A Digital Water Dashboard for Sustainable Groundwater Resources Management in Northern Belize

Karl Payne, Alwyn Mahung, Carmelita Blanco, Tennielle Hendy

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Introduction

- Belize's potable water supply is sourced from a combination of **surface** and **groundwater**.

- According to the Belize Water Service Limited (BWSL), the monthly **water demand** is approximately 230 US million gallons per month.

- Increasing concerns related to water quality degradation, intermittent water supply. **No established groundwater monitoring** network.

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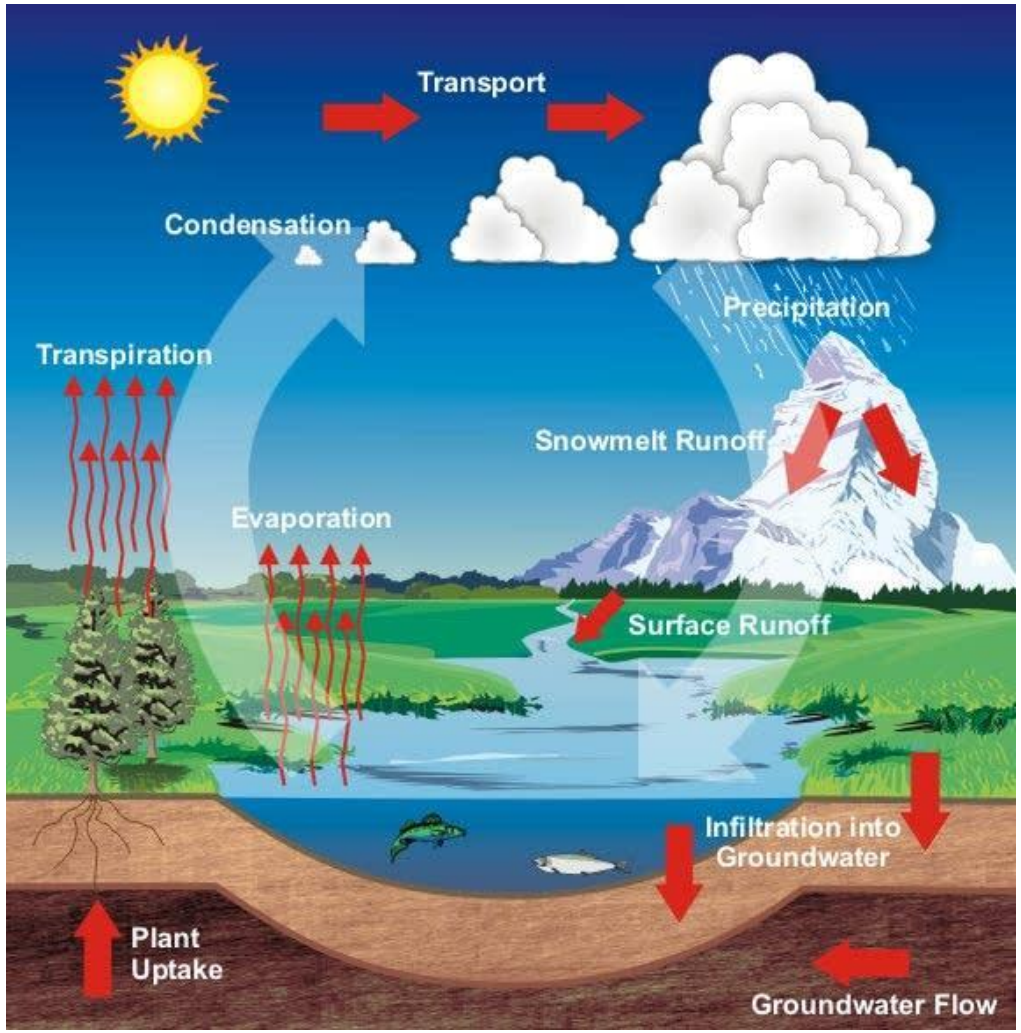
Background: Climate change impacts on water resources

- More intense rainfall events
- Reduction in average annual rainfall
- Intensification of evapotranspiration (ET)



Background: Climate change impacts on water resources

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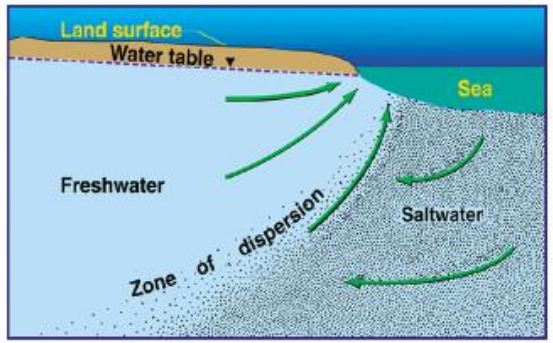
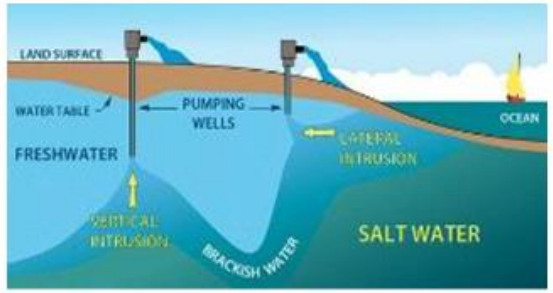
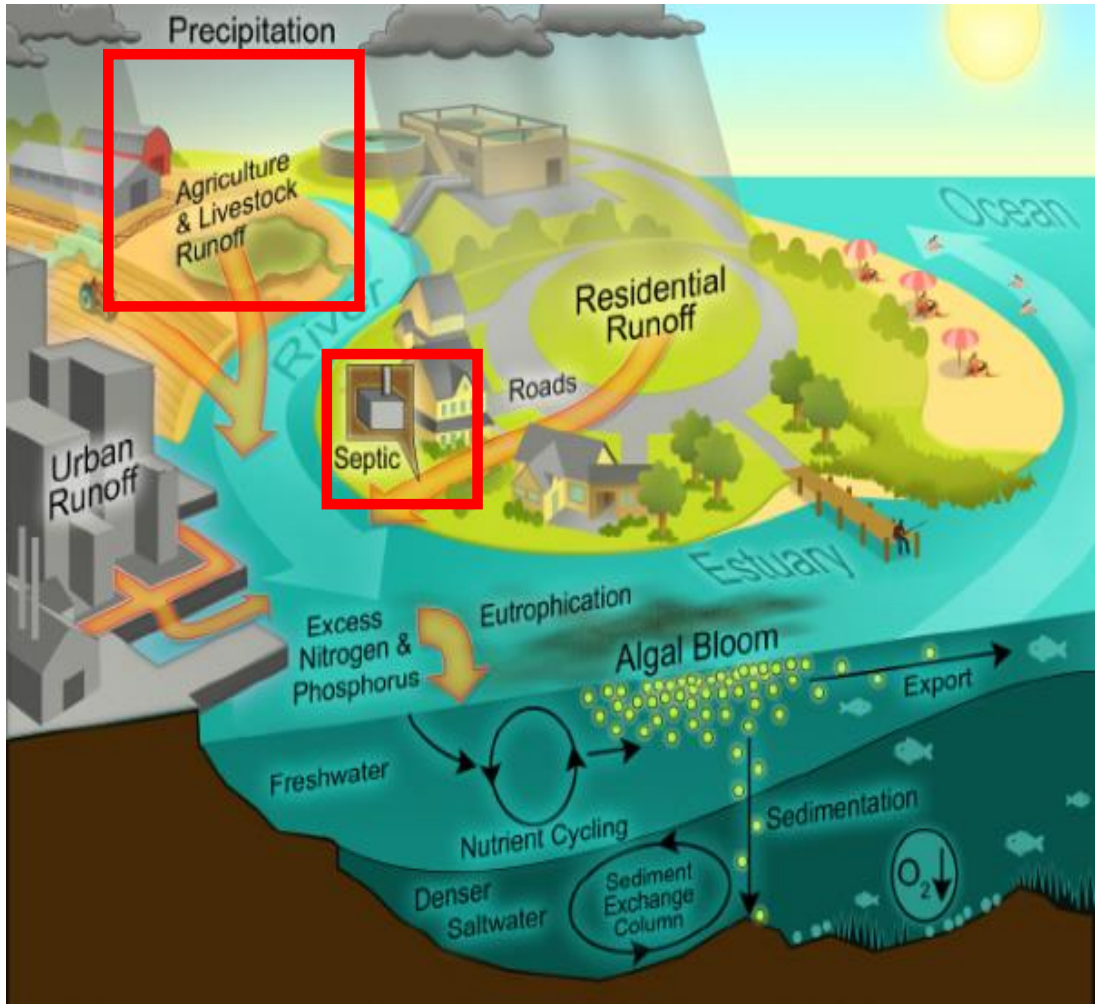
SALINE INTRUSION





Maximum Contaminant Level (MCL) of **250 mg/L**

Many CARICOM Member States often exceed.



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Research Question / Issue

- Lack of data and tools limit scientifically sound approaches to groundwater resources management.

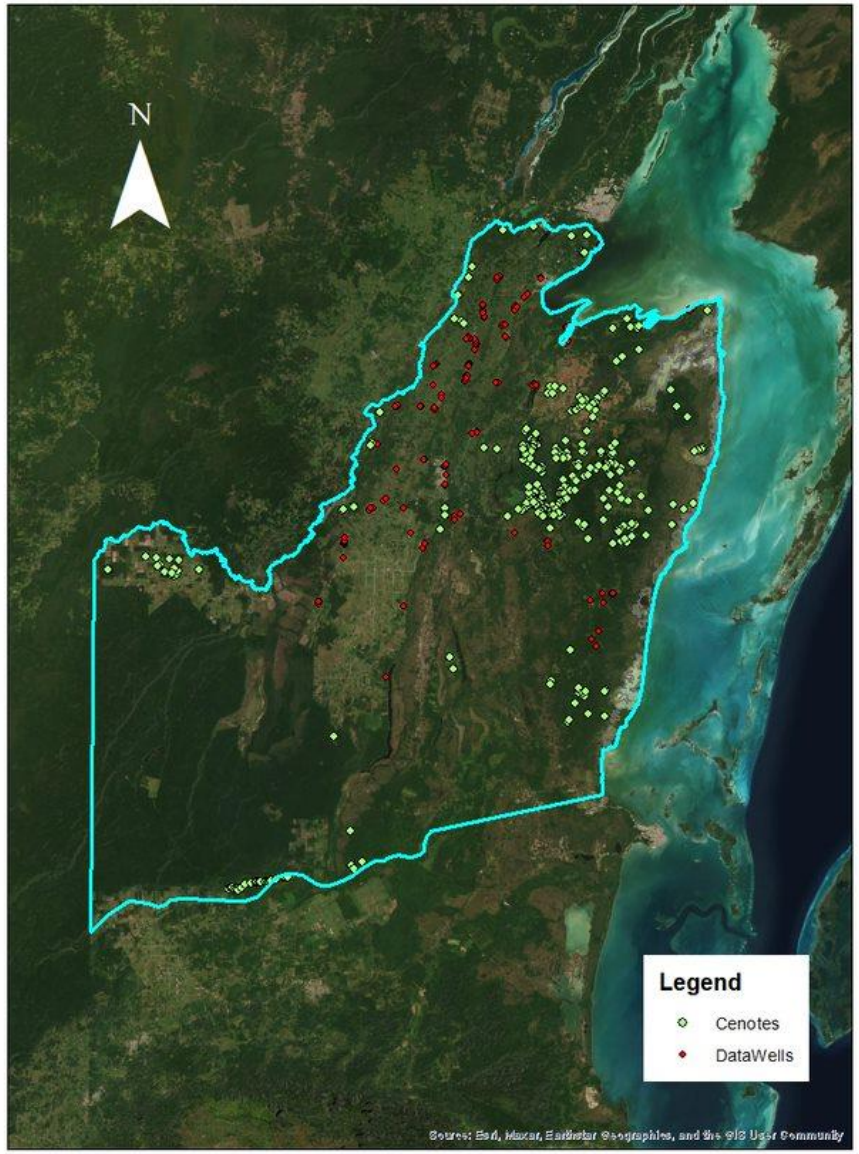
- With the **ongoing climate crisis** filling this gap is critical.

Objectives

- Create new environmental data sets (groundwater level and water quality)
- Develop a new tool that stores and synthesizes multiple data sets, allows for visualization.
- Backend analytics based on physics-based modeling and machine learning.

- Water level and water quality monitoring at ~27 sites in northern Belize.

- Bi-weekly sampling done from September 2022- March 2023 (6-months) using multiparameter probe (conductivity, resistivity, TDS, salinity, temp.)



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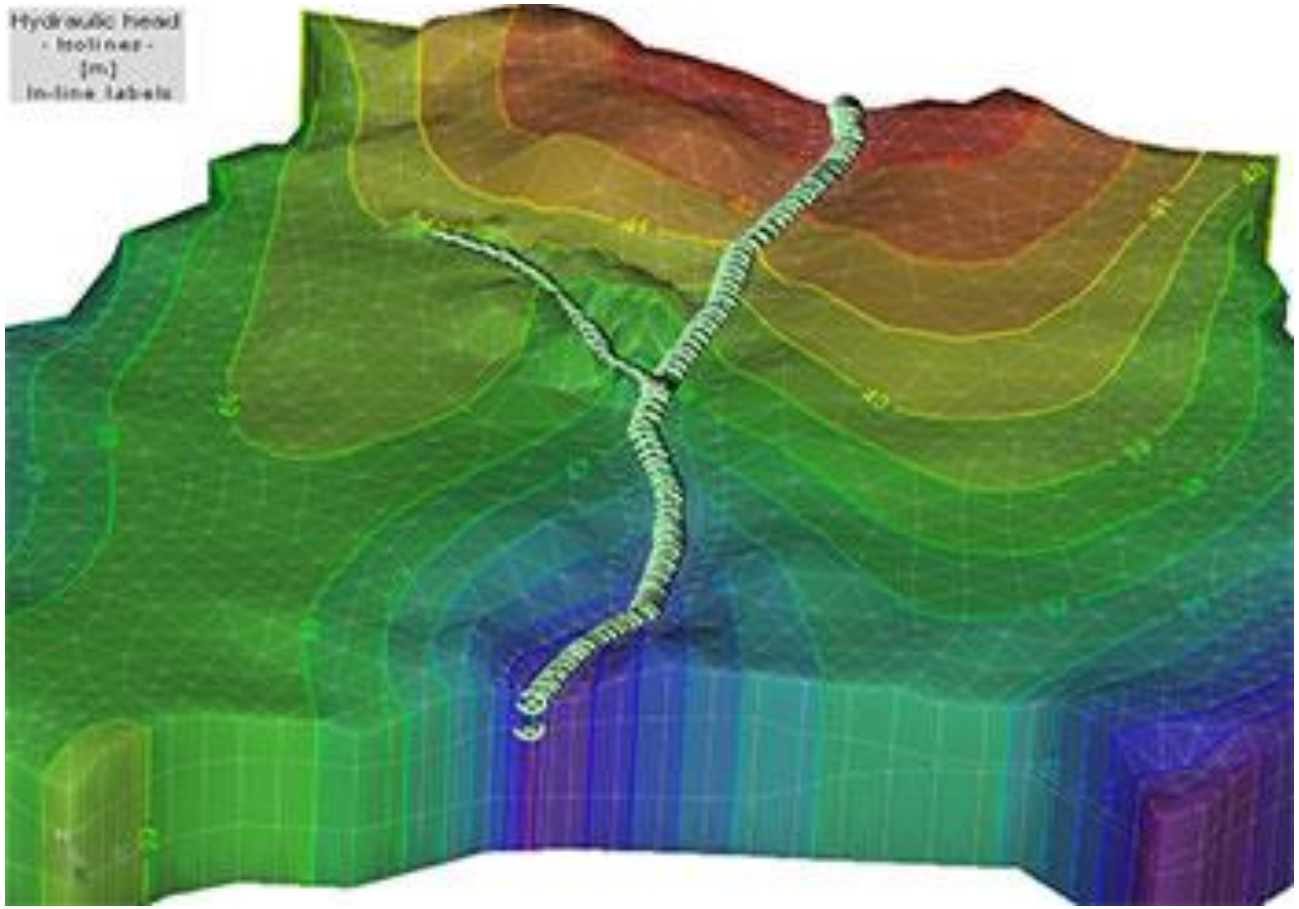
- **Physics-based** groundwater modeling
- Simplified representation of hydrogeology



Artificial Intelligence: Techniques that enable computer programs to mimic human intelligence.

Machine learning is a subset of AI that uses algorithms to learn from data and make decisions or predictions based on that data.

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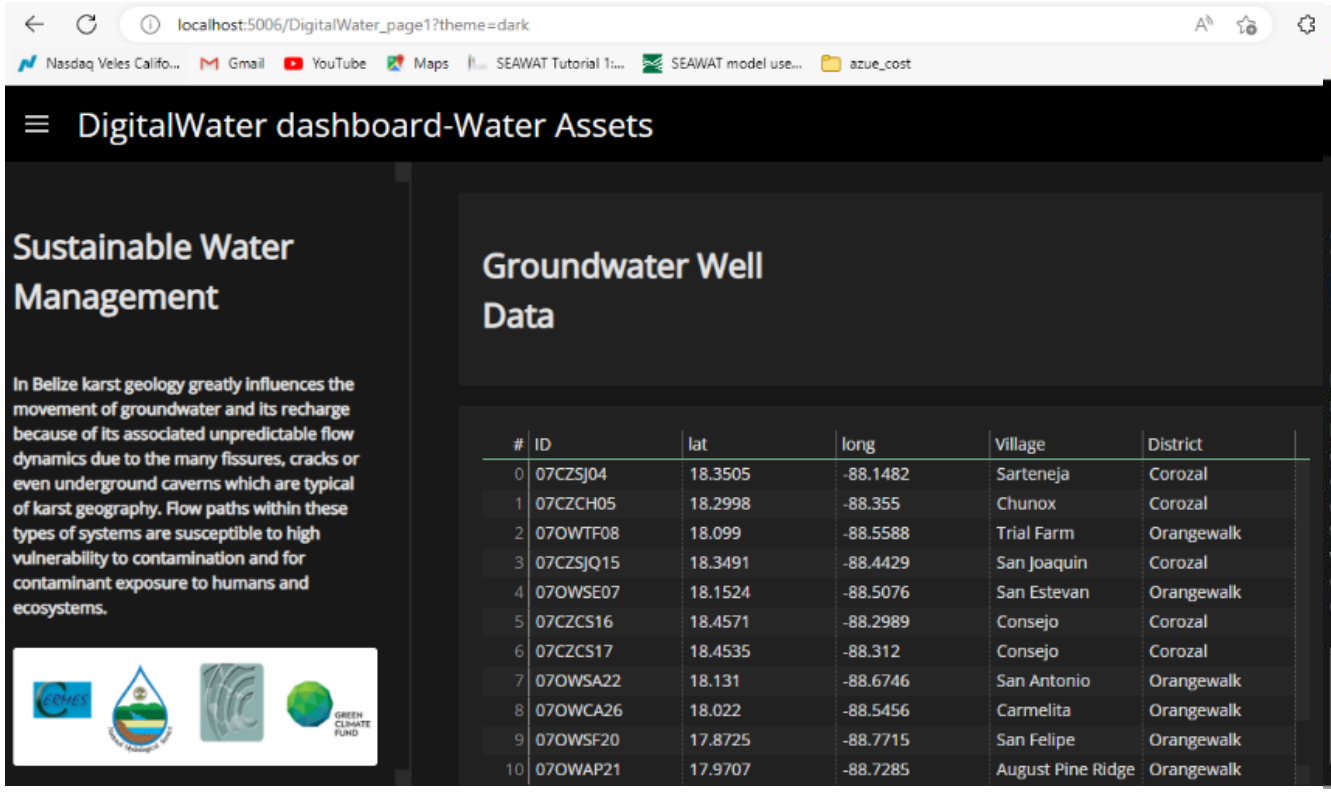
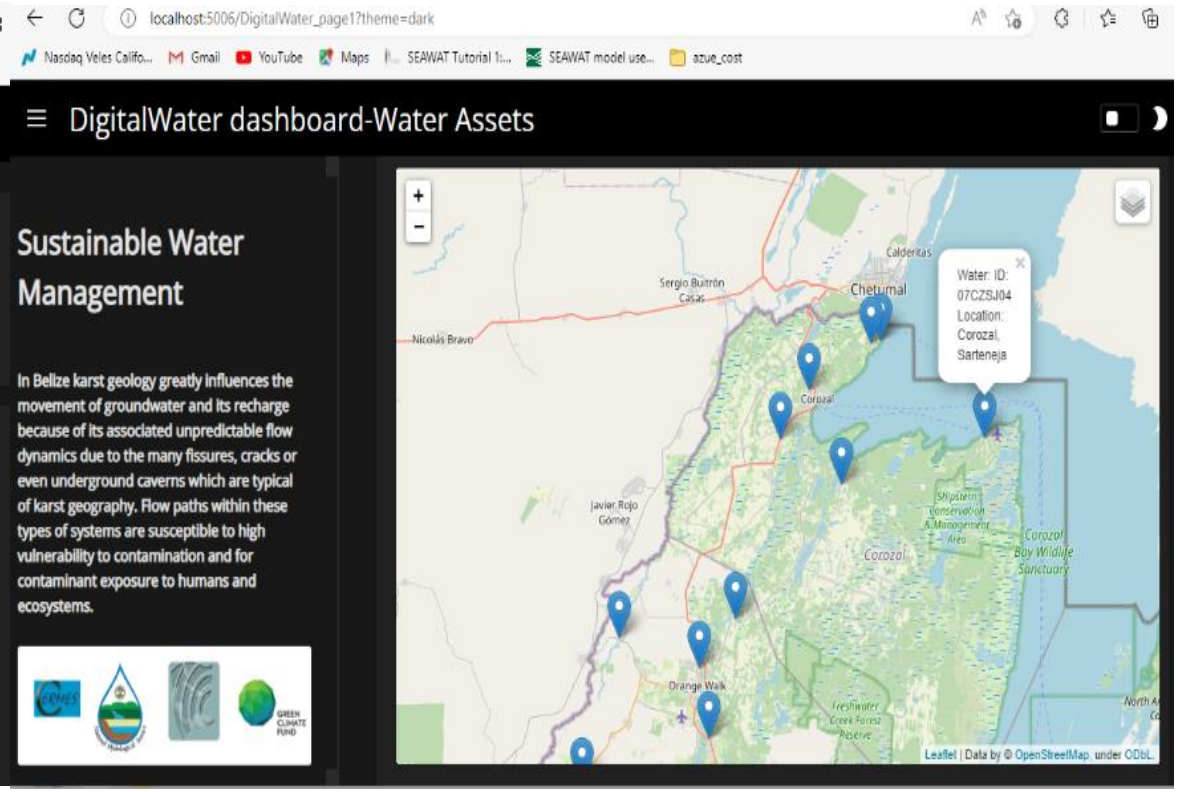
Results: Web-based dashboard



#	ID	lat	long	Village	District
0	07CZSJ04	18.3505	-88.1482	Sarteneja	Corozal
1	07CZCH05	18.2998	-88.355	Chunox	Corozal
2	07OWTF08	18.099	-88.5588	Trial Farm	Orangewalk
3	07CZSJQ15	18.3491	-88.4429	San Joaquin	Corozal
4	07OWSE07	18.1524	-88.5076	San Estevan	Orangewalk
5	07CZCS16	18.4571	-88.2989	Consejo	Corozal
6	07CZCS17	18.4535	-88.312	Consejo	Corozal
7	07OWSA22	18.131	-88.6746	San Antonio	Orangewalk
8	07OWCA26	18.022	-88.5456	Carmelita	Orangewalk
9	07OWSF20	17.8725	-88.7715	San Felipe	Orangewalk
10	07OWAP21	17.9707	-88.7285	August Pine Ridge	Orangewalk



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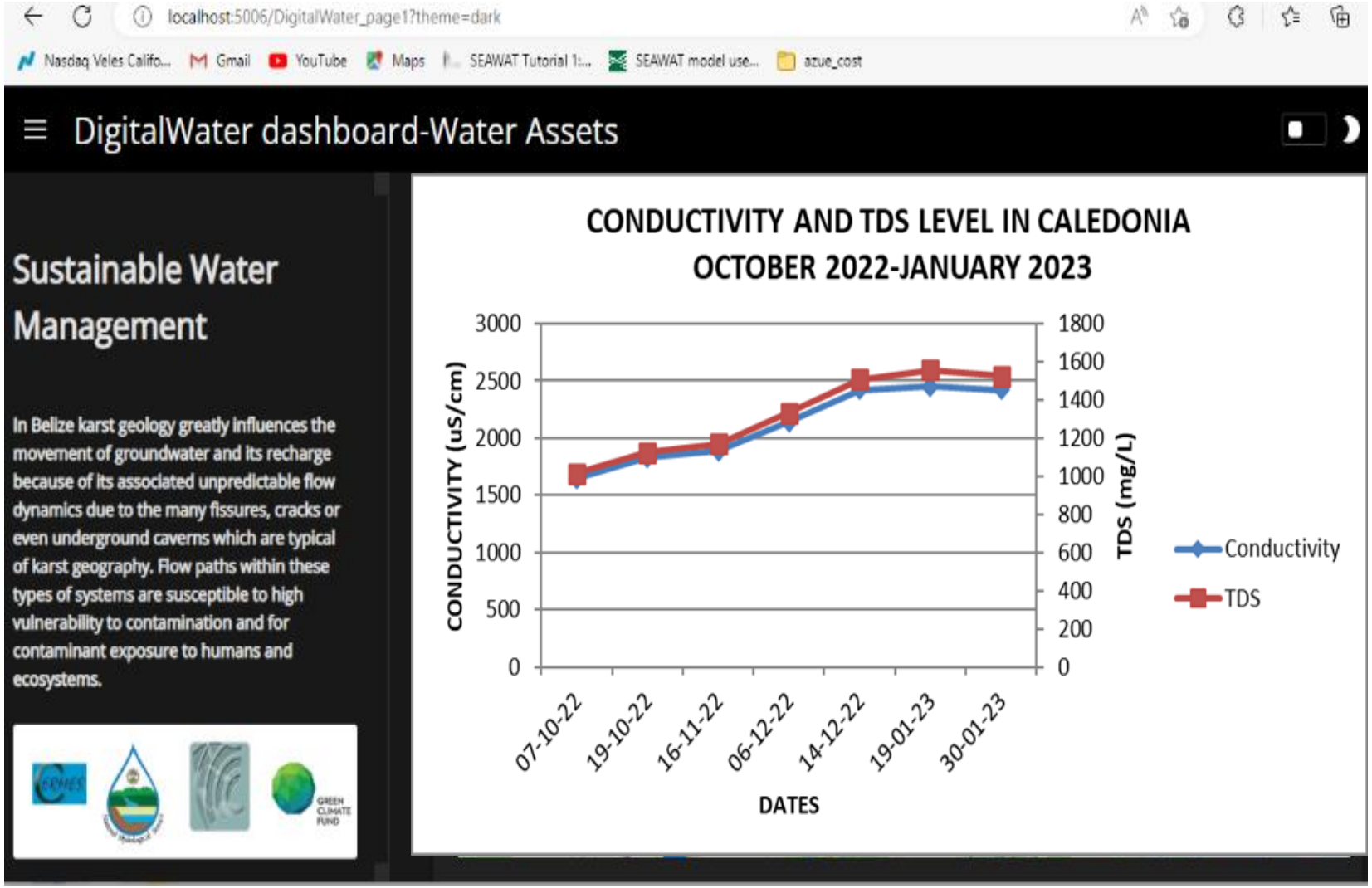

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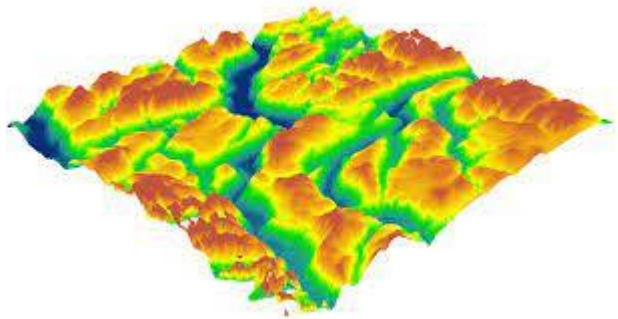
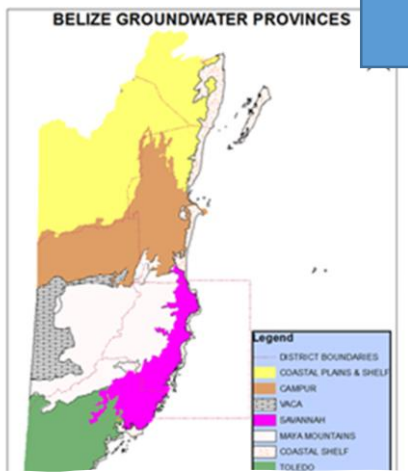
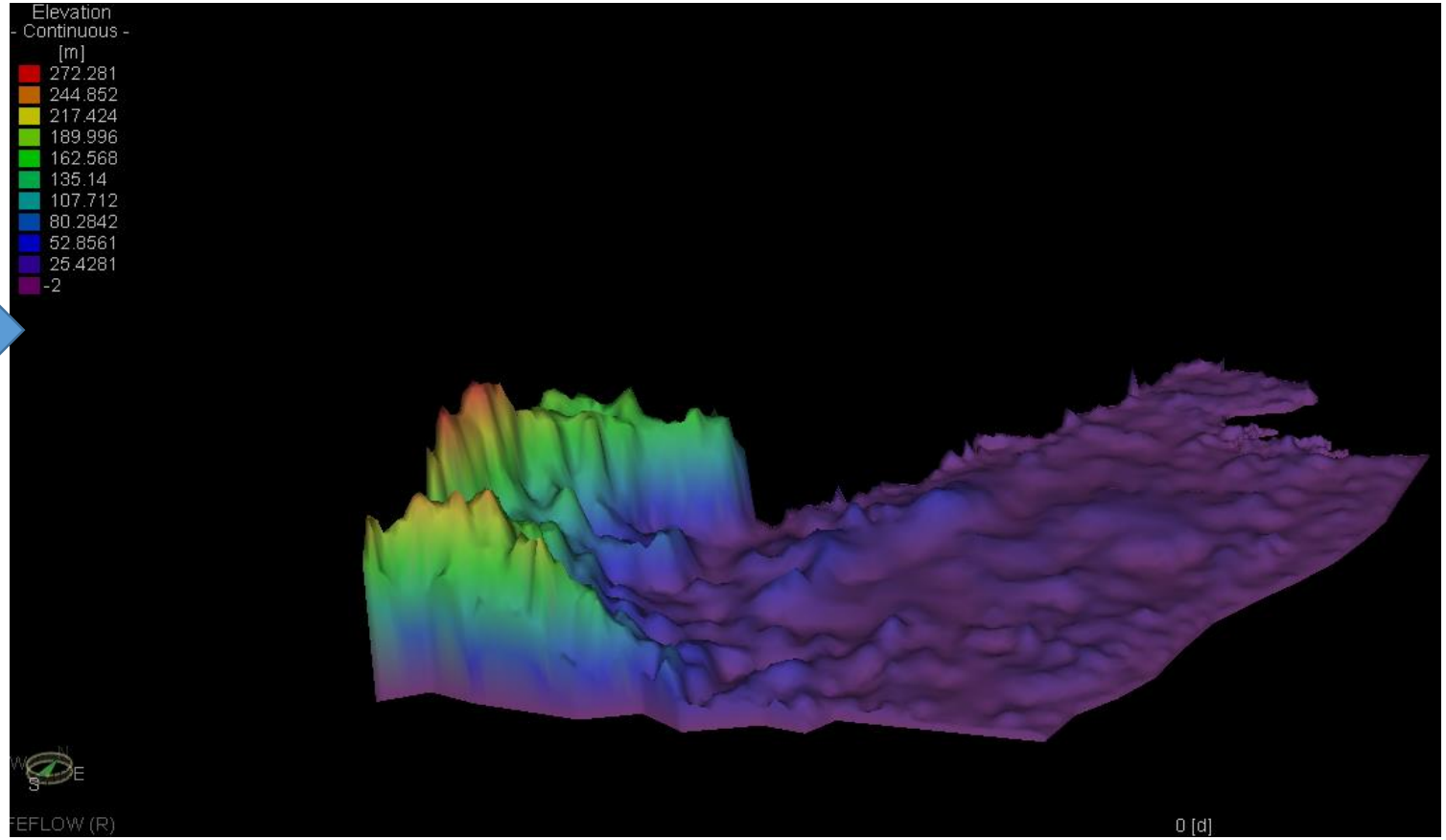
DEM



Geology





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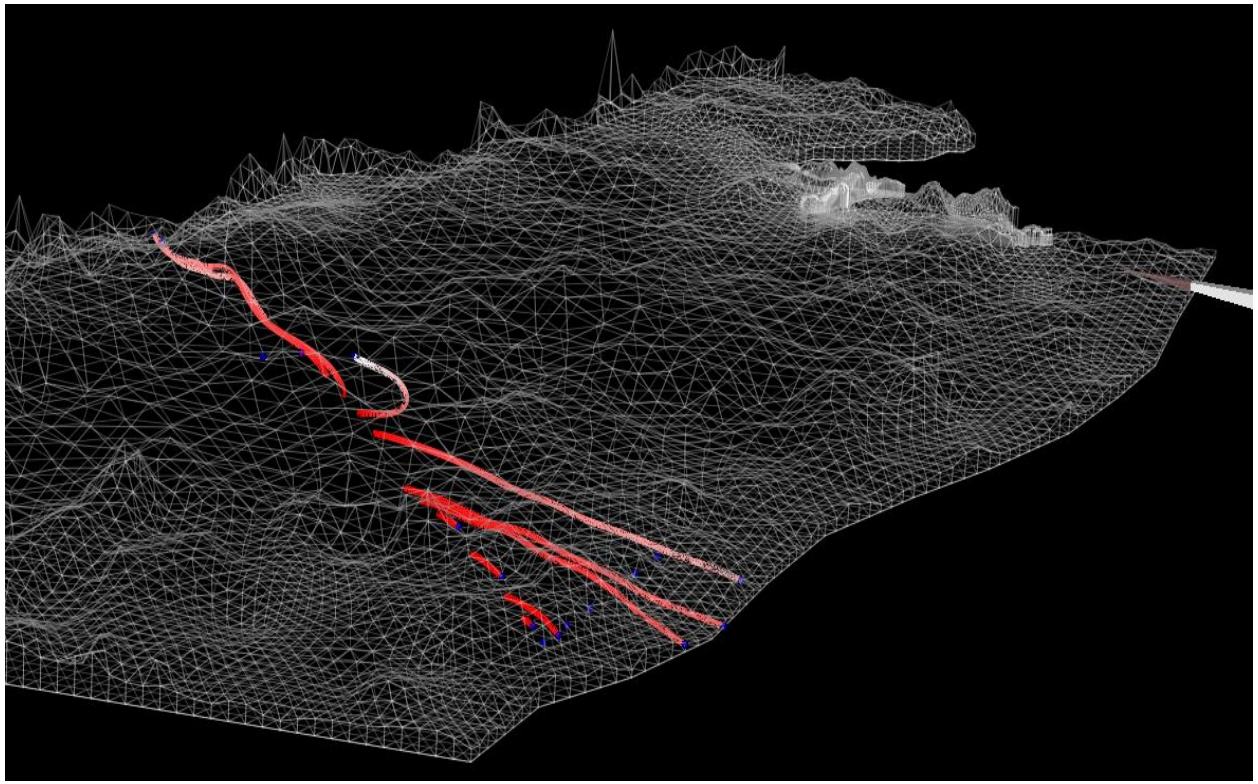
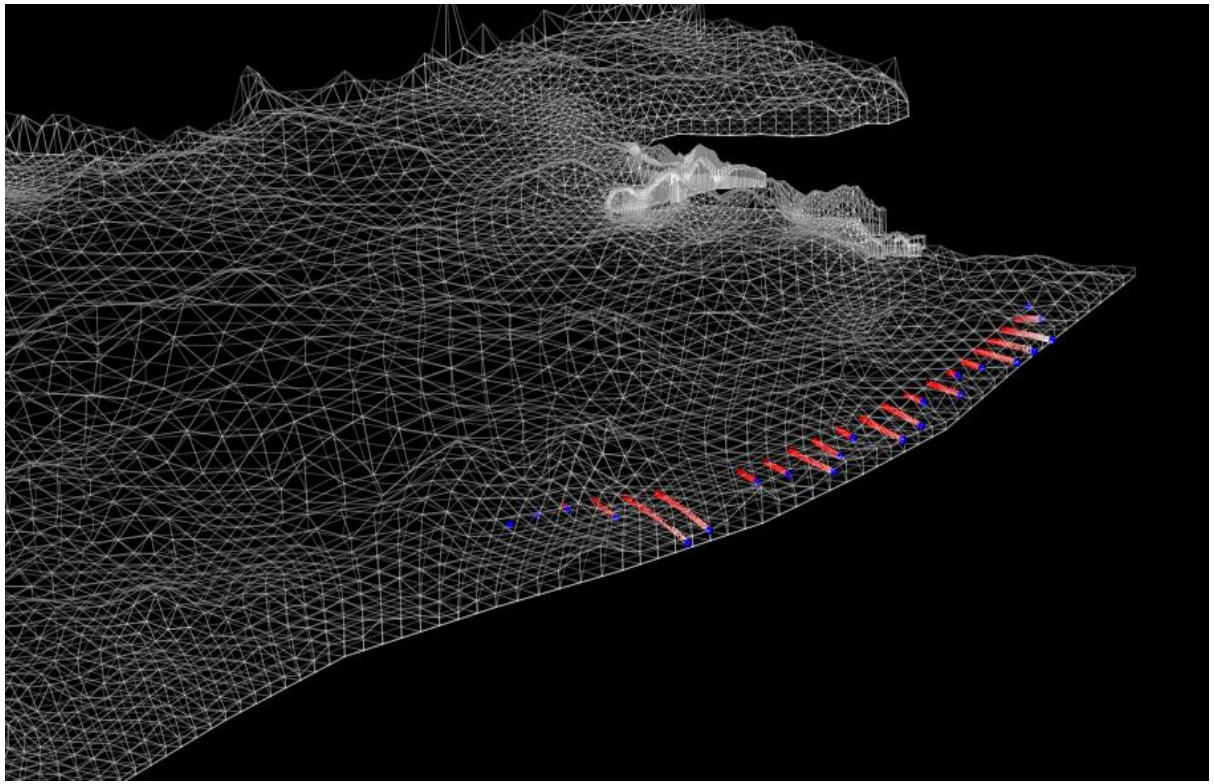
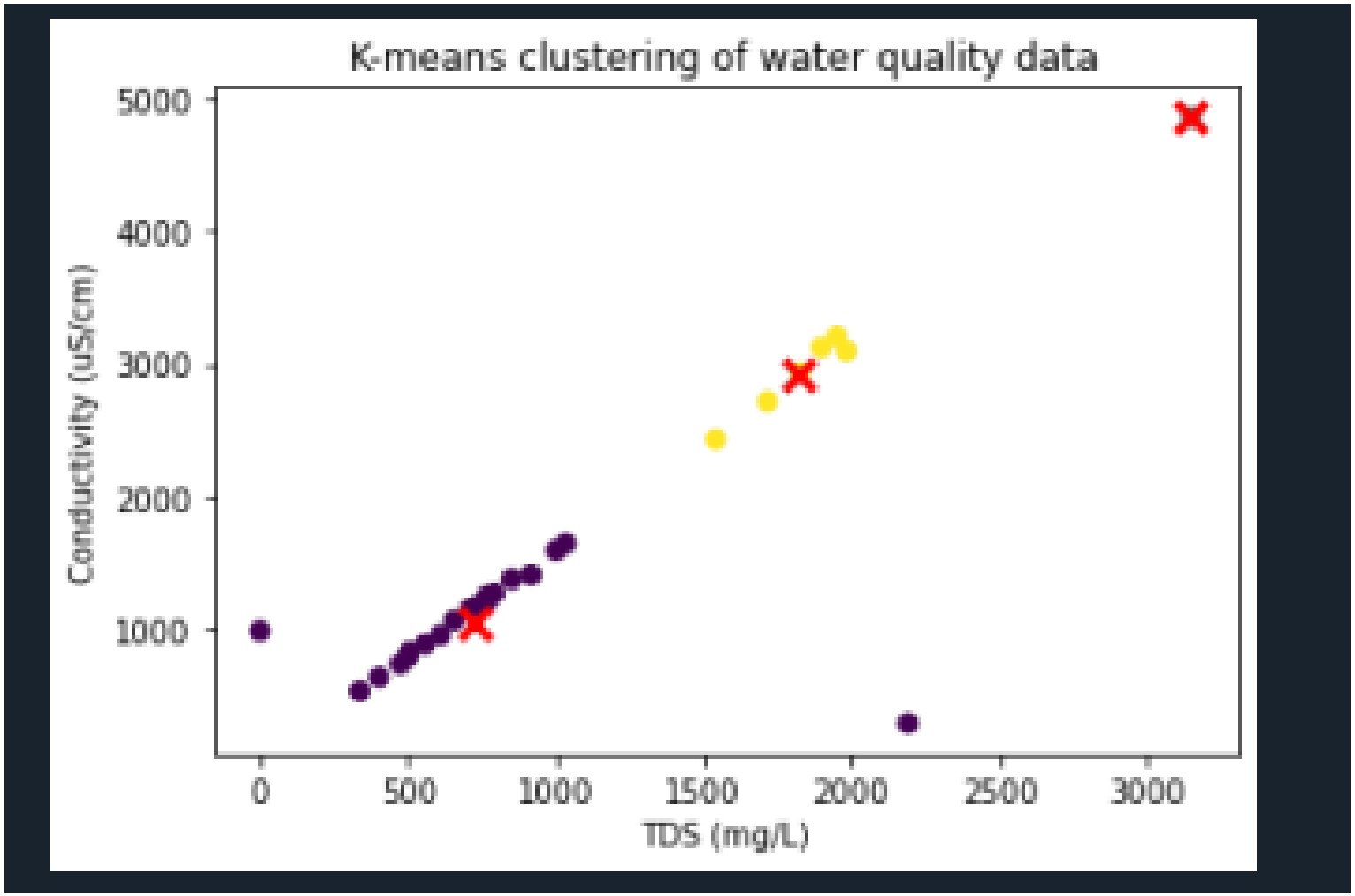




Results: K-means clustering

- **ML algorithm** for clustering showed generally 2 different **water quality "signatures"**

- Land-use and proximity to the coast exert influence on groups



Conclusions

- New data sets have been created that assist with understanding temporal water quality changes.
- A new tool has been developed that can assist resource managers with decision making.
- Real-time data needed to make a fully operational tool.

Acknowledgements

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