Leader: **Oliver Wing**
Presentor brief summary: **Jim Nelson (URL Shortcut https://goo.gl/423js5)**
Logistics:

- Spend 5-minute max to do a quick introduction among all in your group (name, what institute do you work for)
- Determine who takes notes and who will present a summary of the outcome of this breakout this afternoon.
- Make small subgroups (3-5 people) and answer each of the questions below, ensuring a mix of expertise within each group. Ensure each group has 1 laptop with access to this Google Doc, and write down your group's answers in the obvious place. Take for each question ~15-20 minutes in your small subgroup and brief back to larger breakout group (~3-5min each subgroup).

TASKS - FLOOD MODELING & FORECASTING

Model based flood maps either for forecasting or to determine the e.g. 100-year floodplain (return period) are produced at various resolutions. To better understand what is available, useful, or missing, we would like to get your opinion on the following:

1. **What simulated flood products are available, how are they used (if at all) and do they satisfy end-user needs?**

Group 1

- Dartmouth flood observatory:
- CHIRPS: used for precipitation (^)S to 60N,global product, global precipitation product, where there are no stations, it is not reliable
- SRTM: terrain elevation, 30mscale, striping there.
- MERIT DEM: 90m resolution, bias correction, vegetation removed.
- LIDAR data sources: noisy and can be difficult to interpret, not available everywehre
- TANDEMX: another post-processed derivative of SRTM
- GFS: precipitation forecasting
- ECMWF: european weather data
- HRRR model: short time scales, run over the US and Alaska. Based on the WRF model.
- National Water Model: US, early stage of use, some predictoin
- GLOFAS:
- NWS river forecasting
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- Some models will do better than others depending on what the assumptions are embedded within
- For example, if you're interested in 2-week averages, might work, but not for short-time scales
- Over-trust/over-confidence in models from an end-user perspective
- Can multiple satellite products be combined to provide better information for flood forecasting?

Group 2

- KatRisk (proprietary) - Countrywide Probabilistic Flood Model to compute return periods to determine rates for insurance and reinsurance.
- National Water Model - Daily forecasts at the hourly, ten-day, and thirty-day outlook.
- HAND Flood Mapping to turn the flood forecasts to inundation maps

- ECWMF ensemble forecasts downscaled to a higher resolution stream network that provides uncertainty and made useful at local scales

Group 3

- Commercially produced: JBA, Fathom. Tailored mainly for insurances companies, and hence most suited for developed world. Usually not transparent.
- (Robert) UK - re-running few times a day to try to asses areas at risk. Storm surge. Generic calibration allows usage of the model everywhere across the UK, rather than tailored for specific regions.
- FEMA flood maps - vast influence on decision makers and industry. Not designed to support flood risk management.
- Google flood forecasting based. Hydraulic modelling based on Bates 2010, focusing on developing countries.

Group 4

- [PUT NOTES HERE]

2. What are the needs of the various communities (first aid & response agencies, insurance companies, research, planners, …) regarding Flood Model products?

Group 1

- Put existing products together to derive more information content locally
- Need to find good trade-offs between sustainable business models and free access for end-users
- Some government products are opened up during a disaster for on the ground agencies to use (not for commercial purposes)
- Uncertainty associated with the product(s); requires investment; communicate uncertainty to actual information for decision makers; how does an operator interpret probabilities
- What is the most likely and the worst case scenario: this is what emergency managers want to know
- Other types of flooding events: have missed Tsunami flooding; storm-surge; nuisance flooding for coastal communities
- Public needs information communicated to them that conveys risk. E.g. simpson hurricane scale was not helpful for Florence given the downgrade in the hurricane.

Group 2

- Better global DEM data (higher resolutions both vertically and horizontally)
- Local data exchange for calibration and potential future assimilation
- Better flood modeling decision support tools for those in the emergency management/response organizations
- Incorporation of good road, bridges (culverts) and infrastructure layers to support risk/impact/response activities
- Better information about dams/levees/defenses and incorporation into models
- Antecedent moisture conditions to drive models
- Better integration with hydrology and hydraulic models. In urban and high impact areas floods are dominated by the hydraulics.
- Capacity building and communication between the flood data/information providers and the food data/information consumers - those that really need to make decisions. Scientists and modelers must account for the needs of the decision makers
- Specifically from insurance/reinsurance industry
    - Building footprints
    - First floor elevations

    - Post event satellite reconstructions

Group 3

- (Jesus) Lack of water quality/contamination data. Better idea of flood's evolvement could be used for better understanding of contamination sources and propagation. -> Important for insurance as well
- Conveying uncertainty of the different models, for decision maker to be able to that into account, rather than using model outputs as definitive.
- Resolution of input data is very important. Need to capture key feature.
- Operational Flood Forecasting perspective - sense of the scale of the upcoming event, and the approximate timing. As the events happens, finer detail becomes important for operations.
- Individual preperdanse - people can take action to prepare their own property. "2 hour lead time can cut the loss caused by the flood by 50%". Need to know approximate depth to make decisions such as - evacuate, move their vehicle fleet.
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Group 4

- [PUT NOTES HERE]

3. **Are the above needs currently met: what is missing and how do we find it? (E.g. Are unmet needs related to poor communication between modelers and potential end-users? Is there a need for "more science"? If so, what?)**

Group 1

- Social science to communicate risk
- Increase interdisciplinary collaboration(e.g. Social science, engineering, …)
- Put a rain sensor on every cellphone tower (technological innovation)
- Communicate forecast to communities (translate the science & also make sure it (the forecast) is actually communicated)
- Increase credibility
- Lack of information beyond 1st world countries
- Camping example where people died
- Low-cost sensors - - get there Wednesday afternoon!

Group 2

- Focus on standards like WaterML and other data exchanges so that it becomes easier for others to contribute.
- Open Source vs Proprietary? How do we create win-win for everyone?
- White paper from workshops like this can help inform agencies providing resources to do so more efficiently.
- There is a need for more science but perhaps more a pause to learn how to integrate and make current science more impactful. The integration of the relevant sciences is perhaps the greatest needs.
- Decision making tools to bring current data/science to life and make it useful to decision-makers.

Group 3

- Probability is not very well understood. Historical events helpful in disambiguation communication. You can talk about return periods or "What if Harvey would shift to Luisiana". People are more likely to respond to the second.
- Not all datums are the same, which makes it harder for people to interpret gauge measurements.
- Unmet needs may be related to the difficulty caused by lack of consensus between different model outputs. How do you decide which is the authoritative forecast?

- False alarms create distrust, which make people not take action on the forecasts.

Group 4
- [PUT NOTES HERE]

4. How are available/used models tested, is this adequate, is it always necessary?

Group 1
- MIT through media lab: data sharing, getting data from multiple portals to feed into models
- Google data sets: access to global data sets
- Systematic set of testing for flood models; similar to GCM scenarios
- Push towards open-source products?
- Flood modeling: difficult to have high-quality observational data (e.g. remote sensing resolution, cloudcover/vegetation)
- How do you test flooding downstream when you have dams in between, clogged drains, etc.: human management that is “unpredictable”
- Introduce deep learning / AI/ monte carlo analysis / data analytics

Group 2
- Not enough testing is done
- It is always necessary to provide confidence to decision-makers.
- Again standards are needed like WaterML to be able to share local data for testing
- Intercomparison studies so that we can compare model to model in the same areas and understand strengths and weaknesses
- HONESTY by model developers is essential, we over-sell models all the time
- Hackathon workshop where groups are given similar datasets and a scenario and then given the ability to provide solutions. The outcome could be published and would identify strengths/weaknesses of the different models and data/information.

Group 3
- Given climate change models always need be re-evaluated. There is clear indication that there is more rainfall during coastal storms.
- In England there environmental agencies with benchmark tests. You have to perform good on this benchmarks to gain credibility.
- Testing by creating synthetic scenarios, and testing by running models excluding some of the original parameters used for the creation of the scenarios. Does not test core assumptions of the models, rather robustness.
- There is a need in experiments to validate the capability of the models to take into account all complexities.
- Lack of reliable recordings of past events. There is a lot of data, but it’s scattered. Insurance companies have claim data, but it’s hard to puts hand on because of privacy issues.
- Exploring how flood impacts can be tested? Maybe through traffic / social media.

Group 4
- [PUT NOTES HERE]

5. **What temporal/spatial resolution is desired for flood model forecasting/mapping for different communities? Are current products of an appropriate level of complexity for such groups?**

Group 1

- Flooding at the block level; need to couple larger atmospheric models to whose basement is going to flood
- NWS areal flood watches is too large, non-actionable
- Small convective activity is a challenge
- Events that happen at “non-normal / off season” times of year, even for a moderate event (impact for agricultural producers to get crops out prior to event)
- Flash-flood events are difficult

Group 2

- Higher spatial/temporal resolution that can be reasonably managed is better
  - 10 meter resolution is adequate for most applications
  - Emergency responders are less concerned about spatial resolution, but increased temporal resolution is critical.
- Like the science question though we probably have a lot more we can get from the current resolutions before moving on to higher resolutions
- Increased resolution of monitoring systems
- Temporal resolution and vertical resolution needs to be better to help with real-time response

Group 3

- Different needs for different cases. No good sense about that. Temporal/spatial resolution is optimized for the specific actions that’s going to be taken on that forecast.
- People want to know what areas are going to have ponding water after the flood.
- For insurance purpose - building level resolution is required.
- Multi-resolution analysis to understand which resolution is satisfactory. Used in weather, but not yet in flood modelling.
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Group 4

- [PUT NOTES HERE]

BREAKOUT OUTCOME

Top Priority Need (where don’t we do well)

Group 2 - Communication between science/user community to “apply” current models, data, etc. Also communication within science and user communications to share best practices (hackathons for scientists, table tops for users, etc.) - and to communicate uncertainty in an actionable way to the end-user applying the local context (need social scientists, anthropologists)

“Honestly” communicate accuracy, limitations for appropriate application (maybe more ways of standardizing how to compare models).

Group 3 - Respect needs at various scales (go global, stay local??). We need to be focusing on all phases of disaster management cycle - planning, forecasting, response, rather than caring only about accurate forecasts.

Where do we do well (no priority) (caveat for the scientists, technology continues to improve and we should continue the science and data development)
Group 2 - The science and data (e.g. rainfall forecasts for large events), we are actually doing very well, we just are not translating what we have to end users; Translate the scientific output to a usable product; Who has the ownership of the final product to be useful to the stakeholders.
Groups 3 - There is plenty of research efforts, innovation in modelling techniques.
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