I Congresso de

Ciências do Mar na Margem Equatorial Brasileira

São Luiz -27-30/11/2024

Processos biogeofísicos de média e grande escalas modulares da produção biológica e pesqueira do Meta-ecossistema fluviomarinho da Amazônia brasileira

DR. EDUARDO TAVARES PAES

LEMOPA

LABORATÓRIO DE ECOLOGIA MARINHA E OCEANOGRAFIA PESQUEIRA DA AMAZÔNIA

ISARH - UFRA

LABORATÓRIO DE ECOLOGIA MARINHA E OCEANOGRAFIA PESQUEIRA DA AMAZÔNIA
Lemopa

REPENSAPESCA

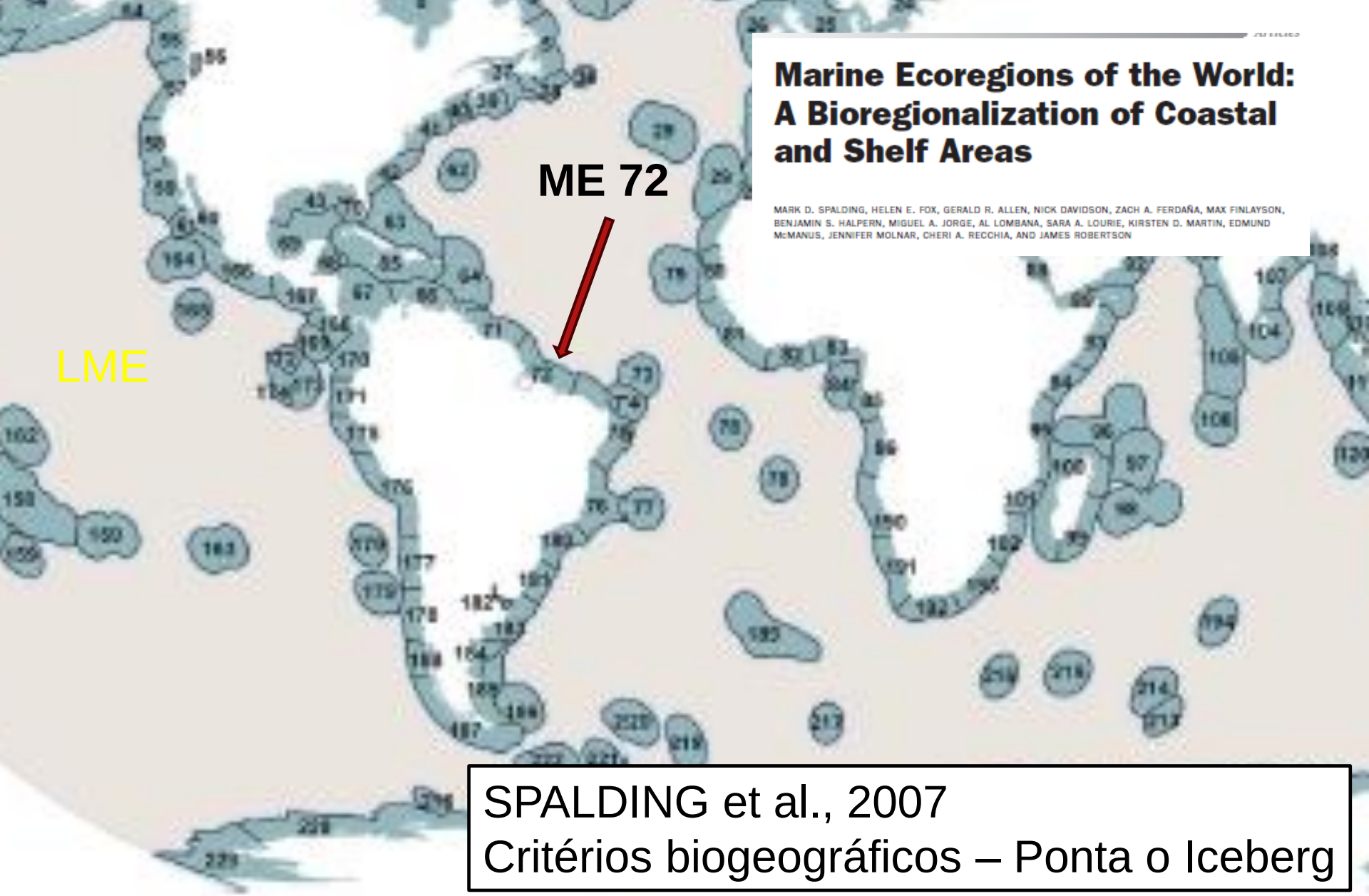
- Mais de 30 Instituições colaboram, incluindo Unversidades do norte e Nordeste, Sul e Sudeste.
- Cerca de 50 pesquisadores, bolsistas e alunos
- Centros de Pesquisa do ICMBio (Cepene e CepNor)
- Bianca e Eduardo no Para; Carol Feitosa no CE; Marcelo Nobrega no RN; Bea, Mauro Maida, Thierry e Sergio Rezende em PE; George na Bahia; Gil Banco de dados (BA); Bruno, Rodrigo e Ze Augusto avaliação de estoques.

UFRPE · Universidade Federal do Ceara · Ufra · UNIFESP · UNIVALI · ICMBio MMA

INCT BIODIVERSIDADE DA AMAZÔNIA AZUL

inct AmbTropic II

Uma introdução e algumas observações

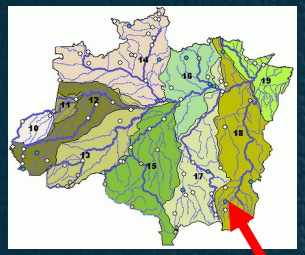


SPALDING et al., 2007
Critérios biogeográficos – Ponta o Iceberg

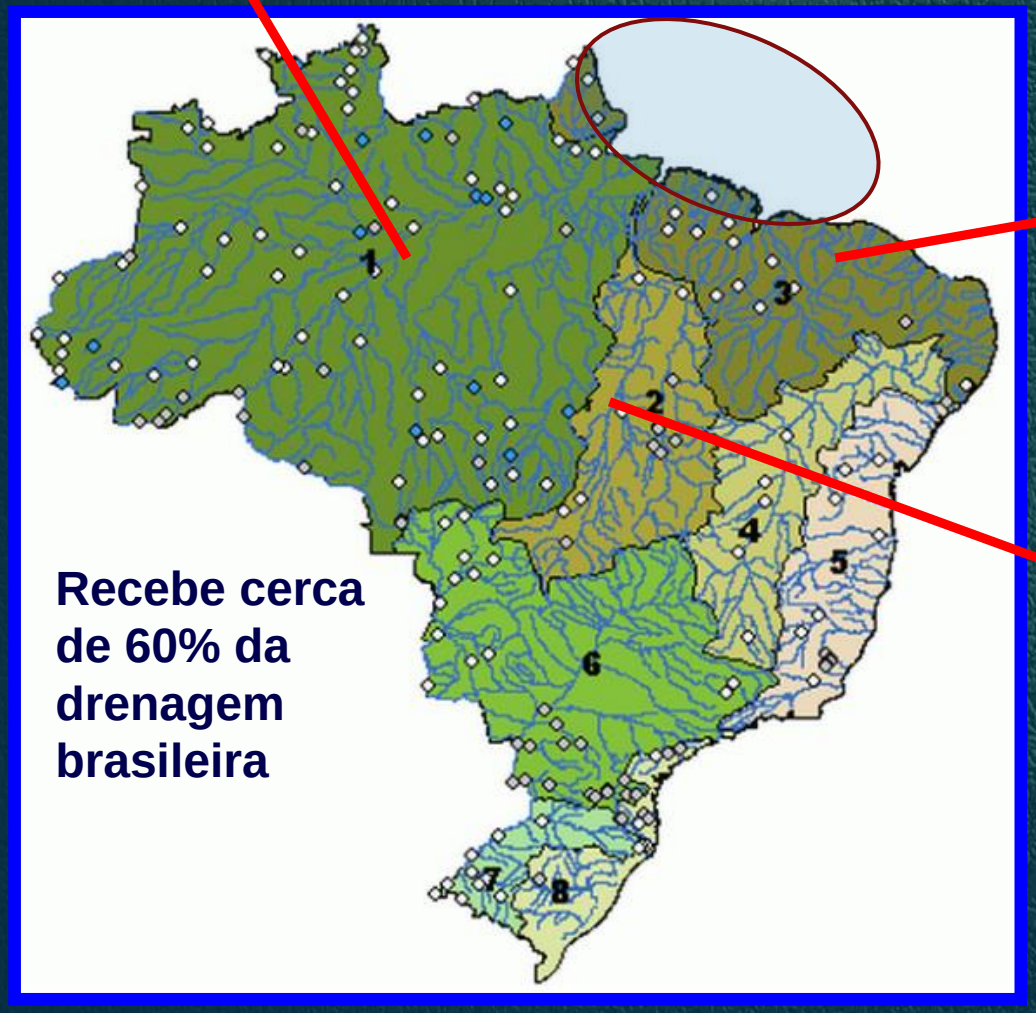
- A zona costeira da Amazônia brasileira que representa 35% da costa do país, possui grande potencial para as atividades de pesca devido à grande quantidade de rios e estuários que deságuam no Atlântico.

Recebe o caudal de três grandes bacias hidrográficas

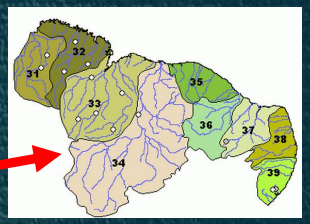
PLATAFORMA CONTINENTAL AMAZONICA BRASILEIRA



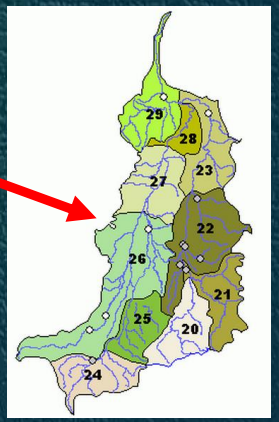
Bacia Amazônica



Recebe cerca de 60% da drenagem brasileira



Bacia Atlântico-Nordeste



Bacia Araguaia-Tocantins

Sistemas e Ecossistemas da Costa Amazônica

1-Manguezais

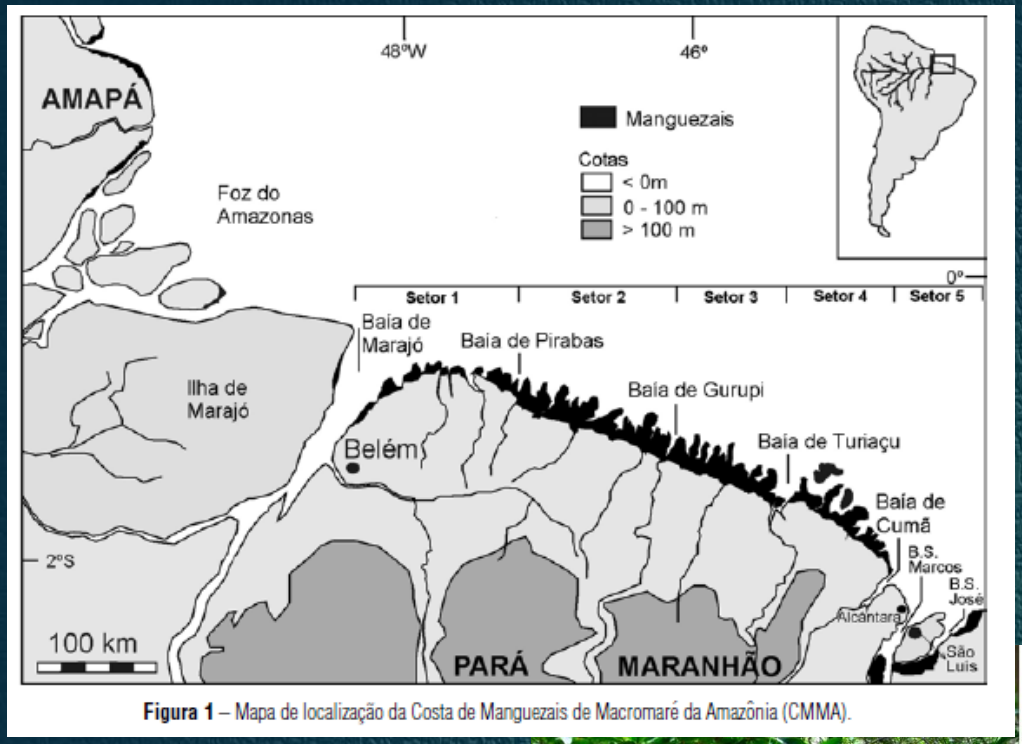


Figura 1 – Mapa de localização da Costa de Manguezais de Macromaré da Amazônia (CMMA).

Revista Brasileira de Geofísica
RBGf
Brazilian Journal of Geophysics
Revista Brasileira de Geofísica (2005) 23(4): 427-435
© 2005 Sociedade Brasileira de Geofísica
ISSN 0102-261X
www.scielo.br/rbg

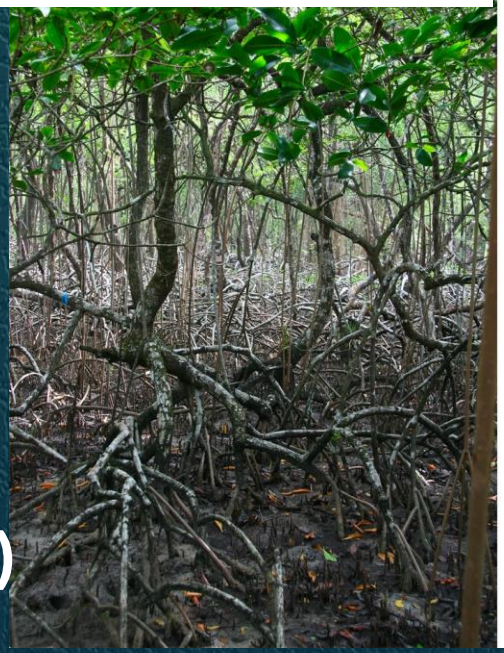
Mangues 9 mil Km2

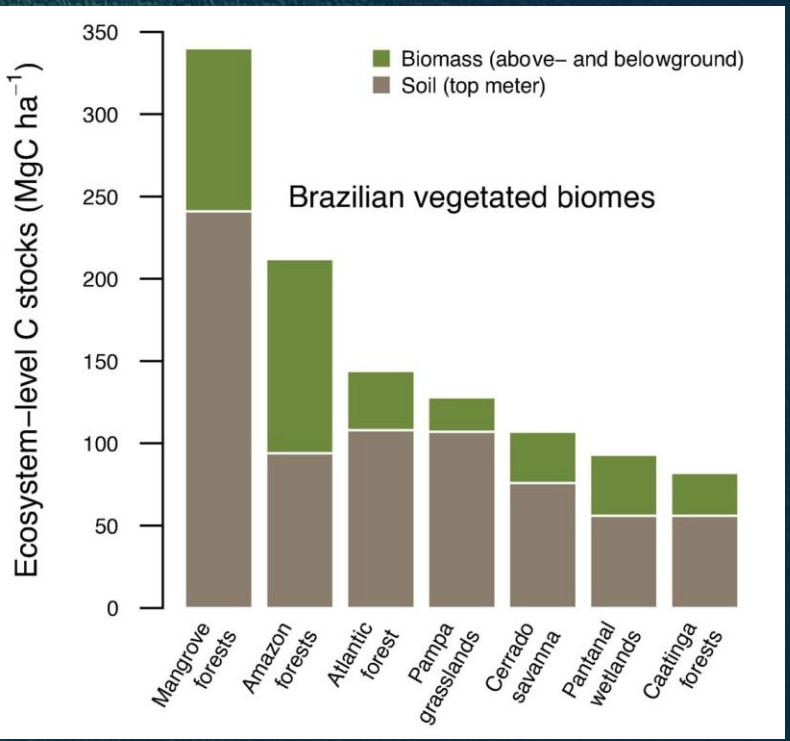
COSTA DE MANGUEZAIS DE MACROMARÉ DA AMAZÔNIA: CENÁRIOS MORFOLÓGICOS, MAPEAMENTO E QUANTIFICAÇÃO DE ÁREAS USANDO DADOS DE SENSORES REMOTOS

Pedro Walfir Martins Souza Filho

Tabela 3 – Áreas de manguezal estimadas por estados da costa norte do Brasil e da CMMA.

	Área de manguezal - km² Este artigo	Área de manguezal - km² Herz, 1991	Área de manguezal - km² Kjerfve and Lacerda, 1993
Amapá	–	1.623	1.823
Pará	2.176,78	1.820	3.894
Maranhão	5.414,31	4.923	5.000
CMMA	7.591,09	6.743	8.894





Frontiers in Forests and Global

Rovai et al. (2022)

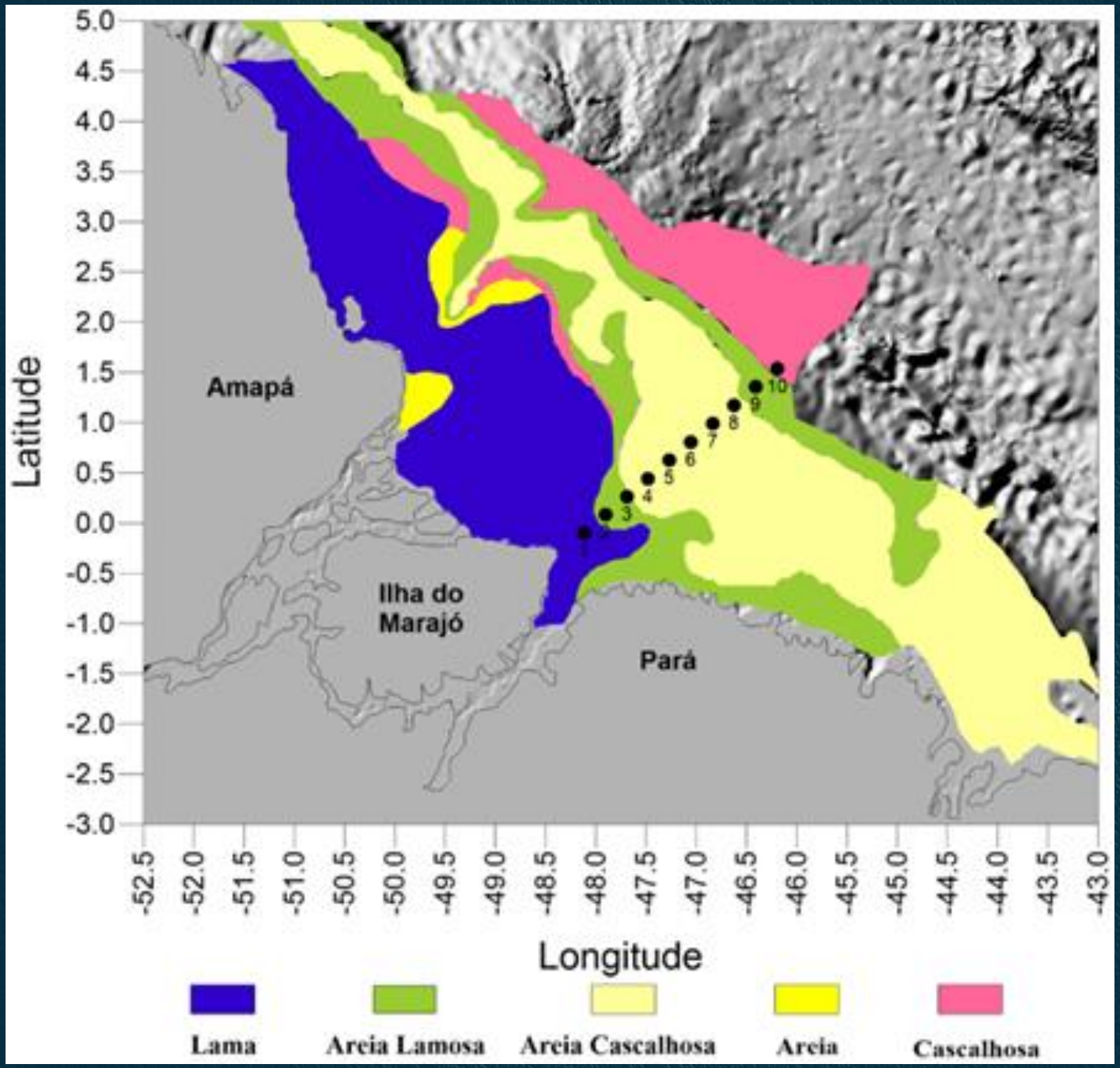
•Grande produção de peixes e crustáceos da região costeira na sua maioria **Demersais**

•**150** (aprox.) comunidades pesqueiras estão distribuída entre **17** municípios costeiros, sendo que os desembarques ocorrem em aproximadamente 90 portos (CEPNOR, 2003). **Cerca de 40 mil** famílias – Pará

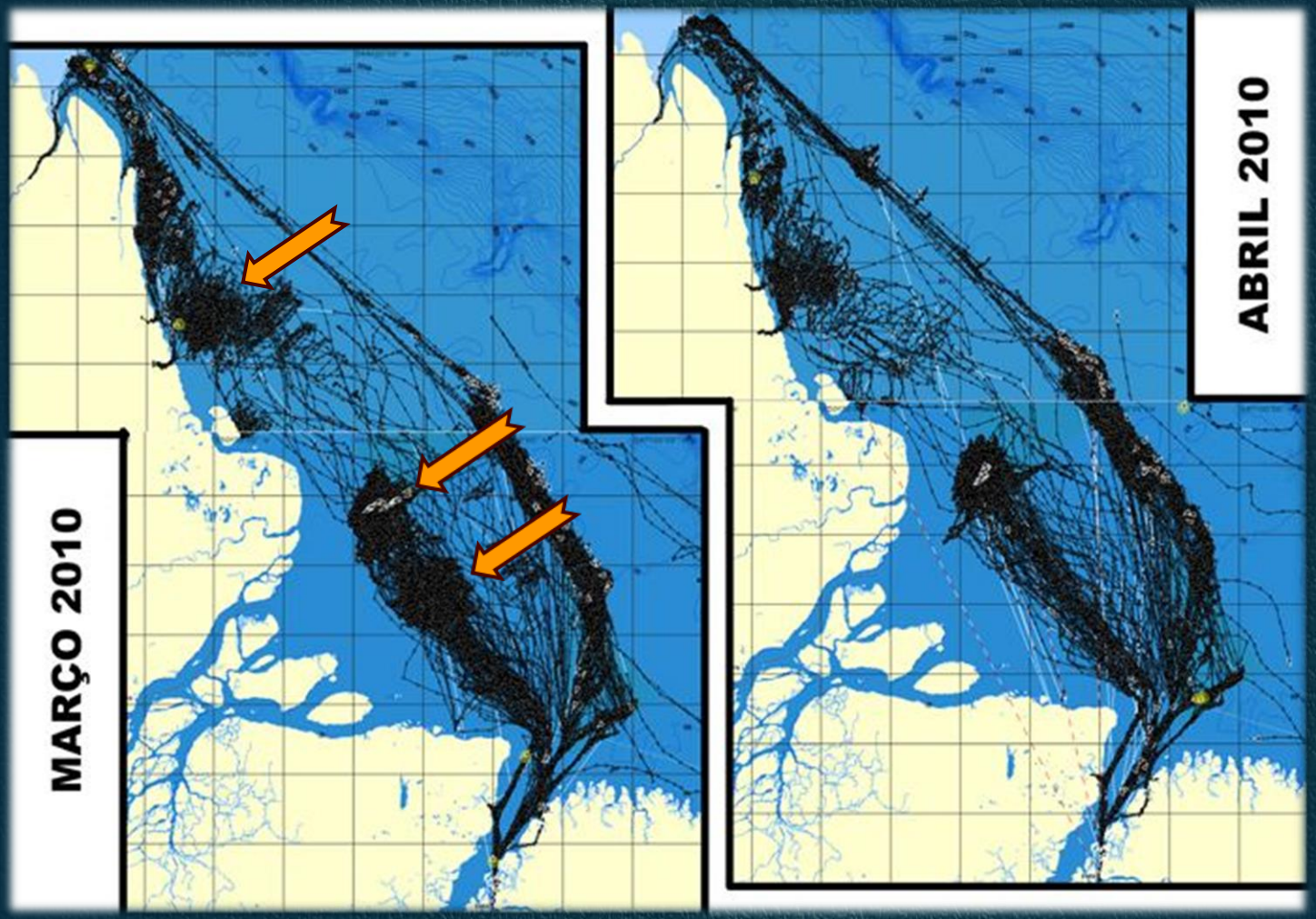
• O Estado do Pará é o POSSIVELMENTE o primeiro colocado no que se refere ao volume de captura marinha no Brasil (cerca de 100 mil ton/ano) e também responde por cerca de 10% das exportações de peixes do país.

2- Pluma do Amazonas

Tipos de Fundo



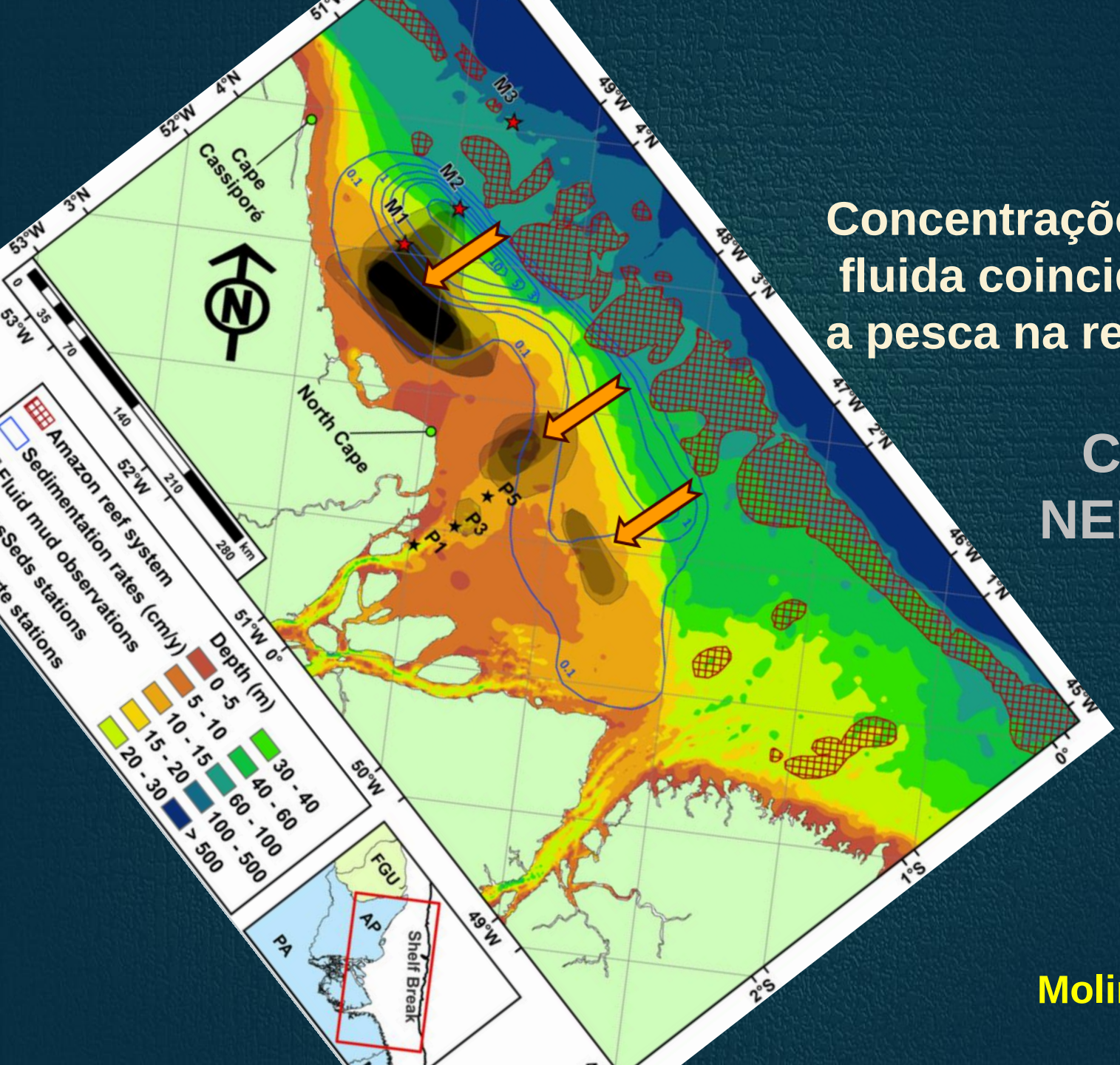
Programa Nacional de Rastreamento de Embarcações Pesqueiras por Satélite.



Aprox. 85% da Produção Pesqueira do Pará
Está associada a Pluma do Amazonas

Concentrações de Lama fluida coincidem com a pesca na região

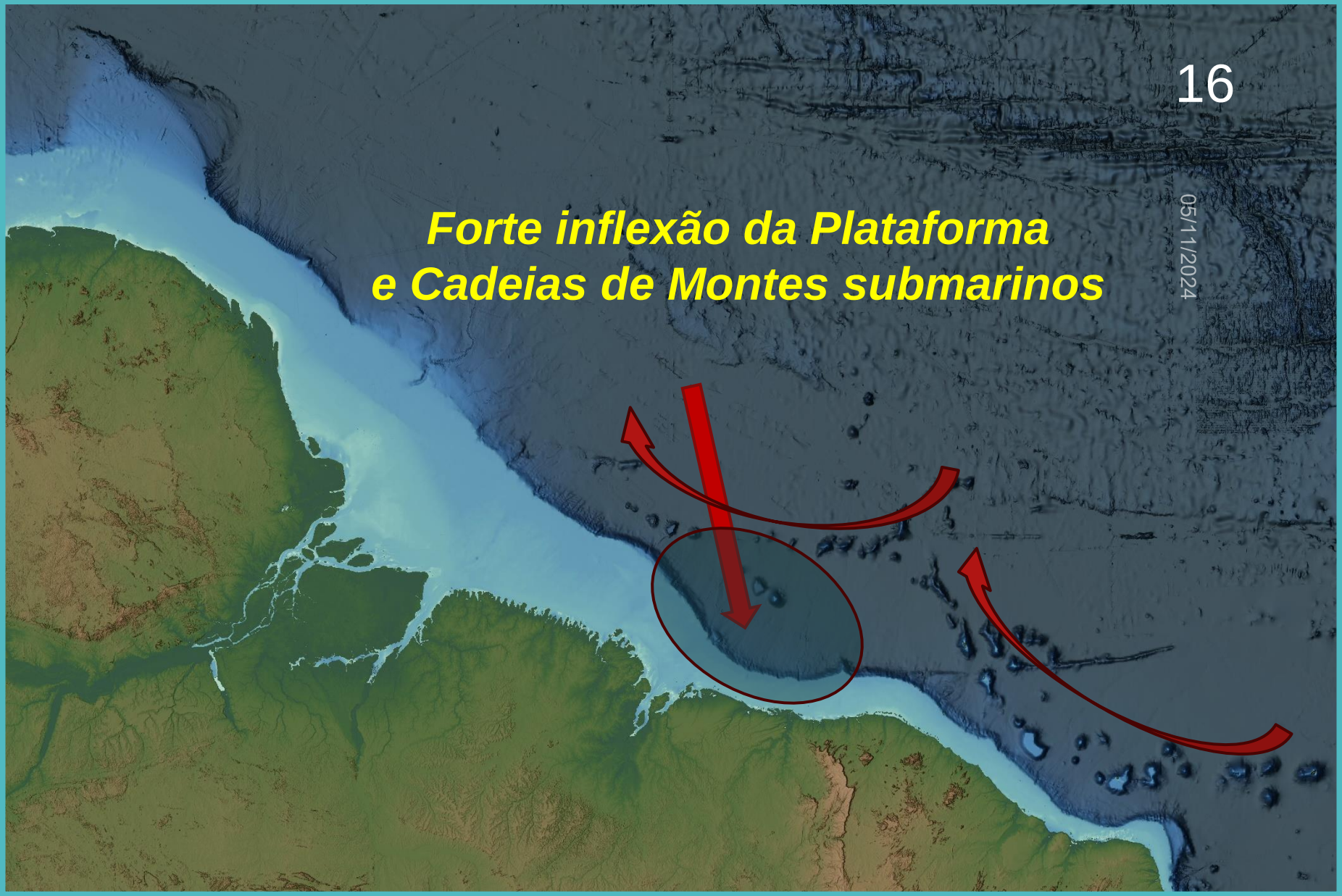
Camada NEFELOIDE

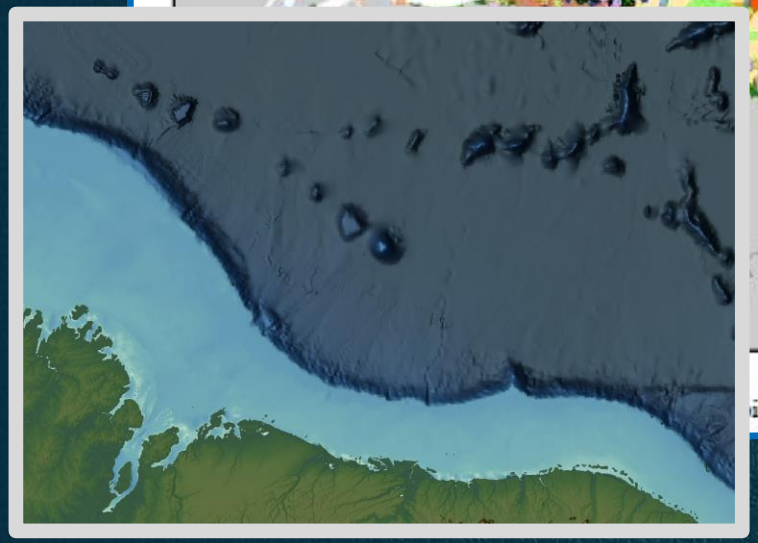


Molinas et al 2020

Plataforma Continental Norte Brasileira:

O Assoalho Submarino


Forte inflexão da Plataforma
e Cadeias de Montes submarinos
05/11/2024



Marine Policy 128 (2021) 104465

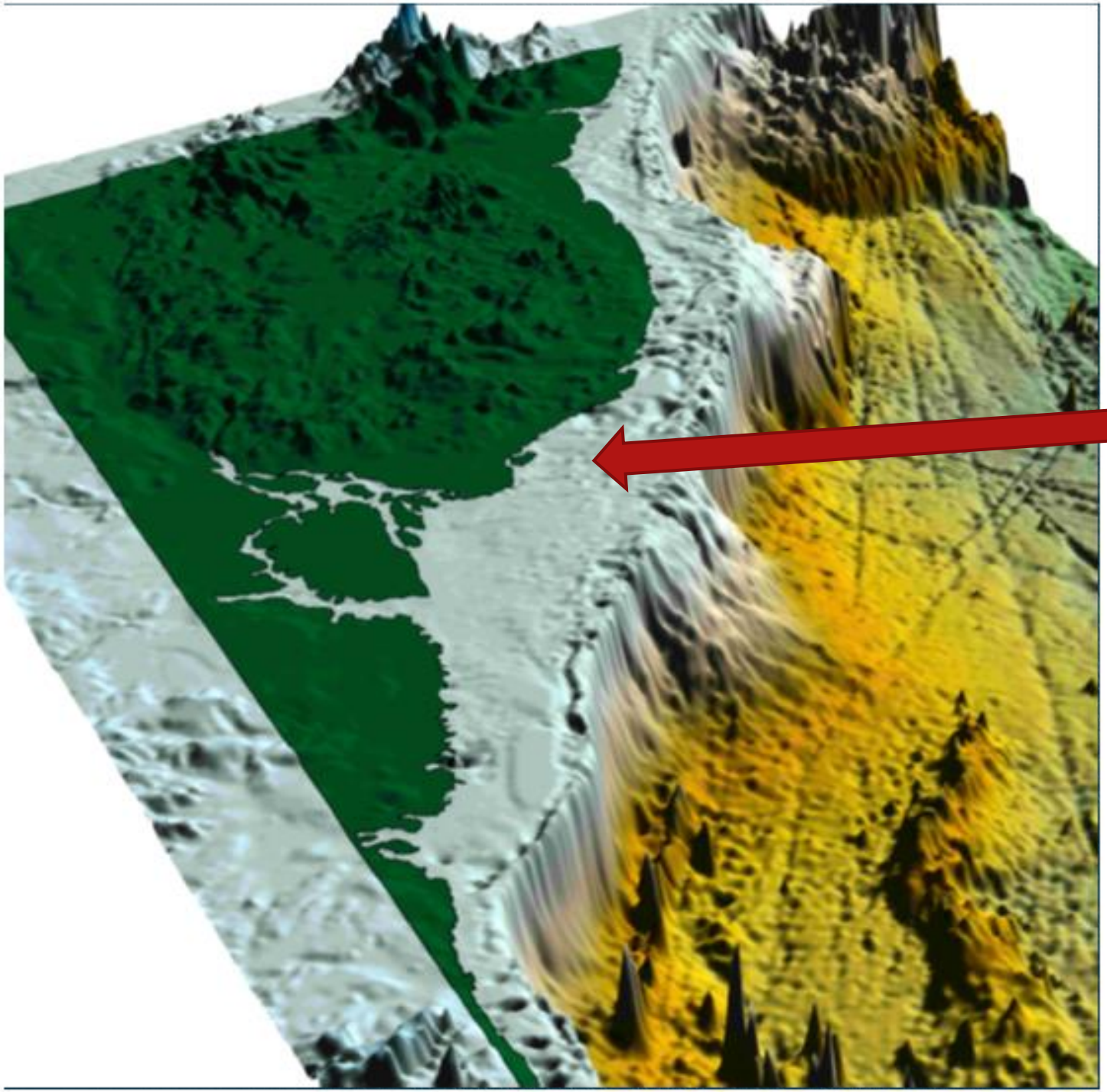
Contents lists available at ScienceDirect

Marine Policy

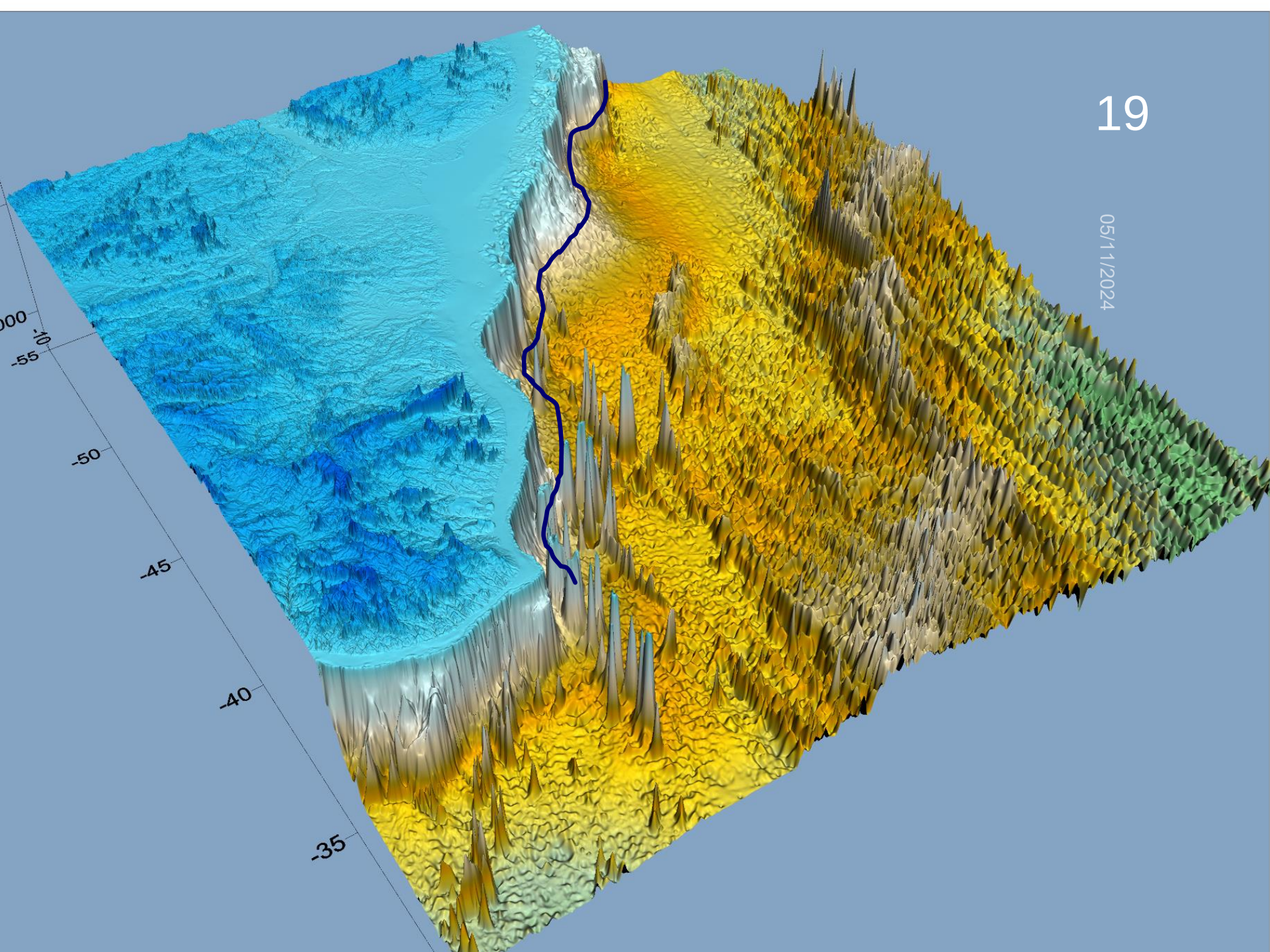
journal homepage: http://www.elsevier.com/locate/marpol

Growing industrialization and poor conservation planning challenge natural resources' management in the Amazon Shelf off Brazil

Laís S. Araujo [a], Ulises Rodrigo Magdalena [a], Tayana S. Louzada [a], Paulo S. Salomon [a], Fernando C. Moraes [b], Beatrice P. Ferreira [c], Eduardo T.C. Paes [d], Alex C. Bastos [e], Renato C. Pereira [c], Leonardo T. Salgado [c], Maria Lucia Lorini [f], Patricia Yager [g], Rodrigo L. Moura [a,*]



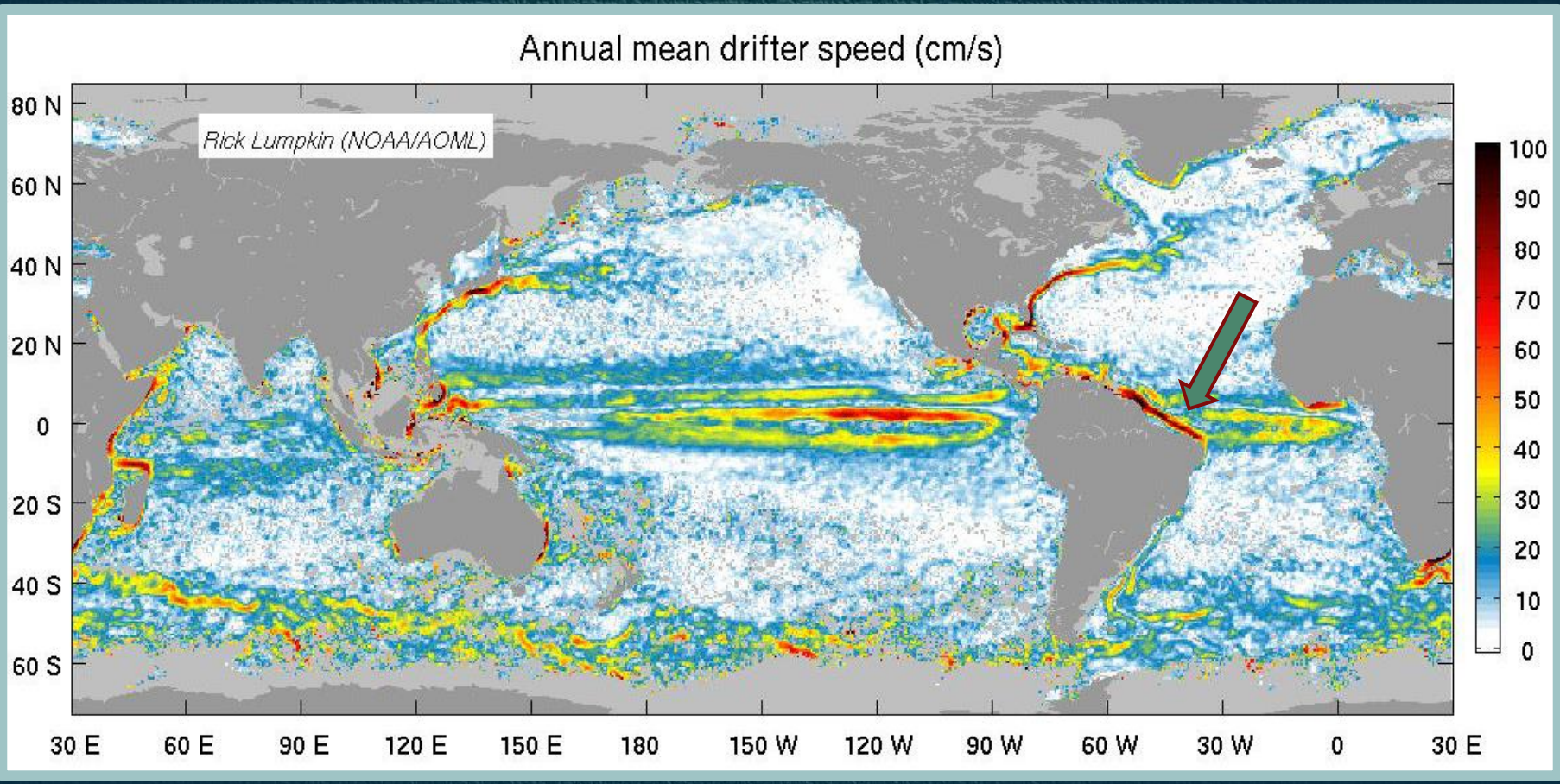
Plataforma Continental Norte Brasileira

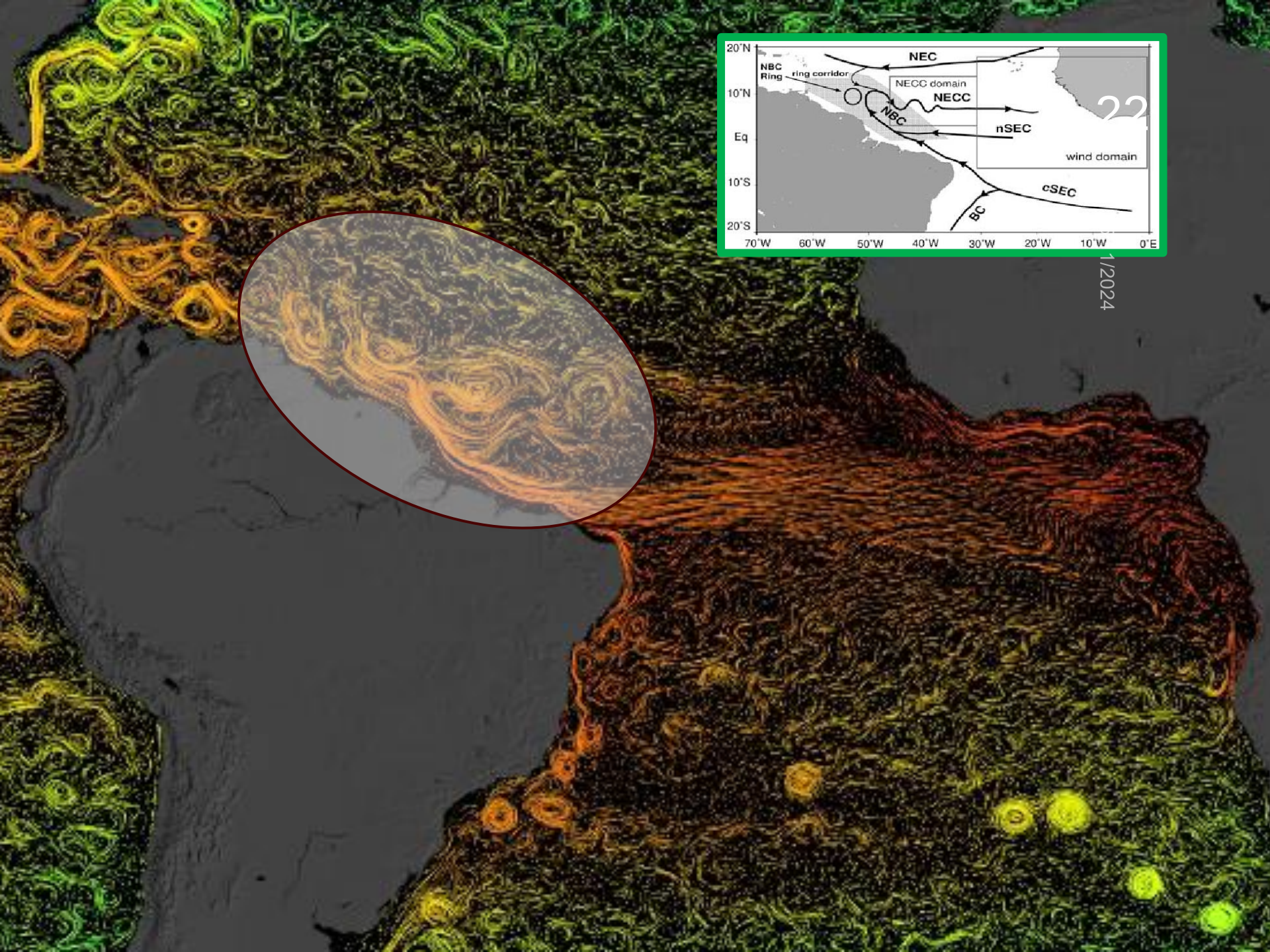

-55
-50
-45
-40
-35

Plataforma Continental Norte Brasileira:

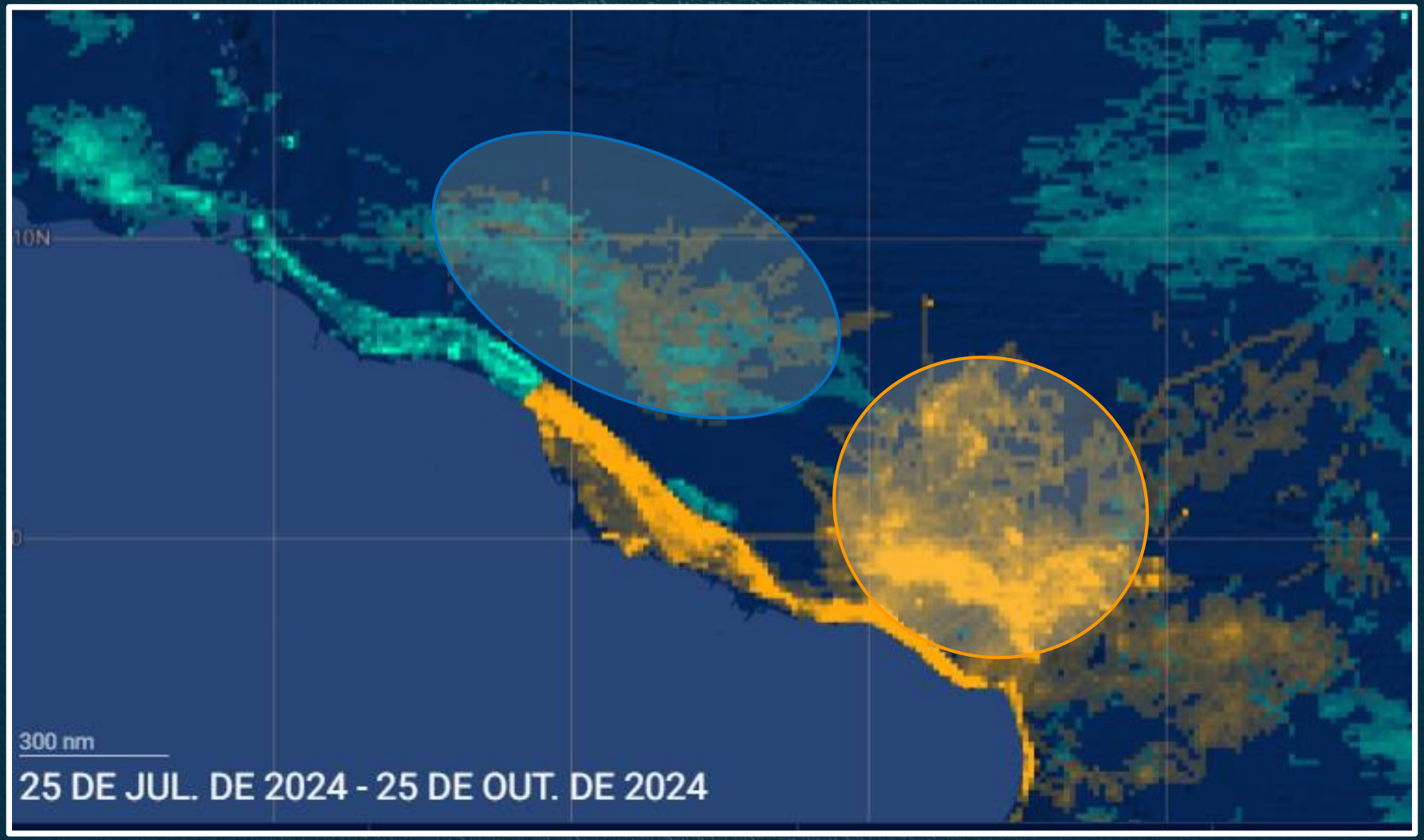
As Correntes

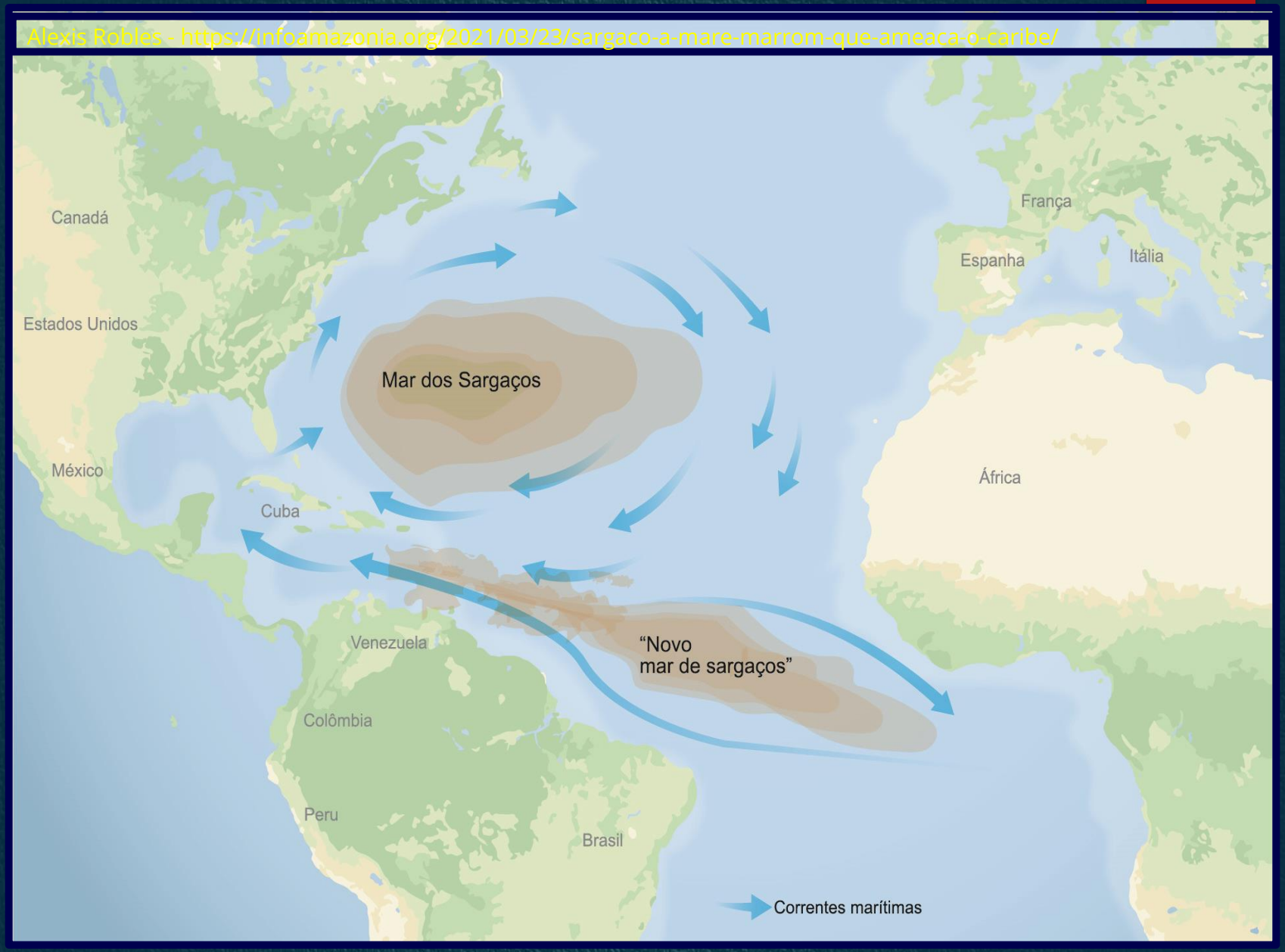
O Média Anual das velocidades das Correntes superficiais (Lumpkin et al 2015)




20°N
10°N
Eq
10°S
20°S
70°W
60°W
50°W
40°W
30°W
20°W
10°W
0°E
NEC
NBC Ring
ring corridor
NECC domain
NECC
NBC
nSEC
wind domain
cSEC
BC

Global Fishing Watch




Alexis Robles - https://infoamazonia.org/2021/03/23/sargaco-a-mare-marrom-que-ameaca-o-caribe/
Canadá
Estados Unidos
México
Cuba
Venezuela
Colômbia
Peru
Brasil
França
Espanha
Itália
África
Mar dos Sargaços
"Novo
mar de sargaços"
Correntes marítimas

Alguns números:

Aproximadamente 7 mil Km cúbicos por ano

Maior que os próximos 7 maiores rios do mundo combinados

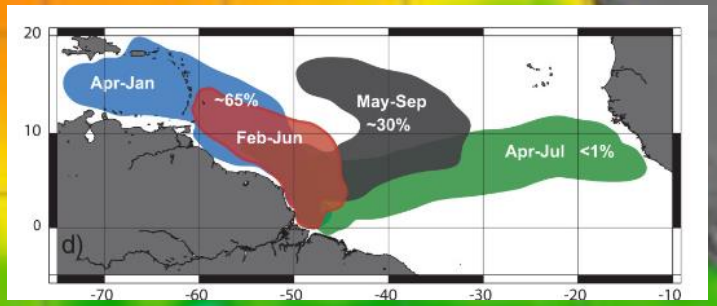
O Amazonas representa 20% de toda a água doce que entra no oceano e 17% da sílica

MODIS - August 7, 2020 - Amazon River Delta

"A grandiosidade desse Rio quando deixa sua morada"

...escutei no carimbó!

"para'wara"



Coles et al , 2013

PNAS

Amazon River enhances diazotrophy and carbon sequestration in the tropical North Atlantic Ocean

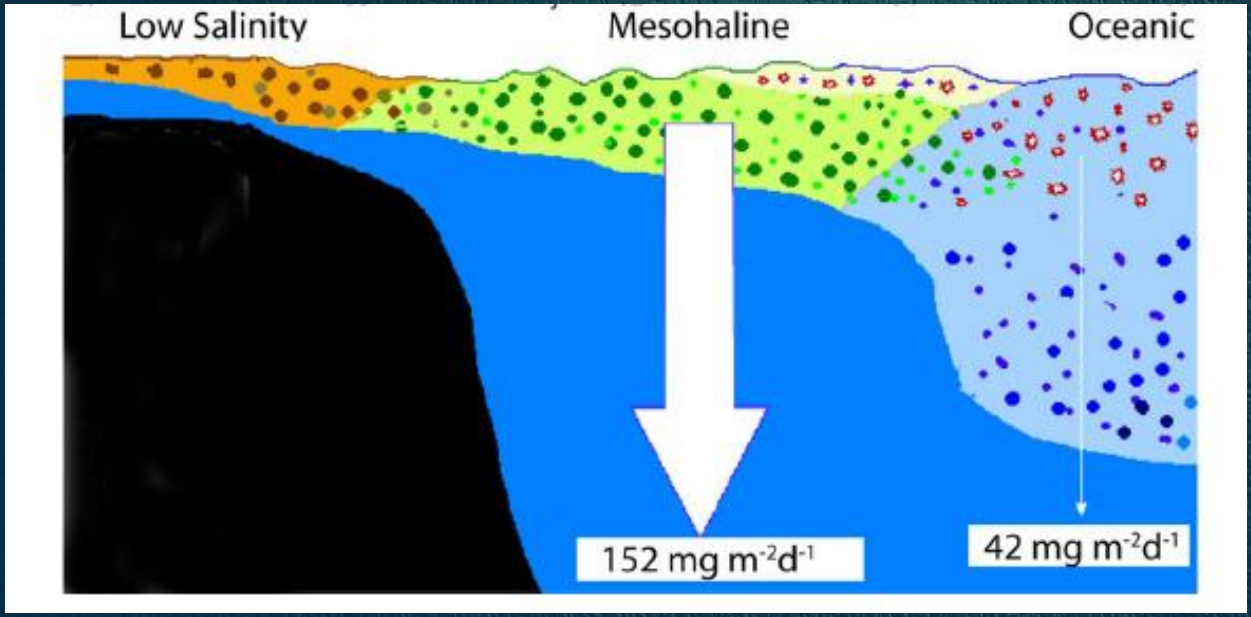
A. Subramaniam*†, P. L. Yager‡, E. J. Carpenter§, C. Mahaffey¶, K. Björkman‖, S. Cooley‡, A. B. Kustka**, J. P. Montoya††, S. A. Sañudo-Wilhelmy‡‡, R. Shipe§§, and D. G. Capone‡‡

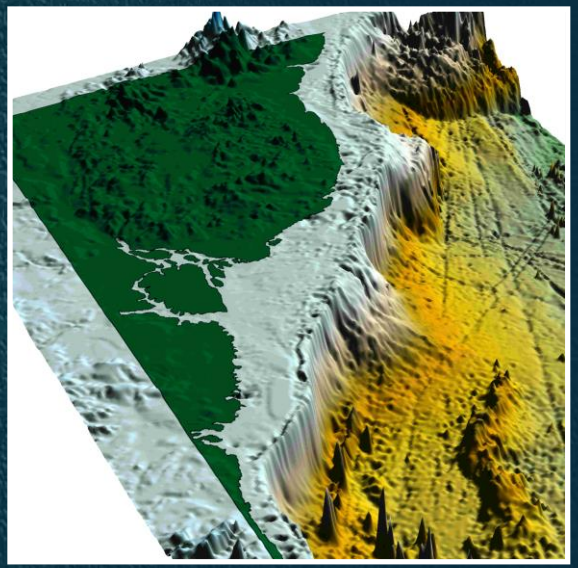
*Lamont–Doherty Earth Observatory, Columbia University, Palisades, NY 10964; ‡Department of Marine Sciences, University of Georgia, Athens, GA 30602; §Romberg Tiburon Center, San Francisco State University, Tiburon, CA 94920; ¶Department of Earth and Ocean Science, University of Liverpool, Liverpool L69 3GP, United Kingdom; ‖Department of Oceanography, SOEST, University of Hawaii, Honolulu, HI 96822; **Institute of Marine and Coastal Sciences, Rutgers, The State University of New Jersey, New Brunswick, NJ 08901; ††School of Biology, Georgia Institute of Technology, Atlanta, GA 30332; ‡‡Wrigley Institute for Environmental Studies and Department of Biological Sciences, University of Southern California, Los Angeles, CA 90089; and §§Department of Ecology and Evolutionary Biology and Institute of the Environment, University of California, Los Angeles, CA 90095

Edited by David M. Karl, University of Hawaii, Honolulu, HI, and approved April 24, 2008 (received for review October 29, 2007)

SC Pluma – 27 - Tg/ano
SC Floresta – 445 - Tg/ano

Area da Pluma:?
Area Floresta 55 Mha



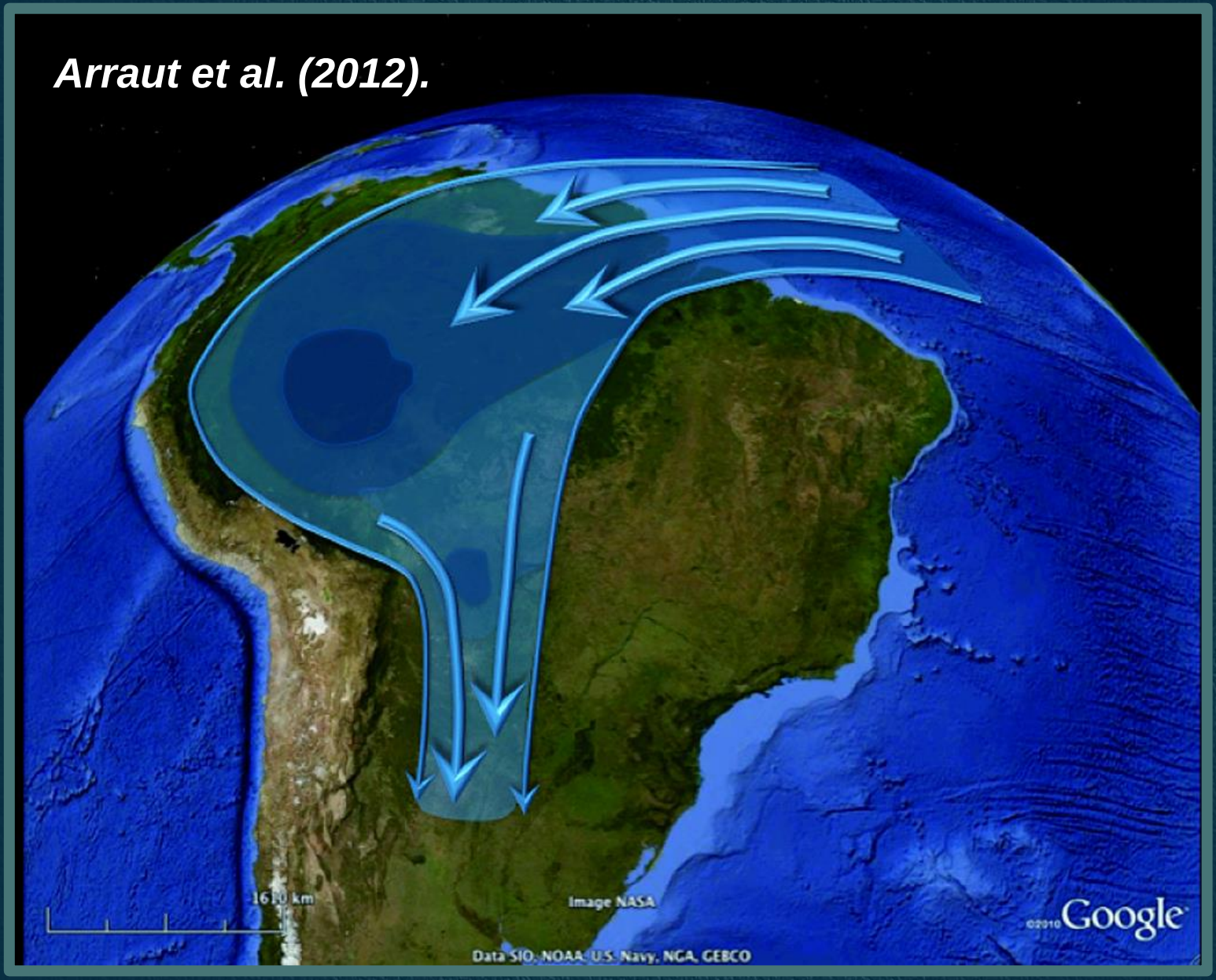


17.5 Tg/ano/ha - Pluma
8.0 Tg/ano/há - Floresta

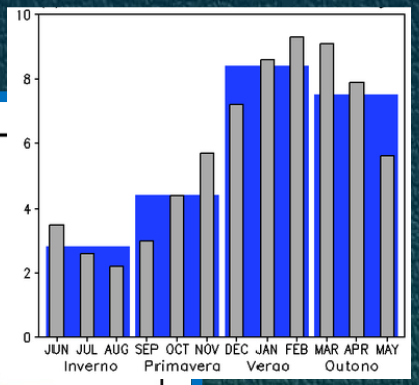
Diazotropia

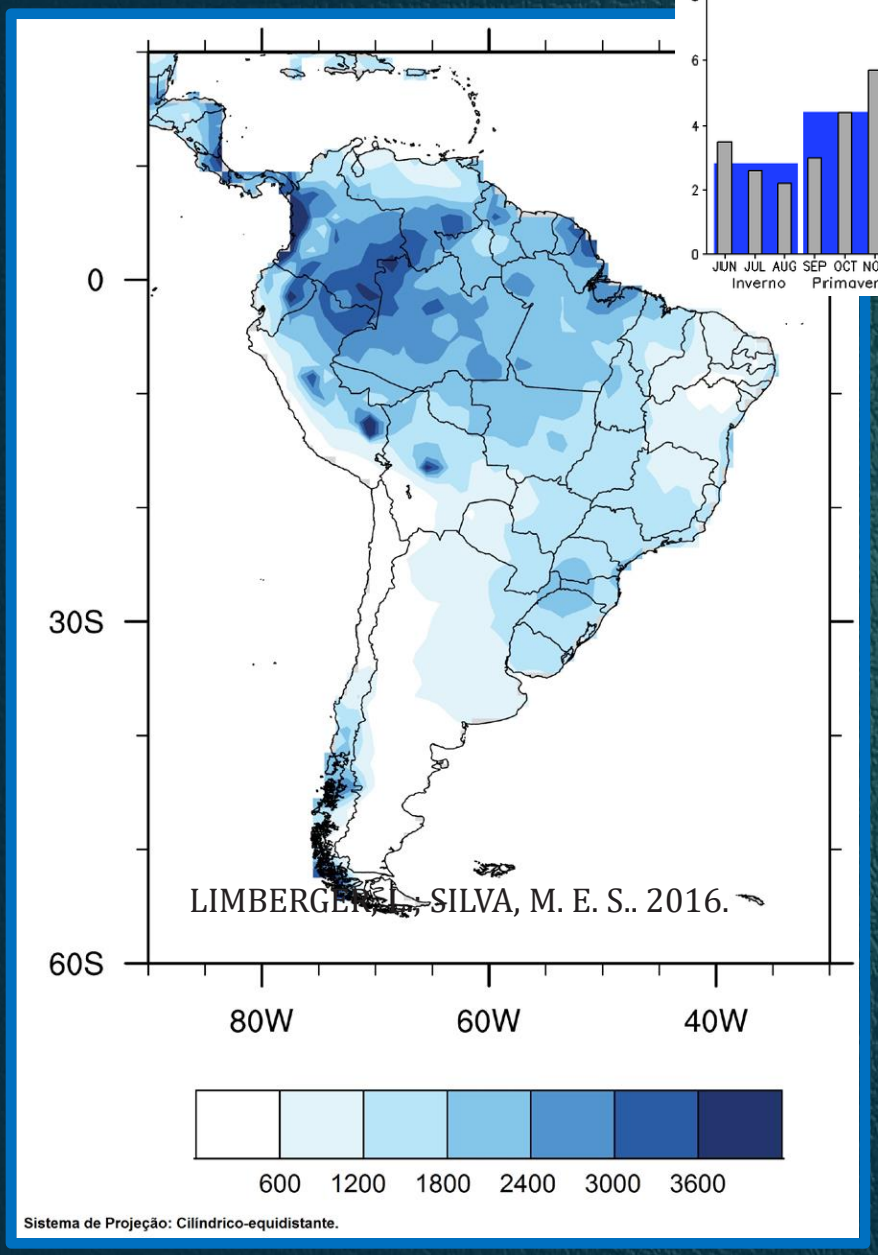
“De onde vem esse Rio-Mar ?”

“para”

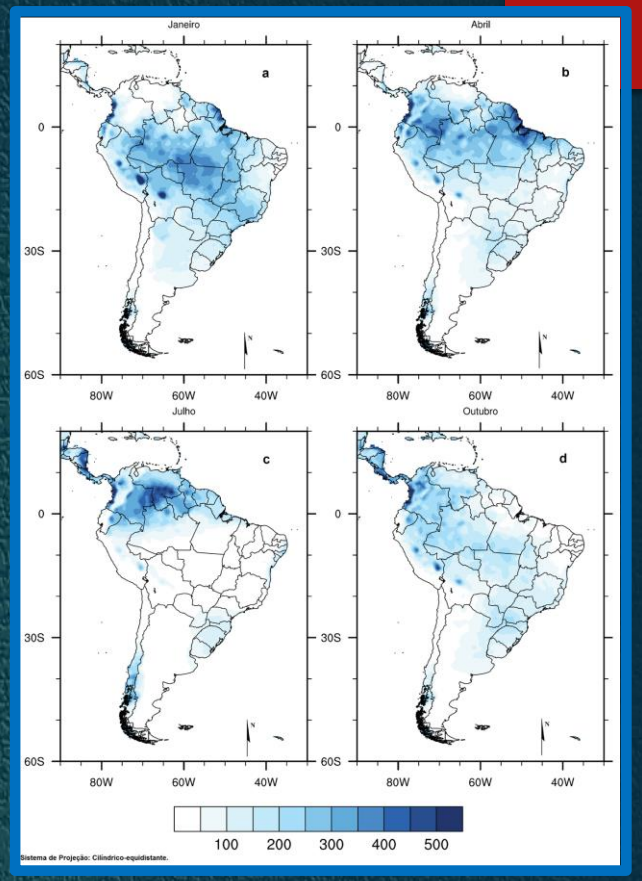

Arraut et al. (2012).
1610 km
Image NASA
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
©2010 Google

Pluviosidade Média (Amazônia legal)



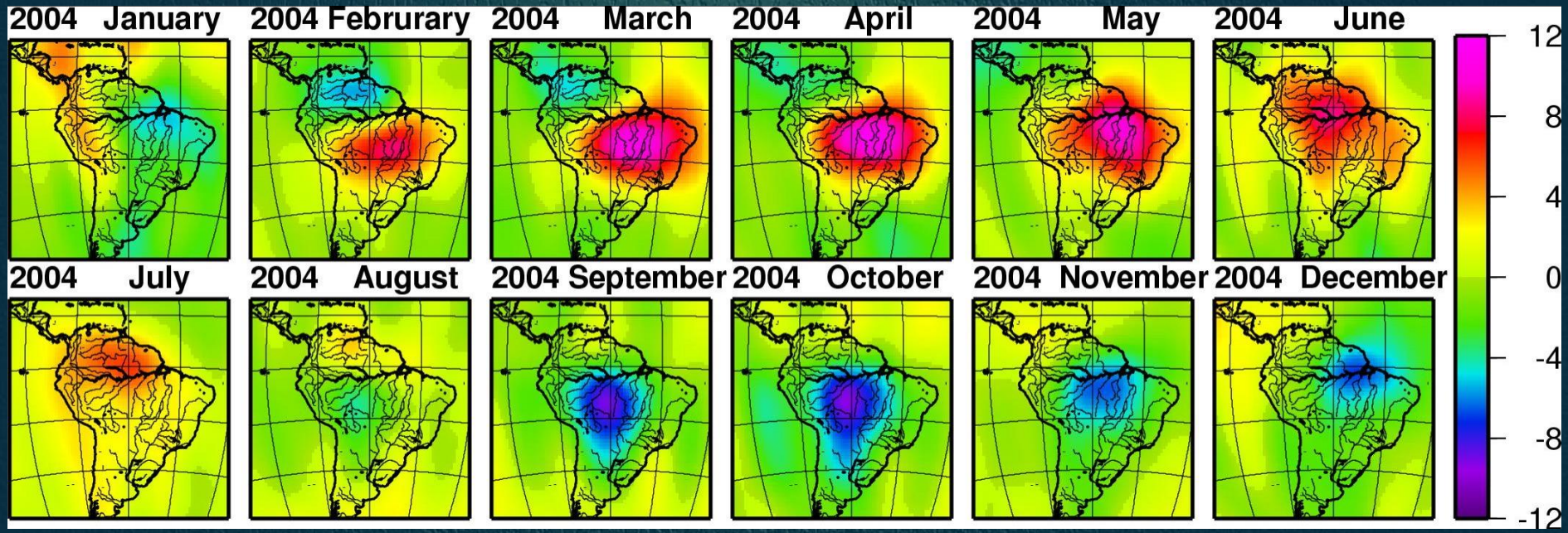


LIMBERGER, L.; SILVA, M. E. S.. 2016.

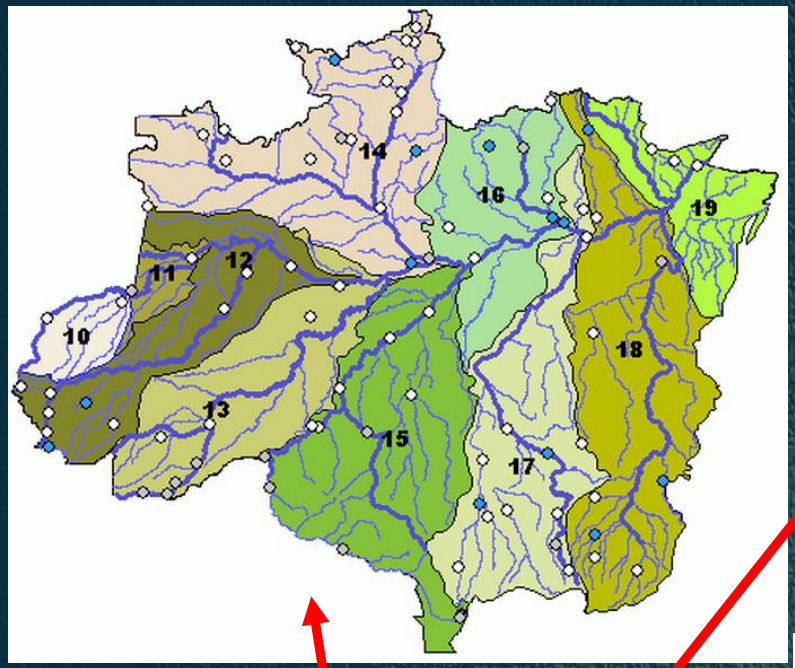


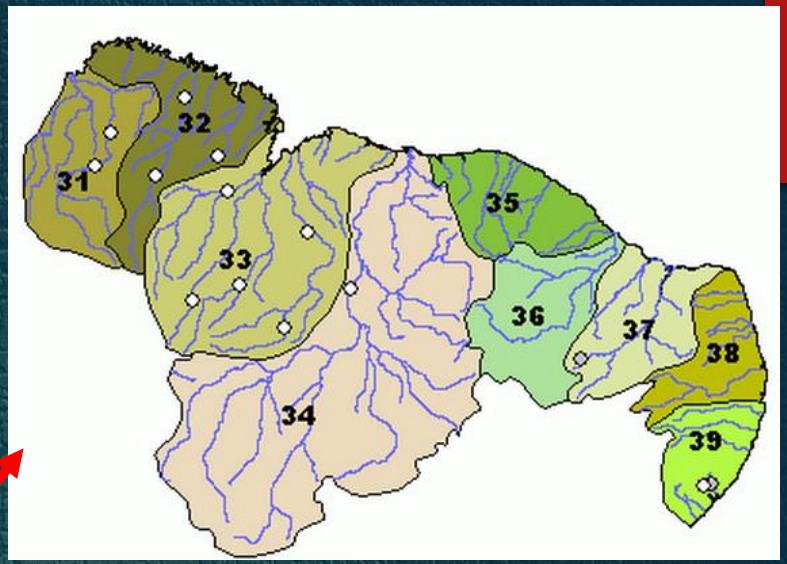
Onde as águas se acumulam?.

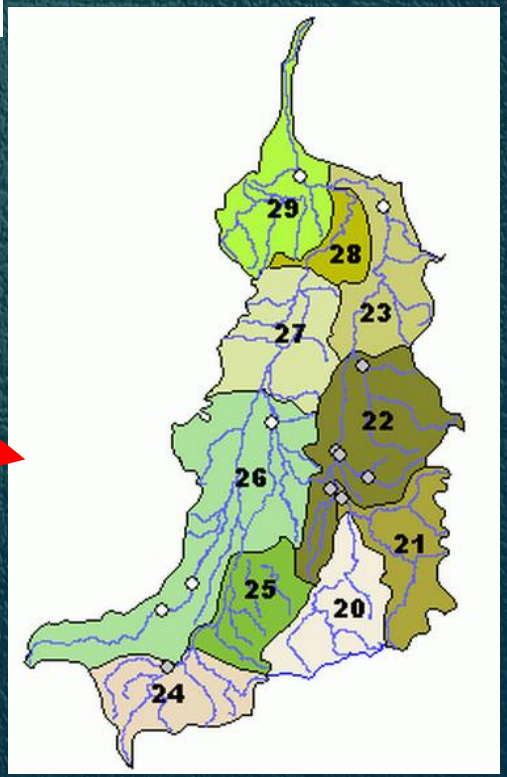
NASA's Gravity Recovery and Climate Experiment (GRACE) between March and December 2003



1 millimeter implies that GRACE detected a gravity change roughly equivalent to the change that an additional 4 centimeters of water would produce

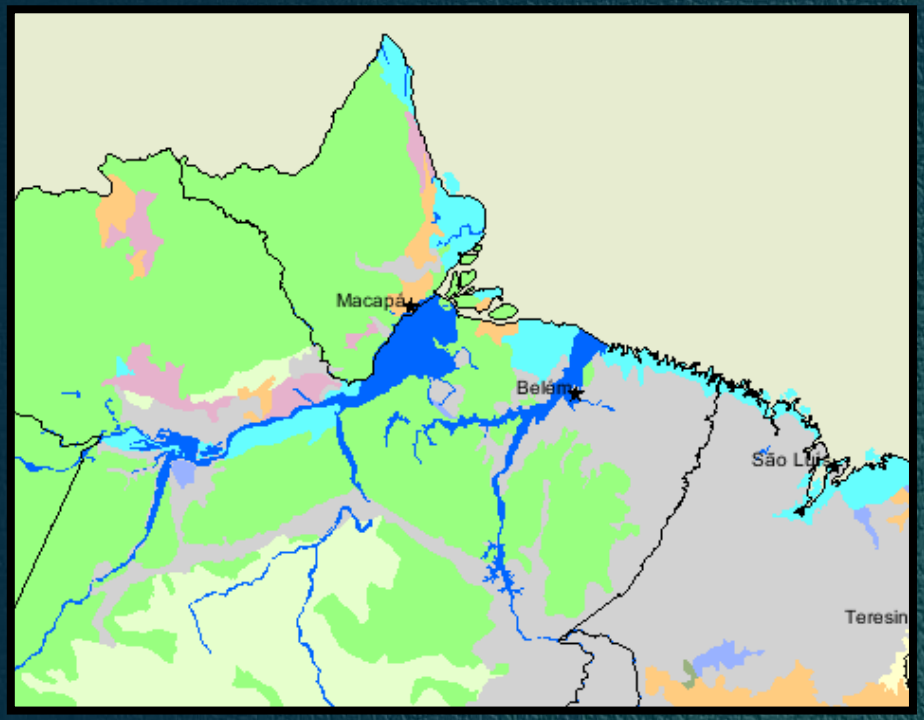




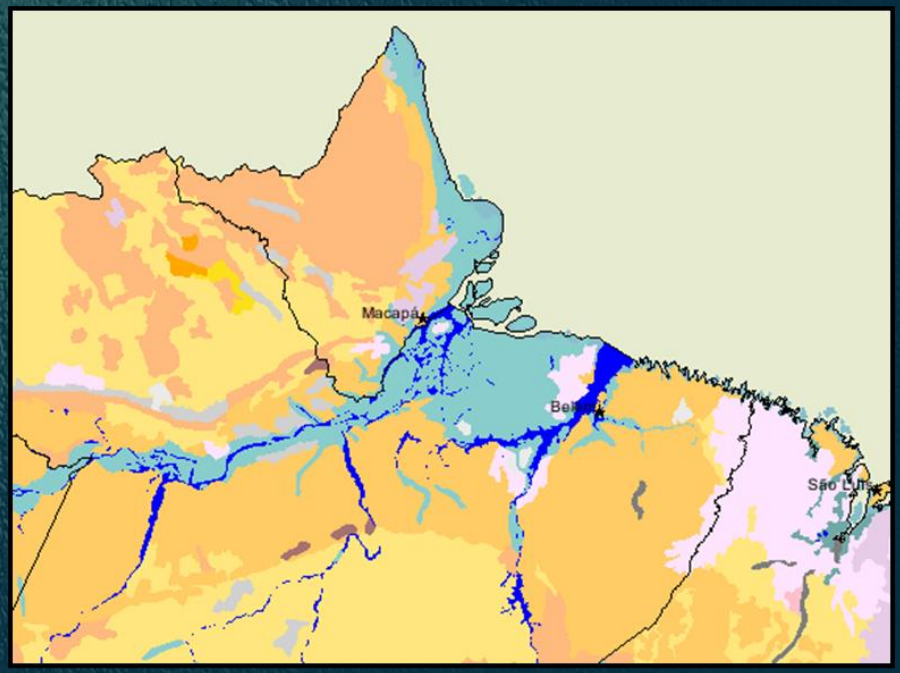


Três grandes Bacias hidrográficas

Tipos de Vegetação



Tipos de Solos



A Vida no Substrato

3- Ambientes recifais Mesofóticos

PERSPECTIVE ARTICLE

Front. Mar. Sci., 23 April 2018 | https://doi.org/10.3389/fmars.2018.00142

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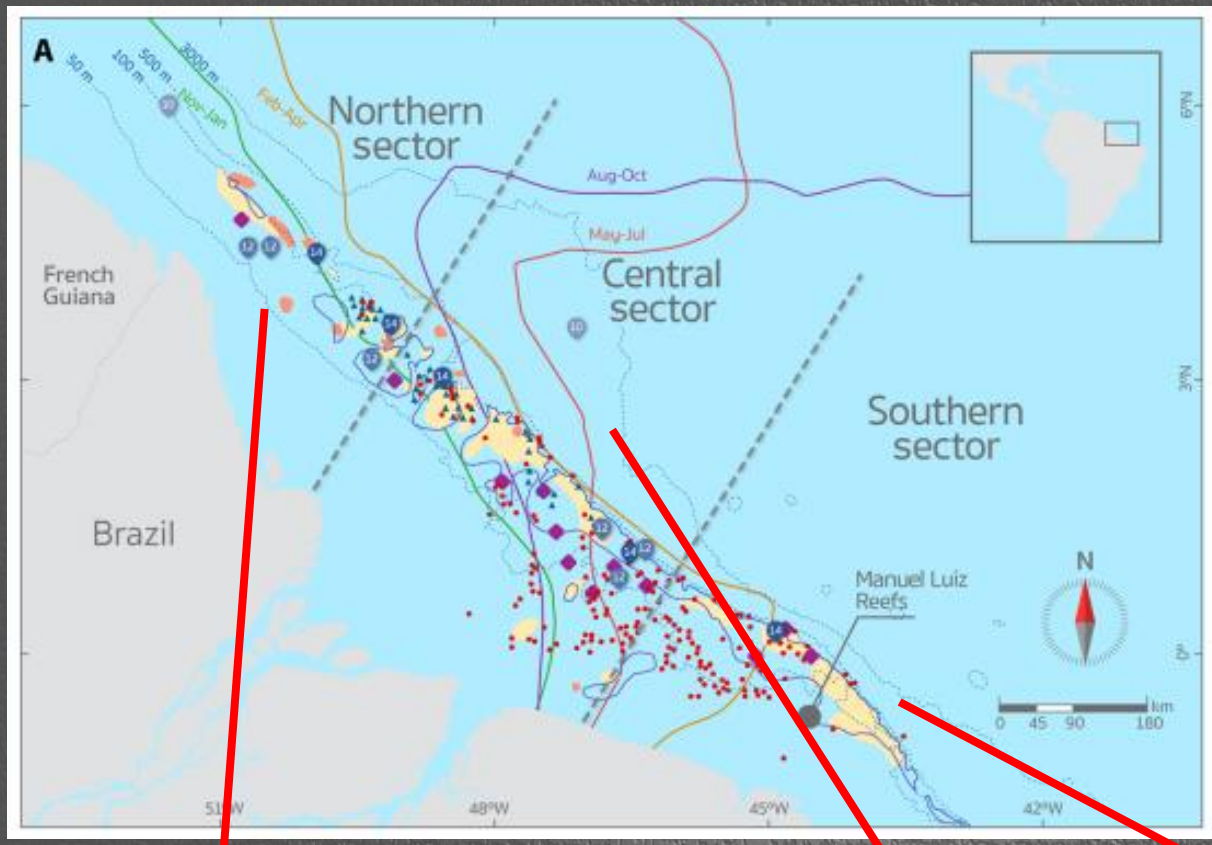
Export citation

Perspectives on the Great Amazon Reef: Extension, Biodiversity, and Threats

Ronaldo B. Francini-Filho[1], Nils E. Asp[2], Eduardo Siegle[3], John Hocevar[4], Kenneth Lowyck[5], Nilo D'Avila[6], Agnaldo A. Vasconcelos[6], Ricardo Baitelo[6], Carlos E. Rezende[7], Claudia Y. Omachi[2], Cristiane C. Thompson[8] and Fabiano L. Thompson[8*]

[1]Federal University of Paraiba, Rio Tinto, Brazil
[2]Instituto de Estudos Costeiros, Federal University of Pará, Bragança, Brazil
[3]Instituto Oceanográfico, University of São Paulo, São Paulo, Brazil
[4]Greenpeace USA, Washington, DC, United States
[5]Greenpeace France, Paris, France
[6]Greenpeace Brazil, Rio de Janeiro, Brazil
[7]Laboratório de Ciências Ambientais, Centro de Biociências e Biotecnologia, Universidade Estadual do Norte Fluminense,



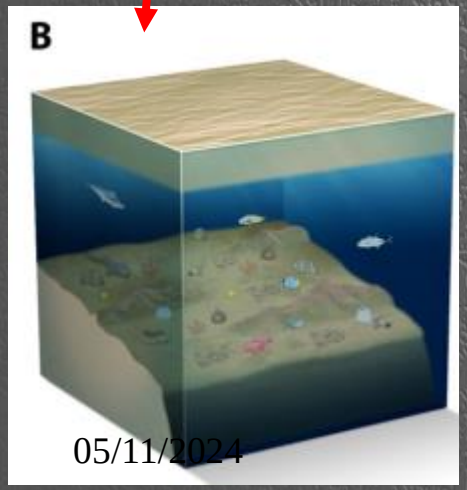
Recife de 9500 km^2

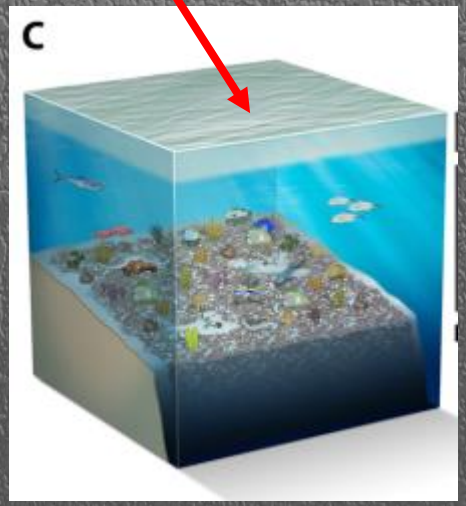
Cruise
2010
2012
2014

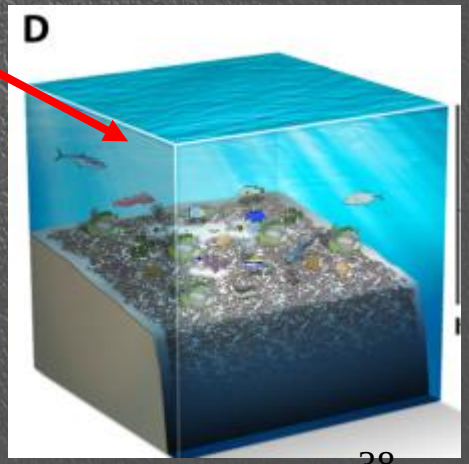
River plume
Nov-Jan
Feb-Apr
May-Jul
Aug-Oct

Fishing spots
Snapper
Lobster

Reef type
Sponge bottom
Rhodoliths
>50% carbonate fraction
Structures



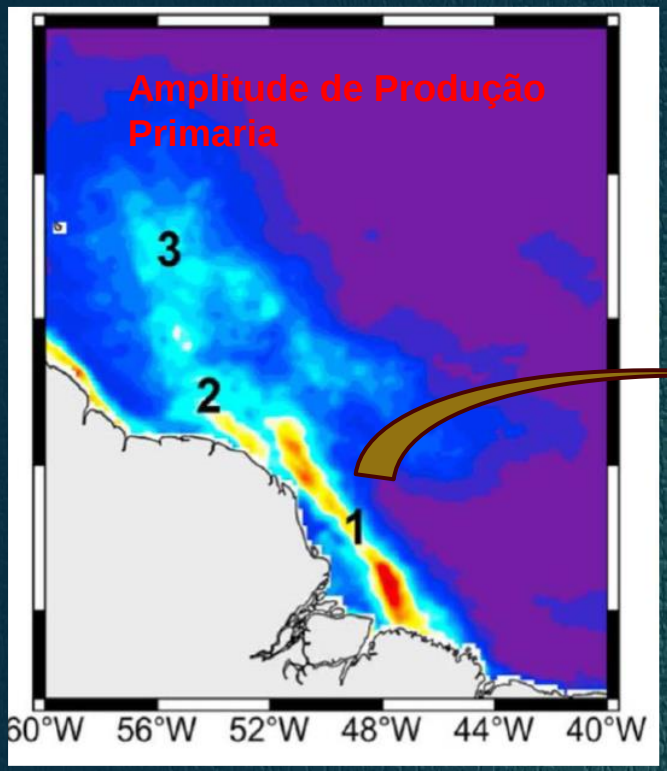




Moura et al. (2016)

MV Alucia, 2017 - UFRJ / Woods Hole / Ocean X

A “chuva” que alimenta



AGU100 ADVANCING EARTH AND SPACE SCIENCE

JGR Biogeosciences

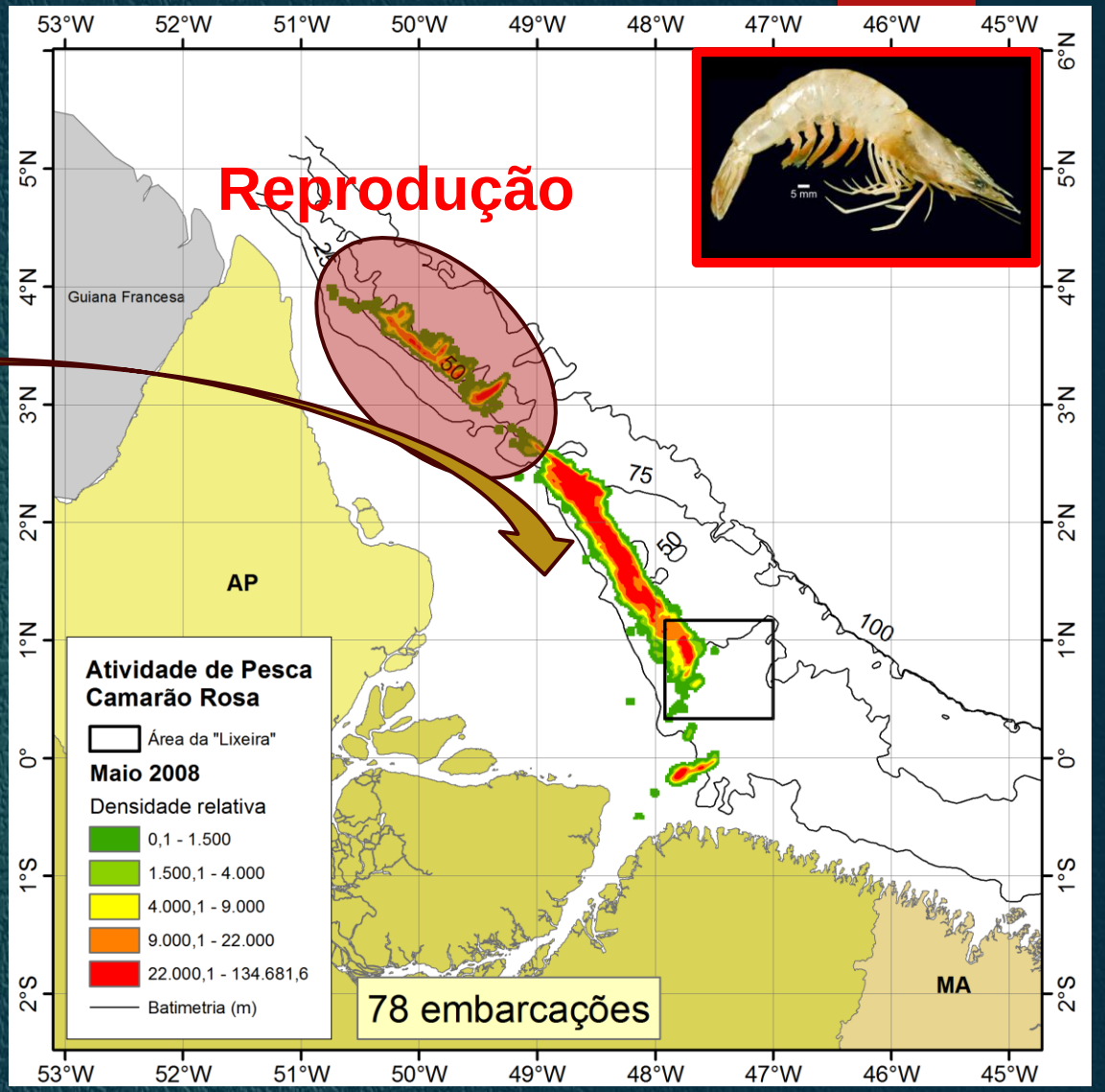
RESEARCH ARTICLE
10.1029/2018JG004665

Key Points:
- Empirical surface salinity captures the main seasonal behavior of the Amazon river plume. The variability of primary productivity is concentrated in the subannual and annual frequency bands
- Export water of the Amazon river has increased in recent years

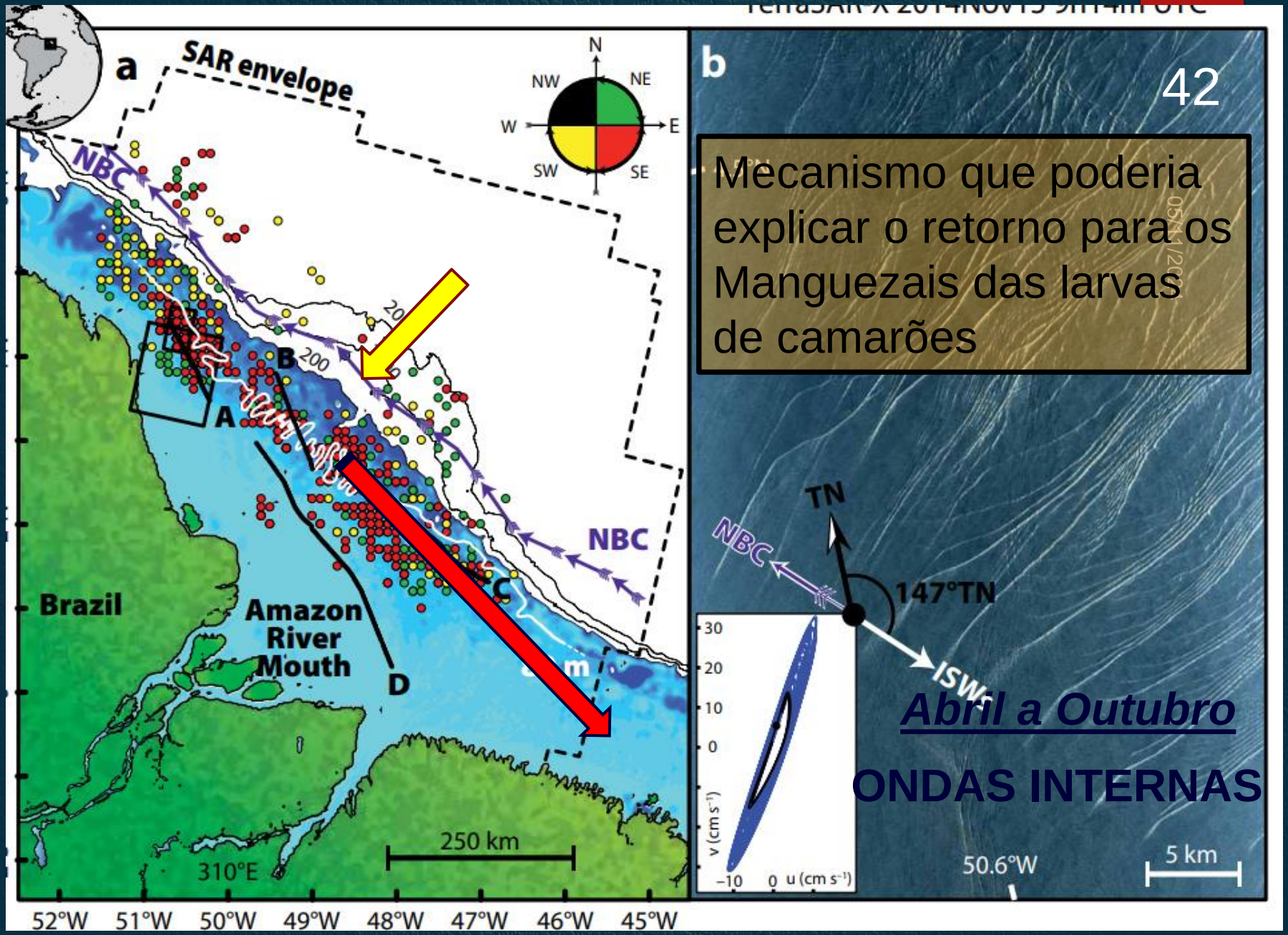
The Salinity Structure of the Amazon River Plume Drives Spatiotemporal Variation of Oceanic Primary Productivity

N. A. Gouveia[1], D. F. M. Gherardi[1], F. H. Wagner[1], E. T. Paes[2], V. J. Coles[3], and L. E. O. C. Aragão[1]

[1]Remote Sensing Division National Institute for Space Research-INPE, São José dos Campos, Brazil, [2]Social-Environmental and Water Resources Institute, Federal Rural University of Amazon, Belém, Brazil, [3]Horn Point Laboratory, University of Maryland Center for Environmental Science, Cambridge, MD, USA

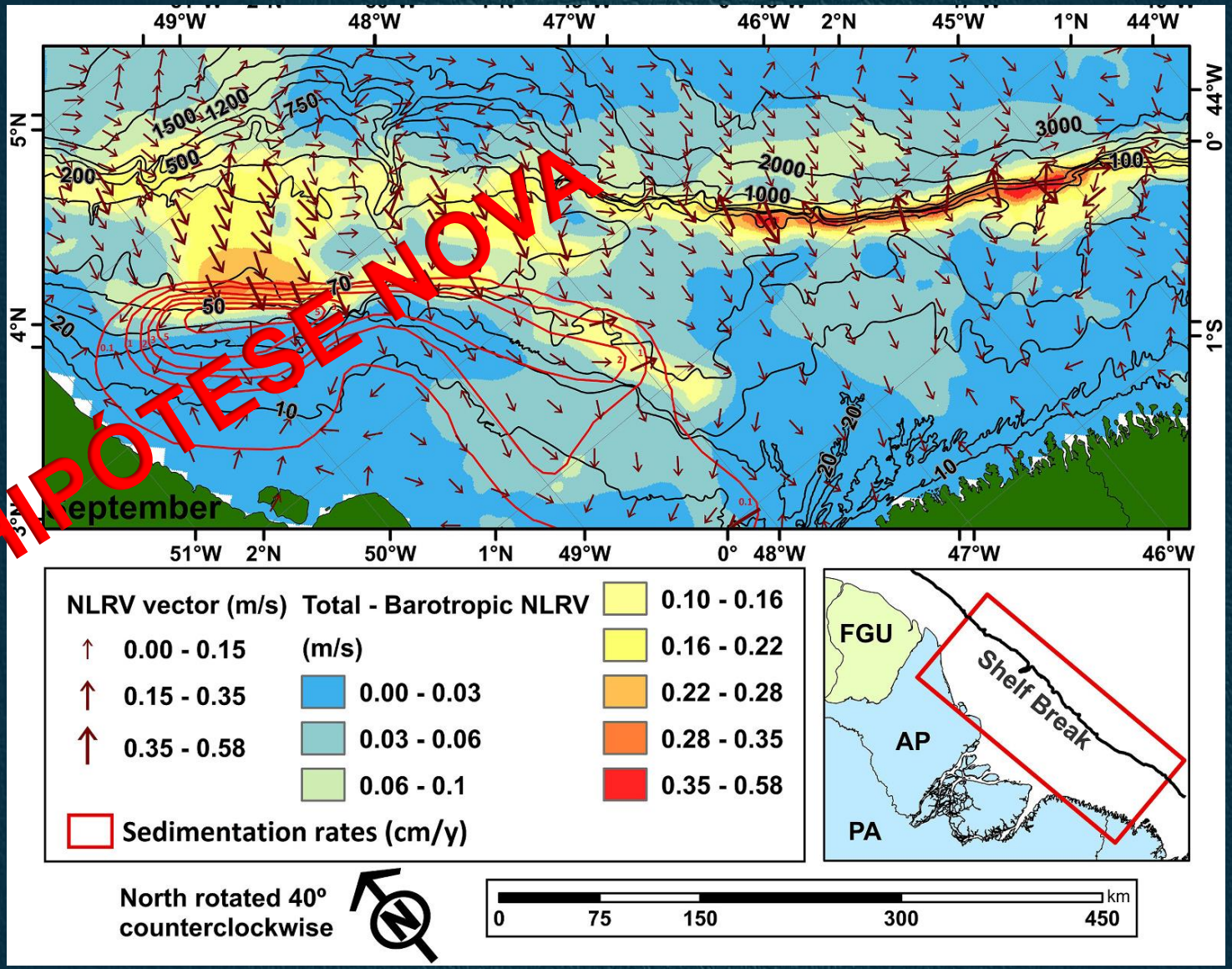


Litopenaeus schmitti (Burkenroad, 1936)



Lentini, et al 2016

Modelo da Circulação residual resultante das ondas internas



Molina et al 2020

Marine Policy 128 (2021) 104465

Contents lists available at ScienceDirect

Marine Policy

journal homepage: http://www.elsevier.com/locate/marpol

Growing industrialization and poor conservation planning challenge natural resources' management in the Amazon Shelf off Brazil

Laís S. Araujo [a], Ulises Rodrigo Magdalena [a], Tayana S. Louzada [a], Paulo S. Salomon [a], Fernando C. Moraes [b], Beatrice P. Ferreira [c], Eduardo T.C. Paes [d], Alex C. Bastos [e], Renato C. Pereira [c], Leonardo T. Salgado [c], Maria Lucia Lorini [f], Patricia Yager [g], Rodrigo L. Moura [a,g,*]

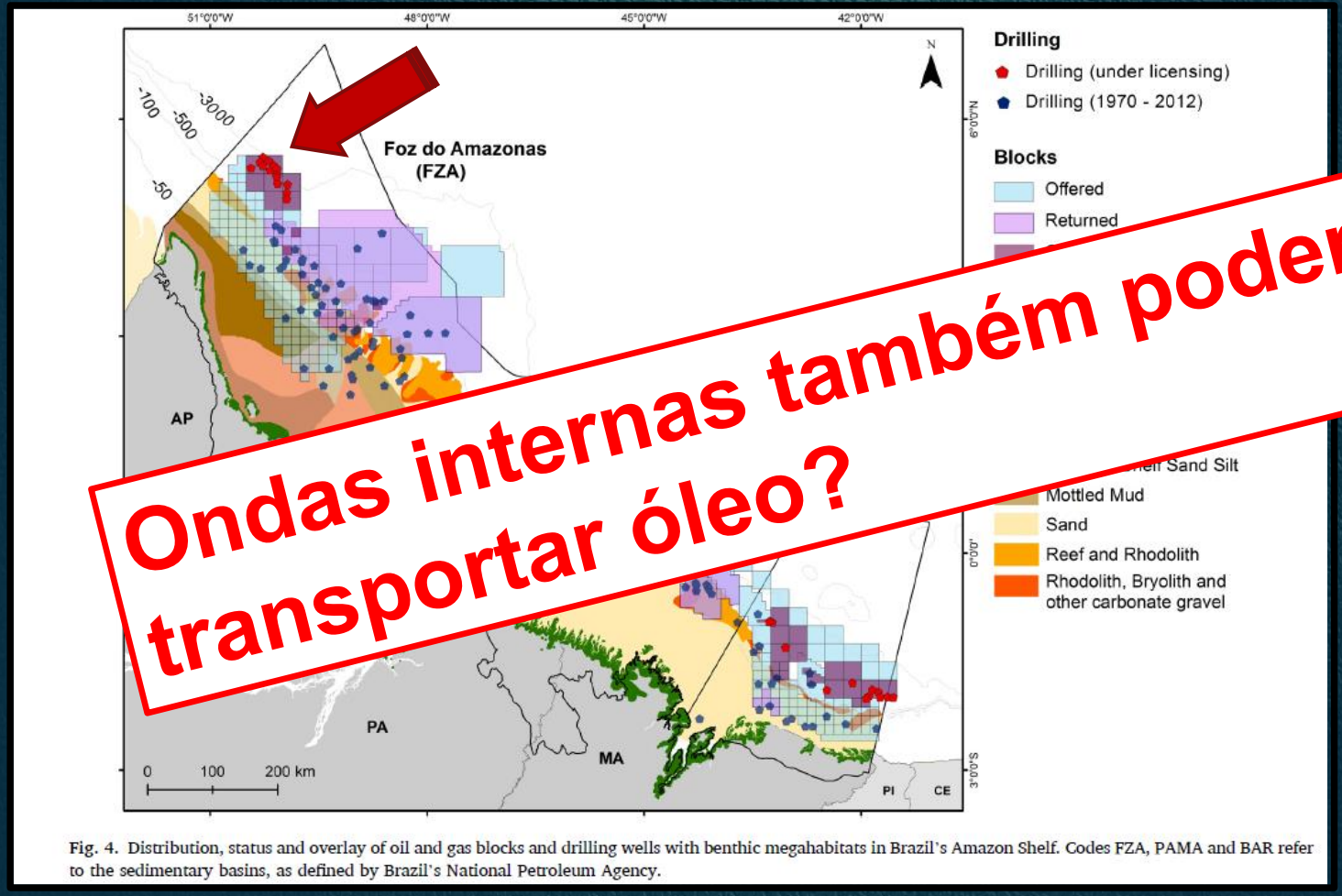
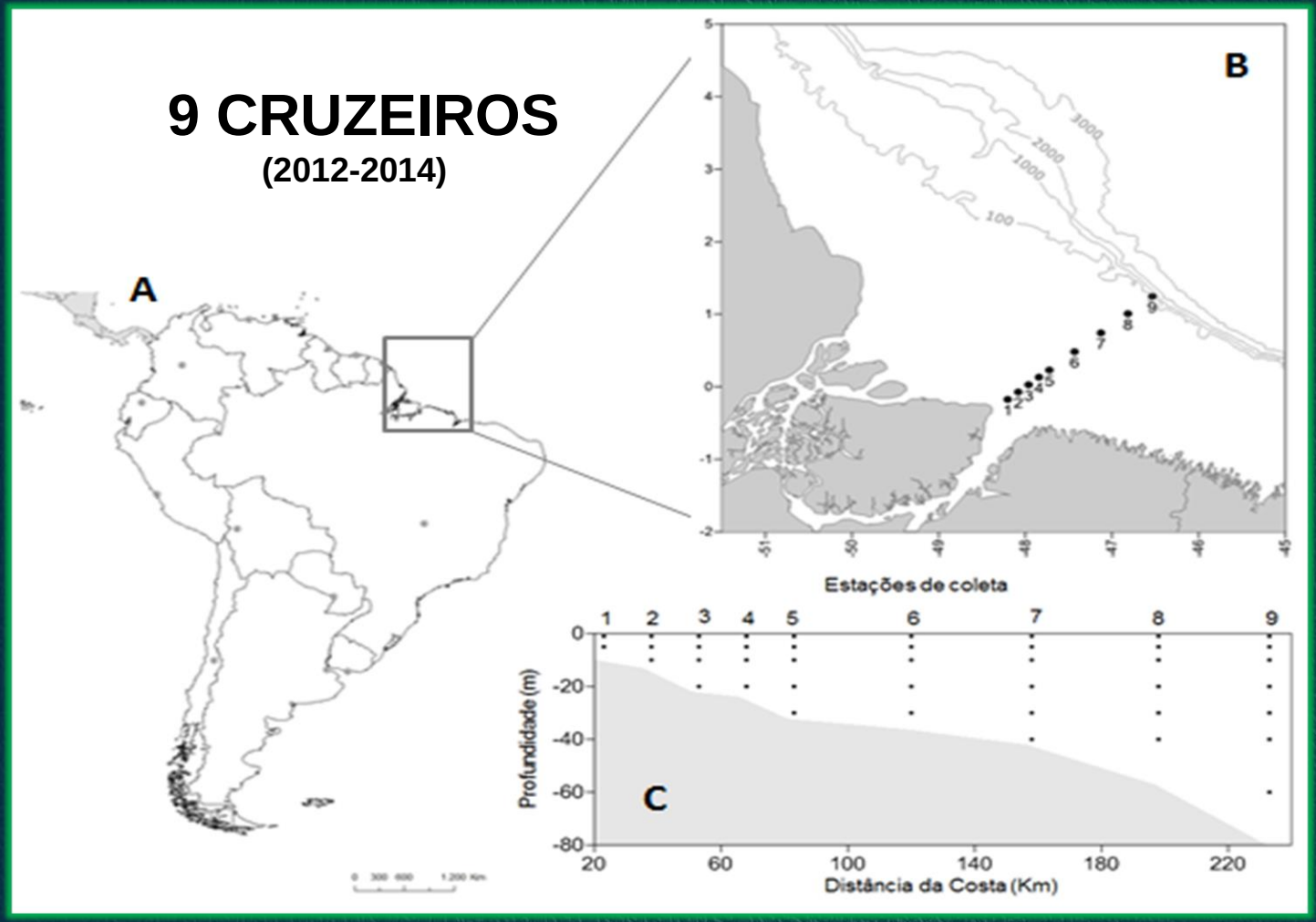


Fig. 4. Distribution, status and overlay of oil and gas blocks and drilling wells with benthic megahabitats in Brazil's Amazon Shelf. Codes FZA, PAMA and BAR refer to the sedimentary basins, as defined by Brazil's National Petroleum Agency.

Ondas internas também poderiam transportar óleo?

Como estudar e entender essas complexas relações?

Indo pra lá!!!!!!



Coletando, estudando. Lendo, horas no laboratório e mais horas ainda no Computador, **GERANDO CONHECIMENTO.**

Brancaleone *Research Vessel*


OCEAN
Protegendo os Ocea


48
05/11/2024


BAD BOY

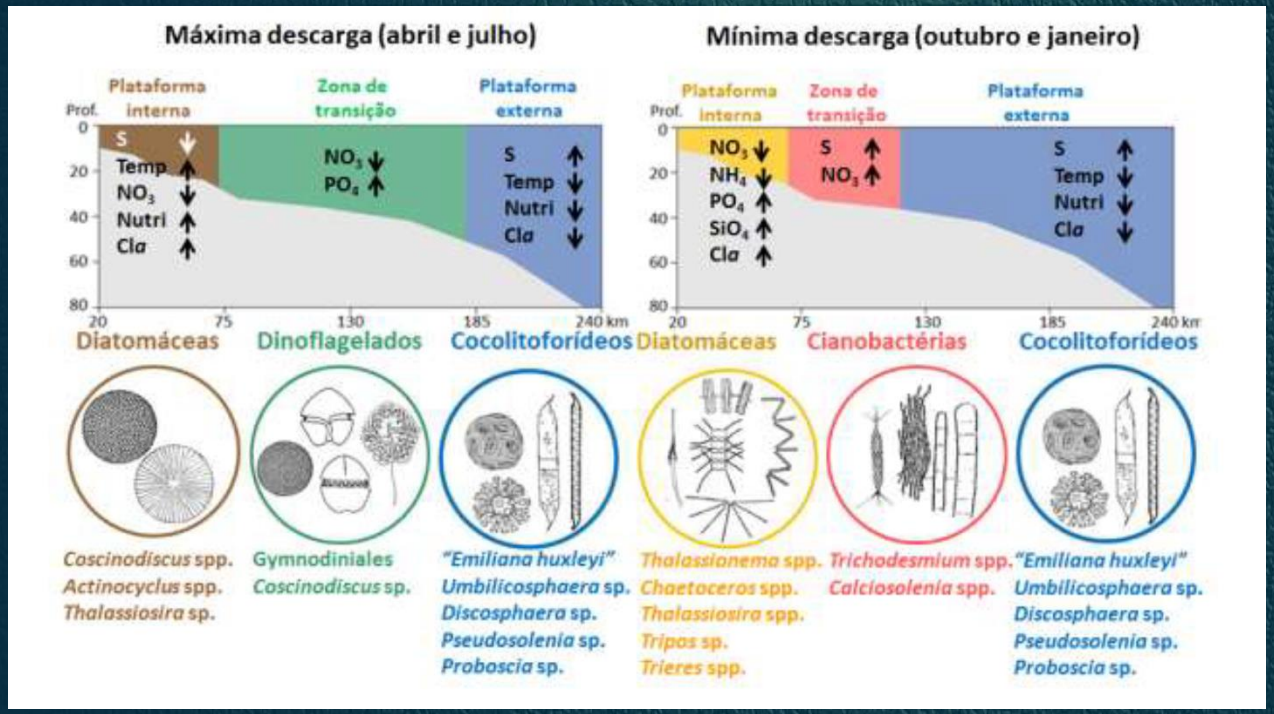

05/11/2024

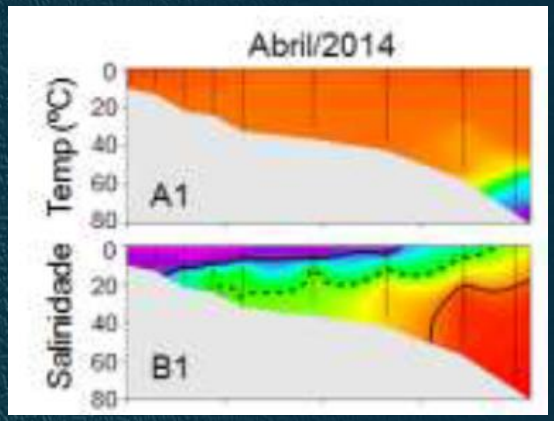
Alguns resultados

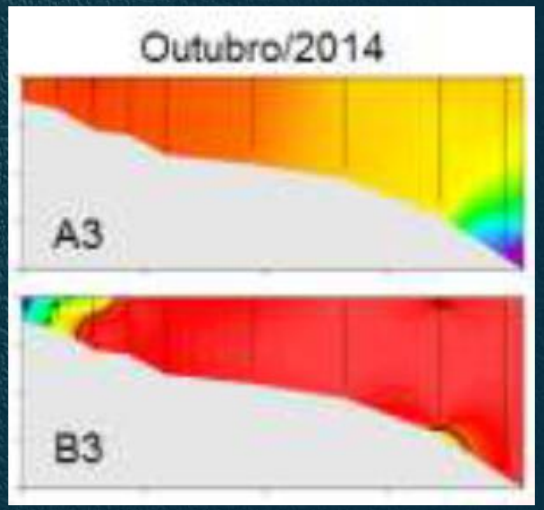
O fitoplâncton na Zona Costeira Amazônica Brasileira: Biodiversidade, distribuição e estrutura no *continuum* estuário-oceano

Caio Brito Lourenço

Tese de doutorado







Rizosolenia e *Hemiaulus* (diatomáceas) *Richelia* (Ciano) - DIAZOTROPIA

PNAS

Amazon River enhances diazotrophy and carbon sequestration in the tropical North Atlantic Ocean

A. Subramaniam*†, P. L. Yager‡, E. J. Carpenter§, C. Mahaffey¶, K. Björkman‖, S. Cooley‡, A. B. Kustka**, J. P. Montoya††, S. A. Sañudo-Wilhelmy‡‡, R. Shipe§§, and D. G. Capone‡‡

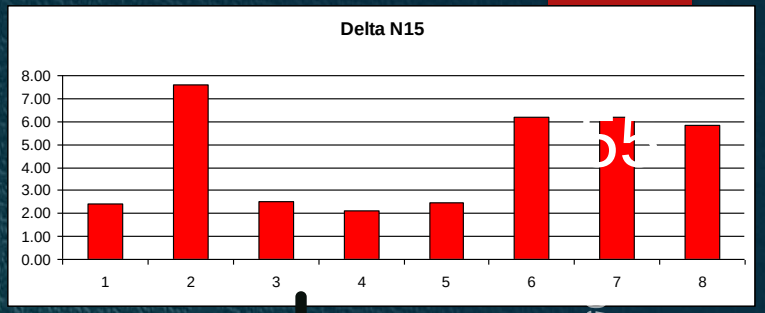
*Lamont–Doherty Earth Observatory, Columbia University, Palisades, NY 10964; ‡Department of Marine Sciences, University of Georgia, Athens, GA 30602; §Romberg Tiburon Center, San Francisco State University, Tiburon, CA 94920; ¶Department of Earth and Ocean Science, University of Liverpool, Liverpool L69 3GP, United Kingdom; ‖Department of Oceanography, SOEST, University of Hawaii, Honolulu, HI 96822; **Institute of Marine and Coastal Sciences, Rutgers, The State University of New Jersey, New Brunswick, NJ 08901; ††School of Biology, Georgia Institute of Technology, Atlanta, GA 30332; ‡‡Wrigley Institute for Environmental Studies and Department of Biological Sciences, University of Southern California, Los Angeles, CA 90089; and §§Department of Ecology and Evolutionary Biology and Institute of the Environment, University of California, Los Angeles, CA 90095

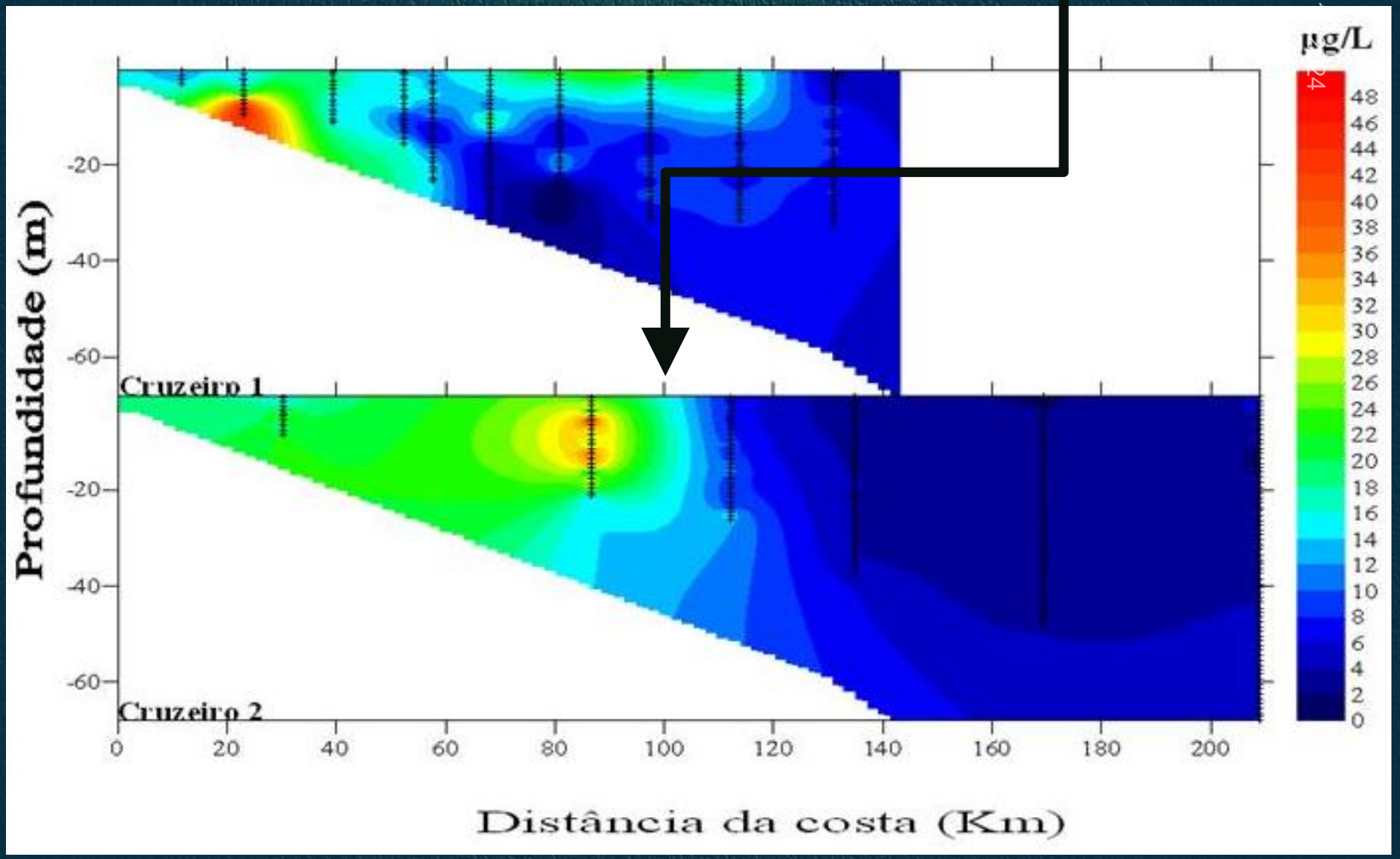
Edited by David M. Karl, University of Hawaii, Honolulu, HI, and approved April 24, 2008 (received for review October 29, 2007)

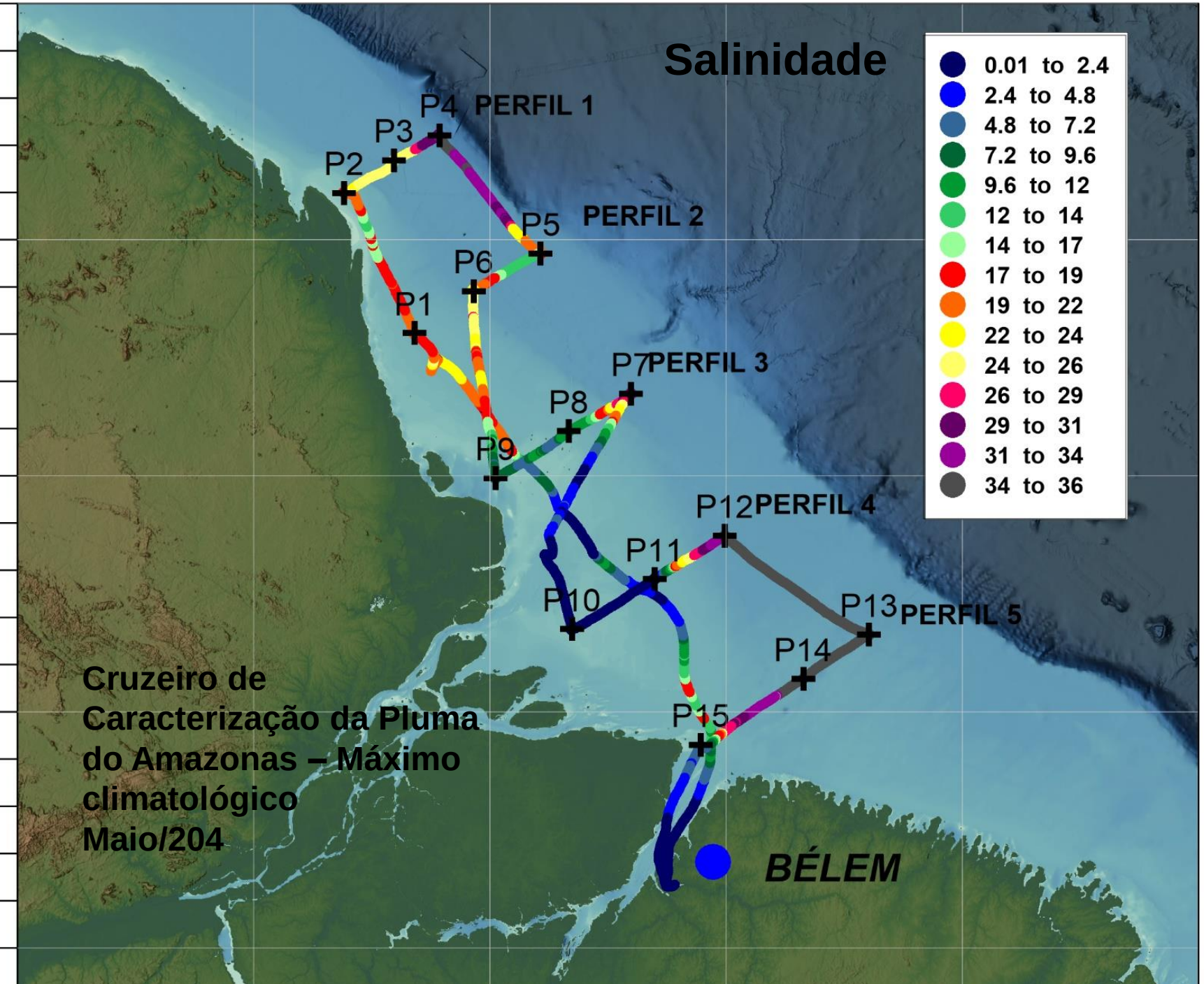

05/11/2024
50 µm

Nitrogênio isotópico baixo no zooplâncton na borda da pluma

Rosangela Souza (mestrado)






Salinidade
0.01 to 2.4
2.4 to 4.8
4.8 to 7.2
7.2 to 9.6
9.6 to 12
12 to 14
14 to 17
17 to 19
19 to 22
22 to 24
24 to 26
26 to 29
29 to 31
31 to 34
34 to 36
P1
P2
P3
P4
PERFIL 1
P5
PERFIL 2
P6
P7
PERFIL 3
P8
P9
P10
P11
P12
PERFIL 4
P13
PERFIL 5
P14
P15
BÉLEM
Cruzeiro de Caracterização da Pluma do Amazonas – Máximo climatológico Maio/204

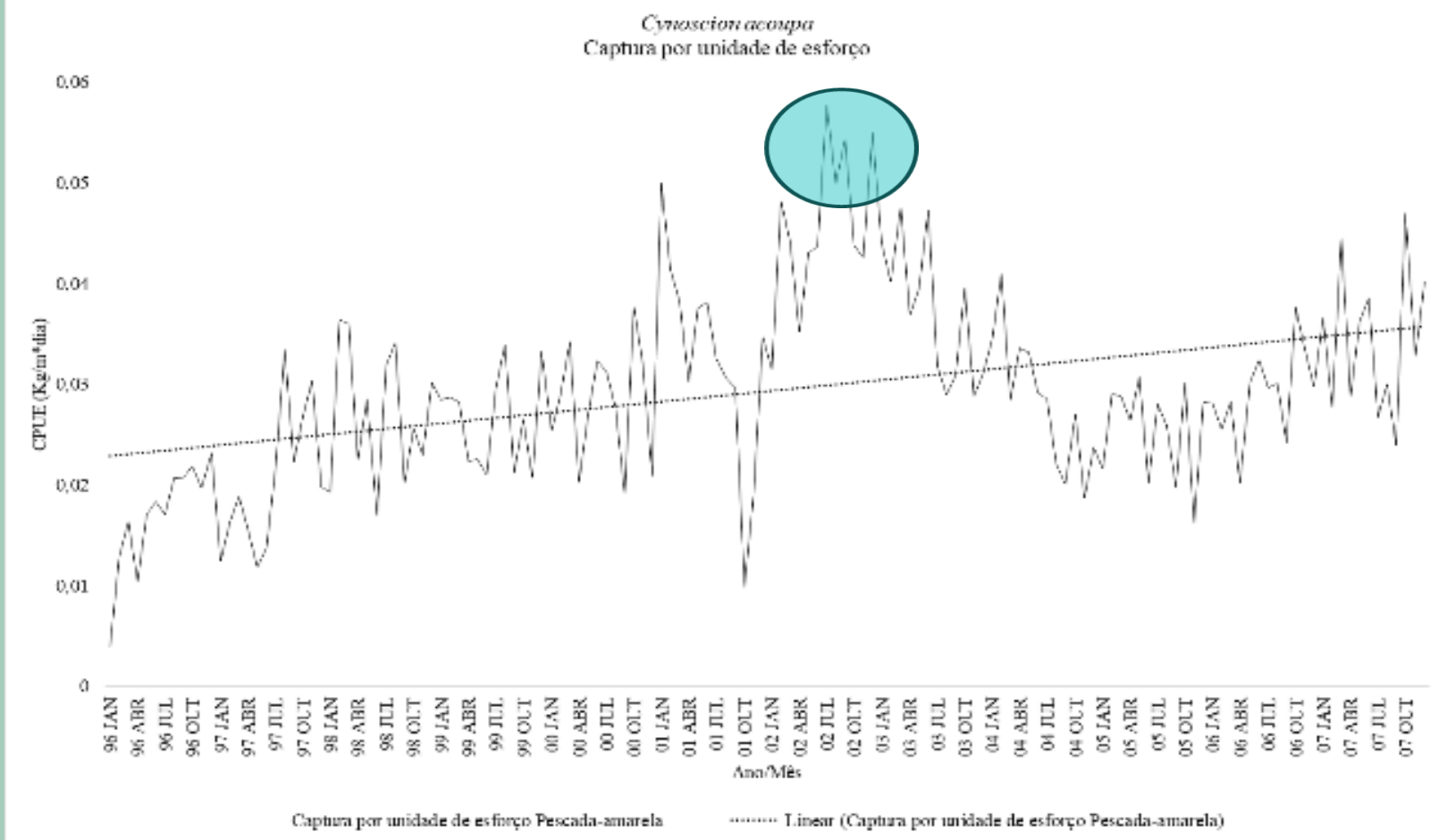
Ecologia e Oceanografia Pesqueira

Análises de séries temporais

EstatPesca – 1998 a 2007 – 700 mil registros de desembarque

Pescada amarela – *Cynoscion acoupa* – 25 mil ton 2002

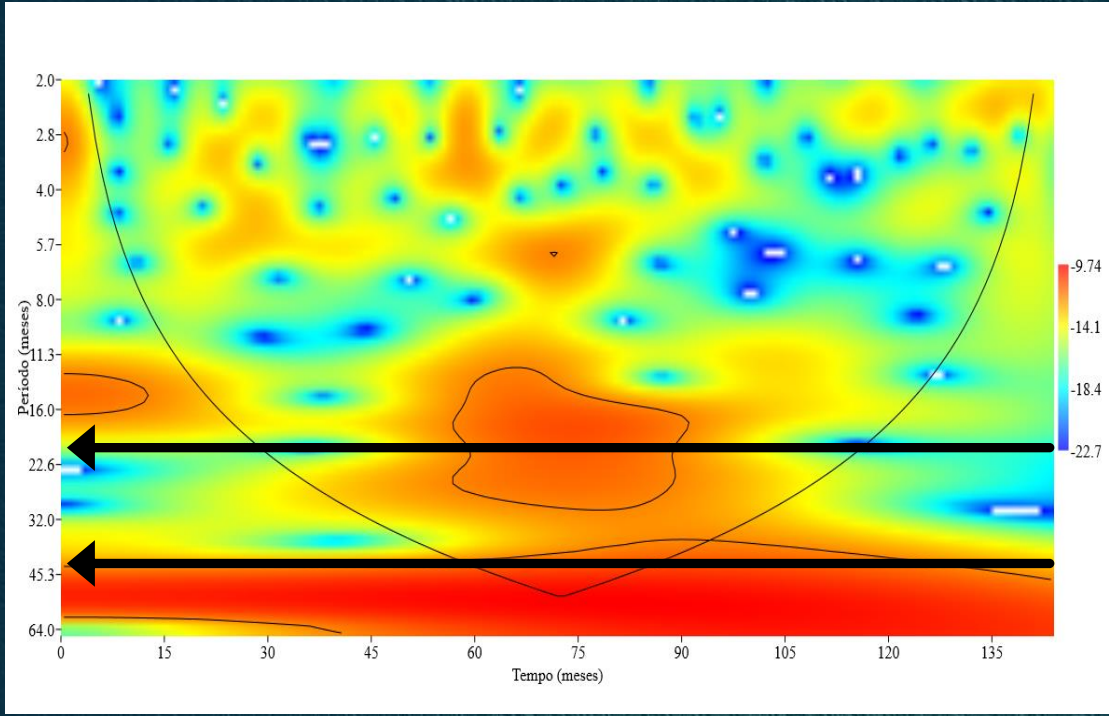
CPUE – Pescada Amarela (jan/1996 – dez/2007)



Dados **ESTATIPESCA** – IBAMA-CEPENOR
Base com cerca de 700 mil registros de desembarques

Dissertação Mestrado
Jeandria Freire

Pescada amarela



CICLOS:

~2 ANOS (AOI)

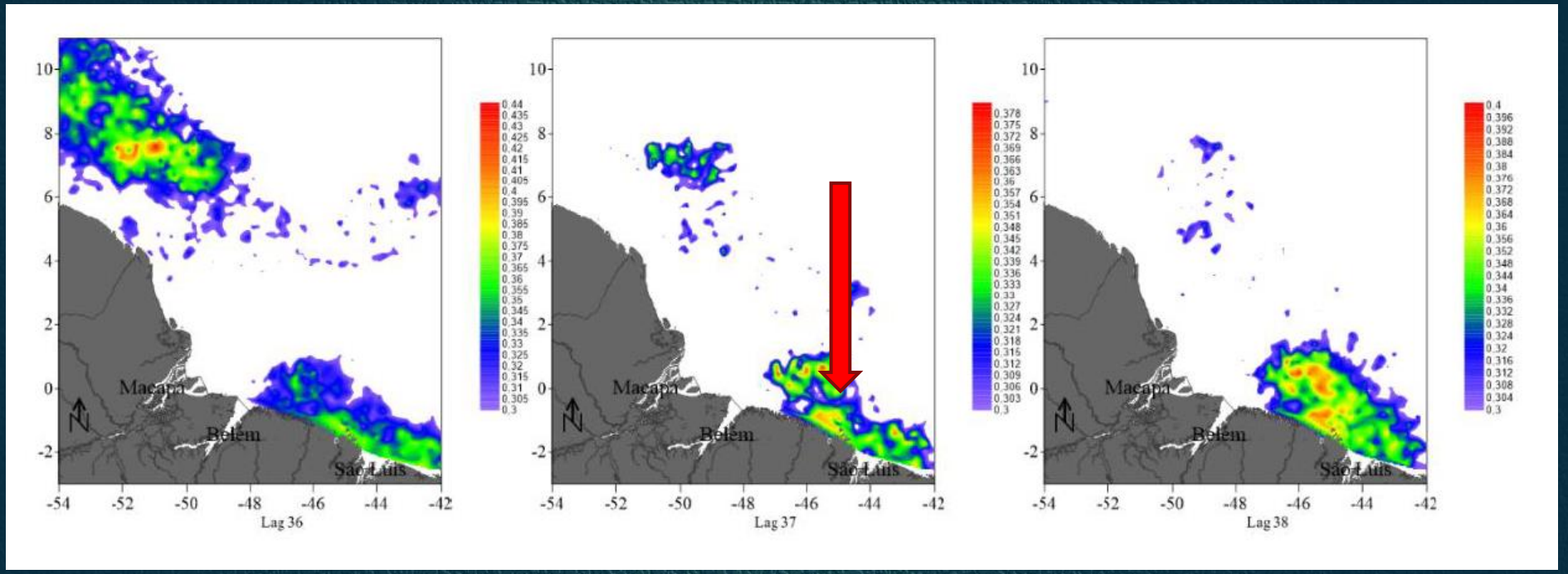
~4 ANOS (El Nino)

ANÁLISE DE SERIE TEMPORAL POR ONDOLETAS

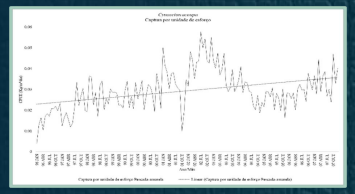
CICLO ANUAL POUCO MARCADO

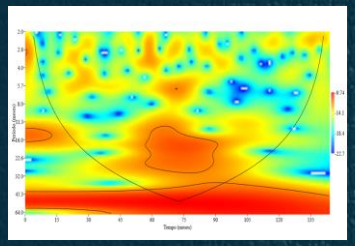
15 espécies estudadas até o momento apresentam periodicidade semelhantes

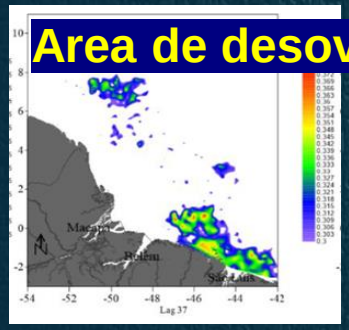
Mapas de Correlação (DEFAZAGENS de 36-38 meses) CPUE x Serie Anomalias TSM (por ponto de grade)



PESCADA AMARELA

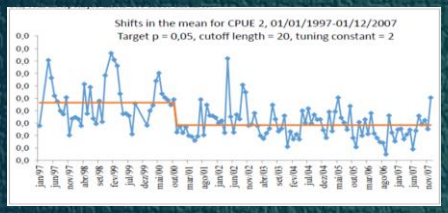


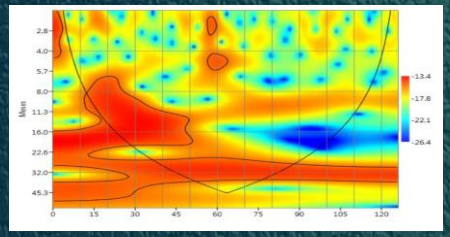




PIRAPEMA


Fonte: Registro de Raulí Marssena (dados não publicados).





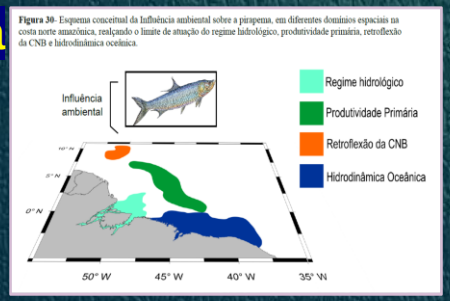
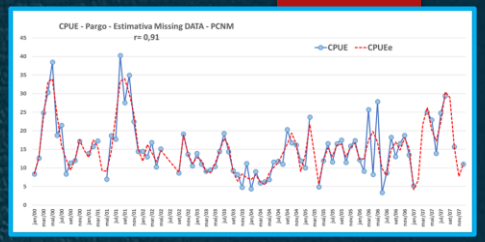
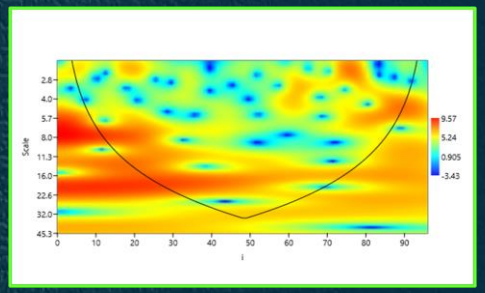


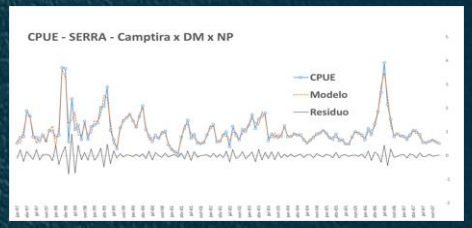
Figura 30- Esquema conceitual da Influência ambiental sobre a pirapema, em diferentes domínios espaciais na costa norte amazônica, realçando o limite de atuação do regime hidrológico, produtividade primária, retroflexão da CNB e hidrodinâmica oceânica.

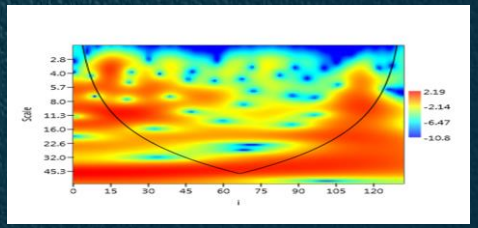
PARGO





SERRA

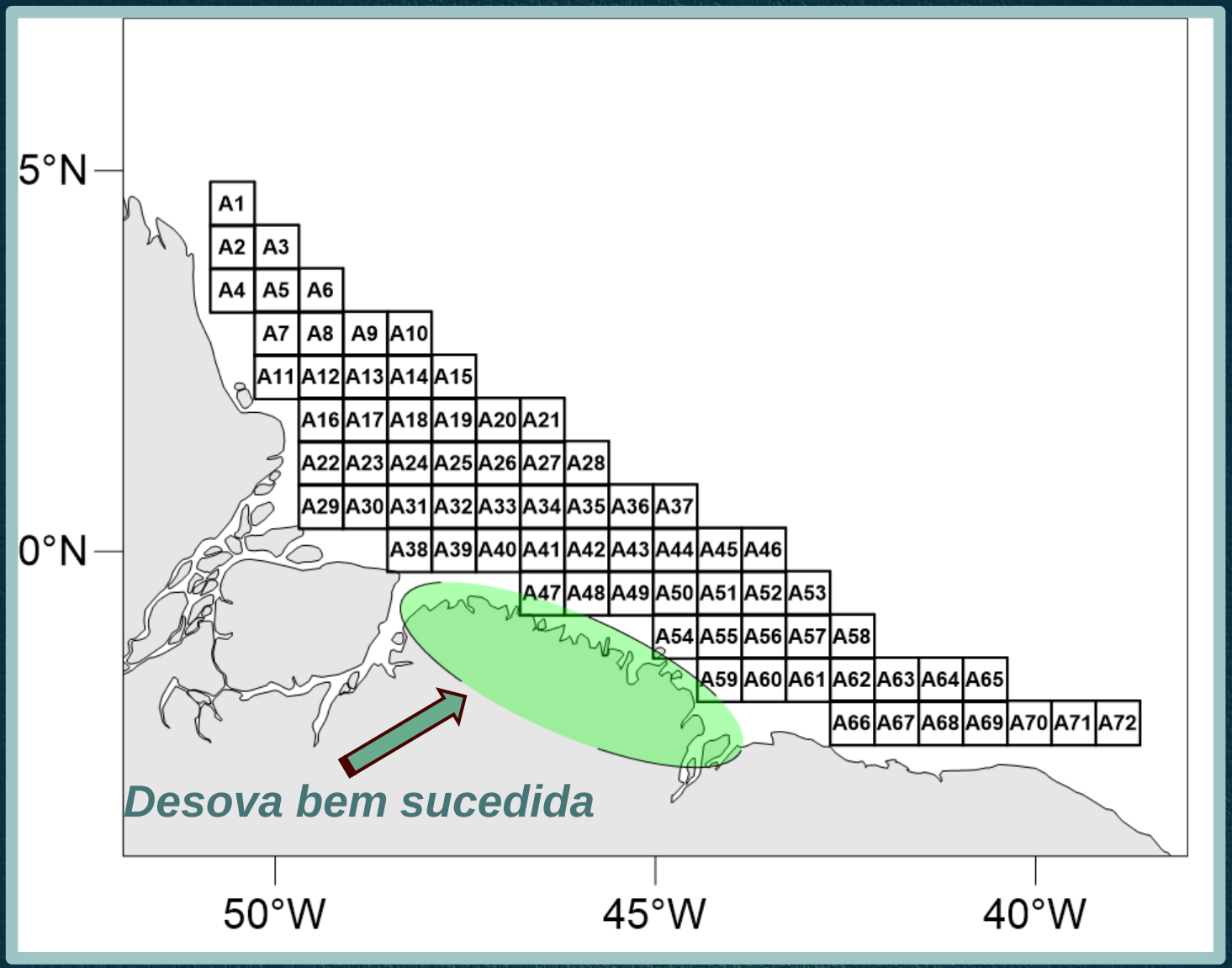




MODELAGEM HIDRODINÂMICA

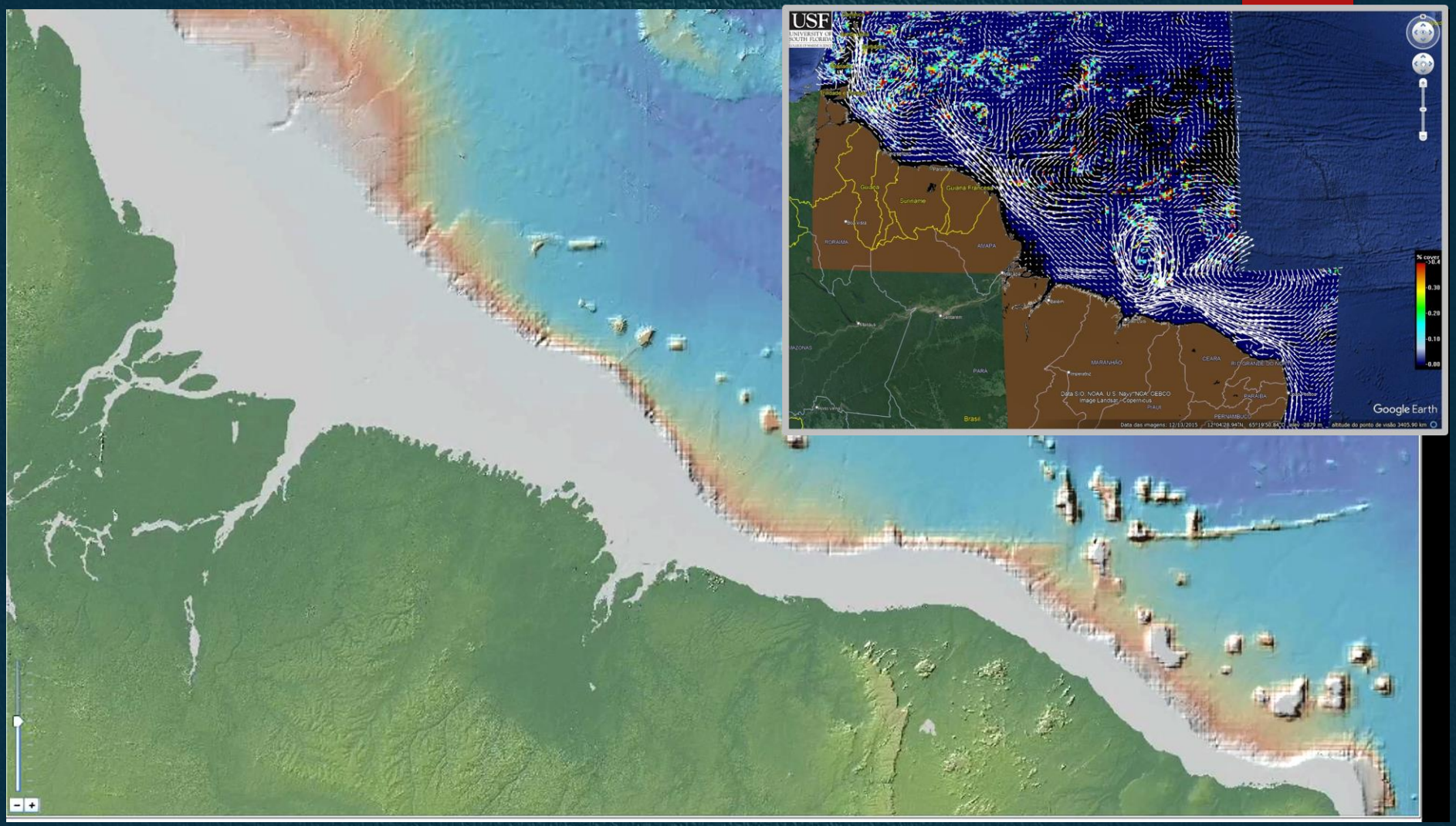
Foi utilizado o Regional Ocean Modeling System (ROMS) para realizar simulações oceânicas na porção oeste do oceano Atlântico tropical Norte. Posteriormente acoplado ao modelo biofísico ICHTYOP, com parâmetros estimados para as larvas de pescada amarela da literatura

Nelson Golveia et all em preparação



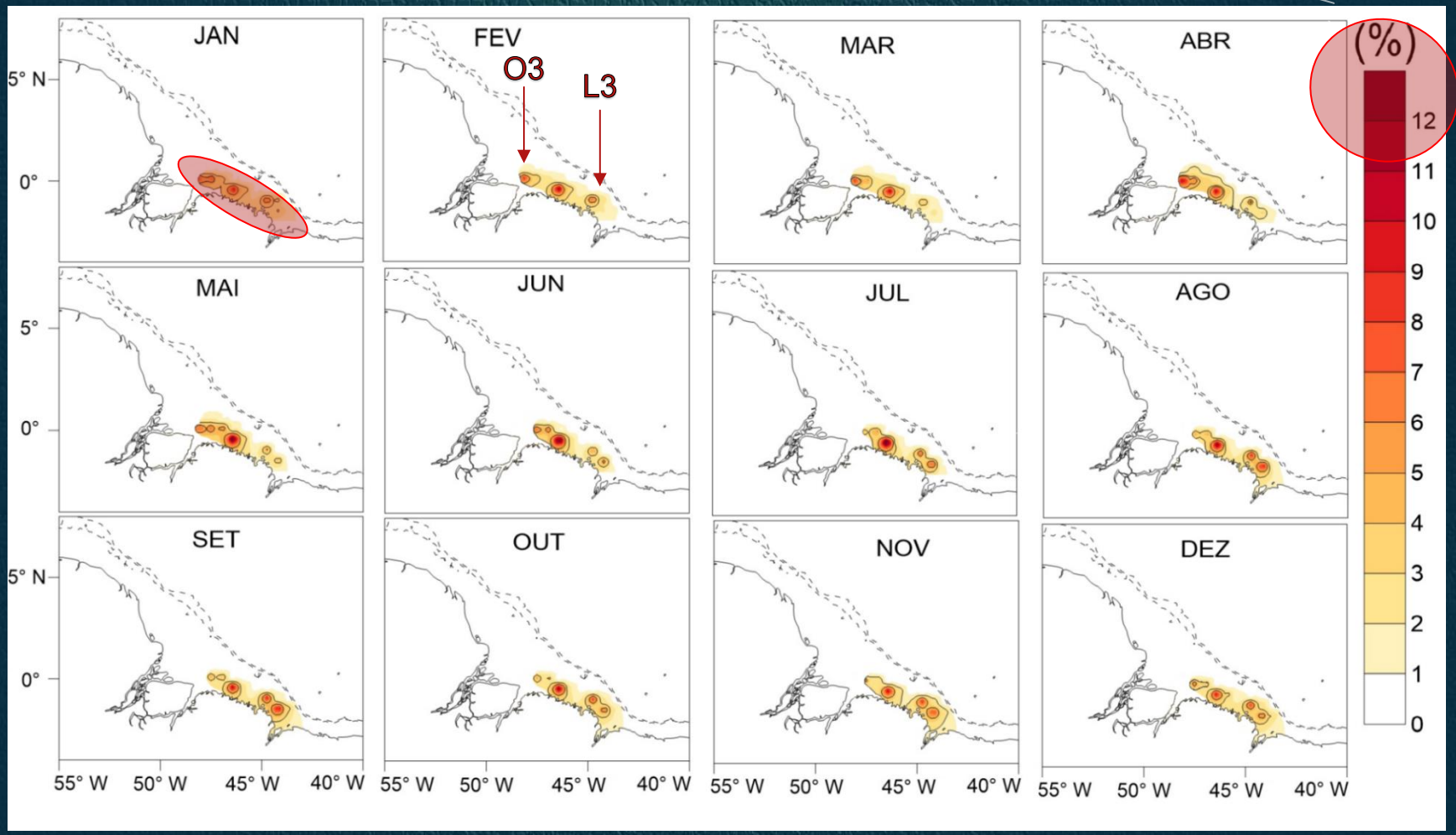
Simulação com 600 mil larvas nos períodos reprodutivos mensal por 20 anos 1996-2015

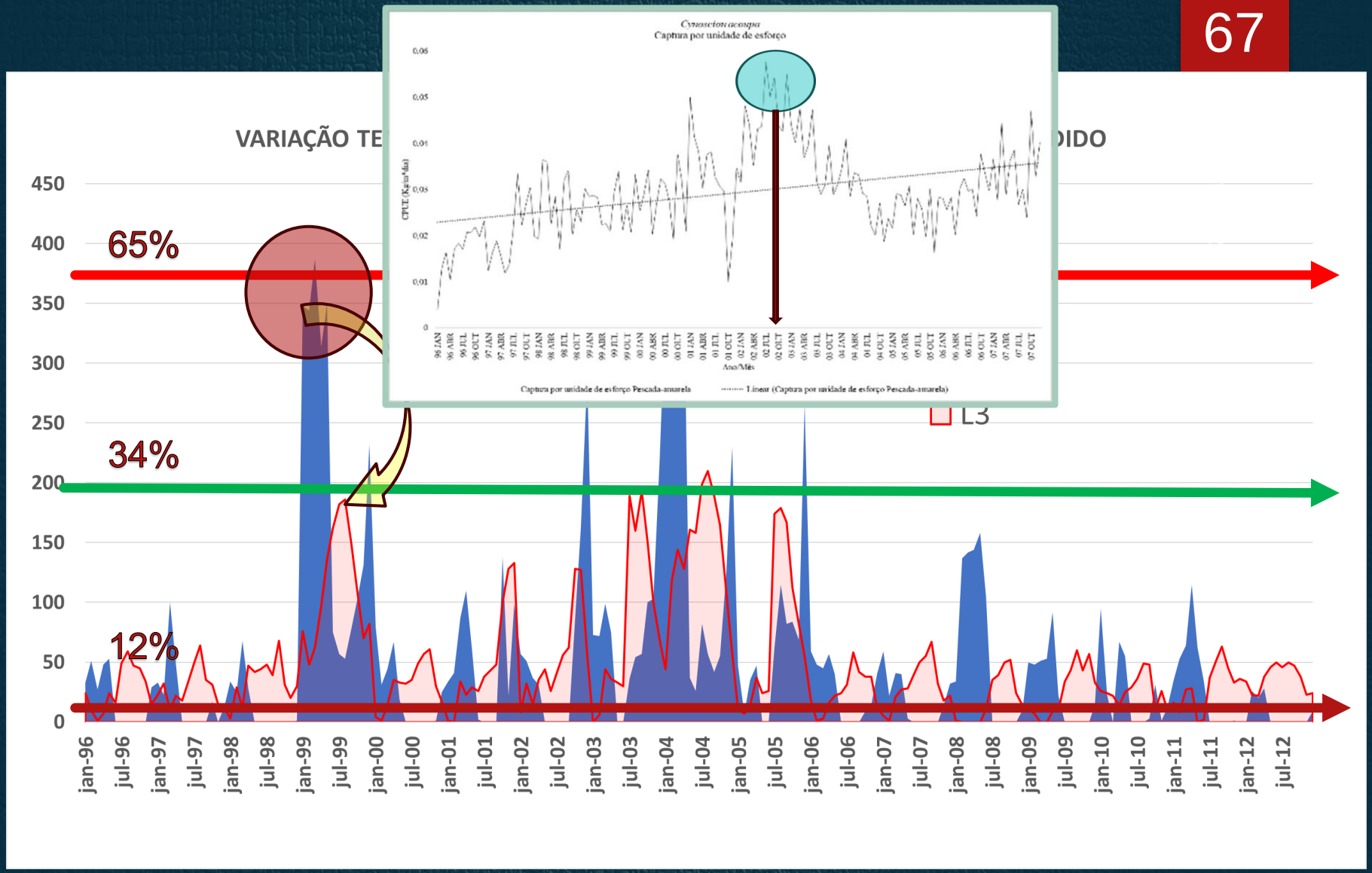
Trajetórias de partículas – ICHTYOP-ROMS



Probabilidades de médias de desova entre 1996 e 2012.

(verificar certa semelhança com Mapa de correlação slide 63)





Hipótese: Anomalia de vorticidade

- Presença de fortes sinais Interanuais ligados à Teleconeções com:

- Pacífico,
- Atlântico Norte e
- Antártica

Contents lists available at ScienceDirect

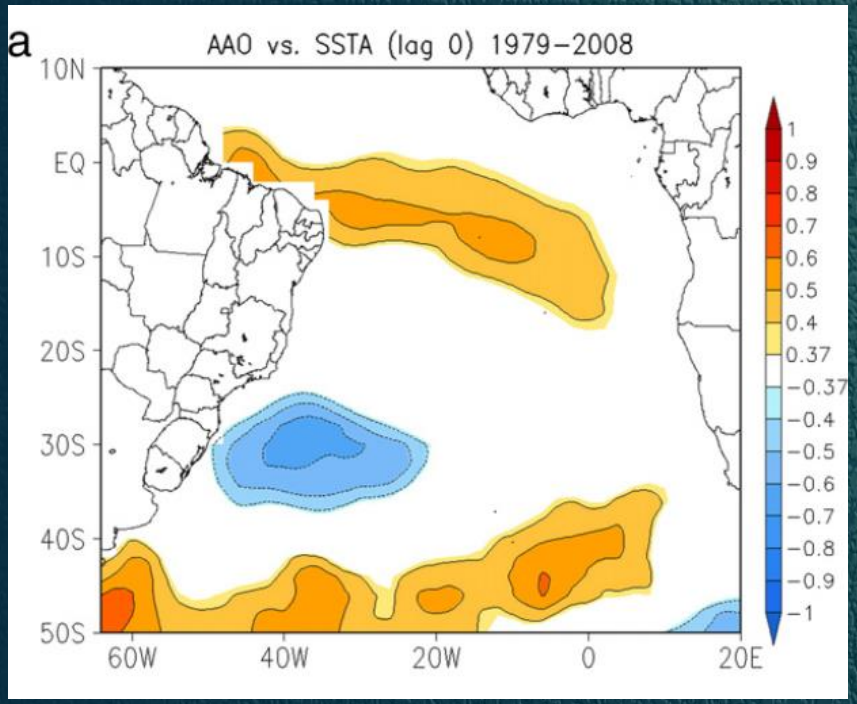
Journal of Marine Systems

journal homepage: www.elsevier.com/locate/jmarsys

Patterns of interannual climate variability in large marine ecosystems

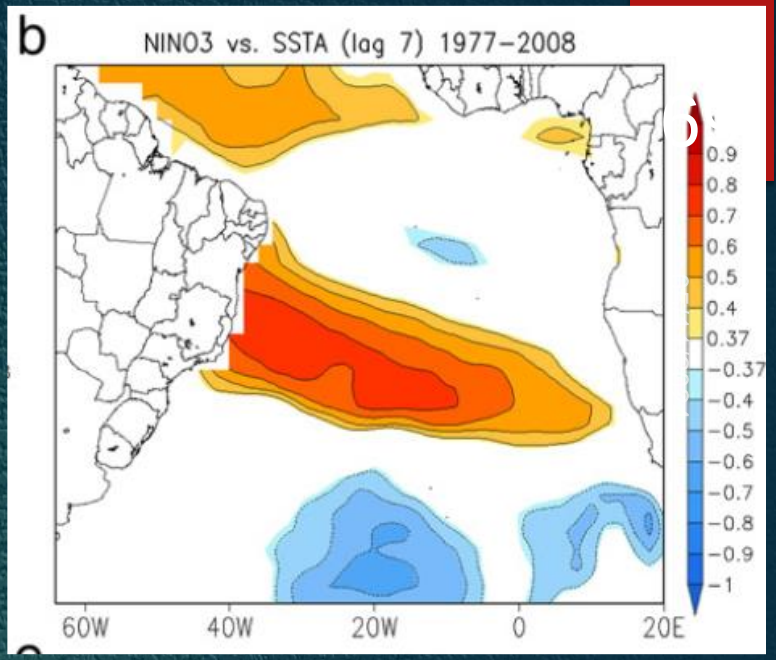
Helena Cachanhuk Soares [a,*], Douglas Francisco Marcolino Gherardi [a], Luciano Ponzi Pezzi [a], Mary Toshie Kayano [b], Eduardo Tavares Paes [c]

[a] Divisão de Sensoriamento Remoto – Instituto Nacional de Pesquisas Espaciais (INPE), Av. dos Astronautas, 1758, São José dos Campos, SP 12227-010, Brazil
[b] Centro de Previsão de Tempo e Estudos Climáticos (CPTEC) – INPE, Rodovia Presidente Dutra, km 39, Cachoeira Paulista, SP 12630-000, Brazil
[c] Instituto Socioambiental e dos Recursos Hídricos (ISARH), Universidade Federal Rural da Amazônia, Avenida Presidente Tancredo Neves 2501, Belém, PA 66077-901, Brazil



Influencia do AAO na ATSM

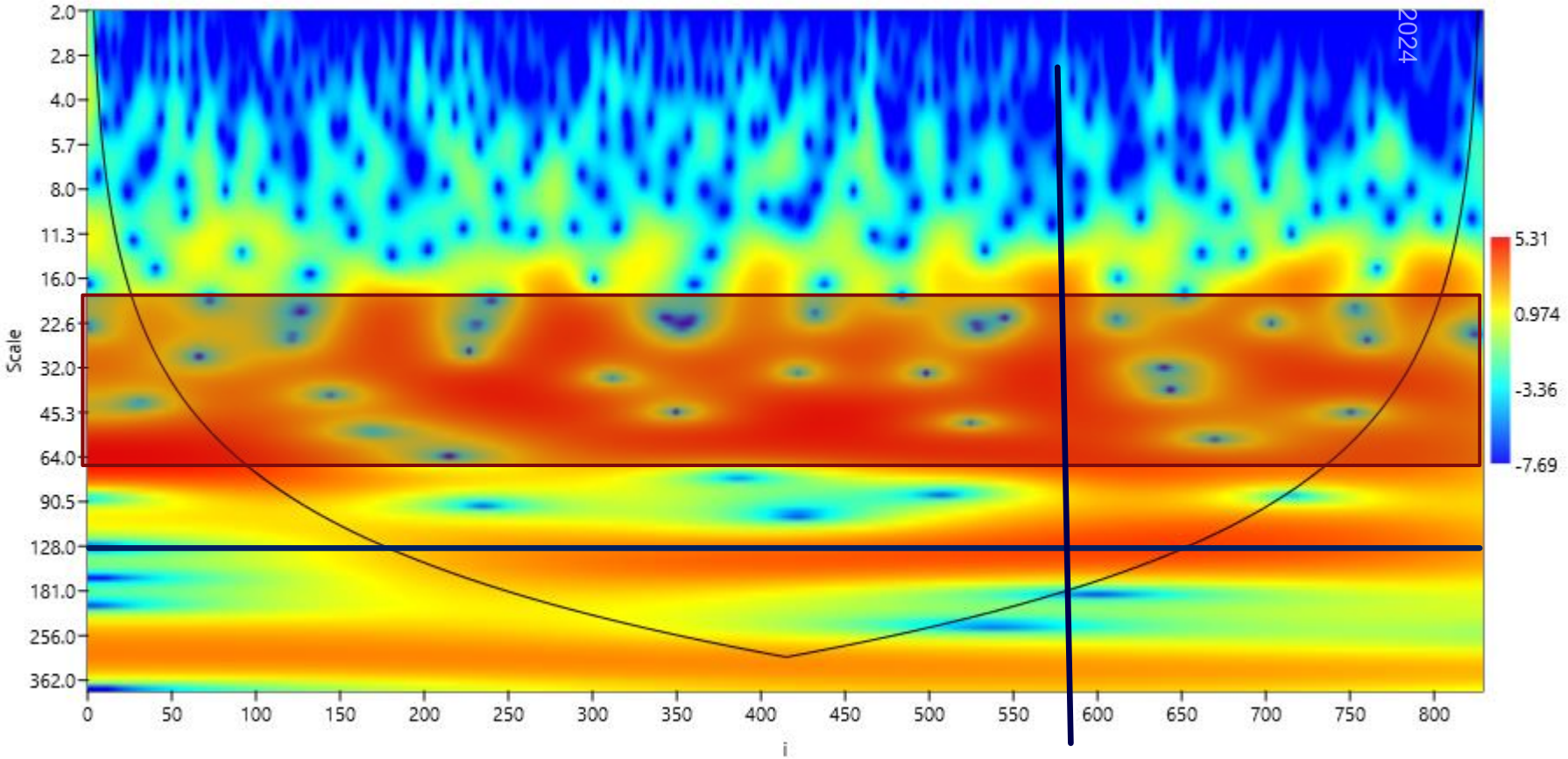
El Nino e AAO – ciclos 2 anos



Influencia do El Nino na ATSM

El Nino – ciclos 2-7 anos

Wavelet Nino 3.4 – (faixa 2 a 7 anos, e 11 anos – **Ciclo Solar**)

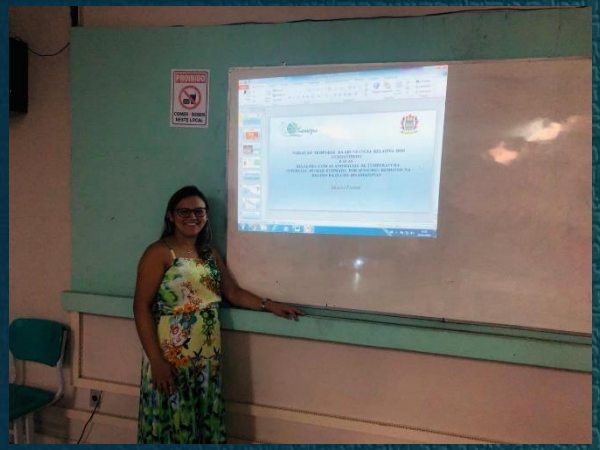


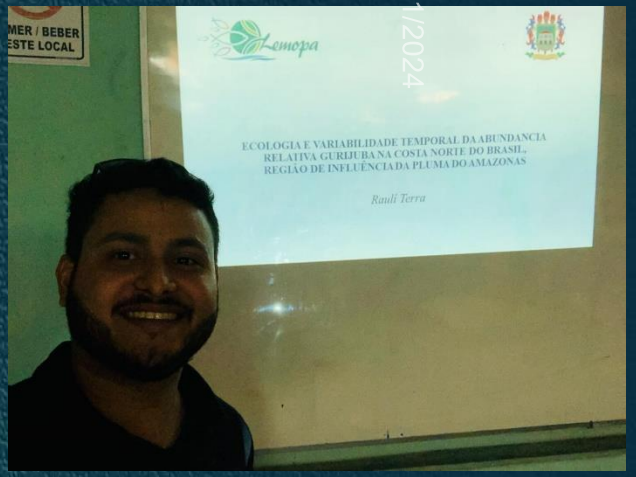
Sinal de maior potencia = 3,6 anos = 43 meses

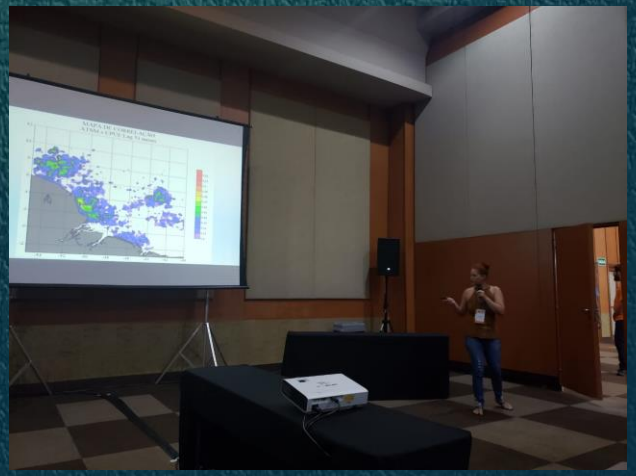
1998

Plataforma Continental Norte Brasileira:

Síntese







Ecology Letters, (2003) **6**: 673–679 doi: 10.1046/j.1461-0248.2003.00483.x

IDEAS AND PERSPECTIVES

Meta-ecosystems: a theoretical framework for a spatial ecosystem ecology

Michel Loreau[1]*, Nicolas Mouquet[2,4] and Robert D. Holt[3]

[1]Laboratoire d'Ecologie, UMR 7625, Ecole Normale Supérieure, 46 rue d'Ulm, F–75230 Paris Cedex 05, France

[2]Department of Biological Science and School of Computational Science and Information Technology, Florida State University, Tallahassee, FL 32306-1100, USA

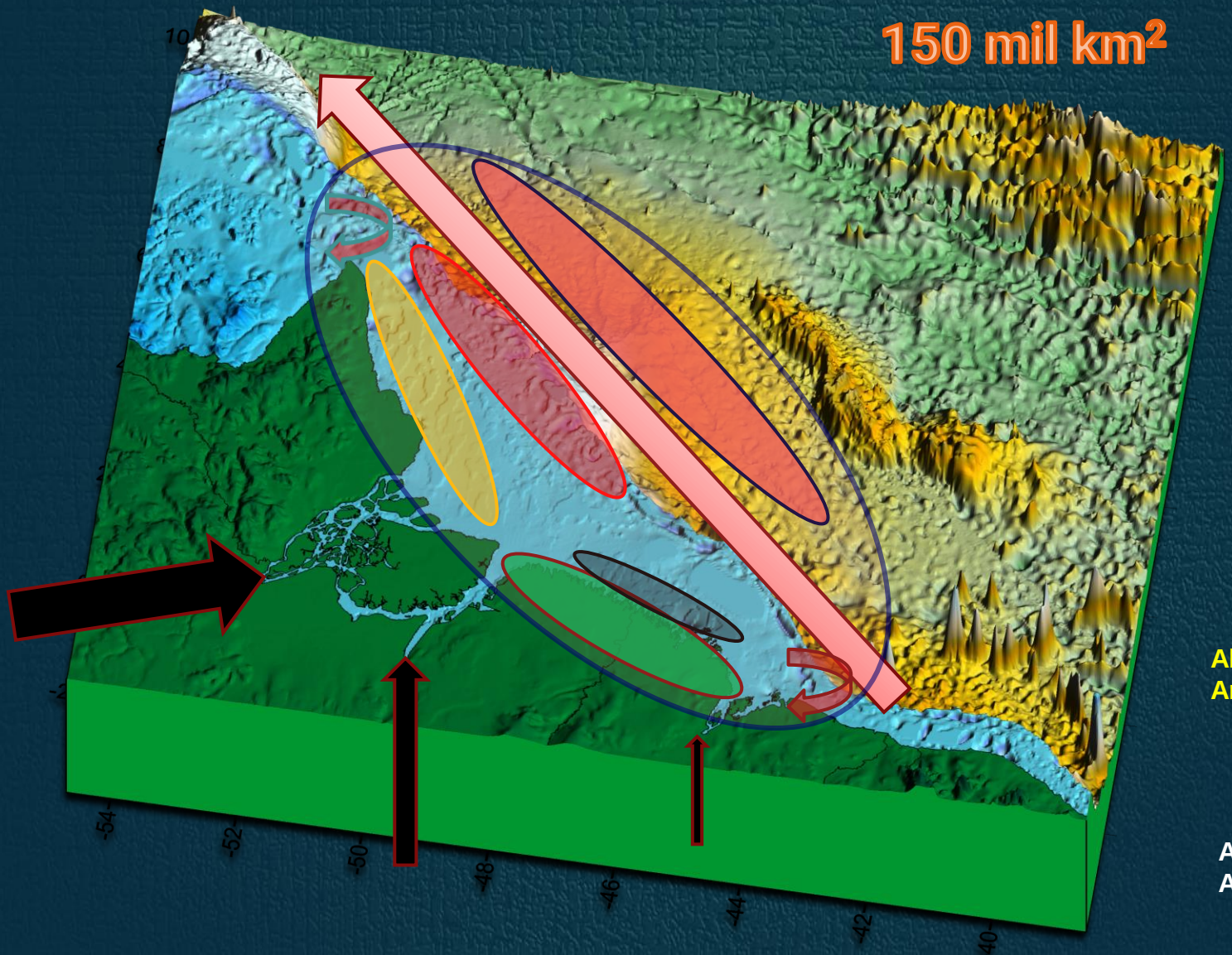
[3]Department of Zoology, University of Florida, 111

Abstract

This contribution proposes the meta-ecosystem concept as a natural extension of the metapopulation and metacommunity concepts. A meta-ecosystem is defined as a set of ecosystems connected by spatial flows of energy, materials and organisms across ecosystem boundaries. This concept provides a powerful theoretical tool to understand the emergent properties that arise from spatial coupling of local ecosystems, such as global source–sink constraints, diversity–productivity patterns, stabilization of ecosystem processes and indirect interactions at landscape or regional scales. The meta-ecosystem perspective thereby has the potential to integrate the perspectives of community and landscape ecology, to provide novel fundamental insights into the dynamics and functioning of ecosystems from local to global scales, and to increase our ability to predict the consequences of land-use changes on biodiversity and the provision of ecosystem services to human societies.

Bases teóricas consistentes

Sistema de Meso escala semi-fechado com forte controle por teleconexões - METAECOSSISTEMA



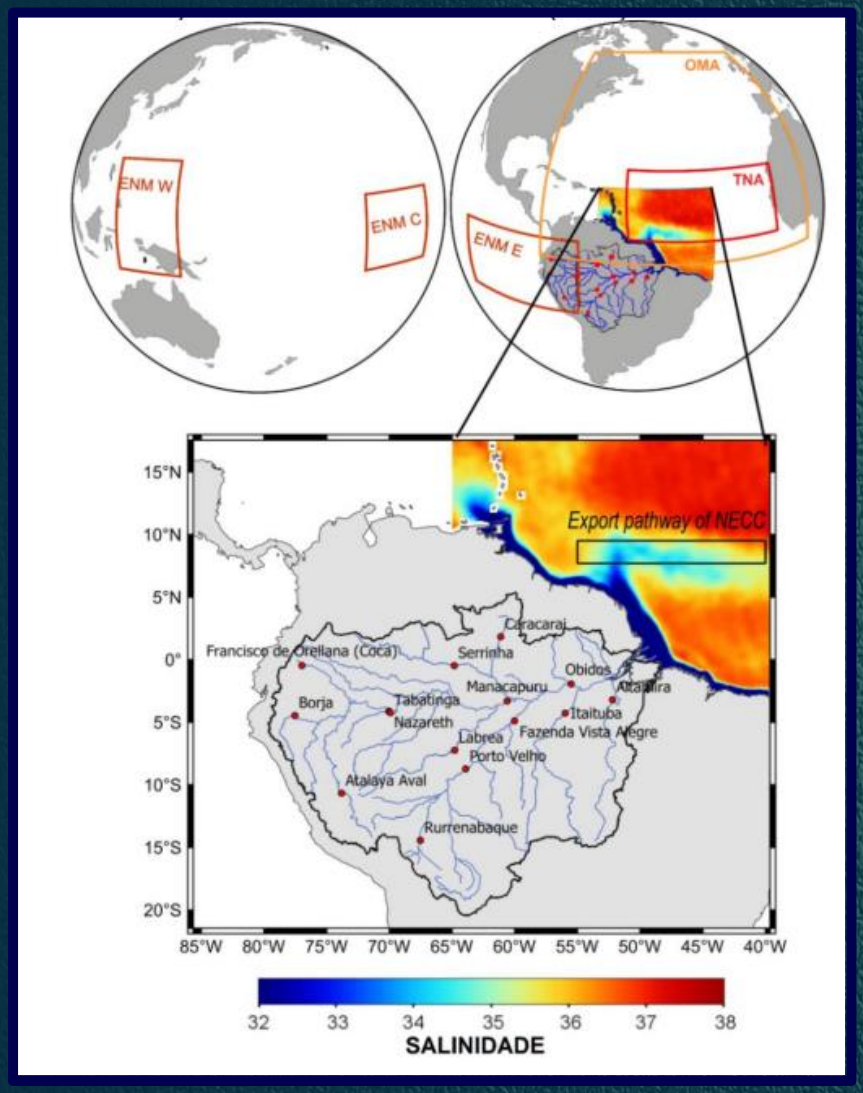
Retenção Larval offshore

Agregações reprodutivas

Criação de juvenis

Alimentação adultos Ambiente lamoso

Alimentação adultos Ambiente coralino



Gouveia, 2019

Se consideramos o grande sistema Bacia amazônica e mar amazônico Podemos pensar em um SUPERSISTEMA AMAZÔNICO

Anais do XVIII Simpósio Brasileiro de Sensoriamento Remoto -SBSR

ISBN: 978-85-17-00088-1

28 a 31 de Maio de 2017
INPE Santos - SP, Brasil

Ecohydrology of the Amazon supersystem

Douglas Francisco Marcolino Gherardi [1]
Nelson de Almeida Gouveia [1]
Fabien Huber Wagner [1]
Luiz Eduardo Oliveira e Cruz de Aragão [1]
Eduardo Tavares Paes [2]

... mais isso é uma outra história

“Às vezes, as coisas que nos são mais importantes permanecem desconhecidas, escondidas por trás da sua familiaridade”

Ludwig Wittgenstein

Vamos Navegar!!!!