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The WMO-SPICE Snow-on-Ground Measurement Intercomparison



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**WMO SOLID PRECIPITATION
INTERCOMPARISON EXPERIMENT
(WMO-SPICE)
2012-2015**

COST ES 1404 Meeting, Grenoble 18-20 March 2015

WMO-SPICE Snow-on-Ground

Background:

- Sub-component of the overall WMO-SPICE project
- Focus on in-situ measurement of snow depth and SWE
- Automated instruments for intercomparison are either provided by the manufacturer or by the site host
- 2013/2014 and 2014/2015



WMO-SPICE Snow-on-Ground

Primary Objectives

1. Characterize and recommend automated methods for the measurement of total snow depth in a range of conditions, including instrument siting and installation
2. Assess Instrument Performance
 - Failure rates
 - Measurement repeatability and noise
 - Accuracy
 - Impacts of signal correction (e.g. for the speed of sound)
3. Instrument Thresholds
 - Minimum/Maximum depths
 - Minimum/Maximum temporal resolution

WMO-SPICE Snow-on-Ground

Secondary Objectives

1. Assess spatial representativeness of point measurements
2. Assess ability of automated sensors to determine SWE of accumulated or freshly fallen snow, linking these measurements to the reference gauge and snow depth measurements where possible



Participating Sites

16 countries hosting a total of 20 field sites;

- *Australia, Chile, Canada, Finland, France, Italy (Nepal), Japan, Korea, Norway, New Zealand, Russia, Poland, Switzerland, Spain, USA.*

~8 countries participating in SoG experiments, ~10 sites



Legend

- | | | | |
|-----|---------------------------------------|-----|---|
| 1. | Caribou Creek, Saskatchewan, Canada | 11. | Haukeliseter, Norway |
| 2. | Bratt's Lake, Saskatchewan, Canada | 12. | FMI/Sodankylä Arctic Research Centre, Finland |
| 3. | Marshall Site, Colorado, USA | 13. | Valdai, State Hydrological Institute, Russia |
| 4. | CARE, Ontario, Canada | 14. | Vojlskaya Observatory, Gorodec, Russia |
| 5. | Tapado AWS, Región de Coquimbo, Chile | 15. | Pyramid Observatory, Nepal |
| 6. | Formigal, Spain | 16. | Gochang, Korea |
| 7. | Col de Porte, France | 17. | Joetsu, Japan |
| 8. | Weissfluhjoch, Davos, Switzerland | 18. | Rikubetu, Hokkaido, Japan |
| 9. | Forni Glacier, Italy | 19. | Guthuga Dam, New South Wales, Australia |
| 10. | Hala Gasienicowa Station, Poland | 20. | Mueller Hut Weather Station, New Zealand |



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Participating Sites



Col de Porte, France



CARE, Canada



Participating Sites



Sodankylä, Finland

Caribou Creek, Canada



Snow Depth and SWE Instruments

Snow Depth



Campbell Scientific
SR50ATH-316SS



Felix Technologies
SL300



ESW GmbH
Jenoptik
SHM30



Hydrological Services America:
Sommer GmbH & Co KG
USH-8

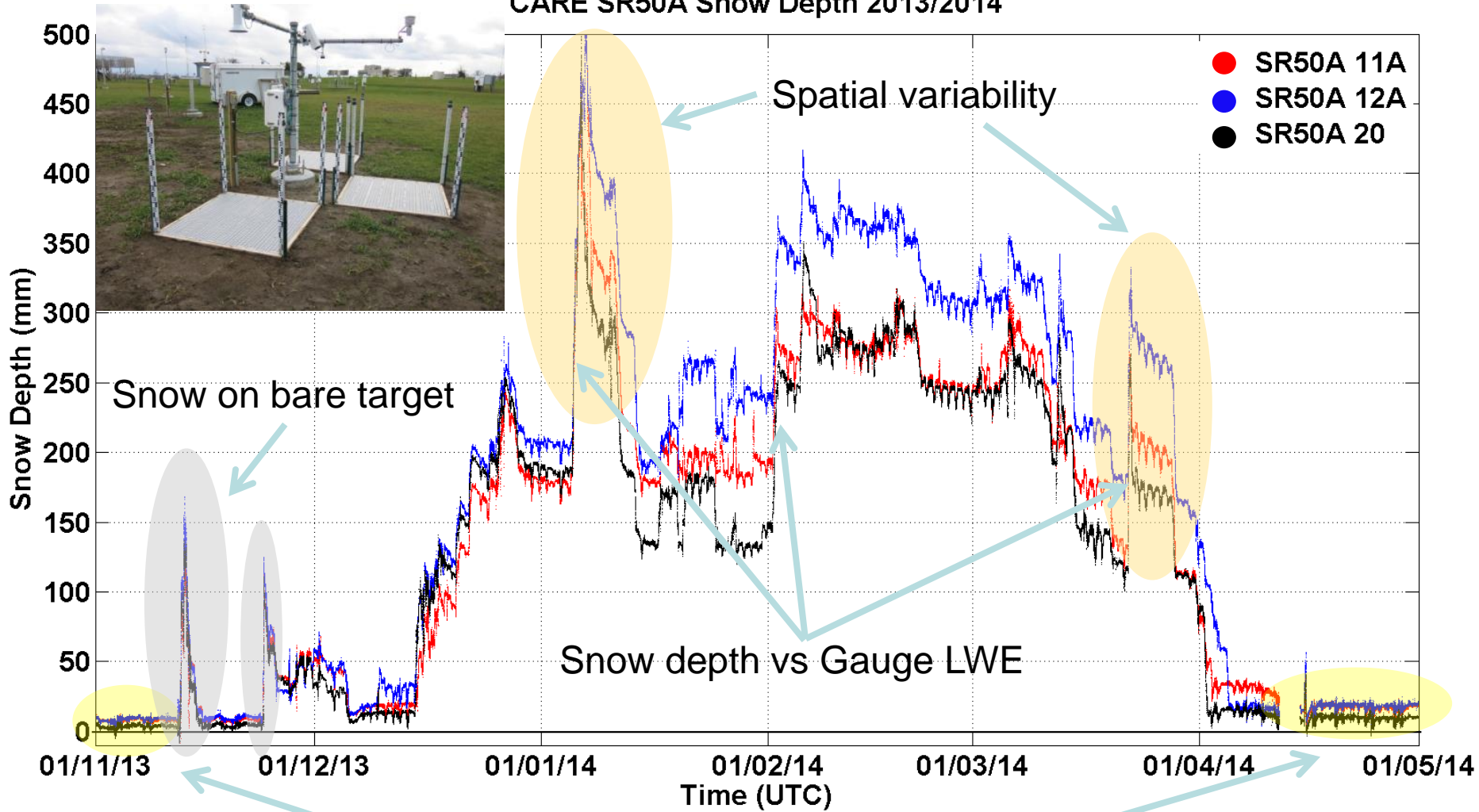
Snow Water Equivalent

Sommer SSG
Snow Scale



Campbell Scientific
CS725

CARE SR50A Snow Depth 2013/2014



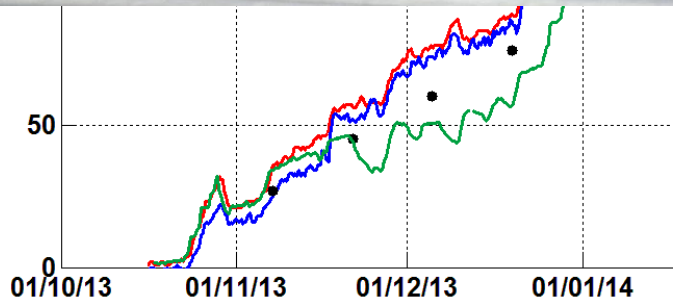
Zero offset consistency?



Preliminary Results

SWE Intercomparison: Sodankylä (Finland)

2013/2014 SWE Intercomparison - Sodankyla



Date (UTC)

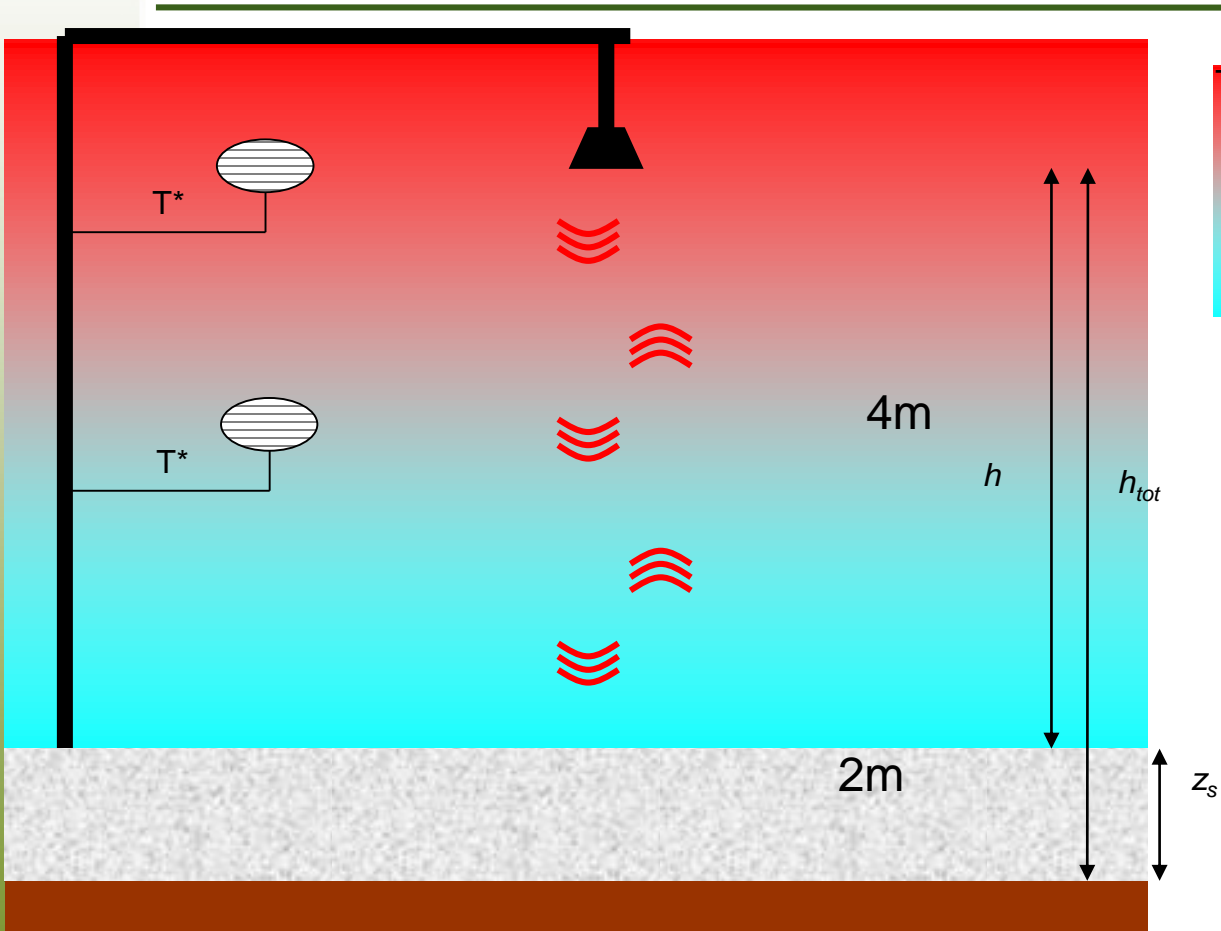


Preliminary Results

Snow Target Assessment



Sonic Correction Error Assessment



- Ultrasonic derived distances require a temperature correction for the speed of sound

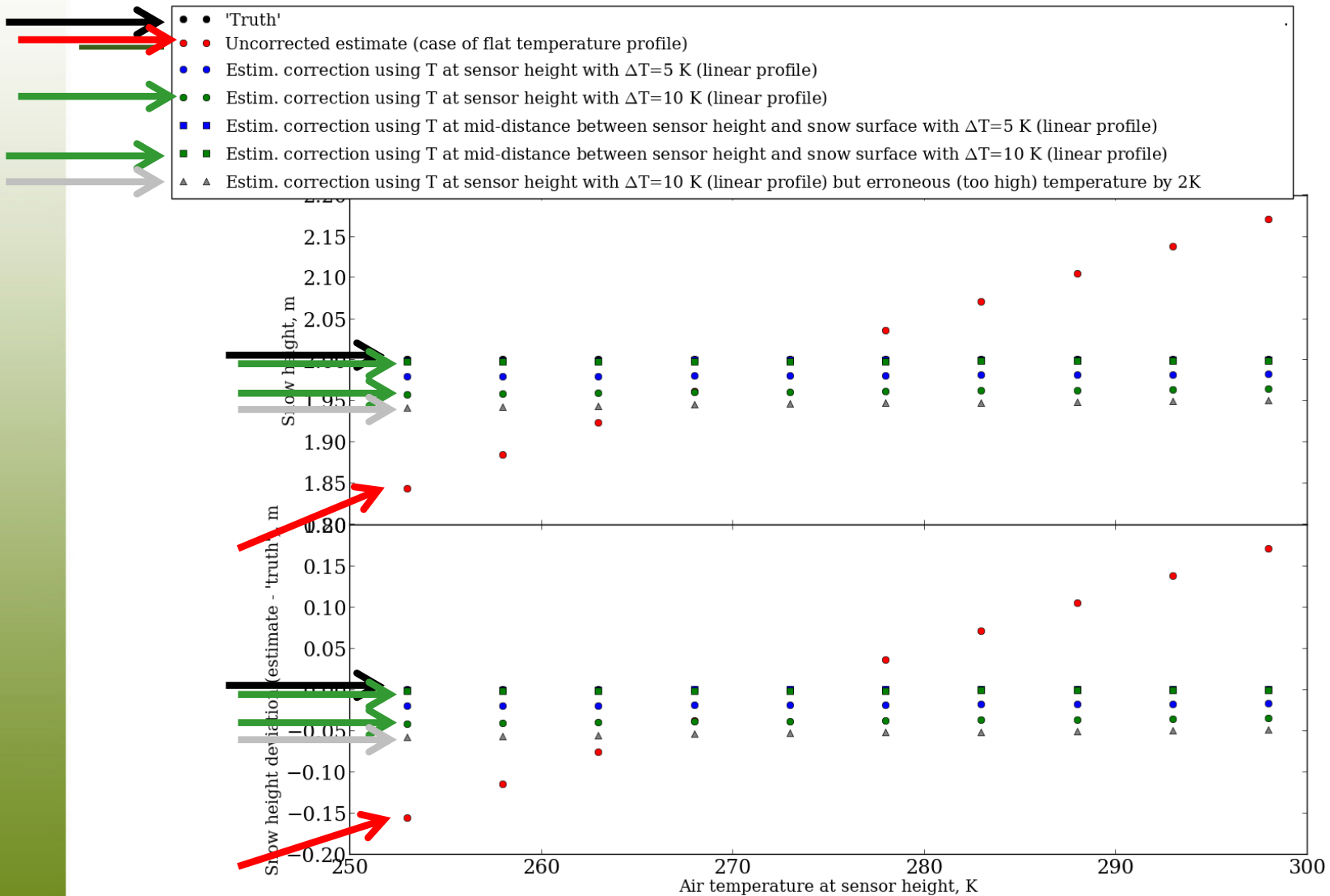
$$h_{corr} = h_{raw} * \text{sqrt}(T/T_0)$$

$$T_0 = 273.15 \text{ K}$$

- Inversions ?
- Where to place a single temperature sensor?

Preliminary Results

Sonic Correction Error Assessment





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Thank You

