

Atmosphere Regional Programme Activities in Bhutan



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The Atmosphere Programme at the International Centre for Integrated Mountain Development (ICIMOD) aims to shape policies and actions to mitigate air pollution and improve environmental and human health. To that end, the Programme promotes the use of science-based knowledge on air quality, atmospheric processes, and climate in ICIMOD regional member countries. The work involves improving understanding of i) atmospheric processes that affect pollutants, ii) air pollution emission sources and their economic drivers, and iii) atmospheric changes and their impacts. It also involves motivating plans, policies, and actions to reduce emissions. Underlying this work is an emphasis on raising awareness, building capacity, and promoting collaboration across institutions and borders.

The programme collaborates with Bhutan's National Environment Commission (NEC) to set up Air Quality Monitoring Stations (AQMS) in Thimphu, Phuentsholing, the Pasakha industrial zone (to monitor heavy particulate loads), Chele La (high-altitude), and Gedu (mid-altitude). These stations report data on meteorological parameters as well as mass concentrations of particulate matter, black carbon (BC), and a few gaseous parameters in ambient air.



Air Quality Monitoring Stations established by ICIMOD and NEC in Bhutan

AQMS in Bhutan have filled globally-relevant data gaps and begun generating real-time data useful to policymakers and the public. The data has enabled better understanding of the impact of pollutants on health and environment in the HKH.

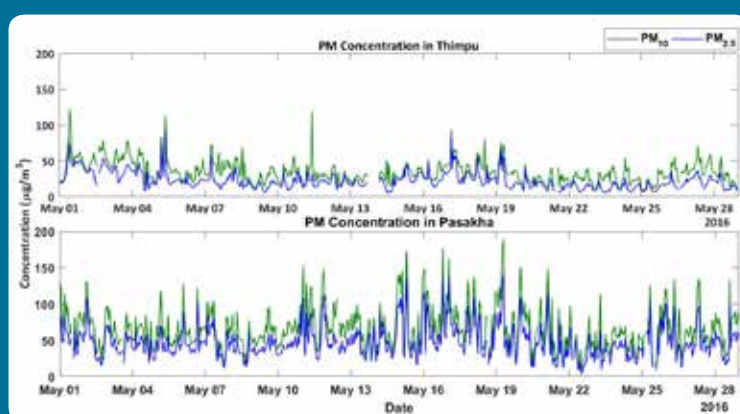
The AQMS in **Thimpu** (~2320 m) houses four gas analyzers to measure surface ozone (O_3), sulphur dioxide (SO_2), carbon monoxide (CO), and nitrogen oxides (NO); an environmental dust monitor, GRIMM-EDM-180D, to measure particulate matter (PM) mass concentration; and an Aethalometer AE33 to measure BC concentration in the ambient atmosphere.

The AQMS set up in **Pasakha**, a town in southern Bhutan and the country's first and biggest industrial hub, is at an approximate elevation of 291 m. Being an industrial township, a high content of Sulphur was observed in the ambient atmosphere of the area.

In the southern Bhutan border town of Phuentsholing, at an approximate elevation of 293 m, and AQMS is located on the premises of the College of Science and Technology (CST), which is the only engineering college in Richending, Phuentsholing, Bhutan.

Black carbon plays an important role in melting snowfields and glaciers by darkening white surfaces and warming air in contact with snowfields and glaciers. The independent black carbon station at **Chelela** is the first high-altitude site in Bhutan, the data of which is used to quantify higher altitude inflow of black carbon towards

Ambient Particulate Matter (PM) Concentration



the Himalayan cryosphere. The station is powered by wind and solar energy, with a bank of storage batteries, and like all other AQMS stations in Bhutan, it transmits live data to a server at NEC and to ICIMOD for quality control. Chelela is in a high-altitude area with approximate elevation of 4,200 m, located in the western part of Bhutan, 60 km from the Haa valley.

A mid-altitude AQMS is located at **Gedu**, a township in southwestern Bhutan located on a peak at an approximate elevation of 1,960 m and surrounded by forest with no nearby source of air pollution with a motive to collect background air quality information. As it faces the Bay of Bengal, Gedu experiences frequent rain and thunderstorms.