

# Clouds

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**Ben Maples**

**MCEN 5228 – Flow Visualization**

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## **Abstract**

This cloud image was taken for the first cloud image assignment of the University of Colorado at Boulder Mechanical Engineering course MCEN 5228 – Flow Visualization. The objective of this assignment was to observe and photograph clouds in order to gain a better understanding of the fluid dynamics of our atmosphere. This cloud image was intended to show the altocumulus undulatus cloud type. The image was taken in the hope that with this visualization more individuals will be able to appreciate and understand the complex fluid relations behind this commonly seen phenomenon.

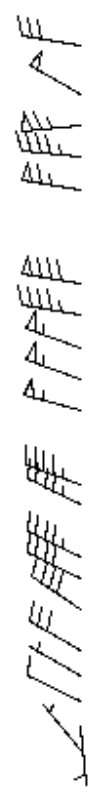
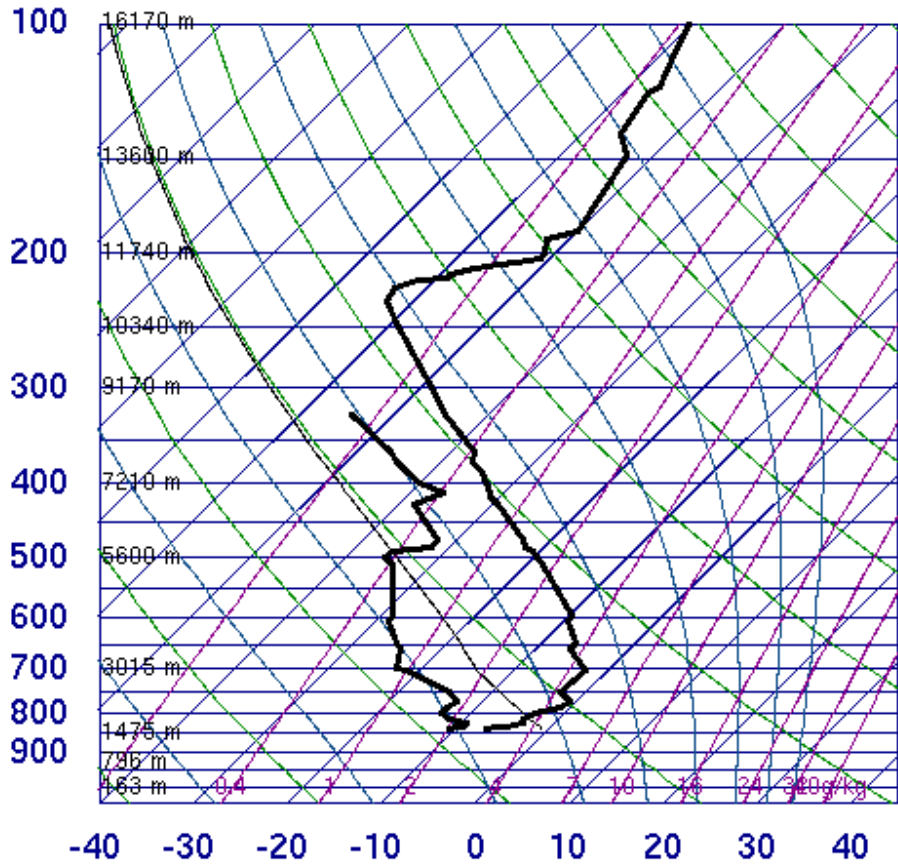
## **Location**

The image of the altocumulus and altocumulus undulatus clouds was taken outside the security gate at the National Wind Technology Center in south Boulder, Colorado. The National Wind Technology Center is located on West 120<sup>th</sup> avenue near the intersection of Colorado state highways 93 and 128. The image was taken facing due south at an inclination of roughly 15 degrees on January 26<sup>th</sup>, 2010 at 8:48 am MDT.

## **Cloud Information**

The clouds presented in this image are of the altocumulus and altocumulus undulatus family. The majority of the clouds happen to fall in the altocumulus category but the “waviness” of one of the clouds puts it into the undulatus group. The rest of the sky, particularly when viewing north, was mostly clear and void of clouds, though isolated altocumulus clouds could be spotted. The previous day was mostly clear with scattered altocumulus clouds and the following day saw a mostly overcast sky. The atmosphere was stable at the time of the image as well as at least 12 hours before and after the image capture as seen in Figure 1.

## 72469 DNR Denver



SLAT	39.75
SLON	-104.87
SELV	1625.
SHOW	-9999
LIFT	14.78
LFTV	14.77
SWET	-9999
KINX	-9999
CTOT	-9999
VTOT	-9999
TOTL	-9999
CAPE	0.00
CAPV	0.00
CINS	0.00
CINV	0.00
EQLV	-9999
EQTV	-9999
LFCT	-9999
LFCV	-9999
BRCH	0.00
BRCV	0.00
LCLT	259.9
LCLP	711.7
MLTH	286.4
MLMR	1.96
THCK	5437.
PWAT	4.14

12Z 26 Jan 2010

University of Wyoming

Figure 1: Skew-T plot for Denver at 6:00 am MDT on January 26<sup>th</sup> 2010.

From this skew-t plot we would expect that clouds would be in the 5600 meter to 7500 meter level because of the proximity of the dew point line to the temperature line. With altocumulus clouds expected up to elevations of 6100 meters and the fact that the image was not taken at the same location as the skew-t plot, the observed clouds agree with what would be expected from viewing the skew-t plot. From visual cues and information from the skew-t plot, it is estimated that the observed clouds were around 20,000 feet in elevation. The altocumulus undulatus cloud that was observed could have been expected from the skew-t plot because near the estimated elevation of the clouds there is a shift in wind velocity. The difference in wind velocity creates a layer in the atmosphere under high shear which causes the clouds to form “waves” or “ripples”.

## Camera Settings

The photo was taken as a digital image with a Casio EX-Z600 set with a focal length of 18.6mm in order to capture the entire sky filled with clouds and not just a single cloud. F-Stop of 8.3, exposure time of 1/320 sec, ISO of 50, size of 2816x2112 pixels, and an aperture value of 2.8 was chosen to capture the clearest image of the clouds while at the same time remaining focus on the foreground for size comparison. No cropping or alteration of the image was done in order to preserve and present the original beauty of the clouds to the viewers.

## Conclusions

This image shows the beauty that clouds can have and the physical phenomena needed to produce these events. Overall the image that was captured came out very well. The photo clearly presented the style of clouds attempted to be captured and it was done in a visually pleasing way. Though overall the image came out well, in the future it would be nice to be able to use a higher quality camera that would allow for better focus on the clouds. Also, a camera that would allow for more zoom so that a more detailed image of the cloud itself could be observed would be appreciated.

## Works Cited

*Alto cumulus undulatus cloud*. (2010, February 27). Retrieved February 27, 2010, from Wikipedia: [http://en.wikipedia.org/wiki/Alto cumulus\\_undulatus\\_cloud](http://en.wikipedia.org/wiki/Alto cumulus_undulatus_cloud)

University of Wyoming. (2010, February 27). Atmospheric Soundings. Wyoming, United States of America.