Computations of Deformation from Current and Predicted Changes in the Distribution of Water

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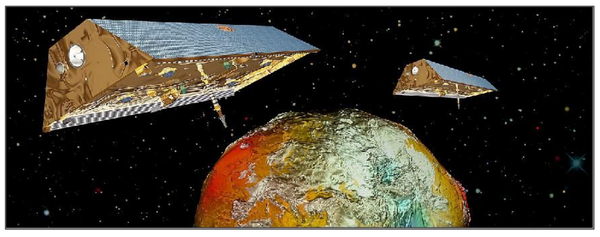
Background

- Surface Loading
  - Water exerts a **load or force** on the Earth's surface
  - This loading contributes to the **seasonal displacement** of Earth's surface
- GRACE (2002-2017) and GRACE-FO (2018-)
  - These satellites **measure the distance between one another**, which shifts due to gravitational changes caused by the **movement of water** on Earth's surface



Objectives

- Creating a user-friendly and easily accessible **database** for surface displacements computed from the **GRACE mission data**
- **Plotting** current and predictive **deformation data** for multiple sites

Methods

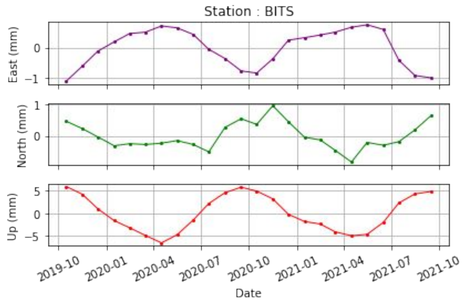
- LoadDef
  - Computes North, East, and Vertical values based on PREM reference model
- tcsh script
  - Combines three files for each site into one
- MatLab
  - Created a script that takes input, creates tables, and transfers the tables to database
- MySQL
  - Open-source database management system

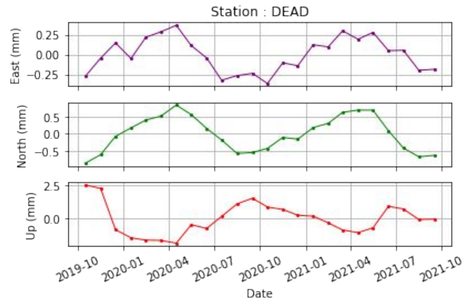
Results

- **Database**
  - 1,049 tables
  - Each table has 7 columns and 132 rows (924 values)
- **Possible Queries**
  - Selecting all data for one site
  - Select all data for one site at a specific time point
  - Selecting multiple columns of data from different tables

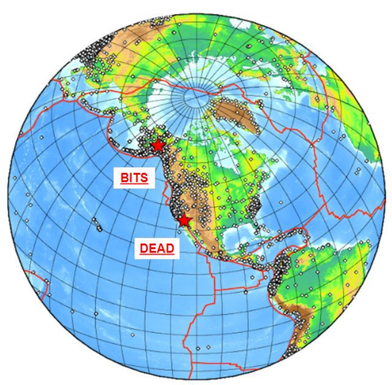
MJD	E_Dis	E_Unc
731324	5.05E-05	0.0001238054251
731346	0.0003838583627	0.0001238054251
731444	-0.0006936177062	0.0001238054251
731475	-0.0005712756553	0.0001238054251

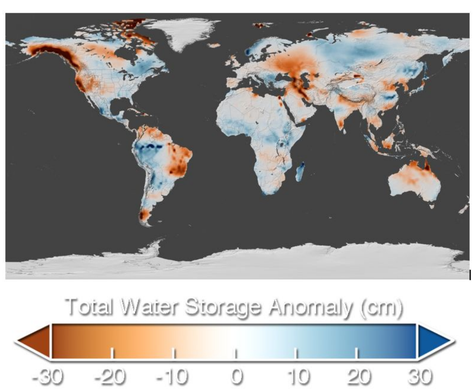
- **Time series analysis** helps researchers to understand the underlying causes of trends and systematic patterns over time
  - BITS- Denali Highway, Matanuska-Susitna, Alaska, USA
  - DEAD - Giant Rock Road, San Bernardino County, CA, USA





- **Mapping of water displacement** allows us to visualize where water is displacing and at what rate (Credits: NASA)





Conclusion

- This database provides a user-friendly and easily accessible platform for our group to accurately study and interpret these changes of the Earth
- Plotting time series data furthers our understanding of how and where water is displacing and guides us in predicting future displacements
- The goal is to use the data our group has collected to visualize water displacement across the entire planet over time and discover any trends or patterns

References

- Martens, H.R., Rivera, L., & Simons, M. (2019). LoadDef: A Python-based toolkit to model elastic deformation caused by surface mass loading on spherically symmetric bodies. Earth and Space Science, 6. https://doi.org/10.1029/2018ea000462.
- "What Earth's gravity reveals about climate change," GFZ News, 16 April 2019.

Acknowledgements

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