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ATMOSPHERIC COMPOSITION CHANGE
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BIAFLUX Exchange of Staff 2006 – REPORT

Silvano Fares
c/o CNR – IBAF
Roma, Italy

BIAFLUX EXCHANGE OF RESEARCH STAFF – REPORT

1. Research staff participation

Award Holder/ Project Leader	Silvano Fares
Team Members/ Collaborators	Janne Rinne, Risto Taipale, Taina Ruuskanen

2. Project /Activity

Title of Project	**BVOCs fluxes from forest ecosystems**
Objectives of Activity	The global emission of volatile isoprenoids (isoprene and monoterpenes) is not negligible, being estimated at 800-1500 TgC y^{-1}, which represents about 10% of the C fixed by photosynthesis, and about 2% of GPP. Volatile isoprenoids have a high impact on the chemistry of the troposphere, as their high reactivity makes them a substrate for reactions with anthropogenic pollutants ultimately potentially leading to ozone and particulate formation (e.g. Chameides et al. 1988). Many studies have investigated the emission of isoprenoids and its biological and environmental control at leaf level (Loreto et al. 2004). However, it is important to quantify the amount of isoprenoids released in the atmosphere in response to environmental changes especially at canopy level, as many compensative mechanisms, may be also occur, for instance driving changes of leaf area index and duration which may in turn affect isoprenoid emission at an integrated canopy scale. Several studies of isoprenoid fluxes at canopy level have been carried out in north-European forests (Rinne et al., 2000), but still not in Mediterranean countries. The scientific objective of the proposed research is to provide new information on fluxes of isoprenoids, and of the main products of isoprenoid reaction from a forest ecosystem. In addition, a training objective was pursued, as by learning flux techniques the grantee will then reproduce them on Mediterranean vegetation during the following year with the hopeful support of the project. Two techniques were used: a) the Disjunct Eddy Covariance (DEC) (Lenschow et al. 1994; Rinne et al. 2001; Karl et al., 2002) in which short separate samples are taken from the continuous time series, and analyzed by a proton transfer reaction mass spectrometer (PTR-MS, Ionicon, Innsbruck, Austria). Vertical flux is given by the covariance of the concentration and the vertical wind speed at corresponding sampling times; and b) the gradient method (Rinne et al., 2000), in which isoprenoid concentration is measured (with PTR-MS) at different heights from the soil to the canopy.

3. Results and Achievements

Isoprene, monoterpenes, acetone, methanol, acetaldehyde concentration were measured at 5 different heights from the soil to above the canopy: 4, 7, 11, 14, and 22 m. From each height air was sampled with a vacuum pump through Teflon tubes and conveyed to the PTR-MS (Details on a similar experimental set-up can be found in Rinne et al. 2005). A zero air sampling was done every 2 h in order to minimize the noise effects. The instrument calibration for the main masses was done weekly using a bottle with a known mix of monoterpenes concentration. Data logged in the PTR-MS computer were analyzed using MAT-LAB, a programming language which interfaces the software and the hardware compounds of the system, and a dynamic of emissions of these compounds during the first days of August was elaborated. Probably because of the exceptionally dry conditions of the soil, monoterpenes concentration was very low during the period studied (below 2 ppb), and non significant differences in concentration between day and night were observed. These results were compared with samplings of June, when environmental conditions were less critical, and a clear dynamic of a daily trend was observed: at each height the concentration in the daylight hour was negligible, while there was an accumulation in the night above 2 ppm. It seems that during the daylight hours monoterpenes are scavenged (maybe by ozone) and removed by the wind. In particular methanol and monoterpene concentrations at 4 m were often the highest compared with the other heights, probably because the wind speed is very low during the night at that height. Methanol and acetone were the compounds detected in the largest amount because of their long reaction time and the consequent low reactivity.

In parallel with the gradient technique, the DEC technique was adopted by integrating air samples taken at 22 m with wind velocity recorded with the sonic anemometer. Correlations between wind velocity and PTR-MS count rates of measured masses (monoterpenes and methanol) were calculated, and positive values of correlations indicated fluxes in particular during the daylight hours. As expected the trend of this emission dynamic is the opposite of the concentration dynamic at 22 m, since the wind velocity drives the process of gas exchange between the canopy ant the atmosphere. Flux quantification will be carried out at the end of the season, keeping into account the instrument calibrations, the noise elimination with the zero air and after preparing ad hoc MATLAB script.

3. Results and Achievements (continued)

4. Expected output / research development

The innovative technique of the disjunct eddy covariance and the gradient method, used in Finland to asses isoprenoid fluxes from boreal forest, will be also reproduced in the Mediterranean area, under extremely different biological and environmental factors. In particular, this visit will be keyed at developing the framework for a correct use of the DEC and gradient techniques in the BIAFLUX field campaign now planned in Castelporziano, central Italy, during 2007, and to which both CNR and the University of Helsinki will participate.

5. Additional information

Is continuing collaboration between you and the hosting institute planned/anticipated?
If yes, give details
The collaboration could continue in the next summer campaign 2007.

Please tick as appropriate for this project

X	Training/Knowledge transfer
	Research Development
X	Measurement/Modelling activity

Early career researchers involved (less than three years post-doctoral research experience)

Name	Affiliation
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Silvano Fares	CNR – IBAF (National Research Council – Institute of Agro-environmental and Forest Biology)

Signature of Project Leader Silvano Fares **Date** **31/8/07**