Re-Exam Ba Course GEO3-4304 Land Degradation
2 February 2010, 9-11hr BBL-276

Question 1
The factor of safety (F) is widely used in studies of mass movements and landslides. The basic formula of the factor of safety is a ratio between total shear strength of soil material and the amount of stress:

$$F = \frac{\sigma}{\tau}$$

a) At what values of F is a slope stable? At what values of F is a slope unstable?

b) What is the role of soil moisture in mass movements?

c) F is computed in detail by the following formula:

$$F = \frac{c + (\gamma_s z - \gamma_w h)\cos^2\theta \tan\varphi}{\gamma z \sin\theta \cos\theta}$$

Describe in your own words how this formula computes the factor of safety (F).
Describe what each of the symbols c γ_s z γ_w h θ φ mean.

d) Creep is a common slope process. What is creep? Can the factor of safety formula be applied to creep processes? Why or why not?

Question 2

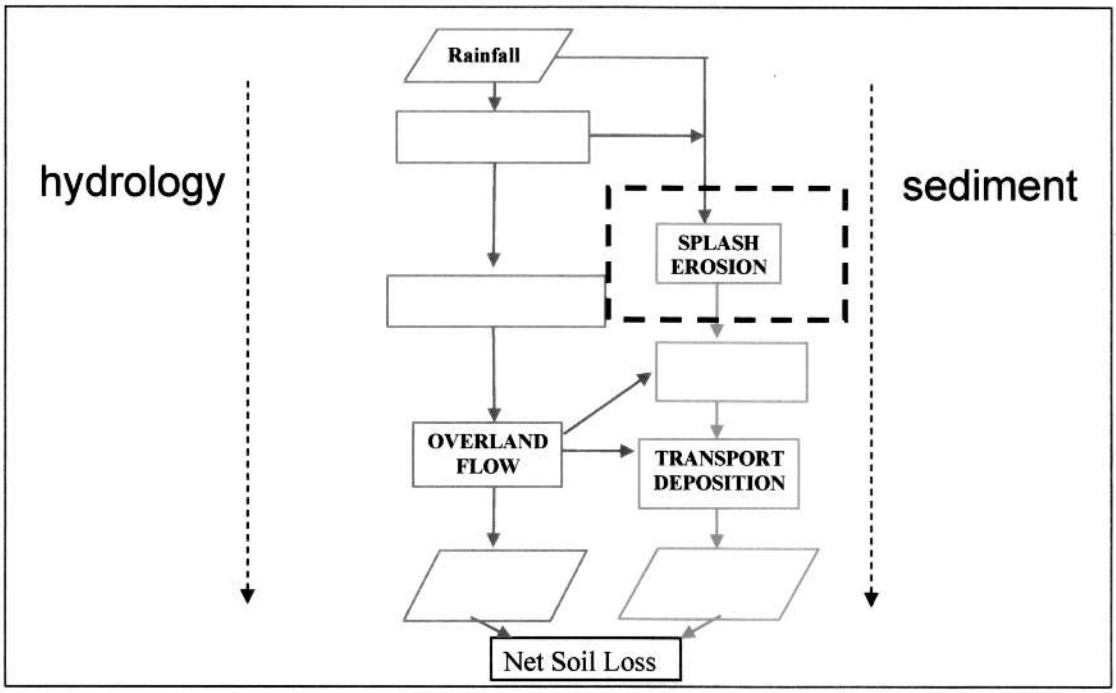
a) What is a pF or water retention curve of a soil? Draw an example of a retention curve for a normal soil, what is given by the x-axis and y-axis, what are the units? What is the significance of pF value 2.0 and 4.2?

b) What is soil water repellency and what are negative effects of soil water repellency?

c) Draw a soil water retention curve (pF-curve) for a repellent and for a normal wettable soil in one figure with labeled X and Y axes. Discuss the differences between the two curves and the causes of these differences.

Question 3:
The Morgan, Morgan and Finney (MMF) based soil erosion model was used during the computer exercises to simulate soil erosion in KwaZulu-Natal. It follows a modular approach to simulate the soil erosion process. It divides the erosion process in a water phase and a sediment phase.

3a. Fill in the empty boxes in the given flow diagram of the MMF model. Motivate your choices and describe the erosion related processes in the filled boxes;



3b. Soil erosion models should account for the distribution of rainfall over the year in relation to the seasonal vegetation cover protecting the soil against erosion. In the USLE erosion model this is done by computing a weighted cover & management factor C. Consider the table below for an area in southern Africa giving the distribution of rainfall and the cover & management factor C over the year. Compute the weighted C-factor for the given year and show how you did your computations.

Month	J	F	M	A	M	J	J	A	S	O	N	D	Total:
Rainfall (mm)	150	150	100	50	150	40	10	50	100	100	50	50	1000
Cover & Management factor C	0.01	0.01	0.01	0.1	0.9	0.7	0.3	0.3	0.1	0.1	0.1	0.1	2,73
Weighted C	1,5	1,5	1	5	135	28	3	15	10	10	5	5	18,96

1000/12 = 83,33

2,73/12 = 0,2275

3c. Given the information in question b and the weighted C-value you computed, what are the most vulnerable months for soil erosion? Why?

3d. Given the situations of question b and c, what kind of soil conservation measures would you recommend to the farmer in this situation? Motivate your answer.

Ingevulde antwoorden volgens my niet goed!

List of Equations Land Degradation Course GEO3-4304

1. $F = 0.001K(Ee^{-aA})^b$
2. $q = -k(\theta)\frac{\delta H}{\delta s}$
3. $Ro = R / Rn$
4. $KE = a + b\log(I)$ a=11.87; b=8.73. Kinetic energy
5. $G = 0.001CQ^d \sin(S)$
6. $SAVI = \frac{NIR - R}{NIR + R}(1 - L)$
7. $yl = \frac{Log(1-(1-g)\frac{R}{C})}{Log(g)} - 1$ years of resource left
8. $\cos(\theta) = \frac{\sigma_{sv} - \sigma_{sl}}{\sigma_{lv}}$ water repellancy
9. $\frac{F}{N} = \frac{W\sin(\alpha)}{W\cos(\alpha)} = \tan(\alpha)$ jets met mass movements
10. $\tau = \rho gRS$ shear stress
11. $V = \sqrt{(g/a)RS} = CR^{0.5}S^{0.5}$ Velocity
12. $V = \frac{R^{2/3}S^{1/2}}{n}$ Mannings equation (resistance
13. $NDVI = R\frac{NIR - R}{NIR + R}$ NDVI
14. $KE = KE_{\max}(1 - a\exp(-bI))$ Kinetic energy
15. $Ds = K_{i3} \cdot KE \cdot \exp(-bh)$ Splash detachment
16. $F = \frac{c + (\rho_s gH\cos(\theta) - \rho_w gW)\tan(\varphi)}{\rho_s gH\sin(\theta)}$ Factor of safety
17. $S_{\max} = 0.935 + 0.498LAI + 0.00575LAI^2$ Maximum water storage
18. $A = R \cdot K \cdot LS \cdot C \cdot P$ Universal Soil Loss equation