

Exercise

1. Determine the total area of the glacier.

Summation of all the area under 'area distribution curve ' from altitude 3900 m a.s.l to 6000 ma.s.l gives the total area of the glacier. (6730000 m²)

Table1: Altitude vs mass balance and the area distribution of the Dokriani glacier					
Altitude	Altitude Range	Area(km²)	Area(m²)	Mass Balance (1992-93) m.w.e.	Specific Mass Balance (1992-93)
3900	<3900	0	0	-4.1	0
4000	3900-4000	0.05	50000	-3.85	-0.1925
4100	4001-4100	0.1	100000	-4.1	-0.41
4200	4100-4200	0.11	110000	-4.2	-0.462
4300	4200-4300	0.16	160000	-4.25	-0.68
4400	4300-4400	0.26	260000	-4.3	-1.118
4500	4400-4500	0.125	125000	-3.8	-0.475
4600	4500-4600	0.045	45000	-3.2	-0.144
4700	4600-4700	0.16	160000	-2.9	-0.464
4800	4700-4800	0.2	200000	-2.6	-0.52
4900	4800-4900	0.525	525000	-2.2	-1.155
5000	4900-5000	0.475	475000	-1.2	-0.57
5100	5000-5100	1.075	1075000	-0.5	-0.5375
5200	5100-5200	0.86	860000	0.1	0.086
5300	5200-5300	0.57	570000	0.2	0.114
5400	5300-5400	0.34	340000	0.3	0.102
5500	5400-5500	0.47	470000	0.4	0.188
5600	5500-5600	0.42	420000	0.6	0.252
5700	5600-5700	0.35	350000	0.65	0.2275
5800	5700-5800	0.26	260000	0.62	0.1612
5900	5800-5900	0.18	180000	0.65	0.117
6000	5900-6000	0.176	176000	0.65	0.1144
>6000	6000-6100	0.02	20000	0.56	0.0112
Total		6.931	6931000	-36.47	-0.2328
Net Balance					
-5.3547					

2. Is it possible to determine the equilibrium line altitude for various budget years from the given graph?

Hint: Yes, it is possible to determine the ELA from the given graph. The ELA is the altitude that corresponds to the point where the mass balance curve intersects the Zero mass balance line. The ELA is calculated from the following graph.

3. Determine the accumulation area ratio for each budget year

Hint: The ratio of total area and the area above ELA gives AAR.

4. Compute the net balance for the budget year 1992-1993.

Hint: Multiply the altitude wise mass balance with the area corresponding to the altitude. Summation of these yields net balance of whole of the glacier for the given year.

Answer: The net mass balance for the budget is -5.33. The complete results for this question are represented in table 1 above.

5. If ELA or AAR is given for the budget year 2000-2001, Can mass balance be determined? Which is the better parameter among the two, ELA and AAR?

Hint: Yes, by using a polynomial equation representing the relationship between ELA or AAR and mass

balances.

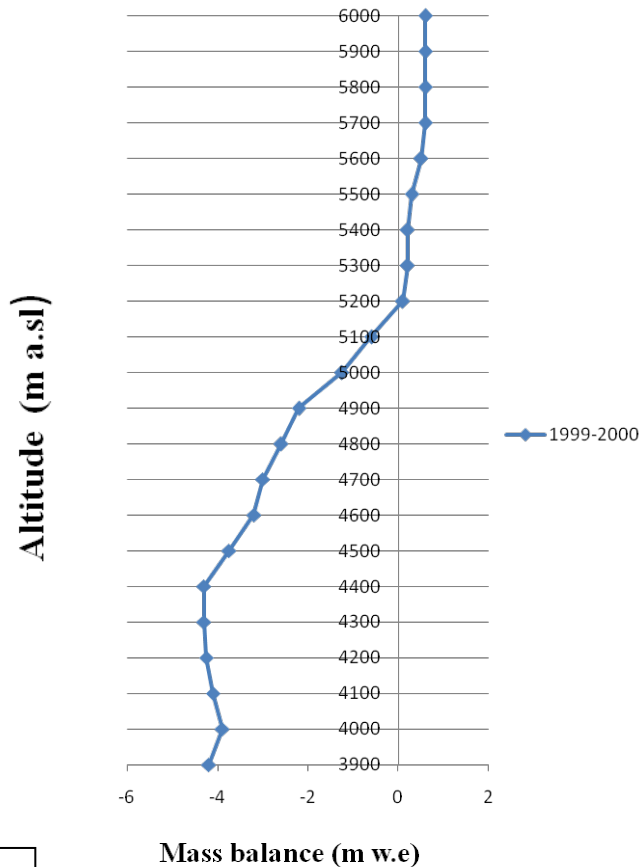


Figure 1

6. What is the rate of change in ELA or AAR from year 1992 to 2000?

Hint: The slope of the graph between various budget yearS and EIA and AAR gives the rate of change (figure 1)

7. Can change in temperature for future be predicted? If yes, predicted the temperature changes for year 2030, 2050, 2080 considering various levels of radiative forcings.

Hint: The change in temperature for various RCP scenarios for corresponding budget year can be deduced from the graph given in the right hand side.

8. Determine the change in ELA and AAR for budget year 2030, 2050 and 2080 due to the change in temperature according to various RCPs. Also, determine the corresponding change in mass balance through AAR.

Hint: The respective change in ELA is estimated using a temperature decrease rate of 1°C per 140 m i.e. a lapse rate of 7.14° C per km (Rathore et al. 2009).

Also, Mass balance = B= 2430 * AAR– 1200

9. Determine the change in precipitation for years 2030, 2050 and 2080 according to various RCP’s. Also determine the corresponding change in mass balance.

Hint: changes in mass balance due to change in precipitation can be calculated using the equation:

$[\Delta B = AAR * \Delta P]$, where,

ΔB is the change in mass balance .

ΔP is the change in precipitation.[3]

The winter precipitation for year 2000 =210 mm w.e

Table				
	Parameters	2030	2050	2080
RCP 2.6	ΔP	4.2	8.4	10.5
	AAR	0.368268	0.283654	0.276929
	ΔB	1.546725	2.38269	2.907751
RCP 4.5	ΔP	5	8.2	10
	AAR	0.310553	0.235444	0.190247
	ΔB	1.552766	1.93064	1.902475
RCP 6.0	ΔP	7	5	8.5

	AAR	0.310553	0.262955	0.171252
	ΔB	2.173872	1.314774	1.45564
RCP 8.5	ΔP	7	9	11.5
	AAR	0.310553	0.193767	0.104658
	ΔB	2.173872	1.743904	1.203566