Internship Opportunity Form

Organization: National Center for Atmospheric Research (NCAR) – Atmospheric Chemistry Observations & Modeling (ACOM)

Address: 3450 Mitchell Ln, Boulder, CO 80301

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Number of interns requested for: (flexible in terms of number of students and semester)

Spring _____ Summer _____ Fall _____
(For most projects there will be opportunities for 1-2 students. Scope of work, length of project and amount of time spent to be discussed with interested students)

Nature of project(s) Please fill in some ideas of what student(s) could do in each category during the internship.

What are the minimum hours that you want the students to commit (full day, half day, min hours)? Full day/half day

1. Research (e.g., Data analysis, hands-on experience, instrumentation development, testing, or maintenance)

· Laboratory chamber investigations of the atmospheric transformation of fire emissions. This topic will involve chamber experiments and data analysis, and micro-scale modeling of the chamber chemistry.

· Model sensitivity studies of the recent West Coast fires (2017, 2018) to understand the interaction of anthropogenic emissions with fire emissions. The main question to be answered is whether fire emissions would cause as severe air pollution downstream if there were no anthropogenic pollution?

· Evaluation of forecasts from global (WACCM, CAM-Chem) and regional (WRF-Chem and WRF with inert tracers) models for the 2019 FIREX-AQ campaign and the 2018 WECAN campaign. Data for evaluation include field campaign data, satellite products, and surface monitoring station measurements.

· Multi-year evaluation of ACOM's global chemical forecast products (CAM-Chem for 2002-2017, WACCM since Jan 2018) with satellite data and/or operational network data.

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· Study of the long-term trends and spatial distributions of ocean emissions of carbonyl sulfide (OCS) using CAM-Chem. Proposed length would be 3-4 months (about 5 hours per week). The expected outcome would be a CAM-Chem compset with online ocean emissions and chemistry of OCS. This would be used to compare to OCS measurements around the globe.

· A short-term project would study global pollution transport, using Hovmöller diagram analysis with MOPITT carbon monoxide data to analyze the typical transport across the Pacific and/or into the Arctic, transport between Australia and New Zealand, and the vertical uplift in the Atlantic.

· Comparing Low Cost Sensors (LCS) with a more advanced instrument, in the lab and deployed at the NCAR Foothills Lab roof and/or near Boulder Reservoir for field testing. This could build into a longer-term project to include aspects of a "gridded array plan" assessing the benefit of using data assimilation (DA) of measurements from ground-based and airborne LCS to constrain high-resolution air quality modeling. LCS sampling techniques will achieve unprecedented spatial resolution of measurements, and DA will test model improvements by incorporating these observations, in addition to data from existing operational networks. Depending on funding, this could be done with actual sensors or as a type of Observation System Simulation Experiment (OSSE) study.

· Analysis of FRAPPÉ/DISCOVER-AQ Colorado Field Campaign Data I: Follow-up study on FRAPPÉ final report (https://www2.acom.ucar.edu/frappe) using aircraft data and the GECKO model to study the role of organic nitrates. Understanding of atmospheric chemistry is needed.

· Analysis of FRAPPÉ/DISCOVER-AQ Colorado Field Campaign Data II: Analysis of WRF-Chem “chem trails” (output of chemical fields along forward trajectories) and aircraft and surface data to look at chemical evolution of air masses (e.g. mixing of emissions from O&G and urban sources; pollution transport into the mountains during upslope events). Could be a short-term project working with existing model output for a case study, or a long-term project in which the student would be running the model and develop a comprehensive analysis of different conditions that lead to high ozone in the Front Range. Understanding of atmospheric chemistry is needed.

· Fire plume transport in north America: Looking at satellite data for different co-emitted species, such as CO and aerosol optical depth (AOD), and see how these can be used together via data assimilation to predict downwind AQ impacts of big fires. ACOM is working on using MOPITT satellite vertical profile information to better constrain surface aerosol in a column AOD measurement. A student would help look at case histories for big western fires over the last decade for which we also have aircraft and/or surface data. This study could also include recent TROPOMI data for both CO and AOD.

· Create a simulated data sets to look at the variability of NO2, O3 and AOD columns that will be detected by geostationary satellites (TEMPO over US and GEMS over Asia). This would be compared with statistics of surface variability as simulated in the model and verified with ground monitoring. Look at the way in which the satellite column data can be used to infer surface air quality exposure close to, and downwind of, sources through OSSEs. This will help get ready for the GEMS data at the beginning of 2020 that ACOM should have early access to.

· Laboratory chamber studies of oxygenated and multi-functional VOCs, involving systematic examination of the chemistry of peroxy radicals and alkoxy radicals. This could also

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tie into the development of structure-reactivity relationships for these radical reactions, and the development of complex atmospheric chemical mechanisms.

2. Communications (presentation, report, poster)

At the end of the project, the student will make a powerpoint presentation, a poster, and a final report. The presentation will be given either at an ACOM internal meeting, and/or at a local student conference such as ESSS Poster Conference (Fall in Boulder).

3. Professional Skills (responsiveness, software skills – e.g., GitHub, Python, Slack, Word processing, Excel)

The student is expected to take ownership of the internship, which means timely response to questions or emails from the host institution and the faculty member, raising questions and concerns professionally and in a timely manner. The student is expected to have basic programming skills and work with the software used at the host institutor (e.g. Python, IDL, NCL, MatLab, Word, Excel), while the host will also provide support and help.

4. Professional Interactions (e.g., seminar, individual project meetings, professional networking)

The student will be encouraged to participate in NCAR seminars and NCAR/ACOM meetings during the visits at NCAR.

5. Leadership (attending meetings)

Meet with ACOM Leadership to discuss career advancements and leadership.

Skills required:

- Good programming skills (Python, IDL, NCL,...), and for some of the projects experience with the Unix environment is also needed.
- At the very least, fundamental understanding of atmospheric chemistry.
- Good communication skills

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