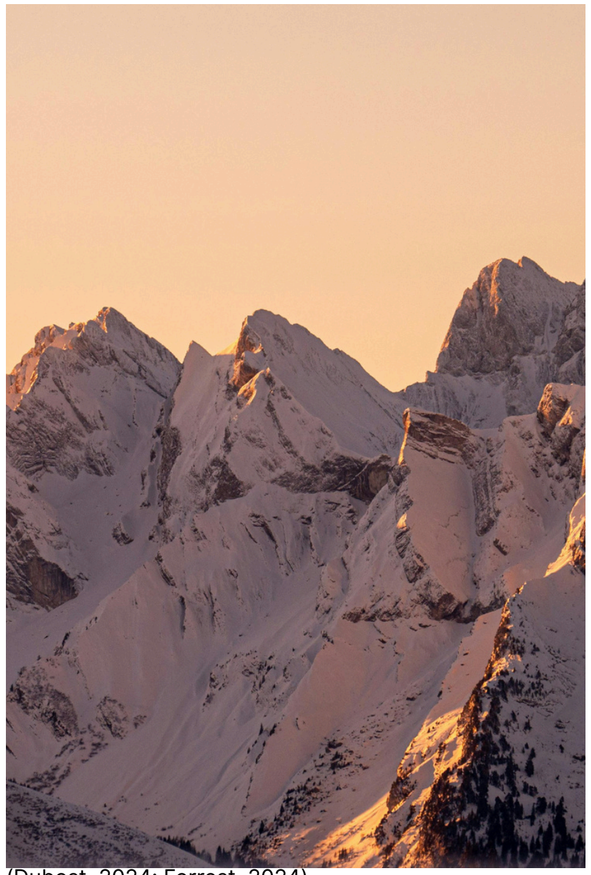
Summer 2025



(Dubost, 2024; Forrest, 2024)

INTEGRATION OF ATMOSPHERIC AND OCEANIC DATA FOR APPLICATIONS

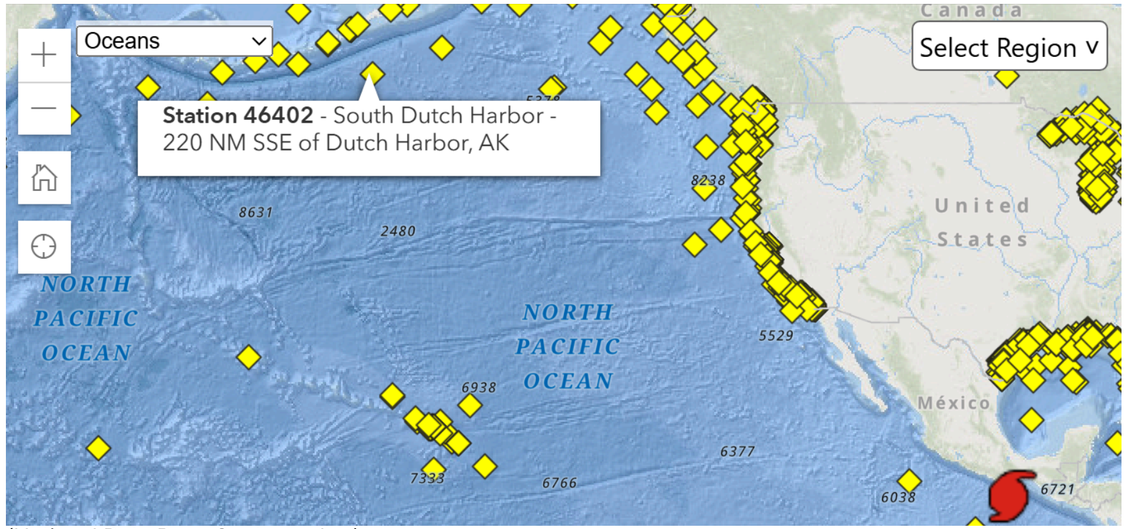
Holli Meyers
University of Washington

PROJECT INSPIRATION

Independent research project focused around information architecture, inspired by the shortcomings of Apple and Samsung's mobile weather apps, which include moon phases but omit ocean tidal information, requiring a separate web browser to look up high and low tide patterns.

LAT	LON	YYYY	MM	DD	hh	mm	WDIR	WSPD	GST	WVHT	DPD	APD	MWD	PRES	PTDY
deg	deg	yr	mo	day	hr	mn	degT	m/s	m/s	m	sec	sec	degT	hPa	hPa
12.000	-23.000	2025	06	18	21	00	47	4.7	5.9	MM	MM	MM	MM	1017.1	MM
21.000	-23.000	2025	06	18	19	00	MM	MM	MM	MM	MM	MM	MM	MM	MM
15.000	-38.000	2025	06	18	19	00	65	8.1	9.3	MM	MM	MM	MM	1017.5	MM
0.000	-10.000	2025	06	18	20	00	159	5.4	MM	MM	MM	MM	MM	1016.4	MM
0.000	-3.051	2025	06	18	20	00	187	5.3	MM	MM	MM	MM	MM	1016.6	MM
37.24	-122.88	2025	06	18	20	30	333	8.4	9.7	2.3	8	MM	MM	1014.8	MM
37.24	126.02	2025	06	18	21	00	160	5.0	MM	0.0	4	MM	MM	MM	MM
34.79	125.78	2025	06	18	21	00	100	4.0	MM	0.5	7	MM	MM	MM	MM
34.00	127.50	2025	06	18	21	00	90	2.0	MM	0.5	7	MM	MM	MM	MM
34.77	128.90	2025	06	18	21	00	240	6.0	MM	0.5	7	MM	MM	MM	MM
37.54	130.00	2025	06	18	21	00	200	3.0	MM	0.5	6	MM	MM	MM	MM
36.35	129.78	2025	06	18	21	00	230	3.0	MM	0.5	5	MM	MM	MM	MM
36.25	125.75	2025	06	18	21	00	150	6.0	MM	0.5	5	MM	MM	MM	MM
8.000	67.000	2025	06	18	20	00	242	6.7	MM	MM	MM	MM	MM	MM	MM

(National Data Buoy Center, n.d.-b)



(National Data Buoy Center, n.d.-a)

Importance

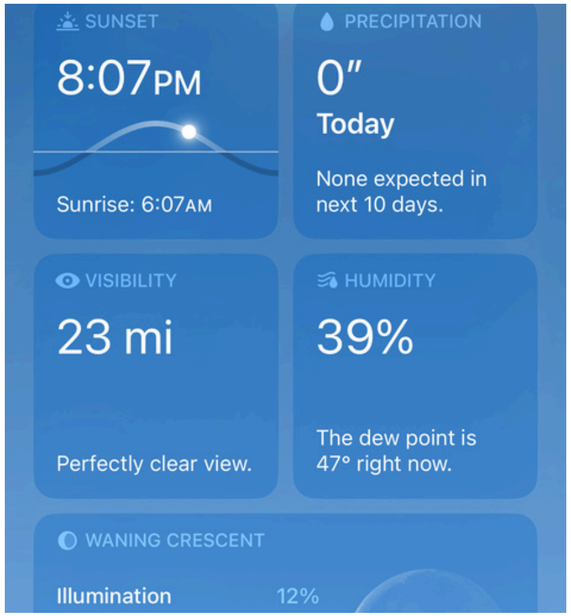
As the effects of climate change increase, our environment is to continue facing extreme and variable weather patterns that will be life altering. Thus, it's important the public has easily accessible access to real-time data to stay informed.

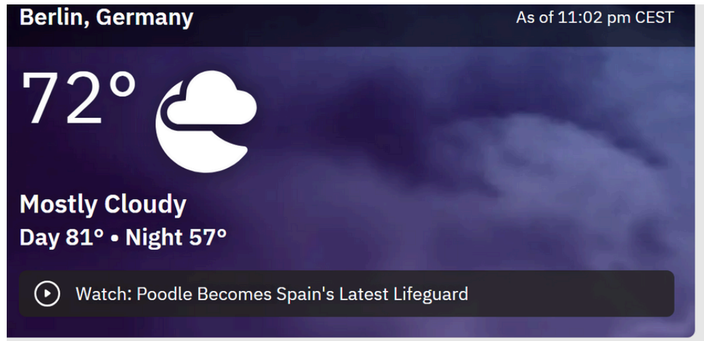
Data Barriers

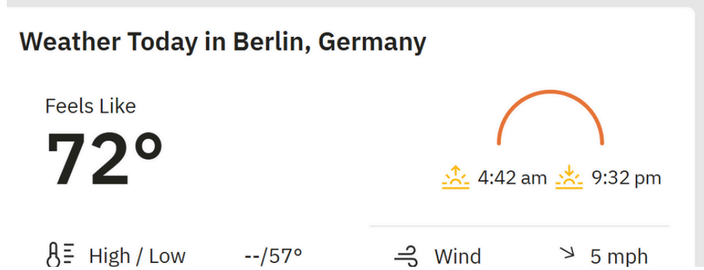
Real-time environmental data can only be accessed on their government agency sites. Few of which can actually be easily found and understood by the general public, and none provide a consolidated overview of the information.

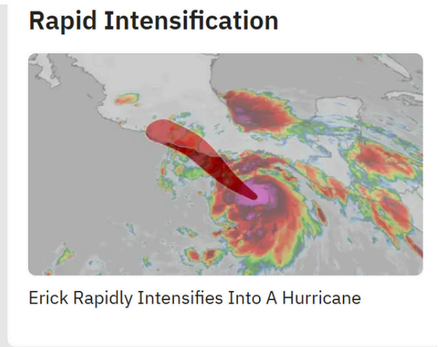
CURRENT APPLICATIONS

Popular weather applications provide traditional data but vary in depth, usability, and features. Some offer detailed forecasts with health and environmental insights, while others focus on warnings and radar maps. **None provided ocean insights**.









(Apple, n.d.; The Weather Channel, n.d.)

Mobile Applications

Includes Apple and Samsung Weather Apps.

Web Applications

Includes The Weather Channel, AccuWeather, and The National Oceanic and Atmospheric Administration (NOAA).

(Cone, 2013; Lindsey, 2022)

PURPOSE

What easier way to solve this fragmented, accessibility problem amongst weather applications than integrating a new portable information structure.

As a result, the project organized, structured, and labeled traditional weather information from atmospheric sources and combined new data sources that contain oceanic information to centralize the data for future application use.

SOURCES

Verified data takes 1-4 weeks to process. Therefore, all real-time data used here for instant observations and estimates is considered preliminary, unvalidated, and subject to change.

Preliminary Data Quality

CO-OPS uses their Continuous Operational Real-Time Monitoring System (CORMS) that provides quality control (QC) and system monitoring functions.

NDBC applies automated and manual QC procedures. Automated checks (detect gross errors, verify ranges, continuity, and relational consistency) go through the NWS Telecommunication Gateway (NWSTG). Then, within 24 hours of the automated release, the data is manually checked by an analyst (graphical analyses and sensor comparisons).

All data checks have overrides in place for storms or other unusual environmental phenomena.

Oceanic Data

Center for Operational Oceanographic Products and Services (CO-OPS), NOAA

API Request
XML and JSON File

Atmospheric Data

National Weather Service (NWS), NOAA

API Request

National Data Buoy Center (NDBC), NOAA

TXT File

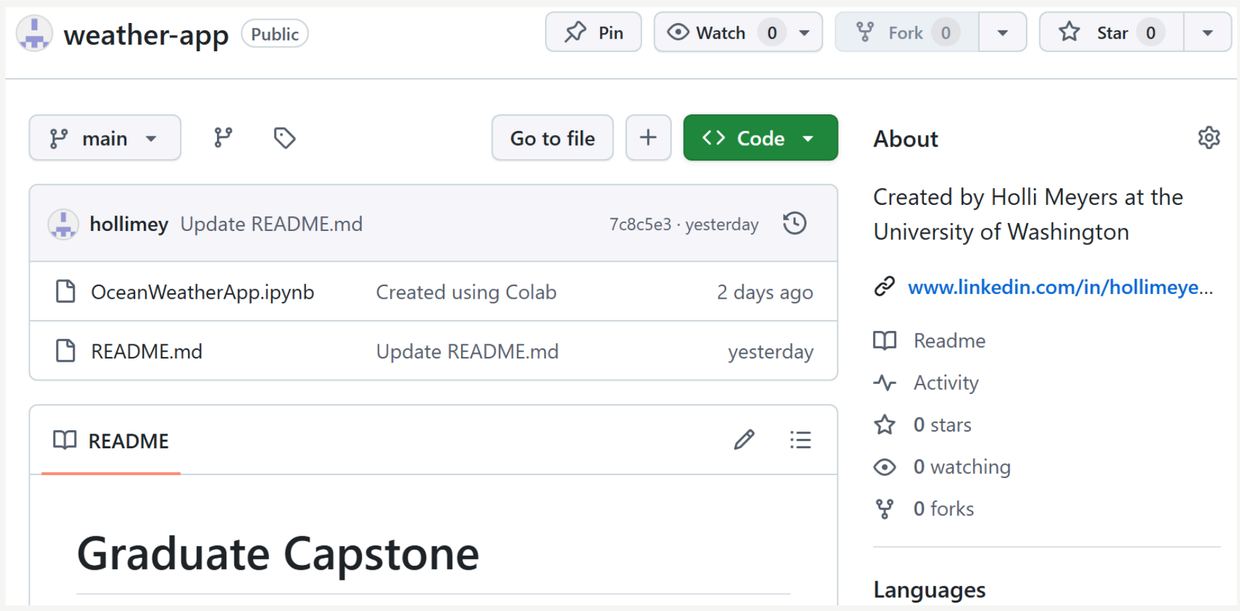
AirNow, Environmental Protection Agency (EPA)

API Request

Sensor Observation Service (SOS), CO-OPS, NOAA

API Request
CSV File

(NOAA, 2008, p. 1; NOAA, 2023, pp. 8–9; EPA, n.d.)




```
[ ]
# fetch tide predictions from CO-OPS API

import requests
import json
from datetime import datetime, timedelta
import pandas as pd

if 'merged_nearby_stations_df' not in globals() or merged_nearby_stations_df.
empty:
    print("Nearby CO-OPS stations are unavailable at this time.")
else:
    today = datetime.now() # date range for yesterday and today
    yesterday = today - timedelta(days=1)

    begin_date_str = yesterday.strftime('%Y%m%d')
    end_date_str = today.strftime('%Y%m%d') # format string YYYYMMDD

    tide_predictions_url = "https://api.tidesandcurrents.noaa.gov/api/prod/
    datagetter"

    about_tides = "Tides refer to the rising and falling of the sea. Which is
    caused by the gravitational pull of the moon and the sun. Tides are very
```

PROCESS

To develop a new portable information structure, a Python Notebook file was created in Google Colab and saved to a GitHub repository for code documentation.

The structure compiles atmospheric data (available in current weather apps) and oceanic data (available only on government sites).

To make the information portable, several sources were integrated by combining them into one JSON structure so that technical users can better understand the information and easily apply the structure to their application.

For sources that were unable to be directly integrate with each other, like those with less precise geolocations, separate JSON structures were formed to represent their different topics.

CODE OVERVIEW

Geocode Location

Provided by a U.S. city/state, the user's location is processed with the geopy library to translate the location string into coordinates.

Fetch and Parse Data

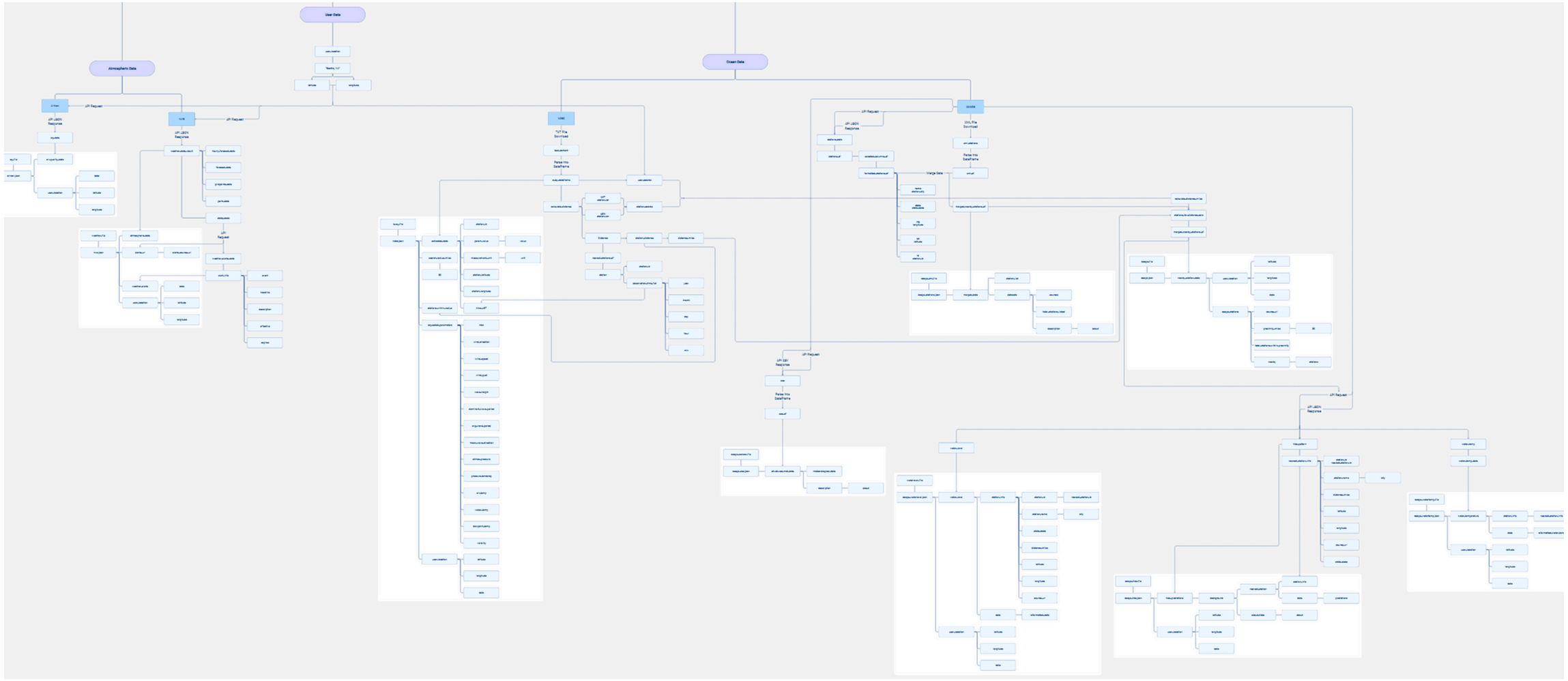
API calls and file downloads were made with the requests library and the location coordinates. End points retrieved include forecasts (7-day, hourly), gridpoints (localized model data), and active weather alerts by state code.

Keys and identifiers obtained include stations (station_id, buoy_id), geospatial identifiers (lat, lon, gridX, gridY, gridId), time-based identifiers (timestamp, datetime), and location Identifiers (office, stateCode).

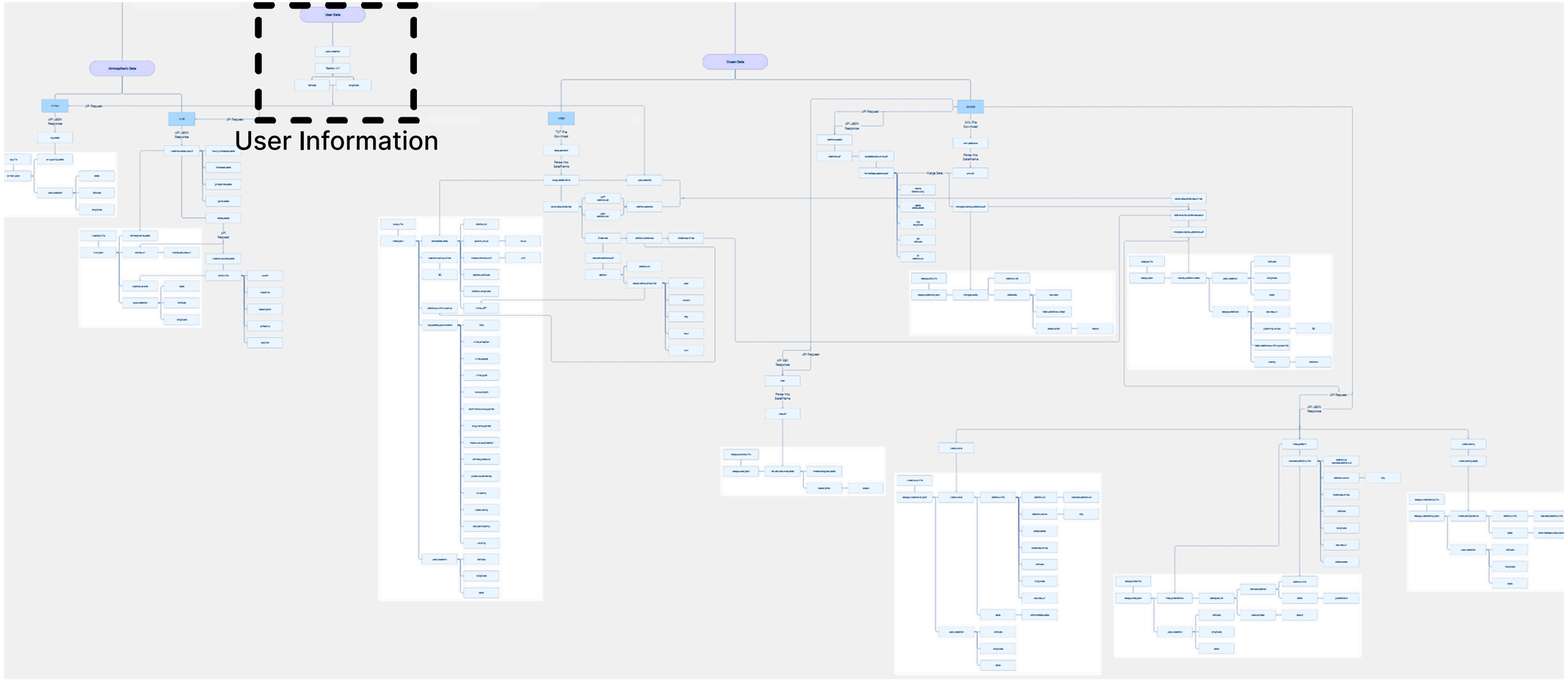
File Structure

Unnecessary keys (@context, icon, temperatureTrend) and empty fields were removed from the new JSON files, and restructured into a normalized schema.

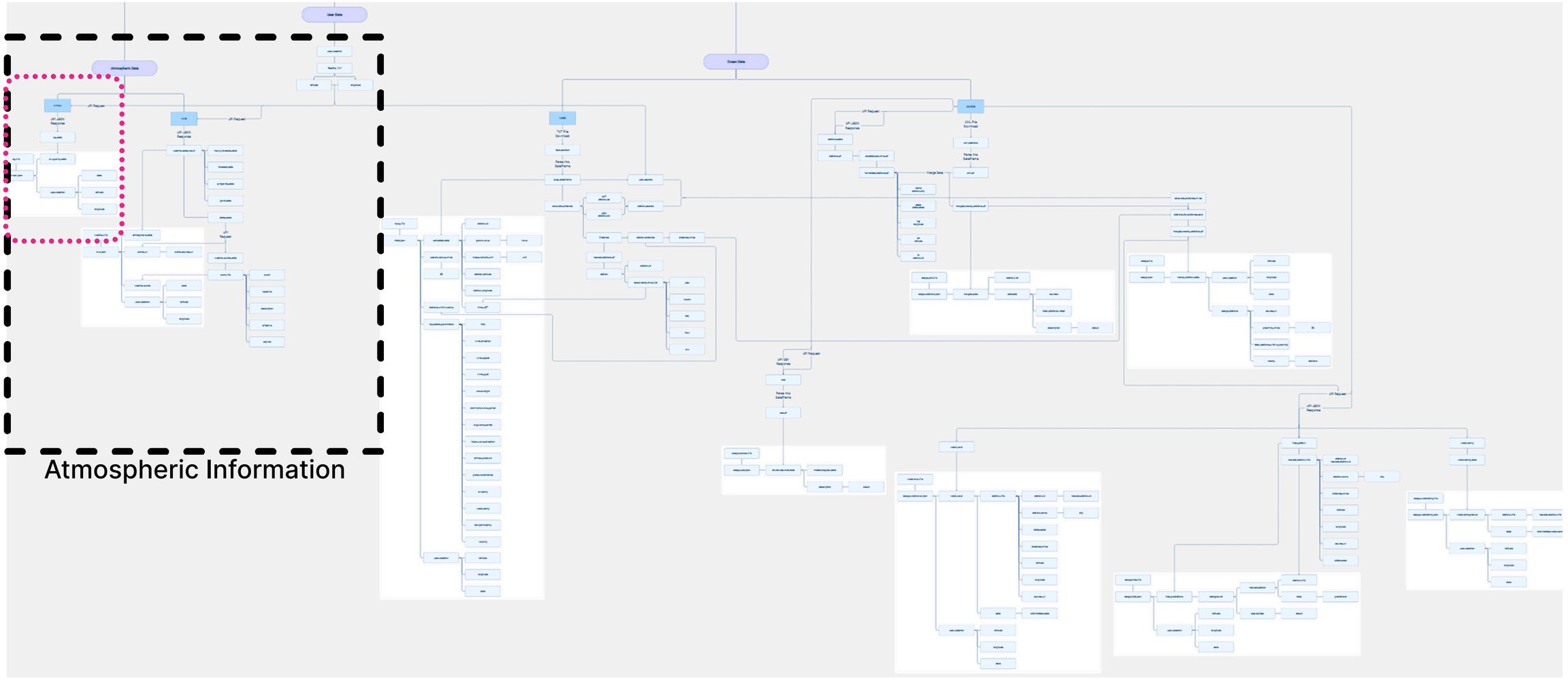
```
# check if data was found after iterating through stations
if found_data:
    reformatted_predictions = []
    if tide_predictions_result and 'predictions' in tide_predictions_result:
        predictions_list = tide_predictions_result['predictions']

        if predictions_list:

            # save json file
            output_filename = "user_data_noaa_coops_tide.json"

            try:
                reformatted_predictions = []
                for prediction in predictions_list:
                    reformatted_predictions.append({
                        "time_LST": prediction.get('t'),
                        "water_level_ft": prediction.get('v')
                    })

                # structure json file
                output_data = {
                    "user_location": {
                        "latitude": latitude,
                        "longitude": longitude,
                        "date": datetime.now().strftime('%Y-%m-%d')
                    },
                    "tide_predictions": {
                        "background": {
                            "about": about_tides,
                            "nearest_station": {
                              "station_info": nearest_station_info,
                              "data": {
                                "predictions": reformatted_predictions
```



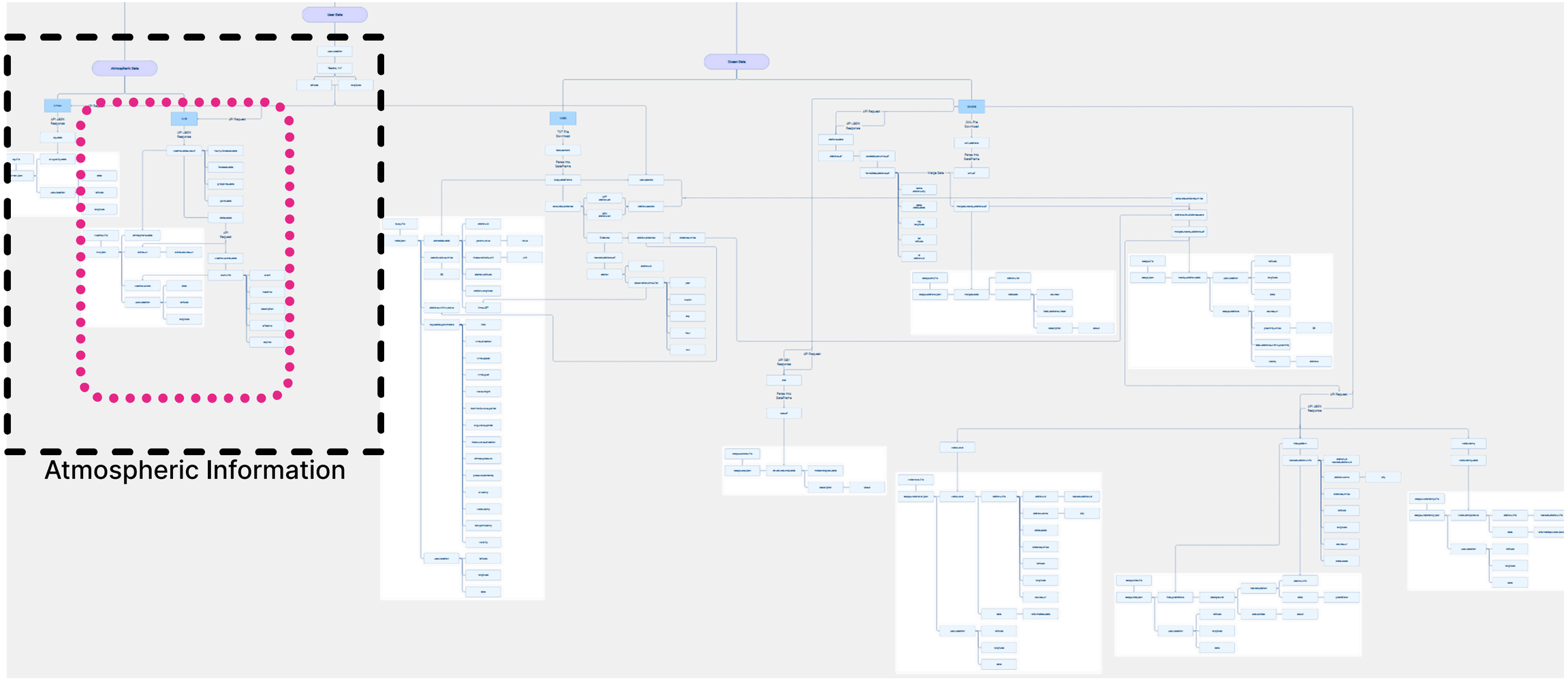
ARCHITECTURE



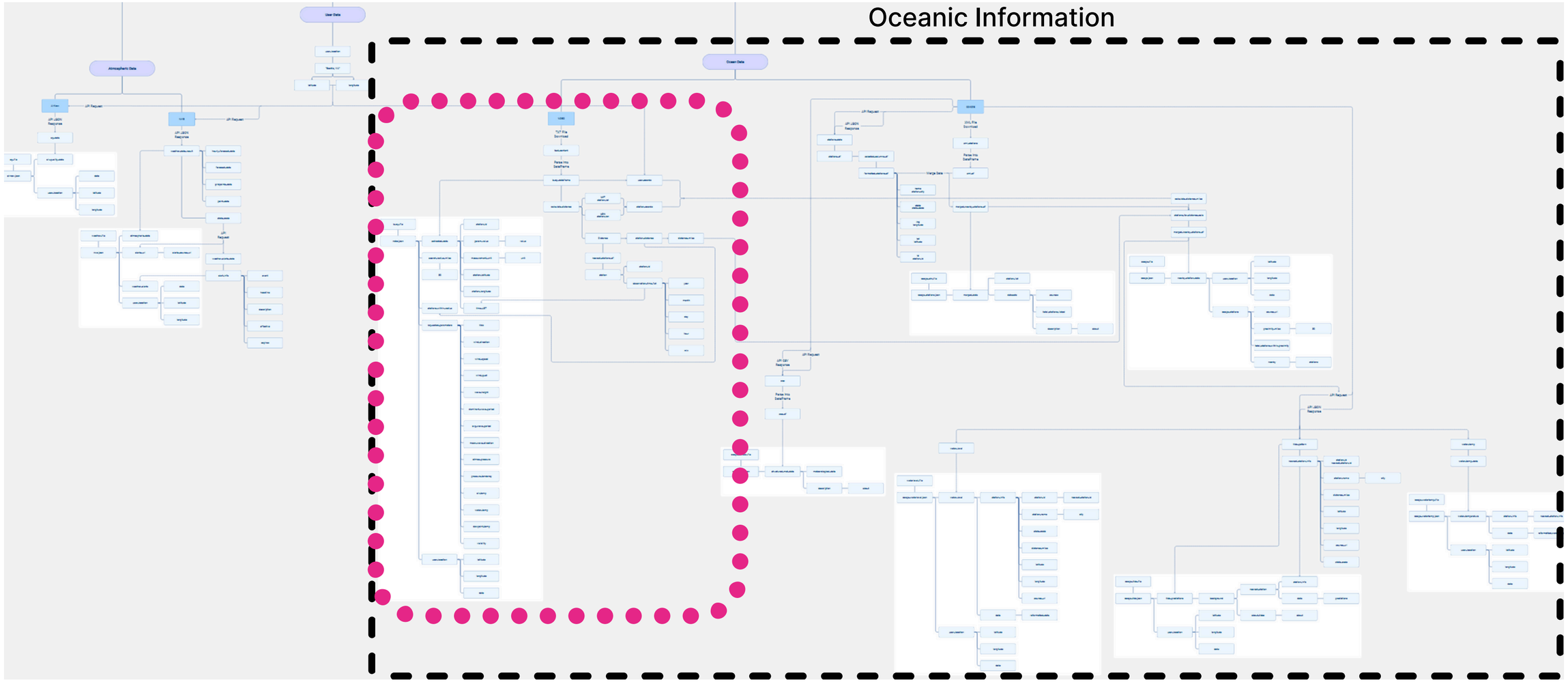
USER LOCATION DATA



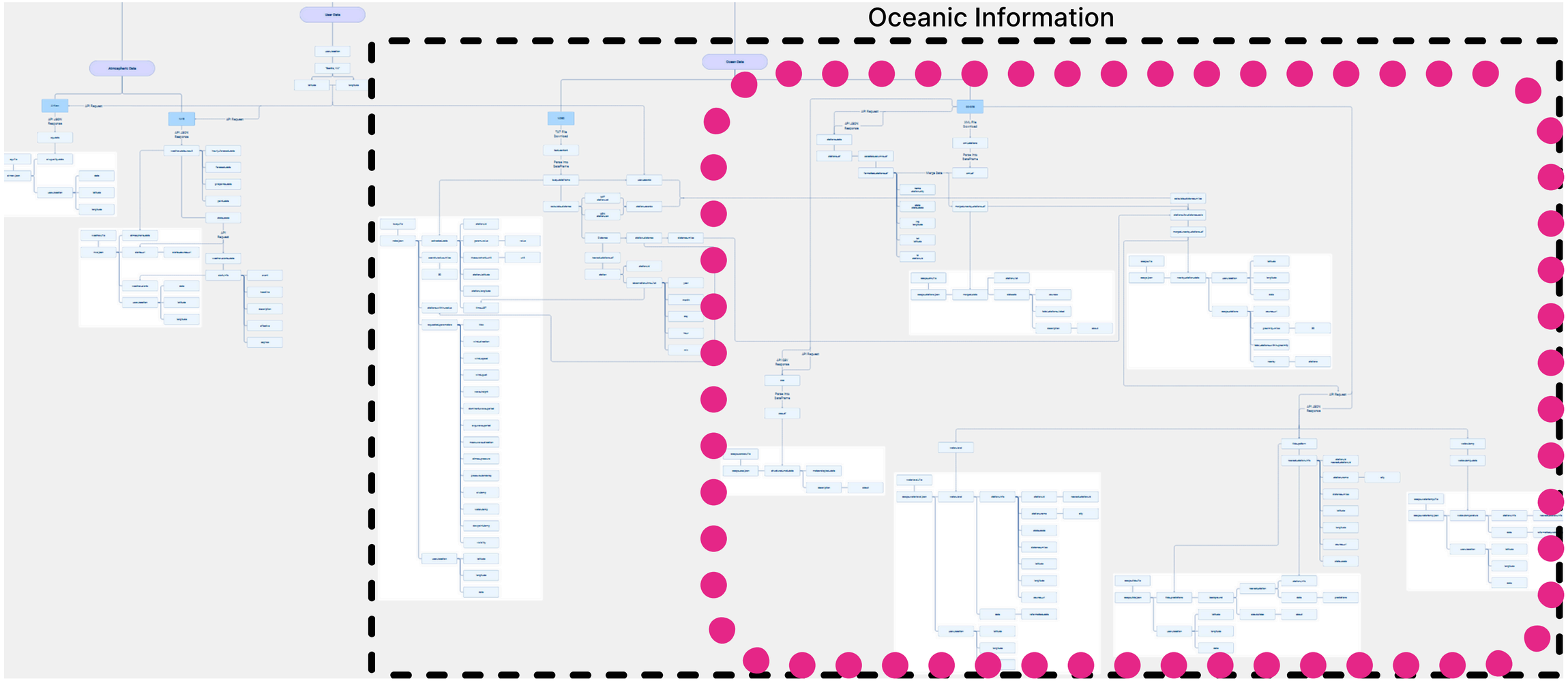
AIRNOW DATA



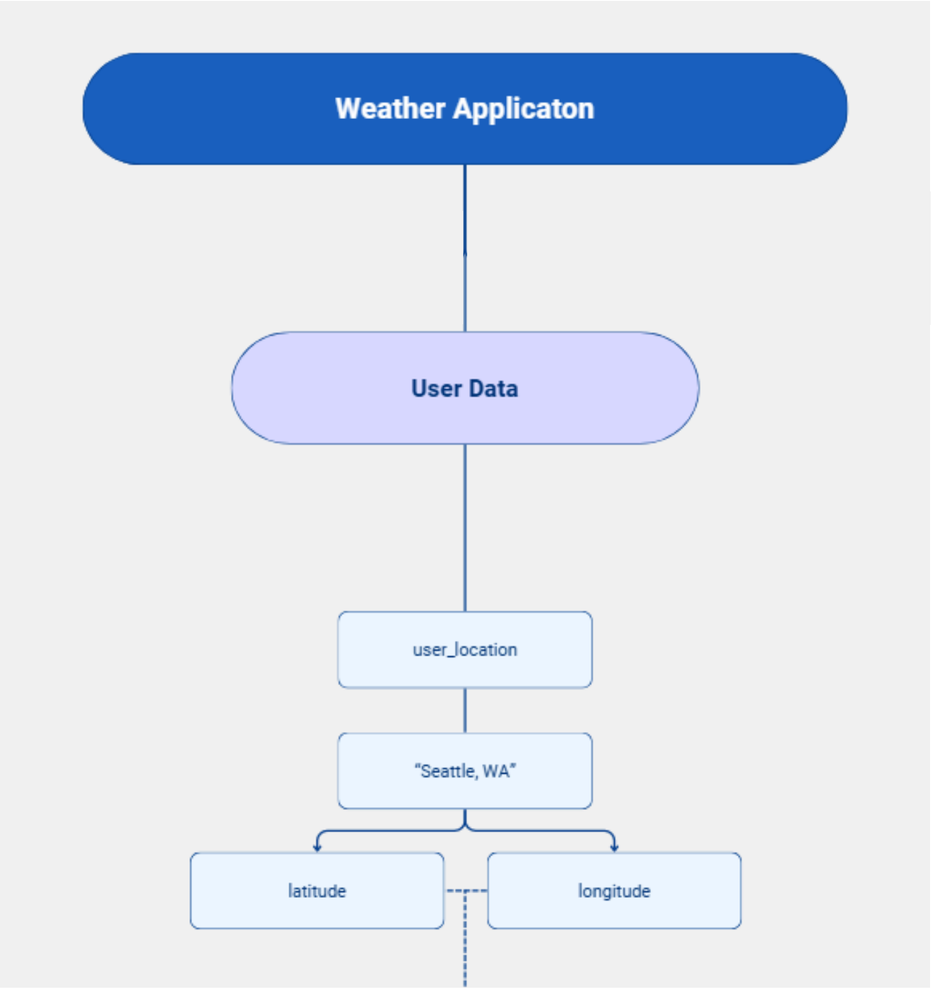
NWS DATA

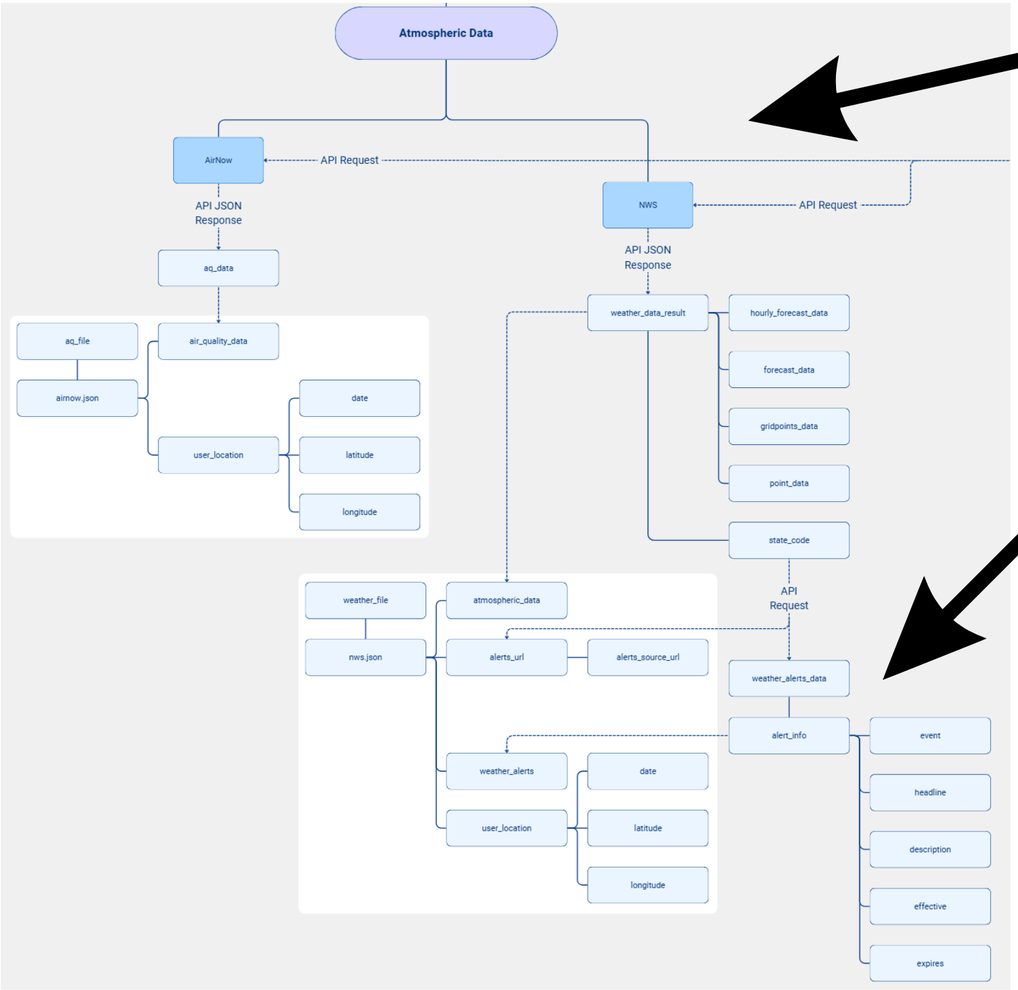


NDBC DATA



CO-OPS DATA





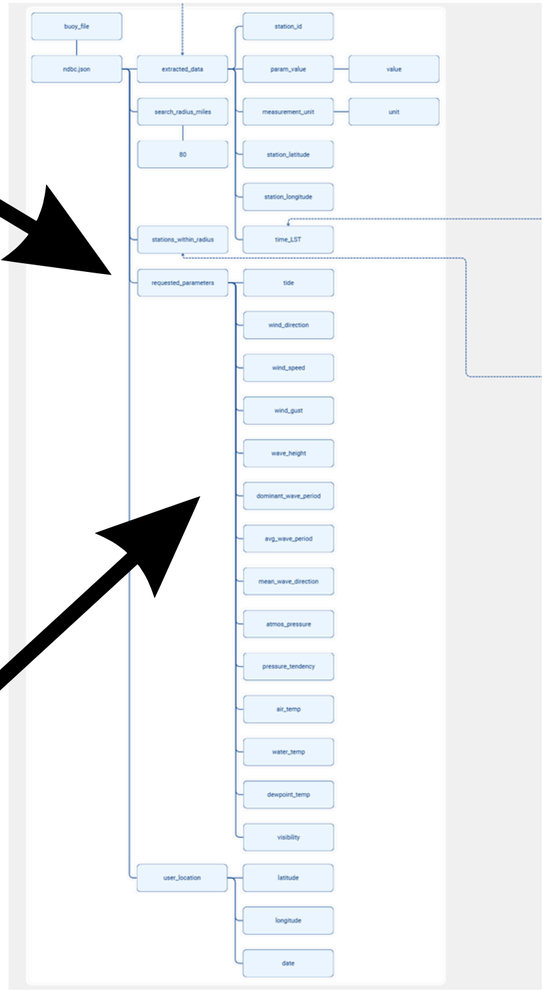
Air Pollutants

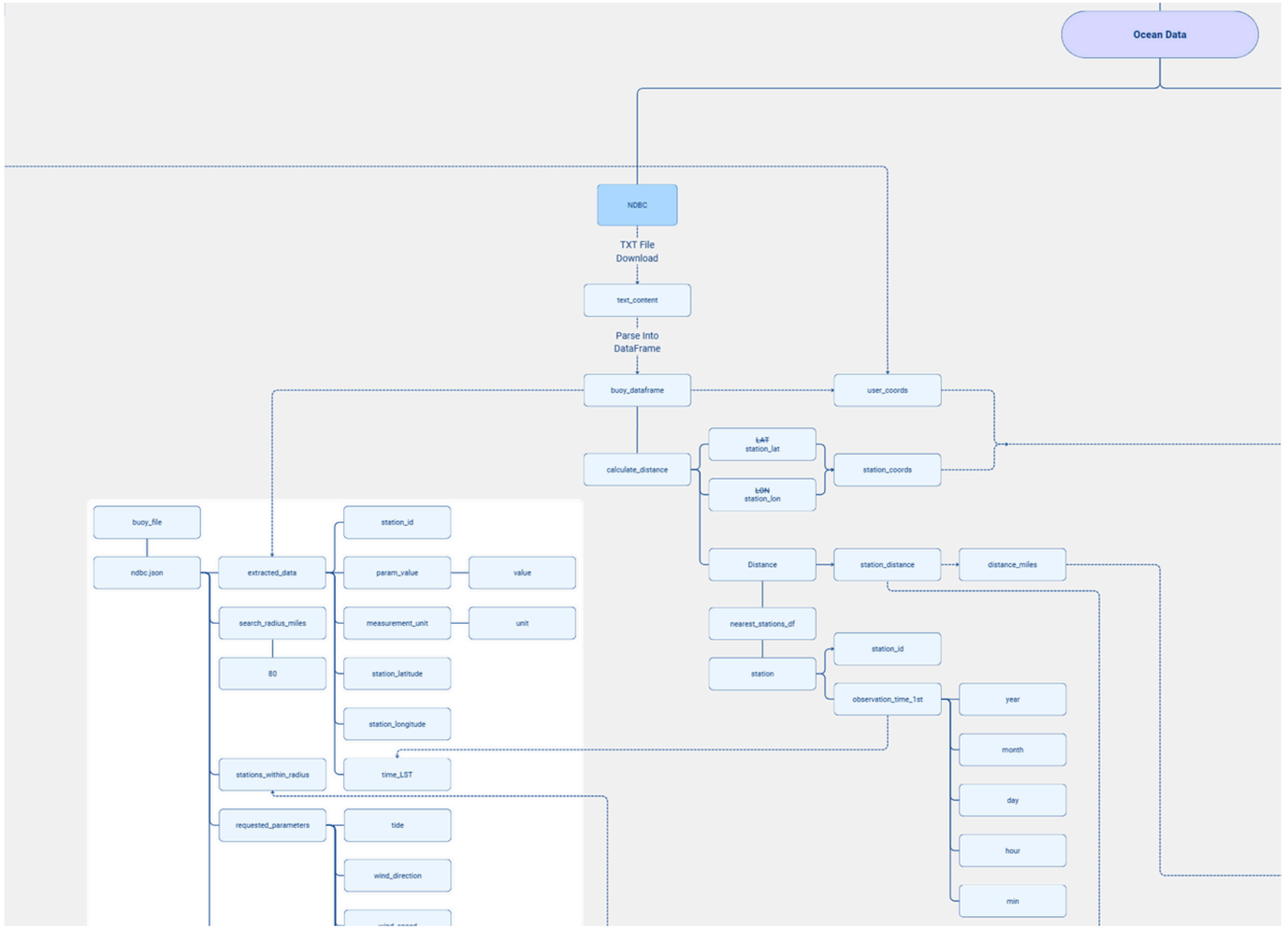
Weather Alerts

CLOSER EXAMINATION

Wave Direction

Wave Height





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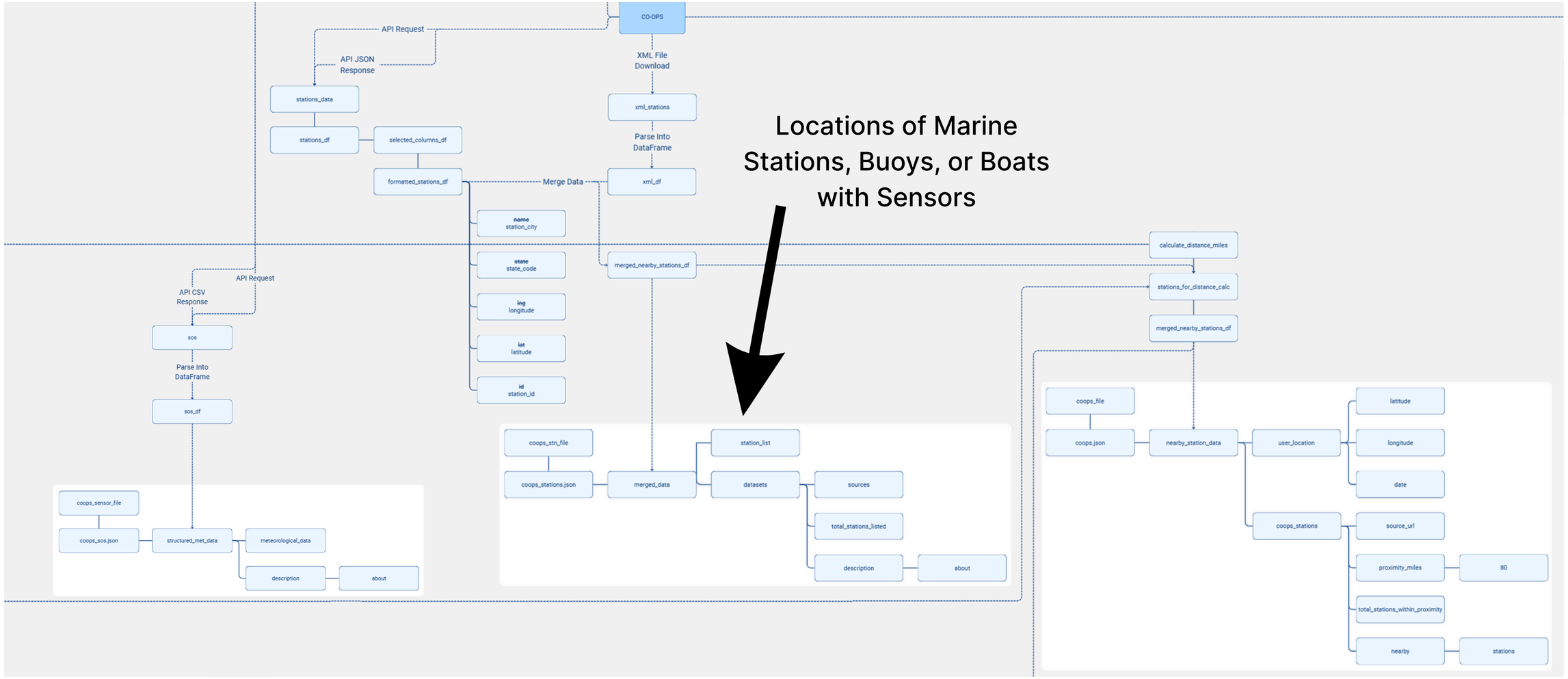

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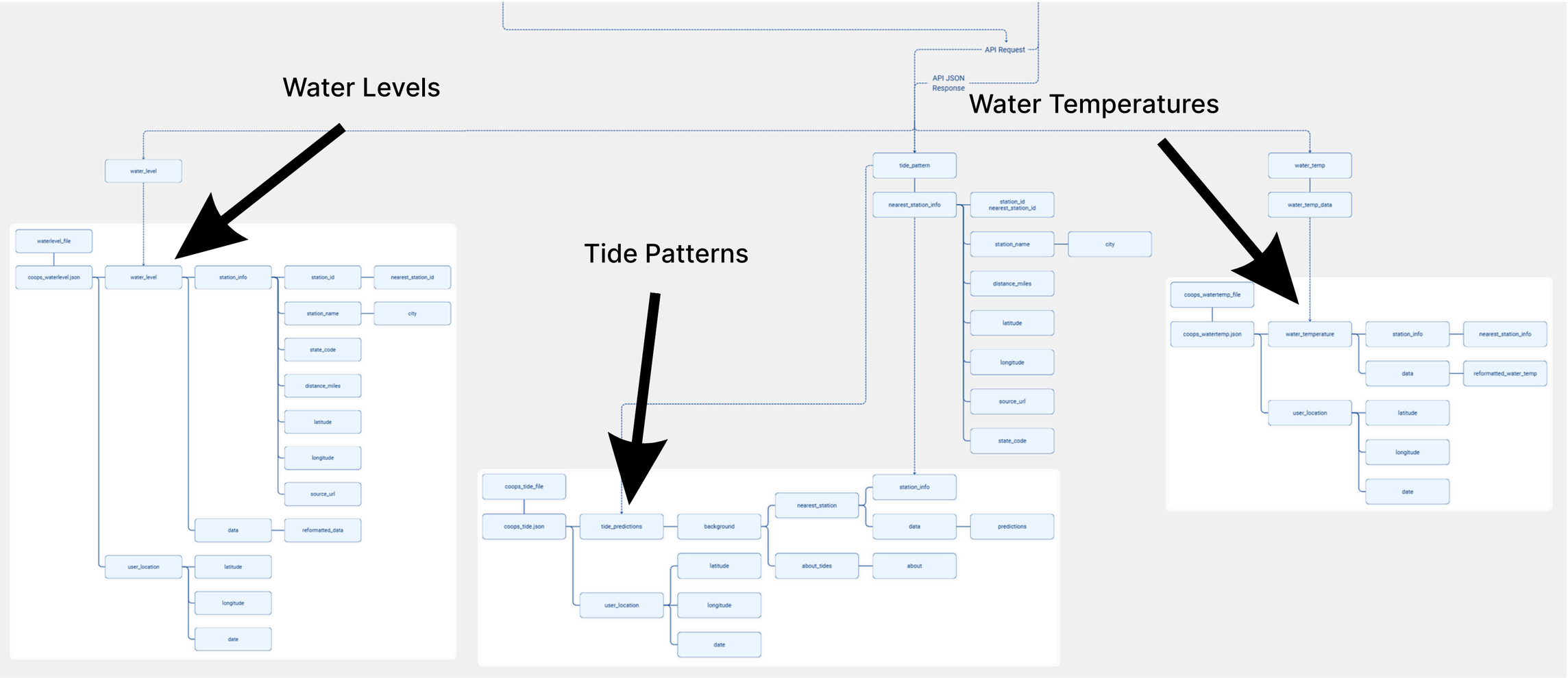

CLOSER EXAMINATION

(Akyurt, 2025; Urlapova, n.d.; Zhukov, 2021; Zola, 2022)

RESEARCH SPONSOR

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* * *

THANK YOU

 linkedin.com/in/hollimeyers/

 github.com/hollimey/weather-app

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