

Geog 4400 Hydrology II Course overview

The title of this course is 'Hydrology II'. It could also be titled 'Applied Hydrology'. The course follows a logical water resources or flood modeling workflow from variable data inputs to GIS-based watershed and floodplain parameterisations to runoff hydrograph and inundation mapping. The objectives are to understand and be able to implement methods for time series hydrological data collection and GIS-based remote sensing and other spatial data preparations in support of hydrologic and hydraulic model simulations. The course has six evaluation components consisting of four extended lab-based project reports (20% each), a single 20 minute class presentation (15%), and an overall participation mark for contributions to class discussions (5%).

In the four practical components, students will learn, discuss & report on the basics of how to:

- i) design a hydrometric data collection and monitoring system for a watershed study and provide a logistical plan for the installation, calibration and download of the sensors (20% - Due February 5th);
- ii) Prepare terrain and landcover data within a GIS environment to set up a watershed and floodplain model for hydrologic and hydraulic analyses (20% - Due March 5th);
- iii) Set up and run model simulations over a study watershed to predict event-based hydrographs through time (20% - Due April 2nd);
- iv) Set up & run simulations of floodplain water levels & inundation extent (20% - Due April 28th)

Practical components iii and iv will build on the ArcGIS data preparation steps conducted in component ii. Case study areas and events within Alberta will be used as the basis for the practical projects. Datasets will be provided. The US Army Corps Hydrologic Engineering Center modeling tools will be discussed and demonstrated in class and will be used for the practical modeling exercises. Students can elect to work on all four project components as individuals or in teams of two. Team work is encouraged in this course, as it mimics the reality of how such projects are often conducted in the work place. Project scope and expectation will be scaled accordingly in consultation with Dr. Hopkinson.

The two interactive components of the course evaluation will address preparation, presentation and participation:

- v) Each student will give a 20 minute class presentation on an applied hydrology theme. A range of topics will be available at the start of the course, and students will choose theirs on a first come first served basis. The talks will start after reading week and will continue to the end of the semester (15%).
- vi) Following each 20 minute presentation, there will be a 10 minute class discussion period. Participation in these discussion periods as well as general lecture period interaction will also be evaluated (5%).

There will be no final examination in this applied course.

Geog 4400 supporting materials.

The course pack constitutes a selection of materials that compliment course lectures. Students are expected to follow lecture materials as well as identify their own sources.

Three of the chapters for this course pack are from the two titles below. The complete publications are available as E-books at the UL library:

- *Chang, H.B. and Hong, Y (eds). 2012. Multiscale hydrologic remote sensing. CRC Press.*
- *Johnson, L.E. 2009. GIS in Water resources Engineering. CRC Press*

The following books are a useful supplement to the course and will be on reserve at the library.

- *Maidment, D.R. (ed). 2002. Arc Hydro. ESRI Press*
- *Maidment, D.R. & Djokic, D. (eds). Hydrologic and Hydraulic modeling support. ESRI Press.*

The following books are also useful in providing the basics of hydrology and further relevant detail on GIS and hydrological modeling.

- *Dingman, L. 2008. Physical Hydrology. Prentice Hall.*
- *Shamsi, U.M. 2005. GIS applications for water wastewater & stormwater systems. CRC Press*
- *Vieux, B.E. 2004. Distributed Hydrologic modeling using GIS (2nd ed). Kluwer Academic.*

The following online materials will support the practical lab-based projects:

Campbell Scientific instrument and data logger manuals:

<http://www.campbellsci.ca/manuals>

Hydrologic Engineering Center software:

<http://www.hec.usace.army.mil/software/>

- *Hydrologic Modeling System (HEC-HMS) manual:*

http://www.hec.usace.army.mil/software/hec-hms/documentation/HEC-HMS_Users_Manual_3.5.pdf

- *Geospatial Hydrologic Modeling Extension (HEC-GeoHMS) manual*

http://www.hec.usace.army.mil/software/hec-geohms/documentation/HEC-GeoHMS_Users_Manual_10.1.pdf

- *River Analysis System (HEC-RAS) manual:*

http://www.hec.usace.army.mil/software/hec-ras/documentation/HEC-RAS_4.1_Users_Manual.pdf

- *GIS tools for support of HEC-RAS using ArcGIS (v9.3 is latest available manual)*

http://www.hec.usace.army.mil/software/hec-georas/documentation/HEC-GeoRAS_4.3_Users_Manual.pdf

- *FEMA flood insurance program (provides supporting context for flood modeling)*

<http://www.fema.gov/national-flood-insurance-program>

Data to support the practicals, will be provided. Software will be installed on GIS lab computers or can be downloaded for home use, as long as students have access to a copy of ArcGIS 10.1.

Proposed class schedule Spring 2014

Week # and Date	Topic / notes	Suggested readings
1. Jan 13, 15	Introduction to Hydro II The course content, requirements and evaluation criteria will be presented. List of student presentation topics <i>Introduce lab # 1</i>	Course pack: The ideal project
2. Jan 20, 22	Monitoring hydrometeorological variables; the inputs for hydrological models CR1000 data logging & instrumentation; water balance components	Course pack: Field hydrology data sections
3. Jan 27, 29	Data logging & instrumentation; energy balance components & eddy covariance calculations	Online instrument manuals: Campbell Scientific web site
4. Feb 03, 05	Remote sensing applications to water balance assessment & flood mapping Wed: Hand in lab # 1	Course pack: Remote Sensing data sections
5. Feb 10, 12	Remote sensing classification of watershed hydrological response units <i>Introduce lab # 2</i> -Presentation topic selection deadline-	Library Reserve: i) Arc Hydro ii) Hydrologic & Hydraulic modeling Course pack: GIS data prep
Feb 17	Reading week	A bit of everything ☺
6. Feb 24, 26	Hydrogeomatics; the use of lidar in support of hydrological research and modeling Intro to lidar data processing (Terrascan)	Library Reserve: iii) Arc Hydro iv) Hydrologic & Hydraulic Course pack: GIS data prep
7. Mar 03, 05	GIS watershed & energy balance modeling, issues of data source and scale Lidar processing automation (LASTools) Wed: Hand in lab # 2	Journal articles & handouts to support these topics will be circulated.
8. Mar 10, 12	Hydrological runoff modeling: lumped, distributed, conceptual, physical, empirical models with examples. <i>Introduce lab # 3</i>	Course pack: Modeling sections Online HEC manuals
9. Mar 17, 19	HEC HMS model components & interface	Course pack: Modeling sections Online HEC HMS manuals
10. Mar 24, 26	Hydrograph analysis: recession, frequency, separation	Journal articles & handouts will be circulated.
11. Mar 31, Apr 02	Climate & landuse changes on runoff and flood impacts Wed: Hand in lab # 3	Course pack: Modeling sections Journal articles & handouts will be circulated.

12. Apr 07, 09	Introduction to flood forecasting, prediction, risk assessment, FEMA flood insurance program <i>Introduce lab # 4</i>	Course pack: Modeling sections FEMA web site Online HEC RAS manuals
13. Apr 14, 16	HEC RAS model components & interface	Course pack: Modeling sections Online HEC RAS manuals
Apr 21	No classes/labs	
Apr 28	No classes/labs Mon: Hand in lab # 4	

Grading Policy:

All work will be marked as a percentage. Percentages will be accumulated according to the weighting scheme and final grades will be determined as follows:

A+	90 – 100 %	B+	77 - 79	C+	67 – 69	D+	57 – 59
A	85 – 89	B	73 - 76	C	63 – 66	D	50 – 56
A-	80 - 84	B-	70 - 72	C-	60 - 62	F	0 - 49

Weighting Scheme

Description	Value	Scope	Due Date
Lab reports	80 %	Four graded lab reports providing background context, analytical methods, results, discussions, conclusions and source references	1. February 5 th 2. March 5 th 3. April 2 nd 4. April 28 th
Class Attendance & Participation	5 %	Students are expected to contribute to class discussions	Entire semester
Oral presentation	15 %	20 minute class presentation plus discussion	After reading week TBD

Policy on Late Assignment and Academic Conduct

Assignments arriving after 4:30PM on the due date are late and will be penalized by 10% for each weekday they are late. Student Discipline Policy will be applied as described on pp. 80-83 of the 2013/2014 University Calendar and academic offences will be penalized accordingly.

Course Web Site: <http://scholar.ulethbridge.ca/hopkinson/classes/hydrology-ii>