Advanced remote sensing based methods for the assessment of the environmental status of lake waters in the Himalayan region: the case-study of the northern and southern side of Mount Everest

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In October 2008, water samplings for subsequent laboratory analyses were collected in 16 lakes, distributed northern and southern the Mount Everest. Distinct features were identified in the absorption properties of phytoplankton, non-algal-particle and coloured dissolved organic matter components. These values were compared to literature data and the absorption budget was presented. The retrieved absorption coefficients and the concentrations of water components, allowed to parameterise a simplified bio-optical model for case-2 waters.
The model performance was evaluated by using ALOS-AVNIR2 data, collected in the study area on 24 October 2008. Bio-optical modelling was then used to explore lake colours and their relation to melt-water inputs and deglaciation processes. The analysis was based on the assumption that if glacier water influx increases, the maximum suspended particle size and particle number density will increase and this will affect light scattering which will be stronger than water absorption so that the lake colour will turn from light-blue, to turquoise, to grey. Vice versa, for decreased melt-water input, water absorption increases and lake colour will range from blue to dark-blue. Optical properties and lake colour of selected lakes were assessed from previous satellite images also, in order to perform a retrospective analysis in relation to the glacier dynamics.
This study presented the absorption proprieties of 16 lakes in Himalayan region that, by means of ALOS-AVNIR2 data, were extended in a wider region, including Nepalian and Tibetan lakes. In such a remote area, remote sensing of spectral properties was demonstrated to be the prevailing tool to characterize the state of lakes, whose colours might be assumed direct and quick-responding indicators of de-glaciations processing. We expect that the present study may provide some feedback to remote sensing-based international activities (as GLIMS, a consortium established to perform satellite-based analyses on glacier extent and changes), as well as to show the potentiality of optical remote sensing to derive environmental-relevant data of the Himalayan region. Therefore, recommendations for further remote sensing-based activities in the study area were finally suggested.