The main task assigned to the UCLA group is the development of a Regional Ocean Modeling System (ROMS) configuration. This ROMS configuration is the backbone of the JPL group's assimilation system for this project. The overall goal is to develop an operational system that delivers information on oceanographic conditions in real-time to research and application users. A simultaneous objective for UCLA group is to improve the understanding of the physical processes that drive the complex ocean circulation and its variability in Prince William Sound (PWS).

To summarize, during Year 1 and Year 2, tasks assigned to the UCLA group were accomplished, namely the development of an adapted PWS ROMS configuration and the evaluation of its ability to simulate the circulation in the Sound, using accurate representation of the circulation in the Gulf of Alaska (GoA). The configuration consists of three embedded grids: the entire GoA (L0), the central part of the GoA (L1) and PWS (L2). The grids horizontal resolution are 10 km, 3.3 km and 1.1 km (resp.). All the essential components (topography, tidal forcing and river run-offs) have been progressively included in the configuration. During this phase, two L0 domains were designed and tested intensively for their sensitivity to open boundaries conditions information (downscaling from general circulation models) to determine the best configuration for mean circulation characteristics and coastal currents. A specific effort was also made to incorporate an accurate topography in both domains, through the merging of different topography data sets and a coastline coherent with the coastline from the NOAA Oil Spill group. The difficulties regarding the tidal forcing implementation were overcome, and
experiments using different tidal forcings were conducted to enhance the accuracy of the tides in the solution.

During Year 3 our main focus was on the implementation of a full freshwater run-offs distribution. This effort is both for the L0/L1 domain (GoA) and the L2 domain (PWS). Part of our activity was also devoted to some model code modifications: the improvement of the run-off time variability and the development of pre-processing tools to design the run-off distribution (allowing us to design/modify easily an important number of point sources). We discovered some numerical delicacies when we performed the long-term integration using both tides and full run-off distributions. These delicacies have now been overcome.

For L2 domain we performed test experiments with different full run-off distributions, which consist of hundreds of point sources distributed around the Sound (close to a line source distribution). The preliminary analysis confirmed that the circulation in the central part of PWS is strongly influenced by the freshwater discharge. It appears also that the tides play an important role in shaping the freshwater patterns (i.e., the strong density gradients). The main remaining issue for the L2 domain is that the simulated salinity is still too high in Summer and Fall (Fig. 1). This is probably due to two factors: the distribution of sources is uncertain in the Sound (positions and associated discharges) and the lack of freshwater advection into PWS by the Alaska Coastal Current (ACC). The former will be improved making use of recent intensive hydrographic observations collected by S. Okkonen (UAF). The latter is related to our on-going work on L0/L1 domain.

For the L0/L1 domain we are currently working on including the “large-scale” freshwater run-off. The objective is to improve the ACC structure with the anticipated consequence of advected freshwater from the GoA Shelf into PWS. Another aspect concerns the sensitivity of the shelf mesoscale activity to the freshwater discharge. From our solutions we note indications that eddies on the outer shelf may have an important influence on the exchanges at Hinchinbrook Entrance (Fig. 2). Preliminary analysis of L0 solution including run-off found changes in the eddy activity on the GoA Shelf. Further validation and improvement will be undertaken with specific attention to the ACC structure. A remaining issue is the still too-high salinity values for the simulated ACC. This is related to the uncertainty (as in L2) of the run-off distribution and discharge in L0. We just obtained from
T. Royer results of an updated freshwater discharge model discharge in the GoA. This information is expected to be very helpful in improving our L0/L1 solutions. We are now working on including it in our configuration. We already have started an experiment by adding point sources for the Canadian rivers in L0 domain (following T. Royer’s recent work). We also began work on an alternative way of prescribing the freshwater run-offs: the part related to the drainage is prescribed through atmospheric precipitation along the coast (to mimic a line source) in addition to point sources associated with the important discharges of the major rivers.

In the meantime we will pursue our process studies so we can understand the roles of the winds, the tides, and the freshwater in the PWS circulation, and the complex nature of the exchanges between the Sound and the GoA.

In summary, we have made substantial progress in learning how to configure a nested model for the Prince William Sound, analyze its solutions to understand the unique combination of winds, tides, rivers, and fjord/island geometry that control its circulations; compare with existing measurements; and transition this forward-integration model to a data-assimilation system that will be a central tool for the upcoming field experiments. However, theses tasks could not quite be completed within the initial 3-year contract, and we are looking for additional funding that will enable us to complete them.
Figure 1: Surface salinity and velocity snapshot during Summer season from L2 domain solution, including a full run-off distribution around the Sound.

Figure 2: Velocity and temperature snapshot at 50 m depth from L2 domain solution. Strong eddies on the outer shelf are clearly observed close to Hinchinbrook Entrance.
Presentations:


Publications: