

Idembergue Barroso Macedo de Moura¹, Daniele Tokunaga Genaro², Roberto Kirchheim³, Alberto Ricardo Torres Galvão Neto⁴, Roberio Bôto Aguiar⁵
1,2,3,4 e 5 GEOLOGICAL SURVEY OF BRAZIL

INTRODUCTION

Brazil is a country of continental dimensions and, therefore, presents different physiographic features, in addition to different patterns of human occupation. Since 2010, the Geological Survey of Brazil has been responsible for the Integrated Groundwater Monitoring Network - RIMAS (the largest groundwater network of regional representativity within South America) in the main regional intergranular aquifers in Brazil.

The historical series available, despite being considered relatively short, made it possible to document significant regional trends resulting from periods of drought, floods and/or changes in patterns of groundwater exploitation.

The present work analyzes and compares the behavior of groundwater surface resulting from the monitoring of three (03) distinct and representative aquifer systems of the Brazilian semi-arid region, namely: Missão Velha – Rio da Batateira, Açú and Cabeças (Figure 1).

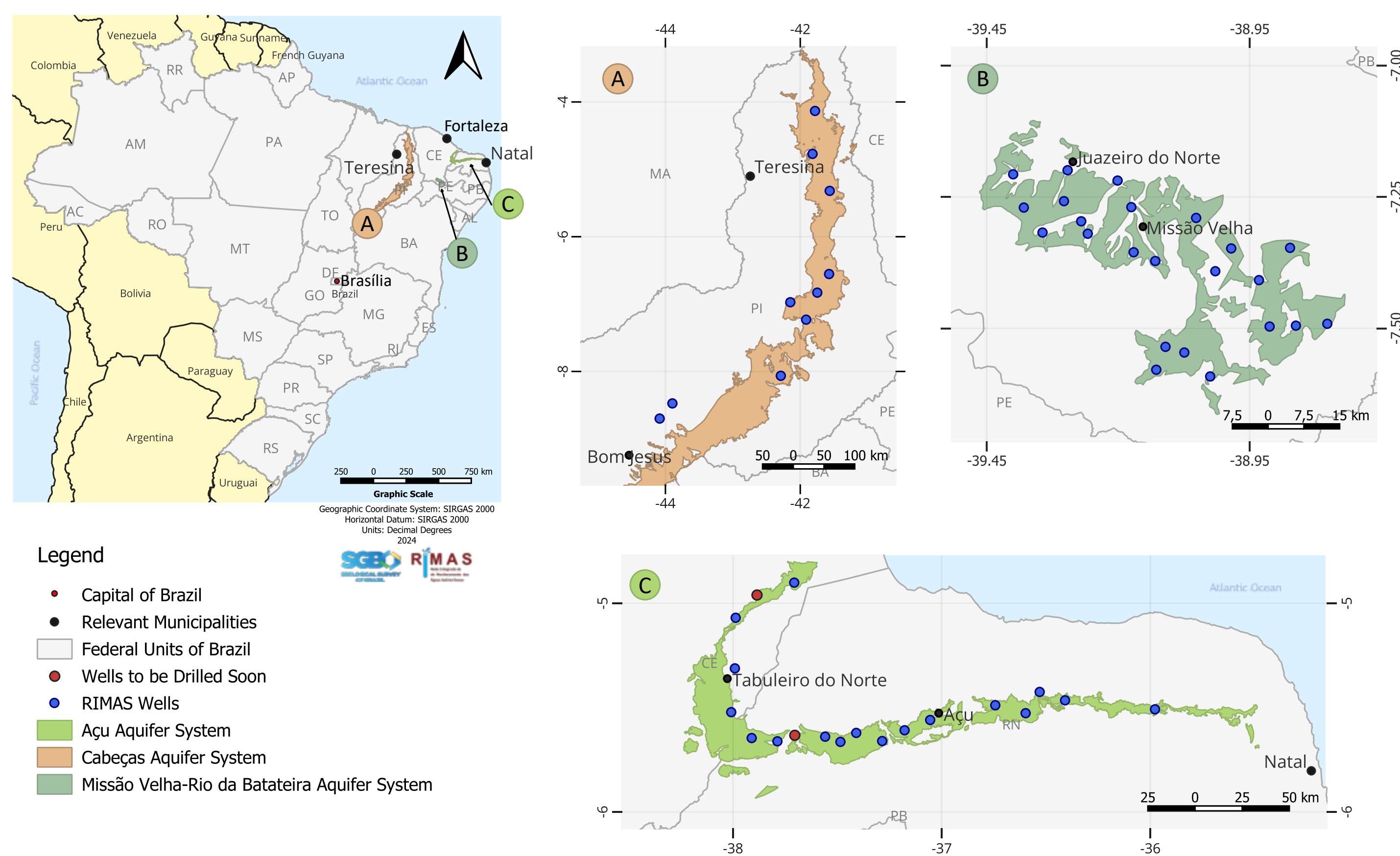


Figure 1. Local map of the wells studied for the three aquifer systems monitored. A. Cabeças Aquifer System (10 Wells); B. Missão Velha – Rio da Bateira Aquifer System (17 Wells); C. Açú Aquifer System (08 Wells).

METHODOLOGY

Groundwater level measurements were performed using manual level meters and automatic level meters (dataloggers).

After the data had been extracted, they were processed and analyzed in an office to remove anomalous values, correct any inconsistencies observed and calculate the median values that would be considered the most representative for each day.

For the treatment and consistency of these data, SGB developed the SIRS system (RIMAS - SIAGAS Integrator System), for import, analysis, consistency and submission of data series to the SIAGAS database and to the RIMAS platform, where the data has been stored, and can be accessed by any user.

RESULTS AND DISCUSSIONS

In 2011 and 2012, the Missão Velha - Rio da Batateira Aquifer System presented an average water level of 25.49 m, with a minimum of 2.86 m in the City of Crato / CE and a maximum of 84.02 m in the City of Juazeiro do Norte / CE.

And in 2023, the Missão Velha - Rio da Batateira Aquifer System had an average value of 29.70 m, with a minimum of 3.31 m in the City of Crato / CE and a maximum of 87.57 m in the City of Juazeiro do Norte / CE.

In 2011 and 2012, the Açú Aquifer System presented an average water level of 24.76 m, with a minimum of 6.44 m in the City of Quixeré / CE and a maximum of 61.62 m in the City of Alto Santo / CE.

And in 2023, the Açú Aquifer System had an average value of 30.13 m, with a minimum of 9.70 m in the City of Quixeré / CE and a maximum of 65.83 m in the City of Alto Santo / CE.

In 2011 and 2012, the Cabeças Aquifer System presented an average water level of 19.66 m, with a minimum of 6.75 m in the City of Wall Ferraz / PI and a maximum of 61.45 m in the City of Pedro Laurentino / PI.

And in 2023, the Cabeças Aquifer System had an average value of 21.24 m, with a minimum of 7.32 m in the City of Wall Ferraz / PI and a maximum of 62.00 m in the City of Pedro Laurentino / PI.

The Missão Velha - Rio da Batateira, Açú and Cabeças Aquifer Systems, in these 13 years of monitoring, presented an average drawdown in the medians water level of 4.21 m, 2.12 m and 1.58 m, respectively (Table 1).

The monitoring program allows the detection of trend of groundwater levels in the studied aquifers assisting discussions on the use of water resources and the environment (Figure 2).

Table 1. Medians of annual data of the water levels of the Missão Velha – Rio da Batateira, Açú and Cabeças Aquifer Systems.

WATER LEVELS OF THE MISSÃO VELHA - RIO DA BATATEIRA AQUIFER SYSTEM / 2011 - 2023						
SIAGAS	MUNICIPALITY	MEDIAN - 2011/2012	MEDIAN - 2023	DRAWDOWN	MINIMUM (2011 - 2023)	MAXIMUM (2011- 2023)
2300020827	Barbalha	13.75	17.38	3.63	13.75 (2011)	18.51 (2021)
2300022129	Brejo Santo	8.16	20.83	12.67	8.16 (2011)	20.83 (2023)
2300022135	Milagres	10.98	17.71	6.73	10.98 (2011)	19.21 (2021)
2300022154	Missão Velha	11.78	13.21	1.43	11.78 (2011)	21.34 (2020)
2300022506	Brejo Santo	20.85	19.80	-1.05	19.60 (2022)	23.90 (2017)
2300022592	Juazeiro Norte	84.02	87.57	3.55	84.02 (2011)	87.94 (2022)
2300022593	Missão Velha	36.60	34.62	-1.98	33.63 (2022)	43.34 (2014)
2300022598	Milagres	50.57	71.01	20.44	50.57 (2011)	71.54 (2018)
2300022599	Missão Velha	41.41	46.75	5.34	41.41 (2011)	48.13 (2021)
2300022600	Abaiara	7.21	9.50	2.29	7.21 (2011)	22.21 (2017)
2300022893	Mauriti	30.20	37.77	7.57	30.15 (2015)	37.77 (2023)
2300022895	Abaiara	20.90	25.08	4.18	20.87 (2013)	25.08 (2023)
2300022896	Brejo Santo	18.99	21.56	2.57	18.99 (2011)	21.56 (2023)
2300022906	Crato	55.87	59.77	3.90	55.87 (2012)	60.32 (2021)
2300022907	Crato	2.86	3.31	0.45	2.51 (2013)	4.69 (2018)
2300022908	Barbalha	12.62	12.43	-0.19	12.00 (2013)	13.29 (2021)
2300022909	Missão Velha	6.48	6.57	0.09	6.48 (2012)	8.53 (2016)
MÉDIA		25.49	29.70	4.21		
WATER LEVELS OF THE AÇÚ AQUIFER SYSTEM / 2011 - 2023						
SIAGAS	MUNICIPALITY	MEDIAN - 2011/2012	MEDIAN - 2023	DRAWDOWN	MINIMUM (2011 - 2023)	MAXIMUM (2011- 2023)
2600039599	Afonso Bezerra	11.55	16.57	5.02	11.55 (2011)	16.66 (2021)
2600039600	Upanema	26.81	26.47	-0.34	26.43 (2023)	26.91 (2017)
2600039601	Assol	40.77	45.55	4.78	40.77 (2011)	45.55 (2023)
2600041031	Apodi	10.59	14.11	3.52	10.59 (2011)	14.11 (2023)
2600049468	Jardim de Angicos	31.36	30.88	-0.48	29.26 (2019)	31.36 (2012)
2300022706	Quixeré	6.44	31.95	25.51	6.44 (2011)	31.95 (2023)
2300022707	Alto Santo	61.62	65.83	4.21	61.62 (2011)	68.59 (2020)
2300022949	Jaguaruana	8.94	9.70	0.76	8.94 (2012)	11.25 (2021)
MÉDIA		24.76	30.13	5.37		
WATER LEVELS OF THE CABEÇAS AQUIFER SYSTEM / 2011 - 2023						
SIAGAS	MUNICIPALITY	MEDIAN - 2011/2012	MEDIAN - 2023	DRAWDOWN	MINIMUM (2011 - 2023)	MAXIMUM (2011- 2023)
2200017099	Alvorada do Gurgueia	10.35	12.35	2.00	10.35 (2012)	12.53 (2020)
2200017170	Cristino Castro	32.05	33.58	1.53	32.05 (2012)	33.58 (2023)
2200046783	Brasileira	20.11	21.59	1.48	20.11 (2011)	27.05 (2017)
2200046784	Castelo do Piauí	11.69	13.34	1.65	11.69 (2011)	19.56 (2017)
2200046785	Wall Ferraz	6.75	7.32	0.57	6.75 (2011)	8.09 (2017)
2200046786	Lagoa do Sitio	16.91	22.51	5.60	16.91 (2011)	22.61 (2018)
2200046787	Jatobá	15.37	18.28	2.91	15.37 (2011)	19.10 (2021)
2200046856	Ipiranga	10.25	9.55	-0.70	9.55 (2023)	10.75 (2017)
2200046857	Pedro Laurentino	61.45	62.00	0.55	60.91 (2013)	62.00 (2023)
2200046858	Oeiras	11.67	11.84	0.17	11.56 (2020)	12.43 (2017)
MÉDIA		19.66	21.24	1.58		

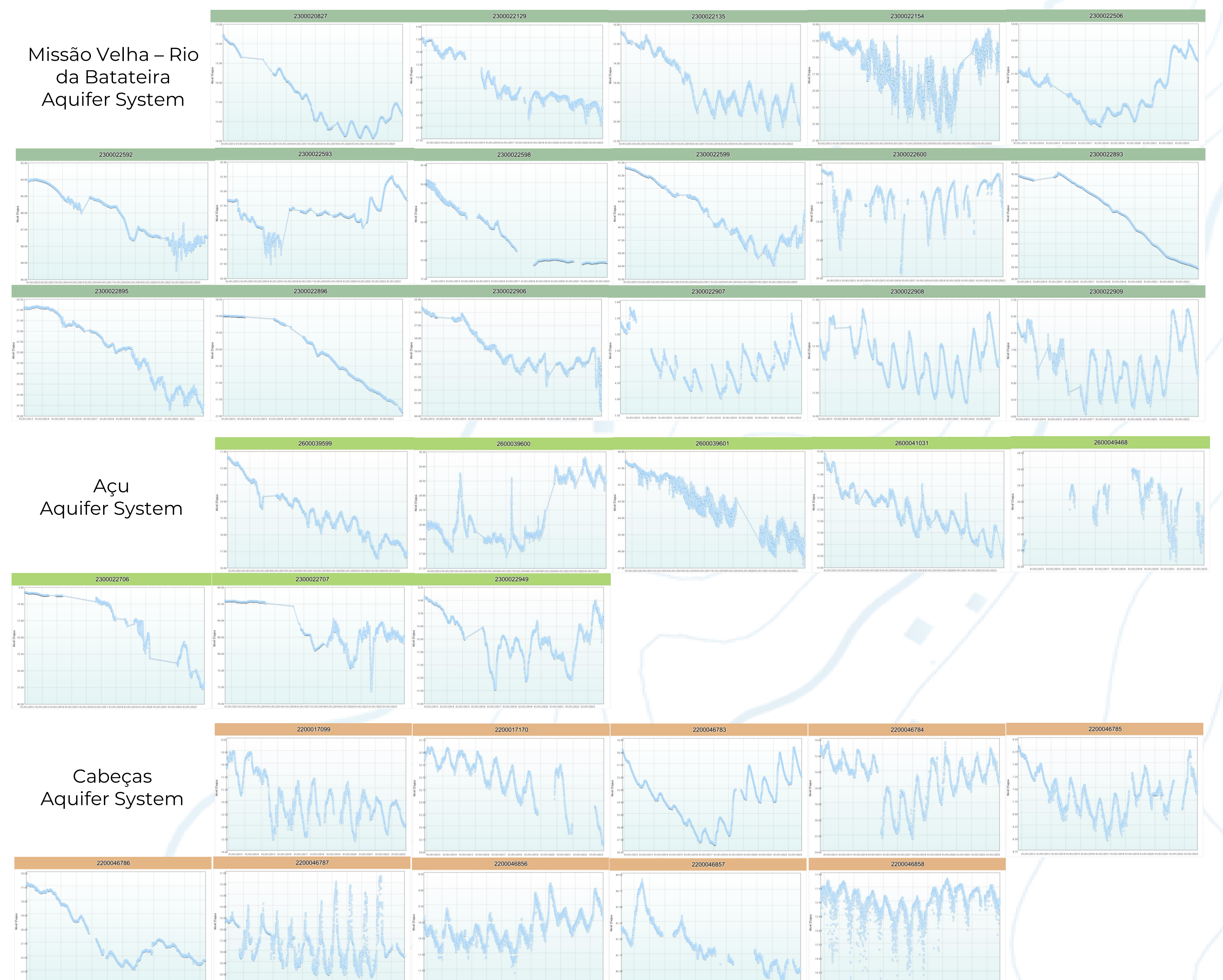


Figure 2. Daily data (synthesized) of the water levels of the Missão Velha – Rio da Batateira, Açú and Cabeças Aquifer Systems available on the RIMAS Platform (<https://rimasweb.sgb.gov.br/layout/>).

CONCLUSIONS

In general terms, data from the water tables of the Missão Velha – Rio da Batateira, Açú and Cabeças aquifer systems, located in the northeast region of Brazil, which is the most water-scarce area in the country, demonstrate that despite some seasonal component in the series, groundwater levels have been declined (drawdown) throughout the monitored period, and this occurs possibly due to low recharge and increased exploitation of groundwater in the Brazilian semi-arid region.

BIBLIOGRAPHIC REFERENCES

BRASIL, SGB. Serviço Geológico do Brasil. RimasWeb, 2024. Disponível em: <https://rimasweb.sgb.gov.br/layout/>. Acesso em: 30 abril 2024.