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Parametrisation of aggregated roughness and sensible heat flux from field scale to hydrological scale by microscale modelling in the Alpilles experiment in France

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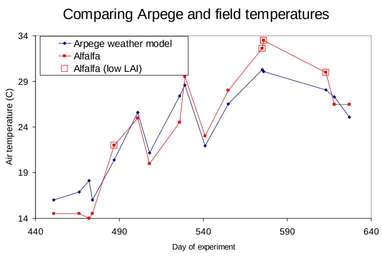
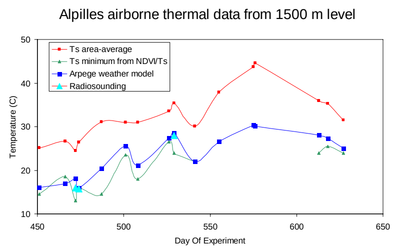
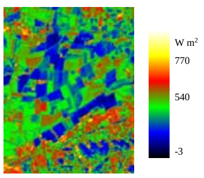






Heat flux map of Alpilles

Sensible heat flux map day DOE 474, radiosounding met-obs.
Average heat flux 193 W m^2,
equilibrium 174 W m^2,
average roughness 0.15 m,
equilibrium roughness 0.09 m
The equilibrium values are not physically correct only the average values from the model.

GOAL

Validate the accuracy of the microscale aggregation sensible heat flux maps to in-situ sensible heat flux observations in various fields through a growing season

METHOD

Calculation the sensible heat flux mpas in heterogeneous terrain by use a so-called surface-flux microscale aggregation model. The results are compared to field flux observations in the Alpilles area, France. A land use map of Alpilles is shown.

The model concept is graphed and the inputs are
- surface temperature maps
- roughness maps
- air temperatures
- wind speed and directions

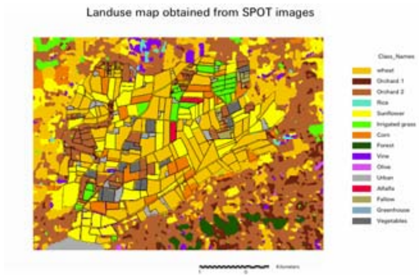
The surface temperature maps are from an airborne thermal radiometer flown at 1500 m and 3000 m heights on 18 days through the growing season in 1997. The maps are calibrated including the effect of emissivity.

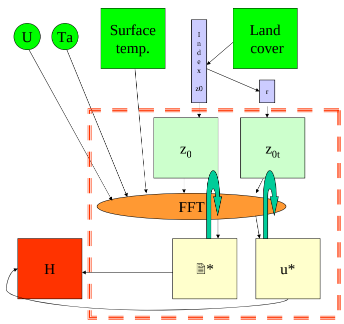
The roughness maps are based on the land cover map and field observation of vegetation height through the growing season. The vegetation height is related to the aerodynamic roughness and the roughness map vary per field through the growing season.

The air temperatures and wind speeds are from the Arpège weather model and from radiosoundings at the Alpilles site when available.

The Arpège weather model air temperatures compare well to in-situ observations in a well-watered alfalfa field in Alpilles. When the Leaf Area Index (LAI) is low in the alfalfa field the 2 m level air temperature is warmer than the Arpège weather model air temperatures at 25 m but otherwise of similar magnitude. Further is there a high correlation (R^2=0.95) and no bias between the daily radiosounding observations at Nîmes 30 km southwest of Alpilles. This ensures that the Arpége weather model air temperature of 30 km by 30 km grid are representative for the Alpilles site.

The average surface temperatures are always some degrees warmer than the Arpége weather results whereas the minimum surface temperatures estimated from the NDVI-Ts relationship are typically colder.





Microscale model from Hasager and Jensen 1999 Q.J.Royal Met. Soc. 125, 2075-2102

RESULTS

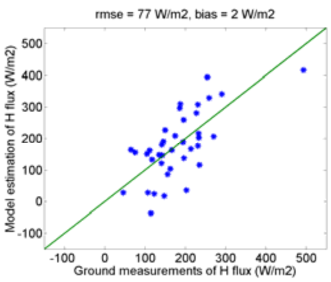
The sensible heat flux comparison between in-situ eddy correlation field observations and the microscale aggregation results are presented for
- all 1500 m flights: rmse 77 W/m^2 and bias 2 W/m^2
- all 3000 m flights: rmse 84 W/m^2 and bias 4 W/m^2
- Alpilles radiosoundings: rmse 94 and bias 0 W/m^2

The assumption in the microscale model is that the roughness for heat is 100 times smaller than for momentum. This is not necessary true and a new version of the model where the roughness for heat is modelled as a function of land cover types (bare soil, building, water, vegetation and Leaf Area Index) is in progress.

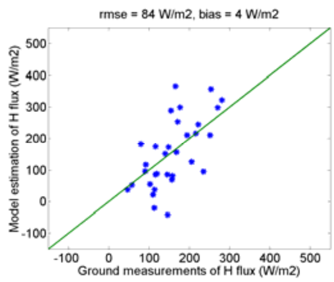
This hopefully will reduce the scatter between in-situ field observations and microscale aggregation results that is larger for certain days, see daily results in lower panel.

DISCUSSION

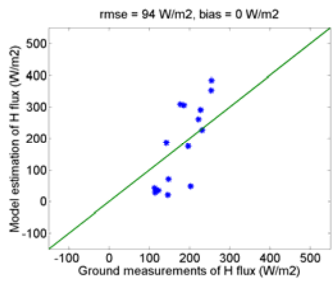
The microscale aggregation model calculates the sensible heat flux pixelwise (here at 20 m resolution). After ascertaining that the local estimates are in accordance with in-situ observations, it is possible to area-average the flux at the 1 km grid scale comparable to NOAA AVHRR resolution. Sensible heat flux estimated from the microscale model at the larger scale may then used as a guideline for applicability of certain simpler calculation methods at that scale.



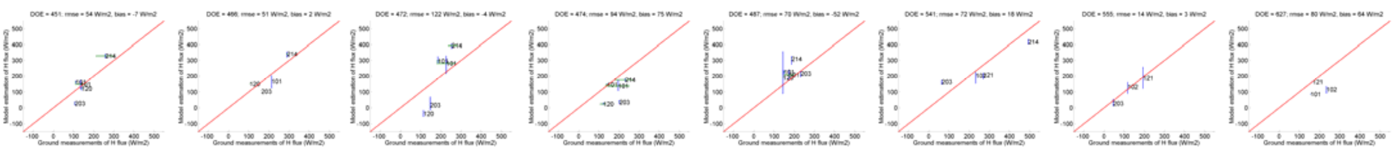
Microscale results and in-situ observations for 1500 m flights and Arpége met-data



Microscale results and in-situ observations for 3000 m flights and Arpége met-data



Microscale results and in-situ observations for 1500 & 3000 m flights and radiosounding data



Microscale model sensible heat flux results and in-situ data. Vertical error bars show spatial in-field variations on model results, horizontal bars show one-hour time average variation. 1500 m and Arpége met-obs.

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