Dusty gust fronts at synoptic scale, initiated and maintained by moist convection over the Sahara desert

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African gust fronts: Major mechanism for dust emission during the wet season

- **Origin**: Cold downdrafts from moist convection.
- **Occurrence**: Over the Sahel and the Sahara during the wet season (May-October).
- **Frequency (associated with deep convection)**: 1-2 days.
- **Main characteristics**:
  - Mean lifetime: 25h.
  - Mean span: 1000 km.
  - Propagation speed: 5-15 m/s.
  - Visibility conditions: 0-1 km.
  - Surface temperature/depth: 30°C/2-4 km.
  - Surface pressure increase: ~9 hPa.

Focus of this study: Dusty cold pools over the Sahara desert

Aspects of interest:

- What are the forcing mechanisms for gust front propagation over the Sahara? (up to ~1000 km from the initial location at generation?)
- What are the synoptic conditions that drive the propagation of gust fronts into the Sahara desert?
- What are the impacts of the dusty cold pools on the atmospheric conditions over the Sahara desert?
- What quantity of dust is lofted by the cold pool during a given MCS event?

Spatio-temporal evolution of the August 3-8th 2006 dusty cold pool

**Initiation phase**

- 1) At 1300 UTC, isolated moist convection over the Air Mountain grew into a MCS (MSC1) over Agadir (8°E, 17°N).
- 2) At 1500 UTC, a second MCS (MSC2) was generated over northeastern Mali.
- 3) At 2100 UTC, MSC1 and MSC2 have merged and formed a large Squall Line (SL).

**Propagation phase**

- Dust load (1 Tg): 1.9 x 10⁶ kg.
- AOD = 0.025.

**New convection over the cold pool**

- Development of new convection over the cold pool.
- New moist convection.
- New aerosol over the cold pool.
- Dust scavenging.

**Dust load in the cold pool**

- Dust load (1 Tg): 1.9 x 10⁶ kg.
- AOD = 0.025.

Discussion & Conclusions

A dusty cold pool of synoptic scale over the Sahara desert was documented using a combination of satellite observations, ground-based measurements, and reanalysis.

- Origin of the cold pool: The cold pool originated from isolated convection over the Air Mountain, that subsequently expanded into a squall line MCS over Mali and Niger on 3 August.
- **Onset of the cold pool**: The cold pool propagated from southwest over 1000 km in latitude during 3 days. This pronounced northward transport resulted from the combination of local and synoptic conditions:
  - **Cold convection over the cold pool**: The cold pool propagated over 1000 km in latitude during 3 days. This pronounced northward transport resulted from the combination of local and synoptic conditions:
  - **New moist convection over the original cold pool**: The vertical distribution of dust and clouds

On 4 August 2006 at 0100 UTC

- Sharp dust front reaching 2 km in altitude.
- Lidar reflectivity associated with the dust front: 7 x 10⁶ km² Sr⁻¹.

On 5 August 2006 at 0200 UTC

- Dust cloud mixed over 3 km in altitude.
- Ladar reflectivity associated with the dust cloud: 3 x 10⁶ km² Sr⁻¹.

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Saharan dust emissions and meteorology