Geophysical Research Abstracts
Vol. 18, EGU2016-9812, 2016
EGU General Assembly 2016

Deducing high-altitude precipitation from glacier mass balance measurements

Rianne H. Giesen (1), Walter W. Immerzeel (2), and Niko Wanders (3)

(1) Institute for Marine and Atmospheric research Utrecht, Utrecht University, Utrecht, Netherlands (r.h.giesen@uu.nl), (2) Department of Physical Geography, Utrecht University, Utrecht, Netherlands, (3) Department of Civil and Environmental Engineering, Princeton University, Princeton, USA

The spatial distribution of precipitation in mountainous terrain is generally not well known due to underrepresentation of gauge observations at higher elevations. Precipitation tends to increase with elevation, but since observations are mainly performed in the valleys, the vertical precipitation gradient cannot be deduced from these measurements. Furthermore, the spatial resolution of gridded meteorological data is often too coarse to resolve individual mountain chains. Still, a reliable estimate of high-elevation precipitation is required for many hydrological applications. We present a method to determine the vertical precipitation gradient in mountainous terrain, making use of glacier mass balance observations. These measurements have the advantage that they provide a basin-wide precipitation estimate at high elevations. The precipitation gradient is adjusted until the solid precipitation over the glacier area combined with the calculated melt gives the measured annual glacier mass balance. Results for the glacierized regions in Central Europe and Scandinavia reveal spatially coherent patterns, with predominantly positive precipitation gradients ranging from -4 to +28 % $(100\,\mathrm{m})^{-1}$. In some regions, precipitation amounts at high elevations are up to four times as large as in the valleys. A comparison of the modelled winter precipitation with observed snow accumulation on glaciers shows a good agreement. Precipitation measured at the few high-altitude meteorological stations is generally lower than our estimate, which may result from precipitation undercatch. Our findings will improve the precipitation forcing for glacier modelling and hydrological studies in mountainous terrain.