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# Satellite Data Utilization in Hydrological Research

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Research in hydrology will often involve an analysis of complex natural and human systems. Such research includes both water resources (catchment-scale water budgets, snowmelt, supply and demand issues) and hazards analysis (flooding, channel erosion, impacts of urbanization). In recent years the wider access of geospatial satellite data to represent these systems, and development of tools and technologies to process this data has increased tremendously. As a result, hydrological research has become a frontrunner in the evolution of the geosciences into its current guise. This editorial summarizes some of the key geospatial satellite data sources and technologies being applied to hydrological research.

From a water resources perspective, satellite imagery has proven particularly effective in developing snowmelt runoff models. One such data source includes the range of Moderate Resolution Imaging Spectroradiometer (MODIS) products available from the NOAA's National Snow and Ice Data Center (NSIDC), in particular the MODIS/Terra Daily Snow Cover imagery. Beginning in 2000, this 500m resolution imagery has been used to calibrate snowmelt runoff across several river basins [1-3]. A further benefit of this product is the availability of the HEG-Win tool to convert the MODIS files from HDF-EOS to GeoTIFF format that allows the snowcover imagery to be correctly geo-referenced and projected in ArcGIS. The NSIDC is also responsible for the Advanced Very High Resolution Radiometer (AVHRR) products which may be used in snowmelt water resources research [4-6]. This data is available from 1982 at a lower resolution of 1km making it more suitable for smaller-scale studies, although errors in the AVHRR data have led to the temporary withdrawal of this product for calibration until later release in 2013.

In 2002 NASA launched the Gravity Recovery and Climate Experiment (GRACE) satellite program with the main aim of accurately measuring Earth's gravity field. By measuring changes in Earth's gravity field, the program can monitor changes in mass including that of water and its movement [7]. Measurements of Earth's gravity field are updated monthly and provide the most accurate water storage change signal across basins with a radius greater than 250-300km [7]. This resource has subsequently been used to determine catchment and region wide changes in surface, soil and groundwater storage over time [8-11]. Although given an initial lifespan of 5 years, the program is still in operation today.

With regard to hazards research in hydrology, especially flooding resulting from changes in land cover, the US Geological Survey Landsat mission has been heavily used by hydrologists. First launched in 1972 as Landsat 1, the mission has seen 5 further satellites successfully come into operation, delivering multi-spectral high resolution imagery of Earth's landscapes. The current Landsat 7 product, in operation since 1999, carries the Enhanced Thematic Mapper Plus (ETM+) providing 30m resolution imagery [12]. This high resolution imagery has proved invaluable for modeling the impacts of urbanization on surface runoff and flooding following a classification of land cover from the raw Landsat imagery [13-15]. As Landsat 7 nears the end of its lifespan, the program looks to continue delivering high quality data for use in hydrological research with the launch of the Landsat Data Continuity Mission (Landsat 8) scheduled for early 2013.

The wide range of readily available satellite data over the last two decades has enabled hydrologists of all backgrounds to analyze Earth's freshwater resources in its many forms. Continued access to both the historical and future data from all agencies involved will allow further analysis of Earth's water resources and of the potential challenges faced in managing this resource.

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