Bridging the resolution gap between satellite data and agricultural applications [1]

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Tuesday, January 6, 2015 - 15:30 to 17:00
Event: Winter Meeting 2015 [2]
Session Type: Breakout [3]
Expertise Level: Beginner [4]
Collaboration Area: Climate Education Working Group [5]
Energy and Climate [6]
Abstract/Agenda:
These two sessions, sponsored by the Agriculture and Climate Cluster, will address the spatial resolution gap between what satellite data can offer and what agricultural applications need, which is often dictated by station observational data over small geographic areas. Focus will be on the USDA Regional Climate Hubs and the needs of their user communities, on other agricultural applications of satellite data, and on a system for the critical co-location of satellite and ground measurements. A panel/group discussion and Q&A towards the end of the second session will provide ample opportunity to bring together the presented topics, to elicit potential solutions, and for everyone to actively participate.

Session 1:

Randy Johnson, USDA FS - Climate Hubs, a national perspective

Liping Di, GMU - Agricultural applications and spatial (and temporal) resolution

Steve Kelling, Cornell U - Satellite data, bird conservation, rice field management, and resolution

Arif Albayrak, NASA GES DISC - System for co-location of satellite and ground data

Session 2:

Wade Crow, USDA ARS - Agricultural applications of SMAP and resolution

Dalia Kirschbaum, GSFC HSL - GPM applications and perspective on resolution

Panel discussion

Notes: Sessions recorded on WebEx: https://docs.google.com/document/d/1JciEBgWPqYknDAKjtKCeOeQfqQRYoVGBx7QR... [7]

Bill introduces session
Focus on relationship between ground and spatial data - thinking about resolution issues

Randy Johnson USDA Regional Hubs for Risk Adaptation

Information Flow to stakeholders
no lack of research, but need to make research better and more useable
provide information in a form stakeholders can understand and use to make decisions (ie: not peer reviewed academic papers)
Tool Makers - not a lot of people taking that data and making it so people can use
Tool reviewers can communicate between tool makers and tool users: "farmers will use this, they

won't use that"
Which shows the importance of the county extension agent - cooperative extension is the major outlet.

Regional Climate Hub - take all the research, synthesize it and send it out to help farmers.
There are an overwhelming number of tools, over 200 tools to help farmers, they can review and figure out what farmers will and won't use.
Can help develop the tools and information.

people change when they interact with somebody else
making a conceptual framework for all of this
Understanding vulnerabilities/risjs
assessing current tools and information
build a network
find gaps and fill
Scale: Regional, courser data
Remote sensing and precision agriculutre - site specific management
on-demand commercial products
Climate Basic - field level data
MODIS level data in relation with farm level data needs
Rangelands, Forests, fire-mapping tools

US Ag is now very much about precision agriculture. Take data and use it to manage on a very small scale. Really fine scale, example: This pass of my tractor down my field. Site specific management to look at the within-field variability. Remote sensing can help. Can the USDA/fed gov provide similar services to make these tools and products available? Never going to compete with the private data available…but private data is expensive.

Remote sensing is good, but farmers and land managers want to know what is going on now. In his field. (Small scale, temporally fast -- high frequency of data. And fine grain data.

Climate Corporation: Helping farmers manage on a field basis. App to Iphone. Monsanto just bought it for a billion dollars.

Remote sensing is hard on a farm scale.

Rangeland - has more remote sensing applications. Larger areas. Can help with what is overgrazed, stressed, etc. More opportunities out west because scale matches better. Land managers want to know what's out there on these large tracts of land.

Forestry - Even more well matched. Land managers don't need to know the day to day stuff, they need to know what's happening every month. Spatial varies. But still there are more opportunities. Remote sensing for forest health monitoring, what's going on, fires, etc. Can alert managers what's out there.

Remote sensing data needs to be combined with field data.

16$/acre/year - what climate core is charging (roughly?)

Liping Di, GMU

Flooding - Worst natural disasters for crop loss.
Remote sensing based post flood crop loss
working with NASS and RMA
activities after a disaster existing services and gaps

shortcomings of current approaches -

Sparse sampling - limited field investigators

Tool limitation.

Tools currently used: MODIS VIIRS NDVI EVI

Surface water records - missing data/gaps. Remote sensing clouds and other reasons why data is missing from surface water extraction.

Crop loss can be seen in remote sensing: proposes remote sensing approach

Compliance investigation - determines if a claim of crop loss meets policy requirements. Did the flood occur during the crop growing season, was the crop actually planted and how much was lost. Spot checks are used to appraise the loss.

Major question: if the claim satisfies the condition "prevent planting" - have the check this all using high resolution imaging.

Important questions: Did the farmer plant anything after the flood? Was the crop actually planted to the extent the farmer claimed? What was the duration of the flood? -etc.

examples with remote sensing approach
compliance investigation/spot check/spatial resolution and temporal resolution gaps

Federal and state level decision making - remote sensing is enough. But for spot check of individual claims, Landsat OLI barely meets the requirements. Higher spatial resolution 5-15 meter multiple spectral iamges are better. Additionaly, there are gaps in temporal resolution. Gaps due to cloud cover etc. for determine flood duration and frequency.

SAR data integration- vegetation indexing - this will help get the data coverage necessary, but still need to address more.

Steve Kelling - Cornell Lab of Ornithology
Bird Returns - Dynamic Conservation in the Central Valley of California

Historically conservation of land: National Parks, etc. Permanent protected areas.
New: concept of following the organism and preserving the area around them (example: following bird migrations)
Link bird mirgration to agricultural land, as 95% of original flyway habitat has been destroyed on the west coast, many birds now use ag land to stop on their migrations.
looking at crop scape imagery for that area
only pay for what we need when we need it: develop a process where (we) would pay farmers to manage their lands for birds for only the times when the birds are there.
syncronizing farming cycles with birding cycles, we need to know where and when birds occur in that flyaway
eBird:
Use bird watchers - 200,000 participatents that collect 200 million bird observations and growing
challenge of multi-scale modeling - spatial and temporal in fine resolution
Niche modeling
Observational data sensors- observers are also sensors: a "sensor network" of birdwatchers.
Remote Imagery Sources
Predictions of occurrence of a species - non parametric machine learning approach Spatio-temporal Ensemble model
Can show peak occurrence of when birds are in the central valley and when they aren't.

Now they can speak to the farmers about potentially having farmers change their plant and harvest times to manage and support the birds.
Forward auction with sealed bids from farmers to allow land use/ keep flooded during key times
Conclusion:
They created more habitat for birds (shorebirds) - reverse auction concept (created tool) for a framework for conservation. Funding came from public and private sources. Created a framework for adaptive management and now can be used in other areas as well.

Arif Albayrak, NASA GES DISC
Multiple sources of data
station, raster, satellite ,
consideration of co-location of types
introducing projects
Also social type for co-location

Satellite and Sensor/Station on ground - 1 to 1 match (when the satellite is overhead)
Spatial co-location
Temporal co-location
Statistics for region of interest
Multi-Station problem. Estimating rainfall for Ag Insurance. Numbers of gauges/stations.
We need to fill in the gaps to provide the information for insurance groups (or whatever group). How to do the interpolation.

Pixel data collected from satellites. Began to see more information. Look at the systems. Whole areas/regions - are different systems. And these features you can include in your algorithms. This data needs to be related to the stations. Contextual co-location.

We have many orbiters and many data sources.

Can turn the different data sets into others. So swath can be turned to point or to grid. Grid to swath or point, point to swatch or grid. All these are co-location problems and can then be merged to give more information and do more scientific analysis.

There is a social aspect of the problem. There are twitter applications where people are the sensors. API is written and can collect data to try to see, for example, where it is raining based on tweets/twitter. Using social media/people as sensors.
Twitter - sampling bias. Collecting data. Collect enough to overcome sampling bias.

Wade Crow - USDA ARS

Dalia Kirschenbaum - NASA GSFC
GPM Constellation Coverage
international constellation
societal benefit areas
early adopter resource examples
webinars and sessions in March 2015

Panel discussion starts

Summary from talks and discussion:

Climate Research - How to provide information in a form that can be used by landowners/managers who are not going to read peer reviewed academic papers.

There is no lack of research, and in a lot of cases the science is easy enough to understand, but the policy and politics is hard. Need more target research and there is a need to make the research that is out there better/more accessible and useable. Outreach through various government and extension programs that can take all the research, synthesize it and send it out to help farmers and land managers. Figure out which tools farmers will and won't use and be a conduit between the development of tools and information and the users.

Scale is important to consider in terms of what types of data and tools and research are needed and can be provided for land managers/farmers in the US.

1. Farms - is smallest/finest scale both spatially and temporally.

2. Rangeland - are larger areas where remote sensing can help with identification of areas that are overgrazed, stressed etc.

3. Forestry - typically an even larger area (though spatial range varies), and temporally management decisions are made on a longer time scale. Managers don't need to know the day to day stuff. Remote sensing for forest health monitoring.

What is needed on the ground (ie: what a farmer wants to know):

- What is going on right now. In his/her field. Which means:

- Higher frequency of data. And finer grain data. (Small scale, temporally fast). This may be best obtained through a combination of satellite and remotely sensed data with on-the-ground data.

- Which brings up the question - where is the data coming from, how is it being used/processed and how can farmers best integrate it into their decision making and ultimately...

Who owns data - Private vs public data. If better resolution data involves blending different - how can public sectors partner with private sectors to make it better?

Points:

- Climate Corporation: Helping farmers manage on a field basis. Including an iphone app. Monsanto just bought it for a billion dollars.

- Data and tools and information comes from many different agencies and government and non-government places. Hard to sort through all the data and all the different ways and places to acquire data especially for decision making purposes.

- How data should or shouldn’t be “used” and if/how to communicate to the end-user (perhaps it should be more of a dialogue situation)
- It’s not just for farmers and landowners, data is used by insurance companies for agricultural insurance. To “spot check” There is sparse sampling and limited field investigators - as well as limitations of tools available:
    - Tools: MODIS VIIRS NDVI EVI

Remote sensing - Quality - how good is good enough? Flagging/rating openly available data (1-3… good okay and bad don't use) etc. Would this rating system be useful? What is being communicated and how is the end user understanding the rating system and the available data. User focus groups are needed to find out - who is using data how and how to cater to them (and when not to?)

In the agricultural insurance arena (for example): Surface water records (flooding) there is often a lot of missing data or gaps in image records. Crop loss and flooding can be seen, but many questions are not necessarily able to be answered by using the currently available remotely sensed data. Need more long term monitoring data systems, as opposed to a data snapshot so that questions can be answered like:

1. What was the duration of the flood
2. Did farmer plant anything after the flood (in flooded area)
3. Did flood occur during crop growing season
4. Was the crop actually planted before the flood - and to what extent was the crop “lost”

For spot check of individual insurance claims, Landsat OLI barely meets the requirements. Higher spatial resolution is needed as well as more temporally robust imaging.

Citizens science - What are ways to use readily available media and the internet to best utilize Citizen Science. What are the pitfalls and where can this be best practiced (for research, for data collection).

1. Users as intentional data collectors (ie: Ebird, which is 12 years old with 200,000 participants that collect 200 million bird observations.)
2. Researchers using online users or user generated information. (ie: Using Twitter or Flicker data) ie: people are the sensors.

1. Example: API is written and can collect data to try to see where it is raining based on tweets (twitter).

Astronomy and ornithology are fields where citizens scientists are considered viable researchers, and possibly this could be extended to other fields as well using internet/media platforms. But:

What are the pros and cons:

How do we qualify this data

What crowdsourcing things can be used

How are outliers decided

How is information weighted

Dealing with Sampling Bias

Attachments/Presentations: Liping_Di_Flood_Crop_Loss.ppt [8]
Steve_Kelling_Bird_Returns.pdf [9]
Arif_Albayrak_Co-Location.pptx [10]
Wade_Crow_Drought_Monitoring.pptx [11]
Dalia_Kirschbaum_Global_Precipitation_Measurement_Mission.pdf [12]

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Teaser: Bridging the resolution gap between satellite data and agricultural applications
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