**Biogeosciences
Discussions**

# *Interactive comment on* "Climate suitability estimates offer insight into fundamental revegetation challenges among post-mining rehabilitated landscapes in eastern Australia" *by* P. Audet et al.

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We (the Authors) thank David Norton for his commentary towards improving our manuscript for potential publication. Here, we offer an initial response to his concerns and outline our intentions and strategy for incorporating adequate revisions to the work, which will be thoroughly annotated in the subsequent manuscript draft.

Comment: The problem I have with [the development of a generic suitability index] is that the definition of highly suitable, moderately suitable and unsuitable (Table 2) is

the same for all seven sites notwithstanding the sites spanning major latitudinal and climatic gradients (extending from central NSW to the very north of Queensland). As a result, and as the authors readily acknowledge, the sites include a wide range of biotypes including desert, temperate, subtropical and tropical.

Response: The purpose of the index is to provide quantitative information as to the fundamental environmental constraints influencing initial ecosystem re-establishment, namely climate and rainfall patterns. Contrary to the Reviewer's insinuations, these types of assessments (or similar) are not currently available or explicitly taken into consideration into post-mining land rehabilitation schemes. What's more, and as mentioned in the Introduction, "the rehabilitation of these affected landscapes [in semi-arid Australia, unlike many temperate ecosystems,] is often complicated by weather-bound factors (e.g. potentially erratic rainfall and periods of drought and flooding) which can cause further challenges for rehabilitation schemes (e.g., dryland salinity and rapid degradation of soil fertility) (Williams et al., 2002)." Therefore, our application of the index across a broad latitudinal gradient outlines more and less challenging ecological zones due to climate 'suitability', which are currently affected by active disturbance (and rehabilitation) due to mining - and then providing a rather useful preliminary "criterion predetermining the success or failure of initial vegetation establishment". In other words, the proposed index facilitates the identification and (ultimately) the mitigation of climate suitability/unsuitability 'risk' rather than implementing ad-hoc solutions. The application of such an index across climates does not pose any restriction but is rather an improvement as based on the specific characteristic of rainfall events, their timely distribution and (daily) intensities rather than yearly averages. Also, the fact that arbitrary parameters are used and combined in a manner to assess potential climate challenges should be beneficial toward adapting this criterion among other ecosystems worldwide. That being said, we recognise that designation of a site 'suitability/susceptibility index' could be misinterpreted (e.g., insinuating that vegetation cannot be established in a given locations). In this regard, we intend to re-qualify the scope of this terminology in the revised draft to specify it as an indication of abiotic constraint.

Comment: Given this range and given that individual plants will be adapted to the environments they grow in (and species composition will be very different across this range of sites), I find it difficult to understand how then there can be one scale for defining what is highly suitable, moderately suitable and unsuitable – surely a rainfall depth of 500 mm per annum, which is defined as unsuitable, is actually likely to be suitable for plant growth in a desert environment that receives 476mm per annum (Ernest Henry site), while obviously it is unsuitable in a wet subtropical environment that receives 1604 mm per annum (N Stradbroke Island). [...] Finally, I can see no benefit from the approach advocated by the authors for rehabilitation planning. Planning of rehabilitation programmes should always take into account the constraints of the local environment including climate and substrate, and species selection for rehabilitation is then based on these considerations. Use of a generic suitability scale does not assist this at all.

Response: The Reviewer is adamantly cynical that this approach to rehabilitation (i.e., using available bioregional climate descriptors to assess potential environmental challenges and build mitigation strategies into planning) is not beneficial. As mentioned above, we recognise how the 'suitability/susceptibility' terminology could be misinterpreted and have outlined steps to account for this over-sight. Indeed, plants emanating from arid zone typically require special adaptations to occupy such highly selective environments. However, in our experience, these adaptations alone do not guarantee early-establishment success (regardless of the size and severity of the mining disturbance impact) particularly in relation to highly erratic rainfall patterns, periods of prolonged drought, and/or highly intense rainfall events. This means, following the example from the comment, a rainfall depth of 500mm per annum when occurred over a total of a few days (such extreme events are possible during monsoonal season across parts of Queensland) will surely not be sufficient to secure vegetation establishment. Hence, "the determination of climate suitability should still provide value-added for describing potential abiotic boundaries affecting ecological development and a generalised prognosis for rehabilitation development". Furthermore, "unlike many bioregional classification systems that are primarily based upon a few broad-scale cli-

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mate criteria (e.g. IBRA 7, 2012), the incorporation of short-term rainfall parameters (which are not directly linked to mean NDVI) has provided greater resolution regarding key criteria which could either favour or hinder the early-establishment of plants (e.g., rainfall intensity, ir/regularity of water availability, and frequency of water-deficit) at the scale of finer ecological processes." For example, the comparison of vastly different climatic zones (such as Nth. Stradbroke Isld. vs. Mt. Isa & Ernest Henry Mine) has provided rather predictable outcomes. Yet, the comparison of finer resolution criteria within ecoregions (such as Mt. Isa vs. Eromanga vs. Ernest Henry Mine) has provided highly relevant insight which was previously unavailable. From this perspective, we have provided a number of "Considerations for initial establishment strategies" in section 4.2 relating to the management of soil properties, the role of pre-emptive irrigation, and optimisation of landform design to overcome and/or mitigate various climate- and rainfall-related challenges. This, being supported (albeit anecdotally) by our ongoing field-level observations.

References Williams, J., Hook, R. A., and Hamblin, A.: Agro-ecological regions of Australia – methodologies for their derivation and key issues in resource management, CSIRO Land and Water, 88 pp., 2002.