Cooking: Deadlier than you thought

Sunday, April 30, 2017

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In developing countries, understanding the content of pollutants in the atmosphere is very important to gauging the health burden associated with air quality as well as the impact on climate change. Although climate change models have traditionally focused on sources such as cars and factories, they have missed a large and deadly source—the kitchen stove.

Nearly half of the world’s population that is located within developing countries utilizes solid fuels such as wood, crop residue, and dried animal dung for cooking. In the developing world, women often times spend several hours a day cooking food on traditional, mud-based stoves over an active fire in poorly ventilated village huts. The resulting indoor pollution level generated from burning these highly inefficient solid fuels is much higher than air quality guideline levels set by the World Health Organization and is associated with nearly four million premature deaths annually worldwide. Furthermore, there is also a myriad of health effects associated with cooking with solid fuels such as chronic obstructive pulmonary disease, acute lower respiratory infections, cardiovascular disease, cancer, and low birth weight for newborns which is a major risk factor for serious health complications, to name a few.

Besides the immediate health effects, burning these types of fuels also produce short-lived climate pollutants that have major localized climate change implications. Short-lived climate pollutants only stay in the atmosphere for a few weeks compared to greenhouse gasses (e.g., carbon dioxide), which can take decades to naturally dissipate from the atmosphere and reflect long-term energy consumption patterns. However, in terms of their ability to affect climate change, short-lived climate pollutants are as significant and as big of a concern as greenhouse gasses. An example of one major
short-lived climate pollutant emitted from the burning of these inefficient solid fuels is black carbon, which is a dark substance that efficiently absorbs UV radiation from the sun and heats up whatever it comes in contact with (similar to when a person heats up when wearing a black sweater on a sunny day). When in the atmosphere, it can cause the overall meteorological cycle to change, impacting the intensity, duration, frequency, and timing of seasonal weather events such as monsoon seasons in South Asia. Furthermore, if black carbon lands on snow or ice, the increased UV absorption hastens the melting process thereby accelerating retreat and disappearance of snow and glaciers that have the ability to significantly impact ecosystems and people’s livelihoods.

A region of particular concern for the production of black carbon from cooking with solid, inefficient fuels is the densely populated Indo-Gangetic Plain with nearly 600 million inhabitants that cover most of North India, Pakistan, Nepal and Bangladesh. Part of this region is bordered by the climate-sensitive Himalayan mountain range—the largest area of snow and ice outside the Polar Regions. Short-lived climate pollutants (in addition to greenhouse gasses) are transported from the Indo-Gangetic Plain to the Himalayas and are a major contributor to changes in the precipitation cycle (e.g., disruptions to the timing and intensity of the monsoon season) as well as the rapid retreat and disappearance of glaciers and snowpack. With nearly one billion people relying on fresh water and contributions to the precipitation cycle from the annual snow pack melt of the Himalayan region, understanding the amount of black carbon in the atmosphere generated from the use of solid fuels in the Indo-Gangetic Plain is critical to understanding the long-term climate and health impacts to this region as a whole. In South Asia, cooking with solid fuels is believed to be the largest contributor to black carbon in the atmosphere; however, significant variability exists for estimates of black carbon concentration at the subregional level.

A profile of outdoor air pollutants can be developed utilizing two main approaches: a top-down approach which starts from the atmosphere and a bottom-up approach which starts from the ground. Although both approaches rely on a multitude of inputs including transport models, emission factors, and remote sensing (i.e., satellite) applications, large discrepancies exist for black carbon source attribution throughout the Indo-Gangetic Plain depending on the approach taken. These discrepancies stem from assumptions using insufficient air pollution concentration data at the local level and can lead to widely varying predictions. For example, existing databases suffer from a limited representation of rural pollution sources, difficulty in distinguishing sources, and reliance on overly generalized information that spans demographics, the amount of fuel used, and emissions from types of fuels utilized.

Much work is still needed to quantify the contribution of cooking with solid fuels to air pollution, including a better understanding of what other pollutants are generated from burning these fuels. However, with an improved understanding of the impact that cooking with solid fuels has on localized air quality, we can develop more informed policies to improve not only the health of local communities but of the climate as well.

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