Rijkswaterstaat
Ministerie van Infrastructuur en Milieu

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Monitoring and predicting floodplain vegetation development on national scale using Sentinel-based analysis in the Google Earth Engine

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COST-CONVERGES April 2019 - Prague

Managing floodplain vegetation

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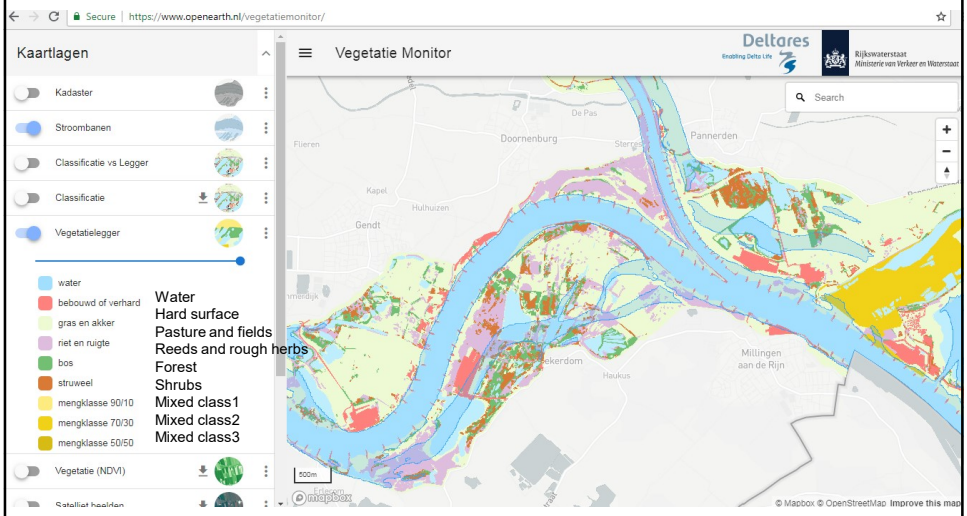
Challenges for the national water board:

- To ensure vegetation status per every 1st of November according to legal requirements – 'vegetation layer' (1x per 6 years updated)
- From 1x per 6 years to updates every few days
- 12.000 owners
- 16 people 'floodplain management-team'

⇒ Get an overview of where to focus management efforts
⇒ in dialog with owners

Legal vegetation map



Use of satellite images

Satellite gives quick and easy access to information for large areas

Sentinel2:

- Specifically designed for land cover and vegetation studies
- Available nearly real-time revisiting time every 5 days, available since summer 2015
- 13 bands with spatial resolution of 10-20-60 m depending on band
- Free and open data policy

Data accessible via the Google Earth Engine

- A powerful cloud-based geospatial processing platform
- Satellite imagery + your algorithms
- (APIs for Java and Python, online code editor)

Approach

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Google earth engine algorithm:

1. Select image and area of interest
2. Classification used random forest supervised classification
3. Test and training set based on airborne photography in 27 classes
4. Translation to classes following the legal vegetation map:
   - Open water
   - Bare land and roads
   - Grass and agricultural fields
   - Rough herbacious fields and reeds
   - Floodplain forest
   - Shrubs

   Increasing roughness
5. Compare with legal map and produce exportable maps and error matrices
6. Analysis accessible via webbased viewer (Mapbox-technology)

Classification in GEE

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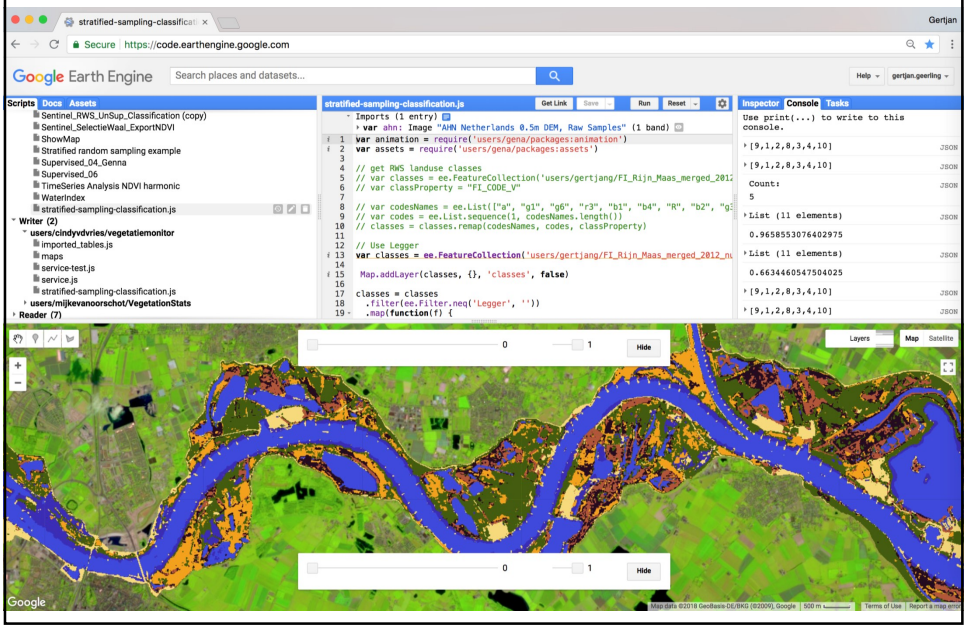
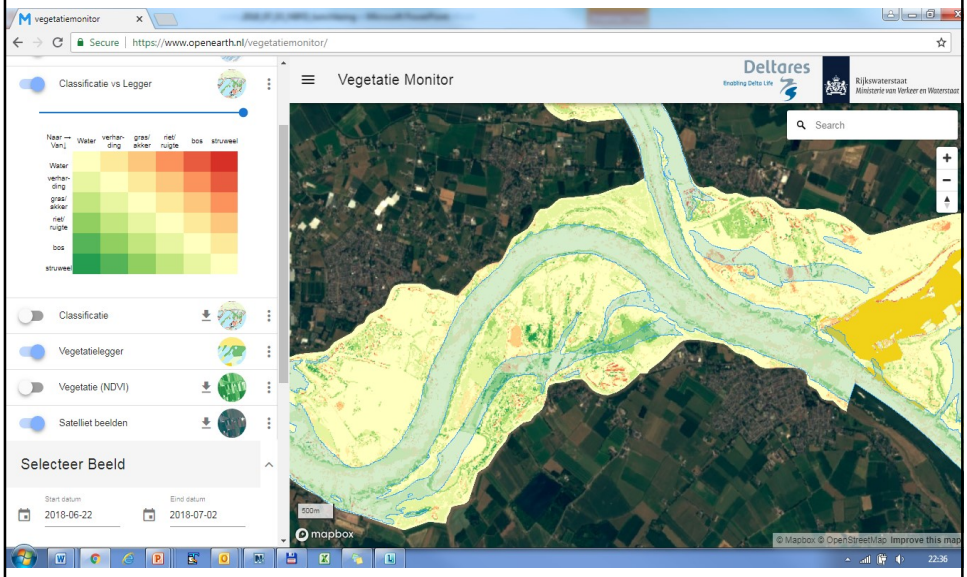
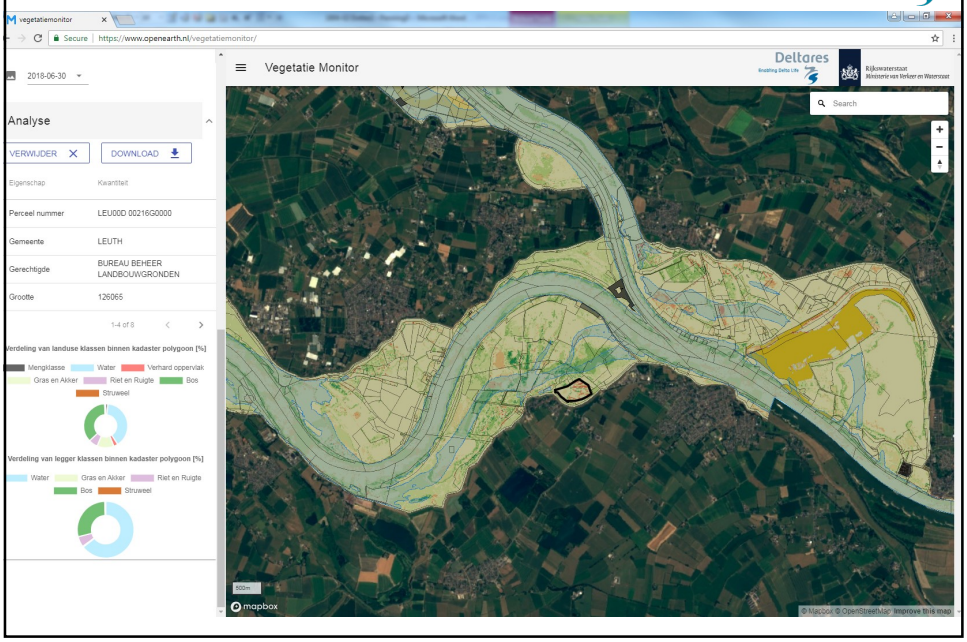


GEE as a powerful tool to monitor



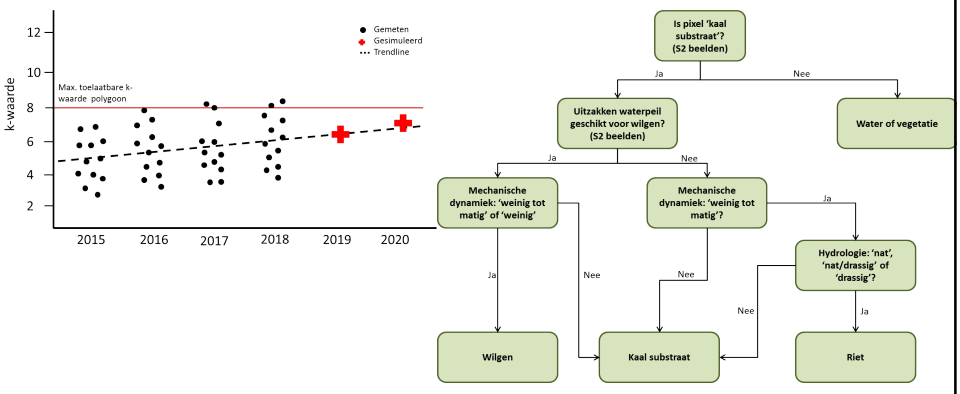
Check per owner & download data



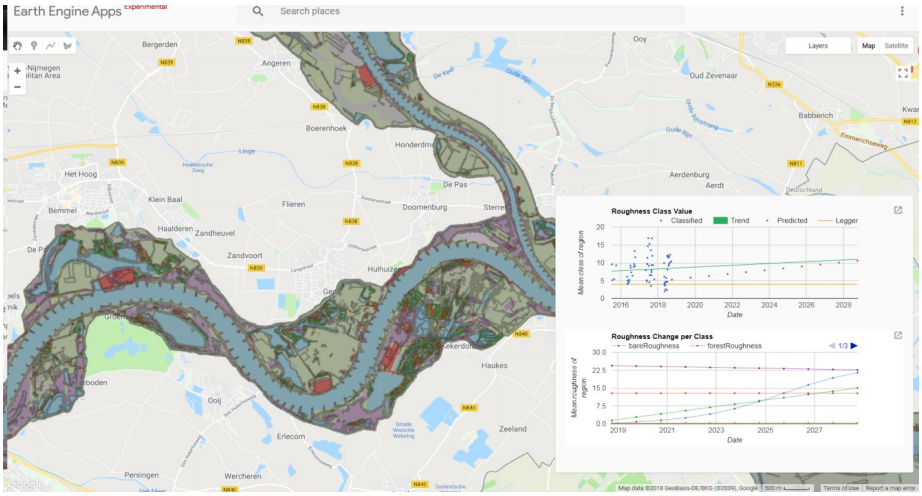
Succesfully tested in the field (15 nov.)

Vegetatievoorspeller – predict changes

- Wish to predict into the near-future (3-10 years) for multi-year management plans
- Link trends from available satellite images to knowlegde rules on vegetation development

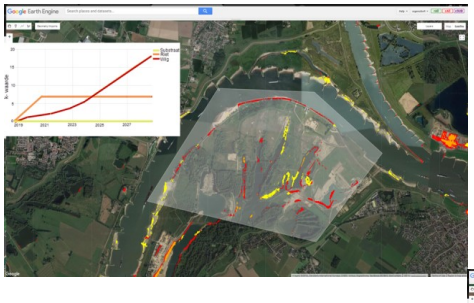


For a given polygon



In relation to grazing intensity within a section

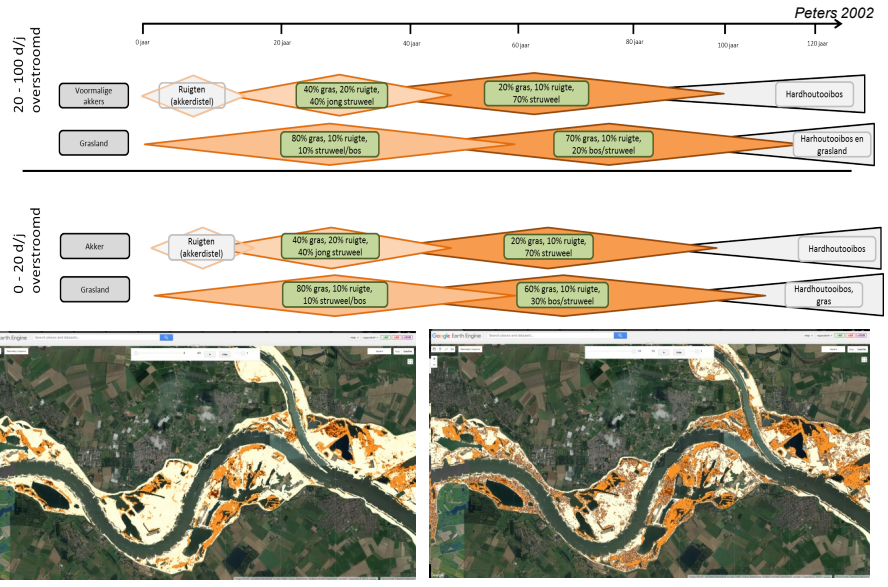
Example: from bare substrate to reeds or willows



Depending on grazing intensity

- **No grazing**
- **Almost no grazing**
- **Average grazing**
- **Intenstive grazing**
- unknown

River stretch scale -> allows for focus



Error matrices

Overall accuracy operational system:

- 66-70%
- Based on a single image (sentinel-2) and raw elevation data (AHN-2) with on the fly classification using a random forest classifier.
- Most difficult to distinguish:
  - grass vs. tall herbaceous vegetation,
  - forest vs shrub.

****accuracy variation depends on the date of image acquisition (phase of growing season)*****.

Current overall accuracy experimental system:

- 74% when using multitemporal images (spectral only, sentinel-2)
- 77% when using multitemporal images + SAR (sentinel-2 + 1)
- 88% when using multitemporal images + AHN-2 (Lidar-DEM)

Conclusion

- Using satellite images gives a good first screening of the current state of floodplain vegetation on the full scale of the Dutch Delta system
- Google Earth Engine also for quick access to very recent images
- Tool is now used by the National Water Board for this years' assessment as a first trial

Future work:

- Include optimized classification in the webviewer tool (multi-temporal + SAR, assess potential for Deep Learning and other Machine Learning techniques)
- Further discussions on what is legally needed for the assessment (frequency of producing a new map, legal status, privacy, minimum acceptable accuracy etc.)

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Thank you!

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