

IAHS International Commission on Remote Sensing

The International Commission on Remote Sensing (ICRS), as one of the current ten scientific commissions under the umbrella of the International Association of Hydrological Sciences (IAHS; [1]), has emerged as a logical response to the availability of spatial data associated with the launch of the first satellites in the 1970^s that were designed to observe the Earth's landscape sphere from space, providing a completely new perspective in which the spatial extent of the territory under observation played the major role. In fact, hydrologists have seen great potential in such data since those early days, as the data have allowed the scientists to continue improving their understanding of the hydrological cycle, including its components, some of which being otherwise very difficult to measure on the Earth's surface for a variety of reasons. Moreover, this is underlined by the fact that ground-based observations are unlikely ever to provide such a comprehensive insight into the ongoing process for a single point in time in terms of the large territory captured. The beginnings of the use of remote sensing (RS) products in hydrology and water management are very often associated with collecting information about the cryosphere. That would not even be otherwise possible if we were dependent merely on ground-based observation, which (if it is being done anywhere in these landscapes at all) is inevitably burdened with a wide range of errors and uncertainties, and sometimes even periodic outages in seasons that are not conducive to such observations. Therefore, it is not surprising that the need for a predecessor of the ICRS has been seriously discussed since the turn of the 1970^s and 1980^s. Especially hydrologists who study snowy and glaciated areas have required the use of RS data. Let us give an example of the then perspective of the related International Commission on Snow and Ice Hydrology (ICSIH), which concerned large-scale studies of snow and built precisely on the potential of RS products (see paper [2], whose author was also an ICRS president). Similarly, the use of RS products within the ICSIH is mentioned in retrospective article [3] and more generally, concerning the needs of the whole IAHS, also in article [4].

The contribution, which was written on the occasion of the 90th anniversary of the IAHS, dates the origins of the ICRS more precisely to the year 1979 when the 17th General Assembly of the International Union of Geodesy and Geophysics (IUGG), of which the IAHS is a part, was held in Canberra, Australia. At that time, a committee was established, which met for the first time in 1981 in Denver, Colorado [5]. The Symposium on Hydrological Applications of Remote Sensing and Remote Data Transmission was held in Hamburg, Germany, in April 1983, as part of the 18th IUGG General Assembly. One of the outcomes of this Symposium was at book [6], the preface to which mentions the fact that the Symposium was organized by the International Commission on Remote Sensing and Data Transmission (ICRSDT), i.e. the predecessor of today's ICRS. However, according to the ICRS officials themselves, the first independent meeting of the Commission took place at the International Workshop on Hydrologic Applications of Space Technologies which was held in Cocoa Beach, Florida, in August 1985 [7] and resulted in publication [8]. It can be deduced from the name (ICRSDT) that data transmission was very essential and important for hydrologists, especially for those in the field of operational hydrology. Indeed, the very first meetings of the ICRSDT were held in the presence of representatives of the World Meteorological Organization (WMO) and other UN organizations (e.g. UNESCO). This is evidence of the hydrologists' assumption that it is the RS products (not only radars but also satellites) that will help improve hydrological forecasts by providing a more precise picture of spatial differentiation of the landscape that forms a catchment. This resulted in further development of microcomputer software to process such data (e.g. geographical

information systems, GIS), as well as development and adaptation of hydrological models, as estimated well by Askew of the WMO [9] (see also contribution [10], whose ideas are expanded in [11]).

It was 15 years before the second independent ICRS meeting took place. As the preface to publication [7] says, that did not mean that ICRS members and supporters had not been active during that period. On the contrary, several joint symposia (i.e. with other IAHS commissions) were organized within the IUGG assemblies and IAHS scientific assemblies, which normally take place two years after the IUGG assemblies. It certainly does not make sense to list all these meetings here. It is much more sensible to refer those interested in a deeper study directly to the website from where it is possible to download the individual articles published in the IAHS "red books", which, by the way, are very rich in detailed information [12]. As an example, let us mention at least the book based on the International Symposium on Integrated Methods in Catchment Hydrology, which took place in Birmingham, UK, in June 1999, where the 22nd IUGG General Assembly was just held at that time. These joint symposia only emphasise the importance of RS applications overlapping to various areas of hydrology and water management. Contribution [5] also mentions that the ICRS was transformed in 1998. At that time, the ICRS, judging at least by the change of the name, presumably lost interest in data transmissions as these became the focus of other expert groups.

The third ICRS meeting, again a symposium with a focus on RS in hydrology, was held in Jackson Hole, Wyoming, in late September 2010 [13]. In the meantime, however, a number of issues were identified that necessitated separate international conferences or, again, symposia to be included in the agenda of the IUGG assemblies, or IAHS scientific assemblies. The GIS applications in hydrology for the purposes of flood forecasting, runoff simulation, (integrated) water management, and environmental modelling thus came to the fore [14, 15]. Hand in hand with the latter, change detection through RS data also gained importance, both in hydrological terms and in general with respect to all environmental components and the needs of human society [14–16]. At these meetings, hydrogeologists also demonstrated their skills, not for the first time. They come together under the umbrella of the International Association of Hydrogeologists (IAH), which is a separate body alongside the IAHS, although it does not form the IUGG. Incidentally, hydrogeologists also stressed the importance of hydroinformatics for the whole hydrology, including RS data processing. Hydroinformatics has gradually been brought into hydrology through hydraulics, which resulted in the formation of the Joint Committee on Hydroinformatics in Cardiff in July 2002 [17]. The Jackson Hole ICRS symposium itself then indicated the continuation of estimating the following hydrological parameters using RS: soil moisture, evapotranspiration, surface temperature, distribution and characteristics of vegetation (including crops and invasive species), and snow pack properties. For these purposes, the combined use of satellite- and airborne instruments was emphasized. It was also found that the above-mentioned hydrological parameters can be well obtained if lidar images taken from the aircraft and the ground are used additionally. Finally, advances in understanding and modelling the hydrological cycle in relation to the start of surface energy balance flux measurements using scintillometers and eddy covariance systems were mentioned [13].

The current ICRS (the present incumbents are listed in [18]) has two sections, one for RS and the other for GIS [5]. Experts from both sections first combined their symposia and conferences, which originally focused separately more on RS and separately more on GIS, into one in Guangzhou, China in 2014.

The purpose of this merged event, or in other words, two events held in one location, was to review and report on advances in GIS and RS technologies as well as their applications in hydrology, water management and the environment, and to share experience of scientists, engineers, NGOs and policy makers worldwide in the fields of meteorology, hydrology, water management, environment, flood forecasting and management, GIS and RS [19].

So far, the most recent stand-alone symposium entitled “Remote Sensing and Hydrology Symposium” (RSHS) has been organized in Córdoba, Spain, in May 2018. The potential to obtain relatively long time series using RS was highlighted there. To achieve this goal, however, it is necessary to consider the merging of data coming from different instruments with different accuracies, including those located on the Earth’s surface. The symposium was divided into several thematic areas:

1. current and future missions for water cycle observation,
2. observations of water cycle components,
3. Earth Observation retrievals and data products linked to the water cycle,
4. applications of RS data in water resources management,
5. crop irrigation management by RS,
6. water quality and soil cover assessment from RS data.

Throughout the symposium, emphasis was placed on integrated water and basin management with regard to potential environmental changes [20]. It should be anticipated in the future that spatial resolution of RS products will increase primarily, which can be used successfully in hydrology. However, if the final information obtained from the data is to be relevant, it is necessary to adapt established approaches and methods to these data, and to be aware of the fact that longer time series derived from RS products may be burdened with different uncertainties in different sections.

We can already look forward to presentations of further activities and outcomes given by ICRS experts. For instance, further symposia are being prepared for the 11th IAHS Scientific Assembly, which is scheduled to take place in Montpellier, France, at the turn of May and June 2022, while celebrating the 100th IAHS anniversary (cf. e.g. [4]). The agenda to date has demonstrated that the interest of the world’s hydrologists in the RS technologies and methods is not waning [21]. Therefore, the author of this informative paper firmly hopes that Czech hydrologists or water managers will not be left behind and he will also be very glad if this paper is of interest to those who have not been aware of ICRS activities so far.

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