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What is the Climate?

S. Lovejoy (1) and D. Schertzer (2)

(1) Physics department, McGill University, Montreal, Quebec, Canada, (2) Université Paris Est, Ecole des Ponts ParisTech, CEREVE, France

Although meteorology and climatology are increasingly considered to be distinct sciences, the actual boundary between "climate scales" and "meteorological scales" is not clear and there are no universally accepted definitions. It is still hard to improve upon the old adage "the climate is what you expect, the weather is what you get". For example [Committee on Radiative Forcing Effects on Climate, 2005], the National Academy of Science essentially accepts this ("Climate is conventionally defined as the long-term statistics of the
weather") proposing only to expand the definition of climate to encompass the oceanic and terrestrial spheres as well as chemical components of the atmosphere. However the weather itself has nontrivial statistics so that the key weather/climate distinction depend on apparently subjective distinction between long-term and short-term statistics.

In this talk, we give an objective basis to the weather/climate distinction with the help of an anisotropic space-time turbulence theory and both lidar satellite radiances, in situ spectra and numerical models of the atmosphere and reanalyses. We show that the latter accurately follow the predictions of multiplicative cascade models up to about 7-10 days. This marks the beginning of a weather/climate transition region which extends up to the cascade outer scale of about 20-30 days (depending somewhat on the atmospheric field), after which the climate regime begins. We bolster this interpretation by empirically constructing space-time (Stommel) diagrammes; we obtain near linear relations between time and (horizontal) space and theoretically predicted power law relations between the vertical and time up until the end of the weather regime ($\sim$10000 km in the horizontal, $\sim$10 km in the vertical, $\sim$10 days in time). We discuss the implications for weather, climate and climate trends.