Measurement-model fusion for global total atmospheric deposition

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The World Meteorological Organization's (WMO) Global Atmosphere Watch (GAW) Programme coordinates high-quality observations of atmospheric composition from global to local scales with the aim to drive high-quality and high-impact science while co-producing a new generation of products and services.

Exposure to atmospheric ozone is a major factor in crop yield losses in many countries, resulting in billions of US $ in losses and having implications for future food security. Likewise deposition of excess atmospheric nitrogen can result in eutrophication of freshwater bodies, with potential impacts on the health of water bodies used for irrigation. Conversely, agriculture is the single largest contributor of ammonia pollution as well as emitting other nitrogen compounds, some of which can make it into the atmosphere and be deposited, potentially affecting crops elsewhere.

To better understand and address the issues posed by deposition of atmospheric pollutants, WMO has a mandate to produce global maps of wet, dry and total atmospheric deposition for important atmospheric chemicals to enable research into biogeochemical cycles and assessments of ecosystem, food security and human health effects.

The most suitable scientific approach for this activity is the emerging technique of measurement-model fusion for total atmospheric deposition. This technique requires global scale measurements of atmospheric trace gases, particles, precipitation composition and precipitation depth, as well as predictions of the same from global/regional chemical transport models. The fusion of measurement and model results requires data assimilation and mapping techniques.

The resulting maps of global total deposition of atmospheric pollutants can provide agriculture and good experts, as well as policy-makers, an overview of where deposition of atmospheric pollutants will have the largest effects on agriculture and food production on a global scale.

Recent Publications

1. Schwede, D., Cole, A., Vet, R and Lear, G., Ongoing US-Canada collaboration on nitrogen and sulfur deposition, EM - A&WMA, June 2019.
2. Wu, Z.Y.; Schwede, D.; Vet, R.; Walker, J.; Shaw, M.; Staebler, R.; Zhang, L. Evaluation and intercomparison of five North American dry deposition algorithms at a mixed forest site; J. Adv. Mod. Earth Sys. 2018, 10, 1571-1586
3. Kharol, S.K.; Shephard, M.W.; McLinden, C.A.; Zhang, L.; Sioris, C.E.; O'Brien, J.M.; Vet, R.; Cady-Pereira, K.E.; Hare, E.; Siemons, J.; Krotkov, N.A. Dry deposition of reactive nitrogen from satellite observations of ammonia and nitrogen dioxide over North America; Geophys. Res. Letts. 2018, 45, 1157-1166.
4. Vet, R.; Artz, R.S.; Carou, S.; Shaw, M.; Ro, C.-U.; Aas, W.; Baker, A.; Bowersox, V.C.; Dentener, F.; Galy-Lacaux, C.; Hou, A.; Pienaar, J.J.; Gillett, R.; Forti, M.C.; Gromov, S.; Hara, H.; Khodzher, T.; Mahowald, N.M, Nickovic, S.; Rao, P.S.P.; Reid, N.W., A global assessment of precipitation chemistry and deposition of sulfur, nitrogen, sea salt, base cations, organic acids, acidity and pH, and phosphorus, Atmospheric Environment, vol. 93, 3–100, 2014 DOI: doi:10.1016/j.atmosenv.2013.10.060
5. Robichaud, A.; Ménard, R.; Zaïtseva, Y.; Anselmo, D. Multipollutant surface objective analyses and mapping of air quality health index over North America; Air Qual. Atmos. Health 2016, 9 (7), 743-759.

Biography

Lorenzo Jesus Labrador is a Scientific Officer at the world Meteorological Organization's (WMO) Global Atmosphere Watch (GAW) Programme. He currently coordinates the activities of three Scientific Advisory Groups to WMO and also coordinates the research-to-services Measurement-Model-Fusion project, aimed at producing global maps of total deposition of atmospheric pollutants on an operational or semi-operational basis. Lorenzo trained as a physicist and went on to obtain a Ph.D in atmospheric Sciences from the Max Planck Institute for Chemistry in Mainz, Germany and the University of Heidelberg in Germany in 2005. After working in academia researching atmospheric chemistry for a number of years, Lorenzo moved to the UK's Met Office in 2015 to work in the Satellite Applications Group, where he worked on developing deep convection products using satellite imagery. In 2018, Lorenzo started working in WMO's GAW programme. Lorenzo has a number of publications in peer-reviewed journals, dealing mostly on the subject of atmospheric chemistry.

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