Snow storage simulations for assessing impacts on climate change in Itasenpara at Toyama Prefecture, Japan

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1. INTRODUCTION

Acheilognathus longipinnis is called Itasenpara in Japan. Itasenpara is a nationally designated protected fish, currently living in several rivers in the Yodogawa River water system of Osaka Prefecture, the Nobi Plain in Gifu Prefecture and the Himi city of Toyama. However, in recent years, the number of Itasenpara has decreased rapidly. It is said that Itasenpara in Busshoji river in Himi city became extinct.

Itasenpara is suitable to live on the water temperature below or equal to 5 degrees Celsius, and it is for hatching and eye pigmentation (Kazuhiko et al., 2006) but a global warming may have been affecting a hydrologic cycle and environment such as water temperature and snowmelt in the rivers. In this study, snow storage simulations were conducted in order to evaluate the effects of snowmelt on rivers where Itasenpara live.

2. STUDY AREA

Snow storage and melt model were applied to whole Toyama prefecture, because it is not enough for a point to evaluation climate change impacts on Itasenpara. Itasenpara lives in the Moo river of Himi city, where water temperature data were collected in this studay. **Figure 1** shows the location of Himi city, Toyama prefecture, and the Moo river.

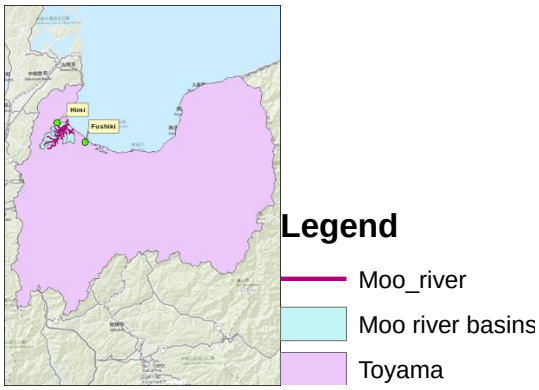

Figure 1. Study area

3. METHODS

In this study, a simplified energy conservation equation (Ohara et al, 2014) known as a degree-day approach is used to calculate the snow melt and snow storage in Himi city, Toyama prefecture, but because the equation is too complex, evaporation and sublimation are not considered here. Also the observed snow water equivalent values were compared.

4. RESULTS

4.1 Calibration simulation: winter simulation in 2011

The snow storage model was first applied to the observation point at the Fushiki in Toyama in 2011 because the snowfall was the largest in 2011, and it was easy to find efficient parameters. **Figure 2** shows the result of calibration. Then the same parameters are used to verify the snow storage of Himi city in the same period. As shown in **Figure 3**, the correlation of those two figures are more than 90%, it means that the parameters used in these simulations are reliable. So we can use the calibrated parameters to calculate the snow storage in whole Toyama prefecture.

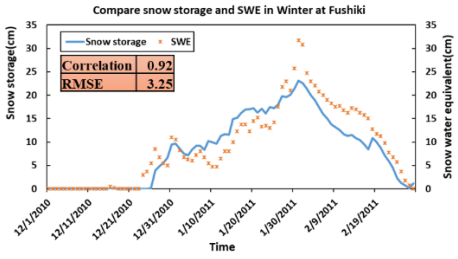

Figure.2 Snow storage between observed and simulated at Fushiki

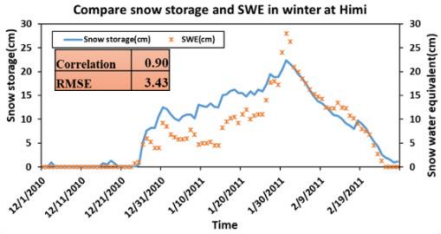

Figure.3 Snow storage between observed and simulated at Himi

4.2 Validation simulation: Annual simulation of 23 years

The following figures show comparison between the simulated snow storage and the observed snow water equivalent in the past 23 years when the observed data is available. And also, due to the limited paper numbers, the simulated results are shown at only

two locations. **Figure 4** shows simulation results at Fushiki, with correlation of 0.77 and a root mean square error of 3.54. **Figure 5** shows simulation results at Himi and results show the correlation of 0.68 and a root mean square error of 3.84. It can be seen that the correlation of Fushiki is greater than that of Himi, and the root mean square error is smaller. Although the correlation of the two points are different, they all show a high correlation. In other words, these parameters can be used to calculate the snow storage in the whole Toyama prefecture in the future.

If the snow melts, what will be the impact on the water temperature of the Moo river? Based on this conjecture, the following investigation was conducted. That is to take the water temperature data of Moo River to analyze whether snowmelt has an impact on it in a short time.

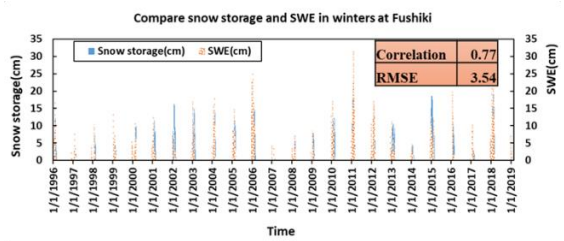

Figure 4. Annual snow storage between observed and simulated at Fushiki in the past 23 years

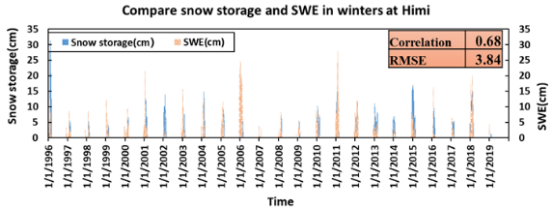

Figure 5. Annual snow storage between observed and simulated at Himi in the past 23 years

5. WATER TEMPERATURE OBSERVATION

Figure 6 shows the observed air temperature, water temperature and the simulated snow melt. It can be seen from figure that the water temperature is correlated with the observed air temperature. Also, it may be seen from the figure that the snow melt might be affecting the water temperature. Especially, after January 6, the temperature decreased, the snowfall increased and the water temperature decreased rapidly. There are many points lower than 5℃, it is suitable for Itasenpara to lay eggs and form eye pigment.

Since Itasenpara is living in Moo river, the temperature of the water directly affects its life, it means they are easy affected by a climate change in the future. So that we need to do a hydrologic simulation in the future. To evaluate whether the water temperature is suitable for its survival.

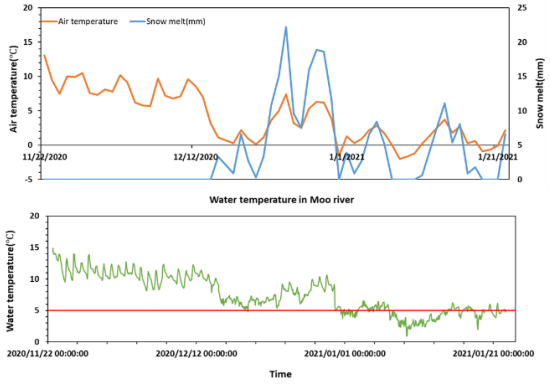

Figure 6 Simulation results in two months

6. FUTURE TASK

It is necessary to calculate the snow storage and snow melt of Toyama prefecture in the past decades, hydrologic simulation to confired that wether snowmelt has an impact on discharge. Then simulate the future snow storage and snow melting conditions, preliminarily determine the possible impact on water temperature, and then evaluate whether it is suitable for Itasenpara to survive.

7. CONCLUSIONS

According to the results of the snow storage simulations, the simulation was modeled reasonably well only one winter, but for 23 years winters, the correlation is a little lower, it can be proved that there is a great correlation between the simulated values and the observed values, which will be used for the calculation of snow storage in the future. From the monthly simulation for water temperature, snowmelt has a great impact on water temperature, in order to further determine, we need to do a hydrological simulation in the future. It should be emphasized that the snow melting is a key point for the habitat evaluation of Itasenpara because they require the low water temperature below 5 degree Celsius.

REFERENCES

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