



GEOG 7082: Land and Atmosphere Interactions

Spring 2024

Thursday 15:00 – 17:45, Space21 Rm 627

Instructor: Dr. Eungul Lee
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Office Hours: Thursday 17:45-18:45, or by appointment
Course Website: We will be using *e-campus*

Prerequisite: Graduate Standing w/ Geog 7006(General Climatology) or equivalent

Required Reading Materials:

Required and Selected Readings (peer-reviewed papers and research proposal) will be available to students via web-link, electronic (PDF) or hard copy. Lecture notes will be available on *e-campus*. Additional reading materials and website links are also available on *e-campus*.

Recommended (not required) Textbooks:

- "Ecological Climatology", 2nd ed., Cambridge, ISBN: 9780521693196 (Gordon Bonan)
- "Visualizing Weather and Climate", 1st ed., Wiley, ISBN: 978-0-470-14775-7 (Bruce T. Anderson and Alan Strahler)

Course Description:

This course is designed for students who are interested in the interactions between land surface and atmosphere through biogeophysical processes. This course will study on the effects of human-induced land cover/use changes (e.g., deforestation, afforestation and irrigation) on the climate systems across the globe. 대기는 지표의 물리적 상태에 영향을 줄 수 있고, 반대로 지표의 물리적 상태의 변화는 대기의 장기간의 상태, 즉 ‘기후’,에 영향을 미칠 수 있다. 이러한 생지물리적 프로세스를 통한 지표와 대기 간의 상호작용은 그 지역의 주요한 기후 피드백이 될 수 있다. 인간의 활동에 기인된 토지피복과 토지이용의 변화(예를 들어, 산림황폐화, 조림사업, 관개농업 증대)가 기후시스템에 미치는 영향을 전 지구적으로 사례별로 연구한다.

Expected Learning Outcomes:

After completing this course, students will be expected to be able to:

1. Understand the roles of land in affecting regional- and large-scale climates in the different geographical regions.
2. Critically read the key research papers in the field of land-atmosphere interactions.
3. Search and critically evaluate the current literature of land-atmosphere interactions.
4. Present their understanding of the land-atmosphere interactions effectively in oral form.
5. Lead an intellectual discussion on the selected research articles of their choice.
6. Apply the climatological knowledge to their fields of interest.
7. Write either a research proposal or a research paper.

Course Requirements:

This course will be accomplished through student-lead presentations and discussions, lectures, and term paper. Determination of your grade will be as follows:

Course Requirements		Points
Attendance & Participation		10
Presentations & Discussions of Reading Assignments	Required readings: presentation & discussion	45
	Selected readings: presentation & discussion	
Term paper	Paper topic	45
	One-page outline	
	Draft	
	In-class presentation	
	Final paper	
Total required		100

Attendance/Assignment Policy:

1. Class attendance is required.
2. If you are not able to make class or turn in assignment, you must contact me in advance (at least 24 hours prior to the scheduled time).
3. For every **absence** there is a penalty on your attendance & participation grades (which is worth a total of 10 points). However, if you let me know in a timely manner about your absence (see #2 above), and you are up to date in all your work, up to 2 absences will be forgiven without penalty.
4. **Assignments of leader of required reading** are due at the day before the class (*Submit your presentation material by 23:59 pm on Wednesday before the class on Thursday via e-campus*) unless otherwise stated. **The other people** submit your questions and/or discussion topics on the required reading *12:00 pm on Thursday* via e-campus. *One-page summary of the selected readings for ALL* is due at *12:00 pm on Thursday* via e-campus. Late assignments will be deducted 20% per each day.

Reading Assignments: Two research papers per a week will be assigned including one required reading and one selected reading (see the reading lists in page 4).

Presentation & Discussion for required reading: One student will give a presentation and lead discussion about the required reading paper to cover a main topic of the week (20 minutes: PowerPoint or other visual tools). *Required readings will be assigned during the first day of class.*
Short discussions for selected readings: All students will lead a discussion about their own selected paper (5 minutes: one-page summary). *A selected reading will be assigned a week before the class.*

Term Paper: Your term paper could be either 'research proposal' or 'research paper', while the topic and contents of term paper should be related to land and atmosphere interactions. Term paper will be graded by paper topic, one-page outline, draft, in-class presentation, and final paper.

Paper topic: A (tentative) title of term paper should be submitted by the due date posted.

One-page outline: Include title, motivation, objectives, and expected results of study.

Draft: Describe the key contents of each structure of term paper and prepare 5-minutes talk on your draft.

In-class presentation: You will give a 15-minute (2-3 minutes for Q&A) presentation of your term paper to the class.

Final paper: A final paper may not exceed 10 pages without references, and with a 12 font of Times New Roman and line spacing 1.5 lines.

Your **term paper** will be graded by the following criteria:

Structure and contents of research proposal:

Structure	Contents
Title (& your affiliation) Summary	Describe <i>interestingly</i> and succinctly the contents of the paper. Summarize in three paragraphs for the major aspects of proposal, intellectual merit, and broader impacts in one-page maximum.
Introduction & Objectives Background	State motivation and objectives of the study. Include <i>review of relevant literature</i> , results from your previous work (optional), and preliminary studies (optional).
Proposed Research	Include data and methods, segmented research tasks linked to research objectives, expected outcomes, potential problems and alternative approaches (optional), and timetable.
Intellectual Merit Broader Impacts	See the Merit Review Facts of U.S. National Science Foundation
References	List cited papers by the format of the first paper in the required reading lists.

* [교육부 이공분야 학술연구지원사업 박사과정생 연구장려금지원사업](#) 연구계획서 양식 이용

Structure and contents of research paper:

Structure	Contents
Title (& your affiliation) Abstract (& Key words)	Describe <i>interestingly</i> and succinctly the contents of the paper. Summarize the major aspects in 250 words maximum. Do Not just copy from a main body!
Introduction	State motivation and objectives of the study. Include literature reviews.
Data & Methods	Describe the climatic and other data and statistical methods.
Results	Explain the major findings from the data analysis.
Conclusions	Summarize major content and draw common themes.
References	List cited papers by the format of the first paper in the required reading lists.

Grading Scale:

- The feedbacks on assignments will be informed by e-campus or email.
- Final grade will be assigned according to the grading scale and will be emailed you along with feedbacks on your term paper.

Social Justice Statement: We support that commitment and expect to maintain a positive learning environment based upon open communication, mutual respect, and non-discrimination. We do not discriminate on the basis of race, sex, age, disability, veteran status, religion, sexual orientation, color or national origin. Any suggestions as to how to further such a positive and open environment in this class will be appreciated and given serious consideration. If you are a person with a disability and anticipate needing any type of accommodation in order to participate in this class, please advise me and make appropriate arrangements with the Office of Disability Services ([장애학생지원센터](#), 02-961-2104~5).

Academic Integrity Statement: The integrity of the classes offered by any academic institution solidifies the foundation of its mission and cannot be sacrificed to expediency, ignorance, or blatant fraud. Therefore, I will enforce rigorous standards of academic integrity in all aspects and assignments of this course. For the detailed policy of Kyung Hee University regarding the definitions of acts considered to fall under academic dishonesty and possible ensuing sanctions, please see the Kyung Hee University Honor Code <<https://www.khu.ac.kr/kor/notice/detail.do?seq=2148417&category=UNDERGRADUATE>>. Should you have any questions about possibly improper research citations or references, or any other activity that may be interpreted as an attempt at academic dishonesty, please see me before the assignment is due to discuss the matter.

Required Readings: One required reading per a week

1. Dirmeyer, PA, D Niyogi, N de Noblet-Ducoudré, RE Dickinson, and PK Snyder (2010), Impacts of land use change on climate. *Int. J. Climatol.*, 30: 1905-1907. [\[Link\]](#)
2. Pielke Sr., RA (2005), Land use and climate change. *Science*, 310: 1625-1626. [\[Link\]](#)
3. Foley, JA, MH Costa, C Delire, N Ramankutty, and P Snyder (2003), Green surprise? How terrestrial ecosystems could affect earth's climate. *Frontiers in Ecology and the Environment* 1: 38–44. [\[Link\]](#)
4. Lee, E., CL Barford, CJ Kucharik, BS Felzer, and JA Foley (2011), Role of turbulent heat fluxes over land in the monsoon over East Asia, *Int. J. Geosciences*, 2 (4), 420-431. [\[Link\]](#)
5. Xue, Y (1996), The Impact of Desertification in the Mongolian and the Inner Mongolian Grassland on the Regional Climate. *J. Climate*, 9, 2173–2189. [\[Link\]](#)
6. Lee, E, TN Chase, B Rajagopalan, RG Barry, TW Biggs, and PJ Lawrence (2009), Effects of irrigation and vegetation activity on early Indian summer monsoon variability. *Int. J. Climatol.*, 29: 573–581. [\[Link\]](#)
7. Lee, E, WJ Sacks, TN Chase, and JA Foley (2011), Simulated impacts of irrigation on the atmospheric circulation over Asia, *J. Geophys. Res.*, 116, D08114, doi:10.1029/2010JD014740. [\[Link\]](#)
8. Foley, J., Coe, M., Scheffer, M. et al. (2003), Regime Shifts in the Sahara and Sahel: Interactions between Ecological and Climatic Systems in Northern Africa. *Ecosystems*, 6, 524–532. [\[Link\]](#)
9. Nobre, CA, PJ Sellers, and J Shukla (1991), Amazonian Deforestation and Regional Climate Change. *J. Climate*, 4, 957–988. [\[Link\]](#)
10. McGuffie, K, A Henderson-Sellers, H Zhang, TB Durbidge, and AJ Pitman (1995), Global climate sensitivity to tropical deforestation. *Global and Planetary Change*, 10, 97-128. [\[Link\]](#)
11. Research proposal of NSF or other external funding agency will be provided [\[To be available in print\]](#).
12. Lee, E, BS Felzer, and Z Kothavala (2013), Effects of nitrogen limitation on hydrological processes and improved hydrology in the Community Land Model (CLM4-CN), *J. Adv. Model. Earth Syst.*, 5, doi:10.1002/jame.20046. [\[Link\]](#)
13. Lee, E, Effects on the Asian summer monsoon of the enhanced SST in the northwestern Pacific: Intermediate complexity GCM simulations (2009), *J. Climate Research(기후연구)*, 4 (1), 1-13. [\[Link\]](#)

Selected Readings: One selected reading per a week from the following lists and/or your choice

Review:

- Mahmood, R., Pielke, R. A., Hubbard, K. G., Niyogi, D., Dirmeyer, P. A., McAlpine, C., Carleton, A. M., Hale, R., Gameda, S., Beltrán-Przekurat, A., Baker, B., McNider, R., Legates, D. R., Shepherd, M., Du, J., Blanken, P. D., Frauenfeld, O. W., Nair, U.S. and Fall, S. (2014), Land cover changes and their biogeophysical effects on climate. *Int. J. Climatol.* 34, 929-953. [\[Link\]](#)
- Pielke, R.A., Sr., Pitman, A., Niyogi, D., Mahmood, R., McAlpine, C., Hossain, F., Goldewijk, K.K., Nair, U., Betts, R., Fall, S., Reichstein, M., Kabat, P. and de Noblet, N. (2011), Land use/land cover changes and climate: modeling analysis and observational evidence. *WIREs Clim Change*, 2: 828-850. [\[Link\]](#)

East Asia:

- Fu, C, (2003), Potential impacts of human-induced land cover change on East Asia monsoon, *Global and Planetary Change*, 37, 219–229. [\[Link\]](#)
- Xue, Y, H-M H Juang, W-P Li, S Prince, R DeFries, Y Jiao, and R Vasic (2004), Role of land surface processes in monsoon development: East Asia and West Africa, *J. Geophys. Res.*, 109, D03105, doi:10.1029/2003JD003556. [\[Link\]](#)

- Lee, E, TN Chase, and B Rajagopalan (2008), Highly improved predictive skill in the forecasting of the East Asian summer monsoon, *Water Resour. Res.*, 44, W10422, doi:10.1029/2007WR006514. [\[Link\]](#) Nature Research Highlights [\[Link\]](#)
- Fu, C and G Wen (1999), Variation of Ecosystems over East Asia in Association with Seasonal, Interannual and Decadal Monsoon Climate Variability, *Climatic Change*, 43, 477-494. [\[Link\]](#)
- He, Y., E. Lee, and J. S. Mankin (2020), Seasonal tropospheric cooling in Northeast China associated with cropland expansion, *Environmental Research Letters*, 15, 034032. [\[Link\]](#)
- Yadav, S. K., Lee, E., and He, Y. (2022), Positive Associations of Vegetation with Temperature over the Alpine Grasslands in the Western Tibetan Plateau during May, *Earth Interactions*, 26(1), 94-111. [\[Link\]](#)
- Oh, J., and Lee, E (2023), Competing effects of vegetation on summer temperature in North Korea, *Theoretical and Applied Climatology*, 1-19. [\[Link\]](#)

India:

- Douglas, EM, D Niyogi, S Frolking, JB Yeluripati, RA Pielke Sr., N Niyogi, CJ Vörösmarty, and UC Mohanty (2006), Changes in moisture and energy fluxes due to agricultural land use and irrigation in the Indian Monsoon Belt, *Geophys. Res. Lett.*, 33, L14403, doi:10.1029/2006GL026550. [\[Link\]](#)
- Douglas, EM, A Beltrán-Przekurat, D Niyogi, RA Pielke Sr., and CJ Vörösmarty (2009), The impact of agricultural intensification and irrigation on land-atmosphere interactions and Indian monsoon precipitation — A mesoscale modeling perspective, *Global and Planetary Change*, 67, 117-128. [\[Link\]](#)
- Niyogi, D., C. Kishtawal, S. Tripathi, and R. S. Govindaraju (2010), Observational evidence that agricultural intensification and land use change may be reducing the Indian summer monsoon rainfall, *Water Resour. Res.*, 46, W03533, doi:10.1029/2008WR007082. [\[Link\]](#)

West Africa:

- Charney, JG (1975), Dynamics of deserts and drought in the Sahel. *Q.J.R. Meteorol. Soc.*, 101: 193–202. doi: 10.1002/qj.49710142802. [\[Link\]](#)
- Xue, Y (1997), Biosphere feedback on regional climate in tropical North Africa. *Q.J.R. Meteorol. Soc.*, 123: 1483–1515. [\[Link\]](#)
- Eltahir, EAB, and C Gong (1996), Dynamics of Wet and Dry Years in West Africa. *J. Climate*, 9, 1030–1042. [\[Link\]](#)
- Charney, J, WJ Quirk, S-H Chow, and J Kornfield (1977), A Comparative Study of the Effects of Albedo Change on Drought in Semi-Arid Regions. *J. Atmos. Sci.*, 34, 1366–1385. [\[Link\]](#)
- He, Y., and E. Lee (2016), Empirical Relationships of Sea Surface Temperature and Vegetation Activity with Summer Rainfall Variability over the Sahel, *Earth Interactions*, 20, 1–18. [\[Link\]](#)
- Lee, E., Y. He, M. Zhou, and J. Liang (2015), Potential Feedback of Recent Vegetation Changes on Summer Rainfall in the Sahel, *Physical Geography*, 36 (6), 449-470. [\[Link\]](#)

Amazonia:

- Gedney, N, and PJ Valdes (2000), The effect of Amazonian deforestation on the northern hemisphere circulation and climate, *Geophys. Res. Lett.*, 27, 3053-3056. [\[Link\]](#)
- Lean, J, and DA Warrilow (1989), Simulation of the regional climatic impact of Amazon deforestation, *Nature* 342, 411-413. [\[Link\]](#)
- Shukla, J, C Nobre, and P Sellers (1990), Amazon Deforestation and Climate Change, *Science*, 247, 1322-5. [\[Link\]](#) Full paper available upon request
- Lettau, H, K Lettau, LCB Molion, 1979: Amazonia's Hydrologic Cycle and the Role of Atmospheric Recycling in Assessing Deforestation Effects. *Mon. Wea. Rev.*, 107, 227–238. [\[Link\]](#)

Global:

- Foley, J, et al. (2005), Global consequences of land use, *Science*, 309, 570-574. [\[Link\]](#)
- Bonan, G, et al. (1992), Effects of boreal forest vegetation on global climate, *Nature* 359, 716 - 718. [\[Link\]](#)
- Eltahir, EAB (1996), Role of vegetation in sustaining large-scale atmospheric circulations in the tropics, *J. Geophys. Res.*, 101(D2), 4255–4268, doi:10.1029/95JD03632. [\[Link\]](#)
- Chase, TN, RA Pielke Sr., TGF Kittel, RR Nemani, and SW Running (2000), Simulated impacts of historical land cover changes on global climate in northern winter, *Clim. Dyn.* 16, 93-105. [\[Link\]](#)
- Zhang, H, A Henderson-Sellers, K McGuffie (1996), Impacts of Tropical Deforestation. Part I: Process Analysis of Local Climatic Change. *J. Climate*, 9, 1497–1517. [\[Link\]](#)
- Zhang, H, A Henderson-Sellers, K McGuffie (1996), Impacts of Tropical Deforestation. Part II: The Role of Large-Scale Dynamics. *J. Climate*, 9, 2498–2521. [\[Link\]](#)
- Chase, TN, RA Pielke, TGF Kittel, R Nemani, and SW Running (1996), Sensitivity of a general circulation model to global changes in leaf area index, *J. Geophys. Res.*, 101(D3), 7393–7408, doi:10.1029/95JD02417. [\[Link\]](#)

U.S.:

- Kueppers, LM, MA Snyder, and LC Sloan (2007), Irrigation cooling effect: Regional climate forcing by land-use change, *Geophys. Res. Lett.*, 34, L03703, doi:10.1029/2006GL028679. [\[Link\]](#)
- Adegoke, JO, RA Pielke, J Eastman, R Mahmood, and KG Hubbard (2003), Impact of Irrigation on Midsummer Surface Fluxes and Temperature under Dry Synoptic Conditions: A Regional Atmospheric Model Study of the U.S. High Plains. *Mon. Wea. Rev.*, 131, 556–564. [\[Link\]](#)
- Chase, TN, RA Pielke Sr., TGF Kittel, JS Baron, and TJ Stohlgren (1999), Potential impacts on Colorado Rocky Mountain weather due to land use changes on the adjacent Great Plains, *J. Geophys. Res.*, 104(D14), 16673–16690, doi:10.1029/1999JD900118. [\[Link\]](#)
- Bonan, G. (1997). Effects of Land Use on the Climate of the United States, *Climatic Change*, 37, 449-486. [\[Link\]](#)
- Lee, E., R. Beida, J. Shanmugasundaram, and H. Basara Richter (2016), Land surface and atmospheric conditions associated with heat waves over the Chickasaw Nation in the South Central United States, *J. Geophys. Res. Atmos.*, 121, 6284–6298, doi:10.1002/2015JD024659. [\[Link\]](#)

Tree-rings:

- Cook E, KJ Anchukaitis, BM Buckley, RD D'Arrigo, GC Jacoby, WE Wright (2010), Asian monsoon failure and megadrought during the last millennium. *Science* 328:486–489 [\[Link\]](#)
- Chuai, XW, XJ Huang, WJ Wang, and G Bao (2013), NDVI, temperature and precipitation changes and their relationships with different vegetation types during 1998–2007 in Inner Mongolia, China. *Int. J. Climatol.*, 33: 1696–1706. [\[Link\]](#)
- Fang, K, X Gou, F Chen, D Frank, C Liu, J Li, and M Kazmer (2012), Precipitation variability during the past 400 years in the Xiaolong Mountain (central China) inferred from tree rings, *Clim. Dyn.* 39: 1697-1707. [\[Link\]](#)
- Leavitt, SW, TN Chase, B Rajagopalan, E Lee, and PJ Lawrence (2008), Southwestern U.S. tree-ring carbon isotope indices as a possible proxy for reconstruction of greenness of vegetation, *Geophys. Res. Lett.*, 35, L12704, doi:10.1029/2008GL033894. [\[Link\]](#)

Search and select a recent article related to land-atmosphere interactions from the peer-reviewed articles below or other related journals:

[Science](#); [Nature](#); [Nature Climate Change](#); [Nature Geoscience](#); [Geophysical Research Letters](#) (GRL); [Environmental Research Letters](#) (ERL); [I. J. Climatology](#); [J. Climate](#); [J. Geophysical Research-Atmos](#)

Course Schedule

Week	Date	Topic	Readings	Assignments	
1	3/7	Course introduction/ Assign the RR papers Introducing Climatology	Anderson & Strahler		
2	3/14	Introducing Biosphere-Atmosphere Interactions	RR #1, 2 and #3		
3	3/21	Land-Atmosphere Interactions across the globe : Biogeophysical processes	East Asia RR #4 SR 1		
4	3/28		Inner Mongolia RR #5 SR 2		
5	4/4		India RR #6 SR 3		
6	4/11		Middle East & Central Asia RR #7 SR 4	Term paper topic	
7	4/18				
8	4/25		West Africa RR #8 SR 5	Outline of term paper	
9	5/2		Amazonia RR #9 SR 6		
10	5/9		Global Scale RR #10 SR 7		
11	5/16		<i>Research Proposal Review</i>	RR #11 Term paper discussion	Draft of term paper
12	5/23	Biogeochemical processes : Carbon, Nitrogen, and Water Coupling	RR #12 SR 8		
13	5/30	Climate Modeling	RR #13 SR 9		
14	6/6				
15	6/13	<i>Individual (or group) meeting for preparing final paper</i>			
16	6/20	<i>Presentations</i>			Final paper (6/24)
RR: Required Readings SR: Selected Readings The course schedule may be changed throughout the semester and the changes will be announced in the class and/or eCampus.					

Course Schedule (Revised)

Week	Date	Topic	Readings	Assignments	
1	3/7	Course introduction/ Assign the RR papers Introducing Climatology	Anderson & Strahler		
2	3/14	Introducing Biosphere-Atmosphere Interactions	RR #1, 2 and #3		
3	3/21	Land-Atmosphere Interactions across the globe : Biogeophysical processes	East Asia	RR #4 SR 1	
4	3/28		Inner Mongolia	RR #5 SR 2	
5	4/4		India	RR #6 SR 3	Term paper topic
6	4/11		<i>NCAR online workshop</i>		
7	4/18		<i>Preparing term paper outline (No class)</i>		
8	4/25		Middle East & Central Asia	RR #7 SR 4	
9	5/2		West Africa	RR #8 SR 5	Outline of term paper
10	5/9		Amazonia	RR #9 SR 6	
11	5/16		Global Scale	RR #10 SR 7	
12	5/23		<i>Research Proposal Review</i>		RR #11 Term paper discussion Draft of term paper
13	5/30	Biogeochemical processes : Carbon, Nitrogen, and Water Coupling	RR #12 SR 8		
14	6/6	<i>No class</i>			
15	6/13	<i>Individual (or group) meeting for preparing final paper</i>			
16	6/20	<i>Presentations</i>			Final paper (6/24)
RR: Required Readings SR: Selected Readings The course schedule may be changed throughout the semester and the changes will be announced in the class and/or eCampus.					