

Sentinel-1 (SAR) Processing for Flood mapping

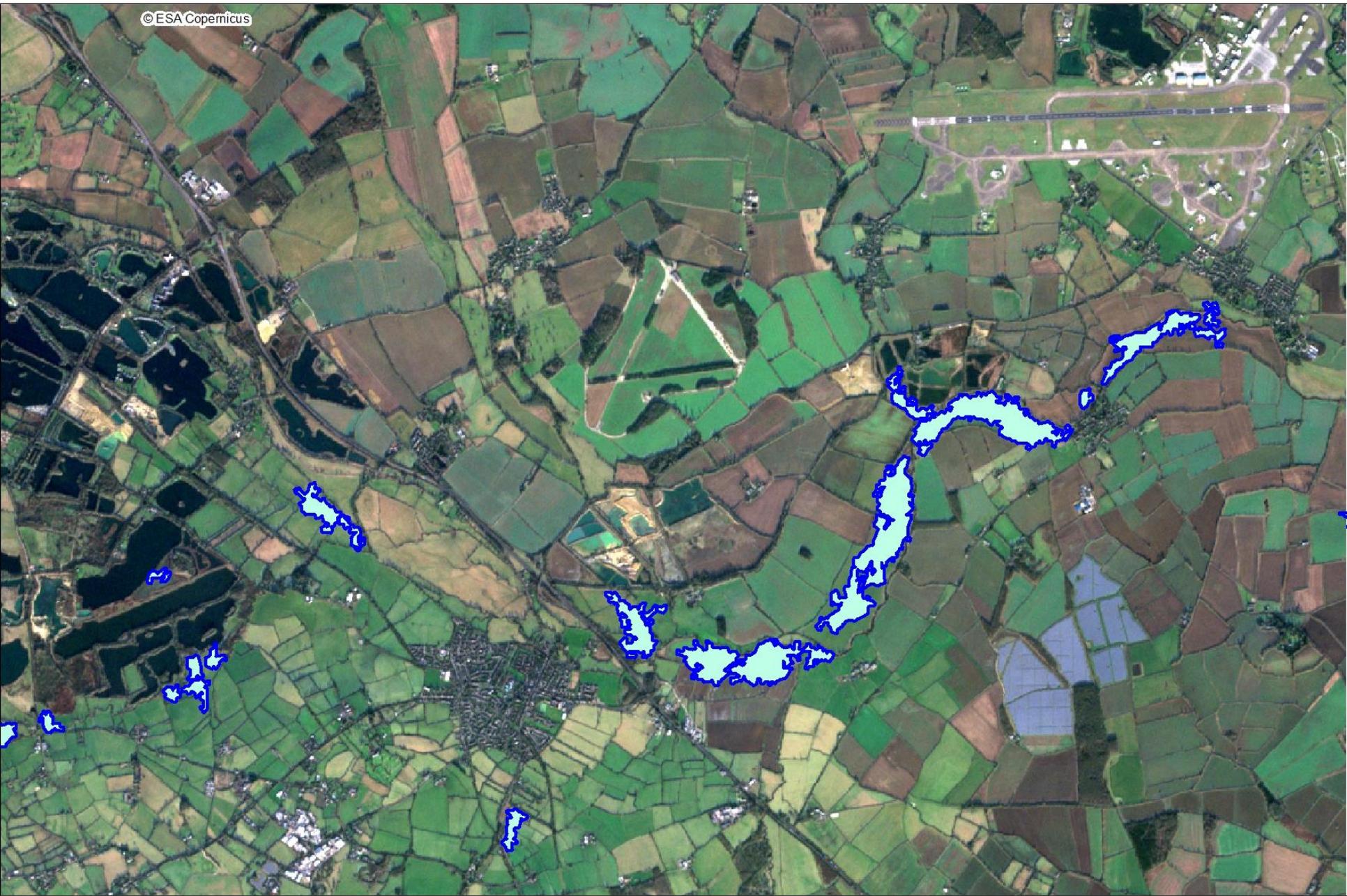
Accessing and Using Synthetic Aperture Radar
(SAR) Data

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Senior Geomatics Analyst
11th November 2020



SAR applications in the EA

- Flood extent mapping
 - Incident rapid response service
 - Slower 'peace time' response service
- Flood depth/volume mapping
 - Calculating requirements for pumping resources
- Currently exploring:
 - Soil moisture applications
 - Interferometric SAR applications



Sentinel-2 5th January 2017* with Flood Outlines

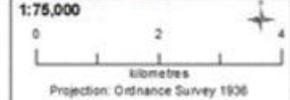
SAR applications in the EA

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OBSERVED

22 February 2014

SOMERSET LEVELS
22nd February 2014
Satellite/LIDAR Data Analysis
Estimated Flood Extent/Depth



Projection: Ordnance Survey 1936

Legend

- TOWNS/Villages
- Estimated Flood Depth (m) 22 Feb
 - < 0.4
 - 0.4 - 0.8
 - 0.8 - 1.2
 - 1.2 - 1.6
 - 1.6 - 2.0
 - 2.0 - 2.4
 - > 2.4
- Watercourses
- Primary Road
- Motorway
- A Road
- Railway
- Permanent Still Waterbodies

Estimated flood extent on 22/02/2014 of the Somerset Levels approx. 8,700 ha using DTM and SPOT method or 8,900 ha using SPOT only method (contact Geomatics for further info)

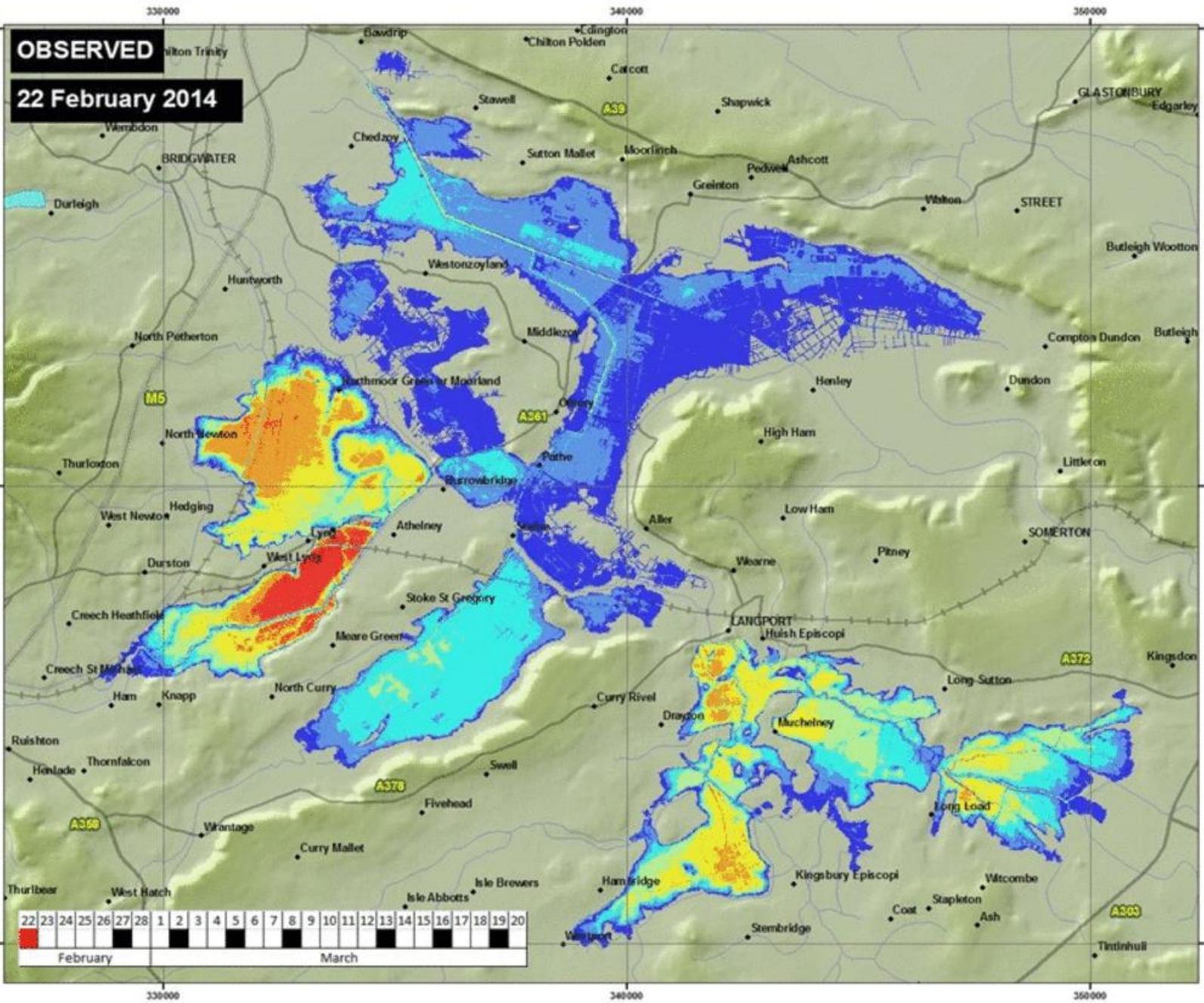
The flood extent was estimated from SPOT5 data acquired on: 22nd February 2014 at 10:41 UTC.

Depth data were inferred from archive UDAR DTM data.

Estimated depth error 20 on RMSE.

Geomatics
 Map generated by Environment Agency, National Operations, Geomatics.
 © Environment Agency, 2014
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 Ordnance Survey 100024199. Strategy - OS
 © Imagery sourced from GeoPages/Esri

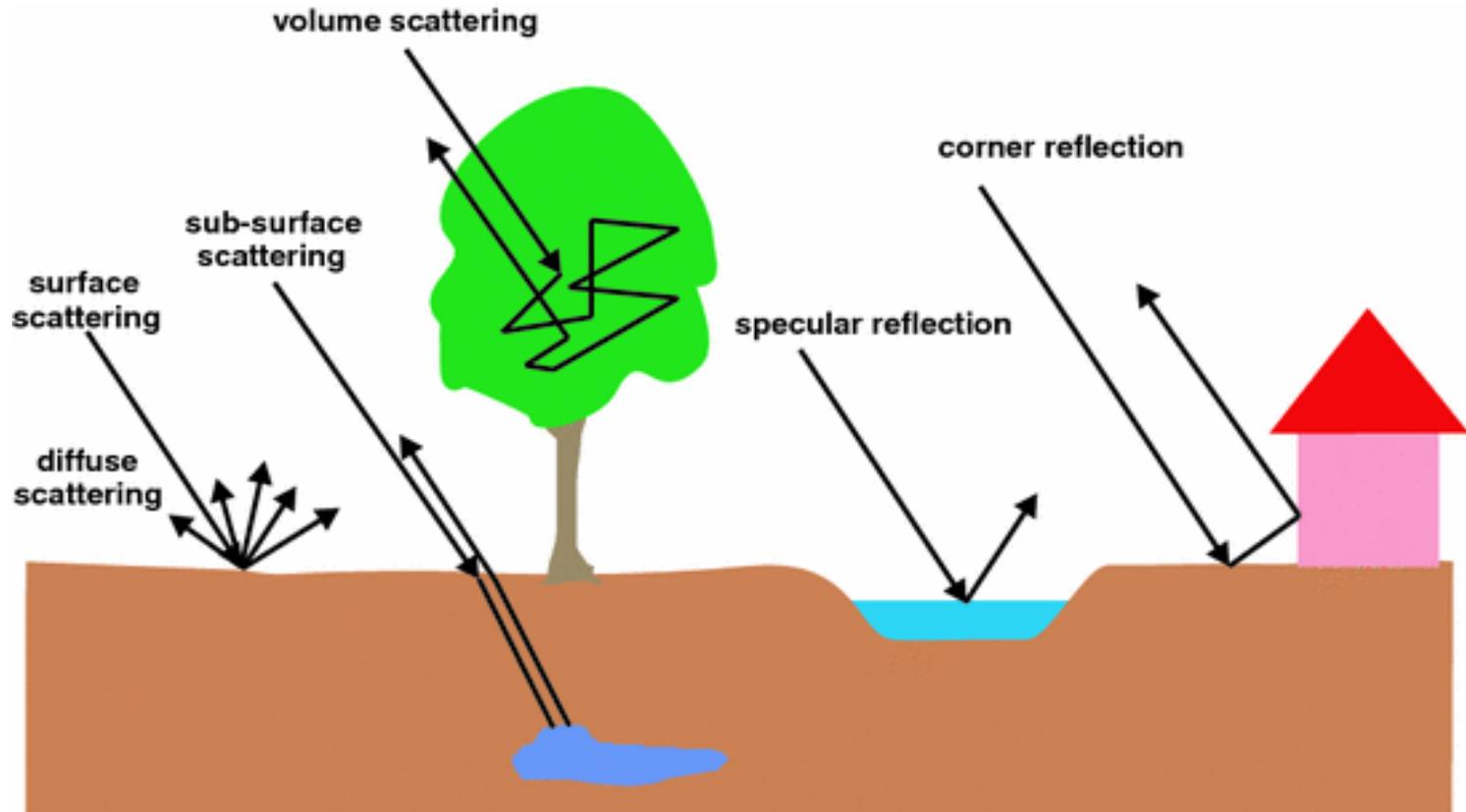
Derived Works Product
Produced: 12th March 2014



SAR applications in the EA

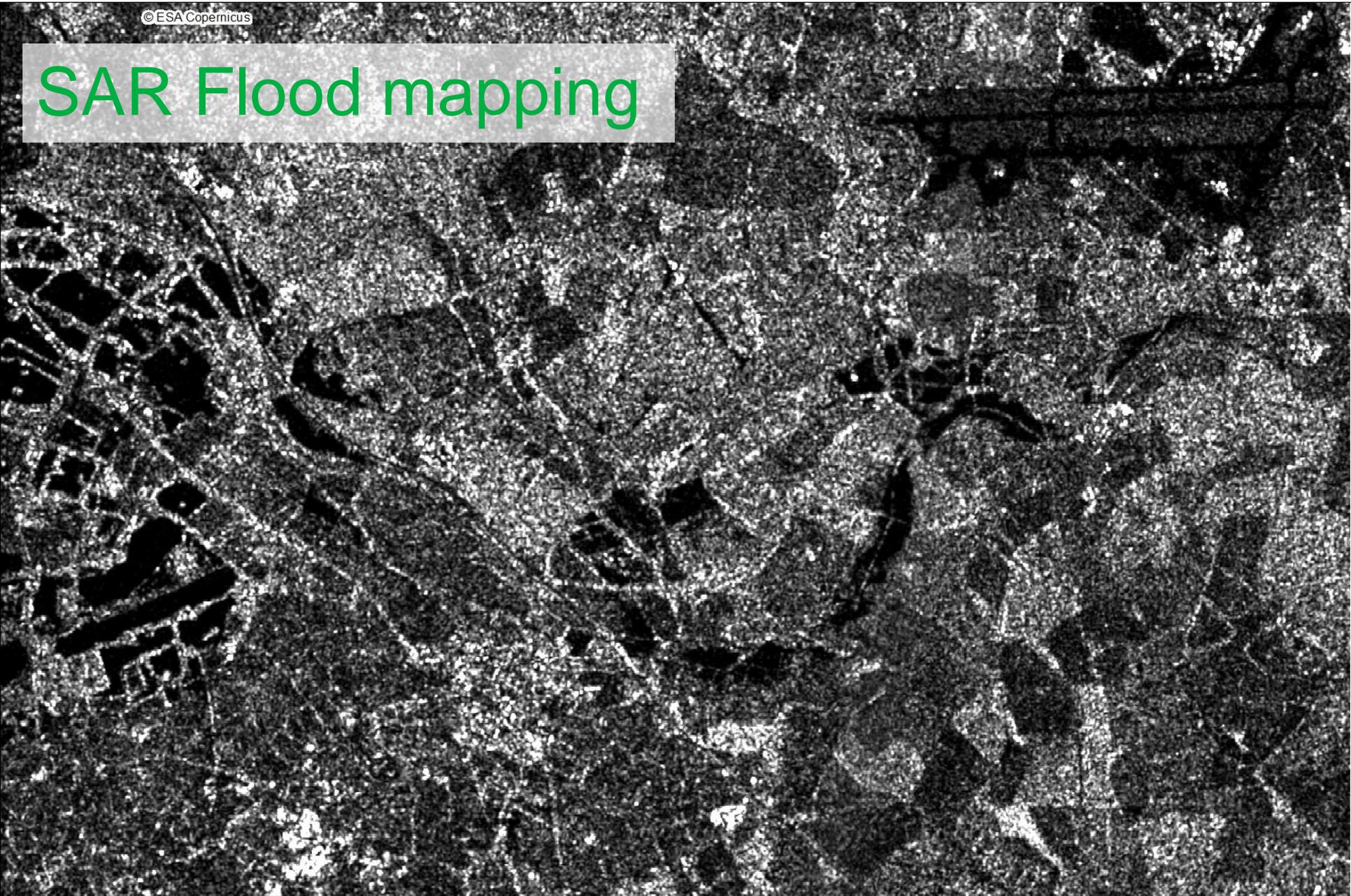
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SAR image interpretation (simplified!)



Awange J.L., Kyalo Kiema J.B. (2013) Microwave Remote Sensing. In: Environmental Geoinformatics. Environmental Science and Engineering. Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-642-34085-7_9

SAR Flood mapping



SAR Flood mapping

- **SAR imagery benefits:**

- Works in most weather conditions (not very windy though)
- Relatively consistent datasets
- Predictable image capture

SAR Flood mapping

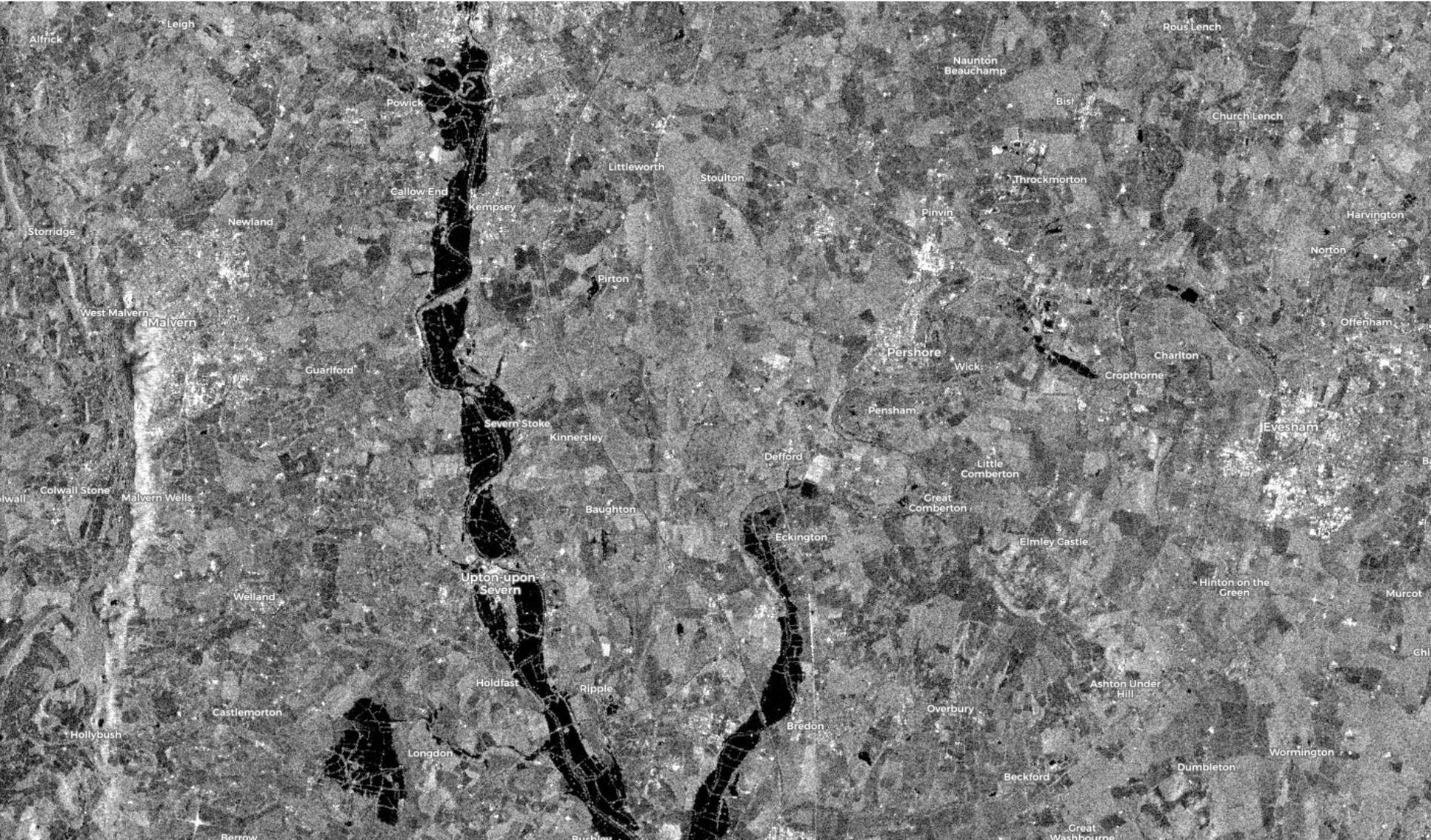
- SAR flood imagery limitations:
 - Noisy imagery
 - Affected by wind
 - Urban areas and field boundaries poorly mapped
 - Outputs easily mis-understood

Sentinel-2 image 18th November 2019

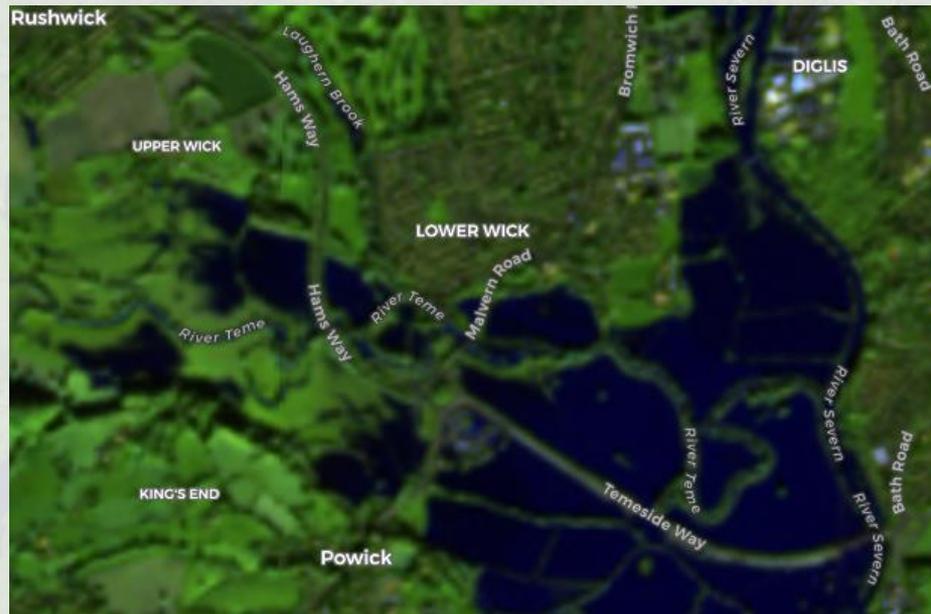
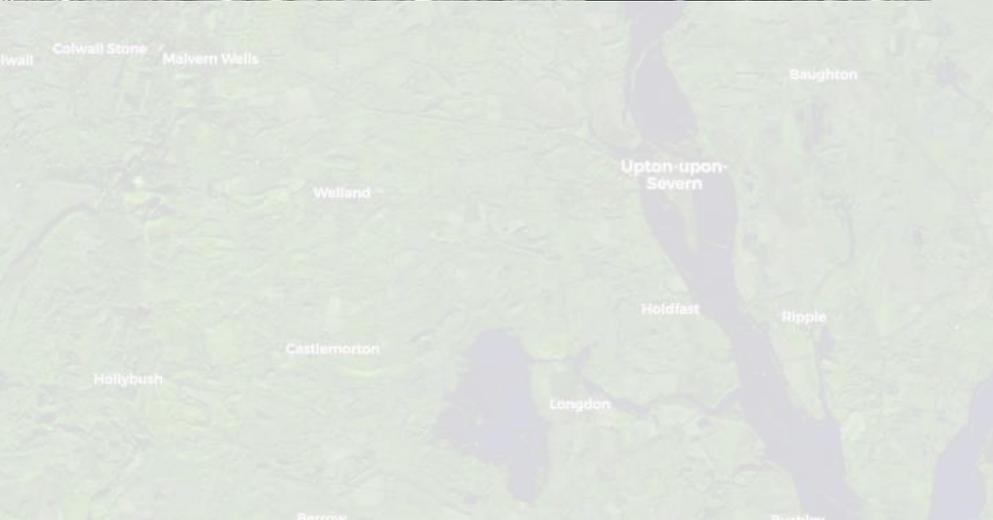
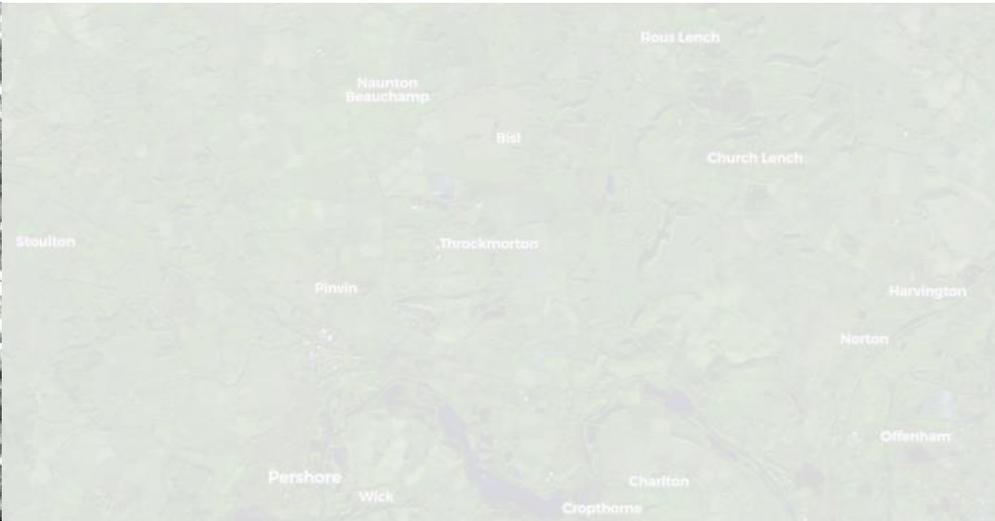
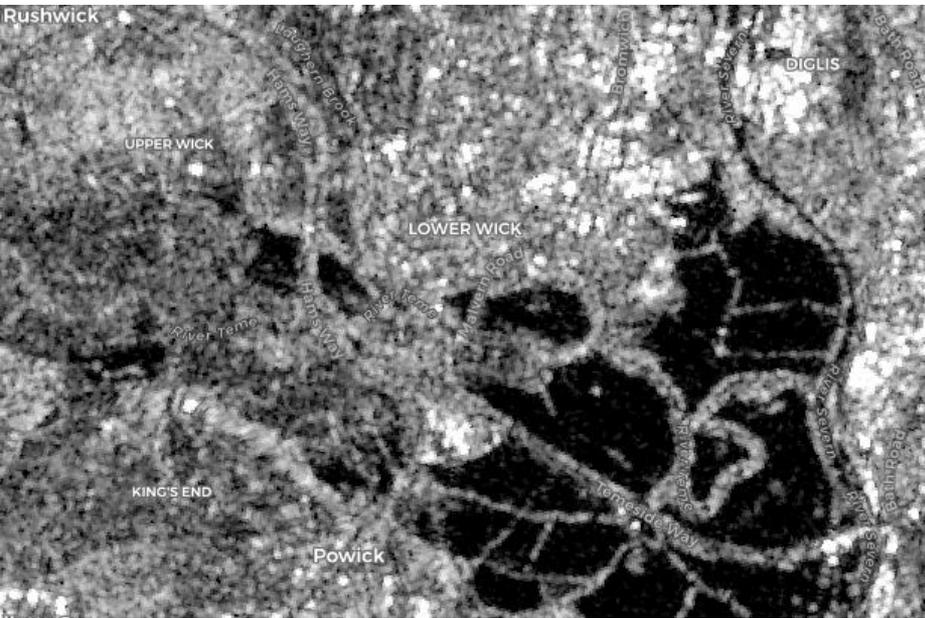


Bands 12, 11 and 4

Sentinel-1 VV image 19th November 2019



Sentinel-1 VV vs Sentinel-2 detail



SAR Flood mapping Workflow

- Imagery acquisition (flood image *and* pre-flood image)
 - EODS or ESA SciHub
- Primary image processing (if ESA SciHub-acquired)
 - Subset
 - Radiometric calibration
 - Speckle filter
 - Ortho-correction – reprojection (OSGB)
- Pre-VH/Pre-VV/Flood-VH/Flood-VV composite generation
- Training sample selection
- Random forest classification
- GIS editing (Slopes/hills/urban/forests masked)
- Manual editing

Insert search criteria...

Display 1 to 6 of 6 products. Select All

Order By: Ingestion Date

Request Done: (
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51.59184360419971,-1.637989330601315
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Download URL: https://scihub.copernicus.eu/odata/v1/Products/S1A_IW_SLC__1SDV_20180405T061457_20180405T0615...
Mission: Sentinel-1 Instrument: SAR-C Sensing Date: 2018-04-05

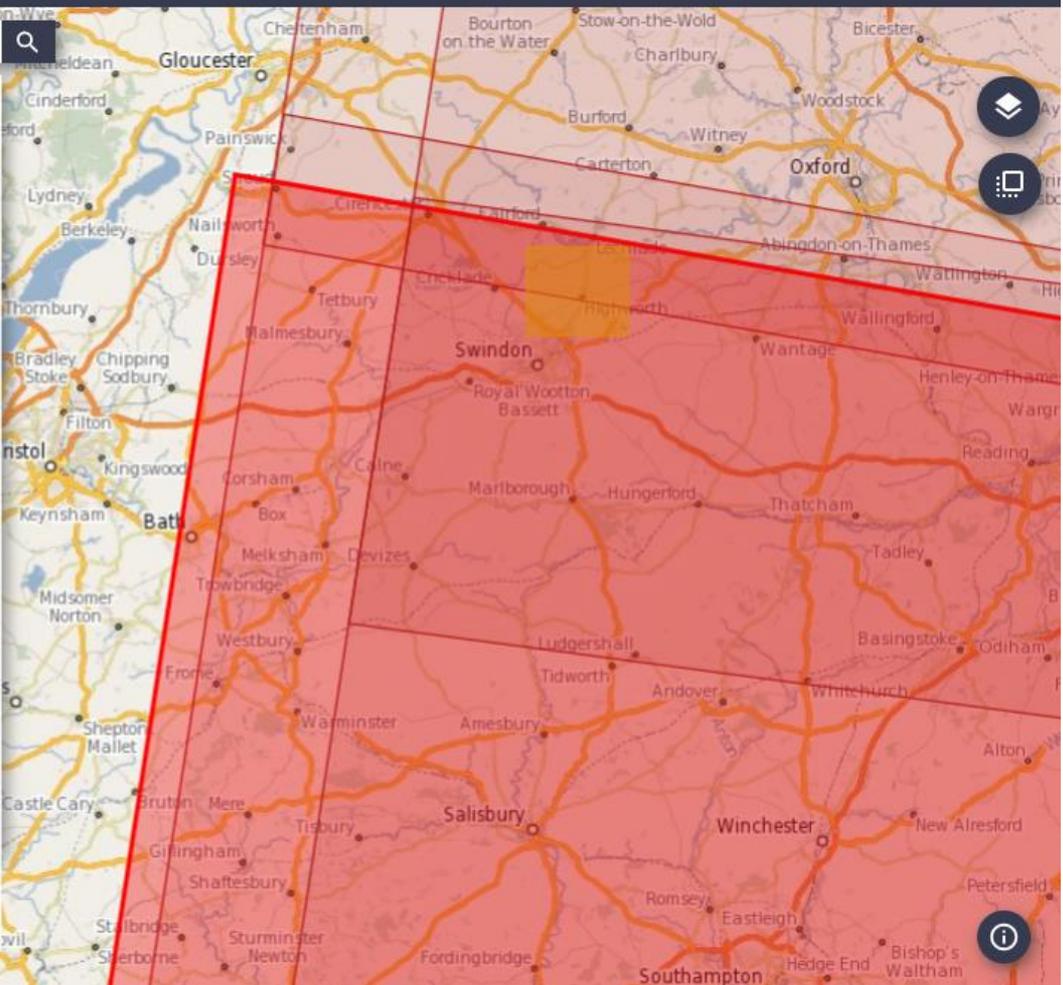
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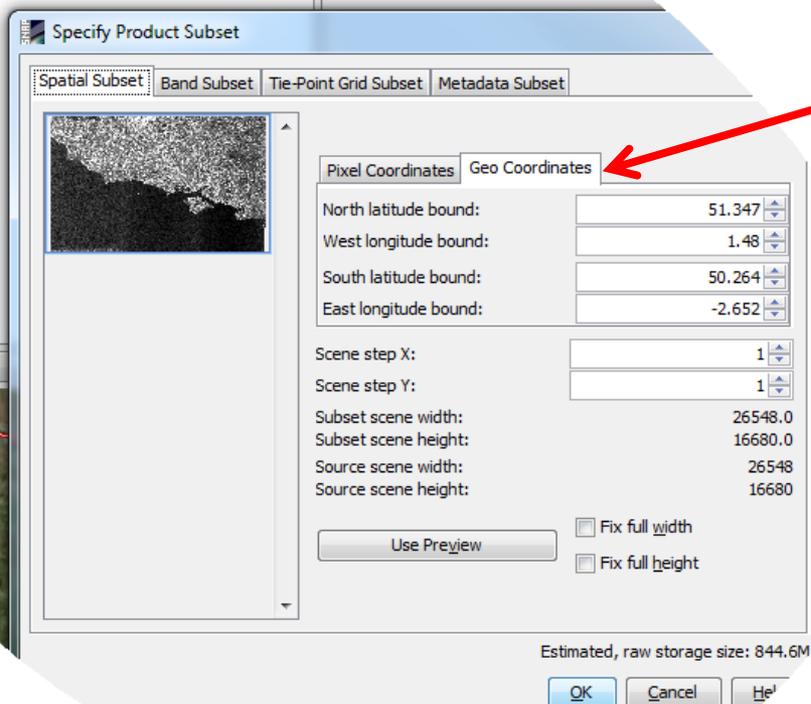
25 << < page: 1 of 1 > >> CLOSE



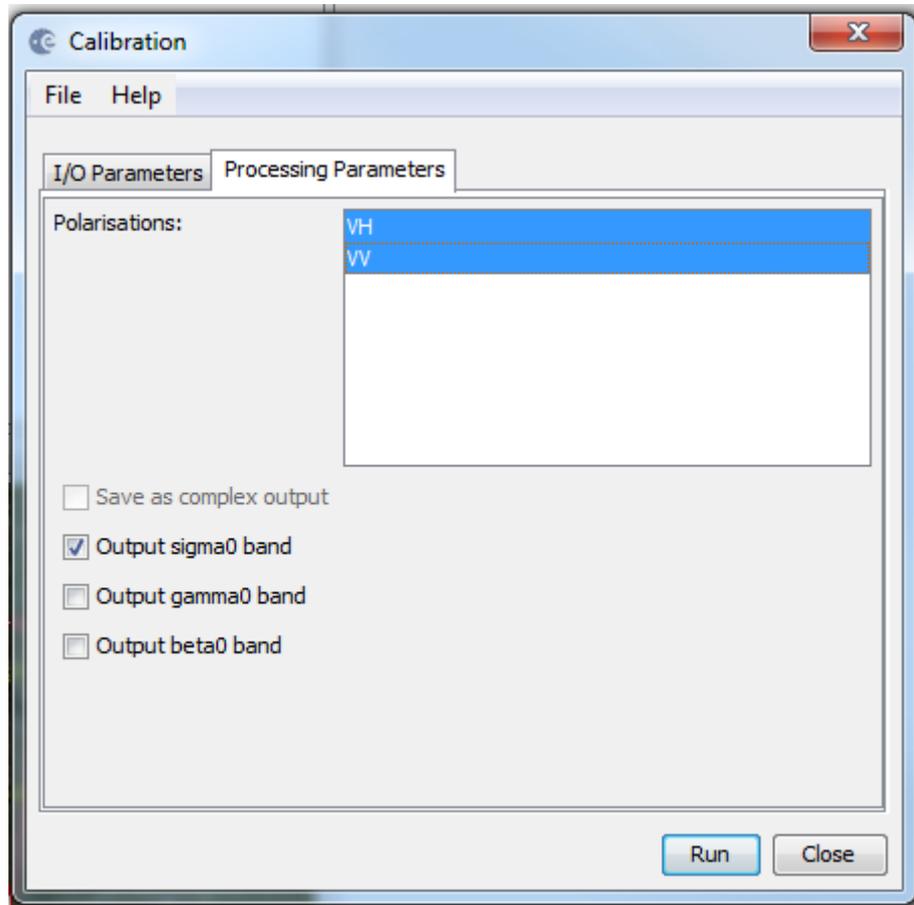
- Select the relevant GRDH image

9. Subsetting (If you want to)

- Use Geo-Coordinates rather than Pixel Coordinates

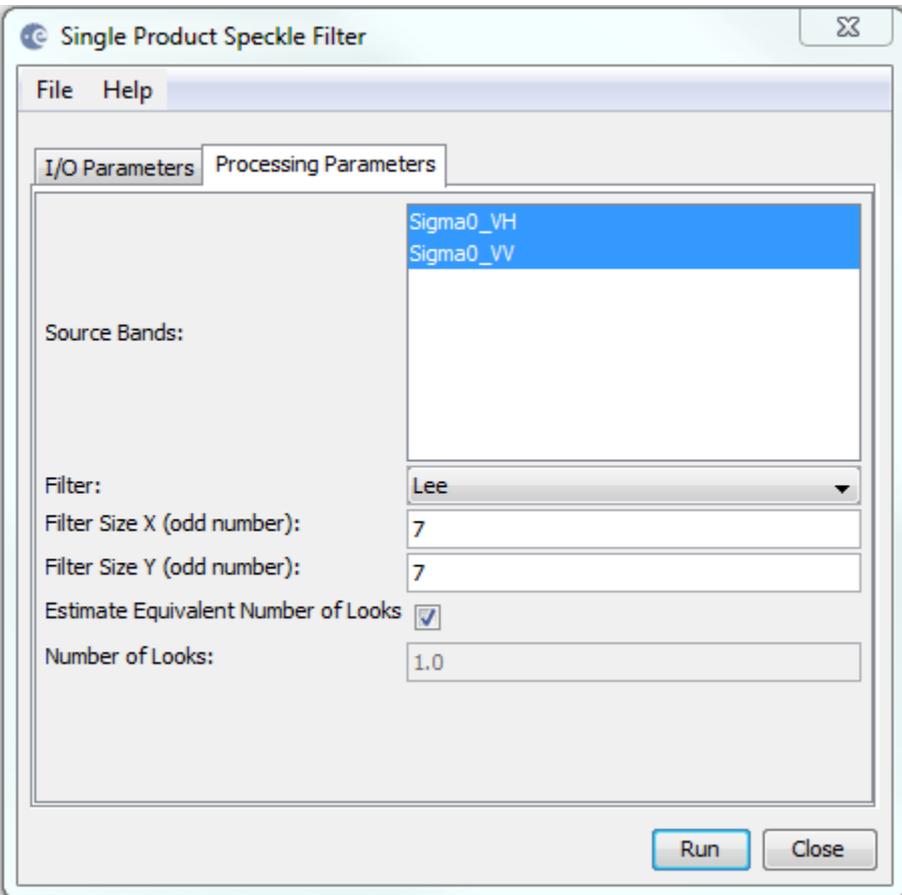


12. Calibrate image



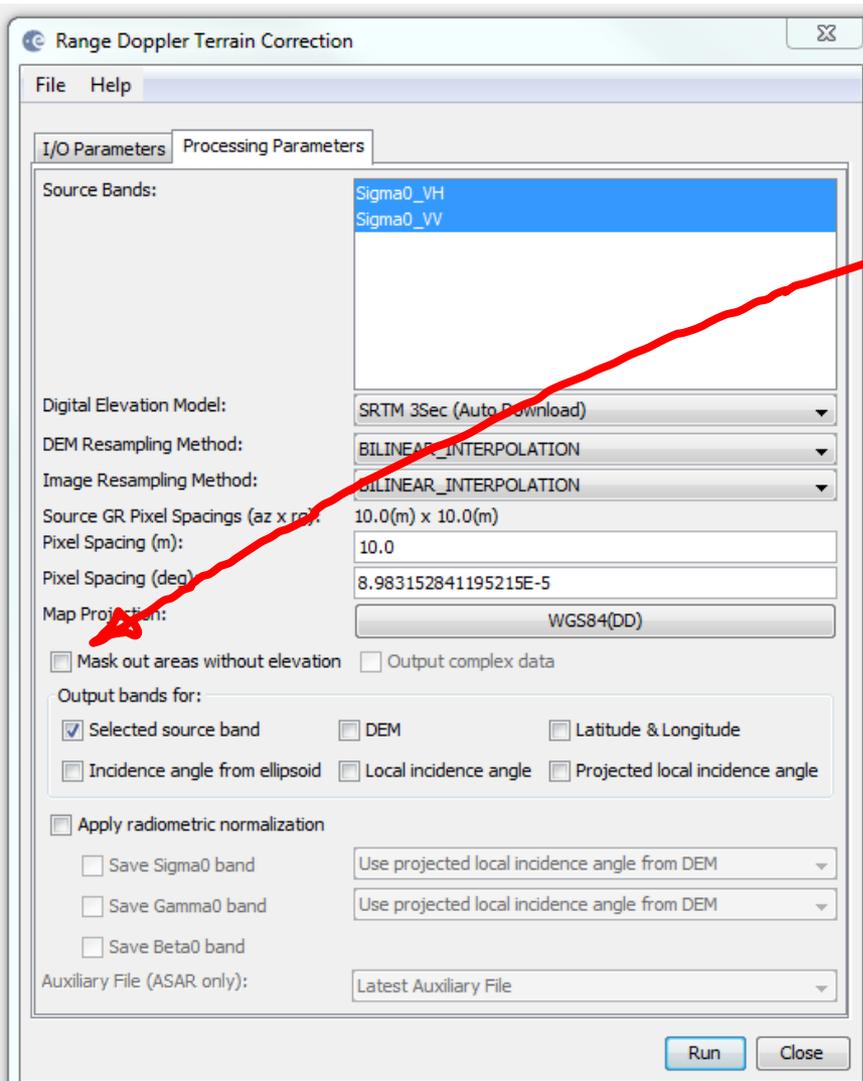
- Highlight both the VH and VV polarizations

14. Speckle Filtering

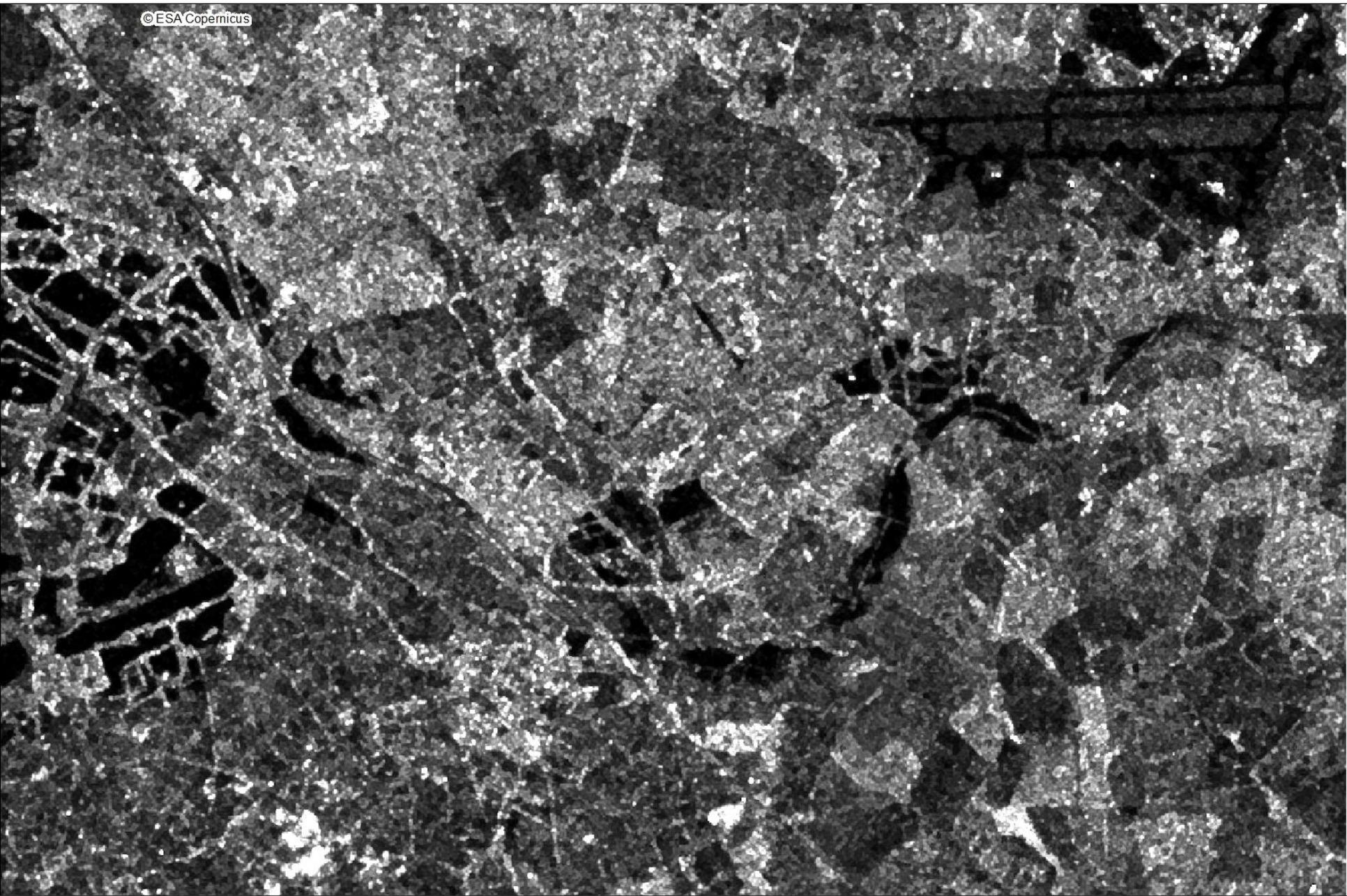


- Leave the I/O Parameters as they are
- In Processing Parameters tab:
- Highlight VH and VV
- Select Filter type “Lee”
- Filter size between 3 and 7 in both X and Y. Would actually recommend using 5 and 5!
- Hit “Run”
- NB Larger number will result in harsher smoothing
- Close the dialogue box

17. Ortho-Correction



- Select both VH and VV
- Un-tick “Mask out areas without elevation”
- Hit “Run”
- This is the longest process and could take up to half an hour for a full scene
- The output will be in WGS84 projection



Sentinel-1 22th November 2016 ARD with Refined Lee filter. VH polarisation



Sentinel-1 22th AND 10th November 2016 ARD composite image stack

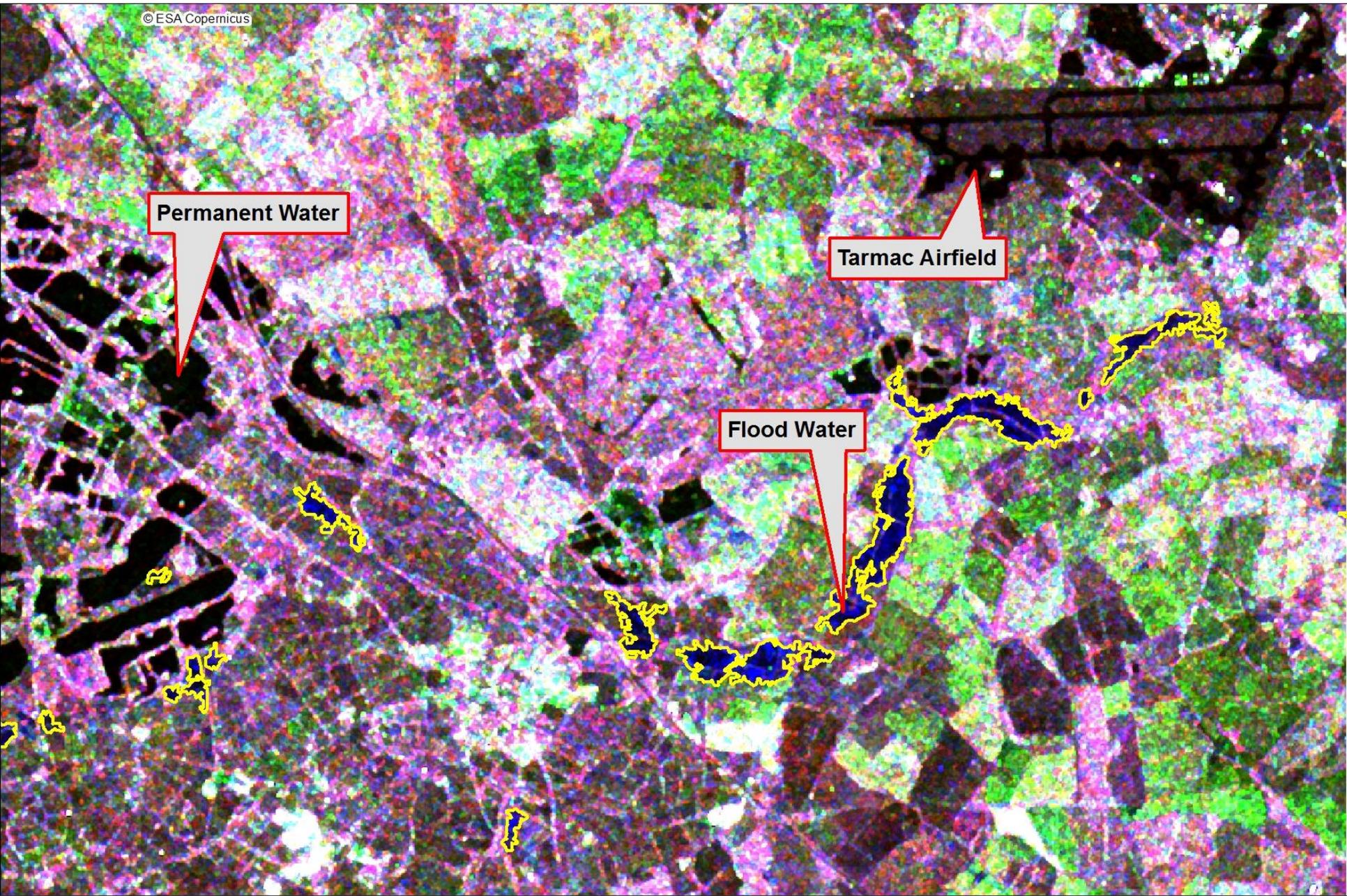


Permanent Water

Tarmac Airfield

Flood Water

Sentinel-1 22th AND 10th November 2016 ARD composite image stack

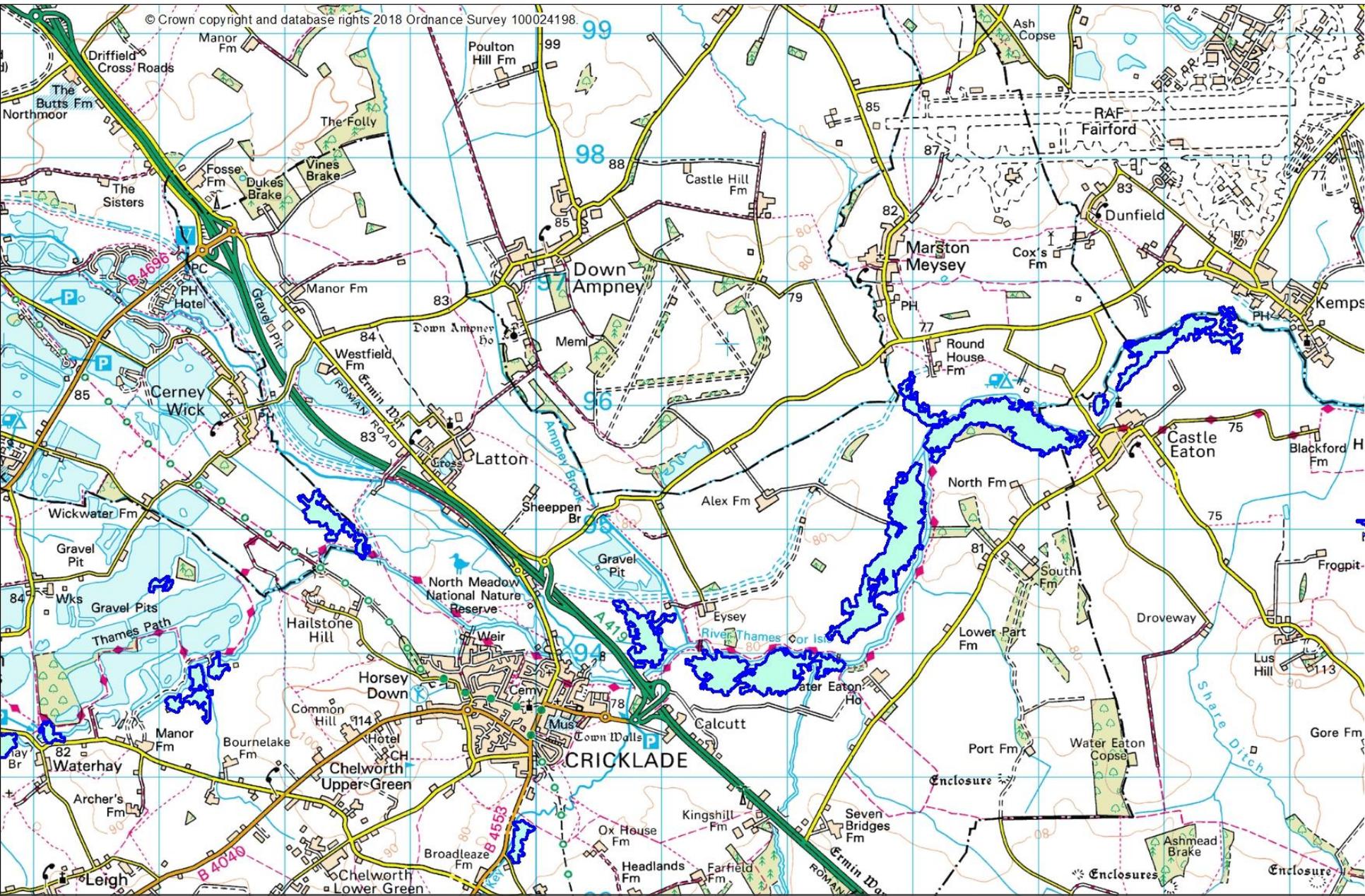


Permanent Water

Tarmac Airfield

Flood Water

Sentinel-1 22th AND 10th November 2016 composite image stack Flood Outline



Ordnance Survey Basemapping with Flood Outlines after post processing with Slope/height and urban masks etc

Thank you for listening!

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