

科目ナンバリング		U-LAS15 10019 LE58										
授業科目名 <英訳>		Rainfall in a Changing Climate-E2 Rainfall in a Changing Climate-E2 :Observations and Predictions					担当者所属 職名・氏名		理学研究科 特別招へい教授 Kummerow, Christian			
群	自然科学科目群				分野(分類)	地球科学(基礎)			使用言語	英語		
旧群	B群	単位数	2単位	時間数	30時間	授業形態	講義（対面授業科目）					
開講年度・ 開講期	2026・ 後期集中	曜時限	集中 2027年2月12日（金） 2限 2027年2月15日 （月）～2月17日（水） 2限 2027年2月22日 （月）2限 2027年3 月2日（火）～3月4日 （木）2限 2027年3 月9日（火）～3月11 日（木）2限 2027 年3月15日（月）～3 月17日（水）2限 2027年3月23日（火） 2限			配当学年	全回生	対象学生	全学向			
[授業の概要・目的]												
Precipitation is controlled locally by the amount of water vapor and upward motions within clouds. In a warming climate, higher amounts of water vapor are expected to produce heavier precipitation. On a global scale, however, precipitation is controlled by evaporation from the Earth ’ s surface, which in turn, is controlled by the available solar and infrared radiation. This course will examine the basic mechanisms of these two controls of precipitation and how each of these is expected to change in a warming climate. Both observations and model predictions will be examined to better understand these mechanism and the confidence we have in our projections.												
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While projections of future precipitation remain uncertain in most regions, there is no shortage of projections about what the future of precipitation may hold. By examining basic theories, climate models, and global observations, the aim of the course is to expose students to the basic principles and the state of current knowledge that will allow them to distinguish true progress in our scientific understanding from projections that are less rooted in basic science. By the end of the course, students will understand the coupling between global warming and predicted changes in precipitation and why we are quite confident in the warming projections but still very uncertain about changes in precipitation.												
[授業計画と内容]												
Lecture 1: Intro to course - controls on water budget -Basics of Earth ’ s Water and Energy balance -Recent attempts to quantify global estimates Lecture 2: Sort-wave (Solar) radiation -Incoming solar radiation -Interaction of radiation with water vapor, clouds and aerosols. Lecture 3: Long-wave (Infrared) radiation												
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Rainfall in a Changing Climate-E2(2)

- Emission from the Earth
- Absorption/emission by greenhouse gases

Lecture 4: Long wave radiation

- Radiative transfer and weighting functions
- Expected changes from increased greenhouse gases

Lecture 5: Clouds and radiation

- Cloud products
- Cloud Radiative effect

Lecture 6: Water and Energy budgets - a historical perspective

- 1896 Arrhenius : On the impacts of doubling CO₂
- 1914 Dines: On the Water and Energy budget of Earth
- 1930-1960 Multiple authors: Water vapor feedbacks in a warming climate

Lecture 7: Modern Water and Energy Diagrams

- What have we learned in the last 100 years?
- Stepping through successive improvements in our understanding

Lecture 8: Conceptual Models of change

- Simple models of change and implications for precipitation
- Snowfall vs rainfall in a warming climate

Lecture 9: Climate Model Projections

- Climate Model Projections and Differences
- Projections of underlying changes - can these be confirmed?

Lecture 10: Water budget: Measurement and uncertainty in water vapor

- Radiosondes
- GPS methods
- Microwave and IR sounders
- Trends in water vapor - theory and observations.

Lecture 11: Measurement and uncertainty in global evaporation

- Theory of evaporation
- In situ measurements over sea and land
- Global estimates of evaporation

Lecture 12: Measurement of precipitation

- In situ
- Radar and radar/Networks
- Surface trends

Lecture 13: The modern era and satellite precipitation - NASA and JAXA

- Radars in space
- Modern satellite products

Rainfall in a Changing Climate-E2(3)

-Can we detect climate change?

Lecture 14: Observed changes and feedback effects

-Cloud Feedbacks

-Changes in means vs extremes

Lecture 15: Course Summary

[履修要件]

Basic high school-level math and physics (calculus not required)

[成績評価の方法・観点]

50% Class Attendance; 50% quizzes at the end of 5th, 10th and 15th lectures. A short self-assessment quiz will be provided with each lecture to allow students to monitor their own understanding.

[教科書]

使用しない

(関連URL)

<https://www.ipcc.ch/report/sixth-assessment-report-cycle/>(Useful Material for further reading: The Intergovernmental Panel on Climate Change (IPCC), Assessment Report 6 (AR6))

[授業外学修（予習・復習）等]

Students are expected to review the course material after each session. The course schedule is designed to provide sufficient time between classes for consistent self-study and deep reflection.

[その他（オフィスアワー等）]

[主要授業科目（学部・学科名）]