Syllabus Advanced Planetary Health

Module ≠ 232	**Module 232 "Advanced Planetary Health"**
Coordinator	Jean-François Guégan, INRAE/IRD senior research professor, *PhD* and adjunct professor at EHESP UMR MIVEGEC USC INRAE, IRD, CNRS, University of Montpellier Agropolis International, 34394 Montpellier, Cédex 5 FRANCE Email: jean-francois.guegan@inrae.fr
Dates	Week 2: January 9th to January 13th, 2023
Credits/ECTS	3
Duration	Number of days: 5
Location	EHESP, 20 avenue George Sand 93210 LA PLAINE ST DENIS
Description	There is growing understanding around the ways human-mediated environmental changes (e.g., land use change, biodiversity loss, wildlife trade, deforestation, climate change) significantly affect the health of wild and domestic animals, plants, and humans, resulting in both infectious and non-communicable diseases. Using a system-based, integrative approach, we explore in this module the relationships between infectious diseases, biodiversity and agro-socioecosystems, the economics of disease and disease drivers, and the impacts of climate change, different types of stressors 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. 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 expertises. 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 change, ecosystem modifications, climate change, agriculture development and intensive farming, economy of development, transcontinental air transport and international trade, established and emerging diseases. The instructors are renowned international specialists in public health, ecology/evolutionary biology, biomathematics and sustainability sciences affiliated to the most famous universities and research institutes in the world.
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 acquired skills	At the completion of the module, the students should have acquired the following skills: - Understand and interpret the main determinants of (new) infectious disease threats in a changing world - Critically assess the quality and opportunity of national and international public health policies when facing these new disease risks - Identify and apply environmental risk assessment methods that are applied for microbial agents - Be able to put new emerging infectious disease risks and other types of risks like pollutants, chemical products and other stressors into perspective with other (agriculture, demography, pollution, international travel and trade,…) dimension of globalization - Understand the major evolution of modern public health toward sustainability sciences and a better integration of global change and planet transformation into the public health agenda, and promote planetary health
Module Structure (details of session)	Session1: An introduction to planetary health. Major drivers of global change: 3H Session 2: Global change and the rise of new threats: 3H Session 3: The microbial nature of life and health: (micro)biological interactions and holobionts. Part I: 3H Session 4: The microbial nature of life and health: (micro)biological interactions and holobionts. Part II: 3H Session 5: Agriculture, biocides, biodiversity, natural ecosystems and public health. Part I. An introduction: 3H Session 6: Agriculture, biocides, biodiversity, natural ecosystems and public health. Part II. Module discussion: 3H Session 7: Avian influenza viruses: from wild birds to pandemics. Part I. Learning from past crises and previous studies: 3H Session 8: Avian influenza viruses: from wild birds to pandemics. Part II. Developing new approaches and identifying new research axes and Ecology of Infectious Diseases: 3H

	Session 9: Poverty Traps Driven by Feedback Between Economics and the Infectious Diseases/other ecological drivers of poverty. Part I: 3H Session 10: Poverty Traps Driven by Feedback Between Economics and the Infectious Diseases/other ecological drivers of poverty. Part II: 3
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	Final exam only. The final exam is designed to integrate many of the concepts and methods the students have acquired in this course. This 2 hour in class exam is planned on ???? 2023.
Course policy	**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. . 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. **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) **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) **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). **Courtesy**: All cell phones/pages MUST be turned off during class time. 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.
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 with a focus on international agriculture**
Lecturer	Jean-François Guégan, INRAE/IRD senior research professor, *PhD* and adjunct professor at EHESP UMR MIVEGEC USC INRAE, IRD, CNRS, University of Montpellier Agropolis International, 34394 Montpellier, Cédex 5 FRANCE Email: jean-francois.guegan@inrae.fr
Session outline	- 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, FAO, OIE, ICS programs in environmental health sciences research initiatives and health perspectives will be discussed within the framework of the “emerging fields” called Planetary Health, sustainable development goals and sustainability sciences
Acquired skills	- Understand the complexity of multi-factorial, non-linear interactions in modern public health, and adapt this to disease surveillance - Identify the matter of spatial and temporal scales in public health - 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 - Identify the main differences across the different new health concepts, i.e. One Health, Ecoheath, Global Health, Planetary Heallh
Reading	McMichael AJ, Nyong A, and Corvalan C (2008) Global environmental changes and health: impacts, inequalities, and the health sector. *BMJ* 336: 191-194. Smith K.F. and Guégan J.-F. (2010). Changing geographic distributions of human pathogens. *Annu. Rev. Ecol. Evol. Syst.* 41: 231-250. Guégan J.-F., Ayouba A., Cappelle J. and Thoisy B. de (2020). Emerging infectious diseases and tropical forests: unleashing the beast within. *Environmental Research Letters*. https://iopscience.iop.org/article/10.1088/1748-9326/ab8dd7/pdf Guégan J.-F., De Thoisy B., Gomez-Gallego M. and Jactel H. (2022). World forests, global change, and emerging pests and pathogens. *Current Opinion in Environmental Sustainability*. Invited review paper (in press). Aron JL, and Patz JA (2001). Ecosystem Change and Public Health. A Global Perspective. Johns Hopkins University Press, ISBN: 0-8018-6581-6). *The Lancet*, special Volume (2015). The Rockfeller 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 Frenk J., Gomez-Dantés O. (2017). False dichotomies in global health: the need for integrative thinking. *The Lancet*, 389: 667-670. Tan J. *et al.* (2017). One Health strategies for rabies control in rural areas of China. *The Lancet*. http://dx.doi.org/10.1016/ White P.C.L., Guégan J.-F., Keune H., De Bell S., Geijzendorffer I. R., Hermans C. M. L., Prieur-Richard A. H., Iroegbu C., Stone D., Vanwambeke S., de Vries S., Ford A. and Graham H. (2020). Integrative policy

	development for healthier people and ecosystems: a European case analysis. *Area.* DOI: 10.1111/area.12618
Duration	2×3 hours
Training methods	Lectures Active participation of the students Discussion and practical works around international reports from United Nations or Non-Governmental Organizations reports and resolutions, e.g., new OHHLEP expert panel production
Validation	None (at the end of the Module)

Sessions 3-4	**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) Email: ma.selosse@wanadoo.fr
	- Background on microbiotas and holobionts - 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
Acquired skills	- To be acculturated and to know the microbial dimension of life - Be able to recognize how microbial ecology shapes physiology, development and health of animals and humans - Identify the parallels between biological and cultural (civilizational) practices - Open the perspective of replacing aseptic environment / axeny by gnotobiotic environments, and promote this orientation in international public health - Be prepared to read and use the newest outcomes of microbiota and holobiont research
Reading	**Theory development** 1. Archie EA, Tung J (2015). Social behavior and the microbiome. *Curr Op Behav Sci* 6: 28-34. 2. Berendsen RL, Pieterse CM, *et al.* (2012). The rhizosphere microbiome and plant health. TIPS 17: 478–486. 1. Diaz Heijtz R, Wang S, *et al.* (2011). Normal gut micro- biota modulates brain development and behavior. *Proc Natl Acad Sci USA* 108: 3047–3052. 2. Hold GL (2014). Western lifestyle: A 'master' manipulator of the intestinal microbiota? *Gut* 63: 5–6. 3. McFall-Ngai M, Hadfield MG, *et al.* (2013). Animals in a bacterial world, a new imperative for the life sciences. *Proc Natl Acad Sci USA* 110: 3229-3236. 4. Nicholson JK, Holmes E, *et al.* (2012). Host-gut microbiota metabolic interactions. Science 336: 1262–1267. 5. Petherick A. (2010) Mother's milk: A rich opportunity. *Nature* 468: S5-S7. 6. Selosse M-A, Bessis A, *et al.* (2014). Microbial priming of plant and animal immunity: symbionts as developmental signals. *Trends Microbiol* 22: 607–613. 7. van der Heijden M, Martin FM, *et al.* (2015). Mycorrhizal ecology and evolution: the past, the present, and the future. *New Phytol* 205: 1406–1423. 8. Yang Y, Jobin C (2014). Microbial imbalance and intestinal pathologies: connections and contributions. *Dis Model Mech* 7: 1131–1142. **Applications** 1. Hart MM, Trevors JT (2005). Microbe management: application of mycorrhizal fungi in sustainable agriculture. *Front Ecol Environ* 3: 533–539. 2. Kelly CR, Kahn S, *et al.* (2015). Update on fecal microbiota transplantation: indications, methodologies, mechanisms, and outlook. *Gastroenterology* 149: 223–237. 3. Tamang JP, Kailasapathy K (2010). *Fermented Foods and Beverages of the World*. CRC Press, Taylor & Francis.

Duration	2 × 3 hours
Training methods	Lecture Active participation of the students
Validation	None (at the end of the Module)

Sessions 5-6	**Module 232 "Advanced Planetary Health"**
Session Title	**Agriculture, biocides, biodiversity, natural ecosystems and public health** **Part I and Part II**
Lecturer	Jean-François Guégan, INRAE/IRD senior research professor, *PhD* and adjunct professor at EHESP UMR MIVEGEC USC INRAE, IRD, CNRS, University of Montpellier Agropolis International, 34394 Montpellier, Cédex 5 FRANCE Email: jean-francois.guegan@inrae.fr
	- Today modern agriculture development, the agri-food industry and new biocides - Neonicotinoids as new threats for ecosystem health, animal health and human health - Multiple tradeoffs in modern agriculture production: benefits and costs for human health and planetary health - Rethinking international agriculture towards more sustainable agriculture
Acquired skills	- Understand how modern agriculture has evolved and why? - Identify the benefits but also the costs of current agriculture, and be able to characterize the main challenges for public health and the health of the planet, and adapt these in research programs - Analyze the sources, pathways and routes of agriculture development and strategies' impacts on environmental health, animal health and human health - Determine the main levers for future actions towards sustainable agriculture, and be able to adapt them for future public health research programs and surveillance
Reading	Rockström J, Steffen W, Noone K *et al.* (2009). A safe operating space for humanity. *Nature* **461**: 472-475. Sachs J, Remans R, Smukler S, Winowiecki L, Andelman SJ, Cassman KG, Castle D et al. (2010). Monitoring the world's agriculture. *Nature* 466: 558-560. https://doi.org/10.1038/466558a Tilman D, Fargione J, Wolff B, D'Antonio C, Dobson AP, Howarth R, Schindler D, Schlesinger WH, Simberloff D and Swackhamer D (2001). Forecasting Agriculturally Driven Global Environmental Change. *Science* 292: 281-284. Doi: 10.1126/science.1057544 WHO (2013). Research Priorities for the Environment, Agriculture and Infectious Diseases of Poverty. WHO Technical Report Series 976. Technical Report of the TDR Thematic Reference Group on Environment, Agriculture and Infectious Diseases of Poverty, 142 p. https://apps.who.int/iris/bitstream/handle/10665/78129/WHO_TRS_976_eng.pdf
Duration	2 × 3 hours
Training methods	Lecture Active participation of the students Discussion and practical work around recent scientific articles and reports
Validation	None (at the end of the Module)

Sessions 7-8	**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 and Ecology of Infectious Diseases**
Lecturer	Marion Vittecoq Institut de recherche de la Tour du Valat, Le Sambuc, Arles, France Email: vittecoq@tourduvalat.org

	- 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.
Acquired skills	- 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 and more generally the environment - Explore how the health of ecosystems and humans can be protected through convergent measures in nature conservancy and public health
Reading	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. *PLoS Pathog* 11: e1004992. 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. *EcoHealth* 12:404–407. Several other publications will be distributed during the course
Duration	2 × 3 hours
Training methods	Lecture Active participation of the students Discussion and practical work around recent scientific articles and articles in newspapers
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 Email: ngonghala@yahoo.com
	- 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
Acquired skills	- Clarify background on model construction, analytical, and numerical methods - Understand and interpret the ecology of poverty through integrated economic-ecological models, and be able to assess it on the field - Recognize evidence from a range of spatial and temporal scales - 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 - Be able to consider it in research programs and adapt it in public health initiatives and strategies

Reading	**Theory development** 1. Calistus N. Ngonghala, Giulio De Leo, Mercedes Pascual, Andrew Dobson, Matthew H. Bonds (2017). General ecological models for human subsistence, health and poverty. *Nature Ecology & Evolution* 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. *Philosophical Transactions of the Royal Society B* 3. Ngonghala et al. (2014). Poverty, disease, and the ecology of complex systems. *PLoS Biology* 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. *Journal of The Royal Society Interface* 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. *Journal of The Royal Society Interface B* (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. *Proceedings of the Royal Society*, *B*, 277: 1185-1192 **Applications** 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. *Proceedings of Royal Society B*: 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. *Trends in Parasitology* 31 (11), 527–530
Duration	2 × 3 hours
Training methods	Lecture Active participation of the students
Validation	None (at the end of the Module)