EGU General Assembly 2020
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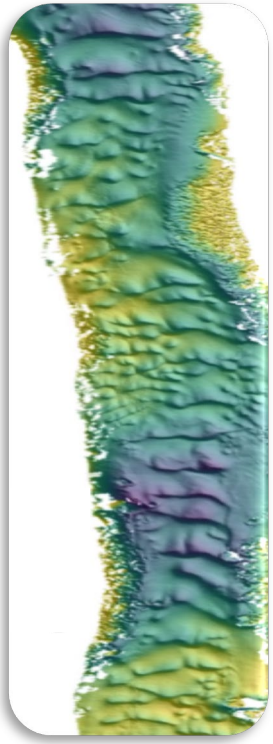
The growth process of river dunes

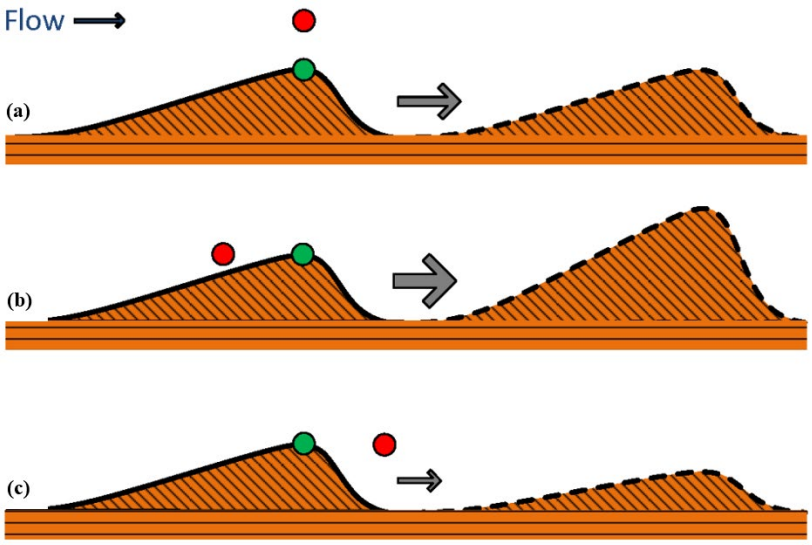


LEGI LABORATOIRE DES ECOULEMENTS GEOPHYSIQUES ET INDUSTRIELS
Rijkswaterstaat
Ministerie van Infrastructuur en Waterstaat
WAGENINGEN UNIVERSITY & RESEARCH

Suleyman Naqshband
Ton Hoitink
David Hurther

Mechanisms of dune growth

- Three main categories at the scale of individual bedforms
  - i. Bed sheets/ridges/spurs (e.g. Venditti et al., 2005; Swanson et al., 2018)
  - ii. Amalgamation process (e.g. Coleman & Nikora, 2011)
  - iii. Spatial lag!? (e.g. Smith 1970; Fredsøe, 1982; Venditti, 2013)



Naqshband et al. 2017, GRL

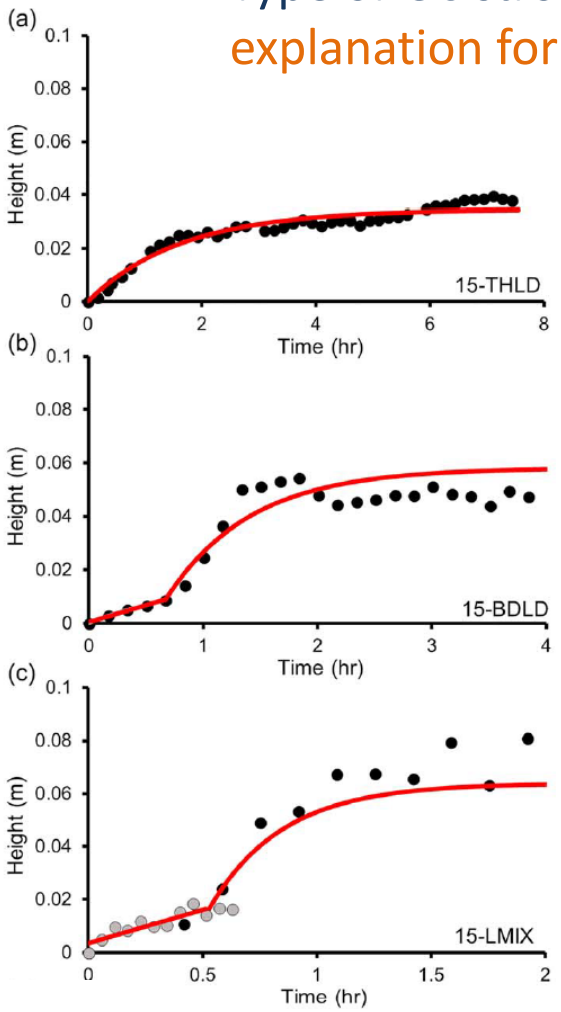
Growth types

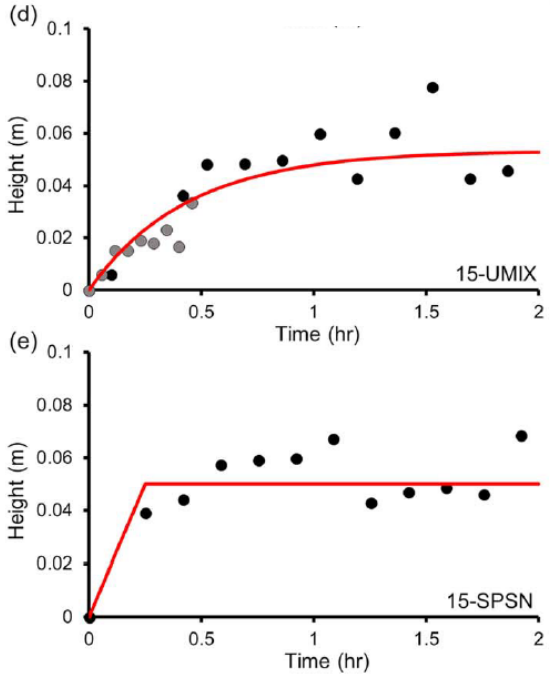
- Types of bedform growth & diminution
  i. Growth from a flat bed – equilibrium at a constant flow rate
  ii. Changes in bedform geometry after reaching equilibrium
  iii. Changes in bedform field due to variation in flow conditions

- Growth curves (GC) exclusively consider bedform dimensions (Λ & λ)

Growth curves

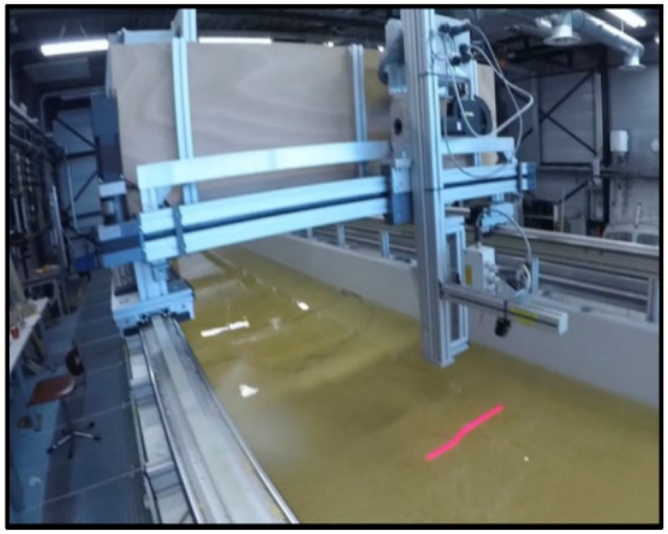
- Type of GC strongly depends on transport stage; no mechanistic explanation for the observed bedform evolution

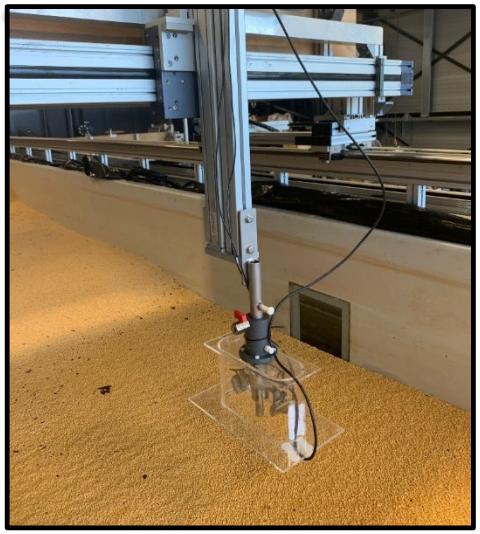


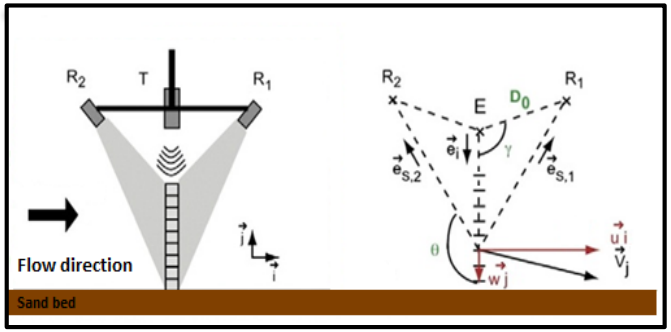


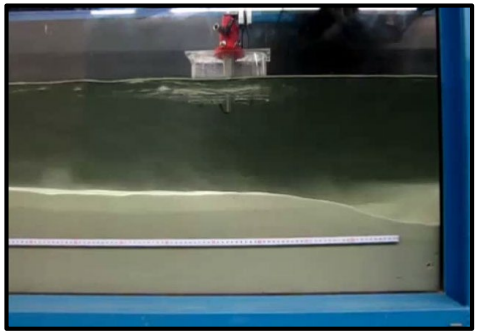
Bradley & Venditti, 2019, JGR – ES

Flume experiments



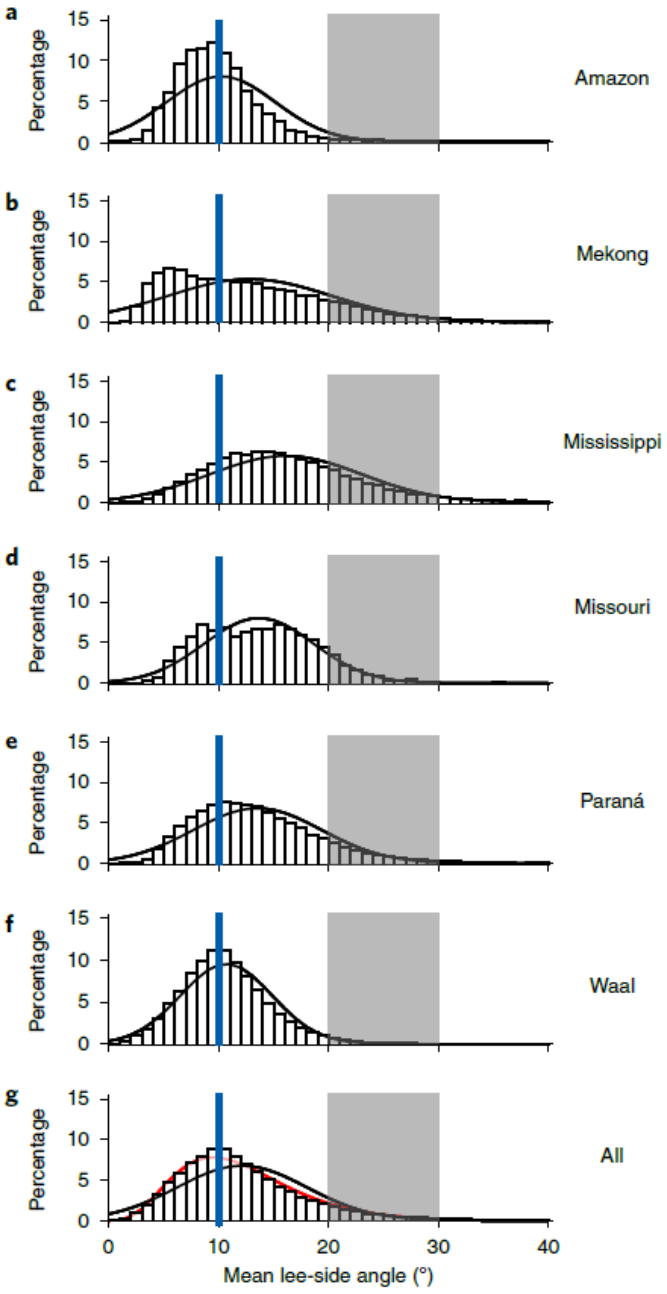




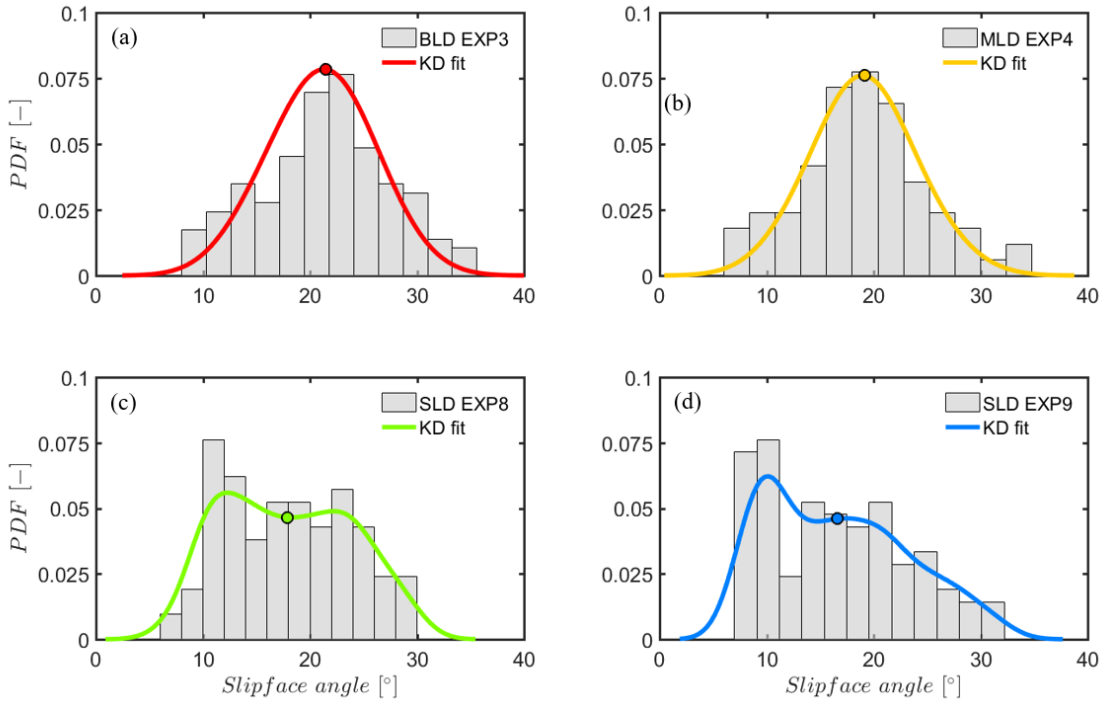


ACVP, *Hurther et al. 2011, JGR-ES*

LADs vs HADs



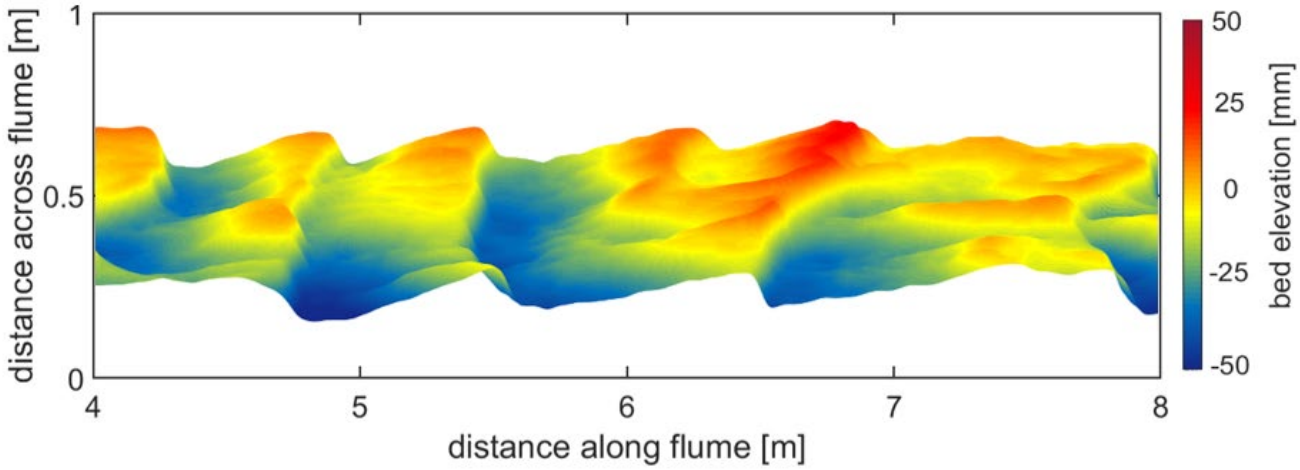
Cisneros et al., 2020, Nature Geoscience

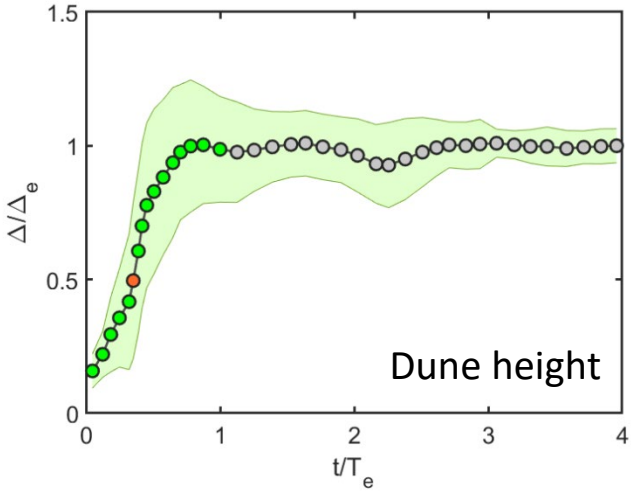


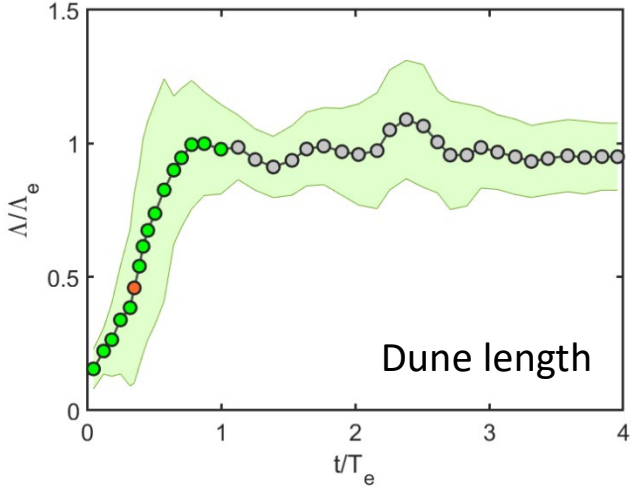
Naqshband & Hoitink 2020, GRL

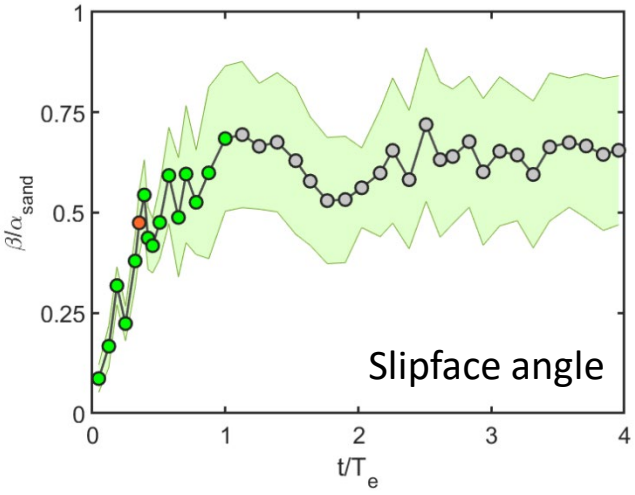
Experiments were conducted using light-weight polystyrene particles to obtain improved dynamic similarity between shallow flow and deep flow dunes.

Flat bed – dynamic equilibrium

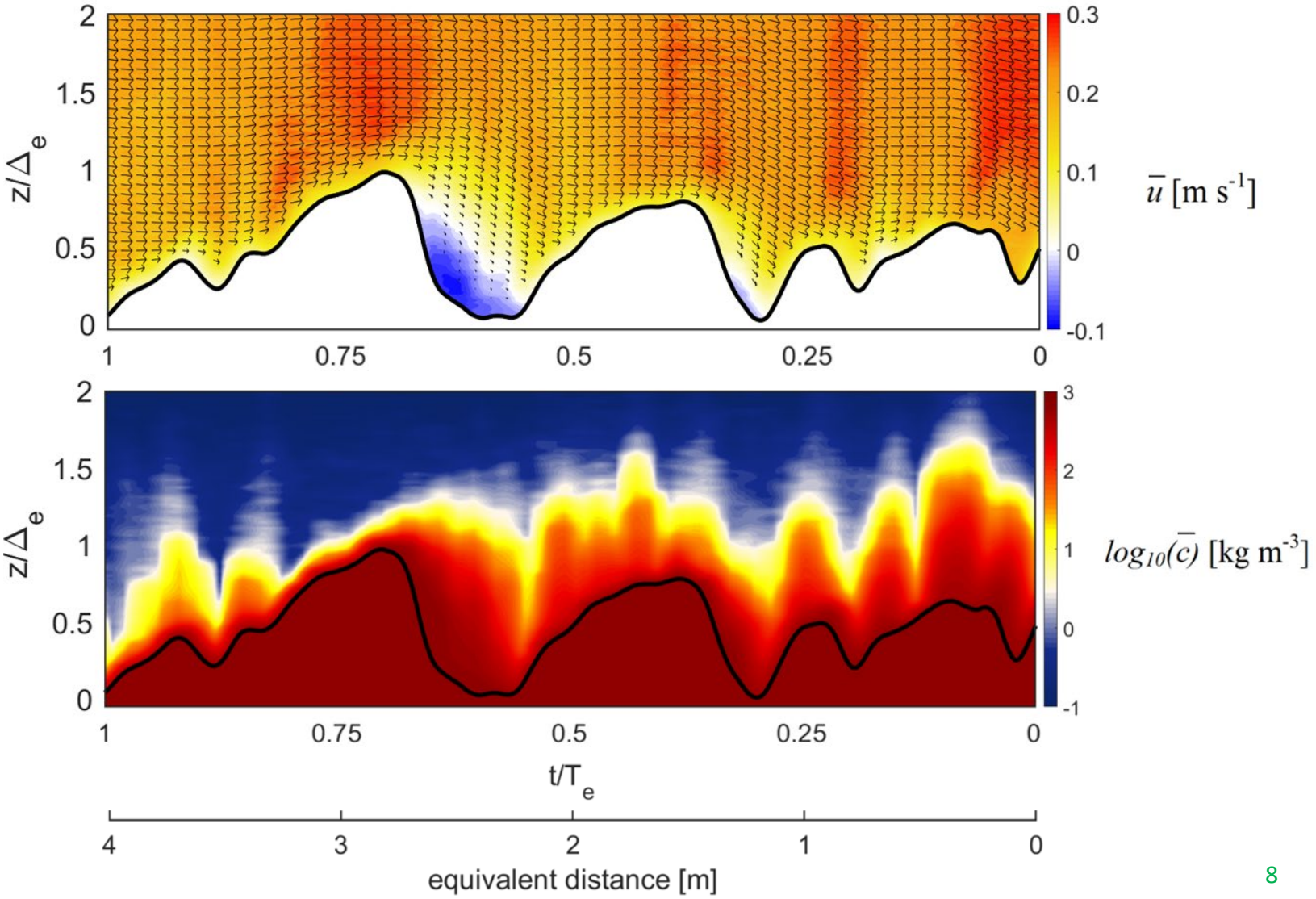




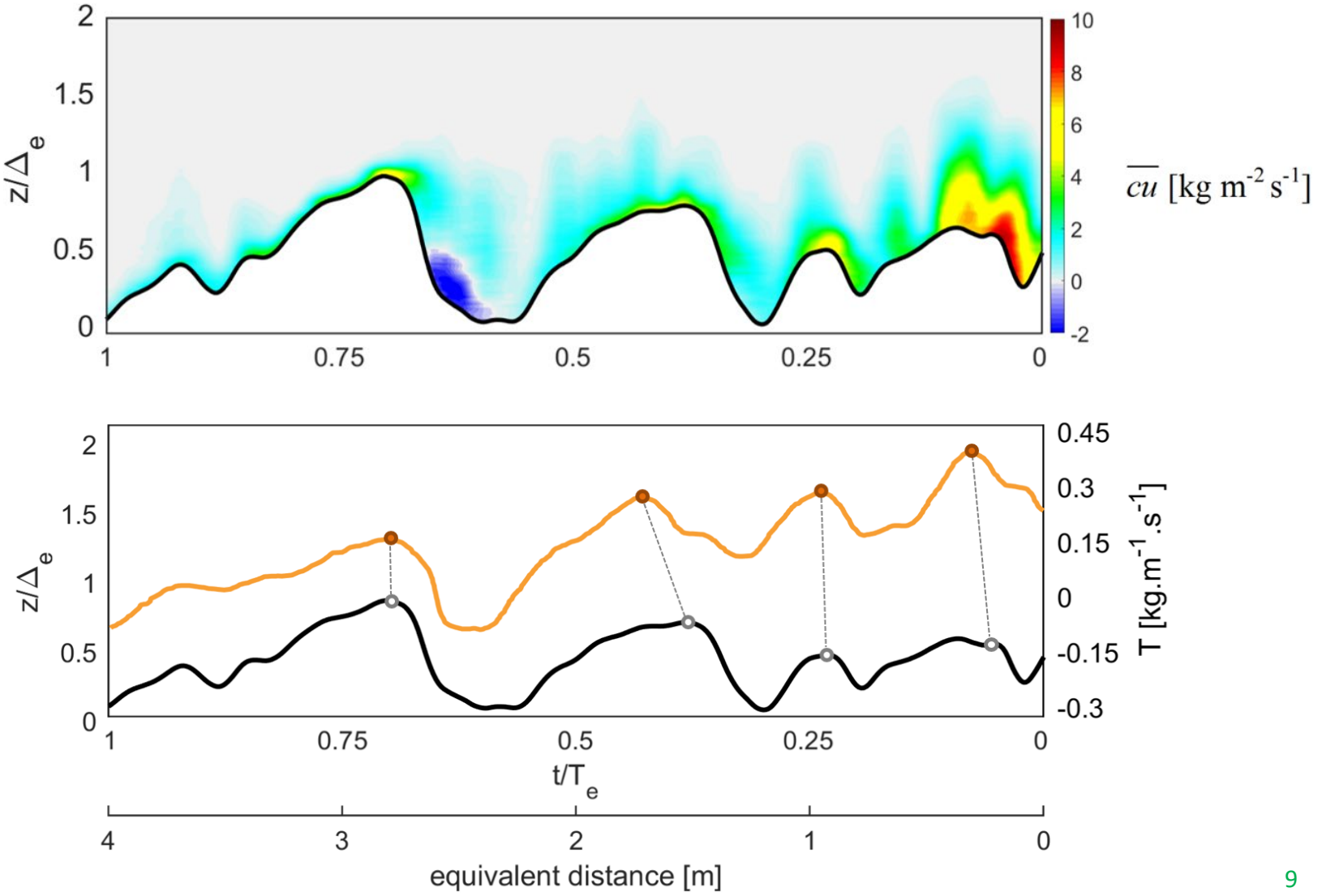




Flow field & sediment concentration



Sediment transport & spatial lag



Main conclusions

- Dune slipface angle adjust to imposed flow at time scales similar to the evolution of dune height & length
- Two phases of dune growth are identified
  i. Initial linear growth
  ii. Second stage of exponential growth
- Strength of downslope near-bed current over dune leeside depends of dune slipface angle
- Initiation of flow separation intensifies trough scouring, further accelerating dune growth