

## ROI Comments/Trends

### Temperature:

- Land and ocean temperatures increased between May and June.
  - Land mean temperatures increased by approximately 1.4K and ocean mean temperatures by approximately 2K.
  - Used Cursor Location/Value tool to confirm trend, very generally, across entire image, not just ROIs.
- More difficult to detect changes in cloud ROI mean temperatures between May and June (some increased, some decreased).
  - Using different ROIs for each date for all of the cloudy areas
  - However, there was a very large mean temperature increase (of 10K) between May and June for the Cold Clouds Over Ocean ROI.
    - Disparity also possibly due to using a cirrus cloud for the ROI in the May image and a cumulus cloud in the June image.
      - Clouds chosen only for proximity.
      - Thus, a second ROI was drawn for the May image, so that two more similar clouds could be compared. (See Reselected ROIs section, below.)
- The mean size of the difference between bands (now defined as B11-B10) is smaller in the June image than it is in the May image over land and water but the June differences are greater than the May differences over clouds.
  - NOTE: for a couple of the ROIs the Band 10 and Band 11 temperature ranges did not actually overlap
    - In these instances, there were relatively small temperature ranges in each band (approximately 0.5K) and relatively large mean difference between the two bands (2 or 3 Kelvin).
- The mean difference between bands 10 and 11 on land and over the ocean is always negative (B10>B11). Over clouds, the mean difference tends to be positive but in a few of the ROI (Warm Clouds Over Island, Coldest Cloud Over Island, and Cold Clouds Over Ocean) the difference in the May image is negative (though never in the June image).
- Changes Due to Reselected ROIs:
  - Difference between May and June mean temperatures for the Cold Cloud Over Ocean ROI decreased (now approximately 3K) due to the new May ROI.
  - Difference between May and June mean temperatures for the Cold Cloud Over Island ROI increased (now approximately 5K) due to the new June ROI.
  - General trends for mean differences between bands 10 and 11 did not change.
    - However, the mean difference for the May Cold Cloud Over Ocean ROI is no longer negative in the new ROI.

### Albedo

- Highest mean albedo over clouds

- Does not appear to have any correlation to cloud temperature or date (i.e. May cloud albedos are not consistently higher than June values, etc.).
- Next highest mean albedo over land
  - Barren land has higher mean albedo than forest in both images.
  - May albedos are higher than June albedos (though only by approximately 0.02).
- Lowest mean albedos over ocean.
  - Albedo relatively consistent between the two dates.
- Two cloud ROIs (Coldest Cloud Over Island and Cold Clouds Over Ocean from May) have anomalously low mean albedos (0.299596 and 0.133105 respectively, compared to approximately 0.5). This is likely because both clouds in these two ROI are cirrus and thus reflect minimally in the bands used to calculate albedo (so not necessarily anomalous once this is taken into consideration).
- Changes Due to Reselected ROIs:
  - The mean albedo value for the May Cold Clouds Over Ocean ROI increased to 0.697206, a value consistent with other cloud albedos from the image.
  - None of the other trends in albedo values listed above changed when recalculated using the new ROIs.

#### NDVI

- Highest mean NDVI values in land ROIs
  - Forest mean NDVI values are significantly higher (by approximately 0.25) than mean NDVI values over barren land.
- Very low, but positive mean NDVI over cloud ROIs.
  - The Clouds Over Ocean ROIs have lower mean NDVI values (approximately 0.02) than the Clouds Over Island ROIs (approximately 0.1).
  - The two cirrus clouds covered by ROIs have mean NDVI values more consistent with the land cover type underneath the cloud (presumably because the cirrus appears transparent in the visible wavelengths).
    - Coldest Cloud Over Island ROI has a mean NDVI value, 0.2, much higher than other clouds (and the maximum value of its range is also unexpectedly high at 0.76). It seems likely that the NDVI for the forest below the cirrus cloud is actually responsible for these values.
    - The May Cold Clouds Over Ocean ROI has a mean NDVI, -0.03, that is much lower than other clouds. Again, this is probably due to reflectance from the underlying ocean, not the cloud.
  - The maximum NDVI values in the May and June Warm Clouds Over Island ROI and the May Cold Clouds Over Island ROI all are much higher than the values computed for almost the other cloud pixels (not only in these ROI, but also in all the other cloud ROIs), suggesting that in these three ROI a small patch of the ROI extends beyond the cloud cover and is capturing reflectance values from the island below the cloud.

- Nevertheless, these three ROIs appear predominantly accurate. Only a few pixels in each ROI are incongruously high and their means are only about 0.05 higher than the other cloud ROIs' mean NDVI values.
- Mean NDVI values over ocean ROIs are negative decimals (i.e. approximately -0.1)
- For each ROI, NDVI statistics are generally consistent between the two dates (i.e. little change).
- Changes Due to Reselected ROIs:
  - The new Cold Clouds Over Ocean ROI for May has a mean NDVI value consistent with the other ROIs for Clouds Over Ocean.
  - The maximum NDVI values for all of the new Clouds Over Island ROIs are much lower than in the original ROIs (now approximately 0.2).

Ice Index – i.e.  $(B4-B6)/(B4+B6)$

- Mean Band 6 reflectance is lower in all the June cloud ROIs than in the May cloud ROIs (i.e. mean ice index values are higher in June than in May for all the cloud ROIs).
  - This temporal difference is especially pronounced in the both Cold Cloud Over Ocean and Cold Cloud Over Island ROIs. (In both, the mean June ice index values are more than twice as large as the May ice index values.)
- Mean Band 6 reflectance is lowest (mean ice index values are highest) over clouds, distinctly higher (mean ice index values lower) over ocean, and highest over land (negative ice index values).
  - There does not appear to be a difference in the ice index values over the cirrus and non-cirrus clouds.
  - However, the two Coldest Cloud ROIs both have much lower mean ice index values, more consistent with the mean values for the Ocean ROIs than the other Cloud ROIs.
    - It is unclear why Band 6 reflectance is relatively high in these regions.
- Changes Due to Reselected ROIs:
  - The size of the temperature difference between the May and June Cold Cloud ROIs decreased (now the June mean ice index values are approximately 0.1 larger than the May values).

Reselected ROIs

- Cold Clouds Over Ocean, May 5<sup>th</sup>
  - Redone because originally over cirrus cloud, making it difficult to compare to the June 22<sup>nd</sup> ROI over cumulous cloud.
  - New ROI close to the coast of Gaudaloupe but entirely over the ocean.
- Cold Clouds Over Island, May 5<sup>th</sup>
  - ROI remains in essentially the same location but a few pieces were redrawn to ensure that they covered only cloud pixels.
    - It actually did not look like there were any non-cloud pixels to begin with but mean albedo and NDVI values seemed were somewhat different from the

standard cloud values; it seemed like land pixels might have been skewing the means so ROI was redrawn especially carefully.

- Cold Clouds Over Island, June 22<sup>nd</sup>
  - A second ROI was drawn on the June date to make the two Cold Clouds Over Island ROIs geographically closer to each other.
    - It was impossible to move the June ROI closer to the May ROI without increasing the mean temperature of the June ROI by approximately 5K. (The two ROIs initially had similar mean temperatures so though the new ROI is more similar to the May ROI geographically, its temperature is less similar.)
- Warm Clouds Over Island, May 5<sup>th</sup> and June 22<sup>nd</sup>
  - Original ROI separated into two ROIs, one for each date. NDVI values for the original ROI suggested that there were vegetation pixels included in the ROI (presumably due to trying to fit one ROI to two different cloud formations). The new ROIs used clouds that were very close to each other and have very similar temperature ranges in each date.