

## The Data of the Observations at the Kolyma Water Balance Station: the Potential of their Application in Academic and Applied Problems and the Need for the Resumption of Special Surveys

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### Introduction

A grid of water-balance stations operated in the former USSR. Detailed observations of the water balance elements were conducted at them within the framework of a single program. The stations were located in all main natural regions of the country. The data of water-balance stations served as the basis for complex studies of the runoff formation regularities in different physiographic regions and also as the basis for the development of runoff calculation methodologies.

### Natural conditions

The Kolyma Water Balance Station (KWBS) is located in the upper reaches of the Kolyma River, in the mountain area, in the zone of continuous permafrost. The climatic conditions are severe at the station - the multi-year mean air temperature is about  $-12^{\circ}\text{C}$ , and the amount of precipitation is from 250 to 440 mm per year. Most of the area is covered by rock slides, cedar elfin wood brush and larch light forest. The permafrost thickness reaches 400 m. The summer thawing depth is from 20 cm in bogged lowlands to 3 m and more on southern rocky slopes.

There are no other experimental catchment basins in the world that are characterized by such natural conditions. As the work [Nasybulin 1976] shows, runoff formation conditions and runoff characteristics at the station are representative of a wide area of the Upper Kolyma and the adjoining areas of the northeast of Russia.

### Station history

The KWBS was organized in severe post-war years. Extended research of a number of areas was conducted in the upper reaches of the Kolyma River during 1947. The catchment basin of the Kontaktovy Creek characterized by a wide variety of the vegetative cover and soils is acknowledged to be the most suitable for observations. The station was built on the 15th of October 1947. First observations of the water runoff were started in May 1948 already, at the Kontaktovy and the Vstrecha Creeks. A grid of rainfall recording stations operated at the Vstrecha Creek catchment basin during 8 years (between 1949 and 1957). Multiple special observations were initiated at the same time on runoff, water-balance and water-non-permeable sites, including observations of the evaporation from the soil, water and snow surface as well as observations of **ground freezing and thawing in different conditions**. The observations program expanded from year to year, and the most remote and hard-to-access station zones were covered

(Fig. 1). In 1968 runoff measurements were started at the unique object, in the basin of the Morozov Creek having no vegetative cover and completely composed of rock slides. Before 1978 the water runoff was observed in nine catchment basins with the area from  $0.27\text{ km}^2$  to  $21.6\text{ km}^2$ . **The summer thawing depth was registered with 20 permafrost measurement devices located in different conditions.** Purely experimental studies were also executed. For example, they included the study of the impact of intra-ground condensation on the water runoff with the use of original devices and installations [Boyarintsev et al. 1991]. The station team included about 30 people with professional higher or secondary-level education.

Water balance observations were suspended at the KWBS since 1997. Only observations at the weather station as well as runoff observations at several creeks are presently carried out there without the participation of specialists-hydrologists. According to some data, the house where the station employees lived and where the long-term data record was kept, burnt out together with unpublished observation materials.

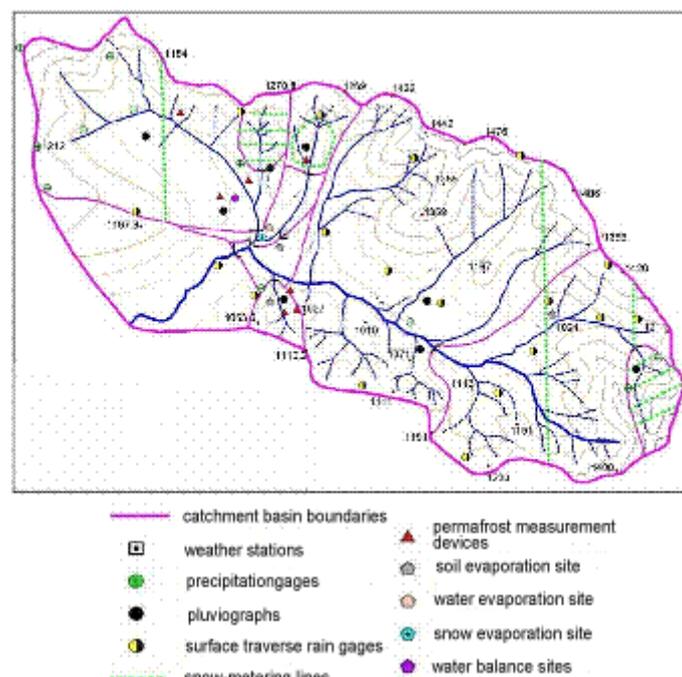


Figure 1. The map of the Kolyma Water Balance Station.

Huge material of hydrometeorological observations was accumulated during 40 years of work at the KWBS. By 1989 they were published in 30 issues the first one of which covers

the period between 1948 and 1957. Later issues were published every year (KWBS observation materials, 1948-1987).

The observation results were reflected in multiple publications (there are more than 100 of them) dedicated to different aspects of the runoff formation in the continuous permafrost zone, the active layer dynamics, the structure of the underlying surface and its impact on hydrological processes.

In 1976 the station was visited by a team of American scientists (Fig. 2). They appreciated the professional and the personal qualities of station employees and their dedication to business. These qualities served as the basis for large-scale field and theoretical works despite the simplicity of the equipment available and severe climate. The American colleagues' report also noted the solicitous attitude to nature from the part of the Soviet scientists. According to Slaughter and Billelo [1977], the materials received at the KWBS do not have analogues in the world practice. A joint suggestion to regularly exchange the observations data, devices, research results in the form of articles and methodological instructions and other materials between American and Soviet scientists was made on the basis of the visit results. This initiative was not implemented unfortunately.

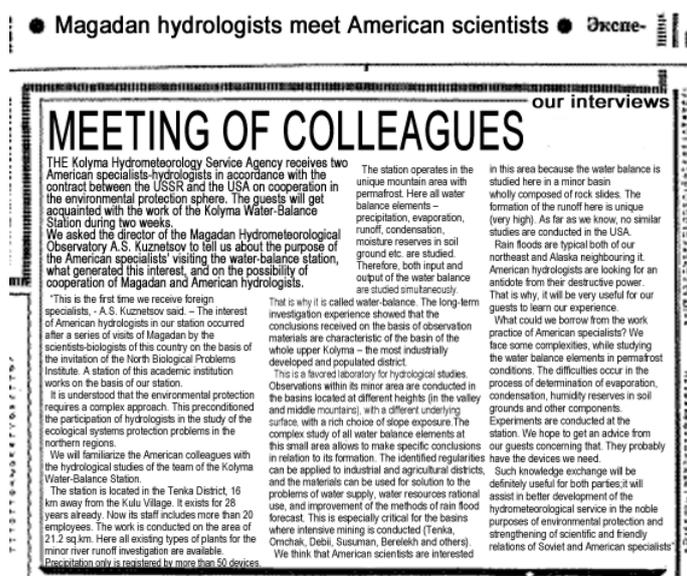


Figure 2. The article in the Magadanskaya Pravda newspaper dated 08 August 1976, Issue 4

### Prospects of use of the KWBS data in academic and applied problems

The materials of special observations of rare duration (40-50 years) were gathered at the station. They characterize the natural conditions that, on the one hand, are not actually illustrated by the data and, on the other hand, are representative of a wide area of the Russia's northeast. Precipitation and flow rate observations together with such rarely measured values as evaporation, water loss from snow, surface runoff, ground thawing and the like make it possible to study the interactions of the particular processes of hydrological cycle with each

other and with the landscape components in detail. The regularities of the runoff formation processes in the unstudied basins of the Russia's permafrost zone can be identified on the basis of the KWBS work results analysis.

The collected materials are invaluable for building and testing of different models: runoff formation, climatic, environmental and vegetation dynamics [Kuchment et al. 2000; Lebedeva & Semenova 2012].

The KWBS data could become a valuable indicator of climate changes and the basis for the study of their impact on the permafrost state and the hydrological regime of rivers, making it possible to penetrate the mechanisms of the ongoing processes. The absence of data for the period after 1990 is especially problematic within the framework of this scientific question because the most significant changes are thought to have begun at that time. Resumption of the observations right now is very important due to this reason.

There is an urgent need to restart experimental studies at the Kolyma station due to the increased interest to the natural processes of the Arctic and the possibility of development of the Eastern Siberia rich natural resources.

29 water-balance stations were operating within the USSR. Now only four of them work. The observations program is significantly reduced at all currently active stations, up to standard runoff and meteorological measurements. Therefore, now they have the status of water-balance stations only conventionally.

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