6

OTHER RESEARCH ACTIVITIES

Indigenous software for generating “Multi-Walled Penta-Graphene Sheet” and “Multi-Walled Penta-Graphene Nanotube” has been developed for the first time. Indian Ocean Sea Surface Temperatures (SST) impact rainfall and temperature patterns over the neighbouring nations. Identifying the low-frequency evolution of SST is critical to examine the empirical prediction skills of the interannual changes in Indian Summer Rainfall.

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6.1 Multi-Walled Penta-Graphene Nanotube

Using in-house indigenous software, the coordinates of a double-walled penta-graphene sheet (Figure 6.1), triple-walled penta-graphene sheet created for the first time. The penta-graphene nanotube (Figure 6.2) created by rolling penta-graphene sheet coordinates geometry.

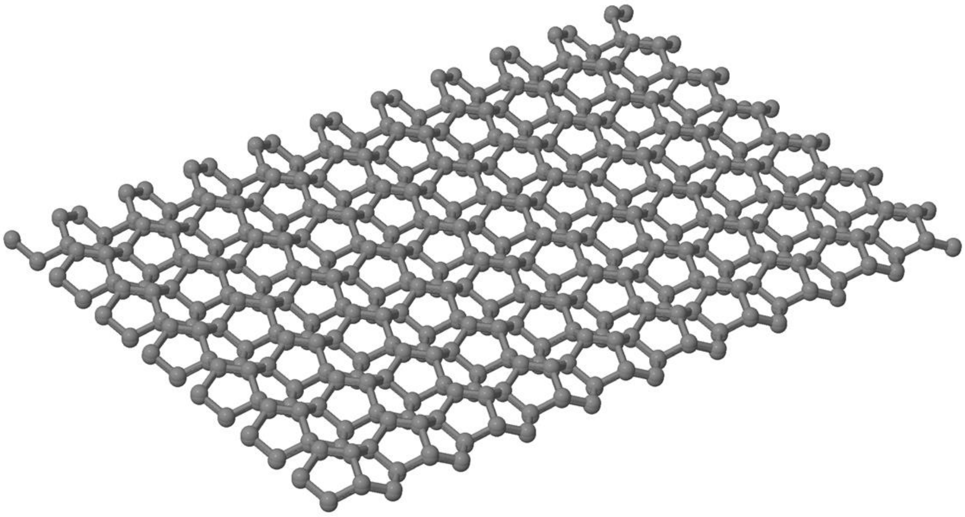

Figure 6.1 Double-walled Penta-Graphene Sheet

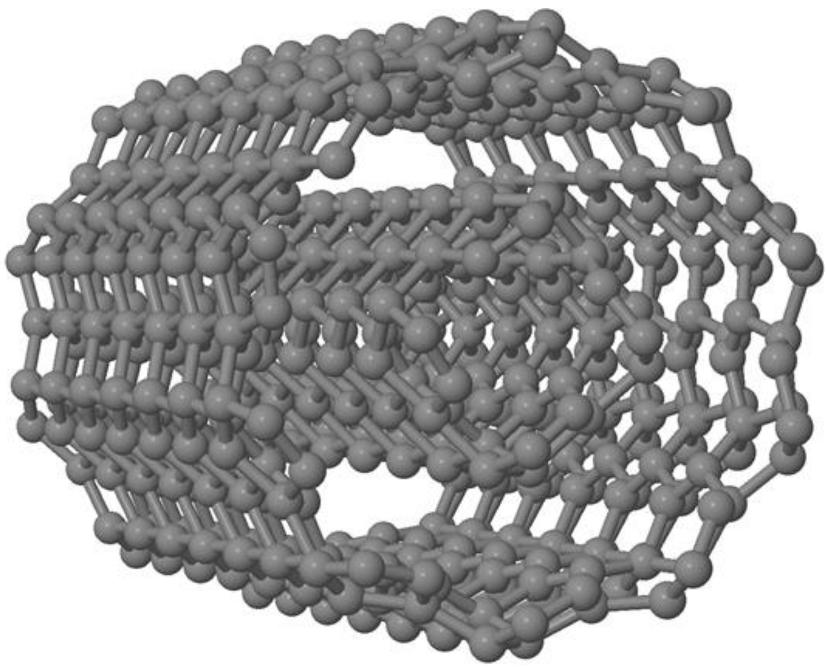

Figure 6.2 Double-walled Penta-Graphene Nanotube

6.2 Physical Insight of Complex Conjugate Numbers in Strain Gradient Models

Strain gradient models are used to investigate the wave propagation of structures. These models predict the dispersion curve in a reasonably competent manner. The length scale is in the form of real numbers. The negative length scale alters the physics of the strain gradient model, which will result in erroneous prediction. But these models fail in predicting the group velocity in the first Brillouin zone. In the present approach, the complex conjugate number predicts the group velocity reliably without violating physics for the first time. The complex conjugate number is valid for two length scale models. So a minimum of two length scales is required while using complex conjugate numbers.

6.3 Best fit of Modified Gaussian Kernel for the investigation of Gradient Models

To develop a gradient model, the identification of suitable kernel is necessary. The simplest model is the Gaussian kernel. The Gaussian model consists of the single length scale therefore; two length scales are required to satisfy the group velocity at the end of the first Brillouin zone. In the present approach, the Gaussian kernel has been modified with two length scale parameters. An excellent match of group velocity has been obtained at the end of first Brillouin zone.

6.4 Two New Modes of Sea Surface Temperature in the Subtropical Indian Ocean

The Sea Surface Temperature (SST) in the Indian Ocean (IO) has been warming unprecedentedly since 1950. Several observational and modelling studies have emphasized the roles of IO warming on the changing weather and climate patterns. Through a series of statistical analyses, we have isolated, characterized, and assessed individual roles of leading modes of variability in IO SST. We report in the following what these exercises had revealed: two new modes.

6.4.1 Abrupt Climate Change Mode

According to the IPCC5 report, an SST trend in southern subtropical IO has been higher than the rest of IO. The evolution of ACC mode in this region had remained negative till about 1975; since then, its value has remained positive. A large and sudden negative dip had occurred in the 1960s and reached a minimum of 0.6 °C around 1968. In the northern IO, its evolution is precisely the opposite, but with slightly diminished magnitudes. The Abrupt Climate Change (ACC) in the southern IO had been cooling till about 1968 and continues to warm that attained the highest values around the year 2000 and 2015-15 meaning? Is it 2000-2015 till recently (Figure 6.3). The opposite trends in northern IO are confined only to the Arabian Ocean after 1985. The values of ACC mode had flipped their signs almost along with the 1976-77 Pacific climate shift. It is also important to note that the secular variations of ENSO's correlation structure over IO are linked to these IO-SST decadal changes.

6.4.2 Unstable Annual Cycle

The dominant period of higher energy component (ie., carrier signal) of the Unstable Annual Cycle (UAC) is 12 months. In the southern IO, their spatial patterns in austral winter are very similar to those of subtropical IO dipole. Its amplitudes were small in 1975s and 2005s. The amplitudes of AC were highest around 1965; curiously, at the same time interval, the whole IO SST had undergone the abrupt climate shift captured by the ACC mode. Their region of large explained-variance is south of 25 °S. This domain is also occupied by the regions of high-explained variances of the UAC and ACC modes, in a near complementary manner. Their spatial proximity and the waxing and waning of their magnitudes in tandem indicate that UAC and ACC modes are responses to a common forcing. Thus, the possibility of both being the integral parts of the same climate variability needs to be investigated.

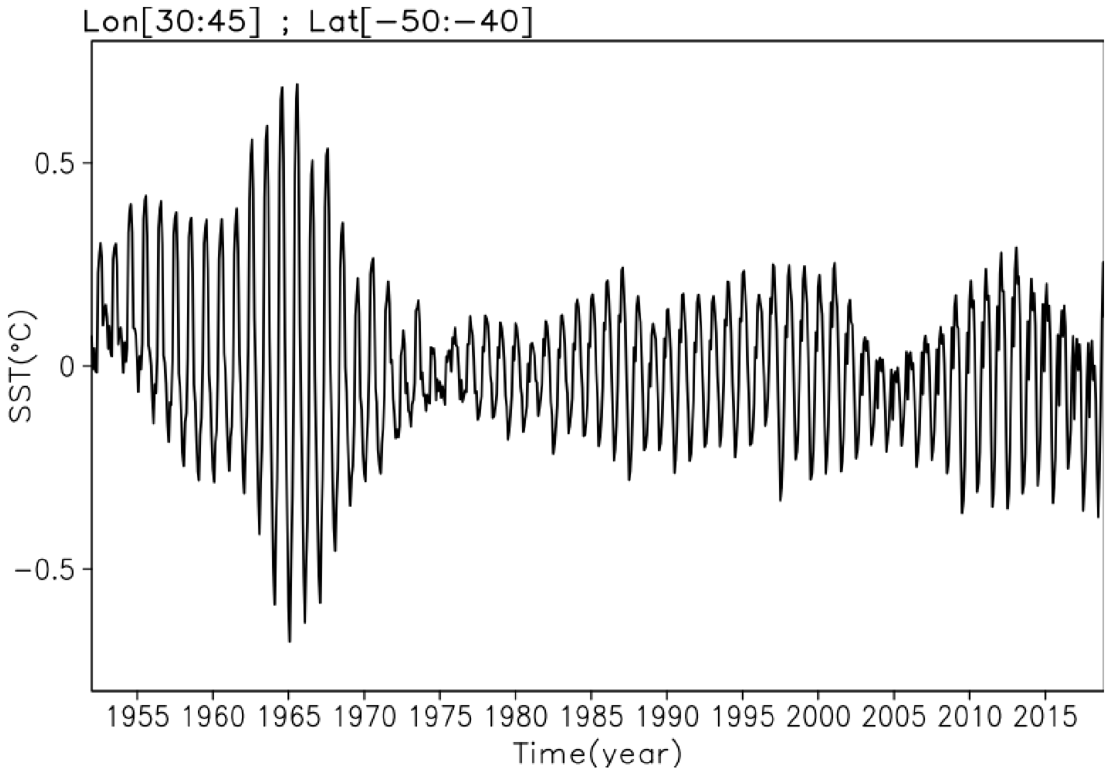

Figure 6.3 Area-averaged time series of Unstable Annual Cycle (UAC) of Indian Ocean Sea Surface Temperature.