**Supplementary materials**



Fig S 1: 2D matrix of quality factor (QC) of echogram from hydroacoustic survey along the

study area (“Petite Côte”). More the QC factor (unitless) is near 1, more the echointegration is

considered as relevant.

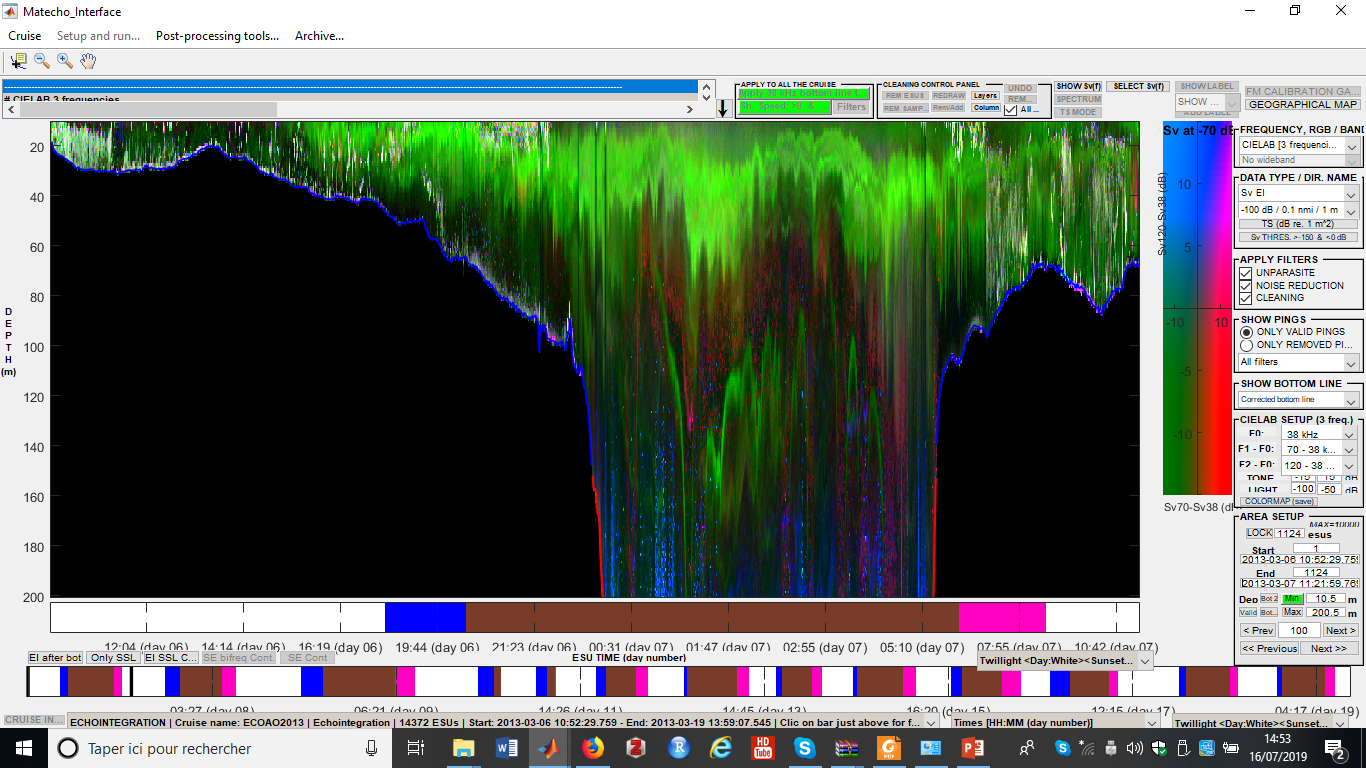
****

Fig S 2: Representation of an ECOAO sea survey echogram (from 06th -07th) at three frequencies. The 38 kHz response and both frequency response differences (here 70-38 kHz and 120-38 kHz) were scaled from 0-255 as CIELAB colorimetric values ([https://fr.wikipedia.org/wiki/L\*a\*b\*\_CIE\_1976](https://fr.wikipedia.org/wiki/L*a*b*_CIE_1976)). This method allow to clearly observe that the signal represented by green echoes (i.e. the same SSL shape than extracted at 38 kHz) is mainly associated to the 38 kHz response, whereas the 70 and 120 kHz provide lower acoustic responses.

Text S 1:Pseudo-code of Layer Matlab code for Sound Scattering Layer (SSL) Thickness calculation. Others SSL descriptors such as acoustic volume backscattering strength (Sv) and Nautical Area Scattering Coefficient sA can also be extracted in this code.

%% Layer

clear all; %close all;

%\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

% CHOIX PARAMETRES

% adresse du répertoire contenant les fichiers Echointegration.mat et Layer.mat

adress\_acou='E:\ECOAO2013\Cruise\_ECOAO2013\Treatment20171021\_120009\CleanResults\Echointegration\';

% adresse du répertoire où sauver les résultats

adress\_save='C:\Users\perroty\Documents\DEVELOPPEMENTS\TOOLS\_IRD\Profil\_station\_ECOAOetAWA\ComparEchoProfil\_Matecho\';

% indice de la frequence qui sont rangées dans l'ordre croissant de fréquence (le 38kHz est kfreq=1 pour ECOAO et kfreq=2 pour Awa)

kfreq=1;

%\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

load([adress\_acou,'Echointegration.mat'],'Time','Sv\_surface','Sa\_surface','depth\_surface','depth\_bottom','TransducerDepth','Night1Sunrise2Day3Sunset4','FrequencySort','BottomShift');

load([adress\_acou,'Layer.mat'],'CleanLayMask','LayDescription38','LayDescriptionHeader');

LayDescription=LayDescription38;

nbcouche=size(LayDescription,1); % LayDescription38 --> nb couche \* nbre descripteur

nbesu=size(Time,2);

IdCouche=LayDescription(:,1);

IdStartCouche=LayDescription(:,5); IdEndCouche=LayDescription(:,6);

TimeStartCouche=LayDescription(:,9); TimeEndCouche=LayDescription(:,10);

DepStartCouche=LayDescription(:,11); DepEndCouche=LayDescription(:,12);

Zone=LayDescription(:,2);

EpCouche=DepEndCouche-DepStartCouche;

d=depth\_surface;

nbzone=max(Zone);

EpAllZone=zeros(1,nbesu); SvAllZone=NaN(1,nbesu); SaAllZone=NaN(1,nbesu); IndiceCoucheAllZone=NaN(1,nbesu);

DepthDebutAllZone=NaN(1,nbesu); DepthFinAllZone=NaN(1,nbesu); IdDepthDebutAllZone=NaN(1,nbesu); IdDepthFinAllZone=NaN(1,nbesu);

for izone=1:nbzone

tmp0=find(Zone==izone);

if(~isempty(tmp0))

tmp0=tmp0(1); ZoneId=[IdStartCouche(tmp0):IdEndCouche(tmp0)];

layer=CleanLayMask(:,ZoneId,kfreq); Sv0=Sv\_surface(:,ZoneId,kfreq); Sa0=Sa\_surface(:,ZoneId,kfreq); Id0=NaN(1,length(ZoneId));

Ep=zeros(1,length(ZoneId)); Sv=NaN(1,length(ZoneId)); Sa=NaN(1,length(ZoneId));

DepthDebut=NaN(1,length(ZoneId)); DepthFin=NaN(1,length(ZoneId)); IdDepthDebut=NaN(1,length(ZoneId)); IdDepthFin=NaN(1,length(ZoneId));

for k=1:length(ZoneId)

tmp=find(layer(:,k)~=0);

if(~isempty(tmp))

IdDebut=min(tmp); IdFin=max(tmp); Id0(k)=layer(IdDebut,k);

if(layer(IdDebut,k)==layer(IdFin,k))

Sv(1,k)=10.\*log10(nanmean(10.^(Sv0(IdDebut:IdFin,k)./10)));

Sa(1,k)=nanmean(Sa0(IdDebut:IdFin,k));

Ep(1,k)=d(IdFin)-d(IdDebut);

DepthDebut(1,k)=d(IdDebut); DepthFin(1,k)=d(IdFin); IdDepthDebut(1,k)=IdDebut; IdDepthFin(1,k)=IdFin;

if(Sv(1,k)==0)

Sv(1,k)=NaN; Sa(1,k)=NaN;

end

else

tmp2=find(layer(:,k)~=layer(IdDebut,k)); layer2=layer(:,k); layer2(tmp2)=0; clear tmp2;

clear tmp; tmp=find(layer2~=0);

if(~isempty(tmp))

Sv(1,k)=10.\*log10(nanmean(10.^(Sv0(IdDebut:IdFin,k)./10)));

Sa(1,k)=nanmean(Sa0(IdDebut:IdFin,k));

Ep(1,k)=d(max(tmp))-d(min(tmp));

DepthDebut(1,k)=d(IdDebut); DepthFin(1,k)=d(IdFin); IdDepthDebut(1,k)=IdDebut; IdDepthFin(1,k)=IdFin;

if(Sv(1,k)==0)

Sv(1,k)=NaN; Sa(1,k)=NaN;

end

end

clear layer2;

end

end

clear tmp;

end

IndiceCoucheAllZone(1,ZoneId(1):ZoneId(end))=Id0;

EpAllZone(1,ZoneId(1):ZoneId(end))=Ep;

SvAllZone(1,ZoneId(1):ZoneId(end))=Sv;

SaAllZone(1,ZoneId(1):ZoneId(end))=Sa;

DepthDebutAllZone(1,ZoneId(1):ZoneId(end))=DepthDebut;

DepthFinAllZone(1,ZoneId(1):ZoneId(end))=DepthFin;

IdDepthDebutAllZone(1,ZoneId(1):ZoneId(end))=IdDepthDebut;

IdDepthFinAllZone(1,ZoneId(1):ZoneId(end))=IdDepthFin;

clear ZoneId layer Ep Sv Sa Id0 DepthDebut DepthFin IdDepthDebut IdDepthFin;

end

clear tmp0;

end

save([adress\_save,'EpSvSa.mat'],'IndiceCoucheAllZone','EpAllZone','SvAllZone','SaAllZone','DepthDebutAllZone','DepthFinAllZone','IdDepthDebutAllZone','IdDepthFinAllZone')

Text S 2:Pseudo-code of ComparEchoProfil Matlab allowing to fit echointegrated echograms to the associated CTD vertical profiles.

clear all; close all; fclose all; warning('off');

%==========================================================================

% ECOAO : type de profils

% # name 1 = prDM: Pressure, Digiquartz [db]

% # name 2 = t090C: Temperature [ITS-90, deg C]

% # name 3 = t190C: Temperature, 2 [ITS-90, deg C]

% # name 4 = c0S/m: Conductivity [S/m]

% # name 5 = c1S/m: Conductivity, 2 [S/m]

% # name 6 = sbeox0V: Oxygen raw, SBE 43 [V]

% # name 7 = sbeox1V: Oxygen raw, SBE 43, 2 [V]

% # name 8 = par: PAR/Irradiance, Biospherical/Licor

% # name 9 = spar: SPAR/Surface Irradiance

% # name 10 = flC: Fluorescence, Chelsea Aqua 3 Chl Con [ug/l]

% # name 11 = 100-CStarTr0: Beam Transmission, WET Labs C-Star [%]

% # name 12 = altM: Altimeter [m]

% # name 13 = sbeox0ML/L: Oxygen, SBE 43 [ml/l], WS = 2

% # name 14 = sbeox0Mm/Kg: Oxygen, SBE 43 [umol/Kg], WS = 2

% # name 15 = sbeox1ML/L: Oxygen, SBE 43, 2 [ml/l], WS = 2

% # name 16 = sbeox1Mm/Kg: Oxygen, SBE 43, 2 [umol/Kg], WS = 2

% # name 17 = nbin: number of scans per bin

% # name 18 = sal00: Salinity, Practical [PSU]

% # name 19 = sal11: Salinity, Practical, 2 [PSU]

% # name 20 = sigma-é00: Density [sigma-theta, Kg/m^3]

% # name 21 = svCM: Sound Velocity [Chen-Millero, m/s]

%==========================================================================

% AWA2014 : DESCRPITION OF THE PARAMETERS IN MATRIX "PROF", SAVED IN EACH MATRIX profil\_d\_\*\*.mat FOR DOWN PROFILS and profil\_u\_\*\*.mat FOR UP PROFILS

% # name 1 = timeJ: Julian Days

% # name 2 = prDM: Pressure, Digiquartz [db]

% # name 3 = t090C: Temperature [ITS-90, deg C]

% # name 4 = t190C: Temperature, 2 [ITS-90, deg C]

% # name 5 = c0S/m: Conductivity [S/m]

% # name 6 = c1S/m: Conductivity, 2 [S/m]

% # name 7 = sbeox0V: Oxygen raw, SBE 43 [V]

% # name 8 = sbeox1V: Oxygen raw, SBE 43, 2 [V]

% # name 9 = flC: Fluorescence, Chelsea Aqua 3 Chl Con [ug/l]

% # name 10 = CStarTr0: Beam Transmission, WET Labs C-Star [%]

% # name 11 = nbf: Bottles Fired

% # name 12 = sbeox0Mm/Kg: Oxygen, SBE 43 [umol/kg]

% # name 13 = sbeox1Mm/Kg: Oxygen, SBE 43, 2 [umol/kg]

% # name 14 = sal00: Salinity, Practical [PSU]

% # name 15 = sal11: Salinity, Practical, 2 [PSU]

% # name 16 = sigma-é00: Density [sigma-theta, kg/m^3]

% # name 17 = sigma-é11: Density, 2 [sigma-theta, kg/m^3]

% # name 18 = density00: Density [density, kg/m^3]

% # name 19 = density11: Density, 2 [density, kg/m^3]

% # name 20 = svCM: Sound Velocity [Chen-Millero, m/s]

% # name 21 = svCM1: Sound Velocity, 2 [Chen-Millero, m/s]

% # name 22 = nbin: Scans Per Bin

%==========================================================================

prompt = {'CAMPAGNE (taper ECOAO ou AWA)','CHOIX DE LA FREQUENCE A ANALYSER (ECOAO--> 38, 70, 120 ou 200 kHz - AWA--> 18, 38, 70, 120, 200 ou 333 kHz)'};

dlg\_title = 'Comparaison profils CTD et Echogrammes'; num\_lines = 1; def={'ECOAO','38'}; answer = inputdlg(prompt,dlg\_title,num\_lines,def,'on');

if(strcmp(char(answer(1)),'ECOAO'))

camp=1;

else

camp=2;

end

FREQUENCES=str2num(char(answer(2)));

%==========================================================================

% PARAMETRES AVANCEES

% adresse du répertoire où se trouve les données acoustiques de la campagne ECOAO et AWA (contenant tous les fichiers du type AWA2014\_\_Y2014M02-the16at154403-the01at075520.mat)

%adress\_acou\_ECOAO='C:\Users\USER\Desktop\HacTest\N058-S014-S1999404\Cruise\_1999404\Treatment20170818\_124508\CleanResults\Echointegration\';

adress\_acou\_ECOAO='E:\ECOAO2013\Cruise\_ECOAO2013\Treatment20171021\_120009\CleanResults\Echointegration\';

adress\_acou\_AWA='E:\AWA2014\Cruise\_AWA2014\Treatment20170615\_133808\CleanResults\Echointegration\';

% adresse du répertoire où se trouve les fichiers des profils (qui doit être different de adress\_acou)

adress\_profil='E:\CEprofil\Station\_ECOAO-AWA\';

% adresse du fichier où sont enregistrées les épaisseurs (sortie du programme "couche.m")

adress\_EpSvSa='C:\Users\perroty\Documents\DEVELOPPEMENTS\TOOLS\_IRD\Profil\_station\_ECOAOetAWA\ComparEchoProfil\_Matecho\EpSvSa.mat';

NbESUVisu=10; % nombre d'esu à visualiser autour de la station (moyenne echogramme fait sur ce nombre d'ESU)

if(camp==1)

TrialName='ECOAO';

ProfilType=[2,10,14,20];

FileNameProfil='CTD\_stations\_ECOAO';

adress\_acou=adress\_acou\_ECOAO;

else

TrialName='AWA';

ProfilType=[3,9,12,16];

FileNameProfil='CTD\_stations\_AWA';

adress\_acou=adress\_acou\_AWA;

end

TypeEi='v'; % ='v' pour analyser l'échogramme des Sv, ='a' pour les echogrammes Sa

ProfName={'Temperature','Fluorescence','Oxygen','Density'};

ProfUnit= {'°C','µg/l','µmol/kg','kg/m^3'};

ProfilUpDown='d'; % ='d' pour analyser le profil descendant ou ='u' pour le profil montant

% Sauvegarde des figures

SaveFIG=1; % =1 pour sauver les figures au format matlab (il suffit de cliquer dessus ensuite pour les ouvrir, faire des zooms, etc..)

SaveFIGppt=1; % =1 pour sauver toutes les figures produites dans un powerpoint (très utile)

LabelFigHH=1; % =1 pour afficher les numéros d'ESU en heure minute (HH:MN), =0 sinon

%\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

% Debut du programme

%\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

temp=pwd;

if(~exist([temp,'\RESULTATS\'],'dir'))

mkdir(temp,'RESULTATS');

end

pathSaveFig=[temp,'\','RESULTATS\']; clear temp;

% chargement profils

load('EK500\_colourmap.dat'); ek5=EK500\_colourmap; clear EK500\_colourmap;

load([adress\_profil,FileNameProfil,'.mat']); month=char(monthtr);

% chargement des sorties de couche.m (début et fin de couche)

load(adress\_EpSvSa);

%for k=12:12

for k=1:length(hourtr)

if(month(k,1)=='F')

m=2;

else

m=3;

end

hh=str2num(hourtr(k,1:2)); mn=str2num(hourtr(k,4:5)); ss=str2num(hourtr(k,7:8));

timep(k)=datenum([str2num(char(yeartr(k))),m,daytr(k),hh,mn,ss]); clear hh mn ss;

timep70(k)=(timep(k)-datenum('1970-01-01 00:00'))\*60\*60\*24;

timpstr(k,:)=datestr(datenum([1970 1 1 00 00 timep70(k)]),'yyyy-mm-dd HH:MM:SS');

if(camp==1)

temp=char(lattr(k)); ii=strfind(temp,'°'); dd=str2num(temp(1:ii-1)); mn=str2num(temp(ii+1:end-1)); lat(k)=dd + mn/60;

if(temp(end)=='S')

lat(k)=-lat(k);

end

clear temp ii dd mn;

temp=char(lontr(k)); ii=strfind(temp,'°'); dd=str2num(temp(1:ii-1)); mn=str2num(temp(ii+1:end-1)); lon(k)=dd + mn/60;

if(temp(end)=='W')

lon(k)=-lon(k);

end

clear temp ii dd mn;

else

lat=lattr; lon=lontr;

end

end

DateStation=timpstr;

filemat='Echointegration.mat';

str\_fr0='000'; str\_fr0(end-length(num2str(FREQUENCES))+1:end)=num2str(FREQUENCES);

repsave=[str\_fr0,'kHz\_',TrialName,'\_',datestr(clock,'dd-mm-yyyy\_HH-MM-SS')]; mkdir([pathSaveFig,repsave]);

save([pathSaveFig,repsave,'\ParametresDeTraitement.mat'],'DateStation','TrialName','adress\_acou','adress\_profil','TypeEi','FREQUENCES','FileNameProfil','ProfilType','ProfilUpDown','ProfName');

Kstation=0; Station=[]; kfile=1; load([adress\_acou,filemat(kfile,:)],'Time'); nbesutot=size(Time,2); crit=0;

NbEsuBloc=1000; IdP=[1:NbEsuBloc];

while(crit==0)

if(IdP(end)>=nbesutot)

IdP=[IdP(1):nbesutot];

crit=1;

end

load([adress\_acou,filemat(kfile,:)],'Sv\_surface','Sa\_surface','Time','depth\_surface','depth\_bottom','TransducerDepth','Night1Sunrise2Day3Sunset4','FrequencySort','BottomShift');

load([adress\_acou,'Layer.mat'],'CleanLayMask');

fprintf('OK\n');

Sv\_surface=Sv\_surface(:,IdP,:); Sa\_surface=Sa\_surface(:,IdP,:); Time=Time(1,IdP); depth\_bottom=depth\_bottom(1,IdP);

day\_night\_twilight=Night1Sunrise2Day3Sunset4(1,IdP);

% mettre la ligne ci-dessous en commentaire (%) pour mettre tout l'échograme

CleanLayMask=CleanLayMask(:,IdP,:); tmp=find(CleanLayMask~=0); CleanLayMask(tmp)=1; clear tmp; tmp=find(CleanLayMask==0); CleanLayMask(tmp)=NaN; clear tmp; Sv\_surface=Sv\_surface.\*CleanLayMask; Sa\_surface=Sa\_surface.\*CleanLayMask;

transFreq=FrequencySort;

ind=find(timep70>=Time(1) & timep70<=Time(end));

if(~isempty(ind))

for kp=1:length(ind)

Kstation=Kstation+1; % compteur de stations

tmp=find(Time>=timep70(ind(kp))); IndStation=tmp(1);

if(day\_night\_twilight(IndStation)==1)

JourNuitStation(Kstation,:)='Nuit ';

elseif(day\_night\_twilight(IndStation)==2)

JourNuitStation(Kstation,:)='Levé ';

elseif(day\_night\_twilight(IndStation)==3)

JourNuitStation(Kstation,:)='Jour ';

elseif(day\_night\_twilight(IndStation)==4)

JourNuitStation(Kstation,:)='Couché';

end

tempek=[IndStation-NbESUVisu:1:IndStation+NbESUVisu]; clear tmp;

if(tempek(1)<1)

tempek=1:1:2\*NbESUVisu;

end

if(tempek(end)>length(Time))

tempek=length(Time)-2\*NbESUVisu:1:length(Time);

end

dtim=Time(tempek);

for k=1:length(Time)

timtot(k,:)=datestr(datenum([1970 1 1 00 00 Time(k)]),'yyyy-mm-dd HH:MM:SS');

end

tim=timtot(tempek,:); DateESU=timtot;

pingdeb=find(dtim>=timep70(ind(kp)));

if(isempty(pingdeb))

pingdeb=find(abs(dtim-timep70(ind(kp)))==min(abs(dtim-timep70(ind(kp)))));

end

pingdeb=pingdeb(1);

pingdebtot=find(Time>=timep70(ind(kp))); pingdebtot=pingdebtot(1);

if(ProfilUpDown(1)=='d')

Name=['profil\_d\_',num2str(ind(kp))]; proftot=eval(Name); clear Name; Name=['profildepth\_d\_',num2str(ind(kp))]; D=eval(Name); clear Name;

else

Name=['profil\_u\_',num2str(ind(kp))]; proftot=eval(Name); clear Name; Name=['profildepth\_u\_',num2str(ind(kp))]; D=eval(Name); clear Name;

end

prof=proftot(:,ProfilType);

for Kfreq=1:length(FREQUENCES)

kfreq=find(transFreq==FREQUENCES(Kfreq)\*1000);

Sv=Sv\_surface(:,tempek,kfreq); Svtot=Sv\_surface(:,:,kfreq); Sa=Sa\_surface(:,tempek,kfreq);

% suppression des NaNs

Ks=1;

for ks=1:size(Svtot,2)

tmp=find(~isnan(Svtot(:,ks)));

if(~isempty(tmp))

maxind(Ks)=tmp(end)+1; Ks=Ks+1;

end

clear tmp;

end

clear Ks; maxind=max(maxind); if(maxind>size(Svtot,1)); maxind=size(Svtot,1); end; Svtot=Svtot(1:maxind,:);

depth=depth\_surface(1,1:maxind);

bottomtot=depth\_bottom(1,:,kfreq);

tmp=find(bottomtot>max(depth)); if(~isempty(tmp)); bottomtot(tmp)=max(depth).\*ones(length(tmp),1); end; clear tmp;

bottom=bottomtot(tempek);

% calcul profil acoustic moyen

Saprof=nanmean(Sa.'); Svprof=10.\*log10(nanmean(10.^(Sv.'/10)));

%==========================================================

% FIGURE

SupTitle='';%['PRESSE "ESC" pour faire des zooms - PRESSE "Y" pour revenir à toute l"image - ECHELLE DE COULEUR: PRESSE "A" ou "Q" pour augmenter ou diminuer la valeur minimale des couleurs (PRESSE "Z" ou "S" pour augmenter ou diminuer sa valeur maximale)' ];

limax=[1 size(Svtot,2) min(depth) max(bottomtot)]; col=[-100 -40]; zoomcurrent=limax; ClimCurrent=col; DClim=10;

tit={''};

titcurrent=tit; Val=0; kcount=1; X=[]; Y=[]; aff=0;

% while(Val==0)% | Val==3)

close all; figure('units','normalized','outerposition',[0 0 1 1],'Name',SupTitle,'NumberTitle','off');

Y(1)=DepthDebutAllZone(IdP(1)+IndStation-1);

Y(2)=DepthFinAllZone(IdP(1)+IndStation-1);

X(1)=IndStation;

X(2)=IndStation;

Val=1;

FigManage;

% end %while(Val==0 | Val==3)

if(~isnan(Y(1)))

tmp=find(D>=Y(1) & D<=Y(2));

if(isempty(tmp))

Temp=NaN; Fluo=NaN; Oxy=NaN; Dens=NaN; Pc=0;

else

Temp=nanmean(prof(tmp,1)); Fluo=nanmean(prof(tmp,2)); Oxy=nanmean(prof(tmp,3)); Dens=nanmean(prof(tmp,4)); Pc=length(tmp)/length(D)\*100;

end

clear tmp;

tmp=find(depth>=Y(1) & depth<=Y(2)); Samoy=nanmean(Saprof(tmp)); tmp2=nanmean(10.^(Svprof(tmp)/10));

if(~isnan(tmp2) & tmp2>0)

Smoy=10.\*log10(tmp2);

else

Smoy=NaN;

end

clear tmp tmp2;

Station(Kstation,:)=[X(1),X(2),D(1),D(end),depth(1),bottomtot(IndStation),Time(X(1)),Y(1),bottomtot(X(1)),Time(X(2)),Y(2),bottomtot(X(2)),abs(Y(2)-Y(1)),Temp,Fluo,Oxy,Dens,Smoy,Samoy,Pc];

else % si pas de couche

Temp=nanmean(prof(:,1)); Fluo=nanmean(prof(:,2)); Oxy=nanmean(prof(:,3)); Dens=nanmean(prof(:,4)); Smoy=10.\*log10(nanmean(10.^(Svprof/10))); Samoy=nanmean(Saprof);

Station(Kstation,:)=[NaN,NaN,D(1),D(end),depth(1),bottomtot(IndStation),NaN,NaN,NaN,NaN,NaN,NaN,NaN,Temp,Fluo,Oxy,Dens,Smoy,Samoy,NaN];

end

SvMoyStation(Kstation).Sv=Svprof; SvMoyStation(Kstation).Sa=Saprof;

%==========================================================

% SAUVEGARDES

ClimCurrent=col; zoomcurrent=limax; aff=1; FigManage; aff=0;

if(SaveFIG==1)

str\_st='000'; str\_st(end-length(num2str(ind(kp)))+1:end)=num2str(ind(kp)); str\_fr='000'; str\_fr(end-length(num2str(transFreq(kfreq)/1000))+1:end)=num2str(transFreq(kfreq)/1000);

saveas(gcf,[pathSaveFig,repsave,'\',TrialName,'\_Station',str\_st,'-',str\_fr,'kHz'],'fig');

end

if(SaveFIGppt==1)

saveppt([pathSaveFig,repsave,'\',TrialName,'\_AllStations.ppt']);

end

close all; pause(0.01); clear Sv depth bottom Svtot depth bottomtot;

end %for kfreq=1:length(transFreq)

clear Temperature Fluorescence Oxygene Density Smoy X Y Pc; clear tempek dtim tim proftot prof D Svprof Saprof pingdeb pingdebtot IndStation;

end %for kp=1:length(ind)

end % if(~isempty(ind))

clear ind;

IdP=IdP+NbEsuBloc;

end % for kfile=1:size(filemat,1)

if(~isempty(Station))

LatitudeStation=lat; LongitudeStation=lon;

save([pathSaveFig,repsave,'\Stations\_',TrialName,'\_',str\_fr0,'kHz.mat'],'JourNuitStation','DateESU','LatitudeStation','LongitudeStation','Station','SvMoyStation');

% ecriture du fichier excel de résultats

fid=fopen([pathSaveFig,repsave,'\Stations\_',TrialName,'\_',str\_fr0,'kHz.xls'],'wt');

fprintf(fid,'N°station \t Date station \t Latitude station (deg) \t Longitude station (deg) \t Ephéméride à la station \t Profondeur minimale station (m) \t Profondeur maximale station (m) \t Profondeur minimale echogramme sur station (m) \t Profondeur maximale echogramme sur station (m) \t Date point1 (seconde depuis 1970) \t Profondeur point1 (m) \t Fond au point1 (m) \t Date point2 (seconde depuis 1970) \t Profondeur point2 (m) \t Fond au point2 (m) \t Epaisseur couche (m) \t Temperature moyenne dans la couche (°C) \t Fluorescence moyenne dans la couche (µg/l) \t Oxygène moyen dans la couche (µmol/kg) \t Densité moyenne dans la couche (kg/m3) \t Sv moyen dans la couche (dB) \t Sa moyen dans la couche (NASC) \t Pourcentage de recouvrement des profils de station par la couche\n');

for k=1:size(Station,1)

fprintf(fid,'%i \t %s \t %4.4f \t %4.4f \t %s \t %4.2f \t %4.2f \t %4.2f \t %4.2f \t %4.4f \t %4.2f \t %4.2f \t %4.4f \t %4.2f \t %4.2f \t %4.2f \t %4.2f \t %4.2f \t %4.2f \t %4.2f \t %4.2f \t %4.2f \t %4.2f \n',k,char(timpstr(k,:)),lat(k),lon(k),char(JourNuitStation(k,:)),Station(k,3:end));

end

fclose all;

fprintf('\n'); fprintf('Les resultats sont sauvegardés dans le répertoire:\n'); fprintf('%s\n',[pathSaveFig,repsave]);

cd([pathSaveFig,repsave]);

else

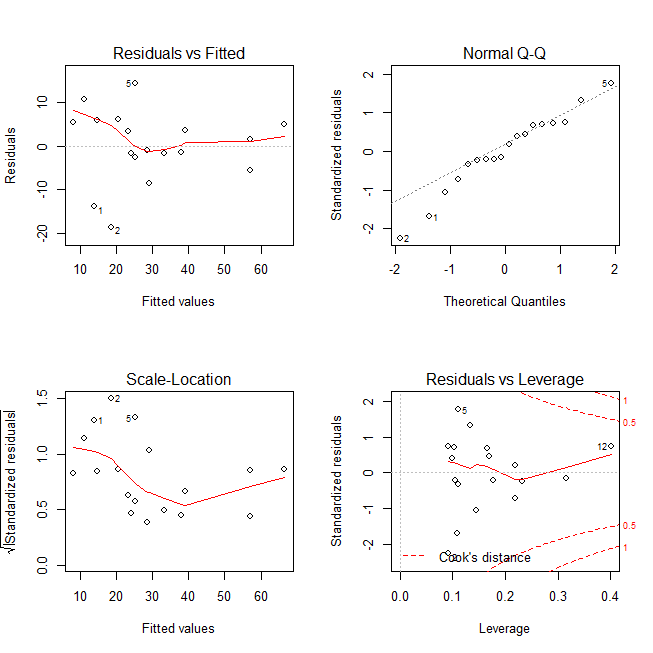
fprintf('Aucune station n"a été traitée !!!\n');

end

warning('on')

Fig S 3:Diagnostic diagrams of ANCOVA (Analysis of Covariance) models between sound scattering layers (SSLs) depth and environmental parameters (water temperature, density, dissolved oxygen, chlorophyll-a, diel period, and bottom depth).

* 1. Inshore area (G1)



* 1. Offshore area (G2)

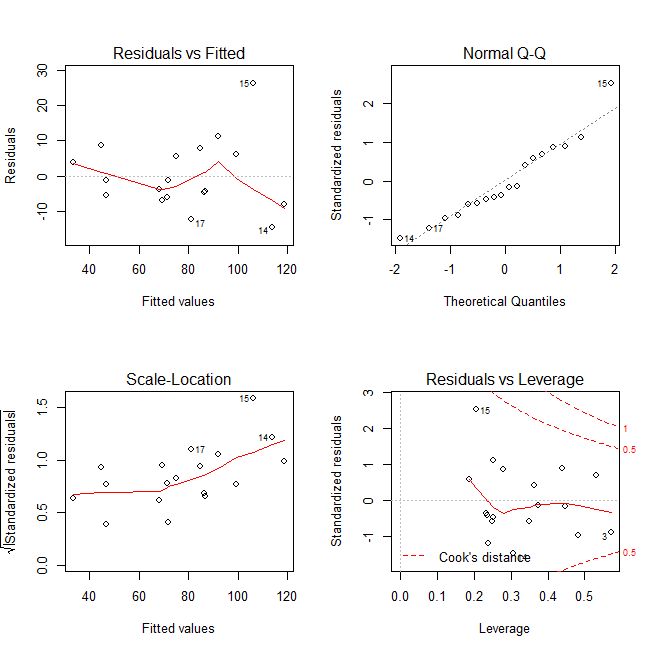
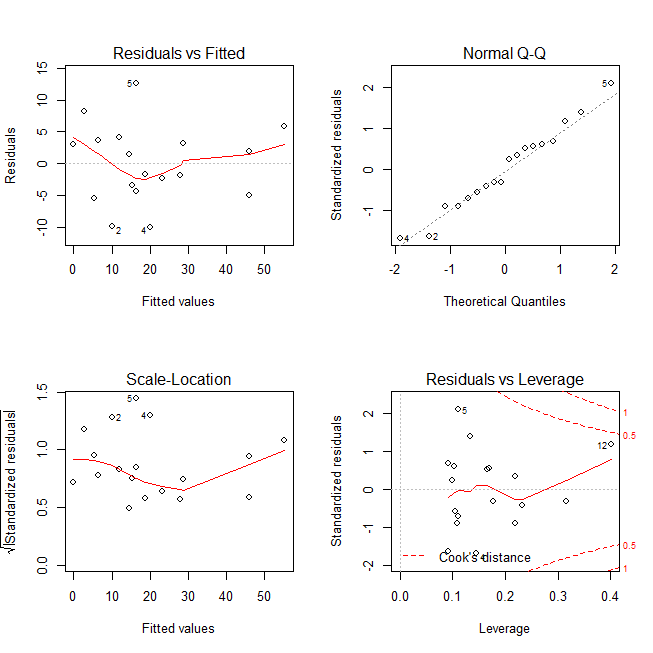


Fig S 4:Diagnostic diagrams of ANCOVA (Analysis of Covariance) models between sound scattering layers (SSLs) thickness and environmental parameters (water temperature, density, dissolved oxygen, chlorophyll-a, and bottom depth.

* 1. Inshore area (G1)



* 1. Offshore area (G2)

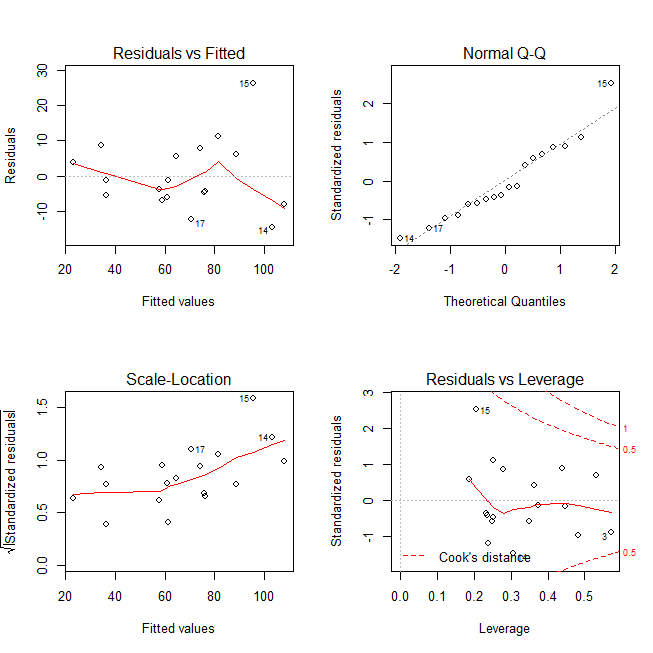


Fig S 5:Diagnostic diagrams of ANCOVA (Analysis of Covariance) models between sound scattering layers (SSLs) density and environmental parameters (water temperature, density, dissolved oxygen, chlorophyll-a, and bottom depth).

* 1. . Inshore area (G1)



* 1. Offshore area (G2)



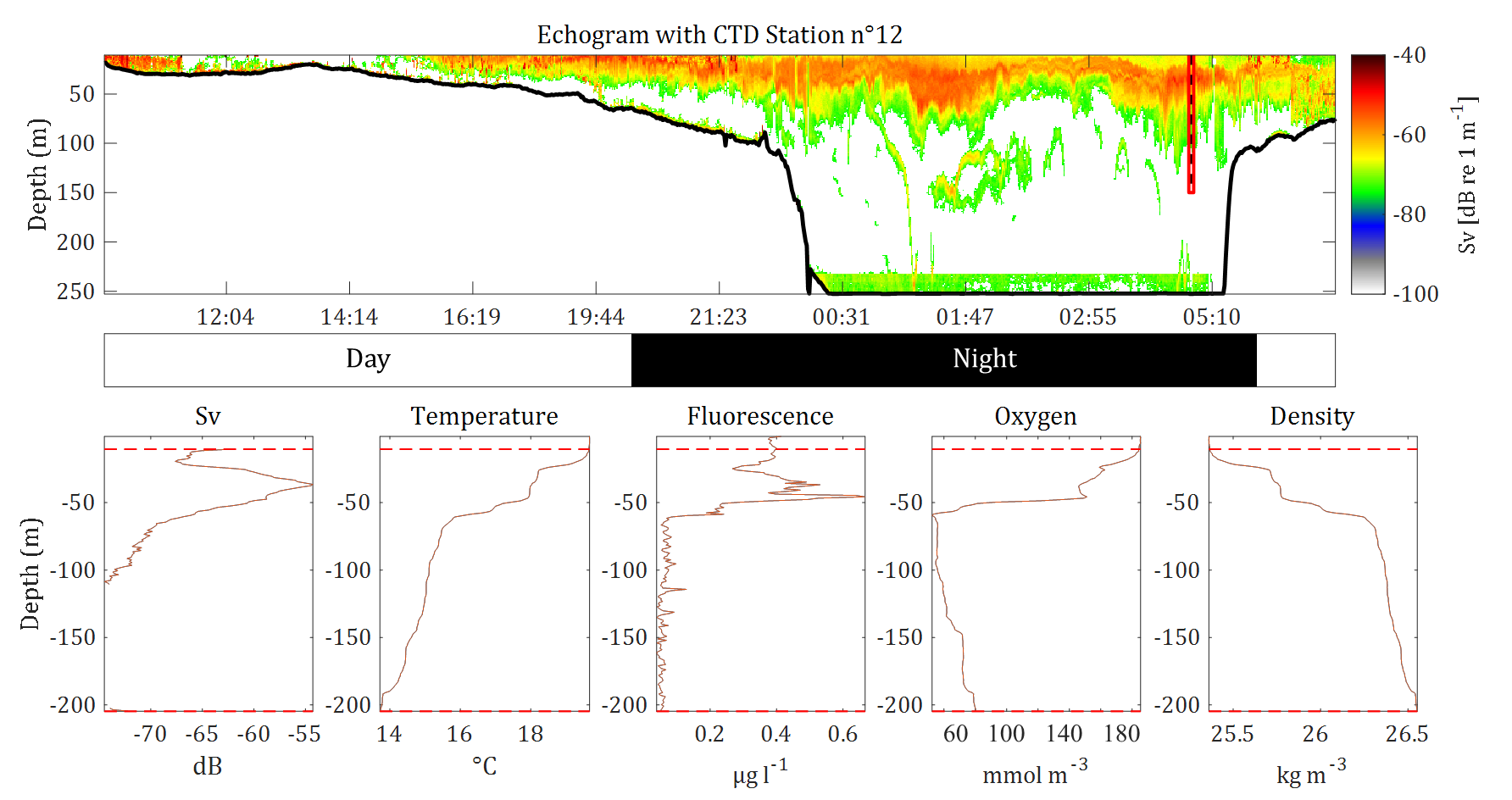
Fig S 6: Positions of vertical CTD stations sampled with a CTD instrument. Diagrams depict temperature, density, fluorescence, and dissolved oxygen relative to daily maps of Sea Surface Temperature (SST) off the Petite Côte (Senegal, West Africa) during the 2014 hydroacoustic survey. (a) Stations along Transect 1 (6 March), (b) stations along Transect 2 (7 March), and (c) stations along Transect 3 (8 March). The blue points are locations for stations of Group 1 (inshore area); red points are locations for stations of Group 2 (offshore area), discriminated according to CTD values measured at 0–10 m depth.

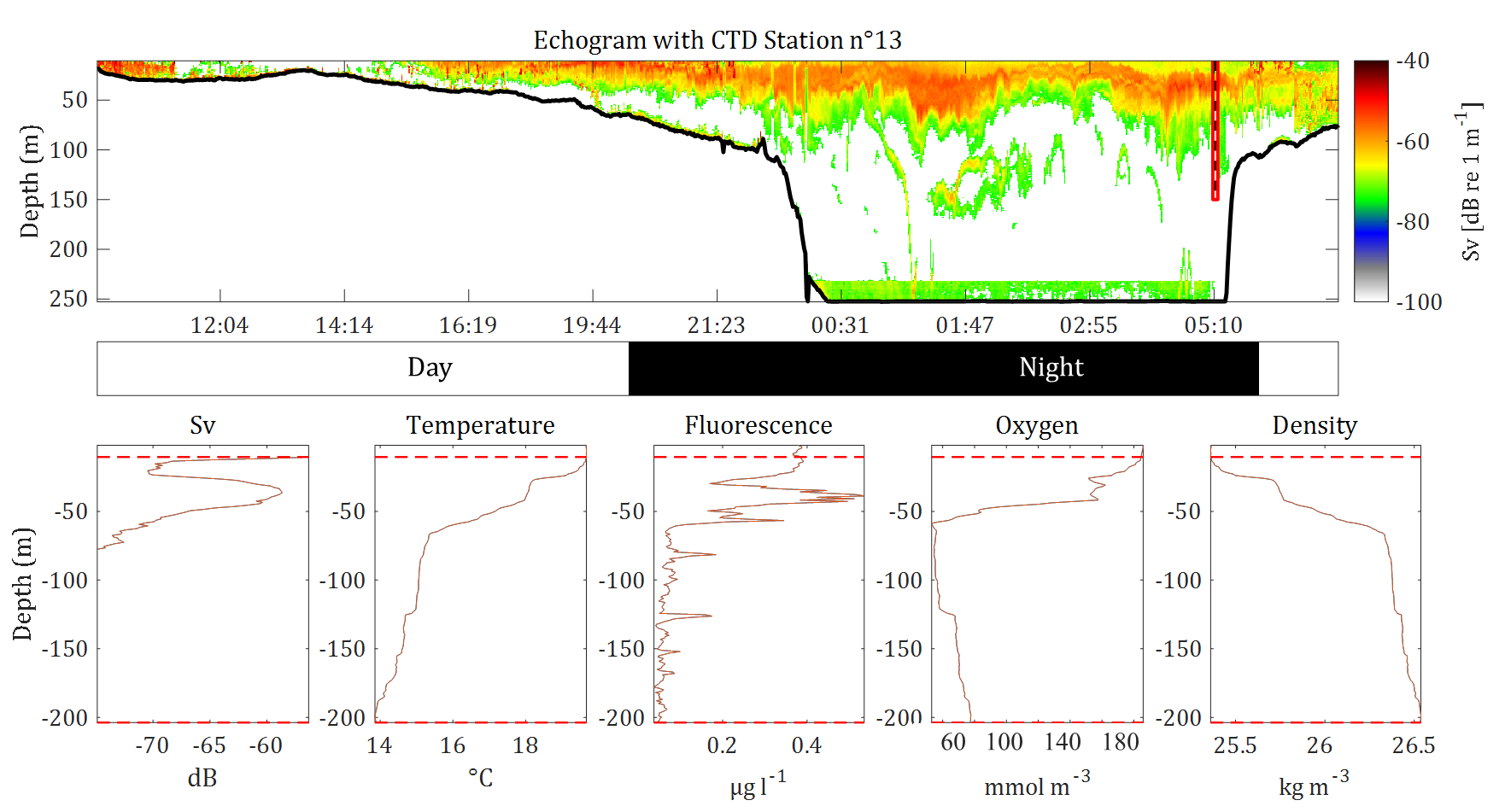
C:\Users\USER\AppData\Local\Temp\Fig_4_parula_new.tiff

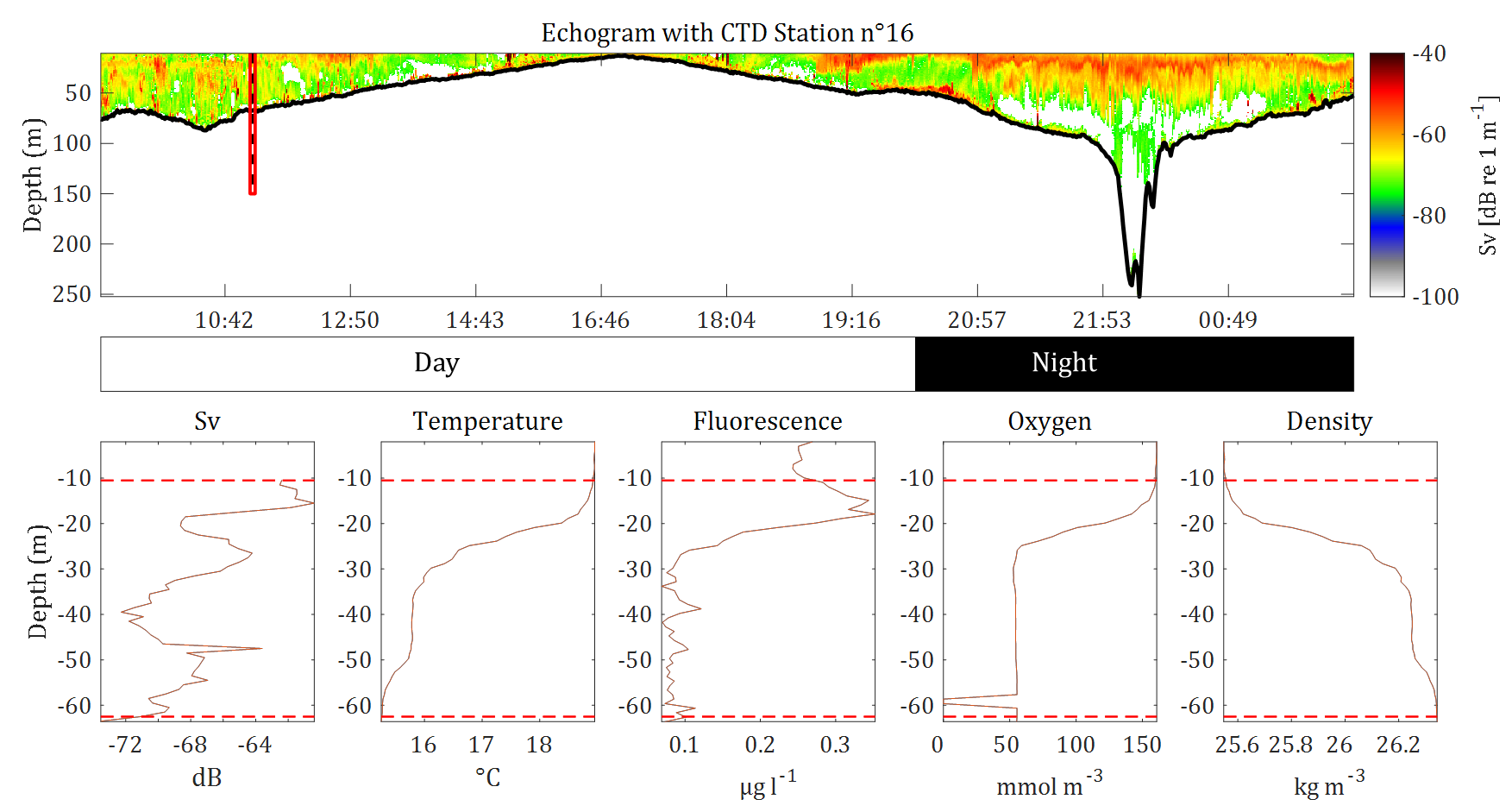




Fig S 7:Mean Sv distribution of SSLs during daytimes (A) and night-times (B) in the study area.





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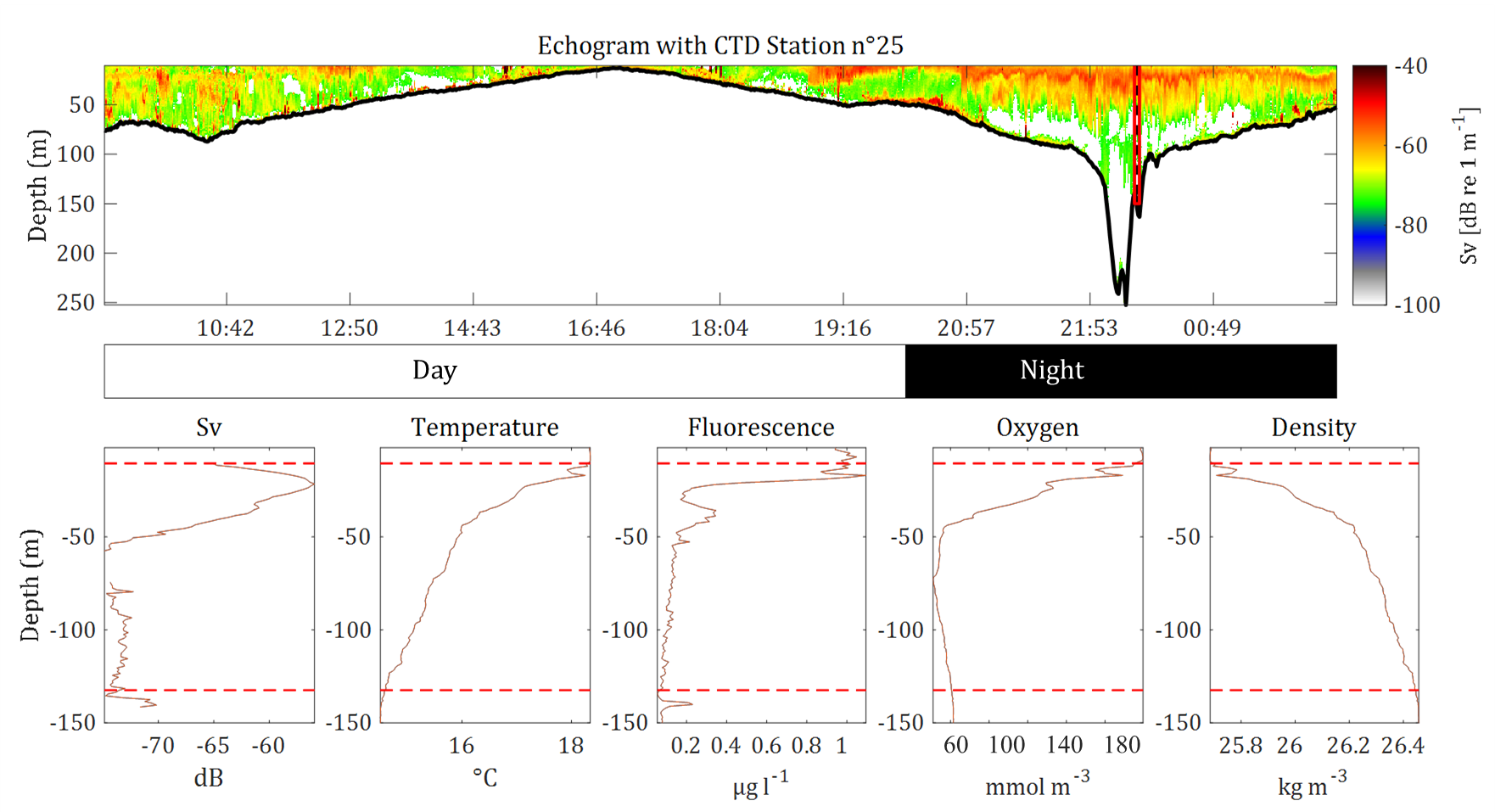
****

Fig S 8: Vertical profile from CTD stations associated to acoustic volume backscattering strength (Sv, in dB) integrated per elementary sampling unit (ESU) of 0.1 nmi for 4 stations: station 12, 13, 16, and 25. The peak of Sv is close to the fluorescence peak (proxy chlorophyll-*a* concentration, in μg l-1) and are related to strong gradient of water temperature, itself related to water density and dissolved oxygen. From the top left to bottom right (i) vertical profile Sv (dB) in the sound scattering layers (SSLs) ; (ii) Profile of mean temperature in SSLs (°C) ; (iii) profile of fluorescence in SSLs; (iv) profile of dissolved oxygen in SSLs (ml l-1); (v) and profile of water density in SSLs (kg m-3).

Table S 1:Result of ANCOVA models between thickness of sound scattering layers (SSLs) and environmental parameters (temperature, density, dissolved oxygen, chlorophyll-a, diel period and bottom depth) in the inshore area (G1) and the offshore area (G2). [G1: Multiple R-squared: 0.869, Adjusted R-squared: 0.8515, p-value: 0.000]; and [G2: Multiple R-squared: 0.8557, Adjusted R-squared: 0.7956, *p*-value: 0.000]. Significant *p*-value in bold.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Coefficient Estimate | | Std. Error | | t value | | *p*-value | |
| Group | Inshore | Offshore | Inshore | Offshore | Inshore | Offshore | Inshore | Offshore |
| Intercept | -11.865 | 56030 | 4.161 | 17610 | -2.85 | 3.18 | **0.012** | **0.007** |
| Bottom depth | 0.916 | 0.21 | 0.148 | 0.06 | 6.15 | 3.41 | **0.000** | **0.005** |
| Diel period (Night) | 11.492 | 27.35 | 3.735 | 8.69 | 3.07 | 3.14 | **0.007** | **0.008** |
| Temperature | - | -383.80 | - | 119.60 | - | -3.21 | - | **0.007** |
| Density | - | -1898 | - | 598.50 | - | -3.17 | - | **0.008** |
| Oxygen | - | -1.76 | - | 0.55 | - | -3.19 | - | **0.007** |

Table S 2:Result of ANCOVA models between depth of scattering layers (SLs) and environmental parameters in the inshore area (G1) and the offshore area (G2). [G1: Multiple R-squared: 0.8056, Adjusted R-squared: 0.7797, *p*-value: 0.000]; and [G2: Multiple R-squared: 0.8557, Adjusted R-squared: 0.7956, *p*-value: 0,000]. Significant *p*-value in bold.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Coefficient Estimate | | Std. Error | | t value | | *p*-value | |
| Group | Inshore | Offshore | Inshore | Offshore | Inshore | Offshore | Inshore | Offshore |
| Intercept | -4.223 | 56040 | 5.603 | 17610 | -0.75 | 3.18 | 0.4627 | **0.007** |
| Bottom depth | 0.954 | 0.21 | 0.200 | 0.060 | 4.76 | 3.41 | **0.000** | **0.005** |
| Diel period (Night) | 12.864 | 27.35 | 5.030 | 8.690 | 2.55 | -3.14 | **0.021** | **0.008** |
| Temperature | - | -383.80 | - | 119.60 | - | -3.21 | - | **0.007** |
| Density | - | -1898 | - | 598.50 | - | -3.17 | - | **0.008** |
| Oxygen | - | -1.76 | - | 0.550 | - | -3.19 | - | **0.007** |

Table S 3:Result of ANCOVA models between sound scattering layers (SSLs) density (log sA) and environmental parameters in the inshore area (G1) and the offshore area (G2). [G1: Multiple R-squared: 0.398, Adjusted R-squared: 0.3178, *p*-value: 0.022]; and and [G2: Multiple R-squared: 0.3448, Adjusted R-squared: -0.01258, *p*-value: 0.490]. Significant *p*-value in bold.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Coefficient Estimate | | Std. Error | | t value | | *p*-value | |
| Group | Inshore | Offshore | Inshore | Offshore | Inshore | Offshore | Inshore | Offshore |
| Intercept | -9.007 | -489.2 | 5.784 | 405.7 | -1.55 | -1.20 | 0.140 | 0.253 |
| Bottom depth | 0.028 | -0.001 | 0.009 | 0.011 | 3.04 | -0.96 | **0.008** | 0.357 |
| Temperature | 0.578 | 3.207 | 0.350 | 2.78 | 1.65 | 1.15 | 0.119 | 0.273 |
| Diel period (Night) | - | -0.126 | - | 0.202 | - | -0.62 | - | 0.546 |
| Density | - | 1.673 | - | 13.78 | - | 1.21 | - | 0.250 |
| Oxygen | - | 0.016 | - | 0.010 | - | 1.48 | - | 0.166 |
| Chlorophyll a | - | 0.679 | - | 1.22 | - | 0.55 | - | 0.590 |