

## MSL 463: Chemical Coastal Processes

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**Instructor: Dr. Ana M. Aguilar-Islas**  
School of Fisheries and Ocean Sciences  
335A Irving II  
474-1524  
[amaguilarislas@alaska.edu](mailto:amaguilarislas@alaska.edu)

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

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### 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: Upper-division standing, general chemistry (e.g. CHEM 105 and CHEM 106), general oceanography (e.g. The Oceans-MSL 111), or permission from instructor for undergraduates, or graduate standing. Stacked with MSL 663 (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 Objectives

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. Apply a topic 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, an oral presentation, two midterms and a final.

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

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.

**Student Presentations:** All students will make an oral presentation that highlights findings from a chosen journal article addressing a chemical process within an Alaskan/Arctic coastal region (topic and reference to be approved by instructor on week 11 (Tuesday).

Paper selection – remember that it has to be a scientific paper addressing a chemical coastal process. For example, the following paper would not be acceptable.

Wagemann, R., E. Trebacz, G. Boila, and W.L. Lockhart. 1998. Methylmercury and total mercury in tissues of arctic marine mammals. *The Science of the Total Environment* **218**:19-31

However, the paper below would be appropriate

Leitch D.R., J. Carrie, D. Lean, R.W. Macdonald, G.A. Stern, and F. Wang. 2007. The delivery of mercury to the Beaufort Sea of the Arctic Ocean by the Mackenzie River. *The Science of the Total Environment* **373**:178-195

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 undergraduate students

|   | Possible points | % of Total |
|---|-----------------|------------|
| Attendance and active class participation | 50              | 10         |
| Homework (4 assignments)                  | 100             | 20         |
| Midterm 1                                 | 100             | 20         |
| Midterm 2                                 | 100             | 20         |
| Presentation                              | 50              | 10         |
| Final                                     | 100             | 20         |
| <b>Total</b>                              | <b>500</b>      | <b>100</b> |

A+ 98-100%

B+ 87-89%

C+ 77-79%

D+ 67-69%

A 93-97%

B 83-86%

C 73-76%

D 63-66%

F < 60%

A- 90-92%

B- 80-82%

C- 70-72%

D- 60-62%

## Support and Disability Services

At UAF, the Office of Disability Services (203 WHIT; 474-5655; TTY 474-1827; [fydso@uaf.edu](mailto: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 review           |                               | 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 |      |  |                               |                                       |
| 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          |                               |                                       |
|              |      | 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                    |                               |                                       |
|              |      | Future challenges and coastal management     |                               | Valiela Ch 14                         |
| 15           |      | Student Presentations                        |                               |                                       |
|              |      | Student Presentations                        |                               |                                       |
| 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 Academic 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.