THE EMEP GRID

According to the definition given in the Protocol on Long-term Financing of the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP): "The geographical scope of EMEP means the area within which, coordinated by the international centres of EMEP, monitoring is carried out." This definition has been referred to in all following protocols to the Convention. Since its adoption in 1984, as Parties have ratified or acceded to the EMEP Protocol, the geographical scope of EMEP has broadened and the EMEP grid has been modified significantly two times.

From 1984 until 1997 a 150×150 km^2 grid were used. In 1997, the grid resolution was changed to 50×50 km^2, while the area covered by the finer resolution EMEP grid remained unchanged. In 2008, the 50×50 km^2 EMEP domain was extended. The technical description of the former and present EMEP grids can be found below.

The extended EMEP 50×50 km^2 grid (2008-2012)

In 2007, the Steering Body to EMEP at its 31st session agreed to a new extension of the EMEP grid in order to include EECCA countries signatories to the LRTAP Convention. The extended EMEP 50×50 km^2 domain includes 132x159 points (with x varying from 1 to 132 and y varying from 1 to 159). The 31st session of the Steering Body agreed that the present extension of the EMEP grid is an interim solution until 2012. By that time, Parties to the Convention on LRTAP will be requested to report emission data to EMEP in a different projection in a longitude-latitude grid. The technical specifications for the EMEP longitude-latitude reporting grid are to be agreed by the Steering Body before 2011.

Technical description of the EMEP 50×50 km^2 grid

The EMEP grid system is based on a polar-stereographic projection with real area at latitude 60° N. The y-axis is oriented parallel to 32° W defined as a negative longitude if west of Greenwich. The extended EMEP 50×50 km^2 domain includes 132x159 points (with x varying from 1 to 132 and y varying

from 1 to 159). Until 2008 the official EMEP 50×50 km^2 grid included only 132x111 points.

For both the extended and the former 50×50 km^2 grids, the latitude, ϕ, and longitude, λ, of any point (x, y) on the grid may be calculated as follows:

$$\begin{aligned} \phi &= 90 - \frac{360}{\pi} \arctan\left[\frac{r}{M}\right] \\ \lambda &= \lambda_0 + \frac{180}{\pi} \arctan\left[\frac{x - xpol}{ypol - y}\right], \end{aligned}$$

in which

$$\begin{aligned} xpol &= 8 \quad \text{(x coordinate of the North Pole)} \\ ypol &= 110 \quad \text{(y coordinate of the North Pole)} \\ d &= 50\,\text{km} \quad \text{(grid length at 60° N)} \\ \phi_0 &= 60^\circ\,\text{N} = \pi/3 \quad \text{(defining latitude)} \\ R &= 6370\,\text{km} \quad \text{(radius of Earth)} \\ M &= R\,/\,d\,[1 + \sin(\phi_0)] \quad \text{(number of grid distances between the} \\ &= 237.73 \qquad\qquad\qquad\quad \text{North Pole and the Equator)} \\ r &= \sqrt{(x - xpol)^2 + (y - ypol)^2} \\ \lambda_0 &= -32\ (32^\circ\,\text{W}) \quad \text{(rotation angle, i.e. the longitude parallel to y-axis)} \end{aligned}$$

The x and y coordinate in the EMEP grid of any given latitude, ϕ, and longitude, λ, can be found from:

$$\begin{aligned} x &= xpol + M \tan\left[\frac{\pi}{4} - \frac{\phi}{2}\right] \sin(\lambda - \lambda_0) \\ y &= ypol - M \tan\left[\frac{\pi}{4} - \frac{\phi}{2}\right] \cos(\lambda - \lambda_0) \end{aligned}$$

It should be pointed out that x and y coordinates calculated with the equations above coincide with the grid-square centre. Thus, if a grid-square has its centre coordinates (x, y), the coordinates of its lower left and right

corners are (x-0.5, y-0.5) and (x+0.5, y-0.5) respectively, and the coordinates (x, y) of its upper left and right corners are (x-0.5, y+0.5) and (x+0.5, y+0.5) respectively.

Technical description of the former EMEP 150×150 km^2 grid

Similarly to the 50×50 km^2 grid, the EMEP 150×150 km^2 grid system is based on a polar-stereographic projection with real area at latitude 60° N. The y-axis is oriented parallel to 32° W. The EMEP 150×150 km^2 domain includes 44x37 points (with x varying from 1 to 44 and y varying from 1 to 37).

For the 150×150 km^2 grid, the latitude, ϕ, and longitude, λ, of any point (x, y) on the grid may be calculated as follows:

$$\begin{aligned} \phi &= 90 - \frac{360}{\pi} \arctan\left[\frac{r}{M}\right] \\ \lambda &= \lambda_0 + \frac{180}{\pi} \arctan\left[\frac{x - xpol}{ypol - y}\right], \end{aligned}$$

in which

$$\begin{aligned} xpol &= 3 \quad \text{(x coordinate of the North Pole)} \\ ypol &= 37 \quad \text{(y coordinate of the North Pole)} \\ d &= 150\,\text{km} \quad \text{(grid length at 60° N)} \\ \phi_0 &= 60^\circ\,\text{N} = \pi/3 \quad \text{(defining latitude)} \\ R &= 6370\,\text{km} \quad \text{(radius of Earth)} \\ M &= R\,/\,d\,[1 + \sin(\phi_0)] \quad \text{(number of grid distances between the} \\ &= 79.24 \qquad\qquad\qquad \text{North Pole and the Equator)} \\ r &= \sqrt{(x - xpol)^2 + (y - ypol)^2} \\ \lambda_0 &= -32\ (32^\circ\,\text{W}) \quad \text{(rotation angle, i.e. the longitude parallel to y-axis)} \end{aligned}$$

The x and y coordinate in the EMEP grid of any given latitude, ϕ, and longitude, λ, can be found from:

$$
\begin{aligned}
x &= xpol + M \tan\left[\frac{\pi}{4} - \frac{\phi}{2}\right] \sin(\lambda - \lambda_0) \\
y &= ypol - M \tan\left[\frac{\pi}{4} - \frac{\phi}{2}\right] \cos(\lambda - \lambda_0)
\end{aligned}
$$

Again, the x and y coordinates calculated with the equations above coincide with the grid-square centre. Thus, if a grid-square has its centre coordinates (x, y), the coordinates of its lower left and right corners are (x-0.5, y-0.5) and (x+0.5, y-0.5) respectively, and the coordinates (x, y) of its upper left and right corners are (x-0.5, y+0.5) and (x+0.5, y+0.5) respectively.

The coordinate transformation between the 150×150 km^2 grid and the 50×50 km^2 grid can be given as:

$$
\begin{aligned}
x_{50} &= 3x_{150} - 1 \\
y_{50} &= 3y_{150} - 1
\end{aligned}
$$