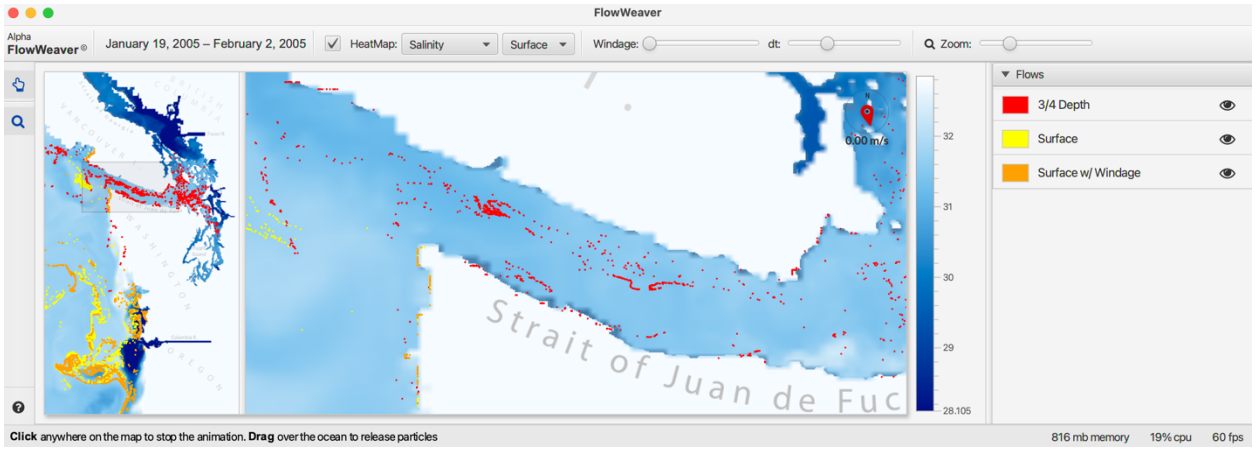
UNDERGRADUATE RESEARCH POSITION: Oceanographic particle tracking visualization code development

Project Overview: Understanding where particles go in the coastal ocean is important for understanding pollution problems such as marine debris and oil spills, as well as for understanding transport of biological organisms such as larvae and phytoplankton. This project seeks to build upon an existing visualization tool to visualize transport in a region of the coastal ocean. The visualization tool uses the outputs from an existing hindcast regional numerical model (analogous to a weather model, but for the ocean) to show transport pathways.

The existing visualization code: flowWeaver was written in Java and incorporated into Processing by Dr. Neil Banas and has been applied for use by Pablo Otero (Otero et al., 2015) on the Galician coastline and Dr. Parker MacCready on the US Pacific Northwest coastline. A former UCSD undergraduate CS major re-wrote the code entirely in Java and added new functionality. A screenshot below shows an example applied to the Pacific Northwest regional numerical model and particle trajectories that were released in the Strait of Juan de Fuca.



While this example is applied to the Pacific Northwest regional oceanographic model this tool can be used with any regional numerical oceanographic model such as this local one.

Project Tasks: The overall project task is to build upon the flowWeaver tool to incorporate additional capabilities. Some specific tasks a student might focus on are included below:

- Further development of the existing visualization tool which integrates computer science and coastal oceanography.
- Making this tool available to the scientific community via a public repository (GitHub) for use as both a teaching tool and a mechanism for teaching and outreach with the general public.
- Creating a web-version of the tool to allow direct access for educators.
- Depending upon the student's interests and abilities, this project may result in writing a manuscript draft with the results.

Each undergraduate research student will start with 1-2 tasks to focus on, working with a team of 2-4 undergraduate researchers.

Qualifications: To do this will require building upon the existing Java code. This will require independence on the student's part, particularly in coding. Some MATLAB programming is also used for model pre-processing. Prior experience with Java, is highly recommended. Additional coding background that could be helpful to understand the back-end of the model simulations that are being fed into this tool include MATLAB, Linux, C and Fortran.

In the process of this project the student will learn:

- Basic coastal oceanography (upwelling/downwelling, estuarine circulation)
- Basic knowledge of oceanographic numerical models
- Processes important to particle transport
- Particle tracking algorithms
- How to use visualization tools such as this one to promote learning via outreach and teaching
- Coding in Java, MATLAB, Linux, and more

Through this project students will have the opportunity to:

- Work with coastal oceanographers and researchers on tool development
- Work with educational experts at Birch Aquarium, the San Diego Science Project, UCSD's Center for Research on Educational Equity, Assessment & Teaching Excellence (CREATE), and local secondary schools.
- Contribute towards an open-source interactive visualization tool capable of being applied across a variety of regional oceanographic modeling systems.
- Contribute towards an open-source interactive visualization tool to be used in secondary curriculum development.

Funding & Timeline: The hours for this project include 3 full months of undergraduate research support. This can be used part-time during the school year and full-time during the summer split amongst 2-4 students. The project will start in January/February 2023.

To Apply: If you are interested, please contact me: Dr. Sarah Giddings, at sgiddings at ucsd.edu and send a copy of your CV and transcript (all in a single pdf), and available times to meet.