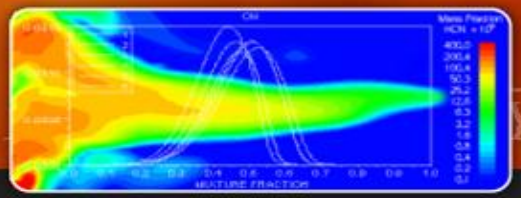
Turbulence in the sky and in a combustion chamber

Wind power

Biomass



CAT

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INNOVATIVE ECONOMY
NATIONAL COHESION STRATEGY

DELICAT

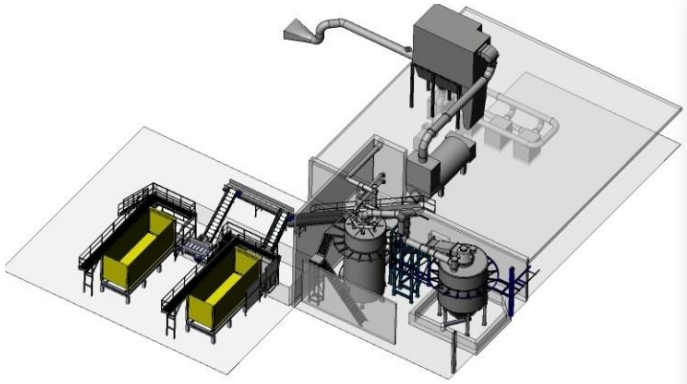
FNP
Foundation for Polish Science

EUROPEAN UNION
EUROPEAN REGIONAL DEVELOPMENT FUND

PROZA
Zastosowania numerycznych prognoz pogody

Real-life syngas burner

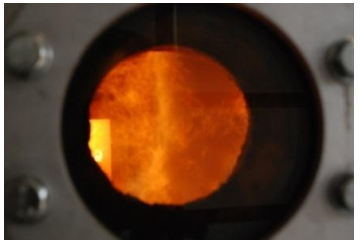
- It is the industry-driven project
- Large heavy-duty installation of thermal utilisation of waste biomass has been setup
- First trials have revealed room and necessity for improvement

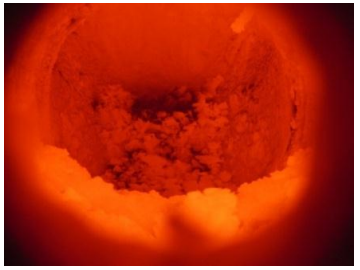


Real-life **syngas** burner

- Syngas consists primarily of H_2, CO, and very often some CO_2, N_2 and others.
- In this project syngas is continuously produced in process of waste biomass gasification

Combustion of syngas

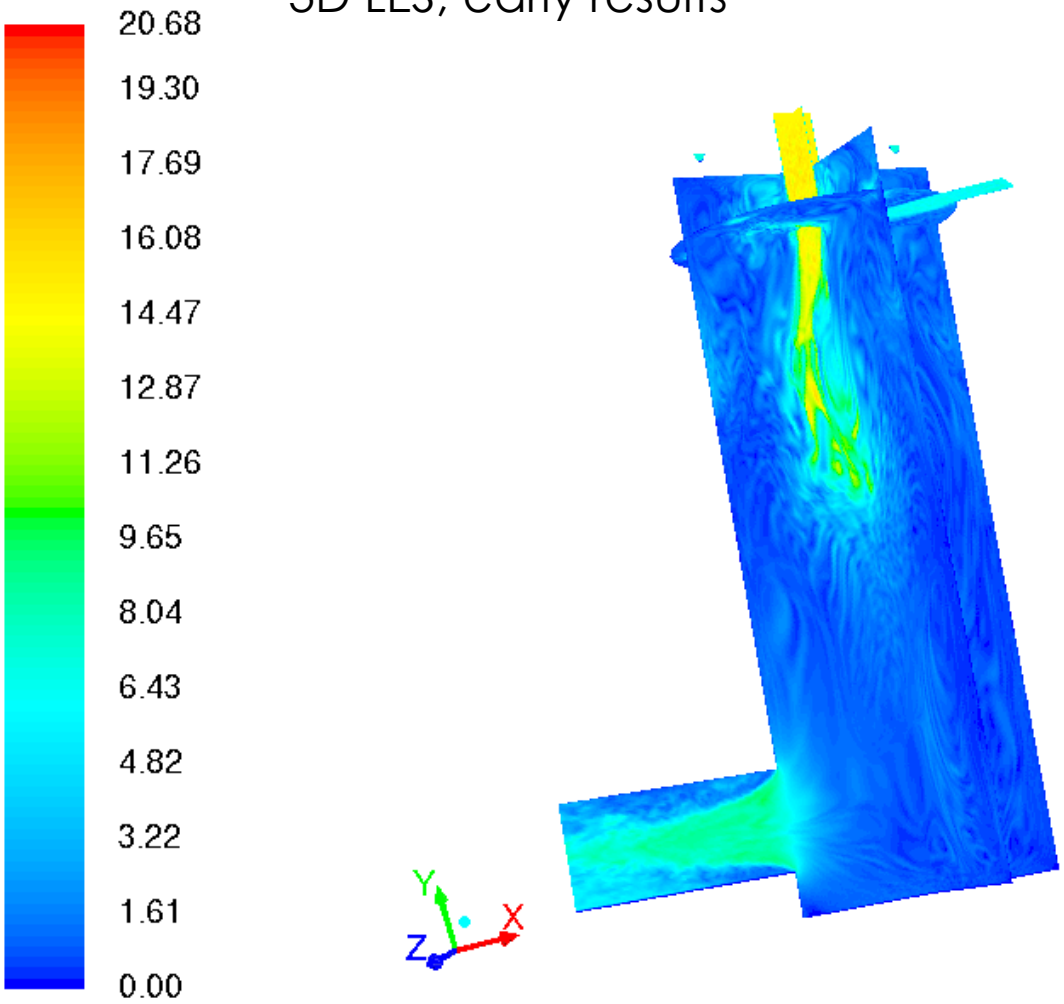




What we do

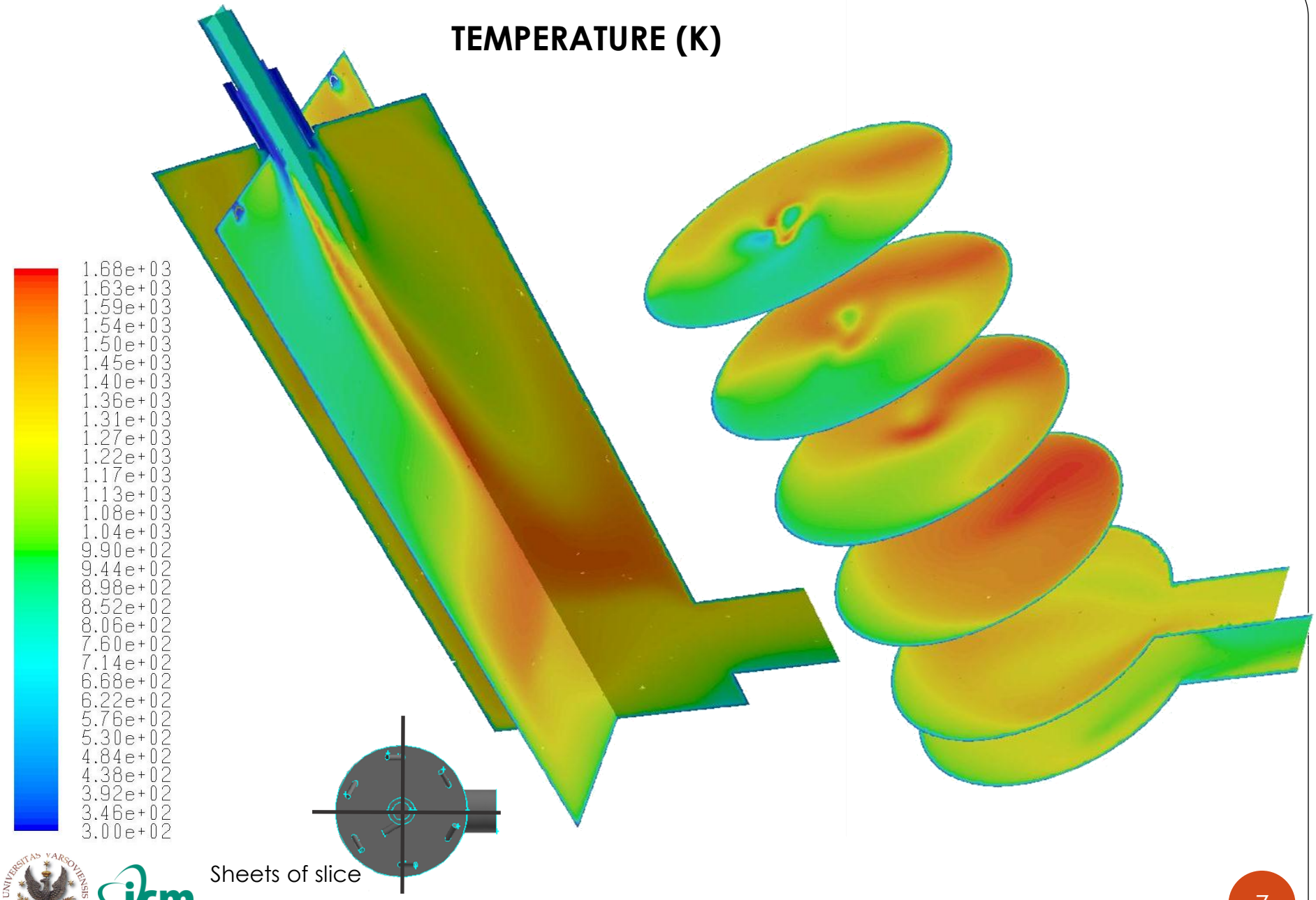
- Investigating differences between varoius types of biomass
- Modelling gasification of a single particle of biomass
- Modelling porous bed of biomass
- ‚Zonal model' of the porous bed of biomass (0D and 1D models)
- Modelling gasification with Fluent
- Crosss-validation with the OpenFoam code
- Measurements and model validation

3D LES, early results



Contours of Velocity Magnitude (m/s) (Time=1.0000e-02)
Mar 23, 2011
ANSYS FLUENT 13.0 (3d, pbns, LES, transient)

TEMPERATURE (K)



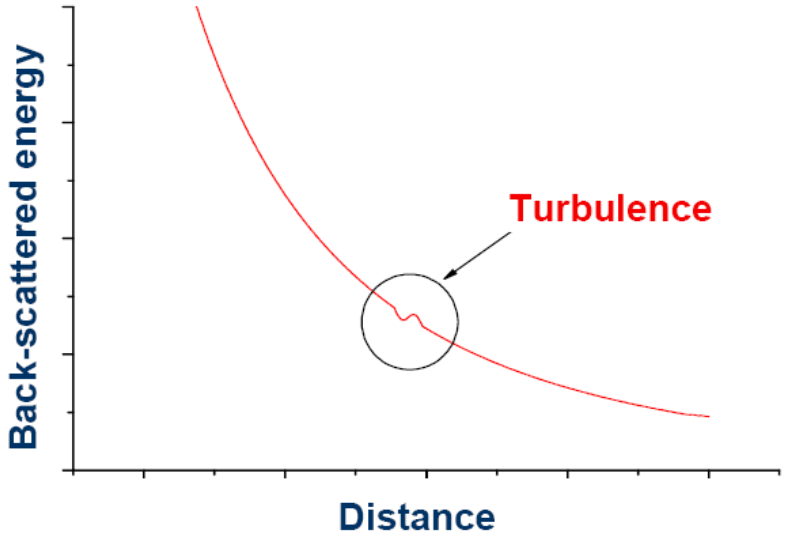
Sheets of slice

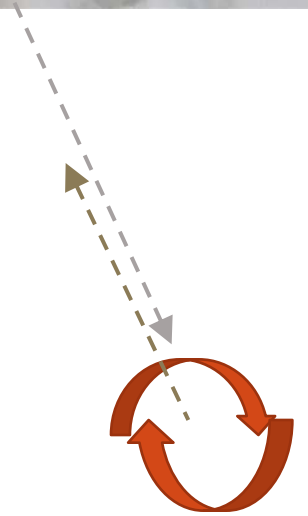
Clear-air turbulence (CAT)

- CAT is turbulence occuring at mid to high altitudes outside clouds
- Plane encounters CAT 'holes in the air':
  - Sudden loss of lift due to vertical gusts
  - When lift is regained large forces act
- Results of CAT encounters:
  - Property damage (tea spilled on neighbours computer)
  - Frequent injuries among crew and passengers
  - Sometimes structural damage to airplane itself

DELICAT overview

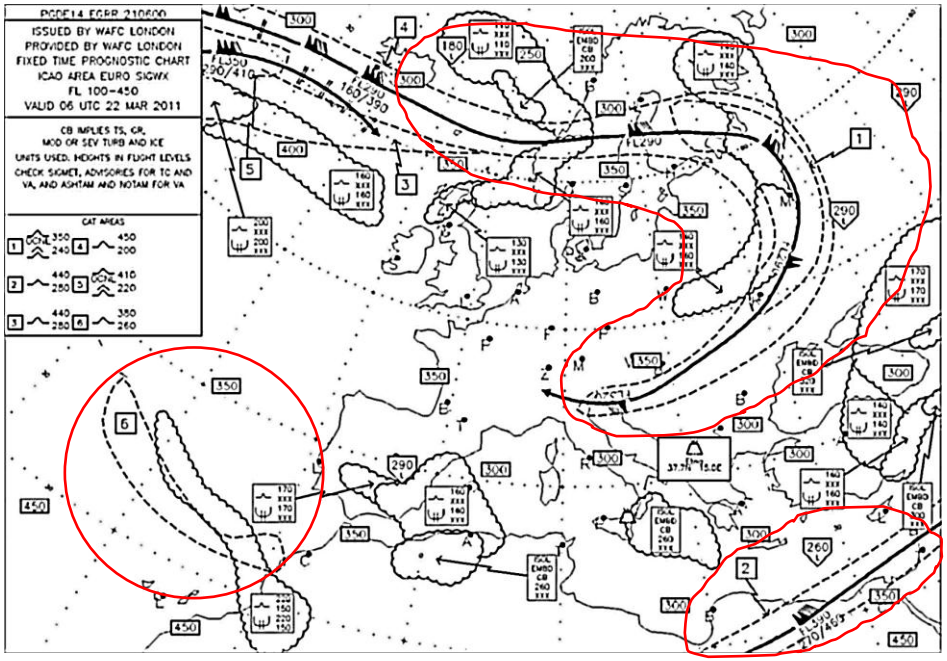
- **Demonstration of LIDAR as medium range (30km) CAT detector**



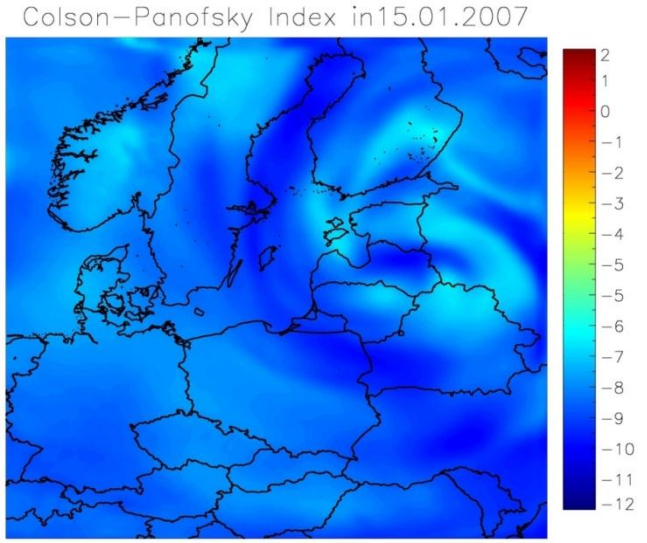


CAT forecasting

- Meteo services
  - Inaccurate
  - Standard CAT localisation

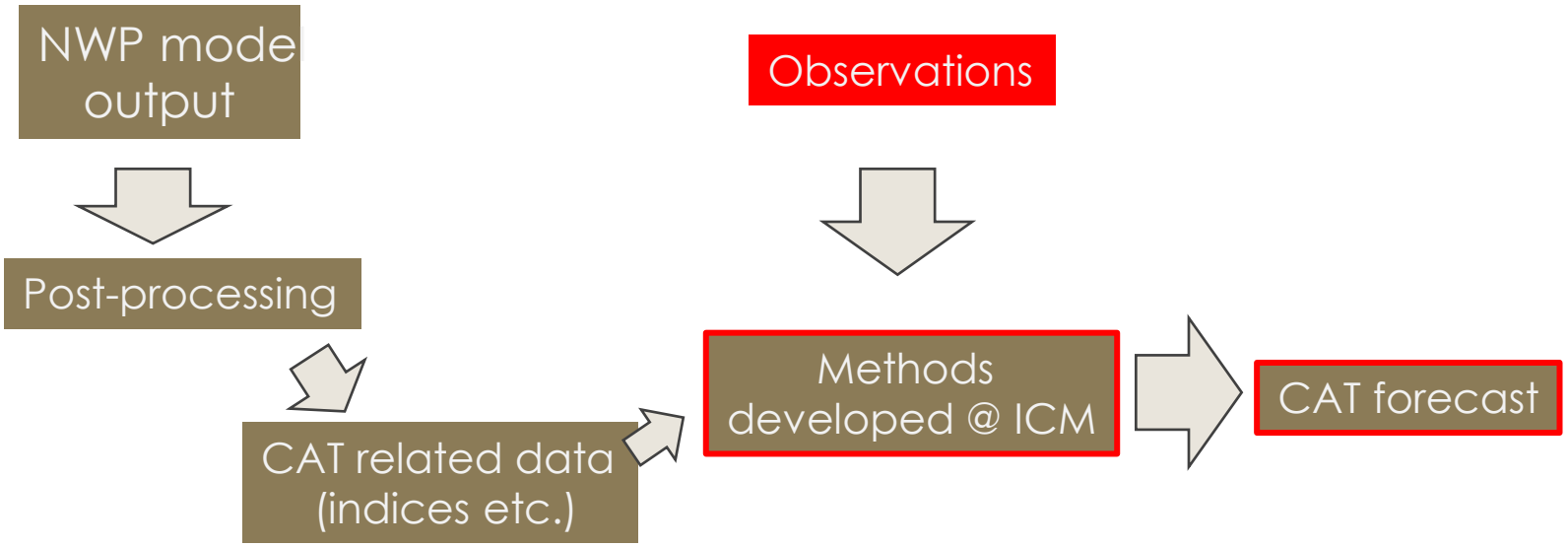


- NWP models
  - Method 1: indices
    - Many different methods
    - Not satisfactory
  - Method 2: GTG
    - Incorporates observations
    - Quite good
    - Only for continental USA



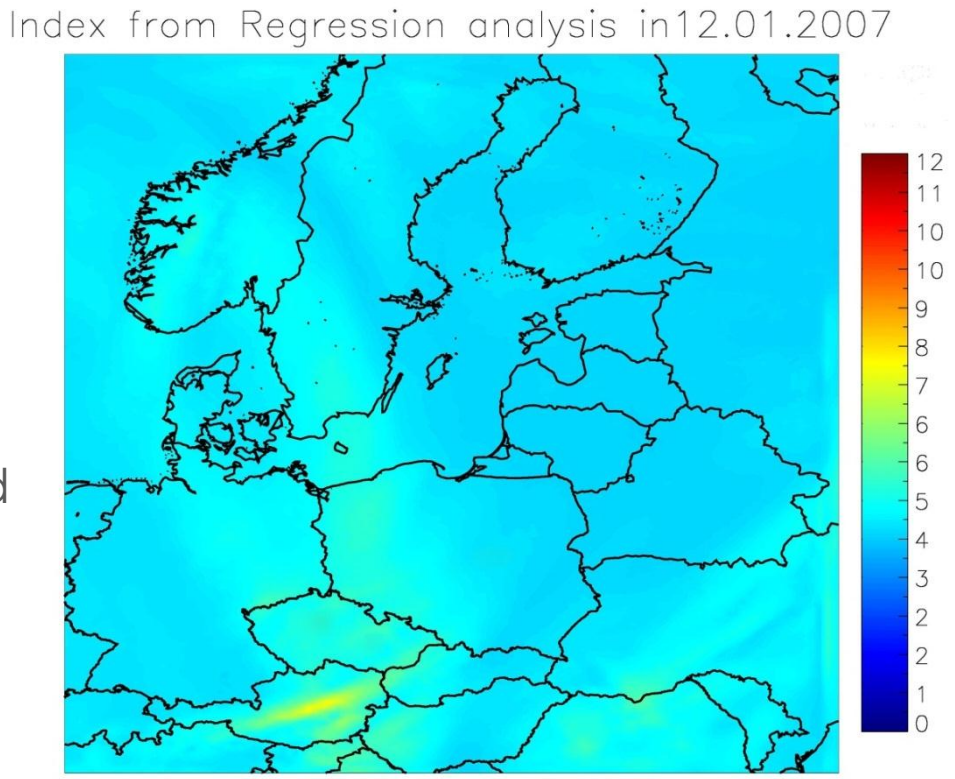
CAT forecasting at ICM

- CAT forecasting is done without using direct observations
- Two methods are developed at ICM that use observations
  - Adaptive multidimensional regression (based on NOAA GTG)
  - Machine learning (Random Forest) based method

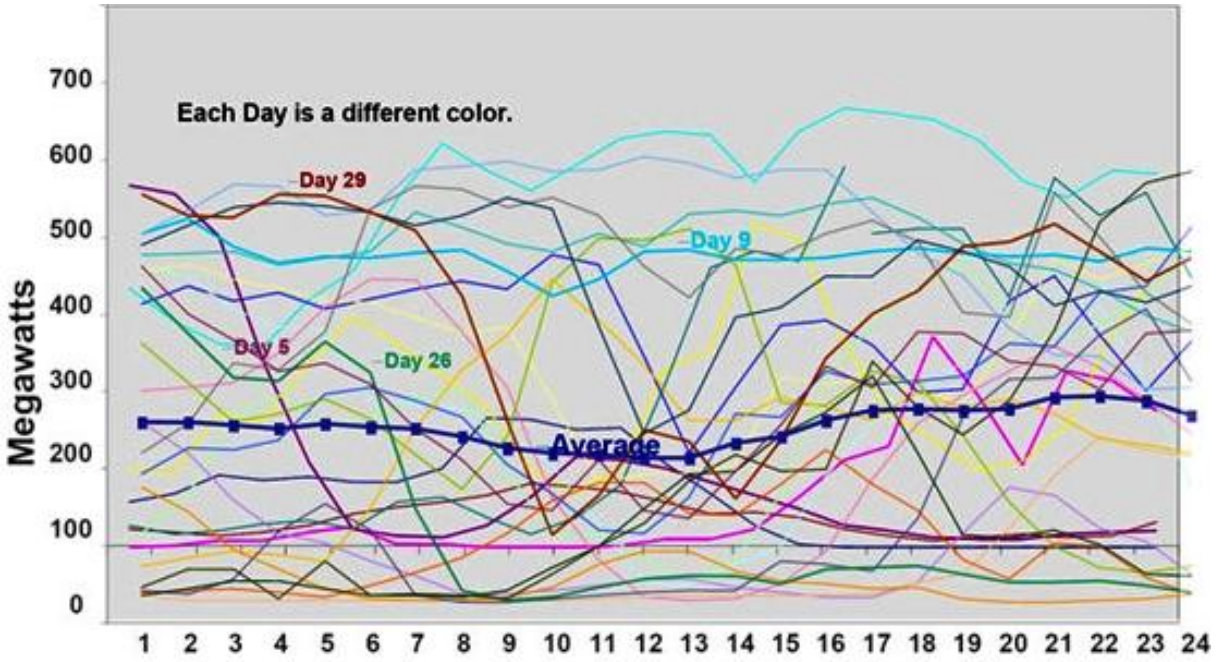


CAT forecasting at ICM

- Example output: Adaptive mutidimensional regression
  - First algorithm of this type in Europe
  - Calculates vertical gust speed



Modelling wind farm output



- Long-term wind potential of a site
  Generally well-developed statistical analysis buut no local wind atlas for Poland

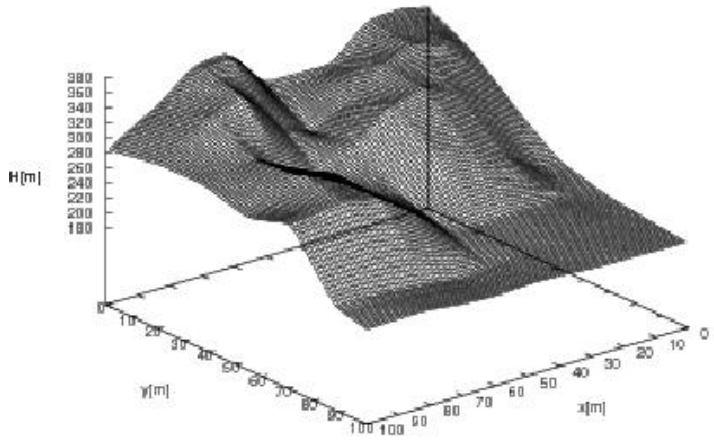
- Short-term (48h) farm output forecasting
  Non-existen and much needed!

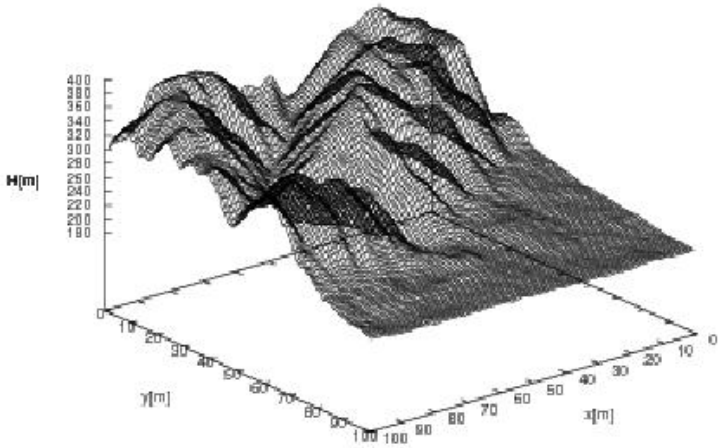
CFD Modelling

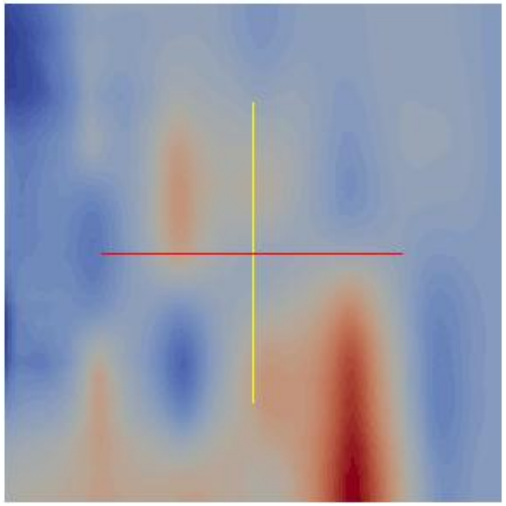
- There are commercial CFD modelling tools for farm modelling
- Those need to be fed with boundary conditions
- They are often used for statistical modelling
- No CFD tools are coupled with the Numerical Weather Prediction models (NWP)

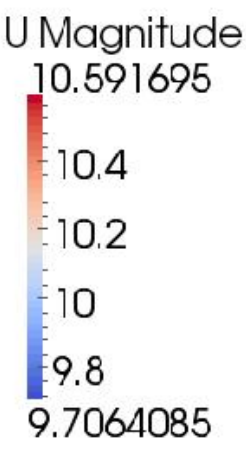
Modelling with improved topography

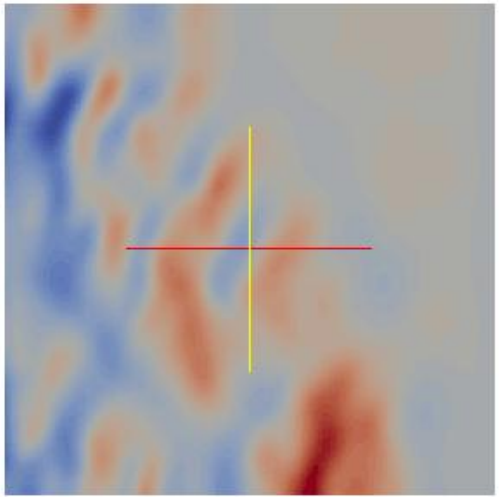
- Wind depends on topography



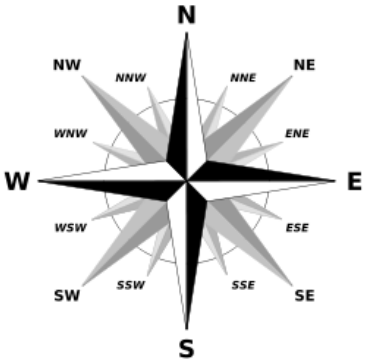


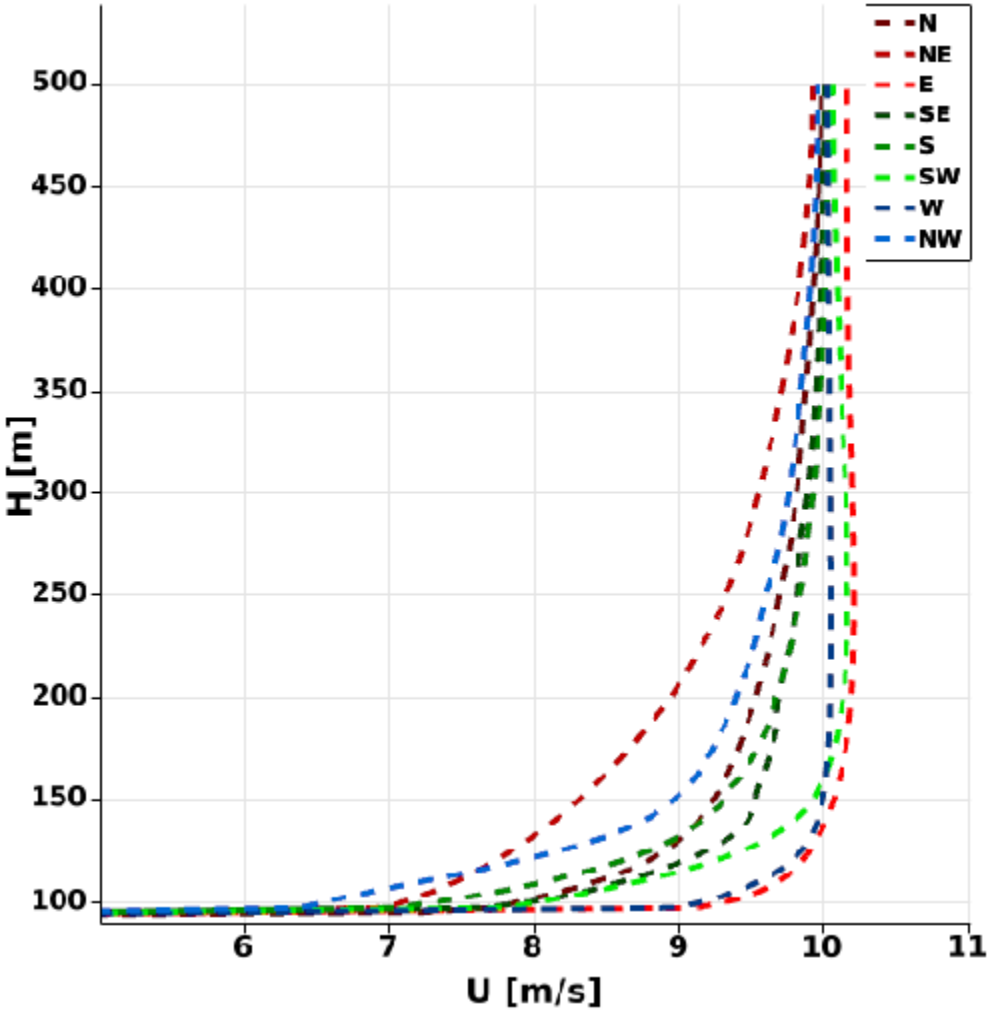






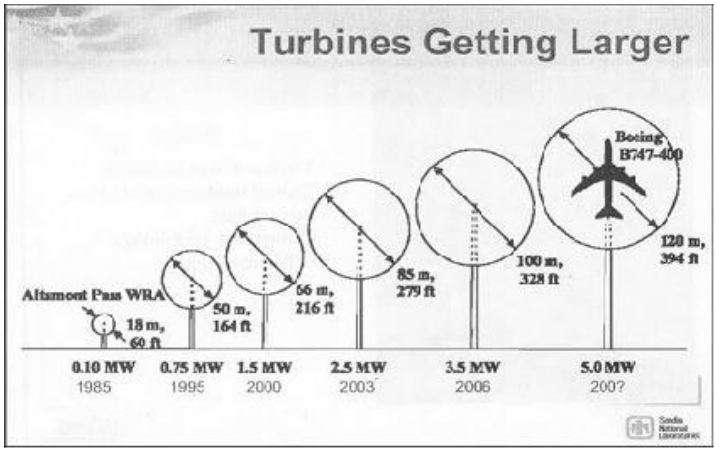
- In complex topography the vertical wind profile depends strobgly on the wind direction

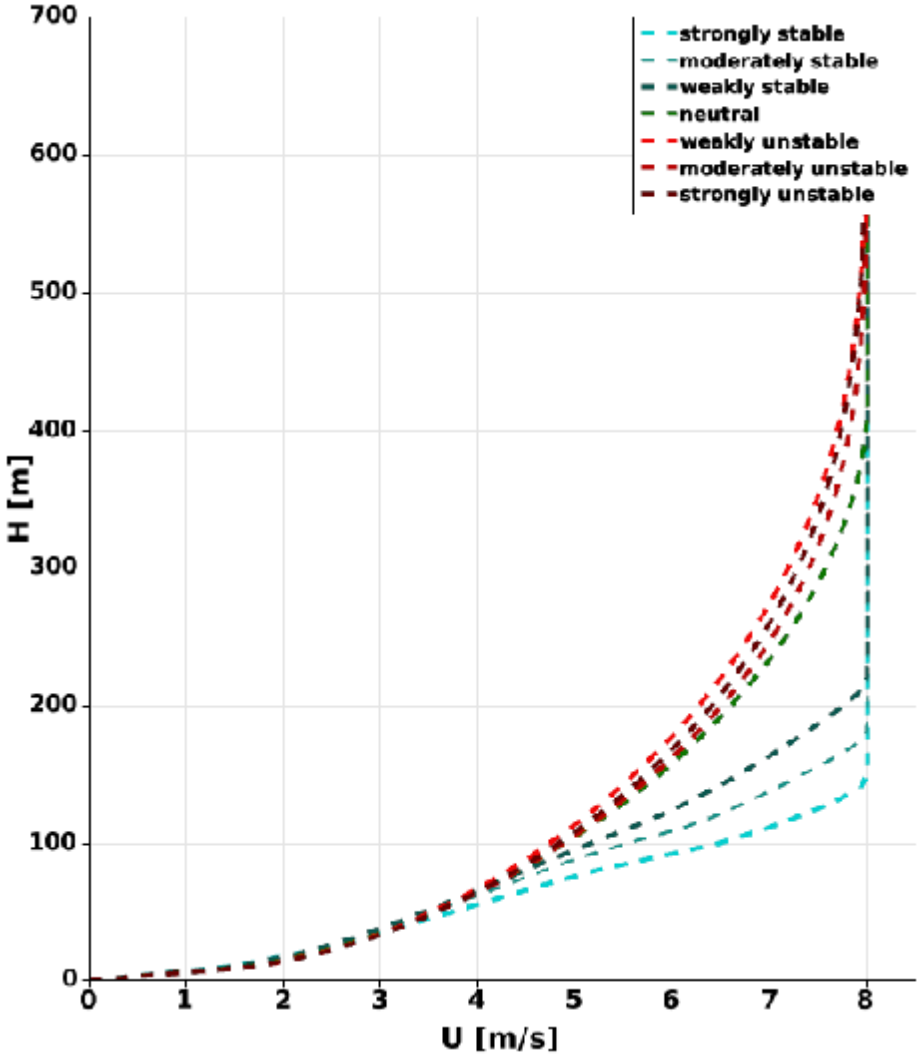




Stability of the atmosphere

- Wind profile depends on the stability of the atmosphere

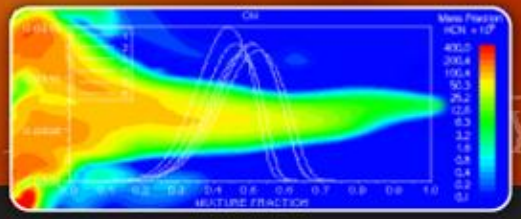




Thank you!

Wind power

Biomass



CAT

Visit our project's homepages

www.syngasburner.eu
www.delicat-fp7.org
www.projekt-proza.pl