

Schedule

1. What are models?

Exercise: Python Skills

2. Energy budget of the Earth

Exercise: Simple Energy Balance Model

3. Nonlinearity, Feedback, and Predictability

Exercise: Nonlinearity and Feedbacks

Exercise: Revised Energy Balance Model

4. Parametrization and Sensitivity

5. Radiative budget

Exercise: 1-layer greenhouse model

Exercise: 2-layer greenhouse model

6. Introduction to fluid dynamics

Exercise: Analytical katabatic flow model

7. Finite difference method

Exercise: Heat Equation

Exercise: Advection-Diffusion Equation

Exercise: Boundary layer Evolution

Exercise: Numerical katabatic flow model

8. Implicit finite difference methods

Exercise: Boundary layer evolution

9. Optimization problem

Exercise: Surface energy balance

Exercise: Sublimation

10. COSIPY snow model

Exercise: Simulations with COSIPY

11. Introduction to PALM

Exercise: Simulations with PALM

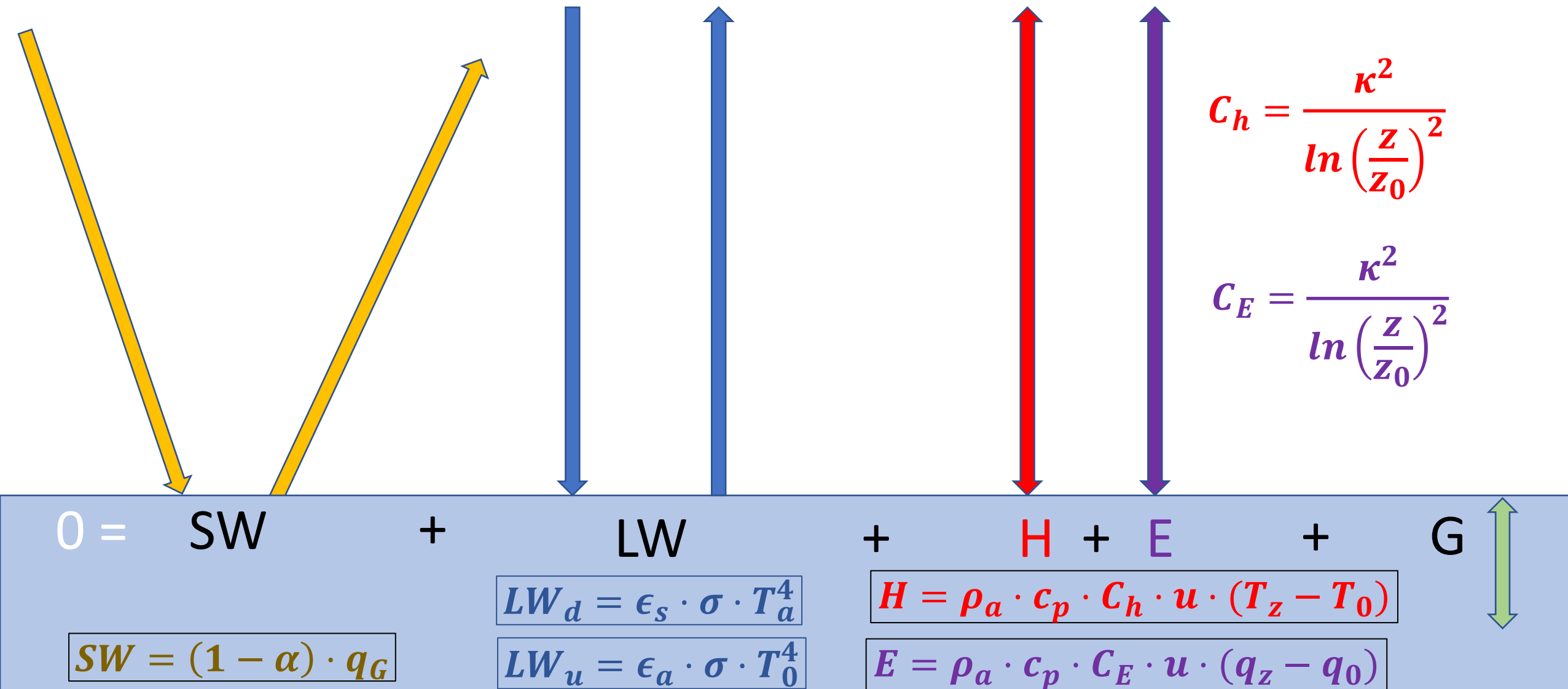
12. How to write an article

Learning objective

Learning objectives

- Understand optimization problems
- Develop a simple surface energy balance model

Surface Energy Balance model (SEB)



Exercise: SEB

Task 1: Develop a simple SEB model. The turbulent flows are to be parameterised using a simple bulk approach. Write a function that takes the following arguments: surface temperature, air temperature, relative humidity, albedo, global radiation, atmospheric pressure, air density, wind speed, altitude measured and roughness length. The function should return the short-wave radiation balance and the two turbulent energy fluxes.

Exercise: SEB

Task 2: Now we need to optimize for the surface temperature. Therefore, we need to write a optimization function. In our case the sum of all energy fluxes should be zero. In this case, the SEB only depends on the surface temperature. So we have to find the surface temperature which fulfils the condition $SEB(T_0)=Q_0+H_0+E_0=0$.

Once the optimization function is written, we use the **minimize function** from the scipy module to find the temperature values

