EXERCISE 1: Build up models for marine disease transmission through contact with environmental pathogens

Learning objective: The learning goal of this lesson is to construct disease models describing pathogen transmisison through exposure to environmental pathogens or free-living pathogens.

The learner will try to construct the SIP (Susceptibles-Infected-Pathogens) and SIPD (Susceptibles-Infected-Dead-Pathogens) models with Matlab using differential equations. For this, the learner will build up the model using the SI and SID model codes from lesson 4. The student will need to add a new variable to incorporate infectious particles in the water column and new parameters to describe relsease of particles from infected and dead individuals, and the infection process based on exposure of susceptibles to these infectious particles. The student will need to spend 10 hours to (1) set the equations, (2) code those in matalb, (3) run a set of simulations with different parameter values and initial conditions, (4) and verify that the model behavior is suitable analyzing outputs (plots).

The exercise

The student will try to build up two models to describe marine disease transmission through contact with environmental pathogens. For this, the student needs to know that some marine microparasitic pathogens can survive several months in the water col-

umn to make contact with or to be absorbed or filtered by hosts. Once inside, pathogens invade the host if they find suitable conditions for reproduction. This pathogen transmission process from the environment occurs via pathogens released from infected and dead infected animals.

The models to construct by the student will be named SIP and SIPD models. In the SIP model, the variables are Susceptible animals S, Infected animals I and environmental or free-living pathogens (infectious particles) P. In this model, pathogens are released by I and contact S. In the SIPD model, we add the dead infected animals variable D. In this model pathogens are released by D and contact S. These models need to consider some new parameters such as particle contact-based transmission rate, release rate of pathogens from infected or dead animals, and removal/decay rate of pathogens from the environment.

Similarly to models described in lesson 4, the student will try to build the ODEs and the MATLAB model scripts (4 scripts) correspondent to each model. Some model diagnostics (plots) as in lesson 4 or new ones are necessary to complete the exercise.