Knowledge Commons for Global Sustainability Challenges

Building an integrated knowledge space for the global statistical community

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State of the art: a rationale for the ARIES approach

1. Decision-makers with limited data and technical capacity often lack access to scientific knowledge. Many are left behind due to cost or technology barriers.

2. Ever-increasing volumes of data are held in silos – different disciplines, geographies, data types and access rights - making it challenging to connect information and make sense of it.

3. Public trust is one of the biggest hurdles faced by AI technologies. People struggle to accept the decisions and answers that AI-powered tools provide as many do not make their inputs, operations, and end goals visible.

4. The AI technology ecosystem is currently dominated by Big Tech - enclosed assets - for profit perspective. Although much software is open-source, access to data remains tightly controlled.
The role of Artificial Intelligence (AI)

Governmental agencies and policy makers often face high barriers when generating environmentally-related knowledge:

- Environmental modelling has high data needs, which must fulfil necessary standards of quality and consistency;
- Large amounts of data result in long processing times, making compilation a slow exercise;
- Statistical-environmental analyses often make use of biophysical models which require technical expertise.

The statistical community would benefit greatly from data and models which are Findable, Accessible, Interoperable and Reusable (FAIR).

Beyond FAIR, the deep knowledge integration enabled by AI can have consequences much beyond convenience.
ARIES: Artificial Intelligence for Environment & Sustainability

# 1 It is a **modelling technology**, rather than a collection of models or specific program/application.

# 2 It is an **AI modeller**, based on **machine reasoning**, a less known branch of AI;

# 3 It defines a variety of data, models and the relationships between them using **consistent and uniform terms**. This allows different data and models to be used together, depending on which data and models are “most appropriate” for the context set by the user;

# 4 It uses AI to determine the “**most appropriate**” data and models for users’ requests.

**Reasoning algorithms** + **Decision rules** + **Multidisciplinary semantics** + **Open data & models** + **Open-source software** = **ARIES: Fast, FAIR multidisciplinary modeling**
imf.aries.risk:imf_kenya_pilot.lst_2018_2023_kenya

- Copernicus Program - sentinel satellite data
- NASA/USGS Landsat Program Landsat satellite data

Environmental monitoring, Disaster management, Urban planning - k.LAB Modeling Paradigm

Assets identified by URN

Data, code & repositories

Semantics

Worldview grounded in core ontology

User's queries

Best case observation

Digital twin

Annotated knowledge

Observation

Hypothesis

Inference

Knowledge

Using a dedicated language

Inform policy makers, scientists, citizens to address environmental challenges

Open science
Potential use cases for ARIES

- Spatial economic valuation of ecosystem services
- Conservation planning
- Spatial policy planning (derived from EO data)
- Forecasting changes in ecosystem service provisioning
- Natural capital accounting
The ARIES for SEEA Explorer
Available since April 2021

# 1 An application of the ARIES technology to compile ecosystem accounts that are consistent with the SEEA Ecosystem Accounting;

# 2 It utilizes freely available remote-sensing derived data and models;

# 3 It can generate accounts for any user-specified terrestrial area in the world;

# 4 It rapidly computes these accounts online, using a web browser;

# 5 It generates a comprehensive report, fully documenting the data, models, coefficients and methods used.

Available since April 2021
Some ARIES for SEEA output examples

A combination of statistical and spatial analysis summarized inTables(1) andMaps(2). Tables are SEEA compliant.
Some ARIES for SEEA output examples

Full transparency for replicability and traceability through Reports(1), a Resource Section(2) & a Dataflow Diagram(3).

1. Introduction

Disclaimer

The designations employed and the presentation of material on this map and any map used in this application do not imply the expression of any opinion whatsoever on the part of the United Nations concerning the legal status of any country, territory or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

This application allows users to select different background layers such as OpenStreetMap, are available for all accounts presented in this report. In collaboration with the ARIES team, a mapping and visualization for various accounts including compiled for any region on Earth using global data, with

1.1. Ecosystem Extent

The Ecosystem Extent Account is the first SEEA EA in all other accounts, so are fundamental to SEEA. Ecosystems are defined as units whose functioning ecosystems is the context and should not be confused with IUCNs Global Ecosystem Typology is the standard application relying exclusively on land cover data.

A full ecosystem extent account includes gross change of the same ecosystem type for each accounting forest clearing for agricultural land, natural expansion requirements to initiate accounting resulting from imper ecosystem services in the formulation of the SEEA EA.
Thank you!

ARIES
ARTIFICAL INTELLIGENCE FOR ENVIRONMENT & SUSTAINABILITY

#UNBigData2024
Integrated Modeling

is a practice meant to maximize the value of scientific information by ensuring its modularity, reusability, interoperability and traceability throughout the scientific process.

1. Linkage
Combine independently produced scientific products into workflows that would be too complex for individual humans to conceive, validate and navigate.

2. Integration
Integrate different modelling paradigms from simple (e.g., deterministic and probabilistic models) to complex approaches (e.g., agent-based and networks) depending on context and scale.

3. Rescaling
Rescale smartly across scales, from local to global, promoting adaptive solutions that are automatically customized to the scale of observation.

4. Adaptive contextualization
Adaptively incorporate the best-available knowledge, from curated global public datasets to “big data” to user-provided data.

5. Delivery
Adopt shared, non-ambiguous semantics in the implementation, documentation and dissemination of products.

6. Tracking
Track quality, uncertainty and provenance throughout modelling workflows.

Relevance of semantics and ontologies for ARIES

- Unambiguous identification of concepts, data, models and results.
- Description of real environmental scenarios.
- Interoperability of data and models.
- Transparency with users in the methodologies applied and results obtained.

Transformation of Knowledge to Knowledge – an insight into modelling in

[Diagram of the transformation process]