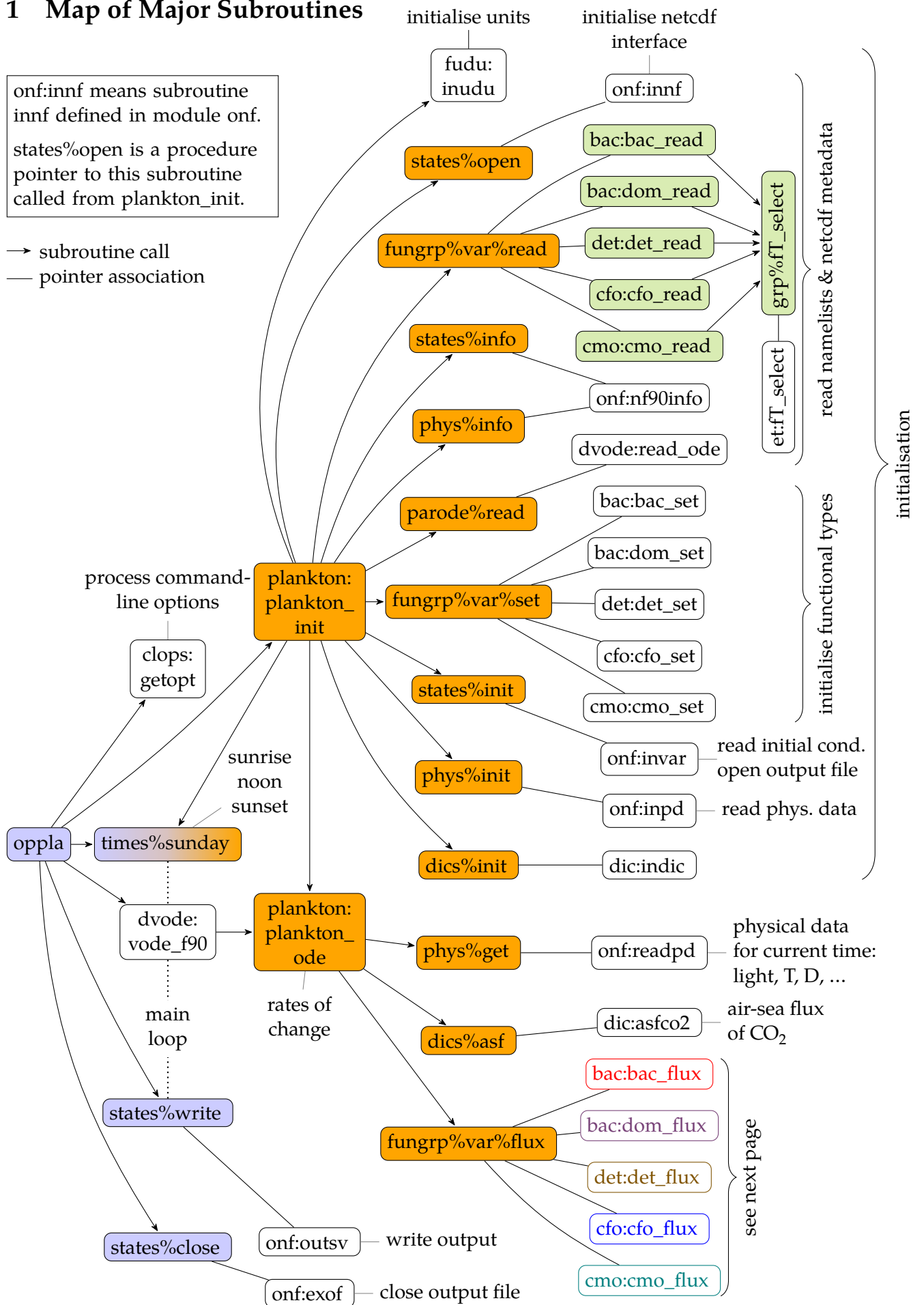


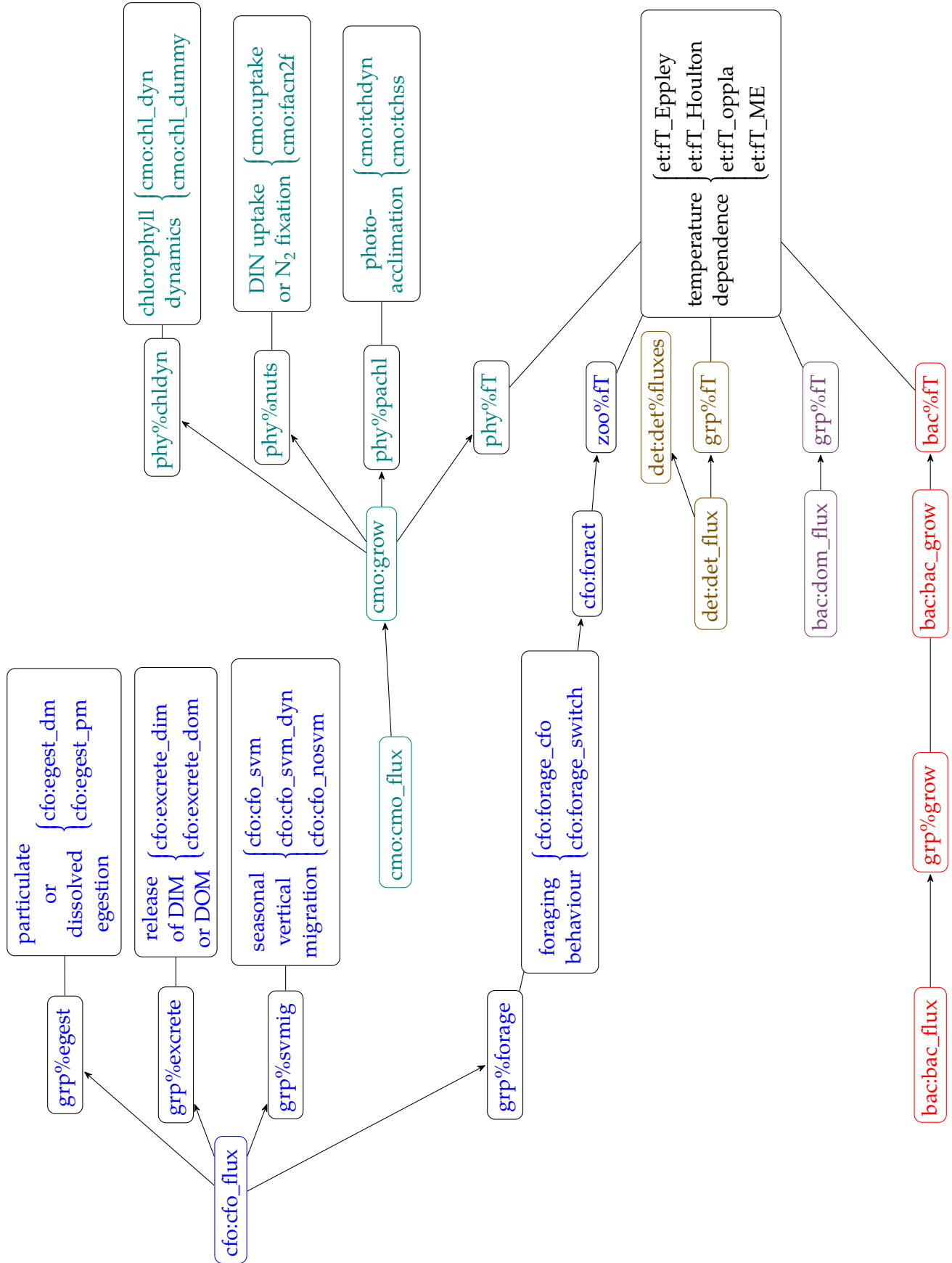
1 Map of Major Subroutines

onf:innf means subroutine innf defined in module onf.
states%open is a procedure pointer to this subroutine called from plankton_init.

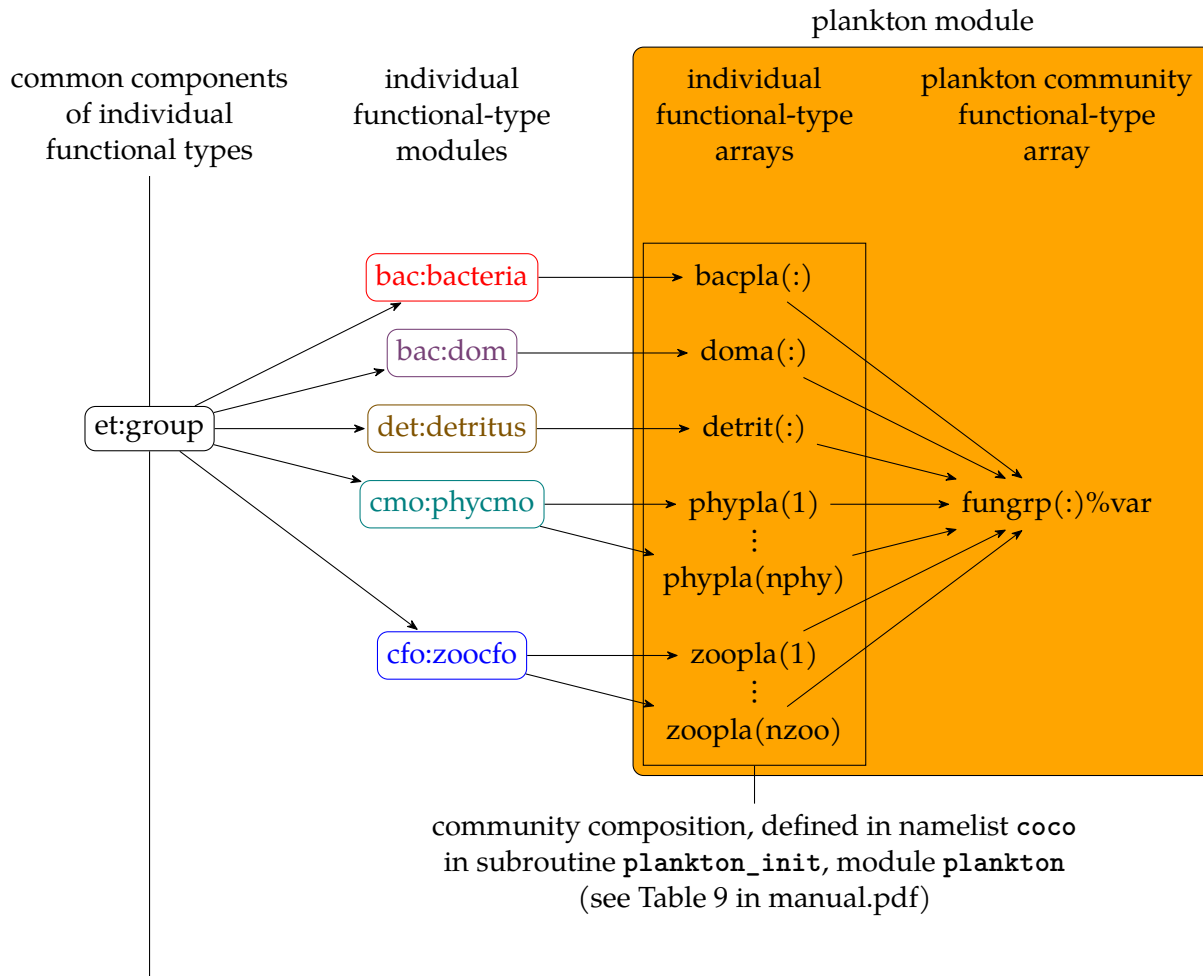
→ subroutine call
— pointer association



1.1 Structure of the flux Subroutines



2 Derived-Type Hierarchy



These components are available in all elements of the `fungrp(:)%var` array.

```

CHARACTER :: name,&           ! of the group
  names, units                 ! of state variables
  constituents                 ! of the group
...
REAL :: Q0(:)                ! subsistence quotas      -> envir%Q0
REAL :: QN, QP,&             ! quotas: N:C, P:C ratios => envir%quotas(2:3,:)
  stick,&                     ! stickiness           => envir%sticky(:)
...
  vv(:),&                     ! vertical velocities   => envir%vvs
...
PROCEDURE :: read,&          ! group-specific namelist(s)
  set,&                       ! connections among groups and with et:local :: envir
  flux                        ! set group-specific fluxes in source matrix soma

```

3 The Source Matrix `soma`

A local source matrix, `box(n)%soma = Sn`, is defined as a pointer to each level n of the global source matrix `envir%soma` in subroutine `plankton_init`: `box(n)%soma => envir%soma(:, :, n)`. The elements of S_n are set in the `fungrp(nfg)%var%flux` subroutines of the individual functional groups `fungrp(nfg)%var`:

$$S_n = \begin{pmatrix} \text{DIC} & \dots & \text{DIN} & \dots & \text{phyt_C} & \text{phyt_N} & \dots \\ 0 & \dots & 0 & \dots & -\left(\begin{smallmatrix} \text{aggregation} \\ \rightarrow \text{phyt_C}^+ \end{smallmatrix}\right) & -\left(\begin{smallmatrix} \text{aggregation} \\ \rightarrow \text{phyt_N} \end{smallmatrix}\right) & \dots \\ 0 & \dots & 0 & \dots & \text{DIC} \rightarrow \text{phyt_C} & 0 & \dots \\ \vdots & \ddots & \vdots & \ddots & \vdots & \vdots & \ddots \\ 0 & \dots & 0 & \dots & 0 & -\left(\begin{smallmatrix} \text{phyt_N} \rightarrow \text{DIN} \\ - \text{phyt} \% Q_0^N \cdot \left(\begin{smallmatrix} \text{DIC} \rightarrow \\ \text{phyt_C} \end{smallmatrix}\right) \end{smallmatrix}\right) & \dots \\ \vdots & \ddots & \vdots & \ddots & \vdots & \vdots & \ddots \\ -\left(\begin{smallmatrix} \text{DIC} \rightarrow \\ \text{phyt_C} \end{smallmatrix}\right) & \dots & 0 & \dots & 0 & 0 & \dots \\ 0 & \dots & \text{phyt_N} \rightarrow \text{DIN} & \dots & 0 & 0 & \dots \\ \vdots & \ddots & \vdots & \ddots & \vdots & \vdots & \ddots \\ \frac{\partial \text{DIC}}{\partial t} & \dots & \frac{\partial \text{DIN}}{\partial t} & \dots & \frac{\partial \text{phyt_C}}{\partial t} & \frac{\partial \text{phyt_N}}{\partial t} & \dots \end{pmatrix} \begin{matrix} \text{aggre-} \\ \text{gation} \\ \text{DIC} \\ \vdots \\ \text{DIN} \\ \vdots \\ \text{phyt_C} \\ \text{phyt_N} \\ \vdots \\ \sum \end{matrix}$$

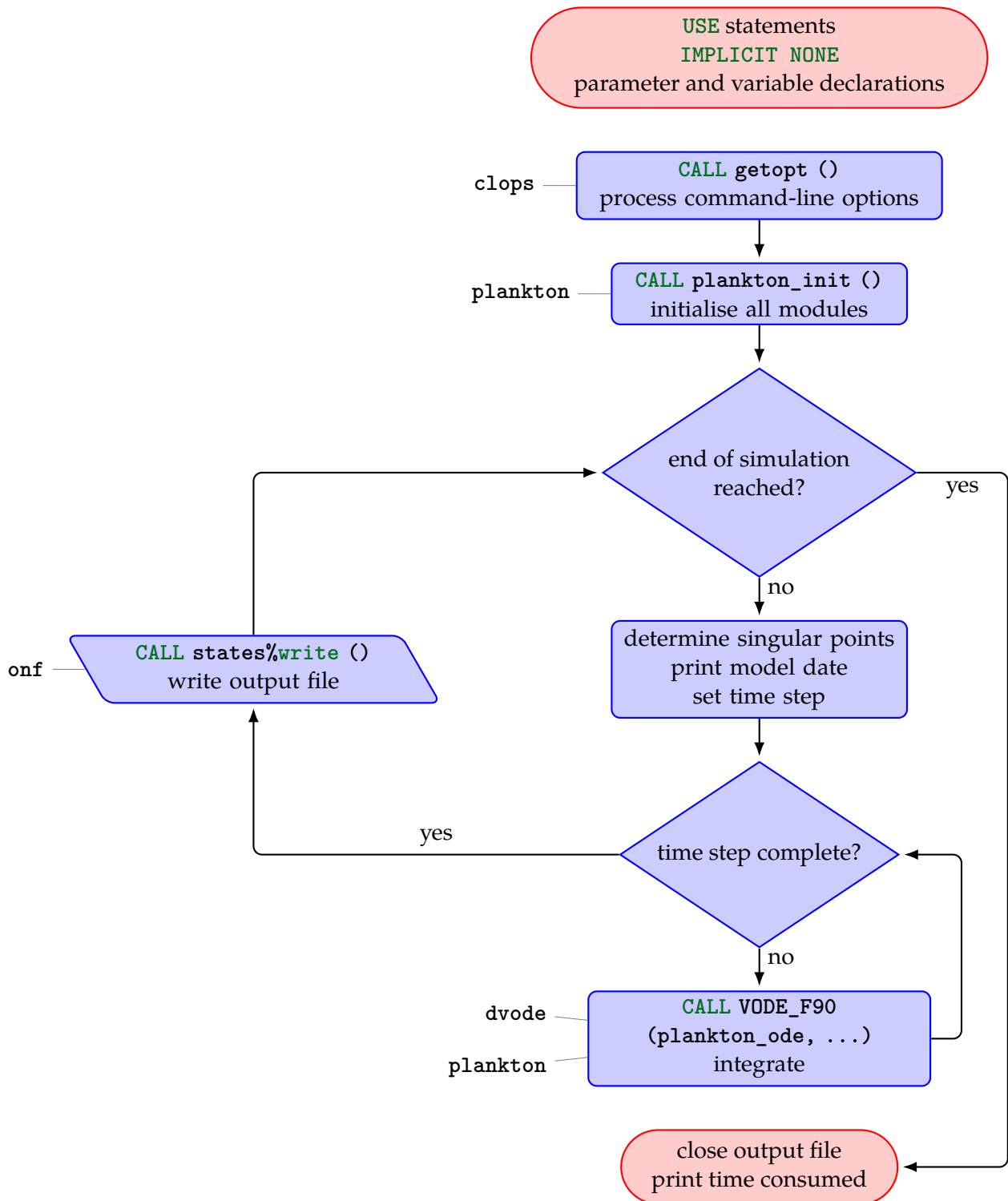
⁺ The names `aggregation→phyt_C`, `DIC→phyt_C`, etc. are stored in the dimension variable `sms` in the output file, and are used as column names when reading the `soma` matrix in R.

^{*} The name `phyt` is provided as an element of `cmo` in namelist `coco`, matching an entry `species` in one of the `cmo` namelists. This applies analogously also to the names `DIC` and `DIN`. What is shown here as `phyt%Q0N` is referred to as `grp%Q0N` in subroutine `cmo:cmo_flux` and as `phy%Q0N` in subroutine `cmo:grow`.

The elements of the S_n are set in the `flux` subroutines of the functional-group modules, which are called from the inner loop of subroutine `plankton_ode`. The column-sums of S_n are the local (partial) time-derivatives of all the state variables, which are added to the vertical fluxes at the end of subroutine `plankton_ode`.

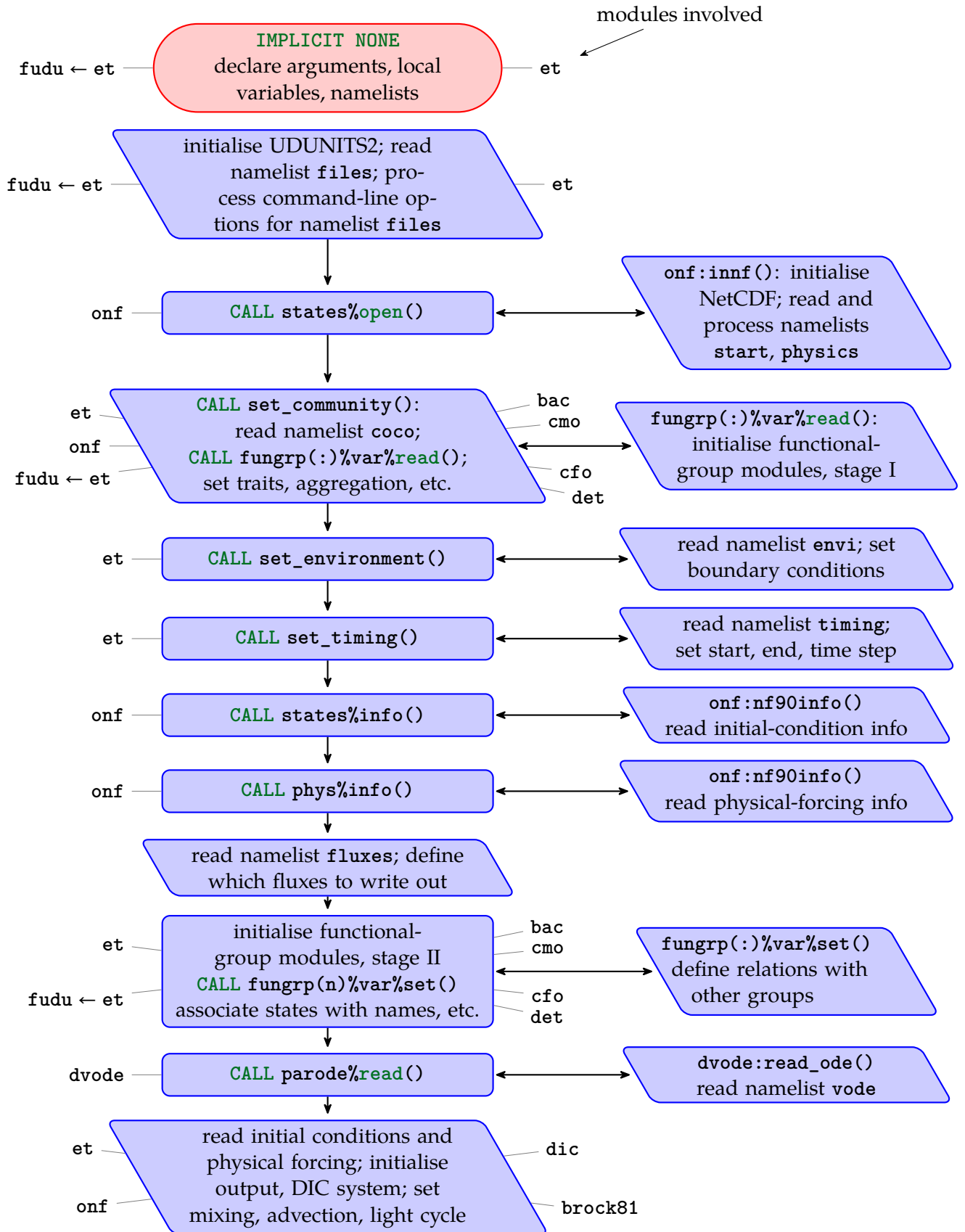
4 Flowcharts

4.1 Main Program oppla (src/oppla.F90)



4.2 Module plankton

4.2.1 Subroutine plankton_init



4.2.2 Subroutine plankton_ode

