Dispersion Modelling in Alpine Valleys: Necessity and Implementation of Non-Hydrostatic Prognostic Flow Simulation with FITNAH for a Plant in Grenoble

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Introduction

The quality of dispersion modelling is profoundly dependend on the quality of meteorological input data !!

Dispersion Modelling *needs* realistic 3D flow- and turbulence-fields;

How do we generate those realistic flow fields ?

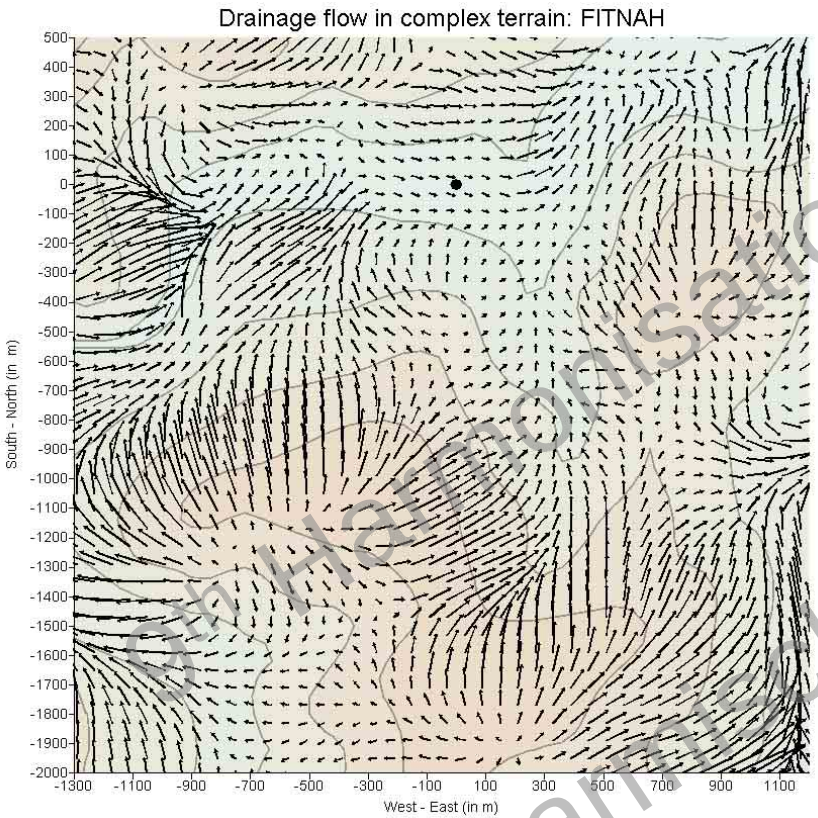
Measurement(s) + Diagnostic flow models:

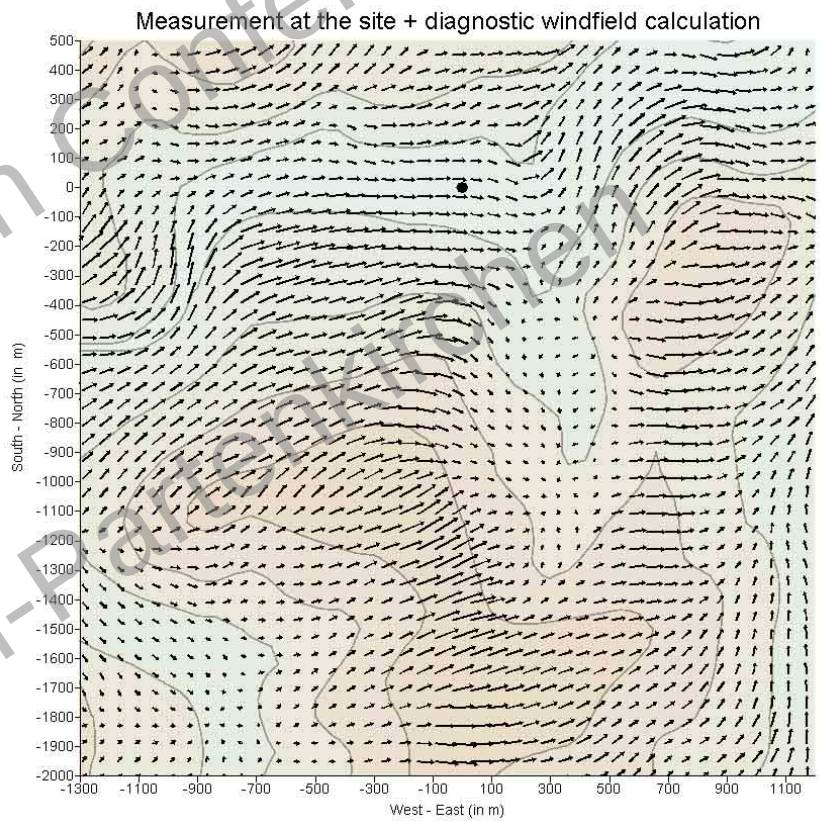
very fast (computer time), but:
not applicable in complex terrain (slope < 1:5)

Prognostic flow models (non-hydrostatic):

ideal type of model, but:
very time consuming simulations

Necessity of non-hydrostatic prognostic flow simulation





Approach

Dispersion modelling in general with LASAT (Lagrange Particle Model)

Calculation with diagnostic model on base of 1 year's measurments:

Dynamically dominated situations

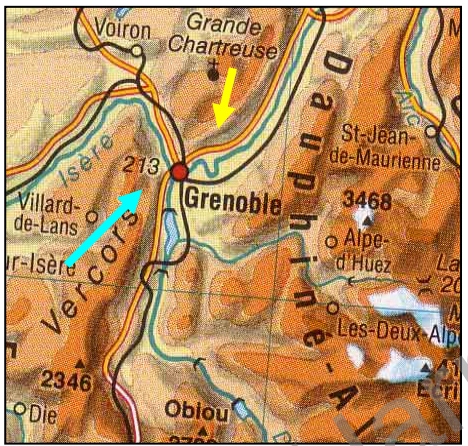
Calculation of a diurnal cycle of thermally induced wind systems with the prognostic model FITNAH:

Thermally dominated situations

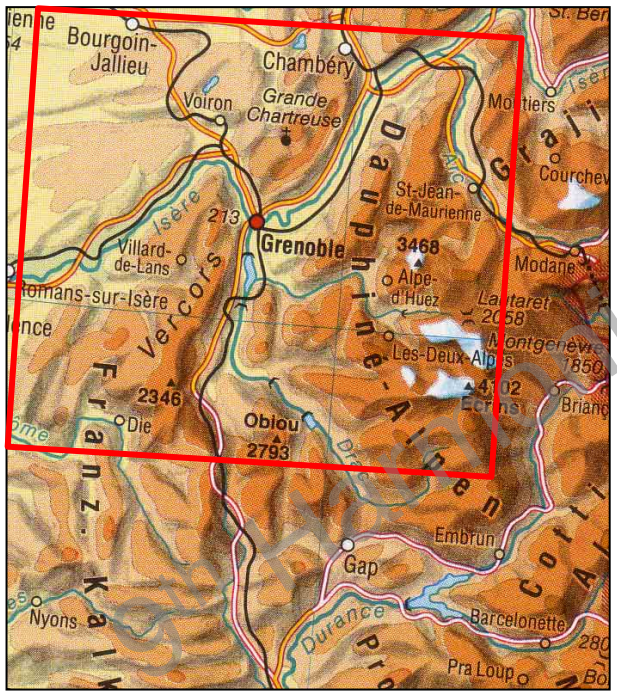
Combination

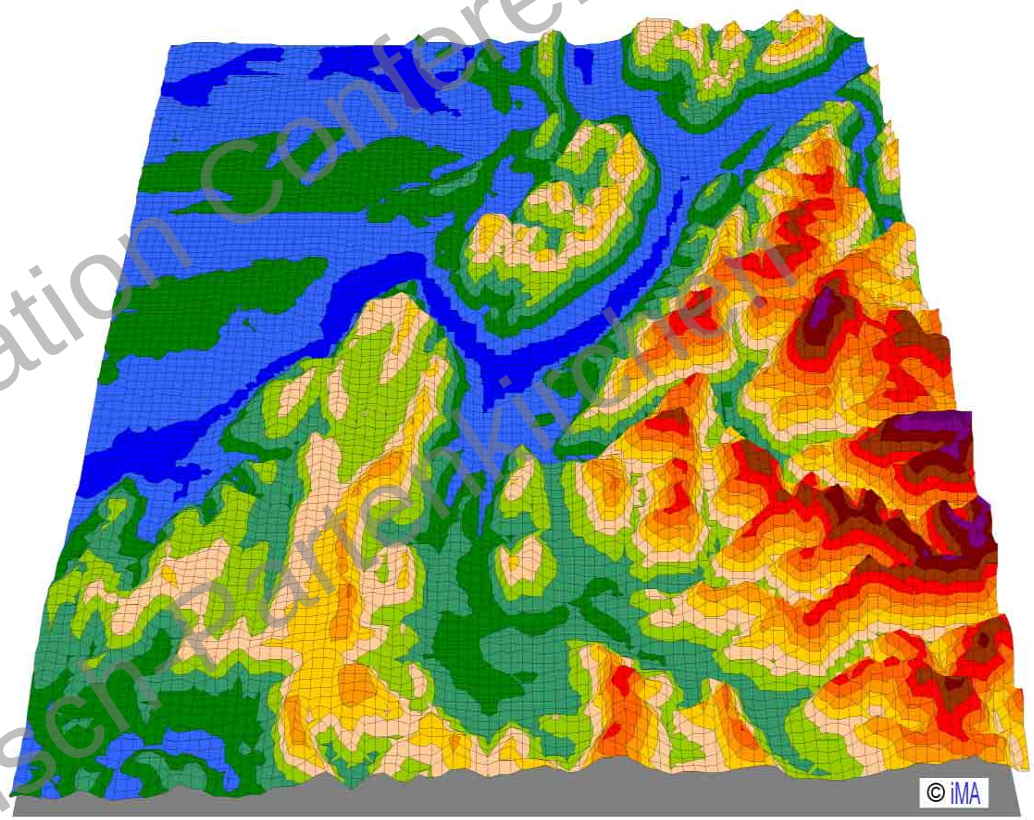
leads to realistic dispersion modelling

Case Study: Grenoble, France



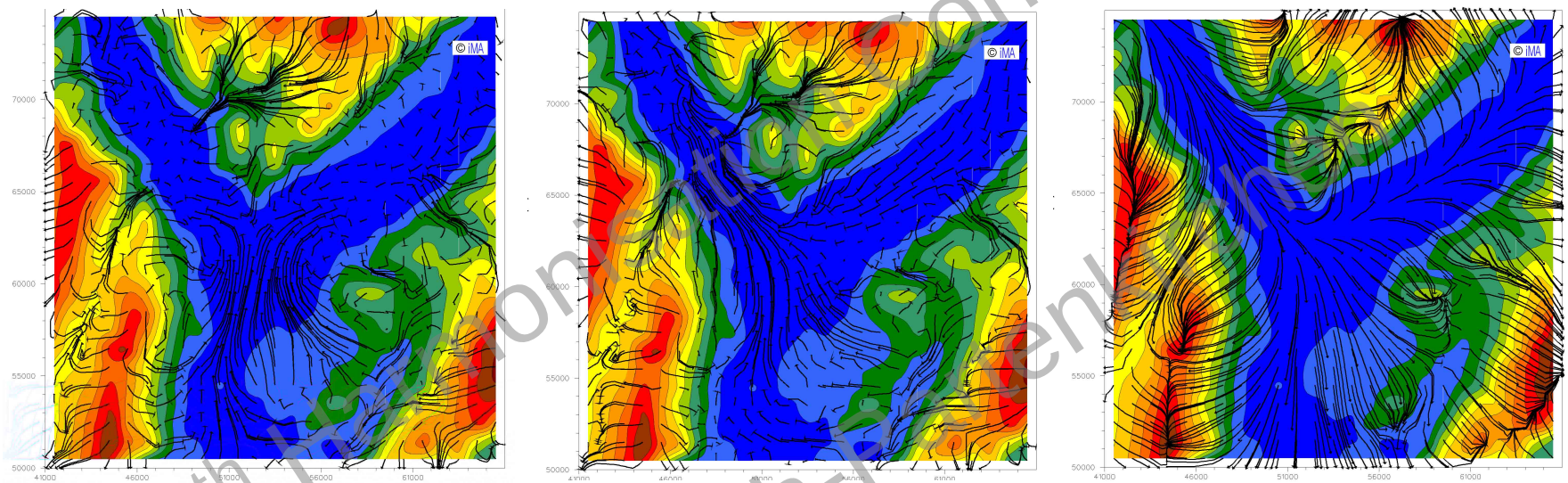
FITNAH model domain (Grenoble, France)





108 km x 108 km, $\Delta x = \Delta y = 1.000$ m

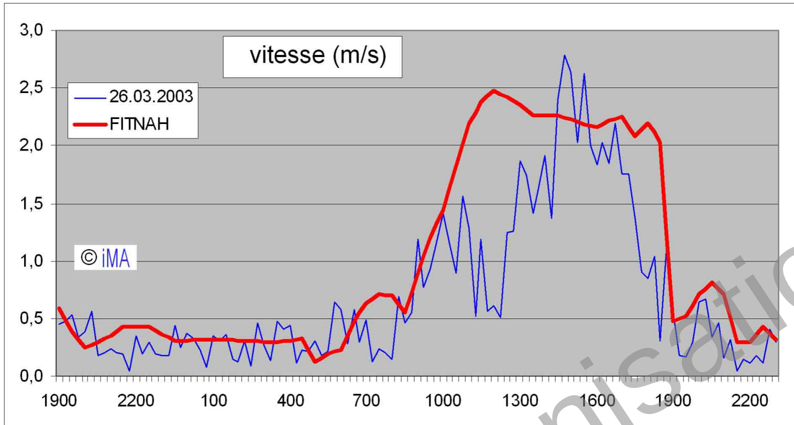
FITNAH results thermally induced wind system

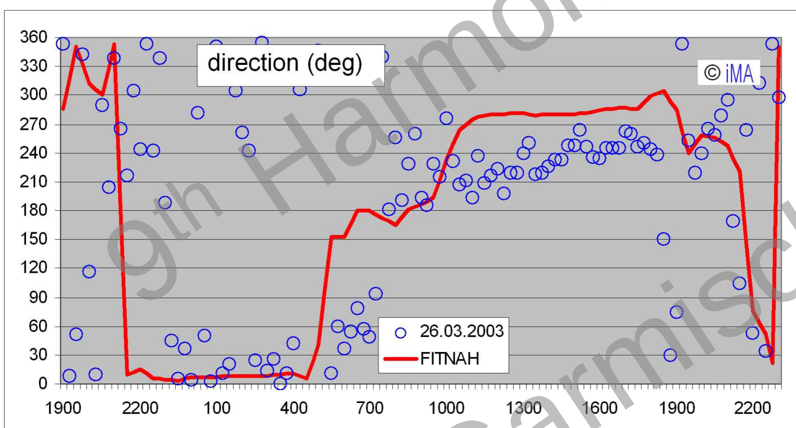


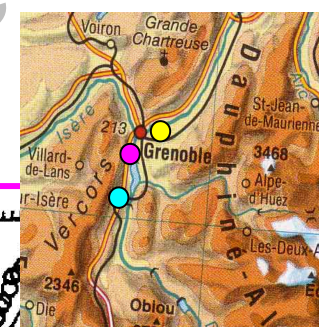
Night

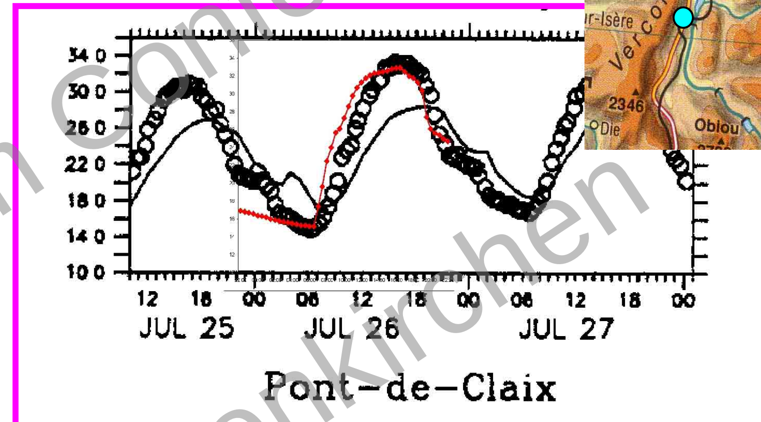
Day

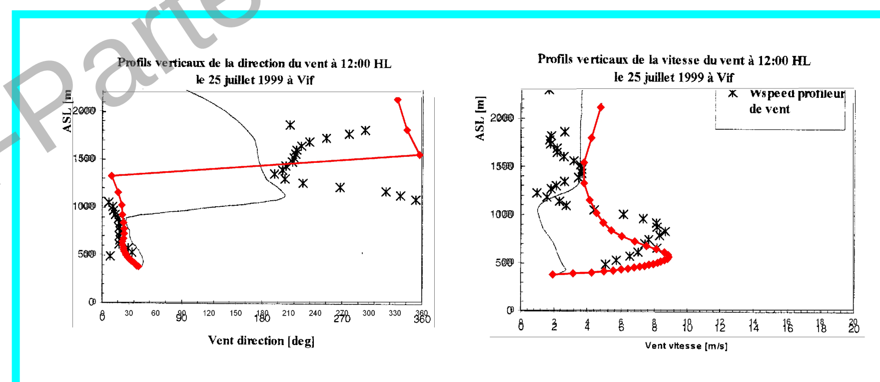
FITNAH results: Comparison with measurements

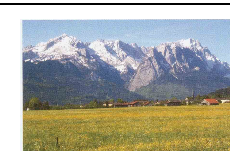




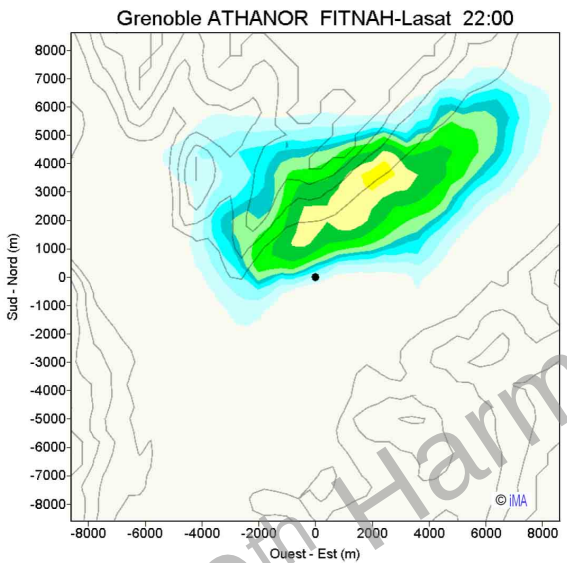


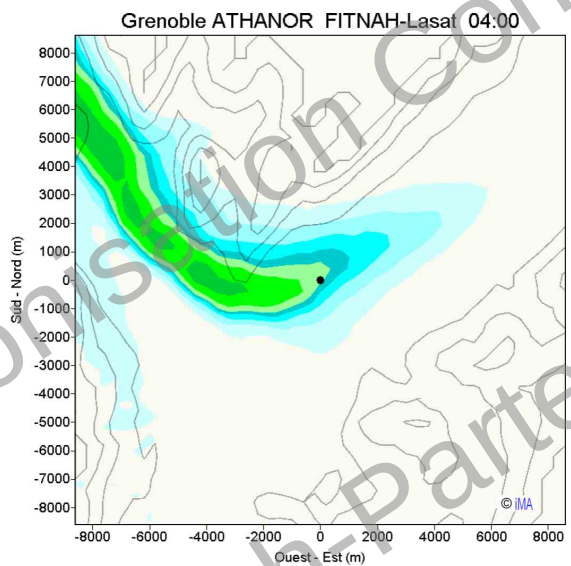


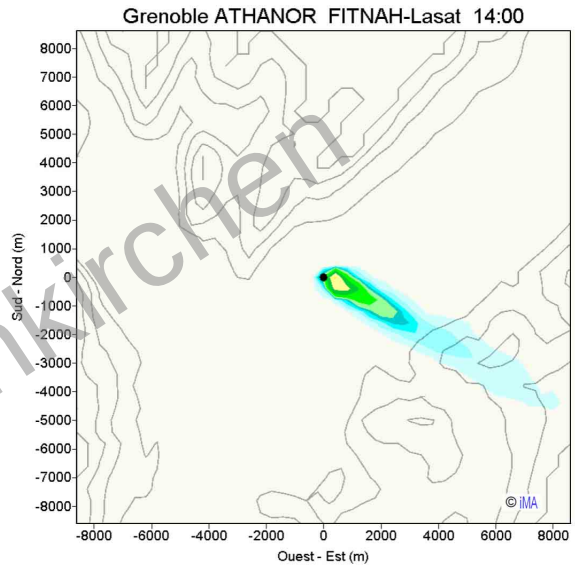




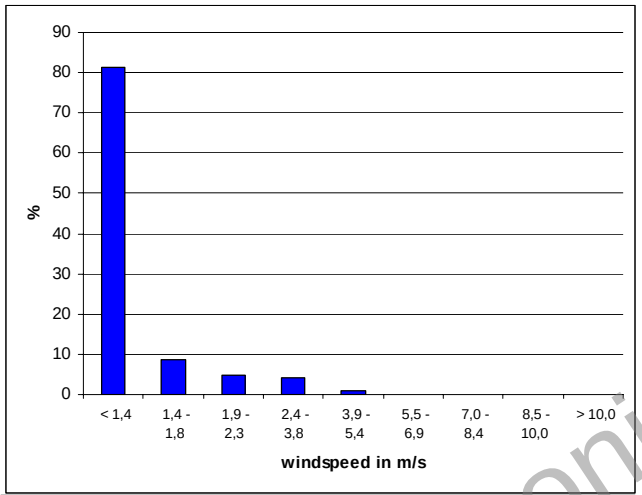
FITNAH – LASAT coupling: Concentration fields

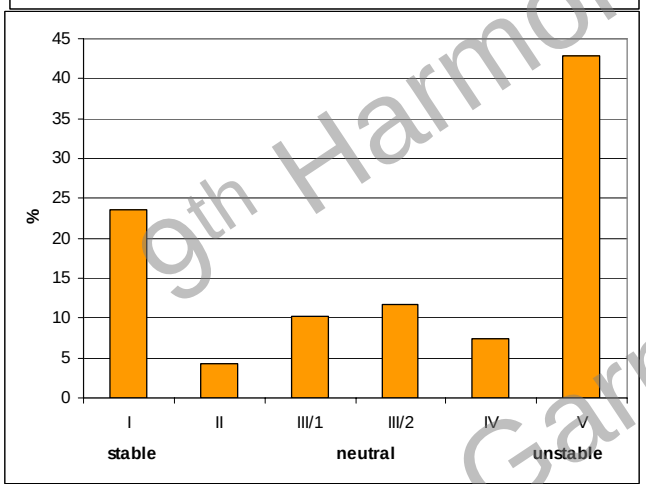


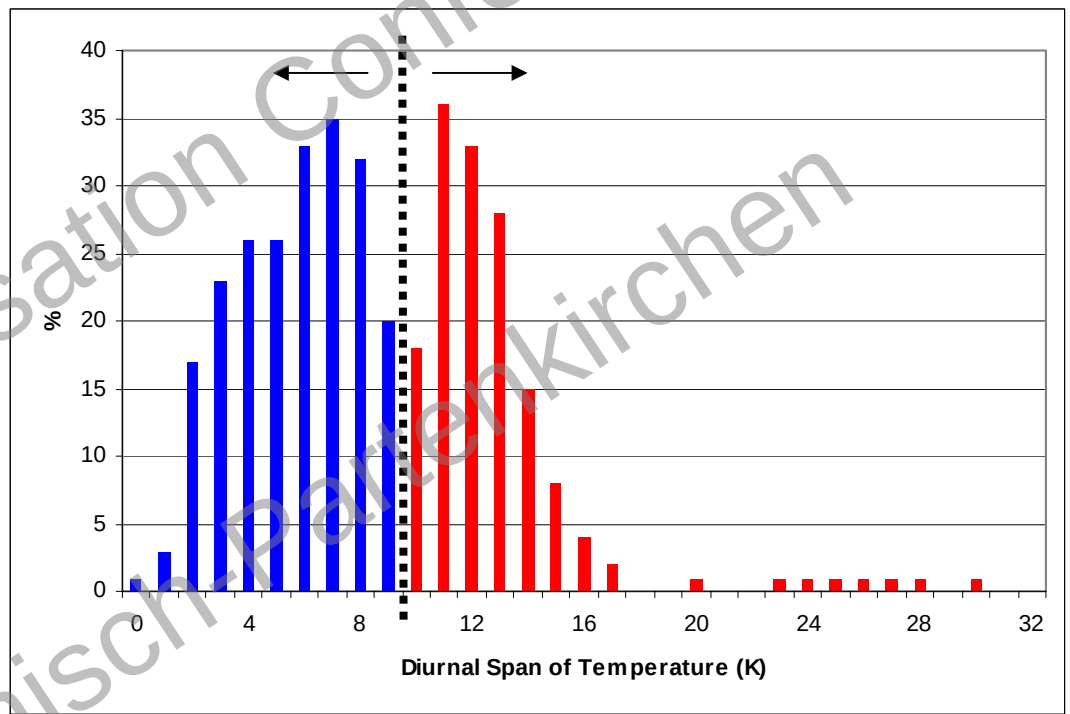




Frequencies of thermally dominated situations, Method of Combination







FITNAH-LASAT results - Concentration Measurements

	gaseous component		particle component	
	Mesures	Simulation	Mesures	Simulation
Point 1	9,1	1,9	12,6	2,6
Point 2	18,6	22,9	25,7	31,6
Point 3	72,4	31,1	100	43

Point 1: affected by a second major source

Point 3: large (still unexplained) scattering in the measurements

→ new measurement campaign, sites selected with help of model results

Conclusions

The incorporation of prognostic non-hydrostatic flow (and turbulence) simulations into dispersion modelling in complex terrain is necessary.

There is no need to calculate a whole years cycle with those time-consuming models, when a suitable meteorological (!) method can be found to identify (and divide) dynamic and thermally induced situations.

The incorporation of FITNAH-results has been successfully applied in a case study of the Alpine valley round Grenoble and can therefore be recommended in comparable locations.