

Review

RAINA, V.K. and D. SRIVASTAVA. 2008. *Glacier atlas of India*. Bangalore, Geological Society of India. 315pp. ISBN-13: 978-8-185-86780-9, hardback. US\$120 (obtainable from <http://www.vedamsbooks.com>).

A standard dictionary definition of an atlas is *a book of maps*. This book is much more than that and, as I explain below, the maps are not even the best parts of it. The book is an eclectic mixture of maps, photos, data tables and assorted essays, in a large format that is almost suited to the coffee table. Atlases of this kind are already a firm part of glaciological publishing (e.g. the remarkable series *Satellite image atlas of glaciers of the world* from the US Geological Survey). The term 'atlas' has also been used for something closer to data reports (e.g. Østrem and others, 1988; Hagen and others, 1993), so the present atlas sits comfortably in the middle of a spectrum. The editors V.K. Raina and D. Srivastava are senior scientists, and the contents of this atlas obviously reflect their engagement with Himalayan glaciers over many decades.

The material is organized into seven sections, with an extensive bibliography in the eighth section. Section 1 is a general essay on glaciers (origin, classification and surface features). There are lots of nice colour photographs to illustrate the different concepts. Some of the definitions are a little loose (e.g. we are told here that glaciers are characterized as *continental glaciers* and *alpine glaciers* and that *valley* and *mountain glaciers* are the same, but we have to turn to table 4 in section 4-b to get the correct definitions). We are also told here that Himalayan glaciers are *temperate/warm*, while outsiders might suspect the near-ubiquity of *polythermal glaciers*. Section 2 is an essay on glacier processes and landforms and, once again, is nicely illustrated. Section 3 is a short essay on surging glaciers, with useful case studies but no new scientific insights.

Section 4-a is a brief introduction to the glacier inventory of the Indian Himalaya. It strikes a slightly apologetic note in that the pace of glacier inventory in this region has been slow since the inception of the World Glacier Inventory in the 1970s (Müller and others, 1977). However, when the slowness of the glacier inventory work in North America is recalled, the great achievement of the Indian glacier inventory is clear. I must strike a carping note here as the multicoloured maps of the different drainage basins (figs 144a, 144b, 145, 146 and 147) would have benefited from some indication of geographical coordinates. A good overall map of the whole Himalaya is also missing, so we cannot put the Indian glaciers into their regional context. The Chinese have published a very detailed report on their glacier inventory (Shi and others, 2008) including excellent maps of drainage basins with a classification of their glaciers into different climatic types. Aside from Indian glaciers, both the Ganga (5O) and Indus (5Q) rivers are fed by large glacierized areas in China. Indian glaciologists initially coded the Brahmaputra as a first-order basin (fig. 144a) and then recoded it as a sub-basin of the Ganga (fig. 144b). The Chinese glacier inventory (Shi and others, 2008) also codes the Brahmaputra, known in China as Yarlung Zangbo (5O2), as a sub-basin of the Ganga (5O), so there is luckily no discrepancy. Political borders are obviously sensitive in this area, but this example shows that glaciers are no respecters of frontiers.

Section 4-b details the glacier inventory of India and is probably the core of this atlas. It starts by revising concepts

from the World Glacier Inventory (Müller and others, 1977) and then lists data for 9575 individual glaciers. These include latitude and longitude, orientations of ablation and accumulation areas, maximum and minimum elevations, maximum length, mean width and surface area together with a six-digit classification, but there is no information about debris cover. The data tables also list estimates of mean depth and volume with reference to a rather old source instead of using more recent ideas on volume–area scaling (Bahr and others, 1997). There is no indication that these printed data are available in digital format, but serious modellers of Himalayan glaciology and hydrology will certainly want digital data. These Indian data should be added to the existing World Glacier Inventory (http://nsidc.org/data/glacier_inventory) to join data from Svalbard, Scandinavia, the Alps, the former Soviet Union, China, New Zealand, parts of both North and South America together with some scattered data from Bhutan, Nepal and Pakistan. No doubt the new data will also be invaluable for the ongoing project on Global Land Ice Measurements from Space (GLIMS) (<http://www.glims.org>).

Section 5-a provides historical documentation of glaciological studies in India, including more nice photos, while available mass-balance data are summarized in section 5-b. The subsequent sections are rather disparate, but I especially enjoyed section 7-a with many black-and-white photographs of glacier snouts, some of which are admirably icy while others are nearly obscured by debris cover. The atlas ends with an extensive bibliography spanning the years 1822–2007.

Who is this book written for? It is obviously a must-have item for any serious student of Himalayan glaciers and will be invaluable for the induction of new workers in the field, Indian and international, as veterans like V.K. Raina and D. Srivastava retire. For example, with growing interest in the role of glaciers in global climate and regional hydrology, there is an obvious need for capacity building and education in the countries south of the Himalaya. Mountaineers and trekkers may also enjoy the nice photographs in sections 1, 2 and 7-a. Even if modellers do get their hands on the digital data, they should occasionally dip into this book as a sort of 'reality check' to remind themselves of some of the still unsolved problems of glaciology.

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