Vegetation evapotranspiration modelled with an Emissivity Contrast Index. A case study in four eddy covariance sites in Italy

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Introduction

Forests cover approximately 30% of the Earth's land surface representing the bulk of many ecological services. Forests are important regulator of terrestrial water balance: Vegetation, through evapotranspiration processes (ET) can indeed modulate hydrological budgets at local, regional, and continental scales.

In the last years various remote sensing products have been developed for the estimation of ET showing interesting results.

In this study we tested a new developed emissivity contrast index (ECI) based on emissivity data from infrared spectral channels of MODIS and ASTER sensors and we compared it to information of ET derived from four eddy covariance sites (three forest areas and one grassland).
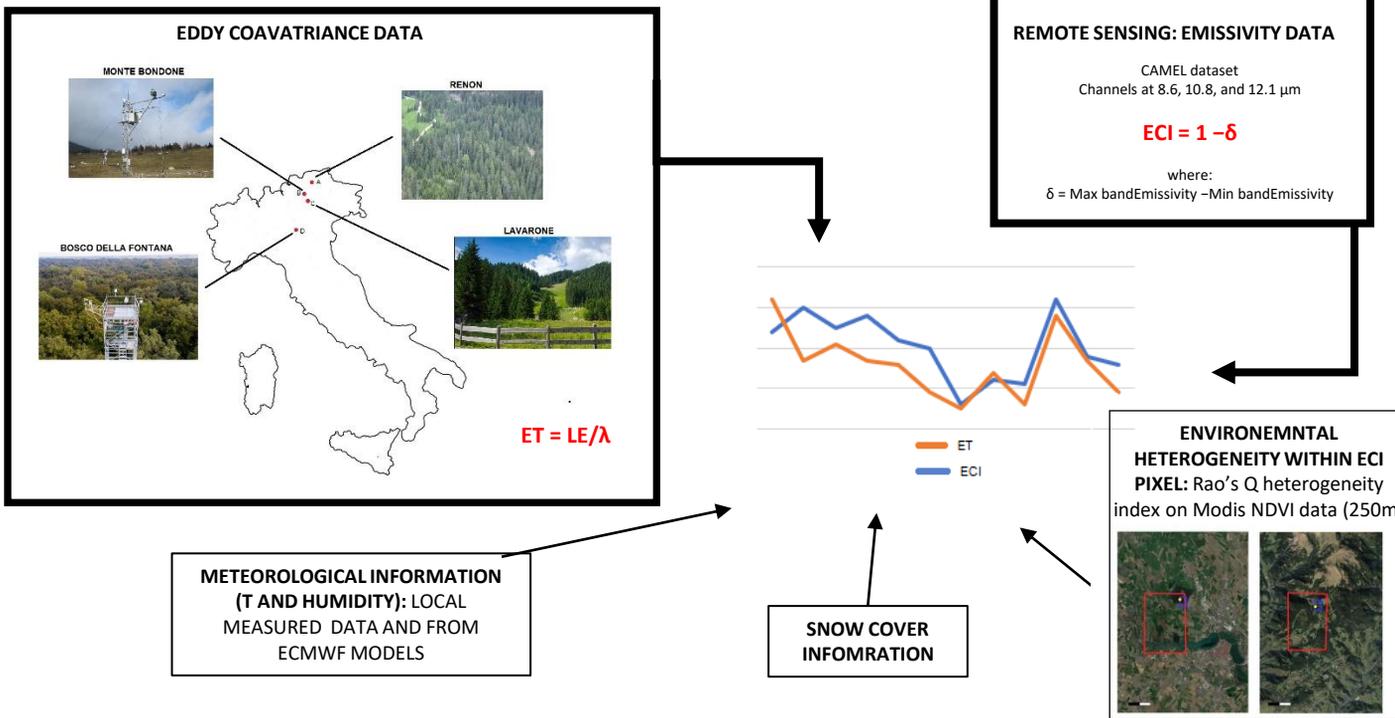
Aim

To test a new developed emissivity contrast index (ECI) based on emissivity data from infrared spectral channels of MODIS and ASTER satellite sensors and compared it to information of ET derived from four eddy covariance sites (three forest areas and one grassland).

Correlate both ET and ECI with data of temperature, humidity (derived from in-situ measures and from the ECMWF models) and snow cover information (derived from remote sensing data - MODIS satellite) in order to understand if these meteorological information might influence the trend of ECI ad ET.
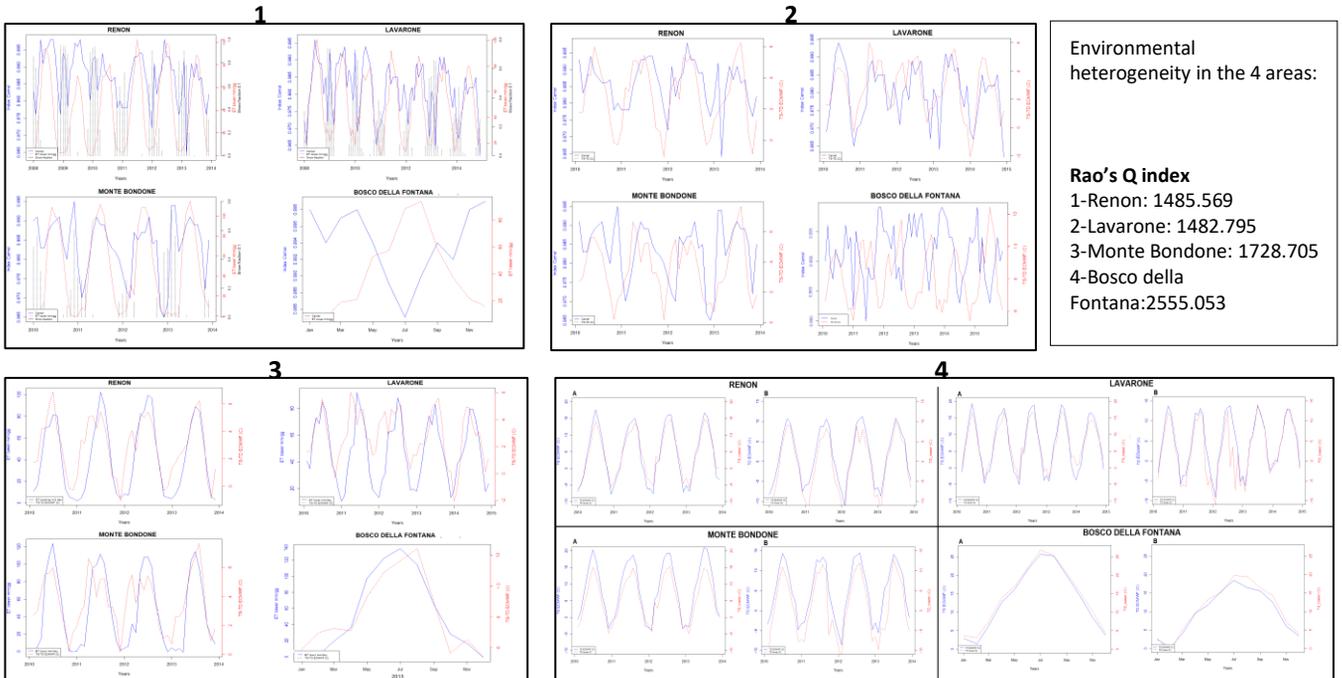
Additionally, in order to assess the effect of the habitat fragmentation within the area of interested over the ECI pixel, the environmental heterogeneity has been calculated through the spectral heterogeneity Rao's Q index.

Material and Methods

EDDY COAVATRIANCE DATA

MONTE BONDONE
RENON
BOSCO DELLA FONTANA
LAVARONE

$$ET = LE/\lambda$$

REMOTE SENSING: EMISSIVITY DATA

CAMEL dataset
Channels at 8.6, 10.8, and 12.1 μm

$$ECI = 1 - \delta$$

where:
δ = Max bandEmissivity – Min bandEmissivity

ET
ECI

ENVIRONEMNTAL HETEROGENEITY WITHIN ECI PIXEL: Rao's Q heterogeneity index on Modis NDVI data (250m)

METEOROLOGICAL INFORMATION (T AND HUMIDITY): LOCAL MEASURED DATA AND FROM ECMWF MODELS

SNOW COVER INFOMRATION

Results

1:ET vs ECI (+ snow cover information)/ 2: ECI vs difference TS-TD ECMWF/ 3: ET vs difference TS-TD ECMWF/ 4: TD/TS local vs TD/TS ECMWF

Environmental heterogeneity in the 4 areas:

Rao's Q index
1-Renon: 1485.569
2-Lavarone: 1482.795
3-Monte Bondone: 1728.705
4-Bosco della Fontana:2555.053

Conclusion

The results showed that the ECI index and the eddy covariance ET are intra-correlated having for three of the four considered sites the same trend.
Snow cover and the environmental heterogeneity of the area have shown to influence the above mentioned correlation.