Comparison of in situ albedo measurements at two Mediterranean mountains in Spain

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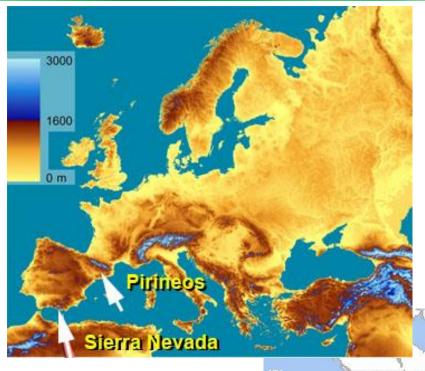












IBERNIEVE project

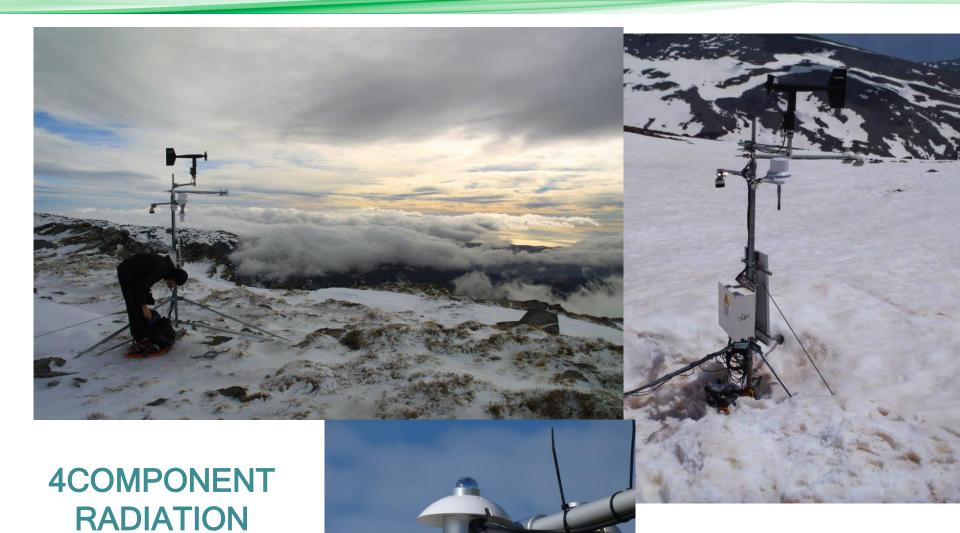
(Spanish National Plan for Research and Innovation)

Mediterranean Climate

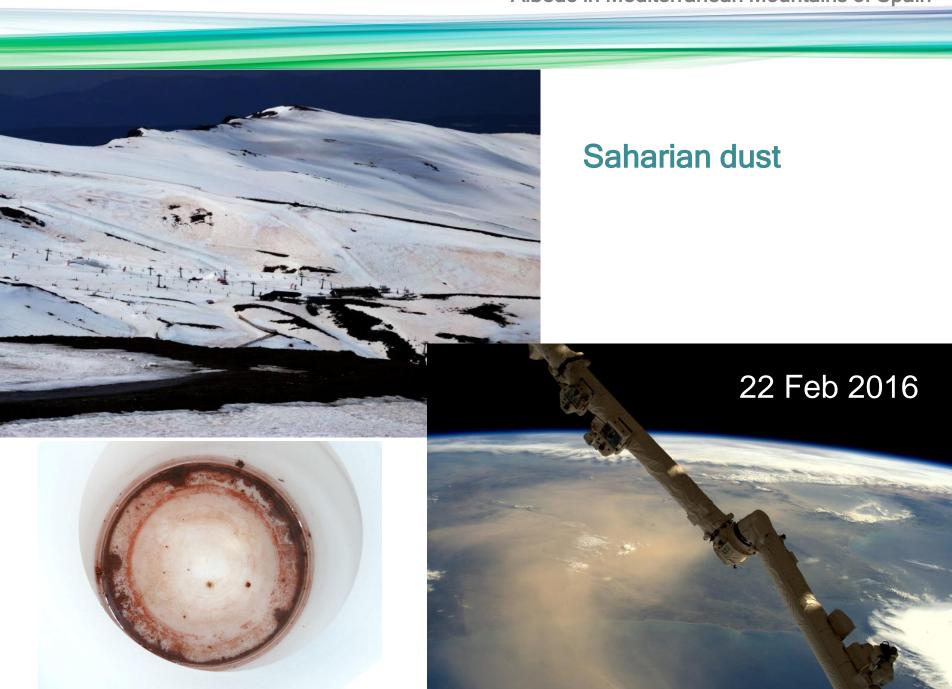


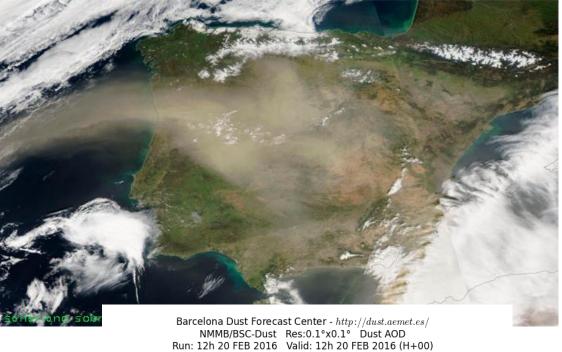






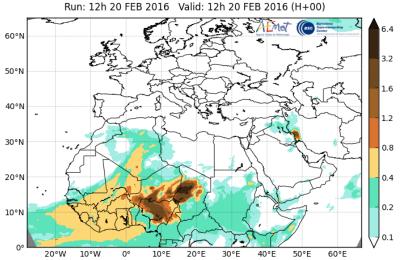
SENSORS





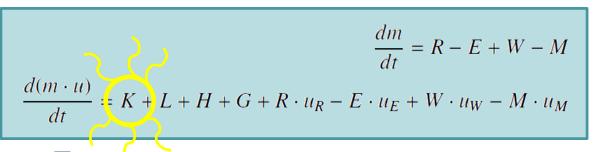
Saharian dust

20-23 Feb 2016





Modelling: Mass and energy balance



Turbulent energy diffusion terms

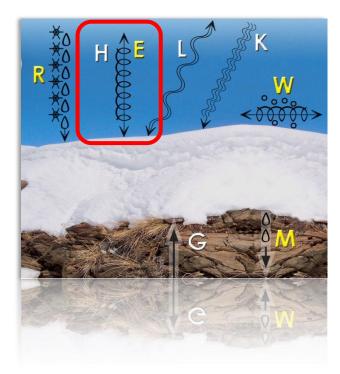
$$U_E = E \cdot uE = \frac{K_{UE}}{\Phi_M \Phi_V} v_a (e_{sn} - e_a)$$

$$H = \left(\frac{K_H}{\Phi_M \Phi_H} v_a + K_{H0}\right) (T_a - T_{sn})$$

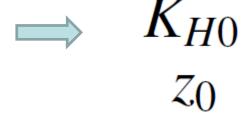


$$K_{UE} = u_E 0.622 \frac{\rho_a}{P_a} \frac{k^2}{\left[ln\left(\frac{z_a - z_d}{z_0}\right)\right]^2}$$

$$K_H = \rho_a c_a \frac{k^2}{\left[ln\left(\frac{z_a - z_d}{z_0}\right)\right]^2}$$



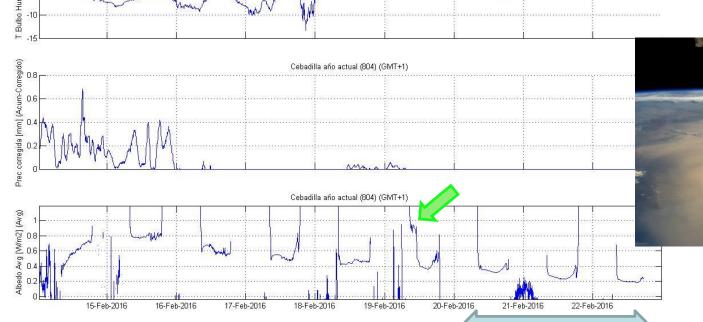
Calibration parameters



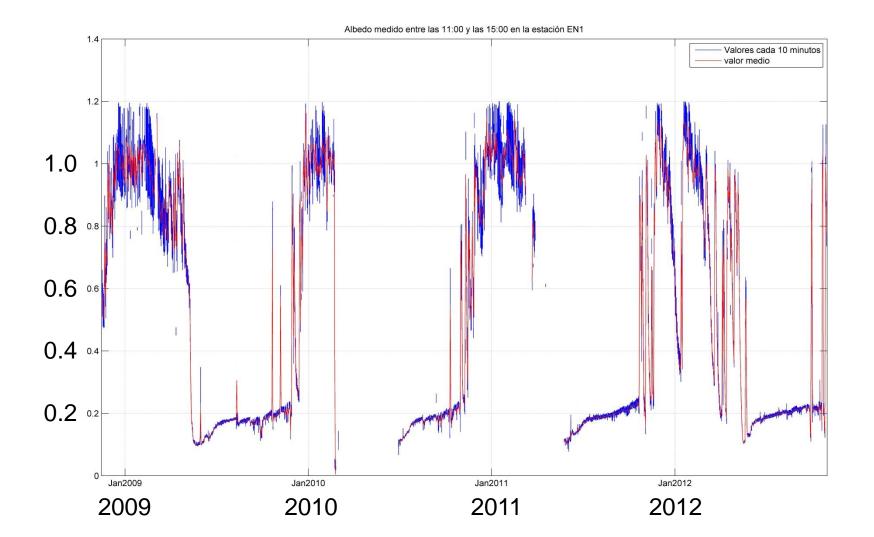


Measurements

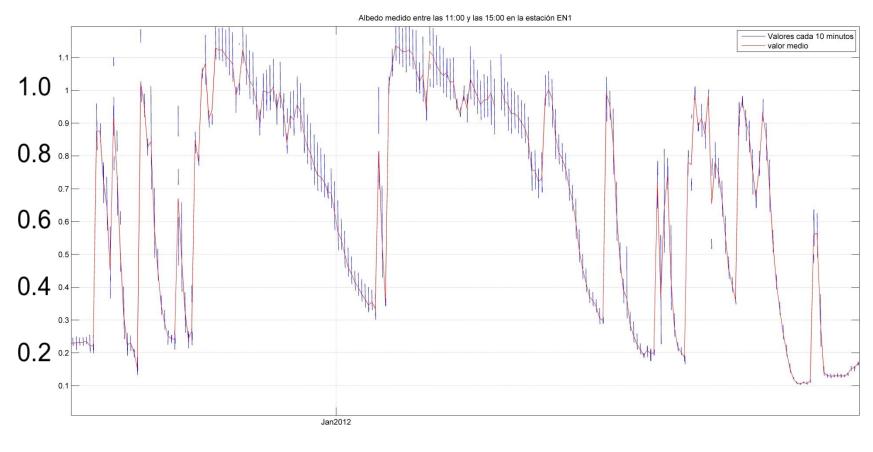
20-23 Feb 2016



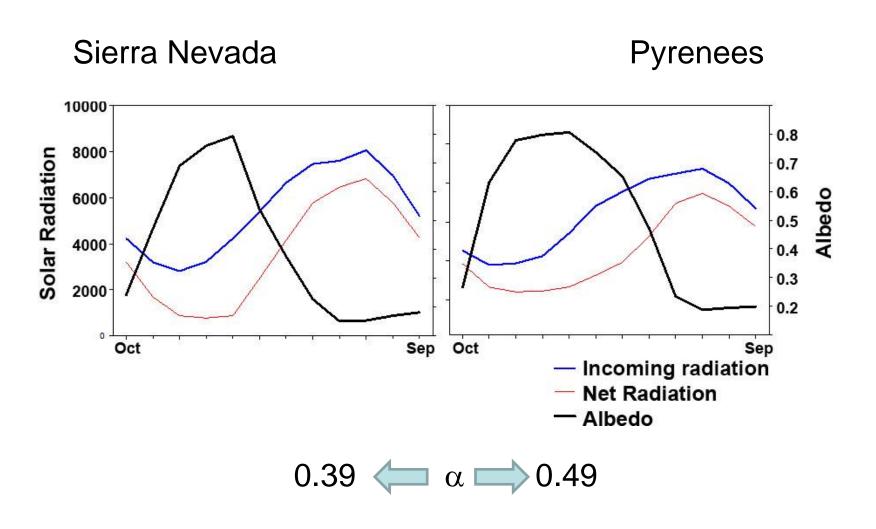
5-min Measurements



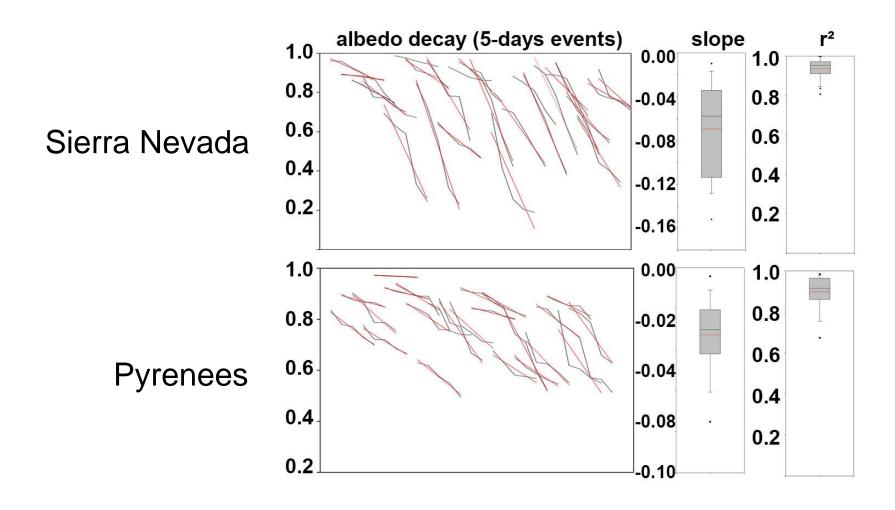
5-min Measurements



Monthly data



Albedo decay (4-component sensors)



Albedo decay

LINEAR TREND - TWO SPEEDS

Ground Measurements: 0.06 (SN) - 0.032 day⁻¹(Pyr)

Modelling: 0.006 (cold) - 0.018 day⁻¹ (melt)

Satellite (Landsat): 0 (cold) - 0.003 day⁻¹ (melt)

(for maximum value)

Pimentel et al 2012: Estimating snow albedo patterns in a Mediterranean site from Landsat images. Proc of SPIE. 88870L

Conclusions

- An important percentage of snowfall may be lost to the atmosphere as ecaposistimation.
 Mediterranean/semiarid high mountain.
- In Sierra Nevada (Spain) vapour losses of 30% at 250 masl and 37°N
- An inter-annual variation from 24 to 33 % depending on magnitude and timing of the snowfalls.
- Evaposublimation is a slower process than melting, but remains active for longer periods.
- Implications of this study important for water planning decision makers.

There are differences in albedo decay between Sierra Nevada and Pyrenees. Faster at the former.

Linear Albedo decay fits well for ground observations, modelling and satellite observations. Two trends (cold-hot/melt).

Albedo and its trend are very variable among sites because of dust, ice, grain metamorphism. Variable with elevation and with aspect.

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