

Ocean Circulation

importance of ocean circulation; characteristic timescales involved; driving forces of ocean circulation; marine biological pump: what is it, how does it work, why is it important; surface currents; how to make surface gyres; interactions atmosphere with oceans - surface winds, where do wind driven gyres occur; influence of Coriolis effect; Ekman transport; geostrophic flow; good explanation of what gets these gyres started and what keeps them going; how to measure ocean surface elevation, how does it relate to ocean surface temperature?; location of convergence zones, upwelling zones, effect of upwelling zones on nutrient status, economy; deep ocean circulation: T-profile of oceans, density profile of oceans, what affects density; why does density vary in this specific way?; Rough composition of sea water, salinity, areas of high-low salinity, variation of density, salinity, temperature with depth, through Atlantic Ocean; NADW, how does it form, where does it form, effects on ocean circulation, climate...; read paper on climatic flip-flop, make sure you understand it, general sketch of deep ocean circulation, effects of ocean circulation on climate.

Short Term Climate Change

Influence of surface winds on oceanic surface circulation, how does El Nino get started, how does it influence climate of tropical Pacific, W Pacific warm pool, where does it rain in El Nino year, where does it rain during La Nina - why? thermocline of equatorial Pacific during ENSO cycle, how to reconstruct ENSO cycle? Southern Oscillation Index, timescales involved? ENSO prediction? global effects of ENSO; Solar cycles, how to reconstruct (sunspots), how much does insolation vary during cycle?, effects on climate? historical records? timescales involved? Volcanoes, how do they affect climate, for how long, how important are they?

Carbon Cycle

Role of C on planet, why important, carbon reservoirs, how are these reservoirs connected, approximate size of reservoirs and residence time in reservoirs, atmospheric CO₂ concentrations, Keeling curve, explain general trend and details, feedback on atm. CO₂: photosynthetic feedback, effects of global warming on biosphere and photosynthetic rates (2 scenarios), oceanic carbon sinks, how is C stored in oceans, how long does it stay there? solubility of CO₂ in water, effects of carbonate weathering and deposition on atmospheric CO₂, effects of silicate weathering on atm. CO₂, long-term CO₂ controls, carbonate formation in oceans, how does it work, why are Bahamas a region of active carbonate formation, yet no CO₂ source? Oceanic CO₂ profile, what causes it, how does it affect carbonate solubility in oceans (carbonate compensation depth), carbon in soils and organic sediment, long-term burial, carbon sequestration + addtl. reading!

Climate Regulation

Gaja hypothesis revisited, early atmosphere, faint young sun problem, how to solve?, evidence for water on Earth, evidence for oxygenated atmosphere, early ways of keeping temperatures high, role of geothermal heat, albedo, greenhouse, early greenhouse gasses, long term control on greenhouse gasses, composition of early-modern atmosphere (approximate), snowball earth, how

does it form, how do you get out of it?

Climate Predictions

how did the climate change over last 1000 years (numbers!), how do climate predictions compare with each other (numbers!), types of climate models, GCM's approach, problems, results? simpler energy balance models: advantages - disadvantages, results? natural forcings on climate, human forcings, level of scientific understanding of these forcings, other effects of global warming,

Pleistocene Glaciations

How do we know? How many, how long do they take, frequency of glacial-interglacial cycles, driving forces (Milankovitch - feedbacks), high resolution records, rapid climate change, details of signal at various timescales, how to explain asymmetry of temp. change?, how to explain change in frequency, role of CO₂, albedo, NADW, ... Heinrich layers, effects of ice sheet dynamics, feedbacks that control CO₂ during glacial - interglacial cycle, role of gas-hydrates, what are they, where are they stable/unstable, how abundant.

Early evidence of glaciations, role of stable isotopes, SPECMAP curve, how to start glaciations, critical areas on Earth, what is necessary to build ice sheet, ice-albedo feedback, where - when?

Ozone

whatever we cover on Tuesday in class.