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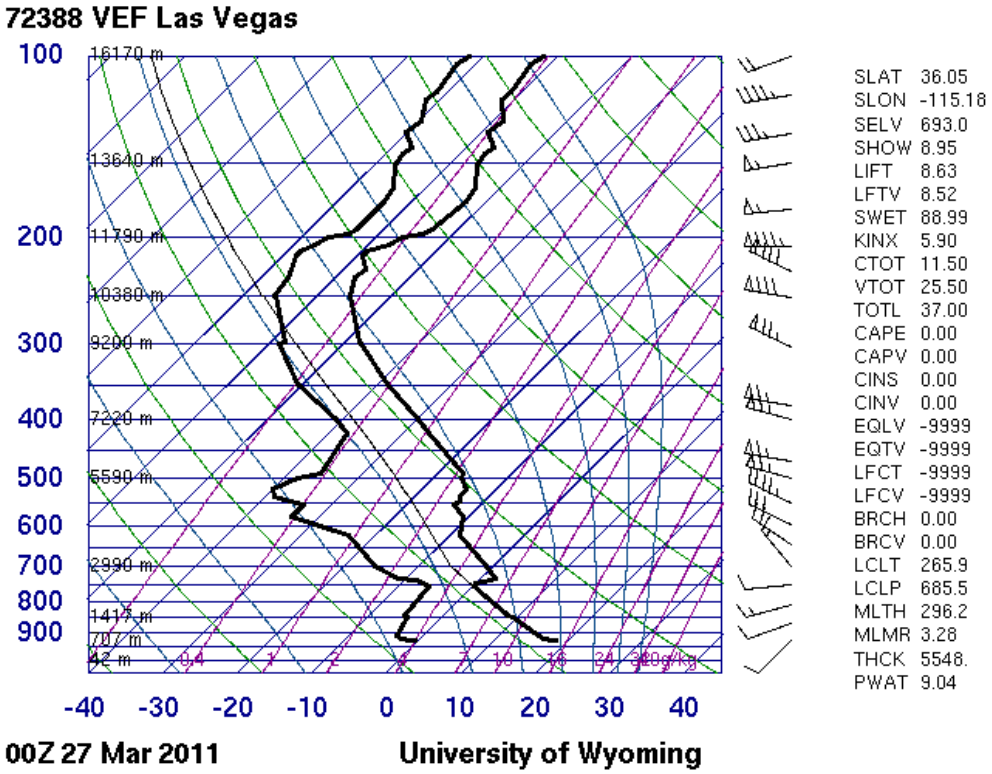
This image was produced as an assignment for a flow visualization class taken at the University of Colorado. The specific assignment was to investigate the appearance and underlying atmospheric conditions that create clouds that we see everyday. This is the second clouds assignment assigned by Professor Hertzberg. This picture was taken on March 26, 2011 after leaving Sand Diego on route for Denver International Airport. From the air it was a particularly sunny day with a very blue sky background and nice rolling clouds which will be investigated both scientifically and aesthetically in the following sections.

The cloud image was taken from a United Airlines aircraft from about midway along the body of the plane. The image was taken facing North-West and from the vantage point the clouds extended as far as the eye could see. The image was taken at approximately negative 15-20 degrees from horizontal. The image was taken at approximately 5 o'clock local time (west coast time) (approximately 6PM MST) on March 26, 2011. The original image was taken about 40 minutes before sunset and the focus of the image is on the rolling clouds visible below the plane.

The clouds visible in the image are altostratus undulatus clouds[i]. The image was taken on a nearly completely cloudy day with very little to no direct sunlight visible from the earth's surface. Since there was so much vaporized moisture present the clouds appeared to be one giant mass that was not subject to random currents. This is the main reason why the cirrus clouds are so contained and not elongated or thin with the appearance resembling altocumulous mamma and lenticularis clouds. The clouds have an undulatus designation due to their wavelike appearance clearly visible in the image. The constant weather which occurred from March 25 to February 27 allowed for the clouds to stay rather compact as the water vapor was not subject to varying flow. The especially blue appearance of the sky in contrast to the white sheets of cirrus clouds was appealing to the eye.

As observed in the skew-T plot below, the weather on March 26, was relatively mild. The dew point curve does take some erratic movement between 1000 and 7200 m, and then drastically increases at around 12,000 m.[ii] This is most likely the elevation at which the altostratus clouds occurred. When the dew point rises significantly the humidity in the air often condenses and crystallizes to become visible to the human eye as clouds.[iii] Altostratus undulatus clouds typically contain 65 ice crystals per cubic centimeter and the length of each of these ice crystals is usually .44 micrometers long. [iv] The 7000 m is a little high compared to the typical 1200 to 6000 m average height of stratus clouds, the overall wavelike appearance and lack of light penetration suggests that the clouds are more closely related to altostratus clouds rather than cirrus clouds.[v] Also San Diego's high humidity and corresponding wet climate on the day of the image may result in slightly atypical cloud elevations and characteristics as compared to other locations.



In this photograph, the field of view is approximately 1000 yards across at where the first wave occurs in the clouds and possibly 100 miles at the horizon. The clouds occurred at ~7000 meters, correlating to a total distance of about 11,000 m (45 deg. Angle). The specific lens used is a 100mm macro lens present on the Cannon 5D MarkII. The camera is of course a digital camera and the aperture was f4, Shutter Speed was 1/125th of a second and ISO settings were 250. The image was further processed using Adobe Lightroom 2 in order to increase the contrast, slightly reduced the glare, and gave the image a slightly warmer feeling light.

This image reveals the science of pressure, temperature, humidity and dew point that allows the atmosphere to contain lots of water but only visibly show it in certain occasions. In this instance the dew point was high enough at a certain range of elevations for the water vapor to condense and freeze to become visible water particles. In other occasions it is interesting to think that lots of cumulonimbus clouds can fill a sky and then only when an exact threshold is crossed will the water precipitate into rainstorms that are commonly observed. In the case of the present image no such combination of storm fronts and high pressure or low pressure systems existed. The atmosphere present on South Nevada and the edge of California was overall fairly consistent with no major random wind gust or counteracting flow. If I was to redo the image, I may have tried to take a picture at sunset as the clouds at sunset were particular beautiful in the hours that followed the time of the picture. Also I was hoping to do a traditional shot of lightning

while leaving the lens open for a prolonged period of time, and unfortunately the dry weather of Boulder did not afford me the possibility in the time span requested.

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[i] "Altostratus - Clouds Online." *Cloud Atlas - Cloud Classification, Cloud Pictures*. Web. 20 Apr. 2011. <http://www.clouds-online.com/cloud_atlas/altostratus/altostratus.htm>.
[ii] *Unisys Weather*. Web. 20 Apr. 2011. <http://weather.unisys.com/upper_air/skew/details.php>.
[iii] "The Water Cycle: Condensation, from USGS Water Science for Schools." *USGS Georgia Water Science Center - Home Page*. Web. 20 Apr. 2011. <http://ga.water.usgs.gov/edu/watercyclecondensation.html>.
[iv] "Cloud Liquid Water Content, Drop Sizes, and Number of Droplets." *UWyo Dept. Atmospheric Sci*. Web. 20 Apr. 2011. <http://www-das.uwyo.edu/~geerts/cwx/notes/chap08/moist_cloud.html>.
[v] Palmer, Chad. "USATODAY.com." *News, Travel, Weather, Entertainment, Sports, Technology, U.S. & World - USATODAY.com*. 16 Oct. 2005. Web. 20 Apr. 2011. <http://www.usatoday.com/weather/wstratus.htm>.