Syllabus Advanced Planetary Health

Module ≠ 232	Module 232 "Advanced Planetary Health"
Coordinator	Jean-François Guégan, IRD/INRAE senior research professor, *PhD* and adjunct professor at EHESP UMR ASTRE INRAE, Cirad, University of Montpellier Centre international de Baillarguet, 34394 Montpellier, Cédex 5 FRANCE jean-francois.guegan@inrae.fr
Dates	Week 2: January 10th to January 14th 2022
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, 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 system-based, integrative 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, 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, 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 learning objectives	At the completion of the module, the students should be able to: - 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 Specify environmental risk assessment methods that are applied for microbial agents - 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
Contributes to the development of the following competences	**Competences :** - Contributes to or leads community based health needs assessments ensuring that these assessments consider biological, social, economic, cultural, political physical determinants of health and wider determinants of health such as deprivation - Understands the local implications of the One Health approach, its global interconnectivity and its impact on health conditions in the population - Performs surveillance of risks and threats to the full continuum of factors that influence and determine health in order to identify intervention needs - Identifies and describes the environmental determinants of health and the connections between environmental protection and public health policy.

	Teaching activities : Classroom lectures, in-room and home practical works, interactive discussions around scientific articles and newspapers articles, depending on context simulation/scenario exercise works, e.g., on-live decision taking in a context of epidemic risk and spread **Evaluation :** Final exam consisting in general of questions related to the different lectures given in this module, or a critical work based on a recent scientific published work related to one of the topics discussed during this module
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: Zoonotic origins and spread of HIV-1 and HIV-2 worldwide. Part I: 3H Session 4: Zoonotic origins and spread of HIV-1 and HIV-2 worldwide. Part II: 3H Session 5: Poverty Traps Driven by Feedback Between Economics and the Infectious Diseases/other ecological drivers of poverty. Part I: 3H Session 6: Poverty Traps Driven by Feedback Between Economics and the Infectious Diseases/other ecological drivers of poverty. Part II: 3H Session 7: Tick-borne diseases in a changing world – research opportunities and health challenges. Part I: 3H Session 8: Tick-borne diseases in a changing world – research opportunities and health challenges. Part II: 3H Session 9: Agriculture, biocides, biodiversity, natural ecosystems and public health. Part I: 3H Session 10: Agriculture, biocides, biodiversity, natural ecosystems and public health. Part II. Module discussion: 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	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 ???? 2022.
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 ASTRE INRAE, Cirad, University of Montpellier Centre international de Baillarguet, 34394 Montpellier, Cédex 5 FRANCE 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
Learning Objectives	- 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 - Identify the main differences across the different new health concepts, i.e. One Health, Ecoheath, Global Health, Planetary Healh

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* (invited topical review). https://iopscience.iop.org/article/10.1088/1748-9326/ab8dd7/pdf 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/
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	**Zoonotic origins and spread of HIV-1 and HIV-2 worldwide.**
Lecturer	Ahidjo Ayouba, PhD. TransVIHMI research Unit IRD/university of Montpellier/INSERM. Montpellier, France. ahidjo.ayouba@ird.fr
Session outline	- Brief introduction to zoonotic diseases and some definitions - Presentation and classification of HIV in the family of retroviruses - Evidence-based demonstration of the zoonotic origins of HIV - Experimental approaches and findings - Worldwide spread of the different HIV clades and its impacts on health
Learning Objectives	- Clarify to roles of human/wildlife/environment interactions in the origins of HIV - Clarify the impact of human activities in the ignition of HIV epidemics in Africa and its spread worldwide. - The module will also explain the importance of non-invasive experimental methods in the study of endangered wildlife species

Reading	1: D'arc M, Ayouba A, Esteban A, et al.Origin of the HIV-1 group O epidemic in western lowland gorillas. Proc Natl Acad Sci U S A. 2015 Mar 17;112(11):E1343-52. doi: 10.1073/pnas.1502022112. 2: Li Y, Ndjango JB, Learn GH, et al. Eastern chimpanzees, but not bonobos, represent a simian immunodeficiency virus reservoir. J Virol. 2012 Oct;86(19):10776-91. doi: 10.1128/JVI.01498-12. 3: Keele BF, Jones JH, Terio KA, et al. Increased mortality and AIDS-like immunopathology in wild chimpanzees infected with SIVcpz. Nature. 2009 Jul 23;460(7254):515-9. doi: 10.1038/nature08200. 4: Van Heuverswyn F, Li Y, Bailes E, Neel C, et al. Genetic diversity and phylogeographic clustering of SIVcpzPtt in wild chimpanzees in Cameroon. Virology. 2007 Nov 10;368(1):155-71. doi: 10.1016/j.virol.2007.06.018. 5: Van Heuverswyn F, Li Y, Neel C, Bailes E, et al. Human immunodeficiency viruses: SIV infection in wild gorillas. Nature. 2006 Nov 9;444(7116):164. doi: 10.1038/444164a.. 6: Keele BF, Van Heuverswyn F, Li Y, et al. Chimpanzee reservoirs of pandemic and nonpandemic HIV-1. Science. 2006 Jul 28;313(5786):523-6. doi: 10.1126/science.1126531. 7: Li Y, Ndjango JB, Learn GH, et al. Eastern chimpanzees, but not bonobos, represent a simian immunodeficiency virus reservoir. J Virol. 2012 Oct;86(19):10776-91. doi: 10.1128/JVI.01498-12. 8: Van Heuverswyn F, Li Y, Neel C, et al. Human immunodeficiency viruses: SIV infection in wild gorillas. Nature. 2006 Nov 9;444(7116):164. doi: 10.1038/444164a. 9: Liu W, Li Y, Shaw KS, Learn GH, et al. African origin of the malaria parasite Plasmodium vivax. Nat Commun. 2014;5:3346. doi: 10.1038/ncomms4346. 10: Liu W, Li Y, Learn GH, et al. Origin of the human malaria parasite Plasmodium falciparum in gorillas. Nature. 2010 Sep 23;467(7314):420-5. doi: 10.1038/nature09442. 11: Liu W, Sherrill-Mix S, Learn GH, et al. Wild bonobos host geographically restricted malaria parasites including a putative new Laverania species. Nat Commun. 2017 Nov 21;8(1):1635. doi:10.1038/s41467-017-01798-5.
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 5-6	**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
	- 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	- 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	**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)

Sessions 7-8	**Module 232 "Advanced Planetary Health"**
Session Title	**Tick-borne diseases in a changing world – research opportunities and health challenges Part I and Part II**
Lecturer	Gwenaël Vourc'h, senior researcher at INRAE, *PhD* and adjunct professor at EHESP UMR EPIA, INRAE VetAgro Sup, Centre INRAE, 63122 Saint Genès Champanelle, FRANCE gwenael.vourch@inrae.fr
	- Vector-borne diseases are very sensitive to environmental changes - Ticks are the most important vector after mosquitoes for human or animal diseases - Addressing challenges of tick-borne zoonoses, requires integrated and interdisciplinary approaches
Learning Objectives	- Understand the link between tick-borne diseases and environmental changes (land-use, biodiversity, climate), as well as socioeconomical changes - Identify the main challenges for surveillance, detection and prevention, at the interface of human and animal health - Explore how new approaches such as citizen sciences and innovative design may help opening new research questions or new mode of actions for complex issues such as zoonoses.

Reading	Diuk-Wasser, M A, Meredith C VanAcker, Maria P Fernandez. 2021. Impact of Land Use Changes and Habitat Fragmentation on the Eco-epidemiology of Tick-Borne Diseases. Journal of Medical Entomology, 58 (4), Pages 1546–1564, https://doi.org/10.1093/jme/tjaa209 Vourc'h, G., J. Brun, C. Ducrot, J.-F. Cosson, P. Le Masson, and B. Weil. 2018. Using design theory to foster innovative cross-disciplinary research: Lessons learned from a research network focused on antimicrobial use and animal microbes' resistance to antimicrobials. Veterinary and Animal Science 6:12-20. https://doi.org/10.1016/j.vas.2018.04.001 Hamer, S A, Rachel Curtis-Robles, Gabriel L Hamer, 2018. Contributions of citizen scientists to arthropod vector data in the age of digital epidemiology,Current Opinion in Insect Science, 28, pp98-104. https://doi.org/10.1016/j.cois.2018.05.005
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 9-10	**Module 232 "Advanced Planetary Health"**
Session Title	**Agriculture, biocides, biodiversity, natural ecosystems and public health** **Part I and Part II**
Lecturer	Jean-François Guégan, IRD/INRAE senior research professor, *PhD* and adjunct professor at EHESP UMR ASTRE INRAE, Cirad, University of Montpellier Centre international de Baillarguet, 34394 Montpellier, Cédex 5 FRANCE 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
Learning Objectives	- 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 - Explore how the health of ecosystems and humans may depend on agriculture development and strategies - Determine the main levers for future actions towards sustainable agriculture
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)