High-resolution UM modelling of topographically triggered convection during INCOMPASS

Flight B968

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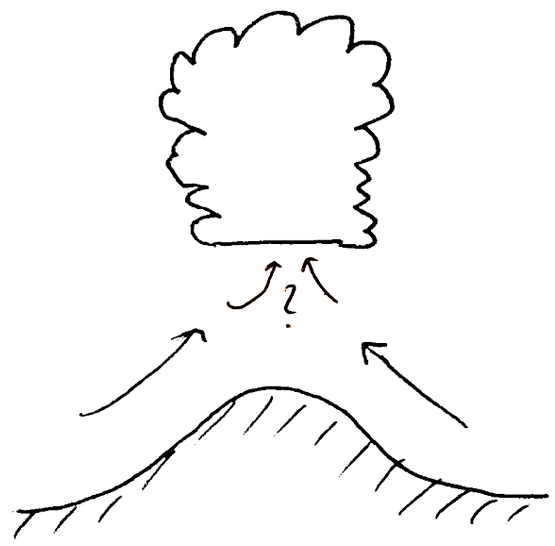
Leeds Dynamics meeting

2/11/2018

Aims

- study effect of topography on scales of coherent boundary layer structures

“How does the presence of topography affect the length-scales of and perturbations within boundary layer structures which trigger clouds?”

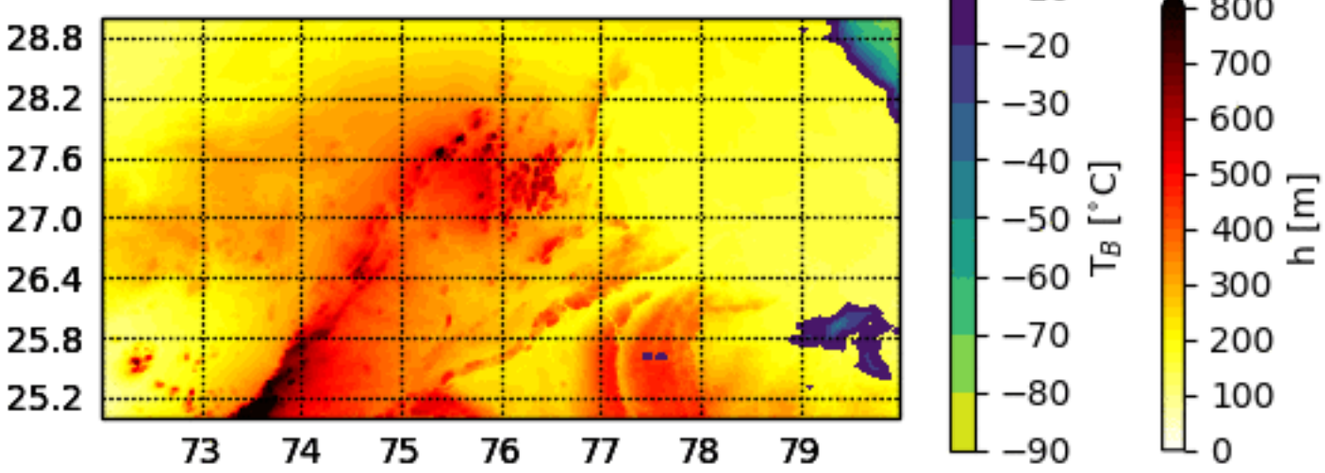


Case details

- Northern India, west of Lucknow.

- 30th June 2016, flight time: 1100-1230 (local), 0530-700 UTC, before onset of convection

Cloud-top temperature



From Emma Barton

04:30 - 05:00 UTC

Simulation setup
Requirements

- Need a model which can represent topography
  - Can’t use MONC, UCLALES. iUM not stable

  ↳ Went with UM

- Need high-resolution (at least Δx~100m) to study boundary-layer structures

  ↳ Need multiple layers of nesting

- Need to identify boundary-layer thermals
  - *TODO*: implement surface release of “radioactive” tracer, e.g. species with half-life (like isoprene)

Simulation setup
What is important for triggering?

- *Moist* boundary-layer air needs to reach *condensation level*
- Is mechanical lift (topography), horizontal convergence or surface fluxes dominating?
    - We can diagnose convergence
    - And vary mechanical lift (by flattening mountain) or surface fluxes (alter soil properties), for now:
        - *Use soil-moisture initiated from global run*, later do parameter study *with uniform soil-moisture* (TODO: determine reasonable soil-moisture values).
        - *Use actual topography based on SRTM (TODO: find out how to flatten in UM)*

Simulation setup

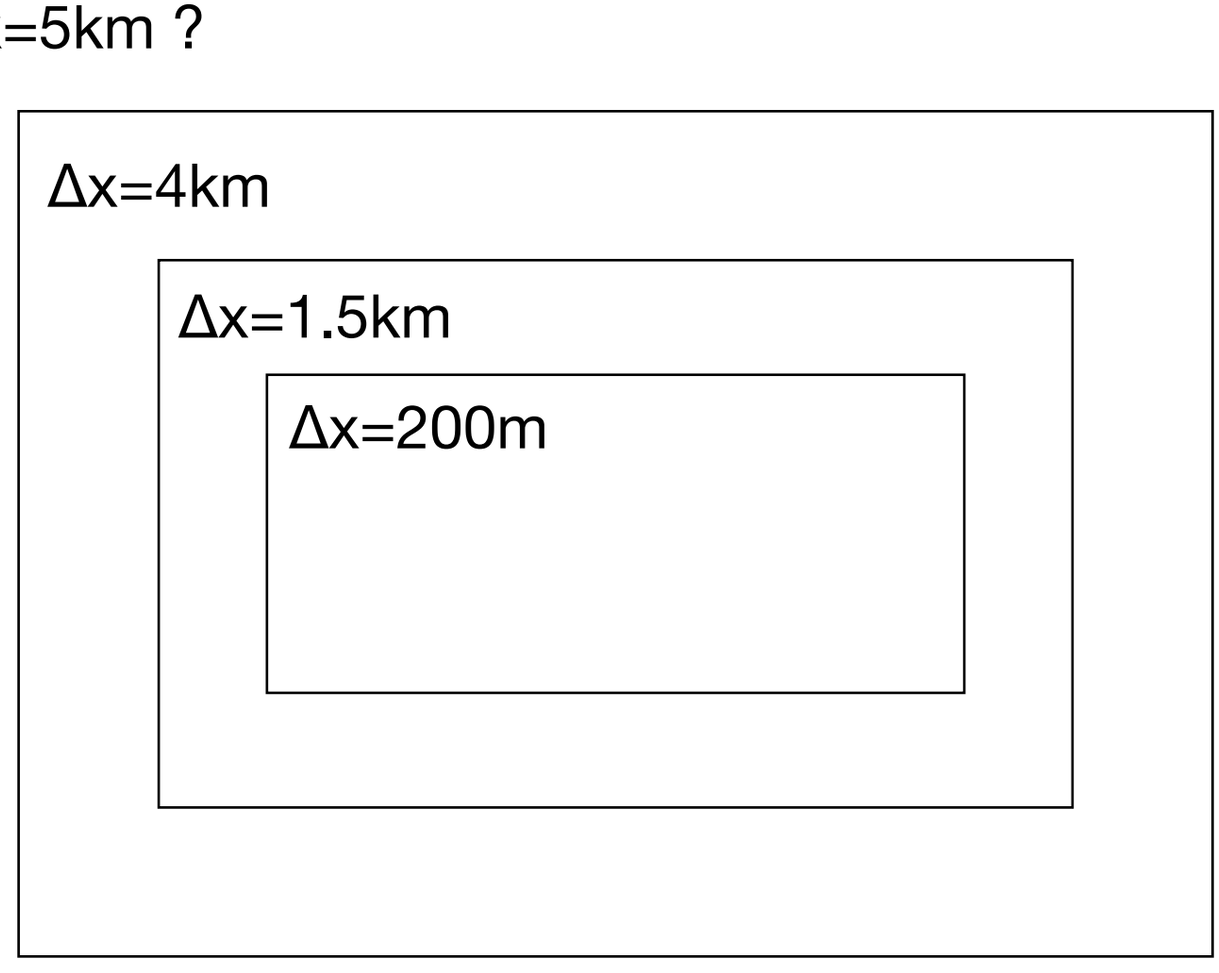
Current setup

🌟 Setup and run done by Chris Dearden (CEMAC) 🌟

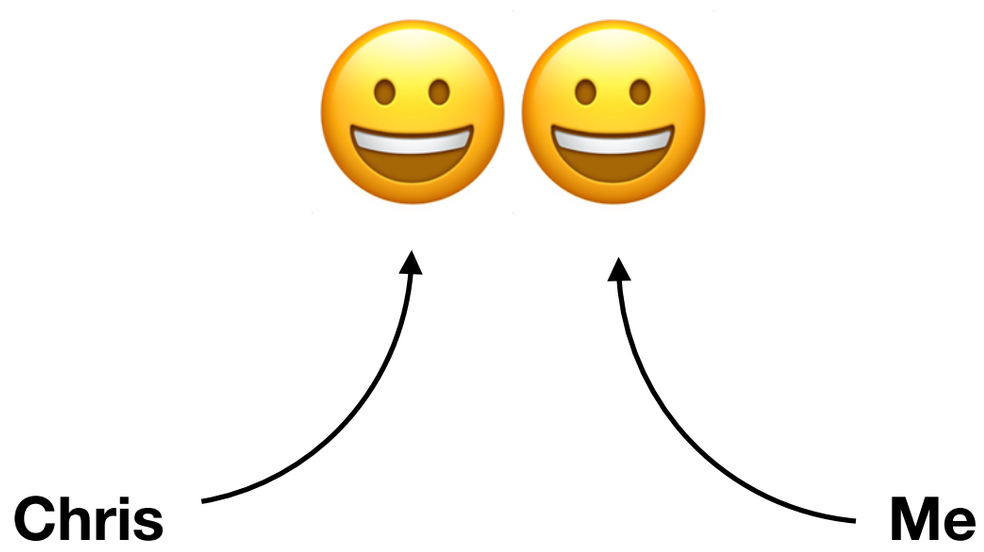
- Using RA1T science configuration in place of UKV_OS37

- Stu Webster: “tried and tested science configuration for use in the tropics”

- TODO: work out exactly what difference are

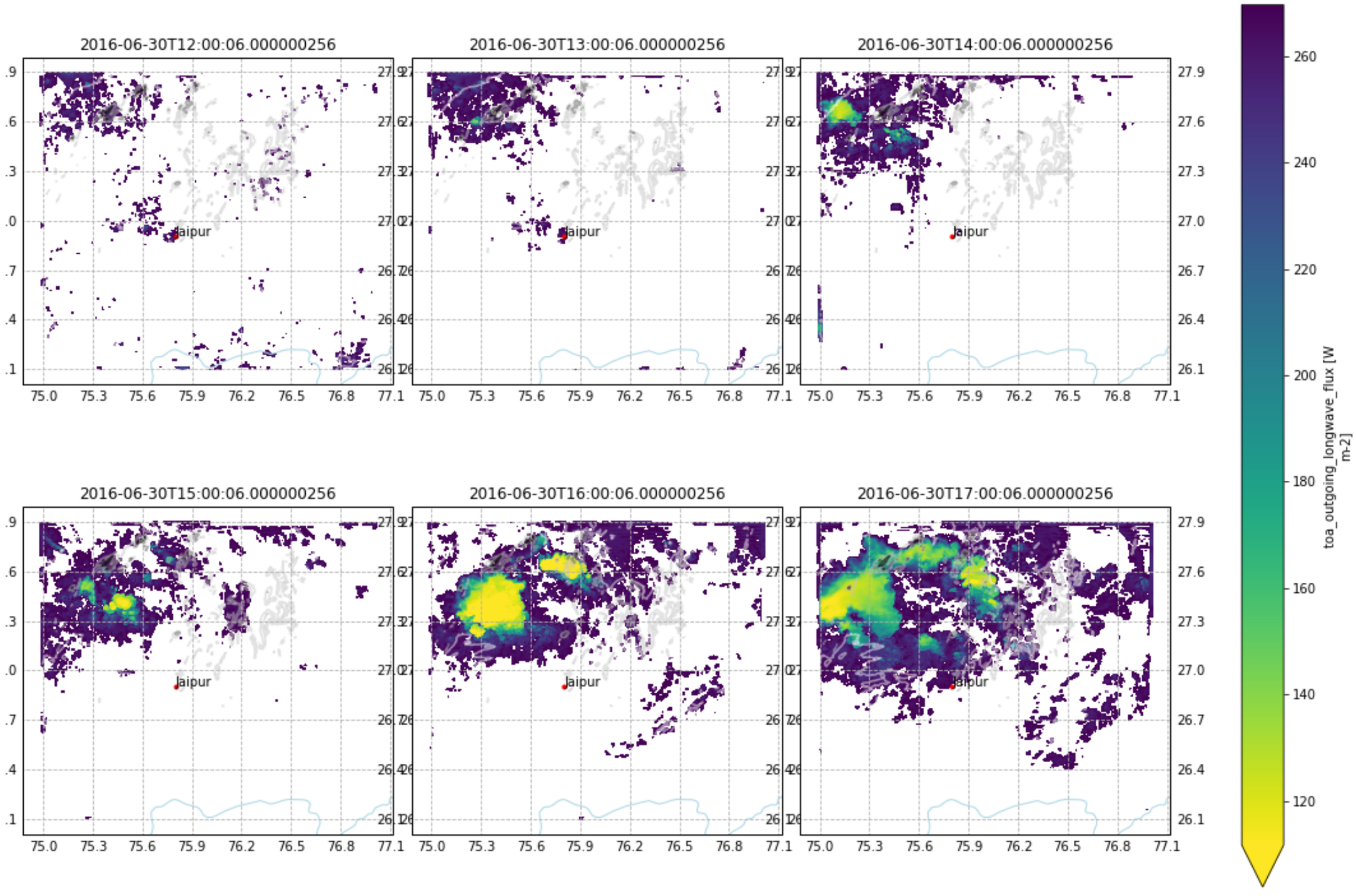


Preliminary results!

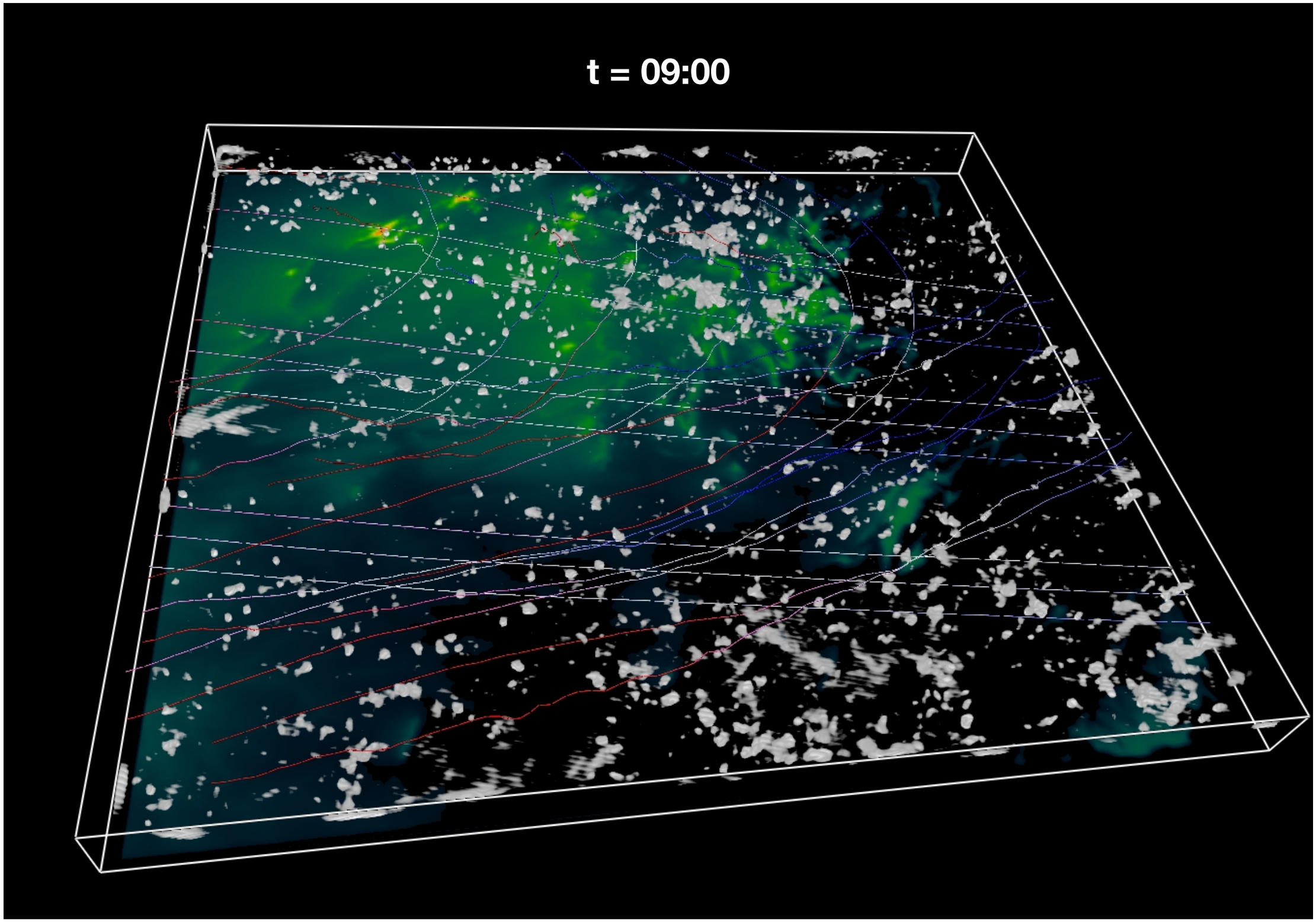


Does convection develop?

Yes!



What does the flow look like?



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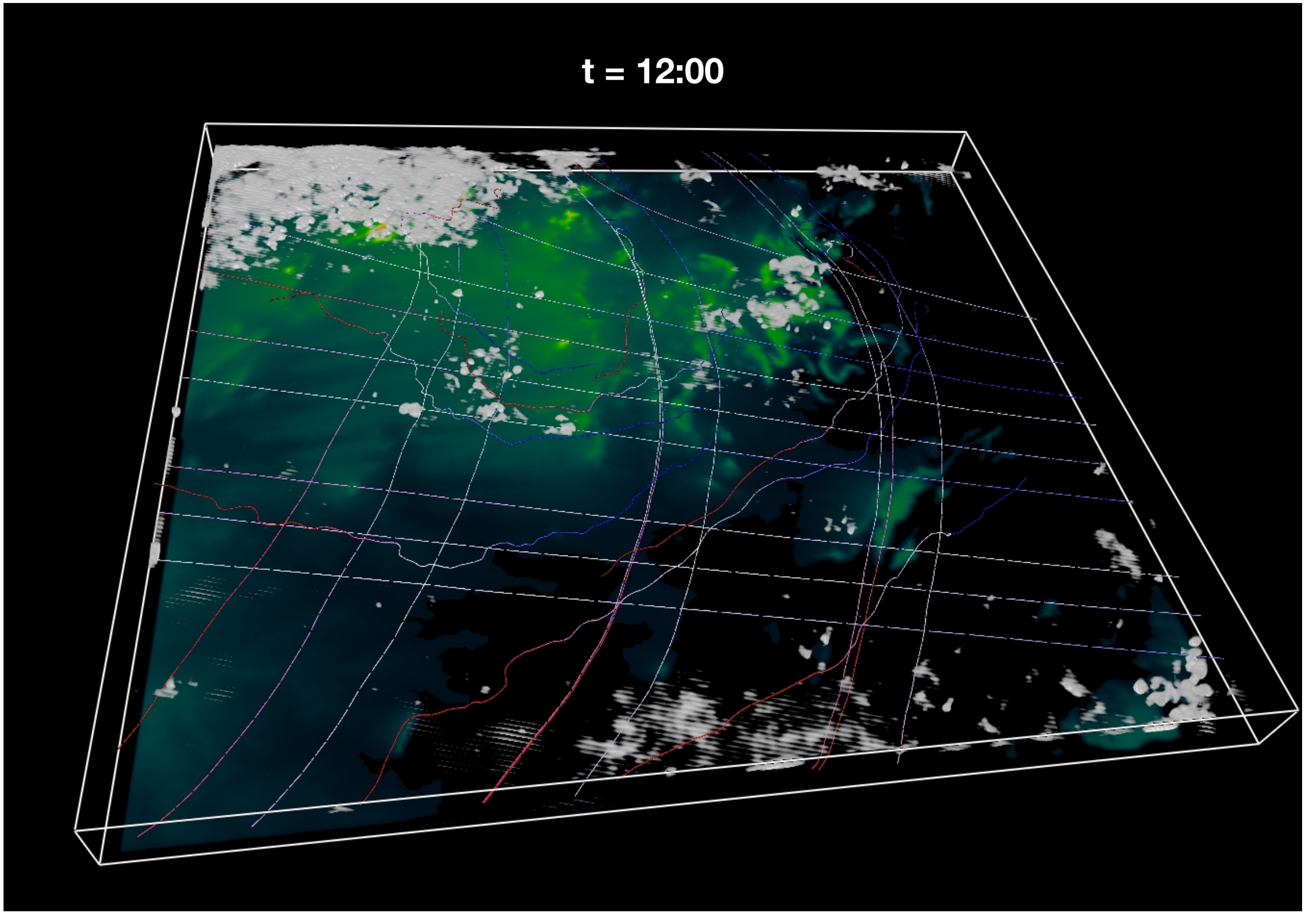

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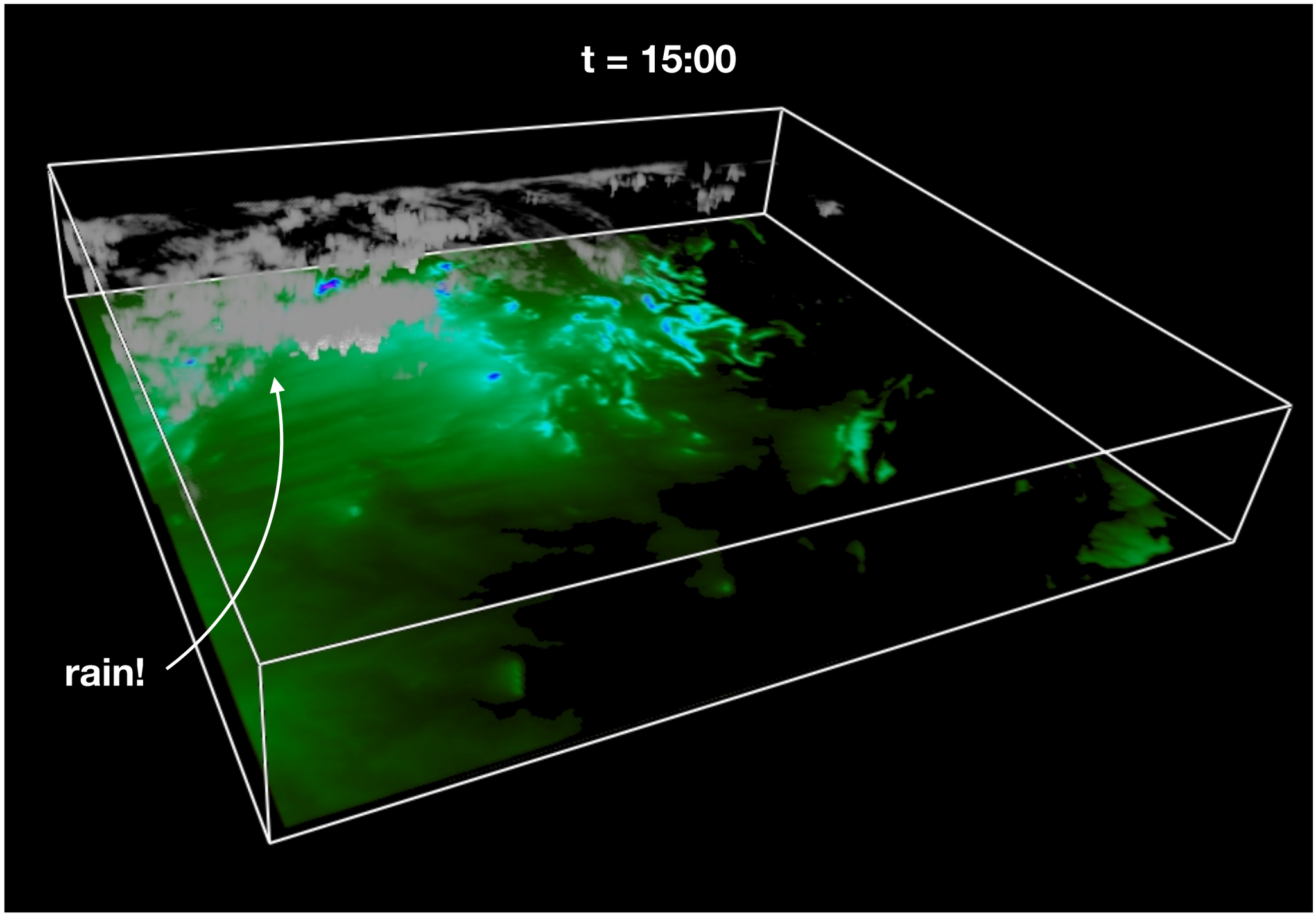

Next steps

- Decide what output variables to include (currently missing e.g. vertical velocity)

- Find out how to implement release of “radioactive” tracer (Leif attending UM training course next week)

- Enlarge domain to include more of mountains to the west

- Determine values to use for horizontally uniform soil conditions

- Do parameter study by varying soil conditions and height of topography

Next steps (more TODOs)

- What are the specific changes in RA1T?
- Can we output profile diagnostics from UM? (e.g. vertical profile of mean temperature, RH, etc)
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