LIFE GAIA Sense PROJECT: INNOVATIVE SMART FARMING SERVICES SUPPORTING CIRCULAR ECONOMY IN AGRICULTURE

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Project Acronym: LIFE GAIA Sense
Project Full Title: Innovative Smart Farming services supporting Circular Economy in Agriculture
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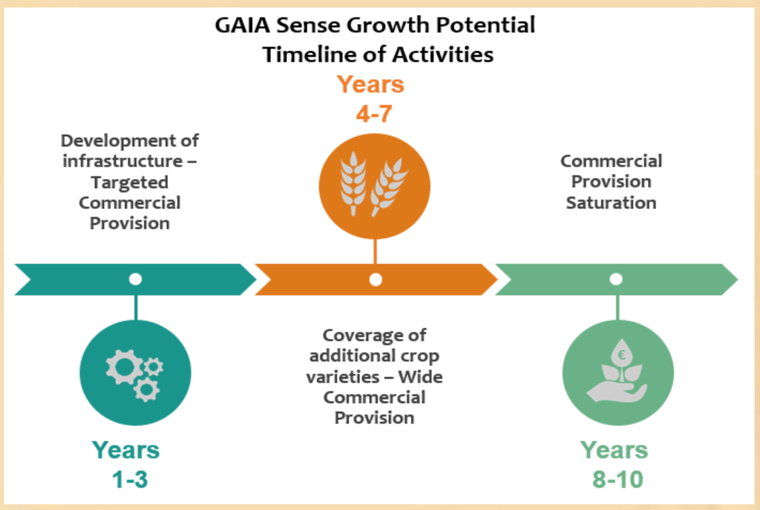
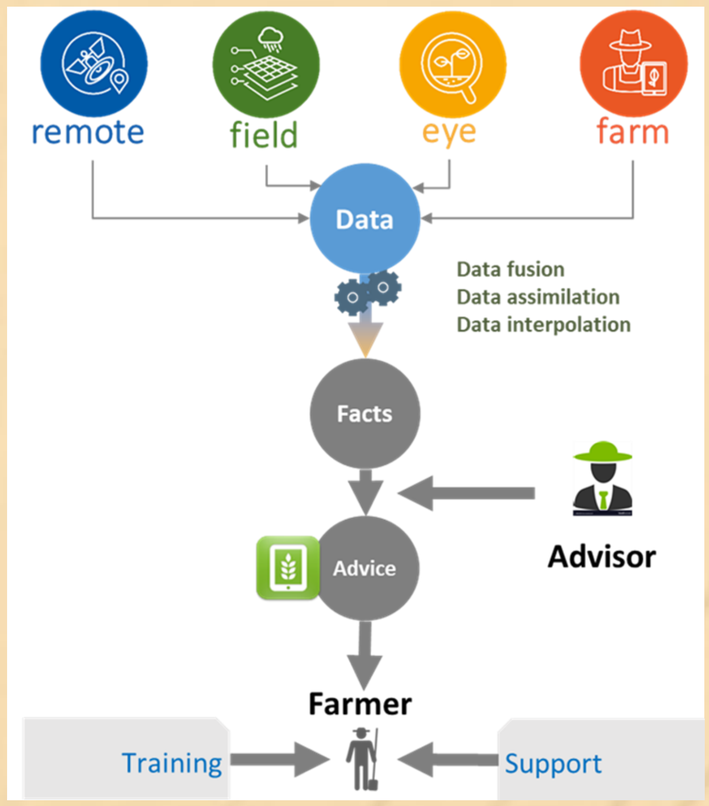


Smart Farming agriculture

The main objective of LIFE GAIA Sense project is to demonstrate GAIA Sense, an innovative "Smart Farming" solution for reducing the consumption of natural resources, as a way to protect the environment and support Circular Economy agriculture models.

- ♦ An innovative method:
  - high-end technology,
  - farmer capable of deciding to either use or avoid inputs (irrigation, fertilizers, pesticides etc.) in a most efficient way,
  - no risk of the annual production.
- ♦ The GAIA Sense platform will be accessible and affordable to farmers either as individuals or collectively through Agricultural Cooperatives.
- ♦ At the core of the system, a data collection infrastructure is established, consisting of dense networks of meteorological/soil stations and traps.



Modelling Methodology for Assessing Air Quality Impacts

Objective of GAIA Sense system environmental evaluation: Risk assessment of air, soil and water pollution due to agrochemicals and fertilizers applied in irrigated agriculture

♦ **Numerical modelling processes:**
1. Atmospheric emissions 2. Chemistry and deposition 3. Nitrogen incorporating mineralization, immobilization, nitrification, denitrification, ammonium exchange uptake and mass transport

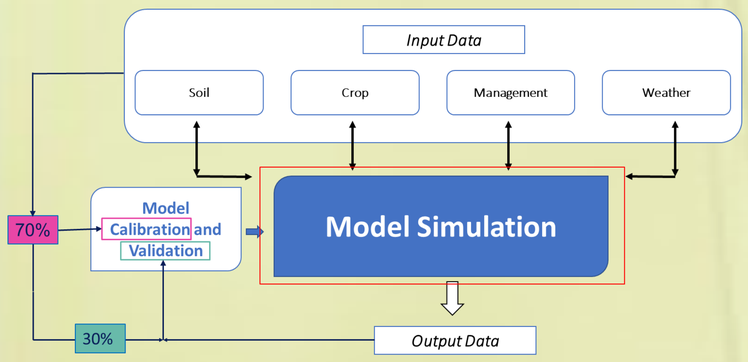
♦ Quality assurance of numerical modelling:
1. Calibration 2. Validation and verification

- GAIA Sense solution: a novel multiscale modelling method for determining air pollution levels is developed within the frame of environmental impact assessment.
- Air quality levels are largely influenced by scale-interaction processes, which have to be realistically described in numerical simulations.

Multi-scale Modelling

Aiming to address the limitations which arise as a result of the disparities between the different modelling scales, a collection of interpolating metamodels was formed introducing a two-way scheme for coupling:

- the mesoscale model MEMO and the microscale model MIMO



GAIA Sense modeling methodology

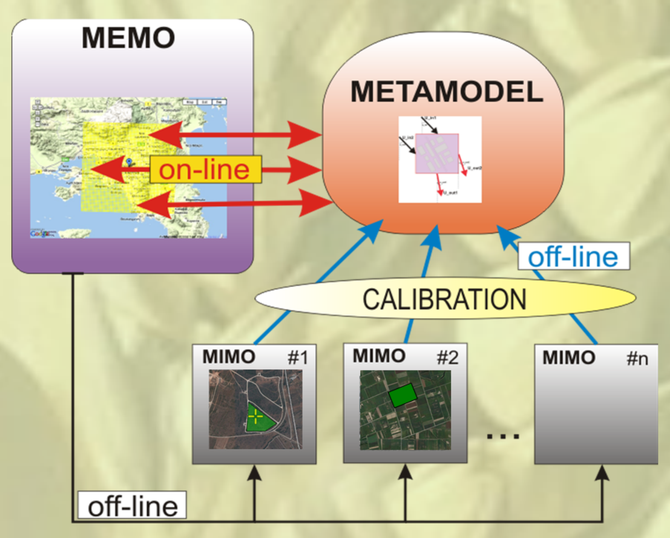
Two-way MEMICO Coupling

Two-way MEMICO coupling scheme:

- a three-dimensional spatial interpolation scheme,
- a spatial adjustment of values within the surface layer and
- the formulation of the lateral boundary conditions to introduce the interpolated values into the microscale model

Mesoscale-Microscale Coupling

- The physical parameters of the mesoscale model modified by the microscale simulations are realistically represented
- For simulating pollutant chemistry and dispersion characteristics, the mesoscale dispersion model MARS-aero is applied at the same spatial resolution as the MEMO/ MIMO model system:
  - downscaling from a spatial resolution of 500m for the surrounding area to 1m in the individual-field scale

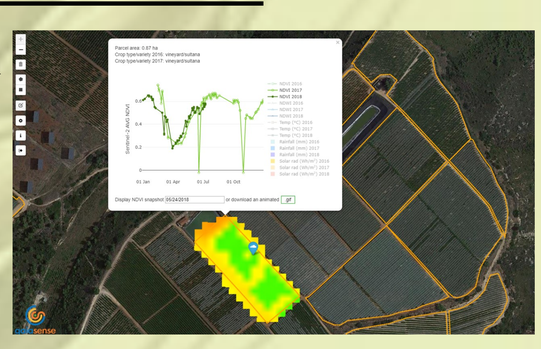


Input data

- The accuracy of modelling estimates strongly depends on the availability of reliable and detailed input data.
- The influx of meteorological and soil moisture data from GAIAtrons and meteorological stations significantly boosts the accuracy and precision (i.e. forecasting skill) of the air quality modelling system.

GAIA Sense Remote Data

- Repository of earth observation data, zoom on test sites
- Source: ESA / Copernicus
- Surface type classification
- Vegetation type
- Time-dependent layers



GAIA Sense Field Data

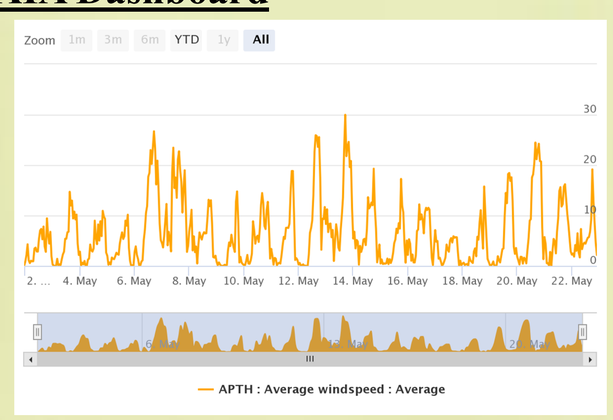
What: Real-time atmospheric & soil data
Source: GAIAtron telemetric stations

Soil data
- ✓ Soil humidity
- ✓ Soil temperature
- ✓ Other

Atmospheric data
- ✓ Ambient temp
- ✓ Relative humidity
- ✓ Wind speed / direction
- ✓ Solar radiation
- ✓ Leaf wetness
- ✓ Precipitation
- ✓ Other

GAIA Dashboard

- ➢ Real-time collection of on-site parameters
- ➢ Web interface for collecting, exporting, formatting and visualising timeseries
- ➢ Automatic export to the operational modelling system



Conclusions

The LIFE GAIA Sense project aims at presenting an efficient and robust tool for implementing the EU policies in reducing the contribution of the agricultural sector over the major environmental burdens. Traditional modelling tools must be further developed in order to realistically cope with the complex system of soil-atmosphere interactions in crop areas. The atmospheric modelling is one of several components contributing to the environmental impact evaluation of GAIA Sense application.

References

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Project Partners

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