

6.1 New Guinea

The few glaciers of Papua (formerly Irian Jaya, Indonesia) and Papua New Guinea are located on the peaks of the great Cordillera of the island of New Guinea. Direct observations are sparse, but historical documents, aerial photographs and satellite images offer insight into the historical glacier changes.



The only tropical glaciers of Asia are located on the mountains of New Guinea. In the 20th century glaciers were found on Puncak Mandala (Juliana 4 640 m asl), Ngga Pilimsit (Idenburg 4 717 m asl) and Puncak Jaya (Carstenz 5 030 m asl), three peaks in Papua, Indonesia, located in the western part of the great Cordillera of New Guinea (Grove 2004). A small ice cap existed on Puncak Trikora (Wilhelmina 4 730 m asl) in Papua New Guinea (Grove 2004). The LIA maximum extent was reached in the mid 19th century (Allison and Peterson 1976).

Regular series of direct measurements of front variation or mass balance are not available. The glacier changes have been

traced from information on glacier extents derived from historical records, dated cairns erected during several expeditions, aerial photographs, satellite images as well as from some in-situ measurements carried out during Australian expeditions in the 1970s (Allison and Peterson, 1989). Most observations focused on the glaciers on Puncak Jaya, namely the **North Wall Firn**; two valley glaciers, **Meren** and **Carstenz**; and the Southwall Hanging Glacier. All have undergone extensive retreat since the LIA maximum extent (Peterson et al. 1973) reducing the entire Puncak Jaya ice cover from almost 20 km² around 1850 to less than 3 km² in 2002, with highest retreat rates around 1940 and in the early 1970s (Klein and Kincaid 2006). All ice masses except some on Puncak Jaya have now disappeared. The isolated ice caps vanished from Puncak Trikora between 1939 and 1962; from Ngga Pilimsit between 1983 and 2003 (Klein and Kincaid, 2006); and from Puncak Mandala between 1989 and 2003 (Klein and Kincaid, 2008). The larger Meren Glacier on Puncak Jaya melted away between 1992 and 2000 (Klein and Kincaid, 2006).



Fig. 6.1.1 Punca Jaya

Fig. 6.1.1 Oblique aerial photograph looking east at Northwall Firn, Meren Glacier and Carstenz Glacier (left to right) on Puncak Jaya. Source: Photograph of 1936 by J.J. Dozy, provided by the *United States Geological Survey* (Allison and Peterson 1989).

Ice covered area (km²):	3
Front variation	
number of series:	3
average number of observations:	5
average time length (years):	46
Mass balance	
number of series:	0
average number of observations:	0

6.2 Africa

The few tropical ice bodies in East Africa are located on Ruwenzori, Mount Kenya and Kilimanjaro. Their recession since the late 19th century has been well documented.



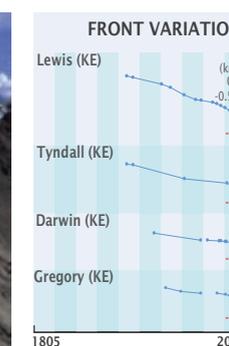
African glaciers are found near the equator in East Africa, situated on three mountains: Ruwenzori (5,109 m asl), Mount Kenya (5 199 m asl) and **Kilimanjaro** (5 895 m asl), of which the latter are volcanoes (Grove 2004). The glaciers are situated in the tropical climate zone. The processes governing accumulation and ablation are thus different from mid-latitude or polar climates. The glaciers reached their LIA maximum extents towards the late 19th century (Hastenrath 2001).

Glaciological studies on Ruwenzori, Mount Kenya and Kilimanjaro have a long history and are summarised in Hastenrath (1984, 2005), Kaser and Osmaston (2002), and Cullen et al. (2006). Several front variation series document the glacier changes on Mount Kenya where also the only African mass balance measurements were carried out on **Lewis Glacier** between 1978 and 1996 (Hastenrath 2005).

The ice cover on Ruwenzori has retreated continuously since the late 19th century, became strongly fragmented and on some peaks has completely vanished (Kaser and Osmaston 2002). The ice bodies on Kilimanjaro have shrunk continuously from about 20 km² just before 1880 to about 2.5 km² in 2003 (Cullen et al. 2006). The plateau glaciers thereby showed a linear retreat, whereas the glaciers on the slopes of the mountain had higher loss rates in the first half of the



Fig. 6.2.2 Lewis Glacier



20th century. Front variation measurements and repeated mapping provide documentation of the century-long history of glacier recession on Mount Kenya, with eight (out of 18) glaciers vanishing in the 20th century (Hastenrath 2005). The ice volume of Lewis Glacier decreased from about 7.7 km³ in 1978 to about 0.3 km³ in 2004 (Hastenrath and Polzin 2004) with an average thickness loss of almost one metre ice per year.

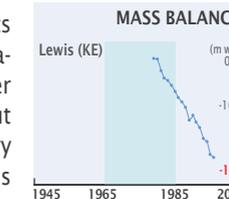


Fig. 6.2.1a Mount Kilimanjaro, 1950



Fig. 6.2.3 Kilimanjaro



Fig. 6.2.1b Mount Kilimanjaro, 1999

Ice covered area (km²):	6
Front variation	
number of series:	14
average number of observations:	6
average time length (years):	71
Mass balance	
number of series:	1
average number of observations:	18

Fig. 6.2.1 a–b Mount Kilimanjaro, Tanzania, northern icefield. Source: Upper photograph taken in the early 1950s by J. West, lower photograph taken in 1999 by J. Jafferji.

Fig. 6.2.2 Lewis Glacier, Mount Kenya, in the mid 1990s. Source: S. Ardito.

Fig. 6.2.3 Mount Kilimanjaro, Tanzania. Space view of the glaciers around the crater (center) and typical surrounding clouds. Source: ASTER satellite image (50 x 45 km), 19 August 2004.