



Solar Household Energy, Inc.

Solar Cooking for Human Development and Environmental Relief

SHE Technical Report no. TR-08

Satellite imagery of atmosphere during experiments, 2015

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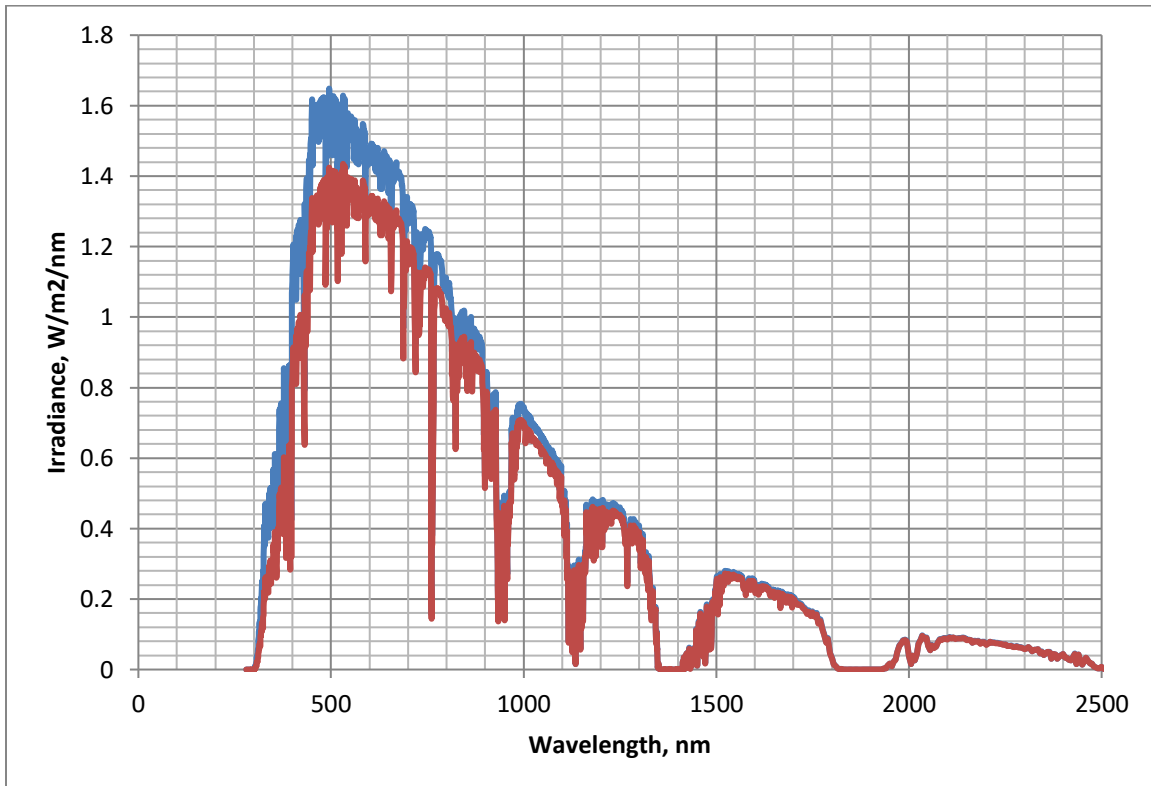
Nov. 11, 2015

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Satellite imagery of atmosphere during experiments, 2015

Solar cooker heating experiments are affected by the transparency of the atmosphere across the entire spectrum from infrared to ultraviolet, though with peak energy in the visible part of the spectrum. One of the main variations in the infrared spectrum is due to the presence of water vapor, which causes strong absorption bands near 950, 1130, 1400 and 1800 nm and other bands at longer wavelengths.



The figure above shows the ASTM G173-03 reference solar spectra for global tilted sensors (blue) and direct radiation within 2.5 degrees of the sun (red). The visible spectrum runs from about 400 nm to 700 nm.

The GOES (Geostationary Operational Environmental Satellite) are located at approximately 36,000 km above the earth. One of the earth-looking instruments on the GOES is an Imager that has five spectral bands. One band is in the visible part of the electro-magnetic spectrum that senses reflected energy (i.e., sunlight), while the other four bands capture emitted or infrared (i.e., heat) energy from the earth. The nominal spatial resolution (or pixel size) of the visible band is 1 km, while the other infrared bands are 4 km.

The central wavelength of the visible band is 630 nm and the central wavelength of the water vapor band is 6480 nm (6.48 microns).

The images below show the visible and water vapor data from the GOES East satellite near times when solar cooker experiments were being conducted in Rockville, MD. The images were downloaded and documented here, because they are only kept on the GOES web site for about a month.

Visible Imagery

Visible satellite images, which look like black and white photographs, are derived from the satellite signals. Clouds usually appear white, while land and water surfaces appear in shades of gray or black. The visible channel senses reflected solar radiation. Clouds, the earth's atmosphere, and the earth's surface all absorb and reflect incoming solar radiation.

Water Vapor Imagery

Water Vapor imagery is obtained from an infrared spectral band centered at 6.48 microns. In the infrared (IR) channel, the satellite senses energy as heat. The earth's surface absorbs about half of the incoming solar energy. Clouds and the atmosphere absorb a much smaller amount. The earth's surface, clouds, and the atmosphere then re-emit part of this absorbed solar energy as heat. The infrared channel senses this re-emitted radiation.

Water vapor satellite pictures indicate how much moisture is present in the upper atmosphere (approximately from 15,000 ft to 30,000 ft). The highest humidities will be the whitest areas while dry regions will be dark. Water vapor imagery is useful for indicating where heavy rain is possible. Thunderstorms can also erupt under the high moisture plumes.

Colorized Enhancements

In some cases, colorized IR images are shown to bring out details in cloud patterns. Depending on the type of enhancement, the colors are used to signify certain aspects of the data, such as cloud-top heights. This is important because taller clouds correlate with more active weather and can be used to assist in forecasting.

How to read file names

Example: ECVS152361615.gif

EC = East Coast GOES East

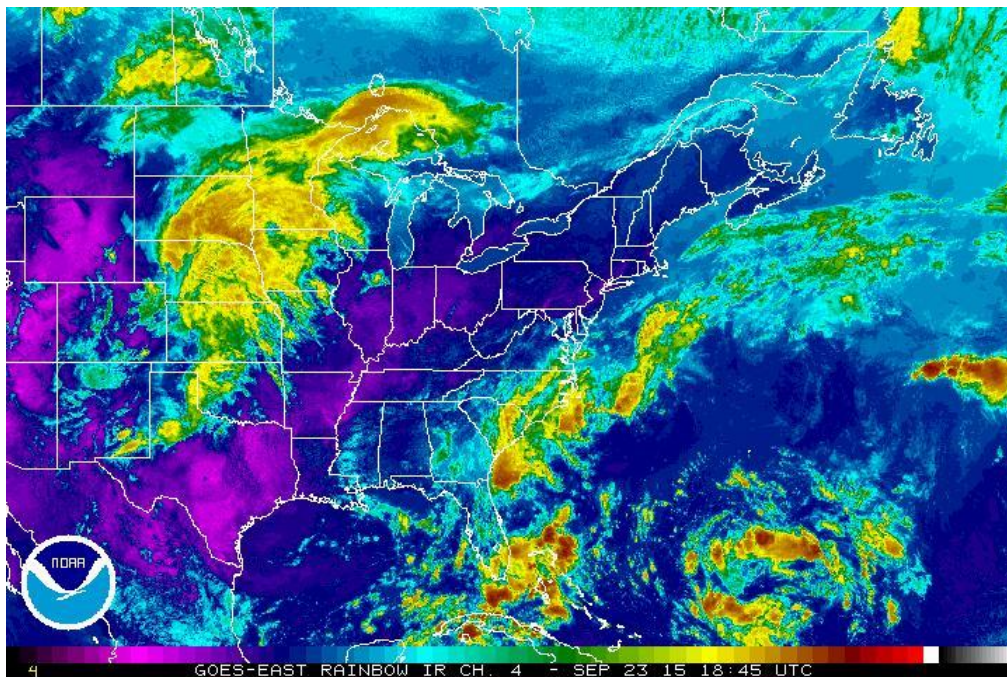
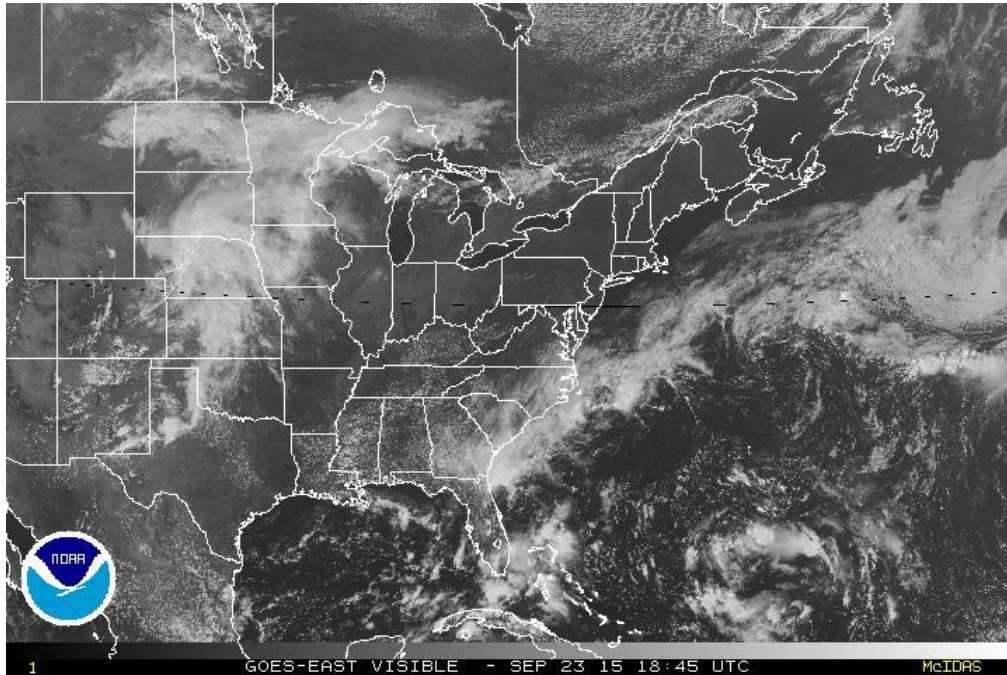
WV = Water Vapor or VS = Visible

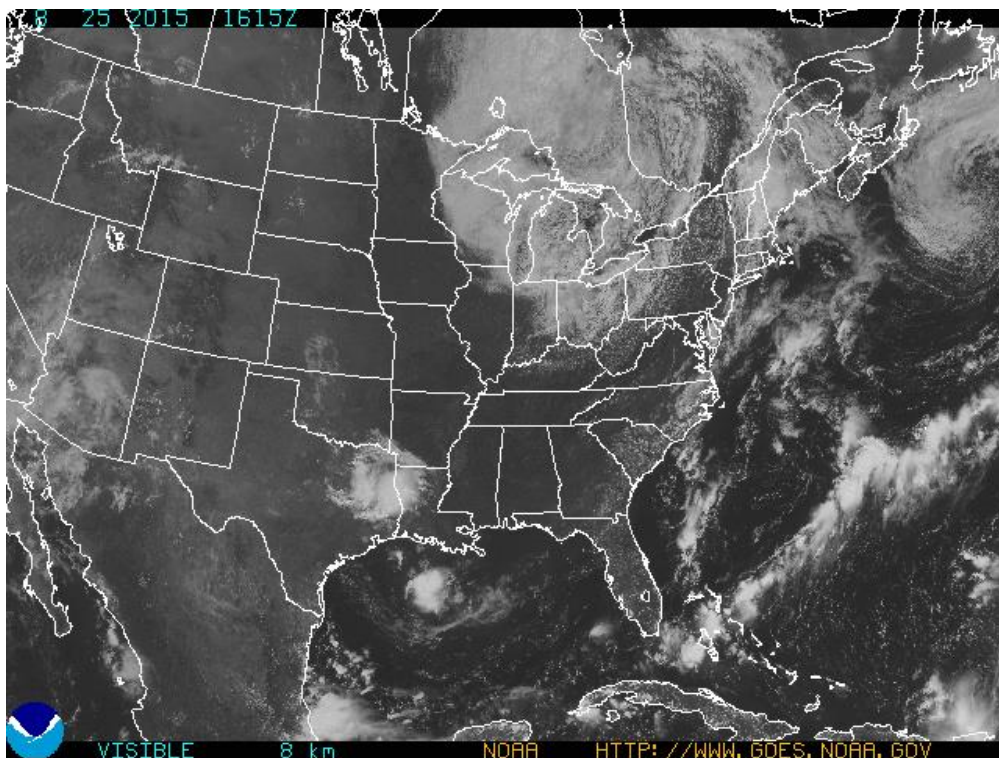
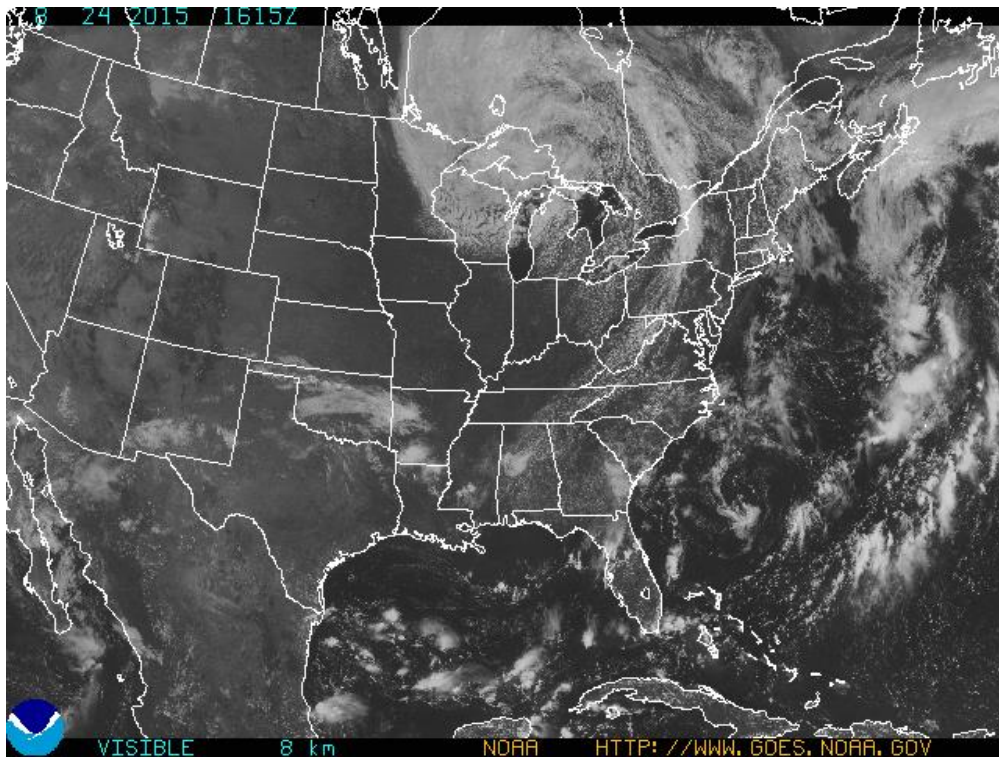
15 = year 2015

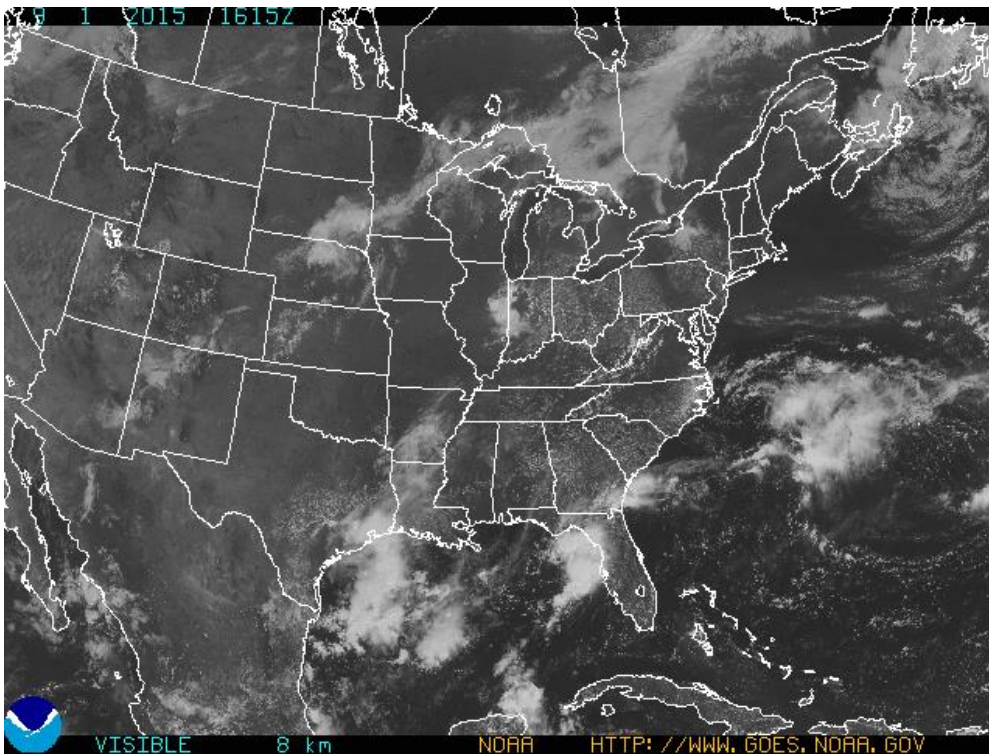
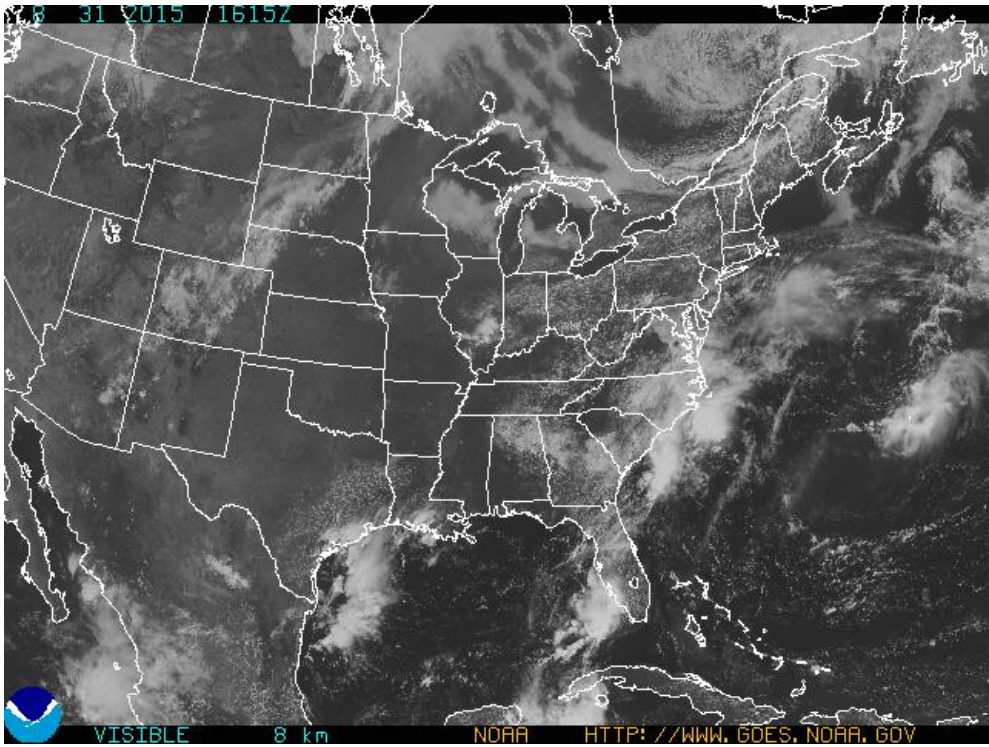
236 = day of year

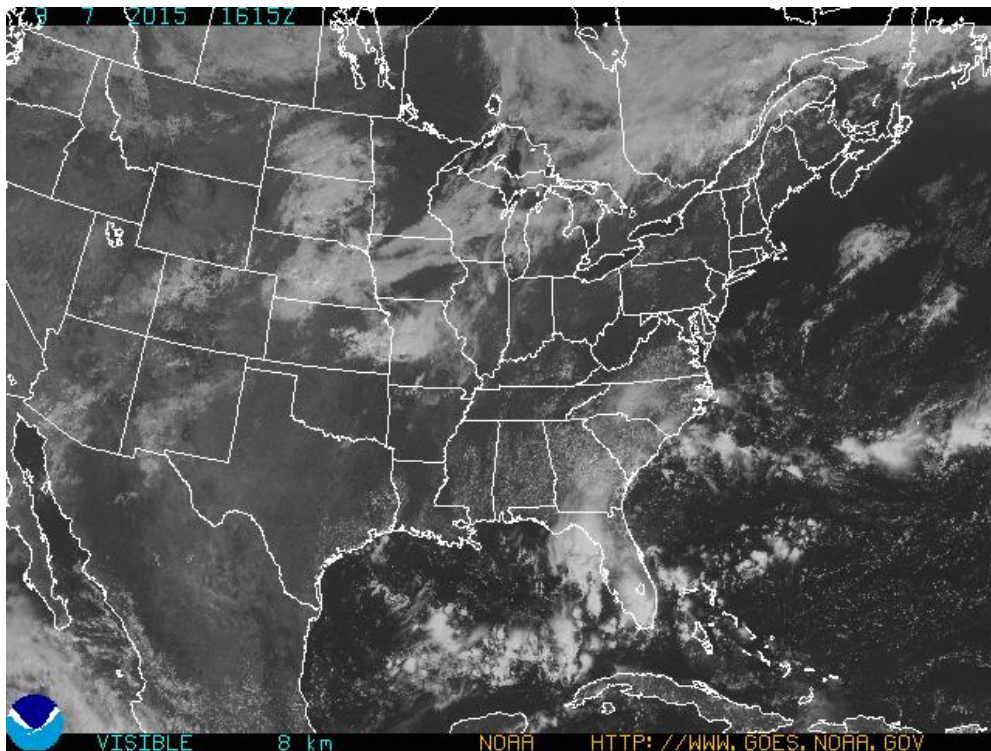
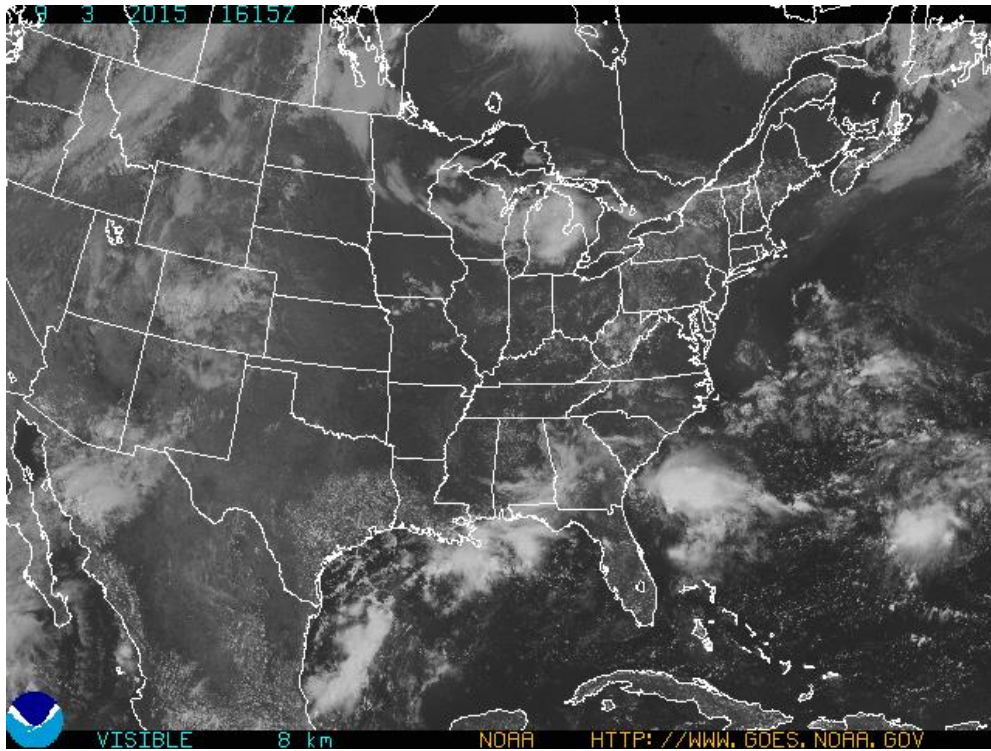
1615 = 16:15 GMT time of image (12:15pm EDT or 11:15am EST)

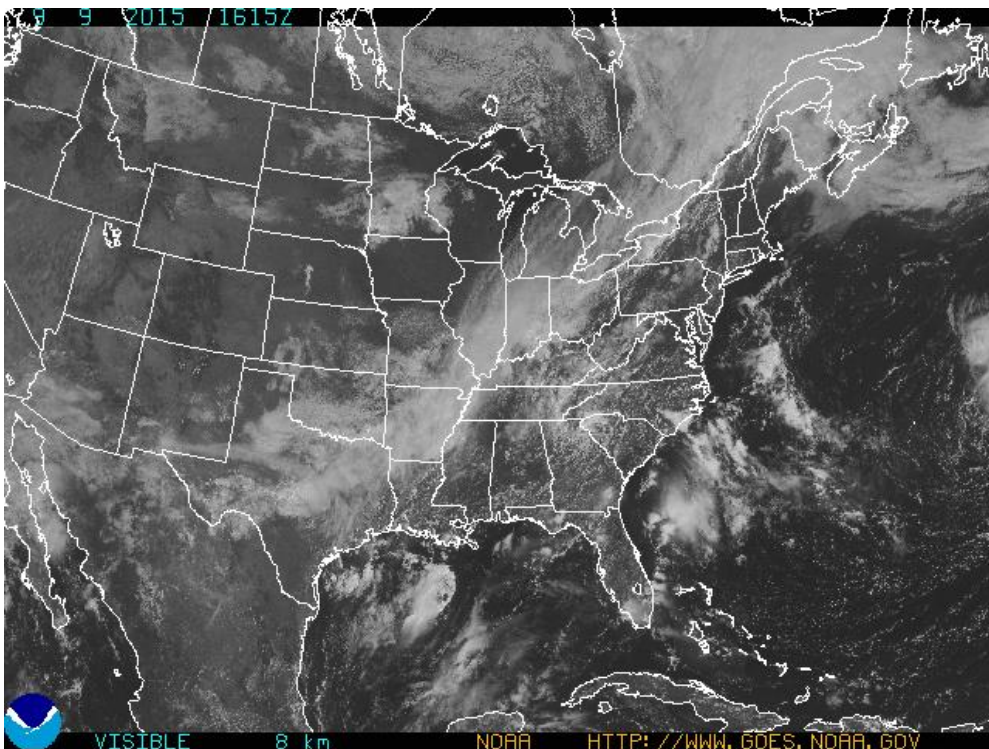
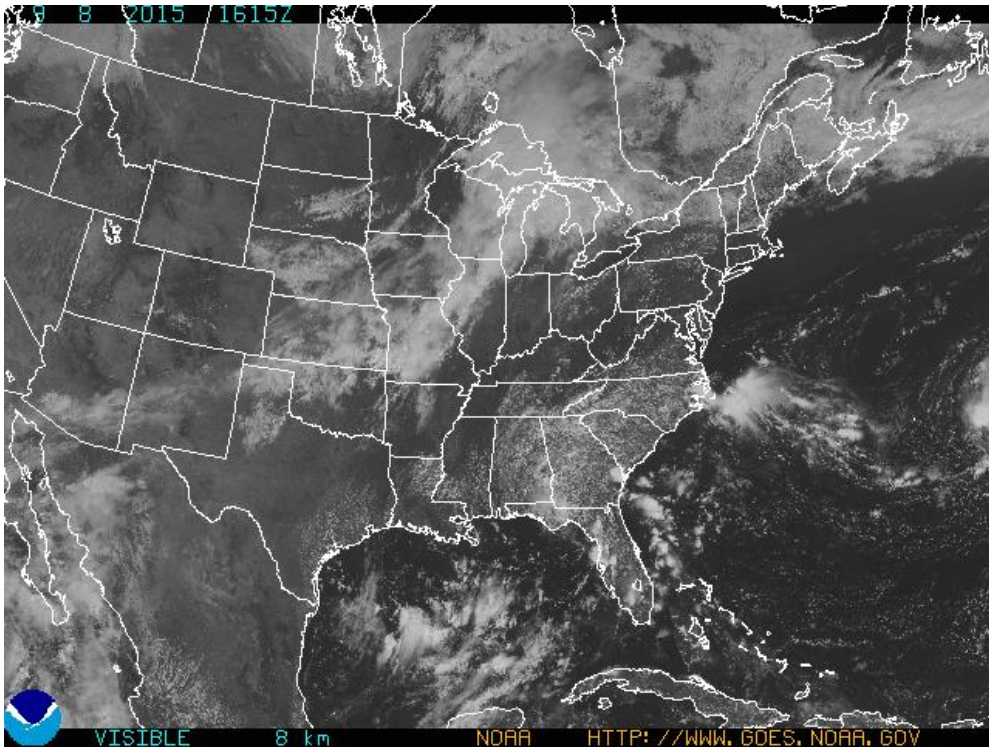
GOES East Visible Maps

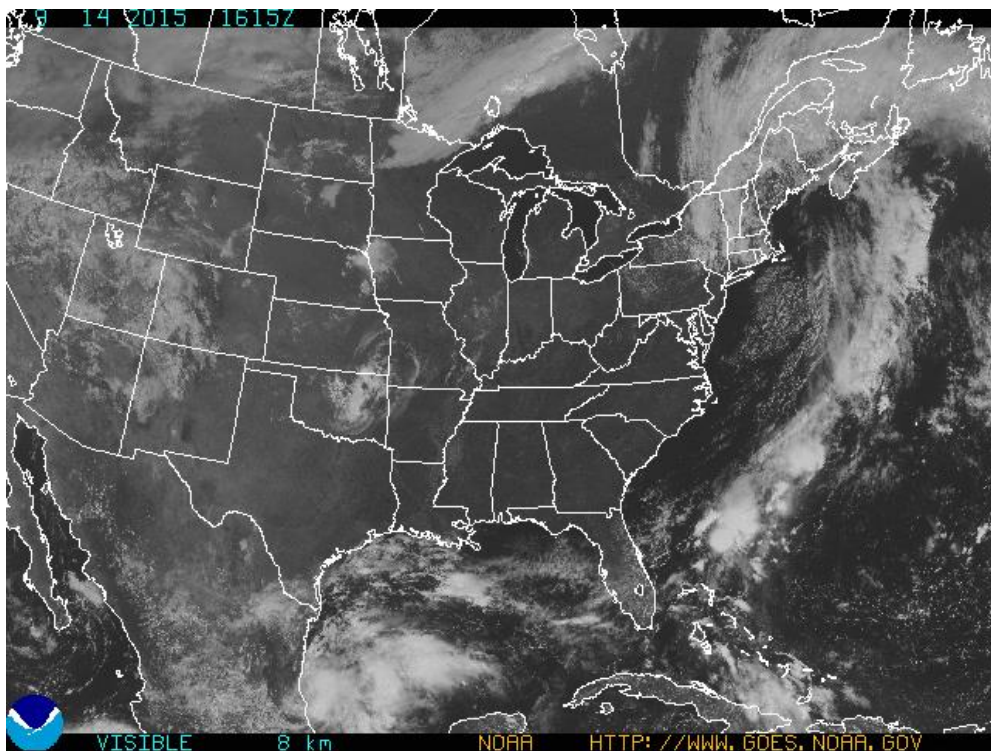
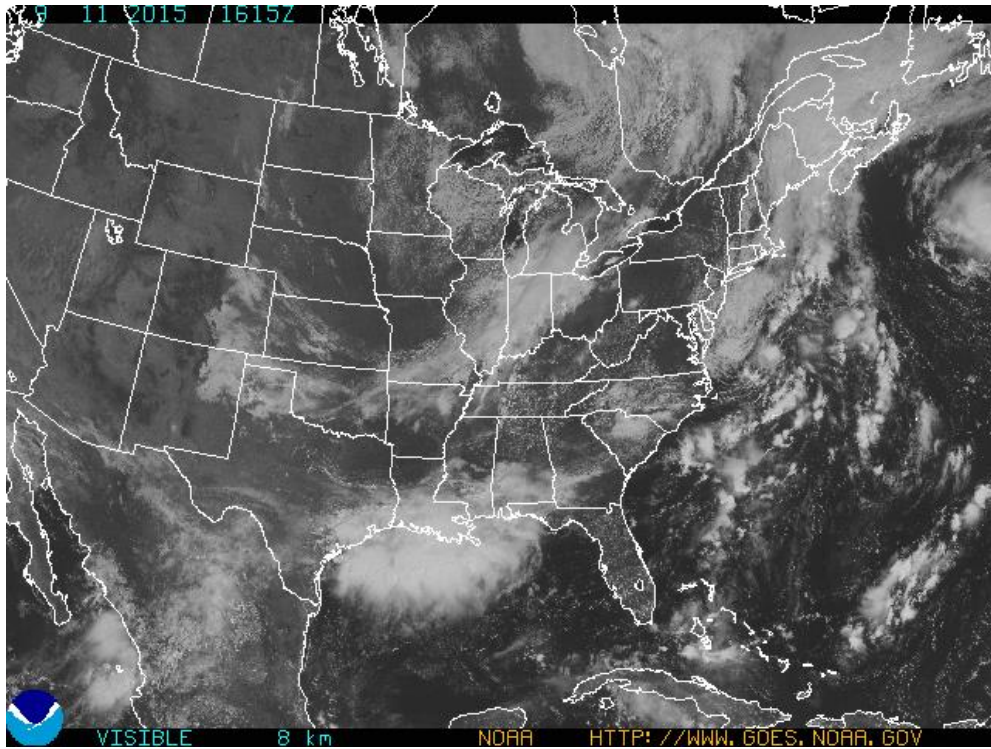


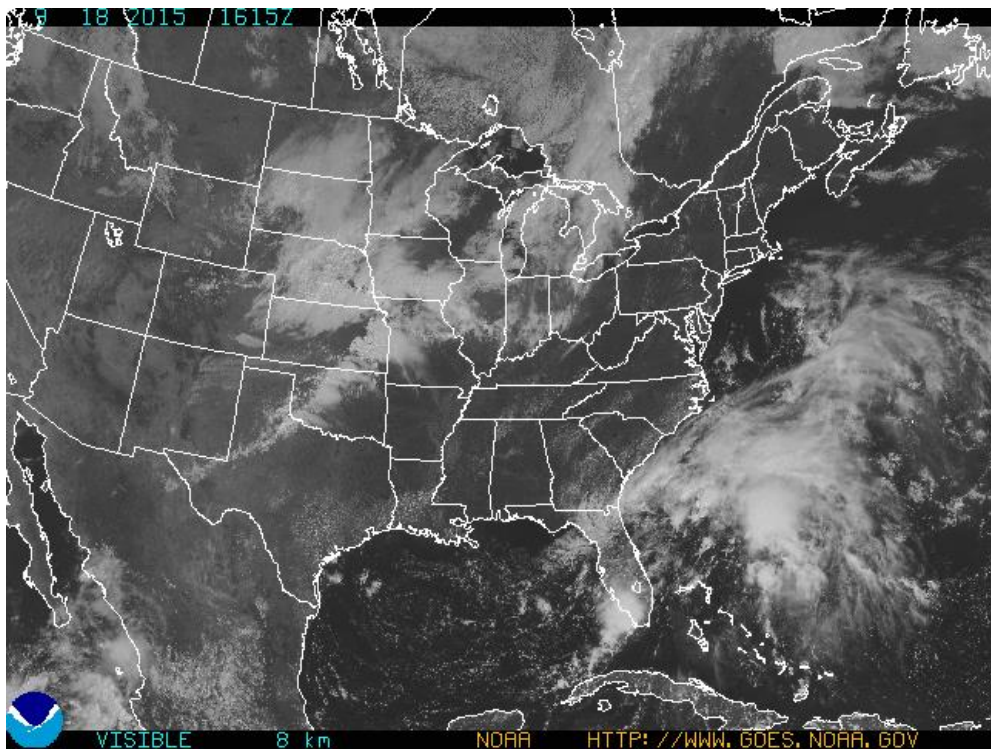
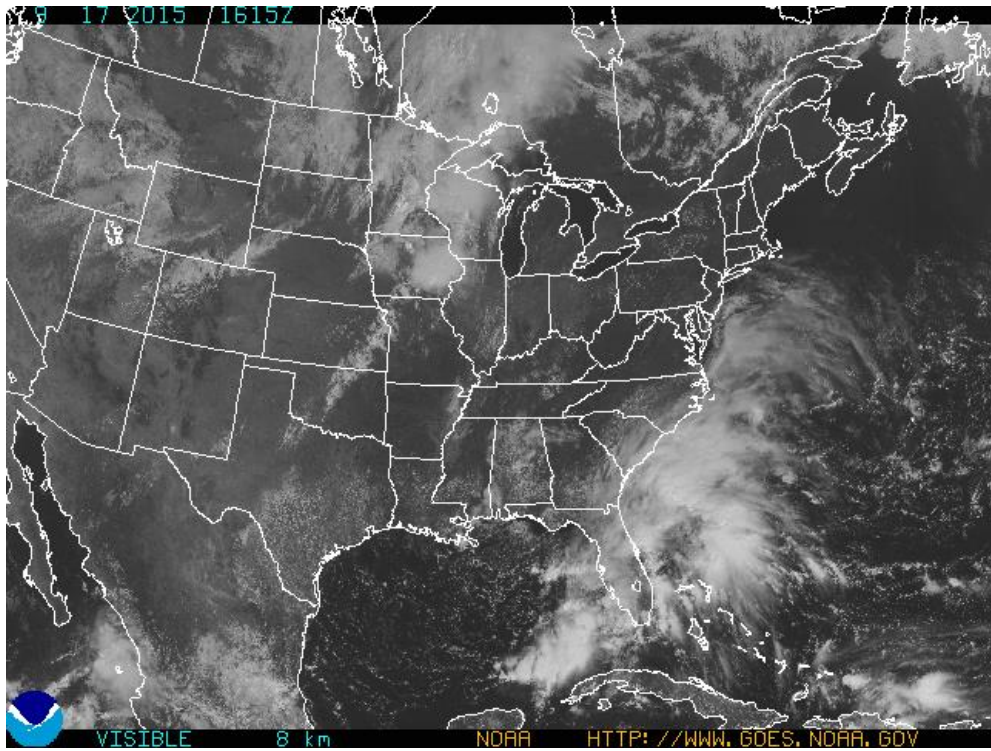




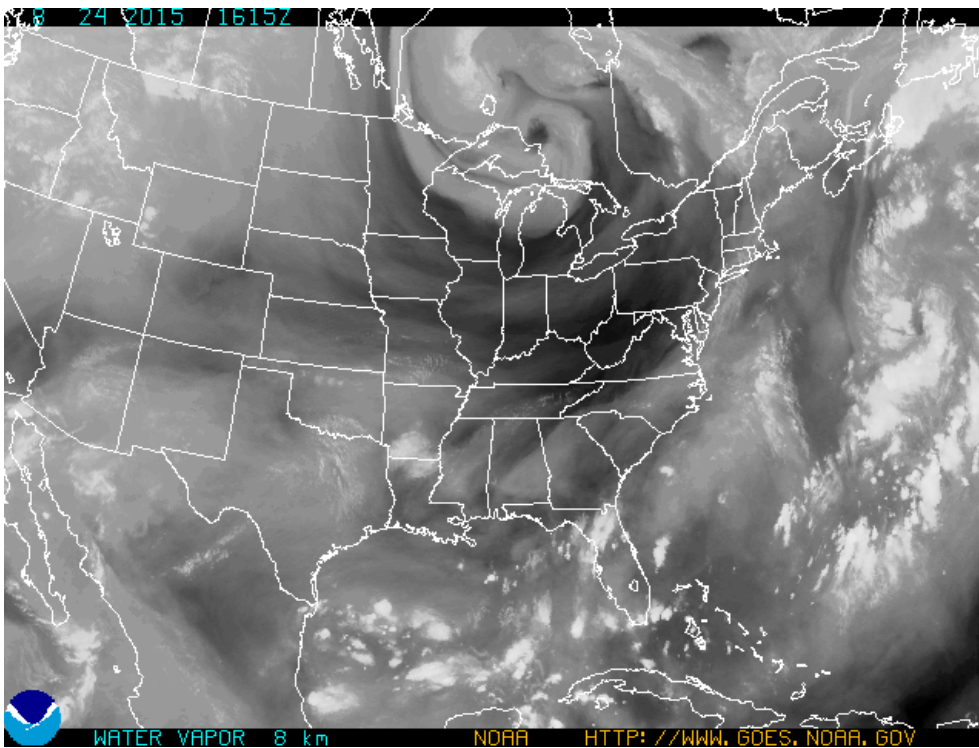
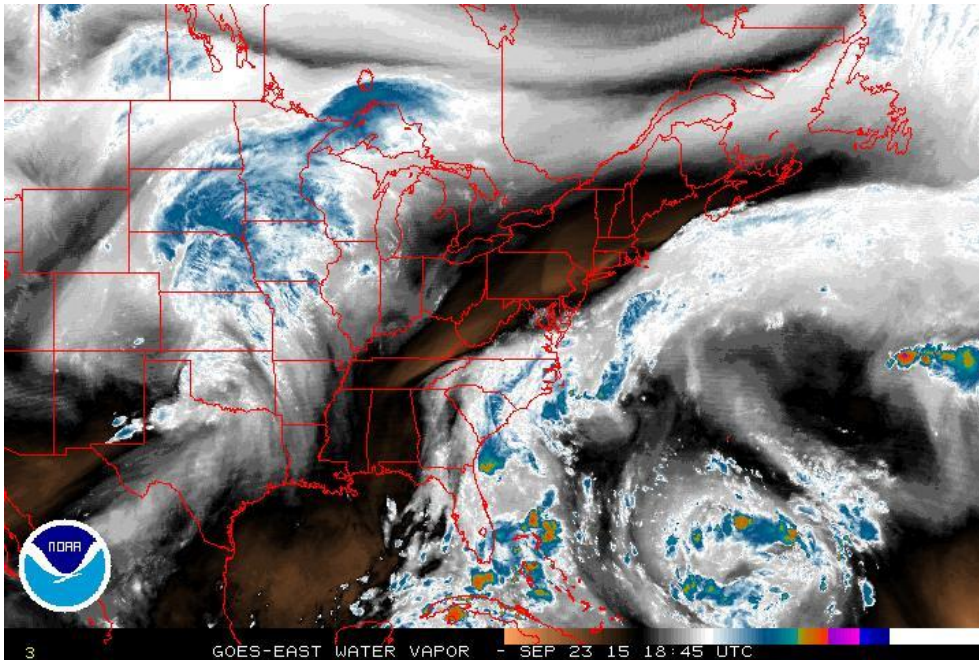


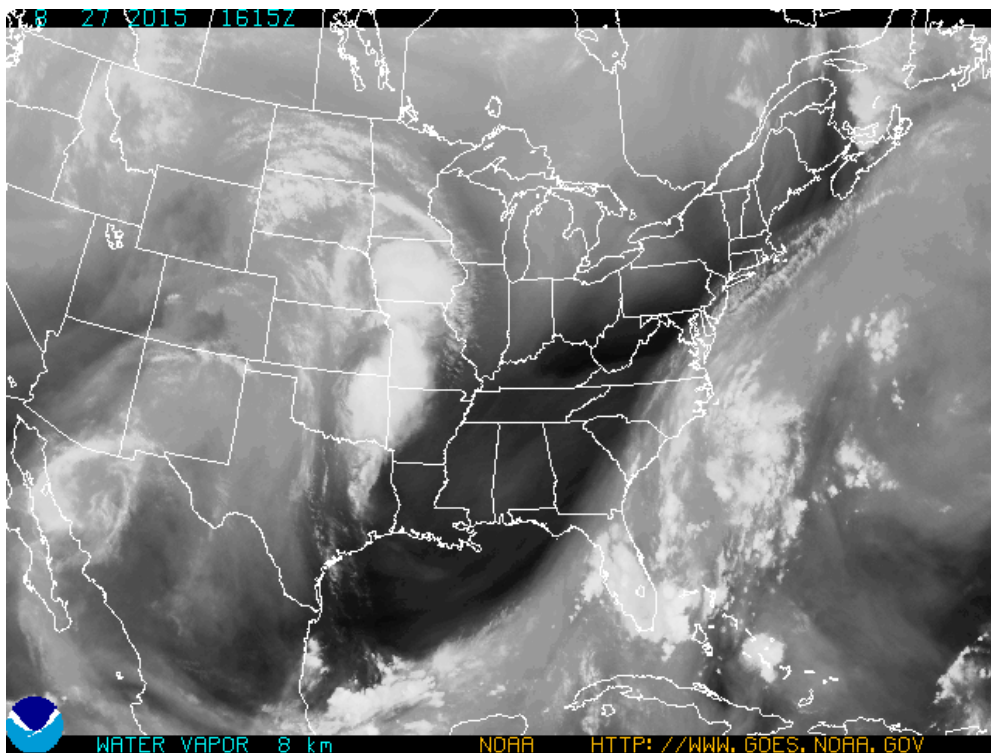
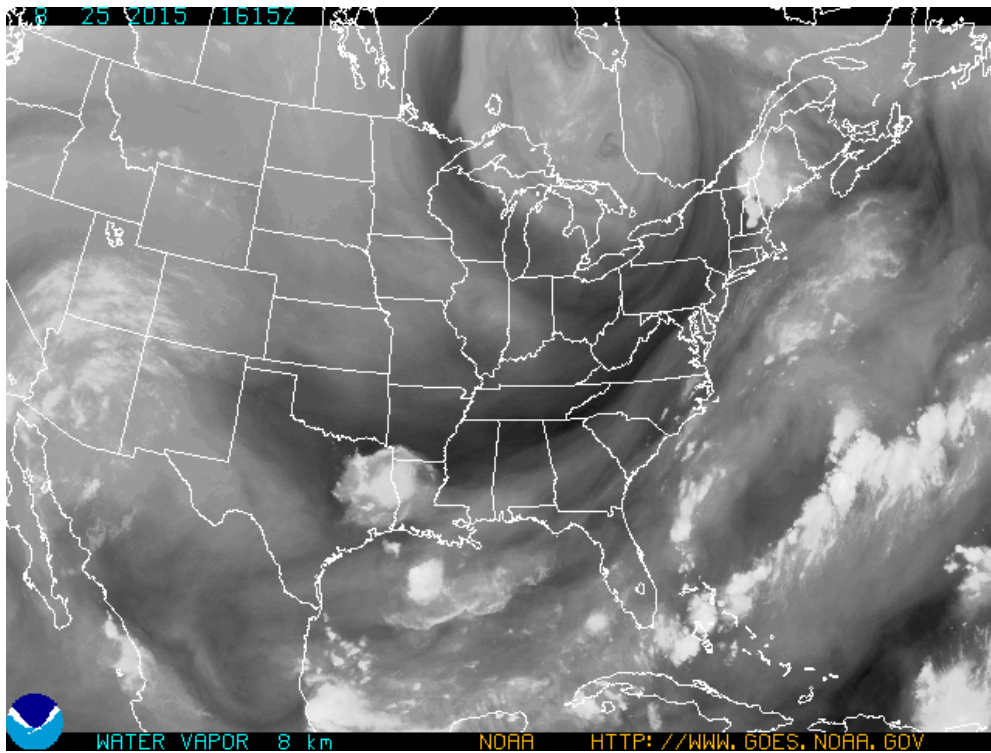


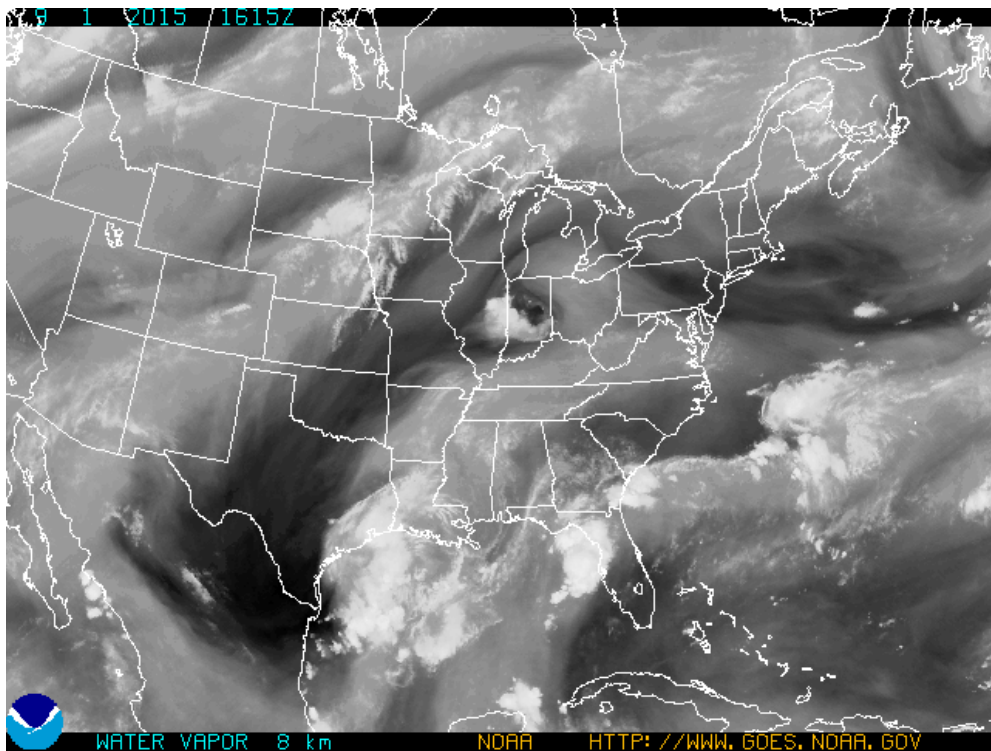
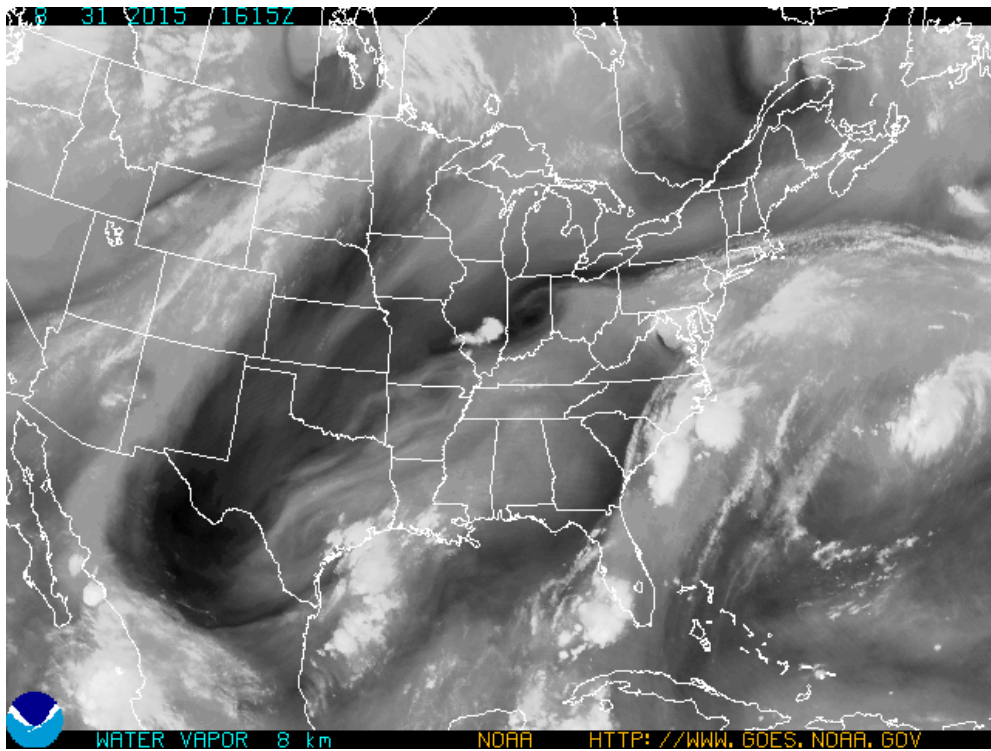


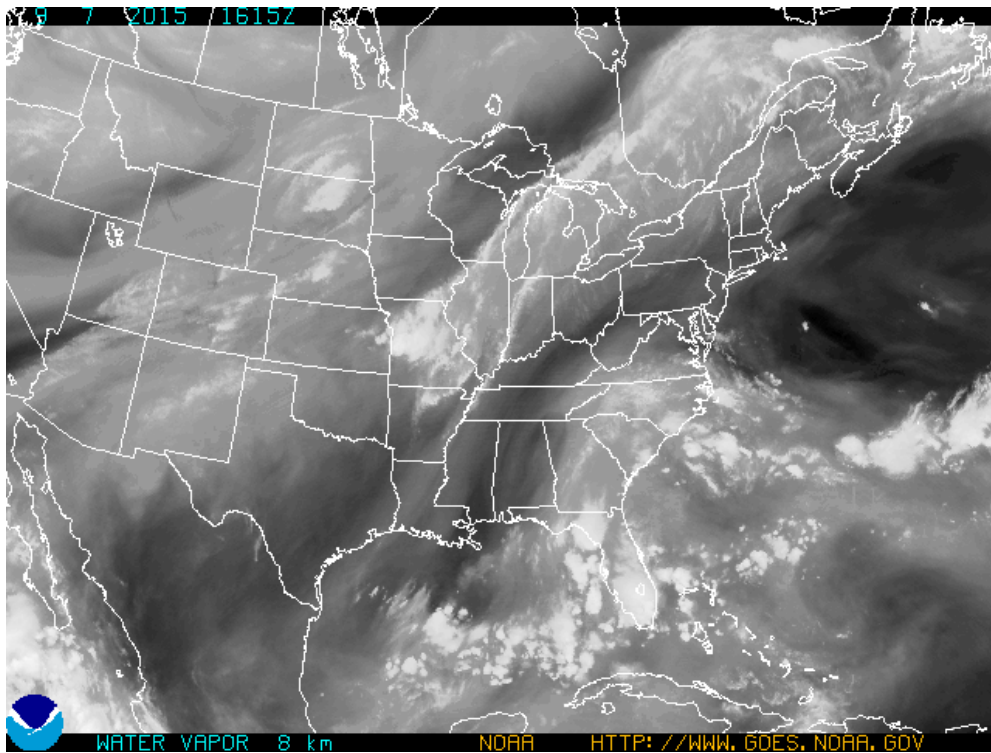
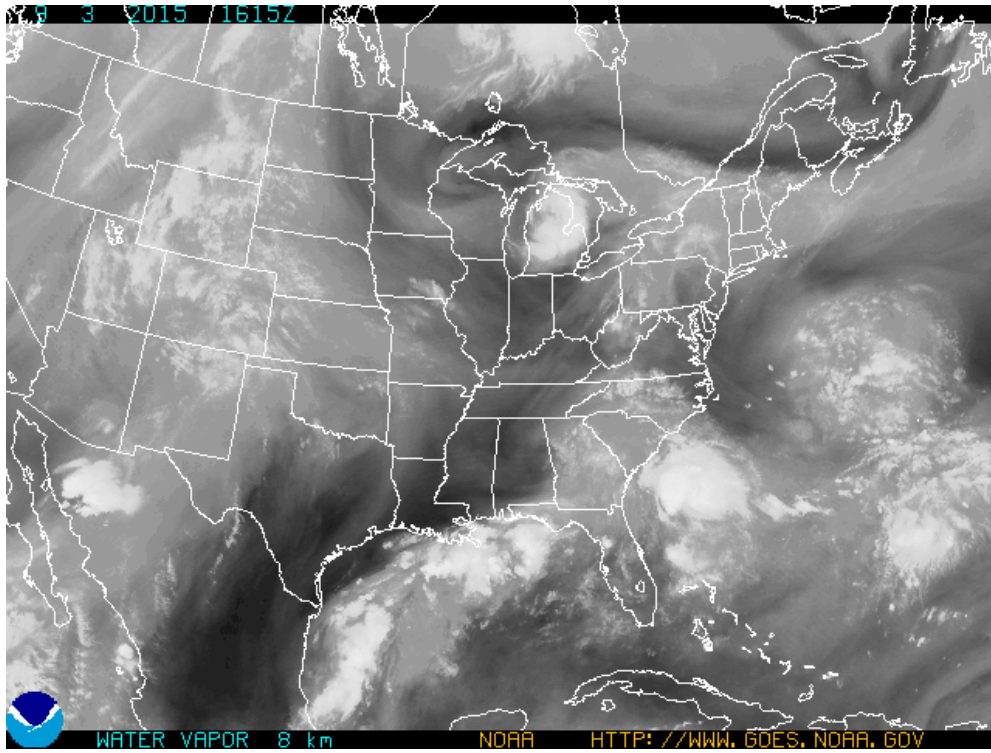


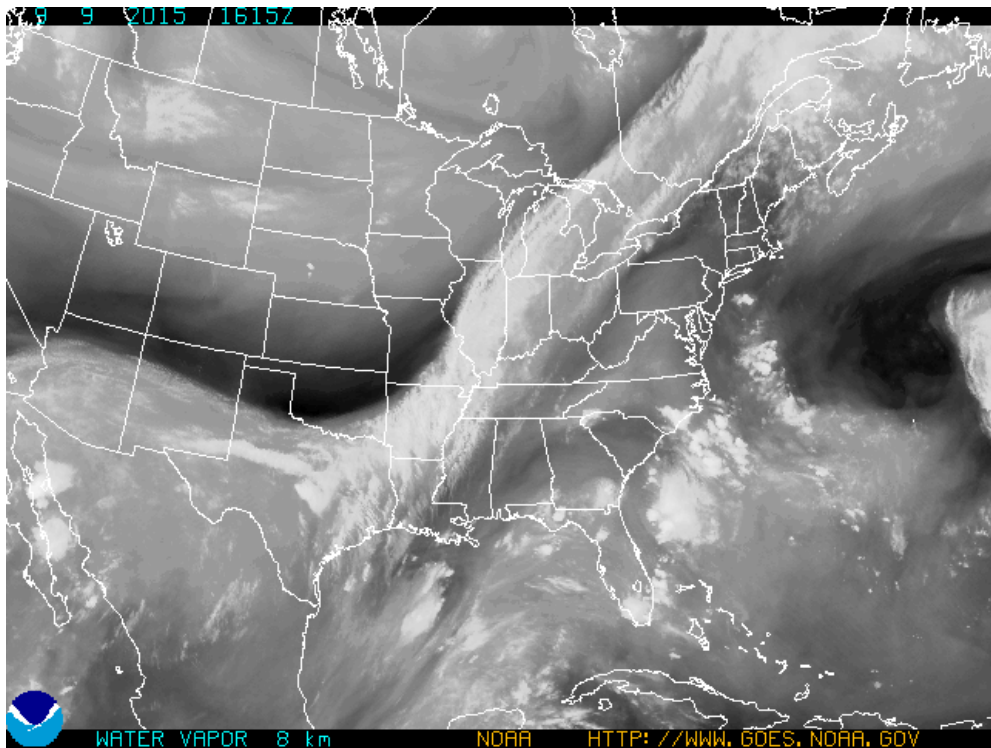
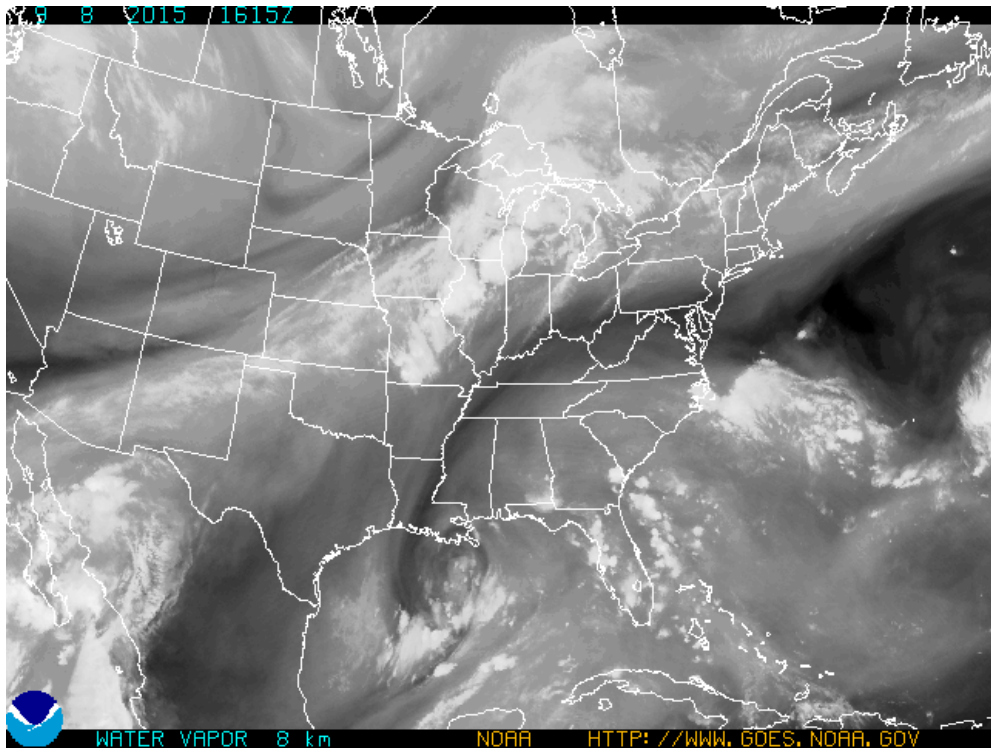
GOES East Water Vapor Maps

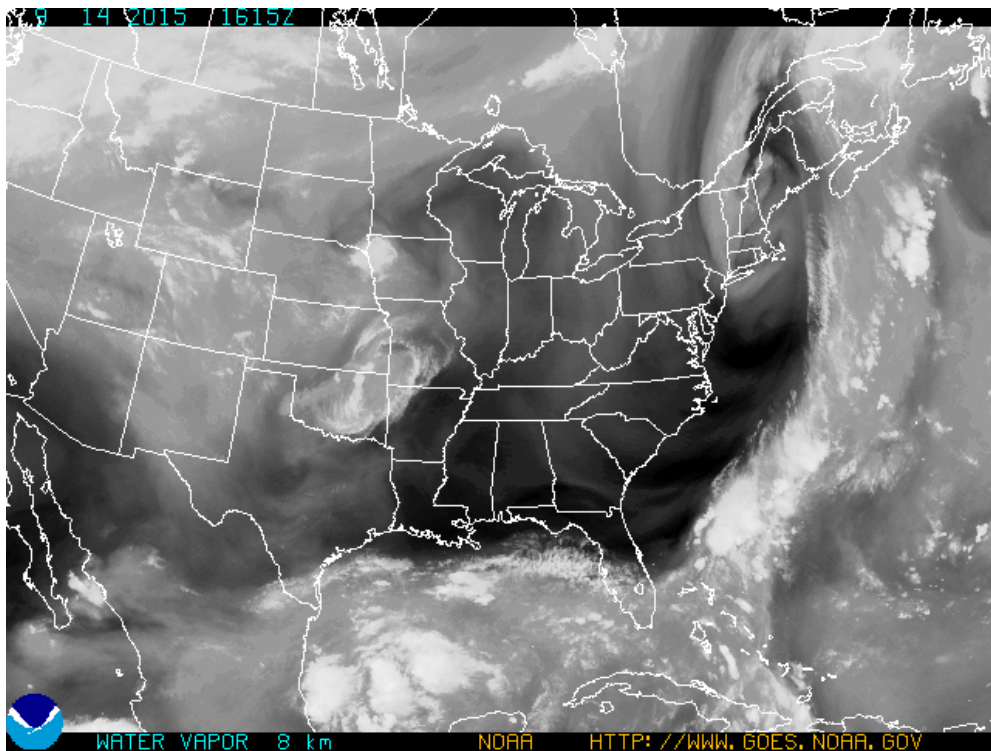
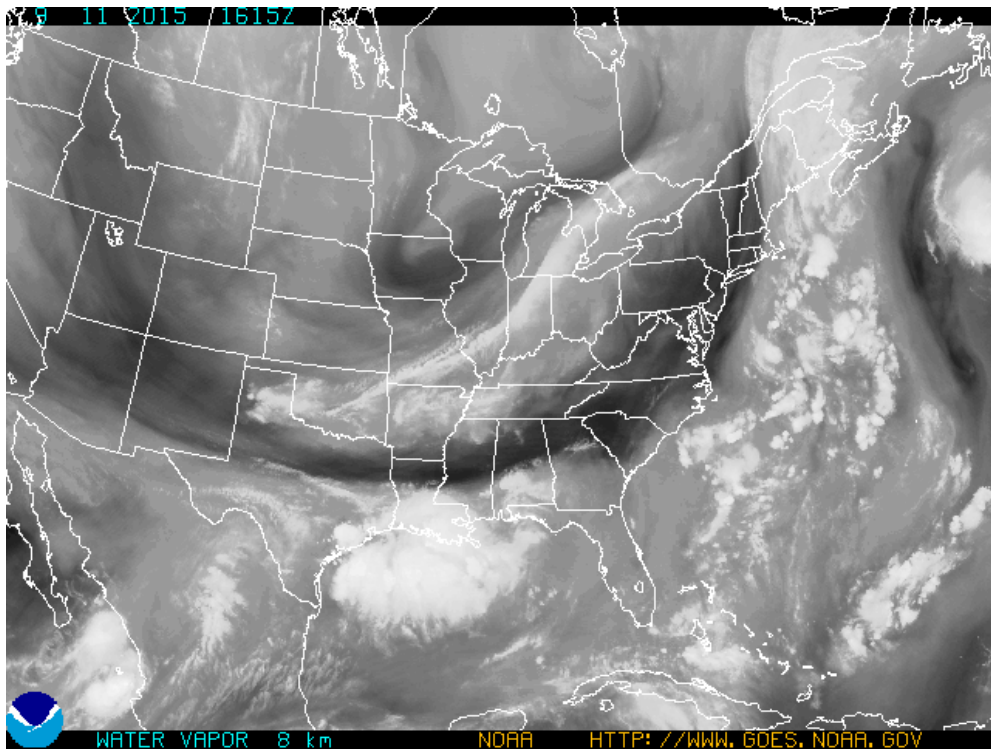


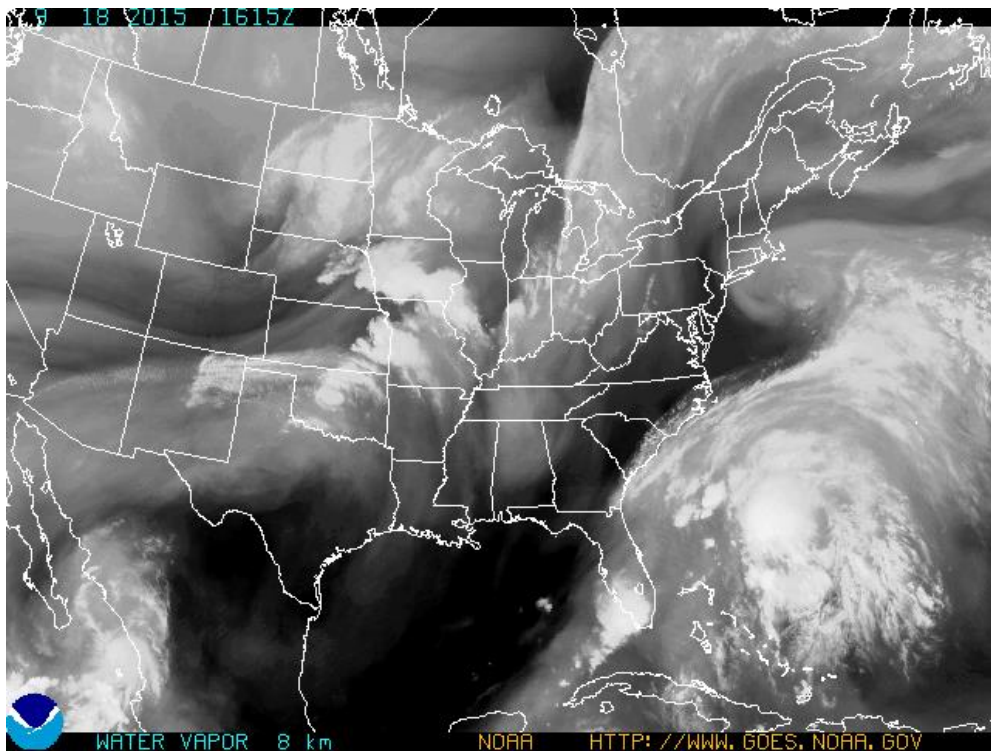
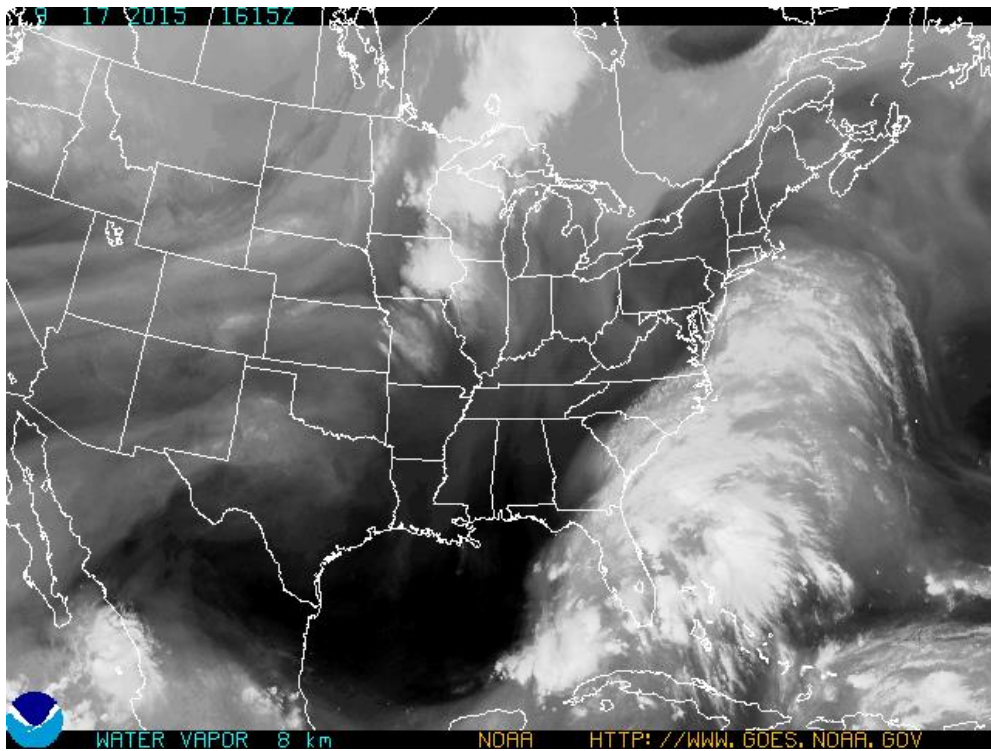












References

NOAA GOES East Satellite Images

<http://www.goes.noaa.gov/srctheast.html>

Standard Solar Spectra

<http://pveducation.org/pvcdrom/appendices/standard-solar-spectra>

GOES Imager Spectral Bands

[http://cimss.ssec.wisc.edu/goes/webapps/bandapp/GOES Imager Spectral Bands overview.pdf](http://cimss.ssec.wisc.edu/goes/webapps/bandapp/GOES_Imager_Spectral_Bands_overview.pdf)