Visualizing oceanic and atmospheric fields on a tile based web map using the Argovis web application

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EARTHCUBE TRANSFORMING GEOSCIENCES RESEARCH

Motivation

Accelerating Climate Science Workflows with a Next Generation Platform for co-located Oceanic and Atmospheric Data. Building new features to visualize and access data to address community needs.

You can help us do this by taking a **short Argovis survey** linked on the home page at `https://argovis.colorado.edu`.

Highlights

- Visualize Argo temperature, salinity, pressure, and biogeochemical (BGC) data by location and time at `https://argovis.colorado.edu`
- Atmospheric river events: display and co-location with Argo profiles
- Gridded data display tool
- Prediction of future float positions
- API for data retrieval from the programming environment of choice
- Angular Front-end with Material icons and animations
- Easy access for both scientists and the general public

Future Developments

- Adding new view features for BGC Argo data
- Including more weather events, such as cyclone track data
- Including more gridded products such as other Argo climatologies and more Southern Ocean State Estimate (SOSE and B-SOSE) fields
- Including more point data and metadata, such as ship-based hydrographic data (GO-SHIP profiles)
- Gridded data comparison tool (to map differences between two grids)
- Upgraded documentation pages

Web Application Overview

RESTful applications allow users or even other apps to interact with a database through a URL. In this case, users query a MongoDB database populated with Argo profiles and other products. As an example, users input a set of latitude-longitude coordinates, date range, and pressure range: the Argovis app (Tucker et al. 2020) sends a response: either raw JSON or an HTML page with data and metadata that fall within these queries. Data is displayed on the map as shown e.g. in Fig. 5a.

API

For added flexibility, an application programming interface (API) gives users access to website data without the need of a browser. Scientists can make selections in their preferred language directly using HTTP APIs (e.g. Fig. 1). Examples of API scripts in Matlab, Python, R are available on the Argovis tutorials page. See Figs. 2 and 3 example uses made possible by API.

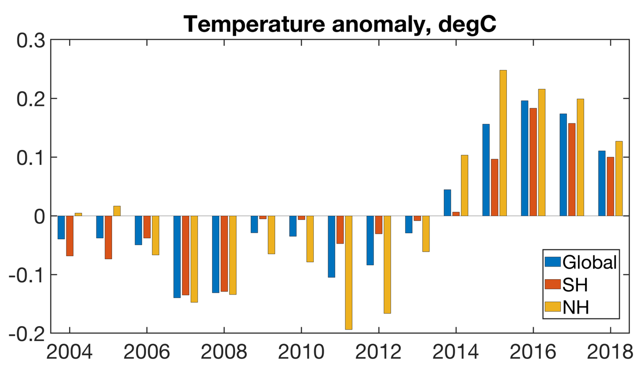

Figure 2: January temperature anomaly at 10 dbar for Northern Hemisphere, Southern Hemisphere, and the global ocean in the Roemmich and Gilson Climatology.

```python
def get_grid(latRange, lonRange, gridName, monthYear, presLevel):
    url = "https://argovis.colorado.edu/griddedProducts/grid/window?"
    url += "latRange=" + stringify_array(latRange)
    url += "&lonRange=" + stringify_array(lonRange)
    url += "&gridName=" + gridName
    url += "&monthYear=" + monthYear
    url += "&presLevel=" + presLevel
    resp = requests.get(url)
    if not resp.status_code // 100 == 2:
        return "Error: Unexpected response {}".format(resp)
    grid = resp.json()
    return grid[0] # should be a list of length 1
def get_float_trajectory_by_point_and_dt(long, lat, dt):
    url = "https://argovis.colorado.edu/covarGrid/"
    url += str(long) + '/'
    url += str(lat) + '/'
    url += str(dt)
    resp = requests.get(url)
    if not resp.status_code // 100 == 2:
        return "Error: Unexpected response {}".format(resp)
    traj = resp.json()
    return traj
def get_ar_by_date(date):
    url = "https://argovis.colorado.edu/arShapes/findByDate?date="
    url += date
    resp = requests.get(url)
    if not resp.status_code // 100 == 2:
        return "Error: Unexpected response {}".format(resp)
    ars = resp.json()
    return ars
```

Figure 1:Python functions that query fields using HTTP library 'request'.

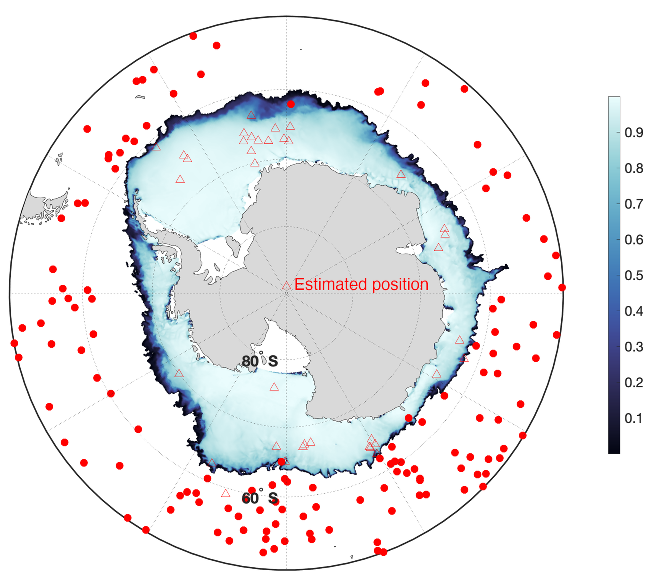

Figure 3: Sea ice area from the Southern Ocean State Estimate (SOSE, Verdy and Mazloff, 2017) on 1st June 2013 and location of Argo profiles (red markers; triangles indicate estimated locations).

Access Atmospheric River (AR) database and Argo profiles within ARs' shapes [Status: Beta version]

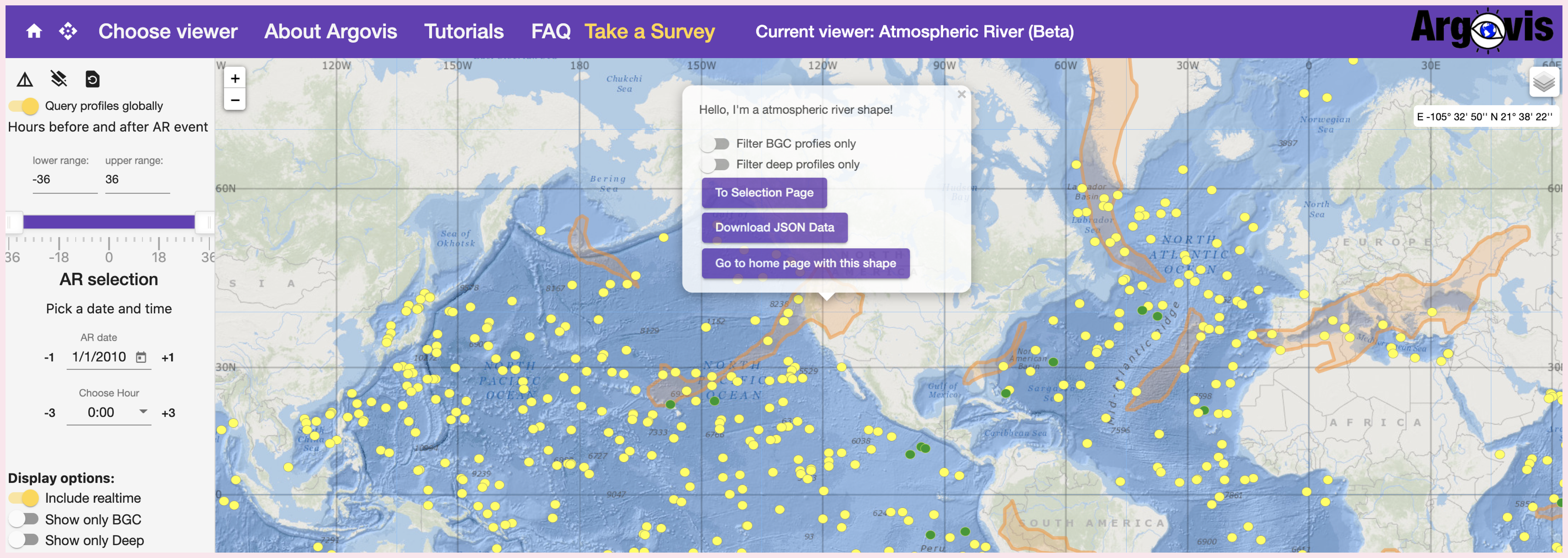

Figure 4: ARs (in orange) for a user-selected date-time (January 1st, 2010 at midnight) globally from the Guan and Waliser (2015) AR product. Argo profiles (dots in the map) are queried by time within an adjustable window of ±36 hours max from the ARs date-time (see horizontal slider on left-side menu to set temporal co-location startegy). The selection page for co-located profiles (Fig. 5b,c) is accessed by clicking the shape dialog window button labeled 'To Selection Page'. An AR shape is converted into a profile selection area by clicking on the shape and the 'Go to home page with this shape' button.

Access profiles within shape including Argo biogeochemical (BGC) data [Status: Implemented]

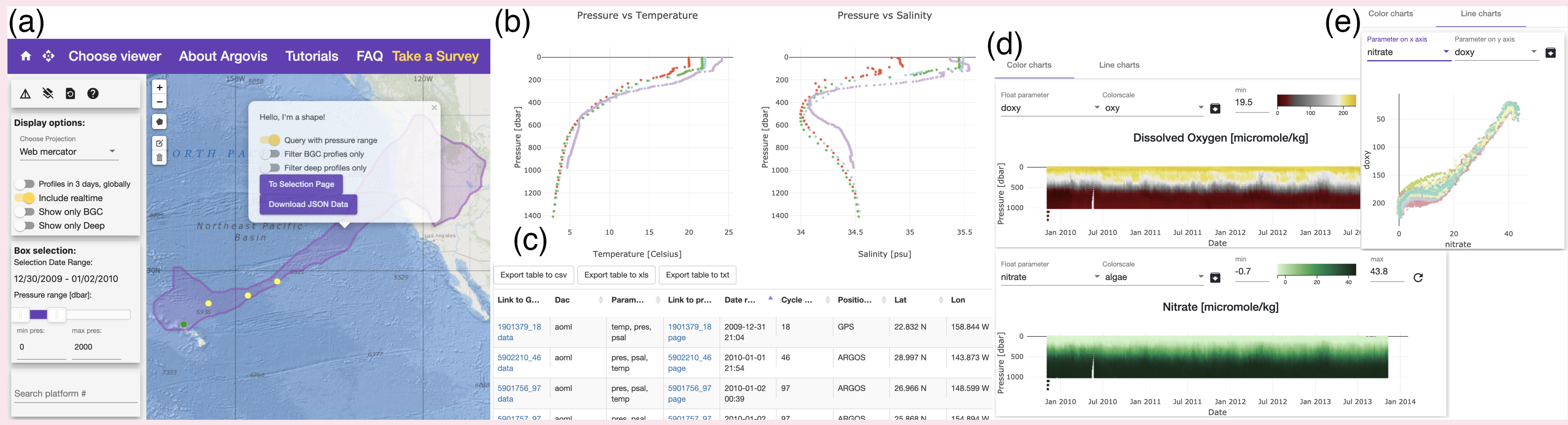

Figure 5: (a) Profiles are queried within a shape and time window (e.g. a shape from Fig. 4). Clicking the shape dialog window button labeled 'To Selection Page', profiles data and metadata can be accessed (e.g. panels b, c). Clicking on the green dot in panel a (or on the corresponding profile in the figures in panel b), the Argo BGC platform page can be accessed to view data for that float (e.g. panels d, e).

Access gridded products [Status: Beta version]

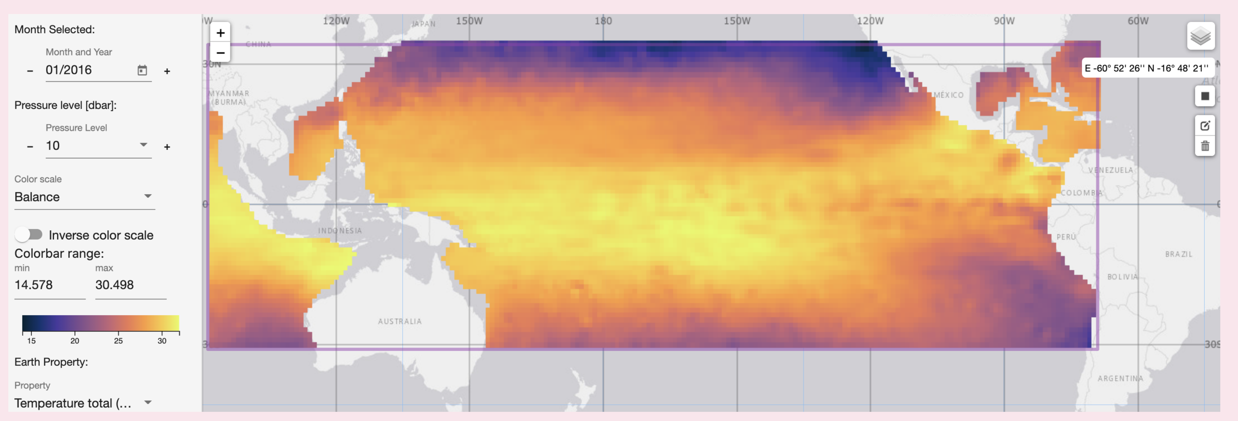

Figure 6: Roemmich and Gilson Climatology: temperature at 10 dbar in the Equatorial Pacific in January 2016. Clicking on the grid displays the temperature at that point. Linear interpolation and inverted color-scale options are selected in the menu on the left.

Prediction of future float positions [Status: Implemented]

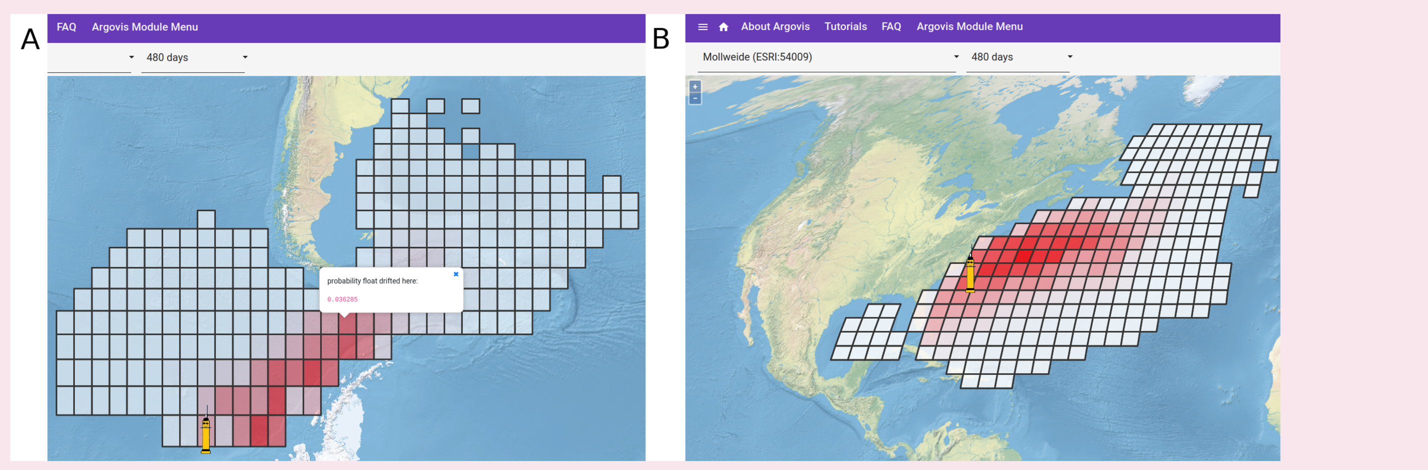

Figure 7: Future float positions by Chamberlin et al. Model prediction shows (a) flow through the Drake Passage and (b) a float projected to move north with the Gulf Stream in the West Atlantic.

Acknowledgements

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Useful Links

- Web: `https://argovis.colorado.edu`
- Twitter: ArgovisWebApp, @ArgovisCU

References

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- Chamberlain et al, 2020: Following the Argo footprints: using existing Argo trajectories to predict future float positions and determine optimal deployment locations to constrain temperature, salinity, and biogeochemical variables, (sub judice)
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