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Simulation of atmospheric composition and air quality on the CHPC

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Air pollution can have large negative impacts on human health, agriculture, ecosystems, visibility and climate. In South Africa, although ambient (i.e. outdoor) air quality is regulated, many areas are out of compliance with the National Ambient Air Quality Standards. In order to protect human health and mitigate impacts, it is critical to improve air quality. The Constitution provides that everyone has a right to have an environment that is not harmful to their health. The Atmospheric Composition Focus Area in the CSIR Climate and Air Quality Modelling (CAQM) research group aims to provide the evidence base to quantify the impacts of air quality and to improve air quality. The group uses the CHPC to run an air quality model (CAMx) to simulate urban and regional air quality at high resolution. CAMx is developed and maintained by Ramboll-ENVIRON (www.camx.com) and is completely open source. CAMx is an atmospheric chemical transport model that simulates the transport and chemistry of pollutants in the atmosphere. The processes represented within the model are complex, and thus computationally intensive, which makes use of the CHPC facility a necessity. In order to run CAMx, the team uses 48 to 72 cores, depending on domain size. In addition, the team uses the CHPC to run metrological (WRF) or climate (CCAM-CABLE) models that provide the meteorological input into CAMx. These are also computationally expensive. Both WRF and CCAM scale very well; and CCAM has been run previously with over 1000 cores. All code (CAMx, WRF and/or CCAM) are compiled with Intel Fortran and all utilize MPI.

Using the CHPC resources, the team has been able to simulate the impact of policy interventions on air quality in cities in South Africa. Additionally, the team has simulated the health risk from air pollution regionally in South Africa. In the past, this has been done using monitoring station data only, which then limits the analysis to only those living directly around the station. These outputs directly provide the evidence base needed for decision makers to draft and implement policies and interventions to effectively improve air quality as well as understand its impacts, now and into the future. This presentation will highlight some current modelling work of the group focusing on urban air quality and air quality management, as well as simulating the impacts of COVID-19 lockdown regulations on air quality in the Highveld.

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