Abstract Submitted
for the DFD05 Meeting of
The American Physical Society

LES investigation of aircraft wake two-vortex system in low level atmospheric turbulence GREGOIRE WINCKELMANS, LOUIS DUFRESNE, LAURENT BRICTEUX, Universite catholique de Louvain (UCL) — The numerical simulation of realistic vortical aircraft wakes constitutes a challenging task, as the problem is of large size, the vortex cores are small, and the Reynolds number is very high. In particular, the vortex cores grow very little during the lifetime of the vortices. Large-eddy simulation (LES) at "essentially" infinite Reynolds number is here used: a Fourier-based pseudo-spectral method in "quasi- Euler" mode (ν set to zero and use of a high order k^{16} hyperviscosity subgrid-scale model, which ensure negligible viscous core growth). The LES grid is also fine enough so as to properly capture relevant dynamics in the core region. A realistic case is simulated: circulation $\Gamma_0 = 400\,\mathrm{m}^2/\mathrm{s}$, spacing $b_0 = 50\,\mathrm{m}$, core radius $r_c = 2.5\,\mathrm{m}$. We use a L^3 computational box of 256^3 grid points and with $L = 200\,\mathrm{m}$. The background atmospheric turbulence is here at low level (dissipation $\epsilon = 0.0001\,\mathrm{m}^2/\mathrm{s}^3$) and was obtained as a pre-simulation. The vortex system engulfs the ambient turbulence, the non-linear interactions then amplify it and this eventually leads to a vortex pair where the surrounding turbulence is independent of the atmospheric background: the low level turbulence thus acts as a seed to create a "turbulent vortex pair" that then lives and decays on its own. We also observe significant axial velocities in the core region. Those results are further being used for simulations of LIDAR return signal.

Gregoire Winckelmans
Universite catholique de Louvain (UCL)

Date submitted: 04 Aug 2005 Electronic form version 1.4