Development of Computational Tools for Visualizations of Deformation from Ongoing and Projected Future Changes in the Distribution of Water and Ice

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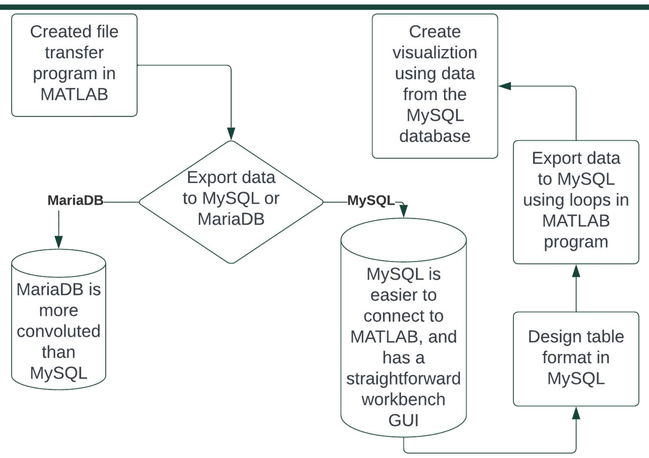
Background

- Data obtained from the GRACE (Gravity Recovery And Climate Experiment) satellite mission
- Our group tracks the deformation of Earth's landmasses based on the redistribution of water mass
- The GRACE mission consists of two satellites orbiting in tandem measuring the distance between each other, which tracks changes in gravity due to surface mass loading
- This data is then run through a suite of programs called LoadDef, converting the raw data into displacement, uncertainty, and time.

Objectives

- Create a relational database in MySQL in order to store the glacier data received from GRACE
- Allow users to easily access data, run queries, and create visualizations
- Create a MATLAB program capable of funneling the data text files into a MySQL datatable
- Connect MATLAB with MySQL utilizing the JDBC (Java Database Connectivity) Driver
- Export the preexisting data from the text files into the database
- Create queries to allow users to interact with the database

Method

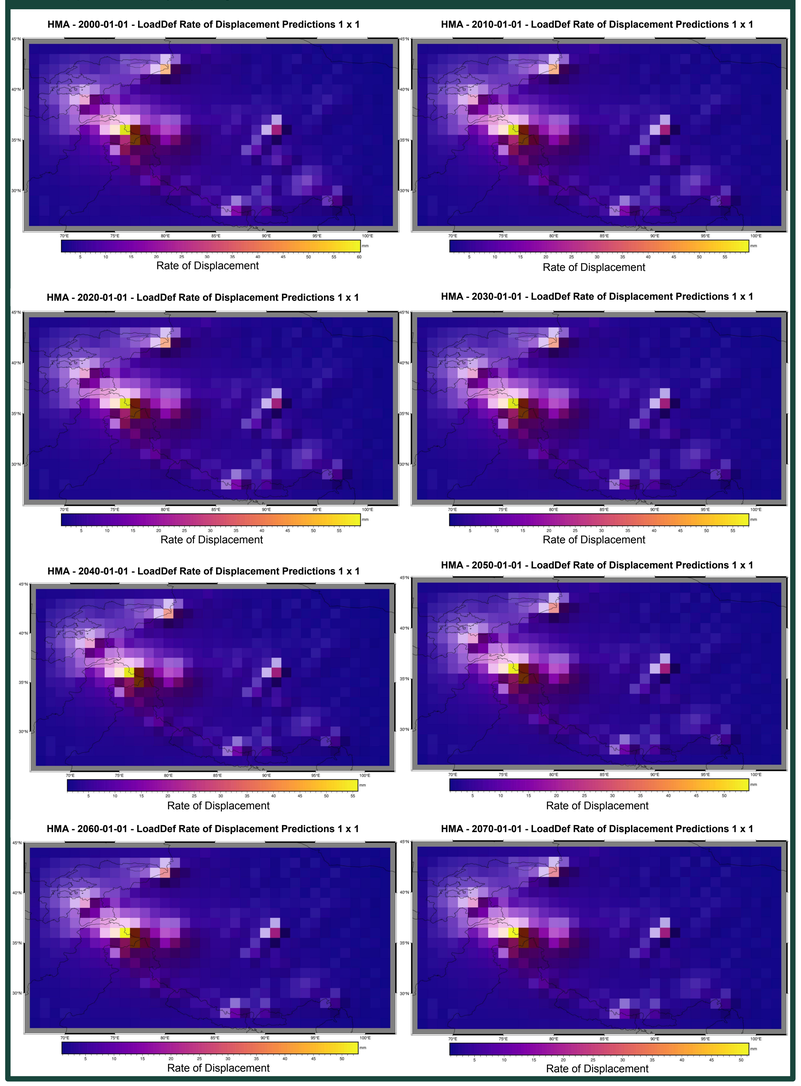


Results

Sample Data Table in the MySQL Relational Database:

#	julian_date	displacement_north	uncertainty_north	displacement_east	uncertainty_east	displacement_vertical	uncertainty_vertical
1	731324	0.000115622	0.000113087	-0.000192793	0.000128258	-0.00204298	0.00101938
2	731346	0.0000238852	0.000113087	0.000454919	0.000128258	-0.00175032	0.00101938
3	731444	0.000189031	0.000113087	-0.000412316	0.000128258	0.000755307	0.00101938
4	731475	0.000269955	0.000113087	-0.000682067	0.000128258	0.00356949	0.00101938
5	731505	0.00064078	0.000113087	-0.000685731	0.000128258	0.0016656	0.00101938
6	731536	-0.000031997	0.000113087	-0.00108796	0.000128258	0.00127959	0.00101938
7	731566	0.000172481	0.000113087	-0.00142619	0.000128258	0.0024582	0.00101938
8	731597	-0.000377679	0.000113087	-0.000504743	0.000128258	-0.00202302	0.00101938
9	731627	-0.000139267	0.000113087	-0.000205397	0.000128258	-0.0000336676	0.00101938
10	731656	-0.000298647	0.000113087	-0.000175868	0.000128258	0.000634473	0.00101938
11	731687	-0.000186924	0.000113087	0.000203421	0.000128258	0.000011506	0.00101938
12	731712	-0.0000484124	0.000113087	0.0005409	0.000128258	0.000900773	0.00101938
13	731778	-0.000112602	0.000113087	-0.000190221	0.000128258	0.00133087	0.00101938
14	731809	-0.000327388	0.000113087	-0.00058805	0.000128258	0.00294441	0.00101938
15	731840	-0.000109248	0.000113087	-0.000854565	0.000128258	0.00332795	0.00101938

Rate of Displacement (mm/year) of High Mountain Asia:



Conclusion

- The original goal was to store large amounts of data from GRACE in an organized fashion, in order to create an easier and more efficient experience to access and find data relevant to the user
- In order to actually put the datasets into tables in MySQL, we had to create a function in MATLAB that would read the text files from the data folder, and export them into the MySQL database
- Using a for-loop, the program is able to loop through the appropriate files in the data folder (files with names ending in '_all'), and then calls the built in 'sqlwrite' function
- Finally, I created a visualization by graphing some of the glacier data using software called GMT, specifically from October 1st, 1999 to October 1st, 2001
- This sample visualization shows what users can create from the data
- When graphed, the visualizations actually show that the predicted rate of displacement is actually slowing down.
- When the land stops rising at such a rate, its because the ice stored in glaciers is running out
- The future goal of the software is to ultimately create a map of the whole world to measure the total rate of displacement

References

Grace Satellite Mission Render:
"The twin satellite Grace in front of the geoid," from GRACE - eoPortal Directory
https://directory.eoportal.org/web/eoportal/satellite-missions/g/grace

Acknowledgements

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Advanced Computational Research Experience for Students