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A report on post-editing of machine translation of *Climate Change 2023*

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Abstract: The rapid progress of computer science has thrust machine translation (MT) into the limelight, praised for its speed and accessibility. Despite its widespread use, concerns persist about the quality of machine-translated content, leading to a reassessment of its effectiveness. Post-editing (PE) has emerged as a solution, blending the strengths of MT and human translation and becoming a mainstream practice in the language service industry. PE improves translation efficiency, reduces costs, and ensures the fidelity of translated text, especially in Chinese. This report focuses on MT combined with PE, examining the translation of Section 4.5 of *Climate Change 2023*, which explores recent mitigation and adaptation strategies for climate change across various sectors. Using SDL Trados Studio 2019 and DeepL, the author conducted PE to refine the translated content, addressing lexical, sentence, and discourse-level issues. Recommendations include establishing terminology databases and employing contextual disambiguation techniques to rectify errors and ensure coherence and formatting. The report emphasizes the importance of navigating translation theories and methodologies, alongside possessing critical analytical skills and a robust knowledge base. Ultimately, this translation aims to enhance discussions on translating climate-related literature, offering valuable insights for future endeavors in this field.

Key words: machine translation; post-editing; *Climate Change 2023*

1 Introduction

Climate change profoundly impacts both human well-being and the health of the planet. The combustion of fossil fuels and unsustainable energy and land practices have driven a global temperature increase surpassing pre-industrial levels by 1.1 degrees Celsius. Consequently, extreme weather events have become more frequent and severe, posing heightened risks to ecosystems and human communities worldwide.

On March 20, 2023, the Intergovernmental Panel on Climate Change (IPCC) convened a press conference in Interlaken, Switzerland, to unveil the Sixth Assessment Report (AR6) Synthesis Report (SYR) titled *Climate Change 2023*. Drawing on findings from three working groups and three special assessment reports, the Synthesis Report summarizes key insights on climate change facts, impacts, risks, and mitigation and adaptation measures. This translation project focuses on Section 4.5 of the report, detailing recent actions by various sectors to address climate change challenges.

The release of the IPCC Sixth Assessment Report is anticipated to furnish essential scientific groundwork for global and governmental climate initiatives, highlighting effective methods to curb greenhouse gas emissions and adapt to anthropogenic climate change. Urgent, equitable climate actions promise not only to mitigate losses but also to yield broader benefits. The report underscores the imperative for ambitious measures to secure a sustainable future for all,

underscoring the significance of this translation endeavor in tackling present climate challenges.

This report belongs to the category of informative texts with straightforward language. Such texts strive for fidelity in translation, aiming for conciseness and clarity similar to the original. The author found that using machine translation for certain practice texts can save time. However, due to the inherent nature of machine translation, which relies on linguistic principles to recognize grammar and automatically translate based on stored lexicons, errors may arise when there are changes or irregularities in syntax, morphology, or semantics. Currently, the analysis system of machine translation systems remains relatively weak. For sentences that have not been correctly analysed and matched, it is often necessary to introduce an additional post-processing stage to perform appropriate node merging and translation handling, in order to obtain a complete translated output [1]. Thus, to reduce translation errors and improve translation quality, post-editing of machine-translated texts is necessary. Furthermore, due to the inherent limitations of machine translation in maintaining discourse coherence and formatting, additional post-editing efforts, particularly in discourse coherence, are essential to further enhance translation quality.

2 Translation process

The translation process employed DeepL as the primary machine translation tool, complemented by SDL Trados as a computer-assisted translation (CAT) tool. Unlike machine translation, SDL Trados relies on a translation memory database rather than automated translation. It allows translators to save previously translated Chinese-English sentence pairs, facilitating future translations by identifying matches in subsequent content. As the author's database was still in its infancy, SDL Trados mainly served to expand it for future use. Additionally, SDL Trados aids in segmenting sentences and presents original and translated text side by side, enhancing accuracy and facilitating review.

Climate science demands specialized terminology, crucial for translation accuracy. Pre-translation research using search engines like Baidu and Google helped establish common expressions of specialized vocabulary. A terminology list, drawn from the Language Sail's Terminology Bank, ensured uniformity with around 200 entries.

This translation method combined machine translation with post-editing. The process involved importing the original text into SDL Trados, translating sentence by sentence using Bing Translate for machine translation. Post-editing addressed errors, retaining relevant information and making quick edits as needed. Completed translations underwent further modification at the discourse level to ensure coherence. Once finalized, the translation was exported for external review, completing the translation process.

3 Case analysis

3.1 Vocabulary translation errors and handling strategies

Accuracy and fluency are emphasized in English-to-Chinese translation. Accuracy not only entails conveying semantic equivalences and pragmatic meaning conversions but also ensures that the target language readers achieve a similar effect as the original language readers from multiple perspectives [2]. However, under the backdrop of machine translation, inaccurate vocabulary translation is prevalent. This includes mistranslation of polysemous words, improper handling of abbreviations, and mishandling of proper nouns. Such errors not only fail to accurately convey the meaning of the original text to readers but may also lead to misinterpretations. To ensure translation quality, post-editing (PE) is indispensable. Therefore, the author will conduct case analyses of vocabulary mistranslation from the perspectives of mistranslation of polysemous words, improper handling of abbreviations, and mishandling of proper nouns.

Example 1: Reducing industry emissions will entail coordinated action throughout value chains to promote all mitigation options, including demand management, energy and materials efficiency, circular material flows, as well as abatement technologies and transformational changes in production processes.

Machine Translation: Jian shao gong ye pai fang xu yao zheng ge jia zhi lian de xie tiao xing dong, yi cu jin suo you de huan jie fang an, bao kuo xu qiu guan li, neng yuan he cai liao xiao lv, xun huan cai liao liu dong, yi ji jian pai ji shu he sheng chan guo cheng de zhuan xing bian hua.

PE Translation: Jian shao gong ye pai fang xu yao zai zheng ge jia zhi lian zhong cai qu xie tiao xing dong, yi tui dong suo you huan jie fang an de shi shi, bao kuo xu qiu guan li, ti gao neng yuan he cai liao li yong xiao lv, cu jin xun huan cai liao chi xu gong ying yi ji jia kuai jian pai ji shu he sheng chan gong yi de zhuan xing bian ge.

Analysis: The focus of this sentence lies in the interpretation of the term "flow". When "flow" is used as a noun, it encompasses meanings such as "liu dong; che liu, ren liu; chi xu sheng chan, bu duan gong ying; (yu yan, si lu, ect.) lian guan; chuan bo, liu tong; liu su, liu lv; liu dong wu; liu liang; da liang; zhang chao; zhao mu; xing bian". Through extensive research, it was found that recyclable materials mainly include metals, aluminum alloy profiles, wood, glass, and gypsum. Recycling materials contribute to environmental protection and sustainable development by reducing energy consumption and environmental pollution associated with the use of new raw materials in the production process. Therefore, in conjunction with the contextual semantics, it is evident that to reduce industrial emissions, there should be a promotion of the continuous supply of recyclable materials.

Example 2: Action to reduce industry sector emissions may change the location of GHG-intensive industries and the organization of value chains, with distributional effects on employment and economic structure.

Machine Translation: Jian shao gong ye bu men pai fang de xing dong ke yi hui gai bian wen shi qi ti mi ji xing chan ye de wei zhi he jia zhi lian de zu zhi, dui jiu ye he jing ji jie gou chan sheng fen pei ying xiang.

PE Translation: Jian shao gong ye bu men pai fang de xing dong ke yi hui gai bian wen shi qi ti mi ji xing chan ye de wei zhi he jia zhi lian de jie gou, dui jiu ye he jing ji jie gou chan sheng fen pei xiao ying.

Analysis: The focal point of this sentence lies in the translation of "location" and "organization". "Location" commonly refers to "di dian, wei zhi; dian ying de wai jing pai she di; ding wei; ji suan ji nei cun li de di zhi (place, position; filming location; positioning; memory address)". The Oxford Dictionary defines "location" as "the act of finding the position of somebody or something" or "a place where something happens or exists". The latter refers to geographical location. Thus, considering the contextual semantics, reducing emissions from the industrial sector would likely change industrial positioning rather than location. "Organization" commonly refers to "zu zhi, ji gou; zu zhi gong zuo, chou bei gong zuo; bian pai, pei zhi, jie gou; tiao li, luo ji xing (organization, institution; organizing work, preparation work; arrangement, configuration, structure; coherence, logic)". According to Collins Dictionary, "An organization is an official group of people, for example, a political party, a business, a charity, or a club", and "The organization of something is the way in which its different parts are arranged or relate to each other". Therefore, considering the contextual semantics, reducing emissions from the industrial sector would likely alter the structure of value chains rather than organization.

Example 3: Sustainable agricultural intensification can reduce ecosystem conversion and CH4 and N2O emissions, and free up land for reforestation and ecosystem restoration.

Machine Translation: Ke chi xu de nong ye ji yue hua ke yi jian shao sheng tai xi tong de zhuan huan he CH4 ji N2O de pai fang, bing teng chu tu di yong yu chong xin zao lin he sheng tai xi tong de hui fu.

PE Translation: Ke chi xu de nong ye ji yue hua ke yi jian shao sheng tai xi tong de zhuan huan, jiang di CH4 (jia wan) ji N2O (er yang hua tan) de pai fang, teng chu tu di yong yu chong xin zao lin he sheng tai xi tong de hui fu.

Analysis: In this sentence, while methane and nitrous oxide are familiar to many, their chemical formulas may be unfamiliar to some readers. Therefore, I have employed a mixed translation approach, providing both the chemical formulas (CH4 and N2O) and their corresponding names (methane and nitrous oxide) for clarity.

Example 4: Green/natural and blue infrastructure such as urban forestry, green roofs, ponds and lakes, and river restoration can mitigate climate change through carbon uptake and storage...

Machine Translation: lv se/ zi ran he lan se ji chu she shi, ru cheng shi lin ye, lv se wu ding, chi tang he hu po yi ji he liu hui fu, ke yi tong guo tan xi shou he chu cun lai huan jie qi hou bian hua...

PE Translation: Zhu ru cheng shi lin ye, lv se wu ding, chi tang he hu po yi ji he liu hui fu, ke yi tong guo tan xi shou he chu cun lai huan jie qi hou bian hua...

Analysis: In this sentence, the machine translation's "Green/natural and blue infrastructure" and "green roofs" are somewhat stiff and may confuse readers. After consulting various sources, I found that "Green/natural and blue infrastructure" refers to "natural or semi-natural infrastructure composed of blue-green space and related constructed systems, considered as a universally effective approach to mitigate and adapt to climate change. Green infrastructure mainly includes street trees, green parks, and building three-dimensional greening; blue infrastructure refers to water landscape and mist systems". It has a more professional translation, namely "blue-green infrastructure". Additionally, if "green roofs" is translated only as "lv se wu ding", it cannot fully reflect the actual meaning of the original text. "Green roofs" in the original text refers to "three-dimensional greening forms using trees, shrubs, lawns, and ground cover plants as carriers on the tops of buildings". Therefore, I translated it as "wu ding lv hua".

3.2 Sentence translation errors and handling strategies

There are numerous instances of mistranslation in machine translation. In this section, the author will analyze representative mistranslation examples from the perspectives of relative clauses, passive voice, and comparative sentences, comparing them with the post-editing translations, and providing different methods and analytical perspectives.

Example 5: Human health will benefit from integrated mitigation and adaptation options that mainstream health into food, infrastructure, social protection, and water policies.

Machine Translation: Ren lei jian kang jiang shou yi yu jiang jian kang na ru shi pin, ji chu she shi, she hui bao hu he shui zheng ce zhu liu de zong he jian huan he shi ying xuan ze.

PE Translation: Zong he jian huan he shi ying fang an jiang jian kang na ru shi pin, ji chu she shi, she hui bao hu he shui zheng ce, you li yu bao zhang ren lei jian kang.

Analysis: The subordinate clause in this sentence is a restrictive relative clause. The machine translation, based on certain algorithms, failed to grasp the intended meaning, resulting in a translation that is obscure and difficult to understand. The author divided the sentence into two parts: one stating the viewpoint (Human health will benefit from integrated mitigation and adaptation options), and the other stating the fact (Integrated mitigation and adaptation options mainstream health into food, infrastructure, social protection, and water policies). Since the emphasis in English is placed first while in Chinese it's placed last, the author placed "zong he jian huan he shi ying fang an you li yu bao zhang ren lei jian kang" at the end of the translation.

Example 6: The environmental footprint of battery production and growing concerns about critical minerals can be addressed by material and supply diversification strategies, energy and material efficiency improvements, and circular material flows.

Machine Translation: Dian chi sheng chan de huan jing zu ji he dui guan jian kuang wu ri yi zeng zhang de dan you ke yi tong guo cai liao he gong ying duo yang hua zhan lue, neng yuan he cai liao xiao lv ti gao yi ji xun huan cai liao liu dong lai jie jue.

PE Translation: Shi shi cai liao he gong ying duo yang hua zhan lue, ti gao neng yuan he cai liao li yong lv, zeng qiang xun huan cai liao liu dong xing ke yi bang zhu jian ruo dian chi sheng chan dui huan jing de ying xiang, jian qing ren

men dui lin jie kuang wu de dan you.

Analysis: In the translation of this sentence, the main difference between machine translation and post-editing lies in the handling of "be addressed by". The machine translation renders it as "...ke yi tong guo...de dao jie jue", which, while not grammatically incorrect, does not serve the purpose of the sentence well, and deviates slightly from the reader's reading habits. The focus of the sentence is on "addressing the environmental impact of battery production and concerns about critical minerals depletion". The machine translation's focus deviates somewhat from this. Therefore, considering the context comprehensively, the author transformed the passive voice into active voice and used the structure "...ke yi bang zhu jie jue..." to connect the sentence.

Example 7: Globally, more financing is directed at grey/physical infrastructure than green/natural infrastructure and social infrastructure, and there is limited evidence of investment in informal settlements.

Machine Translation: Zai quan qiu fan wei nei, zhen dui hui se/ you xing ji chu she shi de rong zi duo yu lv se/ zi ran ji chu she shi he she hui ji chu she shi, er qie dui fei zheng gui zhu qu de tou zi zheng ju you xian.

PE Translation: Zai quan qiu fan wei nei, zheng fu geng qing xiang yu jiang zi jin tou ru lv se ji chu she shi/ wu zhi xing ji chu she shi he she hui ji chu she shi, er bu shi lv se ji chu she shi/ zi ran ji chu she shi, ye bu shi fei zheng gui zhu qu.

Analysis: The focus of this translation lies in handling the relationship between the two clauses "More financing is directed at... than..." and "there is limited evidence of...". The machine translation separates these two clauses, resulting in a lack of coherence in meaning. Through analysis, it can be observed that the intended meaning of the sentence is that governments allocate significant funding to physical infrastructure, while neglecting financing for green infrastructure, social infrastructure, and informal settlements. Therefore, the author connects the clauses using "more inclined to..., rather than..., and not..." to make the sentence more coherent.

3.3 Inappropriate discourse translation and its handling strategies

Machine translation exhibits significant shortcomings in discourse coherence. There are two main aspects: firstly, it overlooks the logical hierarchy intended by the original text, resulting in considerable ambiguity and discontinuity in the discourse, leading to incoherence and improper linkage in the translation. Secondly, the inconsistent translation style is mainly attributed to machine translation's current analysis of the source language, which remains limited to syntactic relations, lacking a holistic understanding of context and discourse.

Example 8: Many industrial and service sectors are negatively affected by climate change through supply and operational disruptions, especially from extreme events, and will require adaptation efforts.

Machine Translation: Xu duo gong ye he fu wu bu men yin gong ying he yun ying zhong duan er shou dao qi hou bian hua de fu mian ying xiang, te bie shi ji duan shi jian de ying xiang, bing xu yao zuo chu shi ying xing nu li.

PE Translation: Qi hou bian hua hui zhong duan gong ying he yun ying, dui xu duo gong ye he fu wu bu men chan sheng bu liang ying xiang, you qi zai zao yu ji duan shi jian shi, gong ye he fu wu bu men xu yao dui sui zhi er lai de gong ying he yun ying zhong duan zuo chu shi ying xing gai bian.

Analysis: In this sentence, "and will require adaptation efforts" functions as a connective device in syntactic cohesion. However, in the machine translation, the use of "bing xu yao zuo chu shi ying xing nu li (and will require adaptation efforts)" is awkward, weakening the logical relationship between "extreme events" and "making adaptation efforts". The author believes that the impact of extreme events necessitates adaptation efforts. Thus, analyzing the deep semantic structure and considering the underlying logic, the translation is rendered as "you qi zai zao yu ji duan shi jian shi, gong ye he fu wu bu men xu yao dui sui zhi er lai de gong ying he yun ying zhong duan zuo chu shi ying xing gai bian (especially

when faced with extreme events, industrial and service sectors need to make adaptive changes to cope with the resulting interruptions in supply and operations)".

Example 9: Urban systems are critical for achieving deep emissions reductions and advancing climate resilient development, particularly when this involves integrated planning that incorporates physical, natural and social infrastructure.

Machine Translation: Cheng shi xi tong dui yu shi xian shen du jian pai he tui jin qi hou shi ying xing fa zhan zhi guan zhong yao, te bie shi dang zhe she ji dao jie he wu li, zi ran he she hui ji chu she shi de zong he gui hua shi.

PE Translation: She ji dao bao kuo wu li, zi ran he she hui ji chu she shi jian she de zong he gui hua shi, cheng shi xi tong zai shi xian da fu jian pai he shi ying qi hou bian hua de fa zhan zhong fa hui de guan jian zuo yong geng wei tu chu.

Analysis: In the machine translation, "particularly when this involves integrated planning that incorporates physical, natural and social infrastructure" is rendered as "te bie shi dang zhe she ji dao jie he wu li, zi ran he she hui ji chu she shi de zong he gui hua shi (especially when this involves integrated planning that incorporates physical, natural, and social infrastructure)". However, the intended meaning is that "urban systems play a key role in achieving significant emissions reductions and adapting to climate change, particularly when integrated planning includes physical, natural, and social infrastructure". Therefore, to present the complete sentence structure and logic, the translation is rendered as "She ji dao bao kuo wu li, zi ran he she hui ji chu she shi jian she de zong he gui hua shi, cheng shi xi tong zai shi xian da fu jian pai he shi ying qi hou bian hua de fa zhan zhong fa hui de guan jian zuo yong geng wei tu chu (urban systems play a crucial role in achieving significant emissions reductions and adapting to climate change, particularly when integrated planning includes physical, natural, and social infrastructure)".

4 Conclusion

This article presents findings derived from the application of machine translation (MT) combined with post-editing (PE) within the framework of *Climate Change 2023*. It aims to pinpoint common errors in MT and offer insights into PE strategies. The key conclusions are as follows:

Firstly, PE is indispensable. MT output from DeepL exhibits numerous errors across lexical, sentence, and discourse levels, underscoring the unsatisfactory quality of MT. Therefore, thorough PE of machine-translated texts is strongly recommended.

Secondly, enhancing translators' bilingual skills is crucial for effective PE. Translation engines primarily rely on corpora to match expressions, but their databases may lack comprehensive coverage of domain-specific terminology. Hence, translators must identify and rectify machine mistranslations during PE, leveraging their language proficiency and translation strategies. Additionally, translators need robust native language proficiency to refine stiff machine-translated sentences for target language readers.

Moreover, PE demands proficiency in various translation software and computer skills. Proficient use of such tools significantly enhances translation speed and quality, bolstering translators' capabilities. However, given the diversity of translation engines and text types, tailored techniques and PE methods are requisite for each scenario.

The article's limitations stem from its focus on a specific report on climate change response measures, limiting its applicability, and the subjective construction of error frameworks based on scholars' interpretations.

In conclusion, the MT+PE approach is gaining traction, with potential for wider acceptance and improved translation quality, empowering translators to excel in their work.

Conflicts of interest

The author declares no conflicts of interest regarding the publication of this paper.

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