In this issue

Academic Freedom

Research and responsibility

While the activity of constructing new knowledge is as pleasurable as creating new music or painting, and requires the same freedom of pursuit in whatever direction desired by the researcher, quite often the outcome of the activity has technological and, therefore, socio-economic repercussions. Science and technology are intertwined and there is a blurring of distinction between the two. Science and technology policies being articulated tend to consider scientific research as utilitarian, to aid agriculture, industry, medicine and engineering.

How can we balance the need for academic freedom with the responsibility of contributing to national development? Academic freedom available to faculty can be exercised to link research to national development. While directing research to aid national development, freedom for curiosity-driven research will invariably extend the impact serendipitously, opines R. B. Grover, Homi Bhabha National Institute, in a General Article on **page 1885** in this issue.

Potato Cyst Nematode

Containing spread

Potato cyst nematode travelled from South America to India via Europe a long time ago along with the introduction of the crop in the subcontinent. The cysts hatch in response to root exudates and the worm firmly embeds its head into the root to suck out nourishment. In potato farms, the infestation can cause loss of harvest by more than 60%.

Given the importance of the crop to India, the ICAR brought together many organisations for an all India research project on nematodes and, from 2011, a survey was initiated in Himachal Pradesh, Jammu & Kashmir and Uttarakhand. A Research Article in this issue provides some important insights necessary to contain the spread of the pest in the hilly states of India: avoid continuous cropping of potatoes, avoid planting for *kharif* and quarantine seeding material from infected areas. Read on from **page 1946** to see how the results of this research led to a response from the Ministry.

Extreme Rainfall Events

Dynamic downscaling

On 1 December 2015, Chennai received 276 mm of rainfall – more than 70% of the expected seasonal rainfall in one day! The human suffering caused in the city was unimaginable. C. Balaji and team from IIT Madras had to come to grips with the problem: there is a need to predict such concentrated downpour of intense rain to enable dealing with the phenomenon.

They used the advanced Weather Research and Forecasting model, taking initial conditions from data representing a quarter of a degree space at three-hour intervals. To improve accuracy, they used a triple-nested domain technique where domains increase in special resolution and results from finer resolutions are fed back to the domain with coarser resolution to update the mesh. Thus they could reach a spatial resolution of about 3 kilometres.

Relying on the monthly mean data of the Chennai–Puducherry region from 1985 to 2005, they applied the pseudo global warming method to project future scenarios from 2015 to 2085. For the theoretical projection, they used a representative concentration pathway that assumes no plateau for rising green house gases.

A consensus of an ensemble of models may be good to predict the Indian monsoon as the Community Climate System Model has demonstrated. But the thermodynamics behind the different models should remain the same, the researchers reasoned. There are six different schemes for the microphysics of cumulus. They tested all six. A warm rain microphysics in combination with the Kain–Fritsch convective parameterization scheme, they found, agreed with the data more closely and so this scheme was selected for further modelling.

The IIT Madras model describes the 2015 event fairly well both temporally and spatially. And it predicts increase in sea surface temperature and moisture in the Bay of Bengal region. Similar flood events in the future may last longer, they say. It is time now for planning to manage and mitigate such events in the south east coast of India. Read on for details in the Research Article on **page 1968** in this issue.

The Air We Breathe

Measuring trace gases

Nitrogen and oxygen account for 99% of the air in the earth's atmosphere. In the remaining one per cent, besides argon, a relatively non-reactive element, there are greenhouse gases such as water vapour, carbon dioxide, methane, nitrous oxide, ozone, and chlorofluorocarbons. And then there are gases like carbon monoxide and oxides of nitrogen, and volatile organic compounds such as benzene, toluene, ethylbenzene and xylene, especially in industrial areas.

Though some of these gases may be present only in concentrations of one in a million parts or less, they have implications on climate, meteorology, environment and human health. So there is a need to constantly monitor these trace gases. What are the technologies available? How can we complement measurements from ground-based instruments with measurements from ship, aircraft, balloons and satellites, to get a more comprehensive understanding of changes in the concentrations of these trace gases due to convection, advection and photochemical reactions? What national and international collaborations are needed to get more accurate data to frame policies controlling air quality and climate change on regional scales, as several trace gases and their by-products are important pollutants in different environments?

Researchers from the PRL Ahmedabad, IIT Gandhinagar and IITM Pune delve into the details in a Review Article on **page 1893** in this issue.

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