中国北方农村室内固体燃料炉灶和土暖气使用对大气雾霾和健康的影响
Contribution of Space Heating to Ambient Air Pollution in a Peri-urban Village in Northern China and Its Implication on Health Intervention

This presentation prepared by

汇报与研究人员

美国加州大学（廖嘉文，Anna Zimmermann Jin 朱安娜，Zoë A. Chafe博士， Ajay Pillarisetti博士，Kirk R Smith教授）

清华大学（单明博士，于涛，杨旭东教授）

北京化工大学（李海熹，刘广青教授）

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The impact of household cooking and heating with solid fuels on ambient $PM_{2.5}$ in peri-urban Beijing

Jiawen Liao [a, *, 1], Anna Zimmerman Jin [a], Zoë A. Chafe [a, b], Ajay Pillarisetti [a], Tao Yu [c], Ming Shan [c], Xudong Yang [c], Haixi Li [d], Guangqing Liu [d], Kirk R. Smith [a]

[a] Environmental Health Sciences, School of Public Health, University of California, Berkeley, CA 94720-7360, USA
[b] Energy and Resources Group, University of California, Berkeley, CA 94720-3050, USA
[c] Department of Building Science, Tsinghua University, Beijing 10084, China
[d] Department of Environmental Engineering, Beijing University of Chemical Technology, Beijing, China


Anna Zimmermann Jin 在中国二合庄实地调研
数月，并采集数据

背景Background

PM2.5能进入呼吸系统甚至通过肺进入血液，损坏呼吸系统，心血管系统，甚至会致癌。

PM2.5 can be inhaled into respiratory system and can enter circulation through lung, thus damaging respiratory system, causing cardiovascular disease even causing cancer.

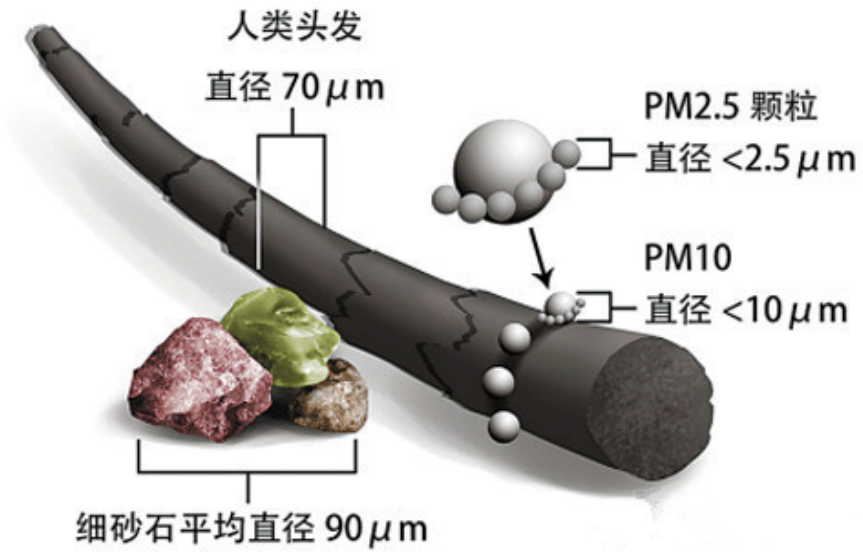
据统计，室外大气PM2.5污染和室内PM2.5污染在2013年造成了近1百万中国人的过早死亡。

According to studies, ambient air pollution and household air pollution from PM2.5 caused nearly 1 million premature death in China in 2013

背景Background

PM2.5是空气动力学直径小于2.5微米的微小颗粒污染物，其小于头发直径的300分之一。细颗粒物PM2.5，是造成中国大气污染和雾霾的主要污染物。

PM2.5, is the particulate matter with aerodynamic diameter less than 2.5 micrometer. PM2.5 is smaller than 1 in 300 of diameter of human hair, but are the main cause of “smog” in ambient atmospheric environment.



背景 Background

与汽车尾气，工业排放一样，室内固体燃料（例如木头和煤炭）的燃烧也会造成室内外空气污染。

Similar to pollution from transportation and industrial activities, household solid fuel(such as wood and coal) combustion will also results in ambient air pollution.

由于固体燃料在中国北方被广泛使用，但目前却还缺乏对中国室内固体燃料（例如木材和煤炭）燃烧对室外空气的影响。因此，本项目利用二合庄作为实验地点，在2012年末至2013年采取数据并研究了室内土暖气和炊事炉灶使用对大气雾霾影响的研究。

Since the wide use of solid fuel in Northern China, it is important to assess the impact of household solid fuel use to ambient air pollution in China. We investigated this question from June 2012 to March 2013 in Er He Zhuang village in peri-urban Beijing.

土暖气锅炉与炉灶与暖气检测器
Coal furnace and Stove Use Monitor (SUM)

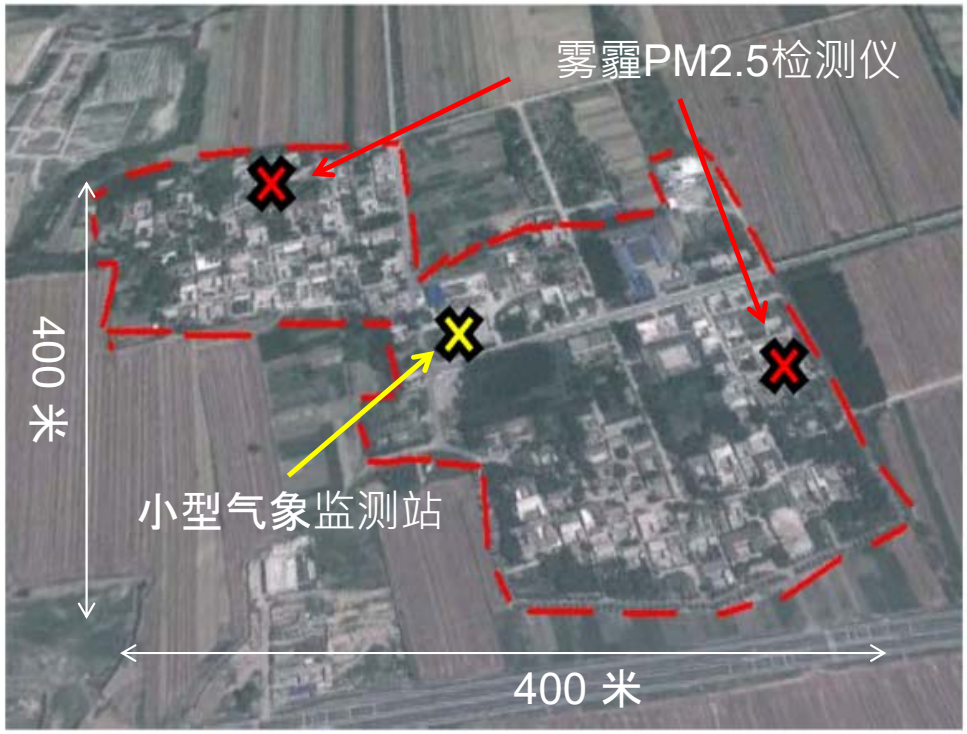
二合庄2013年1月大气雾霾景象 (照片提供自:朱安娜)
Smog in Er He Zhuang village in January 2013

使用木材的土地暖 (上)， 使用蜂窝煤的烧水供暖炉灶 (下)
Floor heating system using biomass(upper), honeycomb coal portable stove (lower)

研究方法 Method

我们在距离北京市区西南40公里外的二合庄进行调研和考察。在近200户村民中，我们走访调查了33户人家室内固体燃料（木材和煤炭）的使用情况，并研究了其对室外大气雾霾污染的影响。

We conducted the research in EHZ village, around 40 km southwest of Beijing and visited 200 villagers and interviewed 33 households about the solid fuel usage. We also monitored outdoor PM2.5 air pollution in EHZ village



二合庄村地图 Map of Er He Zhuang village

监测炉灶与供暖设备的检测仪，仅仅一枚硬币大小

The Stove Use Monitor (SUM), similar size to coin


炉灶与供暖设备的检测仪 (SUM)


炉灶与供暖设备的检测仪 (SUM)


PM2.5 空气污染检测仪
PM2.5 monitor

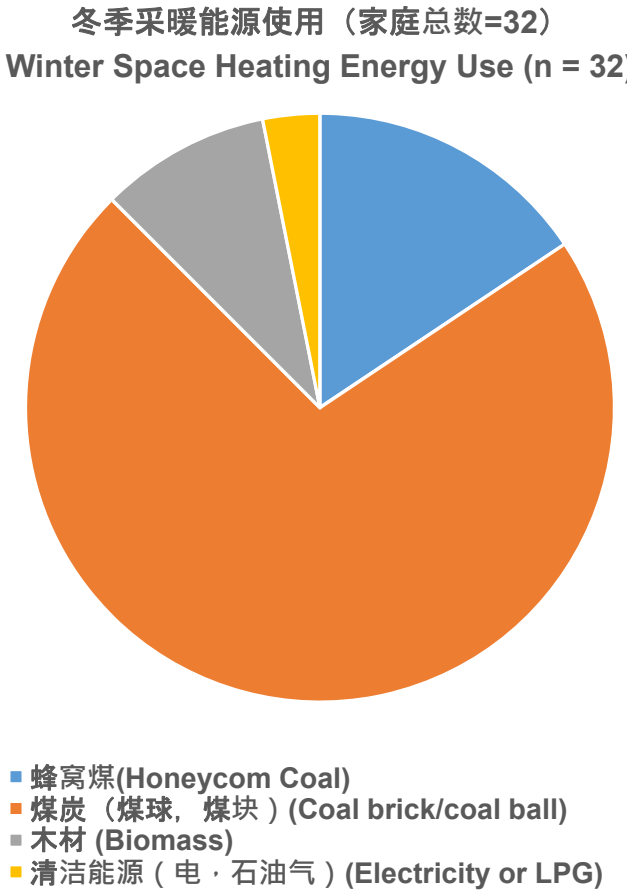
中美两国研究人员正在采集室外空气样品

Investigators from USA and China are conducting PM2.5 air monitoring

研究结果: 能源使用 Results: Energy Usage

从家庭能源问卷中，我们发现大多数村民使用清洁能源（**包括**电能，液化石油气）来进行炊事，但是仍然使用大**量的固体燃料（例如木材和煤炭**）烧锅炉，炕或者土暖气进行室内采暖。平均每户家庭每年炊事使用木材**87公斤**，**采暖使用木材102公斤和煤炭3000公斤。**

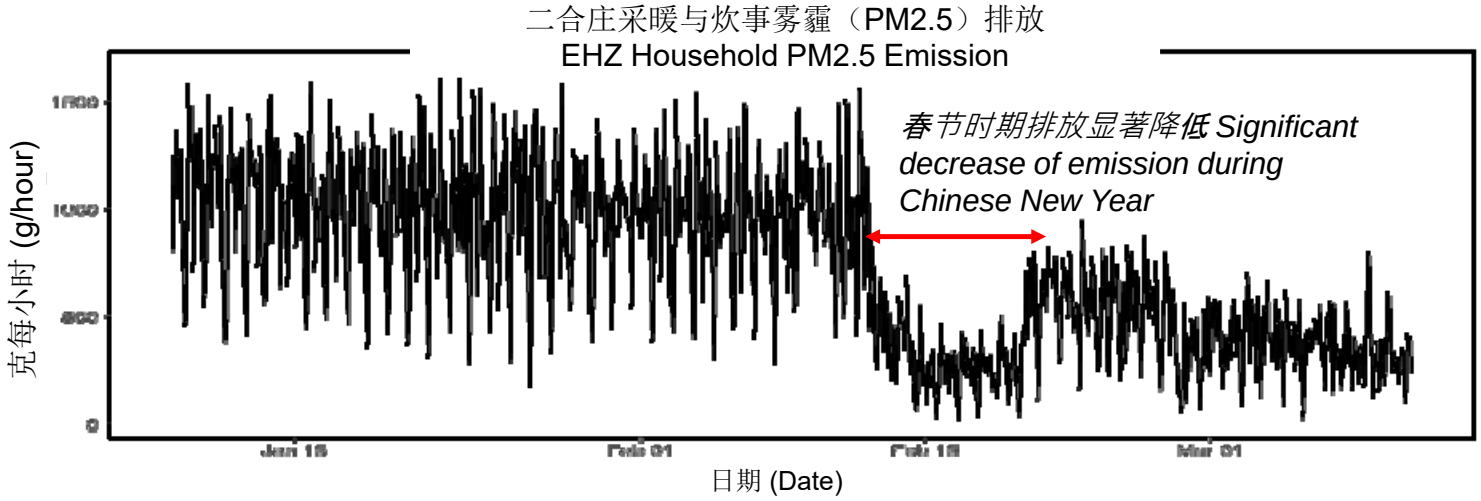
From Household energy survey, most villagers used clean fuel (including electricity and LPG) for cooking, however, still rely on solid fuel (wood and coal) for space heating. The average consumption for cooking using biomass, heating using biomass and heating using coal is 87kg, 102kg and 3000kg per household per year.

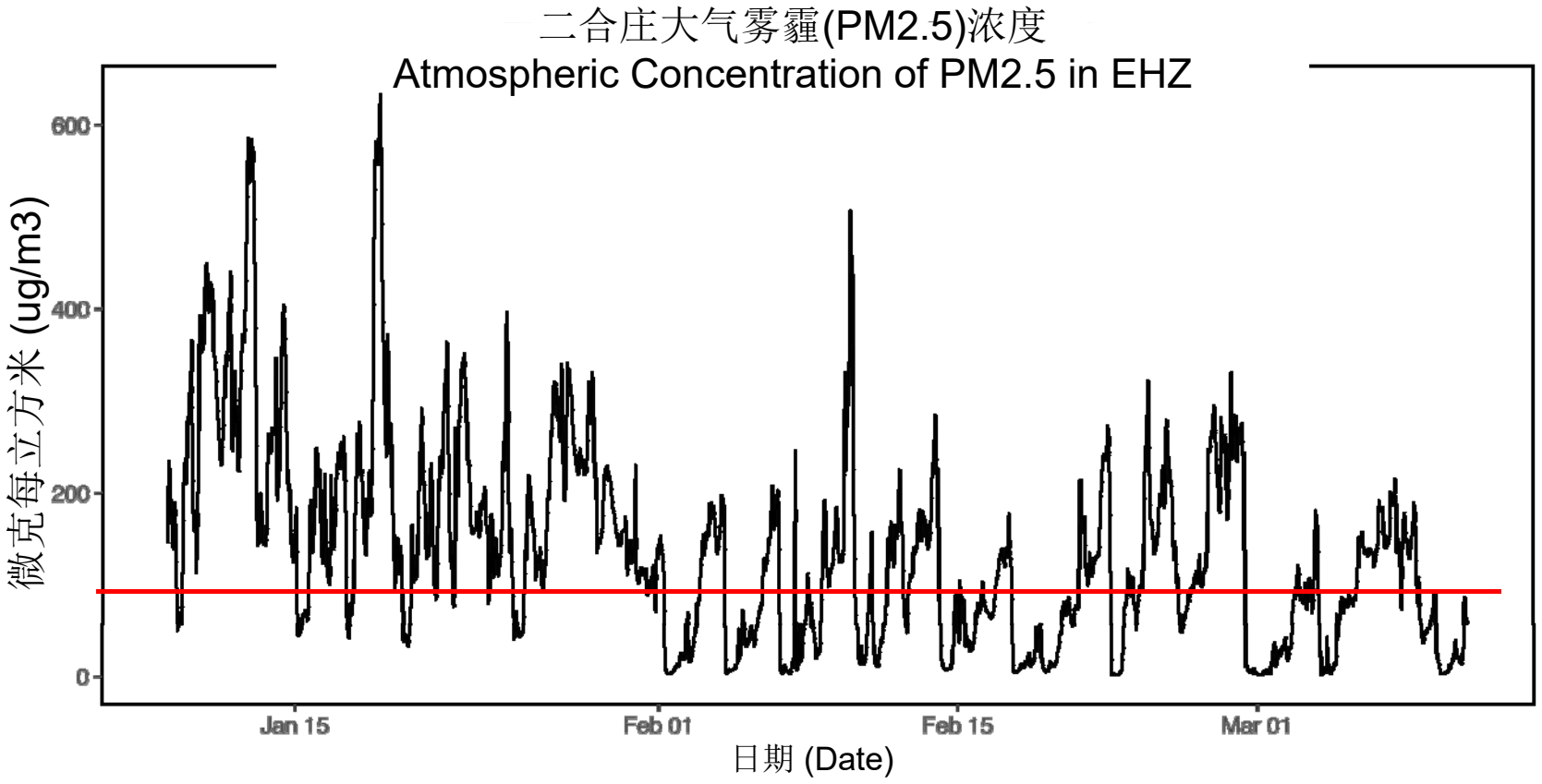


研究结果: 大气雾霾污染
Results: Ambient Air Pollution

从 2013年1月13日至3月10日期间，二合庄村的PM2.5雾霾浓度平均值为 139±107 $\mu g/m^3$(微克每立方米),大大超过中国现行年均值标准35$\mu g/m^3$。从家庭采暖与炊事的平均PM2.5 雾霾排放为736±38 g/hour（克每小时）， 占家庭总排放的92%。根据统计，39%的大气雾霾PM2.5浓度和家庭采暖的雾霾排放存在相关性。

Between Jan. 13th 2013 to March 10th, 2013. The average PM2.5 concentration in EHZ is 139±107 $\mu g/m^3$, *largely exceeded the national standard of 35* $\mu g/m^3$. *The average emission of PM2.5 from household space heating is* 736±38 g/hour, over 90% of which are *from space heating. Statistical analysis indicated that 39% of the PM2.5 concentration associated with household space heating emissions.*





中国PM2.5年均值标准：35 $\mu g/m^3$

（国家标准《环境空气质量标准》GB3095-2016）

China National Standard: 35 ug/m3

建议 Suggestion

根据我的观测，您所在二合庄地区的**室外空气污染（雾霾）和北京城区一样的严重**，这主要是由于您使用的使用煤作为主要燃料的炉灶。
You outdoor pollution has been nearly as bad than that in Beijing during the winter, partly due to pollution from your own stoves

我们研究表明，如果完全使用清洁燃料用于家庭供暖，**可以减少二合庄地区冬季39%左右的大气空气污染**。
Changing all space heating and cooking to clean fuels, such as LPG and electricity, however, **should have reduced your outdoor air** pollution by about 39% in the winter, the worst time of year

建议 Suggestion

因此，除了依靠政府污染大气污染，我们也需要行动起来，使用**电暖，热泵或天然气供暖**可以大大减少室外空气污染

Thus, even if the government is slow in controlling air pollution, you can have much control over you own pollution by using an electric heat pump and LPG.

为了我们的蓝天和健康，**放弃家庭散煤供暖是明智之举！**

For the blue sky and our health, it is good that the village is now saying NO to household coal!

热泵
电暖器

液化石油气暖气

鸣谢与引用的科研报告
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http://dx.doi.org/10.1016/j.atmosenv.2017.05.053

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谢谢！

Thanks for your attention