GEOL-412 Assignment 2

Please answer the following questions as succinctly as you can. Some questions can be answered from material presented in class, on the course website or in the text. Others may require a small amount of research. Full-sentence answers are not required. I don't mind if you work on these in groups, as long as your answers are in your own words. Please reference any sources of information that you use. The total number of points is 40, and this assignment counts for 10% of the final mark. Completed assignments are due by November 12th.

1) The April 10th 1815 eruption of Mt. Tambora in Indonesia was the largest volcanic eruption of the past 1000 years. Over 10,000 people were killed by the eruption itself, and at least another 60,000 were killed by indirect effects, including widespread crop failure and famine in Europe and North America. 1816 is known as "the year without a summer". The table below shows the sizes of the atmospheric reservoirs of H_2O, CO_2 and SO_2, along with the natural fluxes of these gases into and out of the atmosphere, and an estimate of the amount of material injected into the atmosphere during the Tambora eruption. In the context of these numbers explain why Tambora had such a dramatic cooling effect, and no apparent warming effect. (4 points)

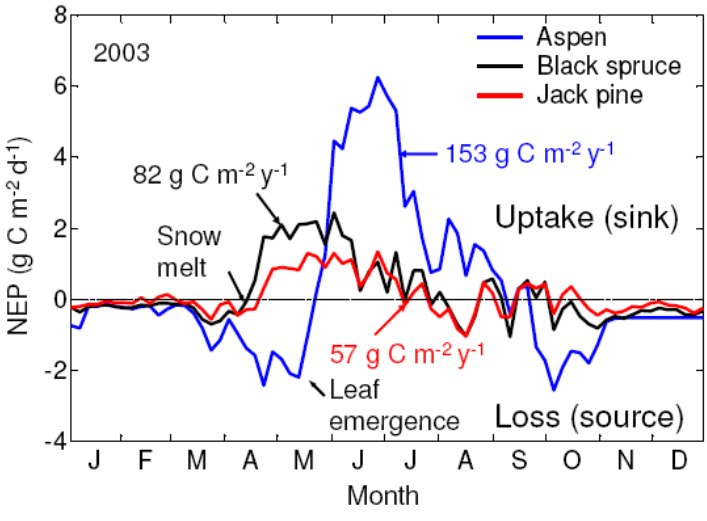
	H_2O	CO_2	SO_2
Atmospheric reservoir (Tg)	16,000,000	2,713,000	4.8
Natural atmos. flux (Tg/y)	650,000,000	820,000	100
Tambora (1815) Tg	3600	1200	120

2) Explain the mechanism by which continental uplift (following continental collision) can lead to cooling, and why would this be more effective in tropical regions than in temperate or polar regions. (4 points)

3) Apart from glacial deposits, many rock sequences formed around the time of the alleged "snowball earth" events include banded iron formations and cap carbonates. Explain how these features support the existing theory of snowball glaciation. (5 points)

4) According to Jeff Lewis it would take a CO_2 level of around 120,000 ppm to bring the earth out of a "snowball" event. Explain the proposed mechanism for achieving such a high CO_2 level, and also why this number is so high, considering that the current 380 ppm is enough to keep us largely ice free. (2 points)

5) This diagram is from David Gaumont-Guay's work in the Canadian boreal forest. NEP (net ecosystem productivity) is expressed as the amount of C either removed from the atmosphere (positive values) or emitted to the atmosphere (negative values) by the three



types of trees. Explain why the curve for Aspen is different than those for the two coniferous species. (6 points)

6) Complete the following table by explaining which aspects of eccentricity and precession can promote the onset of glaciation (3 points):

Obliquity	Glaciation is favoured at low obliquity (tilt) because low obliquity leads to low contrast between winters and summers, and cool summers are necessary for the snow that accumulates in winter to be maintained until the next winter.
Eccentricity	
Precession	

7) Milankovitch's 1940s theory about the orbital control of glaciations was widely rejected until the 1970s, partly because it was argued (correctly) that the insolation effects of the orbital variations were too weak by themselves to cause the observed climate changes. Identify <u>two</u> positive-feedback mechanisms that can amplify the orbital forcings, and describe how they work. (5 points)

8) Describe the mechanism of fractionation of ^{18}O as water vapour moves from the tropics towards the poles, and explain why the $\delta\,^{18}O$ levels of ice that accumulates in polar regions become more negative during prolonged cold periods. (4 points)

9) The earth's average temperature rose by several degrees during the Paleocene-Eocene Thermal Maximum, and stayed high for over 100,000 years. The high temperatures were associated with a strong negative carbon-isotope anomaly in both ocean and land sediments. Some climate scientists think that the PETM is a good analogue for what could happen to the climate over the next few thousand years. Explain how this could be the case. (7 points)