

Incorporating satellite data into weather index-based insurance

Article

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. INDUSTRY - COMM

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14	Incorporating satellite data into weather index-based insurance
15	University of Reading, 16-17 February 2016
16	
17	Title: The first TAMSAT/IRI Weather Index Insurance Workshop
18	
19	What: Twenty-three people from six countries came together to discuss how
20	drought insurance based on remotely sensed data can reduce the impact of
21	weather shocks on some of the poorest people in the world. Participants were
22	drawn from the financial and agricultural sectors, non-governmental and
23	governmental organizations, as well as from universities.
24	
25	When: February 16-17 2016
26	
27	Where: Reading, UK
28	
29	Farmers are highly vulnerable to weather shocks, particularly in regions such as
30	Africa where there is a high reliance on rain-fed agriculture. It is therefore
31	unsurprising that a lot of attention has been paid to developing climate risk
32	management tools for farmers to mitigate and transfer the risk of weather
33	shocks such as drought and flood. In recent years, agricultural insurance has
34	become part of this tool-kit, particularly weather index-based insurance (WII).
35	Rather than compensating observed damage, compensation in WII is determined
36	on the basis of an independent index (such as the cumulative precipitation falling
37	in a certain window of time, or the average yield over a district). The trigger for
38	this index is determined in advance of the season.

40 WII has shown to be a cost effective tool for agricultural climate risk management, particularly for "single peril" situations where there is one 41 42 overriding and externally measurable peril impacting farmers (e.g. low rainfall at 43 the start of the season). Millions of farmers are now covered by WII contracts 44 (Greatrex et al. 2015). A major challenge to scaling WII has been the absence of 45 comprehensive ground based rainfall and crop data, necessary for index design, WII cannot be extended to regions with low gauge 46 pricing and validation. 47 density if it only works in areas covered by existing rain gauges with long 48 histories (Norton et al. 2012).

49

50 Remotely sensed data, such as satellite based rainfall estimates have become a 51 key tool in allowing WII to scale to levels where it could meaningfully impact 52 poverty. They have been used directly in the creation of indices, in validating 53 existing indices, in tracking insured seasons and in assessing basis risk (where 54 the compensation does not match the damages). Hundreds of thousands of 55 farmers are now insured under indices based on remotely sensed datasets, 56 particularly across Africa (Greatrex et al. 2015). For example, the R4 Rural 57 Resilience Initiative currently insures 32,000 poor smallholder farmers using 58 satellite based rainfall and vegetation. Commercial companies such as 59 Agriculture and Climate Risk Enterprise (ACRE), the Ghana Agricultural Insurance Pool and PlaNetGuarantee are also investing heavily in satellite 60 61 derived indices, covering hundreds of thousands of farmers.

62

Satellite derived WII is still a very new field however, with many challenges to overcome. Addressing these requires collaboration between academic and industrial actors, including data providers, agro-meteorologists, insurance aggregators (who design and implement indices), insurance and reinsurance companies (who price them) and non-governmental organizations (NGOs) who can link directly to farmers.

69

70 In order to bring these communities together, the Tropical Applications of 71 Meteorology using SATellite data and ground-based observations (TAMSAT) 72 group and the International Research Institute for Climate and Society (IRI) led a 73 workshop on Index Insurance at the University of Reading, UK, 16-17 February 74 2016. Twenty-three people participated, including scientists specializing in 75 rainfall and land surface remote sensing, experts in climate risk management 76 and index insurance, insurance aggregators and reinsurers. The workshop 77 consisted of short introductory talks followed by in depth discussion in break 78 out groups. A key output is an extension of the TAMSAT/IRI's *Practitioners*' 79 *Guide to using satellite data for index insurance.*

80

A challenge when using satellite data is choosing which of the many satellite products to use (see Table 1 in Maidment *et al* 2014). Satellite rainfall providers, are, moreover, keen to facilitate the use of their data by the insurance industry. Such datasets include TAMSAT (Tarnavsky et al. 2014; Maidment et al. 2014), Climate Hazards Group InfraRed Precipitation with Station data (CHIRPS) (Funk et al. 2015), ENACTS (Dinku *et al*, 2016) and Africa Rainfall Climatology (ARC2) (Novella *et al*, 2013). The characteristics that make remotely sensed data

suitable for WII was a recurring theme of the workshop. For a dataset to be useful to the insurance industry, it must have adequate temporal and spatial resolution, low latency, sufficient length of record, and be easily accessible. The exact requirements depend on the context. For example, although a horizontal resolution of 0.5^o might be suitable for a national insurance program, finer resolution is required for schemes administered at the community level.

94

95 Beyond the basic criteria listed above, datasets must also represent variability in 96 the insured index skillfully enough to pay out at the appropriate time. During the insured season, missing data affects the decision as to whether the index has 97 98 triggered. A sensitivity study presented at the meeting showed that even a low 99 proportion of missing data (<5%) significantly denigrates the accuracy of 100 payouts. Unlike gauge-based datasets, satellite-based rainfall datasets, such as 101 TAMSAT and CHIRP/CHIRPS, rarely contain missing values operationally - a 102 clear advantage of using such data. TAMSAT, for example, has had no missing 103 days since 2006. All African rainfall datasets, however, contain missing historical 104 records. This has the potential to distort pricing because historical data are used 105 to assess how often payouts occur (a historical "burn analysis"). Average payouts 106 can then be used to establish premium levels. Missing historical data impacts the 107 historical burn analysis. If the missing data would have triggered the index, then 108 the premium should have been higher.

109

The workshop provided a forum for data providers and insurers to discuss the
treatment of missing data and to agree on revised guidelines for data providers.
Data providers and insurers have different priorities when accounting for

113 missing data. Data providers aim to estimate missing points as accurately as 114 possible. Insurers, of course, need accurate data. However, they also need to 115 constrain the effect of missing data on pricing - for example, by carrying out burn 116 analyses with missing data filled using several different techniques. Following 117 the workshop discussion, it was agreed that data providers should fill missing 118 data as accurately as possible, but that all filled points should be clearly flagged. 119 In addition, dataset documentation should contain a description of the 120 methodology used for filling data.

121

122 Reduced missing data is clearly an advantage of satellite-based rainfall products. 123 However, remotely sensed rainfall is only a proxy for actual rainfall. It is crucial 124 that indices based on satellite-based rainfall are designed to maximize the skill of 125 the estimation methodology. Aggregation over space as well as over time 126 generally improves skill (for example, Maidment et al 2013). It is important, 127 however, that indices represent the local conditions experienced by the policy-128 holders. It is necessary, therefore, to balance the improvements in skill gained by aggregating against the loss of representativity of local conditions (Black et al. 129 130 2016). For instance, satellites may represent rainfall aggregated over a 1000 x 131 1000 km box accurately (i.e. have good skill), but the aerially averaged rainfall is 132 not representative of conditions experienced by an individual farmer living 133 within the region (i.e. representativity is low).

134

135 At the workshop, the scientific community and data providers emphasized the 136 need to aggregate satellite-based rainfall to maximize skill. The insurance 137 industry participants and other stakeholders highlighted the need for clear

138 guidance from data providers as to the spatial scale that can "trusted." The 139 participants agreed that the final choice of scale for aggregation is highly context 140 dependent. The need to evaluate both skill and representativity of aggregated 141 indices was acknowledged by all.

142

The workshop closed with a discussion of new products, platforms and datasets. 143 144 A range of datasets was discussed, including ENACTS (Dinku et al. 2016), CHIRPS (Funk et al. 2015), and the Climate Change Initiative soil moisture (Liu et al. 145 146 2012). The discussion focused on the importance of using multiple data sources 147 for validation of WII indices, especially in regions where groundtruth data are 148 sparse. Cross comparison of data is a challenge for the insurance industry, and 149 this has motivated the development of a number of platforms, including the 150 NASA-Interdisciplinary Research in Earth Science (NASA-IDS) Remote Sensing 151 for Agricultural Insurance platform, and the Satellite Technologies for Improved 152 Drought-Risk Assessment (SATIDA; Enenkel et al. 2016). These complement 153 training resources, such as the IRI Weather Index Insurance Educational Tool (WIIET; <u>http://wiiet.iri.columbia.edu/WIIET/</u>) and more general drought early 154 155 warning systems, such as the Famine Early Warning Systems Network 156 (FEWSNET) Warning Explorer Earlv (EWX; 157 http://earlywarning.usgs.gov:8080/EWX/index.html).

158

159 In conclusion, remotely sensed data can be used to extend weather index 160 insurance to millions of farmers in Africa and beyond – potentially mitigating 161 their exposure to climate-related risk. On the other hand, inappropriate use of 162 these data could cause great harm. This workshop enabled key players in the

163 weather index insurance industry to engage directly with data providers and 164 scientists. As a result, data providers now have a clearer idea of the way that 165 their products are being used. The insurance industry, moreover, has a better 166 understanding of both the opportunities and pitfalls of using remotely sensed 167 data. Following the success of this workshop, the participants agreed that deeper 168 engagement between data providers, scientists and the weather index insurance 169 industry would be of benefit to all parties. Further workshops, projects and 170 collaborations are planned.

171

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176

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