

BSG Postgraduate Grant Report

European Geosciences Union conference – April 2016

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The British Society for Geomorphology (BSG) was generous enough to support my attendance of the European Geosciences Union (EGU) conference in April 2016. This was the first international scientific conference that I have attended since the start of my PhD, so it was with great anticipation and excitement that I joined the 14,000 or so scientists who descend annually on Vienna for the largest gathering of geoscientists on the continent.

Arriving on the Sunday evening before the start of the conference itself, I was overwhelmed as I arrived at the venue (Vienna International Centre); poster tubes, poster tubes everywhere! The buzz at the large registration hall was palpable. I felt like an oddly geeky fly on the wall, observing thousands of geoscientists as they reunited with colleagues, flicked through the enormous programme with delighted 'oohs' and 'aaahs', and murmured approvingly about how slick the design of the conference venue was this year. Little did I know about the onslaught of manic rushing to see superb science that would come over the next few days!

Luckily I had secured the chance to give both an oral presentation and a poster within the 'Aeolian Geomorphology' session, which has progressively grown in size since its foundation a decade ago. Our session was on Monday morning, starting at 8:30 am, so we launched straight in and I didn't have time to get nervous (a blessing!). The diversity of objectives, methodological approaches and results I witnessed that morning were fascinating, and really opened my eyes to new research avenues. I felt my talk, which focused on presenting a new coupled vegetation-sediment transport model, went well, and the response from the audience seemed positive. Thankfully, I was even asked a few piercing questions at the end, which was an encouraging sign that I had prompted some thought in the audience. Professor Giles Wiggs (my supervisor) wrapped up the session by giving a very insightful retrospective on how the discipline had evolved over the last 10 years. He took us on a journey through the windy deserts of the world, and whilst it was a partly nostalgic account, he also emphasized how bright the future looks for aeolian geomorphologists. This proved to be a highlight of the conference for me.

On Monday evening, I presented my poster in the huge basement hall of the venue; the hubbub of excitable chatter was deafening! I spoke solidly for two hours to various people who were interested in my poster (see Figure 1). This was very encouraging, especially since I had received peer reviewed feedback for the paper a few days before the conference itself, which had raised some issues with the turbulence model we proposed. I was surprised (and delighted) at how approachable big names in the field were, and how productive it was to get their opinion on some of the sticking points I faced. I left that poster session in a buoyant mood, ready to attack my manuscript when I got home!

The rest of the conference was spent walking into random session, focusing mainly on Cryosphere-based sessions in line with my Masters degree, and workshops delving into the science-policy interface. The social aspect of the conference was also superb, and it was a great chance to meet and socialize more informally with fellow Early Career Scientists.

I am very grateful to the BSG for its significant support to help me finance this trip. I would also like to acknowledge the help of both my supervisors, Professor Giles Wiggs and Dr Richard Bailey, who encouraged me to attend the conference and to prepare my work as rigorously as possible. This first taste of international scientific exchange will undoubtedly live long in my mind as one of the key stepping stones in my academic career.

A new turbulence-based model for sand transport

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Aim

Derive and test a new sand transport model that accounts for high-frequency turbulence in the horizontal (u) and vertical (w) components of wind flow.

Context

- Existing sand transport models rely on time-averaged parameters, e.g. wind velocity (U), wind shear velocity (u^*)
- High-frequency turbulence is thought to be important for sand transport, but isn't accounted for in models

Methods

- Turbulence model** tested using two field datasets:
 - Exp.1: 10 mins (10 Hz resolution)
 - Exp.2: 2 hours (1 Hz resolution)
- Performance compared to two existing transport models:
 - Radok (1977):** $Q_{IP} = ae^{bu}$
 - Dong et al. (2003):** $Q_{IP} = a \left(1 - \frac{u_c}{u}\right)^2 \left(\frac{P}{\rho}\right) u^3$

Model

$$\frac{dQ_{IP}}{dt} = H[a(u - u_c)^b - fw] - \left[Q_{IP} \left(\frac{1}{\rho} + cu - dw \right) \right]$$

Entrainment: $a(u - u_c)^b$
 Deposition: fw
 Threshold criterion: $H = \begin{cases} 0, & u < u_c \\ 1, & u \geq u_c \end{cases}$

Q_{IP} = predicted mass flux for the given time interval ($\text{kg m}^{-1} \text{s}^{-1}$)
 u = mean horizontal wind velocity over the given time interval (m s^{-1})
 u_c = horizontal wind velocity threshold (m s^{-1})
 w = mean vertical wind velocity over the given time interval (m s^{-1})
 a, b, c, d, f = empirically fitted constants

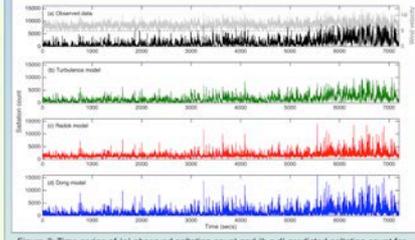


Figure 3: Time series of (a) observed saltation count and (b,c,d) predicted saltation count for Experiment 2, at 1 Hz measurement resolution. Wind velocity shown as grey line in (a).

Maximum over/underestimation of total saltation count (Experiments 1 and 2)

Turbulence model	Radok model	Dong model
+0.26%	+5.50%	-20.53%

Conclusions

- Turbulence model outperforms Radok and Dong models over a range of timescales (10 Hz–10 min)
- A temporal lag in flux response to wind velocity naturally emerges in the model
- 4s and 1 min averaging intervals are identified as best for predicting sand transport
- Modelling sand transport with this new model could help to integrate high frequency turbulent transport processes into long-term, macro-scale landscape modelling of drylands.

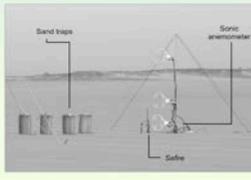


Figure 1: Experimental setup. Site located in NW Namibia, Skeleton Coast

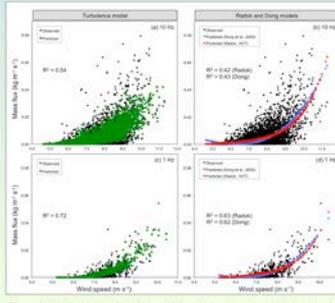


Figure 2: Horizontal wind velocity (m s^{-1}) vs observed and predicted sediment flux ($\text{kg m}^{-1} \text{s}^{-1}$) for Experiment 1, at: (a), (b) 10 Hz measurement resolution; (c), (d) 1 Hz averaging interval.