Geophysical Research Abstracts
Vol. 15, EGU2013-3220, 2013
EGU General Assembly 2013

Remote sensing vs. in situ measurements: Two poles of the same planet?

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The general aim of glacier monitoring is to understand and quantify processes and their changes. The context of climatic change requires mapping a variety of spatial and temporal scales, from time series of single point observations to snapshots in a global scale. A complete picture needs both in-situ and remote sensing data. To combine data recorded by different instruments, the first step is to understand similarities and also differences in how processes are mapped by different methods, and the second to find a method to combine them.
Direct measurements take place in one or more locations, whereas remote sensing data always refers to a larger area, governed the antenna footprint or the resolution of an image. It is often difficult to compare direct and remotely sensed data directly, since some processes or features, even of topographic nature, could dominate the backscatter from one grid cell containing different features.
The sampling rate of direct measurements is governed by accessibility, but can also be quasi-continuous, whereas the sampling rate of remote sensing data is linked to the repeat cycles of the satellites. Direct measurements have no limitation on the application of the same method to the data, whereas satellites have a live span which often is about the time difference of a decade, which needed for calculating volume changes.
Sometimes the terminology refers to observations and/or theory developed on the base of field measurements, often in specific climate conditions or specific glacier types. Remote sensing terminology often uses the same terms, but with slightly different meaning. One example for that is the term Equilibrium line altitude (ELA), which is defined as elevation where the direct surface mass balance is zero. In remote sensing glaciology, 'ELA' often is used synonymous with temporary snow line at the end of the summer season. It is evident that using mixing ELA results from direct and remote sensing observations for long term monitoring or numerical modelling can produce confusing results. In such cases, uncertainty assessments and homogenization procedures must be developed.
Glacier mass balance is another term often used for direct surface mass balance and volume changes derived from remote sensing data. Both methods aim at mapping mass changes, and are valuable because they provide data on different spatial and temporal scales. But the direct mass balance is developed from point data of surface mass balance with all uncertainties in interpolation, whereas the volume change has to be converted to mass balance with a density assumption.
In some cases, it might be even necessary to develop new theoretical concepts to fully exploit the remote sensing data. For example, point measurements of ice thickness and ice flow velocity have led to the development of the theory of ice flow. Today, radar interferometry provides 2D short time snapshots of surface velocity for large areas. DGPS allows quasi-continuous point records.
In the future, it will be a challenge, but also an opportunity, to combine all these observations in different scales to form one common concept.