

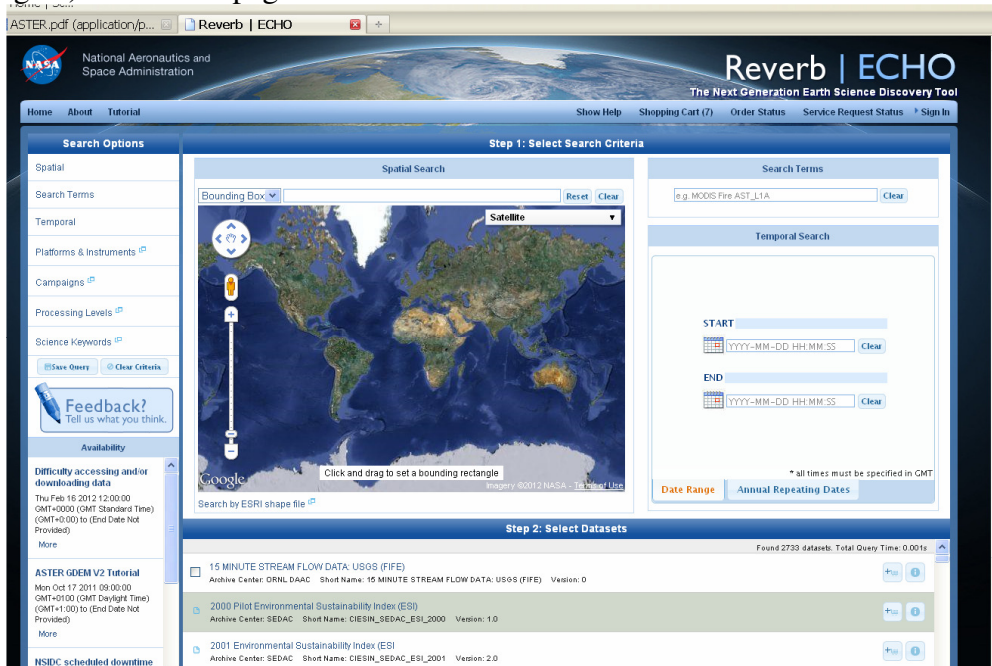
## Getting DEM from ASTER (~30m resolution) + importing it into ArcMap + georeferencing an image on top (e.g. satellite image, geological map)

### Step 1: getting the data from ASTER

WIST where the data used to be available has been replaced by Reverb in February 2012. To access Reverb, go to:

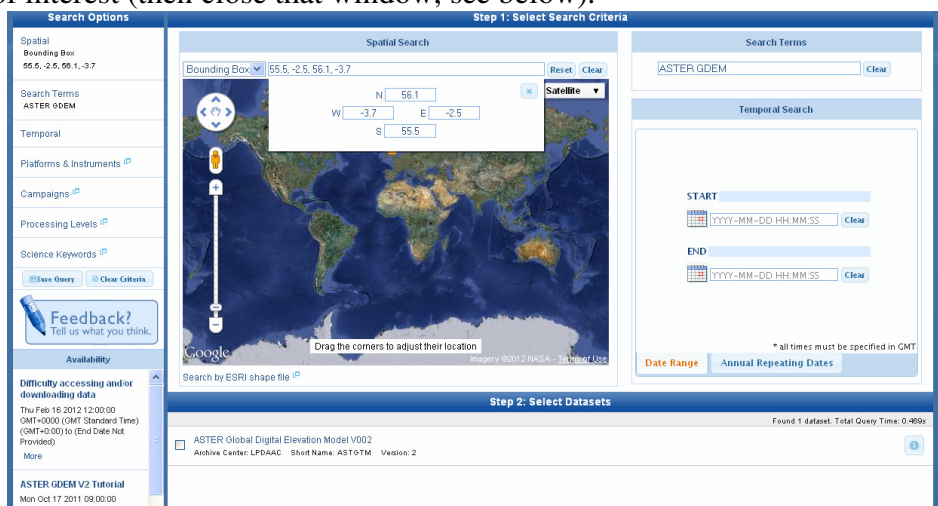
<https://reverb.echo.nasa.gov>

You will have to create an account (if you had created one with WIST, then you won't need to do it again). The home page looks like:



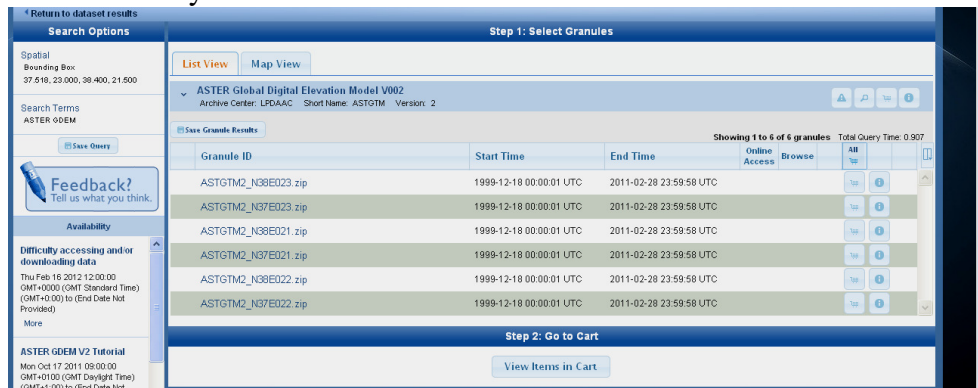
At the top right, specify that you are after ASTER tiles in the “Search Term” bar: type “ASTER GDEM” and the “ASTER Global Digital Elevation Model V002” will appear in the “Select Datasets” window at the bottom.

Then, select the zone of interest in the “Spatial Search” window: you can zoom in and out and use the mouse to draw a rectangle over the zone of interest, or you can click once on the bar next to “Bounding Box” and a window will appear in which you can enter the coordinates of the zone of interest (then close that window, see below).



In the “step 2” window below, select the ASTER option and click on “Search for Granules” at the bottom (the tiles are called Granules here).

The results will appear in a new window. You can add the ones you’re interested in to your cart one by one or you can click the button with “All” written above the little trolley, which will add all the tiles to your cart.

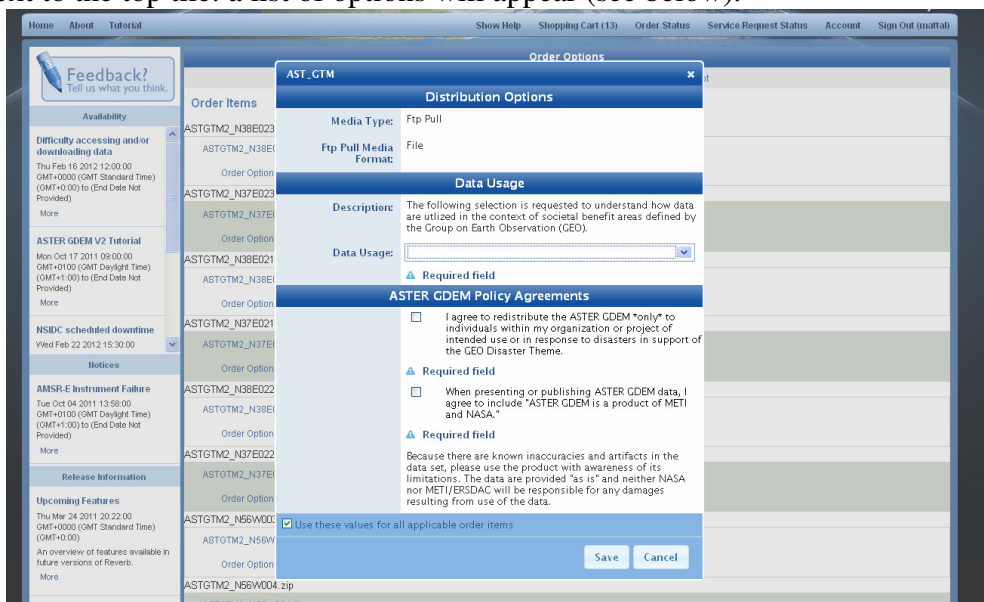


You can check that the items are in the cart (“view items in cart”). If you want to download more tiles, you can use the “return to...” links at the top left or just click on “home” at the top left which will take you to the home page and you will have to re-specify “ASTER GDEM” in the “Search datasets” bar.

When you are finished, go to your shopping cart and place the order. Note: if you haven’t logged on, the tiles will appear as “not orderable”. They will become orderable once you’ve logged on.

After clicking “order”, a page with your details will appear → Proceed.

A new page will appear with the list of tiles and a “Set” button next to each of them. Click on “Set” next to the top tile: a list of options will appear (see below).



Select the relevant data usage (e.g. “Water”) and tick the boxes to acknowledge that you have read:

*I agree to redistribute the ASTER GDEM \*only\* to individuals within my organization or project of intended use or in response to disasters in support of the GEO Disaster Theme. When presenting or publishing ASTER GDEM data, I agree to include "ASTER GDEM is a product of METI and NASA."*

If you let the little box at the bottom ticked, this will apply to all the tiles in your cart so you won't have to repeat the operation for each tile. Save, proceed to check out and submit your order. You should receive a confirmation e-mail shortly after. The instruction e-mail will follow within a couple of minutes-hours.

To download the data using a Unix machine (example: `adder.geos.ed.ac.uk`), follow the instructions given in the e-mail:

- navigate to the folder where you will store the files.
- `ftp e4ft101.cr.usgs.gov`
- enter login name *anonymous* and use your e-mail address as password.
- `bin` (to set mode to binary).
- `cd /PullDir/0302185647tZNqKb` (name of directory given in e-mail).
- `dir` (to check that the files are there).
- `prompt off` (so that the computer doesn't ask you every time if you want to download each file).
- `mget *.*` (to download all the files,).

The operation may take a bit of time if you have more than one tile but the process is usually fast (typically less than 10 seconds per tile).

Then quit and logout.

## Step 2: getting the DEM into ArcMap

If you have only one tile, just use the "Add Data" button in ArcMap. If you have more than one tile and want to stitch them together: Data Management Tools → Raster → Raster Dataset → Mosaic to new Raster → select the different TIFF tiles from ASTER (after unzipping the zip files). If you specify the coordinate during this step, you will end up with artefacts because you cannot specify here the resampling technique. You will specify the coordinate system later.

Note: in some cases (in particular if you have only one tile), the edges of the tiles can have anomalously high or low elevation values (e.g., 32000 m, -32000 m, 99999 m). This means that the data will not be displayed properly and it can create problem when processing the data. To eliminate these data points from the analysis, you can set them to Null: Spatial Analyst Tools → Conditional → SetNull. Select your raster as the input conditional raster AND the input false raster and type in the "Expression" box: `Value < -10 AND Value > 9000` (case and space sensitive). This means: "Set to Null all the points that fulfil the statement and use the value from the input false raster every time the statement is not verified". Give a name to the output raster and click OK. This should solve your problems.

Once the mosaic operation has been performed, you can choose the coordinate system. You need to choose a projected system to have coordinates in meters: Data Management Tools → Projections and Transformations → Raster → Project Raster.

Specify the input raster, then click on the button next to the "output coordinate system" box.

These are two popular options:

1- Select → Projected Coordinates Systems → Continental → ...

- North America Lambert Conformal Conic.prj (for North America)
- Canada Lambert Conformal Conic.prj (for Canada)
- Europe Lambert Conformal Conic.prj (for Europe).

In this case, ArcMap will also require the "Geographic Transformation". I usually use the first one on the list because I don't really know what the numbers at the end of the transformations are. The result doesn't seem to be strongly influenced by this choice (if you have any suggestions with respect to this matter, please let me know).

OR:

2- Select → Projected Coordinates Systems → UTM → WGS1984 → Select the suitable zone, according to the table at the end of this handout.

Specify the “Resampling Technique” as CUBIC → click OK.

Next steps:

- save the project and close ArcMap.
- reopen an empty ArcMap and import the transformed raster (using the “Add Data” button) so that the coordinates are displayed within the new coordinate system.
- In Data Management Tools → Raster → Clip the zone of interest.

### **Step 3: getting the satellite image georeferenced on top of the topo**

Move to the zone of interest with Google map and take a screenshot. In IrfanView (or other visualisation software), paste the screenshot and save it as a JPG. Select the area of interest with the mouse and crop it (Edit → crop selection), then save it.

In ArcMap, use the Add Data button and select the JPG file (don't double-click or it will just show the different layers that compose the JPG file).

Make sure the Georeferencing toolbar is displayed. In the Georeferencing toolbar, use the scroll down menu to have the jpg file appearing in the “layer” box. Then, click on the Georeferencing button → Fit to display.

In the Georeferencing toolbar, click on the button with the green and red crosses (make sure that the active layer in the toolbar is still the JPG image). Using this tool: click on one of the noticeable points on the JPG image (e.g. river confluence, cliff) and double click on the corresponding point on the DEM (you can hide the JPG image in the middle of the operation). The image will be translated/rotated/distorted to make the location fit (note: translation/rotation/distortion can be performed manually using the buttons in the Georeferencing toolbar). Repeat the operation for a few points. Note: it is easier to do this once the fluvial network has been traced. If you are happy with the result, click on the Georeferencing button → Update Georeferencing. If you want to remove one or more points, click on the “link table” button just to the right of the red/green cross button: an editable table with all the tie points will appear.

### **Step 4: visualizing the results in 3D in ArcScene**

Open ArcScene. Note: feel free to explore the different buttons in the toolbar, some do some pretty exciting things, e.g., the bird button (left click accelerates, right click slows down).

Use the Add Data button to add the DEM. Double click on the layer in the layer window → Base Heights → Obtain heights from surface (select the DEM if it is not selected). You can use the “Z unit conversion” to enhance relief (1 is no vertical exaggeration).

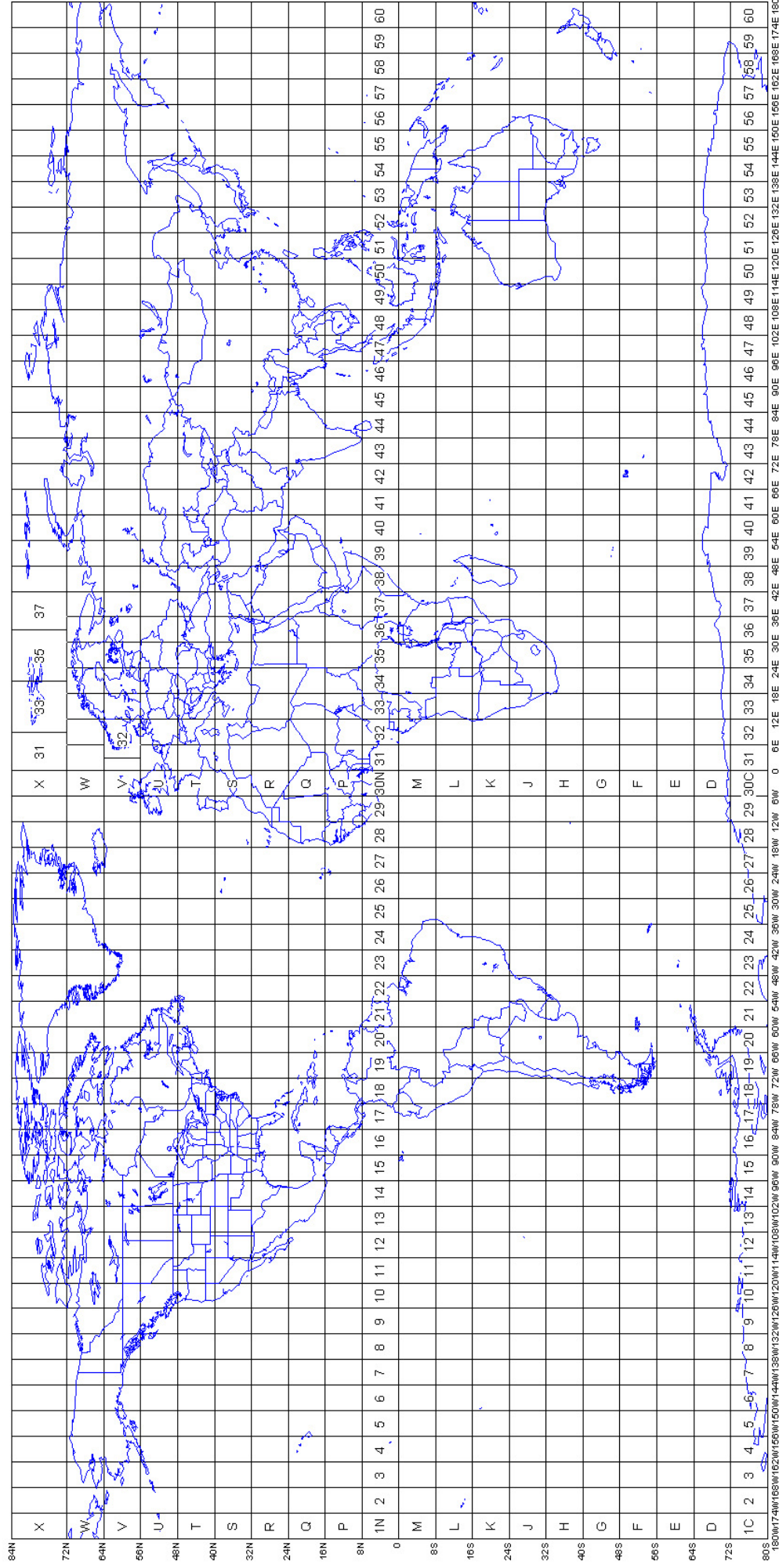
Add data → add the jpg file which has been georeferenced. Do the same operation than above but make sure that the DEM file is selected as the Base Heights.

Hide the DEM layer → you should now see the landscape in 3D (like in Google Earth!). If you want to keep the satellite image wrapped onto the DEM, you may have to do a couple of operations to make sure that it is displayed “above” the DEM:

- in the “Rendering” tab, you can select the “drawing priority” (in the “effects” box). If you give a priority of 1 to the satellite image and a priority of 10 to the DEM, then the image will be drawn on top of the DEM. If the image still disappears in places, you can use the “offset” option at the bottom of the “Base Heights” tab (if you put 5 meters for example, the satellite image will be systematically displayed 5 m above the DEM).

Possible additions (so that it is better than Google Earth!): you can add catchments, fluvial networks, slope map, geological maps, etc. *M. Attal, Feb. 2012 (thank you Simon!)*

## UTM Grid Zones of the World compiled by Alan Morton



There are 60 longitudinal projection zones numbered 1 to 60 starting at 180°W. Each of these zones is 6 degrees wide, apart from a few exceptions around Norway and Svalbard.

There are 20 latitudinal zones spanning the latitudes 80°S to 84°N and denoted by the letters C to X, omitting the letter O. Each of these is 8 degrees south-north, apart from zone X which is 12 degrees south-north.

Areas are referenced by quoting the longitudinal zone number, followed by the latitudinal zone letter. For example, the southern end of South America is 19F.

Within each longitudinal zone the transverse mercator projection is used to give co-ordinates (eastings and northings) in metres.

For the eastings, the origin is defined as a point 500,000 metres west of the central meridian of each longitudinal zone, giving an easting of 500,000 metres at the central meridian.

For the northings in the northern hemisphere, the origin is defined as the equator.

For the northings in the southern hemisphere, the origin is defined as a point 10,000,000 metres south of the equator.

The co-ordinates thus derived define a location within a UTM projection zone either north or south of the equator, but because the same co-ordinate system is repeated for each zone and hemisphere, it is necessary to additionally state the UTM longitudinal zone and either the hemisphere or latitudinal zone to define the location uniquely world-wide.

For further details of the referencing of Grid Co-ordinates within the UTM zones, it is recommended that you visit: