

**GEO 302c Climate: Past, Present and Future
Review Questions for Exam 3**

Note that Exam 3 will have 50 multi-choice questions. The contents to be tested are mainly from the book (see below for specific chapters) plus some additional materials that have been emphasized in class.

1. **Chapter 13 Key terms:** deglacial two-step, Younger Dryas, proglacial lakes
2. What is the best method of measuring the melting of ice sheets over the last 17,000 years?
3. Does the timing of ice sheet melting support the Milankovitch theory that orbital insolation controls the sizes of ice sheets?
4. Were changes in the intensity of summer monsoons in the last 17,000 years controlled by orbital insolation?
5. What evidence suggests that variations in orbital insolation were not the only cause of climate changes during the last 17,000 years?
6. Describe how proglacial lakes travel slowly across the landscape behind melting ice sheets.
7. Why were summer temperatures at high northern latitudes warmer 6000 years ago than they are today?
8. List evidence from ice, land, and water for a cooling in north polar regions since 6000 years ago.
9. How do long-melted ice sheets complicate attempts to measure modern changes in sea level?

Chapter 14

10. **Key terms:** millennial oscillations, Dansgaard-Oeschger cycles, Heinrich events, bedrock pinning points
11. What evidence of millennial oscillations do we find in Greenland ice cores?
12. How do the processes that control $\delta^{18}\text{O}$ changes measured in ice sheets differ from those measured in ocean cores?
13. Why is it difficult to correlate millennial oscillations in records from different regions?
14. Describe two kinds of evidence of millennial oscillations from North Atlantic sediments.
15. What other regions show millennial oscillations like those in the North Atlantic and Greenland?
16. What could explain the small size of millennial oscillations during the last 8000 years?
17. What is the evidence for and against millennial oscillations originating from processes internal to ice sheets?
18. What is the evidence that millennial oscillations originate from interactions between deep water and ice sheets?
19. How could ocean flow cause millennial oscillations to have opposite timing north and south of the equator?
20. Do millennial oscillations form true cycles?

21. Could changes in the Sun account for millennial oscillations?

Chapter 16

22. **Key terms:** Medieval Climatic Optimum, Little Ice Age, dendroclimatology, urban heat island, sunspot cycle, faculae, Maunder sunspot minimum

23. What evidence indicates a cooler climate in Europe and nearby regions during the Little Ice Age?

24. Why are climate changes during the last millennium difficult to detect?

25. What evidence from ice cores suggests that the warming during the 20th century reached levels unprecedented over the last 1000 years?

26. Why are the rings of environmentally stressed trees ideal for detecting climate signals?

27. How could rising CO₂ levels complicate interpretations of changes in tree rings?

Chapter 17

28. **Key terms:** radiosondes

29. What is the urban heat island effect? How does it complicate attempts to synthesize trends of regional, hemispheric, or global temperature change?

30. What other evidence supports the warming shown by surface-station measurements in the 20th century?

31. Name four kinds of satellite evidence that support a gradual warming of high northern latitudes in the last two decades.

32. What do satellites tell us about the strength of the Sun in the late 20th century?

33. Which year was the warmest year in the history of the instrumental records? Which year was the second warmest?

34. Describe major characteristics related to global warming in the past century.

35. How does warming of the ocean affect sea level?

Chapter 18

36. **Key terms:** ozone, chlorofluorocarbons (CFCs), ozone hole, sulfate aerosols, brown clouds, global dimming, greenhouse debate, enhanced greenhouse effect, 2×CO₂ sensitivity, Intergovernmental Panel on Climate Change (IPCC), equivalent CO₂, radiative forcing, preindustrial CO₂ level, anthropogenic CO₂ increase, CO₂ fertilization

37. In what way do sunspot cycles before the 20th century imply a Sun-climate connection?

38. Did volcanic eruptions and El Niño events affect the gradual trend of global temperature over the last century?

39. What are the main human activities that produce CO₂?

40. Where does the extra CO₂ produced by humans go?

41. What human activities produce methane?

42. How high in the atmosphere do sulfate aerosols from smokestacks reach?

43. Why do chlorofluorocarbons (CFCs) reach much higher in the atmosphere than sulfate aerosols?
44. Why is ozone depletion so distinct over Antarctica? Can ozone depletion exist in regions other than Antarctica?
45. When was the ozone hole first discovered? What is its size? Is it present all the year round or only in some months? What months?
46. Why do uncertainties about natural changes in climate make it difficult to detect the effects of greenhouse gases on temperature during the last century?
47. What relative fractions of the estimated 2.5°C warming for a doubling of CO₂ are caused by the radiative effects of greenhouse gases and by feedbacks within the climate system?
48. What are the strongest positive and negative feedbacks acting to amplify and suppress Earth's temperature response to rising levels of greenhouse gases?
49. How similar are estimates of the sensitivity of Earth's surface temperature to changes in CO₂ derived from climate models and those derived from climate history?
50. What factors complicate attempts to estimate Earth's sensitivity to CO₂ by directly comparing the observed 20th-century warming with the measured rise in CO₂ and other greenhouse gases?
51. What would happen to Earth's climate if humans abruptly stopped all emissions of gases and particles to the atmosphere?