Microturbulence profiler data series for cruise Mitra MT0499

Principal Investigator and Data Originator

Dr. Adolf Stips, Space Applications Institute (SAI), Ispra, Italy.

Collaborator

Dr. Karsten Bolding – SAI.

Content of data series

Parameter	Unit	Parameter code	Number of profiles	Comments
Parameters loaded in the PROVESS Database				
Depth	m	DEPHPR01	1829	see BODC processing
Temperature	deg.C	TEMPST01	1829	none
Salinity	PSU	PSALST01	1829	none
Sigma-T	kg m^{-3} –1000	SIGTEQST	1829	none
$\log_{10}$ (dissipation rate)	$\log_{10}(W.m^{-3})$	EPSIFY01	1829	none
$\log_{10}$(Cox number)	dimensioneless	COXNFT01	653	none
$\log_{10}$(temperature dissipation rate)	$\log_{10}(deg.C^2\ s^{-1})$	TDSSFT01	653	none
Parameters available in ASCII files on Disk 2 of the CD-ROM				
Eddy viscosity	$m^2\ s^{-1}$	n/a	1829	*.edd ASCII files
Pseudo-dissipation rate	$m^2\ s^{-3}$	n/a	1829	*.xy2 ASCII files
Brunt-Vaisala frequency squared	s^{-2}	n/a	1829	*.bvf ASCII files
Thorpe scale and displacement	m	n/a	1826	*.tho ASCII files
Turbulent patch length	deg.C m^{-1}	n/a	653	*.akt ASCII files
Epsilon correction factor	Dimensioneless	n/a	1829	*.xyc ASCII files

Instrumentation and data processing by originator

The MSS Profiler is an instrument for simultaneous microstructure and precision measurements of physical parameters in marine water. The MSS Profiler was equipped with a microstructure shear sensor (X), two microstructure temperature sensors (N, H), three standard CTD sensors for precision measurements (P, T, C) and a sensor to measure the horizontal profiler acceleration (A). The microstructure sensors are placed at the tip of a slim shaft, about 150 mm in front of the CTD sensors.

Specification of precision CTD sensors:

Parameter	**Principle**	**Range**	**Accuracy**	**Resolution**	**Time constant**
Pressure (P)	Piezo-resistive	0 – 200 dbar	+/- 0.1 % of full scale	0.002 % of full scale	40 ms
Temperature (T)	Resistor Pt 100	-2 – +30 degC	+/- 0.01 degC	0.001 degC	160 ms
Conductivity (C)	7-Pole-cell	0 – 60 mS/cm	+/- 0.01 mS/cm	0.001 mS/cm	100 ms

Specification of microstructure (N and X) and control (A) sensors:

Parameter	Principle	Sensing element	Length of sensor tip	Time constant
Temperature (N)	Resistance measurement	Thermistor FP07	ca. 0.3 mm	ca. 10 ms
Shear SHE (X)	Lift force measurement at airfoil nose	Piezoceramic bending beam	3.5 mm	ca. 3 ms
Horizontal acceleration (A)	Lift force measurement at pendulum mass	Piezoceramic bending beam	na	ca. 3 ms

The shear sensor was replaced during the experiment. The characteristics of the two shear sensors used were as follows:

Shear Sensor Channel	Number	Sensitivity [Vms^2/kg]	Gain	Remarks
Shear SHE X	5007	0.46E-4	51.7	Casts F99p0005-F99p0139 Calibrated on 06 Apr 1999
Shear SHE X	5003	0.48E-4	51.7	Casts F99p0140 and later Calibrated on 13 Apr 1999

Full details on instrumentation and data processing including algorithms used can be found in the following documents included on the CD-ROM:

'PROVESS 4/99: Report on Data Processing' (Stips, Prandke and Tschesche 1999).
'Recommended Algorithm for Dissipation Rate calculation within PROVESS' (Stips and Prandke 2000').

In summary the procedure of data processing consisted of the following steps:

1. Conversion of the raw data into their physical value using manufacturer's calibration coefficients (temperature N and T in deg. C, pressure P in dbar and conductivity C in mS/cm) or an intermediate value (Counter, Shear SHE and Acceleration). These data were then stored in binary XDR format and information files were created for each cast.
2. A cut-off procedure was then applied which eliminates falsified data at the upper and lower part of the profile. The cut line was generally exactly determined at the lower part of the profile from changes in the pressure to a constant value and also from changes in the signal from both shear sensors. At the upper part of the profile on the other hand, the cut line was not always exactly determined.
3. Checks for data consistency were carried out (transmission and time errors, absolute physical limits, maximal gradients, spikes and calibration). Identified wrong data were flagged in order to perform a correction using a linear interpolation. The settings used for checking absolute physical limits and maximal gradients are detailed below.

Sensor	Channel	Unit	Minimal threshold	Maximal threshold	Max. gradient threshold
Pressure	P	[dbar]	0.0	25.0	0.015
Temperature	T	[degC]	5.0	15.0	0.003
Fast temperature	N	[degC]	5.0	15.0	0.0035
Fast temperature	H	[degC]	5.0	15.0	0.035
Conductivity	C	[mS/cm]	25.0	40.0	0.0045
Shear SHE	X		18000.0	46000.0	1000.0
Acceleration	A		-5.0	5.0	0.18

4. Averaging procedure: the averaging procedure was applied to the corrected data. For the microstructure sensors a mean value over 4 records was calculated. For the precision sensors a mean value over 10 records was calculated.
5. Computation of oceanographic standard parameters: temperature, salinity and density were all

calculated in the depth region 2.0 to 24.0 m in a depth interval of 0.4 m and with a shift between two segments of 0.2 m (50% overlap). The minimum number of values per segment was 30. All parameters were standardized according to UNESCO/ICES recommendation. Pressure was converted into depth by the Saunders and Fofonoff method.

6. Computation of dissipation rate Epsilon: turbulent kinetic energy (TKE) dissipation rates were estimated from the variance of small scale shear using the isotropic formula based on the theory of Allen and Perkins (1952). Details of the procedure applied are described in eg. Prandke and Stips (1996). The computation of dissipation rates included four routines to correct for the loss of sensitivity (long-term stability) of the shear probes, for disturbances caused by components of the profiler, spikes, vibrations and changes in profiler velocity, and to carry out a spectral correction for lost variance.

- Computation of Brunt-Vaisala frequency squared, eddy diffusivity, Cox number, Thorpe scale and Thorpe displacement and rate of diffusive temperature smoothing (Chi).

Sampling strategy

Measurements were carried out from the Meetpost Noordwijk platform (52° 16.43'N and 4° 17.75'E) during the Provess cruise Mitra MT0499 between April 19 and April 30 1999. A proper position at the platform had to be found to carry out measurements undisturbed by the turbulence generated by the platform. The sampling rate for all sensors was 1024 samples per second and the resolution was 16 bit. All measurements were carried out in the falling mode. The sinking velocity of the profiler was adjusted to approximately 0.85 m s^{-1}. The measurements were carried out from the surface (about 2 m) to the bottom (about 17-20 m, depending on tidal cycle).

The table below shows a summary of the data collection.

Station	MST Casts	N° of casts	Time [UTC]	Remarks
F99p	F99p0005 – F99p0139	135	21.04 17:43 – 22.04 05:26	Every 1 hour 10 casts.
	F99p0140 – F99p0456	317	22.04 17:03 – 24.04 04:35	Every 30 minutes 5 casts; some short interruptions.
	F99p0457 – F99p0644	187	26.04 11:38 – 27.04 06:35	Every 30 minutes 5 casts; some short interruptions; cast 617 lost.
	F99p0645 – F99p0689	45	27.04 07:05 – 27.04 07:58	Intensive: approx. 1 cast every min; one short interruption.
	F99p0690 – F99p0714	25	27.04 08:33 – 27.04 09:50	Every 30 minutes 5 casts; some additional casts.
F99t	F99t0001 – F99t0169	169	27.04 11:51 – 27.04 15:55	Intensive: approx. 1 cast every min, one interruption.
	F99t0170 – F99t0466	297	23.04 15:31 – 24.04 02:33	Intensive: approx. 1 cast every min; one interruption.
F99u	F99t0170 – F99t0466	26	24.04 11:19 – 24.04 20:55	Intensive: approx. 1 cast every min; NTC not protected.
	F99t0170 – F99t0466	367	24.04 09:14 – 28.04 10:38	Intensive: approx. 1 cast every min; NTC not protected.

BODC processing

Data files containing the different parameters from individual casts were merged into a single file for each cast based on a single depth channel. This involved resolving for slight differences between the depth channel associated with parameters derived from CTD sensors and that associated with parameters derived from the microstructure sensors. These differences were attributed to the different averaging and cut off procedures used for CTD and microstructure data. As a general rule, if both sets of parameters were present, preference was given to the depth value associated with the microstructure parameters. The resulting imprecision on the depth of the measurements derived from the CTD sensors was generally small (<0.10 m) and at most, resulted in an overestimation of the measurement depth of a single record per profile (generally the first or second record) by between 0.10 m and 0.13 m.

In order to standardise parameter units with those held in the BODC Parameter Dictionary the following modifications were carried out prior to loading the data into a database under the Oracle Relational Database Management System:
- dissipation rates were converted from m^2 s^{-3} to W m^{-3} by multiplying the value by an average density value of 1023.52 calculated for the whole campaign. They were then expressed on a $\log_{10}$ basis.
- temperature dissipation rate and Cox number were also expressed on a $\log_{10}$ basis.

Derived parameters such as eddy viscosity, Brunt-Vaisala frequency squared etc. were not loaded in the database. These parameters are contained in the originator's ASCII files and may be found on Disk 2 of the PROVESS CD-ROM set in the directory: SAI_MSS/MT0499.

Comments on data quality

None to report.

References

Allen HJ, Perkins EW (1952). A study of effects of flow over slender inclined bodies of revolution. Report N°1048, U.S. National Advisory Committee for Aeronautics.

Prandke H, Stips A (1996). Investigation of microstructure and turbulence in marine and limnic waters using the MST Profiler. Technical Note N° I.96.87, European Commission, Joint Research Centre, Space Applications Institute, Ispra/Italy.

Stips A, Prandke H, Tschesche U (1999). Report on microstructure data processing and presentation of the results from the PROVESS-0499 campaign. Technical Note N° I.00.XXX, European Commission, Joint Research Centre, Space Applications Institute, Ispra/Italy.

Stips A, Prandke H (2000). Recommended Algorithm for Dissipation Rate calculation within PROVESS.