Increasing the reliability of flood risk modeling by using adequate elevation data and topography

ICLR Toronto
February 2012

www.Intermap.com
Agenda

- Few words about Intermap and IFSAR
- Motivation? Why do we need to understand better?
- How and where elevation information can play a significant role in risk management
- Different views on the way how information and models can be accessed
- Conclusions
Company History

- Intermap was founded in 1997 by a team of radar engineers and scientists.
- Since then, we’ve consistently been recognized as a leading provider of 3D terrain solutions.
- We are the world’s first organization to collect, process, and deliver complete national 3D elevation datasets for the United States, Europe and parts of Asia Pacific.

Intermap provides geospatial products and services to a wide range of customers.
### NEXTMap®

**Counties**
- USA: 50 States
- Europe: 18 Countries

**Area Size**
- USA: 8,000,000 km²
- Europe: 2,400,000 km²

**Blocks**
- USA: 120
- Europe: 36

**Tiles**
- USA: 55,150
- Europe: 19,556

**Population**
- USA: 301 Million
- Europe: 373 Million

NEXTMap® is the world’s largest 3D Mapping campaign ever covering 10.4 Mio. square kilometers in the USA and Europe.
Ongoing commercial 3D mapping projects. Currently covering more than 1.3 million square kilometres at a vertical accuracy of up to 1m.
Global 3D Mapping Capabilities

Note: IFSAR uses 1 GPS ground station for differential processing; no other ground control points are required.
NEXTMap® Core Products

Orthorectified Radar Imagery (ORI)

Digital Surface Model (DSM)

Digital Terrain Model (DTM)
Digital Elevation Models

- Digital Surface Model
- Digital Terrain Model
Traditional Photogrammetric DEM

30 – meter grid resolution

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NEXTMap DEM

5 – metre grid resolution
Orthorectified Radar Imagery
Data Acquisition vs. Data Integration

- What are the challenges?
  - We need to have the solutions available „today“
  - We can accept that the solution is not the most accurate today, but will improve accuracy through upgrades over a time period
  - „Global coverage“ is key (or National, the World is getting more Global)
  - We want to use what have been already developed and not „reinventing the wheel“
Shortcomings of current DTMs

- Visible map sheet divisions
- Missing national homogeneity
  - Technology & Processes
  - Suppliers & QC-Standards
  - Data Age & Origin
- Disconnect at national borders
So what can we do from mapping perspective?

- Create a **reference Base layer** using not the most accurate technology but very efficient and highly homogenous (IFSAR)

- For **urban and industrial** areas fuse in **more detailed** topography (LiDAR)

- **Reusing** more detailed topography if available e.g. From Local Government

- Creating **Homogenous Integrated Dataset** (NEXTMap)

⇒ **Saving time, money and enabling rapid and efficient solution development**
Murray-Darling River Basin (Australia)

- Project Area

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LIDAR coverage

IFSAR coverage
Murray-Darling River Basin (Australia)

Chowilla LiDAR 2.2 m Resolution
Murray-Darling River Basin (Australia)

Chowilla Fused 5m Resolution
Murray-Darling River Basin (Australia)

LIDAR Water Surfaces

IFSAR Water Surfaces

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### Scope
- Seamless fusion of LiDAR data into NEXTMap Britain DTM for enhanced NEXTMap product for the British Government’s Environment Agency.
NEXTMap Britain DTM v2

- Result
  - Enhanced detail and accuracy, particularly along water courses and in urban areas
  - Excellent correlation
  - Temporal consistency
  - Complete coverage
  - Hydrologic corrected water courses and water body surface
As a result of the blending performed during the Intermap fusing process, the transition is barely or not visible along the majority of edges. Remaining seams are usually caused by blending obstructed regions between LiDAR and IFSAR DTMs.
What Hazard are we talking about?

CAUTION
Hazard of Falling Coconuts and Fronds
Natural Hazards

- Flood
- Hail
- Earthquake
- Windstorm
- Dispersion of Chemicals and Radiation
What is the Opportunity?

- Need for improved, geospatially accurate risk management products is dramatically increasing due to growing number of extreme cost natural disaster events.
  - 2007: 7th warmest year for globe and 2nd warmest for northern hemisphere
  - Worldwide economic loss USD 75bn, insured loss USD 30bn
  - Hurricane Kyrill – economic loss USD 10bn, insured loss USD 5.8bn
  - Flooding in UK – insured loss USD 6bn
  - Tai Flood 2011 – USD 15bn - the fifth costliest insured loss event in the past 31 years

*Change in recurrence of 100-year flood. In some rivers in the west, and in parts of Eastern Europe, for example, 100 year floods could occur every 50 years or less (source JRC)
Flood Risk Zones – Water depth

Flood Hazard map – Flood outlines

Depth of flooding map
River flooding, but also the other ...

Water depth mapping

Very detailed 3D hydraulic modeling

Flash Floods

Coastal Surge
Flood Modeling – Importance of DTM
National Flood Hazard Maps: France

- In cooperation with Guy Carpenter and JBA Consulting
- Most detailed and homogenous river flood hazard maps for France
- Based on NEXTMap France DTM, combined with sophisticated 2-D hydraulic modeling
- Covering 80,000 river km
- Flood hazard Maps for return periods of 1 in 10, 25, 50, 100, 250 and 1000 years
- Additional modelling of several flood defence scenarios
- Water depth grids to estimate flood severity / damage potential
National Flood Hazard Maps: UKFloodMap™

- In cooperation with Ambiental Ltd.
- Most current, and consistent flood hazard maps for UK
- Based on NEXTMap Britain DTM v2, combined with sophisticated 1-D and 2-D hydrodynamic modeling
- 3 flood perils (fluvial, pluvial, tidal)

**Pluvial flood hazard**
- For all urban areas in England, Scotland and Wales
- Modeled using the 75-year return period, in alignment with the ABI statement of principles

**River & Tidal flood hazard**
- For England and Wales
- Delineation of the 1 in 100, 250, 500 and 1000 year return period flood zones
- Flood severity / damage potential information provided in the form of banded water depth grids.
Flood Zoning x Event Model

Zoning Model – Risk Assessment
- Defines zones with certain probability of being flooded
- Used for risk management and UW / Flood Risk Assessment

Event Model – CAT Modeling
- areas affected during one event
- Loss caused by flood – PML
- Used for Reinsurance purposes

=> Exactly the same data used for pricing and exposure modeling together with more transparent approach is bringing key difference to the user
Geo-Coding & Visualization, Risk Assessment

- Address Search / Coordinate Search
- Geo location and 2D Visualization

Risk Assessment

- e.g. Flood, Landslides, Windstorm, Earthquake, ...
Geo-coding as part of the Solution

- Geo-coding accuracy
- Lower accuracy (e.g. street)
Scenario Based Analysis

- Assessment of affected territory under defined scenario
- Understanding the number of properties/citizens/value exposed to risk
Portfolio Upload

Risk Distribution and Accumulation Statistics

Dashboard generation

Reporting

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<th>Postleitzahl</th>
<th>Stadt</th>
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Reliability of the result

- Influence of data accuracy and geo-coding quality on Loss Exceedance Curve (LEC) estimate error

- Lower geo-coding exactness

- Higher geo-coding exactness
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<th>Prevention planning, Early Warning Systems</th>
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Prevention planning, Early Warning Systems

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Flood Impact Forecast, Early Warning

- Flow/Gauge stations information
- Synthetic event set
- Flood Hazard Zones
- Hazard v. event comparison
- Locations at risk:
  - Automatic warning
  - Loss estimation
Risk Application Platform

- GIS Tools
- Analysis
- 3D View
- Risk Management
- Mobile Apps

Aquarius.NET Server

Access Control, Journaling

WMS, WCS, Get Height, Get Profile, MLP, 3D Streaming, Risk analysis

Data Storage

Access Management, Security, Classified

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- B2C Risk management application
- Provision of house based flood risk reporting
- Launched to the public at January 13 2009
- Huge traffic through the flood period in May 2010
Conclusions

- Current, highly accurate and homogenous elevation data allow for more detailed and accurate flood hazard mapping and modeling.

- Evaluate flood risk not only on a property-by-property basis, but also at a portfolio level for large territories.

- Ultimate value through usage of the same underlying hazard information for single property risk assessment (underwriting/pricing) and for portfolio flood exposure modeling (reinsurance).

- All different industries can benefit from having access to such an information. Not talking only about Insurance and Reinsurance industry, but telecommunication, transportation, housing, lending/morgage, ..., public.
Thank You

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