



EARTH CUBE
TRANSFORMING GEOSCIENCES RESEARCH



Argovis: A Next Generation Platform for co-located Oceanic and Atmospheric Data to Accelerate Climate Science Workflows

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Boulder

Outline

- What is Argovis?
- Argovis modules
 - Visualize Argo data by location and time
 - Co-locate Argo with weather events beta
 - Display and compare gridded products beta
- Argovis API: few examples for BGC and Deep Argo
- Summary and future directions

Argovis is a web app and database

The **goal**: make it easy for anyone (both scientists and non-scientists) to visualize and access co-located datasets using a browser or not



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Datasets available:

- Argo profiles*, curated set
- RG2009 climatology (in progress)
- Atmospheric Rivers Climatology by GW2015 (in progress)
- Float trajectory forecasts by Chamberlain et al.



*<http://doi.org/10.17882/42182>

RG2009: Roemmich and Gilson, 2009

GW2015: Guan and Waliser, 2015

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Stay tuned for more gridded products (e.g. B-SOSE, SST, SSH, precipitation, winds, sea ice coverage, WOA18, ...), weather events (e.g. tropical cyclones), ...
Take a survey (on the website) and make your request!

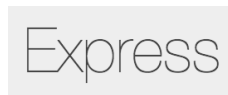
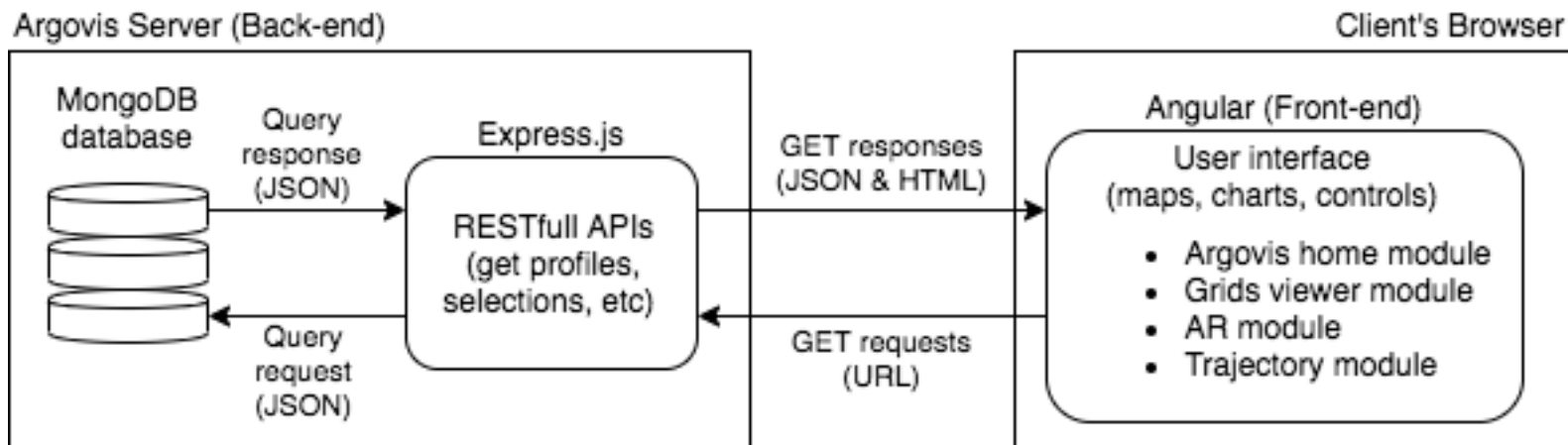
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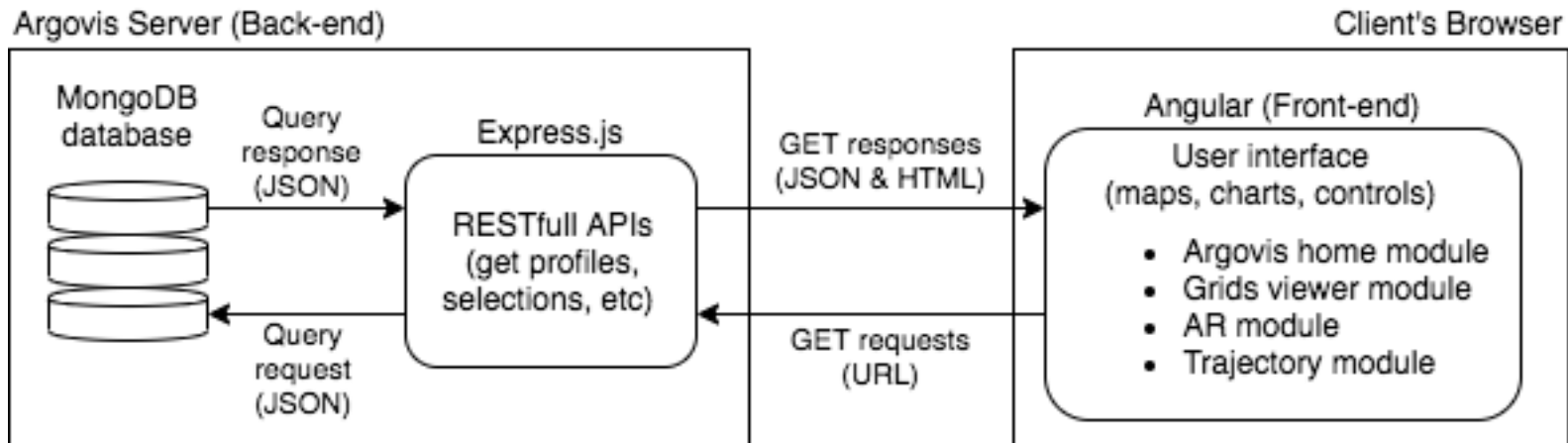
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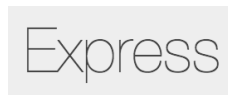
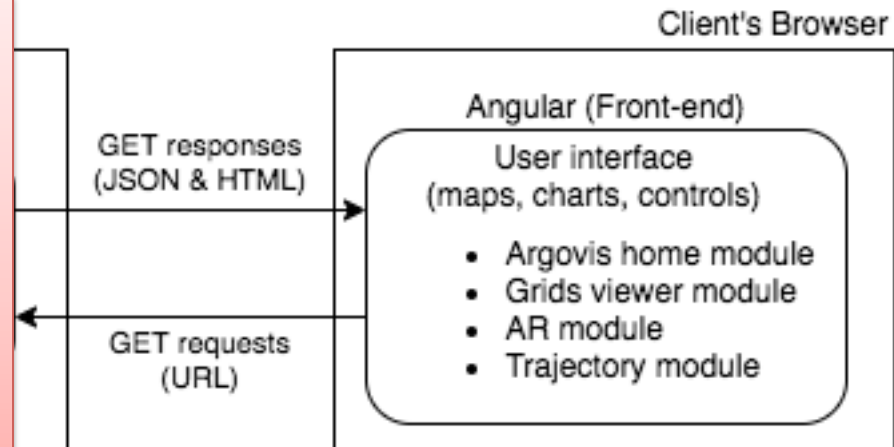


Tucker, T., D. Giglio, M. Scanderbeg, and S.S. Shen, 2020: *Argovis: A Web Application for Fast Delivery, Visualization, and Analysis of Argo Data*. J. Atmos. Oceanic Technol., 37, 401–416, <https://doi.org/10.1175/JTECH-D-19-0041.1>

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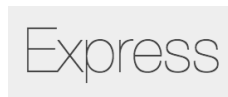
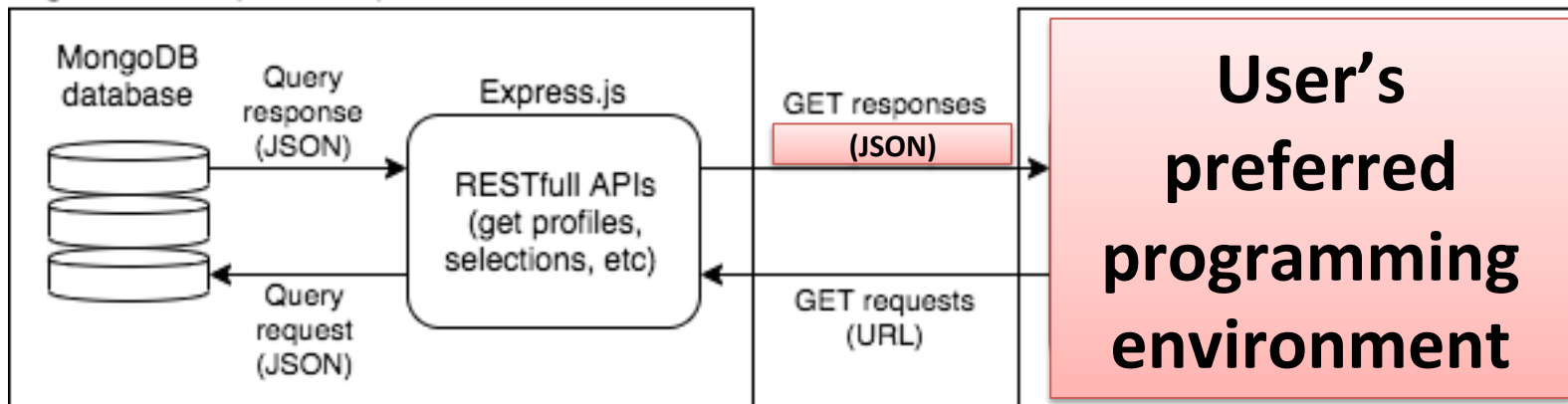
Some of the datasets will not be stored in Argovis, but accessed through API (e.g. from NASA Earthdata)



Argovis is a web app and database

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Argovis Server (Back-end)



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Profiles globally: a 3-day window



≡ [Home](#) [About Argovis](#) [Tutorials](#) [FAQ](#) [Argovis Module Menu](#) [Take a Survey](#)

Choose Projection
Web mercator

▽

Profiles in 3 days, globally
3 day window end date
3/30/2020

Selection Date Range:
03/18/2020 - 04/01/2020

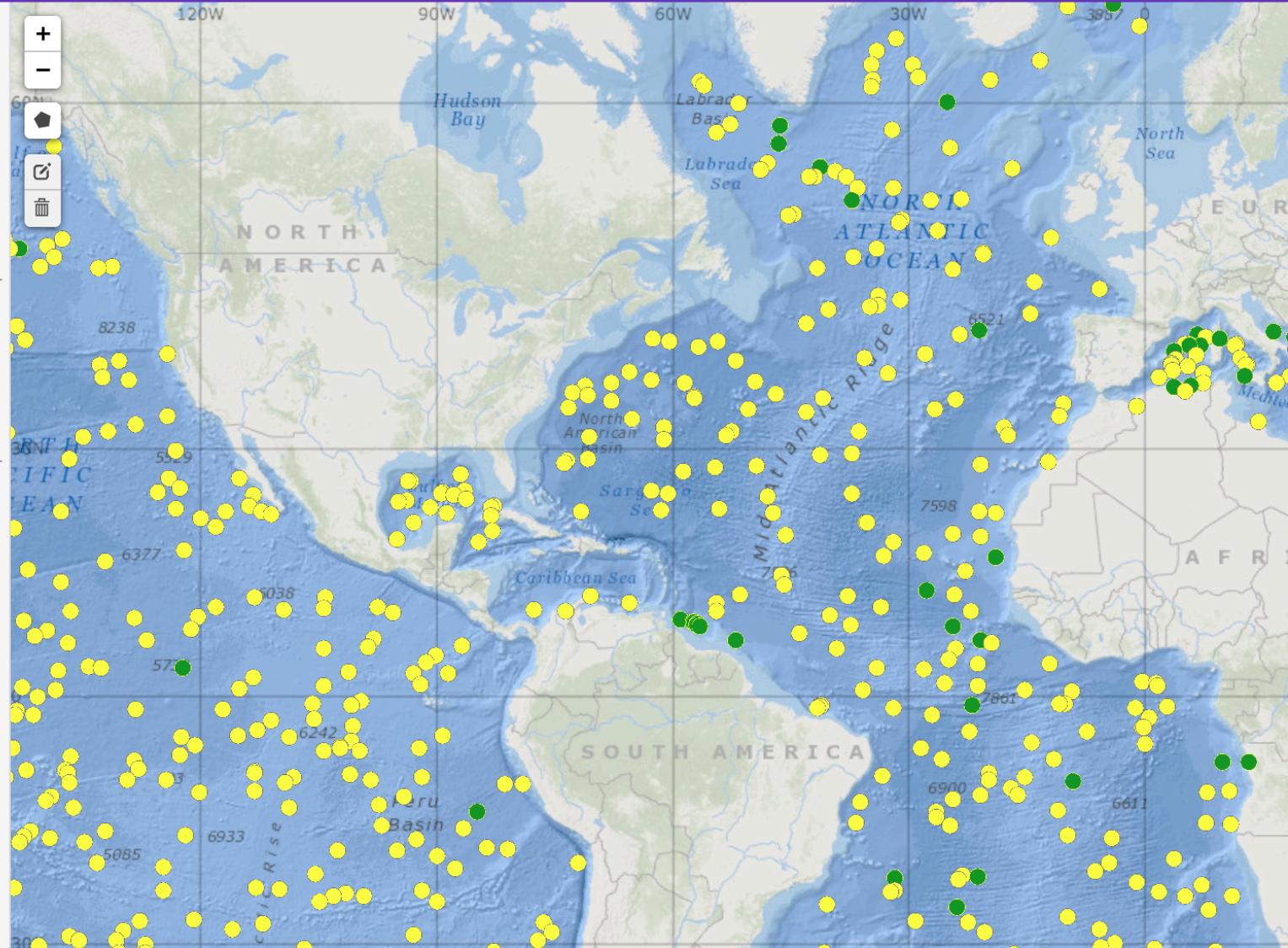
Search platform #

Display options:

Include realtime
 Show only BGC
 Show only Deep

Box selection:
Pressure range [dbar]:

min pres:
0



Toggle to show/hide profiles in a 3-day window, globally.

Select end date for the 3-day window.

Choose Projection
Web mercator

Profiles in 3 days, globally
3 day window end date
3/30/2020

Selection Date Range:
03/18/2020 - 04/01/2020

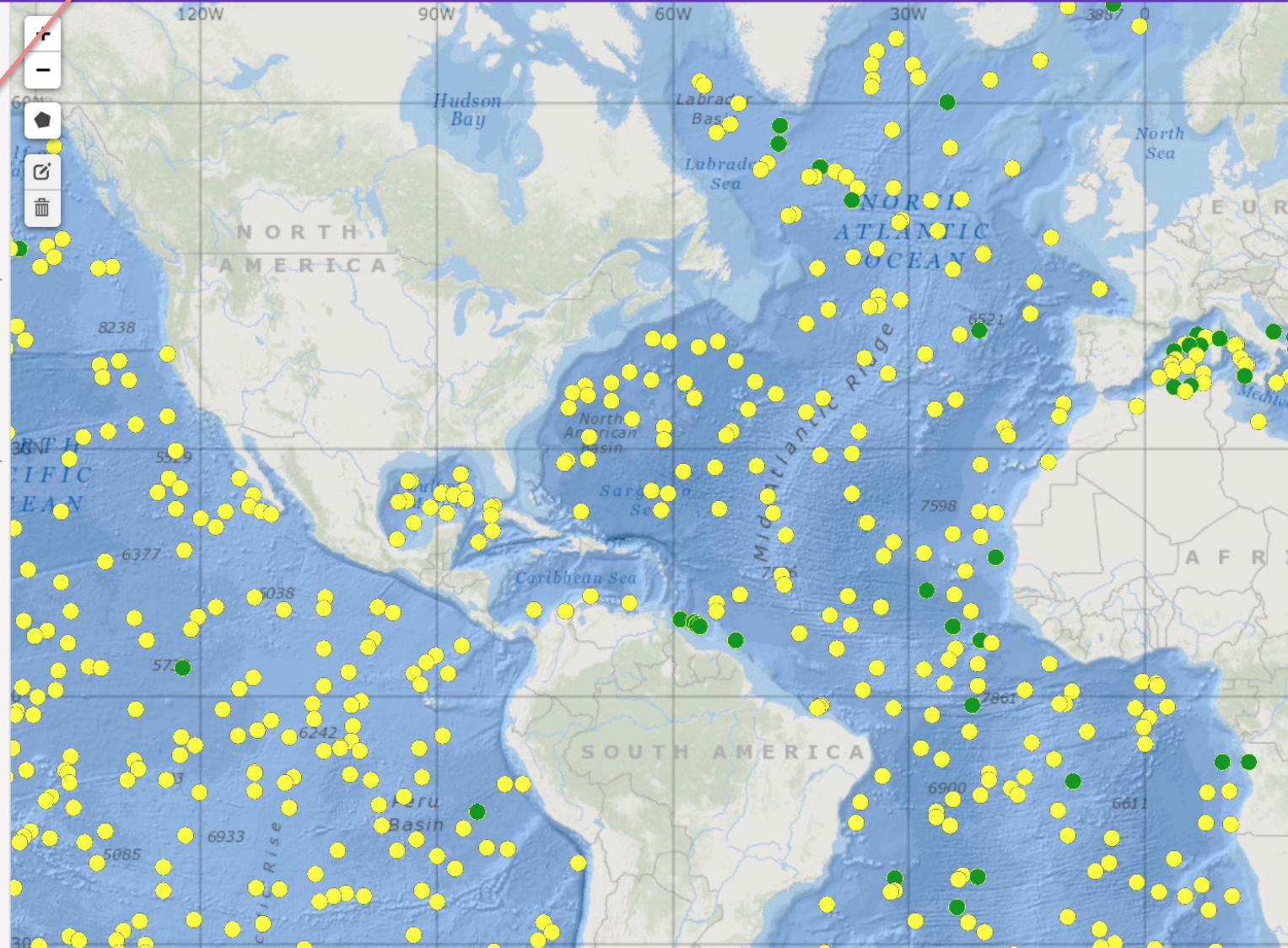
Search platform #

Display options:

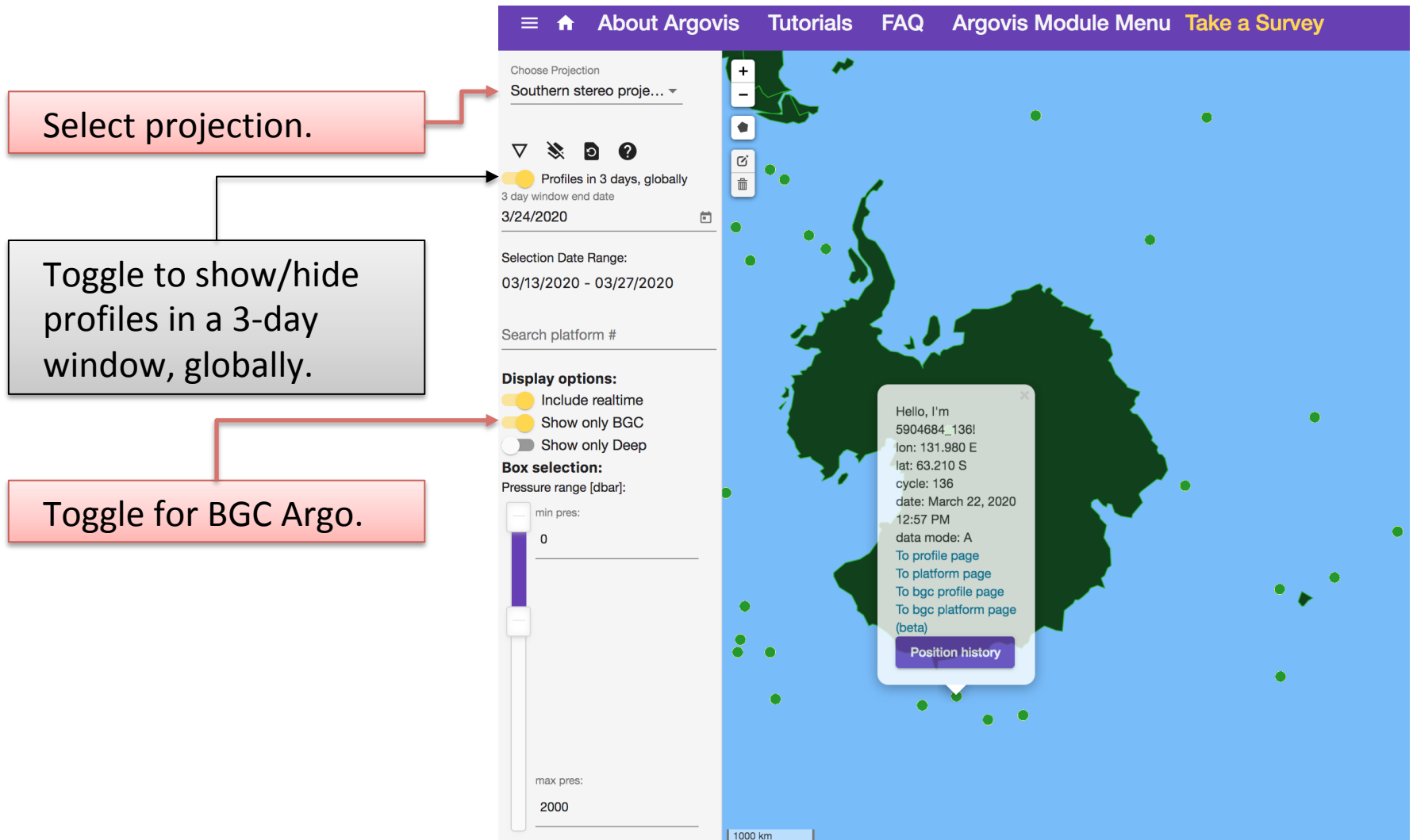
- Include realtime
- Show only BGC
- Show only Deep

Box selection:
Pressure range [dbar]:

min pres:
0



Visualize profiles globally: 3-day window



The screenshot shows the Argovis web application interface. The top navigation bar includes links for 'About Argovis', 'Tutorials', 'FAQ', 'Argovis Module Menu', and 'Take a Survey'. The main content area is split into a left sidebar and a right map panel.

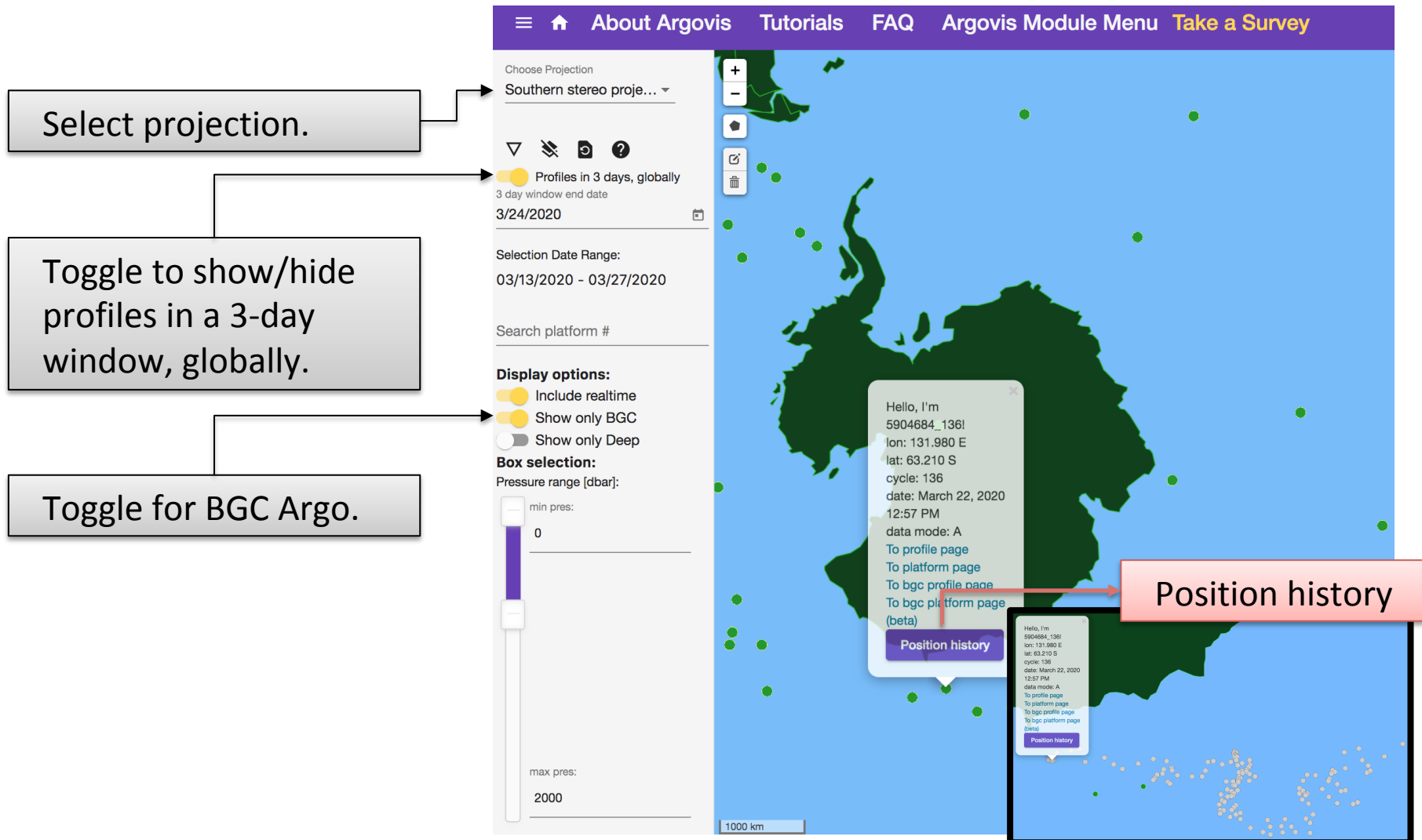
Callout boxes and their targets:

- Select projection.** Points to the 'Choose Projection' dropdown menu, which is currently set to 'Southern stereo proje...'. Below it are icons for map layers and a help icon.
- Toggle to show/hide profiles in a 3-day window, globally.** Points to the 'Profiles in 3 days, globally' toggle switch, which is currently turned on. Below it is the '3 day window end date' field, set to '3/24/2020', with a calendar icon.
- Toggle for BGC Argo.** Points to the 'Display options' section, specifically the 'Show only BGC' toggle switch, which is currently turned on. Other options include 'Include realtime' (checked) and 'Show only Deep' (unchecked).

Map Panel Details:

- The map shows a global view with a dark green landmass and a light blue ocean. Green dots represent Argo profiles.
- A tooltip is displayed over a profile, containing the following information:
 - Hello, I'm 5904684_136!
 - lon: 131.980 E
 - lat: 63.210 S
 - cycle: 136
 - date: March 22, 2020 12:57 PM
 - data mode: A
 - [To profile page](#)
 - [To platform page](#)
 - [To bgc profile page](#)
 - [To bgc platform page \(beta\)](#)
 - [Position history](#)
- A scale bar at the bottom indicates 1000 km.

Visualize profiles globally: 3-day window



The screenshot shows the Argovis web application interface. The top navigation bar includes links for 'About Argovis', 'Tutorials', 'FAQ', 'Argovis Module Menu', and 'Take a Survey'. The main content area is split into a left sidebar and a right map area.

Left Sidebar:

- Choose Projection:** Southern stereo proje... (dropdown)
- Profiles in 3 days, globally:** 3 day window end date 3/24/2020 (calendar icon)
- Selection Date Range:** 03/13/2020 - 03/27/2020
- Search platform #** (input field)
- Display options:**
 - Include realtime
 - Show only BGC
 - Show only Deep
- Box selection:** Pressure range [dbar]:
 - min pres: 0
 - max pres: 2000

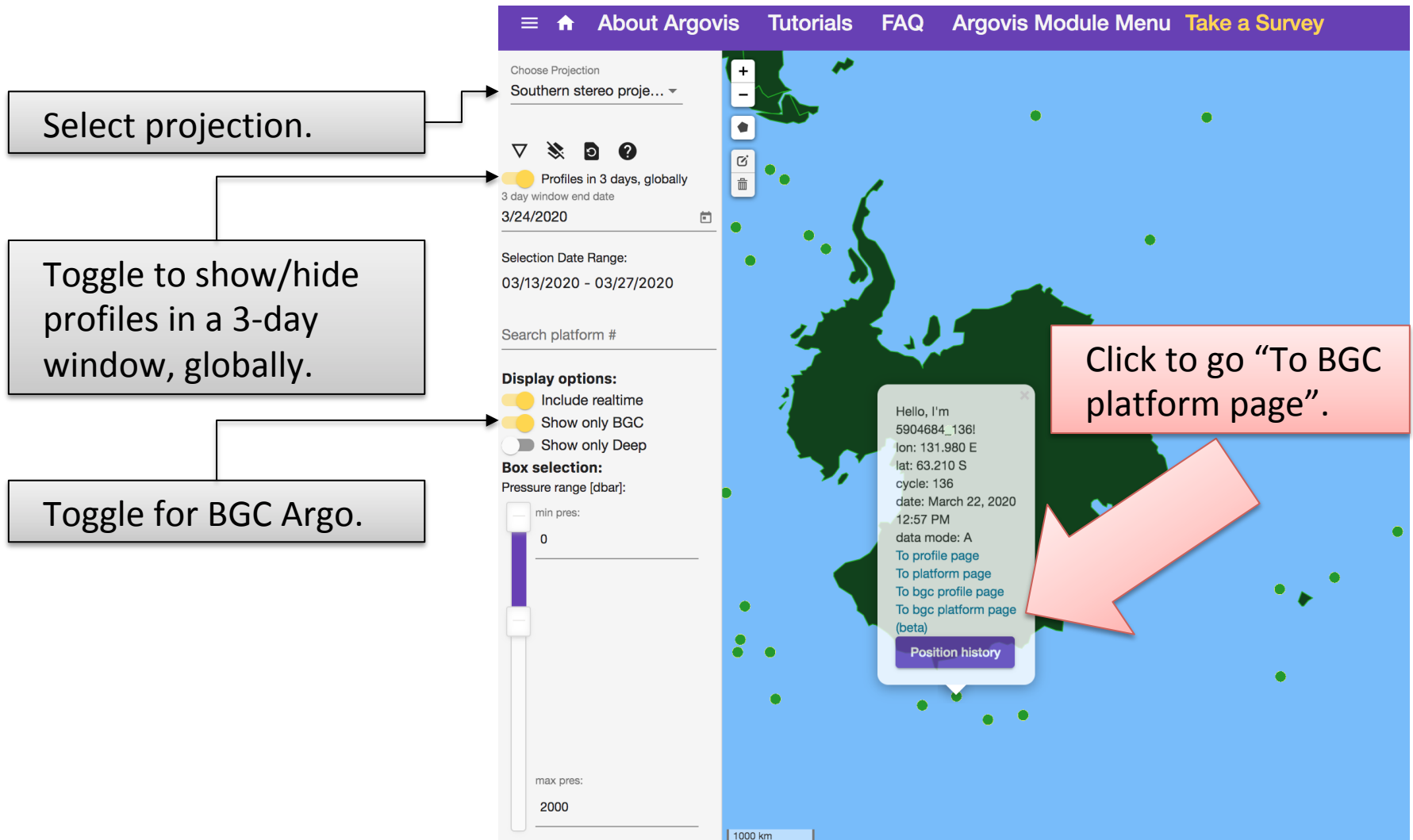
Right Map Area:

- Map showing the Pacific Ocean with green dots representing Argos profiles.
- Information popup for a profile: Hello, I'm 5904684_136! lon: 131.980 E lat: 63.210 S cycle: 136 date: March 22, 2020 12:57 PM data mode: A. Includes links to profile, platform, BGC, and platform pages.
- A red box labeled 'Position history' points to a 'Position history' button in the popup.
- A 1000 km scale bar is at the bottom.

Callouts:

- 'Select projection.' points to the projection dropdown.
- 'Toggle to show/hide profiles in a 3-day window, globally.' points to the 'Profiles in 3 days, globally' section.
- 'Toggle for BGC Argo.' points to the 'Show only BGC' checkbox.
- 'Position history' points to the 'Position history' button in the popup.

Visualize profiles globally: 3-day window



The screenshot shows the Argovis web interface with several callouts:

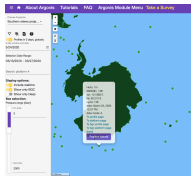
- Select projection.** Points to the "Choose Projection" dropdown menu, which is currently set to "Southern stereo proje...".
- Toggle to show/hide profiles in a 3-day window, globally.** Points to the "Profiles in 3 days, globally" toggle switch, which is currently turned on. Below it, the "3 day window end date" is shown as "3/24/2020" and the "Selection Date Range" is "03/13/2020 - 03/27/2020".
- Toggle for BGC Argo.** Points to the "Display options" section, specifically the "Show only BGC" toggle switch, which is currently turned on. Other options include "Include realtime" and "Show only Deep".
- Click to go "To BGC platform page".** Points to a button in a tooltip that says "To bgc platform page (beta)".

The main interface includes a navigation bar with links for "About Argovis", "Tutorials", "FAQ", "Argovis Module Menu", and "Take a Survey". The map shows a global view with green dots representing profiles. A tooltip for a specific profile provides the following information:

- Hello, I'm 5904684_136!
- lon: 131.980 E
- lat: 63.210 S
- cycle: 136
- date: March 22, 2020 12:57 PM
- data mode: A
- [To profile page](#)
- [To platform page](#)
- [To bgc profile page](#)
- [To bgc platform page \(beta\)](#)
- [Position history](#)

Beta (recently upgraded page, currently only available for BGC floats)

Visualize Argo profiles for a platform



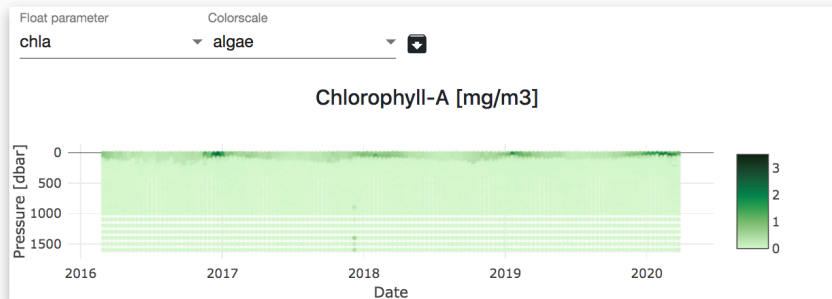
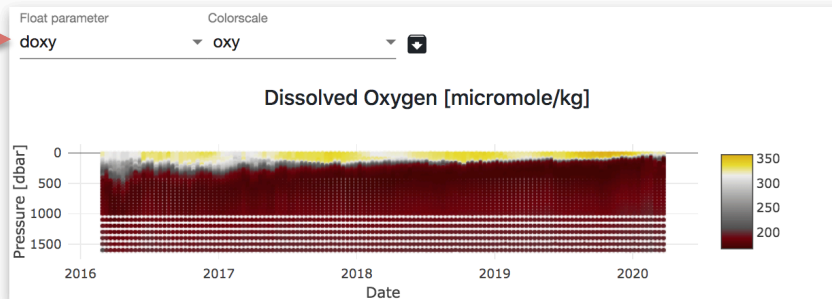
Platform Page

[Home](#)
[About Argovis](#)
[Tutorials](#)
[FAQ](#)
[Argovis Module Menu](#)
[Take a Survey](#)

Beta Product: Still in development!

Select parameter and color-scale

Filter table or sort by column



Platform Number: 5904684

Dac: aoml

Most recent update:
Mar 24th 2020

Number of profiles: 136

Positioning System: GPS

PI: STEPHEN RISER, KENNETH JOHNSON

[link to JCOMMOPS](#)

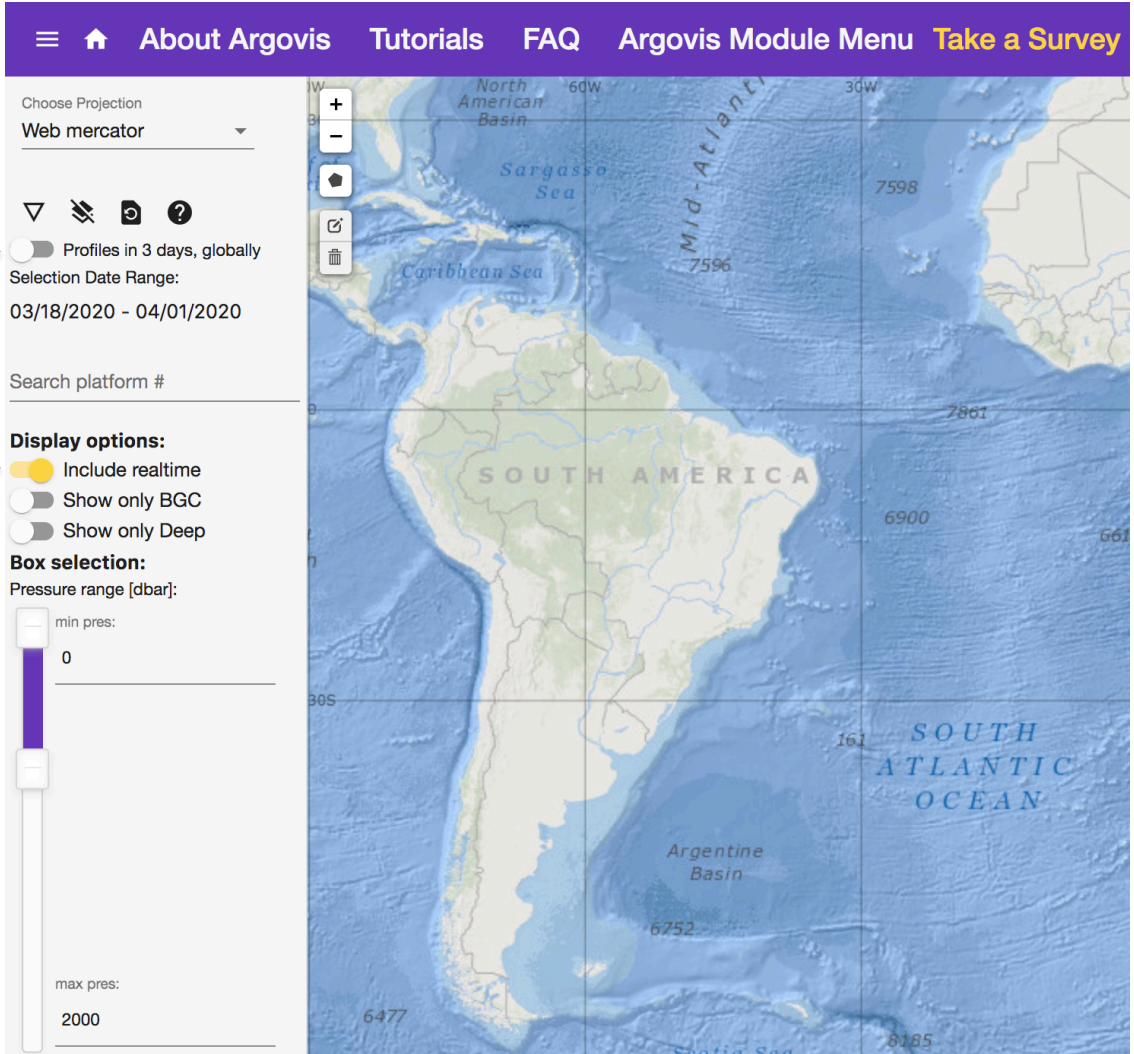
[link to Fleet Monitor](#)

Station Parameters: chla, ph_in_situ_total, temp, doxy, psal, nitrate

Filter

Link to GDAC data	Dac	Date reported	Cycle number	Lat	Lon	Core Data Mode
5904684_1	aoml	February 28th 2016	1	52.978 S	87.658 N	D
5904684_10	aoml	June 5th 2016	10	54.800 S	95.691 N	D

Visualize Argo data by location and time

The screenshot shows the Argovis web application interface. At the top is a purple navigation bar with links for "About Argovis", "Tutorials", "FAQ", "Argovis Module Menu", and "Take a Survey". Below the navigation bar is a control panel on the left side of a map. The control panel includes a "Choose Projection" dropdown menu set to "Web mercator", a "Profiles in 3 days, globally" toggle switch (currently turned off), a "Selection Date Range" of "03/18/2020 - 04/01/2020", a "Search platform #" input field, and "Display options" for "Include realtime" (checked), "Show only BGC" (unchecked), and "Show only Deep" (unchecked). There is also a "Box selection" section with a "Pressure range [dbar]" slider set from 0 to 2000. The map on the right shows a bathymetric view of the Atlantic Ocean, highlighting South America, the Caribbean Sea, the Sargasso Sea, and the Mid-Atlantic Ridge. The map includes a coordinate grid and depth contours.

Toggle to show/hide profiles in 3 days globally.

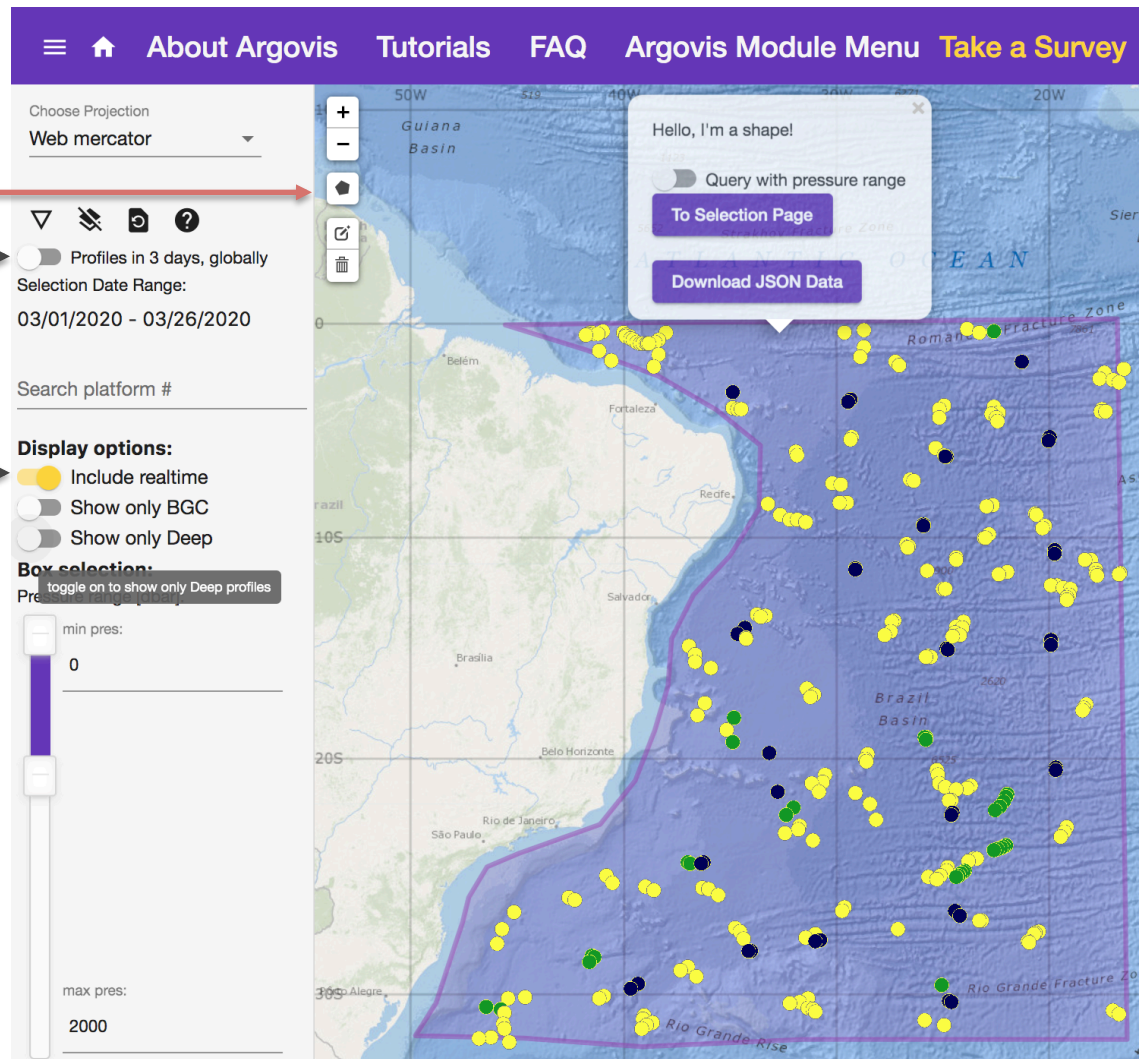
Toggle to include realtime profiles.

Visualize Argo data by location and time

Draw *any* shape of interest.

Toggle to show/hide profiles in 3 days globally.

Toggle to include realtime profiles.

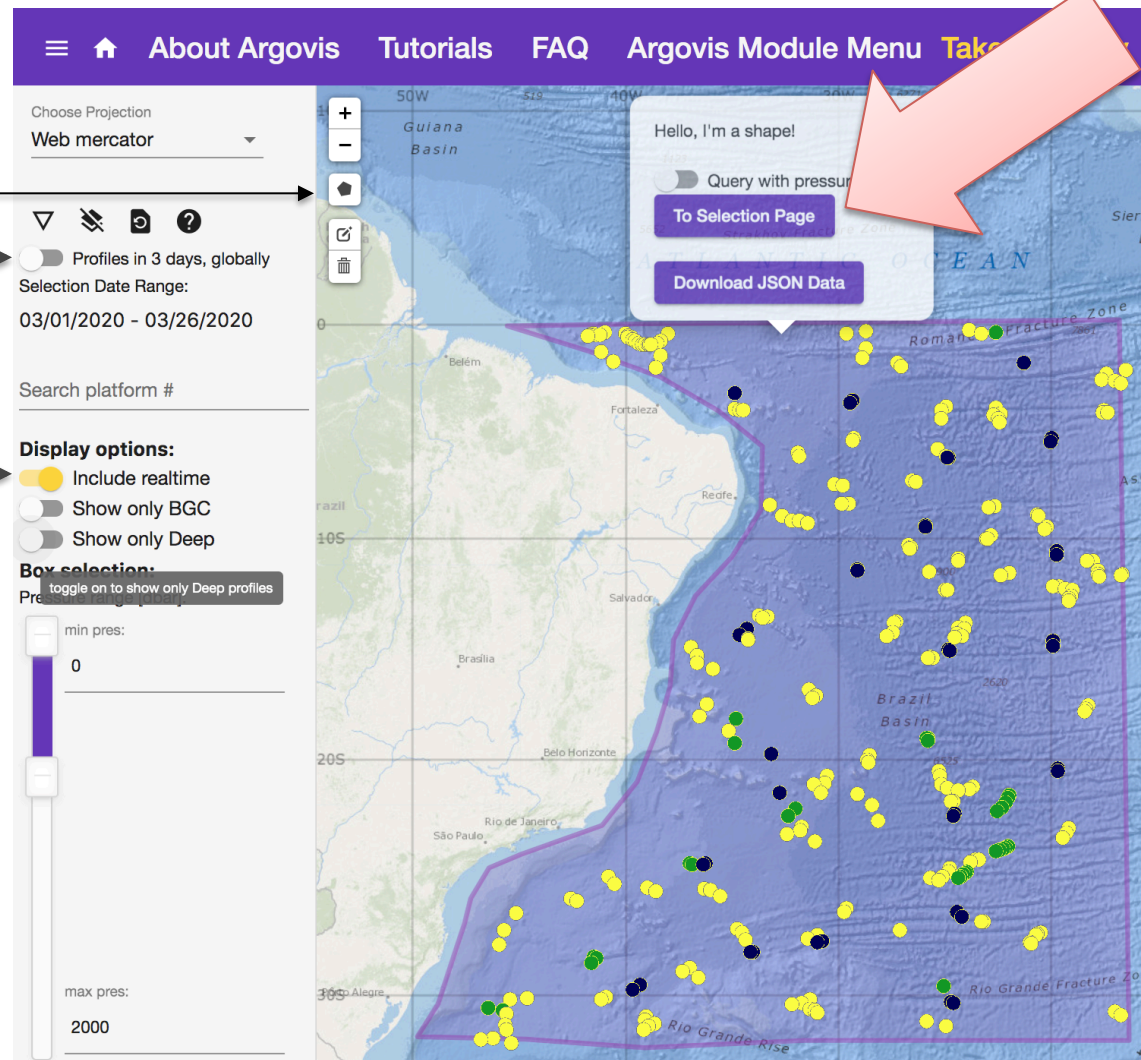


Visualize Argo data by location and time

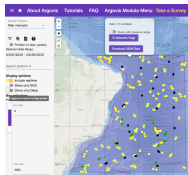
Draw *any* shape of interest.

Toggle to show/hide profiles in 3 days globally.

Toggle to include realtime profiles.



Visualize Argo data by location and time

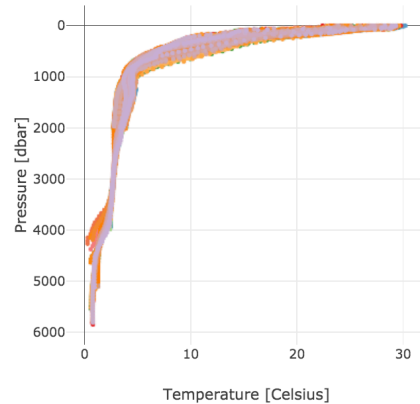


Selection Page (work in progress for BGC variables)

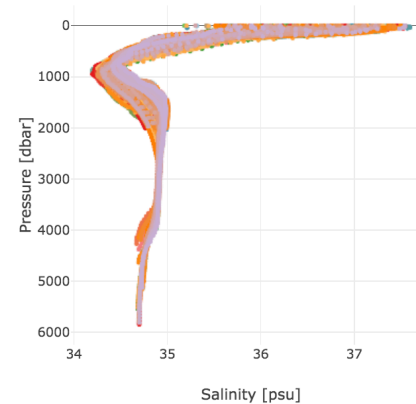
Profile location



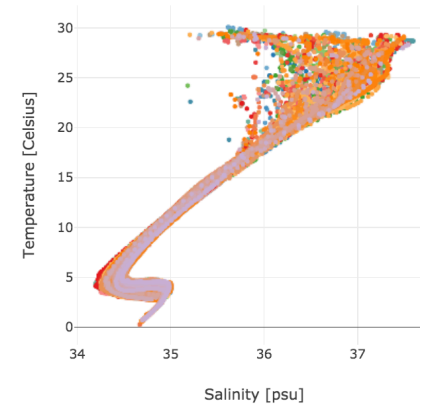
Pressure vs Temperature



Pressure vs Salinity



Temperature vs Salinity



Disclaimer: profiles with Iridium (Positioning System GPS) plot only 200 points max.

[Download data as JSON](#)

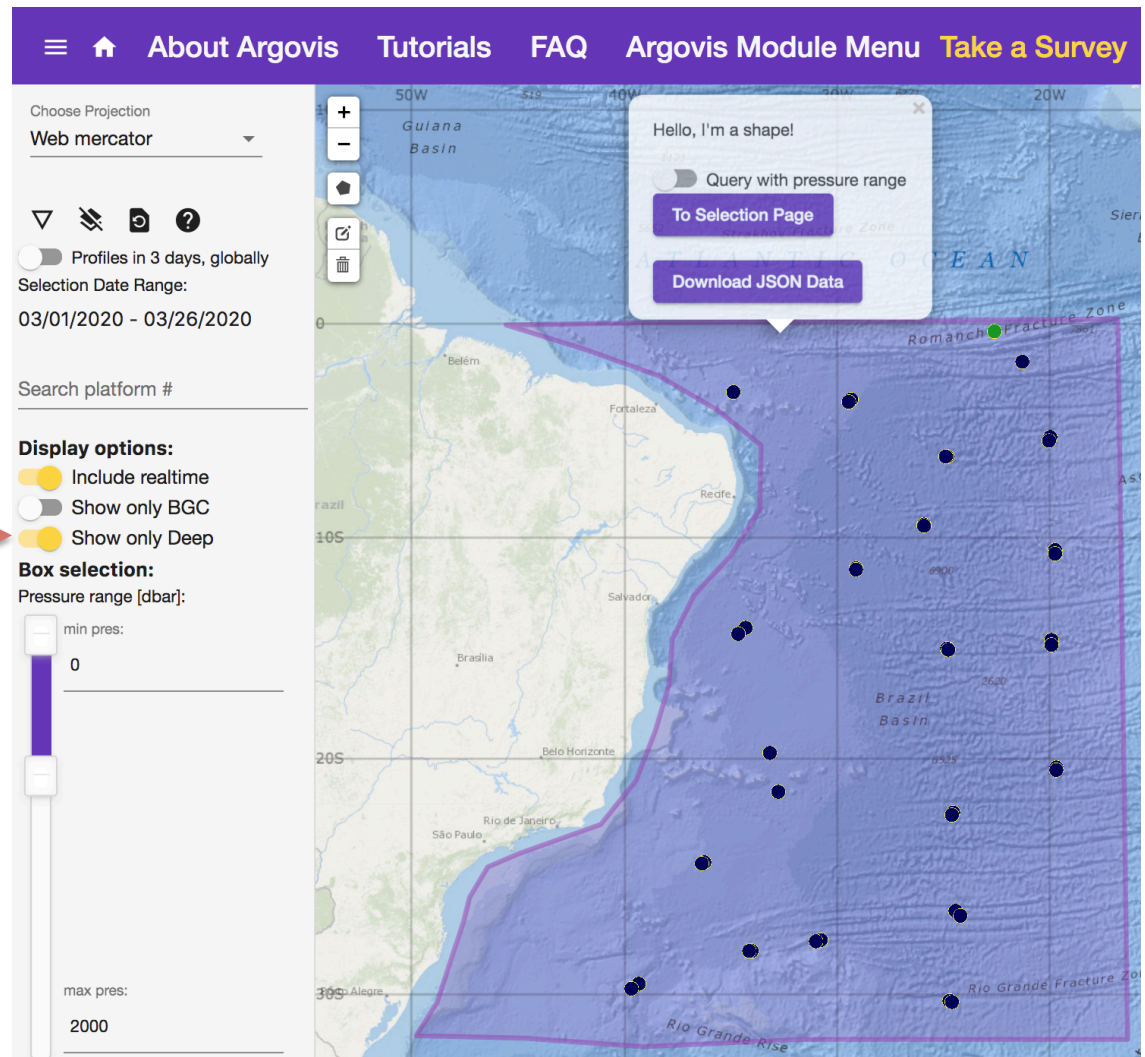
[To main page](#)

Export table to csv Export table to xls Export table to txt

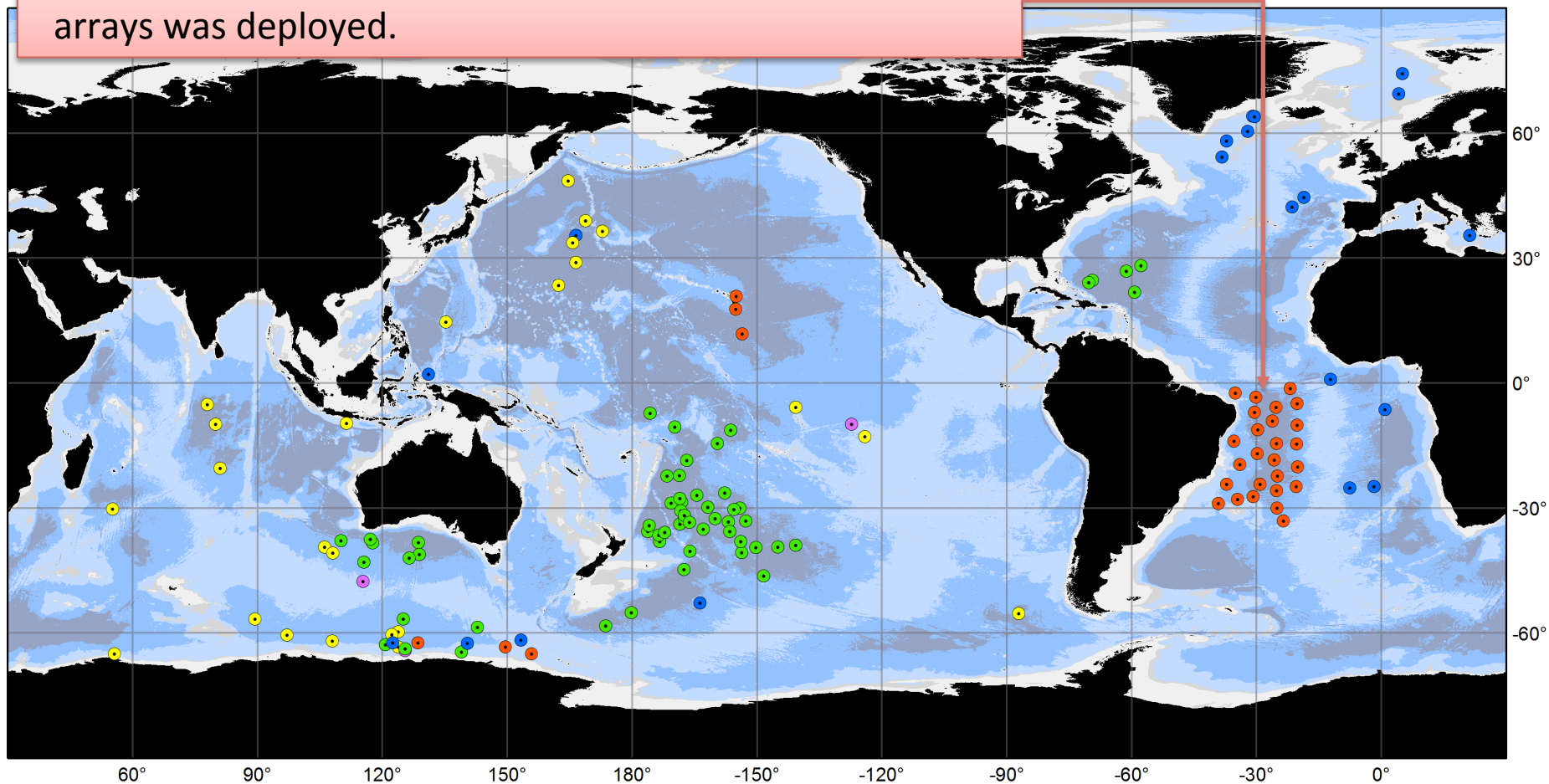
Link to GDAC data	Dac	Parameters	Link to profile p...	Date reported	Cycle number	Positioning s...	Lat	Lon	Core Data M...	Num. of meas.
3902399_14 data	bodc	temp, pres, psal	3902399_14 page	2020-03-25 20:53	14	ARGOS	24.746 S	25.490 W	R	100
3902169_23 data	aoml	pres, psal, temp	3902169_23 page	2020-03-25 20:10	23	GPS	0.069 S	38.418 W	R	1013
3902167_48 data	aoml	temp, pres	3902167_48 page	2020-03-25 19:04	48	GPS	0.137 S	42.142 W	R	1093
3901956_90 data	bodc	temp, pres	3901956_90 page	2020-03-25 17:56	90	GPS	9.634 S	23.420 W	R	556
5905981_53 data	aoml	psal, temp, pres	5905981_53 page	2020-03-25 08:39	53	GPS	28.337 S	41.955 W	A	109
6902984_3 data	coriolis	pres, pres_qc, psal, psal_cc, temp.	6902984_3 page	2020-03-25 07:03	3	GPS	0.005 S	22.974 W	R	957

Visualize Argo data by location and time

Toggle for Deep Argo.



Selected region located where one of the pilot Deep Argo arrays was deployed.



Argo

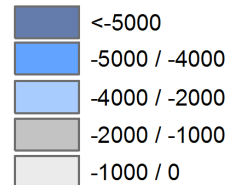
Deep Float Models

February 2020

Latest location of operational floats (data distributed within the last 30 days),

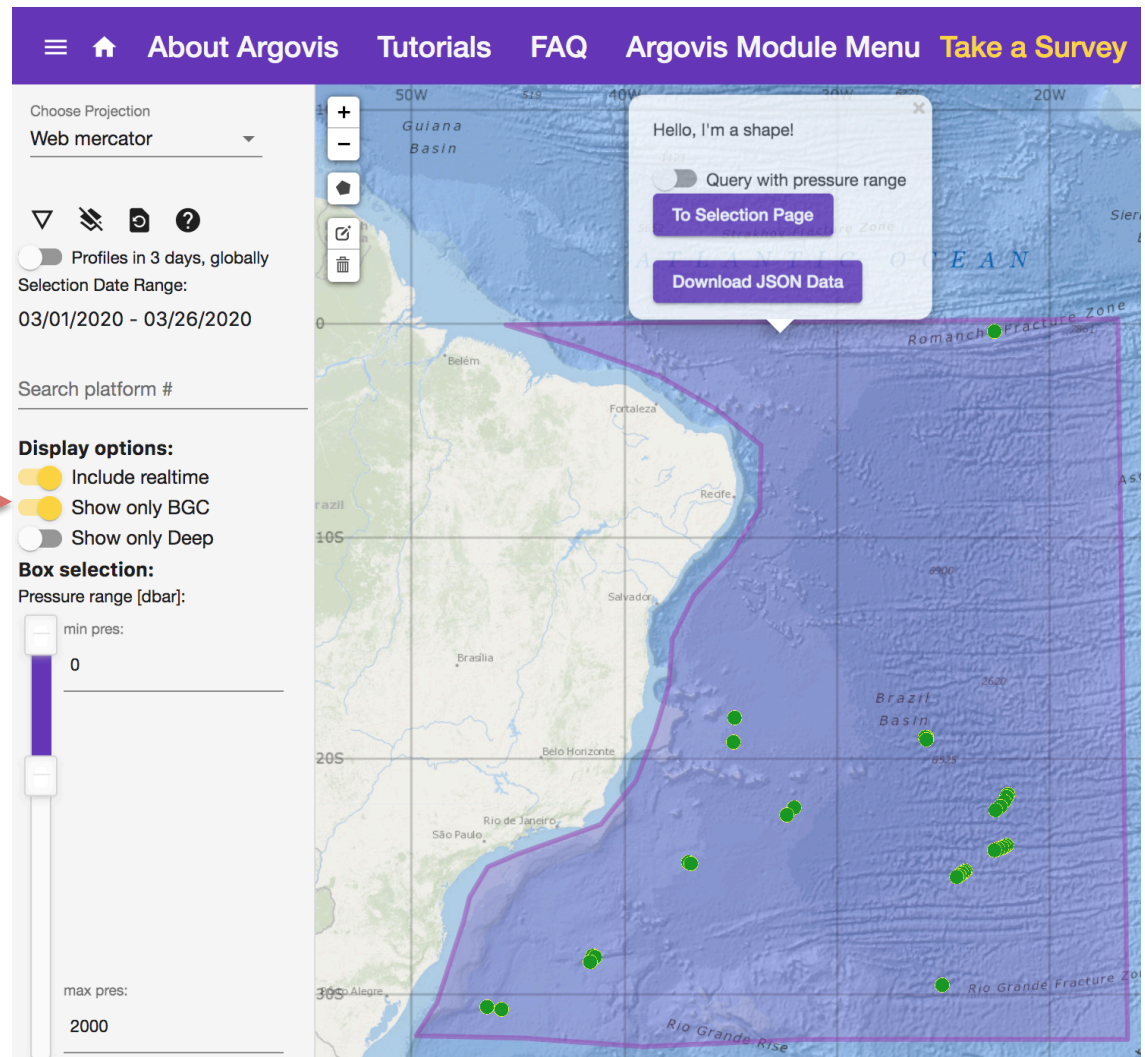
- SOLO_D_MRV (32)
- APEX_D (24)
- ARVOR_D (20)
- NINJA_D (3)
- SOLO_D (57)

ETOPO2



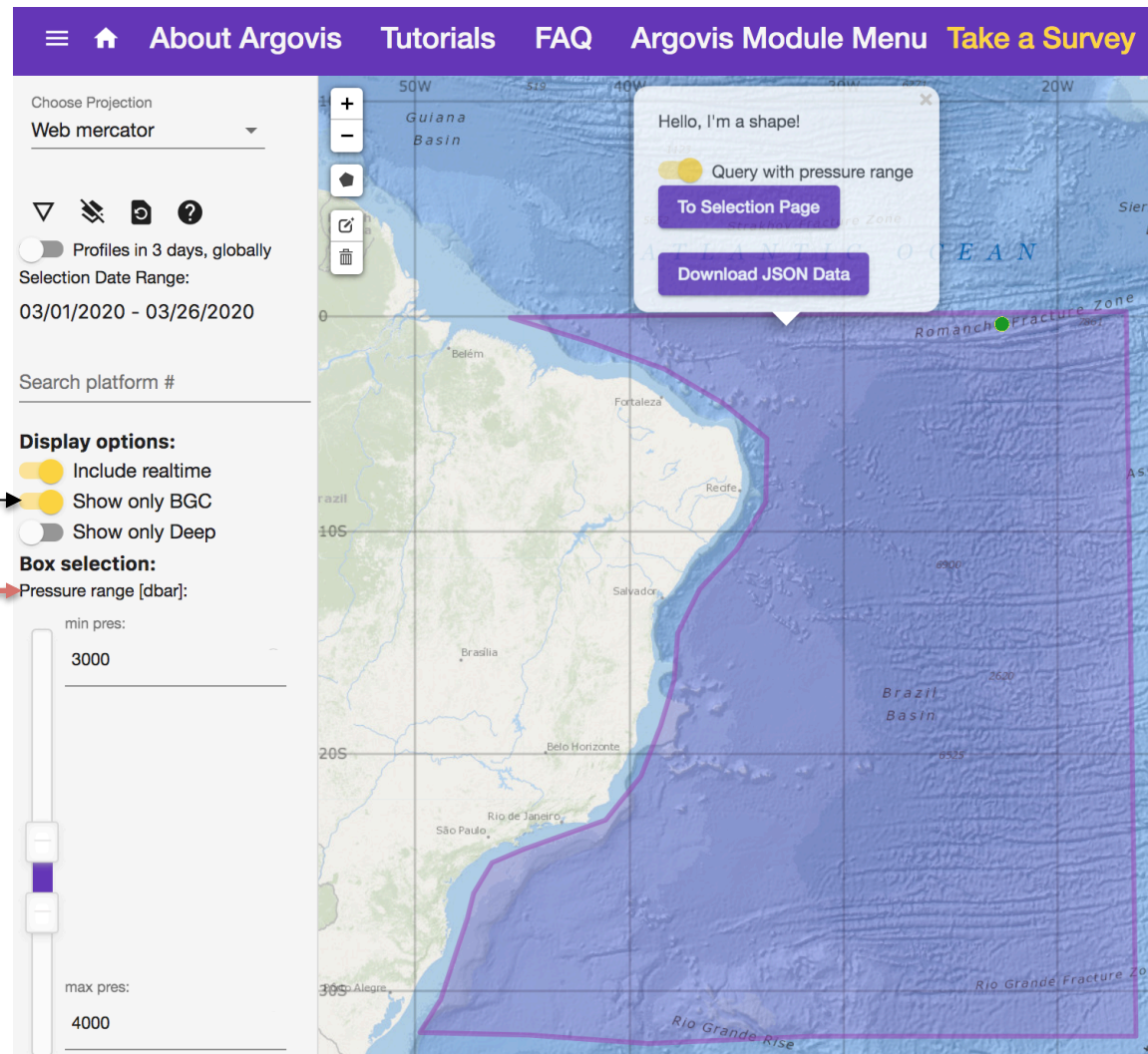
Visualize Argo data by location and time

Toggle for BGC Argo.



Visualize Argo data by location and time

Toggle for BGC Argo.

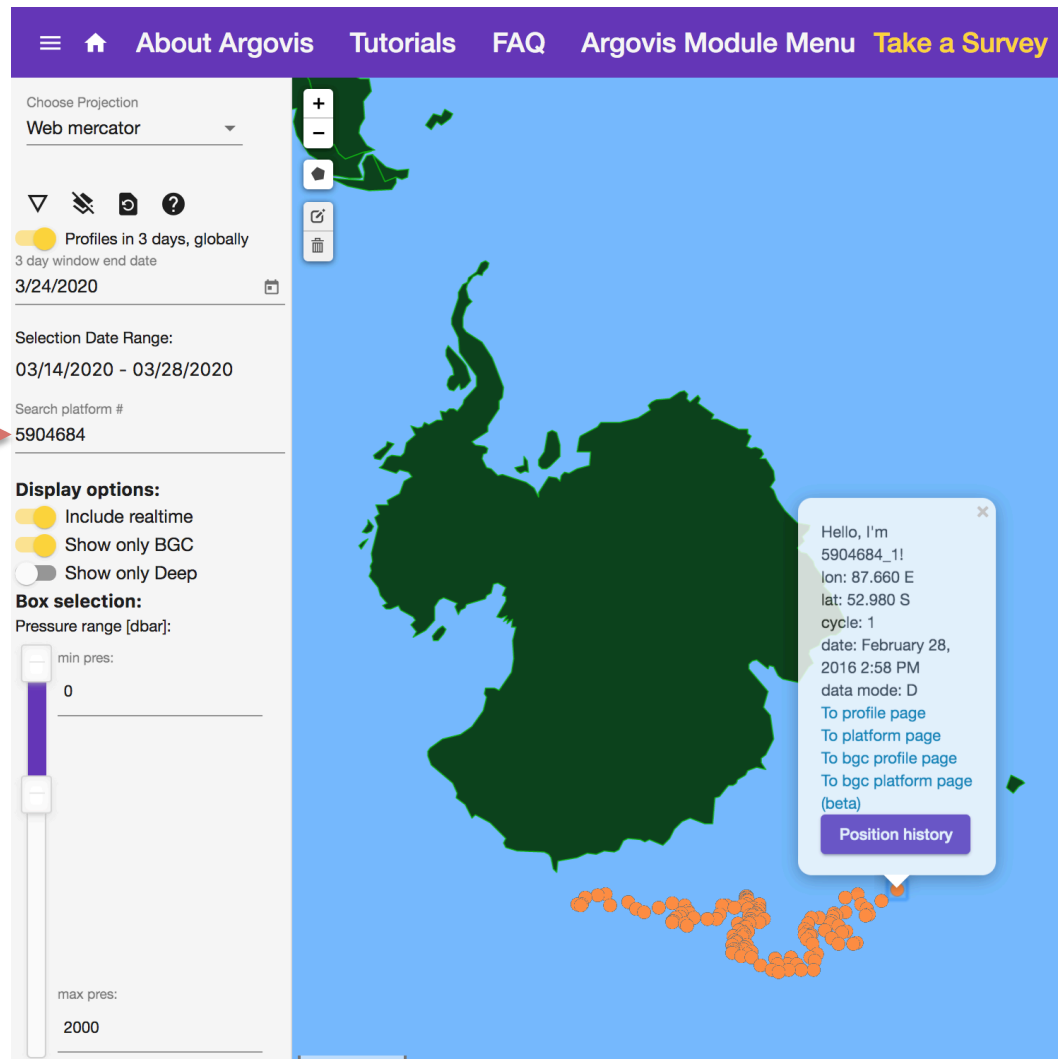


The screenshot shows the Argovis web interface. The top navigation bar includes links for 'About Argovis', 'Tutorials', 'FAQ', 'Argovis Module Menu', and 'Take a Survey'. The left sidebar contains settings for 'Choose Projection' (Web mercator), 'Profiles in 3 days, globally' (toggle), 'Selection Date Range' (03/01/2020 - 03/26/2020), 'Search platform #', and 'Display options' (Include realtime, Show only BGC, Show only Deep). The 'Box selection' section shows a 'Pressure range [dbar]' slider set from 3000 to 4000. The main map area displays a bathymetric map of the Atlantic Ocean with a purple box selection over the Brazil Basin. A popup window titled 'Hello, I'm a shape!' contains a 'Query with pressure range' toggle (checked), a 'To Selection Page' button, and a 'Download JSON Data' button.

Query for pressure range of interest.

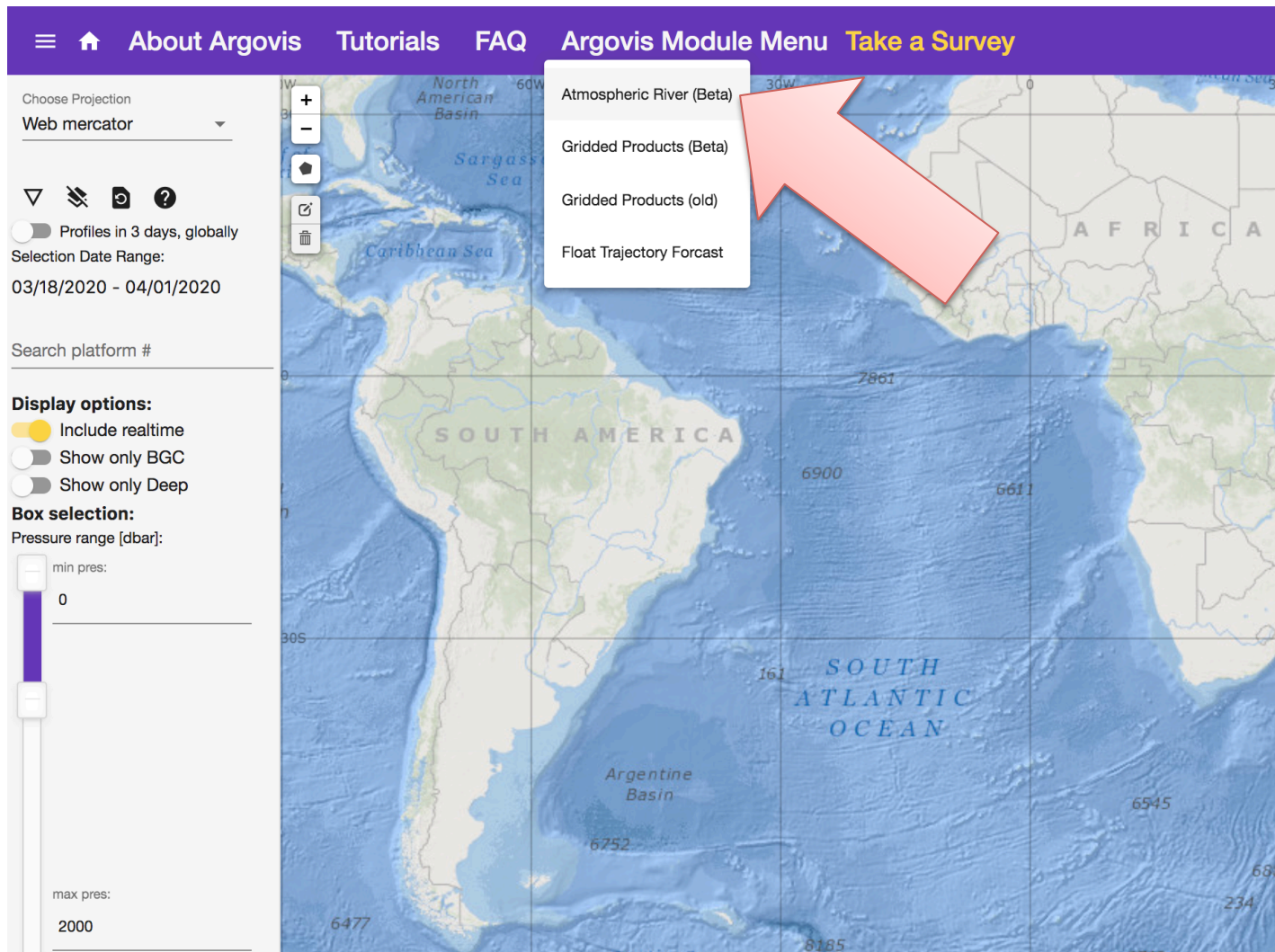
Locate Argo profiles for a platform

Search platform #.

The screenshot shows the Argovis web application interface. At the top is a purple navigation bar with links for "About Argovis", "Tutorials", "FAQ", "Argovis Module Menu", and "Take a Survey". Below the navigation bar is a search and filter panel on the left. It includes a "Choose Projection" dropdown set to "Web mercator", a search bar with the text "5904684", and several filter options: "Profiles in 3 days, globally" (checked), "Include realtime" (checked), "Show only BGC" (checked), and "Show only Deep" (unchecked). Under "Box selection", there is a "Pressure range [dbar]" slider with "min pres:" at 0 and "max pres:" at 2000. The main area is a map of the Pacific Ocean showing a dark green landmass and a series of orange circular markers representing Argo profiles. A tooltip is visible over one of the markers, displaying the following information: "Hello, I'm 5904684_1! lon: 87.660 E lat: 52.980 S cycle: 1 date: February 28, 2016 2:58 PM data mode: D". Below the tooltip are links for "To profile page", "To platform page", "To bgc profile page", and "To bgc platform page (beta)", along with a "Position history" button.

beta

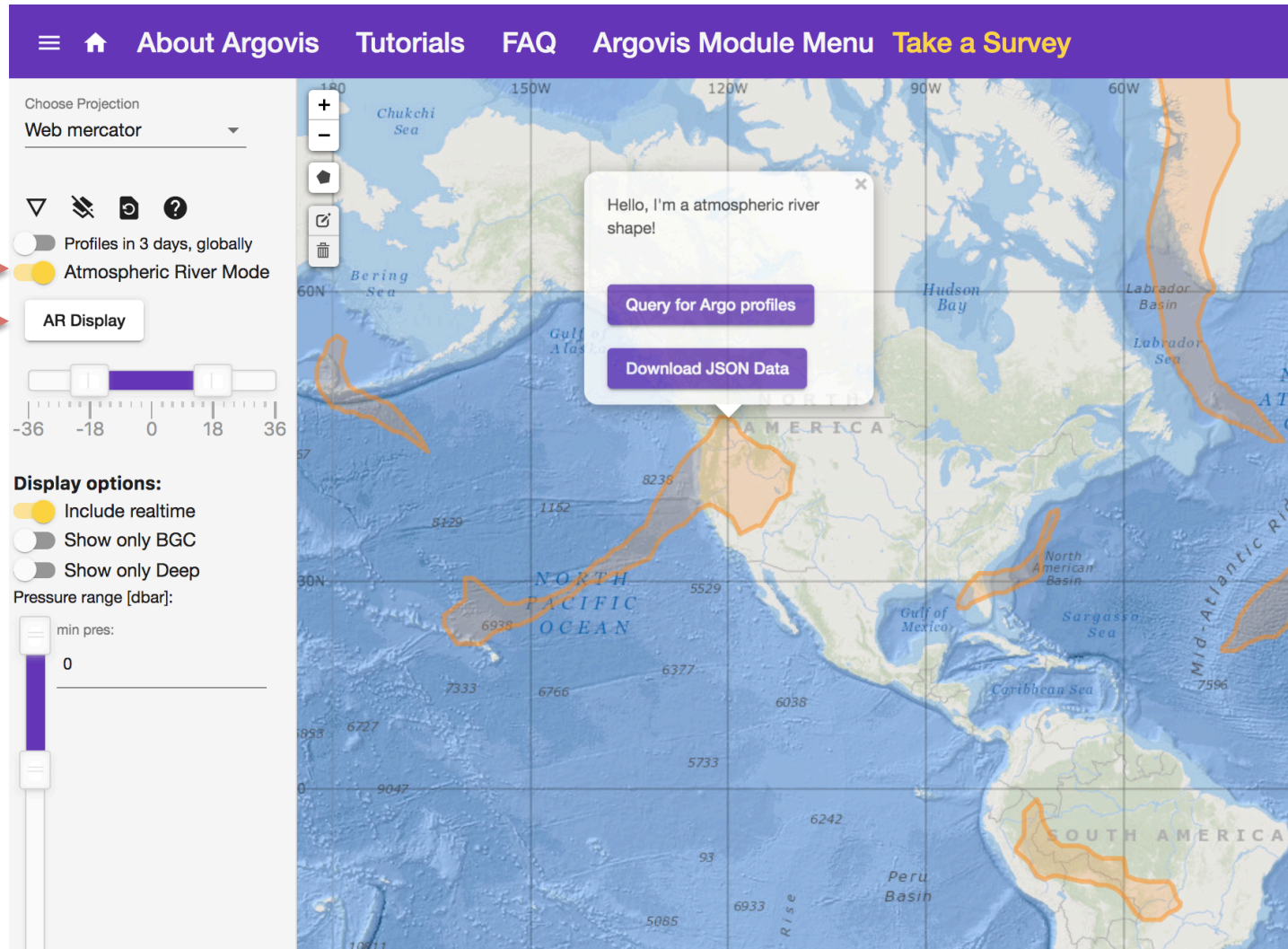
Co-locate Argo with weather events

The image is a screenshot of the Argovis web application interface. At the top, there is a purple navigation bar with a home icon, a hamburger menu icon, and links for "About Argovis", "Tutorials", "FAQ", "Argovis Module Menu", and "Take a Survey". Below the navigation bar, on the left side, is a control panel with several sections: "Choose Projection" (set to "Web mercator"), a set of icons for map interaction, a toggle for "Profiles in 3 days, globally", a "Selection Date Range" of "03/18/2020 - 04/01/2020", a "Search platform #" field, and "Display options" (including "Include realtime", "Show only BGC", and "Show only Deep"). Below these are "Box selection" controls for "Pressure range [dbar]" with a vertical slider set to "0" and "max pres:" set to "2000". The main area of the interface is a map of the Atlantic Ocean, showing South America on the left and Africa on the right. The map includes a grid and labels for various ocean basins like "North American Basin", "Sargasso Sea", "Caribbean Sea", and "Argentine Basin". A white dropdown menu is open over the map, listing four options: "Atmospheric River (Beta)", "Gridded Products (Beta)", "Gridded Products (old)", and "Float Trajectory Forecast". A large red arrow points from the "Atmospheric River (Beta)" option towards the center of the map.

beta

Co-locate Argo with weather events

Activate AR module.

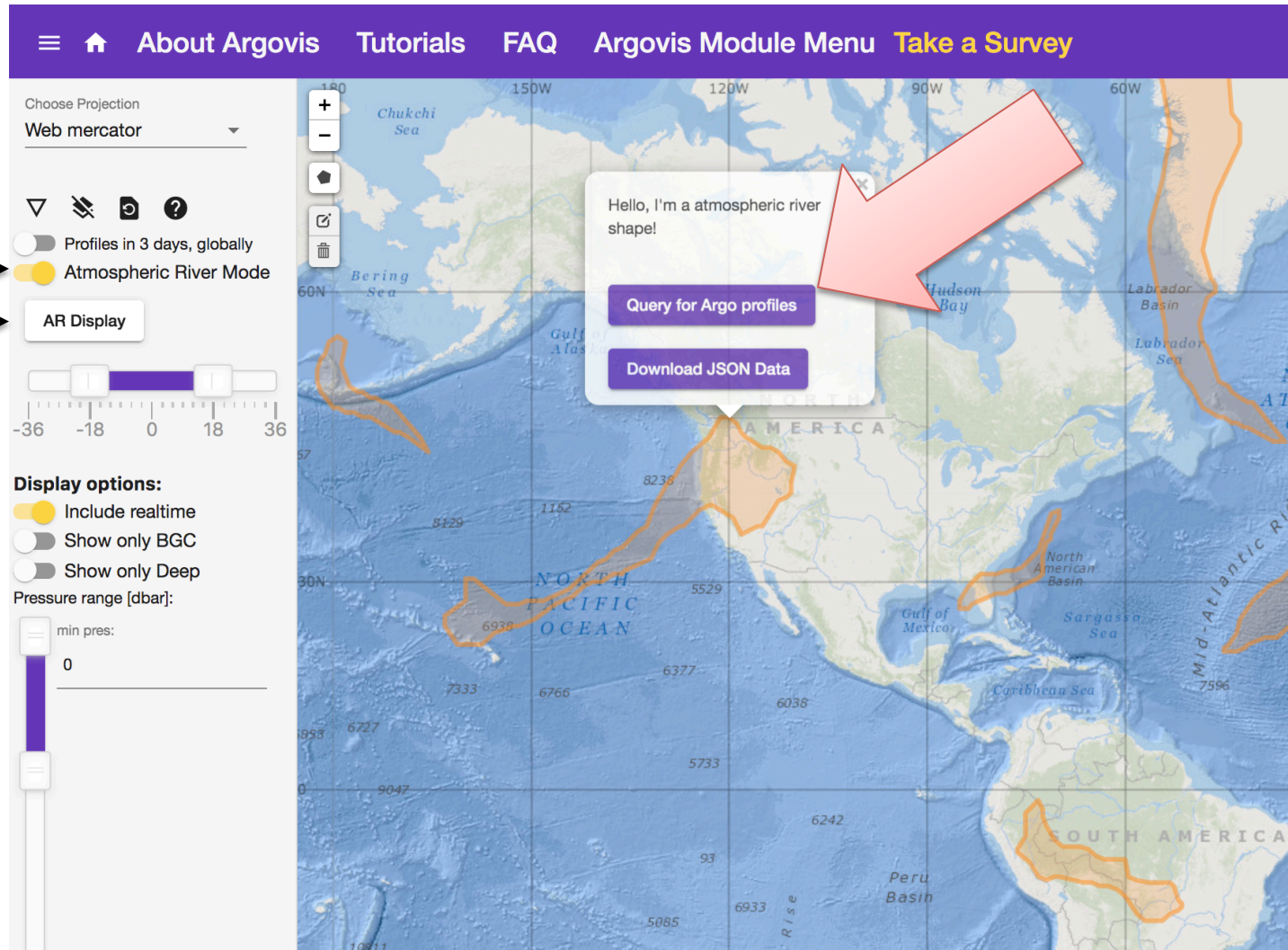


Display weather events (e.g. Atmospheric Rivers by GW2015) globally for time of interest.

beta

Co-locate Argo with weather events

Activate AR module.



The screenshot shows the Argovis web interface with a purple header containing navigation links: About Argovis, Tutorials, FAQ, Argovis Module Menu, and Take a Survey. The main content area features a map of the North Pacific Ocean with orange outlines representing atmospheric rivers. A white tooltip box is overlaid on the map, containing the text "Hello, I'm a atmospheric river shape!" and two buttons: "Query for Argo profiles" and "Download JSON Data". A large red arrow points from the tooltip to the "Query for Argo profiles" button.

Choose Projection
Web mercator

Profiles in 3 days, globally

Atmospheric River Mode

AR Display

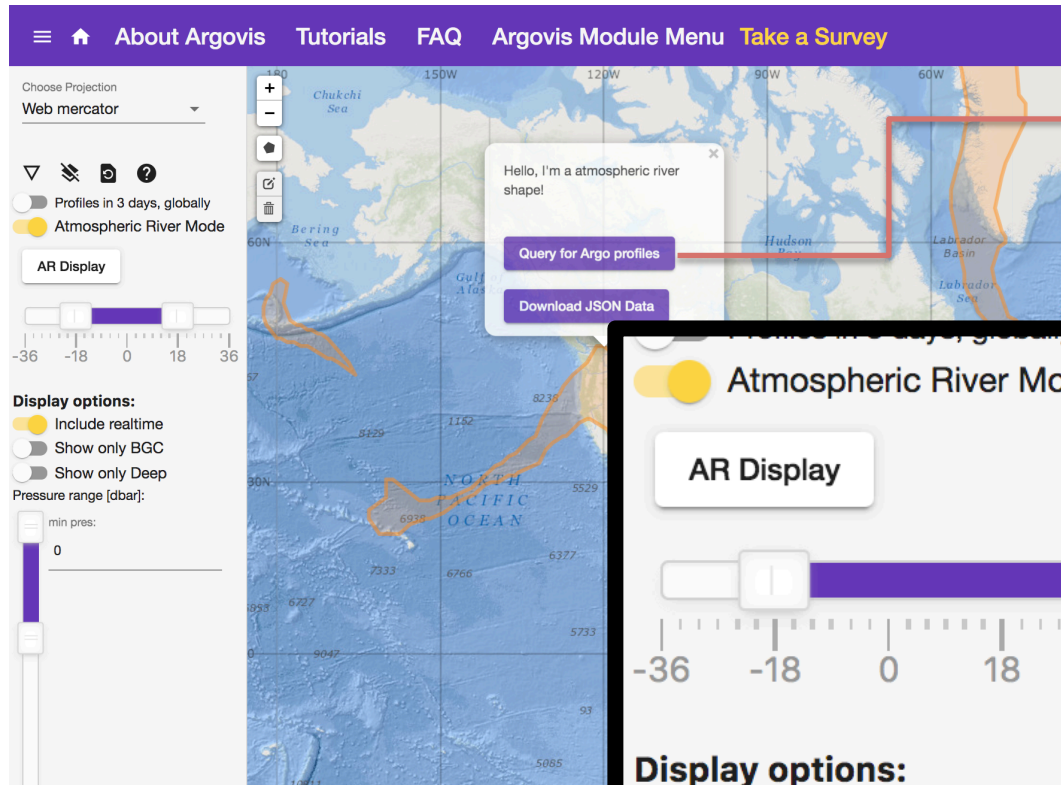
Pressure range [dbar]:
min pres: 0

Display options:
 Include realtime
 Show only BGC
 Show only Deep

Display weather events (e.g. Atmospheric Rivers by GW2015) globally for time of interest.

beta

Co-locate Argo with weather events



Navigation: About Argovis, Tutorials, FAQ, Argovis Module Menu, Take a Survey

Choose Projection: Web mercator

Profiles in 3 days, globally (toggle off)

Atmospheric River Mode (toggle on)

AR Display (toggle on)

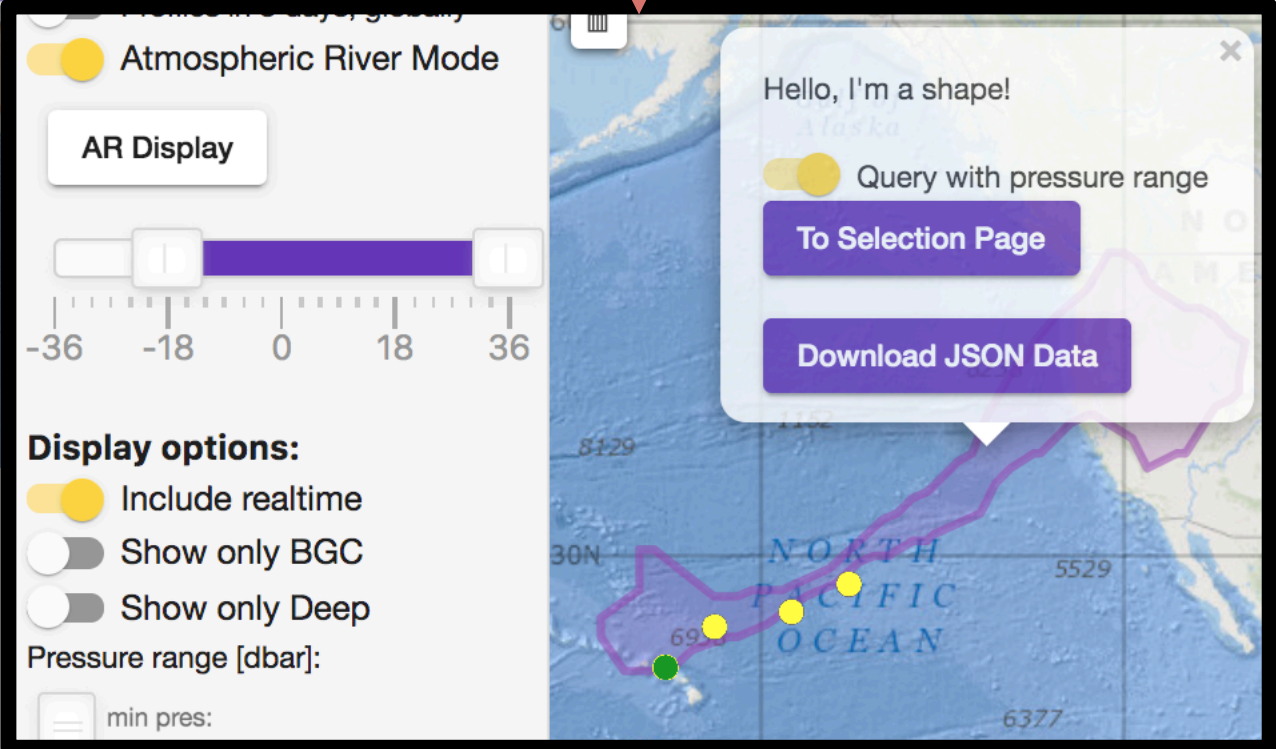
Pressure range [dbar]: min pres: 0

Map: North Pacific Ocean, Alaska, Bering Sea, Gulf of Alaska, Hudson Bay, Labrador Basin, Labrador Sea

Pop-up: Hello, I'm a atmospheric river shape!

Buttons: Query for Argo profiles, Download JSON Data

Show Argo profiles co-located with a weather event.



Atmospheric River Mode (toggle on)

AR Display (toggle on)

Pressure range [dbar]: min pres: 0

Display options:

- Include realtime (toggle on)
- Show only BGC (toggle off)
- Show only Deep (toggle off)

Map: North Pacific Ocean, Alaska, Bering Sea, Gulf of Alaska, Hudson Bay, Labrador Basin, Labrador Sea

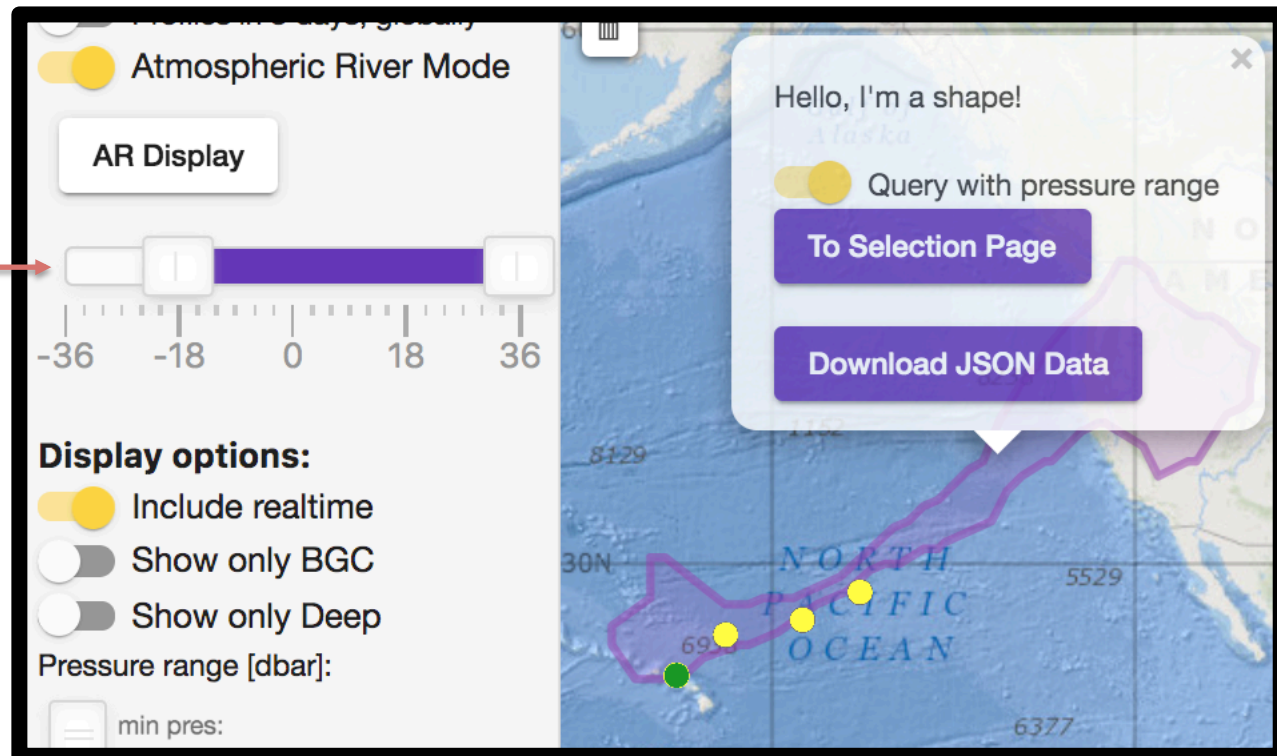
Pop-up: Hello, I'm a shape!

Buttons: Query with pressure range, To Selection Page, Download JSON Data

beta

Co-locate Argo with weather events

Choose co-location strategy (e.g. profiles between 18h before and 36h after the event).

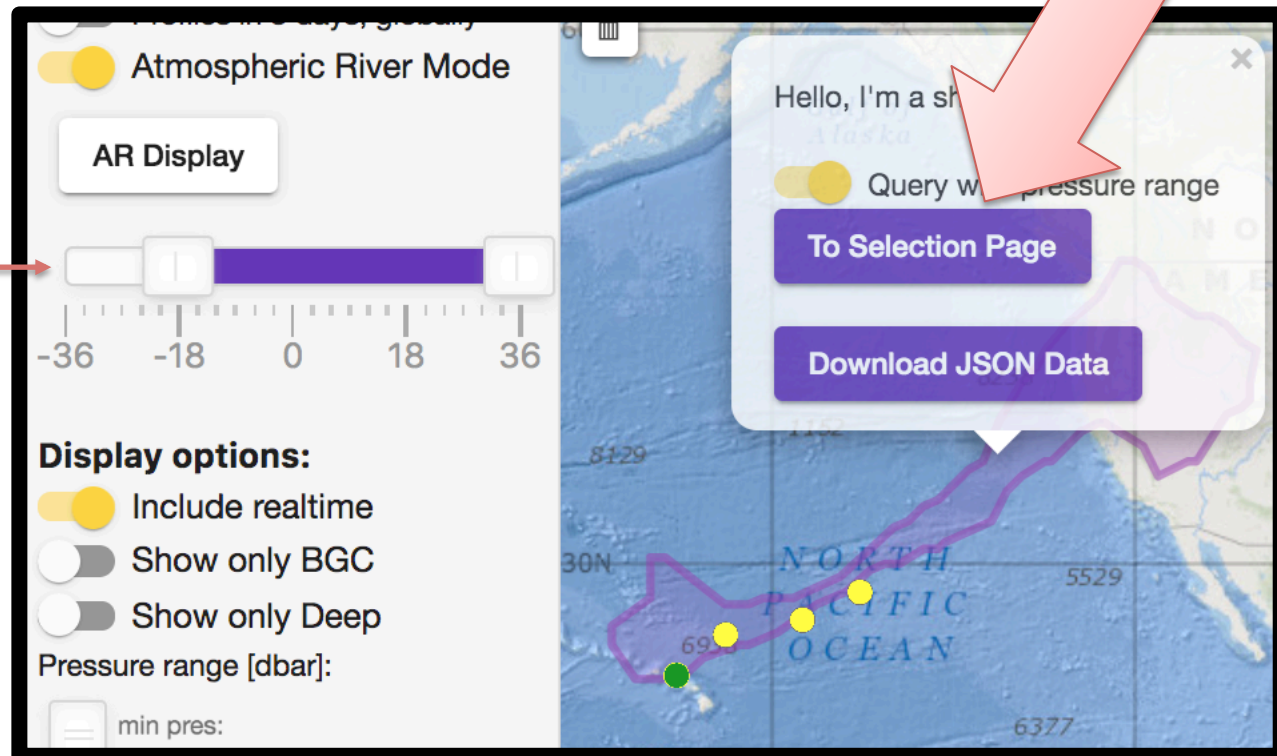
The screenshot shows the Argovis web interface. On the left, there is a control panel for "Atmospheric River Mode". It includes a yellow toggle switch that is turned on, a button labeled "AR Display", and a horizontal slider ranging from -36 to 36. The slider is currently set to 18, with a purple bar indicating the range from 0 to 36. Below the slider are "Display options" with three toggle switches: "Include realtime" (on), "Show only BGC" (off), and "Show only Deep" (off). At the bottom of the control panel, there is a "Pressure range [dbar]" section with a "min pres:" label and an input field. On the right, a map of the North Pacific Ocean is displayed, showing a purple shaded area representing an atmospheric river. A yellow dot is placed on the map, and a tooltip box is open over it. The tooltip contains the text "Hello, I'm a shape!", a yellow toggle switch for "Query with pressure range", and two purple buttons: "To Selection Page" and "Download JSON Data".

beta

Co-locate Argo with weather events

Choose co-location strategy (e.g. profiles between 18h before and 36h after the event).

Go to "Selection Page" to see profiles

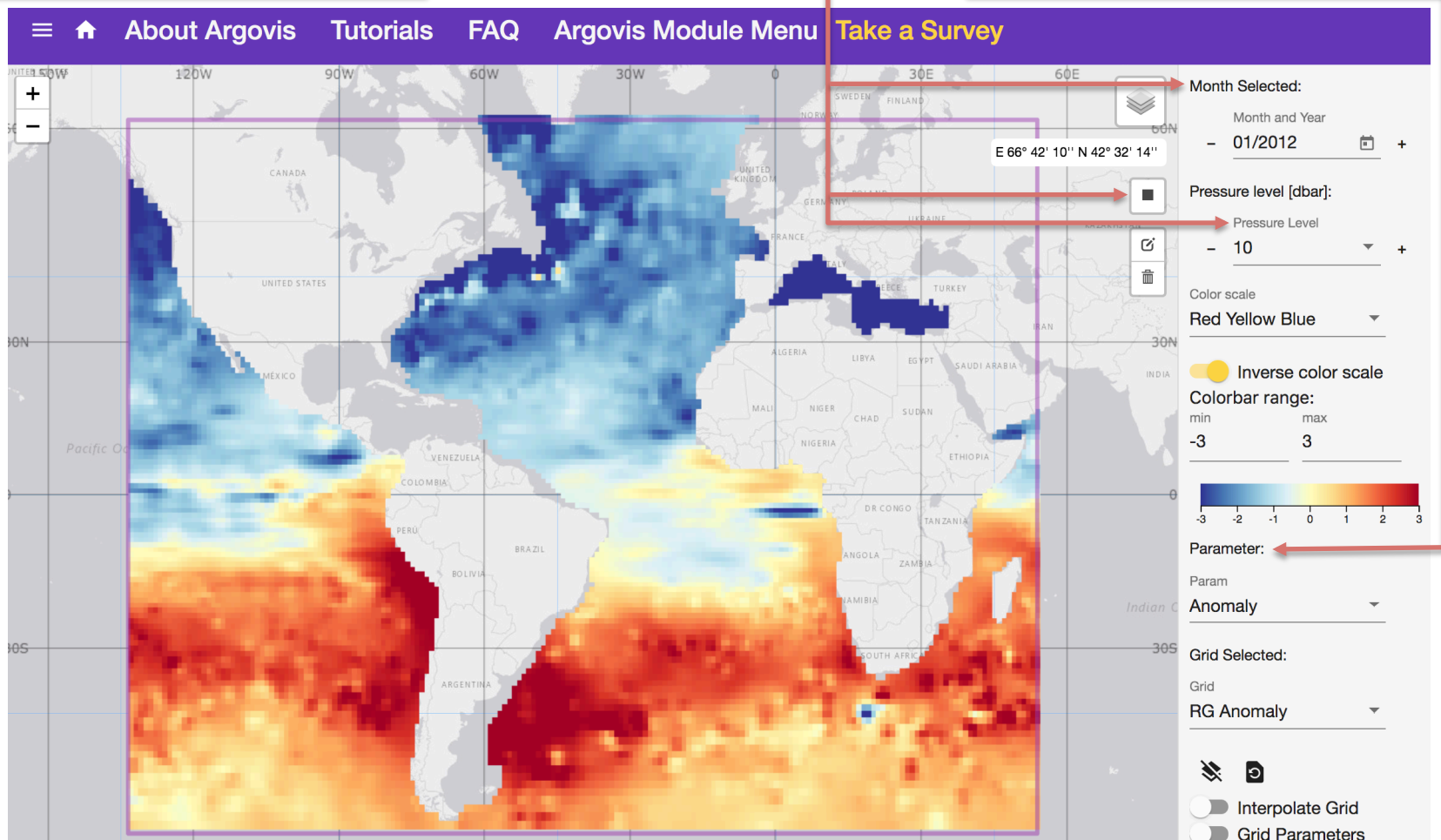
The screenshot shows the Argovis web interface. On the left, there is a control panel for "Atmospheric River Mode". It includes a yellow toggle switch for "Atmospheric River Mode", a button for "AR Display", and a horizontal slider ranging from -36 to 36 hours. Below the slider are "Display options" with three toggle switches: "Include realtime" (checked), "Show only BGC" (unchecked), and "Show only Deep" (unchecked). At the bottom, there is a "Pressure range [dbar]" section with a "min pres:" label and an input field. On the right, a map of the North Pacific Ocean is displayed, showing a purple shaded area representing an atmospheric river event. A white tooltip box is overlaid on the map, containing the text "Hello, I'm a sh...", a yellow toggle switch for "Query w... pressure range", and two purple buttons: "To Selection Page" and "Download JSON Data". A large red arrow points from the "To Selection Page" button towards the top right of the image.

beta

Display and compare gridded data

Display a selection.

Choose product.

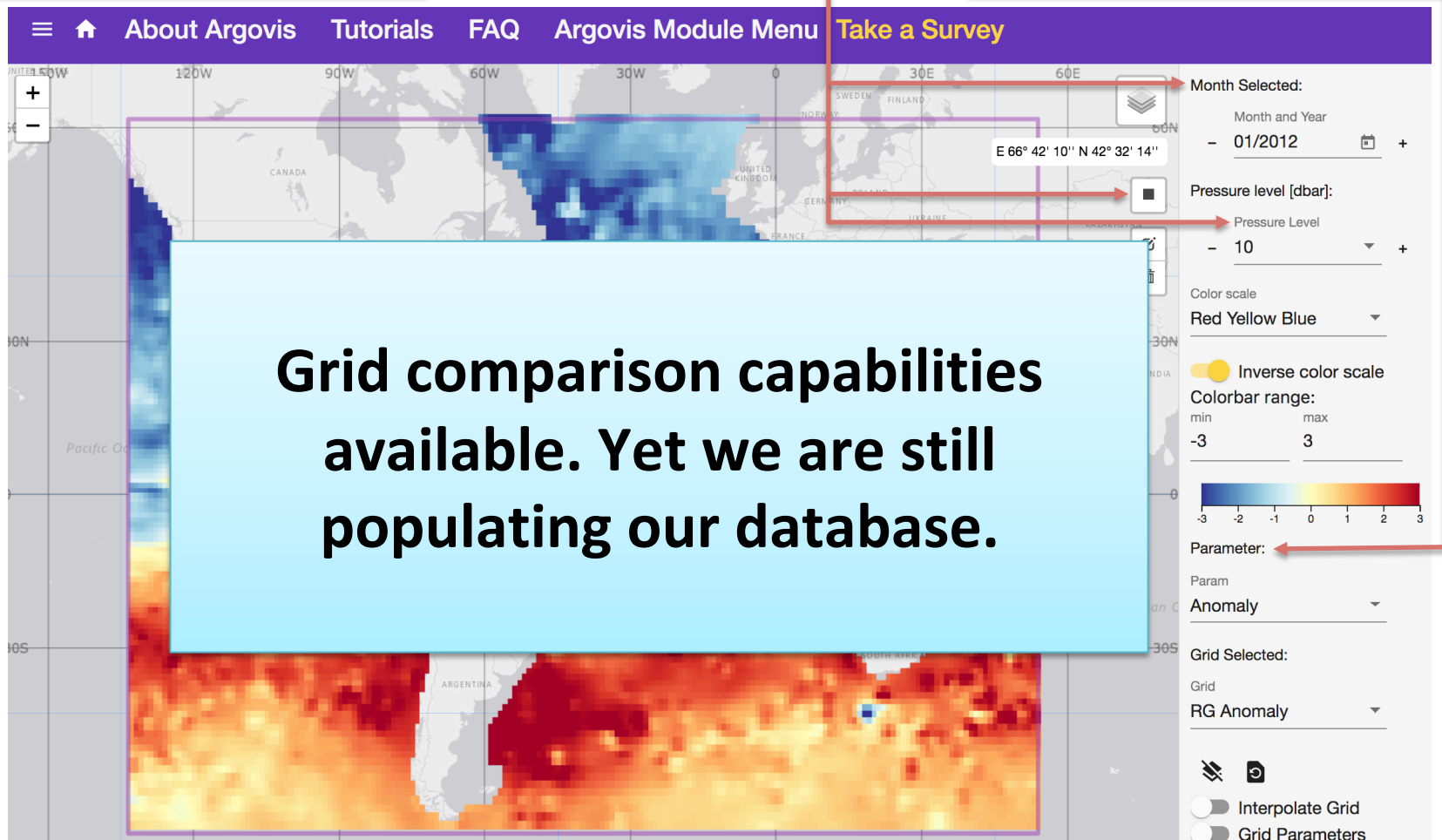


beta

Display and compare gridded data

Display a selection.

Choose product.



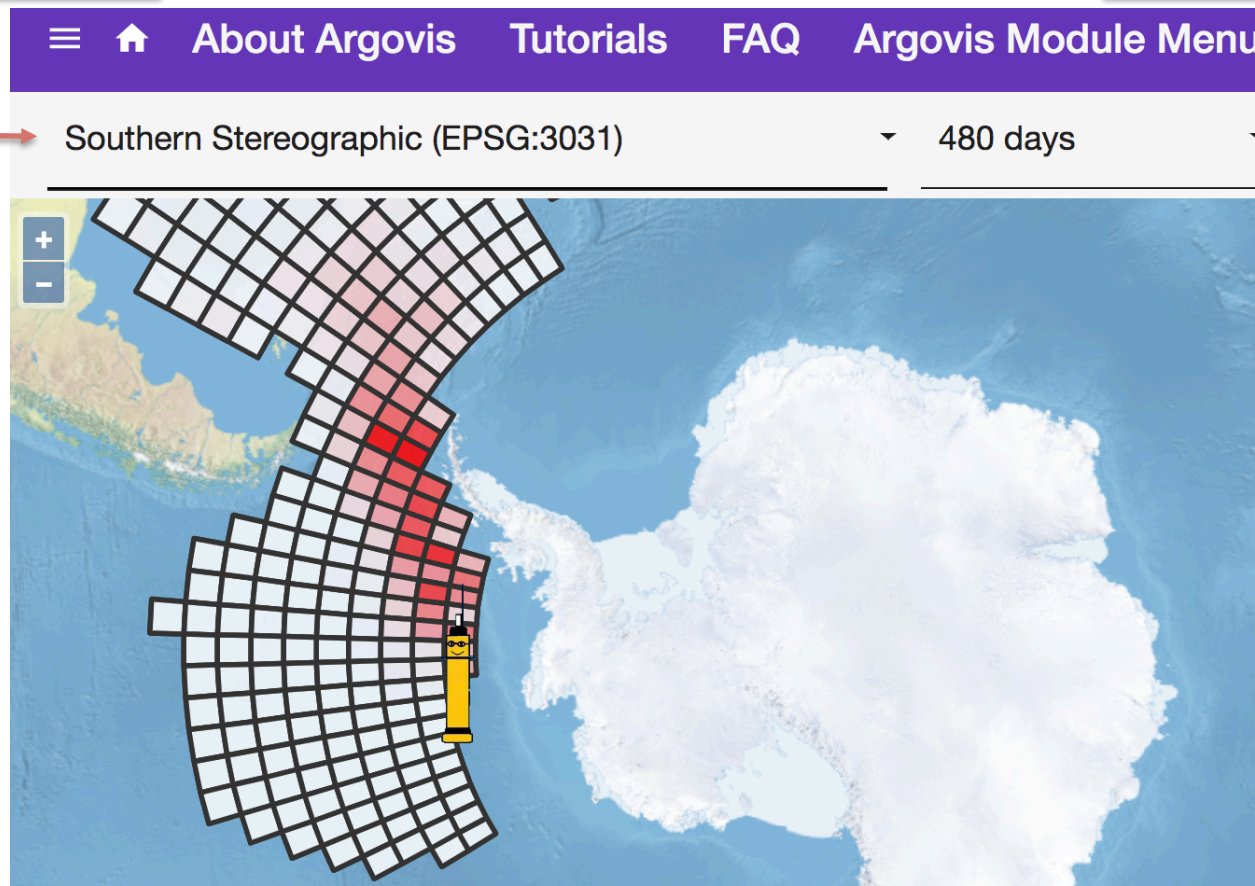
The screenshot displays the Argovis web application interface. At the top, a navigation bar includes links for 'About Argovis', 'Tutorials', 'FAQ', 'Argovis Module Menu', and 'Take a Survey'. The main area features a world map with a data overlay showing a blue-to-red color gradient. A red box highlights a specific region on the map with coordinates 'E 66° 42' 10" N 42° 32' 14"'. On the right side, a control panel allows users to select a product, set the month and year (currently '01/2012'), choose a pressure level (currently '10'), and select a color scale (currently 'Red Yellow Blue'). A color bar below the panel shows a gradient from -3 to 3. At the bottom of the control panel, there are options for 'Interpolate Grid' and 'Grid Parameters'. A large light blue text box is overlaid on the map, containing the text: 'Grid comparison capabilities available. Yet we are still populating our database.'

Grid comparison capabilities available. Yet we are still populating our database.

Display float trajectory forecast.

Select projection.

Select time period.



White to red colors as the float is more and more likely to end up at that location in the time period of interest.

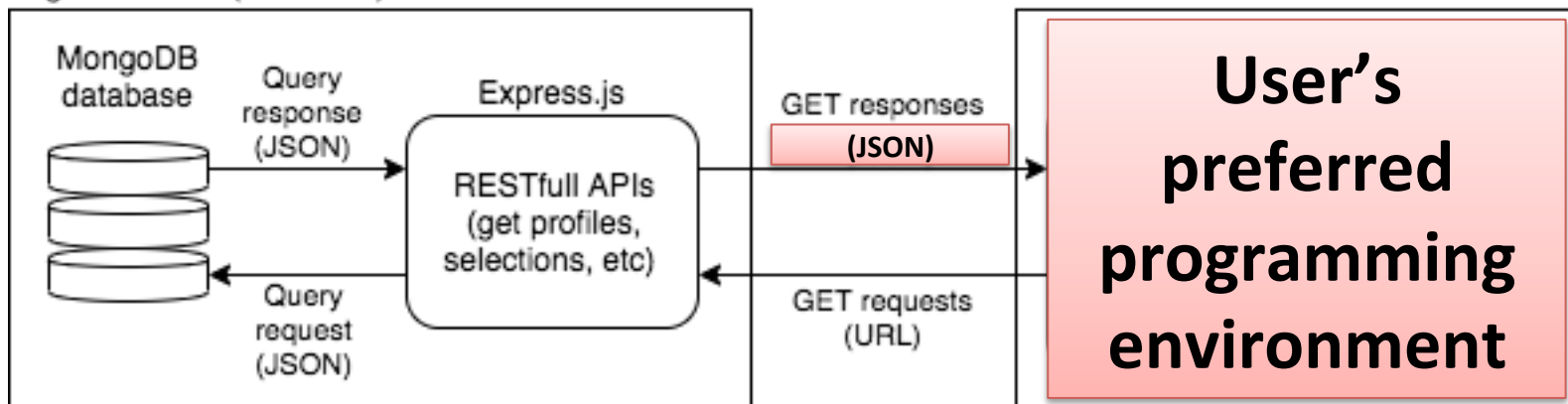
Float trajectory forecasts data by Chamberlain et al. (*in prep*)

Outline

- ✓ What is Argovis?
- ✓ Argovis modules
 - ✓ Visualize Argo data by location and time
 - ✓ Co-locate Argo with weather events beta
 - ✓ Display and compare gridded products beta
- Argovis API: few examples for BGC and Deep Argo
- Summary and future directions

Argovis is a web app and database

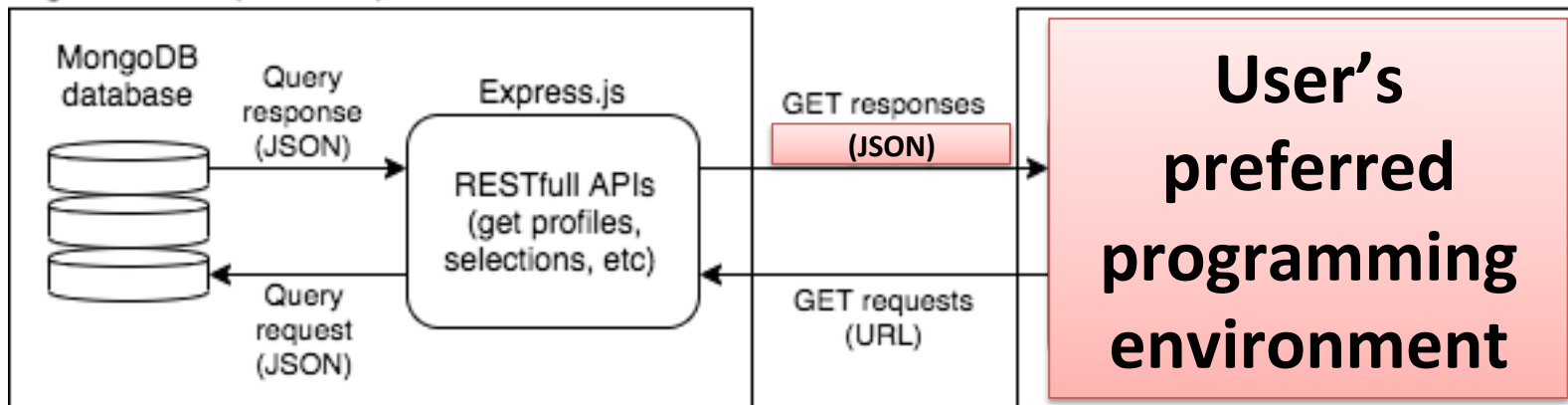
Argovis Server (Back-end)



Example scripts are available on the website in Matlab, Python, R.

Argovis is a web app and database

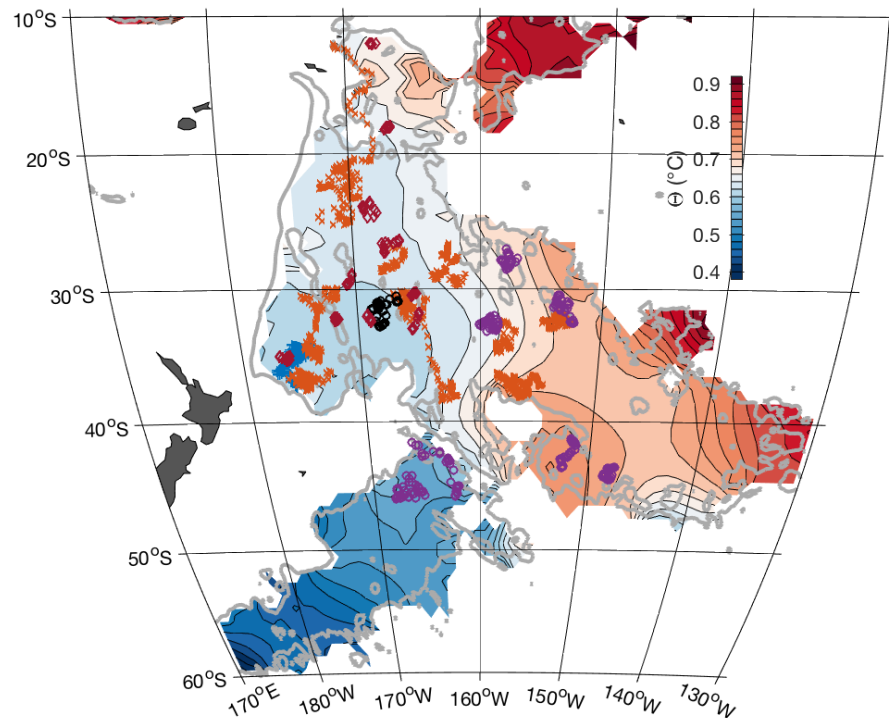
Argovis Server (Back-end)



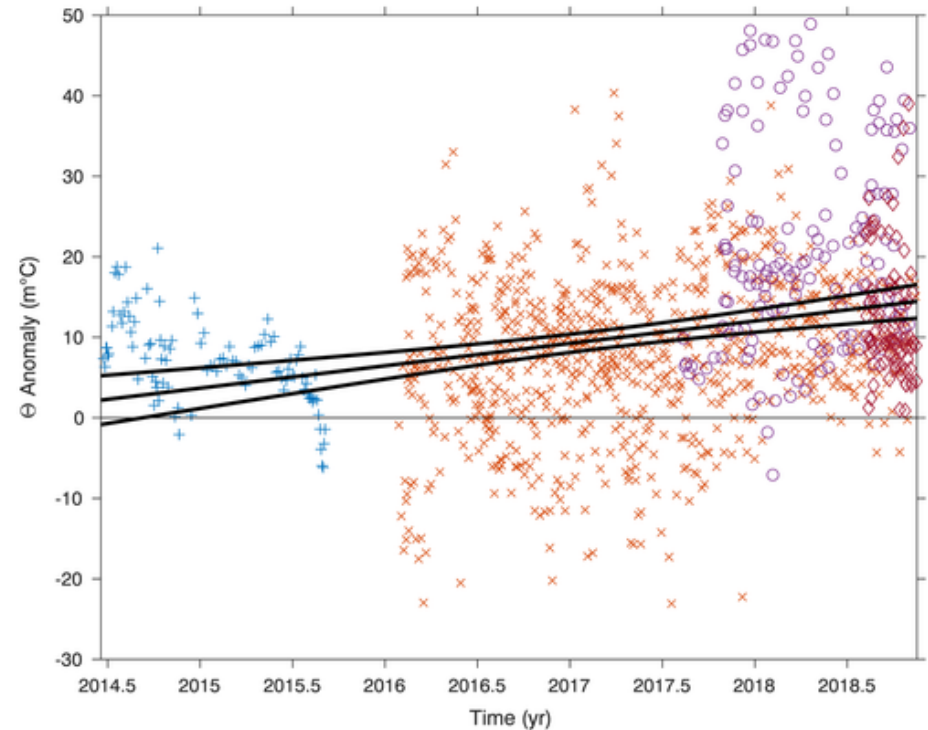
Let's see few examples...

Scientific Results: S.W. Pacific

Deep Argo floats with θ at 5000m



Deep Argo θ anomalies at 5100 dbar

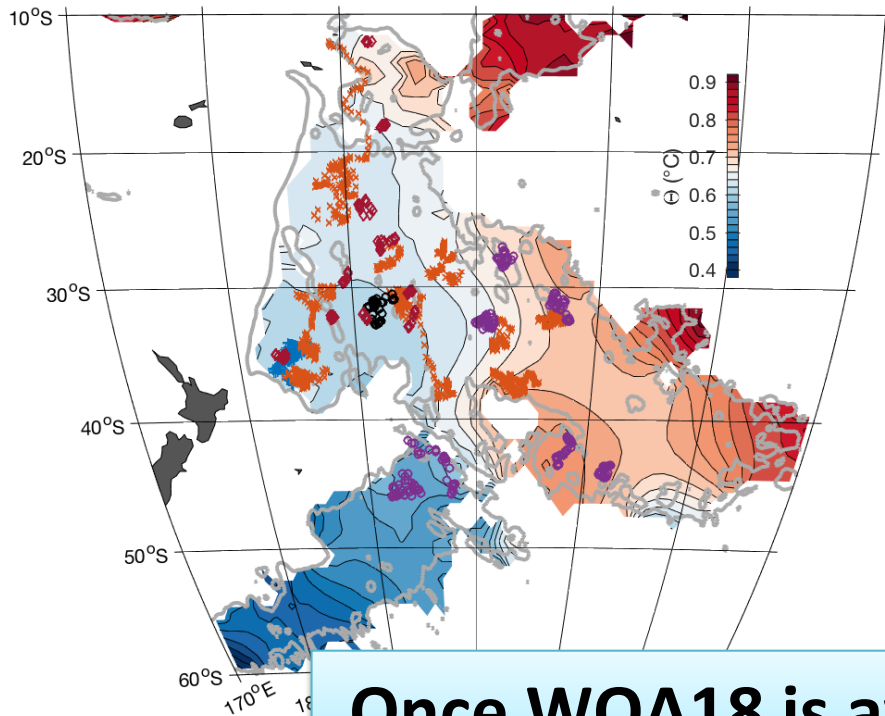


31 deep SOLO floats

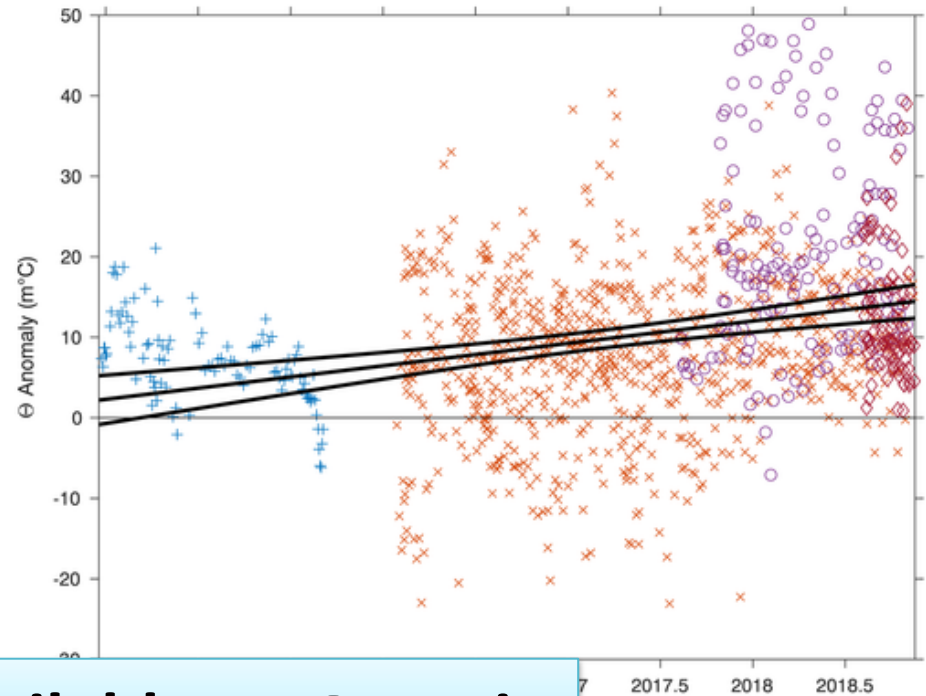
- 2014 (+'s blue)
- 2016 (x's orange)
- 2017 (o's purple & black)
- 2018 (diamonds red)

Scientific Results: S.W. Pacific

Deep Argo floats with θ at 5000m



Deep Argo θ anomalies at 5100 dbar



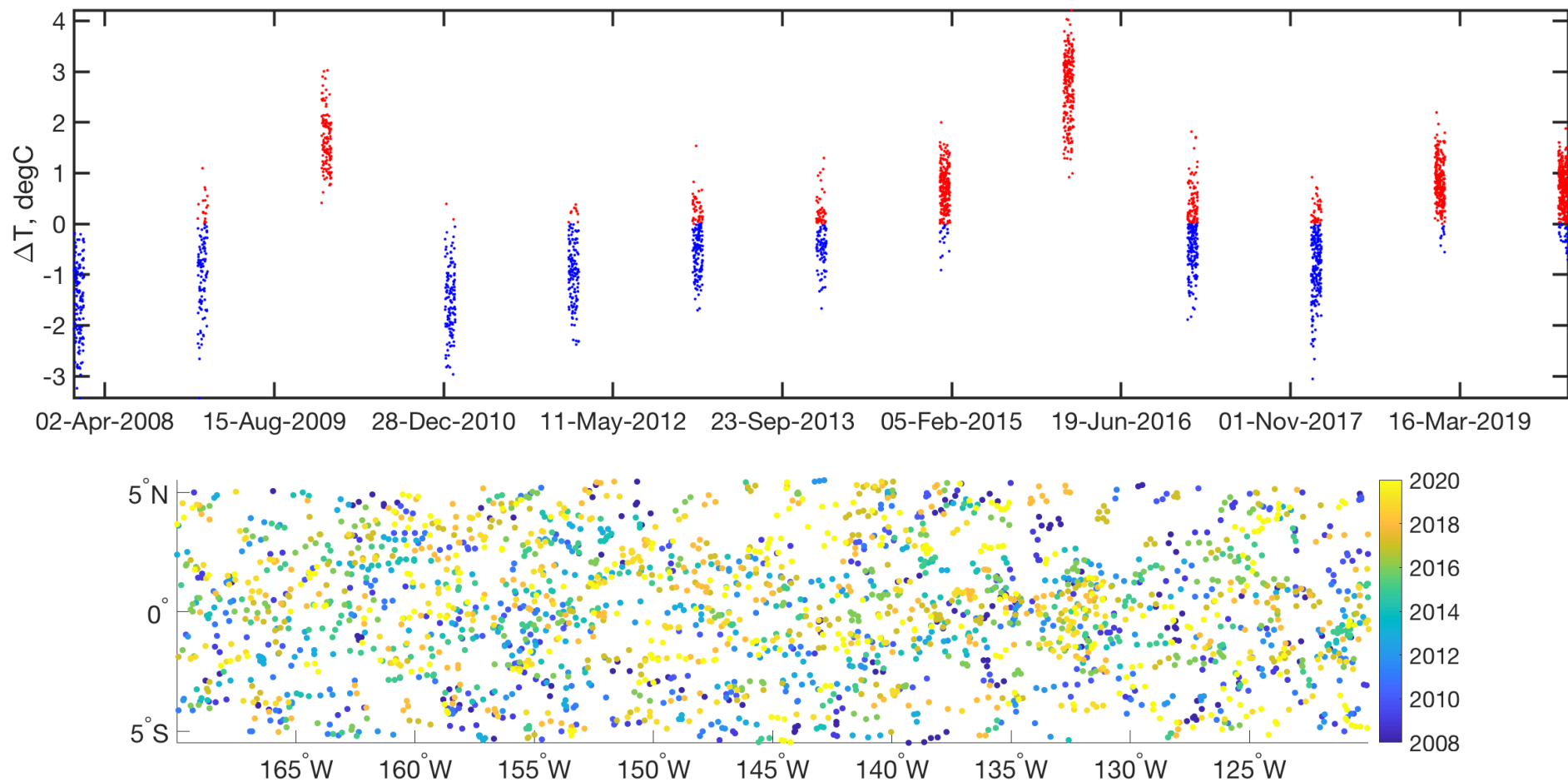
Once WOA18 is available on Argovis

Argovis will help reproduce and update this plot quickly for this region or other regions of interest

Currently possible using Argovis API.



Profiles minus RG2009 climatology: example in Nino 3.4 region in January

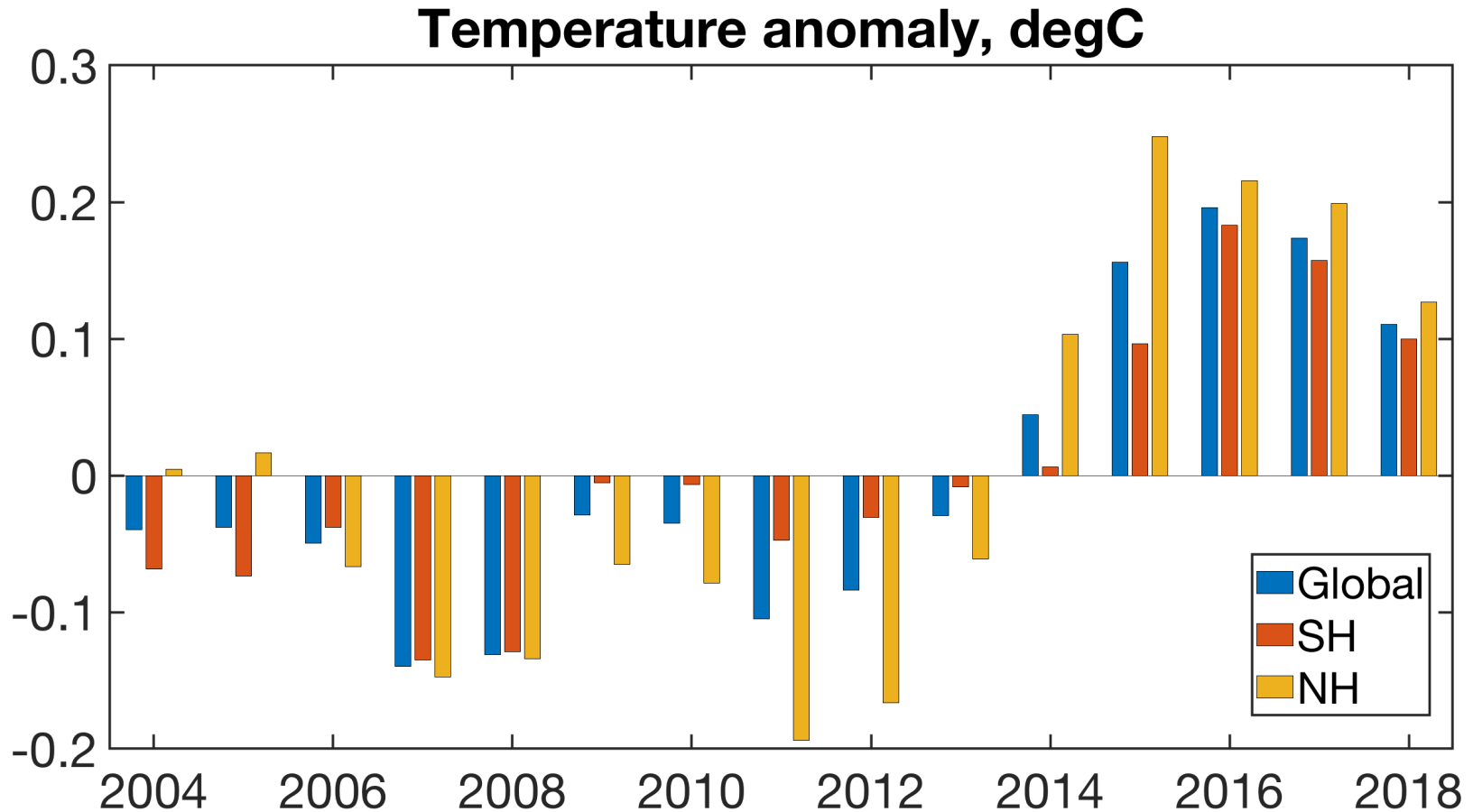


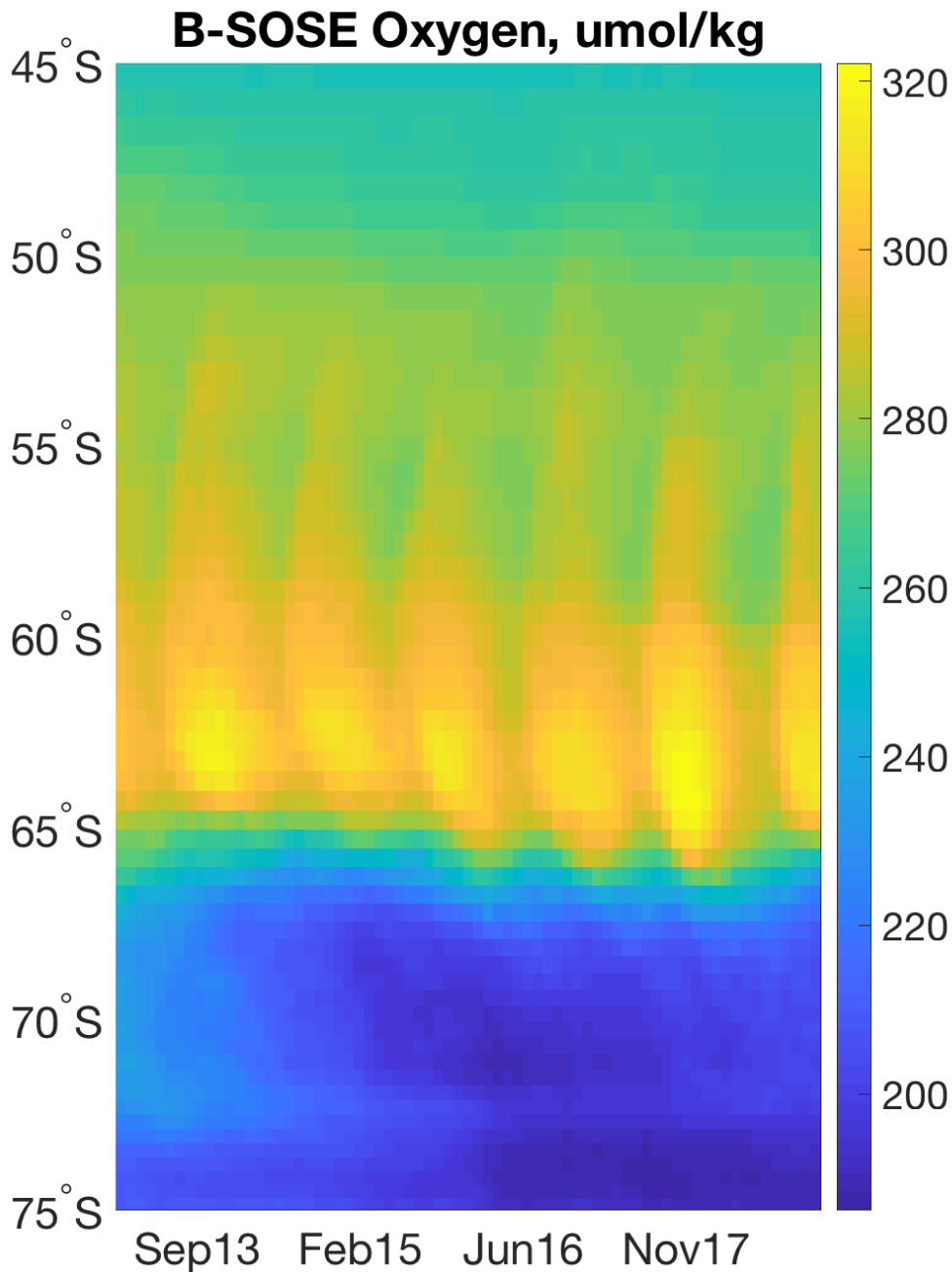
RG2009: Roemmich and Gilson, 2009

Currently possible using Argovis API.



Region average from gridded product



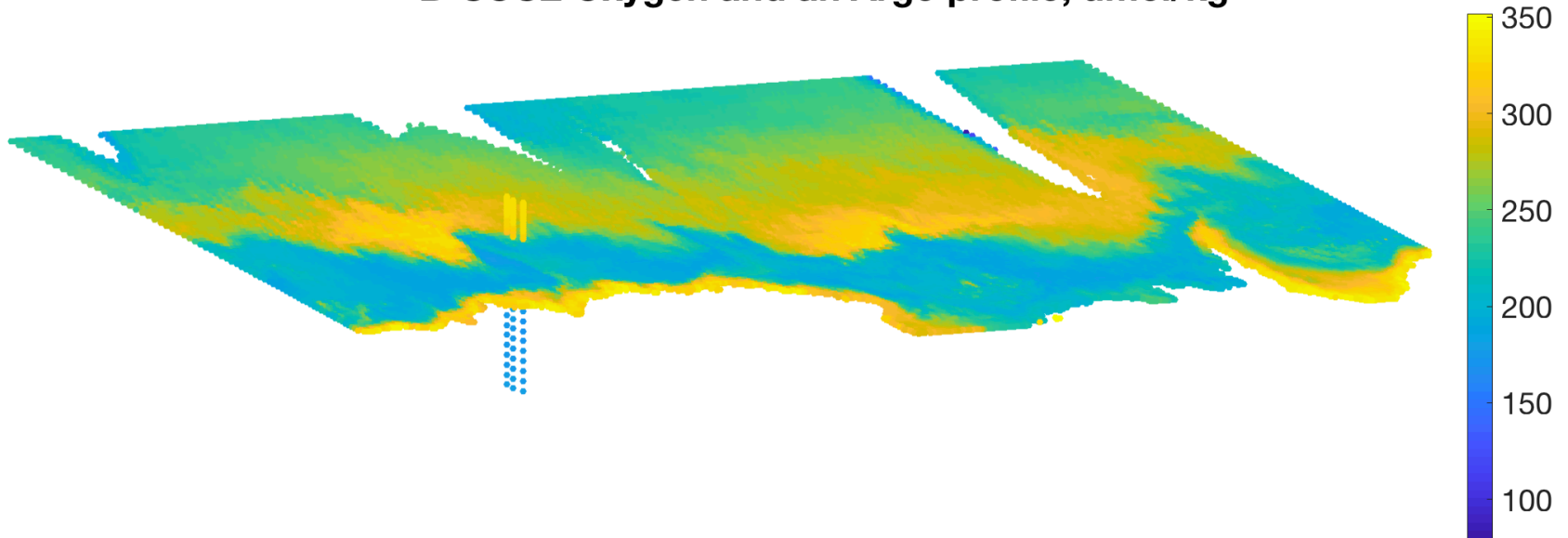


Hovmöller diagram
from gridded
product

**The addition of B-SOSE to
Argovis is in progress.**

Provide context for profile data

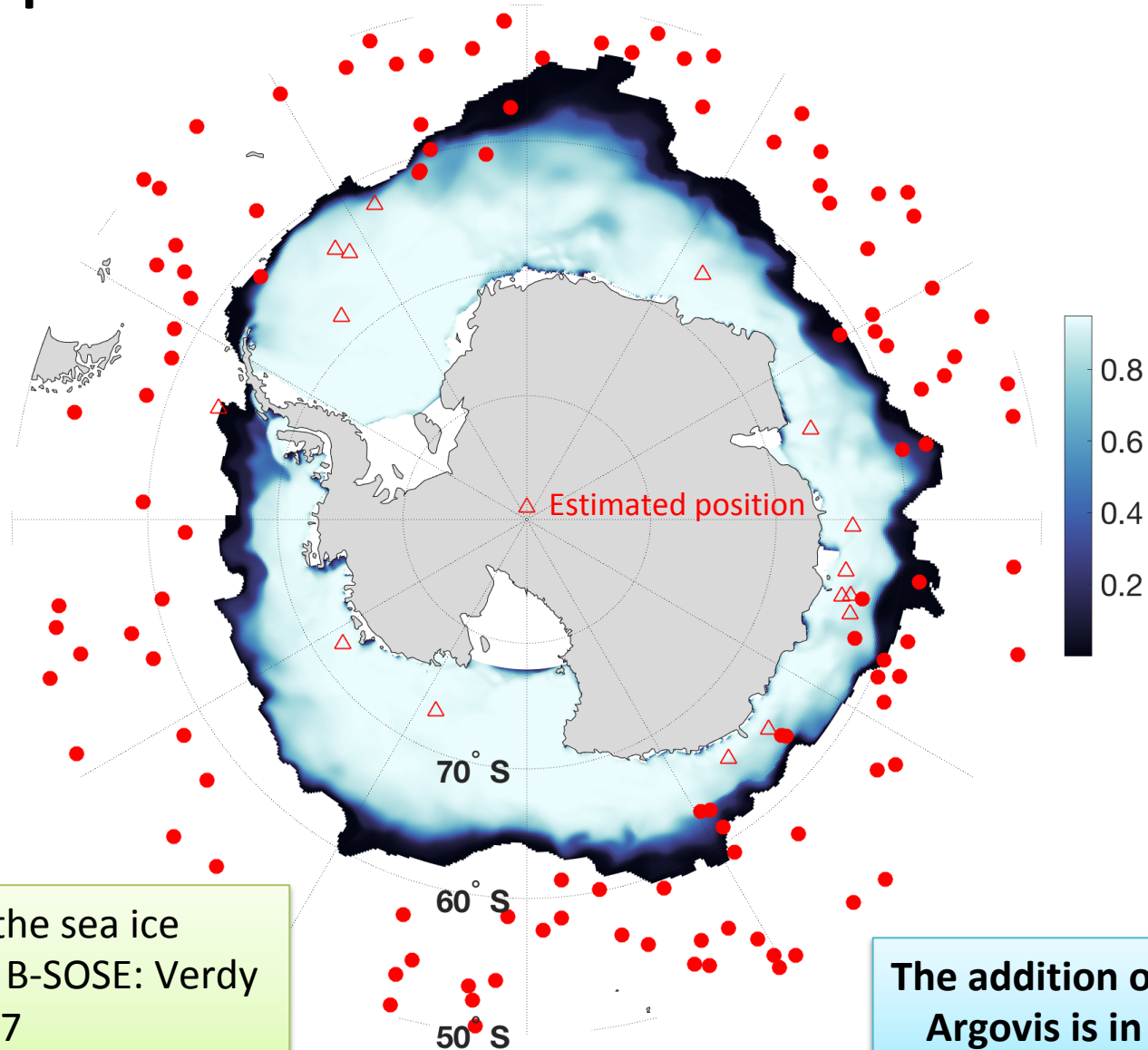
B-SOSE Oxygen and an Argo profile, $\mu\text{mol/kg}$



The addition of B-SOSE to Argovis is in progress.

B-SOSE: Verdy and Mazloff, 2017

Where are Argo profiles with respect to sea ice?



In this example, the sea ice coverage is from B-SOSE: Verdy and Mazloff, 2017

The addition of B-SOSE to Argovis is in progress.



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TRANSFORMING GEOSCIENCES RESEARCH

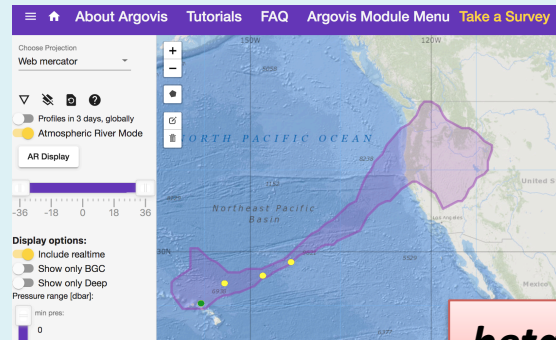
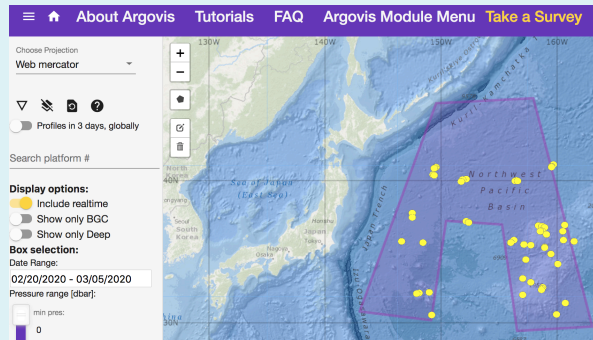


Argovis: A Next Generation Platform for co-located Oceanic and Atmospheric Data to Accelerate Climate Science Workflows

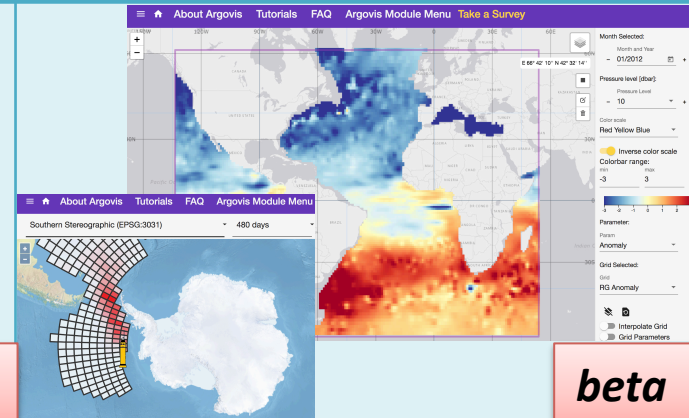
Visualize Argo data by location and time

Co-locate Argo with weather events, satellite data, and more

Display and compare gridded data



beta



beta

Import data of interest in programming environment of choice through API.
For both scientists and non-scientists!



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Twitter: [ArgovisWebApp, @ArgovisCU](https://twitter.com/ArgovisCU)
Contact: donata.giglio@colorado.edu



University of Colorado
Boulder



EARTH CUBE
TRANSFORMING GEOSCIENCES RESEARCH

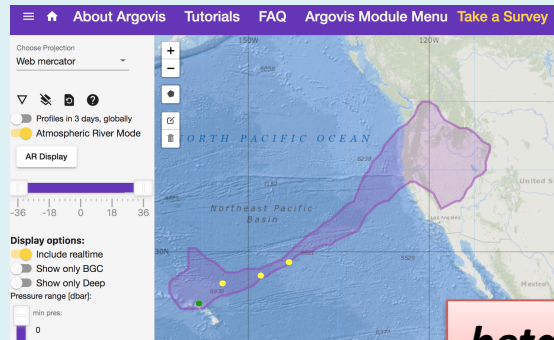
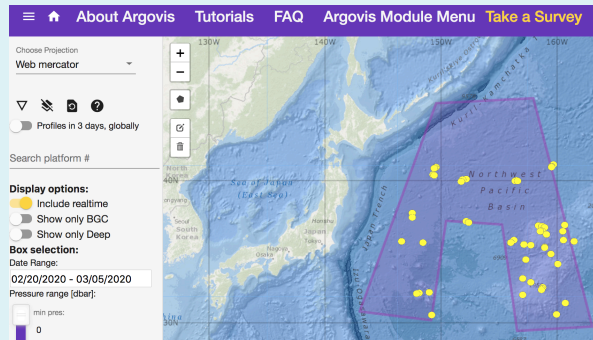


Argovis: A Next Generation Platform for co-located Oceanic and Atmospheric Data to Accelerate Climate Science Workflows

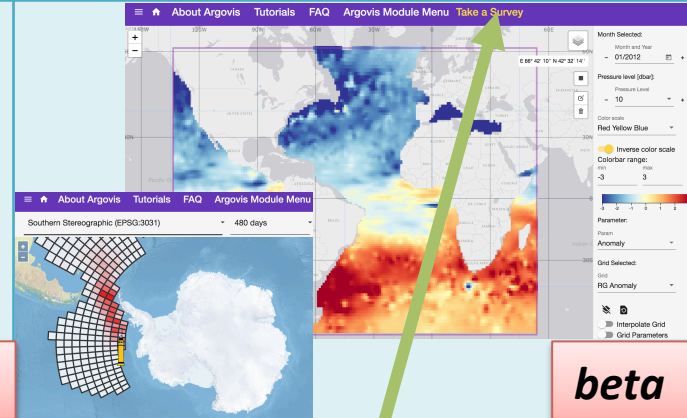
Visualize Argo data by location and time

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beta



beta

Import data of interest in programming environment of choice through API.
For both scientists and non-scientists!

Stay tuned for more gridded products (e.g. B-SOSE, SST, SSH, precipitation, winds, sea ice coverage, WOA18, ...), weather events (e.g. tropical cyclones), ...

Take a survey and make your request!

URL: argovis.colorado.edu
Twitter: [ArgovisWebApp, @ArgovisCU](https://twitter.com/ArgovisCU)
Contact: donata.giglio@colorado.edu



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Boulder