SIO115 Winter Quarter 2015 Study Guide

Also see definitions in the glossary on the class webpage. You are expected to know all of these definitions.

1. General cryosphere
Components of the cryosphere; importance of cryosphere to climate; ice-albedo feedback why is cryosphere sensitive to change? response timescales for cryospheric components; albedos of typical cryosphere components.

2. Ice ages and ice cores
Milankovitch theory for what causes ice ages; oxygen isotopes as a proxy for temperature; how ice cores store record of past climates; how do we date layers in ice cores? Methane sources. Ice albedo feedback; Greenhouse feedback; Bipolar see-saw.

3. Snow cover; Lake and River ice
Importance of snow cover; snow water equivalent; monitoring of snow cover
Types of Lake ice; changes in freeze-up and break-up dates

3. Permafrost
What is permafrost? Types of permafrost; what happens as permafrost thaws? What are the following and how are they formed: ice wedges/yedoma/thermokast/talik
Importance of permafrost to climate (feedback loop); Active layer; features of a "trumpet" plot (T-D profiles for permafrost); impacts of thawing permafrost; permafrost monitoring.

4. Sea-ice
What is sea-ice? How does it form? How is it different to land-ice? Multi-year ice. What is effect of sea-ice on climate. Albedo of sea-ice. Dimensions of sea-ice floe (vertical and horizontal). What is a lead? Sea-ice concentration; Monitoring sea-ice extent and thickness. General trends in Arctic and Antarctic sea-ice extent. Impacts of changing sea-ice extent in Arctic.

5. Land ice – Glaciers and ice sheets
What is land-ice and how does it form? What are the following: Ice cap, glacier, tidewater glacier, alpine glacier, ice shelf, ice sheet, ice stream, snow, firn.
Contribution of glaciers and ice sheets to current sea-level rise. Important of GIC to climate and society. How is a glacier formed? Glacier mass balance/budget terms (gains and losses); Transformation of snow to ice. Zones on a glacier. Equilibrium line, AAR, hypsometry. Measurement of mass balance in field; measurement of mass balance by satellite (three methods). Grounding line (what is it and why is it important); tidal response of ice shelf; circulation in the ice shelf cavity (modes of basal melting, refreezing); iceberg calving.

6. Land Ice – Surface melting

PDD, sources of energy for snowpack (slide 8, skip the next few); latent heat; Greenland supraglacial lakes – what are they, how do they form, where do they form, how do they change throughout the melt season? Antarctica – where does melt occur and why? Limit of ice shelf viability, Larsen-B collapse theory.

7. Land Ice – Glacier and ice sheet dynamics

Polar vs temperate glaciers; stress/strain; elastic; plastic, viscous and viscoelastic materials. Ice structure & deformation (creep); Glen's flow law; glacier movement (slides 21&22 Week 7 Lecture 1); glacier force balance; ice sheet flow – types of bed (stiff vs soft); velocity profiles across and through glacier.

8. Land Ice – Glacier dynamics & subglacial hydrology

Regelation & creep methods of sliding; factors affecting glacier flow; measurement of glacier flow; balance velocity; components of the glacier hydrology system; how water affects ice flow; R-channels; distributed system; Greenland supraglacial lakes & moulins; Antarctic subglacial water system – subglacial lakes, why they exist, how they are detected; active vs passive lakes; how the water exchanges from one active lake to another & how that is detected; surging glaciers (two phases); triggers for surge; what is observed during a surge?

9. Ice sheet changes and the IPCC

Major ice sheet changes (which parts are changing most & why); Antarctic Peninsula and Amundsen Sea changes; What is the IPCC?; range of AR4 projections for SLR from ice sheets and glaciers; what was AR4 missing?