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KI-gestützte Datenaufbereitung für einen Digitalen Zwilling der Umwelt

Von der Geodatenintegration über die Analyse zur fertigen Anwendung mit ArcGIS

22.05.2025

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Lars Behrens
Dr. Peter Saiger-Bonnas

KI in ArcGIS

KI-Anwendungsfälle

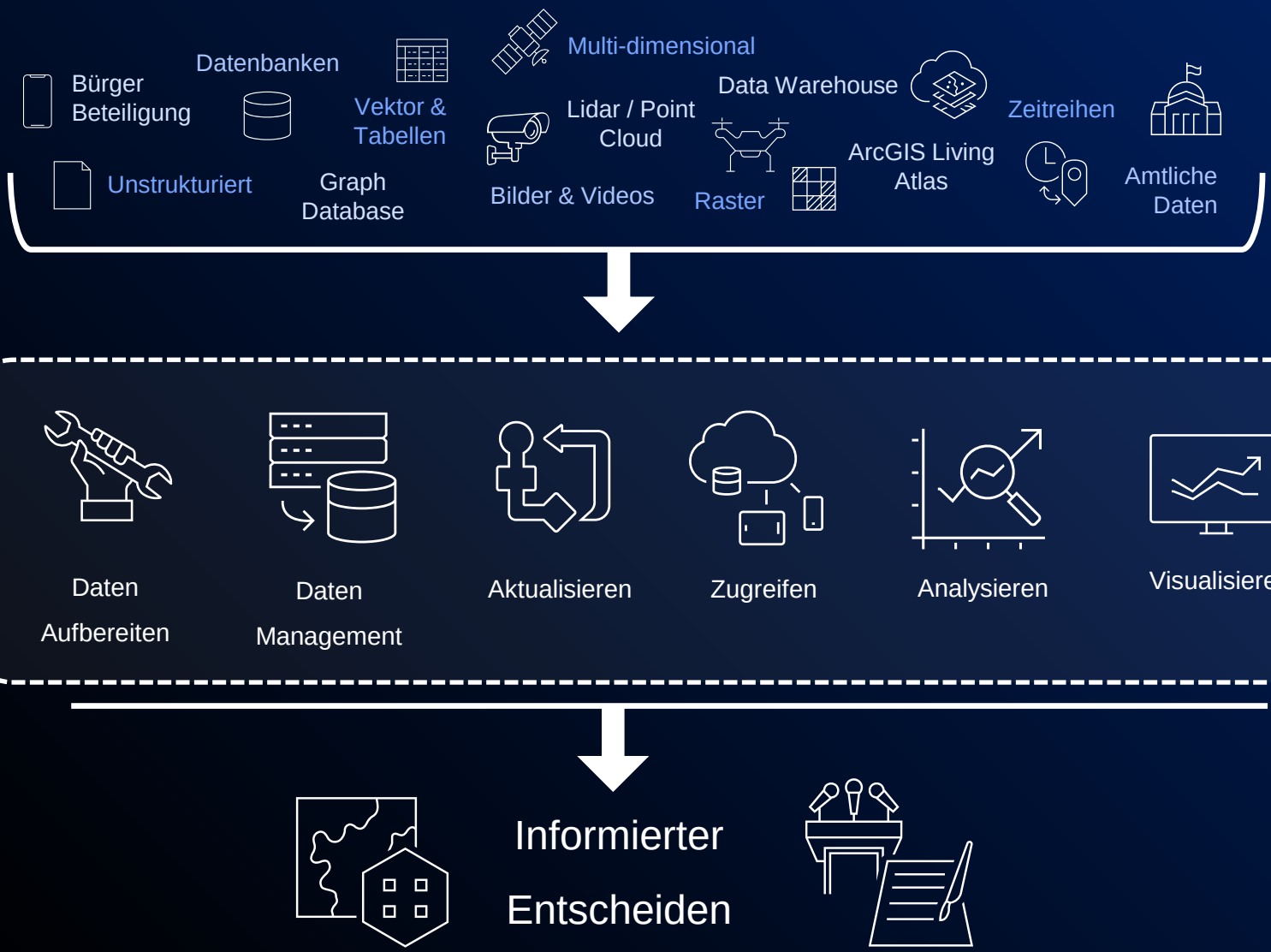
Entwicklung einer Tagebaulandschaft

Analyse und Überwachung von Waldbrandrisiken

Ökologische Standortbewertung von Windparks

Ergebnisse und wie es weitergeht?

ArcGIS System



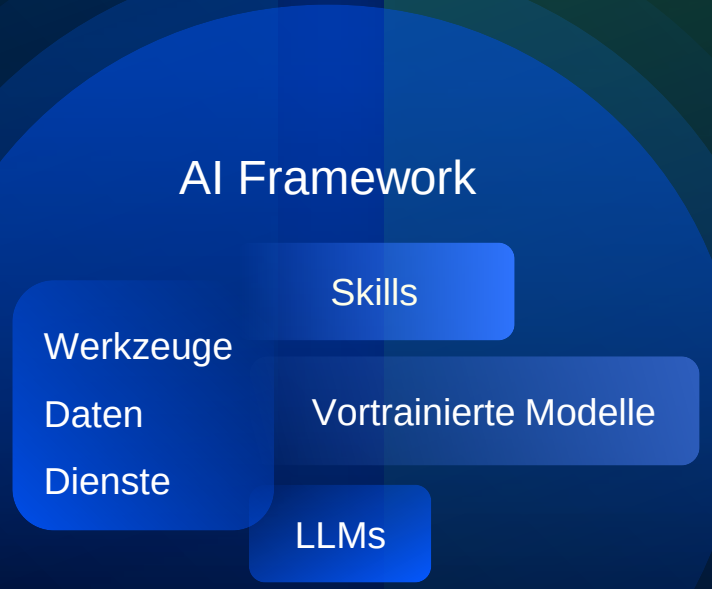
KI in ArcGIS

GeoAI

- Automatisierung der Datenextraktion
- Schneller Erkenntnisse gewinnen
- Vereinigung von räumlichen Analysen und KI

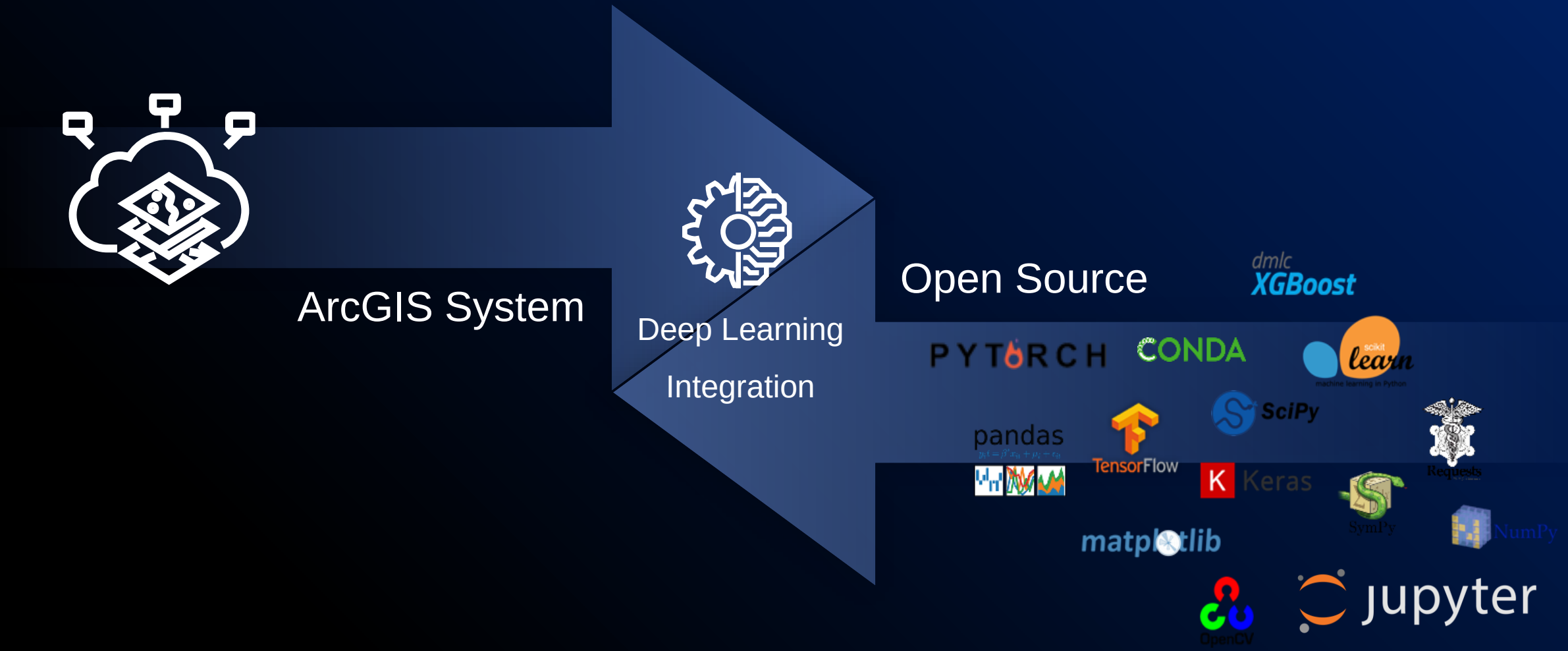
KI-Assistenten

- Erstellung intuitiver GIS-Produkte
- Entlastung von Nutzern
- Steigerung Produktivität



Integration externer Frameworks

KI in ArcGIS



Szenarien für einen Digitalen Zwilling der Umwelt

Entwicklung einer Tagebaulandschaft

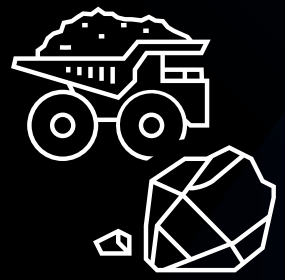
Analyse und Überwachung von Waldbrandrisiken

Ökologische Standortbewertung von Windparks

KI-Anwendungsfälle

KI-Assistenten

Eigenes trainiertes Deep Learning-Modell in Kombination mit Rasteranalysen



Vortrainiertes Deep Learning-Modell

Reifegrad des KI-Anwendungsfalls nimmt zu

1 – Entwicklung einer Tagebaulandschaft

Landbedeckungsklassifizierung mit Deep Learning

Senitnel-2A, RGB 10m

ArcGIS

Daten Management

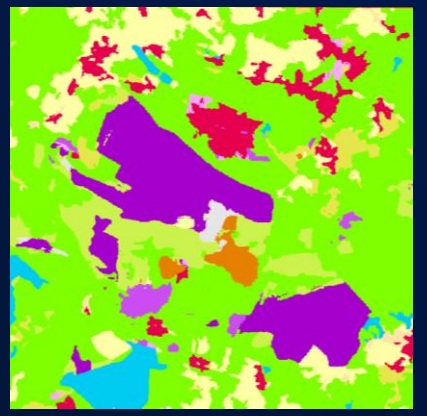
Trainingsdaten Labeln

Vortrainiertes „Land Cover Classification (Sentinel-2)“ Deep Learning-Modell

Aufbereiten

Modell Trainieren

Modell Anwenden



Modell Ergebnisse weiterverarbeiten

2 - Analyse und Überwachung von Waldbrandrisiken

Der GeoAI-Workflow

Totholz labeln

Totholzdetektion mit Single-Shot-Detector (SSD)

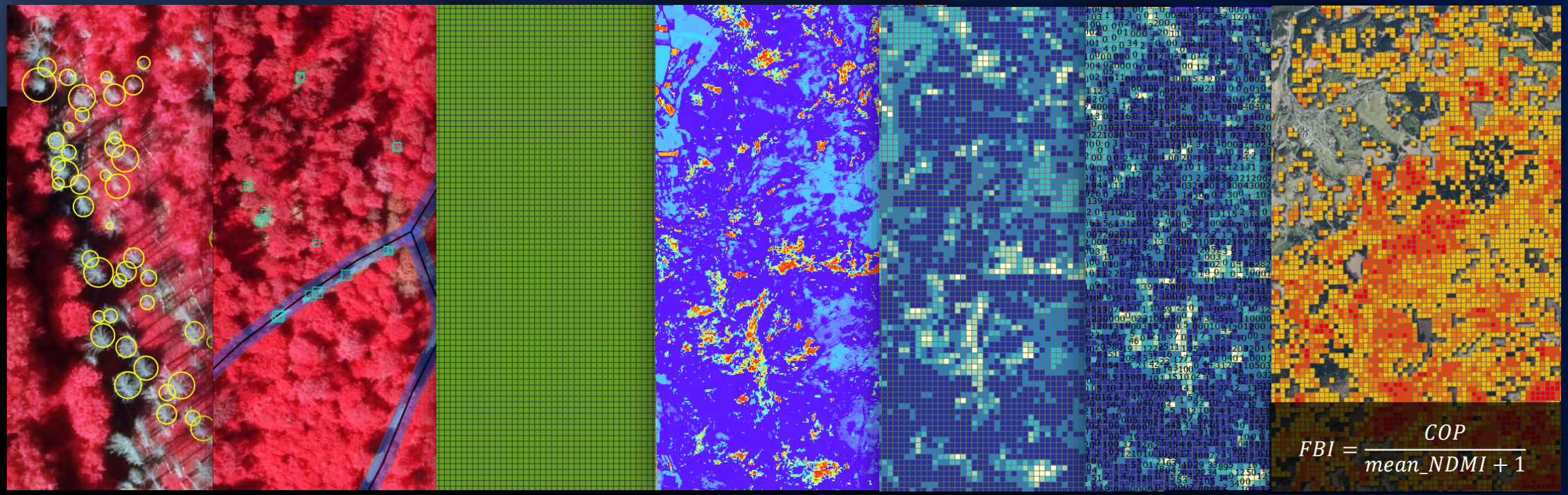
Testfeld mit 1 Hektar Raster erstellen

NDMI aus Sentinel-2A

Zonale Statistik des NDMI

Zusammenfassen von Statistiken und Totholz

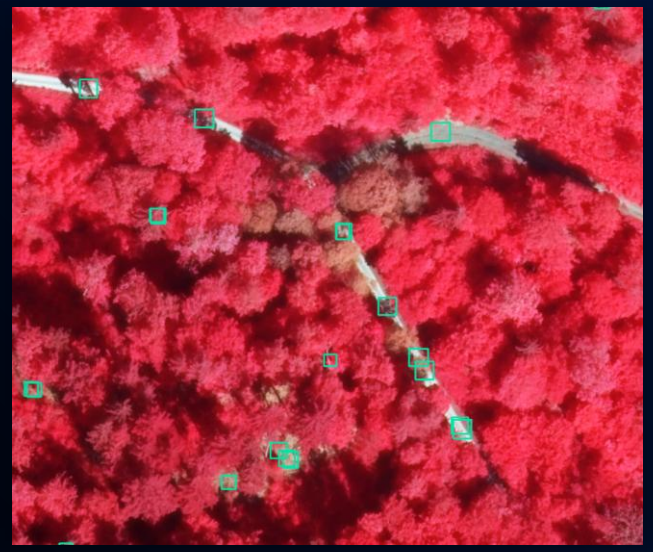
FBI berechnen



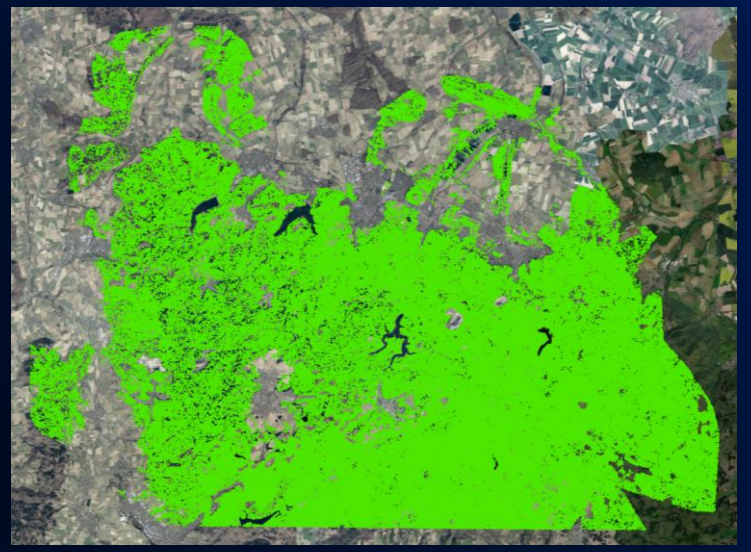
Herausforderungen

Analyse und Überwachung von Waldbrandrisiken

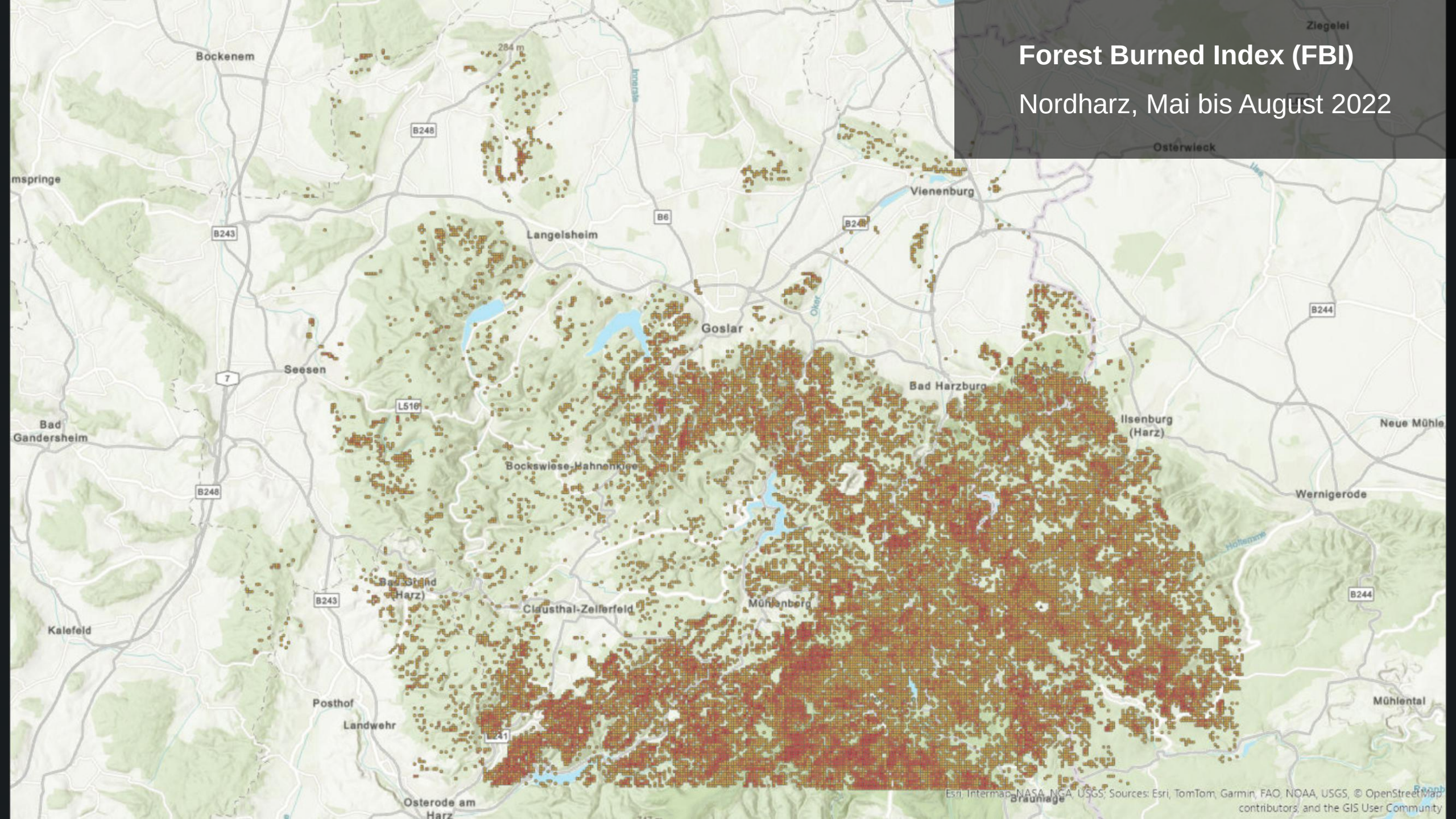
Verkippungen



Radiometrische Inkonsistenz



Rechenleistung


Forest Burned Index (FBI)
Nordharz, Mai bis August 2022
Bockenem
284 m
B248
Langelsheim
B6
B243
Goslar
Seesen
7
L516
Bad Gandersheim
Bad Harzburg
Ilsenburg (Harz)
Neue Mühle
Bockswiese-Hahnenklee
B248
Wernigerode
B243
Clausthal-Zellerfeld
Mühlenberg
B244
Kalefeld
Posthof
Landwehr
Mühlental
Osterode am Harz
Osterwieck
Vienenburg
B244
Braunlage
Esri, Intermap, NASA, NGA, USGS; Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community

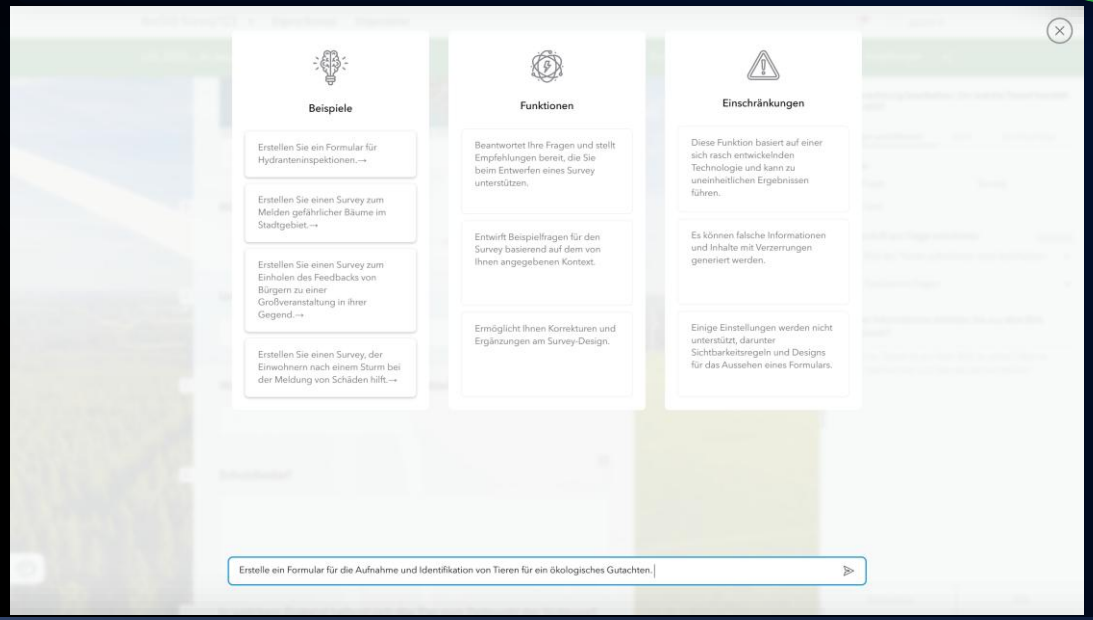
3 - Ökologische Standortbewertung von Windparks

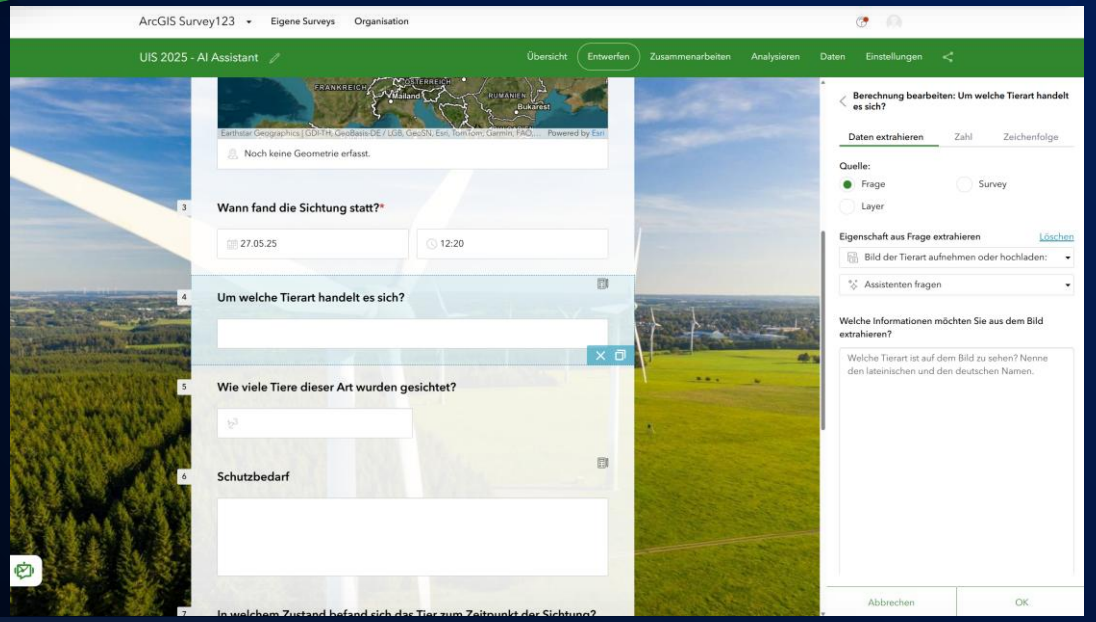
KI-Assistenten im Einsatz

Entwerfen und Erstellen eines Formulars

Beta

Interpretation von aufgenommenen Bildern





KI-Assistenten basierend auf LLMs

KI-Assistenten in der Bildinterpretation

Prompts/Fragestellung:

Um welche Tierart handelt es sich?

Welche Tierart ist auf dem Bild zu sehen? Nenne den lateinischen und den deutschen Namen.

Schutzbedarf

Bewerte ob und wie stark diese Tierart unter Schutz, ob sie auf einer Liste der bedrohten Tierarten steht und in welchem geographischen Raum dieser Schutzstatus gilt?

Ein Digitaler Zwilling der Umwelt

Verschiedene Anwendungsbeispiele

vereint

Scene Viewer in ArcGIS Online

Wie sind die KI-Technologien einzuwerten?

Vortrainierte und eigens trainierte Deep Learning-Modelle

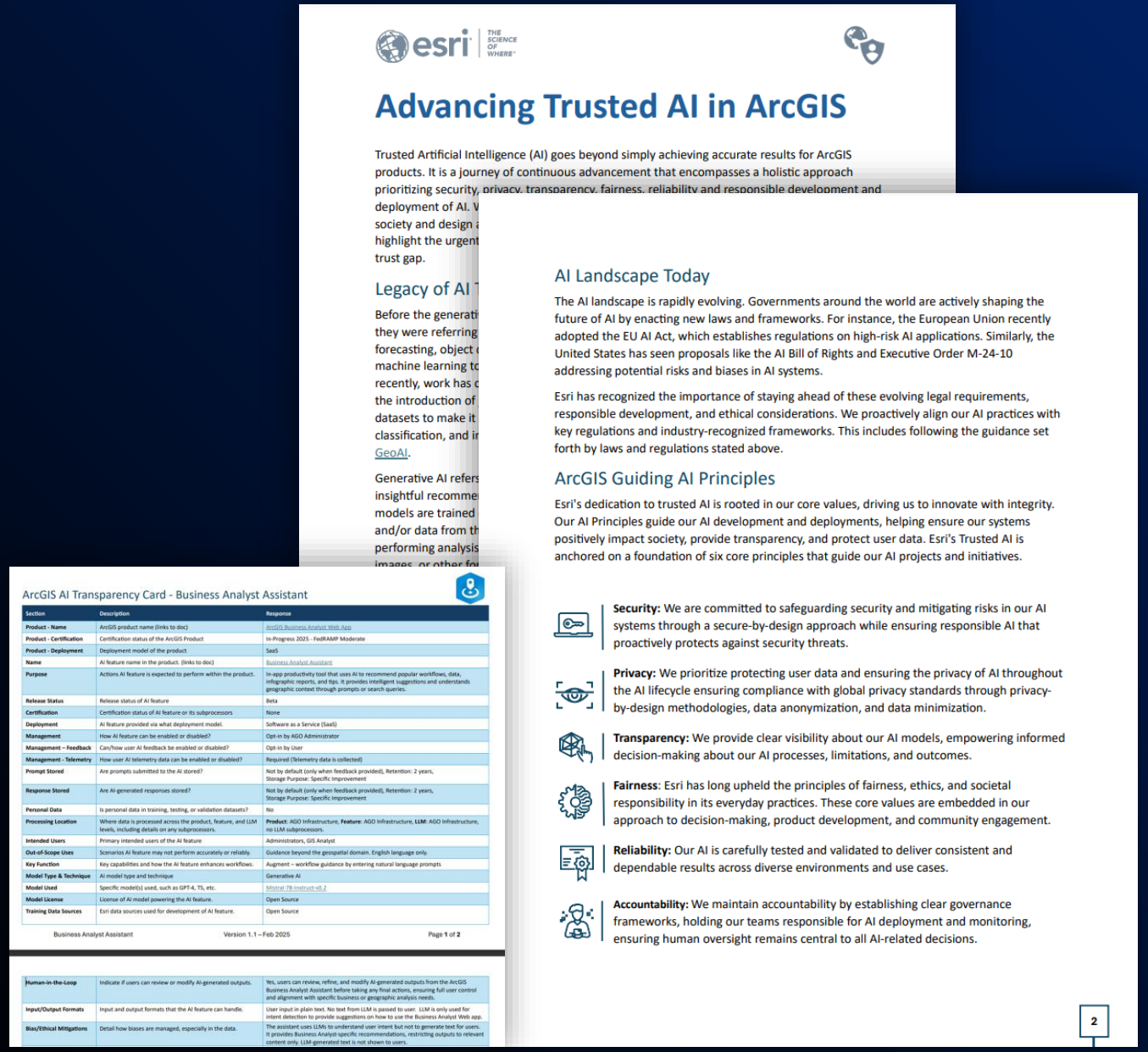
- Schon länger in der Software implementiert
- Sehr ausgereifte und umfangreiche Dokumentation
- Stetige Weiterentwicklung

KI-Assistenten

- Noch nicht vollständig in der Software implementiert, aktuell noch in der Entwicklung (Beta-Phase)
- Nur eingeschränkter Zugriff
- Dokumentation zur Funktionsweise und Anwendung in Bearbeitung

Trusted AI in ArcGIS

- Verfügbar über trust.arcgis.com
- Esri‘s Leitfaden für KI in ArcGIS
  - Sicherheit
  - Datenschutz
  - Transparenz
  - Gerechtigkeit
  - Zuverlässigkeit
  - Verantwortlichkeit



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Advancing Trusted AI in ArcGIS

Trusted Artificial Intelligence (AI) goes beyond simply achieving accurate results for ArcGIS products. It is a journey of continuous advancement that encompasses a holistic approach prioritizing security, privacy, transparency, fairness, reliability and responsible development and deployment of AI. W
society and design a
highlight the urgent
trust gap.

Legacy of AI T

Before the generati
they were referring
forecasting, object
machine learning to
recently, work has
the introduction of
datasets to make it
classification, and in
GeoAI.

Generative AI refers
insightful recomme
models are trained
and/or data from th
performing analysis
images, or other fo

AI Landscape Today

The AI landscape is rapidly evolving. Governments around the world are actively shaping the future of AI by enacting new laws and frameworks. For instance, the European Union recently adopted the EU AI Act, which establishes regulations on high-risk AI applications. Similarly, the United States has seen proposals like the AI Bill of Rights and Executive Order M-24-10 addressing potential risks and biases in AI systems.

Esri has recognized the importance of staying ahead of these evolving legal requirements, responsible development, and ethical considerations. We proactively align our AI practices with key regulations and industry-recognized frameworks. This includes following the guidance set forth by laws and regulations stated above.

ArcGIS Guiding AI Principles

Esri's dedication to trusted AI is rooted in our core values, driving us to innovate with integrity. Our AI Principles guide our AI development and deployments, helping ensure our systems positively impact society, provide transparency, and protect user data. Esri's Trusted AI is anchored on a foundation of six core principles that guide our AI projects and initiatives.

Security: We are committed to safeguarding security and mitigating risks in our AI systems through a secure-by-design approach while ensuring responsible AI that proactively protects against security threats.

Privacy: We prioritize protecting user data and ensuring the privacy of AI throughout the AI lifecycle ensuring compliance with global privacy standards through privacy-by-design methodologies, data anonymization, and data minimization.

Transparency: We provide clear visibility about our AI models, empowering informed decision-making about our AI processes, limitations, and outcomes.

Fairness: Esri has long upheld the principles of fairness, ethics, and societal responsibility in its everyday practices. These core values are embedded in our approach to decision-making, product development, and community engagement.

Reliability: Our AI is carefully tested and validated to deliver consistent and dependable results across diverse environments and use cases.

Accountability: We maintain accountability by establishing clear governance frameworks, holding our teams responsible for AI deployment and monitoring, ensuring human oversight remains central to all AI-related decisions.

2

ArcGIS AI Transparency Card - Business Analyst Assistant

Section	Description	Response
Product - Name	ArcGIS product name (links to doc)	ArcGIS Business Analyst Web App
Product - Certification	Certification status of the ArcGIS Product	In-Progress 2025 - FedRAMP Moderate
Product - Deployment	Deployment model of the product.	SaaS
Name	AI feature name in the product. (links to doc)	Business Analyst Assistant
Purpose	Actions AI feature is expected to perform within the product.	In-app productivity tool that uses AI to recommend popular workflows, data, infographic reports, and tips. It provides intelligent suggestions and understands geographic context through prompts or search queries.
Release Status	Release status of AI feature	Beta
Certification	Certification status of AI feature or its subprocessors	None
Deployment	AI feature provided via what deployment model.	Software as a Service (SaaS)
Management	How AI feature can be enabled or disabled?	Opt-in by AGO Administrator
Management – Feedback	Can/how user AI feedback be enabled or disabled?	Opt-in by User
Management - Telemetry	How user AI telemetry data can be enabled or disabled?	Required (Telemetry data is collected)
Prompt Stored	Are prompts submitted to the AI stored?	Not by default (only when feedback provided), Retention: 2 years, Storage Purpose: Specific Improvement
Response Stored	Are AI-generated responses stored?	Not by default (only when feedback provided), Retention: 2 years, Storage Purpose: Specific Improvement
Personal Data	Is personal data in training, testing, or validation datasets?	No
Processing Location	Where data is processed across the product, feature, and LLM levels, including details on any subprocessors.	**Product**: AGO Infrastructure, **Feature**: AGO Infrastructure, **LLM**: AGO Infrastructure, no LLM subprocessors.
Intended Users	Primary intended users of the AI feature	Administrators, GIS Analyst
Out-of-Scope Uses	Scenarios AI feature may not perform accurately or reliably	Guidance beyond the geospatial domain. English language only.
Key Function	Key capabilities and how the AI feature enhances workflows.	Augment – workflow guidance by entering natural language prompts
Model Type & Technique	AI model type and technique	Generative AI
Model Used	Specific model(s) used, such as GPT-4, T5, etc.	Mistral-7B-Instruct-v0.2
Model License	License of AI model powering the AI feature.	Open Source
Training Data Sources	Esri data sources used for development of AI feature.	Open Source

Business Analyst Assistant Version 1.1 – Feb 2025 Page 1 of 2

Human-in-the-Loop	Indicate if users can review or modify AI-generated outputs.	Yes, users can review, refine, and modify AI-generated outputs from the ArcGIS Business Analyst Assistant before taking any final actions, ensuring full user control and alignment with specific business or geographic analysis needs.
Input/Output Formats	Input and output formats that the AI feature can handle.	User input in plain text. No text from LLM is passed to user. LLM is only used for intent detection to provide suggestions on how to use the Business Analyst Web app.
Bias/Ethical Mitigations	Detail how biases are managed, especially in the data.	The assistant uses LLMs to understand user intent but not to generate text for users. It provides Business Analyst-specific recommendations, restricting outputs to relevant content only. LLM-generated text is not shown to users.

Vom Assistenten zum Agenten...

LLMs vereint mit Skill Functions

AI Framework

Skills

Werkzeuge

Daten

Dienste

Vortrainierte Modelle

LLMs

Produktivität steigern und GIS-Aufgaben vereinfachen

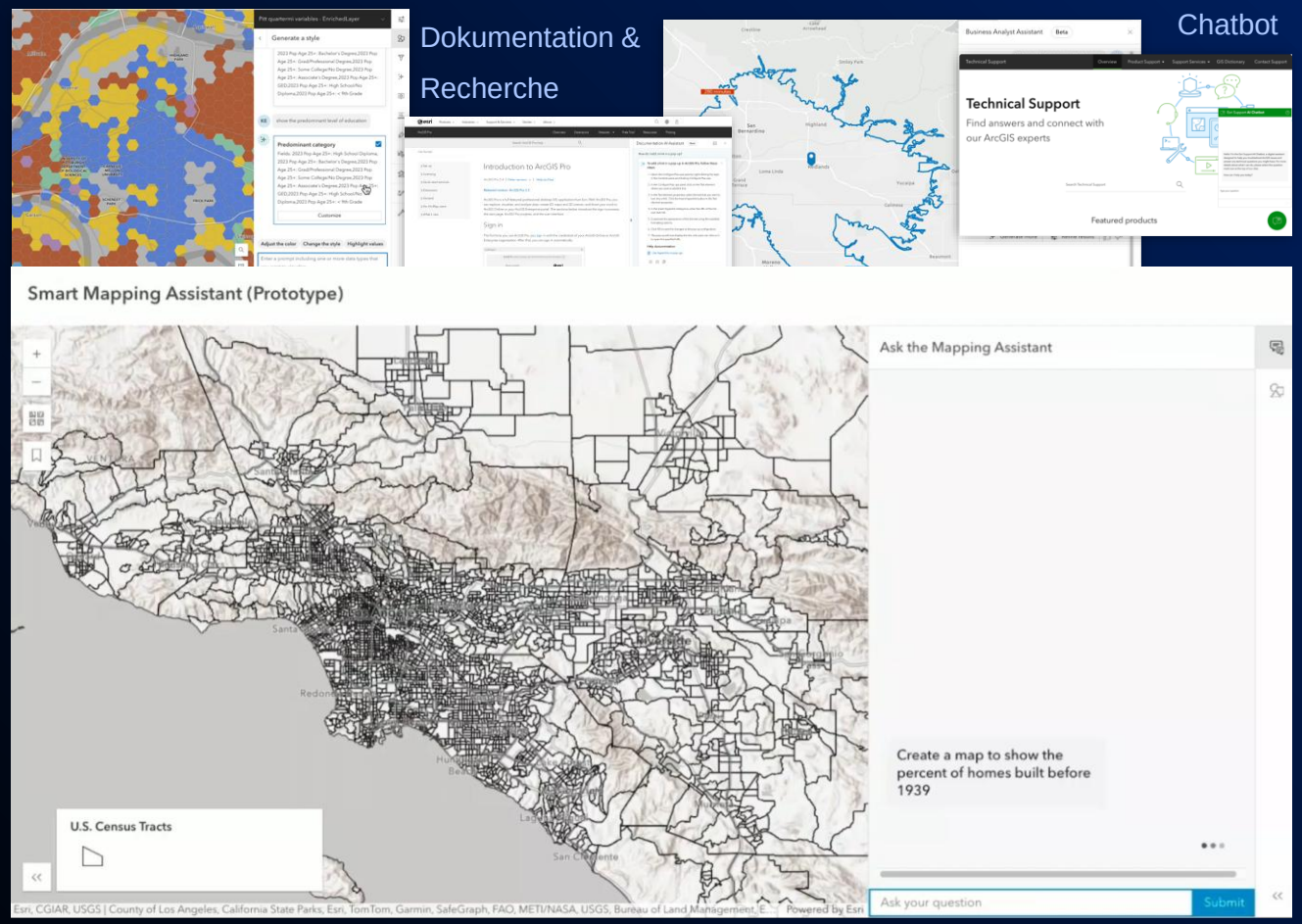
KI-Assistenten

Mapping

Dokumentation & Recherche

Fragen beantworten

Technischer Support Chatbot



Smart Mapping Assistant

Vielen Dank! – Ihre Fragen?

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