Carlos Nobre: **Biogeochemical, Ecosystem, and Human Interactions with Climate and the Complexity of the Earth System**

It is increasingly recognized that humanity is capable of perturbing the entire Earth system; hence, the need of collaboration between natural and social scientists to explore ways of integrating natural and societal processes into present and future Earth System Models, if the latter are to provide quantitative information to use to mitigate and adapt to future changes in the Earth system and to guide society onto sustainable pathways during rapid global change. Future efforts in multidisciplinary Earth system modeling should include: i) the development of global Earth system analysis and prediction models that account for physical, chemical, and biological processes in a coupled atmosphere–ocean–land-ice system; ii) the development of a systematic framework that links the global climate and regionally constrained weather systems and the interactions and associated feedbacks with biogeochemistry, biology, and socioeconomic drivers (e.g., demography, global policy constraints, technologic innovations) across scales and disciplines; and iii) the exploration and development of methodologies and models that account for societal drivers (e.g., governance, institutional dynamics) and their impacts and feedbacks on the environmental and climate systems. The latter is a particularly grand challenge because human behavior is not easily represented within the framework of present-day physical prediction systems.

Carlos Nobre, National Secretary for Research and Development Policy and Programmes of the Brazilian Ministry of Science, Technology and Innovation, Brazil

Dr Carlos Nobre is also Director of the Centre for Earth System Science of the National Institute for Space Research (INPE). His major research interests are biosphere-atmosphere interactions, climate modelling, tropical meteorology, global change and Amazonia. He is the author or co-author of over 130 scientific articles, books and book chapters, which have received over 4 000 citations in the scientific literature. Dr Nobre is a former chair of the International Geosphere-Biosphere Programme (IGBP), and has served as Scientific Coordinator and Chair of the Science Steering Committee for the Large Scale Biosphere-Atmosphere Experiment in Amazonia. He was a director of CPTEC-INPE, as well as a member of the International Advisory Committee of the Programme to Protect the Rain Forests of Brazil. He is the current President of the Board of Directors of the Brazilian Panel on Climate Change, Ministry of the Environment. Dr Nobre has been a member of the Joint Steering Committee (JSC) of WCRP, GEWEX SSG and several GEWEX and CLIVAR science panels.