Detection of Contrails easy with Image Enhancement  
January 25 2009

Contrails are ubiquitous in this era of heavy air traffic, emanating from jet aircraft as elongated tracers in the sky. Like cirrus clouds, contrails are formed of ice crystals. In fact, contrails interact with natural cirrus clouds in a profound way. This You Tube video shows that under certain atmospheric conditions, they cease looking like contrails and evolve into cirrus clouds, leading some to speculate that increases in cirrus clouds due to contrails could affect global climate. Environmental satellites have a unique role in their detection. Unfortunately, without special enhancements, satellite images often show little or no trace of contrails.

NexSat provides a multispectral enhancement that greatly improves contrail detection. The left image below shows what contrails look like from ground level. The NexSat image on the right shows a contrail enhancement product over southern California, derived from the EOS MODIS sensor. Notice the huge number of streaks oriented roughly in alignment with the northwest/southeast air routes.
Infrared images show cirrus clouds well, but contrails tend to be masked by several factors: 1) surrounding natural cirrus with a similar cloud temperatures may mask contrails and 2) transparent contrails can be confused with the surface background characteristics. As a result, it is often difficult to spot contrails with standard satellite products. In the MODIS infrared image below (upper left), we see scant evidence of contrails over Lake Superior. But the contrail enhancement of the same scene (lower right) brings out the contrails as unmistakable streaks. This contrail enhancement technique exploits the brightness temperature differences between two longwave infrared channels (known as “split window”). The greater the difference, the more apparent the thin cirrus and contrails become (reference at bottom).

One of the most popular MODIS products is true color. NPOESS VIIRS will be the first operational weather sensor to provide this product. True color combines three visible channels into a product which simulates natural vision, i.e., what an astronaut would see from space using his or her own eyes. Yet despite its viewing capabilities, true color is woefully deficient when it comes to locating contrails. This is because true color is based on three visible images from the red, green, and blue wavelength bands. Thin cirrus is largely transparent in visible wavelengths, and therefore does not appear well in true color imagery.

The image at the lower left shows true color over southern California. A variety of low clouds appear over land areas, and thick cirrus appears prominently over the ocean. But
contrails are notably absent. However, in the special enhancement of the same scene on the right, contrails appear as numerous thin lines over land and water.

Below are two examples of contrail enhancements over Florida. Natural cirrus is displayed in pink. Notice that contrails tend to appear in conjunction with natural cirrus and disappear in regions where natural cirrus is absent. Aircraft fly through the regions without natural cirrus, but they don’t leave contrails because the atmosphere is too dry. However, contrails reappear in adjacent regions with more upper level moisture and pre-existing natural cirrus.
For more information from about contrails and the contrails product, please view the NexSat Tutorial. In the NPOESS era the VIIRS instrument will have the requisite infrared channels at a spatial higher resolution for a more detailed view of contrails.

For more examples of the NexSat contrail product, go to:


Reference: