interpolate

`ifile ofile`

("interpolate") This function, which interpolates fields from one longitude/latitude grid to another, needs probably a description of the input grid and in any case a description of the output grid. To avoid typing the whole descriptions of the grids the user should use grib description files as explained in Section 3.6 "Grid description files" on page 19.

If `ifile` has SIMPLE, EXTRA, or SERVICE format, then both descriptions must be given, that of the input grid and that of the output grid. If `ifile` has LOLA or GRIB format, then only the description of the output grid must be given, since the input grid is known. It is a good idea to choose LOLA as output format.

First example: To interpolate the EXTRA file `ifile.ext` from a T21 grid to a regular grid with 72 longitude and 36 latitudes, just type

```
cat $GRIDS/t21.grid.asc $GRIDS/r72x36.grid.asc | lola interpolate ifile.ext \
  ofile.lola
```

The environment variable `GRIDS` should be set as described in Section 3.6 "Grid description files" on page 19.

Second example: To interpolate the GRIB file `ifile.grb` to the same output grid, just type

```
lola interpolate ifile.grb ofile.lola < $GRIDS/r72x36.grid.asc
```

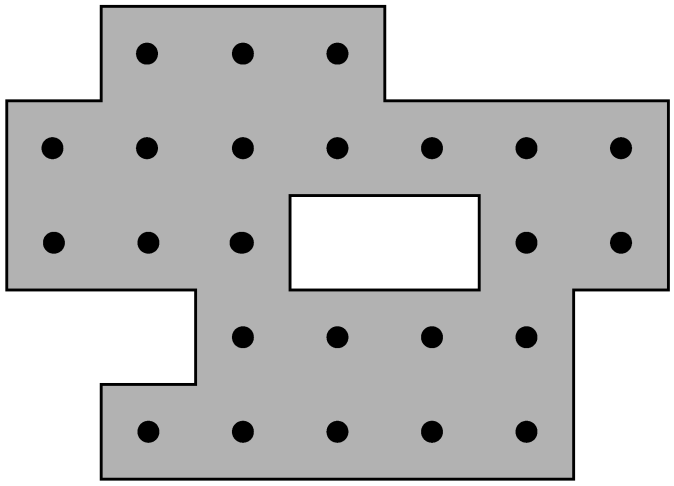
If only a box of `ofile` is needed, construct a grid description file of this box by using the functions `griddesindexbox0` (page 193), `griddesindexbox1` (page 194), `griddeslonlatbox0` (page 194), or `griddeslonlatbox1` (page 194). If the interpolation should be done to compare fields of different resolutions, see function to contrust a common grid.

The basis of the interpolation is an underlying continuous field which is constructed in the following way: For two neighboured longitudes x_1 and x_2 and two neighboured latitudes y_1 and y_2 of the input grid every point at longitude x and latitude y with $x_1 \le x \le x_2$ and $y_1 \le y \le y_2$ is assigned the value

$$a = a_{11} + (a_{21} - a_{11})\frac{x - x_1}{x_2 - x_1} + (a_{12} - a_{11})\frac{y - y_1}{y_2 - y_1} + (a_{22} - a_{21} - a_{12} + a_{11})\frac{(x - x_1)(y - y_1)}{(x_2 - x_1)(y_2 - y_1)} \quad (1)$$

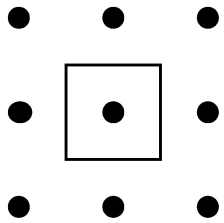
where a_{ij} is the value at longitude x_i and latitude y_j. If one of the four values $a_{11}, a_{12}, a_{21}, a_{22}$ is the missing value, then a is also the missing value.

Afterwards the underlying continuous field is expanded by a half mesh width. In the following figure the black circles represent input grid points which are not the missing value and the shaded area indicates the definition area of the underlying continuous field.



The value at a special output grid point is now computed as a weighted mean of this underlying continuous field over an area which is bounded by lines lying exactly between this grid point and the neighboured ones. (The notion “area

weighted" is explained in Section 3.8 "The concept of area weights" on page 22.) In the following figure the black circles represent output grid points and the square shows the area which is used for computing the area weighted mean to determine the value of the output grid point in the middle.



The special cases of output grid points lying at the edge of the output grid is treated the same as discussed in the explanation of function `weight0` (page 50). Parts of the area at which the underlying continuous field has the missing value are treated as not belonging to the area with the side effect of a probably reduced area size.

(The integral of a term alike in (1) can be computed as

$$\int_{y=y_1}^{y_2}\int_{x=x_1}^{x_2}\left(\begin{array}{l} a_{11}+(a_{21}-a_{11})\dfrac{x-x_1}{x_2-x_1}+(a_{12}-a_{11})\dfrac{y-y_1}{y_2-y_1} \\ \quad +(a_{22}-a_{21}-a_{12}+a_{11})\dfrac{(x-x_1)(y-y_1)}{(x_2-x_1)(y_2-y_1)}\end{array}\right)\cos y\,dx\,dy$$

$$=\left(\begin{array}{l} \quad \dfrac{1}{2}(a_{11}+a_{21})(x_2-x_1)\left[\dfrac{2}{(y_2-y_1)}\sin\left(\dfrac{y_2+y_1}{2}\right)\sin\left(\dfrac{y_2-y_1}{2}\right)-\sin y_1\right] \\ +\dfrac{1}{2}(a_{12}+a_{22})(x_2-x_1)\left[\sin y_2-\dfrac{2}{(y_2-y_1)}\sin\left(\dfrac{y_2+y_1}{2}\right)\sin\left(\dfrac{y_2-y_1}{2}\right)\right]\end{array}\right)$$

where $\int y\cos y dy = y\sin y+\cos y$ and
$\cos y_2-\cos y_1 = -2\sin\left(\dfrac{y_2+y_1}{2}\right)\sin\left(\dfrac{y_2-y_1}{2}\right)$ was used. For small latitudes y_1, y_2 the right handed side simplifies to
$\dfrac{1}{4}(a_{11}+a_{21}+a_{12}+a_{22})(x_2-x_1)(y_2-y_1)$ due to $y_1\approx\sin y_1$ and $y_2\approx\sin y_2$.)

If a sea-land-mask should be used, the interpolation must be split into two parts: The interpolation of land points and of sea points. To interpolate using only the land points the sea points must be set to the missing value. If for example a sea-land-mask for the input grid is called `slmask.t21.lola` and contains 0 for sea and 1 for land points, this can be done by