NM Tech Graduate Certificate in Hydrology - Distance Education Program

The Hydrology Program within the Department of Earth and Environmental Sciences at NM Tech offers a 15-Credit Graduate Certificate program in Hydrology. The hydrology faculty who offer distance education classes are listed below in Table 1.

Table 1. Distance Education Instructors:

Dan Cadol, PhD Colorado State University, 2010, **Interests:** Eco-hydrology and ecohydraulics, surface water hydrology

Andrew Luhmann, PhD University of Minnesota, 2011, **Interests:** karst hydrology, hydro-geochemistry

Mark Person, PhD Johns Hopkins University, **Interests:** numerical modeling, geothermal systems

Deqiang Mao, PhD University of Arizona **Interests:** groundwater geophysics, contaminant hydrology, well hydraulics

Jesus Gomez, PhD New Mexico Tech **Interests:** ground-water surface water interactions, flow and transport processes

Phil Miller, New Mexico Bureau of Geology and Mineral Resources, BSc. New Mexico Tech, **Interests:** Geographic Information Systems

You can interact with the faculty during the classes as they are taught (Fig. 1) or view lectures asynchronously using the CANVAS distance education software environment. Prospective students need access to a computer with a browser and a *high-speed* Internet connection in order to participate in lectures, handle assignments, conduct examinations and communicate with faculty, advisors and peers. The classes are accessed via NM Tech distance learning portal described below. We strongly recommend students to view the lectures in real time, if possible, so they can ask questions interactively. Distance

education students who are on professional travel may turn assignments in late but will be required to take the exam on the same day as regular students.

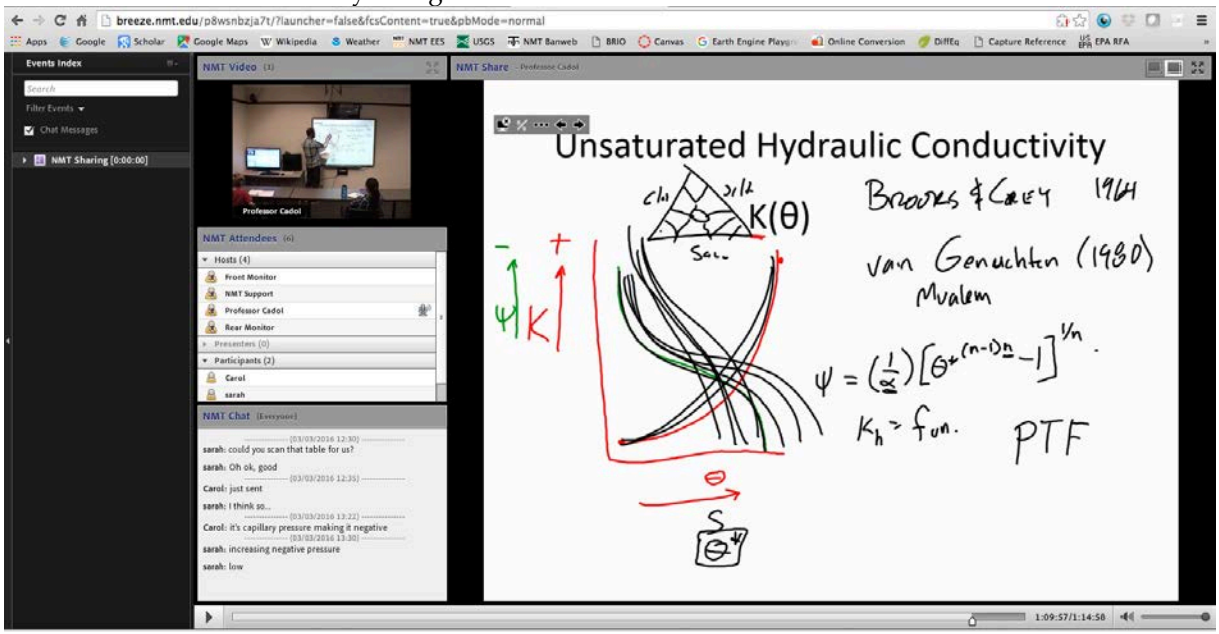


Figure 1. Example of on-line presentations. The instructor and class are seen in the upper left image. The lecture material being presented is shown in the large image in the upper right hand corner of the window. Distance education students can send text messages (lower left hand corner) to interact with the instructor.

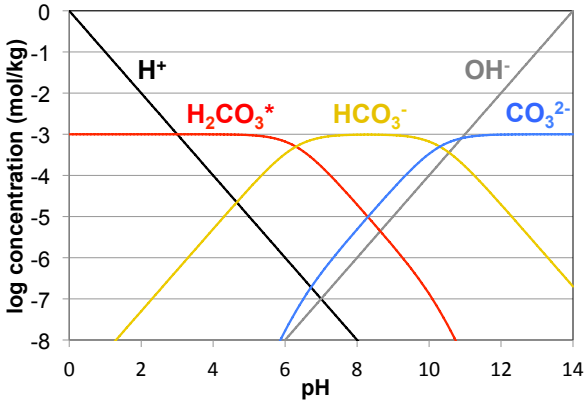
Overview of Online Certificate in Hydrology Program

Our 15-credit Graduate Certificate in Hydrology is intended to provide students with much of the course work that our MSc. students are required to take. On-line students will not be required to participate in laboratory and field components of distance education (DE) classes such as Erth 440. Students who complete the Certificate Program with a B average are eligible to apply this course work towards completion of an MSc. or Ph.D. degrees at NM Tech in Socorro. An MSc. Hydrology degree requires 30 credits and a research thesis. Students must maintain a B average (3.0 GPA) in order to receive a certificate. Courses completed with a grade below a C must be retaken.

All DE students are required to take **Erth 440**. To complete the 15-credit degree requirement, students may choose from the following list of courses: **Geol 512D, Geol 550D, Hyd 507D, Hyd 510, Hyd 511D, Hyd 513D, Hyd 514D, Hyd 543.** These courses are described below.

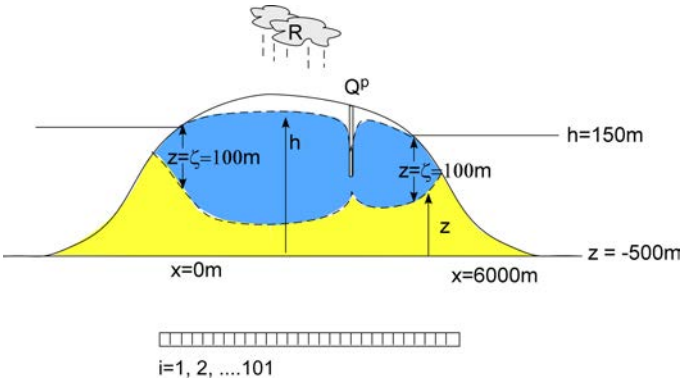
ERTH 440, Hydrological Theory and Field Methods, 4cr, 3 cl hrs, prerequisites: MATH 132, PHYS 132**, o**ffered fall semester**.** Fundamentals of hydrological flow and transport will be presented. Precipitation, runoff processes, and flood generation. Capillarity, unsaturated flow, and infiltration. Laws of flow in porous media, hydraulic storage, and flow to wells. Laboratory and field exercises that demonstrate and implement fundamental concepts of the hydrological cycle.

HYD 507D, Hydrogeochemistry, 3 cr, 3 cl hrs (Prerequisite: CHEM 122; Pre or Corequisite: ERTH 440), Offered fall semester. The thermodynamics and aqueous chemistry of natural waters, with emphasis on groundwater. Chemical equilibrium concepts, surface chemistry, redox reactions, and biochemistry. The interaction of water with the atmosphere and geologic materials. Basic concepts applied to problems of groundwater quality evolution, water use, and groundwater contamination. Shares lecture with ERTH 407, with additional expectations for graduate credit.



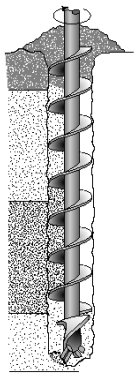
Distribution of aqueous species in the carbonate system with a total carbon concentration of 10^{-3} mol/kg.

HYD 510D, Quantitative Methods in Hydrology, 3 cr, 2 cl, hrs, 3 lab hrs, Prerequisite: MATH 231; Pre or Co-requisite ERTH 440. Offered fall semester. Introduction to the methods of mathematical physics used in hydrologic science. Presented in the context of mathematical models of water and energy balances, fluid flow, and heat & solute transport. Application to aquifers, the vadose zone, land-surface runoff, rivers, and the atmospheric boundary layer. Methods span advanced engineering calculus, including numerics and differential equations. Use of software (Matlab, Maple) or problem solving and solution presentation. Programming with Matlab.



Schematic diagram illustrating geometry of a non-linear, one-dimensional island aquifer groundwater flow model which includes recharge (R), water table elevation (h), the saltwater-freshwater interface position (ζ), and pumping well (Q_p). As part of Hyd 510, students will develop a finite difference sharp-interface of this system using Matlab ©.

HYD 511D, Groundwater Hydrology, 3 cr, 3 cl hrs, Prerequisite: ERTH 440, Offered alternate spring semesters. Study of the occurrence, movement, and chemical and isotopic composition of groundwater. Hydrogeologic properties. Groundwater recharge and stream/aquifer interaction, flow net and hydrograph analysis. Groundwater exploration using geologic and geophysical methods. Groundwater in different geological, climate, and physiographic regimes. Characterization of groundwater using stable isotopes and major ion analysis. Physics of flow to wells, steady- state and transient solutions to well hydraulics equations, image well theory, responses of aquifers to perturbations. Role of groundwater in contaminant migration and heat transfer. (Shares lecture with ERTH 411, with additional expectations for graduate credit)

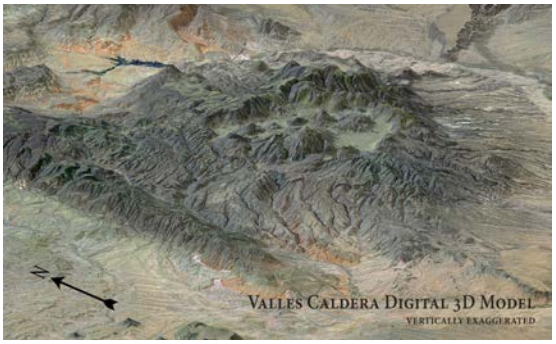


Well drilling using auger method.

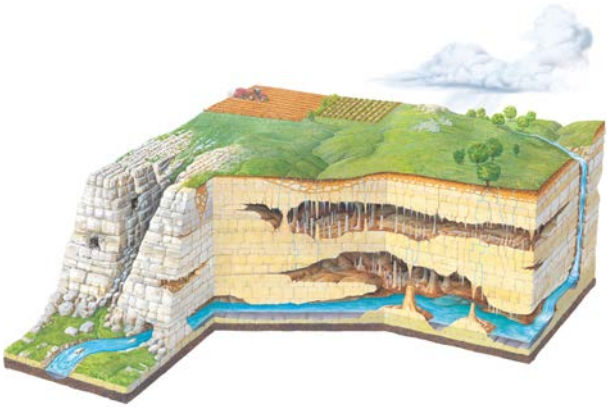
HYD 513D, Watershed Dynamics & Ecohydrology, 3 cr, 3 cl hrs , Prerequisite: ERTH 440, Offered alternate spring semesters. Processes governing hydrological flow rates and pathways through watershed systems: hillslope runoff production and in-channel flood routing. Emphasis on physical mechanisms and their treatment in models, as well as observations made in the field. Interactions between terrestrial plants and water, nutrients, and light resources in semiarid ecosystems and riparian zones. Vegetation induced flow roughness, ecohydrological processes and dynamics, and simple numerical models.

HYD 514D, Vadose Zone Hydrology, 3 cr, 3 cl hrs , Prerequisite: ERTH 440, Offered alternate fall semesters. Physics of unsaturated flow in porous media, multiphase flow, potentials and water retention, unsaturated hydraulic conductivity, transient flow problems. Mathematical modeling of variable-density flow. Analysis of slope stability, drainage through mine tailings and rock piles, hazardous waste migration, soil moisture controls on evapotranspiration and vegetation growth.

GEOL 512D, Introduction to Geographic Information Systems, 3 cr, 2 cl hrs, 3 lab hrs, Offered Spring semester. An introduction to the concepts of geographic information systems (GIS). Theoretical background to GIS; introduction to the nature and analysis of spatial data. ArcView and/or ArcGIS.

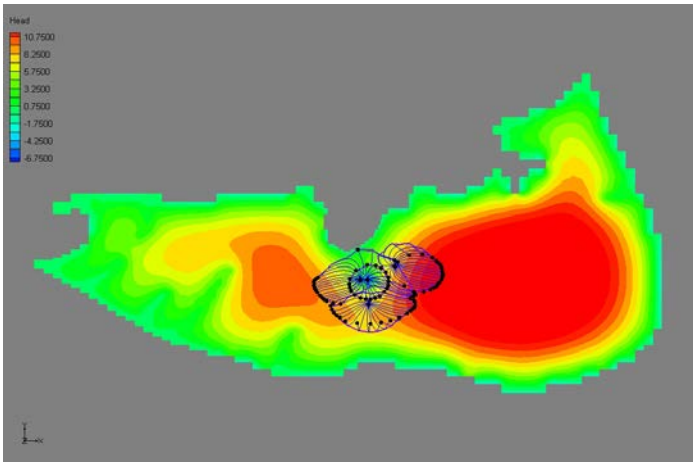


GEOL 550D, Cave and Karst Systems, 3 cr, 3 cl hrs, Prerequisites: CHEM 121 & 122; and either any 100 level ERTH or BIOL 111, Offered spring semester, every other year. A system-based study of caves and karstic terrains over time including formation mechanisms (speleogenesis), hydrology, geochemistry, mineralogy, and geomicrobiology. Emphasis on caves as interactive microcosms cross-cutting many disciplines. Shares lecture with ERTH 450, but is graded separately and additional graduate-level work is required.



from Lascu and Feinberg (2011, Quaternary Science Reviews)

HYD 547D, Hydrological Modeling, 3 cr, 3 cl hrs Prerequisites: ERTH 440, HYD 510 Analysis and synthesis of issues in hydrologic science. Related engineering problem solving. Conceptual modeling process: model conceptualization and parameterization, model diagnosis, testing and validation, and model prediction. Conceptual models for testing scientific hypotheses, assimilating data, developing policy, and solving engineering design and operational problems. Development of simple, two-dimensional groundwater flow models using Matlab. Applications to groundwater flow and contaminant transport problems using MODFLOW GMS software.



Simulated heads due to municipal well field pumping and wellhead delineation zone for Nantucket Island, Massachusetts using MODFLOW-GMS.

Online Program Information and Requirements
Online programs are open to applicants with a bachelors degree in any of the natural sciences or engineering disciplines (e.g. earth science, civil engineering, biology, chemistry). Students taking online classes should expect to take 18-24 months to complete the program.

New Mexico Tech Distance Education Program Department
NM Tech Distance Education Department utilizes the multimedia technology to stream live and recorded lectures to students wherever they are, requiring only that they have a computer with a broadband Internet connection. Questions related to access and use of the distance education program can be found online at:

http://act.nmt.edu/distance/

Or by contacting the Distance Education Department:

Student support:
Call toll-free 866-644-4887
Technical support and DE studio:
local: 575-835-6277
toll-free: 866-357-2779
robert.hepler@nmt.edu

Attending Courses on Line:
In order to login into the class portal and participate in a lecture, go to the following web site:

https://nmt.instructure.com/login/canvas

Applying to NM Tech Graduate Program

Please contact the Graduate Office (575-835-5513; graduate@nmt.edu) to learn how to apply to the NM Tech graduate program as a "Special Graduate" or a "Part Time" graduate student and to obtain a Student ID (a number starting with 900). The Special Graduate Student application processes is faster but eventually you'll need to be converted to a "Part Time" graduate student before receiving your certificate. You must be registered during the semester you receive your certificate. Graduate application forms can be found at the following link:

http://www.nmt.edu/grad-prospective/76-graduate-studies/graduate-studies/4192-graduate-applications

Once you are admitted, your 900 number will be sent to you via the US mail. Alternatively, you'll need to call the graduate office to obtain your 900 number if time is an issue. The graduate school number is 575-835-5513. Once you have your 900 number you can register for the distance learning classes you wish to take. Information and instructions for online registration can be found at the following link:

http://www.nmt.edu/registration-information

Navigating the Course Portal
Once you have created your account and paid for your class, you can proceed to the course portal.

http://act.nmt.edu/distance/

Questions not answered by this brochure can be directed to:

Mark Person, Professor of Hydrogeology, mark.person@nmt.edu,
575-835-6505 (office), 575-517-7578 (cell)