pygeogrids Documentation

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Christoph Paulik

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Contents

pygeogrids is a package for creation and handling of Discrete Global Grids.

It can be used to define a grid on the globe using numpy arrays of longitude and latitude. These grids can also have unique grid point numbers. The grids must not be valid globally but can e.g. only cover the Continents.

When a grid is defined it can be used to quickly find the nearest neigbor of a a given lat, lon coordinate on the grid. For that the lon, lat coordinates are converted to Cartesian coordinates. This approach is of limited use for high resolution data which might rely on a specific geodetic datum.

The class *pygeogrids.grids.CellGrid* extends this basic grid with the ability to store a additional cell number for each grid point. This can be used to tile a grid in e.g. 5x5° cells. We often store remote sensing data in cells to partition a dataset into manageable parts. This link with the grid class enables us to easily find the link between a grid point and the cell file in which the relevant data is stored.

Please see the examples in this documentation as well as the pytesmo code for real world usage examples.

CHAPTER 1

Contents

Examples

```
import pygeogrids.grids as grids
import numpy as np
```

Let's create a simple regular 10x10 degree grid with grid points at the center of each 10x10 degree cell.

First by hand to understand what is going on underneath

```
# create the longitudes
lons = np.arange(-180 + 5, 180, 10)
print(lons)
lats = np.arange(90 - 5, -90, -10)
print(lats)
```

```
[-175 -165 -155 -145 -135 -125 -115 -105  -95  -85  -75  -65  -55  -45  -35
  -25  -15   -5    5   15   25   35   45   55   65   75   85   95  105  115
  125  135  145  155  165  175]
[ 85  75  65  55  45  35  25  15   5  -5 -15 -25 -35 -45 -55 -65 -75 -85]
```

These are just the dimensions or we can also call them the "sides" of the array that defines all the gridpoints.

```
# create all the grid points by using the numpy.meshgrid function
longrid, latgrid = np.meshgrid(lons, lats)
```

now we can create a BasicGrid. We can also define the shape of the grid. The first part of the shape must be in longitude direction.

```
manualgrid = grids.BasicGrid(longrid.flatten(), latgrid.flatten(), shape=(36, 18))

# Each point of the grid automatically got a grid point number
gpis, gridlons, gridlats = manualgrid.get_grid_points()
print(gpis[:10], gridlons[:10], gridlats[:10])
```

```
(array([0, 1, 2, 3, 4, 5, 6, 7, 8, 9]), array([-175, -165, -155, -145, -135, -125, -
↪115, -105,  -95,  -85]), array([85, 85, 85, 85, 85, 85, 85, 85, 85, 85]))
```

The grid point indices or numbers are useful when creating lookup tables between grids.

We can now use the manualgrid instance to find the nearest gpi to any longitude and latitude

```
ngpi, distance = manualgrid.find_nearest_gpi(15.84, 28.76)
print(ngpi, distance)
# convert the gpi to longitude and latitude
print(manualgrid.gpi2lonlat(ngpi))
```

```
(235, 424808.51317782089)
(15, 25)
```

The same grid can also be created by a method for creating regular grids

```
autogrid = grids.genreg_grid(10, 10)
autogrid == manualgrid
```

```
True
```

If your grid has a 2D shape like the ones we just created then you can also get the row and the column of a grid point. This can be useful if you know that you have data stored on a specific grid and you want to read the data from a grid point.

```
row, col = autogrid.gpi2rowcol(ngpi)
print(row, col)
```

```
(6, 19)
```

Iteration over gridpoints

```
for i, (gpi, lon, lat) in enumerate(autogrid.grid_points()):
    print(gpi, lon, lat)
    if i==10: # this is just to keep the example output short
        break
```

```
(0, -175.0, 85.0)
(1, -165.0, 85.0)
(2, -155.0, 85.0)
(3, -145.0, 85.0)
(4, -135.0, 85.0)
(5, -125.0, 85.0)
(6, -115.0, 85.0)
(7, -105.0, 85.0)
(8, -95.0, 85.0)
(9, -85.0, 85.0)
(10, -75.0, 85.0)
```

Calculation of lookup tables

If you have a two grids and you know that you want to get the nearest neighbors for all of its grid points in the second grid you can calculate a lookup table once and reuse it later.

```
# lets generate a second grid with 10 random points on the Earth surface.

randlat = np.random.random(10) * 180 - 90
randlon = np.random.random(10) * 360 - 180
print(randlat)
print(randlon)
# This grid has no meaningful 2D shape so none is given
randgrid = grids.BasicGrid(randlon, randlat)
```

```
[-67.7701097   79.03856366 -71.6134622   63.7418792  -25.91579334
  19.20630556 -79.29563693  11.49060401  33.88811903  41.03189655]
[ -65.98506205  -86.16694426  112.33747512  -49.55645505  -22.02287726
  132.29787487   91.23860579  -92.31842844   94.96203201  -66.00963993]
```

Now lets calculate a lookup table to the regular 10x10° grid we created earlier

```
lut = randgrid.calc_lut(autogrid)
print(lut)
```

```
[551  45 605  85 411 283 603 260 207 155]
```

The lookup table contains the grid point indices of the other grid, autogrid in this case.

```
lut_lons, lut_lats = autogrid.gpi2lonlat(lut)
print(lut_lats)
print(lut_lons)
```

```
[-65.  75. -75.  65. -25.  15. -75.  15.  35.  45.]
[ -65.  -85.  115.  -45.  -25.  135.   95.  -95.   95.  -65.]
```

Storing and loading grids

Grids can be stored to disk as CF compliant netCDF files

```
import pygeogrids.netcdf as nc
nc.save_grid('example.nc', randgrid)
```

```
loadedgrid = nc.load_grid('example.nc')
```

```
loadedgrid
```

```
<pygeogrids.grids.BasicGrid at 0x7f21801b31d0>
```

```
randgrid
```

```
<pygeogrids.grids.BasicGrid at 0x7f218019ec90>
```

Define geodetic datum for grid

```
grid_WGS84 = grids.BasicGrid(randlon, randlat, geodatum='WGS84')
```

```
grid_GRS80 = grids.BasicGrid(randlon, randlat, geodatum='GRS80')
```

```
grid_WGS84.geodatum.a
```

```
6378137.0
```

```
grid_GRS80.geodatum.a
```

```
6378137.0
```

```
grid_WGS84.kdTree.geodatum.sphere
```

```
False
```

Subsetting grids using shapefiles.

```
import pygeogrids.grids as grids
import pygeogrids.shapefile as shapefile
import numpy as np
```

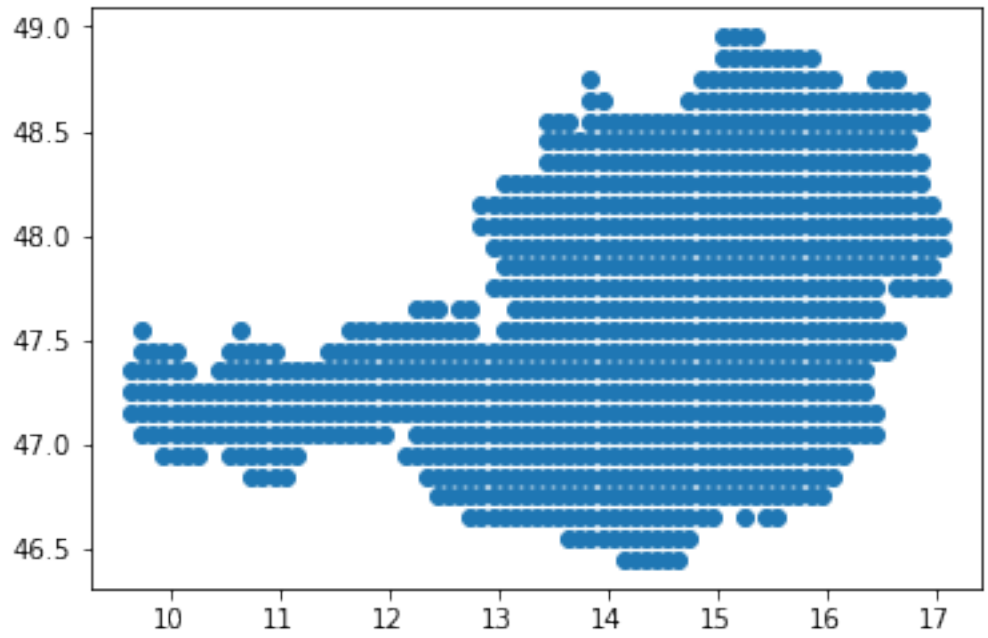
```
testgrid = grids.genreg_grid(0.1, 0.1)
```

We can now subset the 0.1x0.1 degree regular grid with the shapefiles from http://biogeo.ucdavis.edu/data/gadm2.8/gadm28_levels.shp.zip which were downloaded to `~/Downloads/gadm`

```
austria = shapefile.get_gad_grid_points(testgrid, '/home/cpa/Downloads/gadm/',
                                        0, name='Austria')
```

We can the plot the resulting grid using a simple scatterplot.

```
import matplotlib.pyplot as plt
%matplotlib inline
plt.scatter(austria.arrlon, austria.arrlat)
```

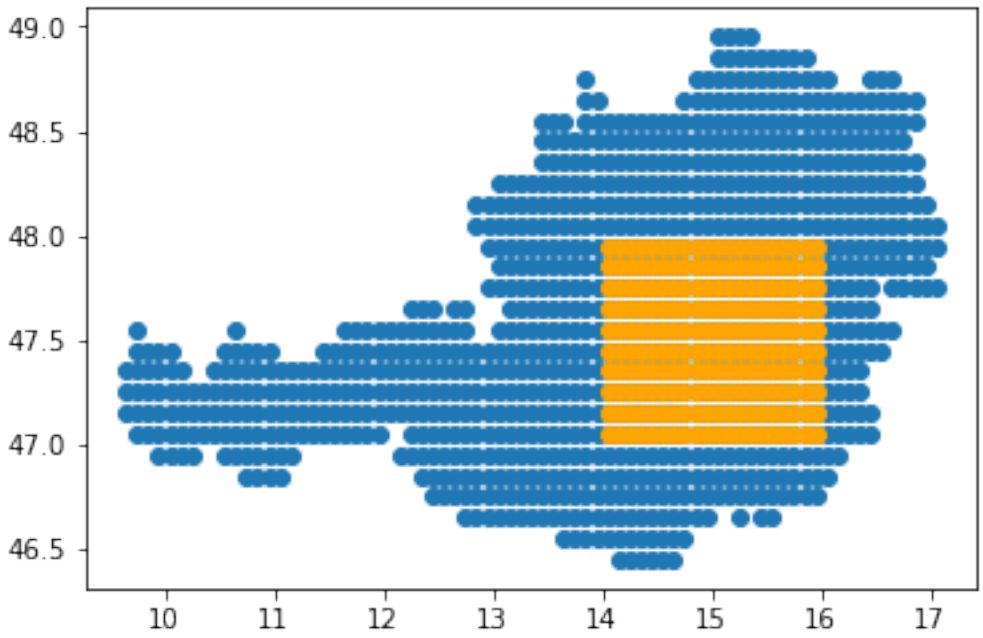


Behind the scenes this functionality uses the `get_shp_grid_points` function of the grid object.

We can also use this directly using any `ogr.Geometry` object.

```
ring = ogr.Geometry(ogr.wkbLinearRing)
ring.AddPoint(14, 47)
ring.AddPoint(14, 48)
ring.AddPoint(16, 48)
ring.AddPoint(16, 47)
ring.AddPoint(14, 47)

poly = ogr.Geometry(ogr.wkbPolygon)
poly.AddGeometry(ring)
subgrid = austria.get_shp_grid_points(poly)
plt.scatter(austria.arrlon, austria.arrlat)
plt.scatter(subgrid.arrlon, subgrid.arrlat, c='orange')
```



Changelog

v0.2.4

- Add option to subset a grid with a shape file (OGRGeometry) in get_shp_grid_points.
- Add shapefile module for reading shapefiles from http://biogeo.ucdavis.edu/data/gadm2.8/gadm28_levels.shp.zip by Global Administrative Level
- Ensure that *get_bbox_grid_points* returns points while taking cell order into account.

v0.2.3

- Fix bug in calc_lut in case of differently ordered subset of a grid.
- Add function to reorder grid based on different cell size. (See grids.reorder_to_cellsize)

v0.2.2

- Add option to load grids with non standard variable name for gpis.

v0.2.1

- Fix bug in gpi2lonlat with subset, see #42
- Add simple script for plotting a global cell partitioning.

v0.2.0

- fix bug in storing/loading grids with shape attribute set.
- change equality check of grids to be more flexible. Now only a match of the tuples gpi, lon, lat, cell is checked. The order does no longer matter.
- Shape definition changed to correspond to what one would expect. Now a 1x1 regular global grid has the shape (180, 360) corresponding to the 180 rows and 360 columns that the array has. This was necessary since the genreg_grid function produced grids with wrong lon2d, lat2d arrays because the shape was not correct

v0.1.9

- bugfix in lonlat2cell. Improvements in dependency installation and documentation.

v0.1.7

- bugfix in gpi2lonlat. Now supports array as input.

v0.1.6

- add geodatic datum functionality to grid objects

v0.1.5

- bugfix of subgrid creation which returned wrongly shaped subarrays

v0.1.4

- fix bug in lookuptable generation when gpis have custom ordering
- add functions for getting subgrids from cells and gpis

v0.1.3

- change meaning and rename grid dimensions to lon2d, lat2d. They do now represent 2d arrays of latitudes and longitudes which means that they no longer have to be regular in order to be able to have a shape. This is useful for e.g. orbit data

v0.1.2

- fix issue #19 by refactoring the iterable checking into own function
- made pykdtree an optional requirement see issue #18

v0.1.1

- added support for saving more subsets and loading a certain one in/from a netcdf grid file
- fix #15 by setting correct shape for derived cell grids
- fix issue #14 of gpi2rowcol input types

v0.1

- Initial version pulled out of pytesmo
- added support for iterables like lists and numpy arrays to functions like find_nearest_gpi. numpy arrays should work everywhere if you want to get information from a grid. see issue #3 and #4
- fixed bugs occuring during storage as netCDF file see issue #8
- comparison of grids is no longer using exact float comparison, see issue #9
- added documentation and examples for working with the grid objects, see issue #1

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```
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```

pygeogrids

pygeogrids package

Submodules

pygeogrids.geodetic_datum module

class pygeogrids.geodetic_datum.**GeodeticDatum**(*ellps*, ***kwargs*)
Class representing a geodetic datum providing transformation and calculation functionality

Parameters **ellString** (*string*) – String of geodetic datum (ellipsoid) as provided in pyproj

EllM(*lat*)
Method to calculate the radius of the curvature

Parameters **lat** (*numpy.array, list or float*) – Geodatic latitudes of the points in the grid

Returns **r** – radius of the curvature

Return type np.array, float

EllN(*lat*)
Method to calculate the radius of the prime vertical

Parameters **lat** (*numpy.array, list or float*) – Geodatic latitudes of the points in the grid

Returns **r** – radius of the prime vertical

Return type np.array, float

GaussianRadi(*lat*)
Method to calculate the gaussian radius of the curvature

Parameters **lat** (*numpy.array, list or float*) – Geodatic latitudes of the points in the grid

Returns **r** – gaussian radius of the curvature

Return type np.array, float

GeocentricDistance(*lon*, *lat*)
Method to calculate the geocentric distance to given points

Parameters

- **lon** (*numpy.array, list or float*) – Geodatic longitude of the points in the grid
- **lat** (*numpy.array, list or float*) – Geodatic latitudes of the points in the grid

Returns **r** – Geocentric radius

Return type np.array, float

GeocentricLat(*lat*)
Method to calculate the geocentric from the geodatic latitude.

Parameters **lat** (*numpy.array, list or float*) – Geodatic latitudes of the points in the grid

Returns **lat_geocentric** – Geocentric latitude

Return type np.array, float

GeodeticLat(*lat*)
Method to calculate the geodatic from the geocentric latitude.

Parameters **lat** (*numpy.array, list or float*) – Geocentric latitudes of the points in the grid

Returns **lat_geodatic** – Geodatic latitude

Return type np.array, float

MeridianArcDist(*lat1*, *lat2*)
Method to calculate the distance between two parallels (meridian arc distance)

Parameters

- **lat1** (*numpy.array, float*) – Geodatic latitudes 1
- **lat2** (*numpy.array, float*) – Geodatic latitudes 2

Returns **dist** – Meridian arc distance

Return type np.array, float

ParallelArcDist(*lat*, *lon1*, *lon2*)
Method to calculate the distance between two points on a given parallel

Parameters

- **lat** (*float*) – Geodatic latitudes of the points in the grid
- **lon1** (*float*) – Longitude of point 1 at the given parallel
- **lon2** (*float*) – Longitude of point 2 at the given parallel

Returns **dist** – Parallel arc distance

Return type np.array, float

ParallelRadi(*lat*)
Method to get the radius the parallel at a given latitude.

Parameters **lat** (*numpy.array, list or float*) – latitudes of the points in the grid

Returns **radius** – Radius of parallel

Return type np.array, float

ReducedLat(*lat*)
Method to calculate the reduced from the geodatic latitude.

Parameters **lat** (*numpy.array, list or float*) – Geodatic latitudes of the points in the grid

Returns **lat_reduced** – Reduced latitude

Return type np.array, float

getParameter()
Method to transform lon/lat to ECEF (Earth-Centered, Earth-Fixed) coordinates representing a 3d Cartesian coordinate system.

Parameters

- **lon** (*numpy.array, list or float*) – longitudes of the points in the grid
- **lat** (*numpy.array, list or float*) – latitudes of the points in the grid

Returns **x, y, z** – 3D cartesian coordinates

Return type np.array

toECEF(*lon*, *lat*)
Method to transform lon/lat to ECEF (Earth-Centered, Earth-Fixed) coordinates representing a 3d Cartesian coordinate system.

Parameters

- **lon** (*numpy.array, list or float*) – longitudes of the points in the grid
- **lat** (*numpy.array, list or float*) – geodatic latitudes of the points in the grid

Returns **x, y, z** – 3D cartesian coordinates

Return type np.array

pygeogrids.grids module

The grids module defines the grid classes.

class pygeogrids.grids.**BasicGrid**(*lon*, *lat*, *gpis=None*, *geodatum='WGS84'*, *subset=None*, *setup_kdTree=True*, *shape=None*)
Bases: object

Grid that just has lat,lon coordinates and can find the nearest neighbour. It can also yield the gpi, lat, lon information in order.

Parameters

- **lon** (*numpy.array*) – longitudes of the points in the grid
- **lat** (*numpy.array*) – latitudes of the points in the grid
- **geodatum** (*basestring*) – Name of the geodatic datum associated with the grid
- **gpis** (*numpy.array, optional*) – if the gpi numbers are in a different order than the lon and lat arrays an array containing the gpi numbers can be given if no array is given here the lon lat arrays are given gpi numbers starting at 0
- **subset** (*numpy.array, optional*) – if the active part of the array is only a subset of all the points then the subset array which is a index into lon and lat can be given here
- **setup_kdTree** (*boolean, optional*) – if set (default) then the kdTree for nearest neighbour search will be built on initialization
- **shape** (*tuple, optional*) – The shape of the grid array in 2-d space. e.g. for a 1x1 degree global regular grid the shape would be (180,360). if given the grid can be reshaped into the given shape this indicates that it is a regular grid and fills the attributes self.lon2d and self.lat2d which define the grid only be the meridian coordinates(self.lon2d) and the coordinates of the circles of latitude(self.lat2d). The shape has to be given as (lat2d, lon2d) It it is not given the shape is set to the length of the input lon and lat arrays.

arrlon
numpy.array – 1D array of all longitudes of the grid

arrlat
numpy.array – 1D array of all latitudes of the grid

n_gpi
int – number of gpis in the grid

gpidirect
boolean – if true the gpi number is equal to the index of arrlon and arrlat

gpis
numpy.array – gpi number for elements in arrlon and arrlat gpi[i] is located at arrlon[i],arrlat[i]

subset
numpy.array – if given then this contains the indices of a subset of the grid. This can be used if only a part of a grid is interesting for a application. e.g. land points, or only a specific country

allpoints
boolean – if False only a subset of the grid is active

activearrlon
numpy.array – array of longitudes that are active, is defined by arrlon[subset] if a subset is given otherwise equal to arrlon

activearrlat
numpy.array – array of latitudes that are active, is defined by arrlat[subset] if a subset is given otherwise equal to arrlat

activegpis
numpy.array – array of gpis that are active, is defined by gpis[subset] if a subset is given otherwise equal to gpis

geodatum
object – pygeogrids.geodatic_datum object (reference ellipsoid) associated with the grid

issplit
boolean – if True then the array was split in n parts with the self.split function

kdTree
object – grid.nearest_neighbor.findGeoNN object for nearest neighbor search

shape
tuple, optional – if given during initialization then this is the shape the grid can be reshaped to

lat2d
numpy.array, optional – if shape is given this attribute contains all latitudes according to the provided 2d-shape that make up the grid

lon2d
numpy.array, optional – if shape is given this attribute contains all longitudes according to the provided 2d-shape that make up the grid

calc_lut(*other*, *max_dist=<Mock name='mock.Inf' id='140626103382736'>*, *into_subset=False*)
Takes other BasicGrid or CellGrid objects and computes a lookup table between them. The lut will have the size of self.n_gpis and will for every grid point have the nearest index into other.arrlon etc.

Parameters

- **other** (*grid object*) – to which to calculate the lut to
- **max_dist** (*float, optional*) – maximum allowed distance in meters
- **into_subset** (*boolean, optional*) – if set the returned lut will have the index into the subset if the other grid is a subset of a grid. Example: if e.g. ind_l is used for the warp_grid some datasets will be given as arrays with len(ind_l) elements. These datasets can not be indexed with gpi numbers but have to be indexed with indices into the subset

find_nearest_gpi(*lon*, *lat*, *max_dist=<Mock name='mock.Inf' id='140626103382736'>*)
Finds nearest gpi, builds kdTree if it does not yet exist.

Parameters

- **lon** (*float or iterable*) – Longitude of point.
- **lat** (*float or iterable*) – Latitude of point.

Returns

- **gpi** (*long*) – Grid point index.
- **distance** (*float*) – Distance of gpi to given lon, lat. At the moment not on a great circle but in spherical cartesian coordinates.

get_bbox_grid_points(*latmin=-90*, *latmax=90*, *lonmin=-180*, *lonmax=180*, *coords=False*, *both=False*)

Returns all grid points located in a submitted geographic box, optinal as coordinates

Parameters

- **latmin** (*float, optional*) – minimum latitude
- **latmax** (*float, optional*) – maximum latitude
- **lonmin** (*float, optional*) – minimum latitude
- **lonmax** (*float, optional*) – maximum latitude
- **coords** (*boolean, optional*) – set to True if coordinates should be returned
- **both** (*boolean, optional*) – set to True if gpis and coordinates should be returned

Returns

- **gpi** (*numpy.ndarray*) – grid point indices, if coords=False
- **lat** (*numpy.ndarray*) – longitudes of gpis, if coords=True
- **lon** (*numpy.ndarray*) – longitudes of gpis, if coords=True

get_grid_points(**args*)

Returns all active grid points.

Parameters **n** (*int, optional*) – if the grid is split in n parts using the split function then this function will only return the nth part of the grid

Returns

- **gpis** (*numpy.ndarray*) – Grid point indices.
- **arrlon** (*numpy.ndarray*) – Longitudes.
- **arrlat** (*numpy.ndarray*) – Latitudes.

get_shp_grid_points(*ply*)

Returns all grid points located in a submitted shapefile, optinal as coordinates. Currently only works in WGS84.

Parameters **ply** (*object, OGRGeometryShadow*) – the Geometry of the Feature as returned from ogr.GetGeometryRef

Returns **grid** – Subgrid.

Return type *BasicGrid*

gpi2lonlat(*gpi*)

Longitude and latitude for given gpi.

Parameters **gpi** (*int32 or iterable*) – Grid point index.

Returns

- **lon** (*float*) – Longitude of gpi.
- **lat** (*float*) – Latitude of gpi

gpi2rowcol(*gpi*)
If the grid can be reshaped into a sensible 2D shape then this function gives the row(latitude dimension) and column(longitude dimension) indices of the gpi in the 2D grid.

Parameters **gpi** (*int32*) – Grid point index.

Returns

- **row** (*int*) – Row in 2D array.
- **col** (*int*) – Column in 2D array.

grid_points(**args*)
Yields all grid points in order

Parameters **n** (*int, optional*) – if the grid is split in n parts using the split function then this iterator will only iterate of the nth part of the grid

Returns

- **gpi** (*long*) – grid point index
- **lon** (*float*) – longitude of gpi
- **lat** (*float*) – longitude of gpi

split(*n*)
Function splits the grid into n parts this changes not function but grid_points() which takes the argument n and will only iterate through this part of the grid.

Parameters **n** (*int*) – Number of parts the grid should be split into

subgrid_from_gpis(*gpis*)
Generate a subgrid for given gpis.

Parameters **gpis** (*int, numpy.ndarray*) – Grid point indices.

Returns **grid** – Subgrid.

Return type *BasicGrid*

to_cell_grid(*cellsize=5.0*, *cellsize_lat=None*, *cellsize_lon=None*)
Convert grid to cellgrid with a cell partition of cellsize.

Parameters

- **cellsize** (*float, optional*) – Cell size in degrees
- **cellsize_lon** (*float, optional*) – Cell size in degrees on the longitude axis
- **cellsize_lat** (*float, optional*) – Cell size in degrees on the latitude axis

Returns **cell_grid** – Cell grid object.

Return type CellGrid object

unite()
Unites a split array, so that it can be iterated over as a whole again.

class pygeogrids.grids.**CellGrid**(*lon*, *lat*, *cells*, *gpis=None*, *geodatum='WGS84'*, *subset=None*, *setup_kdTree=False*, ***kwargs*)
Bases: *pygeogrids.grids.BasicGrid*

Grid that has lat,lon coordinates as well as cell informatin. It can find nearest neighbour. It can also yield the gpi, lat, lon, cell information in cell order. This is important if the data on the grid is saved in cell files on disk as we can go through all grid points with optimized IO performance.

Parameters

- **lon** (*numpy.ndarray*) – Longitudes of the points in the grid.
- **lat** (*numpy.ndarray*) – Latitudes of the points in the grid.
- **cells** (*numpy.ndarray*) – Of same shape as lon and lat, containing the cell number of each gpi.
- **gpis** (*numpy.ndarray, optional*) – If the gpi numbers are in a different order than the lon and lat arrays an array containing the gpi numbers can be given.
- **subset** (*numpy.array, optional*) – If the active part of the array is only a subset of all the points then the subset array which is a index into lon, lat and cells can be given here.

arrcell
numpy.ndarray – Array of cell number with same shape as arrlon, arrlat.

activearrcell
numpy.ndarray – Array of longitudes that are active, is defined by arrlon[subset] if a subset is given otherwise equal to arrlon.

get_cells()
Function to get all cell numbers of the grid.

Returns **cells** – Unique cell numbers.

Return type numpy.ndarray

get_grid_points(**args*)
Returns all active grid points.

Parameters **n** (*int, optional*) – If the grid is split in n parts using the split function then this function will only return the nth part of the grid.

Returns

- **gpis** (*numpy.ndarray*) – Grid point indices.
- **arrlon** (*numpy.ndarray*) – Longitudes.
- **arrlat** (*numpy.ndarray*) – Latitudes.
- **cells** (*numpy.ndarray*) – Cell numbers.

gpi2cell(*gpi*)
Cell for given gpi.

Parameters **gpi** (*int32 or iterable*) – Grid point index.

Returns **cell** – Cell number of gpi.

Return type int or iterable

grid_points_for_cell(*cells*)
Get all grid points for a given cell number.

Parameters **cell** (*int, numpy.ndarray*) – Cell numbers.

Returns

- **gpis** (*numpy.ndarray*) – Gpis belonging to cell.

- **lons** (*numpy.array*) – Longitudes belonging to the gpis.
- **lats** (*numpy.array*) – Latitudes belonging to the gpis.

split(*n*)
Function splits the grid into n parts this changes not function but grid_points() which takes the argument n and will only iterate through this part of the grid.

Parameters **n** (*int*) – Number of parts the grid should be split into.

subgrid_from_cells(*cells*)
Generate a subgrid for given cells.

Parameters **cells** (*int, numpy.ndarray*) – Cell numbers.

Returns **grid** – Subgrid.

Return type *CellGrid*

subgrid_from_gpis(*gpis*)
Generate a subgrid for given gpis.

Parameters **gpis** (*int, numpy.ndarray*) – Grid point indices.

Returns **grid** – Subgrid.

Return type *BasicGrid*

exception pygeogrids.grids.**GridDefinitionError**
Bases: exceptions.Exception

exception pygeogrids.grids.**GridIterationError**
Bases: exceptions.Exception

pygeogrids.grids.**genreg_grid**(*grd_spc_lat=1*, *grd_spc_lon=1*, *minlat=-90.0*, *maxlat=90.0*, *minlon=-180.0*, *maxlon=180.0*, ***kwargs*)
Define a global regular lon lat grid which starts in the North Western Corner of minlon, maxlat. The grid points are defined to be in the middle of a grid cell. e.g. the first point on a 1x1 degree grid with minlon -180.0 and maxlat 90.0 will be at -179.5 longitude, 89.5 latitude.

Parameters

- **grd_spc_lat** (*float, optional*) – Grid spacing in latitude direction.
- **grd_spc_lon** (*float, optional*) – Grid spacing in longitude direction.
- **minlat** (*float, optional*) – Minimum latitude of the grid.
- **maxlat** (*float, optional*) – Maximum latitude of the grid.
- **minlon** (*float, optional*) – Minimum longitude of the grid.
- **maxlon** (*float, optional*) – Maximum longitude of the grid.

pygeogrids.grids.**gridfromdims**(*londim*, *latdim*, ***kwargs*)
Defines new grid object from latitude and longitude dimensions. Latitude and longitude dimensions are 1D arrays that give the latitude and longitude values of a 2D latitude-longitude array.

Parameters

- **londim** (*numpy.ndarray*) – longitude dimension
- **latdim** (*numpy.ndarray*) – latitude dimension

Returns **grid** – New grid object.

Return type *BasicGrid*

pygeogrids.grids.**lonlat2cell**(*lon*, *lat*, *cellsize=5.0*, *cellsize_lon=None*, *cellsize_lat=None*)
Partition lon, lat points into cells.

Parameters

- **lat** (*float64, or numpy.ndarray*) – Latitude.
- **lon** (*float64, or numpy.ndarray*) – Longitude.
- **cellsize** (*float*) – Cell size in degrees.
- **cellsize_lon** (*float, optional*) – Cell size in degrees on the longitude axis.
- **cellsize_lat** (*float, optional*) – Cell size in degrees on the latitude axis.

Returns **cell** – Cell numbers.

Return type int32, or numpy.ndarray

pygeogrids.grids.**reorder_to_cellsize**(*grid*, *cellsize_lat*, *cellsize_lon*)
Reorder grid points in one grid to follow the ordering of differently sized cells. This is useful if e.g. a 10x10 degree CellGrid should be traversed in an order compatible with a 5x5 degree CellGrid.

Parameters

- **grid** (*pygeogrids.grids.CellGrid*) – input grid
- **cellsize_lat** (*float*) – cellsize in latitude direction
- **cellsize_lon** (*float*) – cellsize in longitude direction

Returns **new_grid** – output grid with original cell sizes but different ordering.

Return type *pygeogrids.grids.CellGrid*

pygeogrids.nearest_neighbor module

Created on Jul 30, 2013

@author: Christoph Paulik christoph.paulik@geo.tuwien.ac.at

class pygeogrids.nearest_neighbor.**findGeoNN**(*lon*, *lat*, *geodatum*, *grid=False*, *kd_tree_name='pykdtree'*)
Bases: object

class that takes lat,lon coordinates, transformes them to cartesian (X,Y,Z) coordinates and provides a interface to scipy.spatial.kdTree as well as pykdtree if installed

Parameters

- **lon** (*numpy.array or list*) – longitudes of the points in the grid
- **lat** (*numpy.array or list*) – latitudes of the points in the grid
- **geodatum** (*object*) – pygeogrids.geodatic_datum.GeodeticDatum object associated with lons/lats coordinates
- **grid** (*boolean, optional*) – if True then lon and lat are assumed to be the coordinates of a grid and will be used in numpy.meshgrid to get coordinates for all grid points
- **kd_tree_name** (*string, optional*) – name of kdTree implementation to use, either 'pykdtree' to use pykdtree or 'scipy' to use scipy.spatial.kdTree Fallback is always scipy if any other string is given or if pykdtree is not installed. standard is pykdtree since it is faster

geodatum
object – pygeogrids.geodatic_datum.GeodeticDatum object used for x,y,z coordinates calculations

coords
numpy.array – 3D array of cartesian x,y,z coordinates

kd_tree_name
string – name of kdTree implementation to use, either 'pykdtree' to use pykdtree or 'scipy' to use scipy.spatial.kdTree Fallback is always scipy if any other string is given or if pykdtree is not installed

kdtree
object – kdTree object that is built only once and saved in this attribute

find_nearest_index(*lon*, *lat*)
finds the nearest neighbor of the given lon,lat coordinates in the lon,lat arrays given during initialization and returns the index of the nearest neighbour in those arrays.

find_nearest_index(*lon*, *lat*, *max_dist=<Mock name='mock.Inf' id='140626103382736'>*)
finds nearest index, builds kdTree if it does not yet exist

Parameters

- **lon** (*float, list or numpy.array*) – longitude of point
- **lat** (*float, list or numpy.array*) – latitude of point
- **max_dist** (*float, optional*) – maximum distance to consider for search

Returns

- **d** (*float, numpy.array*) – distances of query coordinates to the nearest grid point, distance is given in cartesian coordinates and is not the great circle distance at the moment. This should be OK for most applications that look for the nearest neighbor which should not be hundreds of kilometers away.
- **ind** (*int, numpy.array*) – indices of nearest neighbor
- **index_lon** (*numpy.array, optional*) – if self.grid is True then return index into lon array of grid definition
- **index_lat** (*numpy.array, optional*) – if self.grid is True then return index into lat array of grid definition

pygeogrids.netcdf module

Created on Jan 21, 2014

Module for saving grid to netCDF

@author: Christoph Paulik christoph.paulik@geo.tuwien.ac.at

pygeogrids.netcdf.**load_grid**(*filename*, *subset_flag='subset_flag'*, *location_var_name='gpi'*)
load a grid from netCDF file

Parameters

- **filename** (*string*) – filename
- **subset_flag** (*string, optional*) – name of the subset to load.
- **location_var_name** (*string, optional*) – variable name under which the grid point locations are stored

Returns **grid** – grid instance initialized with the loaded data

Return type *BasicGrid* or CellGrid instance

pygeogrids.netcdf.**save_grid**(*filename*, *grid*, *subset_name='subset_flag'*, *subset_meaning='water land'*, *global_attrs=None*)

save a BasicGrid or CellGrid to netCDF it is assumed that a subset should be used as land_points

Parameters

- **filename** (*string*) – name of file
- **grid** (*BasicGrid or CellGrid object*) – grid whose definition to save to netCDF
- **subset_name** (*string, optional*) – long_name of the netcdf variable if the subset symbolises something other than a land/sea mask
- **subset_meaning** (*string, optional*) – will be written into flag_meanings meta-data of variable 'subset_name'
- **global_attrs** (*dict, optional*) – if given will be written as global attributs into netCDF file

pygeogrids.netcdf.**save_lonlat**(*filename*, *arrlon*, *arrlat*, *geodatum*, *arrcell=None*, *gpis=None*, *subsets={}*, *global_attrs=None*, *format='NETCDF4'*, *zlib=False*, *complevel=4*, *shuffle=True*)

saves grid information to netCDF file

Parameters

- **filename** (*string*) – name of file
- **arrlon** (*numpy.array*) – array of longitudes
- **arrlat** (*numpy.array*) – array of latitudes
- **geodatum** (*object*) – pygeogrids.geodetic_datum.GeodeticDatum object associated with lon/lat
- **arrcell** (*numpy.array, optional*) – array of cell numbers
- **gpis** (*numpy.array, optional*) – gpi numbers if not index of arrlon, arrlat
- **subsets** (*dict of dicts, optional*) – keys : long_name of the netcdf variables values : dict with the following keys: points, meaning e.g. subsets = {'subset_flag': {'points': numpy.array,

  'meaning': 'water, land'}}
- **global_attrs** (*dict, optional*) – if given will be written as global attributs into netCDF file
- **format** (*string, optional*) –

  choose either from one of these NetCDF formats 'NETCDF4' 'NETCDF4_CLASSIC' 'NETCDF3_CLASSIC' 'NETCDF3_64BIT_OFFSET'
- **zlib** (*boolean, optional*) – see netCDF documentation
- **shuffle** (*boolean, optional*) – see netCDF documentation
- **complevel** (*int, opational*) – see netCDF documentation

pygeogrids.netcdf.**sort_for_netcdf**(*lons*, *lats*, *values*)

Sort an 2D array for storage in a netCDF file. This mans that the latitudes are stored from 90 to -90 and the longitudes from -180 to 180. Input arrays have to have shape latdim, londim which would mean for a global 10 degree grid (18, 36).

Parameters

- **lons** (*numpy.ndarray*) – 2D numpy array of longitudes
- **lats** (*numpy.ndarray*) – 2D numpy array of latitudes
- **values** (*numpy.ndarray*) – 2D numpy array of values to sort

Returns

- **lons** (*numpy.ndarray*) – 2D numpy array of longitudes, sorted
- **lats** (*numpy.ndarray*) – 2D numpy array of latitudes, sorted
- **values** (*numpy.ndarray*) – 2D numpy array of values to sort, sorted

pygeogrids.plotting module

pygeogrids.plotting.**plot_cell_grid_partitioning**(*output*, *cellsize_lon=5.0*, *cellsize_lat=5.0*, *figsize=(12, 6)*)

Plot an overview of a global cell partitioning.

Parameters **output** (*string*) – output file name

pygeogrids.shapefile module

Module for extracting grid points from global administrative areas based on the GADM database.

pygeogrids.shapefile.**get_gad_grid_points**(*grid*, *gadm_shp_path*, *level*, *name=None*, *oid=None*)

Returns all grid points located in a administrative area. For this function the files from http://biogeo.ucdavis.edu/data/gadm2.8/gadm28_levels.shp.zip need to be available in the folder gadm_shp_path Optinal as coordinates. Currently only works in WGS84.

Parameters

- **grid** (*object*) –
- **gadm_shp_path** (*path*) – Location to GADM28 shapefiles
- **level** (*int*) – Global Administrative Database Level 0 : country 1 : province/county/state/region/municipality/... 2 : municipality/District/county/...
- **name** (*str*) – name of region at indicated level. For countries the english name
- **oid** (*int*) – OBJECTID of feature. This only works with the correct level shp.

Returns **grid** – Subgrid.

Return type *BasicGrid*

Raises

- ValueError: If name or oid are not found in shapefile of given level
- ImportError: If gdal or osgeo are not installed

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