The impact of increased spatial data resolution on the detection of the initiation of convection

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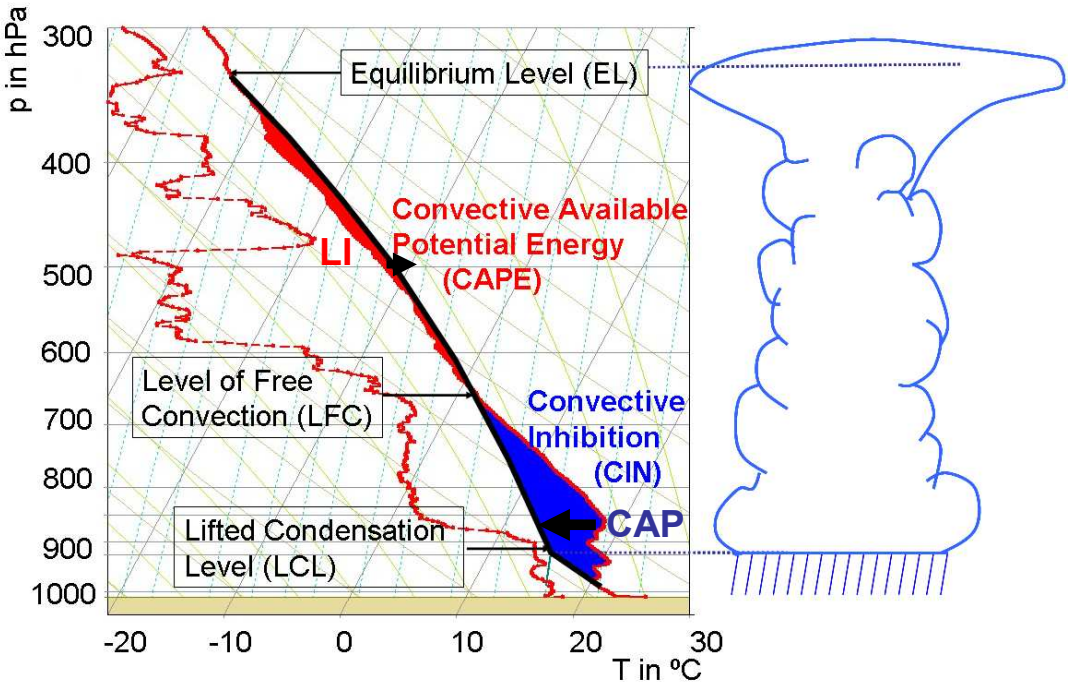
Motivation

Deep Moist Convection

- Low-level moisture
- Instability
- Inhibition

→ Convection indices

- Triggering mechanism

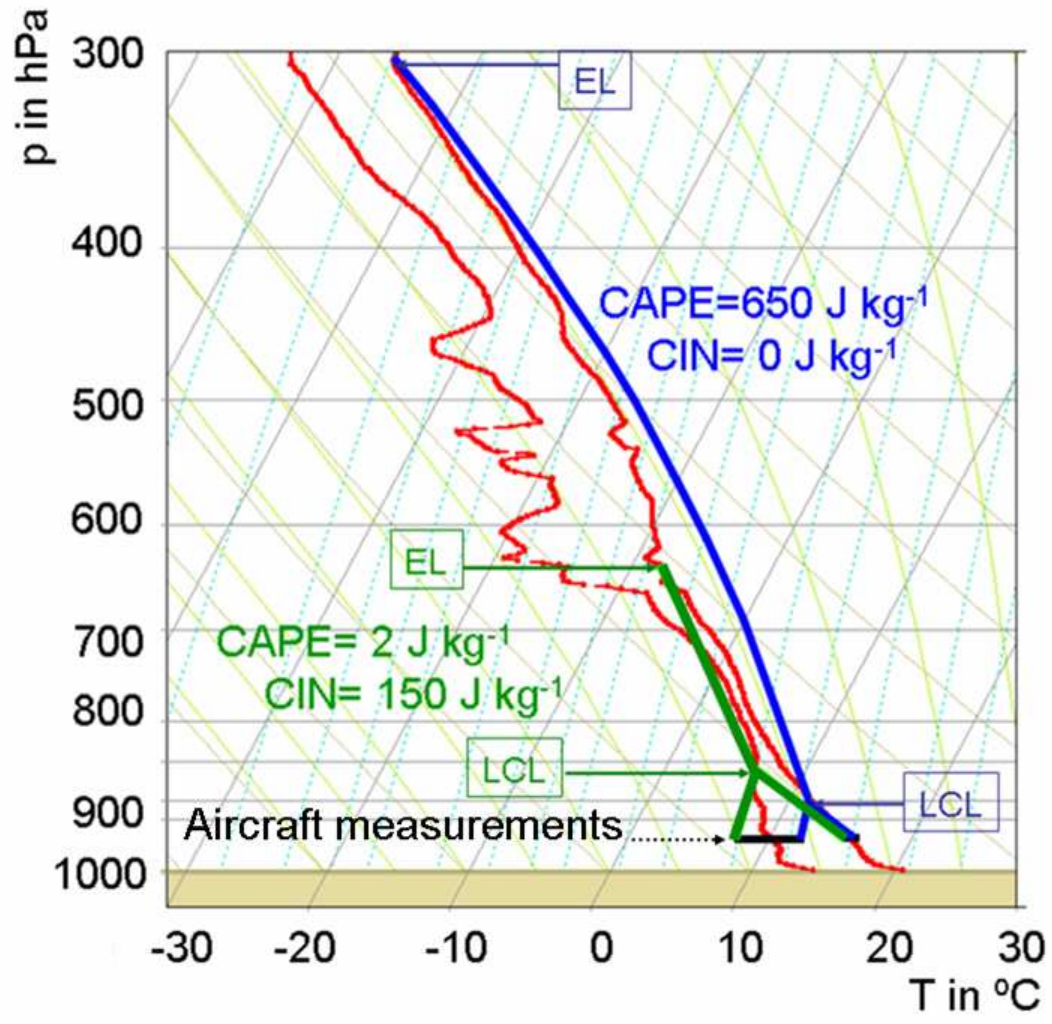


Problem

Highly sensitive to PBL T and q variability

Horizontal resolution of observation systems does not represent adequatly this variability

Sensitivity to low-level T and q variability



Blue_max (T, q)
Green_min (T, q)

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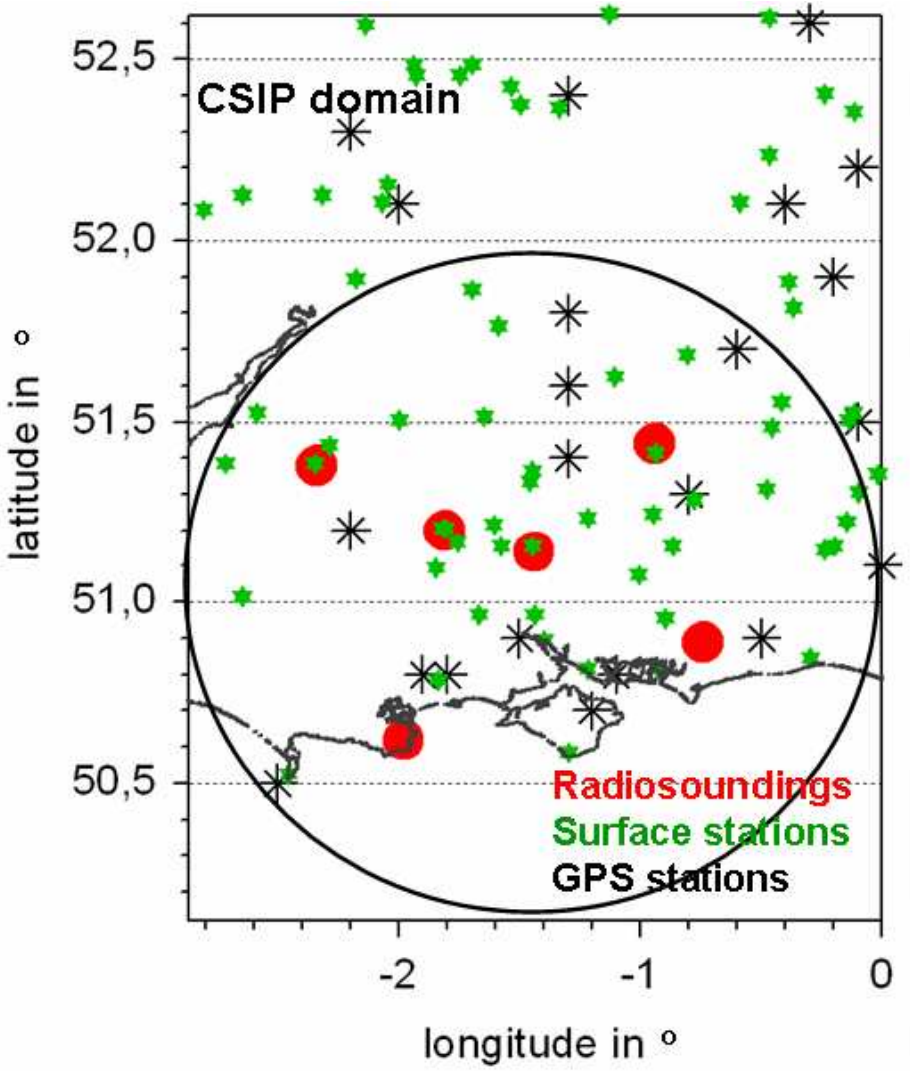
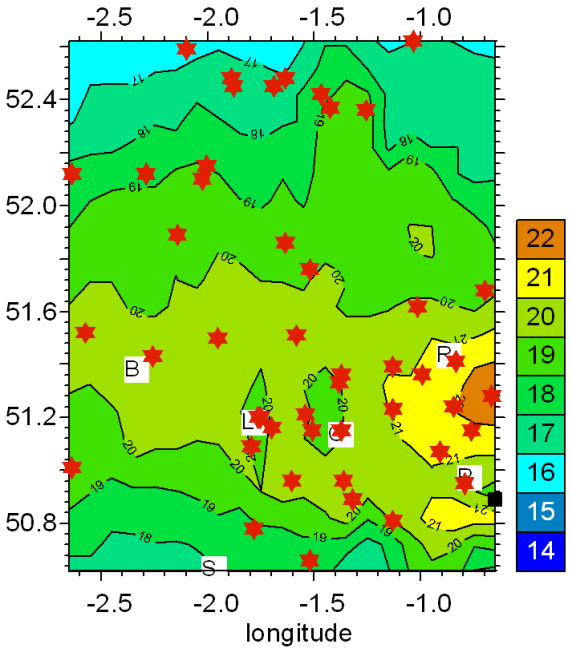
Proposed solution



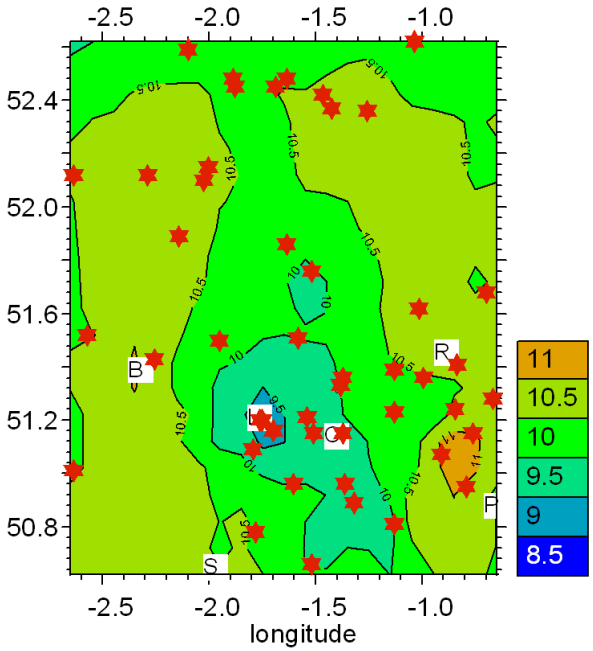
Increased spatial resolution fields of low-level temperature and moisture, and Integrated Water Vapour (IWV) were obtained using the synergetic effect of data from the networks of radiosondes, Automatic Weather Stations (AWSs), and **Global Positioning Systems (GPSs)**.

Increase of resolution of the T, q and IWV fields

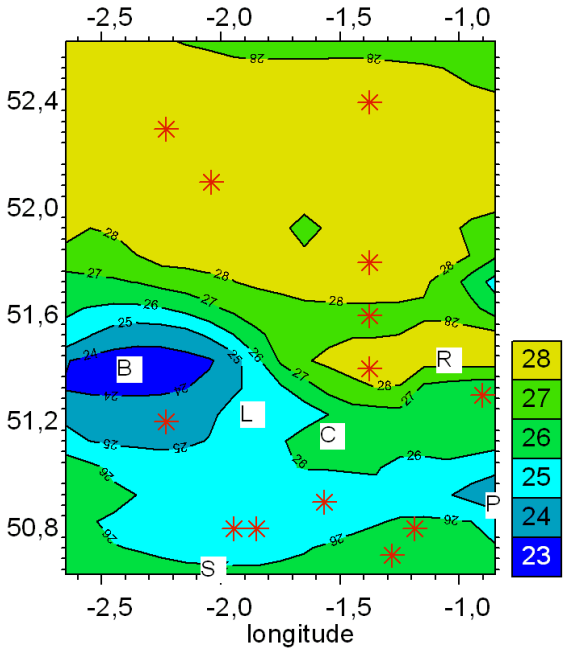
CSIP IOP 5 1200 UTC



Near-surface T [ºC]



Near-surface q [g kg^{-1}]



IWV [kg m^{-2}]

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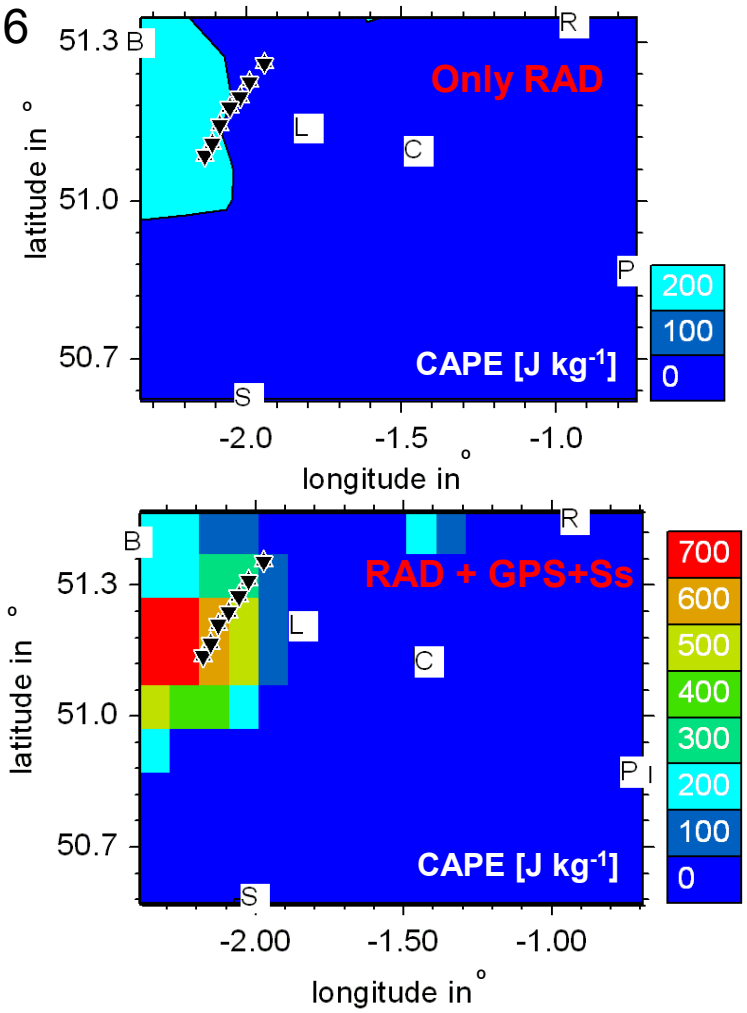
Impact on convective indices

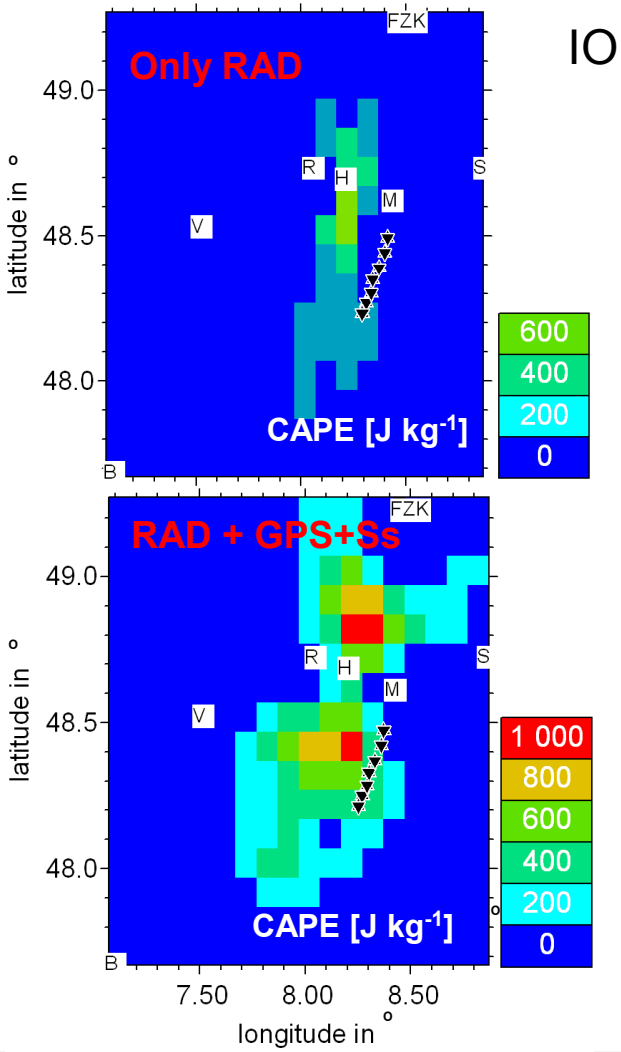
CSIP_almost flat terrain

IOP16



COPS_Complex topography

IOP8b



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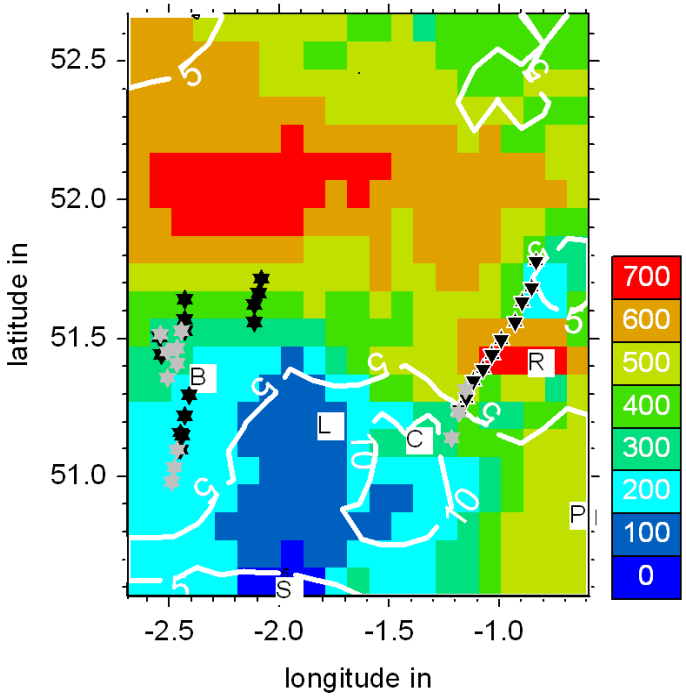
Combination of convection-related parameters

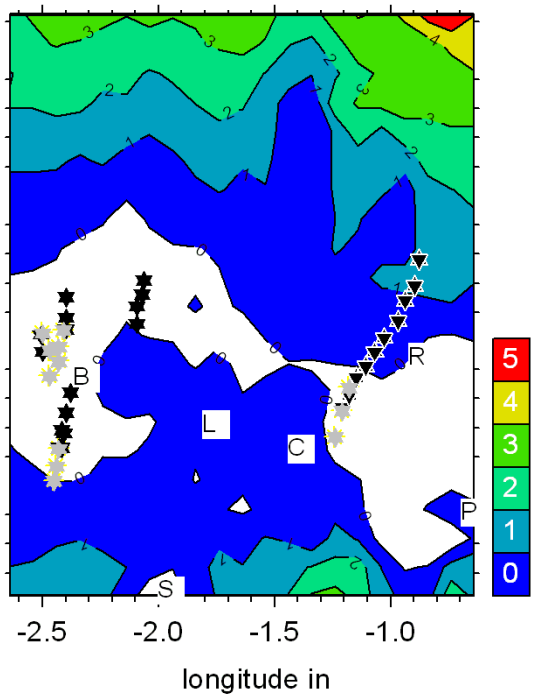
CSIP IOP 5 1200 UTC

Instability/Inhibition

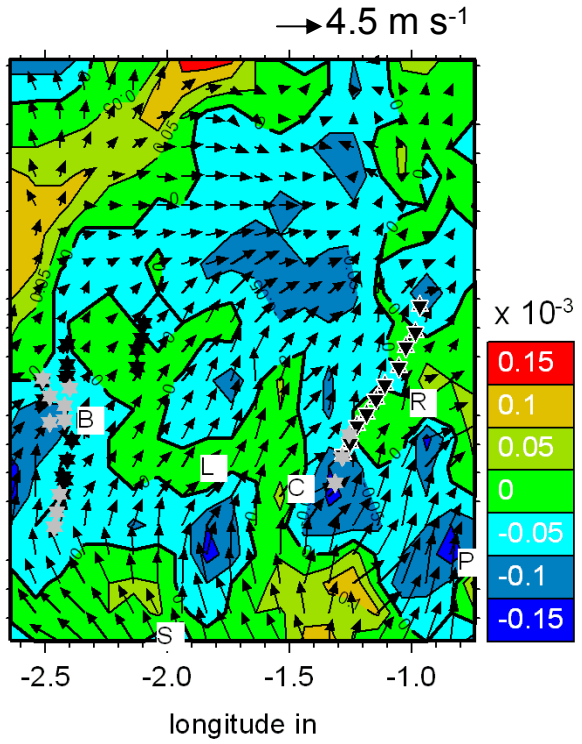


CAPE [J kg^{-1}] (colour scale)
CIN [J kg^{-1}] (isolines)

Triggering



T_c - T_s [K]



Near-surface divergence [s^{-1}]

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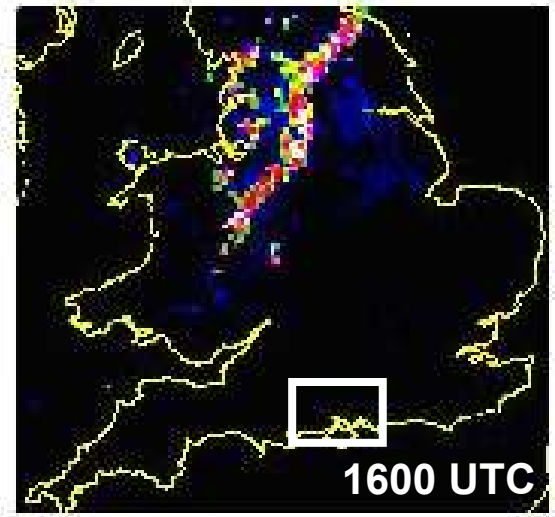
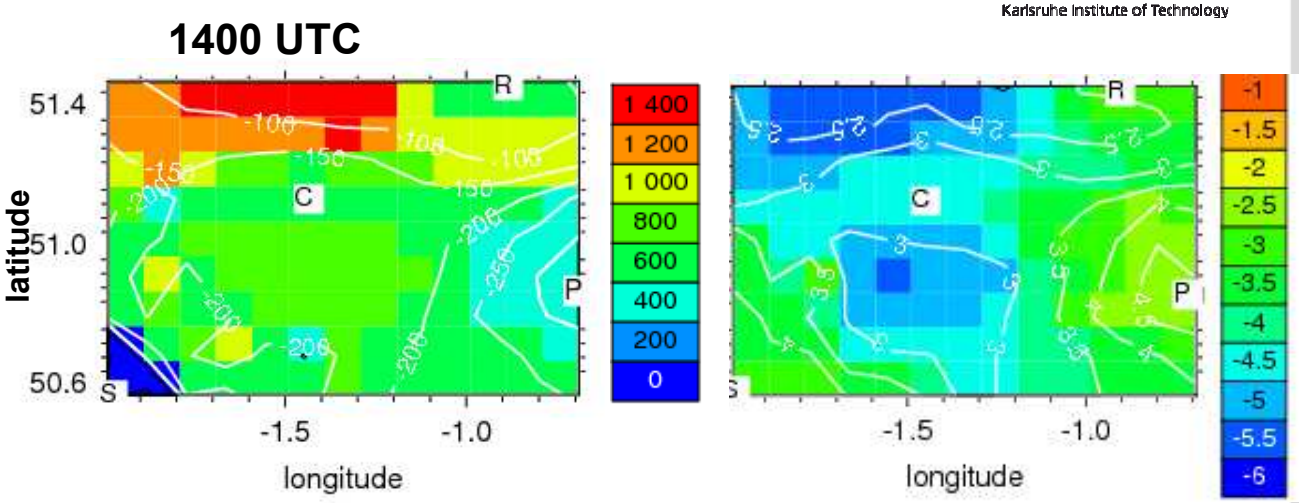
CSIP IOP2: Suppressed deep convection

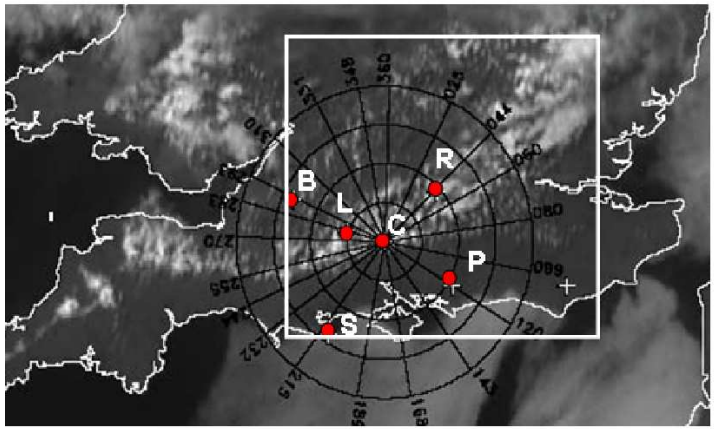


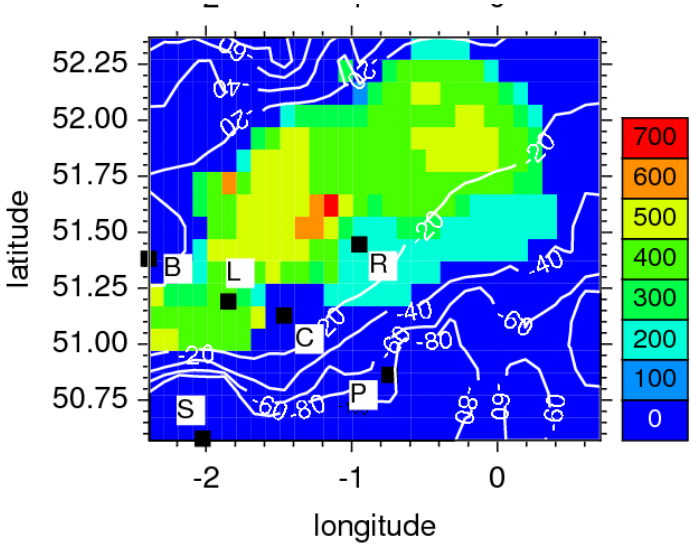


CAPE [J kg^{-1}] (colour scale)
CIN [J kg^{-1}] (isolines)

LI [ºC] (colour scale)
CAP [ºC] (isolines)

CSIP IOP8: Sea breeze





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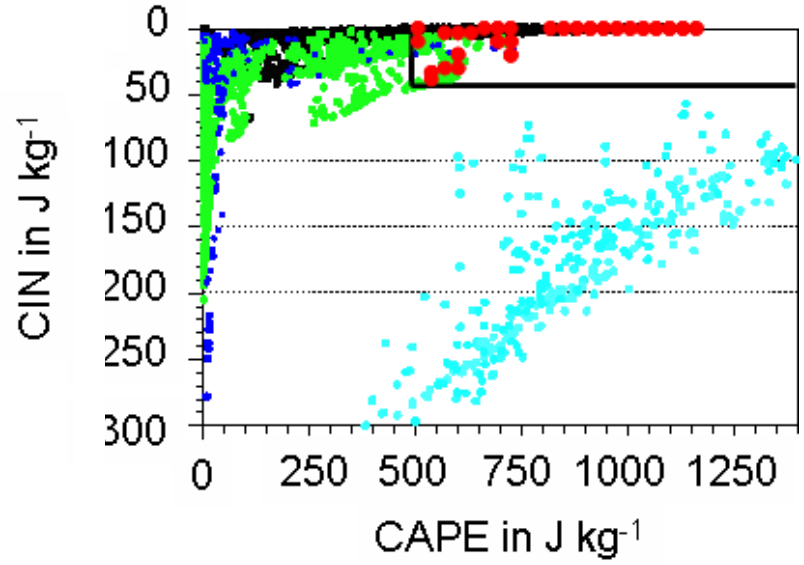
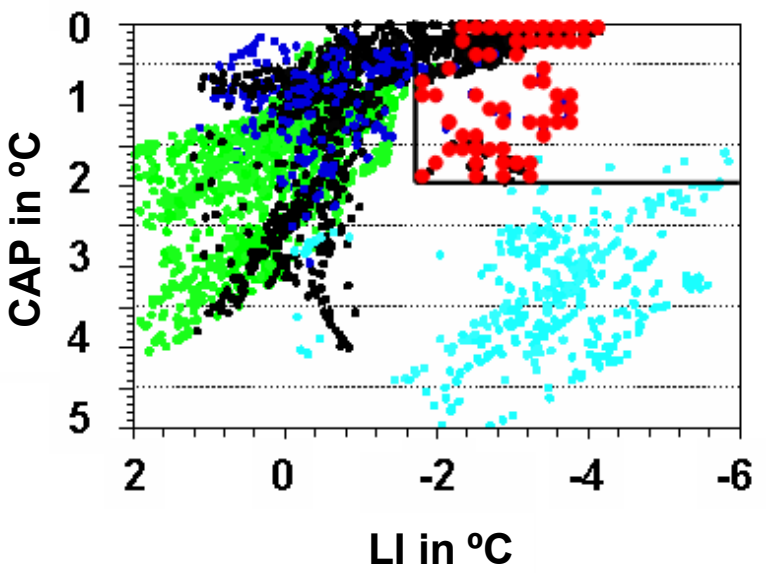
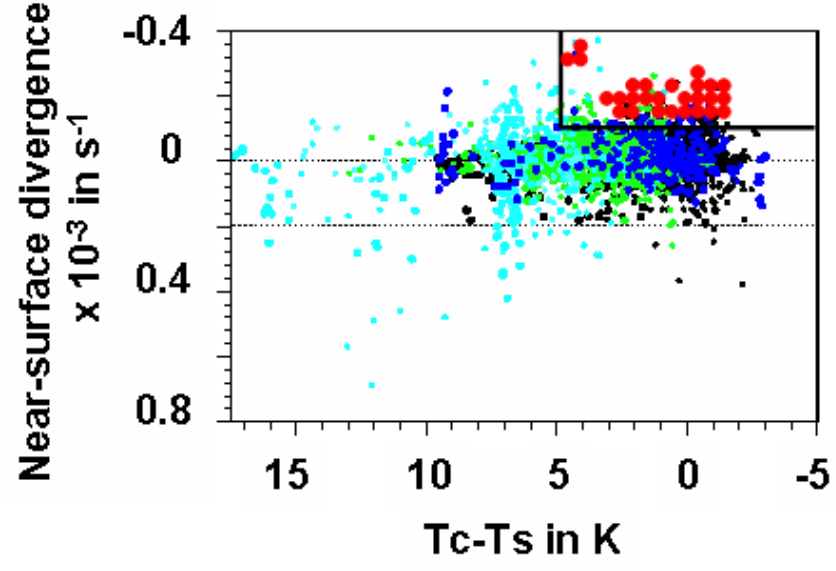
Thresholds for CSIP







- 19 June 2005_IOP2
- 29 June 2005_IOP5
- 13 July 2005 _IOP8
- 18 August 2005_IOP16
- Deep convection

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Conclusions

- The increase in resolution obtained by the combination of radiosondes and GPS measurements resulted in a better spatial representation of the atmospheric conditions leading to deep convection.
- GPS measurements were helpful for both CSIP (almost flat terrain) and COPS (complex terrain).
- The use of the higher-resolution near-surface observations allowed a detailed localization of convergence zones. These convergence zones were highly related to areas where deep convection was initiated.
- Location and timing of the initiation of convection were critically influenced by the structure of the humidity field in the planetary boundary layer.
- To obtain an adequate prediction of deep convection location, a correct representation of water vapour fields, convergence zones and low- and upper level lids will be required.
- COSMO-model will be applied to investigate the impact of high-resolution soil moisture measurements on the prediction of the initiation of convection.