SMART SEA LEVEL SENSORS : DATA GUIDE

LMC 6650: PROJECT STUDIO SAVANNAH MAPS
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Overview

The Smart Sea Level Sensors project is a partnership between Chatham Emergency Management Agency officials, City of Savannah officials, and Georgia Tech scientists and engineers who are working together to install a network of internet-enabled sea level sensors across Chatham County. The data collected by the sensors is real-time(continuously being collected) and is planned to be used for emergency planning and response. The team has currently installed around 43 Sensors in Chatham County.

The team was founded and led by Russell Clark, a Senior Research Scientist at the College of Computing at the Georgia Institute of Technology- Savannah.

Access

The team has provided open-source access to their database via an Application Programming Interface(API). The API is built according to a standard called OGC SensorThings, which makes use of REST(Representational State Transfer- a set of constraints to be used for creating Web services) semantics and JSON(JavaScript Object Notation, a file format that uses human-readable text to transmit data) encoding.

The guide is a partial documentation for the API. This documentation can be used to learn various commands that can be used for the Sea Level Sensors project as well.

For a novice developer to get started, it is recommended to install a software such as Postman(suitable for everyone) or Curl(suitable for those with some experience with the command-line terminal). Links to download these software are given below.
NOTE- if using Postman, remove the ‘curl’ command in your request.

Standards

Under the OGC SensorThing standard, there are 3 main concepts- Things, Locations and Datastreams.

GET https://api.sealevelsensors.org/v1.0/Things(1)/Locations Send Save

The sample data obtained is given below:


```
{
    "value": [
        {
            "name": "Skidaway Dock",
            "description": "Skidaway Dock",
            "encodingType": "application/vnd.geo+json",
            "location": {
                "type": "Point",
                "coordinates": [
                    -81.021504,
                    31.990396
                ]
            },
            "HistoricalLocations@iot.navigationLink": "https://api.sealevelsensors.org/v1.0/Locations(3)/HistoricalLocations",
            "Things@iot.navigationLink": "https://api.sealevelsensors.org/v1.0/Locations(3)/Things",
            "@iot.id": 3,
            "@iot.selfLink": "https://api.sealevelsensors.org/v1.0/Locations(3)"
        }
    ]
}
```


Codebook

Thing: An individual sensor, at a specific location.
Location: The location of a sensor, in latitude and longitude.
Datastream: The data measured by the sensor.
Name: Name of the sensor.
Description: Name of the location at which the sensor is placed.
Properties: Features associated with the sensor.
Historical Locations: Record the time for the current and previous locations of the sensors.
Observed Properties: An ObservedProperty specifies the phenomenon of an Observation.
Observations: An Observation is the act of measuring or otherwise determining the value of a property. An Observation in SensorThings represents a single Sensor reading of an ObservedProperty
FeaturesOfInterest :
This is a value being assigned to a phenomenon.

Data Biography

While studying this dataset, we (the authors) had multiple challenges and questions. To understand the data in detail, potential applications and communal perspectives of this kind of data resource, we had an opportunity to interview “Russ” Russell J. Clark**,** one of the founding members of the Smart Sea Level Sensors API in Chatham County. Russell J. Clark is a Senior Research Scientist at the School of Computing, Georgia Institute of Technology.

Climate changes and satellite monitoring has been a rapidly growing area of research and development in the past few decades with rising sea levels around the world. However, Russ and other founding members of the Sea Level Sensors API observed local discrepancies of the climate news in the streets and neighbourhoods of Savannah, GA. Accurate localized visualization and climate changes are essential for dealing with emergency evacuation situations like floods and this pushed them to start the Smart Sea Level Sensor project.

The initial sensor locations were selected in partnership with the Chatham County emergency management during flood events to monitor damage to infrastructure (primarily bridges) as they are the most important resources for evacuation in flood situations.

Challenge:

The main challenge faced by the team is about the terminology used, varying interpretations and it’s accessibility with people, especially those who need to use the information the most. Clarity is needed for terms like water level, high tide and low tide, and sea level.
In Russ’s words: Every bridge has a different relative height, road conditions and construction, so there’s needs to be a better way to interpret and visualize this data.

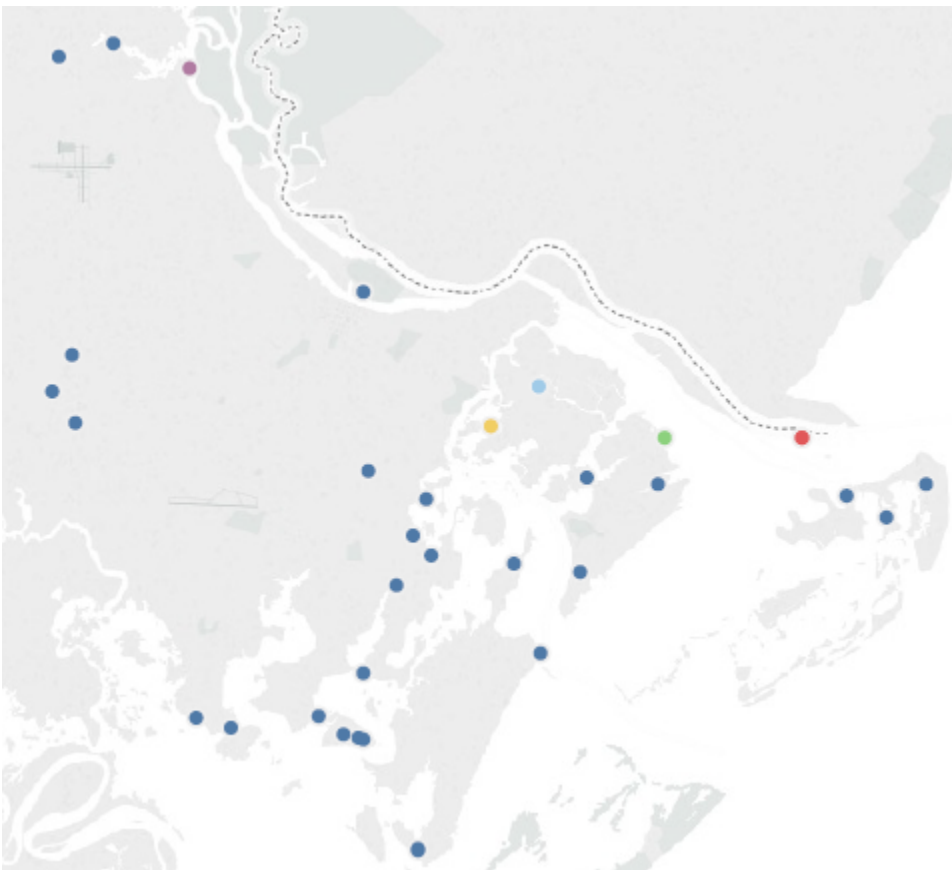
Visualization

Sea level sensors is a temporal and geo-spatial data set ie. every observation in a **Datastream** (refer **Standards**) has a

1. Dimension in time (`2019-01-07T23:45:50.345Z`)
2. Dimension in space (`{"type":"Point","coordinates":[-81.082003,32.023062]}`)

Following visualizations were made to understand the spread of sensors and timestamps. The visualizations combined together provide a complementary understanding to the temporal geo-spatial quality of data and daily patterns in water level data.

Visualization 1: Spatial identity of sensors



Visualization 2 is multi-plot of 5 different sensors around Savannah and their water-levels between September 1,2019 - Oct 10,2019. These are the water-level values

received from the API.

Example:

A water-level of -3.5 indicates that the water-level is 3.5m below the height of the sensor. These plots should be used with caution as each sensor is mounted at a different height above land.

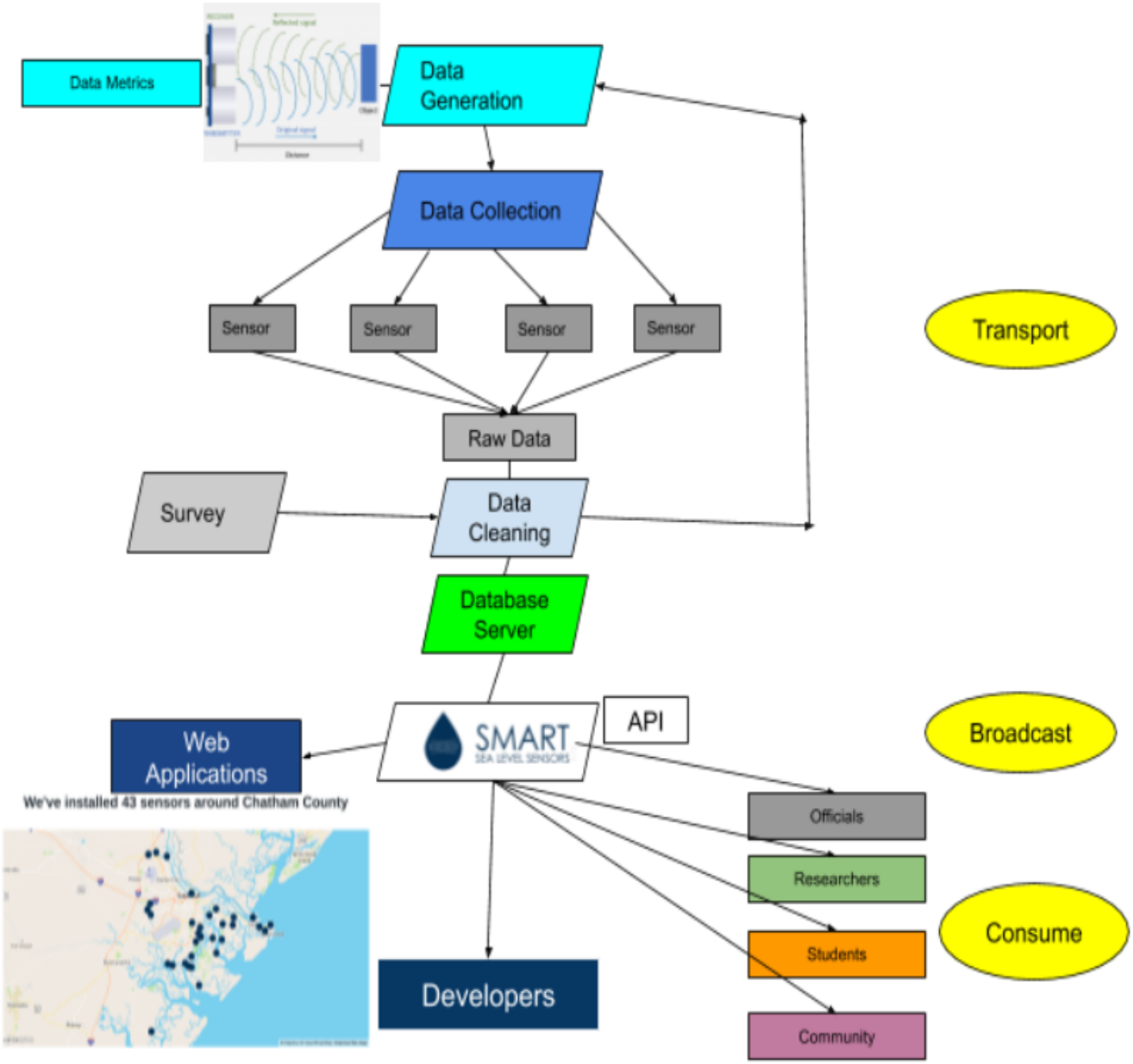
Visualization 2a is an example of how ***NOT*** to interpret data

They also help understand the frequency of data coming in from each datastream temporally. An interesting demonstration about the ongoing challenge of interpreting the dataset is presented in the above visualization.

Fig 2a. Comparing water level sensors without their relative heights.

Fig 2b. Comparing water level sensors with a sense of relative mounting height of sensor (dotted red line)

Data Life Cycle



Uses

This data guide is a guide to read, understand and use sea level sensor data from Chatham County in a variety of applications and fields of study.
However, two main applications that are worth highlighting are

- Flood related awareness, recovery and management

An example of such a project can be accessed here: http://ssls-dashboard-ssls.apps.okd.cloud.rnoc.gatech.edu/?stURL=https%3A%2F%2Fapi.sealevelsensors.org%2Fv1.0%2F

- Future town planning to mitigate climate injustice in neighborhoods

  Data from this API is an invaluable resource to study neighborhood conditions with a flood related history, disparities in communities and quality of life.

Sources

Notes

1.“Smart Sea Level Sensors API, Chatham County”

https://www.sealevelsensors.org/

2.“OGC Sensor Things API Documentation”
http://developers.sensorup.com/docs/

3. The Data Revolution: Big Data, Open Data, Data Infrastructures and Their Consequences, by Rob Kitchin. 2014. Thousand Oaks,California: Sage Publications

Author details

Anuraj and Sandeep are Master's Students working on the Sea Level Sensors API for LMC 6650: Project Studio, Savannah Maps.

Anuraj Bhatnagar

Anuraj is a MS student in the Digital Media program at the Georgia Institute of Technology. He is a programmer and designer interested in Game Design, Mixed Reality and Environmental Justice. He has a background in Computer Engineering, and has experience in data visualisation and data analytics tools such as SAS and Tableau.

His previous works include game prototypes as well as design projects, in the fields of civic design, participatory design, web design and user experience design.

Sandeep Dasari

Sandeep is a Master's student in Music Technology graduate program in School of Music, Georgia Tech. He is an interdisciplinary researcher interested in audio, machine learning, music technology, VR and sonification of data. He has a background in Computer Science working with Machine Learning, Art and Architecture.

His previous works include analyzing interstate highway data for crash conditions, visualizing air pollutant data, converting hand gesture data into music using machine learning. Through this Data Guide and Project Studio course, his interests in data, computer science, audio and machine learning was directed towards bigger world problems such as climate change and flooding situations in Savannah, Georgia.