Distributed inventory: analysis of uncertainty sources. Ukraine case study

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Main idea:

Distributed inventory

↓

uncertainty estimation

↓

uncertainty decreasing

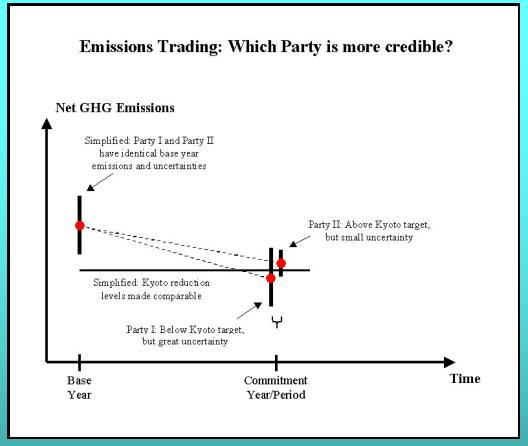
Illustrations:

on the basis of IPCC Methodology

Traditional inventory

⇒ **Inventory** ⇒

⇒ ***Emission value E*** ⇒



+ Universality — Large - small ?

Large or small country ?

Ukraine

603,000 km^2

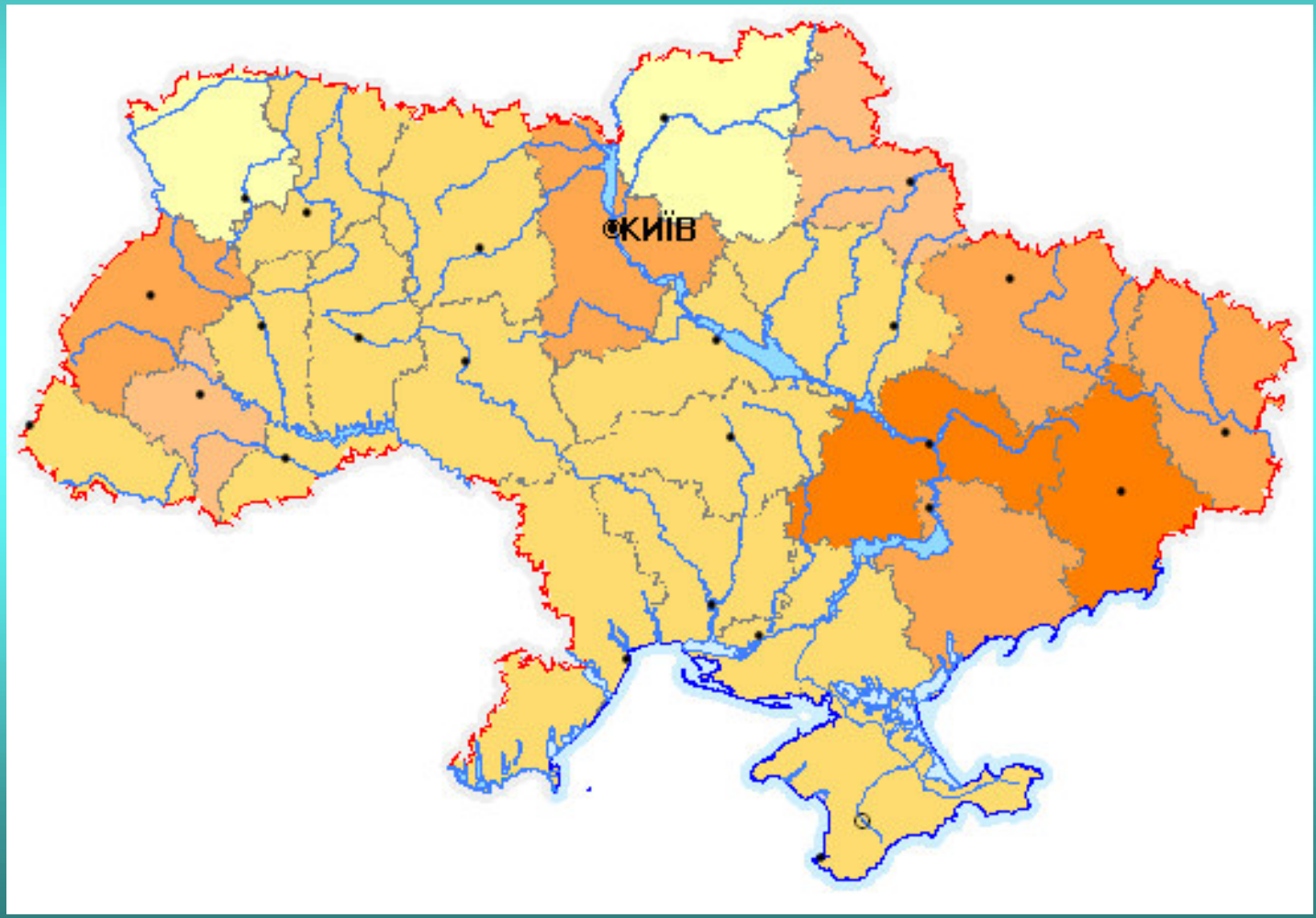
25
regions

≈ 650
districts

$$S_{Ukraine} \approx 2 \cdot S_{Poland}$$

$$S_{Ukraine} \approx 7{,}5 \cdot S_{Austria}$$

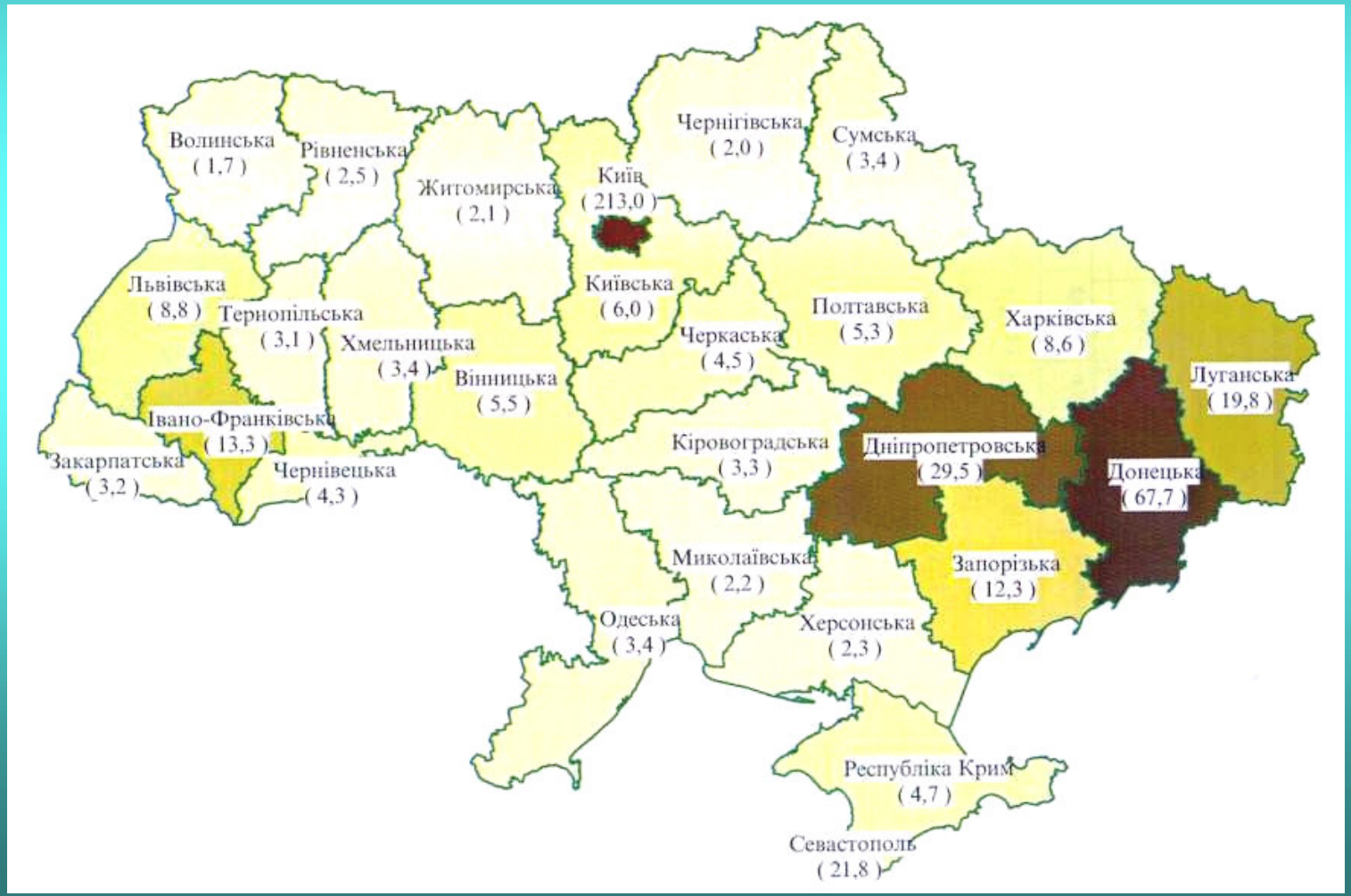
Irregularity of industry location



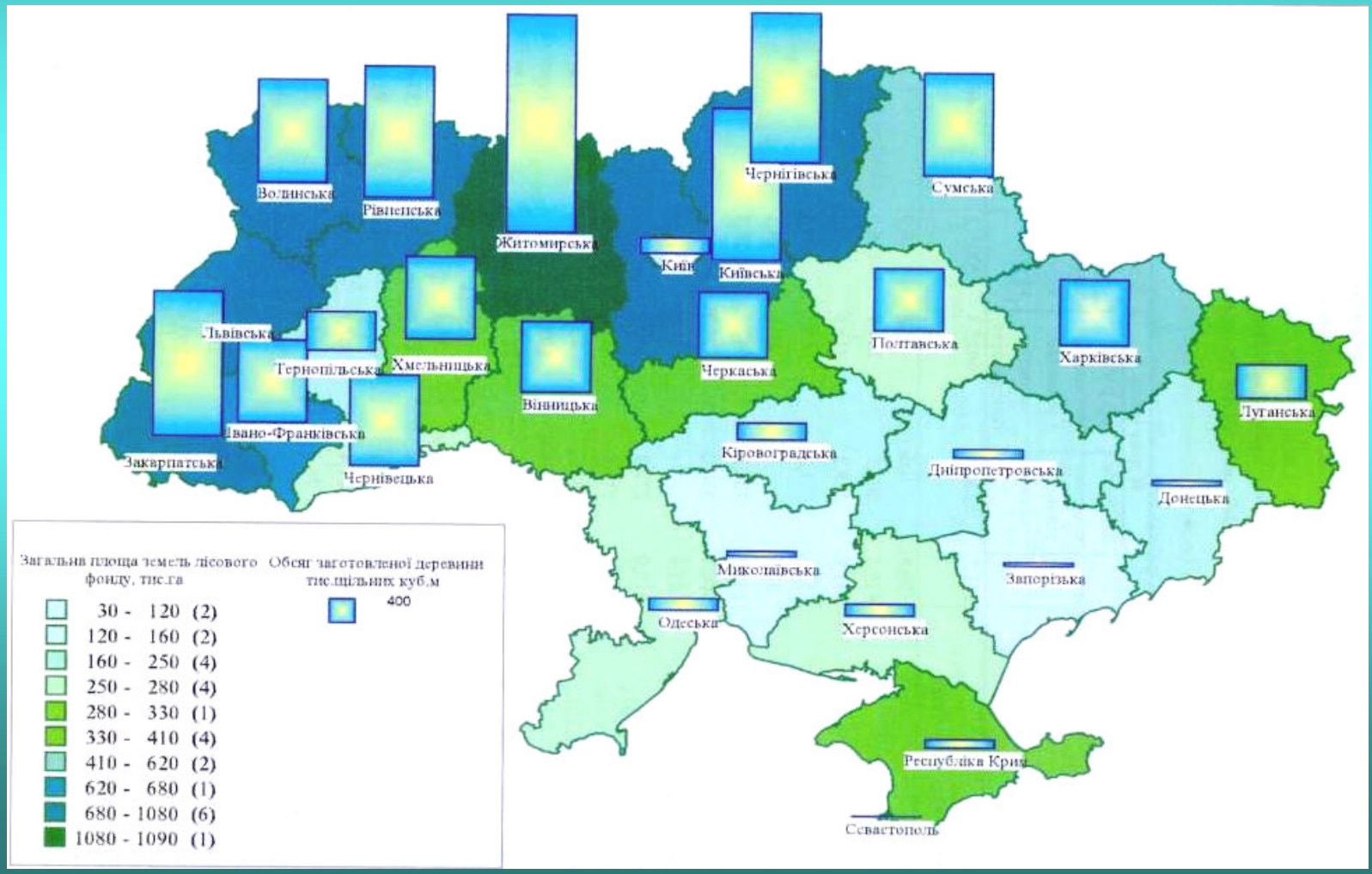
Irregularity of emissions

of harmful substances into the atmosphere per km^2

1,7 — 67,7

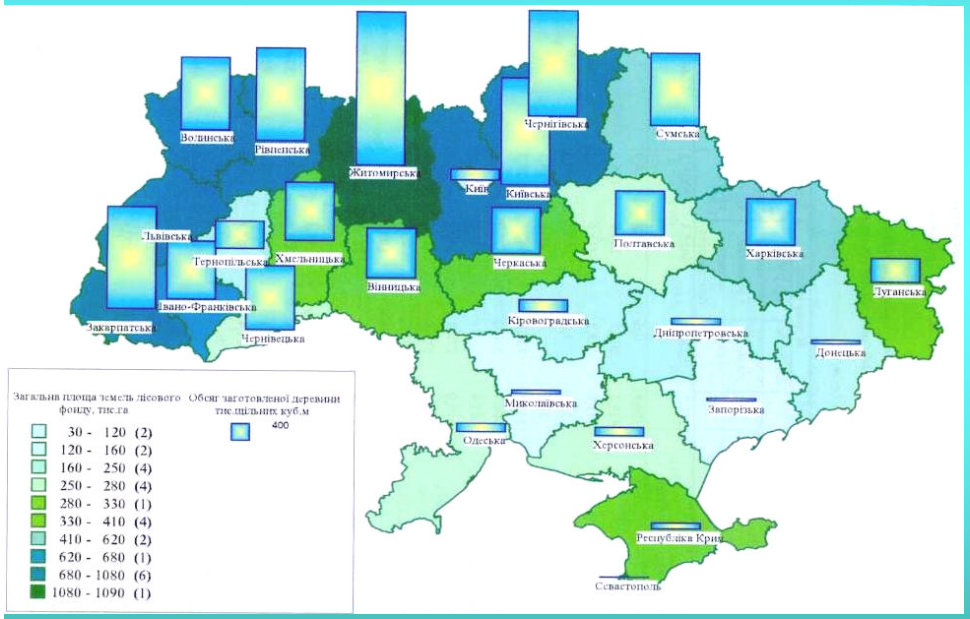


Irregularity of forest fund and wood production

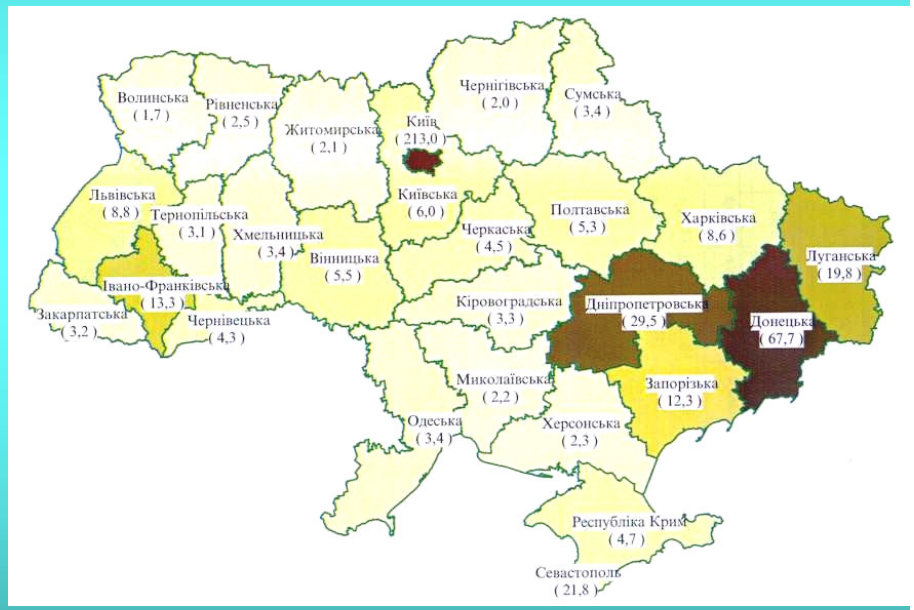


Non-uniform distribution

GHG sinks



emission sources



Effective tool for decision makers ⇒

⇒ Distributed inventory

Distributed inventory levels:

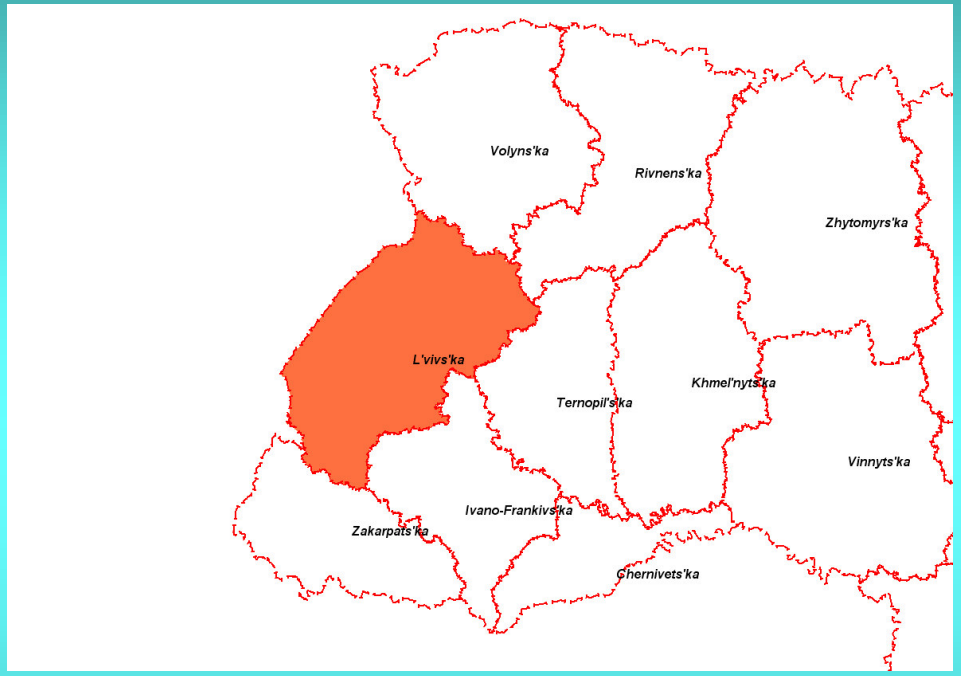
- **The highest inventory level —**
  for the whole Ukraine
- **Middle inventory level —**
  for separate regions/districts
- **The lowest inventory level —**
  for elementary plots

The highest inventory level —
for the whole Ukraine

Output data	Model	Input data (from database)
$E = \|\| CO_2, CH_4, \ldots \|\|$	$\Leftarrow \quad E = f(X)$	$\Leftarrow X = \|\| energy; industry; \ldots \|\|$

Traditional inventory

Middle inventory level —
for separate region/oblast



Output data **Model** **Input data (from database)**

$$E_{region} = \| CO_2, CH_4, \ldots \| \Leftarrow E_{region} = f(X_{region}) \Leftarrow X = \| \text{energy; industry; } \ldots \|$$

Non-traditional inventory

The lowest inventory level

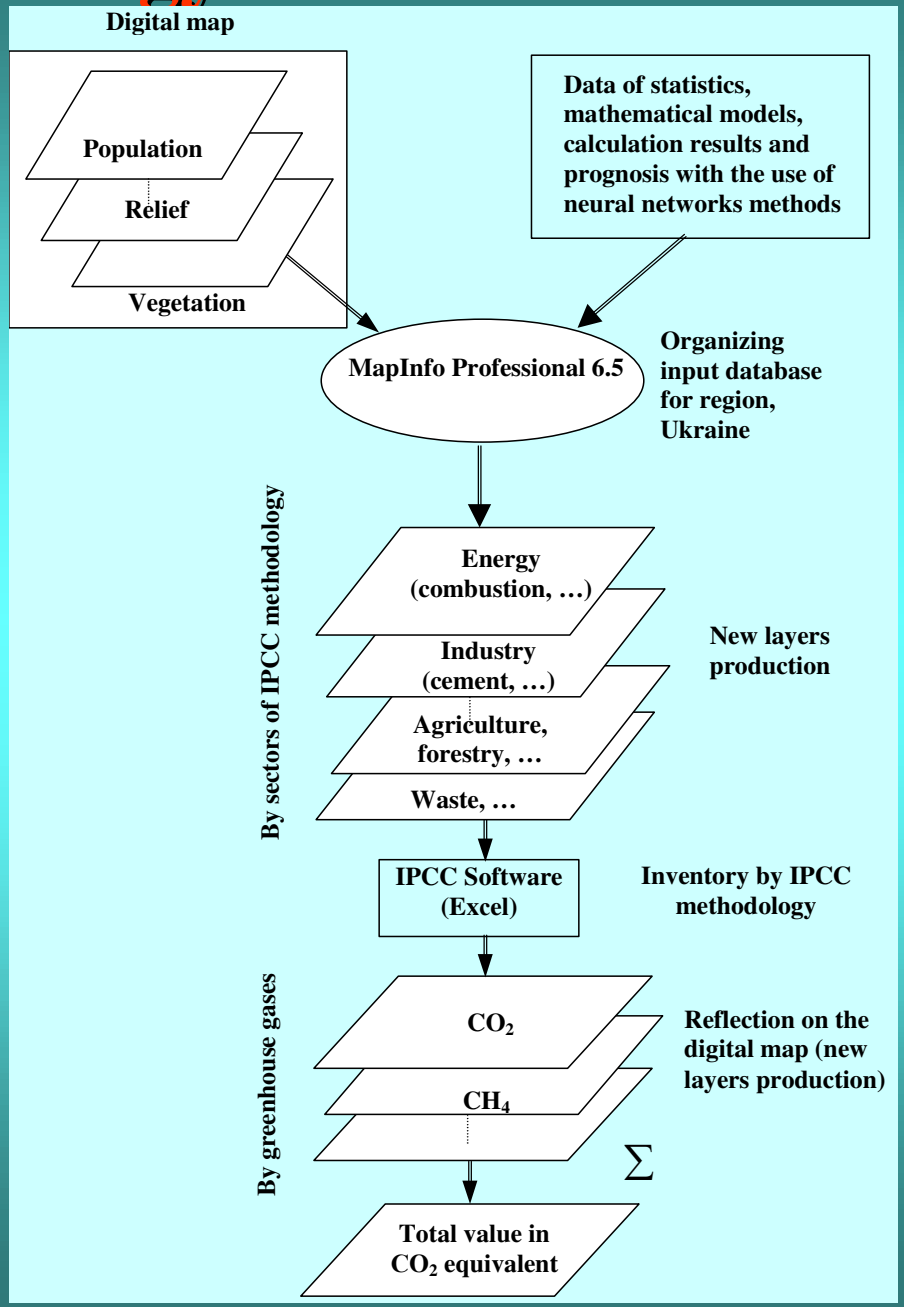
Elementary plot —

Output data	Model	Input data (from database)
$\Delta E_{el.} = \|CO_2, CH4, \ldots\|$	$\Leftarrow \Delta E_{el.} = f(\Delta X_{el.})$	$\Leftarrow \Delta X_{el.} = \|energy; industry; \ldots\|$

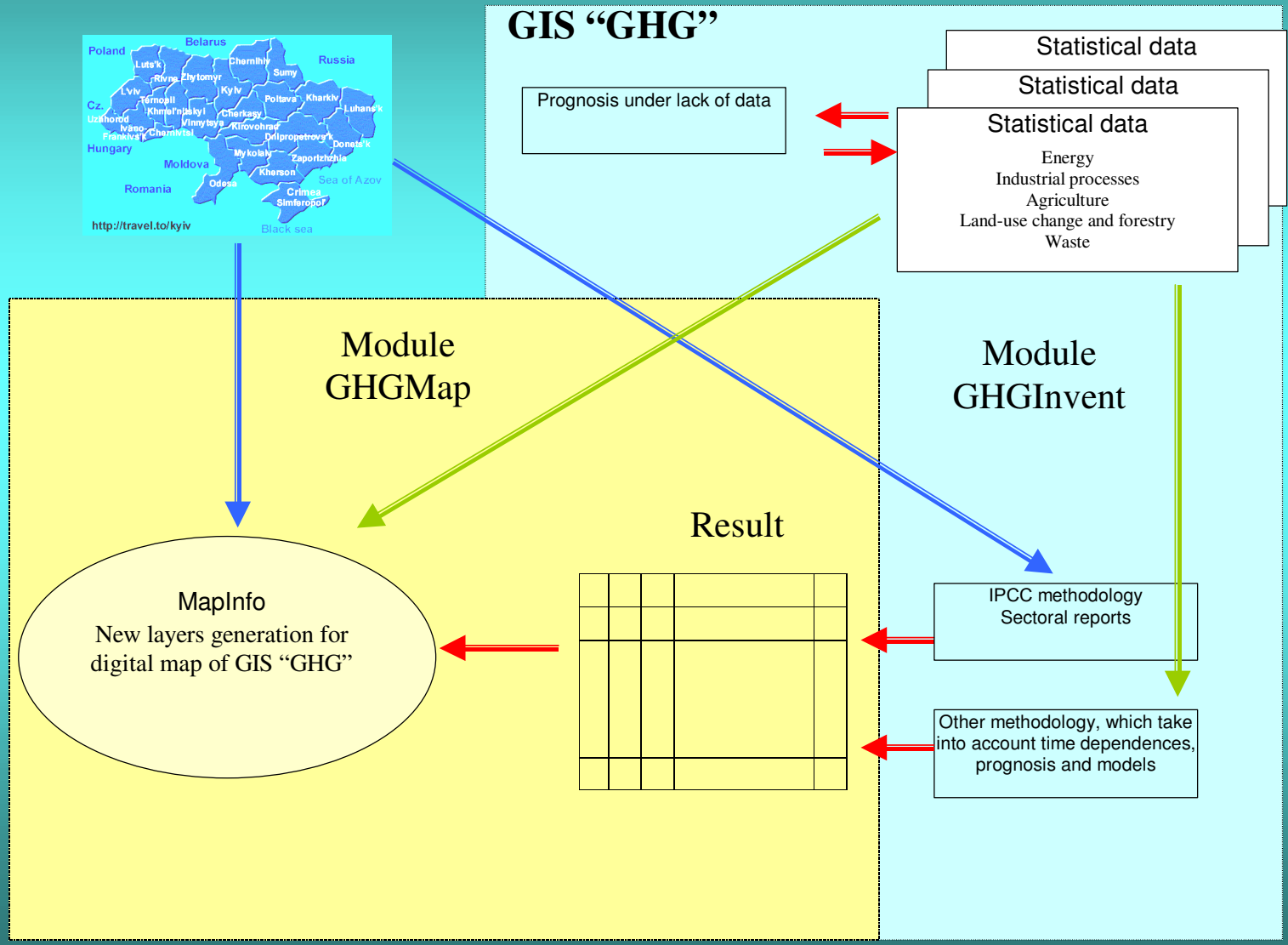
Distributed inventory

Relation between distributed and lumped models – summing on all elementary plots yields result of traditional inventory

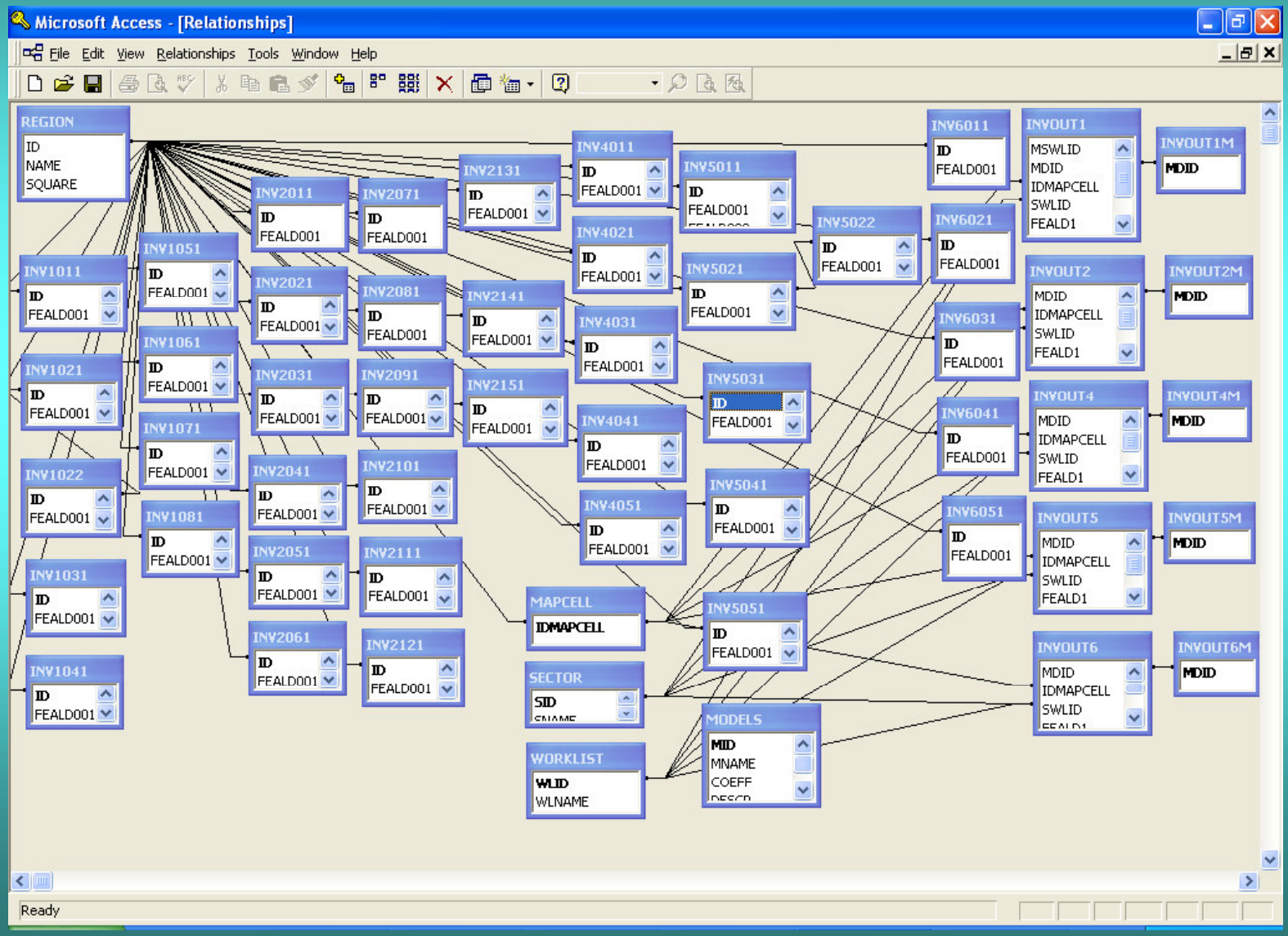
Technology of distributed inventory



Structural scheme of software GIS “GHG”



Interrelations between tables of the database GHGInvNNNN.mdb



Digital map of Ukraine

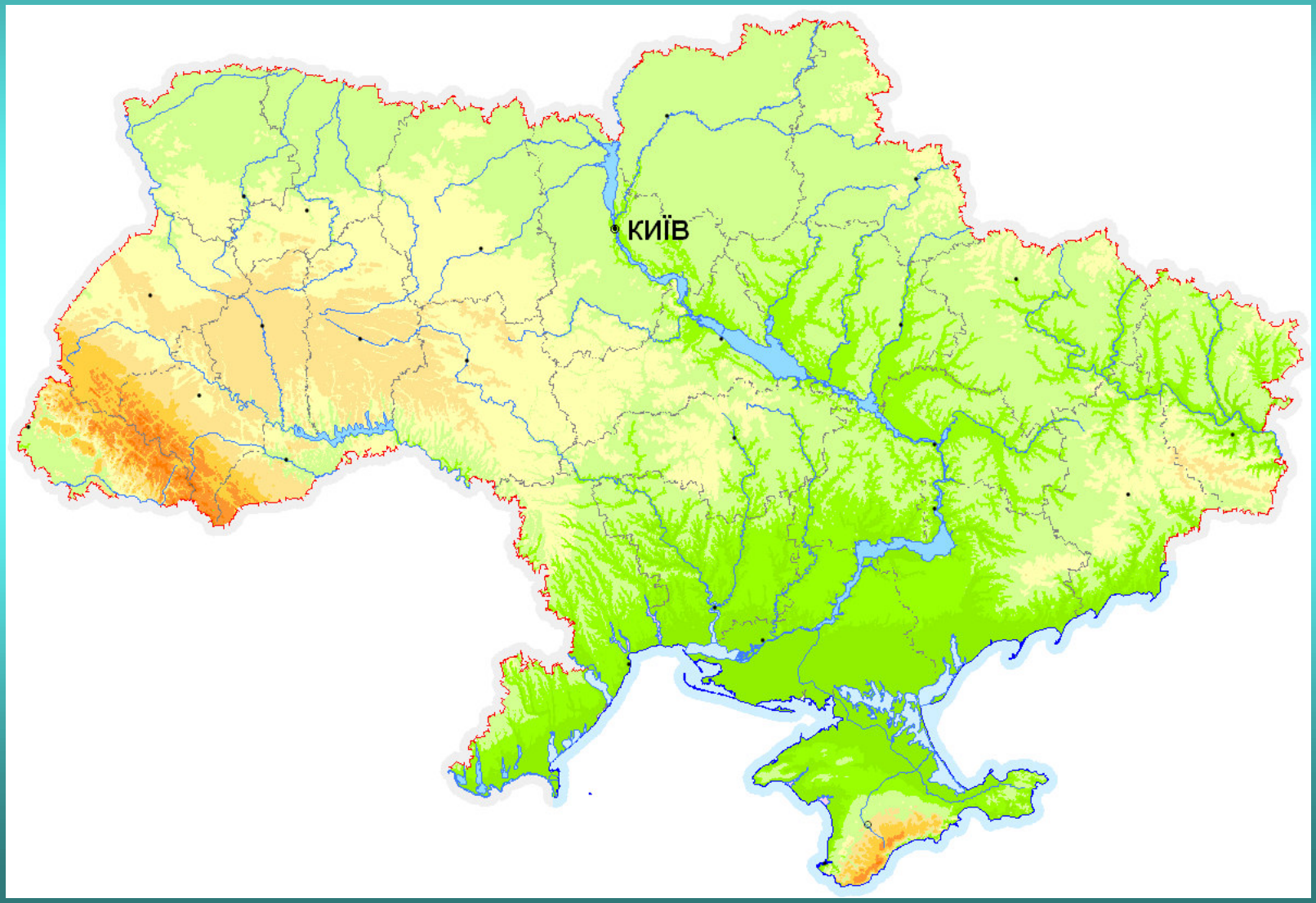
Spatial database of Ukraine of scale 1:500 000

Major segments of the electronic map

- Vegetation and soils
- Land relief
- Settlements (inhabited localities)
- Hydrography and hydroengineering constructions
- Road network and constructions
- Bounds, enclosures and separate natural phenomena

Experimental measurements:

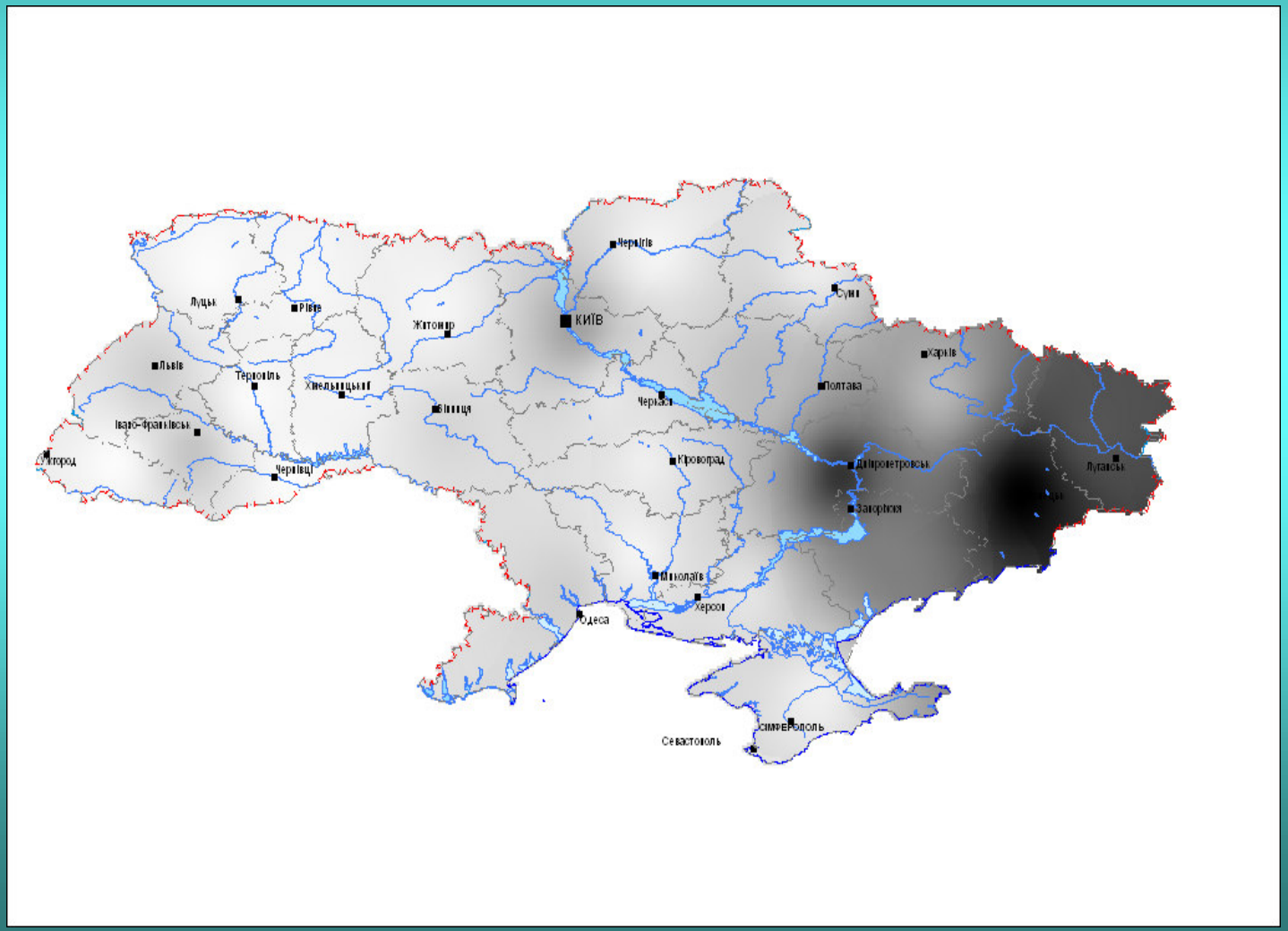
As a physical map ...



Distributed inventory results

Energy sector:

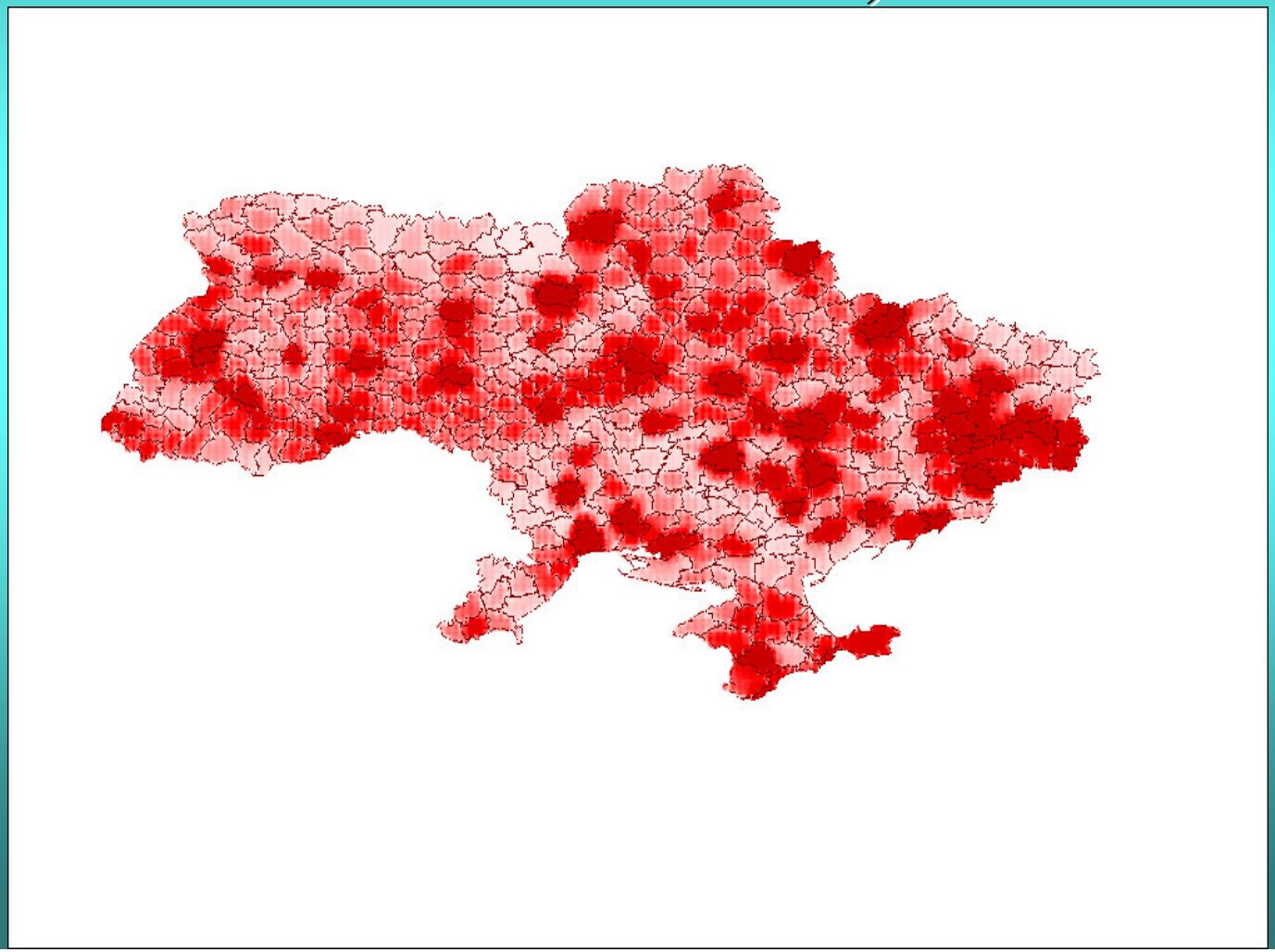
CO_2 emissions from stationary combustion (2000)



Distributed inventory results

Energy sector:

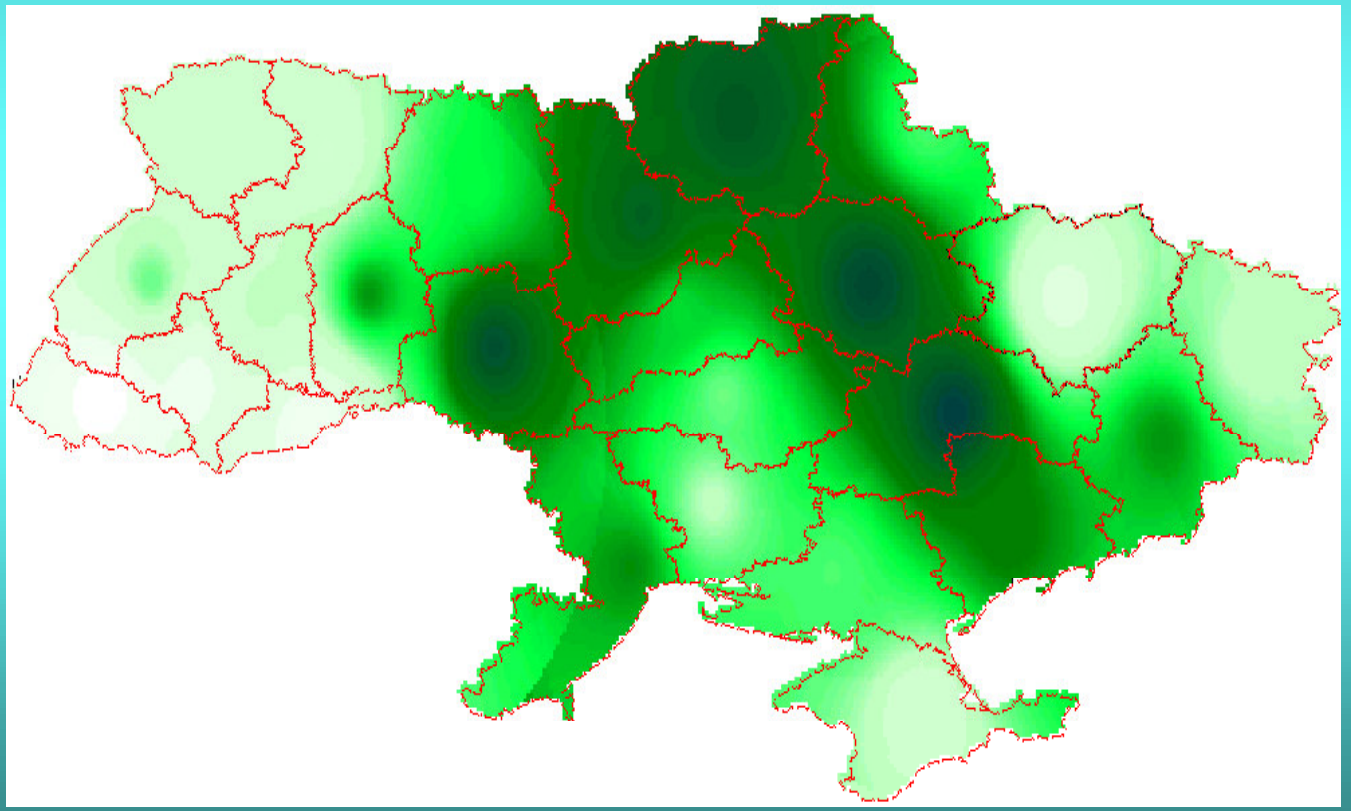
Mobile combustion - road vehicles, district level (2000)



Distributed inventory results

Agriculture sector:

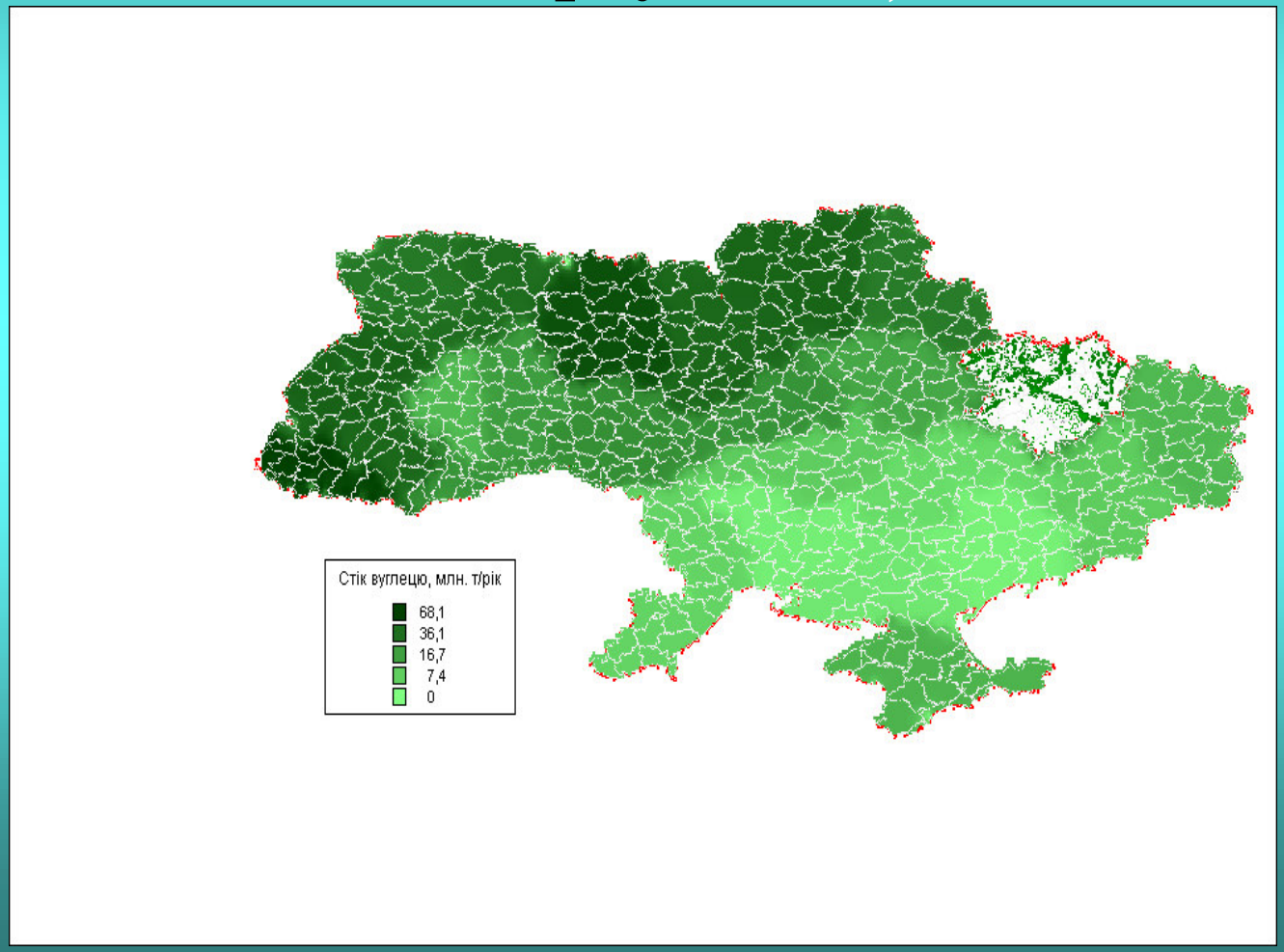
CH_4 emissions from manure management (1990)



Distributed inventory results

Forestry:

Carbon sink into forest phytomass, district level (1996)



Positive features of approach

- Convenient information for decision makers in a country
- Efficiency for large area countries with highly non-uniform location of GHG sources and absorbers
- Transparency of inventory process on different scales and convenience of reporting
- Possibility of effective usage of remote sensing data
- Convenience of comparison with another results
- combination of geoinformation technologies and IPCC methodologies

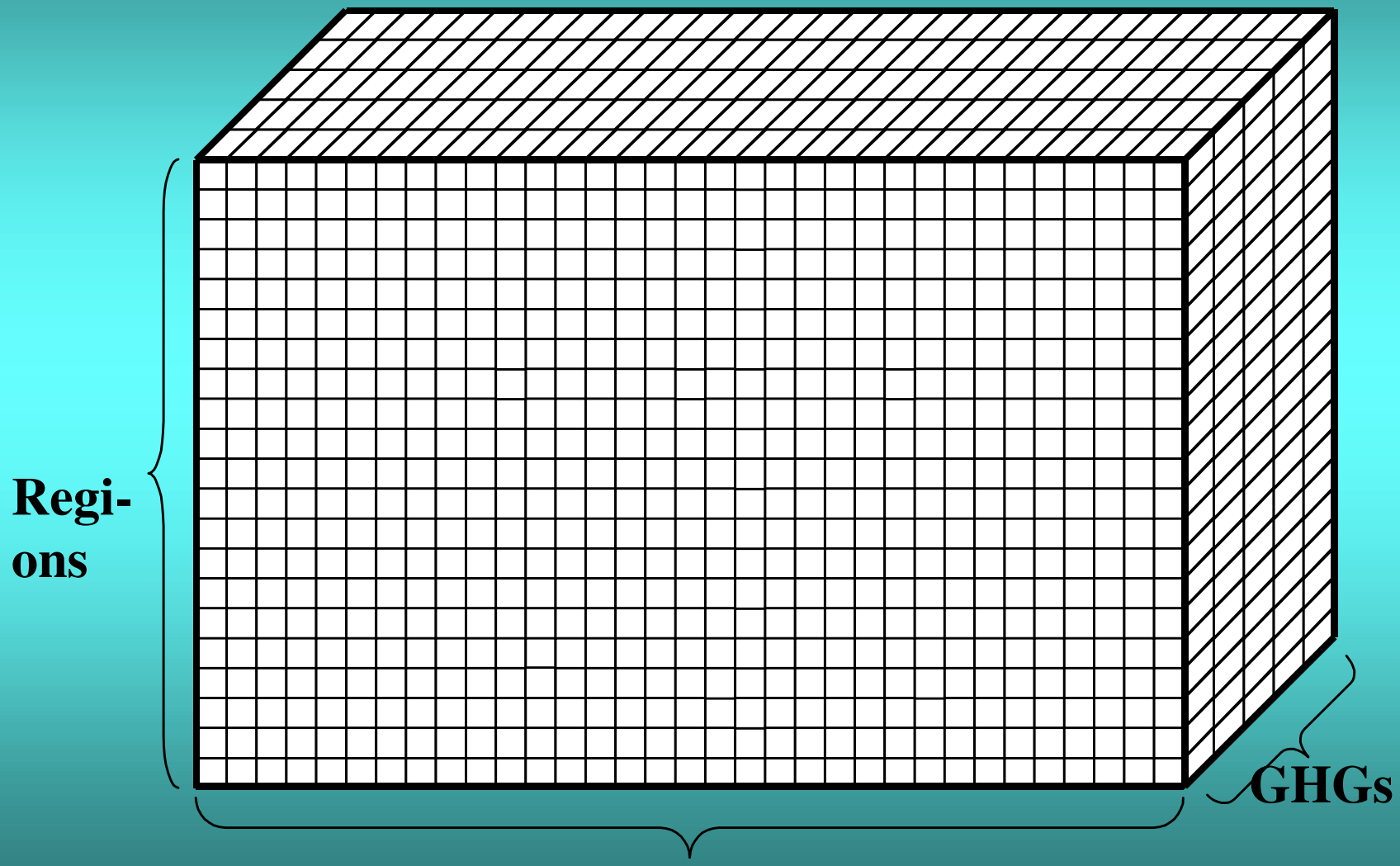
Distributed inventory and Uncertainty ???

Example :

Energy sector, regional level

Energy sector structure

Regional level



IPCC: Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories

Energy sector

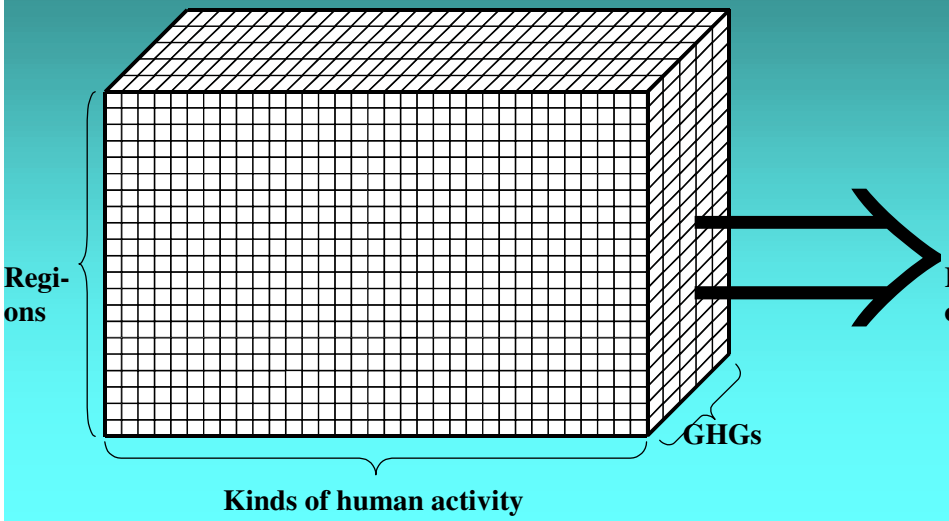
TABLE 2.6
LEVEL OF UNCERTAINTY ASSOCIATED WITH ACTIVITY DATA

Sector	Well Developed Statistical Systems		Less Developed Statistical Systems	
	Surveys	Extrapolations	Surveys	Extrapolations
Public Power, co-generation and district heating	less than 1%	3-5%	1-2%	5-10%
Commercial, institutional, residential combustion	3-5%	5-10%	10-15%	15-25%
Industrial combustion (Energy intensive industries)	2-3%	3-5%	2-3%	5-10%
Industrial combustion (others)	3-5%	5-10%	10-15%	15-20%
Biomass in small sources	10-30%	20-40%	30-60%	60-100%

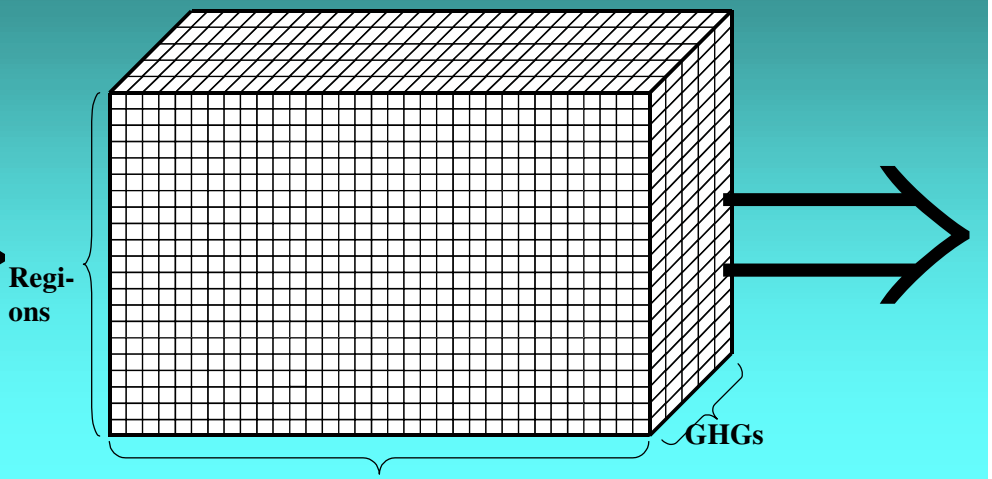
The inventory agency should judge which type of statistical system best describes their national circumstances.

Source: Judgement by Expert Group (see Co-chairs, Editors and Experts; Stationary Combustion).

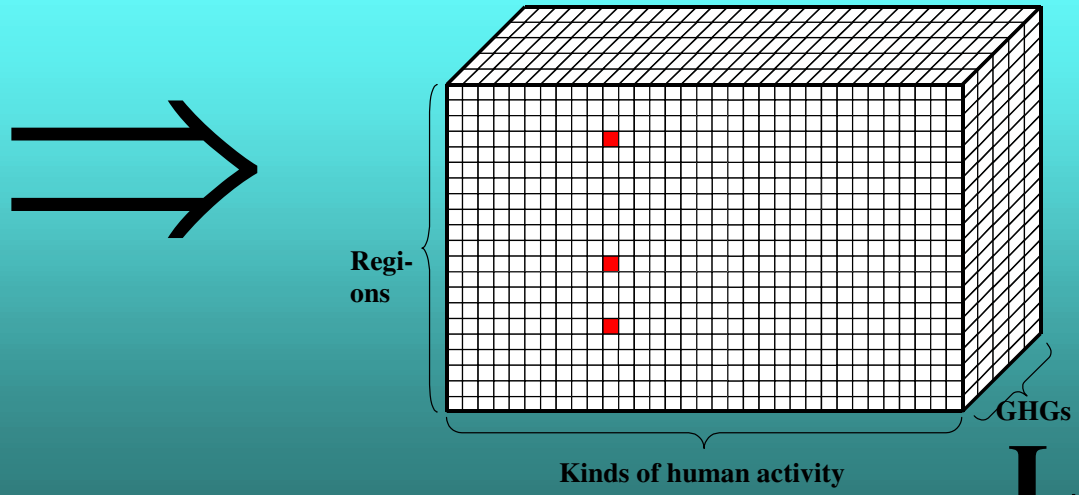
Emissions



Relative uncertainties



Absolute uncertainties

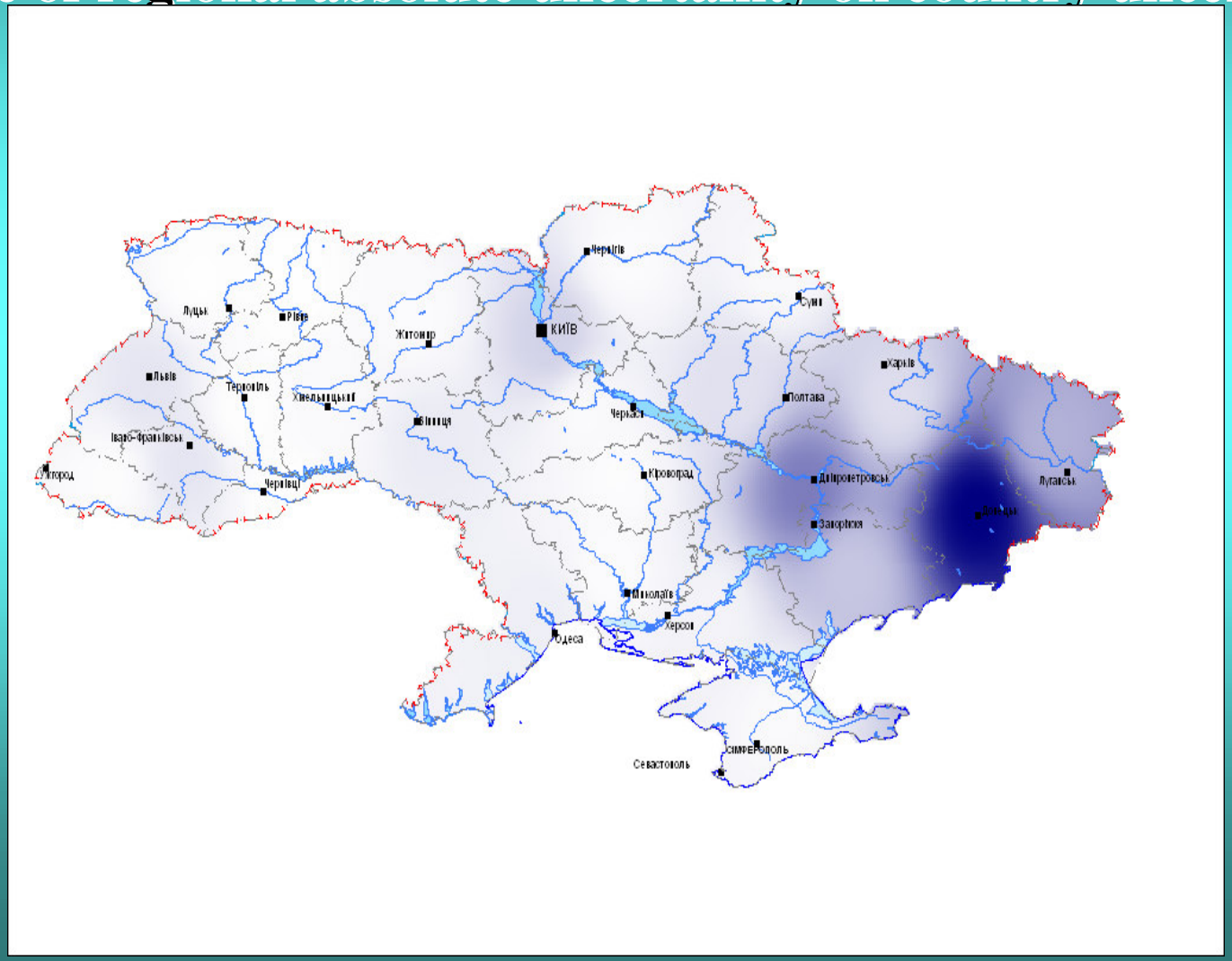


Leaders ???

Map of uncertainties

CO_2 emissions from stationary combustion

An influence of regional absolute uncertainty on country uncertainty



Leaders:

Absolute uncertainty CO_2 emissions from stationary combustion

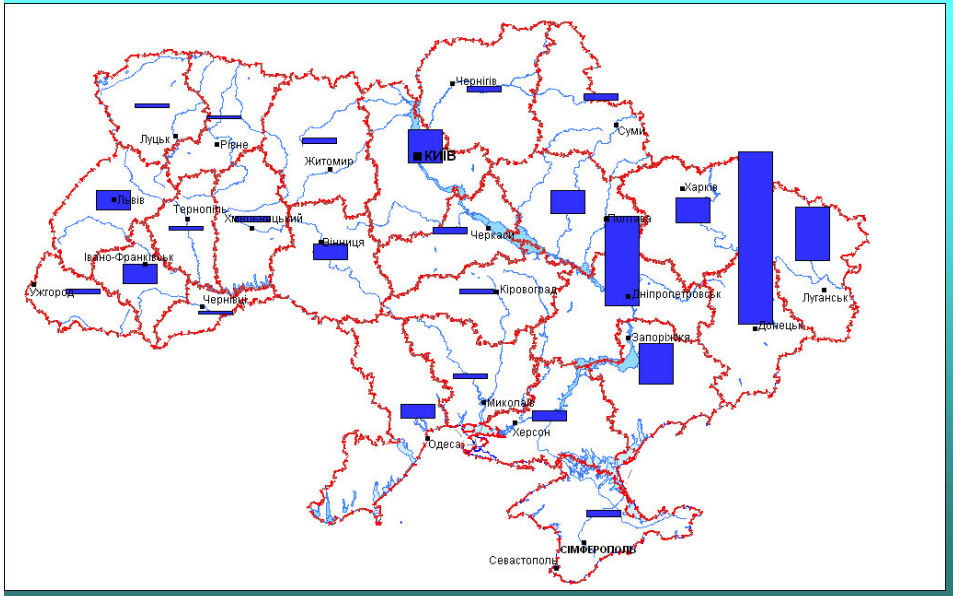
1. Donetsk region - 28,3 %

2. Dnipropetrovsk region - 15,1 %

3. Lugansk region - 9,6 %

Σ = 53,0 %

of all Ukraine GHG emission



Numerical experiment

Ukraine

"Bad" statistics

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Leaders

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Ukraine

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Ukraine

Uncertainty

(Energy sector)

U = 7,40 %

Ukraine

Uncertainty

(Energy sector)

U = 6,02 %

$\Delta U = 1,38\ \%$

Summary of approach

Distributed inventory

↓

Leading region and leading activity

↓

Small investment for leaders

↓

Uncertainty decreasing

Thanks for your attention!