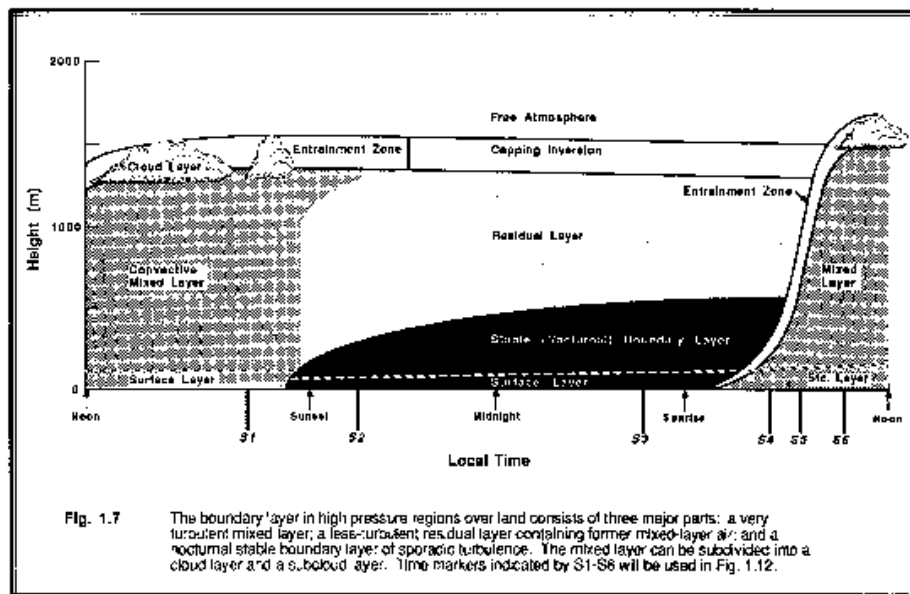Meteorology and Air Quality Group

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Jordi Vilà

Main interests and approach:

- Physical processes in the atmospheric boundary layer and atmosphere-land interaction

- From mesoscale to microscale

- Methodology based on combining experimental and numerical modelling studies

Fig. 1.7 The boundary layer in high pressure regions over land consists of three major parts: a very turbulent mixed layer; a less-turbulent residual layer containing former mixed-layer air; and a nocturnal stable boundary layer of sporadic turbulence. The mixed layer can be subdivided into a cloud layer and a subcloud layer. Time markers indicated by S1-S6 will be used in Fig. 1.12.

Motivation to work with MM5:

1.- To support experimental campaigns

2.- To investigate, by case studies, the physical parameterizations implemented on mesoscale models

Selection of cases

a) Stable Boundary Layer (CASES, USA)
b) Convective Boundary Layer (Cabauw, NL)
c) Boundary Layer in Mesoscale Convective Systems (NW Spain)

Parameterizations of boundary layer in MM5

a) Non-local approach (MRF, BLA)

      - First-order closure
      - Exchange coefficient depends on scaling variables
      - Mixing between different levels
      - Entrainment of air from the free troposphere

b) Local approach (ETA, BRT)

      - One- and half-order
      => TKE equation is solved
      - Mixing only at adjacent levels

Examples:

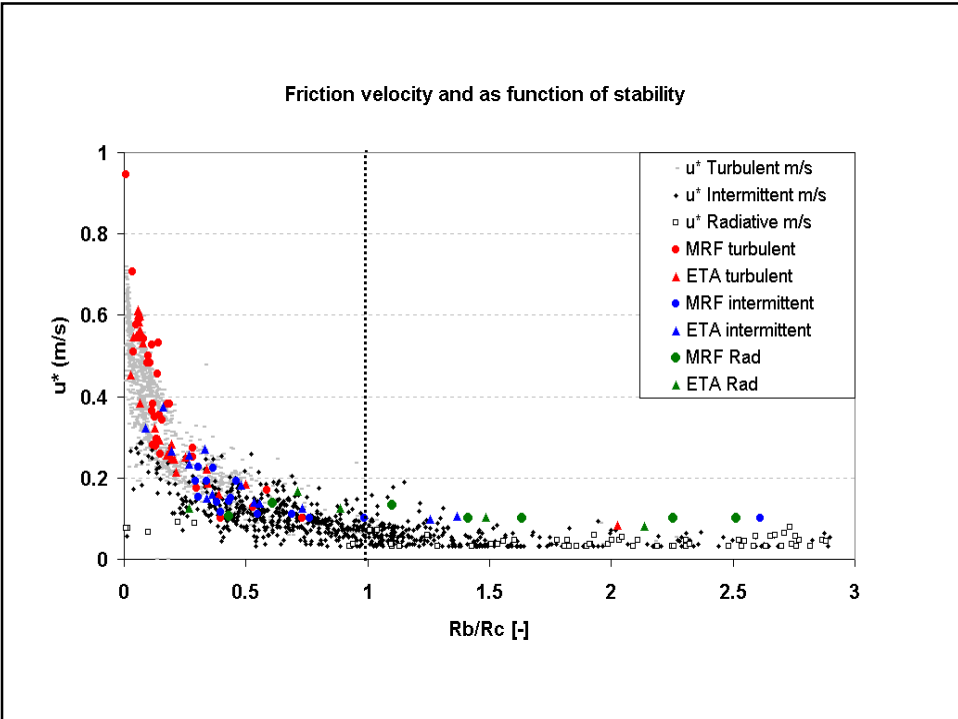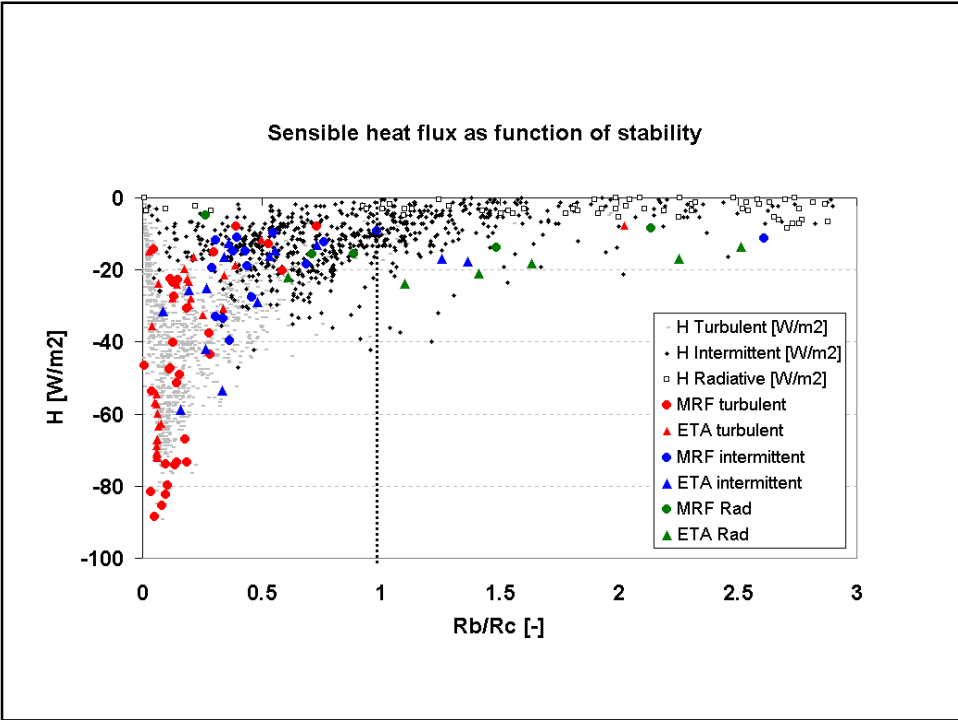a) Stable Boundary Layer
      - Friction velocity as a function Richardson number
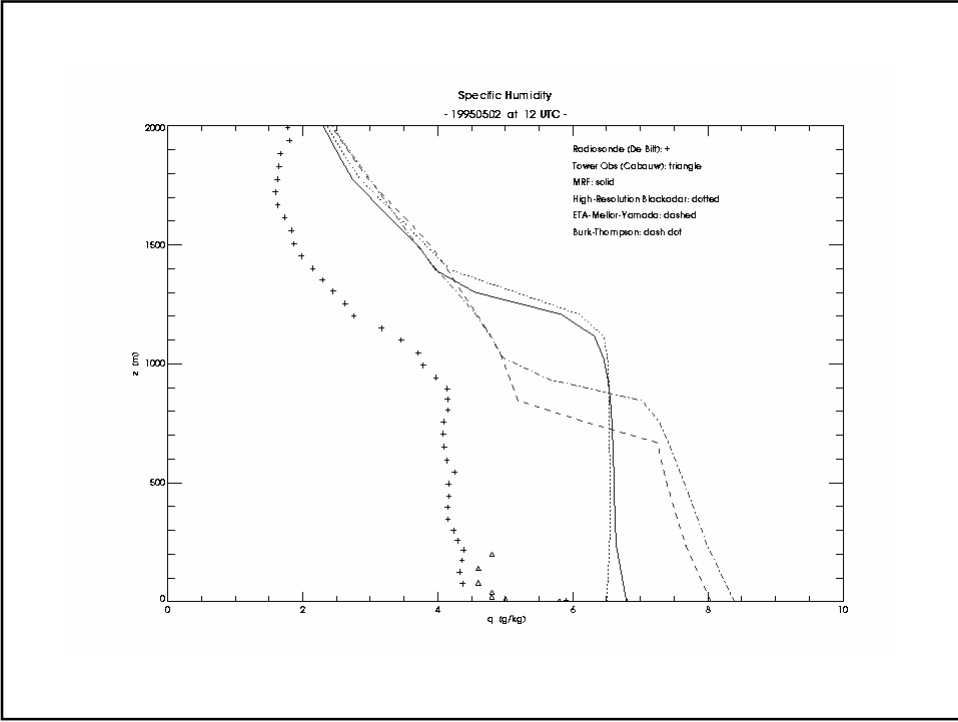   - Sensible Heat flux as a function of the Richardson
      number
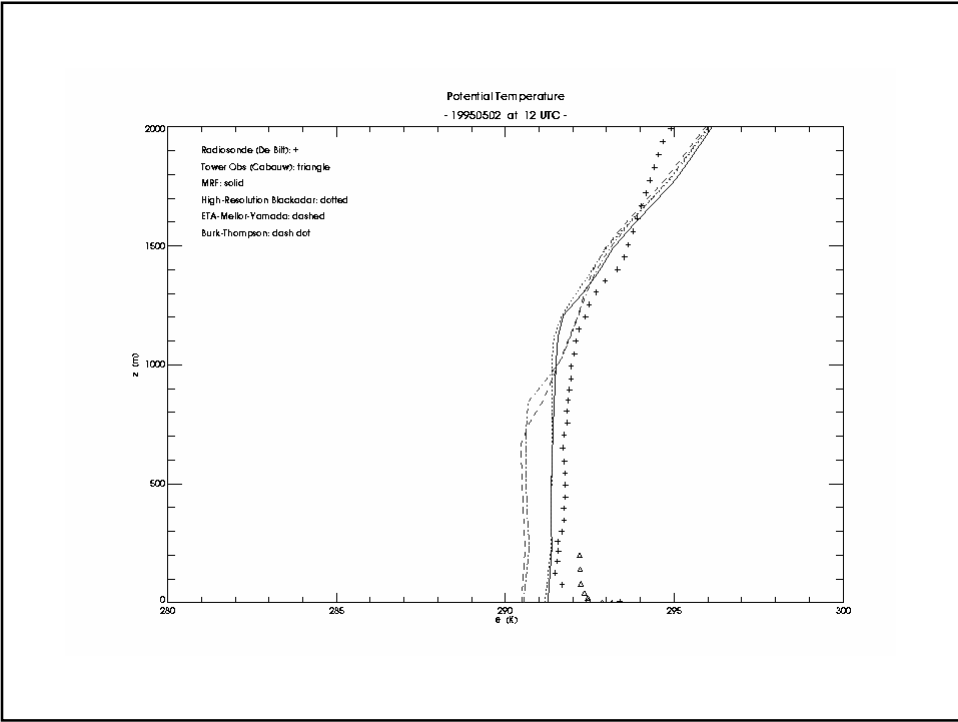
b) Convective Boundary Layer
      - Vertical profiles of potential temperature
      and specific humidity
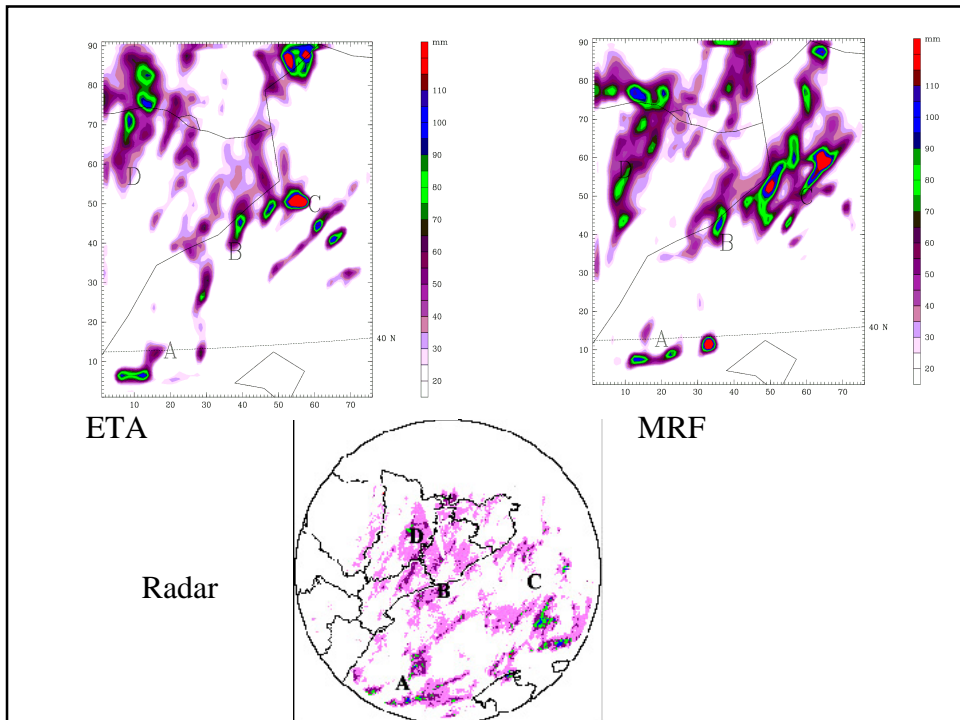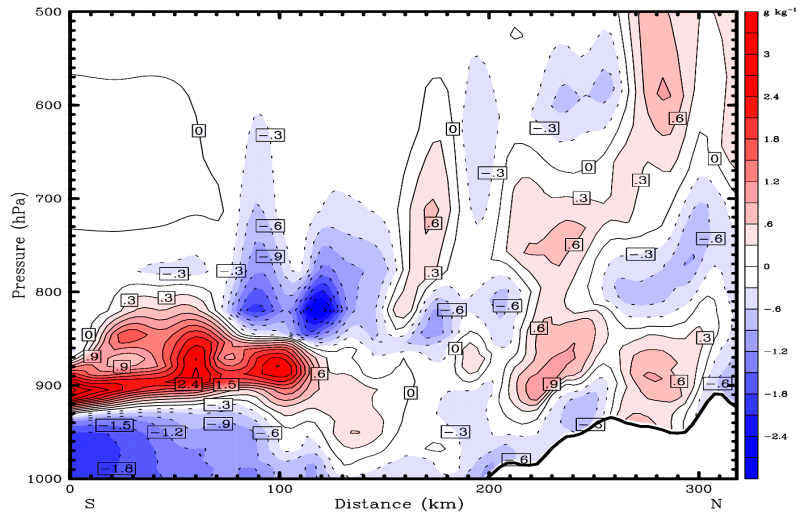
c) Boundary layer in a Mesoscale Convective System
      - Vertical cross section differences (MRF-ETA)
      - 24-hour accumulated precipitation

Sensible heat flux as function of stability

Friction velocity and as function of stability

Potential Temperature
- 19950502 at 12 UTC -

Radiosonde (De Bilt): +
Tower Obs (Cabauw): triangle
MRF: solid
High-Resolution Blackadar: dotted
ETA-Mellor-Yamada: dashed
Burk-Thompson: dash dot

Specific Humidity
- 19950502 at 12 UTC -

Radiosonde (De Bilt): +
Tower Obs (Cabauw): triangle
MRF: solid
High-Resolution Blackadar: dotted
ETA-Mellor-Yamada: dashed
Burk-Thompson: dash dot

Specific humidity difference between two BL-schemes
MRF-ETA

ETA

MRF

Radar

Contribution of our group to MM5-Spanish Network

- Case studies of boundary layer modelled by MM5

- Provide recommendations of the most appropriate BL-schemes

- Methods to analyze the boundary layer variables obtained from MM5

- In the future, improvements of BL-schemes