COARE algorithm

- The COARE algorithm is designed to give estimates of the turbulent fluxes of sensible and latent heat and the stress from inputs of bulk variables

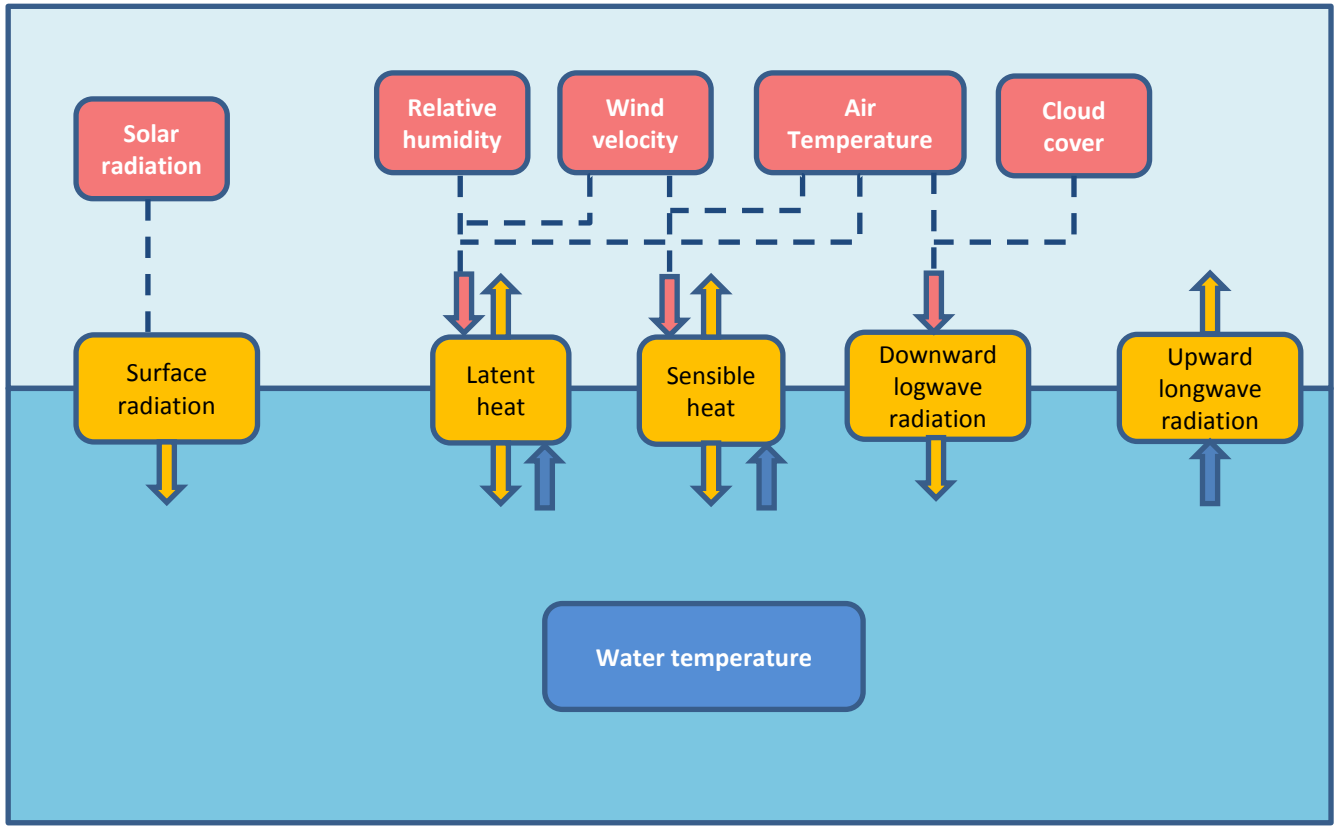
  - developed by C.Fairall (NOAA/ERL), E.F.Bradley (CSIRO), and D.Rogers (Scripps)

- COARE details are documented in:

  - on the algorithm (Fairall et al., 1994a; Bradley and Weller, 1995);

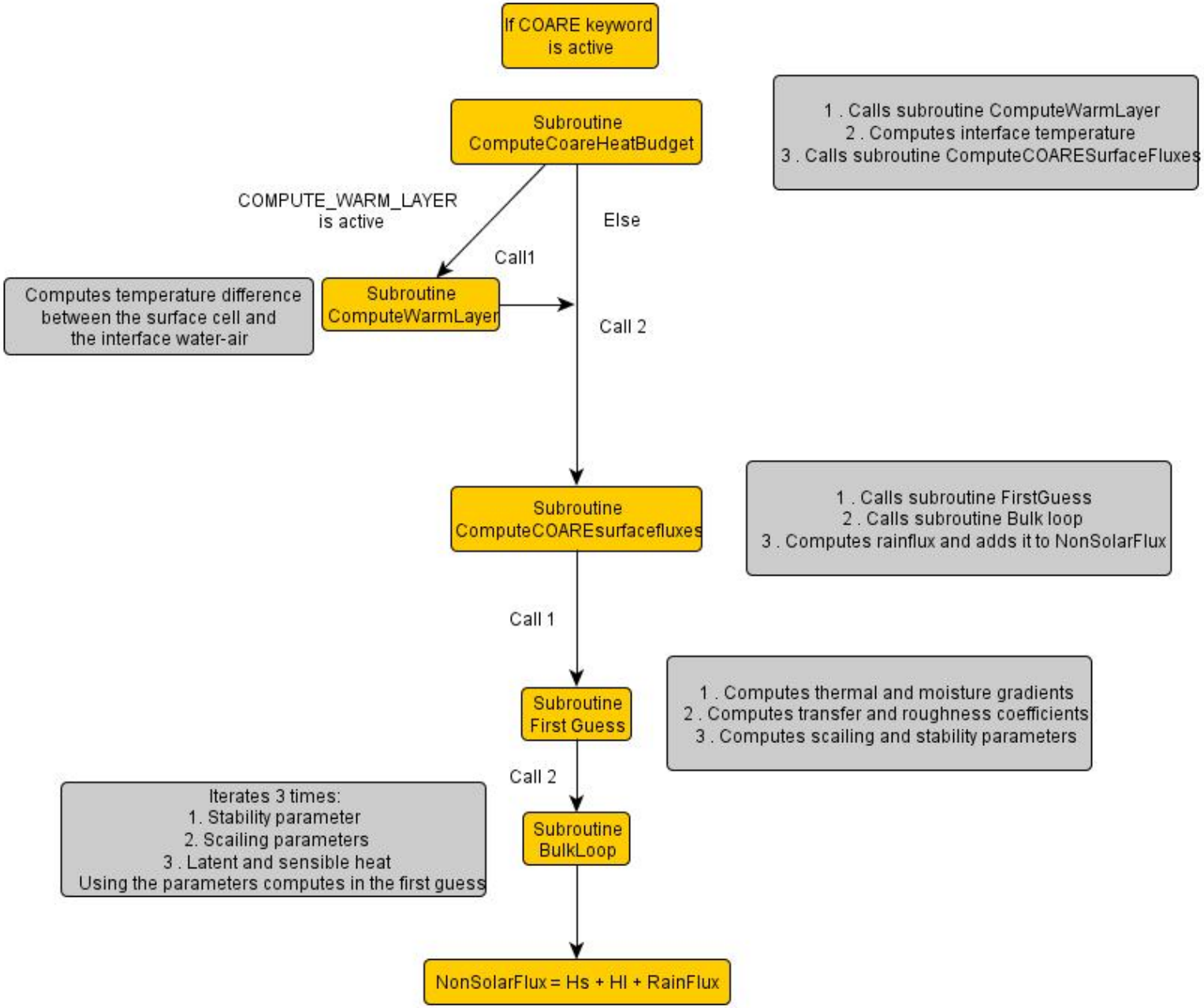
  - cool skin and warm layer effects (Fairall et al.,1994b);

  - bulk transfer coefficients are based on the Liu, Katsaros, Businger (LKB) model (Liu et al., 1979) with some modifications.



Non solar flux = Latent heat + Sensible heat + net longwave radiation

- LatentHeat
- SensibleHeat
- NetLongWaveRadiation
- UpwardLongWaveRadiation DownwardLongWaveRadiation SurfaceRadiation NonSolarFlux
- This algorithm is ready to receive albedo and PBL height and to user must include these properties when using COARE method.
- Albedo is required in all simulations as it is now a property of the InterfaceWaterAir. The user can get Albedo information from meteorological models or time series.


If COARE keyword is active
Subroutine ComputeCoareHeatBudget
1 . Calls subroutine ComputeWarmLayer
2 . Computes interface temperature
3 . Calls subroutine ComputeCOARESurfaceFluxes
COMPUTE_WARM_LAYER is active
Else
Call1
Computes temperature difference between the surface cell and the interface water-air
Subroutine ComputeWarmLayer
Call 2
Subroutine ComputeCOAREsurfacefluxes
1 . Calls subroutine FirstGuess
2 . Calls subroutine Bulk loop
3 . Computes rainflux and adds it to NonSolarFlux
Call 1
Subroutine First Guess
1 . Computes thermal and moisture gradients
2 . Computes transfer and roughness coefficients
3 . Computes scailing and stability parameters
Call 2
Iterates 3 times:
1. Stability parameter
2. Scailing parameters
3 . Latent and sensible heat
Using the parameters computes in the first guess
Subroutine BulkLoop
NonSolarFlux = Hs + Hl + RainFlux

Keywords to use COARE

InterfaceWaterAir.dat

- OUTSIDE the property block:

  USE_COARE : 1/0

  COMPUTE_WARM_LAYER : 1/0

  COMPUTE_COOL_SKIN : 1/0

- INSIDE the property block:

  add the property “albedo”

Atmosphere.dat

- OUTSIDE the property block:

  WIND_MEASUREMENT_HEIGHT : X in meters *

  AIR_MEASUREMENT_HEIGHT : X in meters *

- INSIDE the property block:

  add the property “pbl height”

* These values are dependent on the source of the data, if they were produced by a meteorological model or measured in a meteorological station. Each source will have its description and the user have to provide this information.

InterfaceWaterAir.dat

RUGOSITY : 0.0025
OUTPUT_TIME : 0 10800.
USE_COARE : 1
COMPUTE_WARM_LAYER : 1
COMPUTE_COOL_SKIN : 1
FILTER_SPIKES : 0

<beginproperty>
NAME : surface radiation
UNITS : W/m^2
DESCRIPTION : climatologic solar radiation
…
<endproperty>

<beginproperty>
NAME : latent heat
UNITS : W/m^2
DESCRIPTION : Calculated latent heat
…
<endproperty>

<beginproperty>
NAME : albedo
UNITS : W/m^2
DESCRIPTION : climatologic solar radiation
…
<endproperty>

<beginproperty>
NAME : sensible heat
UNITS : W/m^2
DESCRIPTION : Calculated sensible heat
…
<endproperty>

<beginproperty>
NAME : net long wave radiation
UNITS : W/m^2
DESCRIPTION : Calculated net long wave radiation
…
<endproperty>

<beginproperty>
NAME : upward long wave radiation
UNITS : W/m^2
DESCRIPTION : Calculated upward long wave radiation
…
<endproperty>

<beginproperty>
NAME : downward long wave radiation
UNITS : W/m^2
DESCRIPTION : Calculated downward long wave radiation
…
<endproperty>

<beginproperty>
NAME : non solar flux
UNITS : W/m^2
DESCRIPTION : Calculated infrared radiation
…
<endproperty>

<beginproperty>
NAME : evaporation
UNITS : mg/s
DESCRIPTION : oxygen flux through the water air interface
…
<endproperty>

<beginproperty>
NAME : surface water flux
UNITS : mg/s
DESCRIPTION : oxygen flux through the water air interface
…
<endproperty>

<beginproperty>
NAME : wind stress
UNITS : N/m2
DESCRIPTION : wind stress
DEFAULTVALUE : 0.0 0.0
…
<endproperty>

<beginproperty>
NAME : wind shear velocity
UNITS : m/s
DESCRIPTION : computed wind shear velocity
…
<endproperty>

Atmosphere.dat

OUTPUT_TIME : 0 3600.
RUGOSITY : 0.0025
WIND_MEASUREMENT_HEIGHT : 10.
AIR_MEASUREMENT_HEIGHT : 10.

<beginproperty>
NAME : wind velocity
UNITS : m/s
DESCRIPTION : wind velocity
...
<endproperty>

<beginproperty>
NAME : pbl height
UNITS : m
DESCRIPTION : planetary boundary layer
...
<endproperty>

<beginproperty>
NAME : precipitation
UNITS : mm/hour
DESCRIPTION : precipitation description
...
<endproperty>

<beginproperty>
NAME : solar radiation
UNITS : W/m^2
DESCRIPTION : meteoIST Solar Radiation
ALBEDO : 0.05 ![%]
....
<endproperty>

<beginproperty>
NAME : air temperature
UNITS : ºC
DESCRIPTION : Temperature
...
<endproperty>

<beginproperty>
NAME : relative humidity
UNITS : fraction
DESCRIPTION : Humidity from WRF model results
...
<endproperty>

<beginproperty>
NAME : mean sea level pressure
UNITS : Pa
DESCRIPTION : Mean Sea Level Pressure from WRF model results
...
<endproperty>

<beginproperty>
NAME : cloud cover
UNITS : fraction
DESCRIPTION : cloud cover
....
<endproperty>