
Data Validation Report for OOI Data Workshop - Physics

Table of Contents

Specify the location of the data and where to save figures	2
Download the data from Flanking A	5
Download the data from Flanking B	5
Clean up bad data	6
Download tide gauge data from Juan Fernandez	6
Download Met Data from the Apex Surface Mooring	7
Plot Flanking A pcolor	7
Plot Flanking B pcolor	9
Plot a countour of temperature in time and pressure space	10
Define colors for the next few plots	11
Plot the pressure at Flanking A - whole timeseries	12
Plot the pressure at Flanking A - Zoom in on 11/15/15 - 1/15/16	13
Plot the pressure at Flanking B - whole timeseries	14
Plot Stratification at Flanking A - 3 years	15
Plot Stratification at Flanking B - 3 years	15
Zoom in on Stratification at Flanking A and Compare with Tides	16
Zoom in on Stratification at Flanking A and Compare with Winds	18
Comparing the temp at 130m at Flanking Moorings A and B	19
Calculate the distance between Flanking Moorings A and B	20

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evaluation date: May 24, 2018

Goal of the Data Validation: Look at all the CTDs from Southern Ocean Flanking Mooring A and B to access the temporal and spatial variability of stratification.

1. Diagnose the spring-neap, seasonal, and inter-annual variability
2. Link temporal variability to dynamics - Tides, Winds, Waves
3. Diagnose the spatial variability between moorings A and B (47 km apart)

Review Summary: This data validation uses all available CTD data from Flanking Moorings A and B at the Global Southern Ocean Array as well as meteorological data from the Bulk Meteorology Instrument Package (GS01SU-MO-SBD12-06-METBKA000) on the APEX Surface mooring. Our time period of interest is April 1, 2015 - December 31, 2017 (based on data availability and the science questions motivating this analysis. Note that the met package is one of two available on the APEX surface mooring, but we choose the one with the most data within our timeperiod of interest. We also grab data from a tide gauge at Juan Hernandez, Chile available through <https://uhslc.soest.hawaii.edu/data/>

Further analysis is needed to conclude the relative importance of competing dynamics. Specifically wave data needs to be included in a dynamical analysis, as we know waves play a dominant role in this region. This report was designed to complement an analysis conducted by Justin Stopa, which focused on in situ and remote observations of waves. This initial report indicates that the data available through the Global Southern Ocean Array is adequate to meet the scientific goals of this project.

Specify the location of the data and where to save figures

Note that the data was downloaded through a synchronous API request with a separate python script. The netcdf files were then transferred to my local machine. (The calculations were too heavy without the files being local)

```
clear
close all

basedir='/Users/jmcsweeney/Documents/OOI_DataWorkshop_May_2018/';
savedir='/Users/jmcsweeney/Documents/OOI_DataWorkshop_May_2018/figs/';

% Deployment1
fname1=[...
    'deployment0001_GS03FLMA-RIM01-02-CTDMOG040-recovered_inst-
    ctdmo_ghqr_instrument_recovered_20150401T000001-20151218T123001.nc';...
    'deployment0001_GS03FLMA-RIM01-02-CTDMOG041-recovered_inst-
    ctdmo_ghqr_instrument_recovered_20150401T000001-20151218T123001.nc';...
    'deployment0001_GS03FLMA-RIM01-02-CTDMOG042-recovered_inst-
    ctdmo_ghqr_instrument_recovered_20150401T000001-20151218T123001.nc';...
    'deployment0001_GS03FLMA-RIM01-02-CTDMOG043-recovered_inst-
    ctdmo_ghqr_instrument_recovered_20150401T000001-20151218T123001.nc';...
    'deployment0001_GS03FLMA-RIM01-02-CTDMOG044-recovered_inst-
    ctdmo_ghqr_instrument_recovered_20150401T000001-20151218T123001.nc';...
    'deployment0001_GS03FLMA-RIM01-02-CTDMOG045-recovered_inst-
    ctdmo_ghqr_instrument_recovered_20150401T000001-20151218T123001.nc';...
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    ctdmo_ghqr_instrument_recovered_20150401T000001-20151218T123001.nc';...
    'deployment0001_GS03FLMA-RIM01-02-CTDMOG047-recovered_inst-
    ctdmo_ghqr_instrument_recovered_20150401T000001-20151218T123001.nc';...
    'deployment0001_GS03FLMA-RIM01-02-CTDMOG048-recovered_inst-
    ctdmo_ghqr_instrument_recovered_20150401T000001-20151218T123001.nc';...
    'deployment0001_GS03FLMA-RIM01-02-CTDMOH049-recovered_inst-
    ctdmo_ghqr_instrument_recovered_20150401T000001-20151218T123001.nc';...
    'deployment0001_GS03FLMA-RIM01-02-CTDMOH050-recovered_inst-
    ctdmo_ghqr_instrument_recovered_20150401T000001-20151218T123001.nc';...
    'deployment0001_GS03FLMA-RIM01-02-CTDMOH051-recovered_inst-
    ctdmo_ghqr_instrument_recovered_20150401T000001-20151218T123001.nc'];

fname2=[...
    'deployment0002_GS03FLMA-RIM01-02-CTDMOG040-recovered_inst-
    ctdmo_ghqr_instrument_recovered_20151217T194501-20161206T093001.nc';...
    'deployment0002_GS03FLMA-RIM01-02-CTDMOG041-recovered_inst-
    ctdmo_ghqr_instrument_recovered_20151217T194501-20161206T093001.nc';...
    'deployment0002_GS03FLMA-RIM01-02-CTDMOG042-recovered_inst-
    ctdmo_ghqr_instrument_recovered_20151217T194501-20161206T093001.nc';...
    'deployment0002_GS03FLMA-RIM01-02-CTDMOG043-recovered_inst-
    ctdmo_ghqr_instrument_recovered_20151217T194501-20161206T093001.nc';...
    'deployment0002_GS03FLMA-RIM01-02-CTDMOG044-recovered_inst-
    ctdmo_ghqr_instrument_recovered_20151217T194501-20161206T093001.nc';...
```

```
'deployment0002_GS03FLMA-RIM01-02-CTDMOG045-recovered_inst-  
ctdmo_ghqr_instrument_recovered_20151217T194501-20161206T093001.nc';...  
'deployment0002_GS03FLMA-RIM01-02-CTDMOG046-recovered_inst-  
ctdmo_ghqr_instrument_recovered_20151217T194501-20161206T093001.nc';...  
'deployment0002_GS03FLMA-RIM01-02-CTDMOG047-recovered_inst-  
ctdmo_ghqr_instrument_recovered_20151217T194501-20161206T093001.nc';...  
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ctdmo_ghqr_instrument_recovered_20151217T194501-20161206T093001.nc';...  
'deployment0002_GS03FLMA-RIM01-02-CTDMOH049-recovered_inst-  
ctdmo_ghqr_instrument_recovered_20151217T194501-20161206T093001.nc';...  
'deployment0002_GS03FLMA-RIM01-02-CTDMOH050-recovered_inst-  
ctdmo_ghqr_instrument_recovered_20151217T194501-20161206T093001.nc';...  
'deployment0002_GS03FLMA-RIM01-02-CTDMOH051-recovered_inst-  
ctdmo_ghqr_instrument_recovered_20151217T194501-20161206T093001.nc'];  
  
fname3=[...  
'deployment0003_GS03FLMA-RIM01-02-CTDMOG040-recovered_inst-  
ctdmo_ghqr_instrument_recovered_20161201T193001-20171129T234501.nc';...  
'deployment0003_GS03FLMA-RIM01-02-CTDMOG041-recovered_inst-  
ctdmo_ghqr_instrument_recovered_20161201T193001-20171129T234501.nc';...  
'deployment0003_GS03FLMA-RIM01-02-CTDMOG042-recovered_inst-  
ctdmo_ghqr_instrument_recovered_20161201T193001-20171129T234501.nc';...  
'deployment0003_GS03FLMA-RIM01-02-CTDMOG043-recovered_inst-  
ctdmo_ghqr_instrument_recovered_20161201T193001-20171129T234501.nc';...  
'deployment0003_GS03FLMA-RIM01-02-CTDMOG044-recovered_inst-  
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'deployment0003_GS03FLMA-RIM01-02-CTDMOG045-recovered_inst-  
ctdmo_ghqr_instrument_recovered_20161201T193001-20171129T234501.nc';...  
'deployment0003_GS03FLMA-RIM01-02-CTDMOG046-recovered_inst-  
ctdmo_ghqr_instrument_recovered_20161201T193001-20171129T234501.nc';...  
'deployment0003_GS03FLMA-RIM01-02-CTDMOG047-recovered_inst-  
ctdmo_ghqr_instrument_recovered_20161201T193001-20171129T234501.nc'];  
  
% Flanking B Deployment1  
fbname1=[...  
'deployment0001_GS03FLMB-RIM01-02-CTDMOG060-recovered_inst-  
ctdmo_ghqr_instrument_recovered_20150401T000001-20151219T183001.nc';...  
'deployment0001_GS03FLMB-RIM01-02-CTDMOG061-recovered_inst-  
ctdmo_ghqr_instrument_recovered_20150401T000001-20151219T183001.nc';...  
'deployment0001_GS03FLMB-RIM01-02-CTDMOG062-recovered_inst-  
ctdmo_ghqr_instrument_recovered_20150401T000001-20151219T183001.nc';...  
'deployment0001_GS03FLMB-RIM01-02-CTDMOG063-recovered_inst-  
ctdmo_ghqr_instrument_recovered_20150401T000001-20151219T183001.nc';...  
'deployment0001_GS03FLMB-RIM01-02-CTDMOG064-recovered_inst-  
ctdmo_ghqr_instrument_recovered_20150401T000001-20151219T183001.nc';...  
'deployment0001_GS03FLMB-RIM01-02-CTDMOG065-recovered_inst-  
ctdmo_ghqr_instrument_recovered_20150401T000001-20151219T183001.nc';...  
'deployment0001_GS03FLMB-RIM01-02-CTDMOG066-recovered_inst-  
ctdmo_ghqr_instrument_recovered_20150401T000001-20151219T183001.nc';...  
'deployment0001_GS03FLMB-RIM01-02-CTDMOG067-recovered_inst-  
ctdmo_ghqr_instrument_recovered_20150401T000001-20151219T183001.nc';...  
'deployment0001_GS03FLMB-RIM01-02-CTDMOG068-recovered_inst-  
ctdmo_ghqr_instrument_recovered_20150401T000001-20151219T183001.nc';...
```

```
'deployment0001_GS03FLMB-RIM01-02-CTDMOH069-recovered_inst-  
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'deployment0001_GS03FLMB-RIM01-02-CTDMOH070-recovered_inst-  
ctdmo_ghqr_instrument_recovered_20150401T000001-20151219T183001.nc';...  
'deployment0001_GS03FLMB-RIM01-02-CTDMOH071-recovered_inst-  
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```

```
fbname2=[...
```

```
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'deployment0002_GS03FLMB-RIM01-02-CTDMOG061-recovered_inst-  
ctdmo_ghqr_instrument_recovered_20151216T194501-20161205T113001.nc';...  
'deployment0002_GS03FLMB-RIM01-02-CTDMOG062-recovered_inst-  
ctdmo_ghqr_instrument_recovered_20151216T194501-20161205T113001.nc';...  
'deployment0002_GS03FLMB-RIM01-02-CTDMOG063-recovered_inst-  
ctdmo_ghqr_instrument_recovered_20151216T194501-20161205T113001.nc';...  
'deployment0002_GS03FLMB-RIM01-02-CTDMOG064-recovered_inst-  
ctdmo_ghqr_instrument_recovered_20151216T194501-20161205T113001.nc';...  
'deployment0002_GS03FLMB-RIM01-02-CTDMOG065-recovered_inst-  
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'deployment0002_GS03FLMB-RIM01-02-CTDMOG066-recovered_inst-  
ctdmo_ghqr_instrument_recovered_20151216T194501-20161205T113001.nc';...  
'deployment0002_GS03FLMB-RIM01-02-CTDMOG067-recovered_inst-  
ctdmo_ghqr_instrument_recovered_20151216T194501-20161205T113001.nc';...  
'deployment0002_GS03FLMB-RIM01-02-CTDMOG068-recovered_inst-  
ctdmo_ghqr_instrument_recovered_20151216T194501-20161205T113001.nc';...  
'deployment0002_GS03FLMB-RIM01-02-CTDMOH069-recovered_inst-  
ctdmo_ghqr_instrument_recovered_20151216T194501-20161205T113001.nc';...  
'deployment0002_GS03FLMB-RIM01-02-CTDMOH070-recovered_inst-  
ctdmo_ghqr_instrument_recovered_20151216T194501-20161205T113001.nc';...  
'deployment0002_GS03FLMB-RIM01-02-CTDMOH071-recovered_inst-  
ctdmo_ghqr_instrument_recovered_20151216T194501-20161205T113001.nc'];
```

```
fbname3=[...
```

```
'deployment0003_GS03FLMB-RIM01-02-CTDMOG060-recovered_inst-  
ctdmo_ghqr_instrument_recovered_20161203T191501-20171129T234501.nc';...  
'deployment0003_GS03FLMB-RIM01-02-CTDMOG061-recovered_inst-  
ctdmo_ghqr_instrument_recovered_20161203T191501-20171129T234501.nc';...  
'deployment0003_GS03FLMB-RIM01-02-CTDMOG062-recovered_inst-  
ctdmo_ghqr_instrument_recovered_20161203T191501-20171129T234501.nc';...  
'deployment0003_GS03FLMB-RIM01-02-CTDMOG063-recovered_inst-  
ctdmo_ghqr_instrument_recovered_20161203T191501-20171129T234501.nc';...  
'deployment0003_GS03FLMB-RIM01-02-CTDMOG064-recovered_inst-  
ctdmo_ghqr_instrument_recovered_20161203T191501-20171129T234501.nc';...  
'deployment0003_GS03FLMB-RIM01-02-CTDMOG065-recovered_inst-  
ctdmo_ghqr_instrument_recovered_20161203T191501-20171129T234501.nc';...  
'deployment0003_GS03FLMB-RIM01-02-CTDMOG066-recovered_inst-  
ctdmo_ghqr_instrument_recovered_20161203T191501-20171129T234501.nc';...  
'deployment0003_GS03FLMB-RIM01-02-CTDMOG067-recovered_inst-  
ctdmo_ghqr_instrument_recovered_20161203T191501-20171129T234501.nc'];
```

Download the data from Flanking A

```
for i = 1:12
f=[basedir 'data/deployment1/' fname1(i,:)];
temp1(i,:)=ncread(f,'ctdmo_seawater_temperature');
press1(i,:)=ncread(f,'ctdmo_seawater_pressure');
sal1(i,:)=ncread(f,'practical_salinity');
dens1(i,:)=ncread(f,'density');
end
time1=ncread(f,'time'); % I confirmed the time arrays are the same
z=-[30, 40, 60, 90, 130, 180 250, 350, 500, 750, 1000, 1500];

dn1=datetime(1900,1,1,0,0,0)+(time1/60/60/24);

for i = 1:12
f=[basedir 'data/deployment2/' fname2(i,:)];
temp2(i,:)=ncread(f,'ctdmo_seawater_temperature');
press2(i,:)=ncread(f,'ctdmo_seawater_pressure');
sal2(i,:)=ncread(f,'practical_salinity');
dens2(i,:)=ncread(f,'density');
end
time2=ncread(f,'time'); % I confirmed the time arrays are the same
z=-[30, 40, 60, 90, 130, 180 250, 350, 500, 750, 1000, 1500];
dn2=datetime(1900,1,1,0,0,0)+(time2/60/60/24);

for i = 1:8
f=[basedir 'data/deployment3/' fname3(i,:)];
temp3(i,:)=ncread(f,'ctdmo_seawater_temperature');
press3(i,:)=ncread(f,'ctdmo_seawater_pressure');
sal3(i,:)=ncread(f,'practical_salinity');
dens3(i,:)=ncread(f,'density');
end
time3=ncread(f,'time'); % I confirmed the time arrays are the same
z3=-[30, 40, 60, 90, 130, 180 250, 350];
dn3=datetime(1900,1,1,0,0,0)+(time3/60/60/24);
```

Download the data from Flanking B

```
for i = 1:12
f=[basedir 'data/flankingB/d1/' fbname1(i,:)];
temp1b(i,:)=ncread(f,'ctdmo_seawater_temperature');
press1b(i,:)=ncread(f,'ctdmo_seawater_pressure');
sal1b(i,:)=ncread(f,'practical_salinity');
dens1b(i,:)=ncread(f,'density');
end
time1b=ncread(f,'time'); % I confirmed the time arrays are the same
zb=-[30, 40, 60, 90, 130, 180 250, 350, 500, 750, 1000, 1500];
dn1b=datetime(1900,1,1,0,0,0)+(time1b/60/60/24);

for i = 1:12
f=[basedir 'data/flankingB/d2/' fbname2(i,:)];
```

```
temp2b(i,:)=ncread(f,'ctdmo_seawater_temperature');
press2b(i,:)=ncread(f,'ctdmo_seawater_pressure');
sal2b(i,:)=ncread(f,'practical_salinity');
dens2b(i,:)=ncread(f,'density');
end
time2b=ncread(f,'time'); % I confirmed the time arrays are the same
dn2b=datetime(1900,1,1,0,0,0)+(time2b/60/60/24);

for i = 1:8
f=[basedir 'data/flankingB/d3/' ffname3(i,:)];
temp3b(i,:)=ncread(f,'ctdmo_seawater_temperature');
press3b(i,:)=ncread(f,'ctdmo_seawater_pressure');
sal3b(i,:)=ncread(f,'practical_salinity');
dens3b(i,:)=ncread(f,'density');
end
time3b=ncread(f,'time'); % I confirmed the time arrays are the same
z3b=-[30, 40, 60, 90, 130, 180, 250, 350];
dn3b=datetime(1900,1,1,0,0,0)+(time3b/60/60/24);
```

Clean up bad data

This clean up approach is rudimentary. For a more rigorous analysis, the data clean-up should be more objective. For example, a standard deviation filter or despiking could be done. Also, it is important to note that there is bad data in the datasets that have not been removed here (ie. Flanking B). This is intentional to show the sort of clean up that is important and how outliers may only sometimes be obvious

```
sal1(sal1<20)=nan; sal2(sal2<20)=nan; sal3(sal3<20)=nan;
temp1(:,dn1>736316.395521383)=nan; press1(:,dn1>736316.395521383)=nan;
temp2(:,dn2<736315.847)=nan; press2(:,dn2<736315.847)=nan;

temp1b(:,dn1b>736316.689)=nan; press1b(:,dn1b>736316.689)=nan;
temp2b(:,dn2b<736314.903)=nan; press2b(:,dn2b<736314.903)=nan;

temp3b(:,dn3b<736667.854)=nan; press3b(:,dn3b<736667.854)=nan;
```

Download tide gauge data from Juan Fernandez

This hourly data was downloaded from <https://uhsic.soest.hawaii.edu/data/>

```
tname='/Users/jmcsweeney/Documents/OOI_DataWorkshop_May_2018/data/
h021.nc';

ttime=ncread(tname,'time'); %'days since 1800-01-01 00:00:00
tdn=datetime(1800,1,1,0,0,0)+(ttime);
tsl=ncread(tname,'sea_level');

tname='/Users/jmcsweeney/Documents/OOI_DataWorkshop_May_2018/data/
d021.nc';

ttimel=ncread(tname,'time'); %'days since 1800-01-01 00:00:00
```

```
tdn1=datetime(1800,1,1,0,0,0)+(ttime1);
```

```
tsl1=ncread(tname, 'sea_level');
```

Download Met Data from the Apex Surface Mooring

The other met package (GS01SUMO-SBD11-06-METBKA000) did not have adequate coverage for this analysis

```
mname=[...  
'deployment0001_GS01SUMO-SBD12-06-METBKA000-recovered_host-  
metbk_a_dcl_instrument_recovered_20150401T000030-20151227T111918.nc';...  
'deployment0002_GS01SUMO-SBD12-06-METBKA000-recovered_host-  
metbk_a_dcl_instrument_recovered_20151214T202007-20161212T075726.nc'];
```

```
wtime1=ncread([basedir 'data/met/' mname(1,:)], 'time'); %seconds since  
1900-01-01 0:0:0
```

```
wdn1=datetime(1900,1,1,0,0,0+wtime1);  
weast1=ncread([basedir 'data/met/'  
mname(1,:)], 'eastward_wind_velocity');  
wnorth1=ncread([basedir 'data/met/'  
mname(1,:)], 'northward_wind_velocity');  
wspd1=sqrt(weast1.^2+wnorth1.^2);
```

```
wtime2=ncread([basedir 'data/met/' mname(2,:)], 'time'); %seconds since  
1900-01-01 0:0:0
```

```
wdn2=datetime(1900,1,1,0,0,0+wtime2);  
weast2=ncread([basedir 'data/met/'  
mname(2,:)], 'eastward_wind_velocity');  
wnorth2=ncread([basedir 'data/met/'  
mname(2,:)], 'northward_wind_velocity');  
wspd2=sqrt(weast2.^2+wnorth2.^2);
```

Plot Flanking A pcolor

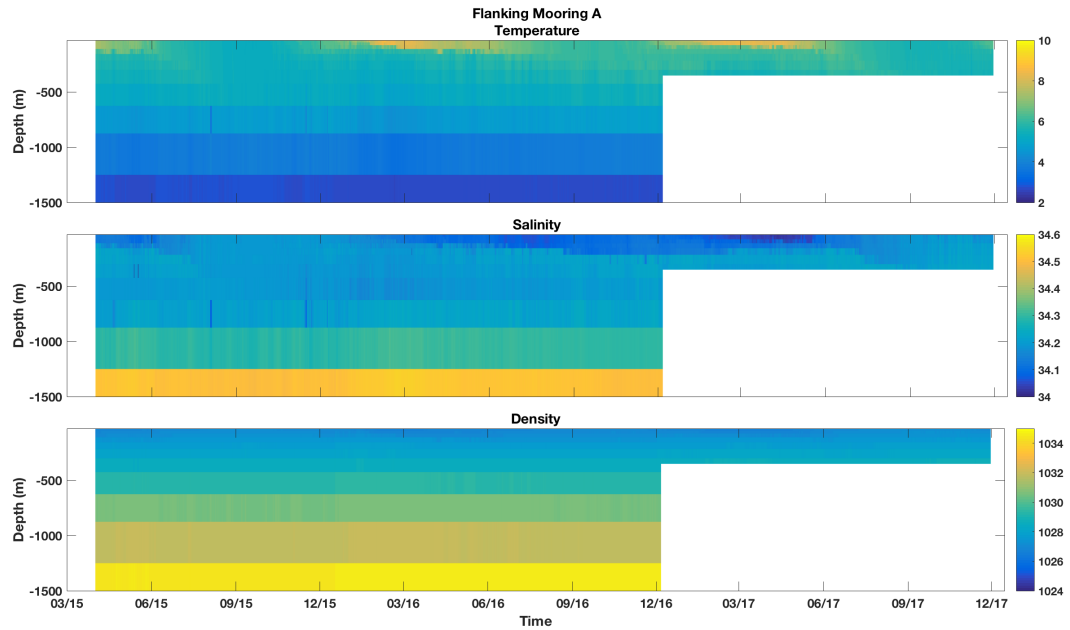
```
close all  
figure('position',[169 93 1247 712]);  
hax=tight_subplot(3,1,[0.05 0.1],[0.08 0.06],[0.08 0.04]);  
  
axes(hax(1))  
pcolorjw(dn1,z,temp1);  
hold on  
pcolorjw(dn2,z,temp2);  
pcolorjw(dn3,z3,temp3);  
colorbar;  
datetick('x','mm/yy')  
ylabel('Depth (m)');  
title(['Flanking Mooring A' char(10) 'Temperature'])  
set(gca,'fontsize',14,'fontweight','bold')  
set(gca,'xtick',datetime(2015,3:3:36,1),'xticklabel',[],'layer','top');  
xaxis(datetime(2015,3,1),datetime(2017,12,15));
```

```
caxis([2 10]);

axes(hax(2))
pcolorjw(dn1,z,sal1);
hold on
pcolorjw(dn2,z,sal2);
pcolorjw(dn3,z3,sal3);
colorbar;
datetick('x','mm/yy')
ylabel('Depth (m)');
title('Salinity')
set(gca,'fontsize',14,'fontweight','bold')
caxis([34 34.6]);
set(gca,'xtick',datenum(2015,3:3:36,1),'xticklabel',[],'layer','top');
xaxis(datenum(2015,3,1),datenum(2017,12,15));

axes(hax(3))
pcolorjw(dn1,z,dens1);
hold on
pcolorjw(dn2,z,dens2);
pcolorjw(dn3,z3,dens3);
colorbar;
datetick('x','mm/yy')
ylabel('Depth (m)');
xlabel('Time');
title('Density')
set(gca,'fontsize',14,'fontweight','bold')
caxis([1024 1035]);
set(gca,'xtick',datenum(2015,3:3:36,1),'xticklabel',datestr(datenum(2015,3:3:36,1),
yy'),'layer','top');
xaxis(datenum(2015,3,1),datenum(2017,12,15));

if 0
    set(gcf,'PaperPositionMode','auto');
    print(gcf,'-dpng','-r300',[savedir 'PcolorFlankingA']);
end
```

Plot Flanking B pcolor

Note the bad salinity data that we didn't clean up. Salinity spiking?

```
close all
figure('position',[169 93 1247 712]);
hax=tight_subplot(3,1,[0.05 0.1],[0.08 0.06],[0.08 0.04]);

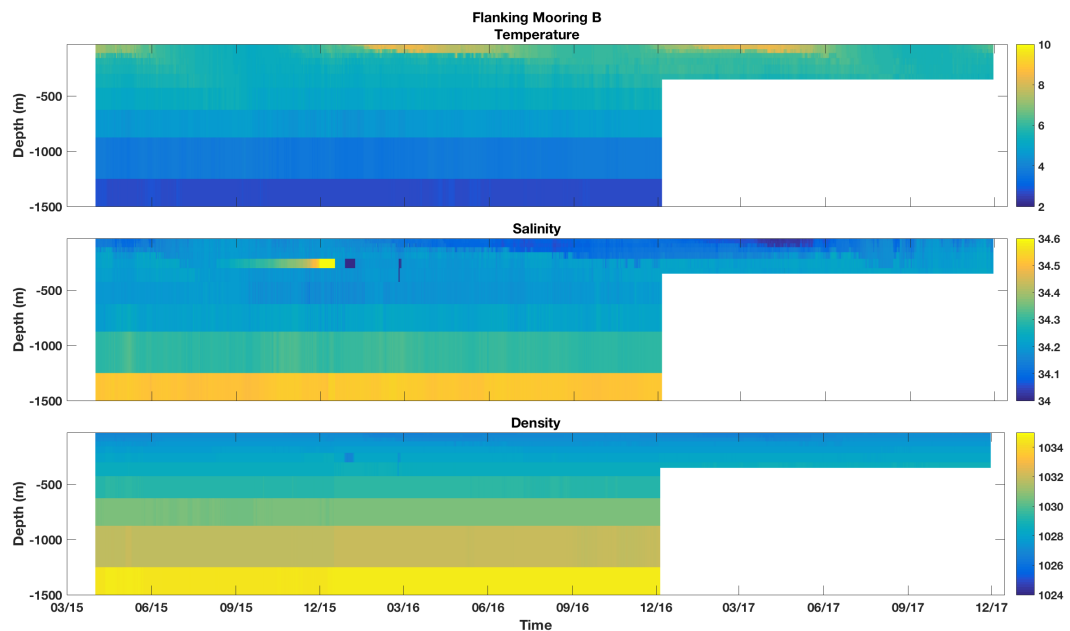
axes(hax(1))
pcolorjw(dn1b,zb,temp1b);
hold on
pcolorjw(dn2b,zb,temp2b);
pcolorjw(dn3b,z3b,temp3b);
colorbar;
datetick('x','mm/yy')
ylabel('Depth (m)');
title(['Flanking Mooring B' char(10) 'Temperature'])
set(gca,'fontsize',14,'fontweight','bold')
set(gca,'xtick',datenum(2015,3:3:36,1),'xticklabel',[],'layer','top');
xaxis(datenum(2015,3,1),datenum(2017,12,15));
caxis([2 10]);

axes(hax(2))
pcolorjw(dn1b,zb,sal1b);
hold on
pcolorjw(dn2b,zb,sal2b);
pcolorjw(dn3b,z3b,sal3b);
colorbar;
datetick('x','mm/yy')
ylabel('Depth (m)');
title('Salinity')
set(gca,'fontsize',14,'fontweight','bold')
```

```
caxis([34 34.6]);
set(gca,'xtick',datenum(2015,3:3:36,1),'xticklabel',[],'layer','top');
axis(datenum(2015,3,1),datenum(2017,12,15));

axes(hax(3))
pcolorjw(dn1b,zb,dens1b);
hold on
pcolorjw(dn2b,zb,dens2b);
pcolorjw(dn3b,z3b,dens3b);
colorbar;
datetick('x','mm/yy')
ylabel('Depth (m)');
xlabel('Time');
title('Density')
set(gca,'fontsize',14,'fontweight','bold')
caxis([1024 1035]);
set(gca,'xtick',datenum(2015,3:3:36,1),'xticklabel',datestr(datenum(2015,3:3:36,1),
yy'),'layer','top');
axis(datenum(2015,3,1),datenum(2017,12,15));

if 0
    set(gcf,'PaperPositionMode','auto');
    print(gcf,'-dpng','-r300',[savedir 'PcolorFlankingB']);
end
```

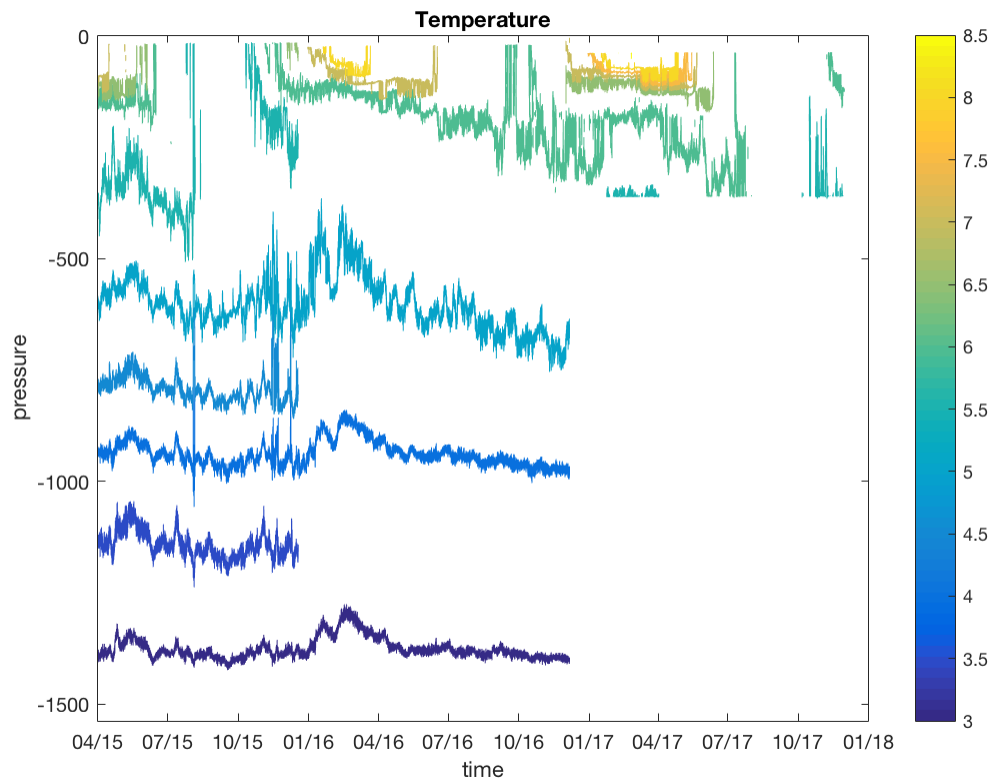


Plot a contour of temperature in time and pressure space

not a good look at this data because this contour code doesn't handle gappy data well

```
figure;
```

```
contour(repmat(dn1,1,12)',-press1,temp1)
hold on
contour(repmat(dn2,1,12)',-press2,temp2)
hold on
contour(repmat(dn3,1,8)',-press3,temp3)
datetick('x','mm/yy')
xlabel('time')
ylabel('pressure')
colorbar
title('Temperature')
```



Define colors for the next few plots

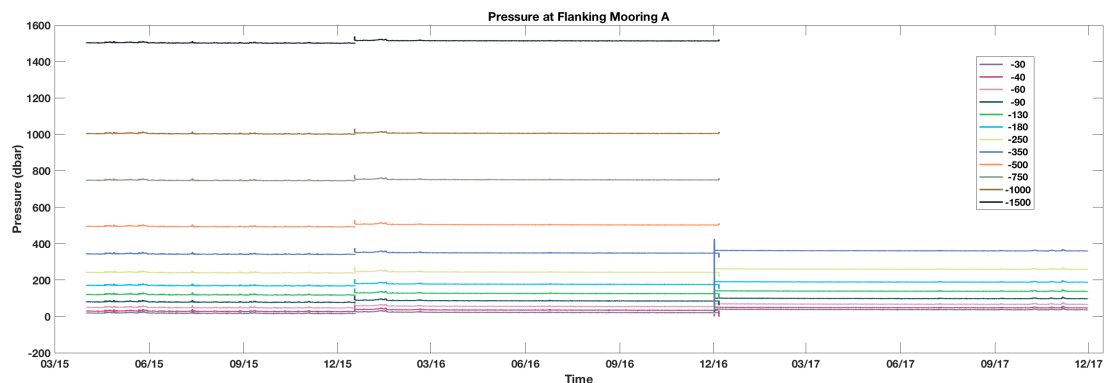
```
clrs(1:12,1:3)=nan;
clrs(1,:)=hex2rgb('#7A6F9B'); %purple
clrs(2,:)=hex2rgb('#C94277'); % pink
clrs(3,:)=hex2rgb('#D499B9'); % light pink
clrs(4,:)=hex2rgb('#0F5257'); % dark green
clrs(5,:)=hex2rgb('#20BF55'); % bright green
clrs(6,:)=hex2rgb('#01BAEF'); % bright blue
clrs(7,:)=hex2rgb('#DDE392'); % light green/yellow
clrs(8,:)=hex2rgb('#537BBC'); % light blue
clrs(9,:)=hex2rgb('#FF8E5E'); % orange
clrs(10,:)=hex2rgb('#839788'); % light green
clrs(11,:)=hex2rgb('#9A6D38'); % brown
clrs(12,:)=hex2rgb('#0D1B2A'); % near black
```

Plot the pressure at Flanking A - whole time-series

```
close all

figure('position',[5 291 1436 514])
set(gca,'position',[0.0389972144846797 0.11 0.935933147632312 0.815]);
for i= 1:12
    h(i)=plot(dn1,press1(i,:), '-','color',clrs(i,:), 'linewidth',2);
    hold on
    plot(dn2,press2(i,:), '-','color',clrs(i,:), 'linewidth',2); hold on
    try
        plot(dn3,press3(i,:), '-','color',clrs(i,:), 'linewidth',2);
    end
    hold on
    catch
    end
end
ylabel('Pressure (dbar)');
xlabel('Time');
title('Pressure at Flanking Mooring A')
set(gca,'fontsize',14,'fontweight','bold')
leg=legend(gca,h,num2str(z')));
set(leg,'box','on','position',[0.86176880222825 ...
    0.466787992476641 0.0515320334261838
    0.380350194552529]);
set(gca,'xtick',datenum(2015,3:3:36,1),'xticklabel',datestr(datenum(2015,3:3:36,1)
yy')));
axis(datenum(2015,3,1),datenum(2017,12,15));

if 0
    set(gcf,'PaperPositionMode','auto');
    print(gcf,'-dpng','-r300',
[savedir 'PressTimeseries_FlankingA_3yrs']);
end
```

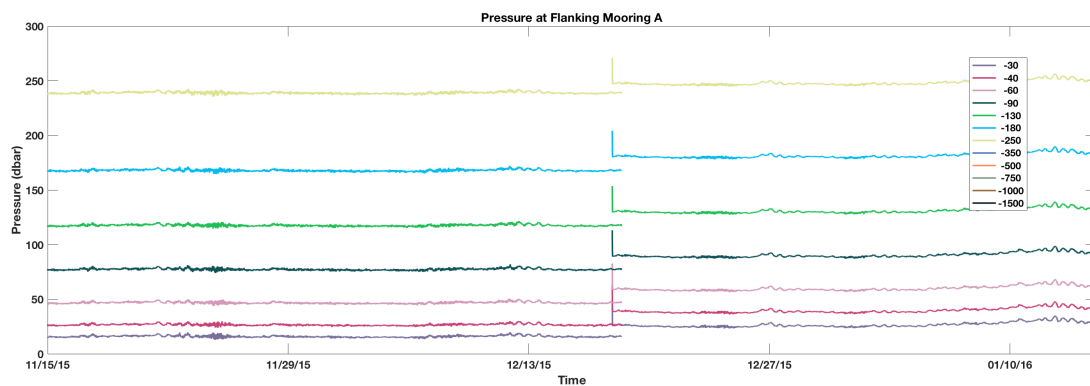


Plot the pressure at Flanking A - Zoom in on 11/15/15 - 1/15/16

```
close all

figure('position',[5 291 1436 514])
set(gca,'position',[0.0389972144846797 0.11 0.935933147632312 0.815]);
for i= 1:12
    h(i)=plot(dn1,press1(i,:), '-','color',clrs(i,:), 'linewidth',2);
    hold on
    plot(dn2,press2(i,:), '-','color',clrs(i,:), 'linewidth',2); hold on
    try
        plot(dn3,press3(i,:), '-','color',clrs(i,:), 'linewidth',2);
    end
    hold on
    catch
    end
end
ylabel('Pressure (dbar)');
xlabel('Time');
title('Pressure at Flanking Mooring A')
set(gca,'fontsize',14,'fontweight','bold')
leg=legend(gca,h,num2str(z')));
set(leg,'box','on','position',[0.86176880222825 ...
    0.466787992476641 0.0515320334261838
    0.380350194552529]);
set(gca,'xtick',datenum(2015,11,1:14:300),'xticklabel',datestr(datenum(2015,11,1:14:300),'dd/yy'));
axis(datenum(2015,11,15),datenum(2016,1,15));
axis(0, 300);

if 0
    set(gcf,'PaperPositionMode','auto');
    print(gcf,'-dpng','-r300',
[savedir 'PressTimeseries_FlankingA_3yrs']);
end
```

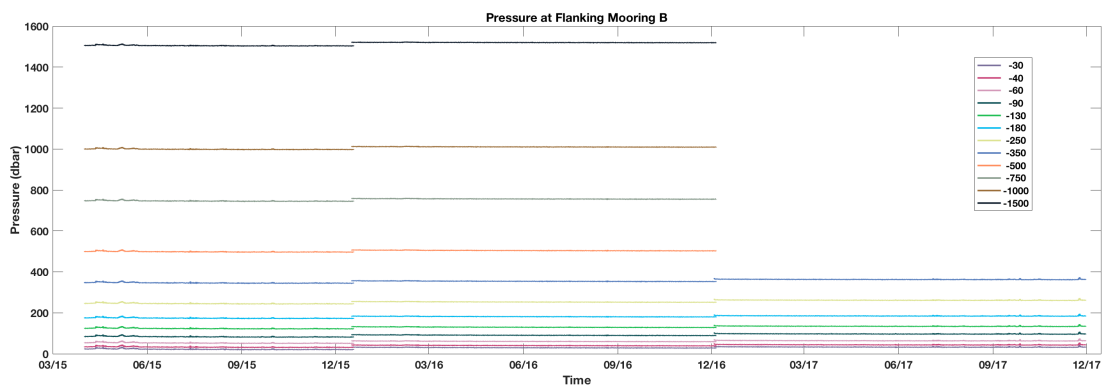


Plot the pressure at Flanking B - whole time-series

```
close all

figure('position',[5 291 1436 514])
set(gca,'position',[0.0389972144846797 0.11 0.935933147632312 0.815]);
for i= 1:12
    h(i)=plot(dn1b,press1b(i,:), '-','color',clrs(i,:), 'linewidth',2);
    hold on
    plot(dn2b,press2b(i,:), '-','color',clrs(i,:), 'linewidth',2);
    hold on
    try
        plot(dn3b,press3b(i,:), '-','color',clrs(i,:), 'linewidth',2);
    end
end
ylabel('Pressure (dbar)');
xlabel('Time');
title('Pressure at Flanking Mooring B')
set(gca,'fontsize',14,'fontweight','bold')
leg=legend(gca,h,num2str(z')));
set(leg,'box','on','position',[0.86176880222825 ...
    0.466787992476641 0.0515320334261838
    0.380350194552529]);
set(gca,'xtick',datenum(2015,3:3:36,1),'xticklabel',datestr(datenum(2015,3:3:36,1)
yy')));
axis(datenum(2015,3,1),datenum(2017,12,15));

if 0
    set(gcf,'PaperPositionMode','auto');
    print(gcf,'-dpng','-r300',
[savedir 'PressTimeseries_FlankingB_3yrs_clean']);
end
```

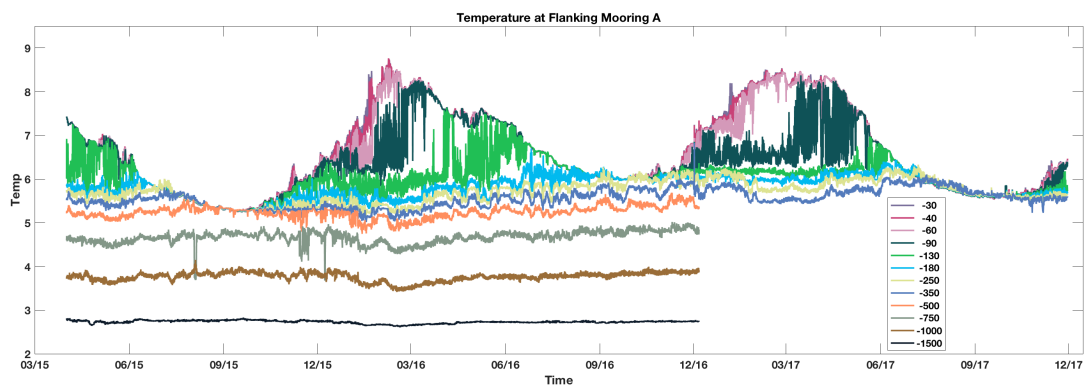


Plot Stratification at Flanking A - 3 years

```
close all

figure('position',[5 291 1436 514])
set(gca,'position',[0.0389972144846797 0.11 0.935933147632312
0.815]);
for i= 1:12
    h(i)=plot(dn1,temp1(i,:), 'color',clrs(i,:), 'linewidth',2); hold on
    plot(dn2,temp2(i,:), 'color',clrs(i,:), 'linewidth',2); hold on
    try
        plot(dn3,temp3(i,:), 'color',clrs(i,:), 'linewidth',2); hold on
    catch
    end
end
ylabel('Temp');
xlabel('Time');
title('Temperature at Flanking Mooring A')
set(gca,'fontsize',14,'fontweight','bold')
leg=legend(gca,h,num2str(z'));
set(leg,'box','on','position',[0.800487465180897 ...
0.118538965239286 0.0515320334261838
0.380350194552529]);
set(gca,'xtick',datenum(2015,3:3:36,1),'xticklabel',datestr(datenum(2015,3:3:36,1)
yy'));
axis(datenum(2015,3,1),datenum(2017,12,15));
yaxis(2,9.5);

if 0
    set(gcf,'PaperPositionMode','auto');
    print(gcf,'-dpng','-r300',
[savedir 'TempTimeseries_FlankingA_3yrs']);
end
```

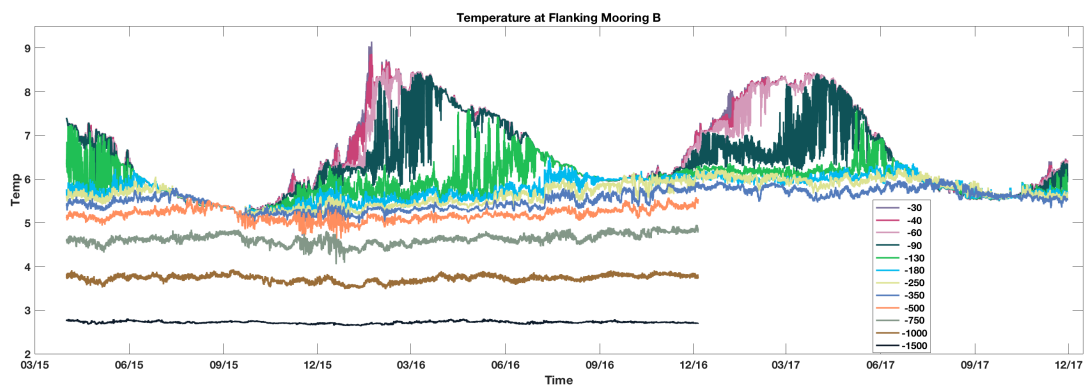


Plot Stratification at Flanking B - 3 years

```
close all

figure('position',[5 291 1436 514])
```

```
set(gca,'position',[0.0389972144846797 0.11 0.935933147632312  
0.815]);  
for i= 1:12  
    h(i)=plot(dn1b,temp1b(i,:), 'color',clrs(i,:), 'linewidth',2);  
    hold on  
    plot(dn2b,temp2b(i,:), 'color',clrs(i,:), 'linewidth',2); hold on  
    try  
        plot(dn3b,temp3b(i,:), 'color',clrs(i,:), 'linewidth',2);  
    hold on  
    catch  
    end  
end  
ylabel('Temp');  
xlabel('Time');  
title('Temperature at Flanking Mooring B')  
set(gca,'fontsize',14,'fontweight','bold')  
leg=legend(gca,h,num2str(z));  
set(leg,'box','on','position',[ 0.787256267409309 ...  
0.1127023893638 0.0515320334261838  
0.380350194552529]);  
set(gca,'xtick',datenum(2015,3:3:36,1),'xticklabel',datestr(datenum(2015,3:3:36,1)  
YY));  
axis(datenum(2015,3,1),datenum(2017,12,15));  
axis(2,9.5);  
  
if 0  
    set(gcf,'PaperPositionMode','auto');  
    print(gcf,'-dpng','-r300',  
[savedir 'TempTimeseries_FlankingB_3yrs']);  
end
```



Zoom in on Stratification at Flanking A and Compare with Tides

```
close all  
  
figure('position',[5 291 1436 514])  
hax=tight_subplot(2,1,[0.15 0.1],[0.08 0.06],[0.06 0.02]);
```

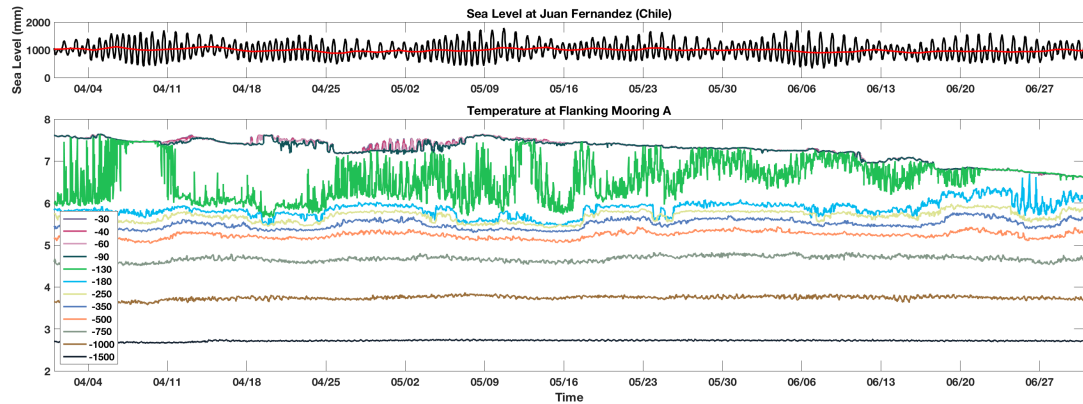


```
axes(hax(1));
plot(tdn,tsl,'k','linewidth',2); hold on;
plot(tdn1,tsl1,'r','linewidth',2);
axis(datenum(2016,4,1),datenum(2016,7,1));
set(gca,'fontsize',14,'fontweight','bold','xtick',datenum(2016,2,1:7:160),...
    'xticklabel',datestr(datenum(2016,2,1:7:160),'mm/dd'));
ylabel('Sea Level (mm)');
title('Sea Level at Juan Fernandez (Chile)')

axes(hax(2));
for i= 1:12
    h(i)=plot(dn1,temp1(i,:), 'color',clrs(i,:), 'linewidth',2); hold on
    plot(dn2,temp2(i,:), 'color',clrs(i,:), 'linewidth',2); hold on
    try
        plot(dn3,temp3(i,:), 'color',clrs(i,:), 'linewidth',2); hold on
    catch
    end
end
% ylabel('Temp');
xlabel('Time');
title('Temperature at Flanking Mooring A')
set(gca,'fontsize',14,'fontweight','bold')
leg=legend(gca,h,num2str(z));
set(leg,'box','on','position',[0.0651114206126513    ...
    0.0971381870291696    0.0515320334261839
    0.380350194552529]);
set(gca,'xtick',datenum(2016,2,1:7:160),'xticklabel',datestr(datenum(2016,2,1:7:160),...
    'dd'));
axis(datenum(2016,4,1),datenum(2016,7,1));

set(hax(1),'position',[ 0.06    0.809338521400778
    0.92    0.138132295719844]);
set(hax(2),'position',[ 0.06    0.08
    0.92    0.626225680933852]);

if 0
    set(gcf,'PaperPositionMode','auto');
    print(gcf,'-dpng','-r300',
[savedir 'TidesTempTimeseries_FlankingA_2mos']);
end
```



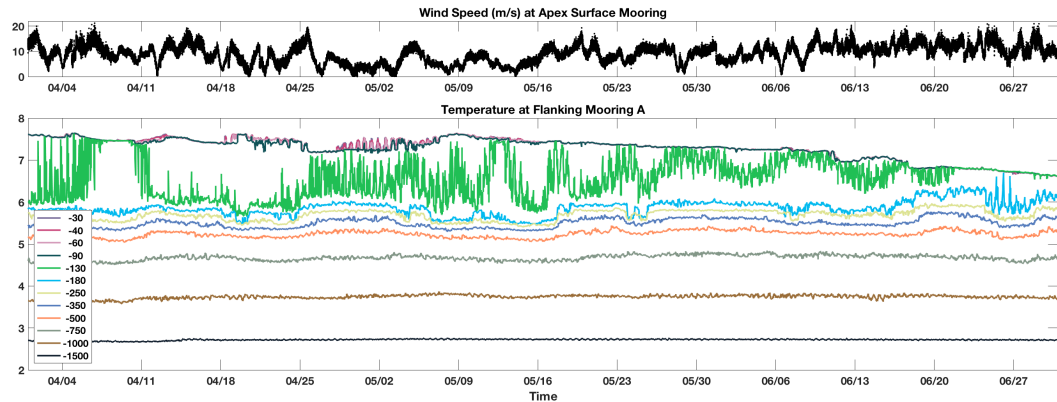
Zoom in on Stratification at Flanking A and Compare with Winds

```
close all

figure('position',[5 291 1436 514])
hax=tight_subplot(2,1,[0.15 0.1],[0.08 0.06],[0.06 0.02]);
axes(hax(1));
plot(wdn1,wspd1,'.k'); hold on
plot(wdn2,wspd2,'.k');
yaxis(0,22);
    xaxis(datenum(2016,4,1),datenum(2016,7,1));
set(gca,'fontsize',14,'fontweight','bold','xtick',datenum(2016,2,1:7:160),...
    'xticklabel',datestr(datenum(2016,2,1:7:160),'mm/dd'));
title('Wind Speed (m/s) at Apex Surface Mooring');

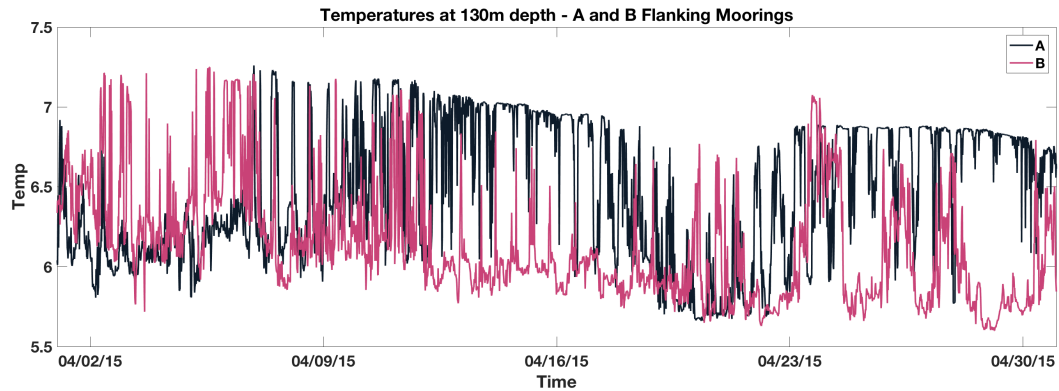
axes(hax(2));
for i= 1:12
    h(i)=plot(dn1,temp1(i,:), 'color',clrs(i,:), 'linewidth',2); hold on
    plot(dn2,temp2(i,:), 'color',clrs(i,:), 'linewidth',2); hold on
    try
        plot(dn3,temp3(i,:), 'color',clrs(i,:), 'linewidth',2); hold on
    catch
    end
end
% ylabel('Temp');
xlabel('Time');
title('Temperature at Flanking Mooring A')
set(gca,'fontsize',14,'fontweight','bold')
leg=legend(gca,h,num2str(z));
set(leg,'box','on','position',[0.0651114206126513 ...
    0.0971381870291696    0.0515320334261839
    0.380350194552529]);
set(gca,'xtick',datenum(2016,2,1:7:160),'xticklabel',datestr(datenum(2016,2,1:7:160),
    'dd'));
axis(datenum(2016,4,1),datenum(2016,7,1));
```

```
set(hax(1),'position',[ 0.06      0.809338521400778  
                        0.92      0.138132295719844]);  
set(hax(2),'position',[ 0.06      0.08  
                        0.92      0.626225680933852]);  
  
if 0  
    set(gcf,'PaperPositionMode','auto');  
    print(gcf,'-dpng','-r300',  
[savedir 'WindTempTimeseries_FlankingA_2mos']]);  
end
```



Comparing the temp at 130m at Flanking Moorings A and B

```
close all  
figure('position',[5 291 1436 514])  
set(gca,'position',[0.0626740947075209 0.130350194552529  
                    0.892061281337047 0.794649805447471]);  
i=5;  
h(1)=plot(dn1,temp1(i,:), 'color',clrs(12,:), 'linewidth',2); hold on  
h(2)=plot(dn1b,temp1b(i,:), 'color',clrs(2,:), 'linewidth',2);  
  
ylabel('Temp');  
xlabel('Time');  
title('Temperatures at 130m depth - A and B Flanking Moorings')  
set(gca,'fontsize',20,'fontweight','bold')  
  
set(gca,'xtick',datenum(2015,1,1:7:2400),'xticklabel',datestr(datenum(2015,1,1:7:2400),  
    'dd/yy'));  
axis(datenum(2015,4,1),datenum(2015,5,1));  
% axis(datenum(2015,4,1),datenum(2015,4,15));  
  
leg=legend([h(1) h(2)],['A';'B']);  
  
if 0  
    set(gcf,'PaperPositionMode','auto');  
    print(gcf,'-dpng','-r300',[savedir 'AvsB_1mo']);  
end
```



Calculate the distance between Flanking Moorings A and B

```
disp(['Distance between Flanking Moorings A and B = ' ...  
      num2str(sw_dist([-54.104, -54.08],[-89.654, -88.932], 'km'),4) ' ...  
      km']);
```

Distance between Flanking Moorings A and B = 47.13 km

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