Dust Mobilization due to Density Currents in the Atlas Region – Observations from SAMUM 2006

Peter Knippertz¹, Carmen Deutscher¹, Konrad Kandler², Thomas Müller³, Oliver Schulz⁴, Lothar Schütz¹

¹Inst. for Atmospheric Physics, University Mainz ³Inst. for Tropospheric Research Leipzig
²Inst. for Applied Geosciences, TU Darmstadt ⁴Inst. of Geography, University Bonn
IMPETUS CLIMATE STATIONS

Iriki, 445 m, 29.8° N, 6.5° W

M‘Goun, 3850 m 31.5° N, 6.5° W,
31 May 2006: SYNOPTIC SITUATION

$Z_{500\text{hPa}}$ & SLP at 12 UTC

Upper-trough over Morocco and weak surface low
31 May 2006: SATELLITE VIEW

Meteosat infrared loop

1100 – 2345 UTC
31 May 2006: SATELLITE VIEW

Meteosat VIS image 1800 UTC
31 May 2006: PHOTOS TINFOU
31 May 2006: PHOTOS TINFOU

Arc clouds
31 May 2006: MEASUREMENTS TINFOU

- Dew point jump
- Weak temperature decrease ← sensible heat fluxes
- Wind acceleration & direction change
- Pressure increase
- Visibility drop
31 May 2006: AEROSOL MEASUREMENTS TINFOU

Units are relative to campaign average
31 May 2006: IMPETUS STATIONS

Dew point

Temperature anomaly
31 May 2006: FRONTAL ANALYSIS

Analysis is based on:
- Satellite images
- 1/2-h dew point & temperature jumps
- 1-h mean wind before & after frontal passage

Propagation velocity ~6 m/s
OTHER CASES: 25 May 2006

Meteosat infrared loop
1100 – 2345 UTC
SUMMARY

- On 8 days out of 4 weeks we observed density currents. → Part of regional climate
- Propagation in direction of local topographic gradient with a velocity of 5–7 m/s.
- Leading edge sometimes exceeding 400 km.
- Precipitation in High Atlas on most density-current days.
- Clear diurnal cycle: initiation during the afternoon and decay in the course of the night. → Lifetime ~10 hours
- Relation to upper-troughs (destabilization, wind shear).
DISCUSSION

- Proposed mechanism could be active in other mountainous regions in the Sahara (e.g. Ahaggar, Tibesti).

- Results point to dust sources near mountains and not only in topographic lows as sometimes assumed (consistent with recent satellite observations).

- Successful numerical modelling of dust cycle should realistically reproduce interaction between orography and moist convection → Challenge for state-of-the-art NWP models.
OUTLOOK

- Climatological analysis of density currents in the Atlas region based on data from IMPETUS climate stations
- Comparison of observed density currents to model results
- Analysis of selected SAMUM dust days
  - Synoptic-dynamic analysis of mobilization and transport → poster 184
  - Source analysis based on meteorology and mineralogy
- JGR paper accepted for publication