Title:	Reaction-diffusion equations and the evolution of dispersal
Type of educational activity/teaching format:	online course
Responsible and offering lecturer:	Adrian LAM (Full professor, Ohio state university)
Start date - end date and duration:	10 times 2 hours. Start January 17th 2pm. Zoom link: https://us02web.zoom.us/j/81220619187?pwd=LzBRc21TZk5ub081Yzd6L3RtL1ZYUT09
Short description of the content of the course:	We introduce some basic tools and discuss some recent progress of reaction-diffusion models motivated spatial ecology and evolution. This course will start by reviewing some basic theory of elliptic and parabolic estimates. The main content consists of three parts. The first part concerns the single species model, covering persistence, critical domain size, global attractivity of positive solutions.Basics of the theory monotone dynamical systems; principal eigenvalue of elliptic/parabolic equations will be introduced. The second part concerns the competition of multiple species. We will discuss the competition model introduced in [Dockery et al., J. Math. Biol. (1998)] and discuss their proof of the case of two species in detail, and their conjecture regarding the Morse decomposition of the N species case. We will then discuss recent progress on N specie. We also introduce the concept of evolutionarily stable strategies and other notions from adaptive dynamics, and discuss related results for stream populations. Basics of the theory of principal Floquet bundle, and elements from dynamical systems will be discussed. The third part concerns a mutation-selection model introduced in [Diekmann et al., Theor. Pop. Biol, (2005)] concerning the competition of infinitely many species. We will discuss the result in [Perthame and Souganidis, Math. Model. Nat. Phenom. (2016)] concerning stationary solutions, and related results in stream populations [Hao et al. Indiana Univ. Math. J. (2019)]. We will also discuss recent progress on the time-dependent problem, including the uniqueness in constrained Hamilton-Jacobi equations [Calvez et al., Cal. Var. Par. Diff. Eq., (2020)]. Most of the course will be self-contained and is aimed at graduate students with knowledge at masters level real analysis.
Workload / Credits:	12 ECTS. Each course requires around 2 to 4 hours of homework.

Target group-level:	2nd year MA, PhD students
Language of instruction:	English
Learning content:	Introduction to research in the area of the course
Learning objectives:	The course will present the main tools used in the area of research covered by the course and end up at the level of present of knowledge, thus opening directly to research topics.
Assessment methods and criteria:	Final exam
4EU+ Flagship:	Flagship 3: Transforming science and society by advancing information, computation and communication
4EU+ Transversal skills/shared competencies:	The field of mathematical biology is developing fast in several 4EU+ universities and this course can serve as a common base of knowledge.