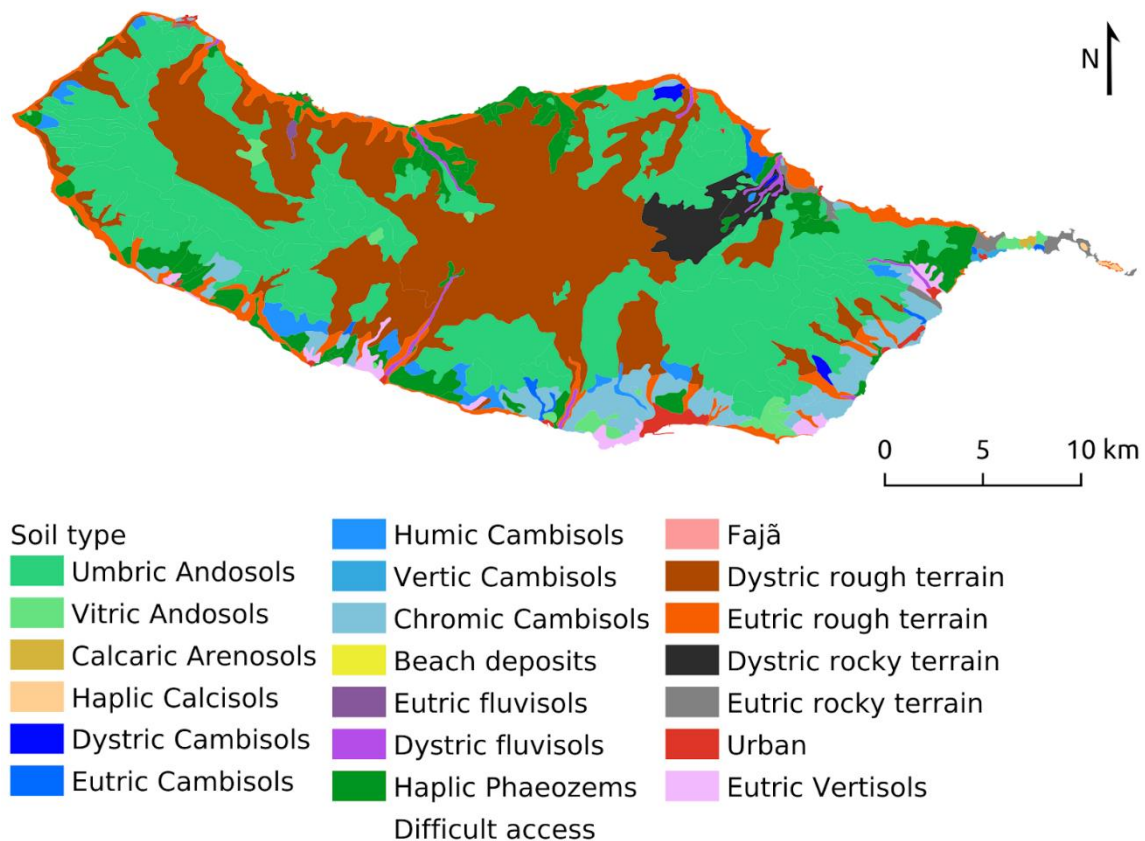


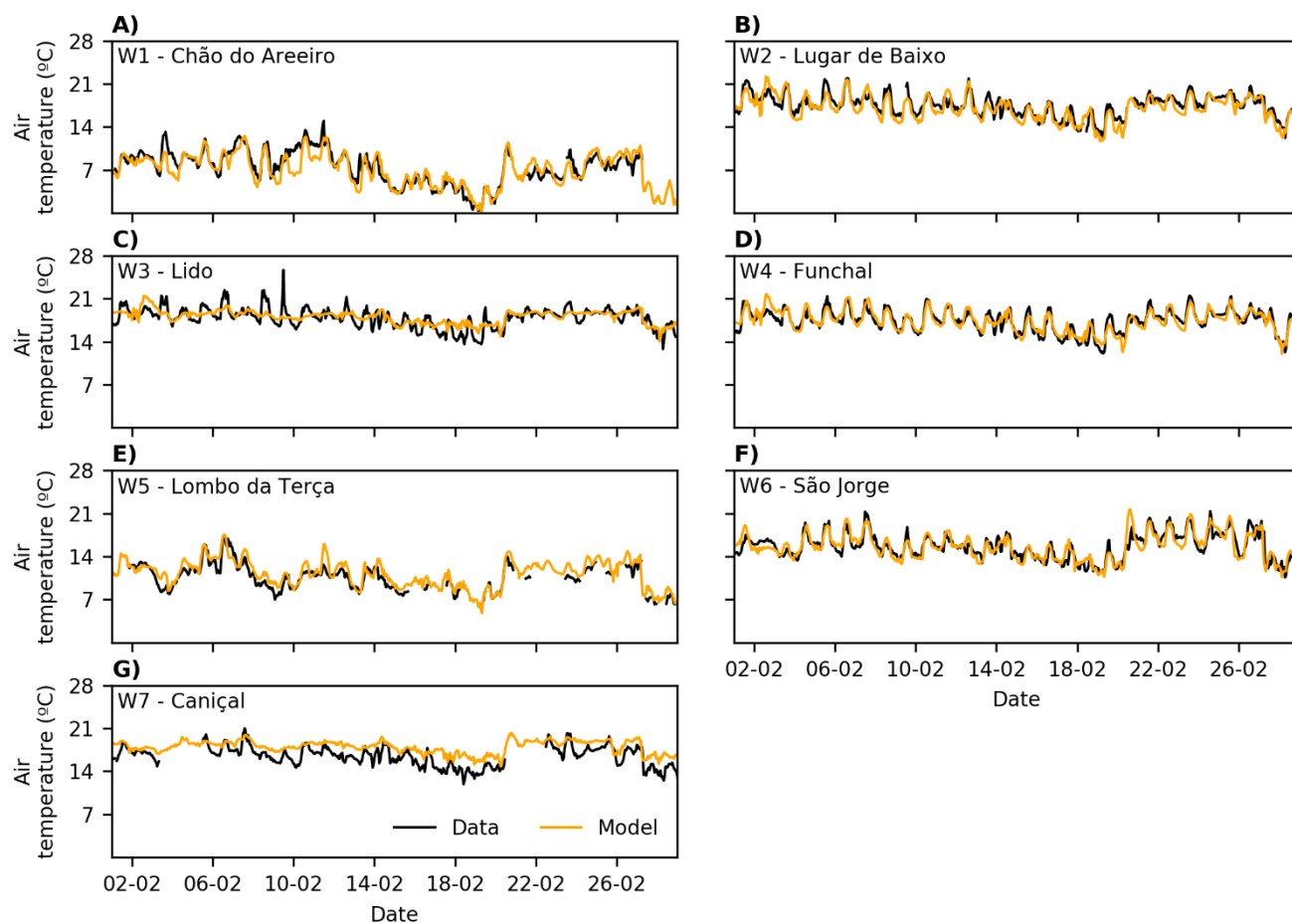
Supplementary Material

1 Supplementary Figures and Tables

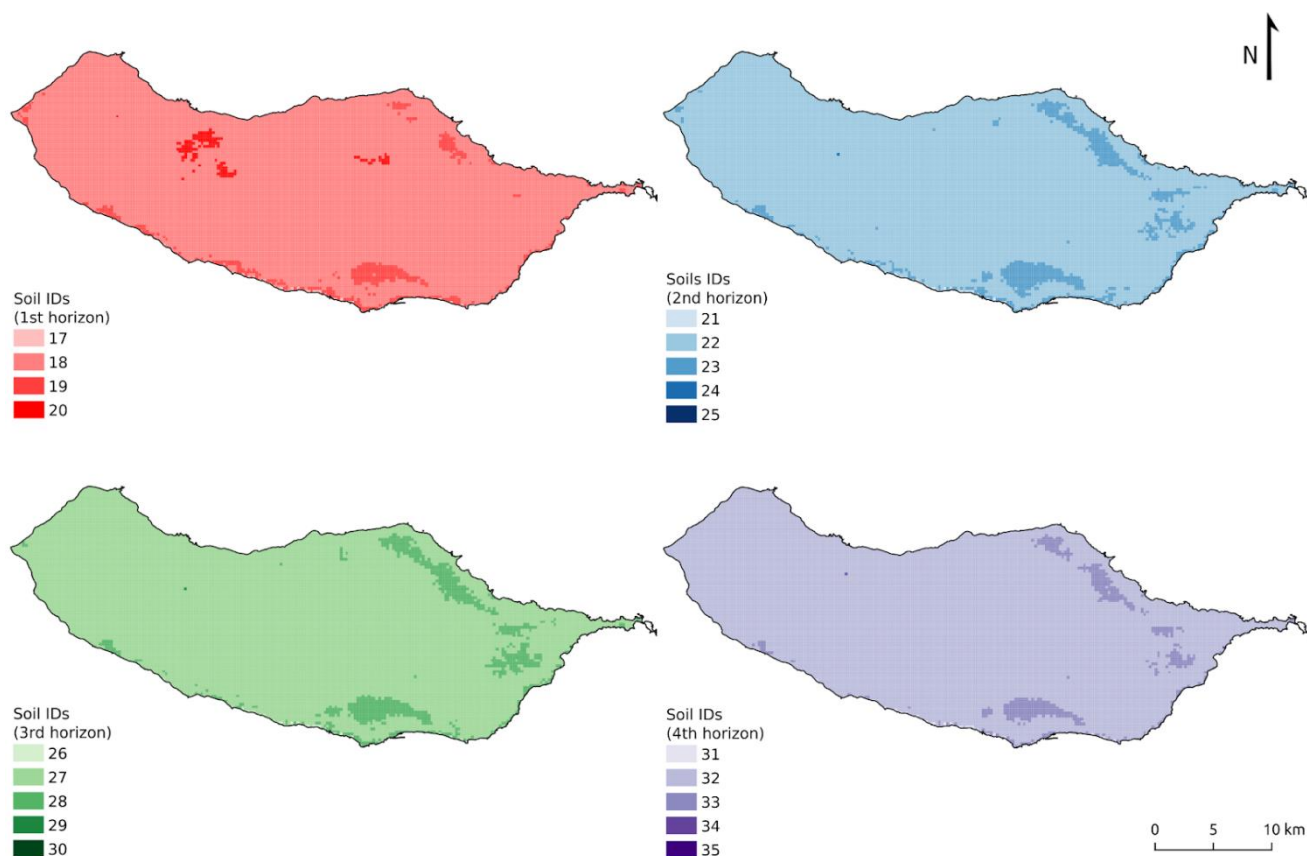
1.1 Supplementary Figures



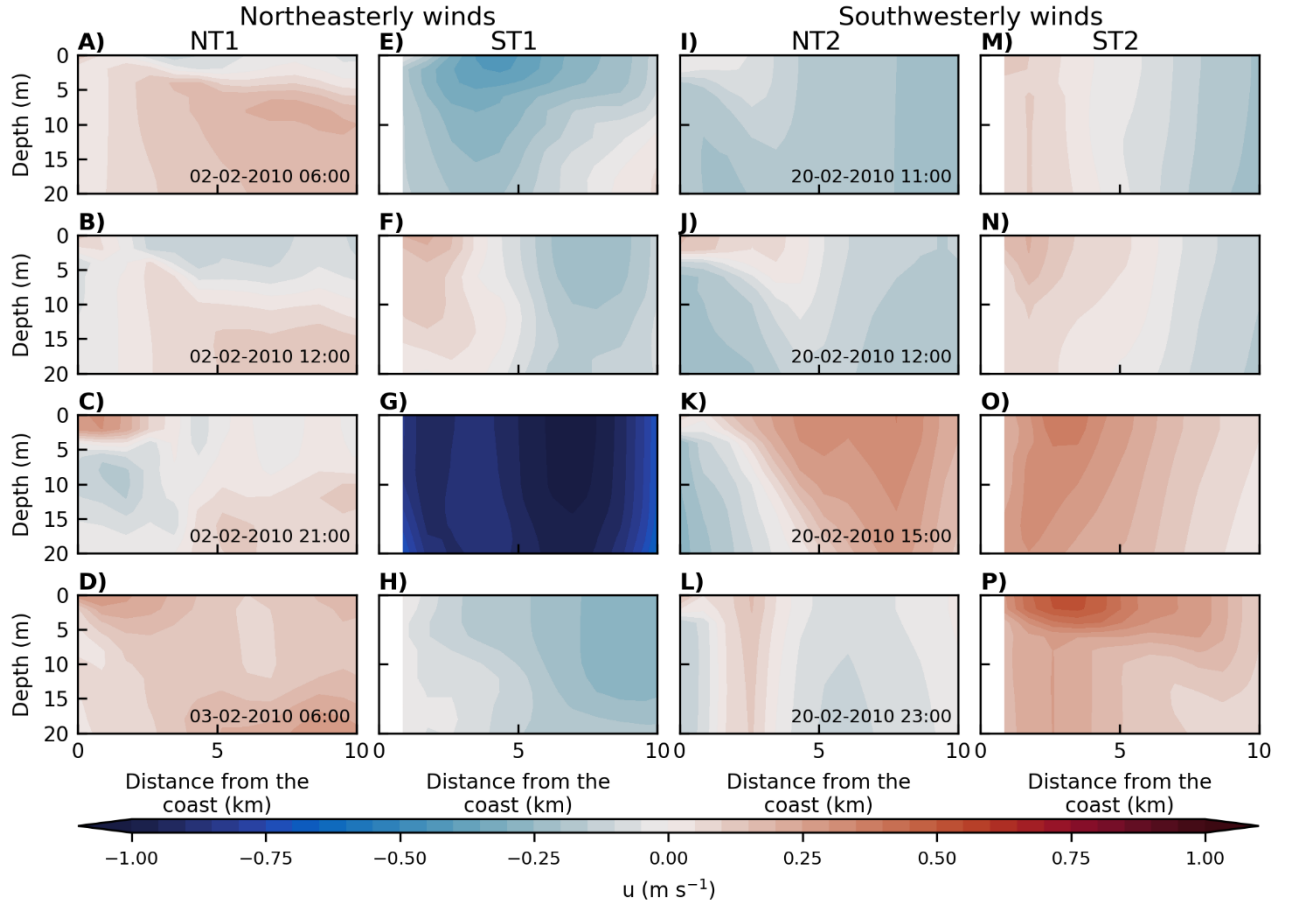
Supplementary Figure 1. Soil Map of Madeira Island.



Supplementary Figure 2. Comparison between the data recorded by the meteorological stations (black line) and the model results (orange line) for air temperature (°C) during February 2010.



Supplementary Figure 3. Spatial distribution of the soil's horizons (soil horizon data in Supplementary Table 4).



Supplementary Figure 4. Vertical variability of zonal-current component (u ; m s^{-1}) in transects (A-D) NT1 and (E-H) ST1 during northeasterly winds and (I-L) NT2 and (M-P) ST2 during southwesterly winds.

1.2 Supplementary Tables

Supplementary Table 1. Geometric characteristics (orientation, area, maximum altitude, main river length, total network length, drainage density and mean drainage slope) of the rivers of Madeira Island. Data was estimated based on the drainage network computed from the Digital Terrain Model (described in section 3.3) using QGIS version 3.14.1 (www.qgis.org).

River	Orientation	Area (km ²)	Maximum altitude (m)	Main river length (km)	Total network length (km)	Drainage density (km ⁻¹)	Mean drainage slope (°)
Ribeira da Janela	North	51.7	1604	24.4	268.6	5.2	27.6
Ribeira de São Roque do Faial	North	49.8	1859	15.7	243.4	4.9	36.0
Ribeira Brava	South	41.0	1689	13.9	201.8	4.9	36.7
Ribeira dos Socorridos	South	38.7	1857	18.5	169.3	4.4	40.3
Ribeira de São Vicente	North	37.7	1720	10.8	207.9	5.5	34.7
Ribeira de São Jorge	North	32.1	1854	11.1	155.4	4.8	34.8
Ribeira de Machico	South	24.4	1079	13.4	140.0	5.7	26.2
Ribeira do Porco	North	20.1	1723	10.8	101.6	5	41.1
Ribeira da Ponta do Sol	South	19	1608	13	96.2	5.1	30.1
Ribeira do Porto Novo	South	17	1419	13.8	89.2	5.3	24.8
Ribeira do Vigário	South	15.5	1408	9.2	84.8	5.5	24.9
Ribeira de Santa Lúzia	South	15.5	1786	12.2	84.7	5.4	27.2
Ribeira de São João - Funchal	South	14.6	1762.1	12.1	71.2	4.9	25.3
Ribeira do Seixal	North	13.8	1636	11.2	72.8	5.3	31.5
Ribeira de Santa Cruz	South	13	1301	10.9	73.5	5.7	21.7
Ribeira de João Gomes	South	11.5	1594	11.3	56.8	5	25.6
Ribeira da Boaventura	South	10.4	1391	11.5	55.4	5.3	25.5
Ribeira de São Bartolomeu	South	10	1262	7.4	45.8	4.6	29
Ribeira da Madalena	South	9.6	1426	7.7	51.3	5.4	26
Ribeira da Tabúa	South	8.8	1572	8.1	42.2	4.8	33
Ribeira Seca	South	8.8	1316	6.8	43.5	5	23.5
Ribeira do Campanário	South	7.7	1432	8.8	39.7	5.1	27.6
Ribeira da Atouguia	South	7.4	1412	6	34.4	4.6	26.8
Ribeira de Santiago	South	6.9	1417	9.1	34.6	5	24.8
Ribeira dos Moinhos - Ponta do Pargo	North	6.8	1284	10	34.2	5	24.4
Ribeira Funda - Calheta	South	6.1	1296	7.9	28	4.6	28.3
Ribeira do Caniço	South	6	1082	8	32.7	5.5	20.6
Ribeira da Calheta	South	5.8	1296	6.4	25.1	4.3	28.8
Ribeira do Inferno	North	5.8	1636	4.8	25.1	4.3	46.4

Supplementary Table 1. (continued).

River	Orientation	Area (km²)	Maximum altitude (m)	Main river length (km)	Total network length (km)	Drainage density (km⁻¹)	Mean drainage slope (°)
Ribeira da Maiata	North	5.4	761	3.7	26.4	4.9	33.7
Ribeira da Cruz	North	5.1	1155	6	26.8	5.2	24.8
Ribeira dos Moinhos - São Vicente	North	5.1	1346	5.6	29	5.7	34.3
Ribeira do Tristão	North	5	1036	5.2	26.5	5.3	26.3
Ribeira do Juncal	North	4.6	1023	6	22.9	5	32.7
Ribeira das Galinhas	South	4.5	1261	6.2	24.9	5.6	24.2
Ribeira dos Marinheiros	South	4.3	1308	8.1	20.2	4.7	24.4
Ribeira do Moreno	South	4.1	749	4.5	26	6.3	20
Ribeira dos Pregos	North	4.1	1221	8.6	26.2	6.4	17.7
Ribeira Funda - São Jorge	North	4.1	919	5.2	23	5.6	23.6
Ribeira do Lazareto	South	3.9	934	4.6	23.5	6	23.6
Ribeira da Soca	North	3.8	1264	7.9	25.1	6.6	18.9
Ribeira dos Câmbios	South	3.5	1124	6.4	19.4	5.5	21.4
Ribeira de João Delgado	North	3.5	1555	3.6	17.7	5.1	38
Ribeiro da Camisa	North	3.4	1447	4.1	16.7	4.9	38.4
Ribeira Funda - Seixal	North	3.1	1233	2.7	14.6	4.7	41.4
Ribeira da Caldeira	South	3	802	4.5	16.4	5.4	25
Ribeira da Vaca	North	3	1021	4.8	15.7	5.2	23.4
Ribeira do Seixo	South	2.9	719	4.3	19.4	6.7	19.4
Ribeira da Quinta Grande	South	2.8	937	4.4	12.9	4.6	25.6
Ribeiro Seco	South	2.8	434	3.9	17.2	6.2	13.1
Ribeiro da Abegoaria	South	2.7	934	6.4	14.7	5.5	20
Ribeira do Serrado - Canical	South	2.6	619	4	14	5.4	24.6
Ribeiro dos Melões	South	2.4	796	3.9	11.6	4.8	26.8
Ribeira da Caixa	South	2.4	1184	5.7	10.4	4.3	29.2
Ribeira do Carvalhal	South	2.3	951	4.2	15.2	6.5	19.9
Ribeira do Galo	North	2.3	815	4	16.7	7.4	16.7
Ribeira da Junqueira	South	1.9	877	4.1	11.2	5.8	18.3
Ribeira da Serra D'Água	North	1.9	1333	3.8	11.1	5.9	34.7
Ribeira de Santo António	North	1.7	677	4.8	10.5	6	18.4
Ribeira da Lage	North	1.7	1215	2.7	8.6	5.1	36.7
Ribeira da Boavista	South	1.6	677	3.4	11.9	7.5	17.1
Ribeiro do Natal	South	1.6	593	2.1	9.2	5.9	27.8
Ribeira do Macapez	North	1.5	562	2.5	8.4	5.6	28.4
Ribeira do Poiso	North	1.5	1152	4.9	9.9	6.7	17.4
Ribeira de Porto Moniz	North	1.4	802	4.3	10	6.9	16.6
Ribeiro do Velho	North	1.4	1189	2.9	8	5.7	37.2

Supplementary Table 1. (continued).

River	Orientation	Area (km²)	Maximum altitude (m)	Main river length (km)	Total network length (km)	Drainage density (km⁻¹)	Mean drainage slope (°)
Ribeira da Pole	South	1.4	614	3.7	8.2	5.9	19.9
Ribeiro do Arco	South	1.4	845	2.5	11.2	8.1	23.3
Ribeira da Vitória	South	1.4	436	3.6	7.4	5.4	15.5
Córrego da Igreja	North	1.3	524	3.1	8	6	19.9
Ribeira dos Moinhos - Santa Cruz	South	1.3	579	2.7	6.8	5.2	19.6
Ribeira da Igreja - Calheta	South	1.3	922	4.4	7.7	6	20.3
Ribeira do Funcho	South	1.3	378	1.9	8.1	6.4	13.8
Ribeira das Caimbos	North	1.2	1047.6	2.2	3.6	2.9	44.3
Ribeira das Eirozes	North	1.2	944	3.7	6	4.9	26.8
Ribeira da Caldeira	South	1.2	729	2.7	5.3	4.4	23
Ribeiro do Arco da Calheta	South	1.2	794	1.9	9.7	8	20.6
Ribeiro do Castelejo	South	1.2	719	3.3	7.4	6.2	20.7
Ribeiro Velho	South	1.2	866	3.2	6.6	5.5	22
Ribeira de São João - Calheta	South	1	869	3.2	6.1	5.9	21.6
Ribeira dos Moinhos - Calheta	South	0.9	784	2.9	4.8	5	21.6
Ribeiro das Freiras	South	0.9	568	2.9	6.3	6.9	13.6
Córrego do Farrobo	North	0.9	496	2.7	5	5.4	19.2
Ribeira da Calcada	South	0.9	814	3.7	4	4.4	23.9
Ribeiro da Quinta	South	0.9	541	2.5	4.7	5.2	16.7
Ribeira da Veste	North	0.9	871	3	4.5	5.1	25.9
Ribeira do Vale	South	0.9	741	3.2	3.8	4.5	18.2
Ribeira das Furnas	North	0.8	1042	2.3	6	7.1	18.9
Ribeiro de São Gonçalo	South	0.8	541	2	4.7	5.8	19.9
Ribeiro Francês	South	0.8	575	2.6	4.9	6.1	18.2
Ribeira da Igreja - Ponta do Pargo	North	0.8	930	3	4.5	5.8	18
Ribeiro da Fazendinha	South	0.7	574	2.5	4.1	5.5	21.2
Córrego do Fojo	North	0.7	839	2.6	4.2	5.8	31.2
Ribeira da Nogueira	North	0.7	1042	1.8	4.1	5.9	25.4
Ribeira da Fajã Pequena	South	0.7	747	2.7	4.3	6.1	18.7
Ribeira da Ponta da Oliveira	South	0.7	496	2.5	4.3	6.2	16.2
Ribeira de Vera Cruz	South	0.7	671	1.6	2.9	4.3	24.3
Ribeira do Serrado - Ponta do Pargo	North	0.7	704	2.6	3.4	5.1	17.4
Ribeira das Covas	North	0.6	565	3.1	4.7	7.3	15.1
Ribeira da Pedra	North	0.6	1340	2.4	2.6	4.5	35.6
Ribeira da Palmeira	South	0.6	335	2.3	3.1	5.4	13.4
Ribeira da Fajã da Eira	North	0.6	1231	1.9	3.7	6.4	36.3
Ribeira do Espigão	North	0.5	535	1.7	4	7.6	16.9
Ribeira da Fajã Grande	South	0.5	571	1.9	3.3	6.6	13.5

Supplementary Table 1. (*continued*).

River	Orientation	Area (km²)	Maximum altitude (m)	Main river length (km)	Total network length (km)	Drainage density (km⁻¹)	Mean drainage slope (°)
Ribeiro do Livramento	South	0.5	461	2.1	3.6	7.4	12.6
Ribeira dos Falcões	South	0.5	835	2.8	3.4	7.2	18.4
Ribeiro dos Lombadinhos	South	0.4	518	2.5	2.7	6.1	19
Ribeiro do Camarinho	South	0.4	492	2.6	3	6.8	14.4
Ribeira da Pedra Branca	North	0.4	1079	0.9	1.3	3	46.9
Ribeira da Terça	North	0.4	815	2	2.3	5.8	28.2
Ribeira de Santo Amaro	South	0.4	417	1.6	2.4	6	16.8
Córrego do Batista	North	0.4	1015	1.4	1.8	4.7	34.8
Ribeira do Pasto	South	0.4	435	1.6	3.1	8.2	13.4
Ribeiro das Árvores	South	0.3	512	1.2	2.1	6.4	21.1
Ribeira da Ponte	North	0.3	678	1.2	2.2	7.6	27.7
Ribeiro Escuro	North	0.3	677	1.4	1.9	6.7	24.8
Ribeiro do Tomarinho	South	0.3	432	1.6	1.9	6.8	15.5
Ribeiro da Granja	North	0.3	865	1	1.1	4.3	39.3
Ribeira da Fajã do Ribeirão	North	0.2	1036	1.6	1.6	6.7	34
Ribeiro dos Agriões	North	0.2	758.9	0.7	0.8	4.1	38.4
Ribeiro dos Pernais	South	0.2	446	1.2	1.4	7.9	19.6

Supplementary Table 2. Types of soils and respective hydrologic groups (SCS, 1972) in Madeira Island.

Soil	Type of soil	Hydrologic group	Area (km ²)	Proportion (%)
Andosols	Umbric Andosols	D	298.15	40.14
	Vitric Andosols	D	9.02	1.21
Arenosols	Calcaric Arenosols	A	0.43	0.06
Calcisols	Haplic Calcisols	B	0.34	0.05
Cambisols	Dystric Cambisols	D	2.11	0.28
Cambissolos	Eutric Cambisols	D	3.43	0.46
Cambisols	Humic Cambisols	D	13.36	1.8
	Vertic Cambisols	D	0.61	0.08
	Chromic Cambisols	D	38.4	5.17
Beach deposits		A	0.03	0
Fluvisols	Eutric fluvisols	A	0.57	0.08
	Dystric fluvisols	A	4.75	0.64
Phaeozems	Haplic Phaeozems	D	51.74	6.97
Fajã		-	0.04	0.01
Rough terrain	Dystric rough terrain	D	239.15	32.2
	Eutric rough terrain	D	43.15	5.81
Rocky terrain	Dystric rocky terrain	D	18.09	2.44
	Eutric rocky terrain	D	5.15	0.69
Vertissolos	Eutric Vertisols	D	8.3	1.12
Urban areas		D	5.35	0.72
Not accessible areas		D	0.33	0.04

Supplementary Table 3. Geometry of river cross-sections as a function of drained area.

Area (km ²)	Top and bottom width (m)	Depth (m)
0.5	3	0.75
1	5	1.5
10	9	2.5
20	15	3
52	20	4

Supplementary Table 4. Hydraulic parameters for each soil horizon. Θ_s , saturated water content; Θ_r , residual water content; η and α are empirical shape parameters; $K_{sat,ver}$, saturated hydraulic conductivity; l , pore connectivity/tortuosity parameter.

ID	Θ_s (m ³ m ⁻³)	Θ_r (m ³ m ⁻³)	η (-)	$K_{sat,ver}$ (m s ⁻¹)	α (m ⁻¹)	l (m)
17 and 18	0.4646	0	1.116	2.25e-05	12.83	-5
19	0.4989	0	1.12	1.97e-6	2.34	-5
20	0.4912	0	1.19	1.64e-6	3.47	-4.3
21 and 22	0.413	0	1.12	1.43e-6	2.27	-5
23	0.46	0	1.30	4.21e-6	0.04	1.18
24	0.37	0	1.18	5.07e-6	0.16	-1.62
25 and 26	0.41	0	1.12	1.43e-6	2.27	-5
27	0.46	0	1.30	4.21e-6	0.04	1.18
28	0.38	0	1.12	4.29e-6	7.17	-5
29 and 30	0.41	0	1.12	1.43e-6	2.27	-5
31	0.46	0	1.12	1.43e-6	2.27	1.18
32	0.38	0	1.12	4.29e-6	7.17	-5
33	0.46	0	1.30	4.21e-6	0.04	1.18
34	0.43	0	1.17	9.93e-6	3.36	-5
35	0.38	0	1.12	4.29e-6	7.17	-5