Preface

Plasmas in space or in the laboratory are often far from thermodynamic equilibrium. In fluids far from equilibrium the preponderance of complex behavior with a wide range of spatial and temporal features, including turbulence and chaos, is now well recognized. In plasmas, where collective effects play a dominant role, the interplay of nonlinearity, dispersion and dissipation leads to a variety of nonlinear waves, turbulence and chaotic phenomena. Examples of such nonlinear phenomena are the Alfvén waves in the interplanetary medium, the response of the magnetosphere to solar wind forcing, substorms, convection vortices and nonlinear structures observed on the auroral field lines, low latitude boundary layer, cusp and plasma sheet boundary layer by several spacecraft.

These phenomena and their theoretical investigation are the topics of a continuing series of *International Workshops on Nonlinear Waves and Chaos in Space Plasmas* in Kyoto (1994), Köln (1997), Carlsbad, California, (1999), and Tromsø, Norway (2001). The fifth of these workshops (NWW-2003), was held during 2–7 March 2003 in Mumbai, India and convened by Gurbax Lakhina, Bruce Tsurutani and Surja Sharma. The Fifth NWW workshop also marked the beginning of a year-long centenary celebration of the world-renowned Alibag Magnetic Observatory run by the Indian Institute of Geomagnetism. The theme and presentations of the workshop did focus on new results in observations, theory, modeling and simulations. Its discussions have contributed significantly to the understanding of nonlinear phenomena like coherent structures, anomalous transport, solitons and turbulence.

This special issue of Nonlinear Processes in Geophysics (NPG) consists of papers drawn from talks presented at NWW-2003 and accepted after the NPG review process (Editors: Jörg Büchner, Gurbax Lakhina and Surja Sharma).

The contributions cover a broad range of physical processes in which nonlinearity plays a dominant role. These range from the generation of zonal flows in the atmosphere and of nonlinear structures in aurorae, magnetospheric cusps and magnetotail, to the collapse of Langmuir waves in the interplanetary medium. Other examples include the nonlinear excitation of high-frequency waves by large amplitude low-frequency waves in the ring current and near the cusps, and the formation of quasi-power law spectrum of Langmuir turbulence by harmonic generation. Recent results from the theory, simulations and data analysis, utilizing FAST, Polar and Cluster spacecraft data, are presented as well.

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(NPG Special Issue Editors)