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Drought Network News

Oct. 1997–
Feb. 1998

A Newsletter of the International Drought Information Center and the National Drought Mitigation Center

Volume 10
No. 1

From the Director

If it seems like considerable time has elapsed since you received the last issue of *Drought Network News*, it is not just your imagination. After much discussion, we decided not to publish the newsletter in October 1997. First, we had a limited number of submissions to include. Second, the task of editing the manuscript for a new drought book was an overwhelming task that was involving much of my time and that of my publications specialist, Deborah Wood. She is also responsible for *Drought Network News*. With more submissions and the near completion of the drought book, I am pleased to be publishing this issue of the newsletter.

The National Drought Mitigation Center (NDMC) organized and conducted two training workshops on drought contingency planning in 1997. These workshops were very successful, with more than 200 participants representing a diverse background of tribal, local, state, federal, and regional organizations and agencies. Three more workshops are planned for this spring. An article about the workshops is included in this issue (p. 3).

The National Drought Policy Act continues to be discussed in the U.S. Congress. The Senate version of the bill (S222) passed last November. An identical version of the bill was introduced in the House of Representatives (HR3035) in November. I testified in support of the bill at a hearing in late January. Although some minor modifications may be made in the bill, it is expected to pass the House. This bill would establish a commission to review existing drought programs at the federal, state, and local level and make recommendations to the Congress and the president on the elements of a national drought policy. The commission would have 18 months to complete its task. The NDMC will work closely with the commission.

The Western Drought Coordination Council (WDCC) is completing its first year of activities. The WDCC was formed by the Western Governors' Association in June 1997 to improve response to drought emergencies in the West, as well as enhance the level of drought preparedness and mitigation in the region. The WDCC is headquartered at the NDMC. (The WDCC was discussed in more detail in the June 1997 issue of *Drought Network News*.) The working groups of the WDCC have completed a number of products, which are (or soon will be) available on the WDCC web site (http://enso.unl.edu/wdcc/). Check it out!

Published in cooperation with the World Climate Program of the WMO

With the growing popularity of the Internet and World Wide Web to distribute information and the comparative costs of distributing this information by more conventional means ("snail mail"), I am exploring the possibility of making *Drought Network News* available only in electronic form beginning in 1999. Our network includes about 1,500 persons, and about half of our network members are outside the United States. Current and back issues of *Drought Network News* are already available via the NDMC web site (http://enso.unl.edu/ndmc/). Although we have been successful obtaining funding for the newsletter up to this point to cover printing and distribution, resources are becoming more and more limited. If you have any comments on electronically distributing the newsletter, I would welcome them.

This issue of *Drought Network News* contains articles about Bulgaria, India and Indonesia, Poland, and China. There has been a lull in recent months in article submissions for publication in *Drought Network News*. Members of the drought network are encouraged to submit articles and reports for publication. Through my participation in international meetings, I have discovered how valuable this information is to the scientific and policy community. It is critical that we share information and lessons learned with others. **The deadline for receipt of articles for publication in the June issue of *Drought Network News* is May 1, 1998.**

Donald A. Wilhite

Contents

Planning for the Next Drought

A National Drought Mitigation Center Workshop Sponsored by the U.S. Bureau of Reclamation and the National Governors' Association

Southeast: Columbia, S.C., March 31–April 2, 1998
Great Plains: Rapid City, S.D., May 6–8, 1998
Midwest and Northeast: Ft. Mitchell, Ky. (Cincinnati area), May 12–14, 1998

Purpose and Objectives

The drought that gripped the Southwest and southern Great Plains states in 1996 was the most recent reminder of the nation's continuing and apparently increasing vulnerability to drought. Although drought is a common feature in the West, it is a normal part of the climate of each region of the United States: drought struck the Southeast in 1986; most of the country, especially the Midwest and Plains states, in 1988–89; the West from 1987 to 1992; and the Northeast in 1995. Experiences from each of these droughts reinforce the need for advance planning. Even though drought is a slow-onset disaster, it is difficult to respond quickly and effectively to reduce the effects of drought unless a contingency plan is already in place. Citizens and stakeholders benefit from the coordinated efforts of local, state, federal, and tribal governments and agencies.

The National Drought Mitigation Center is organizing a series of workshops, each in a different region of the country, on how to prepare for drought. Workshops in Albuquerque and Salt Lake City were held in July and November 1997, respectively, and additional workshops are now planned for the Southeast, Midwest and Northeast, and Great Plains regions.

Workshop participants will learn how to develop a drought plan. Participants will also have the opportunity to discuss their specific planning needs with experts and learn how others coped with recent droughts.

The objectives of the workshops are to:

- help people understand drought and the need for drought planning;
- teach natural resource managers, water utility managers, emergency managers, planners, and others how to develop drought contingency plans;
- help different levels and agencies of government coordinate drought-related programs.

Workshop participants are expected to include local, state, and federal officials; tribal representatives; people responsible for managing water and other natural resources; people in industries affected by drought, such as agriculture, energy, water utilities, recreation, and transportation; reporters; and others interested in reducing vulnerability to drought.

Program

The workshops will focus on early warning systems, vulnerability assessment, drought mitigation, and planning and preparedness. Other sessions will highlight involving stakeholders in advance planning; Internet resources; urban water conservation programs; and how various federal programs and resources can ease drought's effects.

Registration

The workshop has no registration fee. Please register at least two weeks in advance, or sooner, because space is limited. You may register via e-mail by sending the following information to ndmc@enso.unl.edu: which of the three workshops you would like to attend; your name, position, and employer; and contact information, including your full mailing address and phone and fax numbers. To request a brochure (containing additional information about accommodations and facilities for each workshop), contact the National Drought Mitigation Center, University of Nebraska–Lincoln, P.O. Box 830749, Lincoln, NE 68583–0749; phone: (402) 472–6707; fax: (402) 472–6614.

Spring Crops in Bulgaria Damaged by 1996 Summer Drought

Studies suggest there is a decreasing trend in precipitation in both north and south Bulgaria because of precipitation deficiencies in the 1940s and since the 1970s. Bulgaria has experienced several summer drought episodes during the last century, most notably in the 1940s and 1980s. There has been a decreasing trend in precipitation during the potential crop-growing season since the end of the 1970s, and the number of 10-day dry spells during this season has increased since the beginning of the 1970s. In the course of the last 3 decades, there was a decreasing trend in precipitation during the nongrowing season below a base of 5°–10°C. There was also a tendency toward more precipitation deficit periods during the actual growing season of spring crops (from sowing to full maturity).

A large deficiency in precipitation was observed during the summer of 1992. The 1992 drought persisted through 1993. In fact, from 1984 to 1993, the country experienced more than 5 years of drought conditions of various intensities, depending on location. There is no doubt that climate in Bulgaria has become drier in recent years.

Annual precipitation in the country during 1996 was between 450 mm and 650 mm. In some regions of southeastern Bulgaria, annual precipitation was 720 mm; in the mountain regions, it was predominantly between 700 mm and 800 mm (between 75% and 115% of normal). Thus, after normal precipitation during 1994 and 1995, relatively low precipitation occurred again in 1996.

At the beginning of January 1996, air temperatures sharply decreased and snowfall occurred. In most of the country, the snow cover remained. After January 24, the air temperature fell below -20°C, and a long spell of cold weather hit primarily the eastern part of Bulgaria, where in the superficial soil layer the temperature fell to -25°C. The winter season persisted in February and March. The cold weather kept the crops dormant and the snow cover preserved them (Figure 1).

In the third 10 days of April, a period of accelerated development and growth of winter wheat began. Because of the unusually long winter (November–March) and the late spring, the crops, although not frozen, were weak and poorly developed. Cold weather in March and April and snowmelt resulting in oversaturated soil prevented the timely sowing of spring crops by more than a month. By the end of the third 10 days of April, no rainfall had occurred.

In May, a spell of sharply warmer weather (especially during the second 10 days, when maximum air temperatures reached 30–35°C) increased the development of all agricultural crops. However, higher temperatures caused a great thermal gradient between air and soil temperatures, which slowed crop growth and development.

In June, agrometeorological conditions created additional troubles with above-normal thermal conditions, because mean monthly air temperature was about 2°C above the mean multiannual value (Figure 1). In June, when climatic conditions usually lead to maximum precipitation amounts in the country, precipitation was only a third of normal (1961–90 normals) and a soil drought had set in. In the top 1 m of the soil layer, total water reserves of the cereal crops had reached critical values. Because of this, heads of winter wheat remained small and wheat grains were undersized and underfed. Furthermore, some winter wheat crops died. During the period of the current climate normals (1961–90), the national annual winter wheat grain production in Bulgaria was 3,488,000 tons, with an average yield of 3,290 kg/ha, but in 1996, total production was only 1,757,000 tons and average yield was only 1,840 kg/ha, with low baking qualities.

In July, agrometeorological conditions were characterized by high temperatures, with maximum val-

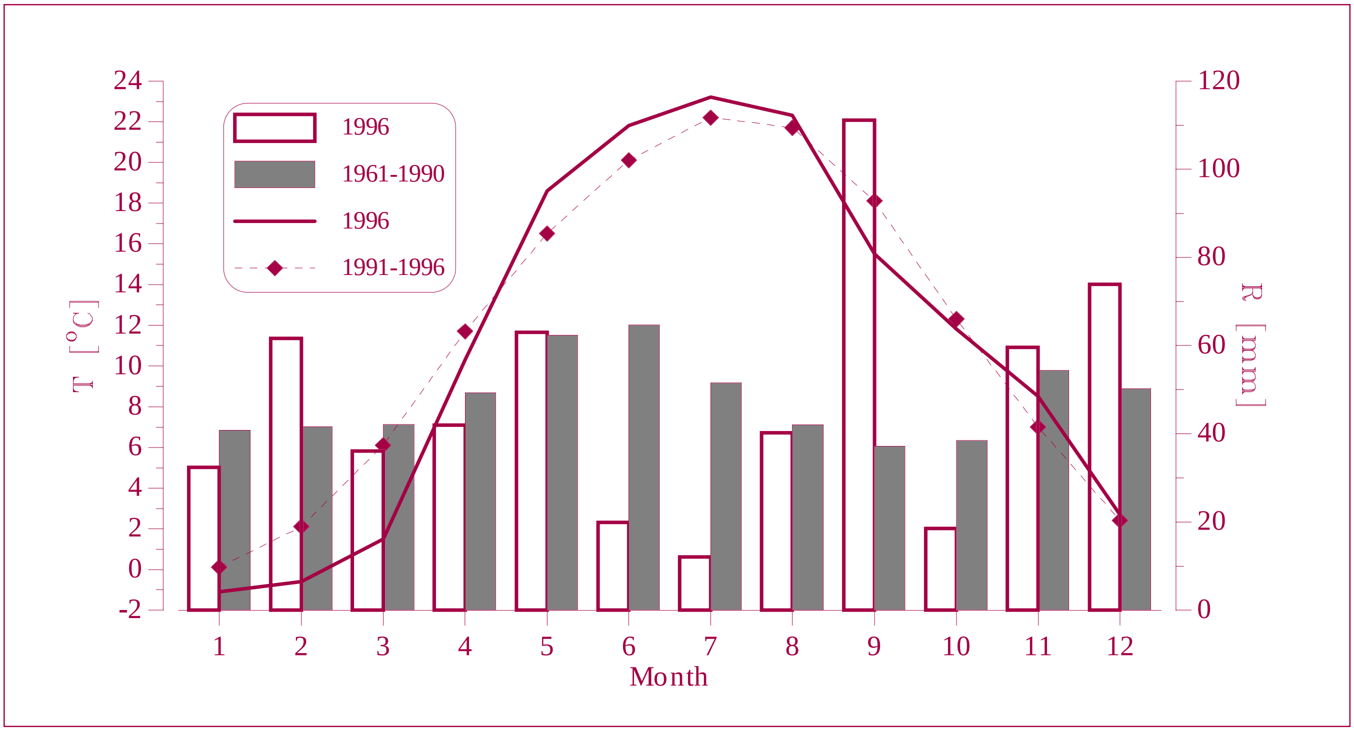

Figure 1. Current and 1996 climatic values of monthly air temperature (lines) and precipitation (bar charts) in Bulgaria.

ues reaching 33–35°C. Atmospheric drought hit the entire country. Precipitation for the month was only 5–10 mm, and at the beginning and end of July no precipitation fell (Figure 1). At the end of the month, the water reserves of the spring crops reached 30–40 mm in the top 1 m of the soil layer, which limited crop development and hampered the growth of all spring crops. As a result, crop reproductive organs were not well developed. The warm and dry weather continued into August.

Generally, the summer was characterized by unfavorable agrometeorological conditions, which led to important aberrations in spring crop production. During the 1961–90 period, the annual average yield of maize, Bulgaria's main forage crop, amounted to 2,252,000 tons, with an average yield of 3,754 kg/ha. In 1996, total maize production was only 998,000 tons, with an average yield of 2,790 kg/ha. Precipitation at the end of August and the beginning of September made harvesting the scanty crops difficult.

The 1996 summer precipitation deficit in Bulgaria was the third drought occurrence during the spring crop-growing season for the last ten years. These droughts were combined with significant daily variations of air temperature. The large air temperature amplitudes caused stress for agricultural crops. As a result, the crop physiological processes, formation of reproductive organs, and (above all) grain filling were disturbed. These unfavorable meteorological conditions caused decreases in yields of major agricultural crops, which in turn affected the food supplies of the Bulgarian population.

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India, Indonesia experiencing opposite effects from 1997 El Niño

It is now well recognized that the El Niño/Southern Oscillation (ENSO) phenomenon is the single most important cause of year-to-year climatic variability. Several studies have documented that a majority of the warm extremes (El Niño events) cause below-normal rainfall over Indonesia, while cold extremes (La Niña events) cause above-normal rainfall over India.

During the current ongoing El Niño episode, temperature anomalies in the Niño 1+2, Niño 3, and Niño 3.4 regions have been the largest values observed in the last 50 years. The pattern of anomalous tropical convection with enhanced activity across the central and eastern equatorial Pacific and suppressed convection over the Indonesian and western Pacific has prevailed since March 1997. This has resulted in drought over Indonesia. Much of Indonesia is suffering its worst drought in 50 years as a result of the effects of the latest El Niño system on weather. However, during this episode, the June–September Indian monsoon rainfall (IMR) was normal—102% of the long-term average. In fact, some regions experienced severe floods. We propose a new hypothesis to explain this.

The IMR has shown distinct above- and below-normal epochs. The periods 1880–95 and 1930–63 are characterized by above-normal rainfall, while the periods 1895–1930 and 1963–90 are characterized by below-normal rainfall (Kripalani and Kulkarni, 1996). The standardized IMR for 14 El Niño cases during below-normal epochs and 9 El Niño cases during above-normal epochs is -1.5 and -0.4, respectively. These means are significantly different at the 1% level, suggesting that the impact of El Niño is more severe during the below-normal epochs than it is during the above-normal epochs. A close examination of the epochal behavior of IMR indicates that around 1990, the IMR tends toward an epoch of above-normal rainfall, implying that after 1990, the impact of El Niño may not be severe for a decade or two. This may be why India did not experience a drought during the 1997 El Niño episode (for details, see Kripalani and Kulkarni, 1997a).

A similar analysis with Indonesian rainfall reveals that whereas the average standardized rainfall during the below-normal epoch is -1.1 (based on seven El Niño cases), it is -0.7 (based on 6 El Niño cases) during the above-normal epochs. The difference between the means is not statistically significant, suggesting that the El Niño can cause drought over Indonesia during the below-normal epoch as well as the above-normal epoch (Kripalani and Kulkarni, 1997b). This explains the 1997 El Niño-related drought over Indonesia.

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Droughts in Poland, 1951–90

Introduction

One of the negative features of Poland's climate is the periodic occurrence of atmospheric droughts. The most frequent source of this phenomenon is the occurrence of long-term (sometimes lasting several weeks) rainless periods. The occurrence of these periods is connected with the persistence of a stationary east European high that joins with the Azores anticyclone via central Europe. In such situations, with the accompanying lack or insufficiency of atmospheric precipitation, a drought begins to develop gradually. First, a soil drought appears, followed by hydrologic drought. During a hydrologic drought, a decrease in the ground water flow into surface waters is observed, among other phenomena. This results in the reduction of water flow in rivers. During such periods, a significant drop in the level of underground waters, as well as drying of some springs and small water courses, is observed.

In its initial phase of development, a drought exerts its first negative effects on crops. Intensification of this phenomenon also causes disturbances in other sectors of the national economy. Droughts and their negative results do not pose the same threat to all areas of Poland, although in general the influence of droughts is stronger here than in the majority of central European countries. This situation is the result of a combination of natural and historic factors.

One of the areas of interest of the Institute of Meteorology and Water Management (IMGW) is continuous monitoring and assessment of the course of meteorological and hydrological phenomena occurring in all areas of Poland. When preparing an analysis of the course of successive periods of drought spells, specialists from the IMGW branch in Poznan noticed the absence of similar studies of this phenomenon in Polish literature. In an attempt to fill this gap, they catalogued all droughts that occurred in Poland from 1951 to 1990. The research methods adopted in this study, and also the general characteristics of droughts in Poland, are summarized in this article.

Materials and Methods

When describing drought phenomena, three interrelated elements of the natural environment were taken into consideration: meteorological conditions, surface waters, and underground waters. The criteria used to characterize drought in each of these elements are presented below.

In the case of atmospheric droughts, the following indices were applied:

- ratio of the height of the atmospheric precipitation in a given period to the sum of multiannual averages assumed as a norm, expressed as a percentage (according to Z. Kaczorowska) (see Table 1);
- index of climatic dryness (climatic water balance), calculated from the following formula:

$$K = P - E$$

where K = index of the climatic dryness (mm), P = atmospheric precipitation (mm), and E = potential evaporation (mm);

Character of period	Height of Atmospheric Precipitation (% of normal) Year/Season	Month
Average	90–100	75–125
Dry	89–75	50–74
Very Dry	74–50	25–49
Extremely Dry	below 50	below 25

Table 1. Ratio of the height of the atmospheric precipitation in a given period to the sum of multiannual averages assumed as a norm, expressed as a percentage.

- potential evaporation according to N. N. Ivanov:

$$E = 0.0018\ (25 + T)^2\ (100 - f)$$

where T = mean air temperature (°C) and f = mean relative air humidity (%).

The limiting value of the climatic water balance was defined as 200 mm/year; values below this indicate the occurrence of an intense drought. Values below 300 mm/year indicate a very intense atmospheric drought. The above criteria for identifying atmospheric drought were applied to precipitation data from 131 measurement stations and (in the case of data referring to elements used to calculate potential evaporation) 56 meteorological stations. Only those atmospheric droughts that occurred on at least 50% of the entire area of Poland were considered.

The occurrence and course of droughts with reference to surface waters was based on analyses of daily flows from 50 water-gauging stations in Poland. Low-flow periods were determined on the basis of the limiting flow (Q_G—calculated for each station)—i.e., the mean flow from the lowest annual flows from 1951 to 1990. Daily flow sequences with values lower than the determined flow (Q_G) and lasting for at least 20 days were treated as low flow periods. A hydrological drought was defined as a period in which a low flow was recorded in at least 10 stations in the country. Periods of low flows occurring in summer (summer–autumn low flows) and those occurring in winter (winter low flows) were analyzed separately.

The basis for the isolation of drought periods comprising the first horizon of underground waters was the assumption that, on at least 20% of the area of Poland, the level of occurrence of the first horizon of underground waters was about 50 cm deeper than the multiannual average for a given month of the year. The above criterion was applied to data from 73 observation stations.

Results

For the period 1951–90, fourteen droughts were isolated and described. Their distribution in the period is shown in Figure 1. In general, the analyzed periods are unequally distributed. The highest frequency of drought occurrence was noted in the decades 1951–60 and 1981–90. Figure 1 also illustrates the sequence of the occurrence of drought symptoms in various elements of the hydrological system. The development of a hydrological drought is preceded

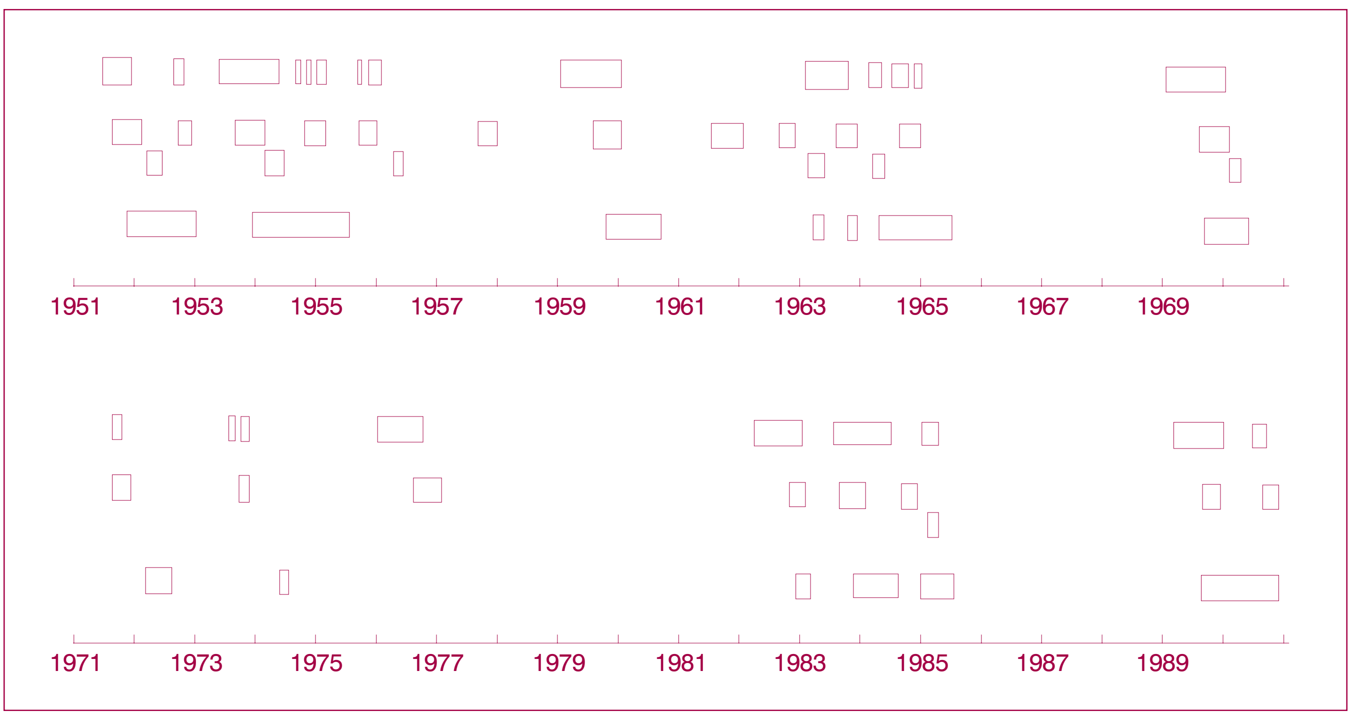

Figure 1. Dry periods in Poland, 1951–90. From top to bottom: first row—atmospheric droughts; second row—hydrological droughts (surface waters), summer–autumn low flows; third row—hydrological droughts (surface waters), winter low flows; fourth row—hydrological droughts (underground waters).

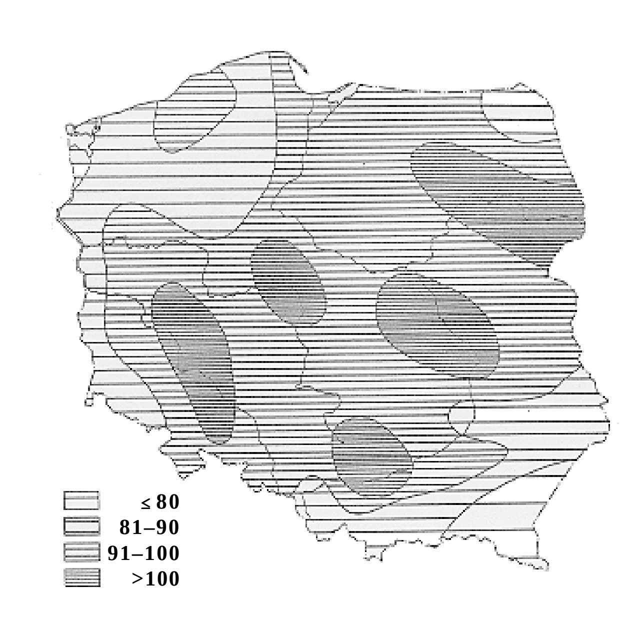

Figure 2. Number of months in atmospheric droughts, 1951–90.

by an atmospheric drought. Analysis confirmed that the beginning of atmospheric droughts in Poland occurs most often in spring–summer months, and the course of atmospheric conditions in this period has a decisive role in determining the depth and areal coverage of drought. The end of drought usually occurs in winter–spring months (November–February).

For hydrological droughts affecting surface waters, the occurrence of summer–autumn low flows was observed to have a significant dependence on atmospheric drought (primarily the shortage of precipitation). In most cases, the beginning of a low-flow period occurred 2–3 months after this deficit was significant. The response of flows to the occurrence of precipitation was usually quite rapid—that is, the end of a hydrological drought commonly occurred in the same (or the next) month in which the atmospheric precipitation was close to or greater than normal.

The occurrence of winter low-flow periods was associated with the appearance of ice on rivers or long periods of low air temperatures (below 0°C) during which the surface flow was stopped and ground water runoff to river troughs was severely restricted.

Drought spells comprising the first horizon of underground water occurred most frequently in summer and autumn. These situations typically result in a considerable lowering of the underground water horizon because of a deficit of atmospheric precipitation, which additionally coincides with common summer situations such as high field evaporation. Relatively few droughts occurring at the end of winter or beginning of spring were caused by a relative shortage of underground water resources resulting from insufficient replenishment. These types of drought spells were of relatively short duration.

Hydrological droughts in underground waters reached their maximum areal coverage most frequently in the winter–spring period, so it was not uncommon that the deficit of underground waters that occurred in the summer–autumn period was further exacerbated in winter.

The end of droughts took place most often in spring or summer. This indicates that only the replenishment of underground water resources in the winter–spring period can end hydrological drought.

When analyzing the drought phenomenon, Polish conditions were also considered. As a result of existing natural conditions, the phenomenon is characterized by the highest stability of its course in the sphere of underground waters and exhibits its highest time and space mobility with reference to atmospheric conditions and surface waters.

The duration of the longest drought periods ranged from 9 to 11 months, and four such situations were recorded in the 40-year study period. These types of long-term droughts were usually also the most extensive ones in terms of areal coverage. The peak drought area usually covered 70%–95% of Poland. An analysis of all cases of isolated atmospheric droughts showed that the phenomenon occurs most often in the center of the Polish lowland, the central south, and part of northeastern Poland (Figure 2).

Similar dependencies were also observed in the case of hydrological droughts. The longest-lasting droughts coincided most frequently with those that were most extensive, comprising more than 40% of the gauging stations used in the study. The longest low-flow periods lasted more than 180 days. The number of low flows analyzed in the 40-year period varied with each station and ranged from less than 4 to more than 20. Analysis of all the collected data revealed that surface water droughts occurred most frequently in the northern belt of the Great Plains of Poland (Figure 3).

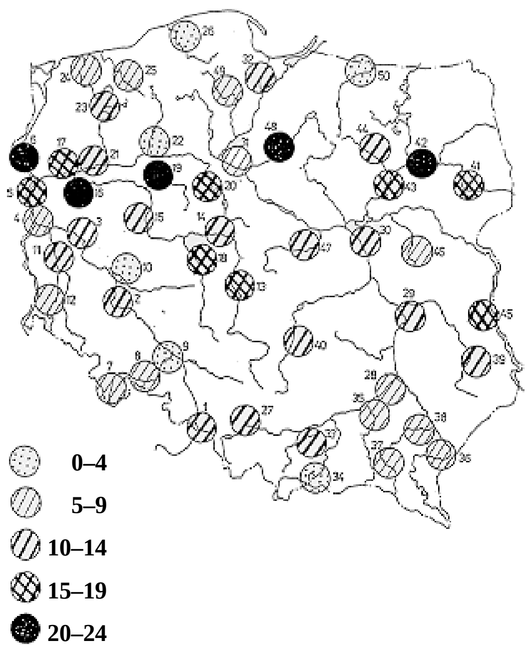

Figure 3. Number of dry periods, 1951–90 (surface waters, low flows).

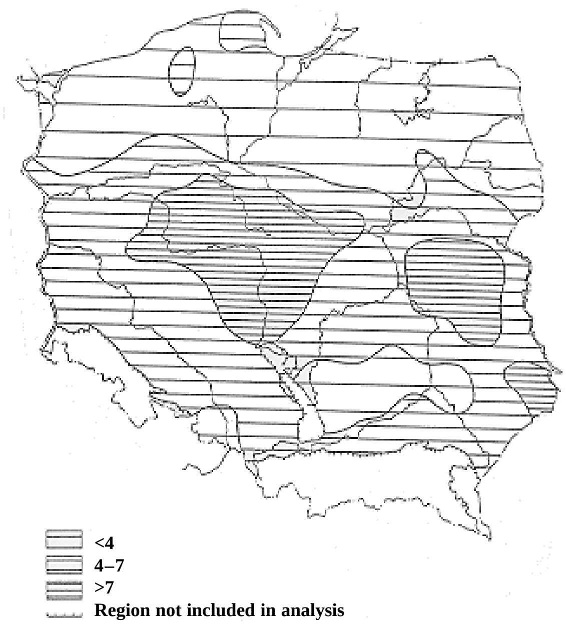

Figure 4. Number of dry periods, 1951–90 (underground water).

Of the hydrological droughts comprising the first horizon of underground waters, 4 droughts lasting more than a year (maximum of 19 months) were isolated. Analysis of their maximum coverage during consecutive periods of occurrence showed that the phenomenon occurred most often in the central and eastern parts of the belt of the Great Plains (Figure 4).

The spatial distribution of the occurrence of drought spells in Poland outlined above is quite unfavorable for the country's economy, especially for agriculture, because a major part of Poland's agricultural potential is concentrated in regions that are most threatened with the possibility of drought.

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China's Drought Climate Monitoring System

In China, about 50% of the country is in arid and semiarid regions. Drought is the most severe climate disaster to affect China, and it causes significant reductions in grain yields. The area affected annually by drought has been estimated at about 20 million ha, which accounts for 59% of the total area affected by disasters. When severe droughts occur, they can affect as much as 33 million ha.

To monitor the occurrence and development of droughts efficiently and provide information on the strength and range of droughts and floods, the China Drought–Flood Climate Monitoring System was developed by the National Climate Center (NCC) in June 1995. The system can monitor the occurrence and development of droughts and floods and analyze disasters comprehensively. Since July 1996, directors of the China Meteorological Administration have been able to obtain information on national drought/flood occurrence on a daily basis through a computer network using the system. The system provides a scientific basis for the government to take measures to prevent drought/flood disasters and safeguard lives and property. The system is also used to study and forecast drought/flood climate.

The main products of the system include publications such as China Drought and Flood Climate Bulletin, Brief Report on Drought and Flood Monitoring, Advisory Report on Climate, and Service Report on Drought and Flood Disasters.

System Structure

The program of this system was written in Fortran, Borland, and FoxPro 2.5 languages. All functions are controlled by menu; the operational interface is user-friendly and convenient. It consists of five subsystems:

1. *Receiving and processing real-time data.* Its function is to receive real-time data, examine data quality, and categorize data.

2. *Statistical information and automatic transmission.* This subsystem can calculate precipitation amounts, percentage of precipitation departure, rainfall days, no-rainfall days, degree of drought/flood, and ranks for any time period; it then automatically transmits the results through the computer network to users.

3. *Data base and its management.* This subsystem includes the data base (precipitation, temperature, drought/flood index, real-time drought/flood information, etc.) and data base management (transferring, adding, calculating, browsing, inquiring data, mapping, printing and outputting figures and tables, etc.).

4. *Drought/flood early warning.* The function of this subsystem is:

   - monitoring the grade of droughts and floods at any station and the evolution of other meteorological elements by using histogram and curve diagrams;
   - consecutively monitoring drought/flood development at the regional and national scale, clearly displaying the characteristics of droughts and floods at various time periods;
   - displaying drought/flood distributions over the country and determining, as soon as possible, the geographical positions (longitude and latitude) and station names where droughts and floods are occurring;
   - comparing and ranking the severity, duration, and extent of drought/flood disasters;
   - monitoring precipitation over the country automatically and continuously, giving early warning when or before droughts and floods occur; and
   - printing drought/flood monitoring figures and tables.

5. *Management of operational products and advisory service.* This subsystem receives, disseminates, catalogs, and registers products published by the main system and other units, so that various kinds of products, information, and reports can be retrieved and used to provide advisory service for users.

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Quarterly Report Provides Assessment of Western Water Supply Indicators

A new quarterly report, *Western Climate and Water Status*, provides decision makers in the western United States with a comprehensive assessment of water supply indicators that can give early warning of emerging droughts. A product of the Western Drought Coordination Council, the report is an important new connection between scientists and policy makers.

It is based on analysis of more than 75 data sources each quarter and is actually produced in two different forms, both of which are available on the World Wide Web at http://enso.unl.edu/wdcc/quarterly:

- The *comprehensive version* is likely to be of interest to water resource planners and others who need a detailed overview of water supply in the western states.
- The *briefing version* is a two-page executive summary with wet and dry areas highlighted on the first page, and relevant water supply maps on the back. It's in Adobe's portable document format, which preserves the layout, but to access it your web browser needs the Adobe Acrobat Reader plug-in, available free from www.adobe.com. The maps are generally U.S. government data products that are produced only in color, so the document is far more effective when printed out in color.

The Council, co-chaired by New Mexico Governor Gary Johnson and U.S. Secretary of Agriculture Daniel Glickman, is producing the report to help states anticipate drought and shift their attention from crisis management to preparedness and mitigation. The drought that gripped the Southwest in 1996 demonstrated that significant opportunities exist for states to reduce economic losses and other effects of drought.

Western Climate and Water Status is based on data through March 31, June 30, September 30, and December 31, so it is ready about two weeks after each quarter's end. It's posted to the web, to achieve the fastest distribution, and can also be sent via e-mail. If you'd like to be added to the list of people to receive the executive summary via e-mail as soon as it's available, please contact Kelly Smith, khsmith@enso.unl.edu.

Announcements

Hazards and Sustainability: Contemporary Issues in Risk Management

Hazards and Sustainability: Contemporary Issues in Risk Management will be held at the Durham University Business School in Durham City, United Kingdom, May 26–27, 1998. This is the fourth conference in a series that began in 1994; its goal is to raise managerial awareness of the nature of risk and environmental sustainability and explore issues involved in risk perception and hazard identification, the management of risk, and crisis/disaster prevention and recovery. For further information, contact Eve Coles, The Centre for Risk and Crisis Management, Durham University Business School, Mill Hill Lane, Durham City, United Kingdom, DH1 3LB; telephone +44 (0) 191 374 1220/7326; fax: +44 (0) 191 374 3386; e-mail: EveColes@aol.com or E.L.Coles@durham.ac.uk.

Hazards–98: Seventh International Symposium on Natural and Man-made Hazards

Hazards–98: Seventh International Symposium on Natural and Man-made Hazards will be held May 17–22, 1998, in Chania, Crete Islands, Greece. Symposium organizers include the International Society for the Prevention and Mitigation of Natural Hazards. The objectives of this series of symposia are to promote the advancement of hazard sciences, explore those aspects that may be similar among the various hazards, review the latest developments in selected fields, and outline directions for future research. The theme of Hazards–98 is "Natural Disasters—How do we mitigate them?" Topics will include geological, meteorological, hydrological/marine, and technological/manmade hazards; disaster prevention, mitigation, and management; economic, social, and political aspects; public education and preparedness; adaptation and risk assessment; insurance; and the International Decade for Natural Disaster Reduction.

For more information, contact the Natural Hazards Society, P.O. Box 49511, 80 Glen Shields Avenue, Concord, Ontario, Canada L4K 4P6.

Water: A Looming Crisis? International Conference on World Water Resources at the Beginning of the 21st Century

The International Conference on World Water Resources at the Beginning of the 21st Century will be held June 3–6, 1998, in Paris. Conference organizers are the United Nations Educational, Scientific and Cultural Organisation (UNESCO), the International Association of Hydrological Sciences, and the World Water Council. Objectives of the conference are to take stock of present knowledge of world water resources, identify water problems that will occur in the next century as a result of increased demand for water, and make recommendations to the international scientific community for dealing with future challenges. For more information, contact UNESCO, Division of Water Sciences, 1 Rue Miollis, 75732 Paris Cedex 15–France (fax: 33 1 45 68 58 11).

Disaster Forum '98

Disaster Forum '98 will be held June 26–July 1, 1998, in Edmonton, Alberta, Canada. Conference partners include Alberta Transportation and Utilities (Disaster Services), Canadian Red Cross, City of Edmonton, and Emergency Preparedness Canada. The Forum is designed for persons and organizations interested in emergency preparedness and will include interactive workshops, presentations, and hands-on planning and response exercises. For more information, contact Disaster Forum '98, Suite 437, 11215 Jasper Avenue, Edmonton, AB, Canada, T5K 0L5 (fax: 403 422–1549, e-mail: disaster @freenet.edmonton.ab.ca, internet: http://www.freenet.edmonton.ab.ca/disaster).

National Conference on Lifesaving Intervention

The 1988 National Conference on Lifesaving Intervention will be held March 28–April 1, 1998, in Denver. It is sponsored by the National Disaster Medical System (NDMS).

The 1988 conference will feature tracks focusing on the following issues: (1) public health, (2) planning, management, and coordination, (3) clinical medicine, (4) field response, (5) technology, and (6) health care facilities. The following training courses will be offered before and during the conference: Communications, Mass Fatalities, Mass Casualty, Moulage, Exercise Design, and Incident Command System (ICS). Full accreditation for continuing education is anticipated for these courses and the main conference. For additional information, contact NDMS at 1–800–USA–NDMS and press the "star" key.

New Book
Reaching the Unreached: Challenges for the 21st Century

The proceedings of the 22nd WEDC Conference, *Reaching the Unreached: Challenges for the 21st Century*, has been published by the Water, Engineering and Development Centre, based at Loughborough University, Leicestershire, United Kingdom. The papers included in the volume discuss ideas and techniques to help fieldworkers plan, provide, operate, and maintain water and sanitation "to reach the unreached." Many of the papers deal specifically with Asia and Africa, and others are relevant for all low- and middle-income countries. Copies of the proceedings may be purchased from WEDC (Loughborough University, Leicestershire LE11 3TU, United Kingdom; e-mail: WEDC@lboro.ac.uk; telephone: + 44 [0] 1509 222885; fax: + 44 [0] 1509 211079). The book may also be viewed online at http://www.lboro.ac.uk/departments/cv/wedc/22conts.htm.

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Drought Network News encourages readers to submit information on current episodes of drought and its impacts; timely reports of response, mitigation, and planning actions of governments and international organizations (successes *and* failures); recent research results and new technologies that may advance the science of drought planning and management; recent publications; conference reports and news of forthcoming meetings; and editorials. If references accompany articles, please provide *full bibliographic citations*. All artwork *must* be *camera-ready*—please provide clear, sharp copies (in black/gray and white only—we are unable to reproduce color artwork) that can be photocopied/reduced without losing any detail. Correspondence should be addressed to

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