Climate MRV for Africa – Phase 2 Development of National GHG Inventory: Data Collection, QA/QC, and Uncertainty Assessment

Lead partner

Project of the European Commission DG Clima Action

EuropeAid/136245/DH/SER/MULTI

Amr Osama Abdel-Aziz, Assen Gasharov, Mike Bess and Laura Lahti
Team Leader and Key Experts
April 2017

Content

- Approaches for Data Collection
- Quality Assurance & Quality Control and Verification
- Uncertainty Assessment

Approaches for Data Collection

Data Collection Principles

- Focus on key categories
  - Largest emissions
  - Greatest potential to change
  - Highest uncertainty
- Choose procedures that continuously improve the quality of the inventory
- Collect data/information at a level of detail appropriate to the method used
- Review data collection activities and methodological needs on a regular basis

Data Suppliers

- Engage data suppliers in activities, such as:
  - Offering an initial estimate of the category
  - Pointing out the potentially high uncertainties
  - Collaborate in improving estimates
  - Scientific or statistical workshops
  - Specific contracts /agreements /MoUs for regular data supply
  - Regular/annual informal updates on the methods that use the data

Data Confidentiality

- Overcome confidentiality concerns by:
  - Explain the intended use of the data
  - Agreement in writing on the level the data will be public (e.g. aggregated data)
  - Offering cooperation to derive a mutually acceptable data sets
  - Giving credits/acknowledgment in the inventory to the data provided

Gathering Existing Data

- National Statistics Agencies
- Sectoral experts
- IPCC Emission Factor Database: http://www.ipcc-nggip.iges.or.jp/EFDB/main.php
- International organizations publishing statistics e.g., International Energy Agency, OECD, IMF, and FAO
- National Libraries
- Universities
- National Inventory Reports from Parties to the UNFCCC
- **Data obtained by measurements (reliability)**
- **Survey and census information**
- **Individual entities as data providers e.g. power plants, production facilities, commercial farms etc.**

Generating New Data

- Generic elements of a measurement program:
  - Measurement objective
  - Methodology protocol (reporting guidelines)
  - Measurement plan with clear instructions to measurement personnel (templates & roles & responsibilities)
  - Data processing reporting procedures and documentation (database & archiving)

Adapting Data For Inventory Use

- Gaps in data sets
- Combining data sets numerically
- Multi year averaging
- Non-calendar year data
- Regional inventory data

QA/QC and Verification

QA/QC – Definitions

- **Quality control** (**QC**)
  A system of routine technical activities accomplished by personnel compiling the inventory.
- **Quality assurance** (**QA**)
  Accomplished by personnel not participating directly into the making and development of the inventory process. (Periodic reviews by independent entity.)
- **Verification:**
  Activities performed during or after the compilation of the inventory to ensure it's reliability. Can occur during QC or QA depending on the stage independent information is used (Alternative 3rd party estimation.)

Elements of a QA/QC System

- An inventory agency responsible for coordinating QA/QC activities (designate a QA/QC coordinator)
- A QA/QC plan
- General QC procedures (Tier 1)
- Source category-specific QC procedures (Tier 2)
- QA review procedures
- Verification activities
- Reporting, documentation, and archiving procedures

QA/QC Plan

- Outline QA/QC and verification activities that will be implemented
- Institutional arrangements for implementing activities
- Scheduled time frame that follows inventory preparation
- Can be referenced and used in subsequent inventory preparation, or modified as appropriate

→ What, how, by who and when?

Quality Control Procedures

- Assumptions and criteria for selection recorded
- Emissions and removals calculated correctly
- Units and conversion factors correct
- Consistency of data between categories
- Uncertainties estimated correctly
- Total GHG emissions checked
- Time series consistency checked
- Completeness checked

Keep in mined your resource and time availability!

Category Specific QC

- QC of Emission Factors
  - Background data of EF
  - Models used to estimate EF
  - Comparison of country specific with default values
  - Comparison with similar countries
  - Comparison with plant specific EF

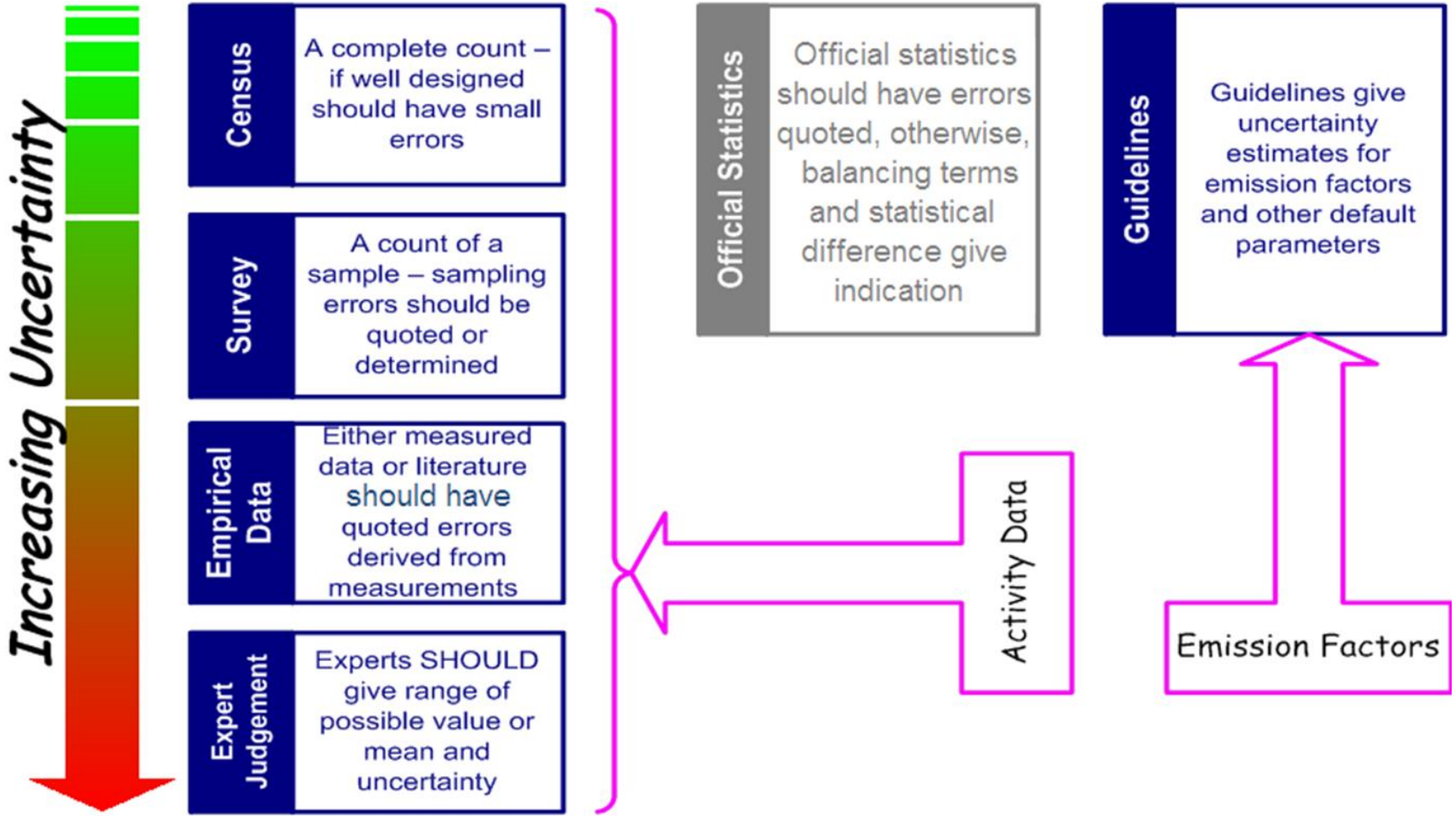
- QC of Activity Data
  - Reference source of data
  - Comparison with other data sets
  - Trend check of activity data

Uncertainty Assessment

Reasons for Uncertainty in Input Data

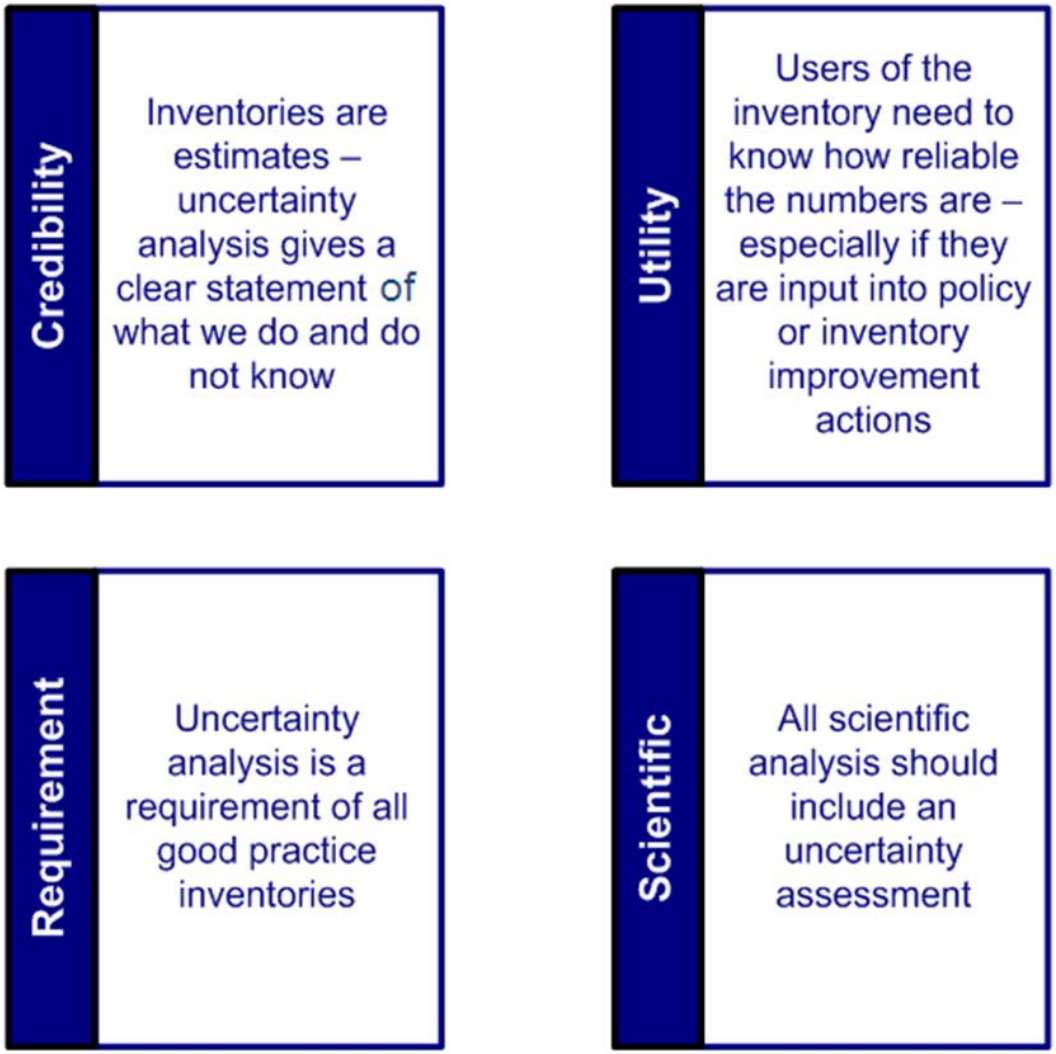
- Lack of data (missing data or extrapolation)
- Measurement error
- Data not truly representative
- Statistical random sampling error
- Misreporting/misclassification

Levels of Uncertainty



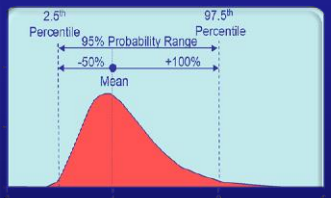
Source: consultative group of expert (CGE) training material on uncertainty analysis

Benefits of Uncertainty Analysis



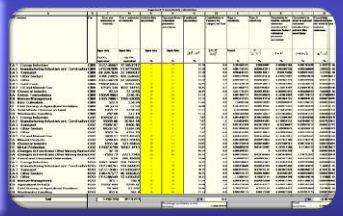
Source: consultative group of expert (CGE) training material on uncertainty analysis

Uncertainty Estimation



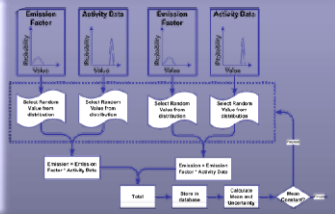
Gather Information

- Collect uncertainty information on activity data and emission factors



Decide approach to use

- Error Propagation
- Monte Carlo



Perform Inventory Analysis

- Spreadsheet
- Software tool

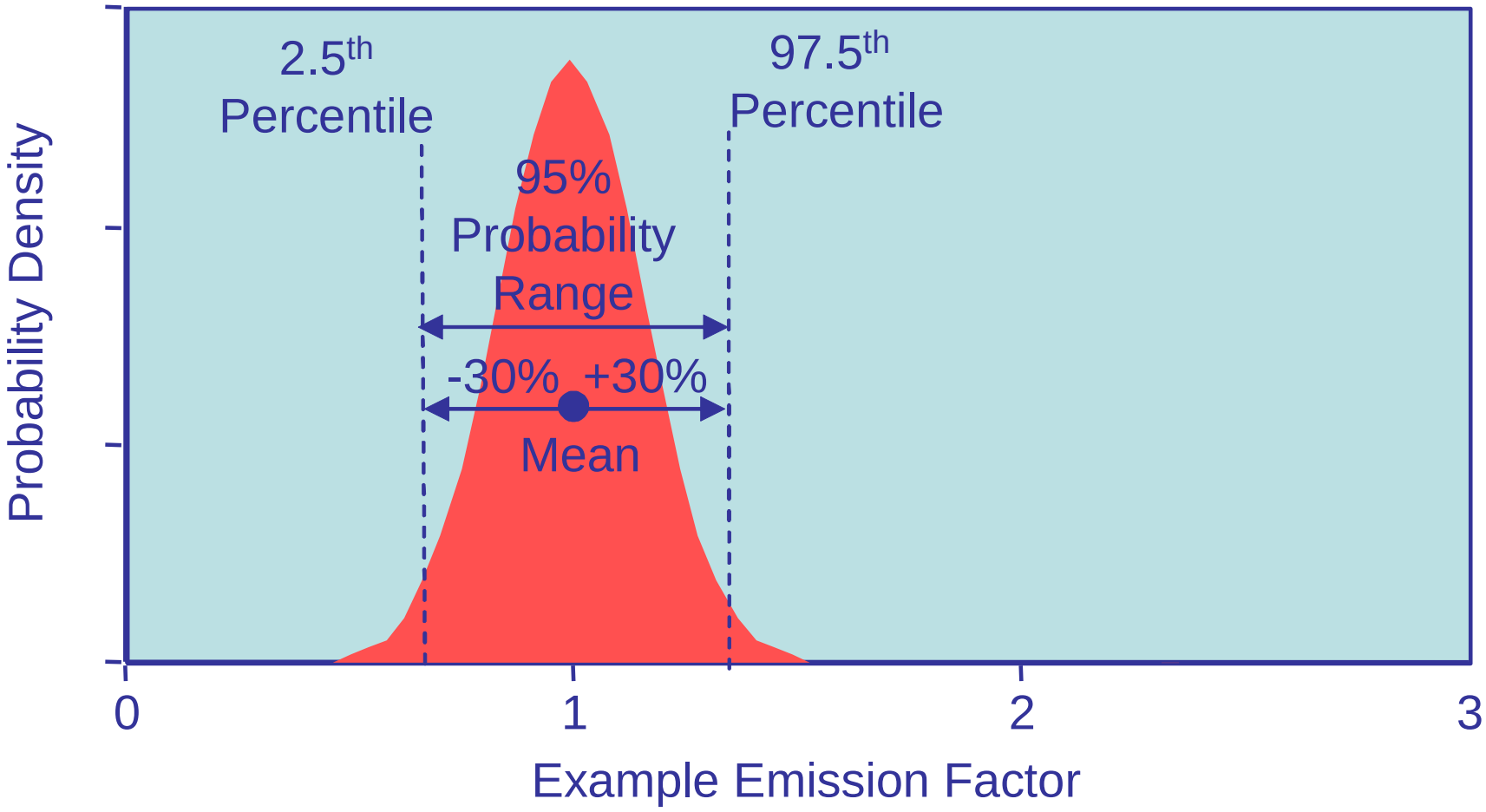
Source: consultative group of expert (CGE) training material on uncertainty analysis

Specifying Uncertainty

- **Uncertainty** is quoted as the 2.5 and 97.5 percentile i.e. bounds around a 95% confidence interval.
- This **can be expressed as**:
  - 234 ± 23%
  - 26,400 (- 50%, + 100%)
  - 2,000 (a factor of 2) (i.e. - 50%, + 100%)
  - An order of magnitude (i.e. 1 to 100)

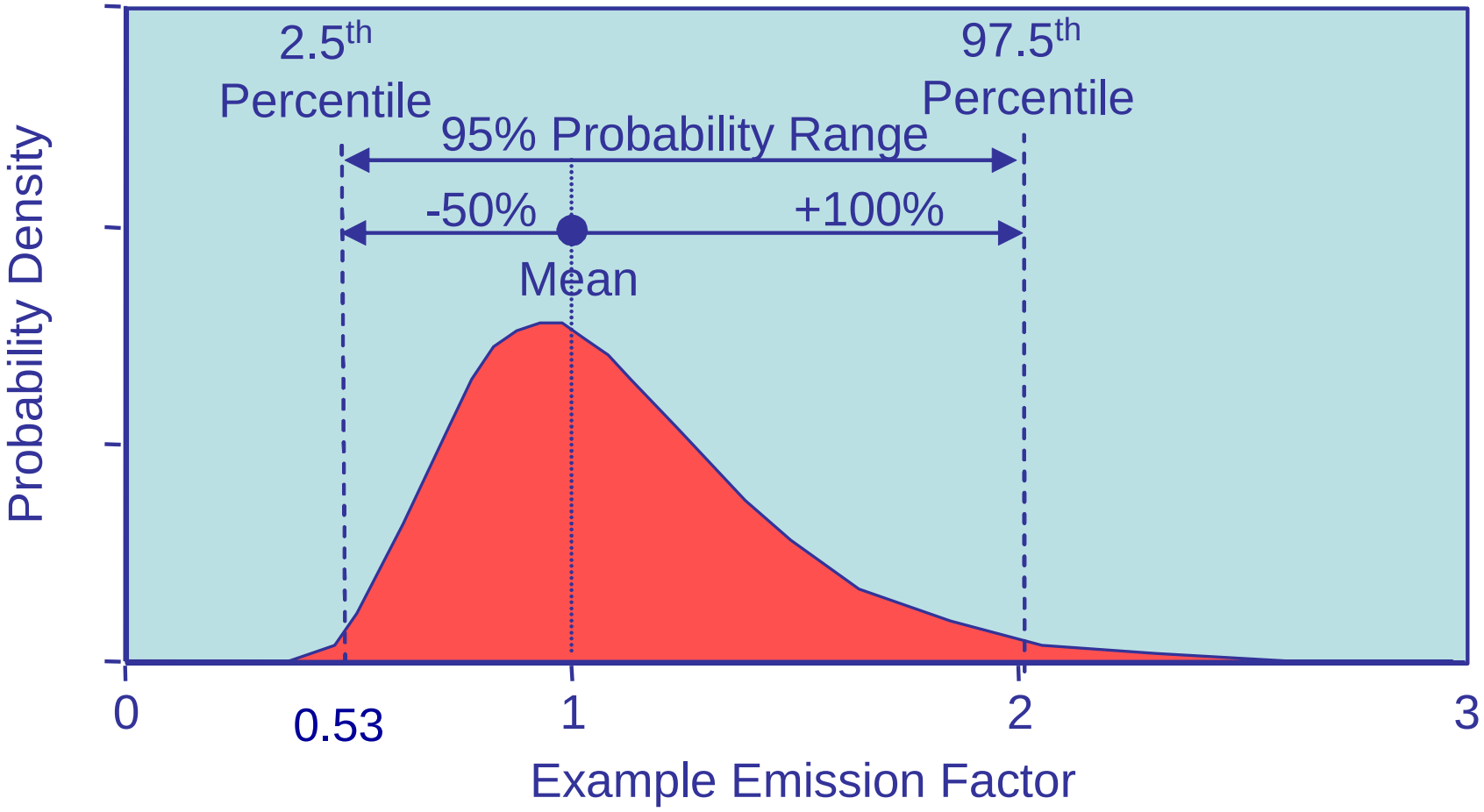
Source: consultative group of expert (CGE) training material on uncertainty analysis

Probability Density – Normal



Source: consultative group of expert (CGE) training material on uncertainty analysis

Probability Density – Asymmetric



Source: consultative group of expert (CGE) training material on uncertainty analysis

Methods to Combine Uncertainty

Error propagation

- Simple - standard spread sheet can be used
  - IPCC guidelines give explanation and equations
- Difficult to deal with correlations
- Strictly (standard deviation/mean) < 0.3
  - ❖A simple solution is provided

Monte-Carlo Simulation

- More complex - Use specialized software
- Needs shape of probability density function (pdf)
- Suitable where uncertainties are large, non-Gaussian, complex algorithms, correlations exist and uncertainties vary with time

Uncertainty of Annual Estimate

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

- U_{SG} = percentage uncertainty in emissions of source category
- U_{EF} = percentage uncertainty in Emission Factor
- U_{AD} = percentage uncertainty in Activity Data

Source: consultative group of expert (CGE) training material on uncertainty analysis version 2 April 2012

Uncertainty of Annual Estimate

$$U_{total} = \frac{\sqrt{(U_{SG1} * X_{SG1})^2 + (U_{SG2} * X_{SG2})^2 + \ldots + (U_{SGn} * X_{SGn})^2}}{\left| X_1 + X_2 + \ldots Xn \right|}$$

- U_{total} = percentage uncertainty in total emissions
- U_{SGn} = percentage uncertainty in emissions of source category
- X_{SGn} = Emissions from SGn

Source: consultative group of expert (CGE) training material on uncertainty analysis version 2 April 2012

Thank you!

Amr Osama Abdel-Aziz, Assen Gasharov, Mike Bess and Laura Lahti