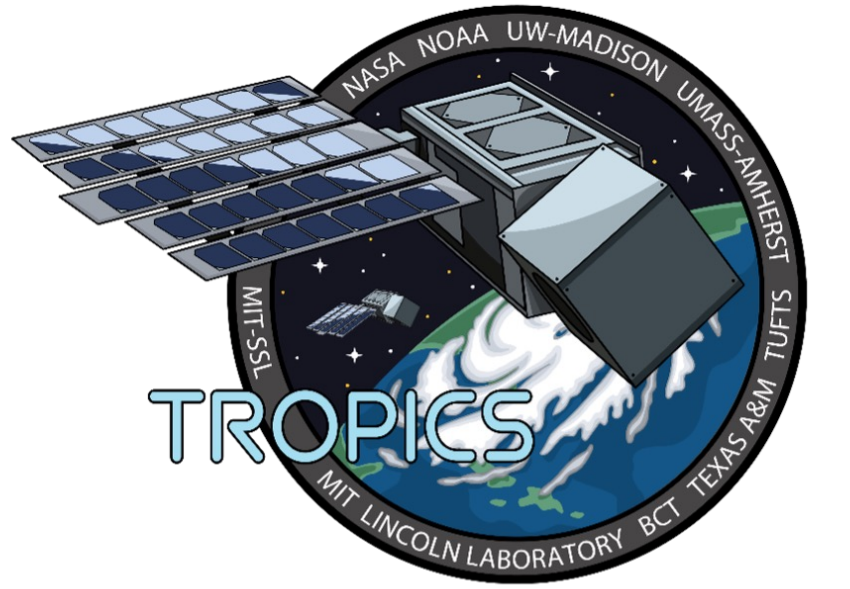


Visualizing Tropical Cyclone Development with TROPICS Data in ArcGIS



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Introduction

The Goddard Earth Sciences Data and Information Services Center (GES DISC) is one of twelve NASA Distributed Active Archive Centers (DAACs) of NASA's Earth Observing System Data and Information System (EOSDIS) and is located at the Goddard Space Flight Center (GSFC). At GES DISC, we archive and distribute a variety of satellite observations and Earth system models from different science focus areas, one of which being weather/atmospheric dynamics data. We also provide data services and web-based tools to access data such as our L2 Subsetter and GIS tools.



Background

- Hurricane Fiona was a Northern Atlantic Tropical Cyclone (TC) that formed September 14, 2022 and lost its tropical characteristics by September 23, 2022.
 - This TC made landfall in several Caribbean Islands including: Puerto Rico, Dominica Republic, and Turks & Caicos.
 - It also made landfall in Nova Scotia as a formidable extratropical storm.
- Fiona was one of three[†] major cyclones that occurred during the 2022 Atlantic Hurricane season.
 - Over the course of its lifetime, Fiona attained Category 4 strength.

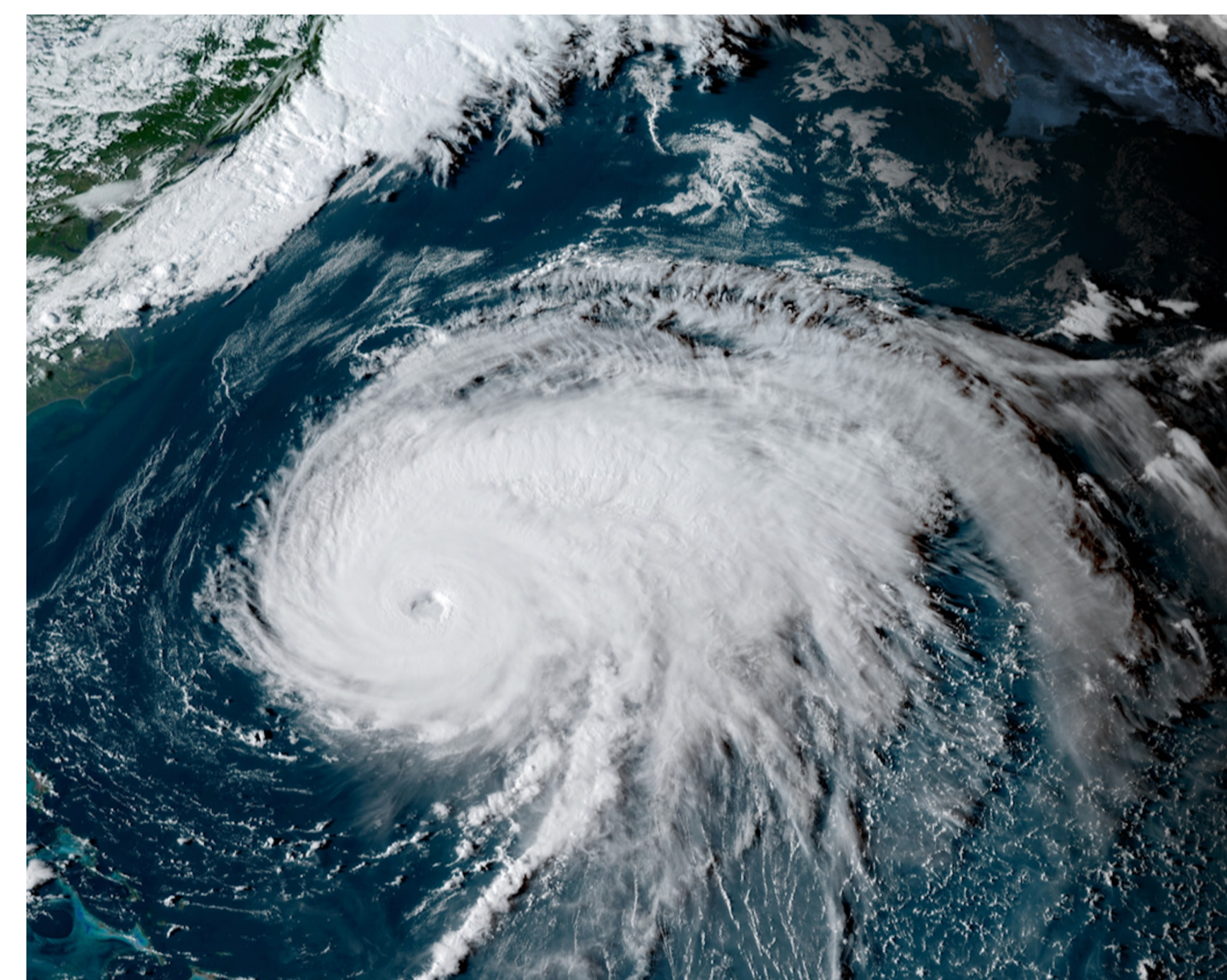


Figure 1: Hurricane Fiona in the Atlantic on September 22, 2022. Courtesy of NOAA GOES-16 and CIRA.

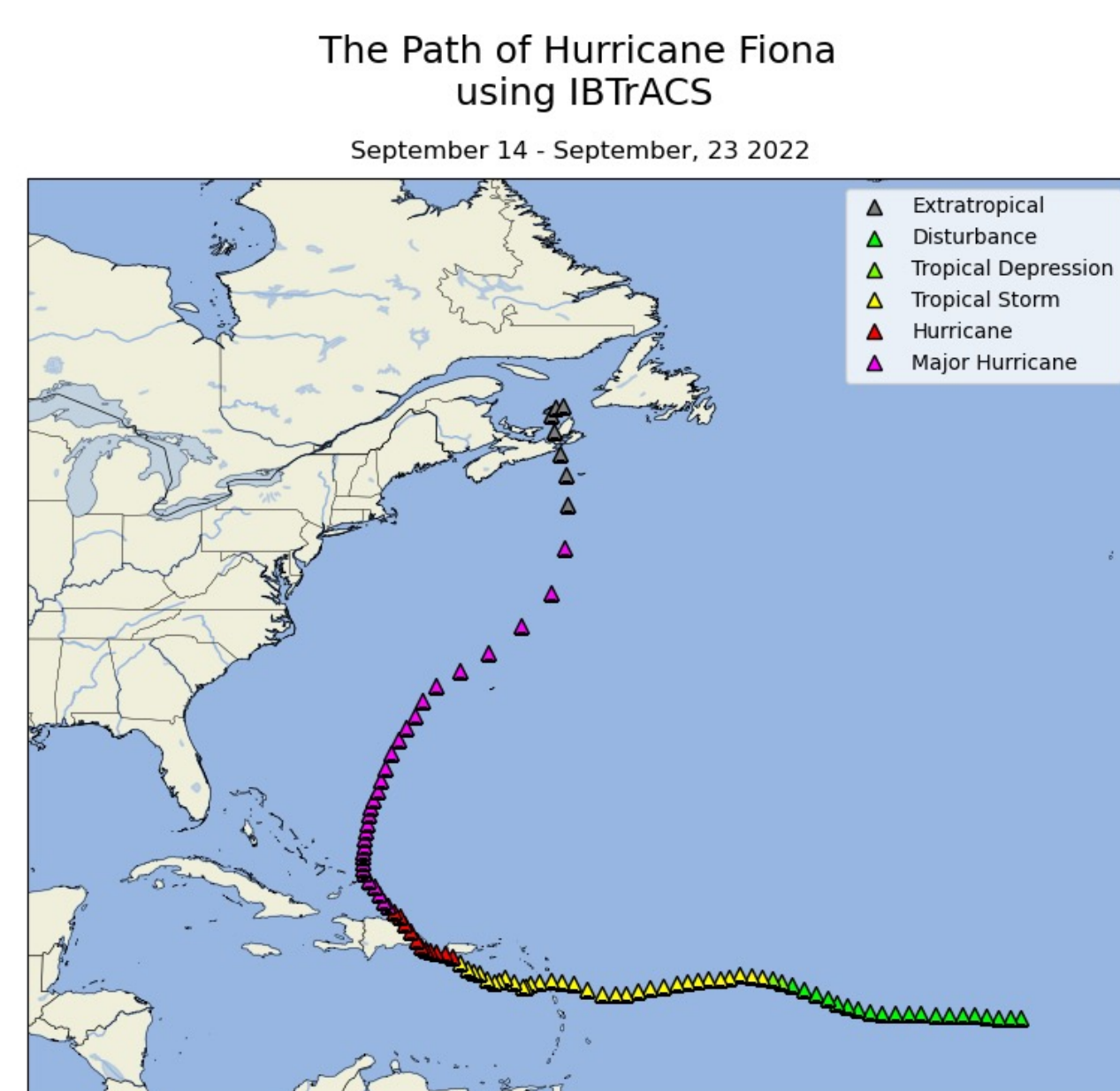


Figure 2: The path and status of Hurricane Fiona over its lifespan. This image uses data from IBTrACS.

GIS Tool

Motivation

- Address a need expressed during the 2023 Joint CYGNSS + TROPICS Meeting
- Provide support for varying skill levels
- Design a unique tool in comparison to those that are currently available

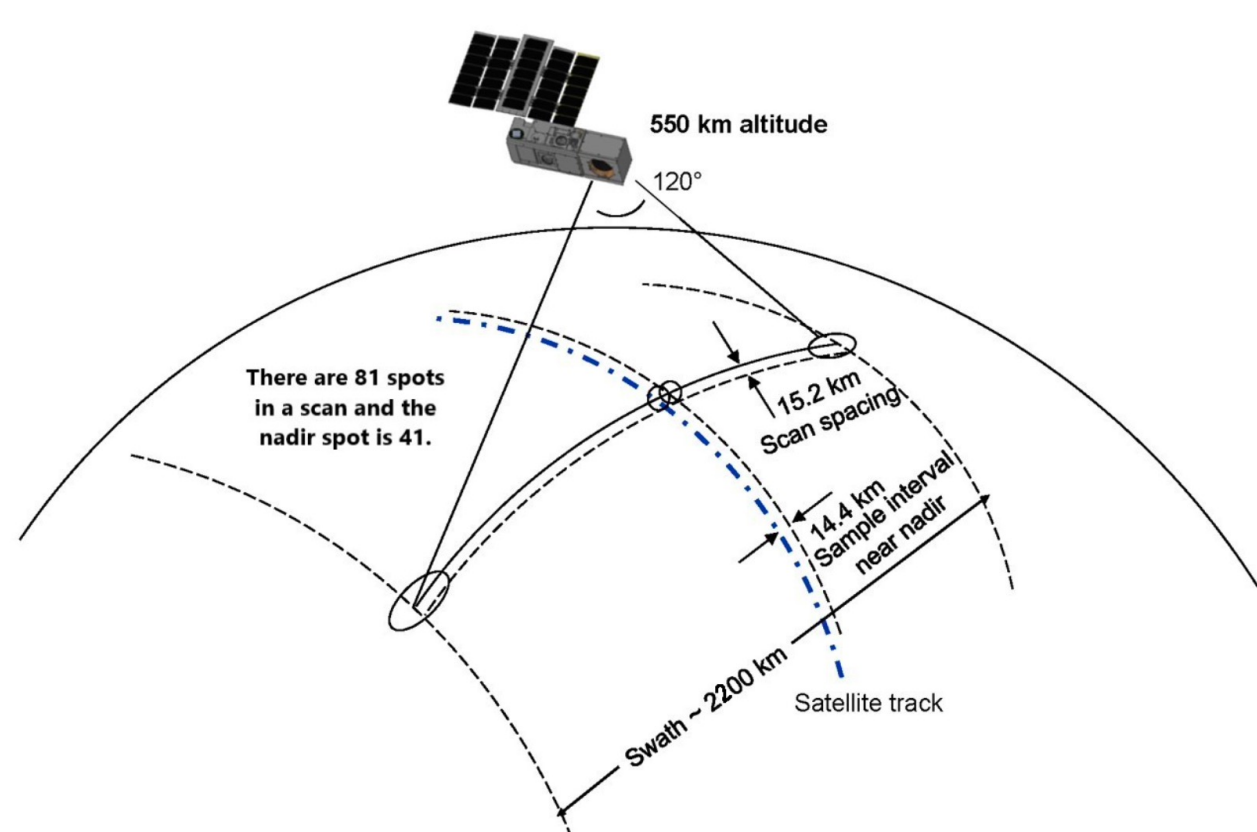


Figure 3: Illustration of the radiometric measurements projected on to the surface of the Earth. The cross-track spacing is 14.4 km and the along-track spacing is 15.2 km. Courtesy of TROPICS User Guide.

Function	Capability (Yes/No)
Custom Colormap	Yes
Range Extents	Yes
Clickable Map Features	Yes
Downloadable	No

Table 1: A list of present capabilities for the ArcGIS Online web tool.

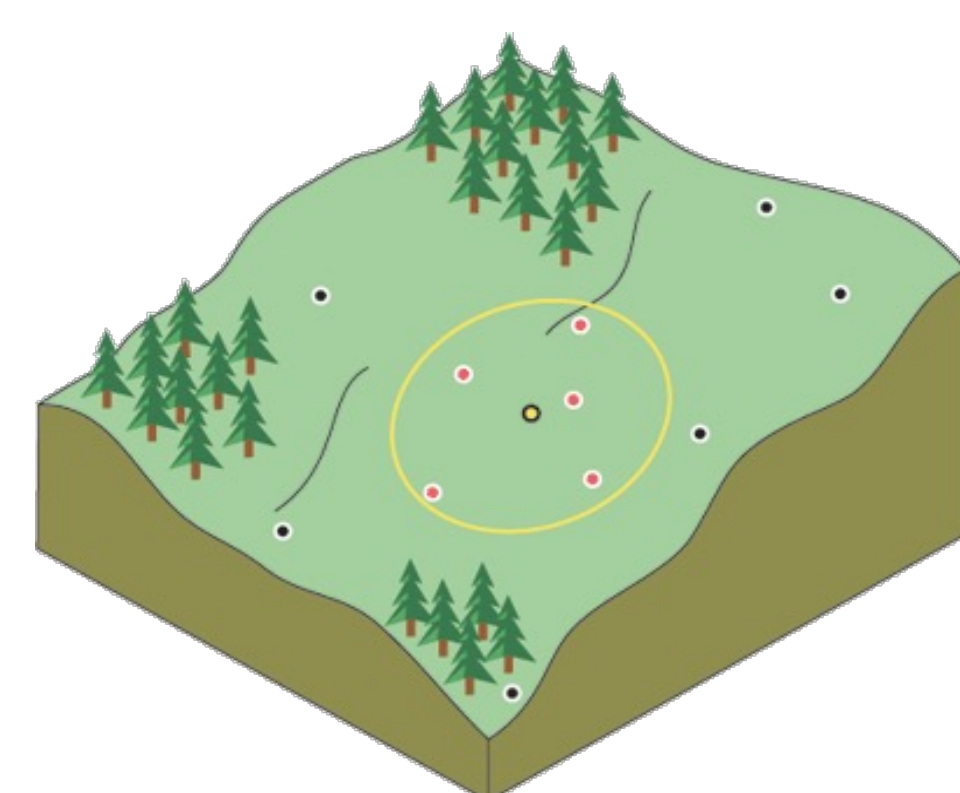


Figure 4: Illustration of the IDW data selection process for interpolation. Courtesy of ESRI.

Inner Workings of the Web Tool

- Account for size variations in CubeSat footprint (See Figure 3)
 - There is NO default interpolation method.
- IDW (Inverse Distance Weighted)
 - Uses a weighted distance averaging
 - Closer data points = more influence (See Figure 4)
 - Simpler to understand
 - Parameter values account for computational expense.
- Other Python libraries and ArcGIS geoprocessing tools were also used (See Figure 5)

GIS Tool cont.

Python Scripting GIS Workflow

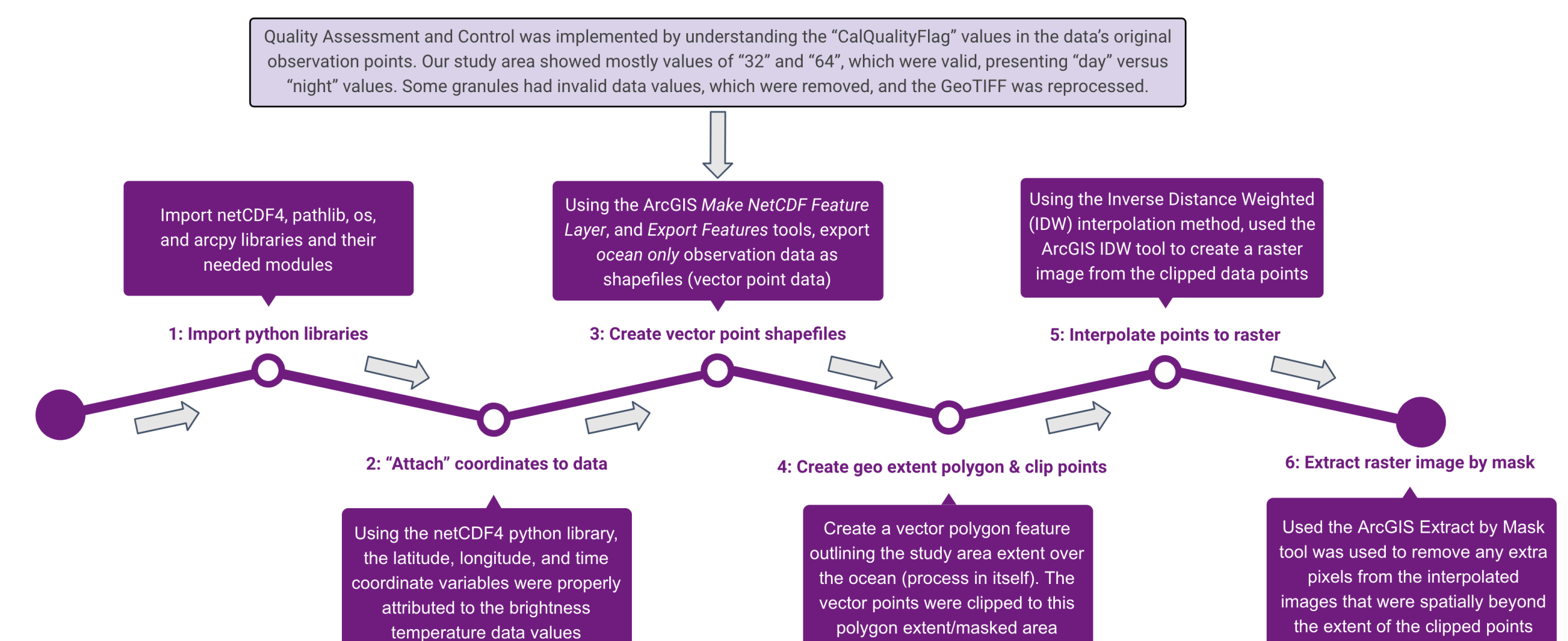


Figure 5: An illustration of the workflow used to generate the imagery from a TROPICS granule using ArcGIS Pro.

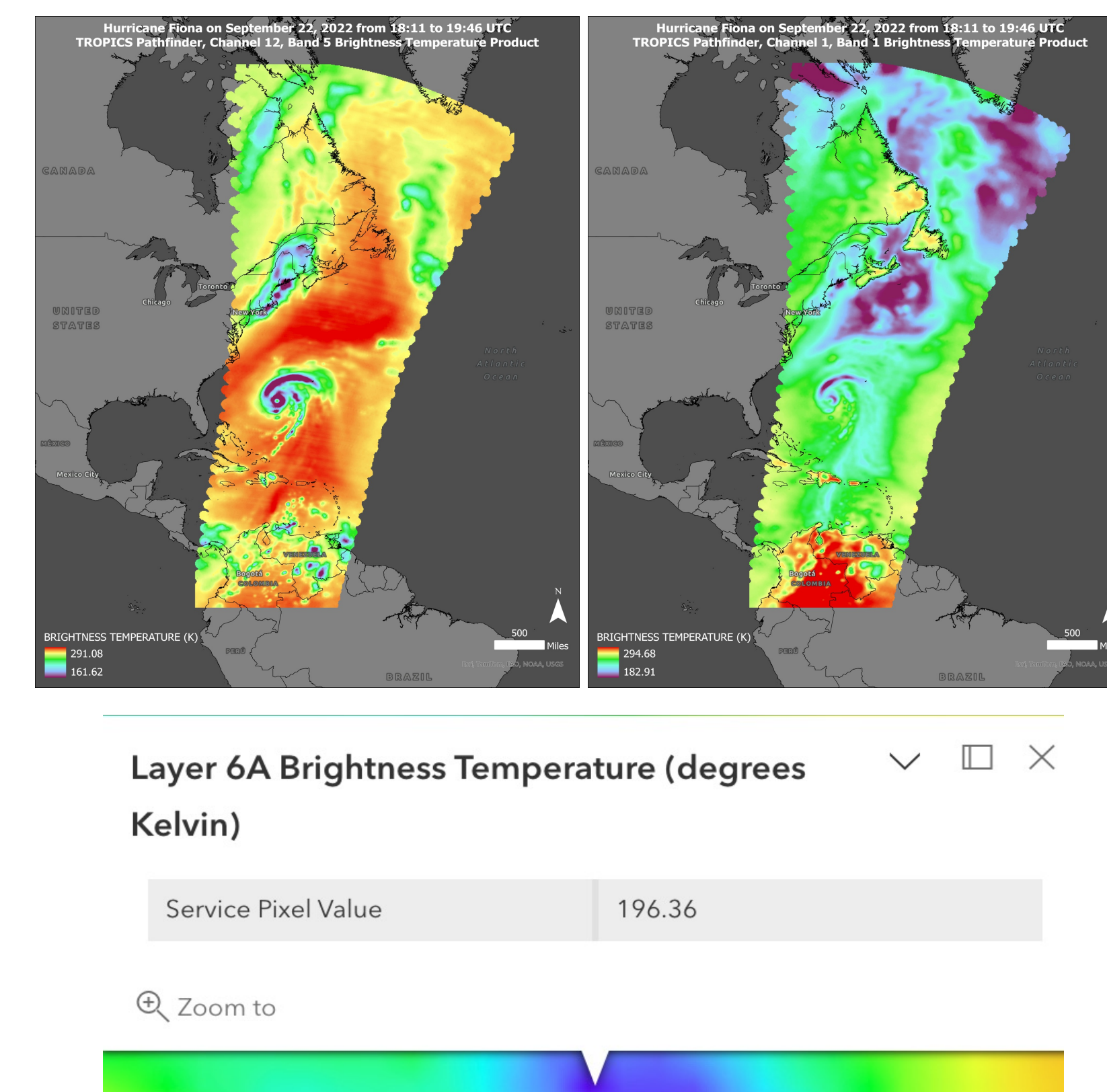


Figure 6: Visualization of Hurricane Fiona on September 22, 2022 from TROPICS Pathfinder Brightness Temperature Channel 12 Band 5 (top-left) and Channel 1 Band 1 (top-right) using ArcGIS software. Rendered brightness temperature value from ArcGIS web interface (bottom).

GIS Web Map

- Highlight notable Tropical Cyclones from the previous season
- Only observes a subset of channels
- Granules are represented by different layers within the web interface:
 - Enables users to observe TC evolution
 - Clickable map features (See Table 1)
 - Users capabilities also include altering layer visibility when toggling between images.

Future

- Define the most appropriate geoprocessing method for interpolating TROPICS Level 1B brightness temperature.
- Expand the tool to include additional data products and future data deliveries.
- Create an accompanying Data-in-Action article which will demonstrate how to visualize TROPICS data using Python
- Further develop tool through implementation of user feedback.
- Continue to support the ArcGIS-TROPICS project.

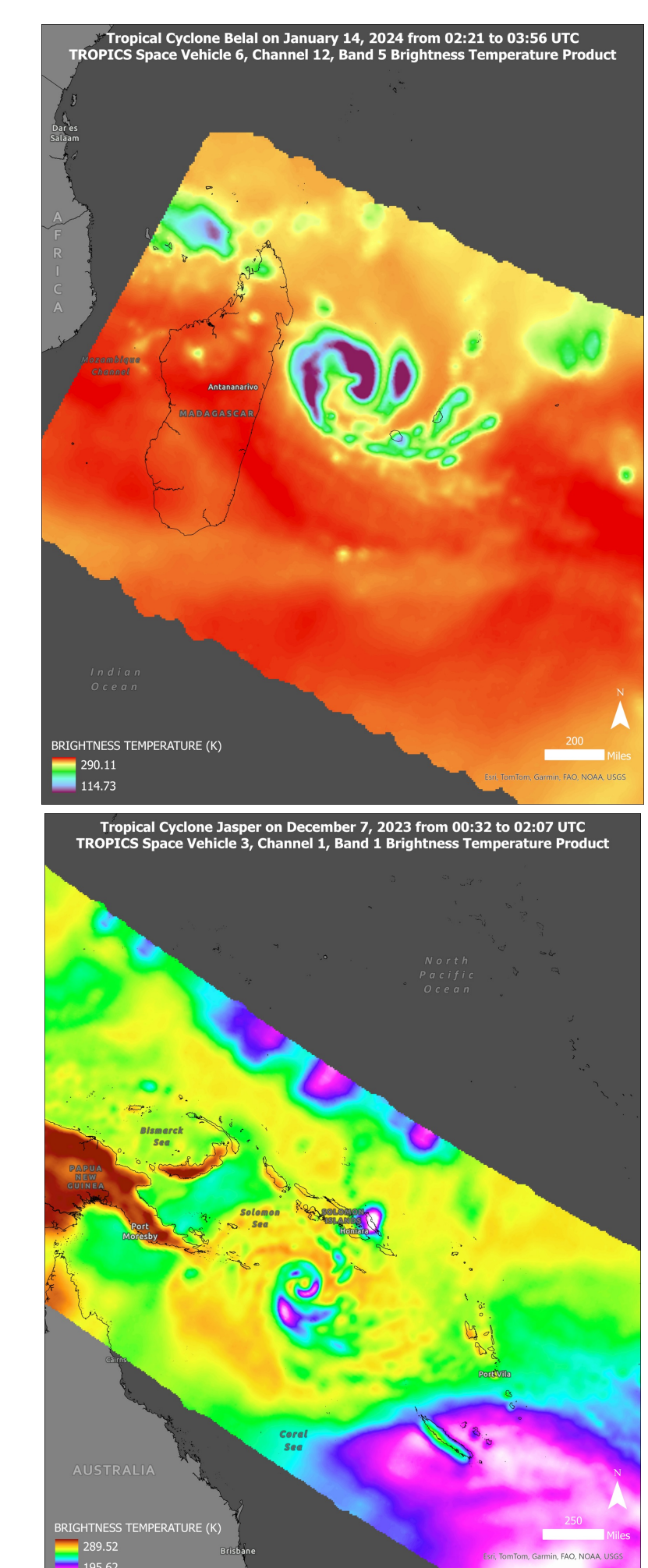


Figure 7: Visualization of TROPICS Brightness Temperature observing Tropical Cyclone Belal on January 14, 2024 at Channel 12 Band 5 via Space Vehicle 06 (top) and Tropical Cyclone Jasper on December 7, 2023 at Channel 1 Band 1 via Space Vehicle 03 (bottom) using ArcGIS software.

Citations

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[†] This includes Bonnie, Ian, and Fiona. Though accounted for, Hurricane Bonnie did not attain major hurricane status until after its departure from the Atlantic Ocean into the Pacific Ocean.

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