

2.3. Drought

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Drought has a detrimental effect on humans, animals and plants. Periods of drought in Switzerland occur in different measure and at different times in the various climatic regions. In the Central Lowlands, no trend could be established for droughts in the 20th century. Only limited scientific knowledge is available on possible changes in drought as a result of climate change. To the south of the Alps, lower runoff rates and drier soils are expected. In the same way, the rivers north of the Alps that are fed by melting snow will probably carry less water owing to reduced snowfall in summer and autumn.

Introduction

Drought is a complex phenomenon, and definitions vary considerably. These are often based not only on meteorological, climatological and hydrological criteria but also on the economic consequences of drought. From the meteorological standpoint, drought signifies "a period of abnormally dry weather sufficiently prolonged for the lack of water to cause serious hydrologic imbalance in the affected area".¹ More generally, "drought is a condition of moisture deficit sufficient to have an adverse effect on vegetation, animals, and man over a sizeable area".²

During dry periods, precipitation is absent for a longer period, the ground dries out, the groundwater table sinks, and rivers, streams and smaller standing waters carry less water or dry out entirely. The effects on agriculture and other commercial sectors depend significantly on the time of year at which they occur (e.g. growth season in agriculture, start of the ski season in winter tourism, etc.). Drought must also be seen in relation to the average climatic conditions in a region.

At least where the Swiss Central Lowlands are concerned, the water levels of the small and medium-sized streams and rivers, and/or their runoff, are a good measure of drought. These indicate the hydrological balance in an entire catchment area, and are hardly affected by occasional rainy days during a longer period of drought. In order for it to serve as a useful indicator, a stream or river should neither be fed directly by a lake, nor have artificial inflows or outflows. In the mountains, runoff is an unsuitable measure of drought owing to the influence of melting snow and ice. Here, low runoff occurs in the winter months.

From the standpoint of natural science, the MAM7 (7 day duration mean annual minimum) index has proved a useful measure of drought. This is based on the lowest average runoff during seven successive days within a calendar year. MAM7 is a sensitive measure of pronounced dry phases, since for low MAM7 values to occur, the time period of 7 days identified must be embedded within a longer period of drought.

Importance of drought

Drought has detrimental effects both ecologically and economically^{3,4}, and certain of these may have political consequences.

Ecological effects

During dry weather periods, less water is in motion. Also, since periods of drought and heat often coincide, the water temperature is often higher. Dissolved substances are not diluted to the same



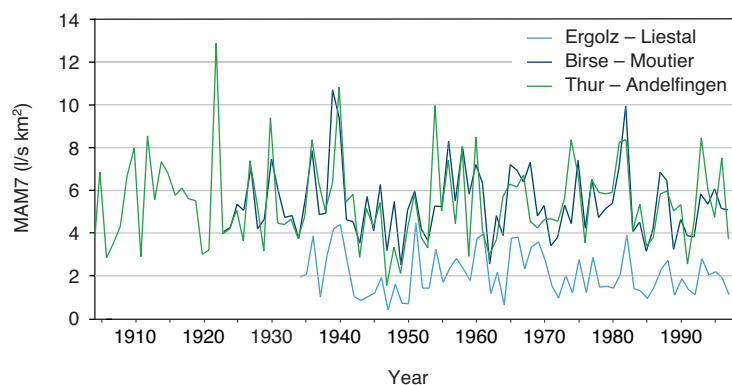


Fig. 26 Lowest average runoff for 7 consecutive days (MAM7 in $l\ s^{-1}\ km^{-2}$) for each year of the time series for the rivers Thur (in Andelfingen), Ergolz (in Liestal) and Birs (in Moutier).⁵

extent and are therefore present in higher concentrations. The dissolved oxygen content of the water decreases. The situation is made more serious if during dry phases water is taken from the rivers for irrigation purposes. Many water organisms thereby experience stress, particularly fish. Their mortality rate increases. Waterside vegetation also suffers from drought, and this can adversely affect animals in the wild.

Economic effects

The water supply is affected by enduring periods of dry weather. Drinking water (from springs and groundwater) can become scarce, and those branches of industry having a high demand for water can suffer restrictions in production (e.g. paper industry and those with high cooling water demands). Energy production in run-of-river and reservoir power stations can be reduced. Also, thermal and atomic power stations may be affected where insufficient cooling water is available, or where additional heating of the river is not permissible. In agriculture, arable and livestock farming may suffer losses in yield. Winter tourism may be affected by inadequate snowfall, and shipping by low water levels.

Political consequences

When water is scarce, the authorities must order restrictions on the use of water (water saving measures, rationing, etc.), and issue and enforce regulations on the use of water from public sources. In severely affected areas, logistic provisions such as water tankers, water pumps, supply pipelines and temporary reservoirs must be provided to avoid scarcity, and measures to maintain hygiene introduced.

Overall, drought is not an existential problem in Switzerland thanks to linked international markets and the plentiful supply of water in mountain regions. Furthermore, periods of dry weather are of varying intensity and often do not occur simultaneously in the different regions.

Observations and trends

By analysing the variations in precipitation and temperature, dry summers may be identified. Over the past 500 years, four extremely dry summers occurred in the Swiss Central Lowlands, namely in 1540, 1669, 1603 and 1947 (in descending order of intensity).⁶ Prior to 1730, dry summers occurred about every 12 to 15 years. Since then, dry summers have occurred only about every 50 years. In the 20th century, only one dry summer was recorded, namely in 1947. The 20th century can therefore be regarded as a particularly favoured century where drought is concerned.

The low-water runoff in various rivers in the Central Lowlands (Fig. 26), which are hardly influenced by human activity except in periods of drought, present a consistent picture.⁵ Here, the year 1947 mostly appears as the driest year. No trend is identifiable in the Swiss Central Lowlands during the 20th century.

Owing to a lack of suitable data to evaluate, the situation to the south of the Alps, and in the Alps themselves, cannot be assessed.

Future changes

According to IPCC⁷, an increase in the intensity of continental summer droughts, and thus the risk of drought over most inner continental areas in central latitudes, is probable in conjunction with climate change.

When dry periods or drought arise in an area, the entire water regime is affected. However, information on changes in precipitation and temperature are not sufficient to assess possible changes in the occurrence of drought. Rather, a knowledge of changes in the intensity of precipitation and the sequence of rainy days at different times of year are needed.

Forecasting precipitation trends is difficult, and is accompanied by considerable uncertainty.

Possible changes include a shift in precipitation distribution in the Alpine region and in other parts of Europe, an increase in the average intensity of precipitation, and a decline in the water content of the ground in summer.

As a result of climate change, more rain and less snow will fall at low and central altitudes, and the snow reserves in the mountains will decline. In areas lacking large water reserves in the form of snow – particularly to the south of the Alps – reduced runoff, more extreme low water and drier soils must generally be expected in summer owing to reduced precipitation and higher temperatures. Also, rivers to the north of the Alps fed by melted snow will probably show reduced runoff owing to reduced snow reserves in summer and autumn. Particularly in the lower reaches of the Rhine, this will lead to more extreme low water, with associated adverse affects on shipping.⁸

Our knowledge of future changes in the occurrence of drought in Switzerland is limited. Any such changes could have relatively extensive consequences. In the past, drought often affected large areas. Despite international trade links, future short-term economic consequences could be significant. The ecological consequences are also very difficult to assess. Notwithstanding this, water is not generally expected to become scarce in Switzerland or in Alpine regions in other European countries favoured by ample precipitation.

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