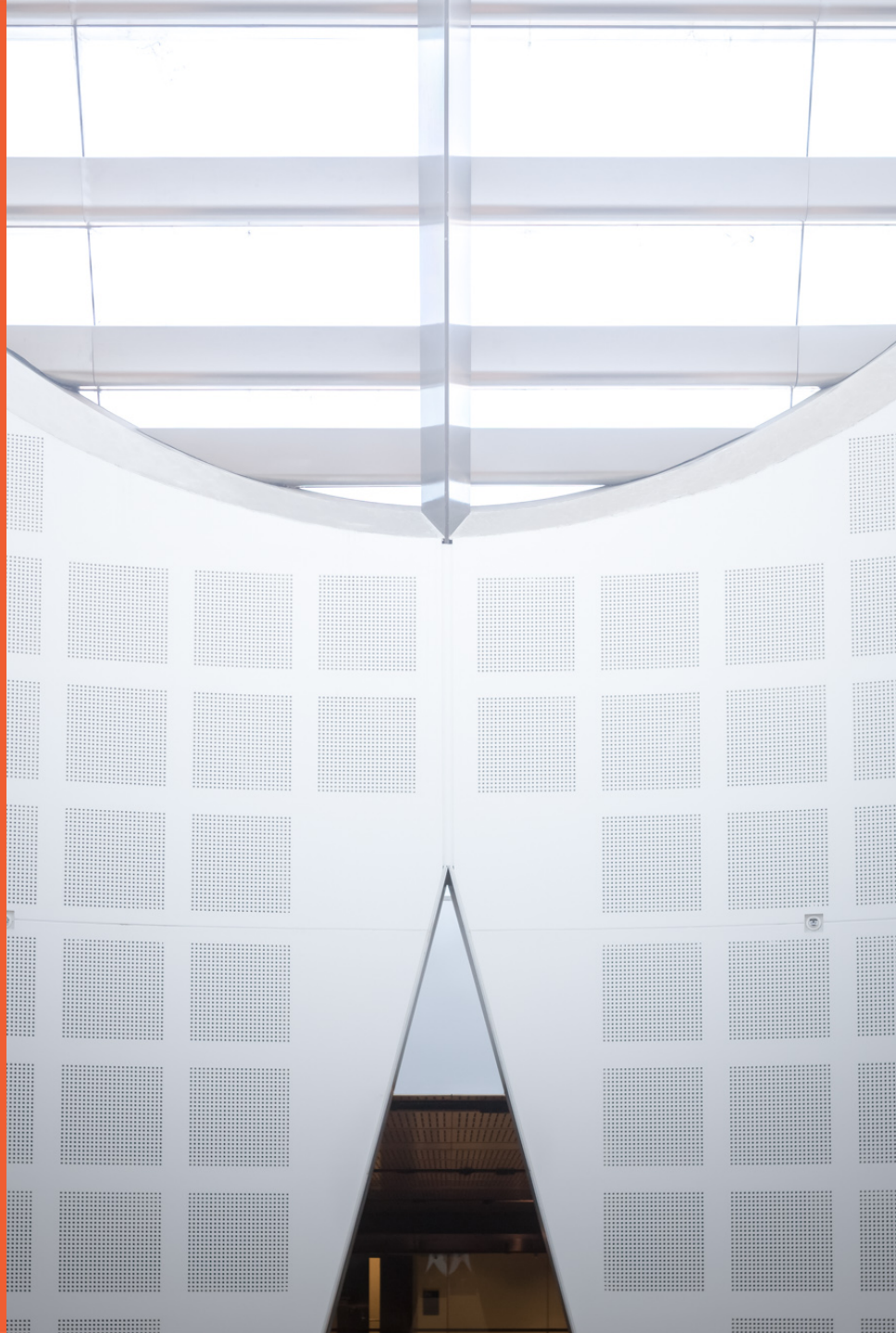
Sensing of farm-scale soil moisture content using a mobile cosmic ray probe

Niranjan Acharige

T.F.A Bishop, B. Evans, P. Filippi, E. Jones, B. Malone, M.F Pedraza, U. Stockmann, J. Moloney

Sydney Institute of Agriculture

THE UNIVERSITY OF SYDNEY



Introduction

Soil moisture: Who needs it? What form?

End user	Horizontal	Vertical	Temporal
Hydrologist	Soil type	Horizons	Daily
Climate modeler	10km+	Surface	Hourly/Daily
Farmer (dry land)	Paddock/100m	Horizons	3 times/year

- Farmer needs soil moisture for management decisions
  - Determine the sowing
  - Determine the fertilizer rates
  - Futures markets

Cosmic Ray Probes

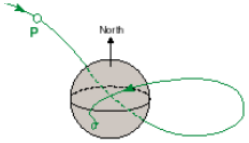
Static & Mobile

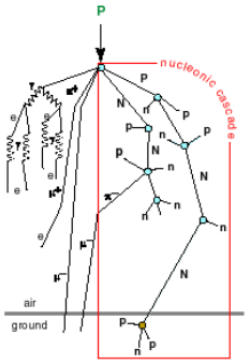
- Vertical support: 12cm in wet soils, 70cm in dry soils
- Horizontal support: ~300m radius
- Non-invasive, non-contact measurements
- Insensitivity to soil texture and surface roughness

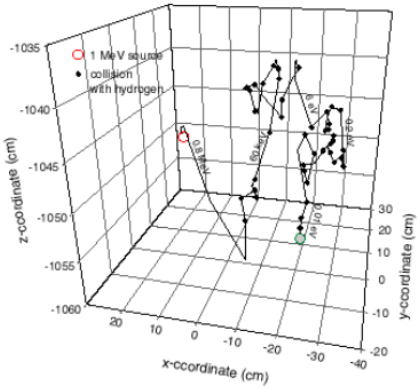
- Mobile version available: trailer mounted
  - CosmOz Rover
  - mapping opportunity

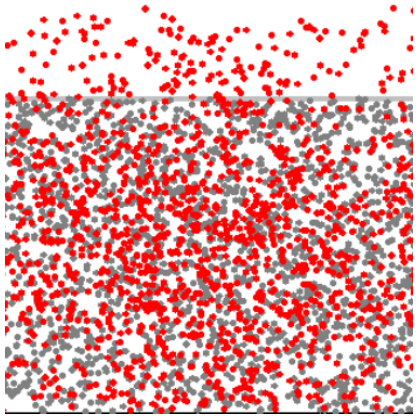
Theory behind

Neutrons count

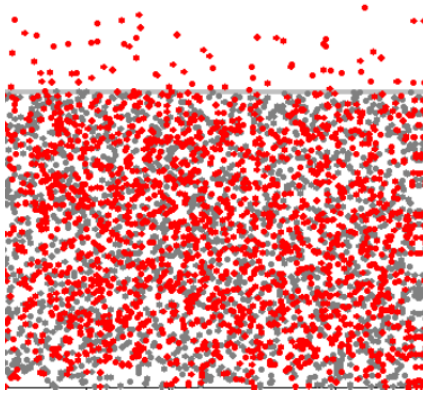








In drier soil,
more neutrons escape

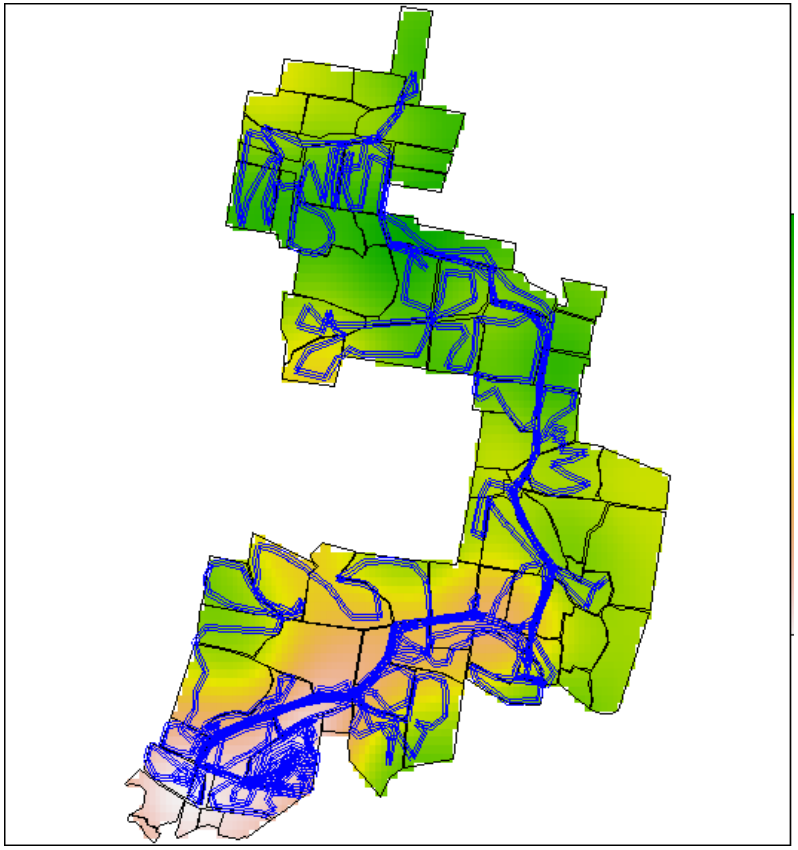


In moister soil,
less neutrons escape

The number of neutrons counted over a period of time is inversely proportional to the amount of water in the soil.

Datasets

Raw neutron count



The blue tracks – CosmOz roving paths

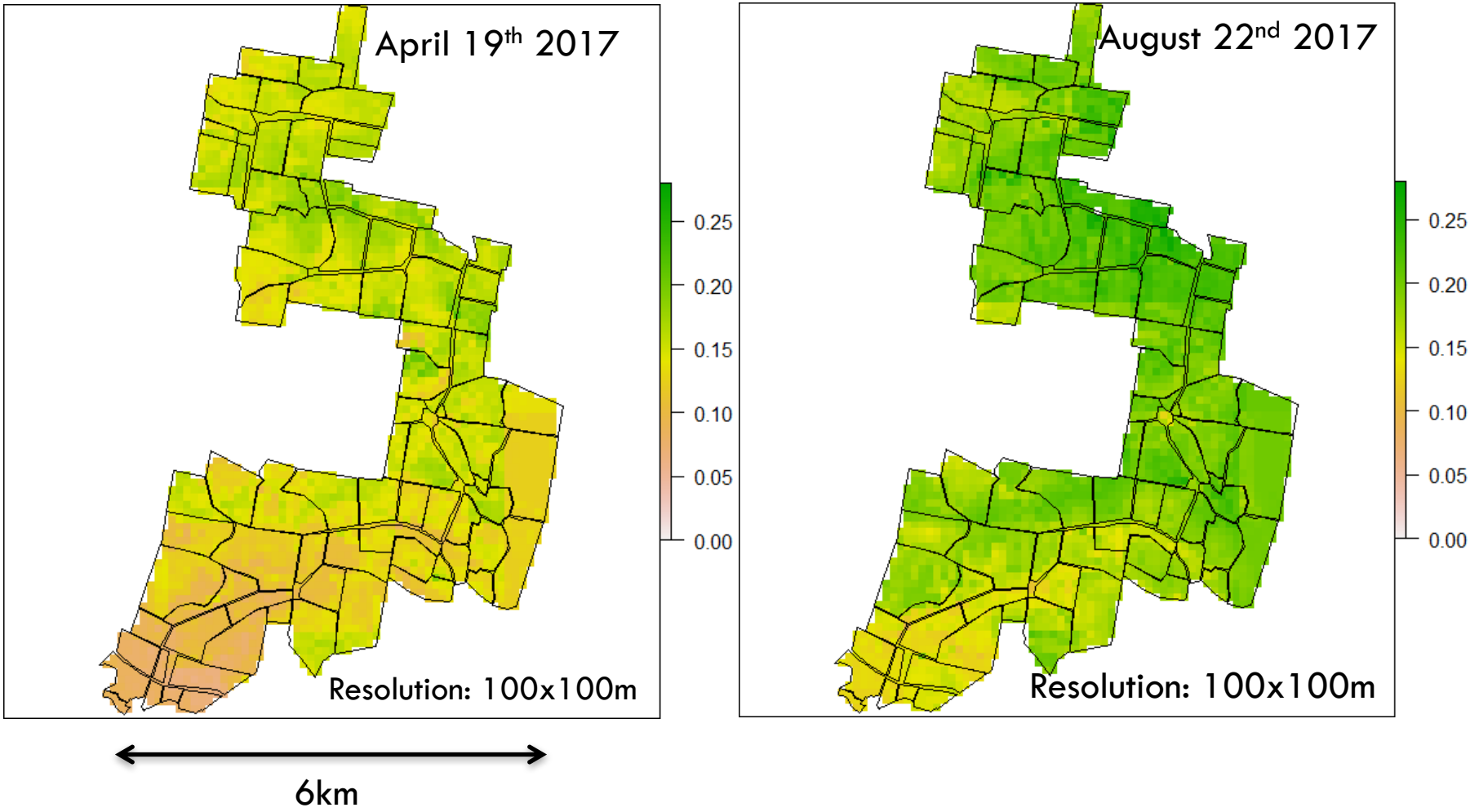
Raw neutron count required to be corrected by removing variation due to environmental factors

&

Calibrate with in-situ soil moisture sampling

Soil moisture maps

Gravimetric soil moisture predictions (0-30cm) – JB Fairfax farms
Muttama (6370 hectares)



Future work

- Consultant who has a CosmOz rover; surveys and sell to farmers

- Nation wide soil moisture product combining with other models & data sources