

AI and Climate Information Needs in Africa

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Climate information needs in Africa

What are Africa's climate information needs?
How do they relate to global concerns?
How can AI help?

Our study involves climate-related questions from **Google Trends** and identifies macro clusters related to the broad themes of understanding climate change, its causes, and potential solutions.

Google Trends: The Epistemic Supercluster

We collect the **top 500 questions**, based on search volume, for the topics 'Climate Change' and 'Global Warming', from the period between 2020 and 2022, from each of the G20 countries, as well as Ghana.

To analyze the questions, we represent them in a **multilingual embedding space** using language-agnostic BERT LaBSE embeddings

To visualize the data, we apply Principal Component Analysis (PCA) to reduce the dimensionality.

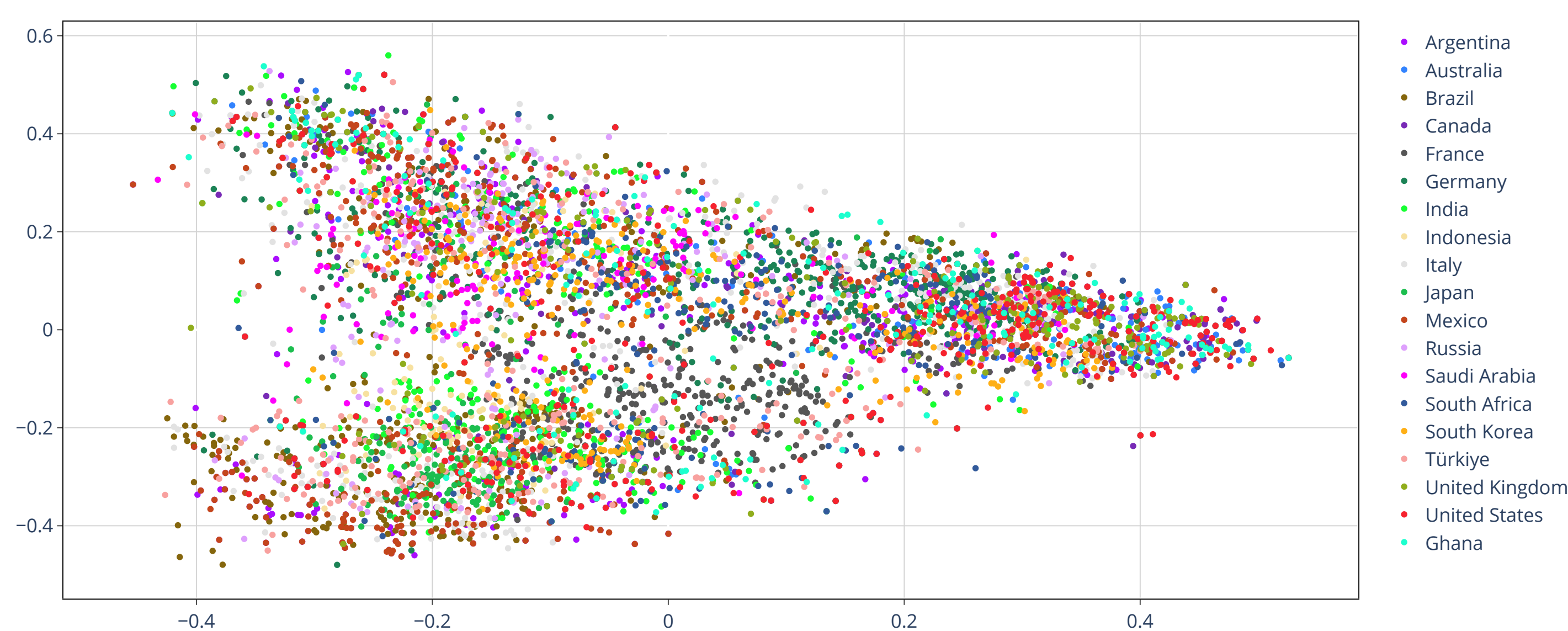


Figure 1. 2D PCA projection of the LaBSE embeddings of all questions in the original languages. The plot suggests the presence of a topical structure that is shared by all countries' data.

Findings:

- Approximate triangular macro structure
- Broad topics concern questions about climate change:
 - topics questions: "what is climate change?"
 - causes: "what are the causes of climate change?"
 - questions regarding what can be done to address climate change: "how to save the Earth?"
- The dominant global climate information needs are epistemic

Caveat: Only a preliminary study. No claim that the data represents any true underlying trends in any statistically accurate sense, nor that each country's data is sampled in precisely equivalent ways.

Google Trends: Fine Grained Topics

We apply Uniform Manifold Approximation and Projection (UMAP) to the first 10 PCA components.

The resulting projection, followed by k-means clustering, identifies more fine-grained structure.

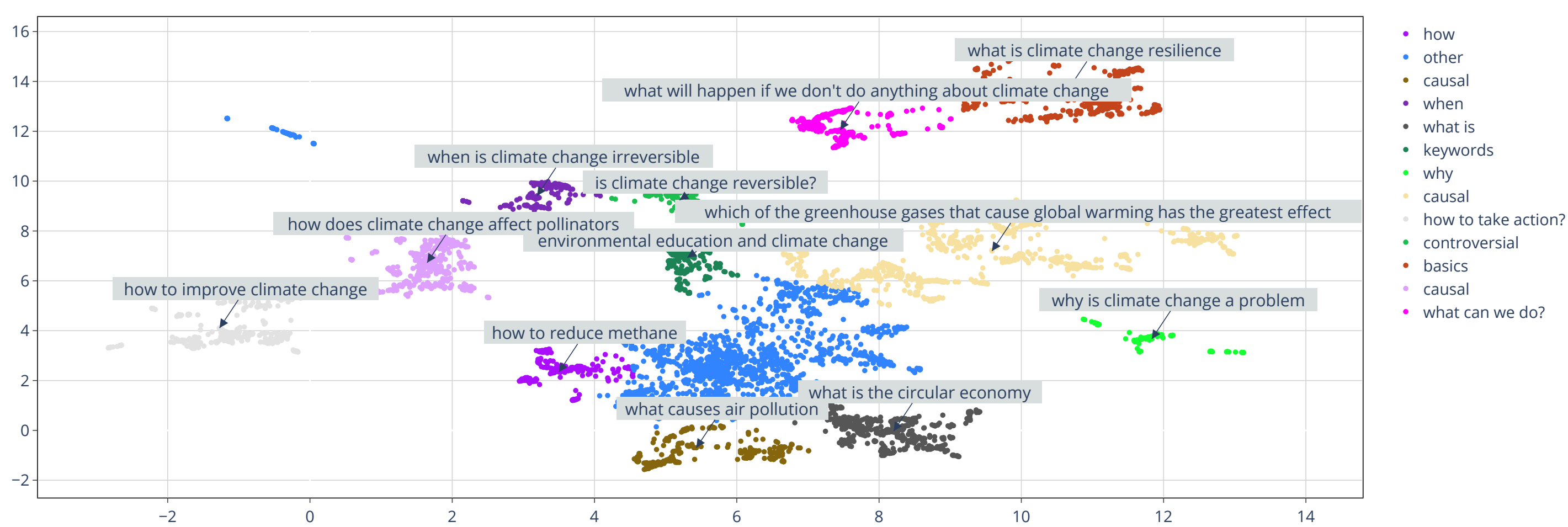


Figure 2. UMAP following PCA-10 reveals more fine-grained structure in the questions data.

The sub-clusters provide a better understanding of the specific topics within the broader macro clusters.

Findings: we find different sub clusters that include

- Basics: "what is global warming"
- Causal: "how does climate change cause draughts?"
- How to take action: "how to scientifically solve the problem of climate change"
- Controversial: "global warming is a hoax"
- Keyword: "France global warming map"

A first look at Ghana and South Africa

- Within Africa, Ghana and South Africa lie across a wide span of latitude, around 7.9° N and 30° S, and are susceptible to different climatic threats that can have immediate effect on their economy.
- For instance, **sea-level rise and coastal economy** are urgent concerns in Ghana, while in South Africa **temperature extremes and less rainfall** are top concerns for agriculture and the associated economy.

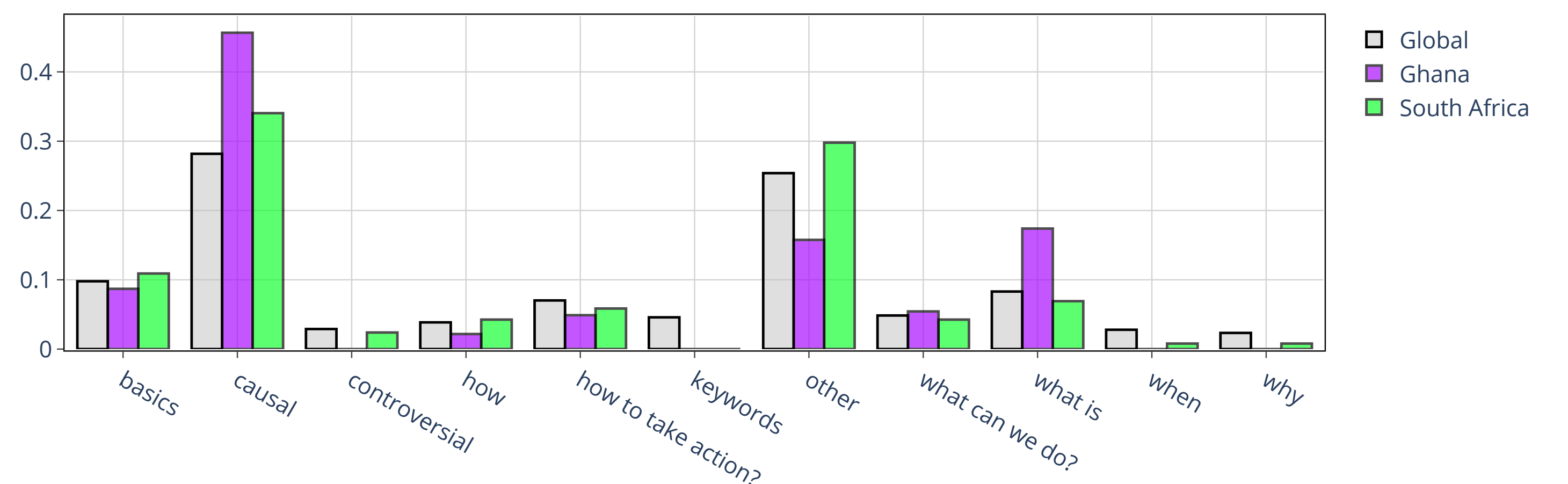


Figure 3. Topic distribution for Ghana (purple) and South Africa (green) compared to the global distribution (gray). Questions in the causal cluster are more frequent in Ghana and South Africa.

Findings:

- Comparing questions distribution of Ghana and South Africa to the global distribution reveals that common and distinguishing concerns in these two areas are about **causes and effects** of climate change.
- For Ghana, we find questions such as:
 - "how does climate affect tourism in West Africa"
 - "how is climate change altering precipitation in Ghana"
 - "how can climate change cause flooding and drought"
- For South Africa we find:
 - "how does climate change affect agriculture"
 - "what is the relationship between climate change and the regularity of droughts in South Africa"
 - "how did the tropical cyclone Eloise impact the economy"
- These question reflect urgent information needs.

Human and AI answers to Climate Questions

Can AI, e.g., in the form of Large Language Models (LLMs) help answer climate-related concerns?

What are its strengths and limitations?

Experiment 1. ChatGPT answers score higher than experts written answers. We ran the following experiments at the University of Ghana.

- Compiled a set of 93 climate questions relevant to Ghana.
- Formed a group of 46 local experts from 13 sectors.
- Divided into 4 groups, they wrote concise answers to each question.
- A different group from the one who wrote the answer assessed the answers' quality
- At the same time, the groups assessed concise answers for the same question generated by ChatGPT.
- The result was that ChatGPT scored 'High' (99%) on all but one ('Medium') answers.

Experiment 2. Experts can provide more specific and informative answers compared to ChatGPT.

Let's look at both ChatGPT and expert's answer to the question:

How does climate change affect the agricultural sector in Ghana?

ChatGPT answer: Climate change affects the agricultural sector in Ghana in several ways: 1. Changes in Rainfall Patterns: Climate change can lead to unpredictable rainfall patterns, which can disrupt the planting and harvesting schedules of farmers. This can lead to crop failures and food shortages. 2. Increased Temperature: ...

Experts Answer: As of 2021, agriculture employs around 45% of the Ghanaian labor force and contributes roughly 21% of the national GDP. Most of these farm workers operate small, rain-fed farms, which are particularly vulnerable to erratic rainfall patterns influenced by a changing climate. Higher temperatures can also impact farmers' crops by decreasing yields and increasing the presence of pests and disease. **One of Ghana's top agricultural products – cocoa – is also vulnerable to rising sea levels.** Ghana is the second largest cocoa producer in the world, with approximately 800,000 farm families contributing to the country's annual production. Most suitable areas for cocoa production exist along Ghana's coast, and are thus in danger of floods, soil salinization, and coastal erosion. These conditions, along with other agricultural impacts like drought, put the livelihood of hundreds of thousands of families at risk.

To a human eye, the expert's answer is clearly superior. But we also ask ChatGPT which answer it prefers and why. This yields the following response:

"Considering that the question specifically refers to Ghana, [the human answer] is more appropriate as it gives specific details and impacts on the agricultural sector, including direct relevance to their main crop, cocoa, and how it might be affected."