**List of Additional Material:**

**List of Additional Tables:**

Table S1. The horizontal wavenumber, wavelength, and group speed for the S2 constituent (period = 12.00 hours; ω = 1.45x10-4 s-1) in a water depth of 500 m and an upper layer thickness of 200 m at 32.5o N, following the equations in Table 1. The mode 1 wavelength is 1000 m and the mode 2 is 500 m. Red numbers indicate wavelengths that are resolvable in the simulations. Unrealistic waves due to wavelengths exceeding Earth’s circumference have been struck through.

Table S2. The horizontal wavenumber, wavelength, and group speed for the O1 constituent (period = 25.82 hours; ω = 6.76x10-5 s-1) in a water depth of 1200 m and an upper layer thickness of 200 m at 32.5o N, following the equations in Table 1. The mode 1 wavelength is 1200 m and the mode 2 is 2400 m. Red numbers indicate wavelengths that are resolvable in the simulations. Unrealistic waves due to wavelengths exceeding Earth’s circumference have been struck through.

**List of Additional Figures:**

Figure S1. The major axes of the a)-c) S2 and d)-f) O1 tidal ellipses for the baroclinic anomalies over the seamount from simulations using the a) and d) LMD, b) and e) MY, and c) and f) NN vertical mixing parameterizations.

Figure S2. The major axes of the a) M2 and b) K1 tidal ellipses from a simulation using the GLS: k-ε vertical mixing parameterization.

Figure S3. Spectra of the mid-water column (level 30) East-West velocities at four locations over the guyot: crown (C) (red), rim (R2) (pink), flank (F2) (green), and basin (B2) (blue) from simulations using the a) LMD, b) MY, and c) NN vertical mixing parameterizations.

Figure S4. Spectra of the surface (level 60) East-West velocity baroclinic anomalies at four locations over the guyot: crown (C) (red), rim (R2) (pink), flank (F2) (green), and basin (B2) (blue) from simulations using the a) LMD, b) MY, and c) NN vertical mixing parameterizations.

Figure S5. Spectra of the surface (level 60) North-South velocity baroclinic anomalies at four locations over the guyot: crown (C) (red), rim (R2) (pink), flank (F2) (green), and basin (B2) (blue) from simulations using the a) LMD, b) MY, and c) NN vertical mixing parameterizations.

Figure S6. Spectra of the benthic (level 5) East-West velocity baroclinic anomalies at four locations over the guyot: crown (C) (red), rim (R2) (pink), flank (F2) (green), and basin (B2) (blue) from simulations using the a) LMD, b) MY, and c) NN vertical mixing parameterizations.

Figure S7. Spectra of the benthic (level 5) North-South velocity baroclinic anomalies at four locations over the guyot: crown (C) (red), rim (R2) (pink), flank (F2) (green), and basin (B2) (blue) from simulations using the a) LMD, b) MY, and c) NN vertical mixing parameterizations.

Figure S8. A transect of the vertical temperature diffusivities averaged over two semi-diurnal tidal cycles at 128o 41.0’ W for different vertical mixing parameterizations: a) LMD, b) MY, and d) NN. c) Observations from *Kunze and Toole* (1997) and *Toole et al*. (1997), In c), GW, 2004 refers to the values of *Ganachaud and Wunsch* (2004) and P, 1997 the observations of *Polzin et al.* (1997).

Figure S9. Spectra of the surface (level 55) vertical temperature diffusivities at four locations over the guyot: crown (C) (red), rim (R2) (pink), flank (F2) (green), and basin (B2) (blue) from simulations using the a) LMD, b) MY, and c) NN vertical mixing parameterizations. Notice the scale is 6 orders of magnitude larger in a).

Figure S10. Spectra of the mid-water column (level 30) vertical temperature diffusivities at four locations over the guyot: crown (C) (red), rim (R2) (pink), flank (F2) (green), and basin (B2) (blue) from simulations using the a) LMD, b) MY, and c) NN vertical mixing parameterizations.

**Appendix A: Mixing Scheme Descriptions.**

Taken from RH17 and R06, with slight modifications and updates

**Additional Tables**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Wave Type** | **Mode** | **k**  **(m-1)** | **λH**  **(km)** | **cg**  **(m s-1)** |
| Two layer interfacial wave: **∞** over **∞** | **-** | 1.7x10-**6** | 580 | 42 |
| Two layer interfacial wave: finite over **∞**: barotropic | **-** | ~~2.2x10~~~~-9~~ | ~~460,000~~ | ~~34,000~~ |
| Two layer interfacial wave: finite over **∞**: baroclinic shallow water | **-** | 6.6x10-5 | 15 | 2.2 |
| Continuous stratification without rotation | 1 | 5.8x10-5 | 17 | 2.5 |
| 2 | 1.2x10-4 | 8.5 | 1.2 |
| Continuous stratification with rotation | 1 | 4.9x10-5 | 20 | 2.1 |
| 2 | 9.9x10-5 | 10 | 1.0 |
| Barotropic Kelvin Wave | - | 2.1x10-7 | 481 | 70 |
| Baroclinic Kelvin Wave | - | 6.6x10-5 | 15 | 2.2 |
| Barotropic Poincaré Wave | - | 1.8x10-5 | 571 | 59 |
| Baroclinic Poincaré Wave | 1 | 4.9x10-5 | 20 | 2.1 |
| 2 | 9.9x10-5 | 10 | 1.0 |
| Shallow water surface gravity wave | - | 2.1x10-6 | 481 | 70 |
| Deep water surface gravity wave | - | ~~2.2x10~~~~-9~~ | ~~460,000~~ | ~~34,000~~ |

Table S1. The horizontal wavenumber, wavelength, and group speed for the S2 constituent (period = 12.00 hours; ω = 1.45x10-4 s-1) in a water depth of 500 m and an upper layer thickness of 200 m at 32.5o N, following the equations in Table 1. The mode 1 wavelength is 1000 m and the mode 2 is 500 m. Red numbers indicate wavelengths that are resolvable in the simulations. Unrealistic waves due to wavelengths exceeding Earth’s circumference have been struck through.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Wave Type** | **Mode** | **k**  **(m-1)** | **λH**  **(km)** | **cg**  **(m s-1)** |
| Two layer interfacial wave: **∞** over **∞** | **-** | 3.7x10-**7** | 2,700 | 90 |
| Two layer interfacial wave: finite over **∞**: barotropic | **-** | ~~4.6x10~~~~-10~~ | ~~2,100,000~~ | ~~72,000~~ |
| Two layer interfacial wave: finite over **∞**: baroclinic shallow water | **-** | 3.0x10-5 | 33 | 2.2 |
| Continuous stratification without rotation | 1 | 2.7x10-5 | 37 | 2.5 |
| 2 | 5.4x10-5 | 18 | 1.2 |
| Continuous stratification with rotation | 1 | ∞ | ∞ | ∞ |
| 2 | ∞ | ∞ | ∞ |
| Barotropic Kelvin Wave | - | 9.7x10-7 | 1,000 | 70 |
| Baroclinic Kelvin Wave | - | 3.1x10-5 | 33 | 2.2 |
| Barotropic Poincaré Wave | - | ∞ | ∞ | ∞ |
| Baroclinic Poincaré Wave | 1 | ∞ | ∞ | ∞ |
| 2 | ∞ | ∞ | ∞ |
| Shallow water surface gravity wave | - | 9.7x10-7 | 1,000 | 70 |
| Deep water surface gravity wave | - | ~~4.6x10~~~~-10~~ | ~~2,100,000~~ | ~~72,000~~ |

Table S2. The horizontal wavenumber, wavelength, and group speed for the O1 constituent (period = 25.82 hours; ω = 6.76x10-5 s-1) in a water depth of 1200 m and an upper layer thickness of 200 m at 32.5o N, following the equations in Table 1. The mode 1 wavelength is 2400 m and the mode 2 is 1200 m. Red numbers indicate wavelengths that are resolvable in the simulations.

**Additional Figures**



Figure S1. The major axes of the a)-c) S2 and d)-f) O1 tidal ellipses for the baroclinic anomalies over the seamount from simulations using the a) and d) LMD, b) and e) MY, and c) and f) NN vertical mixing parameterizations.



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Figure S5. Spectra of the surface (level 60) North-South velocity baroclinic anomalies at four locations over the guyot: crown (C) (red), rim (R2) (pink), flank (F2) (green), and basin (B2) (blue) from simulations using the a) LMD, b) MY, and c) NN vertical mixing parameterizations.



Figure S6. Spectra of the benthic (level 5) East-West velocity baroclinic anomalies at four locations over the guyot: crown (C) (red), rim (R2) (pink), flank (F2) (green), and basin (B2) (blue) from simulations using the a) LMD, b) MY, and c) NN vertical mixing parameterizations.



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Figure S10. Spectra of the mid-water column (level 30) vertical temperature diffusivities at four locations over the guyot: crown (C) (red), rim (R2) (pink), flank (F2) (green), and basin (B2) (blue) from simulations using the a) LMD, b) MY, and c) NN vertical mixing parameterizations.

**Appendix A: Mixing Scheme Descriptions. (Taken from R06 and RH17)**

Taken from RH17 and R06, with slight modifications and updates

**A.1 *Mellor-Yamada* 2.5 Level Turbulence Closure Scheme (MY)e**

*The Mellor-Yamada 2.5 Level Turbulence Closure Scheme (MY)* was designed for boundary layer flows following the logarithmic law of the wall. It is based on equations for the turbulent kinetic energy and a length scale, both of which are time stepped through the simulation (*Mellor and Yamada*, 1982). The parameterization was developed based on observations of laboratory turbulence. It is known to fail in the presence of stratification (*Simpson et al.,* 1996) and was not designed for internal wave mixing (*Large and Gent*, 1999).

**A.2 *Nakanishi-Niino* Scheme (NN)**

The *Nakanishi-Niino* Scheme (NN) is adapted from the Mellor-Yamada 2.5 Level Turbulence Closure Scheme, in an effort to improve how the upper ocean, including the surface mixed layer is handled. The goal was take into account buoyancy effects on the pressure covariance terms affecting the coefficients used for turbulence closure. Like MY, NN is based on the turbulent kinetic energy and a length scale, which are time stepped through the simulation. The differences from MY primarily occur in determination of the length scale and the stability functions. In NN, the stratification plays a role in the calculation of the turbulent length scale. This results in the turbulent length scale decreasing with increasing density stratification (*Furuichi and Hibiya*, 2015). This modification of the turbulent length scale based on buoyancy does not occur in MY (*Furuichi et al.,* 2012). Another difference between MY and NN occurs with the stability functions, where NN includes buoyancy effects in the pressure covariance terms used to determine the constants. A fuller description of the differences, including the mathematics, is given in *Furuichi et al.* (2012) and *Furuichi and Hibiya* (2015). To evaluate the performance of NN vs MY in the ocean, *Furuichi and Hibiy*a (2015) compared microstructure observations to LES model results, using a different model than ROMS. They found NN better matched the observations.

**A.3 *Large-McWilliams-Doney* Kpp Scheme (LMD)**

*LMD* separates mixing physics into three primary physical processes: local *Ri* instabilities due to resolvable vertical shear, internal wave, and double diffusion. The total vertical mixing coefficient for momentum, *Kν,* is a sum of coefficients resolvable for vertical shear and internal waves , while the total vertical mixing coefficient for tracers, *KT,* is a sum of coefficients for each of the three processes. For *Ri* < 0.8, the first of these processes dominates and induces a *Ri* dependence m2 s-1. For *Ri* > 0.8, the internal wave term dominates and *Kν* is a dependent on *N* according to  m2 s-1 with a maximum cutoff value of ~1.0 x 10-4 m2 s-1. In addition, a *K* profile is applied both at the surface and the bottom to represent surface and benthic boundary layers, respectfully. Care was taken in the development of this scheme to avoid scale dependencies (*W. Large*, personal communication, 2004).

**A.4 Generic Length Scale Scheme (GLS)**

*Umlauf and Burchard* (2003) evaluated different mixing parameterizations and developed a set of generic equations, which could be used to describe the combined contribution of various mixing processes:

 (A-1)

 (A-2)

where *D* represents the turbulent and viscous transport, *P* the kinetic energy production by shear, *G* the kinetic energy production by buoyancy, *ε* the dissipation, *κ* the turbulent kinetic energy, *c*’s model constants, and *m*, *n*, and *p* exponents. Like *MY*, the turbulent kinetic energy and length scale are time stepped. In fact *MY* is a special case of *GLS* with *m*=1*, n*=1, and *p*=0. Special cases of *GLS* represent two other developed parameterizations, *κ-ε* (*GLS:κ-ε)* and κ-ω (*GLS:κ-ω)* (*GLS:κ-*ε: *m*=1.5*, n*=-1, and *p*=3; *GLS*:*κ-*ω: *m*=0.5*, n*=-1, and *p*=-1). In the *κ-ε* parameterization, the dissipation, *ε*, is used for the length scale. This parameterization was developed by *Jones and Launder* (1972) and recently modified by *Burchard and Bolding* (2001). In the *κ-ω* parameterization, the rate of dissipation of energy per unit volume and time, *ω*, is used as the length scale, with  where *c0μ* again is a constant. In order to use this scheme in stratified flows, buoyancy was included by *Umlauf et al*. (2003). An additional scheme (*GLS:gen*) with *m*=1*, n*=-0.67, and *p*=2 was developed by *Umlauf and Burchard* (*Warner et al*., 2005). Note, the coefficients for the generic option were changed after 2005 and new values are now standard for the generic option. The standard values for the generic option as given in the ROMS in-file description were used. Readers interested in understanding more about the different length scale assumptions and details of the parameterizations are encouraged to consult the ROMS website (https://www.myroms.org/) and papers by *Burchard*, *Umlauf* and others (*Burchard et al*., 1998; *Burchard and Bolding*, 2001; *Umlauf and Burchard,* 2003, *Umlauf* *et al*., 2003). *GLS* has been implemented in ROMS. *Warner* *et al.* (2005) compared the various *GLS* schemes for various applications including steady barotropic flow, wind-induced surface mixed layer deepening in a stratified fluid, oscillatory stratified pressure-gradient driven flow, and an estuarine situation. The *GLS:κ-κl* performed poorly in the estuarine flow and the other three, *GLS:κ-ε, GLS:κ-ω,* and *GLS:gen*, performed similarly with slight differences (*Warner et al*., 2005). They were unable to ascertain which of these three *GLS:κ-ε, GLS:κ-ω* , and *GLS:gen*, was most realistic (*Warner et al*., 2005).