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High School Students Learn by Direct Experiences on the Effects of Recent Drought on the Water Properties of a Subtributary to the Chesapeake Bay

by Arnolando Valle-Levinson

For a little more than one year now, the HIGH TIDE program has been involving students from four high schools of southeastern Virginia (from the cities of Chesapeake, Norfolk, Portsmouth and Virginia Beach) to measure weekly profiles of temperature, salinity, and density in one of the subtributaries to the Chesapeake Bay. One of the goals of the HIGH TIDE program is to stimulate the interest of pre-college generations about science and, in particular, to propel their curiosity about oceanography. Since the HIGH TIDE program's inception in September 2000, the students have been learning first-hand about the annual cycles of water temperature and salinity (Figure 1a) and about the relative influence of temperature and salinity on water density and density stratification (Figure 1b), among other phenomena. Most interesting has been the high salinity values measured in the autumn of 2001 (over 25) compared to the lower values (between 22 and 23) recorded during the similar period the year before. The students have been able to appreciate that the high salinity values of the autumn of 2001 reflect the dry conditions that have affected the lower Chesapeake Bay. They are discussing

with their teachers the potential implications of the apparently anomalously high salinity on the seafood they eat and the fresh water they drink, and therefore, how it affects their daily life. In this context of direct experiences, high school students are gaining a greater appreciation for science as expressed both by teachers and students participating.

HIGH TIDE stands for **High** Schools of **Tidewater** (the region of Virginia where CCPO and Old Dominion University are located) **I**nteracting on **D**ata collection **E**xperiences. It is a program, funded by the United States National Science Foundation (NSF), that includes both scientific and educational activities. The educational activity bridges high school teachers and graduate students to facilitate data collection experiences for high school students. The program is directed by **ARNOLDO VALLE-LEVINSON**, CCPO associate professor, with the participation of the following teachers and graduate students. Teacher Michael Bates of Maury High in Norfolk participates in the program with CCPO's **DAVID SALAS** and **MARIO CÁCERES** (Mario earned his Ph.D. in August 2001 and is now

back in Chile). Teacher Debora Mosher of Cox High in Virginia Beach collaborates with CCPO's **ANDRÉS SEPULVEDA**. Teacher Mary-Beth Moore of Western Branch High in Chesapeake participates with CCPO's **CRISTOBAL REYES**. Teachers Dan Borick and Heather Groffy from I.C. Norcom High in Portsmouth interact with CCPO's **ROSARIO SANAY**. While high school teachers and students learn by collecting environmental data, Arnolando and CCPO's graduate students learn about teaching methods and techniques that spark the curiosity of the students. The collaboration is yielding an exciting data set from which everybody learns.

The four high schools participating in the program take turns once every four weeks, measuring the profiles of water temperature, salinity, and density. The rotation of high schools allows weekly data collection. Sampling is carried out from a bridge (Figure 2) that crosses the Lafayette River (Figure 1), a branch of the Elizabeth River and James River that ultimately leads to the Chesapeake Bay. Every week, usually on Tuesdays, one of the teachers comes to CCPO with four

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NOTES from the Director.....

A quick glance over this issue of *Circulation* makes one think about youth. Youth can be seen in the highly successful Halloween party for the kids, in HIGH TIDE and the Blue Crab Bowl for high school students, and in our graduate students and staff. That is one of the satisfying aspects of education: we are surrounded by a renewing supply of youth.

Here at CCPO, ANN GARGETT has settled in, taught the core course in physical oceanography, received funding from NSF and NOAA, and hired a marine electronics technician, CHRIS POWELL. The new technician, combined with the arrival of the *R/V Slover* this summer (<http://home.maine.rr.com/rlma/odurv.htm>), greatly increases our capacity for local field work and instrument development and testing.

Continuing on the field work theme, I would like to mention that JAY AUSTIN is continuing the monthly hydro section across the Bay mouth. This section was started in April 1992 and is now producing time series information that will be valuable as we study climate change effects in the region. Jay is interested in incorporating other investigators who might want to initiate time series near the mouth of the Bay. Check out <http://www.ccpo.odu.edu/~jay/cheshome.html> or contact him at jay@ccpo.odu.edu.

Larry Atkinson

Director, Center for Coastal Physical Oceanography

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represents an invaluable data set that students may use to exercise different statistical tools. Lesson plans will be developed by teachers to further the applicability of the data set. A few students have already used parts of the data set to carry out their school science projects. In addition to data visualization and retrieval, the Web site is used to consult the tide tables corresponding to the sampling site and to

verify the date and time of sampling for each high school. The data set furthers the scientific objective of the NSF project to better understand the exchange hydrodynamics at the mouth of estuaries. The data are complementing other observations on water velocities (currently being obtained by Arnoldo) to be put into the context of seasonal and interannual variability. It is hoped that this is only the beginning of a long time

series that eventually will help to shed some light onto the effects of climate variability on estuaries. This will only be accomplished, in addition to securing the sources of funding, with the dedication and participation of middle and high school teachers and students who learn about science while they actually do it.

The HIGH TIDE program is creating synergy with other educational activities. It has become one of the featured oceanographic programs on the Windows to the Universe educational project (www.windows.edu; Roberta Johnson is the contact person) and is being injected with ideas from the local public television station (WHRO, with Brian Callahan being the contact person). Procedures to showcase this program in the Virginia Marine Science Museum, located in Virginia Beach, are being explored. You may become an active participant of this program. If you want to use the data sets being produced, please feel welcome to do so. The data being generated by the project are available for anyone to use. For further information, please consult the program's Web site and/or contact Arnoldo (arnoldo@ccpo.odu.edu).



Figure 3. Students uploading and processing the CTD data.

HAPPENINGS

On November 2, CCPO hosted a Halloween party for the children of faculty, staff, and students. CCPO staff members, **CLEO PHILLIPS** and **BETH MILLER**, organized the event. The children came in a variety of costumes, including scary creatures, popular television characters, animals, and even Harry Potter. The big hit of the party was the "scary box," a **JOE RUETTIGERS** creation. While the kids crawled through an enormous appliance box, they tried to escape the several hands poking through holes on the sides. It generated much laughter, particularly when a few adults gave it a try! (Photos taken by **NANDITA SARKAR** and Joe.)



Pri zes for best costumes were awarded to Li i ana Val l e (l eft) and Jake Mor- gan (ri ght).



Hal l oween party parti ci pants from l eft to ri ght: (l eft chai r) Mi key Kl i nck, Grant Morgan, Nate Tedrow, Jake Morgan. (mi dd l e couch) Emi l i ano Val l e, Al varo Val l e, Mal i k Phi l l i ps. (ri ght chai r) Kathryn Savi dge, Loana Bl um-Green, Hel en Savi dge, A.J. Mi l l er. (standi ng i n front) Li i ana Val l e.

Not pi ctured Wi l l Fri edri chs, Drew Fri edri chs, Chase Mi l l er

NEW STAFF PROFILE

CLEO PHILLIPS came to CCPO in September 2001 as the center's Grants Ad- ministrator. Her responsibilities include plan- ning and managing the center's budgets, as well as overseeing and coordinating daily op- erations. Cleo is also the co-editor of CCPO's newsletter, *CCPO Circulation*.

Cleo previously worked in the Ocean, Earth and Atmospheric Sciences Department here at Old Dominion University as a program support technician. In that capacity, she was responsible for Web page development and administrative support for 23 faculty members, as well as serving as the department's assistant to the undergraduate Chief Departmental Ad- visor.

Cleo moved to the United States from a small island in the Caribbean called St. Kitts. She served in the Army Reserves for seven years and was promoted to a specialist before completing her enlistment. Cleo has a 5-year- old son, Malik, and is presently expecting an addition to her family in the spring. When not consumed with motherhood, she likes reading, cooking, and listening to music.



Just the facts...

PRESENTATIONS

COTA, G.F., "Climate Change in the Arctic: Ecosystem Responses." National Science Foundation, Arlington, VA, September 10, 2001.

COTA, G.F., "Ecosystem Response(s) to Climate Change in the Arctic." Department of Ocean, Earth and Atmospheric Sciences, Old Dominion University, Norfolk, VA, September 6, 2001.

COTA, G.F. and L.R. Pomeroy, "Patterns of Arctic shelf-basin productivity." Arctic System Science Meeting, Salt Lake City, UT, November 14-16, 2001.

COTA, G.F., D.A. RUBLE, X. PAN, and J. WANG, "Bio-optical observations in Virginia coastal waters." Global Imager ADEOS II meeting, Tokyo, Japan, November 14-16, 2001.

COTA, G.F., "How productive is the Arctic?" Center for Coastal Physical Oceanography Fall 2001 Seminar Series, Old Dominion University, Norfolk, VA, November 5, 2001.

COTA, G.F., "Climate Change in the Arctic: Ecosystem Responses." Norfolk Collegiate Upper School, Norfolk, VA, October 30, 2001.

FACH, B., "Modeling studies of Antarctic krill survival during transport across the Scotia Sea." Institute for Marine Science, Middle East Technical University, Ankara, Turkey, December 13, 2001.

HOFMANN, E.E., "Southern Ocean GLOBEC and Modeling Results." Presentation at the British Antarctic Survey, Cambridge, England, October 26, 2001.

HOFMANN, E.E., J.M. KLINCK, E.N. POWELL, S.E. FORD, S. JORDAN, and E. BURRESON, "Modeling Studies of Climate Variability and Disease Interactions in Eastern Oyster Populations." Presentation at the Estuarine Research Federation Meeting, St. Petersburg, FL, November 4-8, 2001.

Holderied, K. and **A. VALLE-LEVINSON**, "Spatial and temporal transport variability at the Chesapeake Bay mouth." Presentation at the Estuarine Research Federation Meeting, St. Petersburg, FL, November 5, 2001.

Kelly, V., E.R. Cooper, **A. VALLE-LEVINSON**, L.A. Codispoti, **L.P. ATKINSON**, and E.K. Haberkem, "Total nitrogen and phosphorous transport at the Chesapeake Bay mouth." Presentation at the Estuarine Research Federation Meeting, St. Petersburg, FL, November 6, 2001.

KLINCK, J.M. and **E.E. HOFMANN**, "Ocean Observations west of the Antarctic Peninsula: a Southern Ocean GLOBEC project." Presentation at the Seventh Biannual Coordinating meeting of iAnZone, Ischia-Naples, Italy, October 15-17, 2001.

KLINCK, J.M., M.S. DINNIMAN, and W.O. Smith, Jr., "Model Study of Circulation and Biogeochemical Processes in the Ross Sea." Poster presentation at the Second International Conference on the Oceanography of the Ross Sea, Ischia-Naples, Italy, October 8-13, 2001.

Matsuno, T., I.-S. Han, A. Isobe, **A. VALLE-LEVINSON**, and T. Yanagi, "Alongshore propagation of small scale meander of the Kuroshio." Presentation at the Workshop on the Cross-Shelf Water Exchange Around the Shelf Break in the East China Sea, Fukuoka, Japan, October 18, 2001.

SAVIDGE, D.K., "Cross-Shelf Transport in the Southern Mid-Atlantic Bight and the Northern South Atlantic Bight." Presentation at the Middle Atlantic Bight Physical Oceanography and Meteorology (MABPOM) meeting, University of Connecticut, New London, CT, October 18-19, 2001.

VALLE-LEVINSON, A., "The paradoxical tropical estuary of Central America." Presentation at the Gordon Research Conference, June 13, 2001.

VALLE-LEVINSON, A., Course on the use of ADCP for six Latin American participants, Center for Coastal Physical Oceanography, Norfolk, VA, August 2001.

VALLE-LEVINSON, A., "Circulation in the Gulf of Fonseca." Presentation at the Ministry of the Environment, Tegucigalpa, Honduras, December 5, 2001.

VALLE-LEVINSON, A., Course on ADCP data processing for 17 Latin American participants, University of Concepcion, Chile, January 2002.

VALLE-LEVINSON, A. and T. Matsuno, "Tidal and subtidal flow along a transect on the East China Sea continental shelf." Presentation at the workshop on the Cross-Shelf Water Exchange Around the Shelf Break in the East China Sea, Fukuoka, Japan, October 18, 2001.

VALLE-LEVINSON, A., K.-C. WONG, and K.T. BOSLEY, "Comparison of the influence of Nor'easters and Hurricane Floyd on water exchange at the Chesapeake Bay entrance." Presentation at the Estuarine Research Federation Meeting, St. Petersburg, FL, November 8, 2001.

VALLE-LEVINSON, A., L.P. ATKINSON, D. FIGUEROA, and L. CASTRO, "Recent findings on the circulation patterns in the Gulf of Arauco." Presentation at the University of Concepcion, Chile, June 2, 2001.

PUBLICATIONS

Bochenek, E.A., **J.M. KLINCK**, E.N. Powell, and **E.E. HOFMANN**, "A biochemical ly based model of the growth and development of *Crassostrea gigas* larvae," *Journal of Shellfish Research*, 20, 243-265, 2001.

