Frequency analysis of WRF extreme precipitation events 10 km resolution Atacama
(FrqAnl_WRF_P_Atacama.csv)

Data format: .csv

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Authors: Janek Walk(a), Georg Stauch(a), Mark Reyers(b), Melanie Bartz(c), Helmut Brückner(c), Frank Lehmkuhl(a)

Institutions: (a) Department of Geography, RWTH Aachen University, 52056, Aachen, Germany; (b) Institute of Geophysics and Meteorology, University of Cologne, 50923, Cologne, Germany; (c) Institute of Geography, University of Cologne, 50674, Cologne, Germany

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Data basis: Reyers, M., 2018. WRF Output daily accumulated total precipitation 10km resolution Atacama. CRC1211 Database (CRC1211DB). DOI: 10.5880/CRC1211DB.20

Publication affiliated to data basis: Reyers, M., Böhm, C., Shao, Y., Löhnert, U., Crewell, S., in revision. Weather types over the southeast Pacific and their impact on the moisture supply to the Atacama Desert. Glob. Planet. Change.

Spatial resolution: 10 km

Spatial extent: 20°S-26°S, 69.5°W-71°W

Temporal extent for time series analysis: 01/01/1982 - 31/12/2017

Software used for analysis: R version 3.4.3, Microsoft Excel 2013 15.0

Abstract:

This file contains the results of a spatio-temporal frequency analysis of extreme precipitation events for the coastal Atacama Desert (20°S-26°S, 69.5°W-71°W). Daily accumulated total precipitation data between 1982 and 2017 from a regional WRF model for the Atacama Desert is used as input data.

Mean annual precipitation, the number of events exceeding specific threshold values in precipitation, coefficients of determination for the logarithmic regression analyses, expected precipitation for given recurrence intervals, and expected recurrence intervals for given precipitation events are given as output.

The spatial resolution is 10 km and the output is stored in a .csv table.

Description:

For the purpose of extreme precipitation values with a relatively high spatial resolution (10 km), we use daily accumulated total precipitation (P) from a simulation with the Weather Research and Forecasting (WRF) model v3.9 (Skamarock et al., 2008). The WRF model is a mesoscale numerical weather prediction system designed for real-time and idealized simulations. The simulation covers the period 1982 to 2017 using actual atmospheric conditions from the ERA-Interim reanalysis dataset (Dee et al., 2011). A horizontal resolution of 10 km is obtained using a double one-way nesting. The model domain ranges from approximately 16.5°S to 26.5°S and from 74°W to 67°W while we focus here on the study area of the coastal to central Atacama (20°S to 26°S, 69.5°W to 71°W). A detailed description of the model setup and an evaluation of simulated rainfall are given in Reyers et al. (in revision).

We conducted simple frequency analysis on the WRF82-17 time series data of P under the assumption that daily resolution is sufficient to differentiate single precipitation events. We only considered P above a threshold values of 2 or 5 mm per day as precipitation events relevant for the frequency analysis of extreme events. Recurrence intervals (RI, in days) were calculated for precipitation events using RI=(n_d+1)/k_p

where n_d is the total number of days in the time series analysed (n_d = 13147) and k_P is the rank of the precipitation event in a descending order. Then, regression analysis between RI and P in order to extract expected precipitation P* for given RI or expected recurrence intervals RI* for given P was conducted. Since extreme values are naturally not normally distributed, logarithmic regression were applied using the common logarithm of RI. As quality criteria for the frequency analysis we defined that the number of modelled precipitation events in the entire time period must be at least 4 and that the regression explains at least 80% of the variance (R^2 = 0.8). Otherwise, no data values were returned. Nonetheless, the study area is characterized by such a strong difference in aridity that two different threshold values for the definition of precipitation events were required. In the hyperarid northern parts of the study area a threshold value of P > 2 mm yielded most reasonable results, while towards the more humid south, regressions are generally too weak using this threshold. Therefore, P > 5 mm was chosen as a second threshold value. We calculated P* and RI* over the whole study area for both threshold values.

No data value: 'NA'

The following variables are included in the data table:

- lon: Longitude [decimal degrees]

- lat: Latitude [decimal degrees]

- MAP: Mean annual precipitation [mm]

- n(P>1): Number of events n (= days) with daily accumulated total precipitation P exceeding 1 mm

- n(P>2): Number of events n (= days) with daily accumulated total precipitation P exceeding 2 mm

- n(P>5): Number of events n (= days) with daily accumulated total precipitation P exceeding 5 mm

- n(P>10): Number of events n (= days) with daily accumulated total precipitation P exceeding 10 mm

- n(P>15): Number of events n (= days) with daily accumulated total precipitation P exceeding 15 mm

- n(P>20): Number of events n (= days) with daily accumulated total precipitation P exceeding 20 mm

- R^2_logRI(d)_P>2_n>=4: Coefficient of determination between log distributed recurrence interval [in days] logRI(d) and precipitation events P > 2 mm regarding only regressions with a total number of modelled precipitation events in the entire time period of at least 4 (n>=4); otherwise the output is 'NA'

- P*(RI=50)_P>2_R^2>=0.8_n>=4: Expected precipitation [mm] for a given recurrence interval RI of 50 years (RI=50) regarding only precipitation events P > 2 mm, a R^2 of at least 0.8, and n>=4; otherwise the output is 'NA'

- P*(RI=100)_P>2_R^2>=0.8_n>=4: Expected precipitation [mm] for a given recurrence interval RI of 100 years (RI=100) regarding only precipitation events P > 2 mm, a R^2 of at least 0.8, and n>=4; otherwise the output is 'NA'

- RI*(P=20)_P>2_R^2>=0.8_n>=4: Expected recurrence interval [years] for a given precipitation event of 20 mm (P=20) regarding only precipitation events P > 2 mm, a R^2 of at least 0.8, and n>=4; otherwise the output is 'NA'

- R^2_logRI(d)_P>5_n>=4: Coefficient of determination between log distributed recurrence interval [in days] logRI(d) and precipitation events P > 5 mm regarding only regressions with a total number of modelled precipitation events in the entire time period of at least 4 (n>=4); otherwise the output is 'NA'

- P*(RI=50)_P>5_R^2>=0.8_n>=4: Expected precipitation [mm] for a given recurrence interval RI of 50 years (RI=50) regarding only precipitation events P > 5 mm, a R^2 of at least 0.8, and n>=4; otherwise the output is 'NA'

- P*(RI=100)_P>5_R^2>=0.8_n>=4: Expected precipitation [mm] for a given recurrence interval RI of 100 years (RI=100) regarding only precipitation events P > 5 mm, a R^2 of at least 0.8, and n>=4; otherwise the output is 'NA'

- RI*(P=20)_P>5_R^2>=0.8_n>=4: Expected recurrence interval [years] for a given precipitation event of 20 mm (P=20) regarding only precipitation events P > 5 mm, a R^2 of at least 0.8, and n>=4; otherwise the output is 'NA'

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