Risque de sédimentation des réservoirs et mesures d'atténuation en faveur de la durabilité en Tunisie
Activity No.: N-W-TN-2

Training on the AnnGNPS Model

30 November / 01 December 2023 –
09:30 to 14:30

Presented by: Dr. D. ZARRIS, WES Non – Key Expert

LDK Consultants Global EEIG

This Project is funded by the European Union

Erosion and Sediment Yield Models: The mathematical simulation of erosion and sediment yield is limited to the Rainfall – Runoff Hydrological models, since runoff is the driving force of erosion and sediment yield. Errors and limitations of the Rainfall – Runoff models are inherited into the erosion and sediment yield models increasing non-linearly the complexiness of these models.

1. Empirical Models: Regression (statistical) models based on siginificant timeseries of measurements. The Universal Soil Loss Equation (USLE) and all its modifications (RUSLE, M-USLE) is the most well known empirical model. The typical USLE computes annual (or mean annual) soil erosion (not sediment yield) within a hillslope whereas M-USLE computes sediment yield per storm provided that maximum flow rate and runoff volume is measured or modelled. USLE does not account for routing within the stream network.

This Project is funded by the European Union

<u>2. Conceptual Models</u>: In these models, the prosecces of soil erosion and sediment yield (and rainfall – runoff) are described as a series of different storages (tanks) with inflows and outflows that are governed by simple equations. The parameters of these models have no physical meaning and cannot be measured in the field. The parameter are computed under calibration procedures with input and output. Conceptual models provide an indication of the qualitative and quantitative effects of land use changes, without requiring large amounts of spatially and temporally distributed input data. Conceptual models reflect the physical processes governing the system but describe them with empirical relationships, e.g., HSPF, SWRBB.

Soil Erosion and Sediment Yield Modelling

Water and Environment Support
in the ENI Southern Neighbourhood region

3. Physically Based Models: Physically-based models provide an understanding of fundamental sediment producing processes and have the capability to access the spatial and temporal variations of sediment entrainment, transport and deposition processes. They described processes involved with the help of mathematical equations dealing with the laws of conservation of energy and mass. Physically based models are generally the most scientifically robust and flexible in both input and output and are based on an understanding of the physical processes that cause erosion and are therefore applicable to a wide range of soils, climatic and land use conditions(e.g. AnnGNPS, SWAT, WEPP, SHETRAN, LISEM, CREAMS, ANSWERS). The parameters of the models have physical meaning and can actually measured in the field. Most of them are rarely known, however.

AnnGNPS is physically – based on the gully erosion component. Rainfall – runoff and sheet/rill erosion are ampirical (SCS CN method and RUSLE respectively). No model can be 100% physoicall based.

Soil Erosion and Sediment Yield Modelling

Water and Environment Support
in the ENI Southern Neighbourhood region

Continuous simulation models: They are useful for analyzing long-term watershed management practices and effects of hydrological changes. AnnGNPS is a continuous simulation model.

Single rainfall event based models: They are useful for (a) evaluating watershed management practices, and (b) analyzing severe actual or design single-event storms. AGNPS (the previous version) is a event – based model.

The AnnGNPS Model

Rainfall - Runoff: A continuous form of the SCS CN methodology with changing CN according to antecedent wet / dry conditions.

Sheet and Rill Erosion: Based on the Revised USLE with a sediment deliver ratio component similar to M-USLE for event-based sediment yield.

Ephemeral Gully Erosion: Based on the Revised Ephemeral Gully Erosion Model (REGEM). It is important that the soils critical shear stress was modified for prior landuse conditions. The geometry of the gullies are determined by relative mathematical equations (Nachtergaele et al., (2002), Woodward's (1999) Equilibrium & Ultimate Gully Width) and the nickpoint (gully mouth) or Headcut (brink) formation and propagation. Sediment transport and deposition are also governed by mathematical equations.

This Project is funded
by the European Union