**Biosketch of Peter Read (April 2017)**



Peter Read (PLR) holds the title of Professor of Physics at the University of Oxford, in recognition of his distinguished contributions over many years in the interdisciplinary fields of geophysical and planetary fluid dynamics, and in planetary meteorology. His research career spans some 30 years, with innovative contributions to fields as diverse as galactic radioastronomy, chaos and turbulence in fluid dynamics, and planetary weather and climate analysis and prediction. During the past 25 years he has been based in the sub-Department of Atmospheric, Oceanic & Planetary Physics, one of the six sub-divisions of the Department of Physics at Oxford University, within which he has led the geophysical and planetary fluid dynamics (GPFD) research group. He was elected as Head of Atmospheric, Oceanic & Planetary Physics in 2008, serving until 2013. Under his leadership, the GPFD group has developed a very wide-ranging research programme that includes a rich mixture of studies in fundamental fluid dynamics (including both laboratory experimentation and numerical modeling), atmospheric modeling of various planets in the Solar System (currently including Mars, Venus, Jupiter, Saturn and Uranus) and analysis and interpretation of spacecraft observations of planetary atmospheres. This extremely broad range of activity has enabled the group to tackle problems with innovative insights that have proved important and influential in a number of fields. He has published more than 150 papers in high-profile journals, together with a research monograph on the climate of Mars and chapters and review articles for at least 6 other books during the past 15 years.

A key feature of PLR’s research during the past 25 years or so has been the highly innovative combination of knowledge and insights gained from studying basic dynamical processes on a laboratory scale in carefully designed and controlled experiments, applied to direct studies in models and observations of actual atmospheric systems. An early example of this kind of approach was to explore the analogy between baroclinic instability in an internally-heated rotating fluid, studied in the laboratory and in numerical models, and the large, coherent oval eddies such as the Great Red Spot and White Ovals in Jupiter’s atmosphere. Although the nature of these major storm systems on Jupiter and Saturn remains controversial, these early studies served to demonstrate the potential importance of a form of instability that combined both baroclinic and barotropic processes, and to demonstrate that compact vortices of a realistic form could sustain themselves by feeding energy (both potential and kinetic) from the system of zonal jets in which they occur.

More recently, PLR’s research has focused on studies of finite-dimensional chaos in rotating fluid systems, and their role in determining and affecting dynamical transport of heat, momentum and tracers, as well as in governing the intrinsic predictability of the flow. This

has entailed highly detailed studies in the laboratory of some delicate nonlinear phenomena, demonstrating conclusively that they can be represented under some conditions as being governed by a low-dimensional chaotic attractor with well-defined predictability properties. This work included the discovery in the laboratory of a new mode of chaotic, time-dependent oscillation in equilibrated baroclinic instability, and the development and application of novel methods of data analysis to reconstruct dynamical attractors from experimental measurements. This was later applied directly both to general circulation model simulations and actual measurements of the atmosphere of Mars to demonstrate quantitatively for the first time (a) that the atmosphere of Mars is intrinsically less complex and chaotic (and therefore intrinsically more predictable) than that of the Earth, and (b) moreover that the source of chaotic behaviour on Mars is at least partly associated with sporadic transitions between global eigenstates that may be stimulated by interactions with the diurnal cycle and thermal tide. This line of work has demonstrated clearly ways in which the circulation and climate of Mars differs from that of the Earth. Recent work within the group has explored possible applications of a similar low-dimensional chaotic paradigm (though without the thermal tide influences) for interannual variations in the Earth’s stratosphere and troposphere (related to the Quasi-Biennial Oscillation) involving nonlinear synchronization with components of the seasonal cycle, which has led to new insights into the complexity of climate feedbacks and is continuing in collaboration with colleagues at the UK Met Office. His group has also demonstrated and studied synchronization phenomena (both periodic and chaotic) in periodically-perturbed rotating annulus experiments.

PLR’s work on chaotic baroclinic flows has been extended recently towards studies of fully-developed, baroclinically unstable, geostrophic turbulence in a rotating fluid. This began with laboratory studies of baroclinic instability in rapidly-rotating containers with sloping endwall boundaries, which clearly demonstrated the ability of upscale energy cascades to form multiple parallel baroclinic zones as a result of wave-zonal flow interactions. This has since been pursued on a much larger scale with three major experimental campaigns carried out on the 13 m diameter Coriolis rotating fluids facility in Grenoble, France, and the 5 m diameter facility at the Turlab in Turin, Italy, thanks to support from the EC-funded Hydralab and EuHIT programmes. This has allowed him to study the detailed dynamics of flows in which a significant inverse energy cascade is active, clearly showing the major role of anisotropic wave propagation effects when a planetary vorticity gradient is present. In addition he conducted several studies of heat transport in rotating, stratified flows due to baroclinic waves and eddies, demonstrating that techniques for parametrizing such transports used in ocean and atmosphere models apply with comparable success to laboratory systems.

In other recent work relating to Jupiter and Saturn, he has found evidence for mixed barotropic/baroclinic instabililties to act so as to hold the observed flow close to a state of neutral stability with respect to a stability theorem due to Arnol’d. This directly emulates the situation hypothesized in connection with baroclinic adjustment on Earth. His group has also shown explicitly from analyses of cloud motions in images of Jupiter that eddies feed energy upscale, but only from scales larger than the internal deformation radius. At smaller scales, however, the energy transfer is downscale, as also seen in numerical model simulations carried out in his group.

He has supervised more than 15 doctoral students during the past 10 years, most of gone on to further research positions in academia, industry or government research institutes in the UK or abroad. He also regularly gives talks and presentations to schools, local astronomical and scientific societies and the general public.

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