Aligning Unstructured Paris Agreement Climate Plans with Sustainable Development Goals

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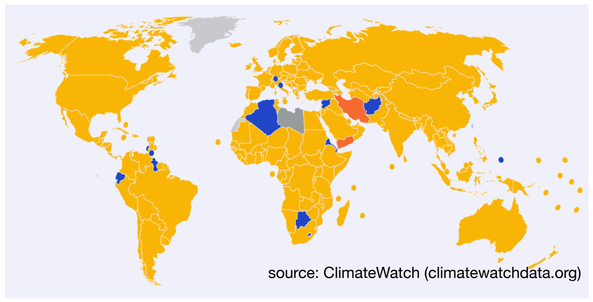
Summary

Aligning unstructured climate policy documents according to a particular classification taxonomy with little to no labeled examples is challenging and requires manual effort of climate policy researchers. In this work we examine whether large language models (LLMs) can act as an effective substitute or assist in the annotation process. Utilizing a large set of text spans from Paris Agreement Nationally Determined Contributions (NDCs) linked to United Nations Sustainable Development Goals (SDGs) and targets contained in the Climate Watch dataset from the World Resources Institute in combination with our own annotated data, we validate our approaches and establish a benchmark for model performance evaluation on this task. With our evaluation benchmarking we quantify the effectiveness of using zero-shot or few-shot prompted LLMs to align these documents.

NDC and SDG

United Nations Sustainable Development Goals (SDGs)
- 17 goals
- 169 sub-targets
- aimed at promoting global well-being and sustainability

Nationally Determined Contributions (NDCs)
- Paris Agreement - each country submits a document
- specify commitments to sustainability and resilience
- presented in unstructured texts
- frequent updates - every 5 years



Linking the NDCs to the SDGs
- enhance understanding of global sustainability targets
- track global progress toward climate goals
- understand shifts in focus between updates

Motivation and Climate-Watch Dataset

Motivation
- labeling NDCs with SDGs is tedious
- existing labels are not exhaustive
- frequent updates to the NDCs

→ **How effective are LLMs for the task of linking sentences in the NDCs to the Sustainable Development Goals?**

Climate Watch Labelled Examples	Goals	Targets
Reduce rural peoples' dependence on fuel for cooking and heating.	12	12.2
Reduce fuel consumption through efficiency standards	7, 11	7.3, 11.2
Guyana will implement other policies to encourage energy efficiency and the use of renewable energy, including building codes and net-metering of residential renewable power.	7	7.2, 7.3

Climate-Watch (CW) Dataset
- ~7k sentences, each labeled with SDG-Goals and SDG-Targets

Limitations of the Climate-Watch Dataset

- noisy labeling
  - no inter-annotator agreement

→ Balanced split *(Data-Balanced)*

- potential bias in labeling methods
  - keyword search
  - relevance to SDGs
- only positive (relevant) annotations
  - precision vs. recall

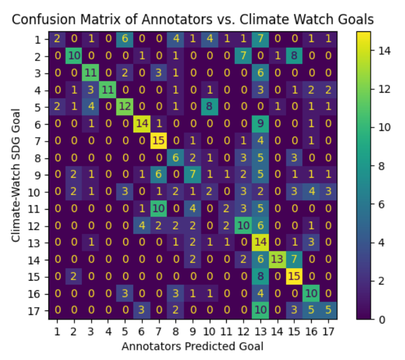
→ Random split (*Data-Random*)

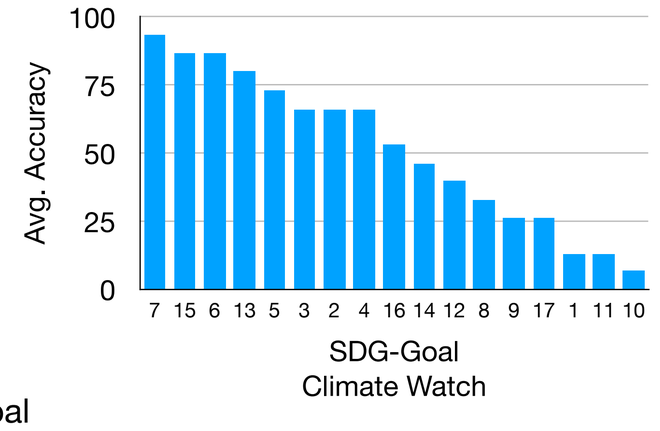
- *Data-Random* and *Data-Balanced* address the limitations of the CW dataset
- We use these to evaluate to what extent LLMs can assist in linking NDCs to SDGs

Data-Balanced

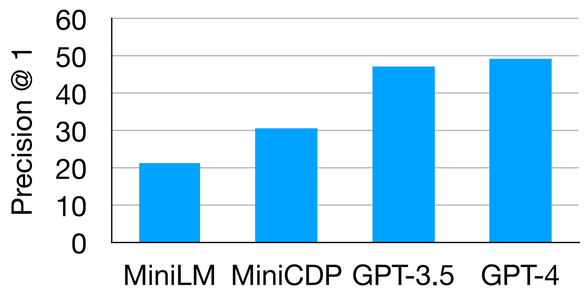
Data-Balanced Dataset
- 85 sentences sampled from CW, 5 from each SDG-Goal
- each labeled by our 3 manual annotators
  - 1 climate policy expert, 2 undergraduate students with some climate policy understanding
- MiniLM and MiniCDP models used as baselines[1]

Our annotators vs. Climate Watch on Balanced Split (SDG-Goal prediction)





Single SDG-Goal

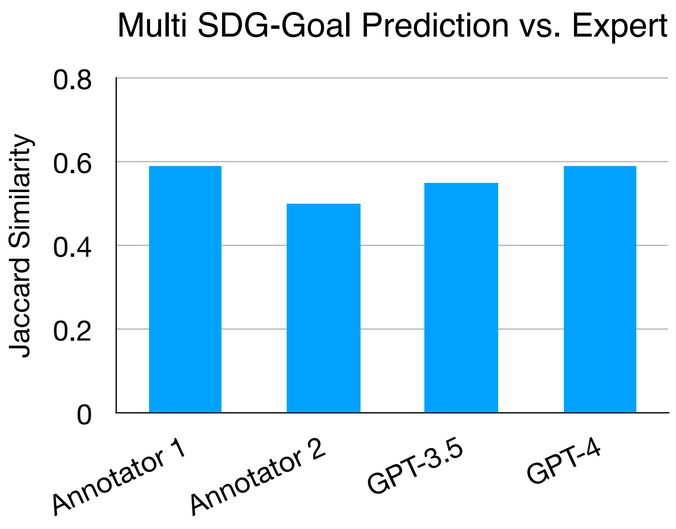


Evaluation
- Each sentence has a single SDG-Goal label as ground truth
- Confusion matrix highlights thematic overlaps between SDG-Goals and inevitable noise in labeling

[1]Spokoyny et al. (2023)

Data-Random

Data-Random Dataset
- 120 sentences, each labeled by our 3 manual annotators
- randomly sampled from the HTML version of the NDC reports
- includes some sentences not relevant to the NDCs

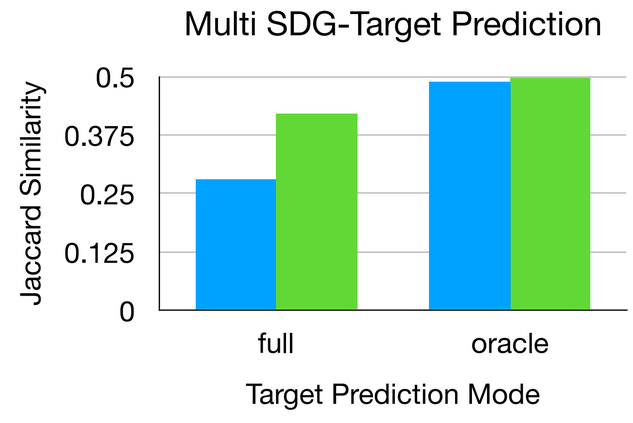


Evaluation
- compared labels by student annotators and GPT against the Expert's labels
- Both GPT-3.5 and GPT-4 perform at similar levels to human annotators

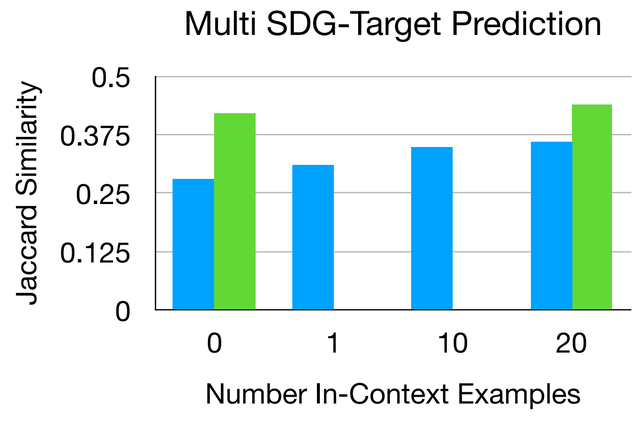
Estimating CW Coverage
- 13 of 120 sentences labeled *not-relevant* by Expert
- 8 *not-relevant* by at least two annotators
- **~10% of NDC have been labeled**

LLMs for SDG-Target Labeling

SDG-Target Experiments
- prompt GPT models to provide a list of targets for sentences in the CW dataset
- CW labels are treated as ground truth



- **full mode:** select from the full list of 169 SDG-Targets
- **oracle mode:** use the ground truth SDG-Goal label to subselect only the corresponding SDG-Targets



Prompting Strategies
- Expert prompting
- More surrounding context
- **Few-shot with in-context learning**

LLM Prompting

You are an environmentalist that is knowledgeable on the 17 Sustainable Development Goals and 169 Targets.The following Input Text was classified as Sustainable Development Goal 7. Predict the Sustainable Development Target (target) out of the following options:	Instruction
Goal 7 Targets: 7.1: By 2030, ensure universal access to affordable, reliable and modern energy services 7.2: By 2030, increase substantially the share of renewable energy in the global energy mix by 2030 7.3: By 2030, double the global rate of improvement in energy efficiency 7.a: By 2030, enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology 7.b: By 2030, expand infrastructure and upgrade technology for supplying modern and sustainable energy services for all in developing countries, in particular least developed countries, small island developing States, and land-locked developing countries, in accordance with their respective programmes of support	Background Information (target or goal list)
Input Text: Developing and using energy-saving construction materials and green materials in housing and commercial sectors. targets: 7.b, 9.4	ICL examples
Input Text: Promoting economic development and sustainable rural livelihoods through sustainable management of environmental resources and increase access to modern forms of efficient and sustainable energy services targets:	New sentence to classify