"Initiation of convection" (CI)
Report of an ad-hoc working group during the COPS planning meeting Sept. 13/14, Stuttgart-Hohenheim

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Tasks:

Identify critical gaps of knowledge
Develop key science questions/hypotheses
Develop list of required instruments and suggest strategies for observations

<u>Three processes are responsible for CI</u>

1) Differential soil and vegetation moisture, differences in surface heating due to land use and orography, and resulting secondary circulations over complex terrain → *local CI*
2) Fronts, *mesoscale CI*
    - temperature fronts
    - differences in the wind/flow field (gust fronts, convergence lines)
    - moisture fronts
3) Upper tropospheric forcing, (*large scale CI*, triggering of potential instability)
    - Upper level troughs,e.g., Rossby waves, causing large scale positive vorticity advection (PVA), increasing with height
    - Cold air advection causing increase of CAPE and deep convection

One can distinguish: stationary/non-stationary forcing; large-/small-scale forcing

<u>Key science questions and hypotheses</u>

- Are there/what are the characteristic differences for the precipitation events which result from the three different processes mentioned above? (shape of precipitation patterns, duration, intensity, onset)
- What is the diurnal cycle of CI (related to processes at the surface and in the PBL)? Why is the diurnal cycle of CI not represented correctly in the models?
- Dynamics: How decisive is the flow in complex terrain for CI? How do secondary mesoscale circulations influence convection? Do the models represent these flow patterns adequately? Can mesoscale models predict the flow? What model resolution is necessary in the horizontal and vertical?
- Initial fields: How well are they characterized in the models? What is the small-scale inhomogeneity of (atmospheric) humidity, temperature, and wind in complex terrain? How decisive are mesoscale/small scale initial errors of the models? What is the impact of targeted observations on the mesoscale (e.g. of the inflow at specific valleys)?

- What causes the heterogeneity in PBL fields? Can specific causes be identified for different onsets and intensity of convection?
- Are latent heat flux and sensible heat flux the same as it is assumed so far in the models? What is the spatial and temporal structure of the fluxes?
- To which extend do cities/villages as sources of local heat and aerosols influence CI?
- To which extend do aerosol loads on the landscape scale influence CI?
- To which extend does cirrus cloud shading inhibits CI?
- How frequent are bores (less frequent in complex terrain because of disturbances by orography)?
- To which extend do gravity waves/mountain waves inhibit/initiate CI?
- How predictable are CI processes in complex terrain?

List of required instruments and strategy for operation

Instruments in addition to data of existing operational instruments and networks (radars, radiosondes, rain gauges, …); needless to say that the data of the existing networks of DWD, Meteo France, MeteoSwiss, Floot Prediction Center Baden-Württemberg, private weather consulting companies etc. should be collected

- Supersites with continuous observations are needed
  - To derive synergetic parameters from the combined set of data and to ensure the quality of the data by intercomparisons.
  - Supersites will be set up near locations of highest probability for CI; as an advantage of low-mountainous regions, the locations of initiation of convection are more confined
  - Scanning multi-wavelength remote sensing instruments of water vapor, wind, temperature, clouds, aerosols… combined with energy balance station(s) and near-by upwind radiosonde launching station(s)
- Airborne observations are needed (with in-situ instruments and with remote sensing instruments) to cover the extended regions under focus, different types of aircrafts are needed to cover different scales and focus on specific parameters/altitude regions
- Operational weather radar network needs to be complemented with additional radars at supersites to achieve dual/triple Doppler radar capability
- Additional stationary and mobile radiosonde stations, reference radiosonde launches and drop-sonde launches
- Satellite remote sensing instrumentation (in special observing modes for COPS?)
- Network of radiation budget stations
- Network of mesonet stations
- Can high-resolution land use maps be derived adequately with satellites or are additional instruments useful, like, e.g. LVIS (http://ltpwww.gsfc.nasa.gov/eib/projects/airborne_lidar/lvis/)?

The strategy for observations needs to comprise extremely flexible components. This can be achieved with small teams being mobile in the field with cars, and being able to launch radiosondes and install met-masts within 30 minutes. In addition to fixed sites, also mobile targeted observations shall be made on the mesoscale, depending on the specific situation of the day and on model simulations assisting in deciding on gaps of the observational network. The idea follows the THORPEX rationale which is on a larger scale.