

PROPRIEDADES FÍSICAS DA ÁGUA DO MAR



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Perguntem, leiam, perguntem de novo



Tópicos a serem abordados

Datas de Provas

- Definições, Divisões, Relações com outras ciências
- Metodologias empregadas: coleta de dados: cruzeiros, fundeios, bóias de deriva e similares (gliders, ROV), sensoriamento remotos, modelagem numérica.
- Equipamentos e técnicas
- Propriedades Física da Água do Mar: temperatura, salinidade, densidade, volume específico, anomalias
- Diagrama T/S
- Massas de Água: processos de formação e análise de massas de água
- Processos de propagação de luz na água do mar
- Processos de propagação do som na água do mar
- Aulas práticas em todos os itens: faz parte da avaliação.

- Provas: 21/05 (1ª. Prova Parcial); 15/07 (2ª. Prova Parcial); 23/07 (segunda chamada 1ª. e 2ª. PPs).
- Segunda chamada – regras da FURG.

LINKS:

<http://www.jason.oceanobs.com/>

AVISO/CNES

<http://topex-www.jpl.nasa.gov/>

TOPEX/NOAA

<http://oceanworld.tamu.edu/>

TEXAS A&M

<http://www.woce.org>

WOCE

<http://www.clivar.org>

CLIVAR

<http://www.lei.furg.br/ocfis/mattom/> Tomczak's Page

<http://podaac.jpl.nasa.gov>

NASA/PODAAC

Referências

1. Tchernia P (1980) Descriptive Regional Oceanography. Pergamon Press, Oxford.
2. Tomczak M, Godfrey JS (1994). Regional oceanography: An Introduction. Pergamon Press, Oxford, 422pp. Disponível cd-rom e página lei
3. Steward, R. (2002). Introduction to Physical Oceanography. Disponível cd-rom e página TAMU.
4. Talley, L.D., Pickard G. L., Emery, W.J., Swift, J.H. (2011) Descriptive Physical Oceanography: an Introduction. Pergamon Press, Oxford.
5. Garrison, T. (2010). Fundamentos de Oceanografia. Cengage.
6. Open University. (Evelyn Brown, Angela Colling, Dave Park, John Phillips, Dave Rothery and John Wright). Ocean Circulation.

Oceanografia Física

- Área da Oceanografia cujo objetivo é o estudo dos movimentos das águas oceânicas, das forças que os causaram e das conseqüências que estes acarretam
- **Movimentos**
- Escalas temporais –segundos – interanuais, decadais
- Correntes
 - De maré
 - Geradas pelo vento
 - Termohalinas
- Ondas
 - Longo período
 - Marés
 - Ondas geradas por ventos
 - Ondas Internas

Oceanografia Física

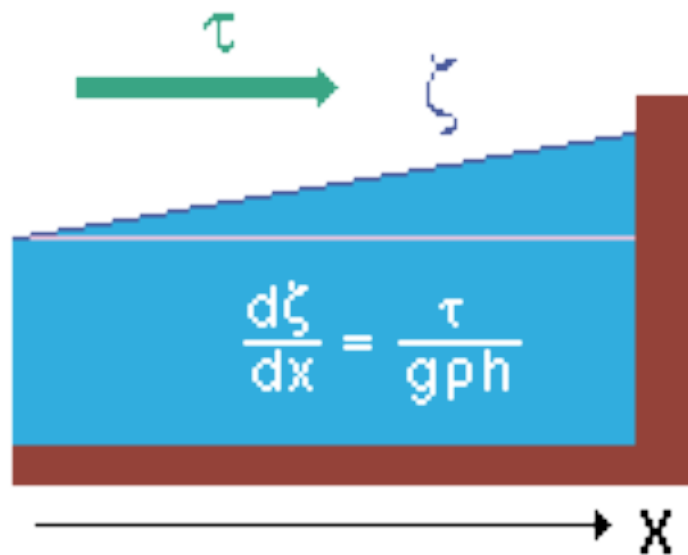
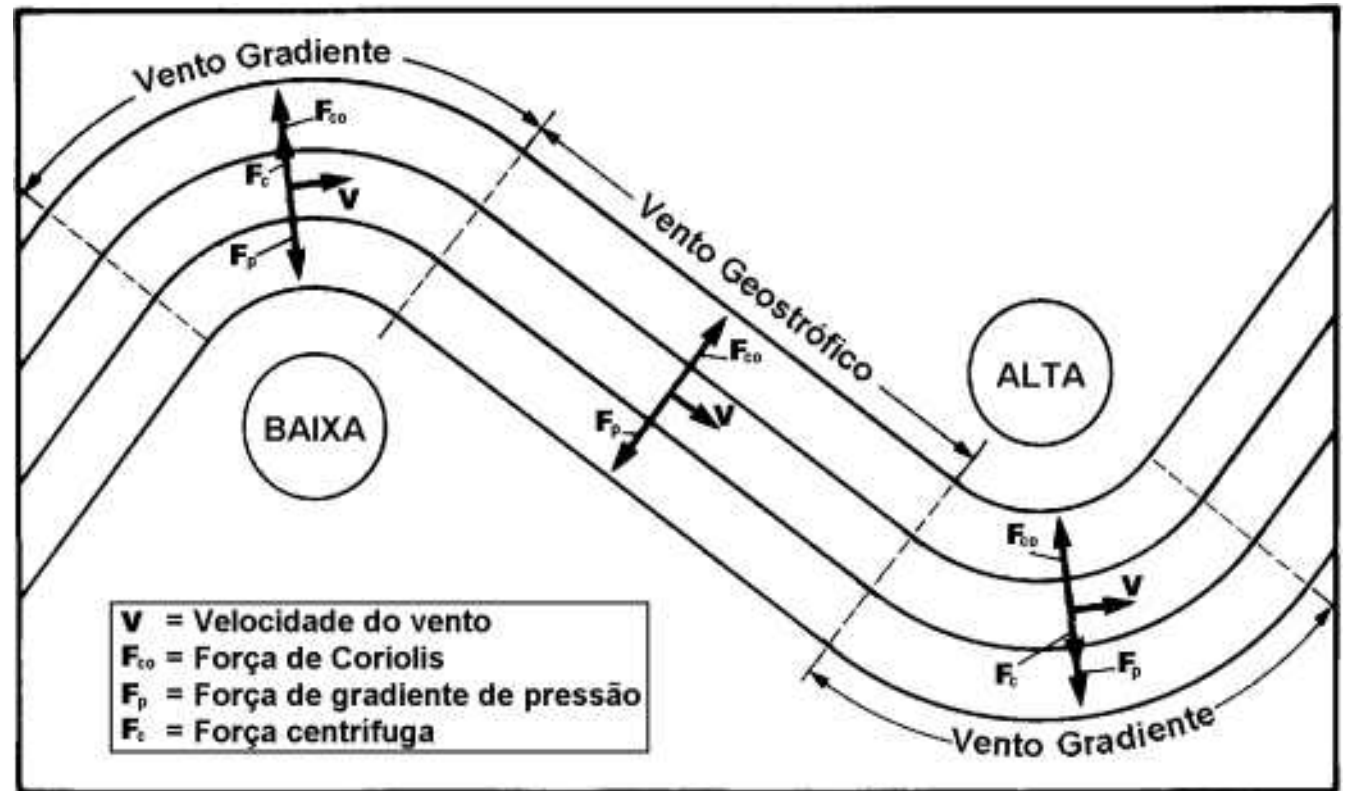
- **Forças**

- Escalas temporais – segundos – interanuais, decadais
- Gravidade g – inclui a força centrífuga
- Fricção – vento, fricção interna, fricção com o fundo
- Gradiente de Pressão – plano inclinado
- Coriolis – força não inercial $f = 2\Omega \sin \phi$ – onde:
- Ω – velocidade angular da terra: $7,29 \times 10^{-5}$ rd/s
- Φ – latitude do local - + hemisfério norte
- Centrífuga – V^2/R – onde R é o raio do movimento

- **Equações**

- **Movimento**
- $du/dt = -1/\rho (\partial P/\partial x) + 2\Omega \sin\phi v - 2\Omega \cos\phi w + F_x$ (outras forças- fricção tangencial, interna, maré)
- $dv/dt = -1/\rho (\partial P/\partial y) - 2\Omega \sin\phi u + F_y$
- $dw/dt = -g - 1/\rho (\partial P/\partial z) + 2\Omega \cos\phi u + F_z$

- Equilíbrio hidrostático $dP = \rho g dz$
- Continuidade
- Advecção-difusão
- <http://www.lei.furg.br/ocfis/mattom/IntroOc/por/lecture06.html>



Modelo de Ekman

- Equilíbrio entre F_{Coriolis} e tensão do vento
- Oceano sem bordas e profundidade ilimitada
- Gradiente de pressão nulo
- Vento constante
- Termo de turbulência constante

f – termo de Coriolis

$$fv = K_z \frac{\partial^2 u}{\partial z^2}$$

K_z Coef. de difusão
turbulenta

$$- 1.3 - 1.5 \times 10^{-3} \text{ m}^2 \text{ s}^{-1}$$

V_0 – velocidade na
superfície

D_e – espessura da camada
de Ekman

$$fu = -K_z \frac{\partial^2 v}{\partial z^2}$$

$$u = + / - V_0 \cos\left(\frac{\pi}{4} + \frac{\pi z}{D_e}\right) \exp\left(-\frac{\pi z}{D_e}\right)$$

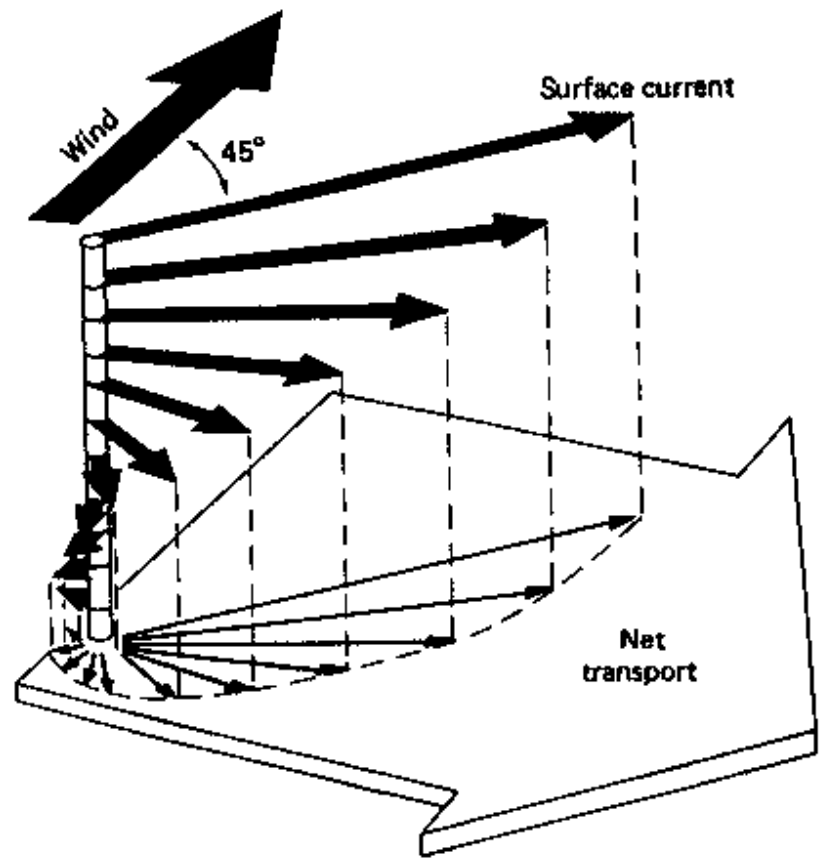
W – velocidade do vento

U, v – velocidades em x e
 y

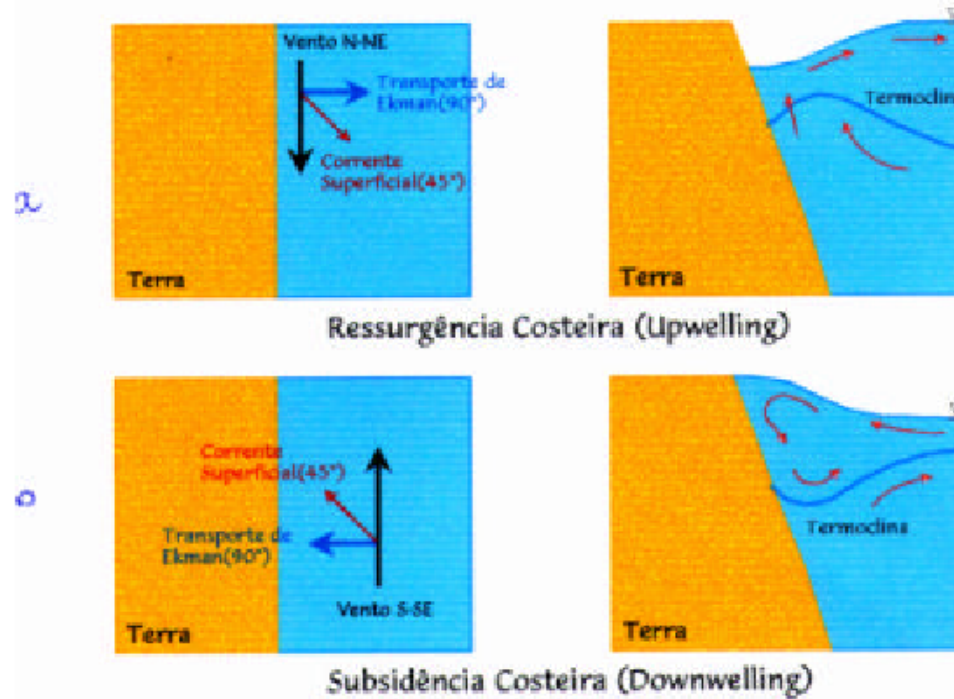
$$v = V_0 \text{sen}\left(\frac{\pi}{4} + \frac{\pi z}{D_e}\right) \exp\left(-\frac{\pi z}{D_e}\right)$$

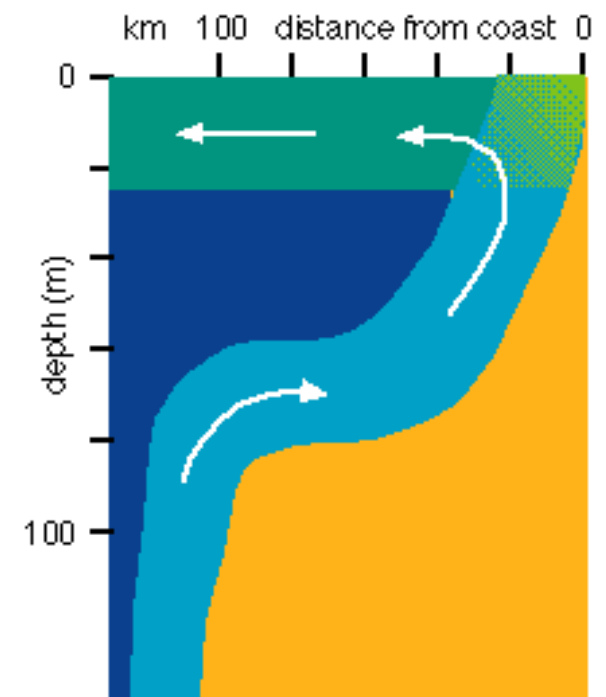
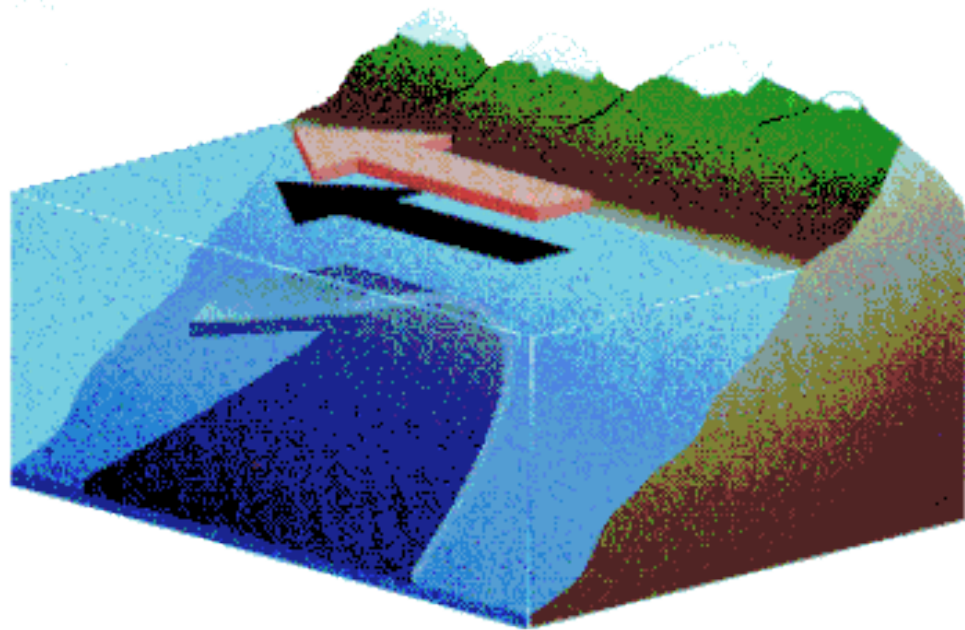
$$D_e = \frac{4.3W}{\sqrt{\text{sen}|\phi|}}$$

$$V_0 = \frac{0.013W}{\sqrt{\text{sen}|\phi|}}$$

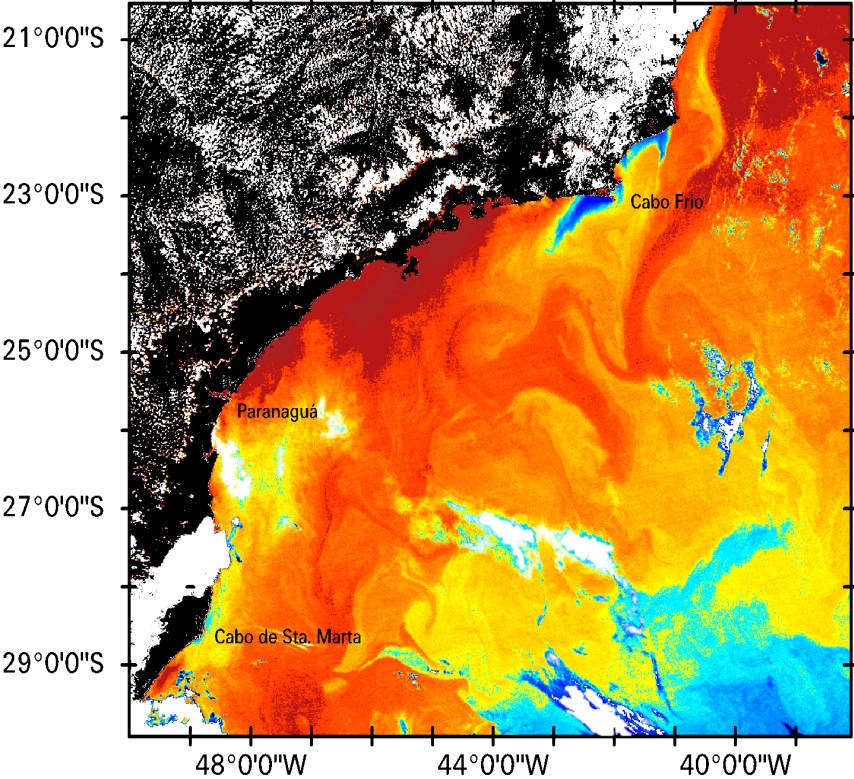


Hemisfério Sul - Divergência e Convergência Costeira





TEMPERATURA SUPERFICIAL DO MAR



TEMPERATURA (°C)

- Nuvens
- Terra
- 17
- 18
- 19
- 20
- 21
- 22
- 23
- 24
- 25
- 26
- 27

Escala
 km
100 0

SENSOR/SATÉLITE: AVHRR/NOAA-14
ALGORITMO: DAYTIME NLSST
AQUISIÇÃO: 07/11/95 - 16:54 GMT
REGIÃO CENTRAL DA BACIA DE SANTOS
CONVÊNIO PETROBRÁS/FURG

Oceanografia Física

- Conseqüências
 - Transporte de propriedades – **salinidade, temperatura**
 - Variação e distribuição de propriedades
 - Propagação de som e luz no mar
 - Processos de mistura entre águas de origens diversas
 - Formação de massas de água
 - Interações Oceano-Atmosfera – clima e meteorologia
- Relações com outras ciências - serve de base para:
 - Transporte e dispersão de substâncias dissolvidas ou em suspensão;
 - Transporte e dispersão de ovos e larvas e de organismos adultos
 - Transporte e dispersão de sedimentos de fundo
 - Processos de erosão costeira
 - Instalação de obras
 - Previsões meteorológicas

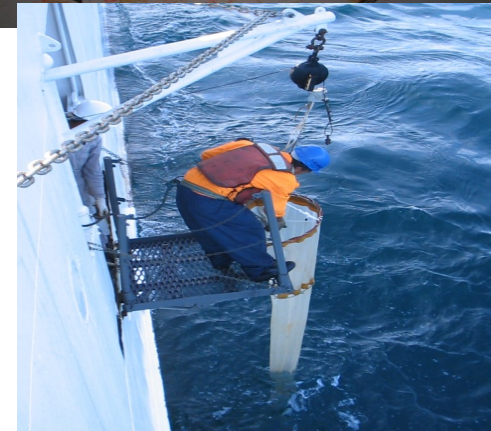
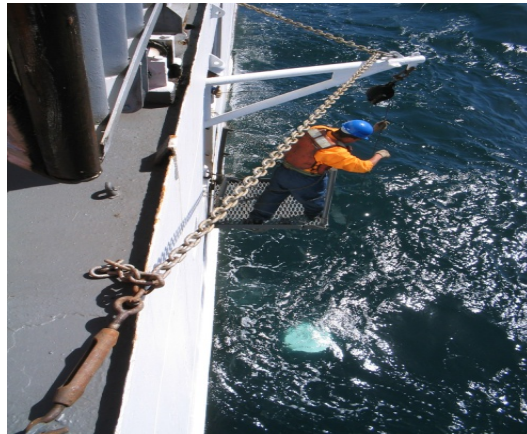
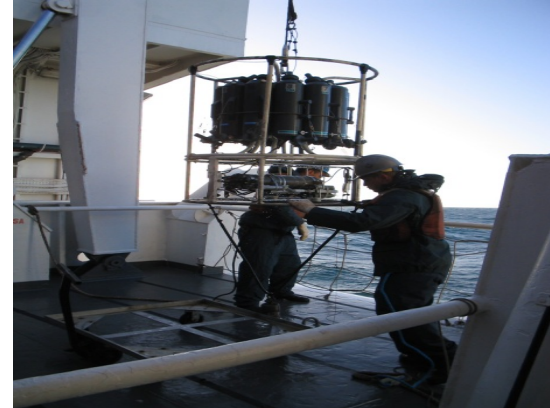
Oceanografia Física

Métodos

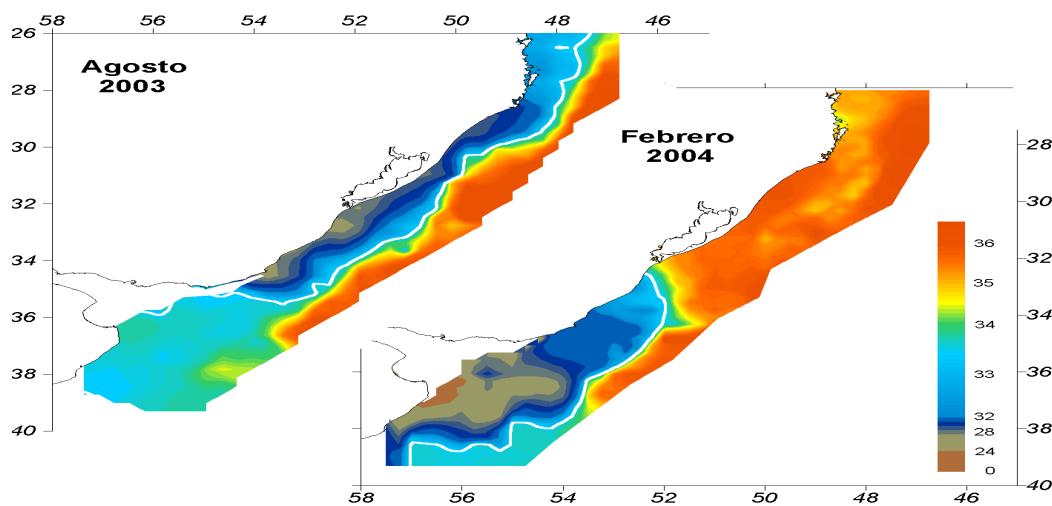
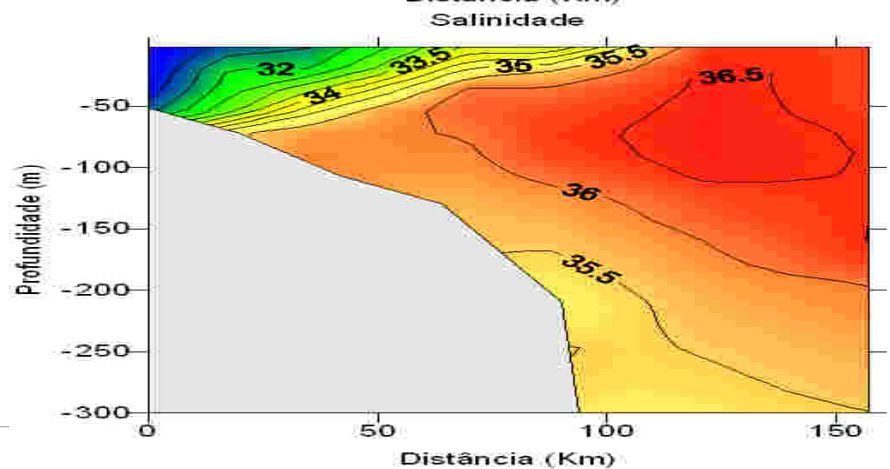
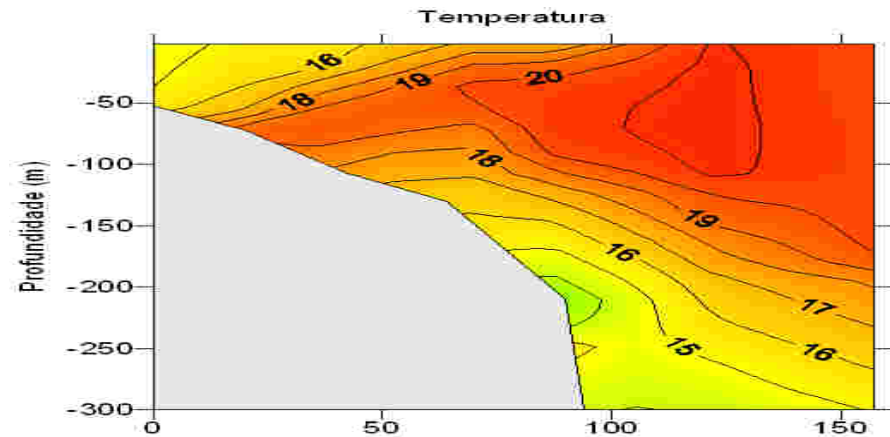
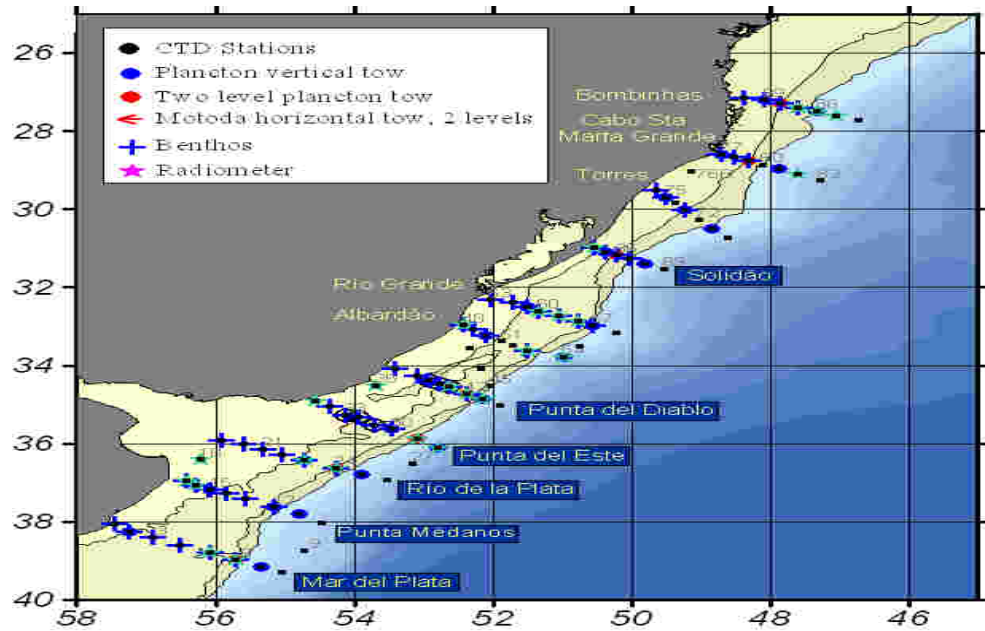
- Medições Diretas
 - Cruzeiros Oceanográficos – distribuição de propriedades
 - Fundeios de equipamentos – séries temporais
 - Derivadores
- Sensoriamento Remoto:
 - Imagens termais AVHRR
 - Imagens em bandas visíveis – Landsat, CZCS, Seawifs, Modis, etc.
- Modelagem Numérica
 - Modelos analíticos
 - Modelos numéricos
 - Elementos finitos
 - Diferenças finitas

Oceanografia Física

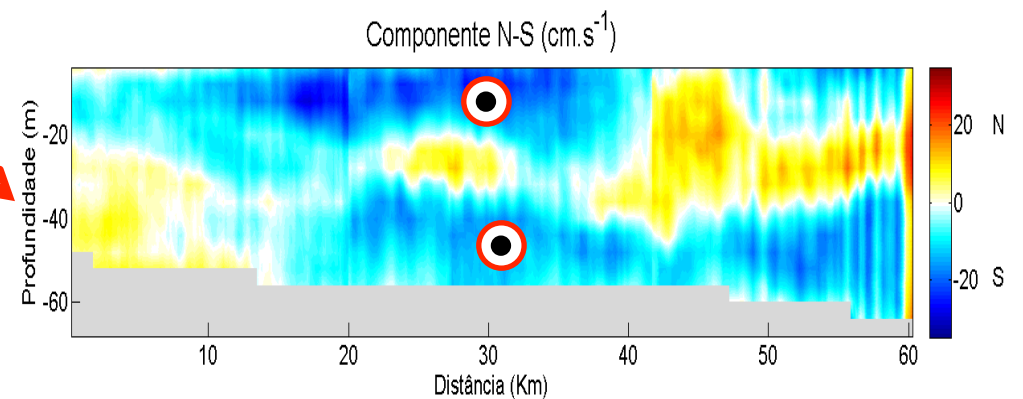
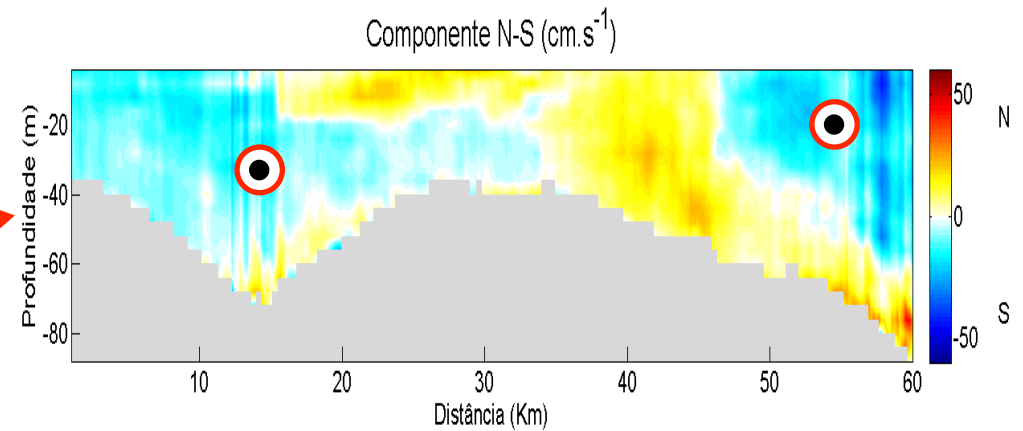
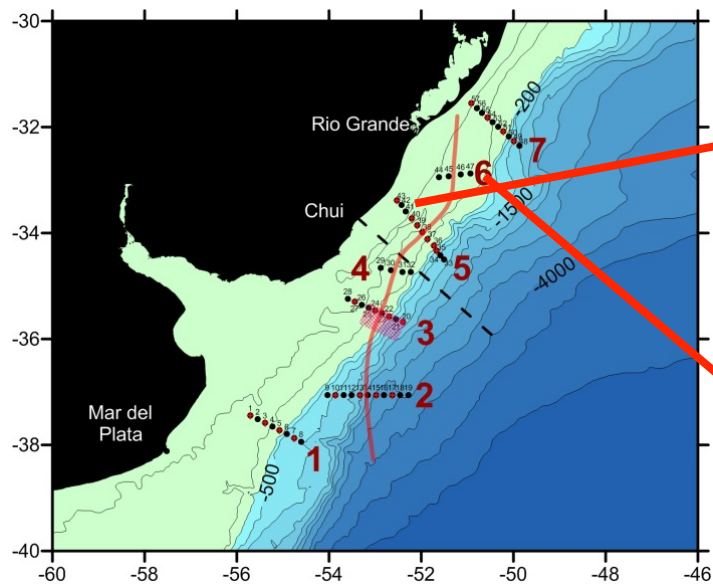
Cruzeiros Oceanográficos



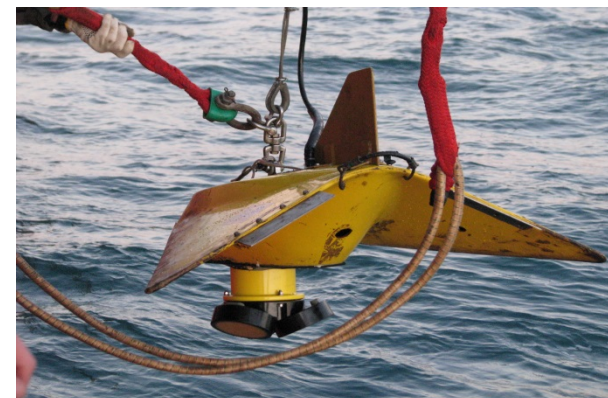
Oceanografia Física



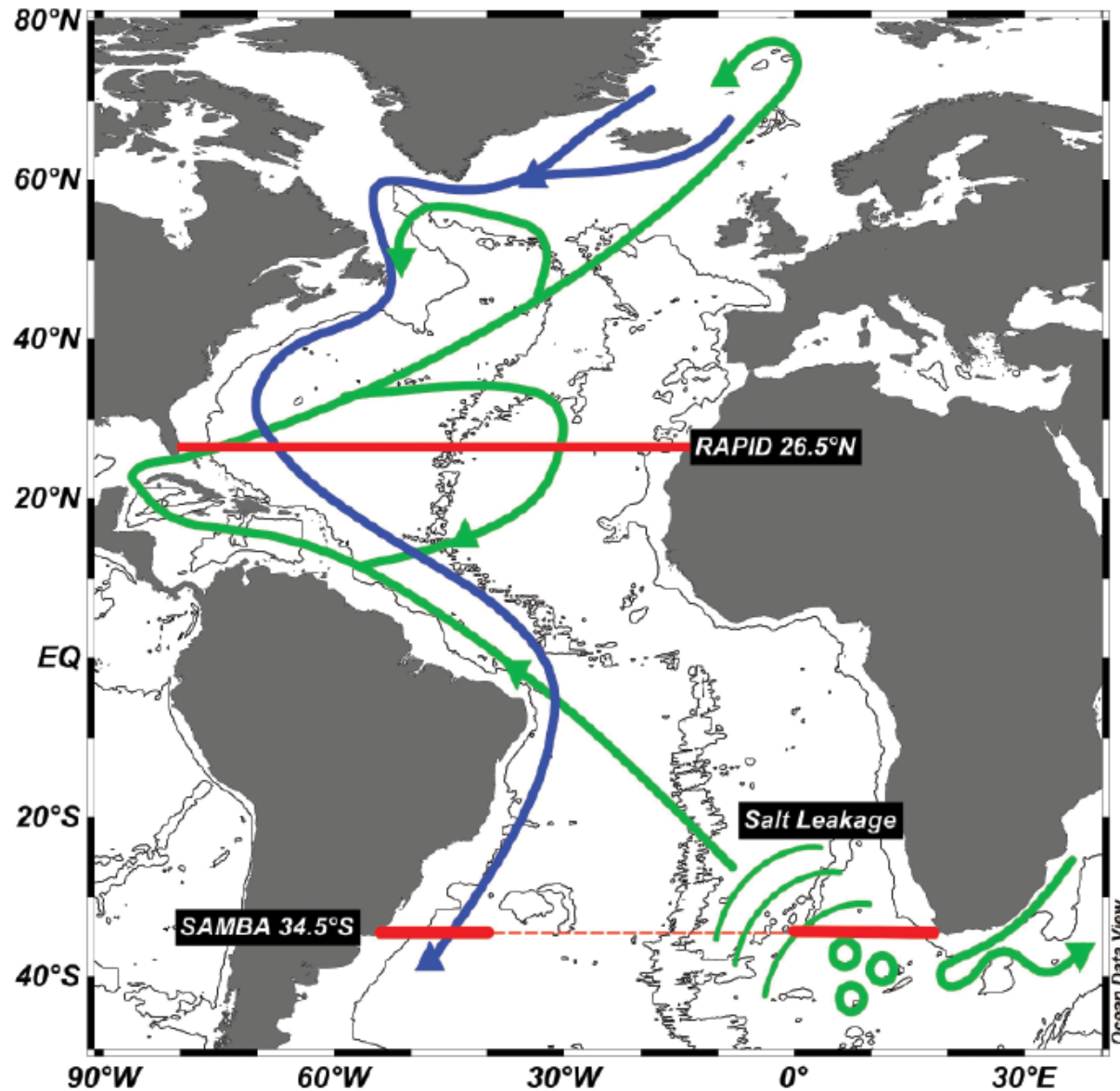
PERFIS DE VELOCIDADE DE CORRENTE MEDIDOS POR ADP 500 KHZ DURANTE O CRUZEIRO STSF - ONE WAY TICKET EM OUTUBRO DE 2013



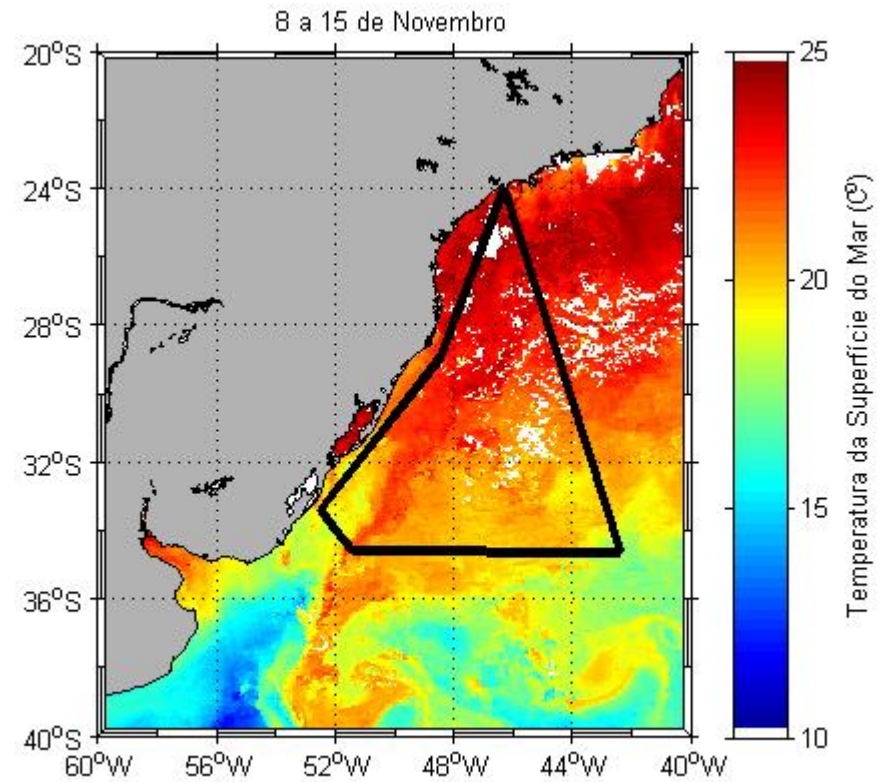
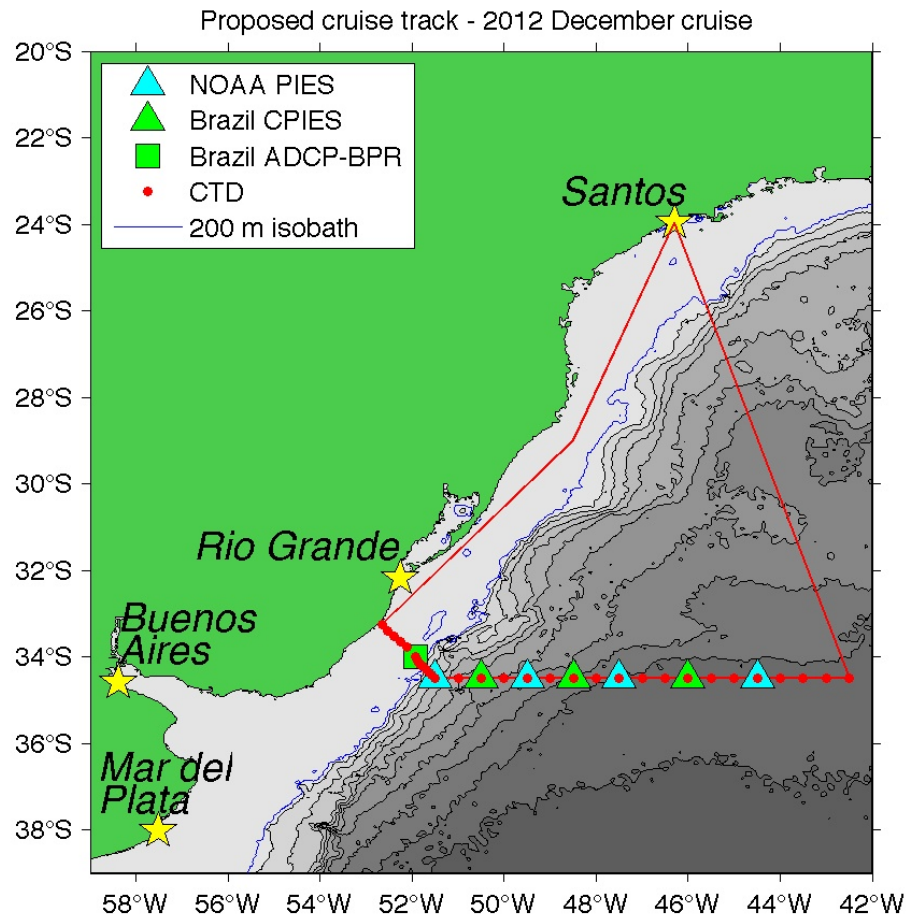
CRUZEIRO MULTIDISCIPLINAR FOCADO NA FSTP ATRAVÉS DA COLETA DE DADOS (CTD, OD, CONC. CLOROFILA A, ADCP-BT, L-ADCP, DO, NUTRIENTES, PLANKTON). OUTUBRO 2013

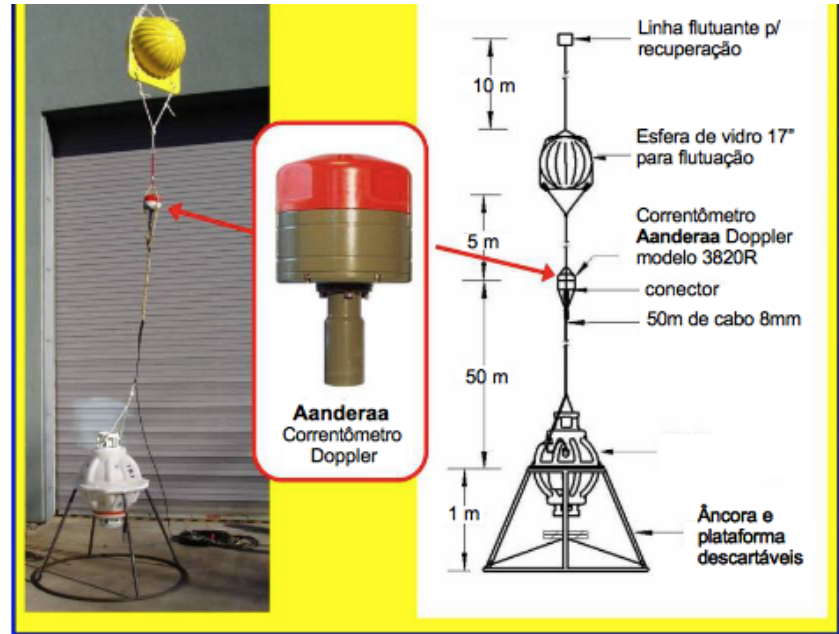


South Atlantic Meridional Overturning Circulation

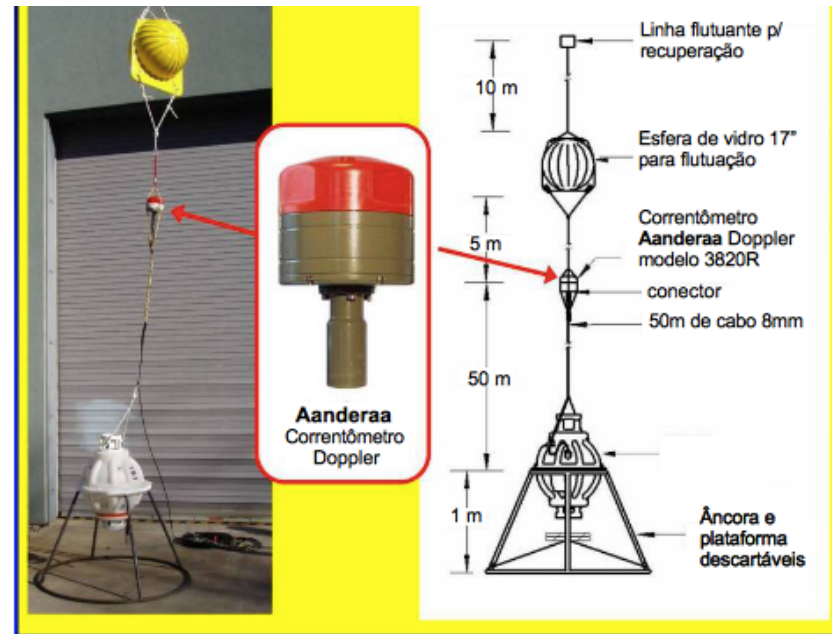


Cruzeiros SAMOC

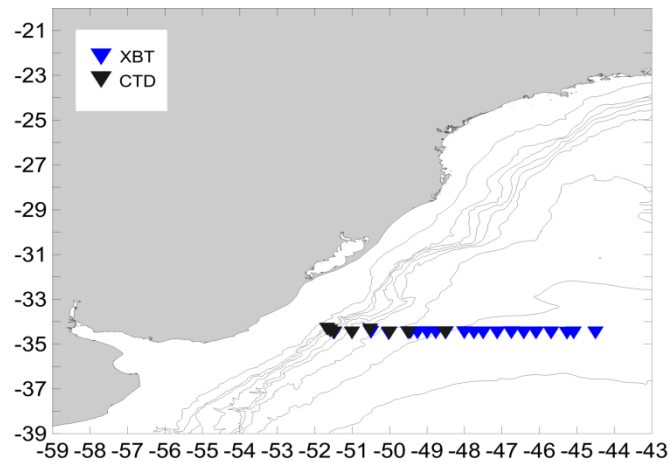
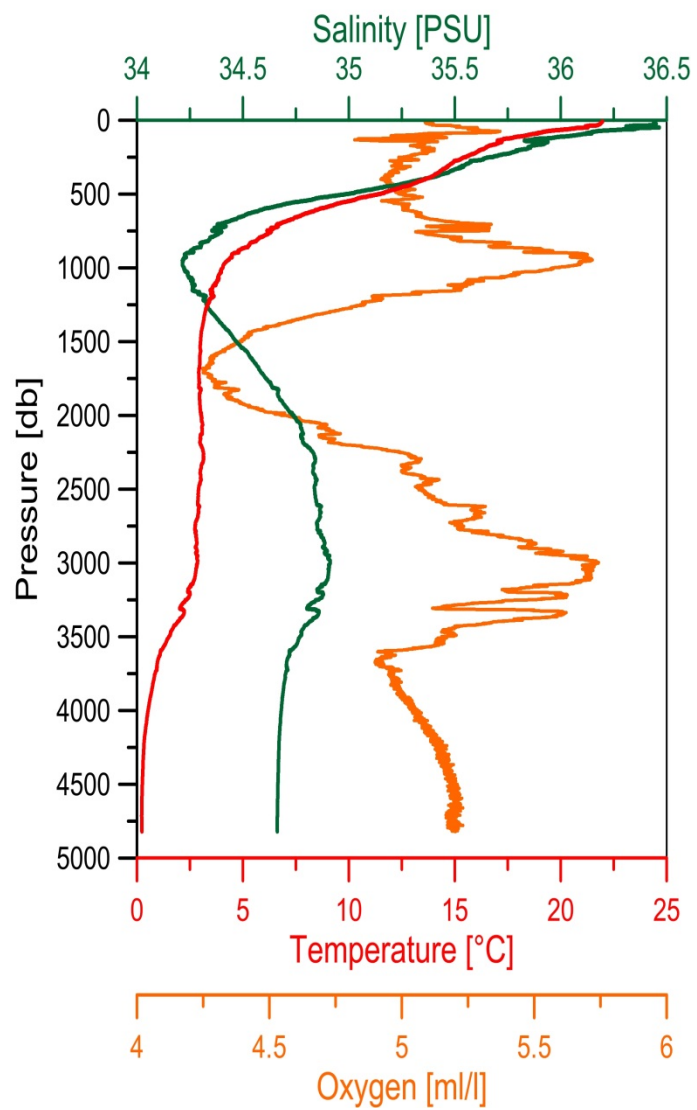




C-PIES – Correntômetro – Pressure Inverted Echo-Sounders - Esses equipamentos utilizam a relação entre a velocidade do som e a densidade (temperatura) da água para estimar quantidade de calor armazenado e a altura dinâmica da termoclina, usadas no cálculo de velocidade geostrófica e fluxos de calor.

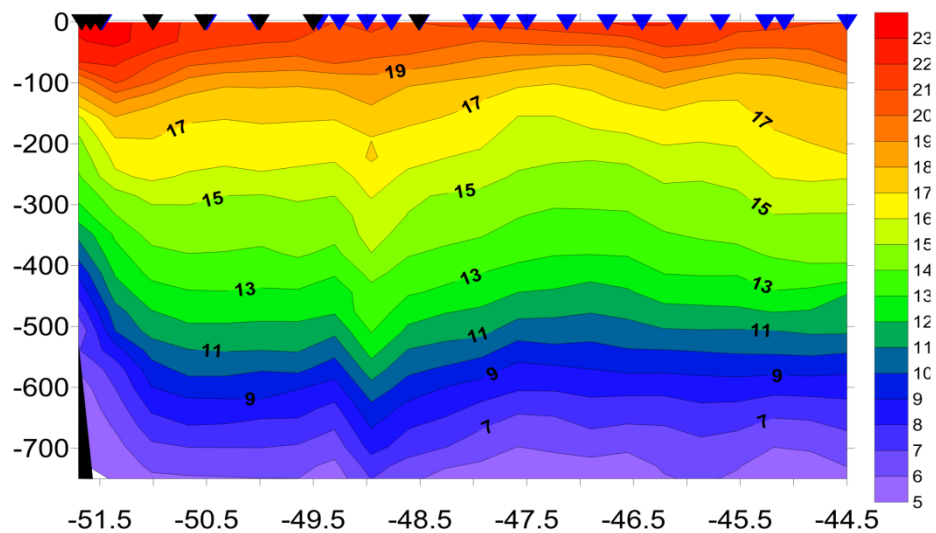


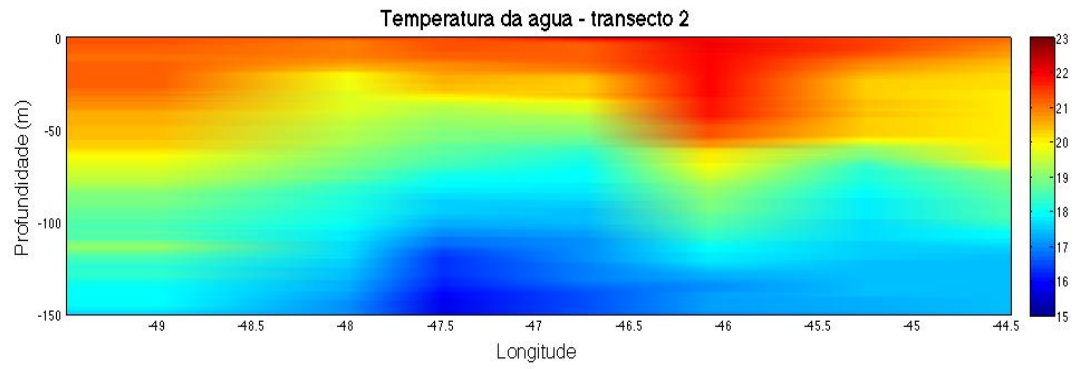
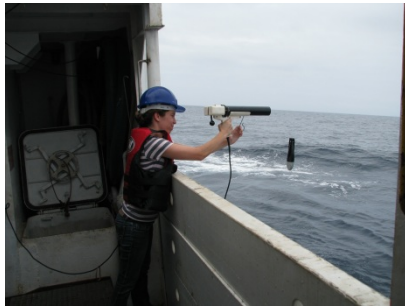
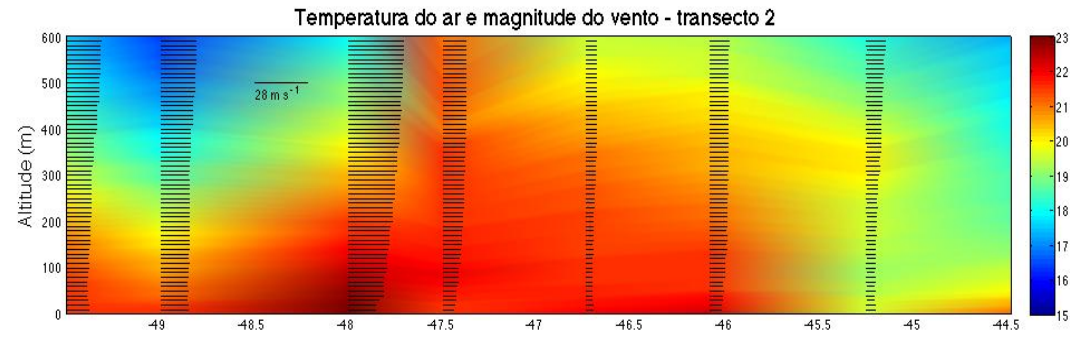
SAM08/SAMOC I - CTD #2



XBT
CTD

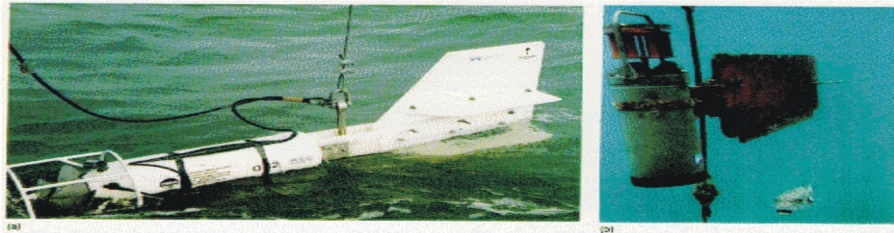
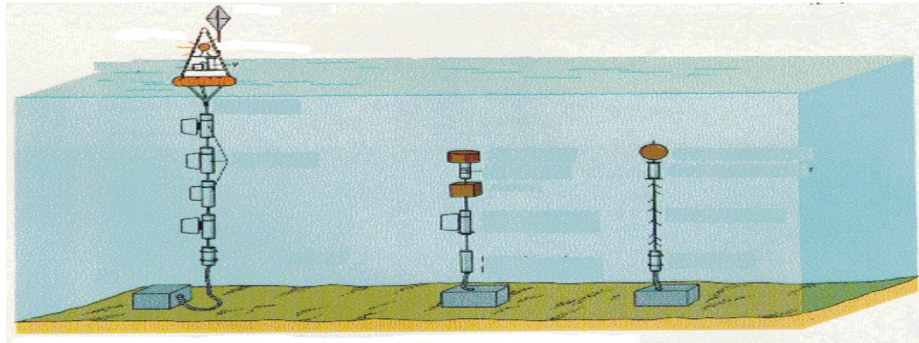
SAM08/SAMOC I - Transect XBT/CTD (34.5 S)





Oceanografia Física: Fundeios – Séries temporais

Medição de Correntes



MONITORAMENTO CONTÍNUO DE PROPRIEDADES: PARA QUE?

- **ESTUDAR UM PROBLEMA CIENTÍFICO**
 - ANALISAR VARIABILIDADE ESPACIAL E TEMPORAL, SUAS CAUSAS (NATURAIS E ANTRÓPICAS) E CONSEQUÊNCIAS
 - AVALIAR TENDÊNCIAS
 - ELABORAR CENÁRIOS
 - CALIBRAR E VALIDAR MODELOS NUMÉRICOS
- **APLICADOS**
 - ESTUDOS DE IMPACTO
 - SEGURANÇA À NAVEGAÇÃO E OPERAÇÕES NAVAIS
 - DISPERSÃO DE SUBSTÂNCIAS LANÇADAS

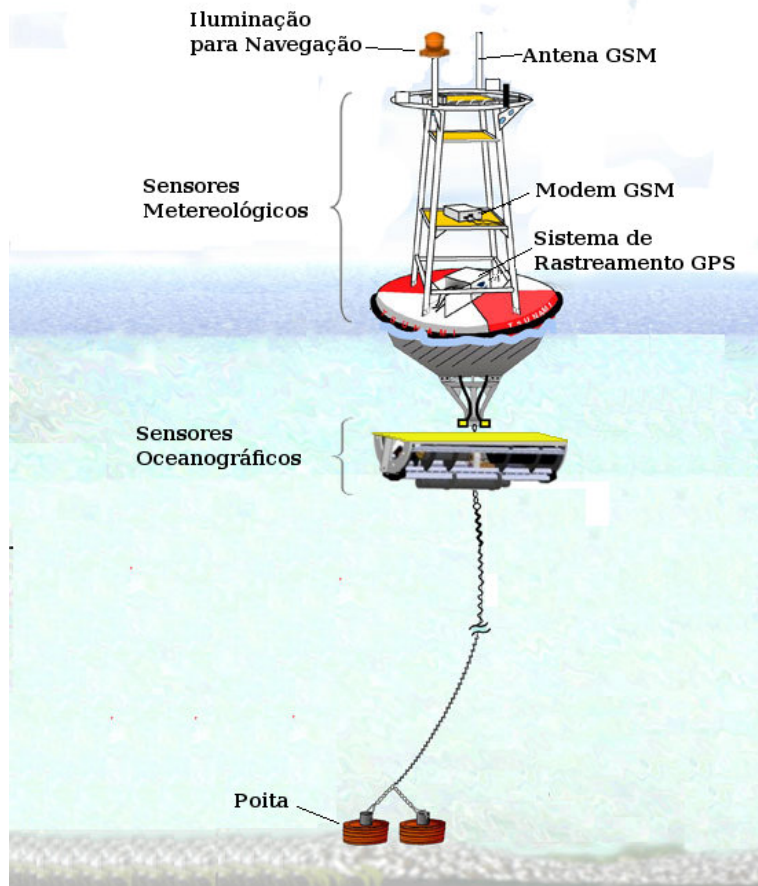
- **O QUE MONITORAR?**

- **INDICADORES METEOROLÓGICOS, HIDROLÓGICOS E OCEANOGRÁFICOS:**
 - FÍSICOS: **VENTOS**, PRECIPITAÇÃO, EVAPORAÇÃO, UMIDADE, PRESSÃO, DESCARGA DE RIOS, **NÍVEIS DAS ÁGUAS**, **CORRENTES**, **ONDAS**, SALINIDADE, TEMPERATURA DO AR E DA ÁGUA, **VISIBILIDADE**;
 - BIOLÓGICOS: CONC. CLOROFILA; ZOO+ ICTIOPLÂNCTON; PEIXES; CRUSTÁCEOS; MOLUSCOS;
 - QUÍMICOS: NUTRIENTES; QUALIDADE DAS ÁGUAS (PH, O₂, CO₂), ÓLEO
 - GEOLÓGICOS: CONC. MATERIAL EM SUSPENSÃO: COMPOSIÇÃO; **BATIMETRIA** (TAXAS DE SEDIMENTAÇÃO);

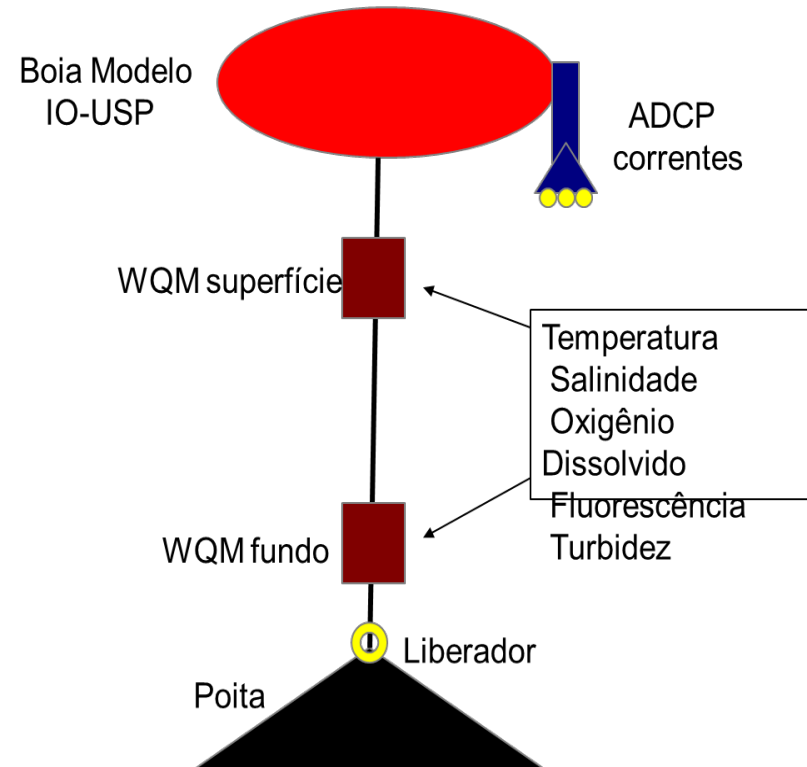
TIPOS DE MONITORAMENTO PARA OBTENÇÃO DE SÉRIES TEMPORAIS

- **ESTAÇÕES EM TERRA – DINÂMICA DE ESTUÁRIOS E ZONAS COSTEIRAS**
 - VENTOS, PRECIPITAÇÃO, EVAPORAÇÃO, TEMPERATURA E UMIDADE DO AR, PRESSÃO ATMOSFÉRICA, NÍVEIS DAS ÁGUAS, DESCARGA DE RIOS.
DADOS DE AGÊNCIAS (ANA) E INSTITUTOS (INMET, INPE)
- **FUNDEIOS**
 - VENTOS, TEMPERATURA AR, UMIDADE, PRESSÃO, NÍVEIS DAS ÁGUAS, CORRENTES, SALINIDADE, TEMPERATURA, CONC. CLOROFILA E MATERIAL EM SUSPENSÃO (FLUORÍMETRO, TURBIDÍMETRO), NUTRIENTES (SENSORES), QUALIDADE DA ÁGUA (SENSORES), OD, CO₂ (SENSORES), PLÂNCTON (SENSORES). **PETROBRAS, PNBOIA, PIRATA, UNIVERSIDADES EM PONTOS ISOLADOS E DE FORMA IRREGULAR**
- **ESTAÇÕES DE RADAR**
 - ONDAS E CORRENTES**
- **CRUZEIROS OU USO DE VEÍCULOS AUTÔNOMOS EM PERÍODOS REGULARES (GLIDERS, BOIAS)**

Fundeios SIMCOSTA com transmissão de dados



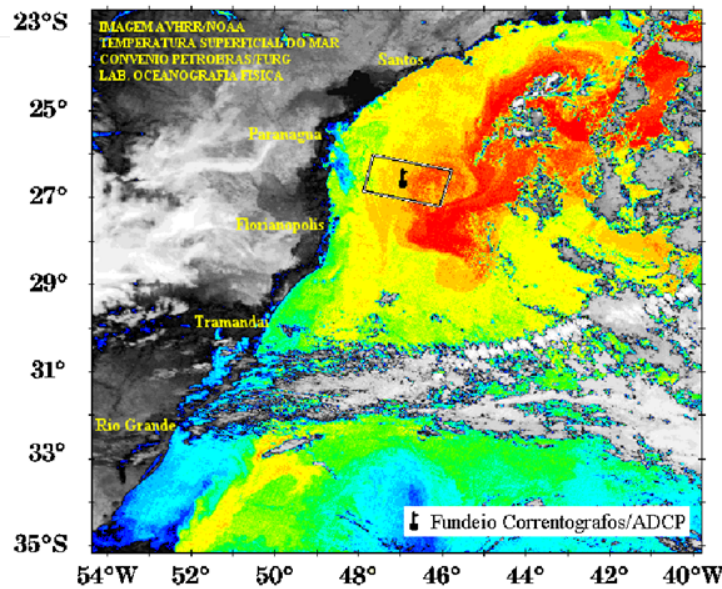
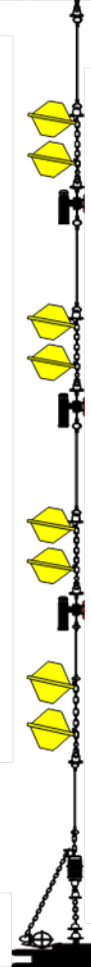
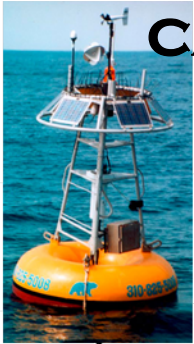
◆ Fundeios INCT-Mar-COII



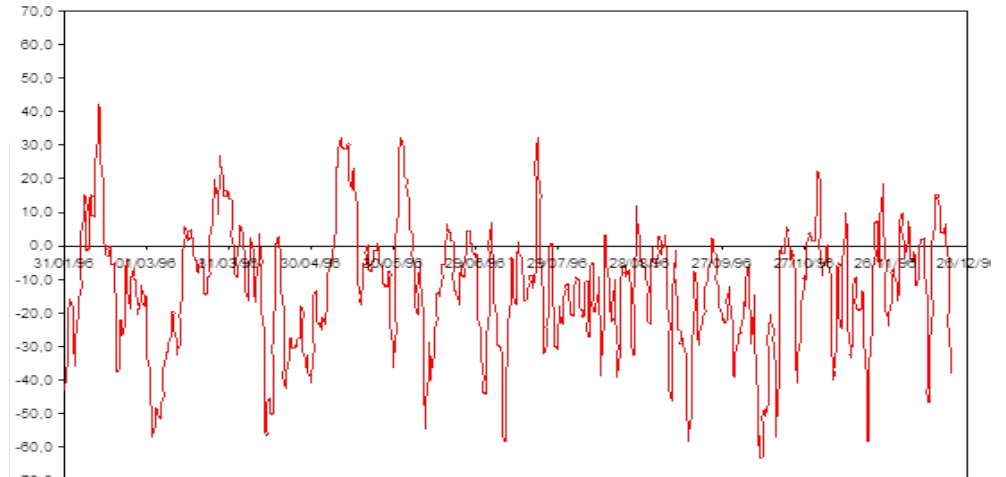
DIFICULDADES:

- **MANUTENÇÃO REGULAR – NORMALMENTE SE OBTÉM FINANCIAMENTO PARA ADQUIRIR O EQUIPAMENTO (IMPORTADO). FALTA DE TÉCNICOS ESPECIALIZADOS; PROBLEMAS COM EMBARCAÇÕES.**
- **VANDALISMO**
- **PESCA DE ARRASTO – RS - 150.000 KM ARRASTO/ANO (BOIAS SUBMERSAS)**

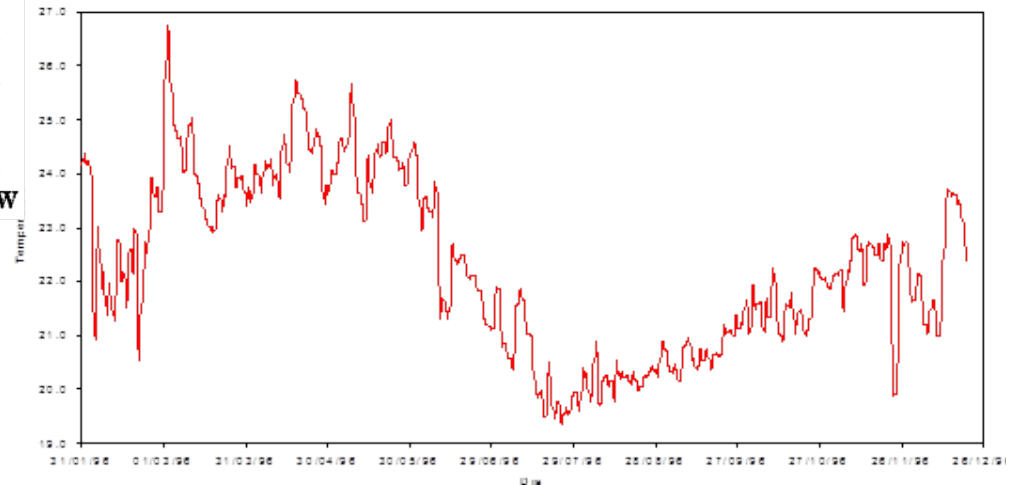
SÉRIES TEMPORAIS DE CORRENTES, NÍVEIS, SALINIDADE E TEMPERATURA NA PLATAFORMA CONTINENTAL DE SANTA CATARINA – PETROBRAS/FURG/UFGRGS/UFSC/UFPR



Componente Norte - Sul - Dado Filtrado 6h - RMC11860

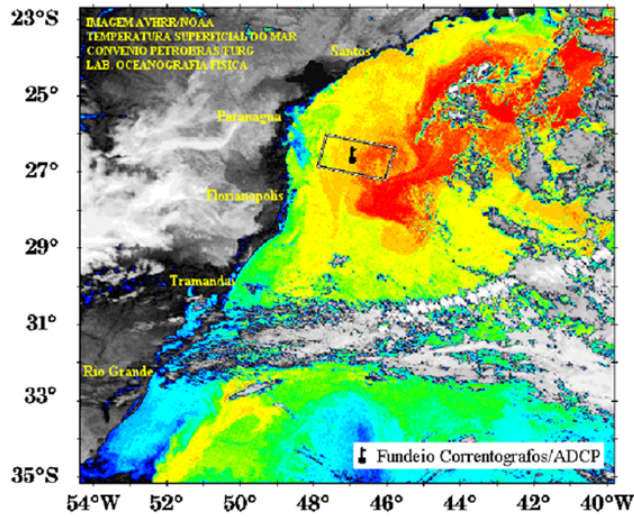
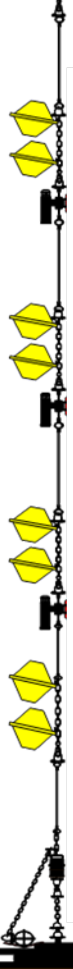
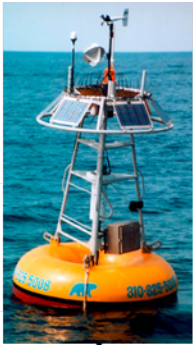


Temperatura - Dado filtrado 6h - RMC11860

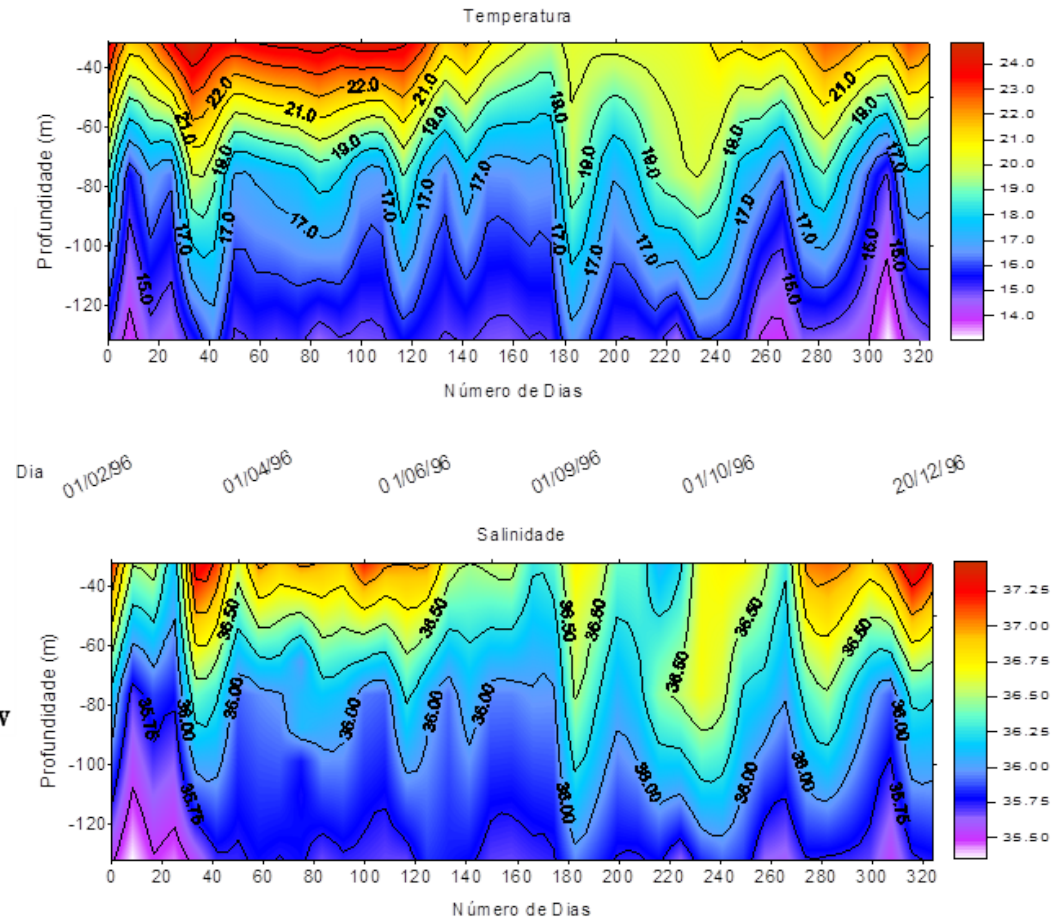


Poita 1000 kg

SÉRIES TEMPORAIS DE CORRENTES, NÍVEIS, SALINIDADE E TEMPERATURA NA PLATAFORMA CONTINENTAL DE SANTA CATARINA – PETROBRAS/FURG/UFGRS/UFSC/UFPR



Poita 1000 kg



FUNDEIOS COM TRANSMISSÃO DIRETA DE DADOS

[HTTP://WWW.NDBC.NOAA.GOV/](http://www.ndbc.noaa.gov/)

National Data Buoy Center
www.ndbc.noaa.gov

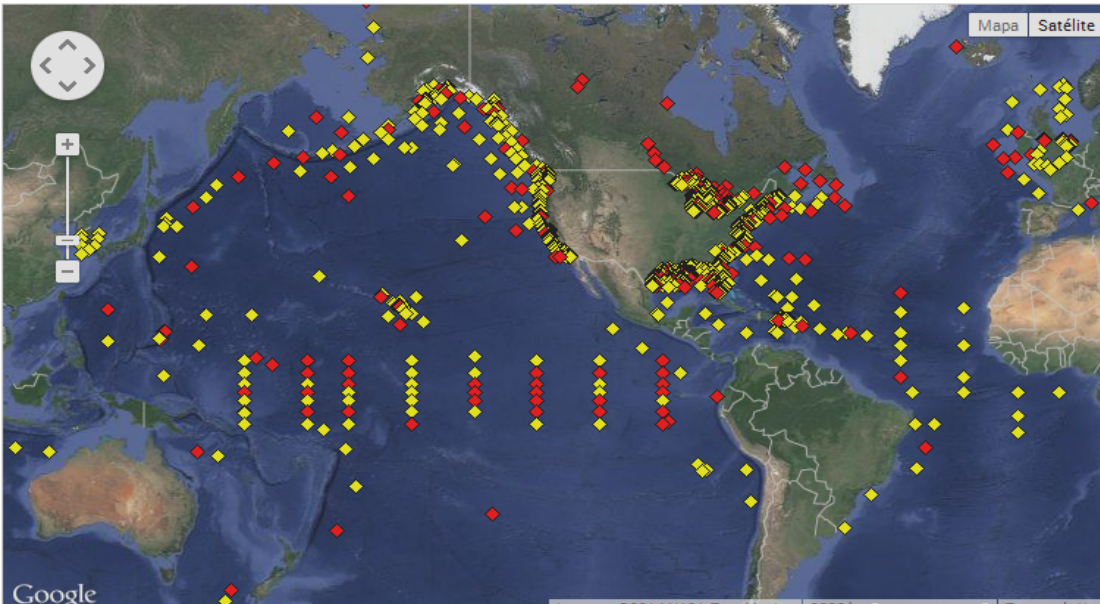
Historical
 DART@
 Oil & Gas ADCP
Obs Search
 Ship Obs Report
 Gliders
 BuoyCAMs
 APEX
 TAO
 DODS
 HF Radar
 OSMC
 Dial-A-Buoy
 RSS Feeds
 Obs Web Widget
 Email Access

Station Status
 NDBC Maintenance
 NDBC Platforms
 Partner Platforms

Program Info
 Find us on Facebook
 NDBC on Facebook
 About NDBC
 Met/Ocean
 Moored Buoy
 C-MAN
 TAO
 DART@
 VOS
 CSP
 IOOS@ Program
 IOOS@ DAC

Publications
 NDBC DQC
 Handbook
 Hurricane Data Plots
 Mariners Weather
 Log

To save the current map view, [right click on this link](#) and select either "Add to Favorites" or "Bookmark this link".
 To view observations, left-click a marker on the map.
 To zoom the map, use the zoom slider on the map; or hold down the **Shift** key while dragging a box; or click the magnifying glass below the zoom slider to turn drag zoom on and off.



Select a region:

- [Atlantic \(Tropical\)](#)
- [Atlantic \(West\)](#)
- [Australia](#)
- [Bay of Bengal](#)
- [Caribbean Sea](#)
- [Central America](#)
- [Chile](#)
- [Europe](#)
- [Gulf of Alaska](#)
- [Gulf of Mexico \(West\)](#)
- [Gulf of Mexico \(East/Florida\)](#)
- [Nova Scotia](#)
- [Pacific \(North\)](#)
- [Pacific \(West\)](#)
- [USA-Alaska](#)
- [USA-Hawaii](#)
- [USA-Great Lakes \(East\)](#)
- [USA-Lake Superior](#)
- [USA-Northeast](#)
- [USA-Northwest](#)
- [USA-Southeast](#)
- [USA-Southwest](#)
- [World](#)

Mouse Cursor Coordinates: **3.16S, 99.49W**

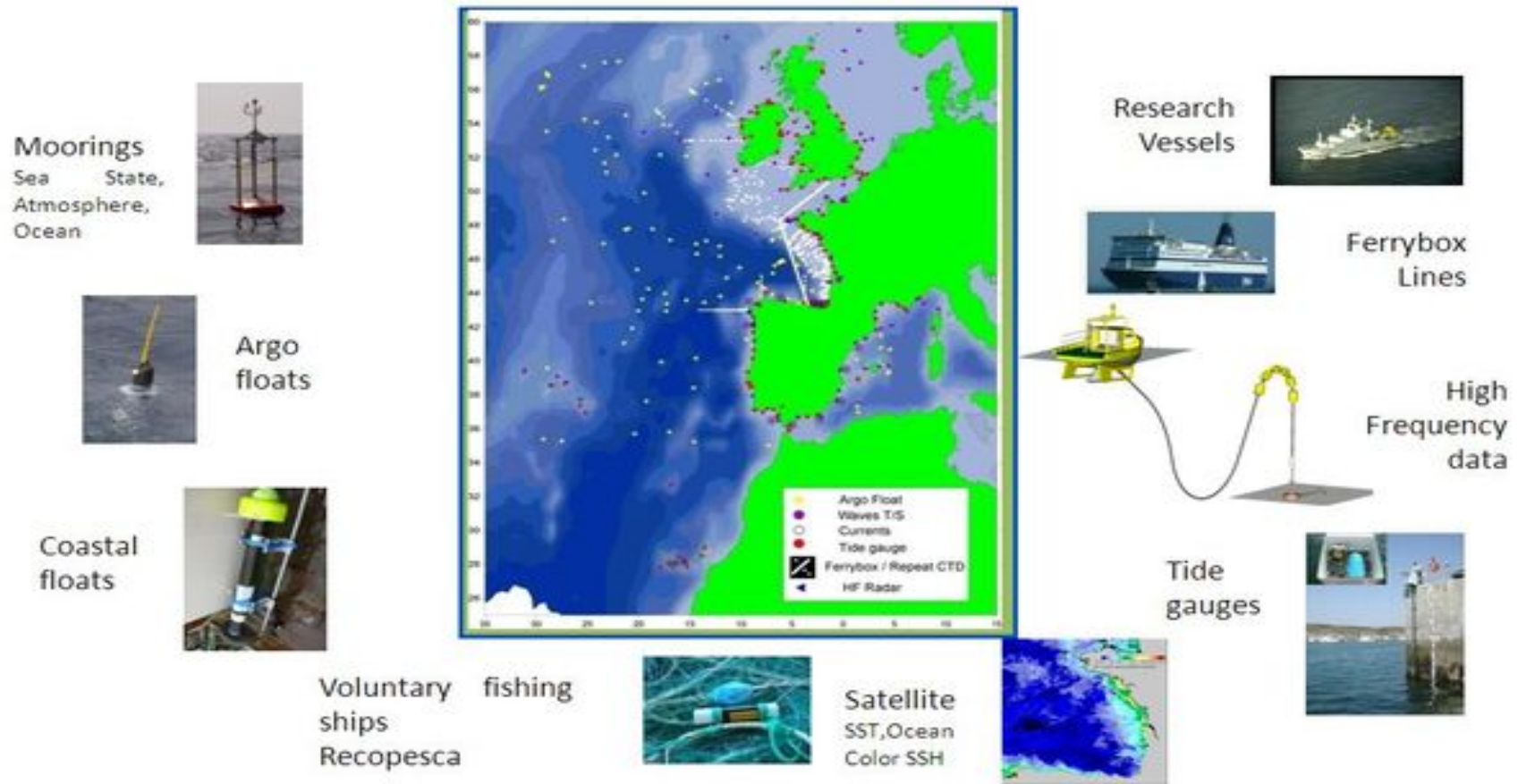
1213 stations deployed
 873 have reported in the past 8 hours

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<http://www.ibi-roos.eu/Observing-systems>



IRELAND-BISCAY-IBERIA REGIONAL OPERATIONAL OCEANOGRAPHIC SYSTEM

THE GOAL OF IBI-ROOS IS TO SET UP AN OPERATIONAL OCEANOGRAPHY ORGANIZATION OPERATED BY PARTICIPATING PARTNERS FROM THE 5 COUNTRIES BORDERING THE **IBERIAN-BISCAY-IRISH MARITIME AREA** (FRANCE, IRELAND, PORTUGAL, SPAIN AND UK), COLLABORATING TO DEVELOP AND IMPLEMENT OCEAN OBSERVING SYSTEMS FOR THE IBI-ROOS AREA, WITH DELIVERY OF REAL TIME OPERATIONAL DATA PRODUCTS AND SERVICES.

OCEAN NETWORKS CANADA

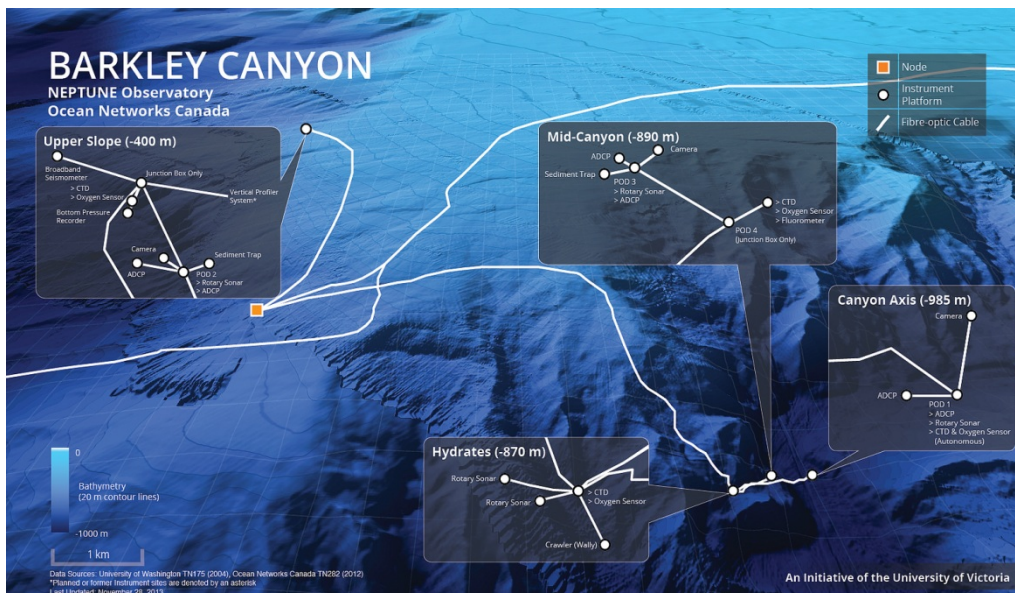
WWW.OCEANNETWORKS.CA



OCEAN NETWORKS CANADA HAS OBSERVATORIES INSTALLED IN 3 REGIONS:

- ARCTIC MINI-OBSERVATORY IN CAMBRIDGE BAY, NUNAVUT
- NEPTUNE OBSERVATORY IN THE NORTHEAST PACIFIC
- VENUS OBSERVATORY IN THE SALISH SEA

NEPTUNE: THE NORTH EAST PACIFIC TIME-SERIES UNDERSEA NETWORKED EXPERIMENTS PROJECT



- UNDERSTANDING HUMAN-INDUCED CHANGE IN THE NORTHEAST PACIFIC OCEAN
- LIFE IN THE ENVIRONMENTS OF THE NORTHEAST PACIFIC OCEAN AND SALISH SEA
- INTERCONNECTIONS AMONG THE SEAFLOOR, OCEAN, AND ATMOSPHERE
- SEAFLOOR AND SEDIMENT IN MOTION

OCEAN OBSERVATORIES INITIATIVE – COASTAL AND GLOBAL SCALE

NODES – WHOI.EDU/OOI_CGSN/

GLOBAL NODES

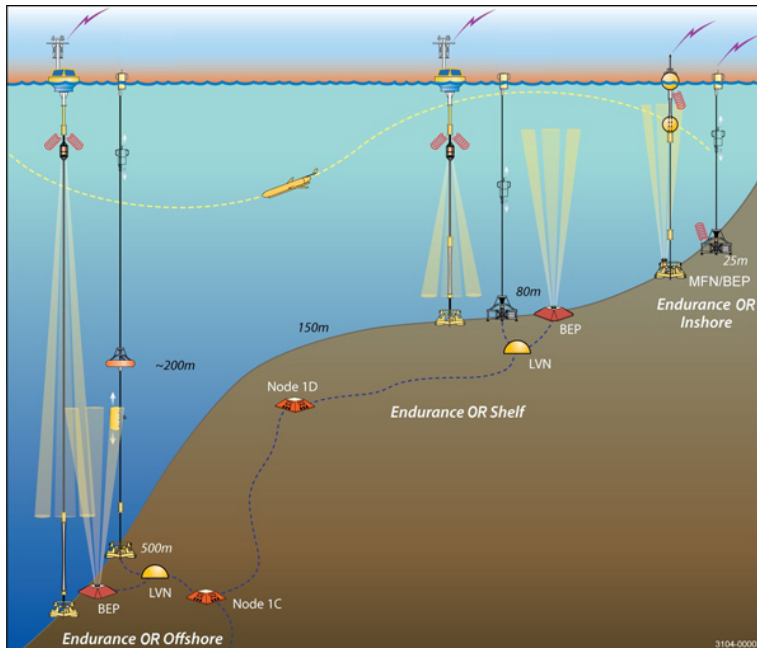
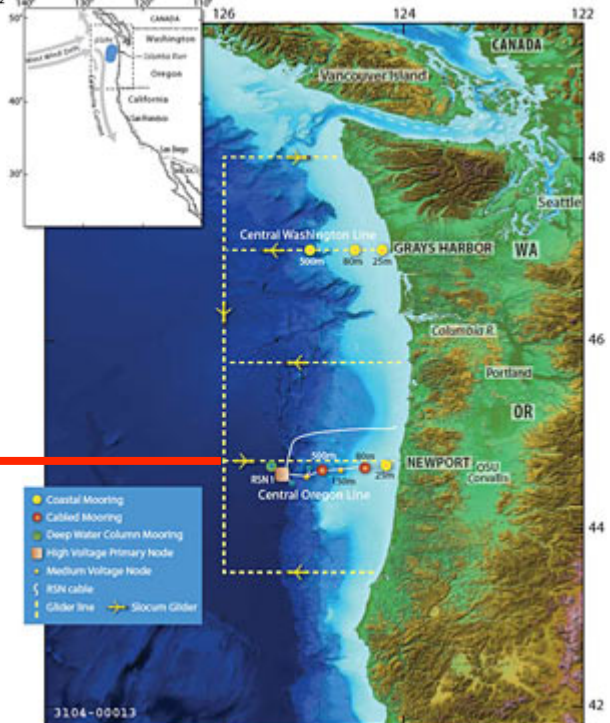
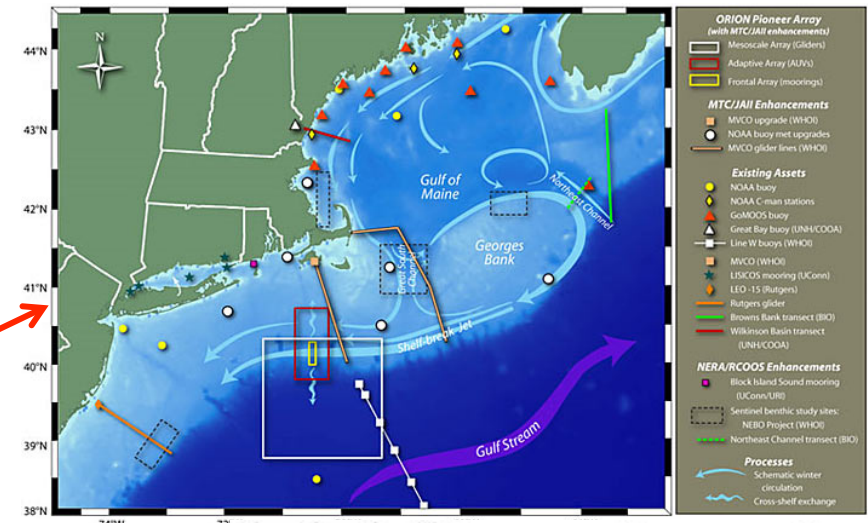
OCEANO AUSTRAL
 MAR DE IRMINGER
 BACIA ARGENTINA
 ESTAÇÃO PAPA (50°N,
 145°W)

COASTAL NODES

PIONEER – COSTA LESTE EUA

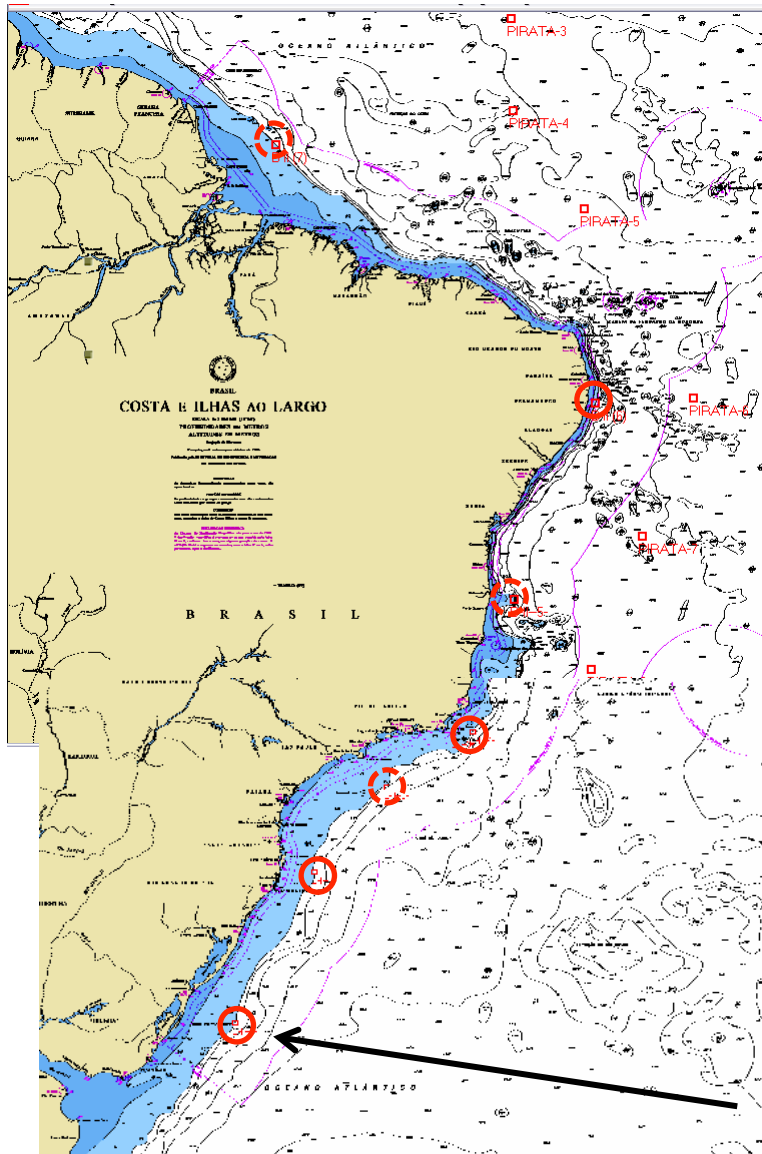
ENDURANCE – COSTA

OESTE EUA



PNBOIA

[HTTP://WWW.MAR.MIL.BR/DHN/CHM/PNBOIA](http://www.mar.mil.br/dhn/chm/pnboia)



PNBOIA – Programa Nacional de Boias Oceanográficas

Objetivos e Justificativas OBJETIVO GERAL

Disponibilizar, em tempo quase-real, à comunidade de interessados, dados meteorológicos e oceanográficos, obtidas nas áreas oceânicas de interesse Brasil.

OBJETIVOS ESPECÍFICOS

- Implantar uma rede de boias de deriva rastreadas por satélites;
- Implantar uma rede de boias fundeadas rastreadas por satélites;
- Implantar um sistema de recepção, processamento e divulgação dos dados recebidos através das duas redes acima.

○ INSTALADA

○ PREVISTA

[HTTPS://WWW.MAR.MIL.BR/DHN/CHM/METEO/PREV/DADOS/PNBOIA/BOIA_RG.HTM](https://www.mar.mil.br/dhn/chm/meteo/prev/dados/pnboia/boia_rg.htm) -
INÍCIO EM 2011 COM ADCP E ONDAS. A PARTIR
DE 2012, SÓ ONDAS E DADOS METEOROLÓGICOS

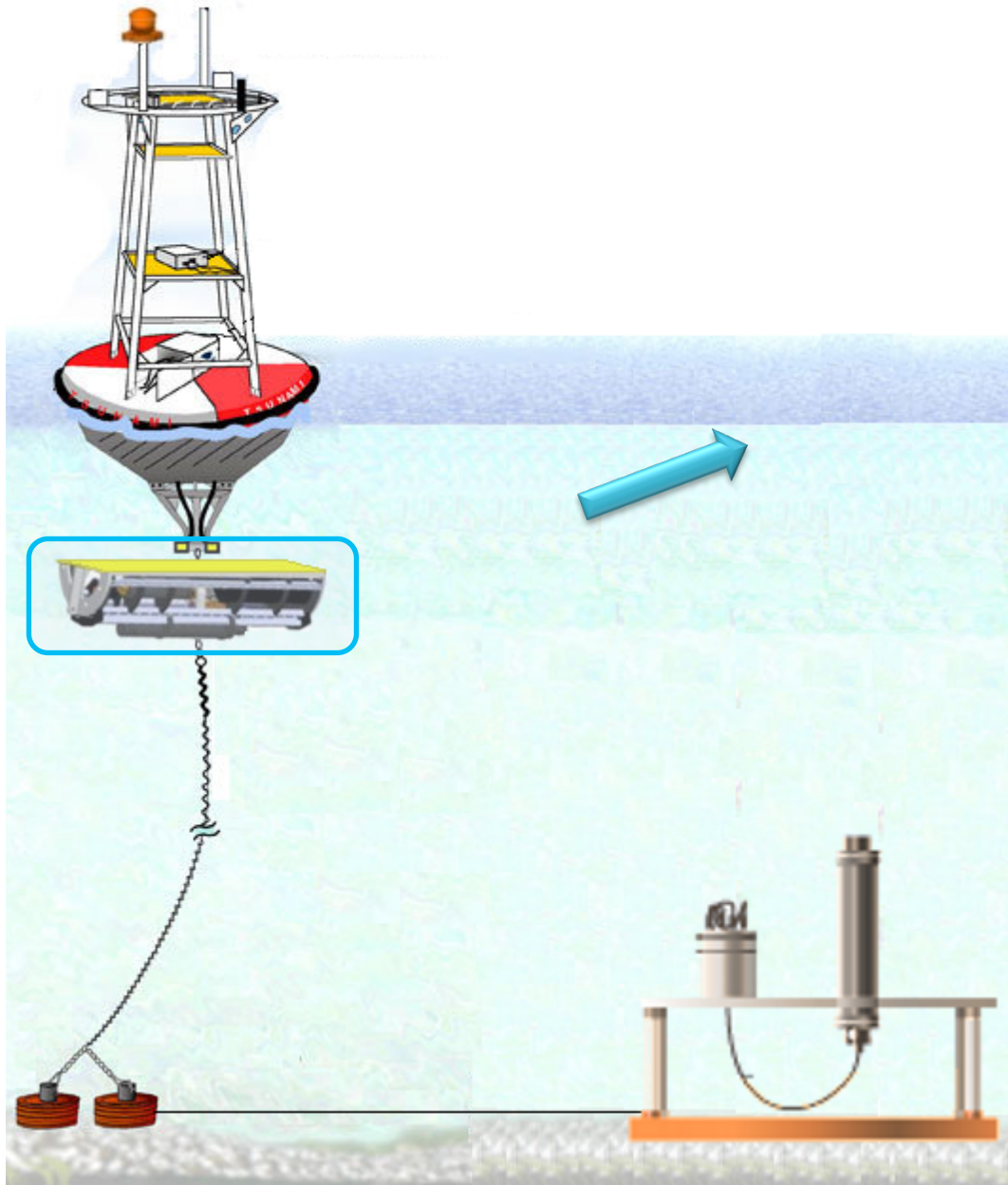
SiMCosta

Configuration

System Oceanographic Surface:

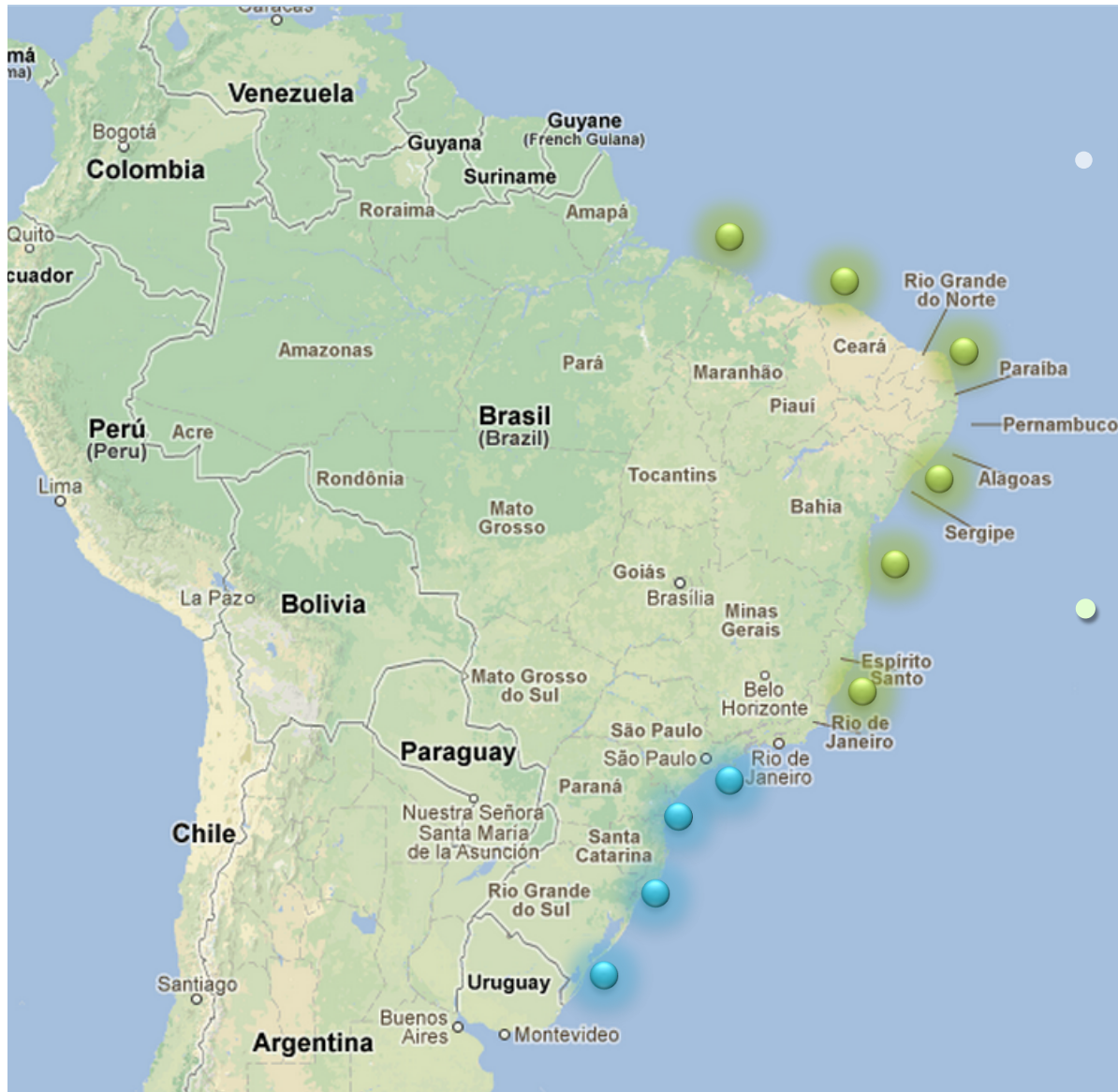
- Backscatter
- Chlorophyll
- Colored Dissolved Organic Matter
- Nitrate
- Dissolved O₂
- Depth
- pH
- Salinity
- Sea Surface Temperature
- Turbidity
- Data Logger Stor-X

(Satlantic Inc.)



SiMCosta

Brazilian Coastal Monitoring System



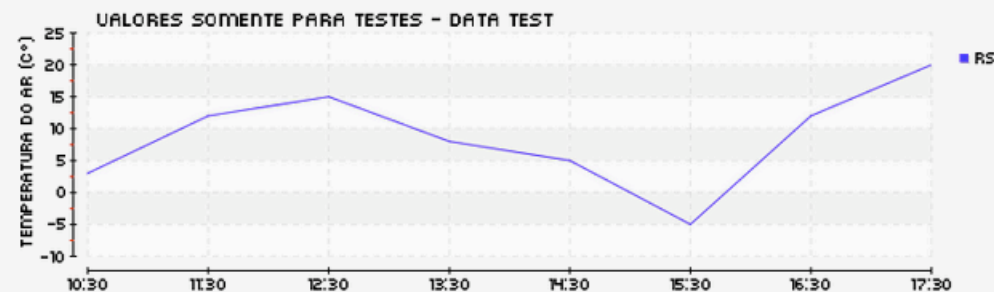
- Initial Phase: ●
south-southeast -
states of RS, SC,
PR and SP

- In Medium Term: ●
entire coastal
region along the
Brazilian territory

Buoy RS

Latitude: 32°12' S Last Update: (teste)
Longitude: 51°45' W City: Rio Grande

Oceanographic		Meteorological	
Water Temperature (°C)	NaN	Air Temperature (°C)	NaN
Turbidity (NTU)	NaN	Wind Direction (°)	NaN
Salinity	NaN	Wind Speed (m/s)	NaN
Profundity (m)	NaN	Atmospheric Pressure (mbar)	NaN
Dissolved O ₂ (ml/l)	NaN	Pluviom. Precipitation (mm)	NaN
Nitrate (µM)	NaN	Conc. of CO ₂ (ppm)	NaN
CDOM (QSDE)	NaN	Solar Radiation (Wm ²)	NaN
Chlorophyll-a (µg/l)	NaN	Air Rel. Humidity (%)	NaN
Perfil de Corrente	NaN		
Wave height	NaN		
pH	NaN		



Click on a buoy in the above map to receive information. If you do not see the markers (buoys), click SiMCosta in the top menu to reload the map items. Click above for a parameter to update the chart.

News

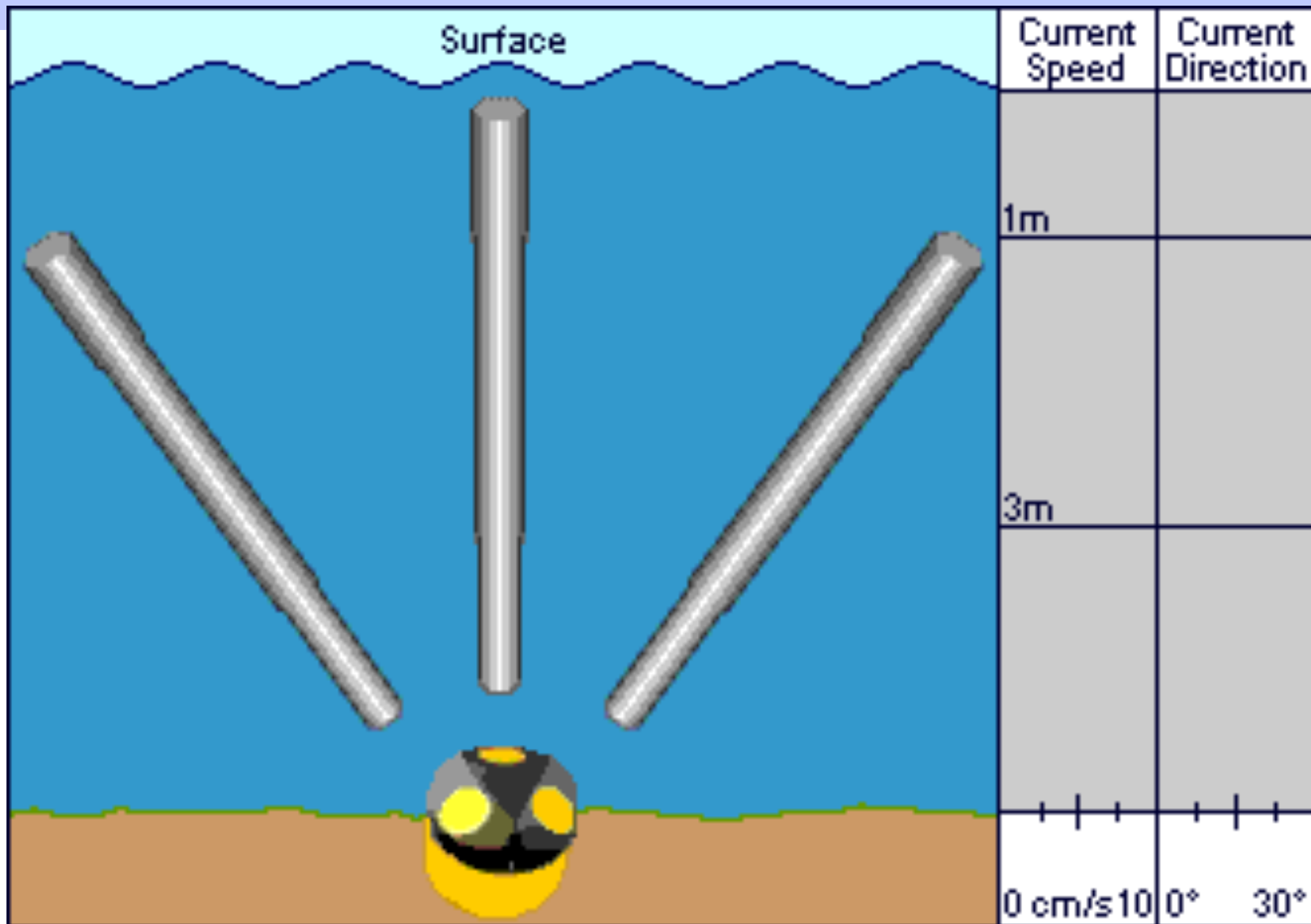
Sistema centralizado em Rio Grande vai monitorar toda a costa brasileira

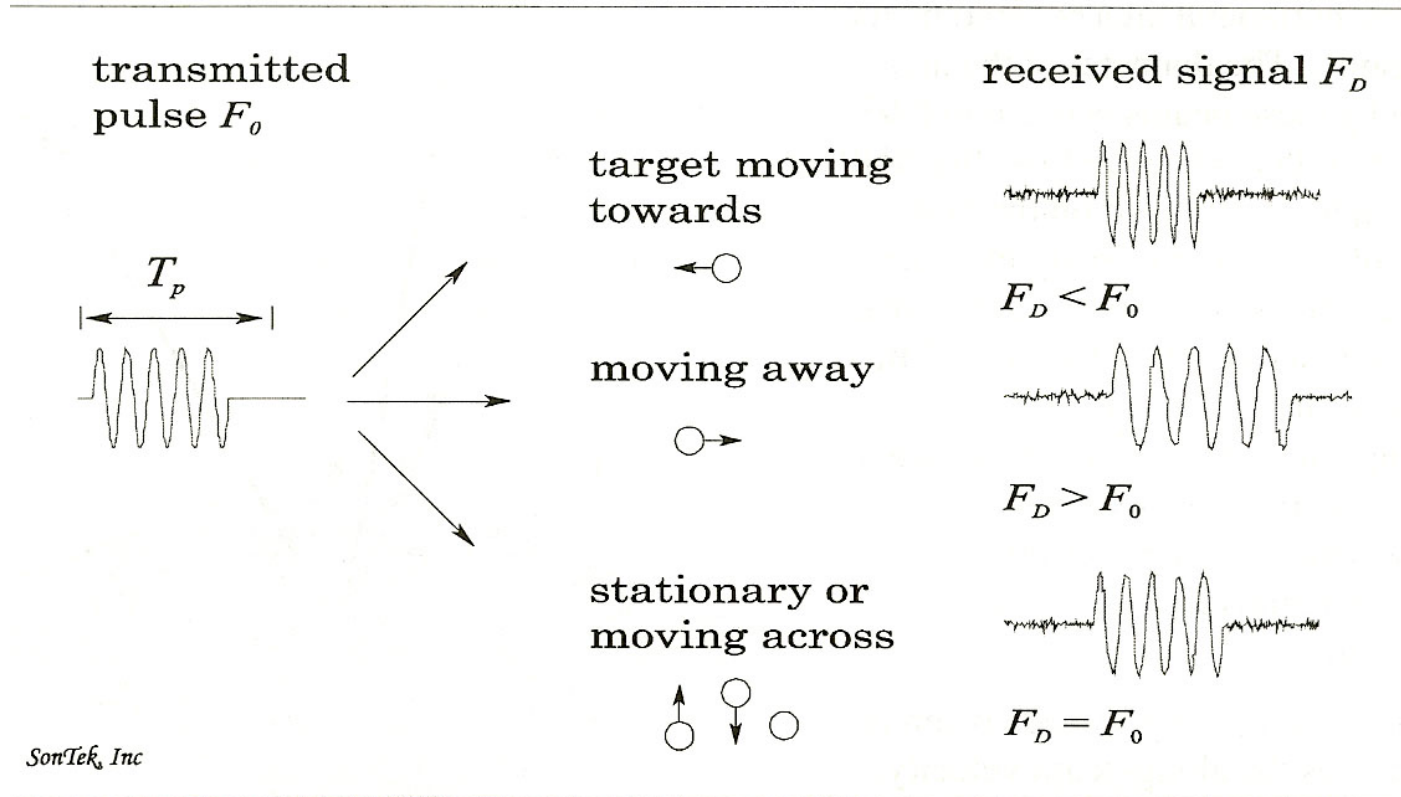
18/10/2013

Projeto auxiliará na prevenção de catástrofes em cidades litorâneas.

www.simcosta.furg.br

Princípio de funcionamento do ADP





$$F_D = -2 F_S (V / c)$$

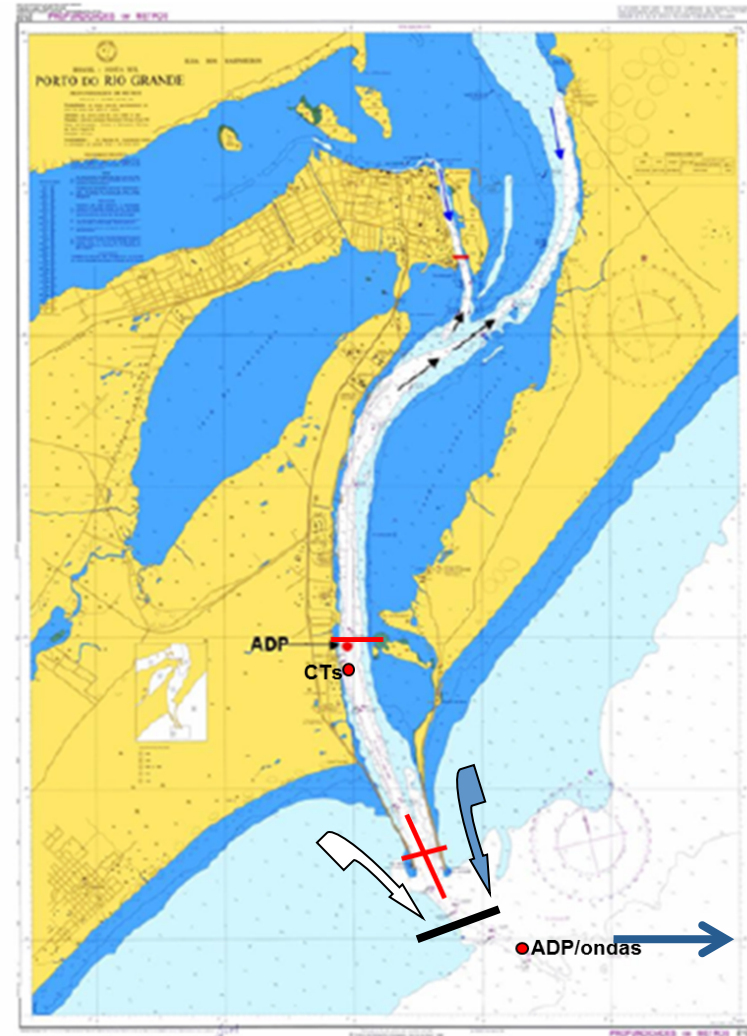
V - velocidade relativa entre fonte e alvo

C – velocidade de propagação do som

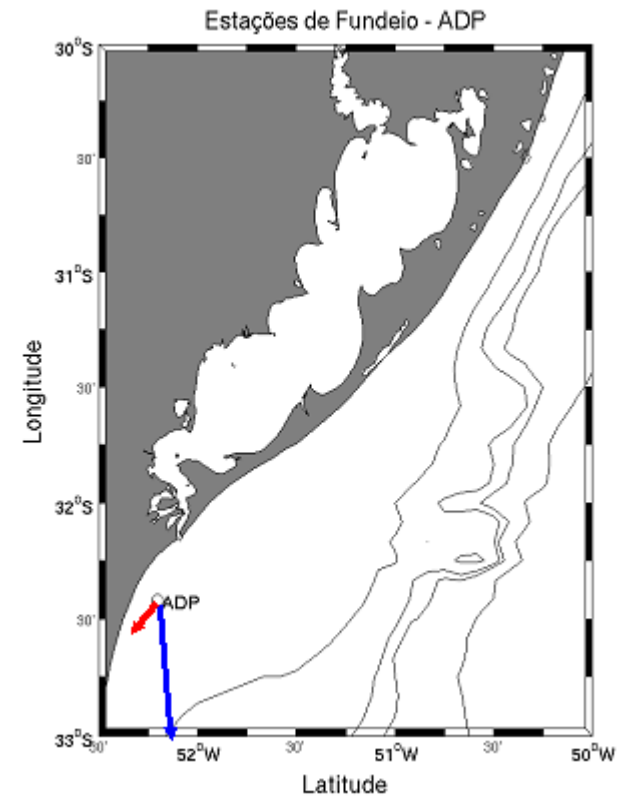
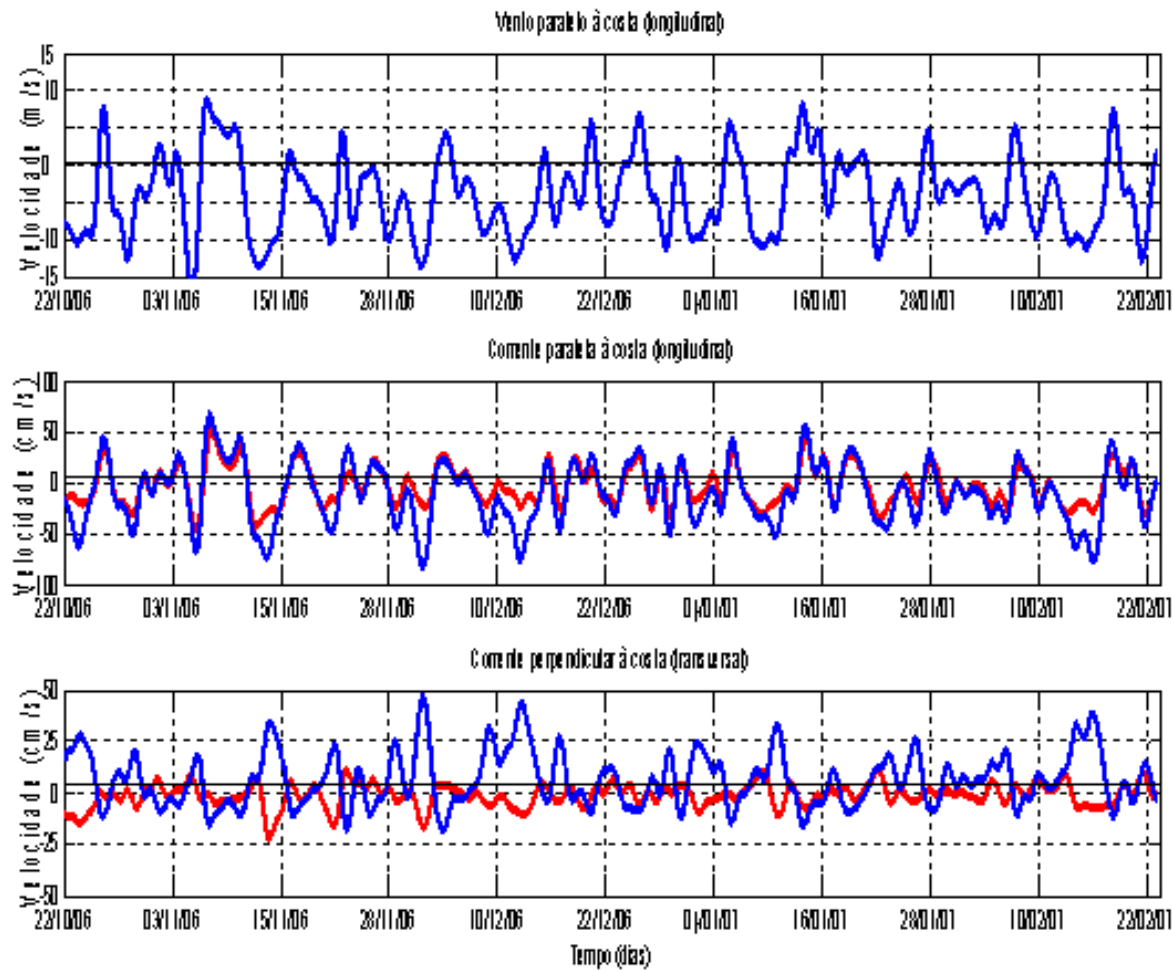
F_S – freqüência de transmissão do som

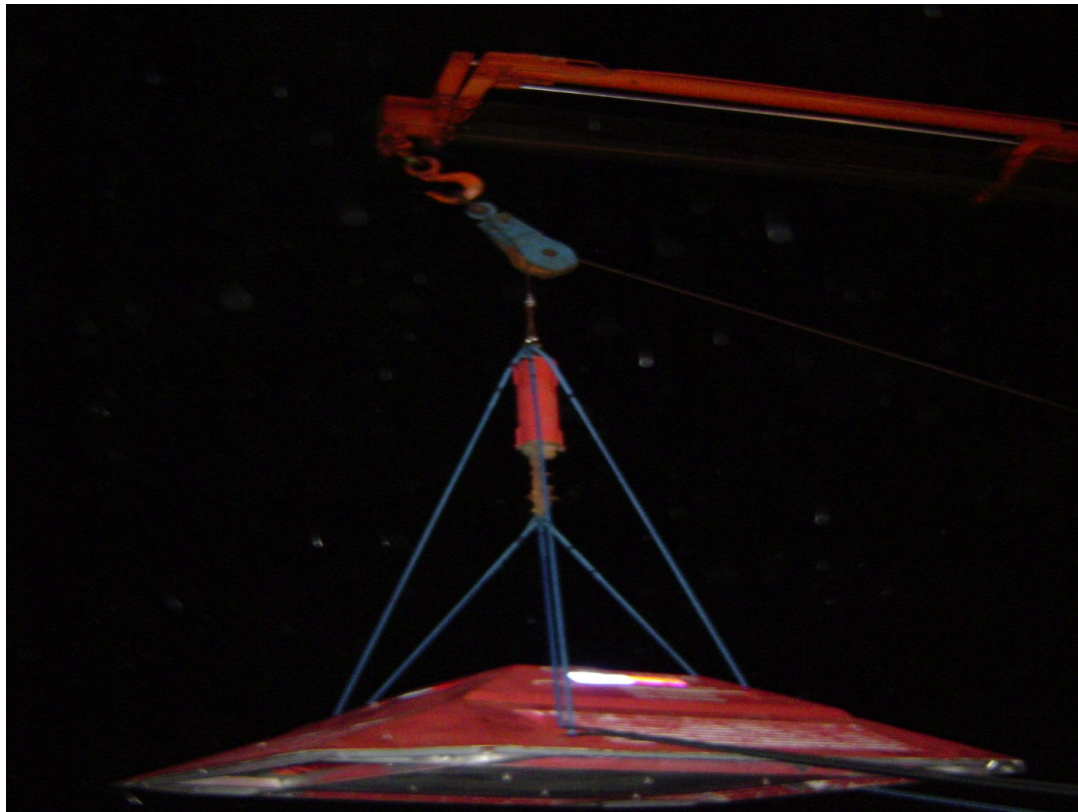
F_D – mudança na freqüência de transmissão (Efeito Doppler)

PROJETO SIMTECO: FUNDEIO ADCP-AWAC – CORRENTES, NÍVEIS E ONDAS – PARCEL DO CARPINTEIRO



Componentes





MONITORAMENTO EM TEMPO REAL PARA MANOBRAS DE PLATAFORMAS DE PETRÓLEO



River, Estuary and Coastal Observing Network

<http://recon.sccf.org> – Florida (USA)

recon.sccf.org

sidade CO2 Webpages Google Maps Ocean Colour Wikipedia News Screenplay Popular Gmail: Email from G Google Translate GreenSeas »



SCCF RECON

Sanibel-Captiva Conservation Foundation
River, Estuary and Coastal Observing Network

[Home](#) [Water Quality](#) [Weather](#) [Feeds](#) [Definitions](#) [About](#) [Sponsors](#)

SCCF RECON

The River, Estuary and Coastal Observing Network (RECON) is a network of optical water quality sensors deployed throughout the Caloosahatchee river and estuary to provide real-time, water quality data to scientists, policy makers, and the general public. RECON's network of high-quality, autonomous, *in situ* sensors can detect the presence of algal blooms and nutrient hotspots.

The extensive watersheds of the Caloosahatchee (1,400 square miles) and Lake Okeechobee (4,400 square miles) each contribute water that flows into the Caloosahatchee estuary and the Gulf of Mexico. Water quality is affected by both Lake Okeechobee discharges and runoff from the Caloosahatchee watershed. Over time, these watersheds have changed from low-nutrient loading marshes and wetlands to high loading urban and agricultural land uses. Nutrients increase turbidity and decrease concentrations of dissolved oxygen (DO). In addition, excess nutrients fuel nuisance algal blooms. Losses of low-nutrient adapted communities, such as seagrasses have contributed to changes in fish, crustacean and marine mammal communities.

Latest RECON News

NEW RECON RIVER SITE

We have established a new RECON site in the Caloosahatchee River. The sensor that had previously been deployed in Moore Haven, has been relocated down the River off of Beautiful Island, approximately one mile downstream from the I75 overpass. This new location will help fill in a data gap for conditions in the upper estuarine section of the River.

[Past News Stories >](#)



Mapa Satélite Híbrido

POWERED BY Google

Mapas cartográficos ©2013 - Terms of Use

Sites

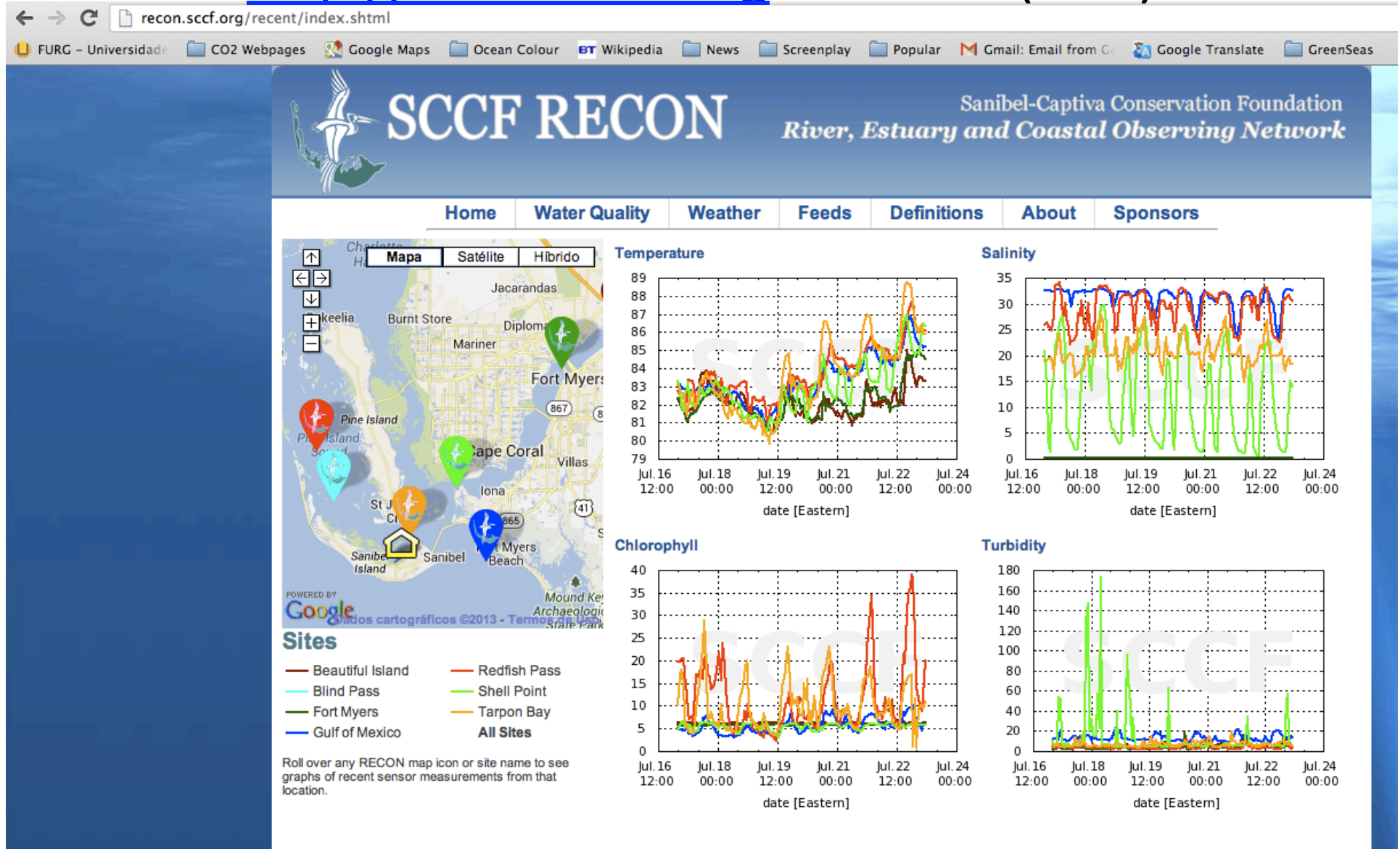
Beautiful Island	Redfish Pass
Blind Pass	Shell Point
Fort Myers	Tarpon Bay
Gulf of Mexico	Home

Roll over any RECON map icon or site name for information and latest sensor measurements for that location.

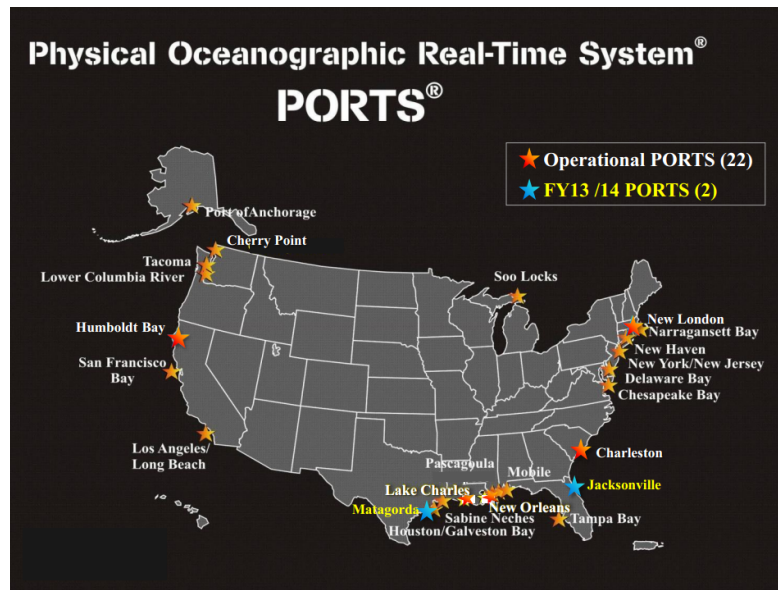


River, Estuary and Coastal Observing Network

<http://recon.sccf.org> – Florida (USA)



NO CASO DE ESTUÁRIOS, UM EXEMPLO É O PORTS®. HÁ TAMBÉM O CBO, O LEO-15 E OUTROS



PORTS® IÉ UMA PARCERIA ENTRE NOAA E A COMUNIDADE MARÍTIMA LOCAL.

PORTS® É UMA FRERRAMENTA PARA APOIAR DECISÕES QUE INTEGRA E DISSEMINA OBSERVAÇÕES AMBIENTAIS, PREVISÕES E INFORMAÇÕES GEOESPACIAIS EM TEMPO REAL. O OBJETIVO É A SEGURANÇA À NAVEGAÇÃO

[HTTP://AAPA.FILES.CMS-PLUS.COM/PHYSICAL%20OCEANOGRAPHIC%20REAL-TIME%20SYSTEM%20\(PORTS%20CAE\)](http://aapa.files.cms-plus.com/Physical%20Oceanographic%20Real-Time%20System%20(PORTS%20CAE))

PARCEIROS

- AUTORIDADE PORTUÁRIA
- AGÊNCIAS ESTATAIS
- PRATICAGENS
- MARINHA
- CORPO DE ENGENHEIROS DO - EXÉRCITO
- COMPANHIAS DE PETRÓLEO
- INDÚSTRIA
- ACADEMIA

FONTES DE RECURSOS

- AUTORIDADE PORTUÁRIA
- TAXAS LOCAIS
- AGÊNCIAS ESTATAIS
- GOVERNO FEDERAL
- SETOR PRIVADO

DADOS MEDIDOS

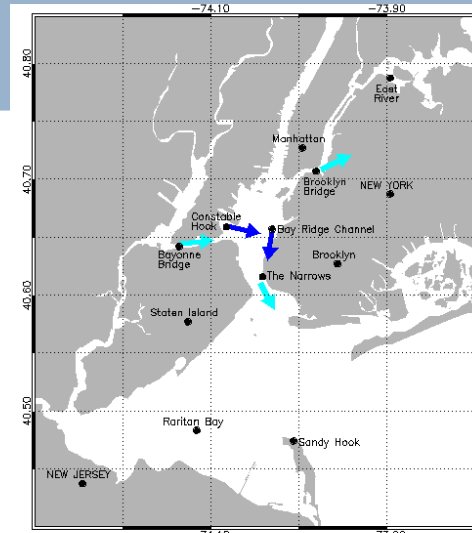
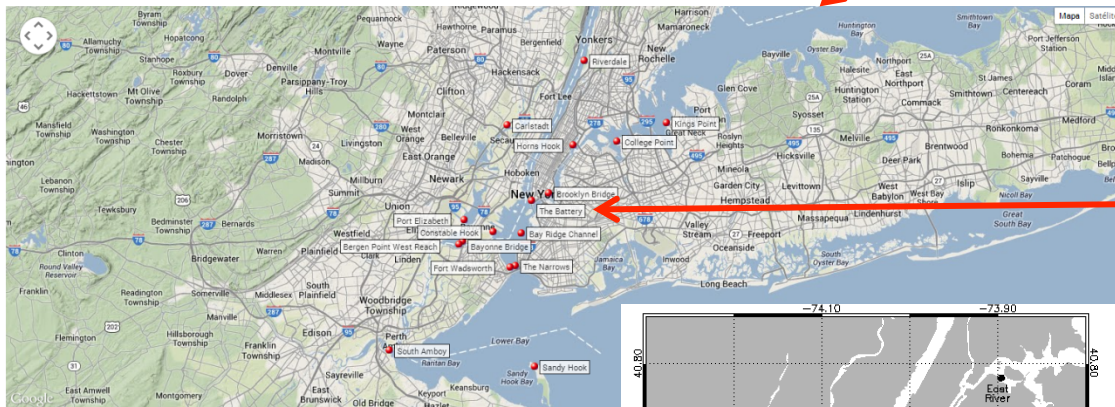
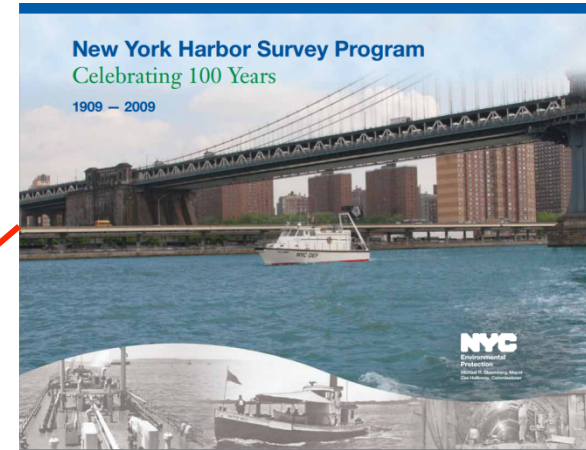
- NÍVEL DAS ÁGUAS
- CORRENTES
- SALINIDADE
- VÃO LIVRE DE PONTES
- PARÂMETROS METEOROLÓGICOS
- VISIBILIDADE
- ONDAS

Measures and disseminates observations and predictions

- Water levels
- Currents
- Salinity
- Air gap
- Meteorological parameters
- Visibility
- Waves



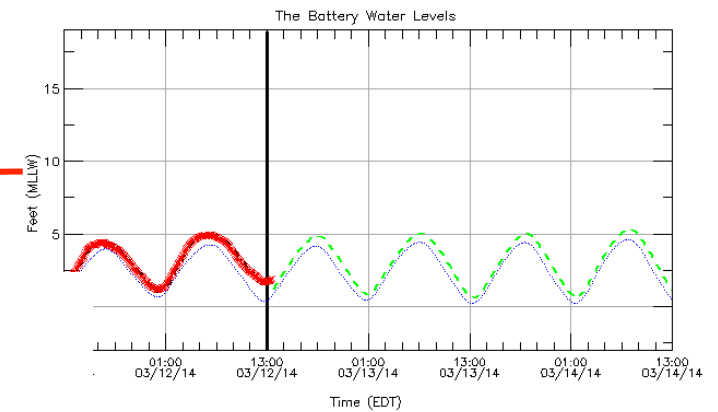
NOAA's CENTER for OPERATIONAL OCEANOGRAPHIC PRODUCTS and SERVICES



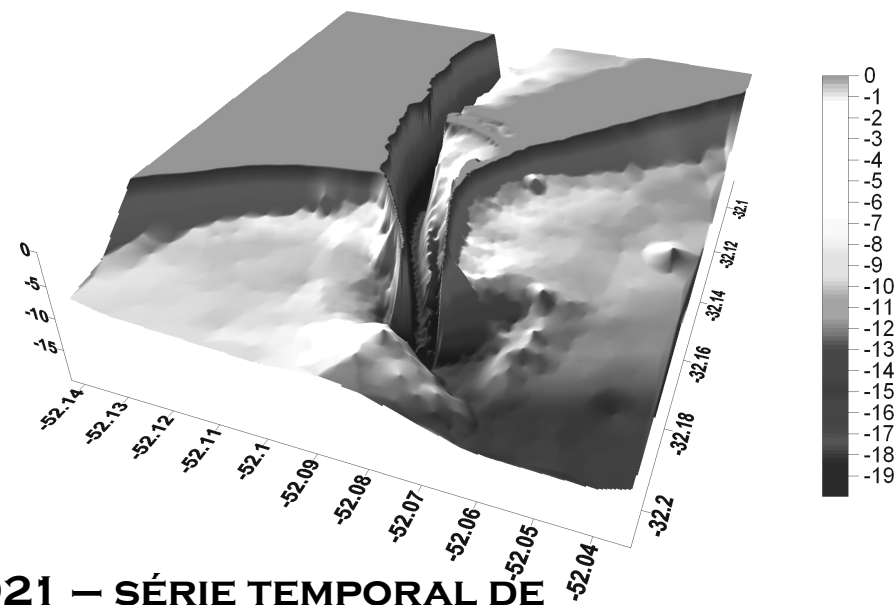
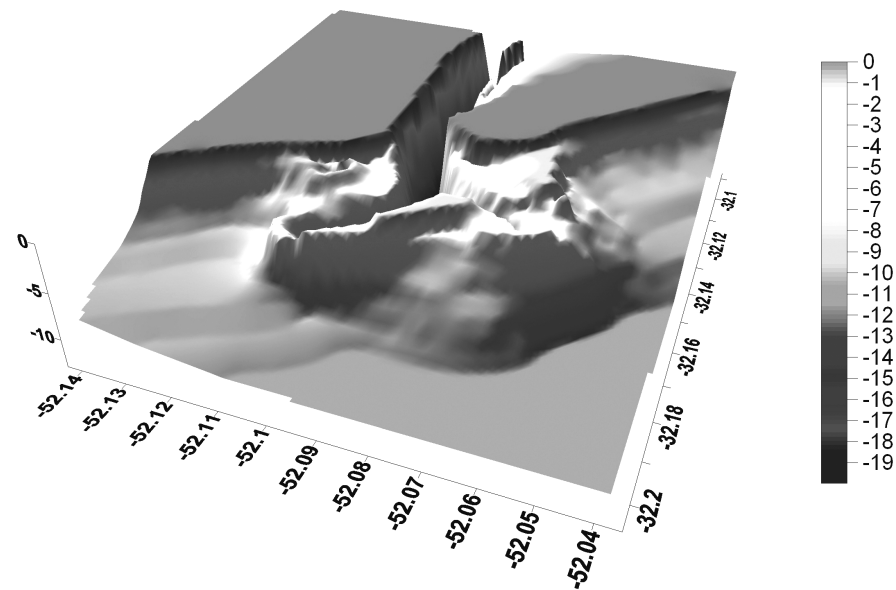
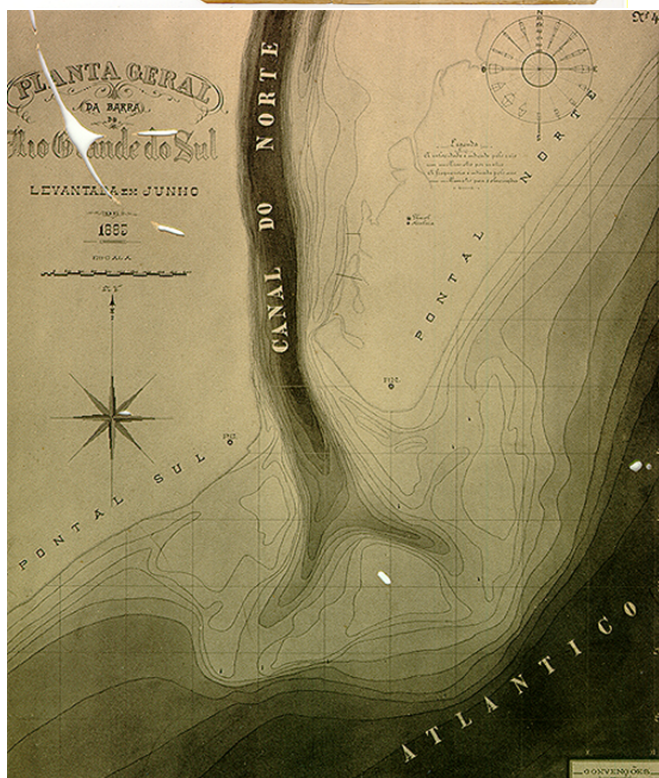
Valid at 0900 (EDT) 03/13/14

NOAA/National Ocean Service
New York Harbor Operational
Forecast System (NYOFS)

Observation:
Tidal Prediction:
Nowcast:
Forecast Guidance:

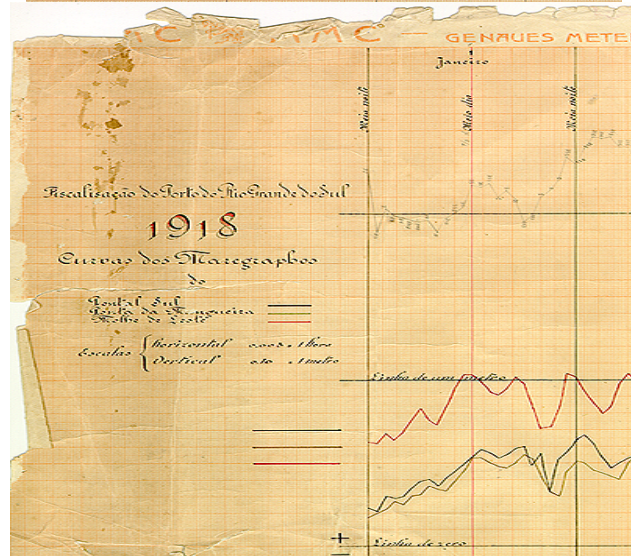
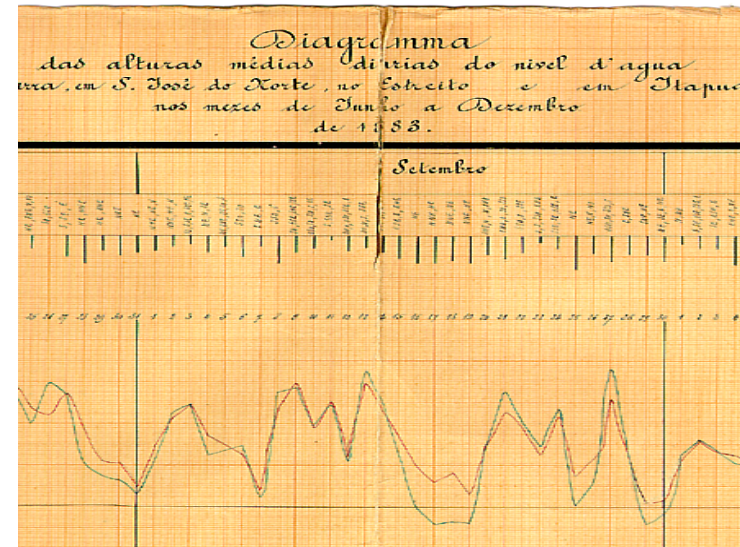
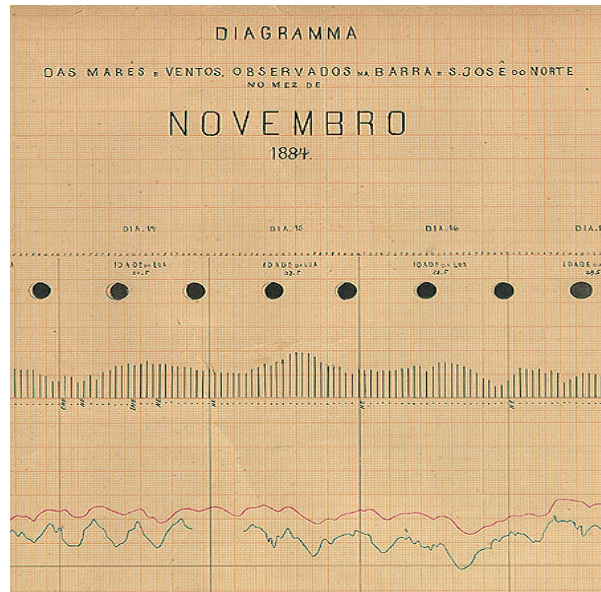


- Current
Knots
- < 0.3
 - 0.3 - 0.6
 - 0.6 - 1.0
 - 1.0 - 1.3
 - 1.3 - 1.6
 - 1.6 - 2.0
 - >= 2.0



DE 1883 A 1921 – SÉRIE TEMPORAL DE BATIMETRIA – ANTES, DURANTE E APÓS A CONCLUSÃO DOS MOLHES

DE 1883 A 1975 – NÍVEL DAS ÁGUAS EM DADOS HORÁRIOS, POR VEZES EM TRÊS PONTOS



MINISTÉRIO DA VIAÇÃO E OBRAS PÚBLICAS

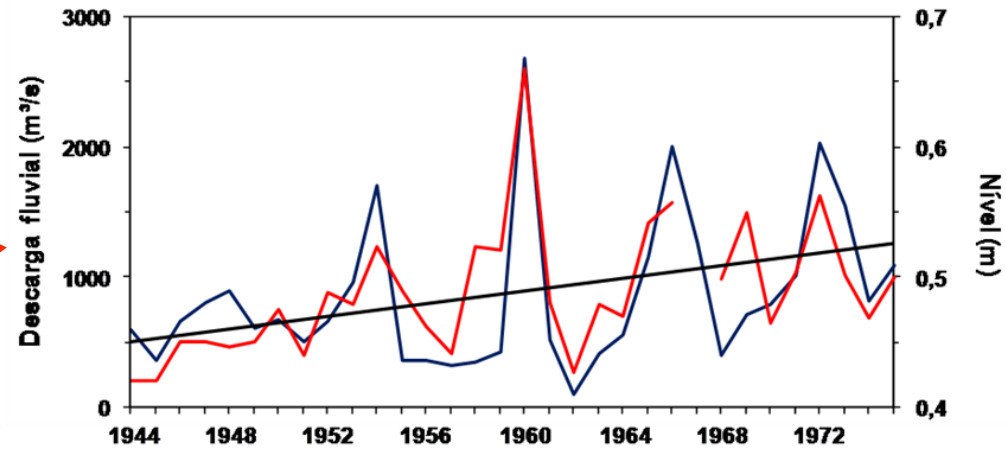
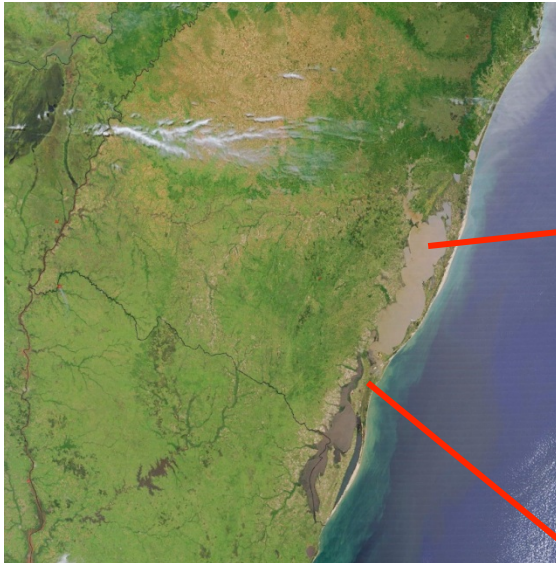
Departamento Nacional de Portos, Rios e Canais
Décimo Oitavo Distrito de Fiscalização

SECÇÃO DE RIO GRANDE.-

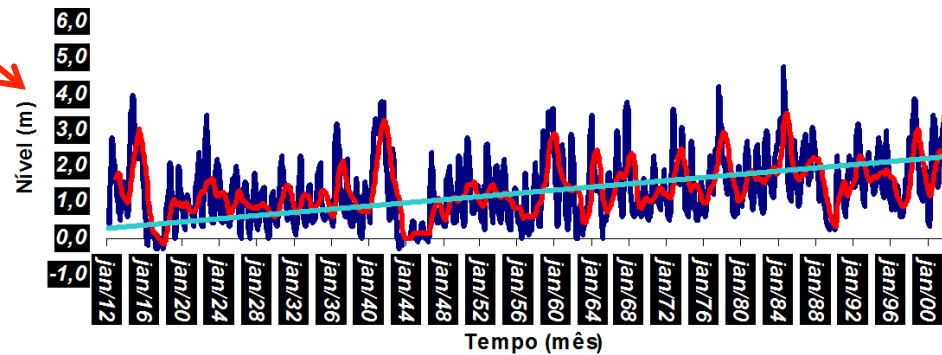
Mapa das ordenadas de Marés relativas ao mês de OUTUBRO do ano de 1915.-

6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
0,61	0,49	0,55	0,44	0,79	0,61	0,05	0,28	0,20	0,27	0,36	0,43	0,23	0,30	0,48	0,34	0,31	0,23	0,53
0,64	0,46	0,52	0,44	0,83	0,60	0,10	0,30	0,25	0,30	0,43	0,43	0,21	0,29	0,52	0,49	0,43	0,23	0,44
0,65	0,49	0,55	0,40	0,86	0,56	0,10	0,33	0,25	0,32	0,48	0,42	0,18	0,23	0,46	0,51	0,55	0,40	0,42
0,57	0,49	0,57	0,41	0,92	0,51	0,05	0,27	0,21	0,26	0,44	0,35	0,16	0,25	0,30	0,39	0,55	0,49	0,56
0,44	0,40	0,51	0,45	0,93	0,54	0,00	0,26	0,19	0,17	0,41	0,27	0,17	0,17	0,22	0,23	0,36	0,50	0,63
0,29	0,27	0,40	0,42	0,95	0,58	0,07	0,28	0,20	0,18	0,43	0,21	0,11	0,21	0,29	0,26	0,21	0,46	0,52
0,29	0,23	0,36	0,36	0,91	0,52	0,08	0,31	0,24	0,20	0,39	0,22	0,03	0,21	0,36	0,32	0,23	0,43	0,42
0,29	0,25	0,32	0,35	0,85	0,44	0,07	0,33	0,30	0,27	0,45	0,21	0,03	0,19	0,36	0,42	0,30	0,42	0,37
0,35	0,32	0,39	0,44	0,85	0,40	0,10	0,35	0,34	0,35	0,52	0,23	0,02	0,16	0,23	0,41	0,43	0,63	0,57
0,35	0,32	0,45	0,49	0,93	0,40	0,17	0,37	0,39	0,34	0,61	0,25	0,05	0,15	0,09	0,21	0,39	0,76	0,51
0,30	0,30	0,43	0,55	0,95	0,42	0,22	0,40	0,42	0,35	0,64	0,29	0,14	0,14	0,02	0,09	0,28	0,69	0,64
0,29	0,31	0,40	0,51	0,94	0,44	0,26	0,42	0,48	0,40	0,64	0,25	0,23	0,22	0,00	0,03	0,08	0,57	0,66

RECUPERAÇÃO DE DADOS HISTÓRICOS



MÖLLER E FERNANDES, 2010



HIRATA ET AL., 2010

TENDÊNCIA DE AUMENTO DE NÍVEL

LAGOA MIRIM - 1,6 CM/ANO

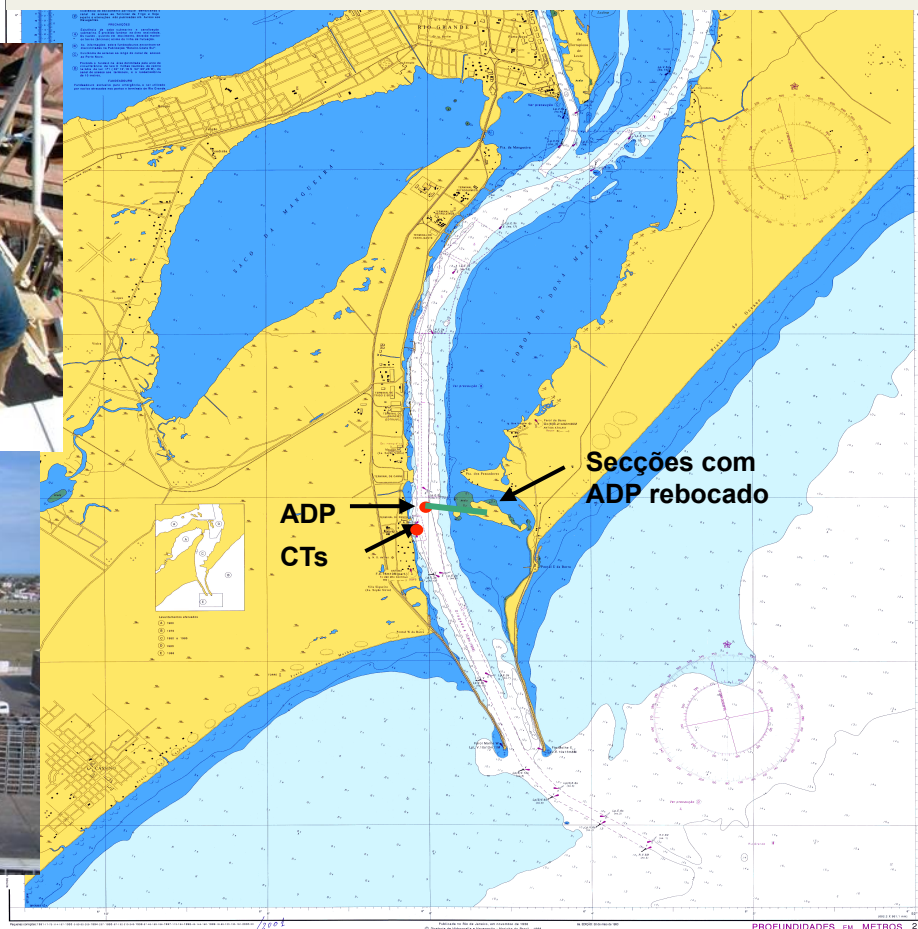
LAGOA DOS PATOS – 2,5 MM/ANO

LOCOSTE – MONITORAMENTO E MODELAGEM

ADP Sontek fundeado de Aug. 2005 a Dez. 2012 - dados horários em **tempo real** de nível e correntes em vários níveis. Interrupções em 2009 e 2012 por dragagem. Panes.

2 CTs Seabird 37SM desde Out. 2003

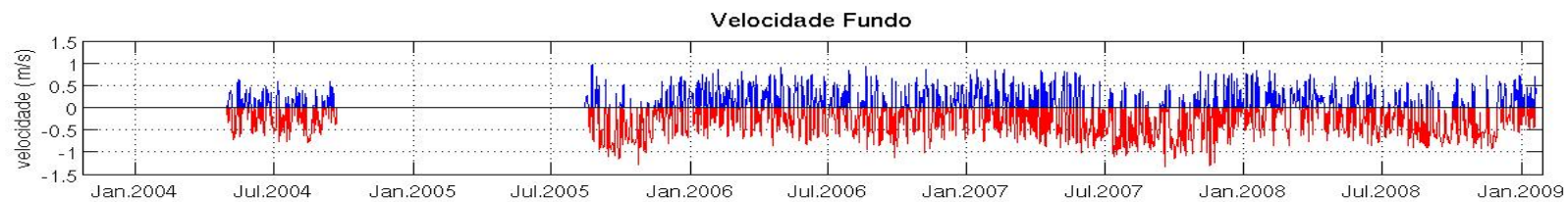
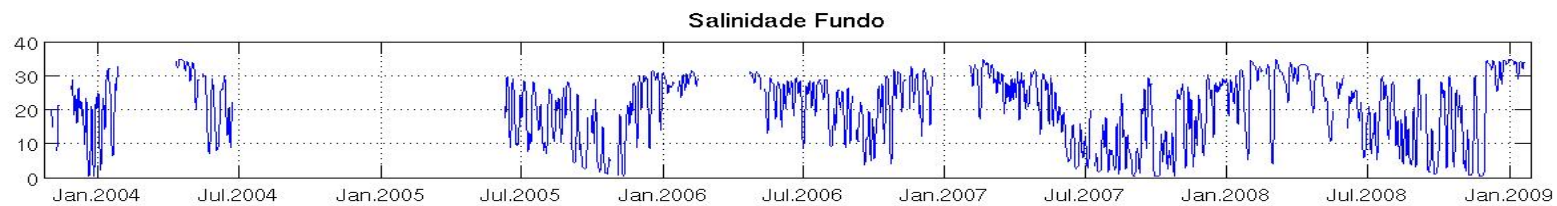
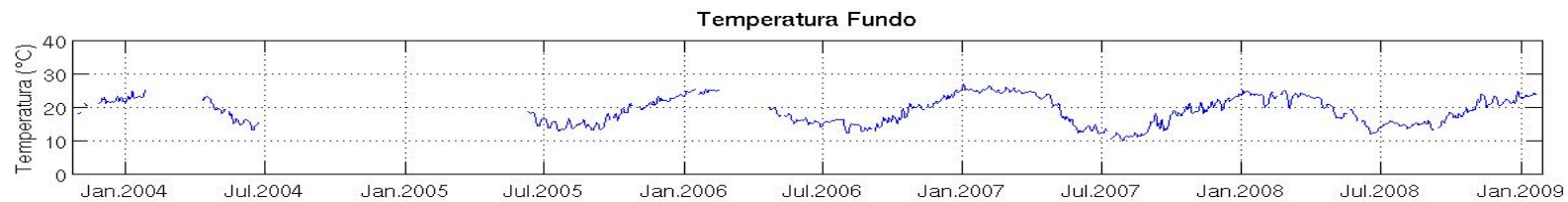
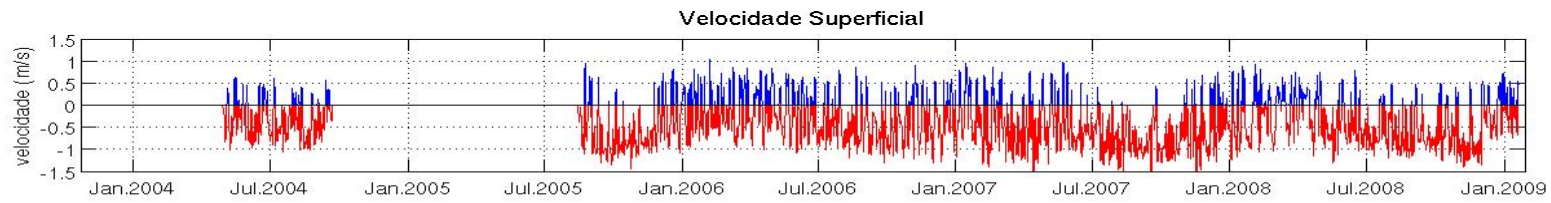
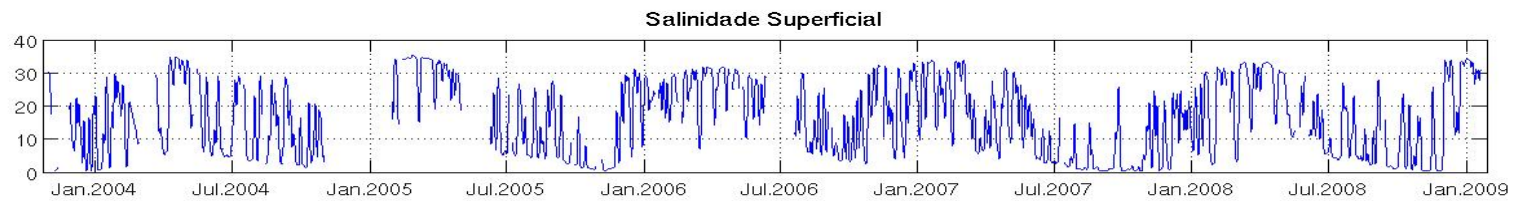
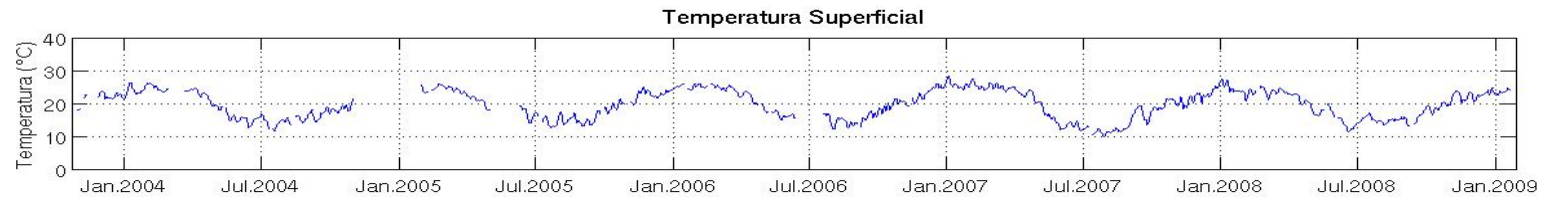
Secções com ADP *bottom tracking*



MANTIDO COM:

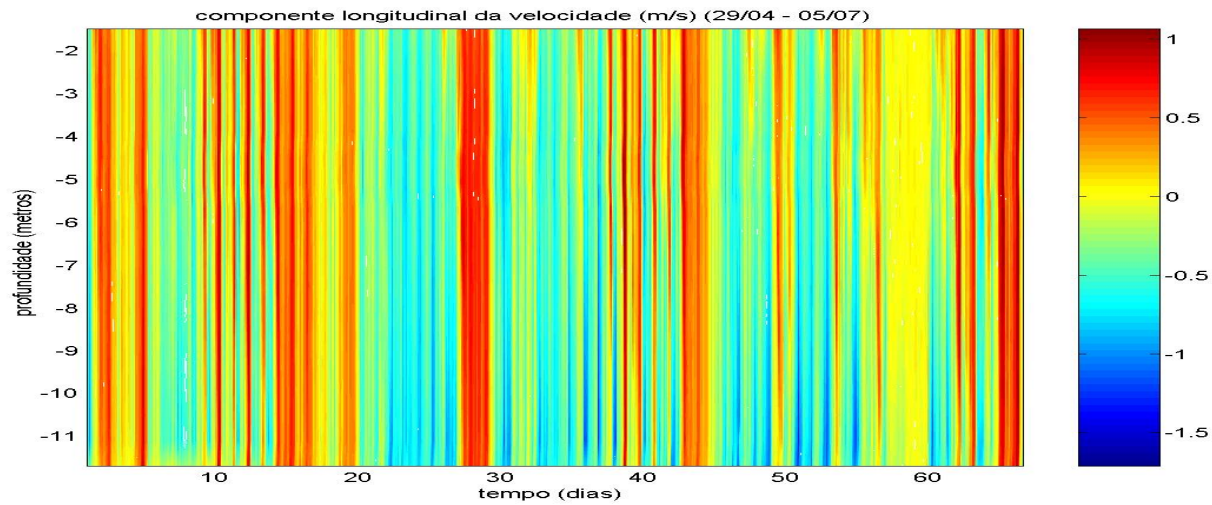
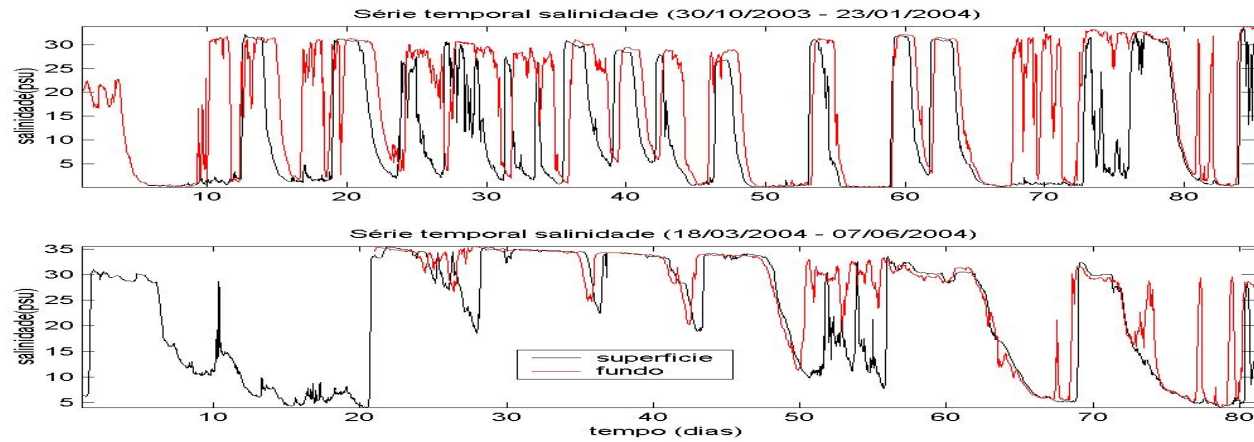
- PROJETOS
- PELD/CNPQ
- FINEP
- PRESTAÇÃO DE SERVIÇOS
- PARCERIAS-PRATICAGEM

DADOS SERÃO DISPONIBILIZADOS NO SIMCOSTA



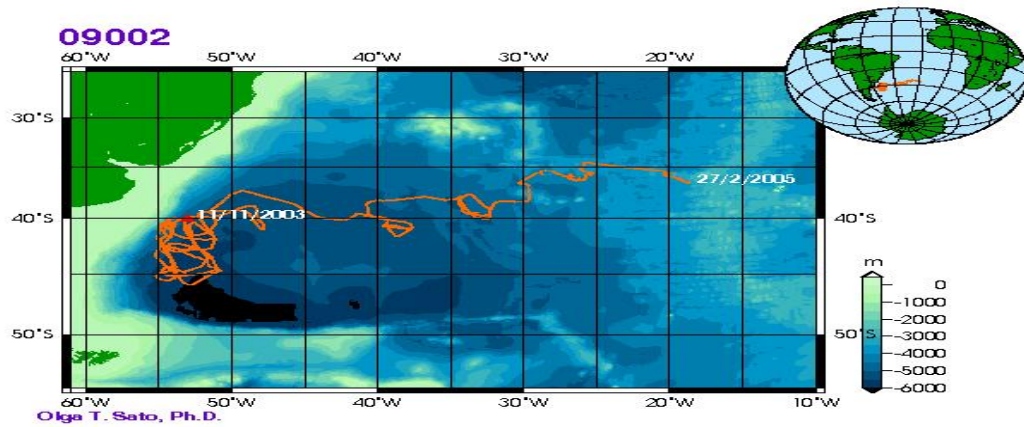
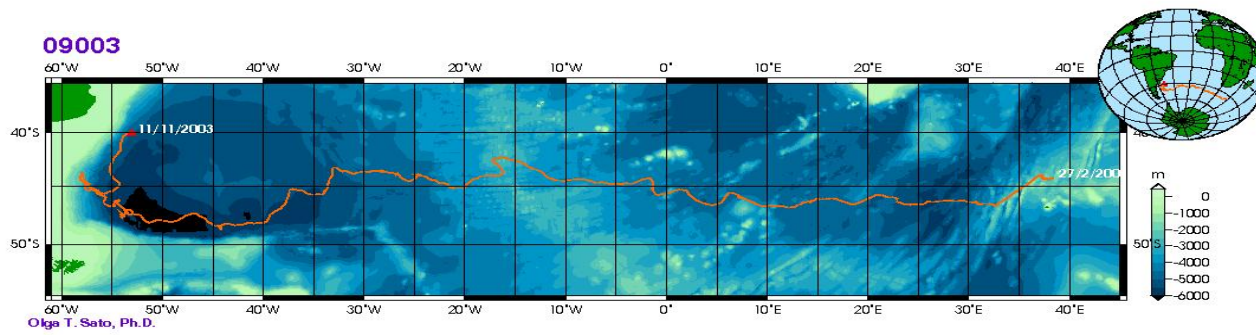
Oceanografia Física

Séries temporais

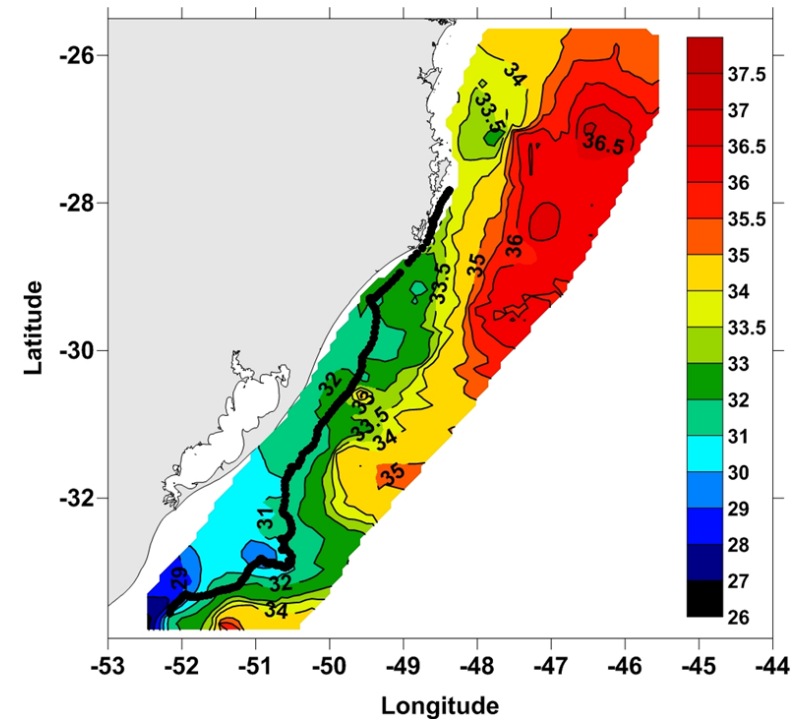
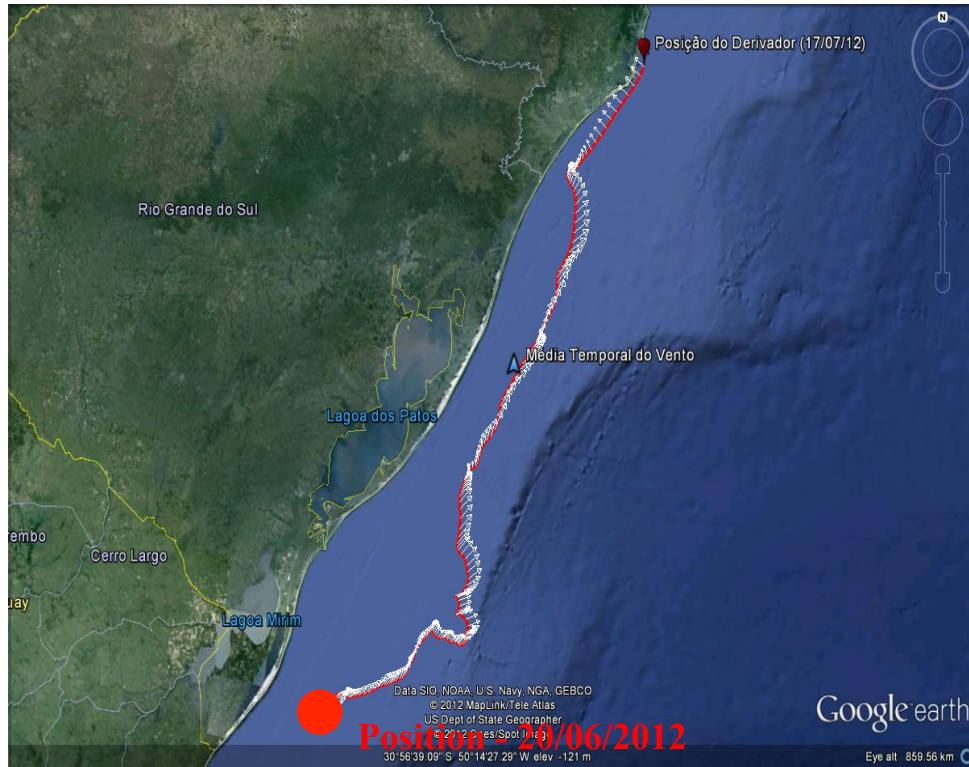


Oceanografía Física

Derivadores

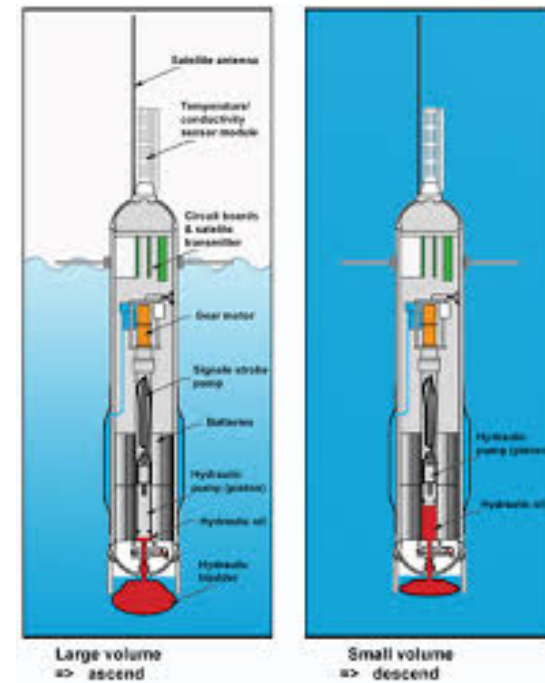
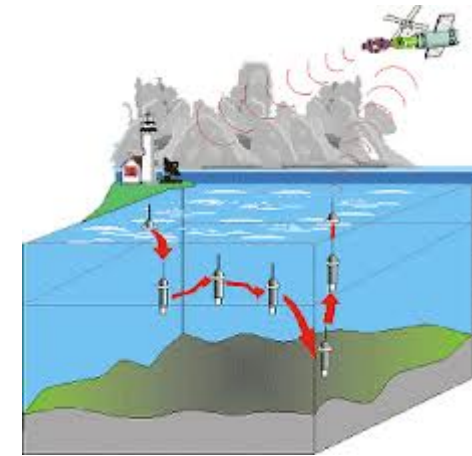
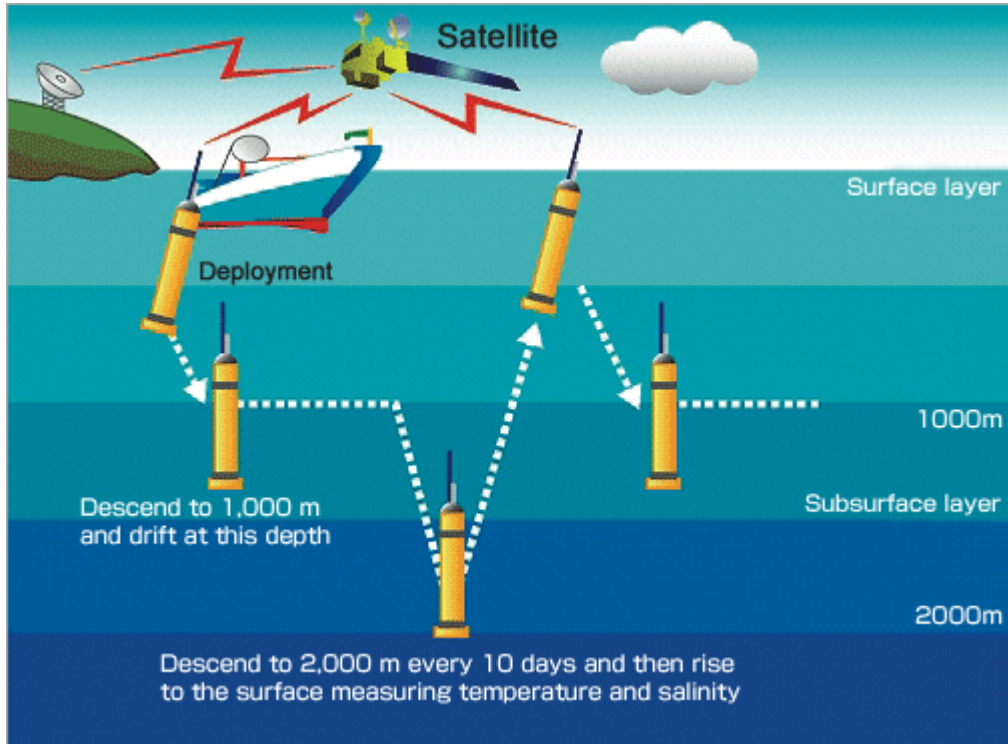


DERIVADOR DE BAIXO CUSTO (LCD) LANÇADO EM 20/06/2012 - ~0.3 M/S

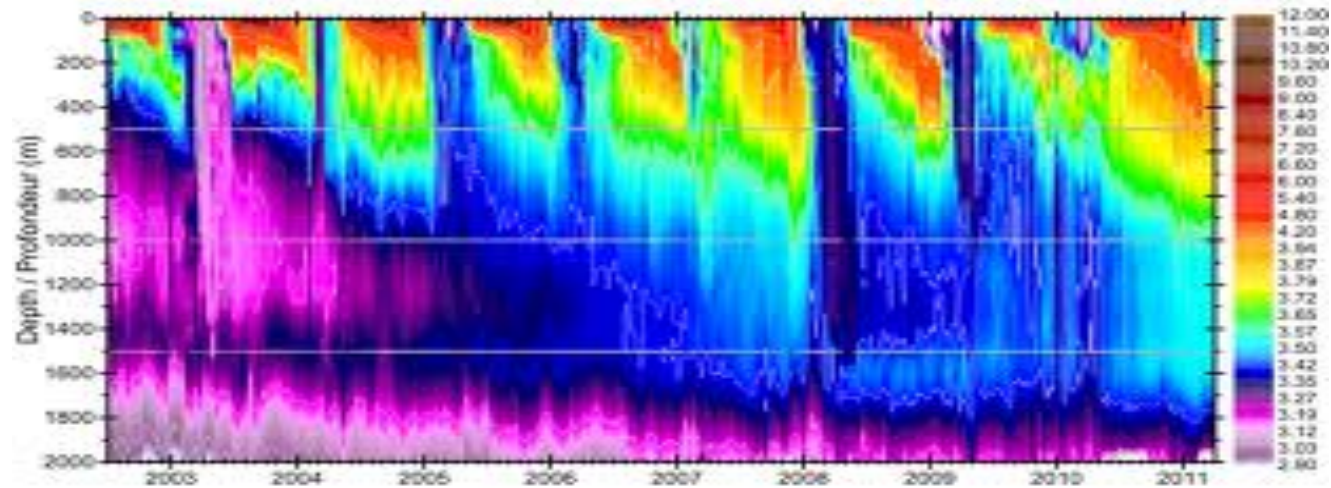
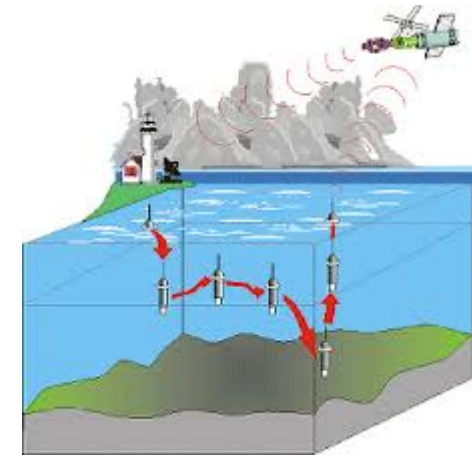
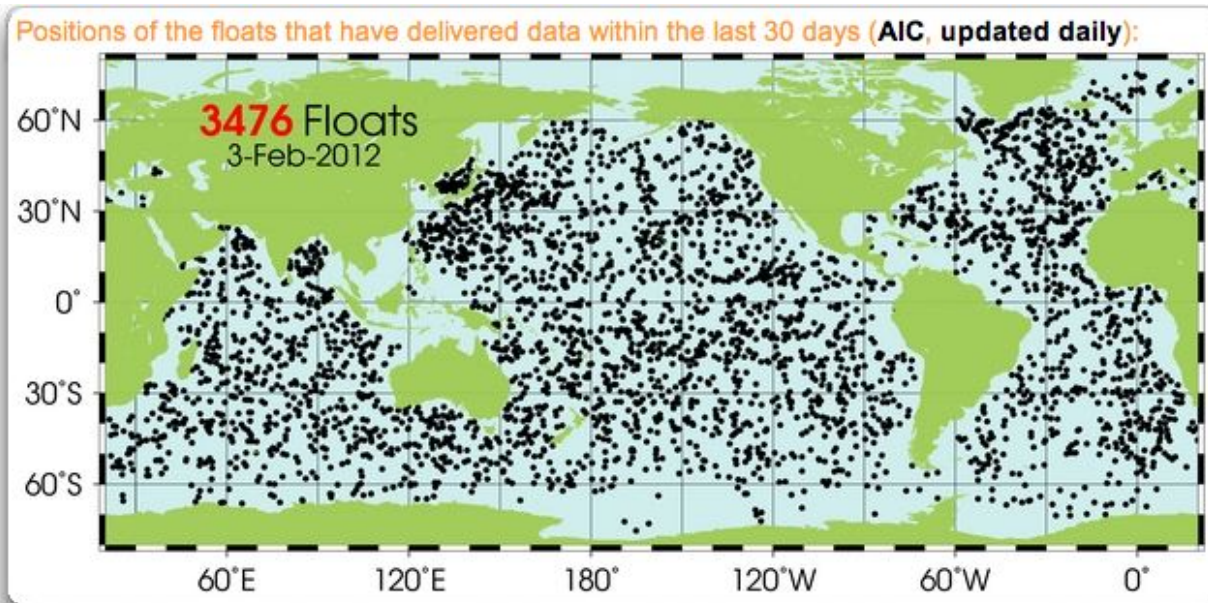


MESMO VENTOS FORTES DE NE NÃO ERAM CAPAZES DE REVERTER O DESLOCAMENTO PARA O NORTE DO LCD. A CAUSA: FLUXO PARA O NORTE DEVIDO AO GRADIENTE DE PRESSÃO FORMADO PELA PRESENÇA DE ÁGUAS DE BAIXA SALINIDADE E TEMPERATURA DERIVADAS DO RIO DA PRATA

Flutuadores ARGO



Flutuadores ARGO



Oceanografia Física

Sensoriamento Remoto

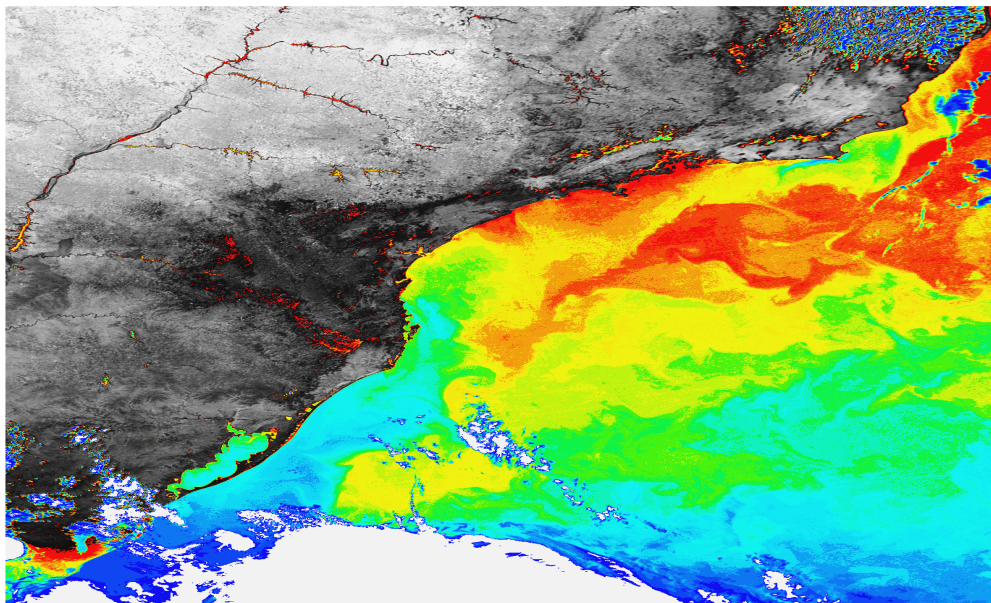
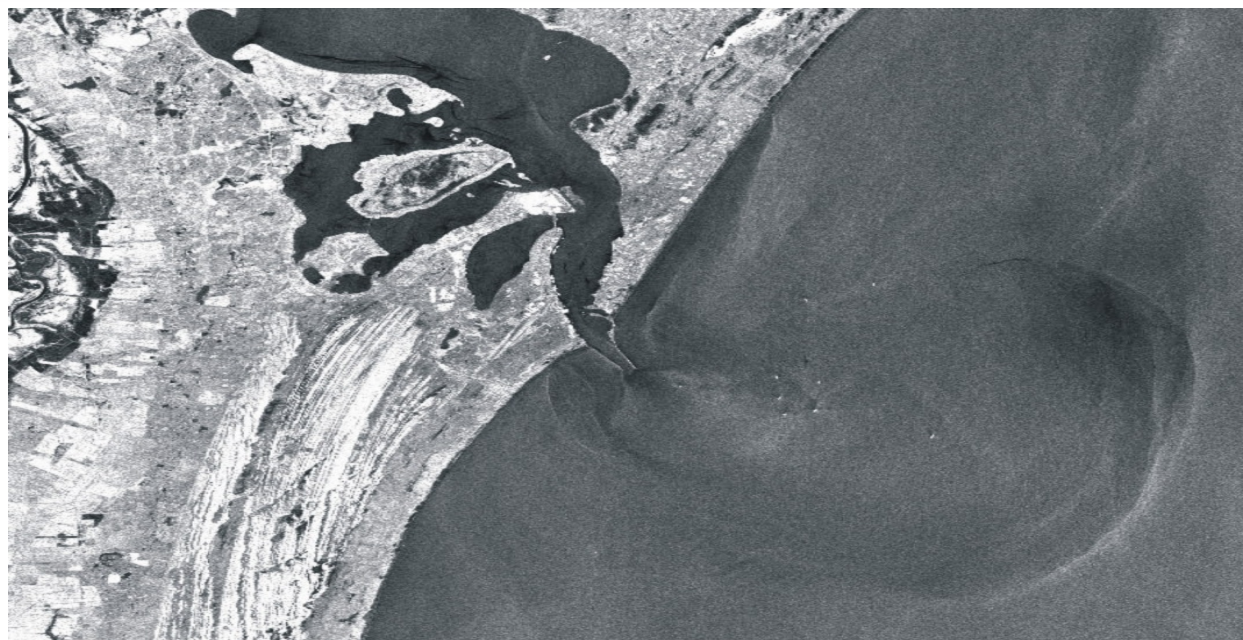
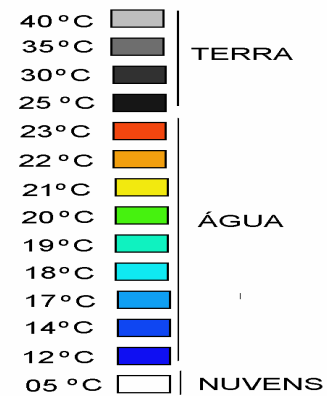


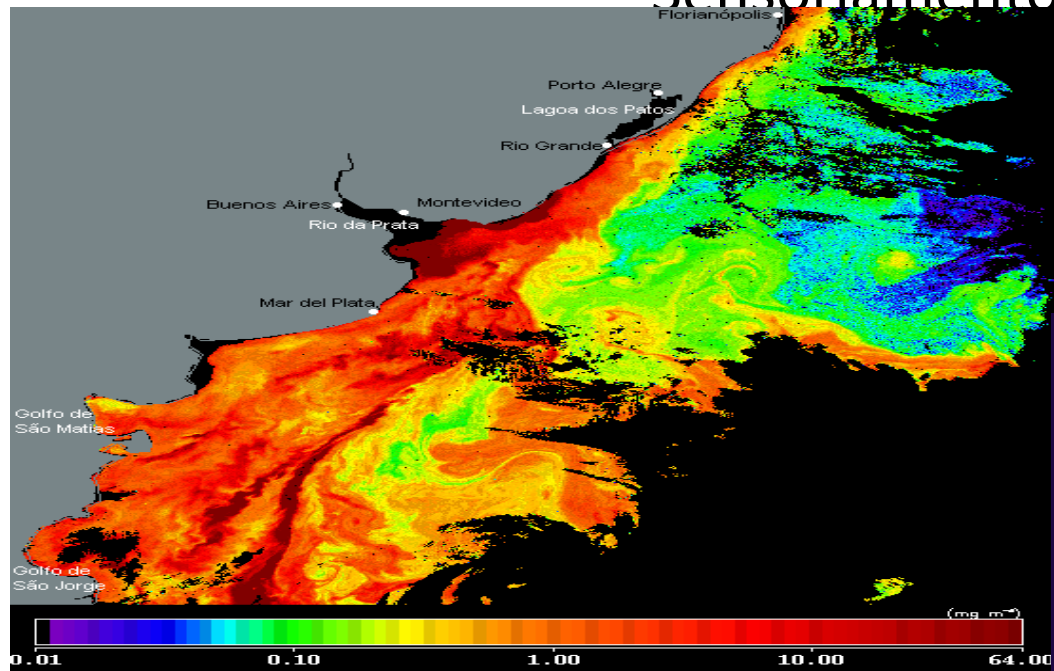
Imagem AVHRR/NOAA-14
18 AGO 1997 - 17:50 GMT

TEMPERATURAS



Oceanografia Física

Sensoriamento Remoto



Oceanografía Física

Modelagem Numérica

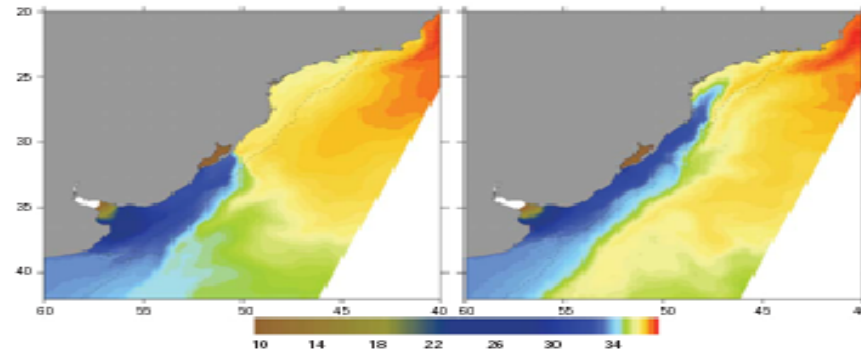


Figura 8. Salinidade de superfície simulada com o Princeton Ocean Model, para um caso do Rio de la Plata igual a 20.000m³/s e ventos típicos de esse o (sudeste e sudoeste).

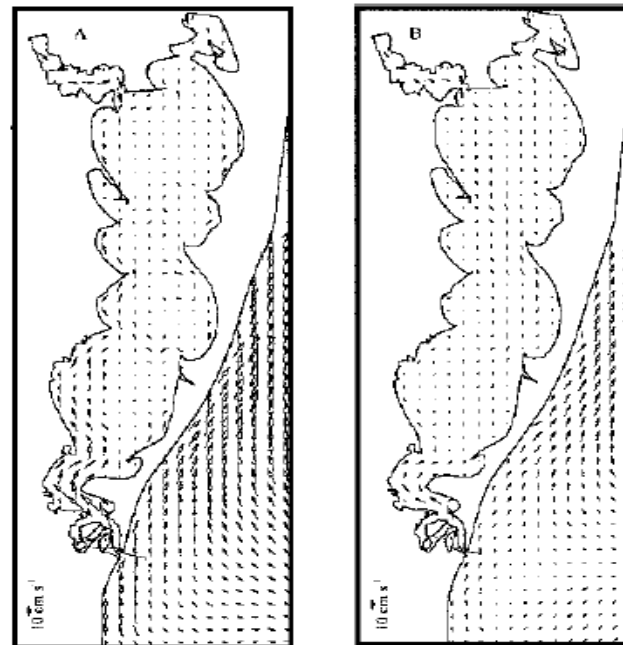


Fig. 14. Plot of surface (A) and bottom (B) currents obtained at hour 35 during a southwest wind event. The model was forced with data recorded between April 6 and 12, 1992.

Network 1 – Harbour environmental management

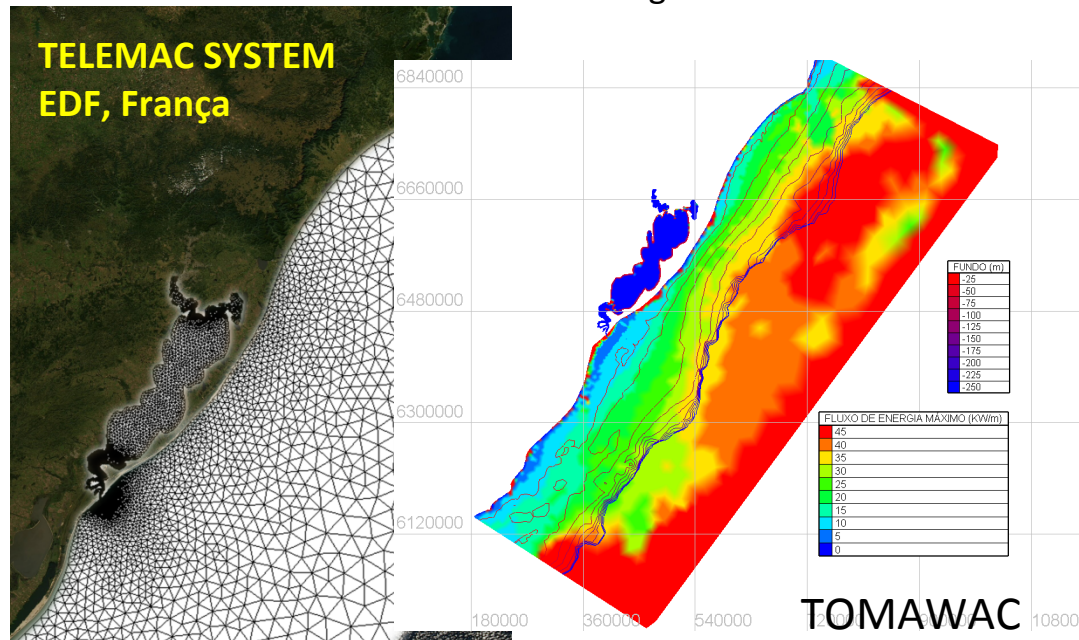


TRANSAQUA

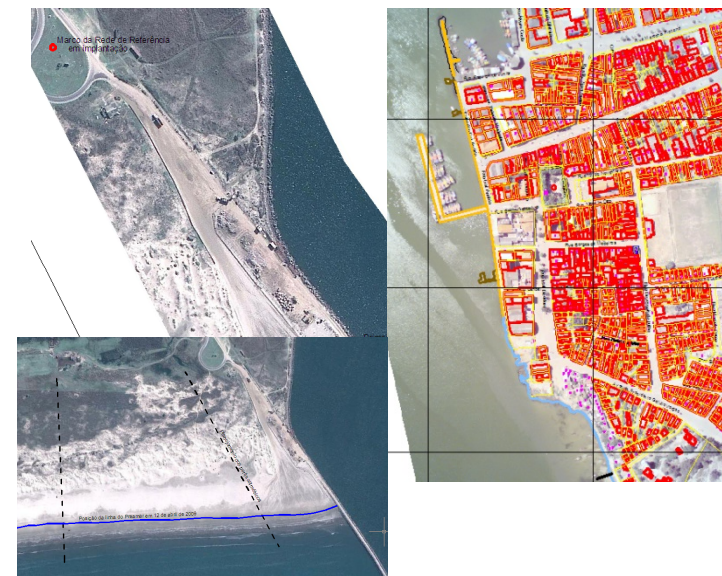
Network 2 – Continuous monitoring



Net work 3 - Numerical modeling

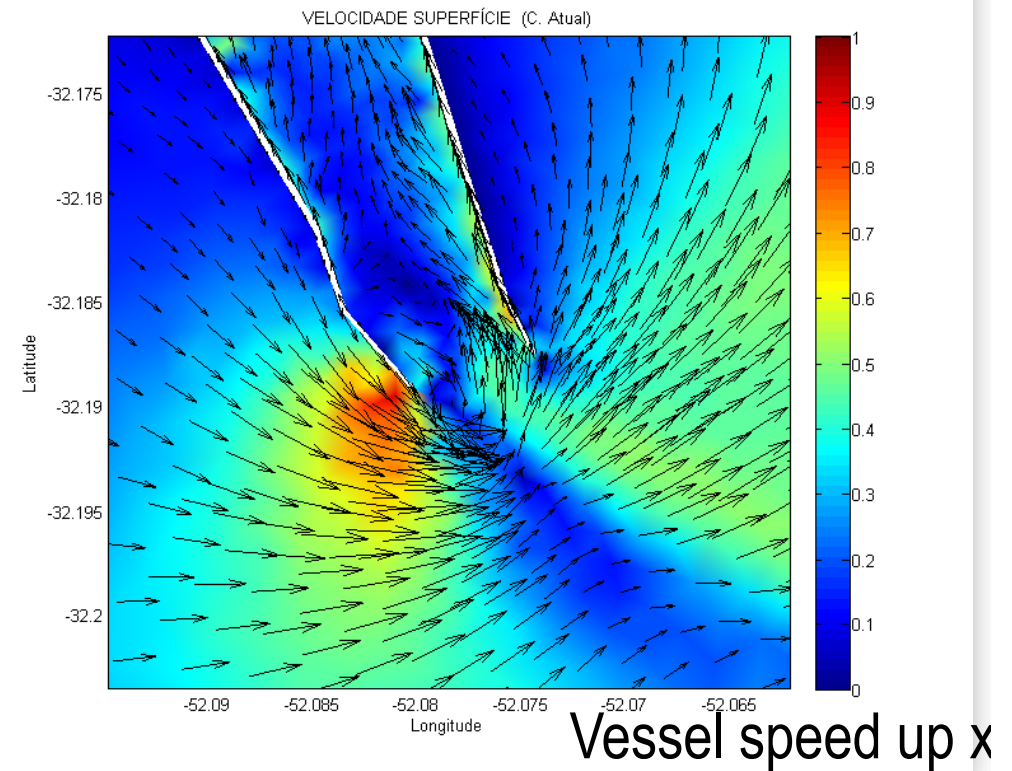
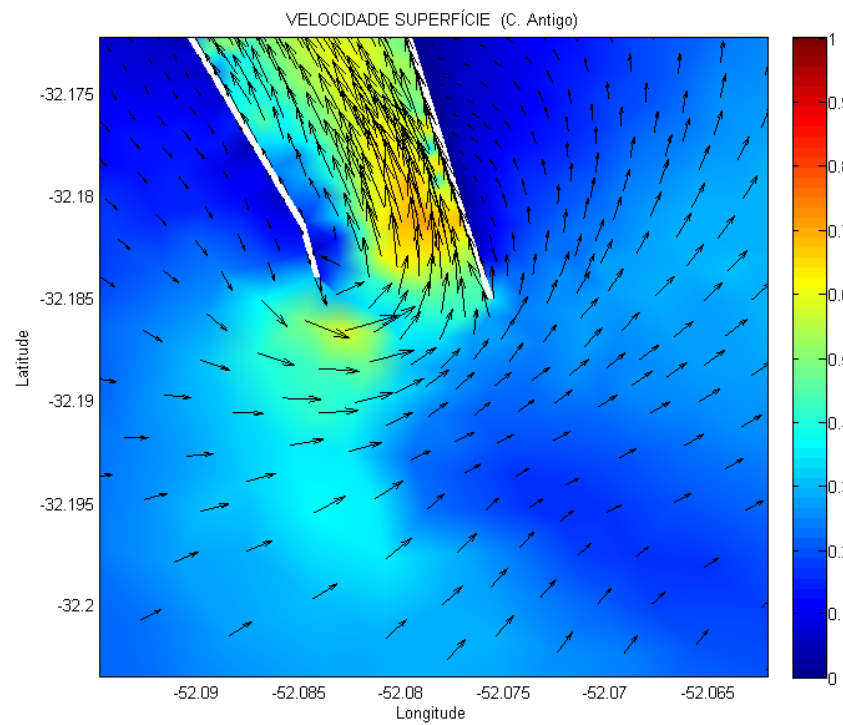


Network 4 - GIS



Results

Current velocity at the surface - Flood event

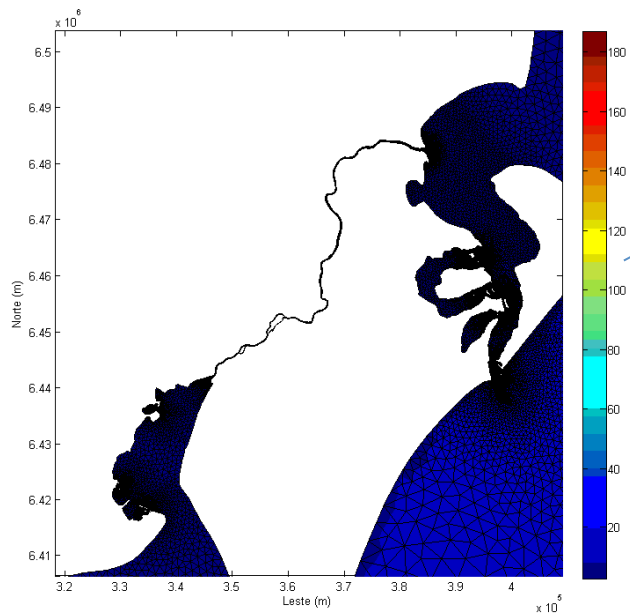
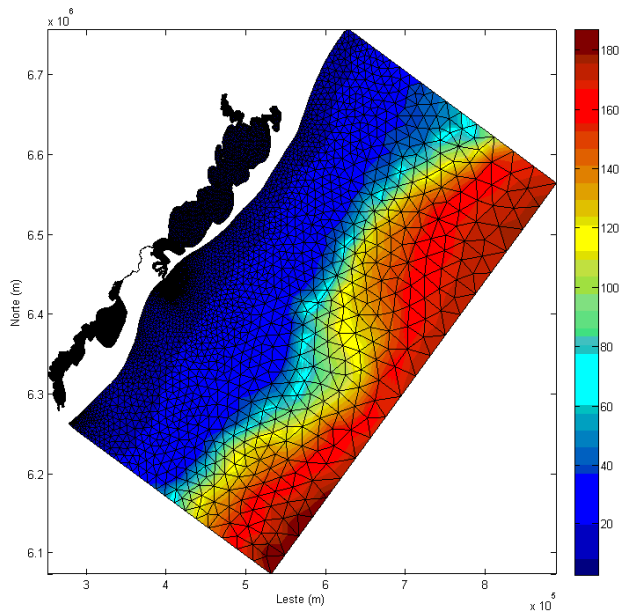


ALÉM DA PARTE CIENTÍFICA, DADOS TAMBÉM SÃO USADOS PARA CALIBRAR E VALIDAR MODELOS NUMÉRICOS APLICADOS EM:

A) OBJETIVOS CIENTÍFICOS

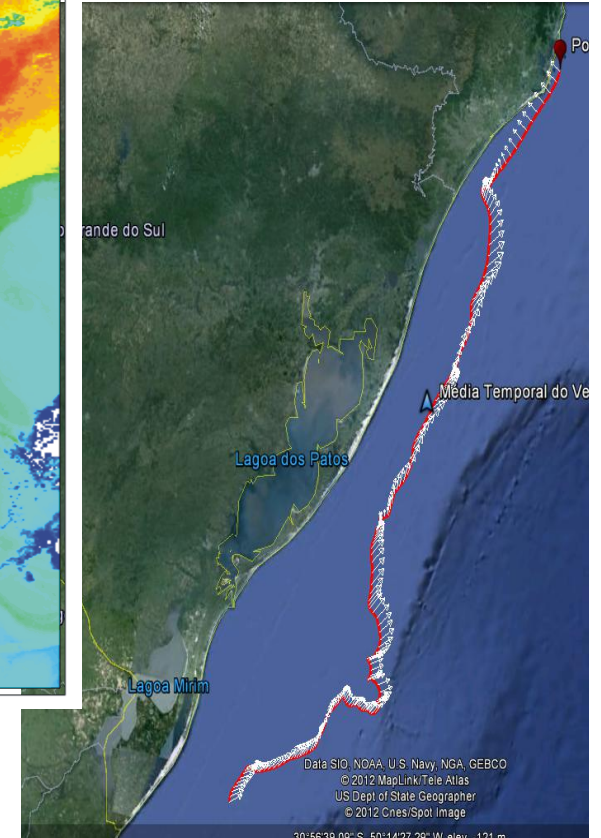
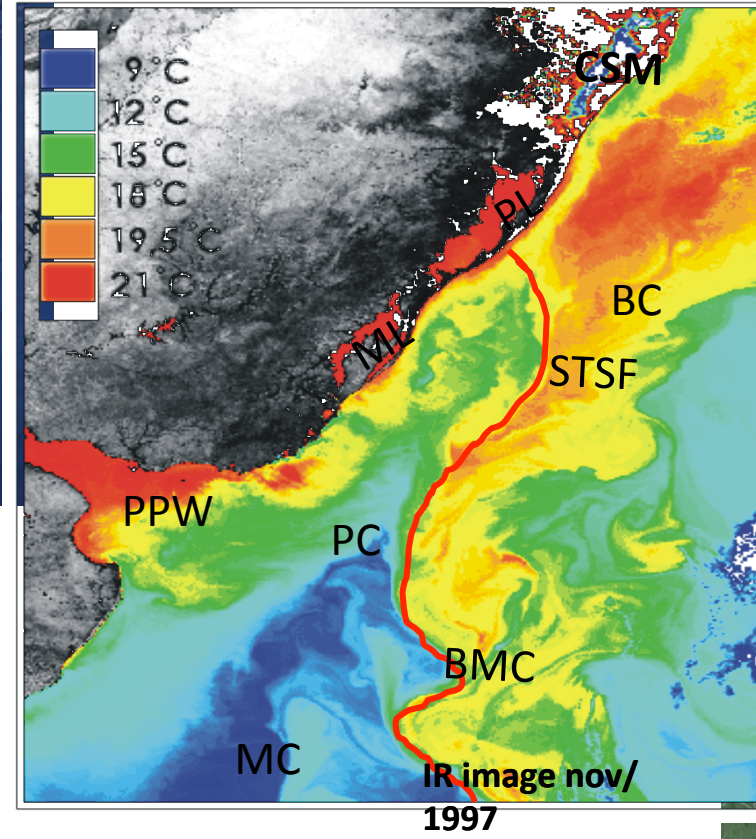
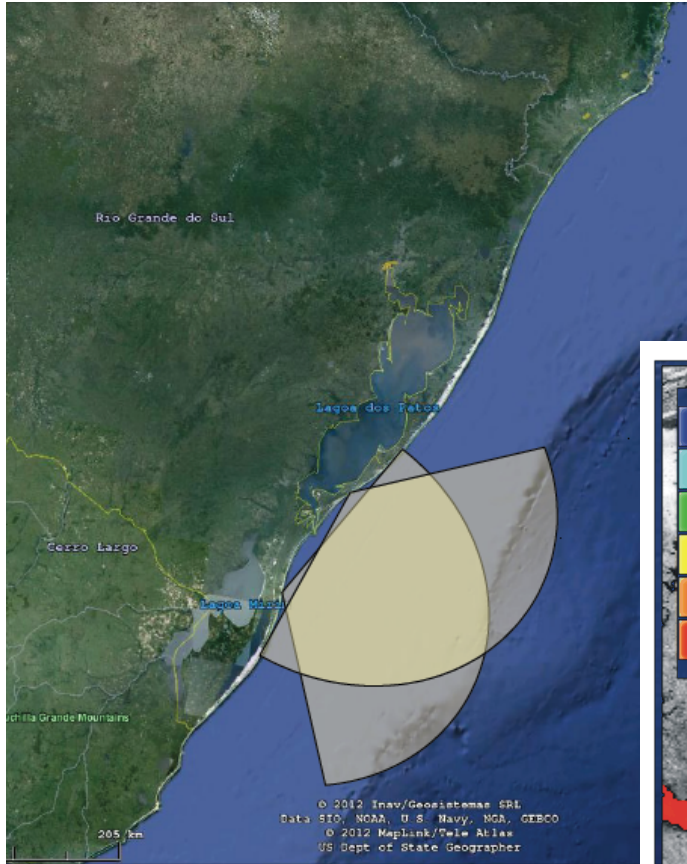
B) ESTUDOS DE IMPACTOS AMBIENTAIS

C) SIMULADOR VIRTUAL PARA TREINAMENTO DE PRÁTICOS EM SITUAÇÕES CRÍTICAS



EM IMPLANTAÇÃO PELO LOCOSTE: RADAR EM PARCERIA COM A IACIT – SCTRS – APROVADA A SEGUNDA ETAPA PARA INSTALAÇÃO DO SEGUNDO GRUPO DE ANTENAS





GLIDERS



**SISTEMA MULTI-
SENSOR
FLUTUABILIDAD
E E MOVIMIENTO
DE LASTRO
CTD,
FLUORÍMETRO
TURBIDÍMETRO
OXÍMETRO
ADCP
CDOM
TRANSMISSÃO
DE DADO POR
SATÉLITE**

Propriedades Físicas da Água do Mar

- **Temperatura**
 - Variação - amplitude
 - Métodos de determinação
 - Distribuição horizontal superficial
 - Distribuição vertical
 - Temperatura potencial
- **Salinidade**
 - Conceito
 - Variação - amplitude
 - Métodos de determinação
 - Distribuição horizontal superficial
 - Distribuição vertical
- **Densidade**
 - Conceito, anomalias, volume específico
 - Variação – amplitude
 - Métodos de determinação
 - Distribuição horizontal superficial
 - Distribuição vertical
 - Estabilidade/Instabilidade

Presença do sal na água do mar: impactos

- Altera:
 - Viscosidade
 - Compressibilidade – propagação do som
 - Índice de refração da luz
 - Densidade
 - Temperatura de máxima densidade
 - Ponto de congelamento

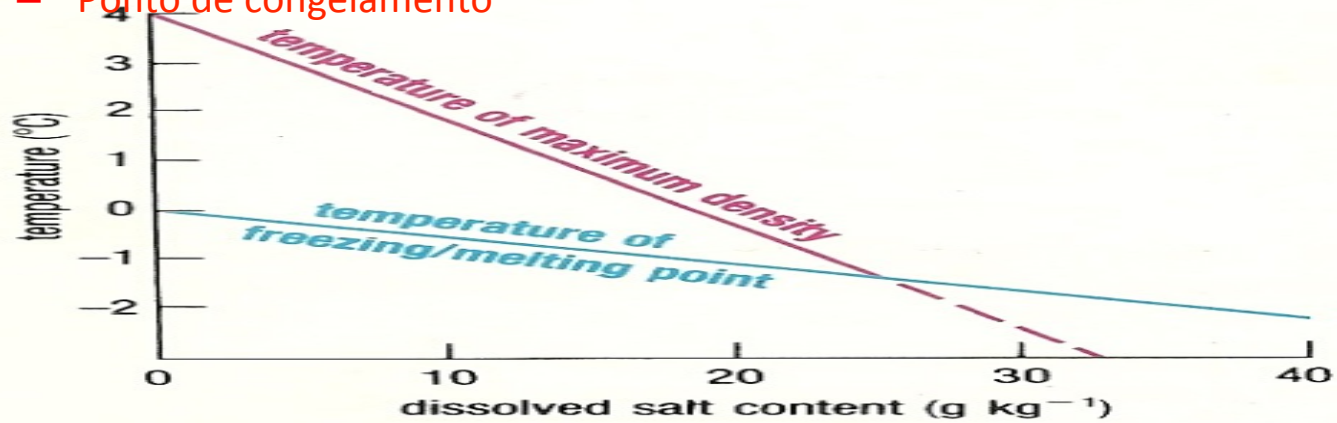
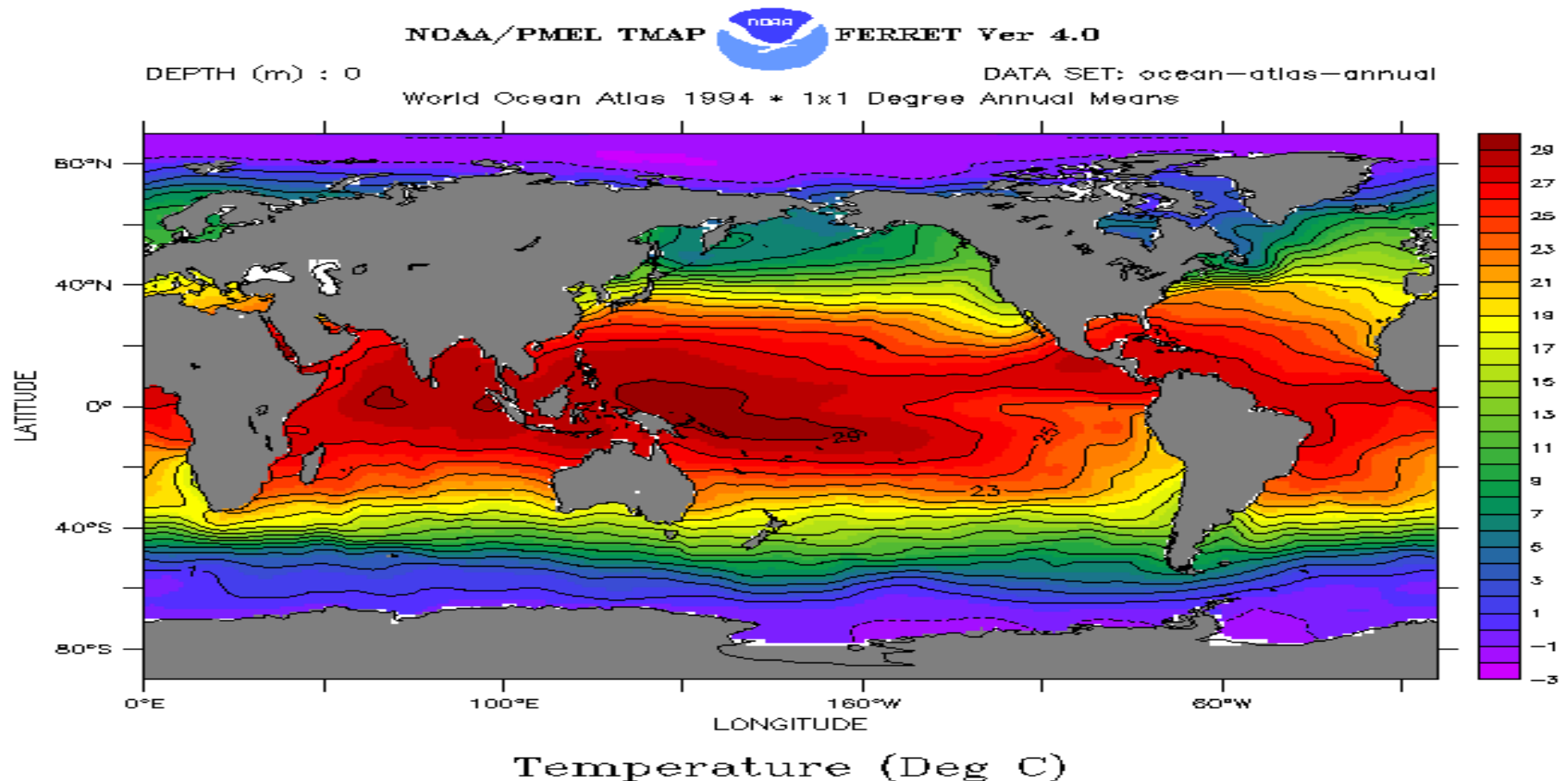


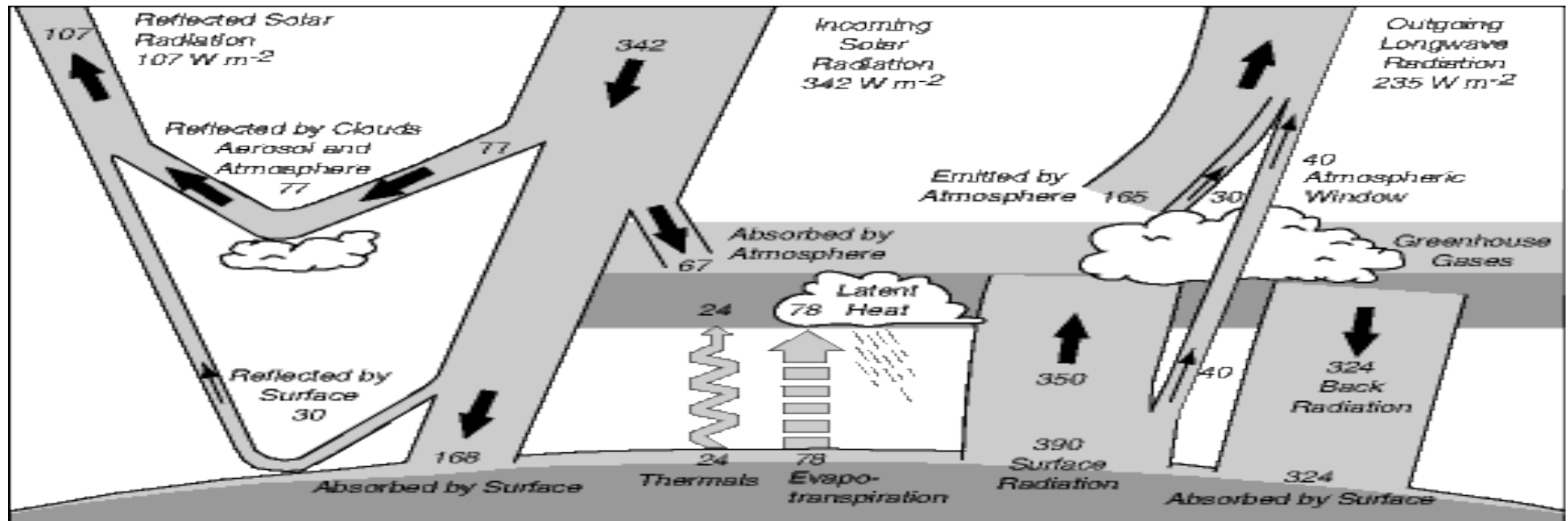
Figure 1.2 Temperatures of freezing and melting point and maximum density of liquid water as functions of dissolved salt content.

Temperatura da Água do Mar



Mean sea-surface temperature calculated from the optimal interpolation technique (Reynolds and Smith, 1995) using shipreports and AVHRR measurements of temperature. Contour interval is 1° C with heavy contours every 5° C. Shaded areas exceed 29° C.

Balanço de Calor



The mean annual radiation and heatbalance of the earth. From Houghton et al. (1996: 58), which used data from Kiehl and Trenberth (1996).

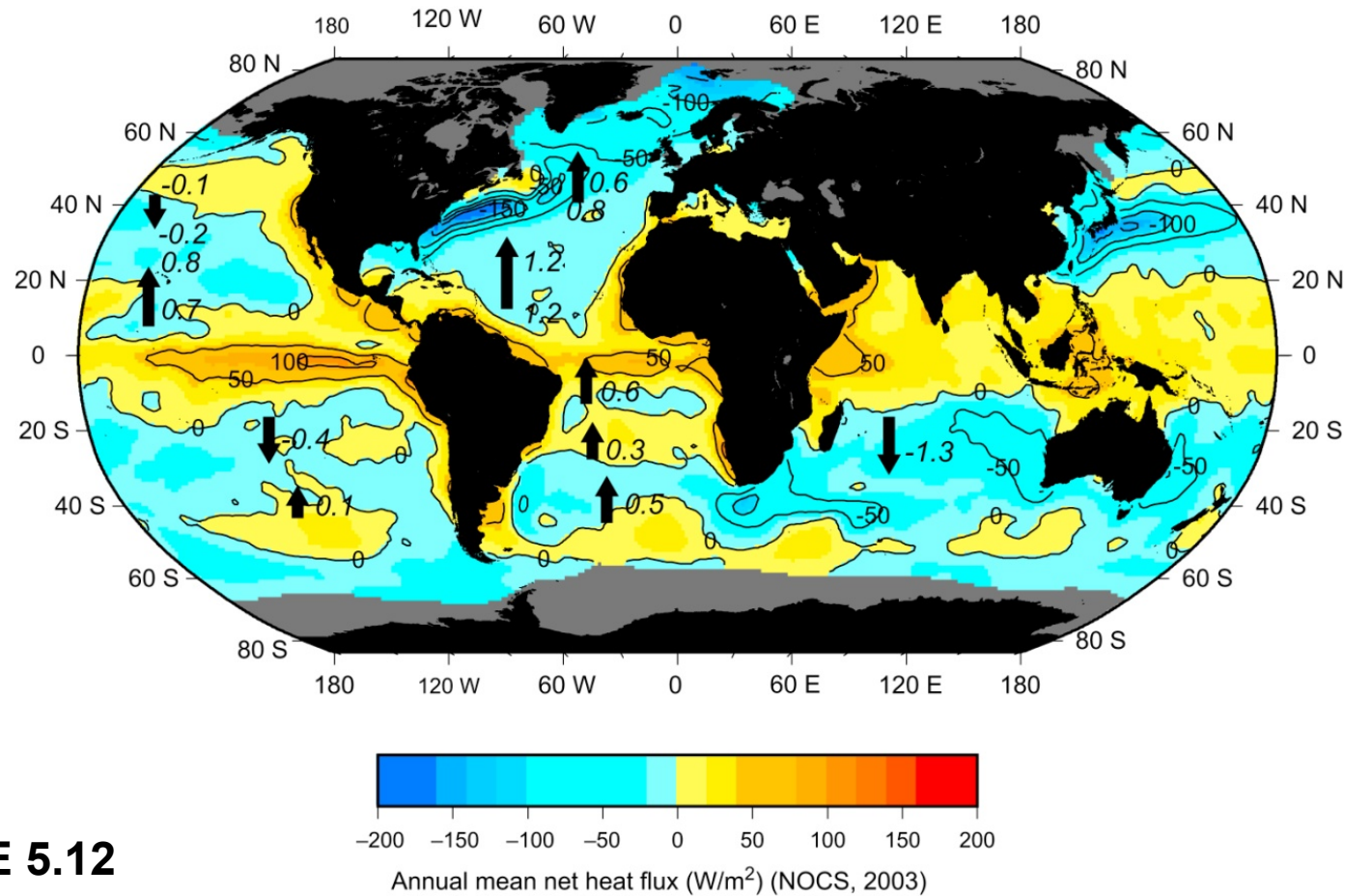


FIGURE 5.12

Annual average net heat flux (W/m^2). Positive: heat gain by the sea. Negative: heat loss by the sea. Data are from the NOCS climatology (Grist and Josey, 2003). Superimposed numbers and arrows are the meridional heat transports (PW) calculated from ocean velocities and temperatures, based on Bryden and Imawaki (2001) and Talley (2003). Positive transports are northward. The online supplement to Chapter 5 (Figure S5.8) includes another version of the annual mean heat flux, from Large and Yeager (2009). This figure can also be found in the color insert.

Garrafas de Nansen e de Niskin



**Nansen water bottles
before (I), during (II), and
after (III) reversing.
(From Dietrich et al. 1980)**

Fig. 6.16. Water sampling bottles (Nansen bottles), circa 1960 for mounting individually on a wire with reversing thermometer racks.



Fig. 6.17. Single Niskin bottle

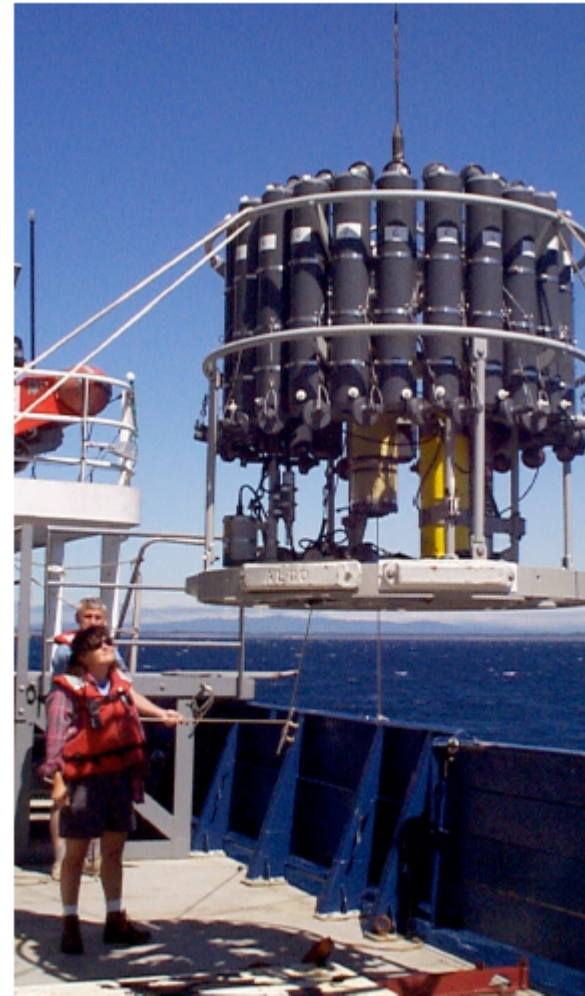


Fig. 6.18. Rosette sampler. Large sampler used in the World Ocean Circulation Experiment, with 36 10-liter Niskin bottles, an acoustic pinger (lower left), an LADCP (center, yellow long), a CTD (bottom, horizontal), and transmissometer (center, yellow short).

Termômetros de inversão



Nansen water bottles before (I), during (II), and after (III) reversing. (From Dietrich et al. 1980)

Fig. 6.16. Water sampling bottles (Nansen bottles), circa 1960 for mounting individually on a wire with reversing thermometer racks.

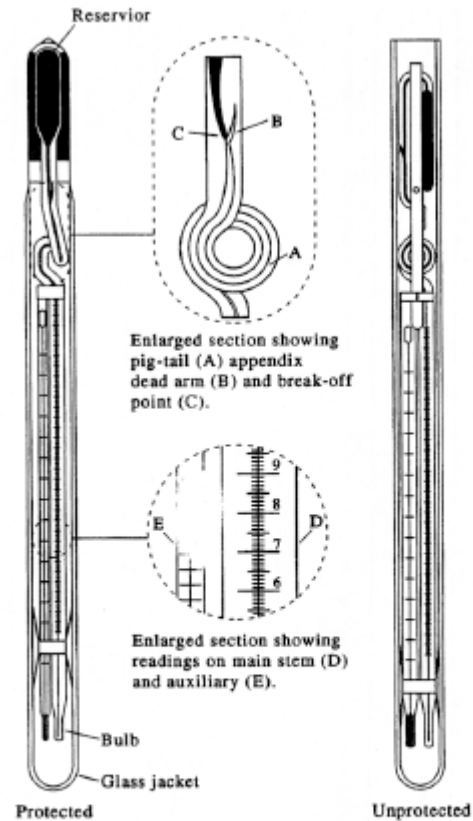


Fig. 6.21. Protected and unprotected reversing thermometers.



Fig. 6.22. Reading reversing thermometers

Bati-Termógrafo mecânico

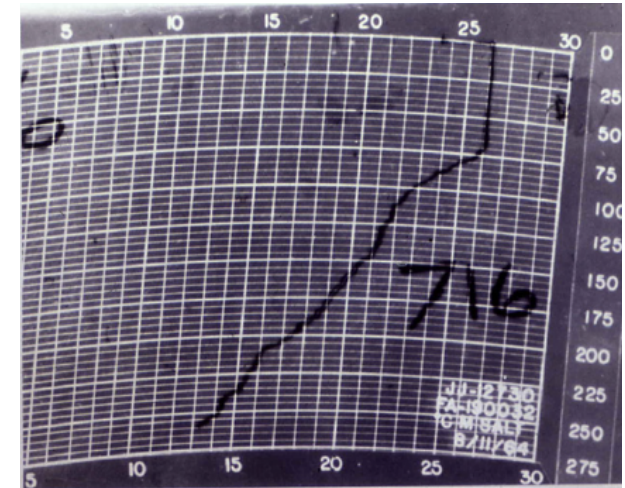
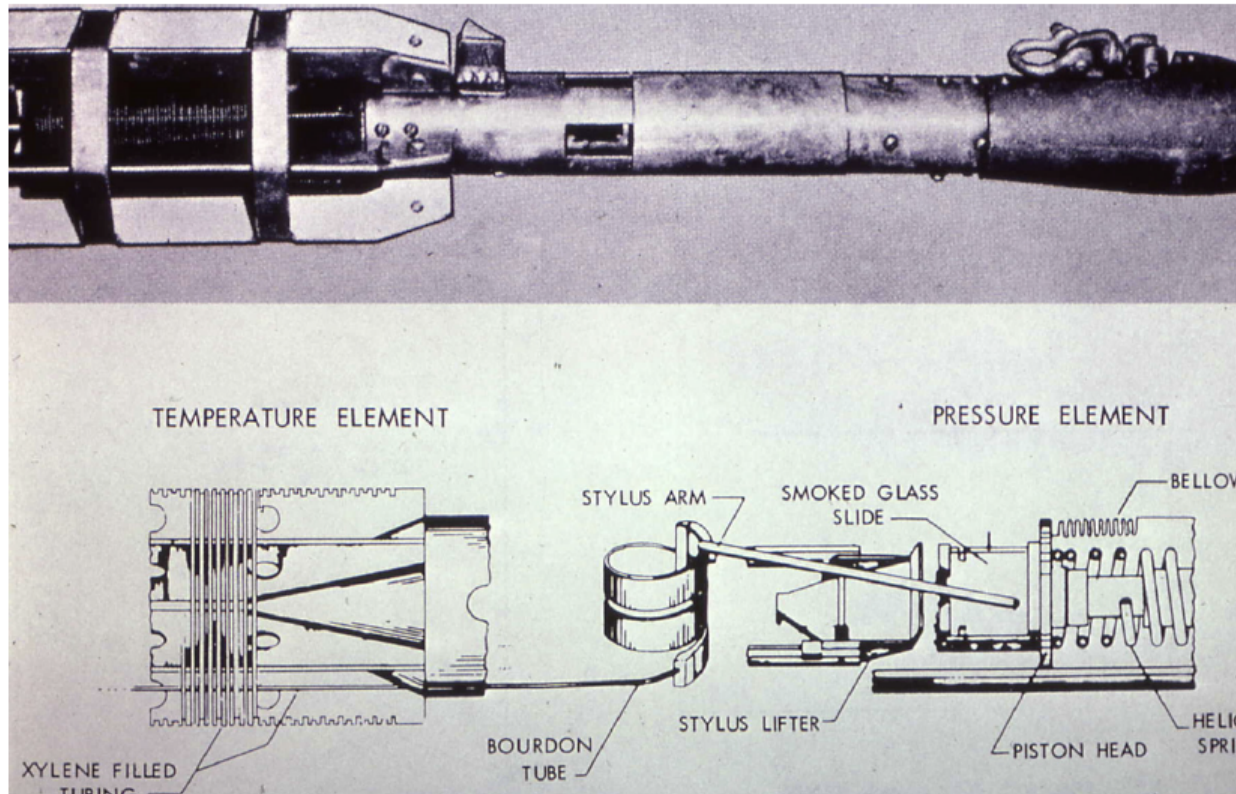
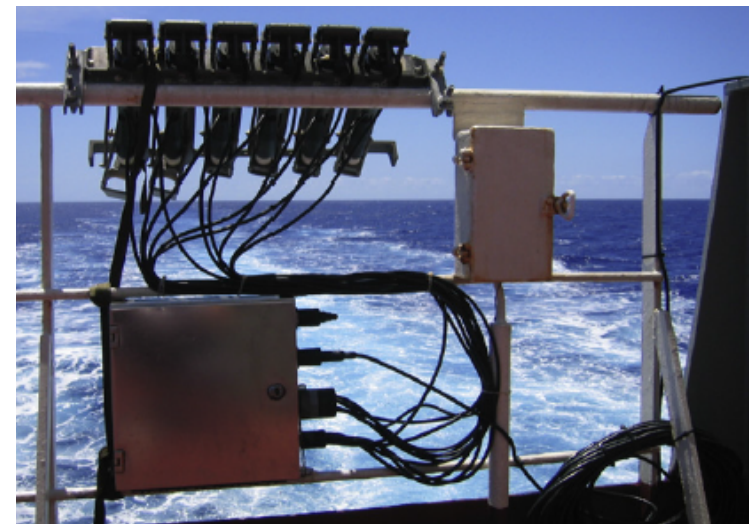
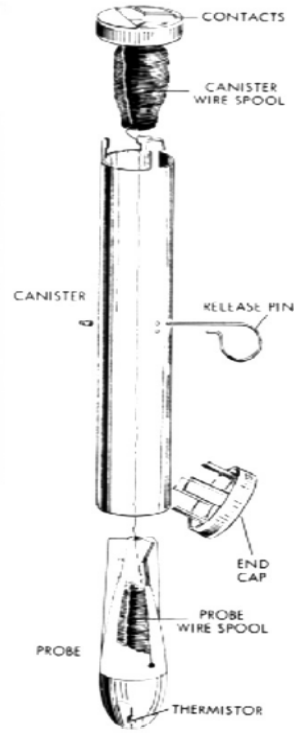
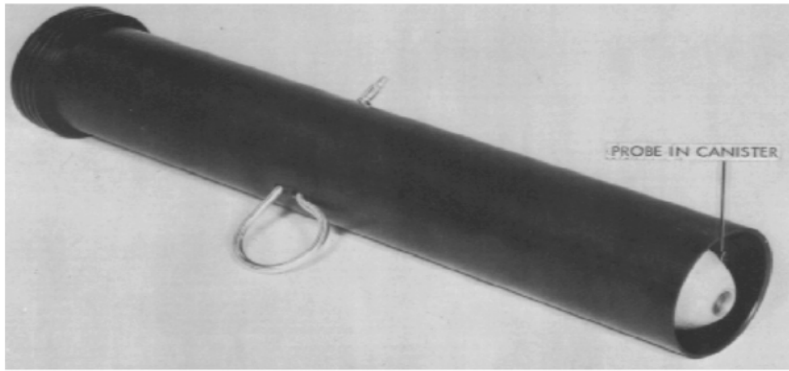


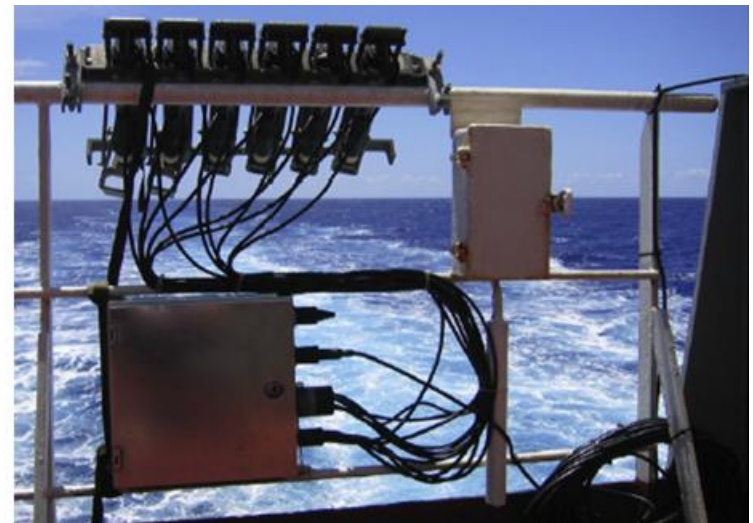
FIGURE S16.16 Mechanical bathythermograph (MBT), in use from 1951 to 1975. Source: Neumann and Pierson (1966).

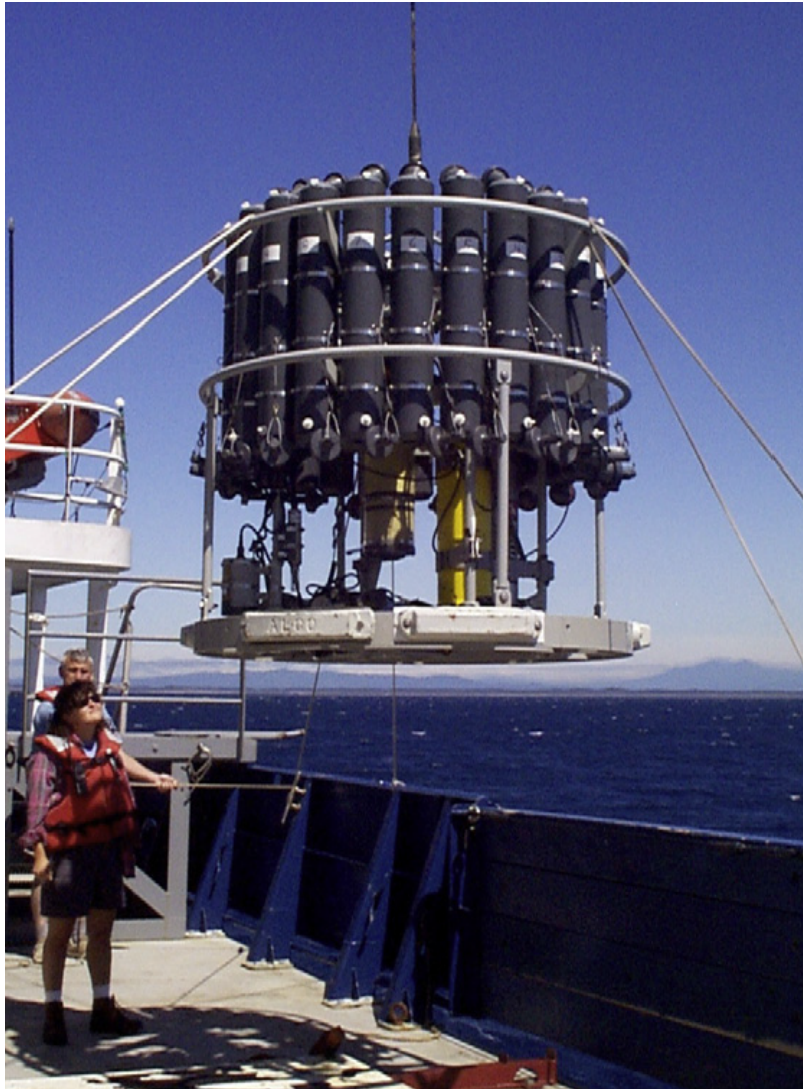




eXpendable-BT

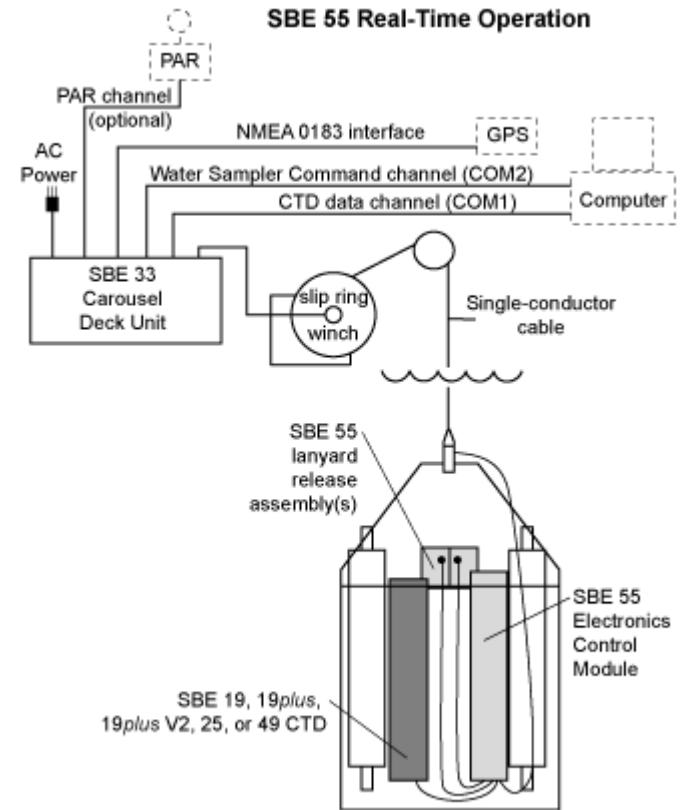
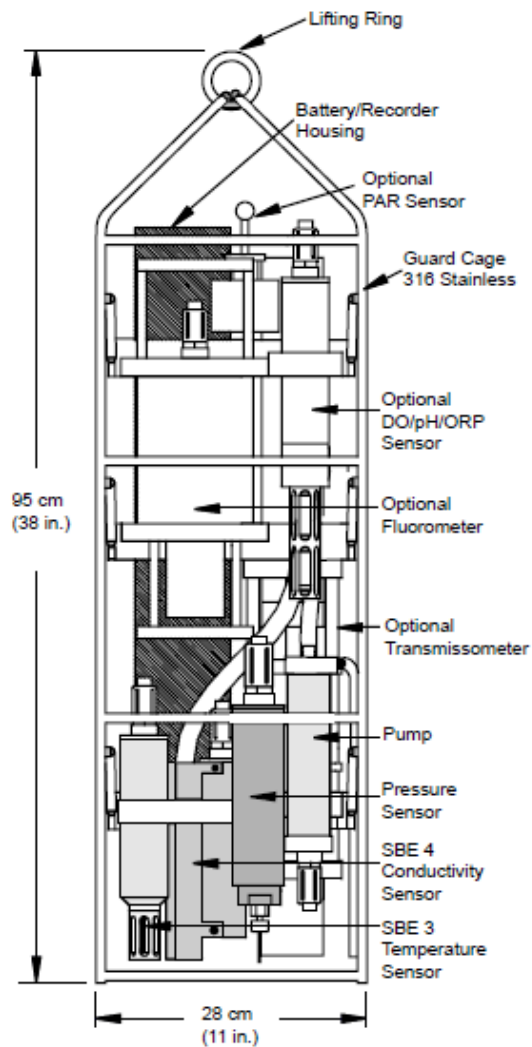
FIGURE S16.18 An expendable bathythermograph (XBT). Source: From NOAA UOTC (2009).

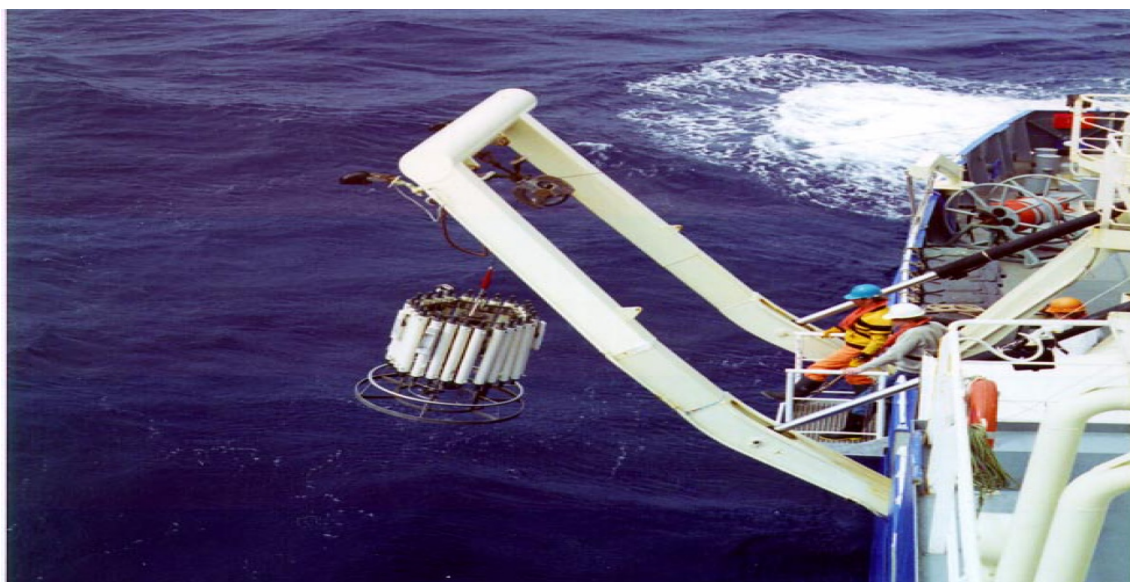




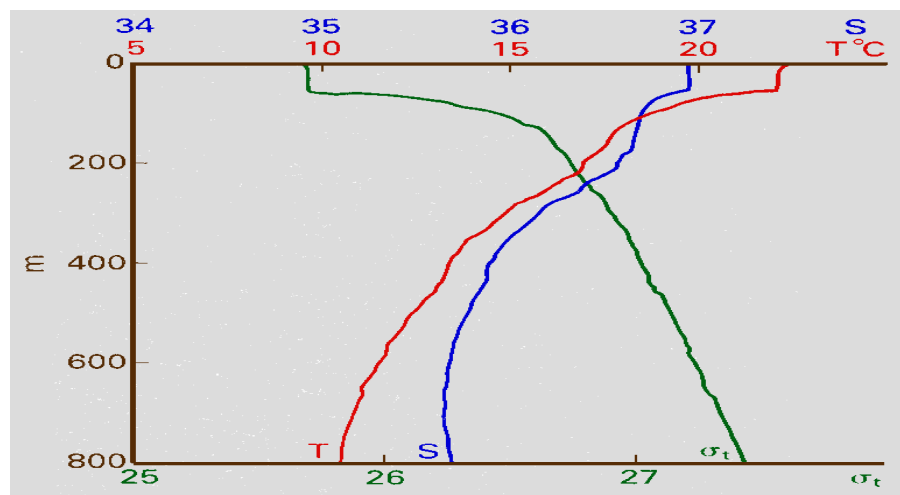
Conductividade Temperatura
Depth (Profundidade)

CTD





A medida hidrografica : Roseta + CTD.



O perfil de T/S/Sigma-t resultante



Barcos de oportunidade

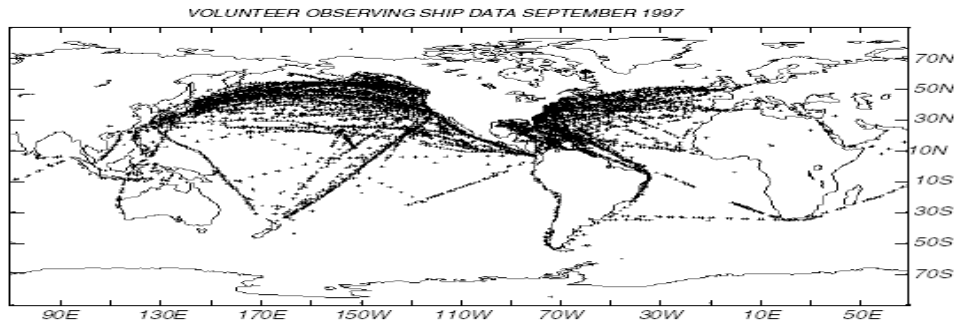
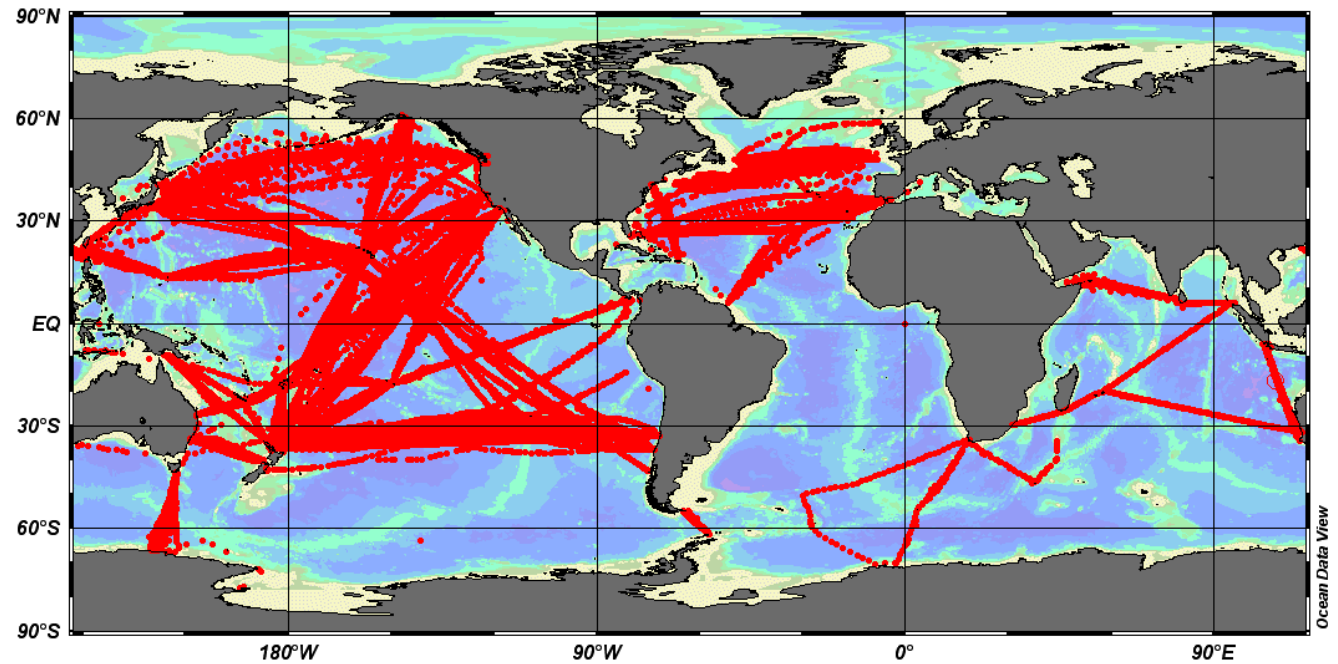
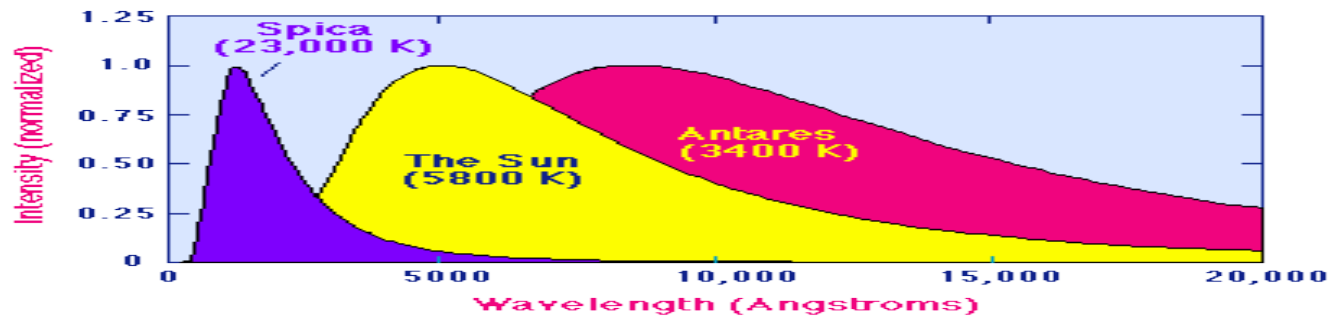


Figure 4.5 Location of surface observations made from volunteer observing ships and reported to national meteorological agencies. (From NOAA, National Ocean Service)

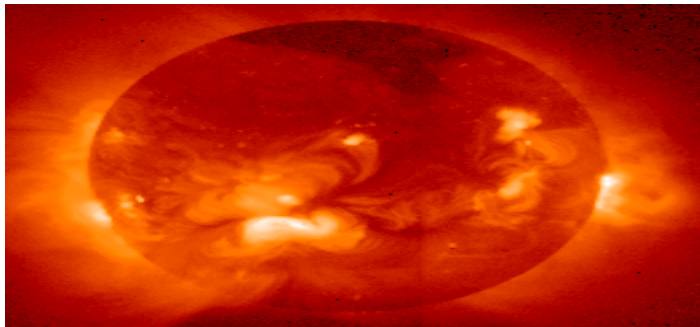
eWOCE UOT - High Density Lines



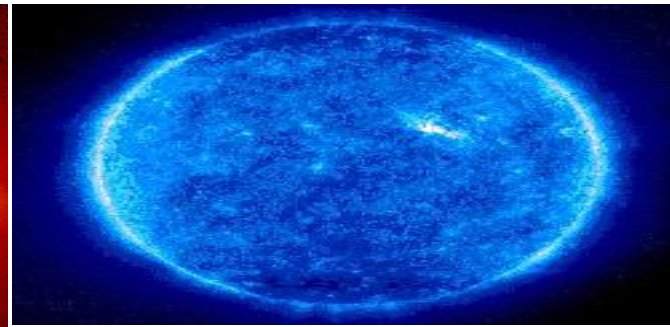
Sensoriamento Remoto Espectros de Radiação E.M.



Espectro Visível: 4000 a 7000 Å ou 400 a 750 μm.

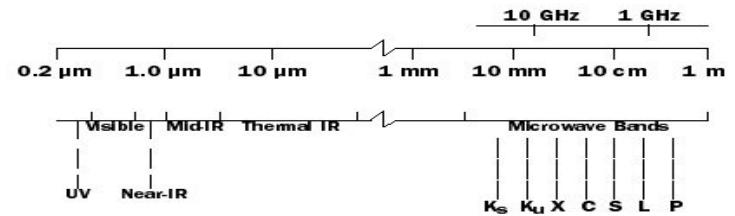
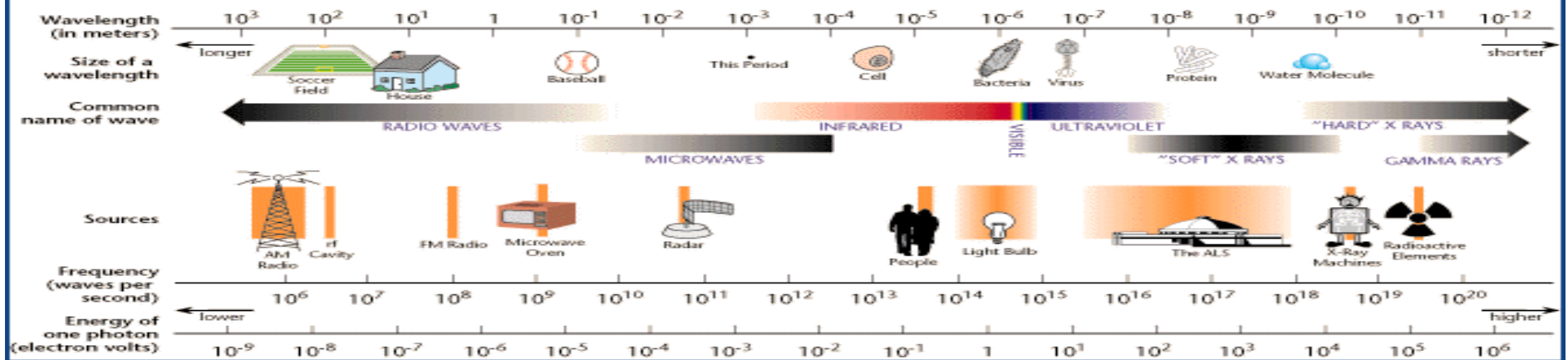


Sol (λ =raios-X)

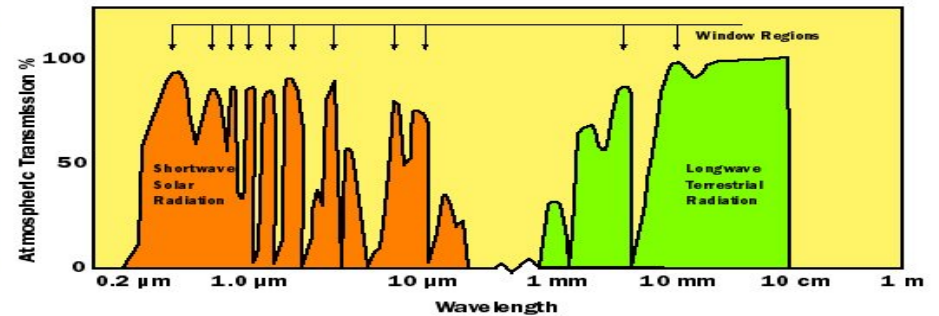
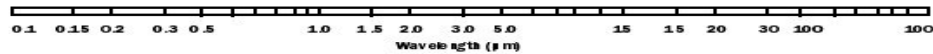
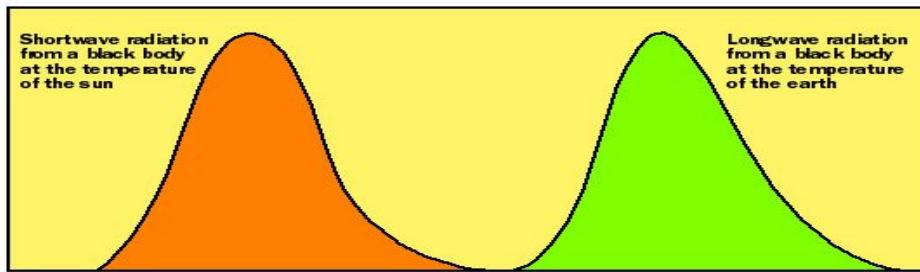


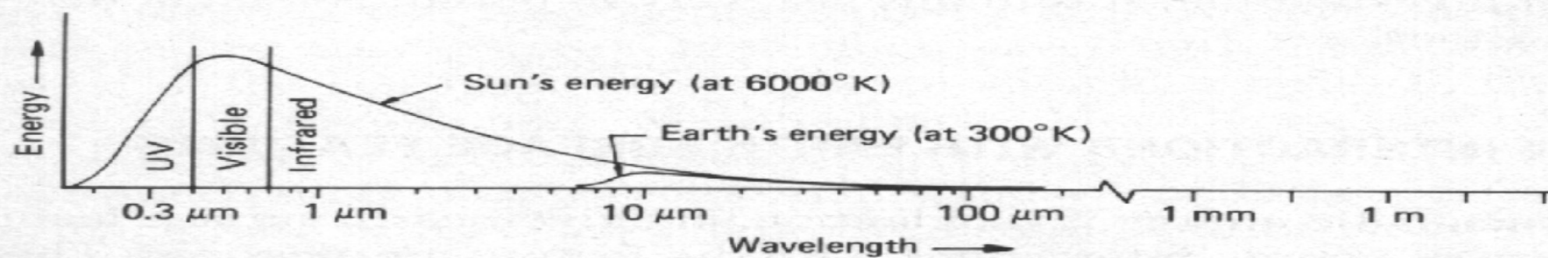
Sol (λ =UV)

THE ELECTROMAGNETIC SPECTRUM

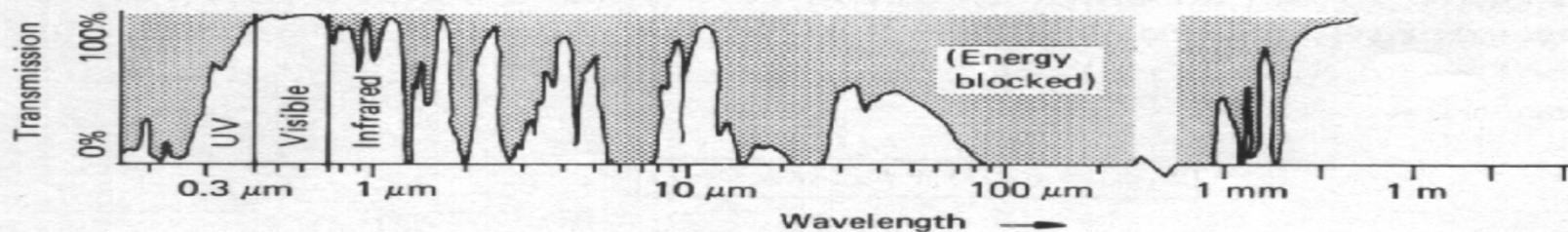


λE_{λ} (normalised)

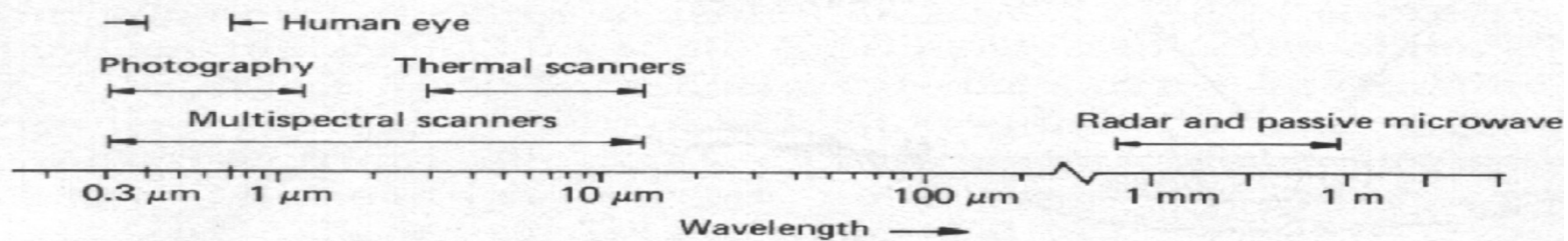


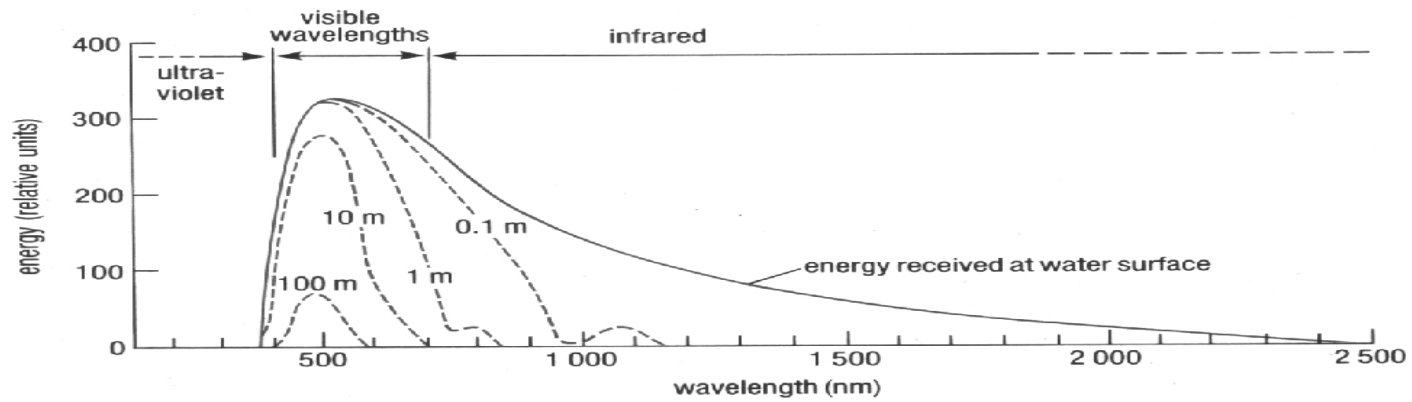
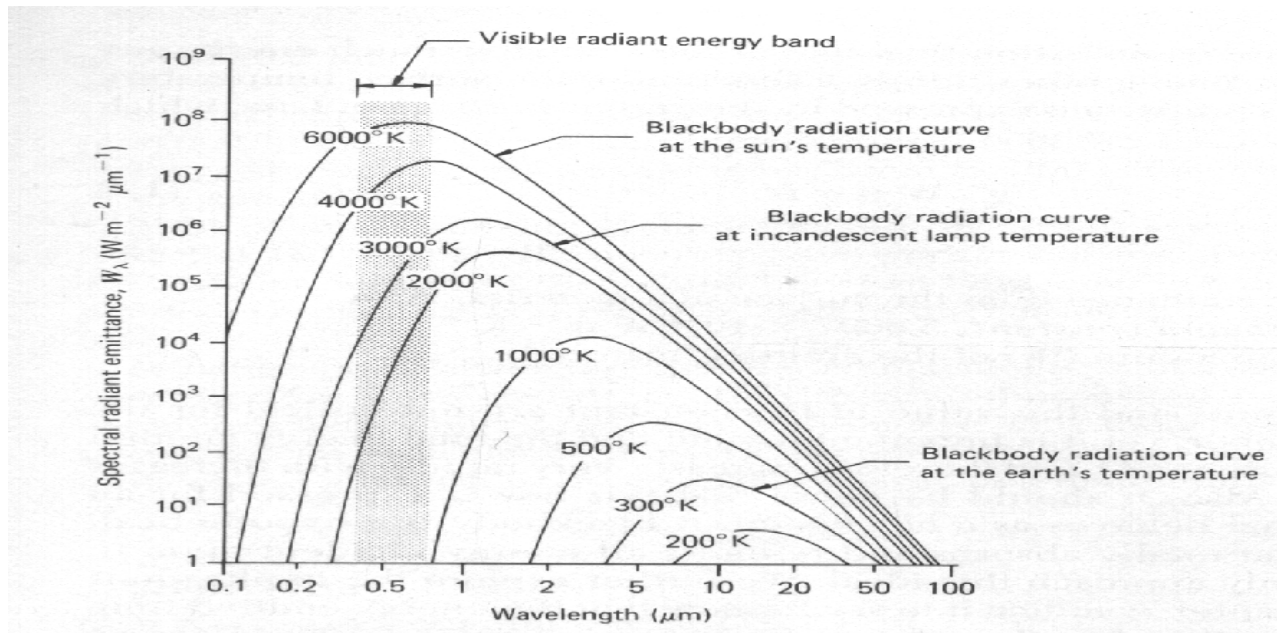


(a) Energy sources

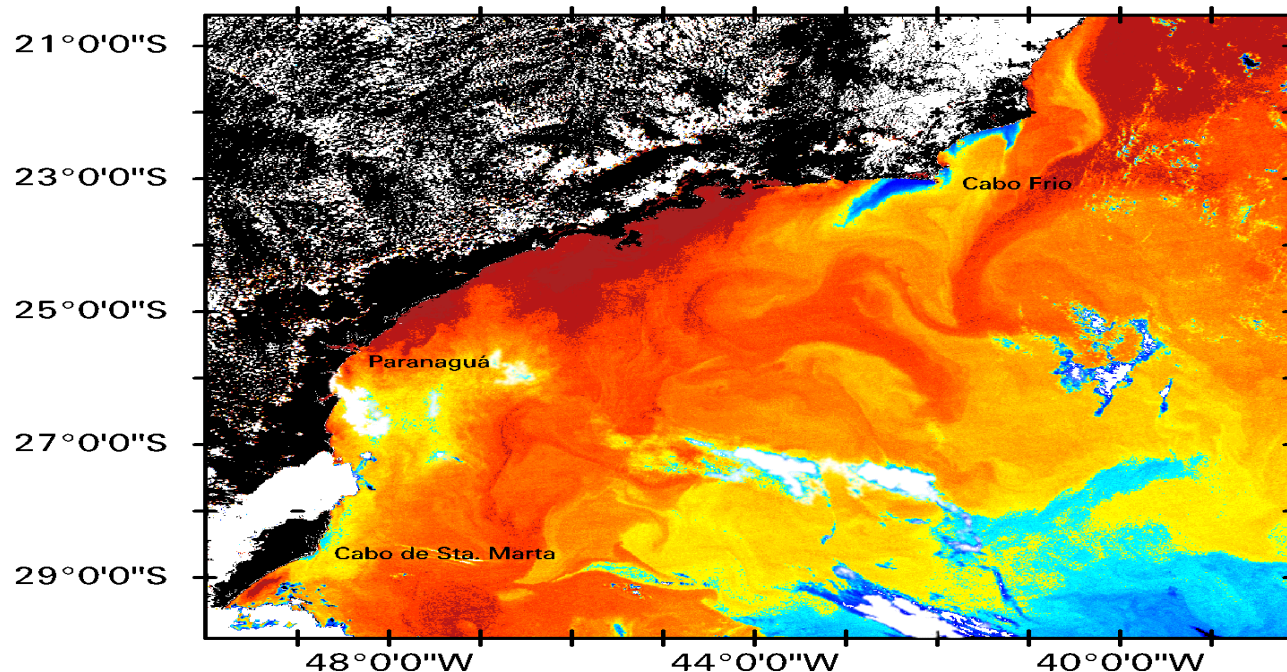


(b) Atmospheric transmittance

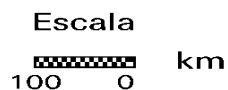
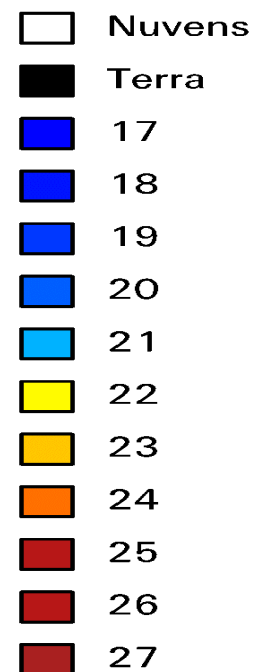




TEMPERATURA SUPERFICIAL DO MAR

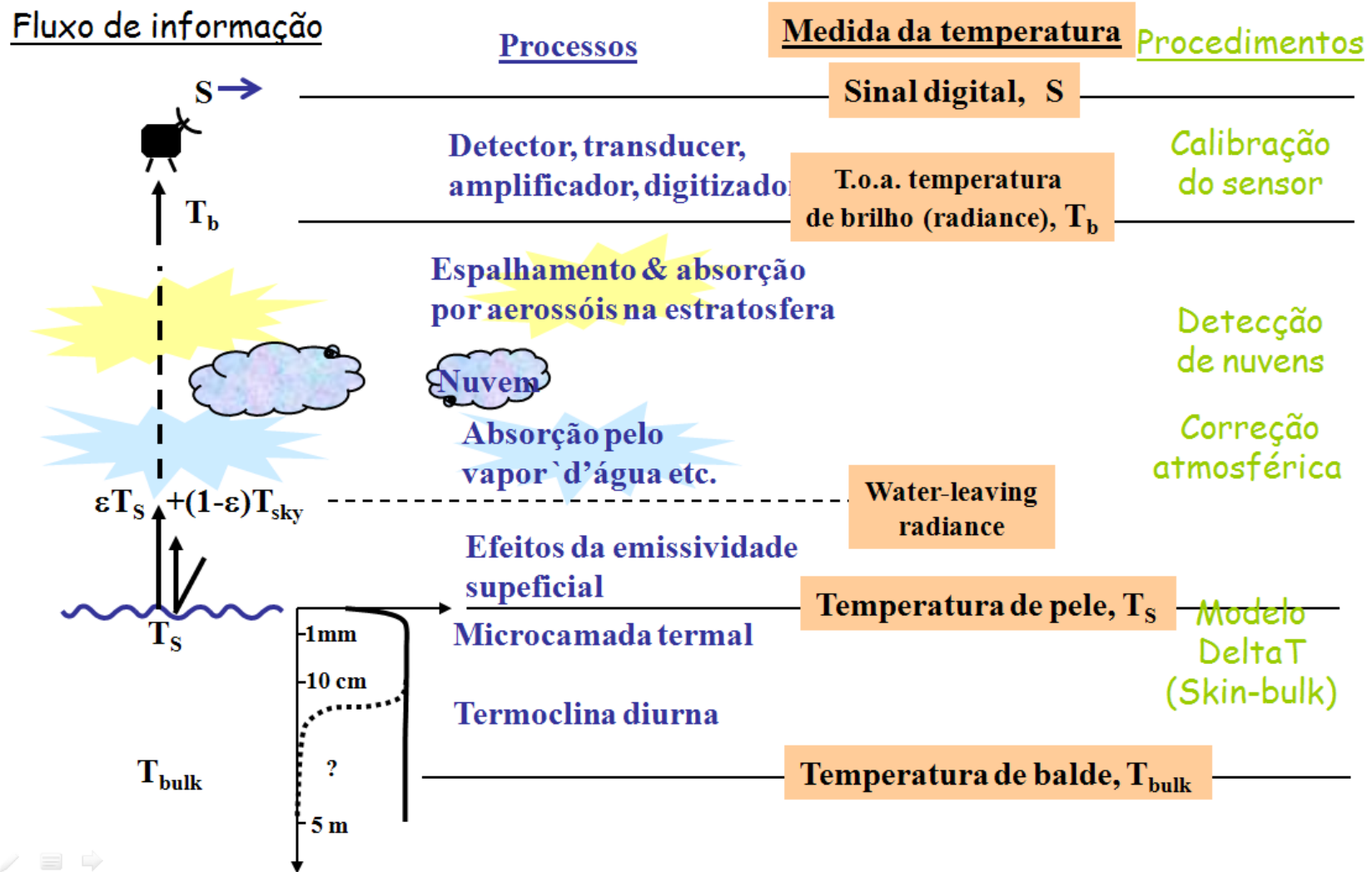


TEMPERATURA (°C)

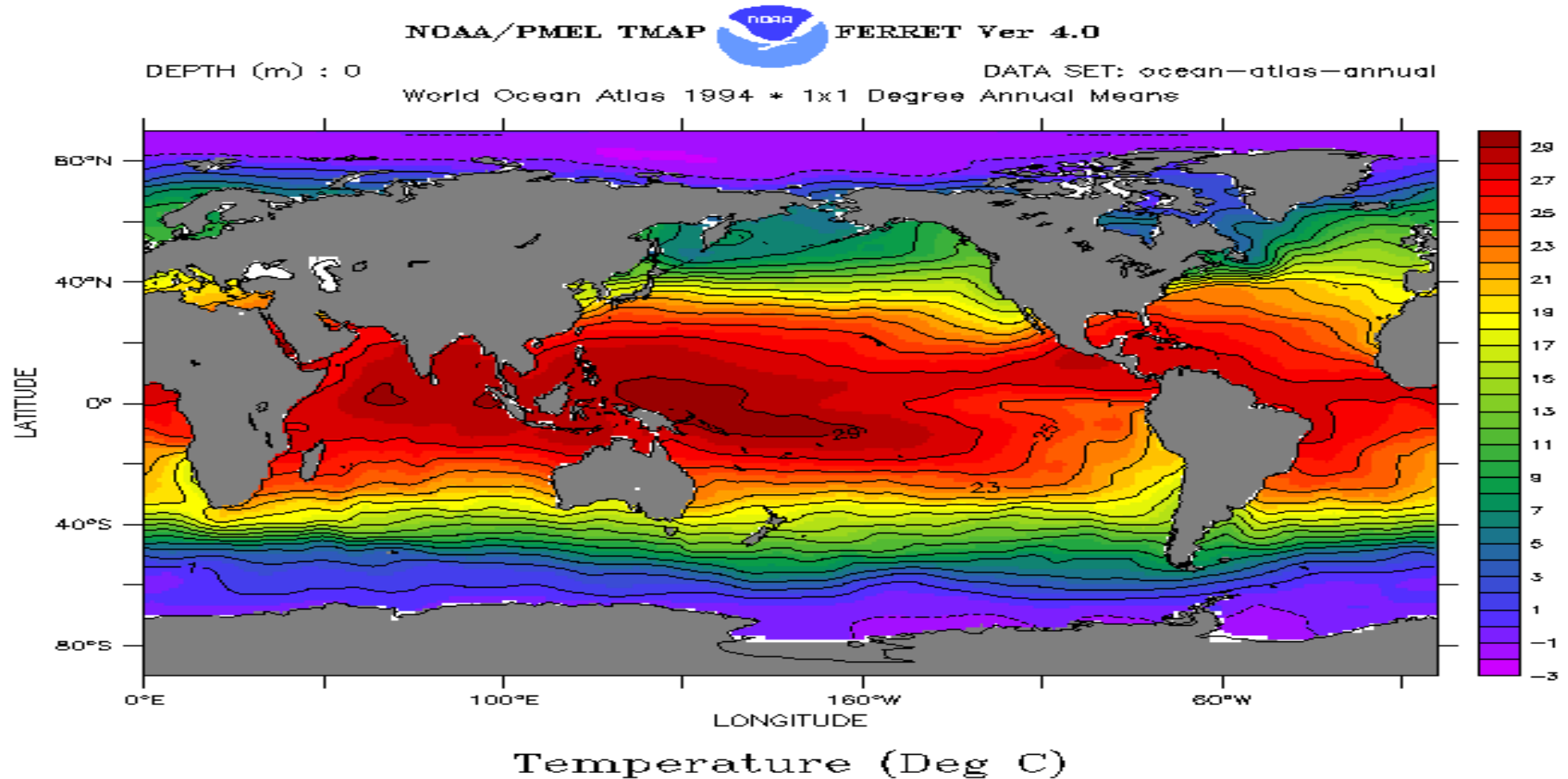


SENSOR/SATÉLITE: AVHRR/NOAA-14
ALGORITMO: DAYTIME NLSST
AQUISIÇÃO: 07/11/95 - 16:54 GMT
REGIÃO CENTRAL DA BACIA DE SANTOS
CONVÊNIO PETROBRÁS/FURG

Processos que afetam a medida de TSM

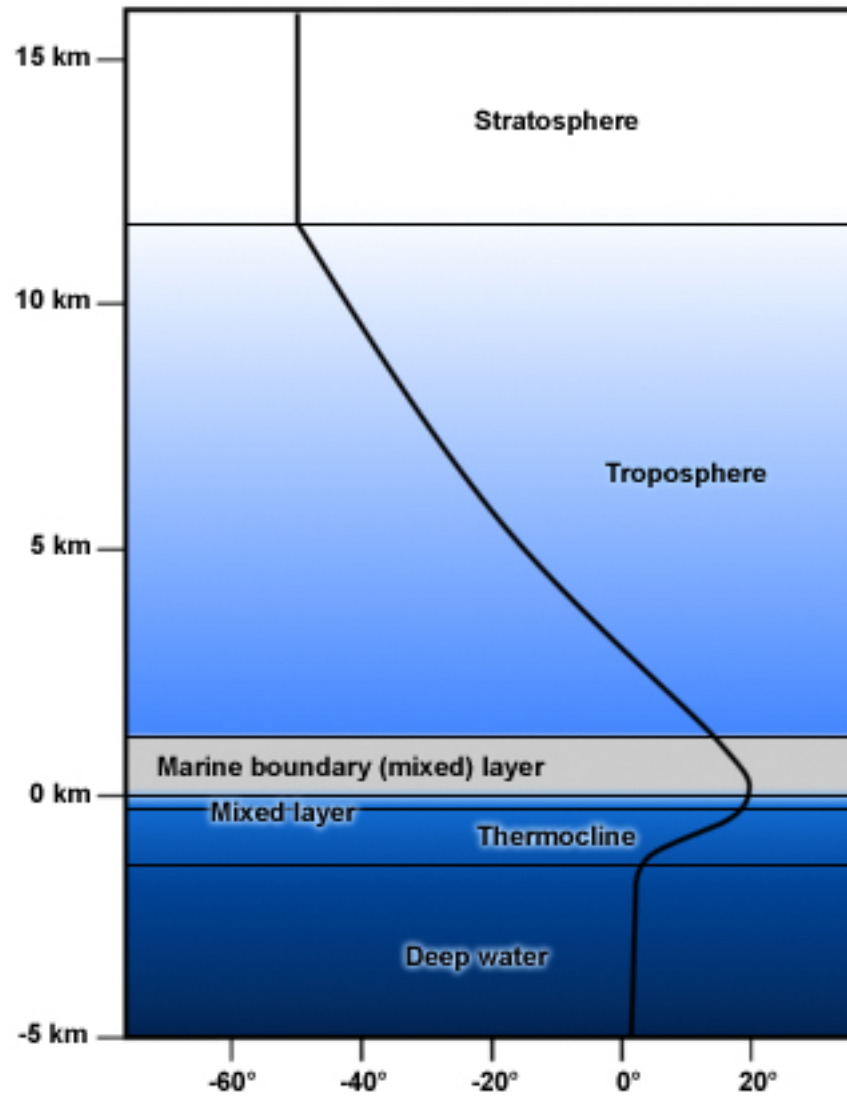


Distribuição horizontal –camada de mistura

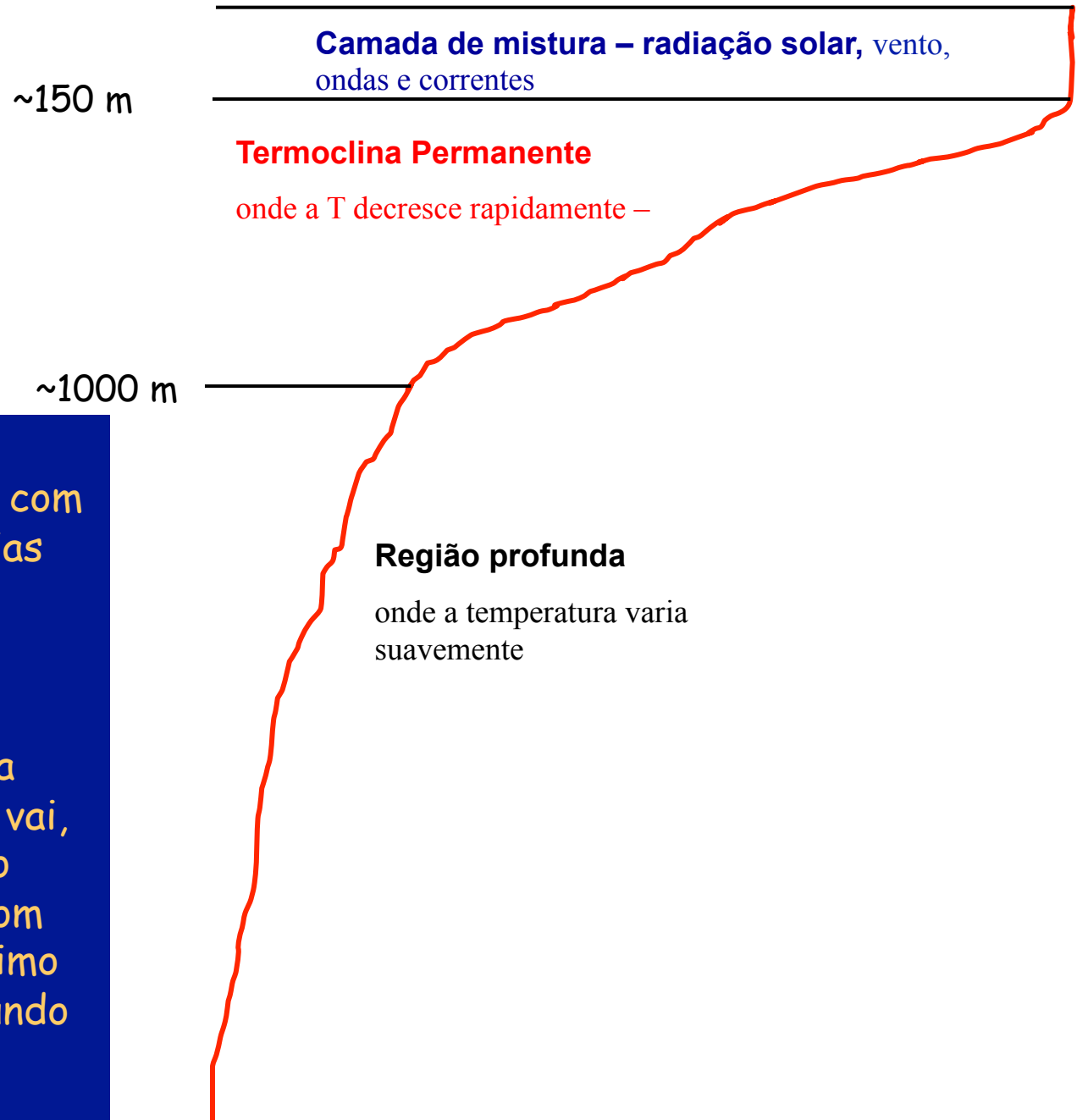


Mean sea-surface temperature calculated from the optimal interpolation technique (Reynolds and Smith, 1995) using shipreports and AVHRR measurements of temperature. Contour interval is 1° C with heavy contours every 5° C. Shaded areas exceed 29° C.

Temperature Profile from Seafloor to Stratosphere



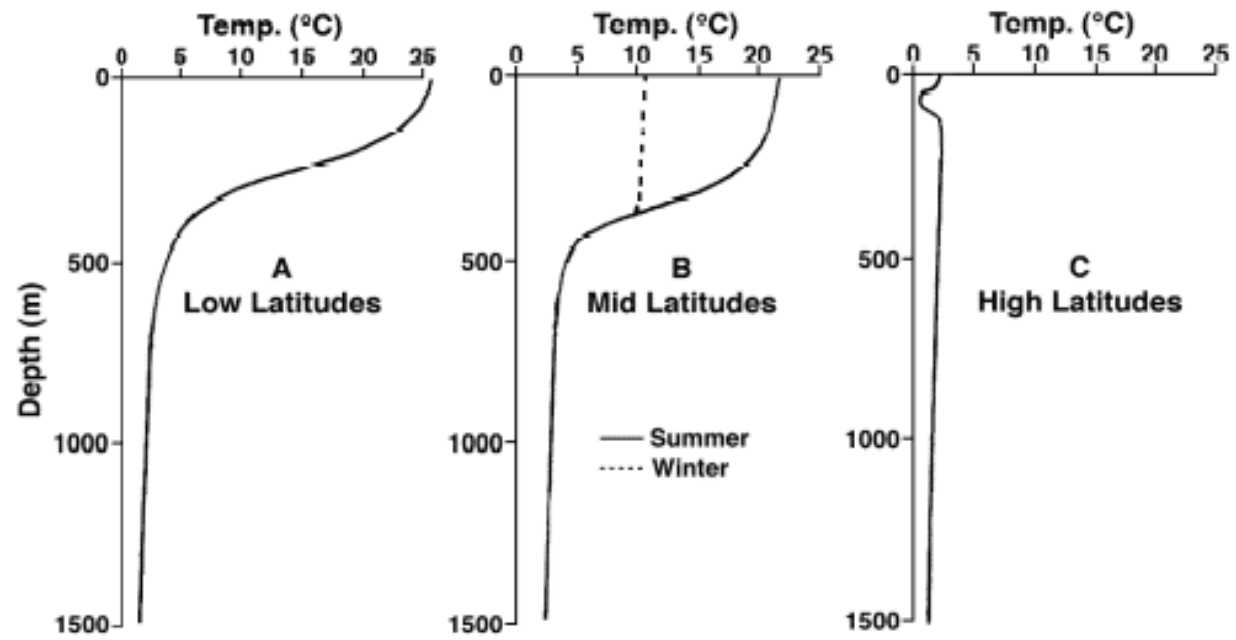
DISTRIBUIÇÃO VERTICAL DA TEMPERATURA ENTRE 60 S E 60 N



Essa estrutura é alterada de acordo com a latitude. Em médias latitudes aparece, também, uma termoclina sazonal.

Em altas latitudes a camada de mistura vai, praticamente, até o fundo do oceano, com perfil com decréscimo suave da T até o fundo

Typical Temperature Profiles



EM FUNÇÃO DA LATITUDE AS ZONAS SE DIVIDEM EM:

BAIXAS LATITUDES Não existem \neq significativas nas estações do ano

T das H₂O's superficiais são sempre altas

Termoclina Permanente

Camada de mistura de pouca espessura.

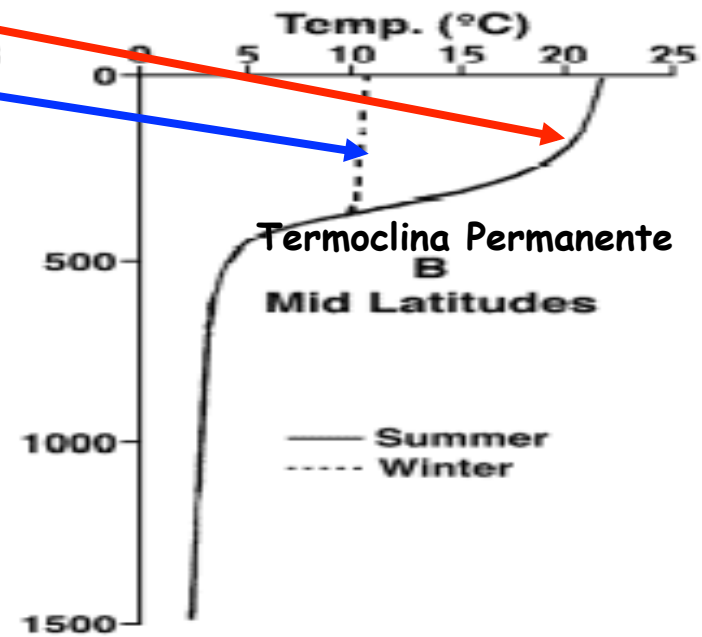
Divergência Equatorial

MÉDIAS LATITUDES

Termoclina Permanente & sazonal

Verão

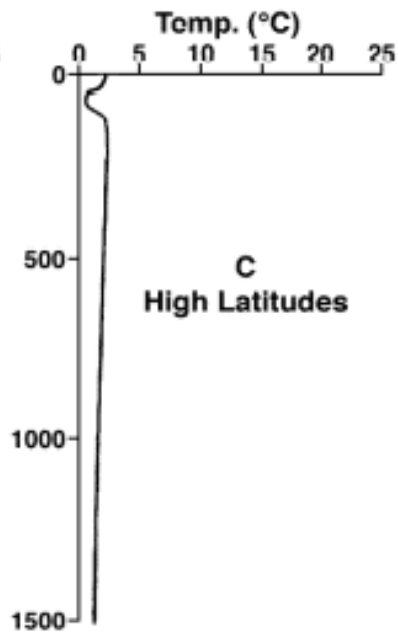
Inverno



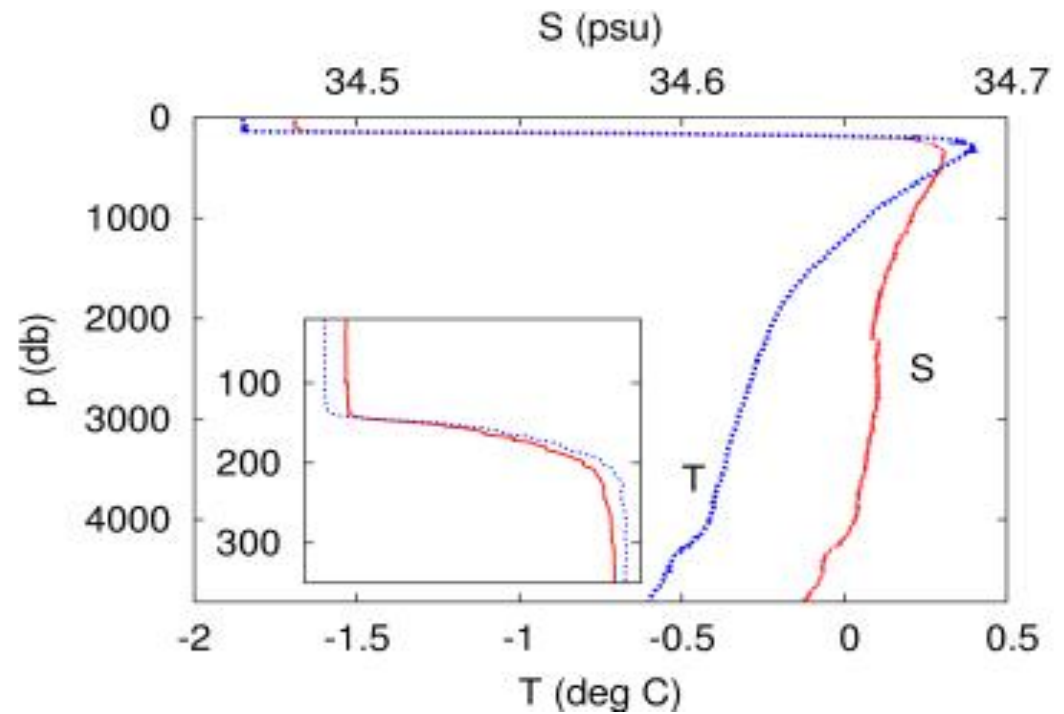
ALTAS LATITUDES

Inexistência da Termoclina Permanente

T quase Cte ao longo da coluna d' água

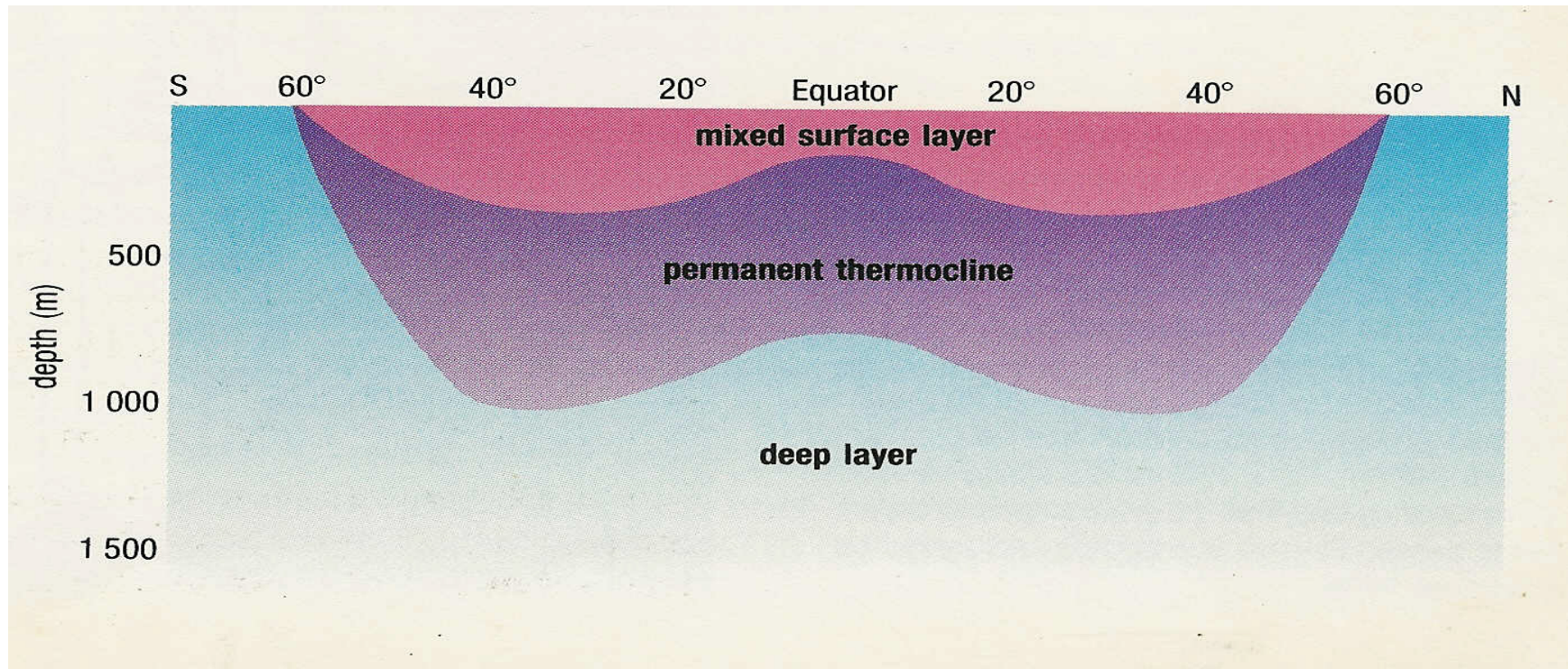


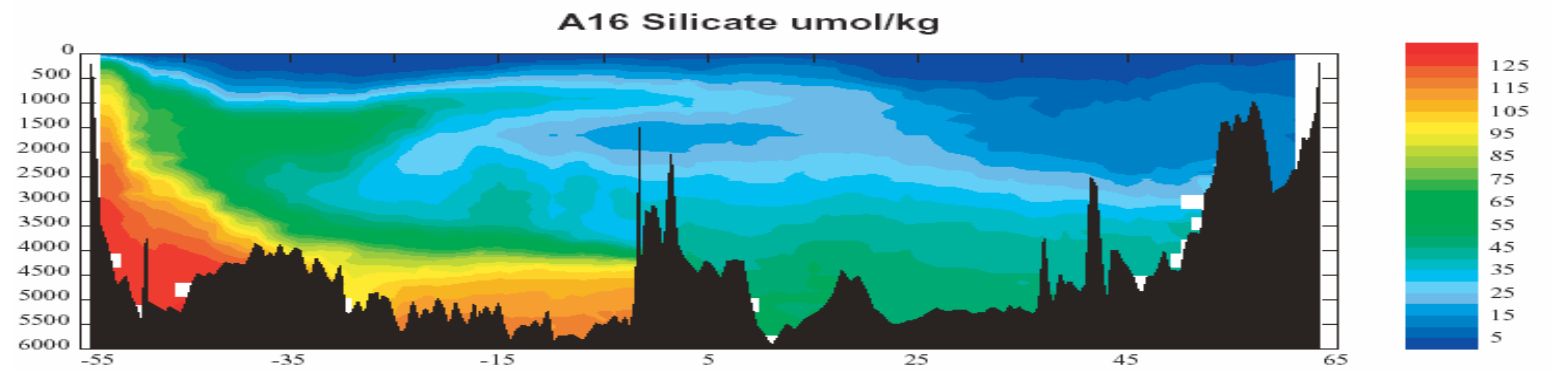
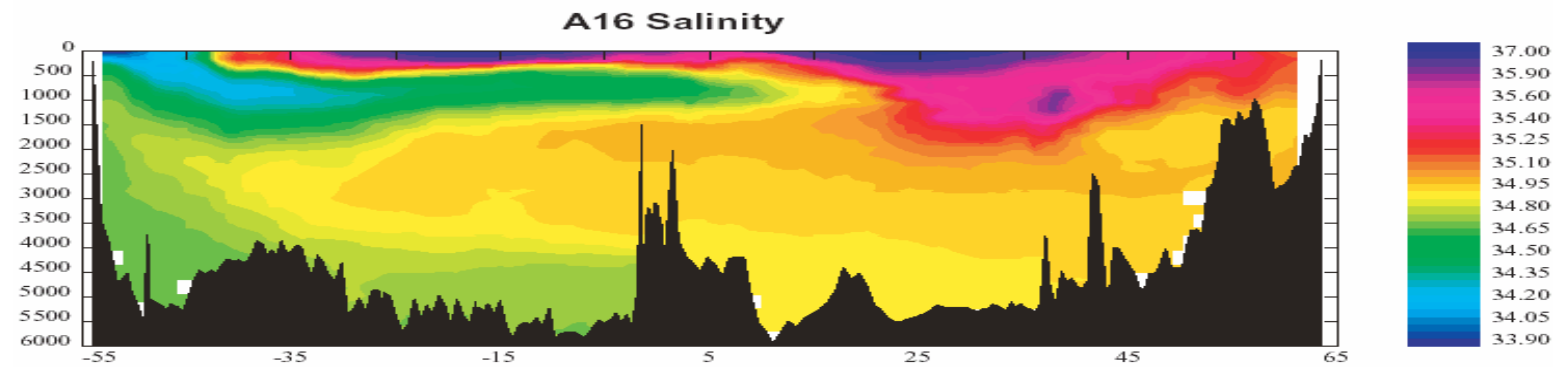
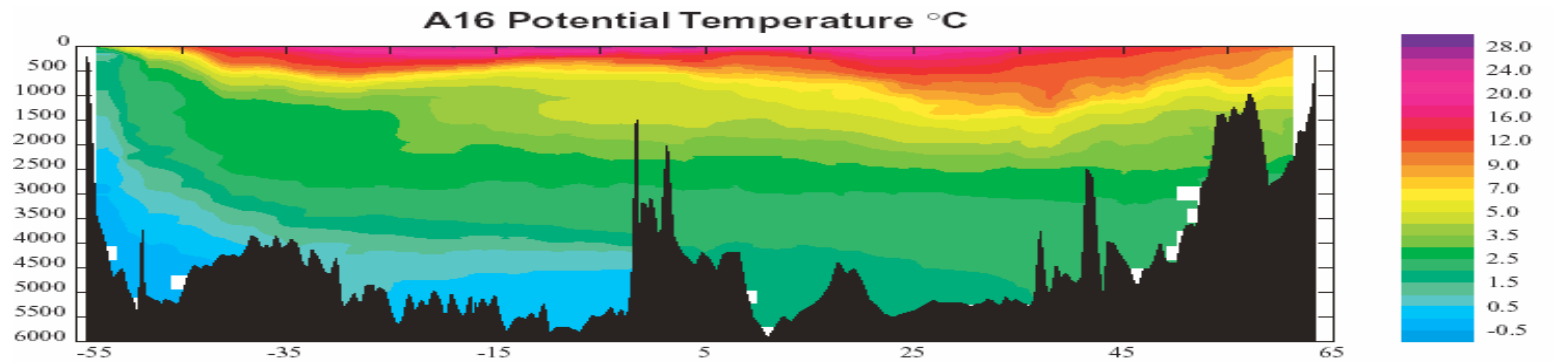
Região Subantártica



Mar de Weddell

Resumo da distribuição latitudinal, em profundidade, da Temperatura

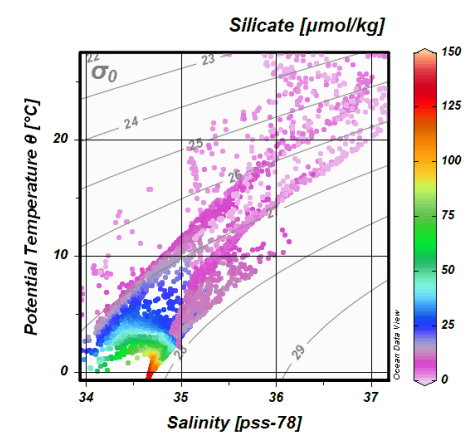
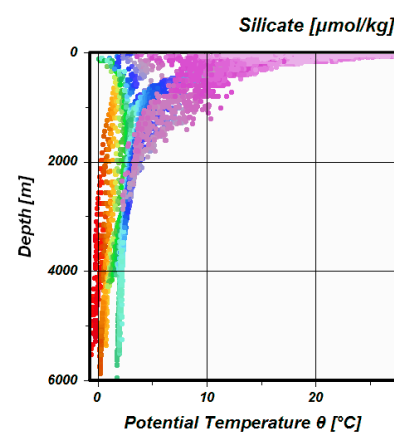
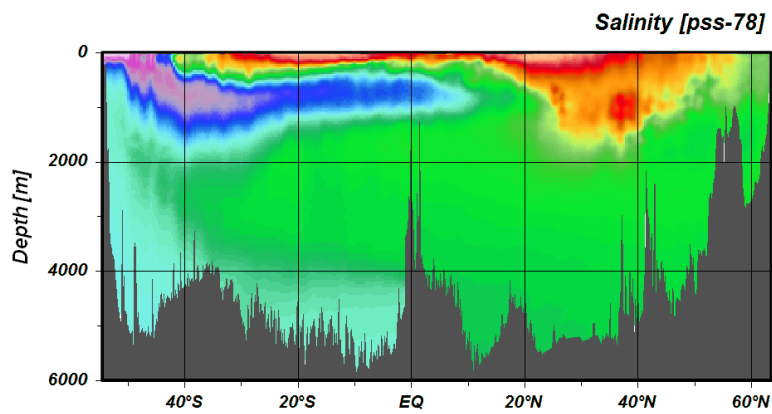
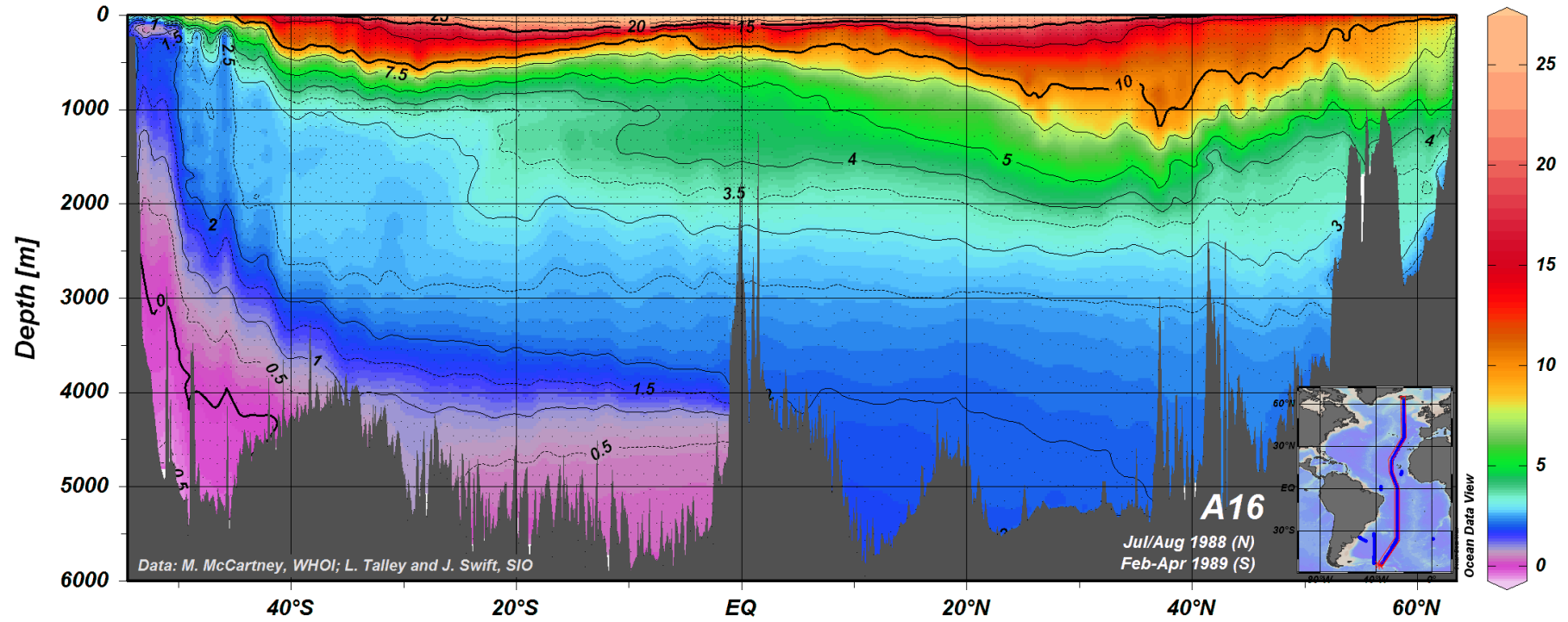




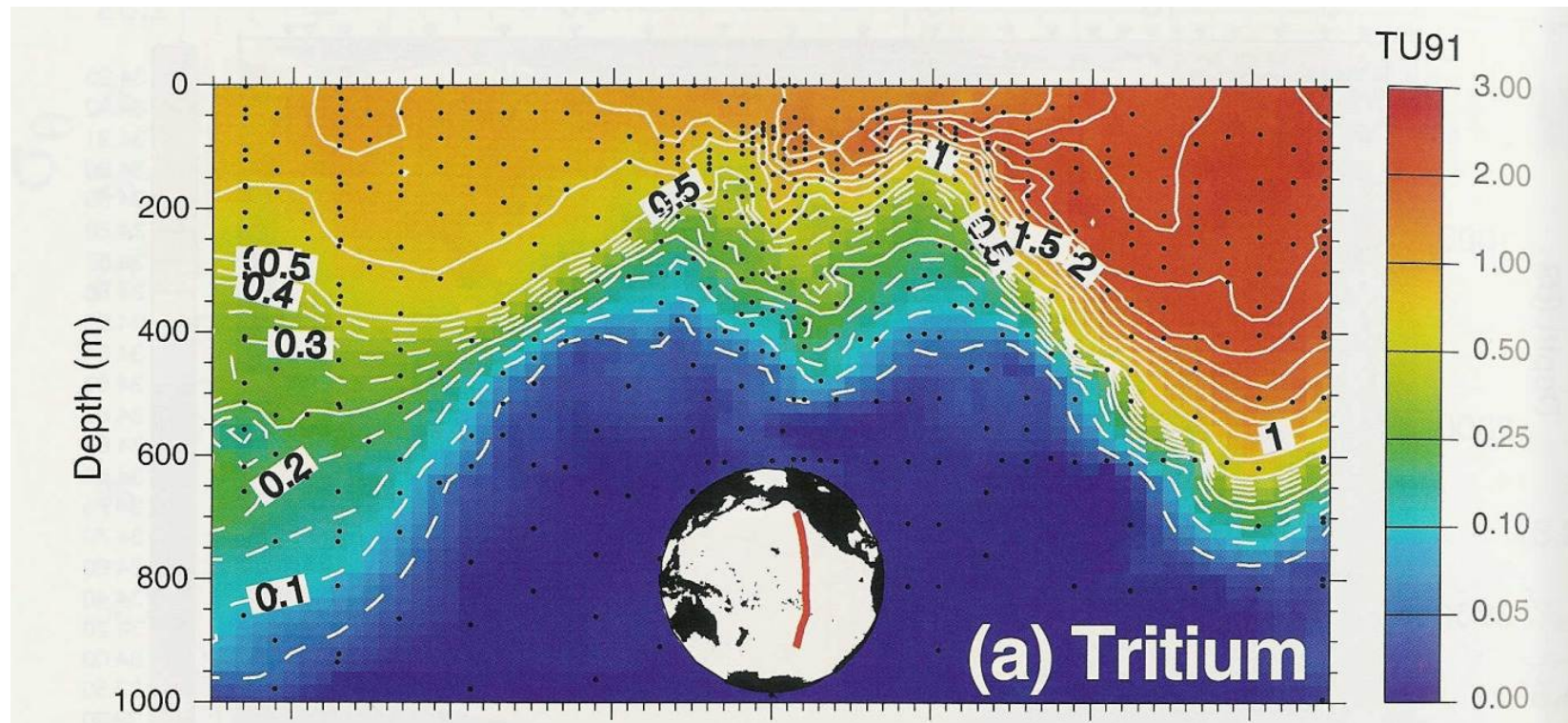
A16 - a WOCE mid Atlantic transect from south (left) to north.
(WOCE IPO)

eWOCE

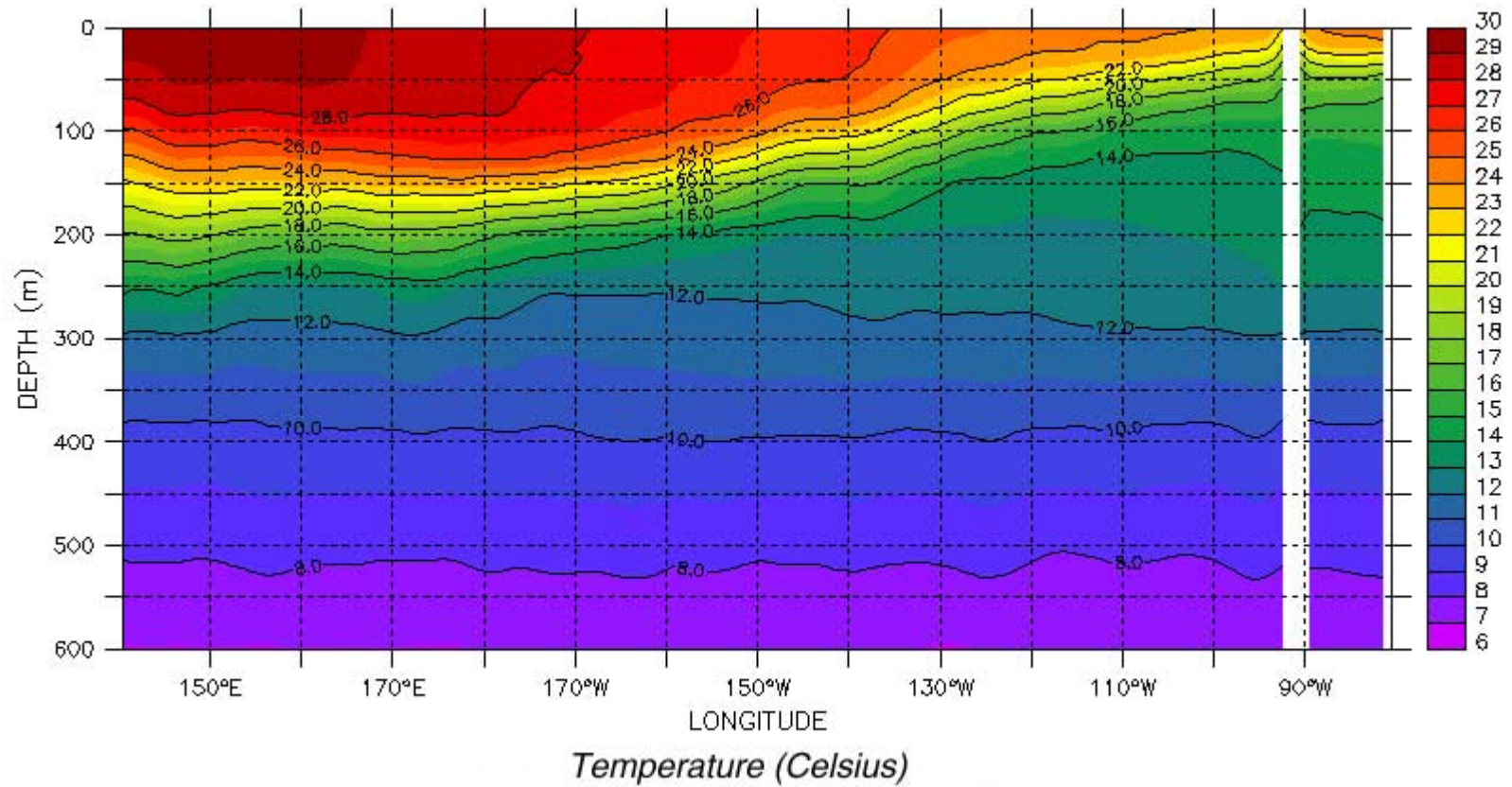
Potential Temperature θ [$^{\circ}\text{C}$]



Distribuição de Trítio no Pacífico



Secção transversal no Pacífico Equatorial: termoclina mais rasa na margem leste do oceano



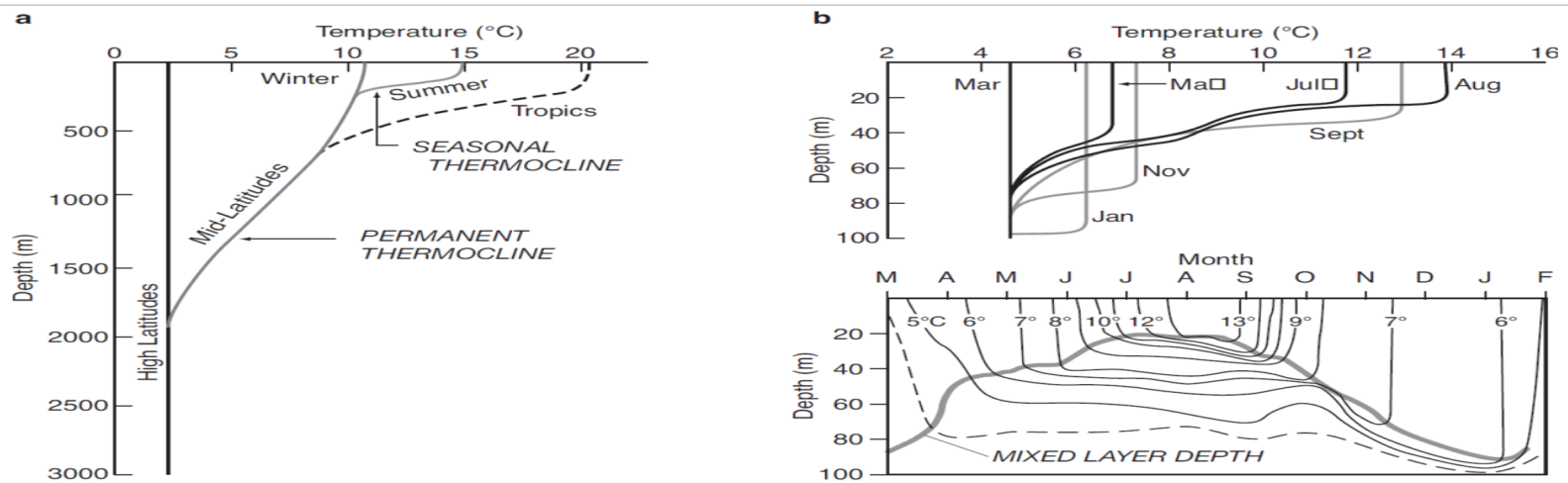
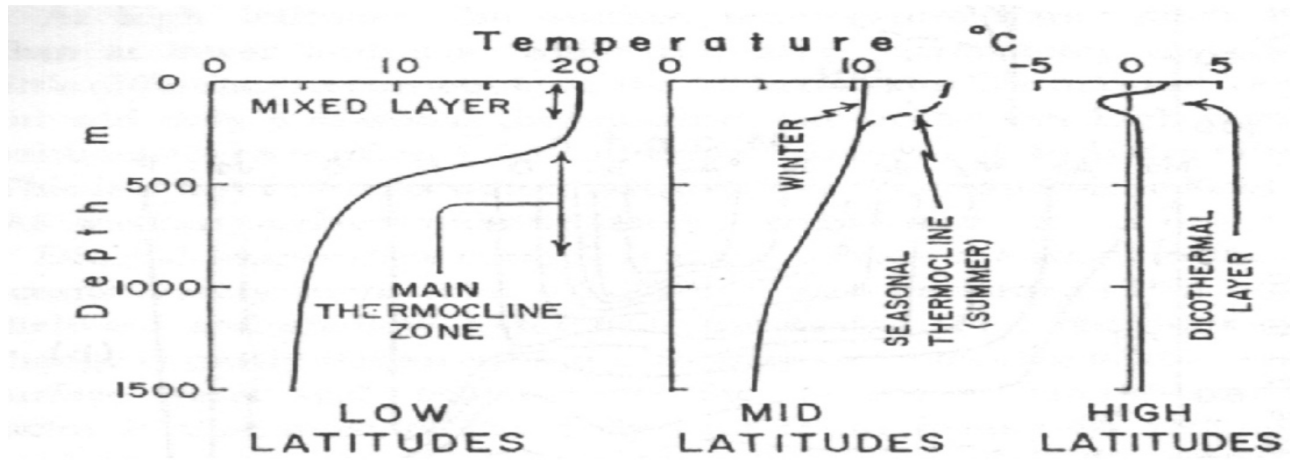
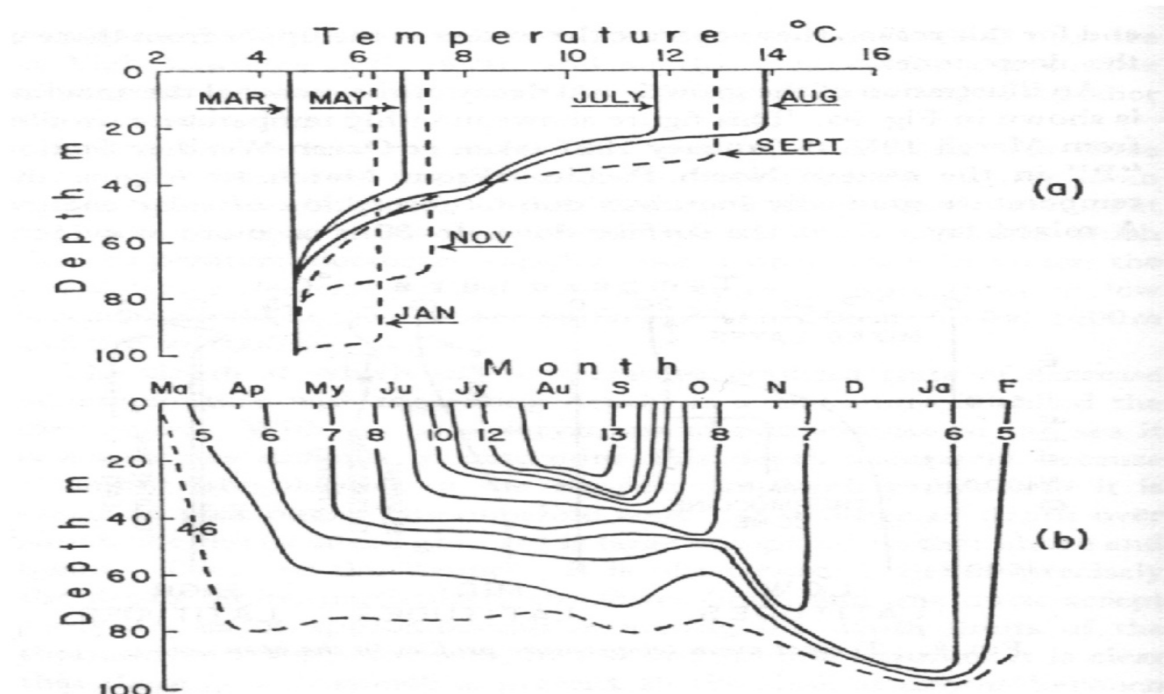


Figure 1.6: Schematic illustration of the vertical variation of temperature through the seasonal cycle (Figure from Sarmiento and Gruber, 2006).

Perfis Verticais de Temperatura



Formação da Termoclina Sazonal
Médias Latitudes



TEMPERATURA POTENCIAL?

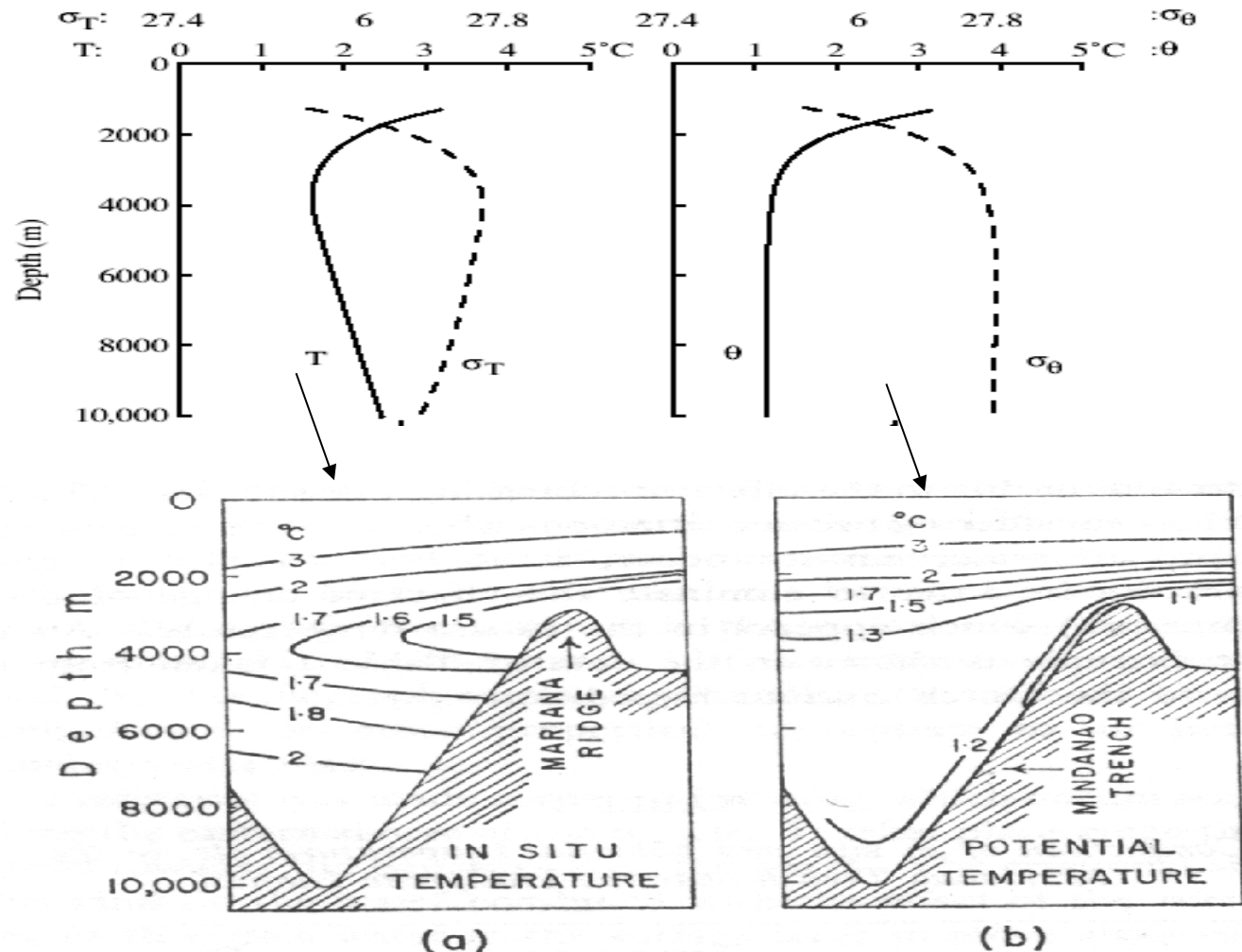
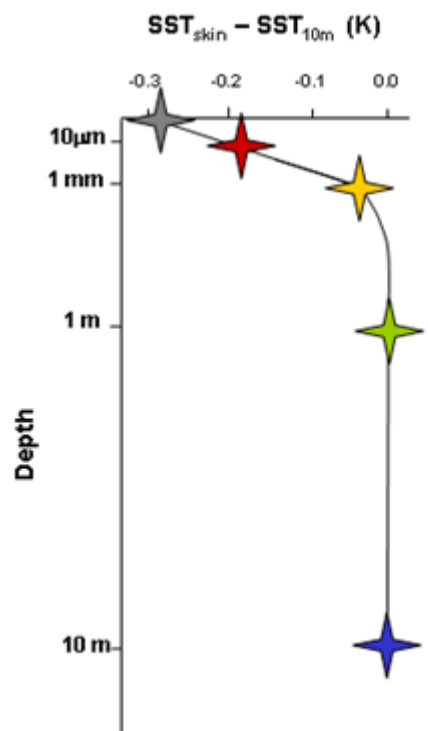
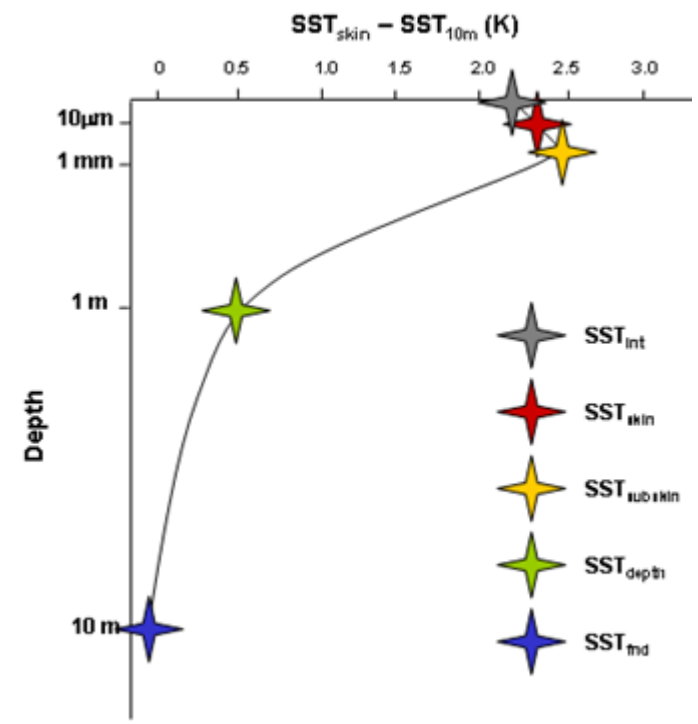


FIG. 10. In situ and potential temperature distributions in the Mindanao Trench (after van Riel).

É a T corrigida a partir da T *in situ* principalmente para grandes profundidades onde existe o efeito da pressão hidrostática.

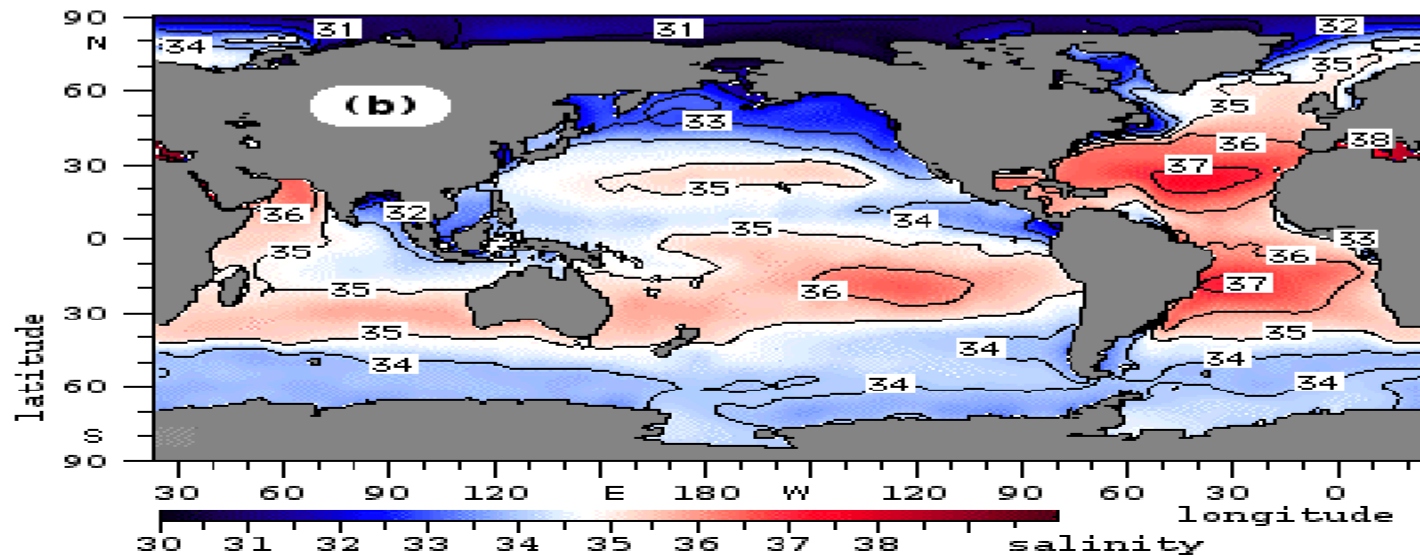
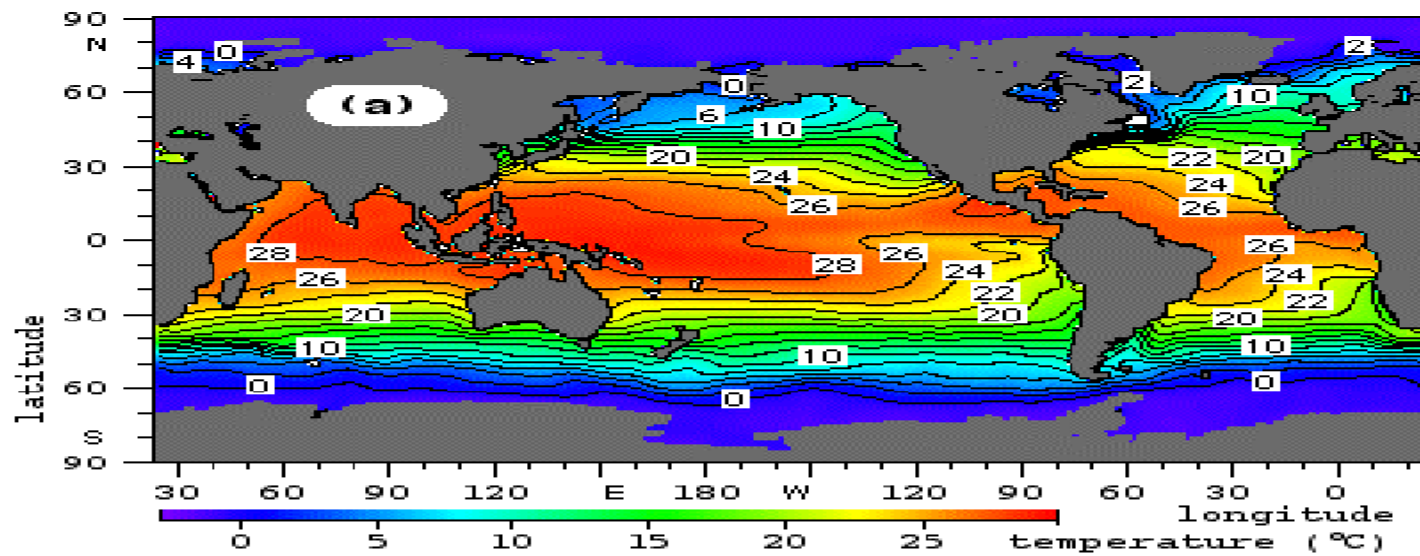


(a) Night time situation, light wind

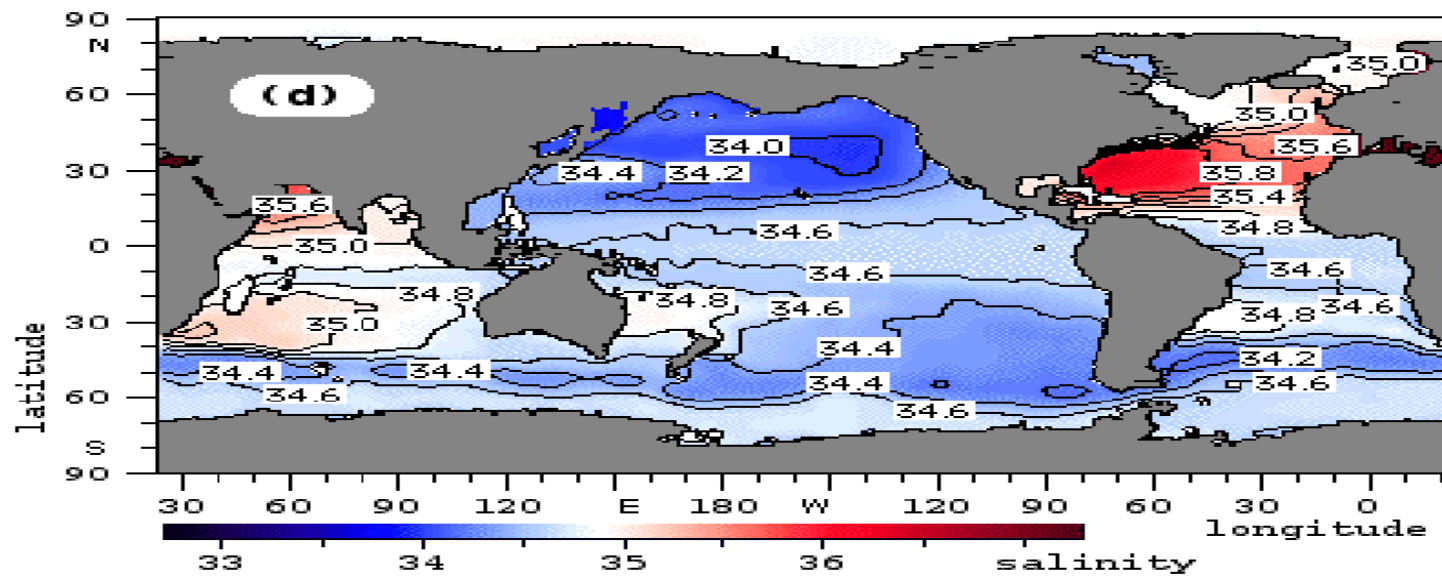
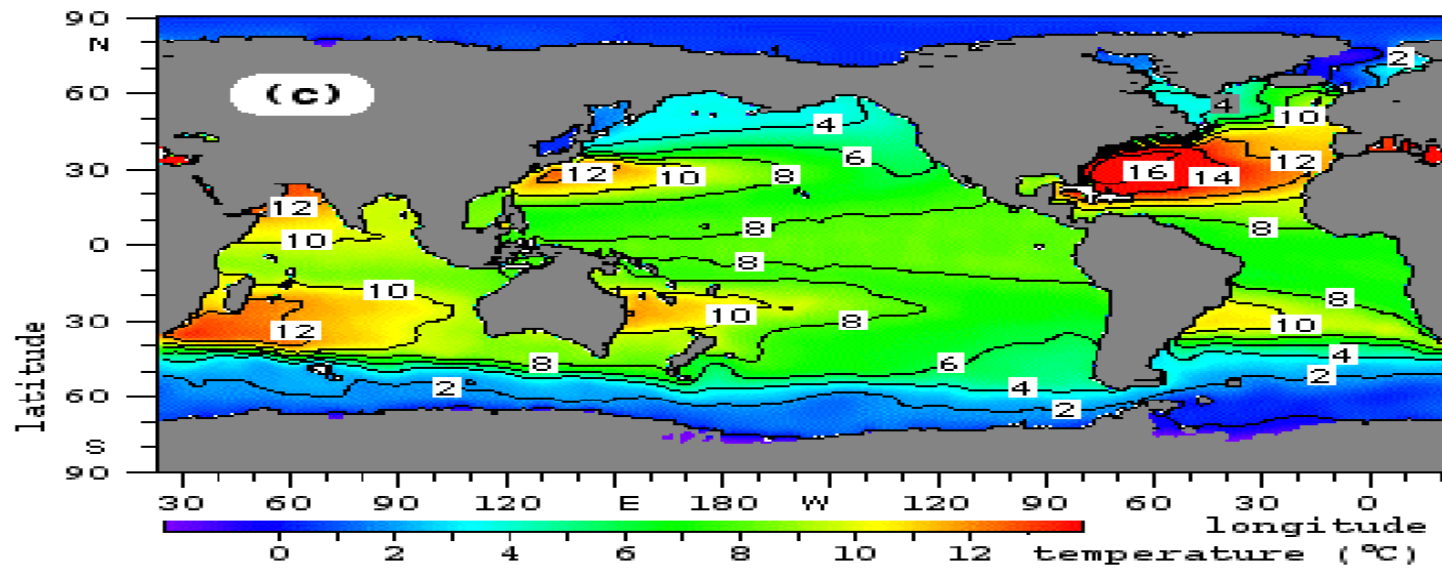


(b) Day time time situation, strong solar radiation and light winds

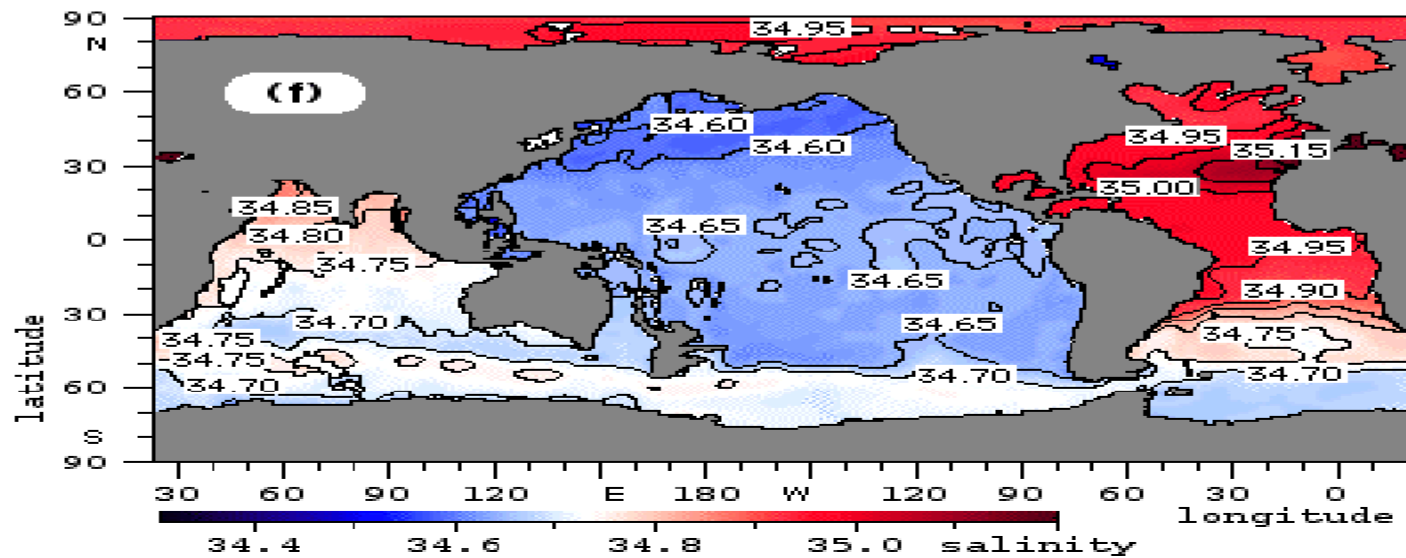
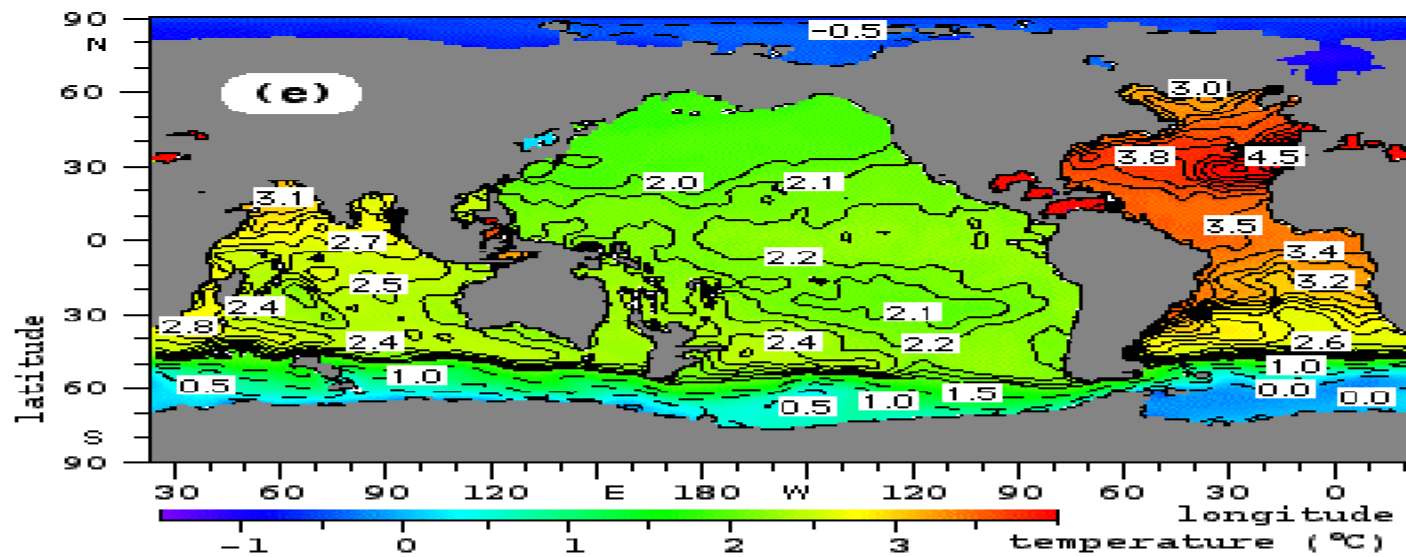
-  SST_{int}
-  SST_{skin}
-  $SST_{subskin}$
-  SST_{depth}
-  SST_{10m}



$Z=0\text{m}$

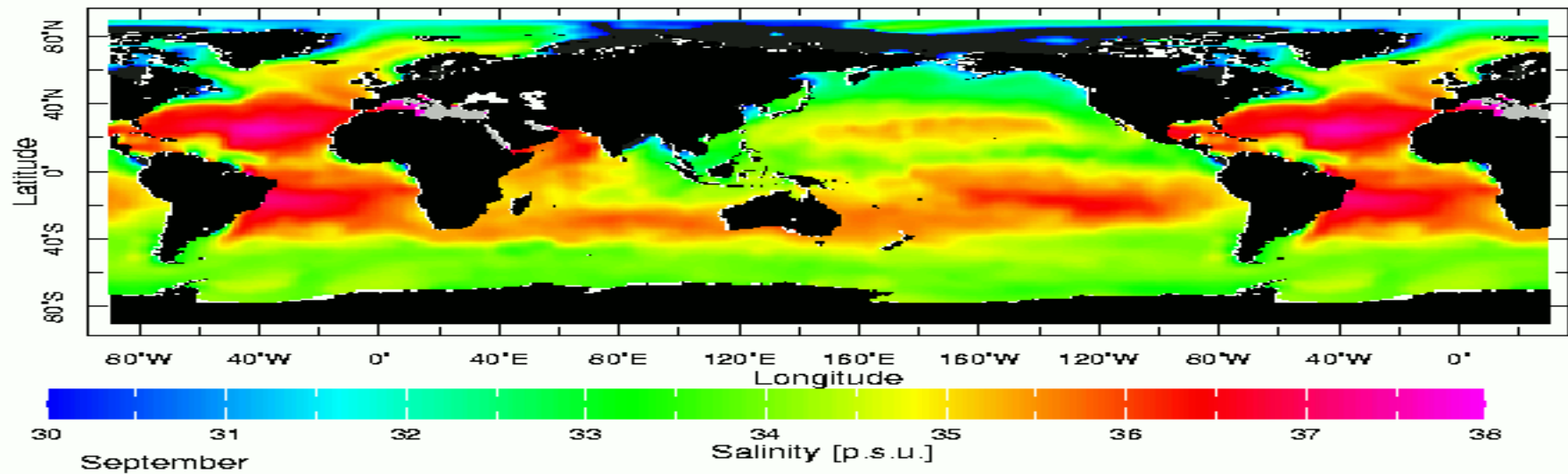
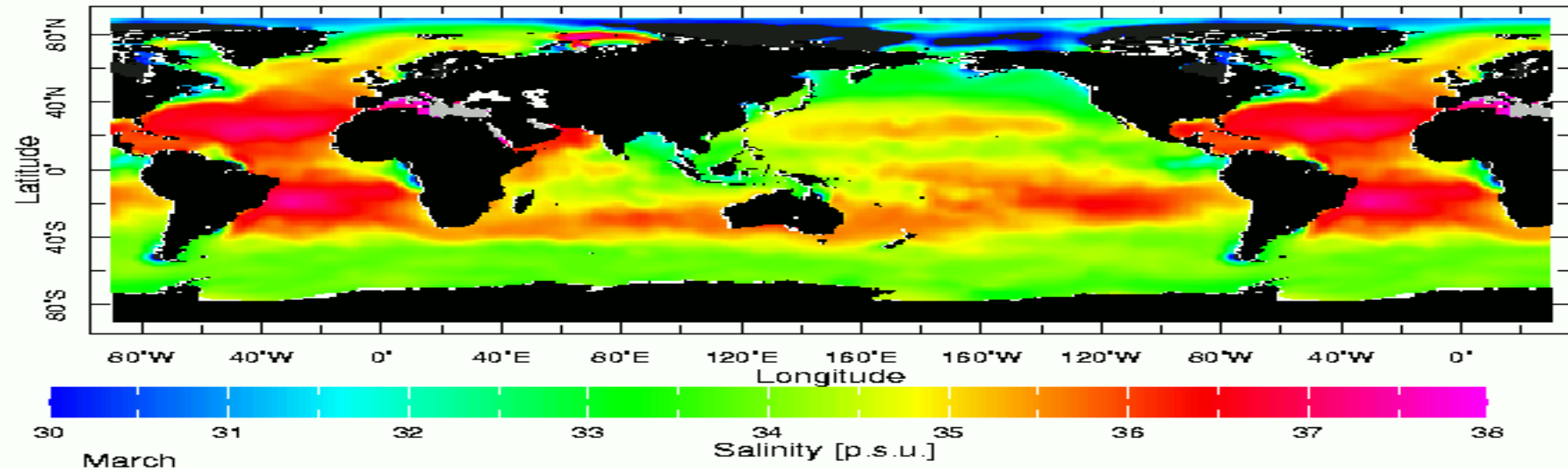


Z = 500 m



Z = 2000 m

Salinidade da Água do Mar



SALINIDADE????

É definida como o peso em gramas de material sólido dissolvido contido em 1 Kg de água do mar

qdo todos os carbonatos foram convertidos a óxidos, os brometos e iodetos em cloretos e todo material orgânico completamente oxidado.

MÉTODOS DE DETERMINAÇÃO

Evaporação [mat orgânica]

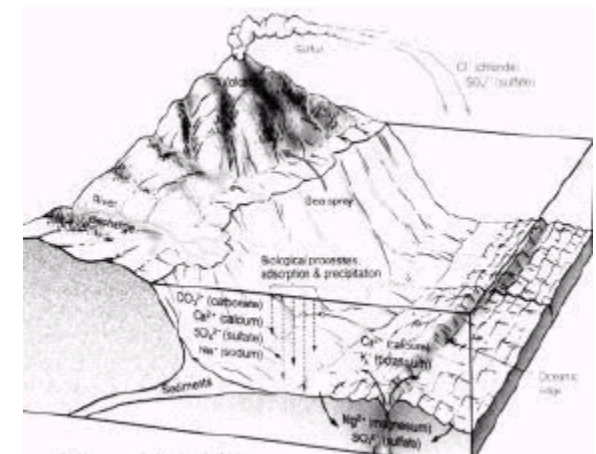
Titulação do íon cloro presente na água (clorinidade)

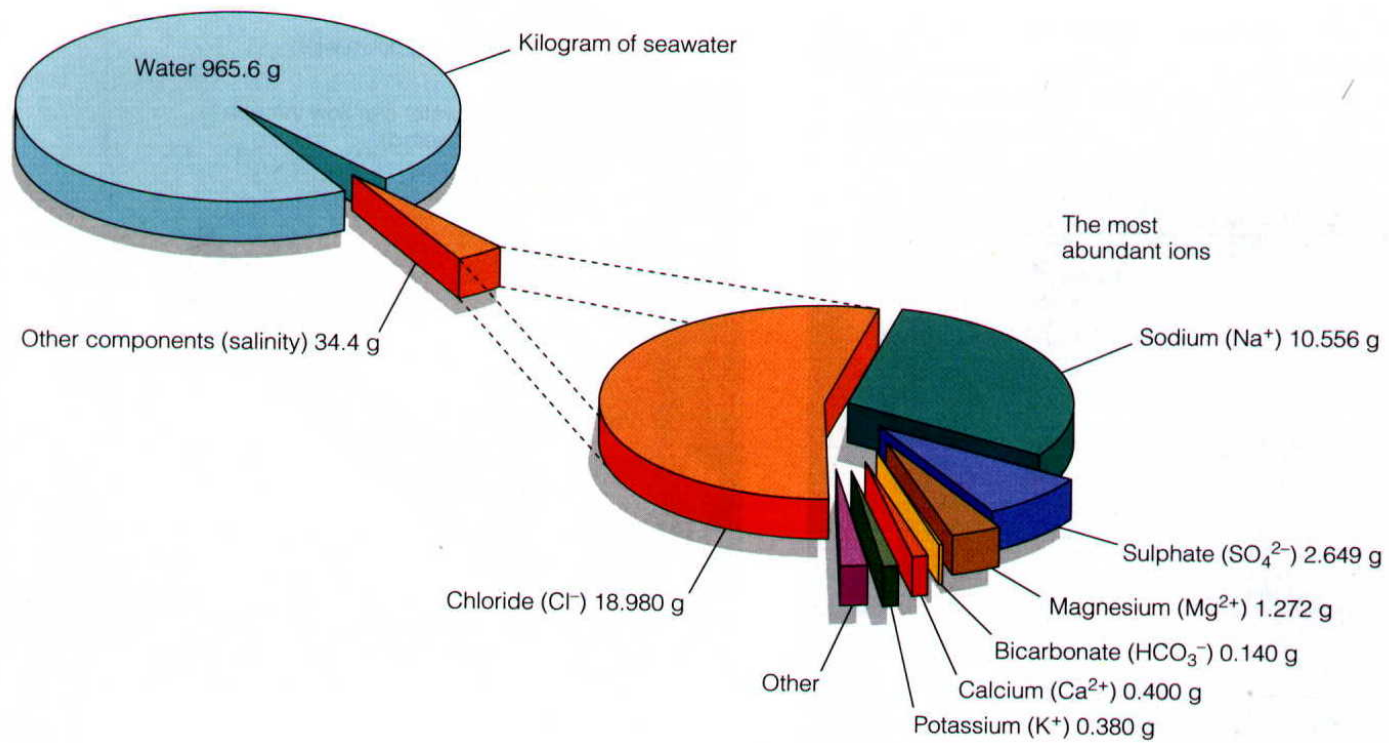
Atualmente condutividade elétrica

Salinidade = 1,80655 Cl.

adicionados pelas erupções vulcânicas e descarga dos rios ao longo do tempo geológico.

1. Cl⁻ com 55% do total de material dissolvido,
2. Na⁺ com 30,6%, sendo que o sal NaCl soma 86%,
3. SO₄ - com 7,7%,
4. Mg⁺⁺ com 3,7%,
5. K⁺ com 1,1%.





Como determinar a salinidade ?

CLORINIDADE

$$S = 1.806\,55\,Cl$$

where *chlorinity* Cl is defined as “the mass of silver required to precipitate completely the halogens in 0.328 523 4 kg of the sea-water sample.”

$$S = -0.089\,96 + 28.297\,29\,R_{15} + 12.808\,32\,R_{15}^2 \\ - 10.678\,69\,R_{15}^3 + 5.986\,24\,R_{15}^4 - 1.323\,11\,R_{15}^5 \quad (6.3a)$$

$$R_{15} = C(S, 15, 0)/C(35, 15, 0) \quad (6.3b)$$

where $C(S, 15, 0)$ is the conductivity of the sea-water sample at 15°C and atmospheric pressure, having a salinity S derived from (6.4), and $C(35, 15, 0)$ is the conductivity of standard “Copenhagen” sea water. Millero (1996) points out that (6.3) is not a new definition of salinity, it merely gives chlorinity as a function of conductivity of seawater relative to standard seawater.

Practical Salinity Scale of 1978 By the early 1970s, accurate conductivity meters could be deployed from ships to measure conductivity at depth. The need to re-evaluate the salinity scale led the Joint Panel to recommend in 1978 that salinity be defined using only conductivity, breaking the link with chlorinity. All water samples with the same conductivity ratio have the same salinity.

The *Practical Salinity Scale of 1978* is now the official definition:

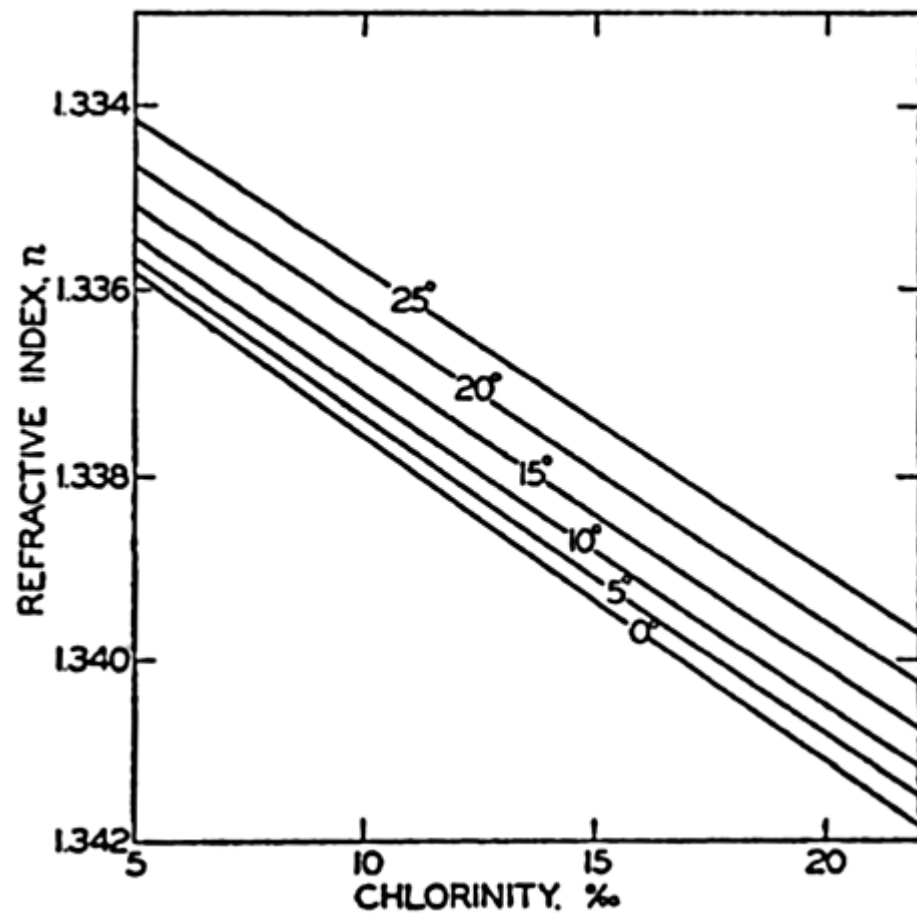
$$S = 0.0080 - 0.1692 R_T^{1/2} + 25.3851 R_T + 14.0941 R_T^{3/2} - 7.0261 R_T^2 + 2.7081 R_T^{5/2} + \Delta S \quad (6.4a)$$

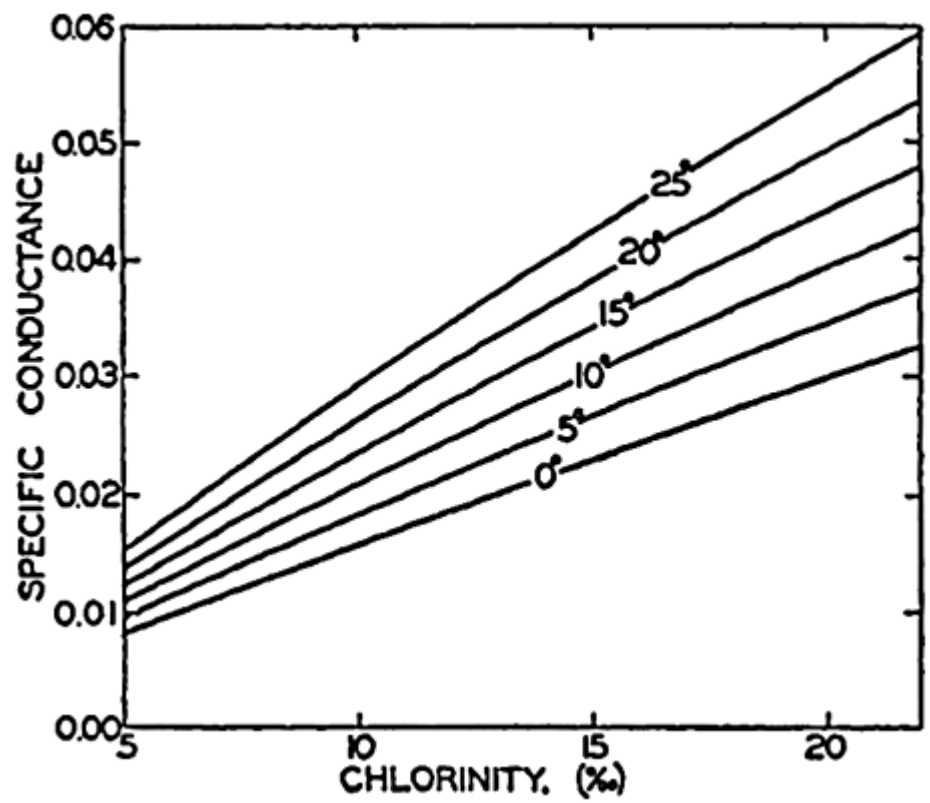
$$R_T = C(S, T, 0) / C(KCl, T, 0) \quad (6.4b)$$

$$\Delta S = \left[\frac{(T - 15)}{1 + 0.0162 (T - 15)} \right] + 0.0005 - 0.0056 R_T^{1/2} - 0.0066 R_T - 0.0375 R_T^{3/2} + 0.636 R_T^2 - 0.0144 R_T^{5/2} \quad (6.4c)$$

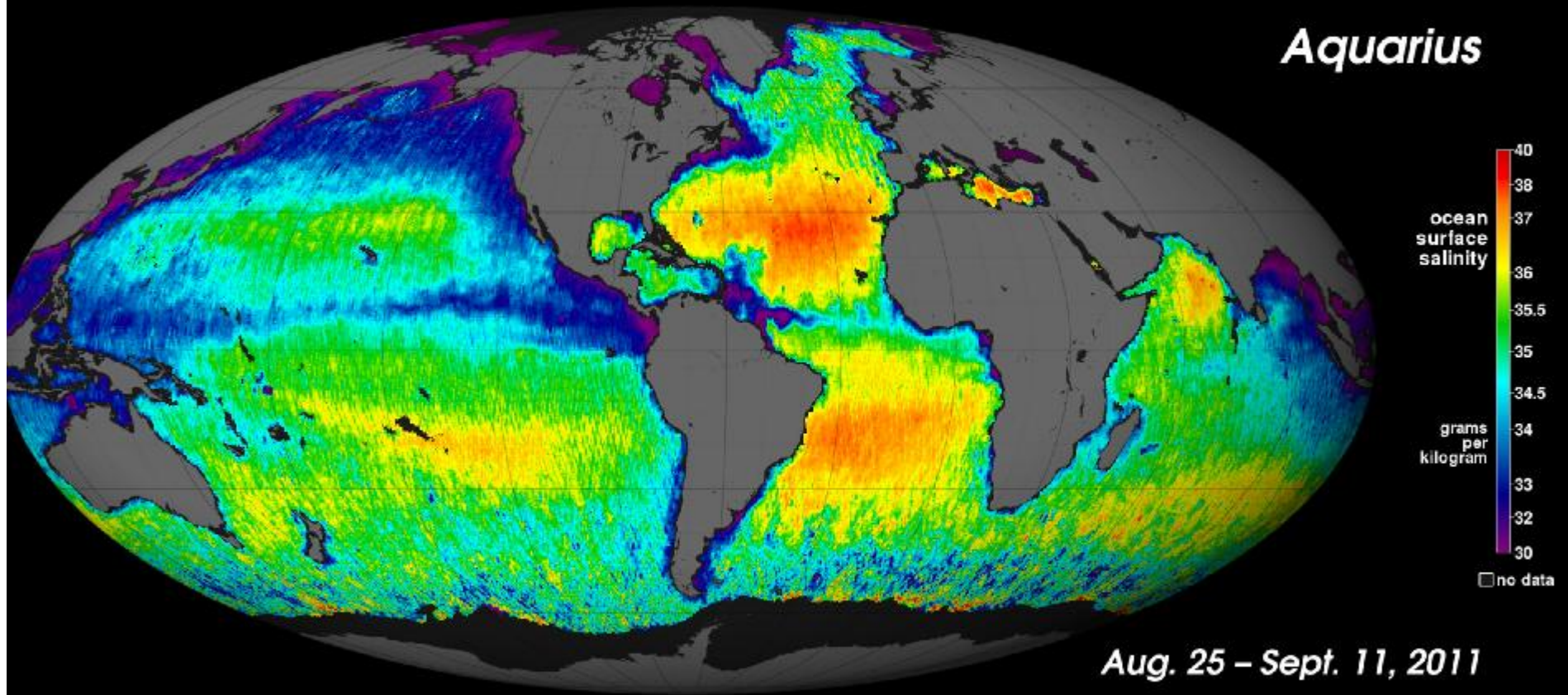
$$2 \leq S \leq 42$$

where $C(S, T, 0)$ is the conductivity of the sea-water sample at temperature T and standard atmospheric pressure, and $C(KCl, T, 0)$ is the conductivity of the standard potassium chloride (KCl) solution at temperature T and standard atmospheric pressure. The standard KCl solution contains a mass of 32.435 6 grams of KCl in a mass of 1.000 000 kg of solution. An extension of (6.4) gives salinity at any pressure (see Millero 1996: 72).

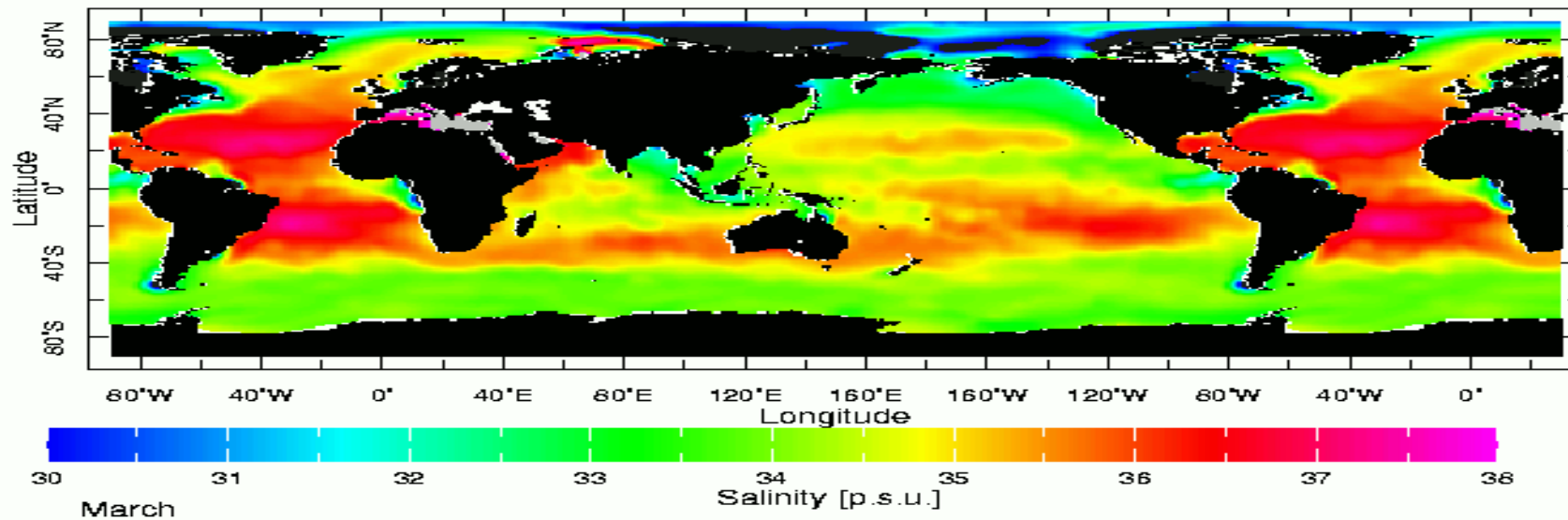




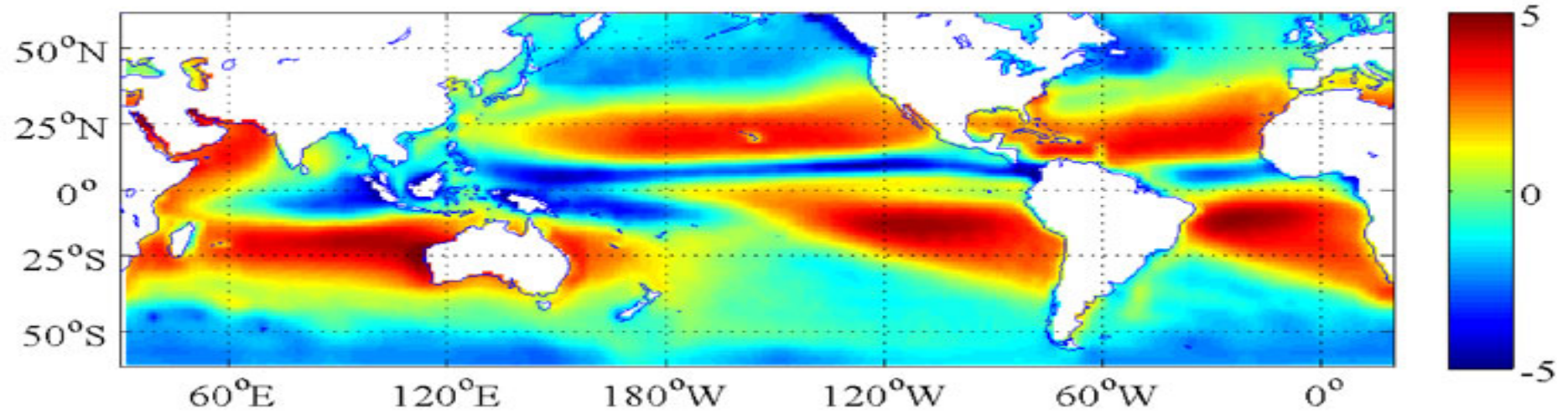
Aquarius



Variação superficial da salinidade: o que causa isso?



Evaporation Minus Precipitation 1981--2002

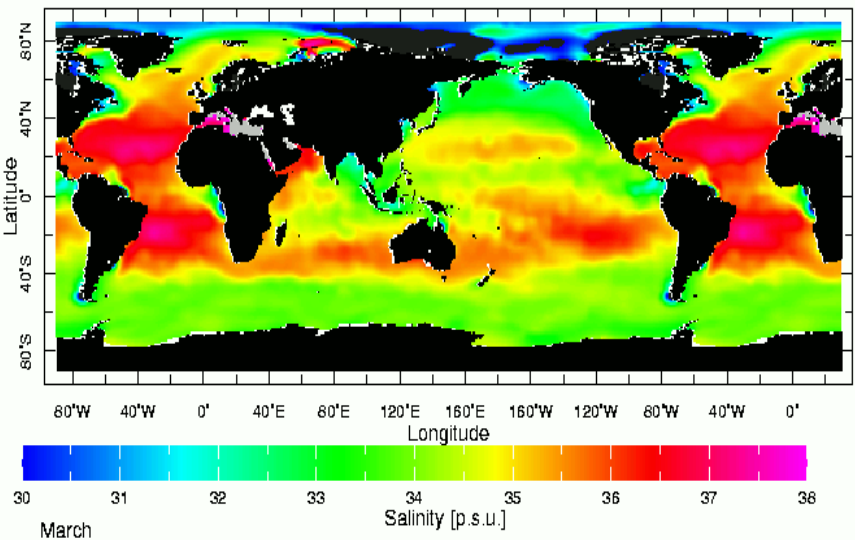
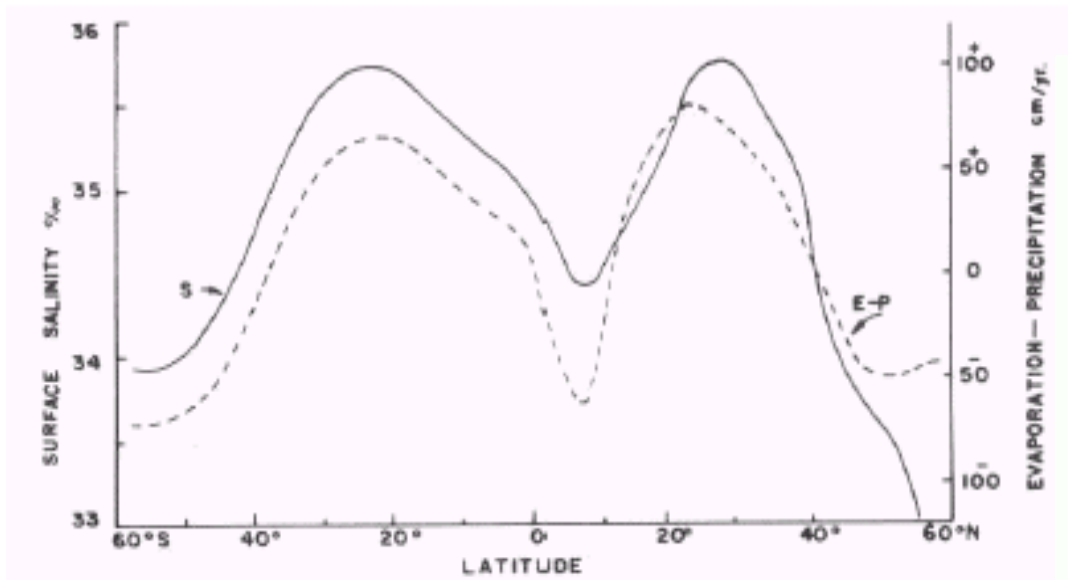
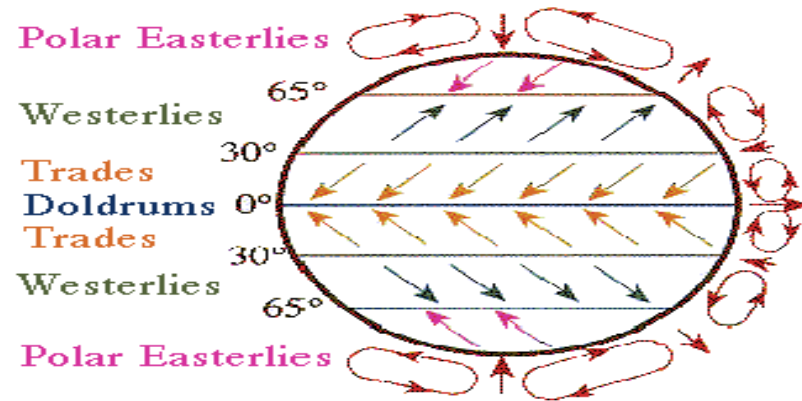


Variação da Salinidade

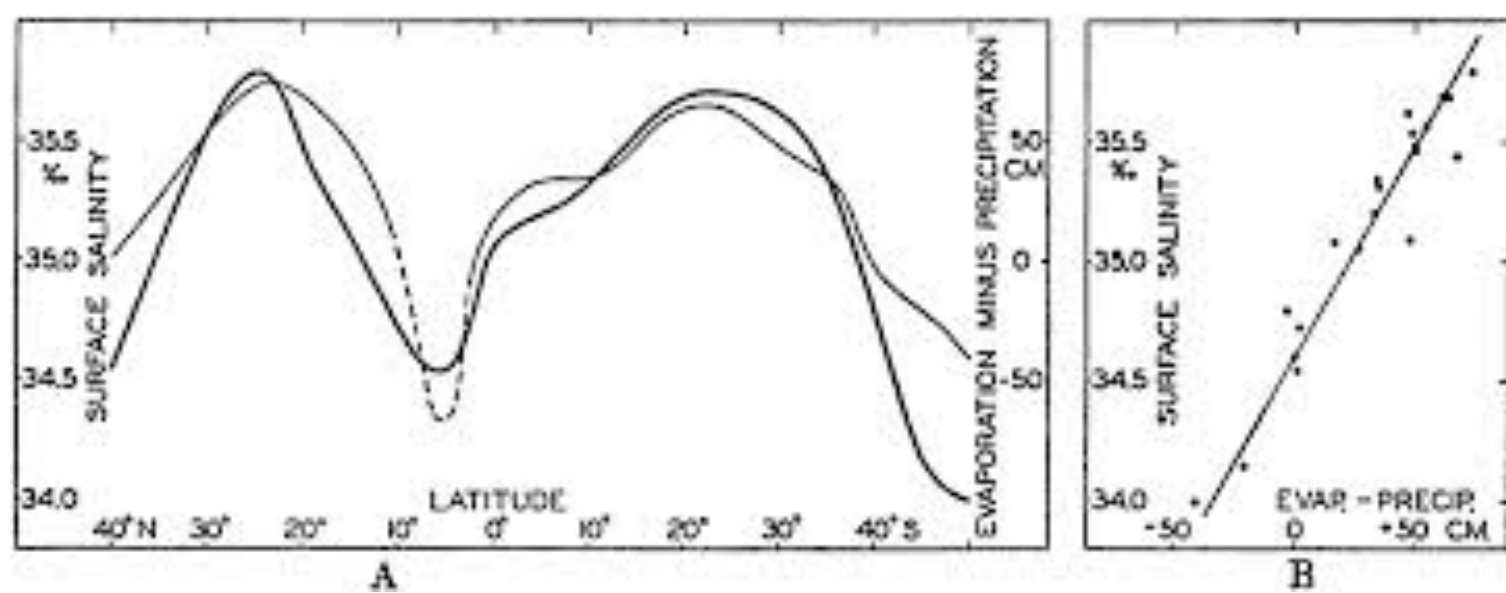
Evaporação, precipitação, aportes continentais, congelamento/degelo

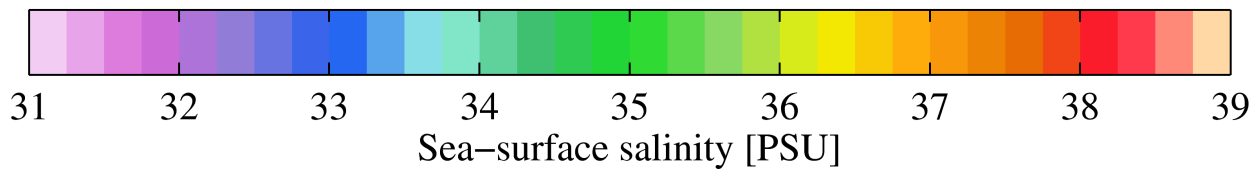
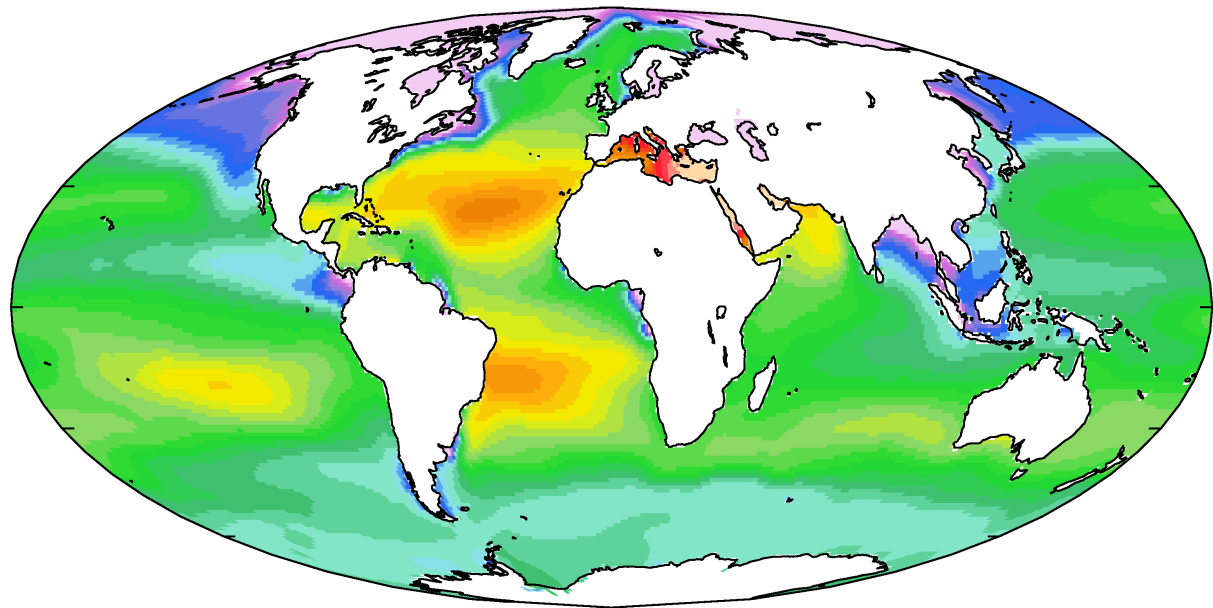
DISTRIBUIÇÃO HORIZONTAL DA SALINIDADE

- aproximadamente zonal
- Depende do balanço E-P
- Max ~20° E>P
- Min Equador P>E
- S média sup 33.8 e 37.5
- Altas latitudes: congelamento/degelo

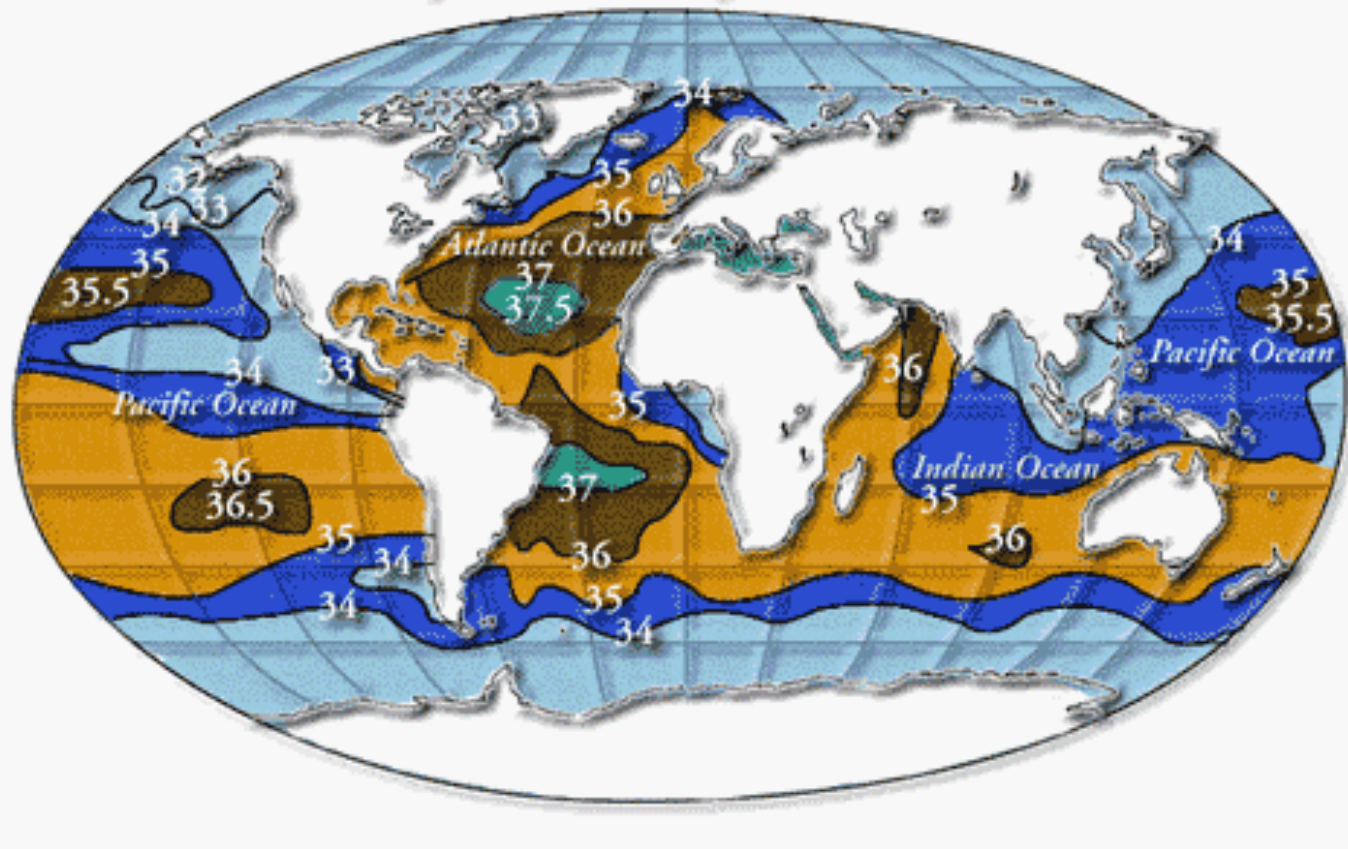


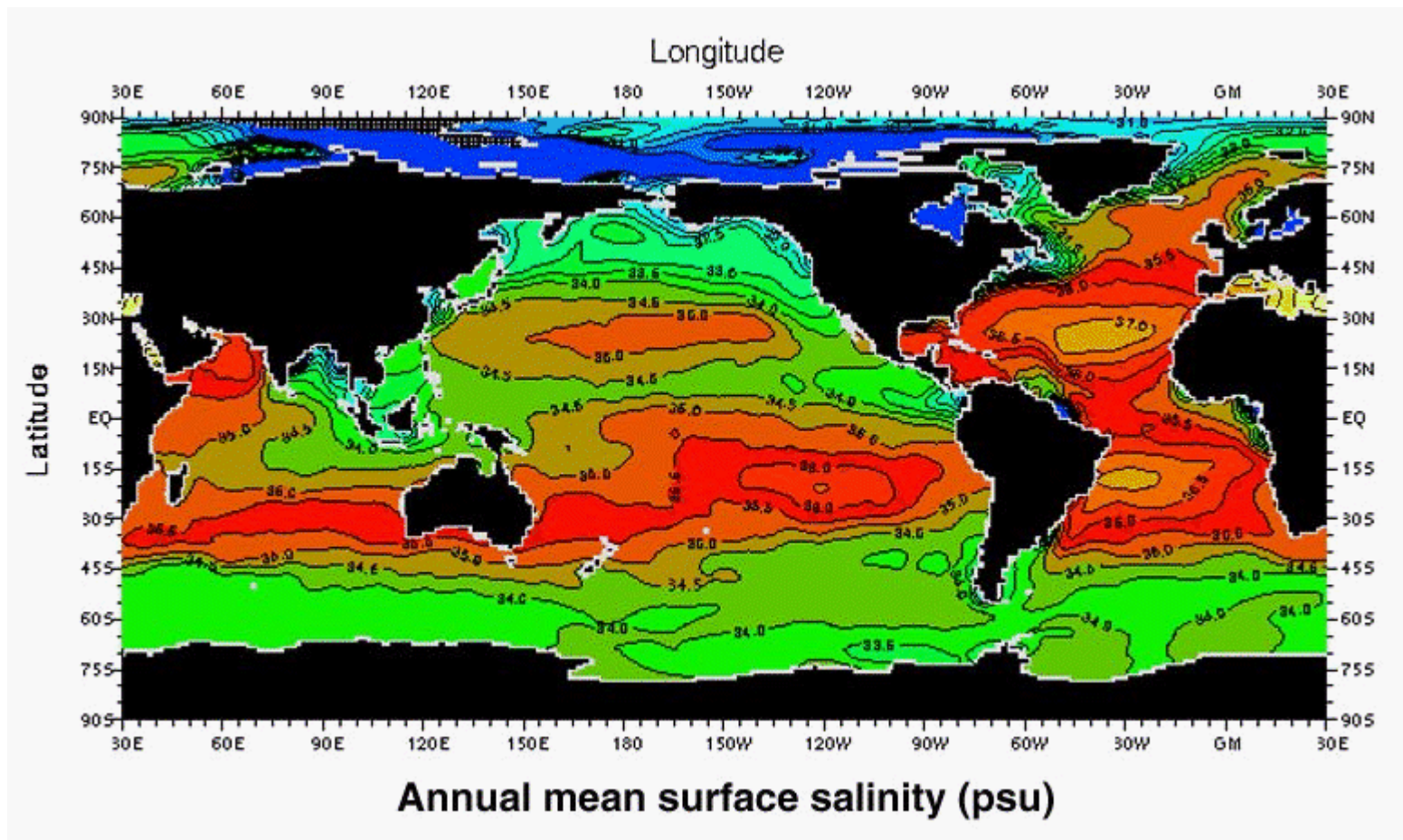
S superficial média para todos os oceanos e diferenças entre evaporação e precipitação (E-P) em função da latitude.



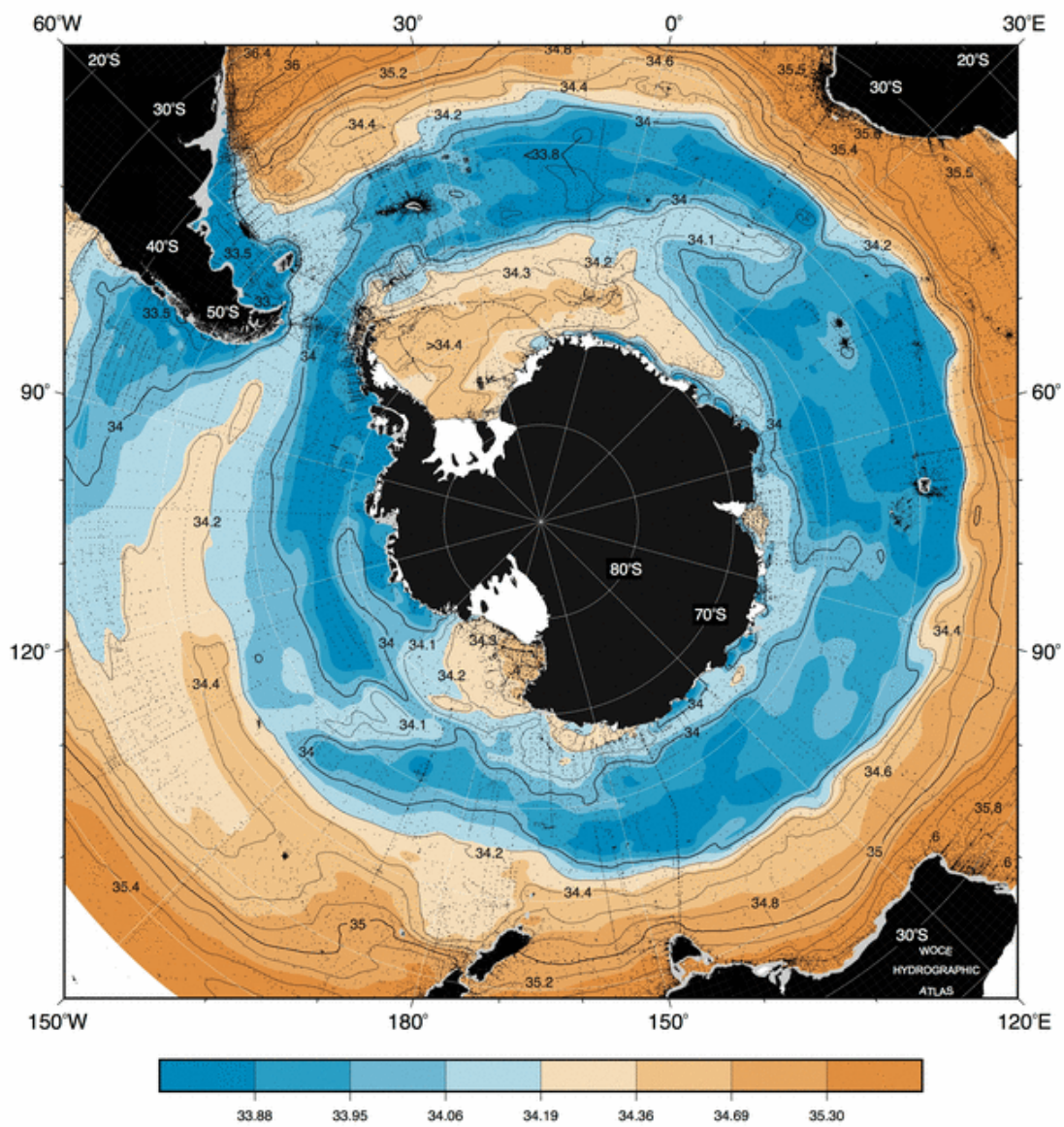


Surface Salinities of the Oceans (‰)



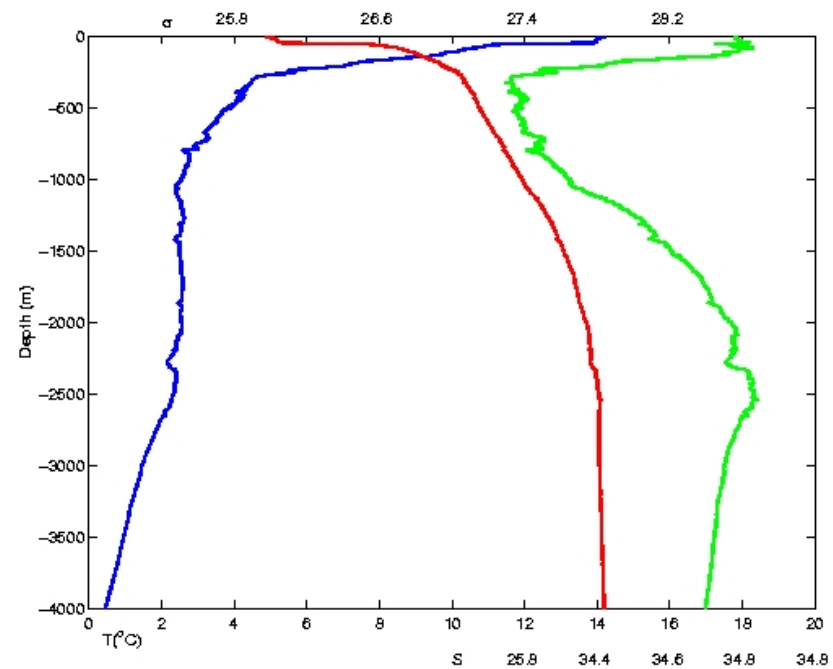
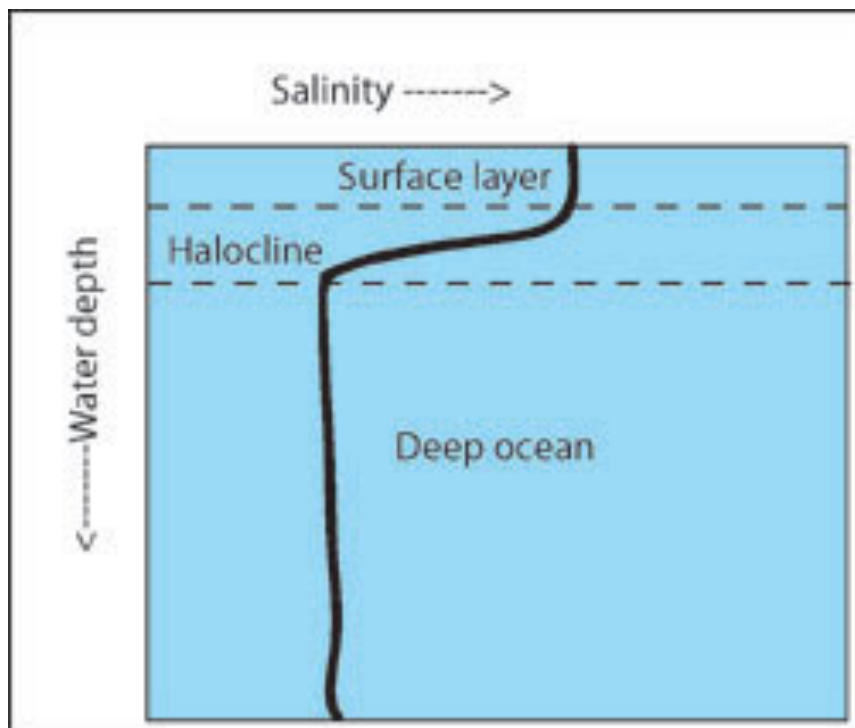


Depth: 50m

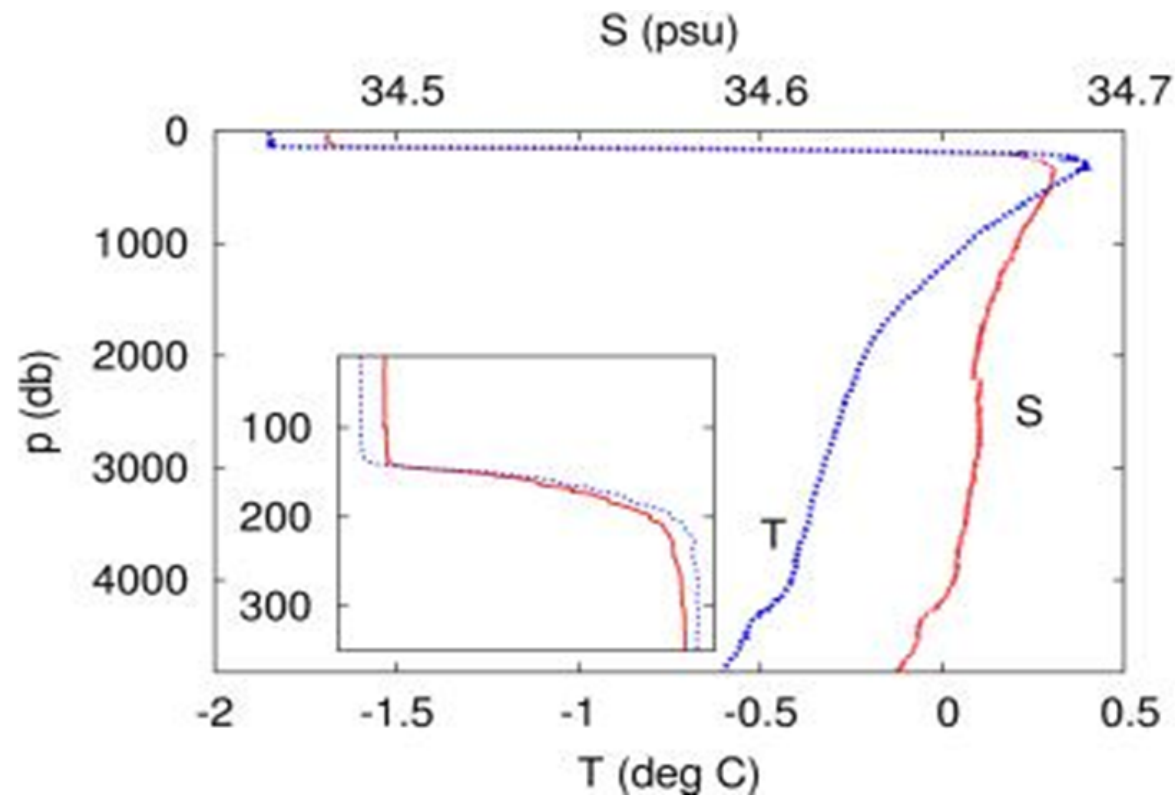


Salinity (PSS78)

DISTRIBUIÇÃO VERTICAL DA SALINIDADE ENTRE 60 S E 60 N



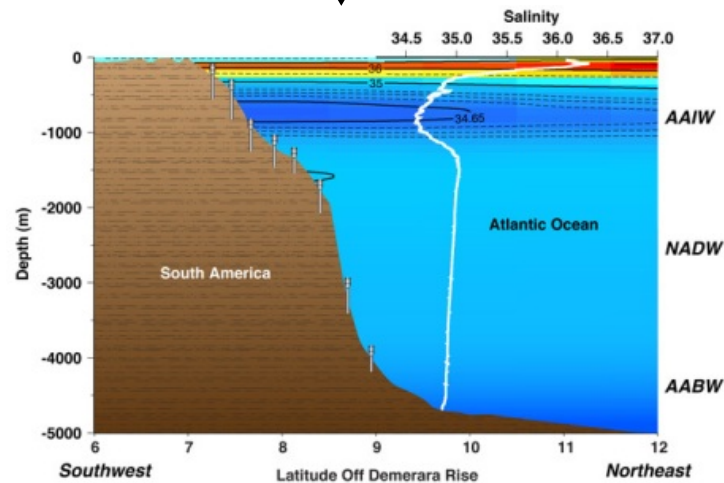
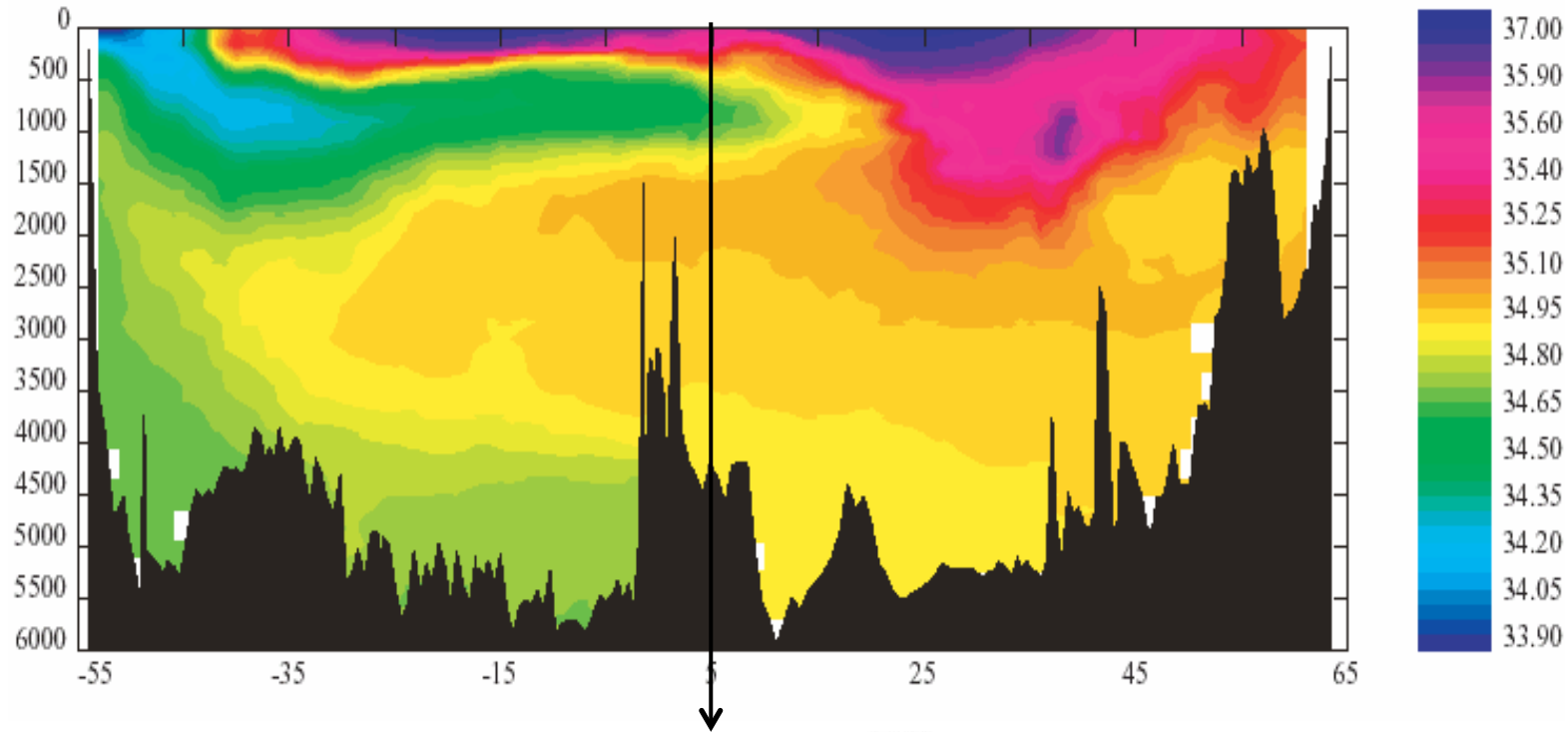
DISTRIBUIÇÃO VERTICAL DA
SALINIDADE EM ALTAS LATITUDES –
MAR DE WEDDELL



DISTRIBUIÇÃO VERTICAL DA SALINIDADE

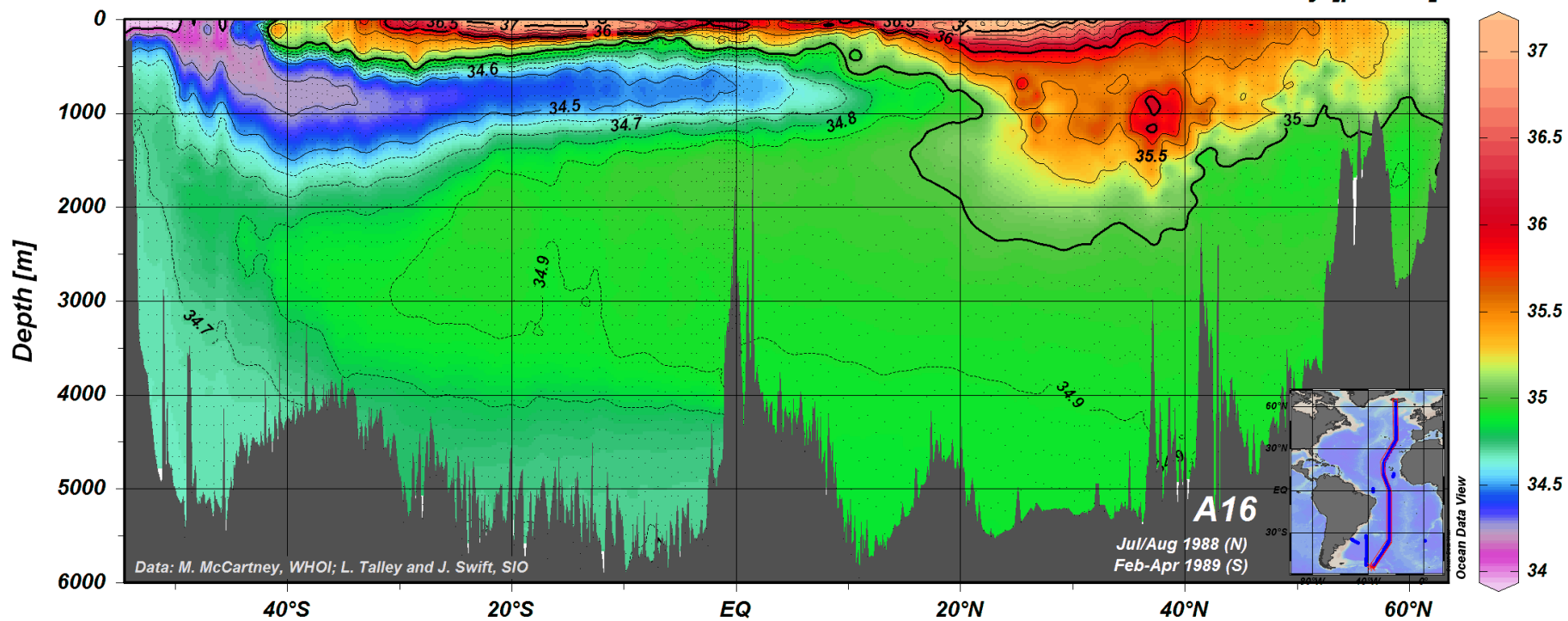
A distribuição vertical da S em baixas e médias lat é caracterizada por um mín de S entre 600 a 1000 m com um aumento a partir dos 2000 m

A16 Salinity

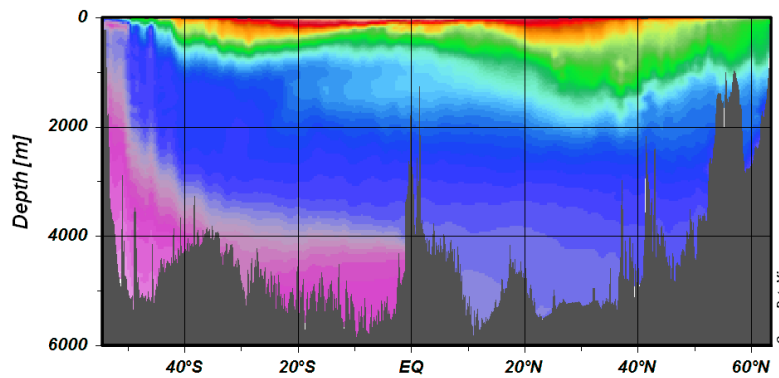


eWOCE

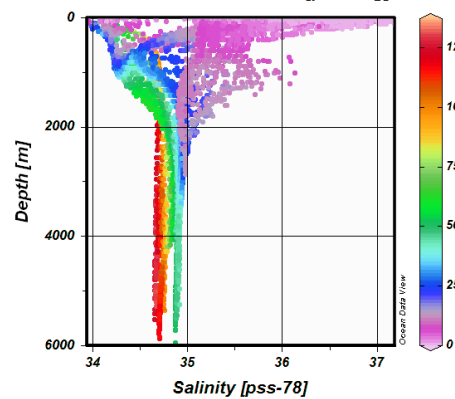
Salinity [pss-78]



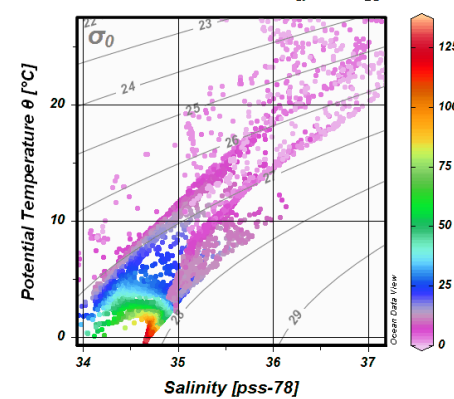
Potential Temperature θ [°C]



Silicate [$\mu\text{mol/kg}$]

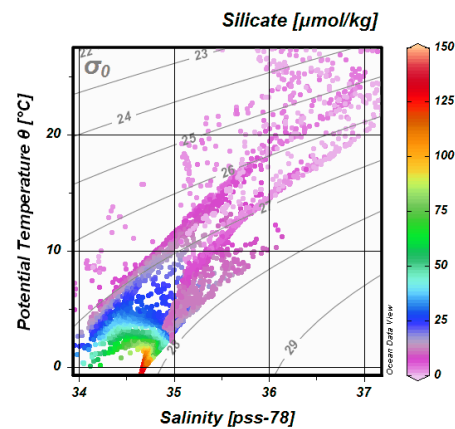
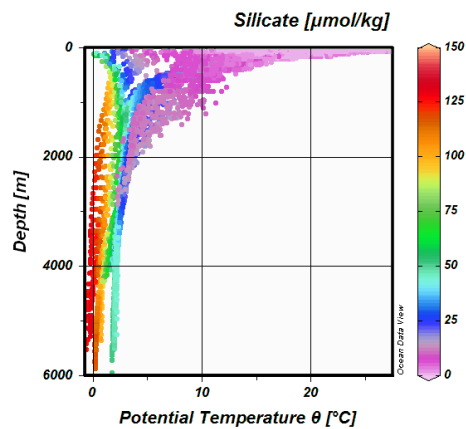
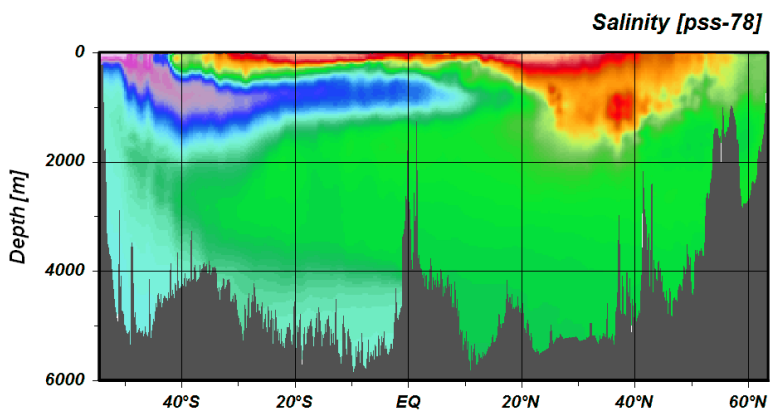
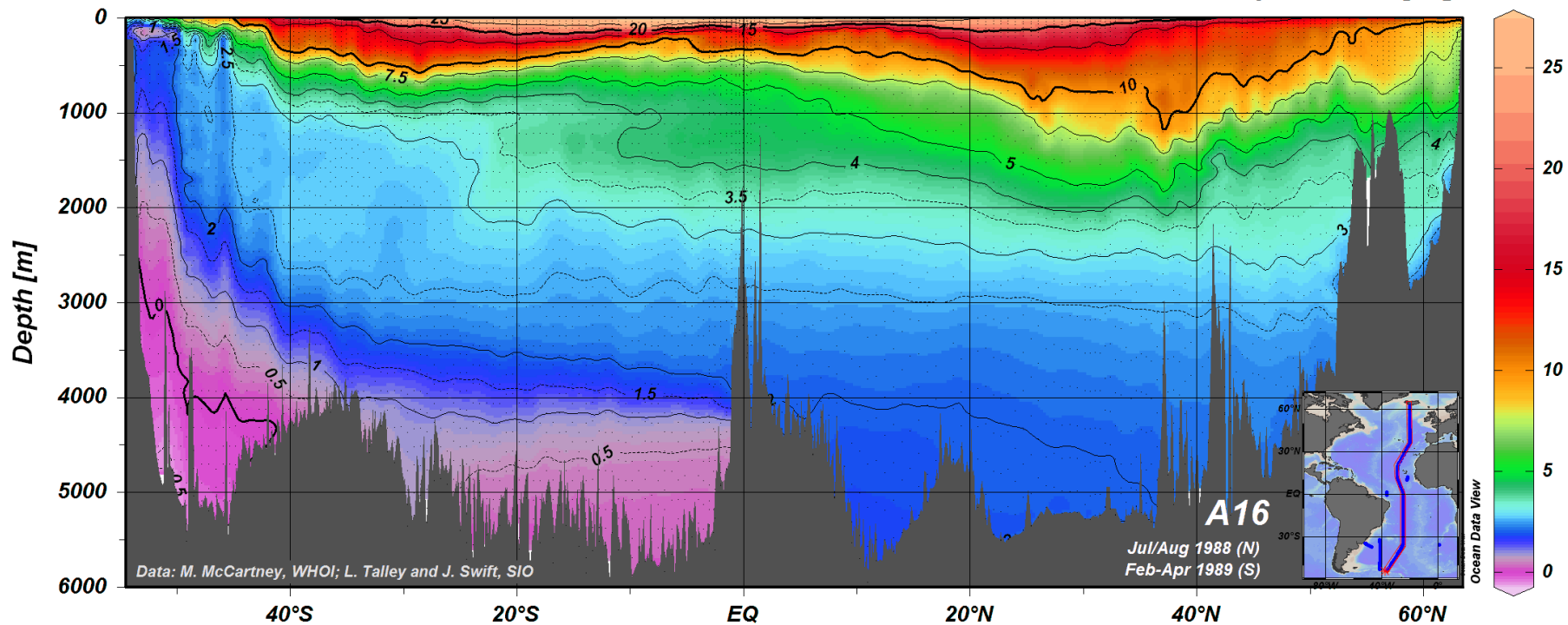


Silicate [$\mu\text{mol/kg}$]



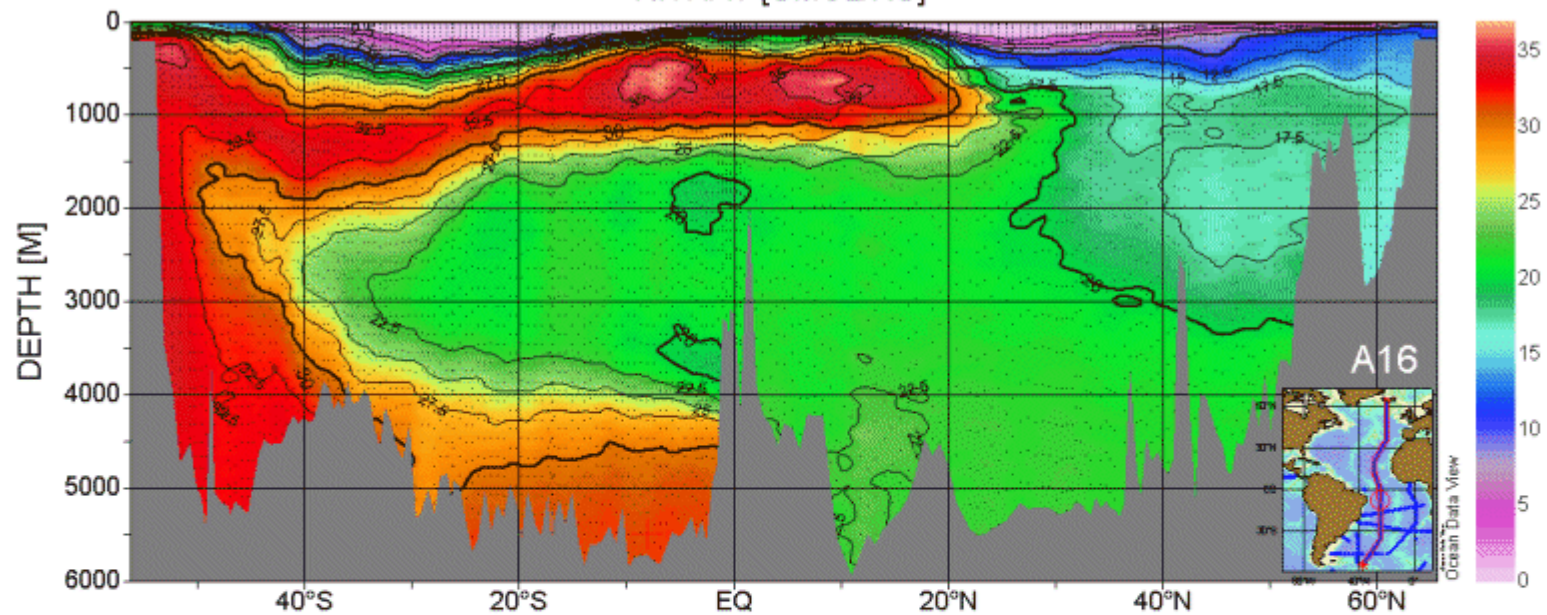
eWOCE

Potential Temperature θ [$^{\circ}\text{C}$]

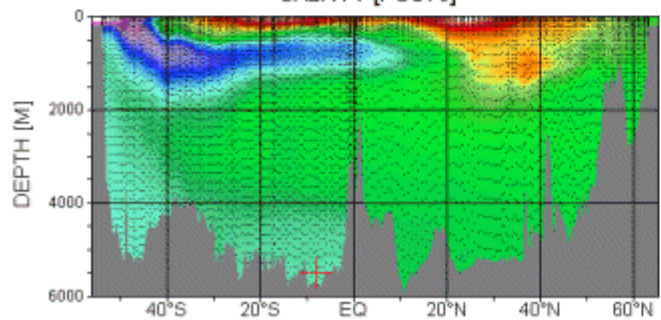


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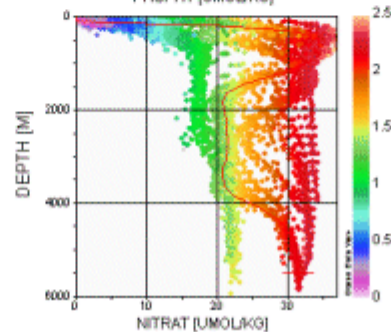
NITRAT [UMOL/KG]



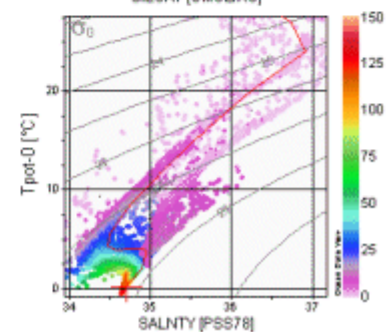
SALNTY [PSS78]



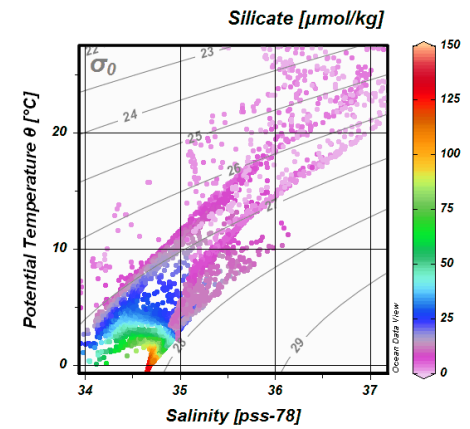
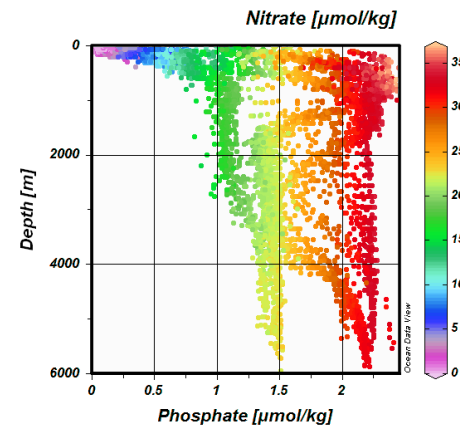
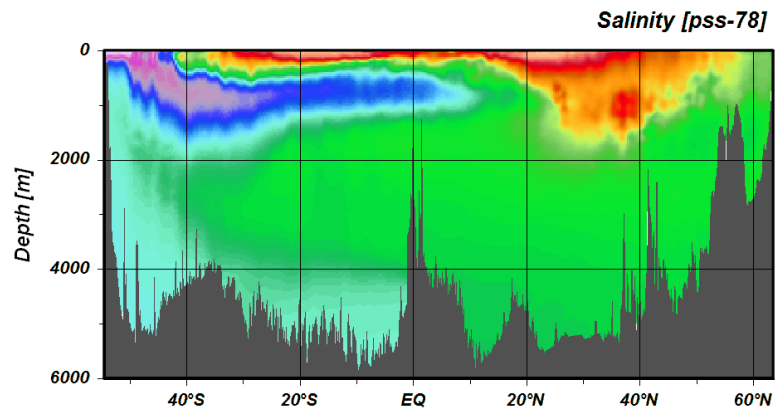
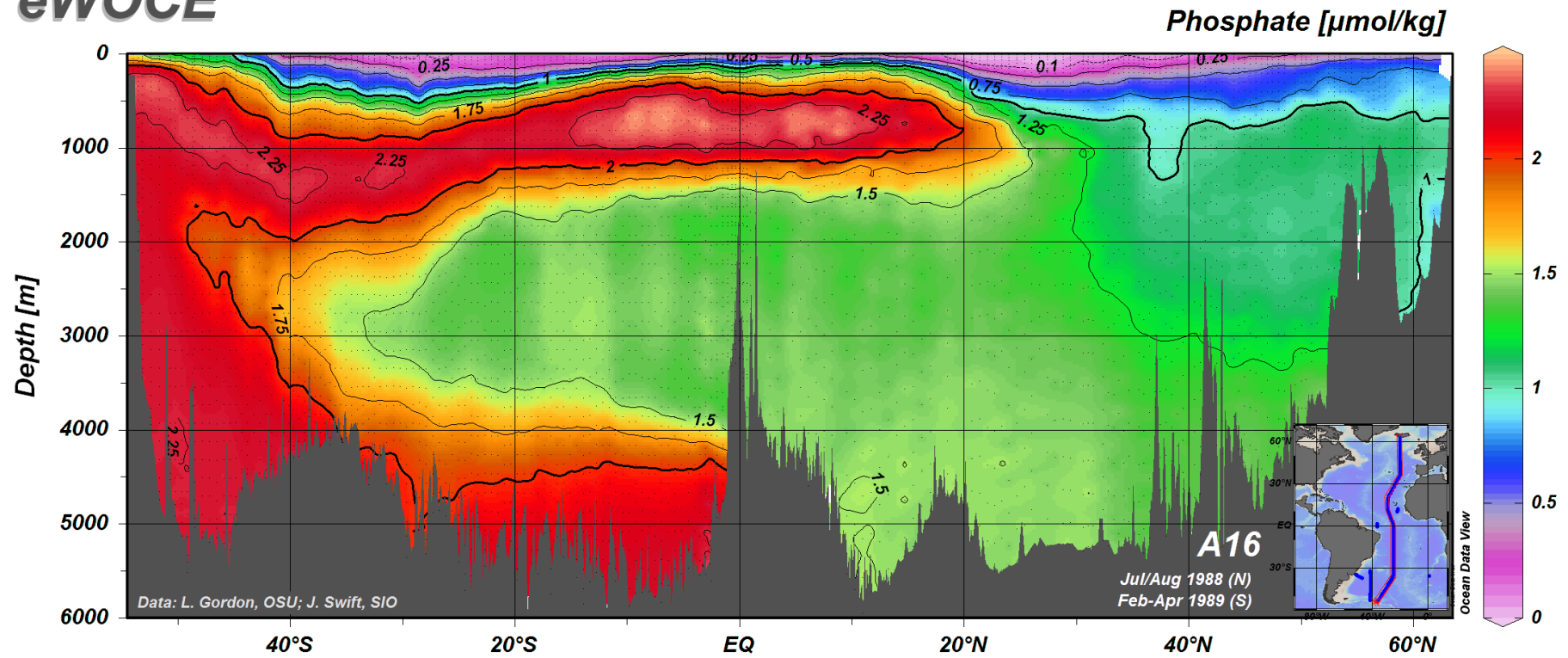
PHSPHT [UMOL/KG]



SILCAT [UMOL/KG]

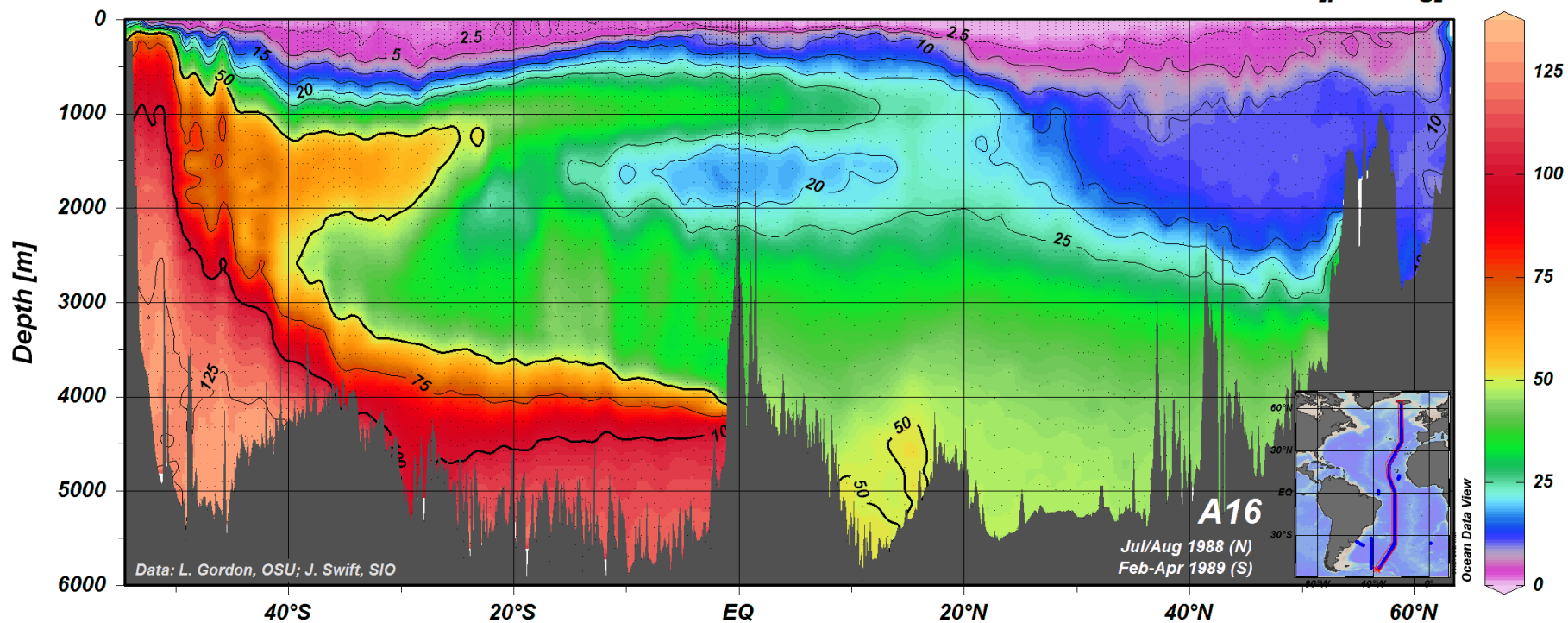


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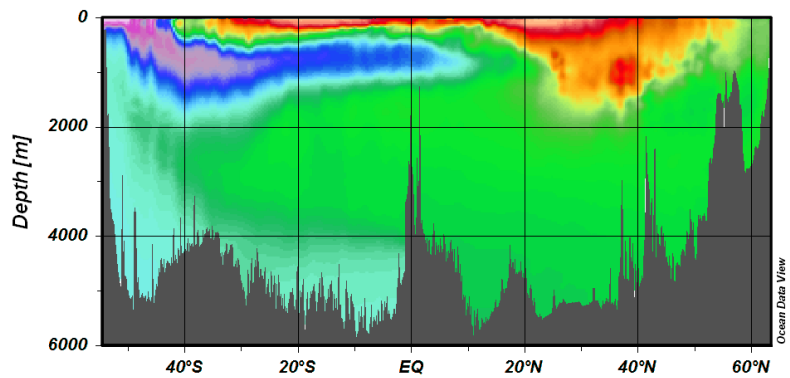


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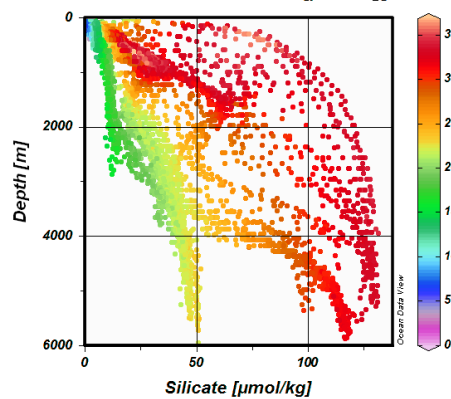
Silicate [$\mu\text{mol/kg}$]



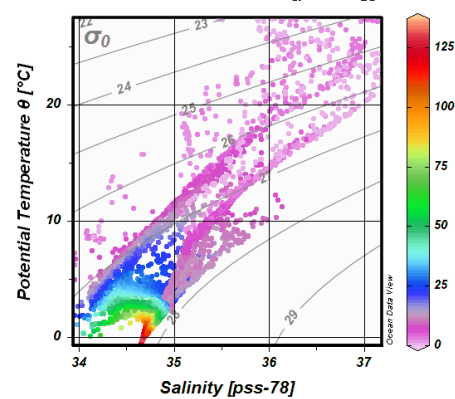
Salinity [pss-78]



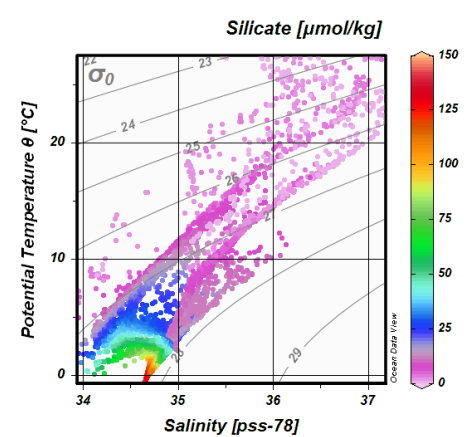
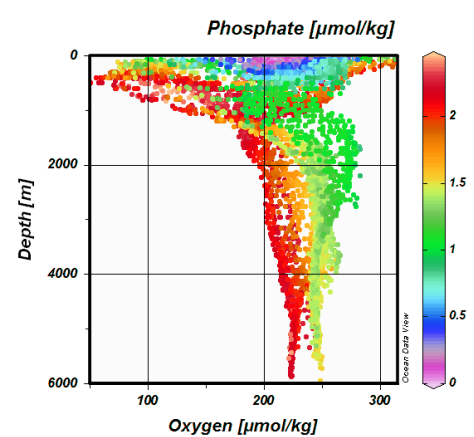
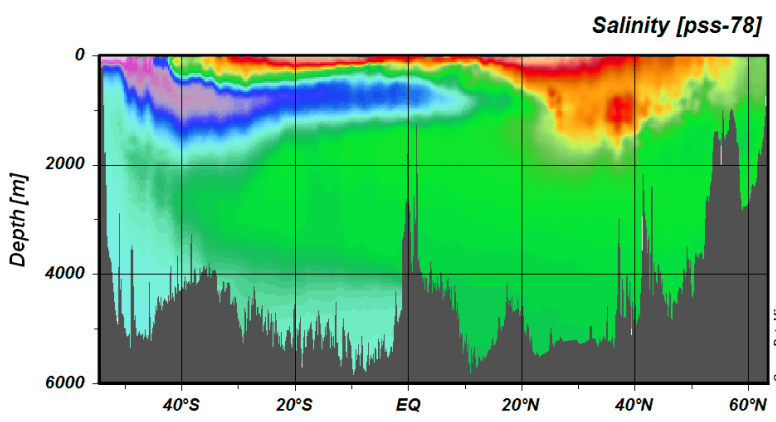
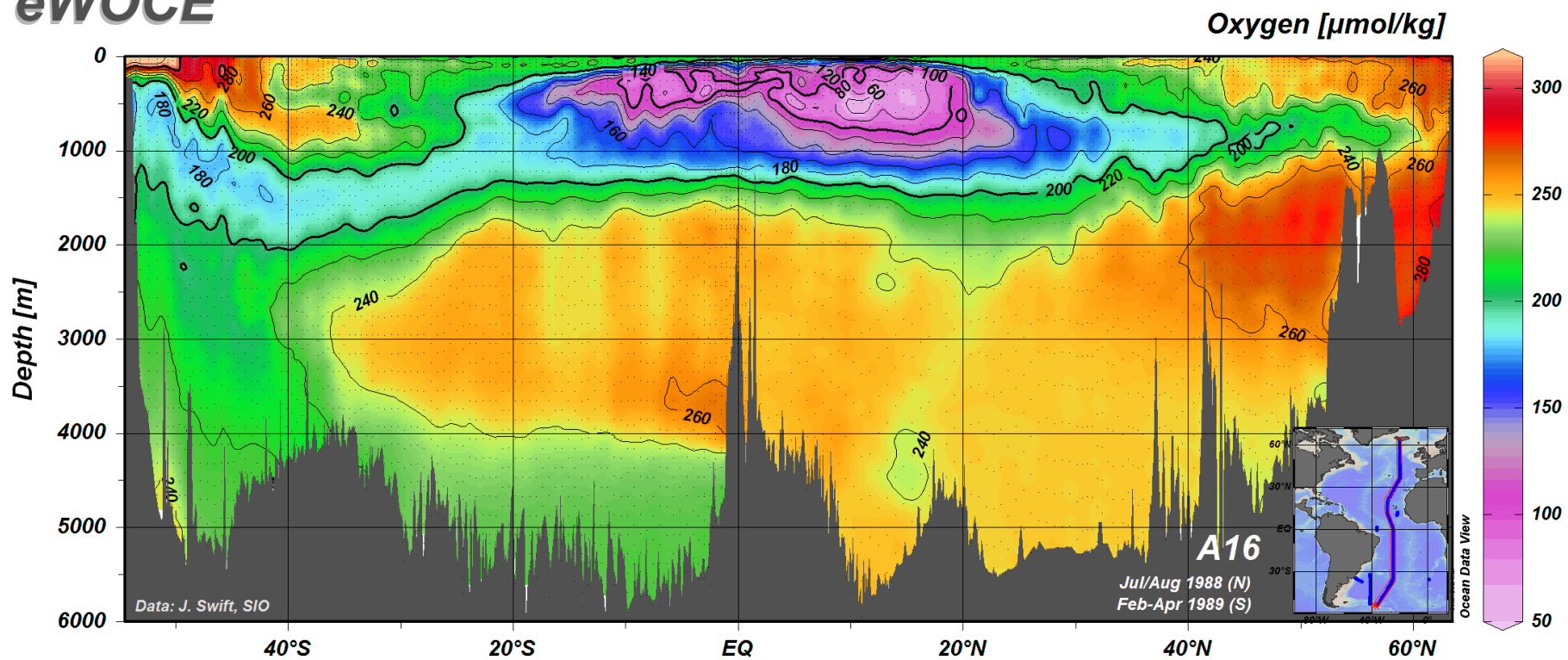
Nitrate [$\mu\text{mol/kg}$]



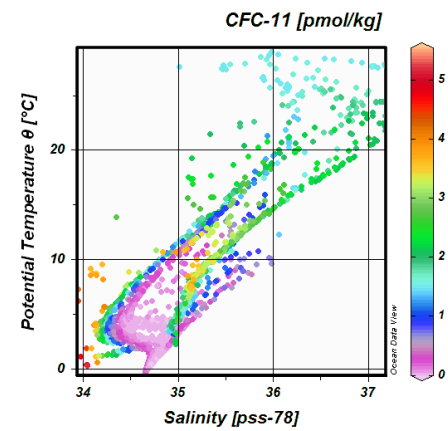
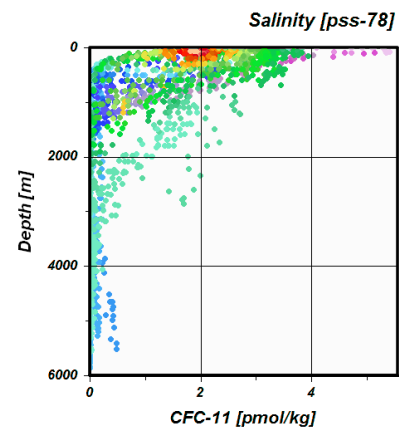
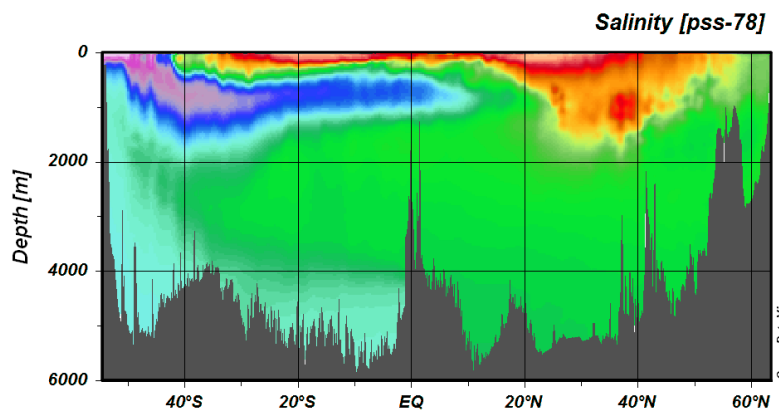
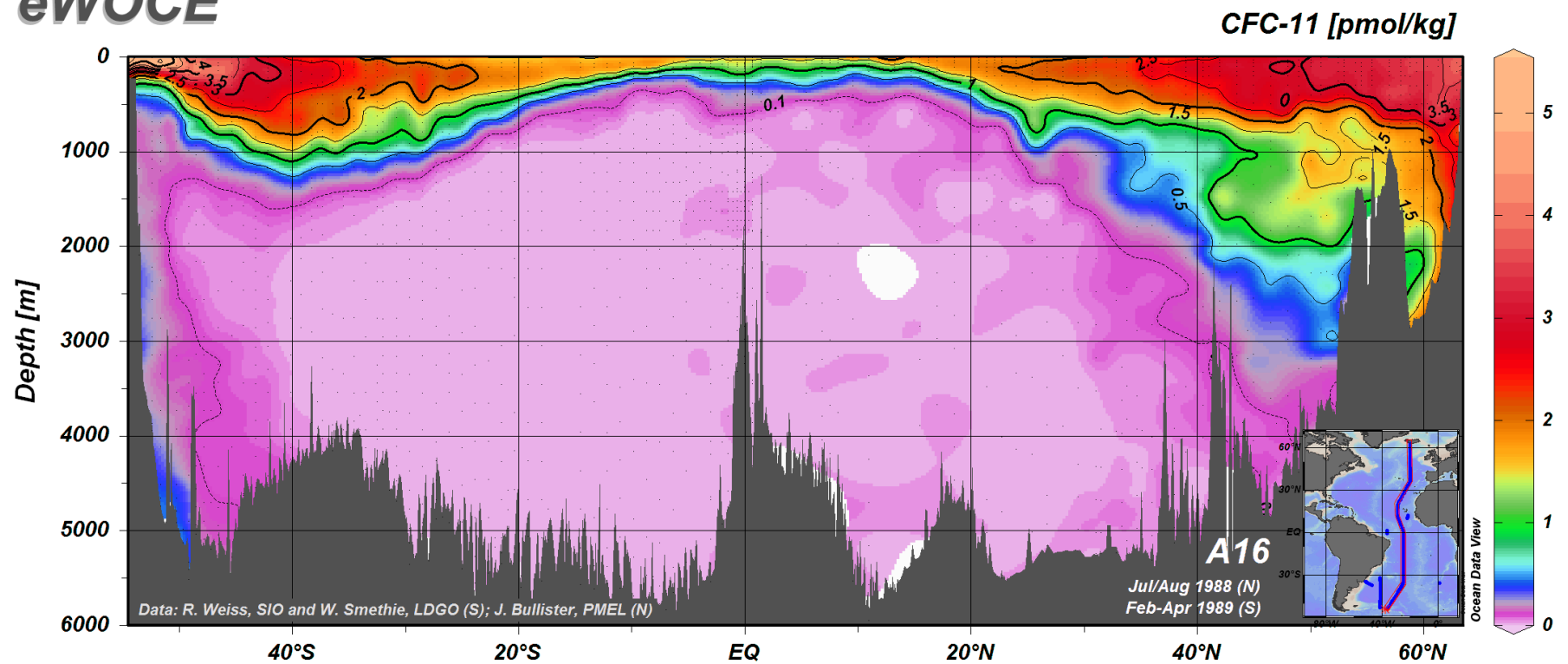
Silicate [$\mu\text{mol/kg}$]

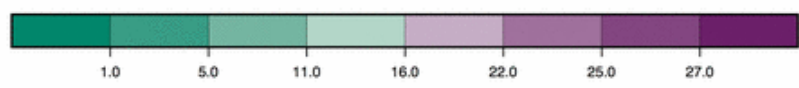
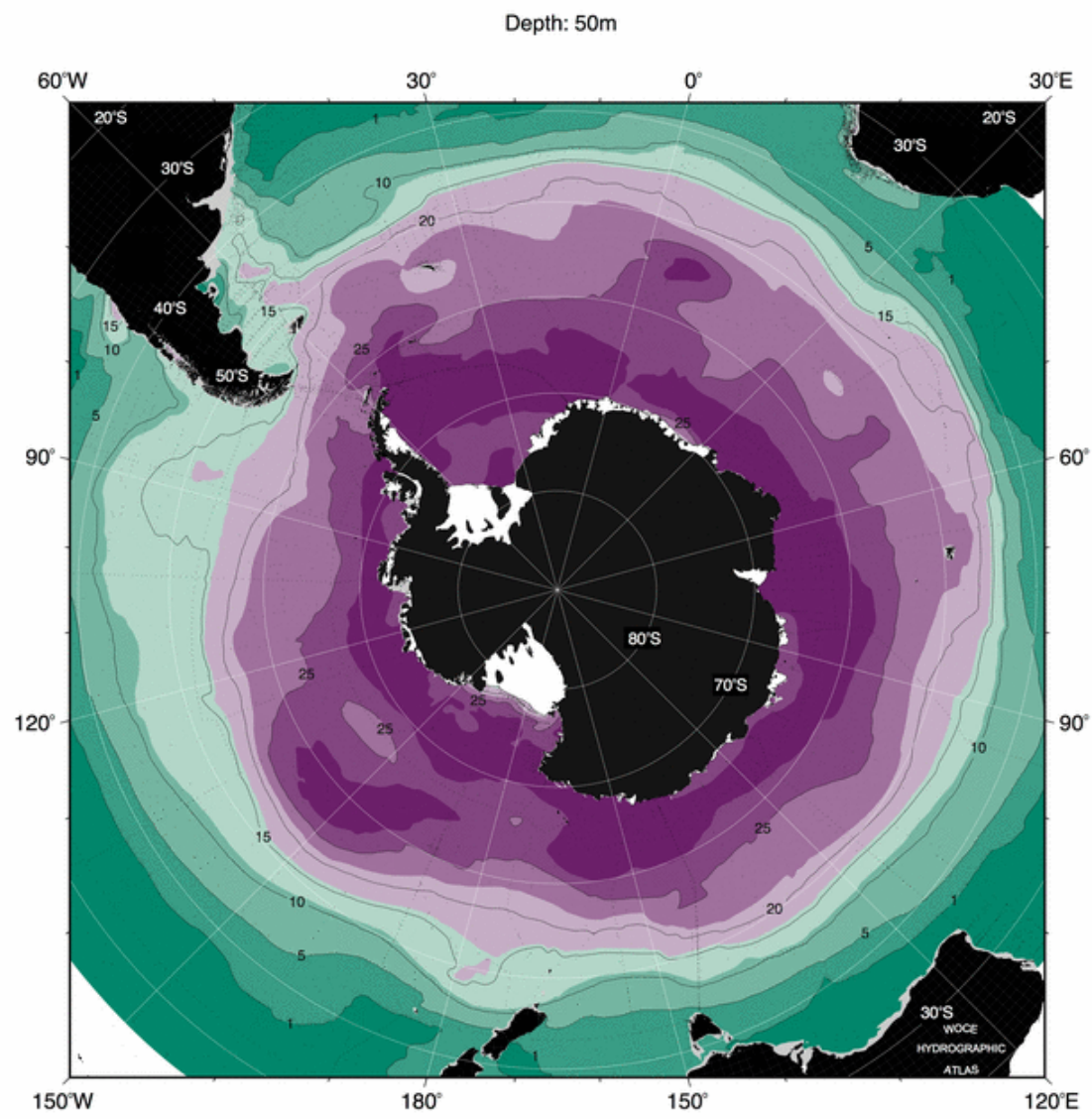


eWOCE

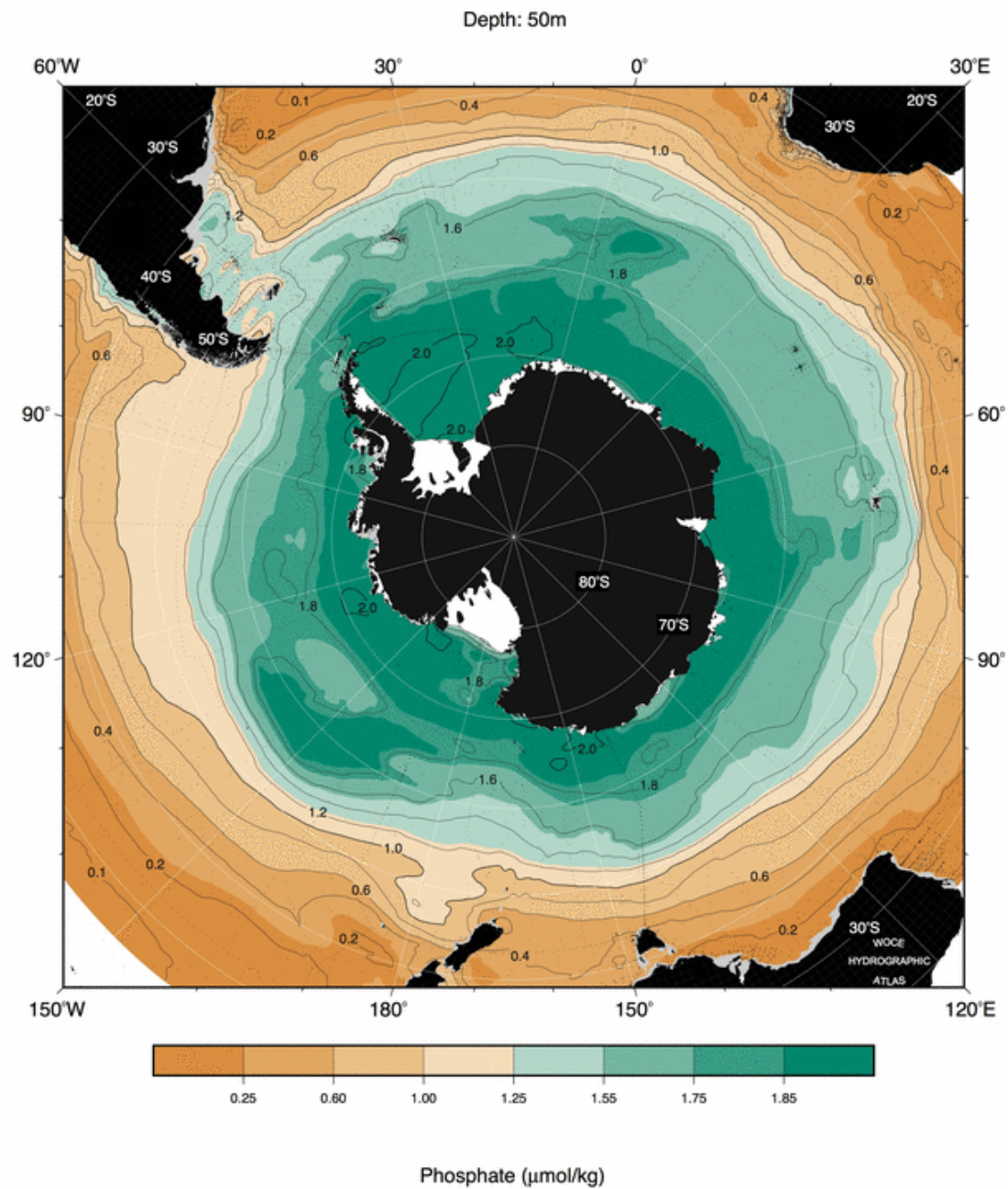


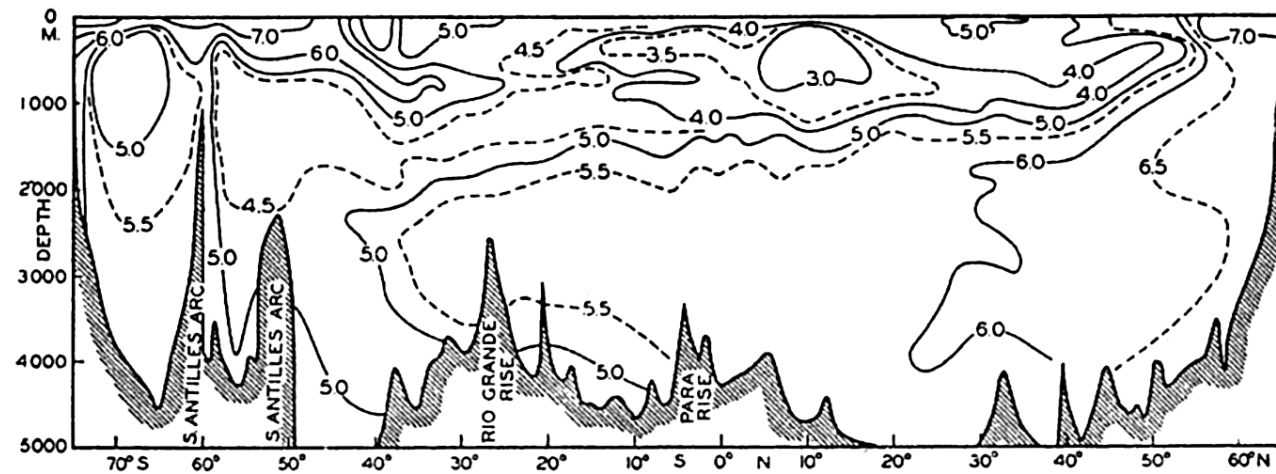
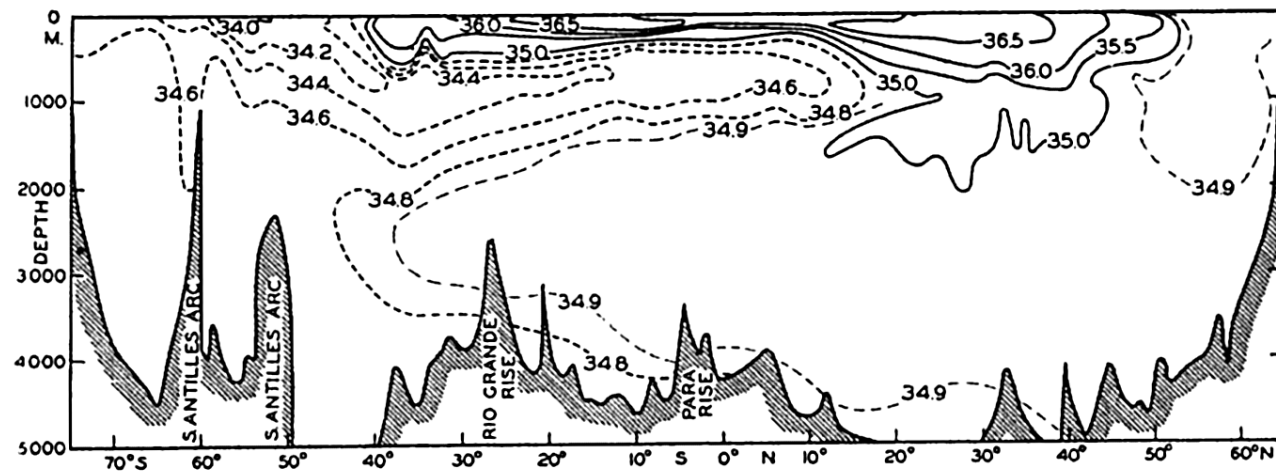
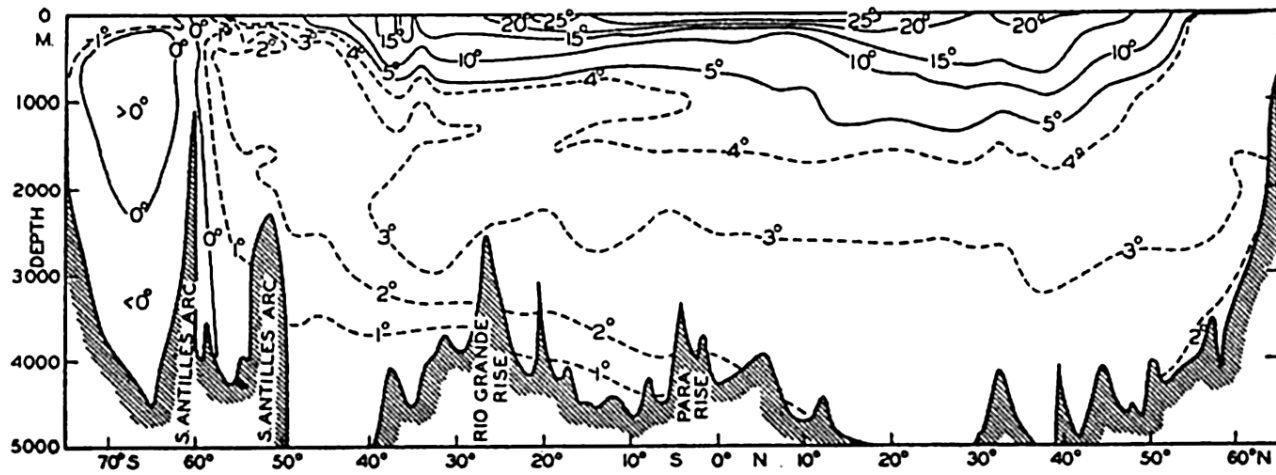
eWOCE

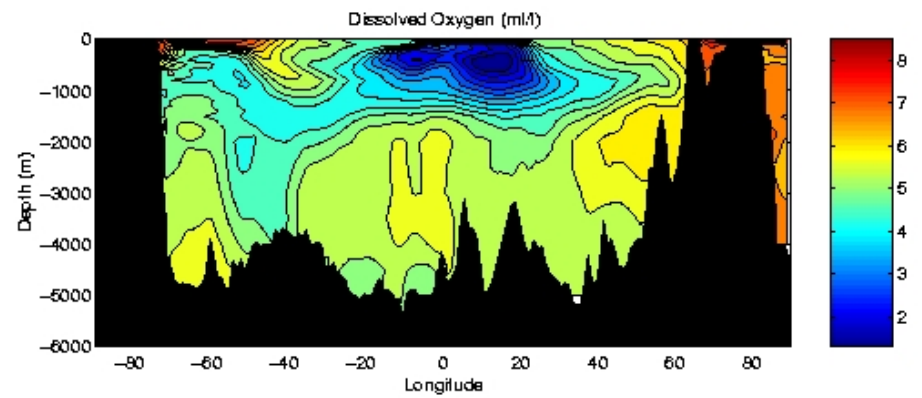
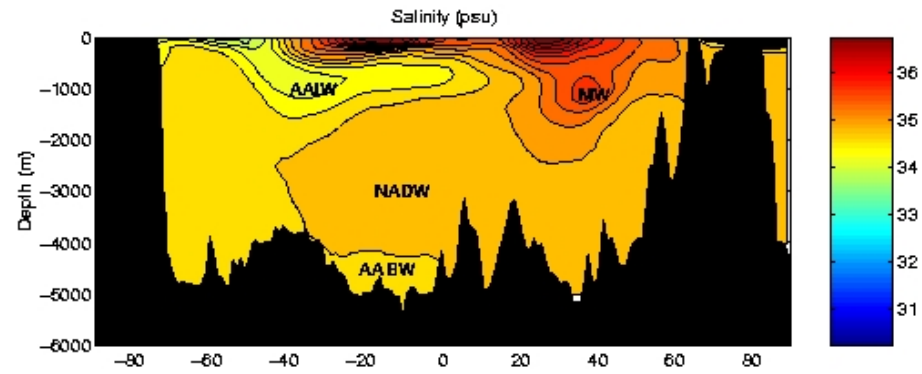
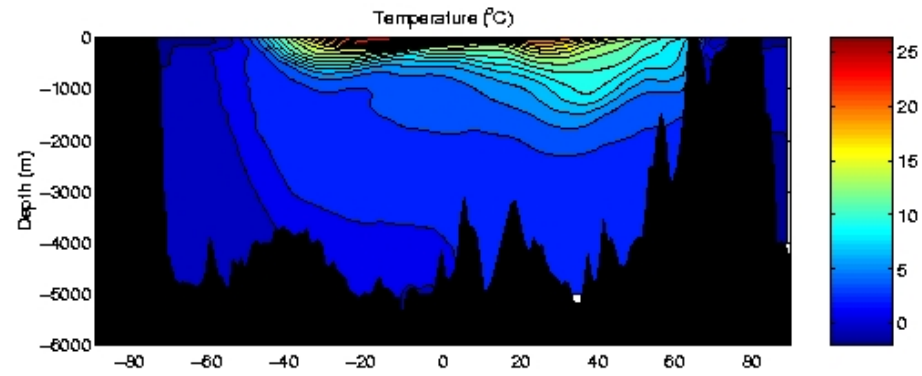




Nitrate ($\mu\text{mol/kg}$)







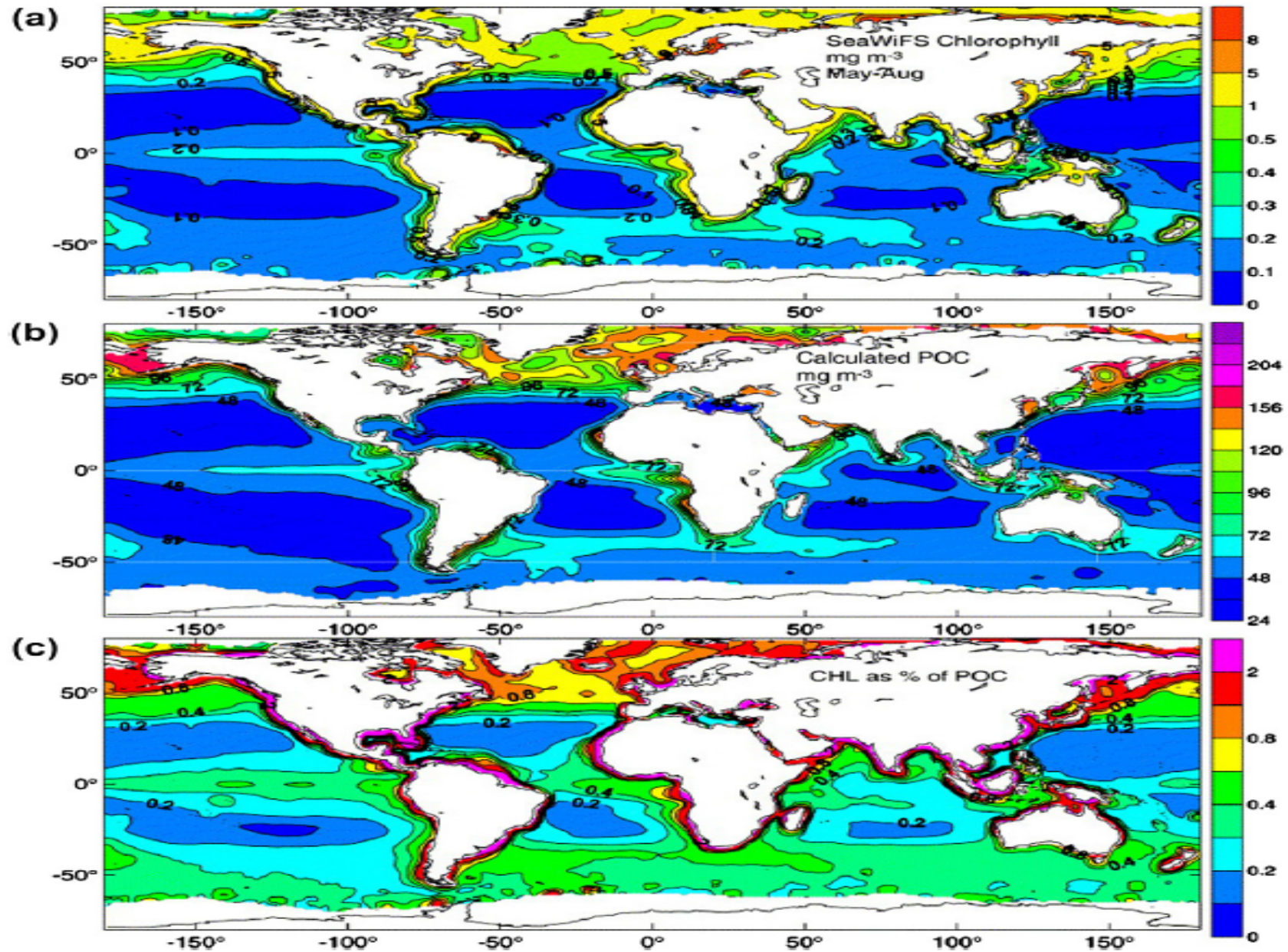
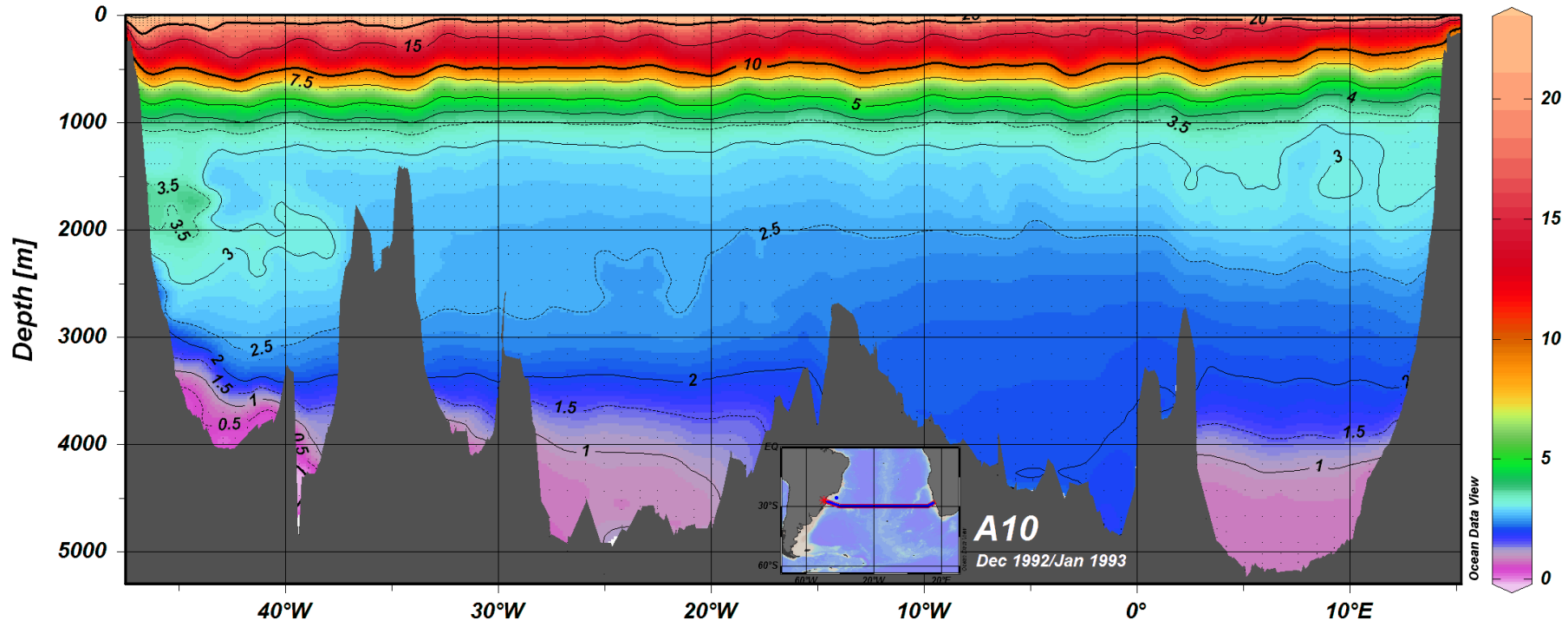


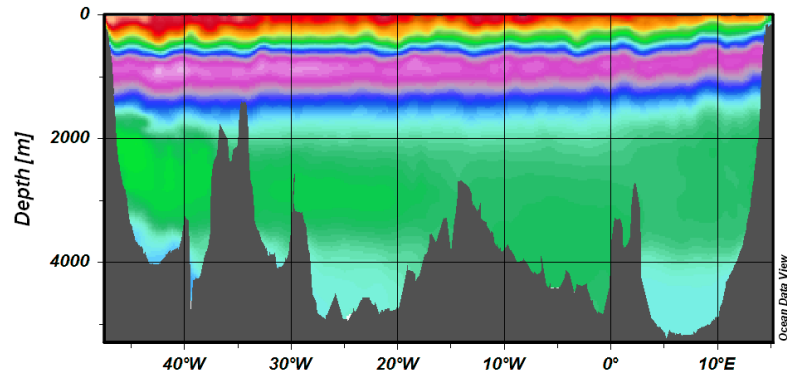
FIGURE S4.2 (a) Chlorophyll (mg m^{-3}), (b) particulate organic carbon (POC; mg m^{-3}), derived from SeaWiFS ocean color data, averaged May–August, 1997–2002, and (c) chlorophyll as % of POC. Source: From Gardner, Mishov, and Richardson, (2006).

eWOCE

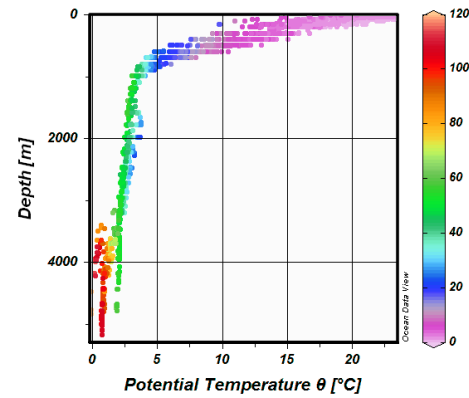
Potential Temperature θ [°C]



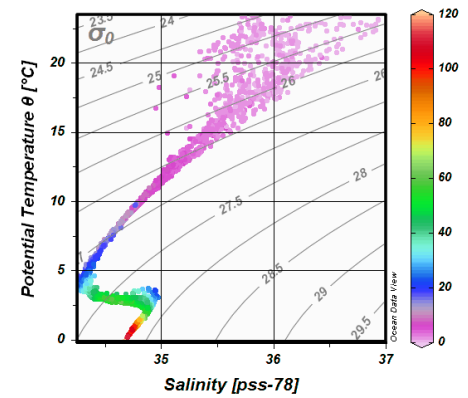
Salinity [pss-78]



Silicate [$\mu\text{mol/kg}$]

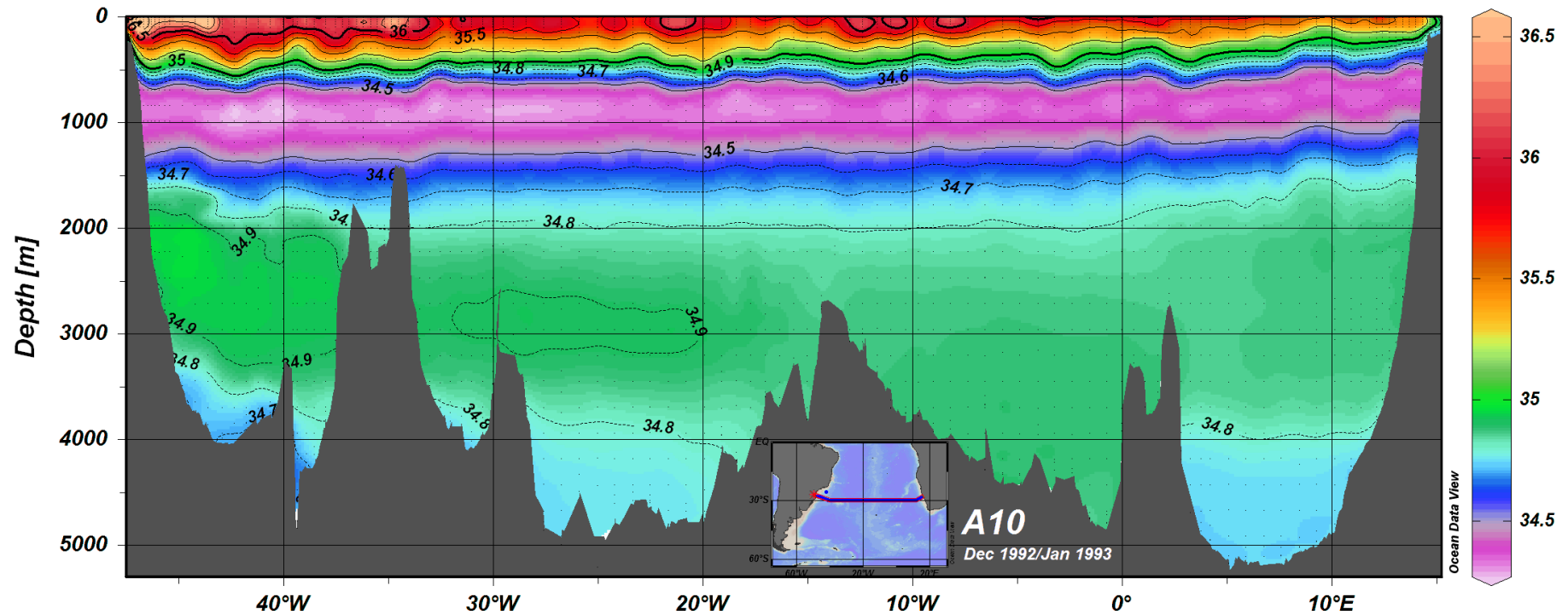


Silicate [$\mu\text{mol/kg}$]

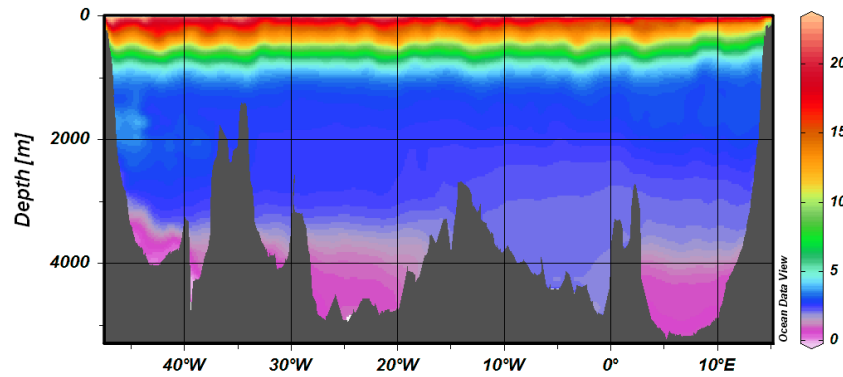


eWOCE

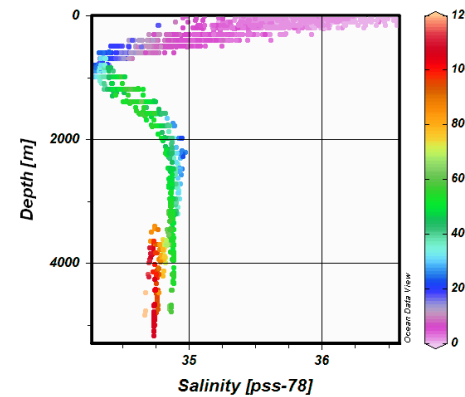
Salinity [pss-78]



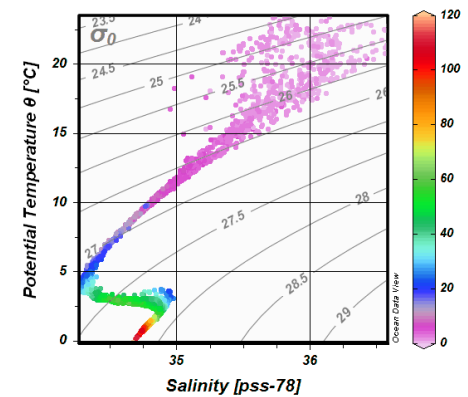
Potential Temperature θ [°C]



Silicate [$\mu\text{mol/kg}$]

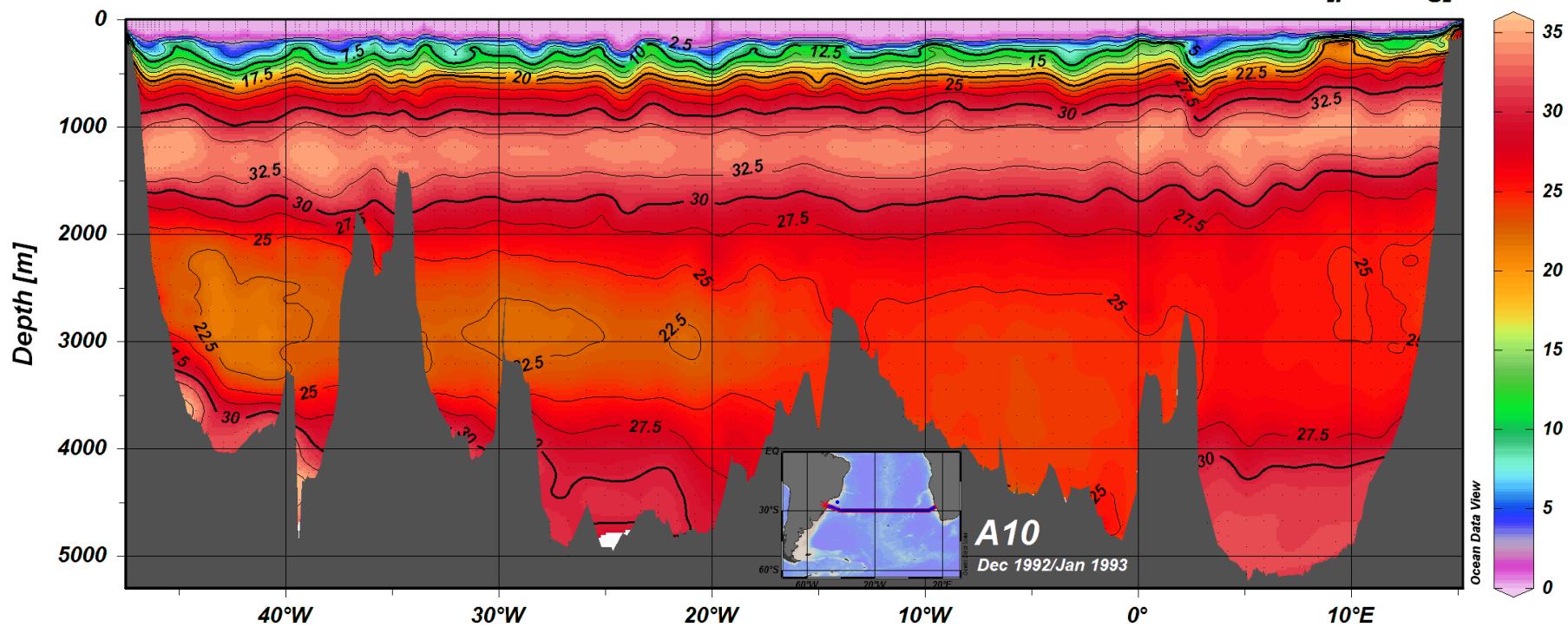


Silicate [$\mu\text{mol/kg}$]

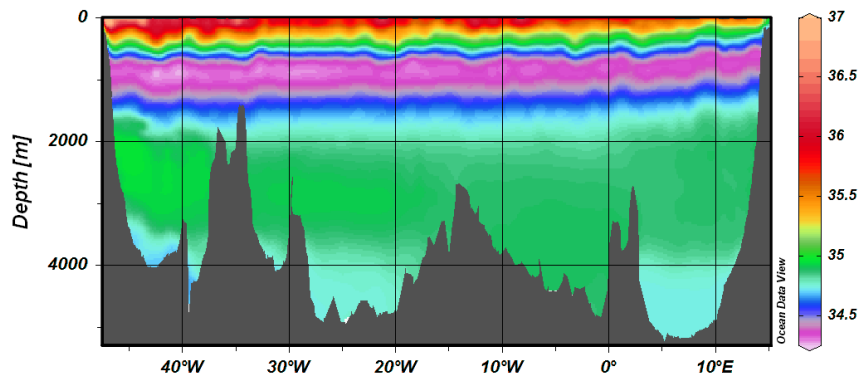


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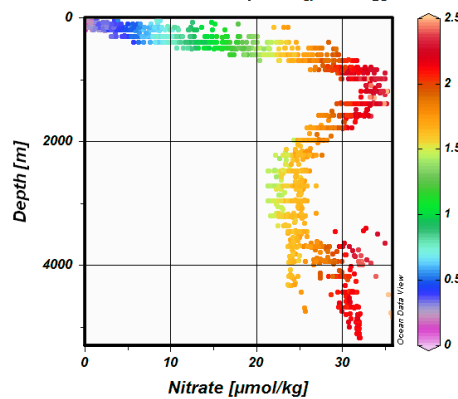
Nitrate [$\mu\text{mol/kg}$]



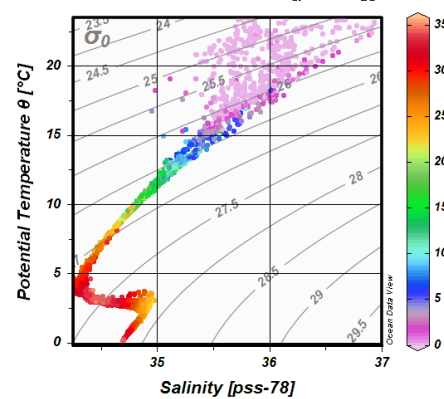
Salinity [pss-78]



Phosphate [$\mu\text{mol/kg}$]

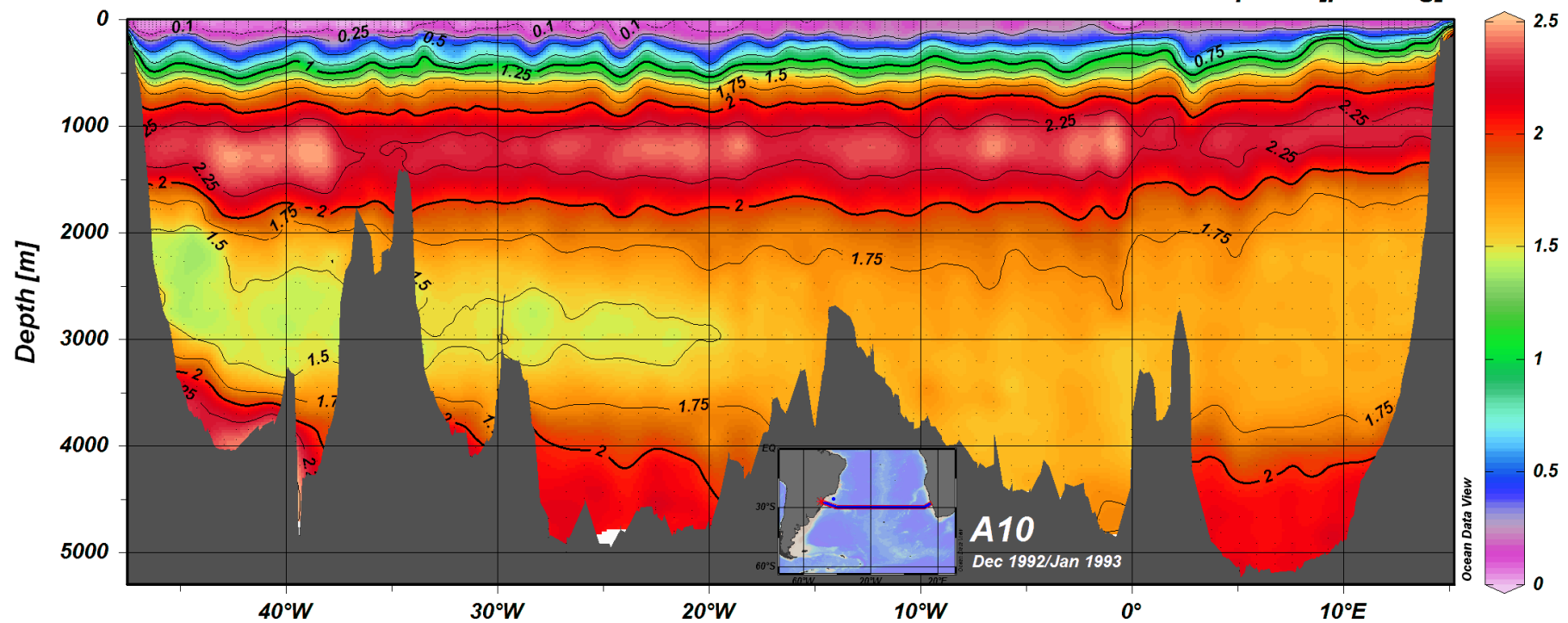


Nitrate [$\mu\text{mol/kg}$]

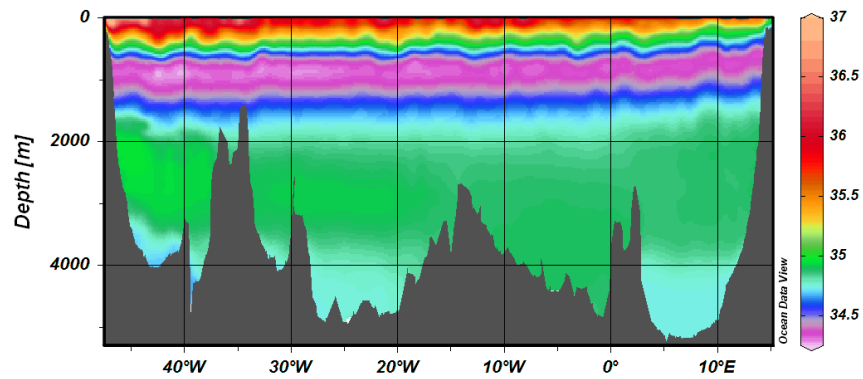


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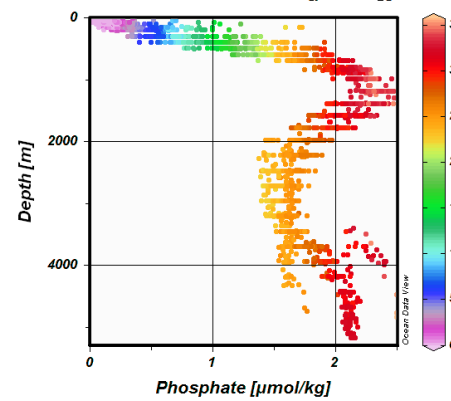
Phosphate [$\mu\text{mol/kg}$]



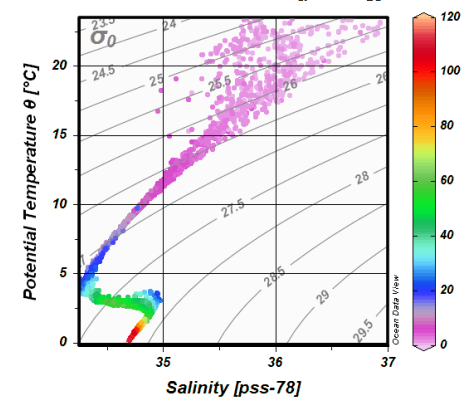
Salinity [pss-78]



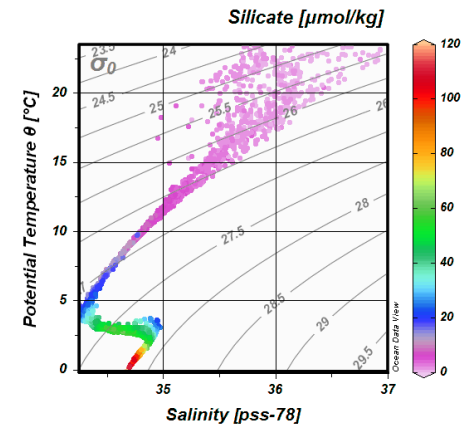
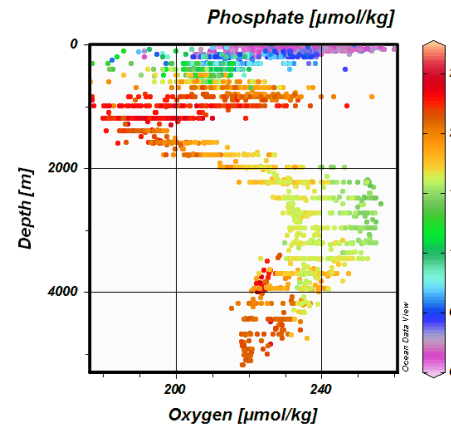
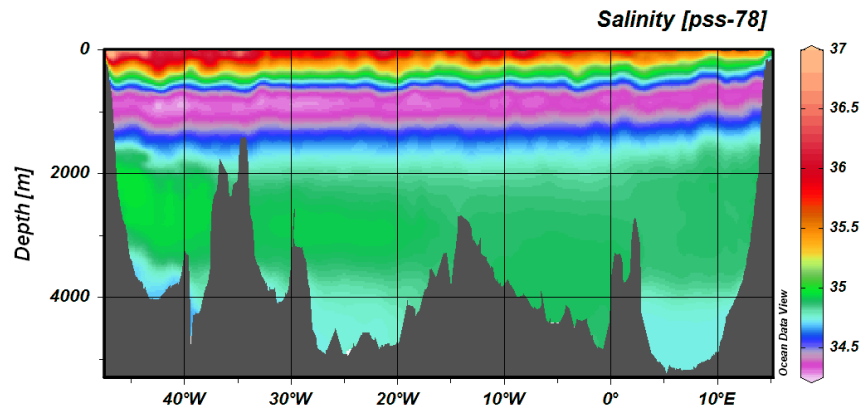
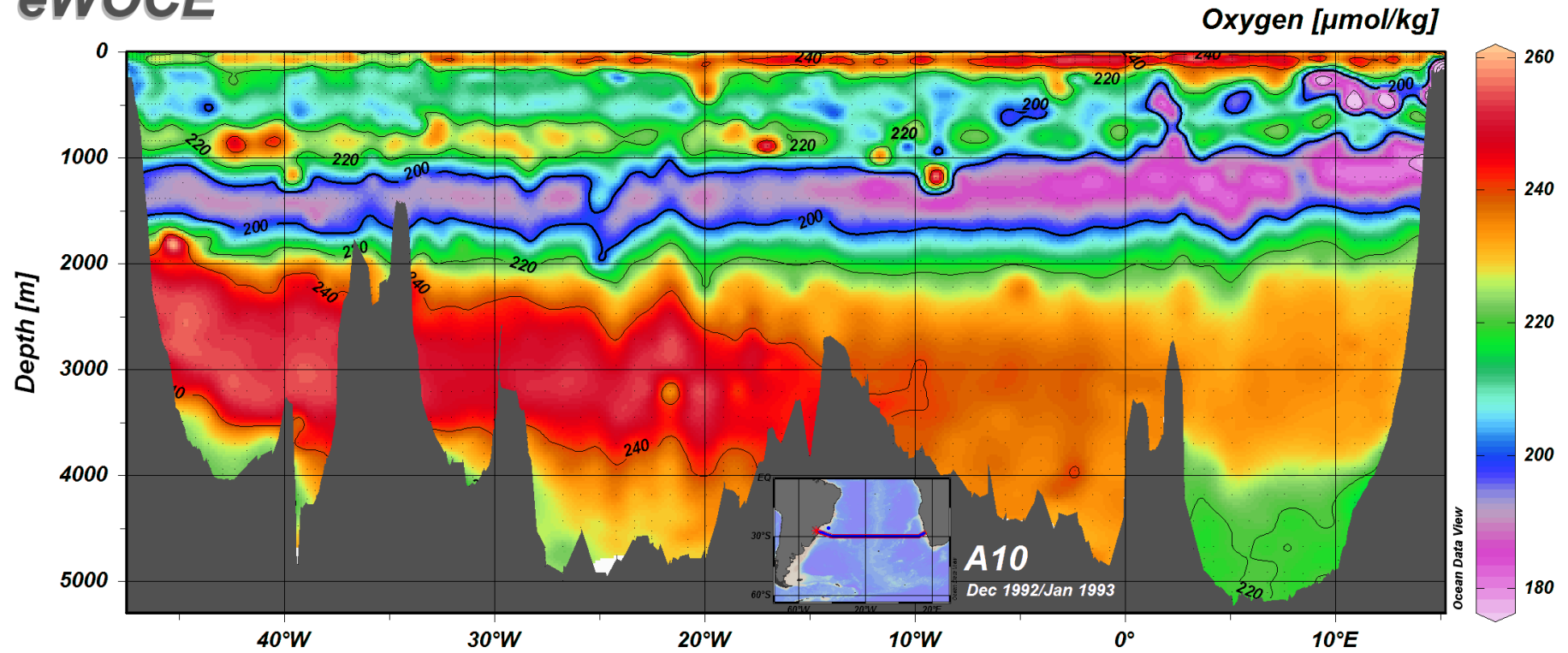
Nitrate [$\mu\text{mol/kg}$]



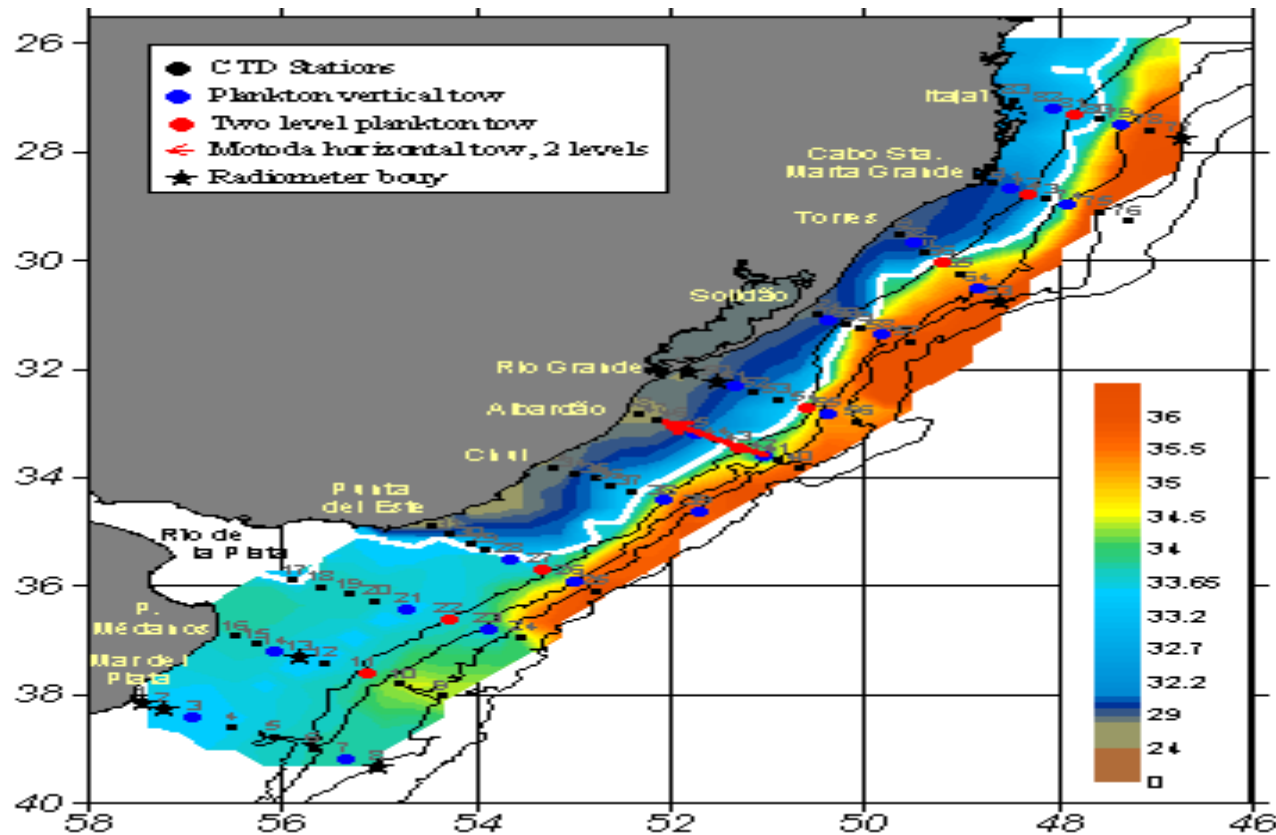
Silicate [$\mu\text{mol/kg}$]

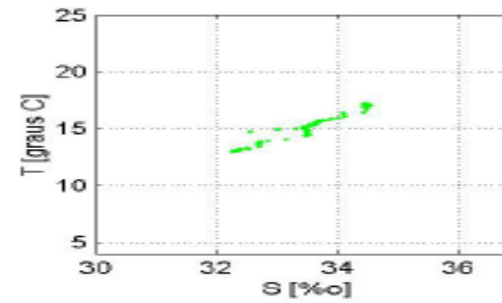
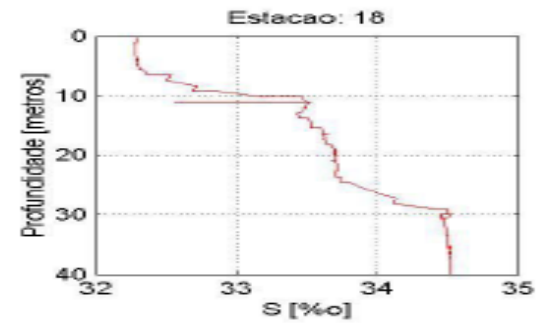
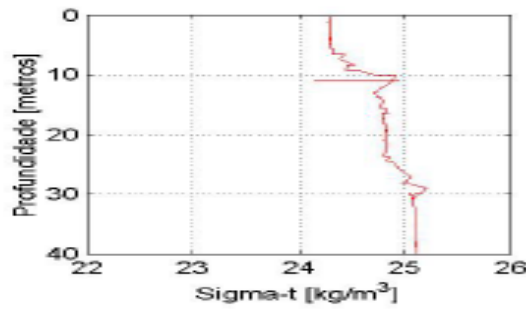
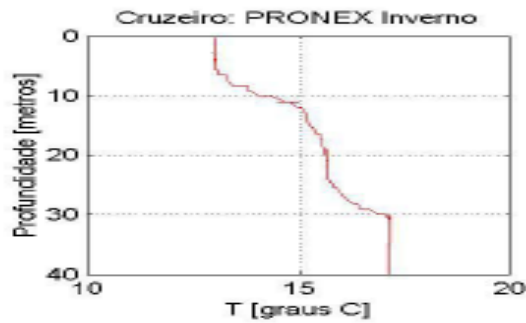
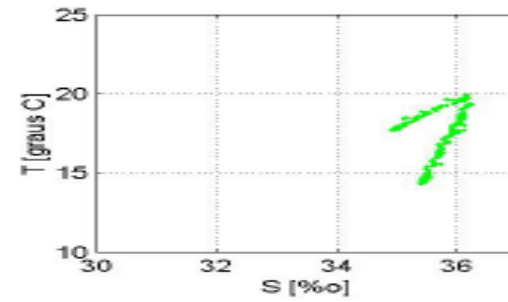
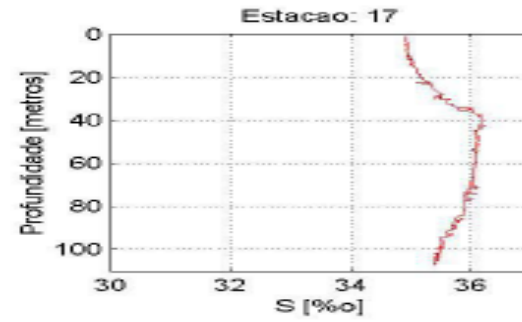
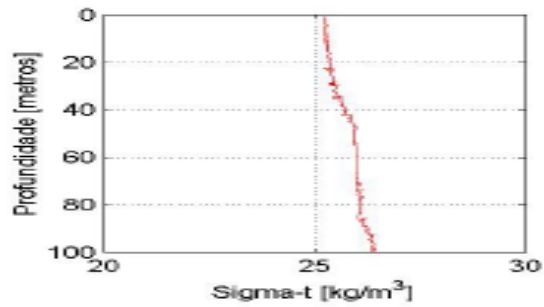
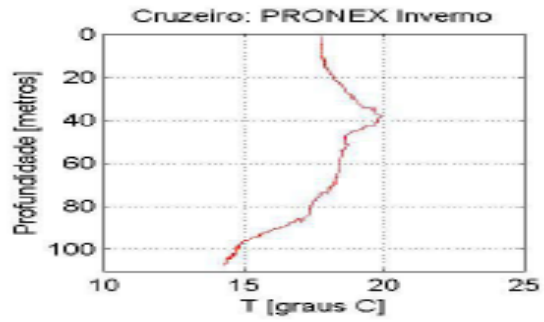


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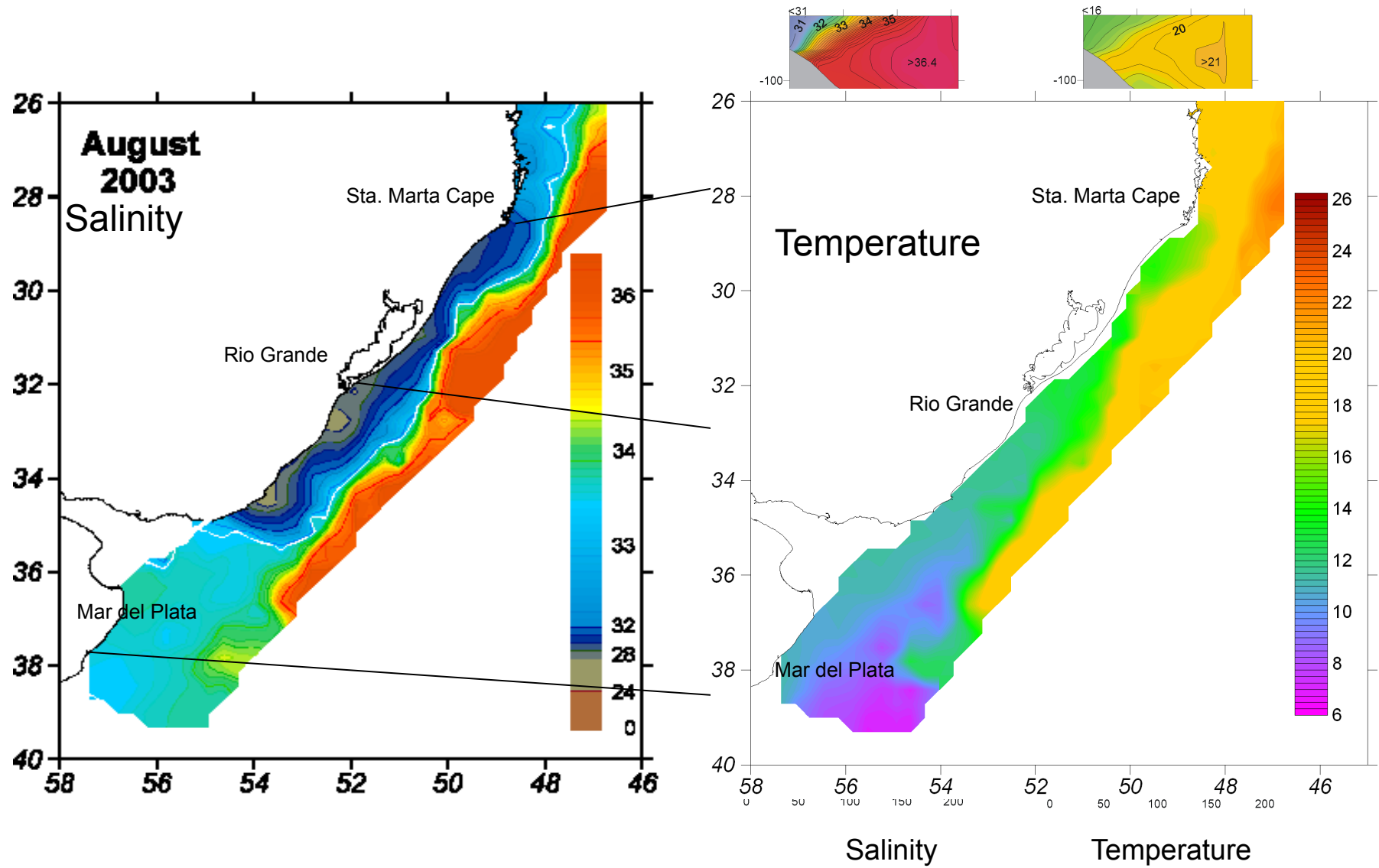


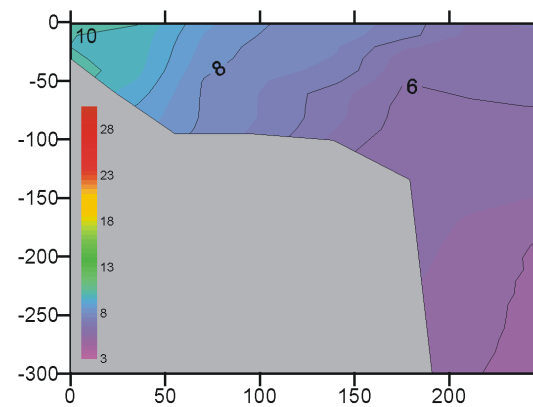
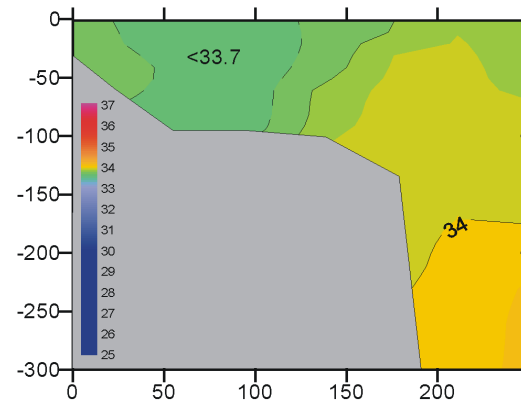
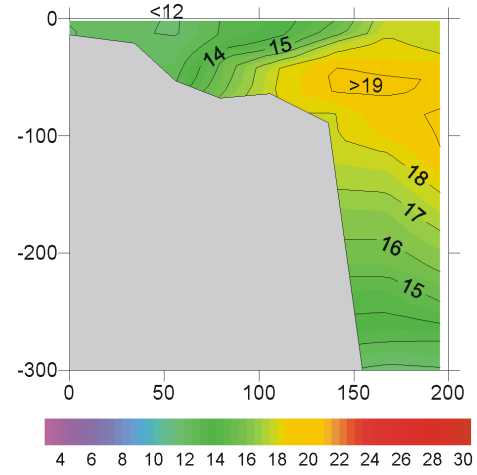
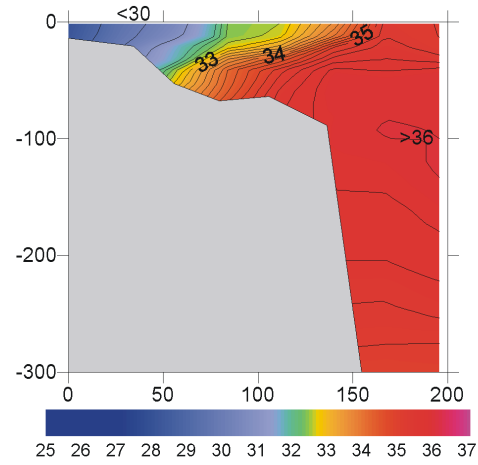
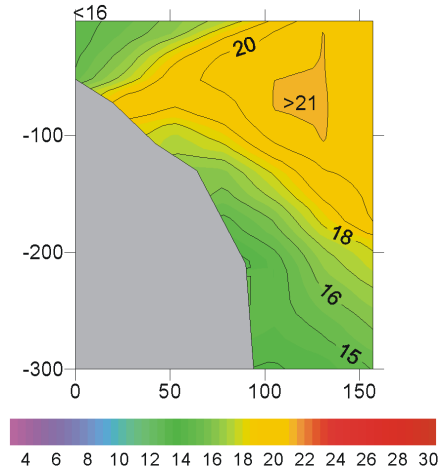
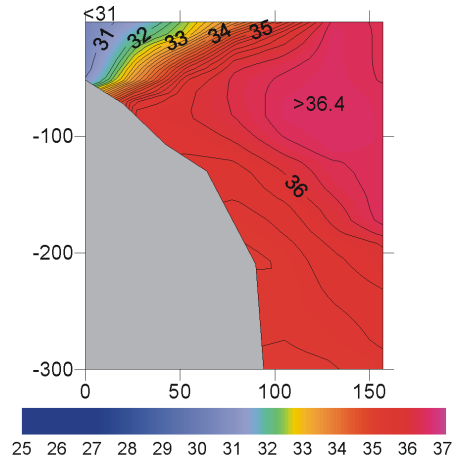
Regiões costeiras onde existe muita descarga fluvial ocorre geralmente uma camada de água superficial de baixa salinidade

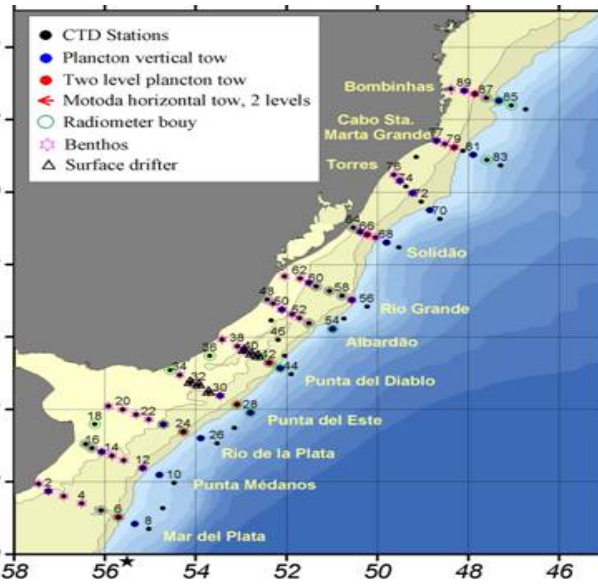
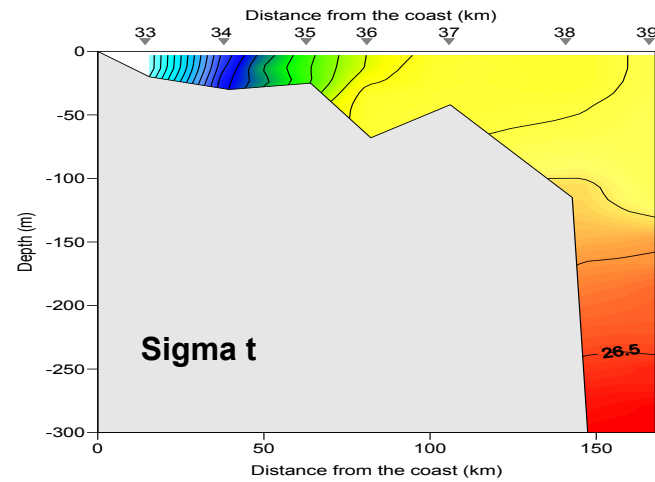
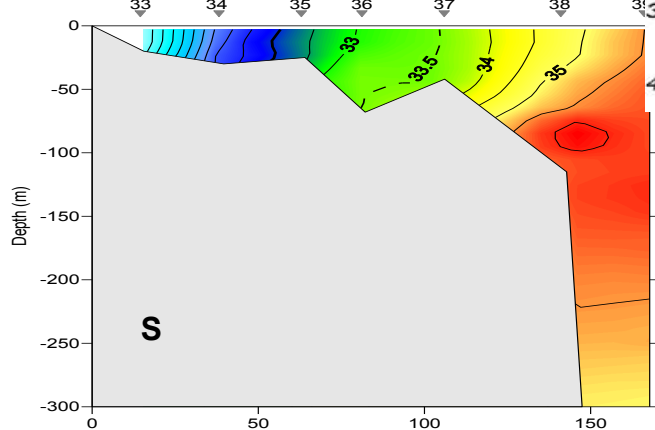
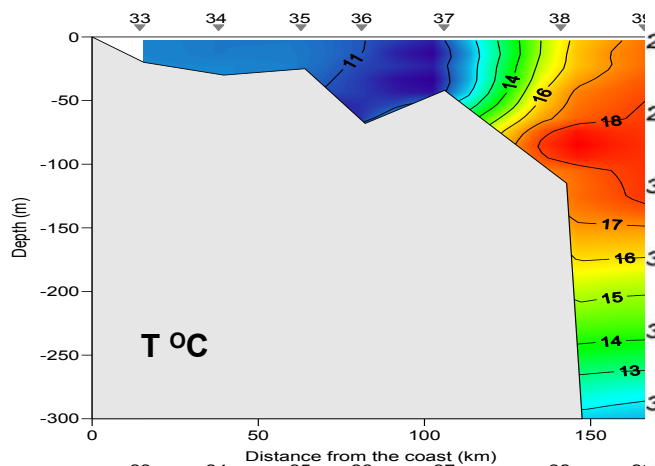




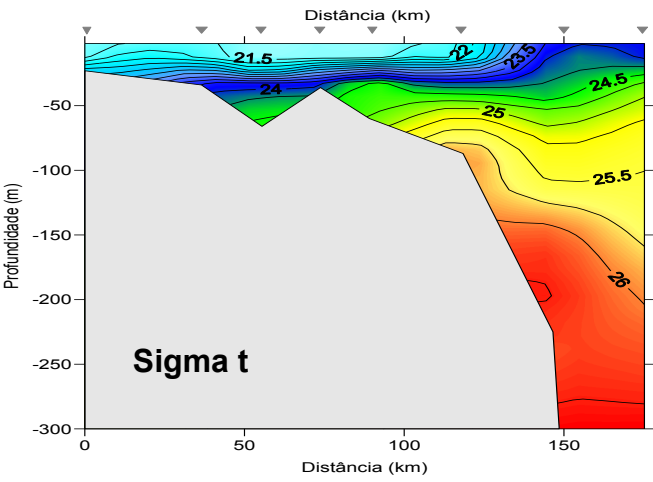
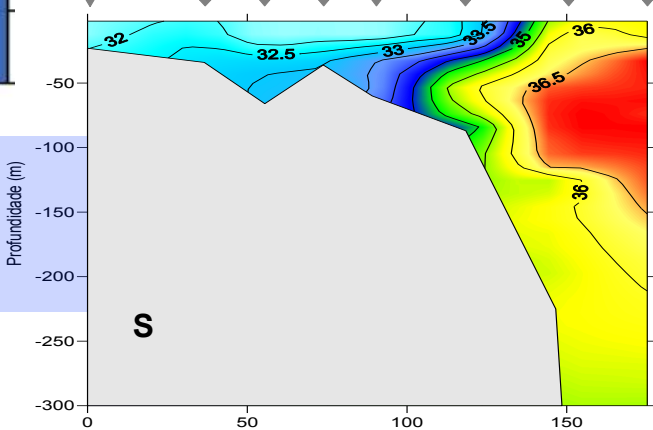
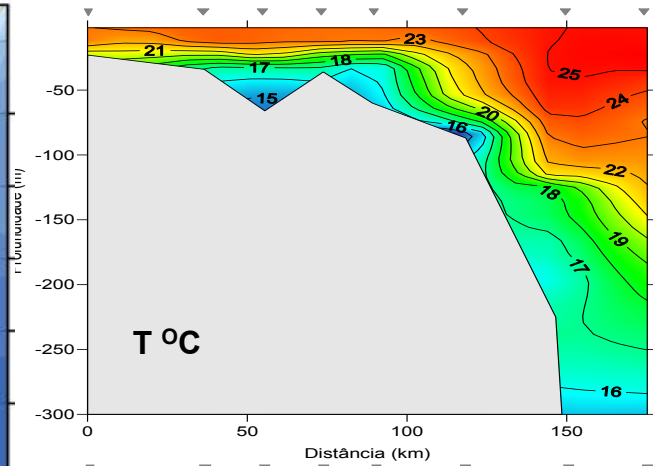
Winter Cruise Results







Punta del Diablo
Winter Summer



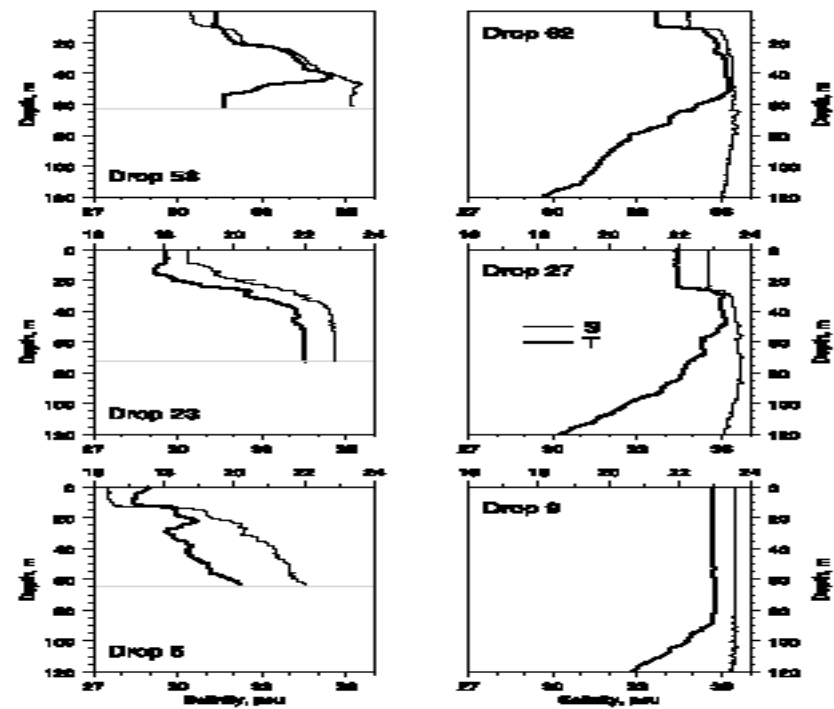


Figure 3. Typical vertical profiles of temperature (bold curves) and salinity (fine curves). The locations of the corresponding stations are shown in Figure 1. The grey horizontal lines in the left panels indicate the bottom.