Local high-energy particles measurements for detecting primary cosmic-ray variations: application for soil moisture estimation

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Cosmic rays neutron sensing

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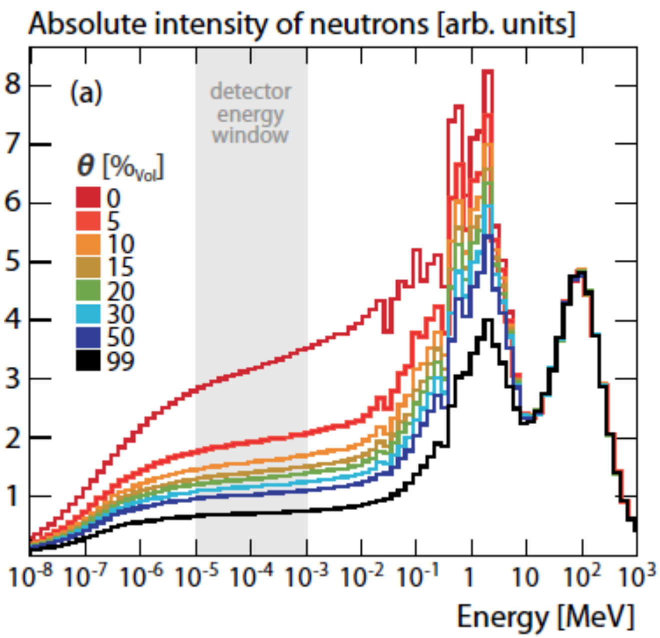
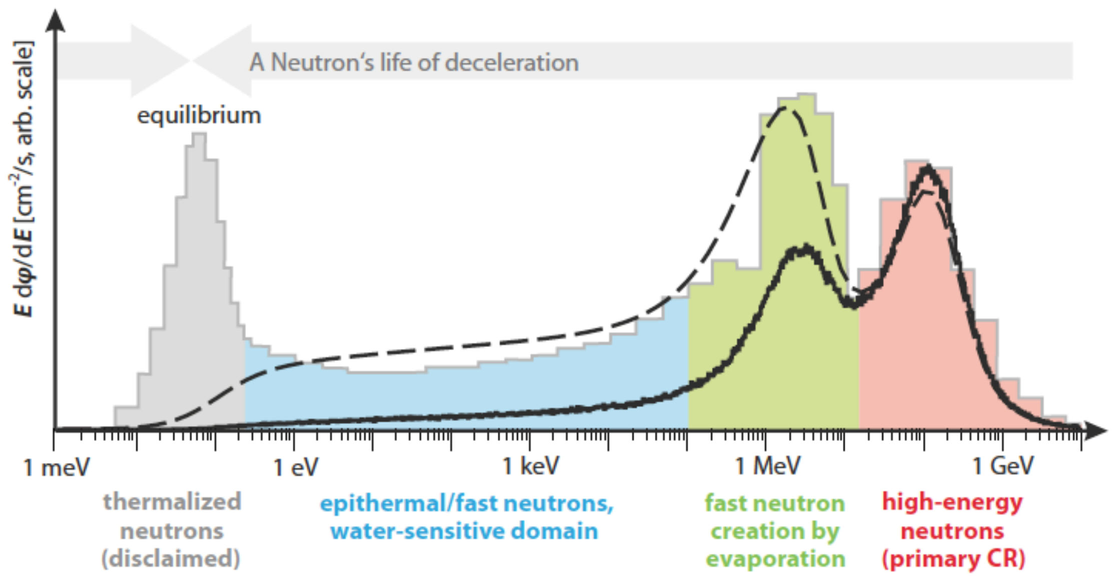
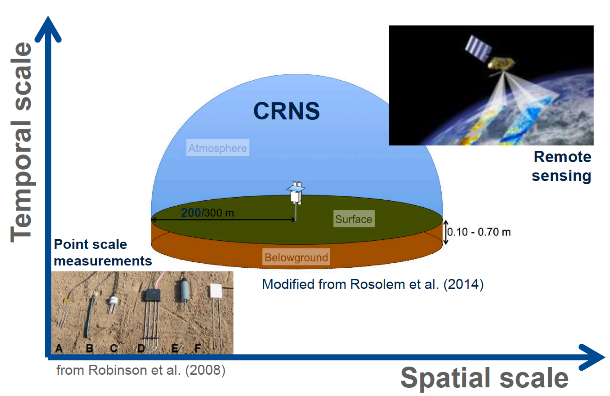


Kohli, M. et al. (2015), Water Resour. Res., 51: 5772–5790



Current measurements capability



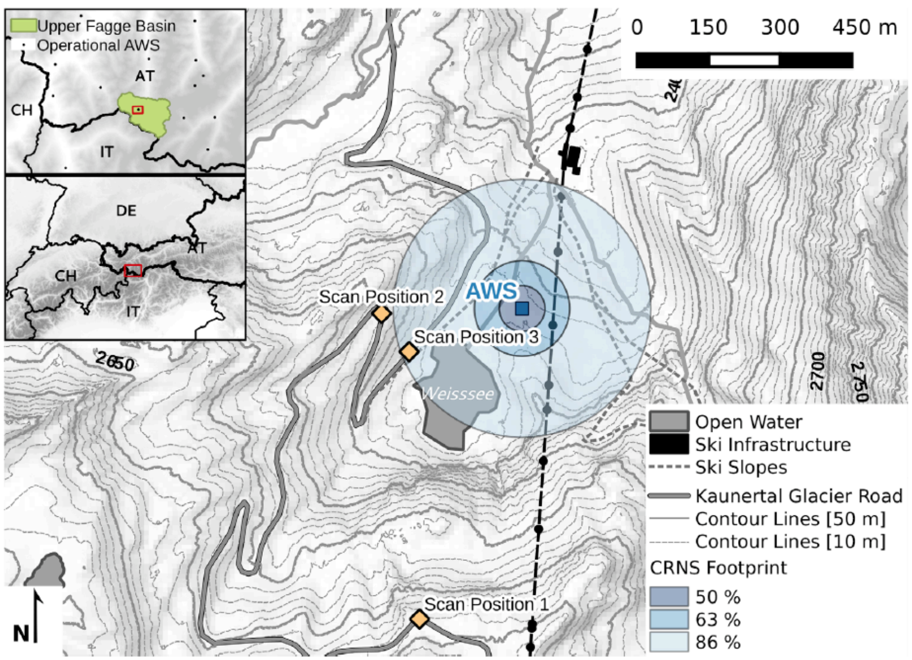
Corrections:

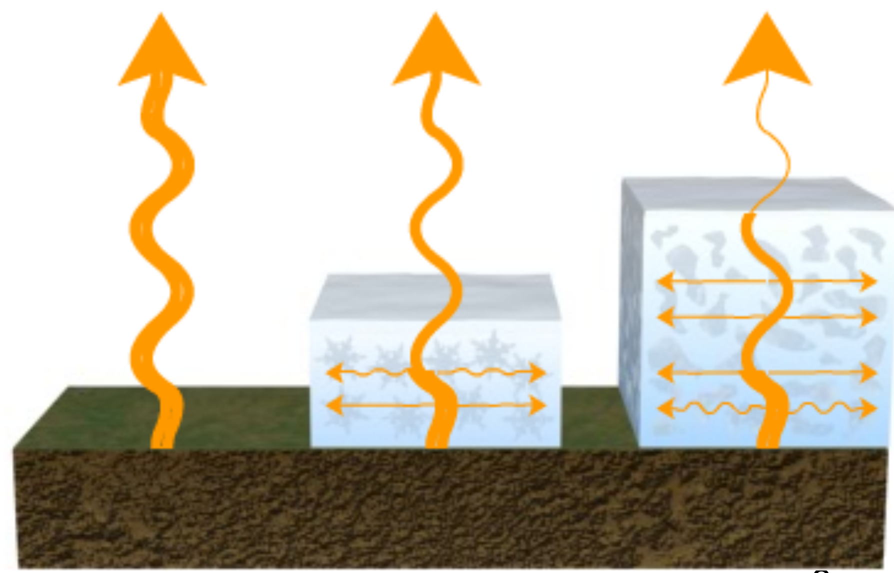
- By atmospheric pressure,
- By air humidity,
- Biomass
- **By temporal fluctuations of incoming cosmic rays (by existing databases of neutron monitoring worldwide stations e.g., Kiel, Germany,**

Measuring SWE aboveground with CRNS

Advantages

- Large footprint -> averaged over 25 hectares
- Easy to maintenance -> out from snowpack
- High durability -> Not buried into the snow
- Insensitivity to soil moisture (over 30 cm of snow)

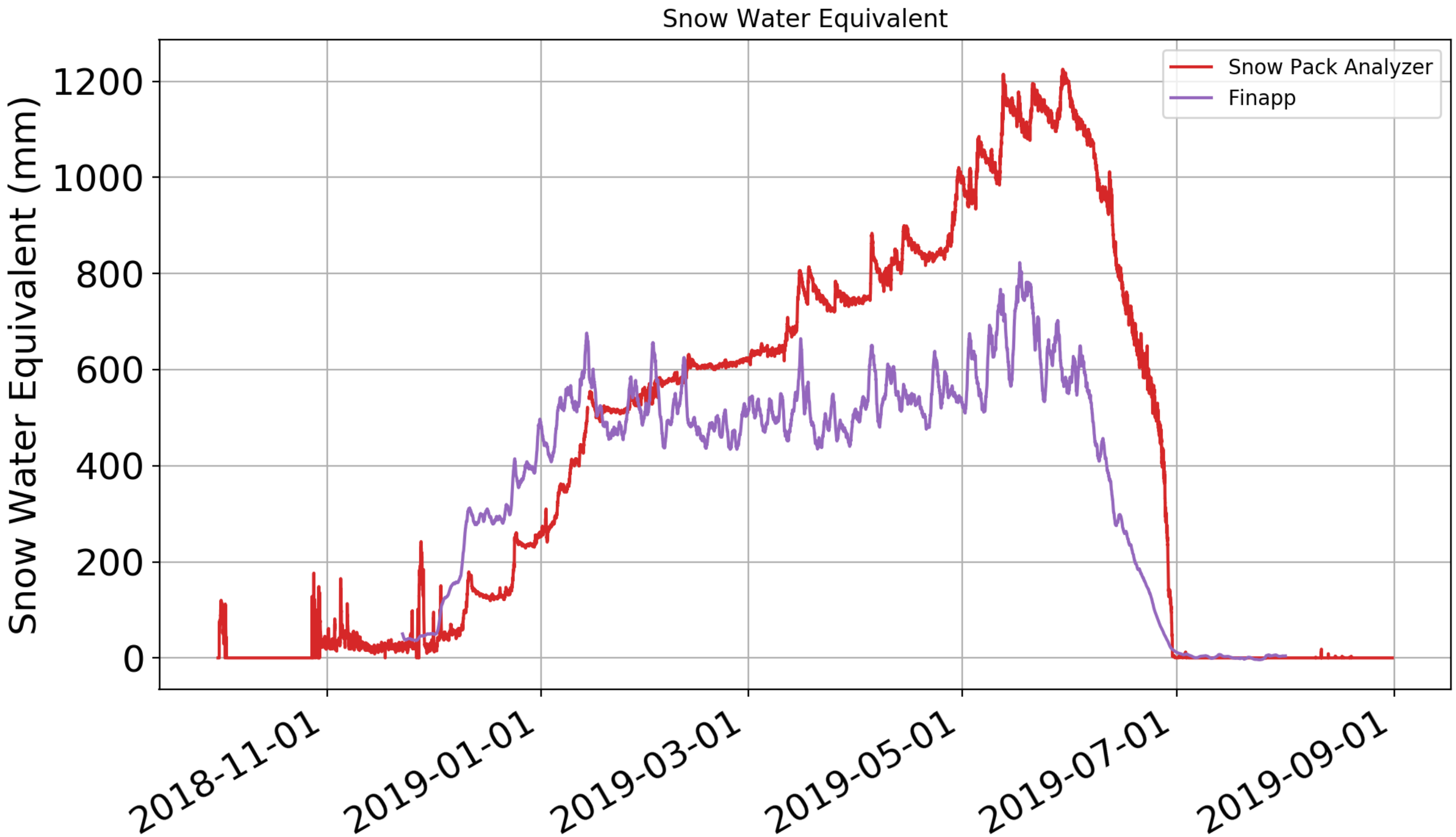




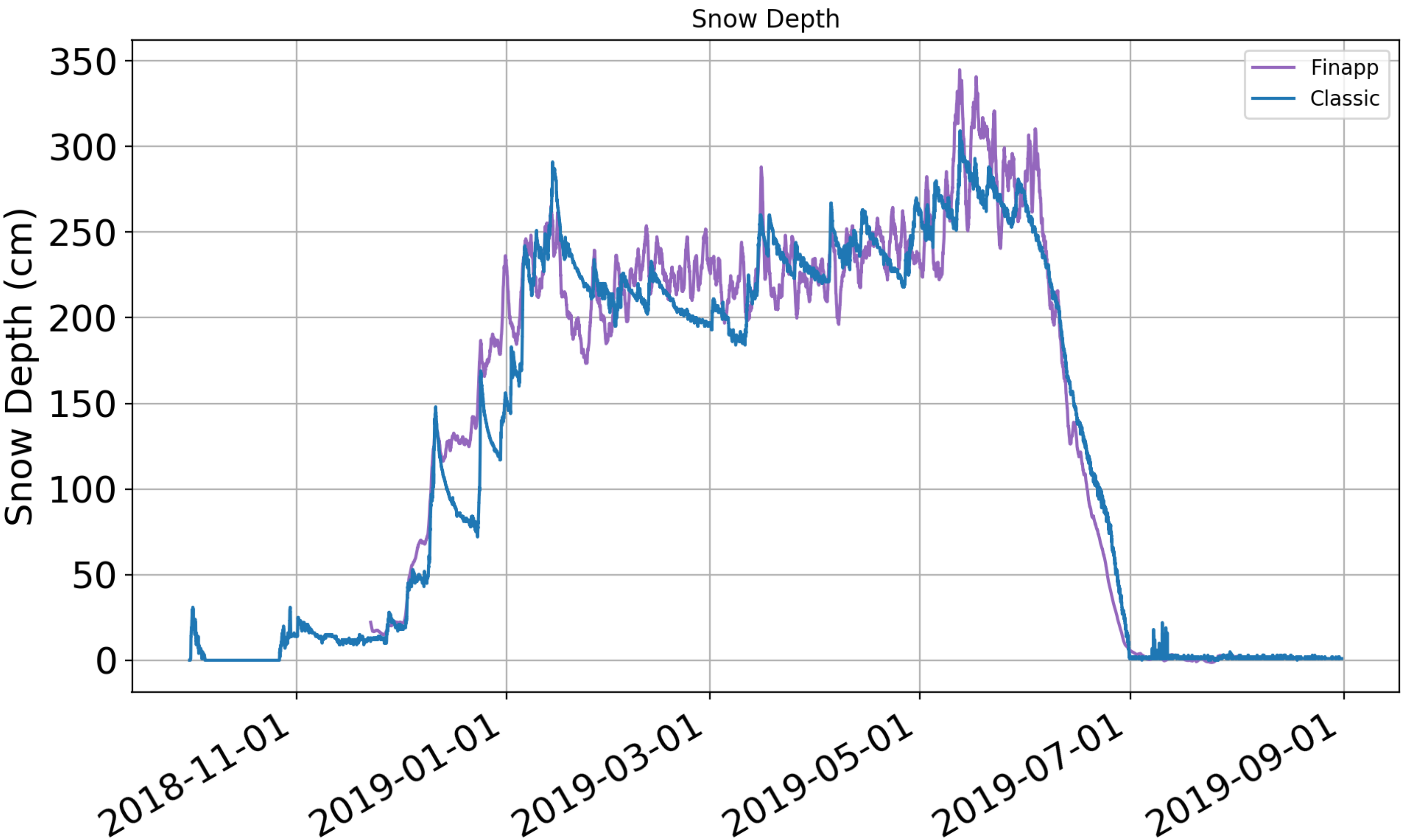
Finapp @ Kaunertal Glacier

Neutron variations @ Kaunertal

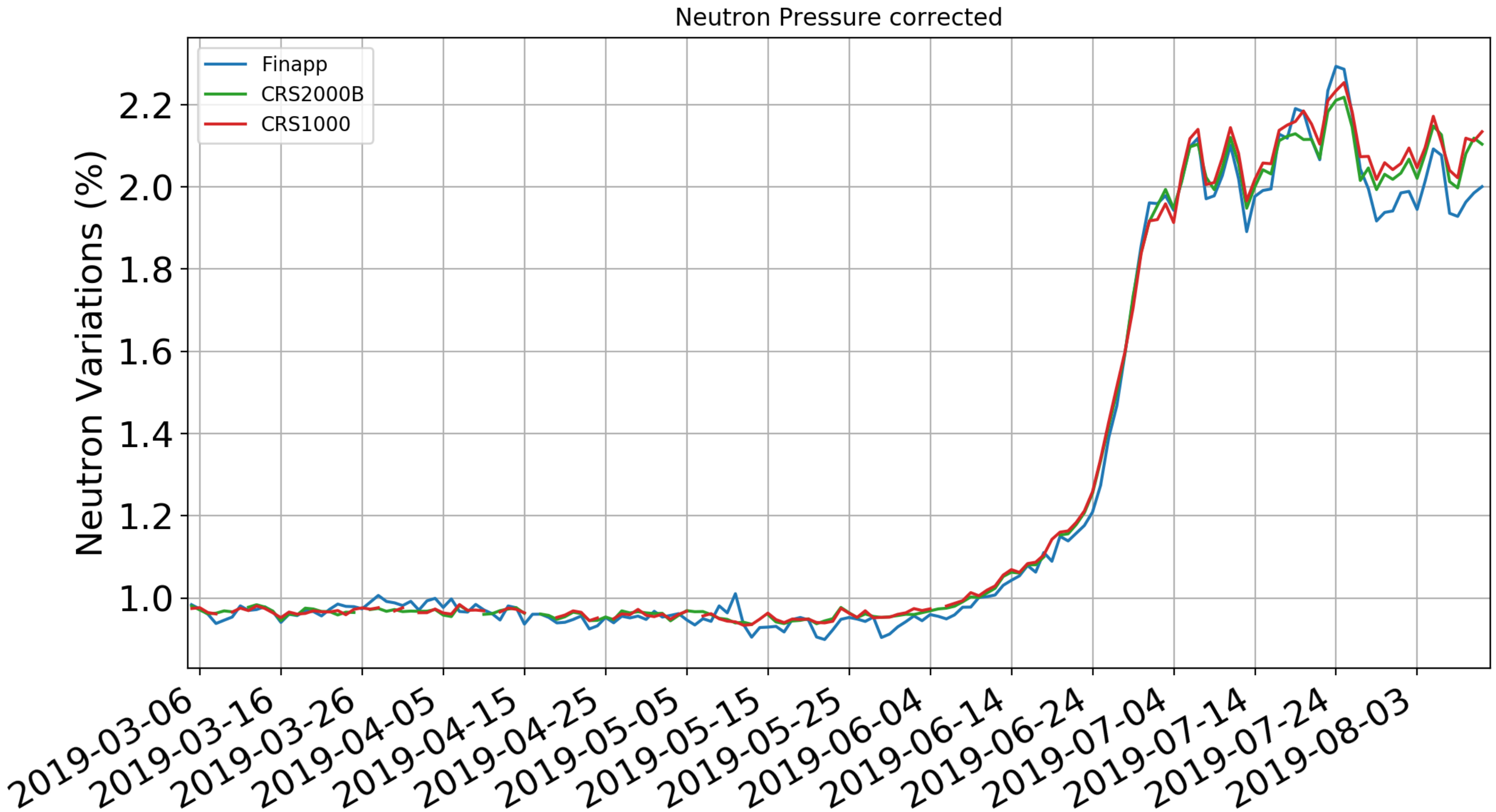
During 2018/19 winter there was articular condition with more than 1000mm of SWE and a completed saturated neutron signal from january



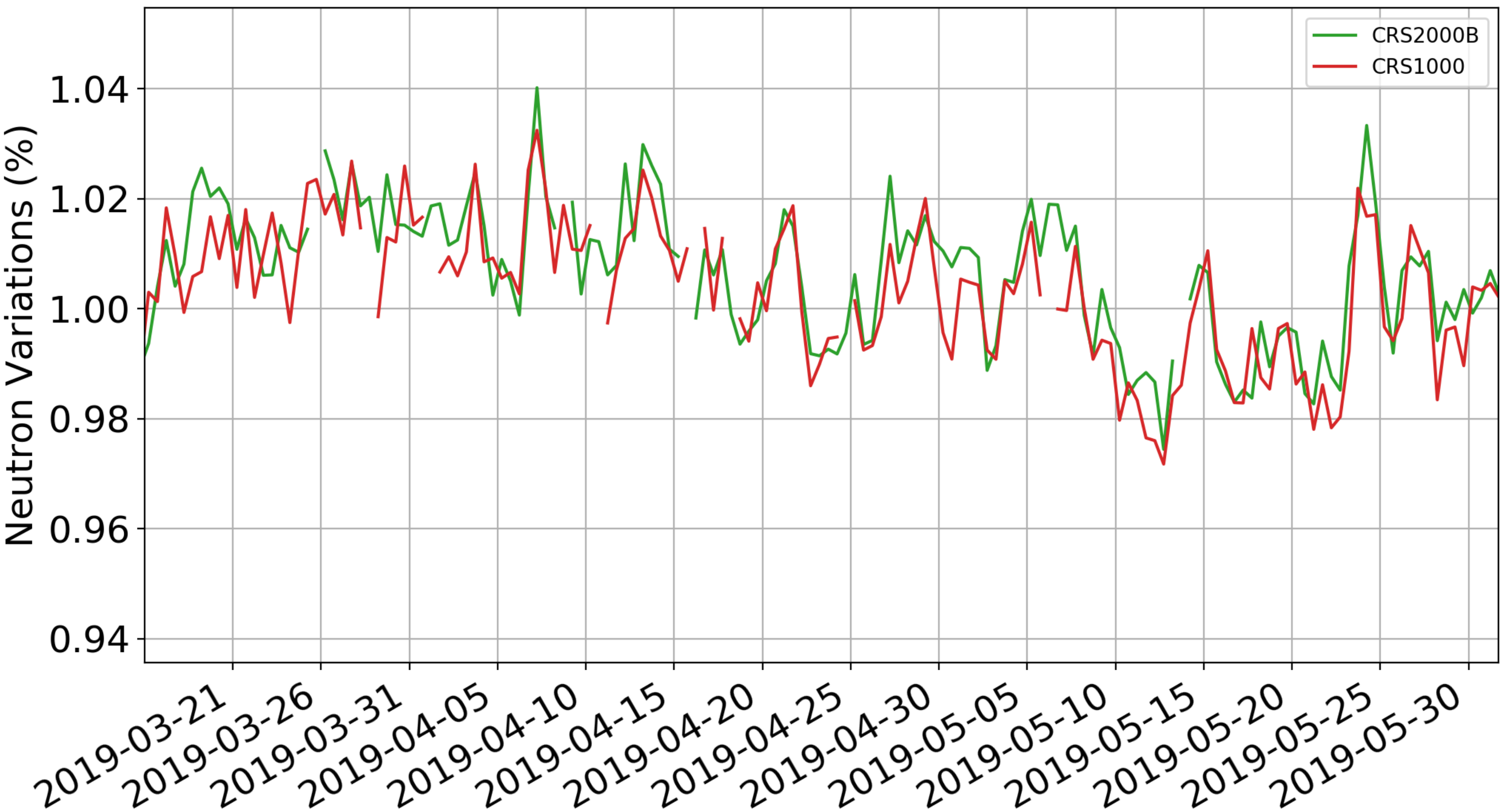
Finapp @ Kaunertal - SWE aboveground



Finapp @ Kaunertal – Zoom on spring

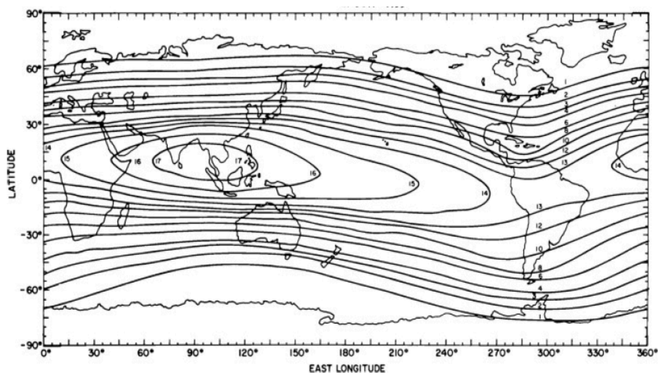


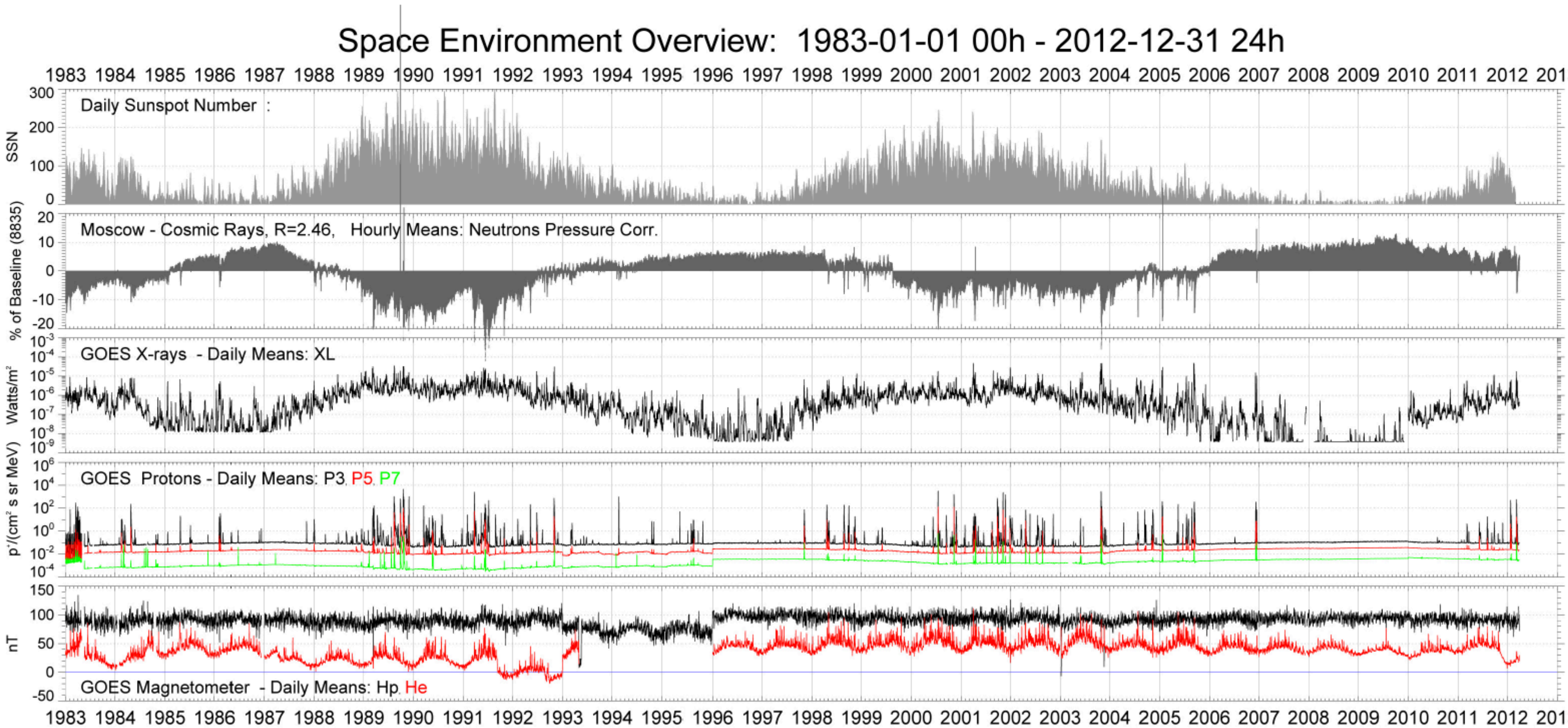
Neutron drop in a saturated signal, incoming?



Why is it so important to measure incoming?

Incidental cosmic radiation can vary considerably over periods ranging from a few days to several months/years. These variations may be due to astronomical events such as solar cycles, solar flares, Forbush events, etc.





Cosmic-Ray Snow Gauges example

The signal measured on the site **has to be corrected by the incidental CR variations** measured by a reference sensor which is protected from the snow at a latitude close to the mountain sensors (Moscow, Ouly-Finland, Athens)

At the end of October 2003, **in 3 days the radiation dropped by almost 18%**.

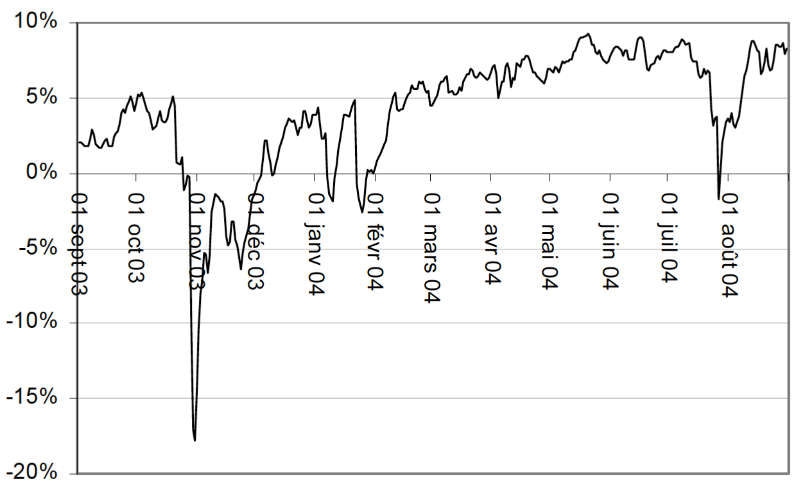
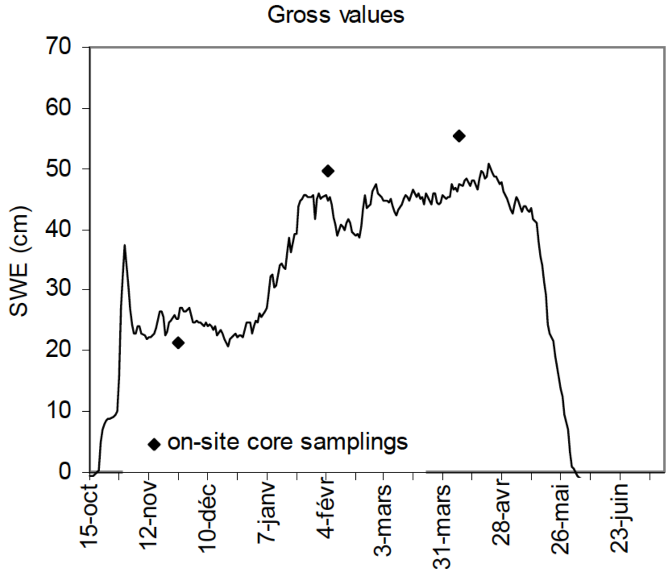
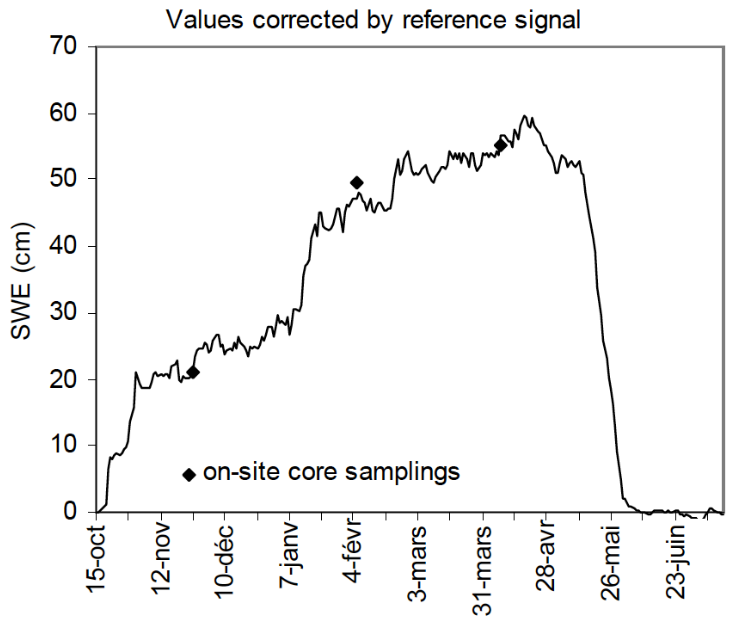
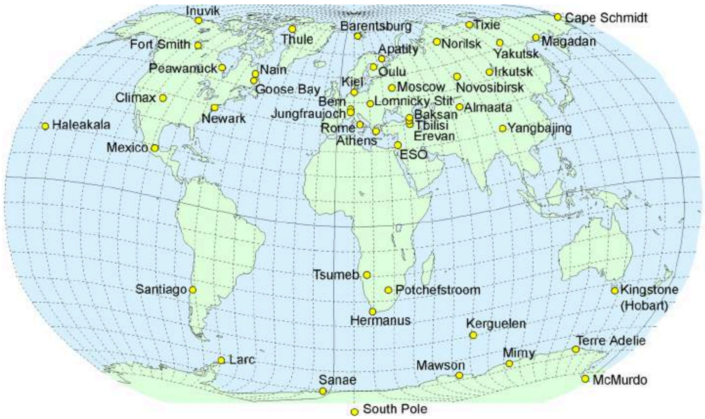


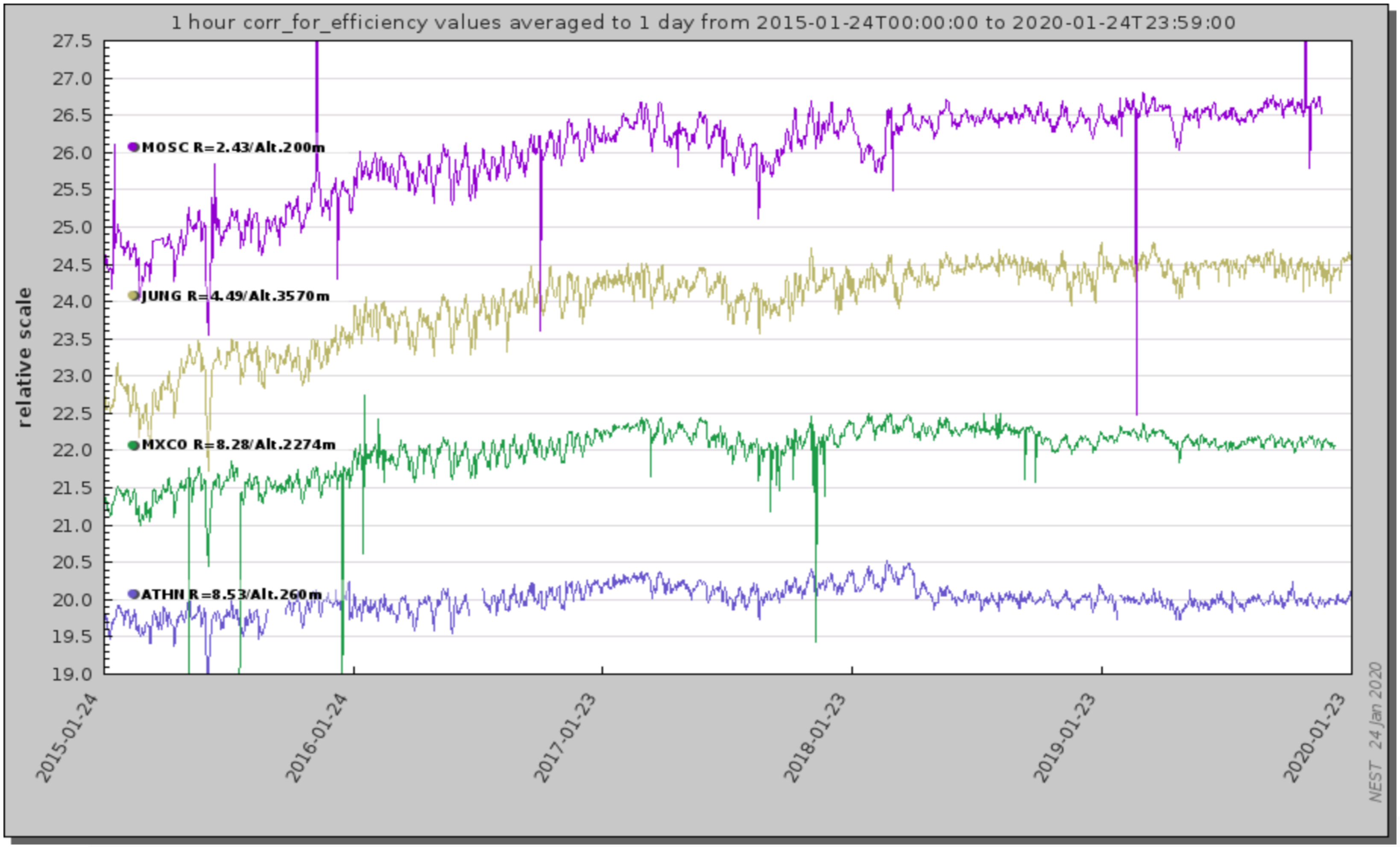
Fig. 5 – Moscow gauge – Relative variations of cosmic radiation (2003-2004 season, September 2002 reference level)





How was managed the cosmic ray fluctuations until now? Neutron Monitor DATABASE: 40 stations over the world

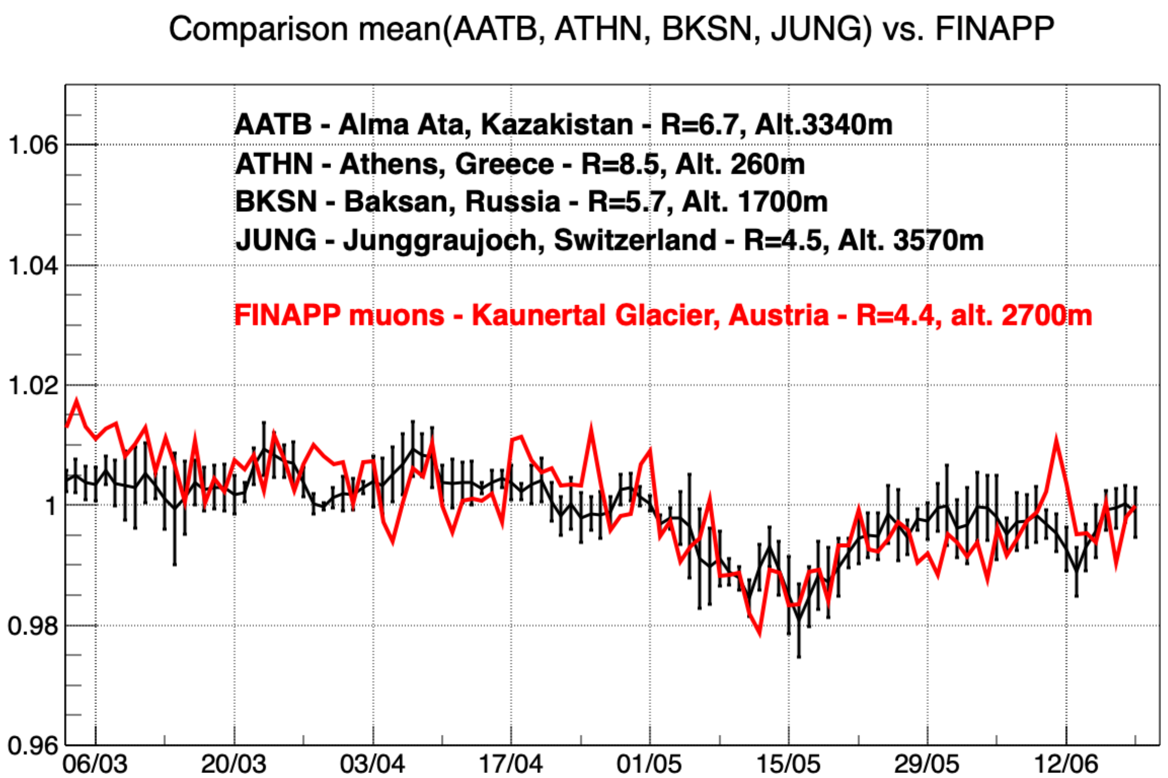




Finapp measures cosmic variations

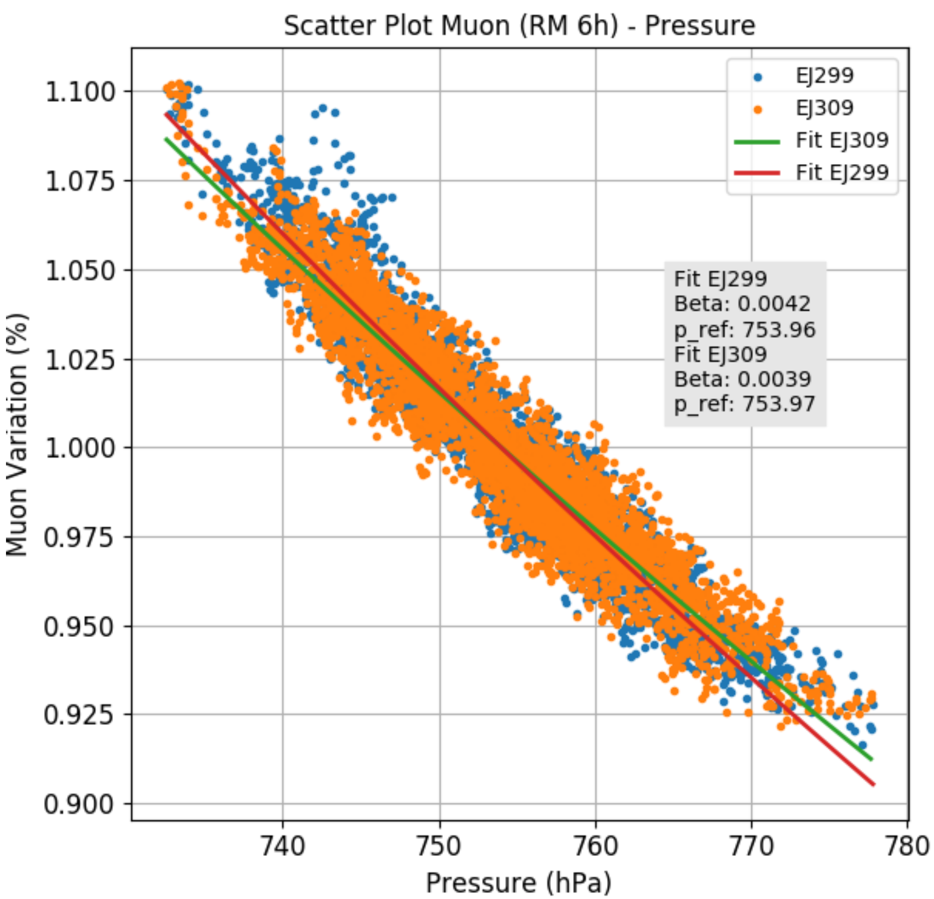
Finapp can measure locally the cosmic-rays fluctuations

The probe is completely autonomous



Finapp measures cosmic variations

Pressure correction for muon varies with altitude



Altitude	Beta	Muon cph
Sea level	0.0020	4.500
1300 m	0.0028	6.000
1918 m	0.0035	9.800
2700 m	0.0042	12.000