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| **114(1)/2025 Fall Semester TIGP-ESS課程資料表****114(1)/2025 Fall Semester TIGP-ESS course information form** |
| 科目名稱(中文) | 空氣污染模式實作 |
| Course Title (English) | Practical Air Pollution Modeling |
| 授課時間Time | Mon, 2:00-4:00 pm |
| 授課地點Location | 3030 |
| 學分數Course Credits | 2 |
| 主要授課老師Main Instructors | 蔡宜君 I-Chun Tsai、陳正平Jen-Ping Chen |
| 聯絡郵件E-mail | ictsai@gate.sinica.edu.tw |
| 辦公時間Office Hours |  |
| 課程目標Course Objectives | * 理解不同複雜程度空氣污染模式的原理、架構及其適用情境
* 累積模式模擬與結果分析的實務經驗
* Understand the principles, structures, and suitable applications of air pollution models with different levels of complexity.
* Build practical experience in model simulation and analysis of results.
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| 授課內容Course Description | 本課程介紹不同複雜程度之空氣污染模式，並強調其實務操作與應用。實作部分將透過三種具代表性的空氣污染模式進行教學，學習模式設定流程以及模式結果在空氣污染議題中的基本應用與分析技巧。This course introduces air pollution models of varying complexity, with an emphasis on practical implementation and real-world applications. Through hands-on exercises with three representative models, students will learn how to set up simulations and apply basic techniques to analyze model results in the context of air pollution issues. |
| 教科書/參考書Textbooks/References | 1. Atmospheric Pollution, by Mark Z. Jacobson, Cambridge University Press (TD883 J37 2002)
2. Ministry of Environment's Air Quality Modeling Support Center Website：https://aqmc.epa.gov.tw/
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| 自編教材比例Self-compiled Textbook/References Proportion(if any) |  需具備使用Linux系統能力，並修習過空氣污染課程Basic proficiency in using the Linux operating system and prior completion of an air pollution-related course are required. |
| 授課方式Course Requirements | █講授(Lecture)；□研討(Seminar)；█實習/實驗(Internship/Experiment)；□個別指導(Individual Discussion)；□其他(Other) |
| 評量配分比重Course Grade | 平時成績10%，模式實作作業60%，期末報告30%Participation/Attendance: 10%,Modeling Assignments: 60%,Final Report: 30% |
| 對應之永續發展目標(SDGs)(請選擇至多3項與教學內容相關的項目) Corresponding Sustainable Development Goals (SDGs) (Please choose up to 3 items related to the teaching content) | □SDG1消除貧窮No Poverty□SDG2消除飢餓Zero Hunger□SDG3健康與福祉Good Health and Well-being□SDG4優質教育Quality Education□SDG5性別平等Gender Equality□SDG6潔淨飲水與衛生Clean Water and Sanitation█SDG7永續能源Affordable and Clean Energy□SDG8就業與經濟成長Decent Work and Economic Growth□ SDG9產業永續創新Industry, Innovation, and Infrastructure□SDG10減少不平等Reduced Inequality□ SDG11永續城市與社區Sustainable Cities and Communities□SDG12永續消費及生產Responsible Consumption and Production█SDG13氣候行動Climate Action□SDG14水生生態Life Below Water□SDG15陸地生態Life on Land□SDG16和平與正義制度Peace, Justice, and Strong Institutions□SDG17全球夥伴Partnerships for the Goals |
| 課程類別Course Category | □ STEAM□人文關懷Humanities and Social Sciences□跨域課程Interdisciplinary Courses□問題導向Problem-Based Learning□總整課程Integrated Curriculum□媒體識讀Media Literacy□創新課程Innovative Curriculum□自主學習課程Self-Directed Learning█無None |
| 課程領域Areas | □基礎學科(共同)(Basic subjects (common)) □固態地球科學(Solid earth sciences) □水圈科學(Aquatic sciences) □應用語言(Applied Languages) █大氣科學(Atmospheric sciences) |
| 產業領域Areas | □地探科技(Geological monitoring technology) █氣象科技(meteorological science and technology) □太空科技(Space Technology) □環保科技(environmental protection science and technology) □資訊科技(Informational Technology) □教學研究(Teaching & research) □地質科技(Geosciences and technology) |

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| 課程進度與內容Lecture outline and content |
| 週次week | 日期Date | 主題Topic | 授課教師/指定閱讀或作業Instructor/Readings or assignments |
| **1** | 9/1 | Introduction | I-Chun Tsai / Jen-Ping Chen |
| **2** | 9/8 | Introduction to Various Air Pollution Models | I-Chun Tsai / Jen-Ping Chen |
| **3** | 9/15 | Air Pollution Model Operation 1--CALPUFF | I-Chun Tsai / Jen-Ping Chen |
| **4** | 9/22 | Air Pollution Model Operation 1--CALPUFF | I-Chun Tsai / Jen-Ping Chen |
| **5** | 9/29 | Air Pollution Model Operation 1--CALPUFF | I-Chun Tsai / Jen-Ping Chen |
| **6** | 10/6 | Air Pollution Model Operation 1--CALPUFF | I-Chun Tsai / Jen-Ping Chen |
| **7** | 10/13 | Air Pollution Model Operation 2-GRAL | I-Chun Tsai / Jen-Ping Chen |
| **8** | 10/20 | Air Pollution Model Operation 2-GRAL | I-Chun Tsai / Jen-Ping Chen |
| **9** | 10/27 | Air Pollution Model Operation 2-GRAL | I-Chun Tsai / Jen-Ping Chen |
| **10** | 11/3 | Air Pollution Model Operation 2-GRAL | I-Chun Tsai / Jen-Ping Chen |
| **11** | 11/10 | Air Pollution Model Operation 3-CMAQ | I-Chun Tsai / Jen-Ping Chen |
| **12** | 11/17 | Air Pollution Model Operation 3-CMAQ | I-Chun Tsai / Jen-Ping Chen |
| **13** | 11/24 | Air Pollution Model Operation 3-CMAQ | I-Chun Tsai / Jen-Ping Chen |
| **14** | 12/1 | Air Pollution Model Operation 3-CMAQ | I-Chun Tsai / Jen-Ping Chen |
| **15** | 12/8 | Air Pollution Model Operation 3-CMAQ | I-Chun Tsai / Jen-Ping Chen |
| **16** | 12/15 | Final Report | I-Chun Tsai / Jen-Ping Chen |
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| 課程所屬學制(Educational System): 博士班(Doctoral Program) |

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| 核心能力I: 請點選本課程培養學生具備核心能力之強度指數，並填寫對應之評量方式Please select core abilities and its corresponding assessments of this course |
| 請勾選學程所訂之核心能力(可複選)█獨立思考與研究能力Independent thinking and research capacity□進階數理及專業知識能力Advanced mathematical and professional knowledge and ability█觀測模擬及分析推理能力Observation simulation and analysis of reasoning ability█電腦及程式語言運用能力Computer and programming language proficiency□國際視野與語文溝通能力International perspective and language communication skills□專業倫理及服務學習能力Professional ethics and service-learning ability |
| 核心能力II: 請點選本課程培養學生具備核心能力之強度指數，並填寫對應之評量方式Please select the core abilities and its corresponding assessments of this course |
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| 強度指數Overall ratingof Core Abilities | 1非常低Very Low | 2低Low | 3普通Medium | 4高High | 5非常高Very High | 評量方式Corresponding Assessments |
| 獨立思考與研究能力Independent thinking and research capacity | □ | □ | □ | █ | □ | □紙筆測驗/會考(Test/Exam) █作業練習(Assignments) █口頭報告/口試(Presentation/Oral Exam) □專題研究報告(書面)(Research Report(printed on paper)) █實作/實驗(Practices/Experiments) □出席/課堂表現(Attendance/Performance) □學習檔案評量(Portfolios Assessment) □█自我評量/同儕互評(Self-Assessment/ Peer Assessment) □作品/創作展演(Products/Creative Performance) □其他(Others)  |
| 進階數理及專業知識能力Advanced mathematical and professional knowledge and ability | □ | □ | □ | □ | □ | □紙筆測驗/會考(Test/Exam) □作業練習(Assignments) □口頭報告/口試(Presentation/Oral Exam) □專題研究報告(書面)(Research Report(printed on paper)) □實作/實驗(Practices/Experiments) □出席/課堂表現(Attendance/Performance) □學習檔案評量(Portfolios Assessment) □自我評量/同儕互評(Self-Assessment/ Peer Assessment) □作品/創作展演(Products/Creative Performance) □其他(Others)  |
| 觀測模擬及分析推理能力Observation simulation and analysis of reasoning ability | □ | □ | □ | □ | █ | □紙筆測驗/會考(Test/Exam) █作業練習(Assignments) █口頭報告/口試(Presentation/Oral Exam) □專題研究報告(書面)(Research Report(printed on paper)) █實作/實驗(Practices/Experiments) □出席/課堂表現(Attendance/Performance) □學習檔案評量(Portfolios Assessment) █自我評量/同儕互評(Self-Assessment/ Peer Assessment) □作品/創作展演(Products/Creative Performance) □其他(Others)  |
| 電腦及程式語言運用能力Computer and programming language proficiency | □ | □ | □ | █ | □ | □紙筆測驗/會考(Test/Exam) █作業練習(Assignments) □口頭報告/口試(Presentation/Oral Exam) □專題研究報告(書面)(Research Report(printed on paper)) █實作/實驗(Practices/Experiments) □出席/課堂表現(Attendance/Performance) □學習檔案評量(Portfolios Assessment) □自我評量/同儕互評(Self-Assessment/ Peer Assessment) □作品/創作展演(Products/Creative Performance) □其他(Others)  |
| 國際視野與語文溝通能力International perspective and language communication skills | □ | □ | □ | □ | □ | □紙筆測驗/會考(Test/Exam) □作業練習(Assignments) □口頭報告/口試(Presentation/Oral Exam) □專題研究報告(書面)(Research Report(printed on paper)) □實作/實驗(Practices/Experiments) □出席/課堂表現(Attendance/Performance) □學習檔案評量(Portfolios Assessment) □自我評量/同儕互評(Self-Assessment/ Peer Assessment) □作品/創作展演(Products/Creative Performance) □其他(Others)  |
| 專業倫理及服務學習之能力Professional ethics and service-learning ability | □ | □ | □ | □ | □ | □紙筆測驗/會考(Test/Exam) □作業練習(Assignments) □口頭報告/口試(Presentation/Oral Exam) □專題研究報告(書面)(Research Report(printed on paper)) □實作/實驗(Practices/Experiments) □出席/課堂表現(Attendance/Performance) □學習檔案評量(Portfolios Assessment) □自我評量/同儕互評(Self-Assessment/ Peer Assessment) □作品/創作展演(Products/Creative Performance) □其他(Others)  |

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