

WEATHER SATELLITE IMAGERY

1. Print this file and associated images. Also answer the Tuesday "Concept of the Day" questions in the Daily Summary File.
2. Complete the Investigation by responding to the *Chapter Progress Questions* (Study Guide binder) and the introductory portion of Investigation 1A from the *Weather Studies Investigations Manual*.

At this writing, we are well along through the winter season. Meteorological winter comprises the months of December, January and February. The astronomical winter runs from the winter solstice in December when we experience the shortest period of daylight for the year to the spring equinox [0514Z (1:14 AM EDT, etc.) Tuesday, 20 March this year] when the daily periods of daylight and darkness are approximately equal. On the equinox daylight and darkness periods will be equal everywhere on Earth except at the poles (allowing for the few minutes of extended daylight due to atmospheric refraction). That means that on the spring equinox, Earth's Northern and Southern Hemispheres are equally illuminated. Also, the local sunrise and sunset positions on your horizon will be due east and west, respectively, at the equinox.

[Image 1](#) is the *visible* satellite display for 0015Z on 06 FEB 2012 (locally Sunday evening, 6:15 PM Central Standard Time, 5:15 PM MST, etc.), labeled across the upper margin "Visible Image" (listed "Visible - Latest" on the course website). The image was at the time when the Sunday evening sunset was occurring along a line stretching between southern Texas and east central Montana on.

This visible image shows the cloud patterns in the western U.S. Expanses of cloud cover extended over the Pacific, offshore from Washington state to central California. Another large patch of clouds was over the "Four Corners" region where Arizona, Utah, Colorado, and New Mexico meet. Smaller areas of clouds are seen elsewhere including lumpy streaks of clouds in northern Mexico. As noted in the Daily Weather Summary for Monday, 6 February 2012, light snow was associated with the area of clouds seen on the visible satellite image in the Four Corners region. [**Note:** The printed satellite image usually displays more detail than is seen on screen. The on-screen image may be enhanced by adjusting the screen brightness and/or contrast.]

Note the short red marks located just beyond the upper and lower map boundaries. Draw a straight line across the satellite view connecting these two marks. The line you drew represents the "**terminator**" or the line separating day and night at the time of Image 1 (0015Z on 06 FEB 2012). Label this line "terminator". This can also be called the sunset line as it was progressing westward across Earth's surface due to Earth's eastward rotation. At the time of the image, sunset was occurring at Jordan, Montana, in east-central MT at

longitude 106.9 °W, latitude 47.3 °N, and Kingsville, Texas along the southern TX Gulf Coast near Brownsville at longitude 97.9 °W, latitude 27.5 °N as well as other locations along the terminator.

1. At the time of the visible satellite image, sunlight illuminating the western clouds was reaching the U.S. from the general direction of [~~(southeast)~~(~~southwest~~)].
2. Cloud conditions, if any existed at this time, were not seen across the eastern half of the image because [~~(the sun had already set leaving darkness)~~
~~(the satellite was not aimed to view the surface)~~].
3. The western portions of the borders of North and South Dakota and Nebraska and Kansas represent approximate north-south longitude lines. The terminator line you drew is [~~(parallel)~~(~~at an angle~~)] to these north-south border longitude lines. The terminator's orientation relative to the north-south longitude lines changes throughout the year and will be discussed in this week's second activity. You can also note that the longitude of Jordan, MT is considerably to the west of the longitude of Kingsville, TX.
4. [Image 2](#) is the *infrared* satellite image (from "Infrared - Latest") for the same time (0015Z on 06 FEB 2012) as the visible image. Compared to the visible image, this infrared image shows much [~~(less)~~(~~more~~)] cloudiness in the eastern half of the country, particularly across the Gulf of Mexico and eastern Canada. Infrared images are basically temperature maps of the surfaces "seen" by the satellite sensor.
5. The infrared images seen on the course website are not enhanced, meaning the shading scale goes from the warmest temperatures as darkest to coldest being lightest. Cold surfaces such as high cloud tops, emitting little infrared radiation appear [~~(bright white)~~(~~dark~~)]. Surfaces with intermediate temperatures appear in gray shadings.
6. Warm surfaces appear relatively [~~(bright white)~~(~~dark~~)] on infrared images (land during much of the year and low clouds).
7. At 0015Z 06 FEB 2012 several areas of rain and thunderstorms were spread across the Gulf of Mexico area. Notable areas of showers and thunderstorms mentioned in the Daily Weather Summary were located across southern Florida and over the western Gulf. The brightness of shading showed those cloud tops to be generally [~~(“warm”)~~(~~“cold”~~)].
8. Comparatively, the white area of clouds seen in the visible image located over the Four Corners area was seen in the infrared image as a relatively medium gray patch of shading. This mass of cloud tops over the Four Corners region was relatively [~~(“warmer”)~~(~~“colder”~~)] than the shower and storm tops of brighter white over the Gulf of Mexico.
9. Note a small blob of cloud in the visible image (Image 1) over the Pacific Ocean near the Washington state coast (under “Image” in the satellite caption). Compare this area to the same position in the infrared view (Image 2). These offshore clouds [~~(were)~~]

(were not)] evidenced in the infrared image because the tops of these coastal clouds were at lower altitudes, with temperatures near those of the water surfaces.

10. If you wished to create a complete 24-hour time-lapse of the cloud patterns across the U.S. such as those routinely seen on television using the satellite images from each hour, you should choose [***(visible)(infrared)***] images because the other type of images would appear black during nighttime hours.

You might be able to see the “lumpy” texture of clouds over northern Mexico in the visible satellite image. This effect comes from the shadows produced from towering storm tops on lower clouds to the east by the low sun angle. Visible satellite views typically provide more detail than infrared ones.

Image 3 is an image from the U.S. Naval Observatory web site, <http://aa.usno.navy.mil/data/docs/earthview.php>, at 6:15 PM CST/5:15 MST, the same time as the satellite images. The depiction in Image 3 is from a model showing the positions of the sunrise and sunset terminators and the portions of the entire Earth's surface in sunlight and darkness at that time. A yellow line has been added to show the equator and a yellow semicircle with rays near the right margin denotes the Sun's subsolar position at that time. The latitude and longitude of this subsolar position is noted in red in Antarctica below the spot. Note the approximate positions of east-central Montana and the southern Gulf Coast of Texas on the global map display.

11. The Image 3 sunset terminator line in North America [***(does)(does not)***] closely coincide with the sunset line you drew where sunsets were 6:15 PM CST/5:15 PM MST.

On the Image 3 map, add one horizontal line about half way between the yellow equator (0°) and the top of the image. Add a second halfway between the equator and the bottom. Your lines represent approximate 45° North and South latitudes. The lengths of the brighter, illuminated portions of your horizontal lines (latitudes) at comparable distances north and south of the equator, are proportional to the lengths of daylight at those latitudes.

12. The latitude-line lengths imply that, in early February, the daylight periods are [***(longer in the Northern Hemisphere)(longer in the Southern Hemisphere)(nearly equal in both hemispheres)***]. The Northern Hemisphere's winter season has several weeks to go following this image before the spring equinox.
13. The notation listing the subsolar point on the Image 3 map shows that, at the time of the image, 0015Z 6 February 2012, the sun was overhead at noon at $179^\circ 13'$ E longitude and [***(23° 26')(15° 52')(0° 07')***] °S latitude. On the equinox, the noon sun will be directly over the equator (0° latitude).
14. The Image 3 map view also suggests that at and near the South Pole, there is [***(no)(partial)(continuous)***] daylight each 24-hour period at this time of year. Note that this is opposite to the daylight condition at or near the North Pole.

Based on different Image 3 model views, you can determine what portion of Earth would be illuminated on the equinox (or any other day of the year). Go to the Naval Observatory website listed above and enter the Year, Month, Day and time of day in Hours and Minutes Universal (Z) time. Finally, click **Show Earth Map**.

Would the length of daylight change on the equator from day to day? Check day and night segments in Image 3 and then check day and night map views on the Naval Observatory website for the upcoming equinox on 20 March 2012. Also, sunrise and sunset times, along with other astronomical information, can be obtained from another U. S. Naval Observatory site, <http://www.usno.navy.mil/USNO/astronomical-applications/data-services/rs-one-day-us>.)

Routinely compare the latest satellite views with the latest analyzed surface map available via the course website. Compare what you see on-screen with your local weather. You can ask yourself such questions as: Are your skies clear or cloudy? Do the satellite views show the same? Are these comparatively high or low clouds?

From the course webpage, **Satellite** section, an applet (*Infrared Surface Temperature Determination*) is available that allows you to see the Celsius temperature of the surface under your cursor on the latest Northern Hemisphere infrared satellite image. (Requires JAVA-enabled browsers.) Check out how warm the dark surfaces are or how cold the cloud tops.

Answer the **Current Weather Studies** activities on the CWS *Answer Form* (provided from the course website on Wednesdays).

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