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Fast Breaking Commentary, October 2010

Article: Jose-Luis Jimenez & André S.H. Prévôt on Organic Aerosols

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Jose-Luis Jimenez & André S.H. Prévôt talk with ScienceWatch.com and answer a few questions about this month's Fast Breaking Paper paper in the field of Geosciences.

Why do you think your paper is highly cited? SW:

Atmospheric particles containing a rich mixture of organic species ("organic aerosols") are abundant in the atmosphere and have major effects on Earth's climate and human health. However, their sources and fate are poorly known, which limits our ability to reduce their impacts.

In our paper we present a new framework for understanding organic aerosols that is consistent with worldwide measurements over the last decade, and that can allow faster progress in these areas in the future. Many other researchers are finding this framework useful to help explain their results or to motivate new research.

Does it describe a new discovery, methodology, or synthesis of knowledge? SW:

Scientist tuning the instrumentation before an experiment at the "smog" chamber at the Paul Scherrer Institut in Switzerland. Photo credit: Urs

Baltensperger.

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All of the above. We presented a synthesis of laboratory and field data from nearly 40 studies around the world, as well as several new discoveries, and a conceptual framework which is consistent with the worldwide data and discoveries. The breadth of evidence presented in the paper to support its findings is probably one of the keys to the wide use of its results by the scientific community.

Would you summarize the significance of your paper in layman's terms? SW:

Organic aerosols, microscopic particles suspended in the atmosphere, derive from many sources, such as motor vehicles, forest fires, living vegetation, etc. Until recently the aerosols from the different sources were often assumed to change little during their time in the atmosphere, and were treated in isolation by researchers. In our paper we showed that these aerosols evolve very quickly in the Earth's oxidizing atmosphere, and that the features of this "aging" are very similar and independent of the original source.

We showed that this aging was making organic aerosols better nuclei for cloud droplets, which can have an important impact on climate. Finally, we proposed a new framework which can be used to understand experimental data, develop computer models, and (importantly) connect the two. We expect that this framework will facilitate and guide future research in this area.

How did you become involved in this research, and how would you describe the particular challenges, setbacks, and successes that you've encountered along the way? SW:

The research presented in the paper is based on a recently-developed technique known as aerosol mass spectrometry (AMS). I (Jose) became involved in the early development of the AMS in 1999 and performed the first ambient measurements with the technique, both on the ground and on aircraft, and during the following decade worked on many of the challenges that needed to be resolved to make the research on our paper possible.

Together with the company that developed and manufactures the AMS instruments (Aerodyne Research, Inc. near Boston), we established a community of researchers using AMS that was much more interactive and sharing than is typical in other areas of research. For example, we just came back from our 11th annual meeting (this time held in a Finnish Forestry Research Station) in which 80 researchers spent three days discussing in great detail new ways to understand and improve this complex instrument.

Together this community has been able to characterize and improve the data from AMS instruments at an extremely rapid pace and to overcome the natural skepticism of the scientific community towards a new technique. We incorporated a wide range of data from this community's research in this paper, and the paper has 64 coauthors for this reason.

Where do you see your research leading in the future? SW:

"In our paper we present a new framework for understanding organic aerosols that is consistent with worldwide measurements over the last decade, and that can allow faster progress in these areas in the future..."

The results in the paper are an important achievement, but they also represent a new beginning for research in this area since we propose a new framework that needs to be more fully characterized and developed in more detail. The larger community is designing new experiments and computer simulations to quantitatively test and expand several aspects of the framework.

For example, our research groups conducted and co-led a large field experiment in California during the summer of 2010, which was designed in part to test some aspects of the new framework. We are also preparing several future field experiments and co-developing new instruments to measure atmospheric organic species faster and with more precision. This research will likely keep us very busy for the next 5-10 years.

Do you foresee any social or political implications for your research? SW:

Our research will allow the development of better computer models to predict the sources and evolution of organic aerosols in the atmosphere. This information will be very useful to regulatory agencies trying to improve air quality and reduce the associated mortality because aerosol particles are the air pollutant most damaging to human health and are thought to be responsible for about 60,000 deaths per year in the US and a few million globally.

As regulatory agencies weigh new management strategies, such as installing particle filters on school buses or using prescribed fires to limit the severity of future wildfires, the improved predictions of aerosol particle impacts enabled by our research will result in more effective decisions. Our results will also be useful for improving climate prediction models, since aerosol effects are one of the most uncertain pieces in climate prediction. Our research can help clarify the impacts of various climate mitigation policies, and to predict future climate more accurately.

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ADDITIONAL INFORMATION:

- Read a Fast Breaking Paper commentary by Jose-Luis Jimenez from February 2010.

KEYWORDS: SECONDARY; MASS; EMISSIONS; PITTSBURGH; CHEMISTRY; OXIDATION; CAMPAIGN; GROWTH; MODEL.

- Select
- Photo 1
- Photo 2
- Photo 3
- Photo 4
- Photo 5

Click the tabs above to view images and descriptions.

Photo 1:

Photo 1: The NSF/NCAR C-130 research aircraft taking off for a research flight as part of the MILAGRO / INTEX campaign in Spring 2006. Photo credit: Edward Dunlea.

Photo 2:

Photo 2: Pollution in the Inland Empire of the Los Angeles basin around Riverside during the summer of 2005, photographed from the top of a local mountain. Photo credit: Michael Cubison.

Photo 3:

Photo 3: Inside of the NCAR/NSF C-130 research aircraft during a research flight of the MILAGRO campaign around Mexico City in Spring 2006. Photo credit: Jose-Luis Jimenez.

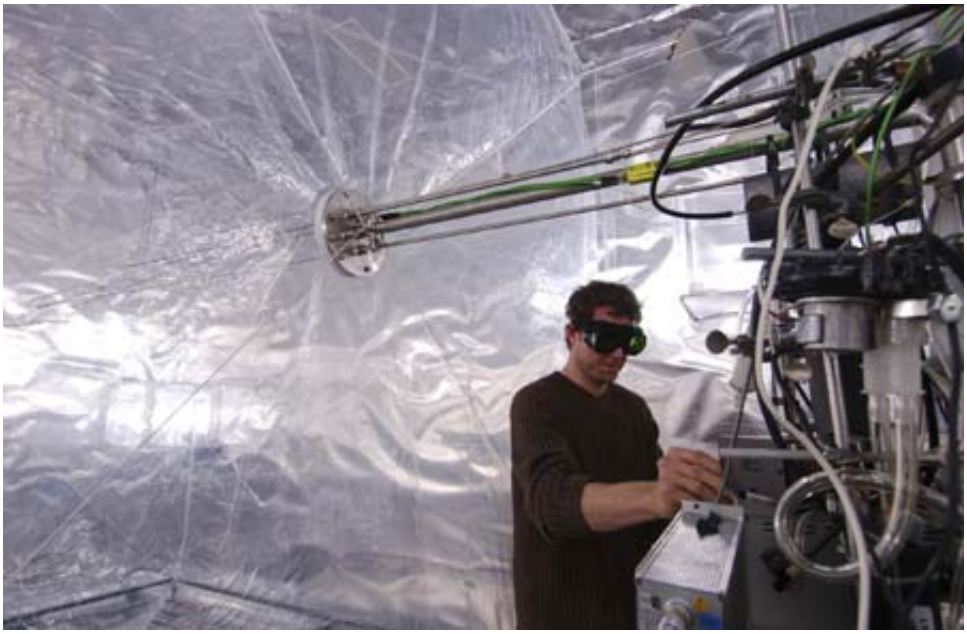
Photo 4:

Photo 4: Scientist tuning the instrumentation before an experiment at the "smog" chamber at the Paul Scherrer

Institut in Switzerland. Photo credit: Urs Baltensperger.

Photo 5:

Photo 5: Loading the instrumentation onto a snow cat at the end of the experiment at the Storm Peak Laboratory in Steamboat Springs, CO. Photo credit: Edward Dunlea.



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