Beyond Urban Mobility
Copernicus data in road transport applications

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Problem

- Complex road conditions in rural areas
- Unknown quality
- Affected by terrain, vegetation, frequency of usage, weather
- Many fatal accidents
- Costly delays
- Unpredictable risks

- 80% of all roads worldwide are in rural areas and not paved
Executive Summary

Earth Observation Satellites
- e.g. Sentinel, Landsat, Constellations

Imagery Layers
- RGB
- Elevation / Topology
- Vegetation
- Surface Type
- Evaporation
- Precipitation Prediction

Basemap

Concept

Output Example
- Accessible via web interface

- RGB transformed to road coordinates

<table>
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<tr>
<th>Feature</th>
<th>gravel</th>
<th>asphalt</th>
<th>unknown</th>
<th>gravel</th>
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<tbody>
<tr>
<td>Road Surface</td>
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<tr>
<td>Slope</td>
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<tr>
<td>Flooding Risk</td>
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<tr>
<td>Avalanche Risk</td>
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<tr>
<td>Overgrow Index</td>
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<td>Smoothness</td>
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<td>-7°C</td>
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<tr>
<td>Surface Temperature</td>
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<tr>
<td>Historical Weather Data</td>
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</table>
Remote Sensing Scenarios

Let the driver know what the road conditions will be like in the next miles

- Remote sensing & static maps
- Weather forecasts
- Road condition predictions
- Known road hazards
- Display alerts

Steep, wet slope 3 miles ahead

Strong crosswinds in 1.5 km, >7bft

Landslide 36 hours ago 2 miles ahead

Gravel road ahead max 20 mph
Target: Drivability API

Key Differentiators

► Vehicle-specific routing
► Weather-dependent routing
► Road hazard predictions
► Bandwidth-aware
Road Profiles

- Multi-resolution road-centric image patches
- Spatial & temporal distribution
- Imagery from Sentinel and NAIP
- Promising classification results, e.g. 98% for Asphalt vs. Dirt* based on Deep Learning
- Ground truth from public authorities & OpenStreetMap

NAIP data, 1x1m resolution, location northeast of Phoenix, AZ
Hazards

- Landslides, mudslides, avalanches, floods, fires, earthquakes, typhoons, hurricanes
- Risks may be predicted from weather forecasts, elevation profiles, vegetation index
- Historical data available from various sources
- Contributes to road risk assessment

Data Source: NASA Global Landslide Catalog
Pilot Implementation
E-Mobility Applications

► Choose route depending on battery state of charge and possibilities for regenerative braking

► On low battery, prefer going downhill first

► On charged battery, prefer going uphill first

Destination
300km
no charging station in between

High-Charge Route
Uphill, shorter, faster, more power consumption

Low-charge Route
Downhill, longer, slower, less power consumption
Challenges

▶ Spatial Resolution
to detect relevant features on the road

▶ Access Functions
sqkm-based vs. line based

▶ Spatial / Temporal Registration
with Supplementary Data Sources, e.g.
Traffic, hazards, incidents