07 Double mass analysis

Double mass analysis

General

Double mass analysis is a technique to detect possible inhomogeneities in series, like jumps, trends, etc. by investigating the ratio of accumulated values of two series, viz:

ï The series to be tested, and

ï The base series.

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The base series is generally an artificial series, i.e. the average of reliable series of nearby stations, which is assumed to be homogeneous.

The result of the analysis is presented in a table and in a plot: the double mass curve. This curve will show a straight line if the test-series is homogeneous. A jump in the test-series will create a break in the double mass curve, whereas a trend will create a curved line.

The computational procedure and options are presented in the next sections.

Series codes

The base and test series can be selected by picking a series in the series list box and pressing the Select or '>>' button. To deselect one of the base series, selected the series in the spreadsheet and press '<<'.

Time interval of analysis

Select the time interval of analysis by clicking the 'Time interval of analysis' option button, HYMOS will then calculate the number of elements in the selected analysis interval. If the number of missing elements is larger than the entered value for the 'Maximum number of missing elements' the time interval will not be included in the calculation.

Computational procedure

Let Y_i,(i=1,N) be the test series and X_i,(i=1,N) the base series. The double mass analysis then considers the following ratio:

or expressed as a ratio of the percentages of the totals for N elements:

In the tabular results 9 columns are presented:

1. time
2. value of series X (base series)
3. accumulated value of series X
4. accumulated value as a percentage of the total of X
5. value of series Y (test series)
6. accumulated value of series Y
7. accumulated value as a percentage of the total of Y
8. ratio (item 6)/(item 3), equation (4.1)
9. ratio (item 7)/(item 4), equation (4.2)

The last column is also presented in the double mass plot.

If the curve shows a distinct break with curve slopes before and after the break, adjustments may take place in two ways:

ï either the data before the break are adjusted to the present conditions by multiplication by the ratio: /, or

ï the data after the break are adjusted to the pre-break conditions; in that case the recent data are multiplied by a factor /.

Input and options

Intervals

hymos makes a distinction between :

ï interval of analysis, and

ï interval of base and test series.

The possible intervals of analysis are: year, month and day. In case of 'year' a number of years is analysed, in case of 'month' a number of months is analysed, and so on.

The interval of the base and test series may be equal to or less than the interval of analysis. In the latter case it means, that annual, monthly and daily data are created by aggregation of data of smaller time intervals, e.g.:

ï seasonal or monthly data to create 'annual' data,

ï daily or decade data to create 'monthly' data, and

ï quarterly or hourly data to create 'daily' data.

This option gives the freedom to use the interval of analysis in part or in full. This will be explained by the following example. Let the interval of analysis be year and the series interval be month:

ï case 1: hydrological years are to be considered and the hydrological year runs from April to March. Then in the start date April is indicated and the number of elements per year is 12.

ï case 2: monsoon data are to be considered, i.e. the 'year' runs from June to September. Then in the start date June is indicated and the 'year' consists of 4 months.

Similar procedures may be followed for 'monthly' and 'daily' data created out of smaller elements.

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Missing data

In case the series contains missing values and one does not want to leave out these 'years', 'months' or 'days' in the analysis, a user specified minimum number of elements per 'year', 'month' or 'day' should be available to define that 'year', 'month' or 'day' as non-missing; in the previous case 1, 8 elements could be a minimum requirement and in case 2, e.g. 3 elements, but this may vary from case to case. If data are missing, in the double mass curve the first value after the missing part will be marked.

Censoring

Data limits (lower and upper boundaries) can be specified to limit the analysis to a given data range. Data outside the boundaries are left out of the analysis.

Base series

The base series is computed as the (weighted) average of series of nearby stations. The weights with sign are input (defaults: sign = + and weight = 1/(number of nearby stations))

Shaping the table of results

Following information is input to shape the table of results:

ï conversion factor: factor applied to the data in analysis to get the desired unit,

ï unit of output: text printed in the table,

ï name of output: header text of the table