H SAF root-zone soil moisture products from ASCAT assimilation

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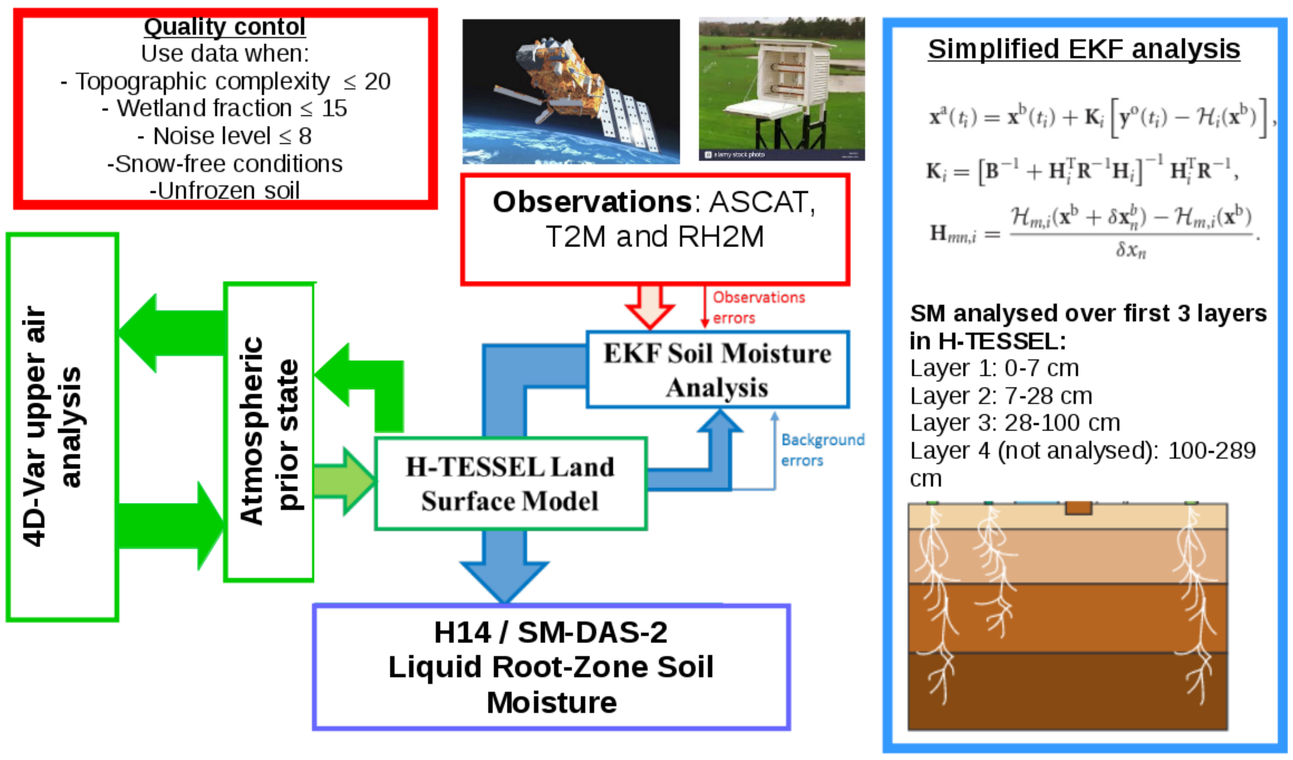
Introduction

The EUMETSAT H SAF aims to provide satellite-derived products with sufficient time and space resolution to satisfy the needs of operational hydrology. The accurate representation of soil moisture (SM) is important for environmental (e.g. floods, droughts) and weather prediction systems. The European Centre for Medium Range Weather Forecasts (ECMWF) provides the core SM products for H SAF using an advanced land-surface data assimilation system, running independently of the NWP system. Scatterometer-derived surface SM observations pre-processed by Tu Wien (Wagner *et al.*, 1999) are assimilated into the ECMWF land surface model (H-TESSEL) using a simplified extended Kalman filter (SEKF, de Rosnay *et al.* (2013)). The resulting root-zone volumetric SM analysis is then screened and normalized to give a soil wetness index, with values between 0 and 1. There are two different root-zone soil wetness index products, with future improvements in development:

1. H14 near-real time product and future H26 product

- Daily **H14 NRT** (36h latency) global root-zone soil wetness index product in GRIB format;
- Simplified extended Kalman filter (SEKF) root-zone SM analysis performed with 12-hour assimilation windows and weakly coupled to atmospheric 4D-Var analysis;
- SEKF assimilates ASCAT-A and ASCAT-B satellite-derived surface SM (H102/H103) and Screen-level temp/humidity, at 25km resolution.

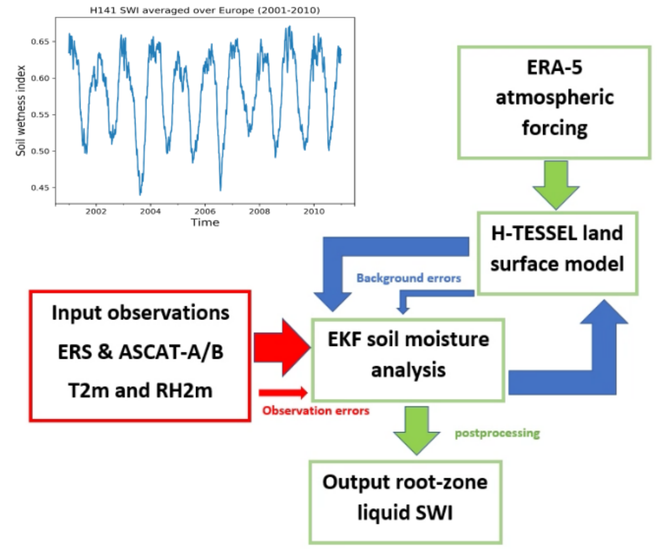


- **Future H26 NRT** product will have **higher resolution (10 km)** and **reduced latency (12 hours)** using the stand-alone surface analysis of Fairbairn *et al.* (2019).

2. H27/H140 data record (1992-2016)

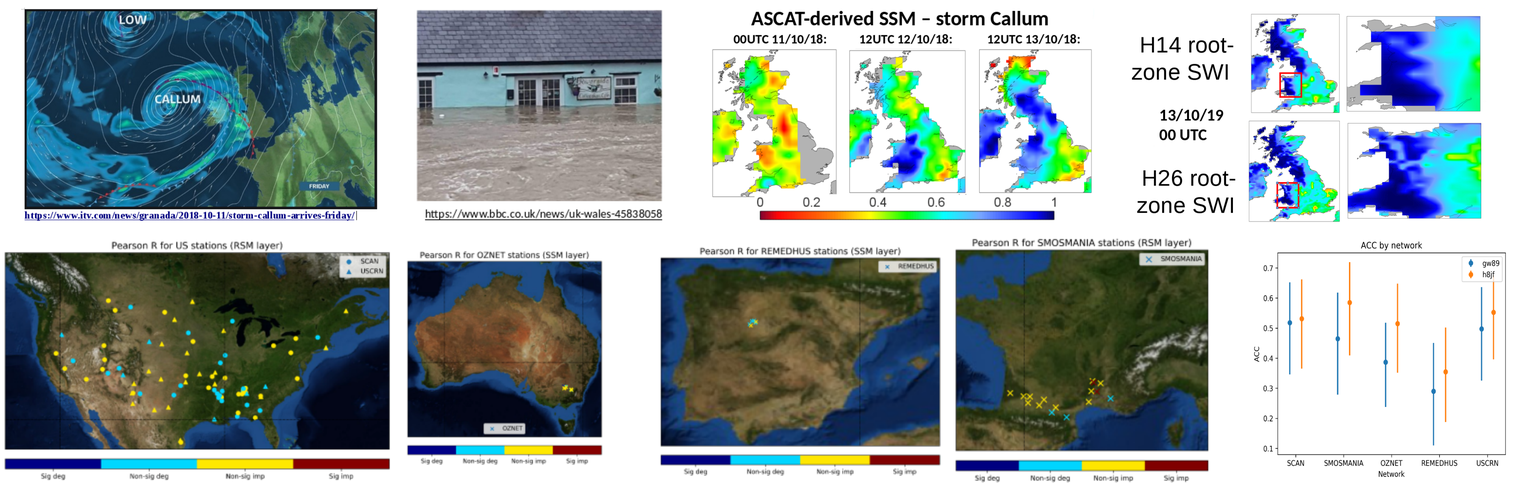
- Global soil wetness index data record product H27 (1992-2014) and H140 (2015-2016) available in grib format;
- Uses an offline version of H-TESSEL land surface model with ERA-Interim atmospheric forcing;
- SEKF employed with 24-hour assimilation windows;
- SEKF assimilates scatterometer-derived surface SM data from ERS/SCAT (1992-2006), ASCAT-A (2007-) and screen-level variables at 16 km resolution.

New H141 data record (1992-2018)



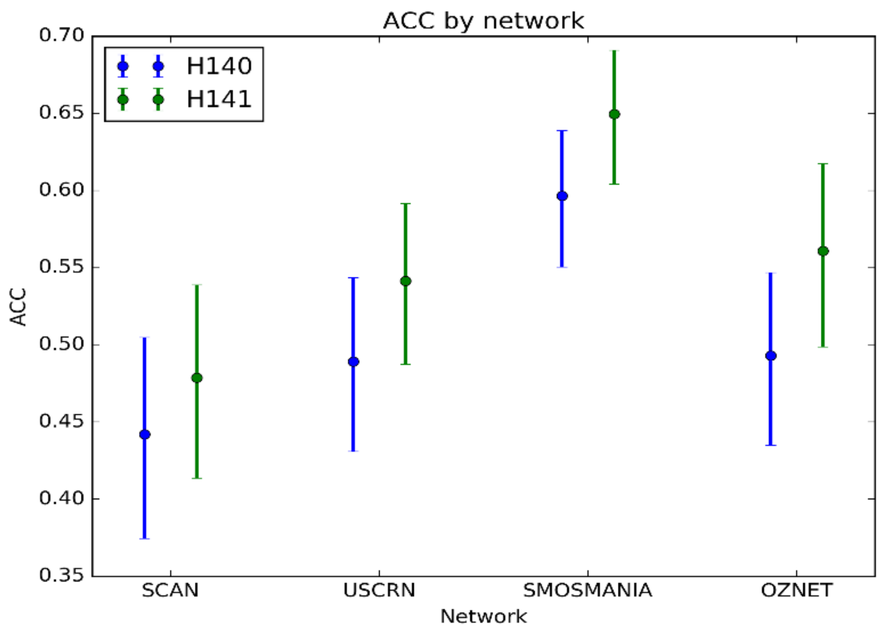
H14 vs H26: Storm Callum example and in situ validation

- H26 root-zone SWI provides (i) finer detail compared with H14 (top, example for Storm Callum) and (ii) improved correlations with in situ observations (bottom) from the international soil moisture network (Dorigo *et al.*, 2011) during June-October 2018:



H141 vs H140/H27

- H141 improves on H27/H140 through **improved atmospheric forcing (ERA-5), increased resolution (10 km)** and ASCAT-A/**B** assimilation.



Summary and future work

- Summary of the two root-zone soil wetness index products:
  1. H14 NRT: 25 km resolution and delivered daily.
  2. H27/H140 data record: Offline reanalysis (1992-2016) at 16 km resolution.
- Key improvements expected in the next project development phase (CDOP-3):
  1. H26 NRT: Latency reduced from 36 hours to 12 hours;
  2. H141 data record: ERA-5 to replace ERA-interim atmospheric forcing, reanalysis extended to 2018;
  3. H26 and H141: Improved resolution (10 km) and output in GRIB and NetCDF formats;
  4. H141 under review (soon available) and operational H26 product expected in 2020.

References

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