# New observatories, new data, and new insights on air pollution in the Himalaya

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FOR MOUNTAINS AND PEOPLE

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- Overview of ICIMOD's Atmosphere Initiative
- New air pollution monitoring stations
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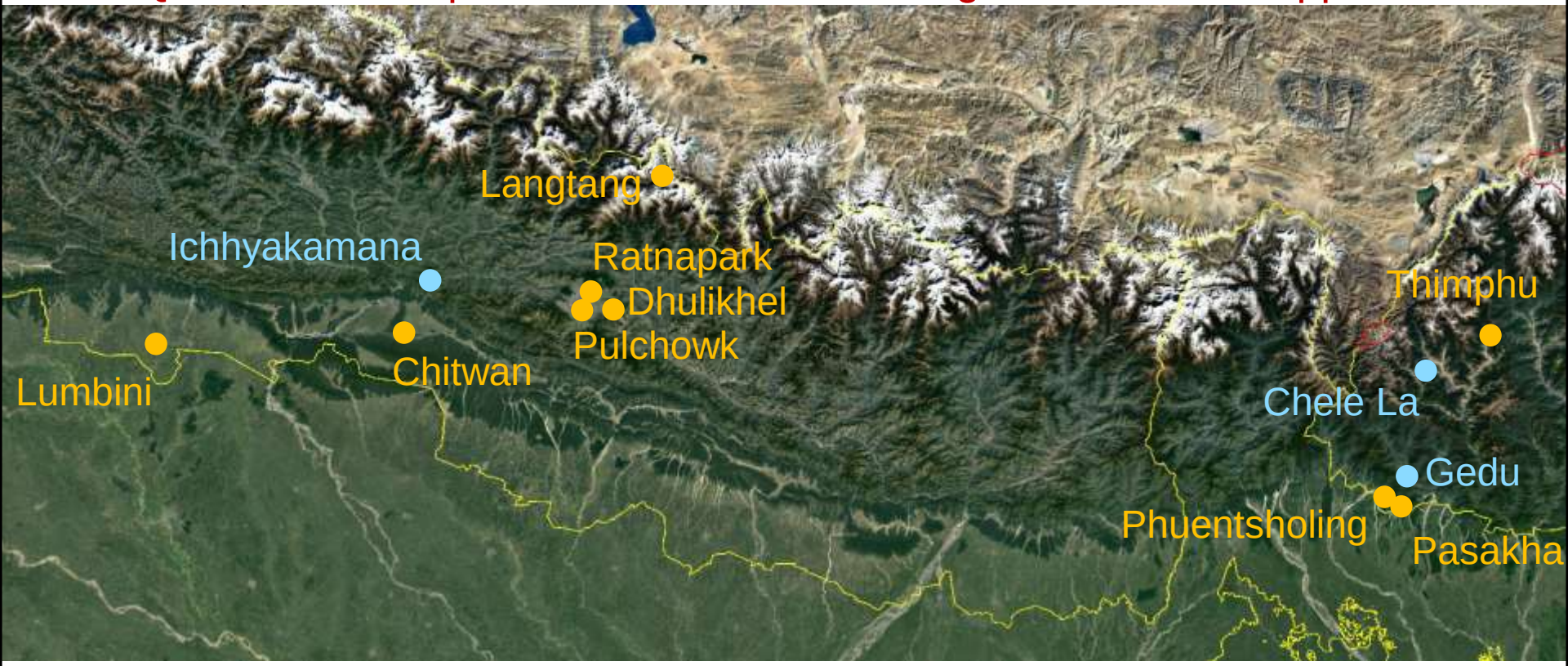
# 7 working areas of the Atmosphere Initiative

A. Improving knowledge about **emissions:** inventories, socio-economic drivers.
**B. Atmospheric processes and change:** Observatories, field campaigns, modeling.
**C. Quantifying impacts**: On climate, cryosphere, water resources, agriculture, tourism, livelihoods, health.
D. Assessing **mitigation options** relevant to the region.
**E. Capacity building:** Supporting PhD students, hosting short courses.
**F. Outreach and network building.**
**G. Policy recommendations** at national, regional and global levels.

# New observatories and AQ monitoring stations

- Working with governments of Bhutan and Nepal to set up air quality monitoring networks.
- 6 AQ stations in Nepal and 3 in Bhutan running with ICIMOD support.




- US embassy contributed 2 AQ stations in Kathmandu to national network, and Government of Nepal is currently installing 7 more stations.

# Air quality monitoring stations

Langtang

Pulchowk

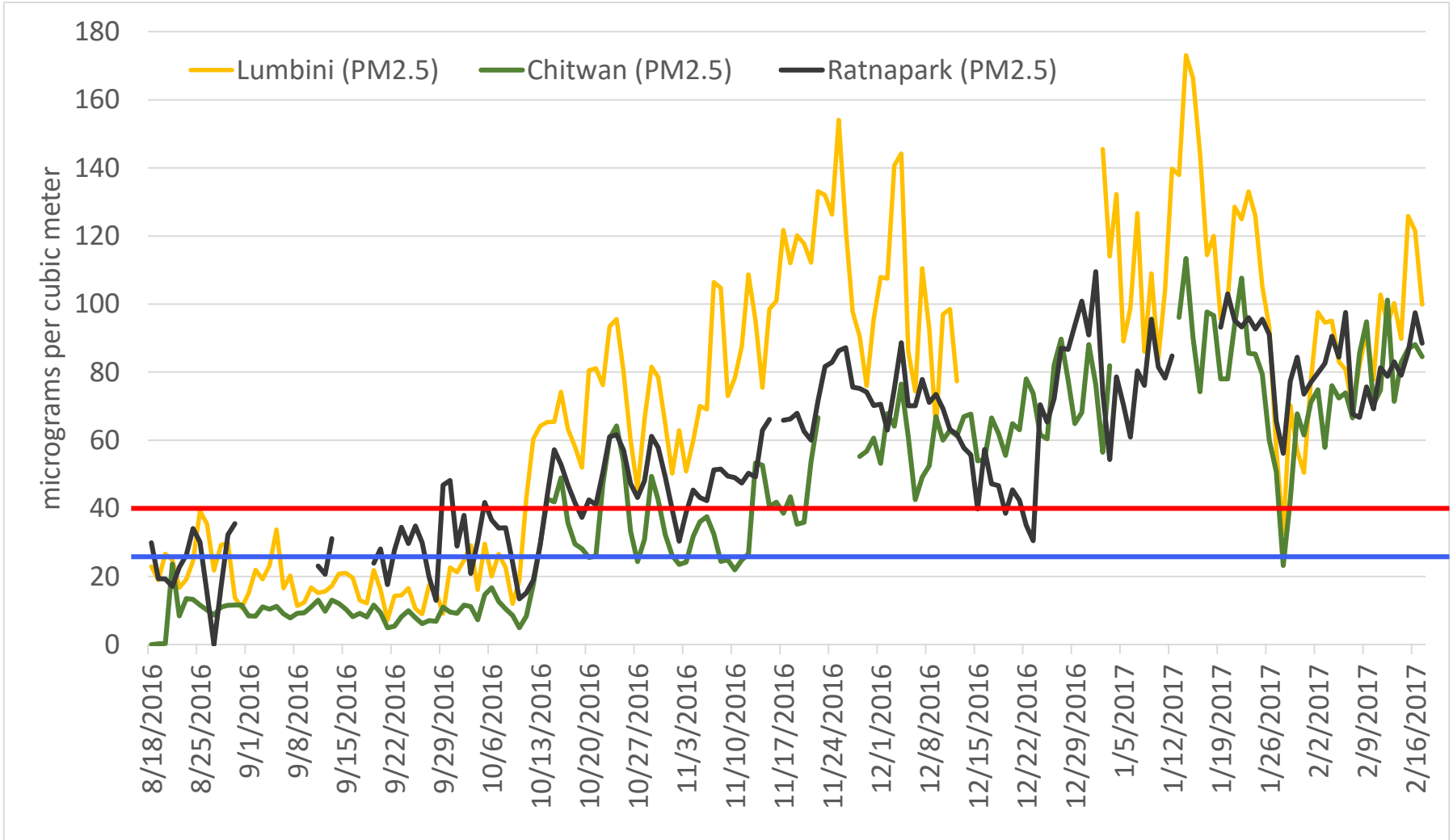
Ratnapark

Dhulikhel

Lumbini

Chitwan

# Realization: Air pollution is a problem beyond the cities!




- During the dry season Lumbini is often MORE polluted than Kathmandu & Chitwan.
- PM2.5 values are FAR above WHO's and even Nepal's more lenient standards.

# Upcoming climate observatories at Ichhyakamana (Nepal) & Gedu (Bhutan)

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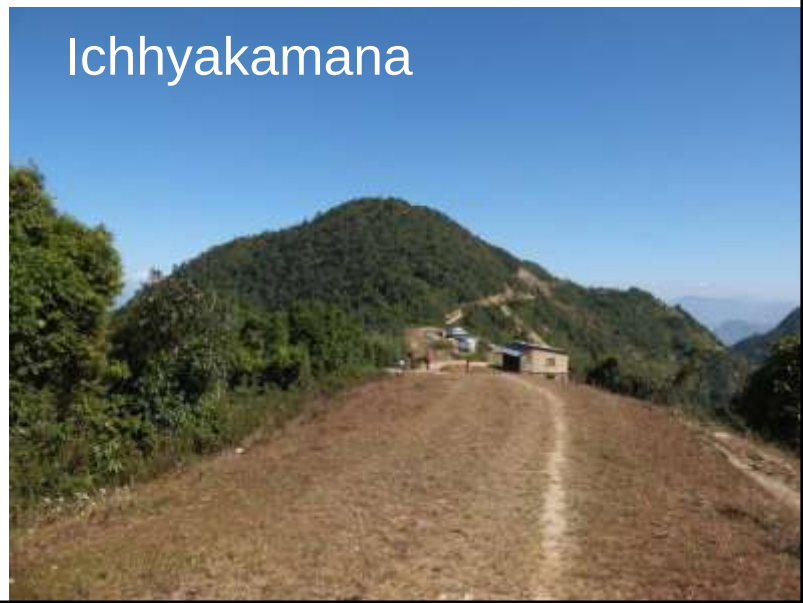
- Locations on 1900-2200 meter peaks overlooking Indo-Gangetic Plains
- At times within IGP haze, at times above it.
- Sites will help quantify inflow of pollutants from plains to mountains.
- Instruments ready for installation:
  - Picarro G2401;
  - TSI APS, CPC, SMPS, nephelometer;
  - K&Z sun tracker,
  - Magee AE-33,
  - Thermo O3,
  - Meteorology, visibility sensors etc.
- Ichhyakamana permission provided by cabinet and will start construction.
- Gedu building almost complete.

# Laboratory building at Gedu

# Black carbon measurements near Yala glacier (4,900m) since September 2016

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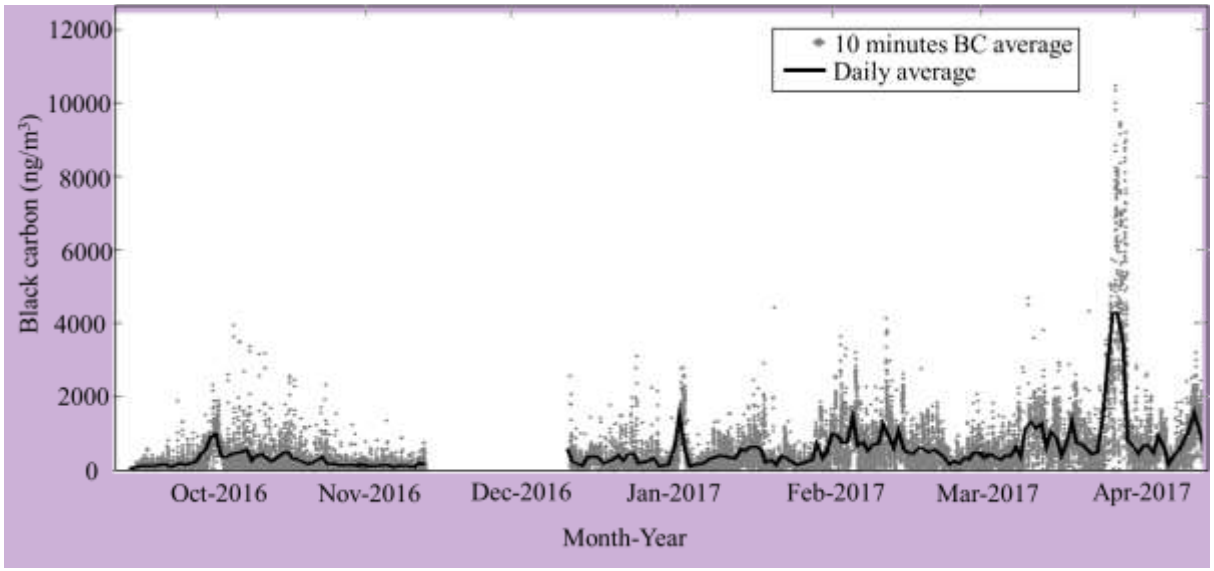



Monthly average BC conc

October-2016 = 325 ng/m3

November-2016 = 171 ng/m3

January-2017 = 378 ng/m3

February-2017 = 622 ng/m3

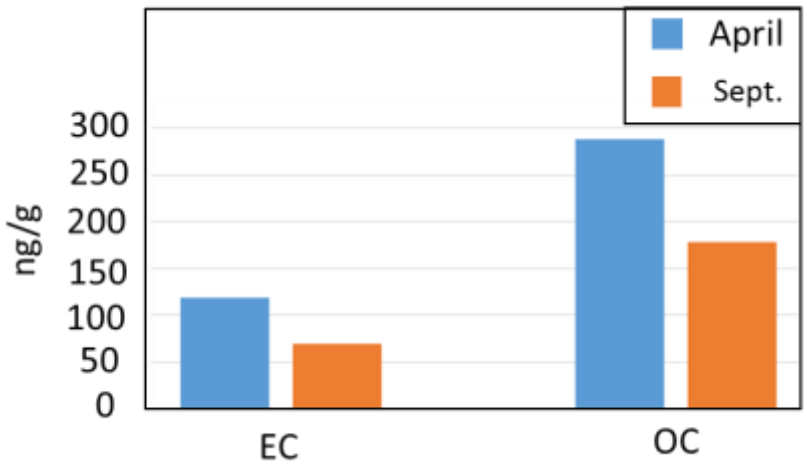
March-2017 = 556 ng/m3

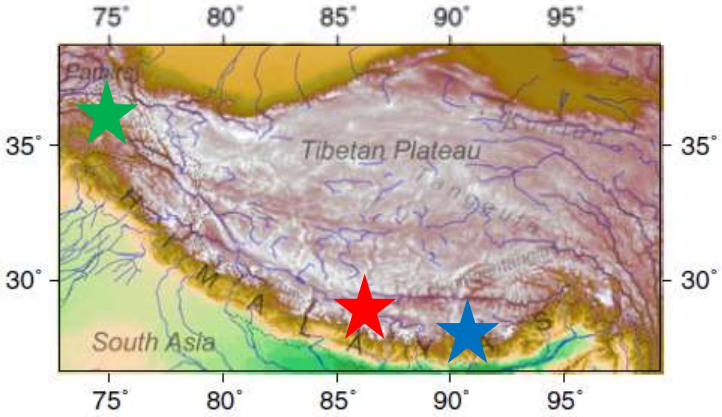
April-2017 = 1177 ng/m3

# Snow and ice sampling in different seasons

Yala glacier

Average concentration of EC and OC in snow samples collected from Yala glacier during April and September-2016

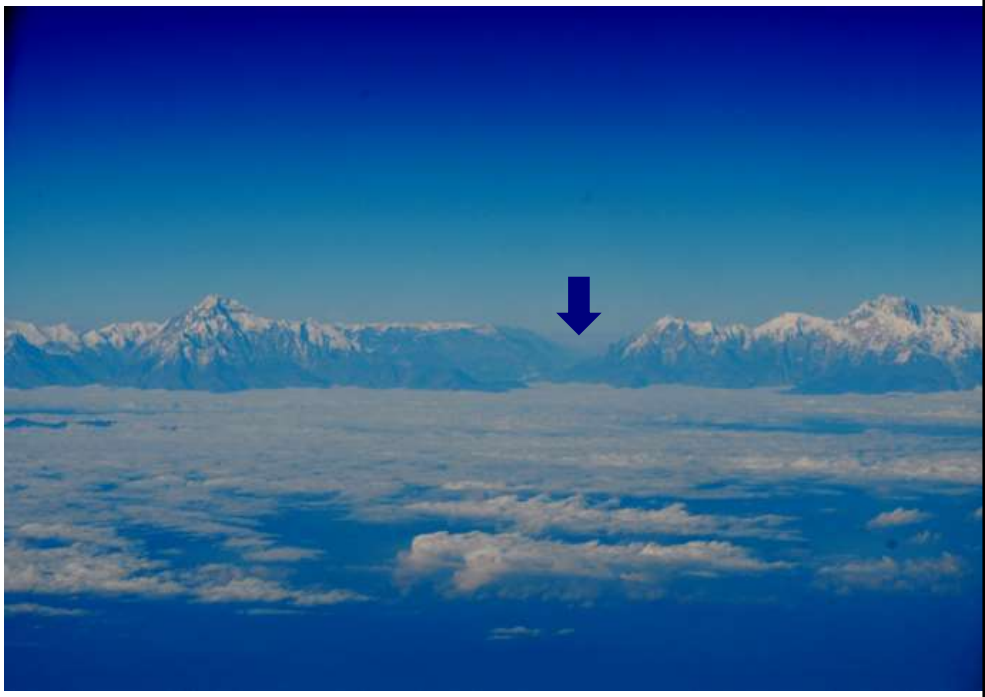


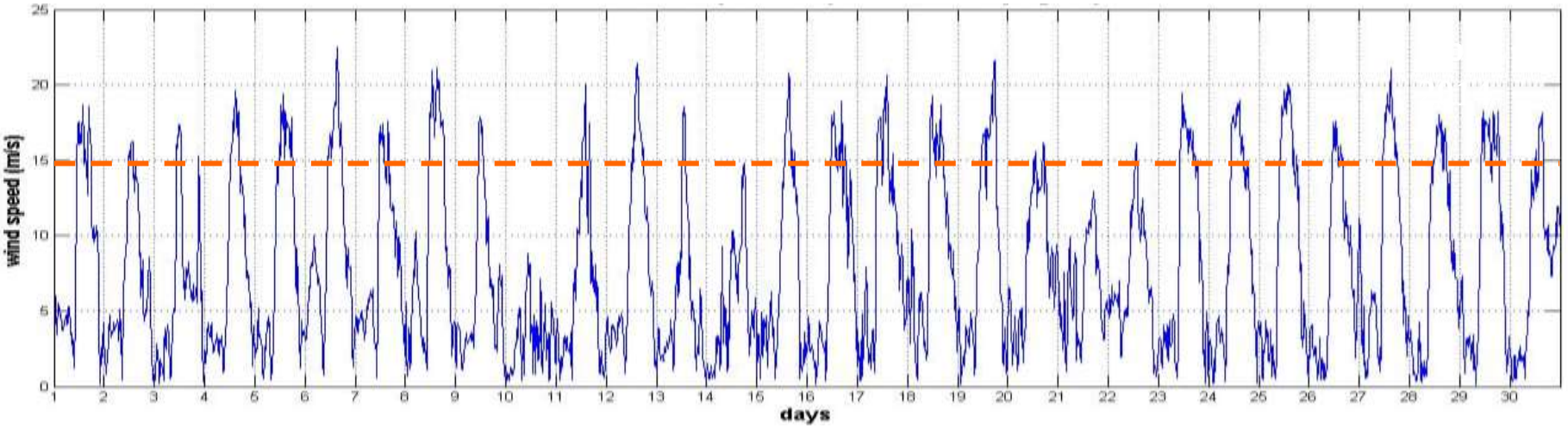



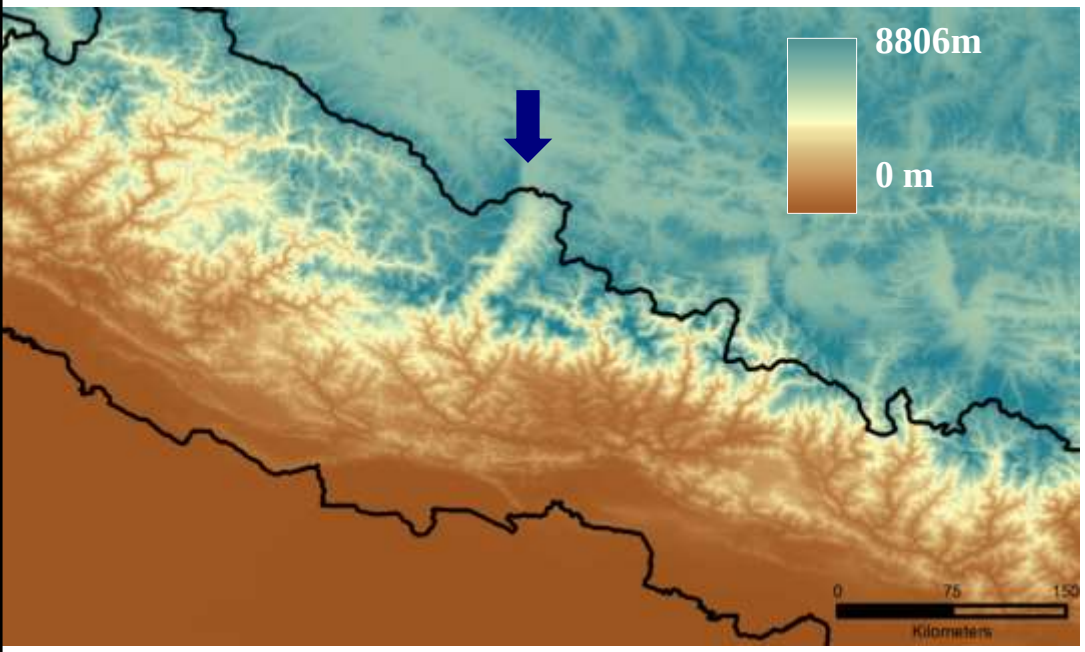

Work of PhD fellow Chaman Gul (enrolled at ITPCAS)

# Trans-Himalayan pollution transport

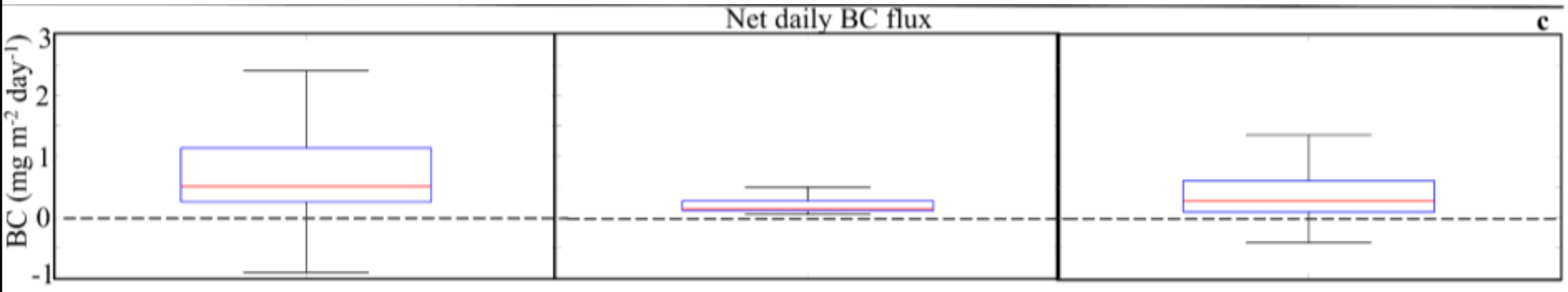
- The Himalaya are NOT an impermeable barrier
- Kali Gandaki Valley, Nepal: Major connection with strong up-valley winds








- Collaborative work with University of Virginia.
- Shradda Dhungel just finished PhD.



# Improving understanding of emissions

- NAMaSTE campaign: Worked with US partners to measure local emission sources (cooking fires, agricultural fires, garbage fires, brick kilns, vehicles).
- Follow-up study on motorcycle emissions:
  - *Work by Linda Maharjan (now at ITPCAS)*
  - *Measured emissions of 56 motorbikes before and after servicing.*
  - *Found that 1-2 % of motorbikes emit 90% of motorbike fleet emissions.*
  - *USD10 servicing can reduce 90% of PM2.5 emissions.*
- Quantitative survey of why open agricultural burning has increased.

# Filter sampling of agricultural residue burning

- November 2016 (Paddy residue burning)
- April 2017 (wheat residue burning)

Work of PhD fellow Manisha Mehra (BHU, India)

# Cleaner brick kilns

- Nepal earthquake provided opportunity for cleaner reconstruction of broken kilns
  - Seed funding from Climate and Clean Air Coalition.
  - Design manuals, engineering support.
- Kiln owners invested own funds (~USD 150K per kiln).
- By now all of Kathmandu's kilns converted to zig-zag firing.
- Significant reductions in coal use, emissions, while producing better bricks.

# Conversion from kilns with straight-line firing to zig-zag

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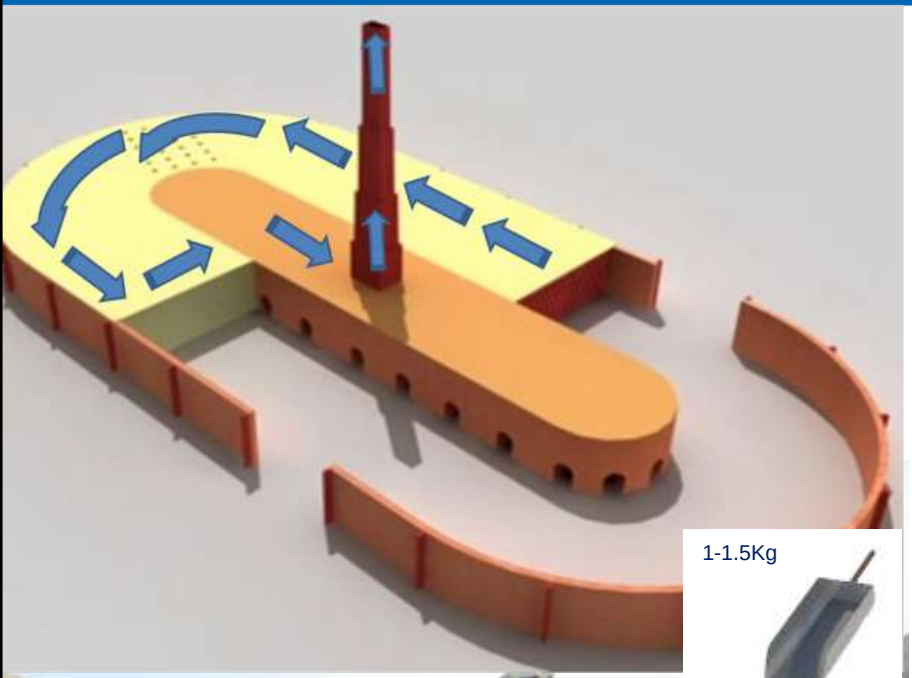
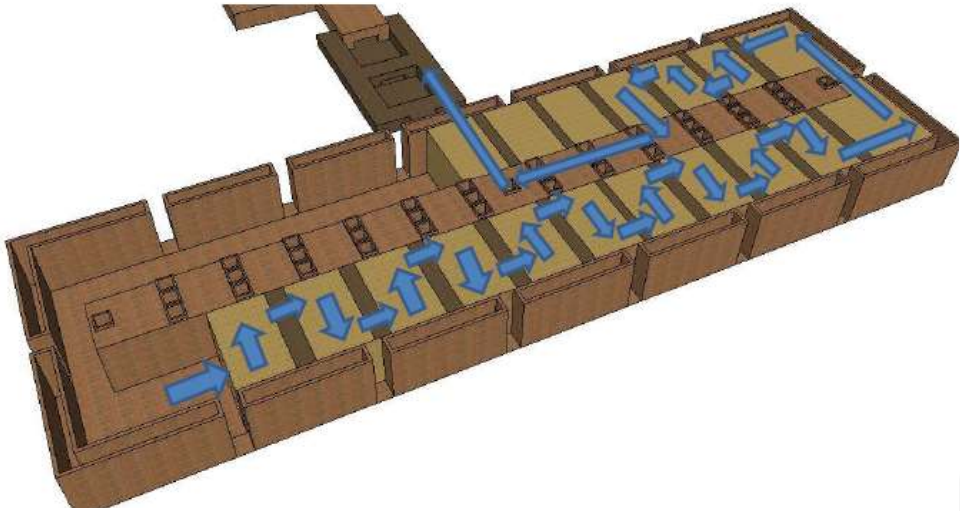
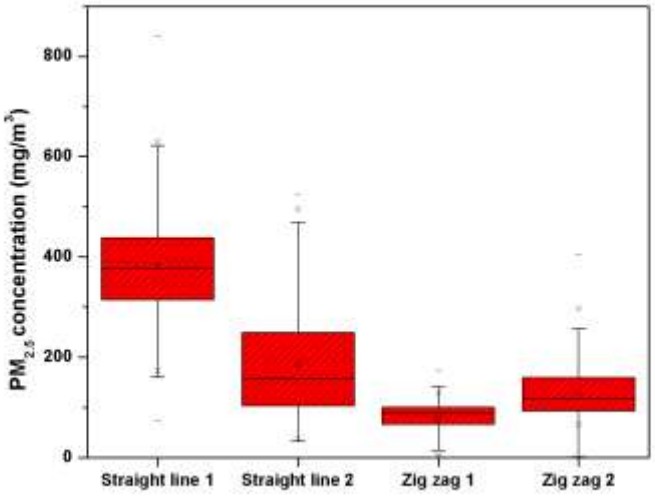


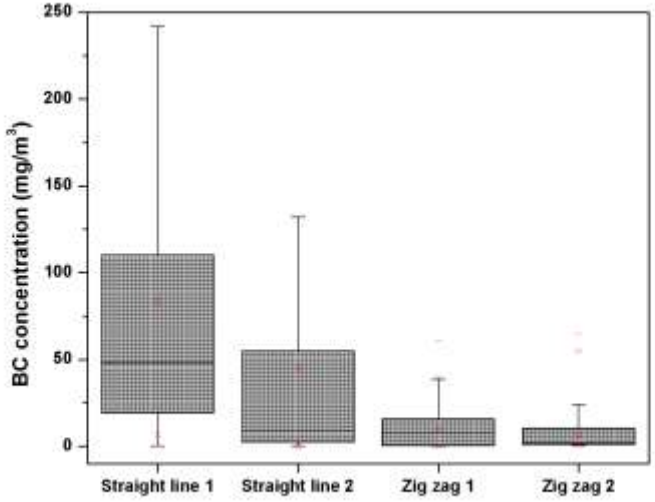


1-1.5Kg



200-400gm


800
600
400
200
0
PM2.5 concentration (mg/m3)
Straight line 1
Straight line 2
Zig zag 1
Zig zag 2


250
200
150
100
50
0
BC concentration (mg/m3)
Straight line 1
Straight line 2
Zig zag 1
Zig zag 2

# Studies on cooking and indoor air quality

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- Comparison of indoor air quality in kitchen versus living space in houses with different stoves, layouts (study by Alpha Thapa)

- Impact of different stoves on exposure and lung function (Parth Mahapatra + doctors from Kathmandu Medical College)
- Provided free health check ups to participating families.

# Estimating contribution of indoor emissions to outdoor air pollution

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- What fraction of cooking emissions escape kitchen? What lag time?
- Measured indoors, at exit, village background, regional background.
- Impacts of outdoor fires.

# Winter fog over the Indo-Gangetic Plains

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- Past 2 decades have had much more winter fog across Indo-Gangetic Plains than before.
- Covers large area, often lasts many days.
- Affects lives of several hundred million people, esp. poorest.
- No scientific consensus on roles played by pollution (CCN) versus changing moisture availability (winter irrigation).
- ICIMOD has been trying to get scientists across the region to work together.
- IF YOU ARE INTERESTED PLEASE JOIN OUR SPECIAL SESSION ON FRIDAY AT 1:30 PM, RIGHT HERE.

# Thank you

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Government of Nepal

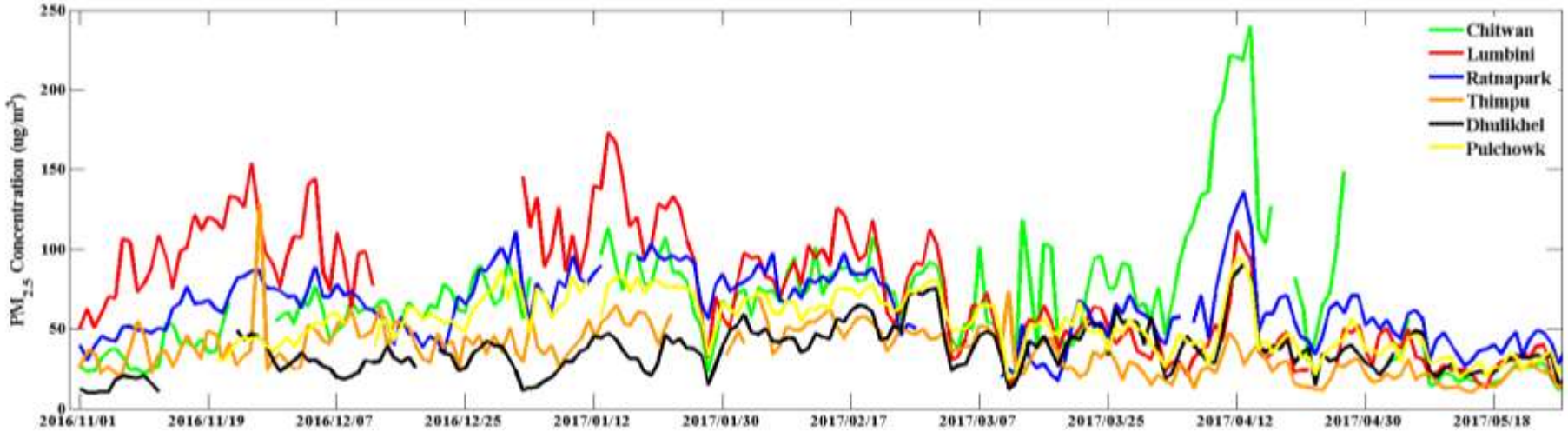
NORWEGIAN MINISTRY OF FOREIGN AFFAIRS

SWEDEN

CLIMATE & CLEAN AIR COALITION
TO REDUCE SHORT-LIVED CLIMATE POLLUTANTS

DFID Department for International Development

## PM2.5 from November 2016 to May 2017




- High concentrations in Lumbini November and December because of the massive open burning of agricultural crop residue burning, and in January because of heating fires during fog.

- High concentrations in Chitwan during Spring because of forest fires.