Science in China Series G: Physics, Mechanics & Astronomy

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Editor's note

There has been a broad international awareness that the earth's environment plays a critical role in the sustainable development of both human society and the global economy. Environmental research has consequently become refined and quantified. The accumulation of substantial amounts of data has necessitated sophisticated modeling and mathematization, which has in turn driven environmental research from the macroscopic to the microscopic as well as the combination of the two. The propensity of mechanics to combine analysis, computation and experiment is highly advantageous to deepening understanding of the basic factors underlying environmental questions. For example, the boundary-layer theory in fluid mechanics has accelerated atmospheric dynamics research, making more accurate weather forecasts possible. Forced convection research discovered that the western strengthening of wind-driven circulation in the northern hemisphere arises from rotation. The theoretical study of multi-phase flow has sharply enhanced the quantitative prediction accuracy of river sediment transport and pollutant dispersion. Thus the profound interconnections and fusion between mechanics and environmental science has become an important trend in current environmental research.

Environmental mechanics, a new field arising from the combination of mechanics and environmental science, is not only directly concerned with economic and societal sustainable development but is additionally an important new growth area within mechanics. The connotation of environmental mechanics includes a broad scope, such as the atmospheric environment, the hydrological environment, the geological environment, the earth-interface process, environmental disasters, environmental multi-phase flows, theoretical modeling, calculation methods and experimental technology.

Over the past 20 years, international environmental mechanics research has progressed at a rapid rate matched by Chinese environmental mechanics research. Chinese mechanical researchers actively contributed to global environmental studies and have made noteworthy achievements. For example, they studied air or water pollutants through the experiments of wind tunnel and layered tank, providing the basis for nuclear power plant design, urban planning CBD and the control of the Suzhou River. They played a role in estuarine and coastal projects through combining channel regulation of the Yangtze River estuary and the control of the Pearl River estuary with research in estuarine unsteady flow and sediment transport. They provided the scientific basis for environmental control throughout western China by establishing the two-dimensional dynamics model of soil and sand sediment on slopes, extending the model to small drainage areas, analyzing factors affecting erosion, and determining the critical slope for

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soil erosion. They investigated the sand charged quantity in wind-sand flow, the basic laws of the electrical field in windblown sand drift and its influences on wind sand flow and telecommunication. They made accurate theoretical predictions of the evolution and main features of wind-sand flow and aeolian physiognomy and provided the design basis for sand-fixing engineering. They studied the earth's interface process, simulated the atmospheric boundary layer with vegetation and analyzed the effects of the crust layer on soil-water motion and its ecological effects. They determined the effects of wave age and stability on the air-sea exchange coefficient by means of turbulence simulation and offered the basis for parameterization of the climate model. They also studied abnormal typhoon tracks by vortex dynamics, and numerically simulated disasters caused by typhoons and storm tides. After more than 20 years of steady research, China has formed the basic framework for environmental mechanics, and has developed a research team of environmental mechanics specialists, who have made substantial contributions to China's sustainable development.

Chinese 21st century environmental mechanics research emphasizes the blending of mechanism research, regularity analysis and preventative measures. This includes such general scientific questions as the basic theories and methods of transportation and flow; gas, fluid and solid interaction; the coupling of multi-phase, multi-component and multi-process; and the scaling effects of modeling experiments in environmental mechanics. It also emphasizes the economic development of China's western and coastal regions, the urbanization process, and actual problems involving significant projects. Examples include the control of arid environments in western China including soil erosion, sand storm and desertification control; river flow, bed-loads in estuaries and coastal zones and pollutants, their influence regularities on ecology; urban air pollution; and the causative mechanisms and prediction of such significant environmental disasters as tropical cyclones, floods, landslide/mud-rock flows and possible global-warming.

Environmental mechanics is a relatively recent interdisciplinary field which is continuing to develop. Environmental mechanics is a key component of sustainable Chinese development, which motivates leading scientific researchers to hold in-depth discussions, exchanges and personnel training in order to maintain a steady pace of environmentally sensitive, fully sustainable development.

In order to raise awareness of recent progress in environmental mechanics research, *Science in China Series G* is publishing a special issue devoted to environmental mechanics. The contents of this special issue include research from a broad cross-section of committed scientists which address mechanical problems in environments and disasters related to water, soil, atmospheres and biological factors. Because environmental mechanical research is one of the primary fields regularly published in *Science in China Series G*, this special issue is intended to stimulate innovative research by Chinese experts in environmental mechanics.

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