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Fractionaly Integrated Flux model and Scaling Laws in Weather and Climate

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The Fractionaly Integrated Flux model (FIF) has been extensively used to model intermittent observables, like the velocity field, by defining them with the help of a fractional integration of a conservative (i.e. strictly scale invariant) flux, such as the turbulent energy flux. It indeed corresponds to a well-defined modelling that yields the observed scaling laws.

Generalised Scale Invariance (GSI) enables FIF to deal with anisotropic fractional integrations and has been rather successful to define and model a unique regime of scaling anisotropic turbulence up to planetary scales. This turbulence has an effective dimension of 23/9=2.55... instead of the classical hypothesised 2D and 3D turbulent regimes, respectively for large and small spatial scales. It therefore theoretically eliminates a non plausible "dimension transition" between these two regimes and the resulting requirement of a turbulent energy "mesoscale gap", whose empirical evidence has been brought more and more into question.

More recently, GSI-FIF was used to analyse climate, therefore at much larger time scales. Indeed, the 23/9-dimensional regime necessarily breaks up at the outer spatial scales. The corresponding transition range, which can be called "macroweather", seems to have many interesting properties, e.g. it rather corresponds to a fractional differentiation in time with a roughly flat frequency spectrum. Furthermore, this transition yields the possibility to have at much larger time scales scaling space-time climate fluctuations with a much stronger scaling anisotropy between time and space.

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