Dr. Bourassa

Prelim Question:

It has recently been suggested that hurricane-related air-sea interaction is modified by a layer of sea spray (as well as waves). It has been suggested that sea spray related processes dominate the transfer of energy for wind speeds in excess of 30ms-1, and that sea spray processes dominate the transfer of momentum for wind speeds >60ms-1. Make plausible arguments on how sea spray could play a dominant role in the vertical transfer of energy and momentum fluxes. Suggest at least one plausible interaction between these processes.

Question:

1. Explain why convection in the atmospheric boundary-layer tends to occur during the day time, and why convection in the oceanic mixed layer (the ocean layer between the surface and a strong potential temperature inversion; analogous to the atmosphere boundary-layer) tends to occur at night. Support your arguments with descriptions of the relevant physical processes.

2. Explain the radiative and thermodynamic processes that are important in the formation of radiation fog.

(Dr. Bourassa)

Diagram and explain how the transfer of energy absorbed in the tropics, and transported poleward, causes the trade winds. Explain the relevant physical processes, and how they influence the strength of the trades.

Dr. Bourassa

Explain the physical assumptions used to describe the Ekman layers in the ocean and the atmosphere. Emphasize the difference(s) between these sets of assumptions. Derive the Ekman profile in the ocean, and use that information to show how the curl of the surface wind-stress is related to the Ekman upwelling.

Prelim Exam Question (Bourassa)

It has been suggested that 'some sort of surface energy flux' could be inferred by measuring the very near surface water temperature at a variety of depths (from 1μm to 1mm). This idea could be tested by measuring the sea 'surface' temperature at a variety of wavelengths. Discuss the following issues.

(1) Why can observations of temperatures at different depths be used to infer an energy flux? (2) What types of turbulent or radiative energy fluxes are likely to be included in the 'some sort of energy flux?' (3) Assuming that the observations are taken from a good platform (but not too close to the platform), what are the advantages of the concept as well the disadvantages (explain other complicating factors)?

Bourassa

Dr. Mark A. Bourassa

Describe how changing the altitude of a satellite can influence its spatial resolution (horizontal and vertical), operational lifetime, and sampling (spatial and temporal). In the case of sampling, distinguish between nadir viewing instruments and those that view in a wide swath.

Dr. Bourassa

Describe (with words, equations, and at least one diagram) how land-sea temperature differences can result in land and sea breezes. Include the horizontal pressure gradient in your description.

Remote Sensing Question (Dr. Bourassa):

Consider an active satellite (i.e., "radar" in space) that uses microwaves to measure sea surface roughness. The satellite beam has an incidence angle of approximately 50 degrees. Discuss how rain lying between the satellite and the sea surface would modify the signal. Hint: The signal applicable to surface roughness must pass from the satellite to the surface, interact with the surface, and again pass through the rain to return to the satellite. Phrase your comments in terms of transmission, absorption, and scattering processes and the consequences of these processes. Say as much as you can. Do not be as brief as you can.

Prelim Question from Mark Bourassa

Consider airborne RADAR (e.g., EDOP) measurements of a hurricane, including the eyewall and a hot tower.

1) Describe why there is a radar response. What is the signal responding to?
2) Describe how the radar response is distributed over the 'material' to which the radar is responding. Is the distribution spatially uniform? Justify your answer.
3) How does the distribution in (2) influence the interpretation of motion?
4) Describe the advantages and disadvantages of using shorter or longer wavelengths.