

# Definition of the interannual experiment ORCA025-G70, 1958-2004

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## 1 Introduction

This report describes the  $1/4^\circ$  model configuration ORCA025-G70 used for the first long experiment with interannual forcing (47 years, from 1958 to 2004) performed by the DRAKKAR project. Experiments with ORCA025 have started in 2004/2005 with 10-year sensitivity experiments using a climatological forcing called "DRAKKAR set 1" (Talandier et al, 2003). The results of those experiments are described in Barnier et al (2006). Following those, another 10 year experiment (ORCA025-G42) was run with climatological CORE forcing (see Large and Yeager, 2004 for the definition of this forcing set). Some aspects of this experiment are documented in Dencausse (2005) and Treguier et al. (2006). In early 2006, a first interannual experiment with the CORE forcing (ORCA025-G50) was started, and stopped after 14 years (8 years spin-up and the years 1958-1965 with interannual forcing). This decision was made because of a very weak thermohaline circulation in the Atlantic (10 Sv), as well as other problems. This is why a new forcing set (DRAKKAR forcing set 3) is used for the present experiment. Note that the forcing set uses data from ERA40 for years 1958 to 2001, but ECMWF analysis for years 2002-2004, causing an adjustment of the upper ocean in 2002, especially in the tropics. This is a technical report: users that are not familiar with the NEMO modelling system ([www.lodyc.jussieu.fr/NEMO](http://www.lodyc.jussieu.fr/NEMO)) should refer to the model documentation. The code is based on version NEMO 1.12.

## 2 Basic settings

The list of CPP keys used for this run is found in table 1.

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| Key               | Description   |
|-------------------|---|
| key_orca_r025     | Configuration name  |
| key_dynspg_ft     | Filtered free surface   |
| key_zdftke        | TKE vertical mixing scheme                                      |
| key_dtatem        | Use temperature data for initial conditions                     |
| key_dtasal        | Use salinity data for initial conditions                        |
| key_dtasss        | Use monthly surface salinity data for relaxation                |
| key_tradmp        | special relaxation to clim T and S in the Gulf of Cadiz         |
| key_flux_core     | Use CORE forcing routines and NCAR bulk formulae                |
| key_trabbc        | Bottom boundary condition for tracers (geothermal flux)         |
| key_traldf_c2d    | 2D lateral diffusion for tracers (depends on dx)                |
| key_dynldf_c2d    | 2D lateral diffusion for dynamics (depends on dx <sup>3</sup> ) |
| key_ldfslp        | Need to calculate isopycnal slope                               |
| key_passivetr     | Passive tracers   |
| key_cfc           | One cfc (code James Orr)  |
| key_c14bomb       | C14 bomb (code James Orr)                                       |
| key_partial_steps | Partial steps topography  |
| key_trabbl_dif    | diffusive bottom boundary layer parameterization                |
| key_trabbl_adv    | advective bottom boundary layer parameterization                |
| key_dimgout       | dimg format for outputs   |
| key_mpp_mpi       | multiprocessor MPI run  |
| key_ice_lim       | Ice model   |
| key_lim_fdd       | Ice model interaction with the ocean.                           |

Table 1: CPP keys for ORCA025-G70 run. Note that even if the code was compiled with key\_trabbc activated, in the namelist we run without geothermal heating.

## 2.1 Horizontal grid

The horizontal grid was defined as a generic 'ORCA' type mesh with 3 poles, using a t-point pivot for the north fold condition. The horizontal grid resolution is 1/4 deg at the equator, leading to horizontal dimensions of 1442 x 1021. The minima of the the scale factors (ocean points) are 5.6 km (zonal direction) and 3.1 km (meridional direction). The maximum is 27.8 km at the equator.

## 2.2 Vertical grid

There are 46 levels on the vertical, with grid spacing ranging from 6 m near the surface to 250 m at 5750 m. The maximum depth allowed in the model is 6000 m. to reach that depth with partial cells, the deepest cell can have a thickness as large as 500 m in the deep basins. The details of the vertical levels as well as the vertical metrics are given in annex A.

## 2.3 Bathymetry

The bathymetry is derived from two input files:

- The 2-minute bathymetry file (etopo2) of NGDC, combination of Smith and Sandwell satellite-based bathymetry (8.2 version), IBCAO (in the Arctic region) and other data in the Antarctic region. The MERCATOR project team has applied additional corrections near the Antarctic (Remy et al, 2003). This file is used for the deep ocean (below 300m) because its spatial scales are consistent over the globe.
- The GEBCO 1mn bathymetry file provided between 88S and 88N. This file is used for bathymetry on the shelf because it is found to be more accurate there (above 200m).

The interpolation onto the model grid has been conducted by taking all the original grid points falling into an ORCA025 grid box, and taking the median of those points. This procedure produces a smoothing of the sub-grid scale topography. The two bathymetries are combined with a linear ramping between 200m and 300m to transition from Gebco to Etopo2. The topography has been smoothed by two passes of a uniform shapiro filter with weight  $w=0.6$ , and hand editing has been performed in key areas. The land/sea mask has been edited by hand by the MERCATOR team.

The experiment is run using the partial cell representation of the topography (key\_partial\_steps). The following values are used to calculate the partial cell layer thicknesses (in namelist namdom: `e3zps_min = 25.` and `e3zps_rat = 0.2.`

A list of hand editions made for this run is given in Annex B. There are substantial modifications compared with the original version of 2004 found on the DRAKKAR web site. A first series of modifications was made in the Indonesian Throughflow region by Ariane Koch Larrouy who runs a limited-area model forced at the boundaries by ORCA025-G32 (Larrouy, Madec et al, in preparation). A second series was made in the

Gulf of Cadiz following the work of R. Almar and S. Theetten (2005). This work was initiated following our finding that Mediterranean waters as well as overflow waters did not sink to the right depth in ORCA025. The results of the tests, as well as the experiments of G. Hervieux (LEGI) confirmed the small influence of the existing parameterizations in the NEMO code: advective and diffusive bottom boundary layer, as well as enhanced bottom friction downstream of the straits. A "cliff" approach was attempted for the Mediterranean outflow, which is to dig a narrow channel from the Gibraltar Strait to the right depth (1200m). This was found to produce mediterranean water at the right depth but too warm and too saline. Despite these flaws we have preferred it to the previous solution (mediterranean water with more or less the right temperature and salinity but too high in the water column). However, after running the model for seven and a half year, we decided that the spurious increase of temperature and salinity at 1000 m in the Atlantic was not tolerable. A relaxation to annual Levitus T and S has been introduced only in layers 21 to 26 (637 to 1297m), in a gaussian patch of radius 100 km centered at 36°N, 7°W. The maximum relaxation coefficient was first 4 days. Starting year 1970, the radius has been decreased to 80 km and the maximum relaxation coefficient set to 6 days.

The cliff approach is also applied to Denmark Strait. The strait is widened and a channel is dug downstream of the deep outflow. We note that in a short experiment with NATL4, the effect of widening Denmark Strait by a factor of two did not lead to an increase of the overall transport because the velocities became smaller in the same proportion as the increase in area. The properties of the waters downstream improved somewhat, and the overturning increased by at least one Sverdrup.

Finally, two islands have been added in the Torres Strait in order to reduce the barotropic transport, but leaving the strait open.

## 2.4 Initial conditions

The initial conditions for temperature and salinity were derived from the Levitus 98 data set for the mean and low latitudes. For high latitudes PHC climatology was used instead. For the Mediteranean Sea, **medatlas** climatology was used. The initial condition for the sea ice is taken from ORCA025-G45b, a previous run with a climatological CORE forcing. This initial condition corresponds to mean January of year 10 of the G45b experiment.

## 3 Forcings

### 3.1 Runoffs

A new runoff file has been calculated using the Dai and Trenberth dataset (Dai and Trenberth, 2002) by Romain Bourdalle-Badie at Mercator:

runoff\_coast1pt\_ant3pt\_obtaz\_1m\_ORCA025.nc. It includes 99 major rivers and coastal runoffs; the total annual mean input is 1.31 Sv. It is a monthly climatology. A report describing the method is found on the DRAKKAR web site (Bourdalle-Badie and Treguier, 2006). We use the namelist variable `nrunoff=2`. In that case, a special treatment is ap-

plied in runoff regions, where the array *upsrnfh* is non zero. This array is read in the runoff file (netcdf variable *socoefr*). It has a value of zero where there is no runoff and 0.5 at runoff points. Since we do not use the centered scheme, there is no need to revert to upstream near runoffs (the TVD advection scheme is used everywhere). In our case the special treatment consists in an enhanced vertical diffusion at the interface of layers 1 and 2 applied in step.F90 (Drakkar configuration manager version):

```
avt (:,:,2) = avt (:,:,2) + 2.e-3 * upsrnfh(:,:)
```

The vertical mixing is then set to  $10^{-3}$  below the top level at runoff points.

*upsrnfh* is also used to avoid SSS restoring in the vicinity of river mouths (which tends to cancel the runoff effect !)

### 3.2 Atmospheric forcing files

The forcing dataset is called DRAKKAR forcing set 3 (DFS3), (Brodeau and Barnier 2006, document in preparation). The early ORCA025 experiments in 2004 used DRAKKAR set 1 (Talandier, 2004). We use a blend of data from various origin and different frequencies. Some come from the CORE dataset assembled by W. Large (available on the GFDL web site); others come from the ECMWF reanalysis ERA40. Note that ERA40 stops in 2002 so that *there is a discontinuity in forcing in 2002* (see last paragraph of this section). Some ERA40 variables, provided at 2 m high, are corrected to height 10 m. For the correction, the iterative algorithm provided by Large and Yeager (2004) is applied to the following ERA40 variables : temperature at 2m, specific humidity at 2m, scalar wind at 10m and atmospheric pressure. Prior to this correction, specific humidity at 2m is computed from the dew-point at 2m and atmospheric pressure. With regard to the 2m/10m correction, we discover (after the run) that for the period 2002-2004 (ECMWF field), the correction was not done and 2m fields were used instead of 10m field. The impact of this error is not well known but some low resolution experiments indicate a low impact.

The input files are the following:

- **Air temperature and specific humidity (10m) :** 6 hourly values from ERA40, corrected as indicated above.
- **Solar and infra-red downwelling radiation :** Daily values from satellites (IS-CCP, Zhang et al. 2004). The corrected version of this product available into the CORE dataset is used. (*qsw\_CORE.nc* and *qlw\_CORE.nc* for short-wave=solar and long-wave=infra-red). Note that for the period 1958-1983, the values are the climatological daily mean of period 1984-2004.
- **Precipitation (total precipitation and snow) :** Monthly fields from CORE, but with correction. Southward to 20°N, the standard CORE product is used. Northward to 30°N the uncorrected CORE product (GXGXS or Serreze) is used, because we believe that the global correction applied by Large and Yeager to the "corrected" CORE dataset is unwarranted in the northern hemisphere. The two

products are blended between 20°N and 30°N. Using the standard CORE product has proven to lead to highly positive global freshwater imbalance both with model simulations and fixed SST off-line tests, leading to a consequent sea level rise. It is also emphasized that the standard CORE precipitation is over-estimated on the nordic seas. Using the proposed blending is expected to solve these two issues since the GXGXS provides much less precipitation at every latitude, especially in the north. Off-line flux computation with prescribed SST showed that along the period 1979-2000 the global freshwater imbalance is +17 mm/year with the standard CORE precipitation while it is -12 mm/year with the proposed DFS3 precipitation product. A zero imbalance was not a the purpose of this correction since, in our experience, model simulations react differently than these off-line tests. Note that for the period 1958-1978, we use a monthly mean climatology deduced from 1979-2004.

The turbulent fluxes, outgoing radiation and albedo are calculated using the formulae proposed with the CORE dataset (Large and Yeager, 2004).

The ERA40 reanalysis stops in early 2002. The first part of the ORCA025-G70 experiment has been carried out until the end of 2001, and we have switched to a new forcing set for years 2002-2004. The CORE radiative fluxes and precipitations are available through the end of 2004. The other variables are taken from the ECMWF analysis provided through a partnership with MERCATOR-Ocean. We have verified a good continuity of the wind and air temperature between the two datasets.

On the other hand, the air humidity differs considerably between ERA40 and ECMWF in the low latitudes. The mean ECMWF specific humidity in this region (20°S 20°N) is about 0.5 g/kg lower than the former ERA40 value. It is also interesting to note that contrary to ERA40, the ECMWF humidity perfectly fits the values of the humidity provided by the CORE dataset (NCEP humidity modified following Large and Yeager, 2004). The spurious decrease of humidity in the equatorial region from 2001 to 2002 is expected to enhance the evaporation and is thus likely to create a cold surface temperature bias in our model. The fact that the simulation prior to ECMWF data integration was actually showing a warm surface bias in this region gave us reasons to believe that the ECMWF humidity was more realistic, so we have applied no correction. Examination of time series of sea surface temperature in the Pacific shows indeed an ajustment of the ocean model in 2002, towards a value in better agreement with TAO buoys.

### 3.3 Interpolation

The forcing fields are preprocessed and interpolated using the int2df interpolation package (Brodeau 2004), available at :

*<http://www-meom.hmg.inpg.fr/Web/Outils/SOSIE/sosie.html>*

The algorithm used follows Akima, 1974 : “A method of bivariate interpolation and smooth surface fitting based on local procedures”. Prior to the interpolation, the GAP procedure implemented into int2df is used to extrapolate sea values onto an extended land mask, this avoids some coastal land values influencing the interpolation process. Moreover, gridded data fields extracted from spectral models such as NCEP and ECMWF

have the disadvantage to propagate erroneous land values onto the sea through spatial features resembling waves especially in the vicinity of coastal mountain ranges. That is why an extended land mask has been created to flag such coastal regions. These regions may be of primary importance, such as the coast of Chile where non-treated winds would hardly generate any upwelling. Another important feature of the interpolation process is the rotation of the wind vector onto distorted regions of the target grid (northward 40°N for ORCA grids).

### 3.4 Katabatic winds

A modification is made to the wind forcing to improve the representation of the katabatic winds around Antarctica (Mathiot and Barnier, 2005). This is done by multiplying the two components of the wind stress by a coefficient read on `katamask.nc` file. This coefficient and its area of application around Antarctica has been determined by comparison over the period 1980-1989 of ERA40 with a downscaling of ERA40 on the Antarctic carried out with the regional atmospheric model MAR designed for the simulation of katabatic winds (H. Gallée, LGGE). The coefficient is constant in time, but has a geographical dependence and an extent over the ocean which fits the results of MAR. This correction of the katabatic winds has been validated by a series of simulations long of 10 years, carried out with a model of the ACC extracted from ORCA05, and driven at its open boundary by the solution of ORCA05-G42 (on going PhD Thesis of Pierre Mathiot). This correction is applied over the period 1958-2001. When switching wind forcing to ECMWF analysis products, (2002-2004), it was turned off: these higher resolution (than ERA40) products have almost correct katabatic winds, and the correction was not tuned for these winds.

### 3.5 Forcing parameters

The forcing routine and the ice model are called only once every two hours, e.g. 5 time steps (`nfice=5` and `nfbulk=5`) in the namelist `namdom`. There is relaxation to sea surface salinity (monthly climatology of Levitus/PHC). The coefficient (m/day) is set in the new namelist:

```
&namsbc  
  cdmp = 0.166666667
```

This value is chosen by consistency with the "strong relaxation" cases in the CORE papers by Griffies *et al.*, 2006. It amounts to a decay time of 60 days for 10 m of water depth. We decided to maintain SSS restoring under the ice cover with a 5-time enhanced coefficient (12 days for 10 m). We also add extra restoring for the Red Sea and Med Sea (decay in the Alboran Sea) (`oce_sbc_dmp` routine).

### 3.6 Miscellaneous

We use the standard NEMO scheme for penetrative solar radiation, based on clear water only. It does not take into account data of water colour. Despite what has been announced before, we do not use a geothermal heat flux.

Note that there is no representation of the diurnal cycle in this experiment: this would require a vertical resolution of 1 m in the upper layers (Bernie and Madec, personal communication).

Finally, there is relaxation to climatological temperature and salinity in a small region in the Gulf of Cadiz (see details in the "bathymetry" section). We relax to the Levitus annual temperature and salinity, the seasonal cycle being small in the relaxation zone (below 637 m).

### 3.7 Sea surface height adjustment

We do not use any SSH adjustment. We set `ln_fwb = .false.` in the namelist. No attempt is made to ensure that the correction term (erp) by relaxation to observed SSS had a zero integral over the global ocean (suppression of the adjustments using "aplus" and "aminus" in routine `ocesbc.F90`). All experiments with CORE forcings had an increase of the global SSH, and so was the case of an hybrid forcing experiment with the 1/2° global model (ORCA05-G60). To minimize this drift, precipitations have been reduced compared with previous cases (section 3.2).

## 4 Ice model

Modification to the standard ice parameters have been suggested at the 2006 january DRAKKAR meeting and tried in experiment ORCA025-G50, but they were found to cause problems. We revert to the same parameters as the first CORE climatological run (ORCA025-G42)

```
&namicerun
  ln_limdyn   = .true.
  acrit      = 1.0e-06 , 1.0e-06
  hsdif      = 0.0
  hicdif     = 0.0
/
&namiceini
  ln_lim_ini = .true.
  ttest     = 2.0
  hninn     = 0.5
  hginn     = 3.0
  alinn     = 0.05
  hnins     = 0.1
  hgins     = 1.0
  alins     = 0.1
/
&namicedyn
  epsd      = 1.0e-20
```



```

alpha = 0.5
dm    = 0.6e+03
nbiter = 1
nbitdr = 100
om    = 0.5
resl  = 5.0e-05
cw    = 5.0e-03
angvg = 0.0
pstar = 1.0e+04
c_rhg = 20.0
etamn = 0.0e+07
creepl = 2.0e-08
ecc   = 2.0
ahi0  = 200.e0
/
&namicetrp
  bound = 0.
/
&namicethd
  hmelt = -0.15
  hiccrit = 0.6 , 0.3
  hicmin = 0.2
  hiclim = 0.05
  amax = 0.999
  swiqst = 1.
  sbeta = 1.
  parlat = 0.0
  hakspl = 0.5
  hibspl = 0.5
  exld = 2.0
  hakdif = 1.0
  thth = 0.2
  hnzst = 0.1
  parsub = 1.0
  alphs = 1.0
/

```

## 5 Parametrizations

All runs are performed with the free surface, constant volume formulation (`key_dynspg_flt` defined).

### 5.1 Advection schemes:

We use TVD for tracers (`ln_traadv_tvd = .true.` ). We use the new momentum advection scheme suitable for partial step topography (`ln_dynvor_een = .true.` ).

## 5.2 Lateral mixing:

**-tracer** : a laplacian isopycnal diffusion is used with `aht0= 300m2/s` at the equator. The coefficient decreases polewards proportionally to the grid size. Associated keys are `key_traldf_c2d` and `key_ldfslp`.

**-dynamics** : A biharmonic horizontal viscosity is used with `ahm0= -1.5 1011 m4/s2` . The viscosity depends on the grid size with  $\delta x^3$ .

In early runs by MERCATOR, the equatorial undercurrent in the Pacific was too energetic. Because of this, an additional laplacian viscosity had been added in a narrow equatorial band (-2 °S, 2 °N) upper layers, with a value of 500 m<sup>2</sup>/s, in the DRAKKAR runs made in 2004. We have found later that the new advection scheme slows down the equatorial undercurrent. We suppress this additional viscosity.

## 5.3 Bottom boundary layer:

A diffusive bottom boundary layer is activated using `key_trabbl_dif` with `atrbb1 =1000 m2.s-1`. The advective boundary layer has been tested in the North Atlantic regional configuration NATL4 with only a small effect (small compared with the improvements found in the FLAME model). We keep the advective BBL scheme all the same (`key_trabbl_adv`).

## 5.4 Vertical mixing:

There is no double-diffusive mixing.

**-tke:** TKE is used to compute the vertical mixing. We use the new version of the TKE routine recently proposed by Gurvan MADEC with the following namelist parameters

```
!-----
!          namtke   turbulent eddy kinetic dependent vertical diffusion
!                  ( #ifdef "key_zdftke" )
!-----
! ln_rstke flag to restart with tke from a run without tke (default F)
! ediff   coef. to compute vertical eddy coef. (avt=ediff*mxl*sqrt(e) )
! ediss   coef. of the Kolmogoroff dissipation
! ebb     coef. of the surface input of tke
! efave   coef. to applied to the tke diffusion ( avtke=efave*avm )
! emin    minimum value of tke (m2/s2)
! emin0   surface minimum value of tke (m2/s2)
! nitke   number of restart iterative loops
! ri_c    critic richardson number
! nmxl    flag on mixing length used
!         = 0 bounded by the distance to surface and bottom
!         = 1 bounded by the local vertical scale factor
!         = 2 first vertical derivative of mixing length bounded by 1
! npdl    flag on prandtl number
!         = 0 no vertical prandtl number (avt=avm)
!         = 1 prandtl number function of richarson number (avt=pdl*avm)
```

```

!           = 2 same as = 1 but a shapiro filter is applied on pdl
! nave     = horizontal averaged (=1/2) or not (=0) of avt (default =1)
! navb     = 0 cst background avt0, avm0 / =1 profile used on avtb
! ln_lsfc  computation surface value of buoyancy length scale as function of wind stress
! lmin     buoyancy length scale minimum value if ln_lsfc = F
! n_etau   test param. to add tke induced by wind
!           = 0 no add tke induced by wind
!           = 1 add tke induced by wind
!           = 2 add tke induced by wind only at the base of the mixed layer
! fr_emin  fraction of TKE surface value which penetrates inside the thermocline
! ln_lc    flag to take into account Langmuir circulation
! c_lc     coef to compute verticla velocity of LC
&namtke
  ln_rstke = .false.
  ediff   =    0.1
  ediss   =    0.7
  ebb     =    60.
  efave   =     1.
  emin    =   1.e-6
  emin0   =   1.e-4
  nitke   =    50
  nmxl    =     3
  npdl    =     1
  navb    =     0
  nave    =     1
  ln_lsfc = .true.
  lmin    =    0.4
  n_etau  =     1
  nhtau   =     3
  fr_emin =    0.05
  ln_lc   = .true.
  c_lc    =    0.15

```

The key modification made to tke is `fr_emin`, the proportion of energy allowed to enter into the stratified ocean below the mixed layer. This is meant to represent mixing by unresolved turbulence due to surface waves and swell. It is supposed to improve the depth of summer mixed layers that were too shallow in experiment G42. The parameter `nhtau` is changed from ORCA025-G50 (it used to be 1). It sets the scheme for the penetration of this energy. The depth is hardwired in the routine. It used to be 40m with a decrease to 5m at the equator. With `nhtau=3`, the depth is allowed to be different in different hemispheres, but finally after testing we set it to 30m in both hemispheres. We want to avoid unrealistic mixing under the ice. For this reason, the Langmuir cells contribution is removed under the ice, and the background coefficient is reduced (see next paragraph).

**-background and convection:** The enhanced vertical diffusion is used when convection is diagnosed. The corresponding namelist block is :

```

!-----
!       namzdf   vertical physics
!-----

```

```

! ln_zdfevd enhanced vertical diffusion          (default T)
! ln_zdfnpc Non-Penetrative Convection          (default T)
! avm0      vertical eddy viscosity for the dynamic (m2/s)
! avt0      vertical eddy diffusivity for tracers (m2/s)
! avevd     vertical coefficient for enhanced diffusion scheme (m2/s)
! nevdm     = 0  apply enhanced mixing on tracer only
!           = 1  apply enhanced mixing on both tracer and momentum
! ln_zdfexp vertical physics: (=T) time splitting (T)      (Default=F)
!           (=F) euler backward (F)
! n_zdfexp  number of sub-timestep for time splitting scheme
&namzdf
  ln_zdfevd = .true.
  ln_zdfnpc = .false.
  avm0      = 1.e-4
  avt0      = 1.e-5
  avevd     = 10.
  nevdm     = 1
  ln_zdfexp = .false.
  n_zdfexp  = 3
/

```

In the previous version of TKE there was an enhancement of the background by a factor of 10 in the top layer (and 5 and 2.5 in the second and third) in order to avoid too shallow mixed layers in summer. This is suppressed in the new version of TKE. The background coefficient is divided by a factor of 10 under the ice.

## 5.5 Bottom friction and lateral boundary condition

The namelist is the following. We use a spatially variable coefficient: the bottom friction coefficient is multiplied by `bfrien=50` in Torres Strait: this is to reduce the flow through this strait, that is observed to be small.

```

!-----
!      nambfr  bottom friction
!-----
! nbotfr  type of bottom friction
!          nbotfr = 0 , no slip
!          nbotfr = 1 , linear friction
!          nbotfr = 2 , nonlinear friction
!          nbotfr = 3 , free slip
! bfri1   bottom drag coefficient (linear case)
! bfri2   bottom drag coefficient (non linear case)
! bfeb2   bottom turbulent kinetic energy (m^2/s^2)
! ln_bfr2d: flag for 2d coef enhancement read in file
! bfrien:  enhancement coefficient (integer > 1)
&nambfr
  nbotfr = 2
  bfri1 = 4.e-4
  bfri2 = 1.e-3
  bfrien = 50
  ln_bfr2d = .TRUE.
  bfeb2 = 2.5e-3
/

```

The lateral boundary condition is free slip (a test with no-slip was made in 2004 and the results were not good, Thierry Penduff, publication in preparation). We modify it locally to decrease the transport at some straits. The following modifications are made in dommsk.F90:

```

IF( cp_cfg == "orca" .AND. jp_cfg == 25 ) THEN ! ORCA R025 configuration
!
! =====
  ii0 = 212 ; ii1 = 212 ! East of Ombai strait
  ij0 = 464 ; ij1 = 465 ; fmask( mi0(ii0):mi1(ii1) , mj0(ij0):mj1(ij1), 1:jpk ) = 2.0
  IF(lwp) WRITE(numout,*)
  IF(lwp) WRITE(numout,*) ' orca_r025: fmask = 2 at the East Ombai Strait'
  ii0 = 210 ; ii1 = 211 ! West of Ombai strait
  ij0 = 466 ; ij1 = 466 ; fmask( mi0(ii0):mi1(ii1) , mj0(ij0):mj1(ij1), 1:jpk ) = 2.0
  IF(lwp) WRITE(numout,*)
  IF(lwp) WRITE(numout,*) ' orca_r025: fmask = 2 at the West Ombai Strait '
  ii0 = 210 ; ii1 = 210 ! exit of Ombai strait
  ij0 = 464 ; ij1 = 465 ; fmask( mi0(ii0):mi1(ii1) , mj0(ij0):mj1(ij1), 1:jpk ) = 2.0
  IF(lwp) WRITE(numout,*)
  IF(lwp) WRITE(numout,*) ' orca_r025: fmask = 2 at the exit of Ombai Strait '
  ii0 = 172 ; ii1 = 175 ! Lombok strait
  ij0 = 463 ; ij1 = 463 ; fmask( mi0(ii0):mi1(ii1) , mj0(ij0):mj1(ij1), 1:jpk ) = 2.0
  IF(lwp) WRITE(numout,*)
  IF(lwp) WRITE(numout,*) ' orca_r025: fmask = 2 at the Lombok Strait'
!
ENDIF

```

and further modifications:

```

! Locally modify shlat :
IF( cp_cfg == "orca" .AND. jp_cfg == 025 ) THEN
!
! =====
! Increased lateral friction in ! ORCA_R025 configuration
! the vicinity of some straits ! =====
!
!! Gibraltar strait and Gulf of Cadiz
  ij0 = 652 ; ij1 = 654
  ii0 = 1125 ; ii1 = 1127
  zshlat=3
  DO jj = mj0(ij0),mj1(ij1)
    DO ji = mi0(ii0), mi1(ii1)
      IF( fmask(ji,jj,jk) == 0. ) THEN
        fmask(ji,jj,jk) = zshlat * MIN( 1., MAX( zwf(ji+1,jj), zwf(ji,jj+1), &
          & zwf(ji-1,jj), zwf(ji,jj-1) ) ) )
      ENDIF
    END DO
  END DO
!
ENDIF

```

## 6 miscellaneous:

**-timestep** : The time steps is set to 1440 s ( 60 steps/day).

**-hpg implicit** : The semi-implicit scheme is applied to allow a larger time step (a factor of two on the cfl criterion linked with internal wave propagation).

**-asselin** : the asselin coefficient is taken to 0.1

## 7 Simulation strategy

The present run starts in 1958 (first year of ERA40 and CORE), directly with the inter-annual varying forcing. We prefer to avoid a long spin up with either climatological or repeated year (the 8 years spin up using year 1958 in ORCA025-G50 was not conclusive).

## 8 Transient tracers

The bomb C14 and CFCs forcings are provided by Zouhair Lachktar and James Orr. The tracers use the same parameterizations as the physics (isopycnal mixing) and the TVD advection scheme. However, we discover a mistake when the run was completed: the BBL schemes were not used for passive tracers as they were for temperature and salinity.

The transients tracers are supposed to start with zero initial conditions near year 1950. To overcome the problem of the missing years we use as initial conditions the tracer distribution of the year 1959 of ORCA025-G50. This should not be a big problem since the tracer concentrations remain quite small in the 50s. Tracers begin after one year of dynamical run in order to avoid the initial geostrophic adjustment of the dynamics.

## 9 Model outputs

### 9.1 Archived fields

Files are stored every 5 days ( $nwrite = 300$  steps). 3D variables are  $U, V, T, S, W, K_z$ .  $K_z$  is a time-average of the total vertical mixing including convection events (suitable for off-line tracer calculations). Two dimensional fields are  $taux$  and  $tauy$  (in U and V files) and in the "grid T" files:

$so\text{ssheig}$  Sea surface height (in meters)

$so\text{mxl010}$  Mixed layer depth (in m) based on a  $\sigma_0$  difference of 0.01 with the surface

$so\text{hefldo}$  Net Downward Heat Flux (in  $W.m^{-2}$ )

$so\text{shfldo}$  Short wave downward radiative flux (in  $W.m^{-2}$ )

$so\text{waflup}$  Net upward water flux in  $kg.m^2.s^{-1}$  (forcing of the sea surface height)

$so\text{waflpd}$  Surface water flux damping in  $kg.m^2.s^{-1}$

$io\text{waflup}$  Ice-ocean water flux in  $kg.m^2.s^{-1}$

sowafld Concentration-dilution water flux (the product of this flux with surface salinity is the forcing term in the salinity equation)

solhflup Latent heat flux (in  $W.m^{-2}$ )

solwfldo Long wave downward radiative flux (in  $W.m^{-2}$ )

sosbhful Sensible heat flux (in  $W.m^{-2}$ )

## 9.2 Storage strategy

Although we have thought about storage in 16 bits, for now the netcdf variables are floats with 32 bits. For best performances, the output are written by each processor in direct acces files. Those files are recombined immediately after the experiment (see Molines (2004) [13] for more details). The output files stored on gaya at IDRIS are 5 days averages. They are netcdf files very similar to classical OPA netcdf output, excepted for a few differences:

- one file for each 5-day average
- definition of time\_counter: The time\_counter gives the number of seconds since the beginning of the run.
- naming convention for the files: There are 5 types of files; 4 corresponds to the different grid points: gridT, gridU, gridV and gridW; a fifth type of file corresponds to the ice model output. File names are almost self explanatory: (*e.g.* ORCA025-G22\_y0010m10d03\_gridT.nc or ORCA025-G22\_y0010m10d03.icemod.nc). The time indicated in the name of the file corresponds to the date at the **end** of the period used to time-average the data.
- archiving the results: The results are archived on rcli002@gaya:ORCA025/. Data are organized in many directories. Raw results from the run are stored under ORCA025-CASE-S (one sub-directory per year then). Mean values computed from the raw results are stored in ORCA025-CASE-MEAN. There are monthly means and annual means (one sub-directory per year). Interannual means are also computed. The implementation of this directory tree for archiving the results, is part of the strategy used in DRAKKAR to share different configurations between groups of users (see Molines *et al.*(2004) [14] ).

Note that the special value on land is zero. This is properly referenced in the header of each file (and causes problems with older versions of the "ncra" software).

## 10 Numerics

### 10.1 Domain decomposition

ORCA025 runs on massively parallel computer, using a domain decomposition technique. Processors that corresponds to land are eliminated in the initialisation procedure; in the

ORCA025 case, the decomposition is done on  $18 \times 12$  processors, but only 186 are used. The choice of the best processor layout is done during a pre-processing phase (see details in Molines (2004) [12]). The message passing between processors is explicitly done using the MPI library (option "isend").

## 10.2 Performance on the IDRIS IBM HPC (zahir)

This configuration is implemented on the IDRIS IBM HPC (zahir), and run on 186 processors, using 47 nodes of 4-processor p655. The communications between the nodes is done via a 'federation' switch which gives excellent performance. The best performance is achieved using the namelist option `c_mpi_send = 'I'`, for message passing (about 30% better than `mpi_bsend!`). The performance has been tested with the other solver (`nsolv=2`) and extra halos to reduce communications: it does not bring a significant gain.

## References

- [1] Almar, Raphael, 2005: Etude de la sortie des eaux Méditerranéennes dans la configuration NATL4 du projet DRAKKAR. Rapport de stage de Master 1 Ocean-Atmosphere de l'université Paul Sabatier, encadrement S. Theetten.
- [2] Barnier, B., G. Madec, T. Penduff, J.M. Molines, A.M. Treguier, J. Le Sommer, A. Beckmann, A. Biastoch, C. Böning, J. Dengg, C. Derval, E. Durand, S. Gulev, E. Remy, C. Talandier, S. Theetten, M. Maltrud, J. McClean, B. De Cuevas 2006: Impact of partial steps and momentum advection schemes in a global ocean circulation model at eddy permitting resolution. *Ocean Dynamics*, DOI: 10.1007/s10236-006-0082-1.
- [3] Bourdallé-Badie R., and A.M. Treguier, 2006: A climatology of runoff for the global ocean-ice model ORCA025. MERCATOR report MOO-RP-425-366-MER.
- [4] Brodeau, L, 2004: A comparison between two interpolation tools. Drakkar report, available at [www.ifremer.fr/lpo/drakkar](http://www.ifremer.fr/lpo/drakkar)
- [5] Dai A., and K.E. Trenberth, 2002: Estimates of freshwater discharge from continents: latitudinal and seasonal variations. *Journal of hydrometeorology*, 3, 660-687.
- [6] Dencausse G., 2005: Etude de variabilité des fronts et du transport global de l'ACC dans un modèle global au  $1/4^\circ$ , Rapport de stage du Master 2 option Oc@ographie physique (Université de Bretagne Occidentale). Encadrement: S. Speich et A.M. Treguier.
- [7] Fichefet, T. and M.A. Morales Maqueda, 1997: Sensitivity of a global sea ice model to the treatment of ice thermodynamics and dynamics, *J. Geophys. Res.*, 102, 12609-12646



- [8] Griffies, S.M.; and C. Böning, A. Biastoch, E. Chassignet, R. Gerdes, W. Large, B. L. Samuels, U Schweckendiek, A.M. Treguier, M. Winton, 2006: A proposal for coordinated ocean-ice reference experiments (COREs). manuscript in preparation.
- [9] Large, W., and S. Yeager, 2004: Diurnal to decadal global forcing for ocean and sea-ice models: the datasets and flux climatologies. NCAR technical note: NCAR/TN-460+STR, CGD division of the National Center for Atmospheric Research. Available on the GFDL CORE web site.
- [10] Tartinville B.: Description of the CLIO model version 3.0, found on the LODYC/OPA web site
- [11] Talandier, C., A.M. Treguier and B. Barnier, 2003: Preparing surface flux fields using bulk formulae for the DRAKKAR project. DRO/LPO report 03-13, Brest.
- [12] Molines, J.M., 2004 : How to set up an MPP configuration with NEMO OPA9 ? Drakkar technical report, Grenoble, 8pp.
- [13] Molines, J.M., 2004 : Drakkar I/O strategy and implementation for MPP runs with NEMO-OPA9. Drakkar technical report, Grenoble, 13pp.
- [14] Molines, J.M., A.M. Treguier and S. Theetten, 2004: Drakkar Config Manager: How to manage and share various model configurations, based on NEMO-OPA9. Drakkar technical report, Grenoble, 14pp.
- [15] Mathiot P., 2005: Interactions océan glace de mer en Antarctique. Rapport de Master 2 STUE de l'Université Joseph Fourier de Grenoble. réalisé au LEGI et au LGGE. Encadrement B. Barnier et H. Gallée. Juin 2005

## A Annex A

### vertical levels

```

zgr_z      : Reference vertical z-coordinates
~~~~~

zsur, za0, za1 computed from
    zdzmin = 6.0000000000000000
    zhmax  = 5720.00000000000000
Namelist namzgr : value of coefficients for vertical mesh:
    zsur = -2143.95922194325158
    za0  = 127.451110365423233
    za1  = 123.075814004137086
    zkth = 23.5629999999999988
    zacr = 9.0000000000000000

Reference z-coordinate depth and scale factors:
level  gdept  gdepw  e3t    e3w
   1    3.05   0.00   6.19   6.00

```

|    |         |         |        |        |
|----|---------|---------|--------|--------|
| 2  | 9.45    | 6.19    | 6.64   | 6.40   |
| 3  | 16.36   | 12.83   | 7.19   | 6.90   |
| 4  | 23.88   | 20.03   | 7.88   | 7.52   |
| 5  | 32.18   | 27.92   | 8.74   | 8.29   |
| 6  | 41.44   | 36.68   | 9.80   | 9.25   |
| 7  | 51.87   | 46.49   | 11.12  | 10.43  |
| 8  | 63.78   | 57.62   | 12.74  | 11.89  |
| 9  | 77.48   | 70.38   | 14.73  | 13.69  |
| 10 | 93.39   | 85.13   | 17.18  | 15.89  |
| 11 | 112.01  | 102.33  | 20.16  | 18.60  |
| 12 | 133.92  | 122.52  | 23.78  | 21.88  |
| 13 | 159.82  | 146.33  | 28.14  | 25.86  |
| 14 | 190.49  | 174.50  | 33.36  | 30.63  |
| 15 | 226.85  | 207.90  | 39.54  | 36.32  |
| 16 | 269.92  | 247.48  | 46.78  | 43.02  |
| 17 | 320.80  | 294.31  | 55.16  | 50.83  |
| 18 | 380.63  | 349.52  | 64.70  | 59.78  |
| 19 | 450.57  | 414.27  | 75.38  | 69.90  |
| 20 | 531.74  | 489.69  | 87.11  | 81.12  |
| 21 | 625.09  | 576.84  | 99.72  | 93.32  |
| 22 | 731.40  | 676.59  | 112.98 | 106.29 |
| 23 | 851.17  | 789.58  | 126.59 | 119.76 |
| 24 | 984.59  | 916.17  | 140.22 | 133.42 |
| 25 | 1131.50 | 1056.38 | 153.54 | 146.94 |
| 26 | 1291.46 | 1209.89 | 166.25 | 159.99 |
| 27 | 1463.71 | 1376.10 | 178.10 | 172.29 |
| 28 | 1647.31 | 1554.16 | 188.92 | 183.65 |
| 29 | 1841.17 | 1743.03 | 198.61 | 193.91 |
| 30 | 2044.14 | 1941.59 | 207.13 | 203.01 |
| 31 | 2255.05 | 2148.67 | 214.51 | 210.96 |
| 32 | 2472.80 | 2363.14 | 220.82 | 217.79 |
| 33 | 2696.36 | 2583.92 | 226.15 | 223.60 |
| 34 | 2924.82 | 2810.03 | 230.62 | 228.49 |
| 35 | 3157.35 | 3040.62 | 234.32 | 232.56 |
| 36 | 3393.25 | 3274.92 | 237.38 | 235.93 |
| 37 | 3631.93 | 3512.27 | 239.89 | 238.70 |
| 38 | 3872.87 | 3752.14 | 241.93 | 240.96 |
| 39 | 4115.66 | 3994.06 | 243.60 | 242.81 |
| 40 | 4359.96 | 4237.64 | 244.95 | 244.31 |
| 41 | 4605.47 | 4482.58 | 246.04 | 245.52 |
| 42 | 4851.97 | 4728.61 | 246.92 | 246.50 |
| 43 | 5099.25 | 4975.52 | 247.63 | 247.29 |
| 44 | 5347.18 | 5223.15 | 248.20 | 247.93 |
| 45 | 5595.62 | 5471.34 | 248.66 | 248.44 |
| 46 | 5844.47 | 5720.00 | 249.03 | 248.86 |

## B Annex B

!

```

! Hand modifications by Anne Marie Treguier and Thierry Penduff,
! as well as Ariane Koch Larrouy for the Indonesian throughflow region.
! on ORCA_R025 bathymetry for partial steps.
!
! #####
! Name of the zoomed area : Torres straits
! zoom ratio :      2
! Thierry: Put some islands in G47
bathy( 279, 460) = 0 !
bathy( 279, 458) = 0 !
bathy( 279, 456) = 0 !
!
! #####
! Name of the zoomed area : Vema fracture zone
! zoom ration :     2
! i min :          946
! i max :          1012
! j min :          507
! j max :          573

bathy( 976, 543) = 4400 ! instead of 4279
bathy( 977, 543) = 4400 ! instead of 4189
bathy( 978, 543) = 4400 ! instead of 4042
bathy( 979, 543) = 4400 ! instead of 3889
bathy( 979, 542) = 4400 ! instead of 4205
bathy( 980, 542) = 4400 ! instead of 4103
bathy( 981, 542) = 4400 ! instead of 4093
bathy( 982, 542) = 4400 ! instead of 4126
bathy( 983, 542) = 4400 ! instead of 4008
bathy( 984, 542) = 4400 ! instead of 3870
bathy( 985, 542) = 4400 ! instead of 3632
bathy( 986, 542) = 4400 ! instead of 3691
bathy( 987, 542) = 4400 ! instead of 3883
bathy( 988, 542) = 4400 ! instead of 3969
bathy( 989, 542) = 4400 ! instead of 4141
bathy( 990, 542) = 4400 ! instead of 4273
! Thierry: new bathy G45
bathy( 992, 542) = 4482 ! instead of 4273
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
! #####
! Name of the zoomed area : Fifteen twenty fracture zone
! zoom ration :     2
! i min :          934
! i max :          1000
! j min :          522
! j max :          588

bathy( 960, 562) = 3800 ! instead of 3782
bathy( 961, 562) = 3800 ! instead of 3630

```

```
bathy( 961, 561) = 3800 ! instead of 3597
bathy( 962, 561) = 3800 ! instead of 3542
bathy( 963, 561) = 3800 ! instead of 3560
bathy( 964, 561) = 3800 ! instead of 3636
bathy( 965, 561) = 3800 ! instead of 3703
```

```
! #####
```

```
! Name of the zoomed area : Lesser Antilles
```

```
! zoom ration : 2
```

```
! i min : 868
```

```
! i max : 934
```

```
! j min : 524
```

```
! j max : 590
```

```
bathy( 903, 547) = 200 ! instead of 670
bathy( 904, 549) = 200 ! instead of 965
bathy( 905, 550) = 200 ! instead of 799
bathy( 905, 551) = 200 ! instead of 909
bathy( 905, 553) = 200 ! instead of 1686
bathy( 906, 554) = 600 ! instead of 1089
bathy( 906, 556) = 200 ! instead of 1331
bathy( 905, 561) = 200 ! instead of 1127
bathy( 905, 563) = 200 ! instead of 636
bathy( 904, 564) = 200 ! instead of 364
bathy( 904, 566) = 400 ! instead of 673
bathy( 893, 574) = 200 ! instead of 1062
bathy( 898, 574) = 200 ! instead of 849
bathy( 898, 572) = 200 ! instead of 403
bathy( 899, 572) = 200 ! instead of 405
bathy( 899, 571) = 200 ! instead of 454
bathy( 900, 570) = 489 ! instead of 489
bathy( 900, 571) = 200 ! instead of 502
bathy( 878, 574) = 300 ! instead of 541
bathy( 881, 573) = 200 ! instead of 414
```

```
! #####
```

```
! Name of the zoomed area : Florida Straits
```

```
! zoom ration : 2
```

```
! i min : 796
```

```
! i max : 862
```

```
! j min : 560
```

```
! j max : 626
```

```
bathy( 827, 599) = 800 ! instead of 707
bathy( 828, 599) = 800 ! instead of 643
bathy( 829, 599) = 800 ! instead of 552
bathy( 829, 600) = 800 ! instead of 610
bathy( 830, 600) = 800 ! instead of 719
bathy( 831, 600) = 800 ! instead of 740
```

```

bathy( 832, 601) = 800 ! instead of 747
bathy( 832, 602) = 800 ! instead of 773
bathy( 831, 602) = 800 ! instead of 761
bathy( 832, 603) = 800 ! instead of 762
bathy( 832, 604) = 800 ! instead of 714
bathy( 832, 605) = 800 ! instead of 638
bathy( 832, 606) = 800 ! instead of 598
bathy( 832, 607) = 760 ! instead of 602
bathy( 832, 608) = 760 ! instead of 610
bathy( 832, 609) = 760 ! instead of 618
bathy( 832, 610) = 760 ! instead of 627
bathy( 832, 611) = 730 ! instead of 620
bathy( 832, 613) = 730 ! instead of 585
bathy( 832, 614) = 730 ! instead of 592
bathy( 832, 615) = 730 ! instead of 622
bathy( 832, 616) = 730 ! instead of 652
bathy( 832, 617) = 730 ! instead of 681
bathy( 832, 612) = 730 ! instead of 603
bathy( 839, 591) = 600 ! instead of 334
bathy( 840, 591) = 600 ! instead of 351
bathy( 840, 590) = 600 ! instead of 554
bathy( 838, 592) = 540 ! instead of 358
bathy( 837, 592) = 500 ! instead of 311
bathy( 836, 593) = 500 ! instead of 342
bathy( 837, 593) = 500 ! instead of 340
bathy( 835, 593) = 500 ! instead of 344
bathy( 834, 594) = 500 ! instead of 434
bathy( 834, 593) = 500 ! instead of 336
bathy( 833, 594) = 500 ! instead of 451
bathy( 833, 595) = 500 ! instead of 483
bathy( 832, 595) = 500 ! instead of 475
bathy( 831, 595) = 500 ! instead of 469
bathy( 830, 595) = 500 ! instead of 485
bathy( 838, 591) = 500 ! instead of 182

```

```
! #####
```

```
! Name of the zoomed area : Gibraltar
```

```
! zoom ration : 2
```

```
! i min : 1092
```

```
! i max : 1158
```

```
! j min : 616
```

```
! j max : 682
```

```

bathy(1127, 654) = 300 ! instead of 194
bathy(1126, 654) = 280 ! instead of 144
bathy(1126, 653) = 280 ! instead of 170

```

```
!
```

```
! Water flowing downstream of Gibraltar into the Atlantic.
```

```

! Create an artificial deep channel based on work by Sebastien Theetten
! and Raphael Almar (2005), revised by Thierry Penduff.
bathy(1125, 653) = 800 ! instead of 320
bathy(1124, 653) = 1100 ! instead of 415
bathy(1123, 653) = 1200 ! instead of 659
bathy(1122, 653) = 1200 ! instead of 881
bathy(1121, 653) = 1200 ! instead of 881
bathy(1120, 653) = 1200 ! instead of 881

! #####
! Name of the zoomed area : Wyville-Thompson ridge, Faroe bank channel
! zoom ration : 2
! i min : 1064
! i max : 1130
! j min : 768
! j max : 834

! Thierry
bathy(1099, 803) = 1050 !
bathy(1100, 803) = 1050 !
bathy(1101, 803) = 910 !
! Anne Marie
bathy(1108, 799) = 870 ! instead of 737
bathy(1108, 800) = 870 ! instead of 737
bathy(1108, 801) = 870 ! instead of 689
bathy(1107, 802) = 870 ! instead of 602
bathy(1107, 801) = 870 ! instead of 565
bathy(1106, 802) = 870 ! instead of 536
bathy(1105, 802) = 870 ! instead of 437
bathy(1105, 803) = 870 ! instead of 575
bathy(1104, 803) = 870 ! instead of 605
bathy(1103, 803) = 870 ! instead of 644
bathy(1102, 803) = 870 ! instead of 777
bathy(1112, 793) = 600 ! instead of 760
bathy(1111, 794) = 600 ! instead of 714
bathy(1108, 795) = 600 ! instead of 727
bathy(1107, 795) = 600 ! instead of 714
bathy(1106, 796) = 600 ! instead of 668
bathy(1113, 793) = 600 ! instead of 615
bathy(1106, 797) = 600 ! instead of 660
bathy(1110, 794) = 600 ! instead of 671
bathy(1109, 794) = 600 ! instead of 662

```

```

!!!!!!!!!!!!!!!!!!!!!! VERSION T.PENDUFF july 12 2006
!! Create an artificial channel to bring dense water
!! down and widen the strait.
!! Name of the zoomed area : Denmark Strait

```

```

bathy(1047,834:835) = 670 ! entrance
bathy(1046,833:835) = 670 ! entrance
bathy(1045,832:834) = 670 ! entrance
bathy(1044,831:833) = 670 ! entrance
bathy(1043,830:832) = 670 !
bathy(1042,829:831) = 670 !
bathy(1041,828:830) = 670 !
bathy(1040,828:829) = 670 !

bathy(1040,827 ) = 1950 ! first flat step (BBLadv)
bathy(1039,827:828) = 1950 !

bathy(1039,826 ) = 2158 ! second flat step (BBLdiff)
bathy(1038,826:827) = 2158 !

bathy(1038,825 ) = 2595 ! outflow channel
bathy(1037,824:826) = 2595 !
bathy(1036,824:825) = 2595 !
bathy(1035,824:825) = 2595 !
bathy(1034,824:825) = 2595 !
bathy(1033,823:825) = 2595 !
bathy(1032,822:824) = 2595 !
bathy(1031,821:823) = 2595 !
bathy(1030,820:822) = 2595 !
bathy(1029,819:821) = 2595 !
bathy(1028,818:820) = 2595 !

! #####
! Name of the zoomed area : NORTH POLE !!!!!!!!!!!!!!!!
! TPENDUFF 19 JULY 2006

bathy(1062,1019) = 0.5 * ( bathy(1061,1019) + bathy(1063,1019) )

! #####
! Name of the zoomed area : Gibbs Fracture zone
! zoom ration :      2
! i min :      982
! i max :     1048
! j min :      708
! j max :      774

bathy(1008, 742) = 3650 ! instead of 3615
bathy(1009, 742) = 3650 ! instead of 3568
bathy(1010, 742) = 3650 ! instead of 3535
bathy(1011, 742) = 3650 ! instead of 3514
bathy(1011, 741) = 3650 ! instead of 3603
bathy(1012, 741) = 3650 ! instead of 3602
bathy(1013, 741) = 3650 ! instead of 3615
bathy(1014, 741) = 3650 ! instead of 3611

```

bathy(1015, 741) = 3650 ! instead of 3565  
bathy(1016, 741) = 3650 ! instead of 3581  
bathy(1017, 741) = 3650 ! instead of 3582  
bathy(1018, 741) = 3650 ! instead of 3651  
bathy(1020, 741) = 3650 ! instead of 3608  
bathy(1021, 741) = 3650 ! instead of 3458  
bathy(1022, 741) = 3650 ! instead of 3318  
bathy(1023, 740) = 3650 ! instead of 3278  
bathy(1022, 740) = 3650 ! instead of 3274  
bathy(1024, 740) = 3650 ! instead of 3279  
bathy(1025, 740) = 3650 ! instead of 3240  
bathy(1026, 740) = 3650 ! instead of 3017  
bathy(1027, 740) = 3650 ! instead of 2963  
bathy(1028, 740) = 3650 ! instead of 3043  
bathy(1029, 740) = 3650 ! instead of 3029  
bathy(1030, 740) = 3650 ! instead of 3110  
bathy(1030, 739) = 3650 ! instead of 2832  
bathy(1031, 739) = 3650 ! instead of 3005  
bathy(1032, 739) = 3650 ! instead of 3019  
bathy(1033, 739) = 3650 ! instead of 3155  
bathy(1034, 739) = 3650 ! instead of 3302  
bathy(1035, 739) = 3650 ! instead of 3383  
bathy(1036, 739) = 3650 ! instead of 3442  
bathy(1037, 739) = 3650 ! instead of 3534  
bathy(1038, 739) = 3650 ! instead of 3621

! #####

! Name of the zoomed area : Oceanographer fracture Zone

! zoom ration : 2

! i min : 982

! i max : 1048

! j min : 616

! j max : 682

bathy(1001, 650) = 3000 ! instead of 2924  
bathy(1002, 650) = 3000 ! instead of 2882  
bathy(1003, 650) = 3000 ! instead of 2864  
bathy(1004, 650) = 3000 ! instead of 2892  
bathy(1006, 650) = 3000 ! instead of 2904  
bathy(1007, 650) = 3000 ! instead of 2736  
bathy(1007, 649) = 3000 ! instead of 2453  
bathy(1008, 649) = 3000 ! instead of 2655  
bathy(1009, 649) = 3000 ! instead of 2766  
bathy(1010, 649) = 3000 ! instead of 2754  
bathy(1010, 648) = 3000 ! instead of 2687  
bathy(1011, 648) = 3000 ! instead of 2662  
bathy(1012, 648) = 3000 ! instead of 2704  
bathy(1013, 648) = 3000 ! instead of 2811  
bathy(1014, 648) = 3000 ! instead of 2907



```
! #####
! Name of the zoomed area : Vema channel
! zoom ration :      2
! i min :      978
! i max :      1044
! j min :      331
! j max :      397
```

```
! #####
! Name of the zoomed area : Valvis ridge South
! zoom ration :      2
! i min :      1092
! i max :      1158
! j min :      305
! j max :      371
```

```
bathy(1119, 341) = 3500 ! instead of 3607
bathy(1123, 344) = 3500 ! instead of 3801
bathy(1126, 346) = 3500 ! instead of 3665
bathy(1141, 362) = 3500 ! instead of 3932
bathy(1142, 362) = 3500 ! instead of 3832
bathy(1143, 363) = 3500 ! instead of 3693
bathy(1141, 361) = 3500 ! instead of 3891
bathy(1140, 361) = 3500 ! instead of 3699
```

```
! #####
! Name of the zoomed area : Rio de Janeiro fracture Zone
! zoom ration :      2
! i min :      1064
! i max :      1130
! j min :      375
! j max :      441
```

```
bathy(1107, 408) = 3900 ! instead of 3714
bathy(1108, 408) = 3900 ! instead of 3805
bathy(1109, 408) = 3900 ! instead of 3882
bathy(1106, 408) = 3900 ! instead of 3593
bathy(1105, 408) = 3900 ! instead of 3533
bathy(1104, 408) = 3900 ! instead of 3561
bathy(1103, 408) = 3900 ! instead of 3570
bathy(1102, 408) = 3900 ! instead of 3539
bathy(1101, 408) = 3900 ! instead of 3399
bathy(1100, 408) = 3900 ! instead of 3282
bathy(1097, 408) = 3900 ! instead of 3529
bathy(1098, 408) = 3900 ! instead of 3404
bathy(1096, 408) = 3900 ! instead of 3722
bathy(1095, 408) = 3900 ! instead of 3815
```

bathy(1094, 408) = 3900 ! instead of 3777  
bathy(1093, 408) = 3900 ! instead of 3871  
bathy(1099, 408) = 3900 ! instead of 3336

! #####

! Name of the zoomed area : Romanche fracture zone

! zoom ration : 2

! i min : 1030

! i max : 1096

! j min : 459

! j max : 525

bathy(1057, 496) = 3700 ! instead of 3849  
bathy(1058, 496) = 3700 ! instead of 3925  
bathy(1059, 496) = 3700 ! instead of 3937  
bathy(1060, 496) = 3700 ! instead of 3942  
bathy(1061, 496) = 3700 ! instead of 4060  
bathy(1062, 496) = 3700 ! instead of 4177  
bathy(1063, 497) = 3700 ! instead of 3995  
bathy(1064, 497) = 3700 ! instead of 4011  
bathy(1065, 497) = 3700 ! instead of 4041  
bathy(1066, 497) = 3700 ! instead of 4044  
bathy(1067, 497) = 3700 ! instead of 4051  
bathy(1068, 497) = 3700 ! instead of 4306  
bathy(1069, 498) = 3700 ! instead of 4106  
bathy(1070, 498) = 3700 ! instead of 4153  
bathy(1070, 499) = 3700 ! instead of 3847  
bathy(1071, 499) = 3700 ! instead of 3871  
bathy(1072, 499) = 3700 ! instead of 3977  
bathy(1073, 499) = 3700 ! instead of 4142  
bathy(1074, 499) = 3700 ! instead of 4280  
bathy(1075, 499) = 3700 ! instead of 4403  
bathy(1076, 500) = 3700 ! instead of 4133  
bathy(1077, 500) = 3700 ! instead of 3974  
bathy(1078, 500) = 3700 ! instead of 3919  
bathy(1079, 500) = 3700 ! instead of 3820  
bathy(1082, 500) = 4200 ! instead of 4183  
bathy(1083, 500) = 4200 ! instead of 4070  
bathy(1084, 500) = 4200 ! instead of 3850  
bathy(1085, 500) = 4200 ! instead of 3668  
bathy(1086, 501) = 4200 ! instead of 3755  
bathy(1087, 501) = 4200 ! instead of 3832  
bathy(1088, 501) = 4200 ! instead of 3853  
bathy(1089, 501) = 4200 ! instead of 3906  
bathy(1090, 501) = 4200 ! instead of 4013  
bathy(1086, 500) = 4200 ! instead of 3665

! #####

! Name of the zoomed area : Red Sea North

```

! zoom ration :      2
! i min :      1266
! i max :      1332
! j min :       558
! j max :       624

bathy(1291, 608) = 1080 ! instead of 991
bathy(1291, 610) = 1080 ! instead of 988
bathy(1308, 577) = 1080 ! instead of 974
bathy(1308, 575) = 1080 ! instead of 951

! #####
! Name of the zoomed area : Red Sea south
! zoom ration :      2
! i min :      1290
! i max :      1356
! j min :       514
! j max :       580

bathy(1319, 556) = 160 ! instead of 94
bathy(1320, 556) = 140 ! instead of 87
bathy(1320, 555) = 140 ! instead of 59
bathy(1320, 554) = 140 ! instead of 45
bathy(1321, 554) = 140 ! instead of 56
bathy(1321, 553) = 140 ! instead of 58
bathy(1322, 553) = 140 ! instead of 66
bathy(1322, 552) = 140 ! instead of 44
bathy(1323, 552) = 140 ! instead of 42
bathy(1323, 551) = 140 ! instead of 48
bathy(1323, 550) = 140 ! instead of 52
bathy(1324, 550) = 140 ! instead of 71

!!!!!!! New THIERRY
!bathy(1325, 549) = 140 !
!bathy(1325, 548) = 206 !
!bathy(1325, 547) = 246 !

!bathy(1324, 549) = 172 !
!bathy(1324, 548) = 245 !
!bathy(1324, 547) = 292 !
!bathy(1324, 546) = 348 !
!bathy(1325, 546) = 400 !
!bathy(1326, 546) = 553 !

!bathy(1326, 545) = 676 !
!bathy(1327, 545) = 676 !
!bathy(1327, 546) = 676 !
!bathy(1326, 547) = 553 !

```

```

!!!!!!!!!!!!!!!!!!!!!!!!!!!!!! VERSION T.PENDUFF july 12 2006
!! #####
!! Name of the zoomed area : Red Sea south
bathy(1329, 547) = 790
bathy(1328, 547) = 790
bathy(1327, 547) = 790
bathy(1326, 547) = 790
bathy(1325, 547) = 790
bathy(1324, 547) = 790
bathy(1323, 547) = 790
bathy(1323, 548) = 790
bathy(1323, 549) = 790

! #####
! Name of the zoomed area : Agulhas
! zoom ration :      2
! i min :      1212
! i max :      1278
! j min :      303
! j max :      369

! #####
! Name of the zoomed area : Mozambique/Comores
! zoom ration :      2
! i min :      1292
! i max :      1358
! j min :      413
! j max :      479

bathy(1341, 448) = 200 ! instead of 1094
bathy(1342, 449) = 200 ! instead of 521
bathy(1341, 449) = 450 ! instead of 1067
bathy(1337, 449) = 200 ! instead of 2751
bathy(1336, 449) = 200 ! instead of 2196
bathy(1335, 449) = 1200 ! instead of 2371
bathy(1331, 448) = 400 ! instead of 1244
bathy(1330, 448) = 400 ! instead of 1298
bathy(1328, 449) = 400 ! instead of 2117
bathy(1327, 450) = 400 ! instead of 1827
bathy(1326, 449) = 400 ! instead of 2056

! #####
! Name of the zoomed area : Mascarene Ridge
! zoom ration :      2
! i min :      1362
! i max :      1428
! j min :      409

```

```

! j max :      475

bathy(1391, 461) = 200 ! instead of 770
bathy(1391, 462) = 200 ! instead of 606
bathy(1391, 463) = 200 ! instead of 693
bathy(1376, 476) = 200 ! instead of 753
bathy(1376, 477) = 200 ! instead of 426
bathy(1363, 477) = 200 ! instead of 1070
bathy(1363, 476) = 200 ! instead of 885
bathy(1362, 475) = 200 ! instead of 1250
bathy(1395, 450) = 280 ! instead of 508
bathy(1395, 449) = 350 ! instead of 936
bathy(1395, 448) = 600 ! instead of 1714
bathy(1394, 443) = 400 ! instead of 614
bathy(1394, 444) = 600 ! instead of 978
bathy(1393, 444) = 450 ! instead of 825
bathy(1393, 445) = 450 ! instead of 1165
bathy(1393, 446) = 500 ! instead of 1546
bathy(1394, 447) = 1100 ! instead of 1823

! #####
! Name of the zoomed area : Seychelles
! zoom ration :      2
! i min :      1346
! i max :      1412
! j min :      437
! j max :      503

bathy(1363, 478) = 800 ! instead of 1683
bathy(1363, 476) = 200 ! instead of 885
bathy(1362, 475) = 200 ! instead of 1250
bathy(1362, 474) = 400 ! instead of 1537

! #####
! Name of the zoomed area : Ninety east ridge north
! zoom ration :      2
! i min :      35
! i max :      101
! j min :      479
! j max :      545

bathy( 68, 501) = 3400 ! instead of 3507
bathy( 68, 500) = 3400 ! instead of 3571
bathy( 67, 490) = 3000 ! instead of 3537

! #####
! Name of the zoomed area : ninety east ridge middle
! zoom ration :      2

```

```

! i min :      29
! i max :      95
! j min :     425
! j max :     491

bathy( 67, 479) = 3650 ! instead of 3698
bathy( 67, 477) = 3650 ! instead of 3607
bathy( 67, 478) = 3650 ! instead of 3756
bathy( 65, 460) = 3400 ! instead of 3600

!
!
! Hand modification by Ariane Koch-Larrouy on
! ORCA_R025 bathymetry combined coast for
! partial step
!
! #####
! Name of the zoned area : Indonesian Throughflow
! i min : 89
! i max : 290
! j min : 395
! j max : 602

! Timor passage
bathy( 202, 453) = 1300.00 ! instead of 1078.23
bathy( 202, 454) = 1300.00 ! instead of 1027.36
bathy( 203, 454) = 1300.00 ! instead of 1176.71
bathy( 204, 454) = 1300.00 ! instead of 1275.38

! Torres is not closed in ORCA025-G44
! bathy( 280, 456) = 0.00000 ! instead of 5.00000
! bathy( 279, 457) = 0.00000 ! instead of 5.00000
! bathy( 279, 458) = 0.00000 ! instead of 5.00000
! bathy( 279, 459) = 0.00000 ! instead of 5.00000
! bathy( 279, 460) = 0.00000 ! instead of 5.00000
! bathy( 279, 461) = 0.00000 ! instead of 5.00000

! land retrieved between Lombok and Sape
bathy( 177, 463) = 195.000 ! instead of 0.00000
bathy( 178, 463) = 300.000 ! instead of 0.00000
bathy( 179, 463) = 400.000 ! instead of 0.00000
bathy( 180, 463) = 566.531 ! instead of 0.00000

! Sape
bathy( 187, 464) = 0.00000 ! instead of 202.594
bathy( 188, 464) = 0.00000 ! instead of 123.500
bathy( 187, 465) = 0.00000 ! instead of 104.000
bathy( 188, 465) = 0.00000 ! instead of 197.500

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! Iles d'Alor
bathy( 203, 465) = 0.00000 ! instead of 241.048
bathy( 205, 465) = 0.00000 ! instead of 1010.97

! Ombai
bathy( 209, 465) = 1800.00 ! instead of 1759.98
bathy( 211, 465) = 1800.00 ! instead of 1671.20
bathy( 212, 465) = 1800.00 ! instead of 1401.44
bathy( 213, 465) = 1800.00 ! instead of 1193.37
bathy( 211, 466) = 1350.00 ! instead of 2057.59
bathy( 212, 466) = 0.00000 ! instead of 2003.67
bathy( 213, 466) = 1800.00 ! instead of 1728.50
bathy( 214, 466) = 1800.00 ! instead of 1682.30
bathy( 216, 466) = 1800.00 ! instead of 1758.57
bathy( 213, 467) = 0.00000 ! instead of 1995.10
bathy( 213, 468) = 0.00000 ! instead of 2735.98

! Molucca strait
bathy( 219, 505) = 4.00000 ! instead of 1758.61
bathy( 220, 505) = 0.00000 ! instead of 761.723
bathy( 217, 500) = 2300.00 ! instead of 2168.49
bathy( 217, 501) = 2300.00 ! instead of 2114.26
bathy( 216, 502) = 2300.00 ! instead of 2176.77
bathy( 217, 502) = 2300.00 ! instead of 2148.22
bathy( 216, 503) = 2200.00 ! instead of 2018.43
bathy( 217, 503) = 2300.00 ! instead of 2071.52
bathy( 216, 504) = 2200.00 ! instead of 1894.76
bathy( 217, 504) = 2300.00 ! instead of 1991.11
bathy( 213, 505) = 1760.00 ! instead of 1847.67
bathy( 214, 505) = 1650.00 ! instead of 1759.12
bathy( 216, 505) = 2200.00 ! instead of 1727.12
bathy( 217, 505) = 2300.00 ! instead of 1999.43
bathy( 218, 505) = 2300.00 ! instead of 2070.33
bathy( 216, 506) = 2200.00 ! instead of 1792.68
bathy( 217, 506) = 2200.00 ! instead of 2139.05
bathy( 218, 506) = 2300.00 ! instead of 2162.49
bathy( 217, 507) = 2200.00 ! instead of 2176.00
bathy( 218, 507) = 2300.00 ! instead of 2191.92
bathy( 217, 508) = 2200.00 ! instead of 2114.59
bathy( 218, 508) = 2300.00 ! instead of 2241.65
bathy( 219, 508) = 2300.00 ! instead of 2258.27
bathy( 217, 509) = 2200.00 ! instead of 2028.10
bathy( 218, 509) = 2200.00 ! instead of 2270.84

! Malacca Strait
bathy( 120, 506) = 0.00000 ! instead of 9.00000

! Sangihe Ridge
bathy( 210, 506) = 2.00000 ! instead of 295.509

```

bathy( 211, 507) = 1000.00 ! instead of 1368.63  
 bathy( 212, 508) = 2.00000 ! instead of 1442.14  
 bathy( 212, 510) = 2.00000 ! instead of 1160.36  
 bathy( 213, 514) = 50.0000 ! instead of 254.383  
 bathy( 213, 515) = 500.000 ! instead of 825.242  
 bathy( 213, 516) = 200.000 ! instead of 815.492  
 bathy( 213, 517) = 4.00000 ! instead of 839.386  
 bathy( 218, 517) = 0.00000 ! instead of 996.012  
 bathy( 213, 518) = 800.000 ! instead of 1035.70  
 bathy( 213, 519) = 1300.00 ! instead of 1526.46  
 bathy( 218, 519) = 0.00000 ! instead of 2027.63  
 bathy( 212, 520) = 4.00000 ! instead of 1947.67  
 bathy( 218, 520) = 0.00000 ! instead of 2984.29  
 bathy( 212, 521) = 0.00000 ! instead of 1521.66  
 bathy( 217, 521) = 0.00000 ! instead of 3147.63  
 bathy( 217, 522) = 0.00000 ! instead of 3276.00  
 bathy( 217, 523) = 0.00000 ! instead of 3154.99  
 bathy( 217, 524) = 0.00000 ! instead of 3272.37  
 bathy( 215, 525) = 0.00000 ! instead of 1061.76  
 bathy( 215, 526) = 0.00000 ! instead of 249.692

! Sumba

bathy( 189, 462) = 610.000 ! instead of 520.226  
 bathy( 190, 462) = 610.000 ! instead of 496.277  
 bathy( 191, 462) = 610.000 ! instead of 571.018  
 bathy( 190, 463) = 167.000 ! instead of 466.042

! sortie Savu

bathy( 197, 456) = 0.00000 ! instead of 770.963  
 bathy( 198, 456) = 0.00000 ! instead of 859.907  
 bathy( 199, 456) = 1041.11 ! instead of 956.650  
 bathy( 204, 457) = 100.000 ! instead of 299.308  
 bathy( 195, 458) = 1100.00 ! instead of 1023.69

! Luzon strait

bathy( 194, 575) = 200.000 ! instead of 667.179  
 bathy( 195, 576) = 100.000 ! instead of 239.656  
 bathy( 196, 577) = 0.00000 ! instead of 625.711  
 bathy( 196, 578) = 850.000 ! instead of 826.502  
 bathy( 196, 579) = 650.000 ! instead of 1396.10  
 bathy( 196, 580) = 1100.00 ! instead of 1909.46  
 bathy( 196, 581) = 850.000 ! instead of 2351.54  
 bathy( 196, 582) = 650.000 ! instead of 2642.53  
 bathy( 196, 583) = 2.00000 ! instead of 2756.72  
 bathy( 196, 584) = 150.000 ! instead of 2773.34  
 bathy( 194, 586) = 1200.00 ! instead of 1533.90

! Molucca Strait

bathy( 232, 496) = 7.00000 ! instead of 50.0000



bathy( 231, 497) = 2.00000 ! instead of 111.500  
bathy( 230, 498) = 2.00000 ! instead of 313.281  
bathy( 231, 498) = 2.00000 ! instead of 13.0000  
bathy( 229, 499) = 147.000 ! instead of 405.520  
bathy( 228, 500) = 2.00000 ! instead of 691.682  
bathy( 225, 501) = 2.00000 ! instead of 289.244  
bathy( 226, 501) = 300.000 ! instead of 560.011  
bathy( 227, 501) = 700.000 ! instead of 730.845

! Lifamatola

bathy( 204, 492) = 3.00000 ! instead of 57.0000  
bathy( 205, 492) = 4.00000 ! instead of 192.000  
bathy( 206, 492) = 3.00000 ! instead of 189.000  
bathy( 207, 492) = 50.0000 ! instead of 14.5000  
bathy( 214, 492) = 4.00000 ! instead of 861.835  
bathy( 215, 492) = 700.000 ! instead of 1153.23  
bathy( 216, 492) = 1829.00 ! instead of 1525.74  
bathy( 217, 492) = 1200.00 ! instead of 1851.48  
bathy( 218, 492) = 200.000 ! instead of 1758.53  
bathy( 219, 493) = 0.00000 ! instead of 1105.22  
bathy( 203, 494) = 60.0000 ! instead of 62.0000  
bathy( 220, 494) = 2.00000 ! instead of 329.407  
bathy( 222, 494) = 500.000 ! instead of 373.465  
bathy( 222, 495) = 500.000 ! instead of 364.917

! Island around Belitung in Java Sea

bathy( 137, 487) = 0.00000 ! instead of 7.00000  
bathy( 139, 487) = 0.00000 ! instead of 16.0000  
bathy( 140, 487) = 0.00000 ! instead of 1.00000  
bathy( 143, 489) = 0.00000 ! instead of 27.0000

! Island isolated rattached to the coast

bathy( 134, 487) = 0.00000 ! instead of 3.00000  
bathy( 135, 487) = 0.00000 ! instead of 6.00000  
bathy( 133, 488) = 0.00000 ! instead of 6.00000  
bathy( 134, 488) = 0.00000 ! instead of 7.50000  
bathy( 133, 489) = 0.00000 ! instead of 6.00000  
bathy( 130, 490) = 0.00000 ! instead of 6.00000  
bathy( 131, 490) = 0.00000 ! instead of 8.00000  
bathy( 132, 490) = 0.00000 ! instead of 7.00000  
bathy( 133, 490) = 0.00000 ! instead of 5.00000

! Balabac Strait

bathy( 179, 530) = 15.0000 ! instead of 25.5000

! Sulu Archipelago

bathy( 188, 519) = 13.0000 ! instead of 155.383  
bathy( 196, 523) = 7.00000 ! instead of 126.000  
bathy( 193, 521) = 2.00000 ! instead of 17.5000

```
! Lombok Strait
bathy( 173, 464) = 0.00000 ! instead of 435.309
bathy( 174, 464) = 160.000 ! instead of 29.0000

! Philippine Archipelago
bathy( 213, 539) = 0.00000 ! instead of 1.00000
bathy( 213, 540) = 0.00000 ! instead of 1.00000
bathy( 213, 541) = 0.00000 ! instead of 1.00000
bathy( 213, 542) = 2.00000 ! instead of 4.00000
bathy( 207, 550) = 0.00000 ! instead of 2.00000

! Taiwan Strait
bathy( 179, 595) = 5.00000 ! instead of 16.0000
bathy( 187, 595) = 22.0000 ! instead of 35.0000
bathy( 188, 595) = 5.00000 ! instead of 22.0000

! Sunda Strait
bathy( 133, 474) = 0.00000 ! instead of 38.0000
bathy( 133, 475) = 0.00000 ! instead of 28.0000
bathy( 133, 476) = 0.00000 ! instead of 37.5000
```