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International Water Resources Association
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JARÐFEINGI
Faroese Geological Survey

Water Management in the Azores Islands

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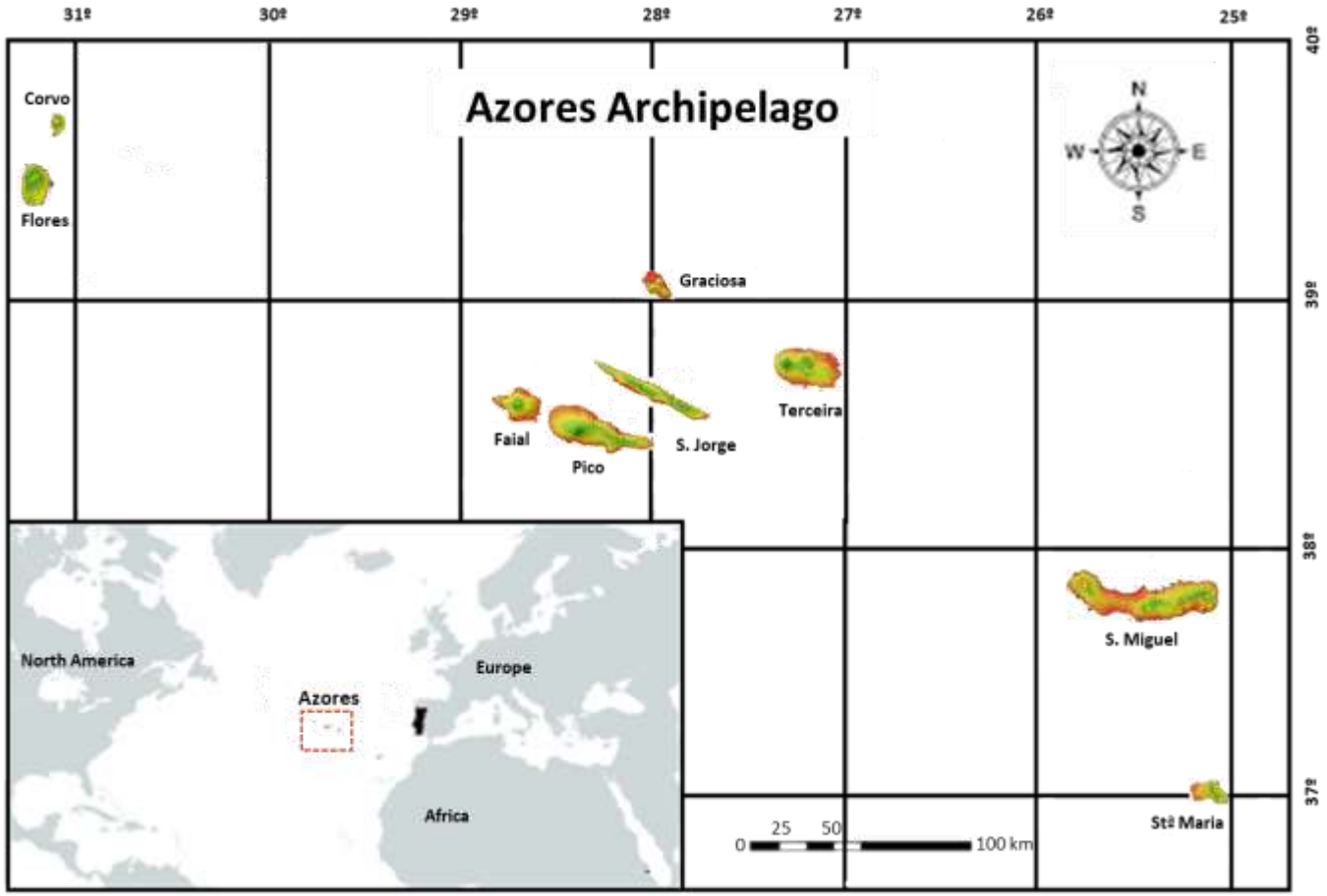
Angra do Heroísmo - Azores

- Hydrologic context – the Terceira island case study
- Strengths
- Challenges

The Azores archipelago



Island	Area (km^2)	Population (2021)	Water resources		
			Groundwater* (m^3/y)	Surface water* (m^3/y)	Abstracted water** (m^3/y)
Stª Maria	97,4	5 578	25 200 000	35 000 000	2 080 000
S. Miguel	759,0	137 699	370 000 000	511 000 000	25 923 000
Terceira	402,2	55 873	193 000 000	205 000 000	10 600 000
Graciosa	60,7	4 301	15 000 000	134 000 000	1 140 000
S. Jorge	237,6	9171	219 000 000	252000000	1 830 000
Pico	447,0	14 114	582 000 000	277000000	1 910 000
Faial	172,4	14 356	74 100 000	112 000 000	2 500 000
Flores	141,7	3 793	101 000 000	194 000 000	1 470 000
Corvo	17,2	374	8300000	13 000 000	70000
Azores	2 346,0	236 413	1 587 600 000	1 733 000 000	47 523 000

* Cruz (2004)

** AHA-DRA (2015)

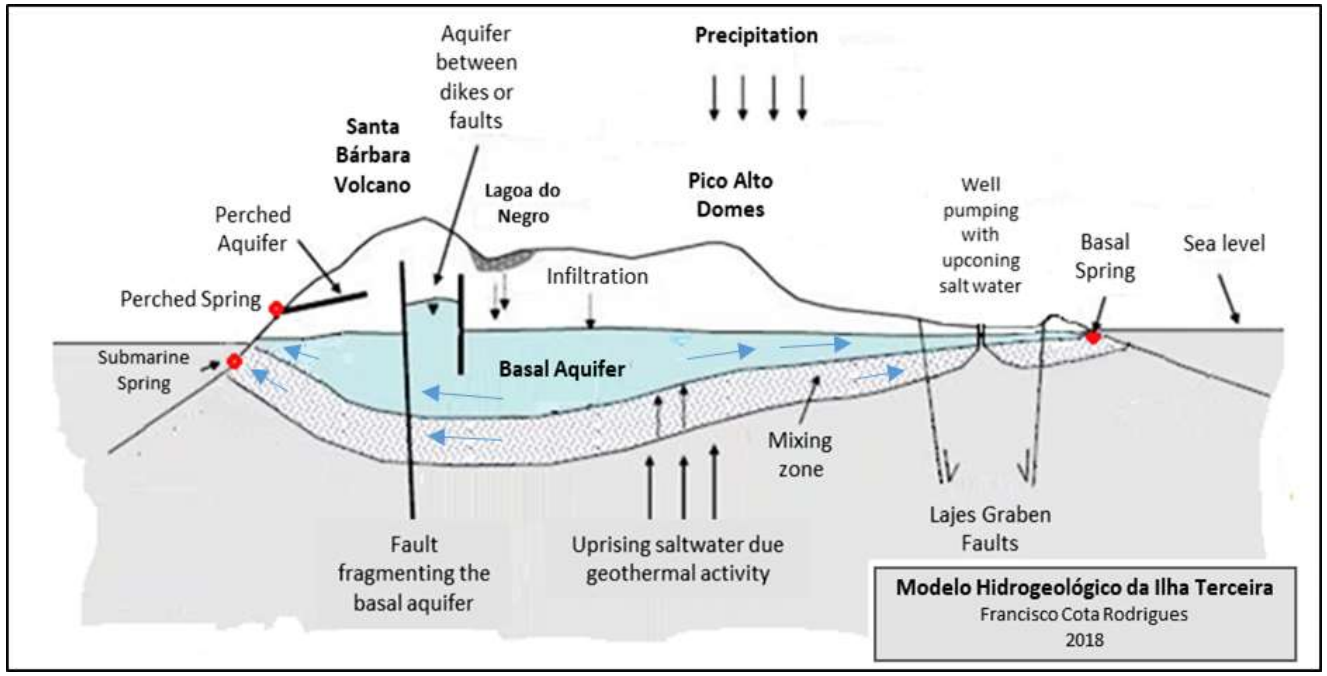
Water abstracted	(m^3/y)	%
Groundwater	46 730 000	98,3%
Superficial water	793 000	1,7%

Azores islands hydrogeological model


Paleosoil


Perched spring (Cabrito)


Basal spring (Bravio)



Pershed aquifers

- Occur at all altitudes
- Abstracted from springs and wells
- Low storage capacity;
- High variability in flow rates;
- High vulnerability to pollution

Basal aquifer

- Occur near sea level
- Abstracted from wells
- High storage capacity
- Low variability in flow rates
- Sea water intrusion problems

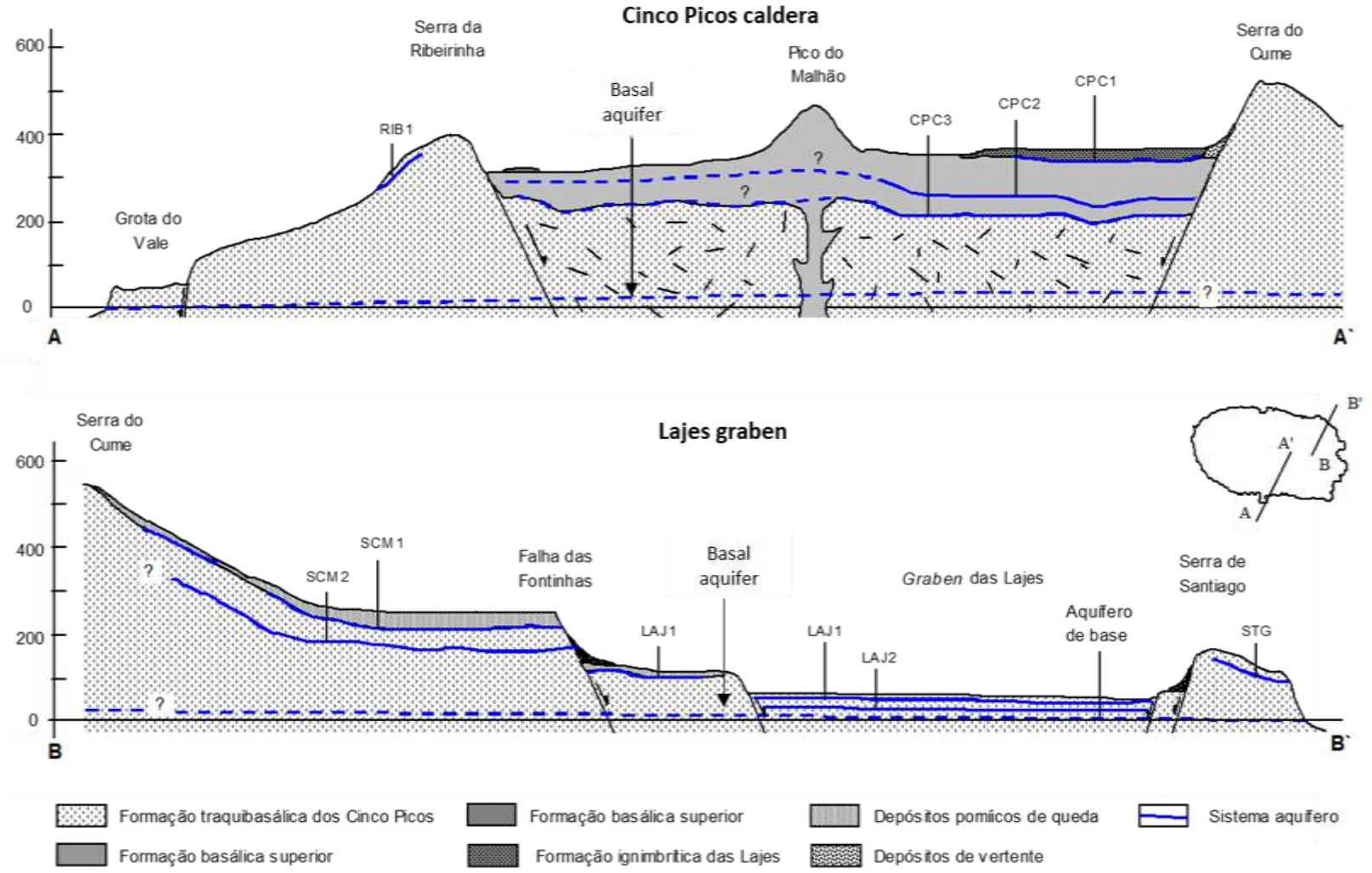
Perched aquifers

There are 31 known perched aquifers on Terceira Island.
The most productive are located inside calderas (Cinco Picos and Guilherme Moniz).

Basal aquifer

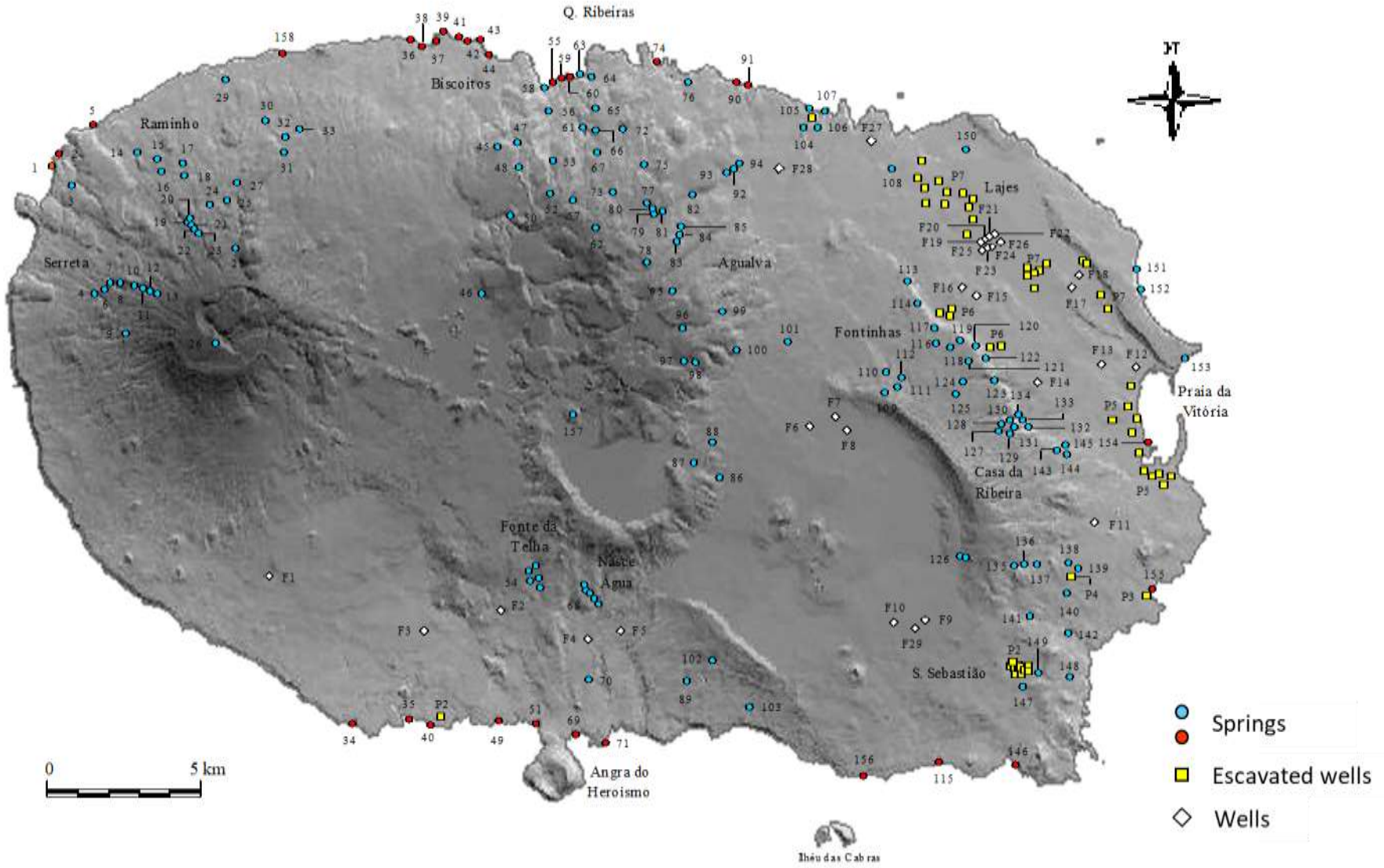
Corresponds to the saturated zone of the island body.
It consists of a mass of fresh water that floats on seawater due to the differences in density.

Cinco Picos caldera and Lajes Graben perched aquifers

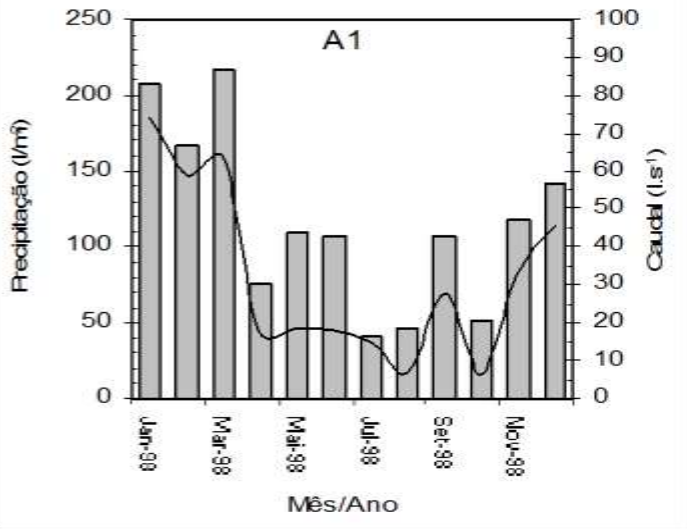


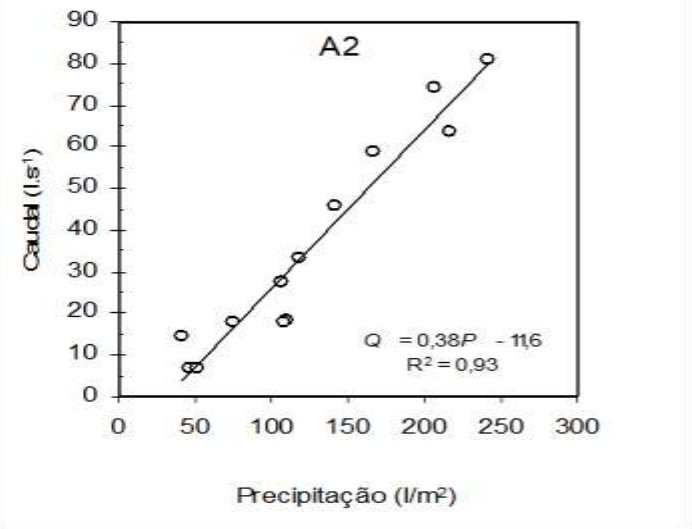
Adapted from Rodrigues (2002).

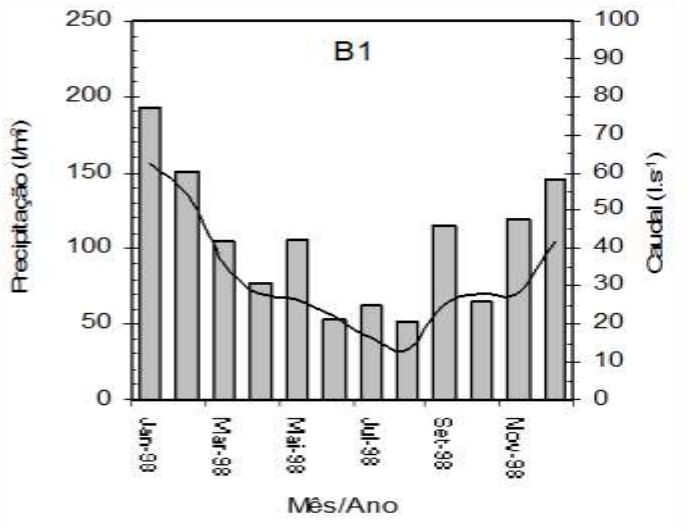
Terceira island groundwater sources

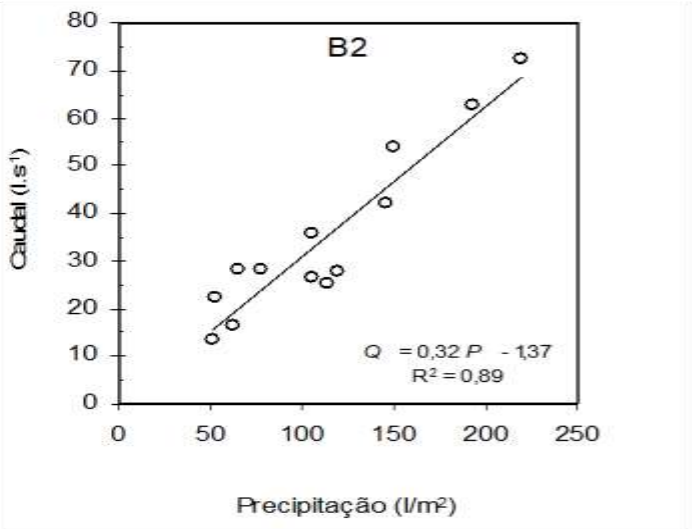


Perched aquifers- relationship between flows and precipitation

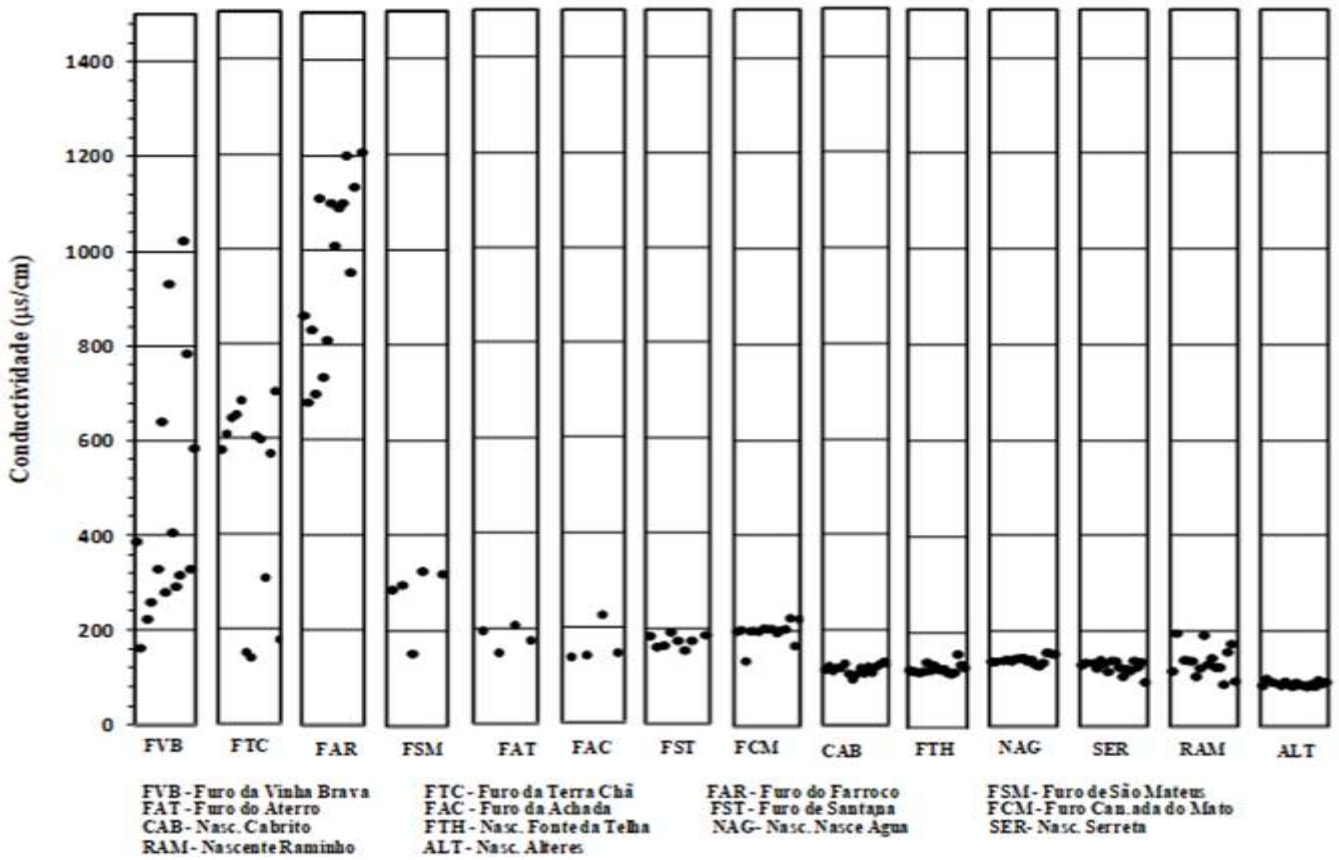








Electrical conductivity in basal and perched waters

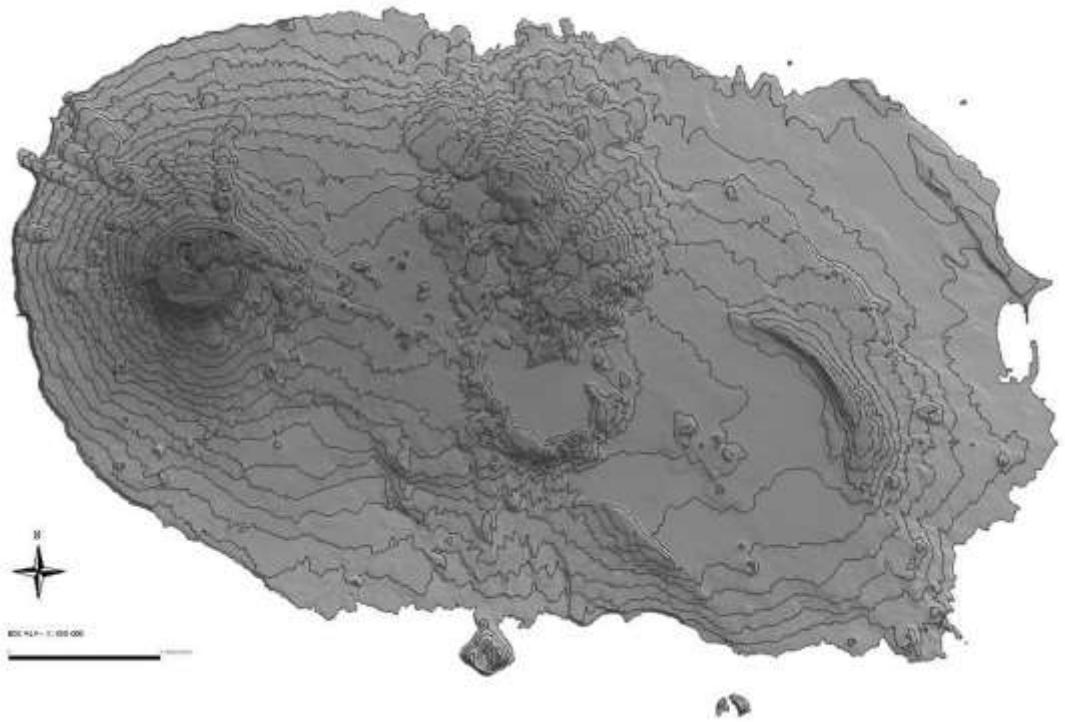


Adapted from Machado (2018).

Basal water with strong salinization processes (wells FVB, FTC and FAR).

Salinization processes depend on flow rates and exploration time

Terceira island case



Area (km^2)	401,6
Maximum widht (km)	29,0
Maximum lenght (km)	17,5
Maximum altitude (m)	17,5

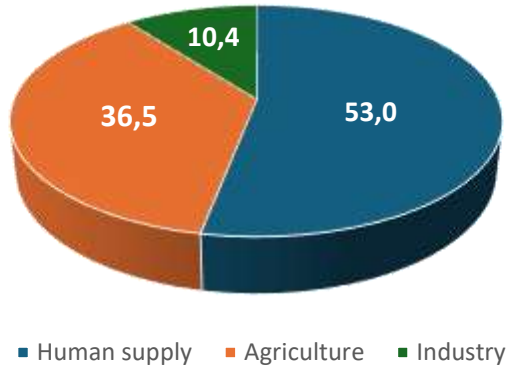
Descriptor	**Terceira island**	**Municipalities**	
		Angra do Heroísmo	Praia da Vitória
Population [a]	53331	33799	19482
Nº Catlle [b]	58802	37771	21031

[a] 2021 census [b] SREA (2009)

Water consumption

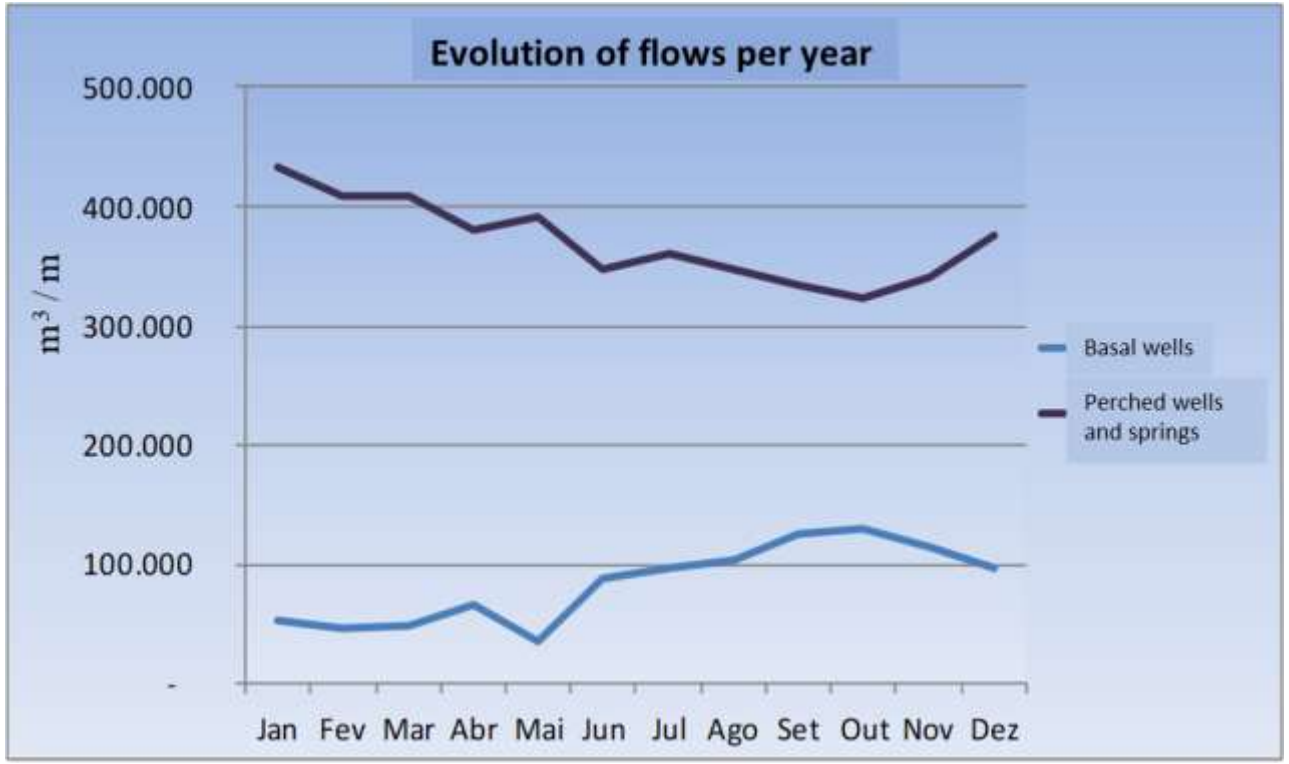
Counties	Human supply (m^3/y)	Agriculture (m^3/y)	Industry (m^3/y)	Total (m^3/y)
Terceira island	6 100 000	4 200 000	1 200 000	11 500 000
Angra do Heroísmo	3 500 000	2 700 000	650 000	6 850 000
Praia da Vitória	2 600 000	1 500 000	550 000	4 650 000

Terceira island water consumption(%)



Perched and basal flows

Estimated groundwater resources (m^3/y)	193 000 000
Groundwater abstracted for supply (m^3/y)	11 500 000
Surface water abstracted for supply (m^3/y)	2 000 000
Groundwater sources abstracted for supply	95
Springs abstracted for supply	80
Drilled basal wells abstracted for supply	15
Driled perched wells abstracted for supply	8
Number of water supply systems	5



Climate change

The scenarios related to climate change point to changes in the **distribution of precipitation**, with the periods of greatest aquifer recharge being concentrated between and October and March (75-80%) and periods of drought between April and September (20-25%)

Increase the recharge seasonality

Decline of resources in the driest period

Risk of salinization of the basal aquifer

Strengths and Challenges

Strengths

- Occurrence of high rainfall in the island's interior, in the main aquifer recharge areas;
- Recharges distributed throughout the year;
- Complementarity of flows from perched aquifers and the basal aquifer;
- Reduced exposure to polluting agents in the high recharge areas;

Challenges

Ensure the quality of groundwater and surface water bodies as well as their conservation and improvement.
Protect water sources and associated ecosystems.
Ensure the quantitative and qualitative supply of water, in a context of sustainable, balanced and equitable use.
Promote an institutional and regulatory framework capable of ensuring the planning and integrated management of water resources.
Promote knowledge and research on island water resources, providing a deep technical and scientific knowledge.
Optimise the monitoring network in order to improve an information and surveillance system relating to water quality.

Strengths and Challenges