

Supplementary Information of “A climatology of local hourly wet spells across the Tropics” by Moron et al. (2024, submitted to Climate Dynamics)

Additional quality checks about hourly records

We consider three additional checks to remove dubious records or rain gauges ; (1) hourly records ≥ 300 mm ; (2) very long sequences of zeros rainfall which could indicate spurious filling of missing data ; (3) long sequences of the same hourly amounts which could indicate spurious repetitions. We considered first any hourly record ≥ 300 mm as dubious, since it is close to the official WMO world record of 305 mm recorded at Holt (Missouri, USA) on June 22, 1947

(https://wmo.int/sites/default/files/2024-01/Table_Extreme_Records_30Jan2024.pdf). We also checked if the surrounding stations within a radius of 50 km (if there are some available stations) receive significant hourly rainfall ≥ 10 mm. Note that the criteria about the consecutive zeros may be a priori irrelevant for our main purpose, which is the analysis of wet spells, but any spurious sequence of zeros will bias any monthly or seasonal amounts, which are also analyzed. The main theoretical issue related to the second and third criteria is the lack of any predefined and unique threshold to decide if a dry or a constant sequence is spurious or not. The second criteria depends clearly on the mean annual cycle and the length of the usual dry season. For example, 9 or 10 consecutive months without any rainfall is highly probable for central Australia or NW India, while it would be highly dubious for a rain gauge located either on the windward side of a tropical island, along the western Ghats in India, or close to the equator in Malaysia. About the third criteria, we decided that any sequence of constant rainfall ≥ 1 mm lasting at least 6 consecutive hours is dubious. We detailed in the following each of the network.

India

The Indian database includes 62 stations having at least 8760 x 5 hourly records and the highest hourly rainfall is 150 mm. The longest sequence of zeros rainfall lasts 7700 hours and occurs at Jaisalmer, which is the driest rain gauge (mean annual amount = 225 mm) and thus appears reasonable. There are two occurrences of 7 and 11 consecutive hours with a constant amount, which are replaced by missing entries.

Australia

The Australian database includes 531 stations having at least 8760 x 5 hourly records. A

single station has hourly records ≥ 300 mm, and the three records are consecutive, which is impossible. So, these records are replaced by missing entries. 6 stations have at least one year without any rainfall (maximum is 480 days), but these stations receive less than 50 mm of annual rainfall in mean. 13 stations have at least $\frac{3}{4}$ of a year fully dry. Again, their mean annual rainfall is ≤ 100 mm, so compatible with such long dry sequences. 0.0015% of the available hourly data are included in wet spells with a constant value and lasting at least 6 hours and the corresponding hours have been replaced by missing entries. The highest hourly rainfall is 272 mm.

Malaysia

The Malaysian database is the most problematic. There are 200 stations with at least 8760 x 5 available hours. There are 5155 hourly records ≥ 300 mm but they are heavily concentrated in 2 rain gauges (with respectively 4832 and 283 cases) with a repetition of the same (very high) values. Both stations are removed from the database. In the remaining 11 stations containing between 1 and 10 hourly records ≥ 300 mm, we checked the hourly amounts recorded at stations within a radius of 50 km. Only 4 cases (out of 40) have at least one surrounding station receiving ≥ 10 mm (maximum = 62 mm) during a ≥ 300 mm event. We choose a conservative approach to replace all these records ≥ 300 mm by missing entries. Only 25 hourly records are ≥ 200 mm after this first cleaning. 11.35% of available hourly records are included in an absolute dry spell lasting at least 6 consecutive months -sometimes 10 consecutive years are dry-, which is highly spurious in a wet country as Malaysia, especially with two wet seasons even if they are not equally abundant across the country. After having replaced the corresponding values by missing entries, one station does not fill anymore the criteria of the 8760 x 5 available entries and is discarded. 0.25% of the available hourly data are included in wet spells with a constant value and lasting at least 6 hours and the corresponding hours have been replaced by missing entries.

Japan

The Japan network contains 37 stations with a maximum hourly record of 152 mm and a longest dry spell of 49 days. Only 0.0076% of the available hourly records are included in a wet spell with constant values and lasting at least 6 hours and are replaced with missing entries.

Brazil

In Brazil, 32 stations are available with a maximum hourly rainfall of 97.8 mm and a longest dry spell of 44 days. The longest wet sequence with a constant value lasts 4 hours.

Polynesia

In Polynesia, the 22 stations, except one, have a maximum dry spell of 4.5 months. The exception is Hiva-Oa (Marquesas Islands), which has 307 consecutive dry days from March 1968. Even if this island is strongly impacted by ENSO events, this spell is considered dubious, also because the second longest dry spell at this station lasts less than 30 consecutive days. So, it is replaced by missing entries. Only 0.0017% of the available hourly records are included in a wet spell with constant values and lasting at least 6 hours and are replaced with missing entries.

New Caledonia and Wallis and Futuna

In New Caledonia, the 60 stations receive a maximum hourly rainfall of 129.8 mm, the longest dry spell lasts less than 68 days. Only 0.0003% of the available hourly records are included in a wet spell with constant values and lasting at least 6 hours and are replaced with missing entries. The 2 stations of Wallis and Futuna receives a maximum hourly rainfall of 94.4 mm, the longest dry spell lasts less than 25 days and the longest wet sequences with constant values lasts 3 hours.

Mayotte

In Mayotte, the 9 stations show a maximum hourly record of 85.8 mm and a longest dry spell of 93 days. The maximum length of a wet spell with constant value is 2 hours which is fine.

Reunion island

In Reunion island, the 82 stations have a maximum hourly rainfall of 157.2 mm. One station (St Pierre), located on the leeward side of the island (mean annual rainfall = 801 mm), shows a dry spell ≥ 6 months, lasting 257 days. Such length seems possible as the second longest dry spell lasts 152 days at this dry station. We thus keep this record. Only 0.0003% of the available hourly records are included in a wet spell with constant values and lasting at least 6 hours and are replaced with missing entries.

French Guiana

In French Guiana, the 9 stations show a maximum hourly record of 78.2 mm and a longest dry spell of 53 days. The maximum length of a wet spell with constant value is 3 hours which is fine. In Martinique, the 36 stations show a maximum hourly record of 125.4 mm and a longest dry spell of 36 days. The maximum length of a wet spell with constant value is 4 hours which is fine.

Guadeloupe and Martinique

In Guadeloupe, the 36 stations show a maximum hourly record of 180.5 mm and a longest dry spell of 141 days. This last value seems huge vs what is recorded in Martinique but it is observed over a flat small island (rain gauge "Capesterre" on Marie Galante island) which has no equivalent in Martinique. Only 0.0009% of the available hourly records are included in a wet spell with constant values and lasting at least 6 hours and are replaced with missing entries.

Additional figures

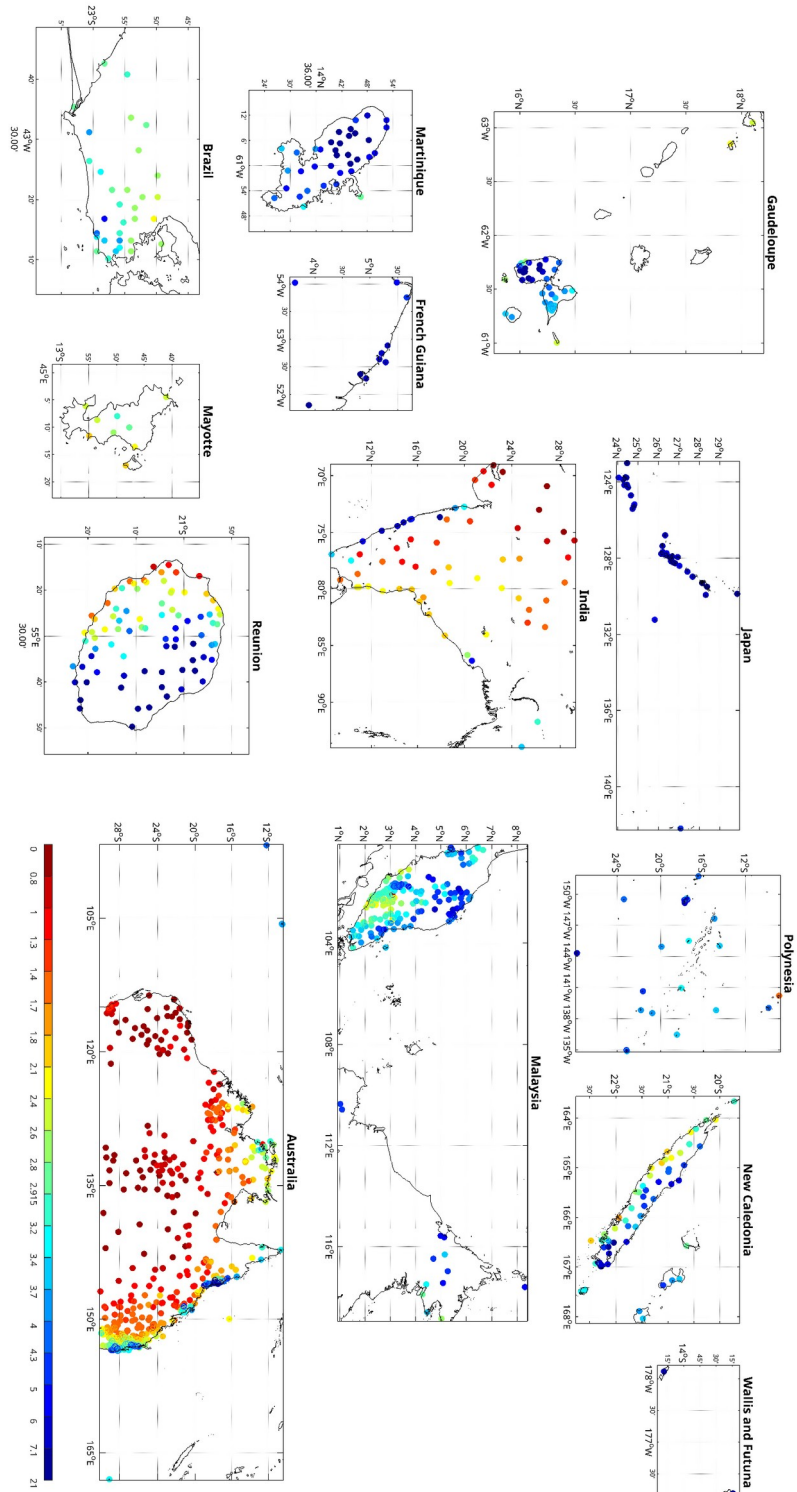


Figure S1: same as figure 1 for the mean frequency of hourly rainfall ≥ 1 mm in %. The color refers to the 5th centiles of the distribution.

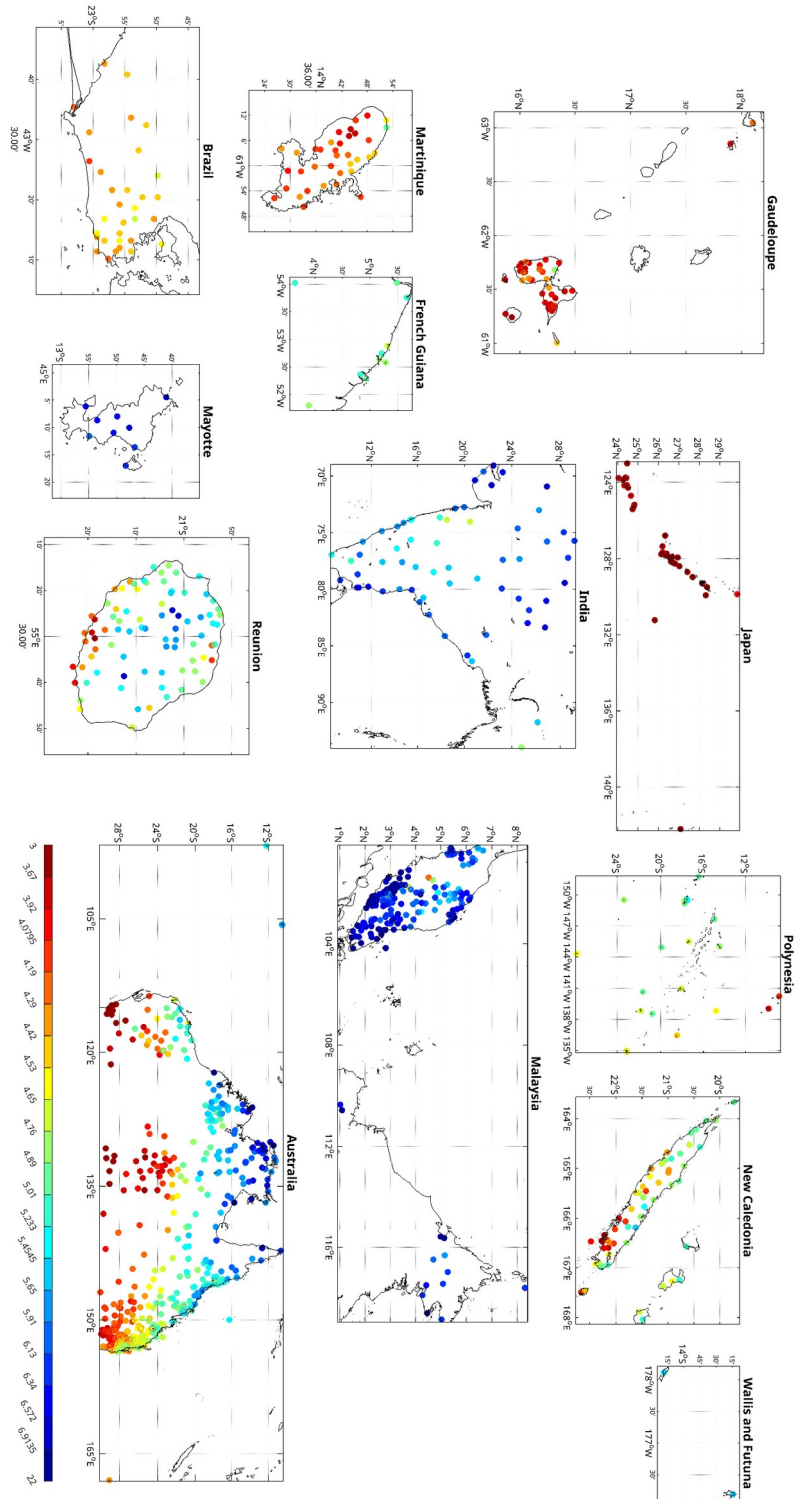


Figure S2: same as figure 1 for the mean intensity of hourly rainfall ≥ 1 mm in $\text{mm}\cdot\text{hour}^{-1}$. The colors refer to the 5th centiles of the distribution.

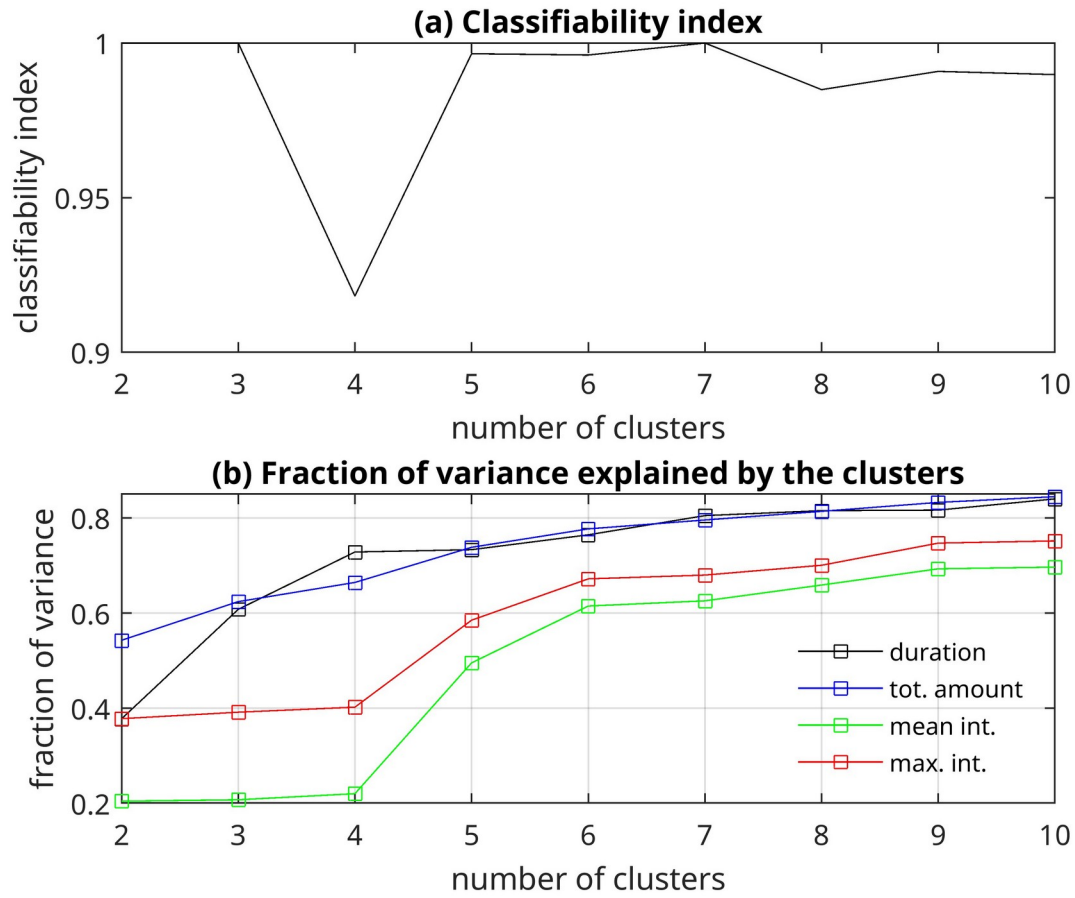


Figure S3: (a) Classifiability index (Roller et al., 2016) and (b) fraction of variance explained by the k clusters of the 24-hour wet spells for duration, square-rooted total amount, mean and maximum intensity of wet spells for the 2- to 10-cluster solutions using 100 replicates for each value of k .