AATM 529 – Air Sea Interactions

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Homework 9

Problem 1

1. Summarize the reading in 5 sentences.
2. List 5 things you found interesting.
3. List 5 questions you have about this topic.

Solution.

1. Studies of the mixed layer over the ocean, such as the S. S. Scotia and the Wyman-Woodcock Expedition, accelerated understanding of the boundary layer, since ocean surface temperature varies slowly diurnally and spatially. Businger (1954) introduced a simple slab model of the mixed layer that discovered that (1) mixed layer recovery depends on initial saturation deficit, (2) strong stability inhibits mixed layer growth, (3) light winds cause more protracted recovery, and (4) varying the entrainment parameter only has a one-third difference. The mixed layer prototype following the simple slab model is excellent at predicting bulk behavior, but a mixed layer similarity hypothesis better captures the mixed layer's vertical gradients and turbulent structures. To explore the behavior of the mixed layer during undisturbed fair weather over the sea, the GARP-GATE program measured radiation, wind, temperature, humidity, and pressure in the boundary layer in the eastern tropical north Atlantic. The program discovered that (1) weak surface heat fluxes still cause mixed layers, (2) models and field observations verify the mixed layer similarity hypothesis, and (3) the surface behaves as a source while the top behaves as a sink.

2.
   - I found it interesting that the loss of the S.S. Titanic fueled meteorologists to better understand the boundary layer, which led to further advances toward understanding eddy behavior and marine fogs.
   - I found it interesting how birds take advantage of circulation variations in the boundary later and how meteorologists in turn learn more from them. We almost treat them as some kind of measuring device.
   - I think it's interesting results from Fig. 5.3 provide so much insight using a simple principle of looking the acceleration of an aircraft to detect the mixed and cloud layer eddies.
   - In Fig. 5.11, it was interesting to compare the measurements made by three different ships that represent different conditions of the trades, but the transitional layer is still present in all three. The three ships clearly detected the presence of trade wind cumuli.
   - It was interesting to learn the kinds of programs (such as GARP-GATE) for measuring and studying the BL during the 1970s to 1980s, and comparing them to the more modern programs we talked about it class.

3.
   - What is the similarity hypothesis discussed in the readings and how was it applied to the simple slab model? Is it similar to what we walked about in class?
   - From Section 5.1.6, how did large eddy modeling help in overcoming the difficulty of achieving reliable statistics via similarity hypothesis in the mixed layer?

- From Section 5.1.9, what is the difference between linear and circular soaring? How can we physically differentiate them besides looking at the values of $-h/L$?
- From Table 5.2, could you elaborate further on the classifications of the BL profiles for GATE? The classifications refer to the percentage of area covered by what? How do we classify, say if we have a small area coverage with high rain intensity?
- From the key points at the end of Section 5.2, why do you think the specific humidity are are not significantly dependent on stability based on the observations of the internal structure of the mixed layer?

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