

Environmental Science EES C18

The Great Lakes: An Introduction to Physical Limnology

North America is endowed with eight of the twelve largest fresh-water lakes in the world. The origin and geological history, the hydrodynamics and hydraulics, the temperature and chemical structure and the ecosystems of the North American Great Lakes will be used as examples of *large* lacustrine systems. Fundamental concepts in physical and biological limnology will be related to features found in the Great Lakes. Topics include: lake origins, lake classification, lake temperature structure and heat budgets, seasonal water circulations, Langmuir circulations, seiches, waves, currents and water levels, plankton ecology, food-web dynamics, exotic species invasions, eutrophication-related phenomena and water quality/fisheries management. Specific anthropogenic influences will be illustrated using case studies from the local environment, and students will be allowed to pursue their own interests through a series of short seminars.

Instructors: Mathew Wells **Office:** S410D

The course consists of: **(a)** a 2-hour lecture each week; **(b)** a 1-hour tutorial/practical class each week, where the assignments are given out and discussed; **(c)** student seminars; and **(c)** designated readings. Each lecture will be accompanied by either a handout or the lectures will be posted on the web.

Lectures: Tuesday 1300-1500 h **Tutorial/Practical/Seminar:** Tuesday 1600-1800 h

Room: SW 221 **Room:** SW 221

Course Grade:

Assignments (3)	35 %
Final Examination	35 %
Mid-Term Test	15 %
Report and presentation	15 %

Prerequisite: EESB03F **Recommended:** EESB02S

N.B. Students with diverse learning styles and needs are welcome in this course. In particular, if you have a disability/health consideration that may require accommodations, please feel free to approach me and/or the AccessAbility Services Office as soon as possible. The UTSC AccessAbility Services staff (located in S302) are available by appointment to assess specific needs, provide referrals and arrange appropriate accommodations (416) 287-7560 or ability@utsc.utoronto.ca. The sooner you let us know your needs the quicker we can assist you in achieving your learning goals in this course.

TENTATIVE COURSE OUTLINE

Week 1 – September 15

ORIENTATION

Course Outline; Lecture Schedule
Practical Schedule; Seminar Schedule

-Great Lakes in a global context
-Introduction to problems of eutrophication

Prof. Schlinders talk at U ofT St George

Week 2 – September 22

THERMAL STRUCTURE OF THE GREAT LAKES ; Assignment I

Thermal Layering & Lake Overturning
Thermocline Development
Thermal Classification of Lakes; Vertical Stability
Examples from the North American Great Lakes
Potential impacts of climate change

Week 3 - September 29

BASIN-WIDE CIRCULATIONS :

Dynamic Forcing of the Lakes
Coastal upwelling; Thermal bar revisited
Great Lakes Circulation

Week 4 - October 6

SURFACE WAVES IN GREAT LAKES Assignment II

Influence of waves on coastal lines
Wave shoaling; Wave breaking & decay; Wave boundary layers
Storm surge; Shoreface Circulation
Influence of fetch on lake dynamics

Week 5 – October 13

BOUNDARIES OF LAKES

The littoral zone
Importance of wetlands and estuaries
River plume dynamics

Week 6 – October 20

WATER AND TEMPERATURE BALANCES IN THE GREAT LAKES

Historical trends
Man made changes due to shipping canals
Changes due to climate

IN CLASS MIDTERM EXAMINATIONS

Week 7 –October 27

ECOLOGY OF THE GREAT LAKES I

Relationships among Nutrients, Water Clarity and Phytoplankton
Mitigating Eutrophication in Great Lakes
Relationship between physical forcing of a lake and the biological response

Week 8 – November 3rd

ECOLOGY OF THE GREAT LAKES II : Assignment III

Food-web Dynamics in Great Lakes
Stressors and Induced Ecological Changes
Invasive exotic Species: Definition and Mechanisms of Introduction
Water Quality/Fisheries Management in a Changing Environment

Week 9 – November 10

POLLUTANTS IN THE GREAT LAKES

Zones of creation of pollutants
Mechanisms of dispersal of pollutants
Bioaccumulation of pollutants

Week 10 – November 17 STUDENT SEMINARS

Week 11 – November 24 STUDENT SEMINARS

Week 12 – December 1 COURSE REVIEW

Last Day of Classes December 4, final examination between December 7 and 18.

UNIVERSITY of TORONTO at SCARBOROUGH

September 2009

Department of Physical & Environmental Sciences

ENVIRONMENTAL SCIENCE EES C18S
THE GREAT LAKES: A LACUSTRINE SYSTEM

READINGS

There is **no required text** for this course, since there is no book that covers all the course material, while several books cover much more material than is required. Thus, specific readings will be given out during each lecture and/or practical sessions; however, a number of texts cover the course material in part and there is one journal devoted specifically to research on large lakes of the world, but with a dominance of papers on North American Great Lakes research:

Journal of Great Lakes Research, International Association for Great Lakes Research.

<http://www.iaglr.org/jglr/journal.php>

This journal and the reference sources below will be used for course readings and as starting points for student seminars.

Books:

Kalff, J., 2002. *Limnology*, Prentice-Hall, NJ, 592 pp.

Wetzel, R.G., 2001. *Limnology: Lake and River Ecosystems*. Third Edition, Academic Press, NY.

The Open University, 1989. *Waves, Tides and Shallow-Water Processes*. Pergamon Press, Oxford, 187 pp.

An online copy is available at "Waves, tides, and shallow-water processes"

<http://simplelink.library.utoronto.ca/url.cfm/51808>

A related book that has some relevance to limnology is the book *Ocean circulation -*

<http://simplelink.library.utoronto.ca/url.cfm/51807>

A few Web Reference Sources:

<http://www.epa.gov/glnpo/atlas/> The Great lakes Atlas

<http://www.great-lakes.net/index.html> Great Lakes Information Network (GLIN)

<http://www.epa.gov/glnpo/index.html> U.S. Environmental Protection Agency (EPA)

<http://www.cciw.ca/nwri-e.html> Environment Canada, National Water Research Institute (NWRI)

<http://www.ilec.or.jp/database/index/idx-lakes.html> Basic Data on World Lakes

<http://www.eolss.net> Encyclopedia of Life Support Systems (EOLSS), Developed under the Auspices of the UNESCO, EOLSS Publishers, Oxford ,UK

<http://ri.ijc.org/> Great Lakes-St. Lawrence Research Inventory, The International Joint Commission's Council of Great Lakes Research Managers (CGLRM)

<http://www.glc.org/> Great Lakes Commission (GLC)

<http://www.ndbc.noaa.gov/index.shtml> National Oceanic and Atmospheric Administration's (NOAA) National Data Buoy Center

<http://www.crh.noaa.gov/ifps/ifps.php?site=dtx&config=marine> NOAA's National Weather Service, Weather Forecast Office

<http://coastwatch.glerl.noaa.gov/> NOAA Coastwatch, Great Lakes Node

<http://www.glerl.noaa.gov/> National Oceanic and Atmospheric Administration (NOAA) Great Lakes Environmental Research laboratory (GLERL)

<http://www.glerl.noaa.gov/res/Programs/ncrais/> National Oceanic and Atmospheric Administration (NOAA) National Center for Research on Aquatic Invasive Species

<http://www.glfc.org/home.php> Great Lakes Fisheries Commission (GLFC)

http://www.dfo-mpo.gc.ca/regions/central/pub/bayfield/02_e.htm Fisheries and Oceans Canada (DFO), Bayfield Institute - Great Lakes Research

<http://www.glsc.usgs.gov/> United States Geological Survey (USGS), Great lakes Science Center