SMAPEX: Soil Moisture Active Passive EXperiment

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Objectives

1. Radar-only soil moisture retrieval (3km)
   Verify baseline algorithms proposed for SMAP

2. Radiometer-only soil moisture retrieval (40km)
   Use the SMAP radar information on surface roughness and vegetation structure (3km) to aid the soil moisture retrieval from the SMAP radiometer (40km)

3. Active Passive soil moisture product (10km)
   Use the high resolution (3km) but noisy SMAP radar observations to downscale the accurate but low resolution (40km) radiometer footprint

*Simulated fields of a) 3km truth soil moisture and retrieved soil moisture for b) 40km passive microwave observations, c) 3km radar observations and d) 3km merged passive microwave and radar observations (Zhan et al., 2006).*
Strategy

- 4 SMAPEX airborne field campaigns (across a seasonal cycle)
- 1-week long campaigns
- Airborne prototype SMAP data with ground observations of soil moisture and ancillary data
- Entire SMAP pixel in semi-arid/irrigated climate
The SMAP test-bed

SM sites
- 0-5cm
- 0-90cm only

SMAP grids
- L3_SM_40km
- L3_HiRes
- L3_AP_SM

Irrigated crop
Dryland crop
Dryland pasture

~40km
Monitoring network

Permanent sites

Semi-Permanent sites
Airborne instruments

L-band Radar

PLMR: Polarimetric L-band Multibeam Radiometer
- Frequency/bandwidth: 1.413GHz/24MHz
- Polarisations: V and H
- Resolution: ~1km at 10,000ft flying height,
- Incidence angles: +/- 7°, +/-21.5°, +/- 38.5° across track
- Antenna type: 8x8 patch array

PLIS: Polarimetric L-band Imaging SAR:
- Frequency/bandwidth:1.26GHz/30MHz
- Polarisations: VV, VH, HV and HH
- Resolution: ~10m
- Incidence angles 15° -45° on both sides of aircraft
- Antenna type: 2x2 patch array
Coverage
Radiometer calibration
Radar calibration

PRC: Passive radar calibrator

PARC: Polarimetric active radar calibrator
Radar calibration
SMAPEx: The concept

Study Area:
One SMAP radiometer pixel (34km x 38km) with 29 monitoring sites

Focus areas YA & YB:
Two SMAP active passive product pixels (~9km x 9km) with 13 monitoring sites ea.

Ground Sampling:
Six SMAP radar pixels (~3km x 3km)
## Flight strategy

### Main Flights

<table>
<thead>
<tr>
<th>Flight Type</th>
<th>Aim</th>
<th>Area</th>
<th>Ground Res.</th>
</tr>
</thead>
</table>
| Regional    | • SMAP active/passive retrieval  
              • SMAP downscaling | 34km x 38km | 1km (P) 10m (A) |
| Target      | • SMAP radar algorithm development  
              • Comparison of active and passive obs. | 9km x 9km | 100m (P) 10m (A) |

### Ancillary Flights

<table>
<thead>
<tr>
<th>Flight Type</th>
<th>Aim</th>
<th>Area</th>
<th>Ground Res.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiangle</td>
<td>Effect of incidence and azimuth angle on radar</td>
<td>1km x 6km (2 strips)</td>
<td>1km (P) 10m (A)</td>
</tr>
<tr>
<td>PALSAR Transect</td>
<td>Comparison PLIS vs PALSAR</td>
<td>8km x 22km</td>
<td>1km (P) 10m (A)</td>
</tr>
</tbody>
</table>
Radar data

hh

hv

vh

vv

PARCS
Radiometer data (h-pol, 38deg)
## Ground sampling strategy

### Monitoring Stations
- **Semi-Permanent (0-5km)**
- **Permanent (0-100cm)**
- **Supplementary**

### Spatial Monitoring
- **Target Sampling**
- **Regional Sampling**

### SMAP grids
- **SMAP Radiometer**
- **SMAP Radar**
- **SMAP Active/Passive**

### Sampling Strategy

#### Regional Sampling
- **Monitoring site**
- 250m spacing
- **Measurements**

#### Target Sampling
- **Monitoring site**
- 50m spacing transects
- **Measurements**

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### Sampling Dates
<table>
<thead>
<tr>
<th>Date</th>
<th>Airborne</th>
<th>Regional</th>
<th>Target Area YB</th>
<th>Regional</th>
<th>Target Area YA</th>
<th>Regional</th>
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<tbody>
<tr>
<td>6/07</td>
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### Soil Moisture Sampling
- **YA4 (crops)**
- **YB7 (grazing)**
- **YB5 (grazing)**
- **YA4 (crops)**
- **YB7 (crops)**
- **YD (crops)**
- **YC (grazing)**

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Supplementary data

Supplementary Station

Soil Gravimetric Samples

Surface Roughness
Ground validation data
Ground validation data

HDAS
- soil moisture
- vegetation type
- vegetation height
- dew amount

Vegetation
- water content
- biomass type
- LAI
- spectral
- crop row spacing/orientation
Vegetation sampling strategy

<table>
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<td>Soil Moisture Sampling</td>
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<td>YB5 (grazing)</td>
<td>YD (crops)</td>
<td>YA4 (crops)</td>
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<tr>
<td>Vegetation Sampling</td>
<td>YA4 (crops)</td>
<td>YB5 (grazing)</td>
<td>YD (grazing)</td>
<td>YA7 (crops)</td>
</tr>
</tbody>
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5 vegetation samples (x) per dominant vegetation type
Volunteers welcome!