# Fitzroy NRM Region K-Factor dataset – Methodology

Author: Peter Zund Date: 3 November 2017

## Intent of product

Dataset that represents the K factor of the USLE at a 90m resolution for the Fitzroy NRM Region for use in P2R models.

## Product authorisation

This product was a requirement of the Reef Water Quality Science Program project RP112G *Mapping soil erodibility in the Fitzroy basin*. Milestone 11 – expected completion September 2017.

## What does the dataset (cell or grid) value represent?

The calculated K factor (surface soil erodibility (0-15cm depth)) of the USLE equation.

## Which pedotransfer function was used?

The original Wischmeier (1978) function as shown in the Brown Book (Rosewell and Loch 2002) , equation 28.2 combined with the sediment density adjustment outlined by Littleboy (1997).

*ASRIS equivalent code*

*a$RAW <- (2.77\*(10^-7)\*(a$P125^1.14)\*(12-a$OM))+(4.28\*(10^-3)\*(a$SS-2))+(3.29\*(10^-3)\*(a$PP-3))*

*a$ADJ <- a$RAW/(1.462+(0.048\*(1.03259^(a$FS+a$CS)))-1) Sediment density adjustment*

*Also original K for reference purposes*

*a$K <- (2.766\*(a$M^1.14)\*(10^-7)\*(12-a$OM))+(4.28\*(10^-3)\*(a$SS-2))+(3.28\*(10^-3)\*(a$PP-3))*

Note: a$ - is the table name where the data is held

Sub-functions used from the same reference were,

**Particle size (M)** calculated using

*ASRIS equivalent code*

*a$P125 <- (a$Clay+ a$Silt + (0.7\*a$FS))\*(100\*exp(-0.019\*a$Clay))*

*Original M from* equation 28.7 (Rosewell and Loch 2002)

*a$M <- (a$Silt + (0.7\*a$FS))\*(100-a$Clay)*

Note: Alternate equation 28.3 which is applied when Silt + Fine Sand exceeds 68% was not implemented. Only few SALI sites had > 68% (Silt and Fine Sand%).

**Organic matter (OM)** calculated as

*1.72 \* OC Walkley & Black (6A1, (Rayment and Lyons 2010)).*

Note: Conversions were limited to 4% organic matter as recommended by Rosewell and Loch (2002), values greater than 4% were changed to 4%.

**Soil structure (SS)** calculated using Table 28.1 (Rosewell and Loch 2002)

*a$SS <- 2*

*a$SS[a$SIZ == 1 & a$TYPE == "GR"] <- 2*

*a$SS[a$SIZ == 2 & a$TYPE == "GR"] <- 3*

*a$SS[a$SIZ == 3 & a$TYPE == "GR"] <- 3*

*a$SS[a$GRADE == "V"] <- 4*

*a$SS[a$TYPE %in% c("PL", "SB", "AB", "CO")] <- 4*

**Profile Permeability (PP)**

*a$PP <- 2*

*a$PP[a$PERMEABILITY == 3] <- 4*

*a$PP[a$PERMEABILITY == 2] <- 5*

*a$PP[a$PERMEABILITY == 1] <- 6*

## How was the dataset produced?

K was calculated at SALI sites within the modelling area using available laboratory and morphological data for the specific SALI site samples less than 15cm deep. 197 sites had samples with all the necessary data to calculate K. K was then interpolated between these sites using Cubist and a series of environmentally related covariates. However 197 sites did not produce a detailed enough site density for Cubist to run successfully.

OC was available at a lot more SALI sites if the surface bulk sample was taken into account. However the surface bulk sample does not include particle size analysis usually. So to increase the number of SALI sites where K can be calculated, OC from any sample in the top 15cm of the profile was attributed to all the available samples within 15cm of the surface of a given SALI site. As a result K could be calculated for 577 SALI sites within the modelling area. However 577 was still not detailed enough for Cubist to run.

The next most limiting soil attribute is particle size. To overcome this limitation, Clay %, Silt % and Fine Sand % maps were created for the whole modelling area using available SALI site data and environmentally related covariates in Cubist. Particle size data was extracted from these maps at SALI site locations that already had all the other necessary laboratory and morphological data for the K factor calculation. The interpolated particle size data was only used if the SALI site had no real laboratory particle size data. As a result, K could be calculated for a total of 986 SALI sites (577 using *real* particle size data and 409 using *interpolated* particle size data). Cubist successfully ran using these 986 SALI sites.

## In what area was the K factor dataset produced?

*Latitude between -26.476401 and -21.205394*

*Longitude between 146.557398 and 151.586142*

## What environmentally related covariates were used?

A set of 23 covariates were used for both the K-Factor and Particle Size datasets. The same covariates for both datasets. The covariates came from various external sources or were made in house. Grid (or cell) values in each covariate were checked to ensure that waterbodies consistently are represented by a NULL (or NA) across all covariates. Table 1, lists the covariate produced in-house and Table 2 lists ready-made covariates sourced externally. Unfortunately, there is no available radiometric data in the Upper Nogoa catchment and radiometric data is an important covariate of soil parent material. To overcome this gap, radioactive K, Th and U were modelled using radiometric data sourced from nearby areas and other related covariates including geology surface mapping in a similar way to that of Kidd (2015). See specific methodology/metadata. The weathering intensity covariate (Wilford 2012) was not used because of gaps in the data for the modelling area.

Table 1 - Covariates produced in-house

|  |  |  |  |
| --- | --- | --- | --- |
| SCORPAN factor | Covariate | Details | Reference |
| Broad relief | Multi-resolution valley bottom flatness (MrVBF) and Ridge Top Flatness (MrRTF) | Produced in SAGA GIS using the MrVBF tool developed by Conrad, O. (2006) that is based on (Gallant and Dowling 2003). Input data used was 3” SRTM Derived Digital Elevation Model (DEM) version 1.0. Output is continious, not classified. | {{446 Gallant, J.C. 2003}} |
| Parent material type | Radiometric potassium; thorium; uranium; total dose/count | Produced using Cubist as implemented by (Kidd *et al.* 2015) radiometric data sampled from RadMap v3 2015 (Nakamura and Milligan 2015) and covariates including (Liu *et al.* 2012) |  |
| Parent material weathering | Radiometric K/Th | Calculated from the modelled radiometric K and Th covariates. A simple weathering index. |  |

Table 2. Covariates supplied by TERN in 2012

|  |  |  |  |
| --- | --- | --- | --- |
| SCORPAN factor | Covariate | Details | Reference |
| Climate | Average daily rainfall – winter | Acquired by the TERN funded project in 2012 from the Bureau of Meteorology, metadata unknown |  |
| Climate | Average daily minimum temperatures - winter | Acquired by the TERN funded project in 2012 from the Bureau of Meteorology, metadata unknown |  |
| Climate | 1” SRTM derived Prescott Index as modified by Linda Gregory | Based on Prescott ((Prescott 1950)) | (Gallant and Austin 2012b) |
| Parent material type | Gravity | Gravity Anomaly Grid of the Australian Region, resolution 0.5-arcminutes, 2008 | (Anon 2008) |
| Parent material type | Magnetics | Fifth Edition Total Magnetic Intensity (TMI) Anomaly Grid of Australia (2010) | (Milligan *et al.* 2010) |
| Landscape roughness | Landscape roughness | Based on the GDAL roughness algorithm in QGIS. Produced by Ross Searle, 2012. | Unpublished |
| Relief | Digital Elevation Model (DEM) – 3“ SRTM DEM-S | Smoothed *Shuttle Radar Topographic Mission (SRTM)* derived digital elevation model, resolution 3-arcseconds, Version 1. | (Gallant *et al.* 2009) |
| Relief – local | Elevation averaged over 300m | Derived from 1" SRTM DEM-S, elevation averaged over 300m radius, resolution 3-arcseconds. | (Gallant and Austin) |
| Relief – local | Slope % | Derived from 1" SRTM DEM-S, resolution 3-arcsecond | (Gallant and Austin 2012c) |
| Relief – local | Median slope percent over 300m range | The focal median of percent slope can be used as a surrogate for modal slope in landform pattern analysis. | (Gallant and Austin 2012a) |
| Relief – local | Topographic position index (TPI) | Topographic position classification identifying upper, middle and lower parts of the landscape. This dataset includes a mask that identifies where topographic position cannot be reliably derived in low relief areas. | (Gallant and Austin 2012d) |
| Relief – broad | Elevation averaged over 1000m | Derived from 1" SRTM DEM-S, elevation averaged over 1000m radius, resolution 3-arcseconds. | {{441 Gallant, J.C 2012}} |
| Vegetation(Johansen *et al.* 2012)  {{438 Johansen, K.G.T. 2012}}(Johansen *et al.* 2012) | Landsat 2000-2010 Fraction of Persistent Green-Vegetation | <http://auscover.org.au/purl/landsat-persistent-green-2000-2010> | {{438 Johansen, K.G.T. 2012}} |
| Vegetation | Mean Fraction of Photosynthetically Active Radiation (FPAR) | Australia-wide, monthly fraction of Photosynthetically Active Radiation absorbed by vegetation (fPAR) derived from Advance Very High Resolution Radiometer data spanning July 1981 to Oct 2011, linearly related to fractional foliage cover. Developed by the Time Series Remote Sensing Team, CSIRO Land and Water in conjunction with the Environmental Biology Group at the Australian National University. Original data supplied by CSIRO Marine and Atmospheric Research. Mean Value in Timeseries, 1km grid, Version 4. | {{437 Donohue,Randall J. 2008}} |
| Vegetation | Bare Soil - Standard Deviation | Fractional cover - MODIS, CSIRO Land and Water algorithm, Australia coverage. Sourced by TERN in 2012 |  |
| Wetness / drainage | Topographic Wetness Index | Derived from 1" SRTM DEM-H, resolution 3-arcsecond. | {{440 Gallant, J.C. 2012}} |

## Products

|  |  |
| --- | --- |
| Product | Details |
| ASRIS\_K\_Fitzroy\_prediction.tif | Predicted K eqveillent to ASRIS – K factor for the Fitzroy NRM Region (Includes Boyne and Styx catchments), the 50th percentile. |
| ASRIS\_K\_Fitzroy\_uncertainity.tif | The difference between the 95th and 5th percentile predictions. The greater the range the greater uncertainty expected. |
| K\_Fitzroy\_prediction.tif | Predicted K – factor for the Fitzroy NRM Region (Includes Boyne and Styx catchments), the 50th percentile. |
| K\_Fitzroy\_uncertainity | The difference between the 95th and 5th percentile predictions. The greater the range the greater uncertainty expected. |
| ASRIS.csv | Site data used after processing. Compare to SALI sites at same location. |
| K.csv | Site data used after processing. Compare to SALI sites at same location. |
| K3\_attribute\_diagnostic\_stats.csv | Model statistics, calibration stats, stats of regression trees created, validation stats of predictions compared to 25% of training data not used in modelling. |
| ASRIS\_average\_variable\_importance.csv | Environmental covariate usage in model |
| K\_average\_variable\_importance.csv | Environmental covariate usage in model |

## References

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Gallant JC, Austin JM (2012b) Prescott index derived from 1" SRTM DEM-S, v2. *CSIRO Data Collection*

Gallant JC, Austin JM (2012c) Slope derived from 1" SRTM DEM-S. v4. *CSIRO Data Collection*

Gallant JC, Austin JM (2012d) Topographic position index derived from 1" SRTM DEM-S. v4. *CSIRO Data Collection*

Gallant JC, Austin JM Relief - elevation range over 300 m derived from 1" SRTM DEM-S. v2. *2012*

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