Contents

1. Introduction

This guide provides a brief introduction to the models that make up the Coupled Ocean-Atmosphere-Wave-Sediment Transport Modeling System (COAWST), as well as the additional user settings required for specific projects. As shown in Figure 1.1, COAWST uses several models and programs that will be presented below:

- **COAWST**: Core of the coupled numerical modeling system. More information in the section 1.7;
- **ROMS**: The hydrodynamic model. More information in the Section 1.1;
- **Sea Ice**: The sea ice model, coupled to ROMS. In this guide we use the Budgell's Sea Ice Model. More information in the Section 1.2;
- **WRF**: The atmospheric model. More information in the Section 1.3;
- ***wrf***: Executable program to start the WRF atmospheric simulation. More information in the section **??**;
- ***real***: Executable program to generate the initial condition and the boundary forces of the WRF. More information in the Section **??**;
- ***WPS***: Package with three programs to generate the files to be used in *real*. More information in the Section **??**;
- ***geogrid***: Program to, mainly, generate the WRF grid domain. More information in the section **??**;
- ***ungrib***: Briefly, the program that extracts the data in *GRIB* format. More information in the Section **??**;
- ***metgrid***: Briefly, the program that interpolates the data generated by *ungrib*. More information in the Section **??**;
- **SWAN**: The wave model. More information in the Section 1.4;
- **MCT**: The set of codes that couples the previous models. More information in the Section 1.5;
- **SCRIP**: Package that interpolates and remaps the model's grids to allow the models to be coupled. More information in the section 1.6.

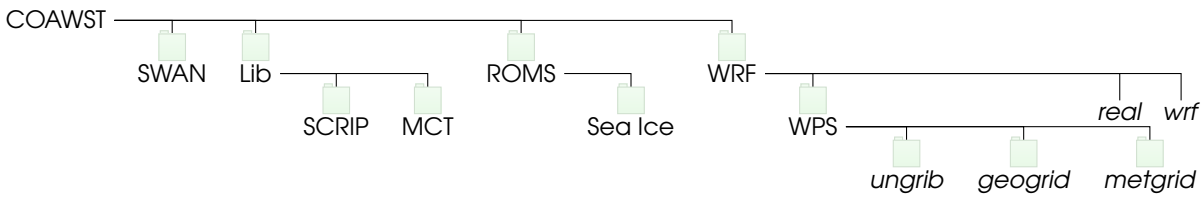

Figure 1.1. COAWST folder structure

When writing this guide, we chosed to use Python as a programming language for some steps. It is a programming language designed with a philosophy of emphasizing the importance of the programmer's effort over the computational effort and prioritizes code readability over speed or expressiveness. The language has a wide and active community, which facilitates the search information by the user, as there is an extensive collection of libraries and documents on the internet.

Python Brazil (*http://python.org.br*) offers great help for beginners, providing introductions about the language and also a guide to use Python for scienfic purposes.

We also use MATLAB as a language. It is a paid, but high-performance interactive software focused on the numerical calculation. The MATLAB Answers website is a platform created to offer help to the users about the language. The site is avaliable at https://www.mathworks.com/matlabcentral/answers/index,

1.1 Regional Ocean Modeling System

The Regional Ocean Modeling System (ROMS; Shchepetkin & McWilliams, 2005) is a three-dimensional ocean model with free surface, vertical sigma coordinate with sigma vertical coordinates (that follow the terrain) and solve primitive equations. The model uses the Reynolds average and the finite difference method to solve the Navier-Stokes equations using hydrostatic approximations and Boussinesq (cite Haidvogel2008).

The hydrostatic equations of momentum use a split-explicit time-step scheme, where the barotropic and baroclinic modes are solved separately, in different finite numbers of steps of time, to solve the free surface equations and it is integrated vertically. This structure separate time-steps frames maintains the volume conservation and consistency preservation that are necessary for the tracers (Haidvogel et al., 2008; Shchepetkin & McWilliams, 2005).

The model solves the horizontally equations through orthogonal curvilinear coordinates of the Arakawa-C grid type (Arakawa & Lamb, 1977). Vertically, the coordinates follow the features of the terrain and allow you to adjust the resolution along the water column. To guarantee the conservation of momentum, the grid uses econd order finite differences (Haidvogel et al., 2008).

ROMS is a model that has free code and its development has the contribution of the user community. Currently, the version used in COAWST is managed by Dr. Hernan Arango of Rutgers University. To access the model code, is necessary to register on the ROMS website (*https://www.myroms.org/*) The site has a extremely useful and very active forum to discuss about questions and suggestions. You can access here: (*https://www.myroms.org/forum*)

We recommend to read the ROMS Technical Manual, written by Hedström (2018). This manual has several information about the equations and algorithms of the model and examples of test cases.

1.2 Budgell's Sea Ice Model

The Sea Ice Model, proposed by Budgell (2005), has the same time and grid steps as the ROMS model and shares the same parallel encoding structure for use with Message Passing Import (MPI). Thus, allows dynamic and thermodynamic modeling where sea ice predominates, such as at high latitudes.

The main attributes of the model, according to Hedström (2018), are:

- Hunke & Dukowicz (1997) and Hunke (2001) elasctic-viscous-plastic dynamics;
- Mellor & Kanta (1989) thermodynamics;
- Orthogonal-curvilinear coordinates;
- Arakawa & Lamb (1977) grid;
- Smolarkiewicz & Grabowski (1990) advection of tracers;
- Lemieux et al. (2015) landfast ice parameterization.

1.3 Weather Research & Forecasting Model

The Weather Research and Forecasting (WRF; Skamarock et al., 2008) is a model developed by the National Centers for nvironmental Prediction (NCEP), the National Center for Atmospheric Research (NCAR) and research groups from different universities.

To integrate the governing equations over time, the Advanced Research WRF (ARW) uses low frequency modes that are integrated using the third-order Runge-Kutta scheme, and the integrated acoustic and gravity (high frequency) modes with a lower time step. By this way, the numerical stability is maintained through a "forward-backward" scheme for acoustic modes that propagate horizontally and an implicit scheme for acoustic modes for vertical propagation and buoyancy oscillations (Skamarock et al., 2008).

The WRF model uses an Arakawa-C type grid (Arakawa & Lamb, 1977), where normal speeds are staggered halfway through the grid of thermodynamic variables, as shown in the schematic representation illustrated in Figure 1.2.

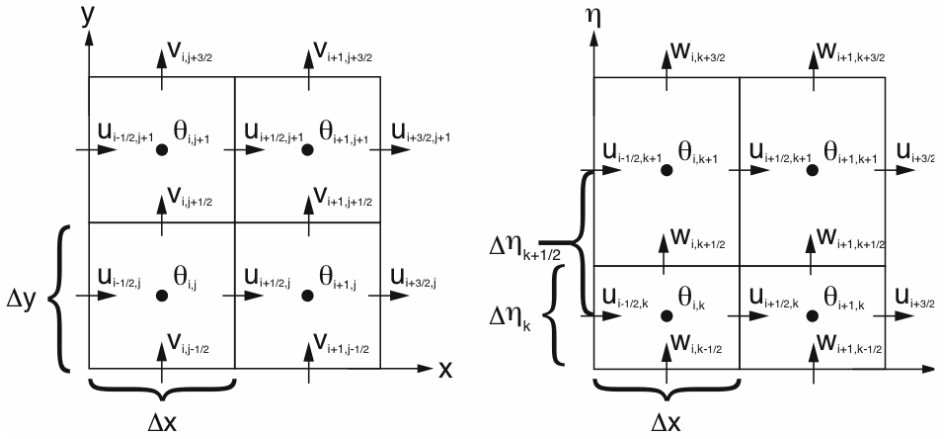

Figure 1.2. Horizontal and vertical grid of Weather Research and Forecast (WRF) using the Arawaka-C grid. The horizontal and vertical components of velocity (**u**, **v** and **w**) are positioned along the faces of the grids and the thermodynamic variables (θ) are positioned in the center of each grid.
Author: Skamarock et al. (2008).

It is important to note that the WRF, without coupling with other models, simulates the surface roughness based on the ratio of roughness to wind shear proposed by Charnock (1955), as exemplified in the following equation 1.1:

$$Z_0 = Z_{ch}\frac{u_*^2}{g} \tag{1.1}$$

Where Z_0 é a roughness, Z_{ch} is the Charnock parameter (a dimensionless value of 0,018), u_* the frictional speed (m/s) and g the gravity acceleration(9,81 m/s^2).

The WRF is avaliable at: *http://www2.mmm.ucar.edu/wrf/users/download/get_source.html*

1.4 Simulating Waves Nearshore

The Simulating Waves Nearshore (SWAN; Booij et al., 1996, 1999) is a third generation model, designed to simulate coastal regions with shallow waters and local currents. The model is widely used in the numerical forecast of the Simulating Waves Nearshore (SWAN; Booij et al., 1996, 1999) is a third generation model, designed to compute in coastal regions with shallow waters and local currents. The model is widely used in the numerical forecast of waves in coastal regions, estuaries, channels and others, being able to use fields of wind, bathymetry and currents provided by other models (Booij et al., 1996, 1999).

Silva (2013) and Booij et al. (1996; Booij et al., 1999) list the main characteristics of the SWAN:

- Wave propagation in time and space, shoaling, refraction due to current and depth, frequency shifting due to currents and non-stationary depth;
- Wave generation by wind;
- Whitecapping, bottom friction and depth-induced breaking;
- Dissipation due to aquatic vegetation, turbulent flow and viscous fluid mud;
- Wave-induced set-up;
- Propagation from laboratory up to global scales;
- Transmission through and reflection (specular and diffuse) against obstacles;
- Diffraction.

More features can be found in SWAN website, avaliable at: *http://swanmodel.sourceforge.net/*.

1.5 Model Coupling Toolkit

The Model Coupling Toolkip (MCT; Jacob et al., 2005; Larson et al., 2005; Warner et al., 2008) is a set of open-source scripts, written in Fortran90 that allow the transmission and transformation of the different data necessary for model coupling. During initialization, model domains are broken down into segments that are distributed between processors, allowing models to be coupled also in parallel.

According to the MCT website, (*http://www.mcs.anl.gov/research/projects/mct/*), the toolkit provides the following core coupling services:

- A component model registry;
- Domain decomposition descriptors;
- A time averaging and accumulation buffer datatype;
- A general spatial grid representation capable of supporting unstructured grids;
- Parallel tools for intergrid interpolation;
- Tools for merging data from multiple components for use by another component;
- A programming model similar to that of the Message Passing Interface.

1.6 Spherical Coordinate Remapping Interpolation Package

O Spherical Coordinate Remapping Interpolation Package (SCRIP; Jones, 1998, 1999) is freely available for download at *https://github.com/SCRIP-Project/SCRIP*. The package is distributed together with COAWST modeling system. This package is used for projects that use more than one model and with different grids (with different spatial resolutions). SCRIP will generate the interpolation weights that will be used to remap the data between the different grids of the different models.

In COAWST, SCRIP was modified to generate a single file (in NetCDF format) that contains the weights based in each model grid.

1.7 Coupled-Ocean-Atmosphere-Wave-Sediment Transport Modeling System

The COAWST Warner et al., 2010, 2008) uses the WRF as the atmospheric model, the ROMS as the hydrodynamic model, the SWAN as the wave model and the sediment transport model Community Sediment Transport Modeling Project (CSTM; Warner et al., 2008), each one coupled by the MCT (Warner et al., 2010, 2008). The frequency with which this information is exchanged between the different models is adjusted by the user.

The coupling between the models allows the different physical processes that occur in both oceanic and atmospheric environments to be identified and analyzed with greater accuracy when compared to simulations without active coupling.(Miller et al., 2018; Pullen et al., 2018).

WARNING This guide does not use CSTM. In case you are interested, there is a study on the transfer of sediments during Hurricane Isabel (2003) by Warner et al. (2010).

As shown in Figure 1.3, the informations exchanged between models are:

- WRF -> ROMS: surface shear and liquid heat fluxes (calculated in ROMS from the components of latent and sensitive heat fluxes) shortwave and longwave radiation, atmospheric pressure, relative humidity, air temperature, clouds, precipitation and wind components ;
- ROMS -> WRF: sea surface temperature;
- SWAN -> ROMS: surface and bottom wave direction, height, length, period, energy dissipation and lower orbital speed;
- ROMS -> SWAN: bathymetry, surface elevation, height of the sea and average currents in depth;

- SWAN -> WRF: roughness of the sea surface (calculated in WRF from the significant wave height, length and period);
- WRF -> SWAN: wind at 10m.

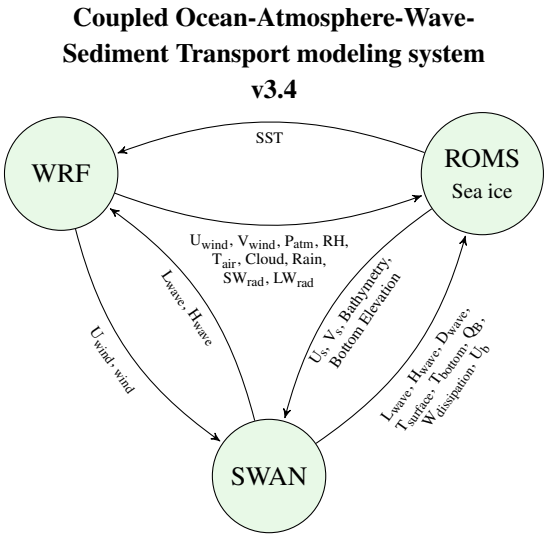

Figure 1.3. Diagram about the exchange of information between the main models that make up the COAWST modeling system. (Warner et al., 2008)

The Woods Hole Coastal and Marine Science Center page provides an experimental presentation on real time of COAWST (Sea Surface Temperature, Sea Surface Height, Significant Height Wave, Current and Wind Vectors and Sediment Dispersion) in the eastern United States and Gulf of Mexico. The content is available at: *https://woodshole.er.usgs.gov/project-pages/cccp/public/COAWST.htm*.

1.8 Materials needed to use this guide

To compile COAWST, this guide uses a cluster with parallel communication and a nonparallel Linux OS with Gfortran. If you choose to compile in on a computer with different specifications, use the original COAWST user manual as a reference, available in the modeling system repository. In this case, see how to download COAWST in the **??** section.

We will use Ubuntu 19.04 LTS. It is important to maintain the same systems operational, as other version may conflict with some libraries used by the *model2roms* toolkit or the COAWST itself.

WARNING This guide uses COAWST v. 3.6.

2. COAWST in a parallel cluster

2.1 About our cluster Kerana

A máquina CRAY XE, também chamada de Kerana, é um cluster com arquitetura massivamente paralela, contando com 84 nós de processamento e 2688 núcleos e está localizada nas dependências do CPTEC/INPE, em Cachoeira Paulista, São Paulo. Por contar com a habilidade de paralelizar operações através da interface MPI, o cluster é ideal para usar modelos numéricos com alta resolução espacial e temporal.

> **ATENÇÃO** Para compilar o COAWST em um computador sem comunicação paralela, utilize o manual original, disponível no repositório original do modelo. Veja como baixar o COAWST na seção 2.6.

2.2 Registrando uma conta de usuário

Para iniciar o processo de requerimento de uma conta de usuário no Kerana, é necessário que o computador nas dependências do INPE possua um IP fixo. É requerido que seu orientador ou supervisor envie um e-mail para o *Helpdesk* do INPE (*helpdesk.cptec@inpe.br*) informando o endereço MAC, *hostname* do computador e motivo da requisição. Caso o computador já possua um IP fixo atribuído, também informe para que ocorra a troca.

Com o IP fixado, o seu supervisor ou orientador entrará novamente em contato com o *Helpdesk* requisitando a abertura da conta no cluster Kerana. Será necessário completar o preenchimento de um formulário via e-mail, como o exemplo a seguir:

1. **Nome do solicitante**;
2. **Local de trabalho**:
3. **Endereço de IP do equipamento de origem**:

4. **Nome e endereço de IP do equipamento de destino**: acesso-hpc.cptec.inpe.br
5. **Serviço/Porta**: ssh/2000
6. **Volume diário de transferência de dados**:
7. **Período de uso**:
8. **Propósito do uso**:
9. **Autorização das chefias dos departamentos**:
10. **Ramal**:

2.3 Acessando o cluster Kerana

O acesso será feito inteiramente pelo terminal do computador. Serão necessários dois comandos primários: um para acesso e manipulação de arquivos e pastas dentro do Kerana e outro para fazer *download* e *upload* de arquivos.

Para acessar e modificar arquivos e pastas, digite no terminal, substituindo *nome.sobrenome* pelo usuário fornecido pelo *Helpdesk*:

ATENÇÃO A partir de agora, sempre que o guia mostrar o usuário *nome.sobrenome*, altere para o seu nome de usuário fornecido pelo *Helpdesk*.

```
1 ssh -Y nome.sobrenome@acesso-hpc.cptec.inpe.br -p 2000
```

Para fazer *download* e *uploads*, digite:

```
1 sftp -P2000 nome.sobrenome@acesso-hpc.cptec.inpe.br
```

ATENÇÃO Não é possível fazer *download* e *upload* de vários arquivos ao mesmo tempo usando o *sftp*. Uma dica é compactar em um único arquivo *tar.gz* e depois descompactá-los.

Para adicionar arquivos do seu computador para o Kerana:

```
1 put arquivo.tar.gz
```

Para extrair arquivos do Kerana para o seu computador:

```
1 get arquivo.tar.gz
```

2.4 Repositório de arquivos

São necessários certos arquivos na área de cada usuário para facilitar a utilização do cluster. Você encontrará eles no diretório:

```
/scratch/adriano.sutil/repositorio/
```

Para copiar os arquivos para sua área, digite:

```
cp -r /scratch/adriano.sutil/repositorio /scratch/nome.sobrenome
```

ATENÇÃO A partir de agora este guia utilizará os arquivos que estão dentro deste repositório, portanto é essencial que eles estejam em sua área.

2.5 Ambiente do Kerana

É necessário ativar alguns módulos no cluster para compilar o COAWST. Neste caso, abra o arquivo chamado *.bashrc* que se encontra na raiz do seu usuário.

```
vim .bashrc
```

Adicione os seguintes campos no final do arquivo, alterando somente o *nome.sobrenome* para o seu nome de usuário:

```
module load java
module load netcdf

export PATH=/scratch/nome.sobrenome/repositorio/Softs/nedit/5.5:$PATH
export PATH=/scratch/nome.sobrenome/repositorio/Softs/bin:$PATH

export PHDF5=${HDF_DIR}
export WRFIO_NCD_LARGE_FILE_SUPPORT=1

export PATH=/home/luciano.pezzi/local/bin:$PATH
export JASPERINC=/home/luciano.pezzi/local/include
export JASPERLIB=/home/luciano.pezzi/local/lib
export LD_LIBRARY_PATH=/home/luciano.pezzi/local/lib:$LD_LIBRARY_PATH
```

Salve e digite no terminal:

```
source .bashrc
```

2.6 Baixando o COAWST

> **ATENÇÃO** O COAWST v3.4 já se encontra no repositório dentro do cluster Kerana, conforme discutido na Seção 2.4.

Para baixar o COAWST, envie um email para o Dr. John Warner (*jcwarner@usgs.gov*), um dos idealizadores do sistema de modelagem regional acoplada.

Após ter o acesso liberado, com as credenciais de usuário e senha disponibilizadas pelo Dr. John Warner, digite no terminal o comando abaixo, alterando o *myusrname* para o seu nome de usuário.

```
svn checkout --username myusrname https://coawstmodel.sourcerepo.com/coawstmodel/COAWST
```

Adicione a pasta do COAWST na sua área de trabalho do Kerana através de *sftp*, conforme a Seção 2.3.

2.7 Automatizando a compilação do COAWST no Kerana

> **ATENÇÃO** Este guia utiliza o COAWST versão 3.4.

Para agilizar o processo, é possível automatizar alguns passos da compilação. Entre no diretório:

```
cd /scratch/nome.sobrenome/COAWST/WRF/arch
```

Abra o arquivo *Config.pl*:

```
nedit Config.pl
```

Procure pelas linhas:

```
printf "\nEnter selection [%d-%d] : ",1,$opt ;
$response = <STDIN> ;
```

E substitua o <*STDIN*> por 42, como no exemplo abaixo:

```
printf "\nEnter selection [%d-%d] : ",1,$opt ;
$response = 42 ;
```

Abra o arquivo *configure.defaults*:

```
nedit configure.defaults
```

Procure pela opção *TRADEFLAG*, que está na linha 1262, aproximadamente:

```
TRADEFLAG = CONFIGURE_TRADEFLAG
```

E modifique por:

```
TRADEFLAG = -traditional
```

Estas modificações selecionarão, na compilação, as configurações do cluster Kerana (*CRAY CCE (ftn/gcc): Cray XE and XC (dmpar)*), dentre as disponíveis para usar o COAWST, como na Figura 2.1.

```
 1. (serial)   2. (smpar)   3. (dmpar)   4. (dm+sm)   PGI (pgf90/gcc)
 5. (serial)   6. (smpar)   7. (dmpar)   8. (dm+sm)   PGI (pgf90/pgcc): SGI MPT
 9. (serial)  10. (smpar)  11. (dmpar)  12. (dm+sm)   PGI (pgf90/gcc): PGI accelerator
13. (serial)  14. (smpar)  15. (dmpar)  16. (dm+sm)   INTEL (ifort/icc)
                                        17. (dm+sm)   INTEL (ifort/icc): Xeon Phi (MIC architecture)
18. (serial)  19. (smpar)  20. (dmpar)  21. (dm+sm)   INTEL (ifort/icc): Xeon (SNB with AVX mods)
22. (serial)  23. (smpar)  24. (dmpar)  25. (dm+sm)   INTEL (ifort/icc): SGI MPT
26. (serial)  27. (smpar)  28. (dmpar)  29. (dm+sm)   INTEL (ifort/icc): IBM POE
30. (serial)               31. (dmpar)                PATHSCALE (pathf90/pathcc)
32. (serial)  33. (smpar)  34. (dmpar)  35. (dm+sm)   GNU (gfortran/gcc)
36. (serial)  37. (smpar)  38. (dmpar)  39. (dm+sm)   IBM (xlf90_r/cc_r)
40. (serial)  41. (smpar)  42. (dmpar)  43. (dm+sm)   PGI (ftn/gcc): Cray XC CLE
44. (serial)  45. (smpar)  46. (dmpar)  47. (dm+sm)   CRAY CCE (ftn/gcc): Cray XE and XC
48. (serial)  49. (smpar)  50. (dmpar)  51. (dm+sm)   INTEL (ftn/icc): Cray XC
52. (serial)  53. (smpar)  54. (dmpar)  55. (dm+sm)   PGI (pgf90/pgcc)
56. (serial)  57. (smpar)  58. (dmpar)  59. (dm+sm)   PGI (pgf90/gcc): -f90=pgf90
60. (serial)  61. (smpar)  62. (dmpar)  63. (dm+sm)   PGI (pgf90/pgcc): -f90=pgf90
```

Figure 2.1. Opções computacionais disponíveis para seleção na compilação do COAWST.

Agora, no mesmo arquivo, procure pelas seguintes linhas:

```
printf "Compile for nesting? (1=basic, 2=preset moves, 3=vortex following) [default 1]: " ;
}
$response = <STDIN> ;
```

E modifique o <*STDIN*> para o modo básico de aninhamento do modelo atmosférico WRF, como o exemplo a seguir:

```
printf "Compile for nesting? (1=basic, 2=preset moves, 3=vortex following) [default 1]: " ;
}
$response = 1 ;
```

2.8 Compilando o MCT

ATENÇÃO Este guia utiliza o COAWST v 3.4.

Cada novo usuário deverá compilar o MCT antes de compilar o COAWST. O primeiro passo é utilizar o arquivo *setup_pgi.sh*. Este arquivo foi copiado do repositório anterior, é indispensável alterar os diretórios contidos nele. Portanto:

```
nedit setup_pgi.sh
```

Caso necessário, altere os diretórios de acordo com o nome da sua pasta do COAWST e execute o arquivo para carregar os módulos necessários:

```
source setup_pgi.sh
```

As bibliotecas serão ativadas, conforme apresentado na Figura 2.2:

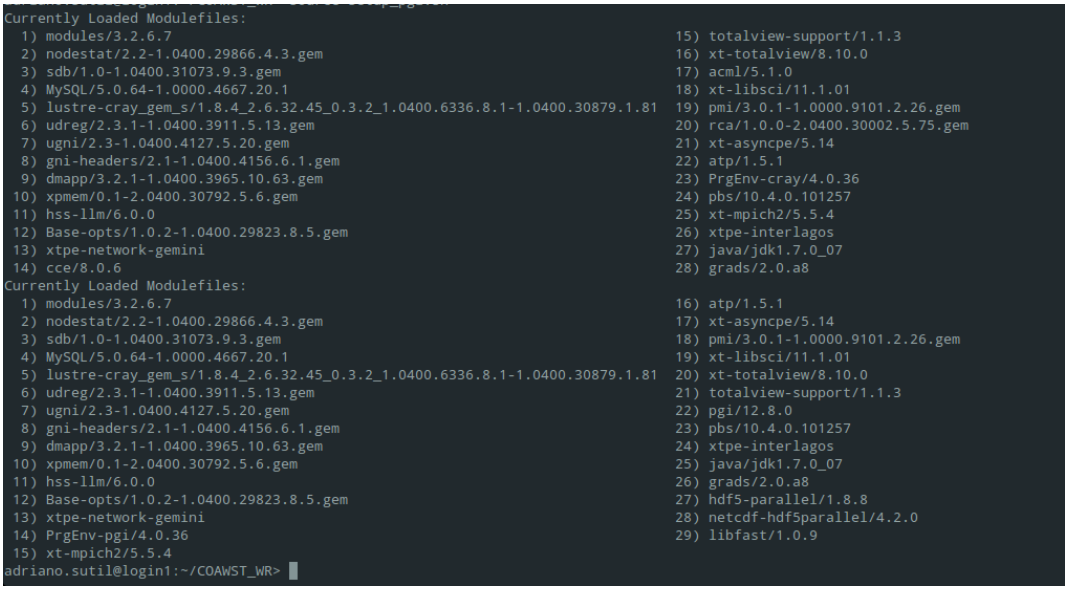

Figure 2.2. Módulos ativados no cluster com o arquivo *setup_pgi.sh* para o usuário adriano.sutil.

Entre na pasta do MCT:

```
cd /home/nome.sobrenome/COAWST/Lib/MCT
```

Abra o arquivo *Makefile.conf*:

```
nedit Makefile.conf
```

E modifique o arquivo conforme a seguir:

ATENÇÃO Lembre-se de alterar o *nome.sobrenome* dos diretórios!

```
FC              = ftn
FCFLAGS         = -O2
F90FLAGS        =
REAL8           = -r8
ENDIAN          = -Mbyteswapio
INCFLAG         = -I
INCPATH         =
MPILIBS         =
DEFS            = -DSYSLINUX -DCPRPGI
FPP             = cpp
FPPFLAGS        = -P -C -N -traditional
CC              = cc
ALLCFLAGS       = -DFORTRAN_UNDERSCORE_ -DSYSLINUX -DCPRPGI -O
COMPILER_ROOT   =
BABELROOT       =
PYTHON          =
PYTHONOPTS      =
FORT_SIZE       =
CRULE           = .c.o
90RULE          = .F90.o
F90RULECPP      = .F90RULECPP
INSTALL         = /home/nome.sobrenome/COAWST/Lib/MCT/install-sh -c
MKINSTALLDIRS   = /home/nome.sobrenome/COAWST/Lib/MCT/mkinstalldirs
abs_top_builddir= /home/nome.sobrenome/COAWST/Lib/MCT/
MCTPATH         = /home/nome.sobrenome/COAWST/Lib/MCT/mct
MPEUPATH        = /home/nome.sobrenome/COAWST/Lib/MCT/mpeu
EXAMPLEPATH     = /home/nome.sobrenome/COAWST/Lib/MCT/examples
MPISERPATH      =
libdir          = /home/nome.sobrenome/COAWST/Lib/MCT/pgi/lib
includedir      = /home/nome.sobrenome/COAWST/Lib/MCT/pgi/include
AR              = ar cq
RM              = rm -f
```

Instale o MCT digitando no terminal os seguintes comandos:

```
make
make install
```

Observe as mensagens que aparecem no terminal e busque por erros. Caso negativo, o MCT foi compilado com sucesso.

2.9 Compilando o caso-teste Sandy

Existem dentro do COAWST alguns casos-teste para serem compilados e trabalhados. Neste caso compilaremos o projeto do furacão Sandy, que acopla e aninha o WRF, o ROMS e o SWAN. Primeiramente, é necessário conhecer a estrutura das pastas e arquivos do COAWST.

A estrutura típica de diretórios do COAWST está exemplificada na Figura 2.3. Serão utilizadas principalmente as pastas *Projects* e *Work*.

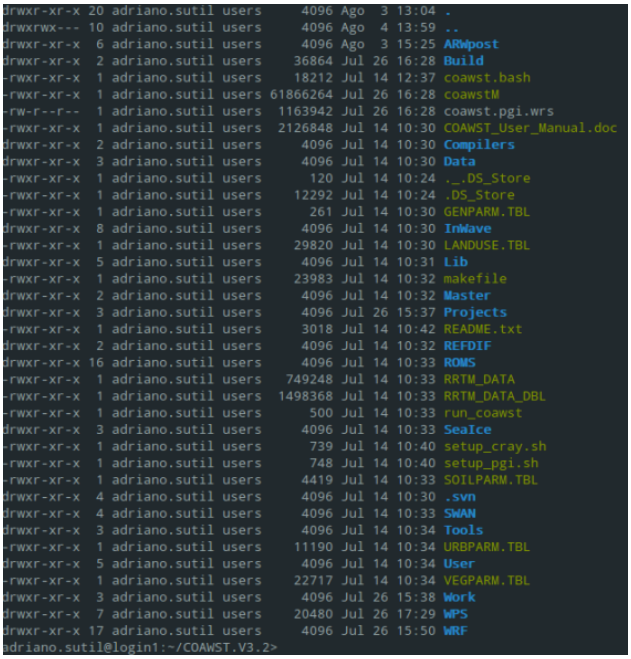

Figure 2.3. Representação da pasta principal do COAWST e as subpastas.

2.9.1 Diretório Projects

Para organizar os projetos, no diretório *COAWST/Projects/Sandy* estão todos os arquivos utilizados para simular o caso Sandy. Deverão constar os seguintes arquivos:

- Bound_spec_command
- coastline.mat
- coupling_sandy.in
- create_sandy_application.m
- hycom_info.mat
- ijcoast.mat

- multi_1.at_10m.dp.201210.grb2
- multi_1.at_10m.hs.201210.grb2
- multi_1.at_10m.tp.201210.grb2
- namelist.input
- ocean_sandy.in
- roms_master_climatology_sandy.m
- roms_narr_Oct2012.nc
- roms_narr_ref3_Oct2012.nc
- Rweigths.txt
- Sandy_bdy.nc
- Sandy_clm.nc
- Sandy_clm_ref3.nc
- sandy.h
- Sandy_ini.nc
- Sandy_ini_ref3.nc
- Sandy_init.hot
- Sandy_ref3_init.hot
- Sandy_roms_contact.nc
- Sandy_roms_grid.nc
- Sandy_roms_grid_ref3.nc
- Sandy_swan_bathy.bot
- Sandy_swan_bathy_ref3.bot
- Sandy_swan_coord.grd
- Sandy_swan_coord_ref3.grd
- scrip_sandy_moving.nc
- scrip_sandy_static.nc
- specpts.mat
- swan_narr_Oct2012.dat
- swan_narr_ref3_Oct2012.dat
- swan_sandy.in
- swan_sandy_ref3.in
- tide_forc_Sandy.nc
- TPAR10.txt
- TPAR11.txt
- TPAR12.txt
- TPAR13.txt
- TPAR14.txt
- TPAR15.txt
- TPAR16.txt
- TPAR17.txt
- TPAR18.txt
- TPAR1.txt
- TPAR2.txt
- TPAR3.txt
- TPAR4.txt
- TPAR5.txt
- TPAR6.txt
- TPAR7.txt

- TPAR8.txt
- TPAR9.txt
- USeast_bathy.mat
- Uweigths.txt
- Vweigths.txt
- wrfbdy_d01
- wrfinput_d01
- wrfinput_d02
- wrflowinp_d01
- wrflowinp_d02

2.9.2 Diretório Work

Para facilitar o gerenciamento das simulações, é sugerida, para cada novo usuário, a criação da pasta *Work* no diretório principal do COAWST, com cada projeto inserido separadamente dentro dele. É nesta pasta que será simulado o caso teste.

```
cd /scratch/nome.sobrenome/COAWST
mkdir Work
cd Work
mkdir Sandy
```

A */scratch/nome.sobrenome/COAWST/Work/Sandy* deverá conter os seguintes arquivos:

- run_sandy.sh
- limpa.sh
- link.sh

O arquivo *run_sandy.sh* é usado para iniciar a simulação, *link.sh* gera links simbólicos na pasta *Work*, que serão utilizados pelos modelos, e o *limpa.sh* é utilizado para limpar a pasta caso ocorra um erro e seja necessário iniciar uma nova integração. Os arquivos se encontram dentro da pasta */repositorio/work_coawst*.

Portanto:

```
cd /scratch/nome.sobrenome/repositorio/work_coawst
cp limpa.sh link.sh run_sandy.sh /scratch/nome.sobrenome/COAWST/Work/Sandy
```

Vá até o diretório */scratch/nome.sobrenome/COAWST/Work/Sandy* e abra o arquivo *run_sandy.sh*:

```
cd /scratch/nome.sobrenome/COAWST/Work/Sandy
nedit run_sandy.sh
```

Procure os comandos a seguir e modifique os diretórios de acordo com o seu nome de usuário:

```
PBS -o /scratch/nome.sobrenome/COAWST/Work/Sandy/rws_total.out
ROOTDIR=/scratch/nome.sobrenome/COAWST
```

2.9.3 Compilando o caso teste

Vá para a pasta do projeto Sandy:

```
/home/nome.sobrenome/COAWST/Projects/Sandy
```

Abra os seguintes arquivos para realizar as modificações dos próximos passos:

- coupling_sandy.in
- swan_sandy.in
- swan_sandy_ref3.in
- ocean_sandy.in

```
nedit coupling_sandy.in swan_sandy.in swan_sandy_ref3.in ocean_sandy.in
```

No arquivo *coupling_sandy.in* procure pela linha de comando abaixo e substitua:

```
OCN_name = Projects/Sandy/ocean_sandy.in
```

E substitua por:

```
OCN_name = /scratch/nome.sobrenome/COAWST/Projects/Sandy/ocean_sandy.in
```

Nos arquivos *swan_sandy.in* e *swan_sandy_ref3.in* complete todos os caminhos dos diretórios abaixo:

Modifique:

```
READGRID COORDINATES 1 'Projects/Sandy/Sandy_swan_coord.grd' 4 0 0 FREE
READINP BOTTOM 1 'Projects/Sandy/Sandy_swan_bathy.bot' 4 0 FREE
&READINP WIND 1 'Projects/Sandy/swan_namnarr_30Sep10Nov2012.dat' 4 0 FREE
INITIAL HOTSTART SINGLE 'Projects/Sandy/Sandy_init.hot'
```

Por:

```
READGRID COORDINATES 1 '/scratch/nome.sobrenome/COAWST/Projects/Sandy/Sandy_swan_coord.grd' 4 0 0 FREE
READINP BOTTOM 1 '/scratch/nome.sobrenome/COAWST/Projects/Sandy/Sandy_swan_bathy.bot' 4 0 FREE
&READINP WIND 1 '/scratch/nome.sobrenome/COAWST/Projects/Sandy/swan_namnarr_30Sep10Nov2012.dat' 4 0 FREE
INITIAL HOTSTART SINGLE '/scratch/nome.sobrenome/COAWST/Projects/Sandy/Sandy_init.hot'
```

E no arquivo *ocean_sandy.in* procure pelas linhas de comando abaixo:

```
MyAppCPP = SANDY
VARNAME  = ROMS/External/varinfo.dat
GRDNAME == Projects/Sandy/Sandy_roms_grid.nc \
           Projects/Sandy/Sandy_roms_grid_ref3.nc
ININAME == Projects/Sandy/Sandy_ini.nc \
           Projects/Sandy/Sandy_ini_ref3.nc
NGCNAME =  Projects/Sandy/Sandy_roms_contact.nc
BRYNAME == Projects/Sandy/Sandy_bdy.nc
FRCNAME == Projects/Sandy/roms_narr_Oct2012.nc \
           Projects/Sandy/roms_narr_ref3_Oct2012.nc
```

E substitua por:

```
MyAppCPP = Sandy
VARNAME  = /scratch/nome.sobrenome/COAWST/ROMS/External/varinfo.dat
GRDNAME == /scratch/nome.sobrenome/COAWST/Projects/Sandy/Sandy_roms_grid.nc \
           /scratch/nome.sobrenome/COAWST/Projects/Sandy/Sandy_roms_grid_ref3.nc
ININAME == /scratch/nome.sobrenome/COAWST/Projects/Sandy/Sandy_ini.nc \
           /scratch/nome.sobrenome/COAWST/Projects/Sandy/Sandy_ini_ref3.nc
NGCNAME =  /scratch/nome.sobrenome/COAWST/Projects/Sandy/Sandy_roms_contact.nc
BRYNAME == /scratch/nome.sobrenome/COAWST/Projects/Sandy/Sandy_bdy.nc
FRCNAME == /scratch/nome.sobrenome/COAWST/Projects/Sandy/roms_narr_Oct2012.nc \
           /scratch/nome.sobrenome/COAWST/Projects/Sandy/roms_narr_ref3_Oct2012.nc
```

Volte para a pasta principal do COAWST e abra o arquivo *coawst.bash*:

```
cd /scratch/nome.sobrenome/COAWST
nedit coawst.bash
```

Procure os seguintes comandos e modifique, se necessário:

```
export   COAWST_APPLICATION=JOE_TC
export   MY_ROOT_DIR=${HOME}/COAWST
export   MY_HEADER_DIR=${MY_PROJECT_DIR}/Projects/JOE_TC
```

Por:

```
export   COAWST_APPLICATION=Sandy
export   MY_ROOT_DIR=${HOME}/COAWST
export   MY_HEADER_DIR=${MY_PROJECT_DIR}/Projects/Sandy
```

Ative novamente os módulos no arquivo *setup_pgi.sh*, e depois compile o projeto com o comando:

```
./coawst.bash -j 4  1> coawst.pgi.sandy 2>&1 &
```

Este comando criará o arquivo de texto *coawst.pgi.sandy* onde será possível acompanhar a evolução da compilação. Abra o arquivo de texto com o comando a seguir e procure pela mensagem final, como na Figura 2.4.

```
nedit coawst.pgi.sandy
```

```
IPA: no IPA optimizations for 5 source files
IPA: Recompiling ./Build/get_sparse_matrix.o: new IPA information
IPA: Recompiling ./Build/master.o: new IPA information
IPA: Recompiling ./Build/mct_coupler_utils.o: new IPA information
IPA: Recompiling ./Build/mod_coupler_iounits.o: new IPA information
IPA: Recompiling ./Build/ocean_control.o: new IPA information
IPA: Recompiling ./Build/ocean_coupler.o: new IPA information
IPA: Recompiling ./Build/read_coawst_par.o: new IPA information
IPA: Recompiling ./Build/read_model_inputs.o: new IPA information
IPA: Recompiling ./Build/roms_export.o: new IPA information
IPA: Recompiling ./Build/roms_import.o: new IPA information
```

Figure 2.4. Mensagem final após compilar o COAWST.

Caso queira acompanhar pelo terminal a evolução da compilação, utilize o comando:

```
tail -f coawst.pgi.sandy
```

ATENÇÃO O processo de compilação é longo!

Pronto! No diretório principal do COAWST, será criado um arquivo chamado *coawstM*. Neste arquivo estarão compiladas todas as informações do seu projeto. Agora com o COAWST compilado, iniciaremos o caso teste.

2.10 Simulando o caso teste Sandy

Para simular o caso, busque pela pasta *Work/Sandy*. Digite:

```
cd /scratch/nome.sobrenome/COAWST/Work/Sandy
nedit run_sandy.sh
```

ATENÇÃO A pasta *Work* deverá conter os arquivos *limpa.sh*, *link.sh* e *run_sandy.sh*. Eles poderão ser encontrados na pasta usada como repositório. Relembre a Seção 2.9.2.

Ao abrir o arquivo, verifique se os diretórios estão de acordo com o seu nome de usuário e digite o comando abaixo para iniciar a integração.

```
qsub run_sandy.sh
```

ATENÇÃO O comando *qsub* submeterá o seu *job*. Ele enviará o script executado para um lote do cluster, reservando uma parte dos processadores para a sua simulação.

O processo gerará dois arquivos para acompanhar a evolução da simulação: o *log.out* e *log.err*. Para abrir, utilize:

```
nedit log.out log.err
```

Ou acompanhe diretamente no terminal com o comando:

```
tail -f log.out
```

As saídas das simulações serão armazenadas na pasta *Work/Sandy*. Caso algum erro ocorra, limpe a área de trabalho com o comando:

```
./limpa.sh
```

ATENÇÃO A simulação do caso teste Sandy poderá demorar 5 horas ao integrar usando 3 processadores.

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