DROUGHT RISK INDEX FOR NATIONWIDE COMPARIOSON IN SOUTH KOREA

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Abstract

Drought indices for the assessment of the potential hazard have been developed focusing on meteorological drought. However, these indices do not reflect the social aspects parting of socio-economic drought. To deal with this problem, we considered the factor of society and recommended the Drought Risk Index (DRI). DRI is comprised of three components, which are hazard, exposure, and capacity. Hazard is computed by climate characteristics (e.g. monthly precipitation), while Exposure depends on the water demand of agricultural, industrial, and municipal sectors. Capacity is divided into adaptive and coping capacities. DRI was conducted for regional comparison and projection for future DRI performed using HadGEM3-RA under RCP 4.5 and 8.5. In conclusion, the highest drought risk appears near the metropolitan area in the entire 21st century.

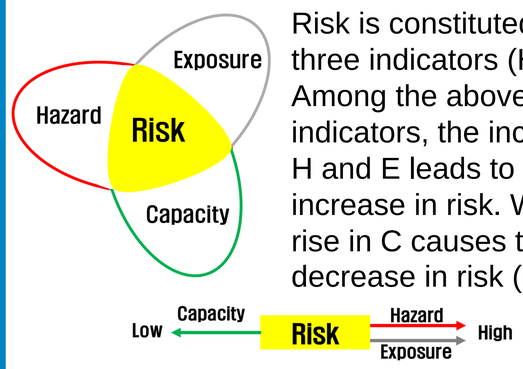
Keywords: drought, drought risk assessment, hazard, exposure, capacity.

Methods

Since the conceptual model for drought risk assessment was applied, the concept of risk should be explained clearly.

Definitions:

- **Drought risk:** the probability of potential damage causing drought affected by climate change.
- **Hazard (H):** the **causation** for drought.
- **Exposure (E):** the **objects** exposed to drought.
- **Capacity (C):** the **ability** of society to **cope with** or **adapt** drought.



Risk is constituted of three indicators (H, E, C). Among the above indicators, the increase in H and E leads to the increase in risk. While the rise in C causes the decrease in risk (Figure 1).

Figure 1: The concept of risk framework (Kim et al., 2019).

Using Eq. [1], drought risk is calculated in the index, a suitable approach for **relative comparison.** Also, the index can determine the **priorities** of the region for disaster management.

$$Drought\ Risk\ Index(DRI) = H^{\frac{1}{3}} \times E^{\frac{1}{3}} \div C^{\frac{1}{3}} \quad [1]$$

Application

For DRI, the 22 data sets are collected to components at 113 basin in Korean Peninsula.

- **H:** the **standardized precipitation index (SPI)** for past and future scenarios (HadGEM3-RA)
- **E:** the **water demand** to use (municipal, agricultural, and industrial)
- **C:** the **coping capacity** – water resources infrastructure data (e.g. emergency water supply facilities, dam and reservoir storage), the **adaptive capacity** – socio-economic status and ability (e.g. per capita personal income, financial self-reliance ratio).

Each component's weight is conjugated Pearson correlation coefficients between the component and drought damage. According to the correlation, the weighted average of the value from 1 to 7 is given at each component. The higher the correlation, the higher the weight.

Results

The relative comparison of past period DRI, three indicators (H, E, C) and future DRI are shown in Figure 2 and Table 1.

The trend of future DRI as mean:

- RCP 4.5: increase in the early 21st century
- RCP 8.5: increase in the mid 21st century

Although the mean of future DRIs increases or decreases according to the future period, it is confirmed that all **maximums** of future DRIs are **higher** values than in the past period.

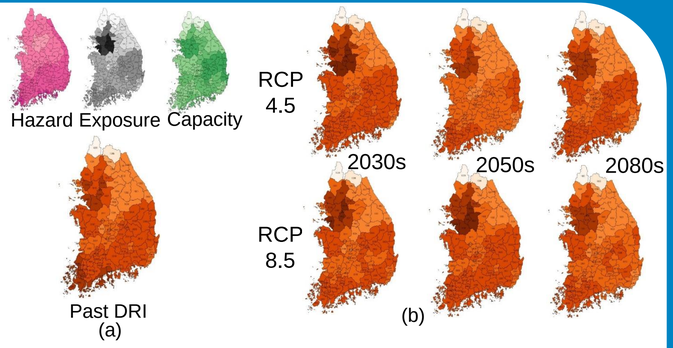


Figure 2: (a) Past DRI, (b) Future DRI with HadGEM3-RA.

Table 1: Future DRI ratio against past DRI with HadGEM3-RA

		2030s	2050s	2080s
RCP 4.5	MEAN	+2.69%	-5.45%	-2.07%
	MAX	+15.40%	+0.59%	+6.43%
RCP 8.5	MEAN	-0.94%	+2.74%	-2.87%
	MAX	+11.88%	+12.56%	+4.89%

Conclusions

For the spatial comparison, the increasing trend indicates the regions near the **metropolitan cities,** including Seoul, while the decreasing trend shows near the southeast area of South Korea.

Bibliography

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