ES476 Hydrology Mid-Term Study Guide – Winter 2014 (updated Feb. 1)
Mid-term Exam Wednesday Feb.5

Study Tips

- complete all labs and worksheets before exam
- use study guide in combination with notes and online powerpoint slide shows
- go back through the in class / lab exercises, make sure you can work the math / units; review map skills
- spend a couple days studying, the exam will be short answer / essay and there is much material.
- don't wait until the last minute!
- carefully go through the notes, some of the material we briefly discussed, but did not spend much time on in class... but the notes will give you the detail.

Exam Procedures

(1) Midterm exam will be 100 points.
(2) Part 1 – Closed book, short answer/essay questions. See key-word/review recommendations below.
(3) Part 2 Open Book- lab-style quantitative questions,

Key Terms and Concepts

Introductory Notes

hydrology
spatial scale
temporal scale
mass
energy
flux
mass transfer functions
    evaporation
    condensation
    precipitation
    runoff
    infiltration
    transpiration
deterministic vs. stochastic processes
hydrologic cycle (sketch it)
convection
advection
groundwater
surface water
global water storage
residence time
compartments
    oceans
    groundwater
    lakes
    glaciers
    ice caps
    transpiration
    evapotranspiration
    runoff
    infiltration
    vegetative interception
    ice sheets
    oceans
    springs
    soil moisture
    atmospheric moisture
    fresh water storage

Global Water Budget Figures

-Sketch hydro cycle in detail
-understand global precip. distribution
-know the basic distribution of water resources
-why is there high runoff in PNW?

Water Chemistry

atoms
isotopes
oxygen isotopes
carbon isotopes
ion
cation
anion
complex ion
dissolved ions in water
molecules
compounds
mixtures
atomic forces
bonding forces
octet rule
stable-8 configuration
valence shell
electron shells
lewis dot model
atomic no.
atomic mass
no. protons
no. neutrons
no. electrons
ionic bonding
metallic bonding
covalent bonding
dot-model reactions
aqueous solutions
solute
solvent
saline solution
salinity

sheath of hydration
dissolution
concentration
mass percent
parts per thousand
parts per million
parts per billion
density
hydrogen bonds
polar covalent bonds
viscosity
weight density

Hydro - Physics Overview

Know how to define and quantify the following...
- mass
- length
- time
- temperature
- force
- angle (degrees)
- area
- volume
- insert worksheets
- delete worksheets

column widths
data sorting
date format
worksheets/workbooks
physical properties of water
- liquid / fluid
- heat capacity
- polar molecule
- solvent
- covalent bonds
- density-visosity-temp

Hydrometeorology

meteorology
weather
climate
temperature
humidity
precipitation
cloudiness
air pressure
water vapor
- velocity
- acceleration
- discharge
- pressure
- force
- energy/work
- power
- momentum
- mass density
- weight density
- viscosity

other physics concepts to consider:

heat
heat flow
heat capacity
volume expansion/contraction
density-driven rise / fall
"hot air balloon model"
heat transfer
- conduction
- convection
- radiation
- heat capacity
- latent heat

particulate matter
dust
condensating nucleii
altitude vs. temp variation
altitude vs. press. variation
Earth-Sun Relation
rotational axis
north pole
south pole
equator
axial tilt (23.5 deg.)
insolation
water vapor
precipitation
solid, liquid, gas
heat energy
evaporation
condensation
freezing
sublimation
humidity
specific humidity
relative humidity
phases
- solid
- liquid
- gas

states / phase changes
- condensation
- evaporation
- melting
- freezing

(consider these in terms of heat loss and heat gain)

conservation of:
- mass
- energy

newton's 2nd law
drainage network
channel network
channel tributaries
infiltration
runoff
channelized flow
overland flow

vapor saturation
saturation capacity
temperature vs. humidity
temperature vs. air volume
hot air balloon model
dew point
dew
fog
clouds
rain
condensating nucleii
cloud droplets
adiabatic heating
stable vs. unstable air
rising air mass
sinking air mass
forceful lifting
covergent lifting
orographic lifting
frontal wedging
air pressure
force / unit area = pressure
altitude vs. air pressure
millibar
pounds per sq. inch

barometer

Trenberth et al Reading 2007
Global Water Budget

P = precipitation
E = evapotranspiration
E – P
Hydrologic cycle
Reservoirs
Storage
Exchanges
Flux
Surface flow
Groundwater flow
Ocean-ice
Vapor transport
Permafrost
Soil moisture
Solar radiation
Latent heating
Soil moisture storage
Sea surface temperatures
Atmospheric moisture
Climate change
E-P = runoff
PRISM models
Climate models
Ice volumes
Cryosphere
Energy supply
Precipitation network

McDonnell 2013 Reading
Runoff Processes

Runoff
Overland flow
Storm flow
Hydrologic model
Subsurface stormflow
Hydrograph
Soil-bedrock interface
Perched groundwater
Transmissive zones
Percolation
Topography
Threshold process
Flowpath
Saturation connectivity
Hillslope hydrology
"fill and spill" process
Hydraulic conductivity
Macro-porosity
Water table
Transient conditions
Microtopography
Fill-and-spill depressions
Old water
Storage-discharge

Flood Climatology
Hirschboeck Reading, 1991

Flood causing weather
-convective thunderstorms
-tropical storms/hurricanes
-extratropical cyclones
-frontal systems
rapid snowmelt
runoff
antecedent soil moisture
snow cover

Air Uplift Mechanisms
-Thermal convection
-large-scale frontal convergence
-orographic lifting

Convectional Processes
-Thunderstorm Activity
-flashy, intense pppt
-Fla/ Gulf, highest occurrence

Mesoscale Convective Complex
-"MCC's" and MCS's
-huge, multiple celled, highly organized thunderstorm complexes

Tropical Cyclones
-largest atmospheric features
-convective processes
-tropical low press. systems
-sources: western N.Atlantic, Gulf, Caribbean
critical temps of sea-surface: >79 F

Large-Scale Atmospheric
-Convergence
-Extratropical Cyclones
-cyclone tracks as westerlies across U.S./Midwest
Orographic Lifting
Antecedent soil moisture
soil mosture content
-summer > ET, < flood potential, < soil moisture
-Snow Cover, Frozen Ground and Snowmelt
-Frozen ground = impervious surface; > flood potential
-spring rain on snow, + snow melt = flood

GO BACK OVER THE SLIDE SHOWS ON THE CLASS WEB SITE; MAKE SURE YOU UNDERSTAND THE PRINCIPLES ILLUSTRATED IN THE SLIDE IMAGES

Big Concept Ideas / Essay Question Possibilities

Can you sketch and discuss the hydrologic cycle? Including all the reservoirs, exchanges, fluxes and storage values?

What are the primary atmospheric processes that trigger precipitation events? Can you list, describe, and sketch the mechanisms?

What types of meteorological conditions lead to flooding in the Pacific Northwest? What about largest flood events in the U.S. as a whole?

Can you list the equations and discuss the difference between energy, force, pressure, and work?

Can you summarize the physical and chemical properties of water?

Why is water a good solvent? Sketch the water molecule.

How are density and buoyancy related to heat in the system?

Can you discuss the global distribution of water in reference to ocean, rivers, lakes, atmosphere, glaciers, etc.

Summarize the physical and chemical properties of water.

Summarize the units and equations for the following: work, pressure, force, acceleration, acceleration due to gravity, newtons, pascals, millibars, continuity equation, storage equation, newton's second law, density vs. weight density

What are the primary lifting mechanisms related to precipitation events.

What is the general circulation model of the Earth's atmosphere? What is the influence of the coriolis effect on the general circulation model.

Compare and contrast cyclones to anticyclones.

Lab Skills to Focus On for Mid-Term

Can you perform simple and complex unit conversions?

Do you understand dimensional analysis and unit algebra?

Do you know how to manage positive and negative exponents with respect to unit algebra?

Can you perform the following quantitative skills:

- plotting a graph
- re-arranging equations
- solving for unknown variables in an equation
- manipulating exponents and bases
- convert between metric and english systems of measurement
- calculate the equation for a line from a graph

calculate the slope of a line
write an equation if given a description of a quantitative problem
convert between degrees and radians when dealing with angular measurement
convert between mass and volume using density

Can you perform the following quantitative skills from the applied problems labs:

determine volumes of water in a reservoir
calculating rates of discharge, evaporation and input into a hydrologic system
converting between various measures of area, length, volume, and discharge
determine the total input and withdrawl from a simple hydrologic system (calcuating water budgets)
determine the discharge of runoff using weirr techniques
calculate the volume of lake water using the frustrum of a cone
solve the input-output conservation equation

Can you perform the following quantitative skills from the contouring exercises

draw contour lines on rainfall data (isohyets)?

- identify contour intervals and interpolate between data points
- Can you use the planimeter and cross-section paper to determine areas?
- Determine average precipitation using the arithmetic, thiessen, and isohyetal methods?
- Can you work with map scales?

Can you calculate solute concentrations in ppm, ppb? ppt?

Can you perform the basic water budget calculations associated with the Mono Lake Exercise

Lab and Class Exercises Covered by the Open Book Part of the Exam

Applied problems in hydrology
Introduction to quantitative methods in hydrology
Water budget calculations
Pressure calculations and conversions
Isohyet contouring / precipitation problems
Water in – water out book keeping problems