

Change in the River Environment of Lake Biwa-Yodo River Basin

<Implementation of a new analysis tool to view the whole basin as a panorama>



Institute of Lake Biwa-Yodo River Water Environmental Research

I. Introduction

The purpose of preparing this brochure

The Lake Biwa-Yodo River basin, covering 8,240 km² with a channel length extending 75.1 km, is a representative basin of Japan and encompasses six prefectures, including Mie, Shiga, Kyoto, Osaka, Hyogo, and Nara. Approximately 12 million people live in the basin, and Lake Biwa is a source drinking water for over 14.5 million people in the Kansai region.

Until the latter half of the 20 th century, rapid changes in society had deteriorated the water quality of the basin. An increase in sewerage plants, coverage area, and effluent regulations had contributed to reduce causes of water pollution and improved the water quality. However, over the past 20 years, changes in water quality have occurred due to changes in social structure, such as population growth and varieties of land use, as well as global climate change.

To aid other studies, the Institute of Lake Biwa-Yodo River Water Environmental Research has prepared maps, which integrated local data including water quality and related data. These maps are available as analysis tools to consider water quality improvement, measures for future water conservation, and water environmental management. These tools help to see conditions of the entire basin from a bird’s eye view.

These analysis tools are available at our website (<http://www.byq.or.jp/ryuikizushu/index.html>).

Institute of Lake Biwa-Yodo River Water Environmental Research
Dr. Keiko Wada

Data Source and Map Information

1) Data Items

Items in the maps are shown in the following table.

Table-1 Items in the maps

Classification	Data items	Number of locations, etc.
Social Structure	• Population • Land use • Population density • Densely-inhabited district	
Weather items	• Annual mean temperature • Mean temperature in summer • Highest temperature in summer • Mean temperature in winter • Highest temperature in winter • Lowest temperature in winter • Annual precipitation • Frequency of precipitation of 30mm/hour and over • Snowfall	Precipitation: 49 locations according to the Meteorological Agency (AMEDAS) + 34 locations by the Ministry of Land, Infrastructure, Transport and Tourism Temperature: 36 locations according to the Meteorological Agency
Water quality items	• Annual mean water temperature • Mean water temperature in summer • Highest water temperature in summer • Highest water temperature in winter • Mean water temperature in winter • Annual mean pH • Lowest water temperature in winter • Annual mean DO • Mean pH in summer • Mean pH in winter • Mean DO in summer • Mean DO in winter • SS • BOD • COD • T-N • T-P	1990: 272 locations 2000: 284 locations 2009: 292 locations
Water quality conservation facility related	• Coverage of sewerage system • Locations of wastewater treatment plants (number of facilities) • Locations of rainwater storage facilities	Wastewater treatment plant: 70 locations Rainwater storage facilities: 142 locations *2

*1 Items in blue are not included in this brochure, but can be viewed on the website of the above described agency.

*2 Set as basic wastewater statistics, although some facilities are not included even in the local governments of the basin region.

2) Targeted period

Data compiled for the preparation of the distribution map are shown below.

- 20 years ago (average of three years, 1988-1990)
- 10 years ago (average of three years, 1998-2000)
- Present (average of three years, 2007-2009)
- Variation Map (difference in data between 20 years ago and present)

3) Water quality data

Water quality data (ave annual concentrations) is a collection of public data from administrative organs and institutes, "Environment GIS" of National Institute for Environmental Studies, the MLIT, prefectures, the Incorporated Administrative Agency, and the Japan Water Agency.

4) Thinking regarding representative sections when constructing the maps.

While water quality of each survey location is shown as point information, it is used as the water quality representing a specific section of the river as shown in Fig.-1.

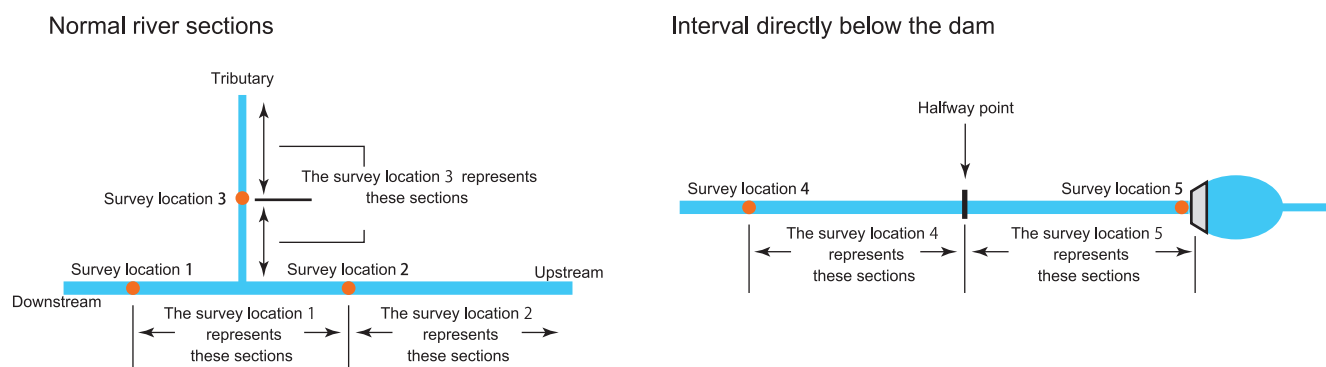


Fig.-1 Thinking regarding water quality survey points during mapping and representative sections

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II. General Outline of Lake Biwa-Yodo River Basin

Outline of Lake Biwa-Yodo River Basin

The outline of the Lake Biwa-Yodo River basin is determined by geographical features such as rivers and mountains. The basin encompasses the western part of Mie, southern half of Kyoto, northern half of Osaka, southwest of Hyogo, and northwest of Nara in addition to Shiga where Lake Biwa is. The Lake Biwa-Yodo River is a Class-A water system with one of the largest basin scale in Japan. This water system has contributed to the prosperity of cities, including Heijokyo (an ancient city in Nara) and Heiankyo (an ancient city in Kyoto). In recent years, it has played an important role as a water source contributing to the social economy of the Kansai region, which is the second largest urban/economic region after Tokyo.

Approximately 12 million people live in the basin, and its water nourishes various living creatures and supports life and industrial activities for many people. Water from Lake Biwa serves as the source of drinking water for 14.5 million people, which includes people outside of the basin, in the Kansai region.

Lake Biwa-Yodo River Basin- Key Data

Items		Facts
Basin dimensions	Entire area	8,240km ²
	Lake Biwa	3,848km ²
Length of main river		75.1km



Nature of Lake Biwa-Yodo River Basin

The beauty of Lake Biwa-Yodo River basin appeared in Manyoshu (the oldest existing collection of poetry). This implies that ancient people communed with nature in the basin.

The formation of Lake Biwa and its water system goes back to approximately 4 million years ago.

Many aquatic creatures evolved into current forms and became indigenous to the lake. The lake is a rich repository of freshwater fishes because the climate is suitable for temperate fishes. Currently the lake supports more than 2,400 species of aquatic plants and animals, of which 61 species are indigenous.

Moreover, large clusters of common reed grass, called Udono-no-Yoshihara, grow along the Yodo River, providing nesting areas and habitats for many small creatures.



Nigoro-buna (*Carassius auratus grandoculis*)
(Lake Biwa: endemic species)



Biwako Oonamazu (*Silurus biwaensis*)
(Lake Biwa: endemic species)

[Source] Shiga Prefecture official website



Yodo River Udono-no-Yoshihara

[Source] official website of Yodo River Office,
Kinki Regional Development Bureau, Ministry
of Land, Infrastructure, Transport and Tourism



Itasenpara bitterling (Deepbody bitterling)

[Source] Yodo River system Itasenpara habitat
environment preservation vision

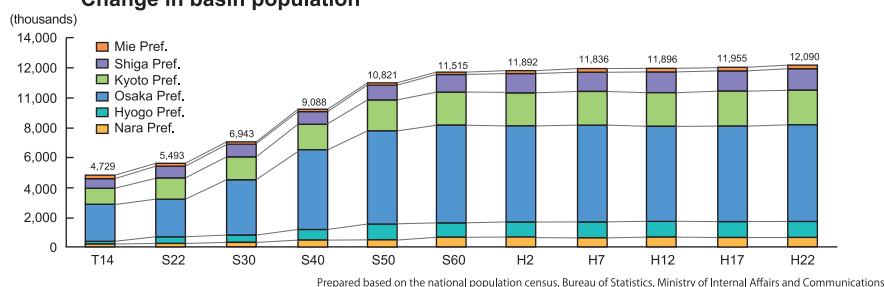
Population and Economic Activities of Lake Biwa-Yodo River Basin

The human population in the basin in 2010 was approximately 12 million, 10% of all of Japan. The population is concentrated in Osaka downstream of the basin, Kyoto midstream, and surrounding satellite cities of each.

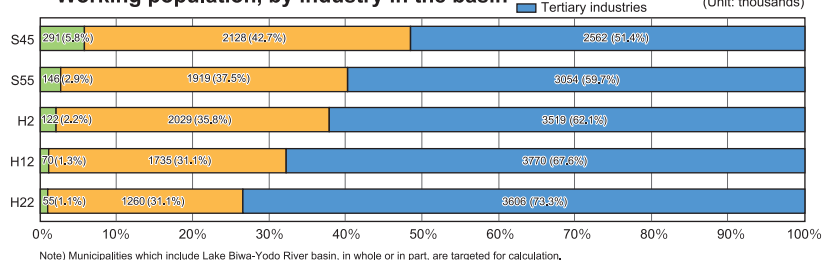
The population in the basin was less than 5 million before 1945 but rapidly increased with the post-war economic recovery and reached over 11 million around 1985. Currently, the population of the basin is increasing gradually.

Secondary industries such as manufacturing decreased while tertiary industries centered on service increased. The basin's total production was around 80 trillion yen after 1990. In recent years, the total production has decreased slightly, but there is still high potential.

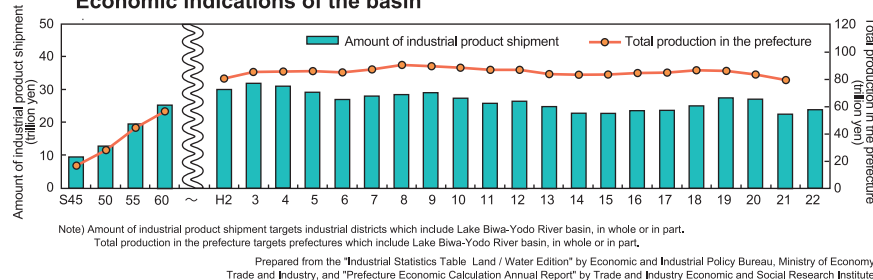
Change in basin population



Working population, by industry in the basin



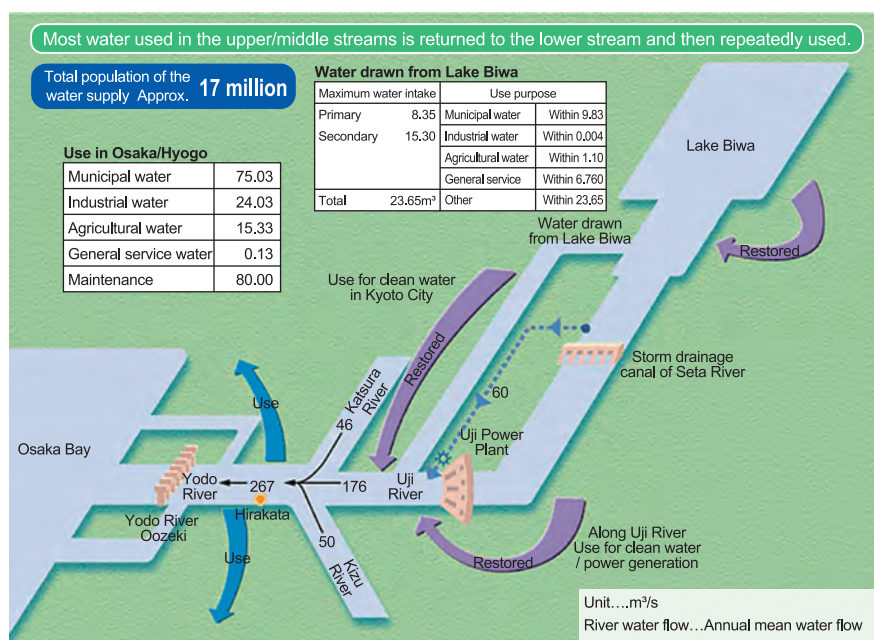
Economic indications of the basin



Characteristics of Water Use of Lake Biwa-Yodo River Basin

The water of the basin is reused from upstream to downstream. For instance, the water is used upstream such as Lake Biwa and reservoirs, and effluent from industries and households are treated at sewage plants to meet a standard and returns to a river. Then the water used in the middle basin centering on Kyoto city via Uji River and canals.

Based on these circumstances, it is important to see the entire basin and understand changes in water quality and factors related to water quality in order to properly manage water from rivers, etc.



Water Supply of Yodo River system *2009

[Source] official website of Yodo River Office, Kinki Regional Development Bureau, Ministry of Land, Infrastructure, Transport and Tourism

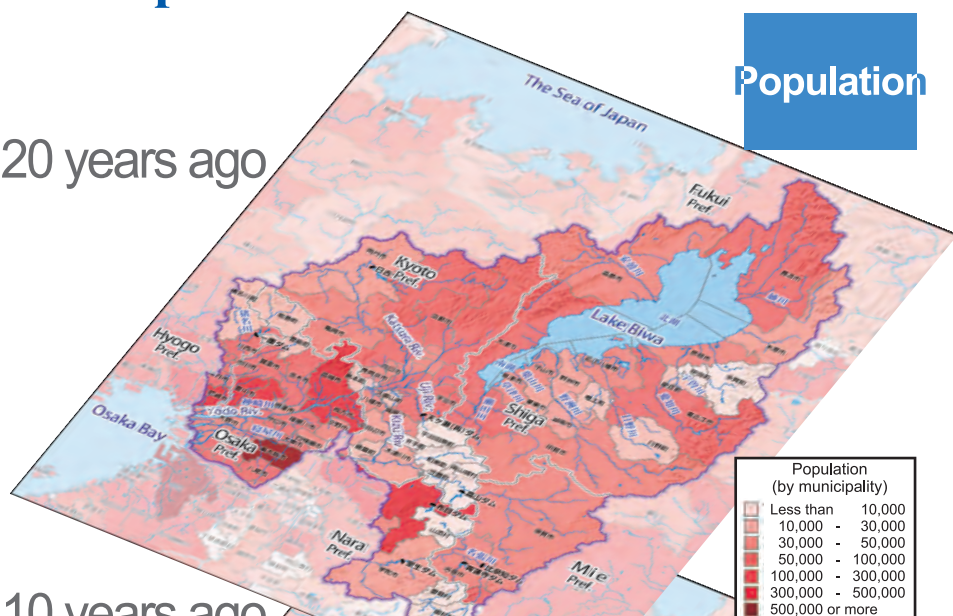
III. Changes in Basin Composition

Population

20 years ago (1990)

Population within the local governments in the basin in 1990 was approximately 11.75 million.

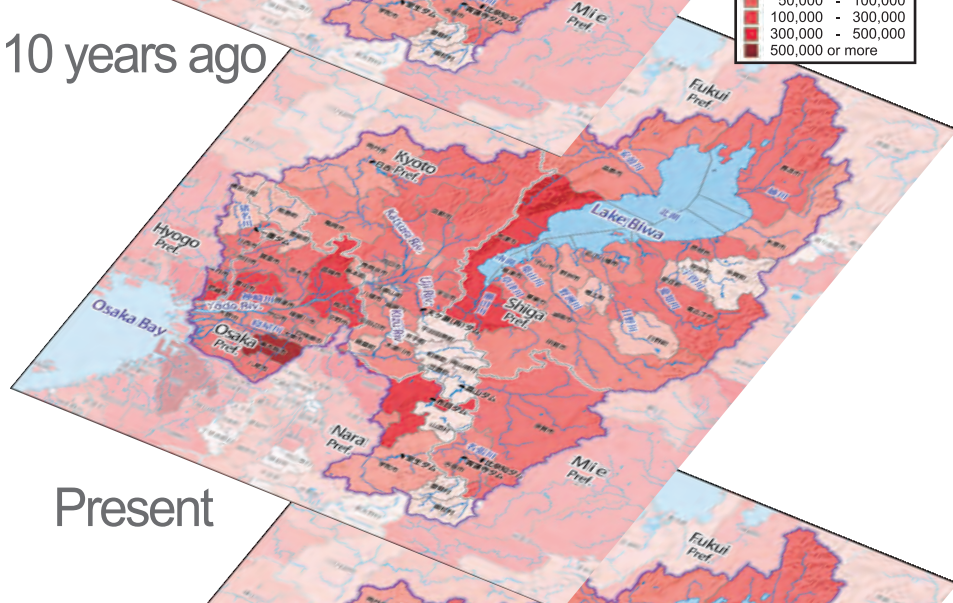
20 years ago



10 years ago (2000)

Population increased to approximately 11.96 million in 2000, with the largest increase in Otsu city, from 277,290 in 1990 to 309,793 in 2000, with an increase of 32,503 (approximately 12%).

10 years ago

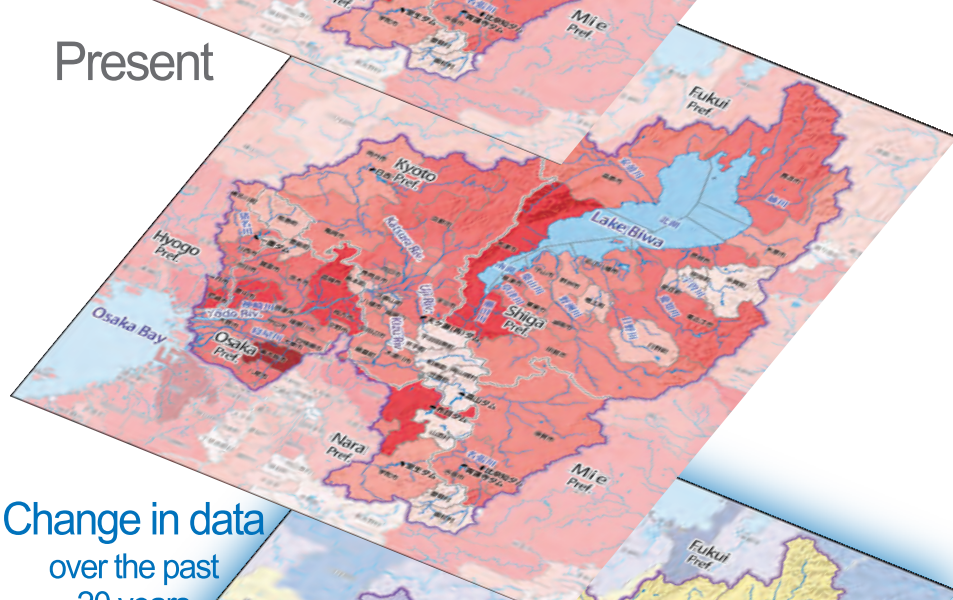


Present (2010)

Population within the local governments in the basin in 2010 was approximately 12.09 million.

Population increase over 10 years since 2000 was the largest in Osaka city, with an increase by 66,540 (approximately 2.6%) to a total of 2.67 million people.

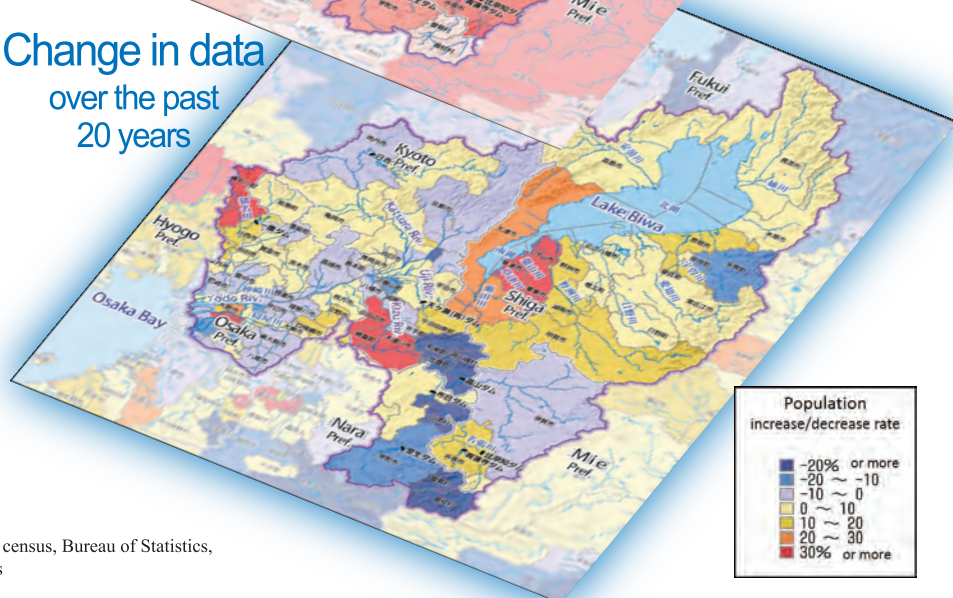
Present



Change in data over the past 20 years

The population within the local governments in the Lake Biwa-Yodo River basin is about 12 million, with an overall increase of approximately 2.9% over the past 20 years. Population increase was especially observed in the South Basin of Lake Biwa, including Otsu city, the Ina River basin, the Kizu River basin, and Osaka city.

Change in data over the past 20 years



20 years ago (1990)

Urban area: Approximately 905km²
 Agricultural area: Approximately 1,347km²
 Forest area: Approximately 4,636km²

20 years ago

10 years ago (2000)

Urban area: Approximately 996km²
 (Approximately 10% increase)
 Agricultural area: Approximately 1,290km²
 (Approximately 4% decrease)
 Forest area: Approximately 4,567km²
 (Approximately 1.5% decrease)

10 years ago

Present (2010)

Urban area: Approximately 1,273km²
 (Approximately 27.8% increase)
 Agricultural area: Approximately 1,080km²
 (Approximately 16% decrease)
 Forest area: Approximately 4,799km²
 (Approximately 5% increase*)

*Results by simple comparison

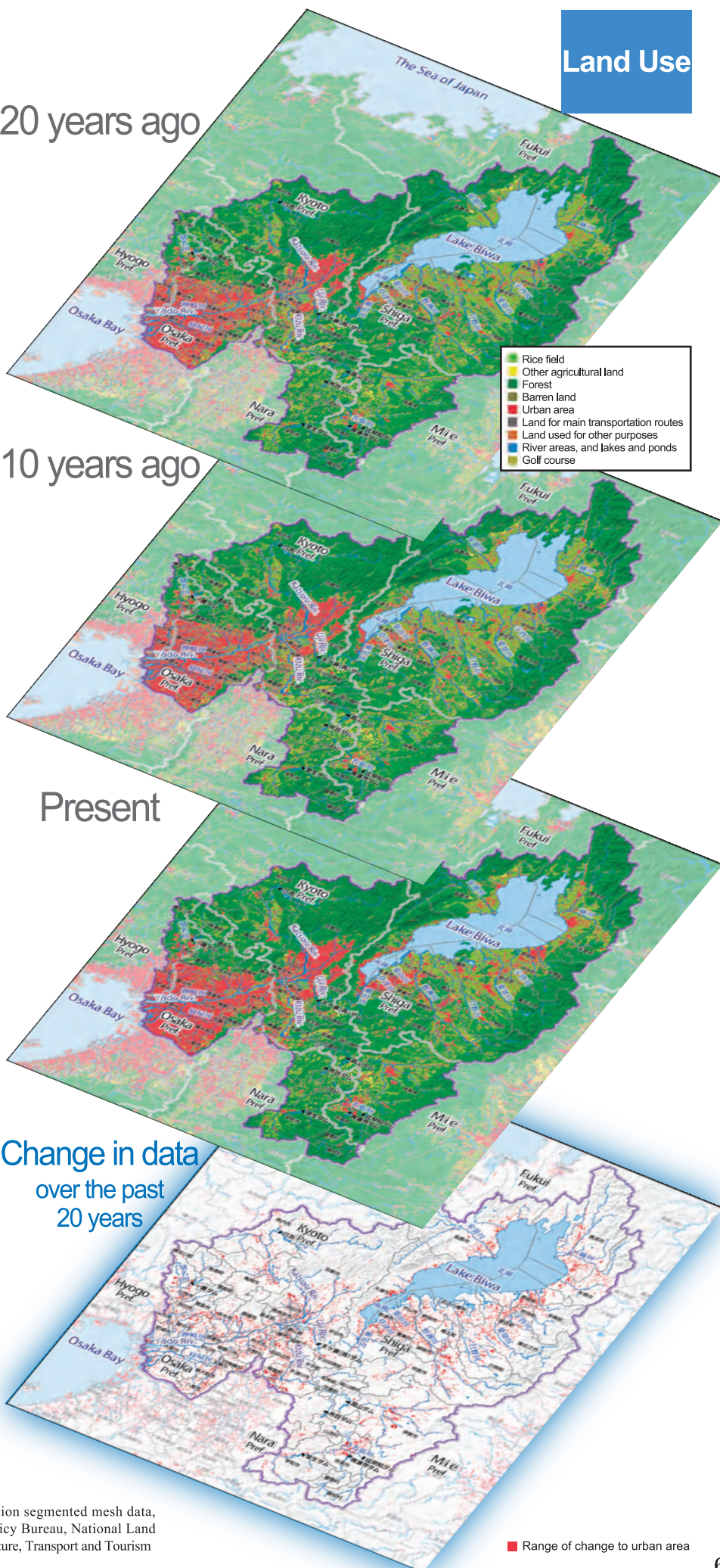
Present

Change in data over the past 20 years

Urban area has increased in response to the increase in population. In particular, this tendency can be clearly seen on the east side of Lake Biwa and the upper basin of Kizu River. In the whole basin (8,240km²) over the past 20 years, urban area has increased 368km², while agricultural land has decreased 265km². Forest land has increased 163km².*

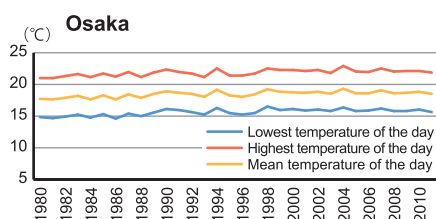
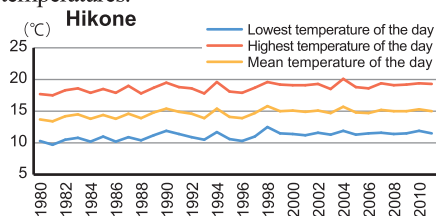
*Results by simple comparison

Change in data
 over the past
 20 years



IV. Climate Changes (Temperature in summer)

When looking at the long-term temperatures in upstream (Hikone) and downstream (Osaka) of the Lake Biwa-Yodo River Basin, a tendency toward higher temperatures in both locations has been observed in recent years, and this is especially clear regarding highest temperatures.



20 years ago (1990)

When looking at the highest temperature in summer, a tendency for higher temperatures was observed downstream from the Yodo River basin, with the highest temperature in Osaka at 35.9 °C, and the lowest in Ikomayama at 30.1 °C.

10 years ago (2000)

A tendency of increased temperatures was even observed upstream in the Lake Biwa basin. The highest temperature was in Hirakata at 36.6 °C, and the lowest was in Ikomayama at 31.2 °C.

Present (2010)

Areas with highest temperatures has expanded to Kyoto and Kyotanabe reached the highest at 37.6 °C. The lowest temperature was in Ikomayama at 31.4 °C.

Change in data over the past 20 years

When looking at the difference in the highest temperature in summer between the present and 20 years ago, there is a tendency for an increased temperature, and this is more clearly seen overall for the entire basin. Temperatures over the past 20 years increased the most in Sonobe in the Katsura River basin, with an increase of 3.4 °C.

The mean/highest temperature in summer was calculated as shown below.

Highest value in summer:

Mean of the highest monthly value between July-September over three years

[Data Source] Japan Meteorological Agency

20 years ago



10 years ago



Present



Change in data
over the past
20 years



IV. Climate Changes (Temperature in winter)

20 years ago (1990)

When looking at the highest temperature in winter, temperatures in Osaka city and the midstream basin of Kizu River were higher. The highest temperature was 21.2 °C in Osaka, and the lowest temperature was 16.1 °C in Minamikomatsu, north of the west bank basin of Lake Biwa.

10 years ago (2000)

A similar distribution was observed at 10 years ago to that of 20 years ago. The highest temperature was 20.9 °C in Osaka, and the lowest temperature was 16.1 °C in Imazu, north of the west bank basin of Lake Biwa.

Present (2010)

At present, the range of the highest temperature in winter expanded to upstream to the Kizu River and the Katsura River basin. The highest temperature was 23.7 °C in Kyotanabe of the Kizu River basin, and the lowest temperature was 18.3 °C in Imazu, north of the west bank basin of Lake Biwa.

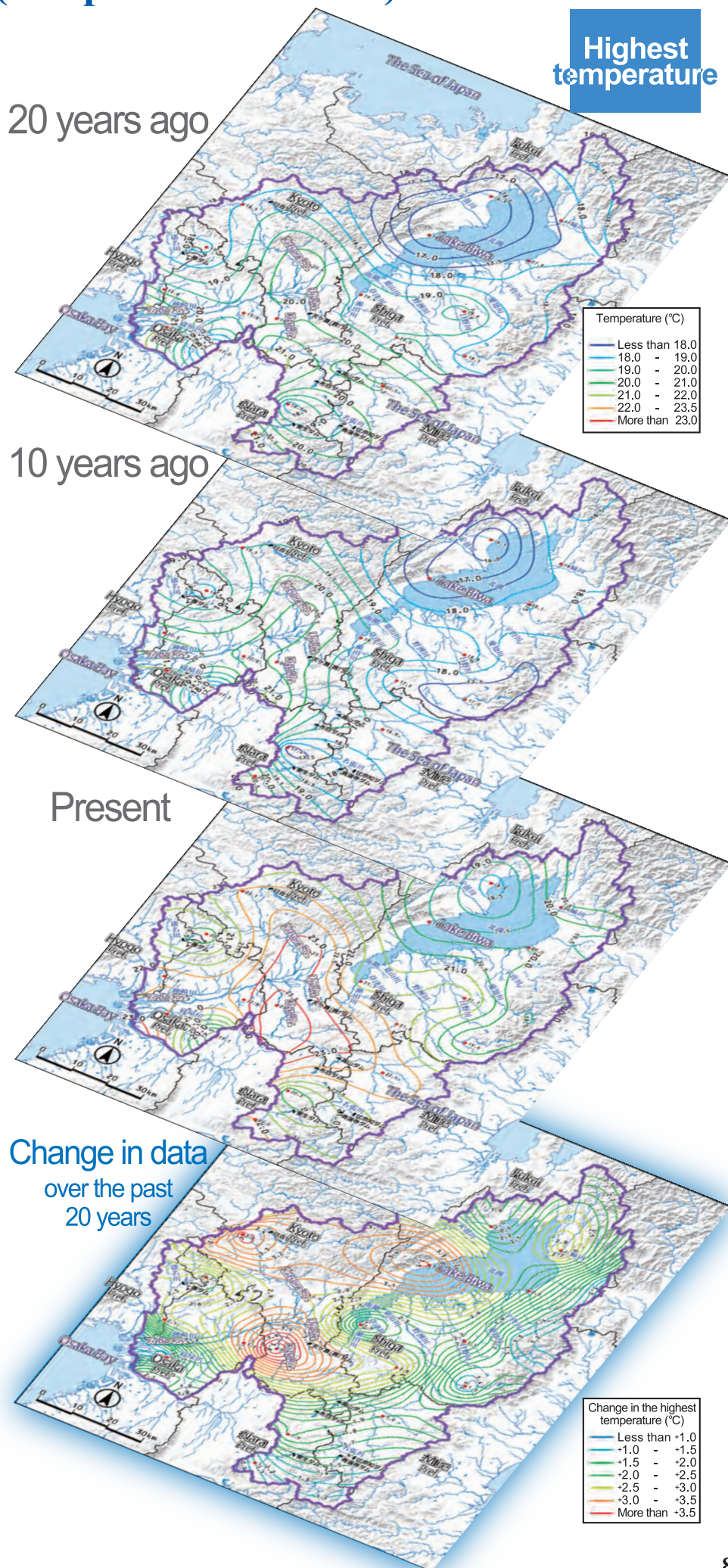
Change in data over the past 20 years

When looking at the difference in the highest temperature in winter between the present and 20 years ago, there is an overall tendency for increased temperature over the entire basin, and this was especially significant in Kyotanabe city in the Kizu River basin, with an increase of 3.9 °C over 20 years.

The mean/highest temperature in winter was calculated as shown below.

Highest value in winter:

Mean of the highest monthly value between January-March over three years



IV. Climate Changes (Accumulated snowfall)

Accumulated
snowfall

20 years ago (1990)

Accumulated snowfall over 100 cm was observed at 2 locations.

The heaviest snowfall was reported in Yanagase, located north of Lake Biwa, at about 466 cm.

20 years ago

10 years ago (2000)

Accumulated snowfall over 100 cm was observed at 3 locations.

The heaviest snowfall was reported in Yanagase at about 575 cm.

10 years ago

Present (2010)

Accumulated snowfall over 100 cm was observed at 2 locations.

The highest value was at Yanagase at about 335 cm, which has greatly decreased compared to 10 years ago.

Present

Change in data over the past 20 years

When looking at the changes over the past 20 years, a decreasing tendency in the north basin, located on the Japan Sea side, was observed (total 4 locations). In particular, accumulated snowfall in Yanagase decreased 131 cm compared to 20 years ago.

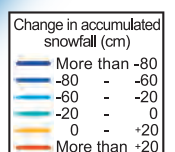
On the other hand, a 16 cm increase was reported in Hikone, located east of North Lake Biwa.

Change in data
over the past
20 years

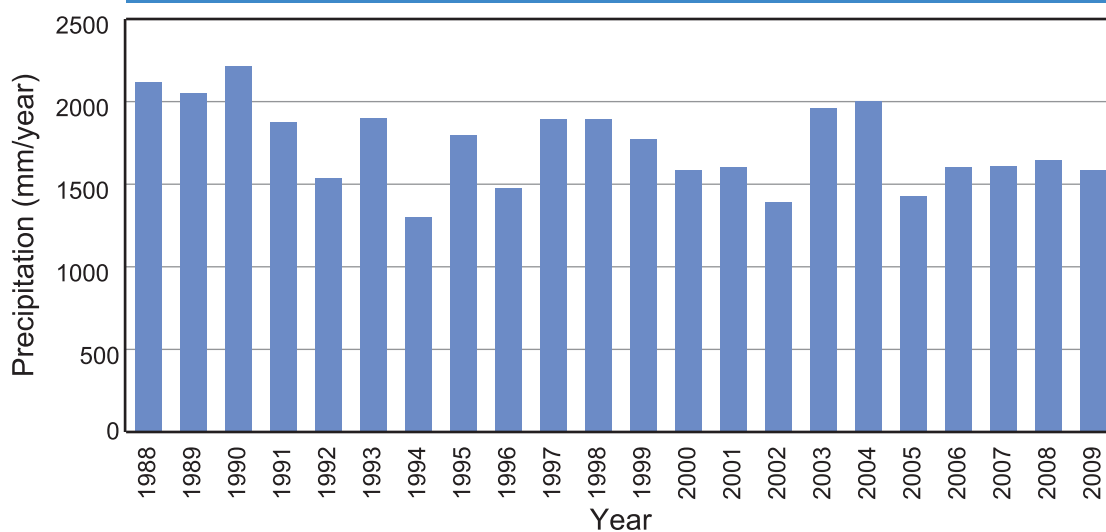
Results of 14 locations are used to prepare the contour,
* but only 5 locations (Osaka, Imazu, Hikone, Yanagase, Kyoto) are located in the basin.

(9 locations outside the basin:

Tarumi, Sekigahara, Miyama, Tsu, Nara, Tsuruga,
Tsuruga, Obama, Imajo, Kobe)

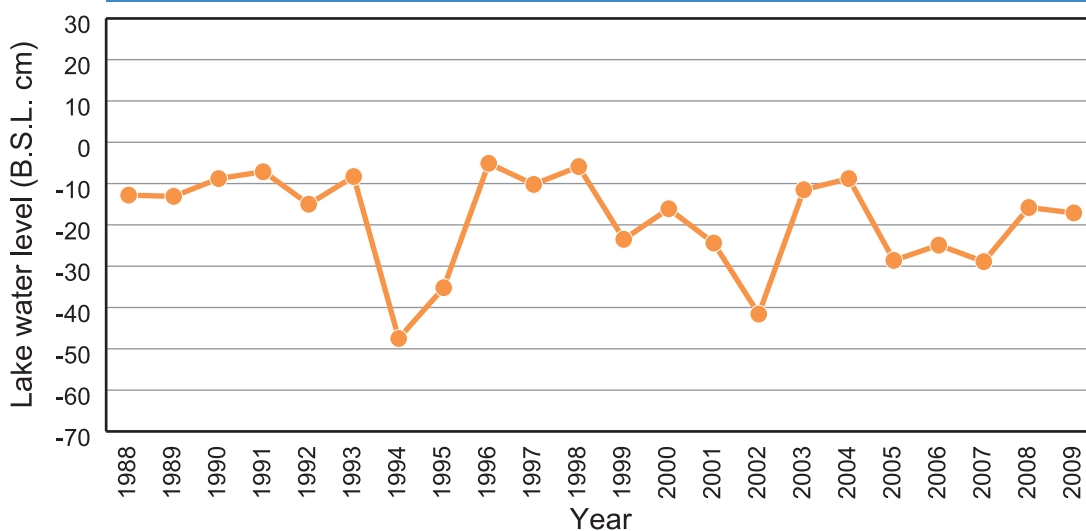


Mean annual precipitation in Lake Biwa basin



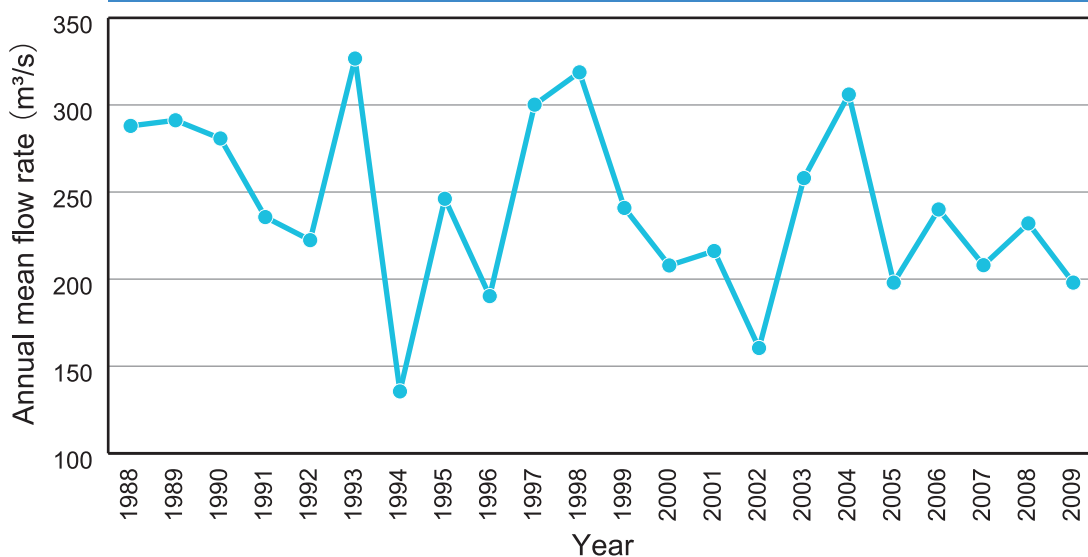
[Data Source] Lake Biwa River Office, Ministry of Land, Infrastructure, Transport and Tourism

Annual mean water level of Lake Biwa



[Data Source] Lake Biwa River Office, Ministry of Land, Infrastructure, Transport and Tourism

Flow rate in Hirakata point of Yodo River



[Data Source] Lake Biwa River Office, Ministry of Land, Infrastructure, Transport and Tourism