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<tr><td>run.m</td><td>MATLAB script that solves the system (18) of the paper</td><td>The script saves the 3 files containing the results of the simplified model function:

• C_from_x,
• C_outflow_from_x
• volumes_from_x

where x is a flag that represents the first year of the simulation.
The run.m script uses the functions contained in the lib folder:
See description at the end of the table for a detailed explanation of this script and of the functions in the lib folder.</td></tr>
<tr><th colspan="3">Files to be used as inputs to MATLAB
(with specific reference to the Lake Iseo test case)</th></tr>
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<tr><td>discharge_1977_2012.in</td><td>ASCII file containing the inflow discharges</td><td rowspan="5">See following lines for a detailed explanation on how the files should be formatted. The file names can be changed when using the run.m script with other test cases, simply by editing the run.m file as explained below.</td></tr>
<tr><td>lake_temp_1977_2012.in</td><td>ASCII file with the time series of the lake temperature profile</td></tr>
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In the following the main script of the model, run.m, is described.

Run.m reads a set of files needed for solving the system (28) of the companion paper. These files must be located on the disk in the directory specified by the *path* variable at the beginning of the script and are associated to the following variables:

- *mixing_depths_series*: is associated to the ASCII file name of the mixing depths evolution. Each row contains the year, the month and the day number. The last column is the depth of the mixing layer (in m). All these data are not constrained by a specific width but must be separated using tabulation *t* character. For instance:

1995	1	1	$h(t_1)$
1995	1	2	$h(t_2)$
1995	1	3	$h(t_3)$
…	….	…	…

  In the case of Lake Iseo, the corresponding file is *mixing_depths_1977_2012.in*

- *daily_discharge*: is the variable associated to the ASCII file name of the inflow discharges. Each row contains the year, the month and the day number. The remaining *x* columns, where *x* is the number of the lake tributaries, contain the discharge value (in mc/s) for each tributary. All these data are not constrained by a specific width but must be separated using tabulation *t* character. For instance:

1995	1	1	$q_1(t_1)$	$q_2(t_1)$	…	$q_x(t_1)$
1995	1	2	$q_1(t_2)$	$q_2(t_2)$	…	$q_x (t_2)$
1995	1	3	$q_1(t_3)$	$q_2(t_3)$	…	$q_x (t_3)$
…	….	…	…	….	….	…

In the case of Lake Iseo, the corresponding file is *discharge_1977_2012.in*

- *daily_temperatures*: is the variable associated to the ASCII file name for the inflow temperatures. Each row contains the year, the month and the day number. The other *x* columns contain the temperature (in °C) for each tributaries in the given day. All these data are not constrained by a specific width but must be separated using tabulation *\t* character. For instance:

1995	1	1	$T_1(t_1)$	$T_2(t_1)$	…	$T_x(t_1)$
1995	1	2	$T_1(t_2)$	$T_2(t_2)$	…	$T_x(t_2)$
1995	1	3	$T_1(t_3)$	$T_2(t_3)$	…	$T_x(t_3)$
…	….	…	…	….	….	…

In the case of Lake Iseo, the corresponding file is *stream_temperature_1977_2012.in*

- *lake_temperatures*: is the variable associated to the ASCII file name with the time series of the lake temperature profiles. The first three rows of the file contain the year, the month and the day number respectively. The following lines contain the depth and the temperature (in °C) at the given depth in the given day, month and year, as in the example below. All these data are not constrained by a specific width but must be separated using tabulation *\t* character. For instance:

	1995	1995	1995	…
	1	1	1	…
	1	2	3	…
h_1	$T_L(t_1,h_1)$	$T_L(t_2,h_1)$	$T_L(t_3,h_1)$	…
h_2	$T_L(t_1,h_2)$	$T_L(t_2,h_2)$	$T_L(t_3,h_2)$	…
h_3	$T_L(t_1,h_3)$	$T_L(t_2,h_3)$	$T_L(t_3,h_3)$	…
…	…	…	…	…

In the case of Lake Iseo, the corresponding file is *lake_temp_1977_2012.in*

- *v*: is the variable associated to the ASCII file of the bathymetry. It contains the lower limit (in m) of each layer, the volume of each layer and the cumulative volume of the lake (in mc).

h_1	V_1	V_1
h_2	V_2	$V_1 + V_2$
h_3	V_3	$V_1 + V_2 + V_3$
…	….	…
h_n	V_n	V_{LAKE}

In the case of Lake Iseo, the corresponding file is *v_18layers.in*

The following variables are also used in order to characterize the intrusion process:

- *g*: it represents the gravity acceleration (m/s^2).
- *slope*: it is the bed slope angle (m/m).
- *alfa*: it represents the vertex half-angle of the triangular cross section expressed (in degree).
- *Manning*: it is the Manning's coefficient (m$^{-1/3}$s).
- *Y0*: the normal depth (in m) used as initial condition for the underflow profile.

The remaining variables are used to configure other settings for the simulation:

- *shift_initial_condition*: it is a boolean variable. Usually set to *false*. Put equal to *true* only to reproduce the results of figure 11, where multiple simulations using different years as initial conditions are performed.
- *format_C*: specify the significant digits (MATLAB format) to be used in the output files.

Run.m saves three files with the following names: *C_from_x*, *C_outflow_from_x* and *volumes_from_x* where *x* stands for the first year of the simulation. These files contain the output produced by the *simplified_model* function, briefly described in the following. For a more detailed description see within the script.

The core functions of the model, contained in *lib* folder and used by run.m script, are:

- *simplified_model* computes the old water concentration within the lake at time *t* using the data provided as input to the function.
- *remove_old_water* solves the system (18) using MATLAB ODE built-in function.
- *diffC* defines the system of differential equation of the model.
- *build_m* builds the mixing matrix *m* of the model.
- *build_q_star* builds the *q** vector of the model.
- *delta_ro* computes the normalized difference between inflow and lake densities used to compute the reduced gravity in the inflow intrusion process.
- *get_temperature* computes the temperature at a given depth using linear interpolation on the lake temperature profile.
- *inflow_parameters* computes the drag coefficient, the entrainment coefficient and the Richardson number of the inflow for the intrusion process.
- *intrusion_depth* computes the intrusion depth of the downflow.
- *millero* computes the lake density as a function of temperature, depth and salinity using Chen and Millero equation of state for fresh water.