T1.6 SOIL MODELLING

When is soil modeling applied?

Soil modeling is commonly utilized to predict the complex natural processes occurring in the vadose zone. Input for soil modeling can be from remote sensing and near-surface geophysics (Pradipta et al., 2022:14).

According to Pradipta et al. (2022) soil processes are typically nonlinear and governed by time-variable boundary conditions requiring numerical approaches to determine soil states and fluxes. These authors have emphasized that the input data of soil modelling typically range from meteorological conditions (e.g., rainfall, temperature, humidity, radiation) and phenological characteristics (e.g., LAI, root depth, albedo, canopy roughness), to hydro physical properties (e.g., soil – water retention, soil hydraulic conductivity). It is noted that *remotely sensed imageries* and *proximal data sensing* such as geophysical acquisition could provide the required data input to drive a model (Figure 1).

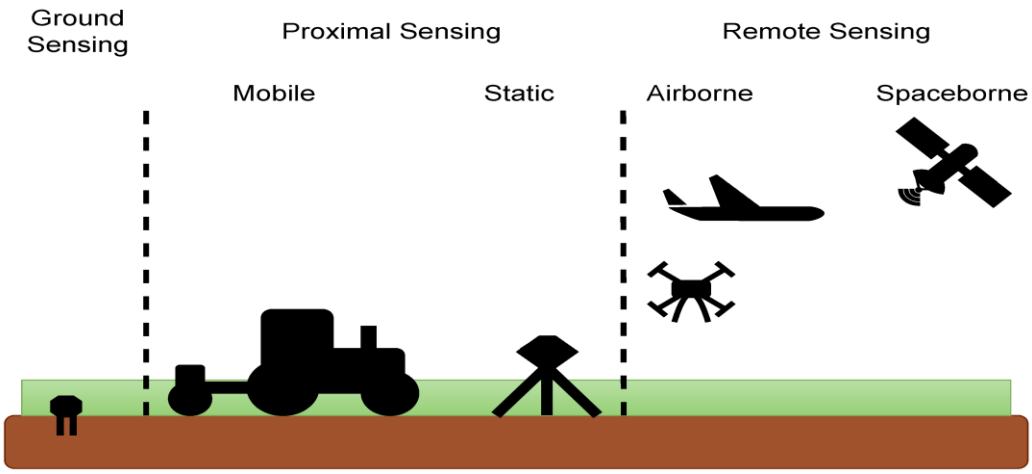

Figure 1: Ground Sensing, Proximal Sensing and Remote Sensing
Source: https://www.mdpi.com/2076-3417/12/11/5471

Proximal soil sensing (PSS) refers to the collection of information about soil properties, often using one or more soil sensors. The sensors detect signals that can be related to specific properties of the soil. PSS technologies include electrochemical sensors (directly measuring pH), electrical resistivity (related to soil texture), and electromagnetic induction (related to salinity). The latter can be coupled with GPS data and provide spatial information about soil properties in the area being evaluated (Society of Precision Agriculture, 2017).

Remote sensing technology is used to collect image data from space or aerial cameras and sensor platforms (Figure 2). These technologies can be used to assess and quantify many soil properties by integrating georeferenced field data with spectral soil properties acquired from sensors. Remotely sensed imagery can improve the spatial and temporal coverage of soil and crop yield data. Aerial and ground-based drones can be used for soil and field analysis, but also for crop planting, pesticide application, crop monitoring, irrigation and health assessment. The sensors collect data on soil water availability, soil fertility, soil compaction, soil temperature and others (Shaheb et al., 2021).

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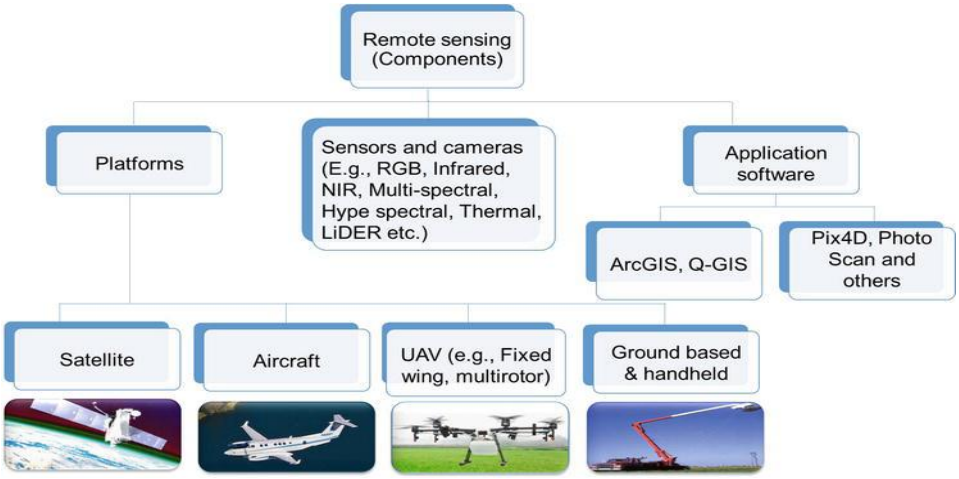

Figure 2: Components of remote sensing technology used in precision agriculture
Source: https://www.intechopen.com/chapters/82490

Pradipta et al. (2022) stressed that among the most commonly used techniques in soil modelling are the Richards equation for water flow and the convection–dispersion equation for solute transport. In this regard, these researchers have summarized the numerical models that are applied (Table 1).

Table 1: Different applications of numerical models that solve the Richards and convection–dispersion equations Source: (Pradipta et al., 2022).

Models	Application
HYDRUS	Simulation of soil water and salt transport
SWAP	Evaluating irrigation practices and determining the optimum irrigation schedule
DAISY	Predicting nitrogen leaching in cultivated area
COUP	Simulating the effect of low soil temperature on transpiration
MACRO	Modeling chlorpyrifos transport in agricultural field
FEFLOW	Simulating transport of contaminant in synthetic aquifer
RZWQM2	Modeling phosphorus dynamic in agricultural field

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List of relevant sources

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Key words

remotely sensed imageries

proximal data sensing such

proximal soil sensing (PSS)

remote sensing technology

numerical models

sensor platforms

sensors

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