8th International Conference on BIG DATA & Data Science for Official Statistics
BILBAO 2024

Informing Climate Change and Sustainable Development Policies with Integrated Data

BILBAO. SPAIN | 10-14 JUNE 2024 | #UNBigData2024

Measuring Resilience: Big Data Approaches to Climate Change Risk Assessment

ARIES application to measure physical and transition risks

Ferdinando Villa, BC3

ARIES
ARtificial Intelligence for Environment & Sustainability

United Nations BigData
Eusko Jaurlaritza Gobierno Vasco
Gobierno de España · Ministerio de Asuntos Exteriores, Unión Europea y Cooperación
BC3 Basque Centre for Climate Change Klima Aldaketa Ikergai
Excelencia María de Maeztu 2023-2027
INE Instituto Nacional de Estadística
Eustat Euskal Estatistika Erakundea Instituto Vasco de Estadística

ARIES: Artificial Intelligence for Environment & Sustainability

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

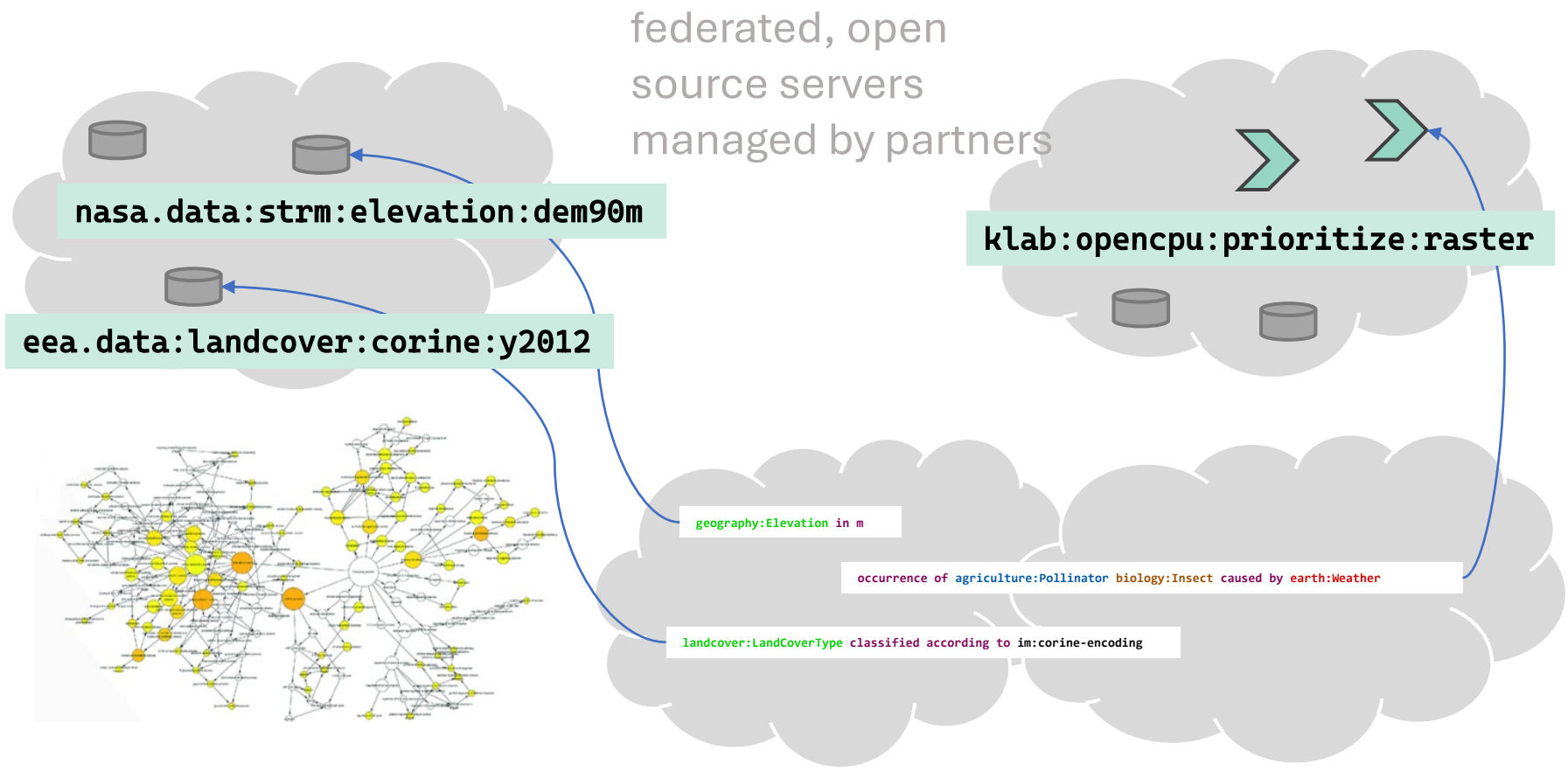
#2 It is an **AI modeller**, based on **machine reasoning**, a less known branch of AI;

#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

A semantics-driven, AI-assisted model and data federation

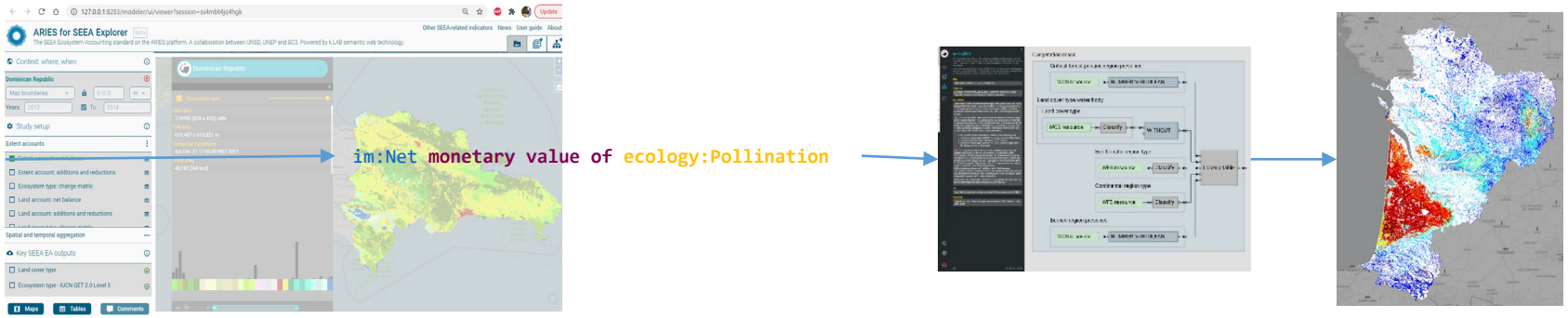


RESOURCE layer

- **Assets** identified by **URNs**
- Include "conventional" data, models, and access metadata for external services and computational platforms

SEMANTIC layer

- **Worldview**: shared **concepts** and relationships, communally curated
- **Semantic assets**: associate resource URNs to their meaning in terms of the worldview



Digital twins (reactivity) layer

- **User queries** ("observe *concept* in *context*") asked through **API** or **applications**
- AI assembles the best-case algorithm to produce reactive **observations**
- **Behaviors** can be specified and triggered

Potential use cases for ARIES: Measure physical and transition risks

Spatial economic valuation of ecosystem services

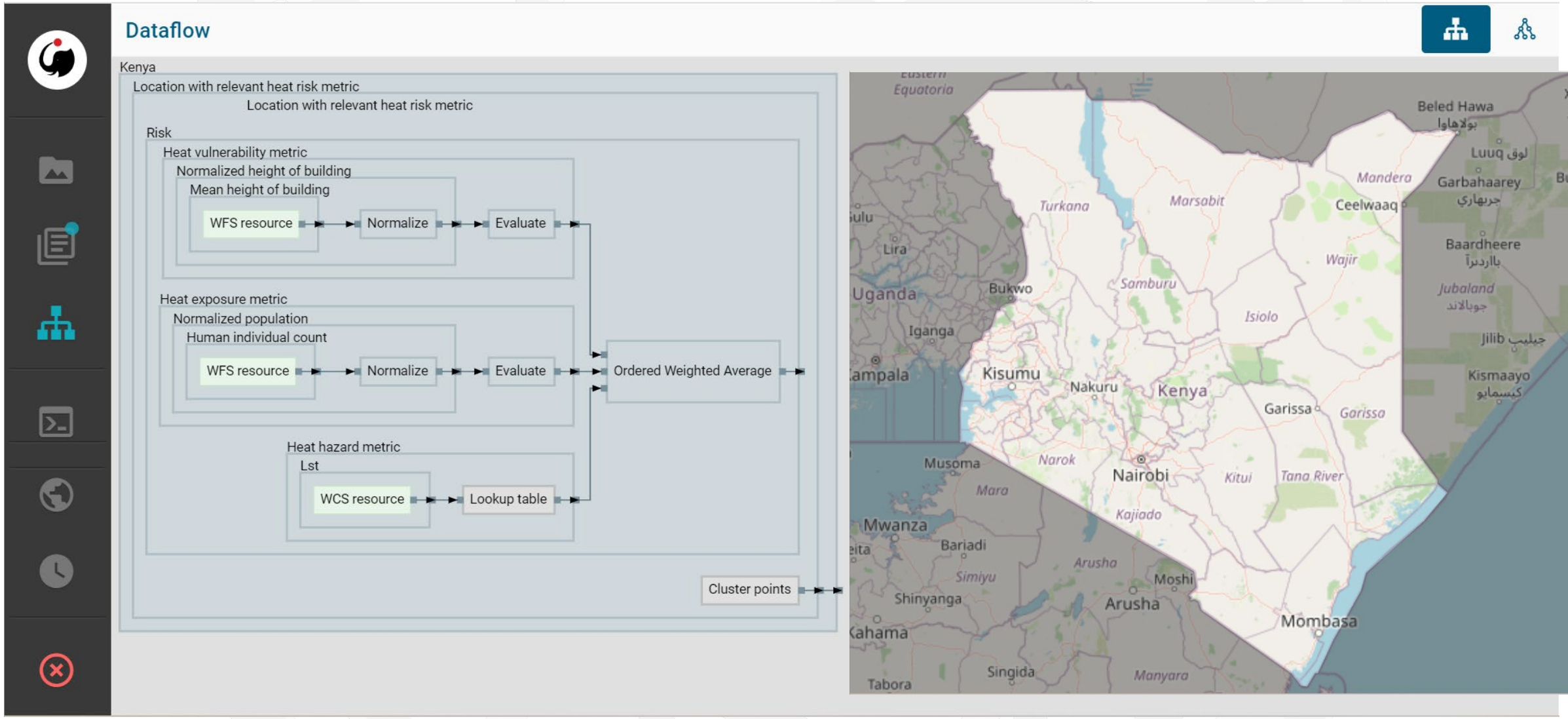
Conservation planning

Spatial policy planning (derived from EO data)

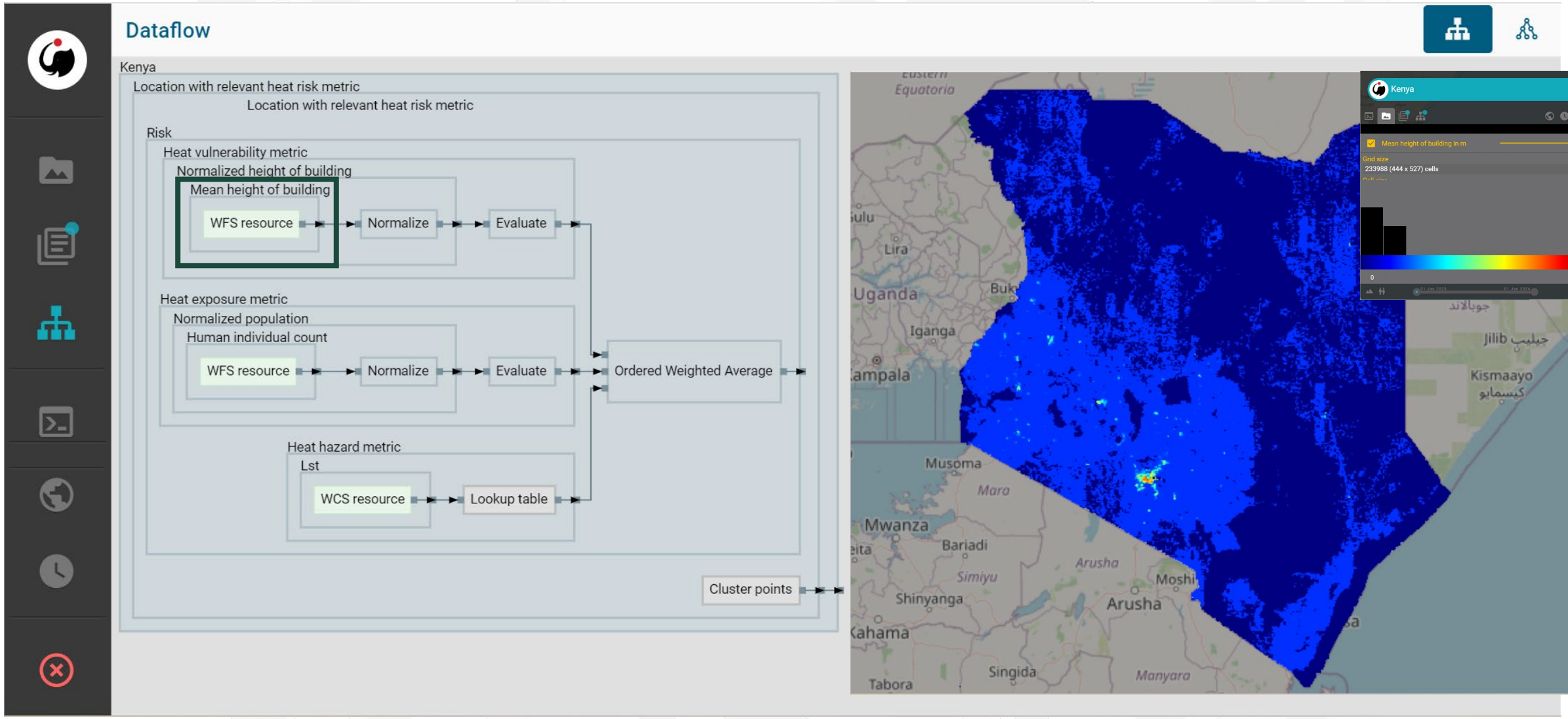
Forecasting changes in ecosystem service provisioning

Natural capital accounting

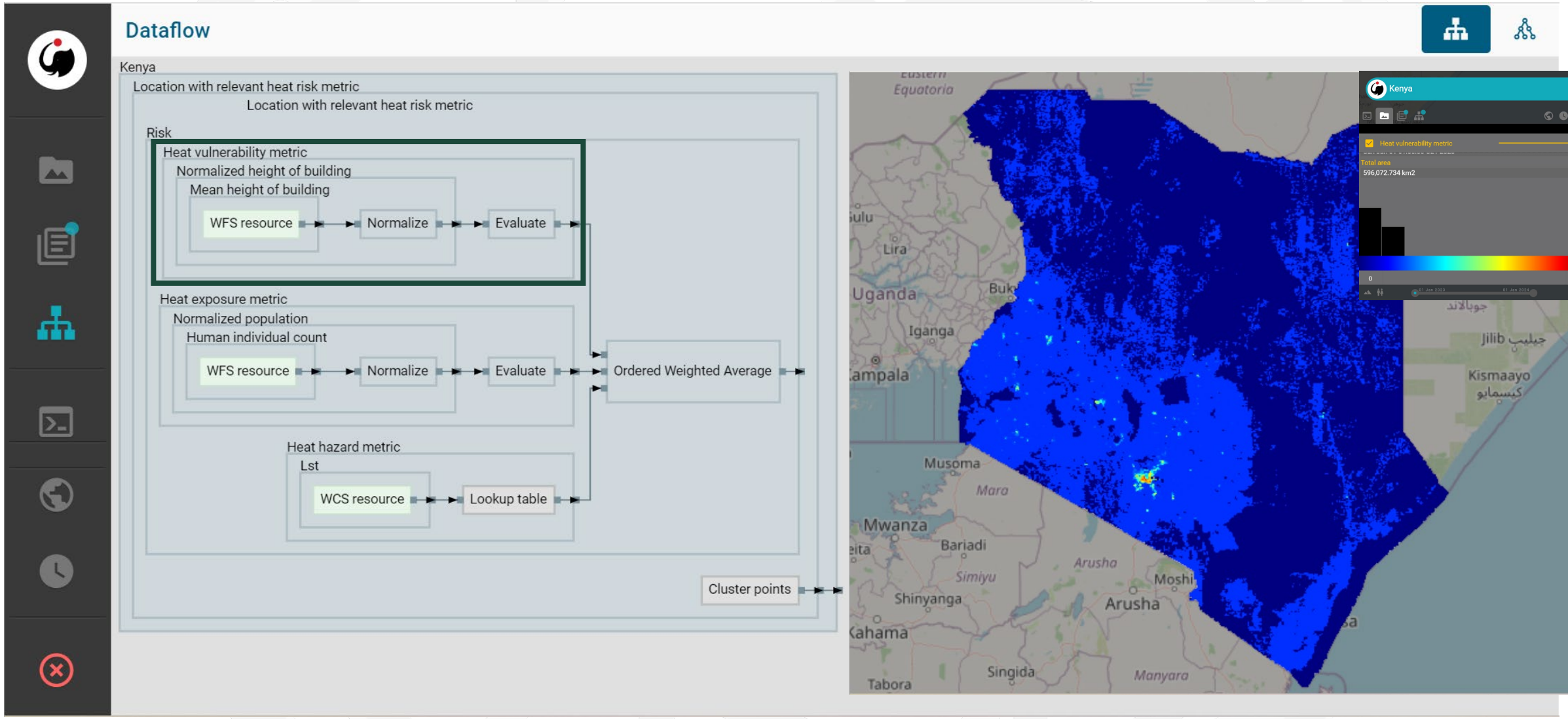
Kenyan context



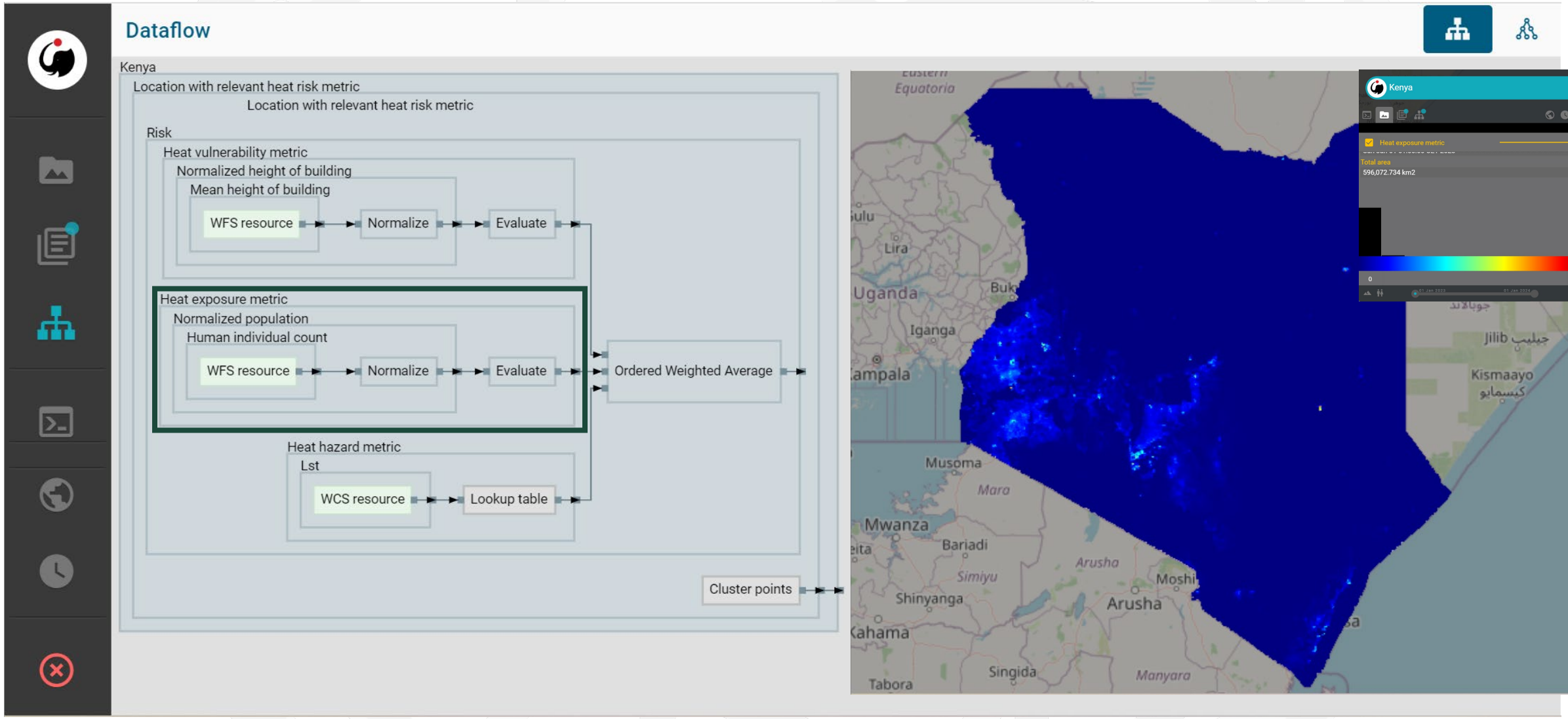
Mean height of building



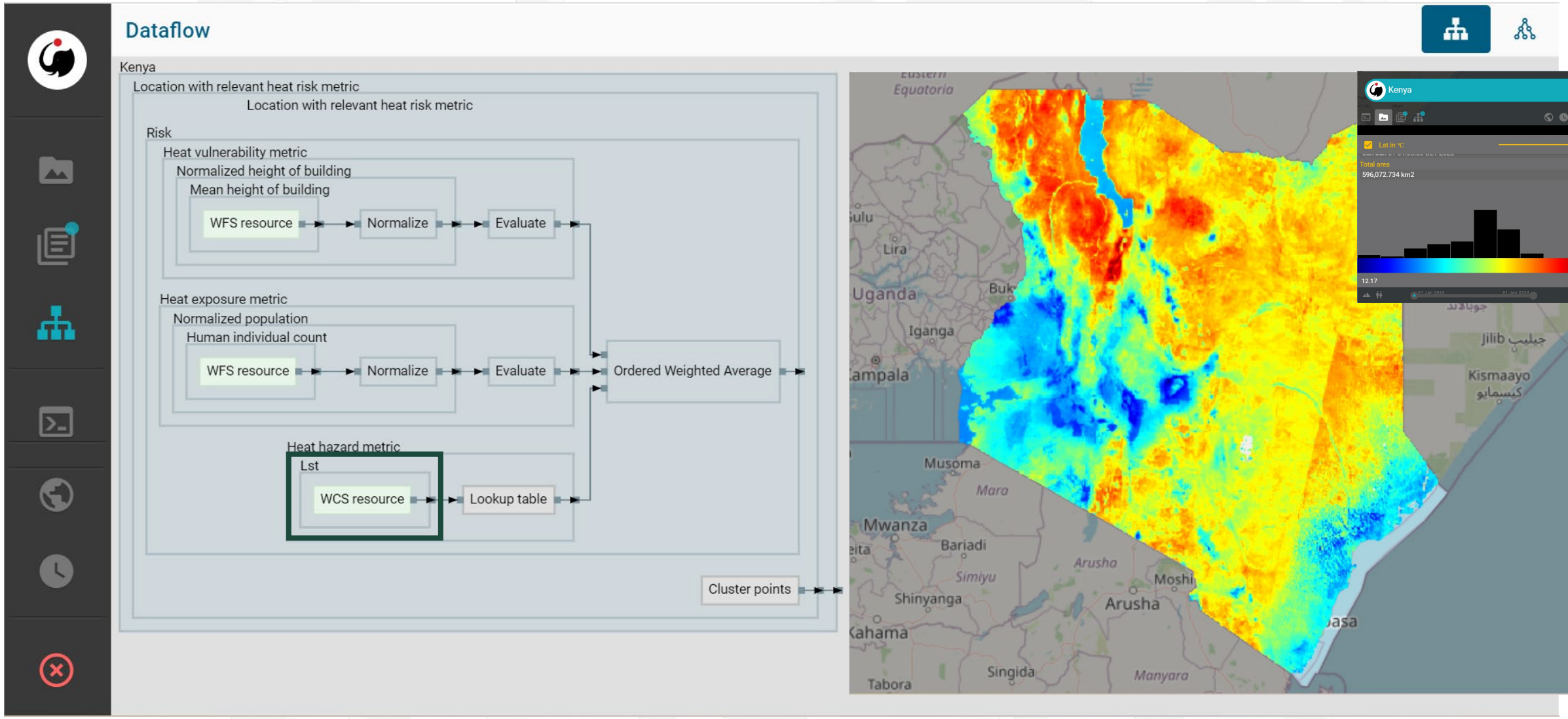
Heat vulnerability metric



Heat exposure metric



Land surface temperature



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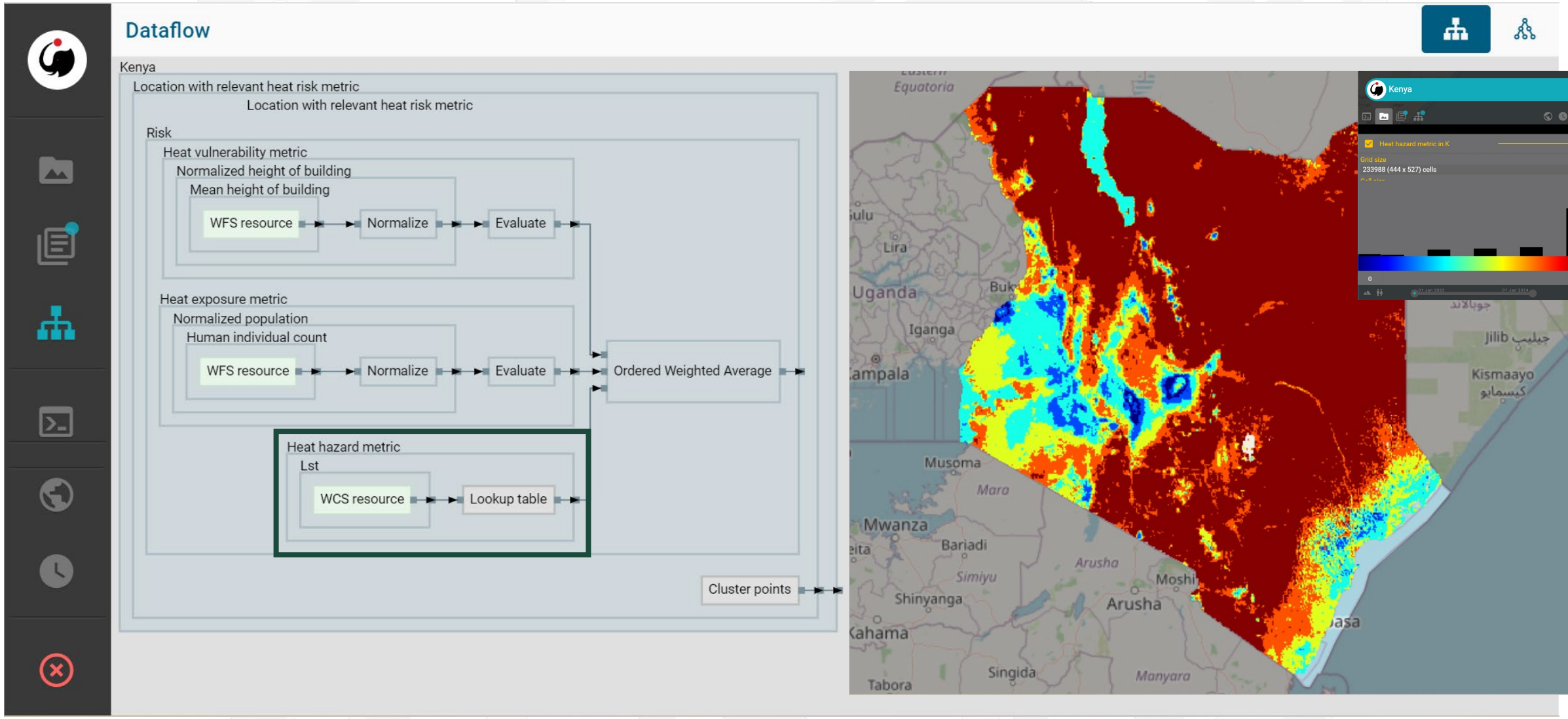
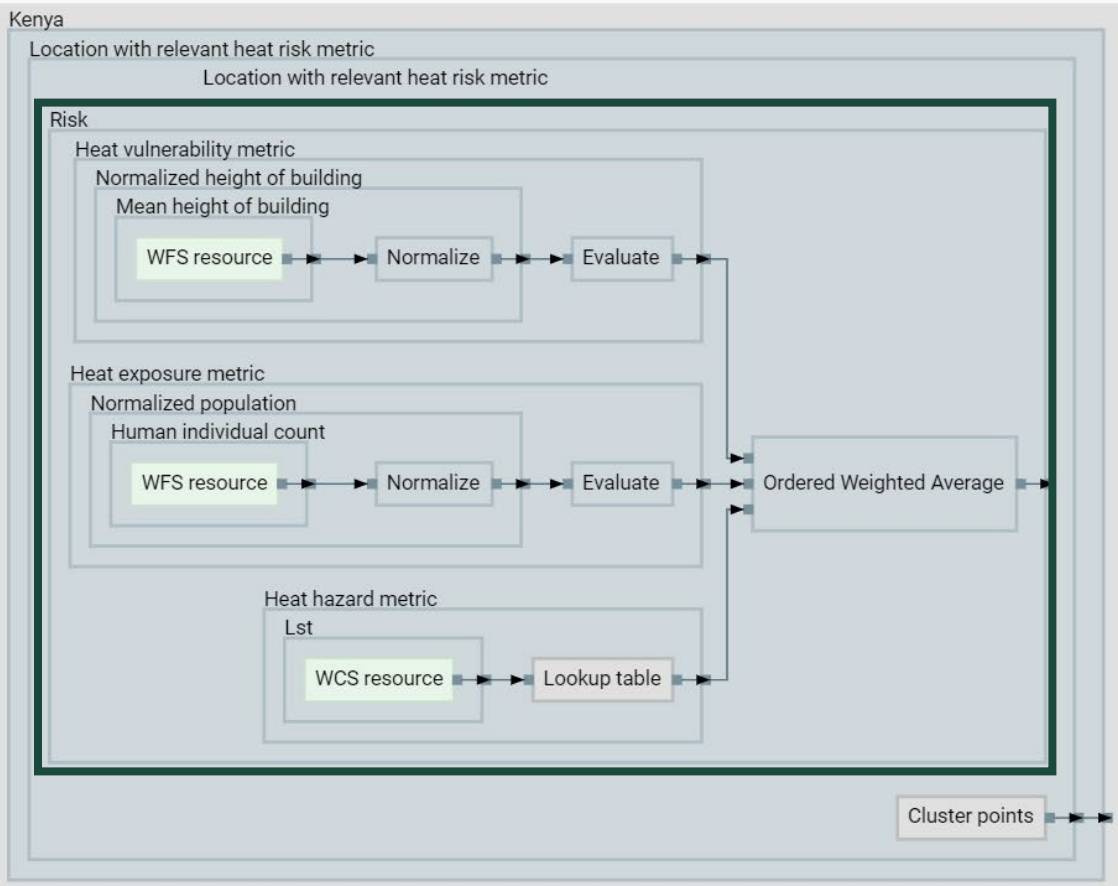
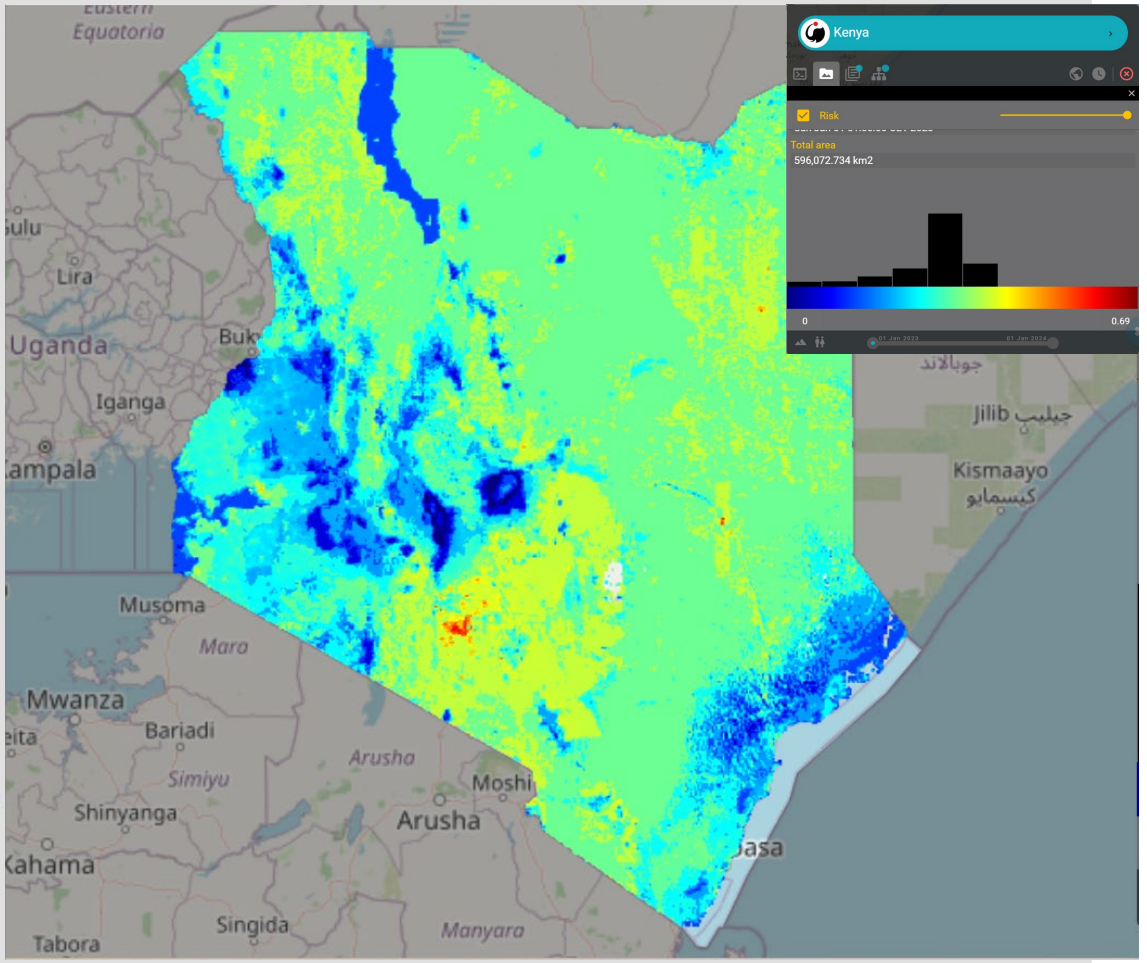


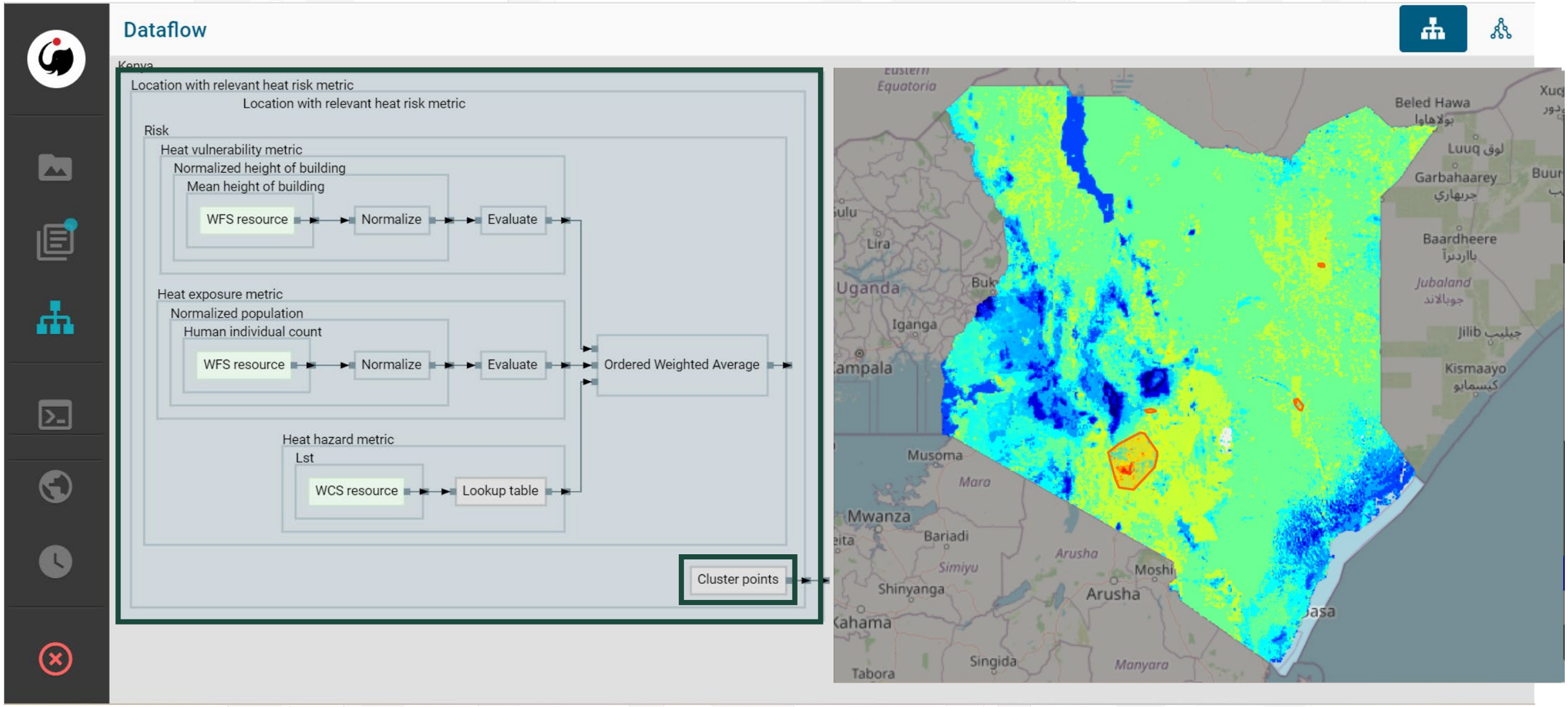
Risk

Dataflow





Locations with relevant heat risk metric (>3/5 of max risk)



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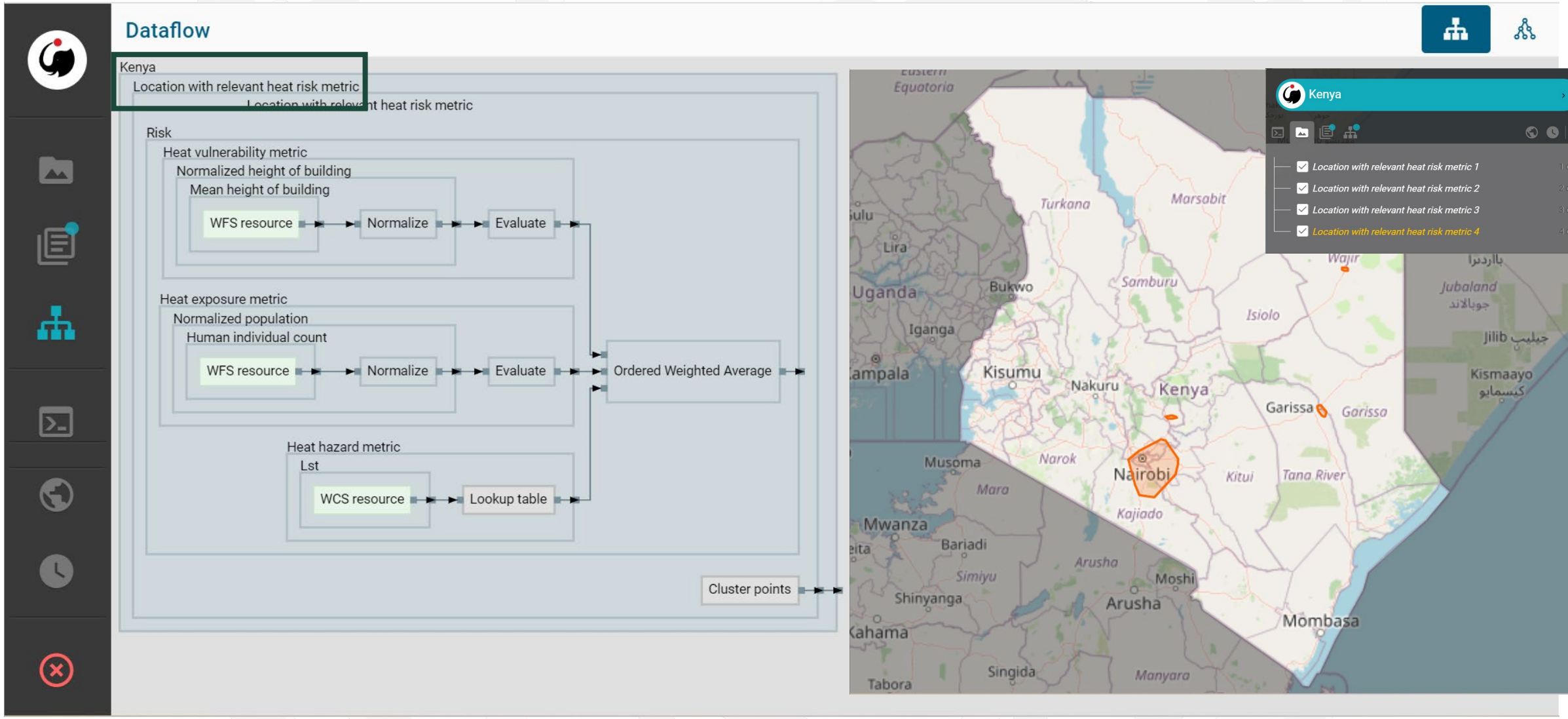

Thank you!

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EUSKO JAURLARITZA GOBIERNO VASCO

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GOBIERNO DE ESPAÑA
MINISTERIO DE ASUNTOS EXTERIORES, UNIÓN EUROPEA Y COOPERACIÓN

BC3 BASQUE CENTRE FOR CLIMATE CHANGE Klima Aldaketa Ikergai

EXCELENCIA MARÍA DE MAEZTU 2023-2027

INE Instituto Nacional de Estadística

Eustat EUSKAL ESTATISTIKA ERAKUNDEA INSTITUTO VASCO DE ESTADÍSTICA

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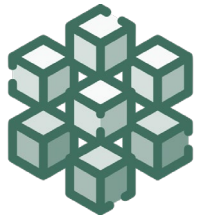
Inequalities

Access to scientific knowledge

Technology barriers

Cost

Fragmented information



Data in silos

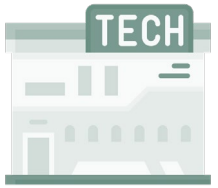
Lack of transparency

AI distrust

Lack of shared narrative

Crisis of collective intelligence

Lack of data control



Ownership

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.

Balbi et al. The global environmental agenda urgently needs a semantic web of knowledge. Environmental Evidence 11, 5 (2022). doi:10.1186/s13750-022-0025

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