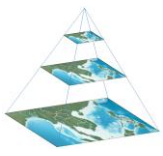




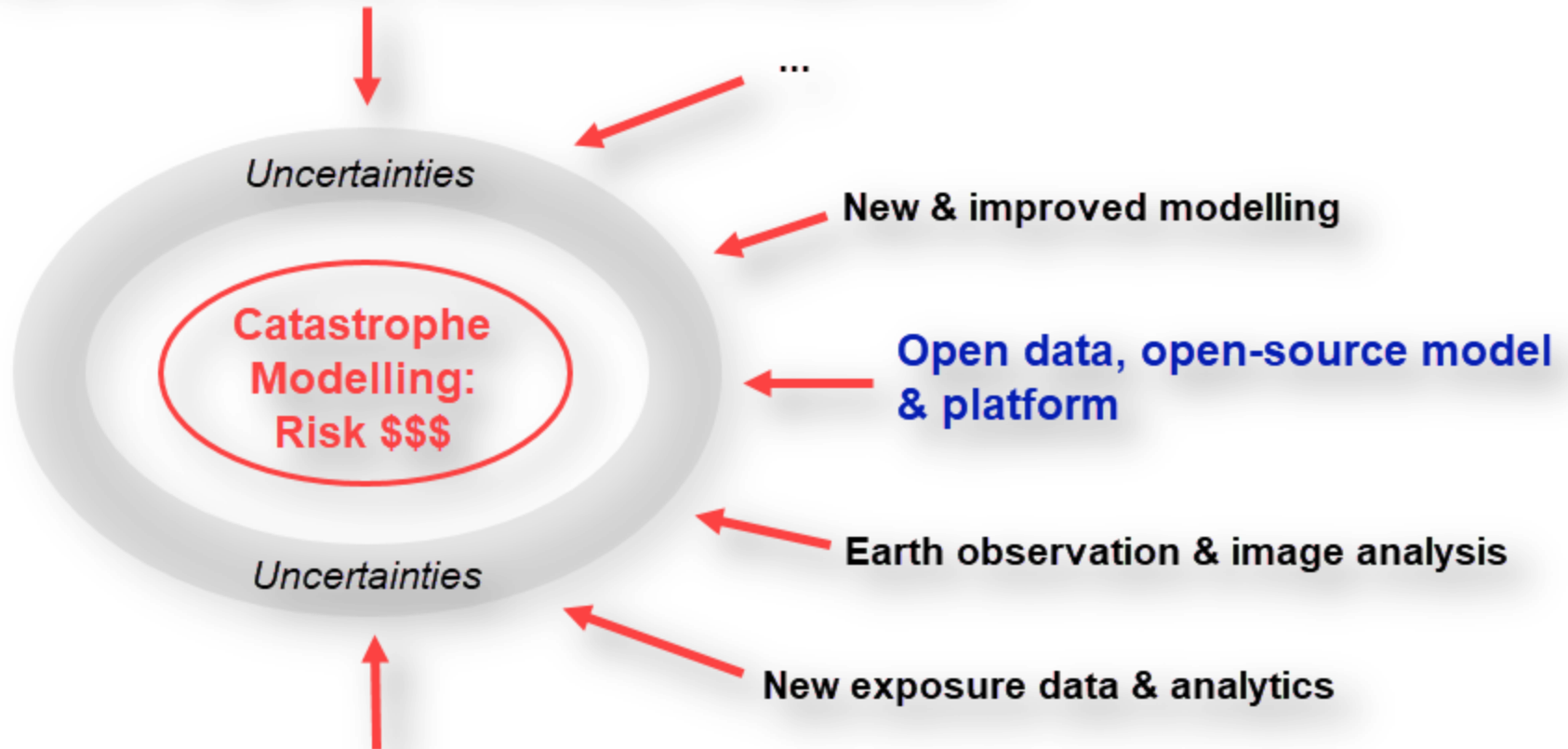
# Reducing Uncertainties in Catastrophe Loss Modelling: New Advances

Dr Keping (Kevin) CHEN  
R&D Innovation Scientist  
[BigDataEarth.com](http://BigDataEarth.com)  
12 December 2018

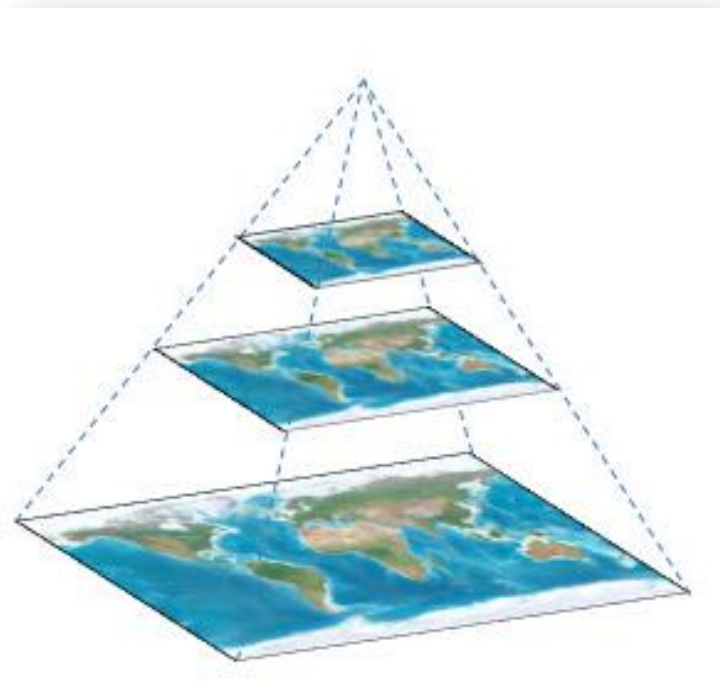


# Reducing Uncertainties in Catastrophe Loss Modelling: New Advances

**Top-down approach: Cross-model comparisons**



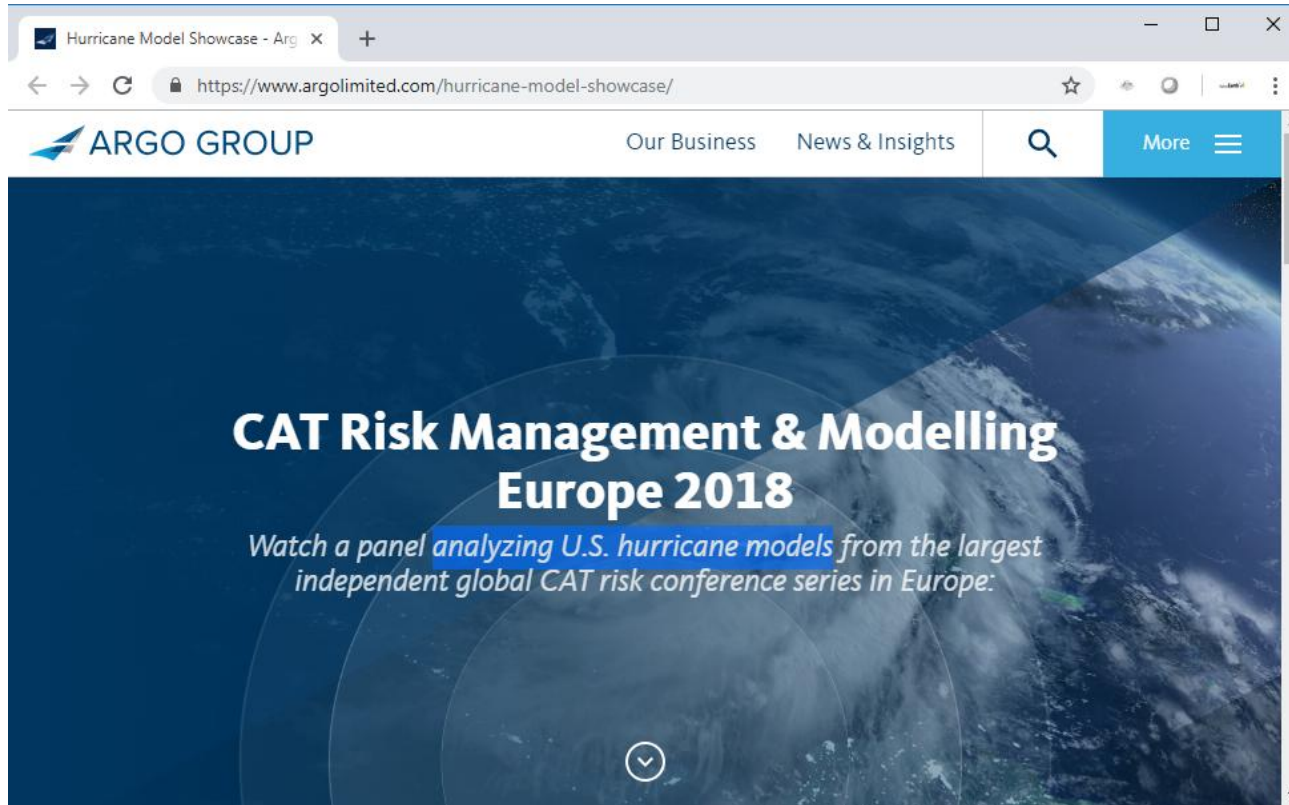
**Bottom-up approach: Site-level location profile report revealing underlying data, context & processes**



# **Part 1: Top-down Approach: Cross-model Comparisons**



# Cross-model Comparisons



03/2018 - Comparison of 4 U.S. **Hurricane** models: **CoreLogic** | **RMS** | **KatRisk** | **ARA**  
Video: <https://www.argolimited.com/hurricane-model-showcase/>

11/2017 - Comparison of 4 U.S. **Flood** models: **AIR** | **CoreLogic** | **KatRisk** | **Impact Forecasting**  
Video: <https://www.argolimited.com/flood-model-showcase/>





# Cross-model Comparisons

Figure 6: Favourable Performance of Modelled Losses (Source: JLT Re, AIR, RMS, Munich Re)

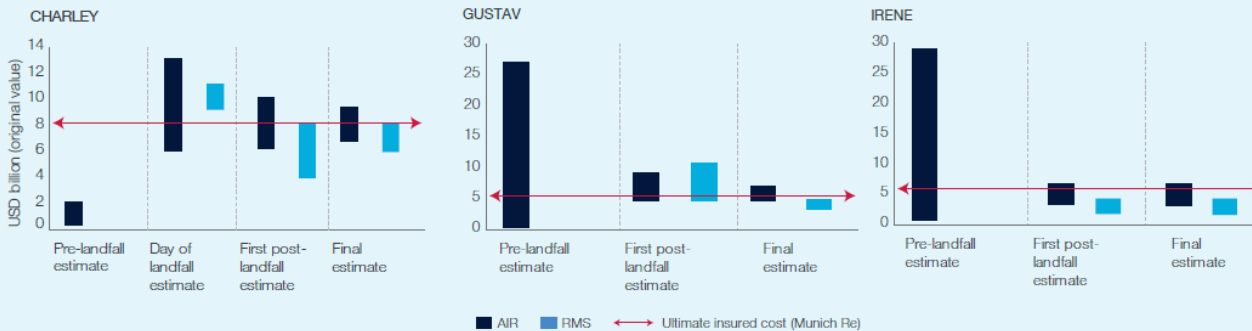
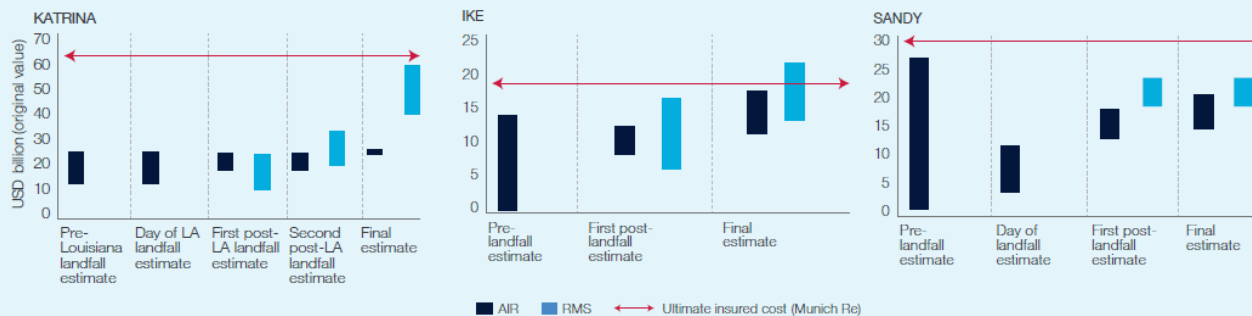


Figure 7: Substandard Performance of Modelled Losses (Source: JLT Re, AIR, RMS, Munich Re)



“The lack of consensus around modelled market losses potentially points to even greater levels of uncertainty for company-level loss estimates.”

Source: 07/2018 JLT RE VIEWPOINT | Catastrophe models: In the eye of the storm

PDF: <http://www.jltre.com/en-gb/our-insights/insights/natural-catastrophe/in-the-eye-of-the-storm>



## **Part 2: Open Data, Open-source Model & Platform**



# Open-source Modelling Platform

<https://oasislmf.org/>

The screenshot shows a web browser window with the URL <https://oasislmf.org/>. The page has a red header with the "OASIS LOSS MODELLING FRAMEWORK" logo and a hamburger menu icon. The main content area is white and features the title "Oasis Loss Modelling Framework" followed by the tagline "An open source catastrophe modelling platform, free to use by anyone." Below this, there are three paragraphs of text describing the community, development, and ecosystem. A large image of a stormy sea is on the left, and a section titled "Our Modelling Platform" is on the right, describing the platform's capabilities and providing a bulleted list of features.

## Oasis Loss Modelling Framework

An open source catastrophe modelling platform, free to use by anyone.

It is also a community that seeks to unlock and change the world around catastrophe modelling to better understand risk in insurance and beyond.

While its development is largely driven by the global (re-)insurance community, it seeks to provide tools and utility to all.

It is constituted as a not for profit company, and our team believes passionately in empowering more people around the world to better understand risk and uncertainty

Our ecosystem consists of more than 15 suppliers covering over 80 models in 2018.

### Our Modelling Platform

The Oasis Loss Modelling Framework provides an open source platform for developing, deploying and executing catastrophe models. It uses a full simulation engine and makes no restrictions on the modelling approach. Models are packaged in a standard format and the components can be from any source, such as model vendors, academic and research groups. The platform provides:

- A platform for running catastrophe models, including a web based user interface and an API for integration with other systems (Oasis



# Open-source Models, e.g. GEM

<https://www.globalquakemodel.org/>

The screenshot shows the GEM Foundation website. The header includes the GEM logo (GLOBAL EARTHQUAKE MODEL) and the OPENQUAKE logo (calculate share explore). The tagline is "a world resilient to earthquakes" with a note "- BETA Version - Site under construction -". Social media icons for Facebook, Twitter, YouTube, Instagram, and LinkedIn are present. The navigation bar lists: Home, Explore, Our Work, About Us, Contribute, Outreach, Publications, GEM2018, and a search bar. The main content area features a large banner for "GLOBAL EARTHQUAKE MODEL" with a central image of Earth. To the right of the image, it says "GEM2018 05 DEC PAVIA ITALY". Below this, there are two buttons: "Event Summary" and "Global Maps".

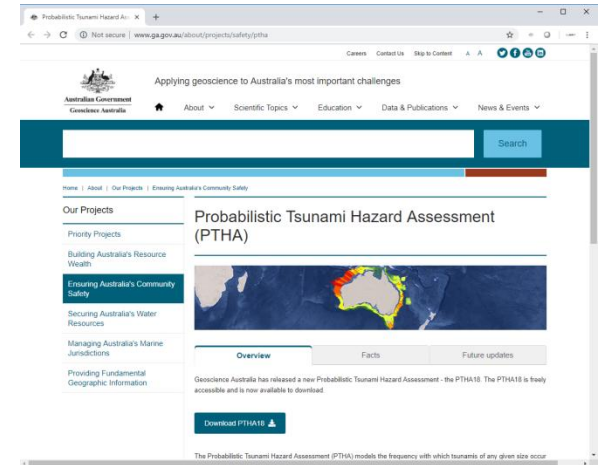
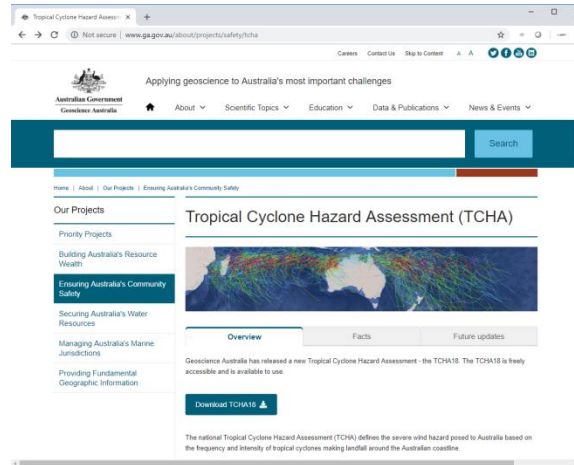
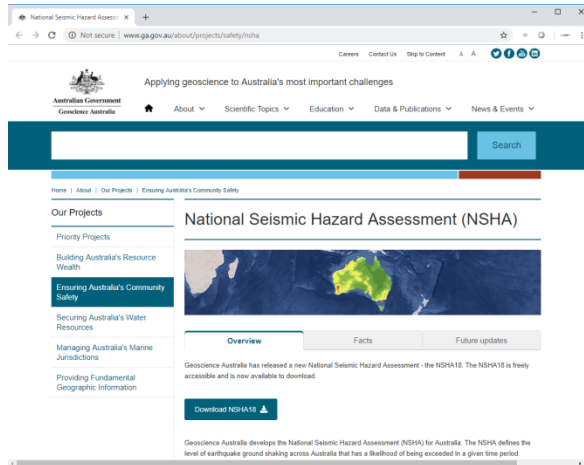
## OUR CORE PRINCIPLES

GEM is motivated to serve the public good in a collaborative, credible, open and transparent manner. We strive to make risk assessment inclusive to create a holistic culture of awareness and resilience, bringing a once-scarce resource available to all sectors and beneficiaries. [View GEM's Core Principles.](#)





# Open-source Models, e.g. from GA



**October 2018: Geoscience Australia - National Seismic Hazard Assessment (NSHA)**

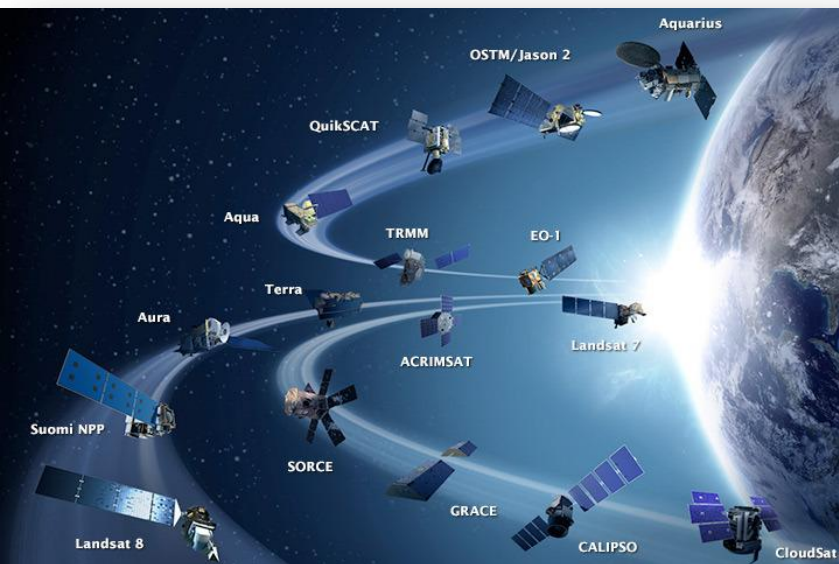
<http://www.ga.gov.au/about/projects/safety/nsha>

**October 2018: Geoscience Australia - Tropical Cyclone Hazard Assessment (TCHA)**

<http://www.ga.gov.au/about/projects/safety/tcha>

**October 2018: Geoscience Australia - Probabilistic Tsunami Hazard Assessment (PTHA)**

<http://www.ga.gov.au/about/projects/safety/ptha>



## Part 3: Global Earth Observation, Image Analysis & Major Events



# Cloud-based Geospatial Processing Engines

## Earth observation data on the cloud, e.g.

- Earth on AWS - <https://aws.amazon.com/earth/>
- Google Earth Engine - <https://earthengine.google.com/>

## Engines, e.g.

- **Google Earth Engine (GEE)**
  - Earth Engine Timelapse
  - Global Forest Loss Map
  - Global Surface Water Map



Google Earth Engine

- DigitalGlobe's Geospatial Big Data Platform (GBDX)
- Planet's Planet Explorer
- EU Sentinel-hub EO Browser, Radiant Earth, etc.



# Earth Observation & Major Events

## Wildfires (bushfires or forest fires)

- Wildfires in California
  - #MendocinoComplexFire and #CarrFire ([link](#))
  - #HolyFire ([link](#))
  - #CountyFire ([link](#))
  - #PawneeFire ([link](#))
- Wildfires in British Columbia, Canada ([link](#))
- Wildfires near Athens, Greece ([link](#))
- Wildfires in Southern Portugal ([link](#))
- Wildfires in Manchester, the UK ([link](#))
- Wildfires in Siberia, Russia ([link](#))
- Bushfires in Australia
  - Winter bushfires in NSW ([link](#))
  - Planned hazard-reduction burns in South Australia ([link](#))
  - Bushfires near Darwin, Northern Territory ([link](#))
  - Rockhampton, QLD ([link](#))



## Floods

- Flooding in the south and west of Japan ([link](#))
- Flooding in Kerala, India ([link](#))

## Volcanic eruptions

- Lava from the Kilauea volcano in Hawaii ([link](#))
- Ongoing eruption of the Krakatau volcano ([link](#))

<https://www.bigdataearth.com/bushfire/monitoring-major-events-with-global-earth-observation-and-geospatial-big-data-analytics/>





# Earth Observation & Major Events

## Share the latest on social media

**BigData Earth** @BigDataEarth

Devastating [#wildfires](#) near [#Kineta](#), [#Greece](#) observed by the new [#Sentinel2](#) imagery on 23 July 2018

1. The use of image band combinations to observe fire front & hotspot
2. Climate-warming trend for the region

Thank you [@CopernicusEU](#) [@ESA\\_EO](#) for the excellent EO imagery source!



Kineta, Greece | 2018-07-23

7:13 PM - 24 Jul 2018

97 Retweets 55 Likes

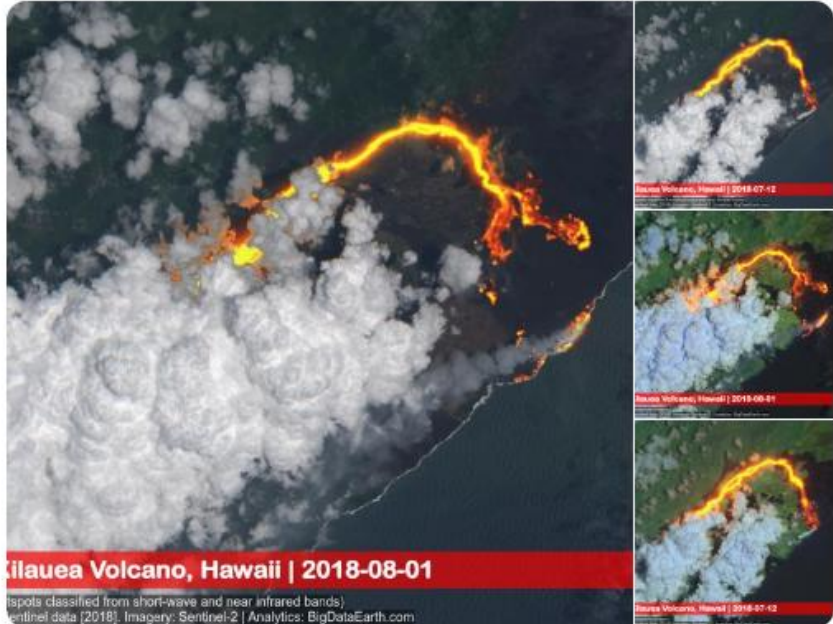
**BigData Earth** @BigDataEarth · Aug 2

Update: Lava from [#KilaueaVolcano](#) in [#Hawaii](#) observed by the new [#Sentinel2](#) imagery on 1 August 2018

1. See changes 20 days apart (from 12 July to 1 August 2018)
2. SWIR bands able to detect hotspots / lava flows

[@CopernicusEMS](#) [@CopernicusEU](#) [@USGSVolcanoes](#)

[#Kilauea](#) [#KilaueaErupts](#)



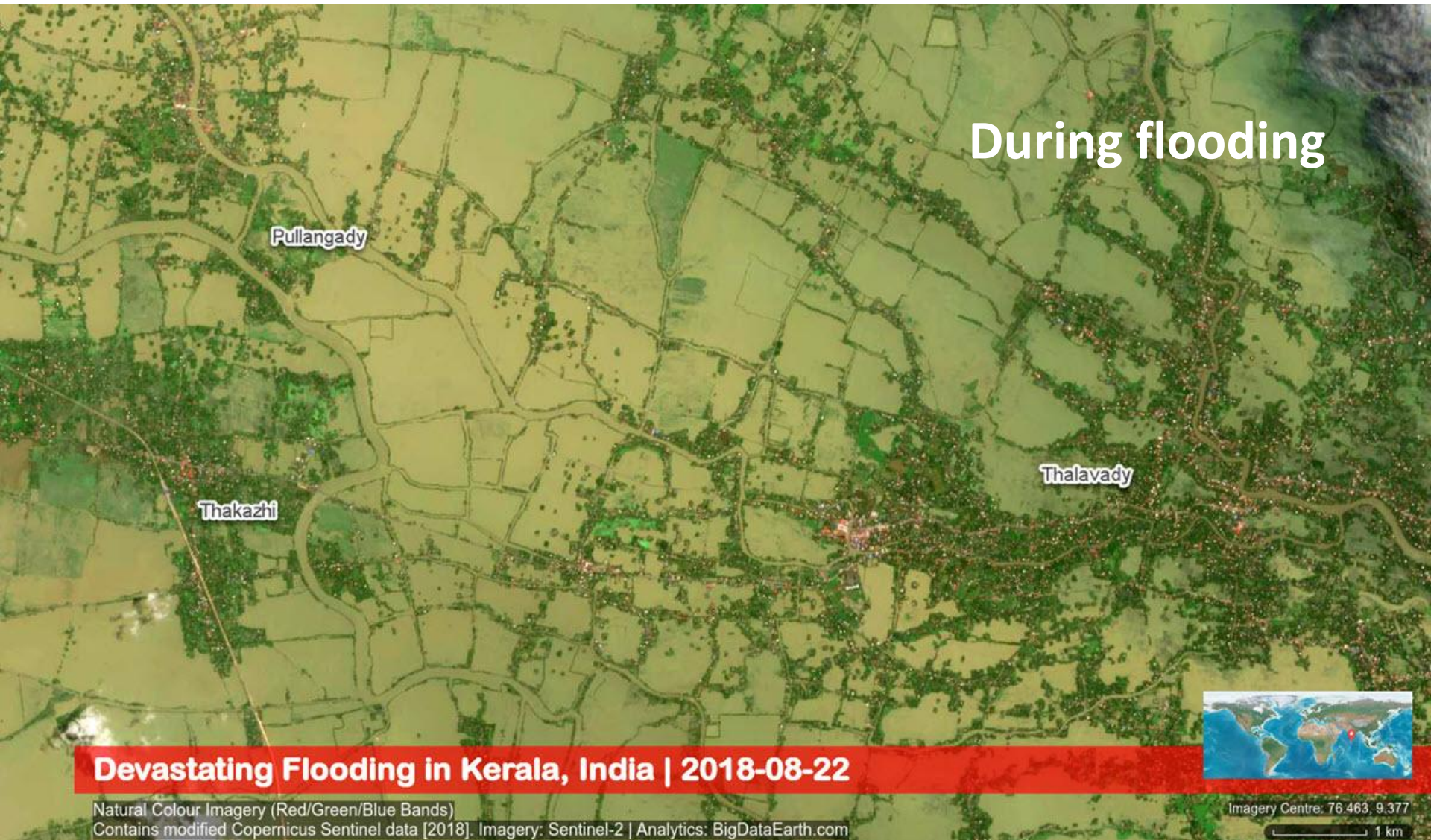
Kilauea Volcano, Hawaii | 2018-08-01

12 8





# Earth Observation & Major Events



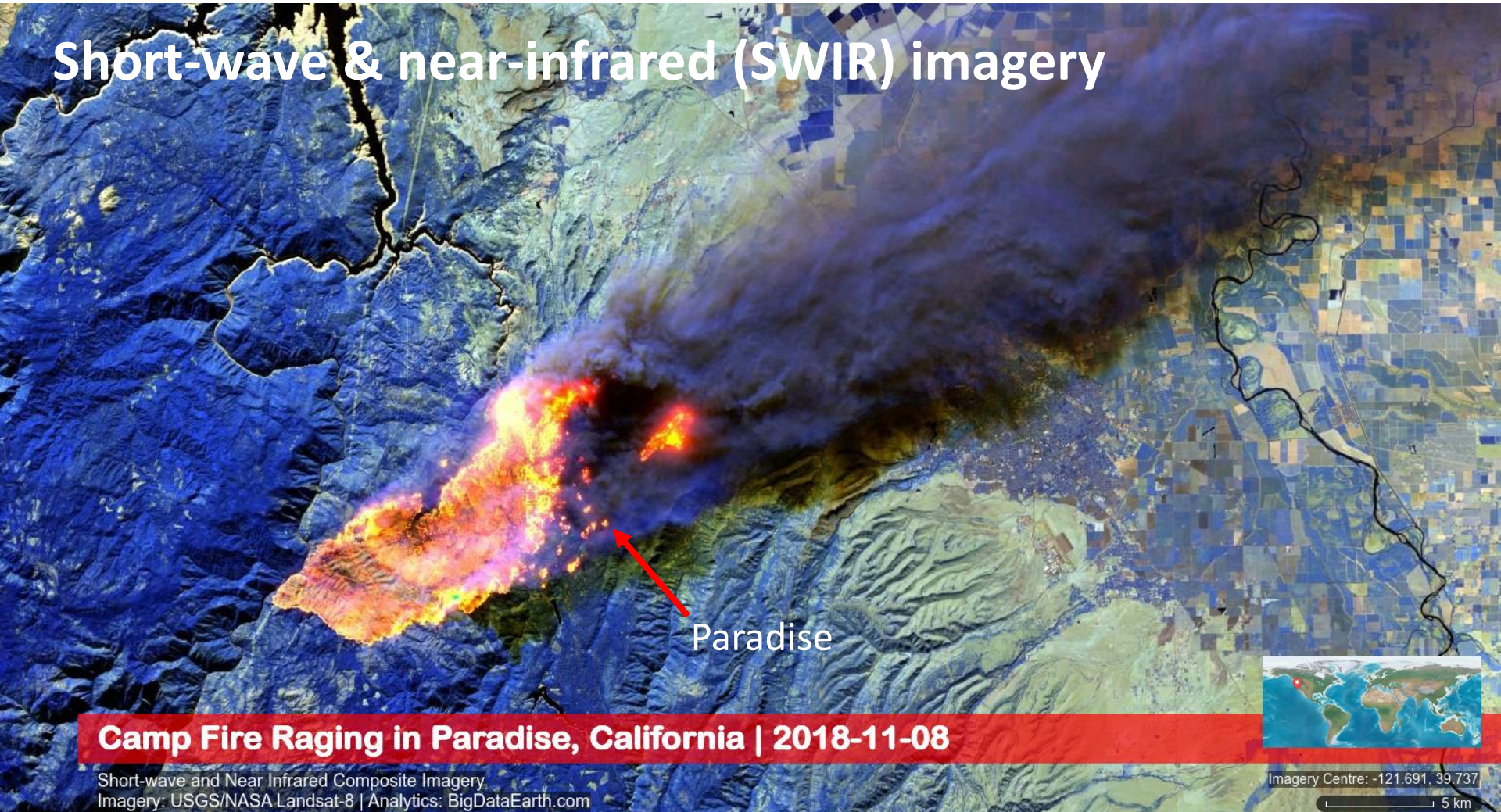




# Earth Observation & Major Events

## Fire hotspots and propagation

Short-wave & near-infrared (SWIR) imagery



<https://twitter.com/BigDataEarth/status/1061777349555892224>





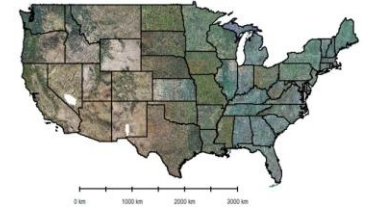
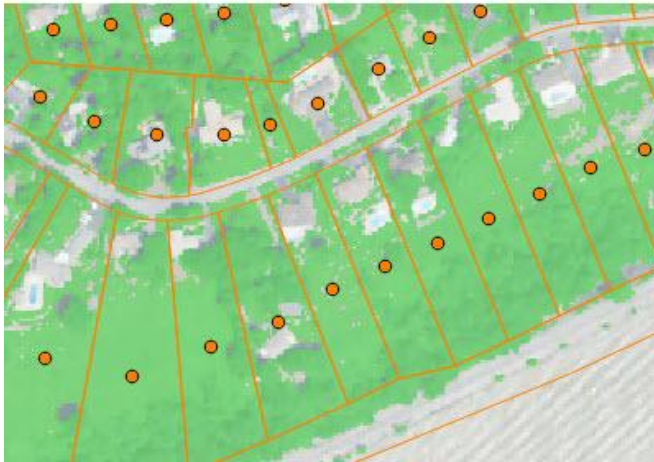
## Part 4: New Exposure Data & Analytics





# Exposure Data - Geocoding

## Land-parcel geocoding



## Roof-top geocoding







# Exposure Data - Building Footprints

**06/2018: Microsoft releases 125 million building footprints in the US as open data**



Source: <https://blogs.bing.com/maps/2018-06/microsoft-releases-125-million-building-footprints-in-the-us-as-open-data>

**10/2018: DigitalGlobe releases 169 million building footprints in the US**

A MAXAR COMPANY

DigitalGlobe | MDA | Radiant Solutions | SSL

DigitalGlobe

Company | Products | Careers | Contact Us

Search Imagery

## Building Footprints

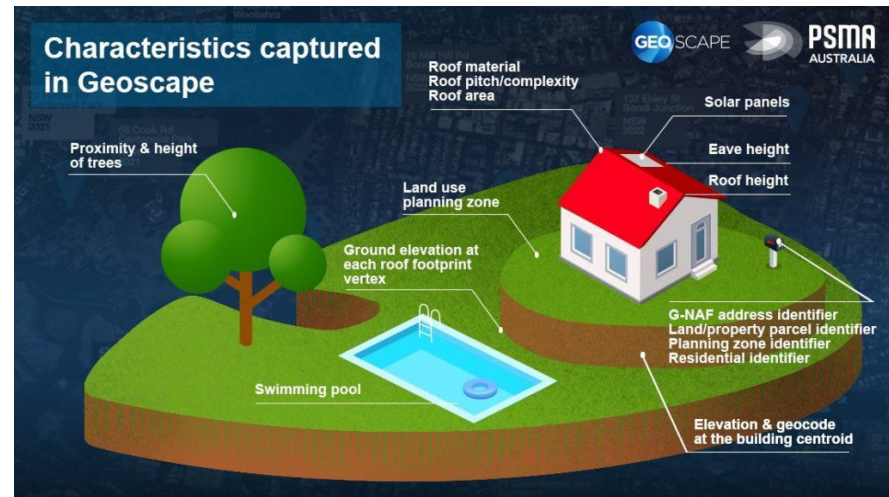
Precision, GIS-ready polygons for expedited analysis

Source: <https://www.digitalglobe.com/products/building-footprints>



# Exposure Data - Building Footprints

11/2018: PSMA releases built environment data for 15 million buildings nationwide



Source: <https://www.geoscape.com.au/how-many-buildings-in-australia-geoscape-achieves-national-coverage/>





# Exposure Data - Building Footprints

Open data: A very small % of false-positive and false-negative errors



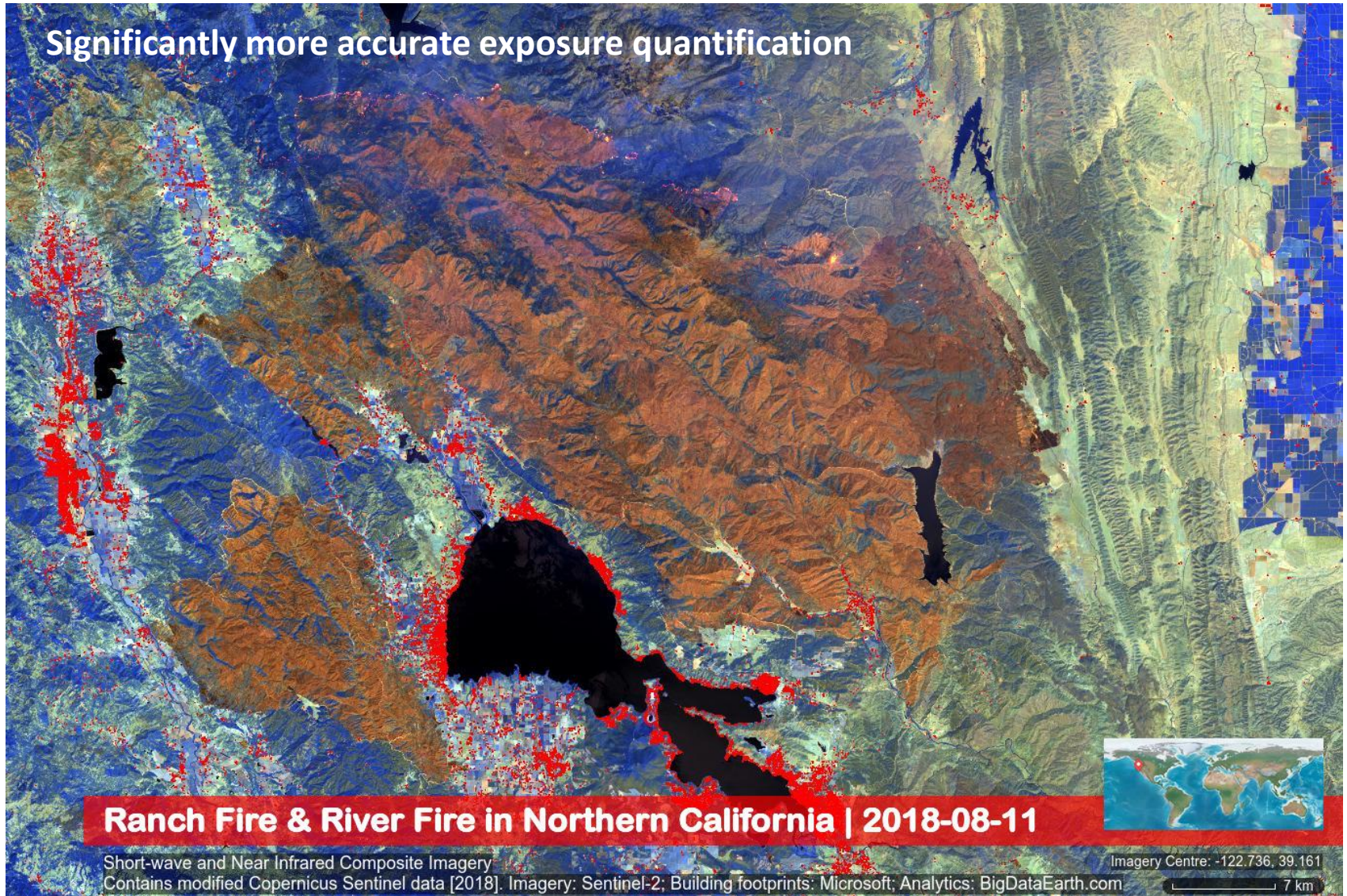
Microsoft building footprints





# Building Footprints - Applications

Significantly more accurate exposure quantification



<https://twitter.com/BigDataEarth/status/1029242799504281602>



## **Part 5: Bottom-up Approach: Site-level Location Profile Report Revealing Underlying Data, Context & Processes**





# New R&D at BigDataEarth.com

## New Products and Services

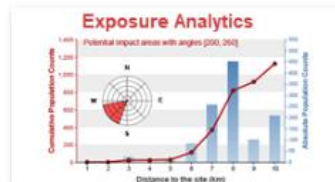
**Main Applications:** Property location information, emergency & insurance, the news media, etc.

**Coverage:** Australia, the U.S., China & other regions

- Building cloud-based big data and analytics platforms
- Creating address-level property location profile reports
- Developing unique hazard and exposure investigation tools
- Creating new software for Earth observation image processing
- Developing a suite of timely information products from Earth observation imagery to reports to animations in response to major events
- Delivering products via web APIs and web services



Location Profile APIs and Cloud-based Big Data Analytics Solutions  
Creating New Values



New Methods and Tools (Web APIs) for Innovative Exposure Analytics in Risk Management



Follow our Twitter for the Latest EO Imagery, Reports & Animations in Response to Major Events



Advancing Bushfire Risk Analytics with Location Profile APIs and Web Services – 4 New Info Products

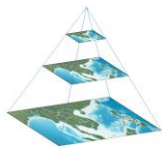


Advancing Flood Risk Analytics with Location Profile APIs and Web Services – 3 New Info Products

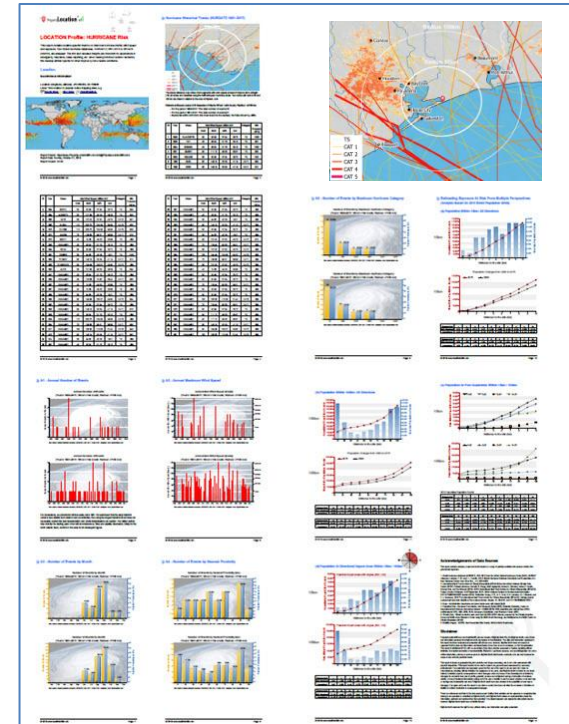
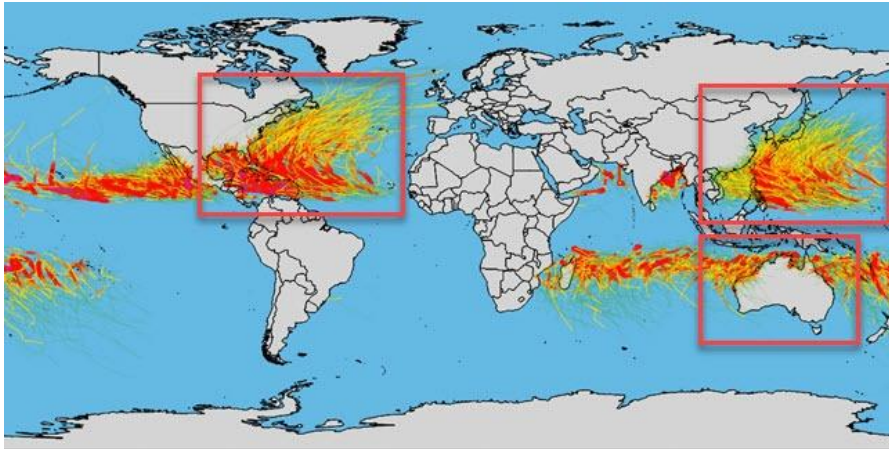


Advancing Cyclone Risk Analytics with Location Profile APIs and Web Services – 3 New Info Products

<https://www.bigdataearth.com/blog/>



# Site-level Location Profile Report – Tropical Cyclone (North Atlantic, West Pacific & Australia)



Two well-known, publicly-available tropical cyclone databases are analysed:

1. Atlantic hurricane database (**HURDAT2**, 1851-2017) from the NOAA National Hurricane Center (NHC)
2. The International Best Track Archive for Climate Stewardship (**IBTrACS v03r10**, released September 2017) from the NOAA National Climatic Data Center (NCDC)

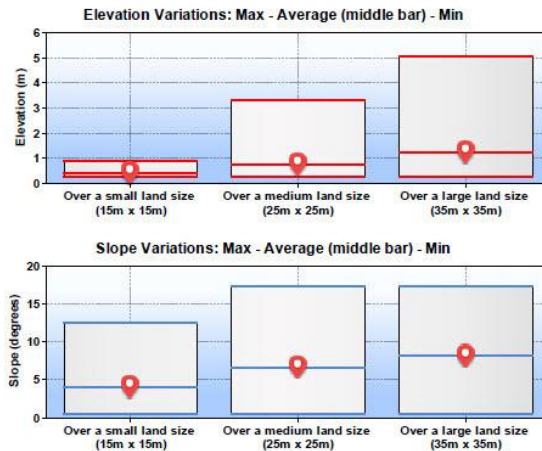
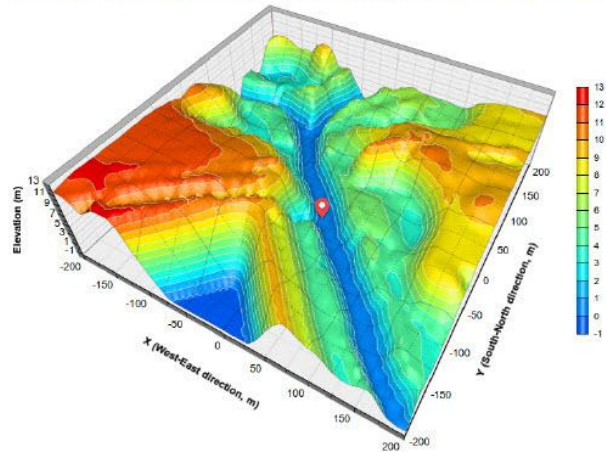
<https://www.bigdataearth.com/hurricane/advancing-tropical-cyclone-risk-analytics-with-location-profile-apis-showcases/>



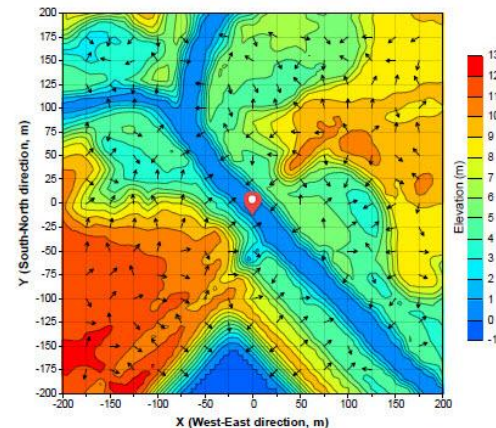
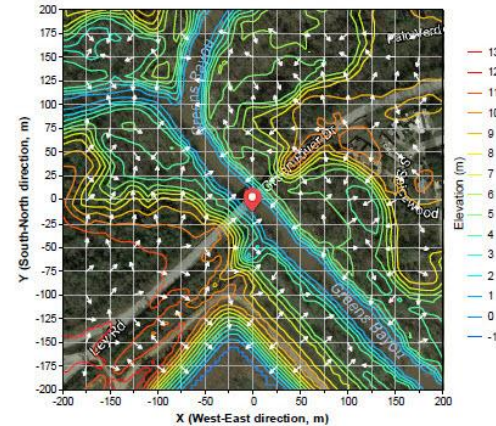


# Site-level Location Profile Report – Flood (Australia, the Contiguous U.S. & other Regions)

► Terrain: Average Elevation & Slope Over Various Land Sizes



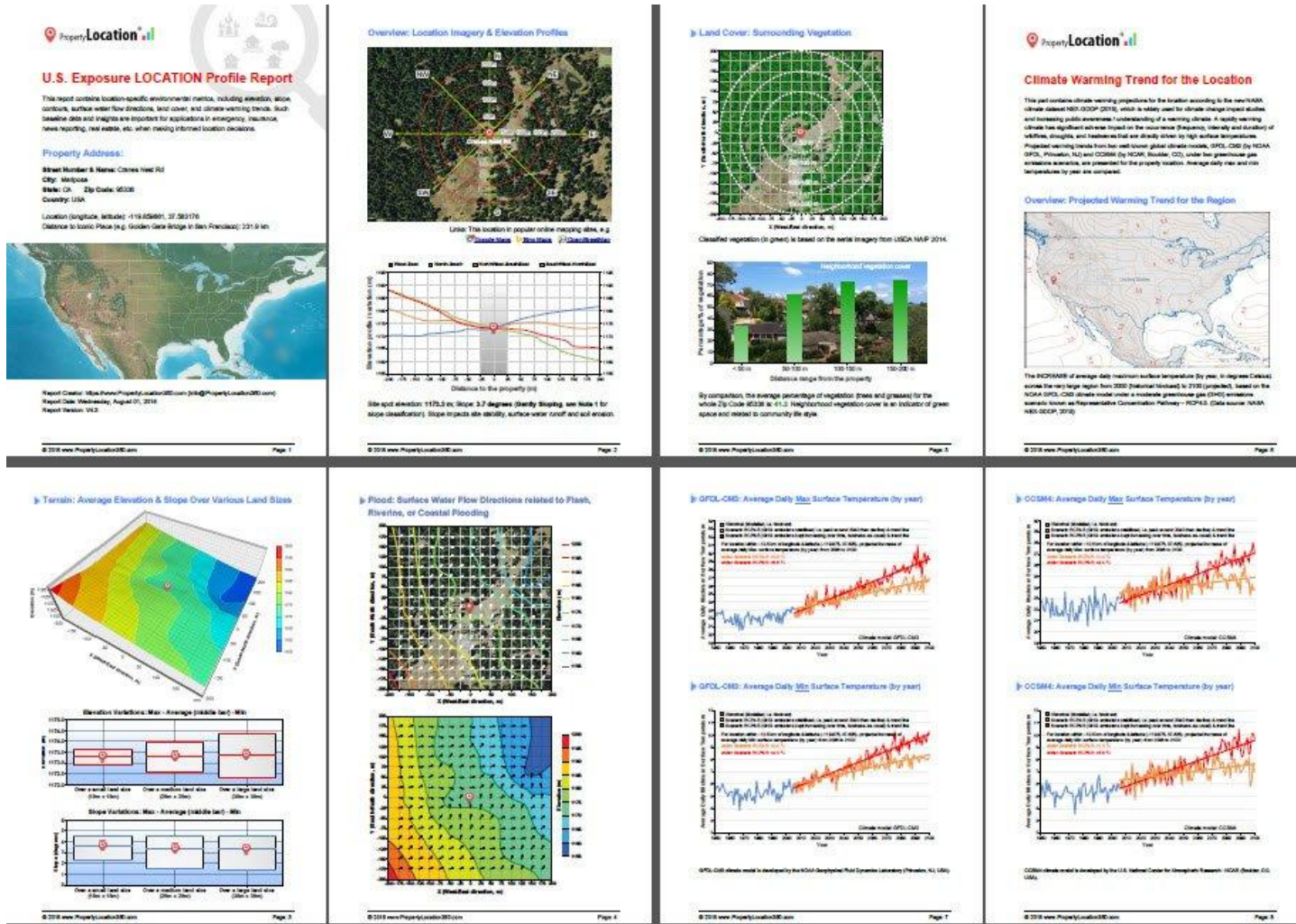
► Flood: Surface Water Flow Directions related to Flash, Riverine, or Coastal Flooding



<https://www.bigdataearth.com/flood/advancing-flood-risk-analytics-location-profile-apis-showcases/>



# Site-level Location Profile Report – Forest Fire (Australia, the State of California & other Regions)

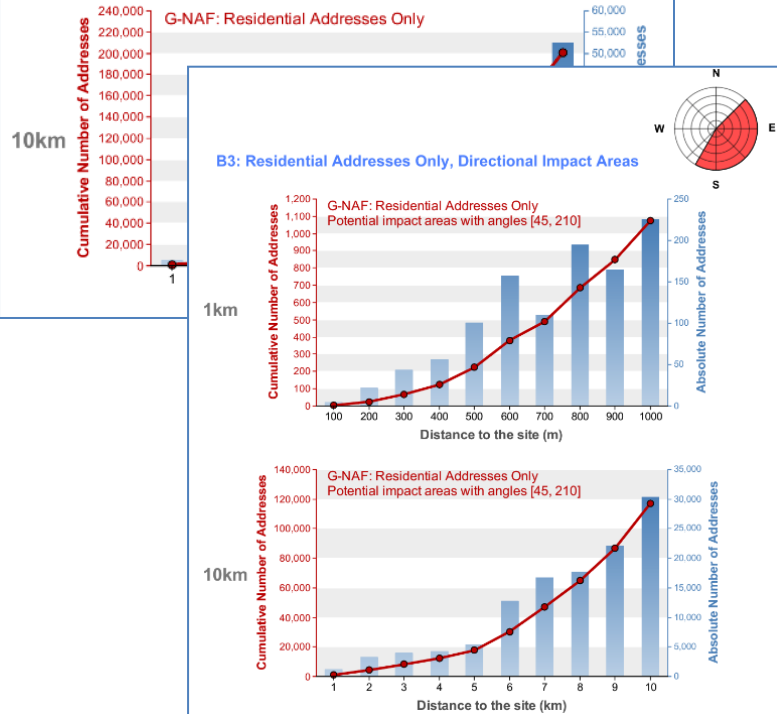
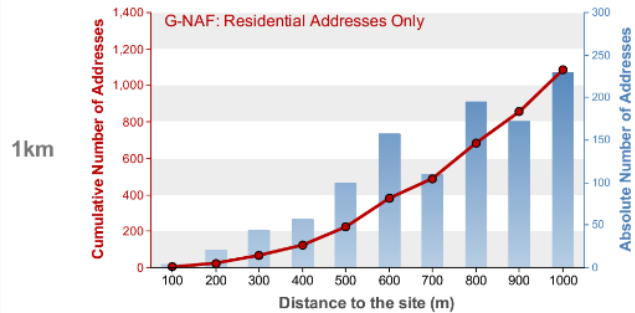


<https://www.bigdataearth.com/bushfire/advancing-bushfire-risk-analytics-location-profile-apis-showcases/>

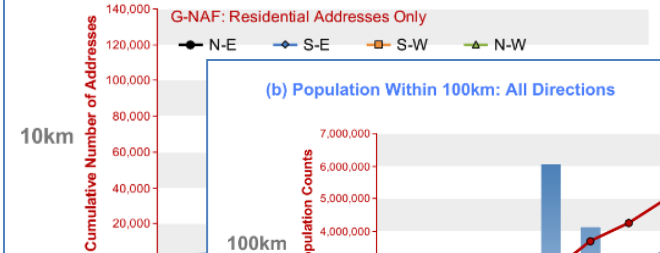
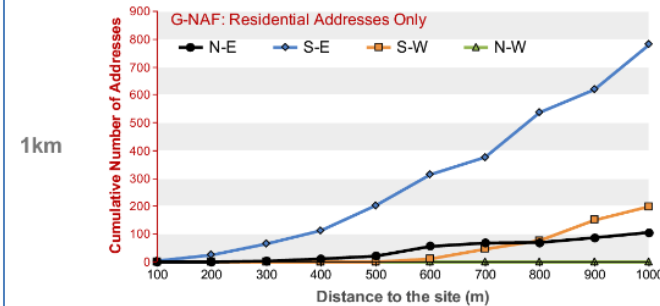


# Plus Rapid Exposure Analytics with Multiple Spatial & Temporal Analysis Methods

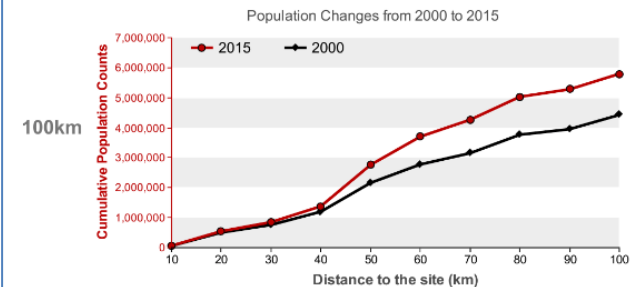
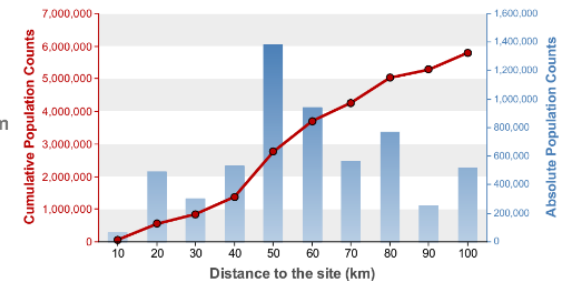
B1: Residential Addresses Only, All Directions



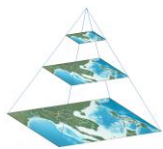
B2: Residential Addresses Only, Four Sections / Quadrants



(b) Population Within 100km: All Directions







# Each Site-level Location Profile Report Delivered in Seconds via Web APIs

APIs Developer Portal: <https://Developer.BigDataEarth.com>

The screenshot shows a web browser window with the address bar displaying <https://developer.bigdataearth.com>. The page has a dark header with the title "BigData Earth - Location Profile APIs" and navigation links for "HOME", "APIS", "API PRODUCTS", "ISSUES", and a "SIGN IN" button. The main content area has a blue background and features a "Welcome to the developer portal" message. Below this, it states that developers can discover and learn about BigData Earth's Location Profile APIs for **property location and hazard risk intelligence**, and encourages signing up for an API key. A list of main features is provided: (1) applications in property location information, emergency & insurance, the news media, etc.; (2) wide coverage including Australia, the U.S. and other regions; (3) integrated location metrics in accessible forms - PDF report, chart, image and animation; and (4) providing location analytics, contextual insights and flexible reporting at your fingertips. A green "Sign up" button is visible at the bottom of the main content area.

## API Documentation

Check out the [API Documentation](#) that describes how to use the APIs and includes code samples in multiple languages. The API Console allows you to directly interact with the API and request reports right here in the developer portal. Please sign in first.

For third-party independent use of APIs with server-side secure implementation and client-side scripting, we provide many examples at two property location information portals:

- (1) <https://propertylocation.com.au/> (for Australia)
- (2) <https://propertylocation360.com/> (for the U.S. and other regions)

We are happy to provide any assistance if needed.

## Developer Support

For more information about the Location Profile APIs, please visit [BigData Earth](#) website.

For subscriptions & technical support, as well as consulting services that turn your data into Web APIs and Web Services (along with the creation of standalone cloud-based big data & analytics platforms and white-label reporting), please stay in touch and send enquiries to [developer@bigdataearth.com](mailto:developer@bigdataearth.com).



# BigData Earth Products and Solutions Enabled by Geospatial Big Data Analytics, Cloud Computing & Automation

Applications, e.g.	Implementation
1 – Major Events and Earth Observation	Desktop-based software & basemaps
2 – Major Events and Location Profile Report	Web APIs & Apps
3 – Tropical Cyclone Risk Analytics	Web APIs & Apps
4 – Flood Mapping & Risk Analytics	Web APIs & Apps
5 – Bushfire Risk Analytics	Web APIs & Apps
6 – Exposure Analytics	Web APIs & Apps

- 📍 Most R&D on implementation of **web APIs and Applications** at scale - Australia, the U.S. and other regions.
- 📍 New opportunities enabled by **geospatial big data analytics (on hazard & risk modelling), cloud computing** and **automation**.
- 📍 Extending the experience to client tasks using the same workflow, i.e. from raw data to analytics to API-enabled information products to web services.



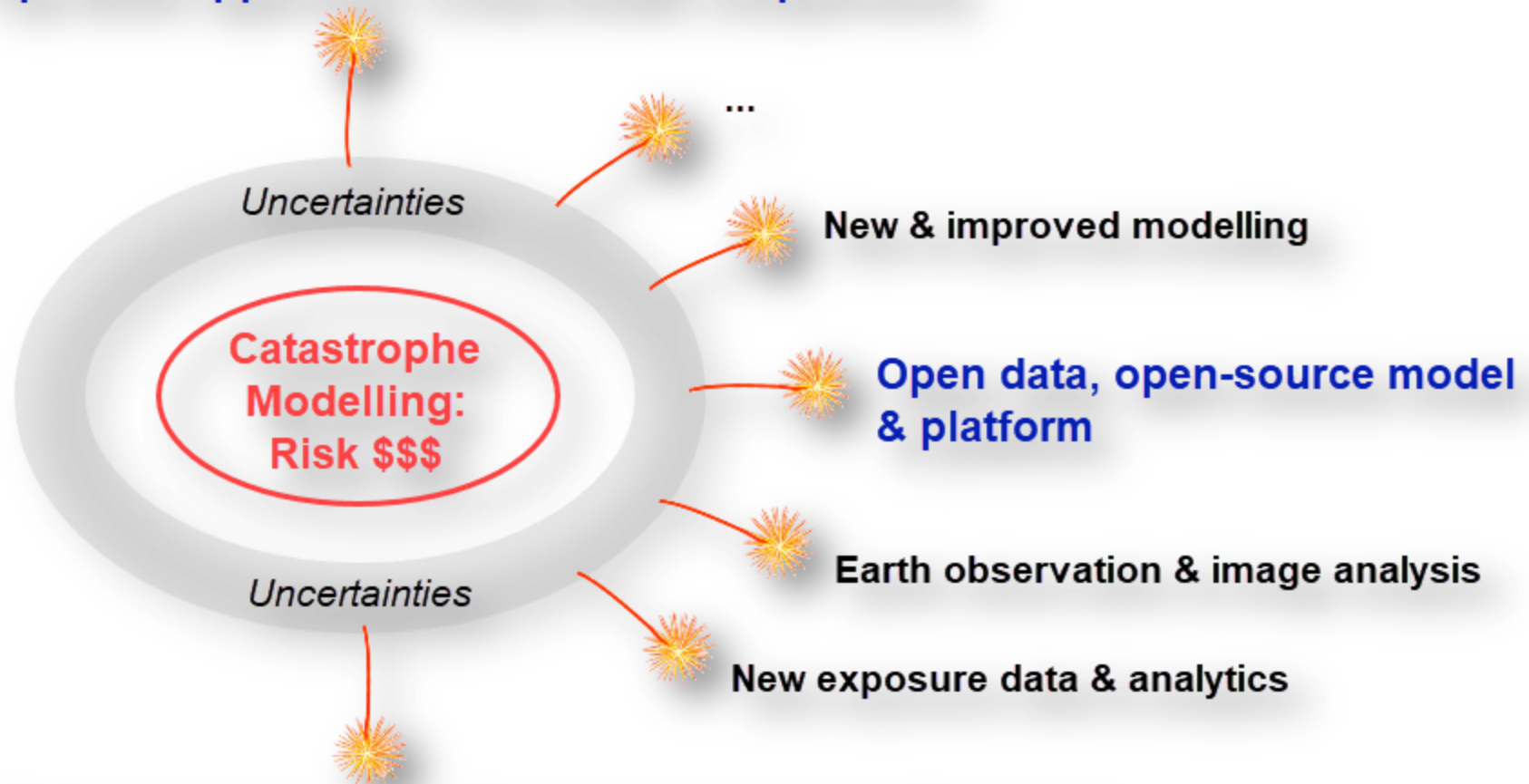
# Summary





# Reducing / Blasting off Uncertainties in Catastrophe Loss Modelling

## Top-down approach: Cross-model comparisons



Bottom-up approach: Site-level location profile report  
revealing underlying data, context & processes

# Thank you!



For more presentations and demonstrations, please contact Keping at BigData Earth. Email: [Keping.Chen@BigDataEarth.com](mailto:Keping.Chen@BigDataEarth.com)