Association of surface stations to NWP model grid points

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1 Introduction

This document describes the algorithm to associate a surface station with a model grid point. This association is designed for delivery of direct model output at a station and for model verification with an optimized association of height dependent values. It is currently implemented and used in the operational verification of MeteoSwiss. The COSMO Working Group on verification has adopted this algorithm as a COSMO standard.

The algorithm searches grid points in the vicinity of the surface station, optimizing horizontal distance and vertical height difference. Land points in the model are preferred over water points, assuming that surface stations are located over land. This is important because some values as e.g. 2 m temperature are strongly influenced by the surface.

2 Search radius depending on model surface at station

First, the surface type (land or water) of the model at the station location is determined. The grid cell, which the station is located in, can be determined by rounding the grid coordinates of the station to the nearest whole number. The transformation of other than grid coordinates (e.g. geographical coordinates) to grid coordinates is not described in this document. Depending on the surface type of the respective model grid cell, the search radius for model grid points around the station is defined as:

$$r_{search} = r_{land} = 1.415 \qquad \text{for land surface,}$$
$$r_{search} = r_{land} = 2 \qquad \text{for water surface, in model grid units.}$$

The value of the radius is chosen to keep the method in close accordance with the previously used method but to allow a wider search area over a flat water surface.

3 Search area and preference of land points

All grid points within a horizontal distance of r_{search} of the exact station location are evaluated. The number of evaluated grid points depends on the location of the station relative to the model grid.

If at least one model grid point within the search radius has a land surface, all water points are excluded from the selection.

In the COSMO model, water surface is present when $FR\_LAND < 0.50$ or $SOILTYP = 9$.

4 Optimization of horizontal and vertical distance

Calculate the horizontal distance $d_{hor} = \sqrt{\Delta x^2 + \Delta y^2}$ (always positive) and the vertical height difference $d_{vert} = \Delta z$ of the station to all grid points to be evaluated, in the same geometrical length unit, e.g. in meter. Combine the two to an optimization distance d_{opt} according to:

$$d_{opt} = d_{hor} + |d_{vert}| \cdot f_{ve} \tag{1}$$

with the vertical emphasis factor $f_{ve} = 500$.

Then select the grid point with the smallest optimization distance d_{opt}. This grid point shall be the model grid point associated with the station.