Attempting to Turn Night into Day; Development of Visible Like Nighttime Satellite Images

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Satellite Support for Aviation Briefings

• Aviation interests are especially concerned about low clouds, low visibility, and thunderstorms.
• Traditional satellite sources provide visible, infrared, and water vapor images.
AWC Vis/Fog (early version of Day/Night) with Airport LIFR (magenta), IFR (red), and MVFR (blue)
Problems with Traditional Satellite Images

- Visible image is dark at night.
- Low clouds and fog detectable only during the day using the visible.
- Untrained users have difficulty in separating high and low clouds on visible image.
- Infrared image shows thunderstorms, but low clouds are difficult to see.
- Need different types of images to see different weather hazards.
- A single type of image which shows all the weather hazards both day and night would be useful for aviation users.
“Day/Night Visible”

- All the GOES channels used to develop a derived satellite image with minimal differences between day and night.

Nighttime Dec. 9, 11:45Z  Sunrise 13:15Z  Daylight at 14:00Z
Processing Steps

• Correct cirrus IR temperatures using Water Vapor Data.
• Use IR temperatures to compute cloud heights.
• Brightness normalize of visible
• Splitting visible into high (above 500mb) and low images with different brightness ranges.
• Generation of nighttime low “fog” cloud image using difference between 3.9 and 11 micron channels.
• Generation of nighttime high cloud image using difference between 11 and 13.5 micron channels.
• Merging low and high cloud images.
• Splitting derived image into high (above 500mb) and low images with difference brightness ranges.
• Merging nighttime image with daytime image.
• Use of enhancement table to bring back full dynamic range of high and low images and tint high image a light blue.
Correcting Cirrus IR Temperature

- Perform correlation between IR and WV clouds. Pixels which show cloud correlation have WV temperature replace IR temperature.
Convert IR Temperature into Heights

- Use seasonally and latitude adjusted standard atmosphere to convert temperatures to heights.
Brightness Normalize Visible

- Compute angle to sun for each pixel.
- Pixels with sun above 3 degrees of the horizon are divided by cosine of solar zenith angle.
Split Visible into High and Low Images

- Clouds above 500mb are given brightness range of 191-255.
- Clouds below 500mb are given brightness range of 1-190.
- Enhancements used to stretch each range into 1-255 with high clouds having a blue tint.
Generate Low Cloud “Fog” Image

- Difference between 3.9 and 11 microns.
- Differences between -4 and +10 Degrees K stretched into full dynamic range of image.
- Water droplets show up white; Ground is gray; Ice crystals show up as black.
Generate High Cloud “Height” Image

• Difference between 11 and 13.5 micron images.
• 13.5 micron image is impacted by CO$_2$, and 11 micron image is not. Difference is related to depth of atmosphere [small differences (white) are high clouds and large differences (gray) are low clouds].
Merge “Fog” and “Height” Images

- Replace any dark “fog” pixels with “height” pixel.
- Force any pixels below 6,000 feet to remain “fog”.
- Split into high (blue) and low brightness ranges and merge with visible image.
Final Product
Available on Web

- Real time day/night images available at [http://wx.erau.edu/erau_sat/](http://wx.erau.edu/erau_sat/).