

Study on the Evaluation of the Impact of the Kumamoto Earthquake on the Water Cycle, Especially Groundwater in the Kumamoto Area from the Aso Caldera

Principal Investigator: Tsutomu ICHIKAWA

Institution: Tokai University, 9-1-1 Toroku, Higashi-ku, Kumamoto 862-8652, JAPAN

Tel: +81-96-386-2706 / Fax: Not Applicable

E-mail: it061082@tsc.u-tokai.ac.jp

Cooperated by: Nagasaki University, National Agriculture and Food Research Organization Kyushu-Okinawa Agricultural Research Center

[Abstract]

Key Words: Water circulation, Kumamoto earthquake, Grassland, Groundwater, Agricultural field

In this study, water cycle simulations were conducted to evaluate the effects of land cover changes such as grasslands and paddy fields, and disasters such as the Kumamoto earthquake on the water cycle in the Kumamoto area from within the Aso caldera. The results showed that if paddy fields within the caldera were to disappear, groundwater recharge would decrease significantly, having a significant impact on the amount of water cycle. In Minamiaso, where grasslands have already been greatly reduced, it was also found that an increasing grasslands will lead to an increase in the amount of water cycle. Hence, the importance of grasslands and paddy fields in the water cycle was confirmed. Although no significant changes in the water cycle were observed in the caldera as a whole due to the earthquake, groundwater discharged from the mountain body due to the large shaking of the earthquake, and local changes in the water cycle, such as depletion of springs at high locations, were observed. The local changes affected the irrigation system. Although the depleted springs are recovering, the increase in groundwater outflow has not subsided six years after the earthquake, and the depletion occurs before the rainy season.

Groundwater flow was discovered at the Tateno Barranco, the connection between the Aso caldera and the Kumamoto area, and it is estimated that about 15 million m³ of groundwater flows through the Barranco per year. Furthermore, rainfall infiltration water on the western slope of the Aso Outer Rim discharges approximately 130 million m³ per year into the groundwater in the Kumamoto area. Then, water of 70 million m³ per year is recharged from the paddy fields and waterlogging projects using the Shirakawa River, which emanates from the Aso caldera, into the groundwater in the Kumamoto area. The total of these amounts occupies about 38% of the annual water supply to the groundwater in the Kumamoto area. Therefore, the Aso caldera and the Kumamoto area are considered to constitute a close regional water circular and ecological sphere. As a creative recovery from the Kumamoto earthquake, residents of the Kumamoto metropolitan area and companies that use groundwater downstream must increase their interaction with the Aso caldera upstream so as to build a sustainable agriculture and livestock industry that will maintain grasslands and paddy fields.

[References]

- 1) H. AMANO and Y. IWASAKI: Sustainability, 14, 1, 545, 19 pages (2022) (IF:3.251)
Estimation of Groundwater Recharge in Kumamoto Area, Japan in 2016 by Mapping Land Cover Using GIS Data and SPOT 6/7 Satellite Images
- 2) H. AMANO and Y. IWASAKI: Int. J. Environ. Res. Public Health, 17, 18, 6605, 18 pages (2020) (IF:3.390)
Land Cover Classification by Integrating NDVI Time Series and GIS Data to Evaluate Water Circulation in Aso Caldera, Japan