Analysis of Blue and Green Virtual Water Contents of Crops

Geneva Starr* and Jana Levison, Water Resources Engineering, University of Guelph

*gstarr@uoguelph.ca

Objectives

1. Investigate Ontario watershed with high agricultural water-use
2. Quantify crop-specific water consumption using virtual water content (VWC) calculations
3. Identify green and blue water components of the VWC and further determine blue water sources
4. Compare results to agricultural water consumption values in regional water budget

Green water: soil moisture of the unsaturated zone
Blue water: liquid ground or surface water (irrigation water in the agricultural context)

Study Area

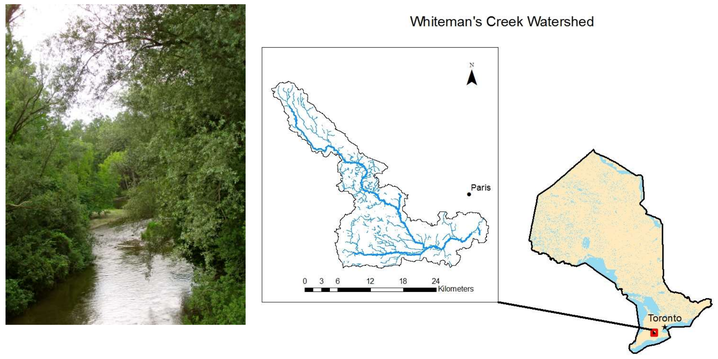


Figure 1: Whiteman's Creek and the watershed location

- 398 km^2 subwatershed of the Grand River watershed
- Cash-crop is predominant land cover
- Lower portion overlies Norfolk Sand Plain with shallow sand aquifer
- Aquifer feeds main tributaries and is also significant source for irrigation water
- In 2010, of 130 water taking permits, all were agricultural except for 1 municipal and 2 commercial

Introduction

Virtual water, embedded in agricultural commodities and manufactured products, is water consumed in the production process. This "hidden" water travels with products and may be exported out of a watershed.

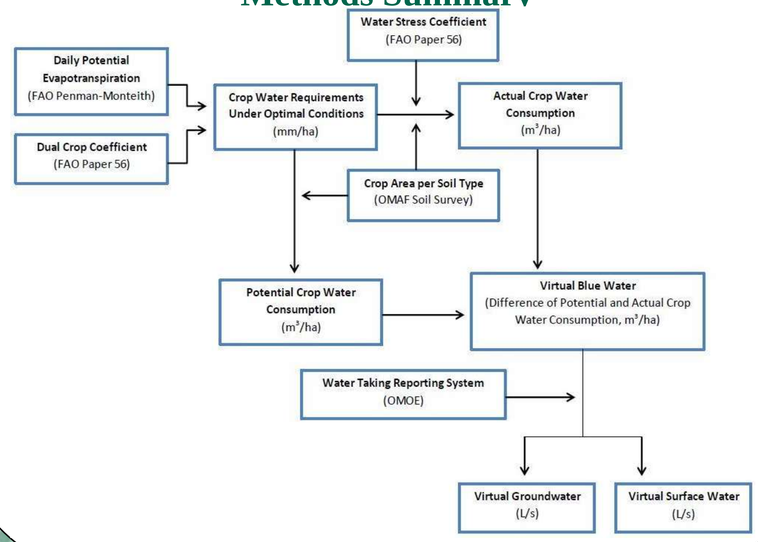
The embedded water is not often quantified in watershed-scale water budgets. However, for agriculturally dominated areas, it is important to account for and to identify its source.

Methods

Assumptions:

- All crops exported out of watershed
- Crops are grown to optimal potential
- Irrigation only occurs June 10 to September 20
- 1983, 2011, and 2012 were the years analyzed based on available crop data

Methods Summary



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Results

Table 1: Overall water consumption by crops in the Whiteman's Creek watershed, with green water being the majority, and groundwater (GW) supplying most irrigation.

Year	Agricultural Water Consumption – Annual Average (L/s)				
	Total	Green	Blue		
			GW	SW	Total
2012	2488	2290	164	34	198
2011	3697	3540	134	23	157
1983	4133	3755	-	-	378

Table 2: Actual water use according to the Water Taking Reporting System data, and the water budget estimation of agricultural water consumption for 2008 (GRCA, 2009).

	Active Permits	% Reporting	Agricultural Water Takings (L/s)		
			Groundwater	Surface Water	Total
2012	115	81	59	10	69
2011	94	77	37	8	45
Water Budget	-	-	-	-	151

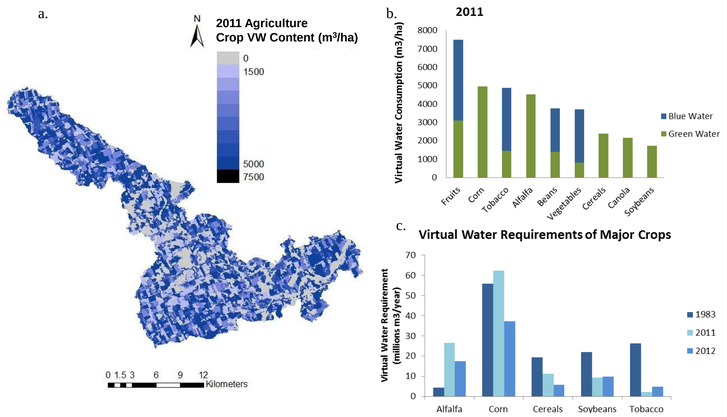

Figure 2: The map (a) shows fields with the greatest virtual water in 2011. The graphs show corn to have the highest rate of green water consumption (b) and overall VWC for each year (c).

Conclusions

- Knowing crop-specific virtual ground and surface water is useful for land-use planning and water resources conservation efforts
- Resulting blue VWC is comparable to water budget's agricultural consumption, but further analysis of green VWC should be done
- Applying virtual water calculations at the regional scale is feasible, and a valuable alternate approach to water consumption estimates