

## Exercises using ASTER L1B data

### 1 Introduction to ASTER

ASTER (Advanced Spaceborne Thermal Emission and Reflection Radiometer) is an imaging instrument flying on Terra, a satellite launched in December 1999 as part of NASA's Earth Observing System (EOS). ASTER is a cooperative effort between NASA, Japan's Ministry of Economy, Trade and Industry (METI) and Japan's Earth Remote Sensing Data Analysis Center (ERSDAC). ASTER is being used to obtain detailed maps of land surface temperature, reflectance and elevation. ASTER captures high spatial resolution data in 14 bands, from the visible to the thermal infrared wavelengths; and provides stereo viewing capability for digital elevation model creation. For more information please see <http://asterweb.jpl.nasa.gov/index.asp>. ASTER L1B data is available on-demand via the USGS Global Visualization Viewer (<http://glovis.usgs.gov>).

A related document on ASTER data is available at [http://spg.ucsd.edu/Satellite\\_Projects/ASTER/ASTER\\_15m\\_data.htm](http://spg.ucsd.edu/Satellite_Projects/ASTER/ASTER_15m_data.htm).

**Table 1. ASTER bands**

Band	Bandwidth (nm)	Pixel Size (m)	Remarks
<b>VNIR = visible near-infrared</b>			
1	520 - 600	15	
2	630 - 690	15	
3N	760 - 860	15	N = normal
3B	760 - 860	15	B = backward looking at 26.7°
<b>SWIR = shortwave infrared</b>			
4	1600 - 1700	30	
5	2145 - 2185	30	
6	2185 - 2225	30	
7	2235 - 2285	30	
8	2295 - 2365	30	
9	2360 - 2430	30	
<b>TIR = thermal infrared</b>			

10	8125 - 8475	90	
11	8475 - 8825	90	
12	8925 - 9275	90	
13	1025 - 1095	90	
14	1095 - 1165	90	

## 2 Ordering ASTER scenes

Once the USGS Global Visualization Viewer (<http://glovis.usgs.gov>) opens, point to your area of interest. From the menu choose *Sensor-ASTER-VNIR*. Once you have found your area, you can increase the resolution from the menu with *Resolution-155 m*. Increase *Max Cloud* to about 30%. You can now browse through the archive with the *Prev Scene*, *Next Scene* buttons. You can select the scene for your order with the *Add* button. You need to register first before you can order ASTER data. The cost of ASTER data is currently \$80 per Level-1B scene but you may get it for free if you register and qualify. Currently educational users and researchers funded by NASA qualify for free ASTER data after applying for it at [http://lpdaac.usgs.gov/aster/aster\\_pricing.asp](http://lpdaac.usgs.gov/aster/aster_pricing.asp).

## 3 Converting ASTER swath to grid

**A.** Geo-referencing ASTER swath data is complicated (see [http://edcdaac.usgs.gov/aster/ASTER\\_GeoRef\\_FINAL.pdf#search=%22ASTER\\_GeoRef\\_Final.pdf%22](http://edcdaac.usgs.gov/aster/ASTER_GeoRef_FINAL.pdf#search=%22ASTER_GeoRef_Final.pdf%22)) and currently WIM cannot accurately geo-locate the swath data. WIM does automatically read the small 11 x 11 latitude and longitude arrays in the Level-1B file but the geo-location accuracy using this small array is very low. We therefore have to use the HEG tool (see <http://newsroom.gsfc.nasa.gov/sdptoolkit/HEG/HEGHome.html>) to convert ASTER swath data to a HDF-EOS grid format. We assume that you have successfully installed HEG and have the basic knowledge how to use it.

**B.** Start HEG and load the ASTER Level-1B file. Select *ImageData1* (in the *Fields* list), *Multi-Band HDF* as the *Output File Type*, *Geographic* as the *Projection* and click *Accept*. Now select *ImageData2* and click *Accept*. Now select *ImageData3N* and click *Accept*. Now click *Run*. That opens a new window and starts the remapping process. After it has finished you will have a new grid file named a *AST-L1B\_\*\_VNIR\_Swath.hdf* of about 84 MB in size. The remapped file is in HDF-EOS format with the HDF-EOS *Geographic* projection that is nothing else but a version of the WIM *Linear* projection. WIM can currently save only one image in a HDF-EOS format file and, therefore, when saving multiple files, WIM will prompt you for a confirmation that you want to save the file as regular HDF. The projection type of the saved file will be changed to *Linear*. At the same time the file size will be reduced from 80 MB to about 30 MB due to the internal compression that WIM uses in HDF files. Therefore, unless you want to keep the file in HDF-EOS format it is recommended to save the file in WIM as HDF under the

same name. A sample ASTER Level-1B file (in HDF format saved in WIM) is on the WIM CD under *Images\ASTER\Dongsha\2005.03.22*.

## 4 Creating ASTER RGB composite images

You can use WIM function *Examine – RGB Image* (  on the toolbar) to create a RGB composite from ASTER bands 1, 2 and 3N. Use band 1 as blue, band 2 as green and band 3N as red. ASTER does not have a real blue band and therefore the created RGB image does not look like a true-color image. Adjusting the colors of a RGB Image is rather slow on large ASTER images; therefore please remember to first select a rectangular area, adjust the colors on it. Below is a small subset of a RGB image of the Venice lagoon of 2006/08/17. You can see a plume of high reflectance due to suspended sediments just south of the city of Venice.



You can view the ASTER images (e.g. the RGB image that you created) in *Google Earth* with *Geo – View in Google Earth* (  icon on the toolbar) or see the boundaries in *Google Maps* (  icon on the toolbar). If you have not yet installed *Google Earth* then you can do it from <http://earth.google.com/download-earth.html>.

## 5 Dongsha atoll

Load a sample ASTER Level-1B file from *Images\ASTER\Dongsha\2005.03.22.* and make a RGB image with *Examine – RGB Image* (RGB). Find the atoll and the small island in the western part of the atoll. Find the aircraft contrails (bright linear features) and their shadows to the north of them. Explain why are the shadows to the north of the contrails? ☺ Cut of a smaller area with *W* and create the coastlines with *C* and *coast\_fill.b*, *Background Value* 0 and *Foreground Value* 100. Make the coastline red with *C*. As the ASTER RGB image that you just made is mostly bluish, the red color will be well visible. Now make the coastline thicker with *Edge – Dilate*. Overlay the dilated coastlines on top of the ASTER RGB image. Why does the coastline change into blue? In order to make the overlaid coastline red, convert it to RGB with *Transf – Convert to 24bpp (RGB)* and then overlay again. You should get something like that:



As you can see the coastline is shifted compared to the image. It likely that the *coast\_fill.b* map is not accurate enough for the 15-m ASTER imagery or that the error is introduced in the geo-location performed by HEG.

## 6 Turbidity

A WAM utility *wam\_turbidity\_aster* calculates relative turbidity by subtracting ASTER band 2 from band 1.

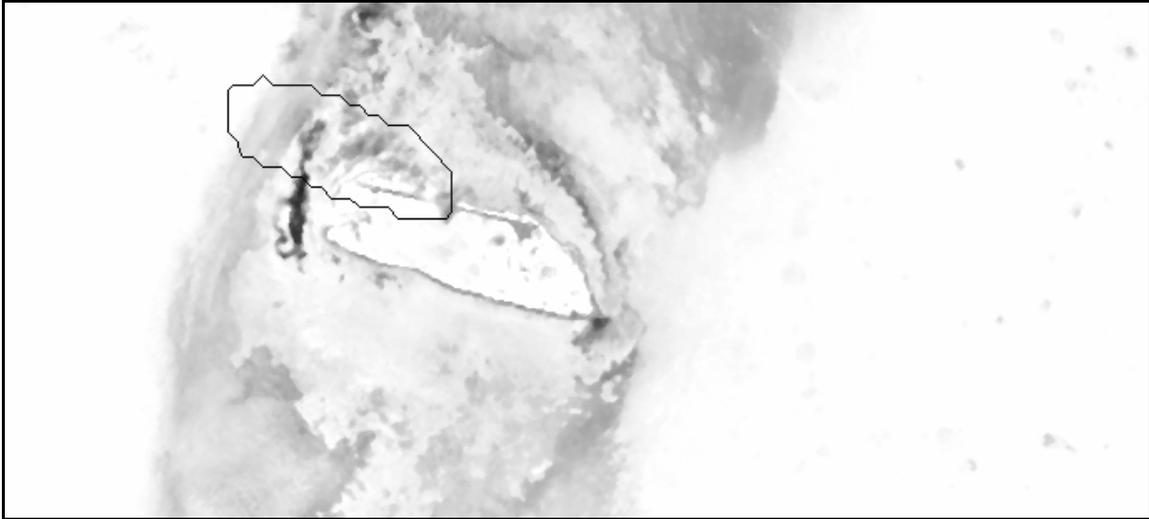
Assuming the ASTER grid file is in C:\tmp folder you can issue the following command:

```
wam_turbidity_aster C:\tmp\AST_L1B_*VNIR_Swath.hdf
```

You can also remap the turbidity image to a standard map by applying the target image as a HDF file.

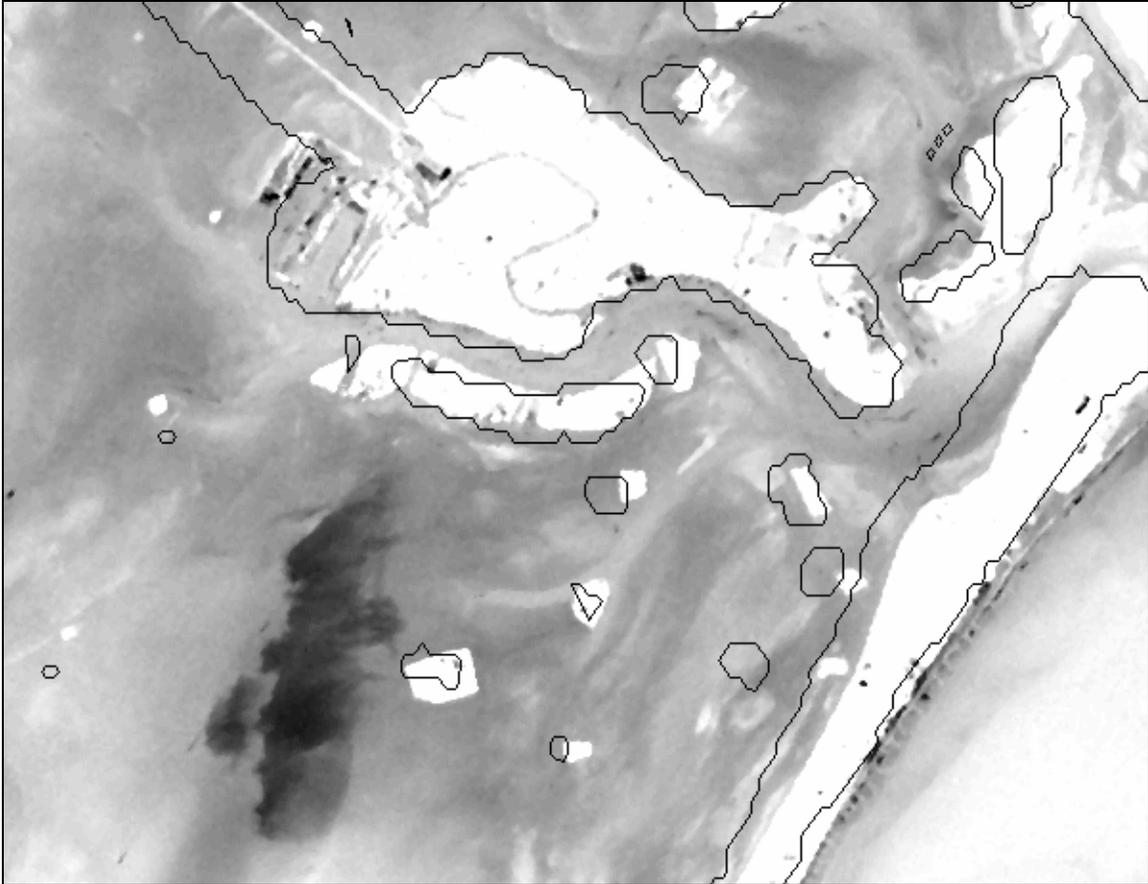
## Exercises using ASTER L1B data

The turbidity data is in a HDF file (*AST\_L1B\*1minus2.hdf*). It is convenient to represent turbidity as a grayscale image with turbid areas dark (black) and clear areas light (white). To do that select the *Settings* (🔧) and set palette to *Grayscale*. Now stretch colors (the *Color Definition* icon) so that *Start* and *End* are reversed, for example, *Start* = 255 and *End* = 58. You should get something like that:



Of course, in this case the “turbidity” is probably not real turbidity but bottom reflectance in the shallow areas. You can notice that the coastlines are shifted.

In case of the Venice sample image you can see the plume of high turbidity south of Venice. The color stretching in the Venice case was: *Start* = 104 and *End* = 58. You can notice that the coastlines of the islands in the Venice lagoon are not uniformly shifted but just not accurate for the 15-m ASTER imagery. Sample ASTER files for Venice are available at [http://spg.ucsd.edu/Satellite\\_Data/Venice](http://spg.ucsd.edu/Satellite_Data/Venice).



## 7 Manually black edges transparent

You can notice that the mapped ASTER grids have edges with no data (black). This is inconvenient if you view the image in *Google Earth* as the black areas cover useful *Google Earth* area. You can make these black edges transparent but currently you have to do this manually. To do that save your image as *Google Earth KML* (\*.kml) file in any folder. Let's assume that you saved it as *test.kml* in *C:\Temp*. This command created a *test.kml* file but also a *test.png* file corresponding to the image. You can then use *ImageMagick* to make the black areas transparent in the PNG file. You need to start a Windows command prompt, change directory to *C:\Temp* and convert the PNG to a transparent black PNG file under the same name:

```
convert -transparent black test.png test.png
```

When clicking on the *test.kml* file, GE will start and load the *test.png* file with transparent black edges. You can install *ImageMagick* from <http://www.imagemagick.org>.