The Malina oceanographic expedition: How do changes in ice cover, permafrost and UV radiation impact on biodiversity and biogeochemical fluxes in the Arctic Ocean?

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Abstract.

1 Introduction

2 Study area, environmental conditions and sampling strategy

2.1 Study area and environmental conditions

2.1.1 CTD and rosette deployments

3 Figures

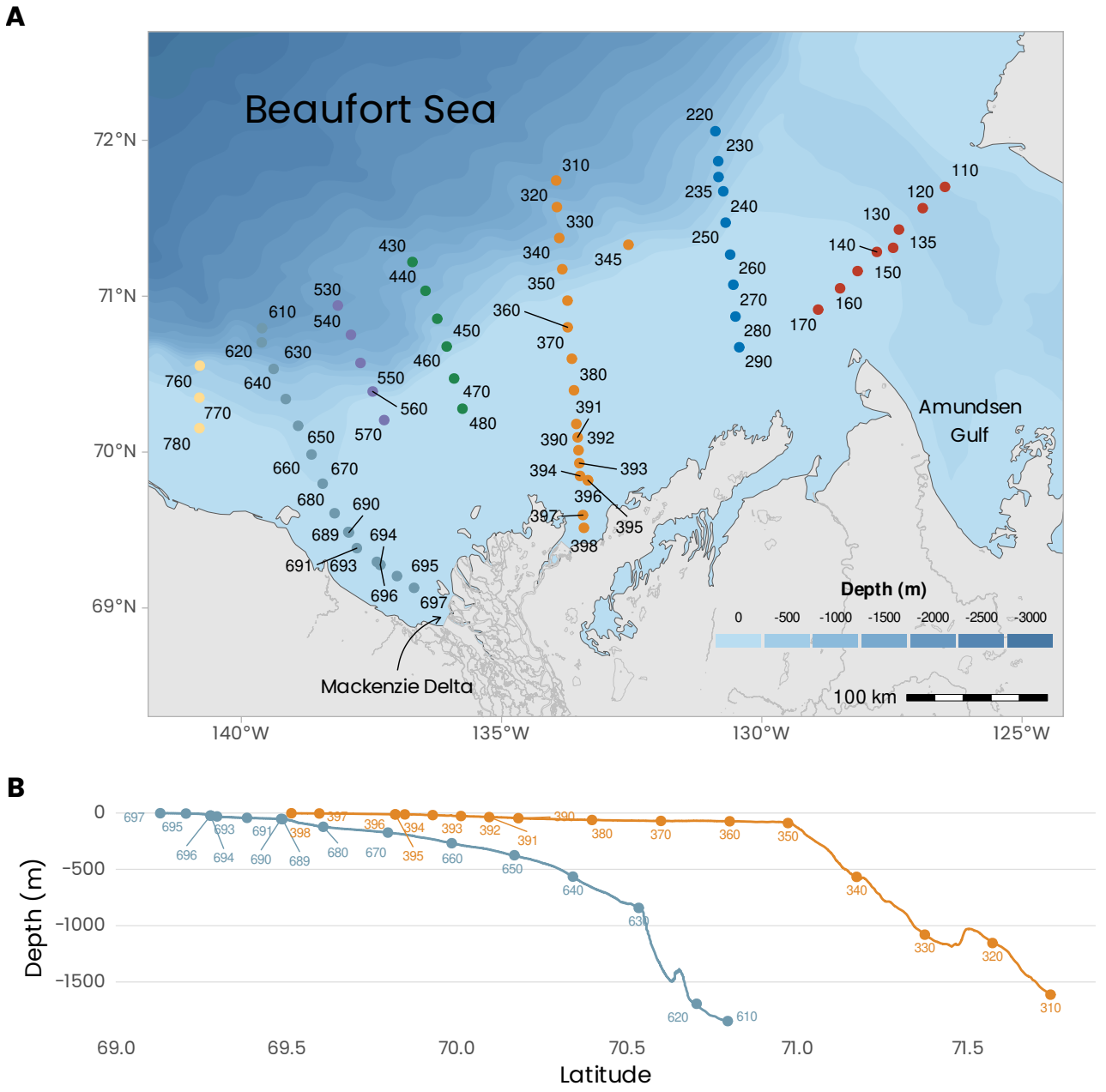

Figure 1. (**A**) Localizations of the sampling sites visited during the MALINA 2009 campaign. The colors of the dots represent the seven transects visited during the mission. (**B**) Bathymetric profiles for transects 600 and 300. Bathymetric data from GEBCO (https://download.gebco.net/).

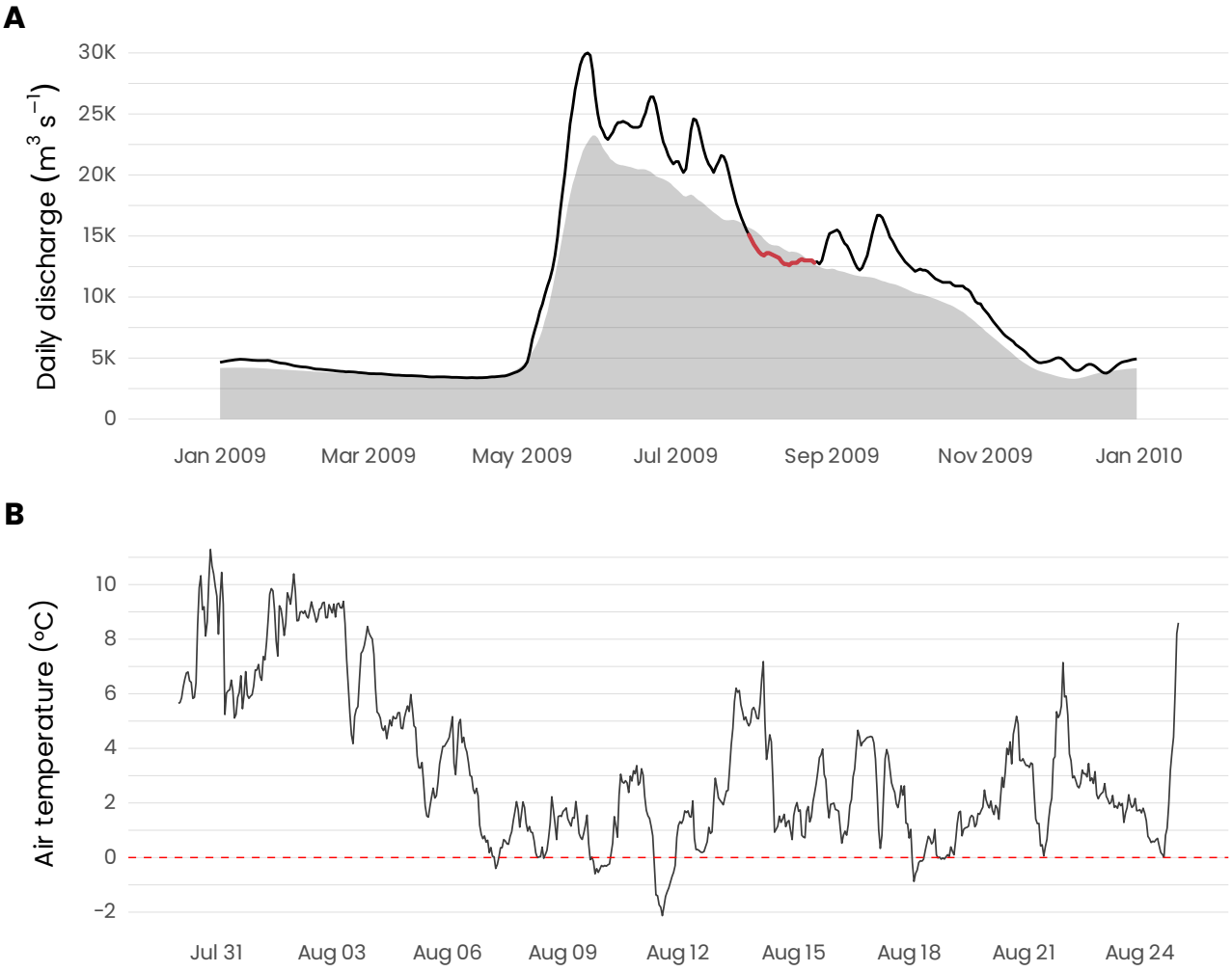

Figure 2. (**A**) Daily discharge of the Mackenzie River at the Arctic Red River junction (station 10LC014). The black line corresponds to the 2009 discharge whereas the coloured segment identifies the period of the MALINA campaign. The shaded area is the mean discharge calculated between 1972 and 2016. Discharge data from the Government of Canada (https://wateroffice.ec.gc.ca/search/historical_e.html). (**B**) Hourly air temperature recorded from the Amundsen's foredeck meteorological tower during the campaign.

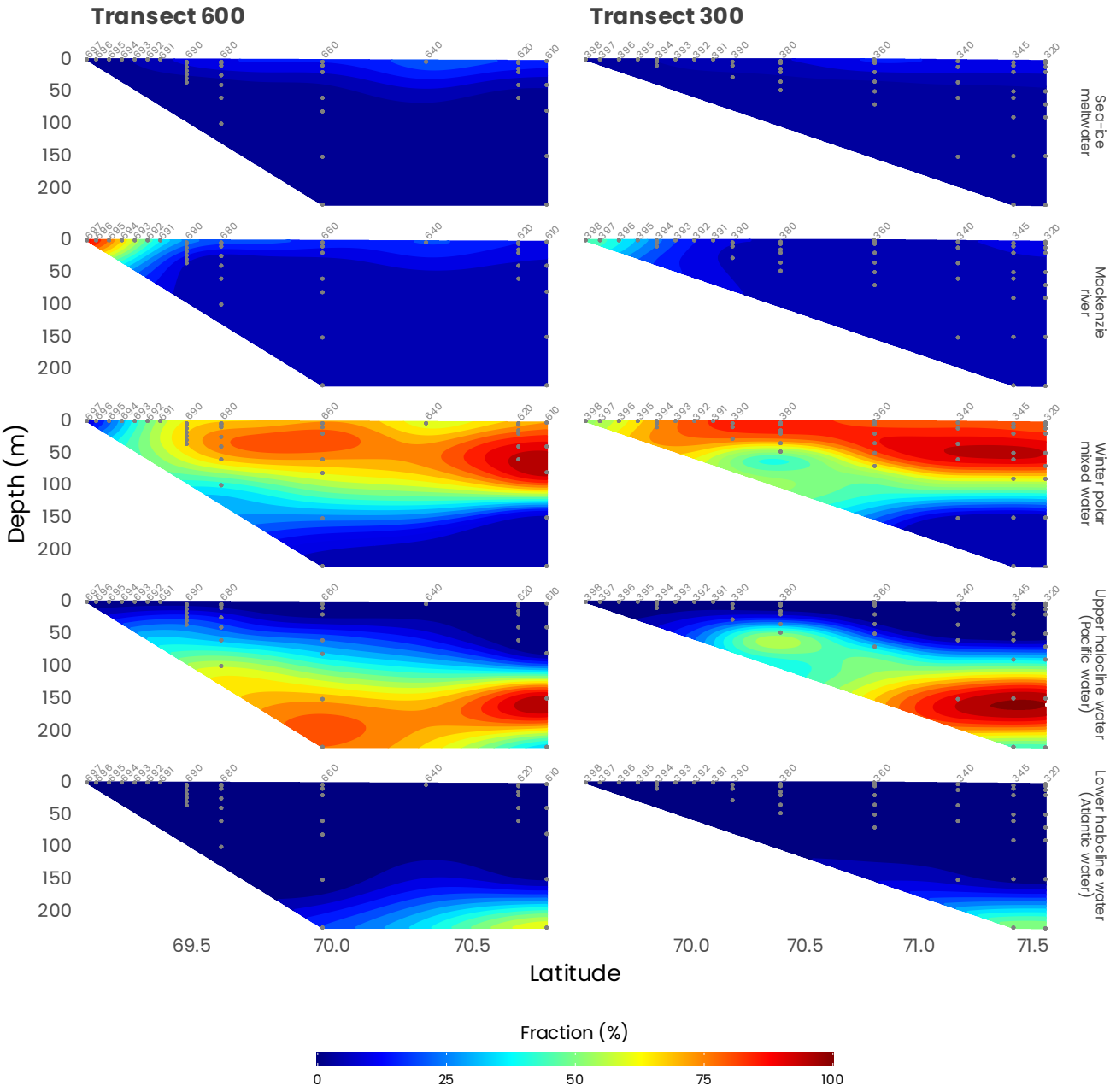

Figure 3. Distribution of source water types along transects 600 and 300 (see Fig. 1). Station numbers are identified in light gray on top of each panel.

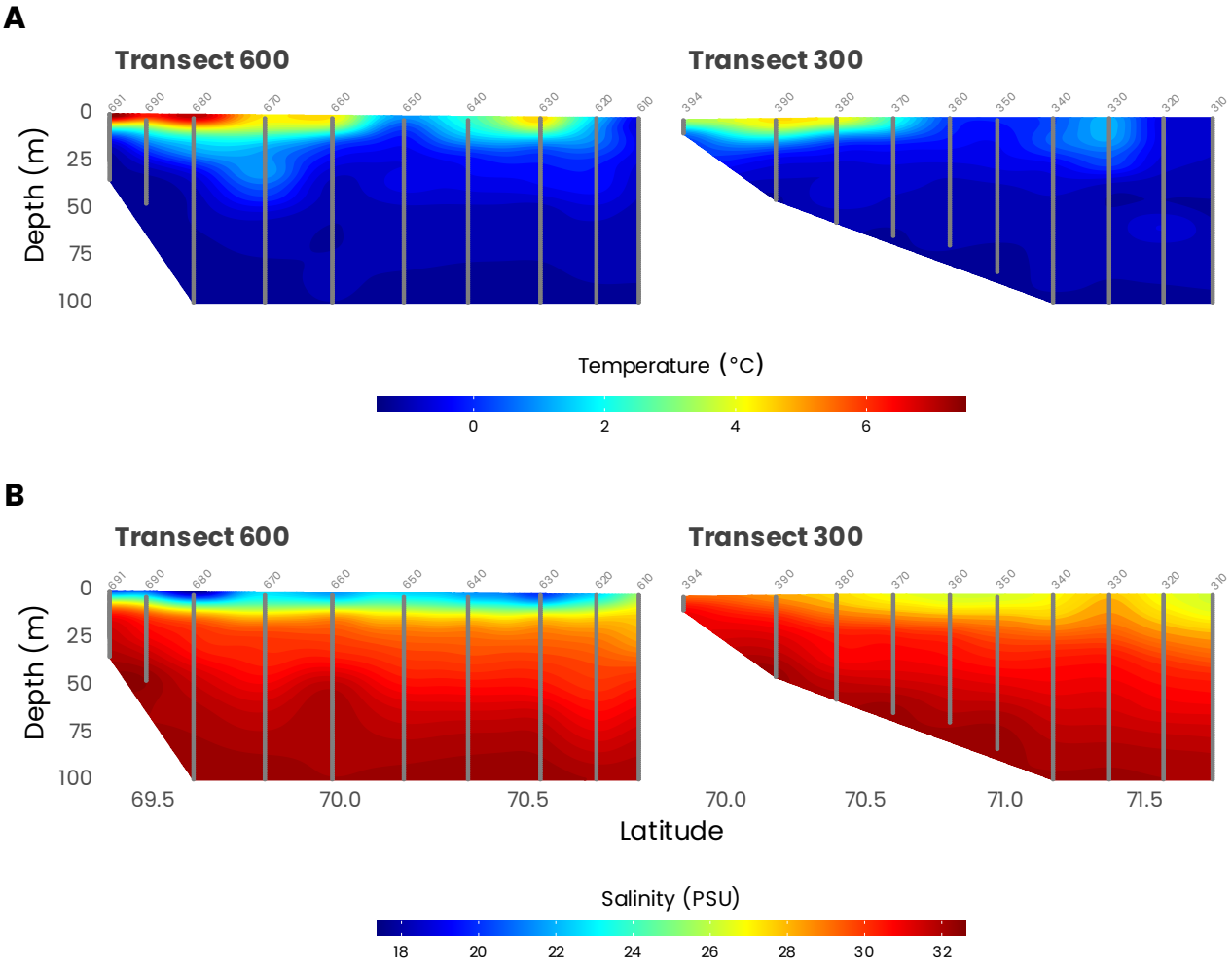

Figure 4. Cross-sections of temperature (**A**) and salinity (**B**) measured by the CTD (gray dots) along transects 600 and 300. Station numbers are identified in light gray on top of each panel.

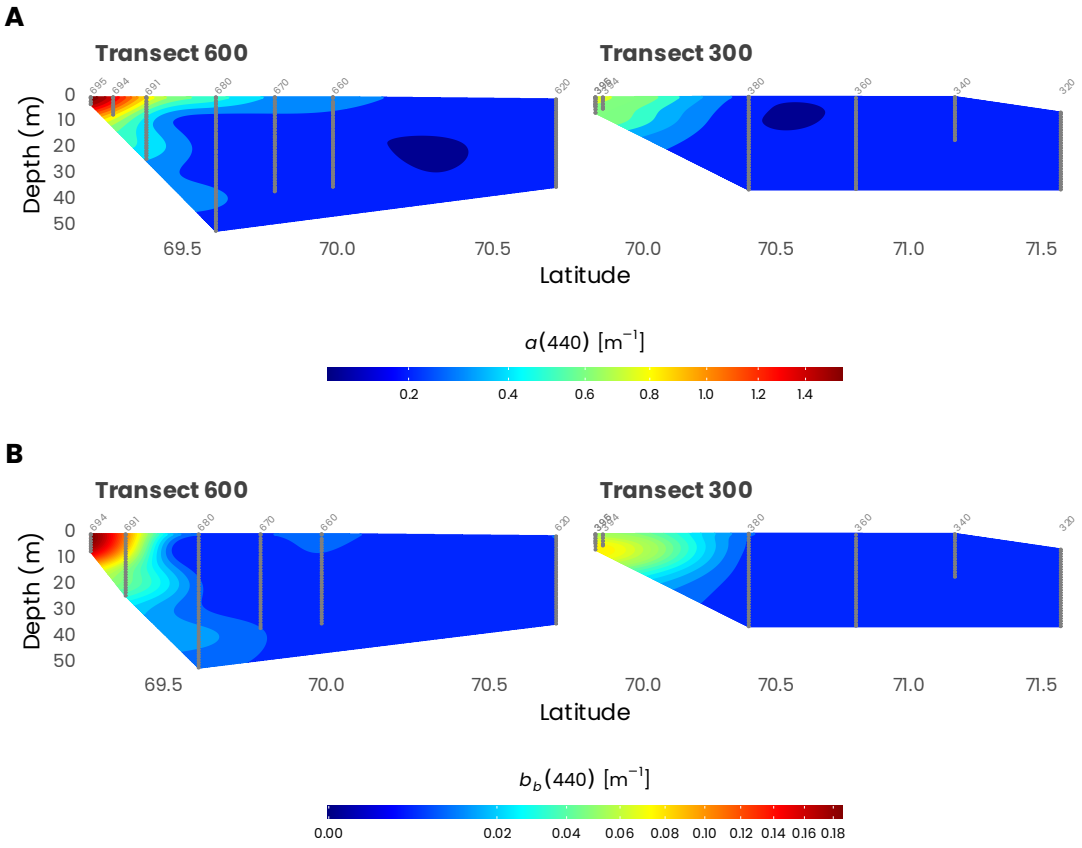

Figure 5. Cross-sections of (**A**) absoprtion ($a(440)$) and (**B**) total scattering ($b_b(440)$) measured from the barge at 440 nm with an AC9 and BB9 respectively along transects 600 and 300. Station numbers are identified in light gray on top of each panel. Note that the data has been square-root transformed for the visualization.

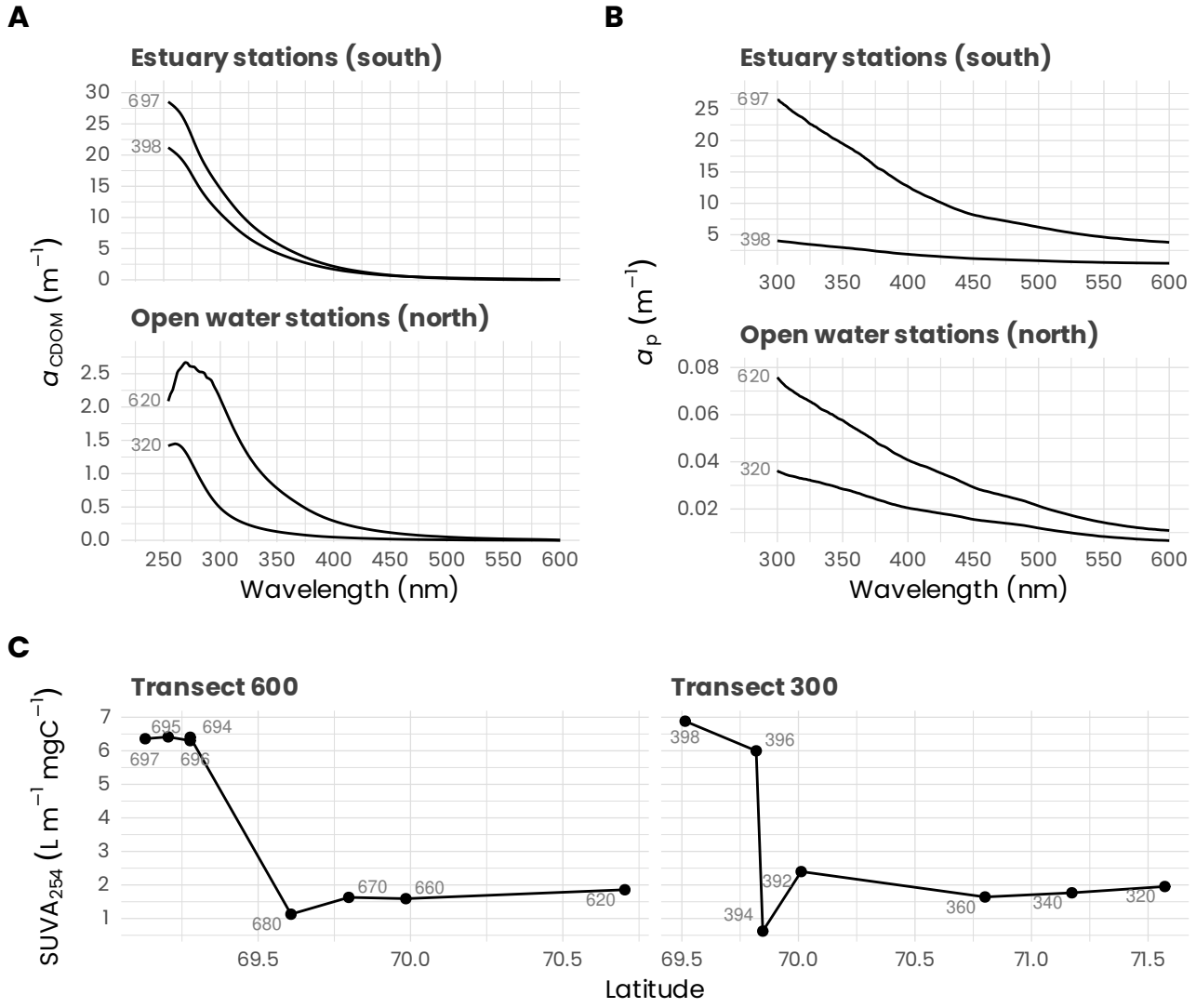

Figure 6. (**A**) Absorption spectra between 254 and 600 nm of chromophoric dissolved organic matter (a_{CDOM}) measured at the surface for the northern (620, 320) and southern (697, 398) stations of the transects 600 and 300. (**B**) Particulate absorption spectra (a_p) measured between 300 and 600 nm measured at the surface for the northernmost and the southernmost stations of the transects 600 and 300. (**C**) Specific UV absorbance at 254 nm ($SUVA_{254}$, i.e. absorption of light at 254 nm per unit of carbon) at surface for stations along transects 600 and 300. Stations are identified in light gray (see Fig. 1 for an overview of the station locations). Note the difference of the y-axes used in panels A and B which highlight the important differences in dissolved and particulate absorption between stations in the estuary and those offshore.

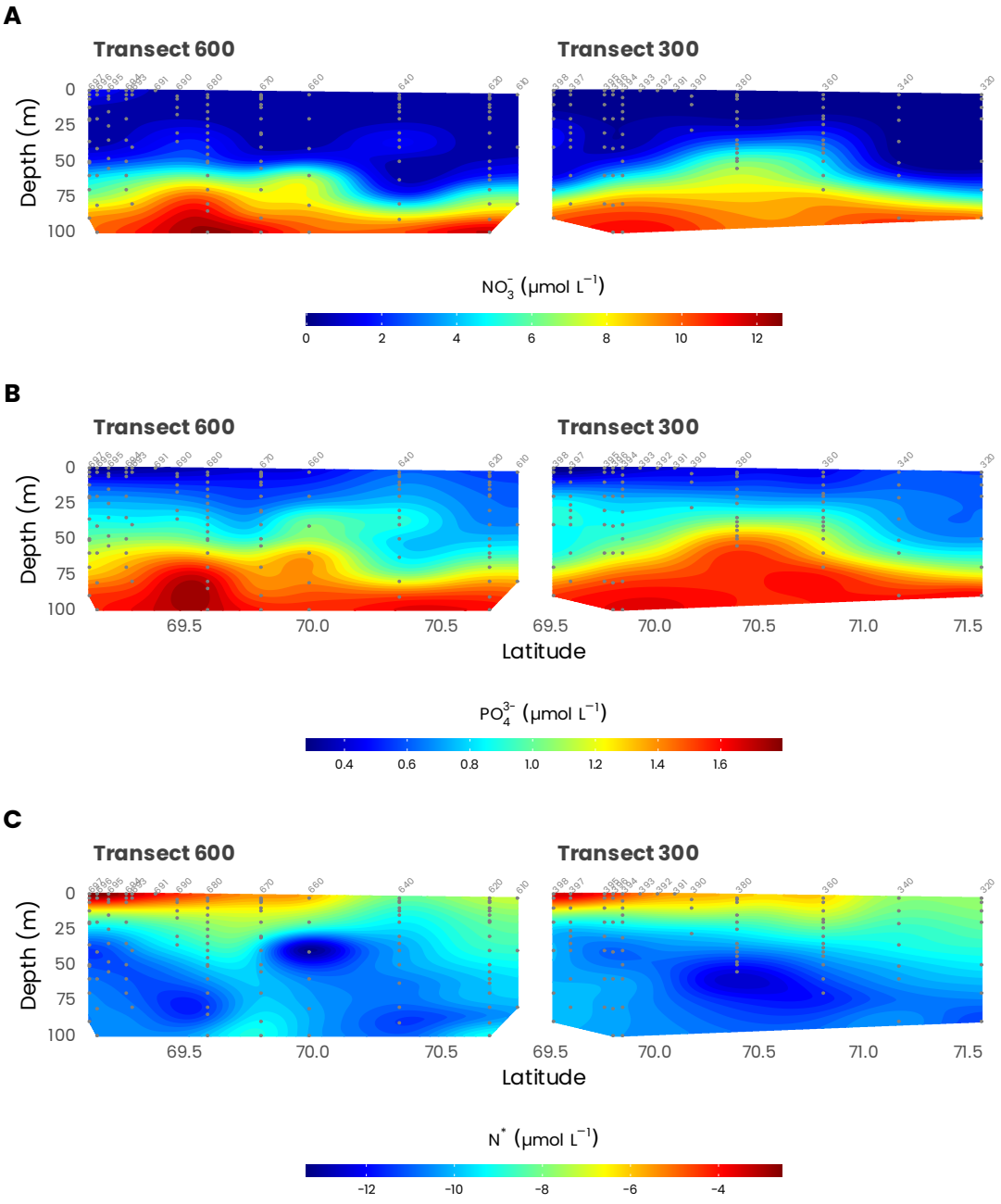

Figure 7. Cross-sections of (**A**) NO_3^- and (**B**) PO_4^{3-} measured from Niskin bottles (gray dots) along transects 600 and 300. (**C**) N^* defined as N - rP with r = N/P = 13.1 (see the text for the details). Station numbers are identified in light gray on top of each panel.

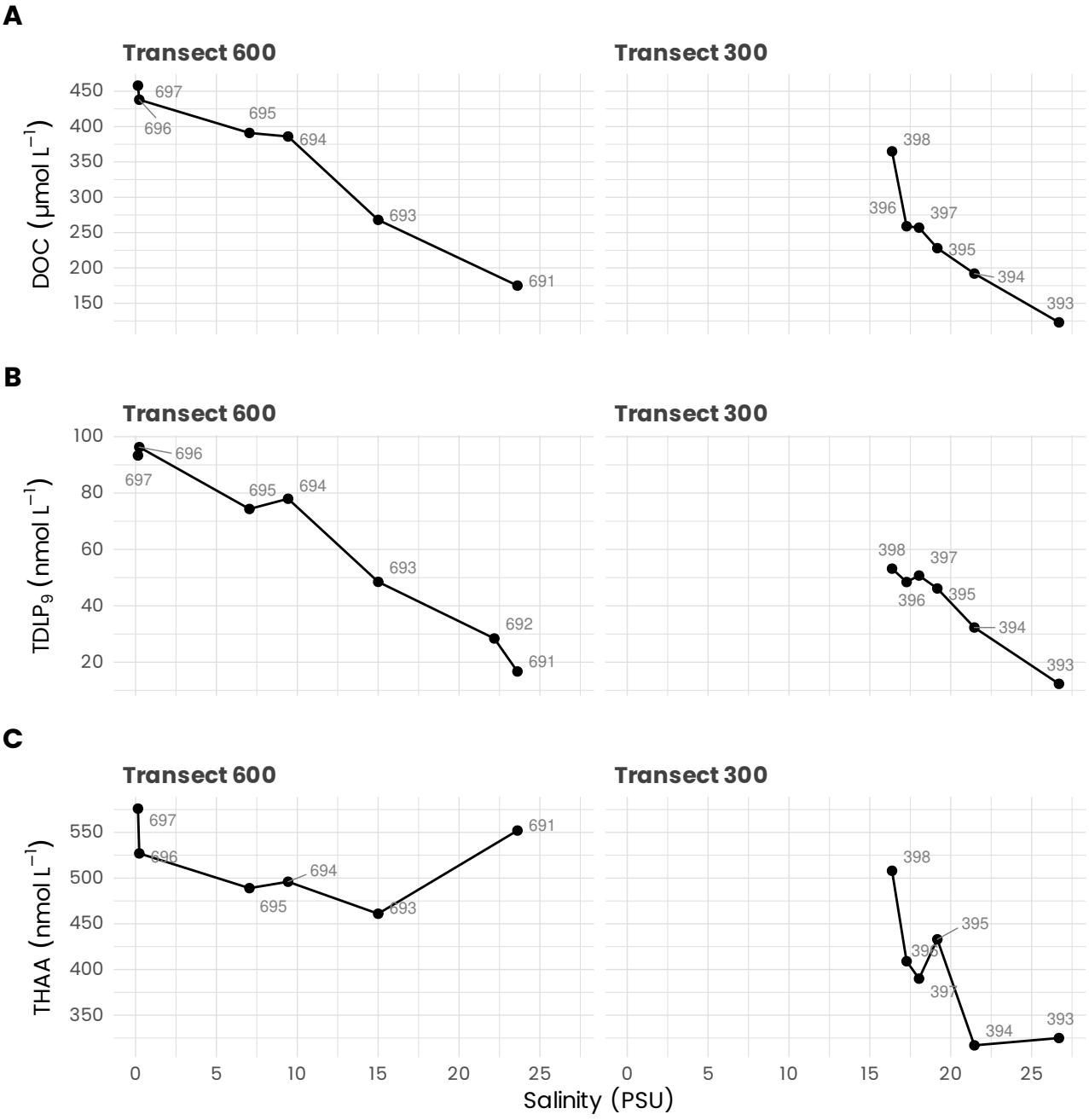

Figure 8. Concentrations of (**A**) dissolved organic carbon (DOC), (**B**) total dissolved lignin phenols ($TDLP_9$), and (**C**) total hydrolysable amino acids (THAA) measured along transects 600 and 300, and plotted against salinity.

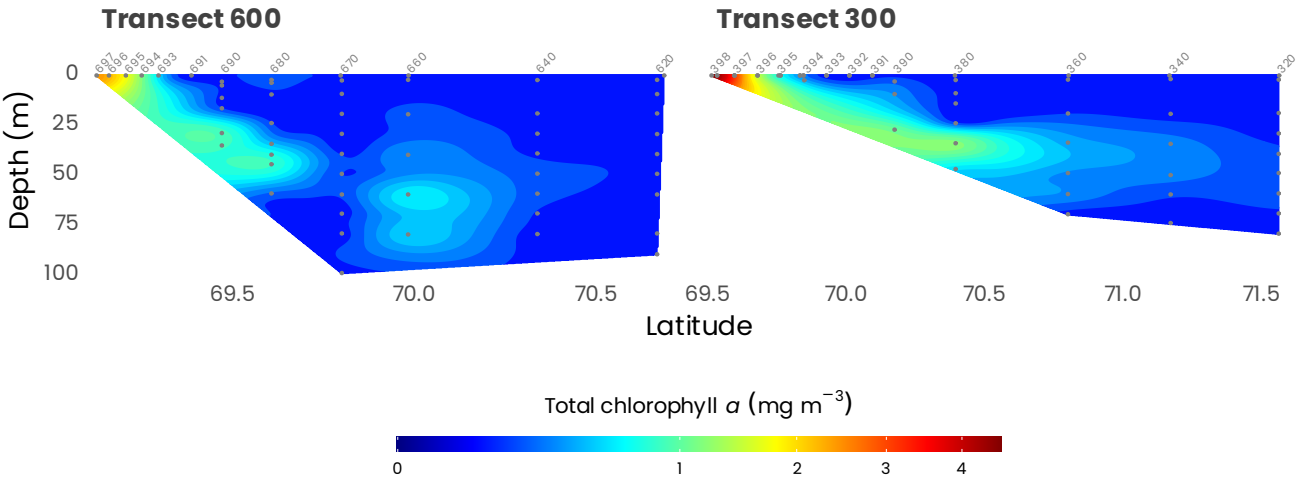

Figure 9. Cross-sections of total chlorophyll-a measured from HPLC (gray dots) along transects 600 and 300. Station numbers are identified in light gray on top of each panel. Note that the data has been square-root transformed for the visualization.

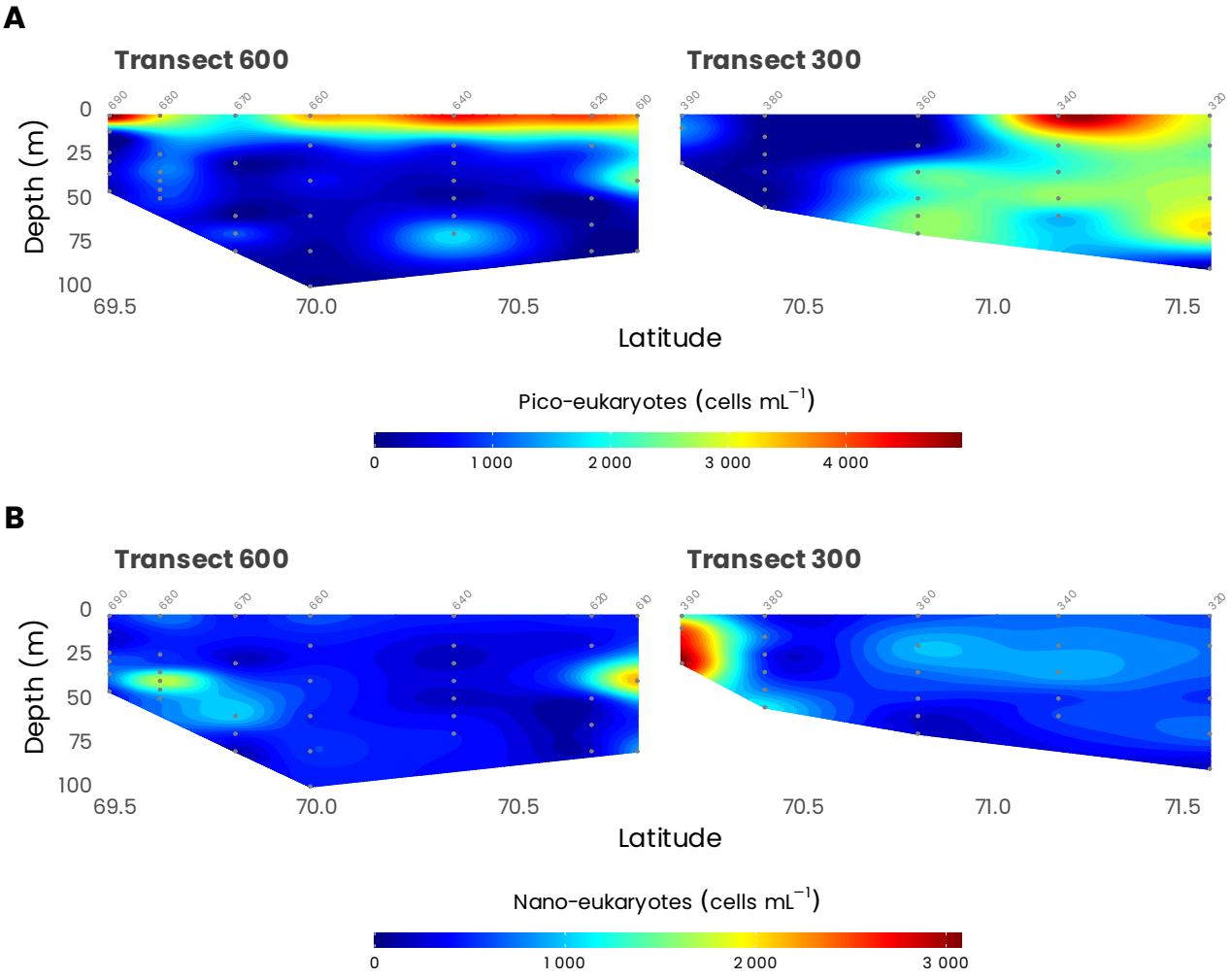

Figure 10. Concentrations of photosynthetic (**A**) pico- and (**B**) nano-eukaryotes measured by flow cytometry during the MALINA cruise on transects 600 and 300.

A
Clone libraries

B
Cultures

Figure 11. (**A**) Taxonomic composition of populations of photosynthetic pico- and nano-eukaryotes sorted flow cytometry from clone library sequences (Balzano et al., 2012b). (**B**) Taxonomic composition of cultures of phytoplankton isolated during the MALINA cruise (Balzano et al., 2012a).

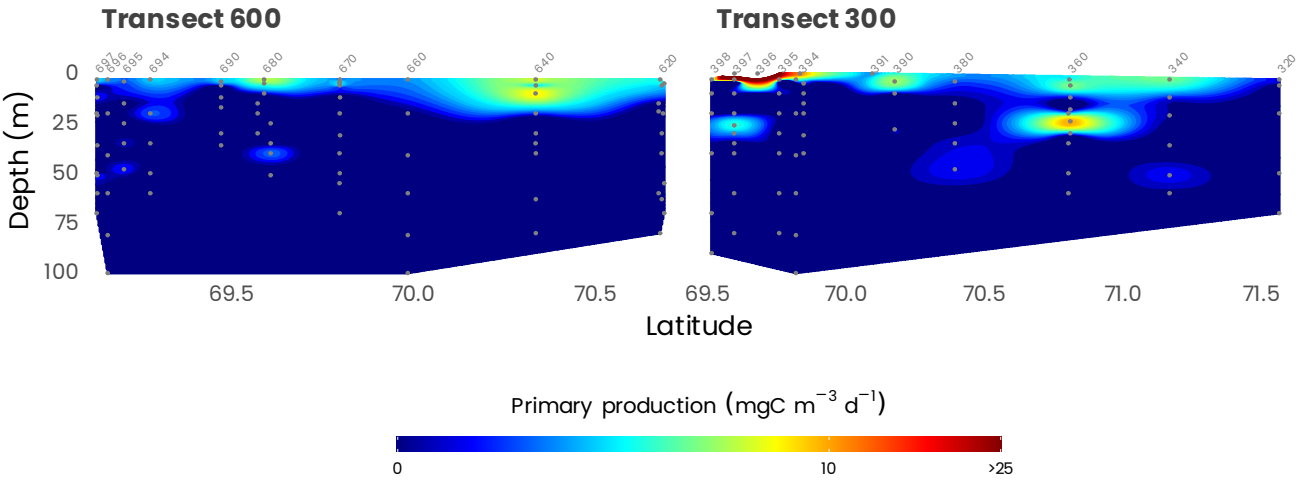

Figure 12. Cross-sections of primary production (gray dots) along transects 600 and 300. Station numbers are identified in light gray on top of each panel. Note that the color scale is presented on a log10 scale.

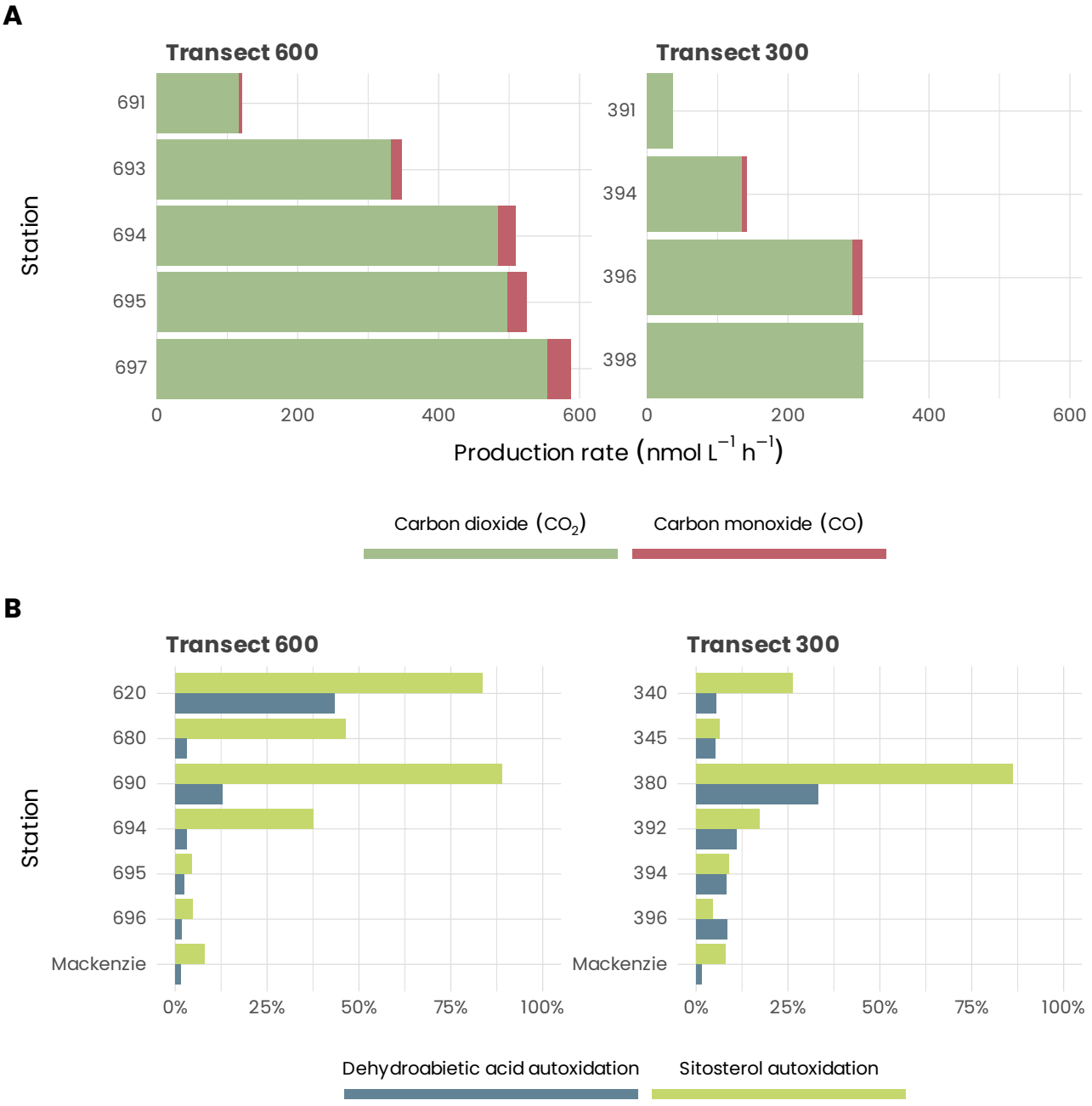

Figure 13. (**A**) CO and CO_2 production measured at 295 nm at surface for stations of transects 600 and 300. (**B**) Autoxidation of suspended particulate material for stations of transects 600 and 300.

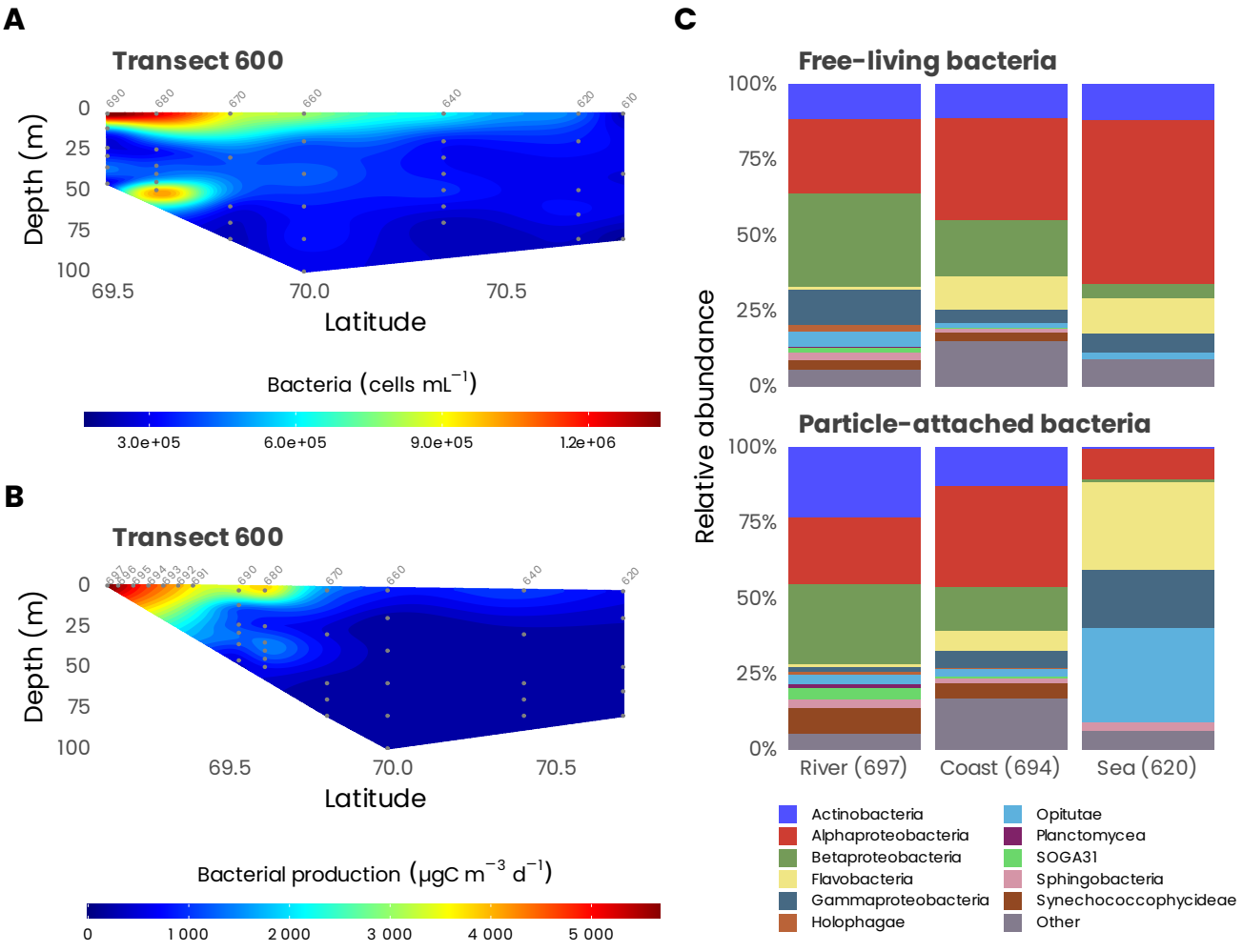

Figure 14. (**A**) Cross-sections of bacterial abundance measured from flow cytometry and (**B**) bacterial production measured along transect 600. Station numbers are identified in light gray on top of each panel. (**C**) Cumulative bar charts comparing the relative class abundances in particle-attached (PA) and free-living (FL) for a selected number of samples in transect 600.

Table 1: Parameters measured during the MALINA oceanographic expedition. Parameters are ordered by alphabetical order.

Parameters	Method	Sampling	Principal investigators
^{137}Cs datation of core samples	Gamma spectrometry	Box corer	Rochon A./ Schmidt
^{137}Cs datation of core samples	Gamma spectrometer	CASQ corer	Rochon A./ Schmidt
^{14}C datation of core samples	Accelerator Mass Spectrometry	Box corer	Rochon A.
^{14}C datation of core samples	Accelerator Mass Spectrometry	CASQ corer	Rochon A.
^{15}N-Ammonium assimilation	^{15}N spiking - incubation - mass-spectrometry	Rosette - Deck incubations	Tremblay J.E./ Raimbault P.
^{15}N-Ammonium assimilation	^{15}N spiking - incubation - mass-spectrometry	Rosette In-situ production line	Tremblay J.E./ Raimbault P.
^{15}N-Ammonium oxidation (Nitrification)	^{15}N spiking - incubation - mass-spectrometry	Rosette - Deck incubations	Tremblay J.E./ Raimbault P.
^{15}N-Ammonium oxidation (Nitrification)	^{15}N spiking - incubation - mass-spectrometry	Rosette In-situ production line	Tremblay J.E./ Raimbault P.
^{15}N-Ammonium primary production (^{13}C)	^{15}N spiking - incubation - mass-spectrometry	Rosette - Deck incubations	Tremblay J.E./ Raimbault P.
^{15}N-Ammonium regeneration	^{15}N spiking - incubation - mass-spectrometry	Rosette - Deck incubations	Tremblay J.E./ Raimbault P.
^{15}N-Ammonium regeneration	^{15}N spiking - incubation - mass-spectrometry	Rosette In-situ production line	Tremblay J.E./ Raimbault P.
^{15}N-N_2 fixation	^{15}N spiking - incubation - mass-spectrometry	Rosette water sample	Tremblay J.E./ Raimbault P.
^{15}N-Nitrate assimilation	^{15}N spiking - incubation - mass-spectrometry	Rosette - Deck incubations	Tremblay J.E./ Raimbault P.
^{15}N-Nitrate assimilation	^{15}N spiking - incubation - mass-spectrometry	Rosette In-situ production line	Tremblay J.E./ Raimbault P.
^{15}N-Urea Photosynthetic parameters	^{15}N incubations mass spectrometry	Rosette Niskin water sample	Tremblay J.E.
^{210}Pb geochronology of core samples	^{209}Po alpha spectrometry	Box corer	Rochon A.
^{210}Pb geochronology of core samples	^{209}Po alpha spectrometry	CASQ corer	Rochon A.
^{226}Ra (particulate)	Gamma spectrometry	Foredeck In-situ pump	Gasser B.
^{226}Ra/228Ra	Gamma spectrometry	Discrete Sample on Continuous System.	Gasser B.
^{234}Th (1 micron < particles > 70 micron)	Beta-counting	Foredeck In-situ pump	Gasser B.
^{234}Th (particles > 70 micron)	Beta-counting	Foredeck In-situ pump	Gasser B.
^{234}Th (Particulate)	Beta-counting	Drifting Sediment trap	Gasser B.
^{234}Th (total)	Beta-counting	Rosette water sample	Gasser B.
^{238}U (Dissolved)	Derived parameter	Rosette water sample	Gasser B.
^{238}U (total)	Alpha-counting	Rosette water sample	Gasser B.
AAPB (abundance)	IR microscopy, fluorimetry. FISH	Rosette water sample	Jeanthon C./ Boeuf D.
AAPB (abundance)	IR microscopy, fluorimetry. FISH	Zodiac water sample	Jeanthon C./ Boeuf D.
Absorption (particulate)	PSICAM	Barge water sample	Leymarie E.
Absorption (particulate)	Spectrophotometer (filters)	Barge water sample	Belanger S.
Absorption (particulate)	Spectrophotometer (filters)	Continuous on way	Belanger S.
Absorption (particulate)	PSICAM	Rosette water sample	Leymarie E.
Absorption (particulate)	Spectrophotometer (filters)	Rosette water sample	Belanger S.
Absorption (particulate)	Spectrophotometer (filters)	Zodiac profiler	Belanger S.
Absorption (total)	PSICAM	Barge water sample	Leymarie E.
Absorption (total)	PSICAM	Rosette water sample	Leymarie E.
Absorption coefficient (total)	HOBI-Labs a-sphere	Barge profiler	Wright V./ Hooker S.
Absorption coefficient (total) (9 wavelengths)	Wetlabs AC9 Serial# 156	Rosette profiler	Ehn J.
Absorption coefficient (total) (9 wavelengths in IR	Wetlabs AC9 Serial# 303	Barge profiler	Doxaran D.
Absorption coefficient (total) (9 wavelengths)	Wetlabs AC9 Serial# 279	Barge profiler	Doxaran D.
Air Relative Humidity	Humidity Sensor	Foredeck Meteorological Tower	Papakyriakou T.
Alkalinity total (TA)	Potentiometry	Barge water sample	Mucci A./ Lansard B.
Alkalinity total (TA)	Potentiometry	Rosette	Mucci A./ Lansard B.
Alkalinity total (TA)	Potentiometry	Zodiac water sample	Mucci A./ Lansard B.
Alkanes	GC-MS	Box corer	Bouloubassi I.
Alkanes	GC-MS	CASQ corer	Bouloubassi I.
Ammonium (NH_4^+) photo-production apparent quantum yield (AQY)	sun simulator - fluorimetry	Rosette water sample	Xie H./ Tremblay J.E.
Ammonium (NH_4^+) photo-production apparent quantum yield (AQY)	sun simulator - fluorimetry	Zodiac water sample	Xie H./ Tremblay J.E.
Aragonite : saturation state	Derived parameter	Barge water sample	Mucci A./ Lansard B.

Table 1: Parameters measured during the MALINA oceanographic expedition. Parameters are ordered by alphabetical order. *(continued)*

Parameters	Method	Sampling	Principal investigators
Aragonite : saturation state	Derived parameter	Rosette water sample	Mucci A./ Lansard B.
Aragonite : saturation state	Derived parameter	Zodiac water sample	Mucci A./ Lansard B.
Archaea (diversity)	CE-SSCP and DNA clone library	Rosette water sample	Joux F.
Attenuation coefficient (total) (9 wavelengths in IR)	Wetlabs AC9 Serial #0303	Barge profiler	Doxaran D.
Attenuation coefficient (total) (9 wavelengths)	Wetlabs AC9 Serial #279	Barge profiler	Doxaran D.
Attenuation coefficient (total) (9 wavelengths)	Wetlabs AC9 Serial #156	Rosette profiler	Ehn J.
Attenuation coefficient at 660 nm	Wetlabs (CRover) transmissometer	Drifting profiling float	Doxaran D.
Backscattering 532 nm	Wetlabs (ECO3) backscatterometer	Drifting profiling float	Doxaran D.
Backscattering coefficient (3 wavelengths in IR)	Wetlabs ECO-BB3 serial #538	Barge profiler	Doxaran D.
Backscattering coefficient (3 wavelengths)	Wetlabs ECO-BB3 serial #028	Barge profiler	Doxaran D.
Backscattering coefficient (6 Wavelength)	HOBI-Labs Hydroscat-6 serial #	Barge profiler	Wright V./ Hooker S.
Backscattering coefficient (8 wavelengths, spectral)	Hydroscat-6 (ser#97074) and two a-Beta (HOBI-Labs)	Barge profiler	Reynolds R.
Backscattering coefficient (8 wavelengths, spectral)	Hydroscat-6 (ser#97074) and two a-Beta (HOBI-Labs)	Foredeck	Reynolds R.
Backscattering coefficient (9 wavelengths)	Wetlabs ECO-BB9 serial# 274	Rosette profiler	Ehn J.
Bacteria (abundance)	Flow cytometry	Rosette water sample	Vaulot D.
Bacteria (abundance)	Flow Cytometry	Rosette water sample	Joux F./ Ortega E.
Bacterial abundance	FISH-TSA	Rosette water sample	Joux F.
Bacterial bio-volume	Epifluorescence microscopy	Rosette water sample	Joux F./ Ortega E.
Bacterial density (benthic)	Flow cytometry	Box corer	Link H./ Archambault P./ Chaillou G.
Bacterial diversity	CE-SSCP and DNA clone library	Rosette water sample	Joux F.
Bacterial Ecto-enzymatic activity	Spectrofluorimetry	Rosette water sample	Joux F./ Ortega E.
Bacterial growth (limitation by nutrients)	Leu-3H incubations - cells counts	Rosette water sample	Joux F./ Jeffrey W./ Ortega E.
Bacterial production	Leucine-3H incorporation	Rosette water sample	Joux F./ Jeffrey W.
Bacterial production	Leucine-3H incorporation	Zodiac water sample	Joux F./ Jeffrey W.
Bacterial production (effects of DOM UV exposure on...)	Leucine-3H incorporation - cell counts	Rosette water sample	Joux F./ Jeffrey W./ Ortega E.
Bacterial production (effects of UV radiation)	Leucine-3H incorporation	Rosette water sample	Joux F./ Jeffrey W.
Bacterial respiration (whole community)	O^2 consumption - Winkler - Incubations	Rosette water sample	Joux F./ Ortega E.
Benthic ammonium flux	Incubations - Colorimetry	Box corer	Link H./ Archambault P./ Chaillou G.
Benthic DOC remineralisation	Incubations - wet oxidation	Box corer	Link H./ Archambault P./ Chaillou G./ Charriere B.
Benthic Macrofauna abundance	Microscopy	Box corer	Link H./ Archambault P./ Chaillou G.
Benthic Macrofauna biomass	Wet weight	Box corer	Link H./ Archambault P./ Chaillou G.
Benthic Macrofauna diversity	Microscopy	Box corer	Link H./ Archambault P./ Chaillou G.
Benthic nitrate flux	Incubations - Colorimetry- Autoanalyzer	Box corer	Link H./ Archambault P./ Chaillou G.
Benthic nitrite flux	Incubations - Colorimetry- Autoanalyzer	Box corer	Link H./ Archambault P./ Chaillou G.
Benthic phosphate flux	Incubations - Colorimetry- Autoanalyzer	Box corer	Link H./ Archambault P./ Chaillou G.
Benthic respiration	Incubations - Optic - Oxygen probe	Box corer	Link H./ Archambault P./ Chaillou G.
Benthic silicic acid flux	Incubations - Colorimetry - Autoanalyzer	Box corer	Link H./ Archambault P./ Chaillou G.
Bioturbation of sediments	Incubation with luminophores	Box corer	Link H./ Archambault P./ Chaillou G.
Calcite : saturation state	Derived parameter	Barge water sample	Mucci A./ Lansard B.
Calcite : saturation state	derived parameter	Rosette water sample	Mucci A./ Lansard B.
Calcite : saturation state	Derived parameter	Zodiac water sample	Mucci A./ Lansard B.
Campesterol, cholesterol, sistosterol and products of degrad	GC-MS	Rosette water sample	Sempere R.
CDOM absorption	PSICAM	Barge water sample	Leymarie E.
CDOM absorption	Spectrophotometer	Barge water sample	Matsuoka A./ Bricaud A.
CDOM absorption	Spectrophotometer	Barge water sample	Wright V./ Hooker S.
CDOM absorption	Ultrapath	Barge water sample	Bricaud A.
CDOM absorption	PSICAM	Rosette water sample	Leymarie E.
CDOM absorption	Spectrophotometer	Rosette water sample	Matsuoka A./ Bricaud A.

Table 1: Parameters measured during the MALINA oceanographic expedition. Parameters are ordered by alphabetical order. *(continued)*

Parameters	Method	Sampling	Principal investigators
CDOM absorption	Ultrapath	Rosette water sample	Bricaud A.
CDOM absorption	PSICAM	Zodiac water sample	Leymarie E.
CDOM absorption	Spectrophotometer	Zodiac water sample	Matsuoka A./ Bricaud A.
CDOM absorption	Ultrapath	Zodiac water sample	Bricaud A.
CDOM fluorescence	HOBI-Labs Hydroscat-6 ser# HS080542	Barge profiler	Wright V./ Hooker S.
CDOM fluorescence	Wetlabs WetStar WSCD	Barge profiler	Doxaran D.
CDOM fluorescence	Wetlabs (ECO3) fluorometer	Drifting profiling float	Doxaran D.
CDOM fluorescence	Haardt fluorometer	Rosette profiler	Belanger S./ Amon/ Sempere R.
CDOM fluorescence EEM (excitation-emission-matrix)	Spectrofluorimetry	Rosette water sample	Belanger S./ Amon/ Sempere R.
CDOM fluorescence EEM (excitation-emission-matrix)	Spectrofluorimetry	Zodiac water sample	Belanger S./ Amon/ Sempere R.
Chlorophyll a and Phaeopigments (concentration)	Fluorimetry Size fractionned	Rosette water sample	Gosselin M./ Belanger S.
Chlorophyll a and Phaeopigments (benthic)	Fluorometric analysis	Box corer	Link H./ Archambault P./ Chaillou G.
Chlorophyll a fluorescence [Fchla (z)]	Chelsea Mini-Track a II fluorometer	Barge profiler	Doxaran D.
Chlorophyll a fluorescence [Fchla (z)]	HOBI-Labs Hydroscat-6 fluorometer	Barge profiler	Wright V./ Hooker S.
Chlorophyll a fluorescence [Fchla (z)]	Wetlabs (ECO3) fluorometer	Drifting profiling float	Doxaran D.
Chlorophyll a fluorescence [Fchla (z)]	SeaPoint fluorometer	Rosette profiler	Gratton Y./ Prieur L./ Tremblay J.E.
CO photo-prod. apparent quantum yield for CDOM	Sun simulator - reduction gas analyzer	Rosette water sample	Xie H.
CO photo-prod. apparent quantum yield for CDOM	Sun simulator - reduction gas analyzer	Zodiac water sample	Xie H.
CO photo-prod. apparent quantum yield for particulate matter	Sun simulator - reduction gas analyzer	Rosette water sample	Xie H.
CO photo-prod. apparent quantum yield for particulate matter	Sun simulator - reduction gas analyzer	Zodiac water sample	Xie H.
CO^2 (atm) concentration	Infra Red	Foredeck Meteorological Tower	Papakyriakou T.
CO^2 (seawater) concentration	Infra Red	Foredeck Meteorological Tower	Papakyriakou T.
CO3 2- concentrations	Derived parameter	Barge water sample	Mucci A./ Lansard B.
CO3 2- concentrations	Derived parameter	Rosette water sample	Mucci A./ Lansard B.
CO3 2- concentrations	Derived parameter	Zodiac water sample	Mucci A./ Lansard B.
Coccolithophorids	Microscopy	Rosette water sample	Coupel P.
Conductivity (z)	Sensor on SBE Fascat CTD serial #	Barge profiler	Doxaran D.
Conductivity (z)	Sensor on SBE Fascat CTD serial #	Barge profiler	Wright V./ Hooker S.
Conductivity (z)	Sensor SeaBird 4c on CTD SBE-911	Rosette profiler	Gratton Y./ Prieur L.
CTD	Seabird	Drifting profiling float	Doxaran D.
Cultures of sorted populations	Sorted by flow cytometry, serial dilution and single cell pipetting	Rosette water sample	Vaulot D.
Current Profile [U (z)]	ADCP (LADCP) RD Instrument 300 KHz	Rosette profiler	Marec C./ Gratton Y./ Prieur L.
delta ^{13}C	Mass Spectrometry	Zodiac water sample	Mucci A./ Lansard B.
delta ^{13}C on suspended particulate matter	Mass Spectrometry	Rosette water sample	Tremblay J.E./ Raimbault P.
delta ^{15}C on suspended particulate matter	Mass Spectrometry	Rosette water sample	Tremblay J.E./ Raimbault P.
delta ^{18}O - water	Mass Spectrometry	Rosette water sample	Mucci A./ Lansard B.
delta ^{18}O - water	Mass Spectrometry	Zodiac water sample	Mucci A./ Lansard B.
delta^{13}C	Mass Spectrometer	Barge water sample	Mucci A./ Lansard B.
delta^{13}C	Mass Spectrometry	Rosette water sample	Mucci A./ Lansard B.
delta^{18}O - water	Mass Spectrometry	Barge water sample	Mucci A./ Lansard B.
Diacids composition	GC/MS	Rosette water sample	Sempere R.
Diacids composition	GC/MS	Zodiac water sample	Sempere R.
Diacids photo-production apparent quantum yield (AQY)	Sun simulator - GC/MS	Zodiac water sample	Sempere R.
Dinoflagellates cysts Abundance	Microscopy	Box corer	Rochon A.
Dinoflagellates cysts Abundance	Microscopy	CASQ corer	Rochon A.
Dinoflagellates cysts Identification	Microscopy	Box corer	Rochon A.
Dinoflagellates cysts Identification	Microscopy	CASQ corer	Rochon A.
Dissolved Inorg. Carbon photo-prod. apparent quantum yield	Sun simulator - indrared CO^2 analyzer	Rosette water sample	Xie H./ Belanger S.
Dissolved Inorg. Carbon photo-prod. apparent quantum yield	Sun simulator - indrared CO^2 analyzer	Zodiac water sample	Xie H./ Belanger S.

Table 1: Parameters measured during the MALINA oceanographic expedition. Parameters are ordered by alphabetical order. *(continued)*

Parameters	Method	Sampling	Principal investigators
Dissolved Organic Carbon (DOC)	High Temperature Catalytic Oxidation	Barge water sample	Wright V./ Hooker S.
Dissolved Organic Carbon (DOC)	High Temperature Catalytic Oxidation	Rosette water sample	Sempere R.
Dissolved Organic Carbon (DOC)	High Temperature Catalytic Oxidation	Rosette water sample	Benner R.
Dissolved Organic Carbon (DOC)	Wet oxidation	Rosette water sample	Tremblay J.E./ Raimbault P.
Dissolved Organic Carbon (DOC)	High Temperature Catalytic Oxidation	Zodiac water sample	Sempere R.
Dissolved Organic Carbon (DOC)	High Temperature Catalytic Oxidation	Zodiac water sample	Benner R.
Dissolved Organic Nitrogen (DON)	Wet oxidation	Rosette water sample	Tremblay J.E./ Raimbault P.
Dissolved Organic Nitrogen (Total) (TDON)	High Temperature Catalytic Oxidation	Rosette water sample	Benner R.
Dissolved Organic Nitrogen (Total) (TDON)	High Temperature Catalytic Oxidation	Zodiac water sample	Benner R.
Dissolved Organic Phosphorus (DOP)	Wet oxidation	Rosette water sample	Tremblay J.E./ Raimbault P.
Ed, Lu, Eu, Es	C-OPS package (320, 340, 380, 395 nm)	Barge profiler	Hooker
Electric resistivity (sediment core physical properties)	Geotek Multi Sensor Core Logger	Box corer	Rochon A.
Electric resistivity (sediment core physical properties)	Geotek Multi Sensor Core Logger	CASQ corer	Rochon A.
Eukaryotes (abundance)	DAPI epifluorescence microscopy	Rosette water sample	Lovejoy C.
Eukaryotes (abundance)	FISH-TSA	Rosette water sample	Lovejoy C.
Eukaryotes (biomass)	DAPI epifluorescence microscopy	Rosette water sample	Lovejoy C.
fCO^2	Derived parameter	Barge water sample	Mucci A./ Lansard B.
fCO^2	Derived parameter	Rosette water sample	Mucci A./ Lansard B.
fCO^2	Derived parameter	Zodiac water sample	Mucci A./ Lansard B.
Foraminifera abundance	Microscopy	Box corer	Rochon A.
Foraminifera abundance	Microscopy	CASQ corer	Rochon A.
Foraminifera identification	Microscopy	Box corer	Rochon A.
Foraminifera identification	Microscopy	CASQ corer	Rochon A.
Gamma density (sediment core physical properties)	Geotek Multi Sensor Core Logger	Box corer	Rochon A.
Gamma density (sediment core physical properties)	Geotek Multi Sensor Core Logger	CASQ corer	Rochon A.
H_2O (atm) concentration	Infrared gas analyzer	Foredeck Meteorological Tower	Papakyriakou T.
HCO^2- concentration	Derived parameter	Barge water sample	Mucci A./ Lansard B.
HCO^2- concentration	Derived parameter	Rosette water sample	Mucci A./ Lansard B.
HCO^2- concentration	Derived parameter	Zodiac water sample	Mucci A./ Lansard B.
Hydro SCAMP (Temp, Salin, Chlorophyll, turb. ...)	SCAMP profiler	In-water profiler	Gratton Y.
Hydrolysable Amino Acids (Total) (THAA)	HPLC	Rosette water sample	Benner R.
Hydrolysable Amino Acids (Total) (THAA)	HPLC	Zodiac water sample	Benner R.
Hydroxyl radicals (OH)	HPLC	Rosette water sample	Sempere R.
Hydroxyl radicals (OH)	HPLC	Zodiac water sample	Sempere R.
Hydroxyl radicals (OH) photo-prod. apparent quantum yield	Sun simulator - HPLC	Rosette water sample	Sempere R.
Hydroxyl radicals (OH) photo-prod. apparent quantum yield	Sun simulator - HPLC	Zodiac water sample	Sempere R.
IP25 (C25 Monounsaturated Hydrocarbon)	GC	Box corer	Masse G.
IP25 (C25 Monounsaturated Hydrocarbon)	GC	CASQ corer	Masse G.
Irradiance	Satlantic (PUV) (305,325, 340, 380,..)	Foredeck	Sempere R.
Irradiance (412, 490, 555 nm)	Satlantic (OCR) radiometer	Drifting profiling float	Doxaran D.
Lignin phenols (dissolved)	GC/MS	Rosette water sample	Benner R.
Lignin phenols (dissolved)	GC/MS	Zodiac water sample	Benner R.
Lipid biomarqueurs	GC-Flamme Ionization Detection / GC-MS	Box corer	Tolosa I.
Lipid biomarqueurs	GC-Flamme Ionization Detection / GC-MS	CASQ corer	Tolosa I.
Lipid biomarqueurs $d^{13}C$	GC-Combustion Isotope ratio MS	Box corer	Tolosa I.
Lipid biomarqueurs $d^{13}C$	GC-Combustion Isotope ratio MS	CASQ corer	Tolosa I.
Long-Wave radiation (Lwin)	Pyrgeometer	Wheel-house radiation platform	Papakyriakou T.
Magnetic susceptibility (sediment core physical properties)	Geotek Multi Sensor Core Logger	Box corer	Rochon A.

Table 1: Parameters measured during the MALINA oceanographic expedition. Parameters are ordered by alphabetical order. *(continued)*

Parameters	Method	Sampling	Principal investigators
Magnetic susceptibility (sediment core physical properties)	Geotek Multi Sensor Core Logger	CASQ corer	Rochon A.
Nanoeukaryotes (abundance)	Flow cytometry	Rosette water sample	Vaulot D.
NH_4^+	Fluorescence	Rosette water sample	Tremblay J.E./ Raimbault P.
Nitrate (concentration)	Satlantic ISUS	Rosette profiler	Gratton Y./ Prieur L./ Tremblay J.E.
NO_2^-	Colorimetry/Autoanalyzer	Rosette water sample	Tremblay J.E./ Raimbault P.
NO_3^-	Colorimetry/Autoanalyzer	Rosette water sample	Tremblay J.E./ Raimbault P.
Organic Compounds High Molecular Weight (HMW)	Sun simulator incubations - HPLC	Rosette water sample	Xie H.
Organic Compounds High Molecular Weight (HMW)	Sun simulator incubations - HPLC	Zodiac water sample	Xie H.
Organic Compounds Low Molecular Weight (LMW)	Sun simulator incubations - HPLC	Rosette water sample	Xie H.
Organic Compounds Low Molecular Weight (LMW)	Sun simulator incubations - HPLC	Zodiac water sample	Xie H.
Oxygen (dissolved)	Discrete samples Winkler Method	Barge water sample	Prieur L.
Oxygen (dissolved)	Idronaut Ocean Seven O^2 sensor	Continuous horizontal	Papakyriakou T.
Oxygen (dissolved)	SeaBird SBE-43 sensor	Rosette profiler	Gratton Y./ Prieur L.
Oxygen (dissolved)	Discrete samples Winkler Method	Rosette water sample	Prieur L.
Oxygen (dissolved)	Discrete samples Winkler Method	Zodiac water sample	Prieur L.
P waves speed (sediment core physical properties)	Geotek Multi Sensor Core Logger	Box corer	Rochon A.
P waves speed (sediment core physical properties)	Geotek Multi Sensor Core Logger	CASQ corer	Rochon A.
Paleomagnetism	Cryogenic magnetometer	Box corer	Rochon A.
Paleomagnetism	Cryogenic magnetometer	CASQ corer	Rochon A.
PAR	Biospherical sensor	Barge profiler	Wright V./ Hooker S.
PAR	Biospherical sensor	Rosette profiler	Gratton Y./ Prieur L./ Tremblay J.E.
PAR	PARLite sensor	Wheel-house radiation platform	Papakyriakou T.
Particle Size Distribution	LISST-100X	Barge profiler	Reynolds R.
Particle Size Distribution	Coulter counter	Barge water sample	Reynolds R.
Particle Size Distribution	UVP-5	In-water profiler	Picheral M.
Particle Size Distribution	LISST-100X	Rosette profiler	Reynolds R.
Particle Size Ditribution	Coulter counter	Rosette water sample	Reynolds R.
Particulate Organic Carbon (POC)	CHN analyzer	Barge water sample	Wright V./ Hooker S.
Particulate Organic Carbon (POC)	CHN analyzer on SPM filters	Barge water sample	Doxaran D./ Ehn J./ Babin M.
Particulate Organic Carbon (POC)	CHN analyzer on SPM filters	Rosette water sample	Doxaran D./ Ehn J./ Babin M.
Particulate Organic Carbon (POC)	Wet oxidation	Rosette water sample	Tremblay J.E./ Raimbault P.
Particulate Organic Carbon (POC)	CHN analyzer on SPM filters	Zodiac water sample	Doxaran D./ Ehn J./ Babin M.
Particulate Organic Matter (POM)	CHN analyzer on SPM filters	Barge water sample	Wright V./ Hooker S.
Particulate Organic Nitrogen (PON)	CHN analyzer	Barge water sample	Wright V./ Hooker S.
Particulate Organic Nitrogen (PON)	Wet oxidation	Rosette water sample	Tremblay J.E./ Raimbault P.
Particulate Organic Phosphorus (POP)	Wet oxidation	Rosette water sample	Tremblay J.E./ Raimbault P.
pH	Spectrophometry	Barge water sample	Mucci A./ Lansard B.
pH	SeaBird SBE-18 sensor	Rosette profiler	Gratton Y./ Prieur L./ Tremblay J.E.
pH	Spectrophotometry	Rosette water sample	Mucci A./ Lansard B.
pH	Spectrophometry	Zodiac water sample	Mucci A./ Lansard B.
pH (total proton scale)	Derived parameter	Barge water sample	Mucci A./ Lansard B.
pH (total proton scale)	Dervide parameter	Rosette water sample	Mucci A./ Lansard B.
pH (total proton scale)	Dervide parameter	Zodiac water sample	Mucci A./ Lansard B.
Photosynthetic eukaryotes (morphology)	Scanning Electron Microscopy	Rosette water sample	Vaulot D.
Photosynthetic eukaryotes (diversity)	DNA clone library and TRFLP of sorted populations	Rosette water sample	Vaulot D.
Photoheterotrophs (diel cycle genes analyses)	RNA expression every 4 hours	Rosette water sample	Jeanthon C./ Boeuf D.
Photoheterotrophs (DNA diversity)	DNA clone library	Rosette water sample	Jeanthon C./ Boeuf D.
Photoheterotrophs (metagenome)	454 sequencing	Rosette water sample	Jeanthon C./ Boeuf D.

Table 1: Parameters measured during the MALINA oceanographic expedition. Parameters are ordered by alphabetical order. *(continued)*

Parameters	Method	Sampling	Principal investigators
Photosynthetic parameters	^{14}C incubations	Rosette water sample	Huot Y.
Phytoplankton (abundance)	Inverted microscope	Rosette water sample	Gosselin M./ Belanger S.
Phytoplankton (taxonomy)	Inverted microscope	Rosette water sample	Gosselin M./ Belanger S.
Phytoplankton pigments	HPLC	Barge water sample	Wright V./ Hooker S.
Phytoplankton pigments	HPLC	Rosette water sample	Ras J./ Claustre H.
Picoeukaryotes (abundance)	Flow cytometry	Rosette water sample	Vaulot D.
Picoplankton (diversity)	DNA clone library	Rosette water sample	Lovejoy C.
Photosynthetic eukaryotes (diversity)	DNA from filters	Rosette water sample	Vaulot D.
Picoplankton (diversity)	RNA clone library	Rosette water sample	Lovejoy C.
Plankton taxonomy	UVP-5	In-water profiler	Picheral M./ Marec C.
$(PO_4)^{3-}$	Colorimetry/Autoanalyzer	Rosette water sample	Tremblay J.E./ Raimbault P.
Pollen and Spores Abundance	Microscopy	Box corer	Rochon A.
Pollen and Spores Abundance	Microscopy	CASQ corer	Rochon A.
Pollen and Spores Identification	Microscopy	Box corer	Rochon A.
Pollen and Spores Identification	Microscopy	CASQ corer	Rochon A.
PR-containing bacteria (abundance)	Q-PCR	Rosette water sample	Jeanthon C./ Boeuf D.
Pressure (Barometric)	Pressure Sensor	Foredeck Meteorological Tower	Papakyriakou T.
Radiance	Camera Luminance	Profile mode	Antoine D./ Leymarie E.
Radiance	Camera Luminance	Surface mode	Antoine D./ Leymarie E.
Radiance (surface leaving radiance)	BIO-SHADE	Barge profiler	Hooker
Radiance (surface leaving radiance)	BIOSORS	Foredeck	Hooker
Radiance (surface leaving radiance)	Satlantic HyperSAS	Foredeck	Belanger S.
Radiance (surface leaving radiance)	TriOS above water sensor	Foredeck	Doxaran D.
Radiance : Sub Product : average cosines	Camera Luminence	Profile mode	Antoine D./ Leymarie E.
Radiance : Sub Product : average cosines	Camera Luminence	Surface mode	Antoine D./ Leymarie E.
Radiance : Sub Product : irradiance (E)	Camera Luminence	Profile mode	Antoine D./ Leymarie E.
Radiance : Sub Product : irradiance (E)	Camera Luminence	Surface mode	Antoine D./ Leymarie E.
Radiance : Sub Product : Lnadir	Camera Luminence	Profile mode	Antoine D./ Leymarie E.
Radiance : Sub Product : Lnadir	Camera Luminence	Surface mode	Antoine D./ Leymarie E.
Radiance : Sub Product : Qnadir	Camera Luminence	Profile mode	Antoine D./ Leymarie E.
Radiance : Sub Product : Qnadir	Camera Luminence	Surface mode	Antoine D./ Leymarie E.
Radiance : Sub Product : scalar irradiance (Escal)	Camera Luminence	Profile mode	Antoine D./ Leymarie E.
Radiance : Sub Product : scalar irradiance (Escal)	Camera Luminence	Surface mode	Antoine D./ Leymarie E.
Rotational movement (accx, accy, accz,rx,ry,rz)	multi-axis inertial sensing system	Foredeck Meteorological Tower	Papakyriakou T.
Salinity	Salinometer	Barge water sample	Gratton Y./ Prieur L.
Salinity	Salinometer	Rosette water sample	Gratton Y./ Prieur L.
Salinity (sea surface) SSS	Thermosalinograph - underway system	Continuous horizontal	Papakyriakou T.
Salinity [S (z)]	Derived parameter from SBE Fastcat LOC IOP pack.	Barge profiler	Doxaran D.
Salinity [S (z)]	Derived parameter from SBE Fastcat NASA IOP pack.	Barge profiler	Wright V./ Hooker S.
Salinity [S (z)]	Derived parameter	Rosette profiler	Gratton Y./ Prieur L./ Tremblay J.E.
Short-Wave radiation (Swin)	Pyranometer	Wheel-house radiation platform	Papakyriakou T.
$Si(OH)_4$	Colorimetry/Autoanalyzer	Rosette water sample	Tremblay J.E./ Raimbault P.
SPM (Suspended Particulate Material)	dry weight (gravimetry)	Barge water sample	Wright V./ Hooker S.
SPM (Suspended Particulate Material)	dry weight (gravimetry)	Barge water sample	Doxaran D./ Ehn J./ Babin M.
SPM (Suspended Particulate Material)	dry weight (gravimetry)	Rosette water sample	Doxaran D./ Ehn J./ Babin M.
SPM (Suspended Particulate Material)	dry weight (gravimetry)	Zodiac water sample	Doxaran D./ Ehn J./ Babin M.
Sugars	HPLC	Rosette water sample	Sempere R.
Sugars	HPLC	Zodiac water sample	Sempere R.
Synechococcus (abundance)	Flow cytometry	Rosette water sample	Vaulot D.

Table 1: Parameters measured during the MALINA oceanographic expedition. Parameters are ordered by alphabetical order. *(continued)*

Parameters	Method	Sampling	Principal investigators
Temperature (Air)	Temperature Sensor	Foredeck Meteorological Tower	Papakyriakou T.
Temperature (Sea Surface)	Thermosalinograph - underway system	Continuous horizontal	Papakyriakou T.
Temperature (Surface Skin)	IR transducer	Foredeck Meteorological Tower	Papakyriakou T.
Temperature [T (z)]	Temp sensor on SBE Fastcat CTD serial #	Barge profiler	Doxaran D.
Temperature [T (z)]	Temp sensor on SBE Fastcat CTD serial #	Barge profiler	Wright V./ Hooker S.
Temperature [T (z)]	Sensor SeaBird 3plus on CTD SBE-911	Rosette profiler	Gratton Y./ Prieur L./ Tremblay J.E.
Total Inorganic Carbon (TIC)	Derived parameter	Barge water sample	Mucci A./ Lansard B.
Total Inorganic Carbon (TIC)	Derived parameter	Rosette water sample	Mucci A./ Lansard B.
Total Inorganic Carbon (TIC)	Derived parameter	Zodiac water sample	Mucci A./ Lansard B.
Total Organic Carbon (TOC)	Wet oxidation	Rosette water sample	Tremblay J.E./ Raimbault P.
Total Organic Nitrogen (TON)	Wet oxidation	Rosette water sample	Tremblay J.E./ Raimbault P.
Total Organic Phosphorus (TOP)	Wet oxidation	Rosette water sample	Tremblay J.E./ Raimbault P.
Trace metals	X-Ray fluorescence spectroscopy	Box corer	Martinez P.
Trace metals	X-Ray fluorescence spectroscopy	CASQ corer	Martinez P.
Urea (concentration)	Spectrophotometry	Rosette water sample	Tremblay J.E./ Raimbault P.
Volume Scattering Function (VSF)	Benchtop use of POLVSM	Barge water sample	Chami M.
Volume Scattering Function (VSF)	Benchtop use of POLVSM	Rosette water sample	Chami M.
Volume Scattering Function (VSF)	Benchtop use of POLVSM	Zodiac water sample	Chami M.
Wind direction	Vane	Foredeck Meteorological Tower	Papakyriakou T.
Wind speed	Anemometer	Foredeck Meteorological Tower	Papakyriakou T.
Major and minor elements	XRF core scanner	CASQ corer	Martinez P.

4 Code and data availability

TODO

Author contributions.

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