**Planning Outline:**

Objective: *For students of ENGS 37 (Introduction to Environmental Engineering) to learn and then apply air quality dispersion modeling using a R-based programming module, with the help of the package ‘openair’ and open-sourced air quality datasets of cities in Germany/USA. Students will be able to understand the basics of dispersion modeling, obtain and clean data sets, analyze those data sets, and communicate results to peers and policymakers.*

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*From ENGS 37 Course Syllabus online:* [*https://cushman.host.dartmouth.edu/courses/engs37.html*](https://cushman.host.dartmouth.edu/courses/engs37.html)

* *Knowledge of the main forms of air, water and land pollution,*
* *Ability to perform a mass balance for an open system,*
* *Ability to design cyclones and electrostatic precipitators, and ability to select the technology appropriate to the application,*
* *Understanding how a wastewater treatment plant works,*
* *Knowledge of methods of pollution prevention inside a manufacturing plant,*
* *Ability to place engineering design in the broader context of sustainable practices,*
* *A basic understanding of risk assessment,*
* *Knowledge of what an environmental engineer is and does.*

*This project most aligns with “and the ability to select technology appropriate to the application”, “ability to place engineering design in the broader context of sustainable practices”, and “knowledge of what an environmental engineer is and does”.*

*I think we enhance this by adding:*

* *Ability to obtain and analyze real-world data using engineering technology*
* *Understanding of common air quality visualizations*
* *Understanding of modern context(s) of environmental engineering*
* *Ability to communicate analysis and research to other engineers and/or policymakers*

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Structure:

* Data sets used:
  + *R package ‘openair’*
  + *Open-sourced air quality datasets of cities in Germany/USE (i.e.,* [*https://www.iqair.com/us/germany/berlin*](https://www.iqair.com/us/germany/berlin)*)*
  + *Up to students’ discretion within a list of curated datasets (by us)*
* Duration:
  + *Air Quality section of class. 3-4 weeks rather than 1-2 weeks. Though it seems like 2-3 weeks would be most appropriate based on the length of the project/modules*
* Format:
  + *Air quality intros (pollutants, sources, etc.) and understanding of regulations*
  + *R introduction and setup*
  + *R programming assignment with a list of provided datasets.*
  + *Potentially skeleton code for students to fill in.*
  + *Final presentation of results and/or report of policy recommendations*
* How will students learn data science?
  + *Students will use datasets of time-variant air quality parameters of different cities in Germany/USA. They will additionally learn to format datasets, to create a variety of graphs based on a dataset, to interpret these graphs, and to consolidate the main message/story from these graphs for their audience.*

Development Plan:

*Clearly outline what you plan on getting done each week. Be realistic in your own capabilities of what can get done in 4 weeks.*

| Timeline: | Objectives: |
| --- | --- |
| Week 2/3 (Scaffolding) | * *Agree on tech stacks (i.e., RStudio, data sources, data formats)* * *Ensure that all of us are able to use RStudio.* * *Have a list of database resources of air quality parameters in different cities in Germany (Berlin or nearby)* * *If data not formatted correctly, format them for ease of use* * *Push/merge initial testing code or readme.* * *Potentially provide some demo code on package ‘openair’ functionalities; or present demo of ‘openair’ example scripts.* * *Google earth* * *Create a list of assignment titles in chronological order* * *Create potential questions for assignments (from Olin, brainstorms).* |
| Week 4 (Development) | * *Expand scaffolding features.* * *Combine policy making tasks with R assignments.* * *Create mini R assignments that lead through interesting ‘openair’ functionalities (i.e., parameter dispersion, windrose, pollutionrose).* * *Create RStudio setup and tutorial assignment* |
| Week 5 (Development) | * *Expand scaffolding features.* * *Continue designing/coding ‘openair’ assignments based on previous week’s meeting feedback.* |
| Week 6 (Development) | * *Continue designing/coding ‘openair’ assignments based on previous week’s meeting feedback.* * *Craft learning module instructions for students.* * *Draft different test cases.* * *Begin work on write-ups/instructions for each assignment (LaTex)* |
| Week 7 (Development) | * *Finish majority of designing/coding ‘openair’ assignments based on previous week’s meeting feedback.* * *Finalize write-ups/instructions for each assignment (LaTex)* * *Bug hunt.* * *Share a demo of the full module to professors/PIs with ways for which they can share feedback.* |

If there’s additional time what else would you like to accomplish:

* *Article or reliable resource on the differences between EU and EPA guidelines*
* *Create a quick look resource/tip sheet on R (possible section: MATLAB vs. R)*
* *Create a quick look resource/tip sheet on different functionalities for openair R package*
* *Walkthrough Videos to accompany written instructions*
* *Create a resource/tip sheet on data visualization*
* *Create a resource/tip sheet/example of policy paper*

Sign Off

| Principal Investigators: | Scott D. Pauls |
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| Course Professor: | Petra Bonfert-Taylor |
| DCAL: |  |

**Assignment Outline:**

**\*\*\*\* Individual assignments were moved to the “Assignments” folder. \*\*\*\***

In chronological order, a list of the assignments that students will complete in the module:

| **Title** | **Purpose** | **Details (specific questions, resources, what we have to make)** |
| --- | --- | --- |
| RStudio Installation and Tutorial on Markdown |  | (can come weeks earlier than other modules) |
| Air Problems |  | Review EPA/EU guidelines and case studies about air quality issues, get gears turning about possible interests for a project |
| More on R |  | make basic plots, get comfort with the language  MATLAB comparison at this point |
| Selecting Your Site(s) |  | Find a place to look at, and download/format its data. Use Google Earth to search for possible first sources |
| Openair Primer |  | Look through your site’s data as you learn about the openair package |
| Preliminary Presentation |  | What do you think you’ll be interested in? Present a topic and some first findings to the class, note your next steps, get feedback, etc. |
| More Openair |  | As needed, walking through project steps |
| Final Project |  | \*provide the necessary questions, etc. at the beginning so people know where they’re going  Report or presentation on air quality topic/problem of choice |
|  |  |  |