

Supporting information for Grid-to-Grid model estimates of daily mean river flow for gauged catchments in Great Britain (1960 to 2015): observed driving data [MaRIUS-G2G-MORECS-daily]

Bell VA, Rudd AC, Kay AL and Davies HN (2018). Grid-to-Grid model estimates of daily mean river flow for gauged catchments in Great Britain (1960 to 2015): observed driving data [MaRIUS-G2G-MORECS-daily]. NERC Environmental Information Data Centre. <https://catalogue.ceh.ac.uk/documents/5f3c1a02-d5c4-4faa-9353-e8b68ce2ace2>

Brief summary of the dataset

MaRIUS (Managing the Risks, Impacts and Uncertainties of drought and water Scarcity) was a UK NERC-funded research project (2014–2017) which developed a risk-based approach to drought and water scarcity (<http://www.mariusdroughtproject.org/>).

The MaRIUS-G2G-MORECS-daily dataset provides Grid-to-Grid (G2G) model estimates of daily mean river flow for gauged catchments across Great Britain (1960 to 2015). The variable provided is

- River flow (m^3s^{-1}),

which is the daily (09:00 to 09:00) mean of G2G flows for locations corresponding to 260 National River Flow Archive (NRFA) gauging stations. At these locations, the G2G river flow estimates can be compared to observed (gauged) river flows. A related file provides details of the 260 NRFA gauging stations.

The meteorological data used to drive the G2G model are observation-based, and consist of:

- 1km x 1km grids of daily rainfall (CEH-GEAR: Keller et al. 2015, Tanguy et al. 2016),
- Monthly potential evaporation (PE) data on a 40km grid (MORECS: Hough and Jones 1997).

Hydrological model – Grid-to-Grid (G2G)

The G2G is a national-scale hydrological model for Great Britain that runs on a 1km x 1km grid (aligned with the GB national grid), at a 15-minute time-step, and is parameterised using digital datasets (e.g. soil types, land-cover) (Bell et al. 2009). The effect of urban and suburban land-cover on runoff and downstream flows is accounted for in the model. G2G has been shown to perform well for a wide range of catchments across Britain (Bell et al. 2009), particularly those with more natural flow regimes as it currently does not include the effect of artificial influences such as abstractions and discharges on river flows. It has recently been shown to perform well specifically for low flows and for drought identification (Rudd et al. 2017). The G2G generally uses spatial datasets in preference to parameter identification via calibration, and where model parameters are required (such as the kinematic wave speeds used in lateral routing) nationally-applicable values are used. Thus calibration has not been used to identify separate model parameters for individual catchments.

G2G requires input time-series of precipitation and PE. The optional snow module (Bell et al. 2016) is not used here, thus precipitation input to G2G is assumed to be rain. Although this needs to be borne in mind, its effect on drought is likely to be limited.

G2G simulations of daily mean natural flows (m^3s^{-1}) are produced for 260 sites across Britain (Figure 1), for the period 1960 to 2015 (for which MORECS PE data are available across Britain). The model spin-up is not included in these files.

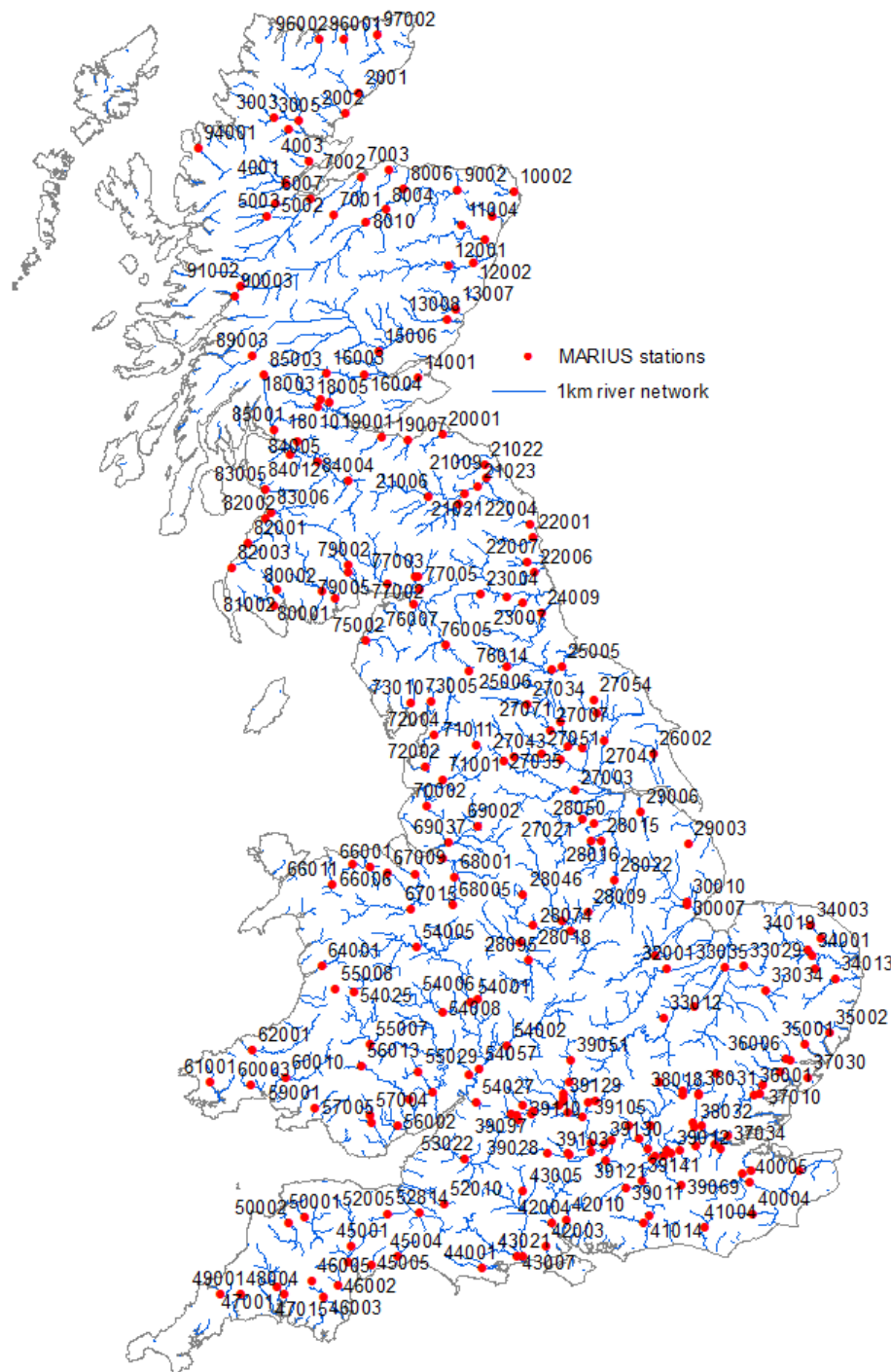


Figure 1. Locations of 260 river gauging (MaRIUS) stations across Britain for which daily G2G model flow estimates (m^3s^{-1}) are available

G2G model input data

The meteorological data used to drive the G2G model are observation-based, and consist of:

- 1km x 1km grids of daily rainfall (CEH-GEAR: Keller et al. 2015, Tanguy et al. 2016),
- Monthly PE data on a 40km grid (MORECS: Hough and Jones 1997).

MORECS provides observation-based monthly estimates of PE (or “potential evapotranspiration”) from well-watered short grass (Penman-Monteith: Monteith, 1965). These PE estimates are copied to each of the corresponding 1km x 1km boxes of the hydrological model grid, and both PE and rainfall are divided equally down to the 15-minute model time-step (Bell et al. 2009, 2016).

The spatial data, such as topography and soil data, used to configure G2G are as in Bell et al. (2009).

How to use the MaRIUS-G2G-MORECS-daily dataset

- The G2G model provides natural flow estimates for the historical period (1960–2015) which can be compared to observed (gauged) river flows (for example from the NRFA; <http://nrfa.ceh.ac.uk/>).
- Performance assessments (e.g. Bell et al. 2009, Rudd et al. 2017) show that G2G simulates river flows reasonably well, performing best for catchments with a natural flow regime (little anthropogenic influence) and a flow record that is considered accurate, but less well where the regime is influenced by artificial abstractions/discharges and where the sub-surface hydrology is unusually complex.
- The flows are for the 1km x 1km G2G grid cell chosen to best represent the location of each NRFA gauging station. The most appropriate G2G grid cell is identified as the one that is closest in terms of geographical location and catchment area, and additional checks have been undertaken to ensure that the G2G flows are for the correct river tributary, and not for a nearby river with a similar catchment area. Despite these checks, in some cases the derived catchment area draining to the 1km x 1km river grid cell will be different to the “observed” NRFA catchment area. This problem can particularly affect small catchments for which discretisation to a 1km x 1km grid leads to proportionally larger errors. All G2G catchment areas are within 8% of the NRFA catchment areas.

Format of the MaRIUS-G2G-MORECS-daily dataset

MaRIUS-G2G-MORECS-daily flow data are stored in a CSV format file. There is a single line header. The first column is the date, followed by a column for each catchment.

Period	Name of .csv file	Years available
Historical	G2G_MORECS_flow_1960_2015.csv	1960–2015

The data follow the standard (365- or 366-day) Gregorian calendar. The time is recorded as the calendar date and the flows are mean values from 09:00 to 09:00 on the following day.

A related file (MaRIUS_NRFAStationInfo.csv) provides details of the 260 NRFA gauging stations for which a corresponding 1km x 1km G2G grid box has been selected, including the station ID, river name, location, G2G easting, G2G northing, G2G catchment area, and any data issues (e.g. station closed).

Acknowledgements

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