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Using Argus video monitoring to determine limiting factors of aeolian transport on a narrow beach

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Introduction

Wind-blown sand is needed for dune growth. However, predicted aeolian sediment transport rates on beaches are often overestimated, as models tend to be solely based on average wind velocity and grain size. Especially on narrow beaches, predicted sediment transport does not always result in actual transport.

Aeolian transport can be seen on camera as streamers and sand strips. These signs of aeolian transport provide insight in what weather and beach conditions favour are required for aeolian transport.

Aim

- Use a long-term (>years) dataset to find moments of limited and unlimited transport and compare their weather conditions.

Used data

- Argus images (snapshot and timex) from the Coast3D tower at Egmond aan Zee (2005-2012).
- KNMI weather data from de Kooy.

Figure 1. Location of the Argus tower at Egmond aan Zee (A) and the weather station at de Kooy (B).

Methodology

1. Find potential transport events based on wind velocity. The wind needs to exceed a threshold for sand transport to be possible.
2. Sort events according to wind velocity *(wind classes)*.
3. Sort events according to visual traces of transport on images *(transport classes)*.
4. When an Argus image shows less signs of aeolian transport than one might expect based on the corresponding wind velocity (i.e. the transport class is lower than the wind class), an event is considered to be limited.
5. The weather and beach conditions of limited and unlimited events are compared.

Used image types

Figure 2. Example of a snapshot image (A), showing both sand strips and streamers. A timex image (B) shows no streamers, since it gives a time-averaged view. This blurs out fast moving objects, which helps determining if transport features are still active. Sand strips move slower, which can be seen when multiple, subsequent images are studied.

Wind classes

Wind class	Wind velocity	Number of events
1	8 m/s	147
2	9-11 m/s	352
3	12 m/s	82
4	>13 m/s	114

Transport classes

Class 0: no transport.

Figure 3A. Small signs of transport, like a few sand patches and streamers.

Figure 3B. More sand patches, but no neat rows of sand strips.

Figure 3C. Beach is partly covered with sand strips.

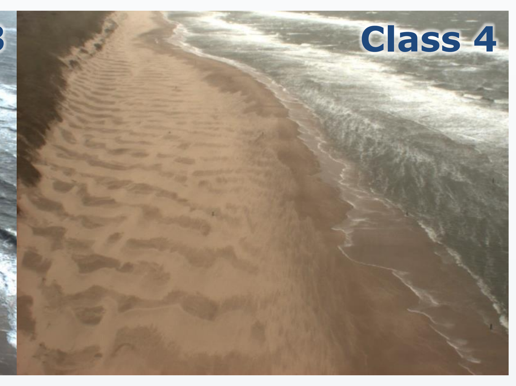

Figure 3D. The beach is covered with sand strips, often in combination with high streamer activity.

Results

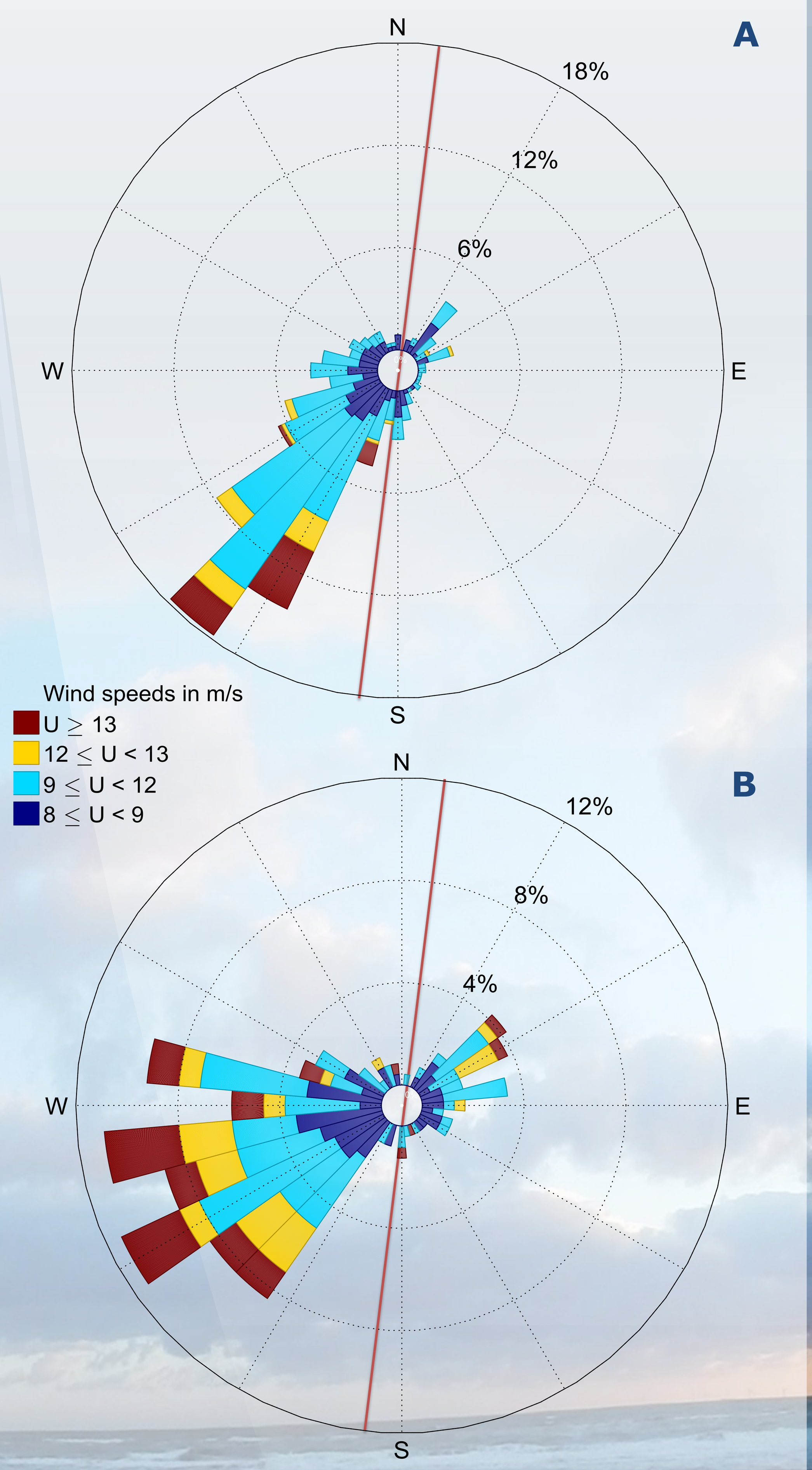

Figure 4. Wind roses for unlimited (A) and limited events (B), with sorted wind velocities (U in m/s). The red line is the coastline's orientation.

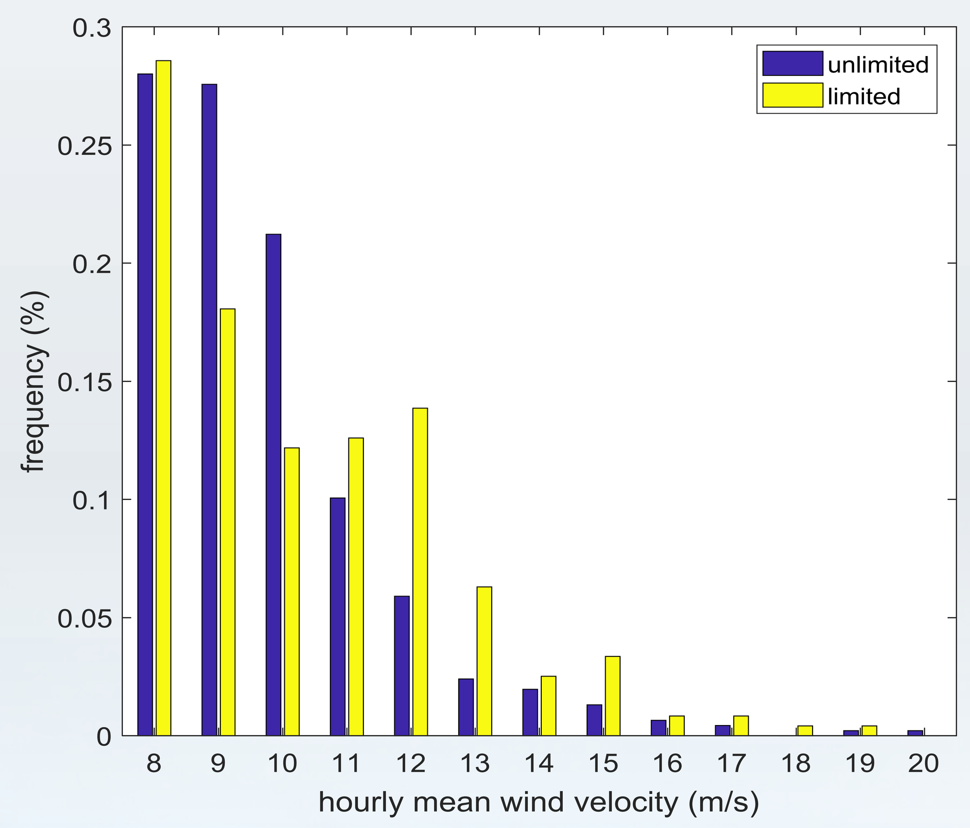

Figure 5. Wind velocity of limited and unlimited events.

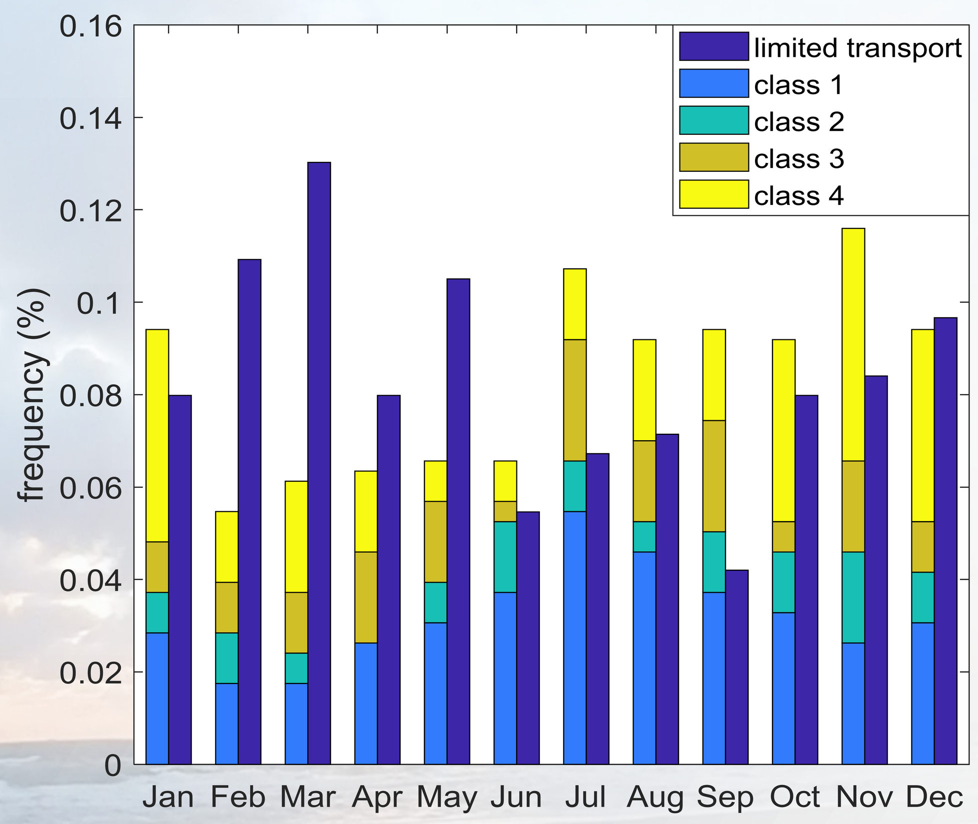

Figure 6. Monthly occurence for limited and unlimited events. The unlimited events are sorted according to their transport classes.

Conclusions

Unlimited

- 457 events (65.8% of dataset).
- Strong focus on south-westerly winds (Fig. 4A).
- Events with minor traces of transport are more common in summer.

Limited

- 238 events (34.2% of dataset).
- Westerly winds are dominant (Fig. 4B).
- Slightly higher wind velocities (Fig. 5).
- Events are relatively more common in winter/spring.
- Strong westerly winds cause beach to flood.
- 60 of the limited events showed unlimited transport at a different part of the day when it was low tide.

Fetch matters: alongshore winds and low tide favour unlimited transport on a narrow beach.

Future research

Use a fetch-type model to predict moments of aeolian transport and determine if the model results qualitatively match with Argus observations.

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