Course: Flow Visualization

Assignment: Clouds 1

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Final Picture:

Fig.1: Final Picture

Introduction:

The Cloud picture was taken towards the first clouds assignment for Flow Visualization course. The atmosphere is a very complex system that is a product of both natural and manmade perturbations and my main intent was to capture a lot of information as possible to represent the system. The best place for that would be up the Flagstaff Mountains because it gives a good elevation and a wider field of view that can deliver a good representative picture. The first attempt was made on Feb 15th 2014 and because of turbulent weather, the pictures did not convince me. There was a predominance of dynamic mountain wave clouds and it did not make sense for me to take a picture that could represent the conditions of that day. A video would have made sense but I was fixed on executing the idea of one big picture. Few examples of pictures taken on Feb 15th 2014 follows for reference.

Fig 2.1: Day 1 Mountain wave clouds (East)

Fig 2.2: Day 1 Mountain wave clouds (West)

Clouds:

The clouds observed were of the following types

1. Mountain Wave Clouds
2. Stratocumulus stratiformis opacus undulatus
3. Altocumulus stratiformis perlucidus
4. Cirrus undulatus

The respective names have been labelled in fig. 3.

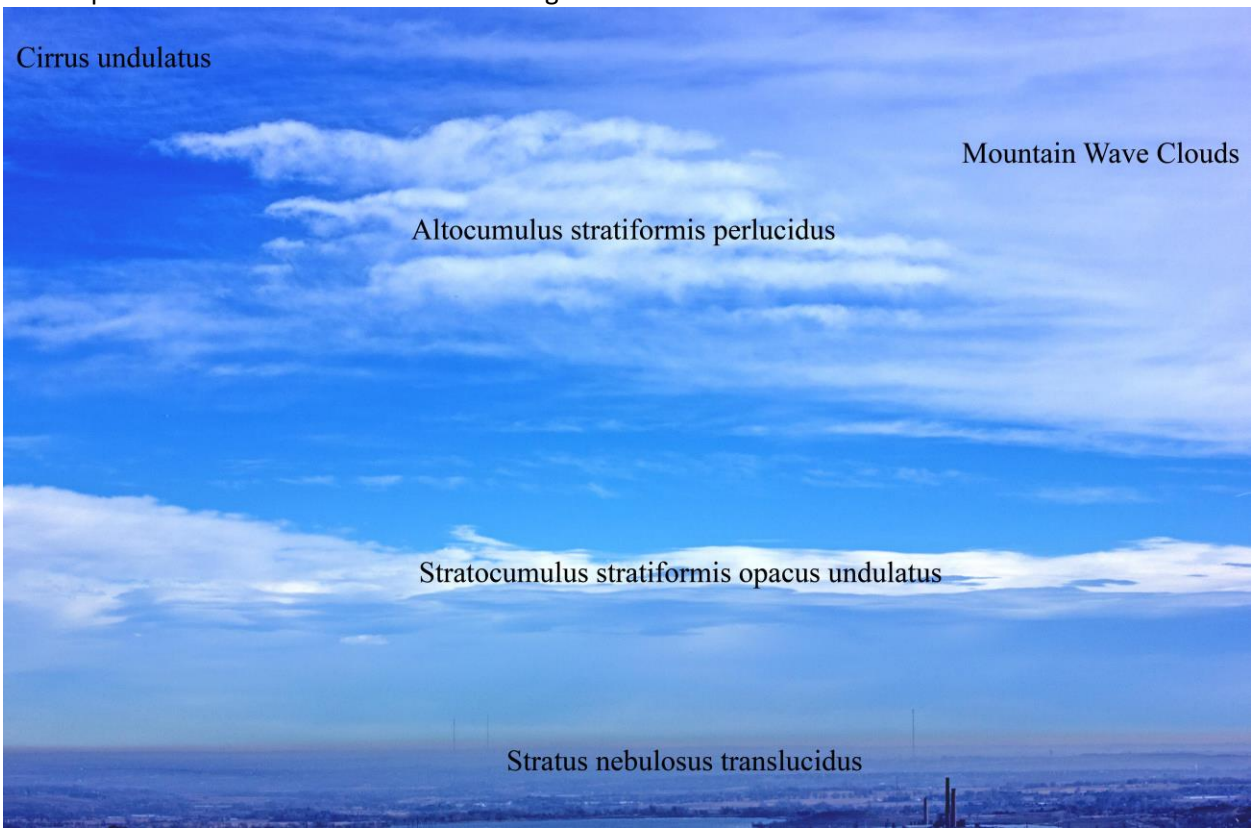

Fig.3: Clouds

In addition to clouds other atmospheric phenomena like industrial smog and the natural optical effect of Stratus Nebulosus were also observed. The closest comparison for the Stratus Nebulosis effect observed here is found on Wikipedia[1] article http://en.wikipedia.org/wiki/List_of_cloud_types

The Stratus nebulosus can be classified into its subtype Stratus nebulosus translucidus due to its low fog like translucent nature giving a slight brownish orange gradient visual effect.

The Mountain Wave Clouds seemed to emerge from the western side of the flatirons glancing its top.

Stratocumulus clouds spotted are classified as Stratocumulus stratiformis opacus undulatus because of its slightly lumpy appearance, undulated base and opaque nature.

The Altocumulus clouds observed in the picture are further classified as Altocumulus stratiformis perlucidus due to its fringed appearance with translucent streaks.
The Cirrus clouds in the picture are classified Cirrus undulatus because of its fringed undulated appearance.

Atmospheric conditions:

Physical atmospheric conditions on 15th Feb 2014 at Boulder was mostly stable. The clouds were stable and there was a mild west to east wind. The wind was pushing mountain wave clouds to the east which can be seen to the right of the picture.

The nearest applicable Skew-T[2] diagram from Denver also confirms a stable atmosphere with small chance of precipitation. It can be seen that the CAPE number is zero indicating a stable atmosphere. In fact, there were few wind carried droplets that fell sometime around 4 PM.

From weatherspark.com the cloud ceiling was found to range from 6500-9000-11000 ft. which matches with the picture. The 6500 ft. clouds were mostly mountain wave clouds, 9000 ft. clouds were altocumulus, stratocumulus and cumulus and 11000 ft. cirrus clouds.

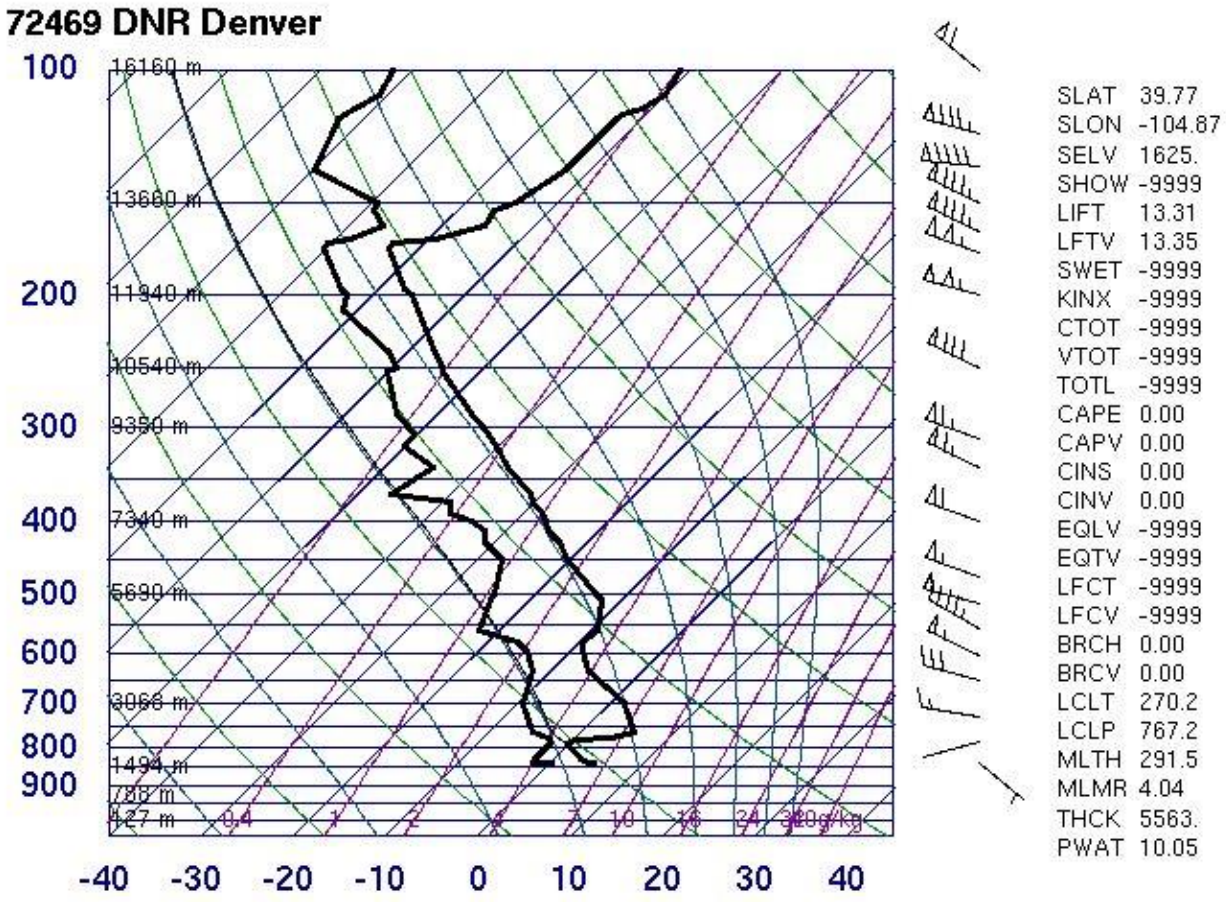

Fig 4: Skew-T plot (Image Credit: University of Wyoming, Department of Atmospheric Science)

Photography:

The shooting spot was at Panorama Point & Fee Station, Flagstaff Rd, Flagstaff, CO 80302 before Flagstaff House at an elevation of approximately 5800 ft. (Coordinates: 40.005934, -105.292518)[3]

The Image details are as follows

File Name	IMG_1300.CR2
Camera Model	Canon EOS REBEL T3i
Firmware	Firmware Version 1.0.2
Shooting Date/Time	2/16/2014 10:56:53 AM
Owner's Name	
Shooting Mode	Program AE
Tv(Shutter Speed)	1/500
Av(Aperture Value)	9.0
Metering Mode	Evaluative Metering
Exposure Compensation	0
ISO Speed	100
Auto ISO Speed	ON
Lens	EF75-300mm f/4-5.6
Focal Length	75.0mm
Image Size	5184x3456
Image Quality	RAW
Flash	Off
FE lock	OFF
White Balance Mode	Auto
AF Mode	Manual focusing
Picture Style	Auto
Sharpness	3
Contrast	0
Saturation	0
Color tone	0
Color Space	sRGB
Long exposure noise reduction	0:Off
High ISO speed noise reduction	0:Standard
Highlight tone priority	0:Disable
Auto Lighting Optimizer	Standard
Peripheral illumination correction	Enable
Dust Delete Data	No
File Size	21129KB
Drive Mode	Self-Timer Operation

The picture was taken with a pitch of $+20^{o}$ pointing upwards to the clouds as subject. The focus was infinite towards the horizon to get as much detail in the picture.

Post Processing:

Fig 5: Original Picture

The original image was shot with 1° roll clockwise due to uneven terrain. The picture was rotated 1° counterclockwise to make it straight and the excess non orthogonal portions on the sides were cropped.

The Color temperature was reduced by 5% using Adobe Photoshop[4] to compensate excess brightness due to solar radiation and to enhance the blue of the sky.

The stacks of the Walmont power plant and the transmission tower in the far end of the picture were not removed to provide the viewer a reference to understand the perspective.

Review:

The image came out as a representation of the dynamic atmosphere as envisaged. The image visually portrays variety and complex nature of the atmosphere. The stratus nebulosis on the background and the fossil fuel fired power plant in the foreground gives a strong statement about atmospheric perturbations invoked by humans and the extent to which we are modifying the natural cycle and its effects calling for responsible action. Though the picture expresses the physics and fluid phenomena there is a possibility of improvement in the photography. The image could be made bolder and vibrant to please the eye. Also, ensuring a proper zero angle for the camera in the future using a spirit level would prevent loss of data in rotation and cropping.

References:

1. Wikipedia article titled ‘List of Cloud Types’
2. Fig.4: Skew T Atmospheric Sounding chart generated using open source software owned by University of Wyoming, Dept. of Atmospheric science
3. Coordinates generated using Google Maps
4. Image post processing done using Adobe Photoshop licensed to University of Colorado, Boulder
5. Cirrus undulatus