2006 ROMS/TOMS European Workshop

Universidad Alcalá, Rectorado building
Alcalá de Henares, Spain
November 6-8, 2006

Organized by: H. G. Arango and W. D. Cabos

How to get to Alcalá de Henares from Madrid Barajas International Airport (MAD)

Train

The metro stop is inside airport Terminal T2, reasonably close to Terminals T1 and T3. If you arrive in Terminal T4, take the bus line 201 to Terminal T2 (see map 1). The entrance is on the lower floor of Terminal T2, off a corridor that also leads to Parking Lot P2. The stop is well marked. Take the metro line 8 (upper right corner of map 1) to the Nuevos Ministerios station (train direction is also Nuevos Ministerios) where you can catch the commuter (Cercanías) train to Alcalá de Henares (see map 2).

From the Nuevos Ministerios station take Cercanías train line C1, C2 or C7 to the Alcalá de Henares stop (see map 2). The total trip takes around 1 hour from the airport underground station, plus around 30 minutes to reach the airport metro stop if your arrival is at Terminal T4. The University of Alcalá is within 15 minutes walking from the train station.

You can take a taxi from the train or bus stations to your hotel. Alternatively, you can walk from the train or bus stations to the Rectorado (see map 3). The University of Alcalá is within 15 minutes walking from the train station. If you take the C2 train, do not continue to the Alcalá de Henares Universidad stop.

Bus

From Terminal T1, T2 or T3 take the Madrid bus line 200, located at arrivals/departures to Avenida de América, Madrid. From terminal T4 take Madrid bus line 204 to Avenida de América, Madrid. The buses are located at the arrivals floor.

From the Avenida de América, Madrid, take interurban bus number 223 (day time) or N202 (night time) to the Calle Brihuega (Continental-Auto, Alcalá de Henares) bus station (close to the Rectorate). There is a taxi stop at the station if you need one.

Taxi

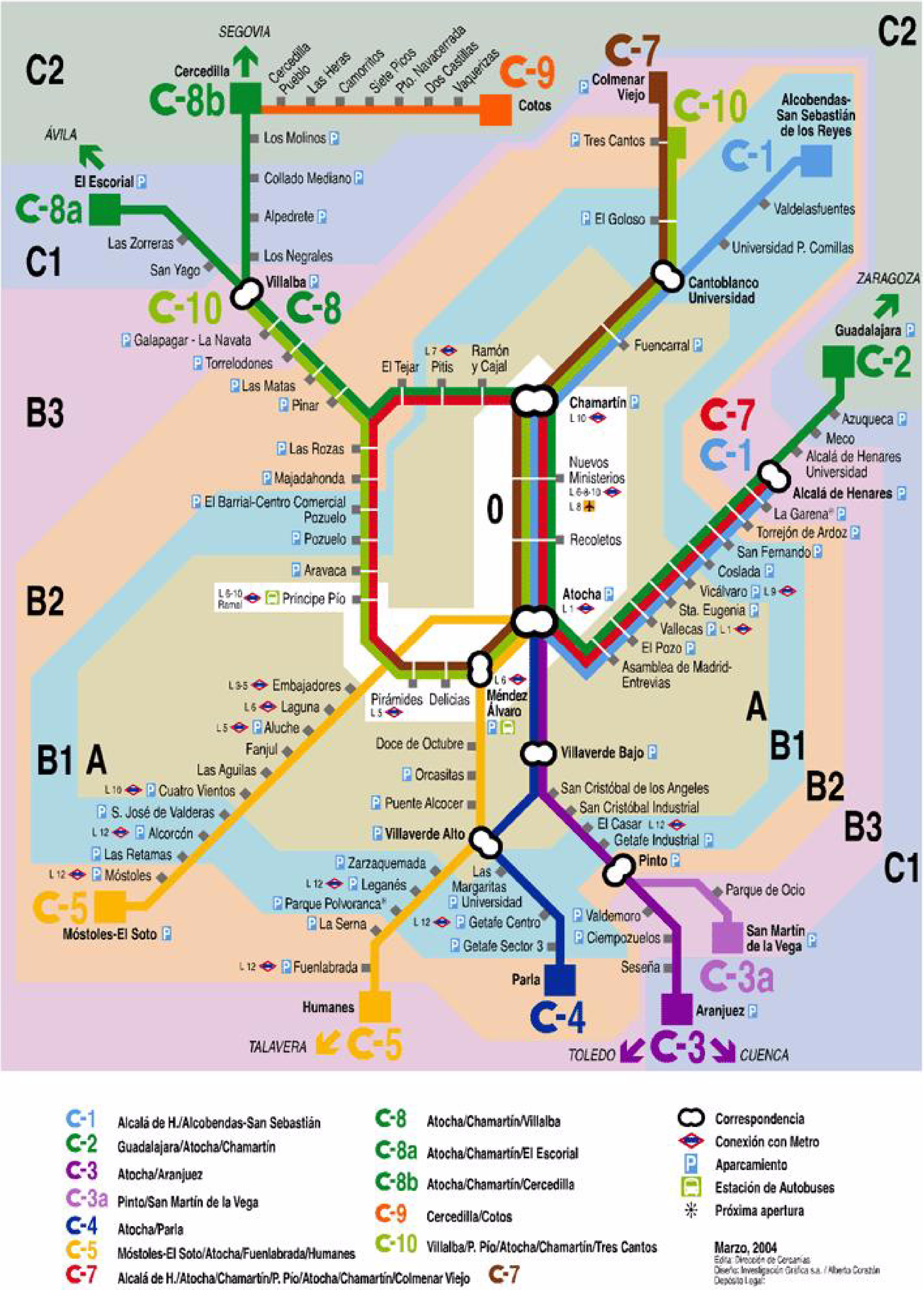
From the Barajas Airport to Alcalá will take about 30 minutes which should cost about 40-45 Euros minimum, subject to traffic jams.

Car

Follow signs to highway A-2 towards Alcalá. You can take exit number 23, although there are some others.

Map 1: Madrid Metro Train

Map 2: Cercanias Commuter Train



Map 3: Alcalá de Henares Hotels

1. Husa El Bedel
2. Hostal Bari
3. Hostal Miguel de Cervantes
4. Partner Cisneros
5. NH Alcalá de Henares
6. Campanile Hotel
7. Kris Alcalá
8. AC Alcalá

Places of Interest

The following list includes a few places to visit in Alcalá de Henares. See map 4 for approximate locations.

1. **University of Alcalá**. (San Diego Square) It was founded by the Cardinal Cisneros in 1499, and today you can see some of his buildings.

2. **The Cervantes Square**. Is the main square of the city. It has this name because there is a Cervantes sculpture. Here you can see the Alcalá Town Hall too.

3. **The Oidor Chapel**. It's situated at the Cervantes Square. Set on fire during the Civil War, today you only can see the bell tower and part of the apse.

4. **Calle Mayor**. It's the longest street with arcade around Europe. It starts at the Cervantes Square.

5. **The Cervantes Birthplace Museum**. The admission is free and you can see the place where the writer was born.

6. **Alcalá de Henares Masterly Cathedral**. There are only two Cathedrals in the world with this title, that means that their canonical members were also Masters.

7. **Hospital Our Lady of the Mercy or Antezana**. It was an aristocratic house that became Charity Hospital in 1483. The admission is free.

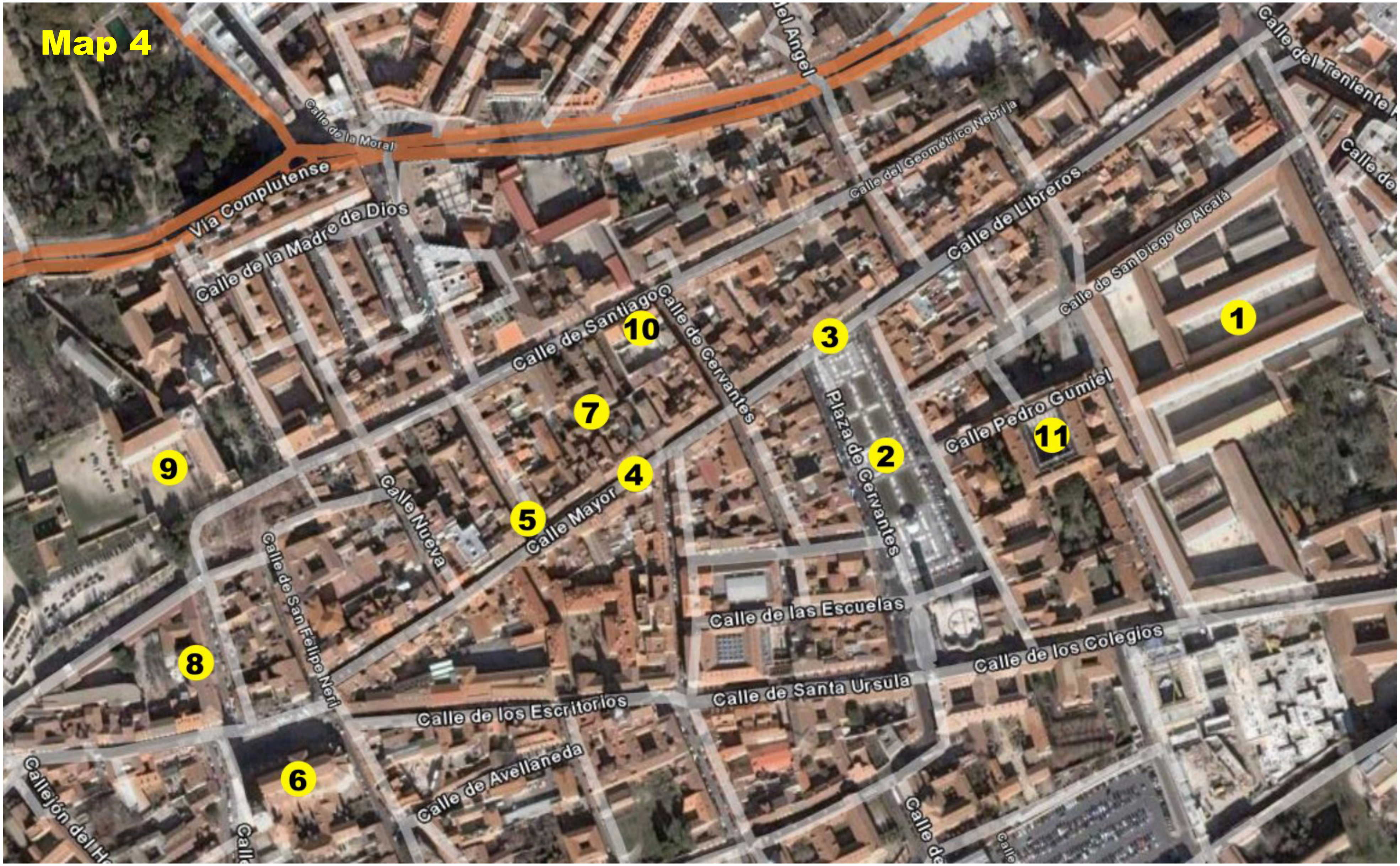
8. **House of Interview**. This building has this name in memory of the interview that took place between Queen Elizabeth The Catholic and Cristobal Colón.

9. **Archbishop's Palace**. It was built by Toledo's prelates as a fortress-castle, but in 1939 suffered a fire that destroyed most of the inside.

10. **Teatro Cervantes de Alcalá de Henares**. Built in 1888, this is one of the two theatres found in the city.

11. **Rectorado, Colegio de San Ildefonso**. The Complutense University (Central University of Madrid) was based here until 1836.

1. University of Alcalá
2. The Cervantes Square
3. The Oidor (hearer) Chapel
4. Calle Mayor
5. Cervantes Birthplace Museum
6. Alcala Masterly Cathedral
7. Antezana
8. House of Interview
9. Archbishop's Palace
10. Teatro Cervantes de Alcalá
11. Rectorado, Colegio de San Ildefonso



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PROGRAM

---------- Monday AM, November 6, 2006 ----------

08:00 Registration

08:55-09:00 Arango/Cabos: Welcome, logistics

Chairperson: Hernan G. Arango

09:00-09:30 (30 min) Chris Sherwood, USGS, USA
Cohesive Sediment Algorithms in ROMS and Sediment Test Cases

09:30-10:00 (30 min) W. Paul Budgell, IMR, Norway
A Global Hindcast of Ice and Ocean Conditions for 1958-2004 using ROMS

10:00-10:30 Break

Chairperson: Paul Budgell

10:30-11:00 (30 min) John M. Klinck, CCPO, Old Dominion U.
Imposed verses Dynamically Modeled Sea Ice: A ROMS Study of the Effects on Polynyas and Water Masses in the Ross Sea

11:00-11:25 (25 min) Michael S. Dinniman, CCPO, Old Dominion U.
Icebergs, Ice Shelves and Sea Ice: A ROMS Study of the Southwestern Ross Sea for 2001-2003

11:25-11:50 (25 min) Bronwyn Cahill, IMCS, Rutgers U.
Bio-physical modeling of the Hudson River plume dynamics from a bio-optical perspective

11:50-12:15 (25 min) Christian Mohn, National U. of Ireland
Temporal Variability in the Physical Dynamics at Seamounts and its Consequence for Bio-Physical Interactions

12:15-14:15 Lunch

---------- Monday PM, November 6, 2006 ----------

Chairperson: John Warner

14:15-14:45 (30 min) William Cabos, U. of Alcalá de Henares, Spain
Nesting Of ROMS For Climate Change Studies In The Gulf Of Lion

14:45-15:10 (25 min) Alvaro Peliz, U. of Aveiro, Portugal
Numerical Studies of the Gulf of Cadiz Circulation

15:10-15:35 (25 min) Pablo Otero, IEO, Spain
Variability of the Western Iberian Buoyant Plume to wind events

15:35-16:05 Break

Chairperson: William Cabos

16:05-16:30 (25 min) Manuel Ruiz Villareal, IEO, Spain
The Iberian Poleward Current around North and Northwest Iberia

16:30-16:55 (25 min) Paula Conde Pardo, IEO, Spain
Circulation Patterns Of The Southern Bay Of Biscay During A Winter-Spring Transition Period

16:55-17:20 (25 min) Luis Ferrer, AZTI, Spain
Operational ROMS in the Bay of Biscay

18:00 Poster Session, Reception

PROGRAM

---------- Tuesday AM, November 7, 2006----------

Chairperson: John Wilkin

09:00-09:30 (30 min) — Hernan G. Arango, IMCS, Rutgers U.
ROMS Framework and Algorithms

09:30-10:00 (30 min) — Javier Zavala-Garay, IMCS, Rutgers U.
Predictability of Mesoscale Variability in the East Australia Current System given Strong Constraint Data Assimilation

10:00-10:30 — Break

Chairperson: Chris Sherwood

10:30-11:00 (30 min) — John Warner, USGS, USA
To Couple or Not to Couple: Optimization for Oceanographic - Wave Model Synchronization

11:00-11:25 (25 min) — Rebecca Zanzig, U. of Washington
Coupling ROMS With CSIM In The Okhotsk Sea

11:25-11:50 (25 min) — Bjørn Ådlandsvik, IMR, Norway
Downscaling Future Climate Scenarios for the North Sea

11:50-12:15 (25 min) — Cure, Marcel, Marine Institute, Ireland
A Tidal and Surge Model of the North East Atlantic

12:15-14:15 — Lunch

---------- Tuesday PM, November 7, 2006 ----------

Chairperson: John Klinck

14:15-14:45 (30 min) — Pierrick Penven, IRD, France
SAfE (Southern Africa Experiments), a modelling platform for the oceanic circulation around Southern Africa

14:45-15:15 (30 min) — Ruoying He, WHOI, USA
Understanding Coastal Circulation in the Gulf of Maine and Middle Atlantic Bight: A Regional Model Hindcast Experiment

15:15-15:40 (25 min) — John Wilkin, IMCS, Rutgers U.
Integrating Ocean Observing and Modeling Systems for Analysis and Forecasting during the August/September 2006 Shallow Water Acoustics Experiment

15:40-16:05 — Break

Chairperson: Pierrick Penven

16:05-16:30 (25 min) — Vincent Combes, Georgia I. of Technology
The Role Of Surface Winds In The seasonal And Interannual Variability Of Large-Scale Eddies In The Gulf Of Alaska

16:30-16:55 (25 min) — Sandro Carniel, CNR-ISMAR, Italy
Measurements and Modeling of Turbulent Properties in the Adriatic Sea

16:55-17:20 (25 min) — Edith Soosaar, Tallinn U. of Tech., Estonia
Numerical modeling of upwelling filaments using ROMS

17:20-17:45 (25 min) — Changming Dong, IGPP/UCLA, USA
Scale Evolution in Coastal Upwelling Frontal Instabilities

PROGRAM

-------- Wednesday, AM, November 8, 2006 --------

	Chairperson: Sandro Carniel
09:00-09:25 (25 min)	Rich Signell, USGS, USA **Developing Standards-Based Analysis and Visualization Tools for ROMS**
09:25-09:50 (25 min)	Robert Hetland, Texas A&M U. **Using Python for Model Analysis and More**
09:50-10:15 (25 min)	David Robertson, IMCS, Rutgers U. **ROMS Web-based Documentation**
10:15-10:45	Break
10:45-12:30 (1 hour 45 min)	Moderators: Arango, Signell **General Discussion**
12:30	Adjourn

POSTERS

1. Abdennadher, Jihene, Institut Prepartoire aux Etudes d'ingenieurs, Tunisia
   The Generation of Internal Tides in the Strait of Sicily and Adjacent Areas
2. Boukhris, Yosr, Faculté des Sciences de Tunis, Tunisia
   Circulation in the Western Mediterranean Sea
3. Ferrer Rodríguez, Luis, AZTI, Spain
   Harbour Hydrodynamic Modelling with ROMS: Bilbao Case Study
4. Figueiredo de Rezende, Lúcio, U. de Aveiro, Portugal
   Mesoscale Variability On The Eastern Brazilian Shelf Through A ROMS Nested Model
5. García García, Eliseo, U. of Alcala de Henares, Spain
   An Analysis Of The Performance Of A Mediterranean ROMS model
6. Iermano, Ilaria, U. Politecnica delle Marche, Italy
   Preliminary Applications Of The ROMS Ecosystem Model To The Northern Adriatic Sea
7. Kim, Chang S., KORDI, South Korea
   Predictability of Sediment Transport arising from Undersea Sand Extraction in Coastal Waters of Korea
8. Kim, Hyun-Sook, USGS, USA
   Numerical study of storm impacts on coastal circulation in Long Bay, South Carolina
9. Long, Wen, U. of Maryland, USA
   ChesROMS Model: a ROMS-based Community Model for the Chesapeake Bay
10. Mason, Evan, University of Las Palmas, Spain
    2D Island Wake Experiments Using Distinct Bathymetric Domains (Representative Of The Island Of Gran Canaria)
11. Teles-Machado, Ana, University of Aveiro, Portugal
    Modelling Study of Gulf of Cadiz Coastal Countercurrent

Talk Abstracts

Downscaling Future Climate Scenarios for the North Sea

Bjørn Ådlandsvik
Institute of Marine Research, Bergen, Norway

Global, coupled, ocean-atmosphere climate models are too coarse and do not yet faithfully represent the regional details of coastal circulations. This is the case in the North Sea, the global system does not accurately resolve the shelf circulation for ecological studies. To obtain more realistic oceanic circulations, ROMS has been used in a dynamic downscaling approach. The global Bergen Climate Model (BCM) system is used to provide both atmospheric forcing and oceanic boundary conditions to a finer resolution model of the North Sea.

A couple BCM simulations have been downscaled corresponding to present (IPCC 20C3M run) and future (A1B run, 21st Century) climate scenarios. The downscaling improves the circulation in the North Sea by providing more realistic Atlantic inflow, improved winter temperatures, and more regional features like the Norwegian Coastal Current.

ROMS Framework and Algorithms

Hernan G. Arango
IMCS, Rutgers University, New Brunswick, NJ, USA

An overview of ROMS framework and algorithms will be presented. Following the Numerical Weather Prediction approach, we have built several adjoint-based platforms for variational data assimilation, ensemble prediction, Generalized Stability Theory (GST) analysis, and adjoint sensitivity analysis. The data assimilation algorithms include both strong (incremental 4DVar) and weak (indirect representers, 4DPSAS) constraint methods. The GST algorithms are used to study the dynamics, sensitivity, and stability of the ocean circulation to naturally occurring perturbations, errors or uncertainties in the the forecasting system. They can also be used to create ensemble initial conditions and to examine adaptive sampling strategies. The adjoint sensitivity platform can be used to study all the physical attributes of the ocean circulation, in a particular region, for any defined sensitivity measure or functional.

A Global Hindcast of Ice and Ocean Conditions for 1958-2004 using ROMS

W. Paul Budgell and **Vidar S. Lien**
Institute of Marine Research, Bergen, Norway

A global version of ROMS coupled to a dynamic-thermodynamic ice model was used to conduct a simulation for the period 1958-2004. The horizontal grid is on a stretched spherical coordinate system providing highest resolution in the northern North Atlantic and Arctic Oceans with a grid size of 17-20 km in those regions. The model is forced with tidal potential with self attraction and earth loading corrections, so that the effects of tidal mixing and residual circulation are included. Atmospheric pressure gradient forcing helps provide more realistic exchanges across straits. The atmospheric forcing is from the CORE (Common Ocean ice Reference Experiment) data set.

Comparison with observations show good agreement in the Nordic Seas, but Gulf Stream separation is too far north in the western North Atlantic. The hindcast data set is shown to provide high quality boundary forcing fields for one-way nesting to a high resolution model of the Barents Sea region.

Nesting Of ROMS For Climate Change Studies In The Gulf Of Lion

William Cabos, **Maria Jose Ortiz Bevia** and **Irene Perez**
Physics Department, Alcalá University, Spain

Global coupled climate models, like those used in the IPCC reports, are too coarse to study the impact of climate change on regional scales. However, they can be used to provide boundary conditions and atmospheric forcing to fine resolution regional applications. In this work, we compare the results from three simulations to study the circulation in the Gulf of Lion. ROMS is forced with boundary conditions and atmospheric fields from the HADCM3 coupled system.

The model domain includes the Atlantic basin and the Mediterranean. It's resolution is 1/6 degree and includes the entire Iberian Peninsula. It is coupled to a 1/18 degree resolution of the Gulf of Lion. The Agrif (Adaptive Grid Refinement In Fortran) package is used in order to get this finer resolution domain.Two simulations are carried out to explore the impact of open boundary conditions in the coupled system. The first uses Orlanski radiation open boundary conditions whereas the second uses boundary conditions from the global model. Next, the fine resolution Gulf of Lion domain is directly forced from the global model.

Bio-physical modeling of the Hudson River plume dynamics from a bio-optical perspective

Bronwyn Cahill and **Paul Bissett**
Florida Environmental Research Institute, Tampa, FL, USA

Bronwyn Cahill and **Oscar Schofield**
IMCS, Rutgers University, New Brunswick, NJ, USA

The Hudson River plume emanates from the highly urbanized New York / New Jersey Harbor complex, and represents a major pathway for the transport of nutrients and chemical contaminants to the coastal ocean. The fate and transport of this material is controlled not only by plume dynamics but also by biological and chemical processes that are coupled to the dynamics of the plume. As part of the Lagrangian Transport and Transformation Experiment (LaTTE), we use ROMS/EcoSim to model and synthesize LaTTE data from a bio-optical perspective, and examine the impact of buoyant plumes on the ecological dynamics of the Northeast US coast. EcoSim is an ecological/optical modeling system that was developed for simulations of carbon cycling and biological productivity. It includes four phytoplankton functional groups, each with a characteristic pigment suite which vary with the group carbon-to-chlorophyll-a ratio, C:Chla. The properties of each functional group evolve over time as a function of light and nutrient conditions. Other EcoSim components include bacteria, dissolved organic matter, and dissolved inorganic carbon cycling. The interaction between EcoSim's components describe autotrophic growth of and competition between the four phytoplankton groups, differential carbon and nitrogen cycling, nitrogen fixation and grazing.

Our first simulations focus on April 2005, coincident with the LaTTE 2005 field program, when a high springtime discharge from the Hudson River estuary took place, and variable mean winds predominantly fluctuated between northeasterlies and southeasterlies. Our results show a buoyant bulge of freshwater developing seaward of the Hudson River estuary in response to the high freshwater discharge event. Transport of the freshwater anomaly appears to respond to the prevailing wind direction: northeasterlies transport the freshwater anomaly southwestward along the New Jersey coast; southeasterlies transport the freshwater anomaly northeastward along the coast of Long Island. Oceansat derived chlorophyll between 5th and 21st April 2005 show plumes of high chlorophyll concentrations (> 5 mgl-1) developing along both the New Jersey and Long Island coasts. The ecological response to the freshwater anomaly, as determined by EcoSim, is being examined.

Measurements and Modeling of Turbulent Properties in the Adriatic Sea

Sandro Carniel
CNR-ISMAR, Venice, Italy

As part of the DART06A-6B cruises, carried out by NRV Alliance of the NATO Undersea Research Center (NURC) in late March and August 2006, a microstructure profiler was deployed to make turbulence measurements in the upper layers of the Southern Adriatic Sea. More than 500 casts were made, resulting in the largest dataset available to-date to our knowledge in this semi-enclosed basin. The main objective of these measurements is to help improve second moment closure (SCM) based ocean mixed layer (OML) models that are in current (and potential future) use in Navy community and operational ocean circulation models. This talk will shortly describe some preliminary results and first comparisons with the ROMS numerical ocean model.

The Role Of Surface Winds In The seasonal And Interannual Variability Of Large-Scale Eddies In The Gulf Of Alaska

Vincent Combes and **Emanuele Di Lorenzo**
Georgia Institute of Technology, Atlanta, GA, USA

Eddies in the open ocean are primarily generated through instability processes associated with regions of strong horizontal shear or upper ocean baroclinicity. However in the Gulf of Alaska interior, the largest ($D \leq 200$ km) and longer lived ($T \leq 4$ yr) eddies originate in coastal areas along the eastern boundary, where the generating dynamics are strongly dependent on the interaction between coastal flows and the complex geometry.

In this study, a high resolution regional oceanic model is used to explore the seasonal and interannual variability of eddy statistics. It is shown that most of the variance in the Gulf of Alaska basin is explained by interannual variability associated with the eddy field. During El Niño the eddy activity in the eastern basin is stronger. For example, consistent with observational records, the model captures a strong Haïda eddy in the winter 1982-83. However in contrast with previous findings by Melsom et al. (1999), who report on the important role of equatorial coastally trapped waves and enhanced baroclinic instability during El Nino years, we find that the baroclinicity of the flow field is not stronger during El Nino years and that local changes in the wind field, typical of the El Nino atmospheric teleconnection, play a bigger role in the generation of stronger eddy fields. Specifically along the eastern basin the eddy field results from a large scale geostrophic adjustment of the coastal flow field in response to a positive perturbation in sea surface height forced locally by poleward winds. The positive sea level anomaly corresponds to enhanced poleward buoyancy flow around the cape. The interplay of the coastal buoyancy flow with the complex coastal geometry is shown to be important in the generation and detachment of the larger eddies. The initial adjustment involves the excitation of nonlinear Rossby waves.

This study leads to a better understanding of the exchanges between inshore and offshore waters in regional oceans characterized by complex geometry at seasonal and interannual time scale. A correct representation of cross-shelf mixing is relevant for biogeochemical cycle in climate models. Also, given the long lived life of eddies generated along the eastern boundary, we hypostatize that these coastal dynamics may play a more important role in basin wide climate variability than previously recognized.

Circulation Patterns Of The Southern Bay Of Biscay During A Winter-Spring Transition Period

Paula Conde Pardo, **Manuel Ruiz Villarreal** and **Pablo Otero Tranchero**
Instituto Español de Oceanografía.Centro Oceanográfico de A Coruña.

Circulation in the northern Iberian coast (shelf and slope) has been studied for the transition period between winter and spring 2006. The effects of the interaction between wind events and the hydrographic conditions over the shelf have been analyzed with ROMS_AGRIF simulations. River plumes, with noticeable relevance in winter, were also taken into account for the experiments and the different evolution of them during upwelling (downwelling) pulses was studied. In this way, the nesting technique of ROMS allows for an effective way of getting better performances at the high resolution domain (1.8km) from an ocean domain (15km resolution). ROMS was forced with the local meteorological model MM5 (30km resolution) in both analytical and predictive experiments. A predictive simulation was successfully performed from May-2006 on. Circulation during winter was characterized by a Poleward slope flow of considerable strength favoured by strong wind pulses, which acts as a wall for the spreading of river plumes. This circulation pattern reverses in spring, when the river run-off reduces. Salinity, temperature and velocity fields were compared with current meter (Cabo Peñas, southwestern Bay of Biscay) and CTD data (cruises in Asturias shelf) with good agreement.

A Tidal and Surge Model of the North East Atlantic

Marcel Curé and **Kieran Lyons**
The Marine Institute, Ireland

It is surprisingly difficult to improve the tidal height predictions made by two dimensional tidal models, by using a 3D model. This talk examines the issues and difficulties in developing a ROMS model for the NE Atlantic, tuned to forecast tide surges and absolute tidal heights in shallow waters adjacent to a steep continental slope.

Our model extends to the Hatton Bank, Shetland and north Spain. It has a horizontal resolution of 2.5 km, 40 levels, and a bathymetry derived from SWATH survey over crucial slope areas. We have added code to include tidal potential for 22 constituents using the Doodson method. The latest version of the Oregon State model TPXO 7 is used at the model boundary. By running the model twice, with and without atmospheric forcing, we can arrive at a good surge prediction.

We compare model runs with and without tide potential and find it to be important in bays and estuaries where the continental margin is narrowest. We compare the model runs with tide gauge data from several Irish and UK gauges and find that whereas the phases are in excellent agreement, the amplitudes are in error by about 10 percent. Initial attention focuses on variable shear bed stress parameterisation using BBL models in ROMS, but in deep water we find departures from the independently generated FES2004 tide model of up to 0.2 m r.m.s. We examine the role of dissipation by internal waves and problems in accurately modelling this important process in our models.

Icebergs, Ice Shelves and Sea Ice: A ROMS Study of the Southwestern Ross Sea for 2001-2003

Michael S. Dinniman and **John M. Klinck**
CCPO, Old Dominion University, USA

Walker O. Smith, Jr.
Virginia Institute of Marine Science, College of William and Mary

A high resolution (5 km) ROMS model of the Ross Sea was created which included the Ross Ice Shelf and simulates the mechanical and thermodynamic effects of the Ice Shelf on the water in the cavity underneath. After a several year spin up period, the circulation model is forced with daily winds for the period September 2001 - September 2003, as well as heat and salt fluxes calculated from atmospheric climatologies by bulk formulae. Instead of a dynamic sea ice model, sea ice concentration is specified from satellite observations which then modify heat and salt fluxes through the melting and freezing cycle. To examine the effects of the extra sea ice due to C-19, simulations were performed using either the climatological ice concentrations or the observed ice for that particular time period. Another simulation was performed where a fixed iceberg (representing B-15A which was nearly stationary throughout this period) was placed in the model.

The area-average annual basal melt rate beneath the Ross Ice Shelf in the simulation with the climatological ice cover (12 cm/yr) is within the range of estimates (12 - 22 cm/yr) from observations. The simulation with the observed sea ice reduces the annual mean melting by about 1 cm/yr. There is reduced advection of warm surface water during austral summer from the Ross Sea polynya into McMurdo Sound in the B-15A simulation, but this effect is small in the austral summer of 2002-2003 since the surface water in the polynya was much cooler than usual because of the extra sea ice due to C-19.

Vorticity Generation in the Wake of an Island with Shelf Slope

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The Regional Oceanic Model System (ROMS) is used to investigate the mechanism of vorticity generation by an island with shelf slope. An idealized island shape with shelf slope is configured with a stratified and rotating flow passing the island. Numerical results show that the mechanism of eddy generation in the wake of the island with the shelf slope is different from our previous study of deep-water island wake: uneven-distributed bottom viscous stress becomes important in the eddy generation, associated with vortex stretching and baroclinic vertical tilting. In order to isolate the bottom stress from baroclinic vertical tilting, a slippery bottom is used in the numerical experiments.

Operational ROMS in the Bay of Biscay

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The Bay of Biscay, in the Atlantic Ocean, with a total area of approximately 250,000 km2, is limited by the northern Spanish and western French coasts. The hydro-climatic regime in the bay corresponds to that of a mid-latitude temperate zone. The currents in the upper layers of the water column are directly related to the wind fields, being their effects more important than the ones induced by circulation systems of higher scales, which are more relevant at deeper water depths off the continental shelf. Close to the shore, the orientation of the coastline (east-west and north-south along the Spanish and French coasts, respectively) together with the seasonal distribution of the prevailing winds explain (to a large extent) the general drift of the surface water masses in the Bay of Biscay. Hence, the winds blow predominantly from the southwest in autumn and winter, generating marine currents that, on an average, cause predominant eastward and northward drift. The wind regime changes towards the north-northwest during spring, causing currents to move in a southerly direction and towards the west-southwest along the French and Spanish coasts, respectively. The summer situation is similar to that of the spring, although the presence of weak winds of high variability results in a more indeterminate general drift direction of the currents (Lazure, 1997). This work shows the ROMS working in the Bay of Biscay in an operational way. Results show that the accuracy of the input data required by the model play a fundamental role in the prediction of the spatial and temporal hydrodynamic evolution. At the upper layers of the water column, the winds confirm their importance on the current forecast, as is shown by the data recovered by drifting surface buoys. This is relevant for the analysis of specific phenomena such as oil spills drifting on the sea surface waters, fish eggs and larvae dispersion, algal blooms, etc.

Understanding Coastal Circulation in the Gulf of Maine and Middle Atlantic Bight: A Regional Model Hindcast Experiment

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A regional ocean model (based on ROMS) is configured to provide circulation hindcast for the coastal region of the Northeastern United States, encompassing the Gulf of Maine (GOM) and the Middle Atlantic Bight (MAB). Coastal circulation in this region is strongly affected by both local momentum and buoyancy fluxes and a wide range of remote, offshore processes such as basin-scale seasonal and inter-annual variability, Gulf Stream meanders, and meso-scale and submeso-scale eddies. The hindcast experiment, therefore, considers realistic forcing conditions. To effectively represent the impact of offshore variability, the Hybrid Coordinate Ocean Model (HYCOM) Global Ocean Data Assimilation Experiment (GODAE) solutions are also used to provide open boundary conditions via one-way nesting approach. Validations of this regional hindcast model and synthesis for coastal circulation during 3-year time period from 2003 to 2006 will be presented. Based on realistic, space and time continuous circulation realizations, we will also report our findings/understandings on seasonal and inter-annual variability of circulation and shelf/deep- ocean exchange processes in this coastal region.

Using Python for Model Analysis and More

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Python is a scripting language that is easy to learn and use (like MATLAB), is object-oriented and very powerful, and is rapidly becoming a standard language for scientific scripting. Many scientists are developing packages and toolboxes in python, for example www-pcmdi.llnl.gov/software-portal/cdat, www.pyngl.ucar.edu, and countless other, smaller packages. Many utilities are being developed with python hooks built in (like VTK, a 3D visualization library). Python has all of the basic tools required for working with numerical model data, in particular NetCDF support. Python can also be used as a wrapper for C and FORTRAN code, so you can have the speed of FORTRAN for number crunching with the ease of a high level language for data I/O. Finally, python is free and open source, and is available on all major computer platforms.

Imposed verses Dynamically Modeled Sea Ice: A ROMS Study of the Effects on Polynyas and Water Masses in the Ross Sea

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A meso-scale resolution (5 km grid spacing) regional circulation model, based on ROMS, has been configured for the Ross Sea, including the continental shelf, the oceanic Ross Gyre and the water under the Ross Ice Shelf (RIS). Daily and monthly atmospheric conditions drive the circulation and surface water transformations. Both mechanical and thermodynamic effects of the RIS are included. The sea ice is simulated in two different methods. In the first, sea ice concentration is specified from satellite observations which then modify heat and salt fluxes through the melting and freezing cycle. In the second, the Los Alamos dynamic sea ice model (CICE) has been coupled to ROMS.

Multi-year simulations are used to contrast the effects of the two different methods. The modeled High Salinity Shelf Water in both simulations is reasonable when compared with a new climatology for the Ross Sea, but it is speculated that the interannual variability is better for the imposed sea ice calculation since the austral summer of 2002-2003 had unusually high ice cover due to the restricted advection of sea ice by a massive iceberg (C-19) which makes it difficult for CICE to accurately model the ice those years. The Ross Sea Polynya in the CICE simulation shows appropriate seasonal behavior providing insight into the polynya dynamics which can not be done with the imposed sea ice model. The smaller, but more important, Terra Nova Bay polynya does not appear in the CICE model unless the small scale katabatic winds in that region are included.

Temporal Variability in the Physical Dynamics at Seamounts and its Consequence for Bio-Physical Interactions

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Seamounts are common features of the deep ocean, and often localised regions of enhanced biomass, even in oligotrophic oceans. Physical dynamics associated with seamounts have often been cited as a principal driving force for their biological functioning. Observations made at an intermediate depth seamount (800m summit) in the subtropical N Atlantic have revealed aspects to temporal variability of physical forcing at seamounts. An array of current meters has shown that a mean anti-cyclonic flow exists at the seamount consistent with that expected for a steady flow forcing the local seamount dynamics. Variability in relative vorticity around the seamount could be attributed to changes in the flow field impacting at the seamount. Variability in the forcing regime at seamounts implies subsequent variability in the coupling between the physical forcing and biological response. Satellite observations of chlorophyll concentrations show that a mean, slightly enhanced chlorophyll signal is present in the Sedlo region. Large spatial and inter-annual variability in the chlorophyll distribution, however, exists both over the seamount and in the surrounding far field ocean. This implies that the seamount may be a source of biological variability in the surrounding ocean which may be due, in part, to the variable physical forcing. Numerical simulations with the 3-dimensional ocean circulation model ROMS of an idealised Sedlo seamount have shown that the retention of passive particles (such as chlorophyll) is significantly reduced if more realistic variable forcing is used to generate the seamount dynamics. Results suggest that long term observations are required to fully quantify the full spectrum of bio-physical coupling.

Variability of the Western Iberian Buoyant Plume to wind events

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The Western Iberian Buoyant Plume (WIBP) is a low-salinity lens formed by river discharge and continental runoff extending over the shelf off NorthWest Iberia. The narrowness of this shelf brings over the interaction of this structure with offshore circulation, specially with the Iberian Poleward Current, a seasonal-enhanced slope current driven by the large-scale meridional density gradient. Much of our knowledge on the variability of river plumes comes from studies of plumes from larger rivers flowing into broader shelves. Furthermore, the strong event variability in winds and the reduced run-off compared to other previously studied river systems in the world make this area an interesting system for comparative studies. Variability is strongly determined by the dominant event-nature of winds in this upwelling-influenced area. In this study, the system is evaluated with ROMS forced by real meteorological data and climatology river discharge during autumn 2002. Model results show how the plume confines to the coast, deepens and accelerates with southerly winds; and gets shallower and expands offshore during both upwelling pulses and relaxation events, when enhanced dispersion in the frontal area is found. We will present an assessment of the performance of the model in the representation of the main features and their variability.

Numerical Studies of the Gulf of Cadiz Circulation

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The the entrainment of Central Water by the Mediterranean Outflow as it descends the northern slope of the Gulf of Cadiz has been proposed to be the generation mechanism of the Azores Current either by the production of a planetary beta-plume or by a topographic beta plume. Although theoretical studies exist that support this link, few attempts have been made to match these two circulation features in one modeling framework. The simulation of realistic Mediterranean Outflow requires resolutions on the order of 2 km, while the Azores Current is a Cross-Atlantic jet. This makes this problem particularly suitable for future 2-way nesting applications. We show results of a step-by-step approach where large scale configurations with a parameterization of the Mediterranean Overflow are used to initialize and control the open boundaries of high resolution Gulf-scale grids with explicitly imposed Mediterranean Outflow.

SAfE (Southern Africa Experiments), a modelling platform for the oceanic circulation around Southern Africa

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South of Africa, the presence of the Agulhas Current and the spawning of Agulhas Rings influence the Benguela upwelling system. Consequently, to model the upwelling system, it is necessary to represent the Agulhas current. The SAfE (Southern Africa Experiments) configuration was built by resolving the dynamics of the Agulhas Current as a whole, from its sources close to Madagascar to the dissipation of the Agulhas Rings in the Southern Atlantic Ocean. SAfE is based on ROMS_AGRIF and was built by using ROMSTOOLS. The grid extends from 2.5W to 54.75E and from 46.75S to 4.8S for. The resolution is 1/4 degree. To treat each specific scientific question, a local refinement is set up. Two types of simulations are carried out: climatological and interannual. For the climatological experiments, the solution is calculated over 10 years, using World Ocean Atlas 2001 for the boundaries and COADS for the surface fluxes. For the interannual experiments, SAfE is using the results of an OGCM (SODA) for the boundaries and NCEP for the surface fluxes. The solution is calculated from 1958 to 2001. Currently, 2 nested grids at higher resolution are integrated into SAfE: the first grid is centered on the Agulhas Bank, South of Africa, to study the dynamics of the cold tongue, which is rich in nutrients. The second grid is adjacent to the entire West coast of Southern Africa to study the Benguela upwelling system.

ROMS Web-based Documentation

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We will discuss the current status and capabilities of ROMS web sites: marine.rutgers.edu/roms and www.myroms.org. In particular, we will present our web-based documentation in terms of short lectures (Webinars), developers weblog, WikiROMS, and manual pages. The WikiROMS is in the early stages and we want to encourage the ROMS user community to participate actively in its development.

The Iberian Poleward Current around North and Northwest Iberia

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Autumn-winter shelf-slope circulation at the eastern boundary of the north Atlantic (Western Europe) is dominated, like in other eastern boundary current (EBC) systems, by a poleward current: the “Iberian Poleward Current" (IPC). Around NW Iberia the coastline changes orientation from south-north to west-east and this feature has an impact on dynamics that has not been properly investigated. On the Iberian west coast, the main forcing mechanism of this poleward flow is the large-scale meridional density gradient parallel to the slope, which is seasonally variable. On the northern coast (southern Bay of Biscay), an along-shore meridional pressure gradient is not present and the poleward flow is expected to decay by friction. In this contribution we will review and present new simulations with ROMS illustrating variability in the IPC and will concentrate on assessing ROMS ability to simulate the main physical processes involved in its generation and dynamics and its interaction with local features like river plumes and topographical accidents and its wind-induced variability. We will investigate the impact of different model set-ups and model parameterization in the results.

Developing Standards-Based Analysis and Visualization Tools for ROMS

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We are building new standards-based tools for ROMS users. One component is a set of Matlab tools that are based on Java rather than machine-dependent mex files. This not only makes the software easier to maintain and install, but gives access to higher level Java functions, such as time conversion and slices along arbitrary sections. As a first step, the data retrieval tools in the SNCTOOLS package have been modified to allow for calls to NetCDF-Java for data input. The RSLICE GUI visualization tool therefore also no longer requires Mex files, as it is built on top of SNCTOOLS. The new higher level tools are being built so that they will work with any CF-Compliant model output, not just ROMS files. The future directions of CF will also be discussed, as there are plans to cover a variety of more sophisticated model relationships, such as grid staggering, mosaics of grids, contact regions and overlapping contact regions.

Cohesive Sediment Algorithms in ROMS and Sediment Test Cases

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Larry Sanford
University of Maryland, Center for Environmental Science

Alan Blumberg
Stevens Institute of Technology, Dept. of Civil, Environmental, and Ocean Engineering

Courtney Harris
Virginia Institute of Marine Science

We have added cohesive-sediment algorithms to the ROMS sediment-transport model that allow ROMS to simulate erosion, deposition, and biodiffusive mixing of sand, muds, or mixed sediments. The new code implements algorithms developed by Sanford and Blumberg (*Modeling resuspension and deposition with a dynamically varying mixed sediment bed* 18th Biennial Conference of the Estuarine Research Federation, 2005). The model assumes that cohesive sediments have a critical stress for erosion that varies (typically increasing) with depth in sediments, determined by various physical and biological properties or processes. This shape of the profile is most readily determined from field or laboratory measurements using instruments like the Gust chamber or Sea Carousel. Erosion and deposition alter this profile, but it is reestablished over a characteristic time scale. The critical stress profile limits the amount of sediment that can be eroded during events with time scales much shorter than the profile restoration time scale. This behavior contrasts with that of non-cohesive material (e.g., sand or silt with less than about 5-10% mud), for which the critical shear stress depends on the grain size and density, rather than depth in the bed. Mixed sediments exhibit cohesive behavior when the mud content exceeds a threshold (15-30%), and a gradual mix of erosion properties is implemented between the limiting thresholds. Biodiffusion is implemented and can redistribute cohesive and non-cohesive sediments within the bed. A few conceptual test cases demonstrate the use and implications of these algorithms in ROMS.

Numerical modeling of upwelling filaments using ROMS

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Upwelling filaments cause offshore export of cold nutrient-rich water. Coastal upwelling and upwelling filaments are common phenomenon in the Gulf of Finland (GOF). Observations show that locations of upwelling centers and filaments are very often highly repeatable.

The Regional Ocean Modeling System (ROMS) is used to model coastal upwelling filaments in a short time period (10 days). To gain an overview of upwelling filaments formation we consider three high resolution (2.7 km) experiments in the GOF area. In the first two experiments, the model is forced with constant wind from west and east cardinal points, while the third experiment is with measured wind from 19 July 1999 to 29 July 1999 when upwelling filaments were observed in GOF. Measured water temperature and salinity profiles (horizontally constant) were used for all three experiments.

In first two experiments upwelling started to occur with one and half day and clear defined filaments emerged between the third and forth day. Anticyclonic eddies, which curved filaments in their rotating direction, developed on the right side of the filaments in the both cases. By the end of the simulation, upwelling was covering the entire coast and had spread cross-shore to half of the GOF. Filaments extended to the opposite coast. More pronounced filaments had started to form a mushroom head shape.

Comparison of the third experiment and observations, show good agreement in the location of filaments, but strength and offshore extent was underestimated in the model. The major difference between simulated and observed filaments was that the modeled filaments tend to curve clockwise while the observed filaments tend to curve counterclockwise.

To Couple or Not to Couple: optimization for oceanographic - wave model synchronization

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Prediction of nearshore processes is important for coastal circulation, water quality, shoreline change, and recreational safety. We have enhanced the capabilities of ROMS to include many new features for nearshore applications, including wetting/drying, morphology, nearshore radiation stress forcings, surface roller model, and two-way coupling to the wave model SWAN. The coupling is performed using shared libraries from the Model Coupling Toolkit. The two-way coupling allows wave propagation to respond to flow from the circulation model and bathymetric changes from the sediment-transport model. In return the mean circulation responds to wave transformations and the sediment transport responds to the wave-orbital motions. Here we focus primarily on the implications for model coupling, describe the methodology, and examine the interactions by varying the synchronization levels. Several simple test cases demonstrate the importance of the wave-current interactions.

Integrating Ocean Observing and Modeling Systems for Analysis and Forecasting during the August/September 2006 Shallow Water Acoustics Experiment

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An operational ocean analysis and forecast system was prototyped using ROMS IS4DVAR data assimilation during the

Shallow Water Acoustics 2006 (SW06) field program in the Mid-Atlantic Bight. A moderate resolution (5-km horizontal, 30 s-level) limited-area model assimilated surface underway thermosalinograph data and salinity and temperature profiles from 4 research vessels, 8 coastal gliders and a towed-body profiler. Daily composite satellite sea surface temperature and gridded altimeter height anomalies were included. Initial conditions were a New Jersey shelf climatology adjusted by relaxation to the kinematic constraints of the model domain. Meteorological forcing was the NCEP-NAM 2-day forecast and, optionally, a local 6-km resolution WRF model. Hudson River discharge was from daily average river gauge observations. Tide boundary conditions are from the Oregon State OTPS harmonic analysis. We assimilated data over 2-day intervals iterating the initial conditions to minimize the model-data misfit over each cycle prior to generating a 2-day forecast.

Climatology was a poor estimator of the initial state in summer 2006 given the extreme Hudson River discharge in July. Assimilation quickly adjusts the model salinity to *in situ* glider observations in the central SW06 region, but in the absence of data in the far field the adjustment was unsatisfyingly local. As the model simulation proceeded, the salinity-corrected region advanced slowly northward and eastward consistent with the adjoint model propagating the model-data misfit upstream. The barotropic transport of the shelf/slope front is not well constrained by the assimilation of temperature and salinity data, arguing in favor of the value of complementary real-time observing systems (CODAR, shipboard ADCP) to constrain velocities. This will be the emphasis of on-going IS4DVAR reanalysis. Project URL: http://marine.rutgers.edu/po/sw06

Coupling ROMS With CSIM In The Okhotsk Sea

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The Regional Ocean Modeling System (ROMS) and the sea ice component of the NCAR Community Climate System Model, CCSM Sea Ice Model (CSIM), have been coupled to create a regional ice-ocean model of the Okhotsk Sea. CSIM is a state-of-the-art dynamic-thermodynamic sea ice model. Together, these models can be used to investigate sea ice and water mass formation, as well as their interannual variability in the Okhotsk. The Okhotsk is important because of its influence on the formation of North Pacific Intermediate Water (NPIW), which has its source in the dense water formed along the Okhotsk Sea shelves. Coastal polynyas and tidal mixing both significantly affect dense water formation. Preliminary results will be presented.

Predictability of Mesoscale Variability in the East Australia Current System given Strong Constraint Data Assimilation

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One of the many applications of data assimilation is the estimation of adequate initial conditions for model forecasts. In this work we evaluate to what extent the Incremental, Strong constraint, 4-dimensional Variational (IS4DVAR) data assimilation can improve prediction of mesoscale variability in the East Australia Current (EAC) System. The observations considered in the assimilation experiments are daily composites of AVHRR SST, 7-day reanalysis of AVISO SSH anomalies, and temperature sections from high resolution expendable Bathythermograph (XBT). Considering all available observations for years 2001 and 2002, ROMS forecast initial conditions are generated every week by assimilating the available observations from the 7 days prior to the forecast initial time. It is shown that assimilation of just surface information (SST and SSH) results in poor estimate of the true ocean state (as depicted by the XBTs) and therefore poor forecast skill of subsurface information. In addition, the resulting circulation is highly sensitive to errors in the initial conditions and therefore the uncertainty (spread) in an ensemble forecast is high. Including the XBTs in the assimilation experiments improves the ocean state estimation in the vicinity of the XBT transects and also reduces the sensitivity to errors in the initial conditions resulting in a more skillful ensemble forecast. Motivated by this finding we explore the utility of including some pseudo-observations based on an empirical relationship between surface and subsurface information known as synthetic XBT (provided by CSIRO). The preliminary results show that better ocean state estimates and more skillful forecasts are obtained in all the domain considered.

Poster Abstracts

The Generation of Internal Tides in the Strait of Sicily and Adjacent Areas

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The Regional Ocean Modelling System (ROMS) is applied to the problem of the generation, propagation, dissipation of internal tides and associated mixing in the Strait of Sicily and adjacent areas. A comparison with tide-gauge data, satellite data, and current meter measurements gave a good agreement.

M2 internal tides are effectively generated over prominent topographic features such as the NW of Sicily, Adventure Bank and the Strait of Messina. All of these topographic features are characterized by steep slopes. The M2 internal tides propagating away from these multiple source regions interfere with each other to create a complicate wave pattern.

Our results suggest that the internal waves in the Adventure Bank are essentially diurnal which is coherent with the observations of Artale et al. (1989). In contrast, the semi-diurnal internal signal dominates in the Messina Strait. The baroclinic energy extracted from the tide is expected to make a significant contribution to mixing in the region.

Circulation in the Western Mediterranean Sea

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The Western Mediterranean sea is of great importance not only for its exchange with the North Atlantic but also for the climate and fishery of the European and North African countries bordering it. In recent years several observations campaigns revealed the complexity of its circulation (Send et al., 1999; Salas et al., 2002; Millot and Taupier-letage, 2005; Testor et al., 2005) and the importance of mesoscale activity (Send, 1999; Testor, 2002; Millot, 2004, Testor et al., 2005).

In the present work, we use the Regional Ocean Modeling System (ROMS), a hydrostatic, primitive equation model to investigate under which conditions the model can properly simulate the observed circulation patterns. With a suite of runs we focus on the importance of resolution together with a proper representation of the topographic field for simulating the observed spreading of Levantine Intermediate Water. The dynamics of both surface and deep layers have revealed a variety of eddy and mesoscale processes that are important for the circulation and spreading of water masses, and for the primary productivity of the marine ecosystem in this region.

Harbour hydrodynamic Modelling with ROMS: Bilbao Case Study

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Harbours are subjected to human pressure that modifies its inner water domain. The reclamation of the harbour platforms for recreational purposes implies that the hydrodynamic modelling of the harbour is important under the economical, social, and environmental point of view.

In this work, the preliminary results for the Bilbao harbour modelling are presented. The Bilbao harbour is located on the eastern side of the Bay of Biscay (Spain). The circulation in this harbour is primarily dominated by tides as implied by hydrographic data. Temperature data indicates that the harbour circulation is also baroclinically driven. ROMS is used to study the circulation in the Bilbao harbour.

Mesoscale Variability On The Eastern Brazilian Shelf Through A ROMS Nested Model

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The Eastern Brazilian Shelf is a narrow, oligotrophic and bathymetrically complex shelf, on the southwestern South Atlantic. On such narrow shelves, ocean – shelf interaction processes are regarded as effective mechanisms for promoting nutrient enrichment and shelf circulation variability.

In this work, we present results of ongoing modeling research concerning the mesoscale variability off the Brazilian coast between 7° – 20° S using ROMS. The larger scale grid has a resolution of 1/4° in longitude and latitude and describes the general features of the large ocean circulation in the South Atlantic. This grid was nested on a mesoscale grid of 1/12° encompassing the area of study. The model was initiated for both climatological and global model outputs (e.g. LEVITUS and SODA).

Model validation is based on the analysis of the mesoscale variability on eddy kinetic energy (EKE), calculated from five years TOPEX/Poseidon and ERS Combined data for sea level anomaly (SLA). Recurrent eddy activities are frequently noticed on the mesoscale grid. Preliminary estimates of the cross-shelf transport are discussed.

An Analysis Of The Performance Of A Mediterranean ROMS model

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In this paper we present an analysis of the benefits of running ROMS in a multiprocessor platform using the Message Passing Interface (MPI). Two different processor clusters with different communication costs and computation capabilities are used to analyze the parallel performance.

Additionally, the Intel Cluster Toolkit is used to profile the ROMS algorithms and study their performance. The information obtained allows us to draw some interesting conclusions.

Preliminary Applications Of The ROMS Ecosystem Model To The Northern Adriatic Sea

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The Adriatic Sea is a continental basin of the Mediterranean Sea, and its north-western part is particularly shallow and affected by large river runoff (Po is the main river, with an average runoff of 1500 m3 s-1). This portion of the Adriatic basin is strongly influenced by eutrophication, mucilage and bottom waters anoxia, which have negative impacts on the environment, fisheries and tourism. Nevertheless, the buoyancy gain due to freshwater is an important source of dense water (up to 30 in sigma-theta) in the northern Adriatic in winter due to the Bora winds.

ROMS was used in the Adriatic Sea during the 2002-2003 Adriatic Circulation Experiment. The operational version, AdriaROMS, is currently running. The biogeochemical module in ROMS has been used to get a better understanding of the Adriatic ecosystem. The main objective is to forecast short term hypoxia events and their connection to nutrient input from various rivers.

The biogeochemical module is based on the Fasham model. It includes a relatively simple representation of nitrogen cycling processes in the water column and organic matter remineralization at the water-sediment interface that explicitly accounts for sediment denitrification.The minimum set of equations consists of a system of seven coupled partial differential equations that describe the dynamics of seven biological constituents: nitrate NO3, ammonium NH4, small and large detritus, phytoplankton, zooplankton, and chlorophyll. In addition, carbon, oxygen and related constituents (TIC and alkalinity) are included.

The model initial conditions is derived from hydrographic data. As in AdriaROMS, the air-sea fluxes are interactively computed by LAMI (Local Area Model Italy) using the ROMS sea surface temperature.

The first simulations show interesting highlights about the coupled physical-biogeochemical Adriatic dynamics.

Predictability of Sediment Transport arising from Undersea Sand Extraction in Coastal Waters of Korea

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Numerical modeling and field experiment have been conducted to predict the sediment transport arising from undersea sand extraction in coastal waters of Korea. The macro-tidal Kyunggi Bay, with an area approximately 20,000 square km, is a major source of under water sand. Approximately 35 million cubic meters of sand are extracted annually. This dredging affects the suspended sediment in the water column which in tern affects the benthic biology and causes coastal erosion. In this study, we conduct numerical simulations using ROMS to investigate the fate of sediment dispersion released at the surface as well as in the bottom layer. Each source level of different sediment size groups has been quantified using field experiment data. The three dimensional hydrodynamic forcing associated with the combined effect of wave and currents in the bottom layer has been also considered.

According to the intensity of sand extraction and hydrodynamic condition, the sediment dispersion in the water column and the deposition feature at seabed show reasonable replacement of new sediment size group, which seems very important to the habitat change for the benthic community.

Numerical study of storm impacts on coastal circulation in Long Bay, South Carolina

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The effects of coastal storms on the regional circulation in Long Bay, South Carolina, are investigated using a coupled ROMS (Regional Ocean Modeling System)-SWAN (Simulating WAves Nearshore) model. Meteorological observations during the South Carolina Coastal Erosion Study (October 2003 – April 2004) reveal three dominant types of storms in the region – warm fronts, cold fronts, and tropical storms. Each storm has a characteristic progression of wind patterns: (1) Warm fronts start with southwestward winds and change to northeastward after the front passes; (2) Cold fronts begin with northeastward winds and shift to southeastward when the front moves out; and (3) Tropical storms change wind directions from the southwest to the southeast during the storm. It is observed that the response of the general circulation in the Long Bay coast to the atmospheric disturbances is upwelling-favorable for the northeastward winds, and downwelling-favorable during the southwestward winds.

The study domain encompasses 300-km of gently arcing shoreline between Cape Romain to Cape Fear, and approximately 100-km offshore to the shelf edge. The model domain is resolved by a 300×130 mesh at 1-km intervals in the horizontal and twenty terrain-following layers in the vertical. The ROMS model is driven by tides and wind stress. Salinity and temperature along the open boundaries are included by nudging to climatological values. The ROMS simulations in the region also include wave-current interactions via dynamic coupling to the surface wave model SWAN. Wave Watch III and NCEP NARR wind data are applied to the SWAN boundary conditions. A time period from October 2003 to April 2004 is simulated, concurrent with the observation study. Model results are compared to an extensive set of measurements collected at eight sites in the inner part of Long Bay, and are used to identify varying circulation response to each storm type. We also examine the importance of wave-current interactions in the study region, and the significance of the Capes on the development of the alongshore pressure gradients.

ChesROMS Model: a ROMS-based Community Model for the Chesapeake Bay

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In this presentation we describe a new initiative aimed at developing a new ROMS-based community model for simulating the Chesapeake Bay (ChesROMS). The model is being developed to provide mechanistic nowcasts and forecasts of hydrodynamic and biogeochemical properties in the bay for an operational modeling system to predict harmful algal blooms (HABs). Specifically, ChesROMS will be used to estimate temperature, salinity and bulk biogeochemical properties for input into empirically derived habitat models that predict the occurrence of several different HAB species. The final goal is to establish a nowcast/forecast system to routinely deliver the most current information on potential HAB outbreaks in the Chesapeake Bay and its major tributaries to the Maryland Department of Natural Resources (and other interested agencies) in a timely and effective manner to improve their existing HAB monitoring program and response capability.

The implementation and validation of ChesROMS is being done in an open forum and is therefore accessible for input and scrutiny from the wider Chesapeake Bay research and management communities and it is also readily available to these communities for a variety of applications. Here we present the fundamental framework of the model with particular emphasis on the physical aspects and the validation and calibration of the model predictions (involving a range of forcings including tides, meteorological fluxes, sea surface temperature, river discharge and lateral open ocean boundary specifications). Thereafter, the physical modeling results of temperature, salinity and bulk biogeochemical properties will be deemed as suitable inputs into habitat models. A 100 × 150 × 30, curvilinear orthogonal grid system is used to cover the entire Chesapeake Bay including its six main tributaries. The initial conditions are quasi-empirical in nature and the model forcing data are from the following pubic domain sources: (i) river discharge data from US Geological Survey (USGS) database1; (ii) surface meteorological forcing from the North American Regional Reanalysis (NARR) model; (iii) tides from the ADCIRC database; (iv) climatological temperature and salinity and non-tidal water levels at open ocean boundaries from the Global Ocean Data Assimilation System (GODAS) predictions; (v) sea surface temperature from satellite measurements.

For initial validation of the modeling system, we simulated the hydrodynamics of the Chesapeake Bay for a five year period (1996 to 2000) on a Linux cluster (8 nodes, 2 processors per node). The flow quantities for examination include surface water level, 3-D flow velocity, temperature and salinity. The validation of the simulated ocean physics is carried out by comparing modeled results with measurements from the National Water Level Observation Network (NWLON) stations and Chesapeake Bay Program monitoring data. Details regarding the model setup, model-data comparisons and specific difficulties encountered in the model implementation phase will be discussed in this presentation.

2D Island Wake Experiments Using Distinct Bathymetric Domains (Representative Of The Island Of Gran Canaria)

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As part of the Spanish government-funded project RODA (Remolinos Oceánicos, Deposición Atmosférico), ROMS is being used to simulate the wake generated by the Canary Current as it passes the island of Gran Canaria off the northwestern African coast. In this poster we present results of some initial experiments, where ROMS is being run in barotropic mode. Three domain configurations are presented: a) an idealised flat bottom configuration (FBC), with an irregularly-shaped cylinder representing Gran Canaria; b) a partial bathymetry configuration (PBC) where just the island is generated using real data and; c) a real bathymetry configuration (RBC) where bathymetric data are used throughout the domain. Mean drag and lift coefficients are calculated for each configuration. Sensitivity to Reynolds, Rossby and Ekman numbers is also explored for the respective configurations, as well as the Reynolds-Strouhal relationship. Results from these sensitivity tests conform to those of other published articles, whilst showing clear distinctions for the three domains (FBC, PBC and RBC).

Modelling Study of Gulf of Cadiz Coastal Countercurrent

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The Gulf of Cadiz in the Eastern North Atlantic, located south of Iberian Peninsula, is characterized by a complex circulation pattern influenced by diverse factors: heterogeneous wind forcing, caused by the abrupt change in coastline orientation; upwelling in the west, and some times southern Iberian coasts; the Mediterranean Undercurrent; and the Eastern extension of the Azores Current. A modelling study using ROMS is conducted to simulate the Gulf of Cadiz circulation. The objective is to investigate the onset of a coastal, warm countercurrent, usually associated with wind relaxation periods.

The current forms in the northern Gulf of Cadiz and flows westward, eventually turning around Cape St Vicente and flowing northward along the Portuguese west coast. The model accurately reproduces the current formation at the same dates observed in satellite imagery. Atmospheric forcing fields were obtained from WRF model simulations for the summer period of 2000.

A number of experiments are described in which we change model forcing and initial conditions to understand the important mechanisms to the onset and driving of the current. The onset of the current is mainly controlled by the interaction of the wind with coastline irregularities, as it happens locally near important capes.