RSS-Hydro

What can space data contribute to prevention, preparedness, response, and recovery?

Guy Schumann, PhD
& the entire team of RSS-Hydro,
& many more in LU & around the world

Guy Schumann gschumann@rss-hydro.lu

Geospatial and modelling intelligence
for managing climate risks

RSS-Hydro

FLOOD MODELLING

SafeCity
Site Specific

APPLIED RESEARCH

Research
Development
Commercialisation

EARTH OBSERVATION

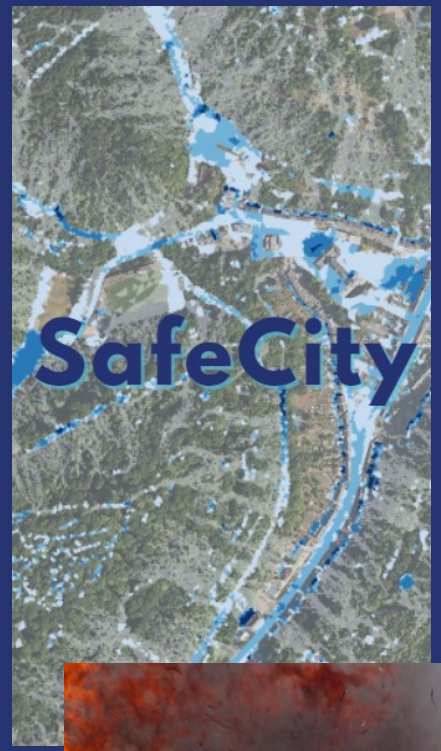
FloodSENS
FireSENS
HydroSENS

HUMANITARIAN

Early Warning
Knowledge Transfer

RSS-Hydro: The Difference

- Building sensor & platform agnostic ML & GPU-powered solutions to better prepare and respond to disasters
- Trusted SatEO Apps (ground & space)
- High fidelity surface water and river hydraulic models for single site and complete city-scale flood risk
- Focus on preparedness & response, and resilience
- High-end 3D visualization



Prepare for the Challenge Ahead

40%
of world population lives on coasts

2.2B
people were affected by floods

$40B
per year in damages

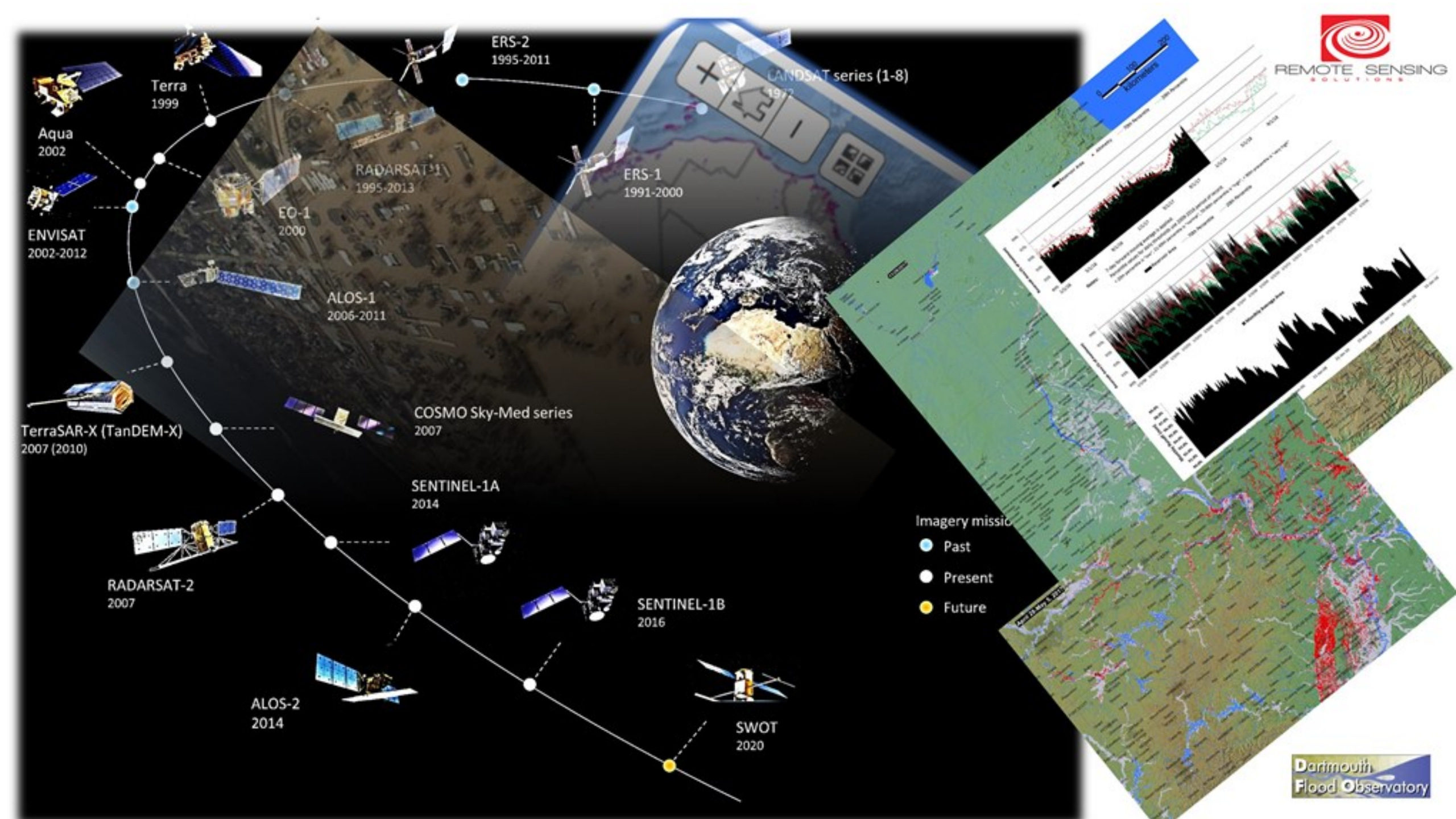
Flooding in Australia

Flooding in India

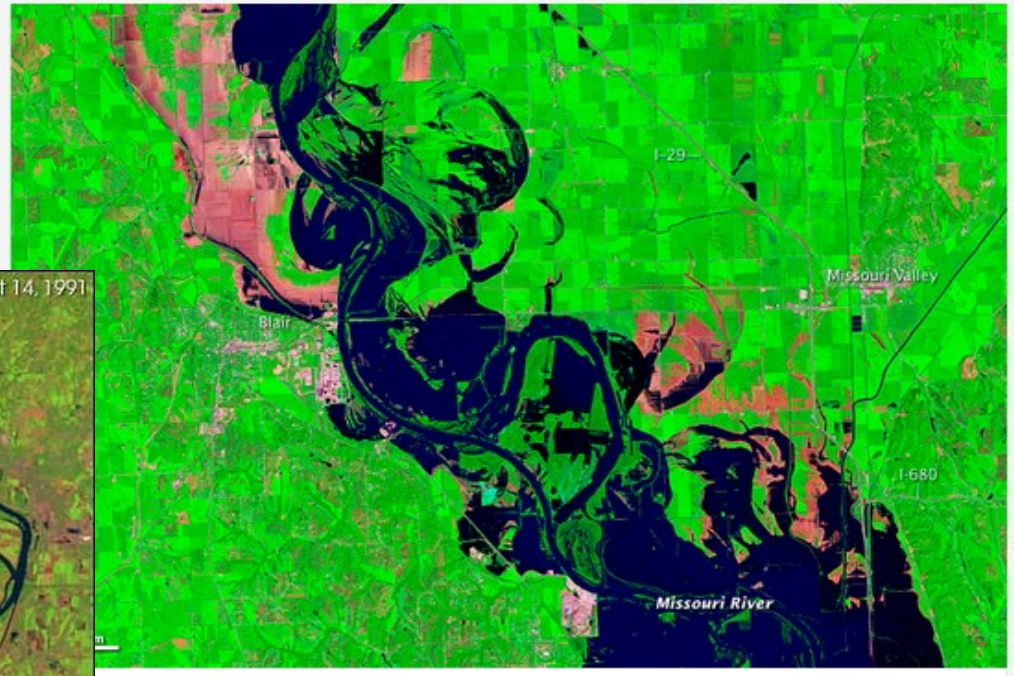
Flood estimation needs to be done remotely as physical access is limited

Deploying instruments in disaster-stricken zones can be dangerous

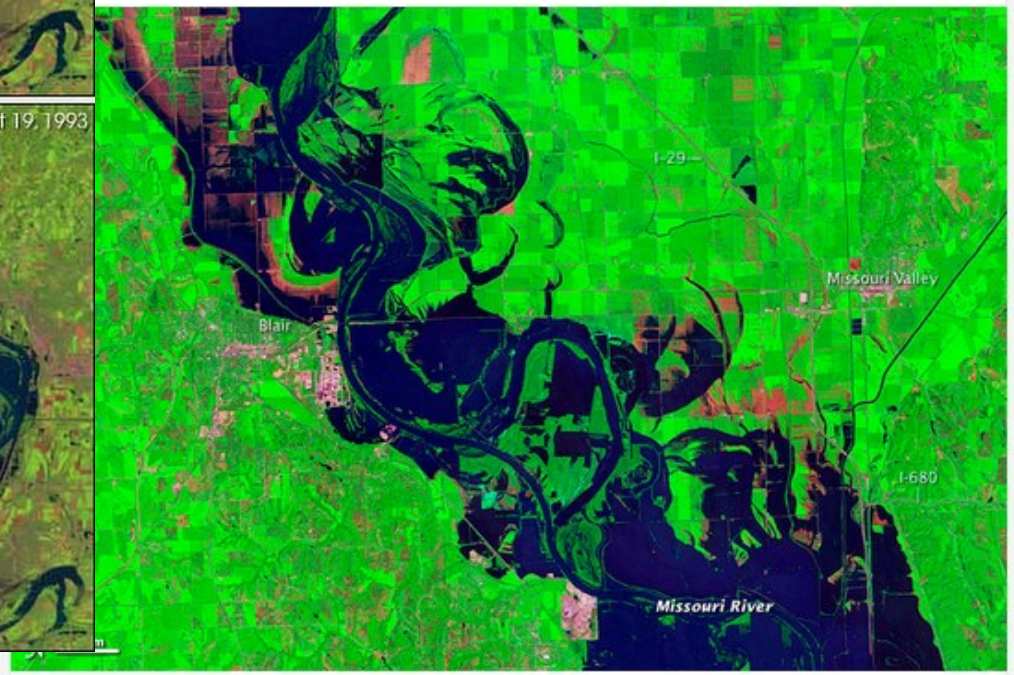
AI for Earth Observation is Crucial


Terra
1999
Aqua
2002
ENVISAT
2002-2012
ERS-2
1995-2011
LANDSAT series (1-8)
1972
RADARSAT-1
1995-2013
EO-1
2000
ERS-1
1991-2000
ALOS-1
2006-2011
TerraSAR-X (TanDEM-X)
2007 (2010)
COSMO Sky-Med series
2007
SENTINEL-1A
2014
RADARSAT-2
2007
SENTINEL-1B
2016
ALOS-2
2014
SWOT
2020
REMOTE SENSING
SOLUTIONS
Imagery missio
Past
Present
Future
Dartmouth
Flood Observatory

Landsat series



d large image (6 MB, JPEG, 4000x4000) acquired August 17, 2011



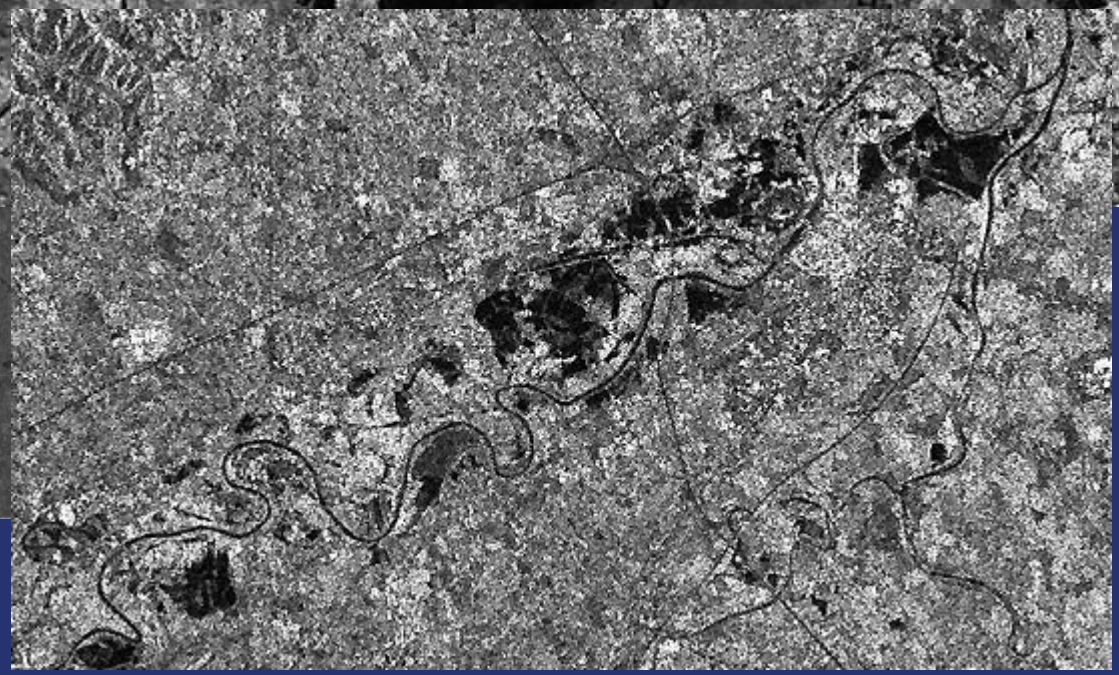
download large image (5 MB, JPEG, 4000x4000) acquired August 1, 2011

SAR

ERS-1

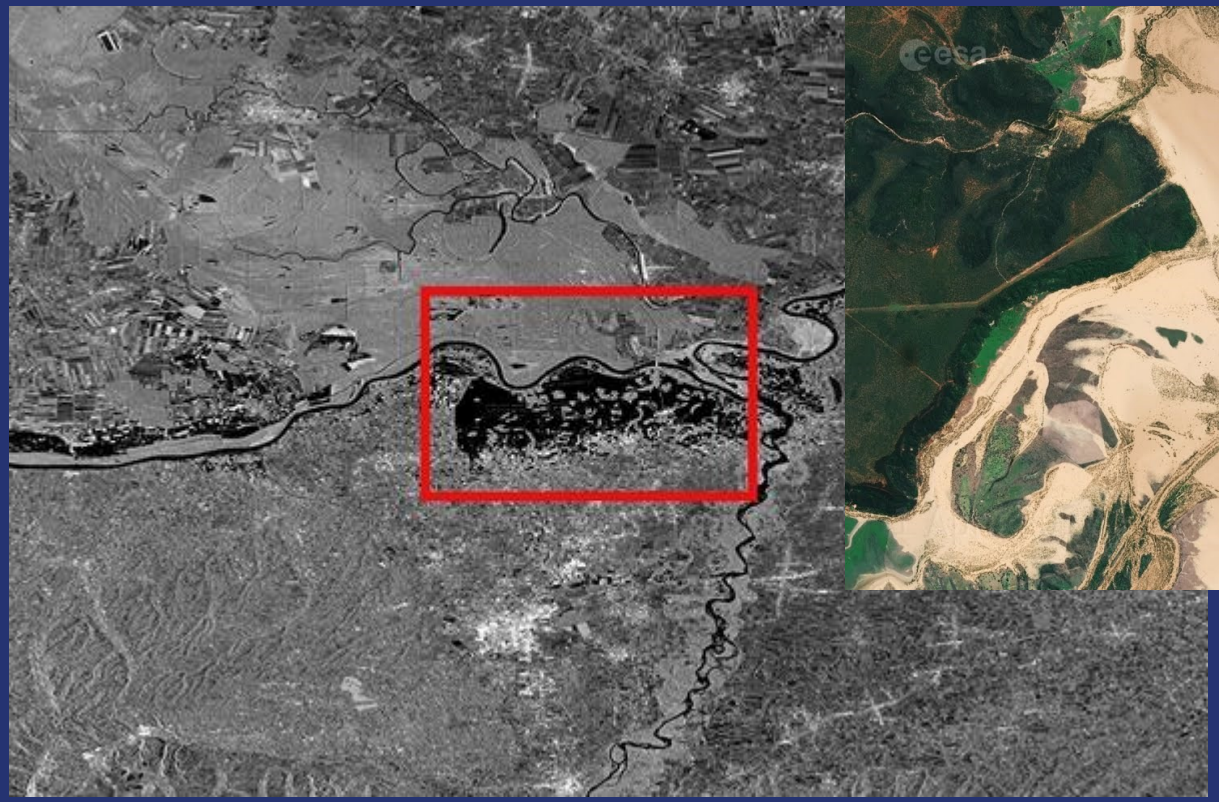
TerraSAR-X

ENVISAT



ERS-1

Sentinel-1 & -2



Queensland (Debbie, 2017)

Early #**Sentinel1** radar scan used for @**CopernicusEMS** flood mapping in the Balkans (2014)


Sentinel 2 imagery (27/09/2022)

Open Access | Editor's Choice | Article

Assisting Flood Disaster Response with Earth Observation Data and Products: A Critical Assessment

by Guy J-P. Schumann [1,2,3,*,†], G. Robert Brakenridge [3,†], Albert J. Kettner [3,†], Rashid Kashif [4,†] and Emily Niebuhr [5,†]

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Remote Sens. **2018**, *10*(8), 1230; https://doi.org/10.3390/rs10081230

A look at historic breakthroughs in flood mapping from space

Special Reports | 12th August 2022

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The image shows flood waters on May 5, 1973, as observe and green wavelengths of light. Vegetation appears red, m Earth Observatory

Environment | 21st June 2024

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RSS-Hydro discusses a prospective all-in-space solution that leverages high-resolution satellites to revolutionise disaster response and enhance global security for a more resilient future.

REVIEW article

Front. Remote Sens. , 29 April 2024
Sec. Image Analysis and Classification
Volume 4 - 2023 | https://doi.org/10.3389/frsen.2023.1280654

Breakthroughs in satellite remote sensing of floods

Guy J-P. Schumann[1,2*]

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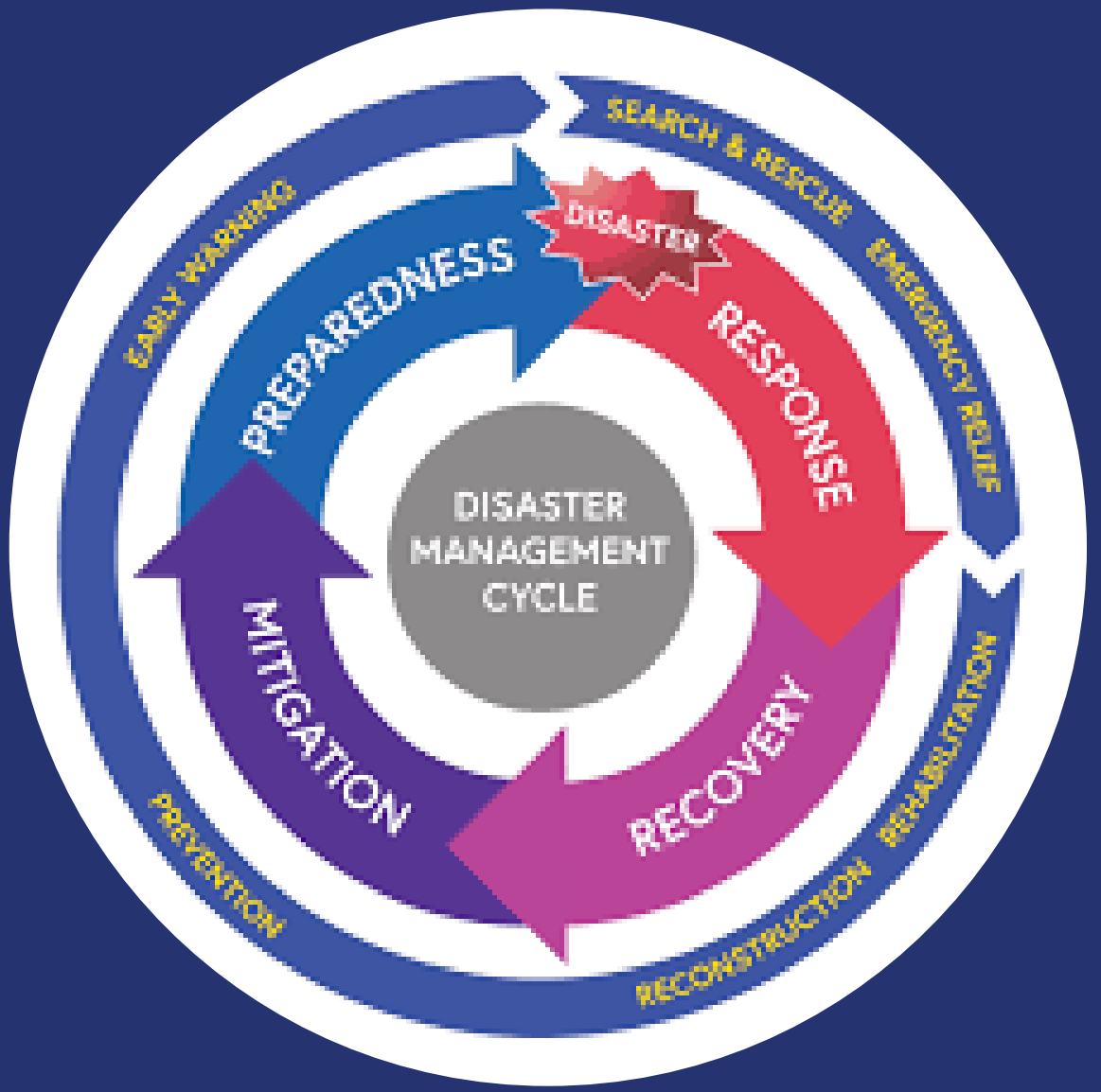
The disaster cycle

- **Mitigation:** Long-term efforts to reduce disaster risk using data from tools like EO-based mapping and simulation modeling to inform protective measures.
- **Preparedness:** Planning and getting ready for disasters using advanced warning models & scenario simulations, like the FloodHub ML from Google and the flood digital twins created by RSS-Hydro, in partnership with big tech companies (NVIDIA, Oracle)
- **Response:** Immediate actions taken during a disaster, informed by real-time data and pre-disaster models (e.g. RSS-Hydro's FloodSENS SatEO application)
- **Recovery:** Long-term process of rebuilding and increasing resilience, guided by damage assessments and insights from all types of data and models
- Is there a space & place in the disaster cycle for space innovation & dual-use technology?



How feasible is dual-use space tech for us?

- Dual-use technologies have both civilian and military applications
- They are vital for national security and economic competitiveness, particularly for disaster management
- Companies developing these technologies face challenges with strict contracts on security, data access, and intellectual property
- While funding has increased, companies must also remain flexible to sell their solutions commercially

IN THE space sector, dual-use technologies are technologies with both civilian and military applications. Designed for one purpose, these technologies have the potential to be adapted for another. Examples include satellite navigation systems, satellite imagery, and communication satellites. Whilst enabling technologies to be dual use opens up a number of opportunities, it also comes with various challenges that developers must consider.

Built on extensive research and development in the areas of Earth observation (EO) and climate modelling, RSS-Hydro develops satellite and modelling technology designed to help authorities and organisations mitigate and manage climate challenges such as flooding and fires. Whilst its applications are developed for civil use, the company is considering the future dual-use potential of some of its products and services. With more and more organisations and space agencies looking to open up missions for dual use, RSS-Hydro has built its recent civil-use services, CeDaRS and FloodPin, with dual use in mind as a possibility for the future.

To find out more about dual-use technologies and the benefits and challenges associated with them, *The Innovation Platform* spoke with Guy Schumann, CEO and Founder of RSS-Hydro.

Can you explain more about what dual-use space technologies are and the potential that RSS-Hydro's products and services have for dual application?
I think 'dual use' can mean different things depending on perspective, but, generally, it refers to applications developed for civil use that also have the potential to be used for defence purposes.

Moving into the defence space brings additional considerations for the companies behind these technologies. They may have to sign strict contracts to align with defence rules, being mindful of such things as security, access to data, access to machines, their team members, and how far they can act with the projects that are for defence or dual use. As an example, there are some public satellite missions developed by the military for civil use, such as the Italian Space Agency's COSMO-SkyMed, which is a co-development of the Italian military and the Government of Italy. These satellites are for civil use, but they are controlled under the military. The Canadian Space Agency has a similar satellite mission, RADARSAT-2, which is used for civil protection under military control. You can obtain these data for research and science, but there may be some location restrictions due to the military control aspect. With COSMO-SkyMed for instance, it's very easy to access information on such things as a volcano, landslide, or flooding. However, the military always has the priority on deciding where the acquisitions are taken.

RSS-Hydro's project, CeDaRS, and its accompanying FloodPin service sit in this arena of dual-use potential. Currently, these contracts are 100% civil but, with the European Space Agency (ESA) likely to move towards dual-use missions in the future, projects like CeDaRS become very appealing from that angle. CeDaRS is designed to provide a framework for very rapid detecting and alerting with an 'all-in-space' solution. All-in-space means that data no longer needs to be transferred down to Earth to be processed and sent as an alert – it can instead all be done from space. This will save a lot of time and will also significantly reduce the volume of information sent. Rather than a mass of data, we can instead send down a very lightweight piece of information to Earth to alert of a disaster.

RSS-Hydro focuses on flood detecting and alerting, and FloodPin is the service angle for the CeDaRS solution. Essentially, it is the pin of information for a given location that we send out. In future, we hope to be able to provide very fast detection and alerting of a flood to devices on the ground before it happens. Whilst the information doesn't have to be super precise, it would serve as a warning to authorities that a flood was due to hit their location in the forthcoming hours.

For me, the biggest concern to make FloodPin work is that it is not just our solution that needs to work, it's also the action that needs to be taken by the person receiving that data. We want to use our services and the projects that we have with the European Space Agency as a means to educate, to make people aware that we are building something but there also needs to be action after.

How important are dual-use technologies in the space sector for ensuring national security and economic competitiveness?
If you take our work as an example, we are predominantly focused on floods and fires or disasters that come from nature but are often exacerbated by humans. We live in places that are very economically important but that can be very vulnerable areas, given the current climate crisis and climate signals that we see. When there is a large flood that makes an area very vulnerable, such as the recent flooding in Texas, it becomes a question of national security. The risks that come from flooding, fires, earthquakes, and related disasters are as much of a threat to national security as conflict is. The aftereffects of a hurricane, for example, are very similar to what you would see following a conflict – communication breakdowns, people needing to be rescued, and even fatalities. Taking care of such a situation is very difficult because you need to evacuate a lot of people. In addition, technology needs to work when there's no internet connection or when there's very little connectivity.

It is also a question of economic viability. How fast can you recover? What's the business disruption during a flood event? What's your company doing? Is there

https://www.innovationnewsnetwork.com/how-feasible-are-dual-use-space-technologies/60075/

Who Benefits?

Citizens

Rescue Teams

Municipalities

Services

Our clients & Partners: Target sectors

- Re-insurance
- Insurance
- Financial risk industry
- Sustainability for Finance
- Governments & Cities
- Utility companies or large corporates with exposed sites/assets
- NGOs and Humanitarian Organizations
- Partnerships with big techs for compute & tech innovation support

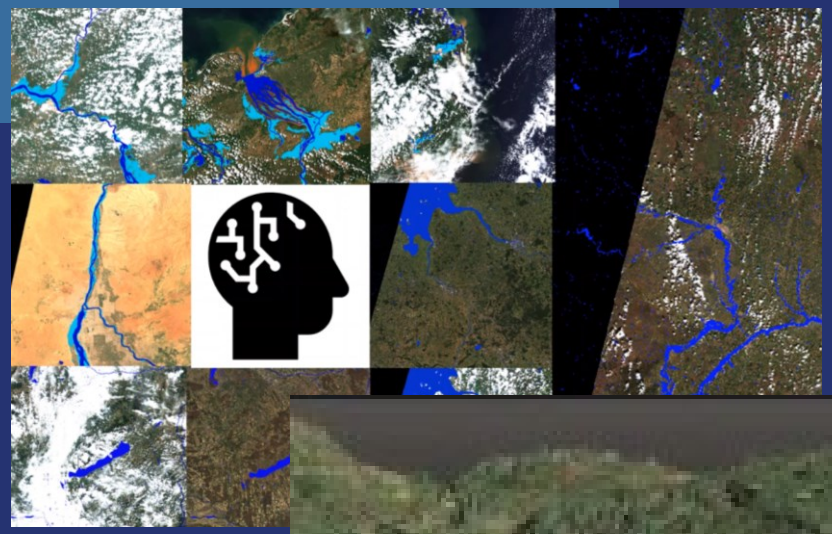
Photo: WFP/Gabriela Vivacqua

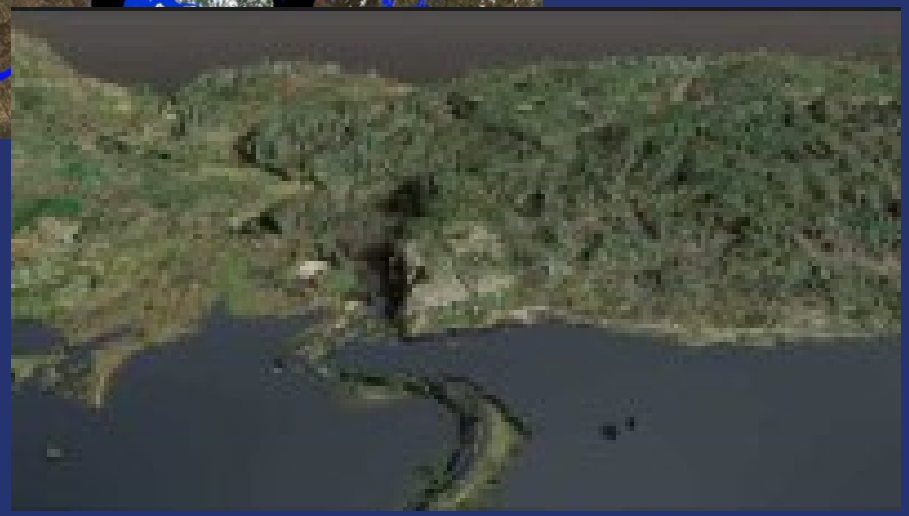
FloodSENS "Smart Sensing of Floods" Business Landscape

FloodSENS

esa space solutions

NVIDIA INCEPTION PROGRAM





Service features

- ✓ Living ML-based app using optical sat images (U-Net)
- ✓ Augmented with auxiliary datasets (DEM, water flow grids) for below cloud cover
- ✓ Explicit uncertainty representation
- ✓ Customizable app features

Benefits

- ✓ Consistent accuracy across diverse biomes
- ✓ Flooding below clouds
- ✓ More historical events mapped
- ✓ More complete single big event maps
- ✓ Validation of cat models & claims
- ✓ Augmented 3D visualization

Enabling Projects, pilots, anchor customers

- WTW
- UN WFP/Moz INGC
- Microsoft Azure
- Google Cloud Services
- NVIDIA / Omniverse
- HPC MeluXina (LU)
- HeManEO (ESA)

Customer segments & Markets

- Humanitarian, GnI
  - NGOs, e.g.
  - Governments
- Commercial
  - (re)insurance
  - risk finance sector
- From local to global: Luxemburg, Europe, Africa, US

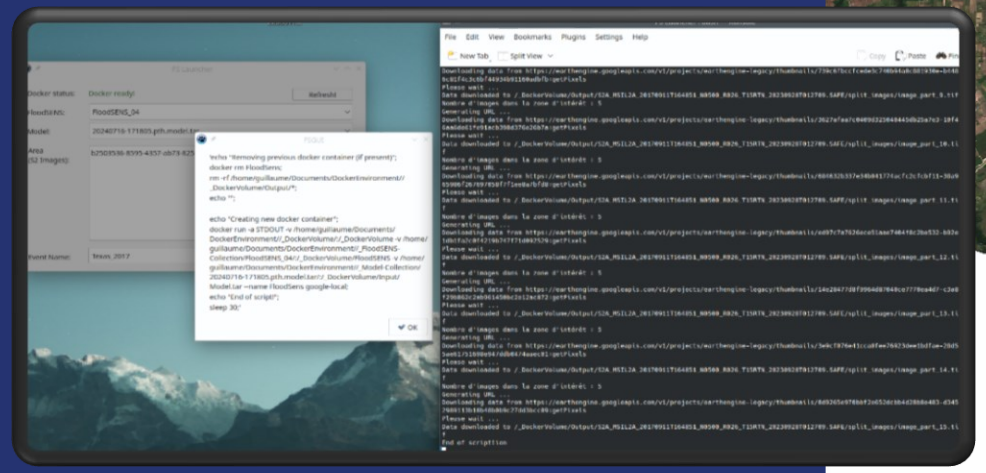
License levels

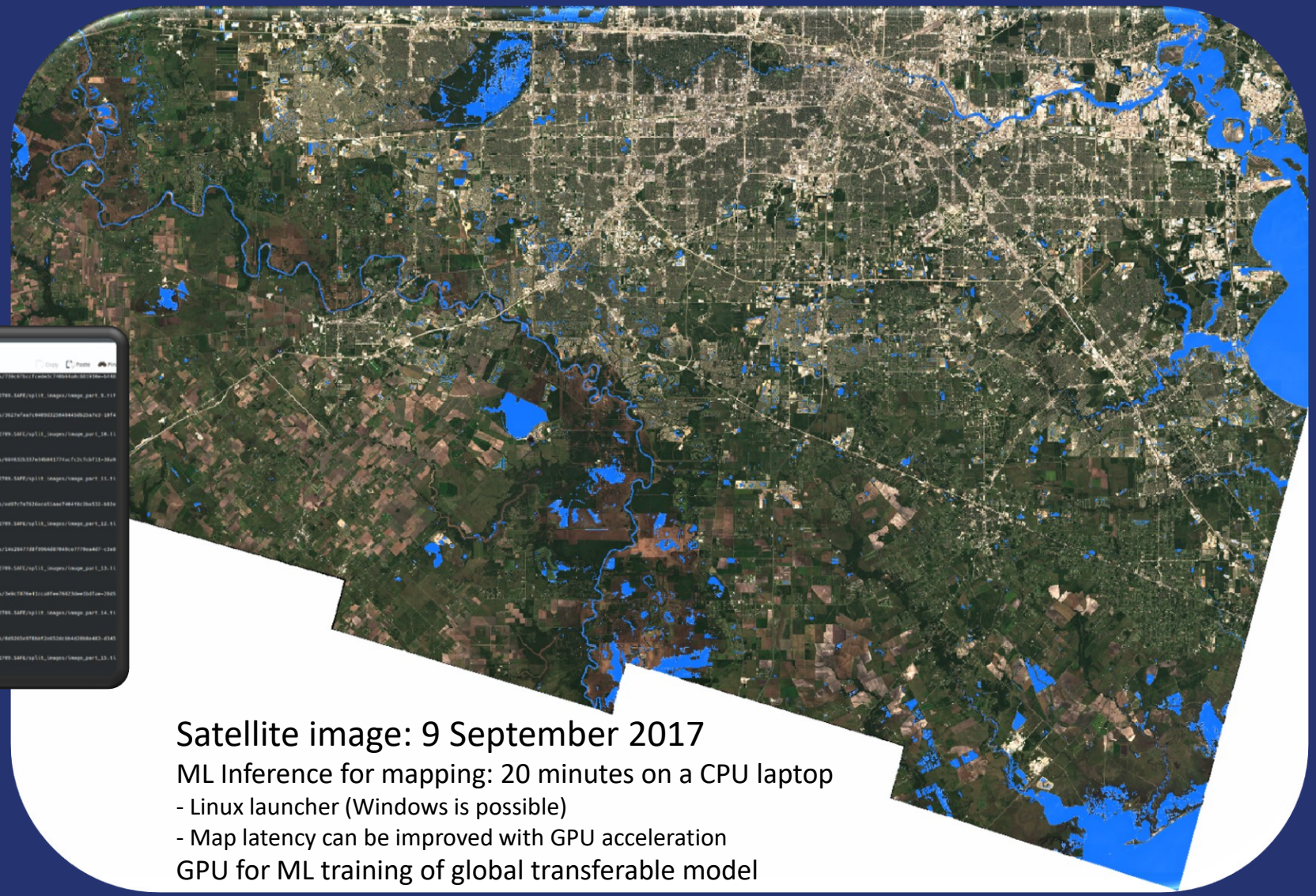
- Basic, on a platform
- Customized, as a service

Ongoing Development

- Trusted data and apps, for data security & ESG
- Complement inputs with multi-mission data & met forecasting: hybrid ML for early warning
- Growing truth label database

Transferability Use Case: Harvey 2017





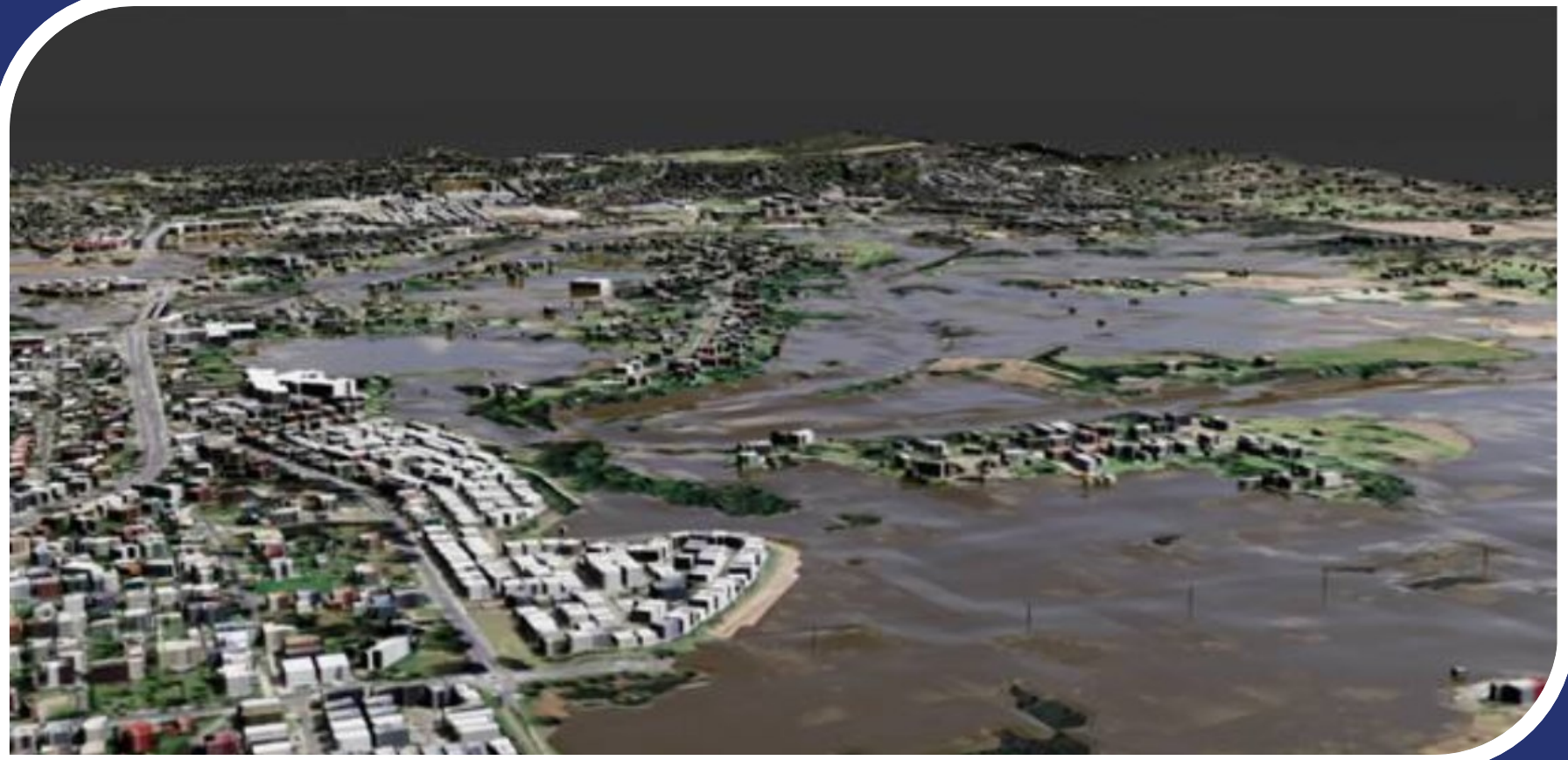
Satellite image: 9 September 2017

ML Inference for mapping: 20 minutes on a CPU laptop

- Linux launcher (Windows is possible)
- Map latency can be improved with GPU acceleration

GPU for ML training of global transferable model

A sample 3D scene generation of a *FloodSENS* (RSS-Hydro/ESA) simulation within NVIDIA's Omniverse platform. Significant flooding in the urban areas of Brisbane is shown for the 2022 event, with flooded above-ground electricity lines, depicted in the lower right area of the scene



https://blogs.oracle.com/cloud-infrastructure/post/rss-hydro-oci-nvidia-energy-infra-ai-flood-model

Getting FloodSENS disaster-cycle ready (here now)

- Faster & clearer information
  - All-in-space solution, with space asset partners D-Orbit & EnduroSat LU
  - Stakeholder customer commitment & R&D with ESA/LSA: CeDaRS

- Safe data & secure information
  - Digital Authentication & Traceability Service (HeManEO-DATS with ESA/LSA R&D) integrated in our SatEO applications: Pilot Service with customer(s) starting 09/25
  - Co-developed with re-insurance stakeholder Willis Re WRN

Getting FloodSENS disaster-cycle ready (ongoing)

- "Always" available intelligence
  - Multi-mission development (our PhD student)
    - Optical, SAR, Passive Microwave, GNSS-R
  - Mix between ML & traditional signal processing workflows
  - At least daily downscaled intelligence during an event
  - Docker & Containers: flexibility & security
  - Deploy in space on constellations & cloud
- Predictive analytics
  - Now: FloodSENS trained on historical & current
    - Uses topography & static hydrology layers
  - Multi-mission implementation ongoing
  - Adding soil moisture & precipitation to ML inputs
  - Predict flooded area hours to days ahead, using forecast inputs

“Every Drop Counts: How FloodSENS is changing Flood Intelligence”

ENDUROSAT RSS-Hydro D-ORBIT NEW SPACE SOLUTIONS

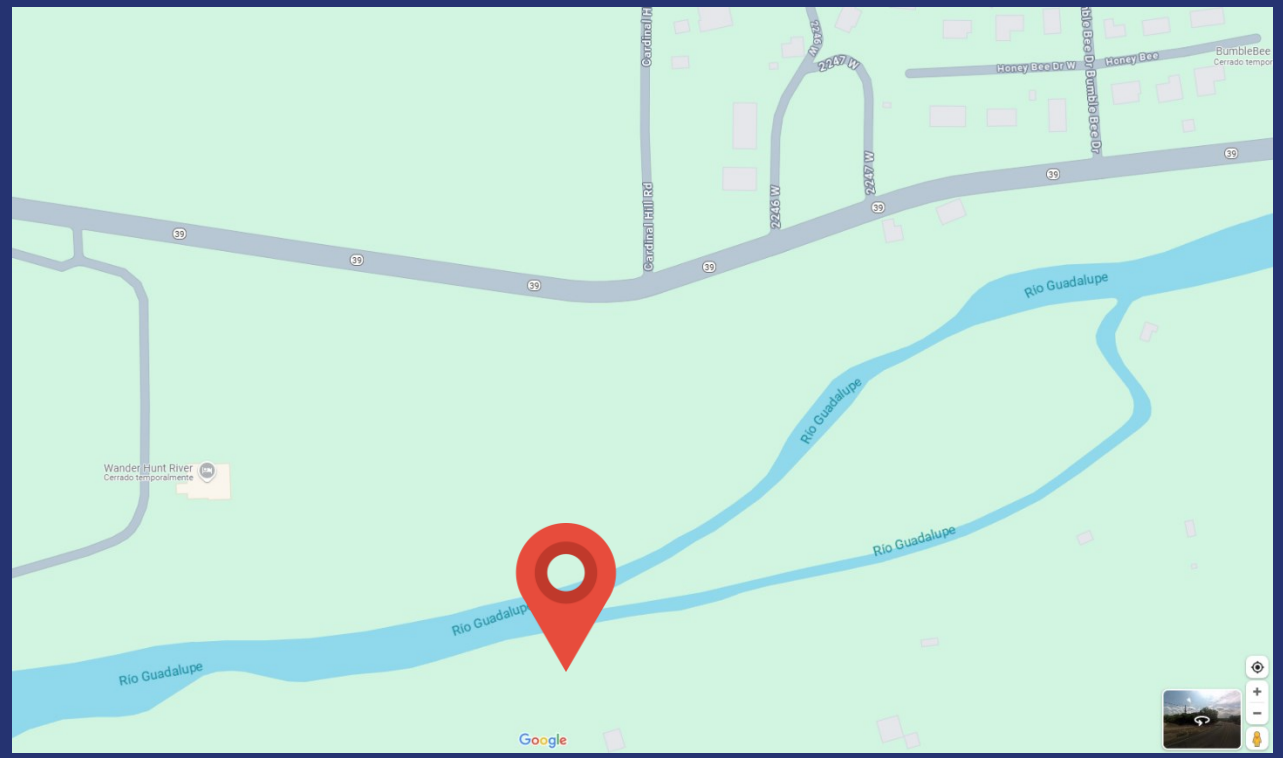
“Every drop speaks”

- *FloodPin*: Global flood intelligence infrastructure.
- Scalable data: Remote/in-situ/in-orbit + modeling.
- Real-time data for action.

- AI-powered, life-saving intelligence.
- Proactive community empowerment.
- New standard: Precision, scale, relevance.

Image used to do the FloodPin service analysis
© Maxar, July 8 2025
Guadalupe River along State Highway 39 near Hunt, TX

Base map layer on a platform or device



Attributes:
{lat; lon;
radius of impact visible on image (m);
level of impact (1-5);
uncertainty of analysis (%);
confidence level in intelligence provided (%)}

FloodPin

Values in FloodPin message:
{30.07; -99.31;
100;
5;
20;
90}

RSS-Hydro
4,240 followers
2w •

🚀 HUGE NEWS for Earth Observation! 🚀
We kicked off 2025 with a BANG! Our #SatEO software launched on D-Orbit's cloud infrastructure aboard Space X' s #Transporter12 mission on January 14th! 🎉

In a groundbreaking first, we processed both #optical (European Space Agency - ESA #Sentinel2) and #SAR (European Space Agency - ESA #Sentinel1) images in orbit, directly addressing the devastating #ShabelleRiver flooding in #Somalia (Nov 2023). This #multimission processing on the #cloud, never before achieved in space, generated actionable flood information in minutes! This dramatically reduces #latency for #EOassisted #disaster #alerting & #response.

Using preloaded images, this successful #derisking demo is just the beginning! Next up: real-time transmission & processing of raw satellite data, from ANY mission, directly in orbit. The future of #rapid #geospatial #intelligence is closer than you think! #FloodSENS-IOX #docker #ML

Thanks to all our amazing #collaborators, #partners, and programs that are supporting us! Special thanks to Luxembourg Space Agency, European Space Agency - ESA & Ben Gaffinet for supporting the initial #FloodSENS development and for their ongoing #support! We also want to thank in particular Viney Jean-Francois Dhiri, Luca Tonini, Pierre-Philippe Mathieu 🚀, James Parr, Bertrand Le Saux & Nicolas Longépé for their continuous #inspiration & support!

"Real SW de-risking is important...!"

Unibap AB
2,864 followers
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🎇🛰️🎇 Impressive results from RSS-Hydro and D-Orbit demonstrating the ability to run multimission data analysis in orbit on the cloud. In the In-Orbit Demonstration, RSS-Hydro's #FloodSENS app processed #Sentinel data from the devastating Shabelle River flooding in Somalia, 2023.

💡 The novelty? The dataset contained both #SAR and #Optical data, two very different data types that have never been processed in orbit in the same place same time before. This experiment paves the road for exciting applications like data fusion and cloud computing in space.

💻 How was it possible? With the help of our newest iX5 in space, launched with D-Orbit's Endless Sky-mission not more than a month ago. This is just the latest of many Unibap edge computers in use on D-Orbit platforms that together have helped to test close to 50 other software applications in orbit.

We look forward to continue supporting D-Orbit with cutting edge compute solutions, and helping our software community to test and evaluate their software products in space!

D-Orbit
65,565 followers
2w •

👏 Congrats to RSS-Hydro for this groundbreaking first aboard our compute node on ION Satellite Carrier! For the first time ever, the same algorithm processed SAR and Optical data, same place same time, directly in orbit, demonstrating the potential to rapidly produce meaningful insight at the speed of relevance on multiple data modalities.

🌏 RSS-Hydro is setting a new standard for disaster response and geospatial intelligence, using D-Orbit's unique infrastructure and services.

🛰️ Beyond deploying payloads, our ION Satellite Carrier also acts as a powerful platform to upload and run #software and algorithms in #space. By integrating edge computing supported by Unibap AB products on flight now with #data from onboard and external sensors, we unlock real-time processing capabilities that were once only possible on the ground.

#wearedorbit #spacetech #edgecomputing #satellites #cloud #cloudcomputing

SPACE | PROFILE

Every drop counts: How space tech innovations are revolutionising Earth observation

With new applications and a project backed by the European Space Agency, RSS-Hydro is poised to revolutionise the field of Earth observation

IMAGINE a world where floods are detected and alerts are sent with pinpoint accuracy weeks in advance, where urban development is meticulously planned based on real-time environmental data, and where the impact of climate change is tracked with unprecedented detail. This is not science fiction; it's the rapidly evolving reality powered by groundbreaking innovations in space platforms, satellite communications (satcom), and Earth observation (EO) missions. Companies like Luxembourg-based RSS-Hydro, with cutting-edge applications like FloodSENS and its new project CeDaRS, supported by the European Space Agency (ESA), are at the forefront of this revolution, demonstrating the transformative potential of an 'all-in-space' approach to understanding and managing our planet.

For decades, Earth observation from space has provided invaluable data for weather forecasting, environmental monitoring, and disaster response. However, recent technological leaps are ushering in a new era of capabilities, making EO more precise, timely, and accessible than ever before.

The dawn of advanced space platforms

The traditional model of large, monolithic satellites is being disrupted by the rise of smaller, more agile platforms. CubeSats and SmallSats, often deployed in constellations, offer increased revisit times, meaning they can image the same area much more frequently. This high temporal resolution is crucial for dynamic events like flood monitoring, where near real-time data is

Illustration of D-Orbit's ION carrier: Infrastructure-as-a-service

essential for effective response. Furthermore, these smaller satellites can be launched more affordably, democratising access to space-based data collection. Companies are also exploring innovative platform designs, including cloud computing infrastructure and modular systems, allowing for greater flexibility and adaptability in orbit.

Satcom supercharging data delivery

The sheer volume of data generated by advanced EO missions demands robust and high-speed communication links. Advancements in satcom are meeting this challenge. Laser communication promises significantly higher data transfer rates compared to traditional radio frequencies, enabling the downlink of massive datasets in a fraction of the time. Inter-satellite links, where satellites communicate directly with each other, create resilient networks that can bypass terrestrial infrastructure, ensuring data reaches users even in remote or disaster-stricken areas. The development of software-defined satellites allows for on-orbit reconfiguration of communication payloads, providing the flexibility to adapt to changing data demands and user needs.

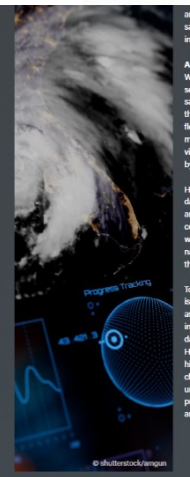
Earth observation missions: A new level of detail

The EO missions themselves are undergoing a radical transformation. Hyperspectral imaging, capturing data across hundreds of narrow spectral bands, provides a far more detailed 'fingerprint' of the Earth's surface, enabling precise identification of vegetation types, soil composition, and even water quality. Synthetic aperture radar (SAR) technology and other microwave systems, a cornerstone of many flood mapping applications, can penetrate clouds and darkness, providing critical information during severe weather events when optical sensors are limited. The integration of artificial intelligence (AI) and machine learning (ML) on board satellites allows for real-time data processing and analysis, extracting actionable insights before the data even reaches the ground. This on-orbit intelligence is crucial for rapid disaster assessment and environmental change detection.

RSS-Hydro: Pioneering integrated space solutions

RSS-Hydro exemplifies the power of these integrated space solutions. It is developing an all-in-space service solution, called FloodPin, that leverages satellite imagery, combined with hydrological know-how and AI, to provide accurate and timely flood insights and impact assessments. This capability is a gamechanger for disaster preparedness and response, allowing authorities and communities to take proactive measures to mitigate damage and save lives.

Furthermore, their project CeDaRS (Comprehensive space-tech powered Disaster Response Solution), supported by ESA, highlights the importance of advanced data processing and analytics. Extracting meaningful information from the vast amounts of EO data requires sophisticated algorithms and infrastructure.



The Project: FloodPin

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r real-time flood insights: RSS-Hydro's odPin leverages AI and multi-sensor llites

era of increasing flood risks, advanced, real-time monitoring cial. Countries and global communities need precise, rapid insights for effective response

ydro's FloodPin service marks a pivotal advancement in flood monitoring and pact assessment, seamlessly integrating cutting-edge space technology phisticated artificial intelligence (AI). At its core lies FloodSENS, a highly ed machine learning algorithm meticulously trained on diverse flood events and locations globally. This powerful algorithm harnesses the immense potential of satellite imagery and hydrological expertise to generate accurate and timely flood insights.

All-in-space solution for flood management

What truly sets FloodPin apart is its remarkable flexibility and efficiency. The service will operate as a purely 'all-in-space' solution, leveraging direct satellite-to-satellite communication and on-board processing capabilities to drastically reduce the latency in delivering critical information. This means that, within minutes of a flood event, stakeholders can receive near real-time insights, enabling swift event mapping and initial impact assessments. This all-in-space approach is particularly vital for wide-area monitoring and rapid response in remote or inaccessible regions, bypassing traditional ground-based processing bottlenecks.

However, FloodPin's capabilities extend beyond this. It can also integrate satellite data and other auxiliary data on the ground, offering enhanced localised detail and precision for specific areas of interest. This hybrid approach allows for a comprehensive understanding of flood dynamics, combining broad-scale overviews with granular insights, thereby catering to a wider range of user needs – from national disaster management agencies to local community responders and even the insurance sector for detailed impact monitoring.

To further increase the reliability and robustness of the FloodPin service, RSS-Hydro is actively collaborating with leading universities and other research organisations as well as big and small tech companies. This ongoing research focuses on investigating a truly multi-sensor, multi-mission flood mapping approach. By fusing data from various satellite types (e.g., optical, radar, microwave) and missions, RSS-Hydro aims to overcome the limitations of individual sensors and ensure continuous, high-fidelity flood monitoring even under challenging conditions like persistent cloud cover or dense vegetation. This commitment to collaborative research underscores RSS-Hydro's dedication to pushing the boundaries of flood science and providing the most accurate and resilient solutions for global flood preparedness and response.

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Open weekdays and **by appointment only**

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