HYPERWAVE

Generic classification technique
for Hyperspectral Data

Pieter Kempeneers, Steve De Backer, Stephanie Delalieux, Bouchra Nechad ,

Walter Debruyn, Pol Coppin, Kevin Ruddick, Paul Scheunders

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Introduction

- Hypercrunch: finding a generic approach to deal with large data sets in Hyperspectral data for classification purposes
- Challenge:
  - concentrated on single application: stress detection in apple orchards
  - Limited pixels available
  - 2 class problem (stress – no stress)

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Methodology

- Focus on relevant information
  - Feature extraction (reflectance bands and wavelet features)
  - Feature selection (floating forward search)
  - Tool for sensor definition and optimization of sensor settings
- Classification
  - Fisher's Linear Discriminant Analysis

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Validation

- Variety of applications with heterogeneous data
- Land application:
  - Dune vegetation along Belgian Coast
  - Historical data (CASI) and new data (to be defined)
  - Two objectives with different levels of complexity
  - Subject of another stereo project: Hyperkart

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Validation

- Aquatic applications in coastal zones (Belcolour)
  - Support for deriving suspended particulate matter and Chlorophyll-a concentration in waters
  - detection of:
    - clouds/shadow, ships/wakes, white caps, sunglinted wave slopes,…
  - Data available (2003):
    - Multispectral (15-band, 250m) MERIS
    - Hyperspectral (63-band, 50m) CHRIS PROBA
    - Hyperspectral (96-band, 4m) CASI

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Current status

- First stage: land applications
  - Synchronized with Hyperkart project
  - Compared with classical approach (Spectral Angle Mapper): 15-20 percent improvement
  - Algorithm fine tuning

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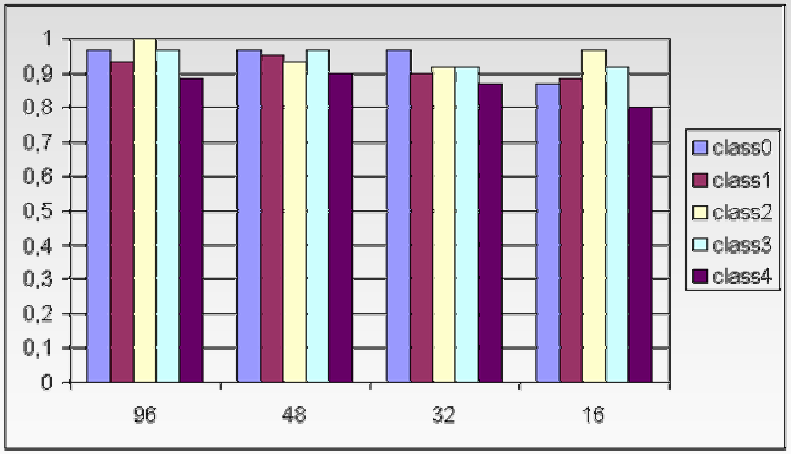
Feature extraction

- Used for sensor definition and optimal band settings
  - Maximum spatial resolution with “acceptable” spectral resolution (differentiate between subtle vegetation classes)
- Wavelet based approach: multi resolution analysis

Sensor recommendation

- 5 classes selected that are “difficult” to differentiate
- Classify with different spectral resolutions (simulated with multi resolution approach)

Classification result



Nr of spectral bands

Resolution tradeoff

Spectral	Spatial
96	2.2 m
48	1.4 m
32	1 m
16	0.9 m

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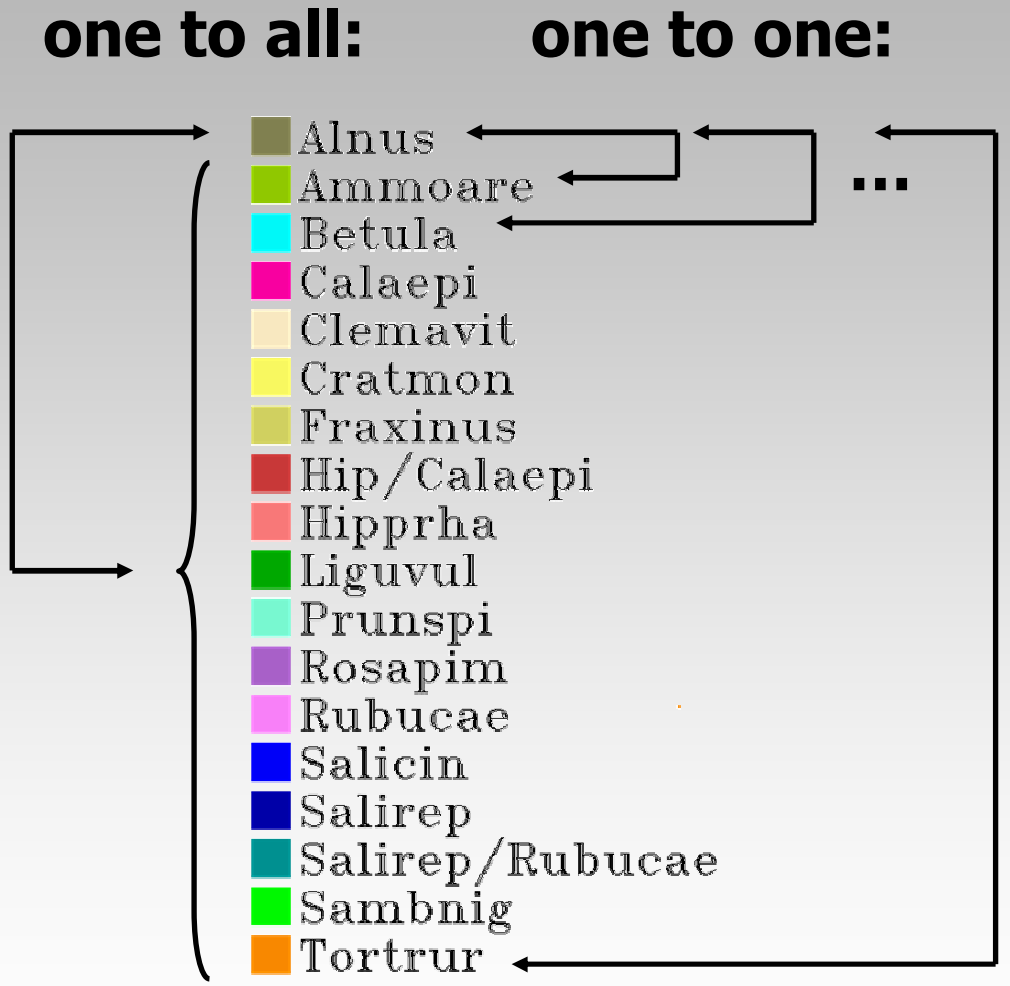
Multi class approach

- Hypercrunch: 2 class approach (stress – no stress)
- Combining binary classifiers
  - One to all: K combinations
  - One to one: K*(K-1)/2 combinations



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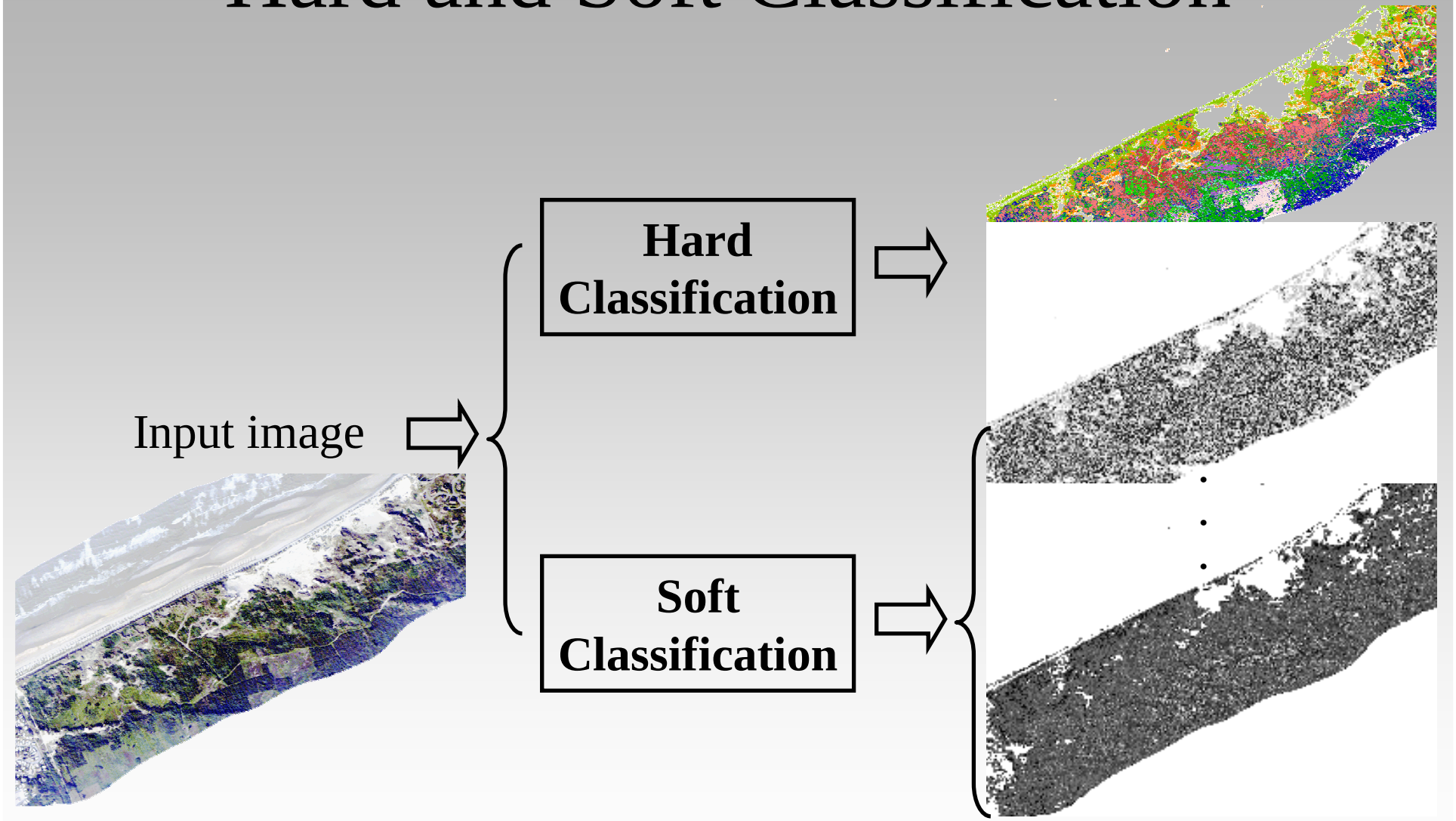
Post Classification

- Output image is noisy (speckle)
  - Spatial smoothing
    - Majority voting
    - Smoothing soft classification results prior to hard decision (probabilities)

Hard and Soft Classification



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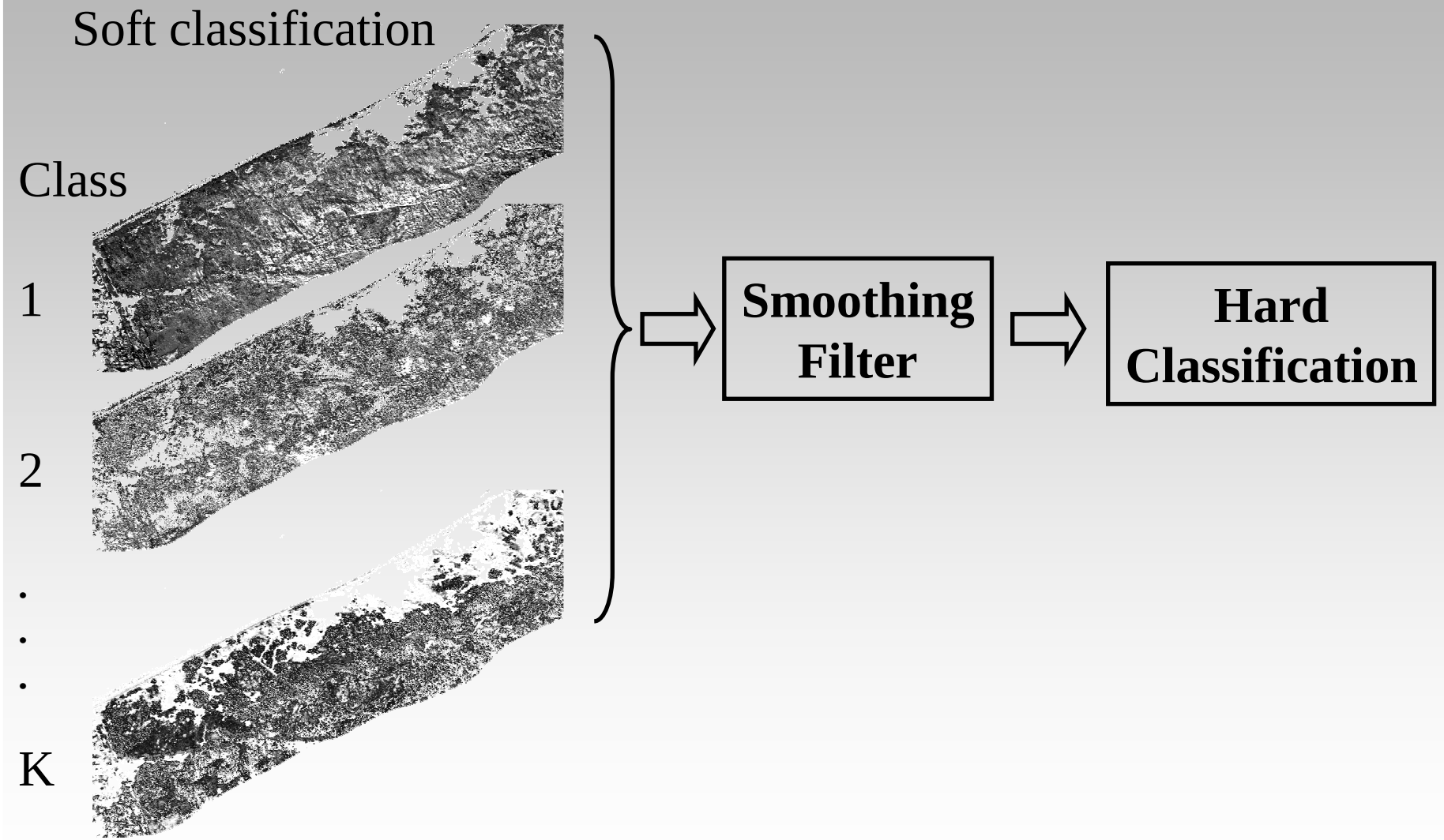
Smoothing classification output



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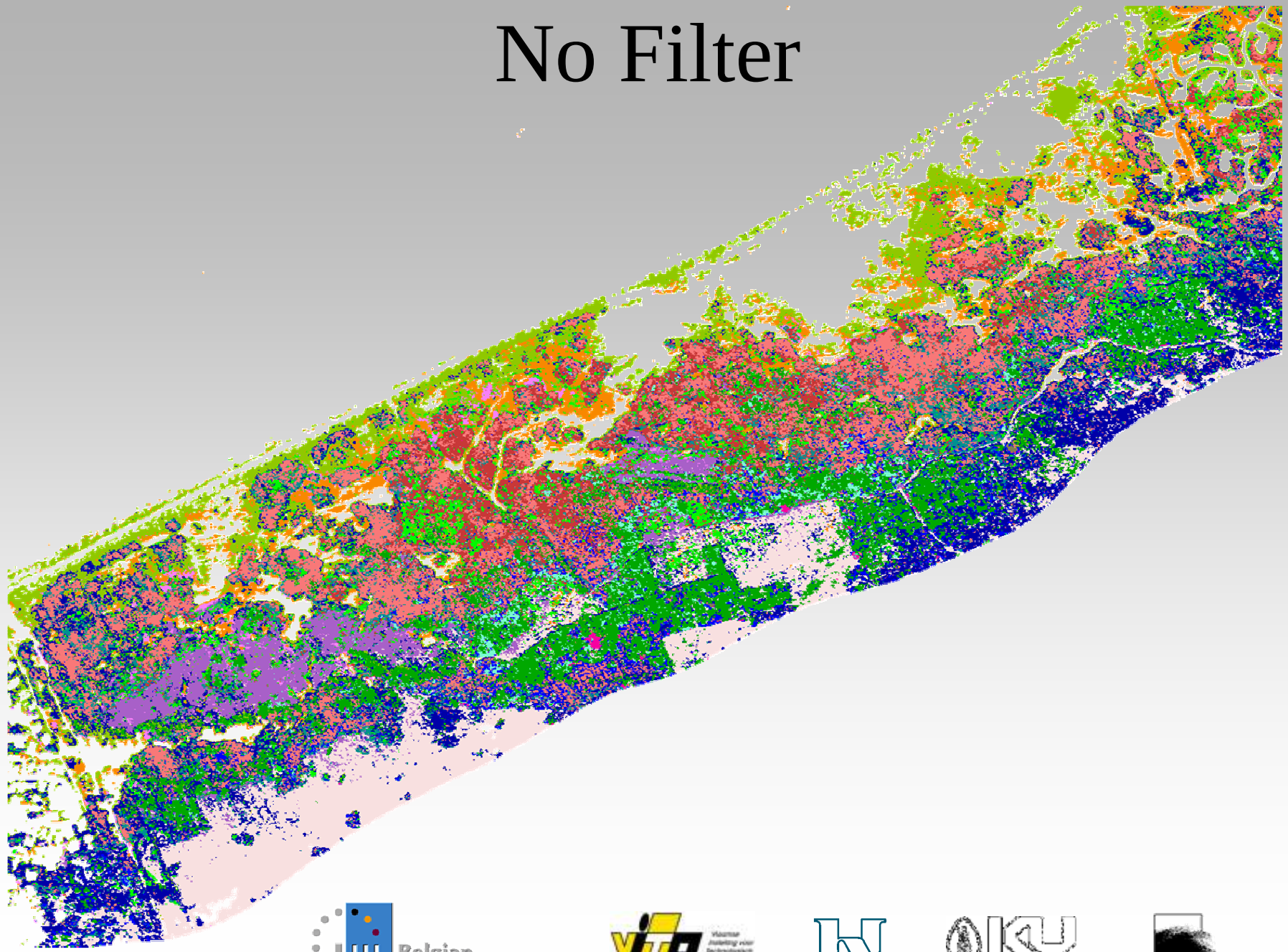
No Filter



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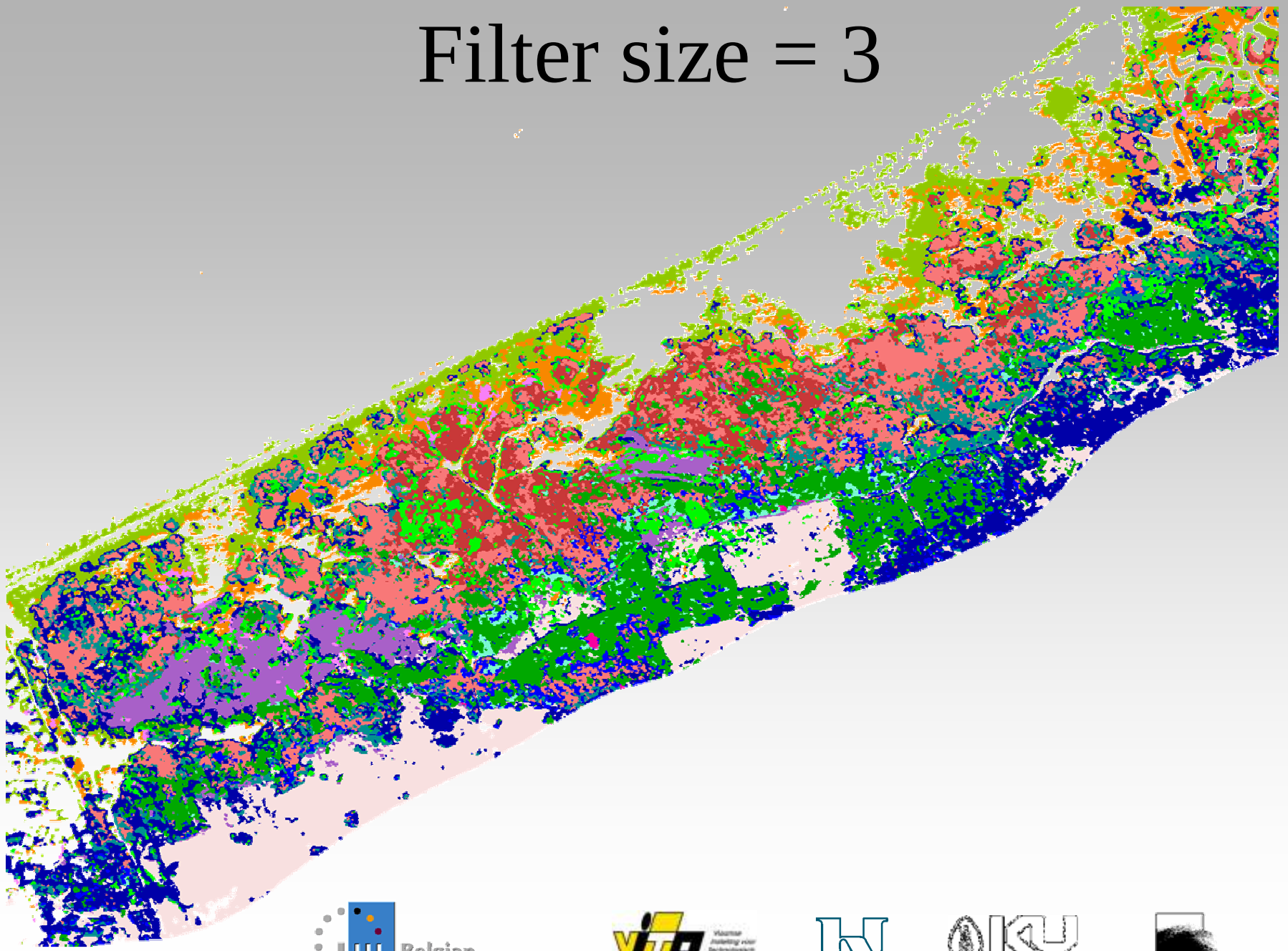
Filter size = 3



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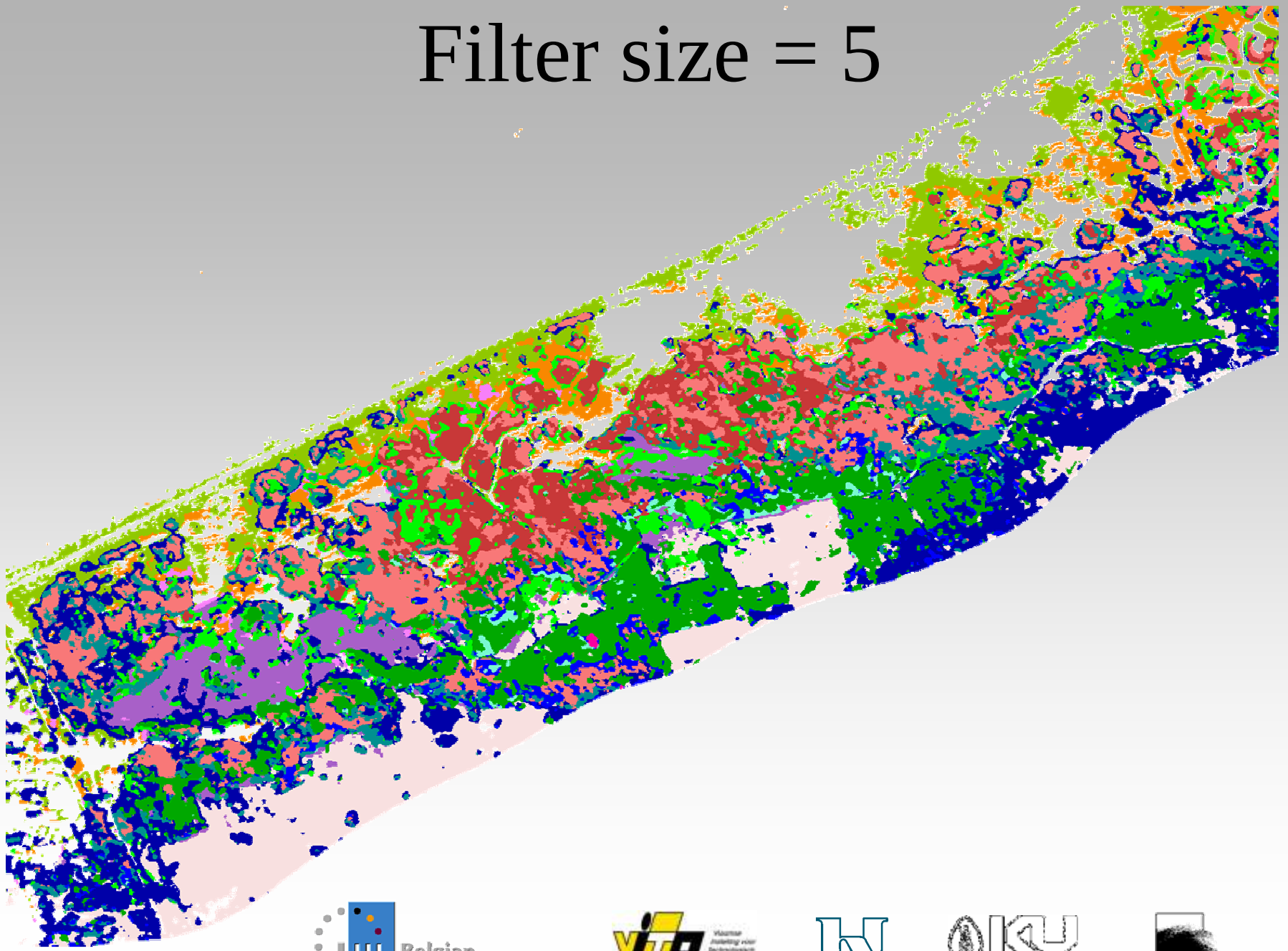
Filter size = 5



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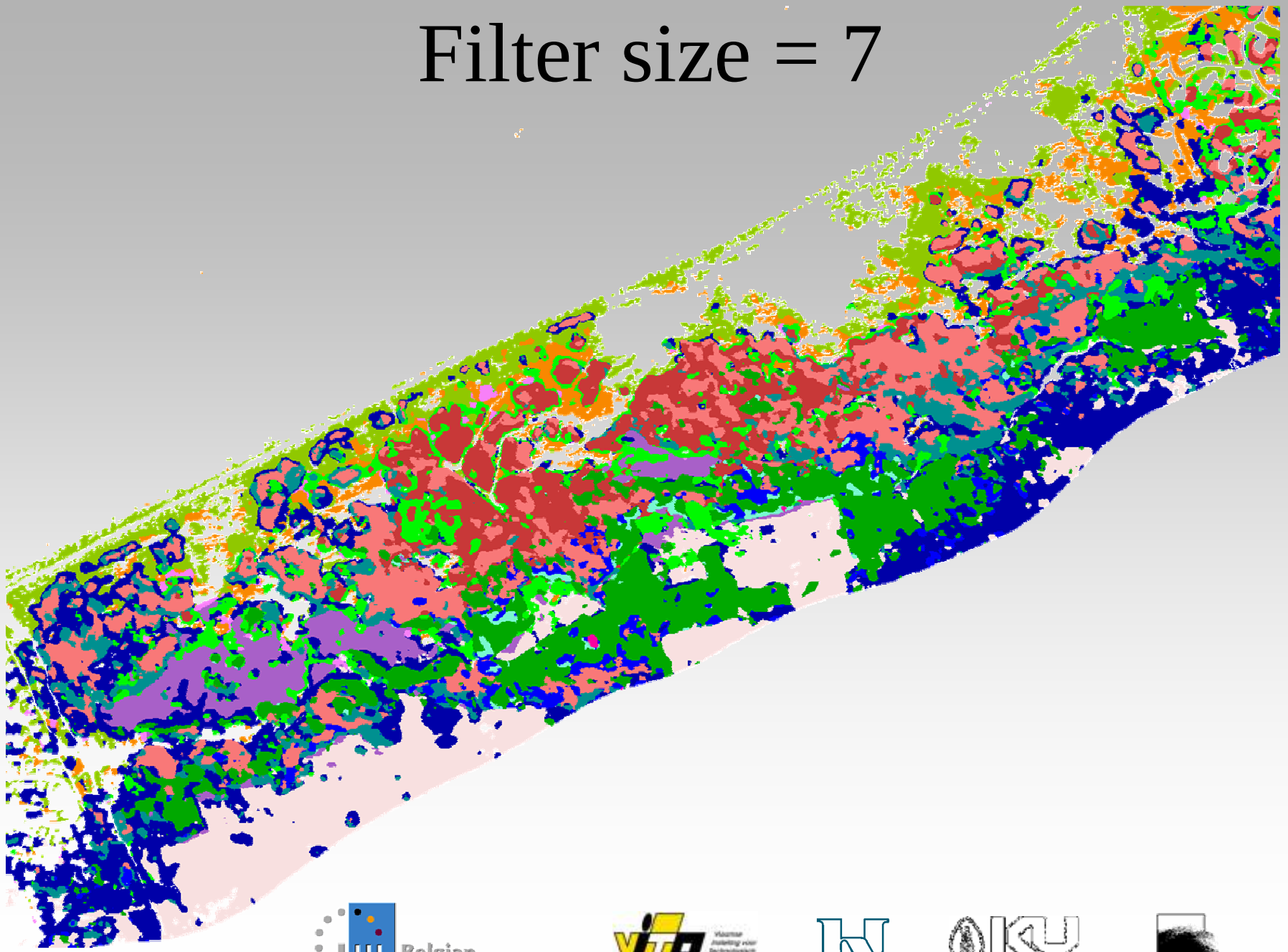
Filter size = 7



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To-do

- Land application
  - Classification of new data
  - Improvement of feature extraction and selection for optimal band settings
  - Validation
- Aquatic applications