Lecture #1 Instructor Notes

First off, welcome. I hope that these notes are interesting and helpful to you. Also, please note that there is a set of "Comments" on each lecture, that go along with the readings and the Instructor's Notes here.

Let us start with the first question you should always ask in a course…..

Q: Why Bother?!?!

A: The scientific, engineering and societal applications listed below…..

1) NAVY (and many are dual-use with civilian)
   a) ASW (from low to medium frequency or LF,MF)
   b) Minehunting (MF)
   c) Acomms (LF and MF)
   d) Obstacle avoidance (MF; started by Titanic)
   e) Bathymetry (MF; don't run ship aground)
2) Ocean Science (Phys Oceano)
   a) ADCP and ACM current profiles
   b) Backscatter imaging for bubbles, turbulence, suspended sediment, hydrothermal plumes
   c) Acoustic thermometry and tomography
3) Ocean Science (Geology and Geophys)
   a) Near surface stratigraphy (MF)
   b) Seismic profiling (LF)
   c) Multibeam bottom mapping (MF)
   d) Interface wave studies (LF)
4) Ocean Science (Biology)
   a) Whale and marmam tracking and behavior (LF,MF)
   b) Fish school and shoal studies (LF,MF)
   c) Phytoplankton and zooplankton abundances (MF, HF)
5) Commercial uses
   a) Fish finders (MF)
   b) Whale watch listening (LF,MF)

c) Oil and gas exploration (LF,MF)

There are plenty of more "killer apps" for sound in the sea, but these give a representative flavor.

In starting the technical end of an ocean acoustics course, one needs to begin with the most fundamental quantity, the soundspeed in the ocean and the seabed. The soundspeed in the water comes from an equation of state relating the soundspeed to temperature T, salinity S, and depth z. In a very simplified form, the soundspeed as a function of depth z (its main dependence) is

$$c(z) = 1449.2 + 4.6T + 1.34(S - 35) + 0.017z + H.O.$$

This is the first equation in the Computational Ocean Acoustics book, and shows that the soundspeed is very sensitive to temperature, weakly sensitive to salinity, and moderately (and linearly) sensitive to depth. The figures in the text just following this equation rather clearly show how this works, with emphasis on mid-latitude and high latitude soundspeed profiles.. The equation of state for soundspeed in the ocean bottom is considerably more complicated, with very different physics determining the soundspeed in sands, muds, silts, rocks, etc. The next few figures following this equation in COA show how the soundspeed field is far more complicated (i.e. has 3 spatial dimensions and time dependent) than our trivial form above. This complication reflects the more detailed physical oceanography and geology.

As a first lecture is always a brief "getting to know you" affair, the notes here are brief. On to Lecture #2.