

Questions for PG Lectures on “Carbon Cycle & Atmospheric Composition”

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- 1)** Write down and explain the key reactions in the global carbon cycle.
- 2)** What is the difference between gross and net fluxes of carbon? Give some examples of how net fluxes change if they are integrated over different timescales.
- 3)** What is the definition of the airborne fraction and what is its value? In one future scenario, CO₂ emissions will increase to 20 PgC/yr by 2050. What would the atmospheric growth rate of CO₂ be in 2050 if the airborne fraction remained constant? What are some potential changes to ocean and terrestrial biosphere processes that could cause the airborne fraction to increase?
- 4)** Imagine the world without the Montreal Protocol (i.e. no regulation of CFCs that deplete stratospheric ozone). Think of as many implications as possible for composition and climate. What would have been different?
- 5)** The subtropics are dry and sunny regions of the globe, where high pressures, downward motion, low-level divergence, and slow surface winds prevail (e.g. the Sahara). The northern hemisphere subtropical regions are expected to expand northward under future climate change as a result of continuous increases in WMGHGs. How do you expect this change in climatic conditions to affect the neighbouring mid-latitude regions (e.g. the Mediterranean) when it comes to tropospheric ozone pollution, in a scenario where anthropogenic ozone precursor emissions remain constant? Also, how does this change in composition then feed back to climate?
- 6)** Black carbon particles absorb shortwave radiation but are fairly transparent in the thermal infrared. They can either exert a warming or a cooling effect on the Earth's surface depending on the altitude of the black carbon layer and the surface albedo. Can you explain why?
- 7)** Name and explain as many characteristics of atmospheric ozone as you can that set it apart from other trace gases such as carbon dioxide.