



The Quality System Assurance (QSA) in the German Emission Inventory Using the MESAP-CalQlator

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Content

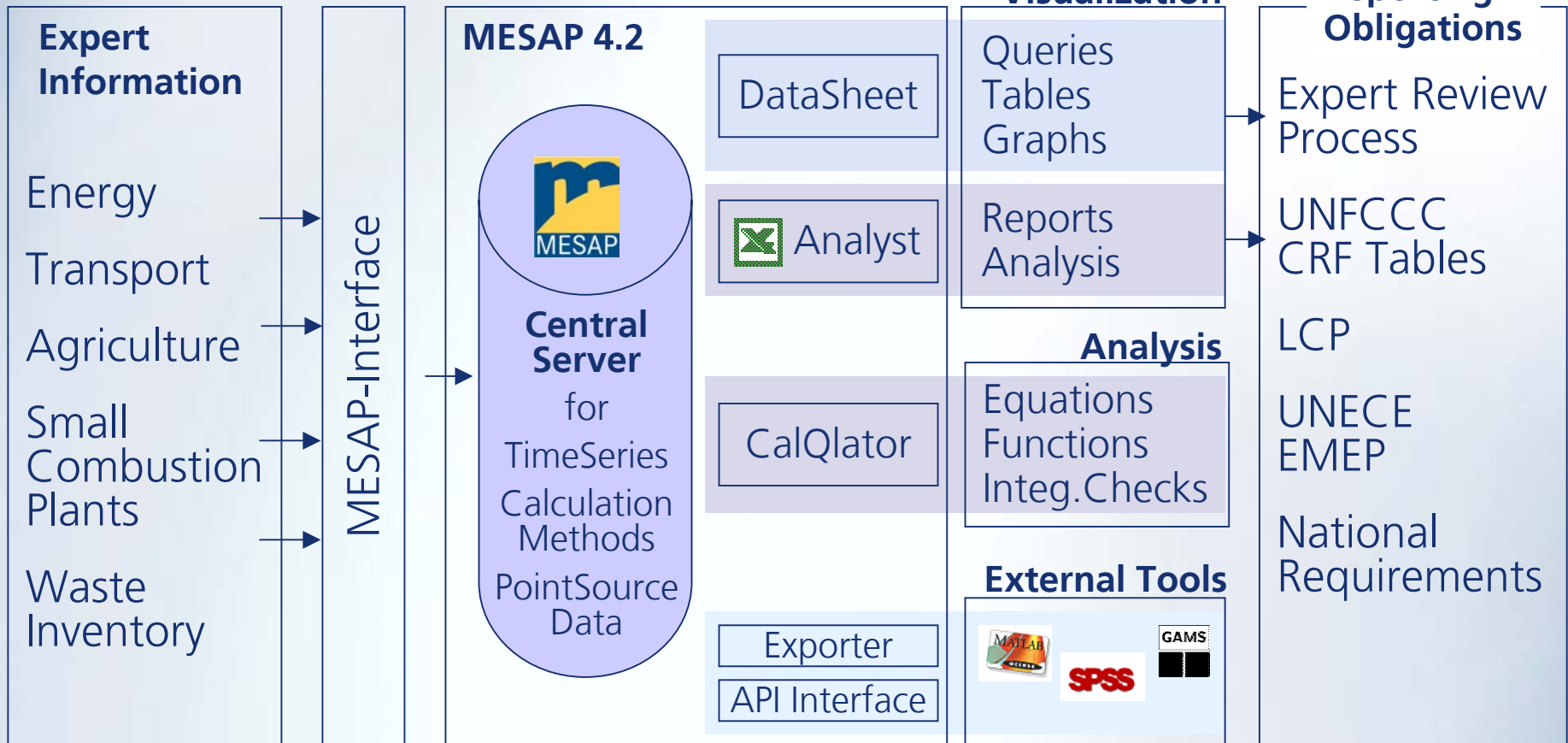
- Goals and Objectives
- Architecture of the CSE-MESAP Software
- The MESAP CalQlator
- How Does CSE-MESAP Support QSA?
- Conclusions

CSE-MESAP was designed to support

1. Collection, Plausibility Check and Documentation of Data
2. Definition of Methods to Calculate Emission and Uncertainties
3. Generation of Reports for UNFCCC, UNECE, etc.

Support of QA Measures and Expert Review Process

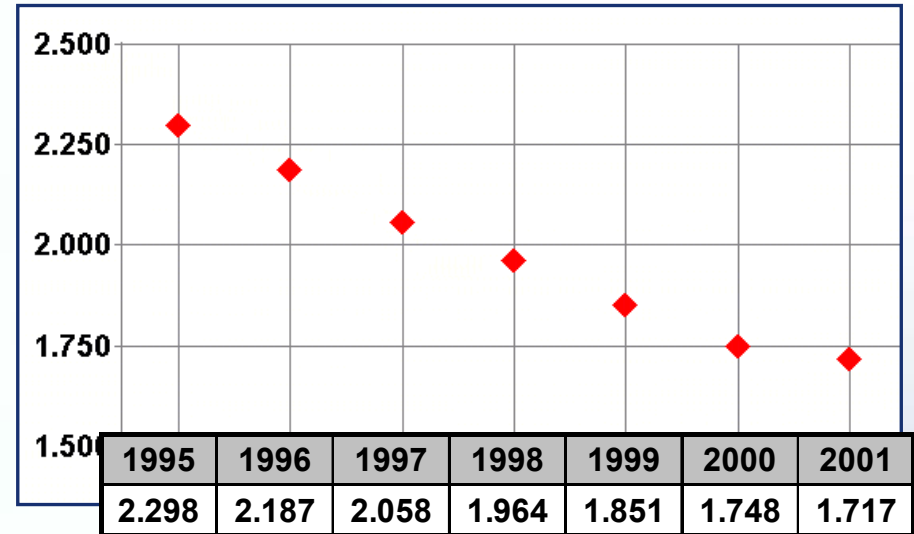
Architecture of CSE-MESAP



Data Collection → Processing, QA and Analysis → Reports & Review

Time Series Object in MESAP

Annual CO₂ Emissions
 in Sector **Traffic**
 of **Rail Vehicles**
 using **Diesel** fuel
 for **Germany** in **Gg**



Multi-dimensional Time Series Key					Specs		Data Values				
Germany	Emission	CO2	RAIL	Diesel	Gg	a	REF	1995	1996	2000	2001
								2.298	2.187	1.748	1.717

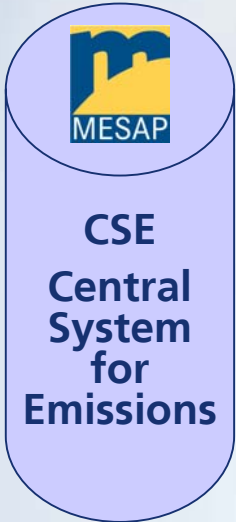
Multi-dimensional
Time Series Key

Specs

Data Values

1. Data Input, Documentation Plausibility Check

MESAP 4.2



DataSheet

all TS 1.A.3 c - Data Sheet

Special Unit	Attribute	FUEL	MODULE	POLL	Unit	1995	1996	1997	1998	1999	2000	2001
1 Germany	Activity Rate	Diesel	UVSCHI		TJ	31.054	29.548	27.806	26.541	25.1		
2 Germany	Emission Factor	Diesel	UVSCHI	CH4	kg/TJ	5	5	5	5			
3 Germany	Emission Factor	Diesel	UVSCHI	CO	kg/TJ	470	470	470	470			
4 Germany	Emission Factor	Diesel	UVSCHI	CO2	kg/TJ	74.000	74.000	74.000	74.000	74.0		
5 Germany	Emission Factor	Diesel	UVSCHI	N2O	kg/TJ	3	3	3	3			
6 Germany	Emission Factor	Diesel	UVSCHI	NH3	kg/TJ	4	4	4	4			
	Emission Factor	Diesel	UVSCHI	NM VOC	kg/TJ	225	225	225	225			
	Emission Factor	Diesel	UVSCHI	NOX	kg/TJ	1.170	1.170	1.170	1.170	1.1		
	Emission Factor	Diesel	UVSCHI	SO2	kg/TJ	61	28	19	19			
	Emission Factor	Diesel	UVSCHI	STB	kg/TJ							

Time Series Documentation for #520009702, [a]

TimeSeries Comment
Comment: UVSCHI, <Übriger Verkehr>, <Zwi08>, <So5mo Übriger Verkehr>, <StBA Schienenverkehr>, <StLAS Schiene...

Literature
 Publisher: Umweltbundesamt, Postfach 33 00 22, 14191 Berlin
 Publisher (short): UBA
 Place: Berlin
 Author: Fr. Pfeiffer, M. Struschka, G. Baumbach
 Title: Ermittlung der mittleren Emissionsfaktoren zur Darstellung der Emissionsentwicklung aus Feuerungsanlagen im Bereich der Haushalte und Klei...
 Year: 31.05.2000
 ISBN:
 Research Report Number: 295 46 364
 UBA Library: 000048
 Comment: Texte 14/00

Contact Person
 Dept. responsible: UBA III 2.2
 Contact in Dept. II 63: Strogies
 Contact (for Details): Rosolski
 Phone:
 eMail:

Activity Rate - Diesel - UVSCHI - TJ - REF

[Value]: 1170
 [Quality]: 3 - estimated
 [User name of modification]: US
 [Date of modification]: 19.03.2002 15:05

2. Emission Calculation, Integrity Checks

MESAP 4.2



CSE
Central
System
for
Emissions

DataSheet

Analyst

CalQlator

Edit Calculation Methods

Variable	Type	Time series (Name)	Time resolution	Unit
ActRate	Input	no assignment, loop variable	Year [a]	
EmFactor	Input	no assignment, loop variable	Year [a]	
Emission	Output	no assignment, loop variable	Year [a]	

```

// Emission Calculation for IPCC Sector 1 A 3 c - UVSCHI
[-1994] // separately for old and new fed. states
Loop (SpacUnit: SPU,   OFS|NFS;
Loop ({{<loop index>: <dimension>, ({{<descriptors>|} | <tree>, <node>}}
  Fuel:      FUEL,   Diesel;
  Pollutant: POLL,   Poll_Tree, POLLS) // CH4, N2O, CO2
  Emission (ATT=EM, SpacUnit, Module, Fuel, Pollutant) =
  EmFactor (ATT=EF, SpacUnit, Module, Fuel, Pollutant) *
  ActRate  (ATT=AR, SpacUnit, Module, Fuel);
End;

[1995-] // for total Germany D
Loop (SpacUnit: SPU,   D;
  Module:  MODULE, UVSCHI; // other traffic railway
  Fuel:    FUEL,   Diesel;
  Pollutant: POLL,   Poll_Tree, POLLS) // CH4, N2O, CO2
  Emission (ATT=EM, SpacUnit, Module, Fuel, Pollutant) =
  
```


2. CalQlator Objects

- Calculation Method

Declared Variables (Input, Output)

//Comments

[Validity Periods]

Equations;

Variables

Operators

Functions

- Calculation Job
 - Period (From, To)

Calculation Method "A"

Calculation Method "B"

...

Calculation Method "X"

2. CalQlator Concept

Calculation Method

[1995-]
 //Equation
 $EM = AR * EF$

TimeSeries

	Spacial Unit	MODULE	POLL	Attribute	FUEL	Unit	1998	1999	2000	2001
+	1	Germany	UVSCHI	Activity Rate	Diesel	TJ	26541	25016	23628	23198
+	2	Germany	UVSCHI	Emission Factor	Diesel	kg/TJ	74000	74000	74000	74000
-	3	Germany	UVSCHI	Emission	Diesel	kt	1.964	1.851	1.748	1.717

Calculation Job

Period
 From:
 To:

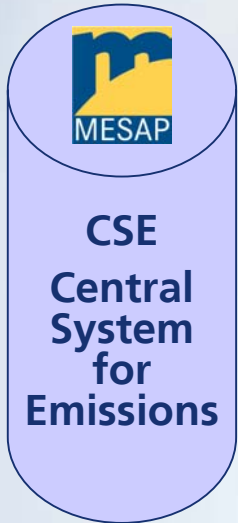
1. Parser
 2. Equation System Builder
 3. Sequencer
 4. Solver
 5. Activity Report
 6. Save Results in Database

2. CalQlator Functions

- Basic Arithmetics + - * / ^ ()
- Mathematical Functions Sqrt, Ln, Exp, Abs
- Comparison Operators < > <= >= <> ==
- Case Differentiation IF, then, else
- Statistical Functions SUM, MIN, MAX, StdDev, VAR, Cnt
- Time Lags t-x, t+y
- Indexed Equations Loop (...) End;

3. Automated Reporting

MESAP 4.2



DataSheet



CalQlator

Microsoft Excel - IPCC for SanDiego.xls

File Edit View Insert Format Extras Data Window Help

Times New Roman 9

Energy Industrial Processes Solvents Agriculture LUCF Waste Summary Other Checklist

B19 =A4AggTSValues(1;"1.A.3.b-G-act";"ir","y";"";"REF";Berichteigenschaften!\$E\$3;"TJ";0)

TABLE 1.A(a) SECTORAL BACKGROUND DATA FOR ENERGY			
Fuel Combustion Activities - Sectoral Approach			
(Sheet 3 of 4)			
GREENHOUSE GAS SOURCE AND SINK CATEGORIES		AGGREGATE ACTIVITY DATA	
		Consumption	
		(TJ)	(t)
1.A.3 Transport		2.429.913,32	NCV
9	Gasoline	1.300.463,00	NCV
10	Diesel	1.065.024,00	NCV
11	Natural Gas	15.900,00	NCV
12	Solid Fuels	43.702,32	NCV
13	Biomass	4.081,00	NCV
14	Other Fuels	743,00	NCV
15	a. Civil Aviation	52.442,80	NCV
16	Aviation Gasoline		NCV
17	Jet Kerosene		NCV
18	b. Road Transportation	2.328.001,00	NCV
19	Gasoline	1.300.463,00	NCV
20	Diesel Oil	1.022.704,00	NCV
21	Natural Gas	NE	NCV
22	Biomass	4.081,00	NCV
23	Other Fuels (please specify)	743,00	NCV

CSE-MESAP Increases Accuracy

Accuracy

- Automatic Unit Conversion
 - ➔ input of values in original unit
- Plausibility Control of Input Data
- Verification of Equation Syntax During Setup
- Automated Reporting Based on Hotlinks
 - ➔ ensure correct data in reports
- Status System to Detect Invalid Results
- Scheduler for Automated Execution of Calculation Jobs

CSE-MESAP Enables Comparability

Accuracy

Comparability

- Comparison of Emission Data Across Sectors and Countries
- Flexible Multi-Dimensional Queries
- Comparisons can be Used to Check Emission Calculation Results

CSE-MESAP Ensures Consistency

Accuracy

Comparability

Consistency

- Consistent Unit Conversion During Calculation (including correct canceling)
- User Definable Integrity Conditions

CSE-MESAP Achieves Completeness

Accuracy

Comparability

Consistency

Completeness

- Every Information is Stored in TimeSeries
- Different Projections can be Stored
- Data Gaps Detected Before Calculation
- Missing Values can be Interpolated
- Reasons for Unavailability can be Documented (e.g. NA, NO, NE)

CSE-MESAP creates Transparency

Accuracy

Comparability

Consistency

Completeness

Transparency

- Comprehensive Documentation of Data
 - Change Date and User
 - Quality Labels
 - Background Information
 - Data Source and Contact Person
- Evolution of Calculation Methods are Documented
- Easy Ad-Hoc Analysis and Queries
 - ➔ Technical Review Process

Conclusions

- Proofed: Standardized Software vs. Individual Solution
 - Expandable: Highly Customizable Without Programming
 - Scalable: Client/Server Architecture
 - Secure: Access Rights Management
- Supports all Relevant QA/QC Measures
- Integration of all Inventory Tasks
 - ➔ collection ➔ validation, calculation, analysis ➔ review, reporting
- Easy Adoption to Other Countries