

# METR 4653/5653: Air Pollution Meteorology and Modeling

## Spring 2011 - Syllabus\*

### General Information:

Did you ever wonder why do ozone alert days happen mainly during summer or why do air quality consultants hire meteorologists? Here are answers: weather phenomena have a strong influence on the dispersion of atmospheric pollutants and air pollution is considered as a weather hazard. Thus, air quality predictions require profound information and knowledge about the meteorological conditions.

The offered course presents an overview of various atmospheric circulation and weather systems and illustrates their relevance to pollutant dispersion. Special emphasis will be put on the processes within the atmospheric boundary layer where most of the pollution problems occur. Basic concepts and theories of turbulent transport and mixing are also introduced. During the second half, different dispersion theories and modeling approaches will be discussed. As an introduction, the different sources of air pollution, their effects on health and welfare, and laws and regulations to control air quality will be briefly described.

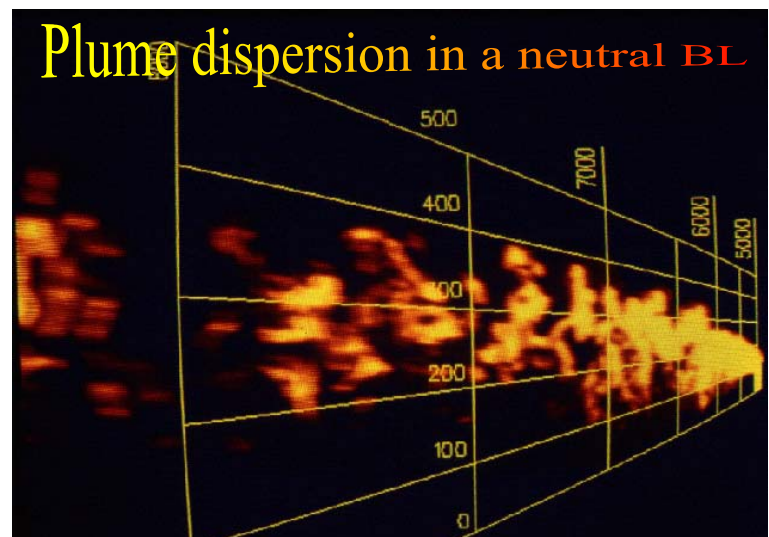
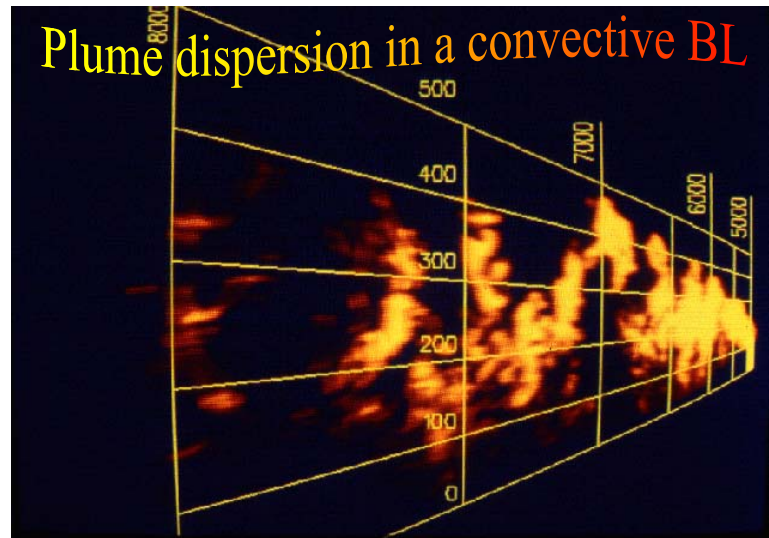
### Instructor:

Dr. Petra Klein, School of Meteorology, NWC 5339, Tel. 325-1631, e-mail: [pkklein@ou.edu](mailto:pkklein@ou.edu)  
Office hours: W 2.00pm-3.00pm or by appointment

### Time and place:

MWF 12:00-12:50 am, NWC 5302

*\*The instructors reserves the rights to alter any or all stated policies if they feel it is in the best interests of students in this class. Any changes to the proposed syllabus will be announced in class.*



## Recommended textbook:

S. Pal Arya, 1999: Air Pollution Meteorology and Dispersion, Oxford University Press.

## Additional Literature:

A.K. Blackadar, 1997. Turbulence and Diffusion in the Atmosphere

J. H. Seinfeld, S. Pandis, 1997: Atmospheric Chemistry and Physics: From Air Pollution to Climate Change. John Wiley & Sons.

K. B. Schnelle, Jr., P. R. Dey, 2000. Atmospheric Dispersion Modeling Compliance Guide. McGraw Hill.

M.P. Singh, S. Raman (Eds.), 1998. Dynamics of Atmospheric Flows: Atmospheric Transport and Diffusion Processes. Computational Mechanics Publications.

R.B. Stull, 2000: Meteorology for Scientists and Engineers. Brooks/Cole.

## Reading Assignments:

The preliminary schedule given below presents an overview of the topics covered in this class and shows the textbook chapters relevant to each lecture. Additional material will be given in the lecture notes and papers will be handed out in class or posted on D2L. It is expected that the student is proactive and reads all relevant material (in particular the textbook chapters) before and/or after the lectures, even when no formal reading assignment is given. This is very important in order to comprehend the extensive material covered in this class.

## Web Sites

You can find the main web site for this class on the OU Desire2Learn system ([learn.ou.edu](http://learn.ou.edu)). METR 5653 has been combined with METR 4653. Important course materials (lecture notes, assignments, grades, etc.) and announcements will be posted on this site. Please become familiar with this site and check it frequently.

## Grading:

Homework Assignments (2-4)	10%
2 In-class Exams	30% (each)
Semester Project	30%
Final Exam	30%

The lowest of the two in-class exam grades will be dropped when course averages are computed for each student. **The final will be a comprehensive exam and the grade in the final cannot be dropped.** An excuse for missing an exam must be provided to the instructor before each exam begins. Late homework will not be accepted. All exams are closed book exams (**textbooks and lecture notes cannot be used**), but students are allowed to prepare and **use their own notes (maximum 2 pages long)**.

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## Semester Projects

A variety of different topics will be available for semester projects. More details will be given during the 2<sup>nd</sup> week of class after an assessment of your main interests. Students enrolled in METR 4653 will be allowed to work in a team of 2-3 students, but each student will be required to submit an independent paper at the end of the semester. Students enrolled in METR 5653 are normally expected to work on individual projects which can be related to their MS or PhD research.

**The deadline for the project reports is Sunday, May 1<sup>st</sup>, 2011. An electronic drop box will be available on D2L which will be open until 6pm on that day.** A hard copy must be submitted in class on Monday 05/02/2011. Additionally, each group has to give an oral presentation to the class during the week of April 25<sup>st</sup>-29<sup>th</sup>, 2011.

## Important Dates

1st Hourly In-Class Exam:	<b>Wednesday, February 23, 2011</b>
2nd Hourly In-Class Exam:	<b>Monday, April 18, 2011</b>
Final Exam:	<b>Friday, May 13, 2011, 1.30-3.30pm</b>

## Attendance and Make-up Policy

In this class, participation will be strongly encouraged. Note that some material will be available only during class. For both of these reasons, I expect 100% attendance to be the norm.

Only under extraordinary circumstances make-ups will be given if an exam is missed. **You MUST notify me BEFORE the exams. Sickness will be accepted as an excuse only if accompanied by a note from a physician.**

## Other Important Policies

**Reasonable Accommodation:** The University of Oklahoma is committed to providing reasonable accommodation for all students with disabilities. Students with disabilities who require accommodations in this course are requested to speak with the professor as early in the semester as possible. **Students with disabilities must be registered with the Disability Resource Center prior to receiving accommodations in this course.** The Disability Resource Center is located in Goddard Health Center, Suite 166, phone 405/325-3852 or TDD only 405/325-4173.

**Academic Misconduct:** All provisions of the Norman Campus Academic Misconduct Code shall apply in cases of academic dishonesty. Academic misconduct is defined as “any act that improperly affects the evaluation of a student’s academic performance or achievement.” All faculty at the University of Oklahoma expect academic integrity from each student. Misconduct such as plagiarism, fabrication, and fraud, as well as attempting to commit such acts or assisting others in so doing, will not be tolerated. Students are responsible for knowing the academic misconduct code, which is included in the student code ([http://judicial.ou.edu/images/stories/student\\_codebook.pdf](http://judicial.ou.edu/images/stories/student_codebook.pdf)). All instances of alleged academic misconduct will be thoroughly investigated and action will be taken according to the rights and responsibilities under the academic misconduct code described at <http://www.ou.edu/provost/integrity-rights/>.

## Schedule and topics

A tentative schedule including a list of topics is attached and also available on D2L. This schedule provides an orientation but is still subject to change.

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Date	Event	Instructor	Topic/Comments	TB chapters
Saturday, January 01, 2011				
Sunday, January 02, 2011				
Monday, January 03, 2011				
Tuesday, January 04, 2011				
Wednesday, January 05, 2011				
Thursday, January 06, 2011				
Friday, January 07, 2011				
Saturday, January 08, 2011				
Sunday, January 09, 2011				
Monday, January 10, 2011				
Tuesday, January 11, 2011				
Wednesday, January 12, 2011				
Thursday, January 13, 2011				
Friday, January 14, 2011				
Saturday, January 15, 2011				
Sunday, January 16, 2011				
Monday, January 17, 2011	<b>Martin Luther King Day</b>	<b>no classes</b>		
Tuesday, January 18, 2011				
<b>Wednesday, January 19, 2011</b>	<b>Begin of classes</b>	<b>P. Klein</b>	<b>Intro lecture</b>	<b>1</b>
Thursday, January 20, 2011				
<b>Friday, January 21, 2011</b>	<b>Lecture 2</b>	<b>P. Klein</b>	<b>Movie: "The search for clean air"</b>	<b>1</b>
Saturday, January 22, 2011				
Sunday, January 23, 2011				
<b>Monday, January 24, 2011</b>	<b>Lecture 3</b>	<b>P. Klein</b>	<b>Sources and effects of air pollution</b>	<b>1</b>
Tuesday, January 25, 2011				
<b>Wednesday, January 26, 2011</b>	<b>Lecture 4</b>	<b>P. Klein</b>	<b>Control of air pollution</b>	<b>1</b>
Thursday, January 27, 2011				
<b>Friday, January 28, 2011</b>	<b>Lecture 5</b>	<b>P. Klein</b>	<b>Atm. Systems and Pollutant Transport</b>	<b>2, 3</b>
Saturday, January 29, 2011				
Sunday, January 30, 2011				
<b>Monday, January 31, 2011</b>	<b>Lecture 6</b>	<b>P. Klein</b>	<b>Discussion Semester Projects</b>	

Date	Event	Instructor	Topic/Comments	TB chapters
Tuesday, February 01, 2011				2,4
<b>Wednesday, February 02, 2011</b>	<b>Lecture 7</b>	<b>P. Klein</b>	<b>Planetary Boundary Layer (PBL) - Basics and Mean Profiles</b>	
Thursday, February 03, 2011				
<b>Friday, February 04, 2011</b>	<b>Lecture 8</b>	<b>P. Klein</b>	<b>PBL - Basics and Mean Profiles</b>	2,4
Saturday, February 05, 2011				
Sunday, February 06, 2011				4
<b>Monday, February 07, 2011</b>	<b>Lecture 9</b>	<b>P. Klein</b>	<b>PBL - Basics and Mean Profiles</b>	
Tuesday, February 08, 2011				4,5
<b>Wednesday, February 09, 2011</b>	<b>Lecture 10</b>	<b>P. Klein</b>	<b>PBL - Structure and Turbulence</b>	
Thursday, February 10, 2011				
<b>Friday, February 11, 2011</b>	<b>Lecture 11</b>	<b>P. Klein</b>	<b>PBL - Structure and Turbulence</b>	4,5
Saturday, February 12, 2011				
Sunday, February 13, 2011				
<b>Monday, February 14, 2011</b>	<b>Lecture 12</b>	<b>P. Klein</b>	<b>PBL - Similarity Theories</b>	
Tuesday, February 15, 2011				
<b>Wednesday, February 16, 2011</b>	<b>Lecture 14</b>	<b>P. Klein</b>	<b>PBL - Similarity Theories</b>	
Thursday, February 17, 2011				
<b>Friday, February 18, 2011</b>	<b>Lecture 15</b>	<b>P. Klein</b>	<b>PBL - param. for disp. Models</b>	4
Saturday, February 19, 2011				
Sunday, February 20, 2011				4
<b>Monday, February 21, 2011</b>	<b>Lecture 15</b>	<b>P. Klein</b>	<b>Review Session</b>	
Tuesday, February 22, 2011				4
<b>Wednesday, February 23, 2011</b>	<b>Exam 1</b>	<b>P. Klein</b>		
Thursday, February 24, 2011				
<b>Friday, February 25, 2011</b>	<b>Lecture 16</b>	<b>P. Klein</b>	<b>Mixing height estimation and Met. Preprocessors</b>	mostly other sources
Saturday, February 26, 2011				
Sunday, February 27, 2011				6
<b>Monday, February 28, 2011</b>	<b>Lecture 17</b>	<b>P. Klein</b>	<b>Gradient Transport Theories - diffusin equ.</b>	

Date	Event	Instructor	Topic/Comments	TB chapters
Tuesday, March 01, 2011				6
<b>Wednesday, March 02, 2011</b>	<b>Lecture 18</b>	<b>P. Klein</b>	<b>Gradient Transport Theories - mol. Diffusion</b>	
Thursday, March 03, 2011				6
<b>Friday, March 04, 2011</b>	<b>Lecture 19</b>	<b>P. Klein</b>	<b>Gradient Transport Theories - turb. Diffusion/K-theory</b>	
Saturday, March 05, 2011				6
Sunday, March 06, 2011				
<b>Monday, March 07, 2011</b>	<b>Lecture 20</b>	<b>P. Klein</b>	<b>Gradient Transport Theories - turb. Diffusion/K-theory</b>	9
Tuesday, March 08, 2011				
<b>Wednesday, March 09, 2011</b>	<b>Lecture 21</b>	<b>P. Klein</b>	<b>Gaussian diffusion models - theory</b>	
Thursday, March 10, 2011				9
<b>Friday, March 11, 2011</b>	<b>Lecture 22</b>	<b>P. Klein</b>	<b>Gaussian diffusion models - theory</b>	
<b>Saturday, March 12, 2011</b>	<b>Spring Break</b>			10
<b>Sunday, March 13, 2011</b>	<b>Spring Break</b>			
<b>Monday, March 14, 2011</b>	<b>Spring Break</b>			10
<b>Tuesday, March 15, 2011</b>	<b>Spring Break</b>			
<b>Wednesday, March 16, 2011</b>	<b>Spring Break</b>			
<b>Thursday, March 17, 2011</b>	<b>Spring Break</b>			
<b>Friday, March 18, 2011</b>	<b>Spring Break</b>			
<b>Saturday, March 19, 2011</b>	<b>Spring Break</b>			
<b>Sunday, March 20, 2011</b>	<b>Spring Break</b>			
<b>Monday, March 21, 2011</b>	<b>Lecture 23</b>	<b>P. Klein</b>	<b>Plume rise</b>	
Tuesday, March 22, 2011				
<b>Wednesday, March 23, 2011</b>	<b>Lecture 24</b>	<b>P. Klein</b>	<b>Deposition</b>	
Thursday, March 24, 2011				9
<b>Friday, March 25, 2011</b>	<b>Lecture 25</b>	<b>P. Klein</b>	<b>Gaussian diffusion models - pract. appl. and limitations</b>	
Saturday, March 26, 2011				mostly other sources
Sunday, March 27, 2011				
<b>Monday, March 28, 2011</b>	<b>Lecture 26</b>	<b>P. Klein</b>	<b>2nd Generation Gaussian Models</b>	
Tuesday, March 29, 2011				
<b>Wednesday, March 30, 2011</b>	<b>Lecture 27</b>	<b>P. Klein</b>	<b>EPA Models - AERMOD overview</b>	
Thursday, March 31, 2011				

Date	Event	Instructor	Topic/Comments	TB chapters
<b>Friday, April 01, 2011</b>	<b>Lecture 28</b>	<b>P. Klein</b>	<b>Statistical theories of dispersion</b>	
Saturday, April 02, 2011				
Sunday, April 03, 2011				
<b>Monday, April 04, 2011</b>	<b>Lecture 29</b>	<b>P. Klein</b>	<b>Numerical dispersion models</b>	
Tuesday, April 05, 2011				
<b>Wednesday, April 06, 2011</b>	<b>Lecture 30</b>	<b>P. Klein</b>	<b>Regional and urban air quality - problems and modeling approaches</b>	<b>7</b>
Thursday, April 07, 2011				
<b>Friday, April 08, 2011</b>	<b>Lecture 31</b>	<b>P. Klein</b>	<b>Tropospheric Ozone and Atmospheric Chemistry</b>	
Saturday, April 09, 2011				<b>11</b>
Sunday, April 10, 2011				
<b>Monday, April 11, 2011</b>	<b>Lecture 32</b>	<b>P. Klein</b>	<b>Microscale Dispersion</b>	<b>12</b>
Tuesday, April 12, 2011				
<b>Wednesday, April 13, 2011</b>	<b>Lecture 33</b>	<b>P. Klein</b>	<b>Microscale Dispersion</b>	<b>mostly other sources</b>
Thursday, April 14, 2011				
<b>Friday, April 15, 2011</b>	<b>Lecture 34</b>	<b>P. Klein</b>	<b>Review Session</b>	
Saturday, April 16, 2011				<b>mostly other sources</b>
Sunday, April 17, 2011				
<b>Monday, April 18, 2011</b>	<b>Exam 2</b>			<b>mostly other sources</b>
Tuesday, April 19, 2011				
<b>Wednesday, April 20, 2011</b>	<b>Lecture 35</b>	<b>P. Klein</b>	<b>Mesoscale Models and Urban Parameterization Schemes</b>	<b>mostly other sources</b>
Thursday, April 21, 2011				
<b>Friday, April 22, 2011</b>	<b>Lecture 36</b>	<b>P. Klein</b>	<b>Mesoscale Models and Urban Parameterization Schemes</b>	
Saturday, April 23, 2011				
Sunday, April 24, 2011				
<b>Monday, April 25, 2011</b>	<b>Lecture 37</b>	<b>students</b>	<b>Presentation of student term projects</b>	
Tuesday, April 26, 2011				
<b>Wednesday, April 27, 2011</b>	<b>Lecture 38</b>	<b>students</b>	<b>Presentation of student term projects</b>	<b>Deadline for project reports, Online submission before 10pm.</b>
Thursday, April 28, 2011				
<b>Friday, April 29, 2011</b>	<b>Lecture 39</b>	<b>students</b>	<b>Presentation of student term projects</b>	
Saturday, April 30, 2011				<b>mostly other sources</b>
				<b>mostly other sources</b>

Date	Event	Instructor	Topic/Comments	TB chapters
Sunday, May 01, 2011				
<b>Monday, May 02, 2011</b>	<b>Lecture 39</b>	<b>P. Klein</b>	<b>Global Pollution Problems</b>	
Tuesday, May 03, 2011				
<b>Wednesday, May 04, 2011</b>	<b>Lecture 40</b>	<b>P. Klein</b>	<b>Global Pollution Problems</b>	
Thursday, May 05, 2011				
<b>Friday, May 06, 2011</b>	<b>Last Lecture</b>		<b>Review</b>	
Saturday, May 07, 2011				
Sunday, May 08, 2011				
Monday, May 09, 2011				
Tuesday, May 10, 2011				
Wednesday, May 11, 2011				
Thursday, May 12, 2011				
<b>Friday, May 13, 2011</b>	<b>Final Exam, 1:30-3:30pm</b>			
<b>Saturday, May 14, 2011</b>	<b>Commencement</b>			
Sunday, May 15, 2011				
Monday, May 16, 2011				
Tuesday, May 17, 2011				
Wednesday, May 18, 2011				
Thursday, May 19, 2011				
Friday, May 20, 2011				
Saturday, May 21, 2011				
Sunday, May 22, 2011				
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Sunday, May 29, 2011				
Monday, May 30, 2011				