Pull Request Details

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1 Ice Melt Parameterization

From Holland and Jenkins (1999), hereafter HJ99, the stability parameter introduced by McPhee (1981) is

$$\eta_* = \left(1 + \frac{\zeta_N u_*}{f L_O R_c}\right)^{-1/2} \tag{1}$$

In L530 of `MOM_ice_shelf.F90`, `n_star_term` is defined as

```
n_star_term = (ZETA_N/RC) * (hBL_neut * VK) / (ustar_h)**3
```

where in L454, `hBL_neut` was defined as (in some conditions, if the model `Hml` not used)

```
hBL_neut = (VK*ustar_h) / absf
```

Therefore `n_star_term` can be identified as $\frac{\zeta_N k^2}{f R_c u_*^2}$ where k is the von Kármán constant (in the model, this is denoted as `VK`).

Now L_O (Obukhov length) in McPhee (1981) is defined as

$$L = \frac{\rho_0 u_*^3}{gk\overline{\rho' w'}} \tag{2}$$

where $\overline{\rho' w'} g/\rho_0$ can be recognised as the turbulent buoyancy flux, which in the model is `wB_flux`, i.e. $L_O = u_*^3/(k \times \texttt{wB\_flux})$.

Therefore, the `n_star_term` is $\frac{\zeta_N k u_*}{f R_c L_O \texttt{wB\_flux}}$.

Now on line L536, $1/\eta_*$ is defined as

```
I_n_star = sqrt(1.0 - n_star_term * wB_flux)
```

Using the above working, the right-hand side equates to

$$\left(1 - \frac{\zeta_N u_* k}{f L_O R_c}\right)^{1/2} \tag{3}$$

which is almost the same as the reciprocal of the HJ99 η_*, in Eqn. (1) except there is an extra factor of the von Kármán constant in the algebraic term. I therefore think there should be a modification made to the definition of `n_star_term` on L530 to remove the extra `VK`:

```
n_star_term = (ZETA_N/RC) * (hBL_neut) / (ustar_h)**3
```