

Facing Intense Summer Heat: What Is Expected of Model Studies?

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Introduction

I am writing this manuscript at the end of May, yet here in Osaka, where I live, we have already experienced several days with temperatures exceeding 30°C. This feels like an early warning that we are in for another intensely hot summer. What should normally be a pleasant, transitional season has suddenly turned summer-like, leaving us physically out of sync. Climate change, it seems, is now altering our traditional sense of the seasons.

Against the backdrop of this worsening climate crisis, two major reports were recently published in Japan: the *Third Assessment Report on Climate Change Impact* released this February, and *Japan's National Greenhouse Gas Emissions and Removals for Fiscal Year 2024* released in April. Together, they offer a stark look at where we stand.

Intensified Climate Impacts in Japan

The *Third Assessment Report* compiles scientific data and academic literature on the impacts of climate change in Japan across seven key sectors: (i) Agriculture, Forestry, and Fisheries, (ii) Water Environment and Water Resources, (iii) Natural Ecosystems, (iv) Natural Disasters and Coastal Areas, (v) Human Health, (vi) Industrial and Economic Activities, and (vii) Daily Life and Urban Life.

The report evaluates 80 specific categories within these seven sectors based on their significance, urgency, and level of confidence. Because the information was gathered primarily from peer-reviewed papers, there is some unevenness in the volume of available sources depending on the field. Nevertheless, the assessment's findings are robust, built upon a comprehensive review of more than 2,000 reference materials.

The results reveal that regarding significance, "serious impacts" are already being observed in 65% of the categories under evaluation, with 29% categorized as experiencing "particularly serious impacts." Specific examples include the degradation of paddy rice, increased river flooding, and a rise in heatstroke cases caused by extreme heat. The report estimates that in a scenario where global temperatures rise by 3°C to 4°C, serious impacts would be felt in 90% of the items, and 63% would face particularly serious impacts. Each assessment is accompanied by an explicit confidence level reflecting the strength of the underlying evidence. In terms of urgency, more than half of the categories were rated as "particularly high." Based on these findings, the report warns that climate change impacts are already clearly manifest and will only worsen if temperatures continue to climb.

The Reality of Japan's Greenhouse Gas Emissions

The *Greenhouse Gas Emissions Report*, by contrast, focuses on the progress of mitigation efforts aimed at halting climate change. Japan's greenhouse gas emissions for fiscal year 2024 decreased from fiscal year 2023, falling below 1 billion metric tons of CO₂ equivalent for the first time since the base year of 2013.

However, this downward trend has slowed. Specifically, emissions in the "Commercial and Other Sectors" exceeded those of the previous fiscal year, and the "Residential Sector" saw a reduction of a mere 0.7%, effectively dragging down overall reduction efforts. Because emissions reduction measures tend to be implemented starting with the easiest options, there were concerns from the beginning that cutting emissions would become increasingly difficult as we approach 2050—and it seems this concern is already becoming a reality.

Climate action is a marathon, not a sprint, so we should not become overly fixated on year-by-year fluctuations. Nevertheless, each of us must take this worrying trend seriously and focus on what is truly needed to sustain emission reductions over the long term.

What Role Should Future Scenarios Play?

To clarify the measures required to realize a decarbonized society in Japan, the National Institute for Environmental Studies (NIES) has examined and reported on Japan's decarbonization scenarios and roadmaps using the Asia-Pacific Integrated Model (AIM), which it has developed over many years. The future visions depicted in these analyses are constructed by assuming several major societal pathways, such as "a society where technology resolves various challenges" or "a society based on sufficiency (knowing what is enough)." These model studies have demonstrated that for substantial emissions reductions, it is indispensable for corporations, consumers, and the government to work as one. Furthermore, they have quantified the specific types, adoption volumes, and associated costs of the technologies that must be introduced.

While these model results provide critical insights for implementing climate measures, a significant gap remains between model projections and reality. Specifically, current geopolitical tensions in the Middle East, accompanying spikes in crude oil prices, and the resulting global economic turmoil are not factored into the models. This omission occurs because long-term models operate under the assumption that these events are temporary shocks that do not alter overarching societal trends or long-term directions.

Within the framework of scientific research, it is difficult to anticipate and represent unpredictable, short-term fluctuations in advance. In the real world, however, climate action progresses and stagnates in waves, heavily influenced by contemporary global affairs. It is precisely during periods like the present, when climate action tends to stall, that we need new analyses driven by fresh perspectives on how to recalibrate our approach.

In the End, It Is Humans Who Must Decide

The scenarios presented in model studies are not intended to accurately predict or prophesy the future. Rather, their purpose is to clarify the challenges involved in reducing greenhouse gas emissions and to provide policymakers with the necessary materials to make informed decisions. That being said, if the underlying societal assumptions differ vastly from reality, it is only natural to feel uneasy about how much one can trust such analytical results. I share these deep concerns myself.

As a point of reference, during the discussions on reducing greenhouse gas emissions immediately following the Great East Japan Earthquake in 2011, a wide range of opinions were voiced—centered primarily on future assumptions regarding nuclear power. To address these disputes, excessive expectations were placed on model studies. However, models could not suddenly produce innovative outcomes that no one had ever thought of before. The end result was a proliferation of redundant calculation results generated simply to match the number of competing political opinions.

This experience made me realize just how difficult it is for models to adapt to shifting realities. Even with today's advanced AI, the ultimate responsibility for decision-making still rests with humans. To avoid making the wrong calls, we must never neglect daily dialogue and learning, and continually sharpen our own sensibilities and judgments.

(Translated by Hideyuki MORI)