Make a point of personally observing an atmospheric, geophysical, or atmospheric optical phenomenon. Observe the phenomenon closely. Any observation that you personally witness during the current semester, and has a relation to the subject matter of this course is fair game. (Examples include atmospheric optics--rainbows, halos, color variations in the sky, etc., condensation of water, cloud formation, dispersion of pollution, behavior of waves breaking, stream flow, effects of wind on water, climatic effects on landforms, Doppler effects--passing ambulance, etc.) Choose a single observation for your subject. Creativity in the choice of your observation and in doing the assignment will be rewarded in the grading. Note points in parentheses below.

Requirements

1. Describe the setting of your observation, including date, time, place, and any circumstances which contribute to the phenomenon. (note: this observation must occur between now and the due date for the assignment.)(10)

2. Describe the phenomenon in detail. Pay careful attention to detail. Use of your creative writing abilities is encouraged. (10)

3. Illustrate the phenomenon or a relevant aspect of the setting or physical mechanism(s) involved with a photograph and/or a sketch or artwork. Digital photographs are preferred and the assignment can be emailed to me at businger@hawaii.edu. Cell phones usually take poor photos (blurry), which will result in a discount in the grading. Try to preserve the relative scales in any sketches or artwork. Creativity in photography or artwork is appreciated. (40)

4. Give a concise explanation of what physically is producing the phenomenon. Refer to the text for this part of the assignment. Include images from the weather server (e.g., a satellite view, sounding, or analysis map) as part of the explanation. http://weather.hawaii.edu (40)

The more specific your choice of observation, the easier it will be to fulfill each of these four steps. The final product should be about one type written page plus an illustration.
SKY PHOTOGRAPHY

Have you ever driven down a road or hiked a trail when the spectacle of the sky was so striking that you stopped dead in your tracks?...if only you had a camera handy. But even nature’s less remarkable skies often include relatively rare and photogenic events. In this short essay I will discuss several of the keys to becoming a good sky photographer and capturing those stunning images.

**Key number one:** The most important ingredient in becoming a successful photographer of the sky is keeping a camera with you. In recent years this has become easier with the arrival of lighter weight 35 mm cameras and digital cameras that combine increased capabilities with ease of use. Many professional photographers prefer single-lens reflex cameras, in which metering and composing are achieved through the lens. However, publishable photographs can be obtained with modern point-and-click models. It can be awkward carrying a camera with you everywhere you go, but as soon as you decide to leave it behind the best rainbow or most dramatic sunset you have ever seen will appear (call it Murphy’s intervention). I keep a camera in my car at most times, and a second one at work; and still I’m caught off guard. It is not enough to have a camera close at hand; you also need memory and live batteries, which tend to run out just as the funnel cloud starts to form. One solution is to keep extra memory cards and batteries on hand. If you are interested in selling your work, it is useful to note that many markets prefer digital files larger than 6 mb for better resolution. Slower ISO speeds ($\leq 200$) give finer grain resolution and provide the best results in bright daylight conditions. Indoors and in the evening higher ISO settings (>800) will keep the image from blurring. The highest ISO setting will result in more noise in the image.

**Key number 2:** Keep an observant eye. Make a habit of searching the sky whenever you exit your home, office or any building. Many visually striking weather phenomena in the atmosphere are fleeting and often occupy only a fraction of the heavens. Therefore, persistent attention to details of the sky will result in dramatic images. Sometimes the brightness of the sun and our healthy tendency to avoid looking towards it causes us to miss some of the most beautiful displays of atmospheric optics (e.g., halos, iridescence or coronas) produced by a variety of thin clouds close to the sun. In looking for such phenomena cover the sun with your extended hand and use of a good pair of sunglasses to enhance the contrast in the clouds, and to protect your eyes from the sun’s harmful ultraviolet rays.

**Key number 3:** Careful composition is the third key to good sky photography. Try to balance the areas of the photograph. To make your compositions more balanced and compelling, divide the viewfinder into thirds in your mind. Then place the subject or focus of your photograph at one of four resulting points of intersection. Choose the foreground of your sky photos carefully. For example, reflections of the sky in a lake or pond can give added interest to the foreground and create dynamic images. Similarly, the use of tree branches to frame a special cloud can add interest to an
area of an image that otherwise lacks detail. On the other hand avoid clutter, such as telephone wires, that distract from your subject. Choose the right lens to show the subject to best advantage. Telephoto lenses are great for isolating areas of special interest in the sky. A strong telephoto is needed to capture a good example of a mirage or the fleeting “green flash” as the sun sets over water. Similarly, the best lens for catching halos and rainbows is a wide angle lens. To photograph an entire double rainbow requires a 90˚-viewing angle. Ironically, wide-angle lenses are more challenging to compose with than telephoto lenses for the very reason that their field of view is so wide.

Some hints for taking special photos: Despite its fleeting nature, good photographs of lightning are surprisingly simple to obtain provided you approach the subject with caution and a bit of patience. On the next stormy night, choose a protected place (e.g., inside a truck) and place your camera on a sturdy tripod (or sand bag) to steady it against jarring from the wind. Select the shutter speed setting that allows the lens diaphragm to remain open while the shutter release is depressed (use the “b” setting for the shutter speed selection in cameras with manual override). Then press the shutter release and wait. Once a bright flash of lightning is observed through the viewfinder let go of the shutter release. The lightning will expose the camera charge coupling device (CCD) chip much as a flash bulb would. To get a really “striking” image leave the lens open for the duration of several lightning strokes.

When shooting halos and coronas that surround the sun you must point the camera directly at the sun. Contrary to intuition, shooting into the sun does not harm your camera, but will often result in underexposure of the subject you’re trying to capture. To avoid this problem it is advantageous to block out the sun with an object such as a treetop or flagpole, and if your camera allows, spot meter the subject for correct exposure. When shooting near the sun, shade the front of the lens to eliminate reflections that are internal to the lens (resulting in those artificial hexagonally-shaped flares in the photos).

Some special cautions: Despite the opportunity to acquire stunning photographs, weather phenomena that inspire great awe such as tornadoes and hurricanes must be approached with extreme caution, and are perhaps best left to professional meteorologists. Hurricanes in particular make poor subjects to approach, not only in the threat that they represent to your health, but additionally your presence can interfere with critical emergency evacuation, rescue and relief efforts.

Parting shot: On your next excursion do pack a camera, and keep your eyes to the sky. You will be rewarded for your persistence and patience in more ways than just good photography. Happy hunting, Steven