



Watermarking Landsat Data

Bruce K. Quirk
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U.S. Department of the Interior
U.S. Geological Survey

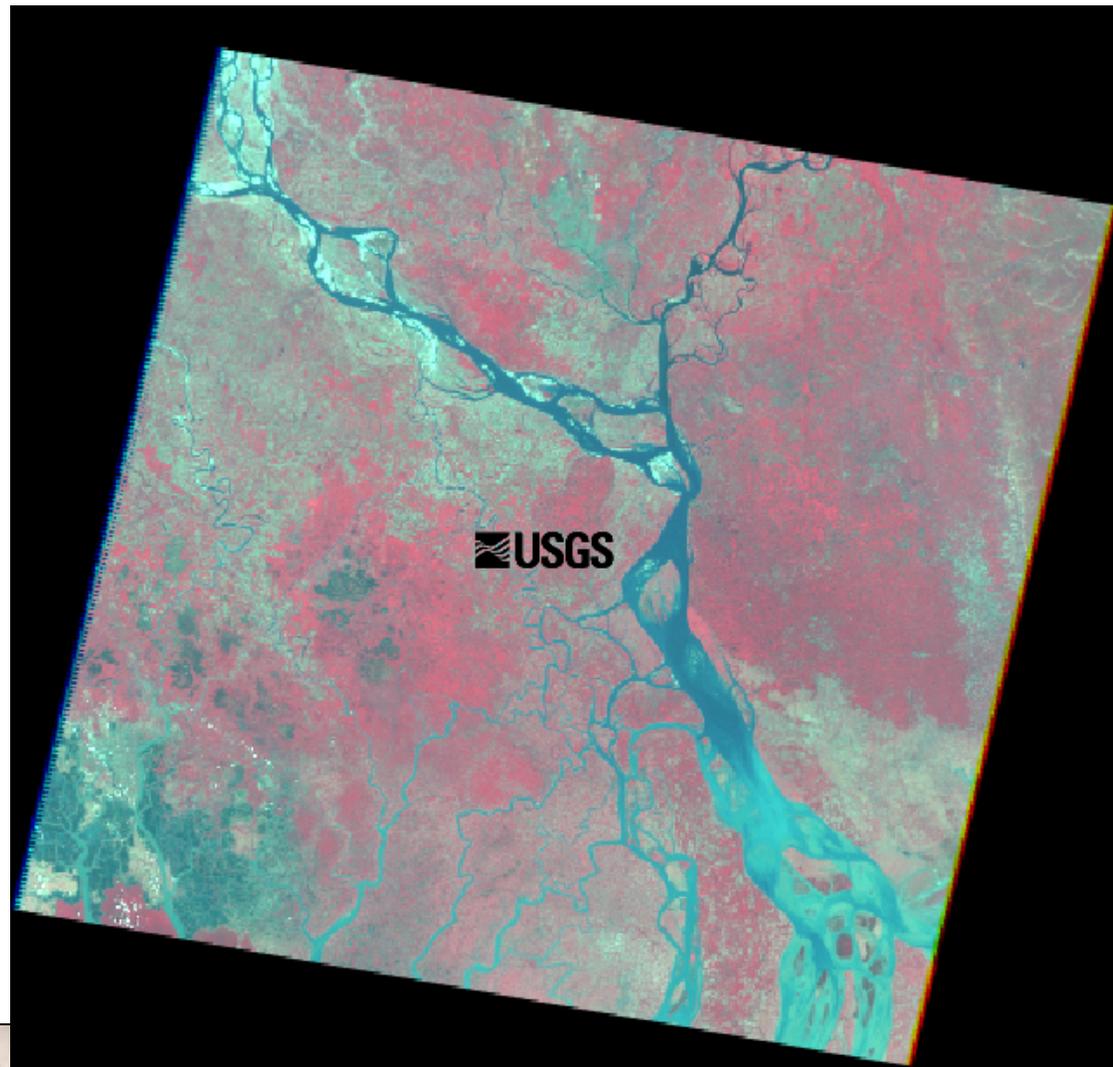
Watermarking Requirements

- **Insert USGS logo “watermark” within the data itself**
 - ◆ USGS visual identification (VisID) compliant to the extent possible
 - ◆ All bands of data affected
- **Landsat web enabling used as test case**
 - ◆ Level 1 Product Generation System (LPGS)
 - Landsat 7 ETM+, Landsat 5 TM, Landsat 4 TM, all MSS eventually
 - ◆ Does not apply to already processed data
- **Reversible**
- **Applies to all USGS remote sensing data sets (satellite, aerial, etc.)**
- **Includes “logos” of partner agencies where appropriate**

Possible Watermarking Implementation

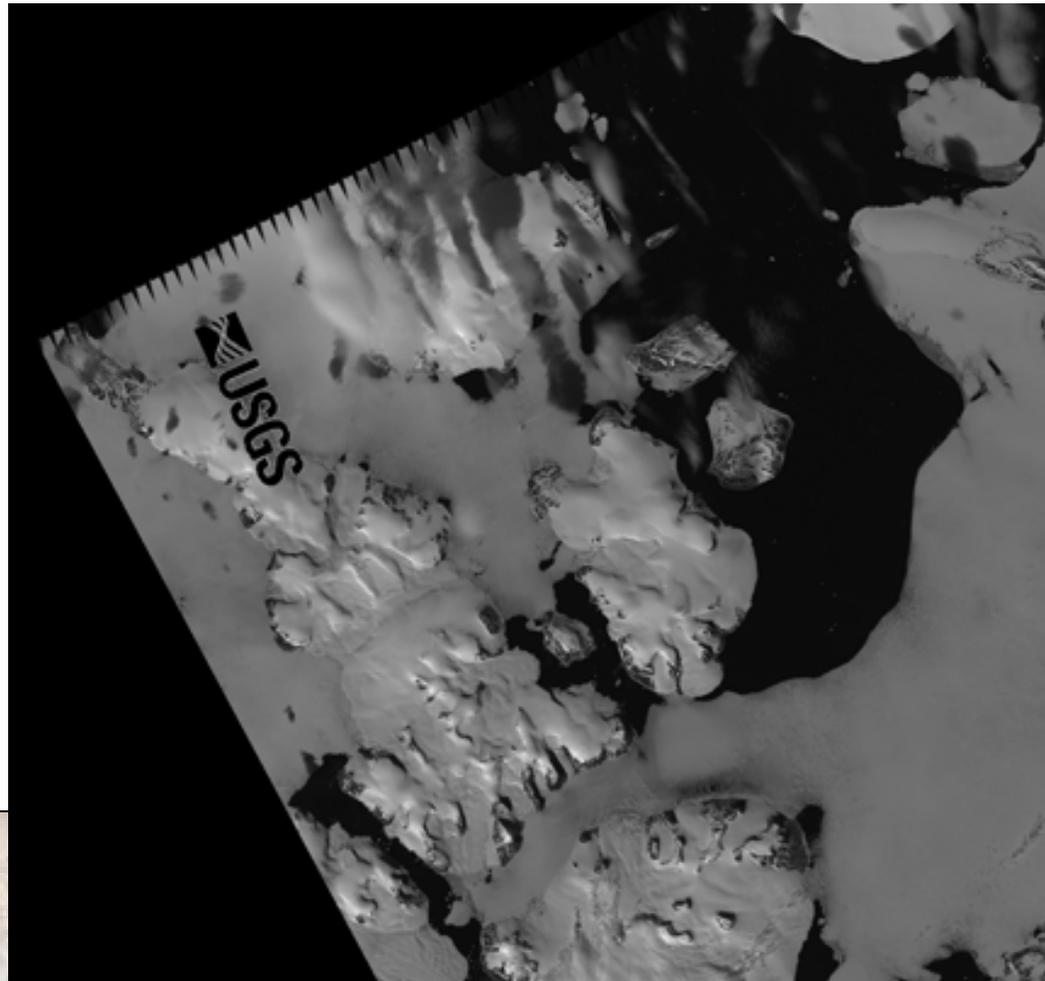
- **Color**
 - ◆ Black VisID (DN = 0)
 - This makes the VisID part of the “background” and will not cause errors in histogram creation or stretching for visualization
- **Location**
 - ◆ In the data itself, not in the collar
 - ◆ Two options for VisID placement investigated
 1. Center of image: Placed after processing
 2. Lower Left: Because each scene is rotated based on its location on the Earth’s surface, the VisID will be placed in the image prior to processing so that it will be rotated to the same degree as the image
 - ◆ At the equator, the VisID will be nearly horizontal
 - ◆ At high latitudes, the VisID will be nearly vertical
 - ◆ If reprojected, the VisID will maintain its location in the image

Example of USGS Logo Placement – Center



Example of USGS Logo Placement – Lower Left

- A high arctic scene
- The grayscale image is the result of only one band used as an example
- The rotation of the USGS is approximate



Possible Watermarking Implementation

- **LPGS Technical Solution**

- ◆ Replace DNs in image with a DN=0 to create the VisID
- ◆ Original DNs will be placed in an additional file per band
 - Each ETM+ scene will have 9 “watermark mask” files (fewer bands in TM & MSS data)
- ◆ Would add ~6.5MB per ETM+ scene
 - Average full scene ~250MB
 - “watermark mask” files are only the size of the watermark, so much smaller
- ◆ Watermark mask composition
 - DN values for VisID location
 - All other areas would have DN=0
- ◆ Schedule: 14 weeks for ETM+
 - Immediate implementation would delay MSS migration to LPGS

Possible Watermarking Implementation

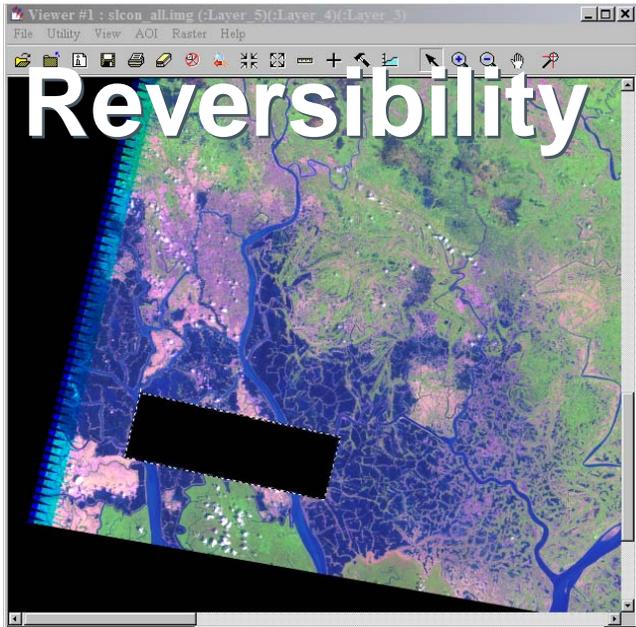
- **Reversibility**

- ◆ Computer software packages could be to reverse watermarking mask:

- $\text{Band_X_Vis} + \text{Band_X_Mask} = \text{Band_X}$

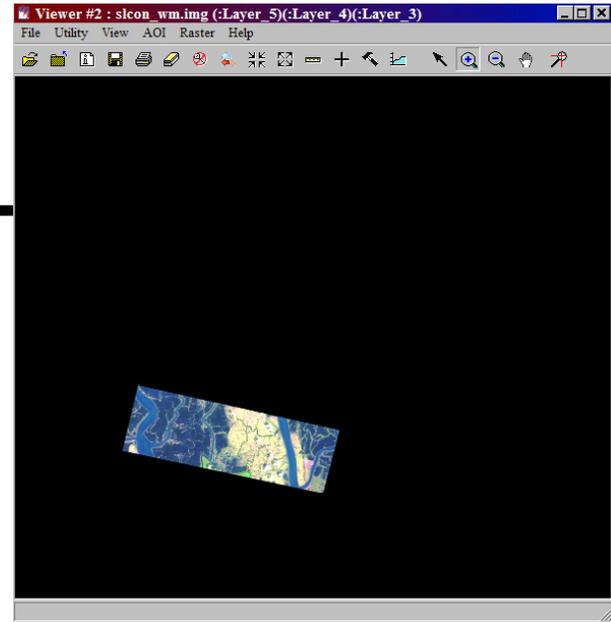
- ◆ Where Band_X_Vis is a full scene file with watermark,
- ◆ Band_X_Mask is the watermarking mask file, and
- ◆ Band_X is full scene without watermark

- ◆ This completely reinstates the original DN's for each band
 - Only works if the VisID has DN's = 0



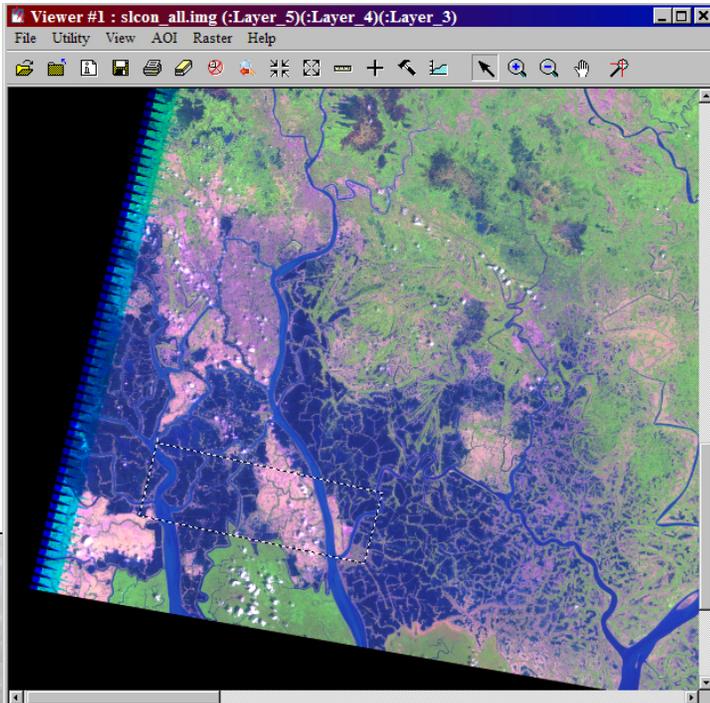
File with watermark

+



Watermark mask file

=



Issues

- **Implementation schedule is 14 weeks for ETM+ only (slightly longer to include TM)**
 - ◆ This delays the MSS migration to LPGS
- **Our partners may/may not want to have their logos included**
- **Not all users may understand process to remove logo or have computer software packages* to do it**
- **Landsat user community reaction**

***Computer software packages required are any remote sensing or GIS software**

Maintaining DN Values

The image displays two side-by-side screenshots of GIS software viewers, illustrating the impact of different processing settings on Digital Number (DN) values.

Viewer #2: slcon_wm.img (Watermark)

Map X: 131377.500000 Y: 2495662.500000 meters
Projection: UTM / WGS 84

Layer	Band	FILE PIXEL	DN VALUE	HISTOGRAM
2		54.000		20041.000
3	Blue	57.000	183.000	4621.000
4	Green	52.000	184.000	2297.000
5	Red	75.000	255.000	1707.000

Viewer #1: slcon_all.img (Full Scene)

Map X: 131377.500000 Y: 2495662.500000 meters
Projection: UTM / WGS 84

Layer	Band	FILE PIXEL	DN VALUE	HISTOGRAM
2		54.000		1370236.000
3	Blue	57.000	196.000	593880.000
4	Green	52.000	127.000	396753.000
5	Red	75.000	222.000	245245.000

The 'FILE PIXEL' values (54.000, 57.000, 52.000, 75.000) are circled in red in both tables, indicating that these values are maintained across the different processing settings.

Watermarking File Structure

- **Current LPGS file structure (after decompression)**

- L71033029_02920080920_B10.tif
- L71033029_02920080920_B20.tif
- L71033029_02920080920_B30.tif
- L71033029_02920080920_B40.tif
- L71033029_02920080920_B50.tif
- L71033029_02920080920_B61.tif
- L71033029_02920080920_GCP.txt
- L71033029_02920080920_MTL.txt
- L72033029_02920080920_B62.tif
- L72033029_02920080920_B70.tif
- L72033029_02920080920_B80.tif

- **Watermarking file structure**

- ◆ Would include a directory: watermark_mask*
- ◆ Additional of 'M' in the filename would indicate the mask file* (thereby keeping all other file names consistent and identifiable)
 - L7M033029_02920080920_B10.tif
 - L7M033029_02920080920_B20.tif
 - L7M033029_02920080920_B30.tif
 - L7M033029_02920080920_B40.tif
 - L7M033029_02920080920_B50.tif
 - L7M033029_02920080920_B61.tif
 - L7M033029_02920080920_B62.tif
 - L7M033029_02920080920_B70.tif
 - L7M033029_02920080920_B80.tif

*Actual implementation may vary slightly