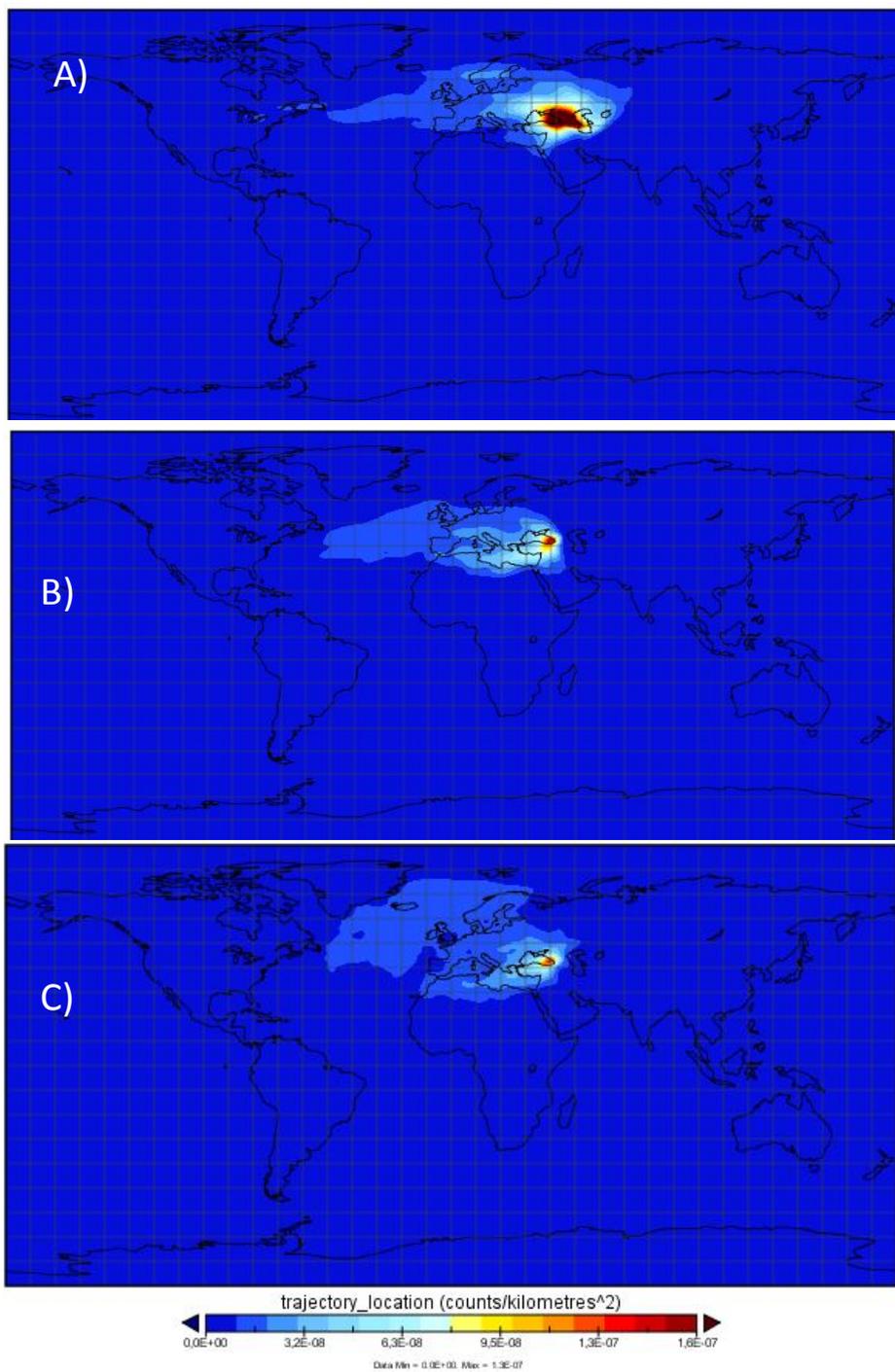


Supplement



**Fig. S1:** Example of the back-trajectories calculations in FLEXPART model (Forster et al., 2007, Stohl et al., 2009): A – July 2012; B – January 2011, C – November 2007 that represent typical trajectory locations with local, Mediterranean and Atlantic moisture sources respectively.

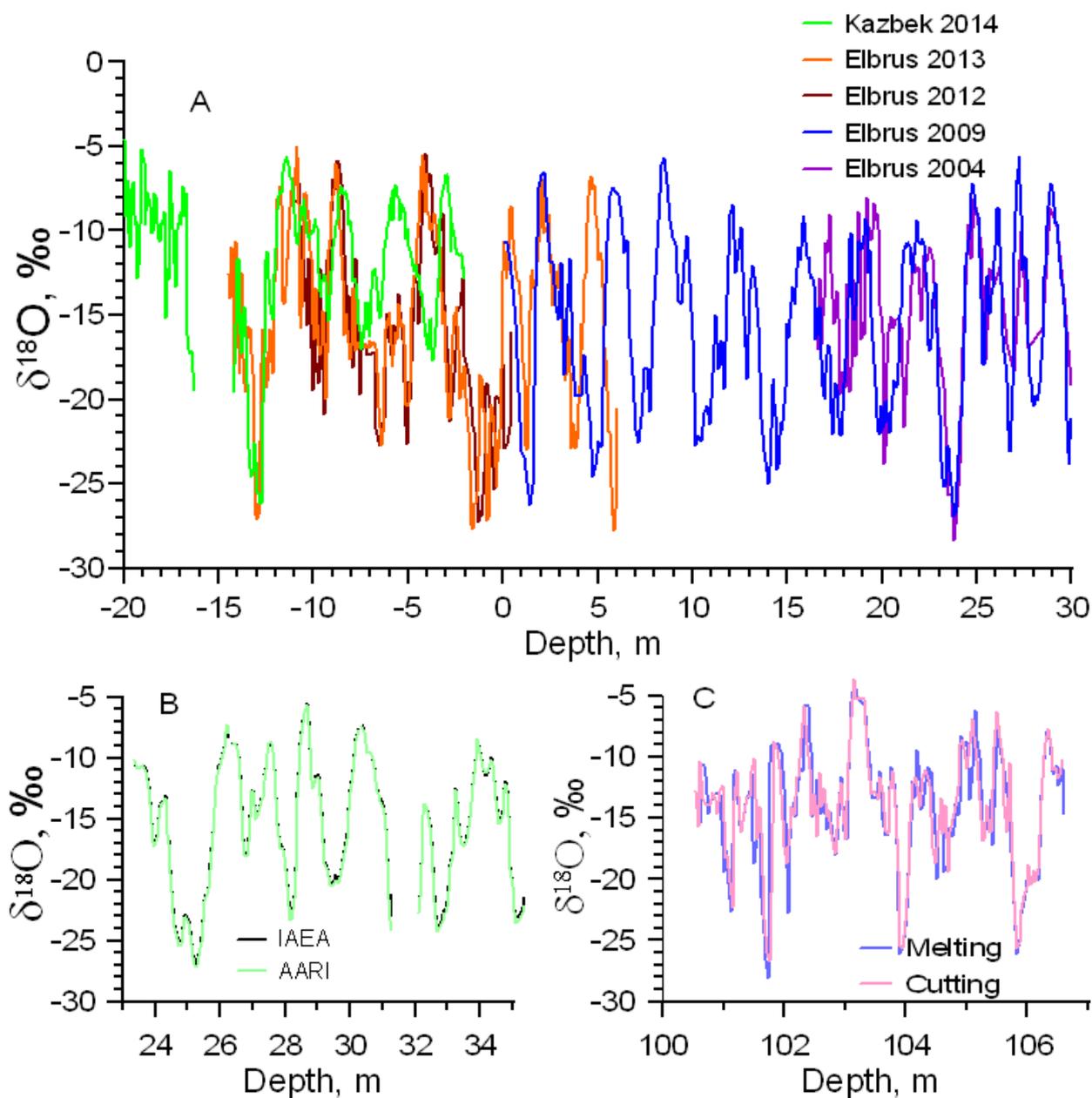
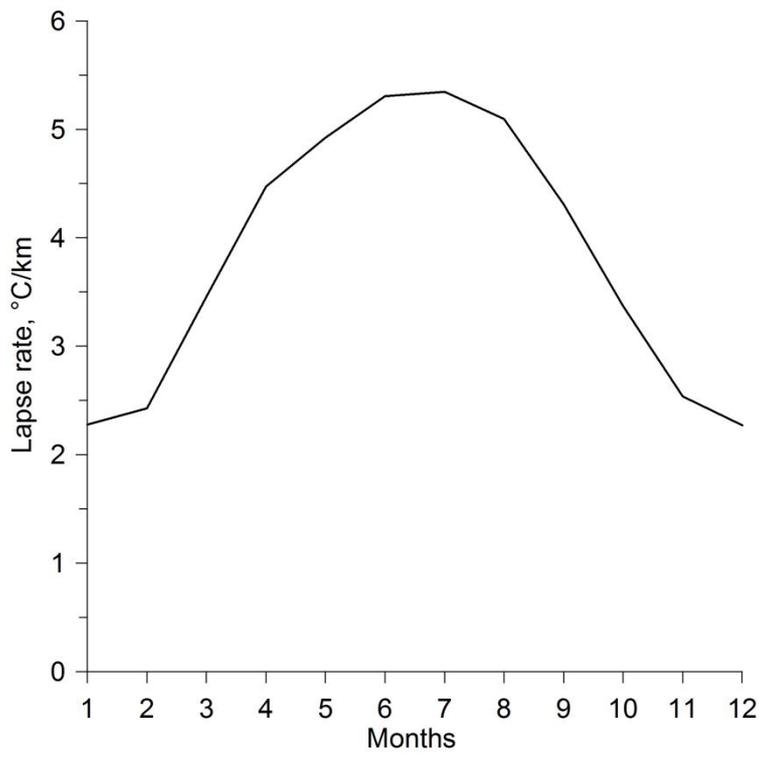
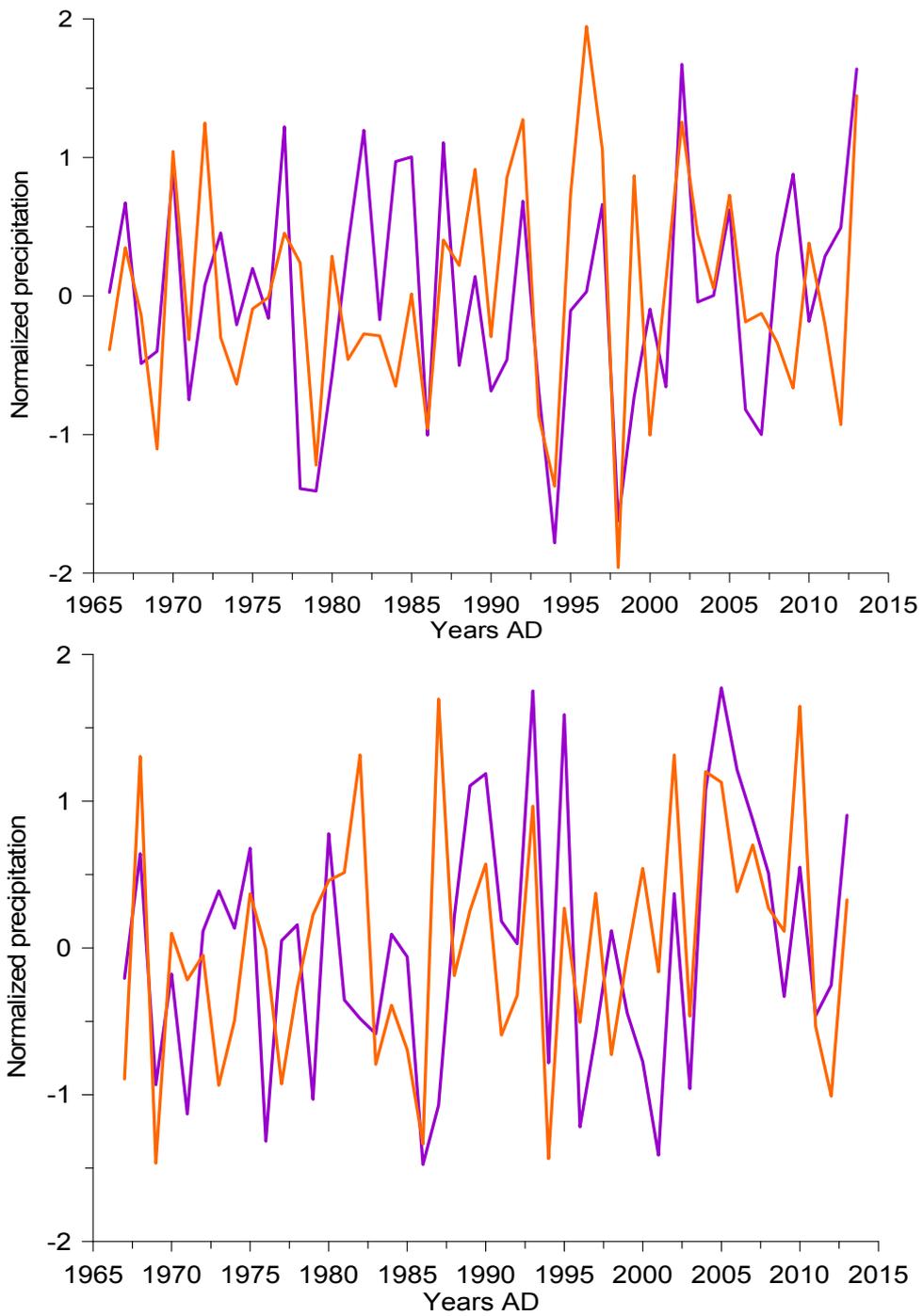


Fig. S2: Ice core  $\delta^{18}\text{O}$  records. a) Comparison of the various depth profiles of  $\delta^{18}\text{O}$  obtained at Elbrus from cores drilled in 2004 (purple), 2009 (blue), 2012 (brown), 2013 (orange) and from Kazbek (green). Individual records have been shifted by the depth range corresponding to the start of each record. All measurements were performed at AARI. b) Comparison between  $\delta^{18}\text{O}$  data measured at AARI (green) and IAEA (black), for a 12 meter ice section, demonstrating the quality of the analytical procedure at AARI. c) Comparison of  $\delta^{18}\text{O}$  data obtained through two different sampling approaches for a 6 m ice segment: in pink, based on the classical cutting approach; in blue, for discrete samples obtained through the continuous flow analysis device (therefore through a continuous melt approach). Note that the exact depth step for each sampling was different. See the main text for details.



**Fig. S3: Calculated monthly mean lapse rate, based on available regional meteorological data for the 1966-1990 period.**



**Fig. S4: Normalized precipitation rate in summer (upper panel) and in winter (lower panel). Orange line shows stack record for the stations situated to the south from the Caucasus and purple line shows the stack for the northern stations.**