MULTIFRACTAL PHASE TRANSITIONS AND SCALING STRATIFICATION IN THE ATMOSPHERE: SOME NEW RESULTS

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Using hundreds of satellite cloud pictures we have recently shown that multifractal cascades extend up to planetary scales. However - as we have argued for over 15 years - such cascades must be anisotropic in order to account for the effect of gravity. In addition, a generic consequence of canonical cascade processes is that high order statistical moments diverge via first order multifractal phase transitions to yield self-organized critical behaviour. Starting in the early 1980's, both of these theoretical predictions (scaling anistropy and multifractal phase transitions) have been tested on various atmospheric data sets, but often in indirect or ways or with data bases with small sample sizes and hence limited statistics. In this talk, we describe a number of experiments in progress which attempt to validate this picture with much higher levels of certainty. First, we report on scaling analyses of velocity and temperature fields using instrumented aircraft over scales of the order of 5000km; showing that - as predicted by the unified scaling model - the horizontal $k^{-5/3}$ scaling does indeed hold up to these very large scales. We then describe an experiment on an instrumented tower to collect of the order 10^9 wind shear measurements to study the probability tails at unprecedented low probability levels. Finally, using the worlds largest SO_2 source (Massaya volcano) and ground based remote sensing, we directly estimate the elliptical dimension characterizing atmospheric stratification. We discuss the implications for modelling pollutant plumes.