

SmartCow

an integrated infrastructure for increased research capability and innovation in the European cattle sector

**Standardizing vocabulary and methods, sharing data:
ontologies, book of methods and data platform**

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Objectives

- ✓ Preparing an inventory of standard operating procedures for animal experiments performed in SmartCow projects and write common guidelines for experimental measurements in cattle physiology and behaviour
- ✓ Interoperability and sharing of data
- ✓ Consolidation and introduction of new traits to the current animal and environmental ontology databases:
 - ✓ ATOL : Animal Trait Ontology for Livestock
 - ✓ AHOL : Animal Health Ontology for Livestock
 - ✓ EOL : Environmental Ontology for Livestock

Main achievements - The Book of Methods

https://books.publisso.de/en/publisso_gold/publishing/books/overview/53/



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Methods in cattle physiology and behaviour research – Recommendations from the SmartCow consortium

Sadjad Danesh Mesgaran, René Baumont, Lene Munksgaard, David Humphries, Emer Kennedy, Jan Dijkstra, Richard Dewhurst, Holly Ferguson, Marta Terré and Björn Kuhla (editors)

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Foreword + 19 guidelines
with doi-numbers

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This book provides an inventory of guidelines for different recordings in an experimental unit. The chapters of this book will



Main achievements - The Book of Methods

19 guidelines covering 8 topics:

- Ethical aspects
- Feed intake
- Body characteristics
- Calves
- Digestive tract physiology
- Behavioural physiology
- Reproduction and health
- Gas exchange and methane emission measurements

- ✓ Peer-reviewed
- ✓ English and format edited
- ✓ Open Access
- ✓ Living handbook (possible update and extensions)
- ✓ Single chapter download
- ✓ Open to external authors



Main achievements – The cloud-based data platform

<https://agrimetrics.co.uk/data-catalogue/>

- ✓ Data Catalogue and Data management plan aligned with FAIR principles
- ✓ Ability to add tags connecting dataset to similar data
- ✓ User controlled up- and download of all type of data

The screenshot shows the Agrimetrics Data Catalogue website. The header includes the Agrimetrics logo, navigation links like 'Apps > Data Catalogue', and user controls such as a search bar, a dropdown menu set to 'SmartCow', and icons for help, notifications, and a user profile. The main content area is divided into a left sidebar and a central grid of data cards. The sidebar contains a 'Clear filters' button, a 'Content' search bar, and filter sections for 'Content' and 'Source'. The 'Source' section lists various organizations with checkboxes. The central grid displays three data cards: 'Demonstration linked-livestock data' (with a cow image and a data table), 'Smartcow WP1 Data' (with a data table), and 'Smartcow WP6 data' (with a cow image). Each card includes a description and a 'Source' field. The bottom of the grid shows partial images of power lines and cows.

Agrimetrics
THE FARMER'S DATA MARKETPLACE

Apps > Data Catalogue

SmartCow

Clear filters

Content

Search by content

☐ Only my data sets ?

☐ Include public data sets ?

☐ Include hidden data sets ?

Source

☐ AHDB

☐ Agrimetrics

☐ Airbus

☐ Centre for Ecology and Hydro...

☐ ChemSpider

☐ EarthEnv

☐ Environment Agency

☐ European Centre for Medium...

☐ European and Mediterranean ...

☐ Met Office Norway

☐ NASA - National Aeronautics ...

Demonstration linked-livestock data

Synthetic linked-livestock data informed by the SmartCow project. [...more](#)

Source: Agrimetrics

Smartcow WP1 Data

Updates of the data captures through the project. [...more](#)

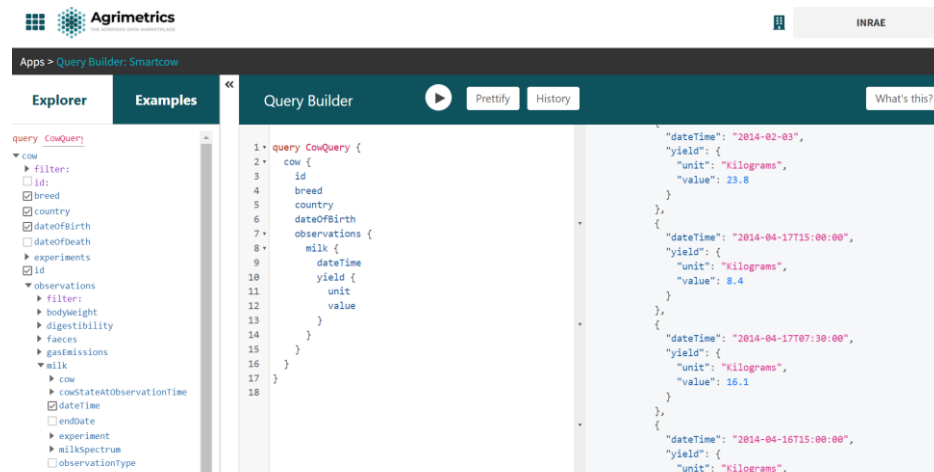
Smartcow WP6 data

2 excel files as examples of files that partners could upload on Agrimetrics PTF for the WP6. These files are "raw" file [...more](#)



Main achievements – The cloud-based data platform

- ✓ Ability to link data within SmartCow
- ✓ Ability to link data with other datasets
- ✓ Linked Livestock demonstration dataset
- ✓ User defined permissions for datasets
- ✓ Advanced search functionality (Catalogue)
- ✓ Selection of data available via API

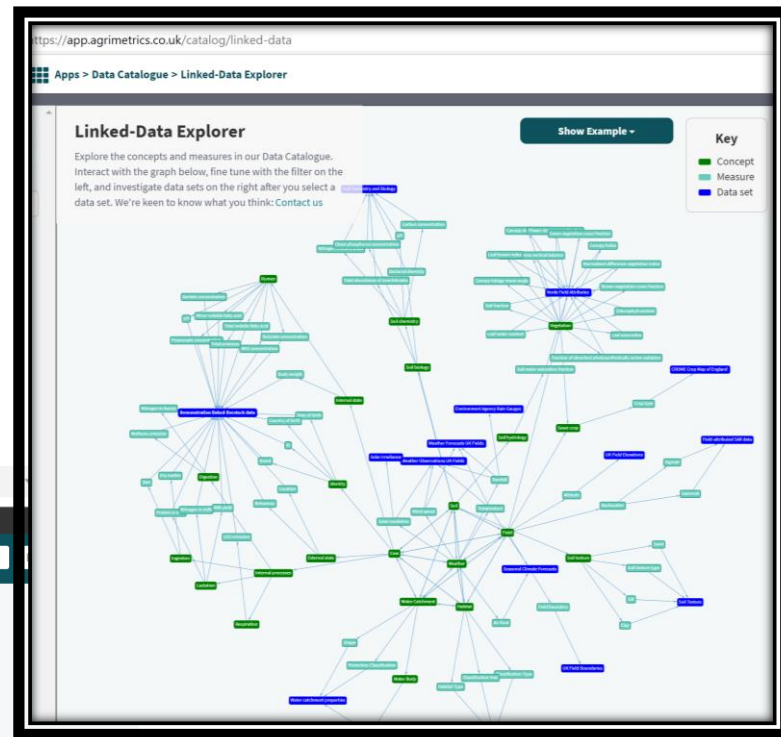


The screenshot shows the SmartCow Query Builder interface. On the left, there's a sidebar with 'Explorer' and 'Examples' tabs. The 'Explorer' tab is active, showing a tree view of data sources: 'cow', 'filter', 'id', 'breed', 'country', 'dateOfBirth', 'dateOfDeath', 'experiments', 'id', 'observations', 'filter', 'bodyweight', 'digestibility', 'faeces', 'gasemissions', 'milk', 'cow', 'cowStateToObservationTime', 'date', 'endDate', 'experiment', 'milkSpectrum', and 'observationType'. The 'Query Builder' tab is active, showing a query editor with a list of fields and a 'Prettify' button. The query is as follows:

```
1. query CowQuery {
2.   cow {
3.     id
4.     breed
5.     country
6.     dateOfBirth
7.     observations {
8.       milk {
9.         dateTime
10.        yield {
11.          unit
12.          value
13.        }
14.      }
15.    }
16.  }
17. }
```

On the right, the 'What's this?' tab is active, showing a JSON response for the query:

```
{
  "dateTime": "2014-02-03",
  "yield": {
    "unit": "Kilograms",
    "value": 23.8
  }
},
{
  "dateTime": "2014-04-17T15:00:00",
  "yield": {
    "unit": "Kilograms",
    "value": 8.4
  }
},
{
  "dateTime": "2014-04-17T07:30:00",
  "yield": {
    "unit": "Kilograms",
    "value": 16.1
  }
},
{
  "dateTime": "2014-04-16T15:00:00",
  "yield": {
    "unit": "Kilograms",
    "value": 16.1
  }
}
```



Main achievements - Ontologies

<https://sicpa-web.cati.inrae.fr/ontologies/visualisation/ontologie/>

- ✓ Links between measurement methods in the book of methods and ATOL/EOL

The screenshot displays the INRAE ATOL ontology visualization interface. On the left, a tree view lists various ontologies under the 'atol' category, including 'digesta acid detergent lignin', 'digesta crude fibre content', 'digesta neutral detergent fib', 'digesta carbonate content', 'digesta choline content', 'digesta lactate content', 'digesta nitrogenous component content', 'digesta total lipid content', 'digesta vitamin content', 'digesta water content', 'digesta gross energy content', 'digesta microbiology trait', 'digesta pH', 'digesta physical characteristic', 'digestive enzyme activity', 'digestive gas production', 'digestive ammonia production', 'digestive carbon dioxide production', 'digestive dihydrogen production', 'digestive hydrogen production', 'digestive hydrogen sulfide production', 'digestive methane production', 'digestive nutrient production', 'digestive system microbiota trait', 'faeces trait', 'feed component digestibility', 'rumenal feed component degradability', 'nutrient absorption', 'urine excretion', 'ingestion', 'nutrient balance', 'supplementation', and 'production trait'. The main panel shows the details for the 'ATOL_0001391' ontology, 'digestive methane production'. The 'Informations' section includes the name, nom, definition in English and French, source (INRAE), link, and comments. The 'Synonyms' section lists exact synonyms: 'digestive CH4 production', 'enteric CH4 production', and 'enteric methane production'. The 'Species' section lists 'Birds', 'Fish', and 'Mammals'. The 'Measurement methods' section is also visible at the bottom.

INRAE

Ontologies - ATOL - EOL - AHOL

Releases

Download

atol

Ontologies

ATOL_0001391

Informations

Name: digestive methane production

Nom: production digestive de méthane

Definition (en): any measurable or observable characteristic related to the quantities of methane (CHEBI: 16183) produced by organic matter fermentation during digestion

Definition (fr): toute caractéristique mesurable ou observable associée à la quantité de méthane (CHEBI: 16183) produit par la fermentation des matières organiques pendant la digestion

Source: INRAE

Link: https://books.publisso.de/en/publisso_gold/publishing/books/overview/53/196

Comments: No results

Synonyms

Exact synonyms:

- digestive CH4 production
- enteric CH4 production
- enteric methane production

Related synonyms:

No results

Species

- Birds
- Fish
- Mammals

Measurement methods

- ✓ Open access
- ✓ Downloadable (OWL or SQL)



Main achievements - Ontologies

✓ 190 new traits added to **ATOL**

- Milk: 53 new traits
- Nutrition: 130 new traits
- Animal welfare and behavior : 6 new traits
- Reproduction: 1 new trait

Milk bacterial count (ATOL_0005263), milk trichloromethane content (ATOL_0005286), Parity (ATOL_0005322), Rumen small entodiniomorphida count (ATOL_0005333), Rumen dasytricha count (ATOL_0005335), Dioxygen consumption (ATOL_0005315), Rumen iso-butyrate content (ATOL_0005317), etc.



✓ More than 40 traits added to **EOL**

- concerning sensors, animal handling facility, milking parlour, climate and temperature

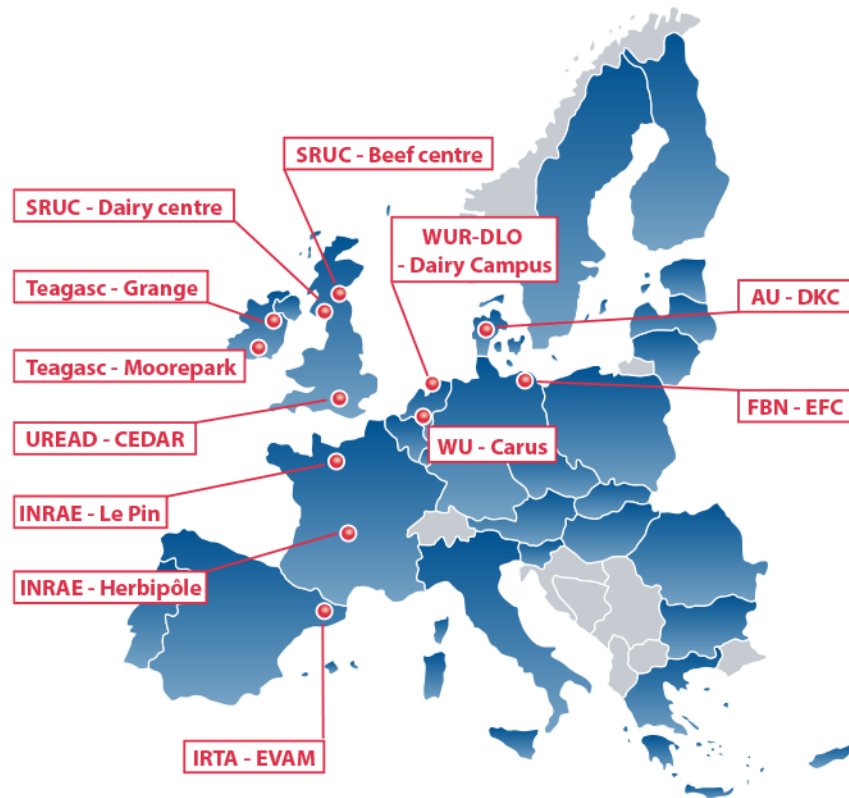
- Book of Methods:
 - Referencing guidelines in scientific publications
 - Verification of the quality of experimental research
 - Allowance of better comparison and re-use of research data
- Data Platform:
 - Potential new value from linked data
 - Ability to find and learn about different datasets
 - User workshops held to train, share knowledge and enable usage of the Agrimetrics Data Catalogue
- Ontologies:
 - More visited website
 - Sensitization of researchers to the use of a common vocabulary to annotate their data

Future prospects

- 2 chapters more for the Book of Methods currently in preparation
„Validation of eating duration using an automatic feeding system” and “Guidelines to apply for ethical approval of animal experiments”
- Further chapters planned in frame of [the SmartCow ERG](#)
- Continual ongoing improvements to the Agrimetrics Data Catalogue
- Involvement of ATOL and EOL in 2 other European projects: PigWeb and INTAQT
- Creation of species-specific interfaces and links with vertebrate traits (VT-ontology; J. Reecy, Iowa State Univ.) for metabolic parameters



Thank you for your attention



First-class Cattle Research Infrastructures (RIs) across Europe:

- 11 major RIs distributed in 7 EU countries
- 12 locations, which include 18 installations
- 2500 dairy and 1000 beef cows

- **Networking of RIs** to inventorize resources, harmonize procedures, and share data
- **Joint research activities** to improve experimental methods and phenotyping capability
- **Interaction with stakeholders** to stay in line with industry needs and improve dissemination

<http://www.smartcow.eu/stakeholders/>

TRAINING PROGRAM

For Scientists, Technicians, Stakeholders, PhD students

- Face-to-face training courses
- Free web-conferences
- One-day study tours in 4 different countries

<http://www.smartcow.eu/resources/training/>

TRANSNATIONAL ACCESS CALLS

Offers external users (academic and industry) free access to SmartCow RIs

- 30 projects during the 4 years of SmartCow
- Access to around 10,000 cow-weeks

<http://www.smartcow.eu/calls/>



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