Homework 10

A. Establishing Area Versus Elevation relationship for artificial reservoirs

Lake Mead

Data for reservoir levels are from 2000 through 2010, time series for reservoir levels are shown in Fig 1; data for reservoir surface area runs from 2004 through 2010, the time series are shown in Fig 2; data for volume variations are from 2014 through 2010, the time series are shown in Fig 3. The height versus area curve is shown in Fig 4. Assume trapezoidal cross section between two successive levels, and the height versus volume variations curve is shown in Fig 5. Fig 5 shows that calculated height versus volume variation matches what is provided on the website at HYDROWEB for Lake Mead.

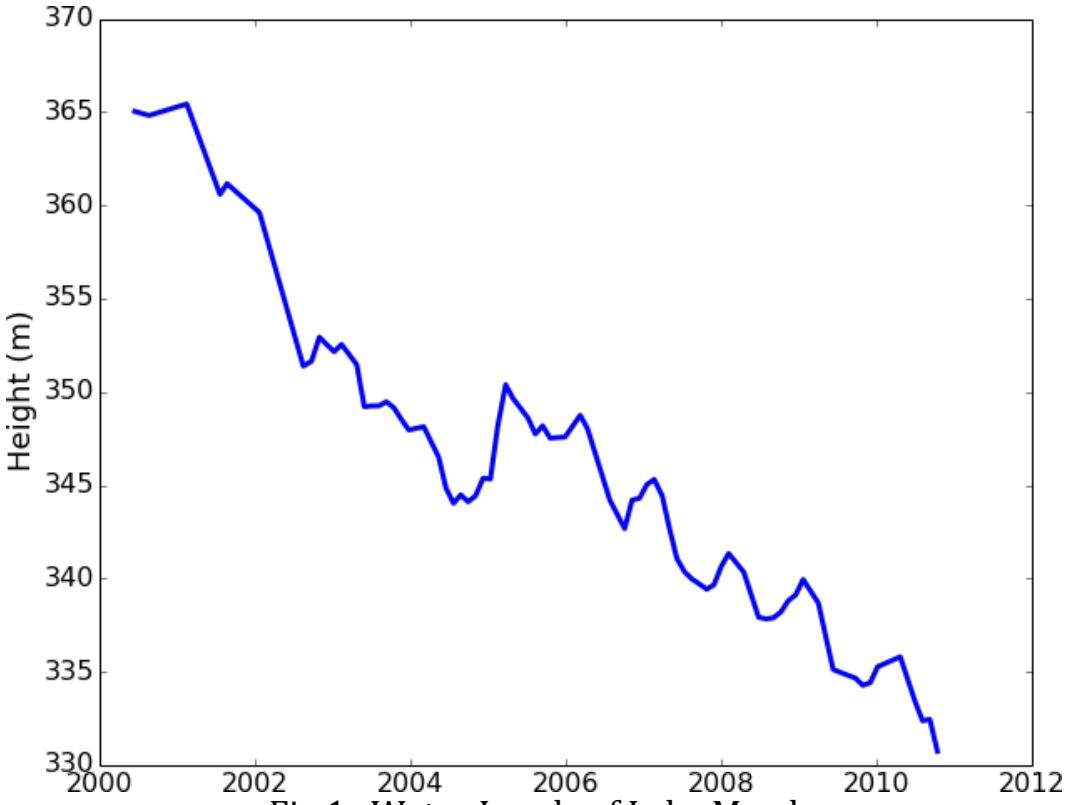

Fig 1 Water Levels of Lake Mead

Fig 2 Surface Area of Lake Mead

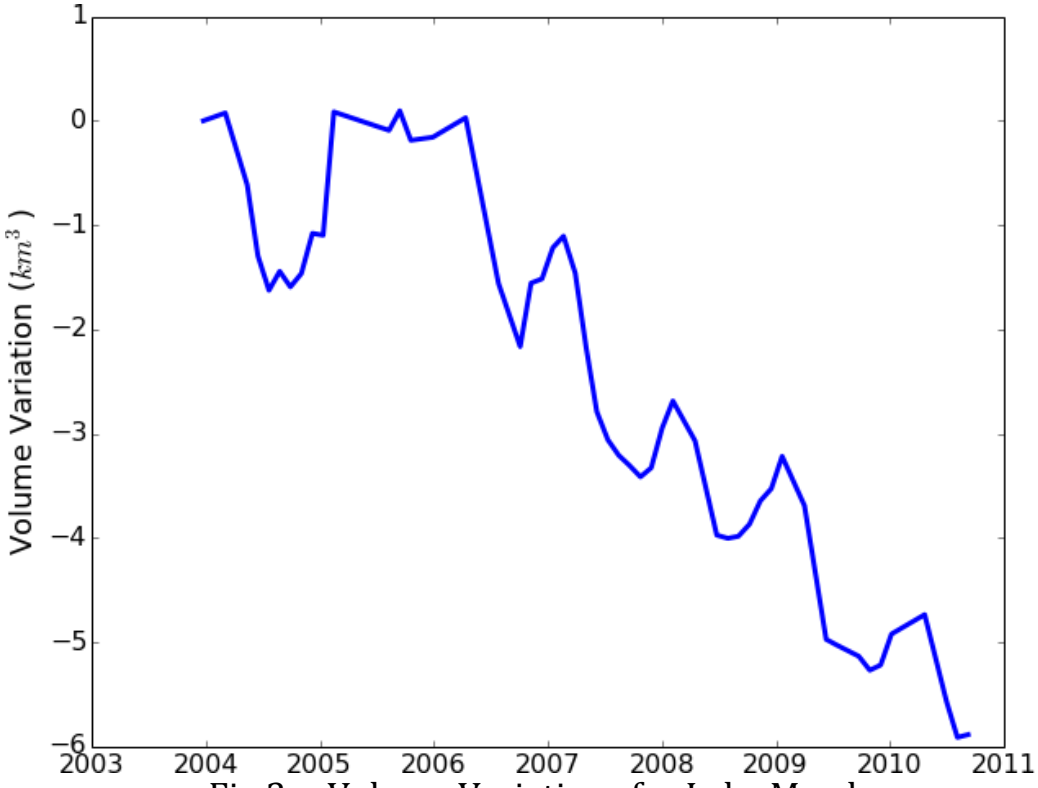

Fig 3 Volume Variations for Lake Mead

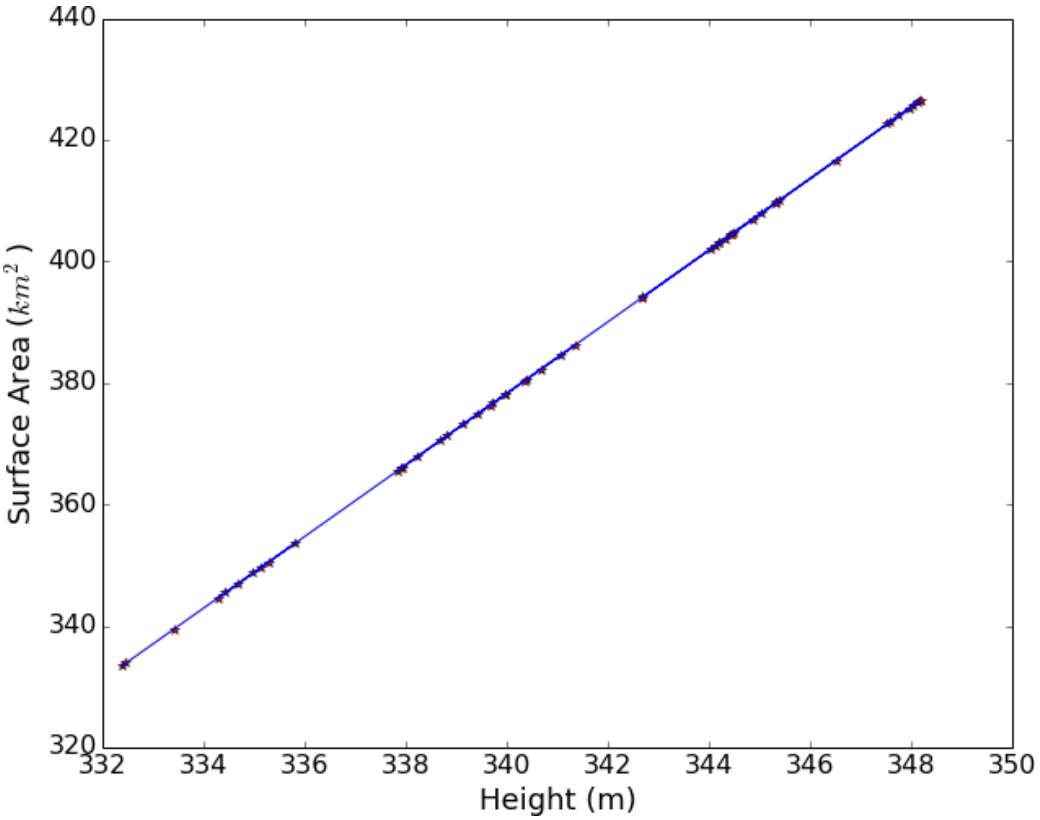

Fig 4 Water Level versus Surface Area for Lake Mead

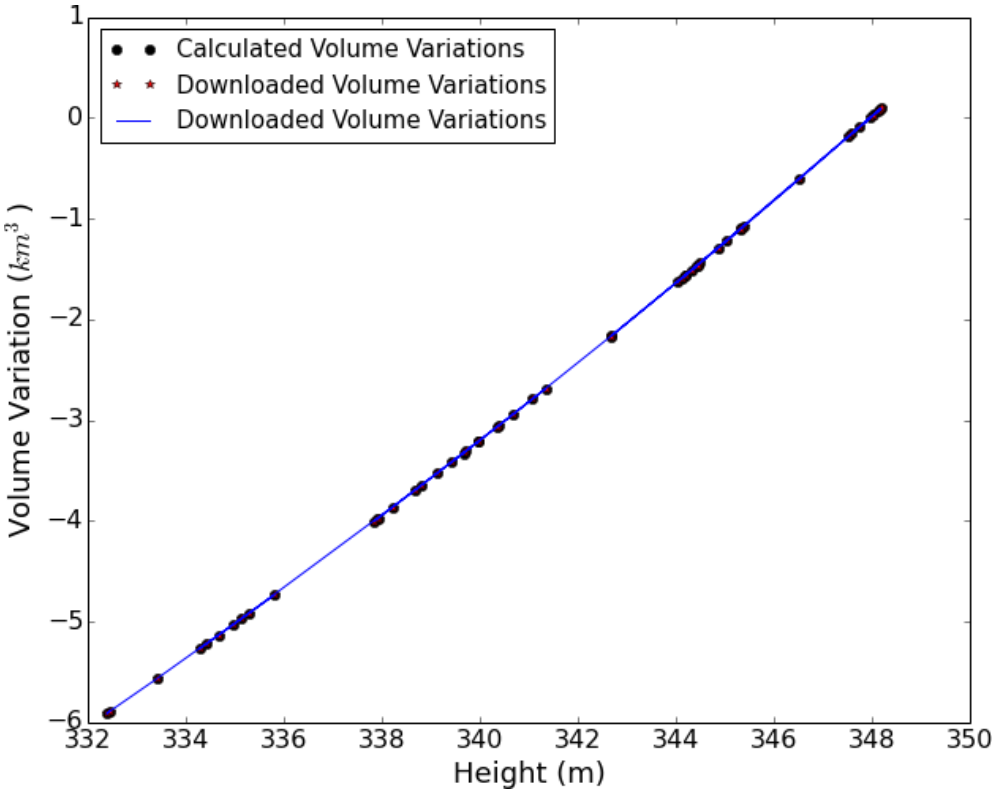

Fig 5 Water Level versus Volume Variations for Lake Mead

Lake Powell

Data for reservoir levels are from 1993 through 2010, time series for reservoir levels are shown in Fig 6; data for reservoir surface area runs from 1993 through 2010, the time series are shown in Fig 7; data for volume variations are from 1993 through 2010, the time series are shown in Fig 8. The height versus area curve is shown in Fig 9. Assume trapezoidal cross section between two successive levels, and the height versus volume variations curve is shown in Fig 10. Fig 10 shows that calculated height versus volume variation matches what is provided on the website at HYDROWEB for Lake Powell.

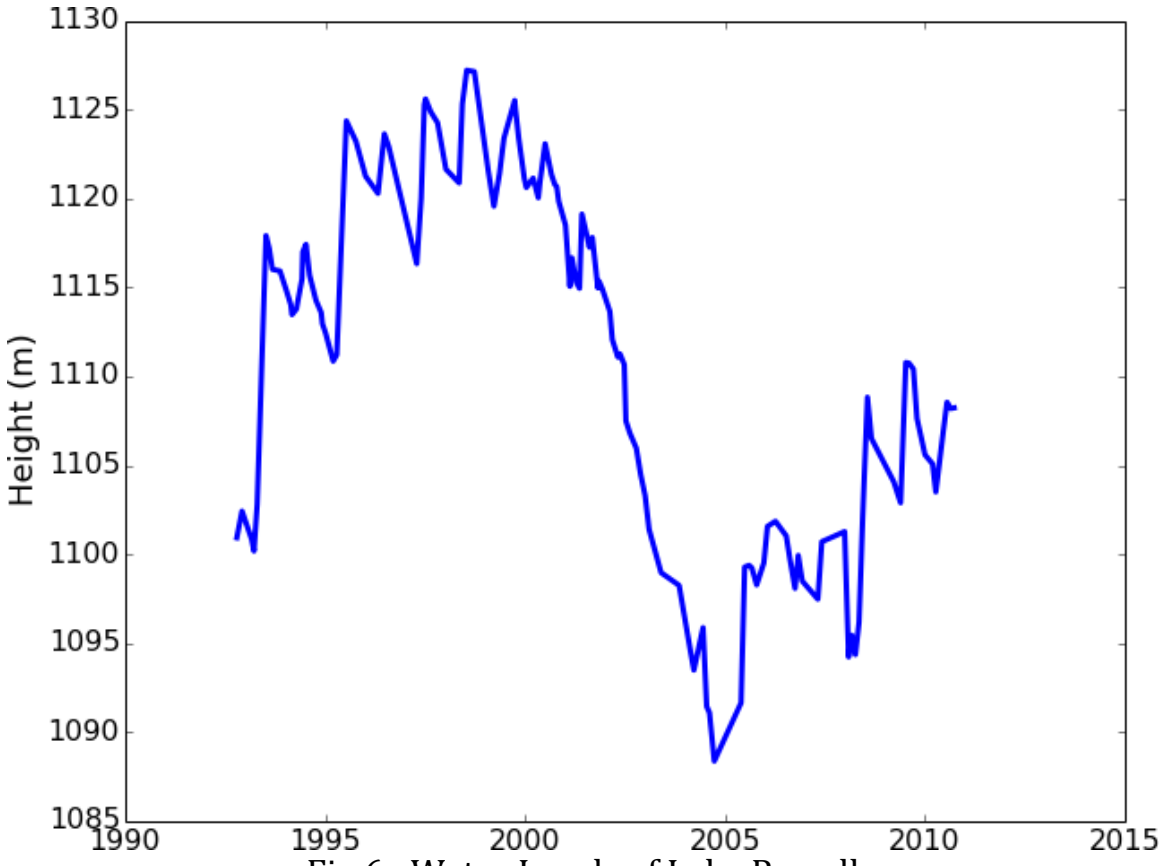

Fig 6 Water Levels of Lake Powell

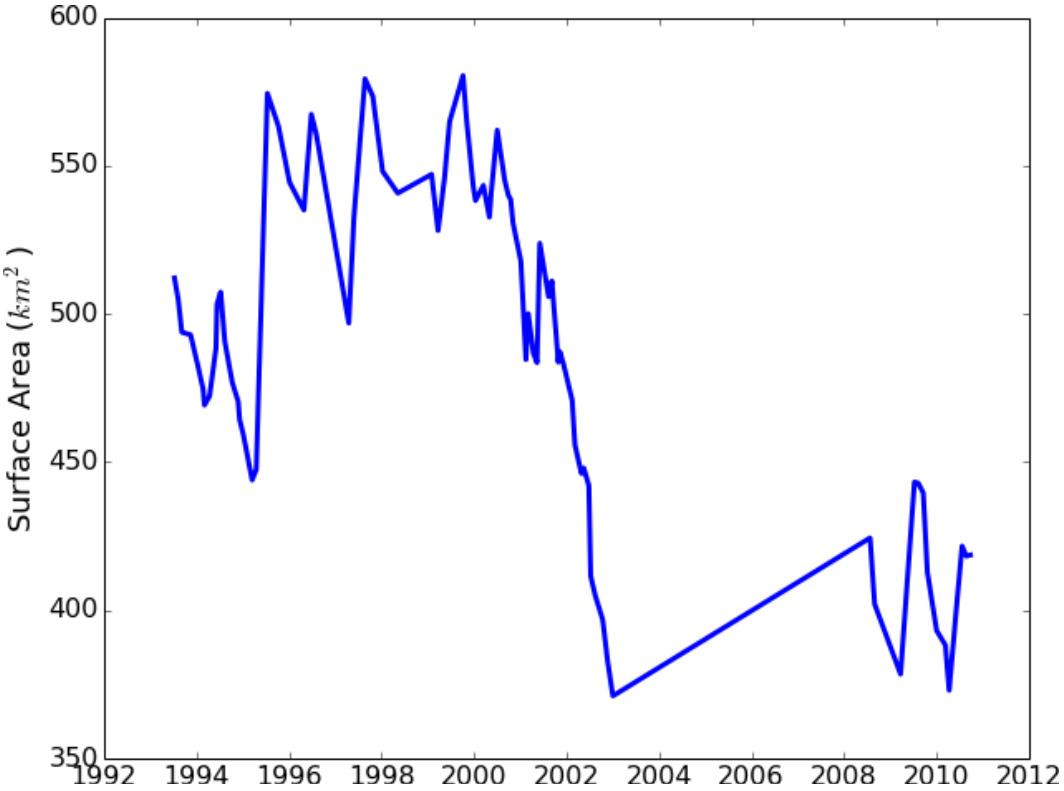

Fig 7 Surface Area of Lake Powell

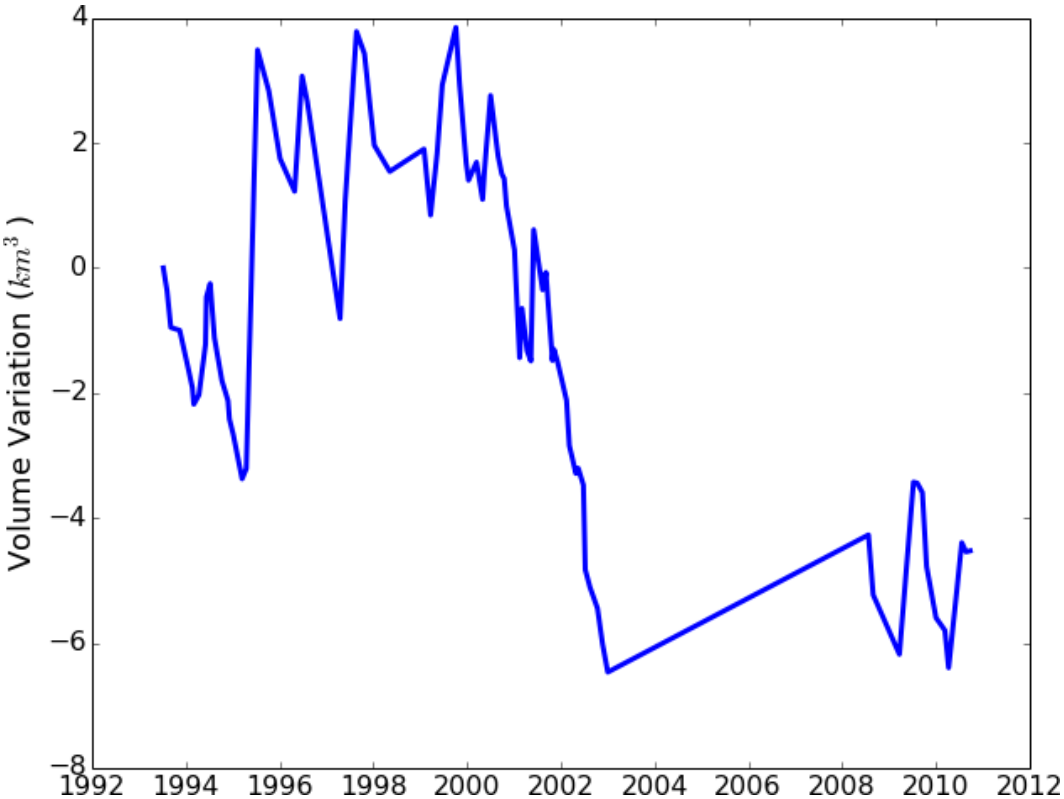

Fig 8 Volume Variations of Lake Powell

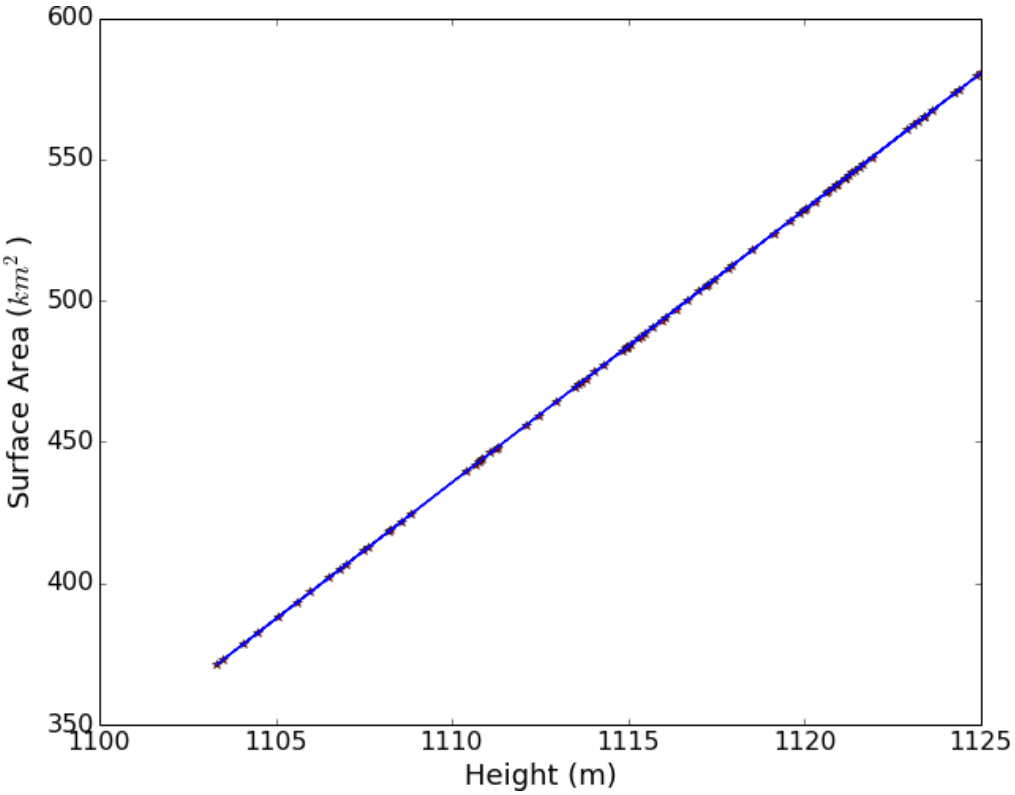

Fig 9 Water Level versus Surface Area of Lake Powell

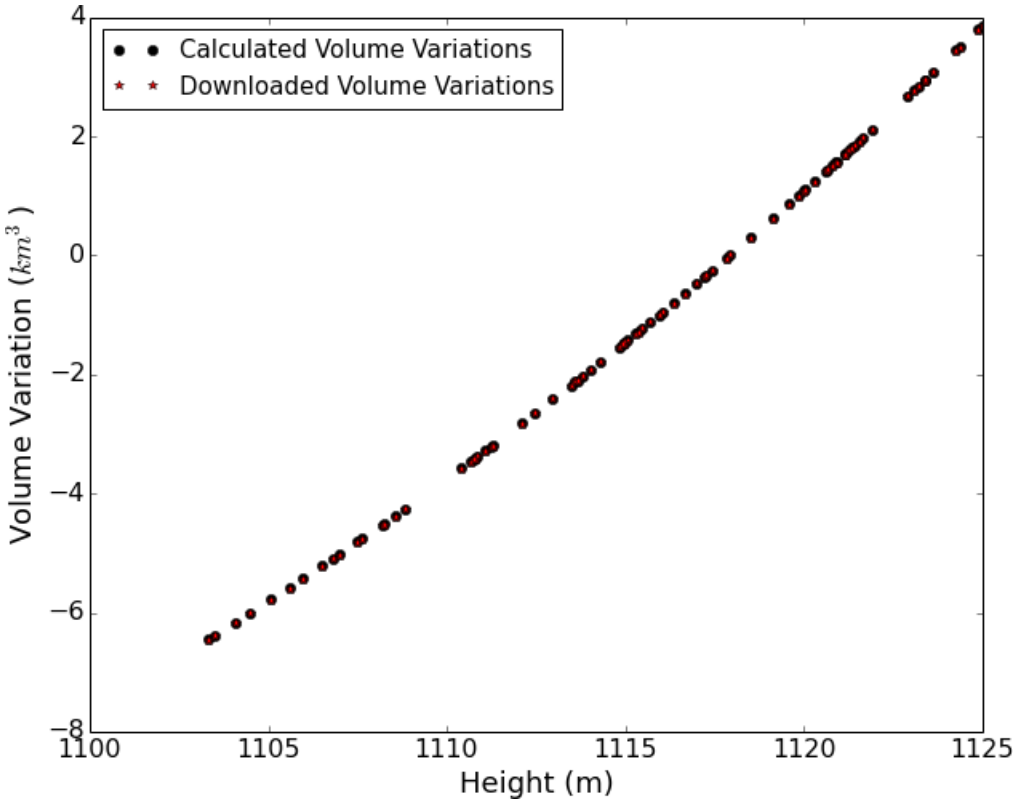

Fig 10 Water Level versus Volume Variation of Lake Powell

Compare Fig 5 with Fig 10, water level versus volume variation has an approximately linear relationship for Lake Mead, whereas for Lake Powell, it has a nonlinear relationship.

B. Tragedy of the Commons: the Story of Aral Sea

Aral Sea (South)

Data for reservoir levels are from 1992 through 2011, time series for reservoir levels are shown in Fig 11; data for reservoir surface area runs from 1992 through 2011, the time series are shown in Fig 12; data for volume variations are from 1992 through 2011, the time series are shown in Fig 13. The height versus area curve is shown in Fig 14. Assume trapezoidal cross section between two successive levels, and the height versus volume variations curve is shown in Fig 15. Water volume in pre-1990s is about 235.46 cubic km, based on Fig 13, the volume of the Aral sea reduced to 50% of pre-1990 level happened in 2001.

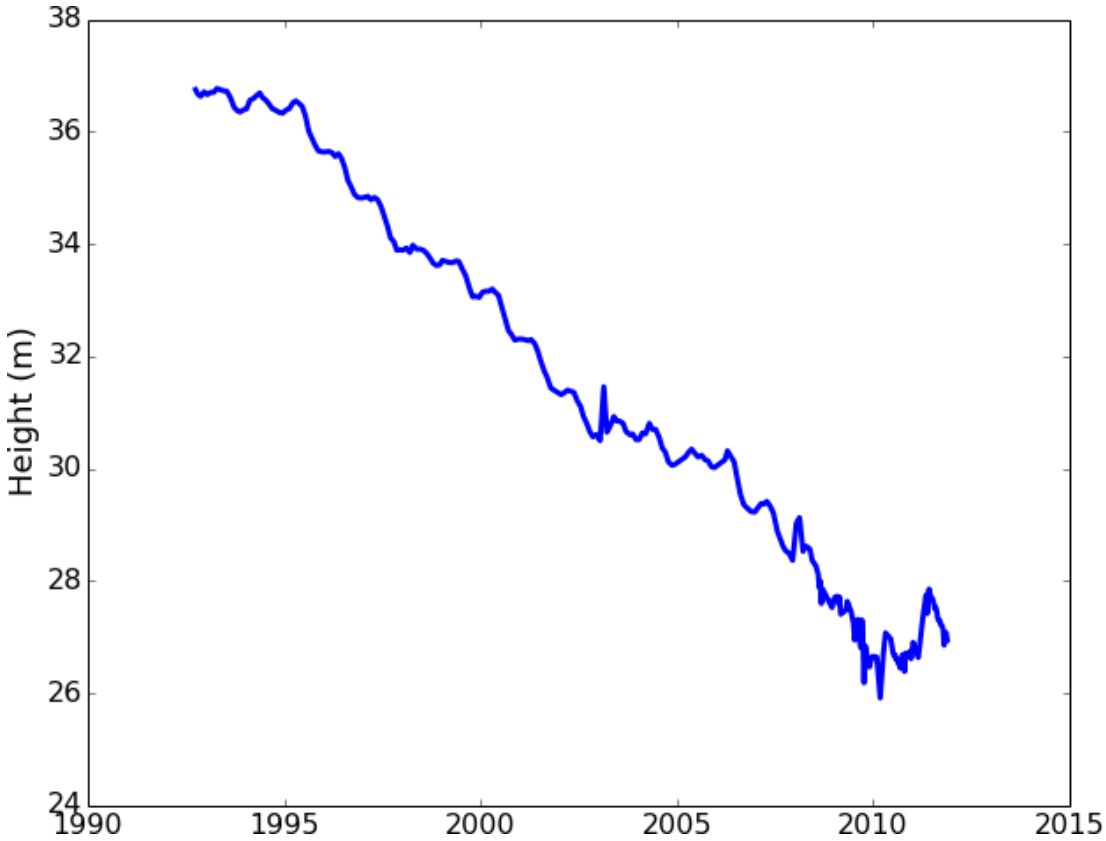

Fig 11 Water Levels for Aral Sea

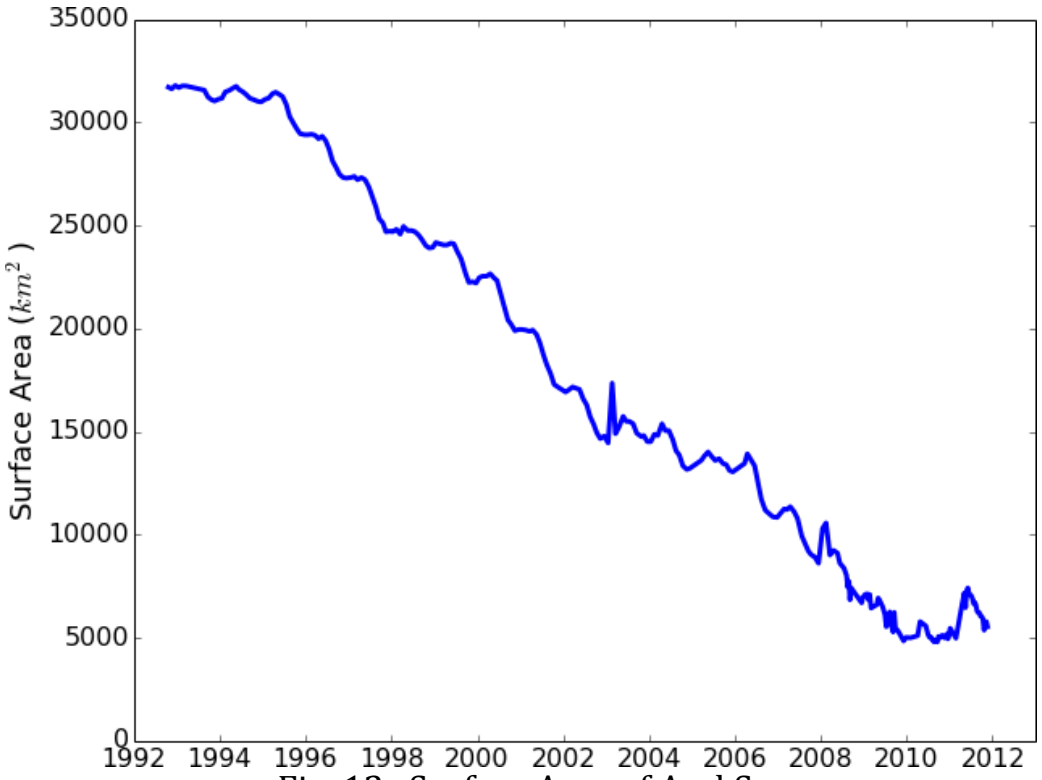

Fig 12 Surface Area of Aral Sea

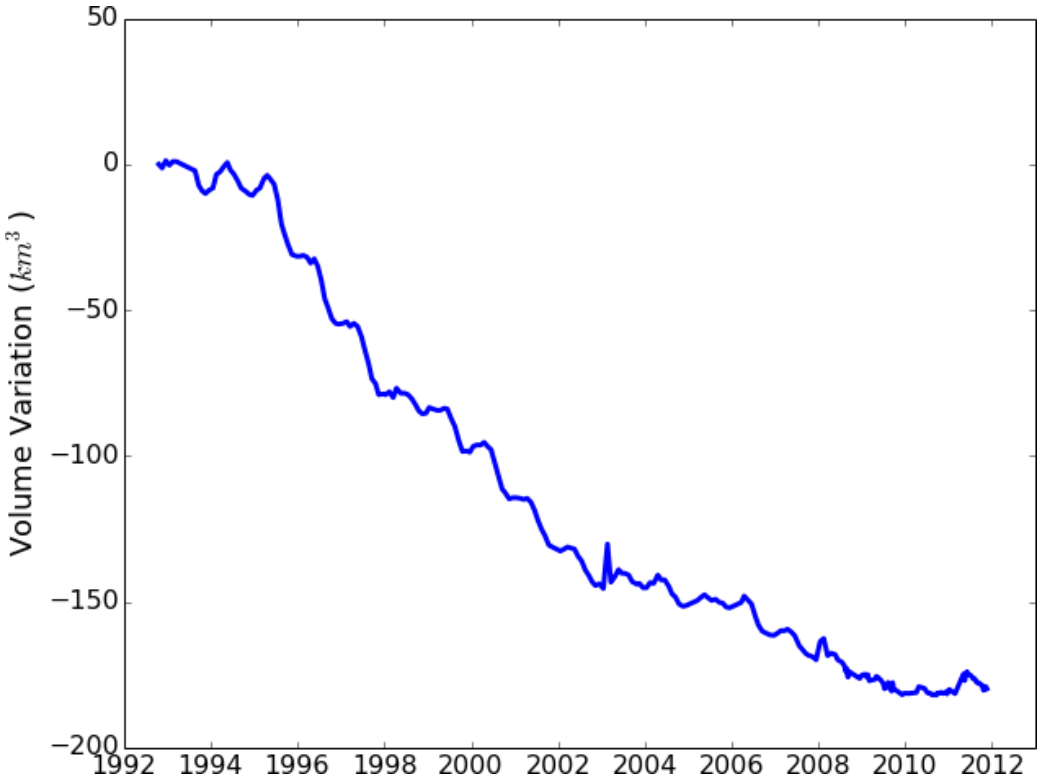

Fig 13 Volume Variation of Aral Sea

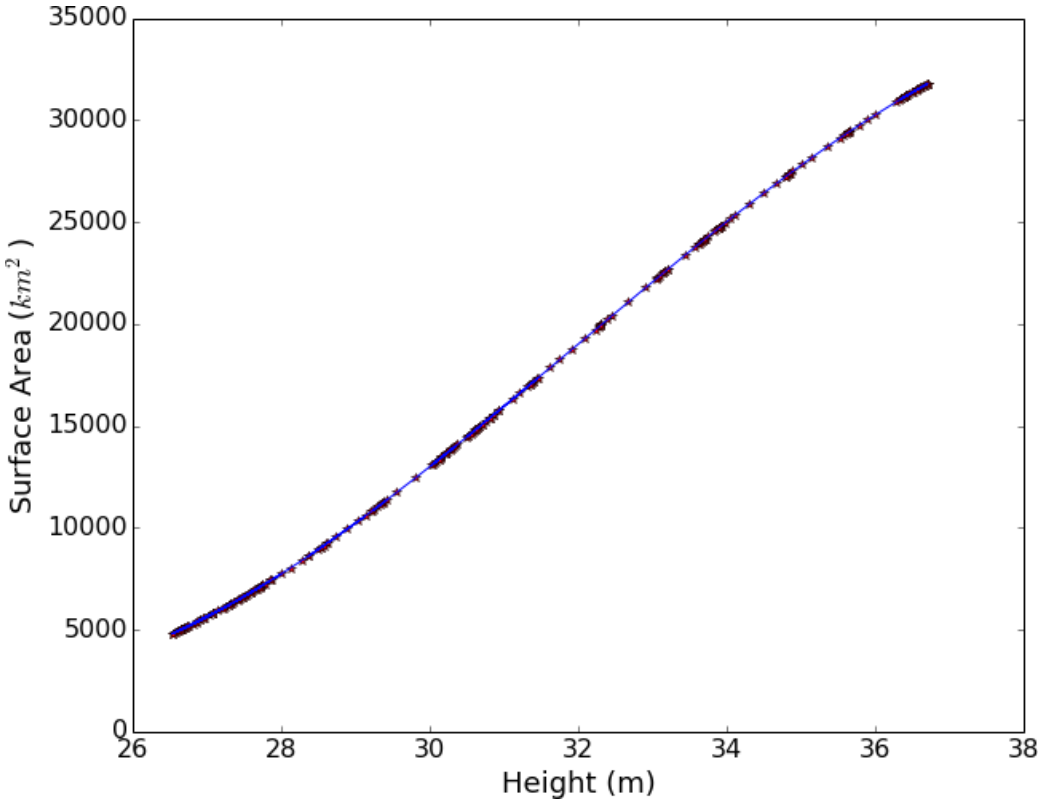

Fig 14 Water Level versus Surface Area for Aral Sea

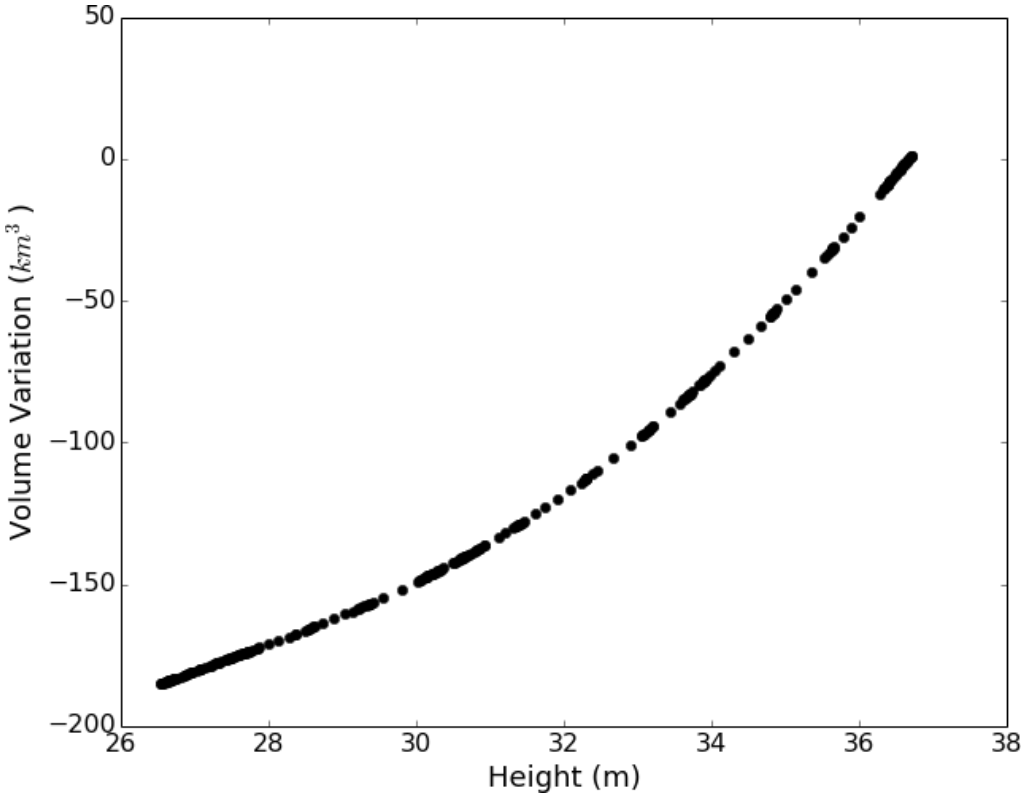

Fig 15 Water Level versus Volume Variation for Aral Sea