ISO Fd Food ERA Chair

Safety Quality Traceability

Food traceability and fingerprints - Compound specific isotope analysis

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Stable isotopes of light elements (H, C, N, O, S)

- Determination of authenticity
- Determination of geographical origin
- Tracing diet-food sources
- Tracing pollution sources in food (CSIA)

New challenge

compound specific isotope analysis to track and determine the origin of organic compounds in the environment and food products

Isotope ratio	Fractionation	Information
$^{2}H/^{1}H$ $^{18}O/^{16}O$	evaporation condensation precipitation	⇒ geographical origin
$^{13}C/^{12}C$	C4, C3 plants marine, terrestrial nutritional status	⇒ diet ⇒ adulteration
$^{15}N/^{14}N$	nitrification/denitrification trophic level marine, terrestrial	⇒ agriculture practice ⇒ diet
$^{34}S/^{32}S$	bacterial	⇒ geographical origin ⇒ agricultural practice
$^{87}Sr/^{86}Sr$	underlyin geology	⇒ geographical origin

These isotopic signatures are translocated through an animal to their product and can be used to trace food origin

Food fraud – Who cares?

Types of analyses

- “Traditional” - authenticity check

is a given compound a natural product from a food material or has it been added ?

- Natural or not natural

e.g. vanillin from beans or synthesized from lignin

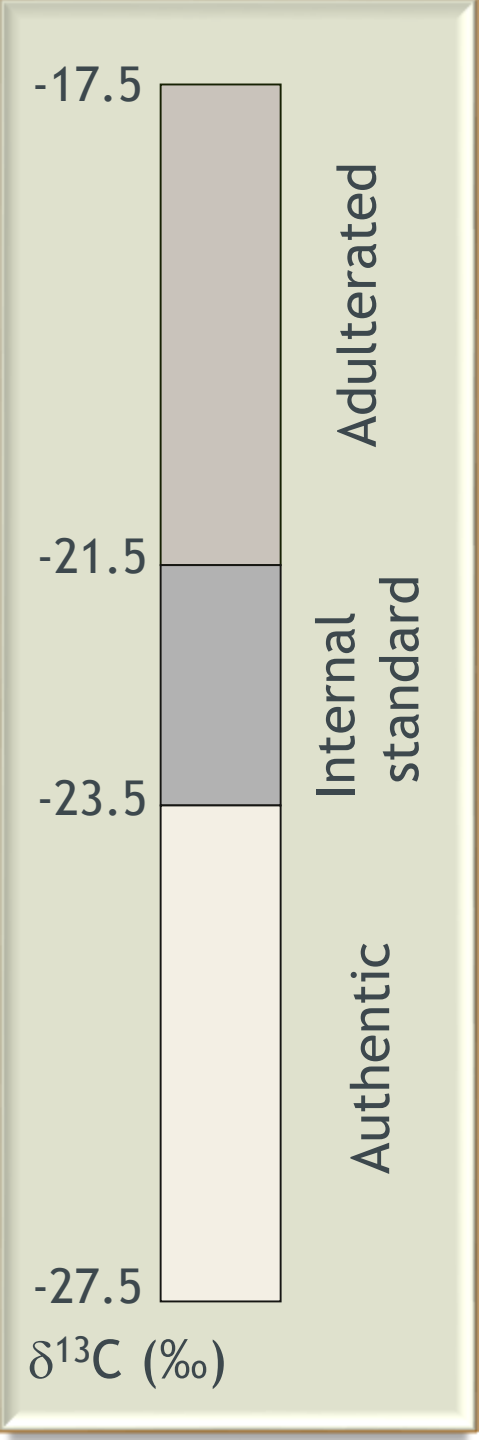
- “New”

Compliance with declaration

e.g. conventional or “organic” production

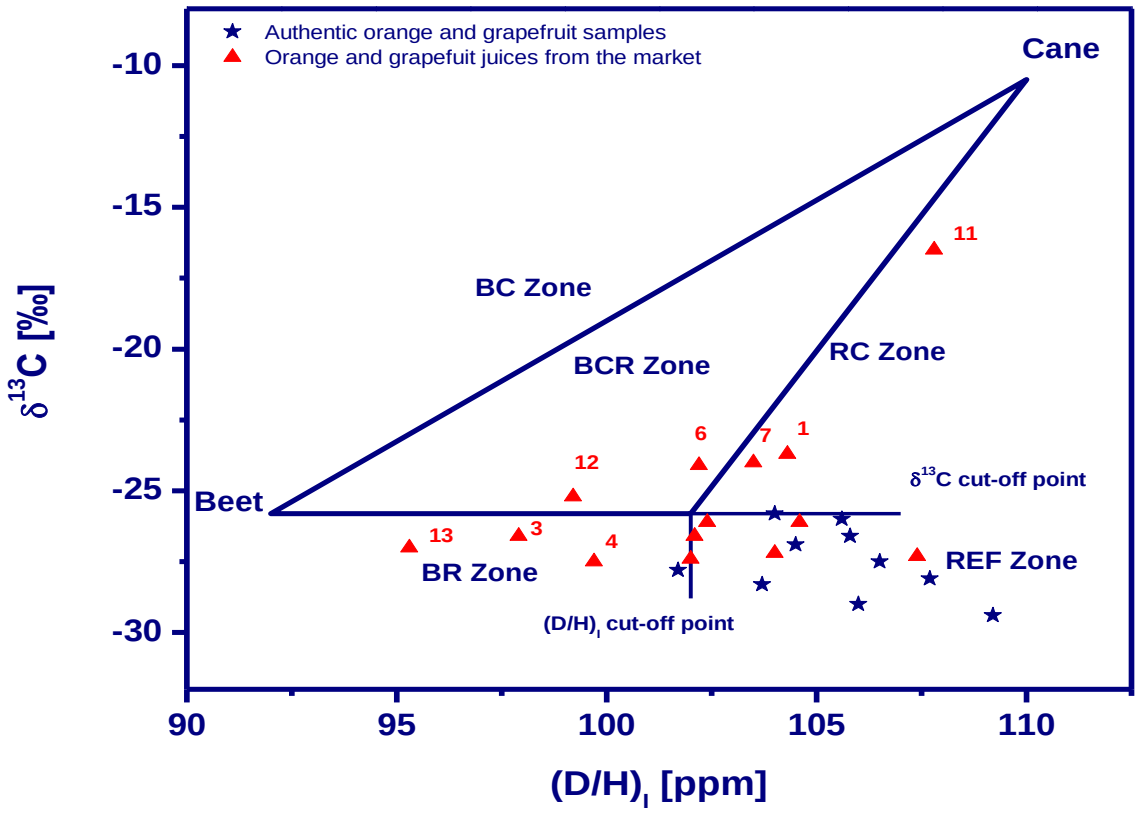
- Geographical origin of (premium) products

e.g. PDO (Emmentaler) cheese or ham (Parma)



Data evaluation methodology

"cutoff-values"



Method of internal standard - honey

Ogrinc et al., JAFC, 2009

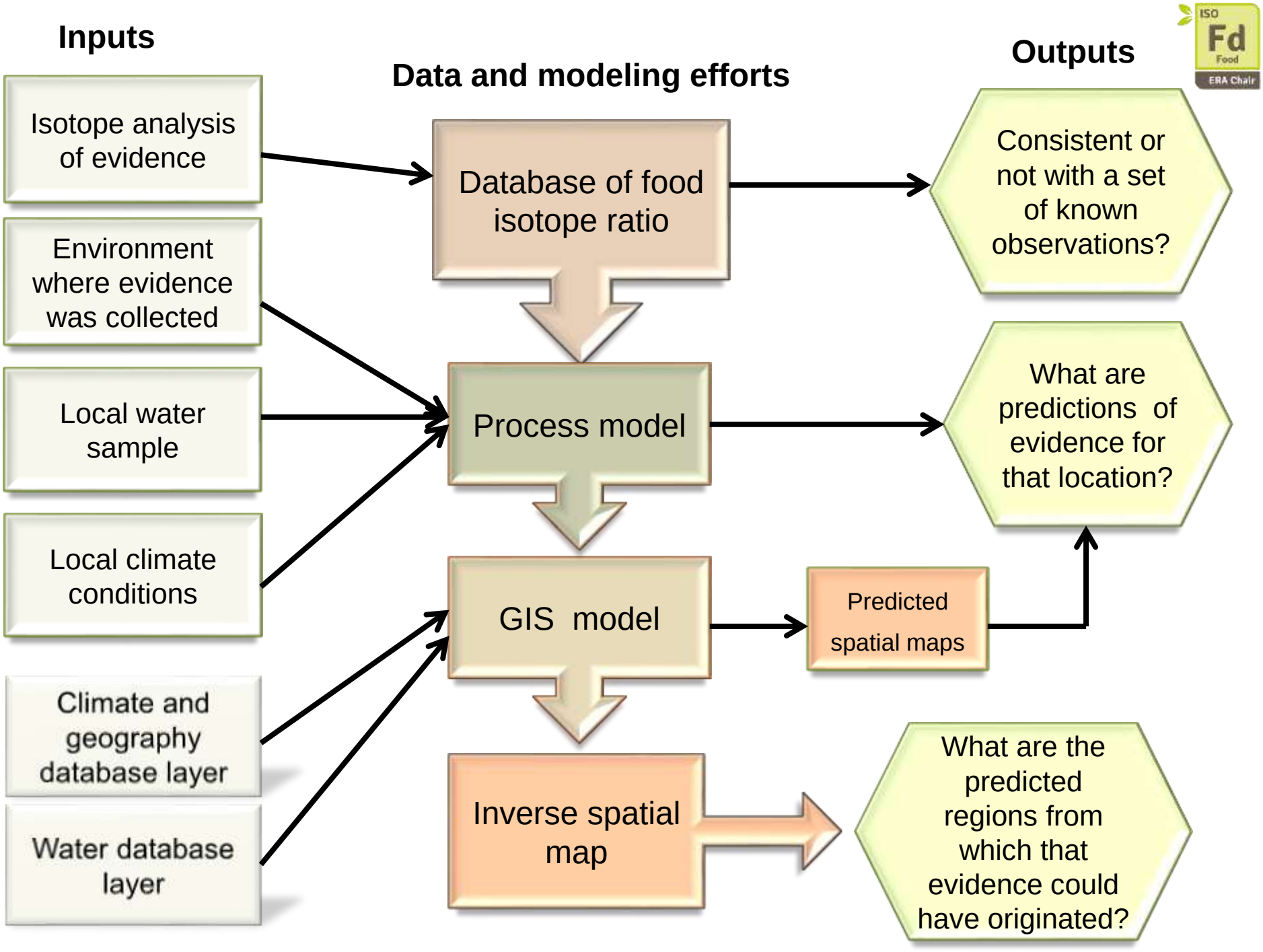
Geographical origin

Multi-element stable isotope pattern

e.g. hydrogen, carbon, nitrogen, sulphur isotope data combined with sophisticated data evaluation methods (Chemometry)

A database of authentic samples is required until now

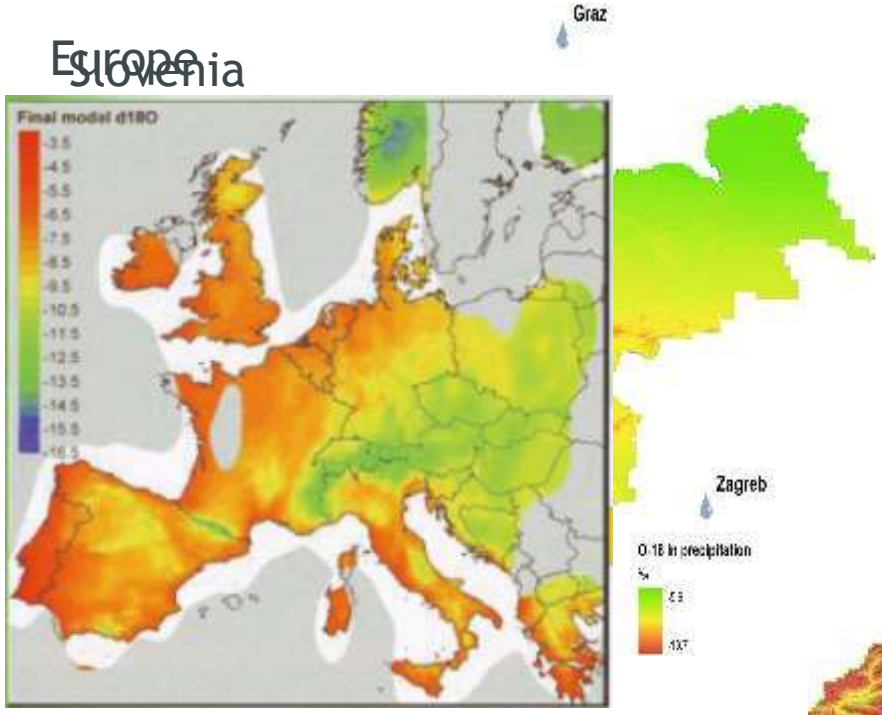
Databases in Slovenia: wine, honey, olive oil, apple juice, milk, sheep and goat cheese


Inputs
Data and modeling efforts
Outputs
Isotope analysis of evidence
Environment where evidence was collected
Local water sample
Local climate conditions
Climate and geography database layer
Water database layer
Database of food isotope ratio
Process model
GIS model
Inverse spatial map
Predicted spatial maps
Consistent or not with a set of known observations?
What are predictions of evidence for that location?
What are the predicted regions from which that evidence could have originated?

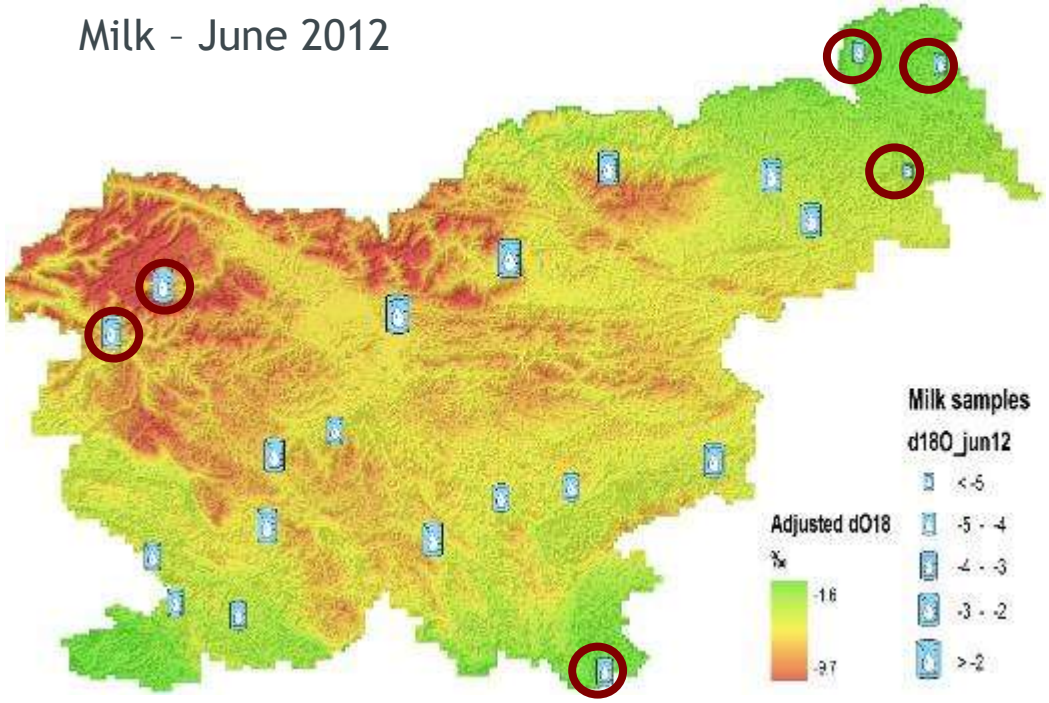
GIS modeling based on isotope, altitude and latitude

Europe

Slovenia

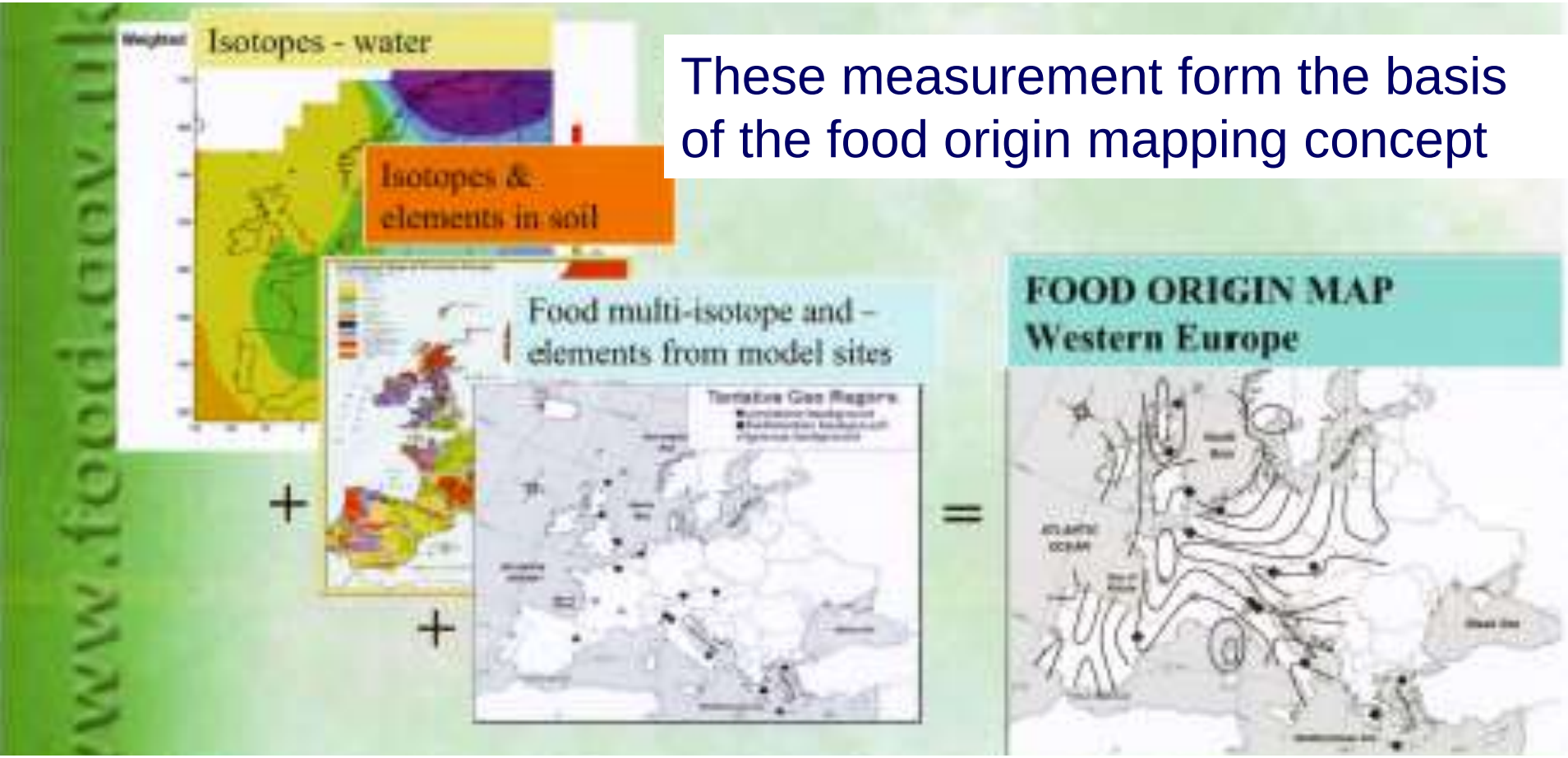


Milk – June 2012



The concept of food origin mapping

www.governmentchemist.org.uk/dm_documents/LGC_talk_BtufO.pdf



These measurement form the basis of the food origin mapping concept

Link the isotopic and TE composition of the commodity to the composition of soil and climate parameters in the production region

Predict the multi-isotopic and ME specification for same food from different origin by extrapolation

Compound specific isotope analysis

- Diet - sources identification and geographical origin – lipid biomarkers

- Tracing contamination sources – PAHs, hormones

Steroid hormones: make an isotope distinction between endogenous (produced naturally) and exogenous (administrated) or synthetic forms of hormones

Sophisticated methods for both sample preparation and instrumental analysis

Metrological - issues

- No certified reference material available - also for solid δ^2H
- Reference material does not match the matrix
- Occurrence of isotope fractionation during sample preparation
- Linearity
- Possible transformation processes and isotope fractionation

Activities within ISO-FOOD

- Research throughout training:
  - PhD study on milk and dairy products (D. Potočnik)
  - Master degree study – database on milk and dairy products
  - New research performed on vegetables available at Slovenian market – PhD study within ISO-FOOD
  - Postdoctoral position – within ISO-FOOD
- Workshops:
  - Food traceability methodologies (2nd yr)
  - Isotopic techniques in food characterization (4th yr)
- Summer school:
  - Authentication of food products by isotope and elemental fingerprinting (2nd yr)
- Interlaboratory exercises:
  - Stable isotope analyses of light elements in foodstuffs (5th yr)
- Accreditation

Activities already performed

- ISO-FOOD project presentation at conferences, symposiums:
  - TEF (Copenhagen)
  - 1st IMEKOFOODS: Conference Metrology Promoting Objective and Measurable Food Quality and Safety (Rome)
  - Workshop organized by IJS and UNILJ-BF in Ljubljana (50 participants including stakeholders)
- Preparation of national and international project (1 national, 3 international – 2 EU, 1 IAEA)
- Associated partners in EU project FoodIntegrity (P. Brerenton, UK)