HPSC0163 – Warnings for Hazards and Threats

Course Syllabus

2024-25 session |Prof Carina Fearnley|c.fearnley@ucl.ac.uk
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This module presents an exciting opportunity to be taught by experts in both the Department of Science and Technology Studies, and the Department of Risk and Disaster Reduction, and engage with the work of the UCL Warning Research Centre, the world's only academic Centre dedicated to the study of warnings for both natural hazards and human made threats.

In our 'Risk Society' there are a number of natural and human-made threats, that often occur as multi-hazard or cascading events. Given the complex and multiple disciplines, actors, and institutions involved in these events, warnings require an inter / trans disciplinary approach to ensure silos are broken down, and that research is orientated towards real-world problems, and finding sustainable solutions, when having to manage conflicting hazard / threat requirements.

This module brings together both academic and practitioner knowledge around what warnings are, how they are designed, how they operate, and how to make warnings effective. This requires bringing a wide range of disciplines together that review disaster risk reduction for all natural hazards and human made threats, science communication, science policy, and understanding risk and uncertainty at scales from the local to the global. Whether warnings are technological, automated, community based, anticipatory, or responsive, this module explores the value of the people-centered warnings, and the need to create inclusive and multi-hazard warnings. Whilst the module explores several old and contemporary case studies, the core focus of the module is on a simulation exercise that evolves during the module providing an opportunity to put into practice the learnings from each week.

Basic course information

Moodle Web site:	https://moodle.ucl.ac.uk/course/view.php?id=43074.
Assessment:	Report: Design Proposal Report for a Warning System - 40% Oral Presentation and discussion - 40% Submission of Warning Policy Note - 40%
Timetable:	Wednesdays 11:00 – 13:00
Prerequisites:	No prerequisites
Required texts:	See reading list below and the online reading list.
Course tutor(s):	Course convenor: Prof Carina Fearnley and Dr Shipra Jain
Contact:	c.fearnley@ucl.ac.uk and shipra.jain@ucl.ac.uk
Web:	http://www.ucl.ac.uk/sts/staff/fearnley
Office location:	22 Gordon Square, Room 1.2a Room 27, South Wing, UCL Main Building (Shipra),
Fearnley office hours:	Please email to arrange a time in person or online Shipra' Office hours: Monday 2-3 PM (walk-in, no appointment needed), for any other time, please email to arrange a time in person or online.
Teaching Assistant	N/A

AI Tools: Category 2: AI tools can be used in an assistive role See details at:
https://www.ucl.ac.uk/teaching-learning/generative-ai-hub/using-ai-tools-assessment

Schedule

UCL Week	Lecture / Seminar	Lecture Date	Lecture Topic	Activity / Guest Lecturer / Theme
6	1	2 Oct 2024	Introduction to Warnings for Hazards and Threats (CF)	Outlining the assessment for the module
7	2	9 Oct 2024	Water where it is not wanted (SJ)	Guest lecture by Fatemeh Jalayer on Tsunami Warning Systems
8	3	16 Oct 2024	Shake, rattle, and roll: The Tōhoku Earthquake and Tsunami (CF)	Simulation exercise on rapid cascading events
9	4	23 Oct 2024	Chernobyl – the major series: Nuclear Meltdowns: (CF)	Performing warnings
10	5	30 Oct 2024	Bake Alert: The Science of Heatwave Warnings (SJ)	Current Operational Heatwave Warning Systems
Reading Week				
12	6	13 Nov 2024	Assessment: Oral Presentations on key policy solutions (CF&SJ)	
13	7	20 Nov 2024	Ready-Set-Go: El Nino and La Nina Warnings (SJ)	Classroom activity on Interpreting real-time El Nino/La Nina warnings from different countries/centres
14	8	27 Nov 2024	Isolation: The global pandemic COVID-19 (CF)	Mock One Pandemic Treaty
Submission of Proposal Report for a Warning System 1/12/2024				
15	9	04 Dec 2024	Innovating Warning Systems: Community engagement and technological advances (SJ)	Seminar on 'AI for warnings and Predictions' by Dr. Saman Ghaffarian
16	10	11 Dec 2024	Don't Look Up: Existential risks from volcanoes and space (CF)	Long term warnings – using the proxy
Submission of Warning Policy Note 13/12/2024				

CF – Carina Fearnley, SJ – Shipra Jain

Assessments

%	Description	Deadline	Word limit
40	Oral Presentation and discussion: Reflection on the Exercise and learnings	13/11/2024	Assessed in class – (lecture 6) ~ 5 minutes
40	Report: Design Proposal Report for a Warning System (gaps and how to address them)	1/12/2024	2,000 words
20	Submission of Warning Policy Note – recommendations based on learnings	13/12/2024	1,000 words

Coursework

Assessment 1: Oral Presentation and discussion (40%)
An oral presentation made by each student will provide reflections on the module and learnings and how this can inform the development of UK MHEWS.

Assignment 2: Report (40%)
The report will be a Design Proposal Report for a Warning System (gaps and how to address them) that provides detailed insights into how to design and operate a MHEWS effectively.

Assessment 3: Policy Note (20%).
Develop a brief UN policy note regarding MHEWS that is two pages long.

Criteria for assessment
The departmental marking guidelines for individual items of assessment can be found in the STS Student Handbook. Individual marking criteria for each assessment will be made available on Moodle.

The Case Study

During 2024-25 the module case study will be on designing a multi-hazard early warning system (MHEWS) for the UK. The case study evolves during the module via a simulation, providing an opportunity to put into practice the learnings from each week. It will be based around the UN-led 'Early Warning for All' initiative, that is this case study will be to propose to the UK Government how to develop a MHEWS in the UK. We will also examine existing MHEWS in El Salvador and Iceland via guest lectures. Further materials will be placed on Moodle and can be read here: https://www.undrr.org/words-into-action/guide-multi-hazard-early-warning/map.

Aims & Objectives

Aims

This course brings together key thinkers, debates, and cutting-edge research on how society has, currently, and may engage with warnings and alerts for natural hazards and human-made threats
The course investigates the key issues in relation to warning governance, how to build a warning system, how to create effective warning and alert systems, and how to design and evaluate warning systems from the local to global scale.

In addition, several relevant practical approaches and methodologies will be applied via case studies, and a dedicated simulation exercise that runs throughout the module used to demonstrate the challenges faced in developing and using warnings to manage large global complex problems.

Vital contextual information covering disaster management, humanitarian operations, working in different regions globally, and strategies for crisis management and response will be considered to help integrate warnings practices.

A wide range of case studies will be integrated from a number of global contexts.

Learning Outcomes

On completion of this course, students should be able to:

1. Describe and critically assess **key theories and frameworks** on warning and alert systems.
2. Summarise the **key issues and debates in warnings** for a wide range of stakeholders on different levels of scale.
3. **Design** warning systems fit for purpose
4. Experience and evaluate the key aspects that make an early warning system effective via the **simulation exercise**

Synthesise and **communicate possible solutions** using the simulation exercise presentations and reports providing valuable transferable skills, and evaluation of warnings

Reading List

Core readings:

There are no specific key textbooks on the topic, however the best core textbooks are:

Smith, K., Fearnley, C.J., Dixon, D. P., Bird, D. K., Kelman, I. (2024). *Environmental hazards: assessing risk and reducing disaster*. 7th Edition, Routledge.

Golding, B. (2022). *Towards the "Perfect" weather warning: bridging disciplinary gaps through partnership and communication* (p. 270). Springer Nature. https://link.springer.com/book/10.1007/978-3-030-98989-7

Other Key texts:

Glantz, M. H. (2007). *Heads Up! Early Warning Systems for Climate, Water and Weather.* https://unu.edu/publications/books/heads-up-early-warning-systems-for-climate-water-and-weather-related-hazards.html#overview

Golnaraghi, M. (Ed.). (2012). *Institutional partnerships in multi-hazard early warning systems: a compilation of seven national good practices and guiding principles*. Springer Science & Business Media. https://link.springer.com/book/10.1007/978-3-642-25373-7

Zschau, J., & Küppers, A. N. (Eds.). (2013). *Early warning systems for natural disaster reduction*. Springer Science & Business Media. https://www.springer.com/gp/book/9783642632341?utm_campaign=3_pier05_buy_print&utm_content=en_08082017&utm_medium=referral&utm_source=google_books#otherversion=9783642559037

More hazard specific texts:

Alexander, D., 2000. Confronting catastrophe: new perspectives on natural disasters. Harpenden.

Amaratunga, D., Haigh, R., & Dias, N. (Eds.). (2021). *Multi-Hazard early warning and disaster risks*. Springer. https://link.springer.com/book/10.1007/978-3-030-73003-1

Brown, M. E. (2008). *Famine early warning systems and remote sensing data.* Springer Science & Business Media. https://link.springer.com/book/10.1007%2F978-3-540-75369-8

De Franco, C., & Meyer, C. (Eds.). (2011). *Forecasting, warning and responding to transnational risks*. Springer. https://link.springer.com/book/10.1057/9780230316911

Fearnley, C.J., Bird, D.K., Haynes, K., McGuire, W., Jolly, G. (Eds.), (2017). *Observing the Volcano World: Volcano Crisis Communication. Springer* - available for free to download as an ebook or separate chapters: https://www.springer.com/gp/book/9783319440958

Funk, C., & Shukla, S. (2020). *Drought Early Warning and Forecasting: Theory and Practice.* Elsevier. https://www.elsevier.com/books/drought-early-warning-and-forecasting/funk/978-0-12-814011-6

Kelman, I., Mercer, J., & Gaillard, J. C. (Eds.). (2017). *The Routledge handbook of disaster risk reduction including climate change adaptation*. London: Routledge.

Lampe, H., Herschinger, E., Nitzl, C., & Willems, J. (2024). Predicting Novel Terrorism: Media Coverage as Early-Warning System of Novelty in Terror Attacks. *Terrorism and Political Violence*, 1-22. https://www.tandfonline.com/doi/full/10.1080/09546553.2024.2345729

Lopez-Carrei, A., Fordham, M., Wisner, B., Kelman, I., and Gaillard, J.C. 2014. Disaster management: international lessons in risk reduction, response and recovery. Routledge 352pp

McDowall, J. (2023). *Attack Warning Red!: How Britain Prepared for Nuclear War*. Random House.

Musavi, S. H. A. (2019). *Early Warning-Based Multihazard and Disaster Management Systems*. CRC Press. https://www.routledge.com/Early-Warning-Based-Multihazard-and-Disaster-Management-Systems/Musavi/p/book/9781032653617

Paul, B. K. Environmental hazards and disasters : contexts, perspectives and management. Wiley-Blackwell 323pp.

Rothery, D. A., 2010, Volcanoes, earthquakes and tsunamis, Teach Yourself, 304pp.

Sene, K. (2008). *Flood warning, forecasting and emergency response*. Springer Science & Business Media. https://link.springer.com/book/10.1007/978-3-540-77853-0

van Leeuwen, C. J., & Vermeire, T. (Eds.). (2007). *Risk assessment of chemicals: an introduction* (Vol. 94). Dordrecht: Springer.

Wenzel, F., & Zschau, J. (Eds.). (2010). *Early Warning for Geological Disasters*. Springer. https://link.springer.com/book/10.1007/978-3-642-12233-0

Wisner, B., Blaikie, P., Cannon, T., Davis, I., 2004. At Risk: Natural Hazards, People's vulnerability and Disasters. 2nd Ed. New York, Routledge. *Wisner, B; Gaillard, J.C; Kelman, I., 2012. The Routledge handbook of hazards and disaster risk reduction. Routledge 875pp.

Zommers, Z., & Singh, A. (Eds.). (2014). *Reducing disaster: Early warning systems for climate change* (p. 9789401785983). Berlin: Springer Science+ Business Media. https://link.springer.com/book/10.1007/978-94-017-8598-3

Essential and other readings:

All essential readings will be listed on and available via Moodle, unless specified. Further details on readings for the module and assessments will be posted on Moodle.

You are encouraged to start your own research to find readings and sources that relate to the module materials, and to take a general interest in key public engagement debates, controversies, and breakthroughs throughout the module.

Key Reports:

Collins, A., Maunder, N., McNabb, M., Moorhead, A., & van Aalst, M. (2009). World Disasters Report 2009-Focus on early warning, early action: https://www.ifrc.org/en/publications-and-reports/world-disasters-report/wdr2009/
https://www.undrr.org/publication/global-status-multi-hazard-early- warning-systems-2023

UNDRR (2006) International Strategy for Disaster Reduction Platform for the Promotion of Early Warning: https://www.unisdr.org/2006/ppew/

UNDRR (2006). Global survey of early warning systems https://www.undrr.org/publication/global-survey-early-warning-systems

UNDRR and WMO (2022) Global status of multi-hazard early warning systems: Target G. https://www.undrr.org/publication/global-status-multi-hazard-early-warning-systems-target-g

United Nations Office for Disaster Risk Reduction and World Meteorological Organization (2023). *Global Status of Multi-Hazard Early Warning Systems.* Geneva, Switzerland. https://www.undrr.org/media/91954/download?startDownload=true

WMO, W. (2018). Multi-hazard early warning systems: a checklist. In *Outcome of the first Multi-hazard Early Warning Conference* (Vol. 22). https://library.wmo.int/records/item/55893-multi-hazard-early-warning-systems-a-checklist?offset=

Key Online Journals:

The International Journal of Disaster Risk Reduction (IJDRR) - https://www.sciencedirect.com/journal/international-journal-of-disaster-risk-reduction
Disaster Prevention and Management - https://www.emerald.com/insight/publication/issn/0965-3562
Disasters: https://onlinelibrary.wiley.com/journal/14677717
Progress in Disaster Science - https://www.sciencedirect.com/journal/progress-in-disaster-science
Environmental hazards: http://www.tandfonline.com/loi/tenh20
Environmental Science & Policy: https://www.journals.elsevier.com/environmental-science-and-policy/

Outline of lectures:

This section provides additional details of the materials addressed each week.

1. Introduction to Warnings for Hazards and Threats (CF)

People commonly visualize a Warning System as a fire alarm, a siren, or colour code, however, warning systems are much more complex. This lecture introduces warnings and alerts by addressing what they are, how they are defined, and the variations of them both in terms of different hazards and threats, functions and purposes, geographies, people, and organisations, and the role they play in society. This lecture will also provide an overview of the module and assessments.

During the seminar the case study for the module will be introduced and discussed, and some background context in relation to the study will be outlined, alongside an introductory activity.

STS / RDR Core theories: Warnings, science, and society, Post-Normal Science

2. Water where it is not wanted (SJ)

This lecture focuses on operational and real-time flood warning systems, covering essential components of the warning value chain such as data, observations, and models. It outlines the structure of flood warning systems and introduces the UNDRR multi-hazard early warning framework. Key flood-causing factors and monitored variables for issuing flood warnings are discussed. Two case studies are featured: the Cyclone Amphan and Bangladesh Flooding of 2020, and the operational flood warning system used in the UK by the Met Office, highlighting diverse approaches to flood warnings and management.
The guest lecture is provided by Prof Fatemeh Jalayer who will provide invaluable insights into tsunami warning systems. Prof Jalayer is leading a new multi-million pound project looking at tsunami warnings in India.

STS / DRR Core theories: Component of the warning systems, Sendai Framework and warning value chain

3. Shake, Rattle, and Roll: The Tōhoku Earthquake and Tsunami (CF)

This lecture will run as a Simulation exercise on The Tōhoku Earthquake and Tsunami in Japan during 2011. Focusing on the role of cascading hazards, the learning materials will examine the role of science in warning systems, developing coherent disaster mitigation strategies and systems, and the role of the scales within warning systems, from local national levels to international levels, and learning from ancestors and traditional knowledge.

STS / DRR Core theories: Managing risk, uncertainty, limitations of scientific knowledge, cascading risks, MHEWS, the role of traditional knowledge / alternative knowledges, co-production, community engagement, and citizen science

4. Chernobyl – the major series: Nuclear Meltdowns (CF)

This lecture explores warnings used for human-made threats using Chernobyl as a case study. This lecture explores the roles of safety laws in chemical and nuclear hazards, warnings during a time of war and conflict

and the compounding effects on warnings, and longer-term existential warnings around the devastation of the environment through significant human activity, and how this affects the perception of the threat.

The practical will involve exploring elements of performing warnings in its many forms and explores the role of the arts and role play in understanding the complexity and dynamics of warnings.

STS / DRR Core theories: Art/Science projects, safety and operational guidance, terrorism and conflict warnings, threats

5. Bake Alert: The Science of Heatwave Warnings (SJ)

This lecture covers the fundamentals of heatwave warning systems, beginning with various definitions of heatwaves, causes of heatwaves, the prediction of heatwaves, and their impacts – all of which play a key role in developing a heatwave warning system. The lecture examines the data and indicators needed for issuing warnings, emphasizing the diversity of real-time heatwave warning systems used by National Meteorological Services. The lecture highlights examples from Singapore, the Philippines, and the UK, showcasing diverse heatwave warning systems used in tropical to extra-tropical environments. Additionally, the lecture touches on the effects of climate change, looking at historical and future trends in heatwaves across globe, and underscores the growing importance and demand of heatwave warning systems.

The practical will involve an activity where we will explore the pros and cons of naming or ranking heat waves.

STS / DRR Core theories: Real-time operational forecasting, Tailored Warning Systems, Communication of Warnings

6. Assessment: Oral Presentations on key policy solutions (CF&SJ)

In this session Assessment 1 will take place. This is an opportunity to learn from one another.

7. Ready-Set-Go: El Nino and La Nina Warnings (SJ)

This lecture provides a comprehensive overview of ENSO, more popularly known as El Nino and La Nina Warnings, diving into the science behind El Niño and La Niña events and their global climate impacts. The lecture discusses similarities and differences in the monitoring criterion used for issuing warnings on El Nina and La Nina, across multiple countries. Multiple ENSO warning systems that are currently being used will be introduced.

During the practical, we will play a game where the participants will role-play as forecasters and issue El Nino and La Nina warnings on the scientific information available through monitoring and observational network.

STS / DRR Core theories: Early Warnings, El Nino and La Nina, Forecasting and Prediction

8. Isolation: The global pandemic COVID-19 (CF)

In this lecture we explore the impact of COVID-19 on the world. This enables a multi hazard perspective across a wide range of economic and social contexts to explore how effective alerts and warnings for the pandemic were. Following the pandemic there has been significant effort placed to generate a Pandemic Treaty for the world, that to date has failed. This includes looking at the role of technology (cell broadcasting and social media, and GIS), the need to talk effectively (community based and driven warnings) and looking forward in time (more extreme climatic hazard events, more displaced populations).

In this lecture, we will run a mock pandemic treaty to explore the challenges in governing warning systems from local to global scales, the role of policy, and the communication of information.

STS / DRR Core theories: Policy development, civil democracy and knowledge, role of technology, standardisation.

9. Innovating Warning Systems: Community engagement and technological advances (SJ)

This lecture focuses on recent advancements in early warning systems and highlights the integration of technology with community-centered approaches. It explores emerging tools like drones and AI, which are transforming the way warnings are researched and implemented. Through multiple case studies, the lecture demonstrates the importance of engaging communities in the development of these systems, emphasizing that both community-driven solutions and technological innovations are crucial for improving the effectiveness of early warnings for natural disasters and other hazards.

There will also be a seminar on by Dr. Saman Ghaffarian who will provide a brief overview of potential applications of 'AI for Warnings and Prediction'

STS / DRR Core theories: community-engagement, co-design and co-development, technological advances, Artificial Intelligence, and Machine Learning

10. I Don't Look Up: Existential risks from volcanoes and space

This lecture explores the role of communication, misinformation, and trust in warnings with reference to the Netflix film 'Don't Look Up'. This encompasses existential risks and how these are factored into long term warnings, using volcanic eruptions and asteroids as an example.

STS / DRR Core theories: Uncertainty and risk communication, science communication and trust, and AI.

Important policy information

Details of college and departmental policies relating to modules and assessments can be found in the STS Student Handbook www.ucl.ac.uk/sts/handbook

All students taking modules in the STS department are expected to read these policies.