HCID

Grid Databases at Multiple Spatial Resolutions

GIS/Programming/Database-friendly Global Grid Identification System

As a basic element of spatial datasets, a new set of grid databases, *HCID*, was developed to facilitate data analysis and exchange in the HarvestChoice project. However, *HCID* can be also used in any discipline where much of spatial analysis relies on grid (raster) type data.

Grid datasets typically have a continental or global extent and is stored and processed in different formats. Some files cover the world, and others cover only a particular region (e.g., Africa). The global grids available here provide cell number identifiers, country identifiers, the fraction area that is land, and with values representing the area covered by each cell. There are grids for a number of different resolutions (30 seconds, 5, 10, 30 minutes, and 1 degree) yet consistently generated.

Grids and Resolution

We define 5 grids with a global extent, using a "geographic" projection. Thus the corner coordinates are (in decimal degree):

- Upper left corner is at lon = -180.0, lat = 90.0
- Lower-right corner is at lon = 180.0, lat = -90.0

Different "resolutions" have different cells sizes. The 1 degree global grid has 360 columns and 180 rows, thus (360 x 180 =) 64800 cells (0, 1, 2, ..., 64799).

To avoid confusion between grid cell numbers for grids with different resolution, we refer to the cell numbers of these grids as: **cell1d**, **cell30m**, **cell10m**, **cell5m** and **cell30s**. For example cell5m = 720 refers to the column 720 and row 0 while cell1d = 720 refers to column 0 and row 3 on their respective grids.

Countries

In the country grids, cell values are numeric code that identifies a country. The link between the identifier and the country name can be made via an access database or with this text file. The country grids were created by converting the GADM (Global Administrative Areas, *http://gadm.org*) version 0.9 polygons to a 30 second global grid, and aggregating using the *mode* (most common value).

Area

As we deal with un-projected grids (latitude/longitude) spatial units are in degrees, and cell resolution is constant in degrees, but not in m^2. This is because one degree longitude is about 0.83 km at the equator, but 0 at the poles. The area grids provide an estimate of the size of each cell (in km^2).

Fraction Land Area

Identifies the fraction of the grid cell that is land area. Derived from the 30 seconds country data.

Unique Cell Identifiers

For a grid of a certain resolution, irrespective of its extent, it is possible to always use the same identifiers for a specific grid cell, even if you are using only a subset of the data (e.g. Africa). A consistent numbering system like that assures a smooth data exchange and analysis. Grid (or raster) data consists of a rectangular area divided into rectangular (typically square) cells. In the example grid drawn [1], the green area represents the grid, with in red the cell numbers starting at zero. There are 10 columns and 5 rows, hence 10 x 5 = 50 cells.

		Columns									
		0	1	2	3	4	5	6	7	8	9
Rows	0	0	1	2	3	4	5	6	7	8	9
	1	10	11	12	13	14	15	16	17	18	19
	2	20	21	22	23	24	25	26	27	28	29
	3	30	31	32	33	34	35	36	37	38	39
	4	40	41	42	43	44	45	46	47	48	49

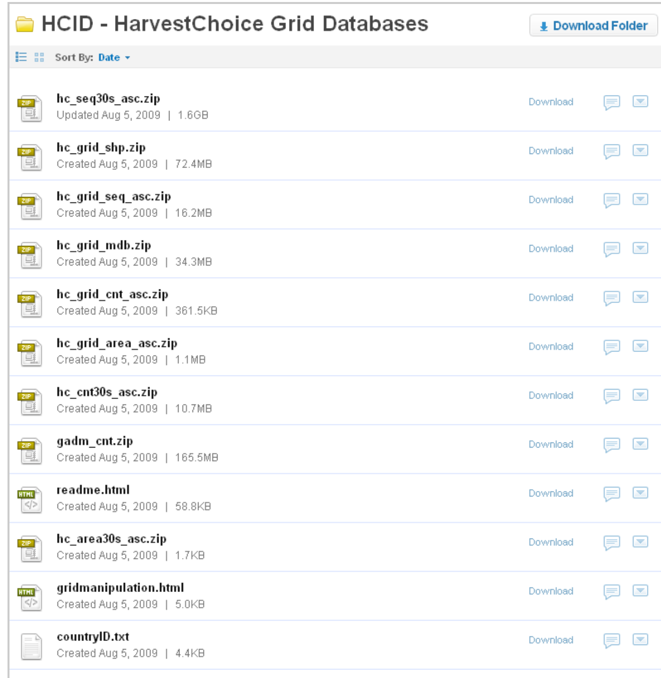
[1] Cell ID numbering scheme used in HCID. This example depicts 36-degree resolution grid cells for illustration purpose.

The sequential numbering starts in the upper-left corner, moves to the right, and then to the next line, to end in the lower-right corner. For computational reasons is easier to start with 0 than with 1 (because in most computer languages arrays are indexed from 0…n and not from 1…n). Therefore the identifier of the last cell will be the total number of cells minus one, which is 10 x 5 - 1 = 49 in this example. Row and column numbers also start with zero. Cell numbers only have meaning for a specific grid (computationally only the number of columns must be the same; but semantically the grid also has the same spatial extent (and resolution).

While a cell could be referred to with a row and column number, it is in most cases much easier to have a single unique identifier (simpler queries for example), also because for the cases where this is necessary, computing the row or column number from a cell number is relatively trivial. Next page shows a number of example functions in *R* language that are useful in this context. Such functions can be easily implemented in other programming languages also.

Download

All the data files can be downloaded from the HarvestChoice Box at: ***https://hc.box.net/shared/baku10bgcz***



Screenshot of the HarvestChoice Grid Database download page

Raster

Grid cells are in the ESRI ASCII raster type format. For each resolution there are three files. One file with cell numbers (filename = "*hc_seq_**"), i.e. the unique identifier for each cell. There is a also a file indicating the country to which (the majority of) that cell belongs (filename = "*hc_cnt_**"). Countries are identified with a numeric code that is linked to country names in the access database and also here. The country grids were created by aggregating from a 30 second grid, using the *mode* (most common value). Finally, there is a file in which the value represents the area of that cell in km2 (filename = "*hc_area_**").

Vector

Same as above for the raster data, but the data are stored in a *shapefile* format: *hc_grid_shp.zip*. That is, each raster cell is a rectangular polygon with the cell number as an attribute for easy (albeit perhaps inefficient) linking and displaying of data. Grid cells that only cover oceans or seas are not included.

Cell Database

The database file (*hc_grid_mdb.zip*) is in the Microsoft Access format, and it has three tables: "*cells*", "*countries*", and "*gridspecs*".

Table cells links the cell numbers of the different resolutions and also links these to the country numbers. This can be used to (dis) aggregate data, for example to distribute data at a 1 degree resolution to different countries.

Table "countries" provides the link between the country codes "CID" and country names. The "gridspecs" table provides some essential parameters for each grid such as number of rows.

Country Boundaries

The country boundaries used to make the country grids is from the GADM version 0.9.

Note

Gridded data is included for all resolutions except 30 seconds resolution because of the large file sizes. If you require cell numbers of country identifiers at this resolution you can use these grids: 30 second cell numbers (*hc_seq30s_asc.zip*) this one is a very big download) and for countries (*hc_cnt30s_asc.zip*).

All of these files are provide for reference; in many cases using a raster type file format and a programmatic approach to calculating cell numbers may be more efficient then linking to these files.

Example R language function for grid data manipulation

```
# The below function use an grid object (list) referred to as "g". This object can be cre-
ated with this functions:
# set up a grid object (list)
setupgrid <- function(xn=-180, xx=180, yn=-90, yx=90, nr=180, nc=360) {
    grid <- list(nrows=nr, ncols=nc, xmin=xn, xmax=xx, ymin=yn, ymax=yx, xres=0, yres=0)
    grid$xres <- (grid$xmax - grid$xmin) / grid$ncols
    grid$yres <- (grid$ymax - grid$ymin) / grid$nrows
    return(grid) }

# get column number from cell number
getcolfromcell <- function(cell, g) {
    if (cell >= 0 & cell < g$nrows * g$ncols) {
    col <- cell - trunc(cell / g$ncols) * g$ncols }
    else { col <- NA }
    return(col) }

# get row number from cell number
getrowfromcell <- function(cell, g) {
   if (cell >= 0 & cell < g$nrows * g$ncols) {
     row <- trunc(cell / g$ncols) }
   else { row <- NA }
   return(row) }

# get cell number from row and column number
getcellfromrowcol <- function(row, col, g) {
  if (row >= 0 & row < g$nrows & col >= 0 & col <= g$ncols) {
     cell <- row * g$ncols + col}
  else {cell <- NA }
  return(cell) }


#To compute a cell number from a coordinate pair (x, y) you can use the functions below
# get column number from x coordinate
getcolnumber <- function(x, g) {
    if ((x >= g$xmin) & (x < g$xmax)) {
    return(trunc((x - g$xmin) / g$xres)) }
    else { if (x == g$xmax) { return(g$ncols - 1) }
    else {return(NA)} } }

# get row number from y coordinaten
getrownumber <- function(y, g) {
    if ((y <= g$ymax) & (y > g$ymin)) {return(trunc((g$ymax-y) / g$yres))}
    else { if (y == g$ymin) {return(g$nrows - 1)}
    else {return(NA)} } }

# get cell number from x and y coordinates
getcellnumber <- function(x, y, g) {
    col <- getcolnumber(x, g)
    row <- getrownumber(y, g)
    if ( (!is.na(col)) & (!is.na(row)) ) { return(row * g$ncols + col) }
```

HarvestChoice generates knowledge products to help guide strategic investments to improve the well-being of poor people in sub-Saharan Africa and South Asia through more productive and profitable farming. To do this, a novel and spatially explicit evaluation framework is being developed and deployed. By design, primary knowledge products are currently targeted to the needs of investors, policymakers and program managers, as well as the analysts and technical specialists who support them. Most decisions that HarvestChoice targets are those having implications that cut across country boundaries.

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