Environment Canada Environnement Canada

Canada

Soil Moisture in Numerical Weather Prediction

Analysis and Prediction in Agricultural Landscapes

Saskatoon, June 19-20, 2007

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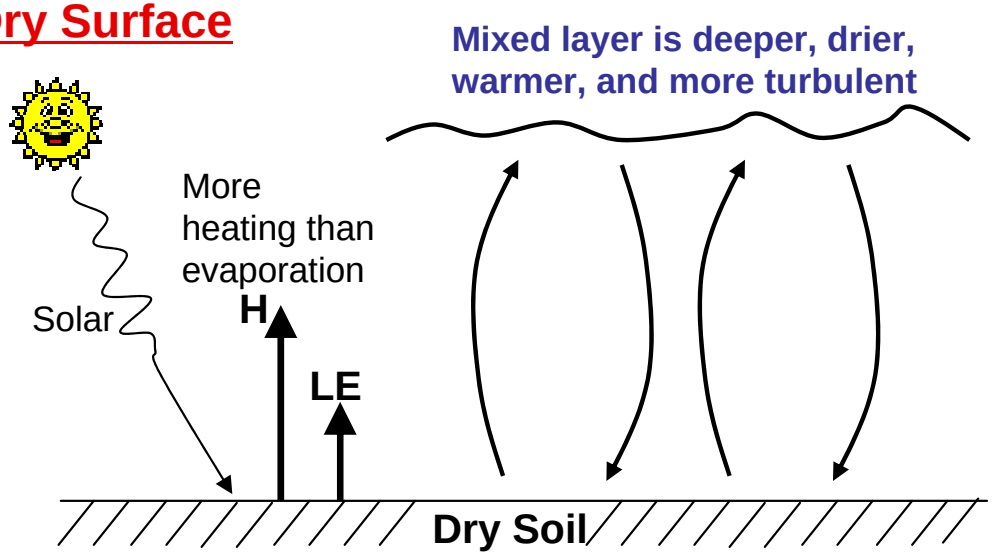
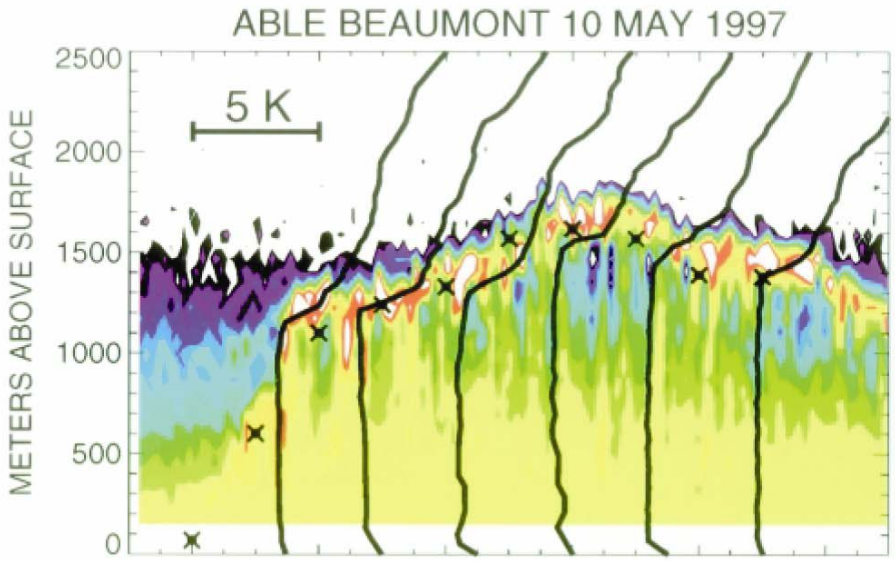
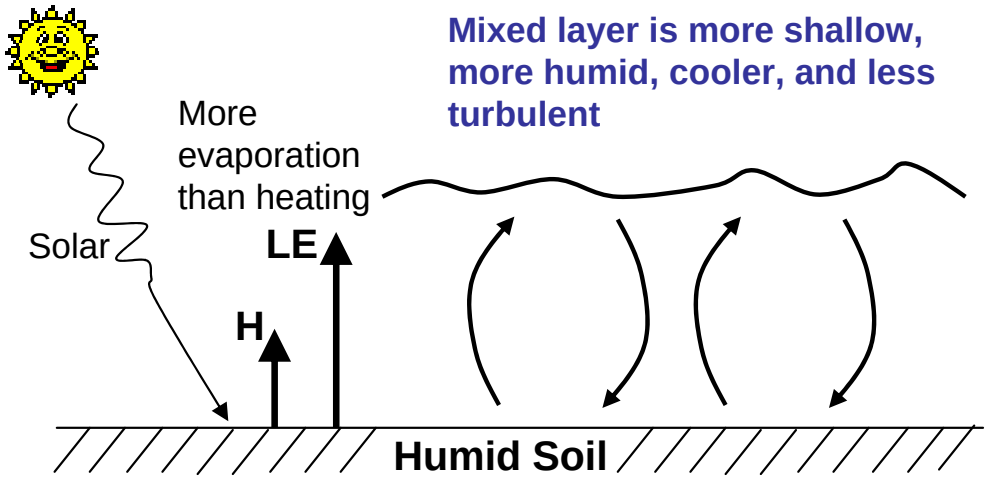
Soil Moisture and the Well-Mixed Boundary Layer

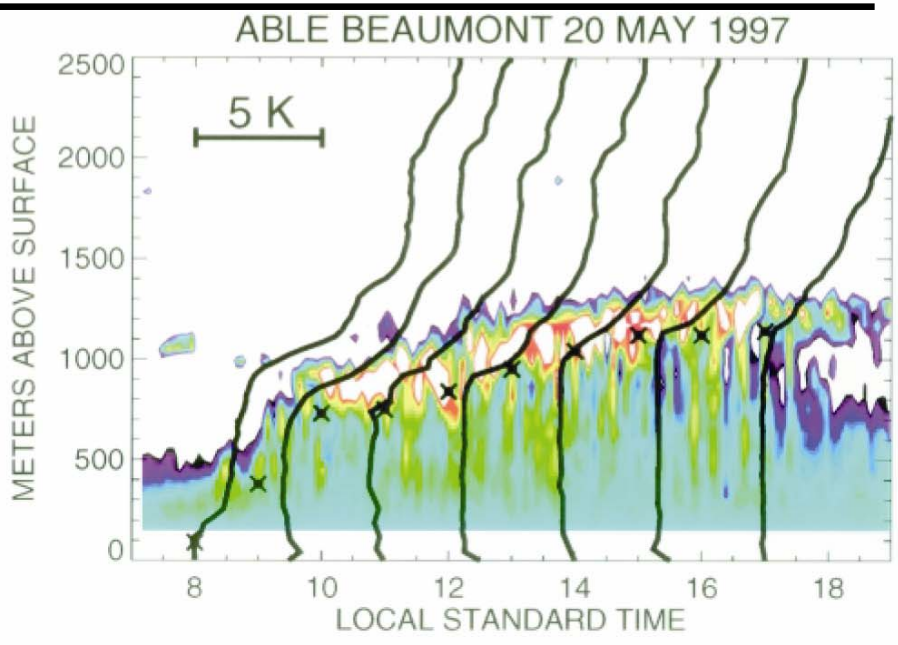
Dry Surface



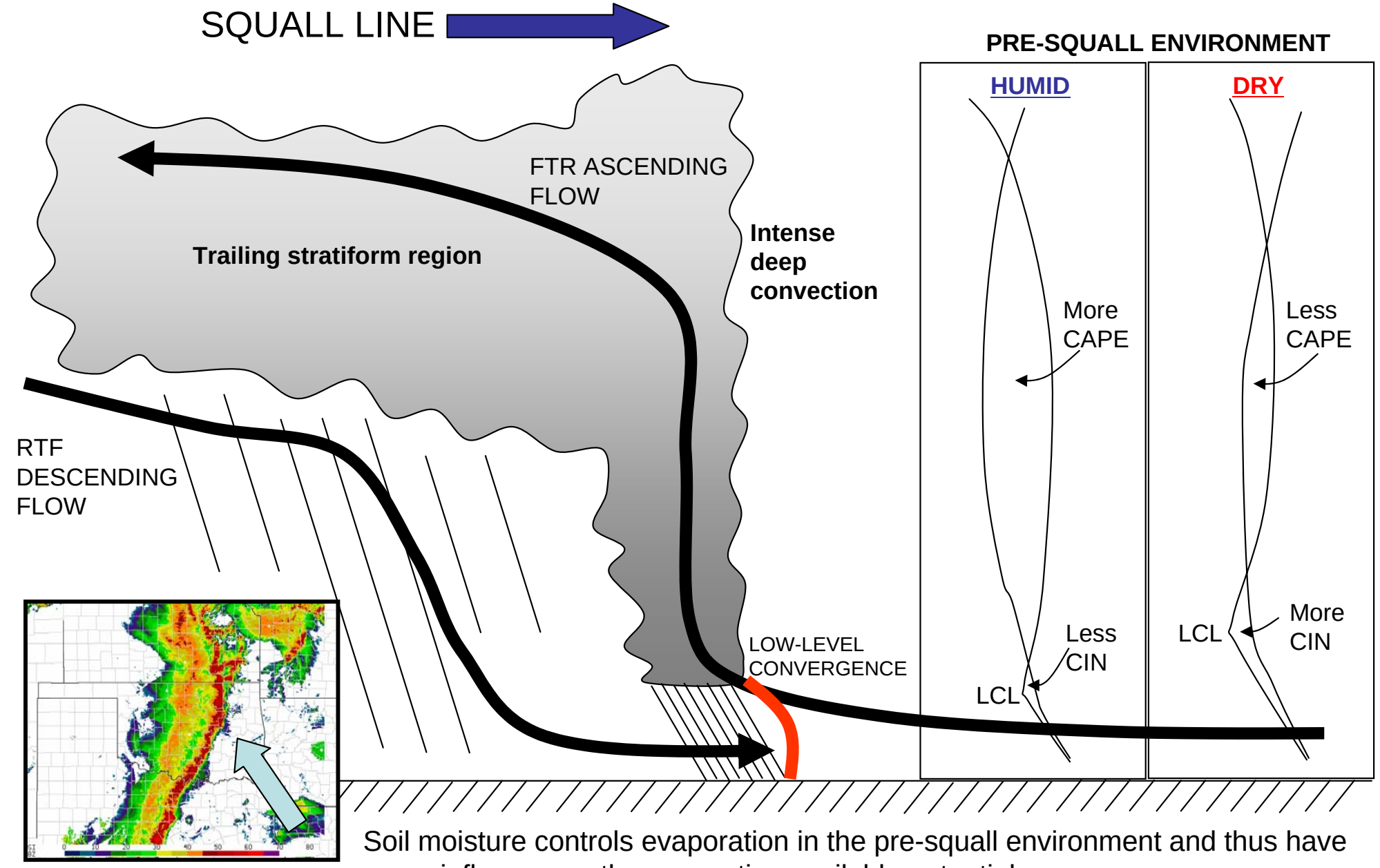


Moist Surface



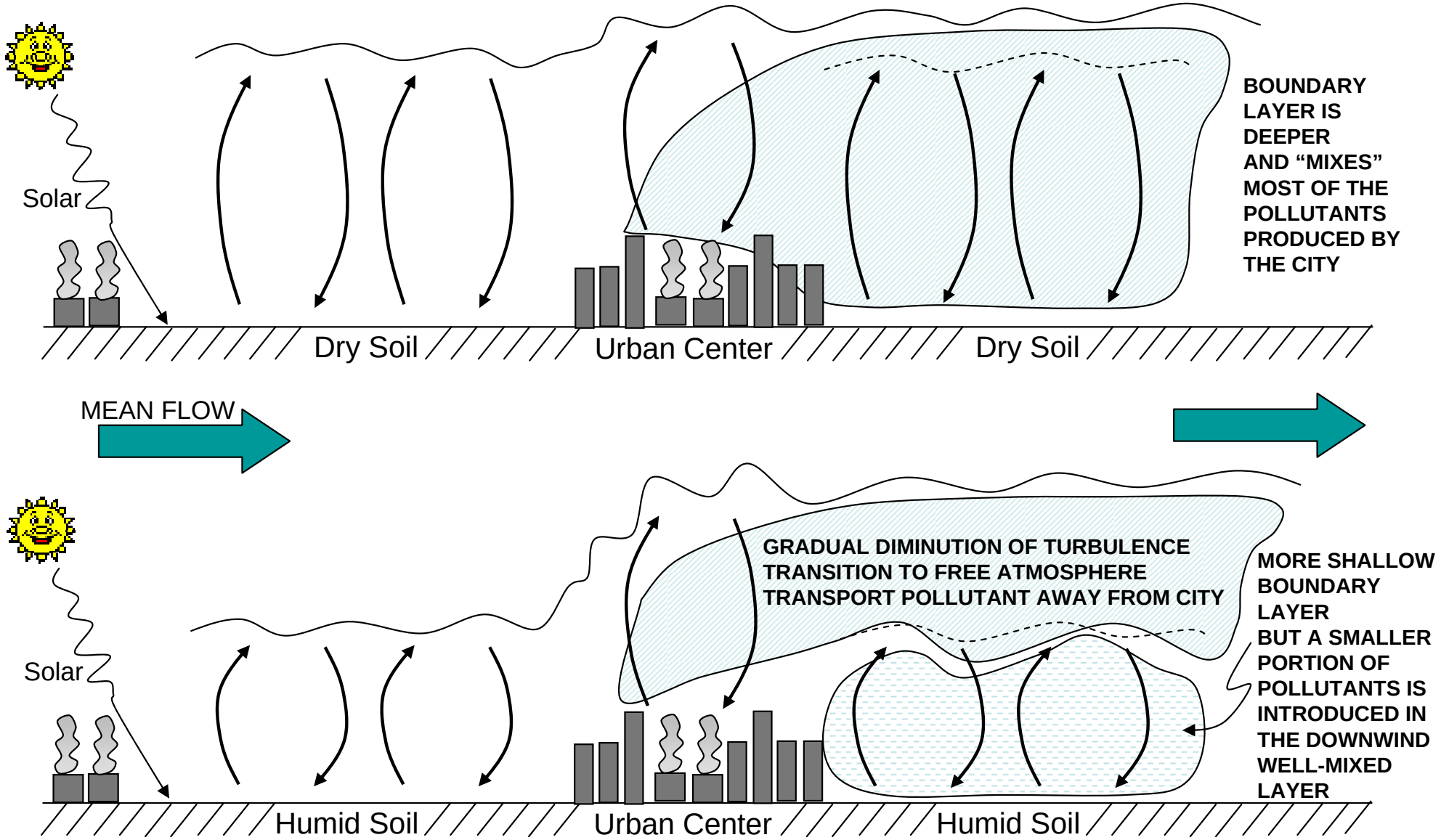


Soil Moisture and Severe Precipitation Events Over Land

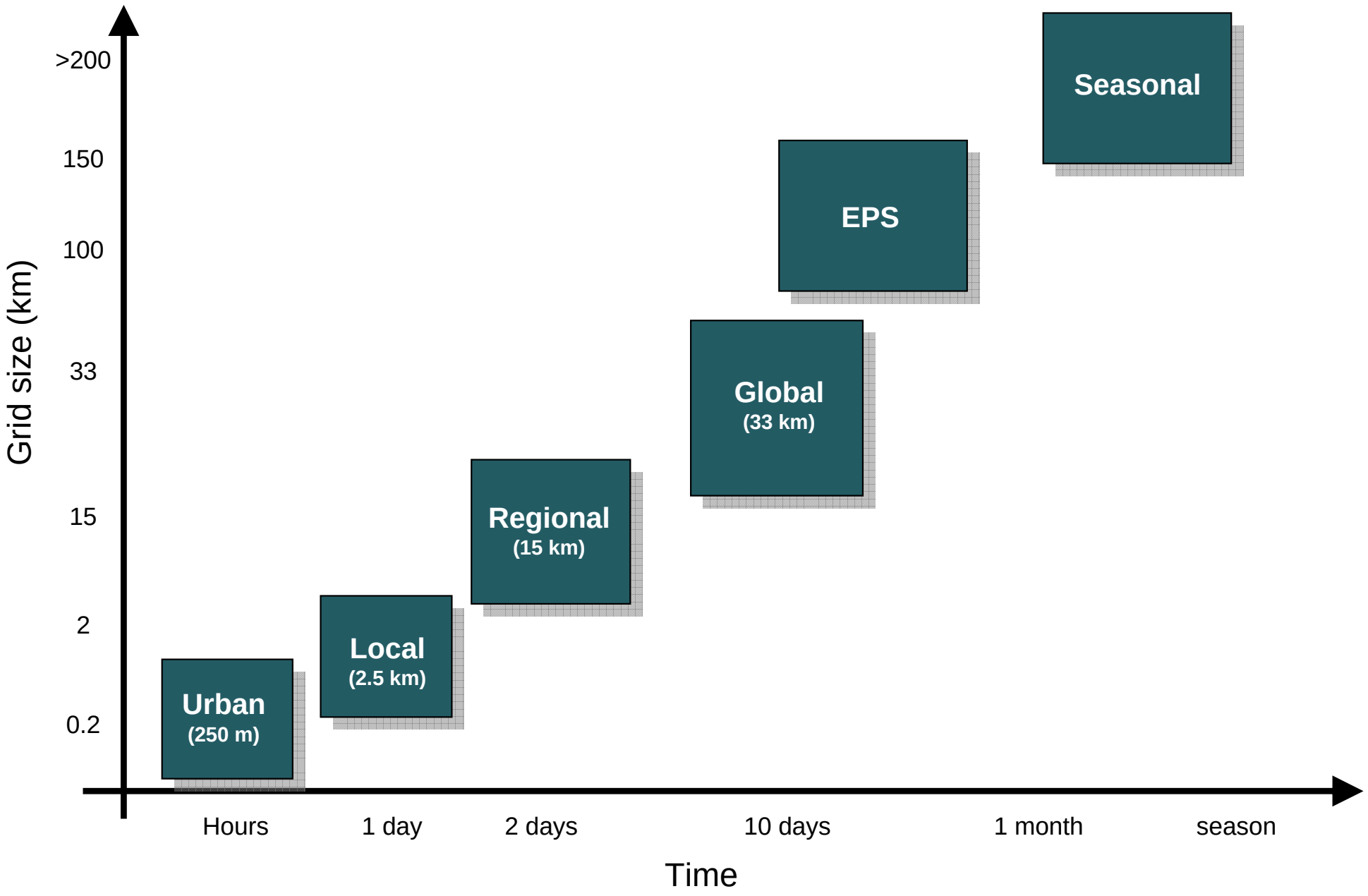


Soil moisture controls evaporation in the pre-squall environment and thus have some influence on the convective available potential energy

Soil Moisture and Air Quality

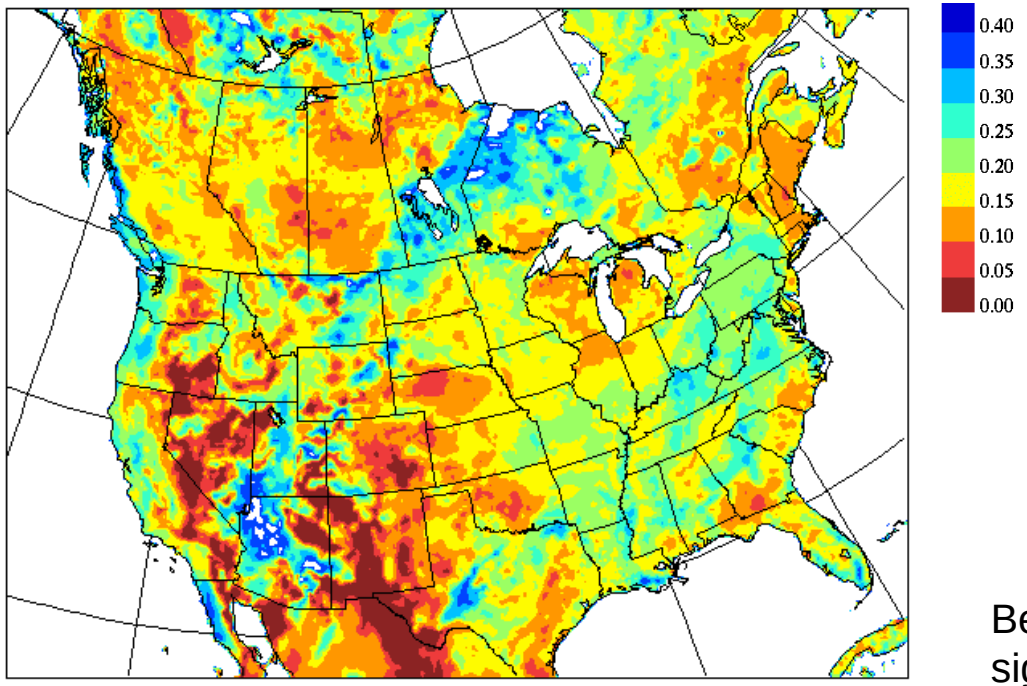


Operational Forecasting Suite at the Canadian Meteorological Centre



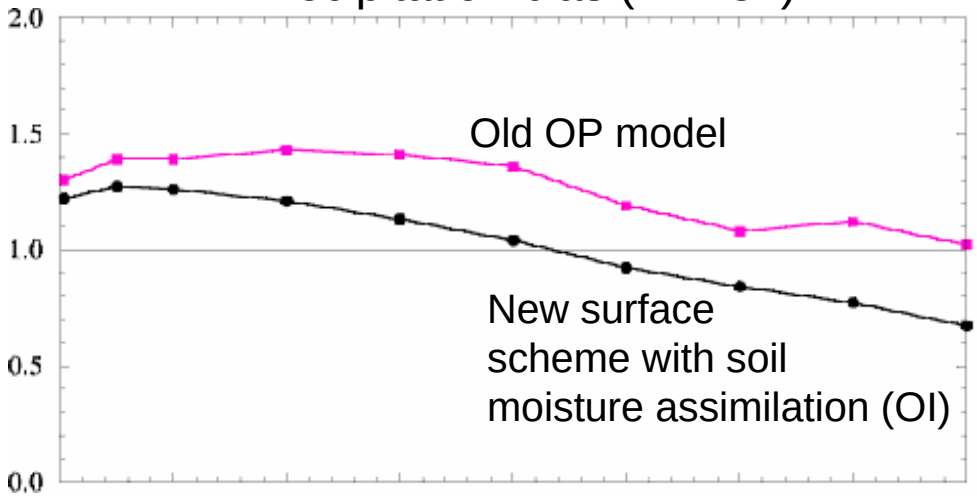
Impact of Soil Moisture on Short-Range Numerical Weather Prediction

Near surface soil moisture

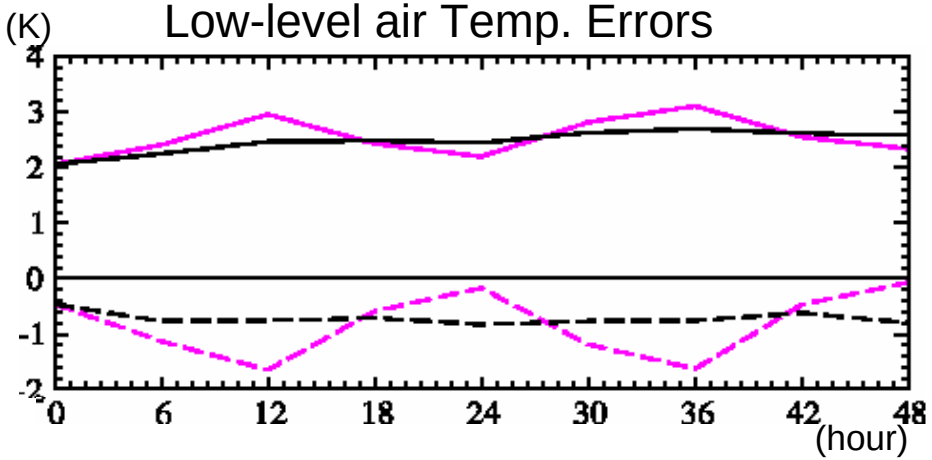


(valid at 1200 UTC 22 October 2004)

Precipitation bias (24-48h)



Low-level air Temp. Errors

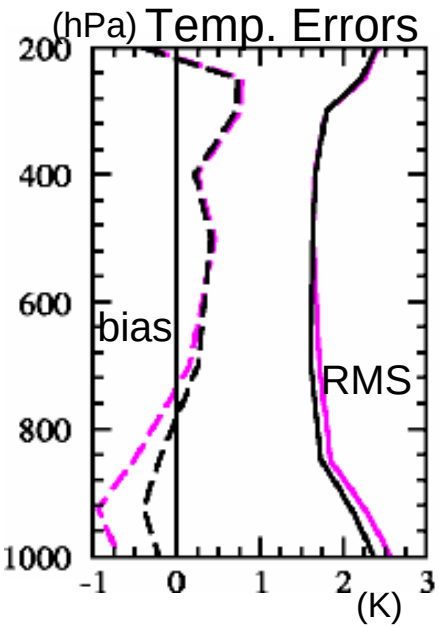


(*Bélair et al.*)

Better soil moisture resulted in significant improvements for:

- Low-level air temp. and humidity
- Diurnal cycle of the PBL
- Precipitation biases

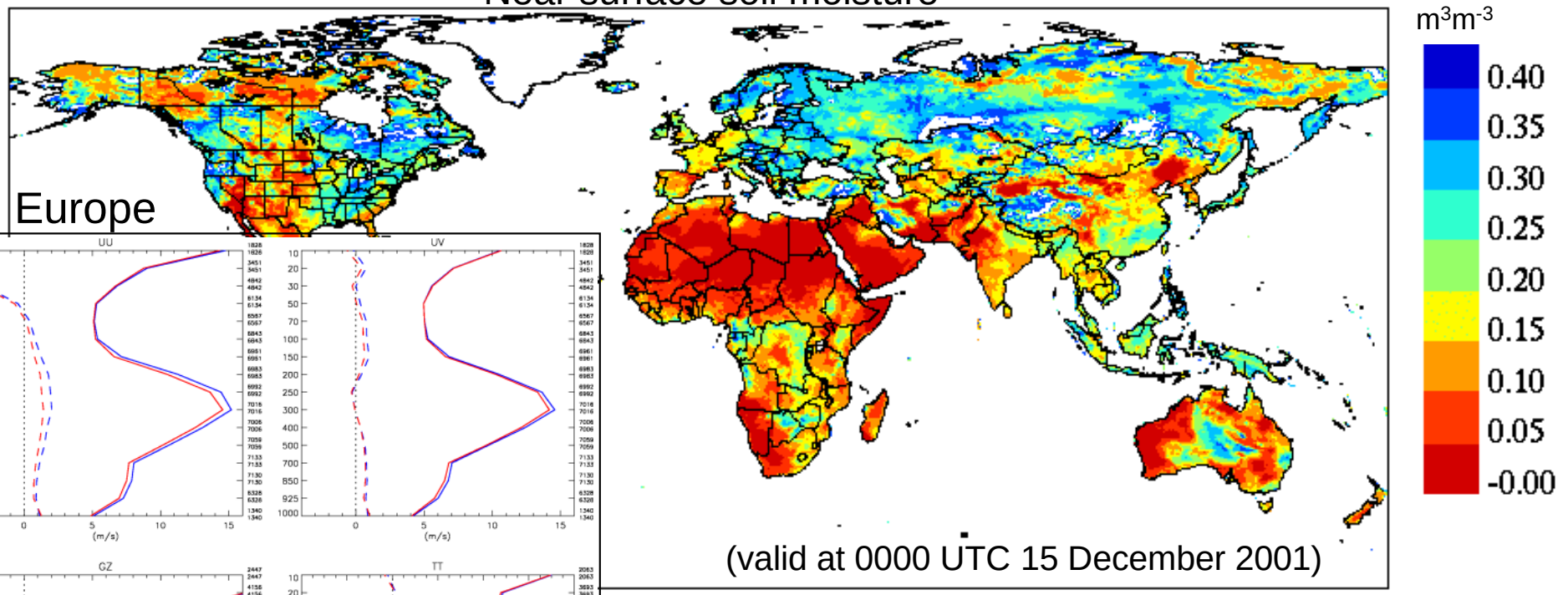
NOTE: mostly in summer



48-h integrations

Impact of Soil Moisture on Medium-Range Numerical Weather Prediction

Near surface soil moisture

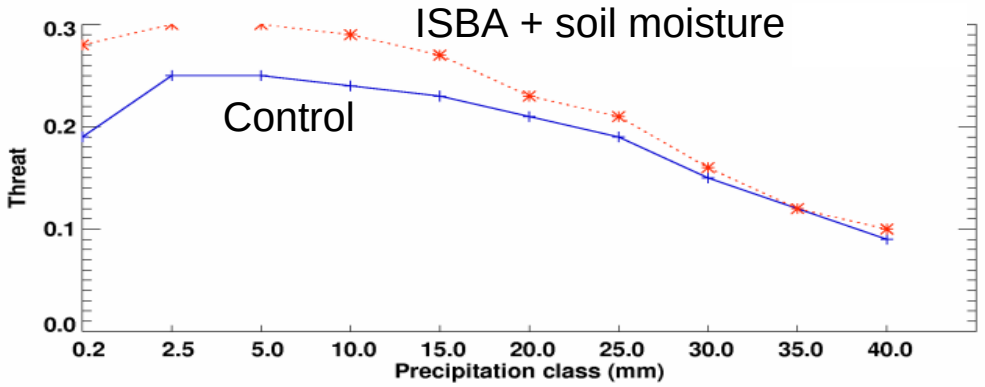


120-h, Europe

Has been implemented in the global forecasting system (31 October 2006).

(*Bélair et al.*)

Precipitation Threat Score (Day 4)- SHEF



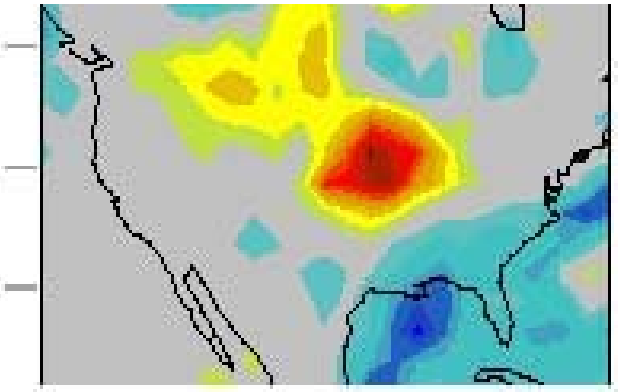
Impact on Seasonal Precipitation

Summer 1993 Rainfall Minus Summer 1988 Rainfall

1988: Very dry

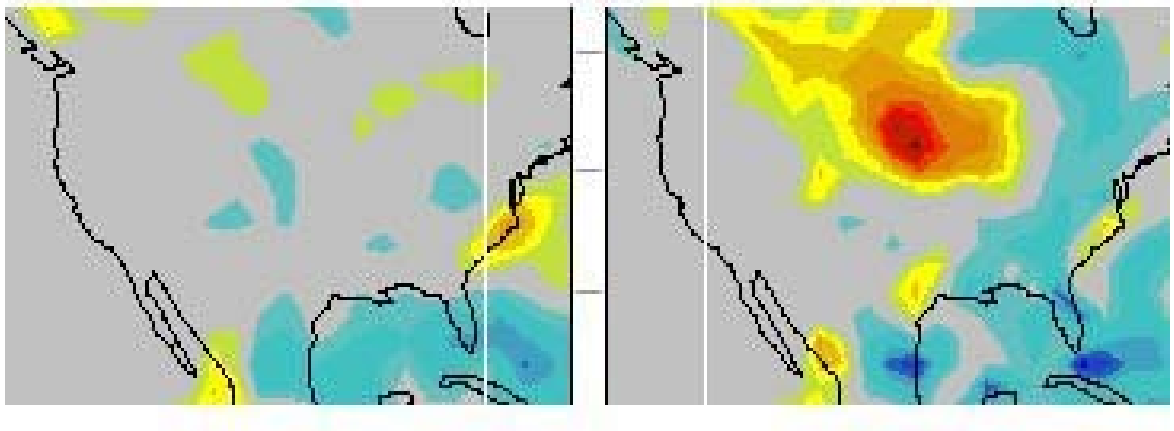
1993: Very wet

Observations



Model driven by SSTs

Model driven by soil moisture and SSTs



Rainfall Difference

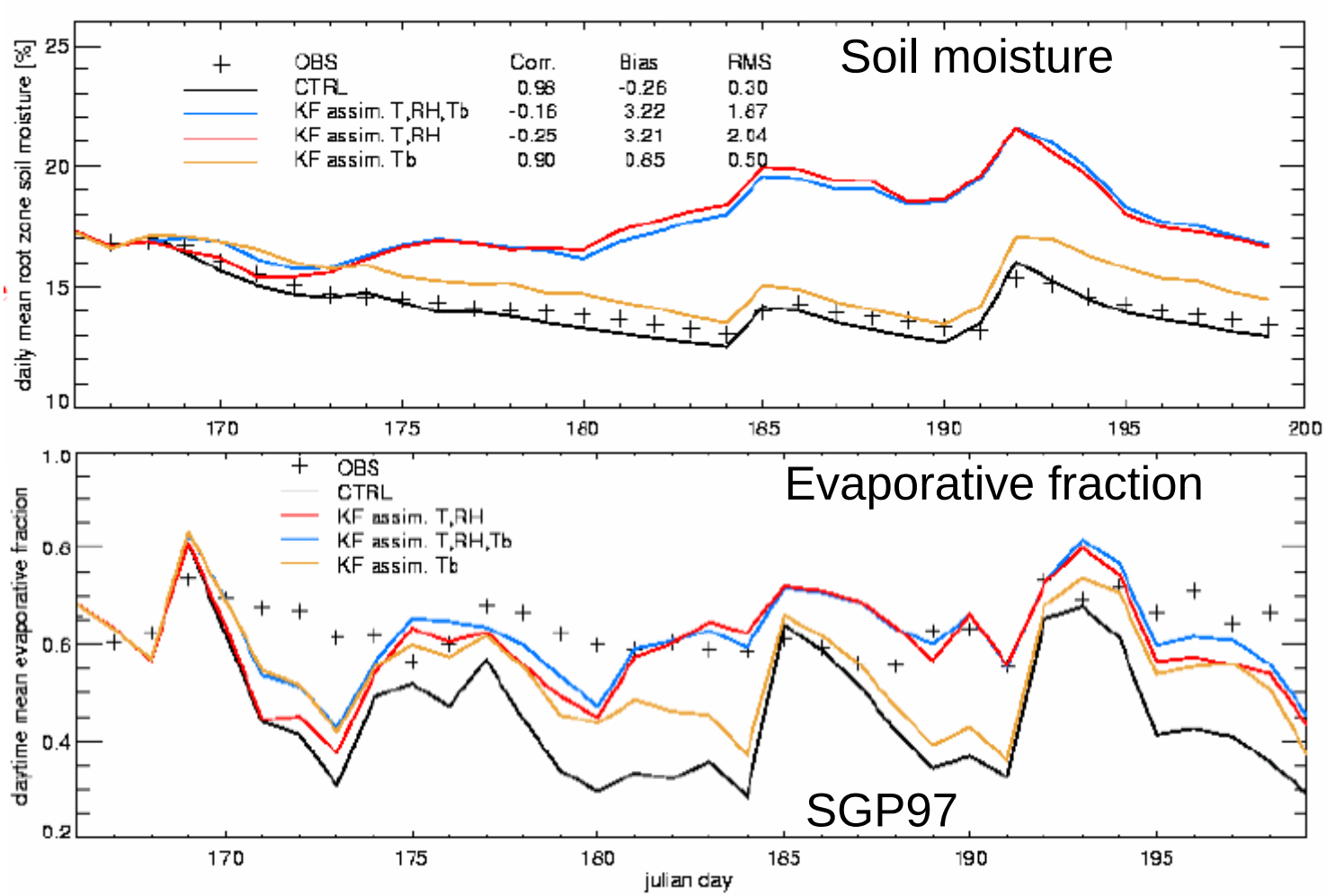
-5 0 +5 [mm/day]

(Schubert et al., 2002)

Improvements and New Features to Come in EC/MRD's Land Surface System

- External land surface modeling system (higher resolution than atm. model)
- CaLDAS for soil moisture land data assimilation
    - Screen-level data
    - SMOS
- Canadian Precipitation Analysis (CaPA)
- Analysis of vegetation (MODIS, with OI approach)
- Refinement to CMC's snow analysis
- Higher-resolution databases for LULC, orography
- CLASS instead of ISBA
- Blowing snow model
- Town Energy Balance for urban areas

Soil Moisture vs Surface Fluxes



(From Ettema, ECMWF/ELDAS workshop on land surface assimilation, 2004)

Assimilation of Tb leads to good representation of soil moisture

But it does not necessarily lead to better surface fluxes

Conversely, the assimilation of screen-level air characteristics leads to better surface fluxes, but soil moisture is far from the observed values.

Soil Moisture in NWP: Issues and Concerns

- Soil moisture is of crucial importance for NWP, at all scales and ranges.
- For NWP, getting surface fluxes right is more important than getting soil moisture right. But current applications in hydrology requires that NWP model be good for *both* surface fluxes *and* soil moisture.
- In Canada's current NWP system, the soil moisture analysis compensates for other errors (e.g., forcing, land surface)
- Soil moisture observations and surface fluxes are required to verify (and improve) NWP model's performance (also need all the information to drive the land systems)

Thank you …

Soil Moisture and Large-Scale Weather Systems