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HYDROLOGICAL MAP OF THE WORLD AT THE SCALE OF 1:2 500 000 ON THE EXAMPLE OF POLAND

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So far, the output of thematic cartography in the realm of hydrology especially with reference to the bigger areas of the globe, that is at general scales / less than 1:1 000 000 / has been comparativeiy small both with respect to the quantity of the prepared maps as well as the scope and complexity of grasping of the subject go. Here dominate either analytical maps relating to chosen region, e. g. maps of various kinds of run-off characteristics / as a good exapie may serve USSR regional atlases / or the maps encompassing the subject in a more complex way, yet elaborated for the whole globe, thus at a very small scales / e. g. the excellent map in Fyzikogeograficheskij Atlas Mira by L.M. Lvovitch at the scale of 1:50 000 000 /, or for a particular area, what makes the problems to be selected only from the point of view of its peculiarity / the interesting examples : the map of Central Europe by R.Keller - 1:3 000 000, the map of Nile basin by R.Keller and K.P.Nippes - 1:5 000 000, the map of Yugoslavia by D.Dukič - 1:2 500 000, the map of Europe by Grimm - 1:5 000 000/. In addition, those maps are not the finite products as far the selection of the cartographic presentation is concerned and one should note the reluctancy with which the isarithmic method is employed - the method which seems to be the most appropriate for the problems connected with e.g. run-off.

In keeping with the most current at present world problem of water resources and their rational utilization, there also arises the need for the cartographic formulation of the related phenomena, in the manner uniform for the whole world to ensure comparability. The most crucial point is the choice of a proper scale for such formulaticn. On the one hand it is imposed by the existent network of hydrometric stations which will provide the majority of the initial data, on the other - presenting on one sheet of such map comparatively large areas, on which there will be shown average dimension river systems and their basin, and not their fragments only. Bearing all this in mind, the authors consider the optimal scale to be that of 1:2 500 000. At the same time, considering the fact that the cartographic service of 7 countries: Bulgaria, CSSR, GDR, Poland, Rumunia, Hungary and USSR have finished their World Map at this scale, there have been created favourable conditions for the derived and thematic maps on its basis, among the others for starting the work on the hydrological world map on the World Map at the scale 1:2 500 000. It should be noted here that the questions of preparing the thematic maps on the World Map 1:2 500 000 basis have been the main concern of the Editorial Board from the very beginning, and that they have been for a long time on the agenda of its successive meetings. One should also come to the conclusions that the content of the map has been selected in such a way as to constitute a skeleton for this work. As far as the requirements of the design hydrological map go, it is our opinion that the World Map, at the scale of 1:2 500 000 absolutely fullfils these conditions.

The design of the presented here map pertains so far only to Poland / the availability of the basis data and the previous design guided the authors who, nevertheless, prepared the map on the skeleton of the appropriate fragment of the "Warsaw" sheet belonging to World Map 1:2 500 000. It is the second version of this map. The first version was presented at the Symposium on Thematic Maps, prepared on the basis of the World Map 1:2 500 000, which was held in Dresden in 1973. The design was there discussed and met with a kindly reception, and the suggestions pertaining to some technical difficulties had been partially considered with the preparation of the new version, presented in July 1976 at the meeting of an appropriate section of the IGU Congress in Leningrad, and discussed in the circle of specialist hydrologists.

In spite of the fact that the presented map refers only to Poland territory, its legend takes into consideration also these problems which do not occur on its area but in other regions of the world - thus one could say that the legend encompases all the problems obviously determined by the range of the map content pertaining to the whole world.

Coming to the discussion of the range of the map content and its editing assumptions, it should be noted that it pertains only to land areas. The authors, who had never taken up the problems connected with oceanology did not feel competent to select the problems refering to sea areas which could be somewhat similar or connected to the hydyrological problems taking occurance on the land territories. The distinct features of these problems seem, however, to suggest the autonomy of the hydrological map in the designed version, which does not necessarily mean that the joint presentation of both the oceanological and hydrological problems on the one map is absolutely impossible. This problem may also constitute a subject of a discussion on the present conference.

On editing the map the authors followed the following principles:

- Phenomena presented should reveal physical connections and always remain in some interdependence. Their showing on a single map cannot therefore be an accidental set of different information.
- The map should be clear and so should not be oberburdened with exscessive information. A purposeful choice of elements is therefore necessary.
- Initial material for the map must be accurate, i. g. so that the representation of water phenomena be possible at least at scale 1:2 500 000.

The numerical data for compiling base map relate to mean annual values for many years. It is adventeageous that these data come from an appropriately long period of time / at least ten years /. Availability of suitable materials on a global scale may still present considerable difficulty.

The content of the presented map includes the following groups of informations:

1° - resulting from a base map,

2° - connected with water resources of the rivers and of their basins,

3° - connected with kind of prevailing water supply to the rivers,

4° - connected with variability of discharge.

I. Information resulting from the content of a base map at the scale of 1:2 500 000

The base map contains information on the natural water phenomena such as: river network, waterfalls, lakes, marshes, icesheets and mountain glaciers, as well as artificial constructions like canals and major reservoirs.

The river network on the 1:2 500 000 map is more detailed than on most maps in this scale. The density of river network can be visually estimated from the map, and so it is possible to conclude about the permeability of sediments in the substratum, as well as the climate. Water divides result from contour maps. The authors propose to introduce continental water divides with a distinction drawn between divides separating drainage areas of the oceans and those separating drainage areas of particular seas. The authors assume water divides of the first order for main rivers emptying directly into the see with a surface of the basin well over 50 000 sq. km. That rule, cannot, however, be applied too rigidly. In the case of basins of the great rivers it would be suitable to introduce water divides of lower orders.

In places where a water divide is interrupted by a canal or ramifying watercourses, a break sign was placed on the divide. The authors propose to introduce divides for endorheic areas, the surface of which is usually larger than 10 000 sq. km and exceptionally for smaller surfaces.

II. Information relating to water resources of the rivers and their basins

The mean discharge informs about the water resources of the rivers while depth of runoff and the spec-yield informs about the resources of the basins.

The mean discharge of rivers / cu. m per sec. / informs how much water flows, on an average, through a cross-section of the river channel. These data are obtainable from the direct mesurement of discharge carried out at constant hydrometric sites. The mean discharge of rivers on a global scale is very differentiated, and is shown therefore ih semi-logarithmic scale. Information so presented althoughfar from precise provides a general picturs of water capacity of particular rivers.

Water resources of the basins can be presented directly by the specific yield, depth of runoff as well as indirectly by the ratio of runoff to precipitation.

The specific yield / litres per sec. per sq. km / informs how many litres of water flow down a sq. km surface area per second.

The depth of runoff / in mm / is equivalent to the height of water depth that drains on a given area in a given time unit. The term is most often used in balance calculations.

Both values relate to the surface and can be interdependently calculated because one litre par sec. per sq. km is equivalent of 31.5 mm layer of annual runoff.

The specific yield and the depth of runoff are shown with the aid of the same isolines, and the surfaces between them were shades in various tones of blue, forming a colourful background of the map. This element, therefore, dominates the contents of the map. This is justified by the great importance of the amount of runoff in water conditions.

The runoff-precipitation ratio is expressed as an abstract number, or in percentages. It is presented on the map as a grey isoline. This coefficient is a relative value and, therefore, only indirectly makes it possible to infer about water resources in a given area. In order to calculate that element it is a necessary to know the depth of runoff and, additionally, the amount of precipitation for the same catchment basins.

III. Information connected with kinds of prevailing water supply to the rivers

With reference to the concept by M. I. Lvovitch / Fizikogeograficheskij Atlas Mira, 1964 / the authors have distinguished four patterns of river supply: rain, snow, glacial and ground.

Rain supply consists of surface downflow of waters from rainfall of considerable intensity. These waters flow directly to the river channels.

Snow supply consists in surface downflow of water from the melting of snow cover during thaws. Glacial supply is the result of the melting of glaciers under the influence of temperatures above 0^{o}. It is concentrated and confined only to rivers whose headwaters are glacisted.

Ground supply consists of precipitation and water from the melting of snow cover that has soaked into the ground. The water reaches the river channels from springs and from direct drainage of underground water horizons.

To obtain information about the supply is not easy, as it requires detailed and laborious analyses of the hydrograms of daily discharge and of the chosen meteorological elements.

The rivers are, usually, characterized by a complex regime of water supply. The authors distinguish three classes of basic supply by using different colours and direction of hachuring:

1. over 70 % of total runoff

2. 50 - 70 % of total runoff

3. below 50 % of total runoff but more than any other separate pattern of supply.

If the secondary supply is considerable and exceeds 30 % of the total runoff it is interduced into the map. The secondary water supply may occur only when the share of the principal kind of supply is less then 70 %.

The distribution of runoff troughout the year is an important information characterizing the river regime. This variability is shown with the aid of graphs of the coefficient of monthly discharge / the ratio of the discharge in particular months to the annual discharge /. These coefficients represent a relative value, and are therefore comparable only for the rivers of varying values of discharge. On chosing the sites for which the graphs of coefficients were drawn the authors followed their representativeness with reference to a major region. From the point of view cartography this method / graphe / is not perfect one, yet as it turned out after numerous attempts of applying another methods, it is the only acceptable, considering the correctness of the map merits.

The authors have also attempted preparing a hydrological map with a similar range of content but at a greater map scale, e.g. hydrological map at the scale of 1:500 000 in "Cracov Voivodship Atlas". Inspite of the fact that including such a map into the set giving characteristics of the geographical environment of a given region seems to be purposeful, yet it should be noted that the scale of 1:500 000 has not been fully used. This has been settled by a comparatively large density of the hydrometric stations in this region.

To sum up, it should be stated that the authors of the designed map are fully aware of the numerous difficulties, and sometimes doubts which will arise during designing it for the whole world. It may happen that it will be necessary to change sections or introduce additional information, or even-due to the lack of data-leave the whole areas undescribed / the "white spots" /. It may also be difficult to obtain at present precise initial data for the whole world. Still, this situation can be resolved in case of international cooperation in the field of cartography and in the framework of the International Hydrological Program.