Checking cloud flagging over SST anomaly areas

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A number of cases where the L2 sea surface temperature (SST) showed an anomaly with respect to the climatic average have been identified by IDEAS. The cause of the anomalies is likely to be failures in the cloud clearing algorithms. Here, a new CL1 file, which incorporates the new gross cloud test (GCT) thresholds, is used on the products that show an SST anomaly to see if the new CL1 file improves the cloud mask. If the new CL1 file masks the area of the SST anomaly as cloud when previously it was left clear by the operational CL1 file, then the SST anomaly will not exist and the new CL1 file can be said to have correctly identified the area as cloudy.

The approximate latitude and longitude of the regions of the SST anomaly have been identified from the images sent by IDEAS and the relevant frame has then been located in the product processed by the prototype processor (PP) using the new CL1 file. This frame is then compared with the matching frame of the operational product. It should be noted that although the start scan of the frame in the PP image and operational product differ, the frames have been matched to the same geographical location.

In 9 out of the 12 cases studied it is possible to identify a region which is masked as cloudy by the new CL1 file that was left as unmasked by the old CL1 file. It cannot be said whether this accounts for the entire region of SST anomaly as the total areas have not been matched, however it clearly shows that for these cases the new GCT thresholds have improved the cloud clearing. There are 3 cases (case 8, South of Australia; case 11, South Pacific and case 12, Equatorial Pacific) where no difference in cloud flag could be observed with the new CL1 file implying that any of the other cloud tests may have failed to identify a region of cloud.

1. 51306 (21 Dec 2011), NE Pacific Ocean

(-130, -140 lon, 20-30 lat)

Scan 10240 corresponds to approximately 32.5 to 31.5 latitude and -136.9 to -131.7 longitude, near the area of the SST anomaly. Figure 1 shows the location of the SST anomaly. Figure 2 shows that there is a significant difference in the cloud flag in this area caused by the GCT to the centre left of the frame. The new GCT test would have masked almost all the frame as cloudy and no SST anomaly would exist.
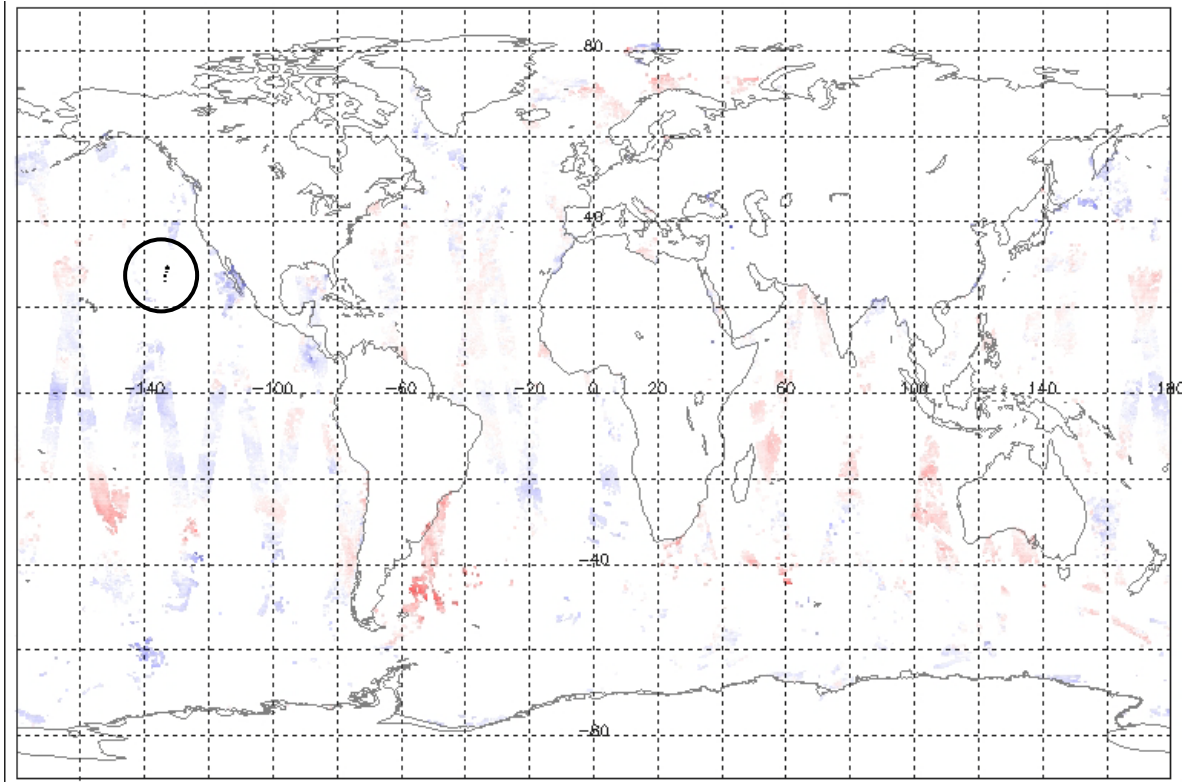
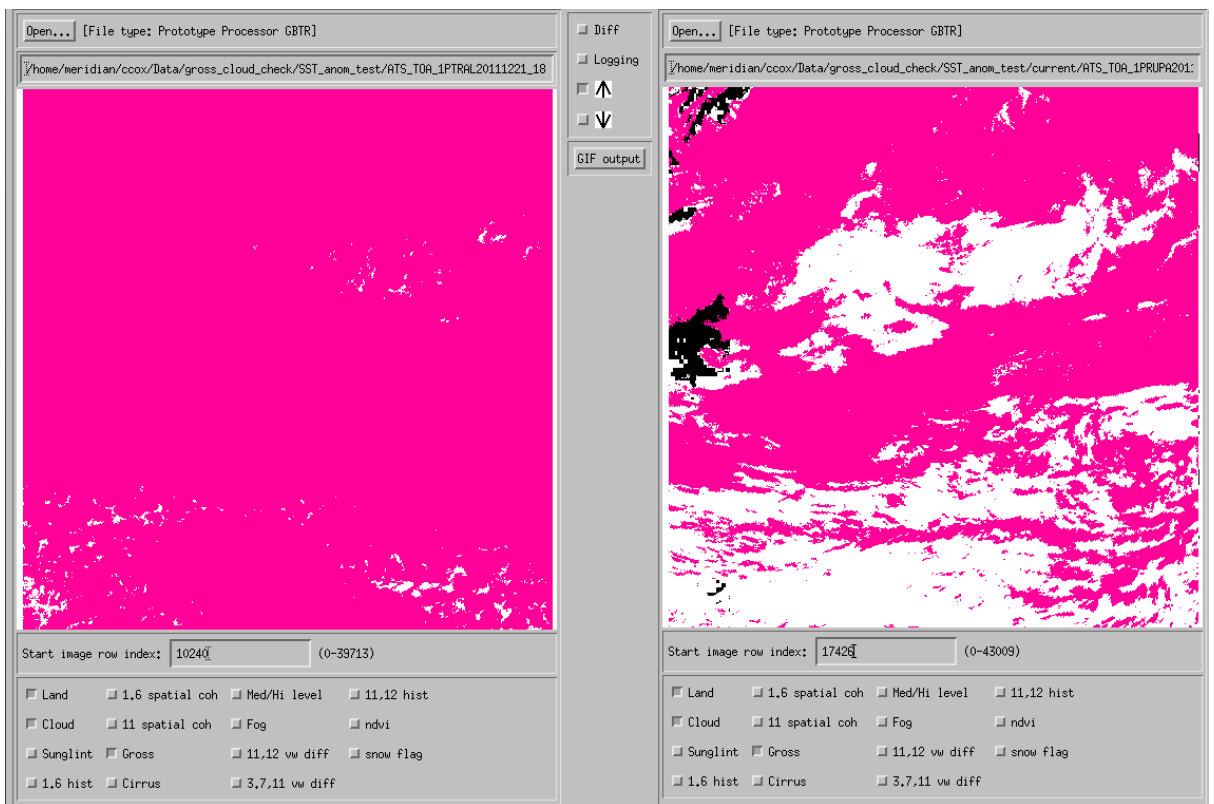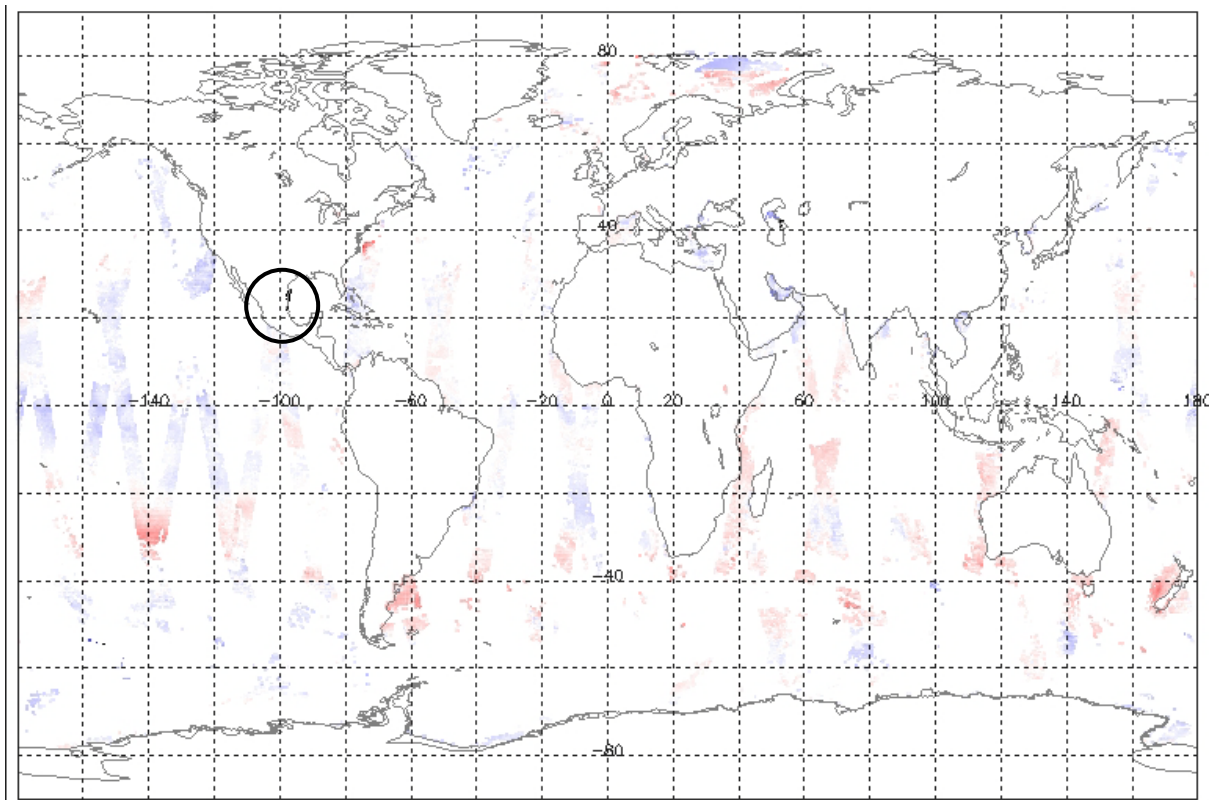**Figure 1. The SST anomaly for 21 Dec 2011 is shown by the circled dark pixels.**

Figure 2. pink=GCT flag, white=cloud flag, black=clear LHS: new CL1 file used in PP. RHS: operational product for the same frame.

2. 51330 (23 Dec 2011), Philippine Sea

No L0 input file. Not checked.

3. 51362 (25 Dec 2011), Gulf of Mexico

(-95, -100 lon, 20, 30 lat)

There is a region covering two frames along the Gulf of Mexico where the cloud clearing algorithm has failed. Using the new CL1 file results in this area being identified as cloud as shown in Figure 5 and Figure 7.
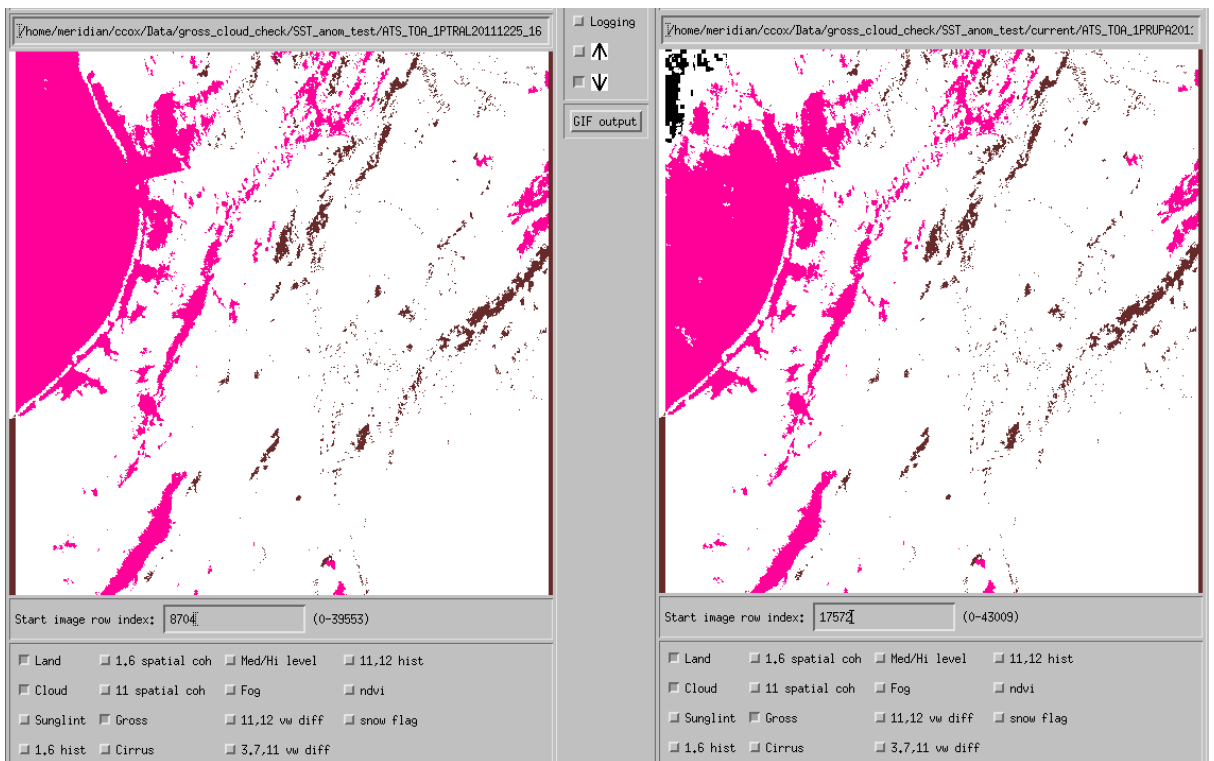

Figure 3. The SST anomaly for 25 Dec 2011 is shown by the circled dark pixels.
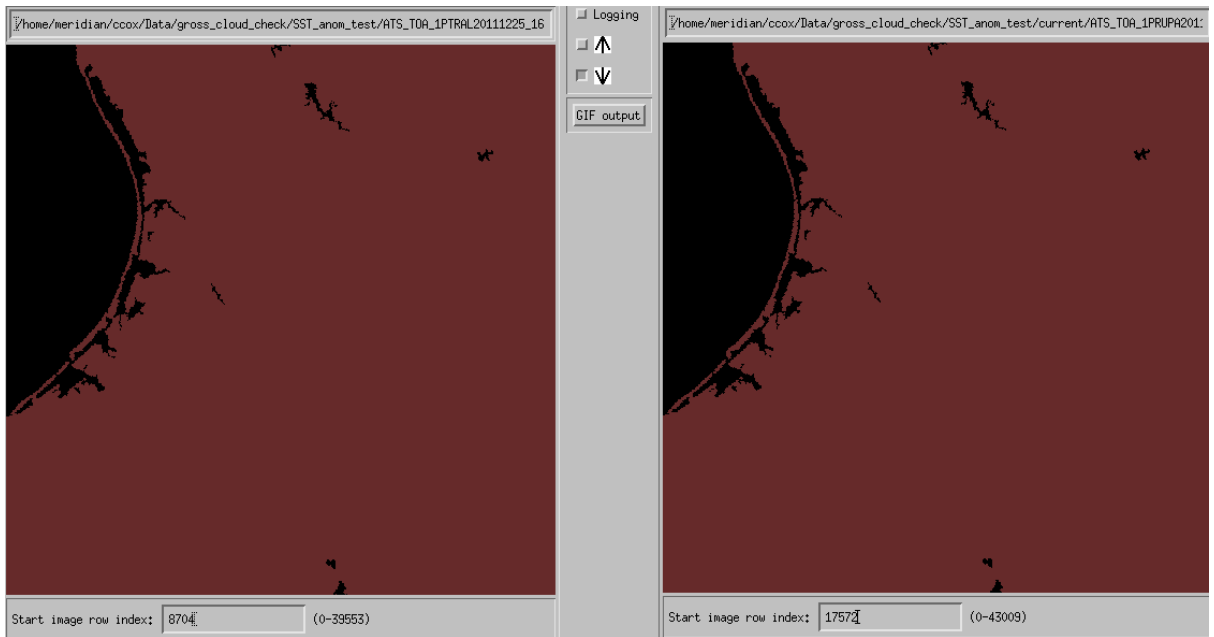
Figure 4. Coast line of the Gulf of Mexico (inverted wrt map projection) demonstrating that the frames have been matched geographically. LHS: New CL1 file used. RHS: operational product

Figure 5. Cloud mask for the section of coast shown in previous image. white=overall cloud mask, pink =GCT, black=clear LHS: New CL1 file used. RHS: operational product. There is a small region to the top left hand side of the image where the new CL1 file has identified the area as cloudy, whereas the operational CL1 file leaves it as clear.
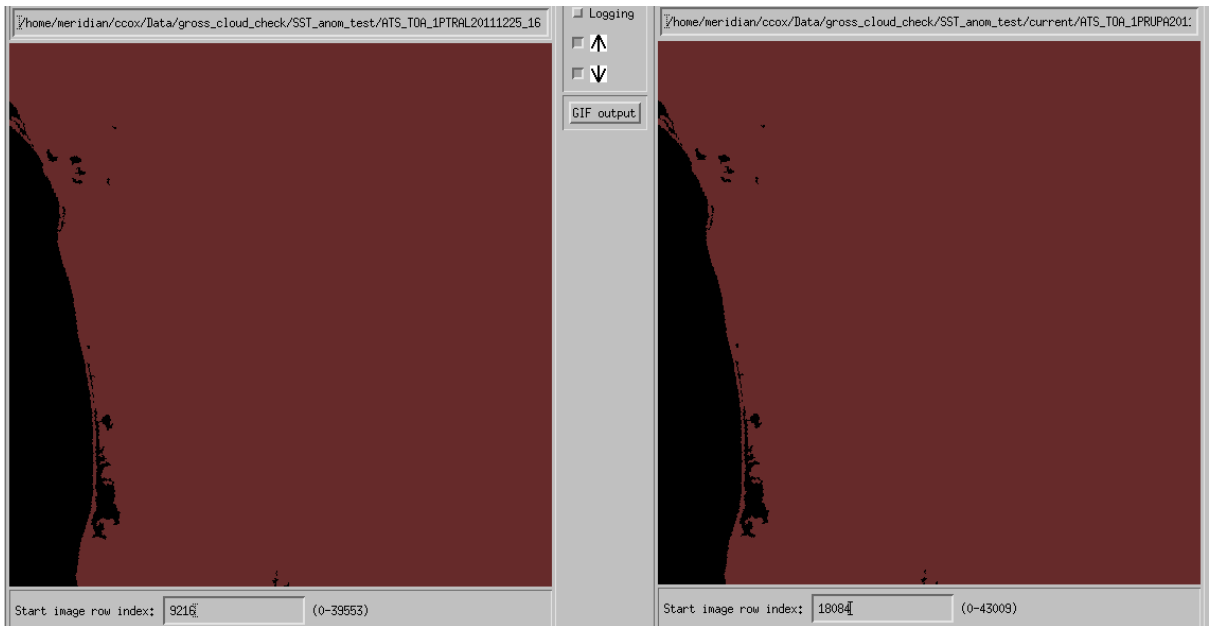
Figure 6. Another section of the coast line of the Gulf of Mexico (inverted wrt map projection). LHS: New CL1 file used. RHS: operational product
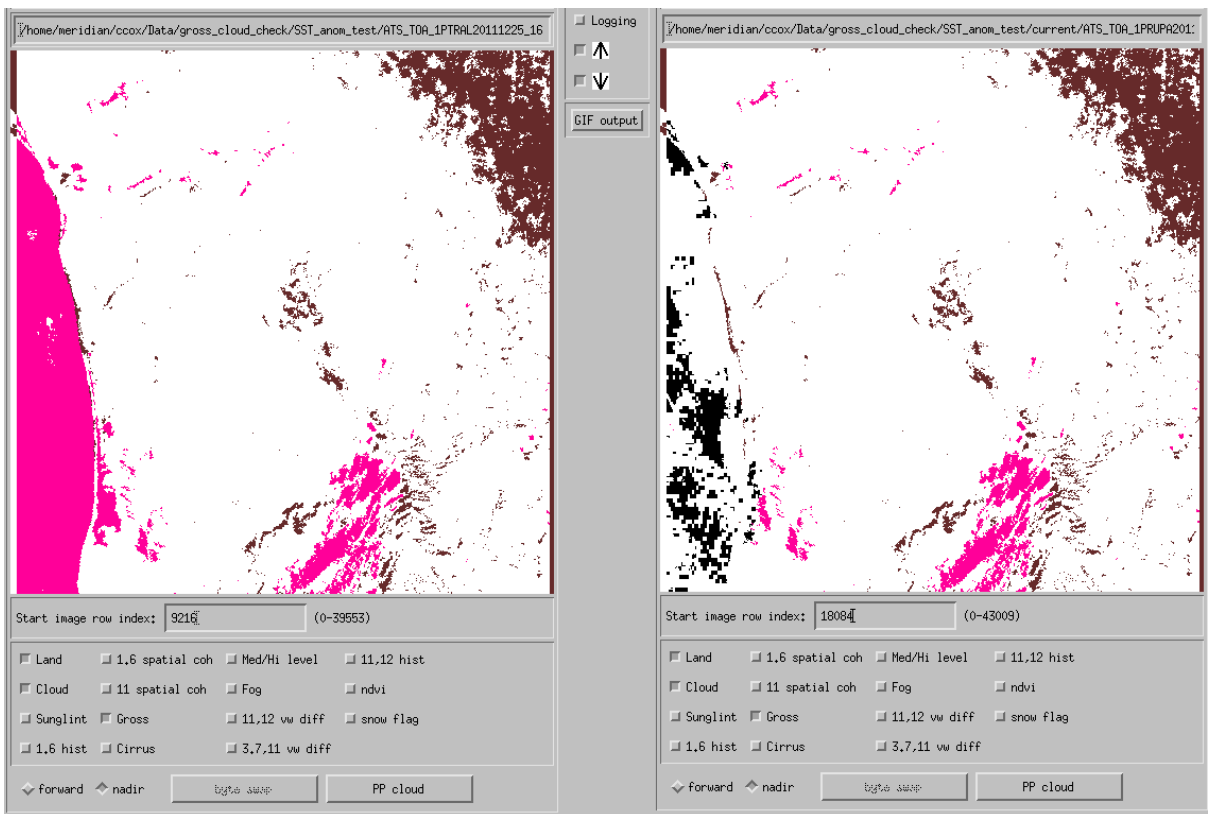
Figure 7. Cloud mask for the section of coast shown in previous image. white=overall cloud mask, pink =GCT, black=clear LHS: New CL1 file used. RHS: operational product. There is a region to the left hand side of the image where the new CL1 file has identified the area as cloudy, whereas the operational CL1 file leaves it as clear.

4. 51367 (26 Dec 2011), near Malaysia and South Pacific

(100, 120 lon, 0, 10 lat)

The new CL1 file results in an area that was previously left clear by the operational cloud mask being identified as cloudy, as shown in Figure 10.
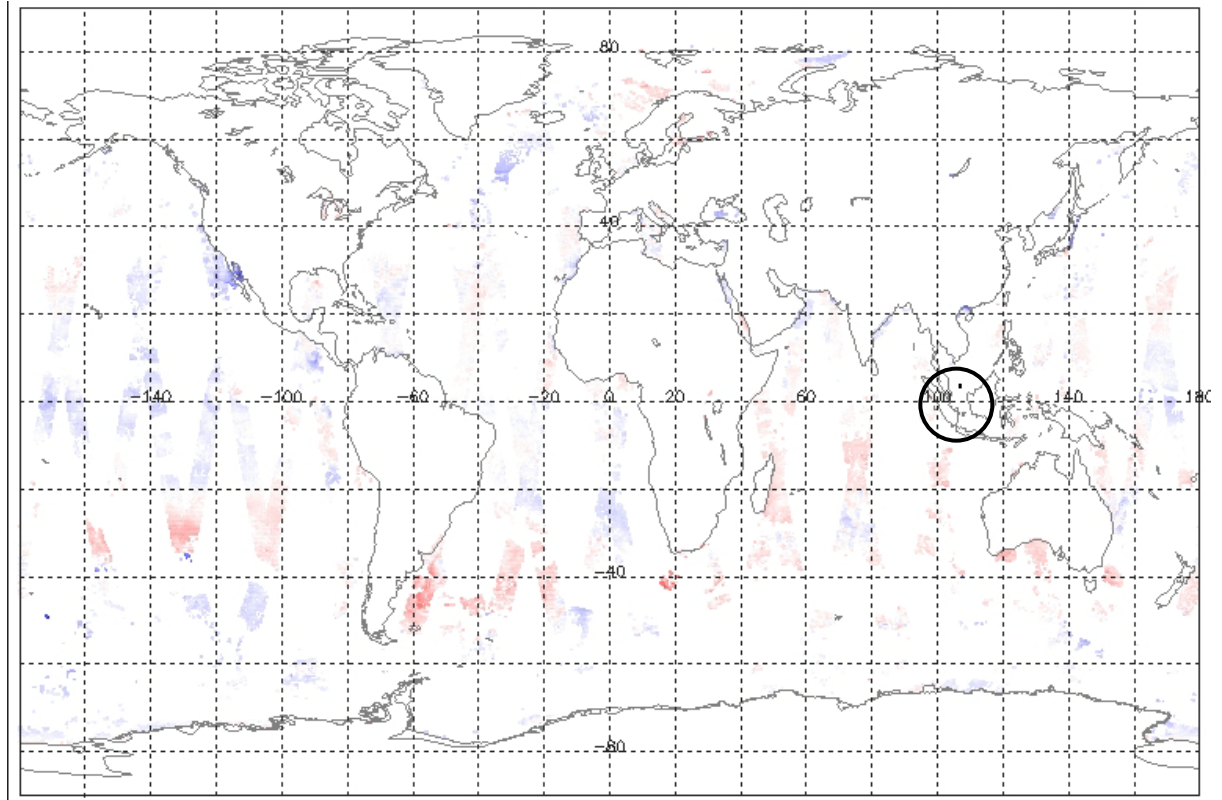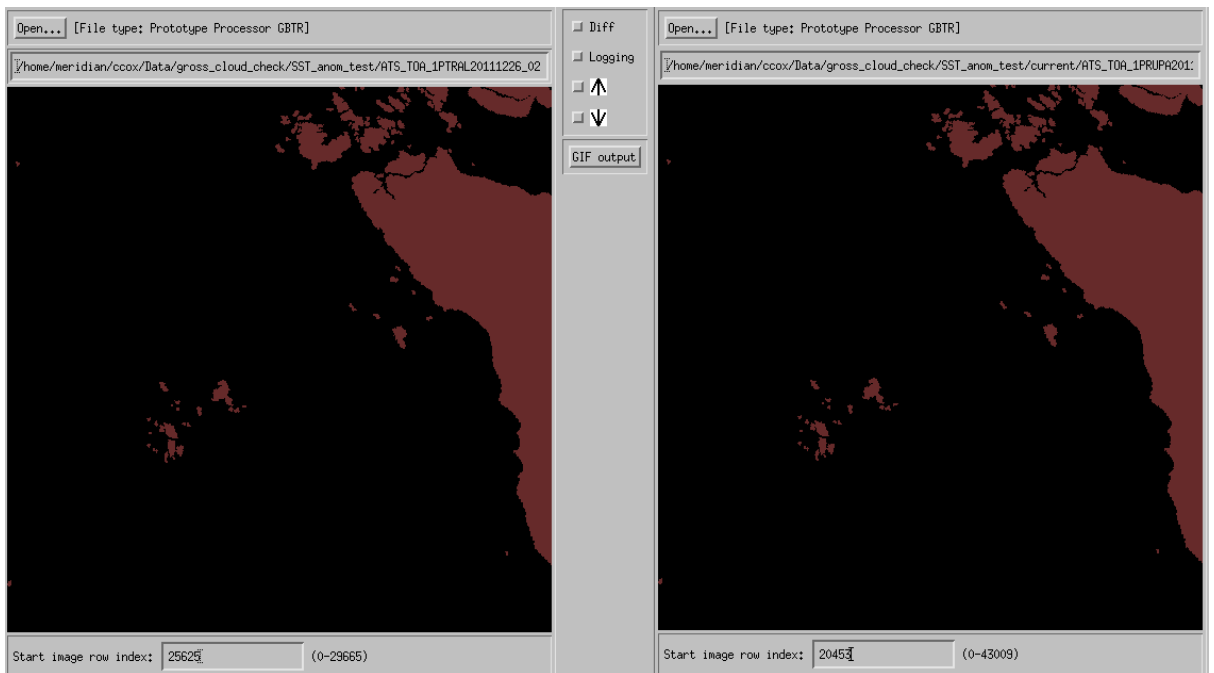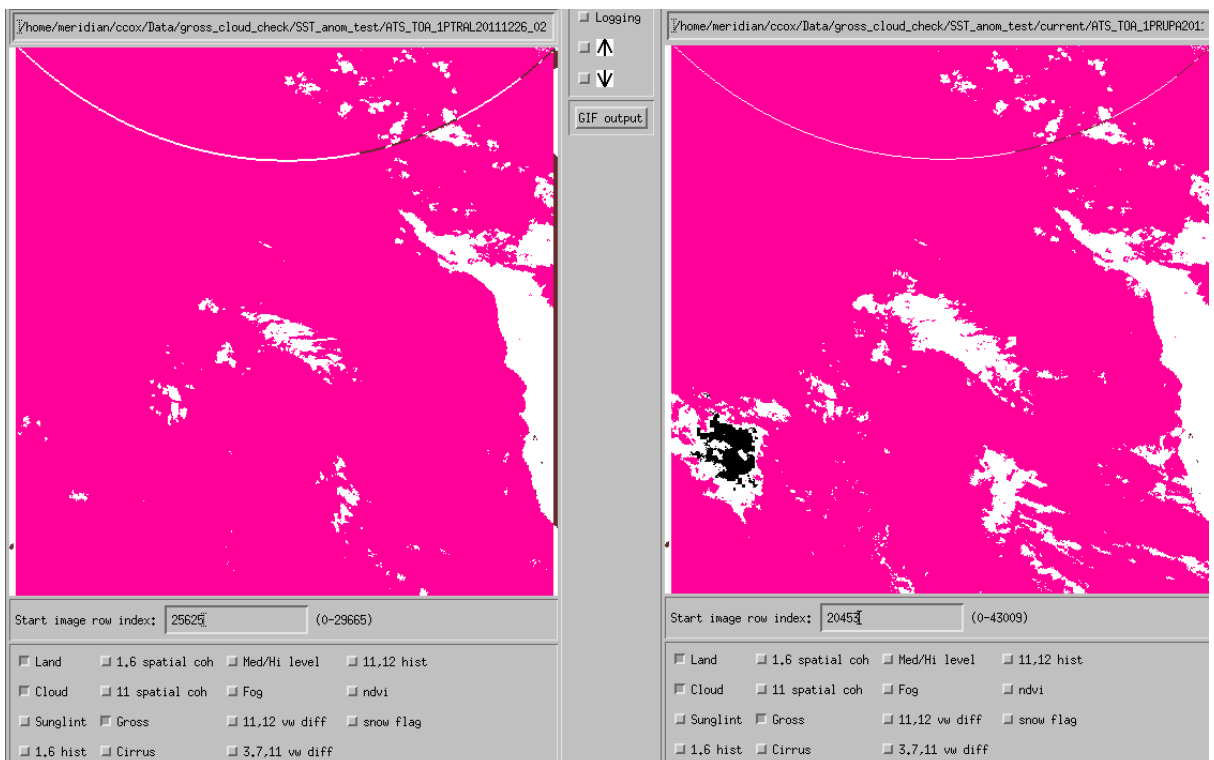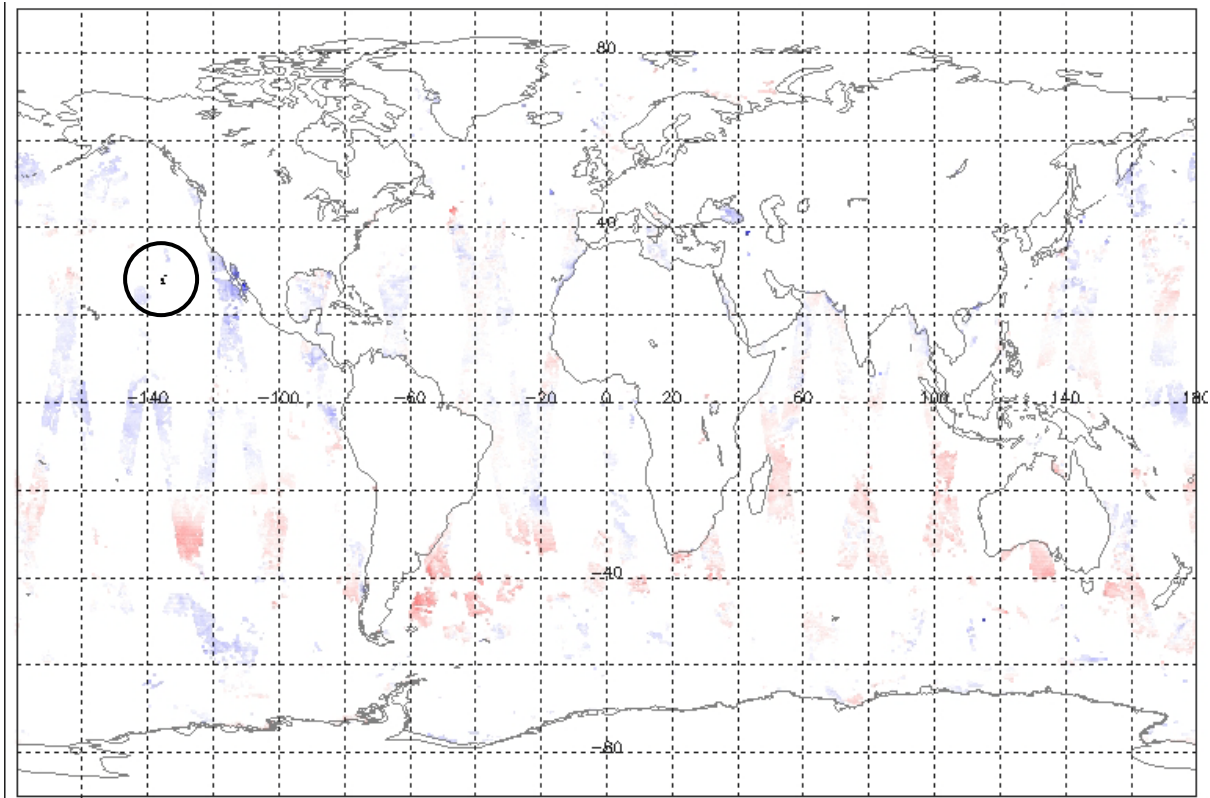

Figure 8. The SST anomaly for 26 Dec 2011 is shown by the circled dark pixels.

Figure 9. Part of the coastline around the region near Malaysia is shown from the PP product and the operational product.

Figure 10. Cloud mask for the section of coast shown in previous image. white=overall cloud mask, pink =GCT, black=clear LHS: New CL1 file used. RHS: operational product. A small area to the bottom left of the frame is left clear by the operational cloud mask, yet correctly determined as cloudy when the new CL1 file is used.

5. 51421 (29 Dec 2011), NE Pacific

(-140, -130 lon, 25, 35 lat)

There are 2 frames that cover the area of SST anomaly shown in Figure 11. The first frame in Figure 12 shows differences in the cloud mask of the product processed by the new CL1 file compared with the operational CL1 file due to the GCT. The second frame in Figure 13 and Figure 14 shows that because a large area of cloud has not been identified in the operational product, this has led to the 11micron spatial coherence test not flagging all of the area as cloudy.
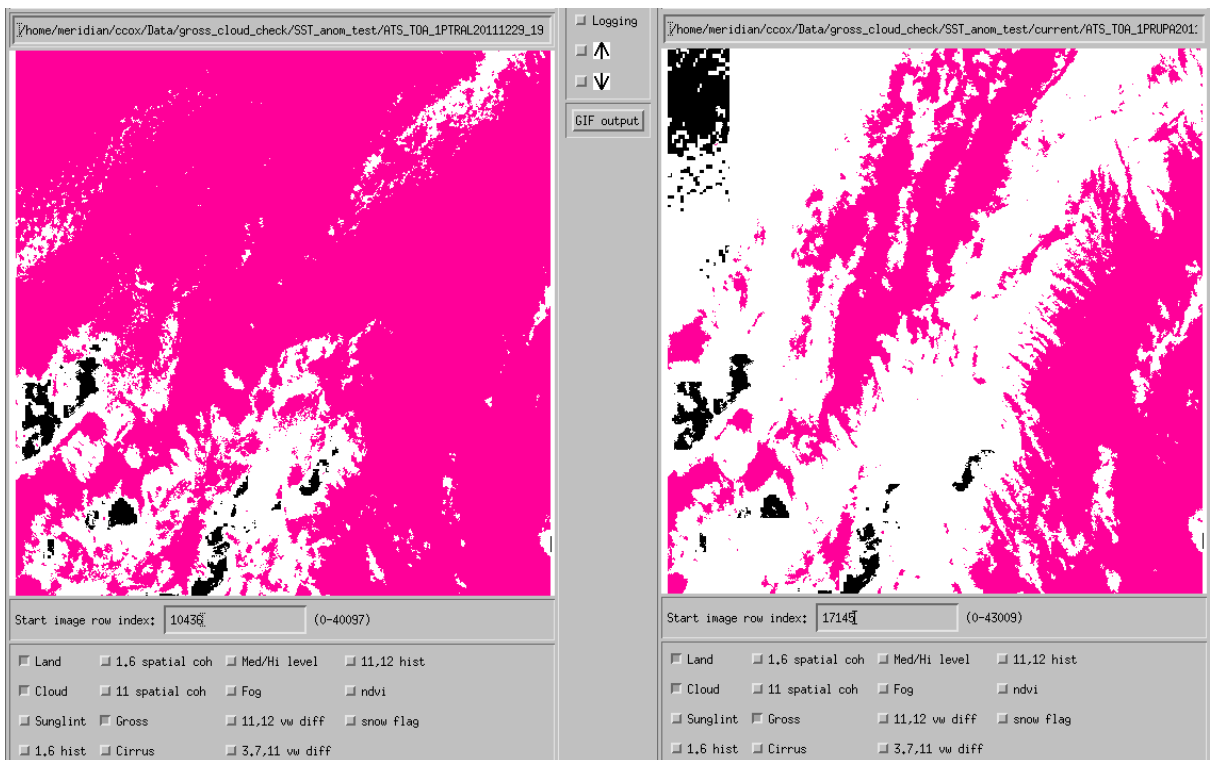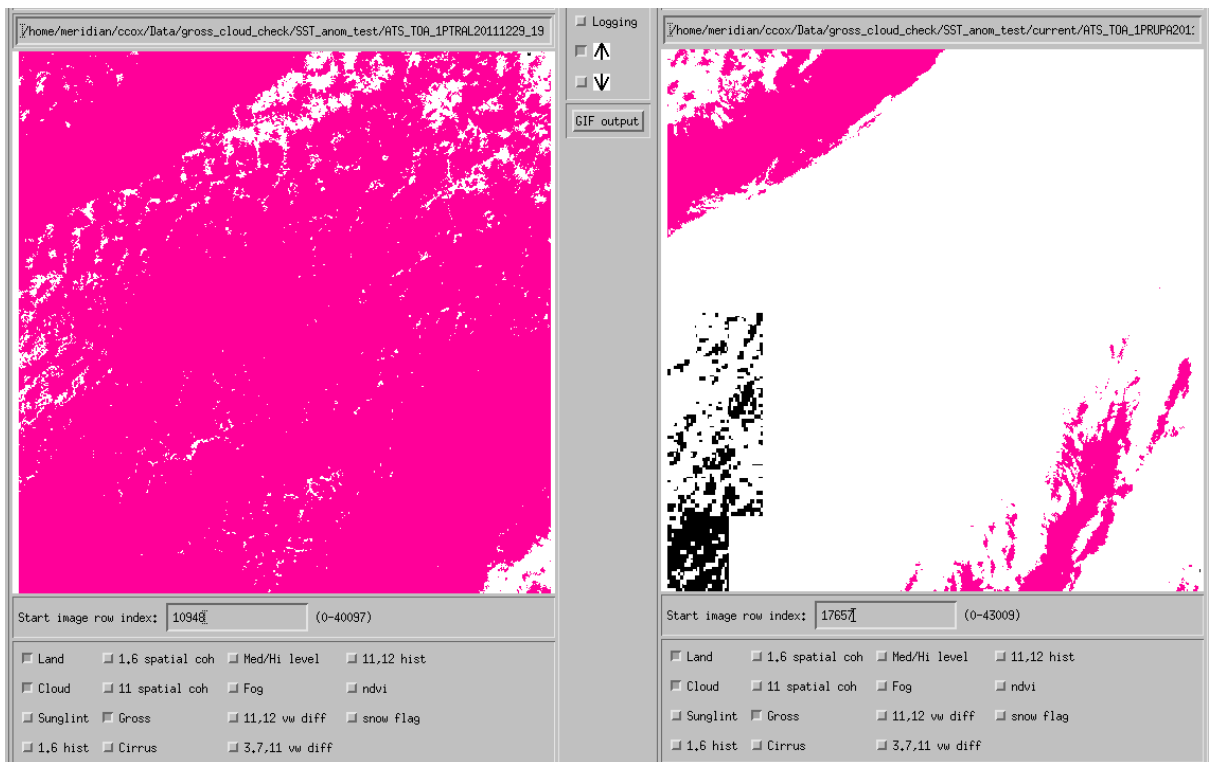

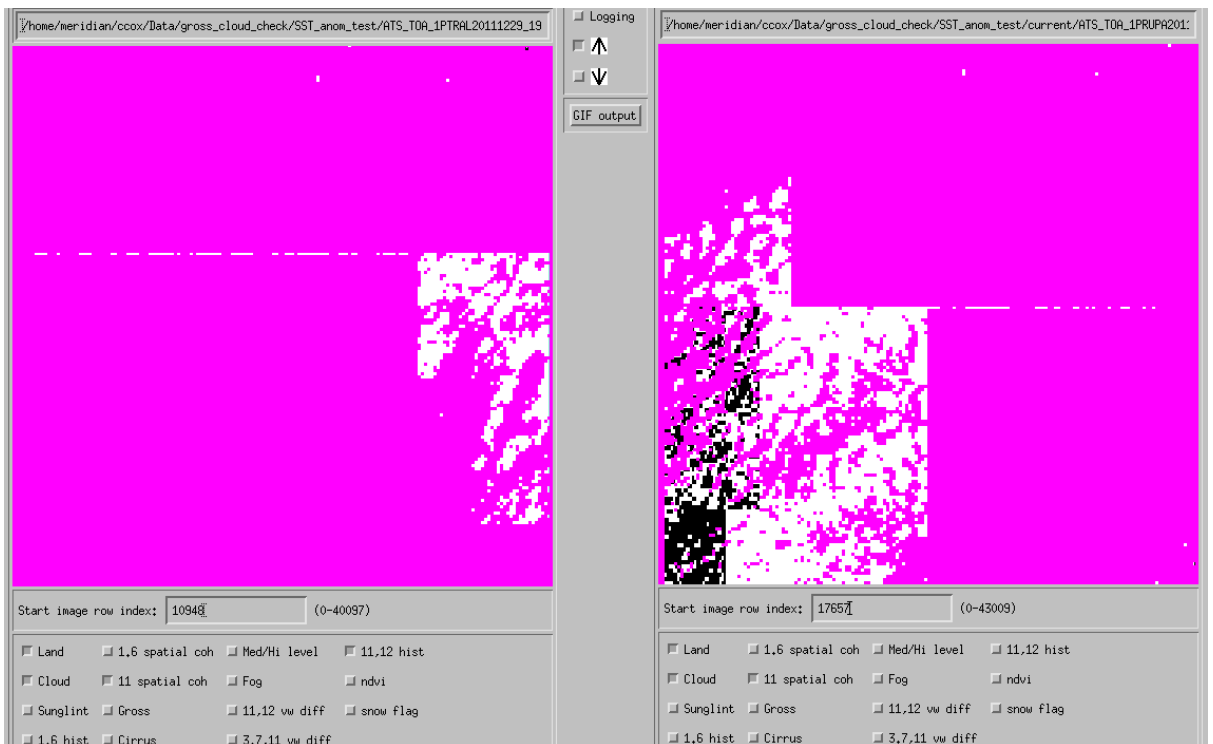**Figure 11. The SST anomaly for 29 Dec 2011 is shown by the circled dark pixels.**

Figure 12. Cloud mask for one frame in the region of the SST anomaly shown in the previous figure.
white=overall cloud mask, pink =GCT, black=clear LHS: New CL1 file used. RHS: operational product.

Figure 13. Cloud mask for the following frame in the region of the SST anomaly. white=overall cloud mask, pink =GCT, black=clear LHS: New CL1 file used. RHS: operational product.

Figure 14. The cloud mask for the same frame as in the previous figure. white=overall cloud flag, purple=11um SCT, black=clear. LHS: new CL1 file used in processing, RHS: operational product.

6. 51439 (31 Dec 2011), close to Vietnam

(100,120 lon, 10, 30 lat)

In this example, a significant area next to the coast has been incorrectly left clear by the operational cloud mask, but flagged as cloud by the GCT with the new CL1 file, as shown in Figure 17.
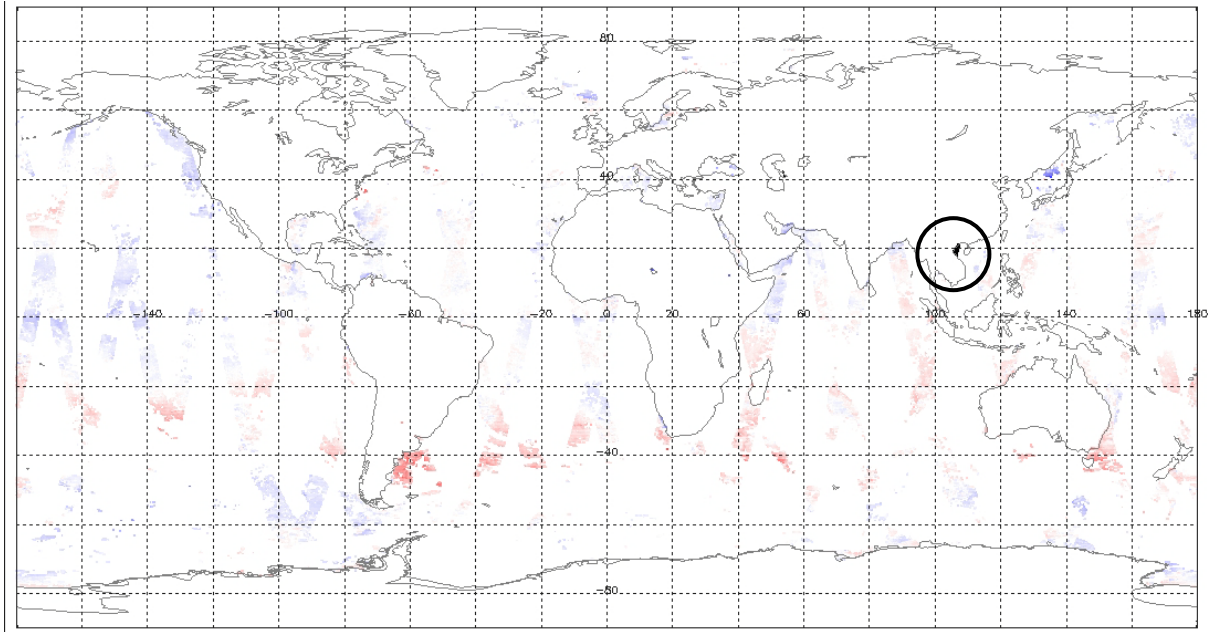
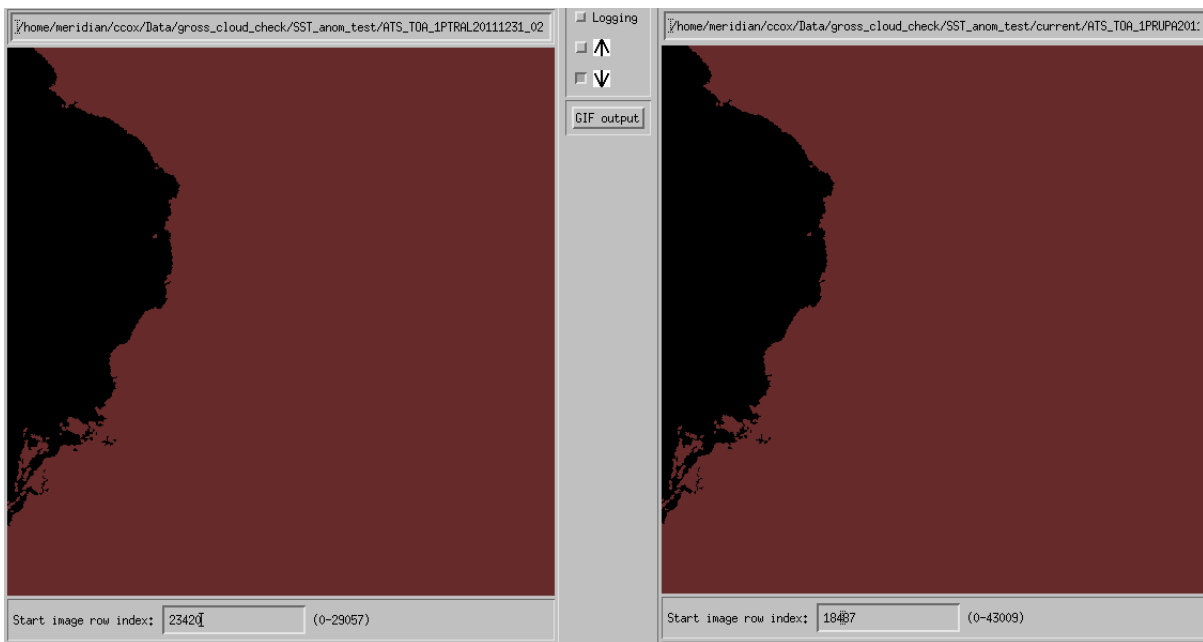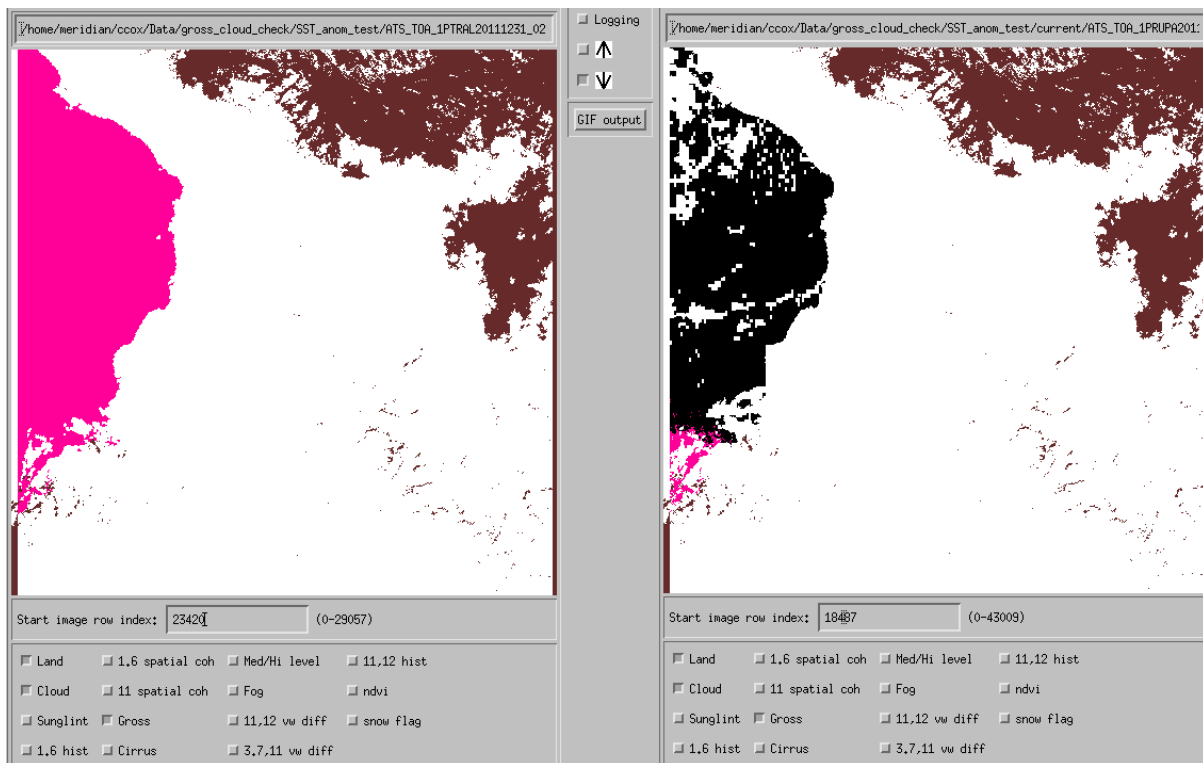**Figure 15. The SST anomaly for 31 Dec 2011 is shown by the circled dark pixels.**

Figure 16. A section of the coast line of Vietnam (inverted wrt map projection). LHS: New CL1 file used. RHS: operational product

Figure 17. Cloud mask for the section of coast shown in previous image. white=overall cloud mask, pink =GCT , black=clear LHS: New CL1 file used. RHS: operational product. There is a region to the left hand side of the image where the new CL1 file has identified the area as cloudy, whereas the operational CL1 file leaves it as clear.

7. 51459 (01 Jan 2012), Tasman Sea

(160, 170 lon, -40, -50 lat)

Figure 20 and Figure 21 show that the GCT and 11micron SCT have been able to flag the area near the SST anomaly as cloudy whereas previously it was left clear.
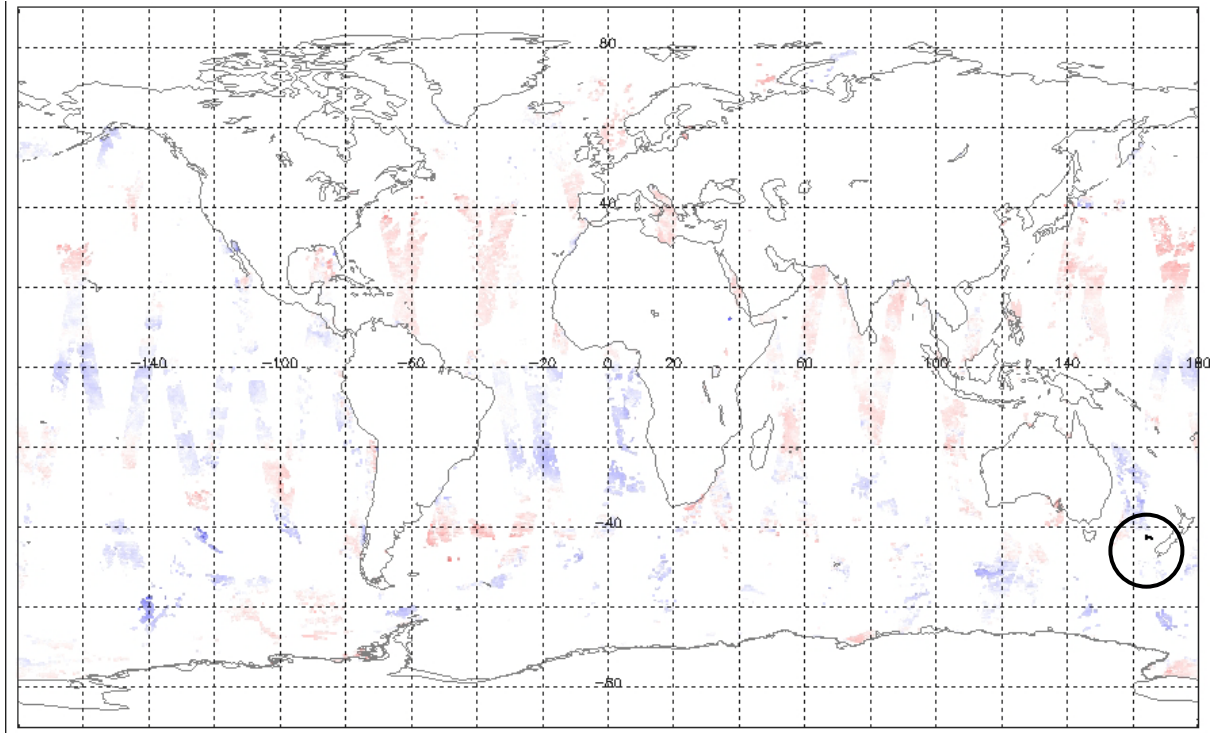
Figure 18. The SST anomaly for 1 Jan 2012 is shown by the circled dark pixels.
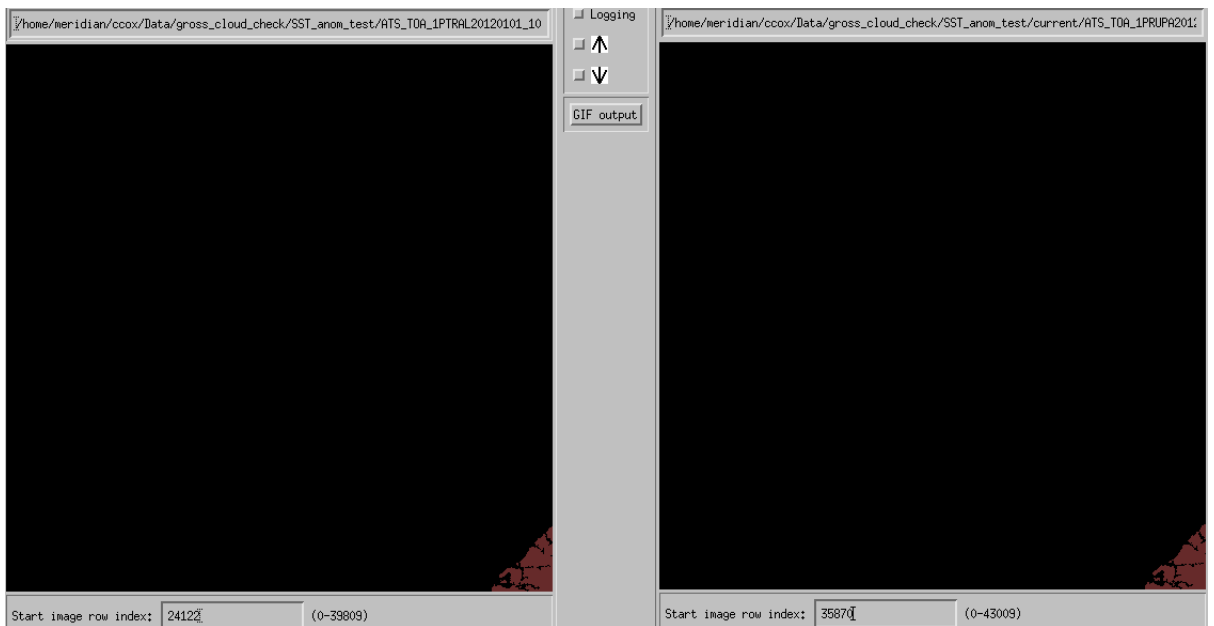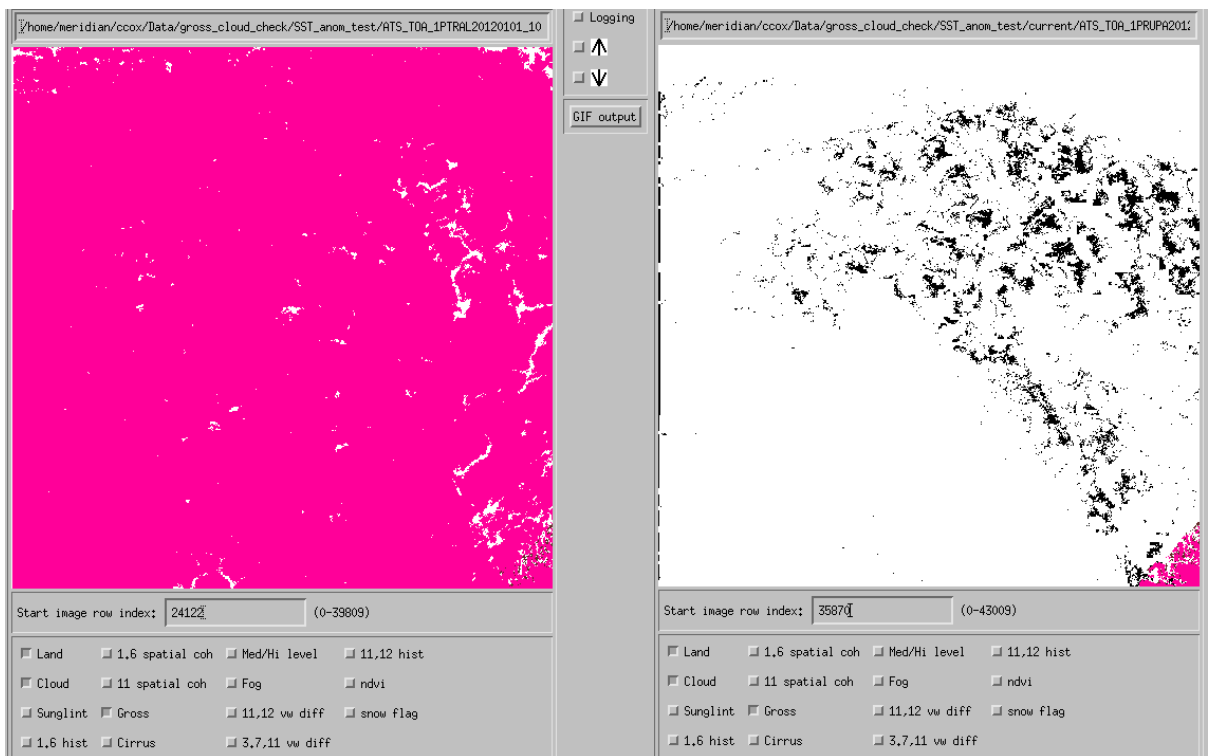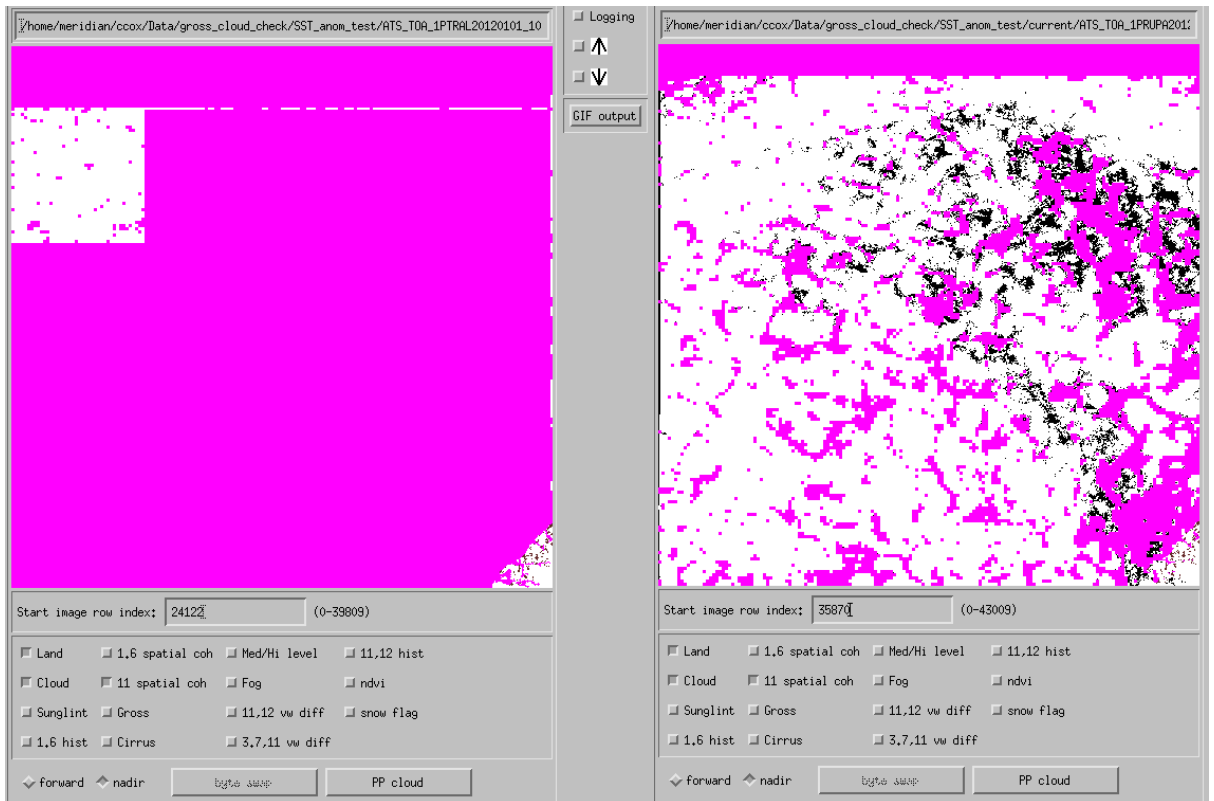

Figure 19. A frame near the area of SST anomaly. LHS: New CL1 file used. RHS: operational product

Figure 20. Cloud mask for the section of coast shown in previous image. white=overall cloud mask, pink =GCT , black=clear LHS: New CL1 file used. RHS: operational product. Most of the frame of the product that used the new CL1 file has been covered in cloud by the new GCT, whereas in the operational product, a significant area remains unmasked by the GCT leaving the SST anomalies observed.

Figure 21. Cloud mask for the section of coast shown in previous image. white=overall cloud mask, purple =11um SCT LHS: New CL1 file used. RHS: operational product. Most of the frame of the product that used the new CL1 file has been covered in cloud. Only some of the frame is masked by the operational CL1 file, contributing to the poor cloud masking and SST anomalies.

8. 51518 (05 Jan 2012), south of Australia

(120, 130 lon, -30, -40 lat)

There were no differences in the cloud flag of the two products near the SST anomaly area that were identified. The SST anomaly may have therefore been caused by a failure of one of the other cloud tests.
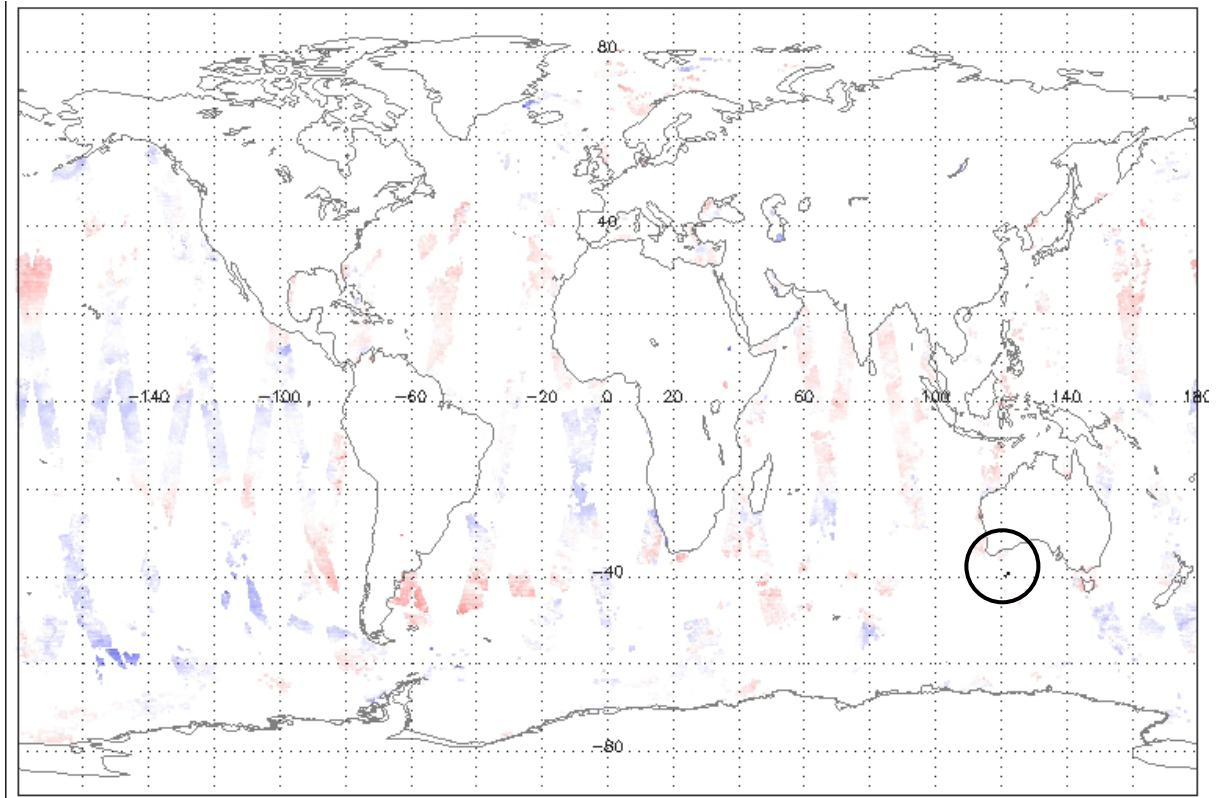
Figure 22. The SST anomaly for 5 Jan 2012 is shown by the circled dark pixels.

9. 51556 (08 Jan 2012), SE Pacific

(-100, -110 lon, -40, -50 lat)

Areas of cloud previously left unmasked are now masked by the GCT and 11micron SCT.
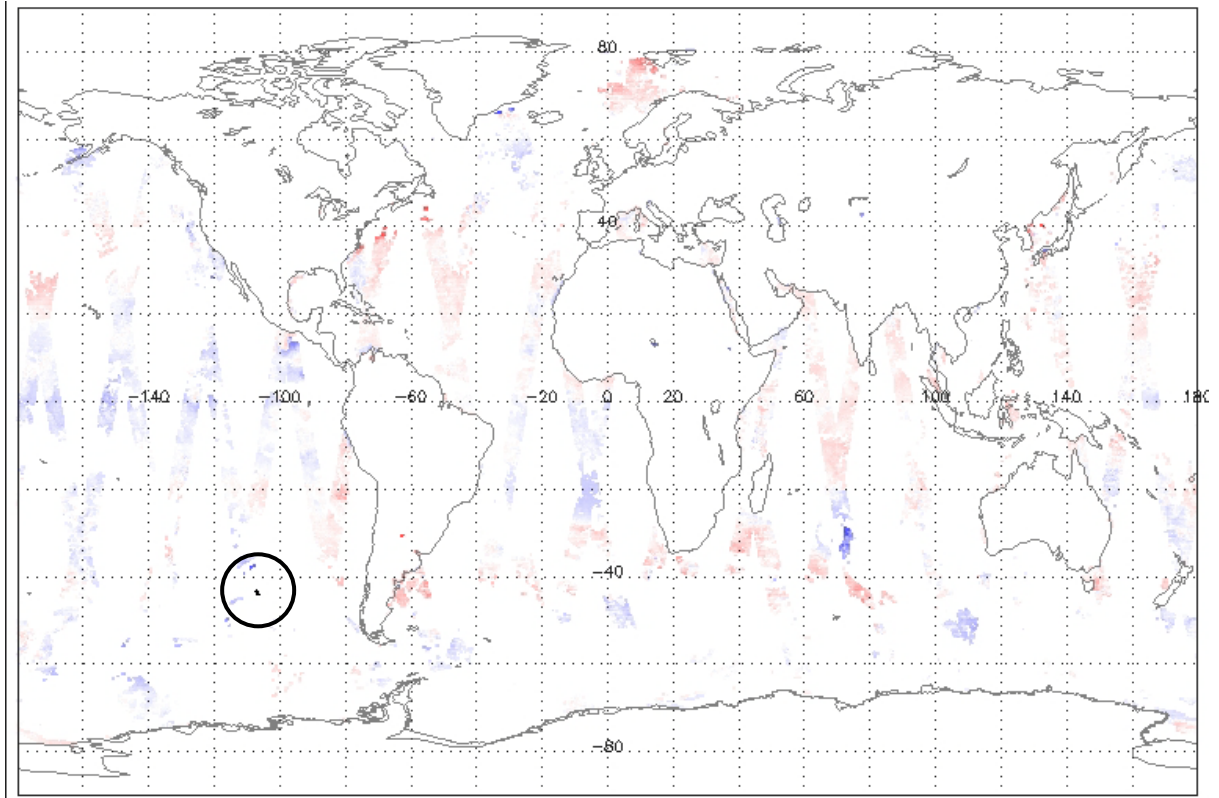
Figure 23. The SST anomaly for 8 Jan 2012 is shown by the circled dark pixels.
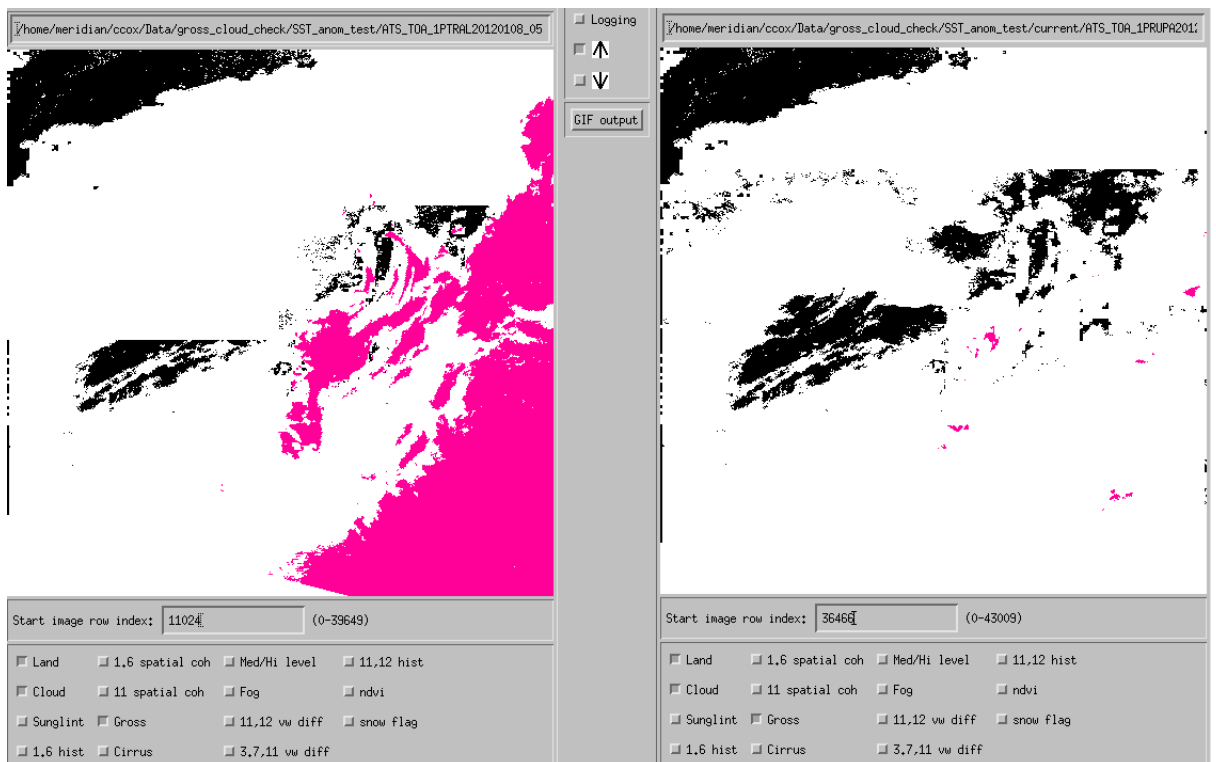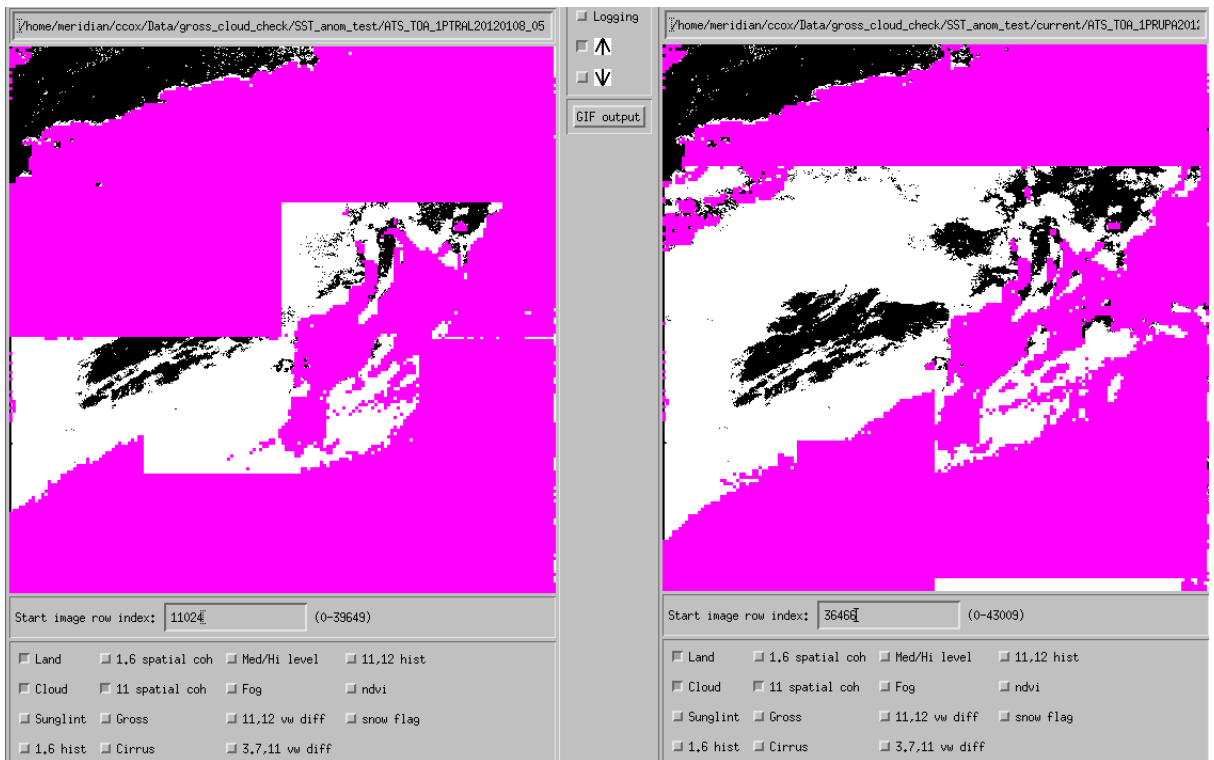

Figure 24. Cloud mask for the area shown in previous image. white=overall cloud mask, pink=GCT, black=clear LHS: New CL1 file used. RHS: operational product.

Figure 25. Cloud mask for the area shown in previous image. white=overall cloud mask, purple =11um SCT, black=clear LHS: New CL1 file used. RHS: operational product.

10. 51601 (11 Jan 2012), south Pacific

(-150, -160 lon, -35, -45 lat)

This example shows that a small area has been left clear by the operational cloud flag. It is flagged as cloudy when the new CL1 file is used.
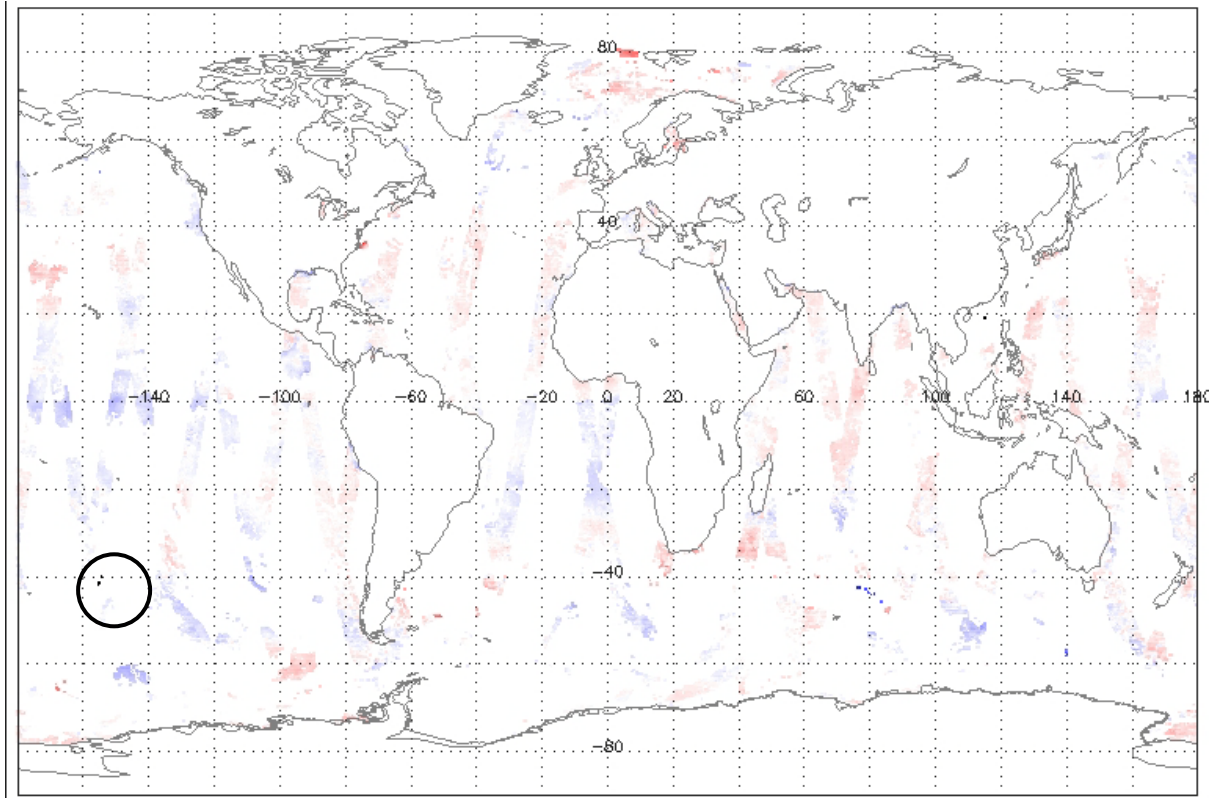
Figure 26. The SST anomaly for 11 Jan 2012 is shown by the circled dark pixels.
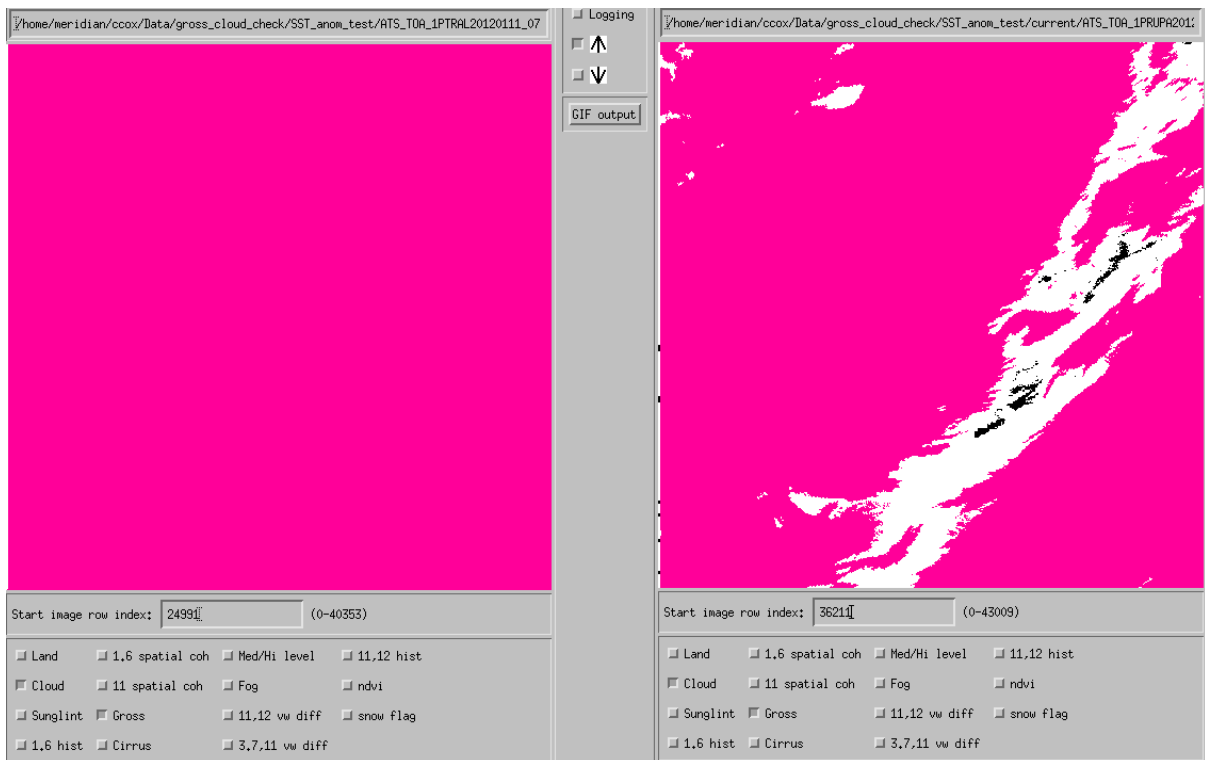

Figure 27. Cloud mask for the area shown in previous image. white=overall cloud mask, pink =GCT, black=clear LHS: New CL1 file used. RHS: operational product. The black area on the RHS image has been

left clear in the operational product. This same area would have been flagged as cloudy if the new GCT thresholds were used, as shown on the LHS.

11.   51615 (12 Jan 2012), South Pacific

(-145, -155 lon, -30, -40 lat)

No significant differences in the cloud mask were observed around the SST anomaly region. Therefore the SST anomaly is likely to be due to cloud clearing failure in other tests.
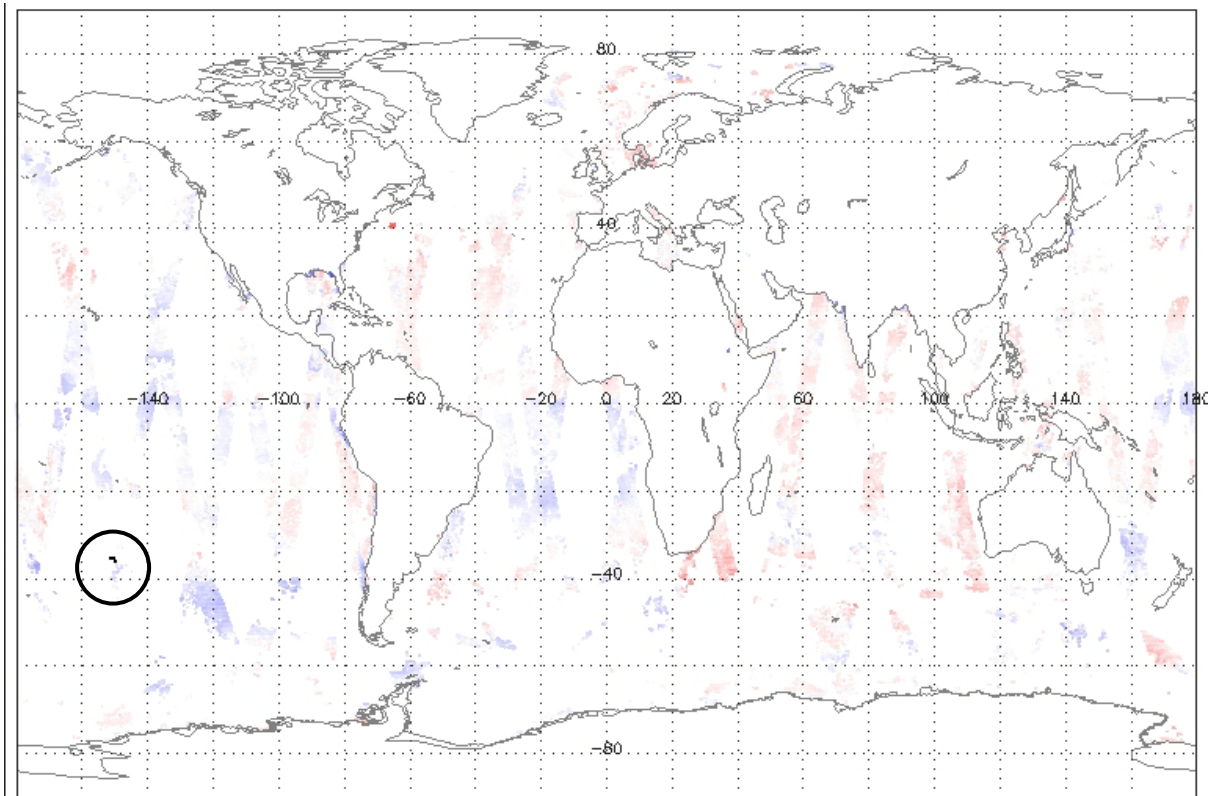

Figure 28. The SST anomaly for 12 Jan 2012 is shown by the circled dark pixels.

12.   51643 (14 Jan 2012), Equatorial Pacific

(-140, -150 lon, 0, 10 lat)

No significant differences in the cloud mask were observed around the SST anomaly region.
Therefore the SST anomaly is likely to be due to cloud clearing failure in other tests.
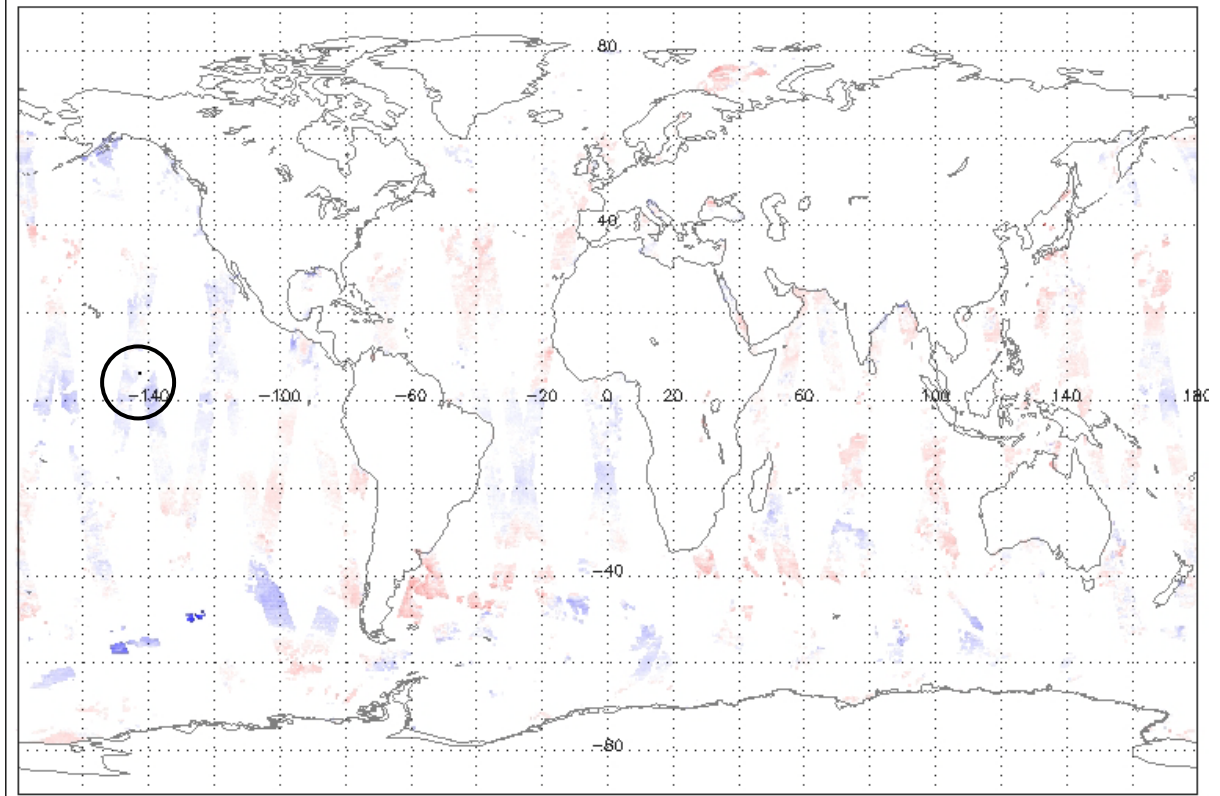

Figure 29. The SST anomaly for 14 Jan 2012 is shown by the circled dark pixels.