Database for Soil Erosion Modelling in Brazil

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Brazil is one of the most important food, fiber and fuel producer in the world. Expansion of cropland and pasture areas may lead to increased soil erosion rates.

Brazilian scientific research on soil erosion has a relatively recent formation, although the first works were published in the forties, and approximately half of the scientific production originated in the last fifteen years.

Observed annual soil loss in soil erosion plots ranges from 0.1 to 175.4 ton ha yr\(^{-1}\).

In Brazil, it is estimated that there are more than one hundred plot experiments for studies of soil erosion.

Efforts should continue to allow field observations in all regions of Brazil, mainly where data is scarce (central-western and northern regions).

Models for monitoring and estimating soil erosion used in Brazil are: USLE (Universal Soil Loss Equation), RUSLE (Revised Universal Soil Loss Equation), WEPP (Water Erosion Prediction Project), SWAT (Soil and Water Assessment Tool).

Denardin (1990); Silva et al. (1997); Marques et al. (1997); Oliveira et al. (2008); Silva et al. (2009) Anache et al. (2017)
What is the best model for Brazil?

We studied soil loss and soil loss tolerance spatialization, estimated by RUSLE versus WEPP models in RS – Brazil.

The models presented different values of soil losses.

Silva et al. (2014)
In Brazil, there are 73 regression equations to calculate erosivity.

These studies are concentrated in the South and Southeast regions (~60%) with a few studies in the other regions, mainly in the North.

The annual rainfall erosivity in Brazil ranges from 1,672 to 22,452 MJ mm ha\(^{-1}\) h\(^{-1}\) yr\(^{-1}\).

Techniques already established in Brazil may be used for the interpolation of rainfall erosivity, such as geostatistics and artificial neural networks.
Rainfall erosivity in small and large scales

The watershed of the Jaguarí and Camanducaia River, MG (Pontes et al., 2015).

The watershed of the Alto Rio Grande River, MG (Carvalho et al., 2015).

The watershed of the Doce River, MG (Silva et al., 2010).

These watersheds are of importance for the production of drinking water, electric power production and mining tailings retention dam.

Rainfall erosivity map of Brazil, an approximation (Oliveira et al., 2012).
Soil Erodibility – K FACTOR

DATABASE: soil erodibility obtained directly: plots under natural and simulated rainfall = 61 soils. The erodibility values show an amplitude of 0.0004 to 0.0840, with the mean value of 0.0185 Mg ha h ha⁻¹ MJ⁻¹ mm⁻¹. All soil classes were considered.
MODELS SUGGESTIONS:


- Silva et al. (PAB, 35(6):1207-1220, 2000): (Latosols)

Oxidic Latosols (Oxisols) have high clay content, however, these soils have low erodibility due to their granular structure, which increases water infiltration. The structure is related to the soil’s oxidic mineralogy. Hence, indirect methods must be adapted.
Development of topographic factor modelling for application in soil erosion models: USPED, RUSLE 3D (Mitasova et al. 1996), and Desmet & Govers (1996)

The complexity of topography is considered

It determines the upstream area that contributes to the flow along each point in the basin, considering the effects of flow convergence/divergence

Large-scale landscape analyses

Reduction of subjectivity: systematic analyses based on Geographic Information Systems (GIS) tools

Interpretation of the researcher: adaptations of analog techniques for the empirical processing of the data

Ease and speed in data processing

Lower relative cost
Maps of the LS factor obtained by RUSLE and RUSLE 3D methods in RS – Brazil.

Different values for the LS factor generate doubts.

Silva et al (2014)
Variables involved in obtaining cover factor: vegetation development; crop management; crop spacing; root system; plant architecture; plant physiology; deposition and decomposition of residues.

The soil cover factor is among the most difficult factors to be obtained by field or laboratory experimentation.

Another important factor in the modelling of soil erosion is the conservationist practices related to the control of soil erosion.

In Brazil, studies related to this factor are still rare.

**DIFFICULTIES:** cost; time-consuming in the experimental conduction; long-term studies; large-scale studies.
Land Use in Brazil (IBGE, 2014) and C Factor

### Land Use

<table>
<thead>
<tr>
<th>Land Use</th>
<th>Contribution %</th>
<th>Millions of hectares</th>
</tr>
</thead>
<tbody>
<tr>
<td>Native forests and pastures</td>
<td>66.1</td>
<td>562.5</td>
</tr>
<tr>
<td>Planted forests</td>
<td>0.9</td>
<td>7.7</td>
</tr>
<tr>
<td>Planted pastures</td>
<td>23.3</td>
<td>198.3</td>
</tr>
<tr>
<td>Agriculture</td>
<td>6.2</td>
<td>52.8</td>
</tr>
<tr>
<td>Urban</td>
<td>3.5</td>
<td>29.8</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>851.0</td>
</tr>
</tbody>
</table>

### VEGETAL COVER

<table>
<thead>
<tr>
<th>VEGETAL COVER</th>
<th>C - FACTOR VALUES</th>
<th>SOURCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soybean</td>
<td>0.00700 – 0.21930</td>
<td>Bertoni et al. (1975), Bertol et al. (2001), Amaral (2006)</td>
</tr>
<tr>
<td>Wheat</td>
<td>0.03500 – 0.21580</td>
<td>Bertol et al. (2001), Amaral (2006)</td>
</tr>
<tr>
<td>Corn</td>
<td>0.00700 – 0.15600</td>
<td>De Maria &amp; Lombardi Neto (1987), Bertol et al. (2002), Eduardo et al. (2013)</td>
</tr>
<tr>
<td>Sugarcane</td>
<td>0.05000 – 0.43140</td>
<td>Donzeli et al. (1992), Cavalieri (1998), Bertoni &amp; Lombardi Neto (2010)</td>
</tr>
<tr>
<td>Palm forage</td>
<td>0.25280 – 0.54280</td>
<td>Albuquerque et al (2007)</td>
</tr>
<tr>
<td>Cotton</td>
<td>0.68460</td>
<td>Bertoni et al. (1975)</td>
</tr>
<tr>
<td>Coffee</td>
<td>0.08660 – 0.65680</td>
<td>Rufino et al. (1985), Biscaia &amp; Osaki (1994), Prochnow et al. (2005)</td>
</tr>
<tr>
<td>Pastures</td>
<td>0.00840 – 0.22000</td>
<td>Silva et al. (2014), Santos et al. (2016)</td>
</tr>
<tr>
<td>Eucalyptus</td>
<td>0.01600 – 0.30000</td>
<td>Martins et al. (2010), Silva et al. (2014), Silva et al. (2016)</td>
</tr>
<tr>
<td>Native Forest</td>
<td>0.00140 – 0.01780</td>
<td>Albuquerque et al. (2007), Martins et al. (2011), Santos et al. (2014), Silva et al. (2014), Silva et al. (2016)</td>
</tr>
</tbody>
</table>

In Brazil there is in the literature the value of the C factor for different crops and management systems.
Opportunities and Future Challenges

- Increase of the network of standard plot studies for soil and water loss studies, notably in the North and Central-Western regions
- Increase the network of automated rainfall and sedimentological stations
- Development of algorithms and interpolators in the concept of artificial intelligence
- Development of connectivity studies of soil erosion and river sedimentation
- Use of remote sensing resources for data generation
- Development of model validation methodologies
THANK YOU FOR YOUR ATTENTION!