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MCEN 5228 – Flow Visualization
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Clouds II

The purpose of the cloud assignment is to capture atmospheric conditions made visible through clouds. Clouds can be indicators of many different atmospheric conditions. They can give indications as to the stability of the air, the wind speed in different regions of the lower atmosphere, the relative humidity, as well as many other phenomena. In addition to this, clouds are also fascinating flow visualizations available to everyone on almost any day.

The cloud image seen below was photographed on the Antarctic Peninsula, Antarctica at 4:00PM on January 4, 2006. The image was taken at sea level near the Portal Point region, 62°02'S 63°58'W, of the peninsula (figure 2) and the clouds are beautifully illuminated by the sun. At this time of the year, there is 22 hour daylight in Antarctica. This also means that the sun travels around the sky (along the horizon rather than the usual east to west) and thus is always at an angle to the horizon (never at 90° directly overhead). Because of this, the sun frequently illuminated clouds in such a way that produced wonderful (almost sunset-like) colors and images.

These clouds appear to be a stratocumulus cloud formation. In Antarctic regions, stratocumulus clouds often occur as dark, heavy rolls which form in bands or columns across the sky [1]. Stratocumulus clouds are low level atmospheric clouds, and the ones pictured are likely at an elevation of 1000 – 2000 meters [2] above the ground (from sea level). The temperature on the day of the photograph was +3 °C with a sea temperature of +4°C. The wind speed and direction was 9 m/s at 60°, and the barometric pressure on January 4, 2006 was steady at 997 hPa (0.98 atm). The stable barometric pressure means that the weather was not changing. In cool regions (i.e. the Antarctic) the barometric pressure can typically read high, because the cold temperatures cause the air to fall. The somewhat low pressure value on this day can explain the clouds seen, and because the barometric pressure is not significantly low, no precipitation occurred. Precipitation is also very rare in the Antarctic, as it is actually a very dry climate – it is theoretically a desert.

Figure 1: Vertically propagating altocumulus mountain wave clouds illuminated by sunrise.

Figure 2: Map of region of Antarctic Peninsula in which image was taken.

Stratocumulus clouds are very similar to stratus clouds. They are differentiated from stratus in that stratocumulus clouds have identifiable elements. Individual cloud elements within the stratocumulus formation, and specifically within cloud streets as can be seen in figure 1, can become more vigorous and take on the form of small to moderate cumulus cloud formations[2]. This event might also be occurring in the image, as several of the cloud formations appear to be transitioning to a cumulus congestus form. Another possibility is that cumulus congestus clouds are spreading out to form stratocumulus cumulogenitus clouds. This can occur in the presence of strong winds[3]. On the day of the photograph, the surface wind speed was 9 m/s. This wind may have contributed to the spreading out of cumulus clouds to create a stratocumulus formation.

The visualization technique used is the photography of clouds in Antarctica. No lighting was used aside from that provided by the sun. The spatial resolution based on the field of view and the pixilation of the image (see below) is around 0.87 meters/pixel. Based on an estimated flow speed of 9 m/s (rotation within the cloud) and a shutter speed of 1/200 sec, the cloud will not blur across any pixels in the photograph.

Photographic Technique:

- Size of the field of view (estimate): 3000 m x 2000 m = 6 km^2
- Distance from object to lens: ~3500 m
- Lens focal length: 75 mm
- Type of camera: Canon EOS Digital Rebel XT, 8.0 Mega Pixel Digital Elph
- Exposure Specs: Aperture – f/5.6, Shutter speed – 1/200 sec, Focus – Auto focus, Image Pixilation – 3456 x 2304 pixels, ISO – 400
- Photoshop processing: None

This image shows an Antarctic stratocumulus street cloud formation. These stratocumulus clouds may be forming due to the spreading out of cumulus congestus clouds in the presence of strong winds. There is also another possibility for the apparent transformation of cloud types; some of the individual cloud elements in the formation may be transforming into cumulus congestus clouds. Whichever the case, the primary cloud formation present is stratocumulus street clouds in the presence of a few cumulus congestus clouds. I like the colors in the image that resulted from the angle of the sun with respect to the horizon. I also like how the landscape

compliments the image and gives a sense perspective with regard to the height of the clouds, but does not have so strong a presence as to appear more prominent than the clouds. Overall there is very little I would change about the image; I am very pleased with the artistic quality of this image and am also pleased to have captured the atmospheric phenomena previously described.

References

[1] http://www.antarcticconnection.com/antarctic/weather/clouds.shtml
[2] Cloud Dynamics. Robert A. Houze, Jr. Academic Press: 1-25.
[3] International Cloud Atlas, abridged. World Meteorological Organization. 1969. Pl 9.