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C2SM Center for Climate Systems Modeling

# Idealized simulations of cumulus convection within Turb-i-Sim

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work with Jürg Schmidli, Oli Fuhrer, Christoph Schär, Marco Arpagaus and many others

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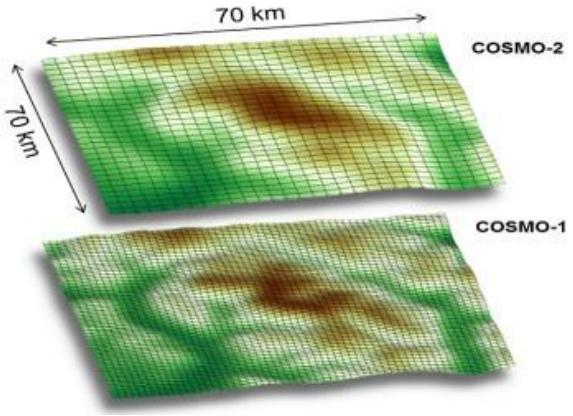
# Motivation


COSMO-NExT




**COSMO-1**

- Convective boundary layer/summer convection/thunderstorms
- Valley winds, Föhn, cold pools, stratus
- Cloudiness and precipitation

**Experiences with kilometer-scale Cloud Resolving Models**

- Delayed evolution of convection, too large and strong precipitation cells, too little weak rain
- Results very sensitive to grid resolution and turbulence scheme

# Goal and objectives

Improve understanding and representation of turbulence (and subgrid-scale clouds) in kilometer-scale COSMO

- Focus on diurnal cycle of moist convection over topography
- Analyze and improve representation of convection initiation in COSMO-1

  Turbulence and shallow convection, mountain winds
- Analyze and improve representation of mixing in resolved deep convection

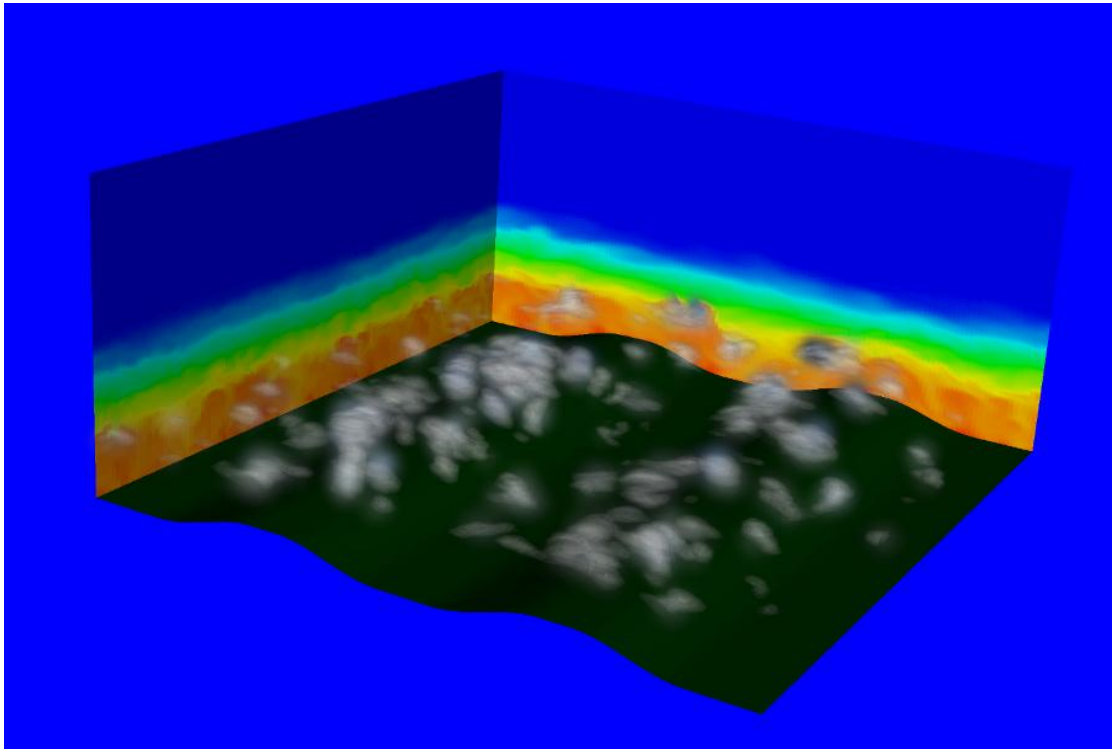
  3D Turbulence and horizontal mixing

# Methods

- LES simulations as a reference (WRF)
- Idealized runs with COSMO 1
- Both flat terrain and topographically forced convection
- Investigate valley winds using real-case COSMO-1 simulations (Jürg Schmidli)

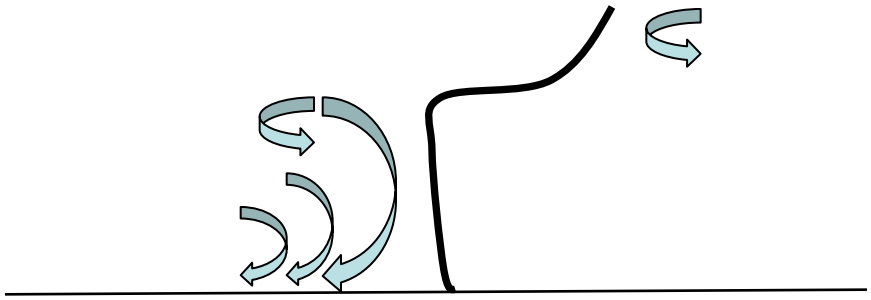
# Ongoing: LES work

- Validation case: ARM diurnal cycle of shallow convection
- Setting up topography
- Comparison to COSMO: idealized case of diurnal cycle
- Useful: option for prescribed surface fluxes in COSMO 5.0



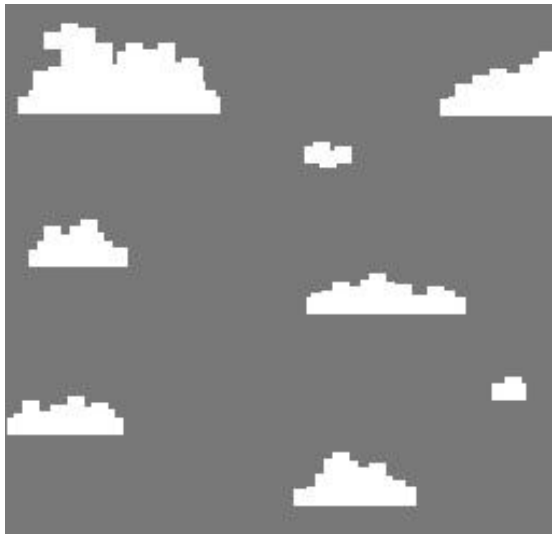
# Future plans

- Impact of different (turbulent and shallow convection) closures on diurnal cycle of moist convection using COSMO-1
- Combine vertical TKE-based scheme with 2d Smagorinsky
- Horizontal mixing in the free troposphere. 'Blending' the PBL scheme and a 3d (LES-like) approach.
- Mixing length scale formulation in PBL and above



# Related work

- Horizontal mixing formulation
- Coordination with recent developments at DWD
  - SGS cloud formulation
  - Work on PBL turbulence schemes



# Ongoing: evaluation of WRF-LES for summer shallow convection (ARM)