Argovis

Argovis Application Programming Interface exposed to co-locate oceanic and atmospheric datasets

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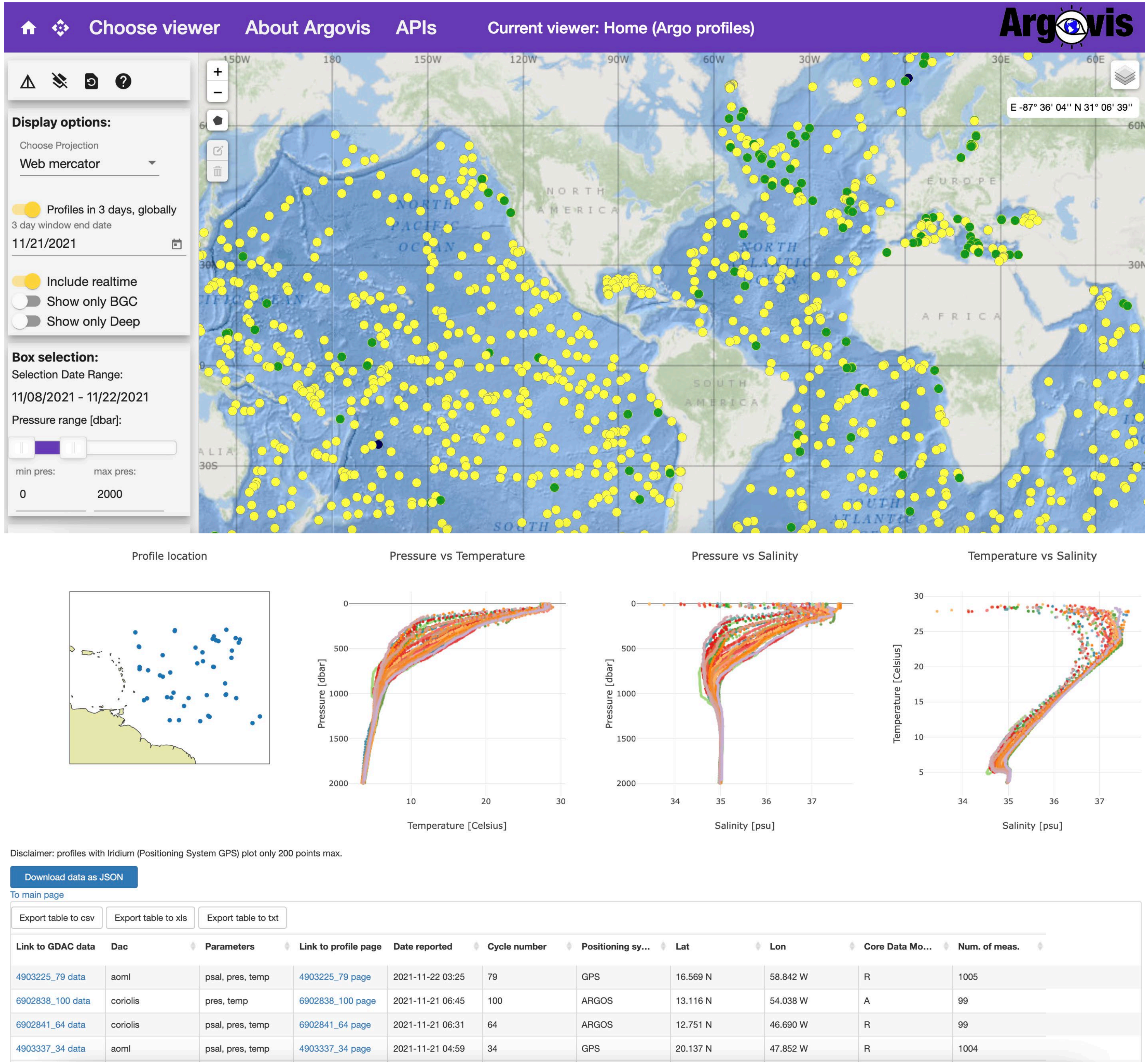
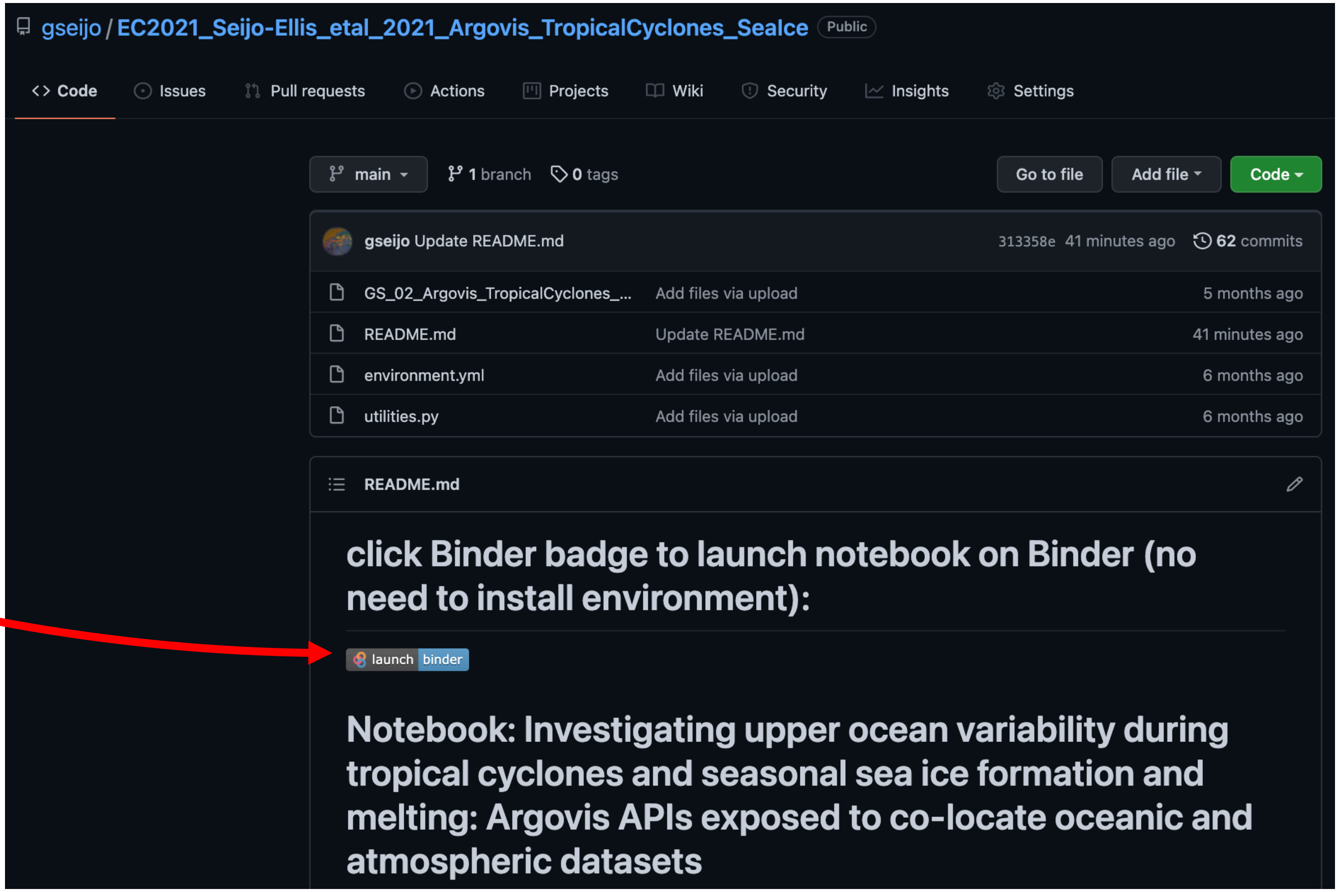
What is Argovis?

- Argo profile data base.
- Allows access to Argo profiles via API.
- Visualize temperature, salinity and Biogeochemistry data by location. (talk in the Data Visualization Tools demo session by Dr. Donata Giglio, Nov 29 @ 19:00 CET)
- View float trajectory forecasts.
- Compare gridded fields.
- **Co-locate Argo data with weather events and sea-ice.**

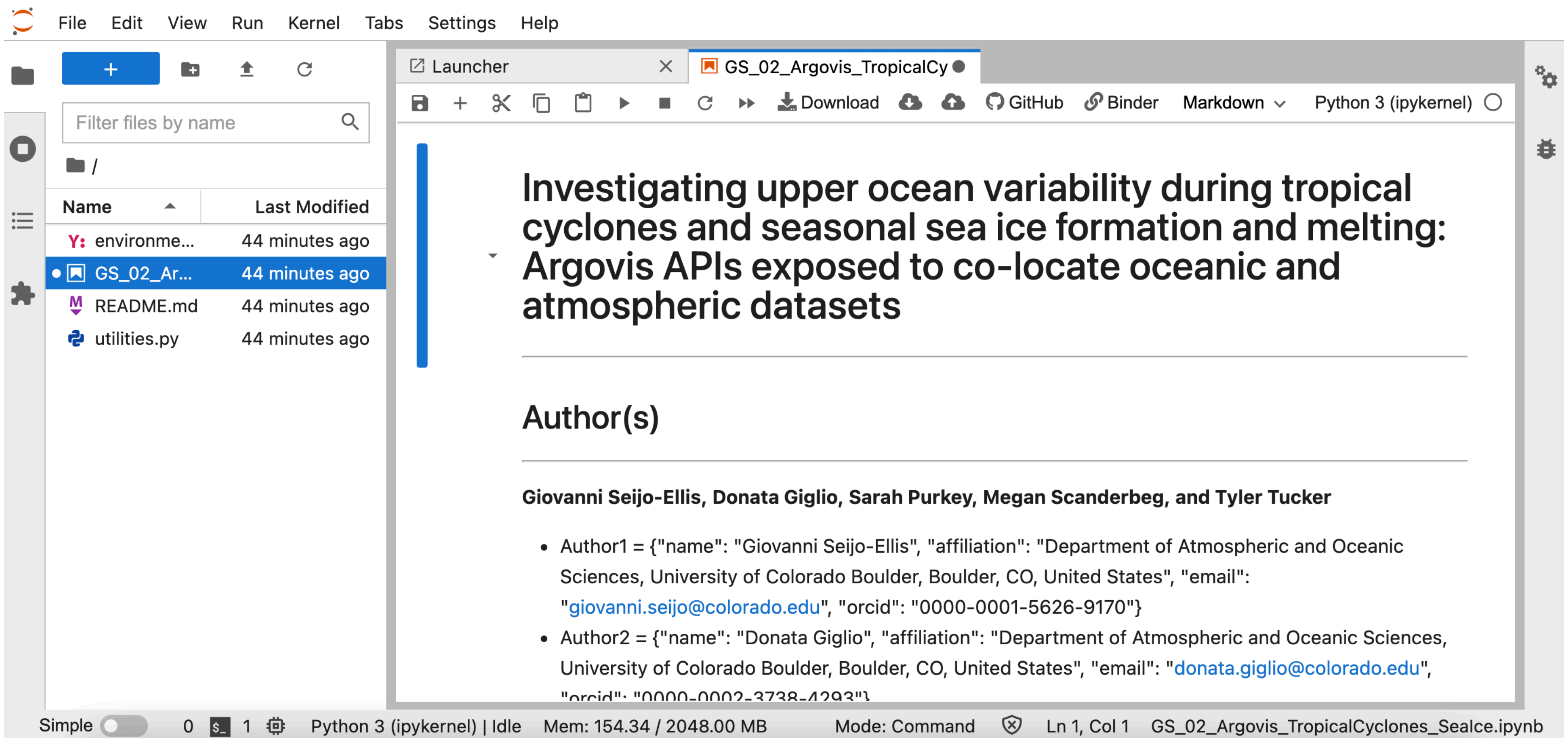


Python notebook: Investigating upper ocean variability during tropical cyclones and seasonal sea ice formation and melting: Argovis APIs exposed to co-locate oceanic and atmospheric datasets

- DOI: 10.5281/zenodo.5496351
- https://github.com/gseijo/EC2021_Seijo-Ellis_etal_2021_Argovis_TropicalCyclones_SeaIce
- Repository built on Binder (click badge to launch without installing environment or libraries!)



Two interactive educational activities with built-in questions and relevant scientific information using Argovis APIs to query and visualize data via python functions.



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Activity 1: Changes in oceanic properties before and after the passage of a tropical cyclone

In this first part of the analysis, the user will extract and plot all Tropical Cyclones (TC) for a particular time-window (defined by the user) via the new TC/storm track data Argovis API. The Argovis database for TC was created using publicly available data by the Joint Typhoon Warning Center and the National Hurricane Center and the Central Pacific Hurricane Center. Once the map of TC tracks is displayed, the user will obtain the names of the plotted TCs (when available) and will be able to choose any TC of interest. Once a TC of interest has been identified, a second API will be used to co-locate Argo observations along the track of interest using a user-defined co-location strategy. A map with the TC track and Argo float locations of interest will be generated. We then compare the dates of the observations with the dates of the TC's passage to identify profiles before and after. The notebook will print available observations along the track before and after the TC's passage. Finally, a plot of temperature and salinity profiles is generated. The profiles are color coded: black (before TC passage), red (after TC passage).

Learning goals:

1- Use Argovis and Python to query Argo float and TC track datasets, parse them, and generate plots.

2- Describe and estimate ocean temperature and salinity changes due to the passage of a Tropical Cyclone.

3- Work collaboratively with your team to answer questions throughout the activity.

Q3. During what time of the year do you expect Southern Hemisphere tropical cyclones to occur? How about tropical cyclones in the Northern Hemisphere? See:https://www.aoml.noaa.gov/hrd-faq/#when-is-hurricane-season.

insert Q3 answer here.

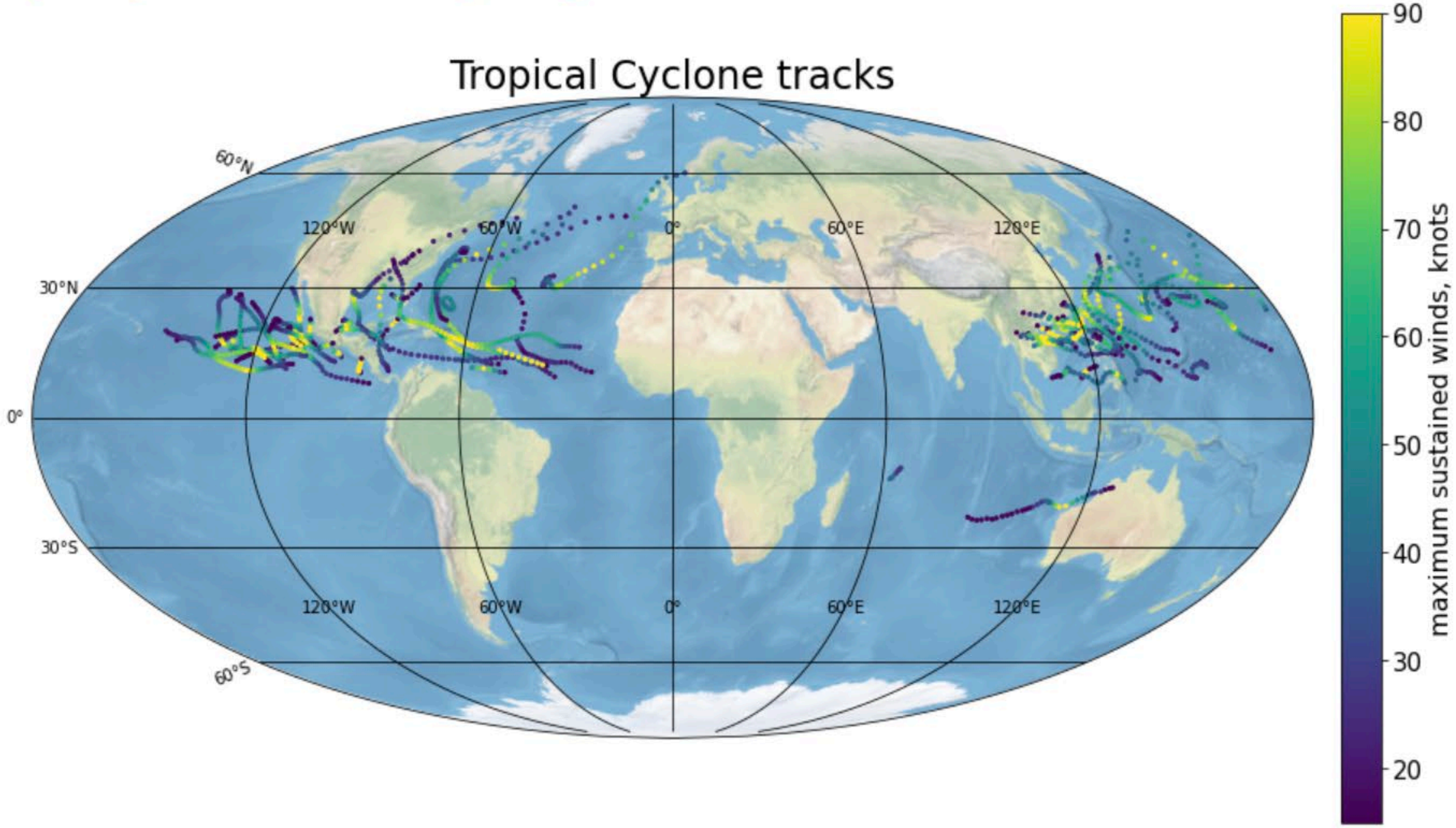
1- Define a time window
2- Plot TC tracks within time window
3- Choose a TC
4- Co-locate Argo profiles along selected track
5- Plot temperature and salinity before and after passage of TC
6- Answer questions during activity leveraging provided information and results from the activity.

Based on your answer to Q3 define a time window for which to download TC data in the Northern Hemisphere:

[5]:
```
#User inputs:
#format: 'yyyy-mm-dd'
#Disclaimer: time windows longer than 3 months may results in data query errors.
start = '2017-07-01'
end = '2017-10-30'
```

[6]:
```
TCs = TC_and_storms_view(startDate=start,endDate=end,tag_TC_or_SH_FILT='TC') #startDate='2018-07-15',endDate='2018-09-15')
```

https://argovis.colorado.edu/tc/findByDateRange?startDate=2017-07-01T00:00:00&endDate=2017-10-30T00:00:00



Caption: *The figure generated shows Northern Hemisphere TC tracks for the selected time window. Each dot along the track shows the storm's position at a given time. The color of each position shows the maximum sustained winds in knots.*

Co-locating Argo profiles along TC track

Print a list of named tropical cyclones included in the map above for the Northern Hemisphere:

[7]:
```
for x in TCs:
    if 'name' in x.keys():
        print('ID: ' + x['_id']+'; '+x['name']+' '+str(x['year']))
```

```
ID: AL182017_HURDAT2; PHILIPPE 2017
ID: EP202017_HURDAT2; SELMA 2017
ID: AL172017_HURDAT2; OPHELIA 2017
ID: AL162017_HURDAT2; NATE 2017
ID: EP192017_HURDAT2; RAMON 2017
ID: AL152017_HURDAT2; MARIA 2017
ID: AL142017_HURDAT2; LEE 2017
ID: EP182017_HURDAT2; PILAR 2017
ID: AL122017_HURDAT2; JOSE 2017
ID: EP172017_HURDAT2; NORMA 2017
ID: EP152017_HURDAT2; OTIS 2017
ID: EP162017_HURDAT2; MAX 2017
ID: AL112017_HURDAT2; IRMA 2017
ID: AL132017_HURDAT2; KATIA 2017
ID: EP142017_HURDAT2; LIDIA 2017
ID: AL092017_HURDAT2; HARVEY 2017
ID: EP132017_HURDAT2; KENNETH 2017
ID: AL082017_HURDAT2; GERT 2017
ID: EP122017_HURDAT2; JOVA 2017
ID: AL072017_HURDAT2; FRANKLIN 2017
ID: EP112017_HURDAT2; ELEVEN 2017
ID: EP102017_HURDAT2; IRWIN 2017
ID: AL062017_HURDAT2; EMILY 2017
ID: EP092017_HURDAT2; HILARY 2017
ID: EP072017_HURDAT2; GREG 2017
ID: EP062017_HURDAT2; FERNANDA 2017
ID: EP082017_HURDAT2; EIGHT 2017
ID: AL052017_HURDAT2; DON 2017
ID: EP052017_HURDAT2; EUGENE 2017
ID: AL042017_HURDAT2; FOUR 2017
ID: EP042017_HURDAT2; DORA 2017
```

Select a storm from the list above (name and year):

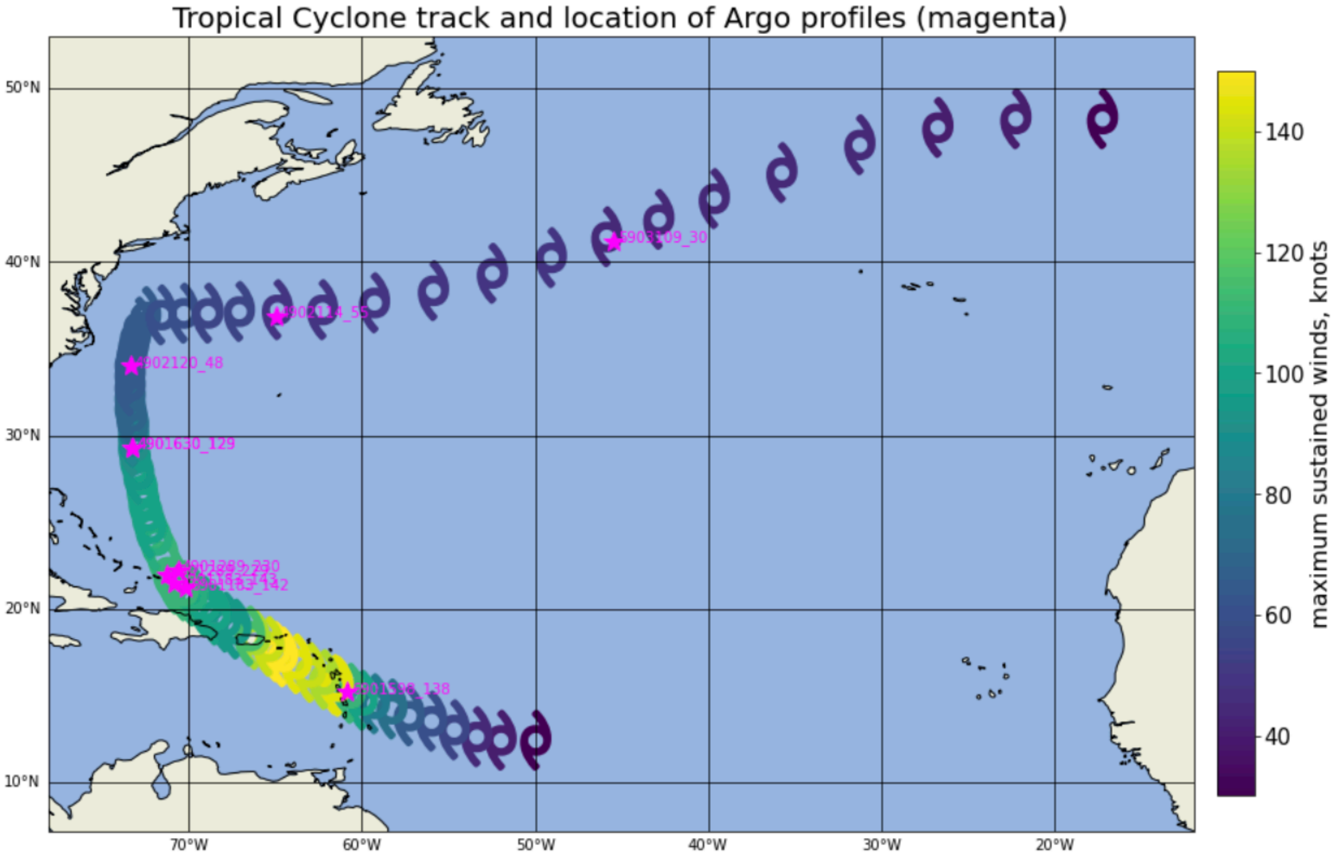
[8]:
```
#User inputs:
tc_name = 'maria'#all lowercase
tc_year = 2017
```

[10]:
```
#User inputs:
#max number of days before and after TC passage to get profile pairs:
delta_days = 7
dx = .75 #degrees longitude
dy = .75 #degree latitude
presRange=[0,100] #decibar, [dbar] to plot profile. Larger range results in longer processing time
```

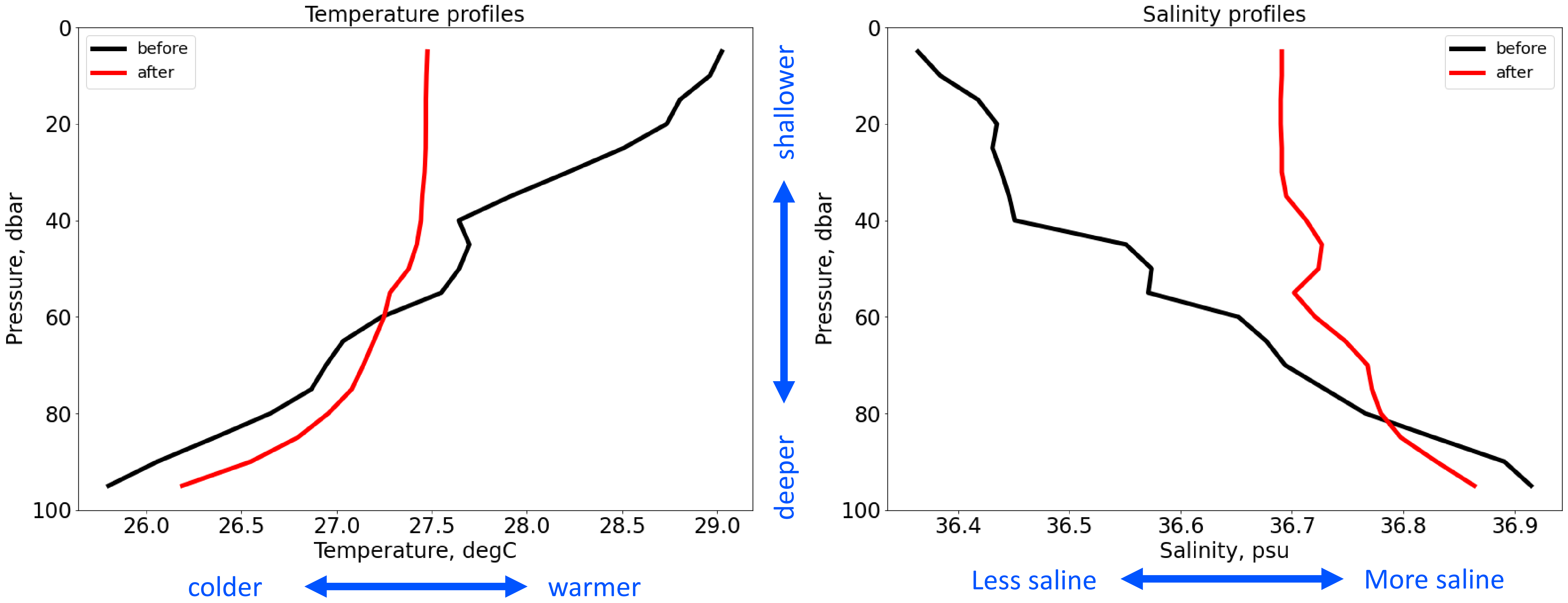
Co-locate Argo profiles along TC track and map location of profiles and TC track:

[11]:
```
df                            = get_track_for_storm(tc_name,tc_year)
[prof_beforeTC,prof_afterTC] = map_TC_and_Argo(df, delta_days=delta_days, dx=dx, dy=dy, presRange=presRange,printing=True, printing_flag=df['_id'][0])
```

https://argovis.colorado.edu/tc/findByNameYear?name=maria&year=2017



Caption: *The figure generated here shows a map of the selected TC track. As before, each storm symbol shows the position of the storm and the color shows the TC's maximum sustained winds in knots. Magenta stars show the position of Argo profiles co-located with the TC track.*



For this storm:

Left: Upper ocean temperatures decrease (become colder) after tropical cyclone.
Right: Upper ocean salinity increase (become saltier) after tropical cyclone.

Activity 2: Changes in oceanic properties as sea ice forms

The second activity in this notebook will guide users to explore sea-ice coverage estimates from SOSE and examine how ocean properties (as observed by Argo floats) change as sea-ice forms. For this, we will leverage the Argo float position QC flag: QC flag = 8, indicates that the position of the float is estimated. This may happen when the float does not surface because it is trapped und
SOSE sea-ice estimate and location of Argo floats will be generated. A list of floats with estimated positions (i.e. thought to be u
the list) in order to identify when the float was thought to be under sea-ice. Finally, the user will generate a multi-panel plot sho
recorded by the float, and c) ocean salinity profiles in time as recorded by the float. SOSE sea-ice fraction is 0 if there is no ice

1- Define a a date and region in the S.O.
2- Co-locate Argo profiles within the defined region and date.
3- Map SOSE estimate for sea-ice fraction and Argo profile locations for selected region and date.
4- Select a profile, plot its location and its QC flag history for position.
5- Plot temperature, salinity and position QC flag along with co-located sea-ice fraction from SOSE.
6- Answer questions during activity leveraging provided information and results from the activity.

Learning goals:

1- Use Argovis and Python to query Argo float and SOSE datasets, parse them, and generate plots.

2- Describe ocean temperature and salinity changes as sea-ice forms and melts.

3- Work collaboratively with your team to answer questions throughout the activity.

Q10. What is SOSE and what type of data does it leverage for its sea-ice estimates? (see: http://sose.ucsd.edu/sose.htm

insert Q10 answer here.

Q11. Does SOSE include Argo float observations? If so, do you expect the SOSE sea-ice estimates to be consistent with

insert Q11 answer here.

Data processing and analysis

Mapping SOSE sea-ice and Argo profile locations

Here the user will define the first set of parameters to begin the second activity. However, the user will define additional parameters as they advance through the activity.

Define region and date of interest for sea ice data:

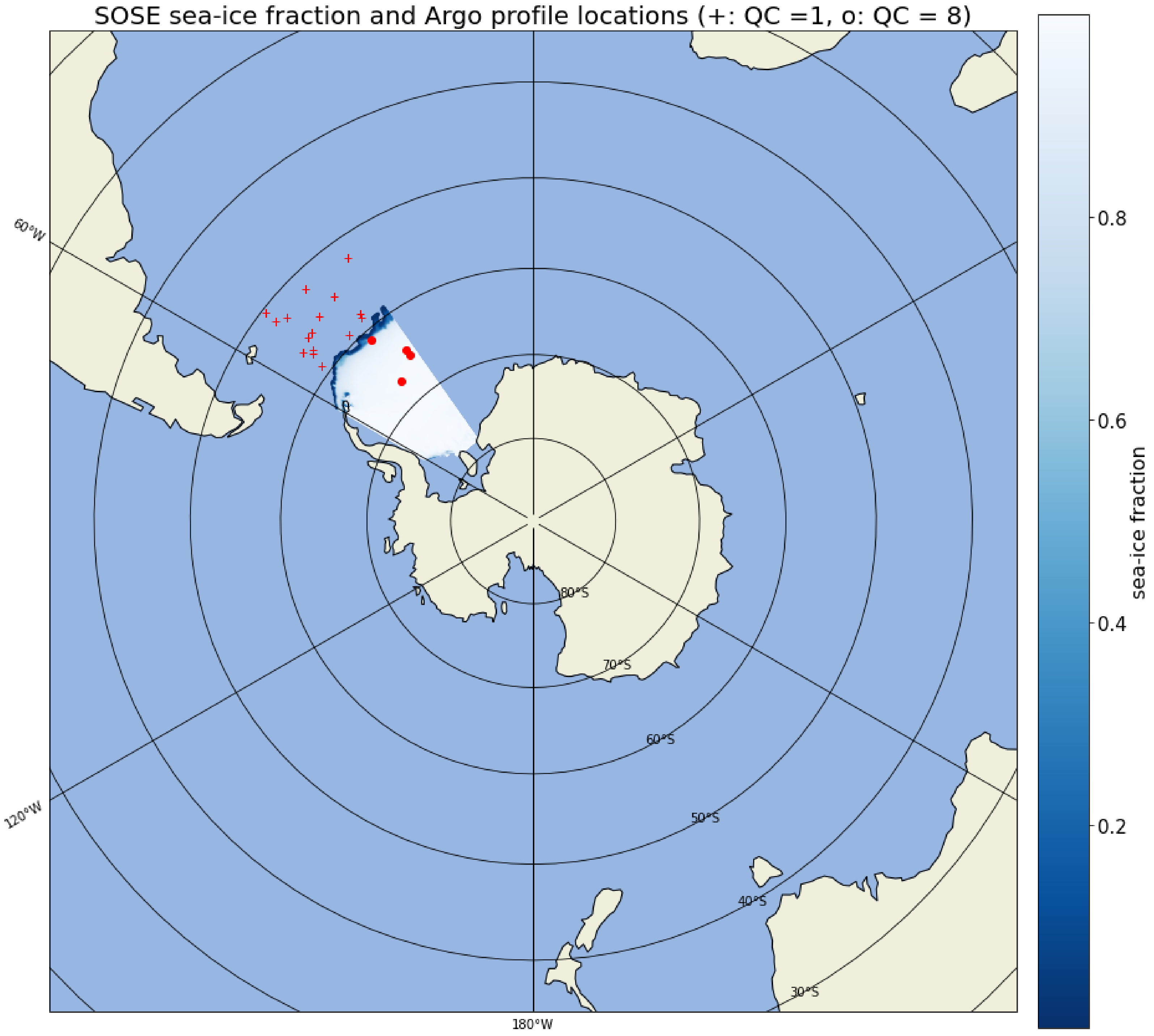
Selected data will be shown on a map, based on which longitude and latitude ranges are defined in xreg_ALL and yreg_ALL and on what date is indicated in date_ALL (see example for the required format). xreg_ALL and yreg_ALL are lists defining longitude and latitude ranges in the overall region of interest: this is needed as there is a limit to the size of data that can be queried at the same time using the Argovis API. Hence, the map is populated one subregion at a time. Please note that the larger the region of interest, the longer the code will take to run, due to the high-resolution of SOSE sea-ice data. We have predefined a region that does not take too long to run, the user is welcome to explore other regions of different sizes.

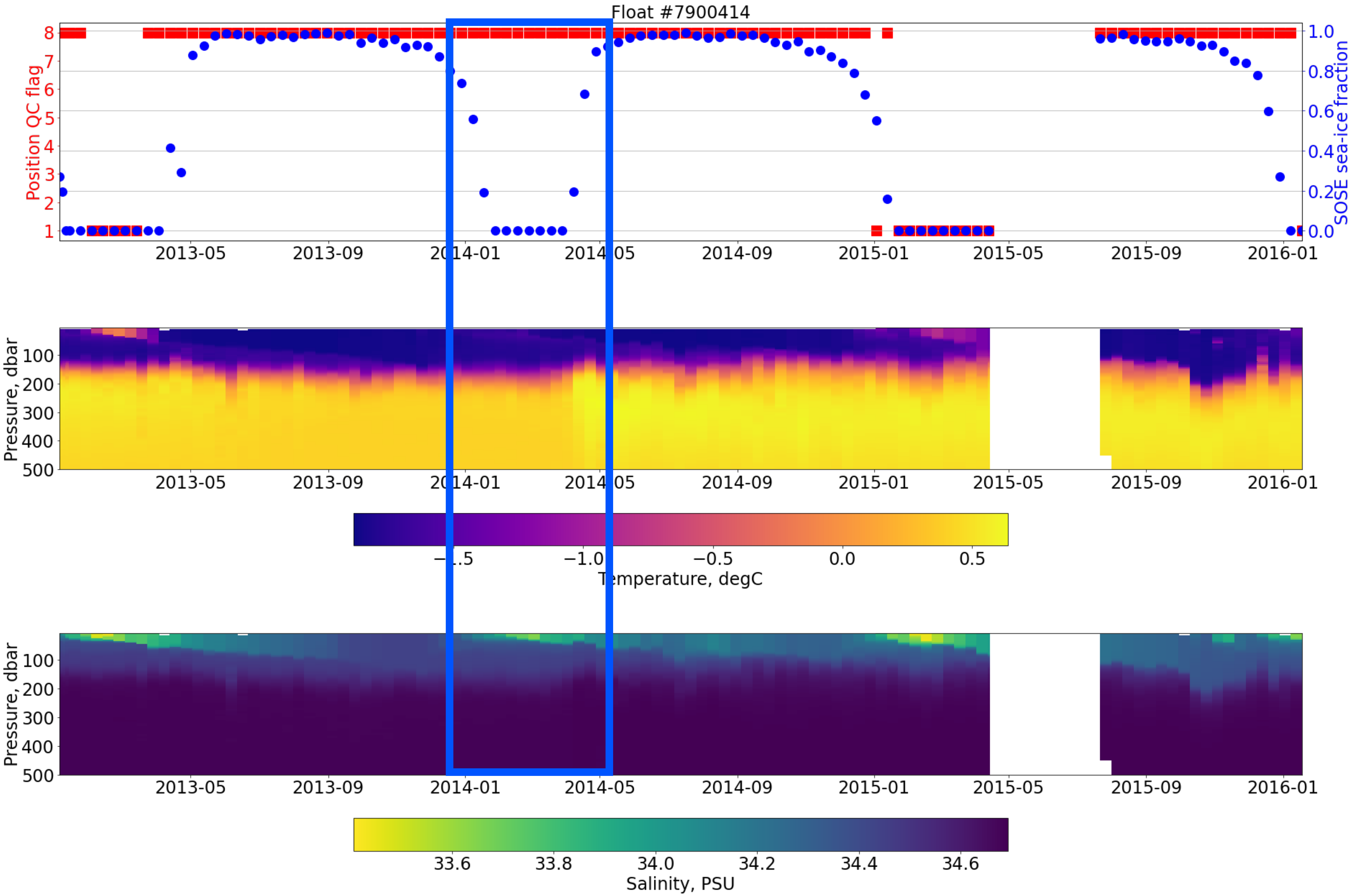
```
#User inputs:
date_ALL = ['2013-06-01']
yreg_ALL = np.arange(-90.,-10.,40.).tolist()
xreg_ALL = np.arange(-60.,-30.,5.).tolist()
```

>>>> Profile ID for profiles under ice (i.e. platformNumber_profileNumber) <<<<
7900408_18
7900401_18
Name: profile_id, dtype: object
7900412_18
7900414_18

QC flag = 8 indicates that the float's position is estimated.

This may happen when the float is believed to be under ice (thus, its position is not transmitted).





Float #7900414
Position QC flag
SOSE sea-ice fraction
2013-05
2013-09
2014-01
2014-05
2014-09
2015-01
2015-05
2015-09
2016-01
Pressure, dbar
Temperature, degC
Salinity, PSU

Activity levels:

Questions are suitable for most levels, but some are more advanced than others and could be removed or included as notes with answers for students to read. Sufficient information is provided throughout the notebook to answer all questions.

- Beginner: use the ‘user-defined’ parameters setup by the authors (i.e., do not make any changes and run the notebook as is).

- Intermediate: make changes only to the parameters identified as ‘user-defined’ and following the guidelines provided.

- Advanced: make changes freely! Explore! And contact us when something breaks!

Seijo-Ellis, G., Giglio, D., Purkey, S., Scanderbeg, M., Tucker, T., Investigating upper ocean variability during tropical cyclones and seasonal sea ice formation and melting: Argovis APIs exposed to co-locate oceanic and atmospheric datasets, Earth Cube Annual Meeting 2021. DOI: 10.5281/zenodo.5496351

Github:

https://github.com/gseijo/EC2021_Seijo-Ellis_etal_2021_Argovis_TropicalCyclones_SeaIce

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Thanks!