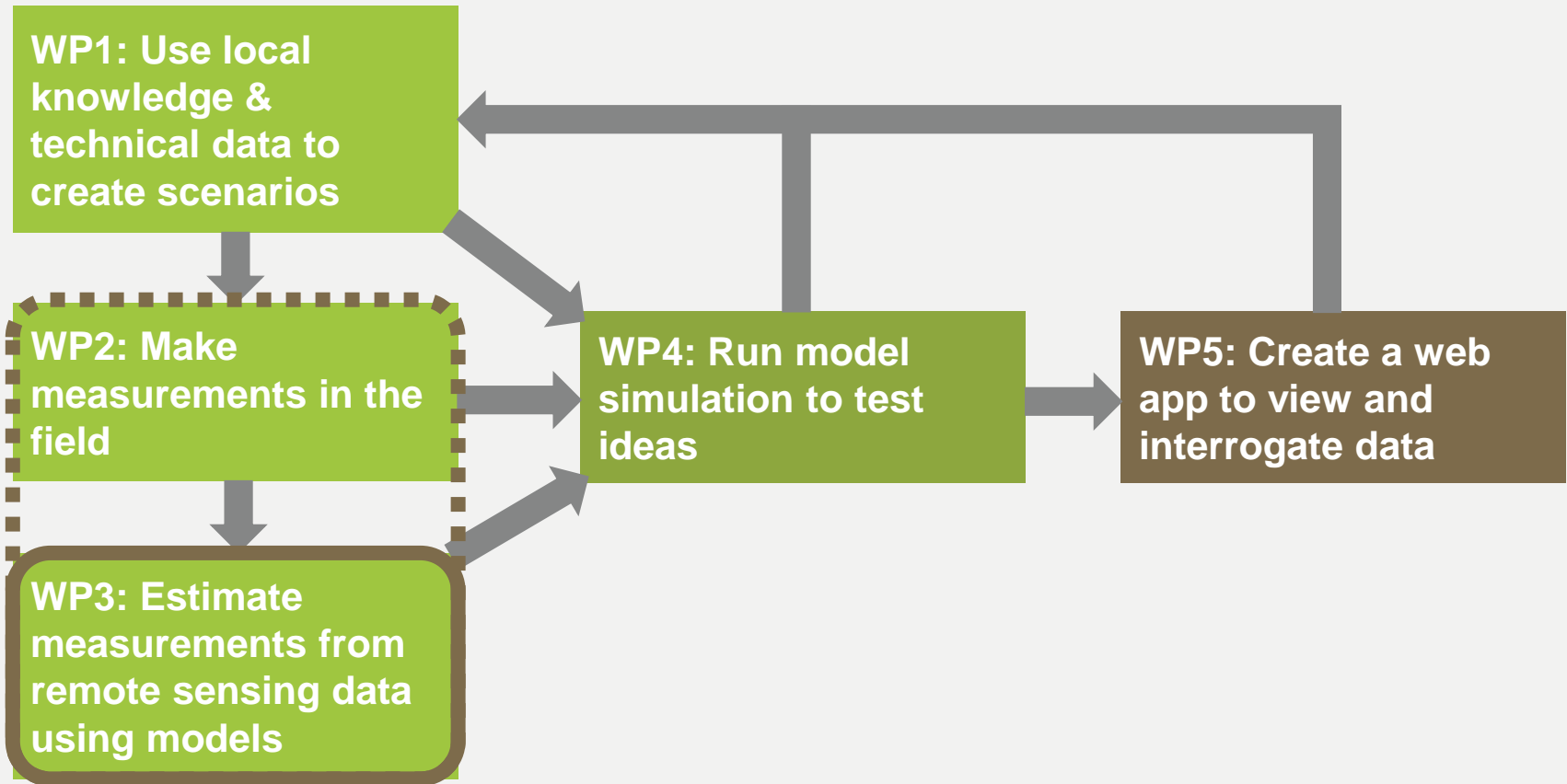# Using Remote Sensing data from satellites and fieldwork to inform NFM

Dr. Will Maslanka

Presentation Outline

- Place in the LANDWISE Project

- Introduce Soil Moisture Remote Sensing Methods

- Satellite Observations

- Fieldwork Observations

Landwise Project Structure

LANDWISE NFM

WP1: Use local knowledge & technical data to create scenarios

WP2: Make measurements in the field

WP3: Estimate measurements from remote sensing data using models

WP4: Run model simulation to test ideas

WP5: Create a web app to view and interrogate data

WP6: Project management and sharing knowledge

3

Remote Sensing - Radar

- WP3 uses RADAR as it's primary remote sensing method

RADAR ( ) ( ) ( ) ( ) ( ) OBJECT

- RADAR echo (or **backscatter**) is a measure of returned signal.
  - Can be used to obtain information about an object.
  - In LANDWISE case, this is soil moisture.

- Other reasons for using RADAR:
  - Not affected by weather (clouds).
  - Not affected by illumination (day/night).

Radar derived Soil Moisture

- Water in the soil affects the dielectric constant of the soil
  - Dielectric constant strongly influences the intensity of the Radar backscatter coefficient, $\sigma°$.

- By measuring $\sigma°$ over a time period, we can estimate **relative soil moisture**, if we have a "wet" and "dry" reference $\sigma°$.
  - Taken by finding largest and smallest $\sigma°$ values in the time series.

- By measuring $\sigma°$ AND surface roughness for a single observation, we can estimate **absolute soil moisture**.
 - Using Radar Backscatter Models.

LANDWISE Satellite use

- Sentinel 1 Constellation
  - Two satellites, launched in 2014 (1A) and 2016 (1B).

  - Strict 6 day repeat cycle, 175 orbits per cycle.

  - Dependable viewing geometry and spatial coverage.

 - Frequency: 5.405 GHz

  - Resolution: 20 x 22 m.

Satellite Observations

UThames Retrieved σ_0 | 30-Jul-2018 | Orbit 030 - Ascending

$\sigma°$

Water
Urban
Suburban
> 0 dB
0 dB
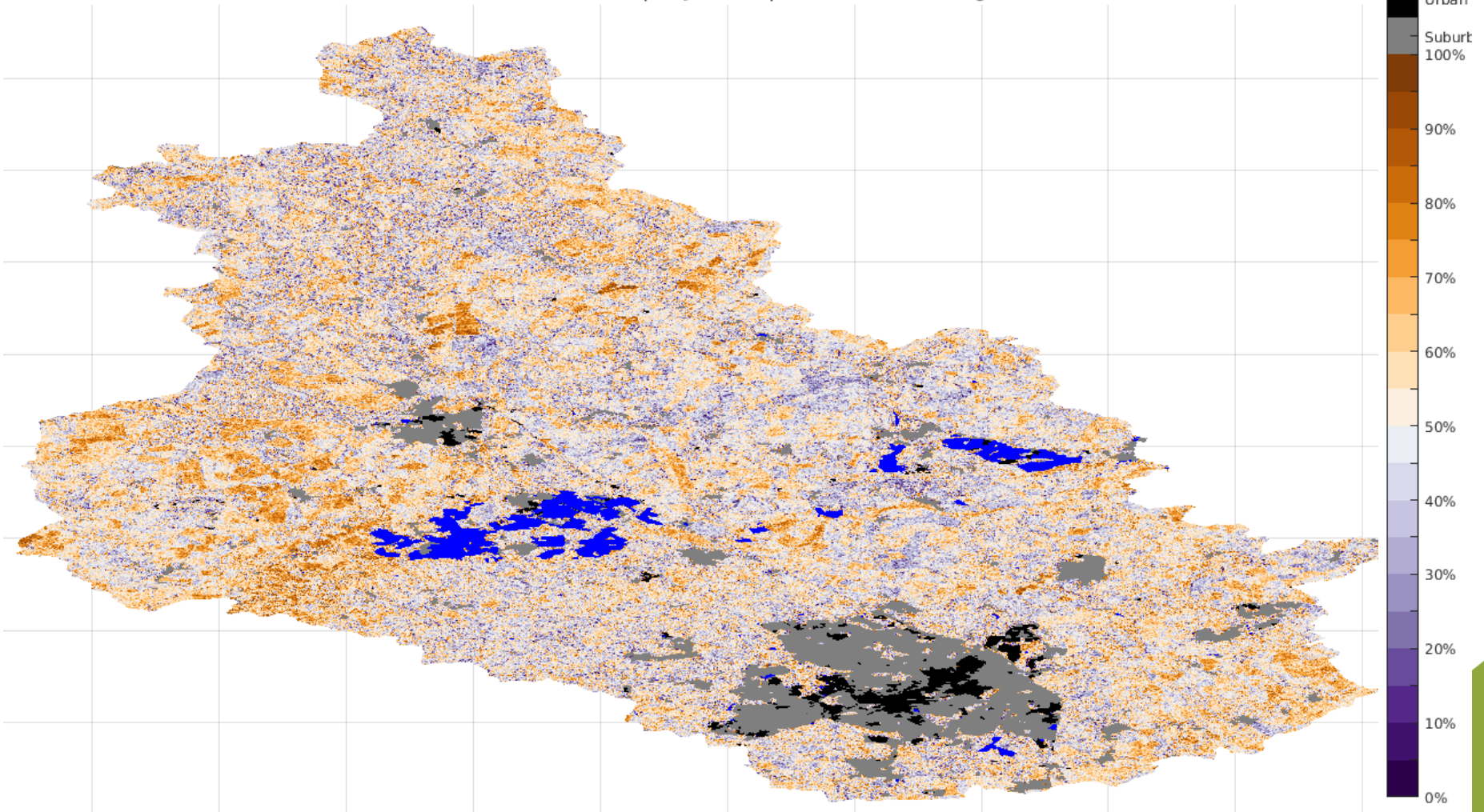-5 dB
-10 dB
-15 dB
-20 dB
< -20 dB
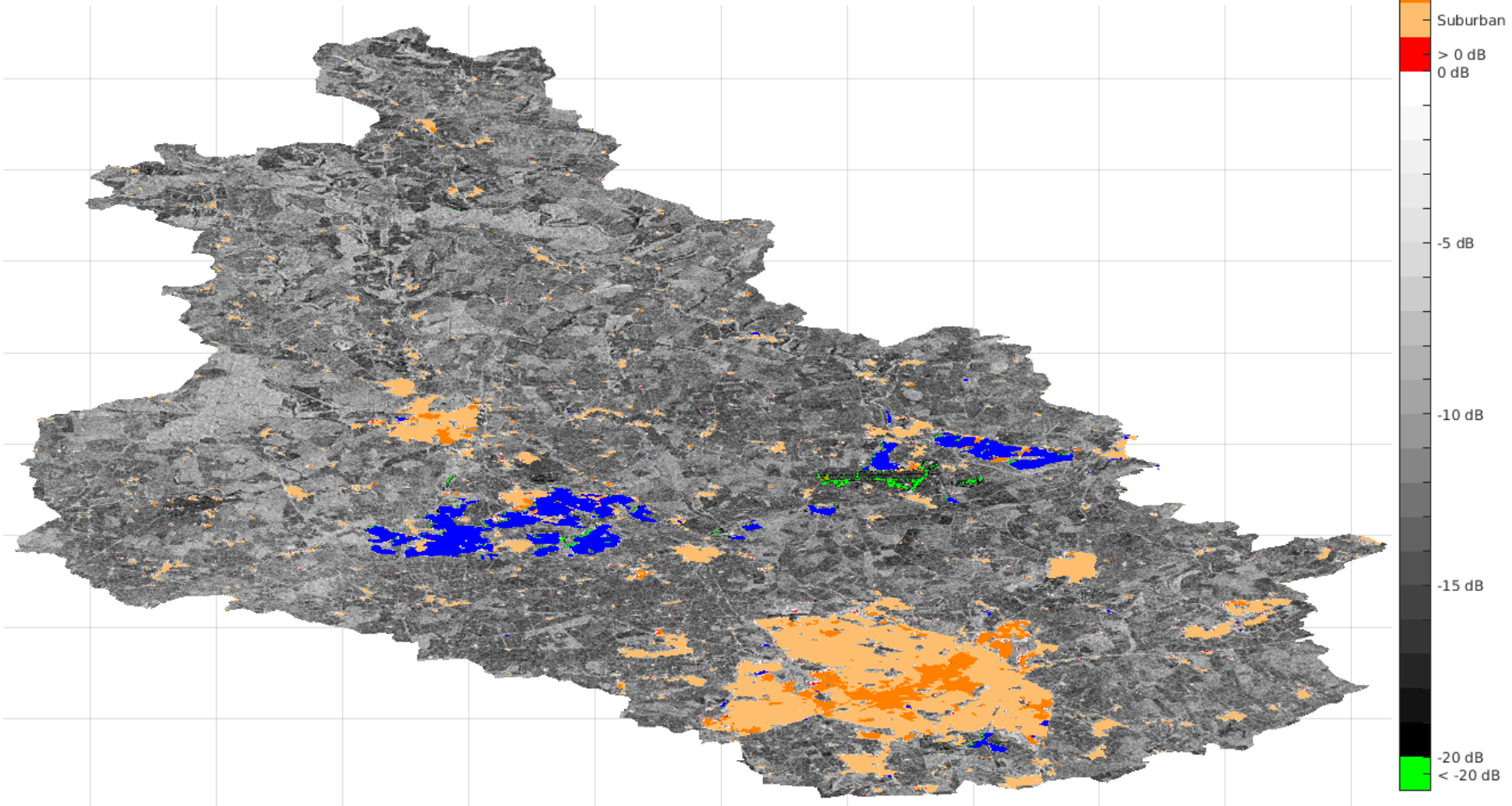
Cause of increased backscatter

- Increase in backscatter coefficient caused by increase in soil moisture (from rainfall)
  - June/July 2018 very dry (Second driest for Thames region since 1910).
  - Intense thunderstorms and front across the UK on 27th July.
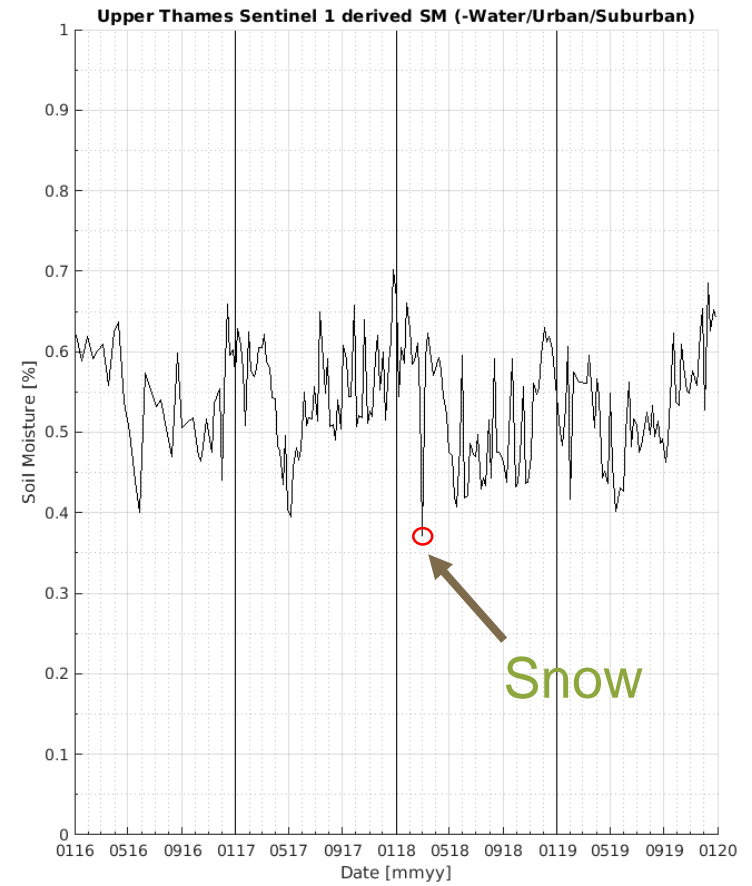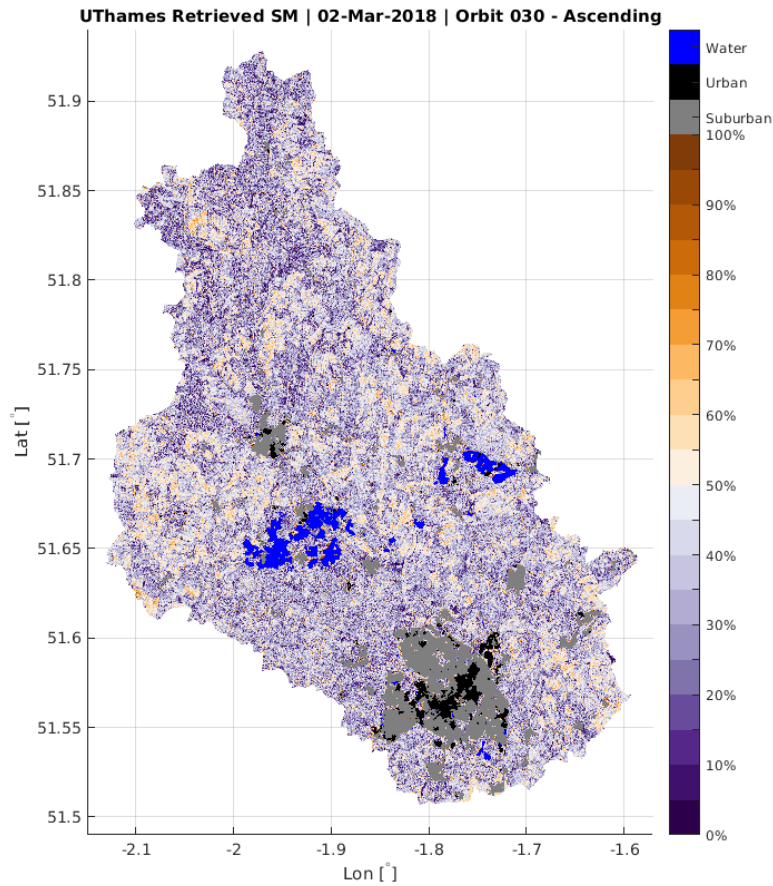 - Lyneham WS (~15km from Swindon) registering ~20 mm over two days.

MoD Lyneham
: 05.06.2018 - 31.07.2018
© weatheronline.co.uk
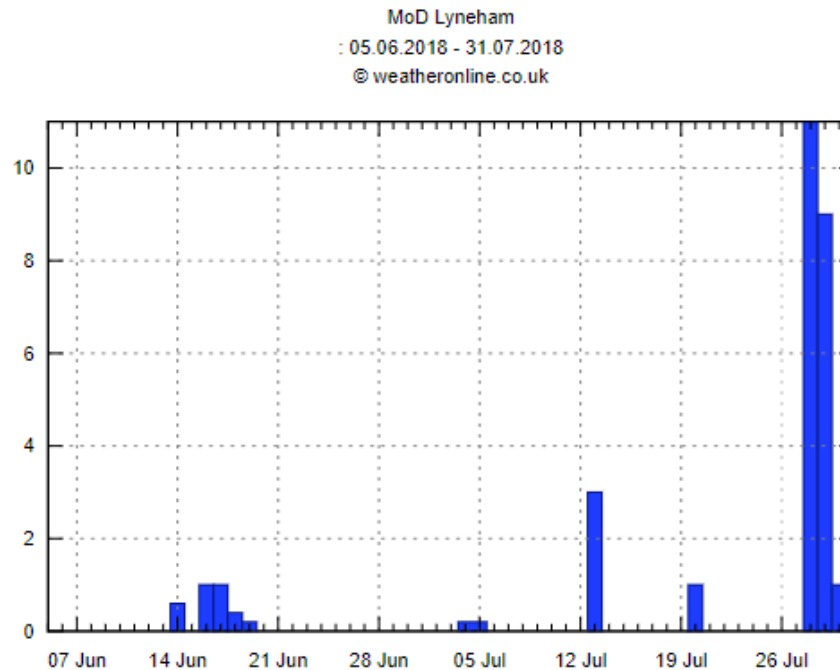
Satellite Derived SM

UThames Retrieved SM | 30-Jul-2018 | Orbit 030 - Ascending

SM

Water
Urban
Suburb
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%

Satellite Derived SM

UThames Retrieved SM | 02-Mar-2018 | Orbit 030 - Ascending

Upper Thames Sentinel 1 derived SM (-Water/Urban/Suburban)

Snow

Detailed Field Survey

- Links with WP2
  - Providing information for hydrological model parameterization (WP4)

- Aim to better characterise field scale heterogeneity for different practices and soil parameters.
  - Take Soil Moisture observations via "ground-based" RADAR units.
  - Linked with detailed field survey
   - Hand held soil moisture probes
   - Soil parameters

Field Obs - Rig

LANDWISE NFM

manual data transfer onto laptop

radar unit + antenna scan along rail

2m

2m

- Rig-mounted RADAR observations

- Transects across fields
  - Able to make high resolution observations across fields

- Georeferenced for repeatability

- Estimates ~3 min per scan
  - ~10 min per observation
    - ~50 observations per day
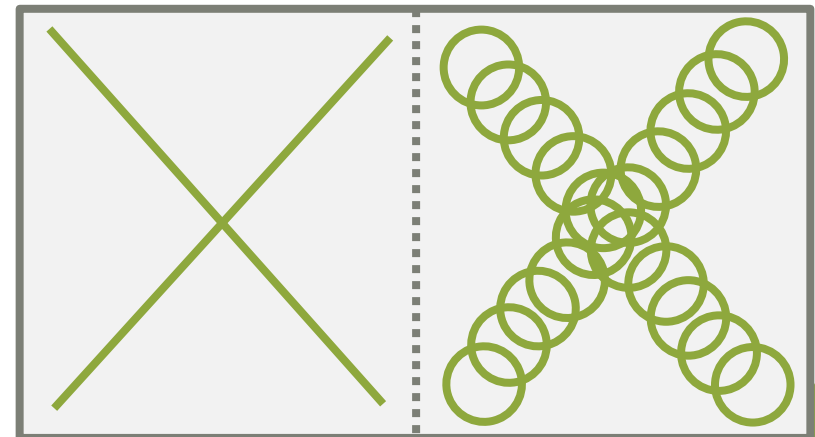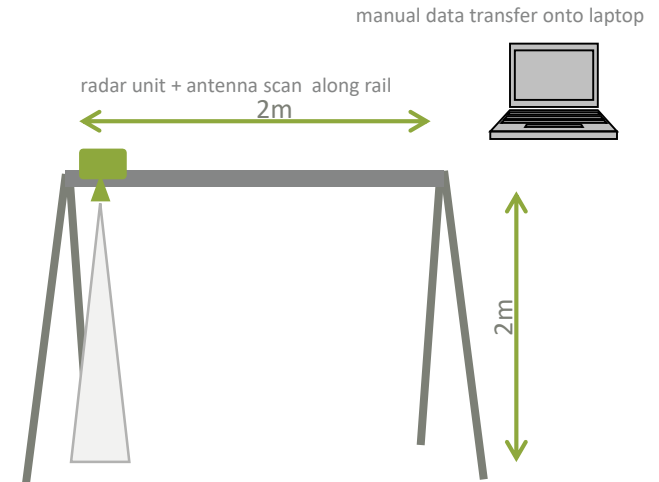
Field Obs -Drone

- Drone-mounted RADAR observations

- Aim to fly the drone in a predetermined pattern
  - Snapshot every millisecond
  - Allows for repeated observations
- Completely non-destructive sampling
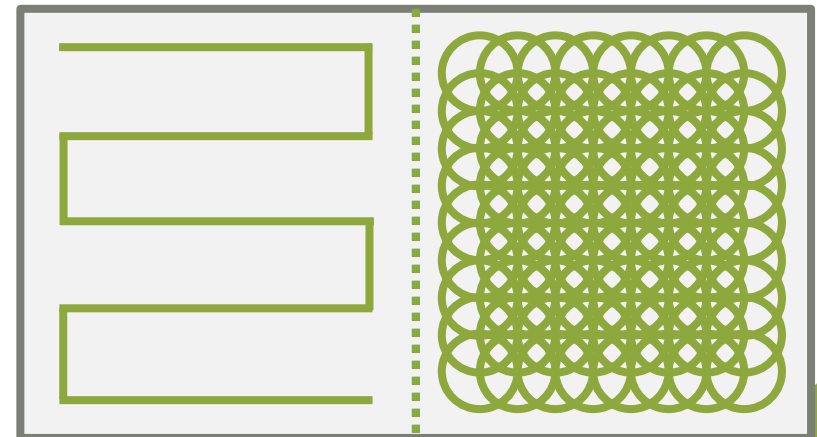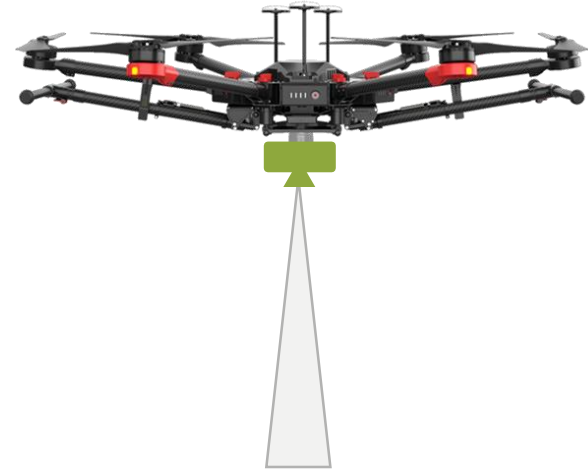
Fieldwork Observations

- Assess how different types of land/soil properties effect soil moisture
  - Till vs No Till?
  - Herbal Ley vs Rye Grass?
  - Trafficked vs non-trafficked areas

- Coincide with Sentinel 1 passes
  - Look to scale up field scale RADAR observations to compare with catchment scale RADAR observations.
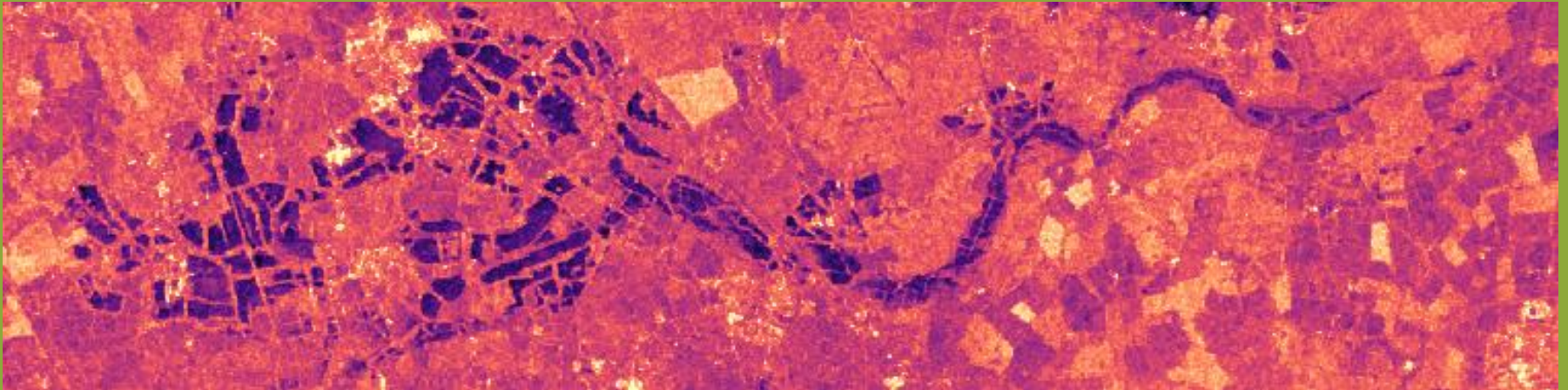
Summary Slide

- Introduced to WP3 work done

- Discussed how RADAR works with respect to soil moisture

- Showed Satellite remote sensing data from Upper Thames

- Introduced remote sensing methodology for fieldwork

Any Questions?

False Colour σ° of Cotswold's Water Park @ Cricklade