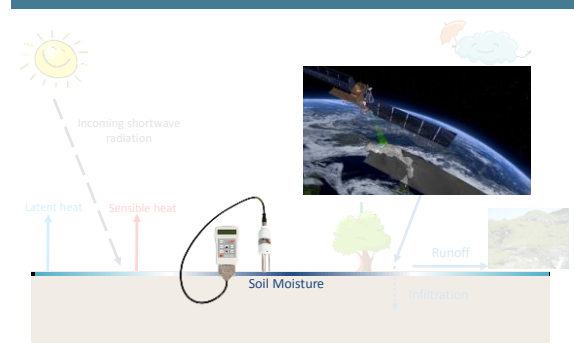


Empirical Derivation of Soil Moisture and Vegetation Parameters from Sentinel-1 SAR in the Rur catchment

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SFB TR32 Subproject C3

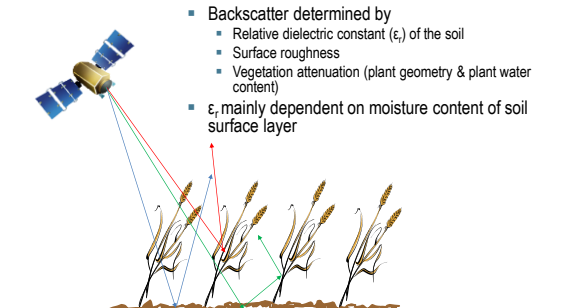
Motivation



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SAR soil moisture retrieval


- Backscatter determined by
 - Relative dielectric constant (ϵ_r) of the soil
 - Surface roughness
 - Vegetation attenuation (plant geometry & plant water content)
- ϵ_r mainly dependent on moisture content of soil surface layer



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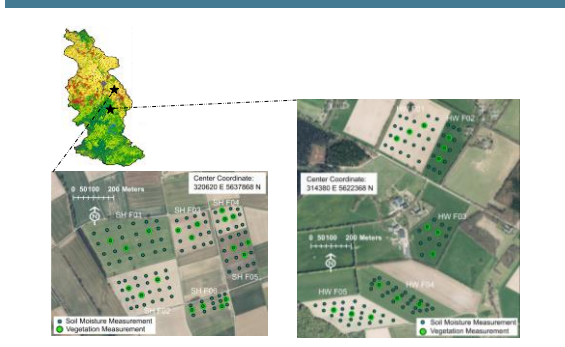
Sentinel-1A/B

- Twin C-Band (5.4 GHz) SAR satellites
- Launched 2014 & 2016
- 12 day repeat cycle (6 day with S1A and S1B!)
- VV-VH polarization over land areas
- Incidence angle 20-46°
- **Our data set:**
 - constant track -> constant looking geometry
 - Incidence angle 38.6°-40.8°
 - Acquisition Time 17:24
 - slc-level processed to 15 m pixels



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Field measurements during Sentinel-1A Acquisitions



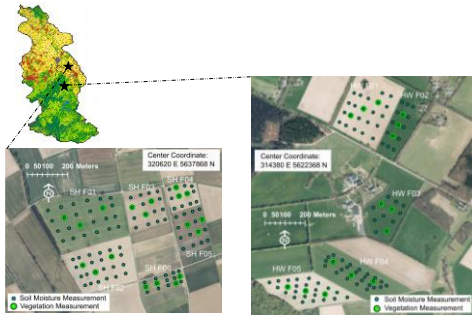
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Measurement Campaigns

Date	Acquisition Time (GMT)	Precipitation between start of measurements and acquisition	
		Selhausen	Hürtgenwald
2015-03-28	17:24	2 mm / campaign aborted	campaign aborted
2015-04-21	17:24	-	-
2015-05-15	17:24	-	-
2015-07-02	17:24	-	-
2015-07-26	17:24	1.8 mm between 18:30-19:30	light precipitation after measurements
2015-08-19	17:24	-	-
2015-09-12	17:24	6.8 mm between 14:30-18:30	light precipitation between 15:00-15:15
2015-10-06	17:24	0.3 mm / measurement campaign aborted	no measurements performed
2015-10-18	17:24	-	-
2015-10-30	17:24	-	-
2015-11-23	17:24	-	-
2016-03-22	17:24	-	Light precipitation between 14:05-14:21
2016-03-29	17:16	1.5 mm between 15:50-16:20 / measurement aborted	no measurements performed
2016-04-15	17:24	-	-
2016-05-09	17:24	-	-
2016-06-02	17:24	-	-
2016-07-29	17:24	-	-
2016-08-13	17:24	-	-
2016-09-06	17:24	-	-
2016-09-30	17:24	-	-
2016-11-17	17:24	-	-

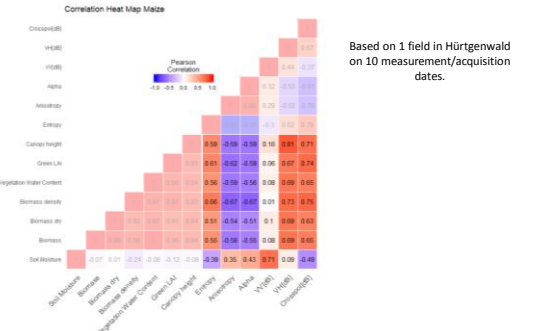
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Field measurements during Sentinel-1A Acquisitions



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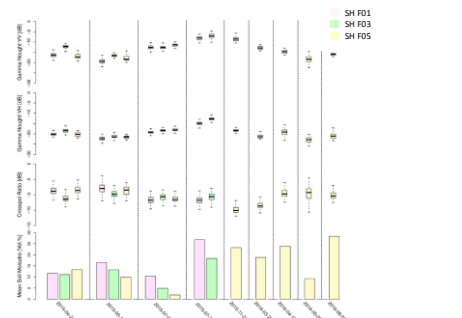
Sensitivity of SAR Observables to Ground Measurements I: Maize Example



Based on 1 field in Hürtgenwald on 10 measurement/acquisition dates.

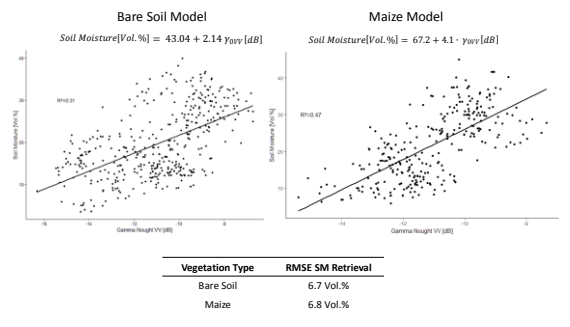
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Sensitivity of SAR Observables to Ground Measurements II: Winter Wheat Example



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Sentinel-1 Soil Moisture Retrieval



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Sentinel-1 Parameter Retrieval

Parameter	RMSE
Soil moisture bare soil	6.7 Vol. %
Soil moisture maize	6.8 Vol. %
Canopy height sugar beet	14 cm
Canopy height maize	53 cm
Vegetation water content sugar beet	5.7 Vol. %
Green LAI cereals	1.5
Green LAI maize	1.3

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Conclusions & Perspective

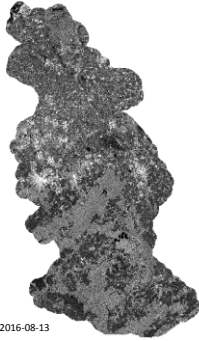
- C-Band SAR data from Sentinel-1 with high incidence angle only suitable for soil moisture retrieval under maize & on bare soil
- Different vegetation parameters could be retrieved with RMSE of ~ 1/4 – 1/3 of value range
- Future studies should concentrate on different bands, and lower incidence angles for soil moisture studies
- Operational soil moisture products with low resolution from passive RS should be combined with high-resolution SAR data to downscale

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Questions??

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Rur catchment acquired by Sentinel 1A on 2016-08-13