The application of high resolution satellite derived soil moisture for flood prediction and estimation

J. Schellekens with contributions from Margherita Sarcinella, Tessa Kramer, Mendy van de Vliet, Laurène Bouaziz, Red Cross 510, and others
“Bridging the gap between science and users”

- Users? Who are they? Do global users exist?
- How?
- Do you need commercial companies?

**This talk:**
- **VanderSat**
- *High resolution Soil moisture from passive microwave*
- *EO and flooding*
- *SM and Discharge*
- *Maliwi case Microwave Flooding*
VanderSat

- Founded in 2015
- 10-14 23 employees (scientists (> 50% has a phd in EO) and entrepreneurs)
- Transition from startup to SME
- Located in Haarlem
- Commercial EO services
  - Prime focus on Microwave data and Soil Moisture

- Mission:
  *Build the best satellite products to solve the global water and food crisis and always keep innovating.*
Background

- 38+ year satellite soil moisture (~4000 users)
- ESA CCI
- Copernicus Climate Services (C3S)

One problem: with a resolution of 25 km it is often too coarse for (commercial) applications
Satellite Soil Moisture

Case study of a catchment in Australia, Van der Schalie et al., 2015: RSE
Why VanderSat?

From informative..................

to actionable!
Operational Products / Services

- **100 m Soil moisture** (daily, global, 2002-now)
- **100 m Land surface Temperature** (daily, global, 2002-now)
- **100m Vegetation Optical Depth** (daily, global, 2002-now)
- **10 m Surface water/Flooding** (based on Sentinel 1)
- **5 m Land Use Maps** (Annual, NL (rest of the world 10 m))
Effect of storms
Floods and remote sensing

- Match made in heaven hell?

- **Optical data:** readily available, high spatial resolution, easy to quantify open water .... But floods come with clouds :-(

- **Active radar (sentinel-1):** high spatial resolution every 3 days in Europe, much less in other places. Hard to distinguish water from runways etc.

- **Passive microwave:** Very clear water signal, daily images globally, low resolution (0.1 degree). Long time records, thus a change to estimate risk

- **Combinations:** e.g, Filipe Aires et. al Downscaling GLIEMS using topographic information
Heavy prec. Poland 2016

Precipitation excess in the period **July 2016** at 0.10 degrees (Beck et al. 2017)

Soil moisture excess in the period **July 2016** at 300 meter (VanderSat)
Creating soil moisture based rating curves for the Meuse catchments

Can we estimate Q from Soil moisture?
(c.f. Van Dijk et. al. 2016 https://doi.org/10.1002/2015WR018545)

An example in the Loison River at Han les Juvigny

- tributary of the Chiers
- 348 km2
- 70% marl and 30% limestone (BDLISA)
- 40% forest, 35% pasture, 23% agri, 2% urban (CORINE)
- 28% wetland, 8% hillslope, 64% plateau (SRTM)
Creating soil moisture based rating curves

Strong summer response while soil moisture is relatively low.
Spatial validation

- Master rating curve based on data of 25 catchments and applied on 25 other catchments
When flooded we have a problem

Example Malawi
Jan 2003

We need something separate for flooded conditions
Flooding from microwave data

- We use the pioneering techniques of the Global Flood Detection System (10 km using 4 day averages)
- VanderSat 4 day average at 100x100m
- Example Malawi Jan 2003
Flooding from microwave data

- We use the techniques of the Global Flood Detection System (10 km using 4 day averages)
- VanderSat 4 day average at 100x100m
- Example Malawi Jan 2003
Forecast-based Financing

A case study for Malawi floods

- 2003 Flood, daily updates
Key message

- Fully operational service (globally, daily)
- Combination of LPRM based soil moisture and MC Ratio on BT -> Describe both dry and wet conditions
- Can be done at 100x100m
- Next step -> merge with Sentinel-1