Publication details

Title:

A ranking of wind erosion risk for agricultural lands (2017)

Date published:
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Abstract:
This dataset is a ranking of estimated wind erosion risk for agricultural lands. Agricultural lands are defined here as those areas under cropping and grazing. The dataset was created in a multi-criteria analysis by combining (i) a modelled map of wind erosion severity for the period 2000 to 2010, (ii) an index map of the total soil nutrient loss, and (iii) maps of 'room for improvement' in ground cover management on agricultural lands within natural resource management (NRM) regions. It was developed to be used with a priority ranking for each NRM region to locate where in a NRM region the wind erosion investment area is and its priority.

Definition of classes
1. Low risk of wind erosion for agricultural land
2. Moderate risk of wind erosion for agricultural land
3. High risk of wind erosion for agricultural land

Detail on how the dataset was created is in Leys et al. (2017).

Descriptive information

Author(s) and/or Stakeholder(s):
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Acknowledgments
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Constraints

LEGAL CONSTRAINTS ASSOCIATED WITH THE MATERIAL

Limitation on the use of the material:
The Office of Environment and Heritage (OEH) has compiled this dataset in good faith, exercising all due care and attention. No representation is made about the accuracy, completeness or suitability of the information in this dataset for any particular purpose. OEH shall not be liable for any damage which may occur to any person or organisation taking action or not on the basis of this publication. Users should seek appropriate advice when applying the information to their specific needs.
Constraints on using the material:
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Other constraints:

Additional information about this material

Purpose for which the material was obtained:
This dataset is an output of a study to provide advice for the National Landcare Program on identifying where funding of improvements in ground cover management on agricultural lands will give the best returns on investment. The investment is to deliver on two of the National Landcare Program's strategic objectives of sustainable land management and ecosystems services.
Progress status of this material:
Completed
Maintenance and Update Frequency:
Not planned

SPATIAL EXTENT(S)

Extent

Description of spatial extent:
Australian Land
Spatial bounding box included in:
West 109.498508 East 157.224616
North -9.352335 South -44.374875

Extent

Description of spatial extent:
Australian Land
Spatial area included in:
Australian Mainland
Australia excluding external territories

Projection:
GDA_1994_Albers
Coordinate reference details: Well-Known Text:
PROJCS["GDA_1994_Albers",GEOGCS["GCS_GDA_1994",DATUM["D_GDA_1994",SPHEROID["GRS_1980",6378137.0,298.257222101]],PRIMEM["Greenwich",0.0],UNIT["Degree",0.0174532925199433]],PROJECTION["Albers"],PARAMETER["false_easting",0.0],PARAMETER["false_northing",0.0],PARAMETER["central_meridian",132.0],PARAMETER["standard_parallel_1",-18.0],PARAMETER["standard_parallel_2",-36.0],PARAMETER["latitude_of_origin",0.0],UNIT["Meter",1.0]]

RESPONSIBILITY FOR THIS MATERIAL

custodian
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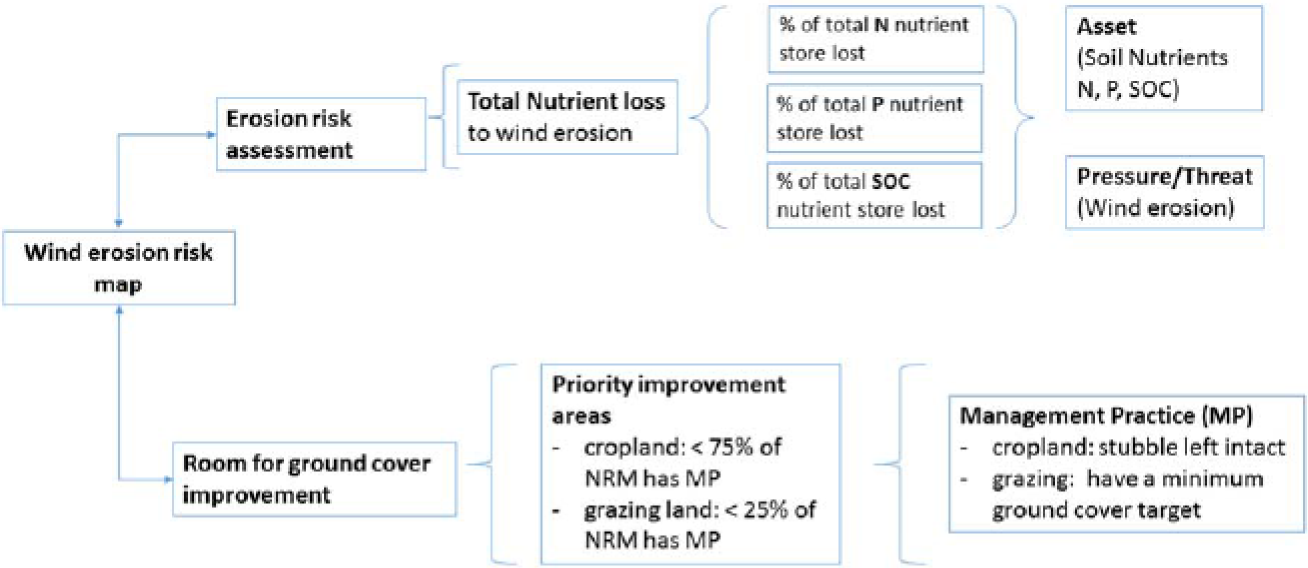
PROCESS USED TO GENERATE THIS MATERIAL

Lineage Statement

Lineage:
This dataset was created using version 3.2 of the MCAS-S Tool based on the following process model:



Separate wind erosion risk maps were created for cropping areas and grazing areas which were then combined to give a~~n~~ final wind erosion risk map.

Calculation of total nutrient loss to wind erosion maps

The total nutrient loss to wind erosion layers were created in the same way for both the cropping and grazing risk maps and then masked to either cropping or grazing lands using the Land Use of Australia 2010-11 dataset (ABARES 2016).

To calculate the "stock" of nutrient, soil nutrient data from The Soil and Landscape Grid of Australia (SLGA) (CSIRO 2017) for total nitrogen (mass fraction of total nitrogen in the soil by weight % - N), total phosphorus (mass fraction of total phosphorus in the soil by weight % - P) and organic carbon (mass fraction of carbon by weight in the < 2 mm soil material as determined by dry combustion at 900 Celsius % - SOC) were used.

The total mass in t ha-1 of each nutrient (N, P, SOC) in the soil profile was calculated depending on the depth of the soil in the grid cell, and in the top 5 cm. Total nutrient mass for N, P SOC was calculated using the bulk density attribute in the SLGA, and constrained by the depth of soil attribute of 0-5 cm, 5-15 cm, 15-30 cm, 30-60 cm, 60-100 cm and 100-200 cm.

The erosion rate was derived from an albedo wind erosion model outlined in Chappell and Webb (2016). This model returns a measure of the total horizontal sediment flux (Qh).

To calculate nutrient loss, the total horizontal sediment flux Qh (g m-1) from 2000-2010 had to be converted to an erosion rate (E) in t ha-1.

$$E\ (t\ ha^{-1}) = Q_h \frac{1000000\ g}{10000\ m^2} *\ 450$$

Where: 450 in is the number of 8 day periods in the 2000 to 2010 period.

Next, the nutrient loss for each MODIS 500m pixel was calculated.

$$N_l = E * N_5$$

Where:

N_l = loss of total nutrient in t ha-1 of the nutrient type
E = erosion rate in t ha-1.
N_5 = nutrient in 0-5 cm estimated value from the Soil and Landscape Grid of Australia in %

Nutrients are lost from the soil at different rates, and soils have different stocks of nutrients. To enable the losses of the three nutrients used in this study to be combined into a single estimate, the relative rate of nutrient loss for each of the three nutrients was calculated by:

$$The\ relative\ rate\ of\ nutrient\ loss = \frac{Mean\ annual\ rate\ of\ nutrient\ loss\ per\ unit\ area}{Total\ soil\ nutrient\ stock\ per\ unit\ area}$$

Where:

$$The\ total\ nutrient\ stock\ per\ unit\ area = \sum_{i=1}^{I}(nutrient\ concentration\ in\ layer\ i * the\ depth\ of\ layer\ i)$$

An index of nutrient loss for wind erosion is calculated by combining the value of the relative rate of nutrient loss for the different types of nutrients. The simplest approach to this combination is to average the values, so:

$$The\ nutrient\ loss\ index = \sum_{j=1}^{J}\left(\frac{the\ relative\ nutrient\ loss\ rate\ of\ nutrient\ j}{J}\right)$$

Where: J is the number of types of nutrient considered, that is, three in this study: N, P and SOC.

Nutrient loss index was grouped into the following classes using an approximate logarithmic scale:

- Very high = >10% of the maximum value
- High = 5 - 10% of the maximum value
- Moderate = 2.5 - 5% of the maximum value
- Low = 1 – 2.5 % of the maximum value
- Very low = <1% of the maximum value

Calculation of grazing wind erosion risk map

The total nutrient loss for wind erosion layer was combined with room for improvement layer to produce a risk map for grazing areas.

The room for improvement layer was derived from the following land management practices indicator: the number of graziers with a minimum ground cover target. The data was sourced from the ABS Agricultural Resource Management Survey 2011-12 (ABS 2013a) and is presented at the natural resource management (NRM) region. This layer was split into the following classes:

- High = 0-12% of respondents have a minimum ground cover target
- Moderate = 13-25% of respondents have a minimum ground cover target
- Low = >25% of respondents have a minimum ground cover target.

The nutrient loss index from wind erosion and the room for improvement layer for NRMs with minimum ground cover were then combined using a Two-way function in MCAS-S to create the following risk classes:

High risk where:

- nutrient loss is very high AND need to improve is high or moderate
- nutrient loss is high AND need to improve is high.

Moderate risk where:

- nutrient loss is very high AND need to improve is low
- nutrient loss is high AND need to improve is moderate or low
- nutrient loss is moderate AND need to improve is high or moderate
- nutrient loss is low AND need to improve is moderate or low.

Low risk where:

- nutrient loss is very low AND need to improve is high moderate or low
- nutrient loss is low AND need to improve is moderate or low
- nutrient loss is moderate AND need to improve is low.

Calculation of cropping wind erosion risk map

The total nutrient loss for wind erosion layer was combined with room for improvement layer to produce a risk map for cropping areas.

The room for improvement layer was derived from the following land management practices indicator: the percentage of crop stubble area left intact. The data was sourced from the ABS Agricultural Resource Management Survey 2011-12 (ABS 2013b) and is presented at the natural resource management (NRM) region. This layer was split into the following classes:

- High = 0-50% of respondents leave the crop stubble intact
- Moderate = 50-80% of respondents leave the crop stubble intact
- Low = >80% of respondents leave the crop stubble intact.

The nutrient loss index from wind erosion and the room for improvement layer for NRMs with stubble area left intact were then combined using a Two-way function in MCAS-S to create the following risk classes:

High risk to improve management practices where:

- nutrient loss is very high AND capacity to improve is high or moderate
- nutrient loss is high AND capacity to improve is high.

Moderate risk to improve management practices where:

- nutrient loss is very high AND capacity to improve is low
- nutrient loss is high AND capacity to improve is moderate or low
- nutrient loss is moderate AND capacity to improve is high or moderate
- nutrient loss is low AND capacity to improve is moderate or low.

Low risk to improve management practices where:

- nutrient loss is very low
- nutrient loss is low AND capacity to improve is moderate or low
- nutrient loss is moderate AND capacity to improve is low.

Calculation of final wind erosion risk map

The final wind erosion risk map was created using the Composite function in MCAS-S to combine the grazing wind erosion map and the grazing wind erosion map using equal weightings.

The MCAS-S process is described in more detail together with illustrations in Leys et al. (2017).

Positional Accuracy:
The dataset is a modelled output based on input data that have a range in accuracy from 500m (wind erosion model) to the natural resource management level (ABS land management practice data).

Logical Consistency:
All input polygon datasets were checked for topological consistency.

Completeness:
Complete.

Additional Metadata

References

ABARES (2016) Land use of Australia 2010-11 ABARES, Canberra, Date Accessed: 23 July 2017, http://data.daff.gov.au/anrdl/metadata_files/pb_luav5g9abll20160704.xml.

ABS (2013a) Customised report: Land Management and Farming in Australia, 2011–12, Catalogue No. 4627.0. Australian Bureau of Statistics, Canberra.

ABS (2013b) Land Management and Farming in Australia, 2011–12, Catalogue No. 4627.0. Australian Bureau of Statistics, Canberra, Date Accessed: 11 September 2017, abs.gov.au/AUSSTATS/abs@.nsf/Lookup/4627.0Explanatory%20Notes12011-12?OpenDocument.

Chappell A, Webb NP (2016) Using albedo to reform wind erosion modelling, mapping and monitoring. Aeolian Research 23, 63-78. doi: http://dx.doi.org/10.1016/j.aeolia.2016.09.006.

CSIRO (2017) Soil and Landscape Grid of Australia. CSIRO, Canberra, Date Accessed: 20 July 2017, http://www.clw.csiro.au/aclep/soillandlandscapegrid/.

Leys J, Chappell A, Mewett J and Barson M (2017). Wind Erosion Assessment for National Landcare Program, NSW Office of Environment and Heritage, Australia