



The Kinneret watershed

1. General background

Lake Kinneret watershed, located in the central part of the Jordan Rift Valley (Northern Israel), is the most important surface water resource in Israel. The major water source for the lake is the $\sim 1,700 \text{ km}^2$ Upper Catchments of the Jordan River (UCJR) including $\sim 920 \text{ km}^2$ in Israel and the remainder located in Syria and Lebanon. In the north of the UCJR, the high elevation of the Mt. Hermon range (between 1,200 - 2,800 m) is the wettest area in the Lake Kinneret watershed, where the average annual precipitation ranges between 1200 - 1500 mm. The Mt. Hermon basins feed the 3 major tributaries of the Jordan River: the Dan with ~ 250 million m^3 (Mm^3) annually, the Hermon ($\sim 110 \text{ Mm}^3$, also known as Banias), and the Snir ($\sim 115 \text{ Mm}^3$, also known as the Hazbani River). The other part of the Lake Kinneret basin is the direct watershed, located in the immediate vicinity of the lake. The area of the direct watershed is $\sim 965 \text{ km}^2$, 577 km^2 of which are in the southern part of the Golan Height to the east of the lake, and the other 388 km^2 are in the Eastern Galilee Mountains to the west of the lake.

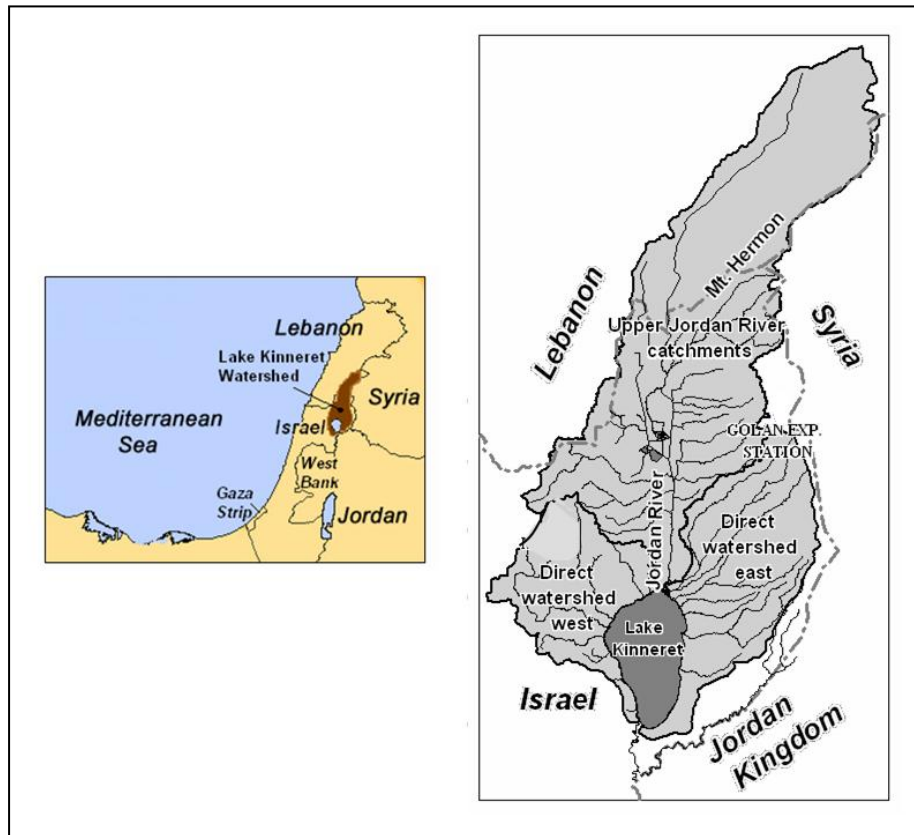


Figure 1: a. Orientation map of the east Mediterranean. b. The Lake Kinneret watershed, including the international borders, the Upper catchments of the Jordan River and, the direct watersheds (east and west)

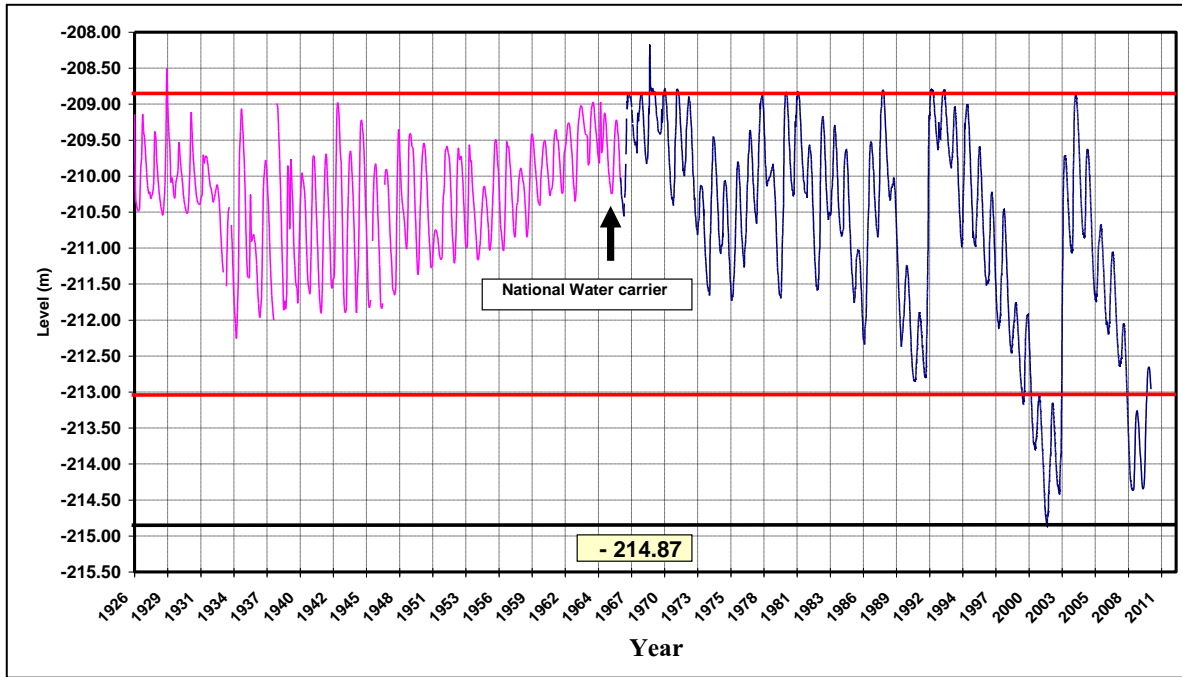


Figure 2: Lake Kinneret levels since 1926

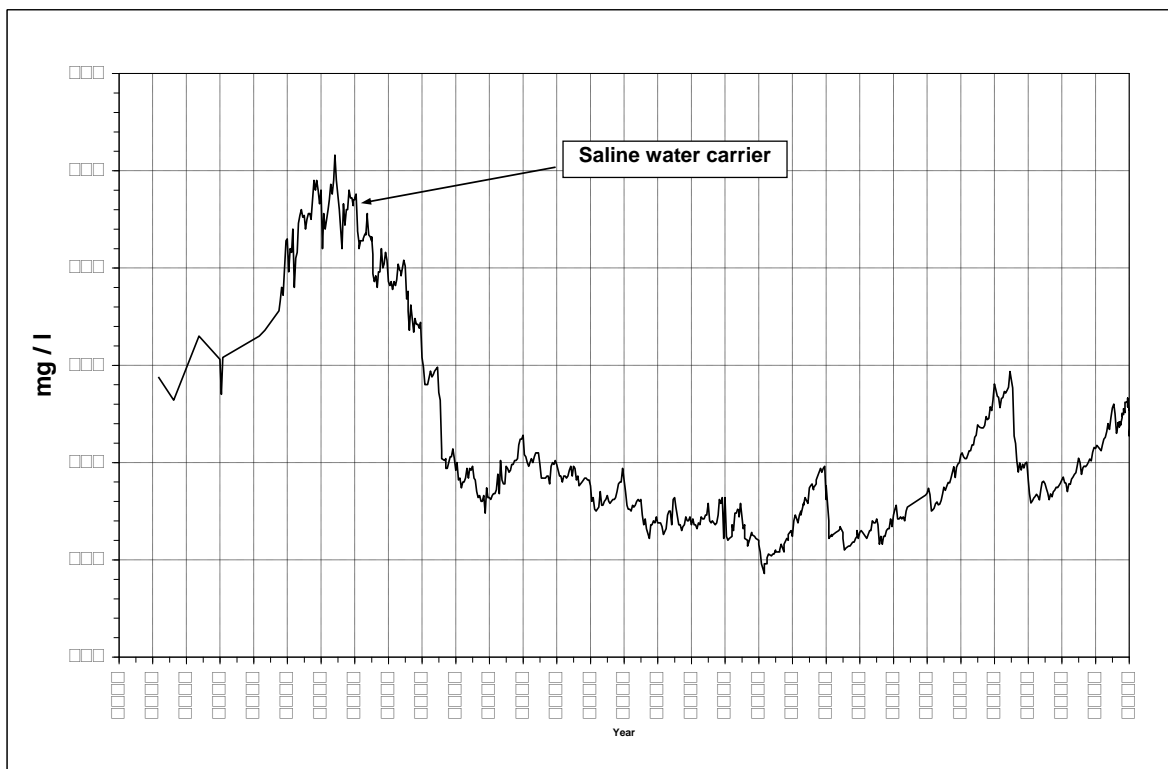


Figure 3: Lake Kinneret salinity concentration since 1950

2. Water balance in the Kinneret Basin

The average annual water flowed into Lake Kinneret over the past decades is 610 Mm³ (for the period 1985-2009) including the Jordan River (415 Mm³), direct rainfall (65 Mm³), direct watershed runoff and artificial diversion (70 Mm³), and springs flowing directly into the lake (55 Mm³). An average of 240 Mm³ evaporate every year, so that the average annual volume of available water is ~370 Mm³. Most of this volume is pumped out from the lake every year for consumption, while some water occasionally overflows to the Lower Jordan River towards the Dead Sea.

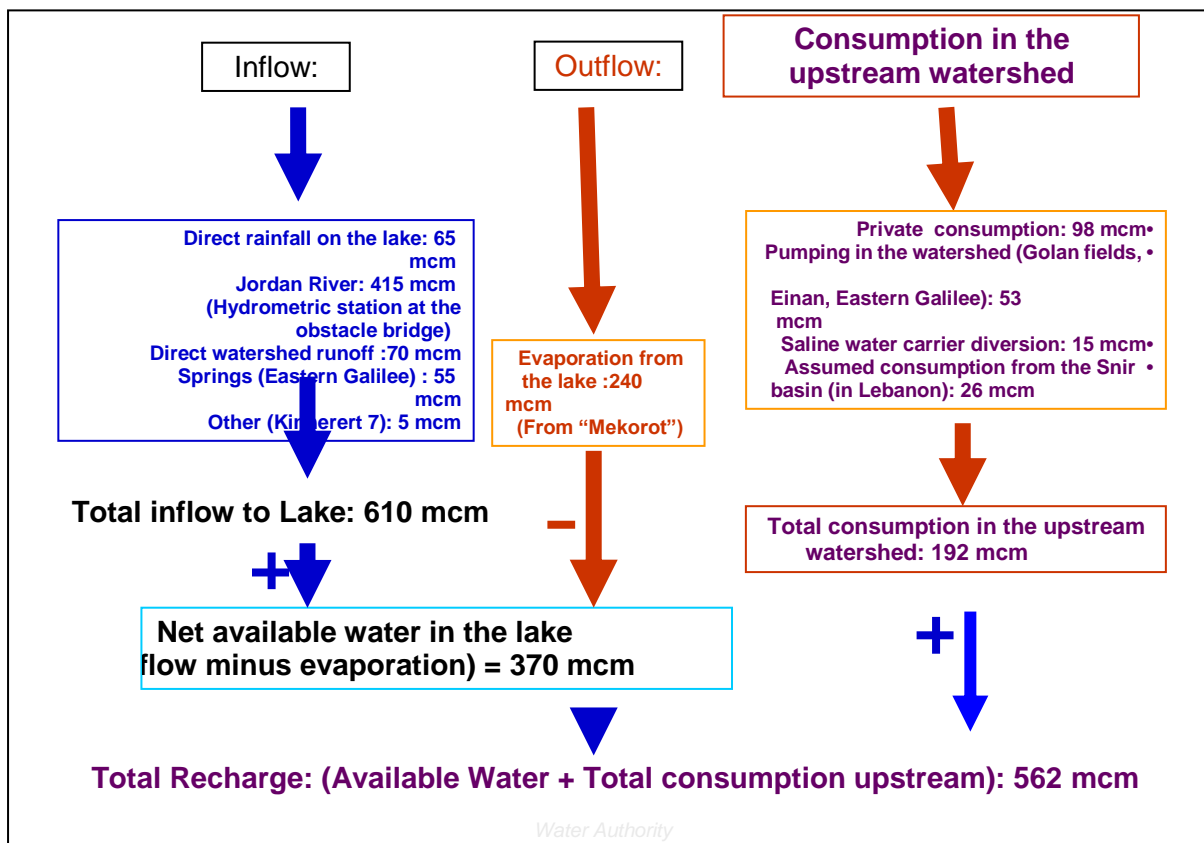


Figure 2: Water Balance in the Kinneret Basin, average values for the Period 1985-2009

Table 1: Lake Kinneret: Natural Inflow minus evaporation (mcm/year)

Hyd Year	Jordan River	Direct rain	Kin. 7	Springs	Runoff	Evaporation
1997-1998	462	69	5.2	70	70	224
1998-1999	215	39	4.7	71	13	238
1999-2000	254	64	5.1	61	52	234
2000-2001	198	52	4.8	15	13	222
2001-2002	326	82	5.1	34	42	229
2002-2003	774	103	5.3	82	198	221
2003-2004	619	68	5.4	32	142	222
2004-2005	442	57	6.6	26	39	223
2005-2006	372	66	45	20	26	224
2006-2007	354	62	5.4	22	26	225
2007-2008	230	44	9.5	18	16	226
2008-2009	268	62	4.4	51	36	227

Table 2: Water Balance in the Kinneret Watershed (mcm/year)

Hydrological year	Total consumption in the upstream watershed	Net available water in Lake Kinneret	Total recharge to the watershed
1975/76	170	416	586
1976/77	167	534	701
1977/78	163	510	673
1978/79	159	110	269
1979/80	134	712	846
1980/81	152	722	874
1981/82	168	274	442
1982/83	226	617	844
1983/84	172	364	535
1984/85	167	368	534
1985/86	180	196	376
1986/87	169	637	806
1987/88	178	653	831
1988/89	172	187	359
1989/90	147	174	321
1990/91	142	116	258
1991/92	156	1176	1332
1992/93	172	635	806
1993/94			
1994/95			
1995/96			
1996/97			
1997/98			

1998/99	223	104	326
1999/00	188	184	371
2000/01	180	69	249
2001/02	186	267	453
2002/03	197	942	1140
2003/04	194	628	822
2004/05	191	332	523
2005/06	192	257	448
2006/07	183	220	404
2007/08	192	82	274
2008/09	206	176	382

Table 3: Inflow, Outflow, Changes in the lake volumes and Lake Kinneret levels

Hyd Year	Years	Inflows-Evap	Outflows	Change in Lake volume (mcm)	Change in Lake level (m)	Lake Level (m)
1973-1974	1973	490	364	126	0.76	-211.43
1974-1975	1974	321	477	-156	-0.96	-210.72
1975-1976	1975	427	348	79	0.49	-211.46
1976-1977	1976	550	457	93	0.57	-211.02
1977-1978	1977	537	488	49	0.30	-210.46
1978-1979	1978	141	374	-233	-1.44	-210.15
1979-1980	1979	739	485	253	1.56	-211.57
1980-1981	1980	743	733	9	0.06	-210.04
1981-1982	1981	295	512	-217	-1.34	-209.98
1982-1983	1982	642	499	143	0.88	-211.31
1983-1984	1983	410	443	-33	-0.21	-210.44
1984-1985	1984	410	514	-104	-0.64	-210.63
1985-1986	1985	227	404	-178	-1.10	-211.26
1986-1987	1986	695	402	293	1.81	-212.33
1987-1988	1987	685	587	99	0.61	-210.57
1988-1989	1988	210	547	-337	-2.08	-209.96
1989-1990	1989	155	253	-98	-0.60	-212.00
1990-1991	1990	148	169	-21	-0.13	-212.59
1991-1992	1991	1120	604	516	3.18	-212.72
1992-1993	1992	677	700	-23	-0.14	-209.41
1993-1994	1993	280	473	-193	-1.19	-209.54
1994-1995	1994	508	480	28	0.17	-210.73
1995-1996	1995	392	493	-101	-0.62	-210.55
1996-1997	1996	369	477	-107	-0.66	-211.16
1997-1998	1997	485	515	-30	-0.18	-211.79
1998-1999	1998	125	268	-142	-0.88	-211.96
1999-2000	1999	230	333	-103	-0.63	-212.95
2000-2001	2000	84	256	-172	-1.06	-213.58
2001-2002	2001	300	237	63	0.39	-214.61
2002-2003	2002	988	405	584	3.60	-214.24
2003-2004	2003	670	627	43	0.27	-210.70
2004-2005	2004	382	542	-160	-0.99	-210.42
2005-2006	2005	296	382	-86	-0.53	-211.40
2006-2007	2006	265	329	-64	-0.39	-211.93
2007-2008	2007	102	364	-261	-1.61	-212.37
2008-2009	2008	211	228	-17	-0.10	-214.04

Table 4: Water Balance for the Kinneret Watershed (mcm/year)

Period	Available water in Lake Kinneret	Total consumption from the upstream watershed	Total recharge to entire watershed
Average:1975 -2009	398	184	582
Median:1975 -2009	358	180	538
Average:1975 -1992	467	166	633
Median:1975 -1992	463	167	630
Average:1993 -2009	320	205	525
Median:1993 -2009	262	196	458

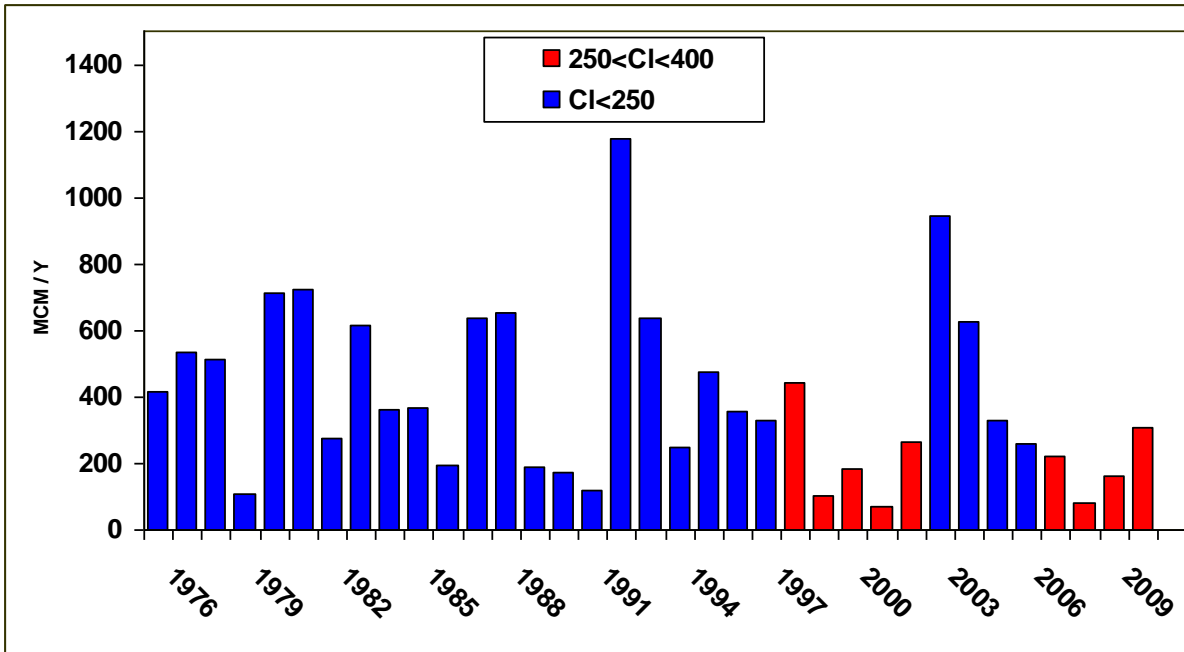


Figure 3: Available water in Lake Kinneret in respect to Cl concentration in the Lake: CI < 250 mg/l (in blue) and 250 < CI < 400 mg/l (in red)

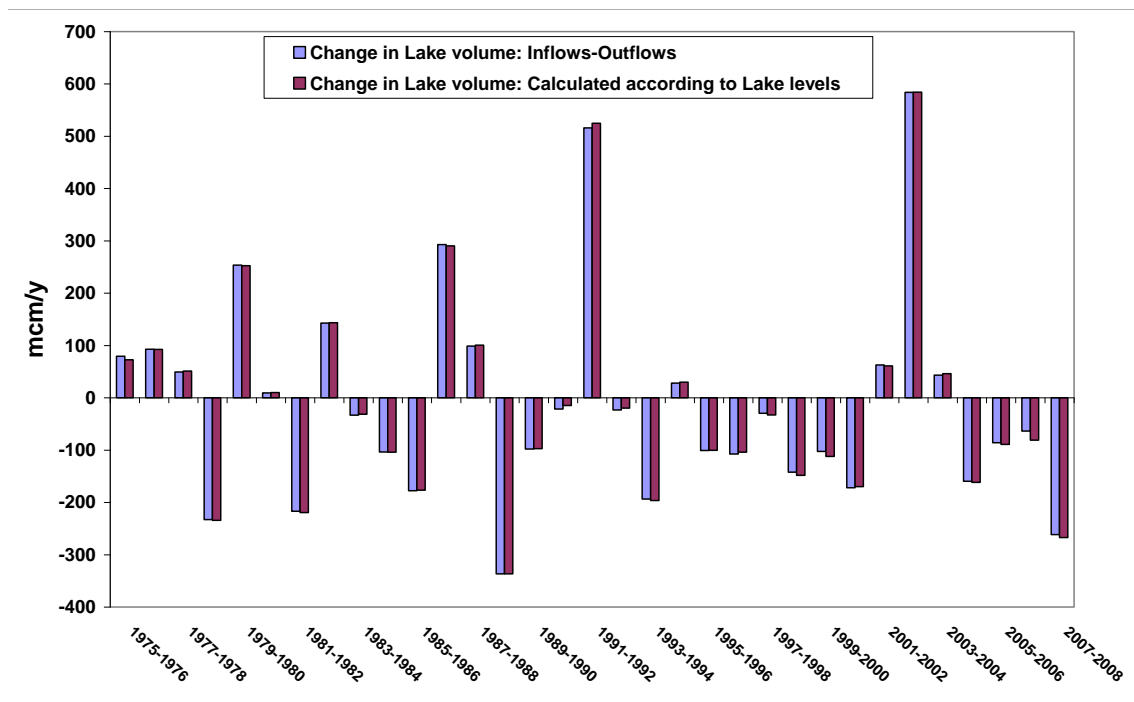


Figure 4: Calculation of Lake Kinneret Balances according to: (A) Inflows minus outflows and (B) Changes in the lake volumes according to the Lake levels