GRFR V1.0:
Global Reach-level 3-Hourly River Flood Reanalysis (1980-2019)

1. Overview

The global reach-level 3-hourly river flood reanalysis (GRFR) dataset includes:

    1) global 0.05 °, 3-hourly/daily runoff data,

    2) 3-hourly/daily naturalized river discharge at 2.94 million river reaches,

    3) global 3-hourly river flood events,

    4) underlying hydrography MERIT-Basins.

Grounded on recent breakthroughs in global runoff hydrology, river modeling, high-resolution hydrography, and climate reanalysis, the 3-hourly river discharge record globally for 2.94 million river reaches during the 40-yr period of 1980–2019 was developed. The underlying modeling chain consists of the VIC land surface model (0.05°, 3-hourly) that is well calibrated and bias corrected and the RAPID routing model (2.94 million river and catchment vectors), with precipitation input from MSWEP and other meteorological fields downscaled from ERA5. Flood events (above 2-yr return) and their characteristics (number, spatial distribution, and seasonality) were extracted and studied. Validations against 3-hourly flow records from 6,000+ gauges in CONUS and daily records from 14,000+ gauges globally show good modeling performance across all flow ranges, good skills in reconstructing flood events (high extremes), and the benefit of (and need for) subdaily modeling.

The GRFR database represents a pioneering effort on global reach-level flood reanalysis and may offer new opportunities for global flood studies in terms of baseline data and potential research pathways. Also, it can better help river-observing satellite missions to develop their discharge algorithms.

2. Data license

GRFR is released under the Creative Commons Atrribution-NonCommecial 4.0 International (CC BY-NC 4.0) license. Please cite the following paper when using the data.

Yang, Y., Pan, M., Lin, P.R., Beck, H.E., Zeng, Z.Z., Yamazaki, D., David, C.H., Lu, H., Yang, K., Hong, Y., and Wood, E.F. (2021). **Global Reach-level 3-hourly river flood reanalysis (1980-2019)**. *Bulletin of the American Meteorological Society*, 102(11), E2086-E2105. https://doi.org/10.1175/BAMS-D-20-0057.1.

3. Data details

3.1 Global 0.05 deg VIC-derived runoff data

Folder: runoff

Filename: RUNOFF_*yyyy*.nc, where *yyyy* stands for year.

Spatial resolution: 0.05 degree

Temporal resolution: 3 hourly/daily (please email for 3 hourly data)

3.2 Global reach-level discharge

Folder: discharge

Filename: output_*pfaf_xx*_1979-2019.nc

where *xx* stands for region, 01 is Africa, 02 Europe, 03 North Asia (Siberia), 04 South Asia, 05 Oceania, 06 South America, 07 North America, 08 Arctic. The *pfaf* is consistent to the MERIT Basins V0.7.

Spatial resolution: global 2.94 million river reaches (derived from 90m DEM)

Temporal resolution: 3 hourly/daily (please email for 3 hourly data)

3.3 Global reach-level 3-hourly river flood
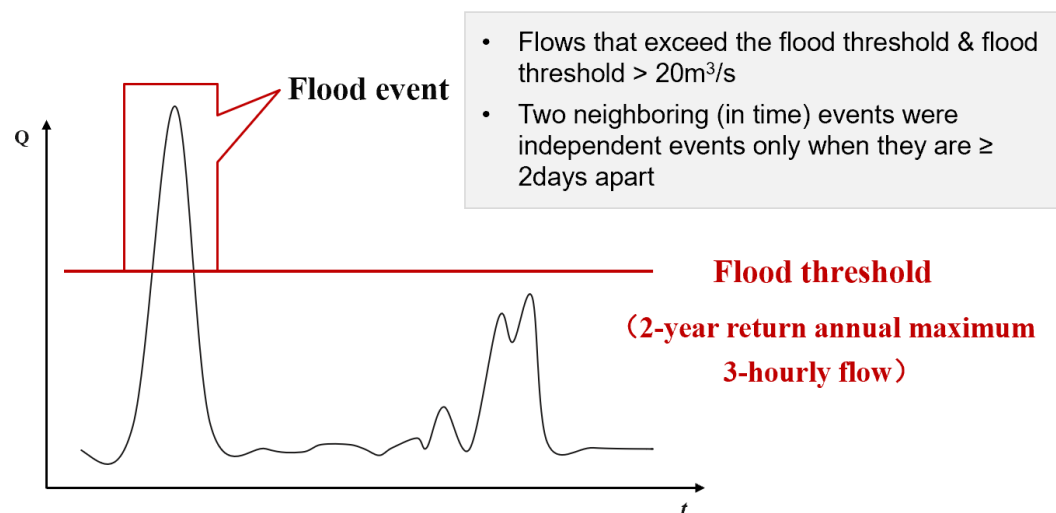
3.3.1 The definition of flood events

Figure 1. The definition of flood events

3.3.2 The flow values of flood events

Folder: flood_events

Filename: mswep_output_mswep_threshold_gt20_pfaf_xx_1980_2019_2daprt.nc

This file provides the flow values for all independent flood events for each *pfaf* continent. The data is organized by rivid ranges, which is consistent to the MERIT Basins v0.7. The value 0 means the flow is smaller than the flood threshold.

3.4 Underlying hydrography

Folder: MERIT_Basins_v0.7.zip (contains two levels: level_01_v0.7 and level_02_v0.7)

Filename:

Level_01_v0.7: pfaf_0x_cat_3sMERIT.cpg/dbf/shp/shx,
        pfaf_0x_riv_3sMERIT.cpg/dbf/shp/shx

Level_02_v0.7: pfaf_xy_cat_3sMERIT.cpg/dbf/shp/shx,
        pfaf_xy_riv_3sMERIT.cpg/dbf/shp/shx

where x stands for region, y stands for the subregion y.

4. Contact information

Please contact us for questions or updates.
Yuan Yang, UCSD, yuanyangthu@gmail.com
Ming Pan, UCSD, m3pan@ucsd.edu
Peirong Lin, Peking University, peironglinlin@pku.edu.cn

5. Others

More details about the data can also be found here: https://www.reachhydro.org/home/records/grfr.

Newer vision of GRFR is coming, where the input precipitation is updated to MSWEP v2.8.

Other related data is GRADES (Global Reach-level A prior Discharge estimates for Surface Water and Ocean Topography), please refer to the following for more details about GRADES:

Lin, P., M. Pan, H.E. Beck, Y. Yang, D. Yamazaki, R. Frasson, C.H. David, M. Durand, T. Pavelsky, G. Allen, C. Gleason, E.F. Wood (2019): Global reconstruction of naturalized river flows at 2.94 million reaches. Water Resources Research. 55 (8), 6499-6516.