

India's First-ever Himalayan High-Altitude Atmospheric and Climate Research Centre



IN a historic development for climate science and international collaboration, Dr Jitendra Singh, Union Minister of State (Independent Charge) for S&T and Earth Sciences, inaugurated the Himalayan High Altitude Atmospheric and Climate Research Centre at village Mandlote in Jammu & Kashmir's Udhampur district on 8 April 2025. Perched at an elevation of 2,250 metres, the centre is now the highest such research facility in the north-western Himalayas and a major step toward placing India at the forefront of global climate research.

The facility was inaugurated in the presence of Dr M Ravichandran, Secretary, Ministry of Earth Sciences, GoI; Prof. Dr Sanjeev Jain, Vice Chancellor, Central University of Jammu; Shri Satish Sharma, J&K State Minister for Science and Technology; Shri Vasu Yadav, Chairman, Jammu & Kashmir Pollution Control Committee; local leaders and the public; and officials/researchers from the participating organisations.

Dr Singh also flagged off the Indo-Swiss Joint Research Project "ICE-CRUNCH" (Ice nucleating particles and cloud condensation nuclei properties in the North-Western Himalayas). ICE-CRUNCH is a collaborative research effort of scientists and researchers from the Central University of Jammu and ETH Zürich, supported by the Swiss National Science Foundation (SNSF) and the Ministry of Earth Sciences, GoI.

Addressing the gathering, Dr Singh described the establishment as a "milestone moment" in India's accelerated journey toward understanding climate sciences. "This state-of-the-art facility, established at one of the cleanest and most pristine locations in the country, will serve as a strategic gateway for advanced climate and atmospheric research," added Dr Singh. He also mentioned that this development makes Jammu & Kashmir a research hotspot in India's global initiative in climate study and research in the Himalayas.

Dr Singh praised this integrated effort as a "synergised model of governance and global scientific partnership," aligning with India's approach to climate resilience and environmental stewardship. He referenced other Himalayan-focused initiatives like the Aroma Mission and the Floriculture Mission as examples of how the region's natural resources are being utilised to bolster India's economy while preserving ecological balance.

The new centre is a product of multi-tier collaboration involving the Ministry of Earth Sciences, the Government of Jammu and Kashmir, the Central University of Jammu, the Swiss National Science Foundation, and ETH, Zurich.

Strategic Significance of the Centre

Located in the hill station Nathatop, an area with extremely low pollution and clean air, the centre offers rare conditions ideal for studying atmospheric processes in the free troposphere.



These studies are essential to understanding cloud formation, aerosol behaviour, and weather dynamics, providing critical data for developing accurate climate models and forecasts.

The first major research initiative at the centre will be the ICE-CRUNCH project, which investigates ice-nucleating particles and cloud condensation nuclei. These particles play a key role in cloud microphysics, influencing precipitation, temperature regulation, and overall climate behaviour.

Experts say this kind of research fills a major observational gap in the Global East and South and will contribute to reducing uncertainty in climate modelling. The data generated here will be integrated into the World Meteorological Organisation's (WMO) Global Atmospheric Watch (GAW) programme, to which the centre aspires to be formally affiliated in the future.

A Hub for Science, Training, and Innovation

Beyond scientific exploration, the centre is set to become a major hub for capacity building and education in atmospheric sciences. Training programmes, student workshops, and field-based studies will be organised to nurture the next generation of Indian climate scientists.

The inauguration ceremony also saw the signing of two significant Memoranda of Understanding (MoUs). The first was between the Central University of Jammu and the India Meteorological Department (IMD), focusing on real-time analysis of extreme weather events and establishing the site as a background observational station for environmental monitoring under the WMO-GAW network.

The second MoU was signed between the Central University of Jammu, the J&K Forest Department, and the Jammu & Kashmir Pollution Control Committee (JKPCC). It aims to facilitate coordinated measurements and long-term atmospheric monitoring at the Centre.

Cutting-Edge Technology and Global Impact

Equipped with world-class instruments, including sophisticated measurement systems from ETH Zürich, the centre is designed to monitor atmospheric conditions with precision. It

will track transboundary air masses moving across eastern and western regions, helping scientists trace pollution sources and study their broader impacts. This capability makes the facility a vital node in global atmospheric research, filling critical gaps in data from the Global East and South.

The centre's integration into international networks, such as the World Meteorological Organisation's Global

Atmospheric Watch Programme, ensures that its findings will contribute to worldwide efforts to combat climate change. Continuous monitoring, in partnership with the India Meteorological Department, will provide long-term data to support global climate strategies.

A Vision for the Future

The establishment of the Himalayan High Altitude Atmospheric and Climate Research Centre aligns with India's broader efforts to bolster its meteorological infrastructure. Recent initiatives, such as the installation of weather radars in Jammu & Kashmir and increased funding for climate research, underscore the nation's dedication to science-driven development.

As the Himalayas evolve from being known as the world's water towers to becoming vital climate observatories, this facility positions India at the forefront of global climate science. It is more than a research station — it is a symbol of hope and collaboration, where scientists from India, Switzerland, and beyond are working together to unravel the complexities of our planet's atmosphere.

The Himalayas are not just a geographical marvel; they are a critical region for understanding climate change. The data collected at Mandlote will help scientists predict how shifts in atmospheric patterns could affect water resources, agriculture, and communities worldwide. By investing in high-altitude research, India is taking a proactive step toward building a more resilient future, both for itself and for the global community.

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From blanketing to bloom: the chill-dependent molecular regulatory signals influencing apple economy

THE apple trees, when in full bloom, embody a picturesque sight among the low-lying foregrounds of the evergreen pines in Himachal Pradesh. The hill state of Himachal Pradesh has also begun to witness changes in climatic conditions as a tragic repercussion of mankind's growing apathy towards the environment. This is significantly going to impact the commencement of events related to apple growth, which accounts for roughly 49% of the state's total acreage planted with fruit crops and 82.5% of its total fruit production. During the last year, 2024, the bud break and blooming were delayed by at least three weeks due to changes in weather patterns.

Apple is a deciduous woody perennial highly sensitive to temperature. A crucial phase of the perennial life cycle of the apple is 'dormancy'. Dormancy is the temporary cessation of visible growth in the actively dividing zones of cells in apple buds, called meristems. Though there are many factors, short photoperiods and low temperatures in autumn act as primary triggers for dormancy. This is an important process of blanketing the fragile meristems for enduring upcoming winters. While it is important to protect the fragile meristems from harsh winters, adequate chilling hours are equally important for adequate blooming and fruit setting. Inadequate chilling decreases the yield potential of apples due to bud break problems.

During winters, the apple branches, therefore adorned with snow, seem to gracefully bow in gratitude towards the heavenly bliss. Following adequate chilling, when favourable growth conditions like temperature, nutrients and water become available, the growth resumes and bud break events are triggered. Flowering occurs in the spring during relatively warm temperatures. This year, the bud break and blooming events have been particularly delayed due to extended cold temperatures. The productivity in fruit crops is directly dependent on timely flowering and fruit set. Apple growers are often worried about the likely impact of climate change on apple production every year.

Over the last decade, understanding the mechanisms governing bud dormancy and bud break, and other temperature-cycling-related growth events has been a topic of research in temperate horticulture. Different environmental cues, primarily related to temperature and light, act as triggers for the activation of various

Pollinator Sanctuary establishment is an essential conservation strategy for preventing the alarming decline of bee populations

BEES represent one of the most important natural pollinators in our global ecosystem. Close to 90% of all flowering plants are directly and/or indirectly dependent on primary pollinators like bees for the purpose of cross-pollination in nature. Without successful cross-pollination by bees, the genetic exchanges between different plants would be restricted, impacting the process of gene flow in nature. Thus, bees have a very strong evolutionary connection with plants for several million years in the geological time scale. Through this systematic evolution, both bees and their host plants have arrived at the current morphological and anatomical characteristics necessary to

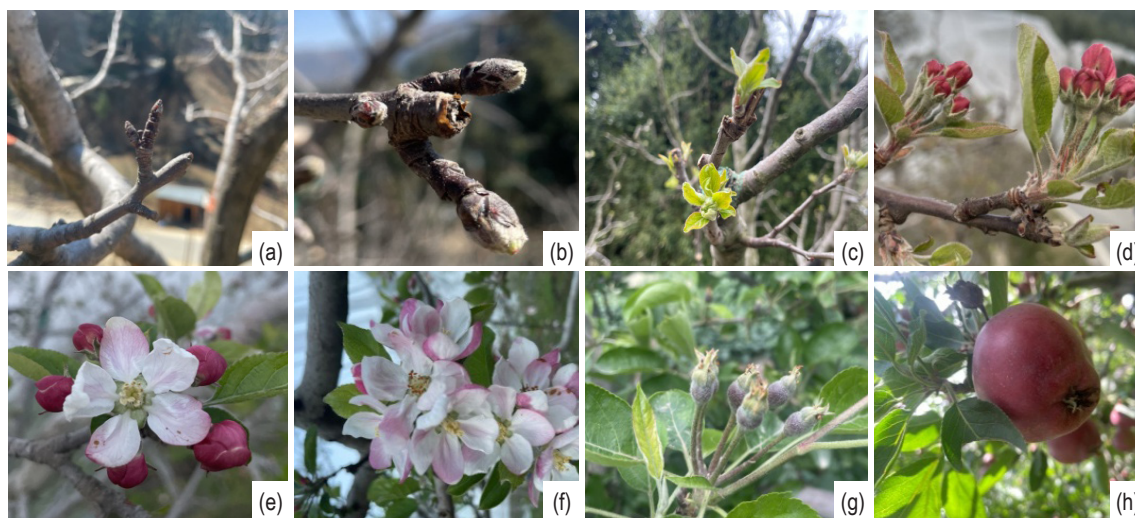
facilitate cross-pollination in nature to secure the next generation of plants.

Not just bees, but scores of other natural pollinators such as moths and butterflies, some species of flies, beetles, ants and wasps, snails and slugs, birds and bats are all involved in the process of cross-pollination of flowers either during the day or nighttime. However, bees are one of the most abundant, diurnal, efficient, prolific, and primary pollinators present in our ecosystem. Not only the honeybees, but also wild (native) and endemic bee species located in specific biogeographical areas are successfully associated with the primary cross-pollination of different plant species. Thus, in simple words, bees play a significant role in the following three industries: Apiculture, Agriculture and Forestry. Hence, bees are integrated both with our global economy and ecology.

Rapid Decline of Global Bee Populations

However, the bee populations are showing a dramatic decline across the planet. Due to both natural and anthropogenic factors, both honeybees as well as native and endemic species are also showing signs of decline in their respective populations. Rapid expansion in the industrial and agricultural sectors with increasing human populations, indiscriminate application of toxic chemical insecticides and excessive use of synthetic chemical fertilizers, air and water pollution, climate change, lack of suitable foraging plants (mellifluous flora), changes in the land use patterns, rise in bee diseases, poor immunity and low nutritional levels in bees, Colony Collapse Disorder (CCDs) have all cumulatively contributed towards an alarming global bee decline.

The loss of bees signifies an imminent danger for both our ecology and economy, as bees are the cornerstones of human civilisation from time immemorial. Without the bees, the stability of our global ecological dynamics is threatened with destabilisation on one hand; and on the



Various stages of progression of bud break and fruit set events in apple: a) Dormant apple bud; b) Early green tip; c) Tight cluster; d) Pink bud; e) King bloom; f) Bloom; g) Fruit set; h) Apple fruit

(m i R N A s) expressed in the apple meristem. In future, this could be beneficial in deciphering the crucial molecules playing important roles in temperature-cycling-related bud growth events in apple. For the effective selection of cultivars for a specific location, a deeper comprehension of the physiological and molecular

molecular and physiological events which regulate bud break. These signals may be brought from distantly localised tissues to bud break sites. It is often challenging to carry out molecular analysis in less-accessible tissues, like the meristem of woody tree species. While working as a Post-Doctoral Fellow at the National Institute of Plant Genome Research (NIPGR), New Delhi, we carried out laser-based excision of the woody apple meristem and identified the tiny molecular regulators

phenomena influencing the dormancy phenomenon is important in apple.

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flowering period overlaps with another, providing bees with available and accessible flowers for an extended period. An abundance of nesting, foraging and feeding sites for bees helps them to recover their numbers and make up for their losses due to their untimely deaths due to pollution.

other hand, people dependent on their livelihoods associated with agriculture, apiculture and forestry are in serious jeopardy. Hence, education and awareness of the public are important. We all need to realise that without the successful conservation of bees, our own virtual existence is simply in jeopardy.

Pollinator Sanctuaries

Bee conservation has been successfully demonstrated by the establishment of Pollinator Sanctuaries. The Pollinator Sanctuaries are established by preparing a seed mix comprising a rich diversity of annual, biennial and perennial plants comprising grasses, forbs, herbs, legumes and local wildflowers. The carefully selected plant diversity provides both nesting and foraging opportunities for the bees and enables them to nest in a purely natural ecological habitat. This helps in the replenishment of a bee colony by removing ecological stress and provides them with easy access to a rich diversity of plants suitable for collecting adequate nectar and pollen across the entire season. Plants are selected in a manner so that their

Food for Thought

Our research in Canada and the US have clearly demonstrated that such creation of natural eight-habitat spots within and around agricultural areas has been greatly successful in attracting a wide diversity of local bee species for foraging, nesting and building hives. Not only bees, but Pollinator Sanctuaries have transformed into local biodiversity enrichment sites with small passerine birds, mammals, amphibians and reptiles finding refuge here. Pollinator Sanctuaries have been found most successful around irrigation canals, ponds, lakes, swamps, bogs, ditches, dugouts, boulevards and avenues, city parks and gardens, backyard kitchen gardens and lawns, farm perimeters, forest fringe areas; and on any agronomically unsuitable areas or unused, open spaces in rural and urban areas. Recreation of natural habitats with melliferous flora has a significant impact on bee conservation as well as local biodiversity preservation.

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