P-007

CARTOGRAPHIC REPRESENTATION OF GLACIER RETREAT IN WESTERN CANADA

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Background: Canada's tradition of mountain cartography began in 1885 when Edouard Deville, the French born Surveyor-General incorporated the photo-topographical method, using oblique mountain photography for detailed map making, spawning the science of photogrammetry. Early mountain cartography was dominated by surveyors who were also alpinists, such as A.O. Wheeler, the founder and first president of the Alpine Club of Canada. Surveyors and cartographers used photo-topography and then aerial photography to generate the National Topographic Series mostly at 1:50,000 scale after 1945. In the 1960s and 1970s, Swiss hillshading expertise was imported to render glacier landscapes with greater realism on topographic maps of the Rocky Mountains, during the International Hydrological Decade (1965-75).

Objectives: The rate of glacier melt retreat has accelerated with global warming after 1980, but cartographic activity has been limited to provincial base mapping by British Columbia and Alberta in the 1980s. The Western Canadian Cryospheric Network (WC2N) has assembled a minimum of four data sets of glacier extents and digital elevation models (DEMs) from 1950-2010 for the ~15,000 glaciers of western Canada, and in some cases maps from the start of the 20th century. The data range from historic topographic maps and early aerial photography to current satellite and LiDAR imagery.

Approach and methods: Satellite image derived glacier coverages have been used to generate a 2005 glacier inventory and compared to a 1980s photogrammetric glacier layer. They show an average reported area loss of 0.5% per year, and glacier snout retreat around 20 metres per year. Displaying these changing extents and their associated glacier surfaces represents a cartographic challenge when compared with conventional topographic mapping.

Results: Solutions include three main options in addition to the simple overlay of multiple area extents, as follows (see example figures). Isarithmic difference maps show glacier wastage through elevation loss between adjacent time periods and over the duration since the earliest DEM; these depict either a continuous range of values, or derived classes. Oblique perspectives utilize draped satellite images on DEMs with overlain glacier vectors and optimized colour combinations for visualization, that also include the generation of anaglyphs and 3D images for display on a Geowall. A third group of image maps exhibit shaded relief renditions in sequence animations, showing both linear glacier retreat and downward wastage, along with associated hydrological changes, which are acquired from digital map files and satellite image processing and enhancement.

Conclusions and future plans: Freely available satellite imagery can now be acquired each year, enabling continual updating of glacier outlines, although a semi-decadal interval is realistic in terms of available human resources and a mapping resolution that exceeds interpretation and processing errors. Monitoring and mapping will continue for selected glaciers to examine continuing or accelerating of ablation rates, with the conclusion of federal funding at the end of 2010 from the Canadian Foundation for Climate and Atmospheric Sciences.