

**Abstract**

Understanding the water and solute balances in the Rio Grande basin of New Mexico and Colorado is important because the water resources of this semiarid region are limited. We are addressing this question by trying to determine the source of the water in the river, whether from precipitation and more concentrated irrigation runoff or from deep basin discharge. We also looked at long term variability of discharge and salt concentration of the Rio Grande through distance and time by way of USGS water quality data. Records of precipitation are included as a baseline.

We have employed the ratio of chloride to bromide concentration to help constrain the sources of the water. Water samples, taken in both summer (irrigation and reservoir releases) and winter (background river discharge and solute loads), were taken at fairly regular distances from the headwaters of the Rio Grande in Colorado to the border at El Paso, Texas. Temperature, pH, conductivity, and total dissolved solids (TDS) were analyzed at each sampling point, and the concentrations of chloride and bromide were analyzed in the lab.

The concentrations of chloride, bromide, electrical conductivity, and TDS all increase with distance from the headwaters. Along several intervals the solute concentrations increase but there is no corresponding increase in the Cl/Br ratio. This indicates that the concentration of solutes is increasing due to evapotranspiration. Along other intervals the Cl/Br ratio increases along with the concentrations, indicating that other sources of water, such as deep basin discharge, may be entering the river. Future research will focus on better identifying these sources of salinity in the Rio Grande basin by measuring other tracers and gathering additional chloride/bromide data.

**Introduction**

Understanding the water and solute balances in the Rio Grande basin of New Mexico and Colorado is important because the water resources of this semiarid region are limited. If we can find large point sources of solutes in the river, we will have a place to start interception and remediation.

We are addressing this question by trying to determine the source of the water in the river, whether from precipitation and more concentrated irrigation runoff or from deep basin discharge. We have employed the ratio of chloride to bromide concentration to help constrain the sources of the water.

We also looked at long term variability of discharge and salt concentration of the Rio Grande through both distance and time by way of USGS water quality data. Incomplete records from 1947 to 1999 were looked at. Records of precipitation from Albuquerque, New Mexico for this same period are included as a baseline.

**Acknowledgements**

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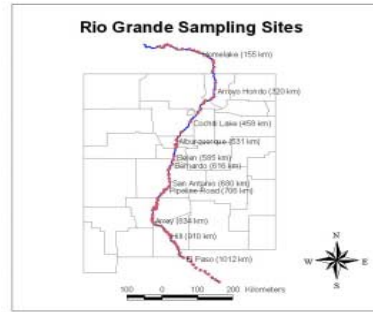


Figure 1: Sampling Sites along the Rio Grande

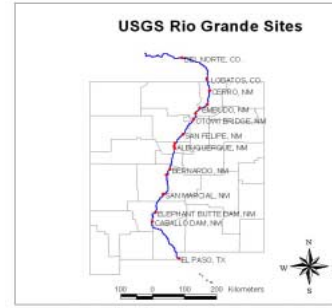


Figure 3: USGS Sites with historical data

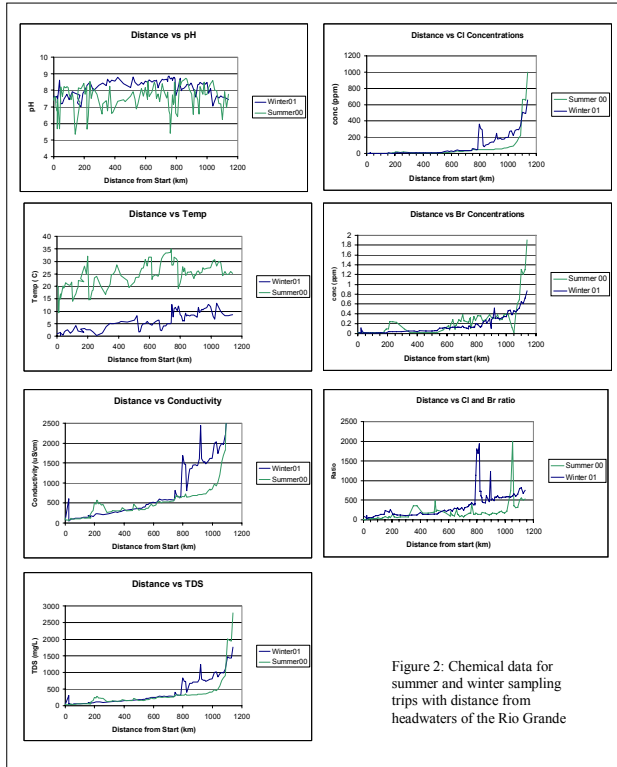


Figure 2: Chemical data for summer and winter sampling trips with distance from headwaters of the Rio Grande

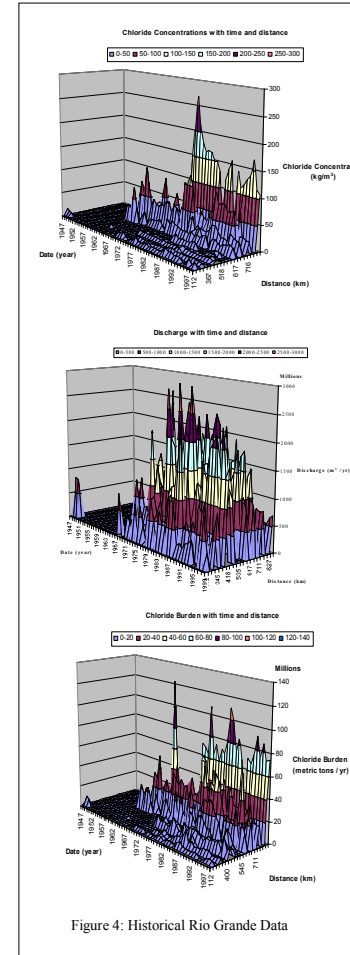


Figure 4: Historical Rio Grande Data

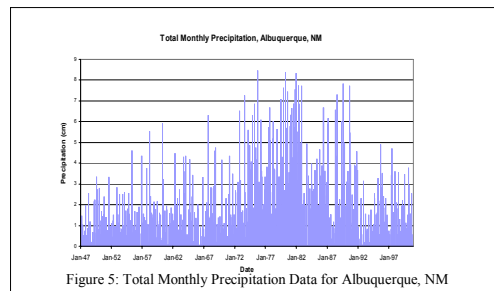


Figure 5: Total Monthly Precipitation Data for Albuquerque, NM

**Methods**

- Chloride/Bromide ratios

Water samples were taken at fairly regular distances from the headwaters of the Rio Grande in Colorado to the border at El Paso, Texas. See Figure 1 for a map of the site. By sampling during different times of the year, we can see changes in discharge and solute load from irrigation and reservoir releases from the summer, and background river discharge and solute loads in winter. Temperature, pH, conductivity, and total dissolved solids (TDS) were analyzed at each sampling point, and the concentrations of chloride and bromide were analyzed in the lab. Figure 2 shows the results of the analysis.

- Long Term Variability

Historical discharge and chloride concentration data for several stations along the Rio Grande were downloaded from the USGS National Water Information System (NWIS) site. A map of the site is shown in Figure 3. Many records were incomplete, lacking several years of data, but we can get an idea of the history of the river from 1947 to 1999.

The discharge was multiplied by the chloride concentration to get the chloride burden. The historical concentrations, discharge, and burden data are shown in Figure 4. Those years with no data are plotted as zero.

- Precipitation Data

Figure 5 shows precipitation data from Albuquerque, New Mexico. The precipitation data for this site is used as a baseline for the Rio Grande Basin both because of its fairly central location and long period of record. The data was taken from the Western Regional Climate Center.

**Observations**

- The concentrations of chloride, bromide, electrical conductivity, and TDS all increase with distance from the headwaters.
- Along several intervals the solute concentrations increase but there is no corresponding increase in the Cl/Br ratio. This indicates that the concentration of solutes is increasing due to evapotranspiration.
- Along other intervals the Cl/Br ratio increases along with the concentrations, indicating that other sources of water, such as deep basin discharge, may be entering the river.
- Future research will focus on better identifying these sources of salinity in the Rio Grande basin by measuring other tracers and gathering additional chloride/bromide data.