インドネシア・バンテン州シダナウ流域における将来の気候変動下における乾季の季節パターンの分析

Analysis of Seasonal Pattern of Dry Seasons under Future Change of Climate in Cidanau watershed, Banten province of Indonesia

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1. Introduction

Climate change has been accelerated by increased greenhouse gas emissions, which are responsible for global warming. Climate change results in uncertainty in weather, which can effect irregular seasonal shifting (IPCC, 2018). The purpose of this research is to identify and analyze the future impact of climate change in seasonal pattern of dry seasons.

2. Study area and methods

Cidanau watershed is located between 6.13°S–6.30°S and 105.82°E–106.07°E in Banten Province, Indonesia and has an area of approximately 226.2 km^2; it is a priority watershed in Indonesia and has natural wetlands surrounded by mountains. Its elevation is between 0 and 1765 m above sea level (asl), with mountainous areas in southern part upstream and lowlands in the western part downstream (Fig.1). The region is tropical dominated by the monsoon and has a mean annual rainfall of > 2200 mm, with the highest monthly rainfall of > 300 mm between December and February and the lowest monthly rainfall of < 100 mm between July and August. The daily temperature ranges from 21°C to 33°C, with the highest and lowest temperatures occurring in January and August, respectively.

To predict future scenarios of climate change, CMIP6 which combines SSPs and RCPs (Menshuhasen et al., 2019), was used for climate change projections in this study. Daily rainfall and temperature projections under combination scenarios, including the SSP1-2.6 (sustainability-green road), SSP2-4.5 (middle of the road), and SSP5-8.5 (fossil fueled development- highway) scenarios (Grose et al., 2020) from four CMIP6 GCMs, were obtained from the Coordinated Regional Climate Downscaling Experiment (CORDEX) for the future period from 2015 to 2100. The future changes were calculated respective to the period from 2002 to 2021 (20 years) as baselines periods for 2041–2060 (short-term), 2061–2080 (midterm), and 2081–2100 (long-term) periods

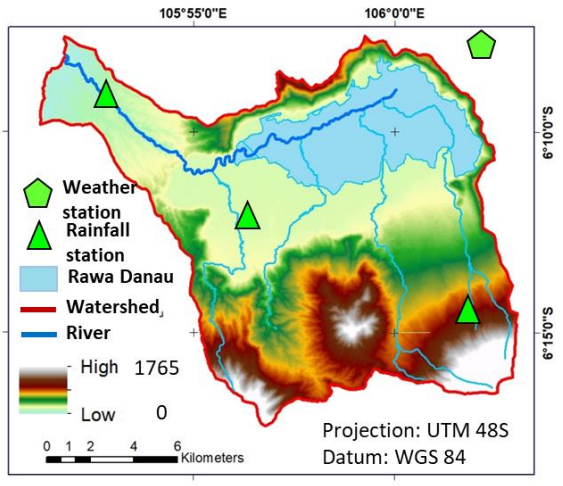

Fig.1 Study area in Cidanau watershed

To determine wet and dry seasons, the rates of rainfall and evapotranspiration that can be

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Keywords: climate change, CIMP6, determining dry seasons, seasonal pattern, SSPs

expressed in another form as the first derivative of continuous functions of cumulative rainfall and evapotranspiration were used. The relevant equation is as follows:

$$N_t = R_t - ET_t, \qquad (1)$$

Where N_t is the rate of water balance (in mm day^{-1}), R_t is the rate of rainfall (in mm day^{-1}), and ET_t is the rate of evapotranspiration (in mm day^{-1}). Then, the dry season can be defined when R_t is lower than ET_t, Which is called a deficit. Meanwhile, the wet season can be defined when R_t is higher than ET_t, it is called surplus.

3. Result and discussion

The probability of future dry season length in all periods increased from 0% in the baseline to 4%–7% in the 121–150-d interval and 1–4 % in the 151–180-d interval under SSP1-2.6, to 3%–7% in the 121–150-d interval and 2–8% in the 151–180-d interval under SSP2–4.5, and to 11%–15% in the 121–150-d interval,3%–4 % in the 151–180-d interval and, 0%–3 % in the 181–210-d interval under SSP5-8.5 (Fig.2). The results indicate that the most probable event of the longest dry season is expected to change and occur further longer in the future under all scenarios

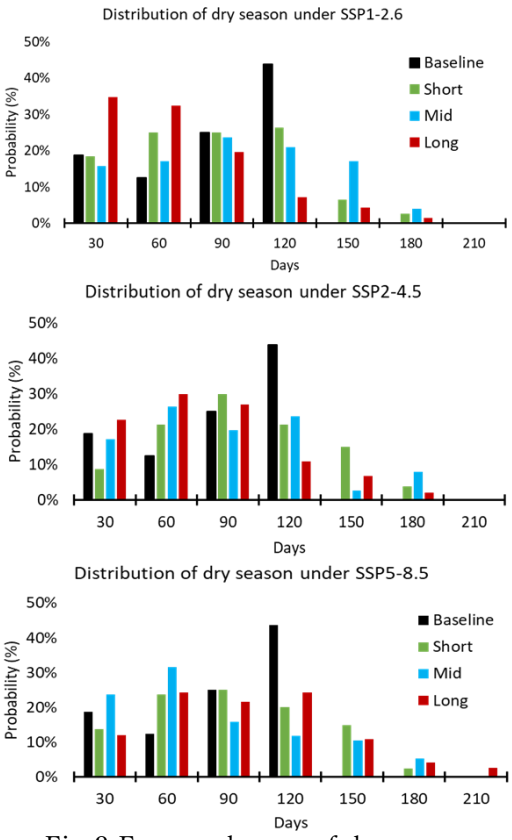

Fig.2 Future change of dry seasons

The mean length of dry season in SSP5-8.5 is expected to considerably increase from 70 d in the baseline to 86 d in the future, that in SPP1-2.6 is expected to considerably decrease from 70 d in the baseline to 51 d in the future, whereas that in SSP2-4.5 is expected to not considerably change from 70 d to 66 d (Fig.3). The results show that there will be no significant change in the mean dry season length under SSP2-4.5 in all periods, with longer dry season in the midterm and shorter dry season in the long-term under SSP1-2.6, and as well as longer dry season in the midterm and long-term under SSP5-8.5. We found that even though the mean dry season length will vary in the short, middle, and long term, the most probable event of the most extended dry season relative to the baseline is expected to occur further longer in the future under all scenarios.

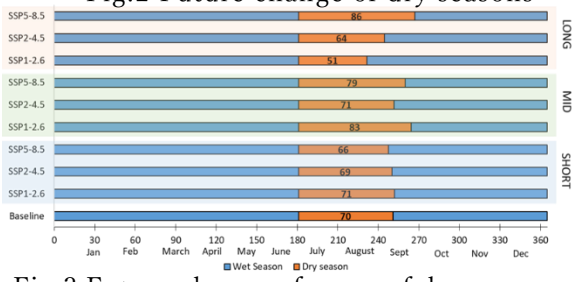

Fig.3 Future change of mean of dry seasons