Lab 3 for GEOL 1147 (Introduction to Meteorology Lab)

I. Introduction

Satellites can be used to monitor radiation fluxes to and from the Earth/atmosphere system. For the following exercises you will look at some examples of satellite images that make use of these fundamental ideas. Satellite images are classified as either visible (produced from *reflected* visible radiation) or infrared (IR, produced from *emitted* longwave radiation). Of course, the planetary surface can only be viewed as a visible image when it is illuminated by a light source (the sun), so that visible images are available only during daytime. On the other hand, IR satellite images are a measure of the amount of radiation being *emitted (not reflected)* from objects in the satellite's field of view. Since all objects emit radiation both night and day, IR images are available both during the day and at night.

For visible satellite images, areas represented by light tones are areas where a large amount of the incoming visible light is being reflected back to space (high albedo). Areas with a high albedo are typically either cloud covered or snow covered.

The IR satellite images show the amount of radiation being emitted in the infrared part of the electromagnetic spectrum. Since the amount of radiation emitted increases with increasing temperature, areas emitting large amounts of radiation have high temperatures, whereas areas emitting smaller amounts of radiation have low temperatures. The image is coded such that *dark* areas represent regions of large IR emission (high temperature) while *light* areas (or color-coded areas) represent regions of small IR emission (cold temperature). Sometimes a scale on the bottom of the image is shown to indicate the range of brightness temperatures displayed.

II. Exercise

1. The blackbody's temperature is 300 K. Use the Stefan-Boltzman law to estimate the amount of energy per square meter per second emitted by the blackbody. Use Wien's law to estimate the wavelength of peak radiation emitted by the blackbody.

2. List the wavelength for the peak radiation emitted by the earth and sun.

3. The following image is the visible satellite image at 18Z on Dec 17, 2012.

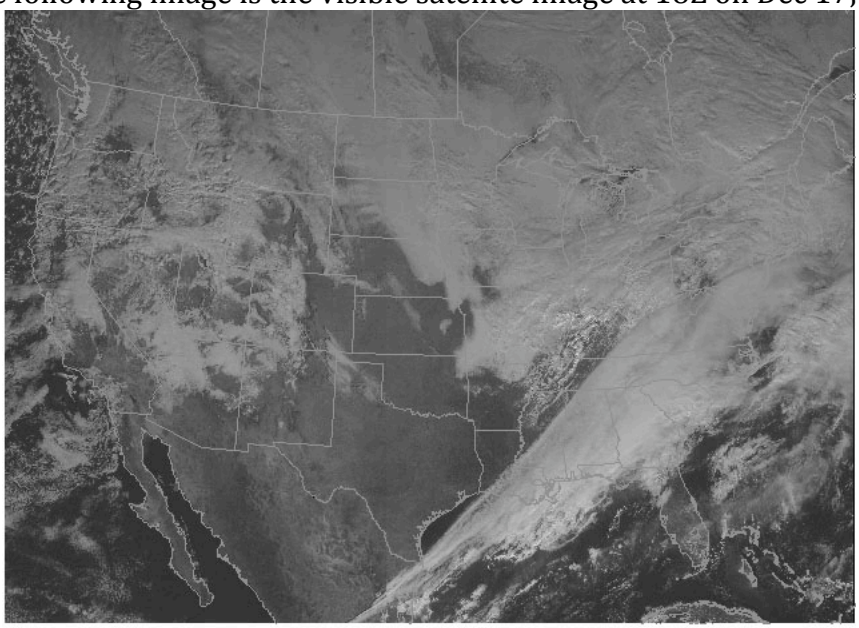

Image at 1800Z Mon 17 Dec 2012

3a. Describe the areas of the US covered by clouds or snow.

3b. How can areas covered by clouds and/or snow be distinguished from other parts of the image?

3c. Identify a large land area that is not covered by either clouds or snow. List that area here.

4. The following image is the infrared satellite image at 18Z on Dec 17, 2012

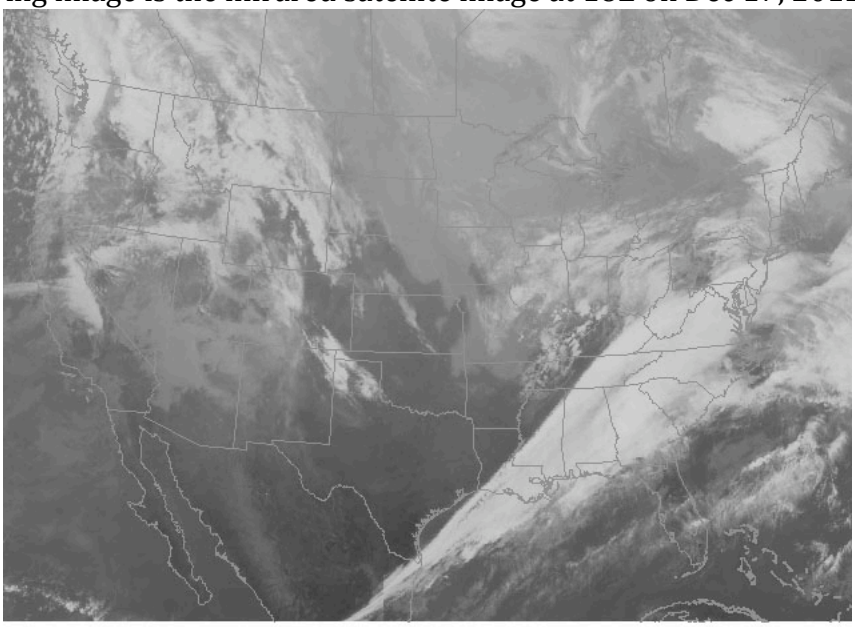

Image at 1800Z Mon 17 Dec 2012

4a. How do the temperatures of the cloud-covered areas differ from the non-cloud-covered region you identified in question 3c?

4b. How does your answer to question 4a fit within the context of our knowledge that temperature generally decreases with height in the troposphere?

5. The following are the IR satellite images for 12Z and 20Z.

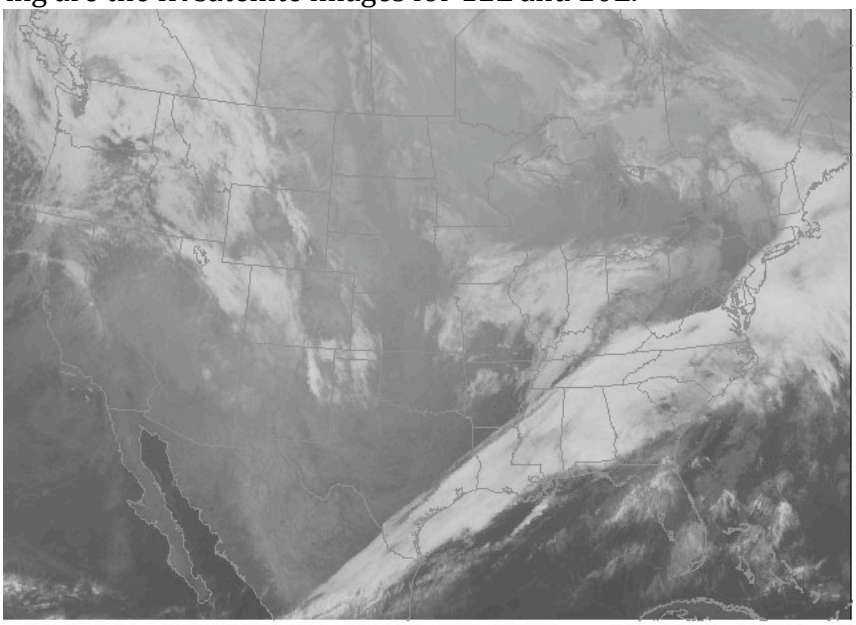

Image at 1200Z Mon 17 Dec 2012

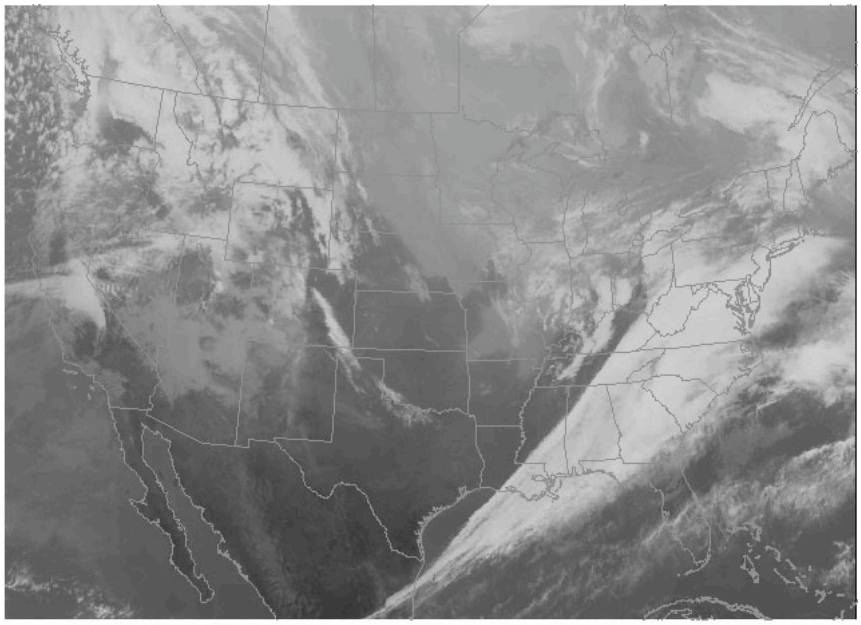

Image at 2000Z Mon 17 Dec 2012

5a. How does the temperature of the cloud free area, identified in question 3c, change between 12Z and 20Z?

5b. Explain why this temperature change is observed. *Hint: Remember that local times in the USA lag behind UTC time.*