Advanced Soil Physics: Spatial Modeling
CRSS 8610
Course Syllabus
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This course will cover current methods for scaling predictions of contaminant transport up to the watershed scale. There will not be a text but we will use journal articles and the proceedings of a 1997 conference on modeling nonpoint source pollution in the vadose (unsaturated) zone to guide discussions. We will discuss science, technology, and policy aspects of watershed-scale modeling. The emphasis will be on the role of soil physical processes.

Prerequisites are integral calculus (MATH 2210) and soil physics (CRSS 4600/6600), or an equivalent course in hydrology. This course does not include a lab. There will be three assignments that will require the use of the BASINS[3] software: a tutorial simulation, simulation of suspended sediment in the Etowah River watershed, and a project chosen by the student (including a short paper). The assignments will be designed to develop familiarity with the BASINS technology. A midterm will cover science and policy readings. There will be no final exam. The last assignment will be due the first day of exam week. Grades will be calculated as follows:

assignment one	10 %	assignment three	30 %
assignment two	25 %	midterm	35 %

All academic work must meet the standards contained in "A Culture of Honesty". All students are responsible to inform themselves about those standards before performing any academic work. The course syllabus is a general plan for the course; deviations announced to the class by the instructor may be necessary.

Course Outline

Scaling up: GIS based models
- Introduction -- Corwin et al. (1-20, 323-342)[3]
- Lumped vs. distributed model – article by Baveye and Boast (261-280)[3]

Introduction to BASINS 3.1
- General description[2]
- Tutorial on Pennsylvania watershed[2] – *Assignment 1*

Finding parameters for watershed models
- Calibration – article by Mulla and Addiscot (63-78)[3]
- Soil survey data – article by Ferguson and Hergert (79-92)[3]
- Incorporating spatial variability – article by Yost et al. (107-118)[3]
- STATSGO and NRCS Technical Note on database saturated hydraulic conductivity[1]
- Land use and land cover[6]

Regulatory background
- Science and policy – article by King and Corwin (309-322)[3]
- TMDL's – EPA document[14]
- Lake Allatoona TMDL – GA EPD document[5]

Soil Water Assessment Tool (SWAT)

AVSWAT-X

Tutorial on Sabine River – *Assignment 2 Part 1*

Modeling water flow with SWAT[10]

Making up precipitation files for SWAT

Calibrating for flow on Sabine River – *Assignment 2 Part 2*

Over parameterized models – article by Kirchner[7]

Midterm Exam

Etowah River modeling project for stream flow – *Assignment 3 Part 1*

Sediment transport

Linear and nonlinear models[4]

Stream channel processes – article by Simon and Rinaldi[13]

Modeling suspended sediment with SWAT[10]

Phosphorus transport

Modeling phosphorus with SWAT[10]

Improvements for modeling P – chapter by Radcliffe and Cabrera[12]

Modeling P loads to Lake Allatoona with SWAT – articles by Lin et al.[8, 9]

Etowah River modeling project for sediment and phosphorus – *Assignment 3 Part 2*

Automated calibration and model uncertainty[11, 15]

References

[1]Anonymous. 2004. Saturated hydraulic conductivity: Water movement concepts and class history. Soil Survey Technical Note No. 6. Natural Resource Conservation Sevice. Lincoln, NE.

[2]BASINS 3.1 Manual, U.S. EPA Office of Water. EPA-823-C-04-004, August, 2004.

[3]Corwin, D.L., Loague, K., and T.R. Ellsworth. 1999. Assessment of non-point source pollution in the vadose zone. AGU. Washington, DC.

[4]Dent, C.L., G.S. Cumming, and S.R. Carpenter. 2002. Multiple states in river and lake ecosystems. Phil. Trans. R. Sos. Lond. 357:635-645.

[5]GAEPD. 2004. Total maximum daily load evaluation for the Little River Embayment in the Coosa River Basin for chlorophyll *a*. Georgia Environmental Protection Division. Atlanta, GA.

[6]King, R.B. 2002. Land cover mapping principles: a return to interpretation fundamentals. Int. J. Remote Sensing. 23: 3525-3545.

[7]Kirchner, J.W. 2006. Getting the right answers for the right reasons: Linking measurements, analyses, and models to advance the science of hydrology. Water Res. Res. 42:W03S04.

[8]Lin, Z., D.E. Radcliffe, L.M. Risse, J. Romeis, and C.R. Jackson. Modeling phosphorus in the Lake Allatoona watershed using SWAT: I. Developing phosphorus parameter values. Submitted to J. Environ. Qual.

[9]Lin, Z., D.E. Radcliffe, L.M. Risse, J. Romeis, and C.R. Jackson. Modeling phosphorus in the Lake Allatoona watershed using SWAT: II. Effect of landuse change. Submitted to J. Environ. Qual.

[10]Neitsch et al. 2005. SWAT Theoretical documentation version 2005. Blackland Research Center. Temple, TX.

[11]Papenberger, F., and K.J. Beven. 2006. Ignorance is bliss: Or seven reasons not to use uncertainty analysis. Water Res. Res. 42: W05302.

[12]Radcliffe, D.E., and M.L. Cabrera. 2006. Suggestions to improve modeling of phosphorus. D.E. Radcliffe and M.L. Cabrera (ed.). Modeling phosphorus in the environment. CRC Press. Boca Raton, FL.

[13]Simon, A., and M. Rinaldi. 2006. Disturbance, stream incision, and channel evolution: The roles of excess transport capacity and boundary materials in controlling channel response. Geomorphology. 79 361-383.

[14]Total maximum daily load (TMDL) program (www.epa.gov/owow/tmdl/overviewfs.html)

[15]van Griensven, A. Draft report. Sensitivity, auto-calibration, uncertainty and model evaluation in SWAT2005