Lightning Talk

Market Research

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Project Overview

- ARA is an advanced wireless research platform covering Iowa State University, Ames, and nearby rural areas. It collects weather and wireless signal data.
- Tasked with creating a system that will recognize and predict when a weather event is occurring.
- This trigger, signals data collection before a given weather event has begun and allows us to continue collecting data until the weather event has passed.
- This weather data will eventually allow researchers to determine how the performance from the ARA framework differs during different weather events.

Problem Statement

- Want to intelligently collect data on a wide range of network data during a variety of weather events.
- Use forecast data to predict future weather events to gather data only when weather events we want to record are going to occur.
- Store collected data and allow for user queries to access and format selected data.

Related Products

Tomorrow Weather

Pros

- Free
- Localized Weather Data
- Real Time
- Many related data points

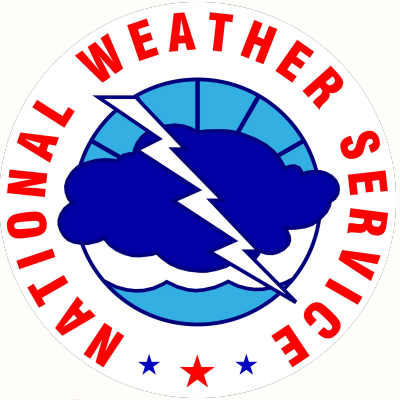
Cons

- Outputs lots of information, some of which we might not need
- Only 25 requests per hour
- Needs an API Key

Example Output

Tomorrow Weather


```
{
    "time": "2024-10-03T16:00:00Z",
    "values": {
        "cloudBase": 0.81,  "cloudCeiling": null,  "cloudCover": 17,
        "dewPoint": 11,  "evapotranspiration": 0.079,  "freezingRainIntensity": 0,
        "humidity": 66,  "iceAccumulation": 0,  "iceAccumulationLwe": 0,
        "precipitationProbability": 0,  "pressureSurfaceLevel": 988.35,
        "rainAccumulation": 0,  "rainAccumulationLwe": 0,  "rainIntensity": 0,
        "sleetAccumulation": 0,  "sleetAccumulationLwe": 0,  "sleetIntensity": 0,
        "snowAccumulation": 0,  "snowAccumulationLwe": 0,  "snowDepth": 0,
        "snowIntensity": 0,  "temperature": 17.38,  "temperatureApparent": 17.38,
        "uvHealthConcern": 1,  "uvIndex": 3,  "visibility": 16,  "weatherCode": 1100,
        "windDirection": 44.69,  "windGust": 3.31,  "windSpeed": 1.19
    }
},
```



Related Products

National Weather Service

Pros

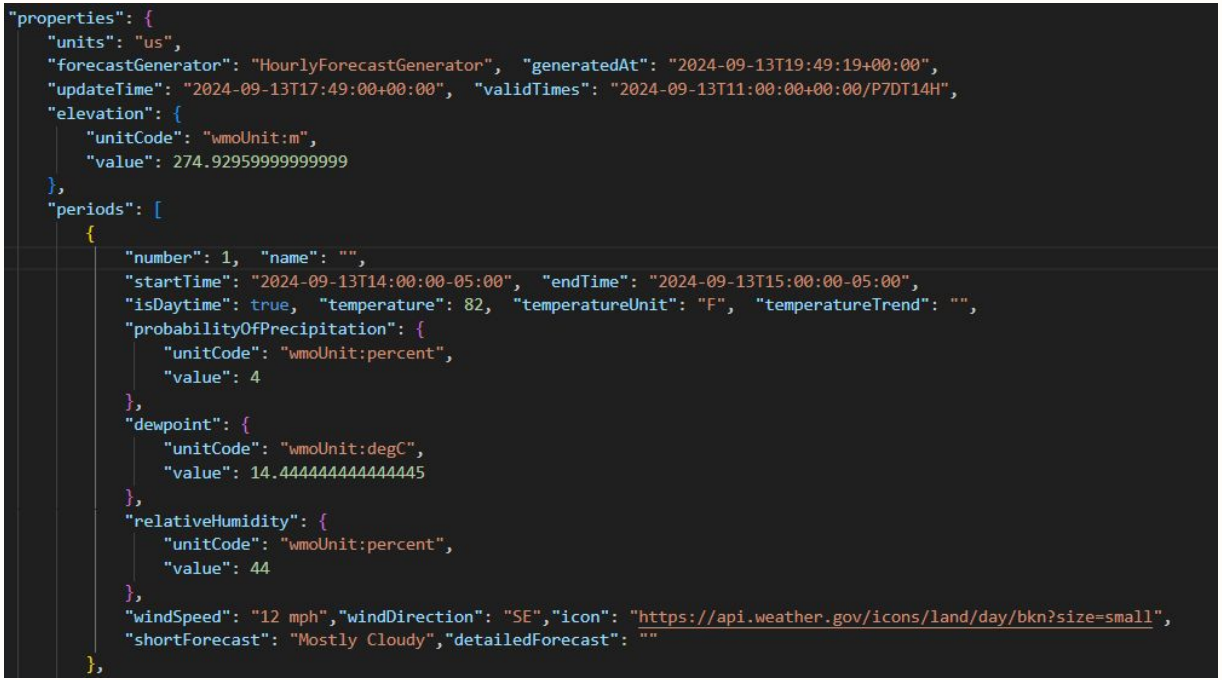
- Free and Open Source
- Data formatted in JSON
- Caches the result of requests, avoiding multiple request to same endpoint

Cons

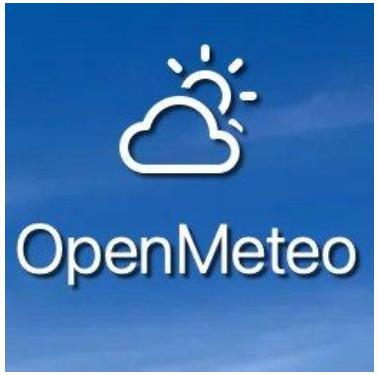
- Initially need two API requests to get location and weather
- Low reliability - APIs go down often
- Integration documentation not thorough

Example Output

National Weather Service




```
"properties": {
    "units": "us",
    "forecastGenerator": "HourlyForecastGenerator",  "generatedAt": "2024-09-13T19:49:19+00:00",
    "updateTime": "2024-09-13T17:49:00+00:00",  "validTimes": "2024-09-13T11:00:00+00:00/P7DT14H",
    "elevation": {
        "unitCode": "wmoUnit:m",
        "value": 274.92959999999999
    },
    "periods": [
        {
            "number": 1,  "name": "",
            "startTime": "2024-09-13T14:00:00-05:00",  "endTime": "2024-09-13T15:00:00-05:00",
            "isDaytime": true,  "temperature": 82,  "temperatureUnit": "F",  "temperatureTrend": "",
            "probabilityOfPrecipitation": {
                "unitCode": "wmoUnit:percent",
                "value": 4
            },
            "dewpoint": {
                "unitCode": "wmoUnit:degC",
                "value": 14.444444444444445
            },
            "relativeHumidity": {
                "unitCode": "wmoUnit:percent",
                "value": 44
            },
            "windSpeed": "12 mph","windDirection": "SE","icon": "https://api.weather.gov/icons/land/day/bkn?size=small",
            "shortForecast": "Mostly Cloudy","detailedForecast": ""
        },
```



Related Products

Open-Meteo

Pros

- No API key needed
- 10000 requests per day
- Geocoding API - finds coordinates of locations
- API can responds with cart of data points to be plotted

Cons

- When testes weather was not accurate
- Lot of information is output
- Not very readable , needs to be diligently formatted

Example Output

Open-Meteo

Coordinates 42.0°N 93.625°E
Elevation 852.0 m asl
Timezone None None
Timezone difference to GMT+0 0 s

	date	temperature_2m	relative_humidity_2m	cloud_cover	wind_speed_10m	wind_direction_10m
0	2024-10-03 00:00:00+00:00	12.542001	46.0	100.0	13.039754	186.340103
1	2024-10-03 01:00:00+00:00	13.092000	46.0	0.0	13.493999	189.210953
2	2024-10-03 02:00:00+00:00	14.992001	42.0	0.0	17.309973	196.927597
3	2024-10-03 03:00:00+00:00	17.441999	37.0	0.0	21.767351	214.215759
4	2024-10-03 04:00:00+00:00	19.491999	33.0	0.0	20.377399	237.994659
5	2024-10-03 05:00:00+00:00	20.892000	30.0	0.0	17.727943	257.092590
6	2024-10-03 06:00:00+00:00	22.591999	27.0	61.0	13.910169	259.562561
7	2024-10-03 07:00:00+00:00	23.341999	24.0	10.0	14.058450	272.935608
8	2024-10-03 08:00:00+00:00	23.591999	23.0	5.0	14.458382	288.886169
9	2024-10-03 09:00:00+00:00	23.341999	22.0	0.0	14.578890	302.905243
10	2024-10-03 10:00:00+00:00	22.691999	23.0	0.0	12.727921	315.000092
11	2024-10-03 11:00:00+00:00	21.642000	25.0	0.0	9.832680	336.250488
12	2024-10-03 12:00:00+00:00	19.691999	31.0	0.0	5.506941	11.309896

Market Gap

- Exists no software/system that predicts weather and then triggers weather data collection from the ARA infrastructure.
    - APIs are used in collaboration with ARA weather stations to determine weather events
- Solution needs to be very specific and integrated with the ARA infrastructure.

New Ideas

- Decided to use more than one weather API to predict weather events.
  - Gives wider range of weather data
  - Increases chances of catching every weather event
- Possible data formatting tools
  - Fastfield

Conclusion

- Current products give us various data metrics we can use to predict weather events for our own system but only when weather event is already happening.
- We need to predict weather events before they happen and collect data an hour before and after weather event
- Utilize the weather APIs to try to predict weather events for our own systems