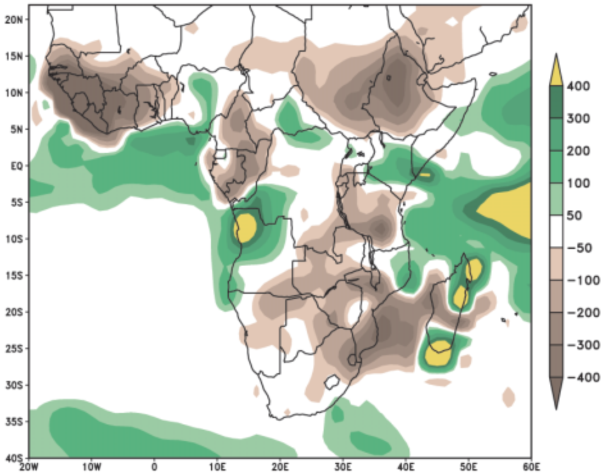

Fig. 72. Annual precipitation anomalies for 2002 for Africa from CAMS combined satellite and rain gauge–derived precipitation estimates. The anomaly base period is 1979–95.

heavy rains. Several roads in the eastern Cape were also closed to traffic.

Most of southern Africa, except for the western and southwestern coast and adjacent interior of South Africa, received below-average rainfall totals during the OND period. This rainfall deficit may have been due to the presence of El Niño and anomalously warm equatorial Indian Ocean surface temperatures. An anomalously warm equatorial Indo-Pacific enhances the probability of below-average summer rainfall totals over much of the region.

Temperatures in October were also below normal ranging from as low as 2°C to more than 38°C within a span of three weeks. This together with a lack of rain caused extensive damage to the wheat crop in the summer rainfall region. Estimated average crop damages of 35%–40% occurred due to the dry conditions and heat.

f. Asia

i) Russia—O. Bulygina,[4] N. N. Korshunova,[4] and V. N. Razuvaev[4]

Weather conditions in 2002 were analyzed for the

KILIMANJARO SNOW—D. Hardy[9]

Snowfall measurements at the summit of Kilimanjaro indicated the return of a more typical precipitation regime during 2002 (Fig. 73). Long-term records from surrounding lowland stations (Tanzania and Kenya) normally exhibit a bimodal seasonality, with a primary peak in MAM (Masika or "long rains"), and a secondary peak in October–November (Vuli or "short rains")—with an enhanced Vuli during El Niño (Ropelewski and Halpert 1987; Nicholson and Kim 1997).

Through 2000 and 2001, Kilimanjaro precipitation seasonality was disrupted (Fig. 73), and the amount of precipitation appears to have been suppressed; these findings are consistent with regional drought conditions (cf. Lawrimore et al. 2001; Waple et al. 2002). The extreme snowfall recorded on Kilimanjaro during January of 2001 was coincident with record rainfall measured elsewhere in the region.

Kilimanjaro's glaciers are extremely sensitive to precipitation variability (Jäger 1931; Kaser et al. 2003, submitted to *Int. J. Climatol.*), as on an annual basis, the summit climate is thermally homogeneous, with a mean annual temperature of –7.1°C. Figure 73 illustrates the consequences of drought for mass balance at the glacier surface, where energy exchange is largely governed by surface albedo. Monthly snowfall of at least 10 cm appears generally sufficient to maintain a neutral or positive mass balance. However, when monthly snowfall is uniformly low (e.g., in 2000) or when wet season precipitation is deficient, Kilimanjaro's severe climate results in conditions favorable for rapid ablation.

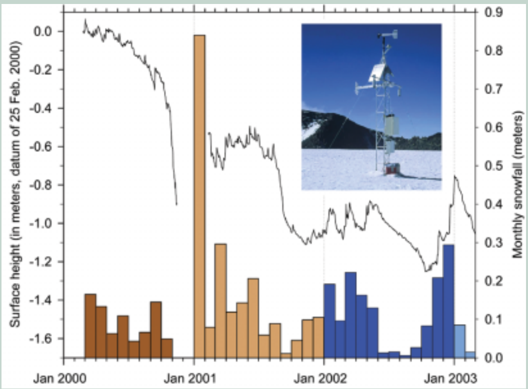

Fig. 73. Snowfall and surface height change on a glacier at Kilimanjaro's summit. Sonic distance sensors on an automated weather station (see inset image) make hourly measurements, allowing determination of surface height (solid line, left-hand scale) and monthly snowfall (bars, right-hand scale). Automated measurements were not available between mid-Nov 2000 and 10 Feb 2001; snowfall during this period was determined indirectly and attributed in the figure entirely to January, a month of extreme precipitation in the region.