Summer 2020
Prof. Dr. Thomas Slawig, Niko Schmidt

Kiel University
Dep. of Computer Science

Computer Science in Ocean and Climate Research

Exercise 4

Tutorial: (Exercise May 5th, 2020) and **Home** (until May 12th, 2020):

Write a Fortran program that performs a simulation with a spatially distributed predator-prey model in the interval $[0, 1]$ and the time interval $[0, T], T > 0$.

- Devide the interval $[0, 1]$ into $N \in \mathbb{N}$ sub-intervals or boxes B_i, $i = 1, \ldots, N$.
- In every box B_i, the two (fish) species x, y are coupled by the classical predator-prey model defined as before. The parameters $\alpha, \beta, \gamma, \delta, \lambda, \mu > 0$ shall be constant.
- Moreover, the species x, y are influenced by spatial diffusion, realized by the *diffusion matrix* D given in the lecture. Here, also $\kappa > 0$ is a constant parameter (the *diffusion coefficient*).
- For the time-stepping, use the explicit or improved Euler method as before with n time steps.
- Choose some parameters, e.g., $\alpha = 2, \beta = 3, \gamma = 1, \delta = 3, \kappa = 0.001, T = 500$ and the discretization parameter $N = 100$ and $n = 4N^2\kappa T$.
- Make some experiments with initial values use x and y. In the beginning, they can be constant.
- Make the simulation run in Fortran, write the end results for $t = T$ to a file and plot them. Writing an array `x` to a file works like this in Fortran:

  ```
  open(unit=20,file='res.dat',status='replace',action='write')
  write(20,'(E20.6)') x
  close(20)
  ```

  You can also save intermediate time instants $t \in [0, T]$ and plot them.