Greenhouse gas Inventory Office of Japan

Uncertainty Assessment of Japan's GHG Inventory

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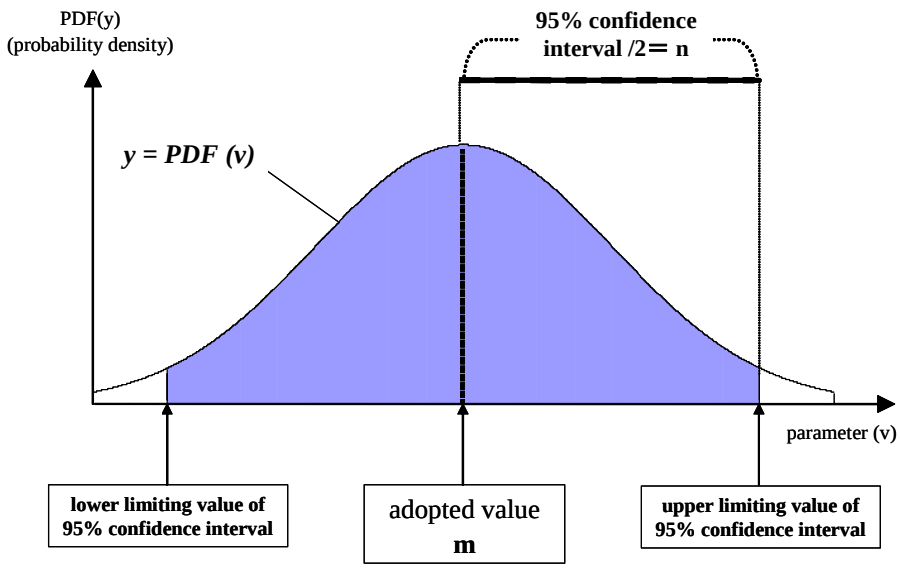
Outline

- Overview of Uncertainty Assessment
- General Procedure of Uncertainty Assessment
- Uncertainty Assessment for Emission Factor (EF) and Activity Data (AD)
- Uncertainty Assessment in each sector (characteristic categories)
- Results of Uncertainty Assessment
- Issues for Uncertainty Assessment
- From Japan's experiment for uncertainty assessment

Overview of Uncertainty Assessment

- ***GPG(2000)*** is base concept for assessment methods.
- **Uncertainty range** is **95% confidential interval**.
- Discussed for uncertainties on the ***Committee for GHG Estimation Methods*** in 2001.
- Japan has **annually conducted** uncertainty assessment based on *the Committee for GHG Estimation Methods*.
- Describe in **Annex 7 of NIR**.
  - 7.1 Methodology
  - 7.2 Results



General Procedure of Uncertainty Assessment

1st STEP: Estimate uncertainties for Emission Factor (EF) / Activity Data (AD) of each source/sink (describe in detail later)

2nd STEP: Combine uncertainties for EF and AD to estimate uncertainties of emission from each source/sink uncertainty.

$$U = \sqrt{U_{EF}^2 + U_A^2}$$

U : Uncertainties of Emissions from Source(%)
U_{EF} : Uncertainties for Emission Factor (%)
U_A : Uncertainties for Activity Data (%)

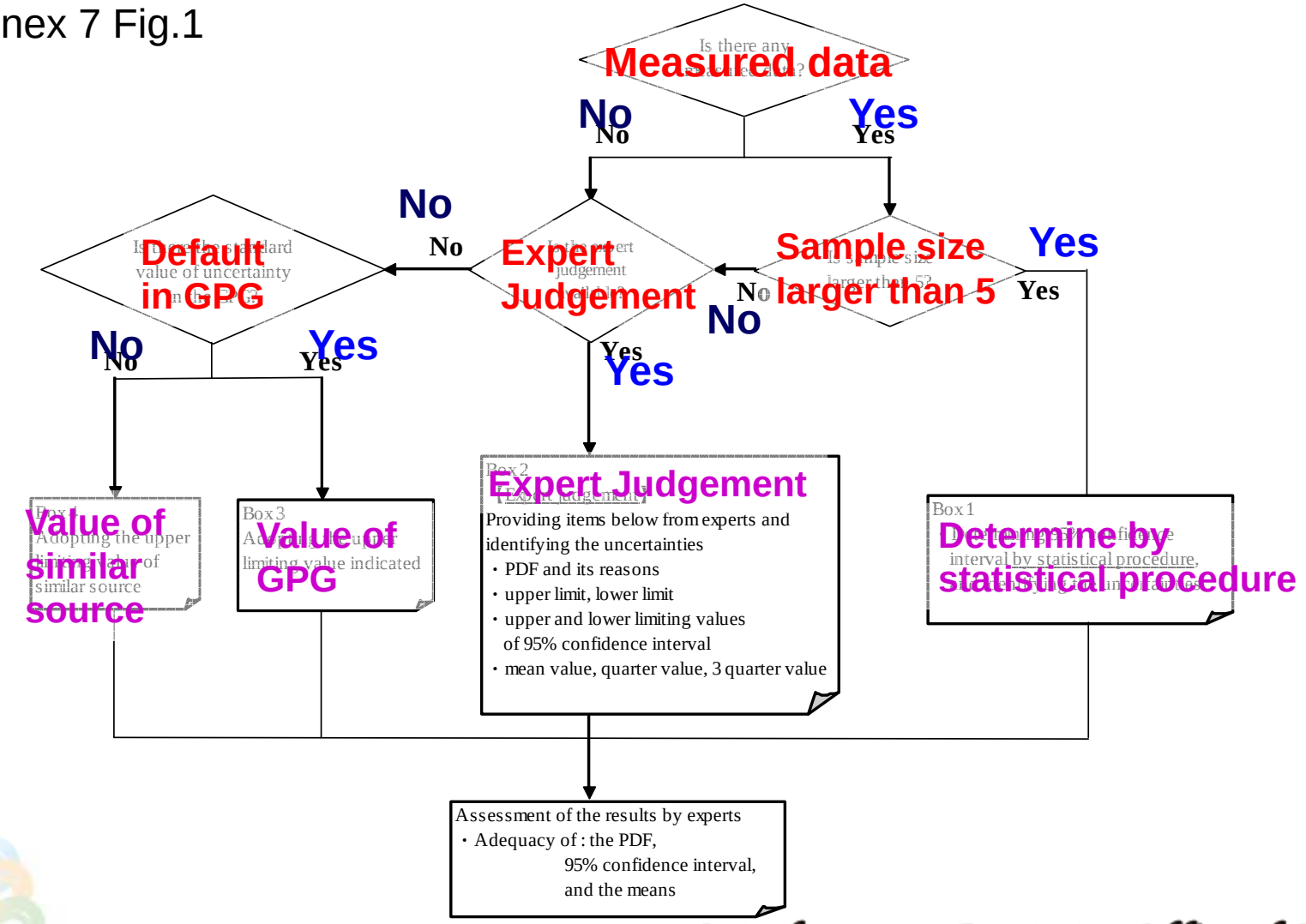
3rd STEP: Combine each source/sink uncertainty to estimate total uncertainty.

$$U_{total} = \frac{\sqrt{(U_1 * E_1)^2 + (U_2 * E_2)^2 + \cdots + (U_n * E_n)^2}}{E_1 + E_2 + \ldots + E_n}$$

U_{total} : Uncertainties of total Emissions of Source(%)
U_i : Uncertainties of Emissions from Source “i” (%)
E_i : Emission from Source “i” (Gg)

Uncertainty Assessment for EF

NIR Annex 7 Fig.1



Uncertainty Assessment for EF

- Calculate by finding the 95% confidential interval
  using statistical procedure.
- Decide by Expert Judgement.
  - document and archiving about the basis for their decision, and factors contributing to uncertainty that are excluded from consideration.
- Adopt default data provided by *GPG (2000).*
- Adopt the standard uncertainty for similar emission source provided by *GPG (2000)*.

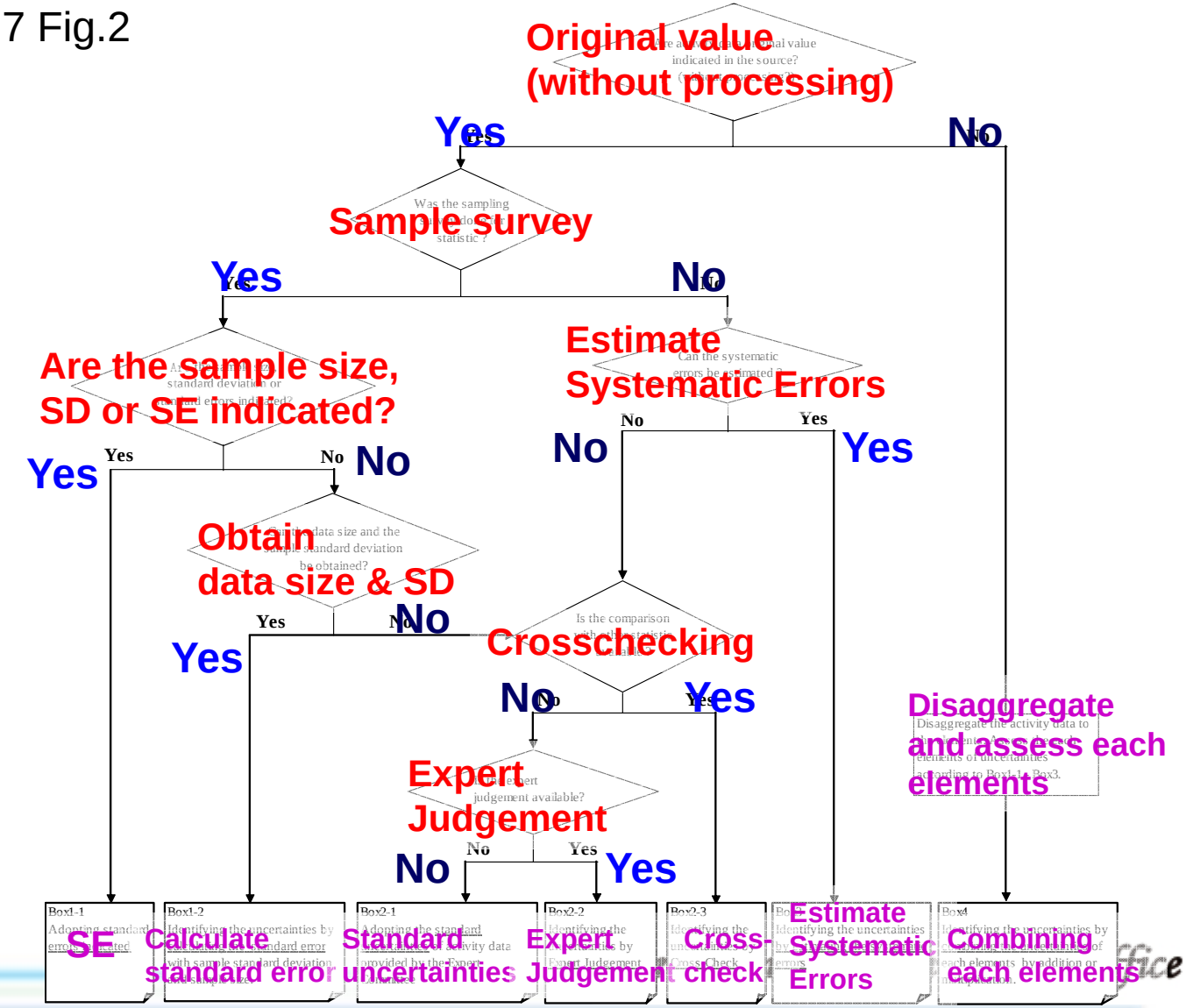
About multiple parameter EF

- Calculate combined uncertainty for EF from each parameter uncertainty.

$$U_{EF} = \sqrt{U_1^2 + U_2^2 + \cdots + U_n^2}$$

Uncertainty Assessment for AD

NIR Annex 7 Fig.2



Uncertainty Assessment for AD

Statistical values based on a Sample survey

- Adopt statistical values on a sample survey
- Decide by Expert Judgement
- Adopt the standard value established by *the Committee for GHG Estimation Methods*

	Designated statistics	Other statistics
Sample survey	50 %	100%

Statistical values **not** based on a Sample survey

- Estimate of systemic error.
- Crosscheck with other statistics
- Expert Judgement
- Adopt the standard value established by the *Committee for GHG Estimation Methods*

	Designated statistics	Other statistics
Complete survey (no rounding)	5%	10%
Complete Survey (rounding)	20%	40%

Uncertainty Assessment for AD

Using statistical values processed as AD

Step1: Breakdown of each element of AD and assessment

Step2: Combining elements

- Sum method (Rule A) : AD is expressed as **A_1+A_2**

$$U_{A-total} = \frac{\sqrt{(U_{A1} * A_1)^2 + (U_{A2} * A_2)^2}}{A_1 + A_2}$$

- Product method (Rule B) : AD is expressed as **A_1 x A_2**

$$U_A = \sqrt{U_{A1}{}^2 + U_{A2}{}^2}$$

Uncertainty Assessment in Energy Sector

1.A. Fuel Combustion

CO2

EF Use **Standard Deviation** of **sample data** of **each fuel's calorific value**

-**Carbon content** of **each fuel** is decided by **C/H ratio**, and **C/H ratio is strongly correlating with calorific value**

CO2

AD Based on the given **statistical error** of solid fuels, liquid fuels, and gaseous fuels, in TJ given in the ***General Energy Statistics***.

Emission Uncertainties are lower than other sector.

Combined uncertainties of each category: 0.3~6%

Uncertainty Assessment in Industrial Processes Sector

2.B.5. Chemical industry (Other)

EF

Carbon Black	Styrene	Coke
CH4	CH4	CH4

(Sample number >= 5)

Calculated by finding the **95% confidential interval** of **measured data**

Ethylene	1,2-dichloroethane
CO2 CH4	CH4

(Sample number < 5)

Estimated by finding the **95% confidential interval** using **Expert Judgement** (in consideration of measured data)

AD **Standard value of 5%** given by the *Committee for the GHG Estimation Methods*

Emission Combine EF & AD $U = \sqrt{U_{EF}^2 + U_A^2}$

Uncertainty Assessment in Agricultural Sector

4.A.1. Enteric Fermentation (Cattle) CH4

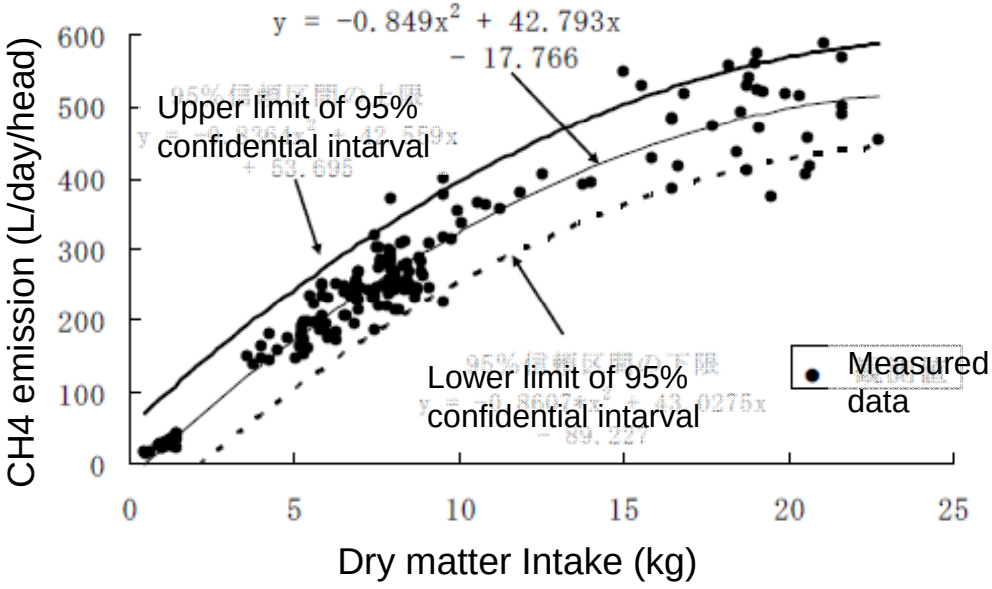
Estimate by each category (Dairy cattle: 4 categories, Non-dairy cattle: 11 categories)

AD **Standard Error** given in the ***Livestock Statistics***

EF Calculated by finding the **95% confidential interval** of **measured data** in accordance with the equation indicated below

Emission Combine EF & AD

$$U = \sqrt{U_{EF}^2 + U_A^2}$$



Uncertainties Assessment in LULUCF Sector

5. A.1. Forestland remaining Forestland CO2

AD forest area

- Evaluated by **comparing** sample forest areas in **Forest Status Survey** with those on **orthophotos** and calculating the uncertainty in accordance with the following equation

$$U\ (\%) = \frac{\left(\frac{|A_1 - a_1|}{a_1} + \frac{|A_2 - a_2|}{a_2} + \cdots + \frac{|A_n - a_n|}{a_n} \right)}{n} \times 100$$

Emission and Removal Factors evaluated by combining the uncertainties of following parameters

• stand volume, basic wood density, biomass expansion factor, root-to-shoot ratio: Evaluated by applying **95% confidential interval** of actually measured data

• carbon fraction: Evaluated by applying a default value in LULUCF-GPG

•Combination Equation:

$$U_E = \sqrt{U_V^2 + U_D^2 + U_{BEF}^2 + U_R^2 + U_{CF}^2}$$

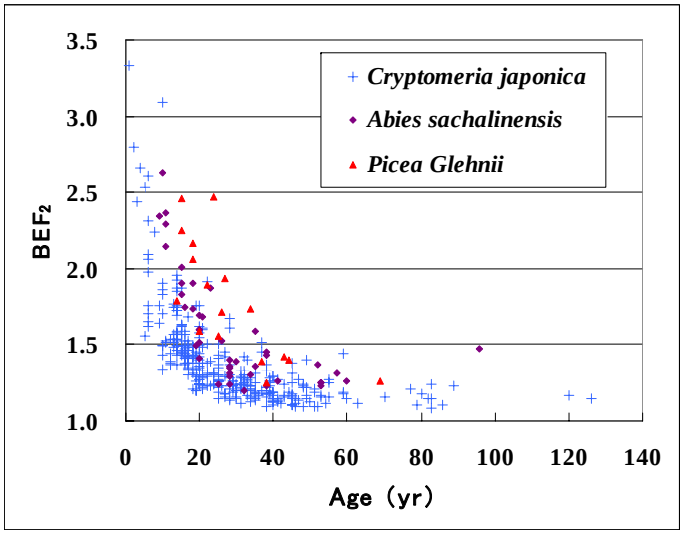


Figure: Measured Data on Biomass Expansion Factor related with Age

Uncertainty Assessment in Waste Sector

6.C.1.a. Incineration of Municipal Solid Waste (plastics)

CO2 | CH4 | N2O

U_{EF}

- C content
- Combustion efficiency

Using 95% confidence interval

Estimated using IPCC default values (upper and lower limit)

U_{AD}

- Uncertainty in incinerated amount
- Uncertainty in percentage of solids

Standard values adopted by the *Expert Committee on GHG Emission Estimation Method*

Based on Expert Judgement

Emission

$$U = \sqrt{U_{AD}^2 + U_{EF}^2}$$

U: Uncertainty in **emissions**, 17%
U_{EF}: Uncertainty in **emission factors**, 4.3%
U_{AD}: Uncertainty in **activity data**, 16%

Results of Uncertainty Assessment

Uncertainty of Japan's Total Emissions in FY2006

Approximately 2%

IPCC Category	GHGs	Emissions / Removals [Gg CO2eq.]		Combined Uncertainty [%] 1)	rank	Combined uncertainty as % of total national emissions	rank
1A. Fuel Combustion (CO2)	CO2	1,185,874	95.0%	1%	10	0.68%	3
1A. Fuel Combustion (Stationary:CH4,N2O)	CH4、N2O	5,129	0.4%	30%	2	0.12%	7
1A. Fuel Combustion (Transport:CH4,N2O)	CH4、N2O	3,238	0.3%	352%	1	0.91%	1
1B. Fugitive Emissions from Fuels	CO2、CH4、N2O	462	0.0%	19%	6	0.01%	8
2. Industrial Processes (CO2,CH4,N2O)	CO2、CH4、N2O	55,643	4.5%	7%	8	0.33%	5
2. Industrial Processes (HFCs,PFCs,SF6)	HFCs、PFCs、SF6	17,290	1.4%	20%	5	0.28%	6
3. Solvent	N2O	266	0.0%	5%	9	0.00%	9
4. Agriculture	CH4、N2O	27,368	2.2%	26%	3	0.57%	4
5. LULUCF	CO2、CH4、N2O	-91,501	-7.3%	19%	7	-1.38%	10
6. Waste	CO2、CH4、N2O	44,811	3.6%	23%	4	0.81%	2
Total Emissions	(D)	1,248,580	100.0%	(E) **2%**			

Results of Uncertainty Assessment

- Japan's total uncertainty is lower than its of other Annex I Countries.

  >>> Ratio of GHG emissions from agricultural sector, which has high level uncertainties, is **lower** than other Annex I Countries.

- Uncertainties are used for **Tier 2 Key Categories Assessment**.

  >>> In Tier 2 KCA, categories with high uncertainty are identified as key categories.

  Example of Japan: N2O Emissions from Civil aviation is small emission, but its category is chosen as key category by Tier 2 KCA.

Issues for Uncertainty Assessment

- Results of uncertainty assessment are seldom utilized in Japan. Reasons are as follows.
    1. Since uncertainty assessment itself includes a certain degree of uncertainty for some parameter, reliability for uncertainty assessment is partially not high enough.
    2. Without uncertainty assessment, we can guess categories with high priority, which should improve in Japan's case. (Categories with high priority are using "NE", using default data, pointed by ERT and so on.)

- In the *Initial Review Report*, ERT recommended that Japan improve the estimate of the overall uncertainty of its inventory.

  > To decide each uncertainty for parameter is so difficult that Japan is also seeking more better methodology.

From Japan's experiment for uncertainty assessment

- Result of uncertainty assessment is one of good index to decide priority of inventory.

- It is difficult to decide uncertainties for each parameter without statistical distribution.