Triggering of convection by boundary-layer processes during IOP4b
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Synoptic conditions
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- Trough over Atlantic – moving slowly eastward
Synoptic conditions

- Moderate mid-tropospheric lifting (~ -8 hPa/h)
- Potential instability high in south east, low in north west
Synoptic conditions – Burnhaupt 1400 UTC

- High CAPE: 1300 J/kg
- Low CIN: 5 J/kg
- High conditional instability
Synoptic conditions – Karlsruhe 1400 UTC

- Moderate CAPE: 450 J/kg
- Moderate CIN: 40 J/kg

Moderate conditional instability
Evolution of convection
Evolution of convection

- 6 cells
- First over Vosges mountains at noon
- Northern Black Forrest not until afternoon
Evolution of convection
Trigger mechanisms

• Valley winds may produce mass convergence at the head of the valley
• Slope winds may produce mass convergence above the mountain crests
Local winds in the Vosges Mountains

- Valley winds from 1100 UTC
Local winds in the Vosges Mountains

- Slope winds from 1000 UTC
Divergence of the horizontal wind

- First convergence – shallow convection
Divergence of the horizontal wind

- Stronger convergence - first precipitation
- Approx. 2 hours after first convergence
Divergence of the horizontal wind

- Cell moved into region with stronger convergence
  - Stronger precipitation
Valley winds – Heselbach

- Onset of valley winds at 1200 UTC
Divergence of the horizontal wind

- Divergence in northern Black Forrest
- No clouds
Divergence of the horizontal wind

- Weak convergence in northern Black Forrest
- First precipitation
Summary

• Pronounced spatial distribution of convective instability

• Convergence caused by local winds was a trigger mechanism

• Convergence occurred 2 hours (Vosges Mountains) and 0.5 hours (northern Black Forrest) before deep precipitating convection
Evolution of convection
Divergence of the horizontal wind

- Cell in region of moderate convergence
Divergence of the horizontal wind

- Stronger convergence – first convective cell
• Convective Temperature not reached
Convective Temperature

- Convective Temperature not reached

- Convective Temperature reached in the afternoon