Grid specification

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What’s included

The grid specification includes ***distances, areas, angles and volumes*** for decomposing thin spherical shells or cartesian space.

It could also contain specifications for exchange grids and masks.

We apply thin-fluid scaling arguments to separate out the vertical.

LRGs and UPGs

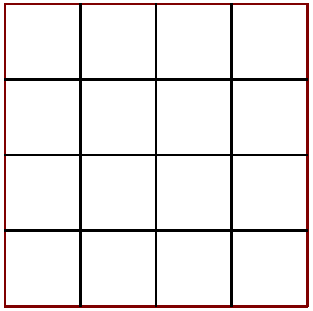
LRG logically rectangular grid.

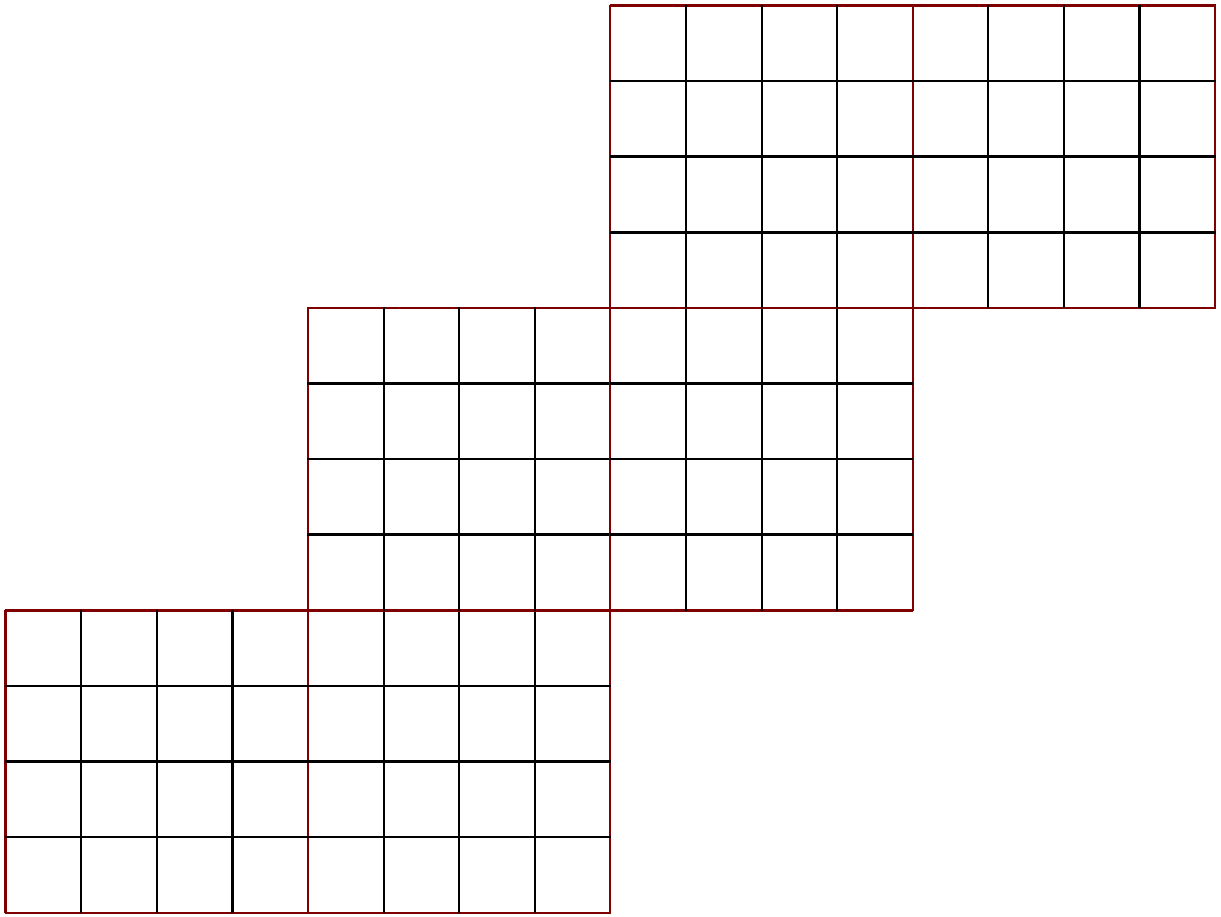
UPG unstructured polygonal grid.

These allow us to describe all conceivable grids for the near- to mid-future.

An actual grid may be composed of a ***mosaic*** of LRGs or UPGs. In principle, you could even mix them (i.e define a grid with some LRG and some UPG tiles).

What is a mosaic?

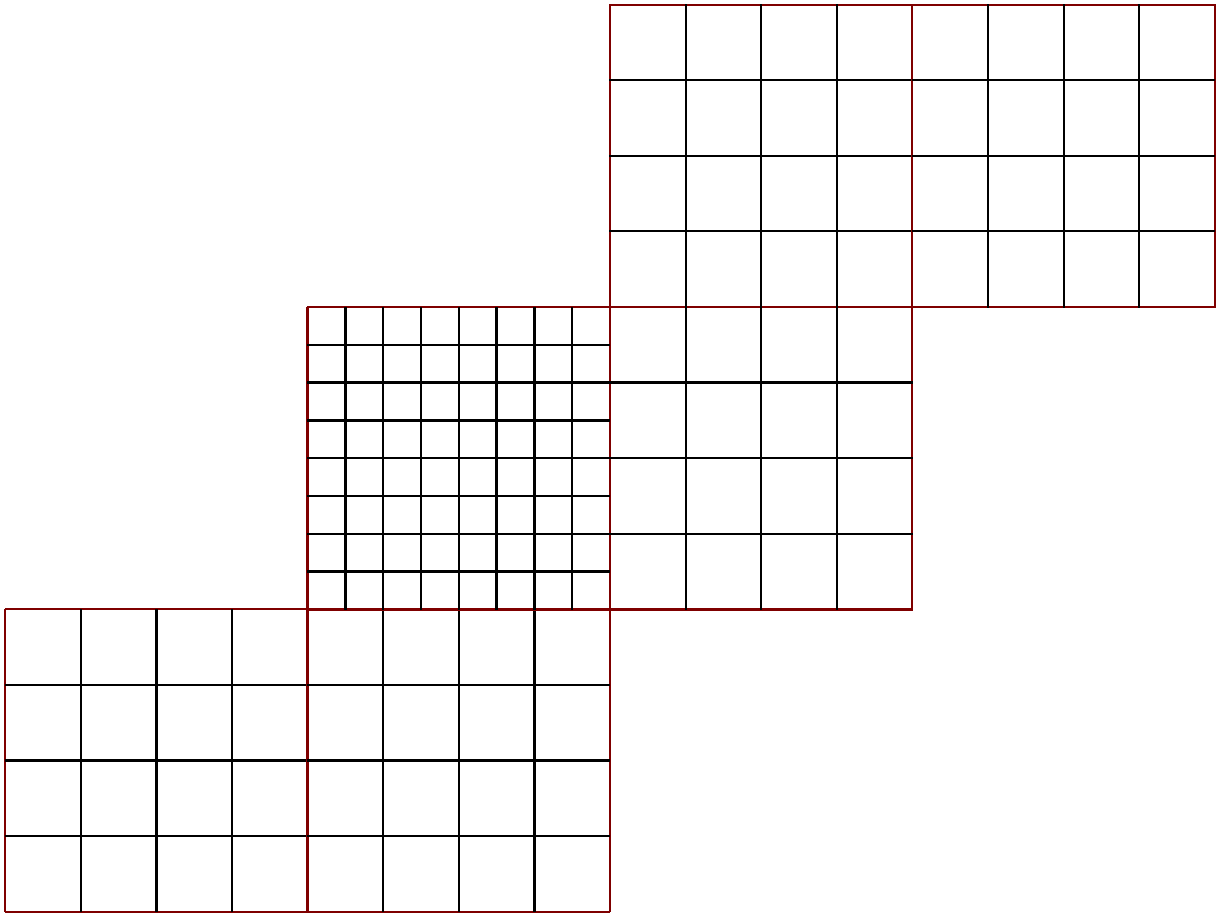




We restrict ourselves to logically rectangular grids (LRGs), in which horizontal index space can be represented by the pair `(i,j)`. The physical coordinates could be curvilinear.

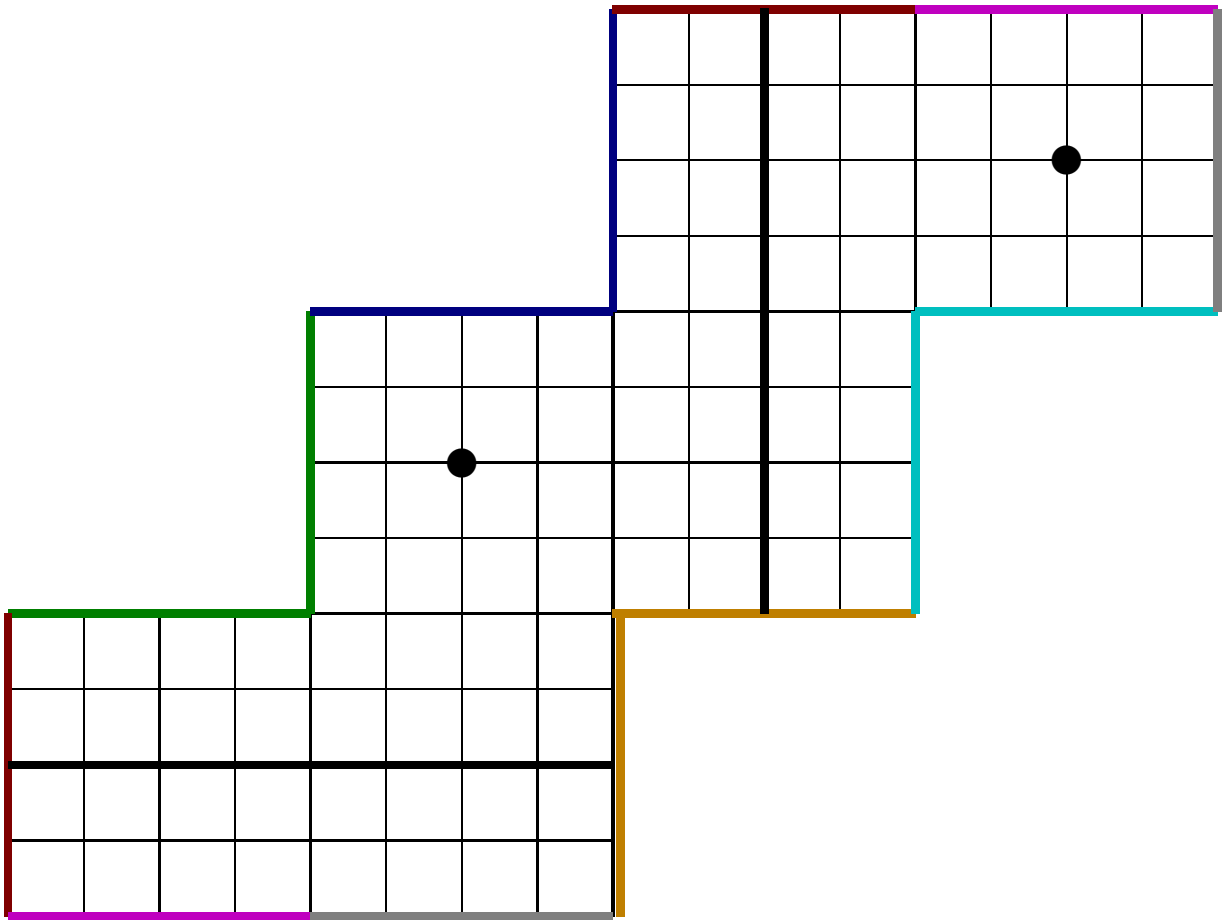
On the left is a basic 4×4 ***tile***; on the right a grid composed of a mosaic of such tiles. This is a ***continuous grid.***

Refined grids



- A ***refined grid*** is where the continuity condition above is violated: where some tiles in the mosaic have more or fewer grid lines than neighbouring tiles with whom they share boundaries.

Cubed sphere



Mosaic topology for the cubed sphere. Note that boundaries may change orientation: the point just to the “west” of **(5,6)** is in fact **(3,4)**; and furthermore vector quantities transiting the boundary at that point will undergo rotation.

Supergrids

Algorithms place quantities at different locations within a grid cell ("staggering"). This has led to considerable confusion in terminology and design: are the velocity and mass grids to be constructed independently, or as aspects ("subgrids") of a single grid? How do we encode the relationships between the subgrids, which are necessarily fixed and algorithmically essential?

In this specification, we dispense with subgrids, and instead invert the specification: we define a **supergrid**. The ***supergrid*** is an object potentially of higher refinement than the grid that an algorithm will use; but every such grid needed by an application is a subset of the supergrid.

LRG supergrids are themselves LRGs while a UPG supergrid can always be described by a unstructured triangular grid (UTG).

The supergrid for the Arakawa LRGs

Global grid attributes

gridspec_version	= *string*;	Version of grid specifi cation (e.g. “1.0”)
gridtype	= *string*;	Type of grid (e.g. “lrg”, ...)
history	= *string*;	Command history; (e.g. “gengrid latlon 180 90 0 -90”)
intend_x_refi nement	= *integer*;	Intended grid (e.g. 2 would mean the grid was intended to describe a coarser grid with half the points in the x-direction)
intend_y_refi nement	= *integer*;	Intended grid(e.g. 4 would mean the grid was intended to describe a coarser grid with quarter the points in the y-direction)
orthogonal	= *logical*	Orthogonal grid flag