LICHENS AT WORK: CONTINUOUS ONLINE MONITORING OF LICHEN ACTIVITY ACROSS ANTARCTICA USING THE PAM-Monitoring SYSTEM

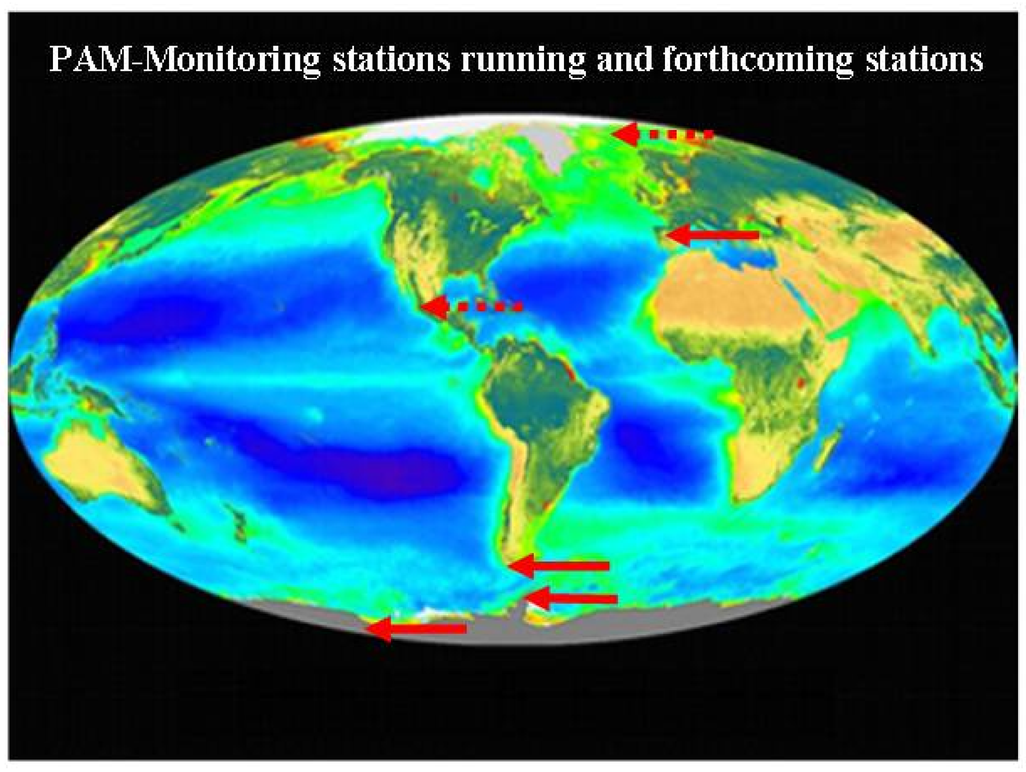
L.G. Sancho*[1], R. Gademann [2], A. Pintado[1] & T.G.A. Green[1].
[1]Departamento Biología Vegetal II, Fac. Farmacia, Universidad Complutense de Madrid, E-28040, Spain, [2]Botanisches Institut , [2]Gademann Instruments, Dürrbachtal 232, D-97080, Würzburg, Germany.

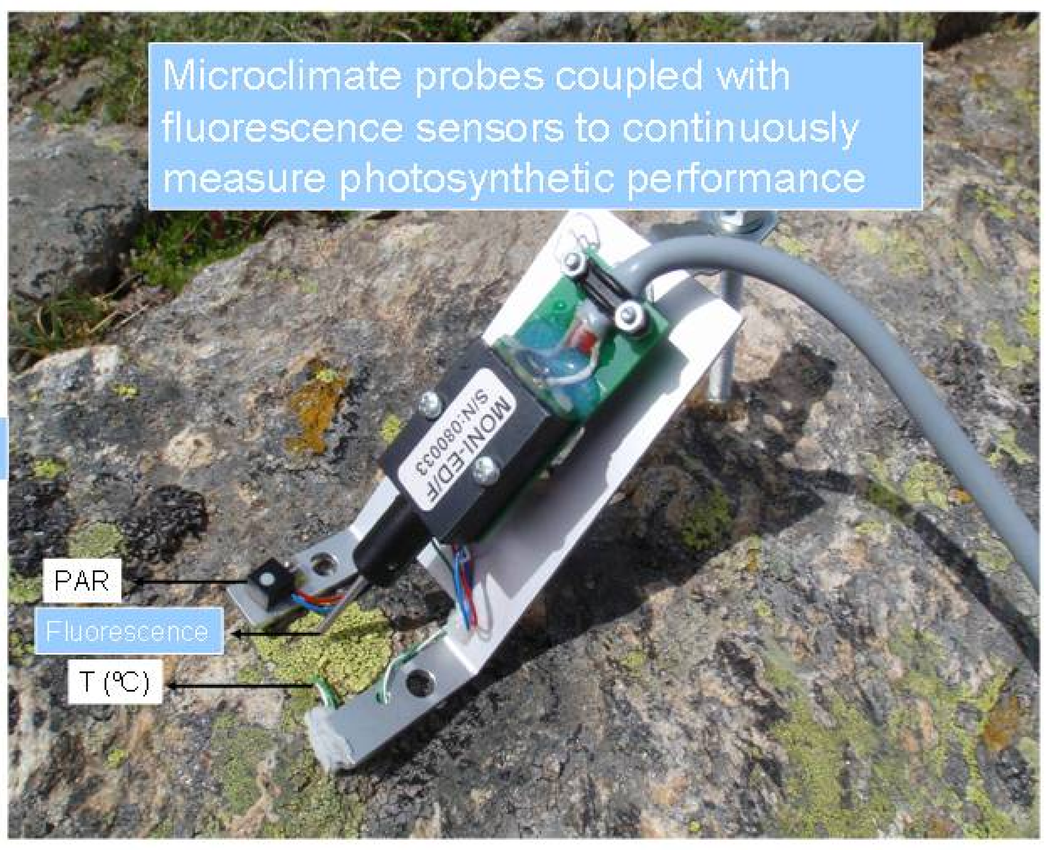
INTRODUCTION

Lichens are major components of vegetation across Antarctica and show a large biodiversity and productivity cline from the northern Peninsula to the southern Ross Sea. The major environmental components that could be controlling this cline are temperature, light and water availability, all three being somewhat interlinked. At present we have little information on which to decide what actually is the major controller of lichen distribution in Antarctica, but we need this information if we are to successfully predict the effects of any climate shift.

We present information and results from three installed PAM-Monitoring Systems (WALZ, Germany), one each in Tierra del Fuego (Navarino Island), Maritime Antarctica (Livingston Island) and Continental Antarctica (Garwood Valley, Ross Sea region). Each machine is fully independent and monitors the activity of 4 or 8 lichens at hour intervals by non-contact chlorophyll fluorescence. Environmental parameters such as air and thallus temperature and light are also measured. Each machine reports immediately by satellite. The advantage of these online monitoring systems is that not only can we get a very good idea as to when the lichens are active and the conditions under which they are active as opposed to the general climatic data normally recorded, but also the potential photosynthetic activity expressed as Electron Transport Rate (ETR). With this new method we hope to calculate seasonal and annual productivity of lichens along environmental gradients.

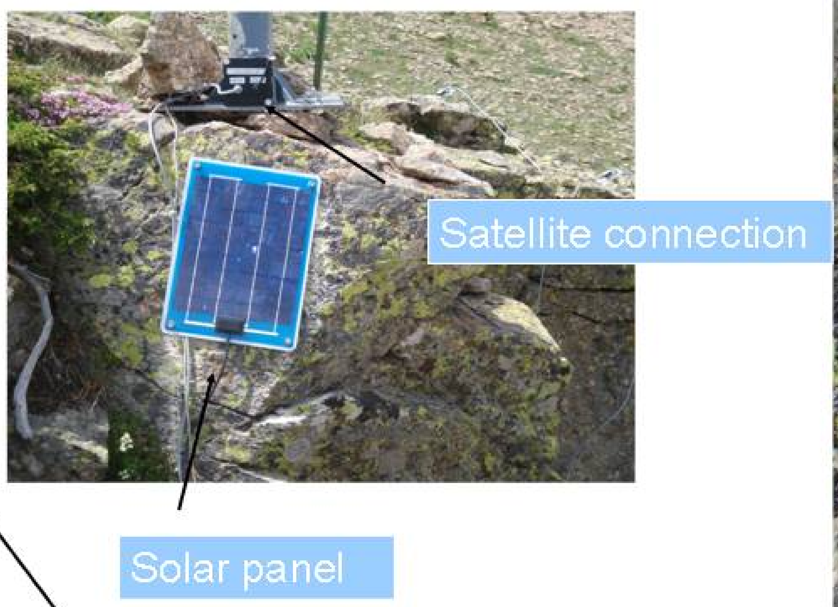
As an example of the possibilities of this new automatic system we show here the data obtained in these stations along a gradient from Tierra del Fuego to Continental Antarctica during 30 summer days.

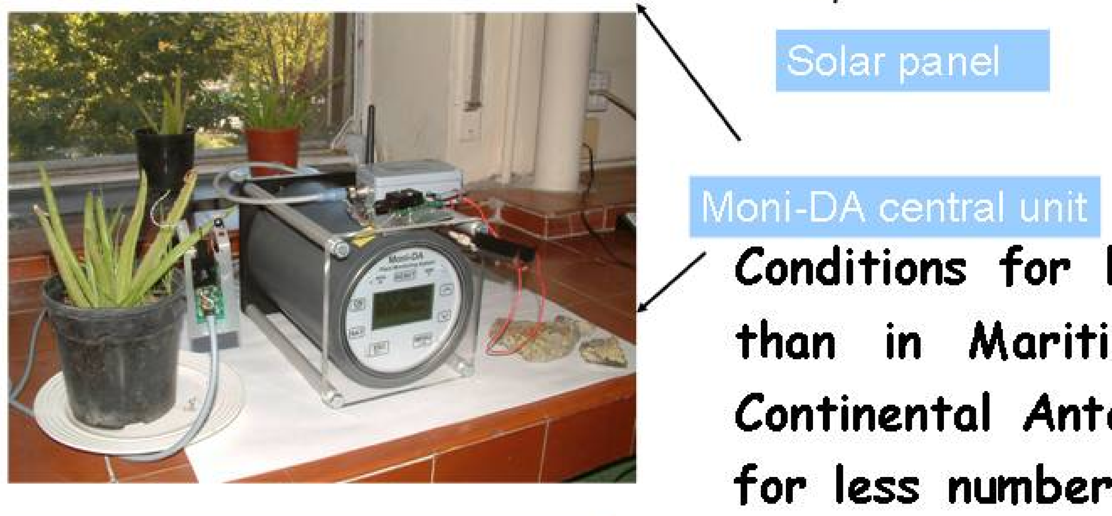




MATERIAL AND METHODS

The PAM-Monitoring system has a central unit (Moni-DA) and four measuring channels, each provided of an optic fiber to measure chlorophyll *a* fluorescence and both light and temperatures sensor. It is specially developed to resist extreme climate conditions and is solar charged by a panel. It is connected to an iridium satellite, so we can check the any time through an internet web page. In this work we show the results obtained during one central month of the austral summer (January 21 to February 22, 2009) for *Usnea aurantiaco-atra* from Tierra del Fuego and Continental Antarctica. Percentage of activity, Electron Transport Rate (ETR), thallus temperature and total PPFD (Photosynthetic Photon Flux Density) were calculated for the same species at both localities. We also show the results obtained during the austral summer 2010 for *Caloplaca* sp. from Continental Antarctica.





Metabolic performance and microclimate of Antarctic lichens monitored on-line by satellite conection

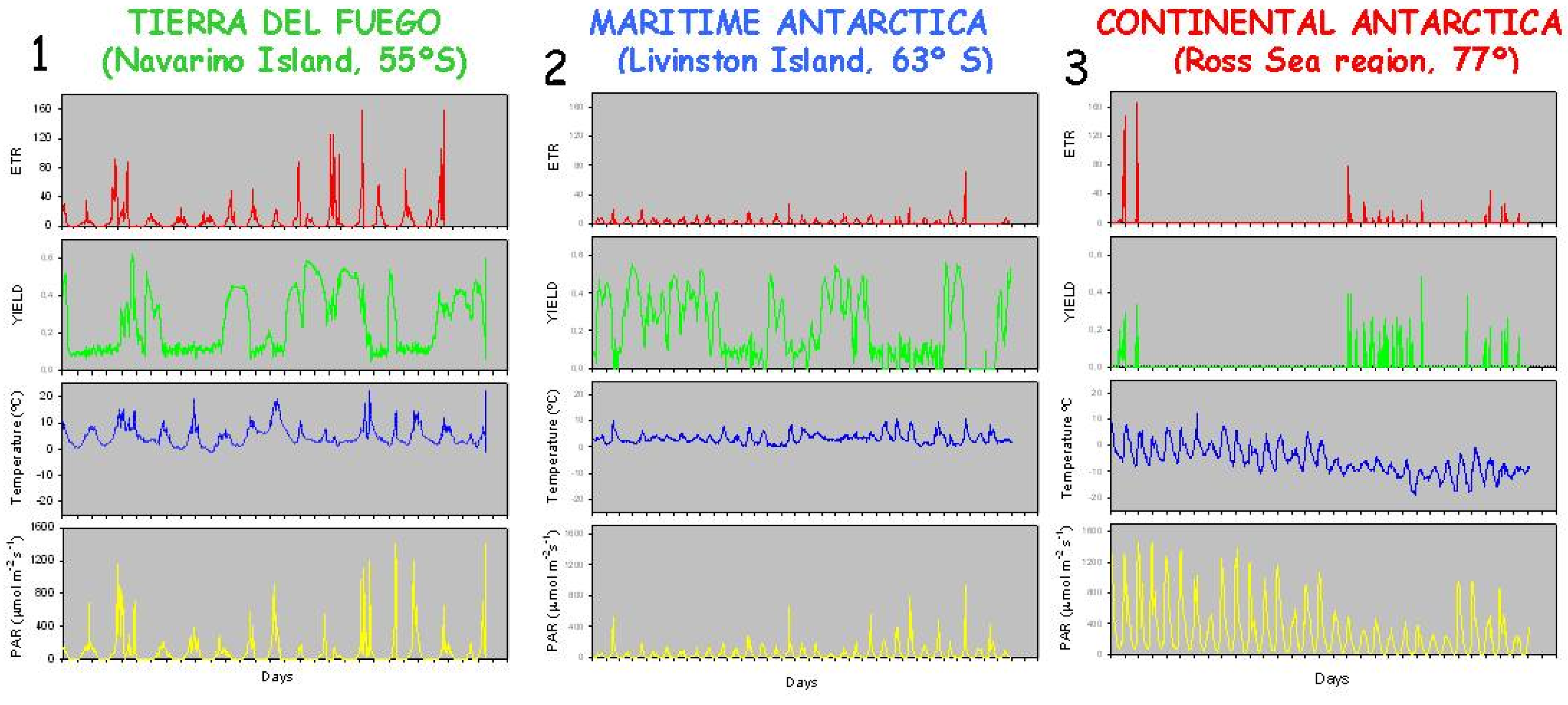


Figure 1-2. Daily courses from January 22 to February 21, 2009 for *U. aurantiaco-atra*.

Figure 3. Daily courses from January 30 to February 28, 2010 for *Caloplaca* sp.

Microclimate and activity of *Usnea aurantiaco-atra* in Tierra del Fuego and Maritime Antarctic

NAVARINO	Jan-Feb	M. ACTIVITY
Temperature	6.03	5.51
PPFD	163.33	152.62
Yield	0.204	0.224
ETR	6.6591	12.274
ΣETR	10361.7	9642.3

LIVINGSTON	Jan-Feb	M. ACTIVITY
Temperature	3.31	2.92
PPFD	49.12	33.03
Yield	0.251	0.328
ETR	2.667	3.107
ΣETR	1707	1385.8

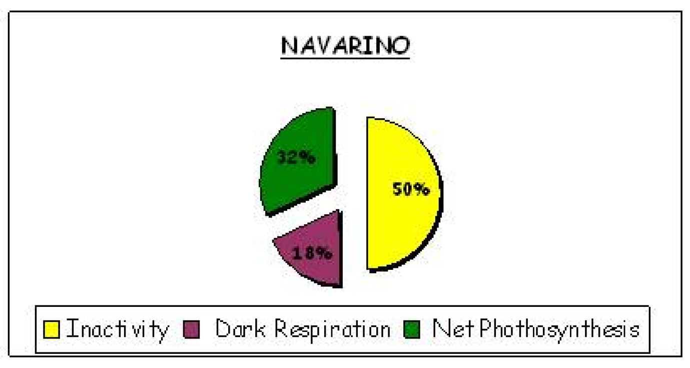
TABLE 1:Summary of the mean parameters on both sites

RESULTS AND CONCLUSIONS

Conditions for lichens in Continental Antarctica are clearly much colder than in Maritime Antarctica and Tierra del Fuego (Figs 1-3). In Continental Antarctica lichens were active (showing photosynthetic Yield) for less number of days than in the other localities. In these days with activity we observed a higher ETR as a consequence of the higher irradiance. Temperature and irradiance are higher in Navarino than in Livingston. We can see slightly longer periods of activity in Livingston, probably because the lower irradiance and temperature let the lichens be active during more time.

Mean thallus temperature is higher in Navarino (table1),but lower when lichen was active in both sites. With respect to mean PPFD, Navarino has higher values than Livingston in all studied period. Mean Yield values are similar but high in Livingston when active.

Figures 4 and 5 show the metabolic activity on both localities in percentages: Total activity is higher in Livingston and it has also slightly higher percentages on photosynthesis and respiration, but no strong differences are observed. The strong difference on the total amount of ETR on both localities is an important issue related with the strongest irradiance in Navarino. As ETR is crude indicator of photosynthetic performance, we could hypothesize that at least in Summer and mainly due to the higher radiation *Usnea aurantiaco-atra* is growing faster on the Sub-Antarctic Navarino Island than on the Antarctic Livingston Island.



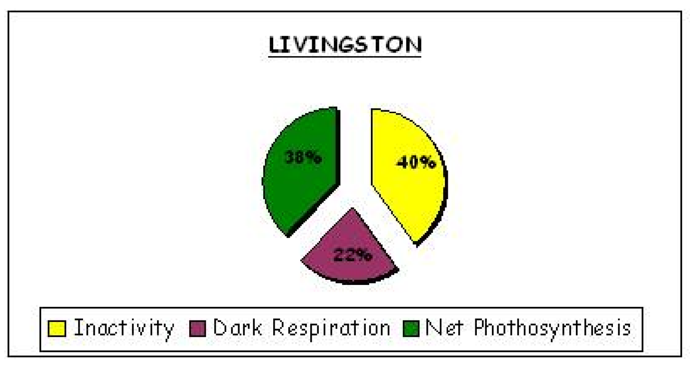


Figure 4-5. Percentages of metabolic activity for *Usnea aurantiaco-atra*

Contact: sancholg@farm.ucm.es; gademann@t-online.de

Acknowledgments
This work has been supported by the grants of the Spanish Ministry of Science: CGL2006-12179-CO2-O1, POL2006-08405 and CTM2009-12838-C04-01