

Syllabus Advanced Planetary Health

Module # 232	Module 232 “Advanced Planetary Health”
Coordinator	Jean-François Guégan, IRD researcher, <i>PhD</i> and adjunct professor at EHESP MIVEGEC (UMR UM-CNRS 5290-IRD 224) Centre IRD, 911 avenue Agropolis, BP 64501, 34394 Montpellier, Cédex 5 jean-francois.guegan@ird.fr
Dates	Week 49: 3 to 7 December 2018
Credits/ECTS	3
Duration	Number of days: 5
Location	EHESP 20 Avenue George Sand 93210 LA PLAINE ST DENIS
Description	<p>There is growing understanding around the ways human-mediated environmental changes (e.g. land use change, wildlife trade, deforestation, climate change, human migration) significantly affect the health of wild and domestic animals, plants, and humans, resulting in both infectious and non-communicable diseases. Using a systems approach, we explore in this module the relationships between infectious diseases, biodiversity and ecosystems, the economics of disease and disease drivers, and the impacts of climate change and demography on health. Through this module, we seek to understand the health implications of current and anticipated global environmental change to identify policy and practical solutions to promote human health, ecosystem integrity, and sustainable development, i.e. Planetary health.</p> <p>We will see using different illustrations how too-narrowly focused vertical programs in medicine and public health cannot address the overlap that exists between animal and human health and even plant health, nor incorporate the necessary social, economic and ecosystem expertise.</p> <p>The adoption of more integrated approaches to human health is central in planetary health, and we need to implement a major shift in public health to better address the pressing global health challenges and achieve policy implementations by the UN's sustainable development goals. The course covers interdisciplinary scientific issues such as environmental systems, ecology, epidemiology, population dynamics, biomathematics and biostatistics, biodiversity changes, ecosystem modifications, climate change, agriculture development and intensive farming, transcontinental air transport and international trade, established and emerging diseases. The instructors are renowned international specialists in medical sciences, ecology/evolutionary biology and biomathematics affiliated to the most famous universities and research institutes in the world.</p>
Prerequisites	Good training, or research interest, in biology, international public health or global health, science of complexity are requested. Strong aptitude to reinterpret basic knowledge in medical sciences and biology. Course #217 attending is an advantage to follow course #230.
Course learning objectives	<p>At the completion of the module, the students should be able to:</p> <ul style="list-style-type: none"> - Identify the main determinants of (new) infectious disease risks in a changing world - Critically assess the quality and opportunity of national and international public health policies when facing these new disease risks <p style="padding-left: 20px;">Specify environmental risk assessment methods that are applied for microbial agents</p> <ul style="list-style-type: none"> - Put new emerging infectious disease risks into perspective with other (agriculture, demography, pollution, international travel and trade,...) dimension of globalization
Module Structure (details of session)	<p>Session1: An introduction to planetary health. Major drivers of global change: 3H</p> <p>Session 2: Global change and the rise of new threats: 3H</p> <p>Session 3: Avian influenza viruses. Part I – Learning from past crises and previous studies: 3H</p> <p>Session 4: Avian influenza viruses. Part II – Developing new approaches and identifying new research axes: 3H</p> <p>Session 5: Agricultural practices and plant health: lessons from the past and strategies for the future : 3H</p> <p>Session 6: The microbial nature of life and health: (micro)biological interactions and holobionts: 3H</p> <p>Session 7: Introduction to evolutionary biology theory. Part I – Epidemiology and adaptive dynamics: 3H</p> <p>Session 8: Introduction to evolutionary biology theory. Part I – Evolutionary epidemiology and transient evolution of pathogens: 3H. We here open the possibility to have a keynote lecture on vaccine strategies and communication.</p> <p>Session 9: Poverty Traps Driven by Feedback Between Economics and the Infectious Diseases/other ecological drivers of poverty. Part I: 3H</p> <p>Session 10 : Poverty Traps Driven by Feedback Between Economics and the Infectious Diseases/other</p>

	ecological drivers of poverty. Part II: 3H
Readings	Students will be provided with textbooks and papers for each session described below
Course requirement	Students are expected to attend all lectures and group works. Beyond 4:00 pm, attendance to group works is not required but permitted for preparing the final presentation.
Grading and assessment	The final exam is designed to integrate many of the concepts & methods the students have acquired in this course. This 2 hour in class exam is planned on Feb 2 or 3 of February 2016.
Course policy	<p>Attendance & punctuality Regular and punctual class attendance is a prerequisite for receiving credit in a course. Students are expected to attend each class. Attendance will be taken at each class. The obligations of attendance and punctuality cover every aspect of the course: - lectures, conferences, group projects, assessments, examinations, as described in EHESP Academic Regulations http://mph.ehesp.fr EHESP Academic Regulation Article. 3). If students are not able to make it to class, they are required to send an email to the instructor and to the MPH program coordinating team explaining their absence prior to the scheduled class date. All supporting documents are provided to the end-of-year panel.</p> <p>Students who miss class are responsible for content. Any student who misses a class has the responsibility for obtaining copies of notes, handouts and assignments. If additional assistance is still necessary, an appointment should be scheduled with the instructor. Class time is not to be used to go over material with students who have missed class.</p> <p>Lateness: Students who are more than 10 minutes late may be denied access to a class. Repeated late arrivals may be counted as absences (See http://mph.ehesp.fr EHESP Academic Regulation Article. 3 Attendance & Punctuality)</p> <p>Maximum absences authorized & penalty otherwise Above 20% of absences will be designated a fail for a given class. The students will be entitled to be reassessed in any failed component(s). If they undertake a reassessment or they retake a module this means that they cannot normally obtain more than the minimum pass mark (i.e. 10 out of 20)</p> <p>Exceptional circumstances Absence from any examination or test, or late submission of assignments due to illness, psychological problems, or exceptional personal reasons must be justified; otherwise, students will be penalized, as above mentioned. Students must directly notify their professor or the MPH academic secretariat before the exam or before the assignment deadline. Before accepting the student's justification, the professor or the MPH academic secretariat has the right to request either a certificate from the attending physician or from a psychologist, or from any other relevant person (See http://mph.ehesp.fr EHESP Academic Regulation Article 4 Examinations).</p> <p>Courtesy: <u>All cell phones/pages MUST be turned off during class time.</u> Students are required to conduct themselves according to professional standards, eating during class time is not permitted during class time, such as course or group work.</p>
Valuing diversity	Diversity enriches learning. It requires an atmosphere of inclusion and tolerance, which oftentimes challenges our own closely-held ideas, as well as our personal comfort zones. The results, however, create a sense of community and promote excellence in the learning environment. This class will follow principles of inclusion, respect, tolerance, and acceptance that support the values of diversity. Diversity includes consideration of: (1) life experiences, including type, variety, uniqueness, duration, personal values, political viewpoints, and intensity; and (2) factors related to "diversity of presence," including, among others, age, economic circumstances, ethnic identification, family educational attainment, disability, gender, geographic origin, maturity, race, religion, sexual orientation and social position.
Course evaluation	EHESP requests that you complete a course evaluation at the end of the school year. Your responses will be anonymous, with feedback provided in the aggregate. Open-ended comments will be shared with instructors, but not identified with individual students. Your participation in course evaluation is an expectation, since providing constructive feedback is a professional obligation. Feedback is critical, moreover, to improving the quality of our courses, as well as for instructor assessment.
Sessions 1-2	Module 232 "Advanced Planetary Health"

Session Title	An introduction to planetary health. Major drivers of global change and the rise of new threats
Lecturer	Jean-François Guégan, IRD researcher, <i>PhD</i> and adjunct professor at EHESP MIVEGEC (UMR UM1-UM2-CNRS 5290-IRD 224) Centre IRD, 911 avenue Agropolis, BP 64501, 34394 Montpellier, Cédex 5 jean-francois.guegan@ird.fr
Session outline	<ul style="list-style-type: none"> - An introduction to module Major 232 with a presentation of the different lecturers and main goals of this module - Global environmental change and planetary health: an introduction with some examples - A focus on land-use change and its impacts on the emergence of infectious diseases - Agriculture development in the Tropics and spread of infectious diseases - Linkages between ecosystems, biodiversity and the microbial world - The course discusses the many different examples of disease emergence/outbreaks and their spatial spread, that are interconnected to Earth systems disruption/alteration and globalization events. It particularly focuses on the dynamics of Earth physical/biological systems and the impacts of increasing human population/consumption on these systems. The syllabus is organized around major questions including (i) the exploration of the linkages between diseases and globalization due to environmental hazards and modernization (e.g. transcontinental air transport of goods and people), (ii) the examination of the consequences of these connections on human health, and (iii) the evaluation of the risks associated with not considering the complexity of these webs of interactions. Strong emphasis will be made on the interactions between complex disease systems and public health economy with an emphasis on situations in developing countries, i.e., Africa. Recent applications to public health policies and decisions by international WHO, UNEP, UNESCO, ICSU programmes in environmental health sciences research initiatives and health perspectives will be discussed within the framework of the “emerging field” called Planetary Health and sustainable development goals.
Learning Objectives	<ul style="list-style-type: none"> - Clarify the complexity of multi-factorial non-linear interactions - Identify the matter of spatial and temporal scales - Define proximal and distal determinants in health - Identify (Non-linear) correlation and causality within the context of disease emergence - Equilibria, disequilibria in (eco)systems, and the emergence of infectious diseases
Reading	<p>McMichael AJ, Nyong A, and Corvalan C (2008) Global environmental changes and health: impacts, inequalities, and the health sector. <i>BMJ</i> 336: 191-194.</p> <p>Smith K.F. and Guégan J.-F. (2010). Changing geographic distributions of human pathogens. <i>Annu. Rev. Ecol. Evol. Syst.</i> 41: 231-250.</p> <p>Aron JL, and Patz JA (2001). Ecosystem Change and Public Health. A Global Perspective. Johns Hopkins University Press, ISBN: 0-8018-6581-6).</p> <p><i>The Lancet</i>, special Volume (2015). The Rockefeller Foundation-The Lancet commission. Safeguarding human health in the Anthropocene epoch: report of The Rockefeller Foundation–Lancet Commission on planetary health. http://www.thelancet.com/commissions/planetary-health</p> <p>Frenk J., Gomez-Dantés O. (2017). False dichotomies in global health: the need for integrative thinking. <i>The Lancet</i>, 389: 667-670.</p> <p>Tan J. <i>et al.</i> (2017). One Health strategies for rabies control in rural areas of China. <i>The Lancet</i>. http://dx.doi.org/10.1016/</p>
Duration	6 hours
Training methods	Lecture Active participation of the students
Validation	None (at the end of the Module)

Sessions 3-4	Module 232 “Advanced Planetary Health”
Session Title	Avian influenza viruses: from wild birds to pandemics. Part I. Learning from past crises and previous studies Part II. Developing new approaches and identifying new research axes axesomics and Ecology of Infectious Diseases

Lecturer	Marion Vittecoq Institut de recherche de la Tour du Valat, Le Sambuc, Arles, France Email: vittecoq@tourduvalat.org
	<ul style="list-style-type: none"> - Importance of environmental compartments in zoonosis dynamics - Multidisciplinary approaches applied to zoonotic disease surveillance - Sanitary crisis management: what happens when wildlife is involved? - New pathways to conciliate human health preservation and biodiversity conservation.
Learning Objectives	<ul style="list-style-type: none"> - Understand how to include environmental compartments in zoonotic disease surveillance - Discover new tools that can help optimizing disease surveillance and control - Identify the factors influencing sanitary crisis management and the specificities of crises that involve wildlife - Explore how the health of ecosystems and humans can be protected through convergent measures
Reading	<p>Ezenwa V O, Prieur-Richard A-H, Roche B, Bailly X, Becquart P, García-Peña G E, Hosseini P R, Keesing F, Rizzoli A, Suzán G, et al. 2015. Interdisciplinarity and Infectious Diseases: An Ebola Case Study. <i>PLoS Pathog</i> 11:e1004992.</p> <p>Voyles J, Kilpatrick A M, Collins J P, Fisher M C, Frick W F, McCallum H, Willis C K R, Blehert D S, Murray K A, Puschendorf R, et al. 2015. Moving Beyond Too Little, Too Late: Managing Emerging Infectious Diseases in Wild Populations Requires International Policy and Partnerships. <i>EcoHealth</i> 12:404–407.</p>
Duration	6 hours
Training methods	Lecture Active participation of the students
Validation	None (at the end of the Module)

Session 5	Module 232 “Advanced Planetary Health”
Session Title	Agricultural practices and plant health: lessons from the past and strategies for the future
Lecturer	Christian Lannou, INRA researcher, <i>PhD</i> Bioger (UR INRA 1290) INRA, BP01, 78850 Thiverval Grignon Christian.Lannou@grignon.inra.fr
	<ul style="list-style-type: none"> - Intensification of agricultural production - Threat to agricultural production posed by pests and diseases - Seek for alternatives to chemical treatments - Durable management of genetic resources - Pathogen adaptation to disease control methods
Learning Objectives	<ul style="list-style-type: none"> - Describe influence of practices on disease risk - Identify link between functional diversity and resistance to disease - Determine scale effects and emerging properties - Integrate practical question to scientific research, and back to practical application - Transfer scientific innovation under practical and cultural constraints
Reading	<p>Theory development</p> <p>Mundt, C.C. 2002. Use of multiline cultivars and cultivar mixtures for disease management. <i>Annual Review of Phytopathology</i> 40: 381-410.</p> <p>Thrall, P.H. et al. 2011. Evolution in agriculture: the application of evolutionary approaches to the management of biotic interactions in agro-ecosystems. <i>Evolutionary Applications</i> 4: 200-215</p>
Duration	3 hours
Training methods	Lecture Active participation of the students
Validation	None (at the end of the Module)

Session 6	Module 232 “Advanced Planetary Health”
Session Title	The microbial nature of life and health: (micro)biological interactions and holobionts

Lecturer	Marc-André Selosse, Pr. Muséum national d'Histoire naturelle & universities of Gdansk (Poland) and Viçosa (Brazil) ma.selosse@wanadoo.fr
	<ul style="list-style-type: none"> - Background on microbiotas and holobiont - Background on symbiosis and mutualism - The microbial dimension of plants' functioning - The microbial dimension of animals' functioning - The microbial dimension of human (an overview in the framework of the previous item) - The microbial dimension of food practices - A general theory on macrobe-microbiota interaction (and its epistemological implications) - Perspective and applications in agriculture and human health
Learning Objectives	<ul style="list-style-type: none"> - Expose students to the microbial dimension of life - Recognize how microbial ecology shapes physiology and development - Identify the parallels between biological and cultural (civilizational) practices - Open the perspective of replacing aseptic environment / axeny by gnotobiotic environments - Be prepared to read and use the newest outcomes of microbiota and holobiont research
Reading	<p>Theory development</p> <ol style="list-style-type: none"> 1. Archie EA, Tung J (2015). Social behavior and the microbiome. <i>Curr Op Behav Sci</i> 6: 28-34. 2. Berendsen RL, Pieterse CM, <i>et al.</i> (2012). The rhizosphere microbiome and plant health. <i>TIPS</i> 17: 478–486. 1. Diaz Heijtz R, Wang S, <i>et al.</i> (2011). Normal gut micro- biota modulates brain development and behavior. <i>Proc Natl Acad Sci USA</i> 108: 3047–3052. 2. Hold GL (2014). Western lifestyle: A 'master' manipulator of the intestinal microbiota? <i>Gut</i> 63: 5–6. 3. McFall-Ngai M, Hadfield MG, <i>et al.</i> (2013). Animals in a bacterial world, a new imperative for the life sciences. <i>Proc Natl Acad Sci USA</i> 110: 3229-3236. 4. Nicholson JK, Holmes E, <i>et al.</i> (2012). Host-gut microbiota metabolic interactions. <i>Science</i> 336: 1262–1267. 5. Petherick A. (2010) Mother's milk: A rich opportunity. <i>Nature</i> 468: S5-S7. 6. Selosse M-A, Bessis A, <i>et al.</i> (2014). Microbial priming of plant and animal immunity: symbionts as developmental signals. <i>Trends Microbiol</i> 22: 607–613. 7. van der Heijden M, Martin FM, <i>et al.</i> (2015). Mycorrhizal ecology and evolution: the past, the present, and the future. <i>New Phytol</i> 205: 1406–1423. 8. Yang Y, Jobin C (2014). Microbial imbalance and intestinal pathologies: connections and contributions. <i>Dis Model Mech</i> 7: 1131–1142. <p>Applications</p> <ol style="list-style-type: none"> 1. Hart MM, Trevors JT (2005). Microbe management: application of mycorrhizal fungi in sustainable agriculture. <i>Front Ecol Environ</i> 3: 533–539. 2. Kelly CR, Kahn S, <i>et al.</i> (2015). Update on fecal microbiota transplantation: indications, methodologies, mechanisms, and outlook. <i>Gastroenterology</i> 149: 223–237. 3. Tamang JP, Kailasapathy K (2010). <i>Fermented Foods and Beverages of the World</i>. CRC Press, Taylor & Francis.
Duration	3 hours
Training methods	Lecture Active participation of the students
Validation	None (at the end of the Module)

Session 2	Module 232 "Advanced Planetary Health"
Session Title	Introduction to Evolutionary Epidemiology Theory. Part I. Epidemiology and adaptive dynamics of pathogens Part II. Vaccination: origin, controversies and optimal implementation

Lecturer	Sylvain Gandon CNRS Director of Research CEFE, 1919 route de Mende, 34293 Montpellier, France Email: sylvain.gandon@cefe.cnrs.fr
Learning Objectives	PART 1 (S. Gandon) 3h: - Explore the epidemiology and evolution of two case studies (myxomatosis, smallpox) to illustrate key consequences of public-health control - Learn how to formalize the epidemiological dynamics of infectious diseases - Learn how to analyze long-term (and short-term) evolutionary dynamics of pathogens using adaptive dynamics (and evolutionary epidemiology theory). Part 2 (S. Gandon & A. Alvergne) 3h: - The history of vaccination and the optimization of vaccination strategies - Presentation and discussion of several controversies around vaccination - Understanding and management of skepticism around vaccination.
Reading	Gandon S., Mackinnon M. J., Nee S. & Read A. F. (2001) Imperfect vaccines and the evolution of pathogen virulence. <i>Nature</i> . 414: 751-756. Day T. & Gandon S. (2007) Applying population-genetic models in theoretical evolutionary epidemiology. <i>Ecology Letters</i> . 10: 876-888. Voinson, M., Billiard, S., Alvergne, A. (2015) Beyond rational decision-making: modelling the influence of cognitive biases on the dynamics of vaccination coverage. <i>PLoS ONE</i> 10(11): e0142990. doi: 10.1371/journal.pone.0142990
Duration	6 hours
Training methods	Lecture Active participation of the students
Validation	None (at the end of the Module)

Sessions 9-10	Module 232 “Advanced Planetary Health”
Session Title	Poverty traps driven by feedback between economics and infectious diseases/other ecological drivers of poverty
Lecturer	Calistus Ngonghala, Ph.D. University of Florida, Gainesville, Florida, USA ngonghala@yahoo.com
	<ul style="list-style-type: none"> - Background and poverty trends - Review of infectious diseases and infectious disease modeling - Empirical evidence: impact of health on poverty and economic growth - Theory of poverty traps - Integrating disease ecology and economic models (deterministic, stochastic, individual-based) - Emergent properties and various tipping points of coupled ecological-economic systems - Economic growth theory - Integrated models of disease ecology and economic growth - Agriculture, disease and economic growth - Land-use change, disease and economic growth - Case studies/applications
Learning Objectives	<ul style="list-style-type: none"> - Expose students to the ecology of poverty through integrated economic-ecological models - Recognize evidence from a range of scales - Clarify background on model construction, analytical, and numerical methods - Use statistical techniques - Achieve broad conceptual understanding of feedbacks between economic growth and ecological drivers of poverty such as infectious diseases, agriculture (renewable resources), land-use change, population growth.

Reading	<p><u>Theory development</u></p> <ol style="list-style-type: none"> 1. Calistus N. Ngonghala, Giulio De Leo, Mercedes Pascual, Andrew Dobson, Matthew H. Bonds (2017). General ecological models for human subsistence, health and poverty. <i>Nature Ecology & Evolution</i> 2. Garchitorena et al. (2017). Disease ecology, health and the environment: a framework to account for ecological and socio-economic drivers in the control of neglected tropical diseases. <i>Philosophical Transactions of the Royal Society B</i> 3. Ngonghala et al. (2014). Poverty, disease, and the ecology of complex systems. <i>PLoS Biology</i> 12 (4), e100182 4. Mateusz M. Plucinski, Calistus N. Ngonghala, Wayne Getz, Matthew H. Bonds (2013). Clusters of poverty and disease emerge in epidemiological networks with community structure. <i>Journal of The Royal Society Interface</i> 10 (80), 20120656 5. Mateusz Plucinski, Calistus N. Ngonghala, Matthew H. Bonds (2011). Health safety nets can break cycles of poverty and disease: a stochastic ecological model. <i>Journal of The Royal Society Interface B</i> (65), 1796–1803 6. Bonds, M.H., Keenan, D.C. Rohani, P. and J.D. Sachs (2010). Poverty traps formed by the ecology of infectious diseases. <i>Proceedings of the Royal Society, B</i>, 277: 1185-1192 <p><u>Applications</u></p> <ol style="list-style-type: none"> 7. Garchitorena et al. (2015). Economic inequality caused by feedbacks between poverty and the dynamics of a rare tropical disease: the case of Buruli ulcer in sub-Saharan Africa. <i>Proceedings of Royal Society B</i>: 282 (1818), 20151426 8. Cassidy L. Rist, Andres Garchitorena, Calistus N. Ngonghala, Thomas R. Gillespie, Matthew H. Bonds (2015). The burden of livestock parasites on the poor. <i>Trends in Parasitology</i> 31 (11), 527–530
Duration	6 hours
Training methods	Lecture Active participation of the students
Validation	None (at the end of the Module)