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# COSMOS-UK: Sampling strategy

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# Introduction

- **New UK Soil Moisture Real-time Monitoring Network: COSMOS-UK**
- Built and operated by: The Centre for Ecology & Hydrology, funded by NERC
- To provide UK wide field-scale soil moisture measurements
- New data to transform hydro-meteorological sciences and related environmental fields



# Science Exploitation

Potential uses of the data may include

Input to land-atmosphere models

Process understanding

Weather prediction

Climate studies

Evaluation of model output

Comparison with satellite data

Hydrological modelling

Prediction of crop yield

Irrigation scheduling

Groundwater recharge

Ecological studies

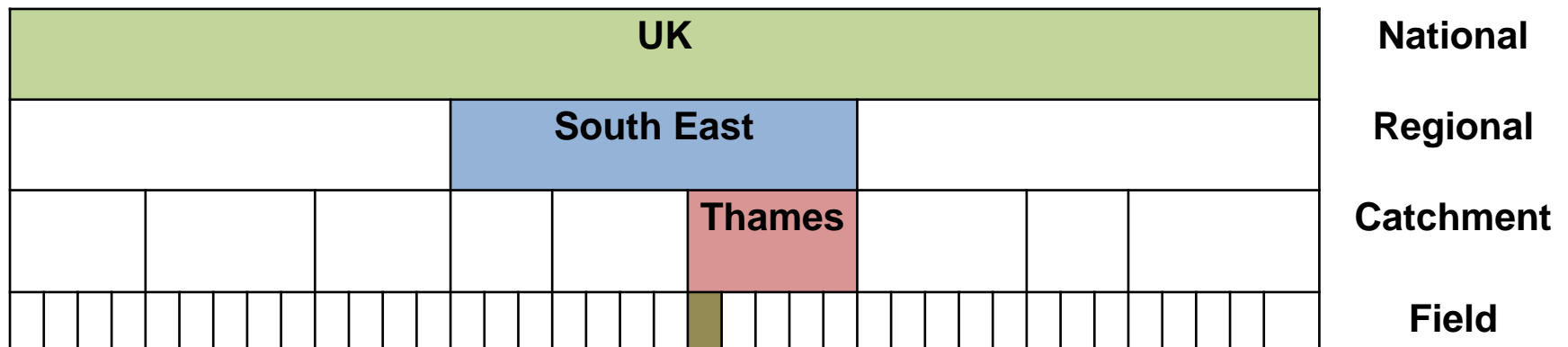
Greenhouse gas controls

# COSMOS-UK network objective

- Provide UK-wide monitoring of soil moisture and meteorological variables for next 5 to 10+ years
- Distribution of 30 to 40+ sites across the UK by autumn 2014
- No sites currently planned in Northern Ireland - may be addressed in a future phase
- Pragmatic approach to site selection

# Sampling Strategy - Ideas

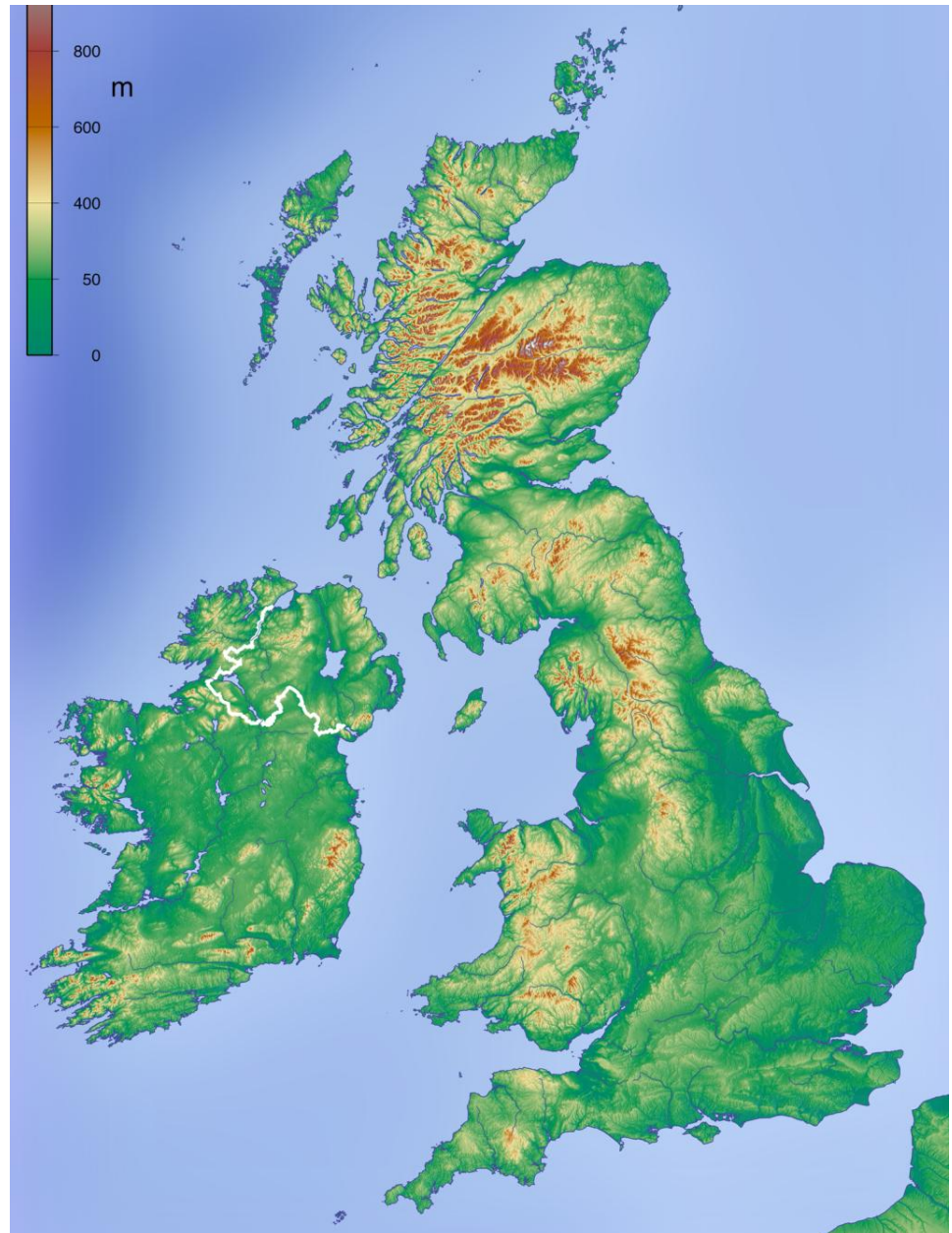
- Where to locate ~30 to 40 sensors?
- UK wide coverage
- Evenly distributed?
- Clusters (e.g. largest expected range, likely drought/flood susceptibility, well-studied catchments)?
- Nested scales – spatial variability?





# UK Environmental Variables

- Factors
  - climate
  - soil
  - geology
  - land cover
  - topography
- Complications
  - snow & woodland
  - varying biomass



# COSMOS-UK Site Selection



# Science exploitation example

- CEH scientists asked to suggest existing field sites and/or ideas for future sites
- No guarantee of site selection
- Every suggestion looked at in detail

☐ Existing Field Site

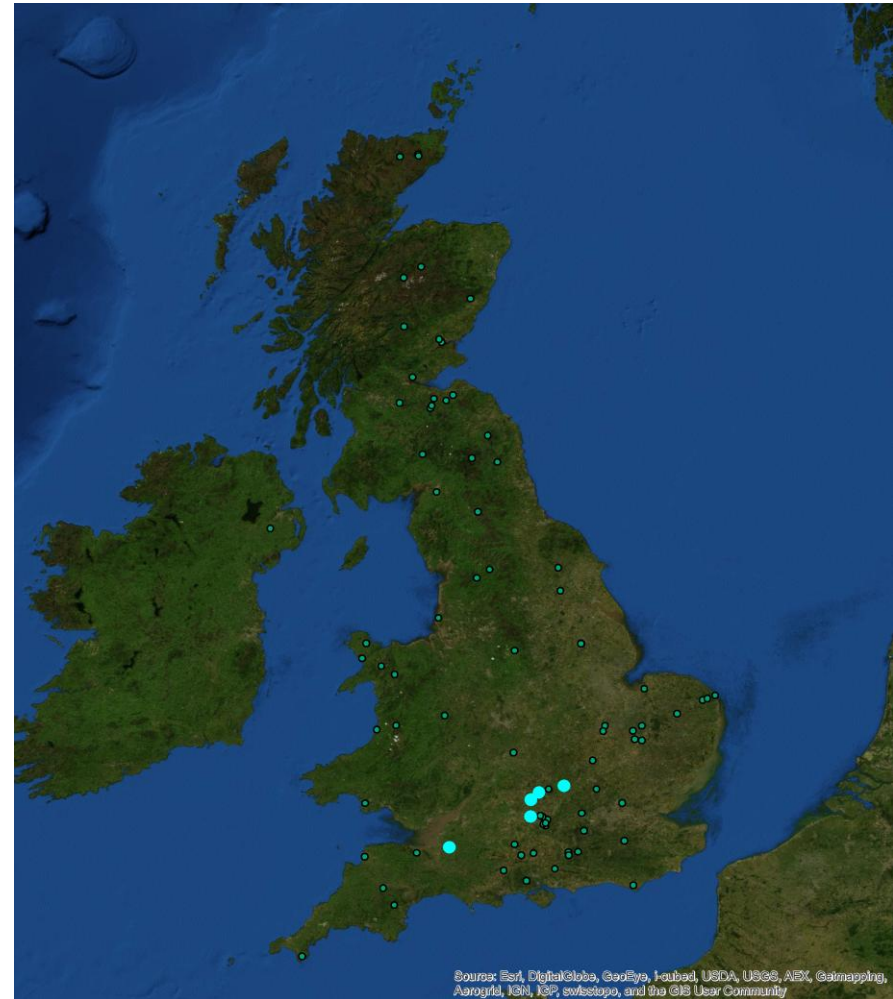
☐ Suggested Future Site Idea

COSMOS-UK: Soil Moisture Observing System Network	
CEH Science Exploitation Group - Site Selection	
Please complete as many boxes as you can/wish!	
Site name	
Location (nearest village/town & county, OS grid ref or lat/long)	
Land owner (e.g. Forestry Commission, National Trust, Crown Estate etc)	
Current purpose of site (e.g. crop studies)?	
Details of ongoing long-term environmental monitoring/modelling?	
Land cover type (e.g. grassland, cereal crops etc)?	
Soil type?	
Reasonably flat site?	
Current access agreement (goodwill/paid short/long-term etc)?	
Potential permission for soil sampling?	
Is the site protected? (SSSI etc)	
Vehicular access possible?	
Security / vandalism issues?	
Significant topographic shading?	
Any streams, rivers, water bodies etc within 350 m?	
Shallow/perched groundwater present?	
Your name	
Your e-mail / phone no.	
We do not need site owner/manager details at this stage as we do not intend to contact them without first consulting you	
Please return completed forms to James Blake, CEH Wallingford ( <a href="mailto:jarib@ceh.ac.uk">jarib@ceh.ac.uk</a> ) by 5 <sup>th</sup> June. Thank you!	

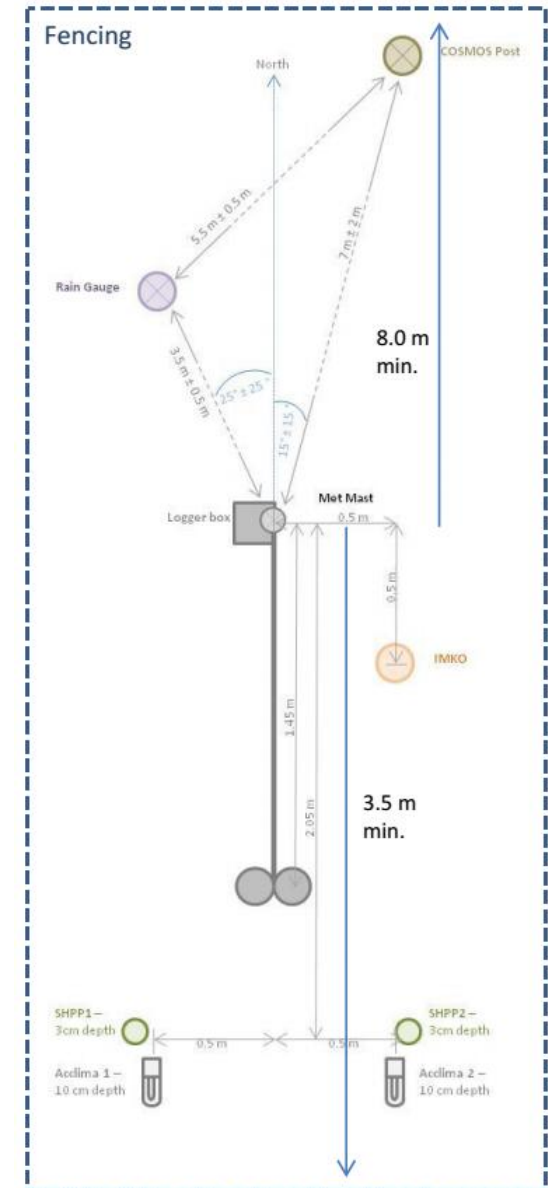
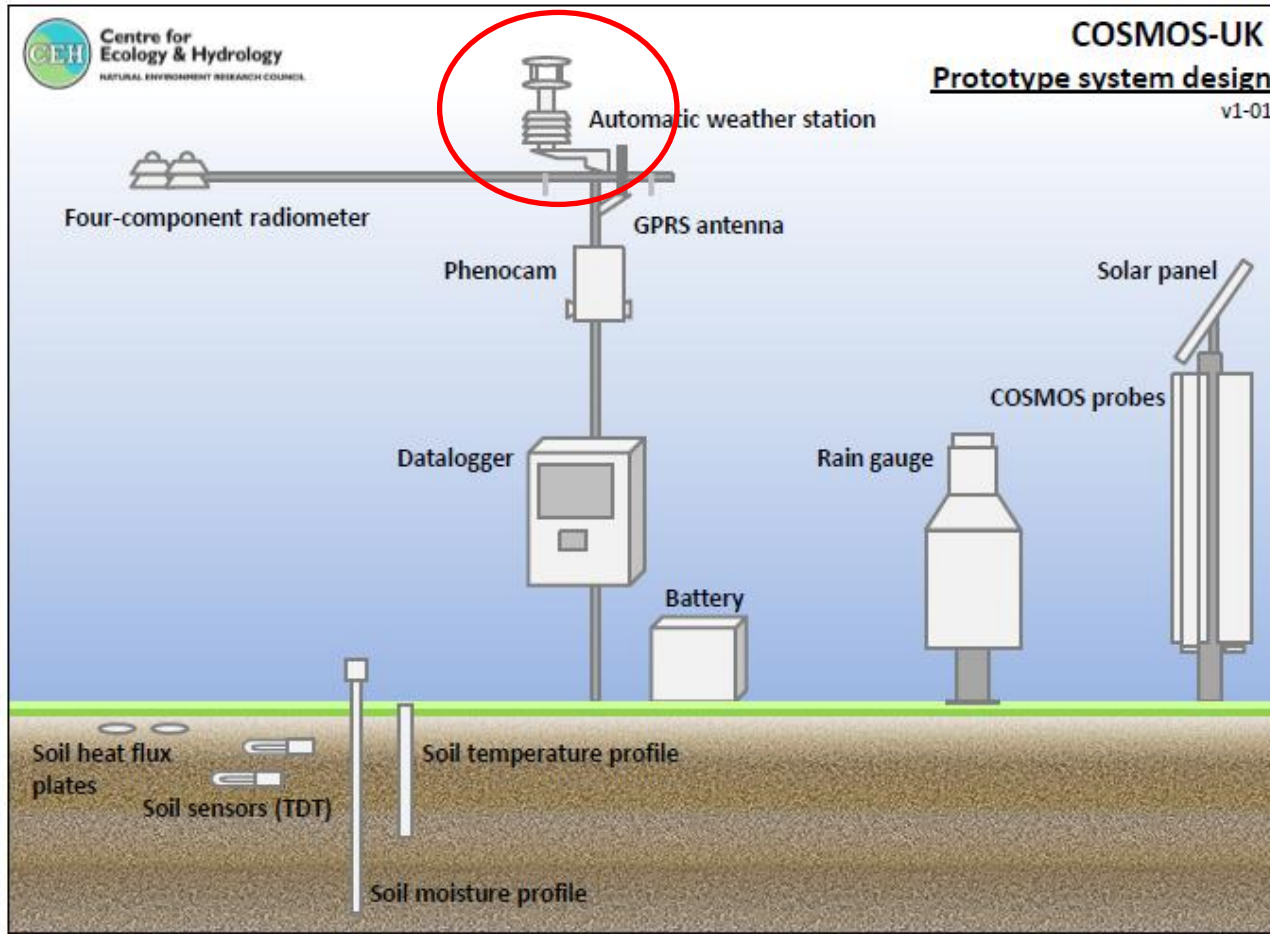


# COSMOS-UK Phase 1 Prototype Sites

- Initial focus on existing CEH field sites
- Close to CEH Wallingford
- Finalise system design and test data acquisition, telemetry and data management systems
- Selection weighted towards areas with large soil moisture variability
- Three grasslands, one ancient deciduous forest, and one wet grassland pending



# COSMOS-UK Phase 1 Prototype Stations



# Calibration: Soil Sampling & analysis

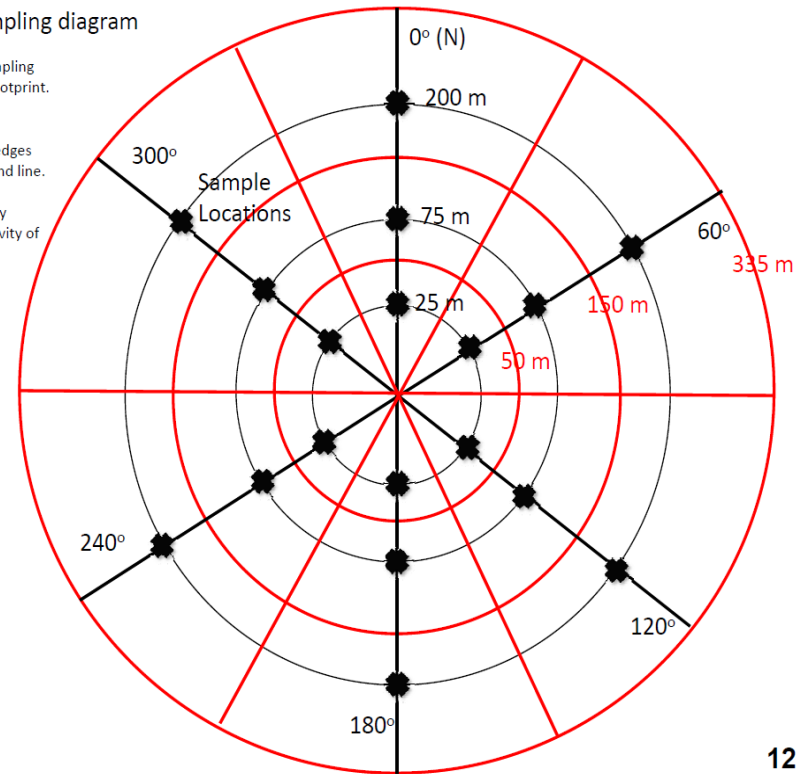
- 108 soil samples from 18 locations at 6 depths
- Compaction issues
- Volumetric soil water and bulk density by oven drying
- Data streams updated
- Lattice and bound water (incinerated @ 1000°C)
- SOM and SOC by loss-on-ignition
- Biological samples

Pore water sampling diagram

Black x's denote 18 sampling locations in COSMOS footprint.

Sampling locations are representative of 18 wedges defined by red circles and line.

Wedge areas are equally weighted due to sensitivity of COSMOS sensor.



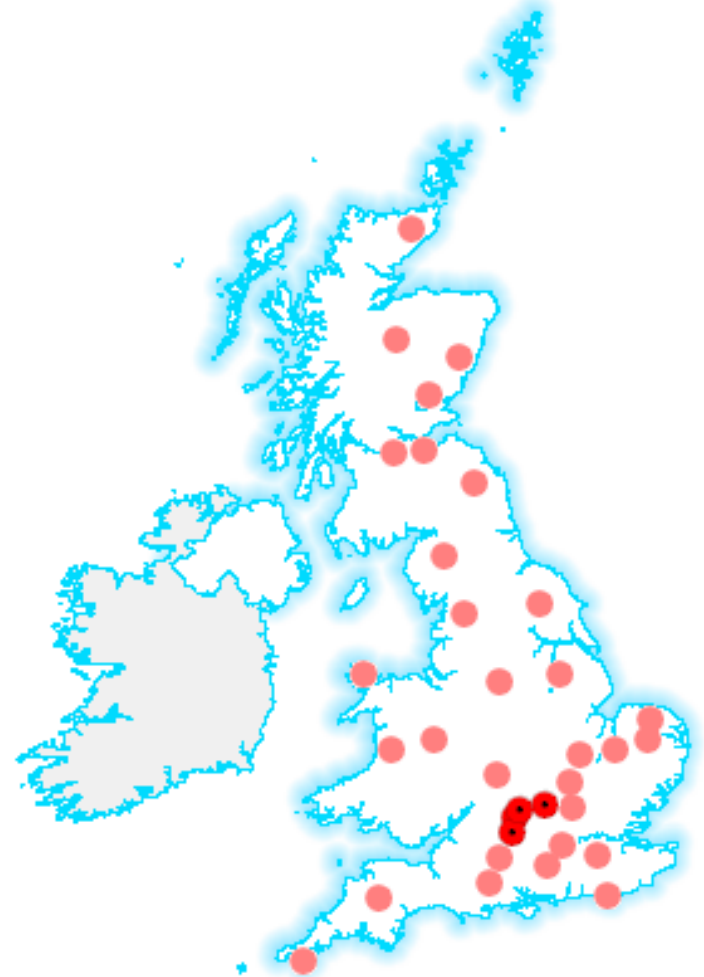
Franz, 2012

# COSMOS-UK: Summary of Year 1

- First stage of COSMOS-UK network development
- Standard weather station and soil sensors
- Four prototype sites now running
- Automated data handling & web services developed by CEH Wallingford:  
<http://www.ceh.ac.uk/cosmos/live-data.html>
- Soil sample collection for gravimetric calibration
- Outreach to science applications and users

# Phase 2: Site Selection

- Existing permissions
- Protected sites (e.g. SSSIs)
- Accessibility
- Security / vandalism risk
- Land cover boundaries
- Streams, rivers, water bodies, etc within 350 m, shallow/perched groundwater



<http://www.ceh.ac.uk/cosmos/live-data.html>



# UK land cover example

Land Cover Class	%	COSMOS-UK sites *	
		Proportional	Targeted
Broadleaved, Mixed and Yew Woodland	6	2	3
Coniferous Woodland	5	3	2
Arable and Horticulture	26	11	6
Improved Grassland	25	11	14
Semi-natural Grassland	13	6	10
Mountain, Heath and Bog	16	7	5
Freshwater	1	0 (note 1)	0 (note 1)
Built-up and Gardens	6	0 (note 2)	0 (note 2)
Coastal	2	0 (note 1)	0 (note 1)

Source: Land Cover Map 2007

\* assuming 40 in total

note 1 – proximity to water (hydrogen) probably excludes these sites

note 2 – urban excluded at this stage

# Phase 2: Site Visits

- Reasonably flat within a 350 m radius
- c. 70 cm soil depth
- Consistent land cover
- Avoid surface water
- Station orientated north-south in 12 x 3 m compound
- Suitable for meteorological instrumentation

# Phase 2: Site Visits

- Calibration points within a 200 m radius are accessible and samples can be taken
- Possible to auger to 30 cm depth for calibration; 50 cm for rain gauge; 75 cm for IMKO sensor
- Sufficient GPRS coverage
- Vehicle access and away from public areas (i.e. reduce risk of vandalism, theft)
- Maintenance visits OK
- Avoid inconvenience for land owner/manager

# Phase 2 Pilot Sites: Hollin Hill, York



<http://www.bgs.ac.uk/science/landUseAndDevelopment/landslides/hollinHill.html>

- BGS: detailed point and down slope soil moisture measurements
- Calibration issues?





# Phase 2 Pilot Sites: Morley, East Anglia





# Phase 3 COSMOS-UK sites

- Increase the density of the network to provide greater spatial coverage
- Increase the monitoring of various land cover-soil-geology combinations
- Address particular science questions or projects (e.g. a subset of stations within a particular catchment; regional network(s) covering a particular land cover type).
- Some phase 3 sites could be built to a lower specification if objective is to increase network density – or visa versa
- COSMOS-UK test and validation site – 120 Acclima TDT sensors

# Thank you.

## Questions..?