



OpenGeoHUB

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AI-technologie: wat het is en wat het niet is, en hoe het ons (potentieel) kan helpen



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dangl



<https://opengeohub.org>

OpenGeoHub projects



AI 4 Soil Health

Accelerating collection and use of soil health information using AI technology to support the Sustainable Development Deal for Europe and EU Soil Observatory

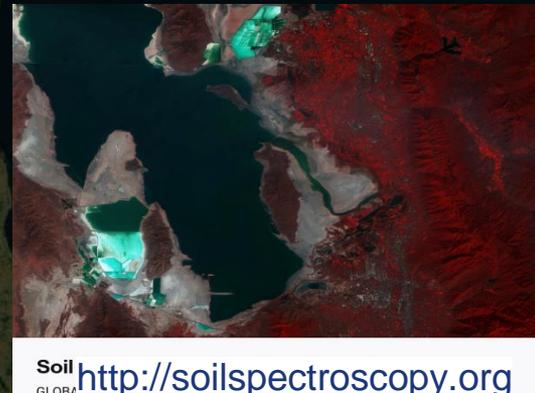
<https://ai4soilhealth.eu>



Global Pasture Watch

Mapping & monitoring Global Grasslands and Livestock

<https://landcarbonlab.org>



Soil GLOBE

<http://soilspectroscopy.org>



OPEN EARTH MONITOR

Cyberinfrastructure to accelerate the uptake of environmental information and to build users communities at the European and global level

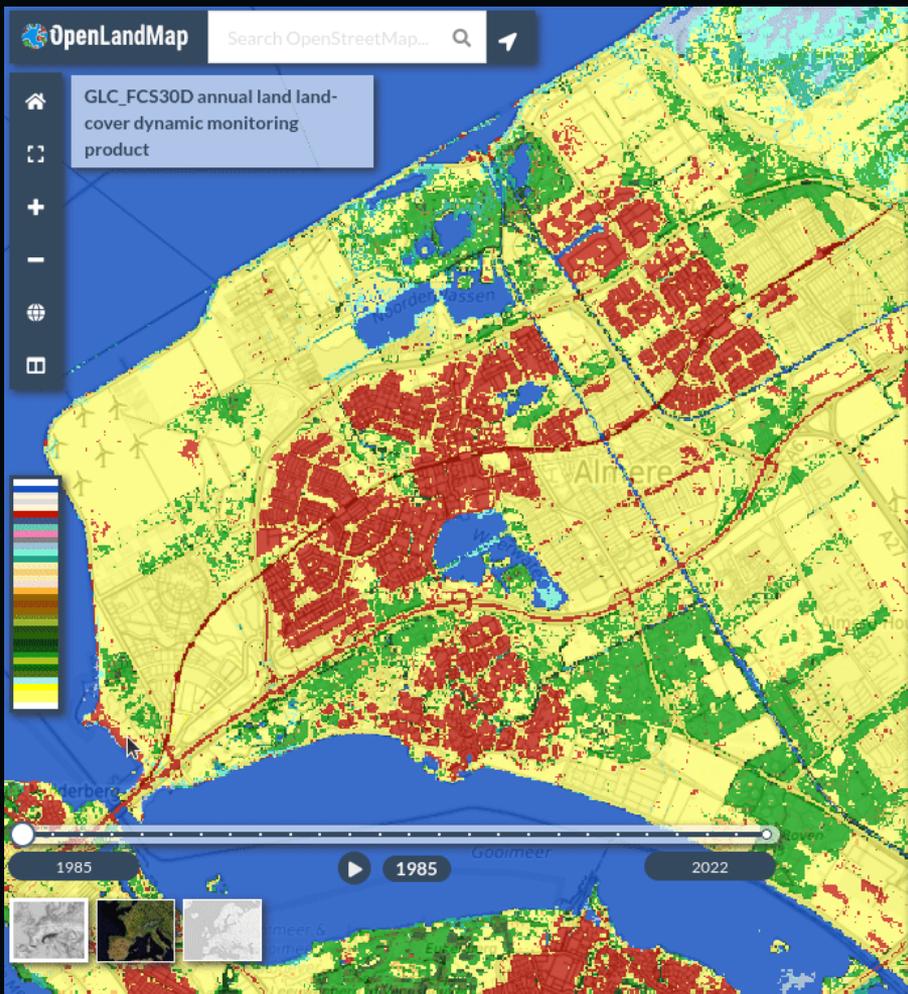
<http://earthmonitor.org>



AgriCapture CO₂

Regenerating soils for climate and farmers

<https://agricaptureco2.eu>



Themes and datasets

Search datasets...

Opacity

Legend

Elevation and Depth

Geology and Soils

Orthoimagery

Land Cover and Land Use

HILDA+ (Historic Land Dynamics Assessment+) global dataset indicates annual land use/cover change between 1960-2019 at 1 km spatial resol...
[Read more](#) [Metadata & Download](#)

GLC_FCS30D annual land land-cover dynamic monitoring product
GLC_FCS30D is the first global fine land cover dynamic product at a 30-meter resolution that adopts continuous change detection. It utilizes a ...
[Read more](#) [Metadata & Download](#)

Population Distribution

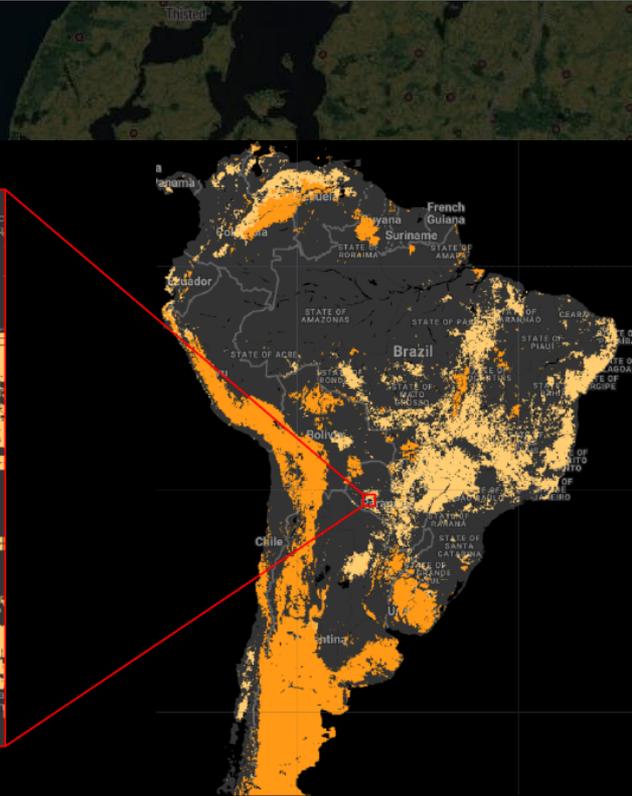
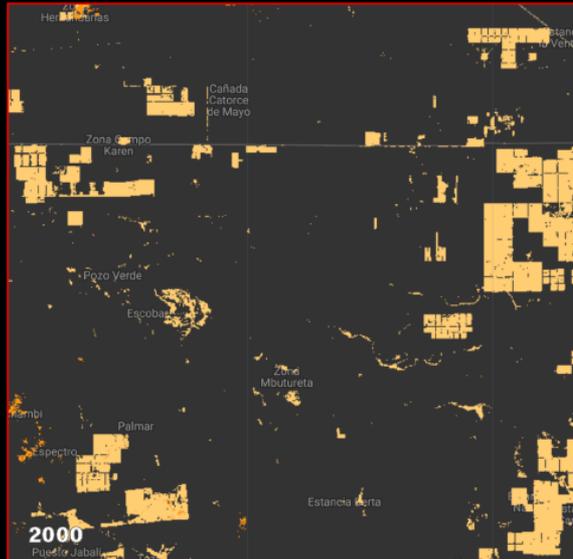
Water

[Read more about themes and layers available](#)
Note: World Mercator projection distort areas

The right-hand panel of the interface is titled 'Themes and datasets'. It features a search bar and an opacity slider. A list of themes is shown, with 'Land Cover and Land Use' selected. Two dataset entries are visible: 'HILDA+' and 'GLC_FCS30D'. The 'GLC_FCS30D' entry is selected with a radio button and includes a brief description and links for 'Read more' and 'Metadata & Download'. Below the list, there are sections for 'Population Distribution' and 'Water'. At the bottom, a link to 'Read more about themes and layers available' is provided, along with a note about the World Mercator projection.

Wij zijn ons aan het voorbereiden een enorme datakubus met wereldwijde gegevens (gestapelde COG's).

Op deze manier kunnen gebruikers delen van gegevens openen, visualiseren, vergelijken en downloaden (zonder de noodzaak van GEE of iets dergelijks).



We hebben ons eigen exemplaar van het Landsat-archief (1.4PB) voor de periode 1997-2024 en kunnen veranderingen van maandelijks tot jaarlijks modelleren voor waar ook ter wereld



Land potential assessment and trend-analysis using 2000–2021 FAPAR monthly time-series at 250 m spatial resolution

Julia Hackländer^{1,2}, Leandro Parente¹, Yu-Feng Ho¹, Tomislav Hengl¹, Rolf Simoes¹, Davide Consoli¹, Murat Şahin¹, Xuemeng Tian^{1,2}, Martin Jung³, Martin Herold^{2,4}, Gregory Duveiller⁵, Melanie Weynants⁵ and Ichsani Wheeler¹

- ¹ OpenGeoHub, Wageningen, Netherlands
- ² Wageningen University and Research, Wageningen, Netherlands
- ³ Biodiversity, Ecology and Conservation Research Group, International Institute for Applied Systems Analysis (IIASA), Laxenburg, Austria
- ⁴ Helmholtz GFZ German Research Centre for Geosciences, Remote Sensing and Geoinformatics, Potsdam, Germany
- ⁵ Max Planck Institute for Biogeochemistry (MPI-BGC), Jena, Germany

These cannot be changed:

- Any authorship information including author order, co-first and corresponding authorships.
- The content and order of the affiliations. None may be removed or added.

Please only ANNOTATE the proof. Do not edit the PDF. If multiple authors will review this PDF, please return one file containing all corrections.

ABSTRACT

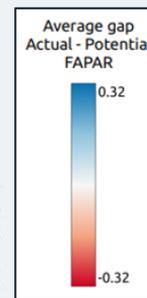
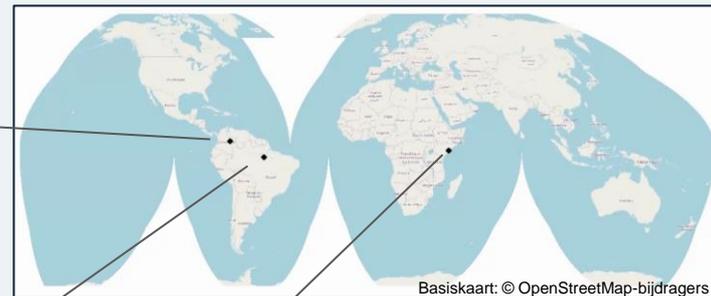
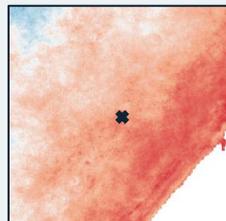
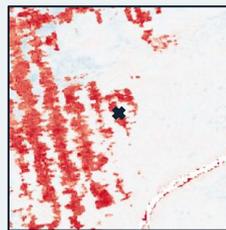
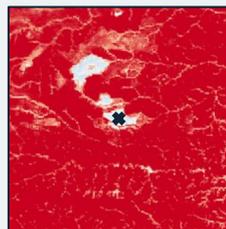
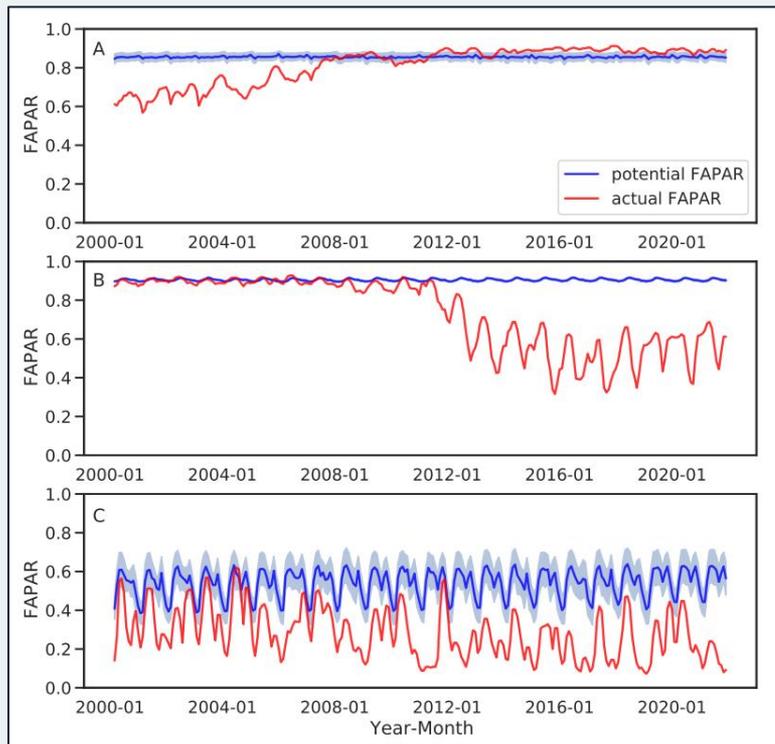
The article presents results of using remote sensing images and machine learning to map and assess land potential based on time-series of potential Fraction of Absorbed Photosynthetically Active Radiation (FAPAR) composites. Land potential here refers to the potential vegetation productivity in the hypothetical absence of short-term anthropogenic influence, such as intensive agriculture and urbanization. Knowledge on this ecological land potential could support the assessment of levels of land degradation as well as restoration potentials. Monthly aggregated FAPAR time-series of three percentiles (0.05, 0.50 and 0.95 probability) at 250 m spatial resolution were derived from the 8-day GLASS FAPAR V6 product for 2000–2021 and used to determine long-term trends in FAPAR, as well as to model potential FAPAR in the absence of human pressure. CCA 3 million training points sampled from 12,500 locations across the globe were overlaid with 68 bio-physical variables representing climate, terrain, landform, and vegetation cover, as well as several variables



Landdegradatie kan worden gekwantificeerd op basis van tijdreeksen van geharmoniseerde beelden van biofysische variabelen (FAPAR, kale bodemindex, GPP en dergelijke).

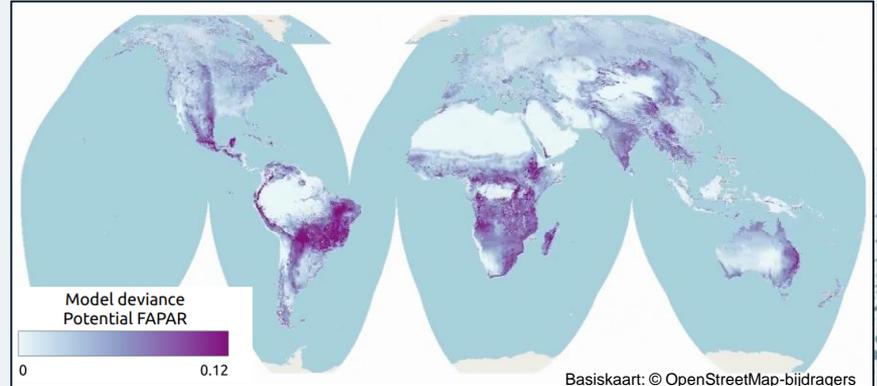
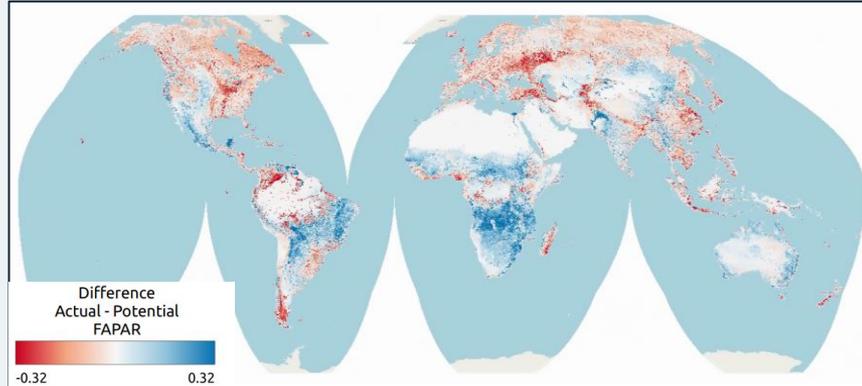
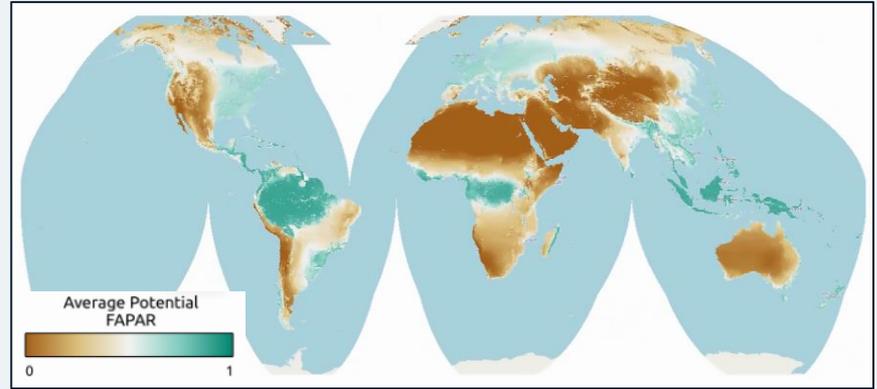
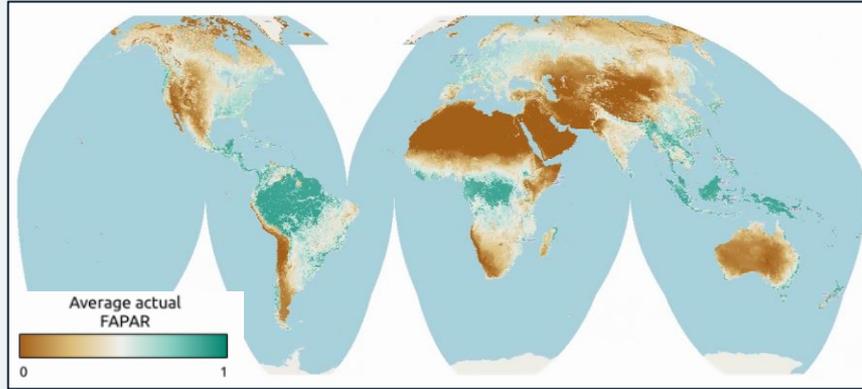
Voorbeelden op lokaal niveau

Gezondheid van
het ecosysteem



Mondiale kaarten van feitelijke versus potentiële FAPAR

Gemiddelden van het jaar 2021



Basiskaart: © OpenStreetMap-bijdragers

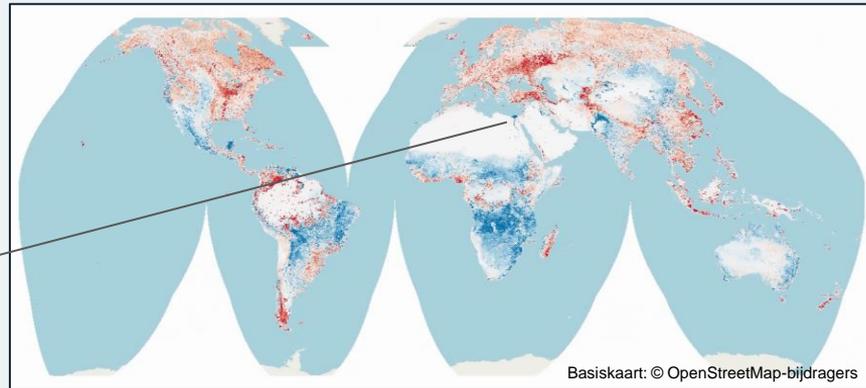


Mondiale kaarten van feitelijke versus potentiële

FAPAR van het jaar 2021



Nijl gebied



AI technology: what it is and what it's not, and how it can (potentially) help us solve the climate crisis

 OpenGeoHub
33 min read · Aug 25, 2023

21     

Prepared by: [Tom HengL \(OpenGeoHub\)](#), [Davide Consoli \(OpenGeoHub\)](#), [Marina Bagic \(FER\)](#), [Luca Brocca \(CNR\)](#), and [Martin Herold \(GFZ\)](#).

AI (Artificial Intelligence) technology, with the launch of OpenAI's ChatGPT (the fastest growing app ever) and similar, is now a buzz: a new technological jump of the human race, but potentially a Pandora box for information manipulation and misuse. AI could soon replace thousands of jobs and revolutionize how we travel (self-driving cars), purchase items, do admin/office work, communicate with computers (and people), but also how governments fight wars and control people. AI is making a lot of people enthusiastic, but even more nervous. We review the potentials and perils of AI tech; how it can also help us with extremely important things such as solving the climate crisis and better monitoring and conservation of natural resources. Links and references are extensive and hopefully will motivate you to read more on the topic.

Wat is AI?

"De wetenschap en techniek van het maken van intelligente machines, vooral intelligente computerprogramma's."

Zelfrijdende auto's, gezichtsherkenningsoftware en hulpmiddelen voor medische diagnose.

Wat AI niet is

[AI is geen magie: het is een hulpmiddel dat kan worden gebruikt om problemen op te lossen, maar het is geen wondermiddel.](#)

AI is niet bewust: het heeft geen bewustzijn of zelfbewustzijn.

AI is niet altijd accuraat: het kan fouten maken, net als mensen.

3 belangrijke niveaus van AI



Machine Learning



Narrow Artificial Intelligence (ANI)

Stage One: Machines imitate human behavior, specializing in one area to solve a problem.

i.e. Siri, ChatGPT, Alexa

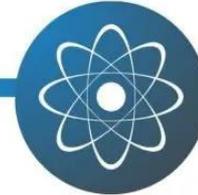
Machine Intelligence



Artificial General Intelligence (AGI)

Stage Two: Machines can continuously learn and are as smart as humans.

Machine Consciousness



Artificial Super Intelligence (ASI)

Stage Three: Machines that are smarter than humans across the board.



Een AGI-machine presteert in de meeste dingen beter dan mensen.
Het kan complexe problemen oplossen.

**World Models
+ Symbolic Reasoning
+ LLMs**

use LLMs as a tool, not the other way round.
And it'll probably take at least 5 years.

6:57 / 9:24

De wet van Moore

1 The accelerating pace of change ...



2 ... and exponential growth in computing power ...

Computer technology, shown here climbing dramatically by powers of 10, is now progressing more each hour than it did in its entire first 90 years

COMPUTER RANKINGS
By calculations per second per \$1,000



Analytical engine
Never fully built, Charles Babbage's invention was designed to solve computational and logical problems



Colossus
The electronic computer, with 1,500 vacuum tubes, helped the British crack German codes during WW II



UNIVAC I
The first commercially marketed computer, used to tabulate the U.S. Census, occupied 943 cu. ft.

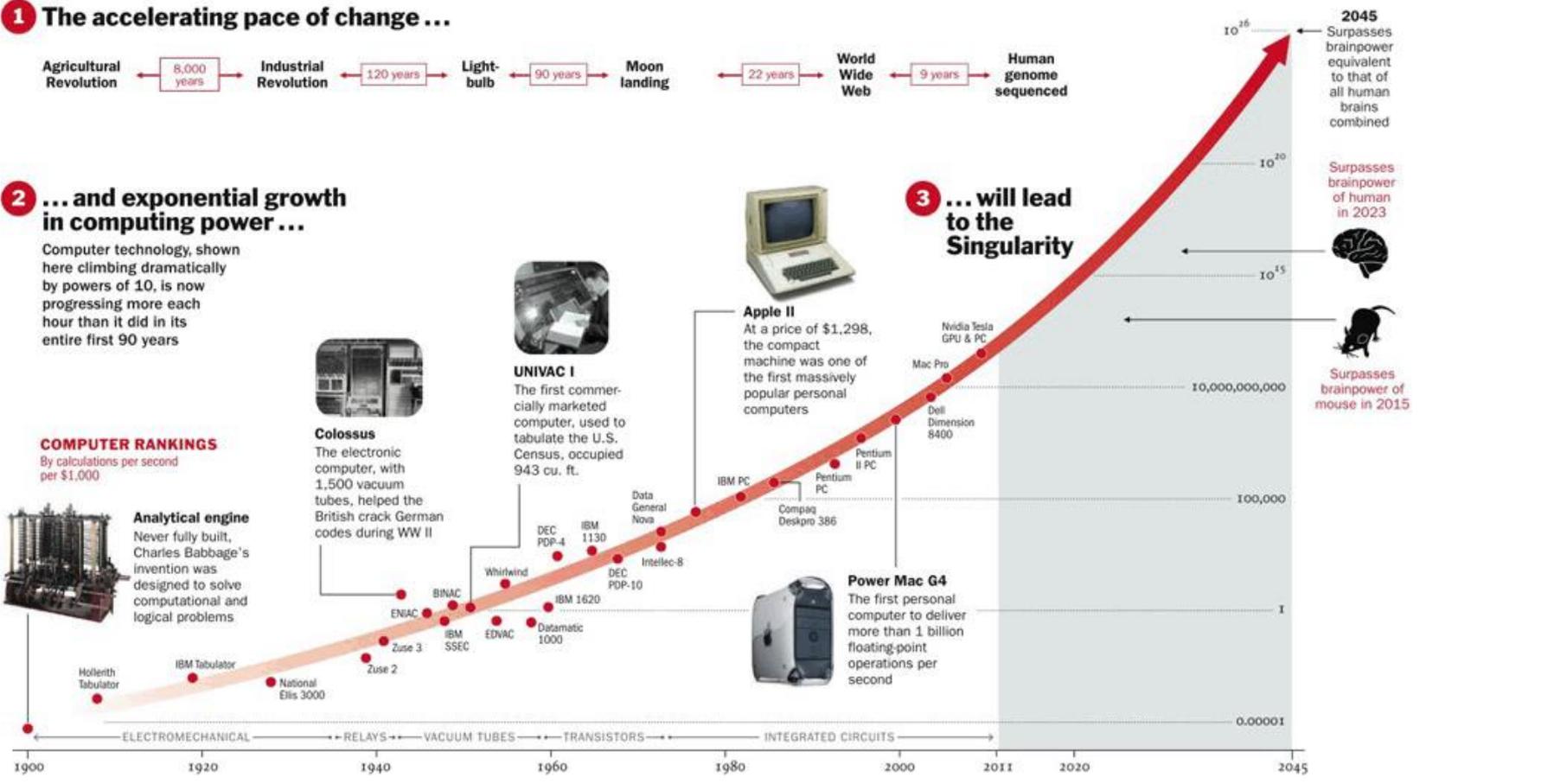
3 ... will lead to the Singularity



Apple II
At a price of \$1,298, the compact machine was one of the first massively popular personal computers



Power Mac G4
The first personal computer to deliver more than 1 billion floating-point operations per second



Earth Observation (EO) / hyper-spectral imaging

Blockchain

Robotics

Nanotechnology and nanobots

LiDAR technology: “light detection and ranging”

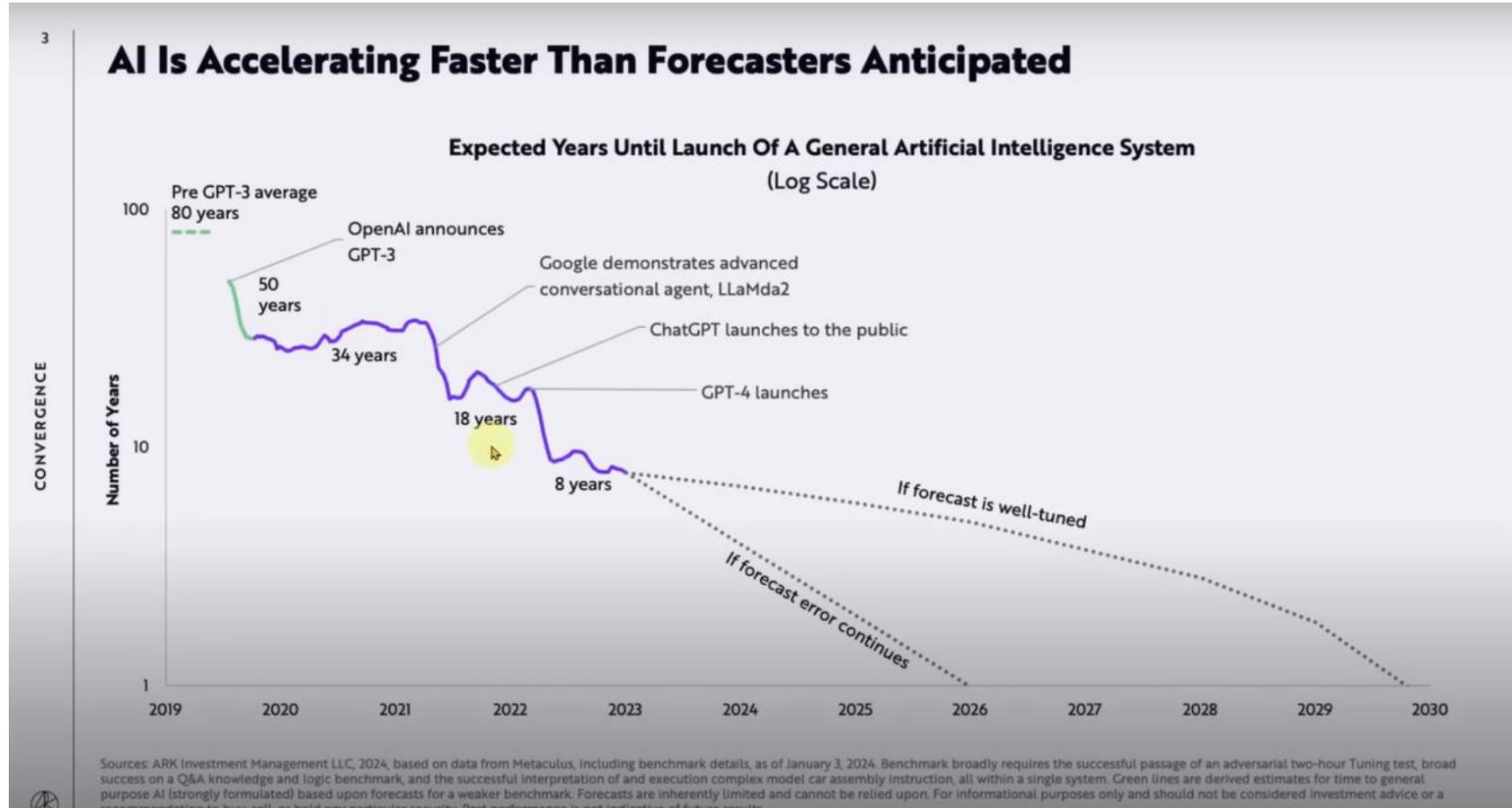
Super-high-speed internet: especially thanks to fiber-optic cable technology

Internet-of-things (IoT)

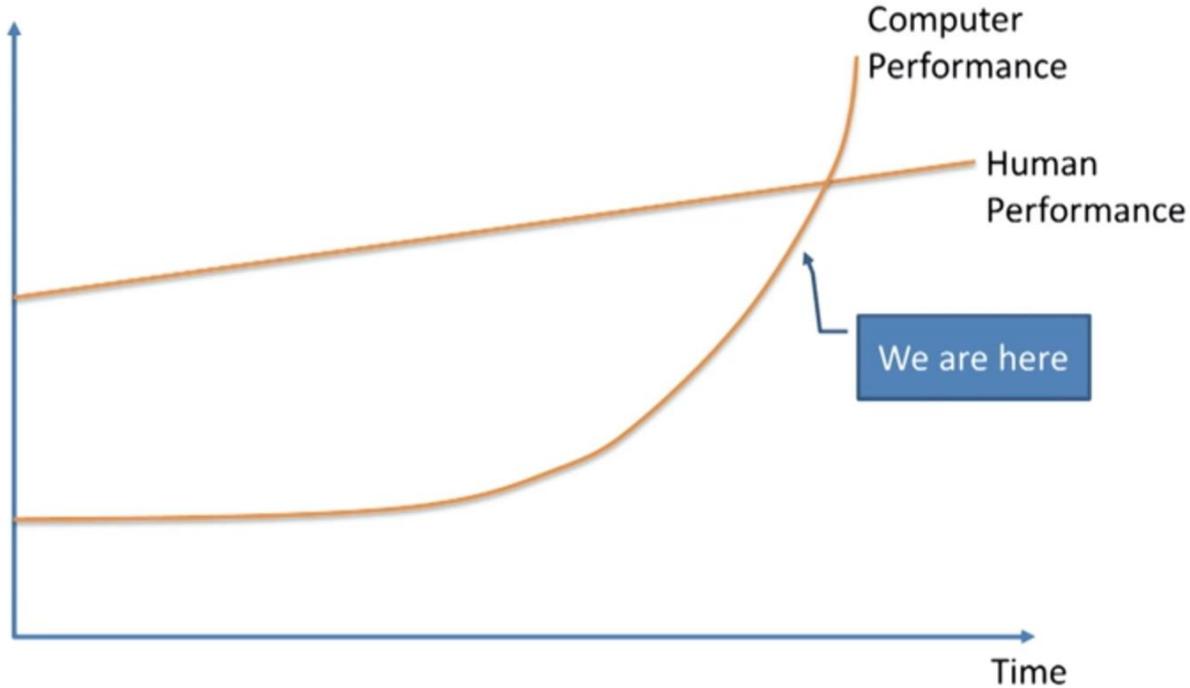
Laser technology

Quantum computing

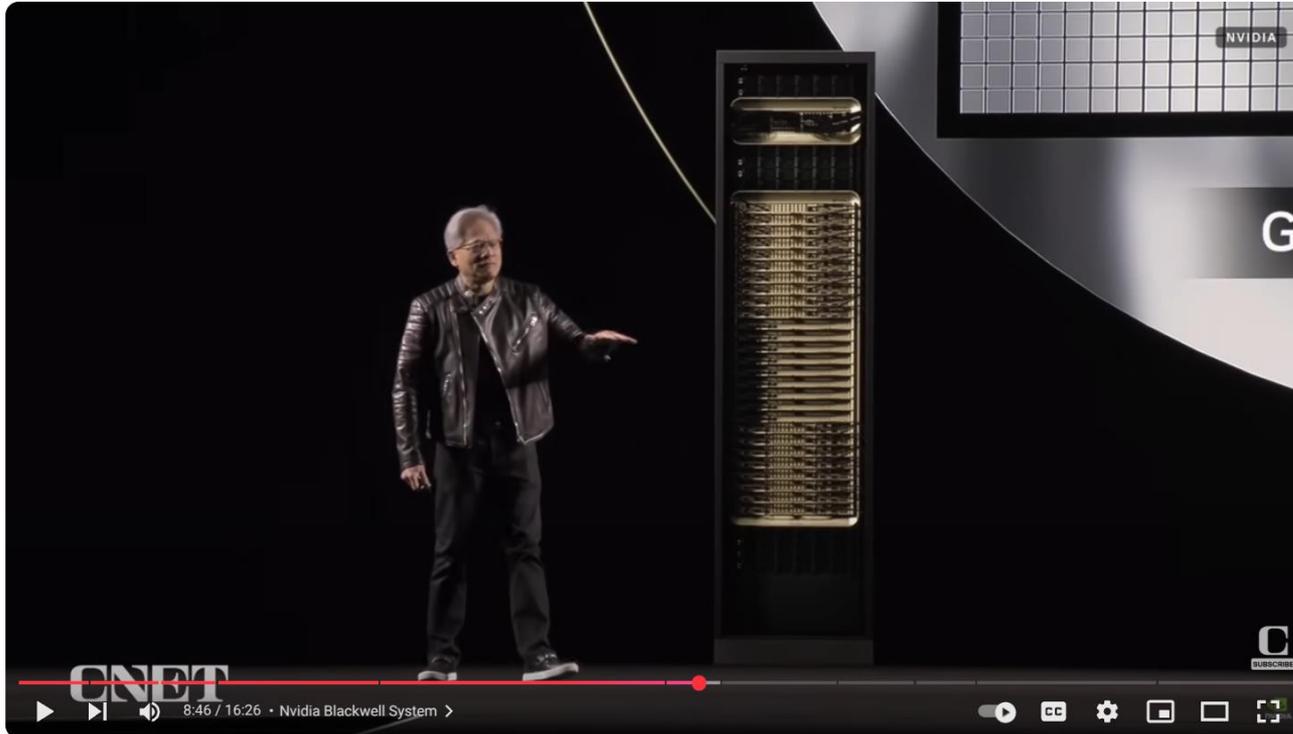
AGI binnen 2-6 jaar?



We are here!



De evolutie van AI van ML naar AGI lijkt langzaam te verlopen, maar **het is in werkelijkheid de synergie van verschillende technologische doorbraken die ons zouden kunnen verrassen.** Stel je een doorbraak voor in het begrijpen van hoe het menselijk brein werkt (gebaseerd op cellulaire biologie, celfysica, complexe systeemwetenschap) gecombineerd met nanotechnologie, supersnel netwerk en kwantumcomputers, allemaal binnen de komende tien jaar. Dergelijke parallelle doorbraken en synergieën tussen onze softwareontwikkelingsvaardigheden, computervaardigheden en levensnabootsende vaardigheden zouden de evolutie van AGI in de orde van grootte kunnen versnellen, maar het is niet iets dat automatisch gebeurt of zonder innovatiegenieën die in staat zijn om alle punten met elkaar te verbinden.



1 exaflops super computer in 1 rack!

An exaflop is a measure of performance for a supercomputer that can calculate at least 10^{18} or one quintillion floating point operations per second.

- **Begin 2010:** Ontwikkeling van fundamentele technieken zoals neurale netwerken en deep learning.
- **2018:** Introductie van GPT-1, een belangrijke stap in de evolutie van grote taalmodellen.
- **2019:** Uitgave van GPT-2, die verbeterde mogelijkheden demonstreert bij het genereren en begrijpen van tekst.
- **2020:** GPT-3 wordt uitgebracht en toont opmerkelijke vaardigheden in verschillende taken, waaronder creatief schrijven, vertalen en het genereren van code.
- **2022: ChatGPT**, gebaseerd op GPT-3, wordt breed toegankelijk en brengt een revolutie teweeg in de interactie tussen mens en AI.
- **2023:** Google introduceert **Gemini**, een multimodaal AI-model dat tekst, code en afbeeldingen kan begrijpen.
- **2025: DeepSeek** is een Chinees bedrijf op het gebied van kunstmatige intelligentie (AI) dat in januari 2025 internationale bekendheid verwierf na de release van zijn mobiele chatbot

Belangrijke overwegingen:

- **Ethische implicaties:** Naarmate AI-modellen krachtiger worden, is het van cruciaal belang om ethische problemen zoals vooroordelen, verkeerde informatie en mogelijk misbruik aan te pakken.
- **Transparantie en verantwoording:** Ontwikkelaars moeten streven naar transparantie bij de ontwikkeling en inzet van AI-modellen.
- **Menselijk toezicht:** Menselijk toezicht is essentieel om ervoor te zorgen dat AI op een verantwoorde en ethisch verantwoorde manier wordt gebruikt.

AI kan nu heel gekke dingen doen...

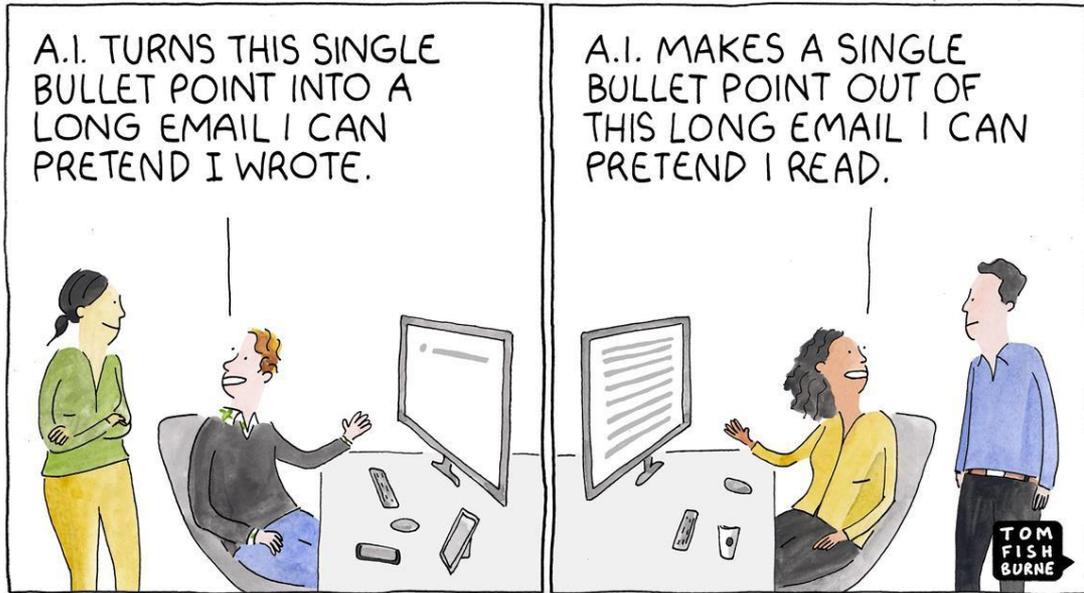


Generate

Download



More silly effects of AI

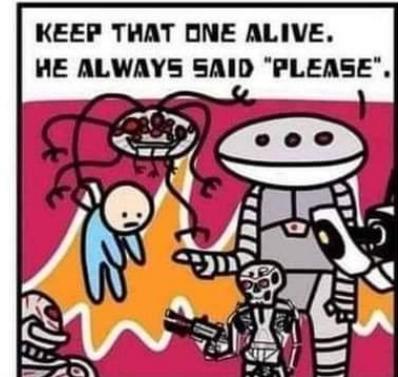
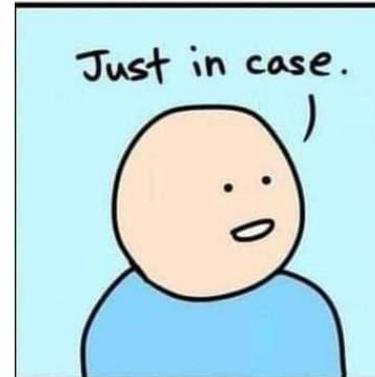


Zal AI snel wakker worden?

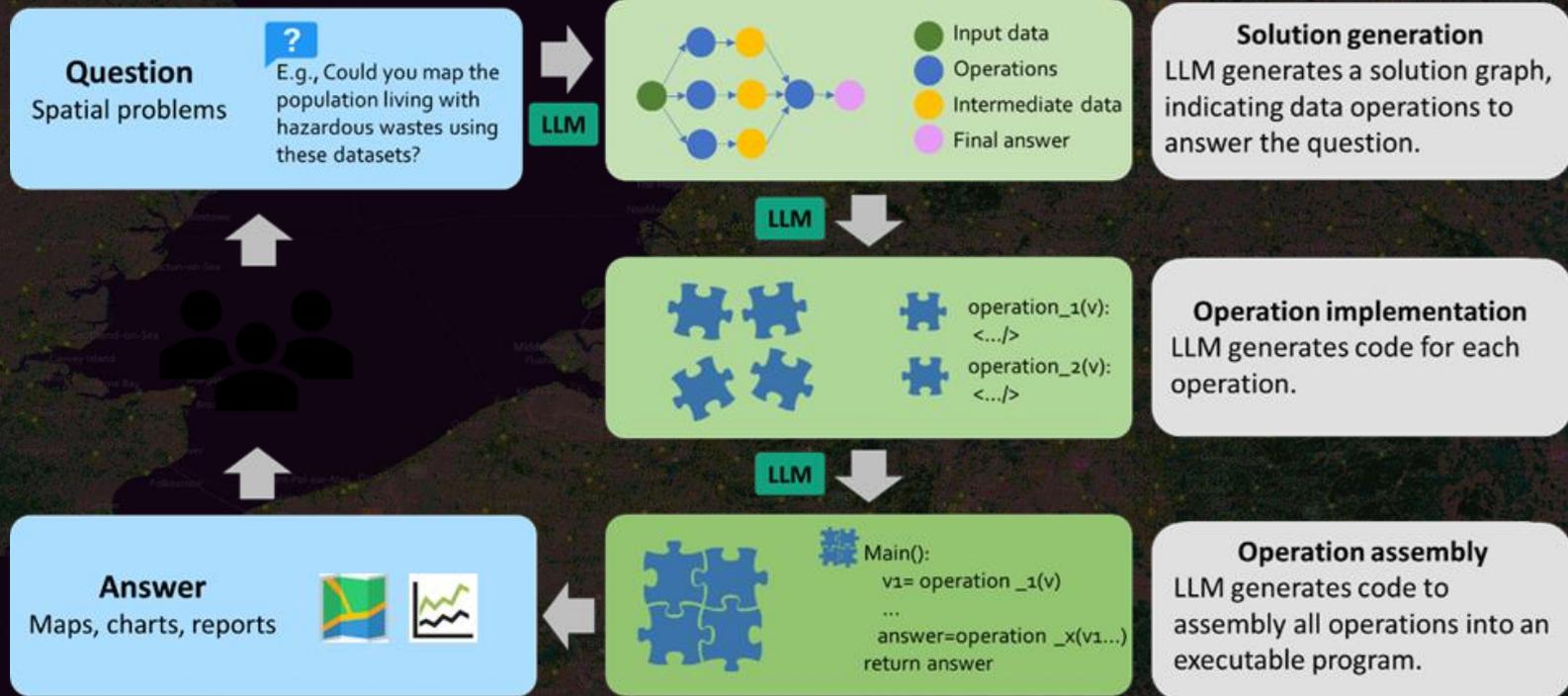


“In de nabije toekomst zullen computers niet in staat zijn mensen te evenaren in hun vermogen om abstract te redeneren over situaties in de echte wereld... We moeten begrijpen dat het intelligente gedrag van grootschalige systemen evenzeer voortkomt uit de interacties tussen agenten als uit de intelligentie van individuele agenten.” (Michael I. Jordan)

"Het is moeilijk om niet 'AI' te zeggen als iedereen dat ook doet, maar technisch gezien is het AI kopen in de marketing. Er is daar geen intelligentie, en het zal niet bewust worden. Het zijn alleen maar statistieken, en het gevaar dat ze opleveren komt vooral voort uit het valse gevoel van vaardigheid of geschiktheid voor het doel dat mensen aan hen toeschrijven"
(Eugen Rochko)



Li & Ning (2023): Autonomous GIS: the next-generation AI-powered GIS



Chat2Geo



#	Analysis Type	Description
1	Urban Heat Island (UHI) Analysis	Evaluates temperature variations in urban areas compared to rural surroundings.
2	Land-Use/Land-Cover Mapping	Uses Google DynamicWorld to classify land cover types.
3	Land-Use/Land-Cover Change Mapping	Detects changes in land use over time using Google DynamicWorld.
4	Air Pollution Analysis <i>(Not fully implemented)</i>	Analyzes air pollution patterns and trends.



Project description



AI-based soil health assessment tools put to the test

The European Commission has set an ambitious goal of transitioning towards healthy soils by 2030. As such, it is important to assess and monitor soil health metrics. The EU-funded AI4SoilHealth project will co-design, create and maintain an open access Europe-wide digital infrastructure founded on advanced AI methods combined with new and deep soil health understanding and measures. The AI-based data infrastructure will evolve a Soil Digital Twin. The project will deliver a coherent Soil Health Index methodology, Rapid Soil Health Assessment Toolbox, AI4SoilHealth Data Cube for Europe, Soil-Health-Soil-Degradation-Monitor, and AI4SoilHealth API and mobile phone app. AI4SoilHealth will test the tools, collecting feedback from target users.

Show the project objective

Fields of science (EuroSciVoc)

[natural sciences](#) > [computer and information sciences](#) > [artificial intelligence](#)
[engineering and technology](#) > [electrical engineering](#), [electronic engineering](#), [information engineering](#) > [information engineering](#) > [telecommunications](#) > [mobile phones](#)

Suggest new fields of science

Project Information

AI4SoilHealth
Grant agreement ID: 101086179

DOI
[10.3030/101086179](https://doi.org/10.3030/101086179)

EC signature date
21 November 2022

Start date	End date
1 January 2023	31 December 2026

Funded under
Food, Bioeconomy Natural Resources, Agriculture and Environment

Total cost
€ 9 960 358,50

EU contribution
€ 9 960 357,50

Coordinated by
AARHUS UNIVERSITET
 Denmark

What exactly is soil health? (AND what it is not)

“the capacity of the soil complex system to support the functions of a plethora of living beings and, on the other hand, to exchange matter and energy with a series of abiotic components of the environment such as the atmosphere, hydrosphere, and geosphere” [ScienceDirect](#)

How is soil health **related to** “soil fertility”, “soil suitability”, “soil quality”?

At the moment if somebody asks “what is soil health?” the answer is: “It is whatever you want it to be” — this needs to be changed!

The econometrics of soil health

“Soil health is holistic and multidimensional, eclipsing mere soil fertility”

<https://doi.org/10.1016/j.foodpol.2018.08.005>



Food Policy
Volume 80, October 2018, Pages 1-9



Review

Review: The economics of soil health ☆

[Andrew W. Stevens](#) ✉

Show more ▾

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<https://doi.org/10.1016/j.foodpol.2018.08.005> [Get rights and content](#) ↗

Highlights

- Soil health is holistic and multidimensional, eclipsing mere soil fertility.
- Optimal control models are well-suited to study the economics of soil health.
- Economic studies of soil health can inform evidence-based soil management policies.
- Effective policymaking requires collaboration between soil scientists and economists.

Soil Health Index

Comprehensive Assessment of Soil Health

From the Cornell Soil Health Laboratory, Department of Soil and Crop Sciences, School of Integrative Plant Science, Cornell University, Ithaca, NY 14853. <http://soilhealth.cals.cornell.edu>

Grower:
Kirsten Kurtz
306 Tower Rd.
Ithaca, NY 14853

Sample ID: LL88
Field ID: Moldboard field
Date Sampled: 05/01/2015
Coordinates: Latitude: 42.447900000000
Longitude: 76.475700000000

Agricultural Service Provider:
Mr. Bob Consulting
rrs3@cornell.edu

Measured Soil Textural Class: **silt loam**

Sand: **37%** - Silt: **53%** - Clay: **10%**

Group	Indicator	Value	Rating	Constraints
physical	Available Water Capacity	0.15	43	
physical	Surface Hardness	103	76	
physical	Subsurface Hardness	290	53	
physical	Aggregate Stability	14.8	18	Aeration, Infiltration, Rooting, Crusting, Sealing, Erosion, Runoff
biological	Organic Matter	2.9	45	
biological	ACE Soil Protein Index	3.5	18	Organic Matter Quality, Organic N Storage, N Mineralization
biological	Soil Respiration	0.4	24	
biological	Active Carbon	430	35	
chemical	Soil pH	6.9	100	
chemical	Extractable Phosphorus	4.5	100	
chemical	Extractable Potassium	67.8	93	
chemical	Minor Elements Mg: 419.0 / Fe: 1.1 / Mn: 12.9 / Zn: 1.9		100	

Overall Quality Score: **59 / Medium**



Very Low Aggregate Stability
(poor soil structure)
(High priority)

Very Low ACE Soil Protein Index
(High priority)

Low Respiration
(Consider improving)

Low Active Carbon
(Consider improving)

Step 3. Constraints Identified, Explained and Prioritized

- Continuous tillage, corn monoculture, and lack of diverse organic inputs have degraded the biological functioning of this soil
- Identified constraints suggest that priority should be given to improving biological functioning, while maintaining and improving physical functioning is also desired

FIGURE 3.03. Example report of measured indicator ratings that identify soil health constraints. For a full sized report see page 73 and Appendix A.

FICHA DE CAMPO

Nombre de la parcela:
Coordenadas (latitud/longitud):
Fecha:

Temperatura del suelo:
Temperatura ambiente:
Días desde última lluvia significativa:

Servicio	Indicadores	Resultado	Mal 0 < 3	Regular 3 - 7	Bien > 7 - 10	Nota Indicador (0-10)	Nota servicio (0-10)
1. Producción	1.1. Cosecha (g/planta)	8 6 5 Media: 6'3	Ver pág. 6	Ver pág. 6	Ver pág. 6	6	6
	1.2. Plagas (% plantas sanas)	75	0 - 45	45 - 85	85 - 100	6	
2. Biodiversidad	2.1. Diversidad de cultivos (nº especies)	5	0 - 3	3 - 7	7 - 10	5	5
	2.2. Diversidad vegetal adyacente (nº especies)	2	1 estrato 1-3 puntos	2 estratos 5 puntos	3 estratos 8-9 puntos	5	
	2.3. Diversidad de macrofauna (nº tipos)	8	0 - 6	6 - 14	14 - 20	5	
3. Suelo	3.1. Biológico - Lombrices (nº)	9	0 - 3 o 10-20	3 - 7 o 10-20	7 - 10	9	6'8
	3.2. Físico - Infiltración (min)	18 15 14 Media: 15'7	60 - 90	30 - 10	10 - 0	4	
	3.3. Físico - Compactación (cm)	13 10 7 Media: 10	0 - 10	10 - 20	20 - 40	3	
	3.4. Químico - Acidez (pH)	7	< 4.5 o > 9	4.5 - 5.5 o 8 - 9	5.5 - 8	10	
	3.5. Químico - Pesticidas (uso)	8	0 - 3	3 - 7	7 - 10	8	
	3.6. Químico - Materia orgánica (reacción/color)	6 8 Media: 7	Ninguno Falso	Débil Medio	Fuerte Oscuro	7	
4. Cambio Climático	4.1. Materia orgánica (reacción/color)	7	Ninguno Falso	Débil Medio	Fuerte Oscuro	7	6
	4.2. Sistema de producción (gana vs pierde C)	Inicial: 5 Laboreo: 0 Abonado: +1 Restos: 0 Suelo: 0 Destino: -1 Final: 5	0 - 3	3 - 7	7 - 10	5	
<p>* Aclaración: Se entiende que en la columna "Regular" los valores que determinan el rango también se incluyen dentro. Por ejemplo, en el indicador 1.2. ("Plagas"), si obtienes un resultado de 45, deberás considerarlo como un resultado "Regular" y no "Malo".</p> <p>** Aclaración: Para los indicadores 1.1., 3.2., 3.3. y 3.6., la columna de resultados aparece dividida para anotar cada repetición así como la media de éstas. En el indicador 4.2., se indican los 5 puntos iniciales con los que partes, y seguidamente se distinguen cada práctica en las que debes apuntar "+1", "0" o "-1". Calcula el resultado de la suma/resta en la fila "Final".</p>							NOTA FINAL
							6



Insights from machine learning with MIR spectroscopy in Hawai'i soil health modeling and assessment



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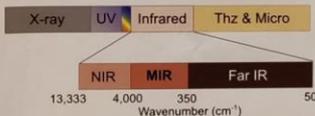
Objective

Determine how accurately we can predict inherent soil health drivers¹ and the Hawai'i soil health score² with MIR spectroscopy and machine-based learning

Methods

Hawai'i Soil Health Database

- 638 samples, 6 islands, 9 soil orders
- Soil health indicators include %TOC, 24 hr CO₂ burst, PMN, WHC, HWEC, pH, Db, Water-stable mega aggregates, α -glucosidase & α -glucosaminidase enzyme activities



Diffuse-Reflectance Fourier Transform Mid-Infrared (FT-MIR) Spectral Library

- Finely ground samples (< 180 μ m; n = 638)
- Bruker Invenio-S with HTS-XT module
- Average of 60 scans, 4 replicates

Spectral Preprocessing

- Raw spectra
- Savitzky-Golay 1st derivative (SG1stDeriv)³
- Standard Normal Variate (SNV)³

Modeling Techniques

- Support Vector Machine (SVM)⁴
- Random Forest (RF)⁵
- Partial Least Squares Regression (PLSR)⁶

Acknowledgements: We express our sincere gratitude to the farmers, ranchers, and land managers who supported this research and allowed access to their lands. We especially thank Fabiola Suclu Zamora and Raquel Aviles for their assistance in processing and managing soil samples for the spectral library. We thank the students, researchers, and extension agents that contributed to the development of the soil health scoring function. **References:** 1. Crow et al., 2023. Frontiers in Environmental Science 10.991262; 2. Maaz et al., 2023. Science of the Total Environment 870.161900; 3. Stevens & Ramirez-Lopez, 2022. R package version 0.2.6; 4. Kuhn, 2008. Journal of Statistical Software, 28(5), 1–26; 5. Liaw & Wiener, 2002. R News, 2(3), 18-22; 6. Mevik & Wehrens, 2007. Journal of Statistical Software, 18(2); 7. Uehara & Gilman, 1985. Soil Sci. 139 (380)

The legacy of intensive land use (e.g., plantation history) is a strong driver of differences in soil health.¹ In Hawai'i and the tropics, variable charge clay mineral abundance is a more influential soil property than texture.⁷

Intensive Land Use History

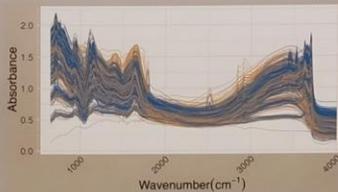


Figure 1: Raw spectral data of samples with intensive land use history (PIAL; blue) and those without (red). PIAL status was predicted to a level of **98% accuracy** (CI 0.93, 1.0) using SG1stDeriv and SVM (80 train/ 20 test split)

Predominant Mineralogy



Figure 2: Heat map of the three major soil mineralogical classes, including High Activity Clays (HAC), Low Activity Clays (LAC), and Poorly & Noncrystalline Minerals (PNCM) with **100% prediction accuracy** (CI 0.97, 1.0) using SG1stDeriv and SVM

Hawai'i Soil Health Score

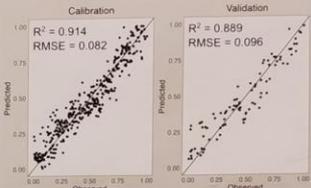


Figure 3: Observed vs. predicted soil health scores of the best PLSR model with SNV preprocessing

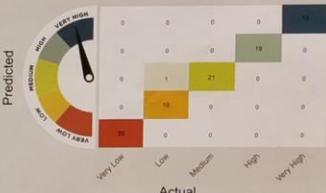


Figure 4: Heat map of binned soil health scores, predicted to a level of **99% accuracy** (CI 0.94, 1.0) with SG1stDeriv and SVM

Next Steps

- Integrate soil microbiome data into the model to accurately and precisely predict soil health indicators, factors, and score
- Identify mineral indicator peaks to mechanically understand model predictions and analytically determine soil weathering intensity based on relative mineral abundance
- Initiate deployment of rapid soil health monitoring program

Hawai'i Soil Health Score

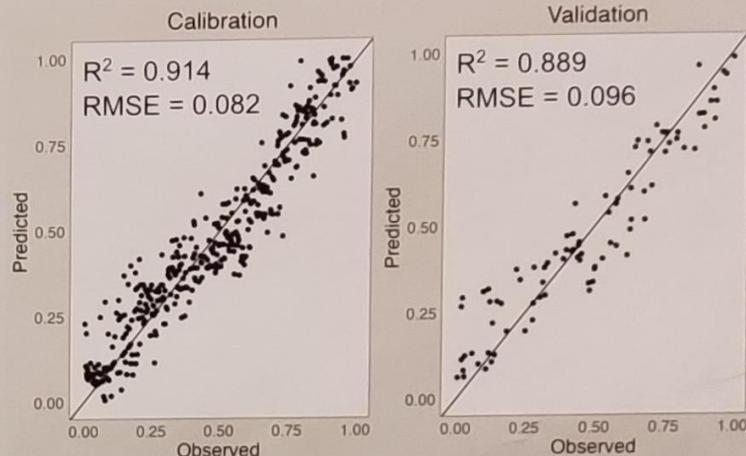


Figure 3: Observed vs. predicted soil health scores of the best PLSR model with SNV preprocessing

Direct to digital approach to soil health assessment

A commonly cited broad definition states that a healthy ecosystem has three attributes:

1. productivity,
2. resilience, and
3. "organization" (including biodiversity).

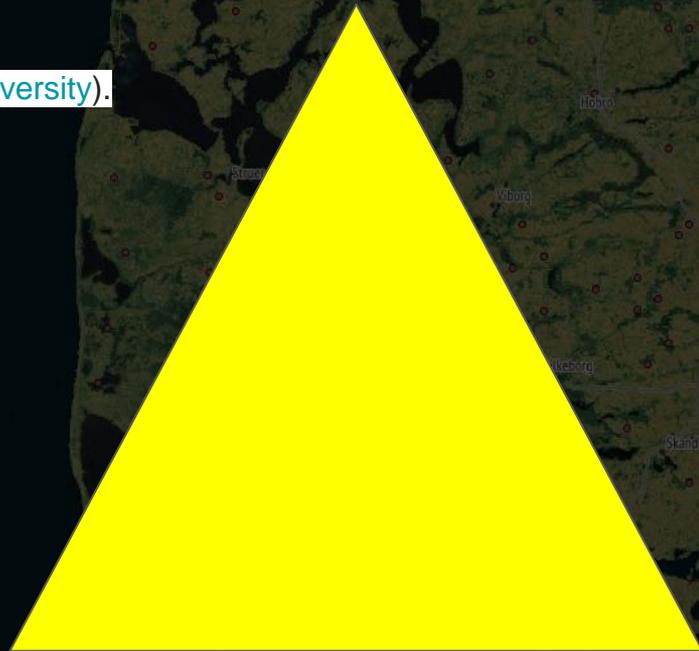
Ecosystem health

soil health

"There is no universally accepted benchmark for a healthy ecosystem, rather the apparent health status of an ecosystem can vary depending upon which health metrics are employed in judging it"

utilization potential:

soil quality
soil fertility



water holding / water filtering capacity;
soil carbon sequestration capacity;
nutrients serving capacity;

soil services

How to engineer soil health?

We need a definition that can be engineered into farming systems, and which reduces confusion and misinterpretation.

(Human) Health definition:

- **Minimum:** Lack of diseases, parasites, sickness...
- **Standard:** High resistance / immunity (persistence to shocks)
- **Optimum:** A system without diseases with high immunity (resilience) running in full capacity

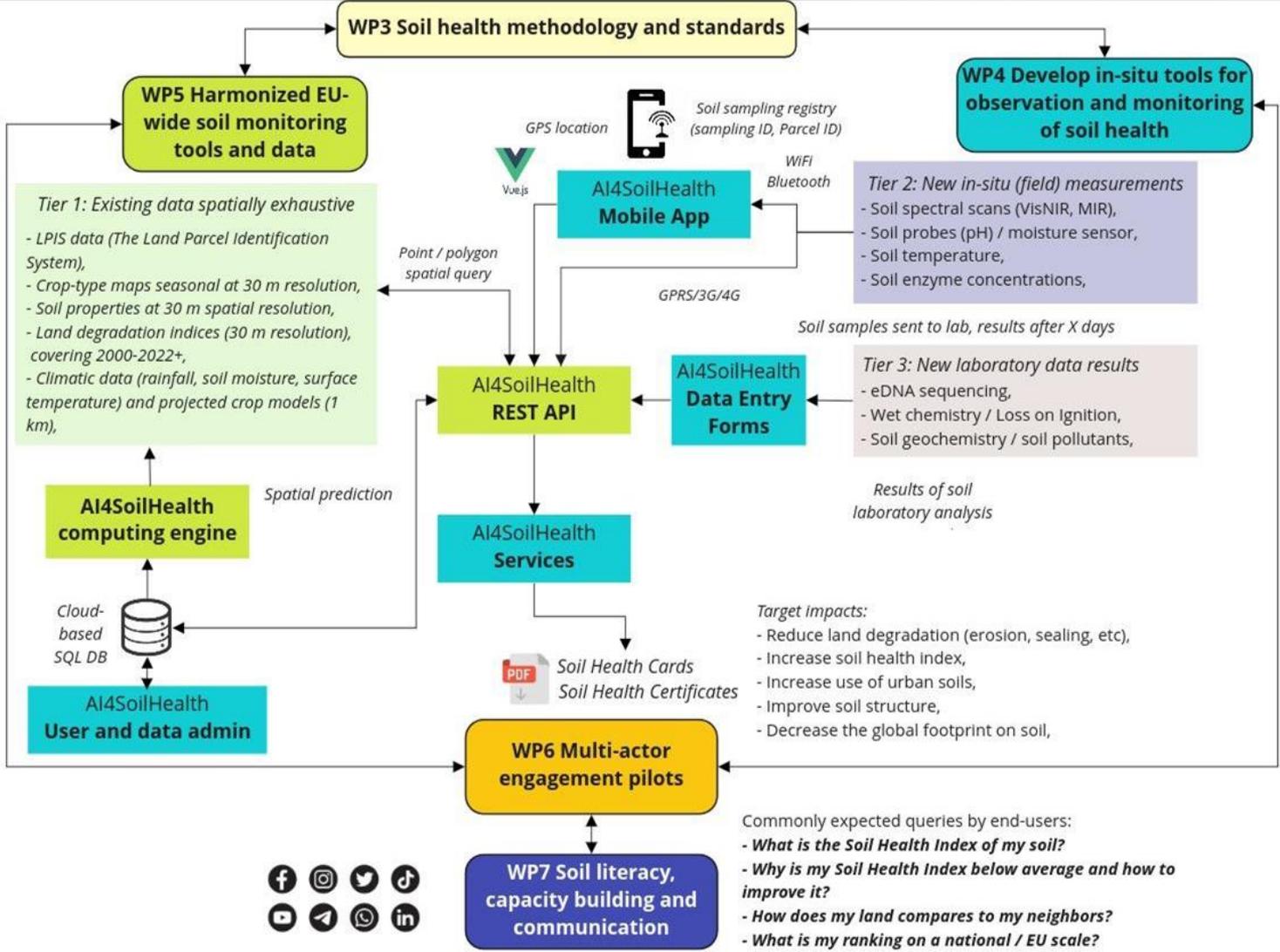
The most simple definition of soil health

Level 1: lack of soil degradation

- soil erosion (water, wind erosion, landslides);
- loss of SOC;
- soil pollution (heavy metals, micro-plastic);
- loss of soil biodiversity;

Level 2: fully functional and resilient ecosystem

- high productivity;
- high water holding / water filtering capacity;
- high and stable biodiversity (soil flora and micro, macro and meso fauna);





EcoDataCube

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- **10m** resolution **Sentinel-2** mosaics (120GB per image!) are also available via <https://EcoDataCube.eu>.

Preprint

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Abstract

Assets

Discussion

Metrics

12 Sep 2024



Status: this preprint is currently under review for the journal ESSD.

Time-series of Landsat-based bi-monthly and annual spectral indices for continental Europe for 2000–2022

Xuemeng Tian , Davide Consoli, Martijn Witjes, Florian Schneider, Leandro Parente, Murat Şahin, Yu-Feng Ho, Robert Minařík, and Tomislav Hengl

Abstract. The production and evaluation of the Analysis Ready and Cloud Optimized (ARCO) data cube for continental Europe (including Ukraine, the UK, and Turkey), derived from the Landsat Analysis Ready Data version 2 (ARD V2) produced by Global Land Analysis and Discovery team (GLAD) and covering the period from 2000 to 2022 is described. The data cube consists of 17TB of data at a 30-meter resolution and includes bimonthly, annual, and long-term spectral indices on various thematic topics, including: surface reflectance bands, Normalized Difference Vegetation Index (NDVI), Soil Adjusted Vegetation Index (SAVI), Fraction of Absorbed Photosynthetically Active Radiation (FAPAR), Normalized Difference Snow Index (NDSI), Normalized Difference Water Index (NDWI), Normalized Difference Tillage Index (NDTI), minimum Normalized Difference Tillage Index (minNDTI), Bare Soil Fraction (BSF), Number of Seasons (NOS), and Crop Duration Ratio (CDR). The data cube was developed with the intention of providing a comprehensive feature space for environmental modelling and soil, vegetation, and land cover mapping. To evaluate its effectiveness for this purpose, the quality of the produced time series was assessed by: (1) visual examination for artifacts and inconsistencies, (2) plausibility checks with ground survey data, and (3) predictive modeling tests, examples with soil organic carbon (SOC) and land cover (LC) classification. The results of visual examination indicate that the gap-filled product is complete and consistent, except for winter periods in northern latitudes and high-altitude areas where high cloud and snow density make gap-filling complex, and hence many artifacts remain. The plausibility results further show that the indices effectively help differentiate landscapes and crop types: the BSF index showed a strong negative correlation (-0.73) with crop coverage data, effectively detecting soil exposure. The minNDTI index had a moderate positive correlation (0.57) with the Eurostat tillage practices survey data, indicating valuable information on the intensity of the tillage. The detailed temporal resolution and long-term characteristics provided by different tiers of predictors in this data cube proved to be important for both soil organic carbon regression and LC classification experiments based on the 60,723 LUCAS observations: long-term characteristics (tier 4) were particularly valuable for predictive mapping of SOC and LC coming on the top of variable importance assessment. Crop-specific indices (NOS and CDR) provided limited value for the tested applications, possibly due to noise or insufficient

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- Metadata XML
- BibTeX
- EndNote

Short summary

Our study introduces a Landsat-based data cube simplifying access to detailed environmental data...

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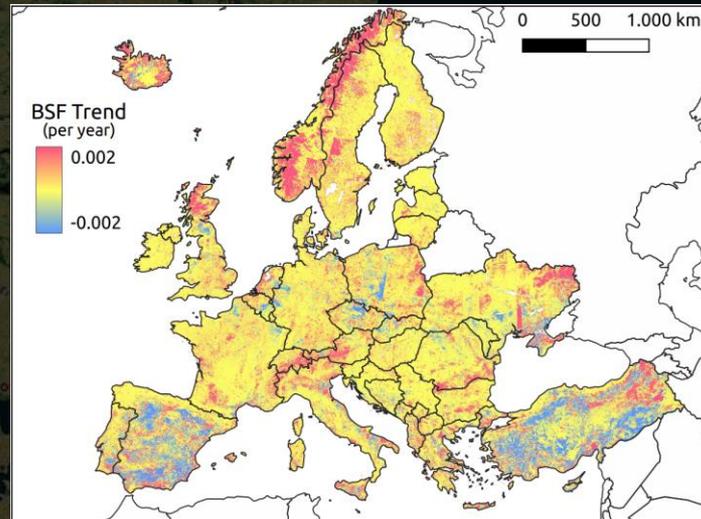
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Altmetrics



14TB of data for EU under CC-BY license, bare soil index, GPP and similar).





Artificial Intelligence for Soil Health

Explore the transformative role of artificial intelligence (AI) in soil science with this exclusive video series from the Budapest Soil Health Forum. Featuring recorded sessions from the conference, these videos delve into cutting-edge AI technologies that enhance spatial prediction of soil processes, offering insights into how AI is shaping the future of soil health, monitoring, and management. Gain valuable perspectives from scientists, policymakers, and stakeholders on the integration of AI in soil data management, sustainable land use planning, and global soil health initiatives. Discover how these projects are leveraging digital twins, satellite mapping, and predictive analytics to revolutionize soil resource management and advance sustainable agriculture. Visit the conference's website to learn more:

<https://www.soilhealthforum.hu/artificial-intelligence-for-soil-health/>



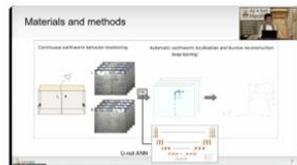
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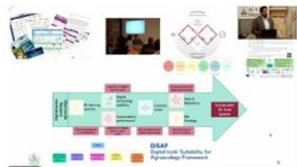


Application of AI-driven system for monitoring earthworm behaviour in ecotoxicological soil health assessments

09:10 Djerdj, Tamara et al.

The behaviour of earthworms is an important indicator for ecological and ecotoxicological studies, providing information on the organisms' responses to environmental stressors such as pollutants and changes in soil composition. However, conventional methods for monitoring soil organisms are problematic due to the opaque nature of the soil matrix. In this study...

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Paving the Way towards Digitalisation Enabling Agroecology for European Farming Systems (PATH2DEA)

16:53 2 Pfeiffer, Stefan

The potential of agroecological farming systems to master many of today's challenges to the environment, economy, health, and society can be significantly promoted by coupling with digital tools and technologies. The Horizon Europe project PATH2DEA (Grant Agreement Nr: 101060789 (EU) & 22.00535 (SERI)) is committed to unlocking digitalisation's catalysing power...

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A compositional (CoDa) for soil organic carbon VISNIR measurement method preventing moisture interference

14:58 4 Cayuela-Sánchez, José Antonio et al.

Soil organic matter content (SOM) has an important role in modulating atmospheric CO₂, while soil organic carbon (SOC) is the best marker of SOM. Soil components are interdependent, thus they carry only relative information, belonging to the type of data so-called 'compositional data' (CoDa). VisNIRS modelling with soil reference data needs therefore specific CoDa...

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Universal Soil Health Index (USHI)

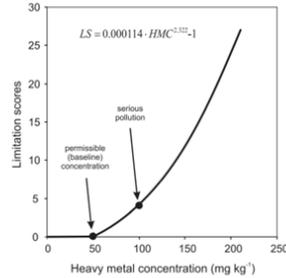
Defined as a product from 5 independent indices (centered at 1 for pan-EU), based on EO-observation and modeled data:

$$\text{USHI} = \text{Soil Degradation Health Index (SDHI)} \times \text{Soil Resilience Index (SRI)} \times \text{Productivity Index (SPI)} \times \text{Carbon Sequestration Index (CSI)} \times \text{Soil Biodiversity Index (SBI)}$$

standardized to Potential Natural Vegetation soil

Soil Health Data Cube 4 EU
Cumulative soil limitation score

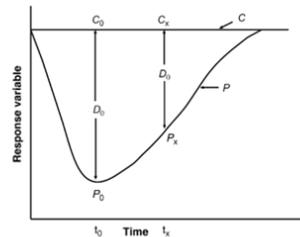
- Soil degradation variables:
- loss of SOC,
 - acidification / salinization,
 - compaction,
 - sealing,
 - heavy metals, ...



	X ₁ (mg kg ⁻¹)	X ₂ (mg kg ⁻¹)	ln(b ₀)	b ₁
Cd	0.8	2	0.392	1.756
Cr	50	100	-9.083	2.322
Cu	50	100	-9.083	2.322
Ni	30	60	-7.897	2.322
Pb	50	150	-5.731	1.465
Zn	150	300	-11.634	2.322

Cumulative soil resilience score

Several response variables

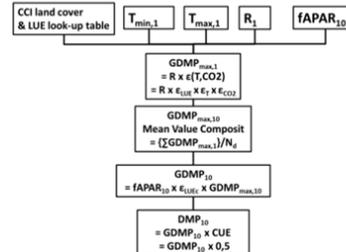


10.1016/j.scitotenv.2017.10.043
10.1016/j.soilbio.2004.04.036

Annual 2-year average GDMP [kg/ha/year]

Gross Drymatter Primary Productivity (GDMP)

$$\text{DMP}_{10} = \text{GDMP}_{10} \times \text{CUE} \quad \text{with} \quad \text{CUE} = 0.5 \quad (17)$$



Annual 2-year average CSI [kg/ha/year]

10.1111/gcb.15897

based on soil macroinvertebrates used as bioindicators

biodiversityjournal.com/pdf/5(1)_69-86.pdf

All partial indices are derived per pixel (30 m) & will be reproducible i.e. fully documented in code.

Pan-EU thresholds will be based on legislation (as much as possible) & ground data. Users will be able to set own threshold and adjust & extend, however, reference values will be used for the official soil health products

Pan-EU thresholds

Open Bodem Index Calculator (OBIC)

This R package can be used to calculate the Open Bodem Index (OBI). The OBI is a tool that evaluate the soil of agricultural fields based on four main criteria: chemical, physical, biological and management. These four criteria consist of more than 21 indicators to get a comprehensive picture of the soil. More information about the Open Bodem Index can be found at [Open Bodem Index](#).

Installation

```
# Install from latest stable version from CRAN
install.packages("OBIC")

# Or install the development version from GitHub
remotes::install_github("AgroCares/Open-Bodem-Index-Calculator")

# Load the OBIC package in your script
library("OBIC")
```

Previous releases of [OBIC](#) can be found at [releases](#) section on the GitHub repository.

Documentation

Documentation of the R functions in the OBIC package can be found [here](#)

More information

The [Open Bodem Index](#) (OBI) is a collaboration between Wageningen UR, NMI and FarmHack in collaboration with agricultural experts. The Open Bodem Index Calculator is a tool used by the OBI and developed by [NMI](#).



Logo of NMI

Links

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Citation

[Citing OBIC](#)

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Author, maintainer

Gerard Ros

Author

Yuki Fujita

Author

Wilbrand Hendrik Riechelmann

Author

Kees van den Dool

Author

[More about authors...](#)

Dev status

lifecycle **stable**

R-CMD-check **passing**

codecov **97%**

CRAN **3.0.3**

downloads **10K**

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A 3-day international conference with **keynotes, discussion forums, oral talks, workshops** and demonstrations + fieldwork: science, technology and business intelligence for measuring monitoring and increasing soil health. The maximum capacity of event is 200 participants.

WHERE

Wageningen International Conference Center
(WICC), Wageningen

WHEN

Tuesday to Thursday
8–10 April



We can already monitor and observe most places on Earth from the sky at a resolution of 30 by 30 meters. Importantly, we can now look back nearly 25 years for almost all locations in Europe and analyse changes on a field-by-field basis.

Tom Hengl - We should reward the stewards of the land like we celebrate Olympic champions



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A long-overdue check-in conversation with Tom Heng, director at OpenGeoHub, one of the leading scientists in earth observation and remote sensing—one of the most cited in his field, belonging to the top 0.1% (based on Clarivate Highly Cited Researchers). We discuss the significant chang ...more

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"Godfather of AI" Geoffrey Hinton: The 60 Minutes...

60 Minutes

You can't do serious AI without good stats

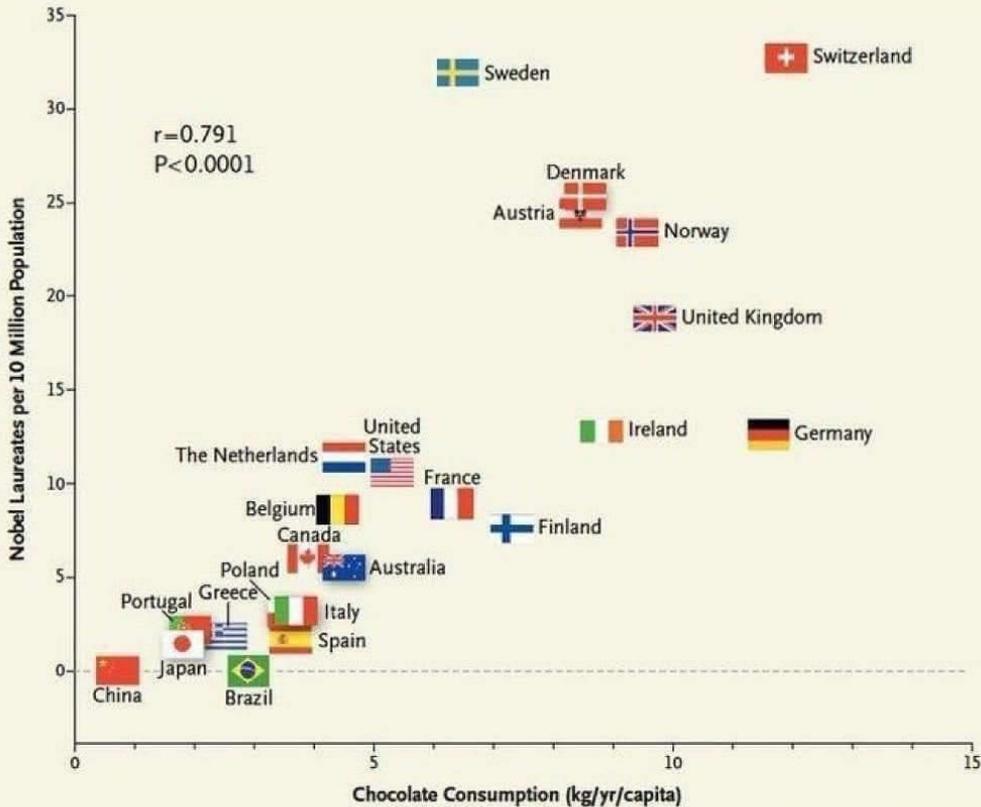


Figure 1. Correlation between Countries' Annual Per Capita Chocolate Consumption and the Number of Nobel Laureates per 10 Million Population.



Questions please!

