AdOc2013 Spring 2013 Lecturer: Chris Jenkins

Mid Term Study Guide
Ocean Temperature, Layering, Surface Dynamics

Dateline: 1306h, 15 Mar 2013

Please familiarize with the content of Garrison "Oceanography: An Invitation to Marine Science" especially the parts listed below. Also with the listed parts of Colling "Ocean Circulation" both books are in the library.

For the points below, you should view the lecture PPT's with your lecture jottings and the chalkboards, and strengthen them with books, the web, discussions, etc. This study guide is a checklist, not a source of understanding of the topics.

Lecture - 1 Feb 2013: Seawater Temperature *Garrison §6.1-6.6 Collings++ §1.1, §2.1-2.3*

slide 1 - albedo (what materials, degrees ?);
slide 2 – know major pathways for radiation and some salient figures on % of incoming and outgoing; also understand briefly the processes involved with each vector (see Garrison ##);
slide 3 – understand that visible has much greater admittance than infrared and ultraviolet; what are their wavelengths ? (in nanometres);
Slide 4 – understand why less heat input into polar areas; by how much ?;
slide 5 – understand why there are seasons and the vocabulary; slide 6 – does everywhere get same sunshine in a year ?;
slide 6 – LOOK at these pictures, look for patterns and anomalies; what is the long radiation ?;
slide 7 – the idea of convection / heat engine;
slide 8 – what causes low & high pressure weather systems ?; this is important;
slide 9 – seeing a weather map; the twist from coriolis; wind directions; slide 10 – water vapor; what are temperature effects on capacity of air to hold it ? ;
slide 11 – heat gain/loss belts; where is the change ? ;
slide 12 – geographic and z-section of the convections;
slide 13 – (vocab) heat, temperature, kinetic energy, adiabatic, sensible heat, latent heat;
slide 14 – understand the triple point of water; heat capacity; hydrogen bonds;
slide 15 – what happens with heat energy with ice->water, water->vapor and reverse; know some values;
slide 16 – sublimation, fractional melting, evaporation;
slides 17,18 – how does sea ice form ? what types ? ;
slide 19 – polynas – what are they ? ;
slide 20 – thick winter ice, what does it do ? ;
slide 21 – (vocab) pycnocline, thermocline, halocline; how do the equatorial and polar seawater temp profiles differ ? ; and why ? ;

slide 22 – be able now to explain the major sea surface tem features (El Nino, warm pool, polar areas, Gulf Stream Peru Current, red sea hot, etc);
slide 23 – day/night ocean/land temperature change; why; heat capacities; LOOK at the map;
slide 24 – ocean climate belts; (vocab) Tropics of Cancer & Capricorn;
slide 25 – summary; worth digesting.

Lecture - 1 Feb 2013: Coordinates, The Big Picture, Coriolis effect *Garrison Box2.1, ApxIV; Collings++ §1.1*

slide 1 – general setup; great & small circles; the angles; prime meridian
slide 2 – (vocab) KNOW these terms !
slide 3 – the seasons – know how they work; tropics Cancer & Capricorn
slides 3,4 – what is a sextant, what did it do ?
slides 5,6 – longitude and time zones, the Harrison's story (*Garrison pp 49-50*)
slide 7 – the analemma – WHY ?
slide 8 – the Water Cycle – KNOW the main vectors, statistics
slide 9 – Global wave patterns – WHERE is it stormiest, calmest ?
slide 10 – geography of the major currents as drawn pre-satellite; KNOW the major currents
slide 11 – S-N cross section of the Atlantic Ocean; the Ocean is layered ! ?WHERE Main depths of changes ?
slides 12,13 – some operational difficulties for working in the ocean; BE able to list some
slides 14,15 – KNOW what is the cause, BE able to predict directions of deviation
slide 15 – Formulation for f, the Coriolis Parameter ($2\Omega \sin\phi * V$) ; KNOW and know how to apply it; *Garrison pp234-236 and Collings pp12-13*

Lecture - 11 Feb 2013: Salinity and Instrumentation *Garrison §7.2*

Slide 1 - instrumentation; CTD modules;
slide 2 - conductivity and temperature (thermistor) devices WHY use ?;
slide 3 - profilers like SeaSoar – WHAT is their advantage ?
slides 4, 5,6 - Nansen and Niskin bottles; HOW do they work ? WHAT do they do ?; inverting thermometers with them WHY ?
slide 7 – salinity – WHAT is it ?; (Vocab) chlorinity, conductivity, evaporation
slide 8 – the main elements/ions/solutes in salinity
slide 9 – the salinity cycle : KNOW main vectors, some statistics
slide 10, 12 – the concept of Residence Time; WHAT are the units ?, formula; work an example !
slide 11 - the law of constant proportions; WHAT does it say ?
slide 13 – the practical salinity scale ; WHY was it invented ? *Garrison p215*
slide 14 – some axamples of the salinities on Earth and in everyday life
slide 15 – rejected brine in freezing HOW's that work ?
slide 16 – processes that alter salinity
slides 17,18,19 – the geography of salinity – latitude bands; memorize some values, locations of extremes

slides 20,21 – salinity layering in the ocean; the halocline; polar and tropical profiles – WHY ?
slides 22,23 – summary WORTH reading !

Lecture - 15 Feb 2013: Surface Ocean Currents *Garrison §9.1-9.4 (p278) Collings §3*

Slides 1,2 – (title)
slides 3,4,5,6 – Instrumentation for current measurement; mechanical meters, string deployments; trackers; acoustic release, buoyancy, trawl-proof methods; *Collings §4.3.4-4.3.6*
slides 7,8 – acoustic doppler current profiler ; *Collings §4.3.7*
slide 9 – fine structure turbulence methods
slide 10 – modeling; grid setup; Eulerian / Lagrangian Methods; SEE chalkboard for the steps involved in modeling
slides 11,12 – Ekman spiral and Ekman transport *Collings §3.1.2*
slides 13,14 – wind-driven gyres; geostrophic balance; NorthAtlantic gyre setup; pycnocline; barotropic and baroclinic, dynamic height,
slide 15 - Upwelling and downwelling; convergences and divergences
slide 16,17 – coastal upwelling and downwelling; wind / coast combinations; other forms of upwelling due to topography; Collings §4.4
slide 18 – revision
slides 19,20 – Antarctic circumpolar circulation (ACC); WORK through the chain of thinking from winds to Ekman transports, to current flows to convergences and divergences; USE the map and cross section; note that there is an oscillation in the ACC
slide 21 – Arctic Ocean circulation; complex, the gyre and Transpolar Current; reversability

Lecture - 15 Feb 2013: Extra on Currents *Garrison §9.1-9.4 (p278) Collings §3*

Slide 1 – title
Slide 2 – an important mission: Aquarius and new technology of salinity measurement [URL: "http://aquarius.nasa.gov/techops.html"]
Slide 3 – Coriolis effect revisited
Slide 4 – Rossby number ; formula ; HOW to use it
Slide 5,6 – The atmosphere; named wind patterns, especially the Trade Winds; the Troposphere *Garrison §8.2*
Slides 7,8 – Land-sea heating effects *Garrison Fig8.20;* the Marine Layer (California);
Slide 9 – atmospheric water vapor – and a puzzle

Lecture - 1 Mar 2013: Circulations and Vorticity *Collings §4 ; Garrison §9*

Slide 1 – Title
Slide 2 – primary and secondary forces
Slide 3 – Coriolis effect revision
Slide 4 – (Vocab) isobaric, isopycnic, baroclinic and barotropic; (coordinates) WHAT we will use
Slides 5,6 – Angular momentum, definition of vorticity; their basic formulae (see also the chalkboard); Curl operator – HOW's it work ?; the handedness of vorticity (+ve, -ve) ; planetary and relative vorticity (definitions); HOW can vorticity be 'added' to currents ?

Slide 7 – Vorticity is the cause of Western Intensification; UNDERSTAND the development of ideas on the North Atlantic Circulation; the Ekman-Sverdrup-Stommel sequence; *Collings §4.2.2*

Lecture - 8 Mar 2013: Equatorial Circulations and the ENSO *Collings §5.1, 5.3 , 5.4; Garrison §9*

Slide 1 – Title

Slide 2 - The pacific ocean currents (revision)

Slide 3 – THIS is a major slide !; trade winds; S Hemi Trade Winds cross the rotational equator; Coriolis sign effects there; divergence; N Hemi Trade Winds; westward transport of warm surface water by South and North Equatorial Currents ; warm pool; dynamic height released eastwards under the doldrums; Equatorial Counter-current; WHY is this system inconstant ?

Slide 4 – a deeper section; SEE how complex the circulation system is; but note flow volumes

Slides 5,6 – Kelvin Waves; Coriolis effect waves; large, slow; equatorial and coastal types; BE able to describe how each operates; *Collings §5.3*

Slide 7 - El Nino; (vocab) ENSO, La Nina; WHAT causes this instability ?; Walker cell, trade winds; *Collings §5.4 ; Garrison §9.5*

Slides 8,9,10,11 – three phases: normal, el Nino, la Nina; HOW important is the W-E thermocline slope ? Weather effects over Peru and Indonesia

Slide 12 – the Southern Oscillation index; WHAT is it ? ; changes of ITCZ during ENSO cycles

Slide 13 – ENSO periodicity; SOME stats; when were the 2 major El Nino events ?

Slide 14,15,16,17 – impacts on sea surface temperatures, US snowfall, other teleconnections