

■ - Introduction

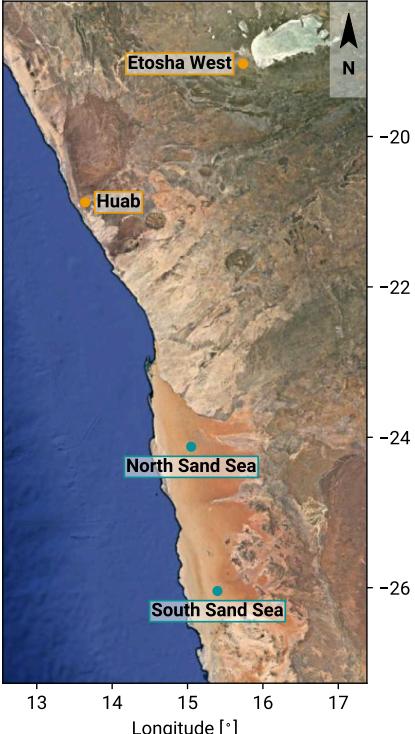
Turbulent flow over complex terrain plays a key role in many environmental and geophysical systems, such as wind power, wave formation and dune dynamics. Compared to hills and mountains, **aeolian sand dunes**, due to their smooth and scalable shapes, are ideal for studying **wind-topography interactions**. While **topography feedback on wind speed** has been largely quantified and understood, much less is known about the **wind direction**, particularly for **giant dunes**, less studied for practical reasons. While the spatial and temporal resolution of global atmospheric models keeps improving, their ability to reproduce precisely near-surface winds remains to be assessed.

- ?
- Can global atmospheric models predict near-surface winds in arid areas?
- ?
- Do giant dunes significantly affect the atmospheric flow?

⚙ - Methods

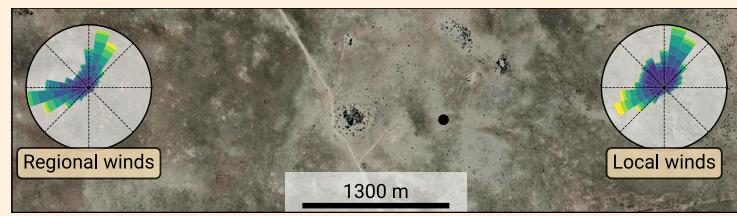
4 different places in the Namib desert:

- regional winds: ERA5-Land (climate reanalysis)
- local winds: in situ measurements

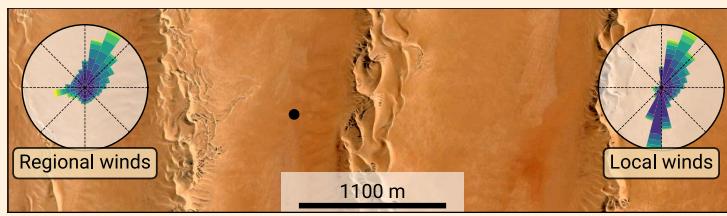


Giant dunes can disturb the wind...

Relatively flat



Between giant dunes

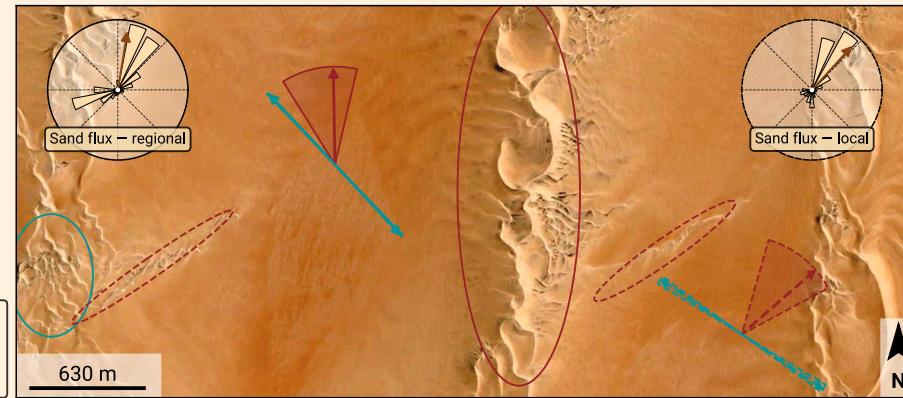


Agreement between regional (ERA5) and local winds !

Local along-dune redirection of **weak** regional winds **at night**

...affecting smaller-scale bedforms in the interdune!

- | | |
|---|---|
| Predicted dune orientations | |
| — Bed instability | — regional winds |
| — Elongation mechanism | -- local winds |

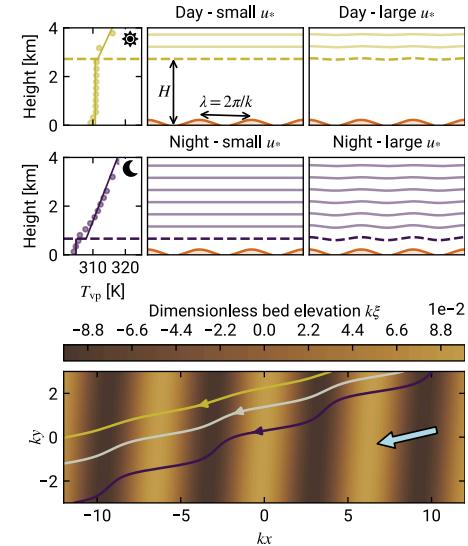


Local Wind Regime Induced by Giant Linear Dunes: Comparison of ERA5-Land Reanalysis with Surface Measurements

Cyril Gadal, Pauline Delorme, Clément Narteau, Giles F.S. Wiggs, Matthew Baddock, Joanna M. Nield, and Philippe Claudin

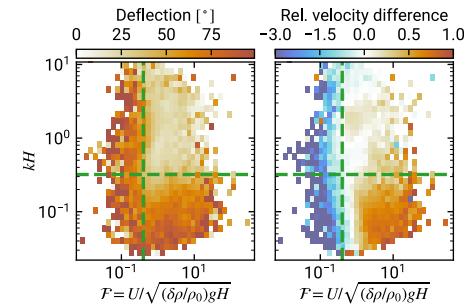
Boundary-Layer Meteorology, 185(3), 309-332

● - Interpretation: flow regimes



Two parameters controlling flow confinement by the Atmospheric Boundary Layer (ABL):

- relative ABL height: kH
- flow Froude number: $\mathcal{F} = U / \sqrt{(\delta\rho/\rho_0)gH}$



✓ - Conclusion

- good wind prediction from climate reanalyses if no subgrid significant topographies
- giant dunes significantly disturb the wind in the interdune
- this changes the morphodynamics of small scale bedforms in the interdune
- confinement by the ABL controls the flow disturbances