How much closer can GNSS-R hydrology retrievals from CYGNSS get us to the truth?

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The UCAR/CU CYGNSS Soil Moisture Product



Validation using in situ data from 5 networks, 203 sites in all Networks used: COSMOS, PBOH2O, SCAN, SNOTEL, USCRN

ubRMSE CYGNSS 0.047 cm3 cm-3 ubRMSE SMAP 0.050 cm3 cm-3

data available to download: https://data.cosmic.ucar.edu/





CYGNSS sees more rain events than SMAP



Soil Moisture Memory

-a phrase with 1000 different definitions



google found 510 journal articles written since 2015 about soil moisture memory Controls on surface soil drying rates observed by SMAP and simulated by the Noah land surface model

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Soil Moisture Memory

-a phrase with 1000 differe McColl et al. used SMAP data and found that the soil surface retains a **@AGU** PUBLICATIONS median 14% of precipitation falling **Geophysical Research Letters** on land after 3 days. **RESEARCH LETTER** Global characterization of surface soil moisture drydowns 10.1002/2017GL072819 ariability of soil moisture m for wet and dry basins Kaighin A. McColl¹, Wei Wang², Bin Peng³, Ruzbeh Akbar⁴, Daniel J. Short Gianotti⁴, K.A. McColl and W. Wang contributed Hui Lu^{2,5}, Ming Pan⁶, and Dara Entekhabi⁴ equally. Mohammad Mahfuzur Rah ¹Department of Earth and Planetary Sciences, Harvard University, Cambridge, Massachusetts, USA, ²Ministry of Educatio Key Points: • Soil moisture drydowns encode Dent. of Civil a nature information on loss terms in the water budget ARTICLES geoscience · We estimate drydown time scales globally using one year of SMAP PUBLISHED ONLINE: 16 JANUARY 2017 | DOI: 10.1038/NGE02868 observations The global distribution and dynamics of surface What happens to soil moisture that other 86%, and Hvdrol, Earth Svst, Sci., 22, 1649-1663, 2018 https://doi.org/10.5194/hess-22-1649-2018 Kaighin A. McColl^{1,2}, Seyed Hamed Alemohammad © Author(s) 2018. This work is distributed under Simon Yueh⁴ and Dara Entekhabi^{1,5*} the Creative Commons Attribution 4.0 License. \odot \odot when?

google found 510 journal articles written since 2015 about soil moisture memory Hydro Edit 39(3), 22, 109, 2018 https://doi.org/10.5194/hes-22-1649-2018 © Author(s) 2018. This work is distributed under the Creative Commons Attribution 4.0 License. © © Controls on surface soil drying rates simulated by the Noah land surface modes

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Fraction of water left in the top 5 cm after 1 day: $1 - \frac{A}{R}$



CYGNSS data show that the land surface retains a median of **53%** of precipitation after **1** day



also, 37% is left after 2 days, and 17% is left after 3 days

using CYGNSS to map flooding and inundation

update:

Option 1: Option 2:







Contents lists available at ScienceDirect

Remote Sensing of Environment

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Development of a global inundation map at high spatial resolution from topographic downscaling of coarse-scale remote sensing data



Remote Sensing Environment

Etienne Fluet-Chouinard ^{a,*}, Bernhard Lehner ^a, Lisa-Maria Rebelo ^b, Fabrice Papa ^{c,d}, Stephen K. Hamilton ^e



Option 3:



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Cyclone Idai







Cyclone Idai







Before







Does this method work?





* Represents different time periods: UNITAR Mar 20, CYGNSS Mar 11-22

* Represents different time periods: MODIS Mar 23, CYGNSS Mar 11-22



Water detected **before** Idai

Water detected after Idai

Summary

(I think) CYGNSS is the only way to answer some short term surface hydrology questions.

Downscaling CYGNSS inundation maps is showing promise, but I'm not all the way there yet.

