

Top-down strategies and tools to promote adaptation and resilient decision-making in agriculture

Top-down strategies

Decision-making in agriculture



zarc[®]

Agricultural Climate
Risk Zoning

*Dr. Ary Fortes
Researcher Scientist*



Mapping risks, reducing losses.

Brazilian agriculture

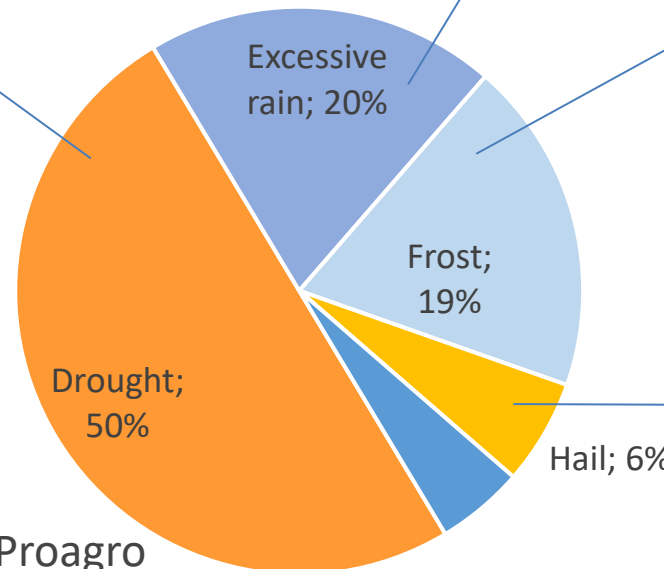
Brazilian agriculture is based on more than 300 species of crops and sends 350 types of products to the world, reaching around 200 countries

- We went from importers to major exporters of agricultural products
- The world's largest soybean producer and the third largest fruit producer
- The world's largest exporter of soybeans, coffee, sugar, orange juice, sugarcane ethanol, beef and chicken.



Understanding the challenges

Risk of adverse meteorological events



Losses in Proagro

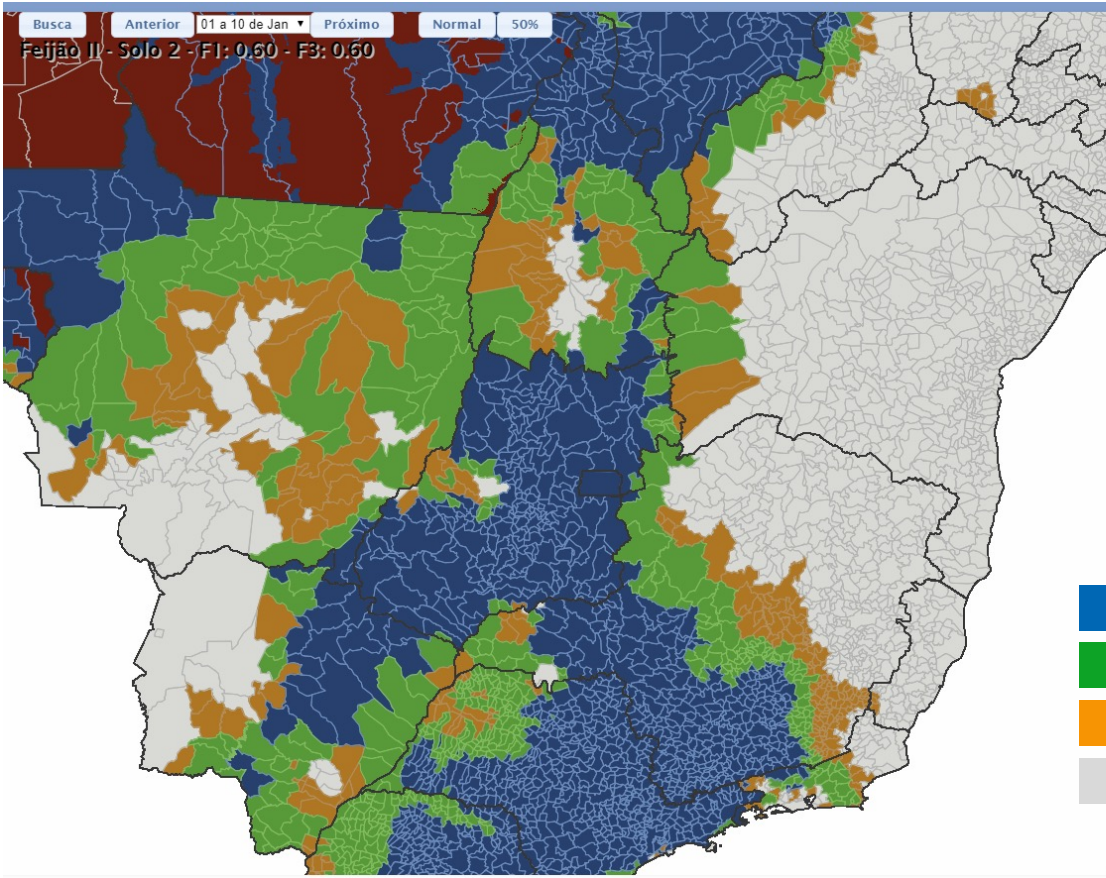
National Program for Agricultural Climate Risk Zoning (Zarc)

- *What is Zarc?*
- *How is it generated?*
- *Police interface: how is it used on ?*
- *2020 to 2023 examples*
- *What's next?*

Agricultural Climate Risk Zoning (Zarc)

It is the delimitation of regions and planting times throughout the year, in classes of probability of adverse weather events (that cause severe yield losses);

Regions



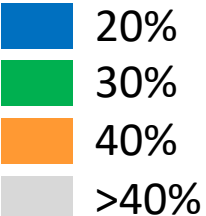
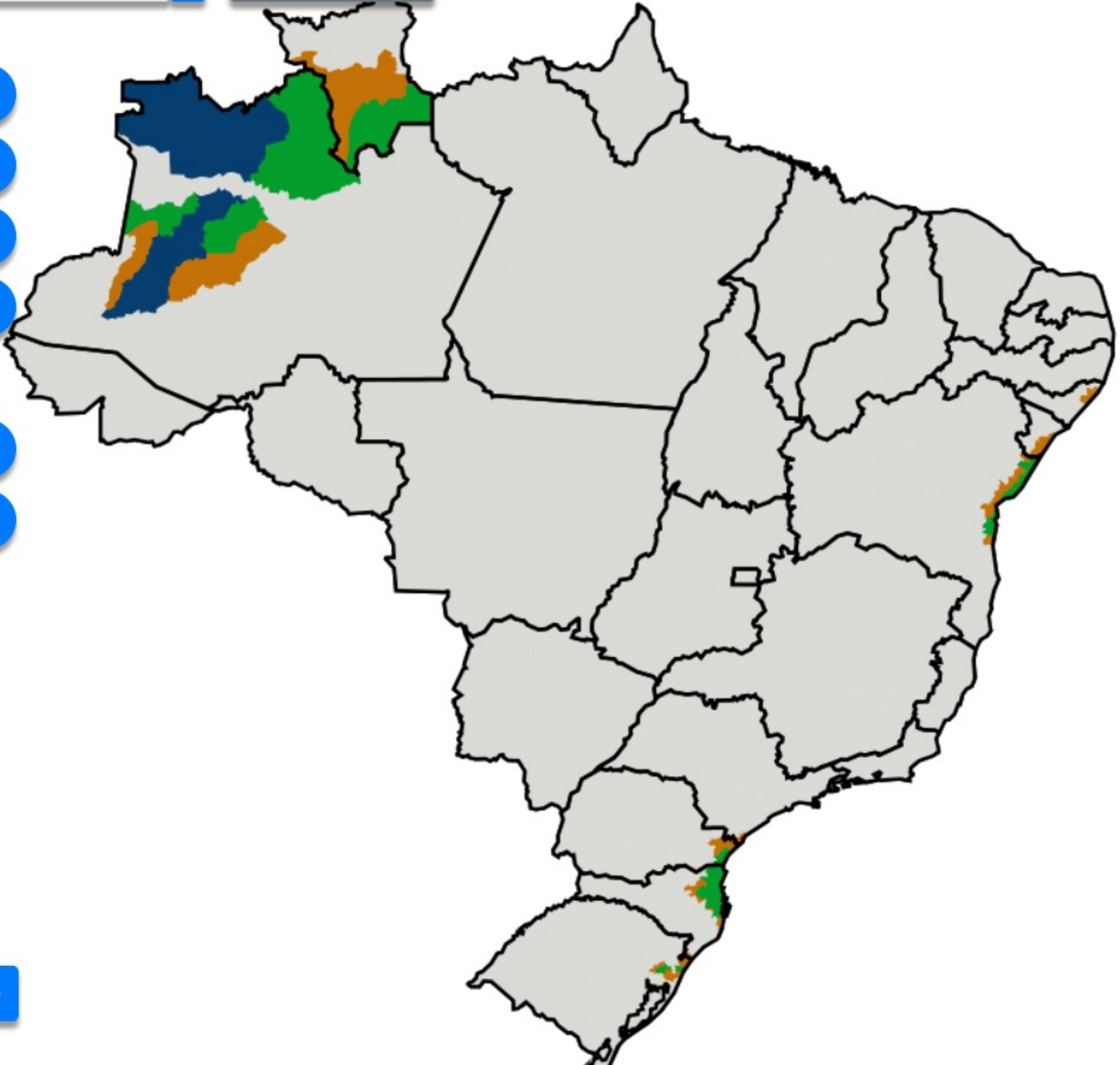
Sowing or planting dates (10-day time step)

Município	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18	D19	D20
Batalha	0	0	0	0	0	40	30	20	20	20	20	20	20	40	0	0	0
Belém	0	0	0	0	0	30	30	20	20	20	20	20	20	20	30	0	0
Belo Monte	0	0	0	0	0	40	30	20	20	20	20	20	20	40	0	0	0
Boca da Mata	0	0	0	0	40	30	30	20	20	20	20	20	20	20	20	40	0
Branquinha	0	40	40	40	40	40	30	20	20	20	20	20	20	20	30	40	0
Cacimbinhas	0	0	0	0	0	40	30	20	20	20	20	20	20	40	0	0	0
Cajueiro	0	0	0	0	40	30	30	20	20	20	20	20	20	20	30	40	0
Campestre	0	40	40	40	30	30	30	20	20	20	20	20	20	20	20	40	0

- Risk 20% (01 – 20%)
- Risk 30% (21 – 30%)
- Risk 40% (31 – 40%)
- Risk >40% (risk not accepted by agricultural policy programs)

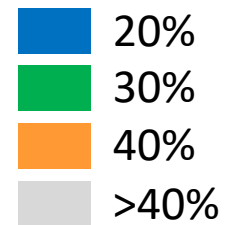
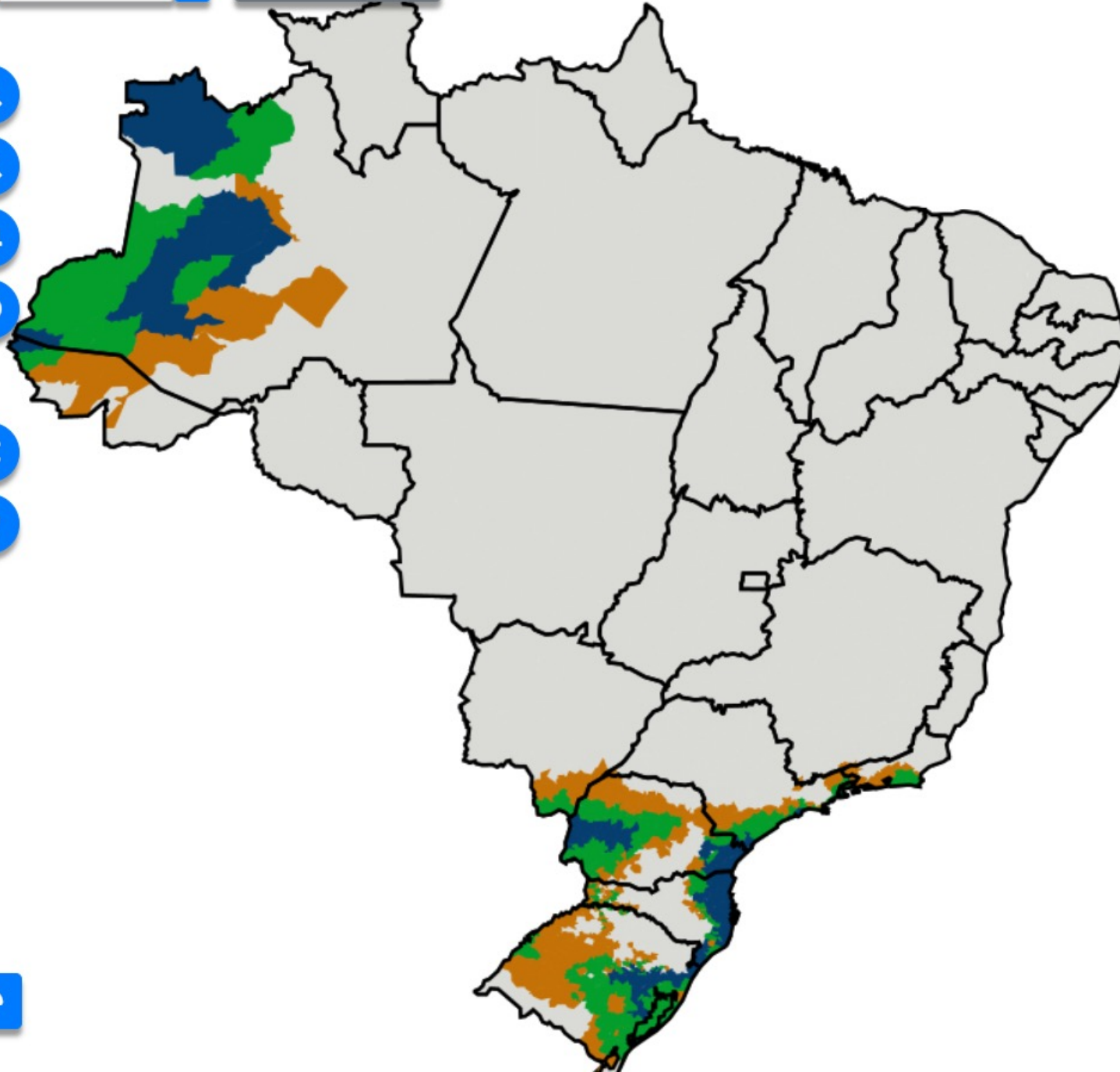
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Milho 100 - Solo/AD: 2



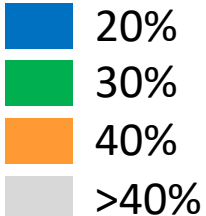
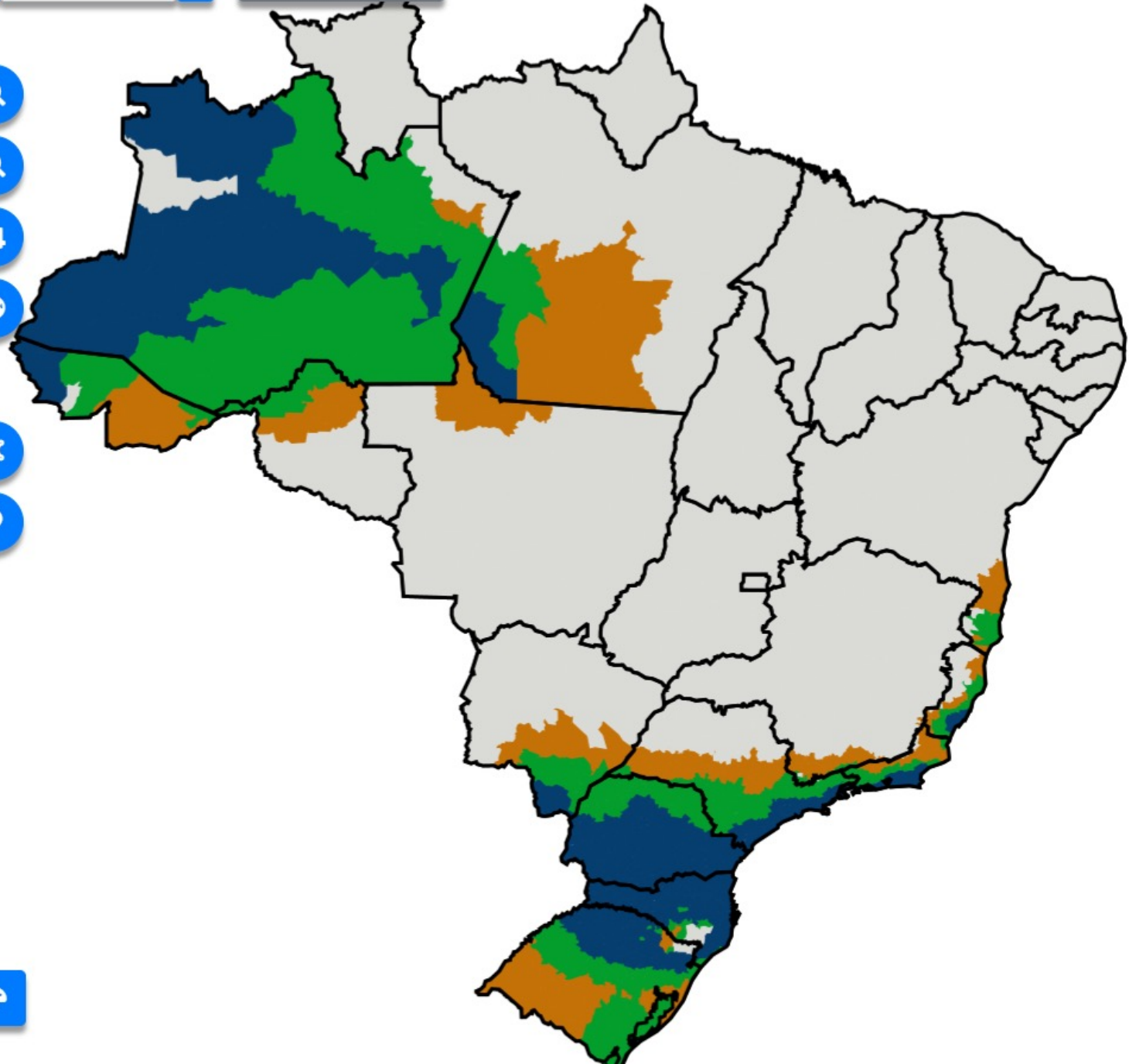
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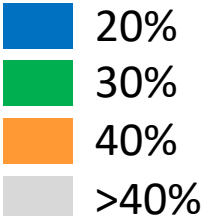
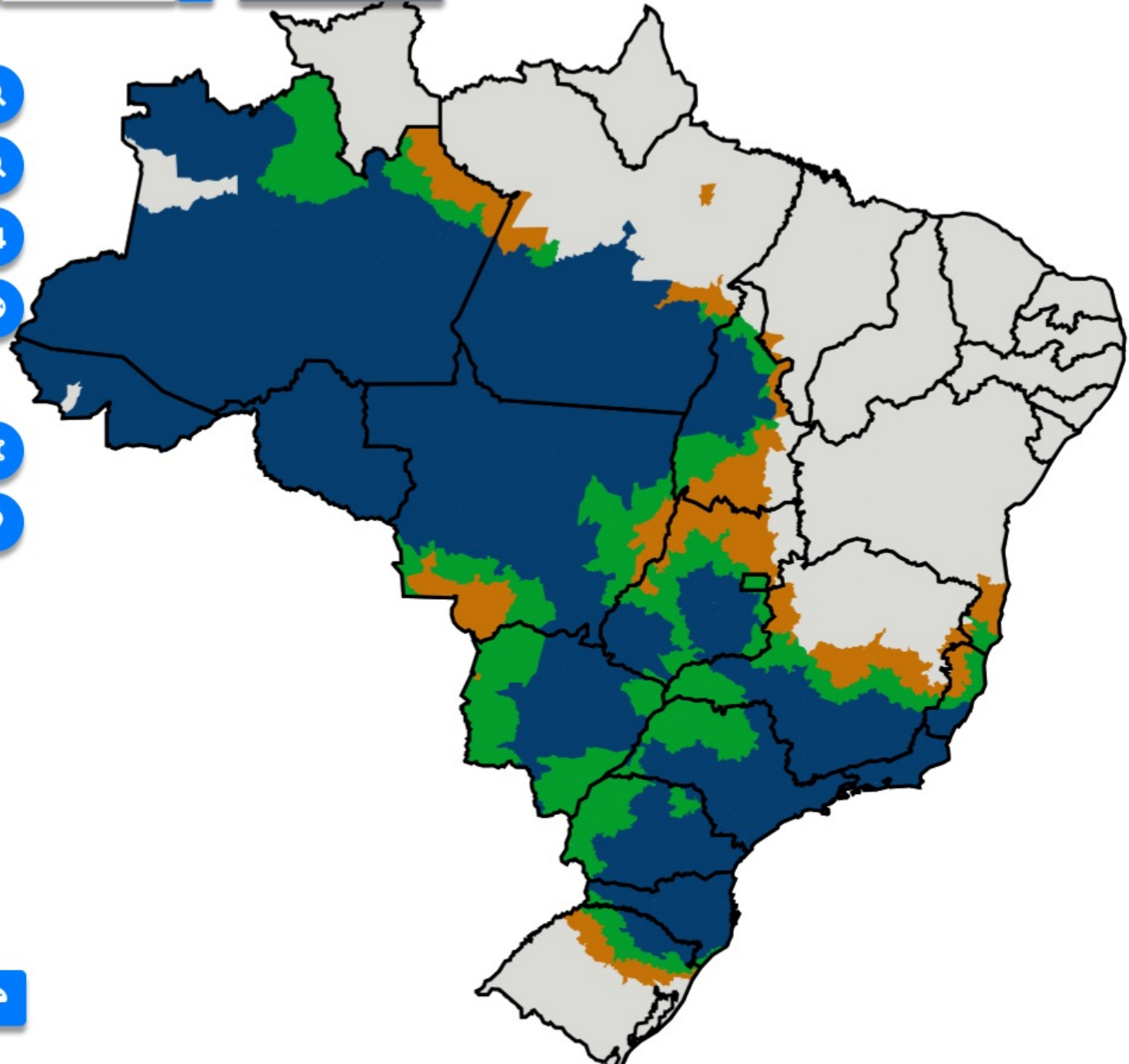
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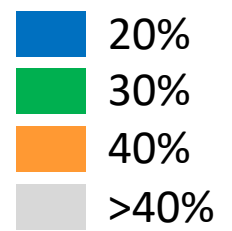
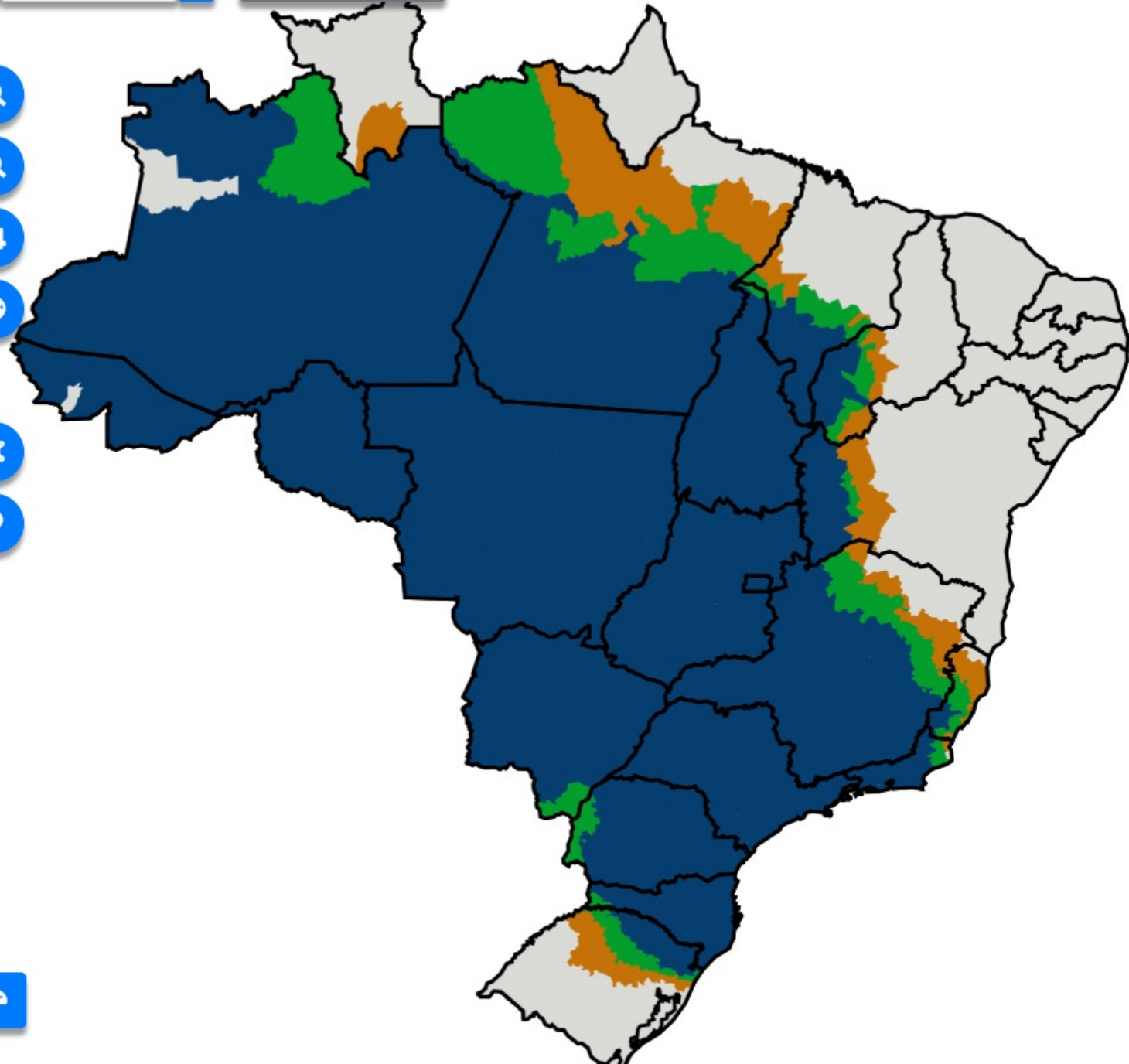
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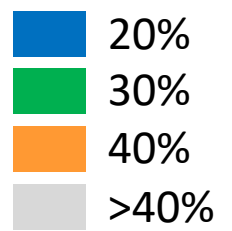
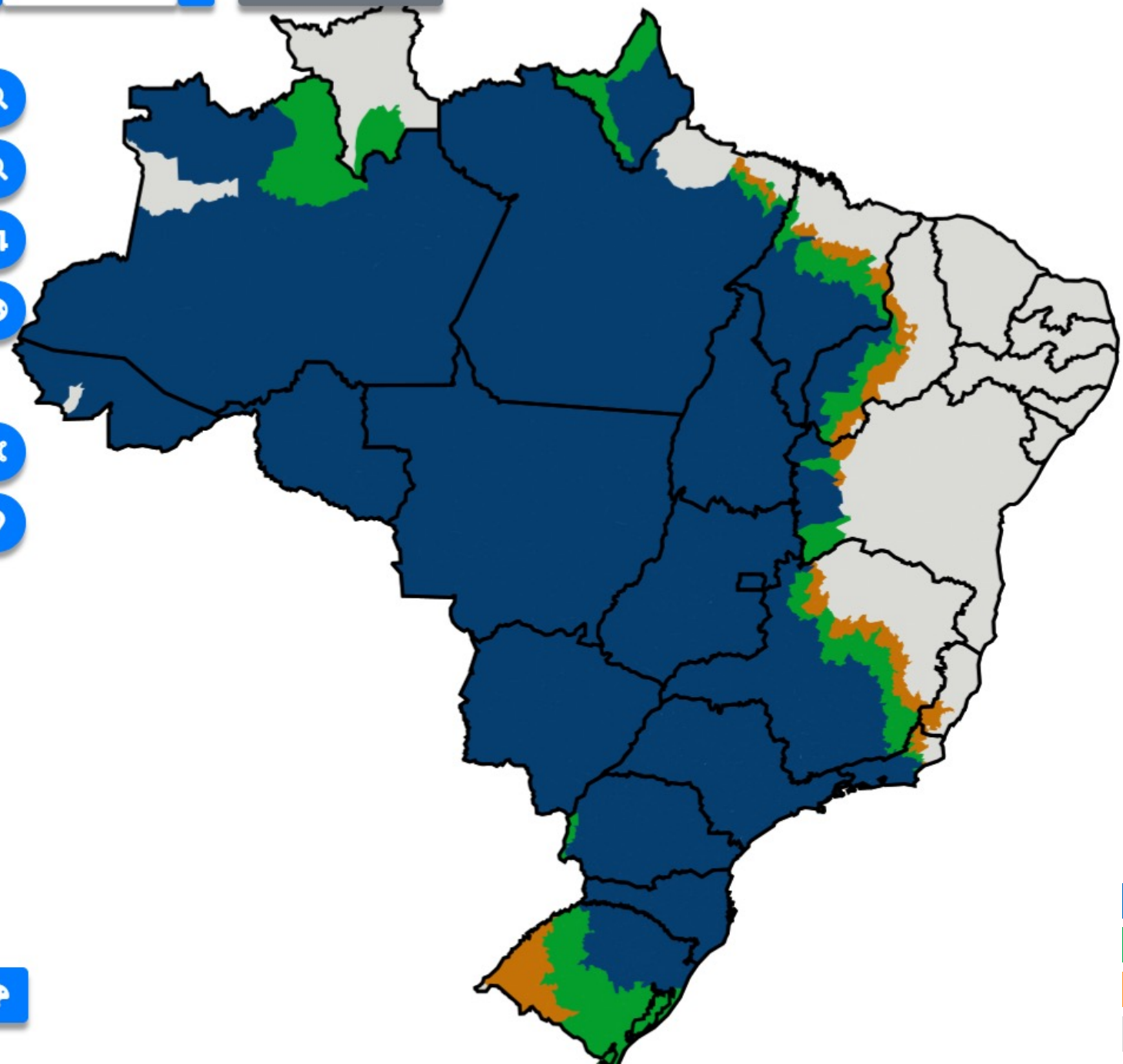
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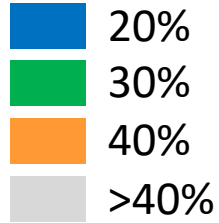
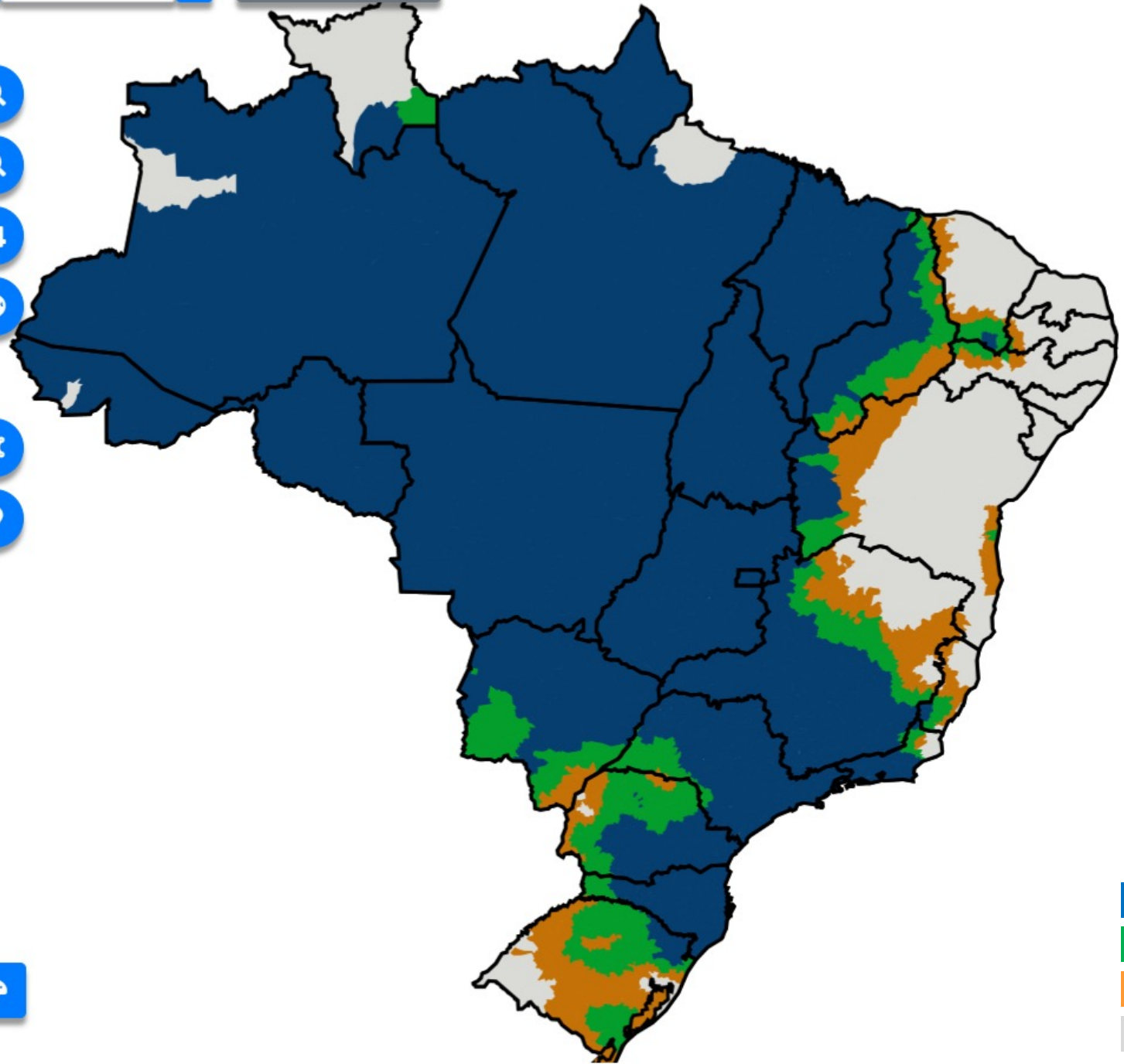
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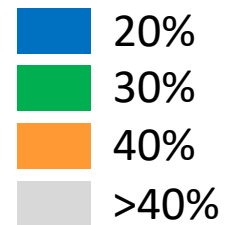
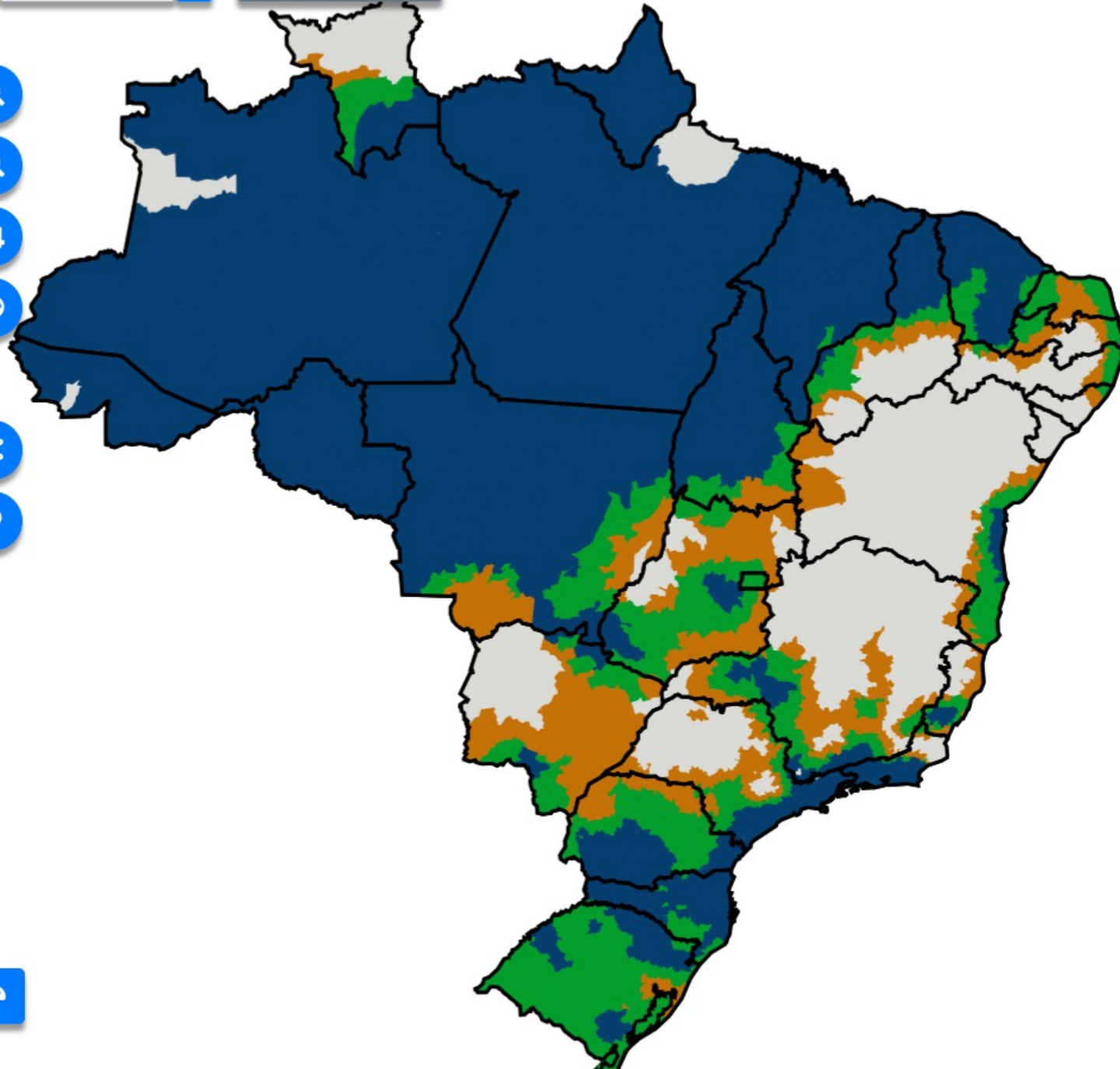
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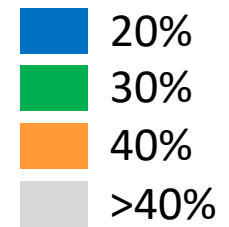
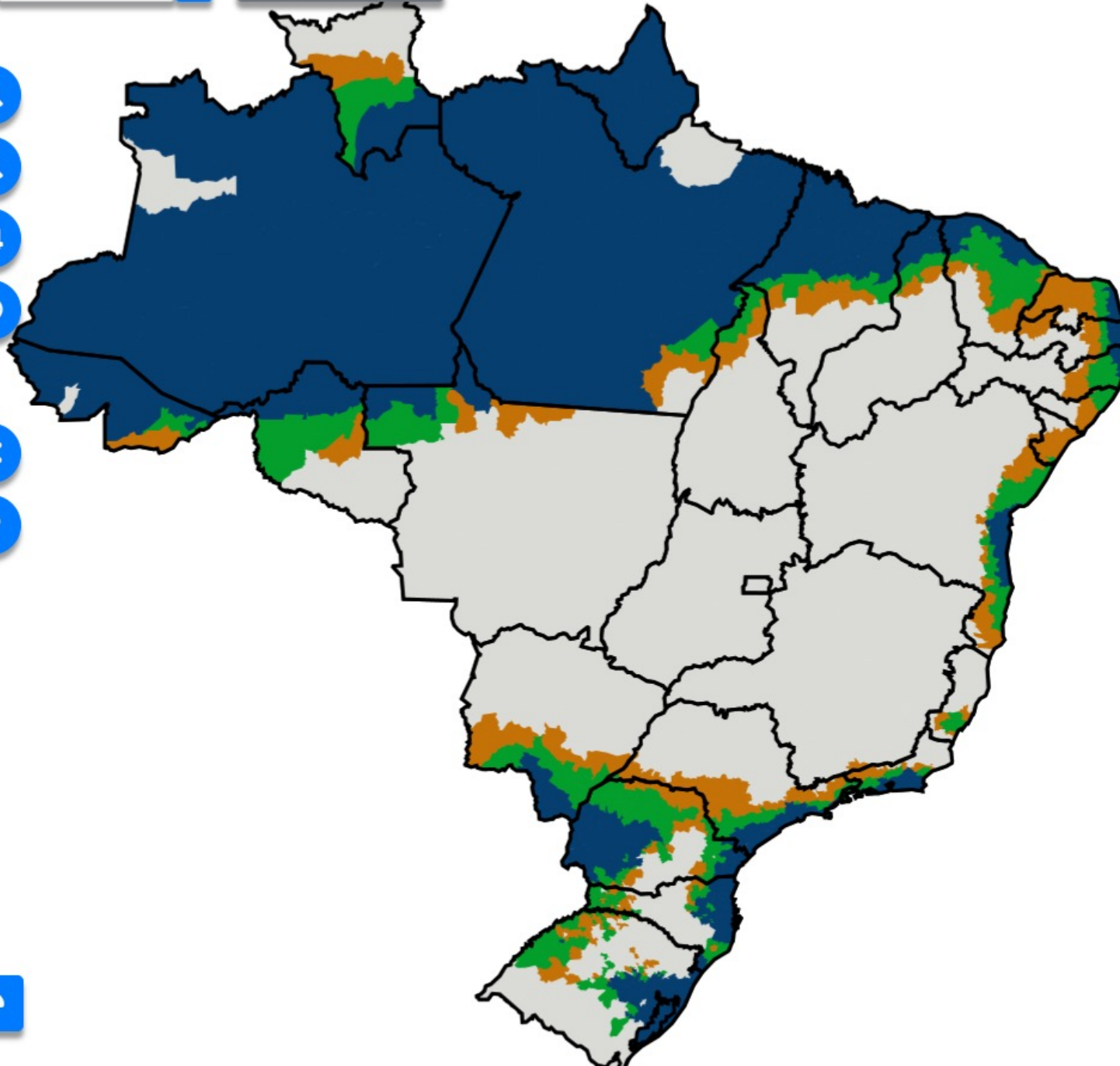
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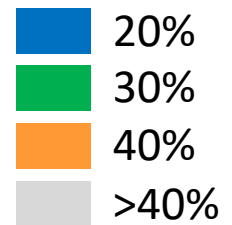
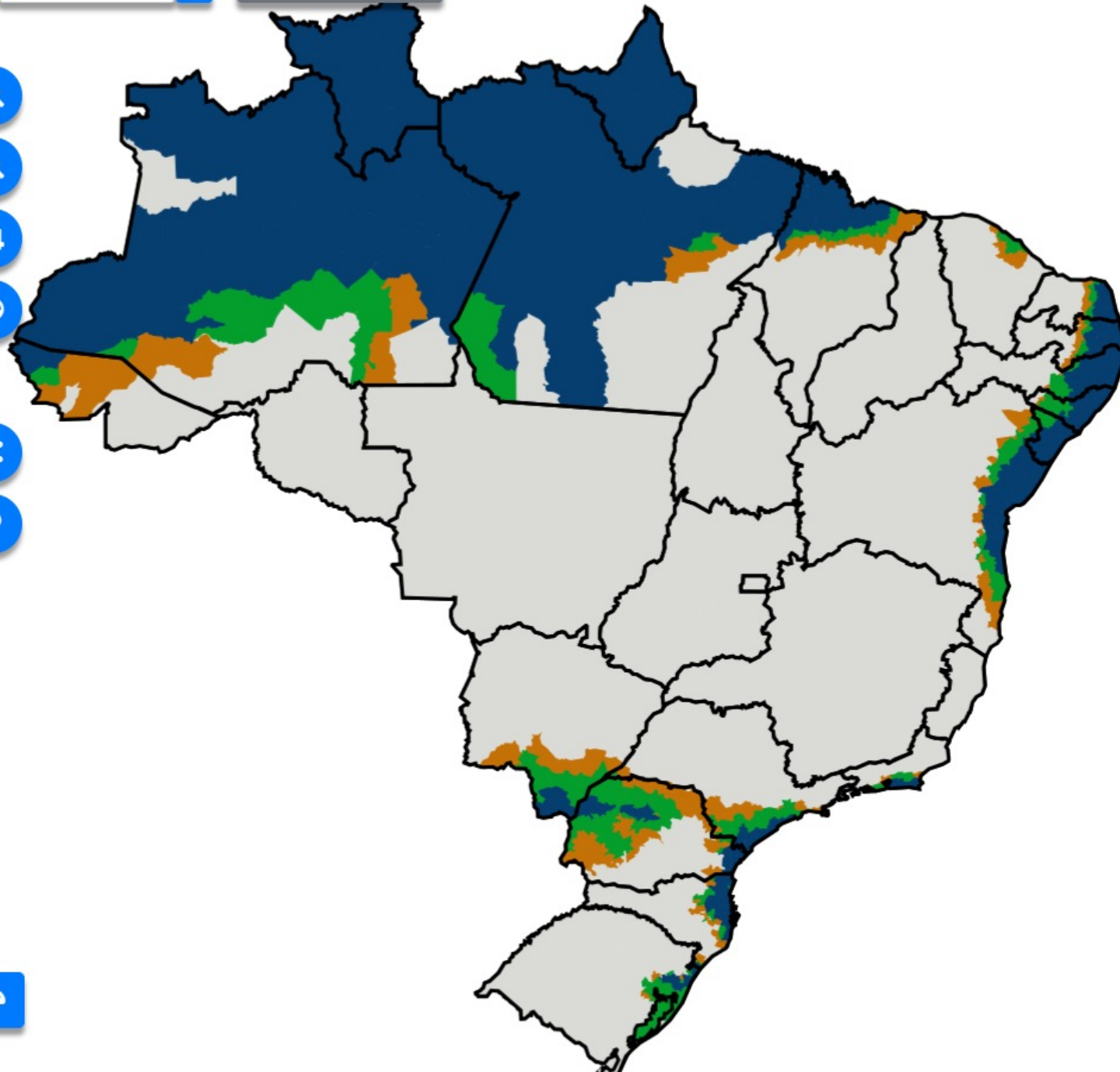
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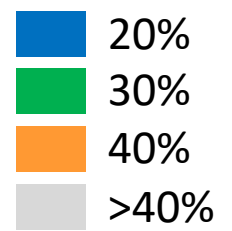
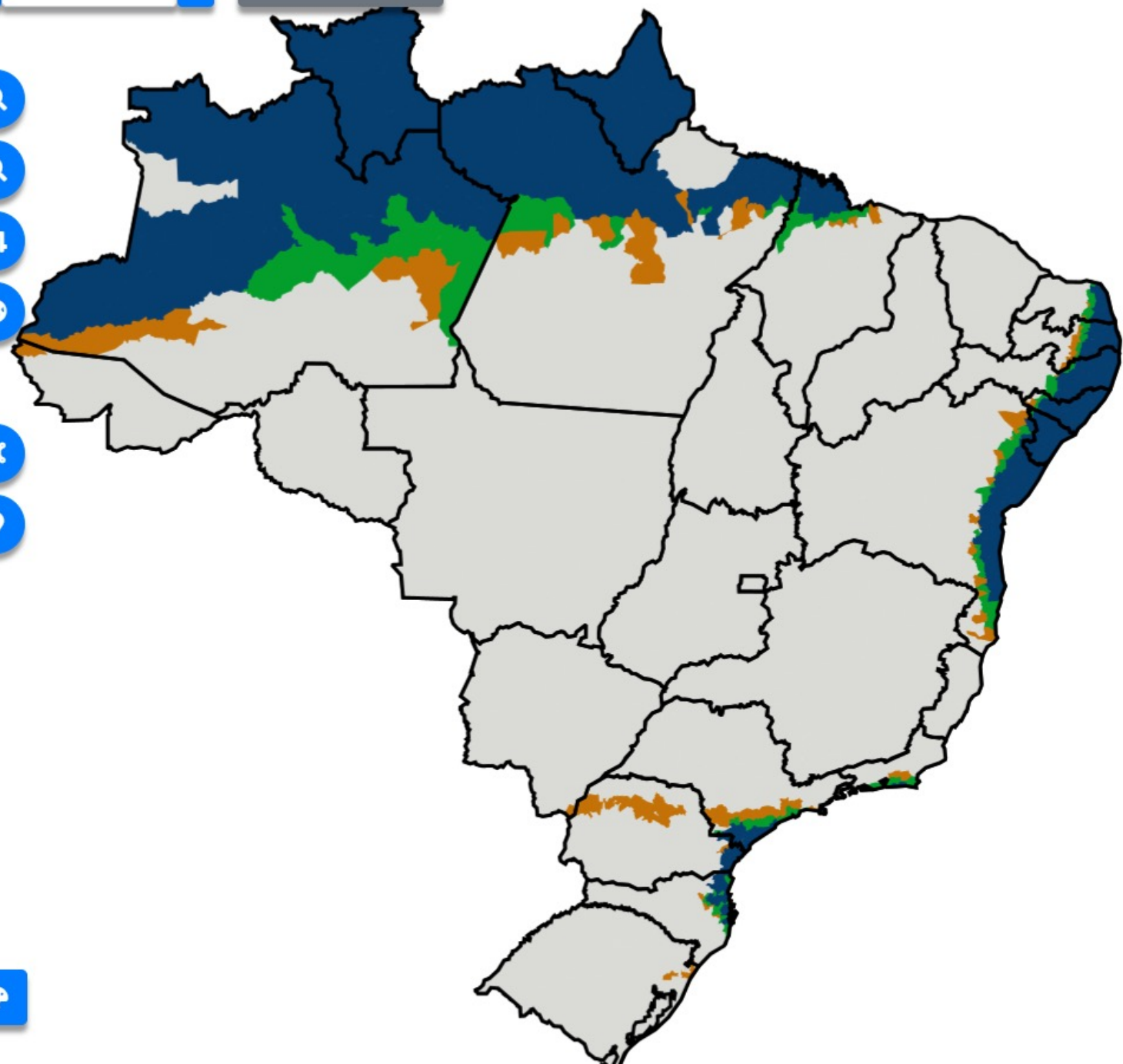
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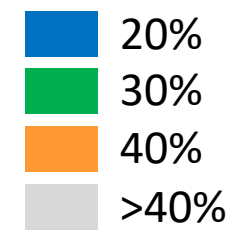
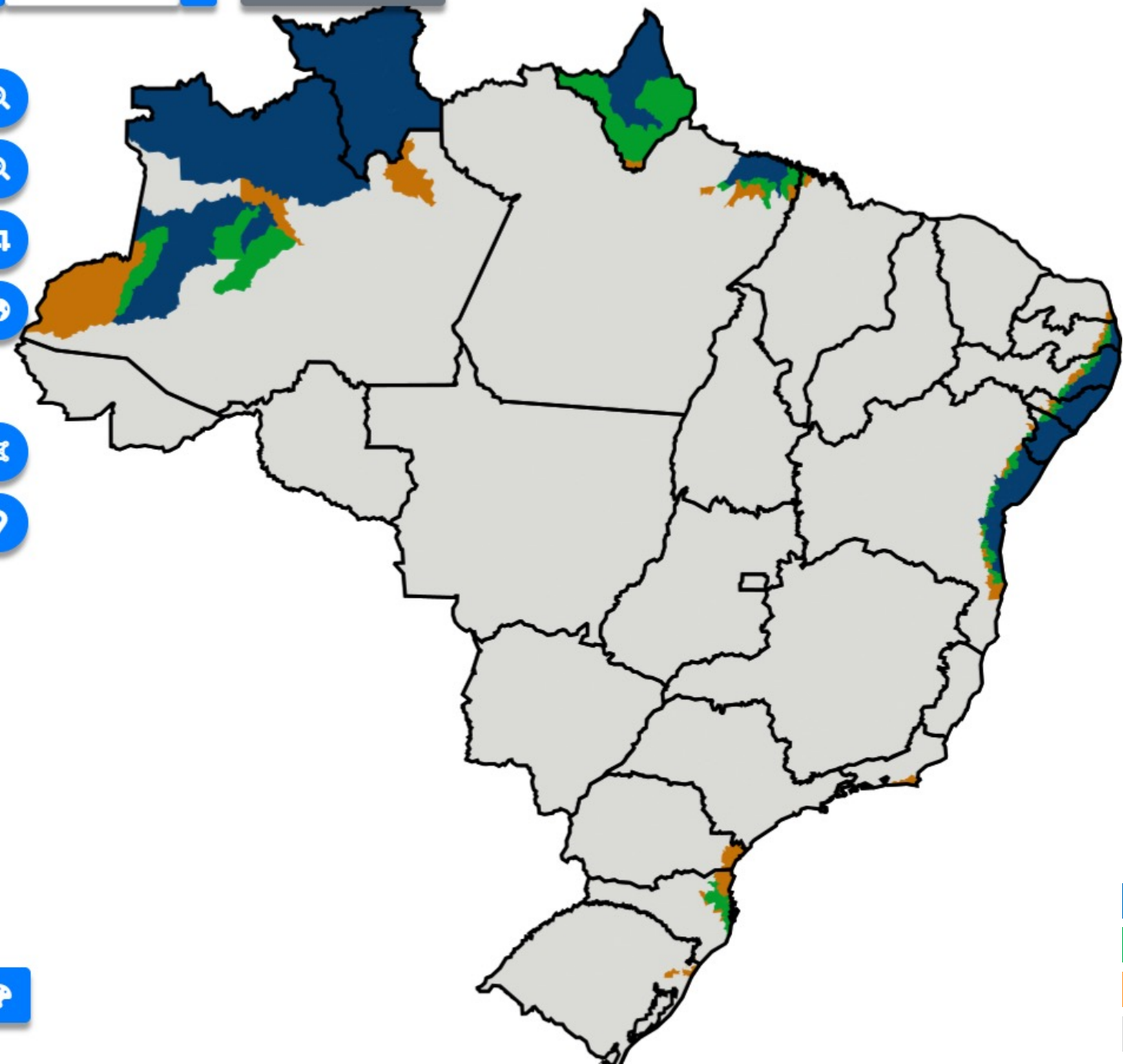
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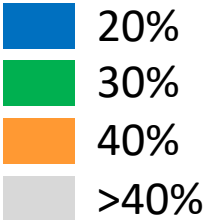
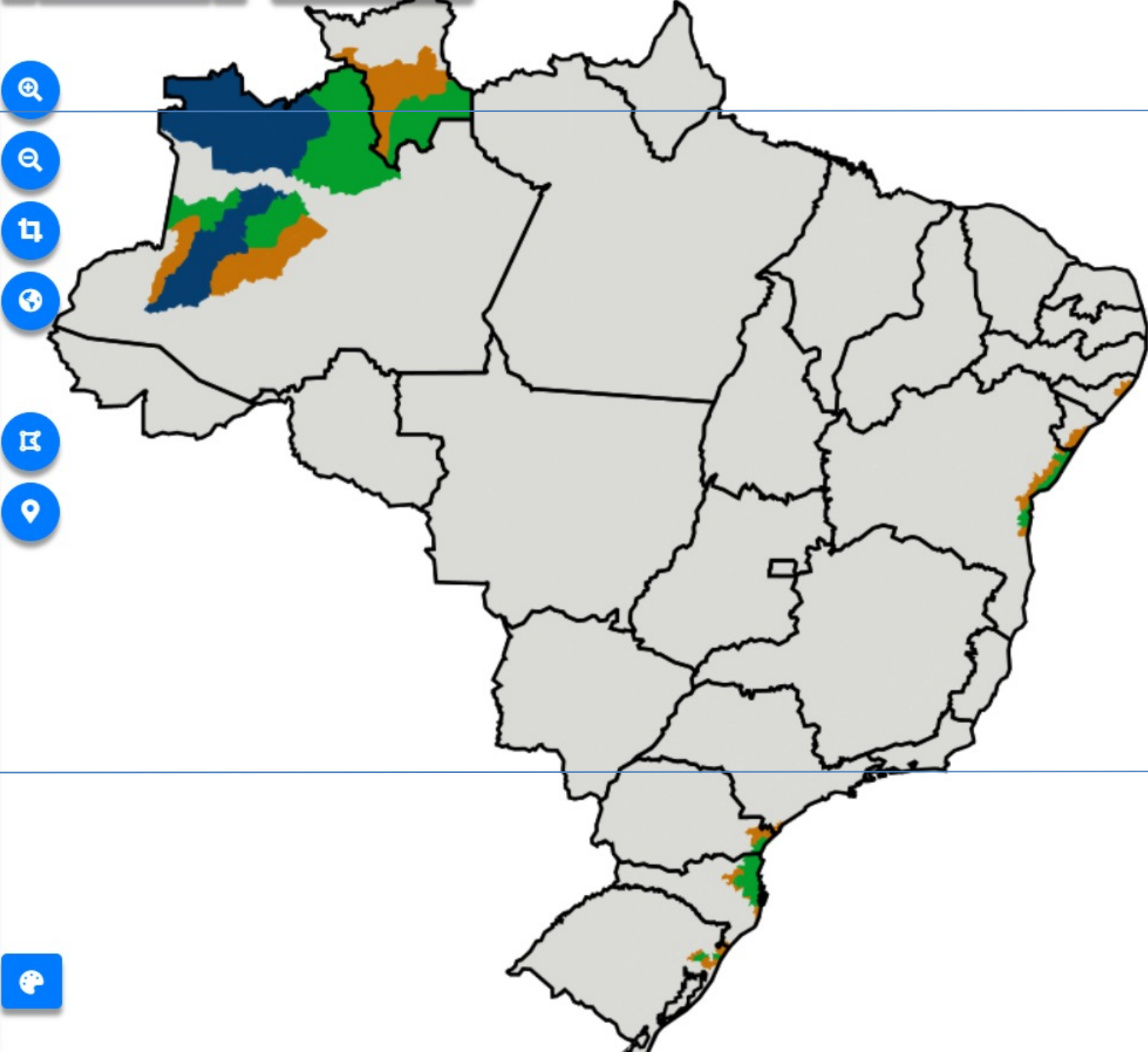


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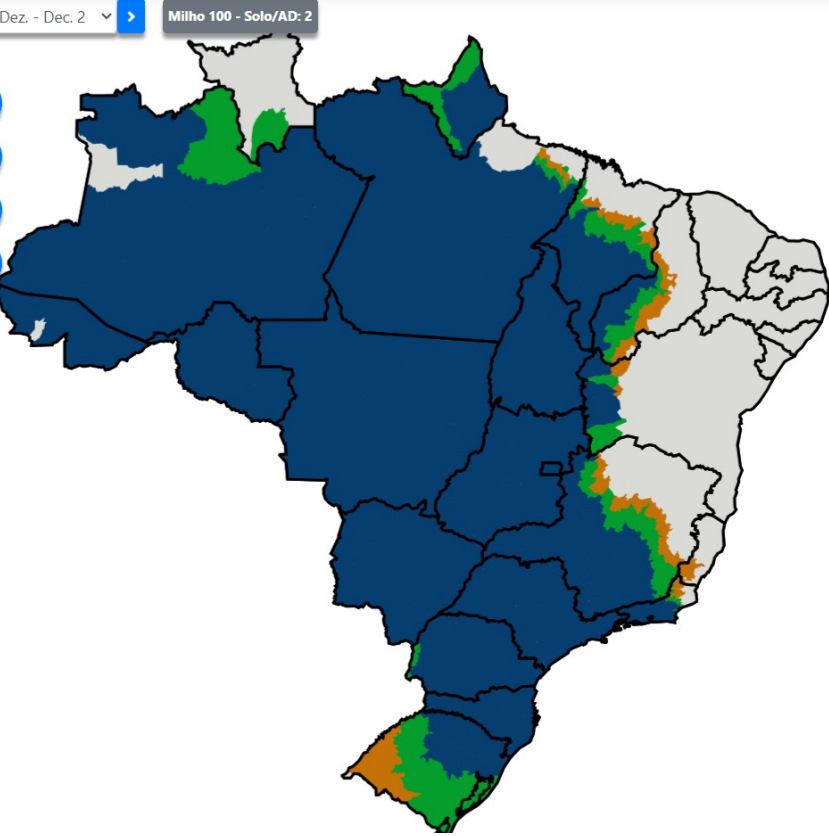
Ecuador



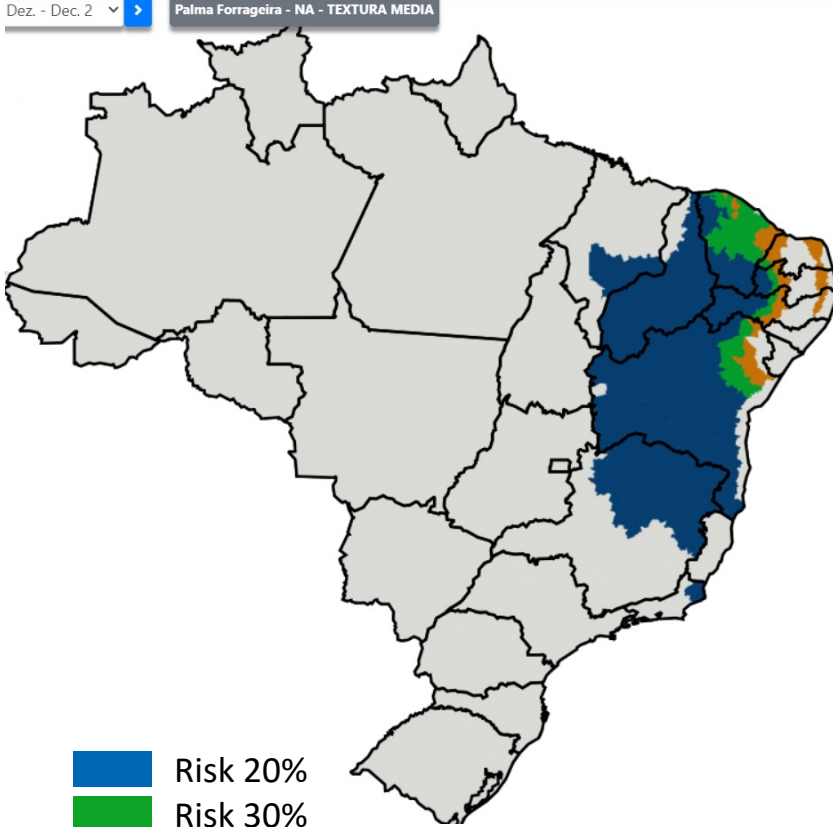
Zarc Results Depends on the crop species



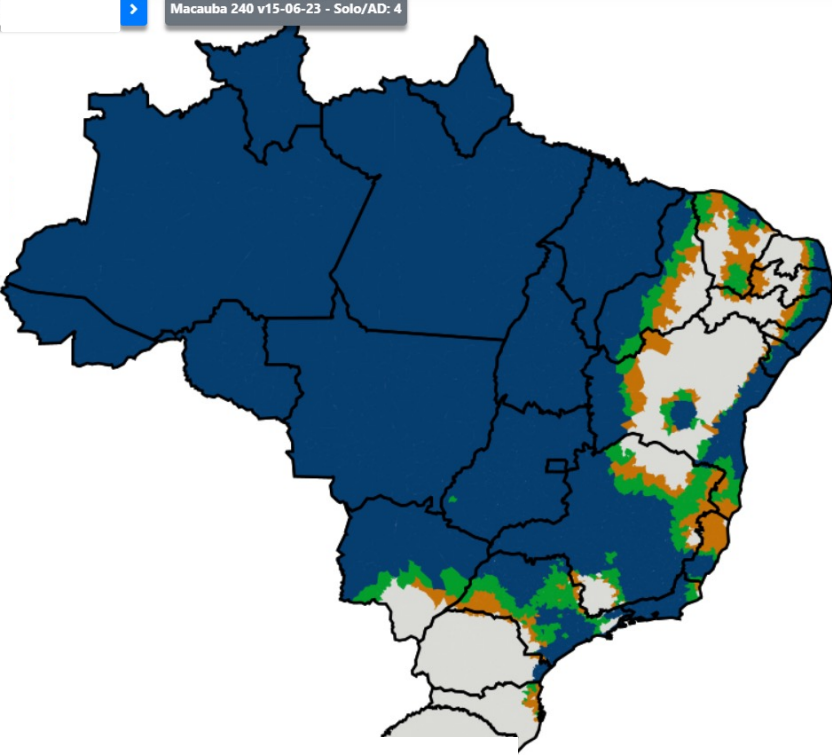
Maize
(*Zea mays*)



Forage Palm
(*Opuntia ficus-indica*)



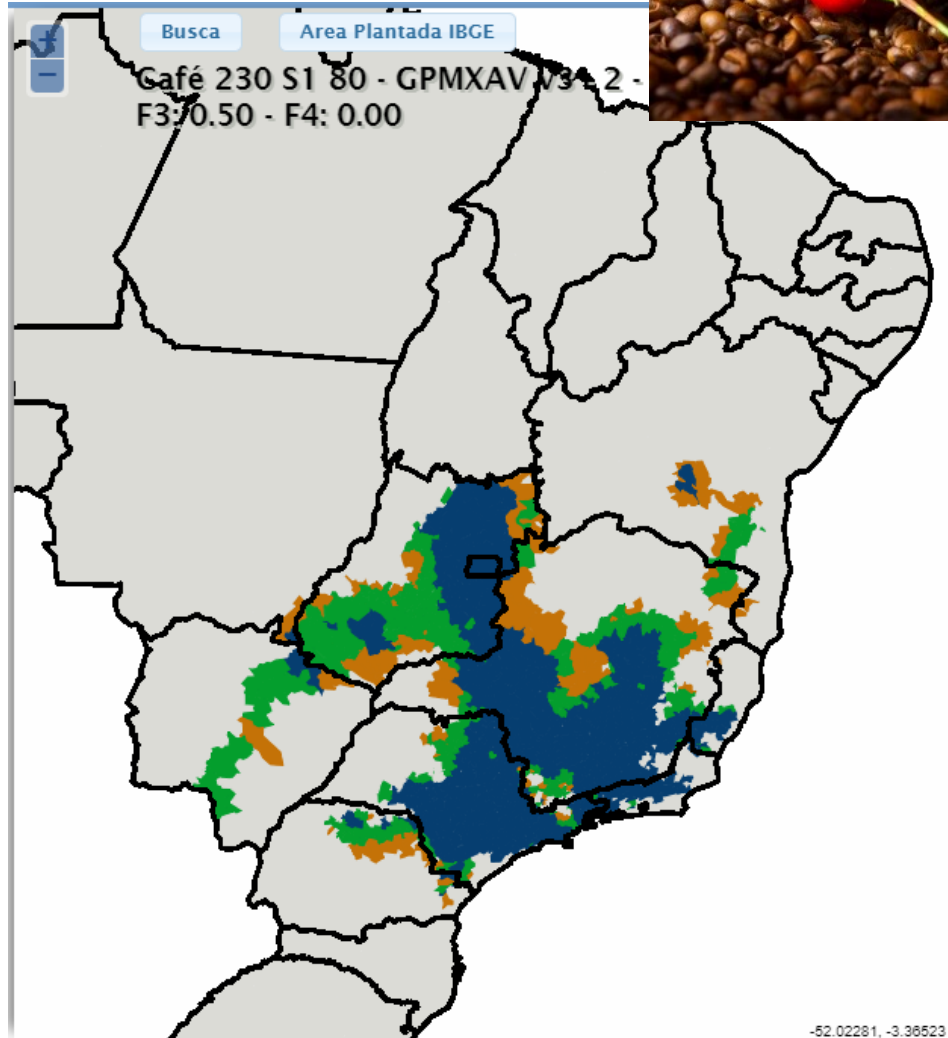
Macaúba
(*Acrocomia aculeata*)



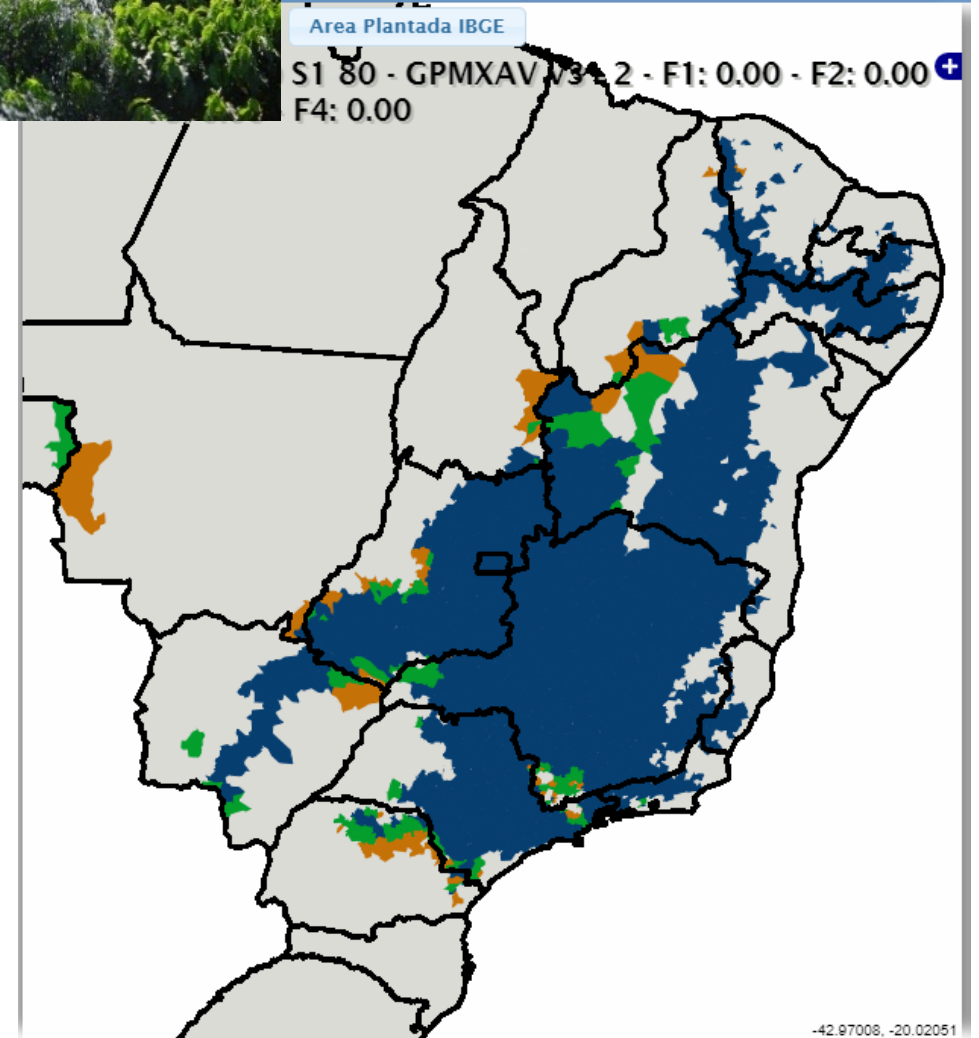
- Risk 20%
- Risk 30%
- Risk 40%
- Risk >40%

Zarc results depends on the crop species and production system

Coffea arabica
(rainfed)



Coffea arabica
(irrigated)



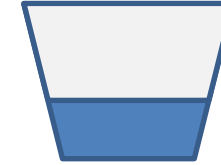
Results are strongly influenced by the soil's ability to store water (Water deficit risks)



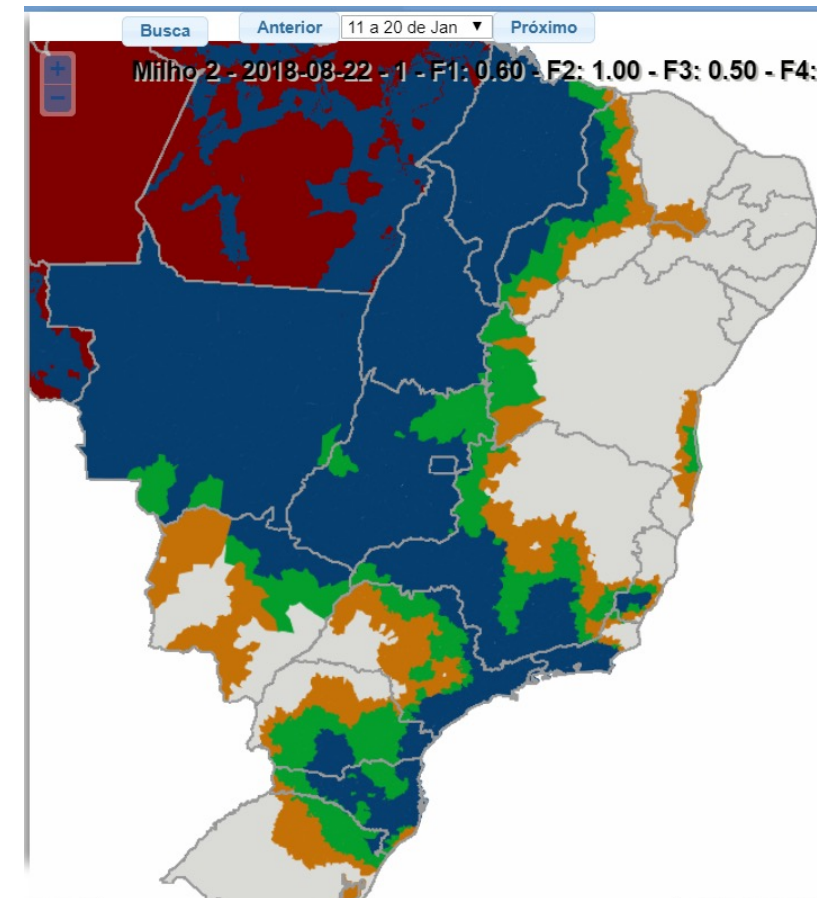
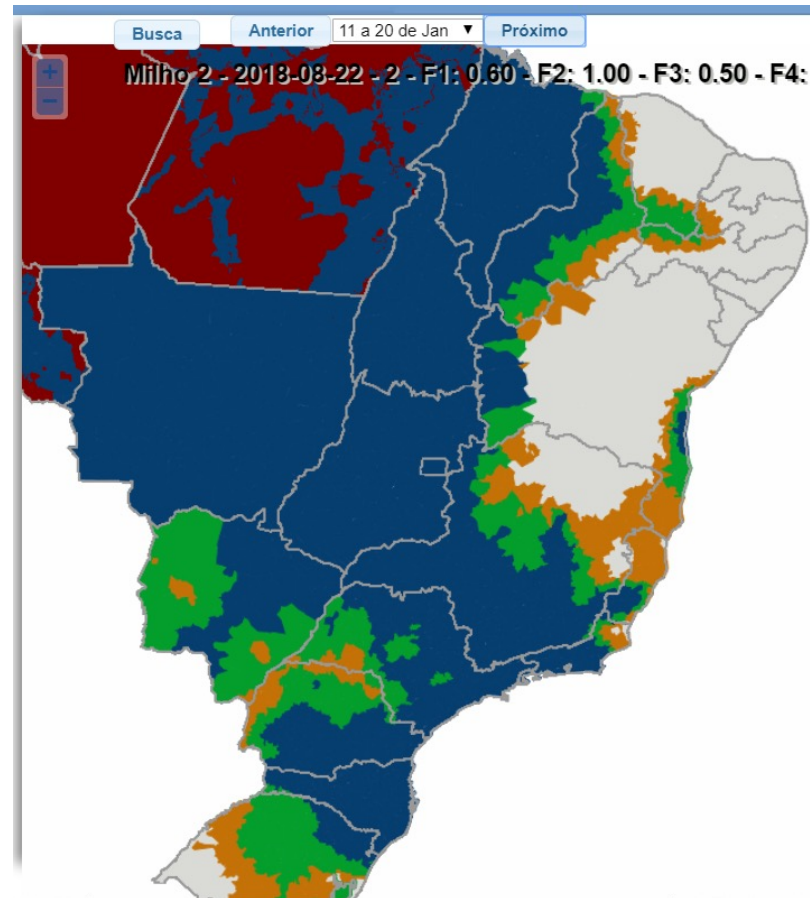
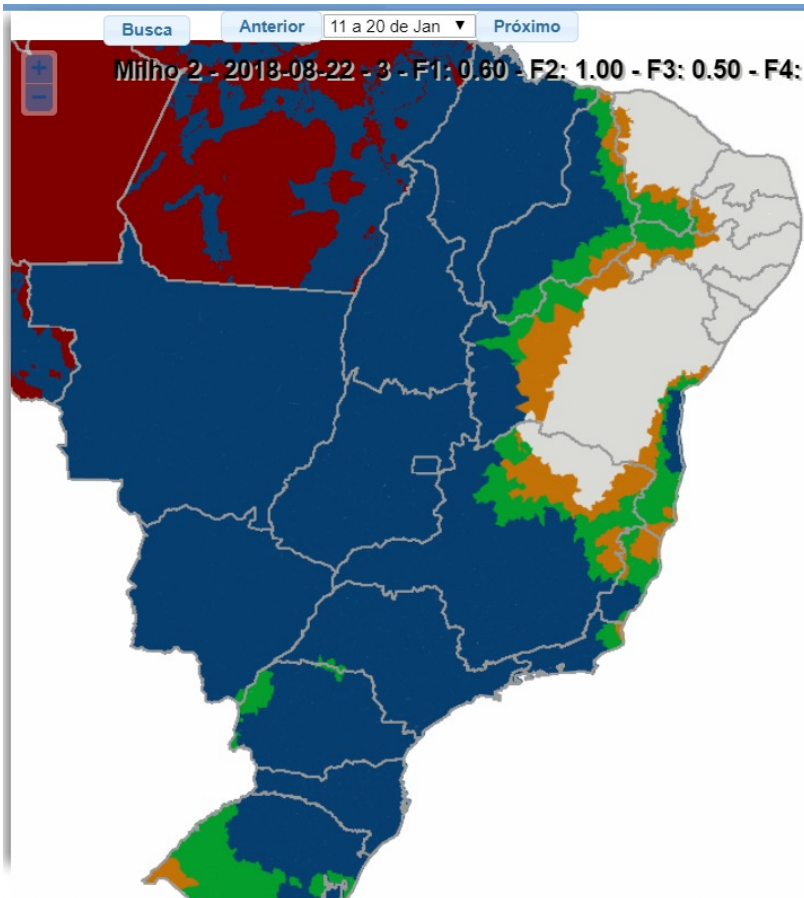
Soil of higher water retention



Soil of medium water retention



Soil of lower water retention



National Program for Agricultural Climate Risk Zoning (Zarc)

- *What is Zarc?*
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In Brazil: Two (2) Agricultural Policy Programs use Zarc guidelines as mandatories:

1) PROAGRO (since 1970's)

Agricultural Activities Guarantee Program

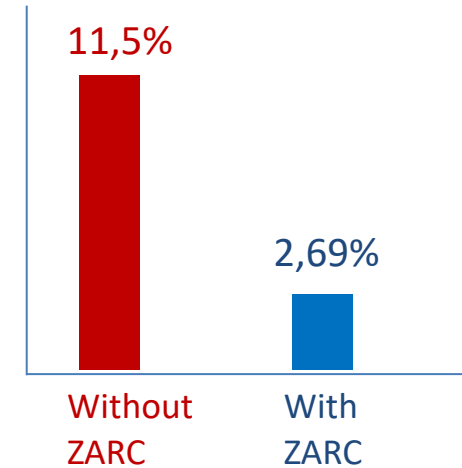
It is a type of credit insurance program operated by the State

2) PSR (since 2006)

Subvention Program to Agricultural Insurance

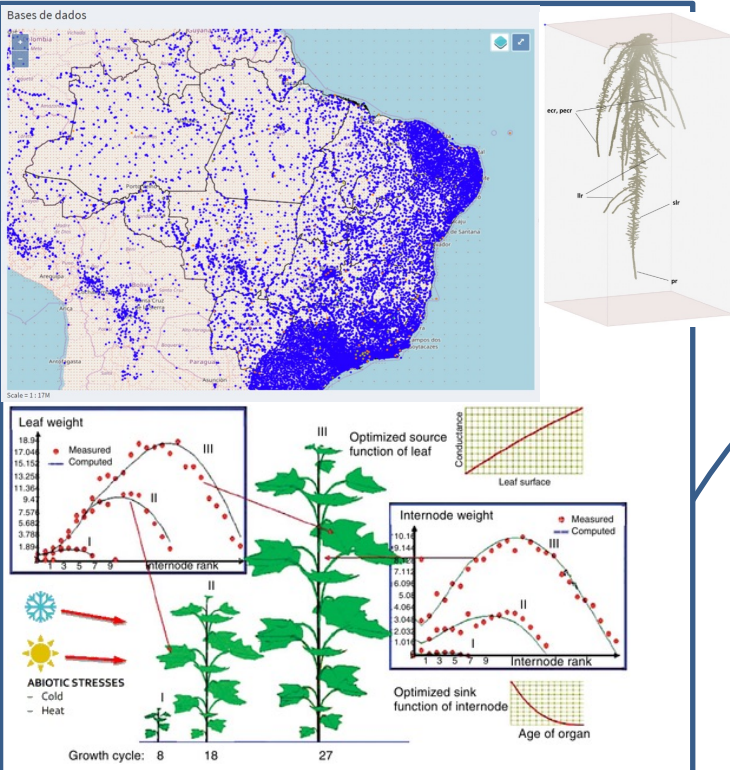
It pays to farmers part of the costs to buy agricultural insurance from private companies. Incentive to develop private insurance sector for agriculture in Brazil.

Loss index 1996-98:



National Program for Agricultural Climate Risk Zoning (Zarc)

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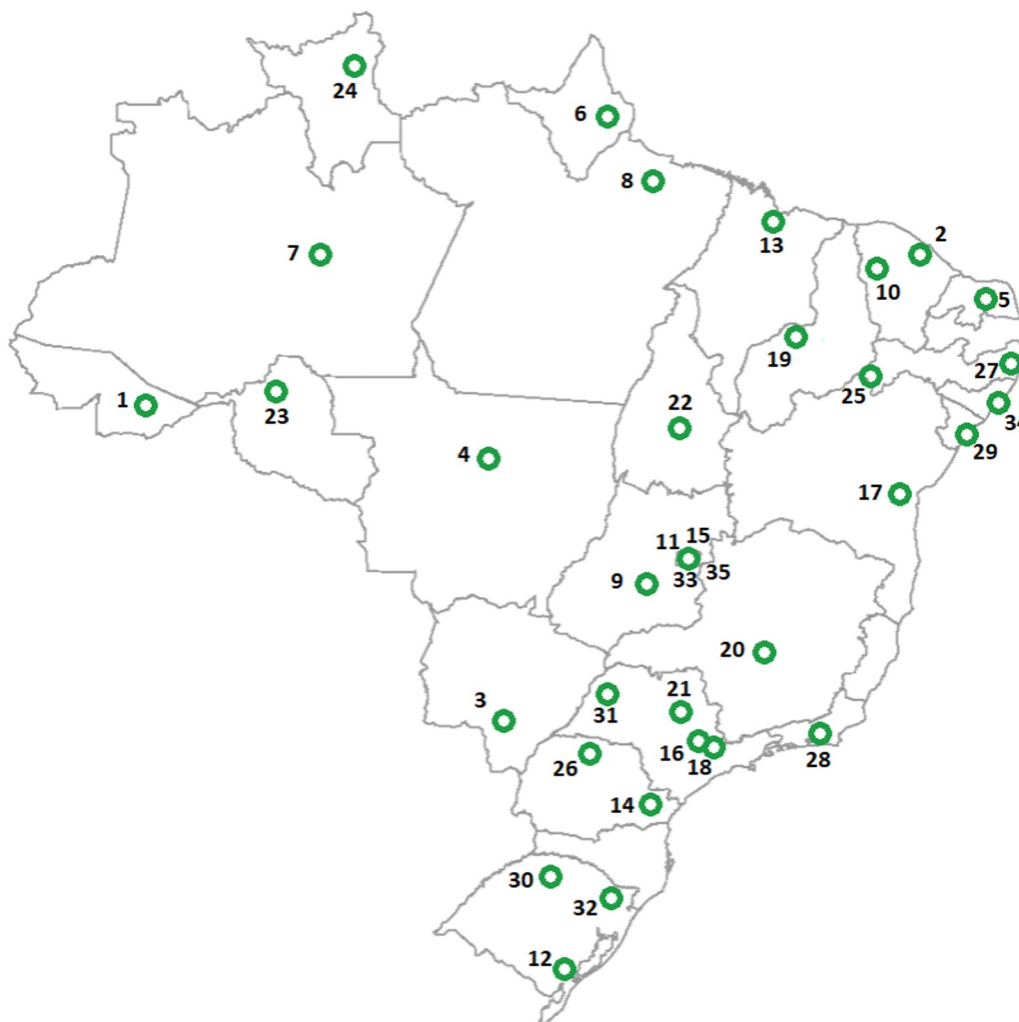
1. Multidisciplinary knowledge and data base



ZARC

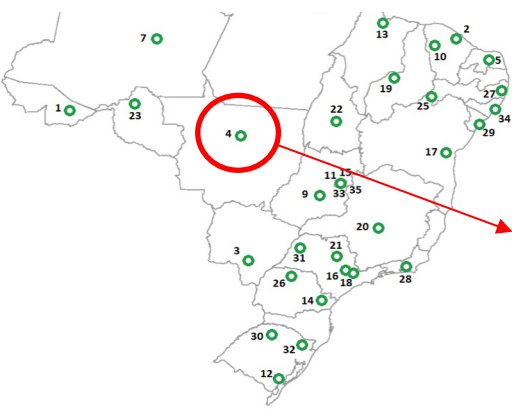
Brazilian genotypes and production systems

Agronomic knowledge comes from:

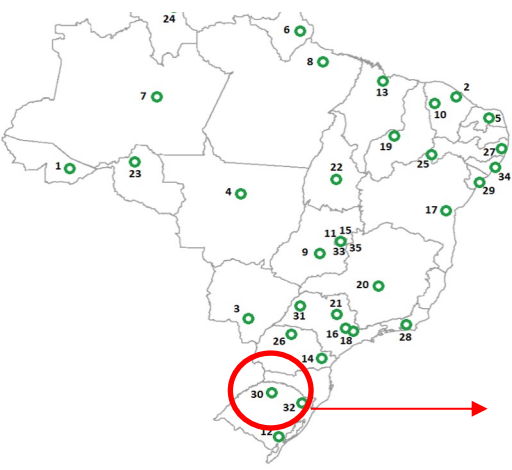


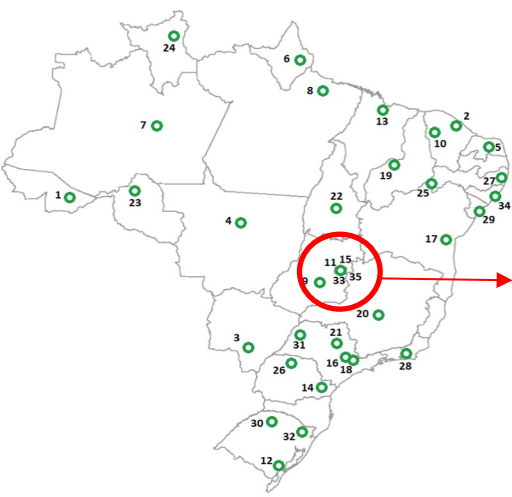
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Embrapa Agroindústria Tropical 2	Fortaleza, CE	Embrapa Meio Norte 19	Teresina, PI
Embrapa Agropecuária Oeste 3	Dourados, MS	Embrapa Milho e Sorgo 20	Sete Lagoas, MG
Embrapa Agrossilvipastoril 4	Sinop, MT	Embrapa Pecuária Sudeste 21	São Carlos, SP
Embrapa Algodão 5	Campina Grande, PB	Embrapa Pesca e Aquicultura 22	Palmas, TO
Embrapa Amapá 6	Macapá, AP	Embrapa Rondônia 23	Porto Velho, RO
Embrapa Amazônia Ocidental 7	Manaus, AM	Embrapa Roraima 24	Boa Vista, RR
Embrapa Amazônia Oriental 8	Belém, PA	Embrapa Semiárido 25	Petrolina, PE
Embrapa Arroz e Feijão 9	Sto. Antônio de GO, GO	Embrapa Soja 26	Londrina, PR
Embrapa Caprinos e Ovinos 10	Sobral, CE	UEP Embrapa Solos 27	Recife, PE
Embrapa Cerrados 11	Brasília, DF	Embrapa Solos 28	Rio de Janeiro, RJ
Embrapa Clima Temperado 12	Pelotas, RS	Embrapa Tabuleiros Costeiros 29	Aracaju, SE
Embrapa Cacaos 13	São Luís, MA	Embrapa Trigo 30	Passo Fundo, RS
Embrapa Florestas 14	Colombo, PR	UEP Embrapa Uva e Vinho 31	Jales, SP
Embrapa Hortaliças 15	Brasília, DF	UEP Embrapa Uva e Vinho 32	Vacaria, RS
Embrapa Agricultura Digital 16	Campinas, SP	Embrapa Agroenergia 33	Brasília, DF
Embrapa Mandioca e Fruticultura 17	Cruz das Almas, BA	UEP Embrapa Tabuleiros Costeiros 34	Maceió, AL
		Embrapa Café 35	Brasília, DF

Embrapa Agrosilvopastoral



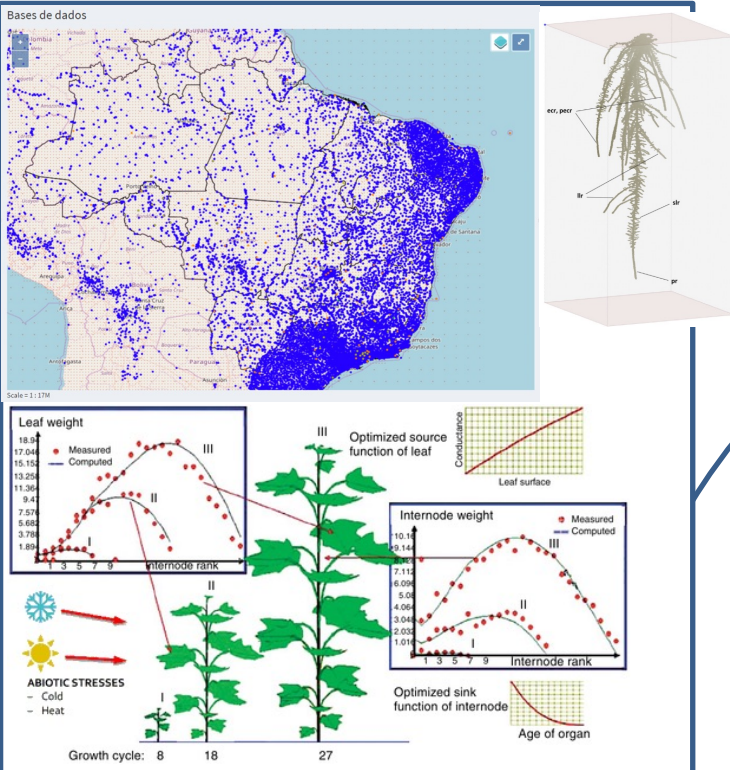
Embrapa wheat



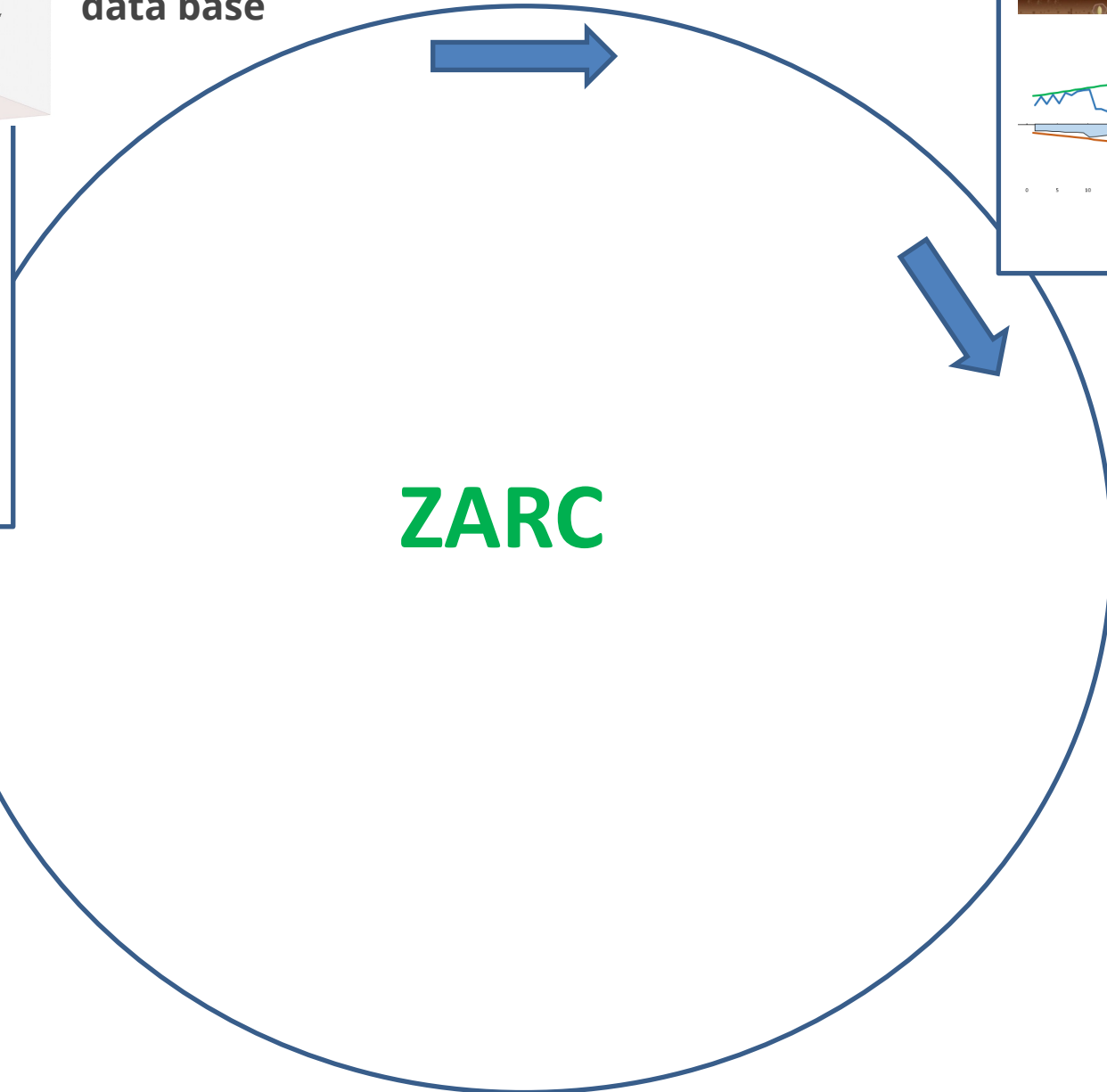


Embrapa Cerrados

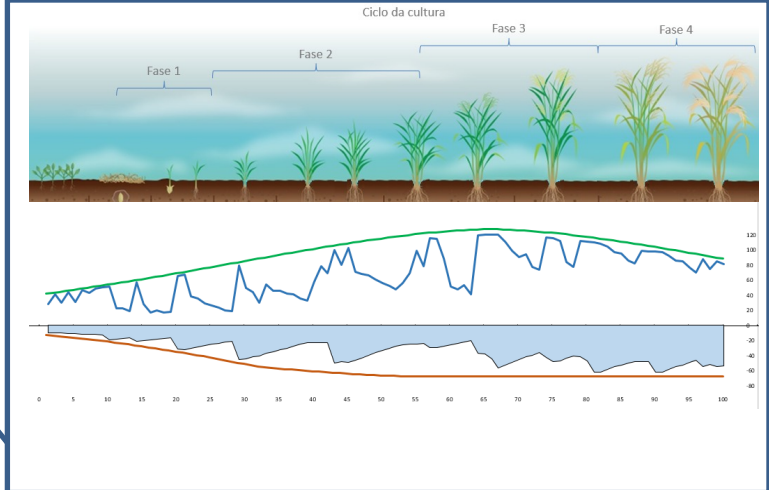


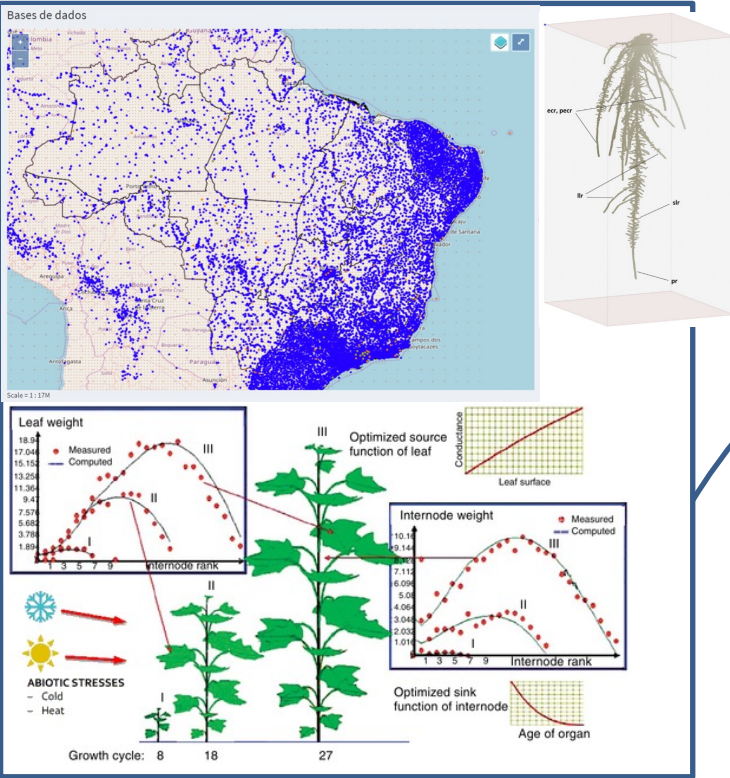


Brazilian genotypes and production systems



2. Crop Modeling

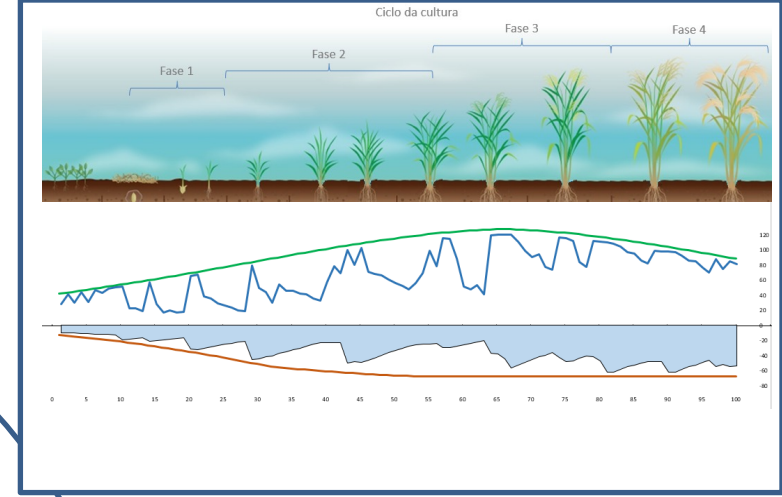




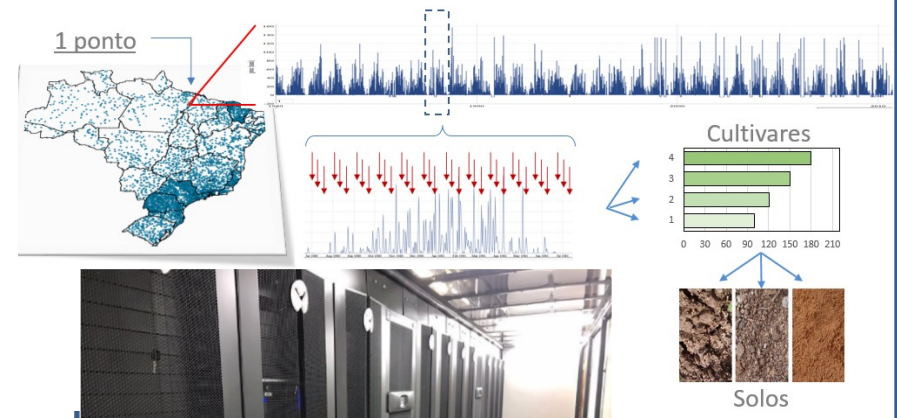
Brazilian genotypes and production systems

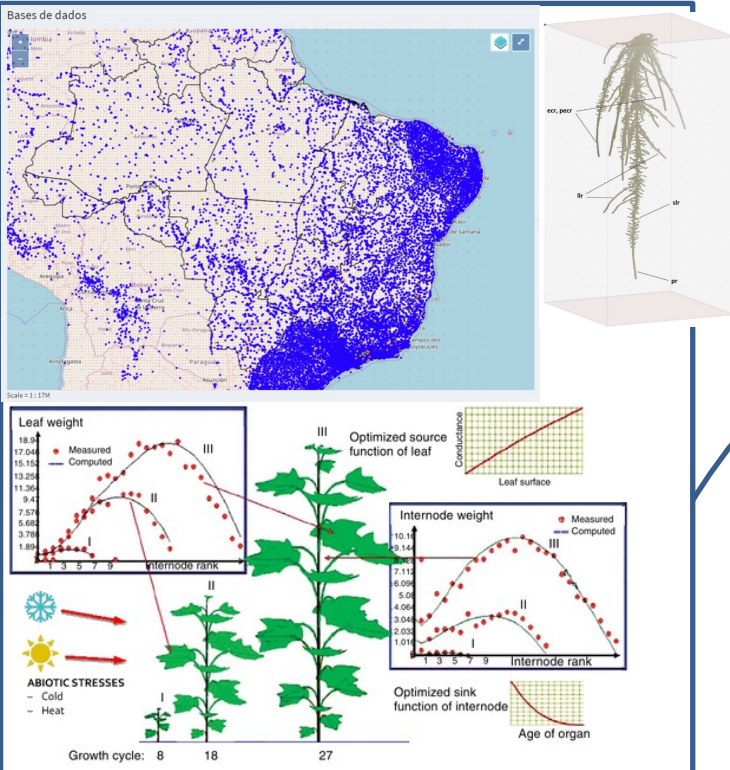
ZARC

2. Crop Modeling



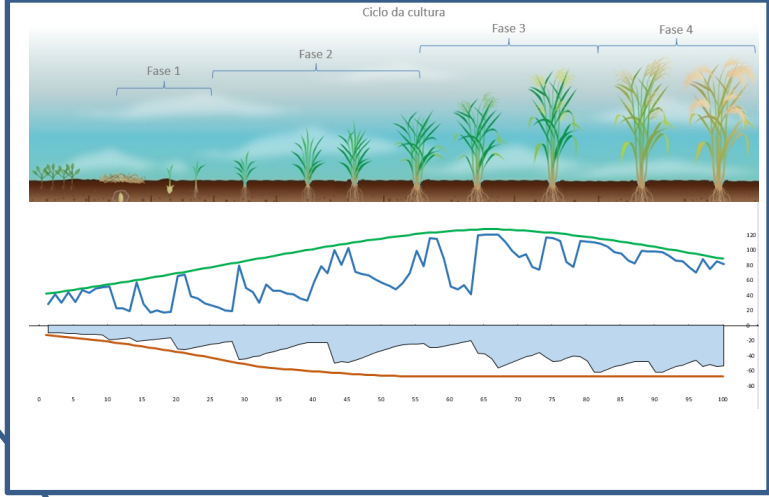
3. Data processing



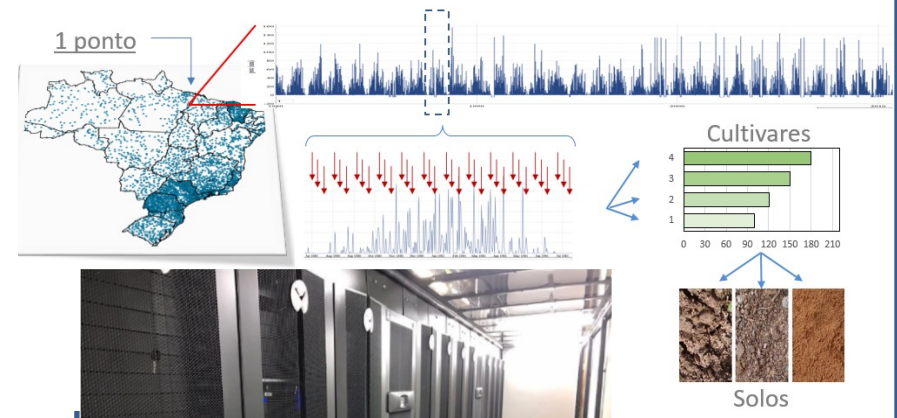


1. Multidisciplinary knowledge and data base

2. Crop Modeling

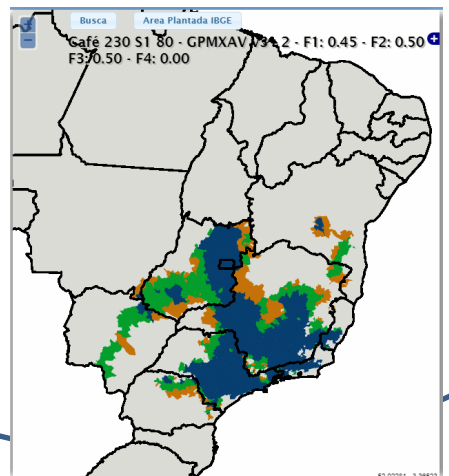


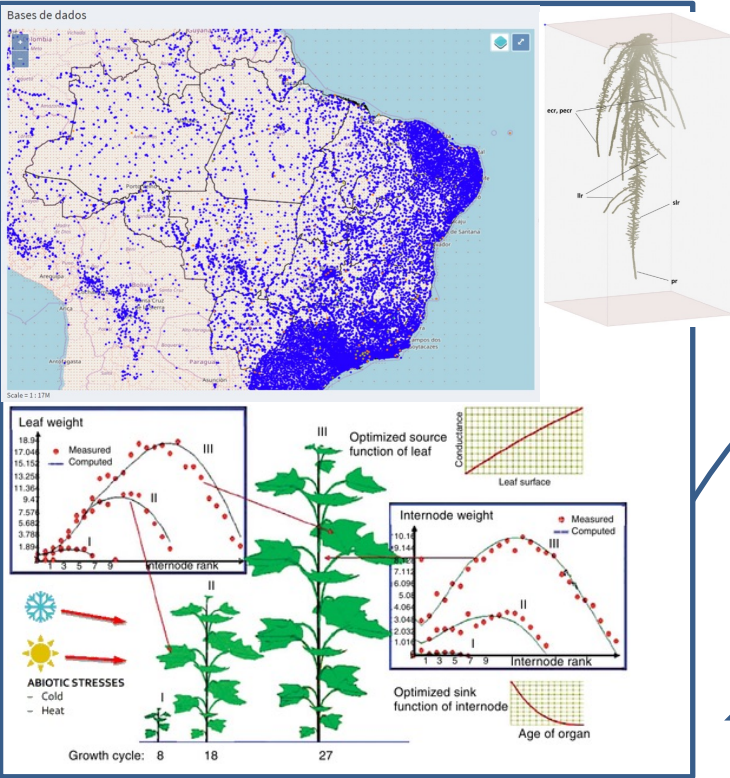
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ZARC

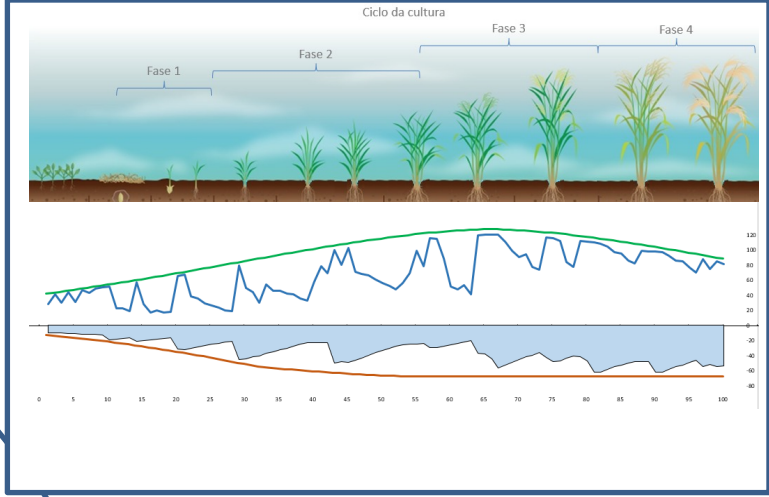
Brazilian genotypes and production systems



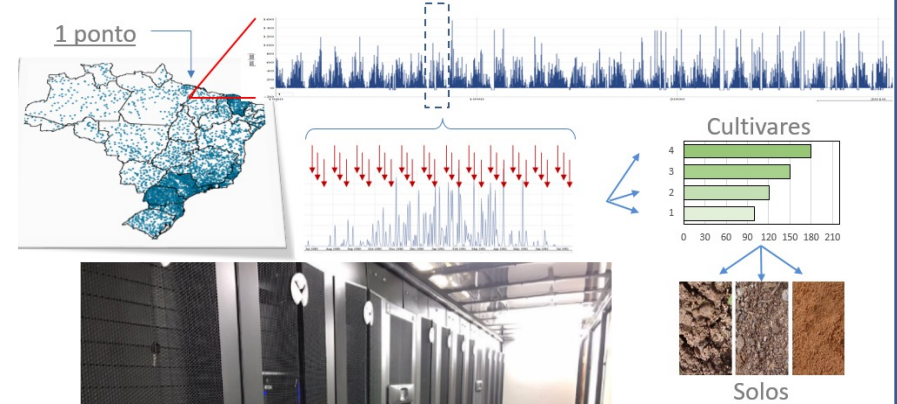


1. Multidisciplinary knowledge and data base

2. Crop Modeling



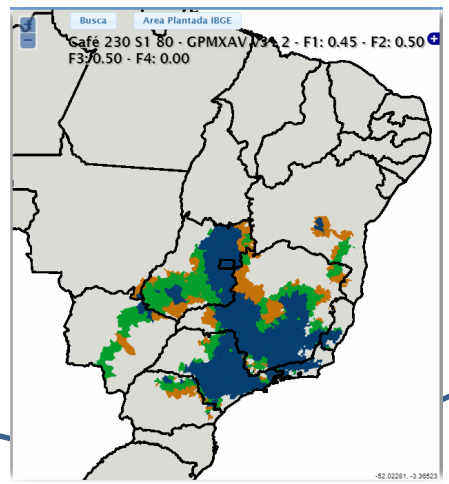
3. Data processing



4. Validation meetings



ZARC



National Program for Agricultural Climate Risk Zoning (Zarc)

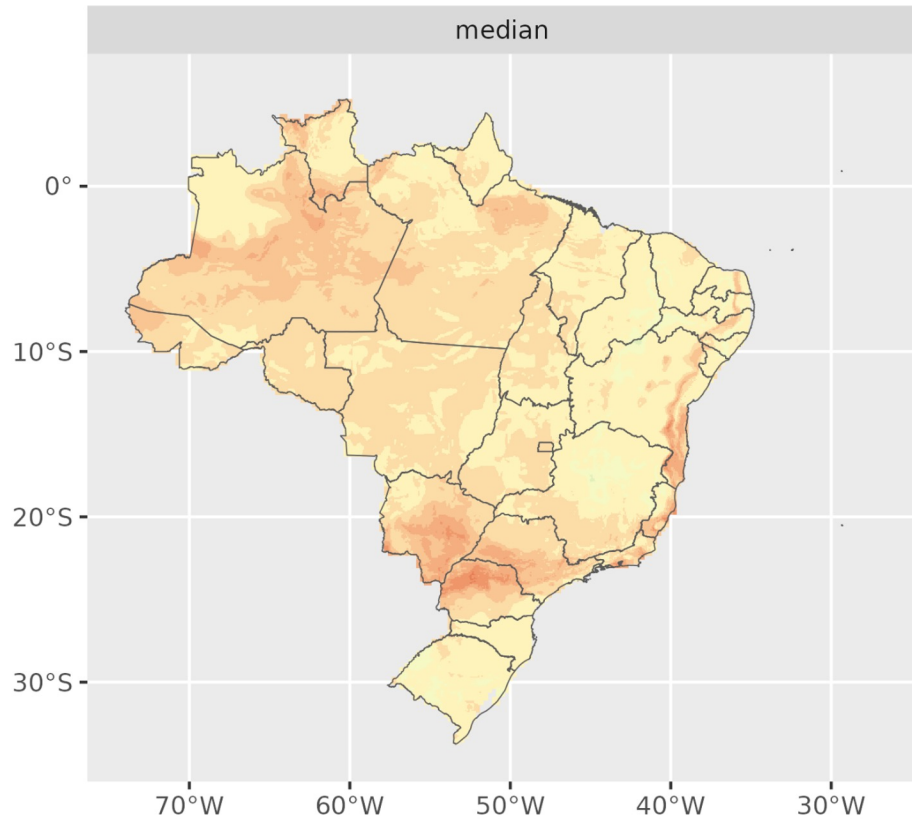
- *What is Zarc?*
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- *2020 to 2023 examples*
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ZARC-scenarios-CMIP6

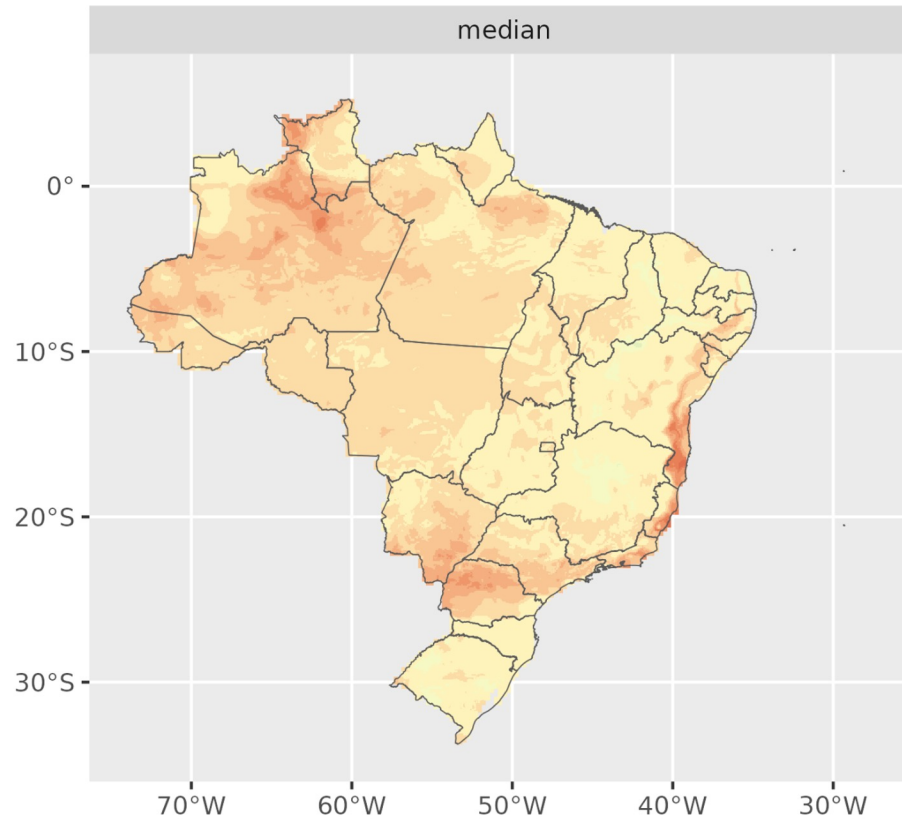
SOY

Anomaly (Fut-past) ensemble - ssp585

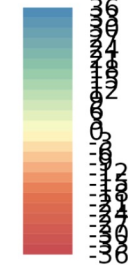
soja_(ISNA F1/F3)_ensemble_ssp585_gwl15_fr



soja_(ISNA F1/F3)_ensemble_ssp585_gwl20_freq_60



Anomalias_decendios_aptos



New methodology for Zarc considering agronomic management levels

Level 1



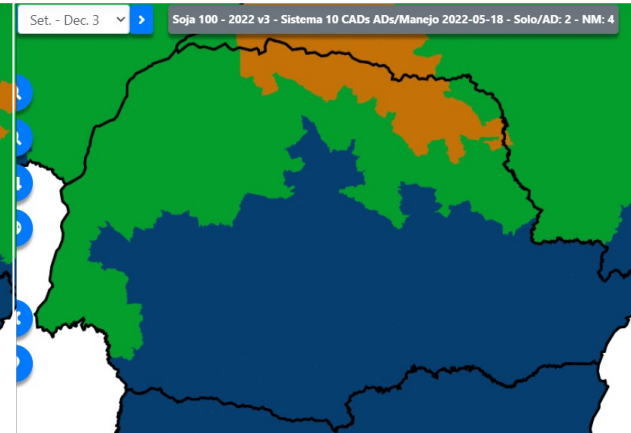
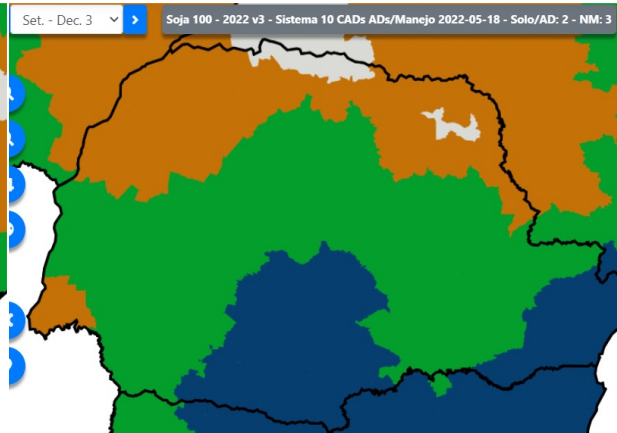
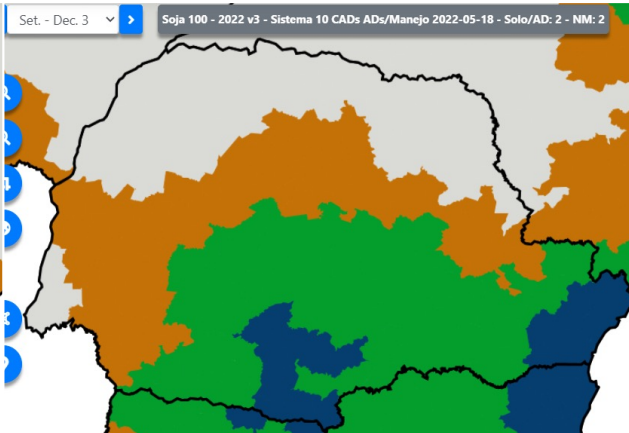
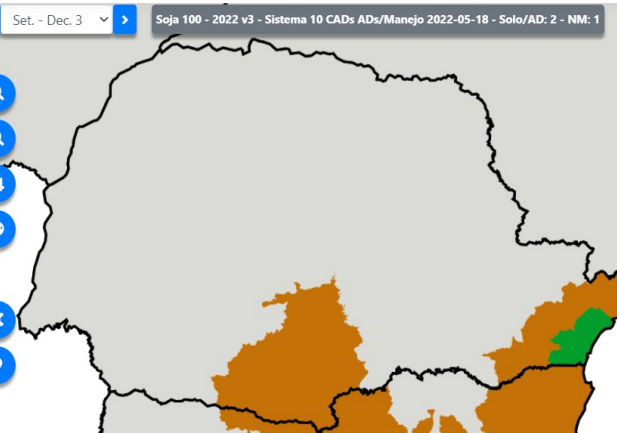
Level 2



Level 3



Level 4



Aims: measure higher or lower risk level in farms in same soil and climatic conditions but with different agronomical practices; Encourage soil preservation and water resources, increase root depth, soil carbon and fertility... **reduce drought risk.**

Thank you!

Falberni De Souza Costa
Idesio Luis Franke
Jacson Rondinelli Da S Negreiros
Carlos Ricardo Fietz
Danilton Luiz Flumignan
Éder Comunello
Harley Nonato De Oliveira
Cornelio Alberto Zolin
Laurimar Gonçalves Vendrusculo
Jorge Lulu
Roberta Aparecida C Monteiro
Jose Renato Cortez Bezerra
Jose Rodrigues Pereira
Tais De Moraes Falleiro Suassuna
José Francisco Pereira
Luis Wagner Rodrigues Alves
Wardsson Lustrino Borges
Alailson Vescelau Santiago
Adriano Venturieri
Roni De Azevedo
Sandra Maria Neiva Sampaio
Alcido Elenor Wander
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