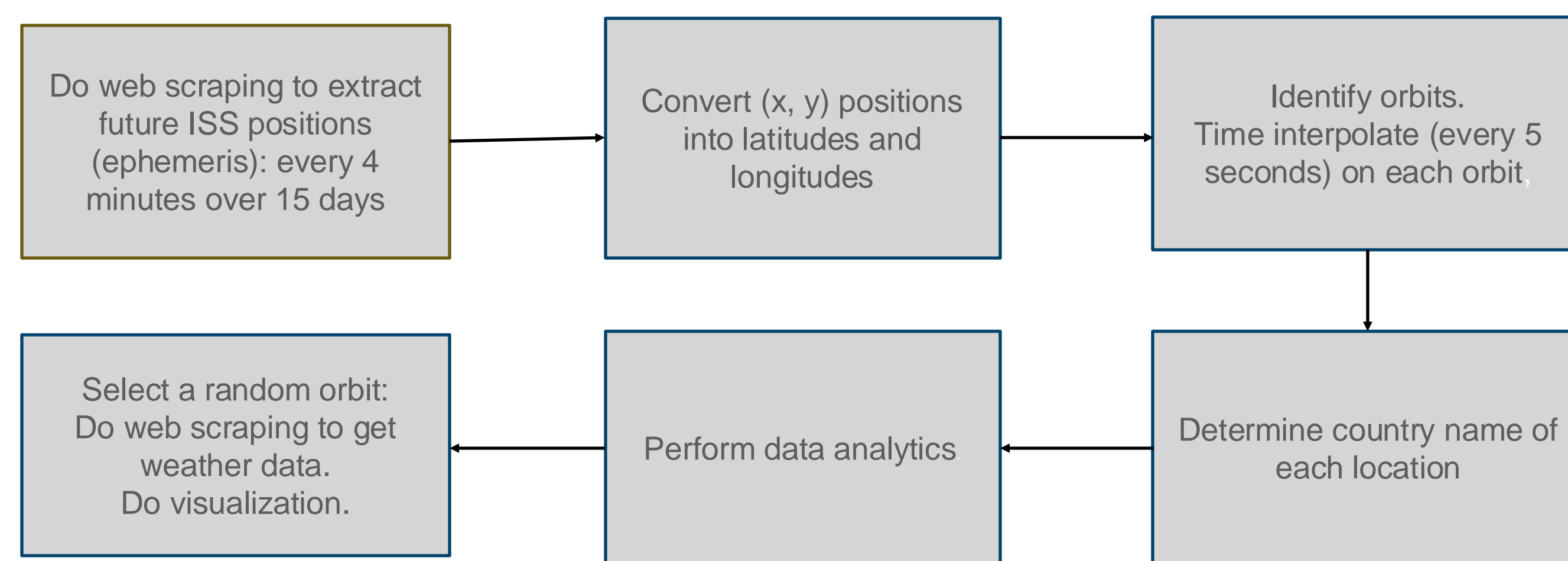


Introduction

The International Space Station (ISS) is a space station that circles (from west to east) the Earth about every 90 minutes and passes over places between latitudes 52 degrees south and 52 degrees north at different times of the day. It is possible to know the future planar position of ISS. We write a standalone Python application that determines such future positions (over a 15-day period) and performs data analytics. The tool also focuses on any individual ISS orbit to gather weather conditions along ISS' path and perform various visualizations. This application can complement the NASA's Spot the station initiative and can serve as an educational tool.

Python workflow

The application performs the following steps to obtain future ISS positions and do various data manipulations and visualizations.



To reduce the time to run all the steps, we offer the option to do the same analysis by focusing on a date range after collecting the 15-day data.

Data analytics

After gathering the data (on future positions) for a given date range, we want to determine the number of ISS orbits, the number of countries visited, the countries most overpassed, etc.

From **April 18, 2025** (at 12:00 pm) till **May 3, 2025** (at 12:00 pm), ISS will:

- Have 218 orbits.
- Overpass 174 countries or territories.
- Fly over Russia, the United States and China 112, 108 and 105 times, respectively.

The figure on the center -top shows the percentage of countries flew over by ISS at a given frequency.

References

1. J. Kouatchou and C. Chen, *Python tool for tracking the movement of the International Space Station and identifying the weather condition along the track*, PyCon US 2024, Poster Session.
2. <https://www.nasa.gov/international-space-station/>

Acknowledgements

We would like to thank the NASA Center for Climate Simulation (NCCS) for supporting this effort.

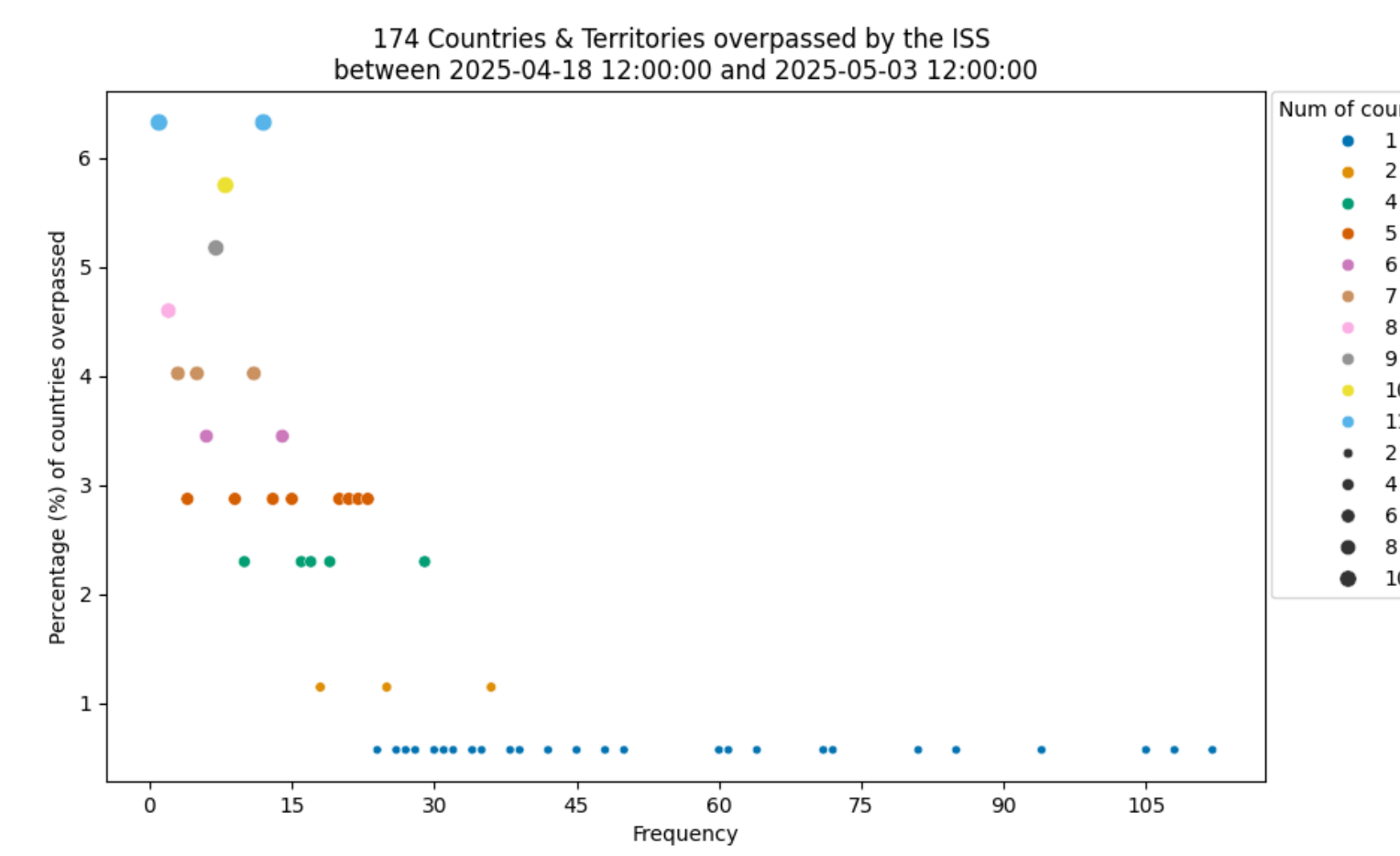


Figure 1: ISS' orbits: percentage of countries overpassed by ISS at a given frequency.

We can also determine the countries that were most visited by ISS:

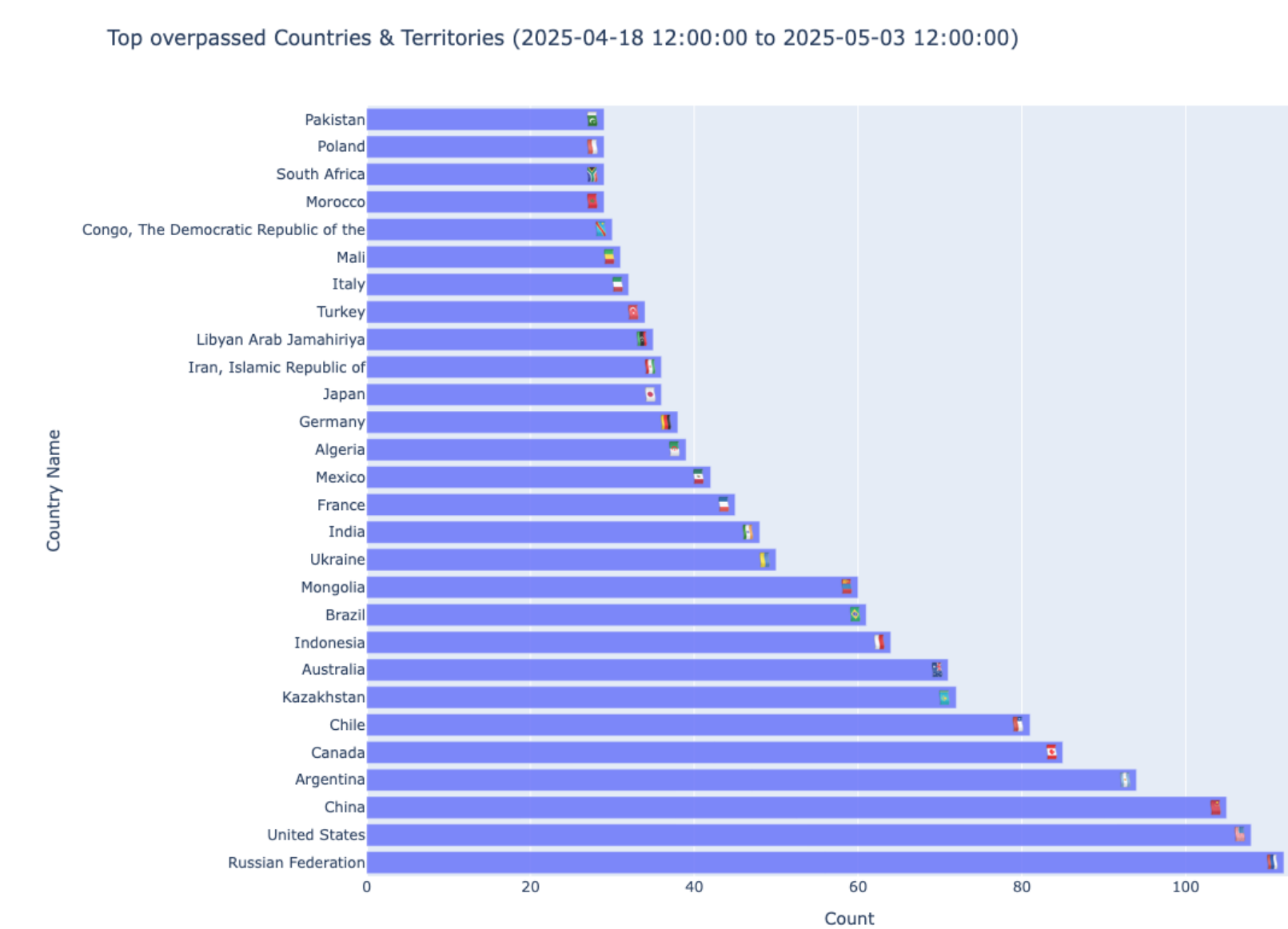


Figure 2: ISS' orbits: bar chart of top countries overpassed by ISS.

The tool allows us to focus on a given country and determine the dates when ISS will be above it. In the figure below, we present the different ISS orbits over the United States.

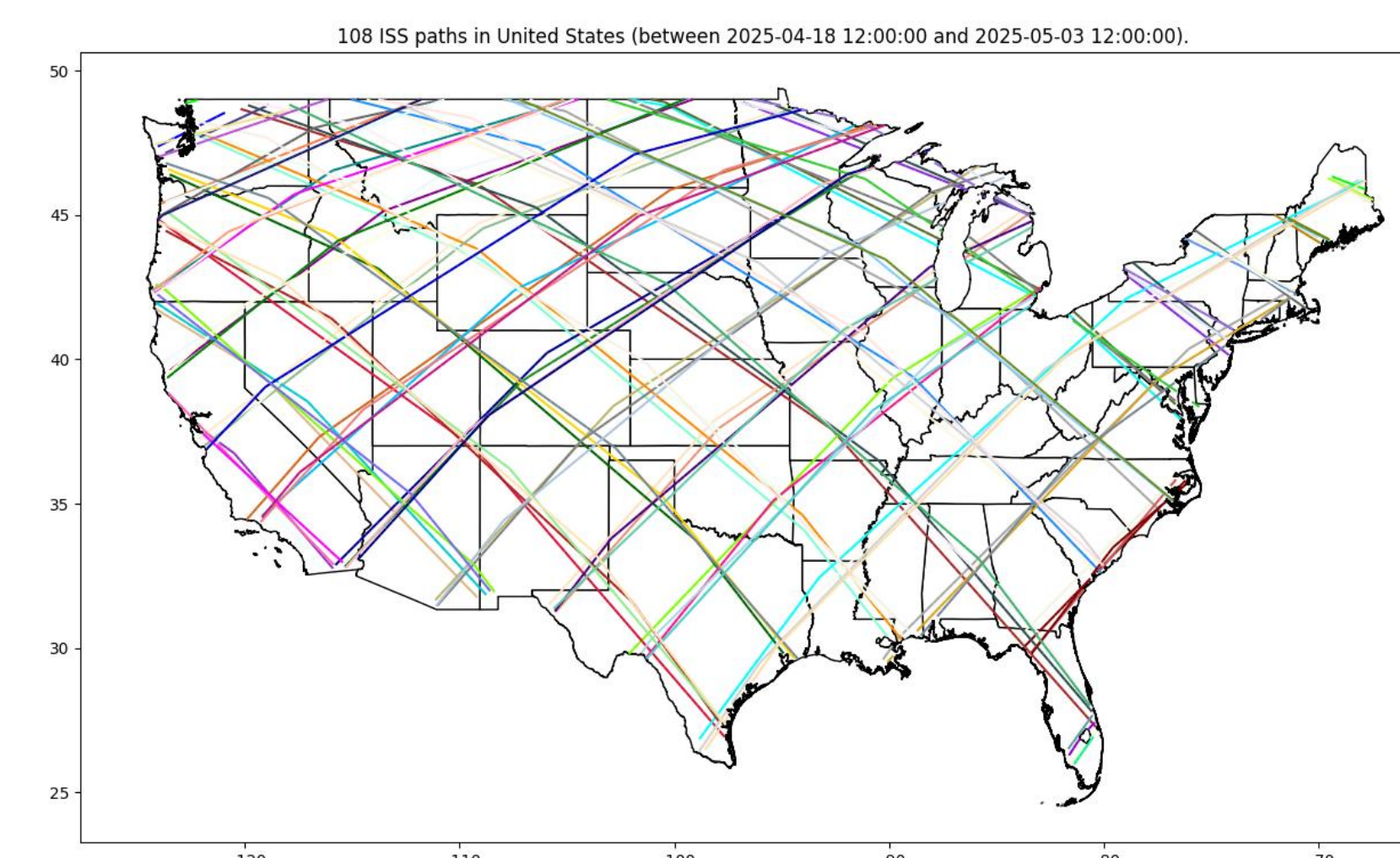


Figure 3: ISS' orbits over the United States.

Data visualization

Here, we take a random full ISS' orbit. We identify each location and gather weather forecast data (over the next few days).

We first map the selected orbit, color each country overpassed and provide the flag of each country.

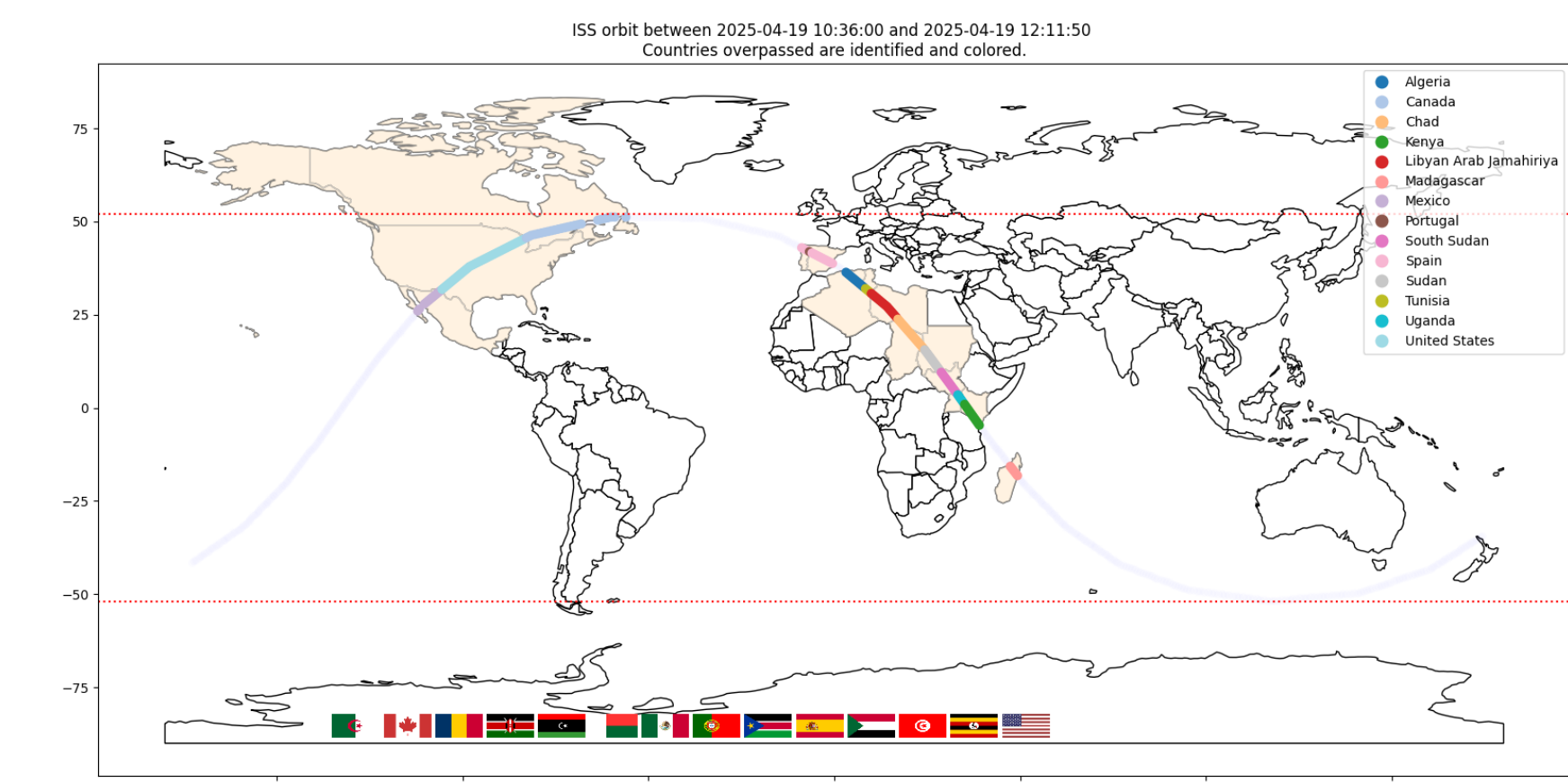


Figure 4: One ISS' orbit: countries overpassed are highlighted and their flags are shown.

Finally, we plot along the orbit the cloud cover that indicates the locations where ISS will more likely be seen from the ground.

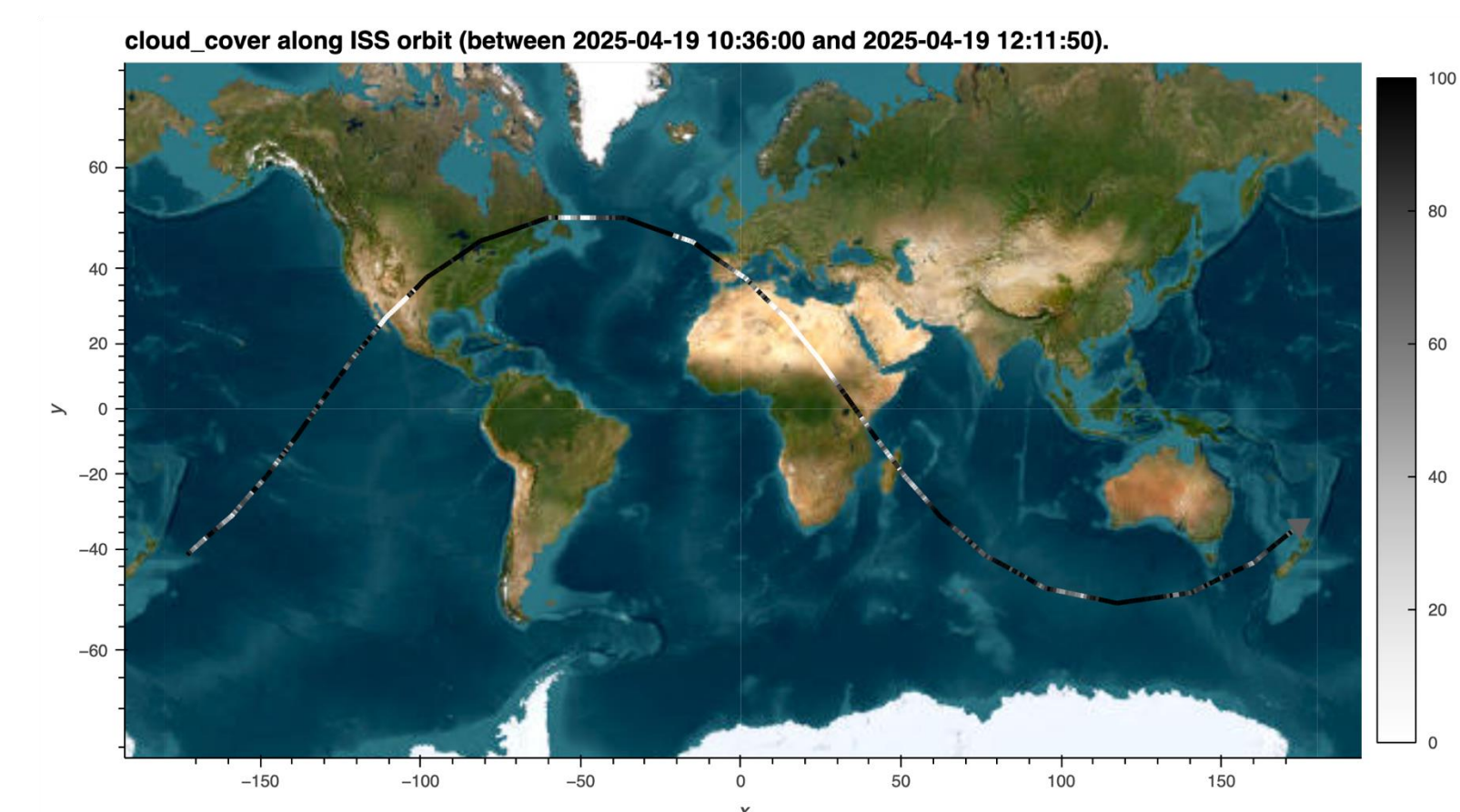


Figure 5: One ISS' orbit: interactive plot of cloud cover values along the path.

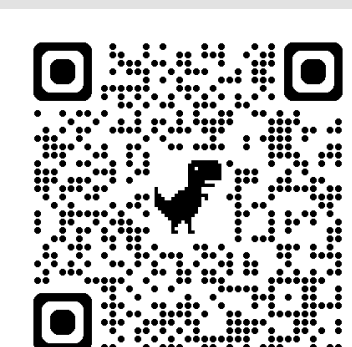
Conclusion and future work

In this work, we wrote a Python tool that collects (over a time range) future locations of the International Space Station (ISS) together with weather data (along an arbitrary orbit). The tool determines which countries are overpassed by ISS and at which frequency. It is also capable of mapping an orbit, labeling the countries along the track and plotting weather conditions. We plan to add more features to the tool by including major cities along tracks and by building a graphical user interface to run it. We also intend to introduce parallel processing and the option to do visualization on a sphere.

Python packages used

The main Python packages the application uses are:

- **requests**: Access a webpage and extract its content.
- **Json/BeautifulSoup**: Parse the content of webpages
- **Seaborn/plotly/hvplot**: Perform visualization.
- **global-land-mask**: Determine if a given location is a land or not.
- **reverse_geocode**: Determine the country of a location.
- **Pandas/GeoPandas/MovingPandas**: Perform data analysis and track ISS' movement.
- **Xarray**: Perform time interpolations.
- **Astropy**: Convert ISS positions into latitudes and longitudes.
- **countryflag/flagpy**: Obtain the flag of a country.



[View the project](#)



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