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The Structure of Turbulent Jets

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We investigate experimentally and describe key aspects of the structure of turbulent jets and their dominant effects connected with non-homogeneity (for example boundary layer - jet interactions). Laboratory experiments at intermediate Reynolds numbers, but allowing to simulate environmental flows produce turbulence by means of jets using different configurations (for example with wall boundary conditions or within an hetereogeneus turbulent ambient field). We compare the different series of detailed experiments that have been performed in the Laboratory of Fluid Dynamics of the UPC on Jet/Plume generated turbulence, its topology and its decay. Measurements of the 3 velocity components by ADV are used to calculate other turbulence parameters and their spectra in order to obtain a basic understanding of local diffusion, non-isotropic mixing and mass transport in jets. We compare different wall and boundary effects on the structure of jets including vorticity production and decay comparing mean and fluctuating velocity components as well as their PDF's and spectra. The turbulent interactions between the jets, vortices and the boundary layer structures generated are discussed taking into account both the inverse and direct cascades of the jets as a function of their distance to the wall or the gradient of environmrntal turbulence. These complex non homogeneous structures occur in many industrial and environmental applications and investigation of their structure will be useful for better estimates of entrainment and mixing efficiency. The importance of the study of turbulence structure and its relevance in diffusion of contaminants in environmental flows where self-similarity is present with very few exceptions in strongly non-homogeneous flows. We describe a methodology based on the evaluation of the spectral behaviour and the structure functions of the velocity fields to determine intermittency. A physical interpretation of the scale independence of the relative exponents indicates the non-homogeneity of the turbulent field, which is characterized by non-local dynamics and not only intermittency. Determining the spectral structure of the

turbulence cascade and the higher order structure functions helps to determine mixing properties and relationships between the kinds of structures that often control mixing.