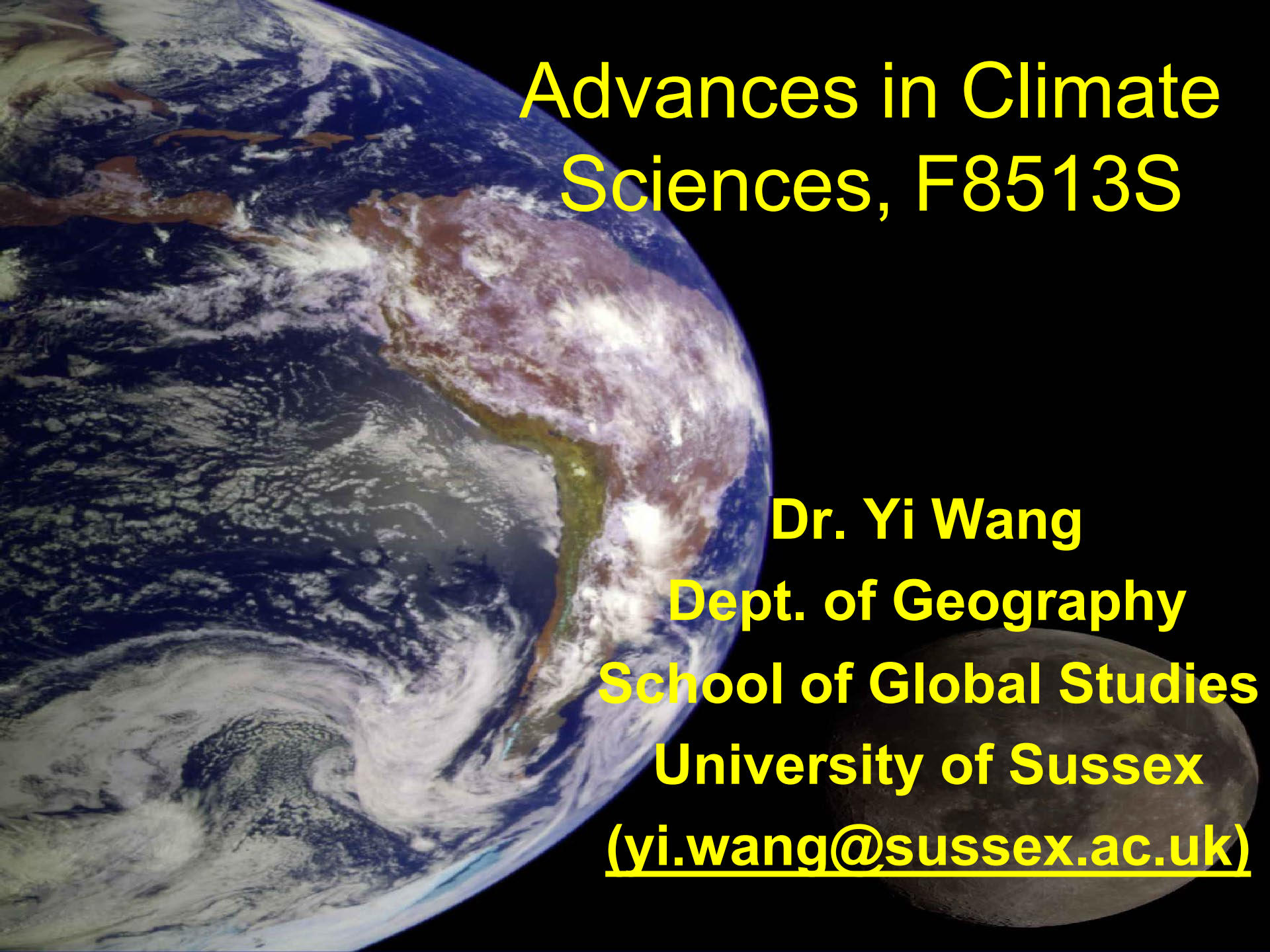

Advances in Climate Sciences, F8513S

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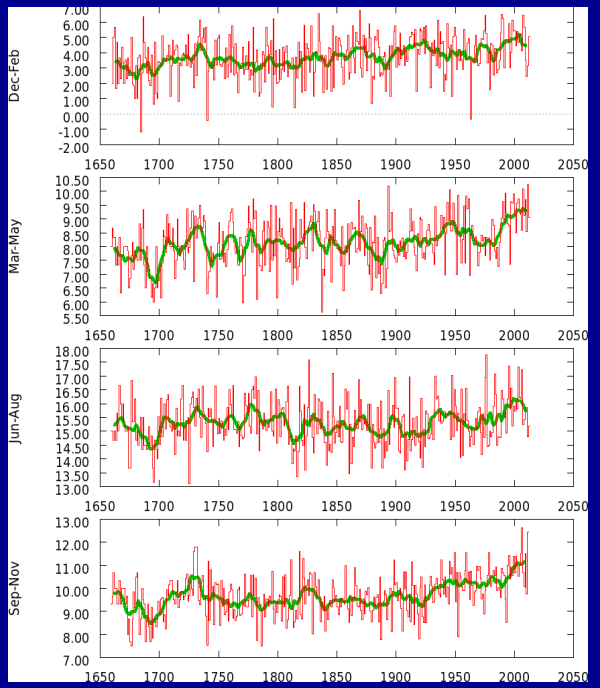
Two Aspects of The Module

1. Climate variability at a wide range of timescales
   - El Nino and Southern Oscillation (ENSO), Pacific Decadal Oscillation (PDO), North Atlantic Oscillation (NAO), Madden-Julian Oscillation (MJO), Arctic Oscillation (AO)……
   - Major uncertainties in climate sciences, such as Earth system sciences, global climate models, IPCC climate projections……

Two Aspects of The Module

2. Quantitative climate analyses
   - Understanding climate data formats (e.g., ascii or binary)
   - Understanding climate data sources (observations or models)
   - KNMI Climate Explorer
   - NOAA Climate Composite Tool
   - Statistics in climate sciences

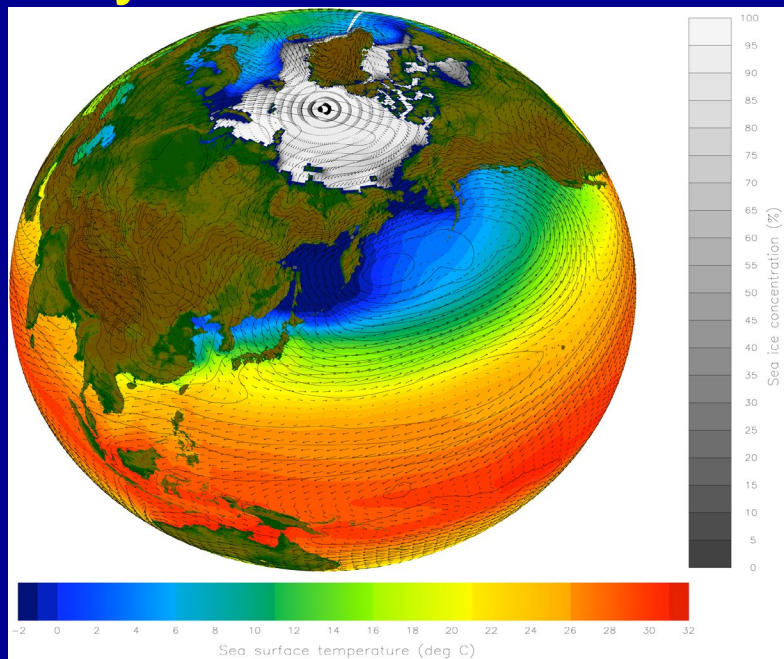


Module Programme: Lectures

- Lecture 1: Introduction to climate sciences
- Lecture 2: ENSO climate variability One
- Lecture 3: ENSO climate variability Two
- Lecture 4: ENSO climate variability Three
- Lecture 5: Climate statistics review and research topics
- Lecture 6: Climate variability at shorter timescales
- Lecture 7: Climate variability at longer timescales

Module Programme: Lectures

- Lecture 8: Earth system and climate models one
- Lecture 9: Earth system and climate models two
- Lecture 10: IPCC climate projections
- Lecture 11: End-of-term summary and report writing



Module Programme: Labs

- Lab 1: Introduction to lab sessions
- Lab 2: KNMI climate analysis one
- Lab 3: KNMI climate analysis two
- Lab 4: NOAA composite tool
- Lab 5: IPCC climate model analyses one
- Lab 6: IPCC climate model analyses two
- Lab 7: Assessment Oral Presentation
- Lab 8: Assessment Oral Presentation

Module Programme: Labs

- Lab 9: Research project one
- Lab 10: Research project two
- Lab 11: Research project three

Two Assessments

1. **An outline of research project: 10-minute presentation at our lab session.**
2. **Climate analysis report (4000-word) due during the mid-year assessment period (AB2) to Canvas (e-submission).**

Module Outline

- Teaching staff: Dr. Yi Wang (convenor)
- One lecture per week (1H).
- One lab session per week (2H).
- I may offer one additional lab session in the term using Zoom.
- Attendance is compulsory for both lecture and lab sessions.

Two Main Research Topics

1. ENSO and Climate Changes:
   a. ENSO and its correlations with rainfall (Asian, Australian, or African monsoons).
   b. ENSO and its correlations with temperature changes (in South Africa).
   c. ENSO and its correlations with Arctic sea ice
   d. ENSO and its correlations with NAO or AMO index
2. IPCC Climate Projections:
   a. What is projected rainfall change over the Sahel/Sahara boundary?
   b. What is projected change of snow season over Canada?

Module Recommended Textbooks

- IPCC AR5 Working Group I Report (downloaded free online @ IPCC website)
- IPCC AR6 Working Group I Report (also free@IPCC website)
- Climate Change and Climate Modelling, David Neelin, Cambridge University Press (2011)
- The Global Climate System, edited by Howard Bridgman and John Oliver, Cambridge University Press (2006)
- Climate Change: A Multidisciplinary Approach, William Burroughs, Cambridge University Press (2010)

Module Learning Outcomes

- Demonstrate some fundamental knowledge on the climate system and its variability over a wide range of timescales (e.g., ENSO, PDO, NAO).
- Understand the cause of climate change and variability (e.g., NAO).
- Understand the key elements of climate models and their predictions.
- Understand the wide spread of climate projections from IPCC Assessment Reports.

Module Learning Outcomes

- Summarise key debates and uncertainties in the climate change (e.g., ENSO, IPCC models)
- Identify research topics and help you develop independent research questions on the climate sciences under two main streams (see above).
- Understand the fundamental approaches used in climate analyses and evaluations (e.g., statistics).