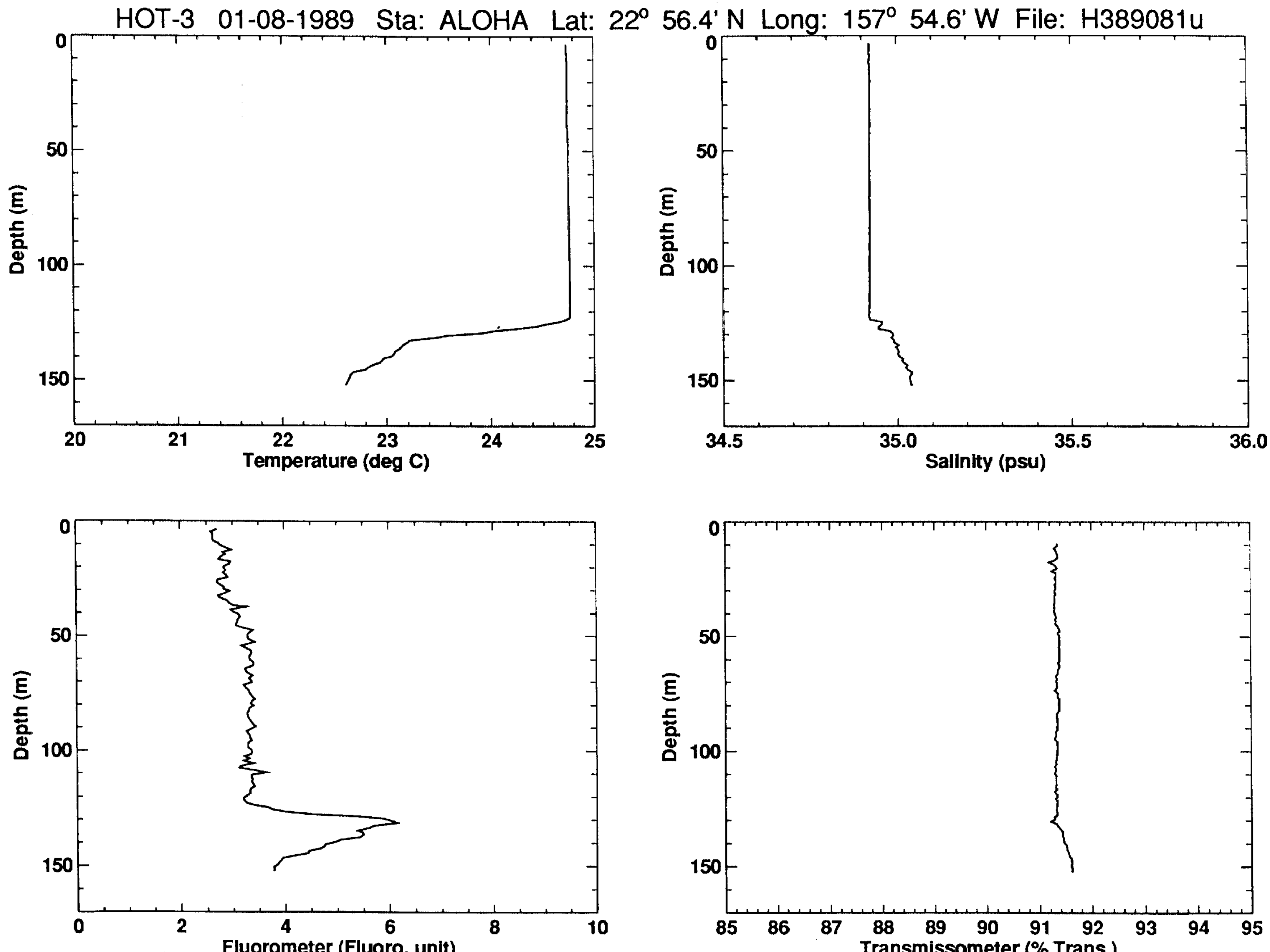

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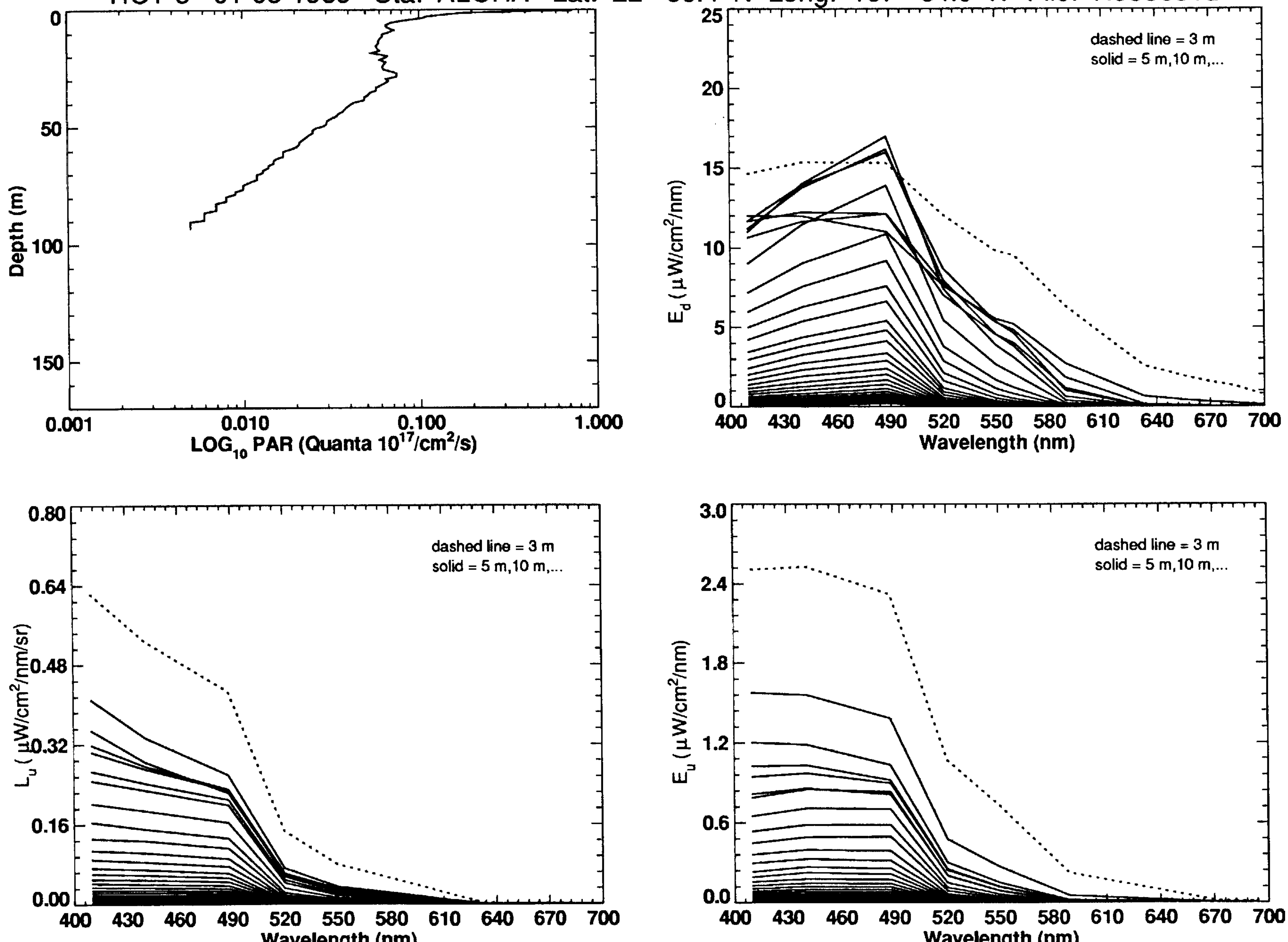

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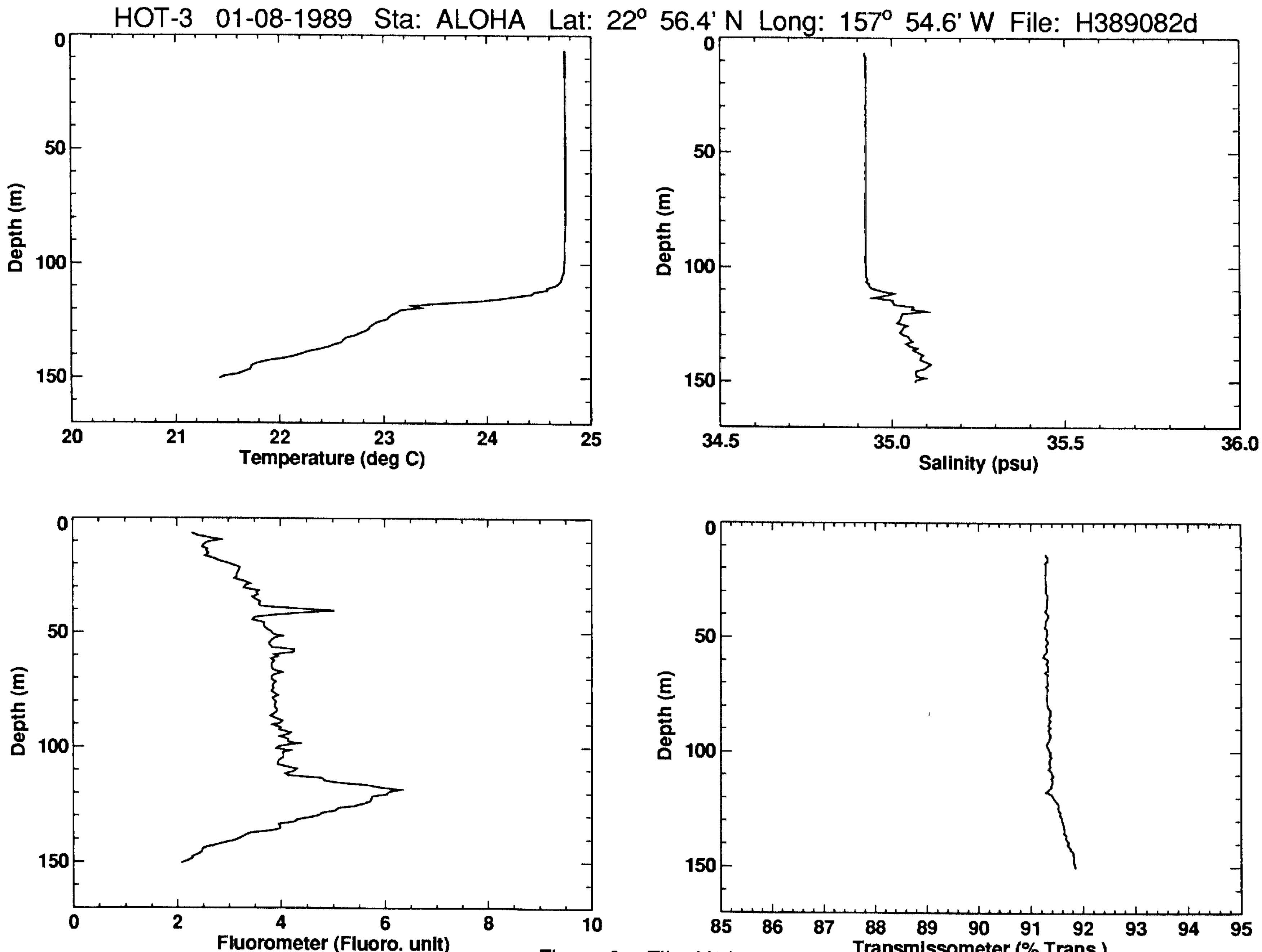

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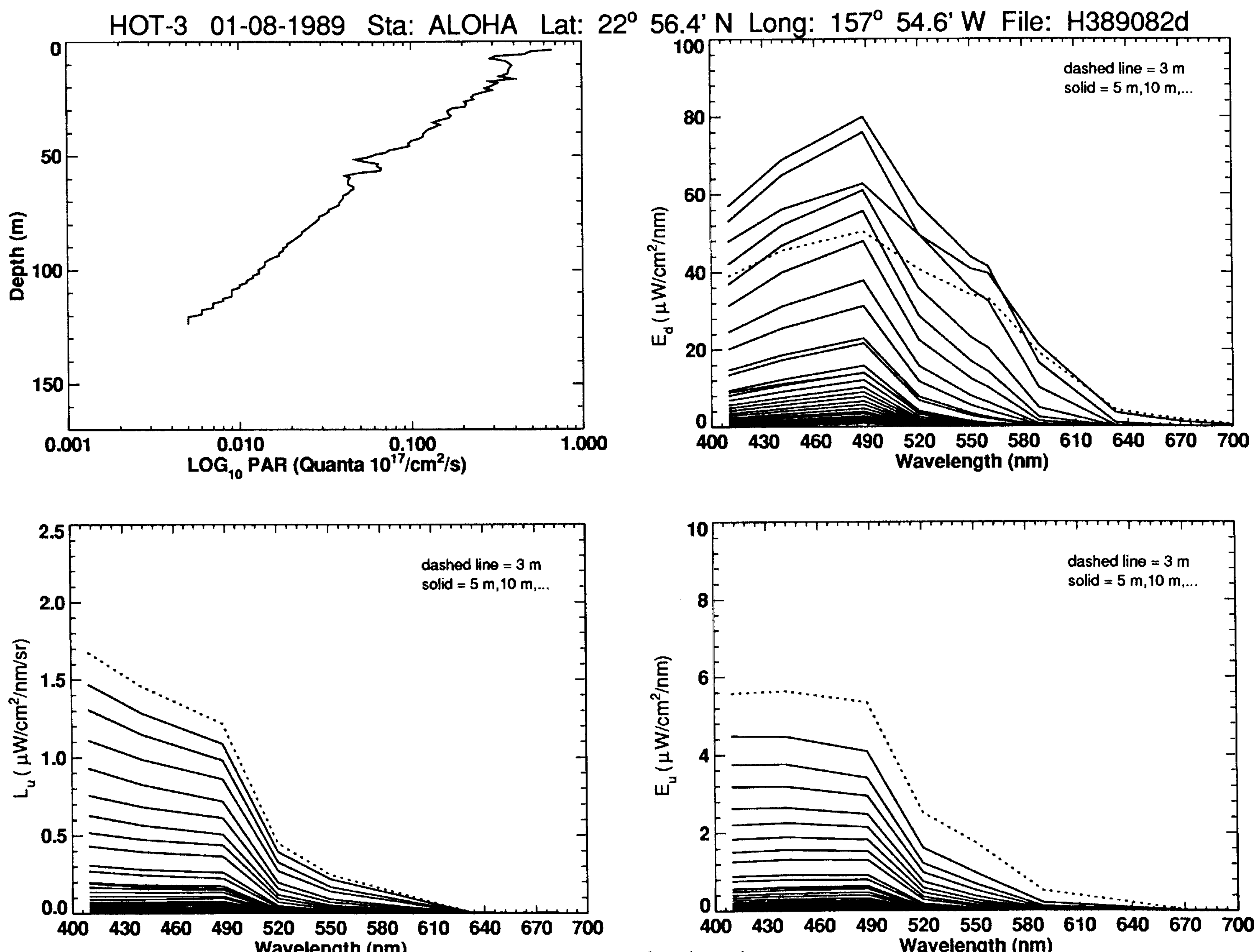

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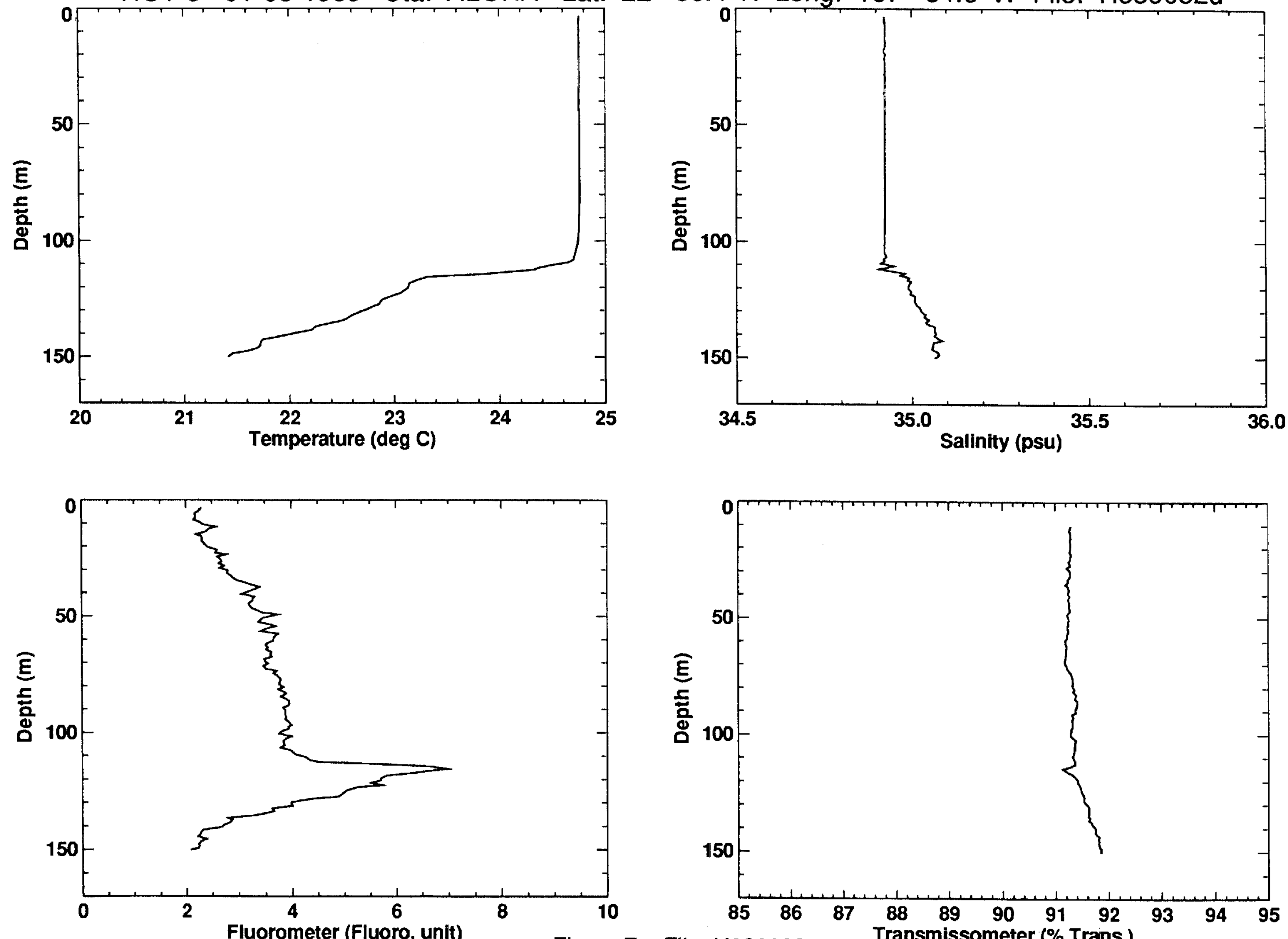

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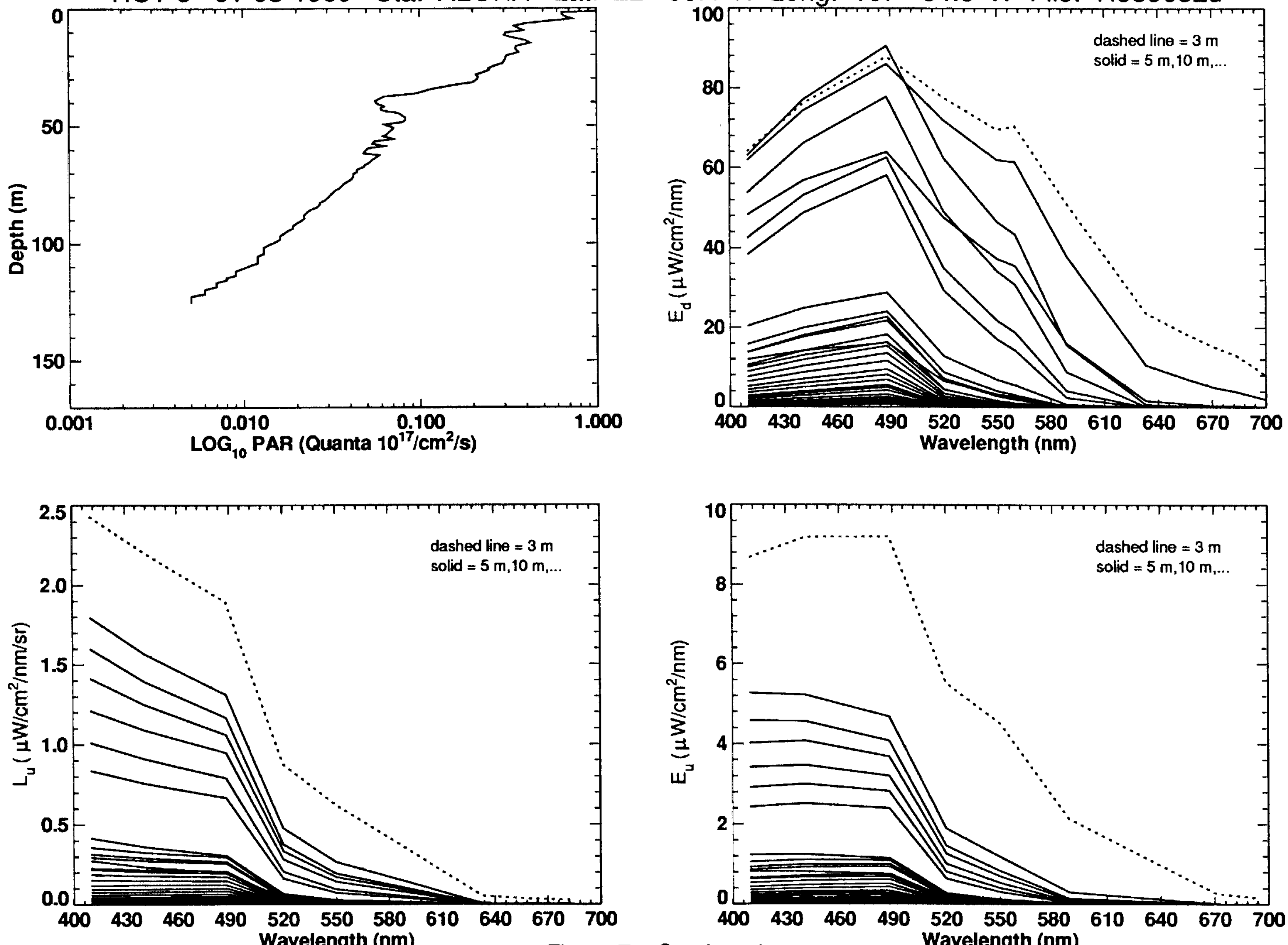

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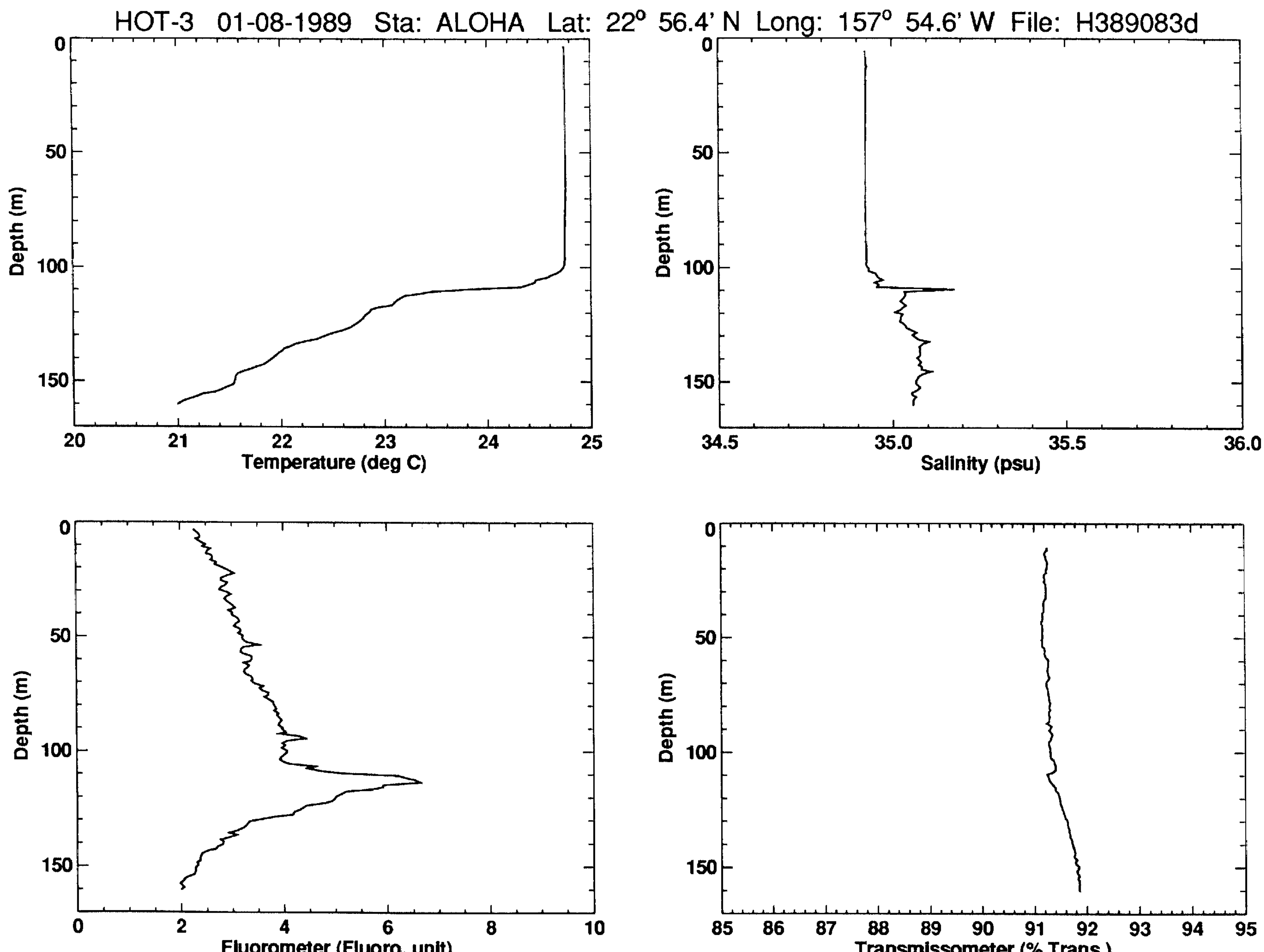

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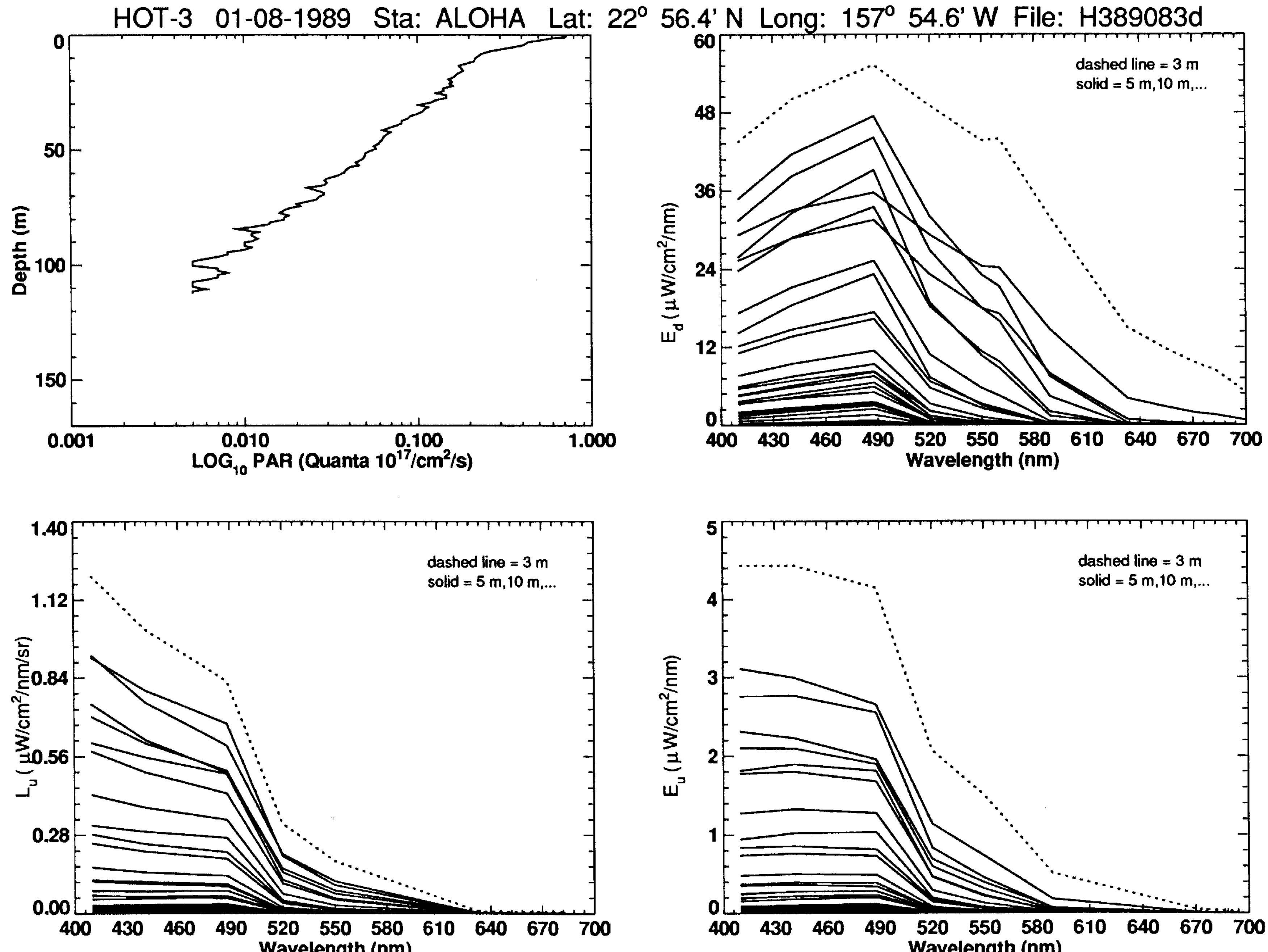

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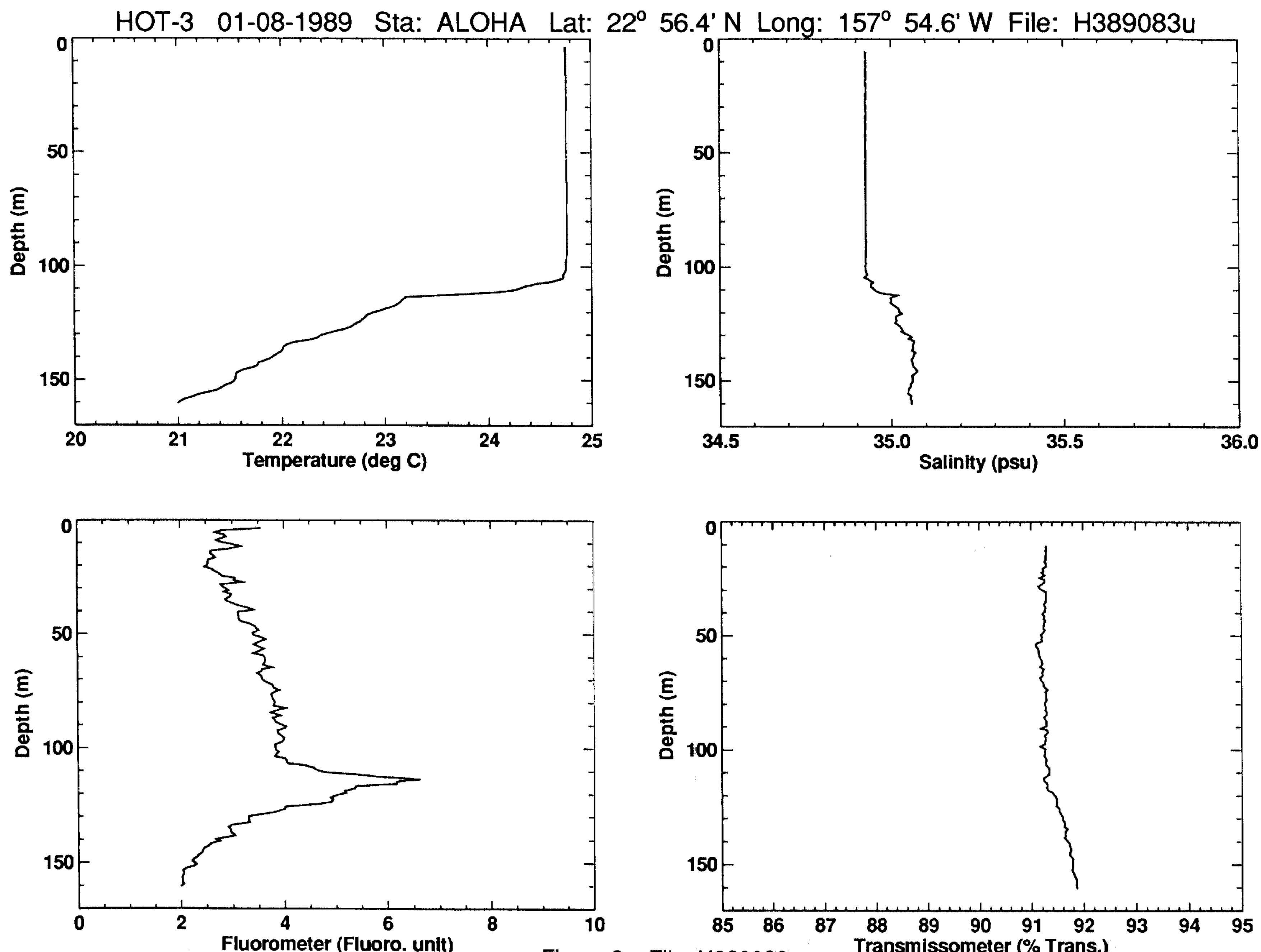

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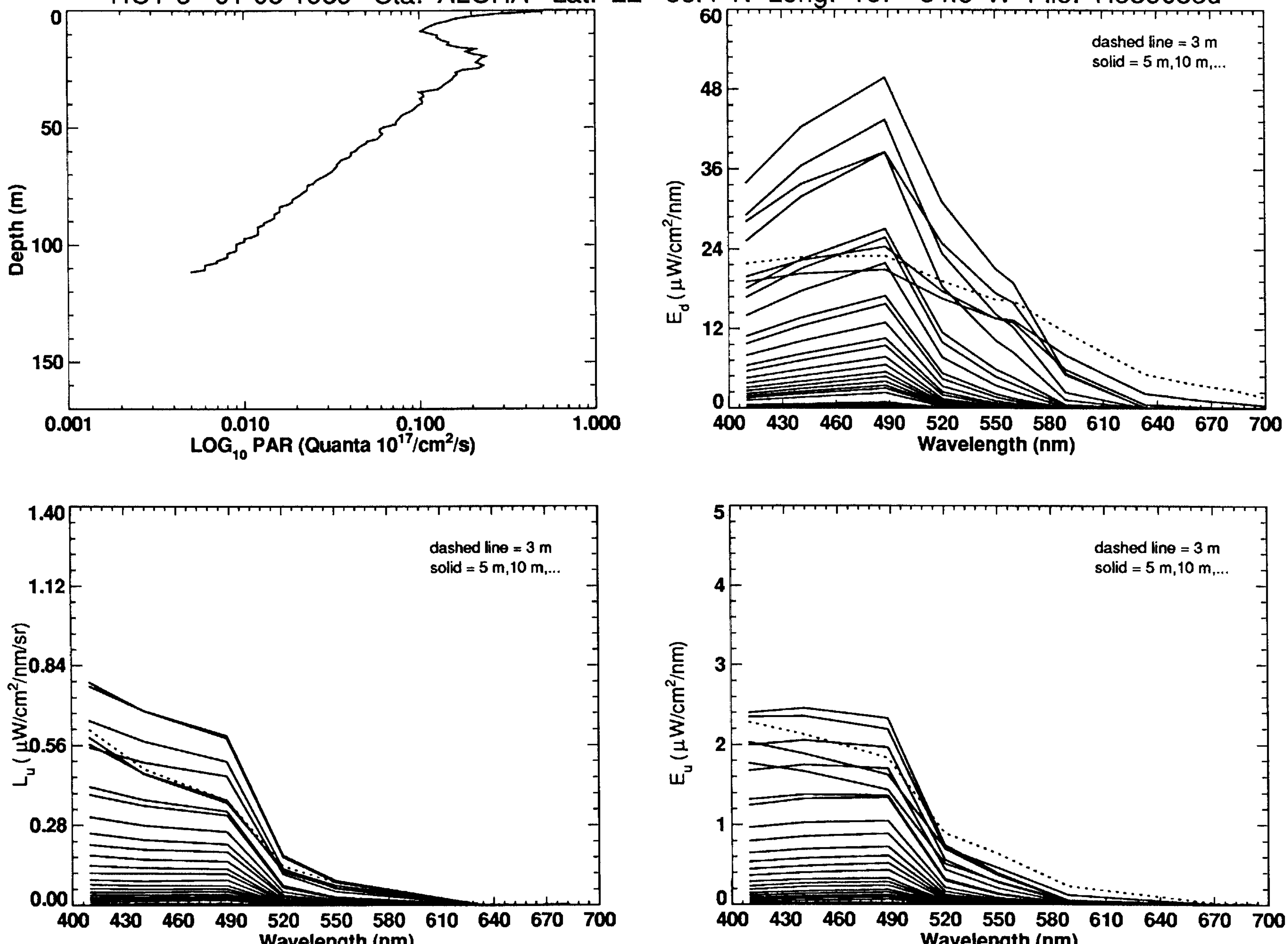

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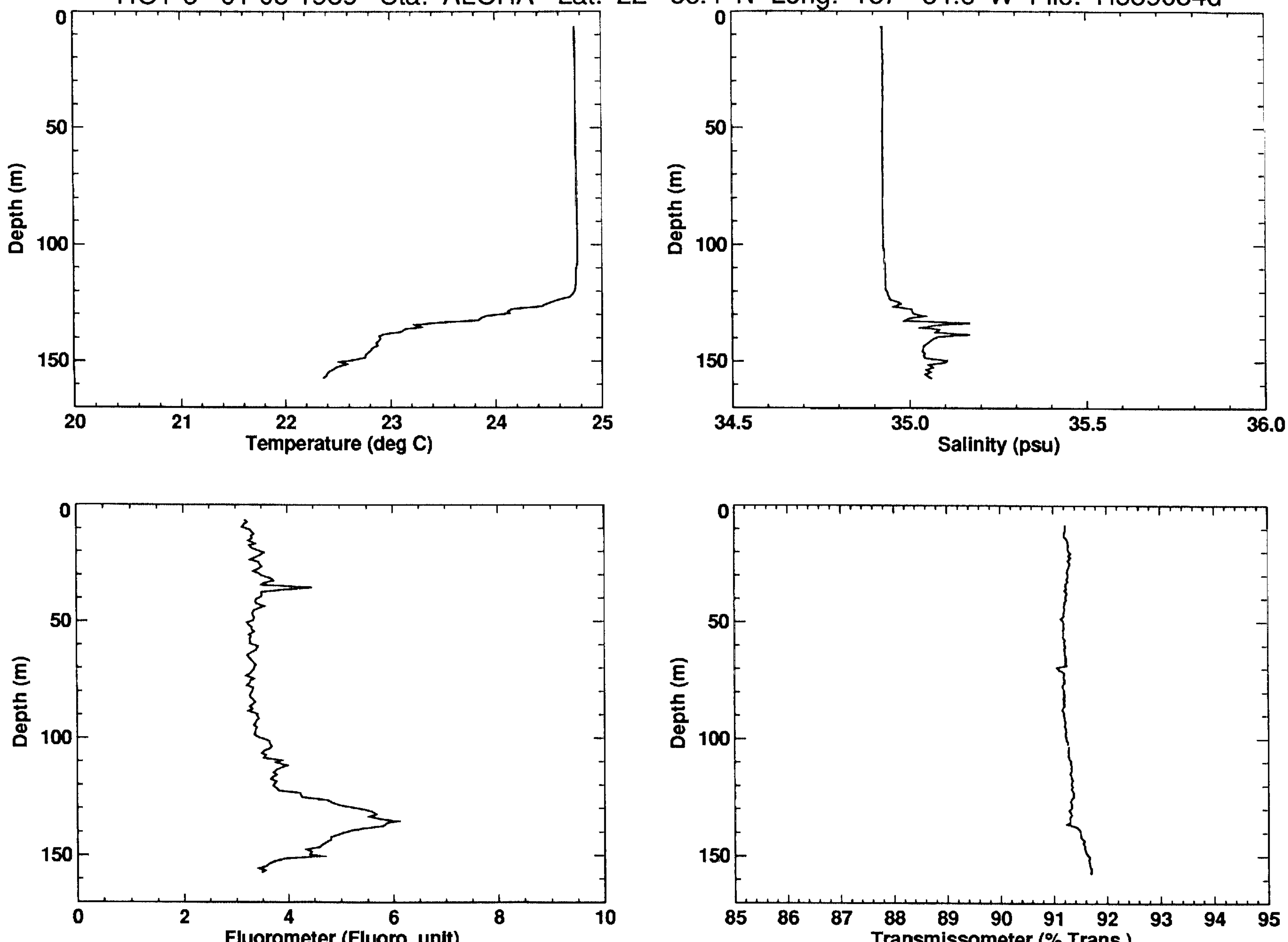

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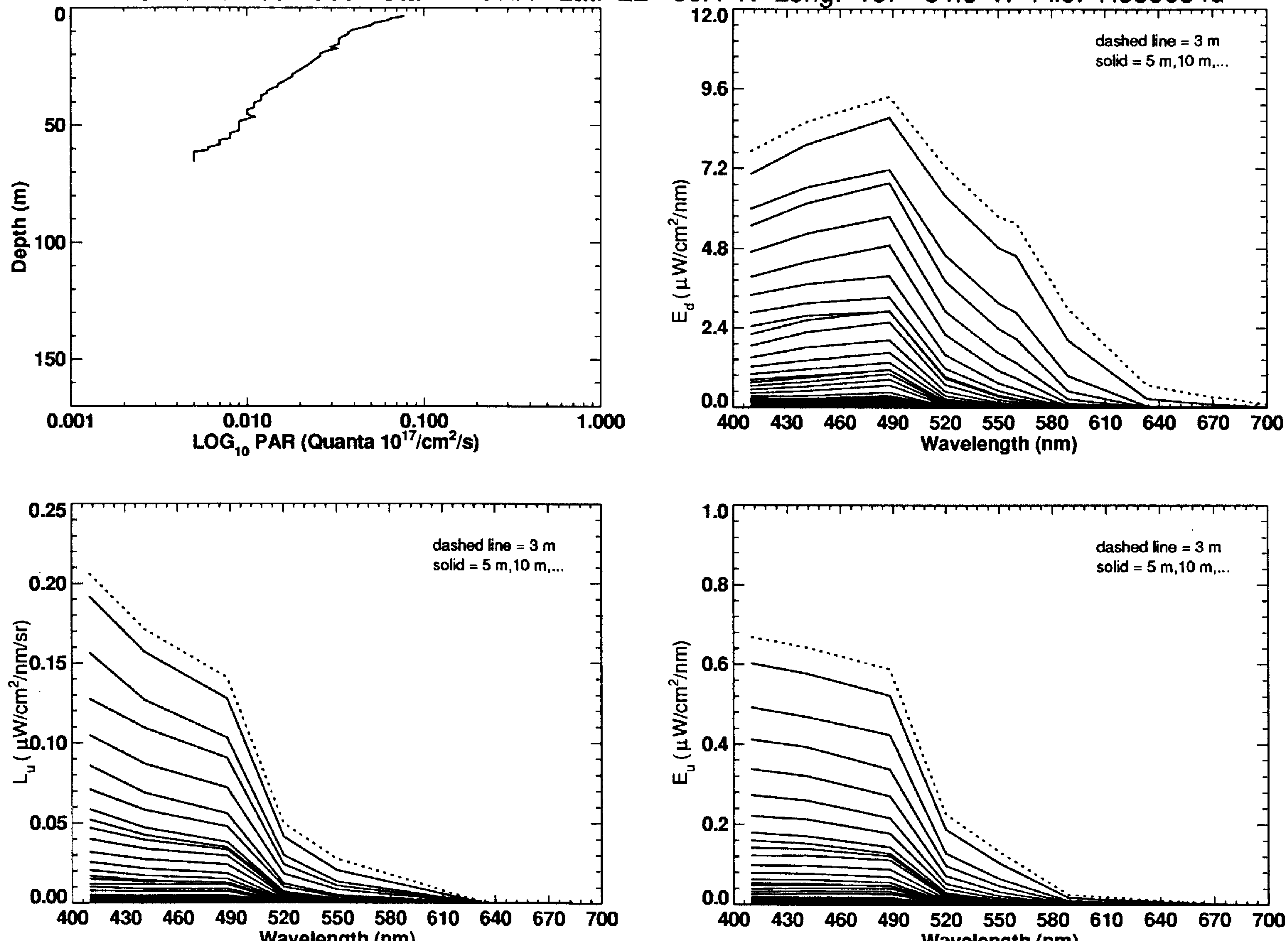

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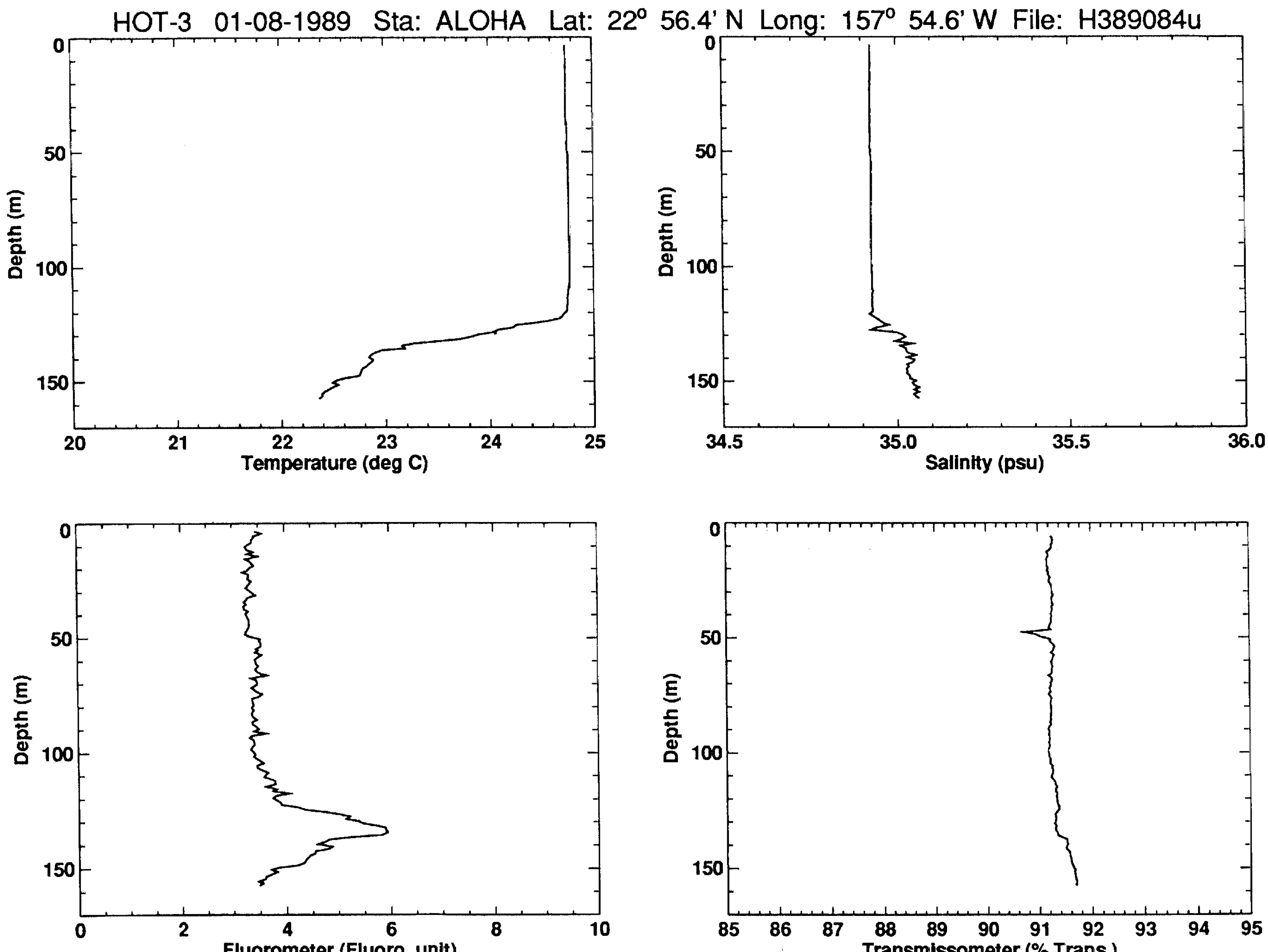

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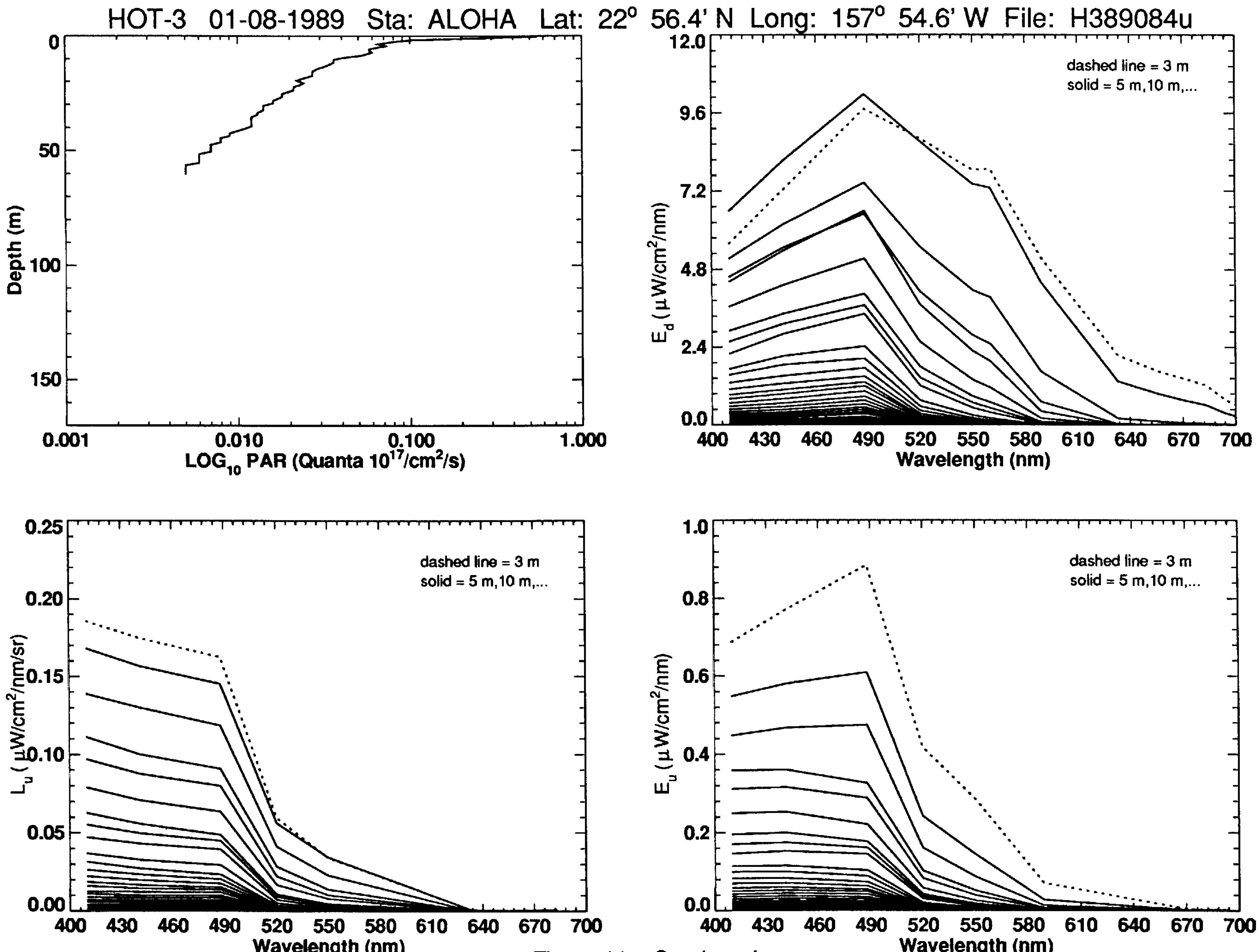

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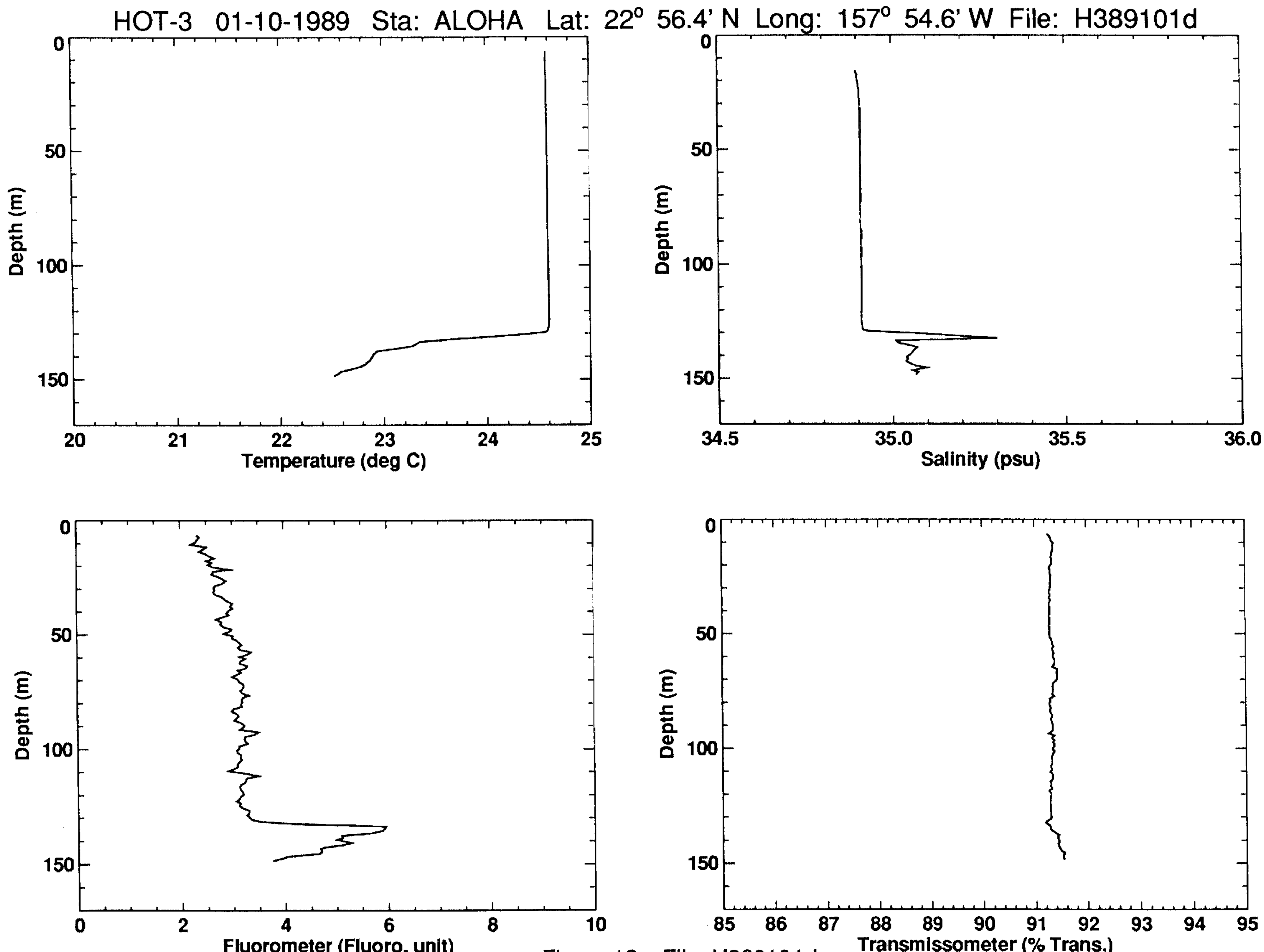

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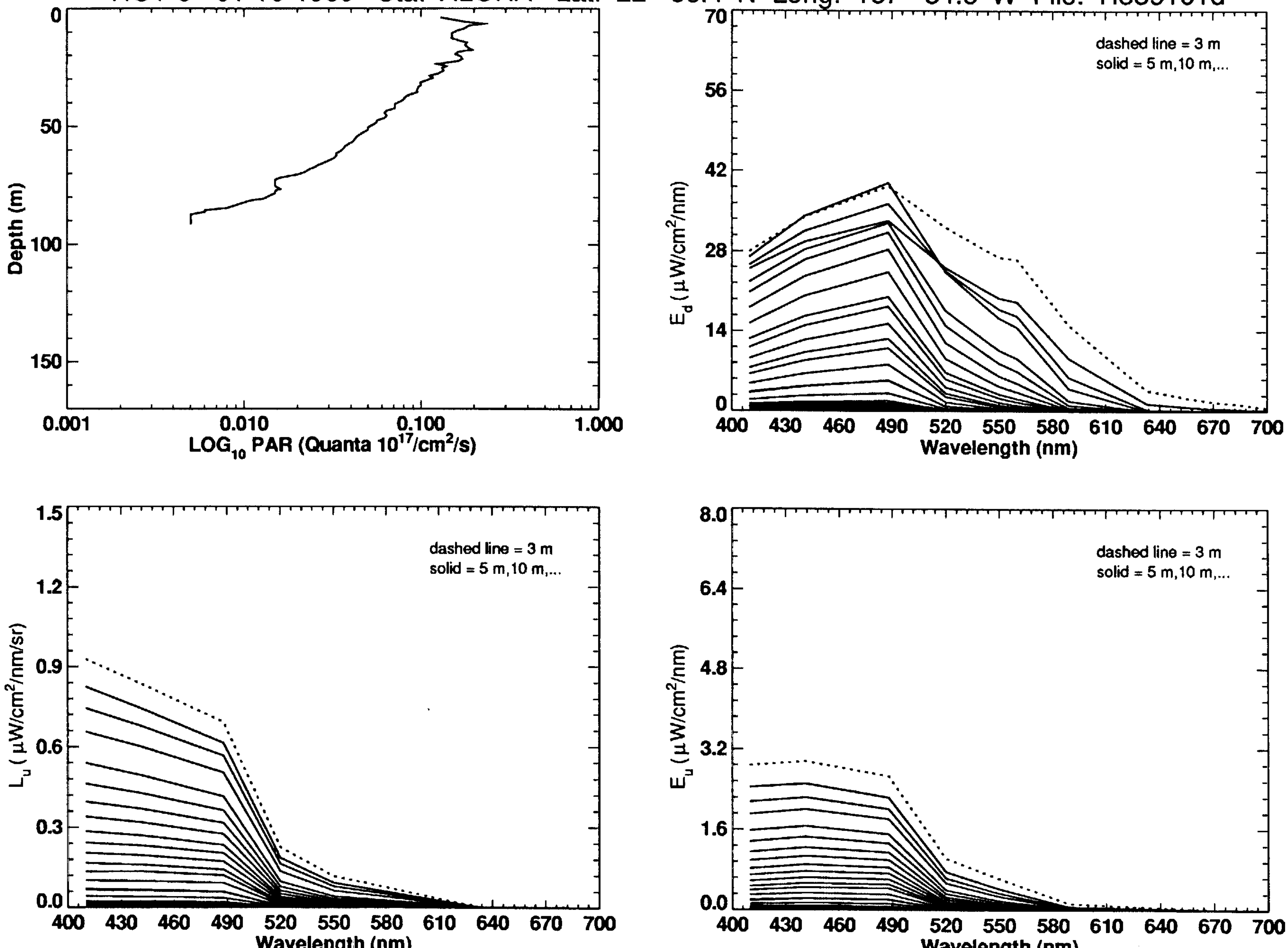

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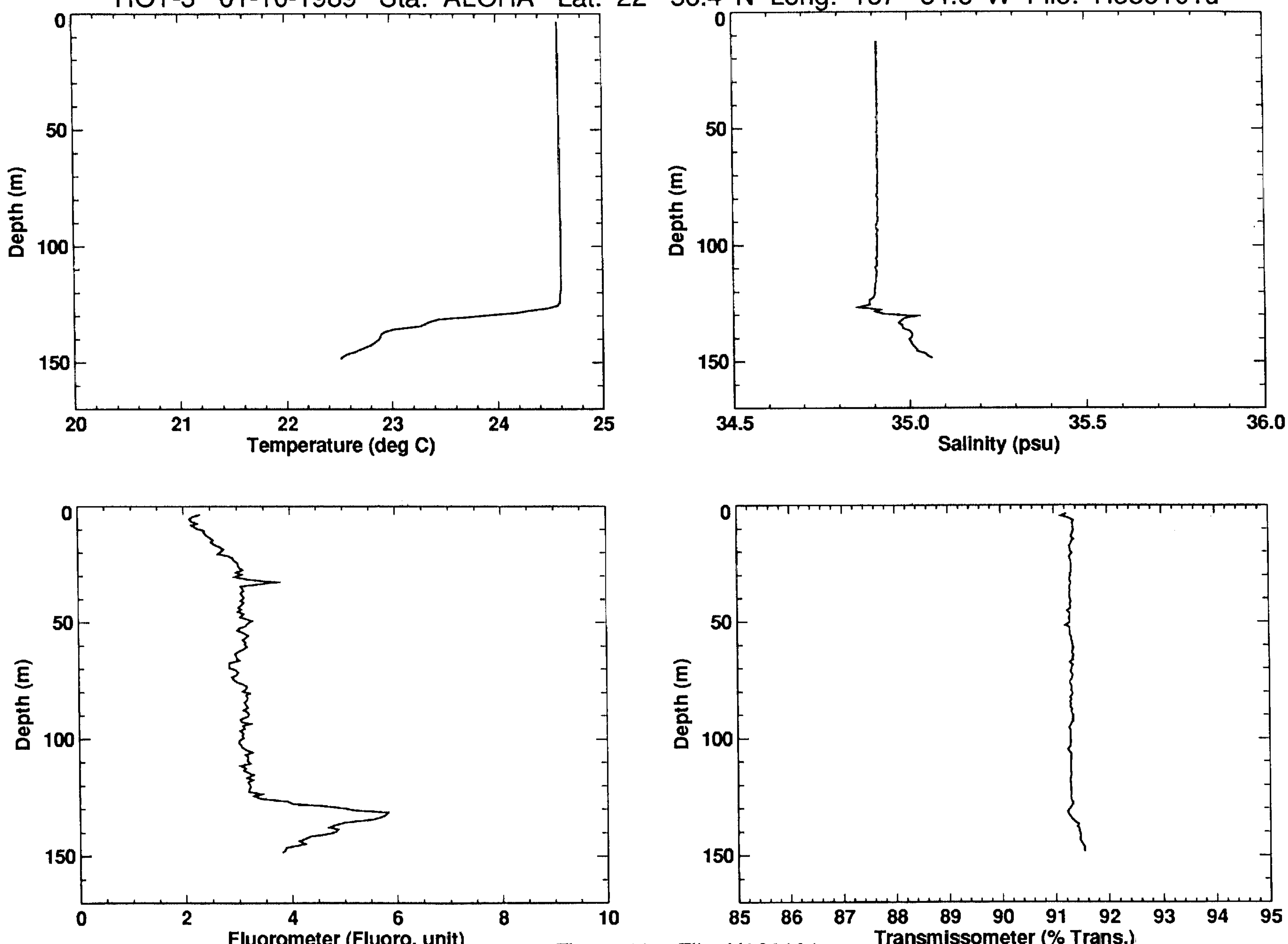

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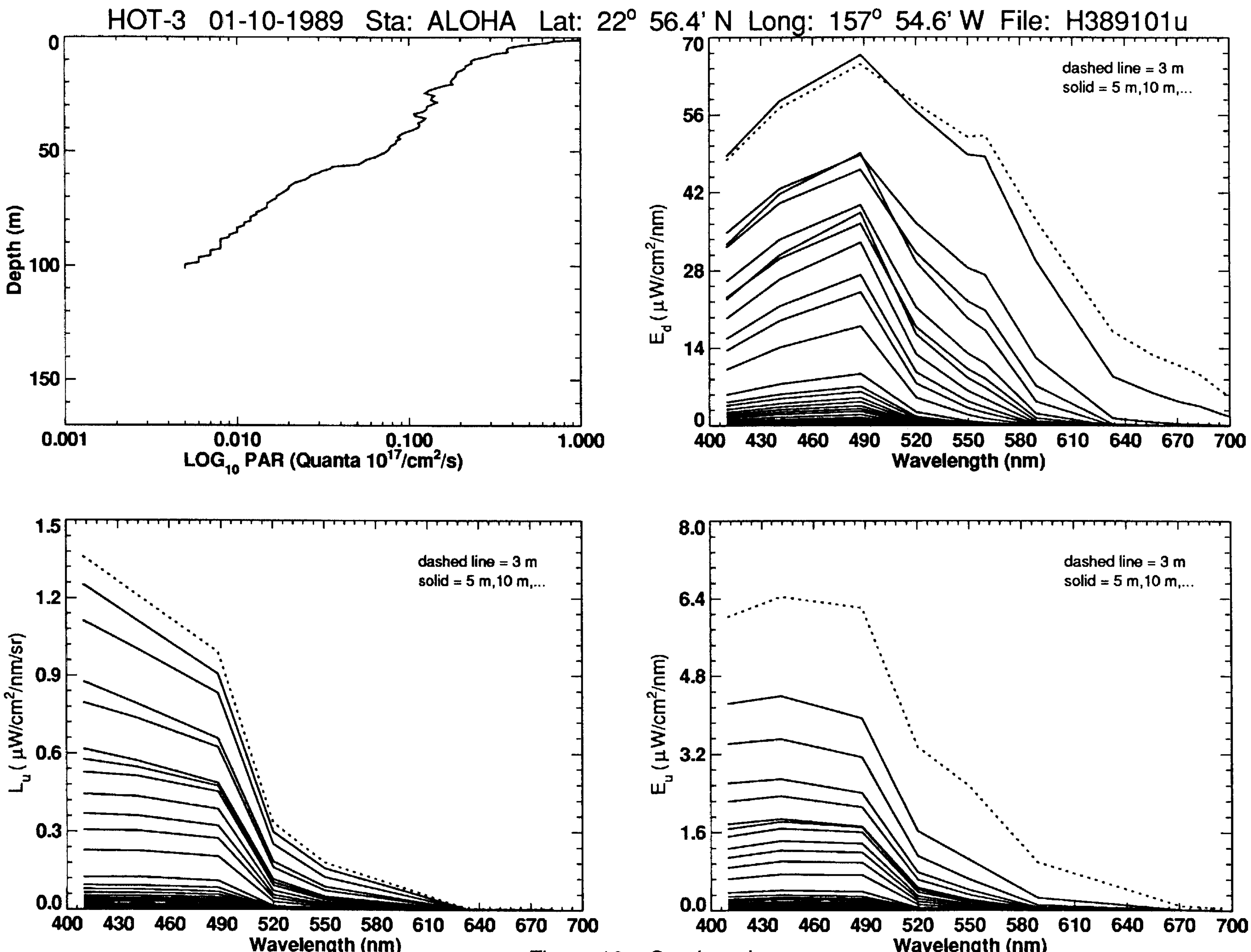

Figure 13. Continued

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16. Abstract

Time-series measurements of the incident surface downwelling irradiance and vertical profiles of the bio-optical properties of the ocean have been measured during the third cruise of the Hawaii Ocean Time-Series to the ALOHA site, 22° 56.4' N, 157° 54.6' W, north of the island of Oahu, Hawaii, during the period January 6-10, 1989. A summary of these data is presented to permit investigators an overview of the data collected. The data are available in digital form for scientific investigators. Requests for the data should be addressed to D. Collins (D.Collins/OMNET:(818)-354-3473).

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