02 INFORMATION ABOUT PRINCIPAL INVESTIGATORS/PROJECT DIRECTORS(PI/PD) and co-PRINCIPAL INVESTIGATORS/co-PROJECT DIRECTORS

Submit only ONE copy of this form **for each PI/PD and co-PI/PD** identified on the proposal. The form(s) should be attached to the original proposal as specified in GPG Section II.C.a. Submission of this information is voluntary and is not a precondition of award. This information will not be disclosed to external peer reviewers. ***DO NOT INCLUDE THIS FORM WITH ANY OF THE OTHER COPIES OF YOUR PROPOSAL AS THIS MAY COMPROMISE THE CONFIDENTIALITY OF THE INFORMATION.***

PI/PD Name: Marlos Goes

Gender: ☒ Male ☐ Female

Ethnicity: (Choose one response) ☒ Hispanic or Latino ☐ Not Hispanic or Latino

Race:
(Select one or more)

- ☐ American Indian or Alaska Native
- ☐ Asian
- ☐ Black or African American
- ☐ Native Hawaiian or Other Pacific Islander
- ☐ White

Disability Status:
(Select one or more)

- ☐ Hearing Impairment
- ☐ Visual Impairment
- ☐ Mobility/Orthopedic Impairment
- ☐ Other
- ☒ None

Citizenship: (Choose one) ☐ U.S. Citizen ☒ Permanent Resident ☐ Other non-U.S. Citizen

Check here if you do not wish to provide any or all of the above information (excluding PI/PD name): ☐

REQUIRED: Check here if you are currently serving (or have previously served) as a PI, co-PI or PD on any federally funded project ☐

Ethnicity Definition:
Hispanic or Latino. A person of Mexican, Puerto Rican, Cuban, South or Central American, or other Spanish culture or origin, regardless of race.
Race Definitions:
American Indian or Alaska Native. A person having origins in any of the original peoples of North and South America (including Central America), and who maintains tribal affiliation or community attachment.
Asian. A person having origins in any of the original peoples of the Far East, Southeast Asia, or the Indian subcontinent including, for example, Cambodia, China, India, Japan, Korea, Malaysia, Pakistan, the Philippine Islands, Thailand, and Vietnam.
Black or African American. A person having origins in any of the black racial groups of Africa.
Native Hawaiian or Other Pacific Islander. A person having origins in any of the original peoples of Hawaii, Guam, Samoa, or other Pacific Islands.
White. A person having origins in any of the original peoples of Europe, the Middle East, or North Africa.

WHY THIS INFORMATION IS BEING REQUESTED:

The Federal Government has a continuing commitment to monitor the operation of its review and award processes to identify and address any inequities based on gender, race, ethnicity, or disability of its proposed PIs/PDs. To gather information needed for this important task, the proposer should submit a single copy of this form for each identified PI/PD with each proposal. Submission of the requested information is voluntary and will not affect the organization's eligibility for an award. However, information not submitted will seriously undermine the statistical validity, and therefore the usefulness, of information recieved from others. Any individual not wishing to submit some or all the information should check the box provided for this purpose. (The exceptions are the PI/PD name and the information about prior Federal support, the last question above.)

Collection of this information is authorized by the NSF Act of 1950, as amended, 42 U.S.C. 1861, et seq. Demographic data allows NSF to gauge whether our programs and other opportunities in science and technology are fairly reaching and benefiting everyone regardless of demographic category; to ensure that those in under-represented groups have the same knowledge of and access to programs and other research and educational oppurtunities; and to assess involvement of international investigators in work supported by NSF. The information may be disclosed to government contractors, experts, volunteers and researchers to complete assigned work; and to other government agencies in order to coordinate and assess programs. The information may be added to the Reviewer file and used to select potential candidates to serve as peer reviewers or advisory committee members. See Systems of Records, NSF-50, "Principal Investigator/Proposal File and Associated Records", 63 Federal Register 267 (January 5, 1998), and NSF-51, "Reviewer/Proposal File and Associated Records", 63 Federal Register 268 (January 5, 1998).

02 INFORMATION ABOUT PRINCIPAL INVESTIGATORS/PROJECT DIRECTORS(PI/PD) and co-PRINCIPAL INVESTIGATORS/co-PROJECT DIRECTORS

Submit only ONE copy of this form **for each PI/PD and co-PI/PD** identified on the proposal. The form(s) should be attached to the original proposal as specified in GPG Section II.C.a. Submission of this information is voluntary and is not a precondition of award. This information will not be disclosed to external peer reviewers. ***DO NOT INCLUDE THIS FORM WITH ANY OF THE OTHER COPIES OF YOUR PROPOSAL AS THIS MAY COMPROMISE THE CONFIDENTIALITY OF THE INFORMATION.***

PI/PD Name: Shenfu Dong

Gender: ☐ Male ☒ Female

Ethnicity: (Choose one response) ☐ Hispanic or Latino ☒ Not Hispanic or Latino

Race:
(Select one or more)
- ☐ American Indian or Alaska Native
- ☒ Asian
- ☐ Black or African American
- ☐ Native Hawaiian or Other Pacific Islander
- ☐ White

Disability Status:
(Select one or more)
- ☐ Hearing Impairment
- ☐ Visual Impairment
- ☐ Mobility/Orthopedic Impairment
- ☐ Other
- ☐ None

Citizenship: (Choose one) ☐ U.S. Citizen ☒ Permanent Resident ☐ Other non-U.S. Citizen

Check here if you do not wish to provide any or all of the above information (excluding PI/PD name): ☒

REQUIRED: Check here if you are currently serving (or have previously served) as a PI, co-PI or PD on any federally funded project ☒

Ethnicity Definition:
Hispanic or Latino. A person of Mexican, Puerto Rican, Cuban, South or Central American, or other Spanish culture or origin, regardless of race.
Race Definitions:
American Indian or Alaska Native. A person having origins in any of the original peoples of North and South America (including Central America), and who maintains tribal affiliation or community attachment.
Asian. A person having origins in any of the original peoples of the Far East, Southeast Asia, or the Indian subcontinent including, for example, Cambodia, China, India, Japan, Korea, Malaysia, Pakistan, the Philippine Islands, Thailand, and Vietnam.
Black or African American. A person having origins in any of the black racial groups of Africa.
Native Hawaiian or Other Pacific Islander. A person having origins in any of the original peoples of Hawaii, Guam, Samoa, or other Pacific Islands.
White. A person having origins in any of the original peoples of Europe, the Middle East, or North Africa.

WHY THIS INFORMATION IS BEING REQUESTED:

The Federal Government has a continuing commitment to monitor the operation of its review and award processes to identify and address any inequities based on gender, race, ethnicity, or disability of its proposed PIs/PDs. To gather information needed for this important task, the proposer should submit a single copy of this form for each identified PI/PD with each proposal. Submission of the requested information is voluntary and will not affect the organization's eligibility for an award. However, information not submitted will seriously undermine the statistical validity, and therefore the usefulness, of information recieved from others. Any individual not wishing to submit some or all the information should check the box provided for this purpose. (The exceptions are the PI/PD name and the information about prior Federal support, the last question above.)

Collection of this information is authorized by the NSF Act of 1950, as amended, 42 U.S.C. 1861, et seq. Demographic data allows NSF to gauge whether our programs and other opportunities in science and technology are fairly reaching and benefiting everyone regardless of demographic category; to ensure that those in under-represented groups have the same knowledge of and access to programs and other research and educational oppurtunities; and to assess involvement of international investigators in work supported by NSF. The information may be disclosed to government contractors, experts, volunteers and researchers to complete assigned work; and to other government agencies in order to coordinate and assess programs. The information may be added to the Reviewer file and used to select potential candidates to serve as peer reviewers or advisory committee members. See Systems of Records, NSF-50, "Principal Investigator/Proposal File and Associated Records", 63 Federal Register 267 (January 5, 1998), and NSF-51, "Reviewer/Proposal File and Associated Records", 63 Federal Register 268 (January 5, 1998).

02 INFORMATION ABOUT PRINCIPAL INVESTIGATORS/PROJECT DIRECTORS(PI/PD) and co-PRINCIPAL INVESTIGATORS/co-PROJECT DIRECTORS

Submit only ONE copy of this form **for each PI/PD and co-PI/PD** identified on the proposal. The form(s) should be attached to the original proposal as specified in GPG Section II.C.a. Submission of this information is voluntary and is not a precondition of award. This information will not be disclosed to external peer reviewers. ***DO NOT INCLUDE THIS FORM WITH ANY OF THE OTHER COPIES OF YOUR PROPOSAL AS THIS MAY COMPROMISE THE CONFIDENTIALITY OF THE INFORMATION.***

PI/PD Name: Sang-Ki Lee

Gender: ☒ Male ☐ Female

Ethnicity: (Choose one response) ☐ Hispanic or Latino ☒ Not Hispanic or Latino

Race:
(Select one or more)

- ☐ American Indian or Alaska Native
- ☒ Asian
- ☐ Black or African American
- ☐ Native Hawaiian or Other Pacific Islander
- ☐ White

Disability Status:
(Select one or more)

- ☐ Hearing Impairment
- ☐ Visual Impairment
- ☐ Mobility/Orthopedic Impairment
- ☐ Other
- ☐ None

Citizenship: (Choose one) ☐ U.S. Citizen ☒ Permanent Resident ☐ Other non-U.S. Citizen

Check here if you do not wish to provide any or all of the above information (excluding PI/PD name): ☒

REQUIRED: Check here if you are currently serving (or have previously served) as a PI, co-PI or PD on any federally funded project ☒

Ethnicity Definition:
Hispanic or Latino. A person of Mexican, Puerto Rican, Cuban, South or Central American, or other Spanish culture or origin, regardless of race.
Race Definitions:
American Indian or Alaska Native. A person having origins in any of the original peoples of North and South America (including Central America), and who maintains tribal affiliation or community attachment.
Asian. A person having origins in any of the original peoples of the Far East, Southeast Asia, or the Indian subcontinent including, for example, Cambodia, China, India, Japan, Korea, Malaysia, Pakistan, the Philippine Islands, Thailand, and Vietnam.
Black or African American. A person having origins in any of the black racial groups of Africa.
Native Hawaiian or Other Pacific Islander. A person having origins in any of the original peoples of Hawaii, Guam, Samoa, or other Pacific Islands.
White. A person having origins in any of the original peoples of Europe, the Middle East, or North Africa.

WHY THIS INFORMATION IS BEING REQUESTED:

The Federal Government has a continuing commitment to monitor the operation of its review and award processes to identify and address any inequities based on gender, race, ethnicity, or disability of its proposed PIs/PDs. To gather information needed for this important task, the proposer should submit a single copy of this form for each identified PI/PD with each proposal. Submission of the requested information is voluntary and will not affect the organization's eligibility for an award. However, information not submitted will seriously undermine the statistical validity, and therefore the usefulness, of information recieved from others. Any individual not wishing to submit some or all the information should check the box provided for this purpose. (The exceptions are the PI/PD name and the information about prior Federal support, the last question above.)

Collection of this information is authorized by the NSF Act of 1950, as amended, 42 U.S.C. 1861, et seq. Demographic data allows NSF to gauge whether our programs and other opportunities in science and technology are fairly reaching and benefiting everyone regardless of demographic category; to ensure that those in under-represented groups have the same knowledge of and access to programs and other research and educational oppurtunities; and to assess involvement of international investigators in work supported by NSF. The information may be disclosed to government contractors, experts, volunteers and researchers to complete assigned work; and to other government agencies in order to coordinate and assess programs. The information may be added to the Reviewer file and used to select potential candidates to serve as peer reviewers or advisory committee members. See Systems of Records, NSF-50, "Principal Investigator/Proposal File and Associated Records", 63 Federal Register 267 (January 5, 1998), and NSF-51, "Reviewer/Proposal File and Associated Records", 63 Federal Register 268 (January 5, 1998).

02 INFORMATION ABOUT PRINCIPAL INVESTIGATORS/PROJECT DIRECTORS(PI/PD) and co-PRINCIPAL INVESTIGATORS/co-PROJECT DIRECTORS

Submit only ONE copy of this form **for each PI/PD and co-PI/PD** identified on the proposal. The form(s) should be attached to the original proposal as specified in GPG Section II.C.a. Submission of this information is voluntary and is not a precondition of award. This information will not be disclosed to external peer reviewers. ***DO NOT INCLUDE THIS FORM WITH ANY OF THE OTHER COPIES OF YOUR PROPOSAL AS THIS MAY COMPROMISE THE CONFIDENTIALITY OF THE INFORMATION.***

PI/PD Name: Yanyun Liu

Gender: ☐ Male ☐ Female

Ethnicity: (Choose one response) ☐ Hispanic or Latino ☐ Not Hispanic or Latino

Race:
(Select one or more)
- ☐ American Indian or Alaska Native
- ☒ Asian
- ☐ Black or African American
- ☐ Native Hawaiian or Other Pacific Islander
- ☐ White

Disability Status:
(Select one or more)
- ☐ Hearing Impairment
- ☐ Visual Impairment
- ☐ Mobility/Orthopedic Impairment
- ☐ Other
- ☒ None

Citizenship: (Choose one) ☐ U.S. Citizen ☐ Permanent Resident ☐ Other non-U.S. Citizen

Check here if you do not wish to provide any or all of the above information (excluding PI/PD name): ☒

REQUIRED: Check here if you are currently serving (or have previously served) as a PI, co-PI or PD on any federally funded project ☐

Ethnicity Definition:
Hispanic or Latino. A person of Mexican, Puerto Rican, Cuban, South or Central American, or other Spanish culture or origin, regardless of race.
Race Definitions:
American Indian or Alaska Native. A person having origins in any of the original peoples of North and South America (including Central America), and who maintains tribal affiliation or community attachment.
Asian. A person having origins in any of the original peoples of the Far East, Southeast Asia, or the Indian subcontinent including, for example, Cambodia, China, India, Japan, Korea, Malaysia, Pakistan, the Philippine Islands, Thailand, and Vietnam.
Black or African American. A person having origins in any of the black racial groups of Africa.
Native Hawaiian or Other Pacific Islander. A person having origins in any of the original peoples of Hawaii, Guam, Samoa, or other Pacific Islands.
White. A person having origins in any of the original peoples of Europe, the Middle East, or North Africa.

WHY THIS INFORMATION IS BEING REQUESTED:

The Federal Government has a continuing commitment to monitor the operation of its review and award processes to identify and address any inequities based on gender, race, ethnicity, or disability of its proposed PIs/PDs. To gather information needed for this important task, the proposer should submit a single copy of this form for each identified PI/PD with each proposal. Submission of the requested information is voluntary and will not affect the organization's eligibility for an award. However, information not submitted will seriously undermine the statistical validity, and therefore the usefulness, of information recieved from others. Any individual not wishing to submit some or all the information should check the box provided for this purpose. (The exceptions are the PI/PD name and the information about prior Federal support, the last question above.)

Collection of this information is authorized by the NSF Act of 1950, as amended, 42 U.S.C. 1861, et seq. Demographic data allows NSF to gauge whether our programs and other opportunities in science and technology are fairly reaching and benefiting everyone regardless of demographic category; to ensure that those in under-represented groups have the same knowledge of and access to programs and other research and educational oppurtunities; and to assess involvement of international investigators in work supported by NSF. The information may be disclosed to government contractors, experts, volunteers and researchers to complete assigned work; and to other government agencies in order to coordinate and assess programs. The information may be added to the Reviewer file and used to select potential candidates to serve as peer reviewers or advisory committee members. See Systems of Records, NSF-50, "Principal Investigator/Proposal File and Associated Records", 63 Federal Register 267 (January 5, 1998), and NSF-51, "Reviewer/Proposal File and Associated Records", 63 Federal Register 268 (January 5, 1998).

List of Suggested Reviewers or Reviewers Not To Include (optional)

SUGGESTED REVIEWERS:
Not Listed

REVIEWERS NOT TO INCLUDE:
Not Listed

COVER SHEET FOR PROPOSAL TO THE NATIONAL SCIENCE FOUNDATION

PROGRAM ANNOUNCEMENT/SOLICITATION NO./CLOSING DATE/if not in response to a program announcement/solicitation enter NSF 15-1 **NSF 15-1** **02/15/15**	FOR NSF USE ONLY NSF PROPOSAL NUMBER **1537769**
FOR CONSIDERATION BY NSF ORGANIZATION UNIT(S) (Indicate the most specific unit known, i.e. program, division, etc.) **OCE - PHYSICAL OCEANOGRAPHY**	

DATE RECEIVED	NUMBER OF COPIES	DIVISION ASSIGNED	FUND CODE	DUNS# (Data Universal Numbering System)	FILE LOCATION
02/17/2015	2	06040000 OCE	1610	152764007	02/17/2015 2:18pm

EMPLOYER IDENTIFICATION NUMBER (EIN) OR TAXPAYER IDENTIFICATION NUMBER (TIN)	SHOW PREVIOUS AWARD NO. IF THIS IS	IS THIS PROPOSAL BEING SUBMITTED TO ANOTHER FEDERAL AGENCY?
590624458	☐ A RENEWAL ☐ AN ACCOMPLISHMENT-BASED RENEWAL	YES ☐ NO ☒ IF YES, LIST ACRONYM(S)

NAME OF ORGANIZATION TO WHICH AWARD SHOULD BE MADE **University of Miami Rosenstiel School of Marine&Atmospheric Sci**	ADDRESS OF AWARDEE ORGANIZATION, INCLUDING 9 DIGIT ZIP CODE **4600 RICKENBACKER CSWY** **KEY BISCAYNE, FL 33149-1031**
AWARDEE ORGANIZATION CODE (IF KNOWN) **0015362010**	
NAME OF PRIMARY PLACE OF PERF **University of Miami, RSMAS**	ADDRESS OF PRIMARY PLACE OF PERF, INCLUDING 9 DIGIT ZIP CODE **University of Miami, RSMAS** **4600 Rickenbacker Causeway** **Key Biscayne ,FL ,331491031 ,US.**

IS AWARDEE ORGANIZATION (Check All That Apply) (See GPG II.C For Definitions)
☐ SMALL BUSINESS ☐ MINORITY BUSINESS ☐ IF THIS IS A PRELIMINARY PROPOSAL THEN CHECK HERE
☐ FOR-PROFIT ORGANIZATION ☐ WOMAN-OWNED BUSINESS

TITLE OF PROPOSED PROJECT **The Interannual Variability of the Brazil Current**

REQUESTED AMOUNT	PROPOSED DURATION (1-60 MONTHS)	REQUESTED STARTING DATE	SHOW RELATED PRELIMINARY PROPOSAL NO. IF APPLICABLE
$ 488,321	36 months	09/01/15	

THIS PROPOSAL INCLUDES ANY OF THE ITEMS LISTED BELOW
- ☐ BEGINNING INVESTIGATOR (GPG I.G.2)
- ☐ DISCLOSURE OF LOBBYING ACTIVITIES (GPG II.C.1.e)
- ☐ PROPRIETARY & PRIVILEGED INFORMATION (GPG I.D, II.C.1.d)
- ☐ HISTORIC PLACES (GPG II.C.2.j)
- ☐ VERTEBRATE ANIMALS (GPG II.D.6) IACUC App. Date ________ PHS Animal Welfare Assurance Number ________
- ☒ FUNDING MECHANISM **Research - other than RAPID or EAGER**
- ☐ HUMAN SUBJECTS (GPG II.D.7) Human Subjects Assurance Number ________ Exemption Subsection ________ or IRB App. Date ________
- ☐ INTERNATIONAL ACTIVITIES: COUNTRY/COUNTRIES INVOLVED (GPG II.C.2.j)
- ☒ COLLABORATIVE STATUS **Not a collaborative proposal**

PI/PD DEPARTMENT **CIMAS**	PI/PD POSTAL ADDRESS **4600 RICKENBACKER CSWY** **KEY BISCAYNE, FL 331491031** **United States**
PI/PD FAX NUMBER **305-361-4457**	

NAMES (TYPED)	High Degree	Yr of Degree	Telephone Number	Email Address
PI/PD NAME Marlos Goes	PhD	2006	305-361-4533	m.goes@miami.edu
CO-PI/PD Shenfu Dong	PhD	2004	305-421-4372	sdong@rsmas.miami.edu
CO-PI/PD Sang-Ki Lee	PhD	1995	305-361-4521	s.lee1@miami.edu
CO-PI/PD Yanyun Liu	PhD	2010	305-421-4089	y.liu5@miami.edu
CO-PI/PD				

CERTIFICATION PAGE

Certification for Authorized Organizational Representative (or Equivalent) or Individual Applicant

By electronically signing and submitting this proposal, the Authorized Organizational Representative (AOR) or Individual Applicant is: (1) certifying that statements made herein are true and complete to the best of his/her knowledge; and (2) agreeing to accept the obligation to comply with NSF award terms and conditions if an award is made as a result of this application. Further, the applicant is hereby providing certifications regarding conflict of interest (when applicable), drug-free workplace, debarment and suspension, lobbying activities (see below), nondiscrimination, flood hazard insurance (when applicable), responsible conduct of research, organizational support, Federal tax obligations, unpaid Federal tax liability, and criminal convictions as set forth in the NSF Proposal & Award Policies & Procedures Guide,Part I: the Grant Proposal Guide (GPG). Willful provision of false information in this application and its supporting documents or in reports required under an ensuing award is a criminal offense (U.S. Code, Title 18, Section 1001).

Certification Regarding Conflict of Interest

The AOR is required to complete certifications stating that the organization has implemented and is enforcing a written policy on conflicts of interest (COI), consistent with the provisions of AAG Chapter IV.A.; that, to the best of his/her knowledge, all financial disclosures required by the conflict of interest policy were made; and that conflicts of interest, if any, were, or prior to the organization's expenditure of any funds under the award, will be, satisfactorily managed, reduced or eliminated in accordance with the organization's conflict of interest policy. Conflicts that cannot be satisfactorily managed, reduced or eliminated and research that proceeds without the imposition of conditions or restrictions when a conflict of interest exists, must be disclosed to NSF via use of the Notifications and Requests Module in FastLane.

Drug Free Work Place Certification

By electronically signing the Certification Pages, the Authorized Organizational Representative (or equivalent), is providing the Drug Free Work Place Certification contained in Exhibit II-3 of the Grant Proposal Guide.

Debarment and Suspension Certification

(If answer "yes", please provide explanation.)

Is the organization or its principals presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency? Yes ☐ No ☒

By electronically signing the Certification Pages, the Authorized Organizational Representative (or equivalent) or Individual Applicant is providing the Debarment and Suspension Certification contained in Exhibit II-4 of the Grant Proposal Guide.

Certification Regarding Lobbying

This certification is required for an award of a Federal contract, grant, or cooperative agreement exceeding $100,000 and for an award of a Federal loan or a commitment providing for the United States to insure or guarantee a loan exceeding $150,000.

Certification for Contracts, Grants, Loans and Cooperative Agreements

The undersigned certifies, to the best of his or her knowledge and belief, that:

(1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, ''Disclosure of Lobbying Activities,'' in accordance with its instructions.

(3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, Title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

Certification Regarding Nondiscrimination

By electronically signing the Certification Pages, the Authorized Organizational Representative (or equivalent) is providing the Certification Regarding Nondiscrimination contained in Exhibit II-6 of the Grant Proposal Guide.

Certification Regarding Flood Hazard Insurance

Two sections of the National Flood Insurance Act of 1968 (42 USC §4012a and §4106) bar Federal agencies from giving financial assistance for acquisition or construction purposes in any area identified by the Federal Emergency Management Agency (FEMA) as having special flood hazards unless the:

(1) community in which that area is located participates in the national flood insurance program; and
(2) building (and any related equipment) is covered by adequate flood insurance.

By electronically signing the Certification Pages, the Authorized Organizational Representative (or equivalent) or Individual Applicant located in FEMA-designated special flood hazard areas is certifying that adequate flood insurance has been or will be obtained in the following situations:

(1) for NSF grants for the construction of a building or facility, regardless of the dollar amount of the grant; and
(2) for other NSF grants when more than $25,000 has been budgeted in the proposal for repair, alteration or improvement (construction) of a building or facility.

Certification Regarding Responsible Conduct of Research (RCR)
(This certification is not applicable to proposals for conferences, symposia, and workshops.)

By electronically signing the Certification Pages, the Authorized Organizational Representative is certifying that, in accordance with the NSF Proposal & Award Policies & Procedures Guide, Part II, Award & Administration Guide (AAG) Chapter IV.B., the institution has a plan in place to provide appropriate training and oversight in the responsible and ethical conduct of research to undergraduates, graduate students and postdoctoral researchers who will be supported by NSF to conduct research.
The AOR shall require that the language of this certification be included in any award documents for all subawards at all tiers.

CERTIFICATION PAGE - CONTINUED

Certification Regarding Organizational Support

By electronically signing the Certification Pages, the Authorized Organizational Representative (or equivalent) is certifying that there is organizational support for the proposal as required by Section 526 of the America COMPETES Reauthorization Act of 2010. This support extends to the portion of the proposal developed to satisfy the Broader Impacts Review Criterion as well as the Intellectual Merit Review Criterion, and any additional review criteria specified in the solicitation. Organizational support will be made available, as described in the proposal, in order to address the broader impacts and intellectual merit activities to be undertaken.

Certification Regarding Federal Tax Obligations

When the proposal exceeds $5,000,000, the Authorized Organizational Representative (or equivalent) is required to complete the following certification regarding Federal tax obligations.
By electronically signing the Certification pages, the Authorized Organizational Representative is certifying that, to the best of their knowledge and belief, the proposing organization:
(1) has filed all Federal tax returns required during the three years preceding this certification;
(2) has not been convicted of a criminal offense under the Internal Revenue Code of 1986; and
(3) has not, more than 90 days prior to this certification, been notified of any unpaid Federal tax assessment for which the liability remains unsatisfied, unless the assessment is the subject of an installment agreement or offer in compromise that has been approved by the Internal Revenue Service and is not in default, or the assessment is the subject of a non-frivolous administrative or judicial proceeding.

Certification Regarding Unpaid Federal Tax Liability

When the proposing organization is a corporation, the Authorized Organizational Representative (or equivalent) is required to complete the following certification regarding Federal Tax Liability:

By electronically signing the Certification Pages, the Authorized Organizational Representative (or equivalent) is certifying that the corporation has no unpaid Federal tax liability that has been assessed, for which all judicial and administrative remedies have been exhausted or lapsed, and that is not being paid in a timely manner pursuant to an agreement with the authority responsible for collecting the tax liability.

Certification Regarding Criminal Convictions

When the proposing organization is a corporation, the Authorized Organizational Representative (or equivalent) is required to complete the following certification regarding Criminal Convictions:

By electronically signing the Certification Pages, the Authorized Organizational Representative (or equivalent) is certifying that the corporation has not been convicted of a felony criminal violation under any Federal law within the 24 months preceding the date on which the certification is signed.

AUTHORIZED ORGANIZATIONAL REPRESENTATIVE	SIGNATURE	DATE
NAME		

TELEPHONE NUMBER	EMAIL ADDRESS	FAX NUMBER

Summary

Overview

Classical linear wind-driven circulation theory predicts that a western boundary current, such as the Brazil Current (BC) in the subtropical South Atlantic, is a passive feature, with the role of closing the mass imbalance created by the Sverdrup interior. This wind-driven gyre dynamics, as well as the interaction with the global thermohaline flow, is responsible for most of the decadal variability of the global western boundary currents. However, at interannual timescales, other local and remote mechanisms involving mesoscale eddies and planetary waves are important. Here, we propose to investigate the variability of the BC on interannual timescales, and its relationship to the large-scale mechanisms that drive it. We will analyze hydrographic, satellite, and ocean reanalysis data, and perform eddy-resolving modeling experiments. In the hydrographic data analysis, which will include a large number of high-density transects, we will examine the structure of the BC at different latitudes, the relationship of the BC with the location and strength of the gyre, and the effect of the large-scale wind forcing. Complimentary satellite altimetry and model reanalysis data will provide a quasi-synoptic view of the mean and eddy flow of the BC, as well as the impact of Rossby wave mechanisms on the BC variability. A process-based study using global eddy-permitting ocean model simulations will be performed, in which we will separate the influence of local and remote wind forcing on the region. These runs will be compared against a nested eddy-resolving regional model of the western South Atlantic domain, where we will investigate how the mesoscale eddy processes may respond to and feedback on the regional variability at longer timescales.

Intellectual Merit

The intellectual merit of this proposal is in its potential to improve understanding of the BC system using data analysis and numerical model experiments. Understanding the BC system may bring important scientific and societal impacts: (i) at the surface, it carries warm Tropical Water and has strong eddy variability, forcing in large extent the regional upwelling and weather patterns; (ii) it has a unique vertical structure, receiving contributions from several water masses (e.g., central, intermediate) at different levels and latitudes; (iii) it is a western boundary current that closes the South Atlantic subtropical gyre; and (iv) its relative weak time-mean flow indicates strong interactions with the Atlantic meridional overturning circulation. However, very few scientific papers have investigated the BC interannual variability, in part because of a lack of in-situ observational data. Deliverables from this project include the analysis of a large collection of direct measurements of the BC, the production of synthetic BC time series at two latitudes, and model results centered on forcing mechanisms of the BC variability.

Broader Impacts

Results from this work will be presented at scientific meetings and published in high standard oceanographic journals. In addition, this proposal will provide funding for early career scientists (Goes and Liu), will advance the NSF's education goals through the mentoring of a postdoctoral researcher (Liu), and include women in science (Dong and Liu). This work is related to societal impacts because it can improve the capability of ocean prediction, and therefore, regional sea level and weather forecasting. This project includes a significant amount of basic oceanographic research, i.e., ocean circulation, wind driven gyres, and Rossby wave adjustment, which can be used to develop curriculum for undergraduate and graduate classes at the University of Miami. We plan to involve college students as interns to participate in the proposed research. In addition, this work will enhance collaboration between the University of Miami and Brazilian universities.

TABLE OF CONTENTS

For font size and page formatting specifications, see GPG section II.B.2.

Appendix Items:

*Proposers may select any numbering mechanism for the proposal. The entire proposal however, must be paginated. Complete both columns only if the proposal is numbered consecutively.

1. Background

The subtropical gyre is the main dynamic feature in the upper circulation of the South Atlantic. Fed by waters from the Agulhas leakage region and Subantarctic front, the South Equatorial Current (SEC) flows westward across the basin, and closes the northern part of the gyre circulation. The southern branch of SEC (from now on just SEC) bifurcates off the Brazilian coast at different latitudes and depths (e.g., Rhines and Young, 1982; Rodrigues et al., 2007; Calado et al., 2008). In its bifurcation, the SEC feeds into the North Brazil Undercurrent/Current (NBUC/NBC), which flows northward across the equator (Silveira et al., 1994; Goes et al., 2005), and the Brazil Current (BC), which flows southward along the Brazilian coast (Signorini 1978). At approximately 38°S, the warm salty southward-flowing BC encounters the cold, fresher northward flow of the Malvinas Current, generating a strong thermohaline front known as the Brazil-Malvinas Confluence Front, with lateral temperature gradients as high as 1° C/100 m (Gordon and Greengrove, 1986; Goni and Wainer, 2001). This region is characterized by one of the highest eddy kinetic energy in the world ocean, partly due to the presence of simultaneous warm and cold rings and eddies (Lentini et al., 2006).

The BC system is unique in terms of its vertical structure among subtropical boundary currents (Silveira et al., 2008; Soutelino et al., 2013). Close to its origin (15-20°S), the BC carries mostly Tropical Water and is confined to the top 200 m (Figure 1). Between 20°S and 25°S, the BC flows south- southwestward from the surface down to pycnocline levels (400-500 m), carrying additional Central Water, summing up to a transport ranges from 5 to 10 Sv in this region (Evans and Signorini, 1985; Silveira et al., 2000). Below 500 m, the flow direction is reversed and is associated with the intermediate flow towards the north-northeast (Böebel et al., 1999). Further downstream (~28°S), the vertical extent of the BC is largely increased (~1200 m) due to the addition of approximately 2-4 Sv of Antarctic Intermediate Water (AAIW) from the Intermediate Western Boundary Current (IWBC) flow (Böebel et al., 1999; Schmid et al., 2000).

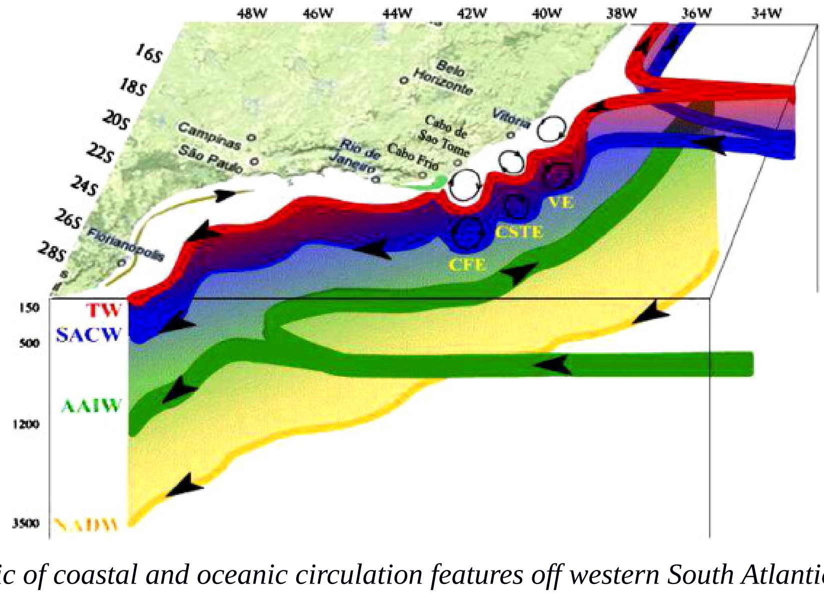

Figure 1: *A schematic of coastal and oceanic circulation features off western South Atlantic. North of 28N, the BC transports both Tropical Water (TW) and South Atlantic Central Water (SACW), while the IWBC transports AAIW northward. South of 28N the IWBC changes direction. At abyssal depths the Deep Western Boundary Current carries North Atlantic Deep Water (NADW) southward (Adapted from Calado et al., 2008).*

The relatively weak transport of the BC was first suggested to be a result of the influence of the thermohaline component of the general circulation (Stommel, 1965). In spite of its weak mean flow, the BC is characterized by intense meandering and occasional eddy shedding (Signorini, 1978; Silveira et al., 2001). Recent studies using altimetry data (Vianna and Menezes, 2011) define the BC as irregular, patchy, and flowing mostly in the shallow midshelf. At 20°S, as also shown in Soutelino et al. (2011), the BC does not appear to be a time-averaged western boundary geostrophic current below the Ekman layer. They argue that there are indications that the BC variability is much stronger than its mean value. However, in-situ measurements of the BC are still incipient in the region for answering this question.

The mesoscale activity observed along the lee of Abrolhos Bank (~18-20°S), in the northern part of the BC domain, was first described by Schmid et al. (1995), and observations revealed a cyclonic feature denominated Vitoria Eddy. Later studies using modeling and satellite altimetry data analysis have shown a translation equatorward of the Vitoria Eddy (Campos 2006; Arruda et al., 2014). Soutelino et al. (2011) using synoptic ADCP survey data described the BC flow between 10° and 20°S as weak and eddy dominated, and additional analysis showed that these eddies are either recurrent or permanent. Besides the vertical shear between the different components of the circulation in the southwestern boundary of the Atlantic, other factors may play important role in the variability of the BC, such as the interaction of the flow with bottom topography, thermohaline effects, and inertial and recirculation components (Wunsch and Roemmich, 1985; Deser et al 1999; Soutelino et al., 2013).

Close to its formation region, the seasonal variability of the BC strength has been suggested to be linked to the latitude of the SEC bifurcation (Rodrigues et al., 2007; Silva et al., 2009), which indicates that the variability of the BC is mostly wind-driven, i.e., Ekman pumping and associated remotely forced waves. Further south, in the confluence region, seasonal fluctuations of the BC transport have been associated with the local wind stress curl (Matano et al., 1993; Goni and Wainer, 2001). These fluctuations in the BC flow may drive the latitudinal variability of the confluence location (Garzoli and Giulivi, 1994), although the interannual variability of the BC is not well known. On interannual timescales, variations in the strength of the South Atlantic subtropical gyre, and thus of the BC along the western boundary, must also be driven in first order by changes in the basin-wide wind stress curl (Witter and Gordon, 1999; Deser et al., 1999; Vivier et al., 2001), and wave mechanisms which constitute a delayed response due to ocean adjustment associated with the Sverdrup dynamics (Deser et al., 1999; Silva et al., 2009).

Recent studies have analyzed trends in the South Atlantic subtropical gyre: Vianna and Menezes (2011) use altimetry to suggest that the subtropical gyre has been slowly migrating southward and growing in amplitude, with the NBUC and the SEC intensifying a few cm s^{-1} during the altimetry period. Similarly, a southward shift in the surface Brazil-Malvinas Current Front has been detected in the last 15 years using altimetry and drifter data (Goni et al., 2011; Lumpkin and Garzoli, 2011). In agreement with those studies for the surface circulation, a southward subtropical gyre expansion is also suggested at intermediate levels (Goes et al., 2014), forced by a southward trend in the maximum wind stress curl and an increase in the Southern Annular Mode (SAM), the leading mode of atmospheric variability in the southern hemisphere (Gong and Wang 1999; Marshall 2003).

The associated strengthening of the western boundary current induces positive sea surface temperature (SST) trends along its path (Wu et al., 2012), which are significantly higher than their basin averages. The SST and heat content gradients across the western boundary current may have considerable impact on the local weather (Putrasahan et al., 2013), and on the zonal density gradients across the basin, which may impact the meridional overturning and heat transport, producing remote impacts in the climate system.

Interestingly, in the analysis of surface velocity data of Lumpkin and Garzoli (2011), statistically significant changes in the location of the confluence are apparently not connected to changes in the transport of the BC. In fact, there is strong barotropic conversion from mean to eddy energy inside the BC region (Oliveira et al., 2009, Mano et al., 2009), such that the Sverdrup balance for most parts of the BC may not apply. In such, the gyre strengthening may end up increasing the conversion to eddy variability inside the BC instead of increasing its transport, similar to what happens inside the NBC (Garzoli et al., 2004; Goes et al., 2009). Additional complication may arise from the baroclinic instabilities created by the vertical shear between the BC, the NBUC and the IWBC flows (e.g., Silveira et al., 2008; Soutelino et al., 2013). On interannual-to-decadal timescales, other sources of variability in the BC current may arise as a result of oscillations caused by remote forcings and internal perturbations linked to the Atlantic meridional overturning circulation (AMOC) variability (Garrafo and Kamenkovich, 1996; Johnson and Marshall, 2004; Danabasoglu, 2008).

Previous studies focused mostly on describing the seasonal variability of the western boundary BC, or on portraying and explaining the intense mesoscale activity in the region. However, a comprehensive study of the large-scale influence on the BC, specifically on the influence of the local and remote surface fluxes, on the strength and instability of the current, has not yet been performed. Understanding the mechanisms that control the variability of the South Atlantic western boundary will advance the regional ocean forecast skill, as well as the improve the knowledge of the processes responsible for the South Atlantic meridional overturning variability. Here we will expand on previous studies by confronting the regional variability of the western boundary current with mechanisms that control the large-scale features of the South Atlantic. Our use of direct measurements of the BC in two locations (22°S and 34°S), and process-based high resolution modeling will provide additional information that is not included in previous studies, which generally use purely ocean surface observing platforms data or modeling.

2. Project Overview

The broad goal of this project is to improve understanding of the Brazil Current (BC) system variability on interannual timescales, and the impact of the local and remote surface forcings on the regional variability of the BC. To achieve this goal, we will use a set of oceanographic (in-situ and satellite) data, ocean reanalysis and eddy-resolving model experiments. One of the strengths of the proposed work is that we will use a collection of over a decade of data from the AX97 XBT transect, which measures the BC quarterly, at a high density across 22°S, and has not been so far analyzed in depth.

In addition, we will examine the interannual variability of the South Atlantic Ocean temperature structure, its relation to sea level and thermocline variability, and their causes. To achieve these objectives, a suite of sensitivity experiments will be performed using an Ocean General Circulation Model (OGCM). Specifically, in the model analysis we will assess the relative contributions of atmospheric forcing over the South Atlantic Ocean and remote forcing from the Indo-Pacific and North Atlantic, and assess the effects of oceanic internal variability.

The main scientific questions we want to answer, which will be the core of the research plan are:

I) What are the coherent characteristics of the BC variability at different latitudes and frequencies?

II) How are the subtropical gyre-scale features associated with the variability of the BC?

III) What is the sensitivity of the mean and eddy variability of the BC to local and remote large-scale surface forcing?

The BC is a western boundary system with relatively weak mean flow and strong mesoscale variability. The interaction of the mesoscale variability and the mean flow structure, in terms of seasonality, location and gyre strength will also be analyzed. Understanding the large scale processes that control the BC variability will provide better climate predictability for the region. In addition, this project will promote a strong collaboration between the University of Miami and the Brazilian scientists. As follows, our research plan will detail the objectives and work tasks to be completed in order to answer the questions above described.

3. Research Plan

Our key objectives are: (i) to provide new estimates of the BC parameters such as transport, eddy kinetic energy, and vertical stratification; (ii) to provide new mechanistic insights into coherent aspects of the BC across the basin; and (iii) explore the local and remote drivers of the western boundary current variability in the South Atlantic.

Specifically, we will subdivide the proposed work in five main tasks, four mainly observational, which will focus on the detection of the internal variability in the BC region; the fifth task is mostly based on controlled experiments using an oceanic general circulation model, and will address how the remote and local forcings account for the western South Atlantic variability. A list of the tasks is given below:

1. Use the XBT transect data to estimate the observed variability of the BC at 22°S and 34°S. Estimate how the AX97 XBT transect compares with Argo data in terms of structure and seasonal variability of the BC, and produce a method to use the synergy of both datasets (such as a reference level velocity from Argo) to create an improved representation of the BC.

2. Estimate a surrogate of the BC strength using altimetry and XBT data. This product will consist of the BC transport at 22°S and 34°S at 7-day timesteps starting in 1992. Analysis of potential coherent patterns of variability between the BC across 22°S and 34°S, and across the subtropical South Atlantic.

3. Analyze the BC variability in terms of the local “quasigeostrophic” Sverdrup theory, where the wind stress curl in the eastern side of the basin controls the variability of the western boundary current through Rossby wave adjustment. Simple numerical model simulations will give support to the observational results.

4. Analysis of interannual changes in the mesoscale variability of the BC. To achieve this, drifter and altimetry products will be analyzed. We will separate the variability of absolute dynamic topography in the Western South Atlantic basin in different period bands, and estimate the main propagation modes for each period band. Propagating Rossby patterns across the basin and eddy variability will be disentangled in the altimetry signal.

5. Analyze the response of the BC to local and remote surface forcings. For this, numerical experiments with an eddy-permitting (0.25°) global ocean model, nested to a regional eddy-resolving (0.08°) ocean model will be performed, and compared under different set of surface flux fields.

3.1 Ocean data

In order to pursue our objectives, we will rely on a synthesis of raw ocean data and ocean data products to directly assess the temporal and spatial structure of the BC, and link the variability of the BC with basin scale phenomena. To accomplish these observational tasks, we will utilize the following products:

a. Ocean profiles: We will use temperature data from three high-density expendable bathythermograph transects: AX18/AX17 (along 34°S and northward extension), AX97 (along 22°S, between Rio de Janeiro and Trinidade Island), and AX08 (across the subtropical gyre).

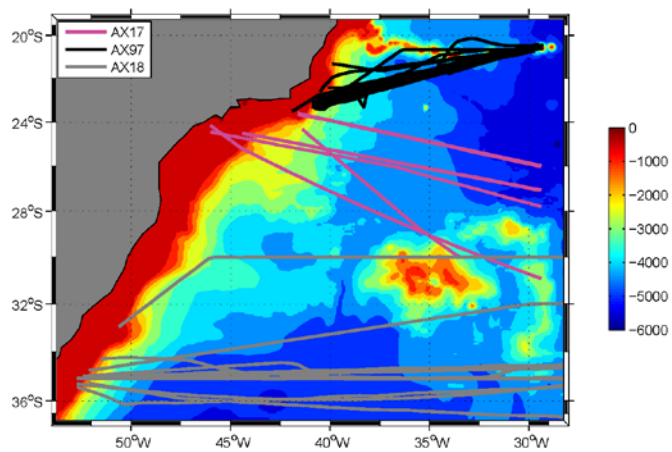

Figure 2: *Location of the main XBT transects to be used in the proposed work. They are labeled as AX17 (magenta), AX97 (black), and AX18 (grey). Contours are the local bathymetry (in meters).*

These transects are carried out approximately five times a year, starting in the early 2000s (Figure 2). Temperature profiles are sampled for the upper 800 m at an average of 20-25 km spacing. Salinity is estimated on these profiles using historical T-S relationships for the region, according to the method of Hansen and Thacker (1999). Mixed layer depth and parking velocity from Argo floats will also be used. Argo data are collected and made freely available by the International Argo Program and the national programs that contribute to it (http://argo.jcommops.org). Monthly average gridded Argo products are also available in the IPRC website (http://apdrc.soest.hawaii.edu/projects/argo/).

b. Drifter: We will use the drifter data products from the methodology documented in Lumpkin and Johnson (2013). It consists of data from the Global Drifter Program (GDP), analyzed as 5-day low-passed geostrophic velocities (ug(x,t), vg(x,t)) since 1979. Geostrophic velocities are created by subtracting the Ekman part, defined by the Ralph and Niiler (1999) parameterization with updated coefficients from Niiler (2001) and NCEP 6-hourly winds. Because drifter-only data may suffer from sparse sampling, we will also use the drifter–altimeter synthesis combines geostrophic velocity anomalies, as derived from altimetric-mapped sea level anomalies, with a gain coefficient taken from the amplitude of concurrent drifter measurements, to produce weekly snapshots of absolute geostrophic currents (and absolute dynamic topography) at a 1/3° resolution (Beal et al., 2013).

c. Surface fluxes: We will use the ERA-Interim (www.ecmwf.int) global atmospheric and surface parameters from 1 January 1979 to present, available at T255 spectral resolution (~80 km). Monthly averages of daily means will be used to study the wind stress curl forcing and SST response in the South Atlantic. These data will be also used to force the model simulations (Task 5, described below).

d. Altimetry: The altimetry data used in this study were downloaded from the AVISO data center (http://www.aviso.oceanobs.com). They consist of Ssalto/Duacs Absolute Dynamic Topography (ADT) merged products. The data from all altimeter missions (Jason1 and 2, TOPEX/Poseidon, ENVISAT, GEOSAT Follow On, ERS1 and 2, and GEOSAT) are processed by the Ssalto/Duacs system in order to provide a consistent and homogeneous catalogue of products for varied applications. The series of weekly data in delayed time extend from October 1992 to approximately 6 months from the present day. Our domain is from 40°S to 15°S, 60°W and 20°E with a grid resolution of 1/3° x 1/3°.

e. Ocean Reanalysis: For comparison with observational estimates and spatial coherence assessment, the Estimating the Circulation and Climate of the Ocean, Phase 2 (ECCO2; Menemenlis et al., 2008; http://www.ecco-group.org) will be used, which is available at a 1/3° horizontal resolution at 3-daily averages since 1992.

3.2 Proposed Work

The analysis of the oceanographic data and model reanalysis listed above, as well as performing and analyzing additional model simulations will be the core of the proposed work. The five tasks that define the proposed work will be developed as follows:

The **Task 1** will consist of estimating the BC variability using the XBT transects data AX97 at 22°S (Mata et al., 2012), and AX18 at 34°S (Dong et al., 2009). Preliminary analysis show that the BC has a mean volume transport of ~4 Sv at 22°S (Figure 3, top-left) and increase to ~ 12 Sv at 34°S, which is consistent with the additional southward flow at intermediate level between the two sections. A five year oscillation is apparent in the transport variability of the BC region (Figure 3, bottom), and also observed in the mixed-layer depth across the basin from a third XBT transect data (AX08; Goes et al., 2013), suggesting that a coherent variability between the boundary and interior may take place, with a delayed response defined by adjustment through baroclinic Rossby wave mechanisms. We will use the information of the quality controlled data from Argo floats to estimate absolute geostrophic transports down to 1000 m depth across the XBT AX97 and AX18 transect locations at the western boundary. This will be performed by padding the vertical shear component of the Argo data. We will also compare the Argo and XBT only products, and analyze the deficiencies and strengths of each dataset, and the value of information added by merging the two datasets.

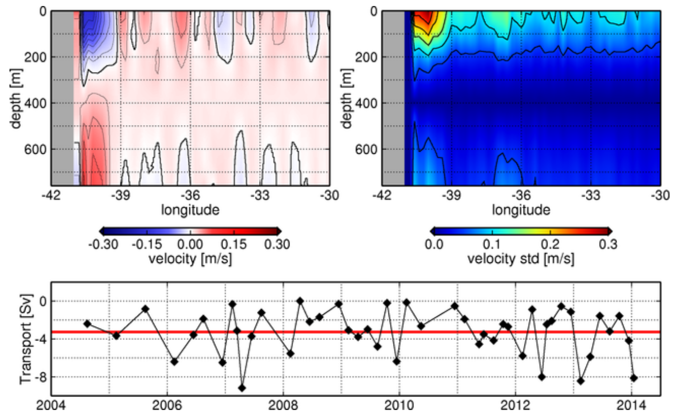

Figure 3: *(top left) Mean absolute geostrophic velocity at 22°S calculated using the AX97 temperature data, salinity from historical TS relationships, and reference dynamic height at 800m from IPRC Argo product. (top right) Standard deviation of the velocity (m/s). Bottom: Absolute geostrophic transport in the upper 400 m of the BC based on the AX97 estimates.*

In **Task 2**, the altimetric sea surface height will be used to construct a proxy of the BC transport variability across the XBT transect at 22°S and 34°S. This methodology will be similar to the one used in Goes et al. (2013) and Dong et al., (2015), and consists of two steps: (i) regressing the dynamic height derived from the in situ data (XBT, Argo) to the temperature and salinity at defined levels, and (ii) regressing the dynamic height on the absolute dynamic height from altimetry, therefore creating links at different locations between the sea surface height from altimetry and the temperature and salinity profiles from the in-situ data. After creating these relationships, the in-situ quantities can be expanded in time for the whole period of the altimetry coverage. The constructed timeseries will be validated with the in-situ data and used to study the long-term variability of the BC.

In **Task 3** we will estimate the Sverdrup transport streamfunction and associate it with the transport of the BC calculated directly from in-situ data. According to the Sverdrup theory, the integrated wind stress curl (WSC) determines the Sverdrup streamfunction strength zonally (Figure 4). Previous studies considered the WSC anomaly as a proxy for the strength of the BC (Matano et al., 1993, Vivier et al., 2001, etc.). Figure 4 assumes a steady, linear state, which could be achieved quickly due to fast barotropic adjustment (McCarthy et al., 2000). However, the evolution of the Sverdrup transport is not what might be observed in the region close to the AX97 transect (22°S). The baroclinic Rossby wave transit time appropriate for the latitude band 20°-40°S is approximately 3-6 yr, assuming a group velocity of 2.5-5 cm s^{-1} (based on satellite altimetry measurements; see Chelton and Schlax 1996). Other mechanisms that also influence the BC variability, such as compensations due to the vertical structure of the BC, or the breakdown of the BC into eddies since a stronger BC flow would also increase the shear. Indeed, Ma (1996) showed that NBC rings can be generated either as a consequence of the reflection of westward propagating equatorial Rossby wave packets deepening the thermocline, or during the spin up by wind forcing.

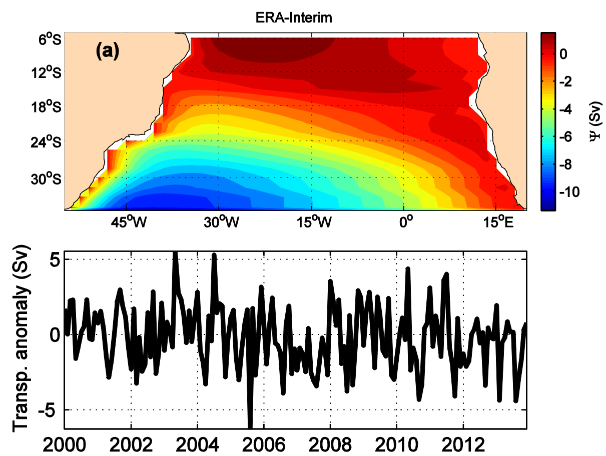

Figure 4: *(top) Average Sverdrup streamfunction (Ekman removed) derived from the ERA-Interim wind stress data for. (bottom) Time series of the BC transport anomalies across 23°S calculated from the Sverdrup streamfunction (Sv) .*

We will investigate these main causes of the BC variability, and coherent patterns across the South Atlantic. Variability of basin-scale metrics such as mixed layer depth (Argo), sea surface height (altimetry), and model reanalysis (ECCO2) results will be analyzed. Lagged correlations between wind stress curl anomalies and thermocline variability will also aid tracking forced thermocline anomalies, similar to wind forced salinity anomalies at intermediate depth calculated in Goes et al. (2014). Gyre parameters such as strength and latitude will be calculated directly from ocean observations. A reduced-gravity model (Goes et al., 2009) will be used to understand the mechanisms of Rossby wave propagation and eddy generation in a simplified framework. We will use 3 ½ layers in this model to be able to simulate the interaction between the IWBC and the BC, and its effect on baroclinic instabilities. Preliminary analysis (Figure 5) shows that increasing the IWBC flow reduces the strength of the BC, similar to the mechanisms shown in Mano et al., (2009) and Spall (1996), and that gyre adjustment and large-scale Rossby waves are capable of inducing eddy generation in the western boundary [e.g., Schmeits and Dijkstra, 2001; Berloff et al., 2007].

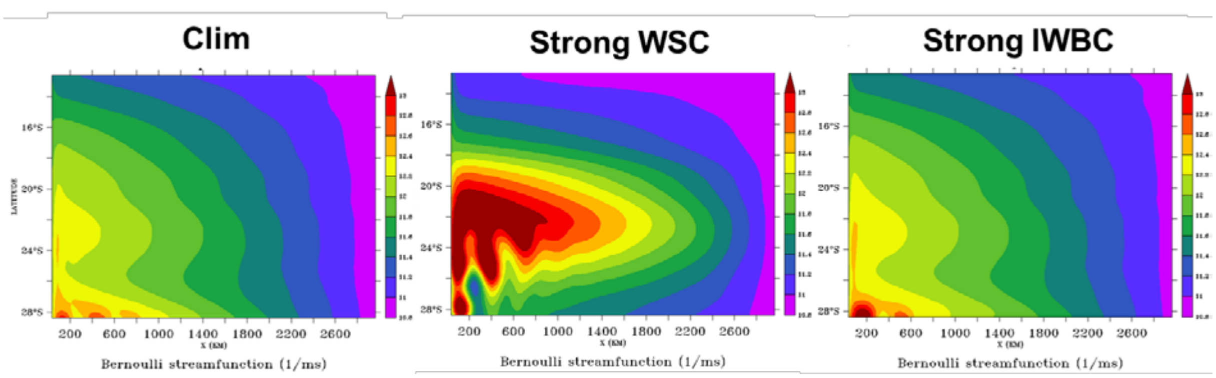

Figure 5: *Mean Bernoulli streamfunction of the first model layer for the simulations with the 3 ½ layer reduced gravity model. (a) Control forced with climatological winds (b) strong wind stress curl anomaly, and (c) strong IWBC flow. Panel (b) presents eddy generation south of 24S, suggesting that the gyre variability is linked to the eddy generation in the western boundary.*

Task 4: The eddy variability is an important part of the BC flow. Here, the eddy variability of the BC will be compared to the mean flow, similar to Mata et al. (2006) and Oliveira et al. (2009), where the barotropic conversion of the flow was calculated. In addition, the strength of the BC and gyre-scale parameters (Task 3), such as location and strength of the Sverdrup gyre, as well as baroclinic Rossby wave variability will be compared to the BC eddy variability. Eddy variability statistics of the BC can be retrieved directly from the drifter data and the gridded drifter/altimetry product (Figure 6). An investigation of the location and causes for the interannual variability of the mesoscale features in the region will be performed.

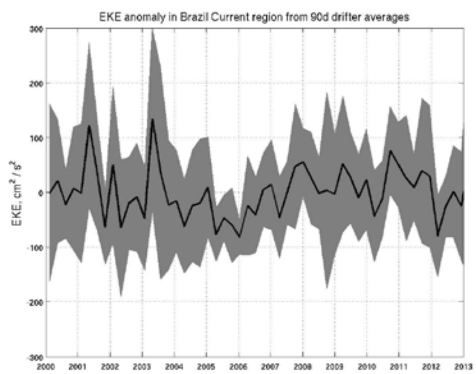

Figure 6: *Anomalies (relative to the climatological EKE) of geostrophic eddy kinetic energy (EKE) in the BC region (50W-30W/20S-30S) derived from drifter data from 2000 to 2013. Shaded is the confidence limit for the estimates. Strong EKE anomalies in 2001 and 2003 may be related to low spatial coverage. Drifter/altimetry synthesis would overcome the coverage issue (Courtesy of Rick Lumpkin).*

In addition, we will analyze the satellite absolute dynamic topography (ADT) for different period bands. To decompose the ADT signal into main bands of variability of the BC (Figure 7), we will use the wavelet filtering methodology described in Torrence and Compo (1998). After decomposing the signal into period bands, an Extended EOF analysis will be performed on each band to capture the main propagating modes of variability. Previous works (e.g., Fernandes et al., 2009) suggest that mesoscale eddies and baroclinic wave trains can propagate poleward with a phase speed similar to the mean BC value. This may provide insights on the latitudinal coherence of the BC along the boundary. Here are some examples and details of how the methodology will be applied in this work:

a. Wavelet Filtering

The wavelet analysis of the detrended ADT anomalies (Figure 7) close to the AX97 transect (22°S/40°W) show that the BC region variability is dominated by the eddy contribution, with periods between 20 and 45 days (Rocha et al., 2014). However, there is indication of variability on interannual timescales, from 2 to 5 year periods.

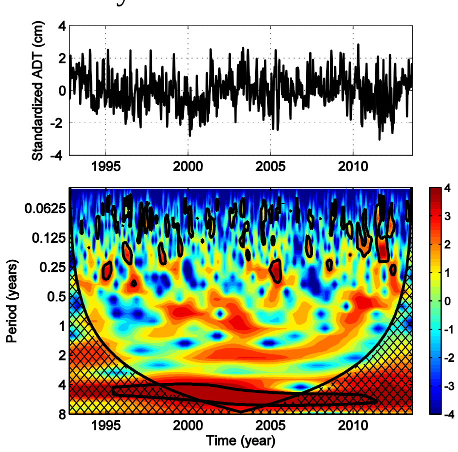

Figure 7: *Wavelet analysis of the ADT anomalies in the BC region, off Cabo Frio, Brazil (22°S/40°W). Top panel shows the time series of ADT anomalies. Bottom panel shows the frequency distribution of the ADT anomaly timeseries. The hatched area represents the region where the analysis is not valid, and the black contours are the periods that are significant at the 95% interval. Note the increased energy in 2010-2011 at periods from 40 to 90 days.*

The wavelet transform is essentially a bandpass filter of uniform shape and varying location and width. By summing over a subset of the scales in (1), one can construct a waveletfiltered time series:

$$x_n = \frac{\delta_j \delta_t^{1/2}}{C_\delta \psi_0(0)} \sum_{j=j_1}^{j_2} \frac{R\{W_n(s_j)\}}{\left(s_j^{1/2}\right)} \quad (1)$$

The factor $\psi_0(0)$ is an energy scaling, and $s_j^{1/2}$ converts the wavelet transform to an energy density. The factor C_δ is a constant for each wavelet function, $R\{W_n(s)\}$ is the real part of the continuous wavelet transform. Therefore, this filter has a response function given by the sum of the wavelet functions between scales j_1 and j_2.

This filtering can also be performed on both the scale and time simultaneously by defining a threshold of wavelet power. This “denoising” removes any low-amplitude regions of the wavelet transform, which are presumably due to noise. This technique has the advantage over traditional filtering in that it removes noise at all frequencies and can be used to isolate single events that have a broad power spectrum or multiple events that have varying frequency. A more complete description including examples is given in Donoho and Johnstone (1994).

b. Empirical Orthogonal Function (EOF) methods

Data that contains propagating signals or oscillations in time or in space are very common in oceanographic applications. The Extended and Complex EOF (EEOF and CEOF) methods can be used to identify such propagations (see Navarra and Simoncini (2010) for a description of the methods). For the CEOF, the presence of propagation is indicated by two successive EOF modes (EOF1 and EOF2, Figure 8) whose patterns are in quadrature in space, namely the relative maxima of one pattern correspond to the zero lines of the other and the two EOFs explain a similar amount of variance. Moreover, there is a shift in time corresponding to a quarter of a wavelength between the coefficients of the EOF1 and EOF2. Therefore, the variation of the coefficients (PCs) shows a periodic behavior in time. A quarter-wavelength shift in time is the phase lag typical of a harmonic wave, and this shift is a peculiar phase relation that indicates propagation. The EEOF method is more flexible, and the time lags can be chosen to represent a particular feature (Figure 8). The EOF analysis is been able to find couples of modes that are strongly linked; in fact they may be part of the same physical system (Figure 8). Therefore, the variation in time of the EOF coefficients seems to identify the kind of variability that can be expressed as a harmonic wave with real part given by the EOF-1 and imaginary part by the EOF-2. Mathematically, the EEOF method consists of computing the Hilbert Transform (HT) of the time series at each grid point, and performing the EOF of the matrix composed of these HT transformed signals. The real and imaginary parts of the EOF will correspond in space to a shift in time, both corresponding to one “coupled” principal component PC. Therefore the speed, phase, and amplitude of the propagation can be estimated by a pair of coupled EOFs.

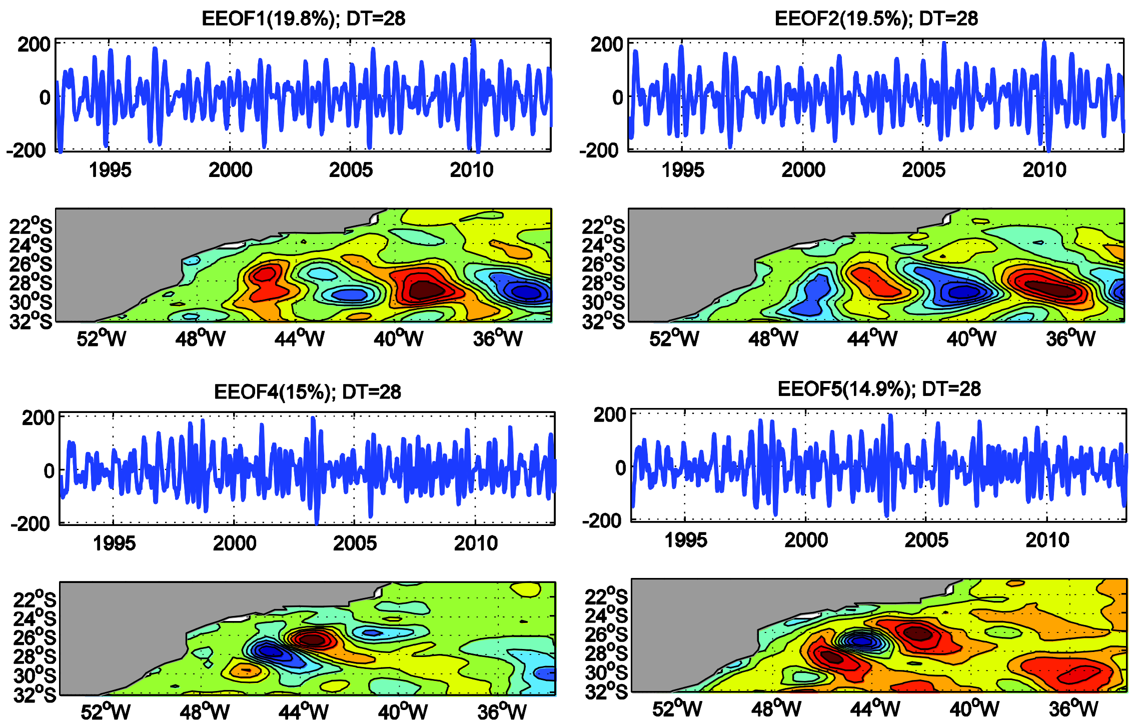

Figure 8: *Extended empirical orthogonal functions (EEOF) of the altimetric absolute dynamic topography for a region in the southwestern Atlantic. The top panels (EEOF1 and 2) and bottom panels (EEOF 4 and 5) show a 28-day phase shift suggesting propagation features like Rossby waves (EEOF1 and 2) and eddy translation (EEOF4 an 5).*

In **Task 5**, we will design and perform various model experiments to explore local and remote large-scale processes that may influence the variability of the BC. We will focus on the processes responsible for the mean and eddy variability within the BC on interannual timescale.

The overall goal of our modeling experiments is to explore the interaction of local and remote surface fluxes (of both momentum and heat) over the western boundary region of the South Atlantic. This modeling effort will focus on three specific research questions: (i) what is the importance of the South Atlantic wind stress curl to the BC variability?; (ii) what is the role of the South Indo-Pacific wind stress curl in the BC variability?; (iii) to what extent the North Atlantic Ocean influence the BC variability? We will define and use metrics to quantify the impact on the BC region with respect to its vertical structure, the strength of the mean flow, and eddy activity along different latitudes (see Figure 1) of the BC path. We will use both a global domain model and one-way nested regional model for the South Atlantic.

a) Global model and regional nested model for the western South Atlantic

The latest version of the Modular Ocean Model (MOM5, Griffies et al., 2004; Gnanadesikan et al., 2006) developed at the Geophysical Fluid Dynamics Laboratory (GFDL) will be used as our modeling tool. We will use both a global domain model and one-way nested regional model for the South Atlantic. As shown in Figure 9, the regional model, which is nested to the global ocean model, contains the western South Atlantic Ocean (50ºS-10ºN and 65ºW-30ºW). The global model is fully coupled to a sea-ice model and has the eddy-permitting horizontal resolution of 0.25º. The regional nested model has the fully eddy-resolving horizontal resolution of 0.08º over the western South Atlantic. Both the global and the regional nested models have 25 vertical z-coordinate levels.

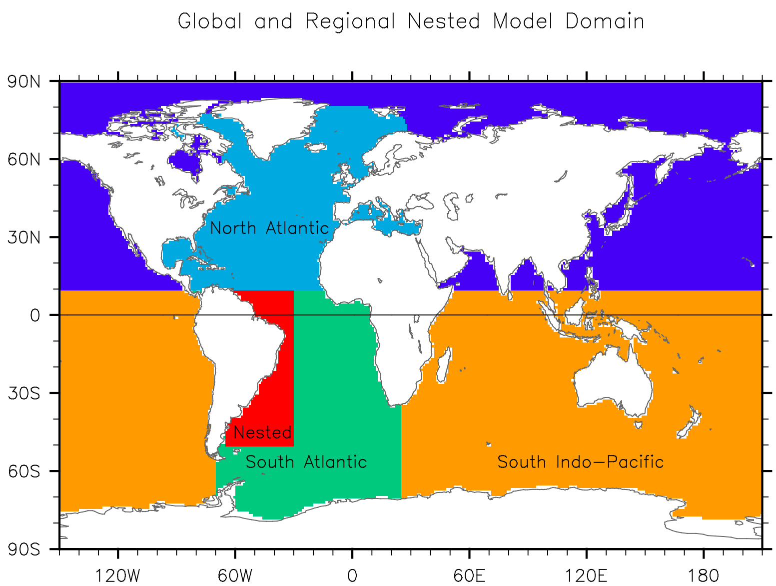

Figure 9: *Global ocean model domain and the distributions of basin sub-domains where either the real-time or climatological surface fluxes will be applied in the forced experiments (see Table 1). The nested area (red) represents the west South Atlantic, the domain of the nested model.*

b) *Proposed model experiments*

As summarized in Table 1, five experiments will be performed using both the global and regional nested models under five different sets of surface flux fields.

Table 1. *List of proposed model experiments. These experiments will be performed for both the global domain at 0.25º resolution, and one-way nested regional domain of the western South Atlantic Ocean at 0.08º resolution. See the text for more detail.*

Experiments	Description
Spinup experiment (SPINUP)	Temperature and salinity initialized with World Ocean Atlas 2013; Forced with ERA Interim surface flux climatology over the global ocean.
Control experiment (CNTR)	Forced with ERA Interim surface fluxes (1979-2015) over the global ocean after the spinup experiment.
South Atlantic forcing experiment (SATL)	Same as the control run, except that the real-time surface forcing is applied only within the South Atlantic while the other regions are forced with climatology.
South Indian and Pacific forcing experiment (SIDP)	Same as the control run, except that the real-time surface forcing is applied only within the South Indian and Pacific while the other regions are forced with climatology.
North Atlantic forcing experiment (NATL)	Same as the control run, except that the real-time surface forcing is applied only within the North Atlantic while the other regions are forced with climatology.

First, to spin up the global and regional nested models, the models will be initialized using temperature and salinity fields obtained from the World Ocean Atlas 2013 and integrated for at least 200 years using the ERA Interim surface flux fields. In the spin-up run and other model runs, the 6-hourly surface wind vector, air temperature and specific humidity, daily shortwave and downward longwave radiative heat fluxes, and monthly precipitation rate will be specified, whereas the upward longwave radiative heat flux and turbulent surface fluxes will be determined interactively by using the 6-hourly surface wind speed, air temperature and specific humidity, along with the model-produced SSTs. To incorporate the impact of atmospheric noise during the spin-up, the surface forcing fields in each model year will be randomly selected from the period of 1979-2000 following the spin-up methodology used in Lee et al. (2011).

After the spinup run, both the global and the regional nested model will be integrated from 1979-2015 using the real-time ERA Interim surface flux fields. This experiment will be referred to as the control experiment. The other three sensitivity experiments are identical to the control experiment except that real-time surface winds will be applied only over specified oceans; for the rest of the ocean, the surface flux fields in each model year will be randomly selected from the period 1979-2000 (i.e., reference surface flux fields) as in the spinup run. In the first sensitivity experiment (SATL), real-time surface flux fields will be prescribed over the South Atlantic, and the rest of the ocean will remain with the reference surface flux fields. In the second sensitivity experiment (SIDP), real-time surface flux fields will be used over the South Indian Ocean and the South Pacific Ocean, and the other oceans will remain with the reference surface flux fields. Similarly, in the third experiment (NATL), real-time surface flux fields will be used over the North Atlantic Ocean, and the other oceans will remain with the reference surface flux fields.

c) *Model analysis*

1. Model validation (control simulation): Altimetry data and ARGO float data

Since our model experiments will follow the calendar years from 1979 to 2015, we will be able to perform side-by-side comparisons with our collected datasets described in Section 3.1. In the control run, comparison with observations (Section 3.1) will be performed globally, but attention will be given to the South Atlantic domain. Mean characteristics of density (temperature and salinity), mixed layer depth, sea level, the South Atlantic meridional overturning circulation and BC structure will be considered. In the western South Atlantic sector, we will compare the root-mean-square (RMS) for these variables to infer how their variability compares with the observed ones. The barotropic component of the velocity will be inferred from vertical averages of the velocity fields. We will also compare the statistics of eddy variability within the control simulation run, by a high pass filtering of the surface data using the wavelet methodology described in Section (4a), or between the pair of global eddy-permitting and the nested eddy-resolving runs under the same forcing by calculating their residuals.

2. Local versus remote forcing effects on the BC variability

It is well known that the main adjustment in the ocean thermocline occurs via baroclinic Rossby wave mechanisms. Locally, both Ekman convergence (divergence) and westward baroclinic Rossby wave propagation influence the properties such as the thermocline depth and sea level variability. Additional contribution arises from oceanic internal variability. Sea level anomalies reveal propagating patterns, mostly classified as the first baroclinic mode Rossby waves (Chelton and Schlax, 1996). The origin of these anomalies spreading across the South Atlantic is not always clear, because the South Atlantic receive water mass contributions from multiple oceans (Gordon, 1986; Garzoli et al., 2011). Contributions from the North Atlantic

Ocean surface fluxes are mainly due to changes in the subtropical cells, and the variability is linked to the subpolar gyre and northern seas. The subpolar gyre variability (Hakinnen and Rhines, 2004), affect the deep convection regions, and anomalies spread through alterations in the variability of the Atlantic meridional overturning circulation (Dong and Sutton, 2002; Johnson and Marshall, 2004; Goes et al., 2009). From the Indo-Pacific region, anomalous contributions may spread through the Drake Passage and Agulhas Leakage regions (Sprintall 2003; Beal et al., 2011), and there is strong evidence that the Indo-Pacific remote surface forcing is connected in large extent to the variability of the South Atlantic subtropical gyre (De Ruijter, 1982, Speich et al., 2007).

Here, we will investigate the patterns and time-scales of propagations toward the western South Atlantic forced locally and remotely, and how they influence the variability of the BC region. For this, we will produce pentadal maps and lead-lag correlation of anomalies, calculated as the residual between two simulations, of the thermocline, sea-level and upper-ocean heat content. Hovmoller plots will be used to compare the propagating sea level, temperature and salinity features across the South Atlantic. In addition, we will attempt to implement the EEOF analysis globally to follow the main propagation patterns of these quantities.

We will compare each of the forced experiments against each other, as well as against each pair of nested simulations by calculating their residuals. The eddy/internal variability will be investigated again by band-pass wavelet filtering. The effect of the internal variability on the mean circulation will be investigated locally by the changes in the barotropic streamfunction and the vertically integrated velocities. Special attention will be given to the location of the Brazil-Malvinas confluence region, and the recirculation gyre in the western boundary region (Vianna and Menezes, 2011), which may be highly influenced by the local eddy variability and advective pathways, similar to what is found in the North Atlantic subtropical gyre (Zhang et al., 2008, van Sebille et al., 2011).The coastal sea level and SST timeseries will be analyzed to investigate how eddy and the local and remote forcing influence its variability. Additionally, we will infer properties of the South Atlantic meridional overturning and heat transport, in terms of barotropic, Ekman and vertical shear components, as well as gyre and overturning variability (Dong et al., 2014; Goes et al., 2015). With this analysis, we will understand the role of remote forcing changes on the density gradient structure across the South Atlantic, and how it may relate to impacts across the basin.

4. Project Management

4.1 Project Team

PI Goes will lead the overall project management. PI Goes will lead the observational part, and will lead the simulations in the simplified reduced-gravity model. Co-PI Dong will produce the new synthetic BC timeseries, following the methodology that has already been applied in Dong et al. (2015), and will lead the model comparisons of meridional overturning and heat transport in the South Atlantic. Co-PIs Lee and Liu will lead the modeling component of the proposal, define the experiments and run the simulations. Liu is an expert in regional ocean modeling, and has already performed downscaled high-resolution model simulations using MOM4.1 in a similar way in the Atlantic Ocean, but with a focus on the Gulf of Mexico and Caribbean Sea (Liu et al, 2012; 2015). During her PhD, she studied the potential impact of climate change on the ocean circulation in the Galápagos Archipelago using a high-resolution ocean model (Liu et al. 2013).

All PIs will collaborate on the analysis and model/data comparisons, and synthesizing and disseminating the results via scientific papers, talks, and on a webpage at the University of Miami. The collaborator Dr. Lumpkin will help with the analysis of drifter product data in the Brazil Current region, and provide expertise on the South Atlantic interannual variability. The XBT data at 22°S off the coast of Brazil is carried out under the lead of Dr. Mata from FURG. The data will be made available in real time by Dr. Mata Dr. Mata and Dr. Cirano will assist on the interpretation of the data and offer their expertise on the Brazil Current variability. Dr. Mata and Dr. Cirano have their own funding, and they are planning a visit to Miami to promote the scientific and educational collaboration between the two universities in this and future projects.

4.2 Broader Impacts

This work will address several components of the broader impacts criterion defined by the National Science Board: 1) Improve the scientific knowledge of the response of the western boundary current to large scale forcings in the unique Brazil Current system. This knowledge will improve the capability of regional sea level and weather forecast; 2) Provide opportunity for early career scientists (Goes and Liu), and participation of women in science (Dong and Liu); 3) Enhance infrastructure for research and education by providing training for a postdoc (Liu) and involvement of college students as research interns; 4) Disseminate the scientific results via papers and talks, and provide educational outreach by producing didactic material that will be freely disseminated through the web to the community; 5) Increase partnership between the University of Miami and the Brazilian Universities (FURG and UFRJ).

4.3 Timeline

The proposed study will be performed over a 3-year period, which represents the three phases of the research. The first phase will be deserved to (1a) acquiring all necessary datasets, (1b) calculating the BC parameters along 22°S and 34°S using XBT and Argo data, (1c) implementing the synthetic profiles methodology to estimate continuous changes in those locations, and (1d) adaptation of the ocean general circulation model and nested eddy-resolving model to the region of study, and initial spinup. The second phase will be ascribed to (2a) study the eddy variability in the region using in-situ, altimetry and reanalysis data, (2b) associate the BC current variability with Sverdrup and Rossby wave mechanisms across the basin, and (2c) perform the ocean model experiments. The third phase is intended for (3a) the ocean model simulations validations and (3b) analysis with focus on the role of the remote and local surface fluxes variability and impacts on the western South Atlantic through ocean teleconnections. More specifically, we will proceed as follows, in terms of the tasks detailed in Section 3:

	TASK 1	**TASK 2**	**TASK3**	**TASK4**	**TASK5**
Year 1	**X**	**X**	**X**		**X**
Year 2			**X**	**X**	**X**
Year 3					**X**

Finally, the tasks associated with the broader impacts will be performed throughout the extent of the project. We expect to produce at least two scientific articles (years 2 and 3), and disseminate the results in yearly scientific conferences and on the university website. We expect the summer interns to join the research team during the summer of years 2 and 3. Meetings with our Brazilian collaborators will be done, either in scientific conferences, teleconferences or in potential visits to the University of Miami.

5. References

Arruda, W.Z., Campos, E.J.D., Zharkov, V., Soutelino, R.G., I.C.A. da Silveira, 2013: Events of equatorward translation of the Vitoria Eddy. Cont. Shelf Res., 70, 61-73.

Beal, L. and Co-authors, 2011: On the role of the Agulhas system in ocean circulation and climate. Nature, 472, (7344), 429-436, doi:10.1038/nature09983.

Beal, L. M., V. Hormann, R. Lumpkin, and G. R. Foltz, 2013: The Response of the Surface Circulation of the Arabian Sea to Monsoonal Forcing. J. Phys. Oceanogr., **43**, 2008-2022.

Berloff, P., A. Mc C. Hogg, and W. Dewar, 2007: The Turbulent Oscillator: A Mechanism of Low-Frequency Variability of the Wind-Driven Ocean Gyres. J. Phys. Oceanogr., 37, 2363-2386. doi: http://dx.doi.org/10.1175/JPO3118.1

Calado, L., I.C.A. Silveira, A. Gangopadhyay, B.M. Castro, 2010: Eddy-induced upwelling off Cape São Tomé (22°S, Brazil), Cont. Shelf Res., 30, 1181-1188.

Calado, L., A. Gangopadhyay, I.C.A. da Silveira, 2008: Feature-oriented regional modeling and simulations (FORMS) for the western South Atlantic: Southeastern Brazil region, Ocean Modell., 25 (1-2), 48-64.

Campos, E., 2006: Equatorward translation of the Vitoria Eddy in a numerical simulation Geophys. Res. Lett., 33, L22607.

Chelton, D., and M. Schlax, 1996: Global Observations of Oceanic Rossby Waves, Science, 272 (5259), 234-238.

Danabasoglu, G., 2008: On Multidecadal Variability of the Atlantic Meridional Overturning Circulation in the Community Climate System Model Version 3. J. Climate, 21, 5524-5544. doi: 10.1175/2008JCLI2019.1

De Ruijter, W. P. M., 1982: Asymptotic analysis of the Agulhas and Brazil current systems, J. Phys. Oceanogr., 12, 361-373.

Deser, C., M. A. Alexander, and M. S. Timlin, 1999: Evidence for a Wind-Driven Intensification of the Kuroshio Current Extension from the 1970s to the 1980s. J. Climate, 12, 1697-1706.

Dong, B.-W. and Sutton, R. T, 2002: Adjustment of the coupled ocean-atmosphere system to a sudden change in the Thermohaline Circulation. Geophys. Res. Lett. 29, doi:10.1029/2002GL015229.

Dong, S., S.L. Garzoli, M.O. Baringer, C.S.Meinen, and G. J. Goni, 2009: Interannual variations in the Atlantic Meridional Overturning Circulation and its relationship with the net northward heat transport in the South Atlantic, Geophys. Res. Lett., 36, L20606, doi:10.1029/2009GL039356.

Dong, S., G. Goni, F. Bringas, 2015: Interannual Variations of the South Atlantic Meridional Overturning Circulation from Satellite Observations. Submitted to Geophys. Res. Lett.

Donoho, D. L., and I. M. Johnstone, 1994: Ideal spatial adaptation via wavelet shrinkage. Biometrika 81, 425-455.

Evans D. L., and S.S. Signorini, 1985: Vertical structure of the Brazil Current, Nature, 315, 48-50.

Fernandes, A. M., I. C.A. da Silveira, L. Calado, E. J.D. Campos, A. M. Paiva, 2009: A two-layer approximation to the Brazil Current-Intermediate Western Boundary Current System between 20°S and 28°S, Ocean Model., 29, 154-158.

Garrafo, Z., and V. M. Kamenkovich, 1996: A note on the transport of the Brazil Current, Geophys. Res. Let., 23, 13 1629-1632.

Gordon, A. L., 1986: Interocean exchange of thermocline water, J. Geophys. Res., 1(C4), 5037-5046.

Garzoli, S. L., and C. Giulivi, 1994: What forces the variability of the Southwestern Atlantic boundary currents? Deep-Sea Res., Part I, 41, 1527-1550.

Garzoli, S.L., A. Ffield, W.E. Johns, and Q. Yao, 2004: North Brazil Current retroflection and transports. J. Geophys. Res., 109, C01013, doi:10.1029/2003JC001774.

Garzoli, S.L and R. Matano, 2011: The South Atlantic and the Atlantic Meridional Overturning Circulation. Deep-Sea Res. II, 58(17-18), 1837-1847, doi:10.1016/j.dsr2.2010.10.063.

Goes, M., R. Molinari, I. C. A. da Silveira, and I. Wainer, 2005: Retroflections of the North Brazil Current during February 2002. Deep Sea Res. I, 52, 3, 647-667.

Goes, M., D. Marshall, and I. Wainer, 2009: Eddy formation and its importance with respect to abrupt changes in the Atlantic Meridional Overturning Circulation. J. Physical Oceanogr., 39, 3021-3031.

Goes, M., G. Goni, V. Hormann, R. Perez, 2013: Variability of the Atlantic off-equatorial eastward currents during 1993-2010 using a synthetic method, J. Geophys. Res.-Oceans, 118, 6, 3026-3045.

Goes, M., I. Wainer, N. Signorelli, 2014: Investigation of the causes of historical changes in the sub-surface salinity minimum of the South Atlantic, J. Geophys. Res.-Oceans, 119, 5654-5675, doi:10.1002/2014JC009812.

Gong, D. Y. and S. W. Wang, 1999: Definition of Antarctic oscillation index, Geophys. Res. Lett., 26 (4), 459-462.

Goni, G. J., and I. Wainer, 2001: Investigation of the Brazil Current front variability from altimeter data, J. Geophys. Res., 106, 31,117-31,128.

Goni, G., and I. Wainer, 2001: Investigation of the Brazil Current front variability from altimeter data, J. Geophys. Res., 106, 31,117-31,128, doi:10.1029/2000JC000396.

Gordon, A. L., and C. L. Greengrove, 1986: Geostrophic circulation of the Brazil-Falkland confluence, Deep Sea Res., 33 (5), 573-585.

Gnanadesikan, A., and Coauthors, (2006), GFDL's CM2 Global Coupled Climate Models. Part II: The Baseline Ocean Simulation. J. Climate, 19, 675-697.doi: http://dx.doi.org/10.1175/JCLI3630.1

Griffies, Stephen M., Matthew J Harrison, Ronald C Pacanowski, and Anthony Rosati, (2004), A Technical Guide to MOM4, GFDL Ocean Group Technical Report No. 5, Princeton, NJ: NOAA/Geophysical Fluid Dynamics Laboratory, 342 pp.

Häkkinen, S., and P. Rhines, 2004: Decline of Subpolar North Atlantic Circulation During the 1990s, Science, 304 (5670), 555-559.

Hansen, D.V., and Thacker, W.C., 1999: Estimation of salinity profiles in the upper ocean, J. Geophys. Res., 104: doi: 10.1029/1999JC900015.

Johnson, H. L., and D. P. Marshall, 2004: Global teleconnections of meridional overturning circulation anomalies, J. Phys. Oceanogr., 34, 1702-1722.

Lentini, C, G. Goni, and D. Olson, 2006: Investigation of the Brazil Current rings in the confluence region, J. Geophys. Res., 111, C06013.

Liu, Y., S.-K. Lee, B. A. Muhling, J. T. Lamkin, and D.B. Enfield, 2012: Significant reduction of the Loop Current in the 21st century and its impact on the Gulf of Mexico. J. Geophys. Res., 117, C05039, doi:10.1029/2011JC007555.

Liu, Y., L. Xie, J.M. Morrison, and D. Kamykowski, 2013: Dynamic downscaling of the impact of climate change on the ocean circulation in the Galapagos Archipelago. Advances in Meteorology, 837432, doi:10.1155/2013/837432.

Liu, Y, S.-K. Lee., D. B. Enfield, B. A. Muhling, J. T. Lamkin, F. E. Muller-Karger, and M. A. Roffer., 2015: Potential impact of climate change on the Intra-Americas Sea: Part-1.A dynamic downscaling of the CMIP5 model projections. J. Mar. Syst., doi: 10.1016/j.jmarsys.2015.01.007.

Lumpkin, R., and G. C. Johnson, 2013: Global ocean surface velocities from drifters: Mean, variance, El Nino-Southern Oscillation response, and seasonal cycle, J. Geophys. Res. Oceans, 118, 2992-3006.

Mano, M. F., A. M. Paiva, A. R. Torres Jr., and A. L. G. A. Coutinho, 2009: Energy Flux to a Cyclonic Eddy off Cabo Frio, Brazil. J. Phys. Oceanogr., 39, 2999-3010, doi: http://dx.doi.org/10.1175/2009JPO4026.1

McCarthy, MC, Talley LD, and Roemmich D. 2000. Seasonal to interannual variability from expendable bathythermograph and TOPEX/Poseidon altimeter data in the South Pacific subtropical gyre. J. Geophys. Res.-Oceans. 105:19535-19550.

Ma, H., 1996: The dynamics of the North Brazil Current retroflection eddies, J. Mar. Res., 54, 35-53.

Mata, M. M., S. E. Wijffels, J. A. Church, and M. Tomczak, 2006: Eddy shedding and energy conversions in the East Australian Current, J. Geophys. Res., 111, C09034, doi:10.1029/2006JC003592.

Mata, M. M., M. Cirano, M. R. V. Caspel, C. S. Fonteles, G. Goni, and M. Baringer, 2012: Observations of Brazil Current baroclinic transport near 22 S: variability from the AX97 XBT transect. Exchanges (Hamburg. Print), v. 58, p. 5-10.

Matano, R. P., M. G. Schlax, and D. B. Chelton, 1993: Seasonal variability in the Southwestern Atlantic. J. Geophys. Res., 98, 18 027-18 035.

Menemenlis, D., J. Campin, P. Heimbach, C. Hill, T. Lee, A. Nguyen, M. Schodlok, and H. Zhang, 2008: ECCO2: High resolution global ocean and sea ice data synthesis. Mercator

Oce. Quart. Newsl., 31, 13-21.

Marshall, G. J., 2003: Trends in the southern annular mode from observations and reanalyses. J. Climate, 16 (24), 4134-4143.

Navarra, A., and V. Simonsini, 2010: A guide to orthogonal functions for climate data analysis. Springer, Dordrecht; New York, 151 pp.

Niiler, P. P., 2001: The world ocean surface circulation, in Ocean Circulation and Climate, Int. Geophys. Ser., vol. 77, edited by G. Siedler, J. Church, and J. Gould, pp. 193-204, Academic Press, San Diego, Calif.

Oliveira, L. R., A. Piola, M. M. Mata, and I. Soares, 2009: Brazil Current surface circulation and energetics observed from drifting buoys, J. Geophys. Res., 114, C10006.

Putrasahan, D., A. Miller, and H. Seo, 2013: Regional coupled ocean-atmosphere downscaling in the Southeast Pacific: impacts on upwelling, mesoscale air-sea fluxes and ocean eddies, Ocean Dyn., 63 (2013), pp. 463-488 http://dx.doi.org/10.1007/s10236-013-0608-2

Ralph, E. A. and P. P. Niiler, 1999: Wind-driven currents in the Tropical Pacific. J. Phys. Oceanogr. 29, 2121-2129.

Rhines, P. B., and W. R. Young, 1982: A theory of wind-driven circulation: Mid-ocean gyres. J. Mar. Res., 40, 559-596.

Rocha, C. B., I. C. A. da Silveira, B. M. Castro, and J. A. M. Lima, 2014: Vertical structure, energetics, and dynamics of the Brazil Current System at 22°S-28°S, J. Geophys. Res. Oceans, 119, 52-69, doi:10.1002/2013JC009143.

Rodrigues, R. R., L.M. Rothstein, and M. Wimbush, 2007: Seasonal variability of the South Equatorial Current bifurcation in the Atlantic Ocean: a numerical study, J. Phys. Oceanogr. 37, 16-30.

Schmid C., H. Schafer, G. Podestá, and W. Zenk, 1995: The Vitória Eddy and Its Relation to the Brazil Current. J. Phys. Oceanogr., 25, 2532-2546.

Schmeits, M. J., and H. A. Dijkstra, 2001: Bimodal Behavior of the Kuroshio and the Gulf Stream. J. Phys. Oceanogr., **31**, 3435-3456. doi: 10.1175/1520-0485(2001)031<3435:BBOTKA>2.0.CO;2

Signorini, S.R., 1978: On the circulation and the volume transport of the Brazil Current between the Cape of São Tomé and Guanabara Bay. Deep-Sea Res. 25, 481-490.

Silva, M., M. Araujo, J. Servain, P. Penven, and C. A. D. Lentini, 2009: High-resolution regional ocean dynamics simulation in the southwestern tropical Atlantic, Ocean Modell., 30(4), 256-269, doi:10.1016/j.oce-od.2009.07.002.

Silveira, I.C.A., L.B. Miranda, and W.S. Brown, 1994: On the origins of the North Brazil Current. J. Geophys. Res. 99 (C11), 22501-22512.

Silveira, I.C.A., A.C.K. Schmidt, E.J.D. Campos, S.S. Godoi, and Y. Ikeda, 2001: A corrente do Brasil ao largo da costa leste brasileira. R. Bras. Oceanogr. 48 (2), 171-183.

Silveira, I.C.A., L. Calado, B.M. Castro, M. Cirano, J. A. M. Lima, and A.S. Mascarenhas, 2004: On the baroclinic structure of the Brazil Current-intermediate Western boundary current system. Geophys. Res. Lett., 31 (14), L14308.

Silveira, I., J. Lima, A. Schmidt, W. Ceccopieri, A. Sartori, C. Franscisco, and R. Fontes, 2008: Is the meander growth in the Brazil current system off Southeast Brazil due to baroclinic instability? Dyn. Atmos. Oceans 45, 187-207.

Soutelino, R.G., Silveira, I.C.A., Gangopadhyay, A., and Miranda, J.A., 2011: Is the Brazil Current eddy-dominated to the north of 20S? Geophys. Res. Lett., 38 (3), L03607.

Soutelino, R.G.; Gangopadhyay, A; Silveira, I.C.A., 2013: The roles of vertical shear and topography on the eddy formation near the site of origin of the Brazil Current. Cont. Shelf Res., 70, 46-70.

Speich, S., B. Blanke, and W. Cai, 2007: Atlantic meridional overturning circulation and the Southern Hemisphere supergyre, Geophys. Res. Lett., 34, L23614, doi:10.1029/2007GL031583.

Spall, M. A., 1996: Dynamics of the Gulf Stream/deep western boundary current crossover. Part II: Low-frequency internal oscillations. J. Phys. Oceanogr., 26, 2169-2182.

Sprintall, J., 2003: Seasonal to interannual upper-ocean variability in the Drake Passage. J. Mar. Res. 61:1-31, http://dx.doi.org/10.1357/002224003321586408.

Stommel, H., 1965: The Gulf Stream. A physical and dynamical description, 2nd Ed., University of California Press, Berkeley, 248 pp.

Torrence, C. and G.P. Compo, 1998: A Practical Guide to Wavelet Analysis. Bull. Amer. Meteor. Soc., 79, 61-78.

vanSebille, E., M. O. Baringer, W. E. Johns, C. S. Meinen, L. M. Beal, M. F. deJong, and H. M. vanAken, 2011: Propagation pathways of classical Labrador Sea water from its source region to 26°N, J. Geophys. Res., 116, C12027, doi:10.1029/2011JC007171.

Vianna, M. L., and V. V. Menezes, 2011: Double-celled subtropical gyre in the South Atlantic Ocean: Means, trends, and interannual changes, J. Geophys. Res., 116, C03024, doi:10.1029/2010JC006574.

Vivier, F., C. Provost, M. P. Meredith, 2001: Remote and Local Forcing in the Brazil-Malvinas Region. J. Phys. Oceanogr., 31, 892-913.

Witter, D. L., and A. L. Gordon, 1999: Interannual variability of South Atlantic circulation from 4 years of TOPEX/POSEIDON satellite altimeter observations, J. Geophys. Res., 104(C9), 20927-20948, doi:10.1029/1999JC900023.

Wunsch, C., and D. Roemmich, 1985: Is the North Atlantic in Sverdrup Balance?. J. Phys. Oceanogr., 15, 1876-1880.

Biographical Sketch

Marlos Goes
Cooperative Institute for Marine and Atmospheric Studies
University of Miami
4600 Rickenbacker Causeway
Miami, FL 33149
Phone: (305) 361-4533
Fax: (305) 361-4457
E-Mail: mgoes@rsmas.miami.edu

(a) Professional Preparations:

Educational Institution	*Major*	*Degree*	*Degree Year*
University of Campinas, Brazil	Physics	B.Sc / Licenciate	1999
University of Sao Paulo, Brazil	Oceanography	M.Sc.	2001
University of Reading, UK	Oceanography	Doctorate fellow	2005
University of Sao Paulo, Brazil	Oceanography	Ph.D.	2006
Penn State University, USA	Climate studies	Post-doc.	2009

(b) Appointments:

2010 - present	Assistant Research Scientist, Cooperative Institute for Marine and Atmospheric Studies, University of Miami.
2009-2010	Oceanographic Consultant, Applied Science Associate, Sao Paulo, Brazil.
2007-2009	Post-doctoral fellow, The Pennsylvania State University.
2007	Visitor Scientist, POGO-SCOR scholarship, University of Maryland.
2004-2005	Visitor research Assistant, CAPES scholarship, University of Reading, UK.
2000-2006	Graduate Research Assistant, University of Sao Paulo, Brazil.

(c) Publications

(i) Five most related

Goes, M., G. Goni, S. Dong (2015), An optimal XBT-based monitoring system for the Atlantic meridional transport at 34°S, Submitted to *J. Geophys. Res*.

Goes, M., I. Wainer, N. Signorelli (2014), Investigation of the causes of historical changes in the sub-surface salinity minimum of the South Atlantic, in press at *J. Geophys. Res.-Oceans*.

Goes, M., G. Goni, V. Hormann, R. Perez (2013), Variability of the Atlantic off-equatorial eastward currents during 1993-2010 using a synthetic method, *J. Geophys. Res.*, 118 (6), 3026-3045, doi: 10.1002/jgrc.20186.

Goes, M. , D. Marshall, and I. Wainer (2009), Eddy formation and its importance with respect to abrupt changes in the Atlantic Meridional Overturning Circulation. J. Physical Oceanogr., 39, 3021-3031, doi: 10.1175/2009JPO4004.

Goes, M., R. Molinari, I. C. A. da Silveira, and I. Wainer (2005), Retroflections of the North Brazil Current during February 2002. Deep Sea Res - Part 1., 52, 3, 647-667, doi:10.1016/j.dsr.2004.10.010.

(ii) Five others

Goes, M., M. Baringer, and G. Goni (2015), The impact of historical biases on the XBT-derived meridional overturning circulation estimates at 34°S, Geophys. Res. Let., doi:10.1002/2014GL061802.

Goes, M., G. Goni, K. Keller (2013), Reducing biases in XBT measurements by including discrete information from pressure switches, *J. Atmos. Ocean. Tech*., 30, 810-824, doi:10.1175/JTECH-D-12-00126.1.

Wainer, I., **M. Goes**, L. N. Murphy, and E. Brady (2012), Changes in the Water Mass Formation Rates in the Global Ocean for the Last Glacial Maximum, Mid-Holocene and Pre-Industrial Climates, *Paleoceanography*, Vol. 27, PA3101, doi:10.1029/2012PA002290.

Sriver, R. L., **M. Goes**, M. E. Mann, and K. Keller (2010), Climate response to realistic tropical cyclone-induced ocean mixing in an Earth system model of intermediate complexity, *J. Geophys. Res.-Oceans*, doi:10.1029/2010JC006106.

Goes, M., Urban, N. M., Tonkonojenkov, R., Haran, M., Schmittner, A., and Keller, K. (2010), What is the skill of ocean tracers in reducing uncertainties about ocean diapycnal mixing and projections of the Atlantic Meridional Overturning Circulation?, *J. Geophys. Res*., doi:10.1029/2010JC006407.

(d) Synergistic activities

Presenter at the *NOAA/AOML Open House* for the local schools and general public, May 24, 2013.

Member of the XBT international science team.

Member of the AOML's *Buoys and Gulls* employee organization (2012-present).

Reviewer for: Research proposals (NOAA, FACEPE/Brazil, NSF), and research articles (*J. Geophys. Res.*, *Climatic Change, Geophys. Res. Lett., J. Atmos. Ocean Tech., Earth System Dyn.*).

(e) Collaborators & Other Affiliations

Graduate advisors: Ilana Wainer (USP/Brazil), David P. Marshall (U.Oxford/UK)
Post-doctoral advisor: Klaus Keller (Penn State)

Collaborators:
Gustavo Goni (NOAA/AOML), Shenfu Dong (U. Miami), George Halliwell (NOAA/AOML), Molly Baringer (NOAA/AOML), Lisa N. Murphy (U. Miami), Renellys Perez (U. Miami), Verena Hormann (U. Miami), Klaus Keller (Penn State), Ryan Sriver (U. Illinois), Ilana Wainer (U. Sao Paulo), Mauricio Mata (Federal University of Rio Grande), Natalia Signorelli (U. Sao Paulo), Lisa Murphy (U. Miami), Amy Clement (U. Miami), Esther Brady (NCAR).

Biographical Sketch

SHENFU DONG
CIMAS/University of Miami
4600 Rickenbacker Causeway, Miami, FL 33149 USA
Phone: (305) 361-4372
Fax: (305) 361-4412
E-mail: sdong@rsmas.miami.edu

PROFESSIONAL PREPARATION

Ocean University of China, China	Physical Oceanography	B.S., 1994
Ocean University of China, China	Physical Oceanography	M.S., 1996
University of Washington	Physical Oceanography	M. S., 1999
University of Washington	Physical Oceanography	Ph.D., 2004

APPOINTMENTS

Associate Research Scientist, University of Miami, 2011-present
Assistant Research Scientist, University of Miami, 2007-2011
Postdoctoral Scholar, Scripps Institution of Oceanography, 2004-2007.
Research Assistant: University of Washington, 1997-2004.

PUBLICATIONS

(a) Five most related:

Dong, S., G. J. Goni, and R. Lumpkin, 2015: Mixed-Layer Salinity Budget in the SPURS Region on Seasonal to Interannual Time Scales. *Oceanography*, in press.

Dong, S., M. O. Baringer, G. J. Goni, C. S. Meinen, and S. L. Garzoli, 2014: Seasonal variations in the South Atlantic Meridional Overturning Circulation from observations and numerical models. *Geophys. Res. Lett*., 41, 4611-4618.

Domingues, R., G. Goni, S. Swart, and S. Dong, 2014: Wind forced variability of the Antarctic Circumpolar Current south of Africa between 1993-2010. *J. Geophys. Res.*, 119, 1123-1145.

Dong, S., M. Baringer, G. Goni, and S. Garzoli, 2011: Importance of the assimilation of Argo Float Measurements on the Meridional Overturning Circulation in the South Atlantic. Geophysical Research Letters, 38, L18603, doi:10.1029/2011GL048982.

Dong, S., S.L. Garzoli, and M.O. Baringer, 2011: The role of inter-ocean exchanges on decadal variations of the northward heat transport in the South Atlantic. Journal of Physical Oceanography, 41(8):1498-1511.

(b) Five other publications:

Ansorge I., M. Baringer, E. Campos, S. Dong, Rana A. Fine, S. Garzoli , G. Goni, C. Meinen, R. Perez, Alberto Piola, Michael Roberts, Sabrina Speich, Janet Sprintall, Thierry Terre, and Marcel Van den Berg, 2014: "Bridging the Atlantic," *EOS*, Transactions, American Geophysical Union, 95(6):53-54, doi:10.1002/2014EO060001.

Dong, S., and K. A. Kelly, 2013: How Well Do Climate Models Reproduce North Atlantic Subtropical Mode Water? J. *Phys. Oceanogr*., 43, 2230 - 2244.

Meinen, C. S., S. Speich, R. C. Perez, S. Dong, A. R. Piola, S. L. Garzoli, M. Baringer, S. Gladyshev, and E. Campos, 2013: Temporal variability of the meridional overturning circulation

at 34.5°S: Preliminary results from two boundary arrays in the South Atlantic. *J. Geophys. Res.*, **118**, 6461-6478.
Wang, C., S. Dong, A. T. Evan, G.R. Foltz, and S.-K. Lee, 2012: Multidecadal covariability of North Atlantic sea surface temperature, African dust, Sahel rainfall and Atlantic hurricanes. *J. Clim*., 25:5404-5415, doi:10.1175/JCLI-D-11-00413.1
Dong, S., S. T. Gille, J. Sprintall, and E.J. Fetzer, 2010: Assessing the potential of Atmospheric Infrared Sounder (AIRS) surface temperature and relative humidity in turbulent heat flux estimates in the Southern Ocean. *J. Geophys. Res*, 115,C05013, doi:10.1029/2009JC005542.

SYNERGISTIC ACTIVITIES

- Member of US AMOC Team Member (2010-present)
- Member of the AMS Air-Sea Interaction Committee (2009 – present).
- Junior member of Mentoring Physical Oceanography Women to Increase Retention (MPOWIR) Mentoring Group, 2009 – present
- Member of American Geophysical Union, American Meteorological Society
- Organizer of the seminar series for the Physical Oceanography Research Division at SIO for 2004-2005 academic year

COLLABORATORS

Drs. Sarah Gille, Janet Sprintall, Kathryn A. Kelly, Lynne Talley, Susan Hautala, Chunzai Wang, Silvia Garzoli, Molly Baringer, Christopher S. Meinen, Gustavo J. Goni, Eric J. Fetzer, Rick Lumpkin, Denis Volkov, Marlos Goes.

Graduate and Postdoctoral Advisors

Kathryn A. Kelly	Graduate Advisor
Yong Du	Graduate Advisor
Sarah Gille	Postdoctoral Advisor
Janet Sprintall	Postdoctoral Advisor

Biographical Sketches

Sang-Ki Lee
Cooperative Institute for Marine and Atmospheric Studies
University of Miami
4600 Rickenbacker Causeway
Miami, FL 33149
Phone: (305) 361-4521
E-Mail: s.lee1@rsmas.miami.edu
Web: http://www.aoml.noaa.gov/phod/people/sklee.html

(a) Professional Preparations:

University of Miami	Climate studies	Post-Doc.	2002-2004
Old Dominion University	Oceanography	Ph.D.	1995
Old Dominion University	Oceanography	M.Sc.	1993
Inha University (South Korea)	Oceanography	B.Sc.	1991

(b) Appointments:

2011 - present	Scientist, Cooperative Institute for Marine and Atmospheric Studies, University of Miami
2007 – 2010	Associate Scientist, Cooperative Institute for Marine and Atmospheric Studies, University of Miami
2002 - 2007	Assistant Scientist, Cooperative Institute for Marine and Atmospheric Studies, University of Miami
2002 - 2004	Postdoctoral Associate, Cooperative Institute for Marine and Atmospheric Studies, University of Miami
1996 - 2001	Research Engineer, Maritime Research Institute, Samsung Heavy Industries (South Korea)
1991 -1995	Graduate Research Assistant, Old Dominion University

(c) Publications

Five publications related to the proposed research

Lee, S.-K., D. B. Enfield, C. Wang, 2005. Ocean General Circulation Model Sensitivity Experiments on the Annual Cycle of Western Hemisphere Warm Pool. Journal of Geophysical Research, Vol. 110, No. C09004, doi:10.1029/2004JC002640.

Lee, S.-K., D. B. Enfield and C. Wang, 2007. What Drives Seasonal Onset and Decay of the Western Hemisphere Warm Pool? Journal of Climate, Vol. 20, No. 10, 2133-2146.

Lee S.-K., W. Park, E. van Sebille, M. O. Baringer, C. Wang, D. B. Enfield, S. Yeager, and B. P. Kirtman, 2011. What caused the significant increase in Atlantic Ocean heat content since the mid-20th century? *Geophys. Res. Lett.*, doi:10.1029/2011GL048856.

Lee, S.-K., C. R. Mechoso, C. Wang and J. D. Neelin, 2013: Interhemispheric influence of the northern summer monsoons on the southern subtropical anticyclones. *J. Climate*, 26, 10193-10204. doi:http://dx.doi.org/10.1175/JCLI-D-13-00106.1.

Liu Y., S.-K. Lee, B. A. Muhling, J. T. Lamkin and D. B. Enfield, 2012. Significant reduction of the Loop Current in the 21st century and its impact on the Gulf of Mexico. *J. Geophys. Res*, 117, C05039, doi:10.1029/2011JC007555.

Five additional publications:

Lee, S.-K., D. B. Enfield and C. Wang, 2008. Why Do Some El Ninos Have No Impact on Tropical North Atlantic SST? *Geophys. Res. Lett.*, 35, L16705, doi:10.1029/2008GL034734.
Lee, S.-K. and C. Wang, 2008. Tropical Atlantic decadal oscillation and its impact on the equatorial atmosphere-ocean dynamics: A simple model study. *J. Phys. Oceanogr*., 38, 193-212.
Lee, S.-K., C. Wang and B. E. Mapes, 2009: A simple atmospheric model of the local and teleconnection responses to tropical heating anomalies. *J. Climate*, 22, 272-284.
Lee, S.-K. and C. Wang, 2010: Delayed advective oscillation of the Atlantic thermohaline circulation. *J. Climate*, 23, 1254-1261.
Lee, S.-K., D. B. Enfield and C. Wang, 2011. Future impact of differential inter-basin ocean warming on Atlantic hurricanes. *J. Climate*, 24, 1264-1275.

(d) Synergistic activities

Guest editor Progress in Oceanography, “Special issue: Gabriel T. Csanady volume”, 2006.

(e) Collaborators & Other Affiliations

Collaborators:

David Enfield (UM/RSAMS), Chunzai Wang (NOAA/AOML), Molly Baringer (NOAA/AOML), and Brian Mapes (UM/RSMAS)

Graduate Advisor:

Gabriel T. Csanady (retired)

Postdoctoral Advisors:

David B. Enfield (NOAA/AOML), Chunzai Wang (NOAA/AOML), Carlisle W. Thacker (NOAA/AOML)

Graduate students and Postdoctoral-Scholars advised:

Sarah Larson (UM/RSMAS), Pedro DiNezio (UM/RSMAS), Hailong Liu (UM/RSMAS), Yanyun Liu (UM/RSMAS) and Zhenya Song (UM/RSMAS)

Biographical Sketch
Yanyun Liu
Cooperative Institute for Marine and Atmospheric Studies
University of Miami
4600 Rickenbacker Causeway, Miami, FL 33149
Phone: (305) 361-4538
Email: liu5@miami.edu

(a) Professional Preparation

North Carolina State University, USA	Marine Science	PhD	2010
Ocean University of China, P.R. China	Marine Meteorology	MSc	2005
Ocean University of China, P.R. China	Meteorology & Computer Science	Dual BSc	2002

(b) Appointments

Postdoctoral Associate, CIMAS, University of Miami and NOAA/AOML 2010/08 - present
Graduate Research Assistant, North Carolina State University 2005/08 - 2010/07
Graduate Research Assistant, Ocean University of China 2002/01 - 2005/07

(c) Publications

(i) Five most closely related publications

Liu, Y, S.-K. Lee., D. B. Enfield, B. A. Muhling, J. T. Lamkin, F. E. Muller-Karger and M. A. Roffer., 2015. Impact of climate change on the Intra-Americas Sea: Part-1. A dynamic downscaling of the CMIP5 model projections. J. Marine Syst, in press, http://dx.doi.org/10.1016/j.jmarsys.2015.01.007.

Muhling, B. A., Y. Liu, S.-K. Lee, J. T. Lamkin, M. A. Roffer, F. E. Muller-Karger and J. F. Walter III., 2015. Impact of climate change on the Intra-Americas Sea: Part-2. Implications for Atlantic bluefin tuna and skipjack tuna adult and larval habitats. J. Marine Syst, in press, http://dx.doi.org/10.1016/j.jmarsys.2015.01.010.

Liu, Y., L. Xie, J. M. Morrison, D. Kamykowski and W. Sweet, 2014. Ocean Circulation and Water Mass Characteristics around the Galapagos Archipelago Simulated by a Multi-Scale Nested Ocean Circulation Model. Intl J. of Oceanogr., doi:10.1155/2014/198686, 16pp.

Liu, Y., L. Xie, J. M. Morrison, and D. Kamykowski., 2013. Dynamic downscaling of the impact of climate change on the ocean circulation in the Galapagos Archipelago. Advances in Meteorology, 2013:837432, doi:10.1155/2013/837432, 18 pp.

Liu Y., S.-K. Lee, B. A. Muhling, J. T. Lamkin and D.B. Enfield, 2012. Significant reduction of the Loop Current in the 21st century and its impact on the Gulf of Mexico. J. Geophys. Res, 117, C05039, doi:10.1029/2011JC007555.

(ii) Five other significant publications

Liu, Y., S.-K. Lee, C. Wang, D. B. Enfield, B. A. Muhling and J. T. Lamkin, 2015. Impact of the Atlantic multidecadal oscillation on North Atlantic Ocean circulation variability. in revision.

Muller-Karger, F. E., J. P. Smith, S. Werner, R. Chen, M. Roffer, Y. Liu, B. Muhling, D. Lindo-Atichati, J. Lamkin, S. Cerdeira-Estrada, and D. B. Enfield, 2015. Natural variability of surface

oceanographic conditions in the offshore Gulf of Mexico. Prog. Oceanogr. doi:10.1016/j.pocean.2014.12.007.
Muhling, B. A., S.-K. Lee, J. T. Lamkin, and Y. Liu, 2011. Predicting the effects of climate change on Bluefin tuna (Thunnus thynnus) spawning habitat in the Gulf of Mexico. ICES J. Mar. Sci., doi:10.1093/icesjms/fsr008.
Sweet W. V., J. M. Morrison, Y. Liu, D. L. Kamykowski, B. A. Schaeffer, L. Xie, S. Banks, 2009. Tropical instability wave interactions within the Galápagos Archipelago, Deep Sea Res, Part I, 56 (8), pp 1217-1229.
Liu Q. Y., Y. Liu, 2008. An ability testing of experiment scheme for response of the intermediate ocean-atmosphere model to external forcing, J. of Ocean University of China, 38, (1), 1-6.

(d) Synergistic activities
Presenter at the joint NOAA-NASA workshop for bluefin tuna research at U. Miami on Dec 8-10th, 2014.
Reviewer for research articles (Journal of Hydrology, Advances in Meteorology, Coral Reefs)

(e) Collaborators & Other Affiliations
Collaborators:
D. B. Enfield (CIMAS), G. J. Goni (NOAA/AOML), D. Kamykowski (NCSU), J. T. Lamkin (NOAA/SEFSC), S.-K. Lee (U. Miami), J. M. Morrison (UNCW), B. A. Muhling (U. Miami), F. Muller-Karger (USF), M. A. Roffer (ROFFS), F. Semazzi (NCSU), M. Upton (ROFFS), R. van Hooidonk (U. Miami), R. Wanninkhof (NOAA/AOML), L. Xie (NCSU)

Graduate Advisors and Postdoctoral Sponsors
PhD Advisors: Lian Xie & John M. Morrison
Postdoctoral Sponsors: Sang-Ki Lee & John T. Lamkin

SUMMARY PROPOSAL BUDGET

YEAR 1

FOR NSF USE ONLY	
PROPOSAL NO.	DURATION (months) — Proposed: / Granted:
AWARD NO.	

ORGANIZATION
University of Miami Rosenstiel School of Marine&Atmospheric Sci

PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR
Marlos Goes

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. **Marlos Goes - Principal Investigator**	6.00	0.00	0.00	**37,279**	
2. **Shenfu Dong - Co-Principal Investigator**	1.00	0.00	0.00	**7,527**	
3. **Sang-Ki Lee - Co-Principal Investigator**	1.00	0.00	0.00	**8,328**	
4. **Yanyun Liu - Co-Principal Investigator**	6.00	0.00	0.00	**28,074**	
5.					
6. (**0**) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.00	0.00	0.00	**0**	
7. (**4**) TOTAL SENIOR PERSONNEL (1 - 6)	14.00	0.00	0.00	**81,208**	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (**0**) POST DOCTORAL SCHOLARS	0.00	0.00	0.00	**0**	
2. (**1**) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	0.50	0.00	0.00	**2,386**	
3. (**0**) GRADUATE STUDENTS				**0**	
4. (**0**) UNDERGRADUATE STUDENTS				**0**	
5. (**0**) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				**0**	
6. (**0**) OTHER				**0**	
TOTAL SALARIES AND WAGES (A + B)				**83,594**	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				**34,270**	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				**117,864**	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.) **Computer Storage** $ **5,000**					
TOTAL EQUIPMENT				**5,000**	
E. TRAVEL 1. DOMESTIC (INCL. U.S. POSSESSIONS)				**3,000**	
2. FOREIGN				**0**	
F. PARTICIPANT SUPPORT COSTS 1. STIPENDS $ **0** 2. TRAVEL **0** 3. SUBSISTENCE **0** 4. OTHER **0**					
TOTAL NUMBER OF PARTICIPANTS (**0**) TOTAL PARTICIPANT COSTS				**0**	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				**0**	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				**0**	
3. CONSULTANT SERVICES				**0**	
4. COMPUTER SERVICES				**0**	
5. SUBAWARDS				**0**	
6. OTHER				**0**	
TOTAL OTHER DIRECT COSTS				**0**	
H. TOTAL DIRECT COSTS (A THROUGH G)				**125,864**	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) **MTDC (Rate: 57.0000, Base: 120864)**					
TOTAL INDIRECT COSTS (F&A)				**68,892**	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				**194,756**	
K. SMALL BUSINESS FEE				**0**	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				**194,756**	

M. COST SHARING PROPOSED LEVEL $ **0** AGREED LEVEL IF DIFFERENT $

PI/PD NAME
Marlos Goes

ORG. REP. NAME*

FOR NSF USE ONLY		
INDIRECT COST RATE VERIFICATION		
Date Checked	Date Of Rate Sheet	Initials - ORG

 ***ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET**

SUMMARY PROPOSAL BUDGET

YEAR 2

FOR NSF USE ONLY		
PROPOSAL NO.	DURATION (months)	
	Proposed	Granted
AWARD NO.		

ORGANIZATION
University of Miami Rosenstiel School of Marine&Atmospheric Sci

PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR
Marlos Goes

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. **Marlos Goes - Principal Investigator**	4.00	0.00	0.00	**25,598**	
2. **Shenfu Dong - Co-Principal Investigator**	1.00	0.00	0.00	**7,753**	
3. **Sang-Ki Lee - Co-Principal Investigator**	1.00	0.00	0.00	**8,578**	
4. **Yanyun Liu - Co-Principal Investigator**	6.00	0.00	0.00	**28,916**	
5.					
6. (**0**) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.00	0.00	0.00	**0**	
7. (**4**) TOTAL SENIOR PERSONNEL (1 - 6)	12.00	0.00	0.00	**70,845**	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (**0**) POST DOCTORAL SCHOLARS	0.00	0.00	0.00	**0**	
2. (**1**) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	0.50	0.00	0.00	**2,458**	
3. (**0**) GRADUATE STUDENTS				**0**	
4. (**0**) UNDERGRADUATE STUDENTS				**0**	
5. (**0**) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				**0**	
6. (**0**) OTHER				**0**	
TOTAL SALARIES AND WAGES (A + B)				**73,303**	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				**30,953**	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				**104,256**	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				**0**	
E. TRAVEL 1. DOMESTIC (INCL. U.S. POSSESSIONS)				**3,000**	
2. FOREIGN				**0**	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ **0**					
2. TRAVEL **0**					
3. SUBSISTENCE **0**					
4. OTHER **0**					
TOTAL NUMBER OF PARTICIPANTS (**0**) TOTAL PARTICIPANT COSTS				**0**	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				**0**	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				**2,000**	
3. CONSULTANT SERVICES				**0**	
4. COMPUTER SERVICES				**0**	
5. SUBAWARDS				**0**	
6. OTHER				**0**	
TOTAL OTHER DIRECT COSTS				**2,000**	
H. TOTAL DIRECT COSTS (A THROUGH G)				**109,256**	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) **MTDC (Rate: 57.0000, Base: 109256)**					
TOTAL INDIRECT COSTS (F&A)				**62,276**	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				**171,532**	
K. SMALL BUSINESS FEE				**0**	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				**171,532**	

M. COST SHARING PROPOSED LEVEL $ **0** AGREED LEVEL IF DIFFERENT $

PI/PD NAME
Marlos Goes

ORG. REP. NAME*

FOR NSF USE ONLY		
INDIRECT COST RATE VERIFICATION		
Date Checked	Date Of Rate Sheet	Initials - ORG

 *ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET

SUMMARY PROPOSAL BUDGET

YEAR 3

FOR NSF USE ONLY		
PROPOSAL NO.	DURATION (months) Proposed	Granted
AWARD NO.		

ORGANIZATION
University of Miami Rosenstiel School of Marine&Atmospheric Sci

PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR
Marlos Goes

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. Marlos Goes - Principal Investigator	4.00	0.00	0.00	26,366	
2. Shenfu Dong - Co-Principal Investigator	1.00	0.00	0.00	7,986	
3. Sang-Ki Lee - Co-Principal Investigator	1.00	0.00	0.00	8,836	
4. Yanyun Liu - Co-Principal Investigator	1.00	0.00	0.00	4,964	
5.					
6. (0) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.00	0.00	0.00	0	
7. (4) TOTAL SENIOR PERSONNEL (1 - 6)	7.00	0.00	0.00	48,152	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (0) POST DOCTORAL SCHOLARS	0.00	0.00	0.00	0	
2. (1) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	0.50	0.00	0.00	2,532	
3. (0) GRADUATE STUDENTS				0	
4. (0) UNDERGRADUATE STUDENTS				0	
5. (0) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				0	
6. (0) OTHER				0	
TOTAL SALARIES AND WAGES (A + B)				50,684	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				22,044	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				72,728	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				0	
E. TRAVEL 1. DOMESTIC (INCL. U.S. POSSESSIONS)				3,000	
2. FOREIGN				0	
F. PARTICIPANT SUPPORT COSTS 1. STIPENDS $ 0 2. TRAVEL 0 3. SUBSISTENCE 0 4. OTHER 0					
TOTAL NUMBER OF PARTICIPANTS (0) TOTAL PARTICIPANT COSTS				0	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				0	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				2,000	
3. CONSULTANT SERVICES				0	
4. COMPUTER SERVICES				0	
5. SUBAWARDS				0	
6. OTHER				0	
TOTAL OTHER DIRECT COSTS				2,000	
H. TOTAL DIRECT COSTS (A THROUGH G)				77,728	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) MTDC (Rate: 57.0000, Base: 77728)					
TOTAL INDIRECT COSTS (F&A)				44,305	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				122,033	
K. SMALL BUSINESS FEE				0	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				122,033	

M. COST SHARING PROPOSED LEVEL $ 0 AGREED LEVEL IF DIFFERENT $

PI/PD NAME
Marlos Goes

ORG. REP. NAME*

FOR NSF USE ONLY		
INDIRECT COST RATE VERIFICATION		
Date Checked	Date Of Rate Sheet	Initials - ORG

 *ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET

SUMMARY PROPOSAL BUDGET

Cumulative

ORGANIZATION **University of Miami Rosenstiel School of Marine&Atmospheric Sci**	FOR NSF USE ONLY PROPOSAL NO.	DURATION (months) Proposed	Granted
PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR **Marlos Goes**	AWARD NO.		

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. **Marlos Goes - Principal Investigator**	14.00	0.00	0.00	**89,243**	
2. **Shenfu Dong - Co-Principal Investigator**	3.00	0.00	0.00	**23,266**	
3. **Sang-Ki Lee - Co-Principal Investigator**	3.00	0.00	0.00	**25,742**	
4. **Yanyun Liu - Co-Principal Investigator**	13.00	0.00	0.00	**61,954**	
5.					
6. ( ) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.00	0.00	0.00	**0**	
7. (**4**) TOTAL SENIOR PERSONNEL (1 - 6)	33.00	0.00	0.00	**200,205**	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (**0**) POST DOCTORAL SCHOLARS	0.00	0.00	0.00	**0**	
2. (**3**) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	1.50	0.00	0.00	**7,376**	
3. (**0**) GRADUATE STUDENTS				**0**	
4. (**0**) UNDERGRADUATE STUDENTS				**0**	
5. (**0**) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				**0**	
6. (**0**) OTHER				**0**	
TOTAL SALARIES AND WAGES (A + B)				**207,581**	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				**87,267**	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				**294,848**	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.) $ **5,000**					
TOTAL EQUIPMENT				**5,000**	
E. TRAVEL 1. DOMESTIC (INCL. U.S. POSSESSIONS)				**9,000**	
2. FOREIGN				**0**	
F. PARTICIPANT SUPPORT COSTS 1. STIPENDS $ **0** 2. TRAVEL **0** 3. SUBSISTENCE **0** 4. OTHER **0**					
TOTAL NUMBER OF PARTICIPANTS (**0**) TOTAL PARTICIPANT COSTS				**0**	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				**0**	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				**4,000**	
3. CONSULTANT SERVICES				**0**	
4. COMPUTER SERVICES				**0**	
5. SUBAWARDS				**0**	
6. OTHER				**0**	
TOTAL OTHER DIRECT COSTS				**4,000**	
H. TOTAL DIRECT COSTS (A THROUGH G)				**312,848**	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE)					
TOTAL INDIRECT COSTS (F&A)				**175,473**	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				**488,321**	
K. SMALL BUSINESS FEE				**0**	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				**488,321**	

M. COST SHARING PROPOSED LEVEL $ **0** AGREED LEVEL IF DIFFERENT $

PI/PD NAME **Marlos Goes**	FOR NSF USE ONLY INDIRECT COST RATE VERIFICATION		
ORG. REP. NAME*	Date Checked	Date Of Rate Sheet	Initials - ORG

C ***ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET**

BUDGET JUSTIFICATION

This proposal, entitled "The Interannual Variability of the Brazil Current" is being submitted to the National Science Foundation and will cover a three year period from September 1, 2015 through August 31, 2018.

A. Senior Personnel
Salary support is requested for: PI M. Goes, 6 months/year in year 1, and 4 months/year (year 2 and 3) of the project. Goes will lead the project and work on the observational analysis; Co-PI Y. Liu (post-doc), 6 months/year on year 1 and 2, and 1 month/year in year 3 for model development, simulations and analysis. Y. Liu is funded for the rest of the year; Co-PI S-K Lee will receive 1 month/year to give his expertise in the modeling development and analysis. Co-PI S. Dong, 1 month/year for data analysis. The collaborators R. Lumpkin and M. Mata and M. Cirano will work on this project for one month per year at no additional salary cost.

B. Other Personnel
Salary for IT personnel or research support is included for 0.5 month/year for computational and operational support.

C. Fringe Benefits
Fringe benefits are charged at a rate of 40.69% on senior salary. An annual increase of 3% is included on the fringe benefit rate. Benefits include retirement, worker's compensation, health, life and dental insurance, termination, and Medicare.

D. Equipment
Computer Costs: One storage unit will be used for modeling output and observational data storage associated with this project is budgeted as $5000 in the first year.

E. Travel
We request travel funds for PI Goes and co-PI Liu to attend scientific meetings and present the results of the project. The amount of $3000/year is requested for domestic travel for the duration of the project. Co-PI Dong and co-PI Lee have their own travel funds.
Typical travel costs for researchers working on the project will be at the most economical coach airfares, which range from $400 - $800 for domestic travel. Hotel room rates average $145 - $175/night. University of Miami per diem rate allowance is $50/day respectively. Other costs associated with travel may include but are not limited to: meeting registration, abstract fees, rental car, fuel charges, taxis, metro, shuttles and portage.

F. Other Direct Costs
Publication Costs: The budget includes $2,000 each year as the estimated cost of preparing and publishing project results. All publication costs will be handled in accordance with the policies and procedures of the University of Miami.

G. Facilities and Administrative Costs
This work will be carried out at the U. Miami/RSMAS and NOAA/AOML facilities. The University of Miami's negotiated F & A rate is 57% MTDC with DHHS.

Current & Pending Support (Marlos Goes)

Current Support

None

Pending Funding

Title : The Interannual Variability of Brazil Current (this proposal)
Agency: NSF
Location of Project: University of Miami
Proposed Time Period: 09/01/2015 – 08/31/2018
Requested Funds: $488,321
Person Months: 6/4/4 months

Current and Pending Support (Shenfu Dong)

Current Support:

Project/Proposal Title: Assessment of the Meridional Overturning Circulation and Meridional Heat Transport and their temporal variability in the South Atlantic. (PIs: G. Goni, and S. Dong)
Source of Support: NASA/OSTST
Total Award Amount: $30K
Location of the Project: NOAA/AOML
Start and End Date: 01/01/2013-12/31/2016
Commitment (months/year) 1

Project/Proposal Title: Investigating the Processes Contributing to the Salinity Differences between Aquarius and in situ Measurements (PIs: S. Dong, D. Volkov, and F. Beron-Vera)
Source of Support: NASA/OSST
Total Award Amount: $552K
Location of the Project: University of Miami
Start and End Date: 07/01/2014-06/30/2017
Commitment (months/year) 3

Project/Proposal Title: OceanIndicatorsintheTropicalandSouthAtlanticOcean (PIs: G. Goni, S. Dong, M. Goes, and F. Beron-Vera)
Source of Support: NOAA/CPO
Total Award Amount: $471K
Location of the Project: NOAA/AOML
Start and End Date: 03/01/2014-02/28/2017
Commitment (months/year) 2

Project/Proposal Title: Variability and coherence of the Atlantic Meridional Overturning Circulation (PIs: M. Baringer, G. Goni, S. Dong, X. Xu, and E. Chassignet)
Source of Support: NOAA/CPO
Total Award Amount: $239K
Location of the Project: University of Miami
Start and End Date: 07/01/2014-06/30/2017
Commitment (months/year) 1

Project/Proposal Title: Atlantic BiogeoChemical Fluxes (ABC fluxes) Previous Track Record (Lead PI from US: M. Baringer, Lead PI from UK: E. McDonagh)
Source of Support: UK
Total Award Amount: $129K
Location of the Project: University of Miami
Start and End Date: 10/01/2014-09/30/2020
Commitment (months/year) 0.5

Pending

Project/Proposal Title:The Brazil Current Variability from interannual to decadal timescales (this proposal)

Source of Support:	NSF
Total Award Amount:	$423K
Location of the Project:	University of Miami
Start and End Date:	01/01/2015-12/31/2017
Commitment (months/year)	1

Current and Pending Support (S.-K. Lee)

Current:

(1) NOAA/CPO MAPP Program: Toward developing a seasonal outlook for the occurrence of major U. S. tornado outbreaks, PIs: S.-K. Lee (4 mon/yr), R. Atlas, C. Wang, D. B. Enfield, and S. Weaver, $430.0K, August 1, 2012 to July 31, 2015.
(2) NOAA/CPO MAPP Program: Variability and predictability of the Atlantic warm pool and its impacts on extreme events in North America, PIs: C. Wang, S.-K. Lee (5 mon/yr) and D. B. Enfield, $442.2K, August 1, 2012 to July 31, 2015.
(3) NASA: Management and conservation of Atlantic Bluefin Tuna (Thunnus Thynnus) and other highly migratory fish in the Gulf of Mexico under IPCC climate change scenarios: A study using regional climate and habitat models, PIs: M. A. Roffer, J. T. Lamkin, F. E. Muller-Karger, S.-K. Lee (1 mon/yr), B. A. Muhling, and G. J. Goni, $722K, 1 Sep 2011 – 31 Aug 2015.
(4) NOAA: Sustained and targeted ocean observations for improving Atlantic tropical cyclone intensity and hurricane seasonal forecasts, PIs: G. Goni, S.-K. Lee (1 mon/yr), W. McCall, J. Morell, H.-S. Kim, C. Wang, D. Enfield, E. Ulhorn, abnd J. Cione, $700K, 1 Feb 2014 – 31 Jan 2016.

Pending:

(1) NOAA/CPO MAPP Program: Evaluating the NMME-2 system prediction skill for springtime ENSO phase evolution and its relation to tornado outbreaks in the U.S., PIs: S.-K. Lee (4 mon/yr), R. Atlas and C. Wang, $69.0K, August 1, 2015 to July 31, 2016.
(2) NOAA/CPO MAPP Program: Process-oriented evaluation and study of CMIP5 climate models: biases in the Atlantic warm pool region versus North American rainfall and hurricane activity, PIs: C. Wang and S.-K. Lee (2 mon/yr), $434.3K, August 1, 2015 to July 31, 2018.
(3) NOAA FATE Program: Decadal prediction of physical and biogeochemical processes in the Gulf of Mexico and US Caribbean Sea, with impacts on new gear-restricted areas for Atlantic bluefin tuna, PIs: J. Lamkin, Y. Liu, S.-K. Lee (1 mon) and B. Muhling, $139.8K, August 1, 2015 to July 31, 2017.
(4) NSF: The Interannual Variability of Brazil Current (this proposal), PIs: M. Goes, Y. Liu, S. Dong, S-K Lee (1 mon), $488,321K, September 1, 2015 to August 31, 2018.

Current and Pending (Yanyun Liu)

Current Support:

None

Pending Support:

Project/Proposal Title: The Interannual Variability of Brazil Current (this proposal)
Source of Support: NSF
Total Award Amount: $488,321
Location of the Project: University of Miami
Start and End Date: 09/01/2015-08/31/2018
Commitment (months/year) 6.0

Facilities, Equipment, and Others at University of Miami

1. Computer Resources

The proposed MOM5 experiments will be performed using NOAA high performance computing system (HPCS) in Boulder, Colorado. The jet cluster system at HPCS consists of approximately 5440 CPU cores using 2.6 GHz Intel SandyBridge processors. Each node has 2 GB per processor interconnected using QDR Infiniband. We are currently using the maximum of 256 CPUs concurrently with the total disk storage space of 2 Tbytes.

Additional local computer resources are available at the University of Miami Center for Computational Science. Allocation of time on those machines can be requested during the proposal duration. The UM computational resources encompass a wide range of processors and system architectures and support several paradigms including massively parallel applications. The UM Pegasus cluster, IBM iDataplex and Blade Chassis architecture is provided with 10,000+ x86 (5,500 2.4 GHz Sandy Bridge, 4,500 Harpertown) 220 TFlops aggregate performance. Each cluster provides 500 TB High Performance of Global Parallel File System based storage and 19 TB aggregate RAM. The storage architecture is designed to provide high-speed access for both computation and presentation to client systems.

2. Data Storage

Additionally to the storage space provided by the University of Miami, a personal storage device (~10-15 Tb) is included in the budget for the use in the project.

3. Unfunded Collaborations

The collaborators R. Lumpkin, M. Mata and M. Cirano will work on this project for up to two months per year at no additional salary cost. Their roles in the project are described in the project description and attached Letters of Commitment.

Data Management Plan

We will provide the data necessary to recreate our results (e.g., model codes, input files, value-added data sets, and the specific model simulations results and data/model diagnostics) on a project web-page after six months of their production. These data products and model results will be hosted on local computing systems at UM and NOAA, and on the storage device to be purchase under the proposed budget. These data will be made freely accessible to the public and scientific community.

We plan to use multiple avenues of dissemination of our results, which will constitute an important element of the broader impacts of this project. Our results will be published in recognized scientific journals easily assessable for the scientific community, at scientific meetings such as AGU's Fall meeting and Ocean Sciences meetings, and in the University of Miami and NOAA webpages.

Postdoctoral Researcher Mentoring Plan for NSF Proposal

Dr. Yanyun Liu will be funded as a postdoctoral researcher for 6-months per year during the first two years, and 1 month per year in the third year of the project. The postdoctoral researcher's development will be enhanced through the well-established program of mentoring activities at the University of Miami (UM). The goal of the mentoring program will be to provide the skills, knowledge and experience to prepare the postdoctoral researcher to succeed in his/her career path. To accomplish this goal, the Dr. Liu will be offered, through the school's dedicated Postdoctoral Programs Office, a series of intensive workshops involving a combination of lectures, discussions, readings, written exercises, and practical experiences to enhance his/her professional development. These events include workshops to enhance skills in Scientific Writing, Professional Skills and Ethics and Grant Writing. Specific elements of the mentoring plan will include:

- Working with the postdoctoral researcher to establish and implement a yearly individual development plan based on the process of UM's Rosenstiel School of Marine and Atmospheric Science (RSMAS).
- Seminars and workshops on how to identify research funding opportunities and write competitive proposals, offered by the UM's Postdoctoral Programs Office.
- Participation in a weekly seminar series with invited speakers who are leading scientists in the fields, sponsored by the Meteorology and Physical Oceanography (MPO) division of UM/RSMAS.
- Participation in NOAA Atlantic Oceanographic and Meteorological Laboratory (AOML)'s informal research report seminars, in which all AOML scientists are expected to present their on-going research regularly.
- Participation in NOAA/AOML's visiting scientist seminars, which are offered irregularly at least once a month.
- Opportunities to network with visiting scholars who are leaders in our field by having individual one-on-one meeting and/or lunch/dinner with them when they participate in the UM/RSMAS's MPO weakly seminar series and NOAA/AOML visiting scientist seminars.
- Travel to at least one conference each year [e.g., AGU meeting] (travel funds are included in the budget), with the goal that the postdoctoral fellow presents a poster or oral presentation at the conference.
- Participation in journal clubs for graduate students and postdocs, in which participants meet by-weekly, along with one or more faculty facilitator, to discuss and critique recent journal articles in the field and to discuss how to write and submit journal articles.
- Participation in the weekly research group meetings, in which members will be expected to present their research regularly, and feedback will be given to help all members to develop their communication and presentation skills.
- Participation in NOAA/AOML's summer internship program to enhance his/her mentoring skills for undergraduate students.
- Opportunity to participate teaching both graduate and undergraduate students at UM/RSMAS.

Additionally, the PIs will help and work together with the postdoctoral researcher to produce high-quality scientific papers that list him/her as the first or a co-author. The PIs will also provide feedback on the scientific content and style of all manuscripts prepared by the postdoctoral researcher.

Success of this mentoring plan will be assessed by tracking the progress of the postdoctoral fellow through her/his individual development plan, interviews of the postdoctoral fellow to assess satisfaction with the mentoring program, and tracking of the postdoctoral fellow's progress toward his/her career goals after finishing the postdoc.