Genesis of the land surface scheme ISBA

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The scientific context

Some key questions at the end of the 70's and in the 80's

- The role of land surface processes on the atmosphere at different scales
  - Breeze circulations (Mc Cumber, 1980 ; …)
  - Severe storms (Benjamin, 1986 ; …)
  - Climate variability (Mintz, 1981 ; ...)
  - ……..
- The desertification in Africa (Charney 1975 ; ...)
- The climate impact of deforestation (Henderson-Sellers and Gornitz, 1984 ; ...)

The modelling context

- Limitation of the land surface parameterizations used in large scale and mesoscale models to reproduce accurately the energy and water budgets in particular at the diurnal scale, accounting for the heterogeneities of soils and vegetation coverages

- New parameterizations developped for large scale models including a new set of processes (Dickinson, 1984, BATS; Sellers et al., 1986 SiB; see also Anton's presentation) :

  - Interception of water by the vegetation
  - Moisture uptake by plant roots
  - Stomatal resistance to transpiration
  - A canopy layer with its own heat balance
  - ……..

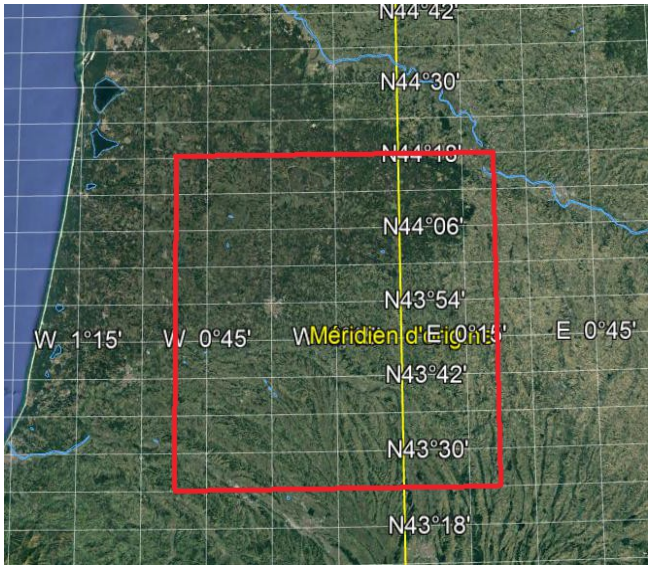
A field experiment context

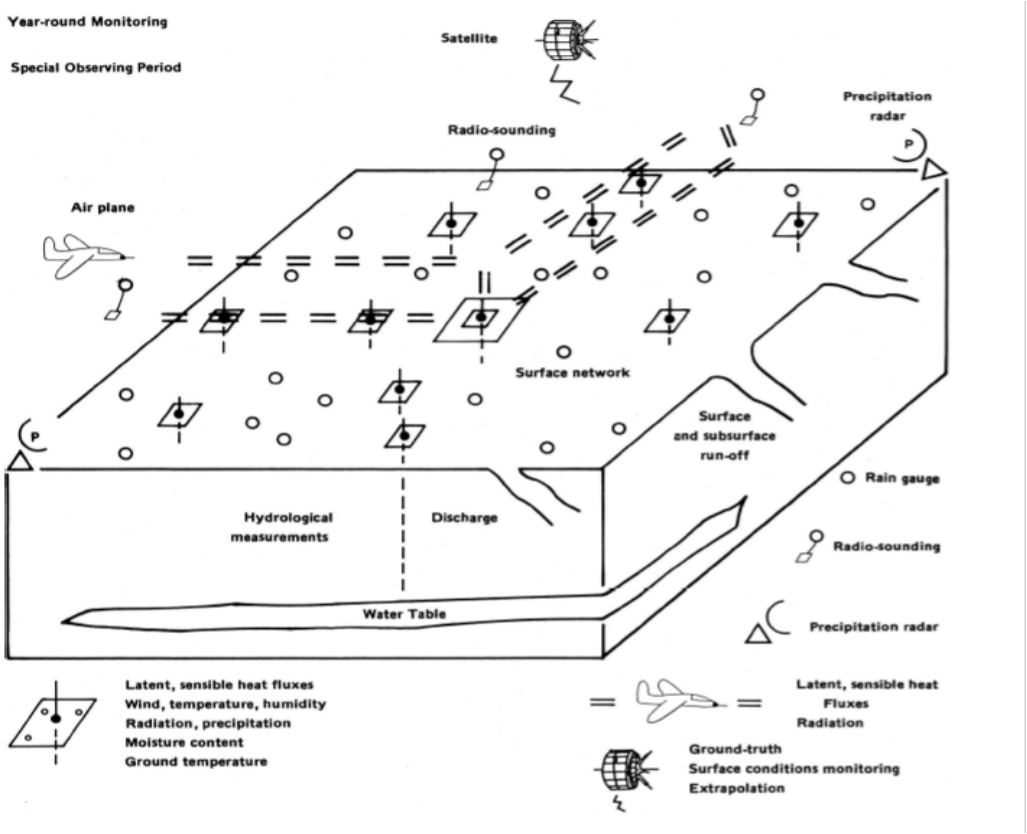
HAPEX—MOBILHY: A Hydrologic Atmospheric Experiment the Study of Water Budget and Evaporation Flux at the Climatic Scale

- Aimed at studying the hydrological budget and evaporation flux at the scale of a GCM (general circulation model) grid square, i.e., 104 km2.
- Different surface and subsurface networks operated during the year 1986, to measure and monitor soil moisture, surface-energy budget and surface hydrology, as well as atmospheric properties.
- To provide a data base against which parameterization schemes for the land-surface water budget will be tested and developed.

Source: André et al., BAMS, 1986

A field experiment context





Source: André et al., BAMS, 1986

Some terms of the « order »

- A parametrization to be later implemented in the Météo-France research mesoscale, climate and weather forecasting models.
- A trade-off between the ability of the model to reproduce the main land surface processes but limiting the soil and vegetation parameters to be prescribed.
- To account for future inversion of the scheme implied by the new variational data assimilation systems.
- Use of the HAPEX-MOBILHY data set for the evaluation of the parameterization and the adjustment of some parameters.

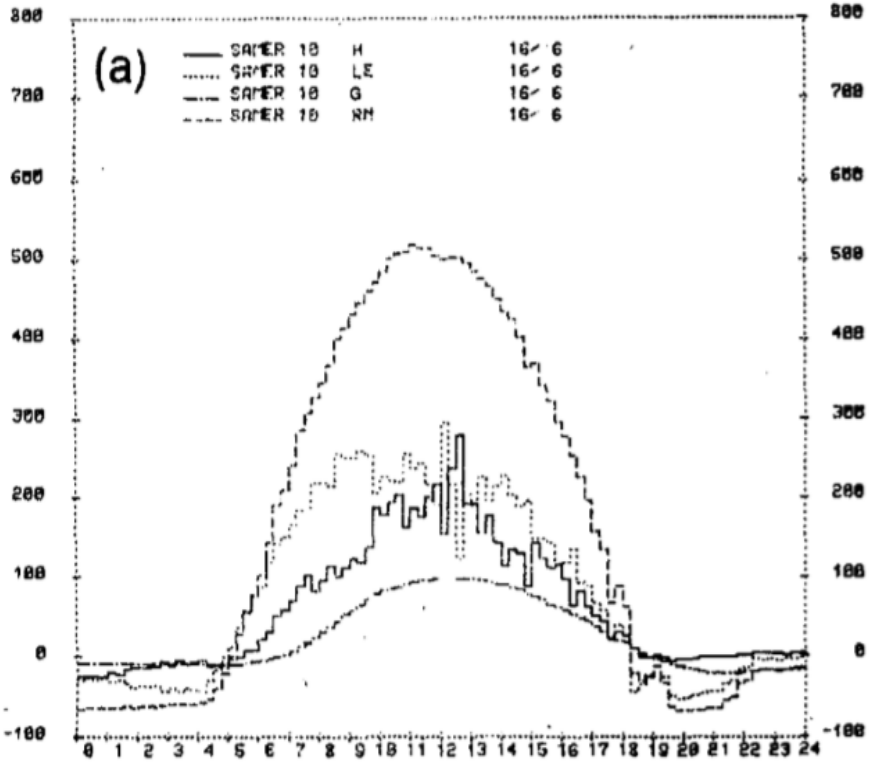
The « simple parameterization » in short

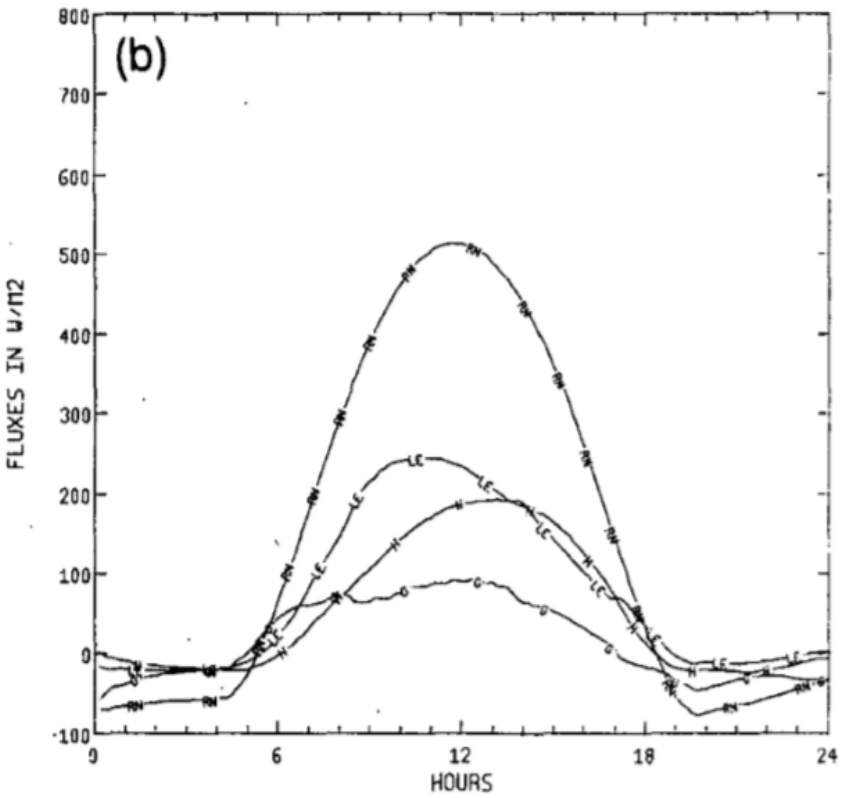
- Only 14 « secondary » parameters for soil and vegetation physical characteristics calculated or determined through 1D model adjustments as functions of two primary parameters : the soil texture (11 from Clap and Hornberger, 1978) or the vegetation type (to be infered from existing vegetation maps).

- A single energy budget for the soil surface whatever the vegetation coverage.

- Only 5 pronostic variables at a given location : 2 soil temperatures and 2 soil reservoir contents determined through the force restore method, and an interception reservoir for vegetation

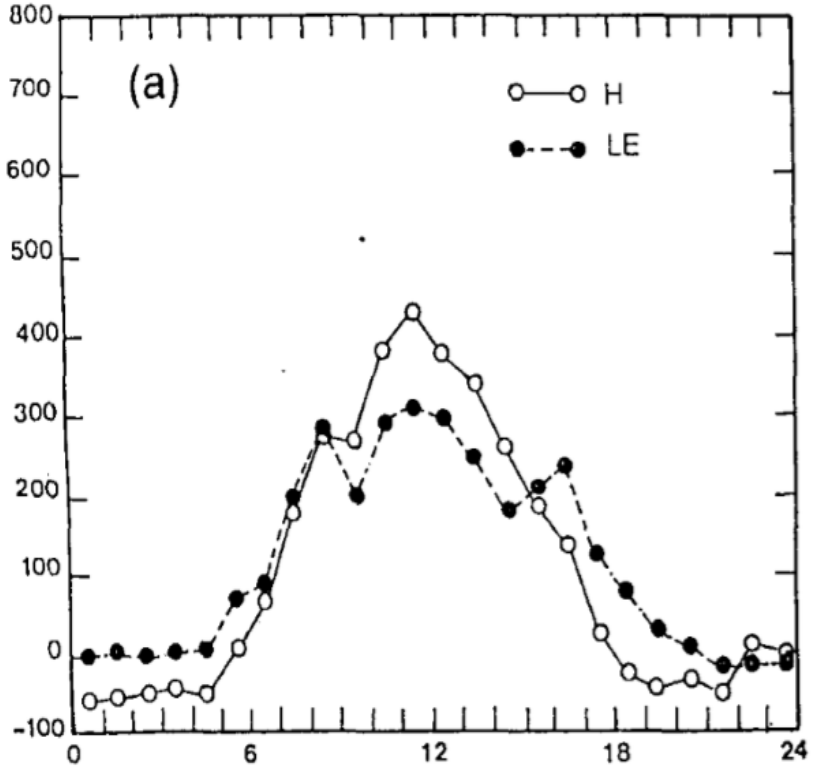
An example of result : the corn case

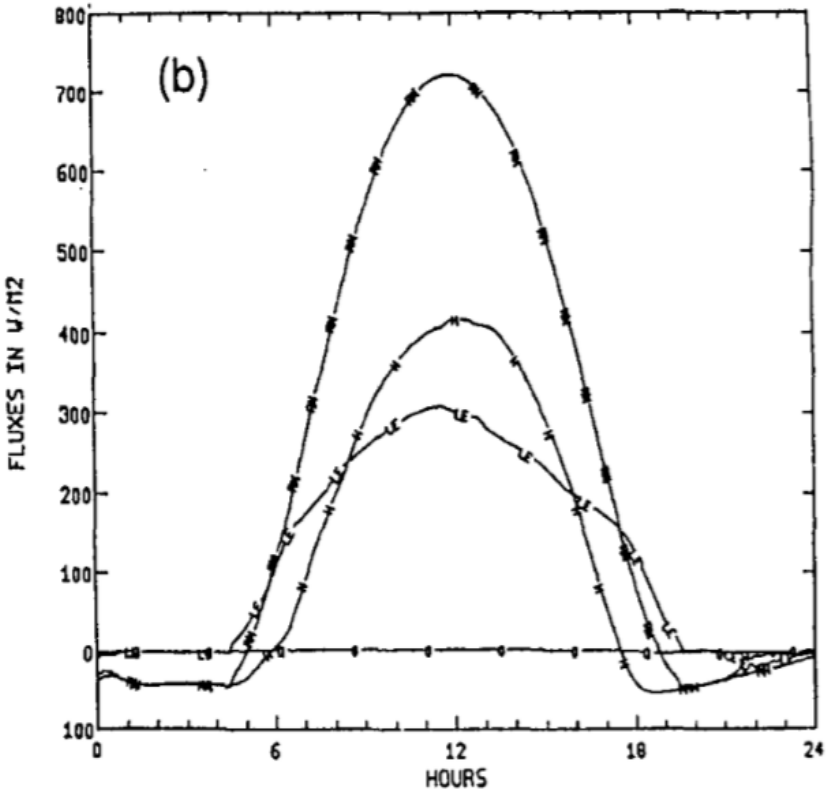




Source: Noilhan and Planton, 1989, MWR

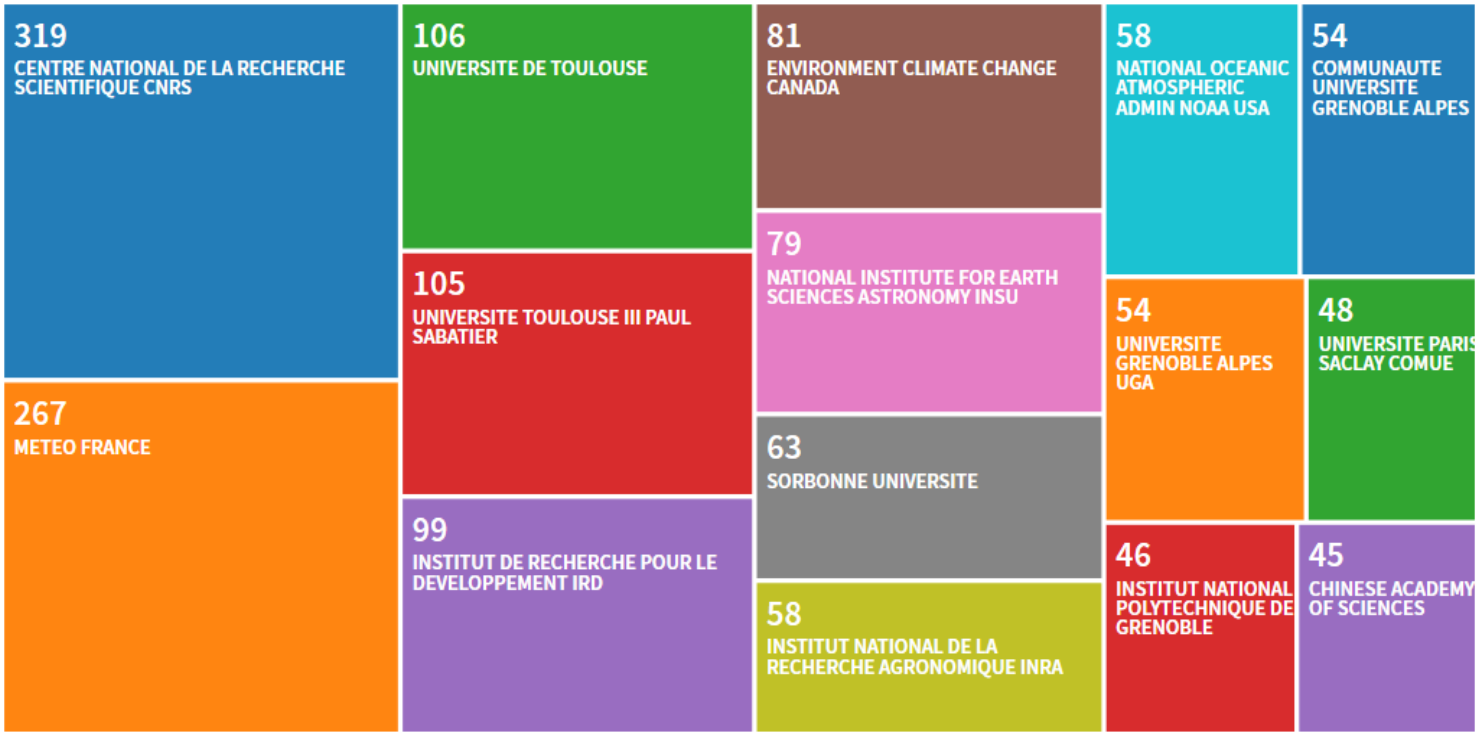
An example of result : the forest case





Source: Noilhan and Planton, 1989, MWR

A first step of very productive researches led by Joël



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