Modeling the multi-frequency emission of Mediterranean forests and comparisons with experimental data

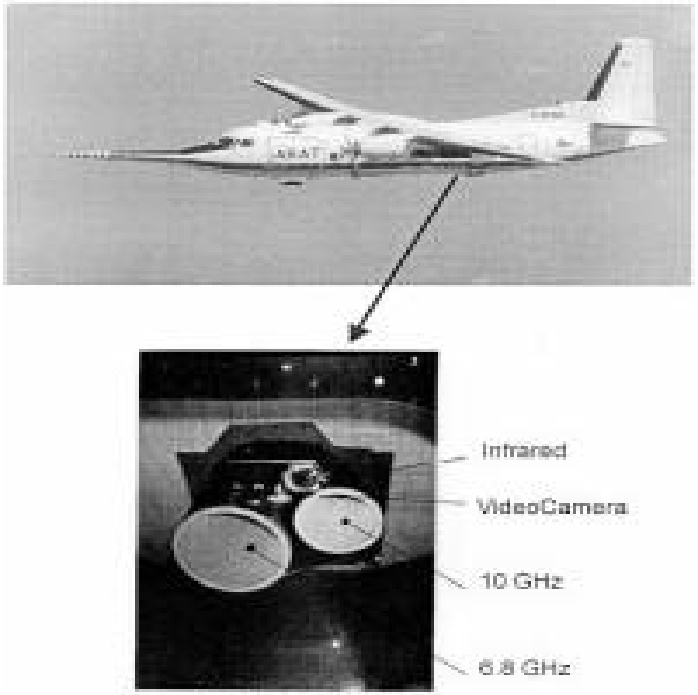
Della Vecchia , P. Ferrazzoli, L. Guerriero, R. Rahmoune
Tor Vergata University, *DISP*, Rome, Italy

E. Santi, S. Pettinato, S. Paloscia
IFAC-CNR, Florence, Italy

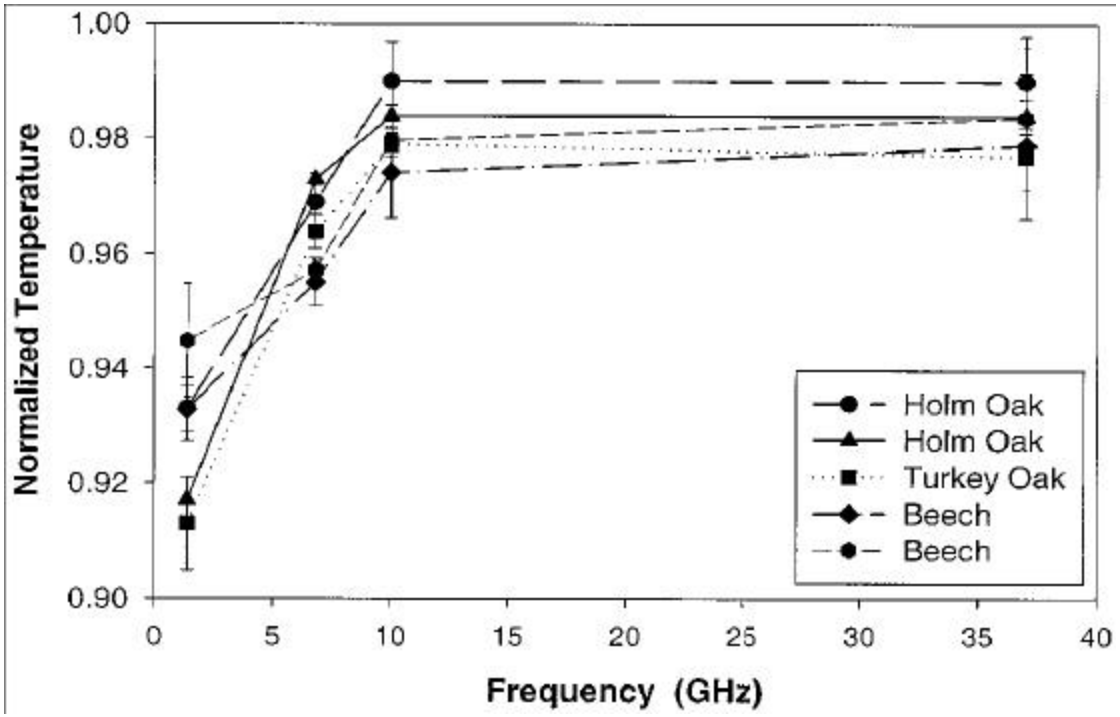
Abstract

This poster shows comparisons between multifrequency emissivity values measured by airborne radiometers over forests and model simulations.
The model generally reproduces the absolute values, the forest volume (biomass) effects and the seasonal variations.
As expected, the emission is dominated by crown for higher biomass forests. However, for lower biomass forest, soil contribution is comparable with crown one, especially in Winter.

Site and measurements (Macelloni et al., 2001)



AREA	Type	dbh(cm)	Woody volume (m^3/ha)	LAI
Ulignano	Turkey oak	12.3	200	2.2
Colognole	Holm oak	19.5	239	5.1
Cala Violina	Holm oak	14.9	344	4.2
Teso	Beech	36	712	3.6
Vallombrosa	Beech	40.5	1433	4.3



Vertical polarization, 30°

The Model (Ferrazzoli and Guerriero, 1996)

- Is based on radiative transfer theory
- Adopts a discrete approach to represent forest elements
- Includes the effects of soil (half-space) and litter (dielectric layer)
- Combines contributions by a matrix algorithm which includes multiple scattering
- Computes emissivity for the whole canopy, and for single components

Required inputs (available from measurements or allometric equations):

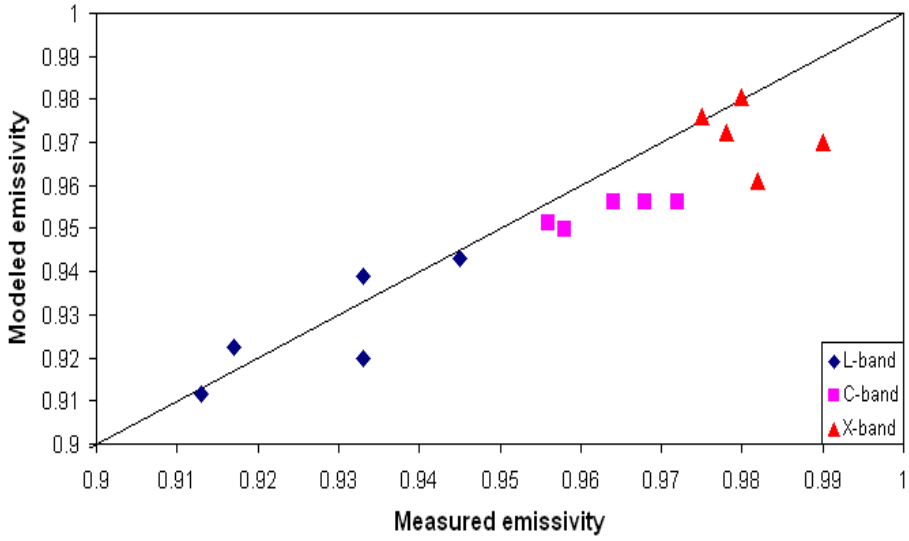
- Soil moisture, Soil roughness, Litter coverage
- Tree density (ha^{-1})
- Distribution of dimensions for trunks, branches, leaves
- Distribution of orientations for trunks, branches, leaves
- Permittivity of trunks, branches, leaves

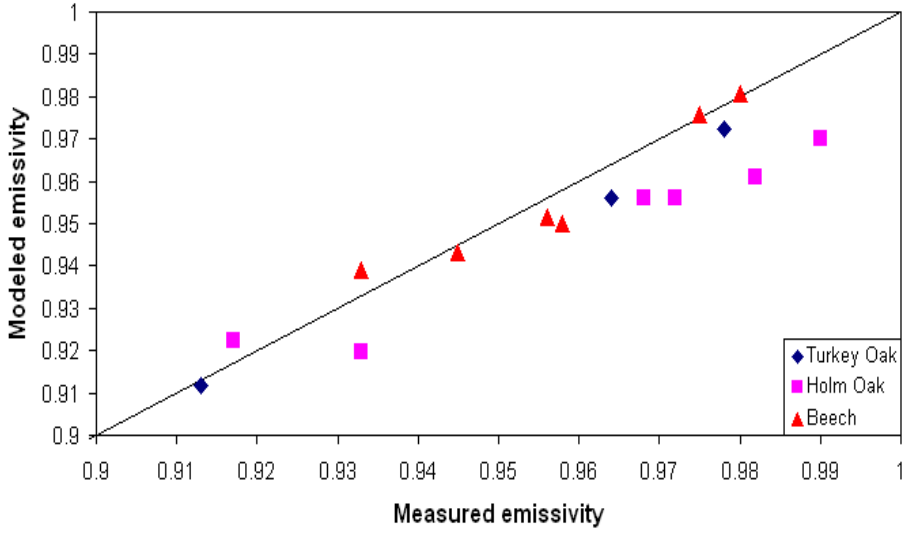
Basically:

- Trunk and leaf variables obtained by ground measurements
- Total volumes of single components (branch, leaf) related to dbh by means of allometric equations available in the literature

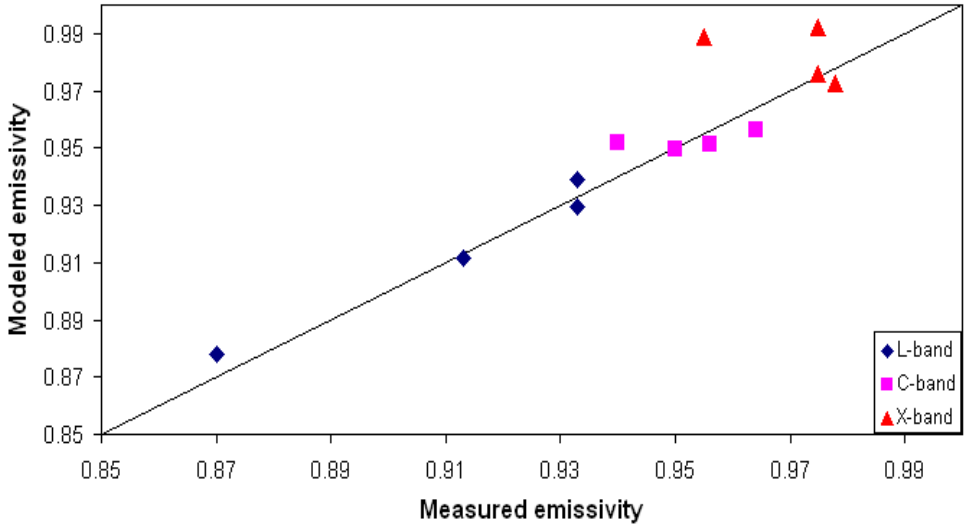
Comparisons

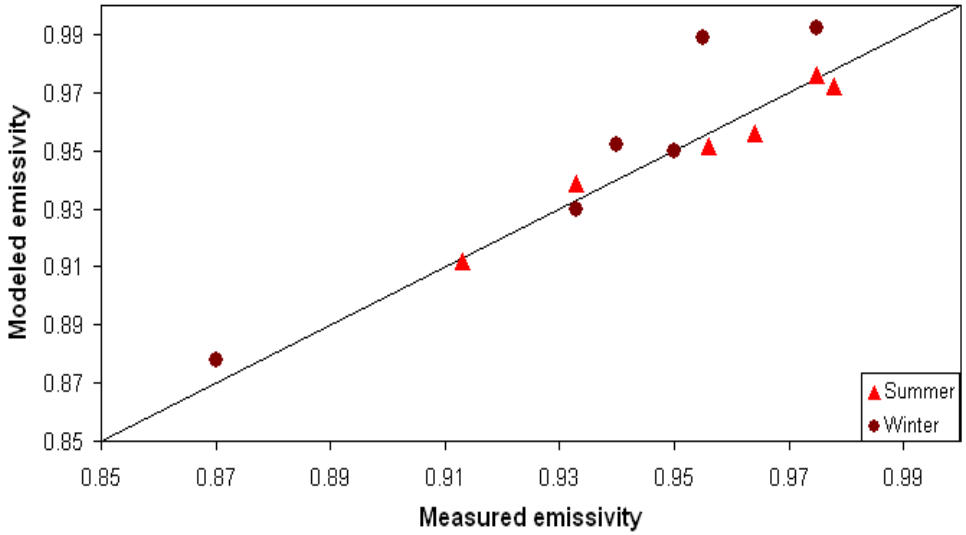
All forests in Summer





Ulignano and Teso, Winter + Summer

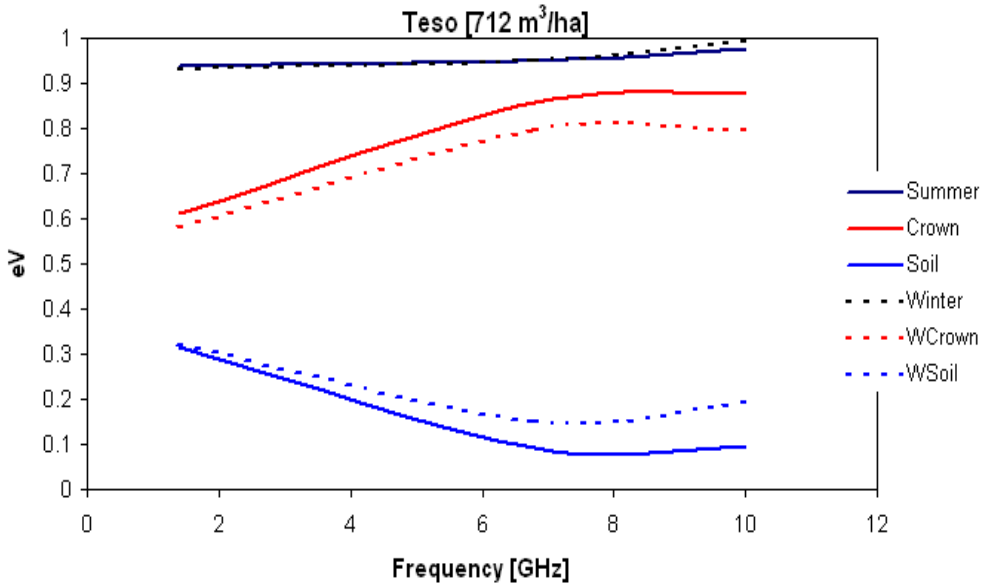




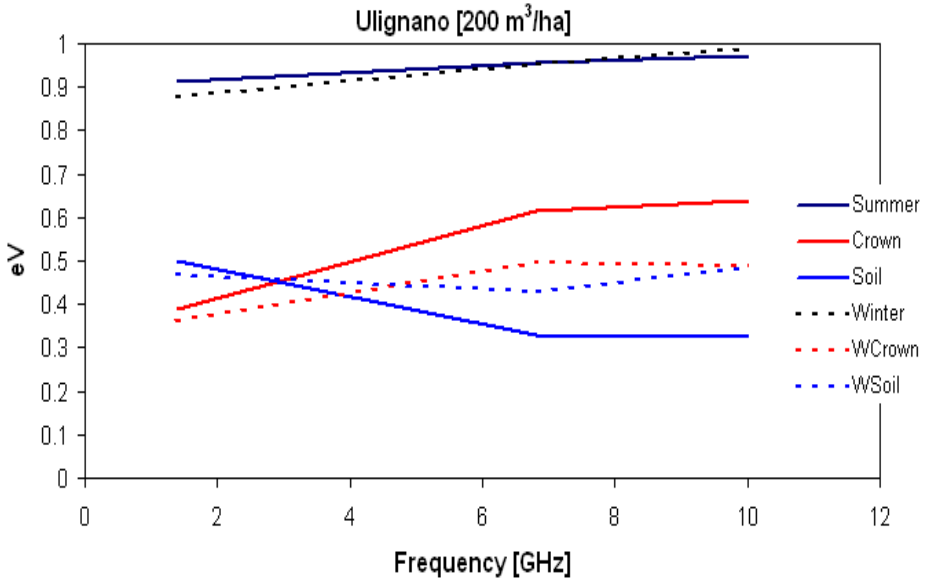
Absolute emissivity values and seasonal effects are generally reproduced .
There are discrepancies for Holm oak and at X band in Winter

Simulated emission due to forest components

V pol, 30°



Higher woody volume (biomass): soil contribution is much lower than crown contribution.



Lower woody volume (biomass): soil contribution is comparable with crown contribution, especially in Winter.

Main concluding remarks

•At L band the emissivity increases with biomass and, for the lower biomass values, is sensitive to seasonal effects (soil moisture).
•At C and X band, all emissivity values are higher, and less influenced by biomass and seasonal changes.
•The effects of frequency, biomass and seasonal changes are generally reproduced by the model. Some discrepancies need further investigation.
•A single component simulation allows us to better appreciate the roles of frequency and biomass.

Contact points:
P. Ferrazzoli, ferrazzoli@disp.uniroma2.it
S. Paloscia, s.paloscia@ifac.cnr.it