Soil Moisture Product Assessment

WP4.6 Inputs

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Soil Moisture Data Generation

- CSME Cryosat2 soil moisture products full release
  - Simpson
  - Tenere
  - Kalahari
- Jason2 Processing for Soil Moisture Validation work

CSME Products Full Release v1.0

- Processing chain upgraded with information from beta release product assessment

- Cryosat2 Soil Moisture (CSME) Full v1 product release for slightly more than validation year of 2013 over Simpson, Tenere, Kalahari deserts. Products uploaded to website.

- Shown on following slides…
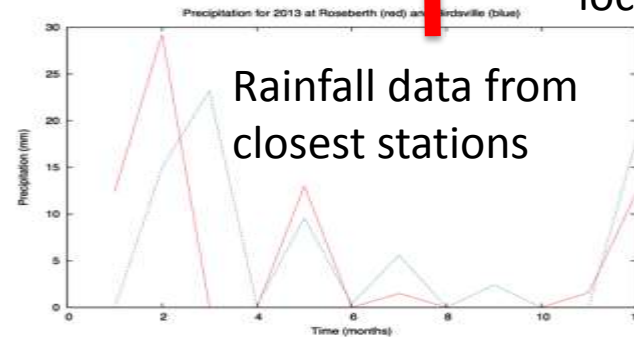
CSME Products - Simpson

Track 1349 Sigma0(purple) R1(blue) R2(yellow) DREAM(green) R1(red) R2(dk blue)

Simpson track repeats with DREAM
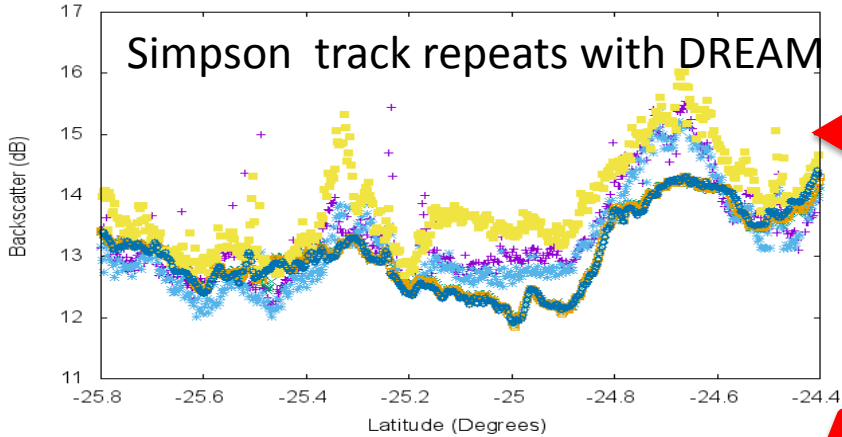
- Simpson recrafted DREAM works well for Cryosat2 backscatter

- Simpson very arid, no surface drainage. Little signal in validation year in CSME data
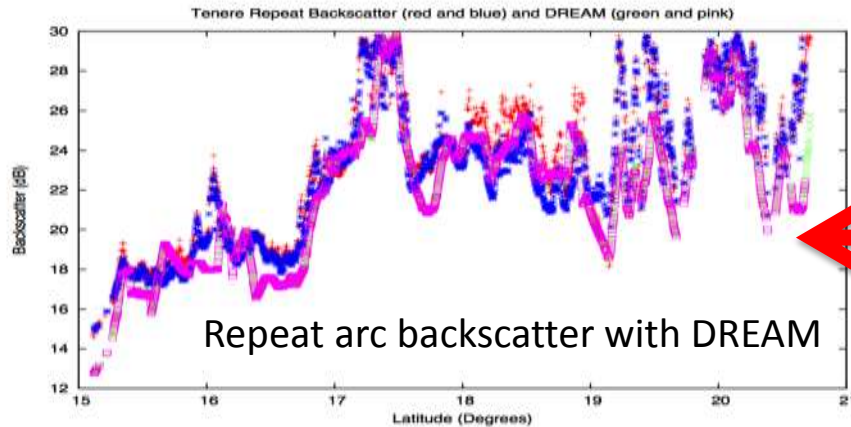

Simpson Jan-Mar 2013

Simpson Apr-June 2013

Simpson Jul-Sept 2013

Simpson Oct-Dec 2013
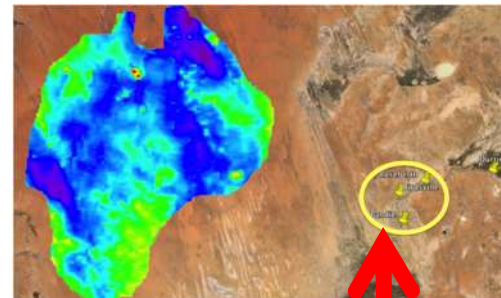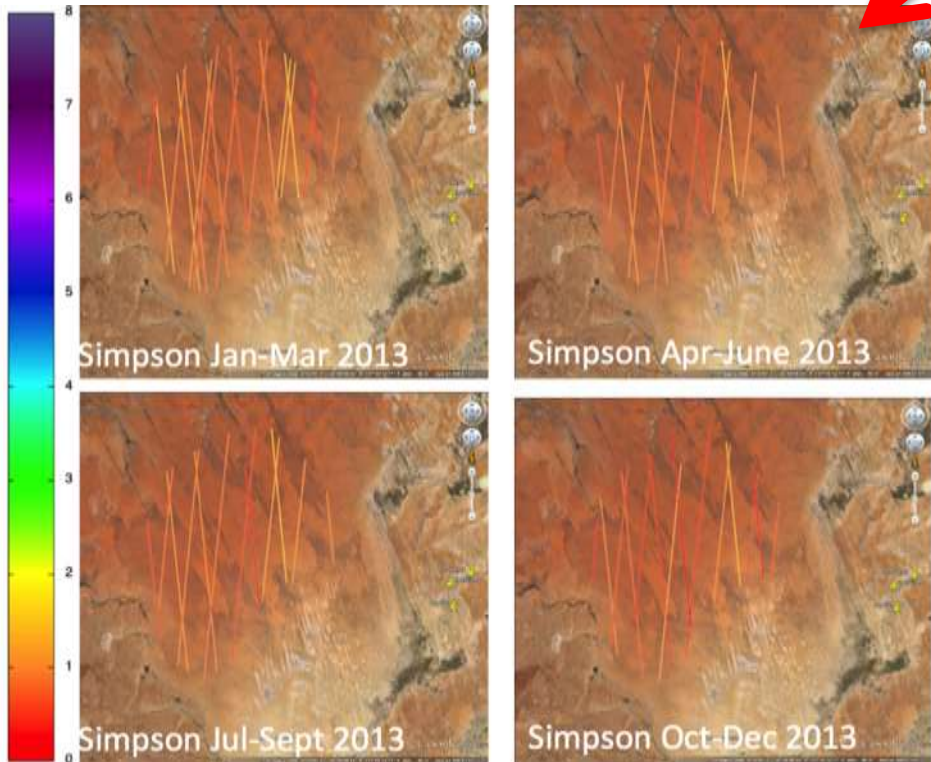
Stations distant from DREAM area
No surface flow so precipitation localised

Rainfall data from closest stations

Needs longer timeseries to see signals

Precipitation for 2013 at Roseberth (red) and Birdsville (blue)

CSME Products - Tenere

Repeat arc backscatter with DREAM

- Good performance of enhanced DREAM is seen in backscatter along-track plots with repeat passes

Tenere Jan-Mar 2013 Tenere Apr-June 2013
Tenere July-Sept 2013 Tenere Oct – Dec 2013
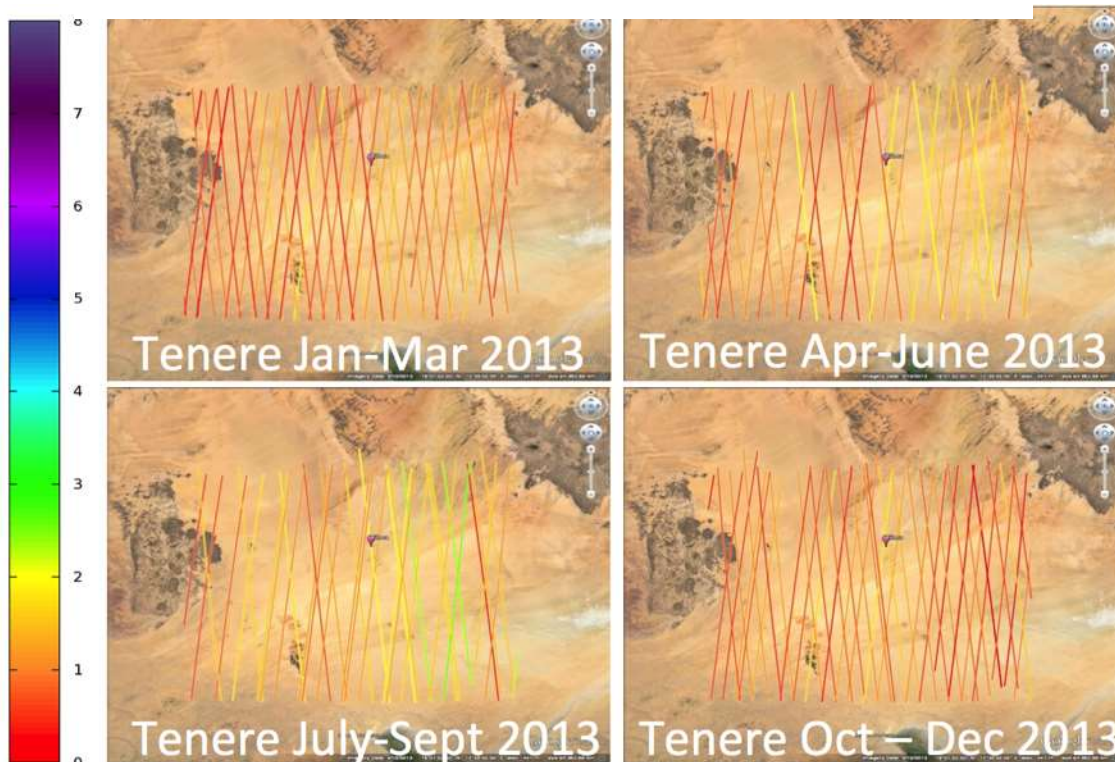
- Tenere has small annual soil moisture signal. Did not really expect to see this from Cryosat2 as there is no useful repeat cycle, but changes are apparent.

CSME Products - Kalahari

Track 1795 Sigma0(purple) R1(blue) R2(yellow) DREAM(green) R1(red) R2(dark blue)

Example repeat backscatter profiles with DREAM

Kalahari Jan-Mar 2013

Kalahari Apr-Jun 2013

Kalahari Jul-Sept 2013

Kalahari Oct-Dec 2013
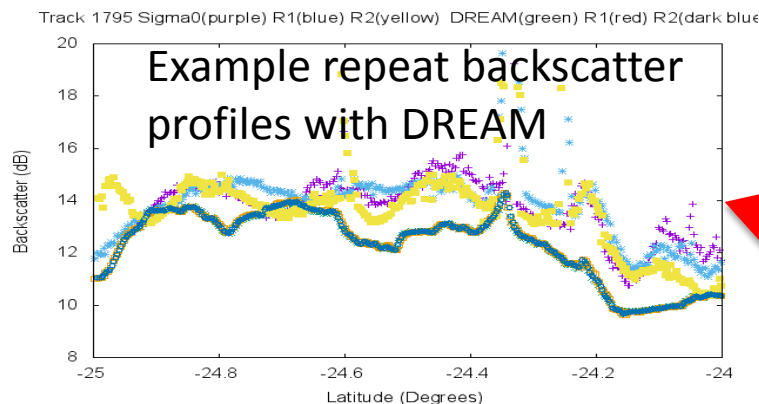
- Difficult test area for DREAM due to paleo-hydrology signatures but re-crafted DREAM performance extremely good.
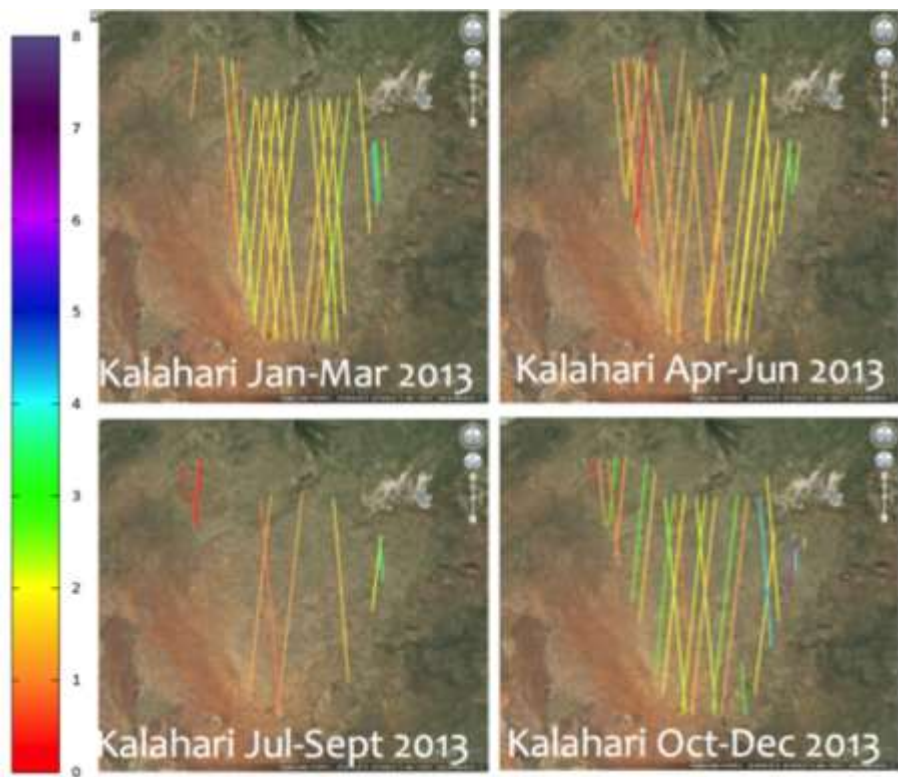
- Kalahari has several wetter months so this chosen as best prospect for seeing soil moisture signal. East side wetter: variation apparent

- CSME products for validation year shown on left as track averaged soil moisture estimates

Jason2 Soil Moisture Processing for CSME Validation

- Very limited in-situ data. Planned to use ESA SMALT Jason2 outputs but these only available over Tenere and found to be in error

- Decided to build new processing chain for Jason2 and use re-crafted DREAMS to generate soil moisture estimates

- Track averaged products made for consistency with CSME products
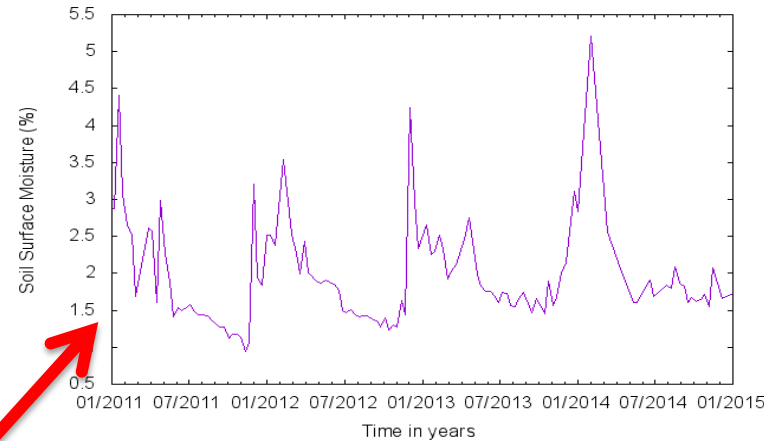
Jason2 Soil Moisture Derivation

Using Cryosat2 enhanced DREAMS, Jason2 data were processed over Simpson, Tenere and Kalahari deserts

Processing chain for Cryosat2 data rebuilt for Jason2. NO repeat arc masking was applied as had always been done with repeat arc data: this to test enhanced DREAM performance.

Very good result with enhanced DREAMS, soil moisture successfully derived over all three test deserts.

Track based estimates generated for CSME validation: enhanced spatial sampling for 'pixels' along-track now being generated for Kalahari and Tenere deserts..

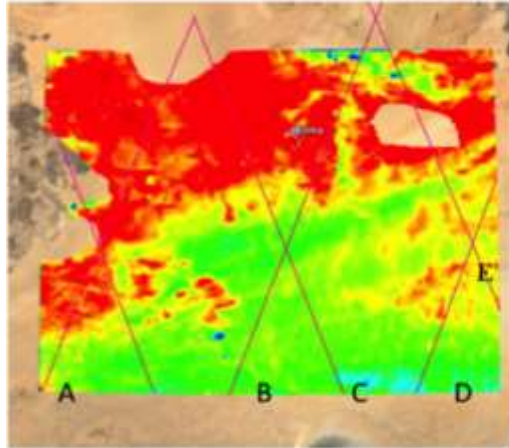Kalahari Desert Sample "Pixel" Soil Moisture from Jason2 Track

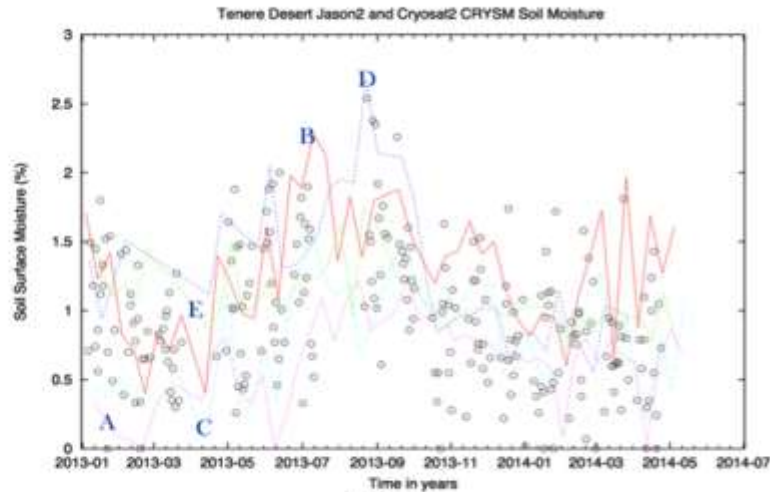Tenere Desert Sample "Pixel" Soil Moisture from Jason2 Track
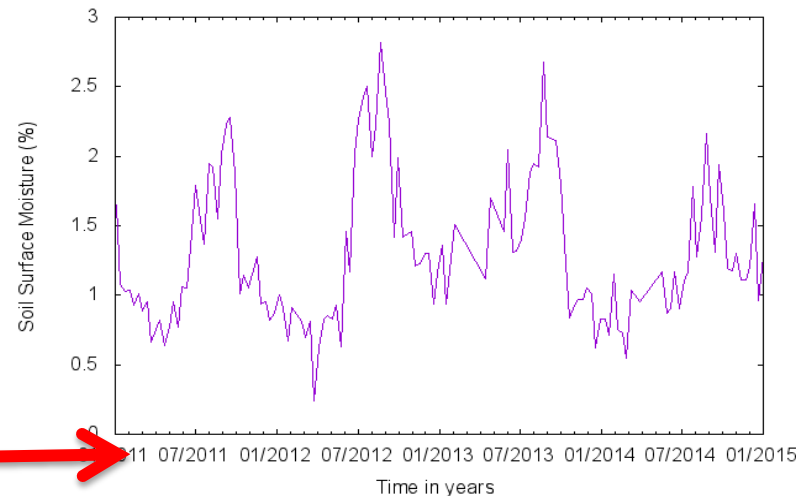
Soil Moisture Product Assessment

- CSME products generated for slightly more than validation year.

- In-situ data extremely sparse so Jason2 data processed to give validation dataset (ESA SMALT data not useable)

- Simpson desert has insufficient signals in validation year: need long timeseries for comparison

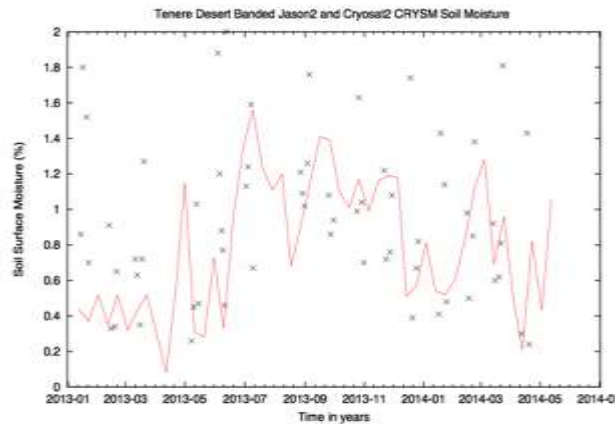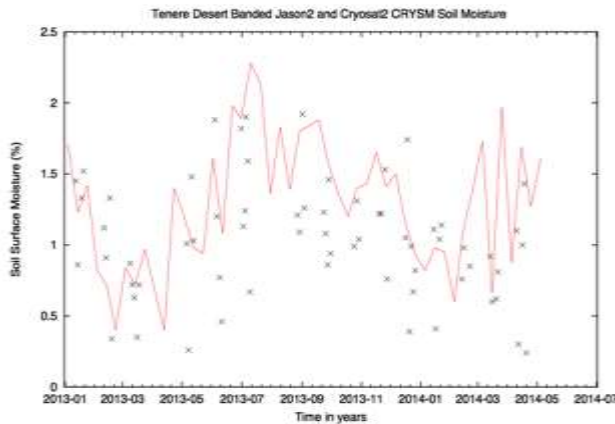- Validation outcomes for Tenere and Kalahari including longitude banded results for Tenere

Tenere Jason2 Validation

(a)

Tenere Desert Jason2 and Cryosat2 CRYSM Soil Moisture

(b)

Tenere Desert Banded Jason2 and Cryosat2 CRYSM Soil Moisture

Tenere Desert Banded Jason2 and Cryosat2 CRYSM Soil Moisture

Two example Jason2 Tenere soil moisture timeseries with nearest CSME track results

Jason2 track averaged soil moisture brackets geographically dispersed Cryosat2 estimates

Huge desert, so results were 'banded' by longitude to select closest Cryosat2 and Jason2 tracks

Good agreement seen

Kalahari Jason2 Validation
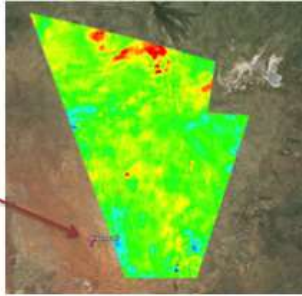
Kgaligadi transfrontier park holds average precipitation and temperature data
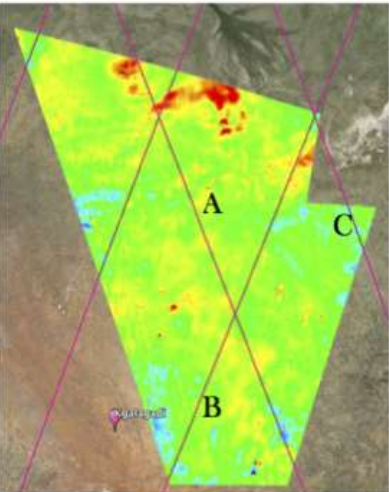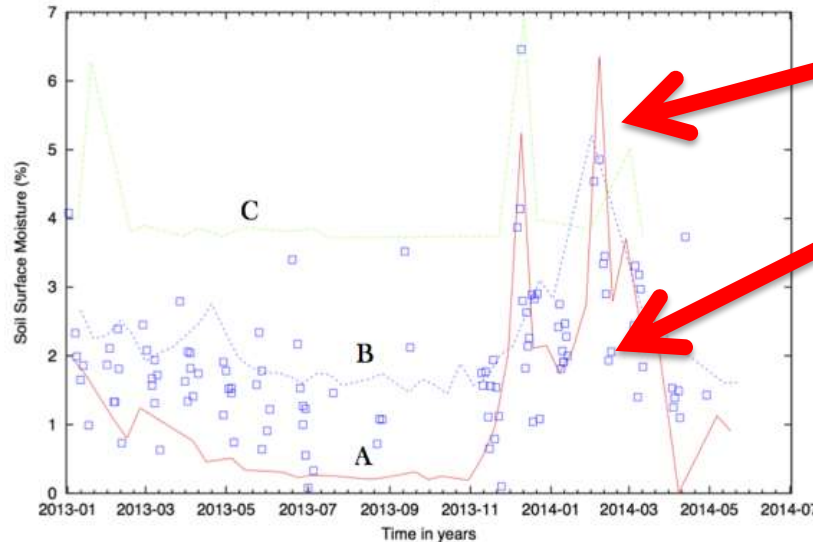
Kalahari desert: plotting average rainfall at Kgalagadi and CSME soil moisture shows clear correlation except first 3 months of 2013 appear dryer than normal precipitation curve implies.

(a)

(b)
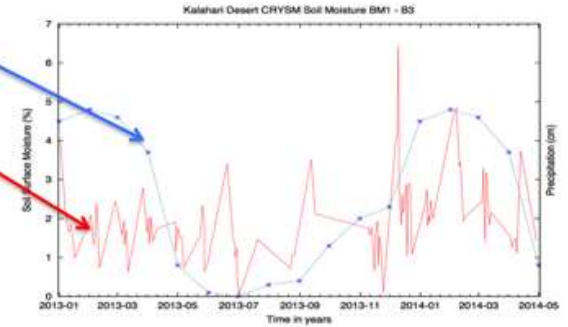
Limited in-situ data

Jason2 soil moisture estimates 'bracket' Cryosat2 spatially dispersed estimates: good correlation found!

Conclusions

- Very good agreement between Jason2 and Cryosat2 estimates.

- Soil moisture from Cryosat2 LRM mode works.

- SAR mode data – theoretically no problem for this technique. Only 1 track found over DREAM – Gibson desert (thanks to Remko). This gave good correlation with LRM backscatter and DREAM: studies of S. Africa transition zone also gave good outcomes.

- Conclusion: detailed soil moisture along-track estimates will be possible from Sentinel3 SAR mode data over all areas for which DREAMS can be crafted