EXAMINATION GEO3-4304 QUATERNARY CLIMATE AND GLOBAL CHANGE

MONDAY 25 January 2016 17.00 – 20.00 EDUC ALFA

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Carefully read the questions. Provide complete but not overly lengthy answers.
You may answer in English or in Dutch with mixed-in English terminology.
This exam has 5 questions.

Q1 Definitions / vocabulary

Briefly explain the meaning of the underlined words in *4 out of the following 6* items:

a) Heinrich event
b) Climate sensitivity
c) Steric sea level change
d) Global warming potential
e) The difference between a GCM and EMIC
f) NAO

Q2 Ice cores

a) The Greenland (GRIP/GISP/N-GRIP/NEEM) and Antarctic (Vostok/EPICA) ice-core oxygen (resp. deuterium)-isotope records show major similar trends, reflecting glacial-interglacial changes, as well as climate fluctuations during a glacial. However, there are also some key differences between the Greenland versus Antarctic records, over a range of time scales. Describe typical differences and their causes for:
   - the record as a whole
   - climate fluctuations during the last glacial period
   - the transition from the LGM into the Holocene

b) Describe at least 3 methods that can be used to determine age-depth relationships in Greenland ice cores, and indicate the main limitations of each method.
c) How can we reconstruct variations in precipitation rate on the Greenland Ice sheet during the past glacial? Mention at least 2 methods.

Q3 Sea level change

Going from a glacial to an interglacial, relative sea level curves vary greatly across the globe due to several factors.

a) Describe at least four different processes that cause these differences in relative slr curves, and draw a schematic relative sea level change curve reflecting (combinations) the effects of these mechanisms. Indicate roughly the appropriate magnitudes and timing of these sea level variations in your figures. Explain you answer.
b) Suppose that global warming will continue in the coming centuries and causes the Greenland ice sheet to decay, resulting in a global average eustatic sea level rise of 7 m (assume Antarctica remains unaffected).
   - Draw the relative sea level curve for the Greenland coast for the coming 500 yrs and for the coming 10,000 yrs. Explain your graph.
   - Do the same for Australia.

Q4 Climate modeling of the past

A research team proposes to use a General Circulation Model (GCM) to reconstruct the changes in global climate pattern that occurred during the transition from the LGM into the Holocene. For such an experiment three categories of information are required: 1) climate forcing and radiation (question 4a relates to this); 2) description of the LGM geographical boundary conditions for the model (question 4b relates to this); 3) climate proxy data to verify the model results (question 4c relates to this).

a) Which forcings determined the global climate during this period, and how can the magnitude of each of these forcings be determined (and dated) for this period? Mention at least 3 different forcings.
b) Which geographical data that influence the global climate patterns are required to carry out the simulations, and how are these reconstructed (and dated) for the simulated period?
c) Which proxies for the climate during the investigated period might be used (and how are they dated) to evaluate the climate model results?

Q5 Future climate

Over the past years IPCC has presented 3 generations of emission scenarios: IS92, SRES and RCP.

a) Describe the main differences between and ideas behind these scenarios.

During the November-December 2015 climate conference in Paris a consensus has been achieved that we should aim at a maximally 2 degrees global warming by the end of the century.

b) Draw schematic graphs that show for the period 1750 – 2500 the trends of past and agreed '2 degrees stabilisation in 2100' for: Global T, GHG concentrations, GHG emissions, and global sea level. You do not need to give precise values along the vertical axis, but indicate the trends between 1750 until the year 2500. Give a brief explanation of the shape of the curves.