MSL 663: Chemical Coastal Processes

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Class meeting times: TBA
Location: TBA
Office Hours: After class (1 hour)
or by appointment

Course Description
A study of chemical processes in the coastal ocean. This course will examine chemical interactions at different boundaries, and explore physical and biological controls on the chemistry of coastal environments. Some of the topics to be covered include: The role of suspended particles; coastal acidification; photochemical processes; controls on coastal productivity; future challenges in coastal management. This course is intended for students with a background in general chemistry and marine science.
Prerequisite: graduate standing. Stacked with MSL 463 (3+0)

Course Goals
1. To provide students with a view of the coastal ocean from a chemical perspective.
2. To generate discussion on current and future issues affecting coastal ecosystems.

Learning Outcomes
1. Become familiar with chemical processes occurring in coastal/shelf waters.
2. Identify physical and biological controls affecting the distribution and behavior of chemical species.
3. Critically evaluate the direction of future coastal/shelf research.
4. Relate topics examined during lectures to Alaskan coastal waters

Course Policies and Requirements
Lecture **attendance** and active **participation** in class is expected from all students. 5% of the final grade will be based on attendance (no more than 3 unexcused absences) and 5% on class participation (e.g. asking/answering question, participating in discussion). In addition to participation during lectures, students will be evaluated based on four homework assignments, a synthesis paper, an oral presentation, two midterms and a final.

Email communication will be used to distribute class information, updates and changes to the syllabus.

Four **homework assignments** will be given. Collaboration among students is encouraged. However, each student is expected to submit their own work. Homework assignments will not be accepted after the due date, unless arrangements have been made in advance with the instructor.

Exams. There will be two midterms and one final which are to be completed during the regular class period. The exams will be closed-book, and will require short-essay and diagramed answers. The final exam will be comprehensive with an emphasis on material covered after the second midterm.

Background Readings. There is no required textbook. Reading assignments will come from several books and the primary literature. Chapters from textbooks will be found on eReserves (http://eres.uaf.edu/eres/default.aspx) PASSWORD: TBA. Primary literature articles will be obtained from the library (http://library.uaf.edu/findarticles). Contact the instructor or a librarian if you need help obtaining articles.

Synthesis Paper. Choose and investigate a well-defined, focused topic that will be written as a paper. You are to choose an Alaskan coastal region and synthesize 2 to 4 key journal articles on the particular chosen topic and write a synthesis overview.

1. Topics will be selected during the first week of April. You will need instructor approval before moving ahead. This is to ensure you are "on track" with a focused topic.
2. An outline with chosen references will be due on week 12 (Tuesday)
3. The paper will be due in class on week 14 (Tuesday).
4. The body of the paper should have 1.5 line spacing, size 12 font (Time or Times New Roman) and 1 inch margins – it should be approximately 9 to10 pages with appropriate figures and tables inserted into the text.
5. All tables and figures need to have proper headings or captions, and need to be properly referenced.
6. Reference format:
   In the body of the text "The concept of new production (Eppley and Peterson, 1979) has provided valuable insight …"
   In the **Reference** section at the end of the paper:
   "Eppley, R.W., and B.J. Peterson. 1979. Particulate organic matter flux and planktonic new production in the deep ocean. Nature, **282**: 677-680."
7. The synthesis needs to be in your own words. It is OK to directly use a sentence from one of the articles as long as you use quotes and reference it properly.

Topic selection – remember that it has to be a focused paper from a **chemical coastal process perspective**. For example, a paper on trace metals in seawater is not acceptable, but a focused paper on sources of mercury in the Aleutian Archipelago would be acceptable. Similarly, a paper on organic matter in seawater is not acceptable, but a focused paper on input of organic matter by the Yukon River would be acceptable.

Student Presentations: All students will make an oral presentation of highlights from their synthesis paper. Presentations will take place during the last week of lecture.

Note: This is a stacked 400/600 level course. The material covered will be the same for both versions of the course, but the grading will differ. To receive full credit, graduate students will be required to 1) answer the A and B portions of homework and exam questions; 2) write a 10 page synthesis paper; 3) present the topic of the synthesis paper orally to the class; 4) be able to critically evaluate the direction of future coastal/shelf research at the end of the course; and 5) attend and participate in class. While undergraduate level students will be required to 1) answer only the A portion of homework and exam questions; 2) present a published scientific paper orally to the class; and 3) attend and participate in class.

Lack of **academic integrity** including plagiarism is not acceptable and will not be tolerated.

Points and grading scale for graduate students

	Possible points	% of Total
Attendance and active class participation	50	10
Homework (4 assignments)	100	20
Midterm 1	75	15
Midterm 2	75	15
Paper/Presentation	100	20
Final	100	20
Total	**500**	**100**

A+	98-100%	A	93-97%	A-	90-92%
B+	87-89%	B	83-86%	B-	80-82%
C+	77-79%	C	73-76%	C-	70-72%
D+	67-69%	D	63-66%	D-	60-62%
		F	< 60%		

Support and Disability Services

At UAF, the Office of Disability Services (203 WHIT; 474-5655; TTY 474-1827; fydso@uaf.edu) ensures that students with physical or learning disabilities have equal access to the campus and course materials. If you have specialized needs, please contact this office or the instructor to make arrangements.

Lecture Schedule (Subject to change)

Week	Date	Lecture Topic	Assignment	Reading
1		Introductions, overview, logistics		
2		Coastal zone classification		Open University Ch. 5-8
		Chemical composition and mixing		
3		Residence time and input variability		Eyre, 1998
		Floculation processes	Homework 1 Due	Boyle et al., 1974; Sholkovitz, 1976
4		Organic speciation of trace metals	Hwk 1 returned	van den Berg, 2000; Buck et al., 2005
		The roll of Suspended particles		Turner and Millward, 2002
5		Photochemical Processes		Sulzberger, 2000
		Photochemical Processes (cont.)	Homework 2 Due	Moran & Zepp, 2002
6		Midterm 1	Hwk 2 returned (2/21, office)	
		Carbonate system; Coastal Acidification	Midterm 1 returned	Emerson & Hedges Ch.4
7		Coastal Acidification (cont.)		Borges & Gypens, 2010
		Dissolved Oxygen; hypoxia/anoxia		Grantham et al., 2004
8		Interactions at sediment/water interface	Homework 3 Due	Presley and Trefry 1980; Libes Ch.12
		Sedimentary transformation of organic matter		Artemyev Ch. 4
SPRING BREAK				

Week	Date	Lecture Topic	Assignment	Reading
9		Sedimentary transformation of trace metals	Hwk 3 returned	
		The role of bacteria		
10		The influence of sea ice		Melnikov Ch. 3
		Midterm 2		
11		Isotopes as tracers	Topic Due. Midterm 2 returned	Libes Ch. 5
		Isotopes as tracers (cont.)	Homework 4 Due	Swarzenski et al., 2000
12		Upwelling, fronts and eddies review	Outline/References Due	
		Controls on coastal productivity	Hwk 4 returned	Alongi Ch 7
13		Controls on coastal productivity (cont.)		Hutchins et al., 1998
		Interdisciplinary coastal research		Ocanography, 21(4): 90-107,
14		Coastal Observing Systems	Paper Due	
		Future challenges and coastal management		Valiela Ch 14
15		Student Presentations		
		Student Presentations	Papers Returned	
16		Final Exam		

Texts

Alongi, D.M. (1998) *Coastal Ecosystem Processes*. CRC Press, Boca Raton, FL, 419 pp.

Artemyev, V.E. (1996) *Geochemistry of Organic Matter in River-Sea Systems*. Kluwer Acedemic Publishers, Dordrecht, 190 pp.

Emerson, S. and Hedges, J. (2008) *Chemical Oceanography and the Marine Carbon Cycle*. Cambridge University Press, Cambridge, 453 pp.

Libes, S.M. (1992) *An introduction to Marine Biogeochemistry*. John Wiley & Sons, Inc., New York, 734 pp.

Melnikov, I.A. (1997) The Arctic Sea Ice Ecosystem. Gordon and Breach Science Publishers, Amsterdam, 204 pp.

The Open University (1997) *Waves, Tides and Shallow-Water Processes*. Butterworth-Heinemann, Oxford, 187 pp.

Valiela, I. (2006) *Global Coastal Change*. Blackwell Publishing, Malden, MA, 368 pp.

Articles

Borges, A. V. and N. Gypens. 2010. Carbonate chemistry in the coastal zone responds more strongly to eutrophication than to ocean acidification. Limnology and Oceanography, **55**(1): 346–353

Boyle, E.A., R. Collier, A.T. Dengler, J.M. Edmond, A.C. Ng, and R.F. Stallard. 1974. On the chemical mass-balance in estuaries. Geochimica et Cosmochimica Acta, **38**: 1719-1728.

Buck, K.N., J.R.M. Ross, and K.W. Bruland. 2007. A Review of total dissolved copper and its chemical speciation in San Francisco Bay, California. Environmental Research **105**: 5-19

Eyre, B. 1998. Transport, Retention and Transformation of Material in Australian Estuaries. Estuaries 21(4A): 540-551

Grantham, B.A., F. Chan, K. J. Nielsen, D. S. Fox, J. A. Barth, A. Huyer, J. Lubchenco, and B. A. Menge. 2004. Upwelling-driven nearshore hypoxia signals ecosystem and oceanographic changes in the northeast Pacific. Nature, **429**: 749-753.

Hutchins, D.A., G. R. DiTullio, Y. Zhang and K. W. Bruland. 1998. An iron limitation mosaic in the California upwelling regime. Limnology and Oceanography, **43**(6): 1037-1054

Moran, M.A. and R.G. Zepp. 2002. Role of Photoreactions in the Formation of Biologically Labile Compounds from Dissolved Organic Matter. Limnology and Oceanography, **42**(6): 1307-1316

Presley, B.J., and J.H. Trefry. 1980. Sediment-water interactions and the geochemistry of interstitial waters.

Salisbury J., M. Green, C. Hunt and J. Campbell. 2008. Coastal acidification by rivers: A new threat to shellfish? Eos, Transactions, American Geophysical Union **89**(50):513

Sholkovitz, E.R. 1976. Flocculation of dissolved and inorganic matter during the mixing of river water and sea water. Geochimica et Cosmochimica Acta, **40**: 831-845.

Sulzberger, B. 2000. Photooxidation of Dissolved Organic Matter; Role for Carbon Bioavailability and for the Penetration Depth of Solar UV-Radiation. In: Gianguzza, A., Pelizzetti, E., and Sammartano, S. (eds.), *Chemical Processes in Marine Environments*. Springer, Berlin, pp.75-90.

Swarzenski, P.W., Corbett, D.R., Smoak, J.M., and McKee, B. 2000. The use of U-Th series radionuclides and transient tracers in Oceanography: An overview. In: Hester, R.E., and Harrison, R.M. (eds.), *Chemistry in the Marine Environment*. Royal Society of Chemistry, Cambridge, 98 pp.

Turner, A. and G. E. Millward. 2002. Suspended Particles: Their Role in Estuarine Biogeochemical Cycles. Estuarine, Coastal and Shelf Science, **55**: 857–883

Van den Berg, C.M.G. 2000. Organic Complexation of Metals in Seawater. In: Gianguzza, A., Pelizzetti, E., and Sammartano, S. (eds.), *Chemical Processes in Marine Environments*. Springer, Berlin, pp.189-200.