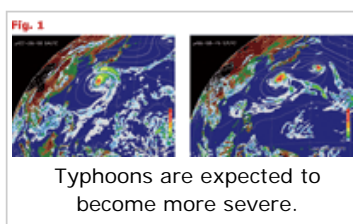


# CLIMATE CHANGE: IMPACTS ON JAPAN



## Not raining, pouring

Japan's relatively high average rainfall of between 1,000 and 2,000 mm a year is not expected to change much this century. But the way it arrives will.



Typhoons are expected to become more severe.

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The traditional pattern of monsoonal 'plum rains', or *tsuyu*, in June and July followed by the typhoon season in August and September is breaking up under climate change. Rainfall is already becoming more variable.

Several studies based on data from the Japan Meteorological Agency now show a long-term increase in intense rain events across the whole of the country (Fig. 4). Longer, more frequent, drought periods are also expected in the coming decades, according to So Kazama of the Graduate School of Environmental Studies at Tohoku University. Snowfall and snow melt

patterns in Hokkaido are also changing.

Water quality is also expected to decline with a warmer climate (see, 'Suffocation of a national asset'). Warmer water contains less dissolved oxygen, which leads to less biological breakdown of disruptive chemicals. In lakes, higher temperatures interrupt the natural turnover processes that occur in winter or in spring and autumn, allowing higher levels of nutrients to concentrate at the surface and increasing the risk of algal blooms. "Fisheries and agriculture and industry have been warning about this problem," Kazama says, "but there are few researchers working on it."

A steady supply of clean water is essential to people, agriculture and industry. Expanding water storage capacity and improving management of dams, reservoirs and other water infrastructure is the most obvious way of coping with less predictable rainfall. Discussion and planning for that is beginning to occur, says Kazama, but it is not simple.

## Physical problems compound environmental concerns

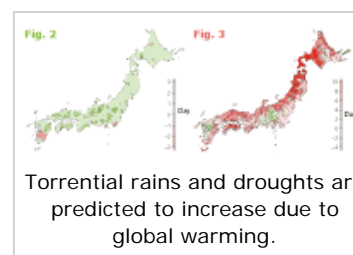
In a long, thin, mountainous country like Japan — with short, rapidly flowing rivers — heavy rainfall leads to an increase in flooding and erosion. And that results in sedimentation of the dams. "The storage capacity of the reservoirs decreases, and you need to spend money on managing sediment," Kazama explains. "Also, sediments can carry chemicals and nutrients that make the water quality worse. So you need more sophisticated, more expensive water treatment plants."

About 60% of fresh water harvested in Japan is used for agriculture and, as the climate warms, the combination of a receding snow line, earlier snow melt, earlier flowering and longer growing seasons will begin to change where crops can be grown. Rice, in particular, depends on spring snow melt water for planting.

Only some of Japan's smaller islands use underground water as a primary

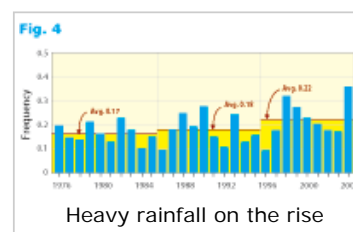
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Torrential rains and droughts are predicted to increase due to global warming.

[Enlarge image](#)



Heavy rainfall on the rise

[Enlarge image](#)

source at present, but these islands and the coastline are the very regions where saline water is likely to intrude into the supply as sea level rises.

A warmer climate also puts greater pressure on water supplies in other ways. According to the IPCC report, every 1°C rise in average temperature demands about a 10% rise in the water needed for irrigation. And the growing demand for water in Japan's cities due to increased industrialization and a 2°C to 3°C rise in temperature over the past century has already led to expressions of concern in a country where water traditionally has been abundant.

"We are now looking at problems of lack of water," says Kazama noting that people are beginning to call for the government to promote water conservation.

### Suffocation of a national asset

Global warming impacts combine with many other factors that result in complicated changes for Lake Biwa. More than 60 km long and 20 km wide in places, Japan's largest lake provides drinking water for about 17 million people, particularly in the cities of Kyoto and Otsu at its southern end.

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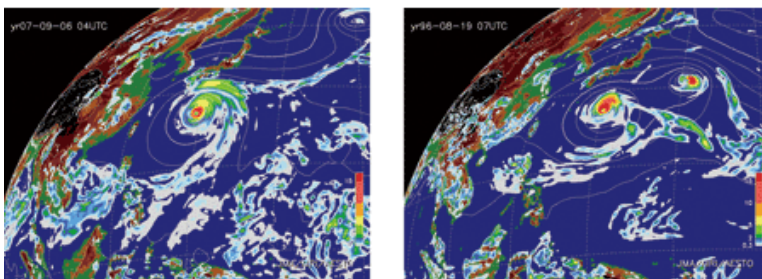
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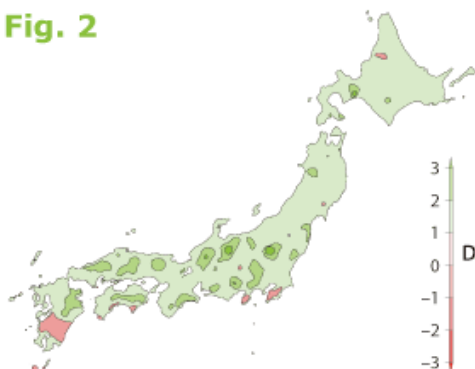
**Fig. 1**



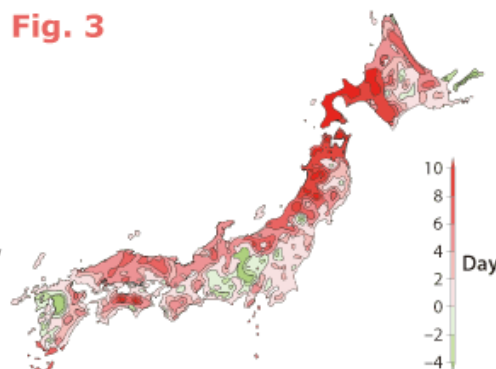
Typhoons simulated by the super-high resolution atmospheric model under the present climate (left) and at the end of the twenty-first century (right). Future typhoons will have higher maximum peak winds, and greater rainfall (mm/hr) as indicated by the red areas.

(Source: MRI/JMA/AESTO)

**Fig. 2**



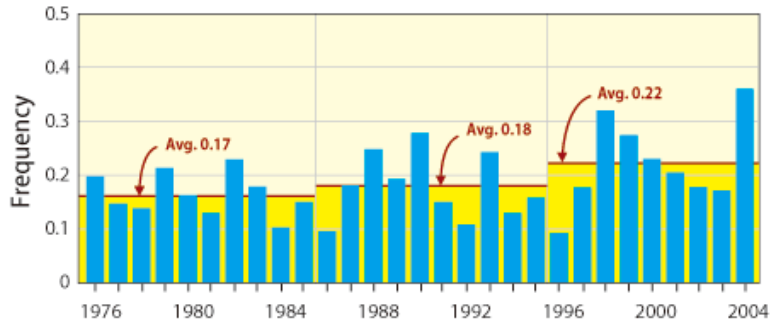
**Fig. 3**



Torrential rains and droughts are predicted to increase due to global warming. In about 100 years, areas of Japan are predicted to experience an increase in the annual number of days with over 100 mm of rainfall (left), and no rainfall (right).

(Source: Japan Meteorological Agency website)

**Fig. 4**



The annual number of heavy rainfall events with over 50 mm of rain per hour, as measured by Japan's Automated Meteorological Data Acquisition System (AMeDAS), is generally increasing although there is annual variation.

(Source: Japan Meteorological Agency website)

### Suffocation of a national asset

Global warming impacts combine with many other factors that result in complicated changes for Lake Biwa. More than 60 km long and 20 km wide in places, Japan's largest lake provides drinking water for about 17 million people, particularly in the cities of Kyoto and Otsu at its southern end. Its waters, via the Yodo River, flow through Osaka. About 60% of its catchment is forested.

One direct impact of global warming already is evident. "You've got a broken oxygen pump," says Masahisa Nakamura of Shiga University, and a former director of the Lake Biwa Research Institute. Traditionally, during winter, the surface water cooled to just below 7°C. This cold, dense water descended some 90 to 100 m to the bottom, carrying a high concentration of dissolved oxygen with it; it was commonly referred to as "a deep breath [for] Lake Biwa", according to Nakamura. But average air temperatures have warmed over the past few decades to the point at which the warmer surface water fails to descend all the way to the bottom. The result at the bottom of the lake is "a lot of fish suffocating and freshwater shrimps scattered around dead."

Problems caused by the lack of oxygen at depth are compounded by runoff from industrial and agricultural developments, and from the forested areas where global warming is causing increasingly intense rain storms that wash organic acids from the soils. Algal growth results, chokes water intakes and sucks more oxygen from the water.

Deteriorating water quality already demands a more intensive, more expensive level of water treatment. While industrial contamination may have lessened, Japan must now find a way to protect this tremendous national asset from its interaction with climate change.



(Source: A-giâu/Wikipedia - GNU Free Documentation license)