PolEmiCa model for local air quality assessment in airports

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1. INTRODUCTION

Aircraft is dominant source at the airport. **Aircraft** is special source of air pollution due to some features; the most important one is an **exhaust gases jet**.

The PolEmiCa consists of the following components:

1. **engine emission model** provides emission factor assessment, including influence of operational and meteorological factors;
2. **jet transport model** evaluates jet parameters, as rise height Δh_A due to buoyancy effect, horizontal σ^2_y and vertical σ^2_z dispersion parameters are needed as input to dispersion modeling of aircraft sources;
3. **dispersion model** calculates the dispersion of the pollutants due to atmospheric turbulence and wind.

Main purpose of the **PolEmiCa** is the dispersion (**Pol**lution) and inventory (**Emi**ssion) **ca**lculation for the main emission sources at the airport.

2. EMISSION INVENTORY

Summary of Comparison between the tools

Sub stance	LAS PORT	EDMS	ALAQS	ADMS	PEGAS	PolEmiCa
CO	331475	766456	285032	377899	382258	**303706**
HC	57039	111781	64780	52294	59778	**72311**
NO_x	328742	360286	360232	351933	383563	**375666**
SO_x	88501	108318	90929	86787	166303	**124012**
PM10	6297	10645	6378	7323	6867	**3639**
PM2.5	5217	9099	3095	6237	5787	**1377**

3. JET MODEL

A three-dimensional model of a jet was generated in FLUENT 6.3 by using Large Eddy Simulation method to assess the aerodrome surface impact on jet's structure

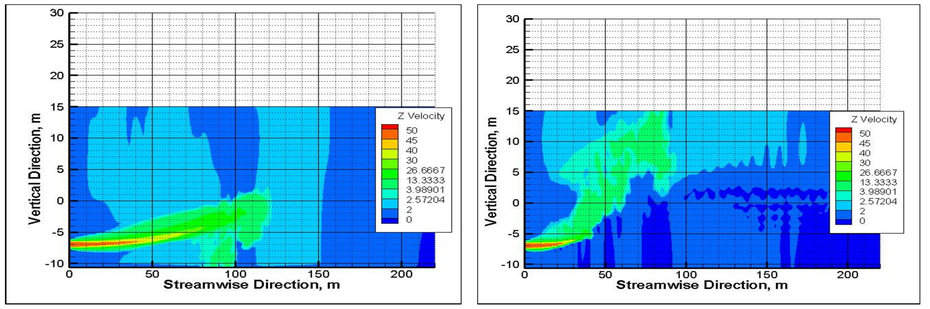

Fig. 1: Mean velocity contours of wall and free jet

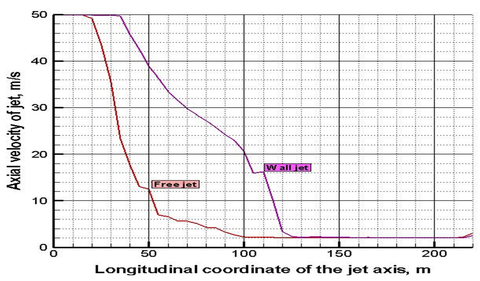

Fig. 2. Maximum velocity decay along the axis of the free and wall jet

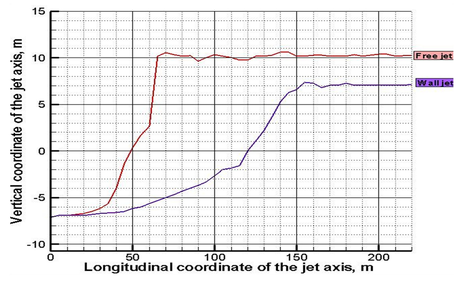

Fig. 3: Buoyancy effect of free, wall jet: longitudinal /vertical coordinate of axis

4. VERIFICATION OF POLEMICA

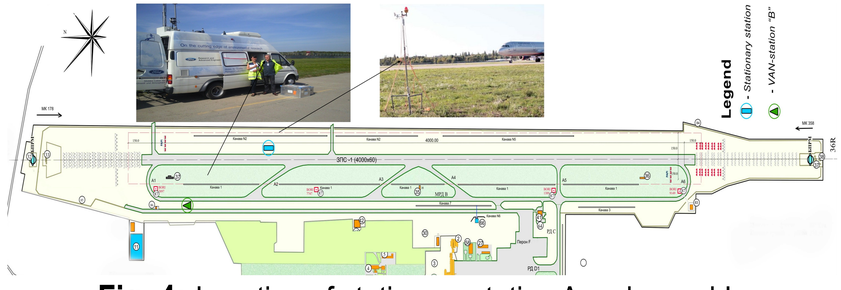

Fig. 4: Location of stationary station A and movable station B at International Boryspol Airport

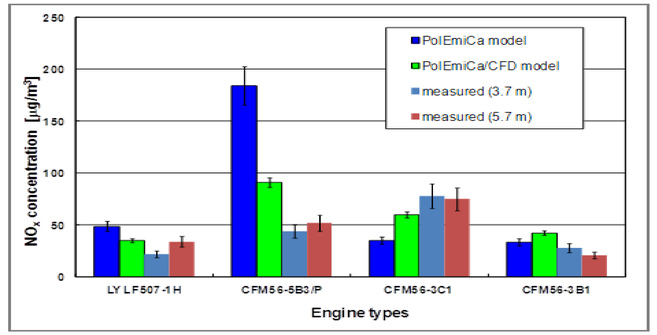

Fig. 5: Comparison of the PolEmiCa and PolEmiCa/FLUENT 6.3 model results with the measured NO_x concentration in the plume from aircraft engine

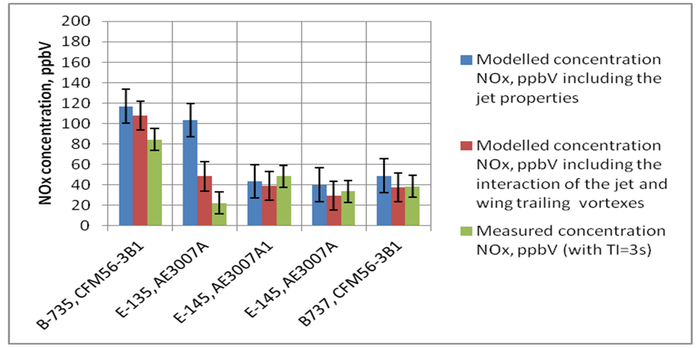

Fig. 6: Comparison of the PolEmiCa (previous/improved version) results with the measured NOx

CONCLUSIONS

Comparison of Fluent results for the jets allow to reveal some differences: the decay rate of axial velocity on 40-50% higher for free jet than for the wall jet (Fig.2); the jet arises over the ground surface due to buoyancy effect much faster and higher for free jet (on 30%) than in case of wall jet (Fig.3).

Using CFD-code (Fluent 6.3) allow to improve the comparison between measured (averaged for 3 s) and modeling concentration on 30% by taking into account lateral wind and ground impact on jet parameters (Fig.5) and the interaction of the jet with wing trailing vortexes (Fig.6).