Infiltration quantification at the watershed scale using hydrological models, in a semi-arid context (Kaluvelly-Pondicherry coastal sedimentary basin, Pondicherry territories and Tamil Nadu state, India)

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The Kaluvelly-Pondicherry coastal sedimentary basin is one of the catchments of the HELP program from UNESCO (Hydrology for Environment, Life and Policy). It is used as a pilot area to study the not well known salinisation process and its dynamic, as it is representative of coastal sedimentary systems lying on hardrock formations of the Bay of Bengal. Salinisation problems concern many inhabited indian area on the coastline.

This basin covers 1200 km^2 and counts 1 200 000 inhabitants. It is situated in a semi-arid zone, and receives most of its rainfall during the North-East monsoon (October to December). Traditionnal agriculture practices had previously been gouverned by rainwater retention in shallow tanks. Since 1970, their maintenance has been neglected in favour of groundwater tapping. Due to this, a drastic water table drawdown together with a salinity increase have been recorded by Harvest in the Vanur aquifer (the main aquifer of the multilayered sedimentary system). Sources of salinisation in this aquifer have been identified by a previous geochemical and isotopic study (Ozouville et al., submitted). Hydrodynamic calculation of the seawater/freshwater movement in 1D show that seawater intrusion can be expected to occur within 3 to 20 years after 2000, depending on the value of unknown parameters (porosity) or boundary conditions

(recharge).

However quantification of the water resources at the basin scale and evolution of their quality are still questions, at which this work is willing to bring some answers able to help to the water resources management. To do this a 3D hydrogeological model of the multi-layered system is going to be built. First the water balance and especially the infiltration term have to be closely looked at. We have studied the hydrological fonctionning of the Anpakkam sub-watershed (56 km^2) during the 2004 and 2005 monsoon seasons (respectively 817 and 1116 mm of rainfall). Due to the semi-arid climate and a very flat topography, the subwatershed is covered by a non-perenial channels system, and by 5 tanks. Climatological data available at one station, coupled to the flow data at the subwatershed outlet acquired by Harvest team and ourselves, allow us to use and compare several hydrologic models. Infiltration rates thus estimated are then compared to estimation done by others authors with others methods like isotopic tracers. The hydrologic models used are GR4J, MODSUR, and a specific model built thanks to the VENSIM software. Topmodel has been tried but appeared not adapted to very flat topography and dry climates.

Our preliminary results are that the infiltration is important (15 to 40% of the total rainfall), and that a treshhold of 170 to 200 mm of rainfall in about 10-12 days is necessary to start some runoff. The tanks have a double impact: storage in them absorbs the first rainfall event(s), and leakage from them help to keep a small runoff for about a month after the end of the rainfall.