

NOAA Panama Project

Abstract

The Panama Canal relies on rain-fed streamflow into Gatun Lake, the canal's primary storage facility, for operations – principally ship passage and hydropower generation. Precipitation in much of Panama has a strong negative relationship with eastern tropical Pacific sea surface temperature (SST) and this relationship is reflected in Gatun Lake inflows. For example, the correlation coefficient between wet season July-December inflow and NINO3 SST is -0.53 over the period 1914-1997.

Operational capabilities to predict tropical Pacific SSTs have been demonstrated by several forecast systems during the past decade, and (as we show) such SST forecasts can be used to reduce the uncertainty of estimates of future inflows (compared with climatological expectations).

Because substantial reductions in lake inflow negatively impact canal operations, we wondered whether these forecasts of future inflows, coupled with a method for translating that information into effective operational policy, might result in more efficient canal management. A combined simulation / optimization / assessment "virtual" canal system was implemented and exercised using operational El Niño forecasts over the period 1981-98. The results show the following main points:

- i) At current demand levels the canal system is robust unless flows are substantially reduced (i.e., during El Niño episodes) or forecasts are extremely accurate.
- ii) The inclusion of accurately specified levels of forecast uncertainty is critical in developing economically beneficial policies.
- iii) The situations in which imperfect forecast information can be useful lie between those where storage and future inflows are relatively high, and those where storage and inflows are relatively low. In the former case, demands can be met without the benefit of forecast information, and in the latter case even perfect forecast information cannot prevent operational curtailments.
- iv) For a nominally configured canal system, the use of operational El Niño forecasts with appropriately specified uncertainty resulted in approximately \$US 330,000,000 (about 3%) in increased income compared with the use of deterministic climatological forecasts.

Below is a schematic of the Panama Canal water resources system. The system is described more thoroughly in a forthcoming issue of the journal Advances in Water Resources.

Graham, N.E., Georgakakos, K.P., Vargas, C., and M. Echevers, 2005:
Simulating the value of El Niño forecasts for the Panama Canal. *Advances in Water Resources* (in press).

To obtain a full copy of the article, contact HRC.

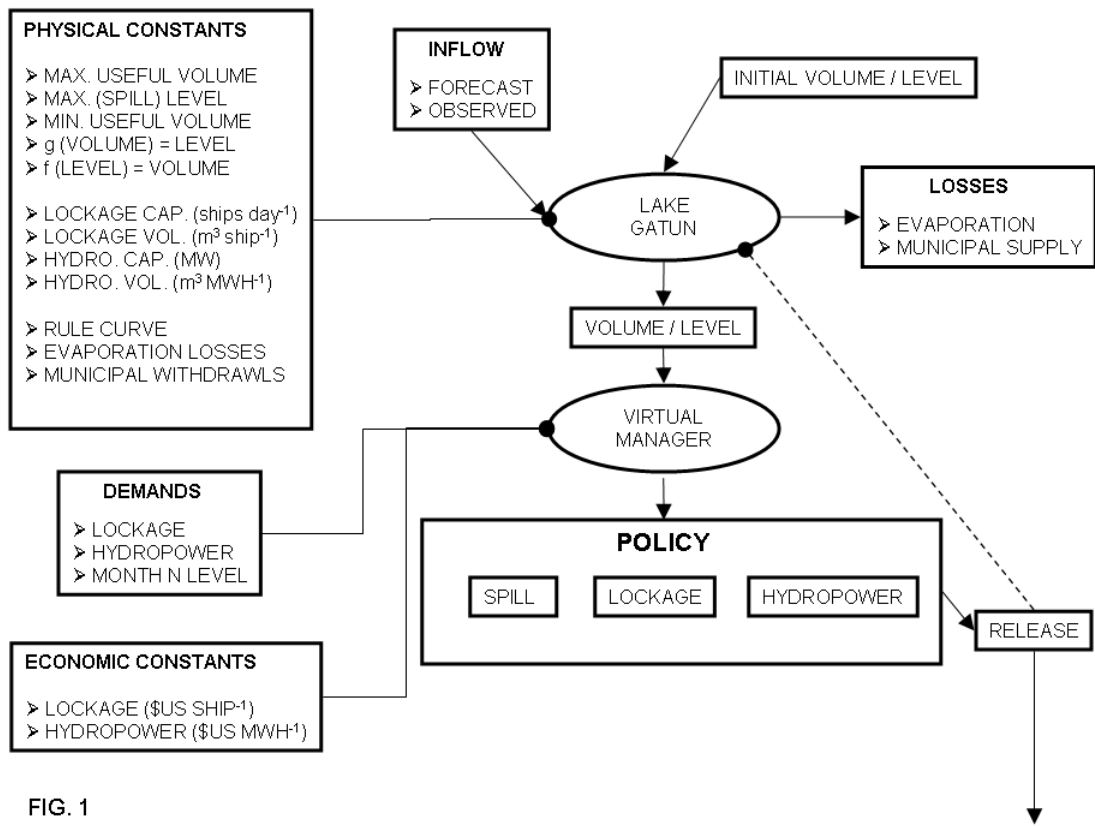


FIG. 1