PERSPECTIVE IN USING A REMOTELY SENSED DRYNESS INDEX IN DISTRIBUTED IN HYDROLOGICAL MODELS AT THE RIVER-BASIN SCALE

By J. Andersen, I. Sandholt, KH Jensen, JC Refsgaard and H Gupta. 2002 Hydrological Processes.

.

- Objective:
  - To improve model performance (Sandholt et. al 2002)
  - Compare remotely sensed dryness index to simulated moisture & evaporation
- Location:
  - Senegal River Basin, West Africa

Background

- Soil moisture content:
  - Important variable in modeling (hydrology, meteorology, climate)
  - Highly variable in space & time
    - Difficult to characterize
- Temperature Vegetation Dryness Index (TVDI)
  - Derived from AVHRR and NDVI

TVDI Method

$$\mathrm{TVDI} = \frac{T_s - T_{s_{min}}}{a + b\ \mathrm{NDVI} - T_{s_{min}}}$$

T_s = observed surface temperature

NDVI = observed vegetation index

T_{smin} = minimum observed surface temperature in the image

a and ***b*** = constants defining up edge of the triangle

TVDI Method

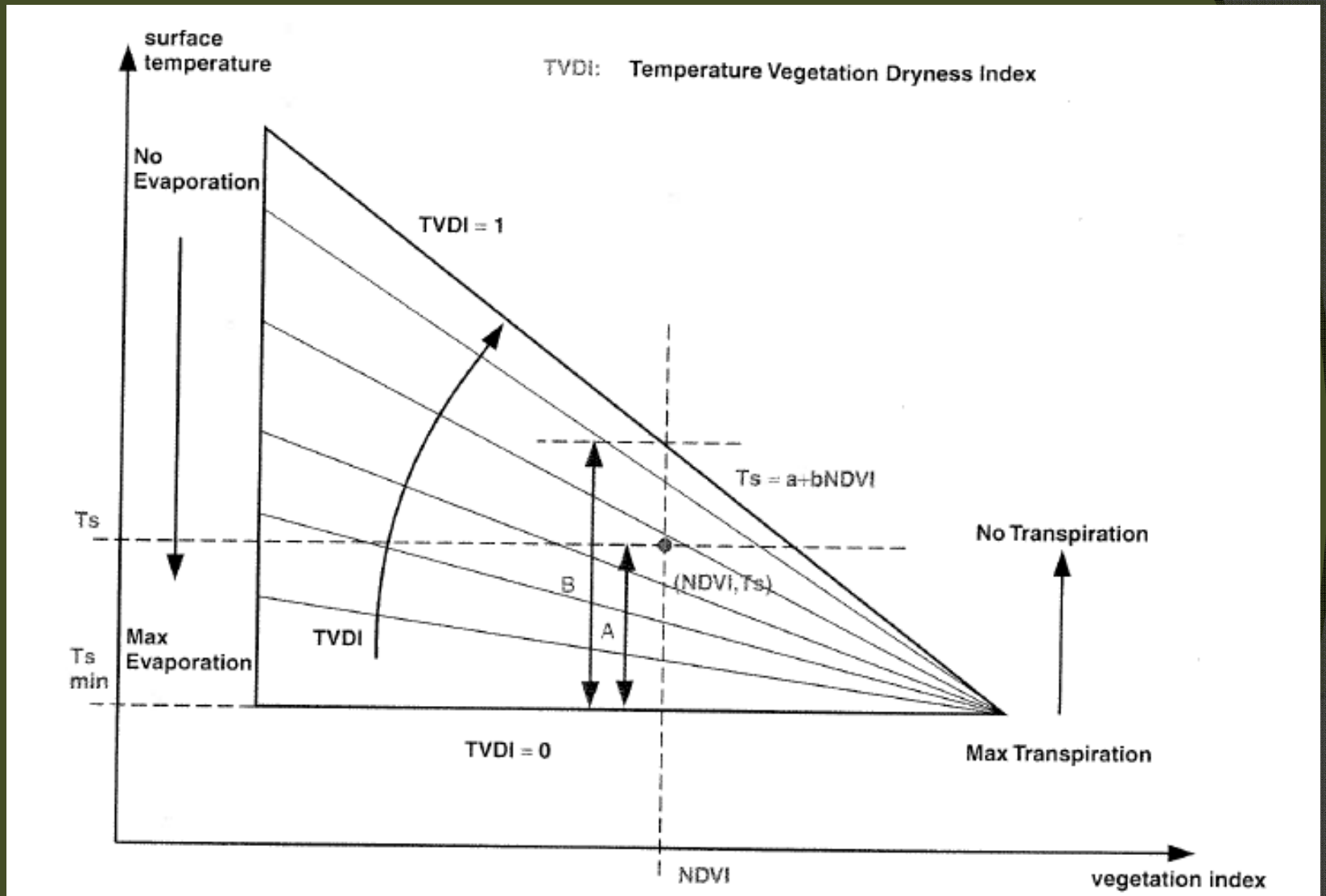

Figure 1. Definition of the temperature vegetation dryness index (TVDI). The TVDI for a given pixel (NDVI, T_s) is estimated as the ratio of the lengths of lines A and B, see Equation (1). Isolines for TVDI have been drawn on the triangle for illustration. From Sandholt *et al.*

TVDI

- TVDI method = interpret the location of image pixels in the Ts/NDVI space in terms of their soil moisture/evaporation status

- TVDI relates to soil moisture
  - High values indicate dry conditions
  - Low values indicate moist conditions

- A dry surface will have higher temperature than a moist surface

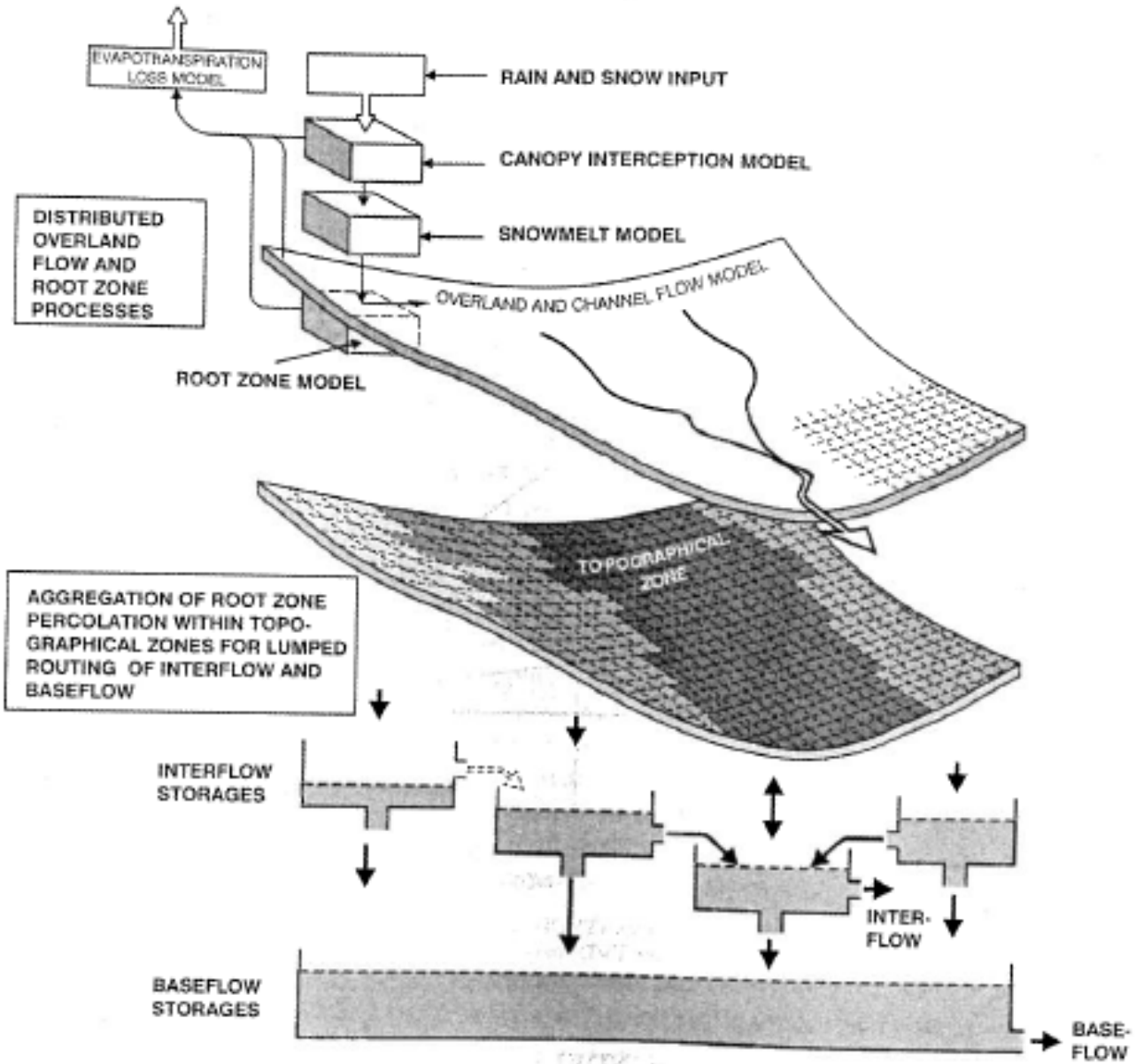

Figure 2. The modified version of MIKE SHE

Study Area

- Senegal River Basin
  - Located in Guinea, Mali, Senegal & Mauritania, West Africa
  - 375000km^2 drainage area
  - deep, permeable sandy soils

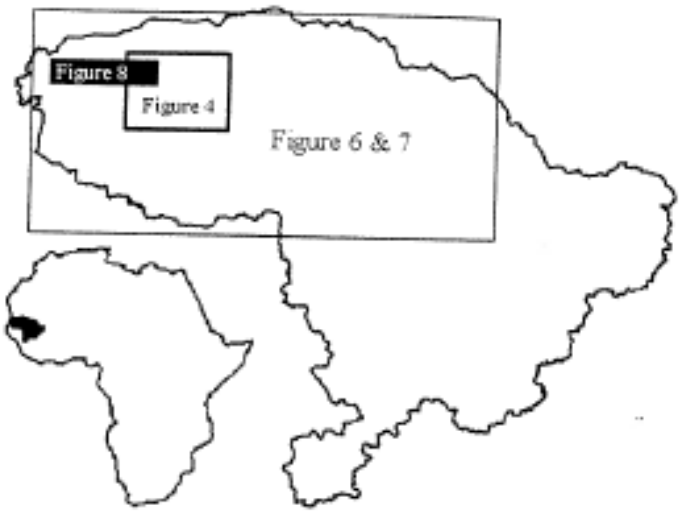

Figure 3. The Senegal River Basin and the three subareas in Figures 4, 6, 7 and 8

Three types of spatial soil moisture distribution

- Natural Soil Moisture
- Model Soil Moisture
- Remotely sensed soil moisture distribution
  - (the TVDI method from Sandholt et. al., 2002)

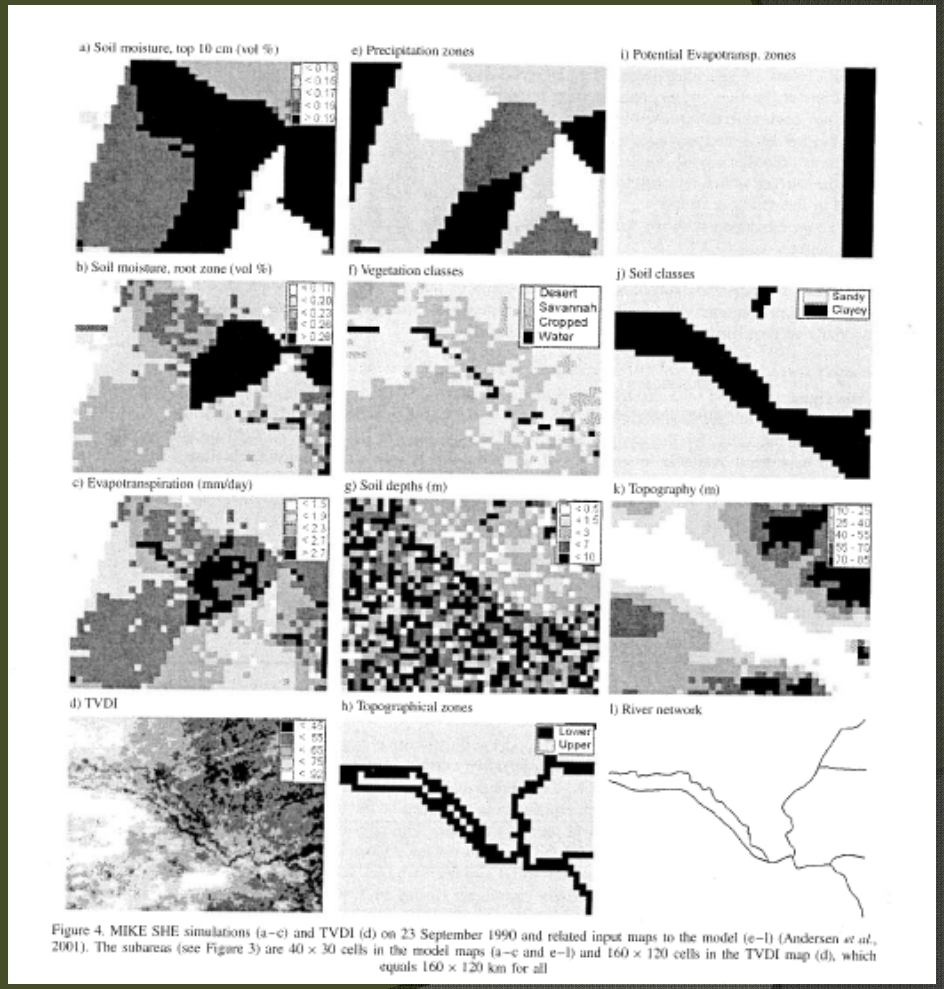

Figure 4. MIKE SHE simulations (a–c) and TVDI (d) on 23 September 1990 and related input maps to the model (e–l) (Andersen *et al.*, 2001). The subareas (see Figure 3) are 40 × 30 cells in the model maps (a–c and e–l) and 160 × 120 cells in the TVDI map (d), which equals 160 × 120 km for all

Comparison of TVDI and Model Simulated Data

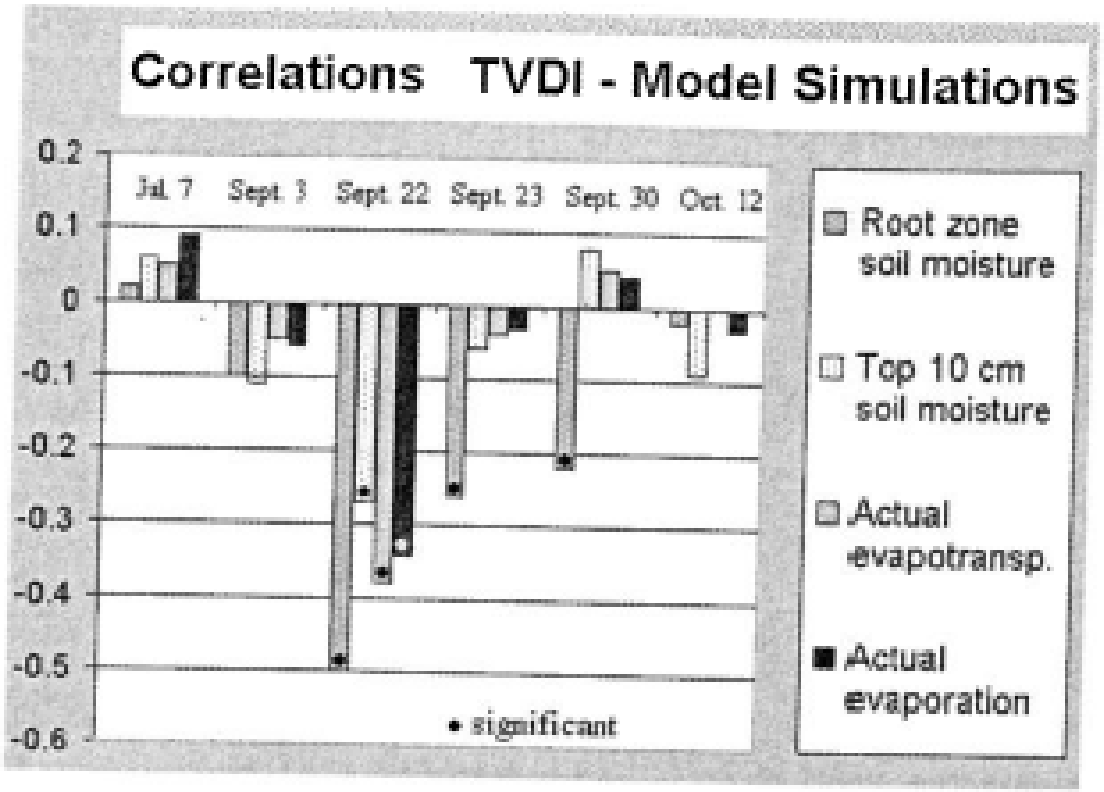

Figure 5. Correlation coefficients for all comparisons of TVDI and the four model simulations on the six chosen days, 1990

Discussion

- Correlations between TVDI and root zone soil moisture where statistically significant in half of the cases
- Uncertainties in model estimates and in TVDI estimates
- TVDI method based on AVHRR is not sufficient or robust for hydrological operations in the study area
- Main problems due to cloud cover
- Accuracy of TVDI estimates need improvement