

# PALM Ocean Version

PALM group

Institute of Meteorology and Climatology, Leibniz Universität Hannover

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## PALM - Ocean Version - General Features

- ▶ Ocean and atmosphere version are sharing the same code.
- ▶ The ocean version is switched on by setting the +inipar - parameter:
 

```
ocean = .TRUE.
```
- ▶ There are only few parts in the code which differ between both versions. In the ocean version:
  - ▶ an additional prognostic equation for salinity is solved,
  - ▶ in the buoyancy term (w-equation) and the stability-related terms (SGS-TKE-equation), potential temperature is replaced by potential density,
  - ▶ density is calculated from the nonlinear equation of state for seawater. So far, only the initial hydrostatic pressure is entered into this equation.



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# PALM - Ocean Version - Equations

Momentum:

$$\frac{\partial \bar{u}_i}{\partial t} = - \frac{\partial \bar{u}_k \bar{u}_i}{\partial x_k} - \frac{1}{\rho_0} \frac{\partial \bar{p}^*}{\partial x_i} - \varepsilon_{ijk} f_j (\bar{u}_k - \bar{u}_{k_g}) - \delta_{i3} g \frac{\bar{\rho} - \tilde{\rho}}{\rho_{ref}} - \frac{\partial u'_k u'_i}{\partial x_k}$$

Potential Temperature:

$$\frac{\partial \bar{\theta}}{\partial t} = - \frac{\partial \bar{u}_k \bar{\theta}}{\partial x_k} - \frac{\partial u'_k \theta'}{\partial x_k}$$

Density  $\rho = \rho(S, q, ph)$  is calculated from the equation of state for seawater using the algorithm from Jackett et al. (2006)

Salinity:

$$\frac{\partial \bar{S}}{\partial t} = - \frac{\partial \bar{u}_k \bar{S}}{\partial x_k} - \frac{\partial u'_k S'}{\partial x_k}$$

$$\frac{\partial \bar{u}_k}{\partial x_k} = 0$$

$$\frac{\partial^2 \bar{p}^*}{\partial x_k^2} = \frac{\rho_0}{\Delta t} \frac{\partial \hat{u}_k}{\partial x_k}$$



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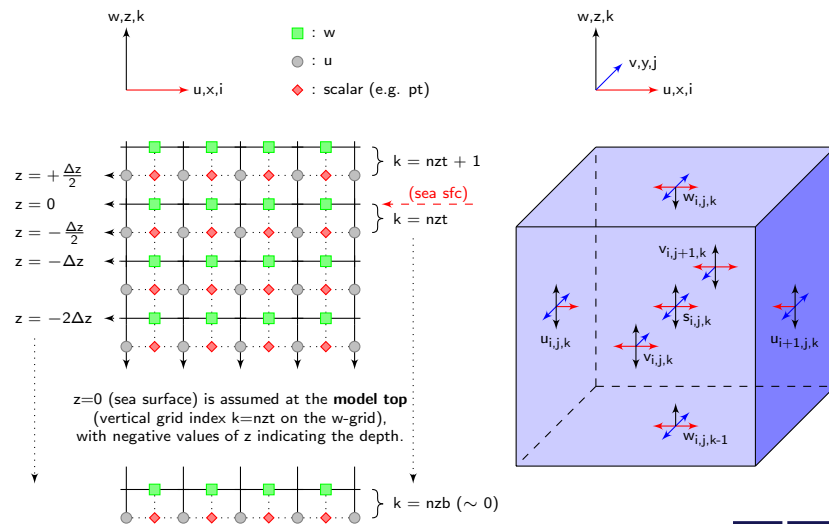
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# PALM - Ocean Version - Grid Structure and Conventions



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## PALM - Ocean Version - Boundary Conditions

The following boundary conditions should be used for the ocean version. Some of them are not set by default, so please set them manually.

▶ Ocean surface ( $z=0$ ):

- ▶ Fluxes should be given at the ocean surface for all quantities. This requires parameter

```
top_momentum_flux.u = ..., top_momentum_flux.v = ..., bc_uv.t = 'neumann'
```

- ▶ Momentum:

```
use_top_fluxes = .TRUE.
```

- ▶ Temperature:

```
top_heatflux = ..., bc_pt.t = 'neumann'
```

- ▶ Salinity:

```
top_salinityflux = ..., bc_sa.t = 'neumann'
```

▶ Ocean bottom ( $z=-...$ )

- ▶ A Prandtl-layer should be used at the bottom:

```
prandtl_layer = .TRUE.
```



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## PALM - Ocean Version - Further Settings

▶ Initial profiles:

- ▶ The ocean version can only use:

```
initializing_actions = 'set_constant_profiles'
```

- ▶ Profiles are constructed piecewise linear from the top (surface), using parameters (e.g.):

```
pt_surface = ..., pt_initial_gradient = ..., pt_initial_gradient_level = ...
```

▶ Random perturbations:

- ▶ Random perturbations are by default applied to the upper third of the model domain!



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