

Syllabus Module 232

Module # 232	“Global Environmental Changes and Health” Major A
UE coordinator	Jean-François Guégan, IRD researcher, <i>PhD</i> MIVEGEC (UMR UM1-UM2-CNRS 5290-IRD 224) Centre IRD, 911 avenue Agropolis, BP 64501, 34394 Montpellier, Cédex 5 jean-francois.guegan@ird.fr
Dates	January 9 th to 13 th 2017
Credits/ECTS	3
Duration	Number of days: 5
Module description	<p>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. 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 (i) on the consequences of nowadays vaccine strategies for disease, control and their consequences on disease agent persistence, spread and evolution, and (ii) 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 Conservation Medicine or Darwinian Medicine</p>
Prerequisites	Good training, or research interest, in biology, international public 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, not an obligation.
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 - specify environmental risk assessment methods that are applied for microbial agents - 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: Land- use change, ecosystem alteration, agriculture development, intensive farming and health. An introduction: 3H</p> <p>Session 2: Ecosystem alteration and re-emergence of pathogens: 3H</p> <p>Session 3: Climate change and infectious diseases: 3H</p> <p>Session 4; Adaptation of disease vectors to environmental changes in the Tropics: 3H</p>

	<p>Session 5: Agricultural practices and plant health: lessons from the past and strategies for the future : 3H</p> <p>Session 6: Avian influenza A viruses: from wild bird to pandemic: 3H</p> <p>Session 7: Community Ecology of diseases: 3H</p> <p>Session 8: Imperfect vaccines in a changing world, and their consequences for public health</p> <p>Session 9: Poverty Traps Formed by Feedback Between Economics and the Ecology of Infectious Diseases</p> <p>Session 10 : Ecological literacies in health practices. An introduction to Conservation Medicine : 3H</p>
Course requirement	Students are expected to attend all lectures and group works. Beyond 5:00 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.
Location	Reid Hall (Paris)
Readings	Students will be provided with Textbook and papers for each session described below

Session 1	Module 232 “Advanced Global Environmental Changes and Health”
Session Title	Land-use change, ecosystem alteration, agriculture development, intensive farming and health. An introduction
Speaker	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.quegan@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 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
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>
Duration	3 hours
Dates	Monday January 9 th 2017. 9 a.m.-12 a.m.
Training methods	Lecture

	Active participation of the students
Validation	None (at the end of the Module)

Session 2	Module 232 “Advanced Global Environmental Changes and Health”
Session Title	Ecosystem alteration and (re-)emergence of pathogens
Speaker	Benjamin Roche, Chercheur IRD, docteur UMMISCO (UMI UPMC/IRD 209) Centre IRD, 32 avenue Henri Varagnat, F-93143 Bondy benjamin.roche@ird.fr
Session outline	<ul style="list-style-type: none"> - Overview of the how ecosystem modifications can alter animal biodiversity - Ecological mechanisms of biodiversity on pathogen transmission according to the different transmission processes - The consequences of biodiversity decline on pathogen adaptation to humans and design of public health strategies -
Learning Objectives	<ul style="list-style-type: none"> - Define how small ecological perturbations can have dramatic effect on animal biodiversity? - Explain how each animal species have a different susceptibility to become infected - Identify the role of biodiversity on vector-borne diseases and its consequences for the predictability of their spatio-temporal dynamics. - Identify the crucial lack of knowledge for directly-transmitted zoonoses - Recognize the pivotal role of biodiversity in pathogen adaptation to humans - and how biodiversity can be used for public health strategies - Discuss how Pathogens enhance great biodiversity
Reading	<p>Keesing, F.; Belden, L. K.; Daszak, P.; Dobson, A.; Harvell, C. D.; Holt, R. D.; Hudson, P.; Jolles, A.; Jones, K. E.; Mitchell, C. E.; Myers, S. S.; Bogich, T. & Ostfeld, R. S. Impacts of biodiversity on the emergence and transmission of infectious diseases. <i>Nature</i>, Department of Biology, Bard College, Annandale, New York 12504, USA., 2010, 468, 647-652</p> <p>Roche, B. & Guégan, J. Ecosystem dynamics, biological diversity and emerging infectious diseases <i>Comptes Rendus Biologie</i>, 2011, 334, 385-392</p> <p>Collinge, S. H. & Ray, C. (Eds.) <i>Disease ecology: Community structure and pathogen dynamics</i> Oxford University Press, 2006</p>
Duration	3 hours
Dates	Monday January 9 th 2017. 2 p.m.-5 p.m.
Training methods	Lecture Active participation of the students
Validation	None (at the end of the Module)

Session 3	Module 232 “Advanced Global Environmental Changes and Health”
Session Title	Climate change and infectious diseases
Speaker	Guillaume Constantin de Magny, IRD researcher, <i>PhD</i> MIVEGEC (UMR UM1-UM2-CNRS 5290-IRD 224) Centre IRD, 911 avenue Agropolis, BP 64501, 34394 Montpellier, Cédex 5 guillaume.demagny@ird.fr
Session outline	<ul style="list-style-type: none"> - Climate change, some definitions - Infectious and non-infectious impacts of climate change - Ecology of <i>Vibrio cholerae</i> and cholera transmission
Learning Objectives	<ul style="list-style-type: none"> - Practice multidisciplinary approach in health - Identify how long-term researches can change scientific and health paradigm? - Model various sources of data - Apply fundamental research
Reading	<p>Colwell RR, Huq A, Islam MS, Aziz KMA, Yunus M, Khan NH, Mahmud A, Sack RB, Nair GB, Chakraborty J <i>et al.</i> Reduction of cholera in Bangladeshi villages by simple filtration. <i>Proceedings of the National Academy of Sciences of the United States of America</i> 2003, 100(3):1051-1055.</p> <p>Colwell RR. Global climate and infectious disease: the cholera paradigm. <i>Science</i> 1996, 274(5295):2025-2031.</p> <p>Constantin de Magny G, Murtugudde R, Sapiano MR, Nizam A, Brown CW, Busalacchi AJ, Yunus M, Nair GB, Gil AI, Lanata CF <i>et al.</i> From the Cover: Environmental signatures associated with cholera epidemics. <i>Proceedings of the National Academy of Sciences of the United States of America</i> 2008, 105(46):17676-17681.</p> <p>King AA, Ionides EL, Pascual M, Bouma MJ. Inapparent infections and cholera dynamics. <i>Nature</i> 2008, 454(7206):877-880.</p>
Duration	3 hours
Dates	Tuesday January 10 th 2017. 9 a.m.-12 a.m.
Training methods	Lecture Active participation of the students
Validation	None (at the end of the Module)

Session 4	Module 232 “Advanced Global Environmental Changes and Health”
Session Title	Adaptation of disease vectors to environmental changes in the Tropics
Speaker	Frédéric Simard, Team manager and researcher, Biology, ecology and genetics of mosquito populations, HDR Centre IRD, 911 avenue Agropolis, BP 64501, 34394 Montpellier, Cédex 5 didier.fontenille@ird.fr
Session outline	<ul style="list-style-type: none"> - Overview of the evolution of vectors (mainly mosquitoes) in response to global changes and environment heterogeneity - The importance of the vector population scale in the understanding of the distribution and dynamics of pathogen transmission
Learning Objectives	<ul style="list-style-type: none"> - Identify what is a vector? - Define Parameters involved in biology and distribution of major malaria and dengue/chikungunya vectors, in Europe and Africa - Recognize genetic factors of vectors (and viruses) involved in adaptation to environmental changes - Discuss climate and environment changes consequences on vector-borne disease transmission: is it possible to predict?
Reading	<p>Fontenille D, 2011. Le Chikungunya gagne la France. <i>La Recherche</i> déc 2011: 52-55.</p> <p>Simard F, Ayala D, Kamdem GC, Pombi M, Etouana J, Ose K, Fotsing JM, Fontenille D, Besansky NJ, Costantini C, 2009. Ecological niche partitioning between <i>Anopheles gambiae</i> molecular forms in Cameroon: the ecological side of speciation. <i>BMC Ecol.</i> 9: 17.</p> <p>Poncon N, Tran A, Toty C, Luty AJ, Fontenille D, 2008. A quantitative risk assessment approach for mosquito-borne diseases: malaria re-emergence in southern France. <i>Malaria J.</i> 7: 147.</p> <p>Ayala D, Fontaine MC, Cohuet A, Fontenille D, Vitalis R, Simard F, 2010. Chromosomal inversions, natural selection and adaptation in the malaria vector <i>Anopheles funestus</i>. <i>Mol. Biol. Evol.</i> 28: 745-758</p>
Duration	3 hours
Dates	Tuesday January 10 th 2017. 2 p.m.-5 p.m.
Training methods	Lecture Active participation of the students
Validation	None (at the end of the Module)

Session 5	Module 232 “Advanced Global Environmental Changes and Health”
Session Title	Agricultural practices and plant health: lessons from the past and strategies for the future
Speaker	Christian Lannou, INRA researcher, <i>PhD</i> Bioger (UR INRA 1290) INRA, BP01, 78850 Thiverval Grignon Christian.Lannou@grignon.inra.fr
Session outline	<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	Mundt, C.C. 2002. Use of multiline cultivars and cultivar mixtures for disease management. <i>Annual Review of Phytopathology</i> 40: 381-410. 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
Duration	3 hours
Dates	Wednesday January 11 th 2017. 9 a.m.-12 a.m.
Training methods	Lecture Active participation of the students
Validation	None (at the end of the Module)

Session 6	Module 232 “Advanced Global Environmental Changes and Health”
Session Title	Avian influenza A viruses: from wild bird to pandemic
Speaker	Michel Gauthier-Clerc, Senior Scientist, <i>PhD, DVM</i> Centre de recherche de la Tour du Valat Le Sambuc, 13200 Arles, France gauthier-clerc@tourduvalat.org
Session outline	<ul style="list-style-type: none"> - Wildlife and emerging Infectious diseases - Ecology of avian influenza and West Nile viruses in wildlife - Disease surveillance in wildlife - Population dynamics and wildlife monitoring
Learning Objectives	<ul style="list-style-type: none"> - Identify global changes, biodiversity crisis and emerging infectious diseases - Classify interfaces between wildlife, animal and public health - Determine the ecology of avian influenza and West Nile viruses in wild birds and the consequences for human health - Demonstrate the interest of disease surveillance in wildlife

Reading	Greger M. 2007. The Human/Animal Interface: Emergence and Resurgence of Zoonotic Infectious Diseases. <i>Critical Reviews in Microbiology</i> , 33:243-299. Duff JP, Holmes JP, Barlow AM. 2010. Surveillance turns to wildlife. <i>Veterinary Record</i> 167 (5) 154-156
Duration	3 hours
Dates	Wednesday January 11 th 2017. 2 p.m.-5 p.m.
Training methods	Lecture Active participation of the students
Validation	None (at the end of the Module)

Session 7	Module 232 “Advanced Global Environmental Changes and Health”
Session Title	Community Ecology of Disease
Speaker	Parviez Hosseini, EcoHealth Alliance Lead Research Scientist, Ph.D. EcoHealth Alliance 460 W 34 th St, NY, NY, USA 10001 hosseini@ecohealthalliance.org
Session outline	<ul style="list-style-type: none"> - Concept of Community in Ecology - Biodiversity of Parasites - Parasites: Consumers/Predators - Parasites: Invasive Species - How biodiversity affects parasite-host relations
Learning Objectives	<ul style="list-style-type: none"> - Identify parasites as members of ecological community - Clarify how parasites are part of that community - Define how changes in host community affect parasites - Discuss how changes parasite community affect hosts - Recognize utility of ecological approach to health issues
Reading	Keesing, F., Holt, R.D. & Ostfeld, R.S. Effects of species diversity on disease risk. <i>Ecol Lett</i> 9 , 485–498 (2006). Packer, C., Holt, R., Hudson, P., Lafferty, K. & Dobson, A. Keeping the herds healthy and alert: implications of predator control for infectious disease. <i>Ecol Lett</i> 6 , 797–802 (2003). Lafferty, Kevin D, Andrew P Dobson, and Armand M Kuris. 2006. “Parasites dominate food web links.” <i>Proceedings Of The National Academy Of Sciences Of The United States Of America</i> 103 (30) (July 25): 11211–11216. doi:10.1073/pnas.0604755103.
Duration	3 hours
Dates	Thursday January 12 th 2017. 09 a.m.-12 a.m.
Training methods	Lecture Active participation of the students
Validation	None (at the end of the Module)

Session 8	Module 232 “Advanced Global Environmental Changes and Health”
Session Title	Imperfect vaccines in a changing world, and their consequences for public health
Speaker	Sylvain Gandon, CNRS researcher, <i>PhD</i> CEFE, UMR 5175, 1919 route de Mende, 34293 Montpellier, Cedex 5 sylvain.gandon@cefe.cnrs.fr
Session outline	<ul style="list-style-type: none"> - A few examples: myxomatosis and smallpox - Epidemiological models: impact of vaccination - Evolutionary models: virulence evolution - The impact of vaccination on virulence evolution - Discussion on more complex cases
Learning Objectives	<ul style="list-style-type: none"> - Introduction to mathematical epidemiology (R_0, critical vaccination coverage) - Introduction to evolutionary epidemiology (virulence evolution) - Vaccination and its impact on epidemiology and evolution
Reading	Anderson, R. M.; May, R. M. (1991). <i>Infectious diseases of humans: dynamics and control</i> . Oxford and New York: Oxford University Press.
Duration	3 hours
Dates	Thursday January 12 th 2017. 2 p.m.-5 p.m
Training methods	Lecture Active participation of the students
Validation	None (at the end of the Module)

Session 9	Module 232 “Advanced Global Environmental Changes and Health”
Session Title	Poverty Trap Driven by Feedback Between Economics and Ecology of Infectious Diseases
Speaker	Calistus Ngonghala National Institute for Mathematical and Biological Synthesis Knoxville, Tennessee University, USA ngonghala@yahoo.com
	<ul style="list-style-type: none"> - Background on integrated economic and ecological models - Empirical support for the effect of health on economic productivity - Integrated theoretical models of disease ecology and economic growth - Integrated statistical models of disease ecology and economic growth - Analysis of deterministic poverty traps - Analysis of stochastic poverty traps - Additional ecological considerations
Learning Objectives	<ul style="list-style-type: none"> - Expose students to integrated economic and ecological models - Recognize evidence from a range of scales - Clarify background on model construction and analytical methods - Use statistical techniques - Achieve broad conceptual understanding of feedbacks between economics and disease ecology
Reading	Bloom, D E. and Canning, D. “The Health and Wealth of Nations” <i>Science</i> 287:1207-1209. Bonds, M.H., Keenan, D.C. Rohani, P. and J.D. Sachs, “Poverty traps formed by the ecology of infectious

	diseases", <i>Proceedings of the Royal Society, B</i> , 277: 1185-1192.
Duration	3 hours
Dates	Friday January 13 th 2017. 9 a.m.-12 a.m.
Training methods	Lecture Active participation of the students
Validation	None (at the end of the Module)

Session 10	Module 232 "Advanced Global Environmental Changes and Health"
Session Title	Ecological literacies in health practices. An introduction to Conservation Medicine
Speaker	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"> - A definition of what is conservation medicine - Study-cases of the relationships between human and animal health, and environmental conditions - An understanding of the ecological causes of changes in human and animal health; and of the consequences of diseases to populations and ecological communities. - Practical aspects of conservation medicine
Learning Objectives	<ul style="list-style-type: none"> - Develop general skills to a new emerging transdisciplinary field - Identify the likely consequences of increased contact between human and wildlife, domestic animals and human populations for emergence and spread of infectious diseases - Recognize paradigm shifts in both medicine and environmentalism - Appreciate the diagnostic and surveillance tools needed to move toward effective disease control among wild populations and ecosystems - Integrate new, collaborative ways to address ecological health concerns
Reading	Aguirre (Editor), A. Alonso, <i>et al.</i> <i>Conservation Medicine: Ecological Health in Practice</i> , Oxford University Press (Sep 2002) ISBN 0-19-515093-7. Stearns S.C. and Koella J.C. <i>Evolution in Health and Disease</i> . Oxford University Press (Jan 2008) ISBN 0199207461
Duration	3 hours
Dates	Friday January 13 th 2017. 2 p.m.-5 p.m.
Training methods	Lecture Interactive case studies Active participation of the students
Validation	A 3-hours examination based on scientific questions within the field and a critical review of a recent scientific article (at the end of the Module)