UNIVERSITY OF COLORADO - BOULDER

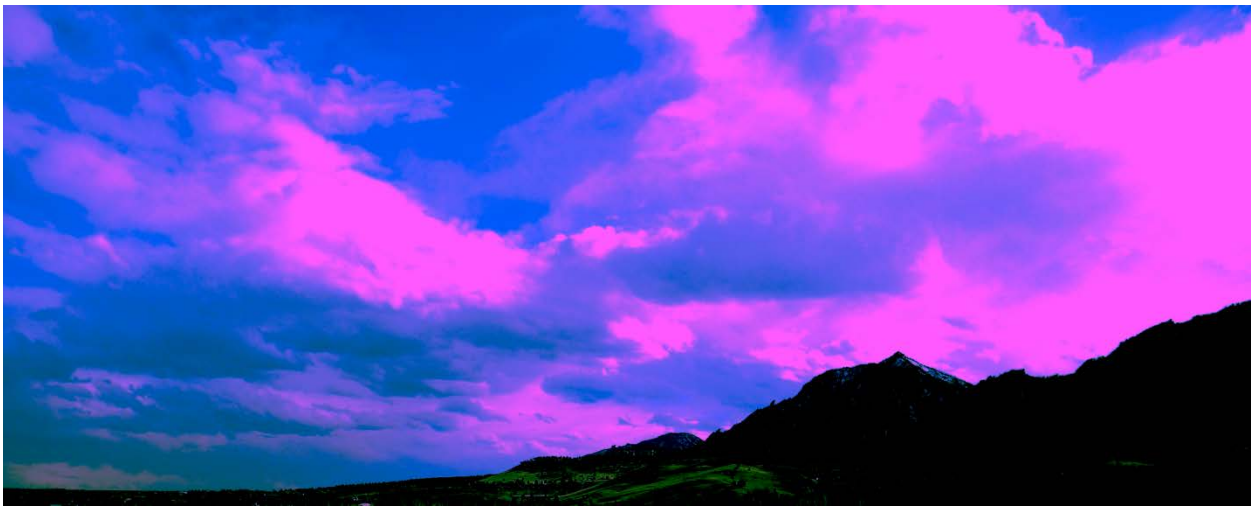
Flow Visualization

Clouds 2

By: Daniel Lopez

4/16/2013

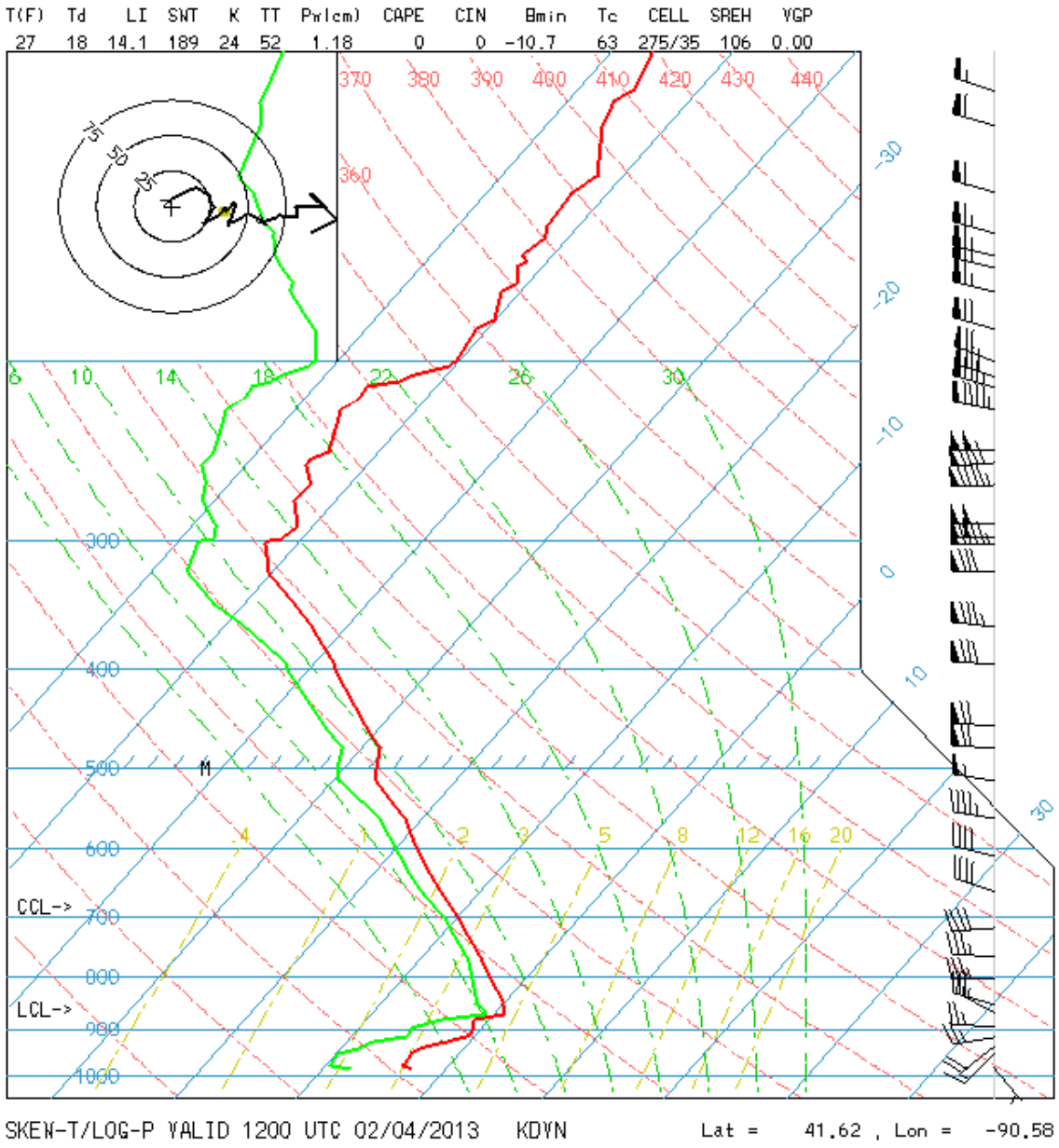
MCEN 4151 – Professor Jean Hertzberg



I still find clouds hard to understand. There are many different types at different heights experiencing different forces. Sometimes they are an overcast mess and indistinguishable. Other times the clouds are sharply defined. The intent of this image was to capture variety. However, the intent was lost in editing. I ended up liking the artistic skyline and colors is the augmented image even though it is harder to distinguish cloud formations.

This photo was taken on April 4th 2013 at 4:00 PM mountain time. The photo was taken from 10 floors above ground level facing South with the setting sun to the right. The center foreground building, in the un cropped image, is JILA (Joint Institute for Laboratory Astrophysics). There was steady wind from the west and the surface temperature was 45 degrees Fahrenheit.

I believe the large center cloud is a stratocumulus created by a hydraulic jump off the front range. Mountain waves are characterized by the Froude number which is the ratio of characteristic velocity to the wave propagation velocity[3]. When the ratio is balanced, about equal to one, standing waves form[1]. The wave propagation velocity is determined by the atmospheric stability and mountain's change in height. The constant wind from the west likely matched the needed velocity given the Front Range is about 1,500 feet and was a very stable temperature gradient up to the lower condensation limit. The cloud was stationary and possibly pinned by the inversion at 860 hPa. There were no other clouds at the same elevation.



Skew-T Diagram from UCAR's Archive[2].

A Nikon Coolpix L100 camera was used with F-stop f/3.5, 1/6 second exposure time, ISO-800, 5mm focal length, and3.6 aperture. Photoshop was used to darken the skyline and bring out details in the clouds by adjusting color contrast.

This image does not reveal much in the way of fluid physics. The focus is on the number of cloud types and beauty of Bear Peak Mountain.

Work Cited:

[1] "Advances in Meteorology, Climatology and Atmospheric Physics - Springer." *Advances in Meteorology, Climatology and Atmospheric Physics - Springer*. N.p., n.d. Web. 05 Mar. 2013.

[2] "Image Archive." *Image Archive*. N.p., n.d. Web. 05 Mar. 2013.

[3] "Froude Number." *Froude Number*. N.p., n.d. Web. 05 Mar. 2013.

Original Photo: