Spatio-temporal deforestation monitoring using Sentinel-2, Landsat 7/8

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**PlanetLabs, Germany
***FAO, Forestry Department, Italy
**** ESA, Italy

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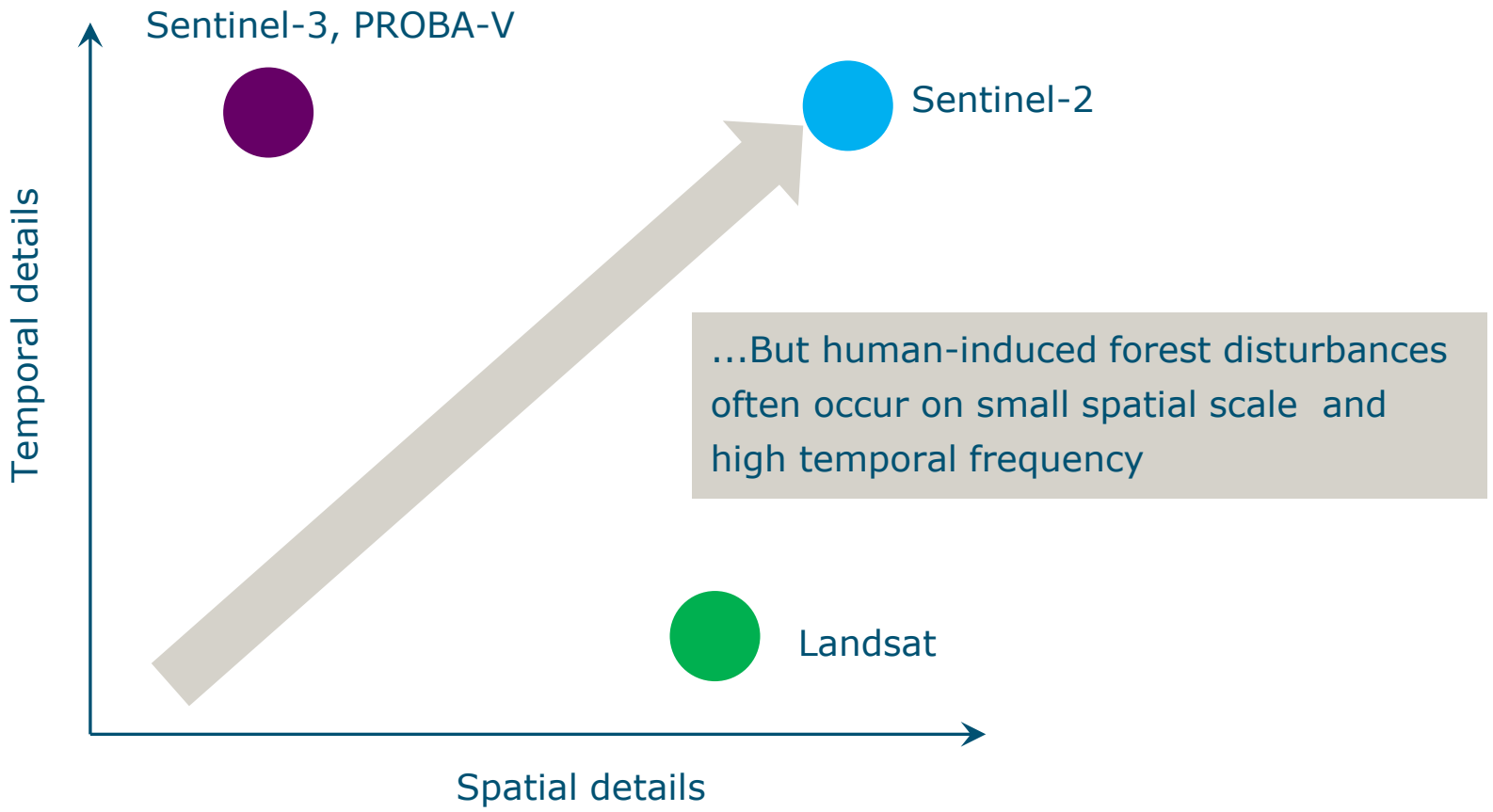
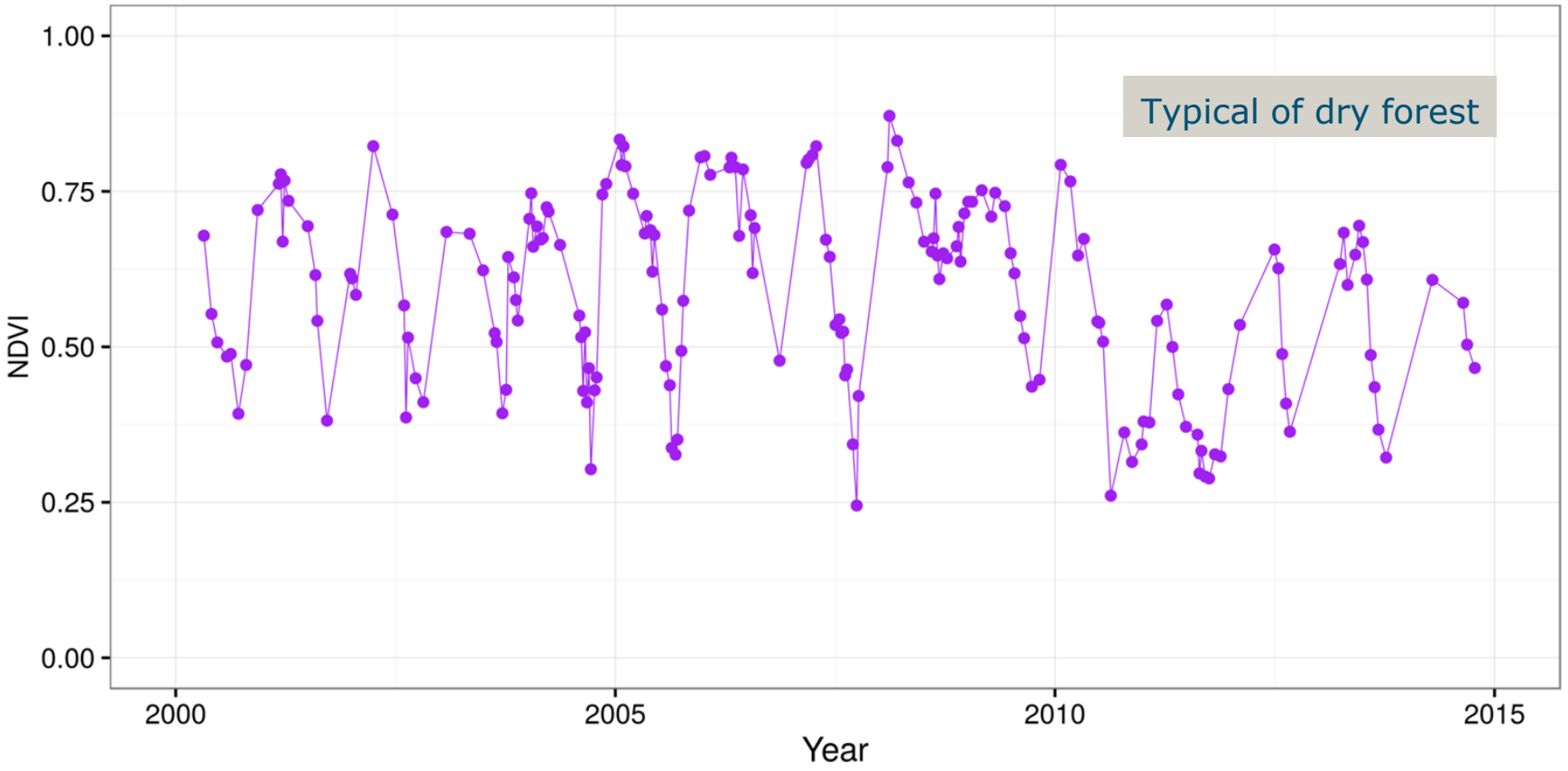
The bright side of remote sensing, Brussels, 2016

Forest cover change monitoring



Problem 1: Seasonality in irregular time series



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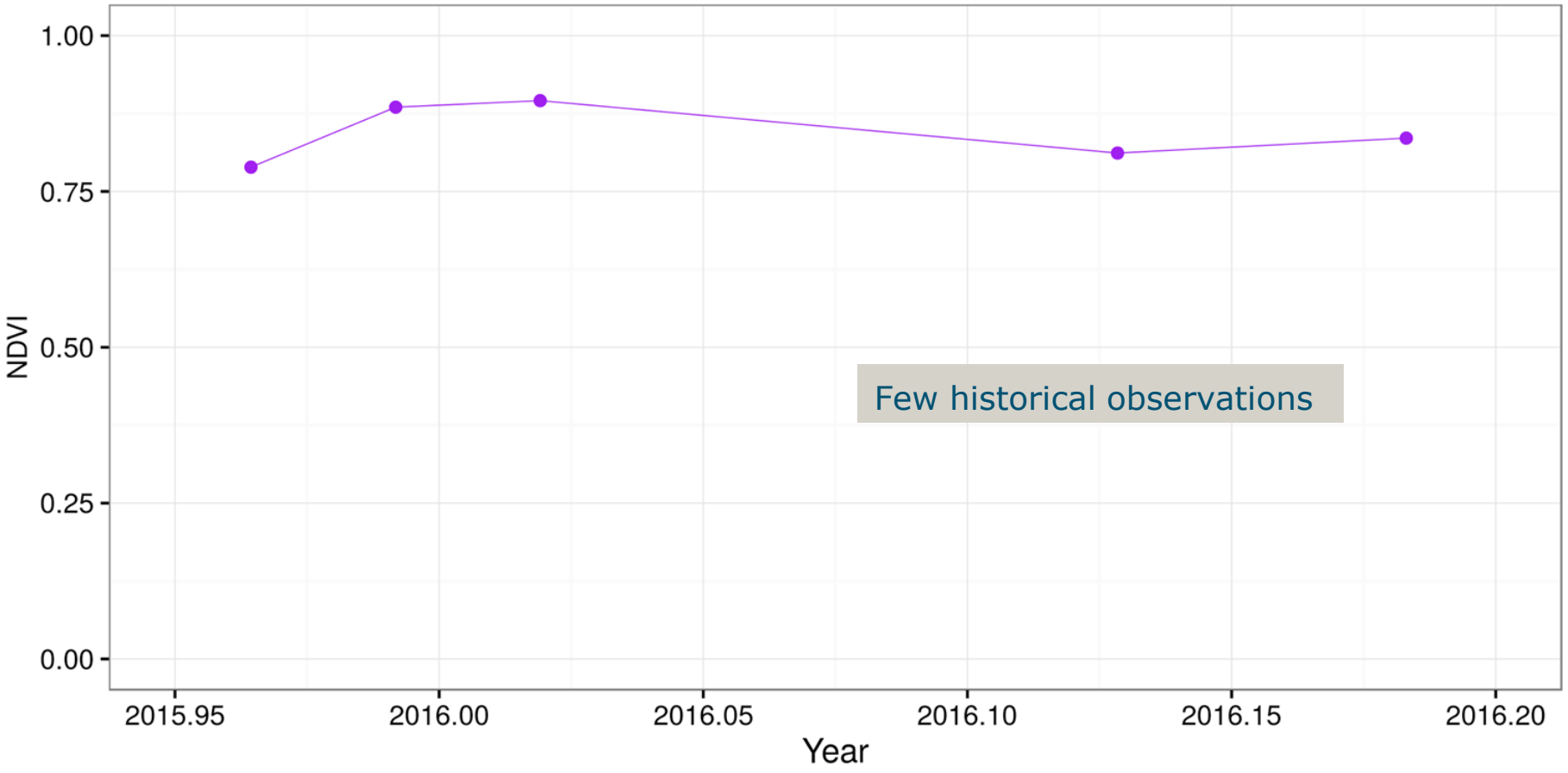
Problem 2: Short time series – example Sentinel-2



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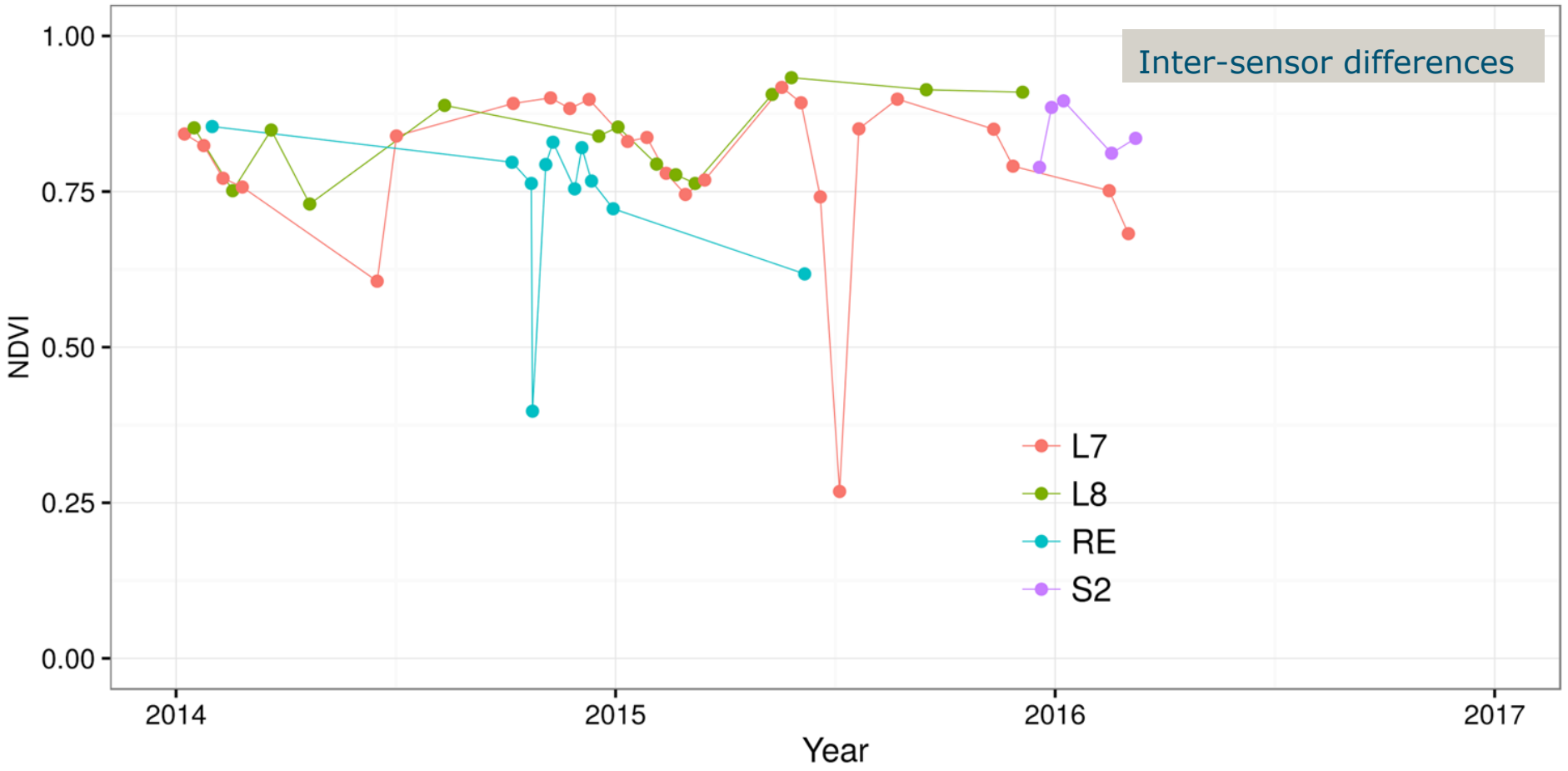
Problem 3: Multi-sensor differences in time series



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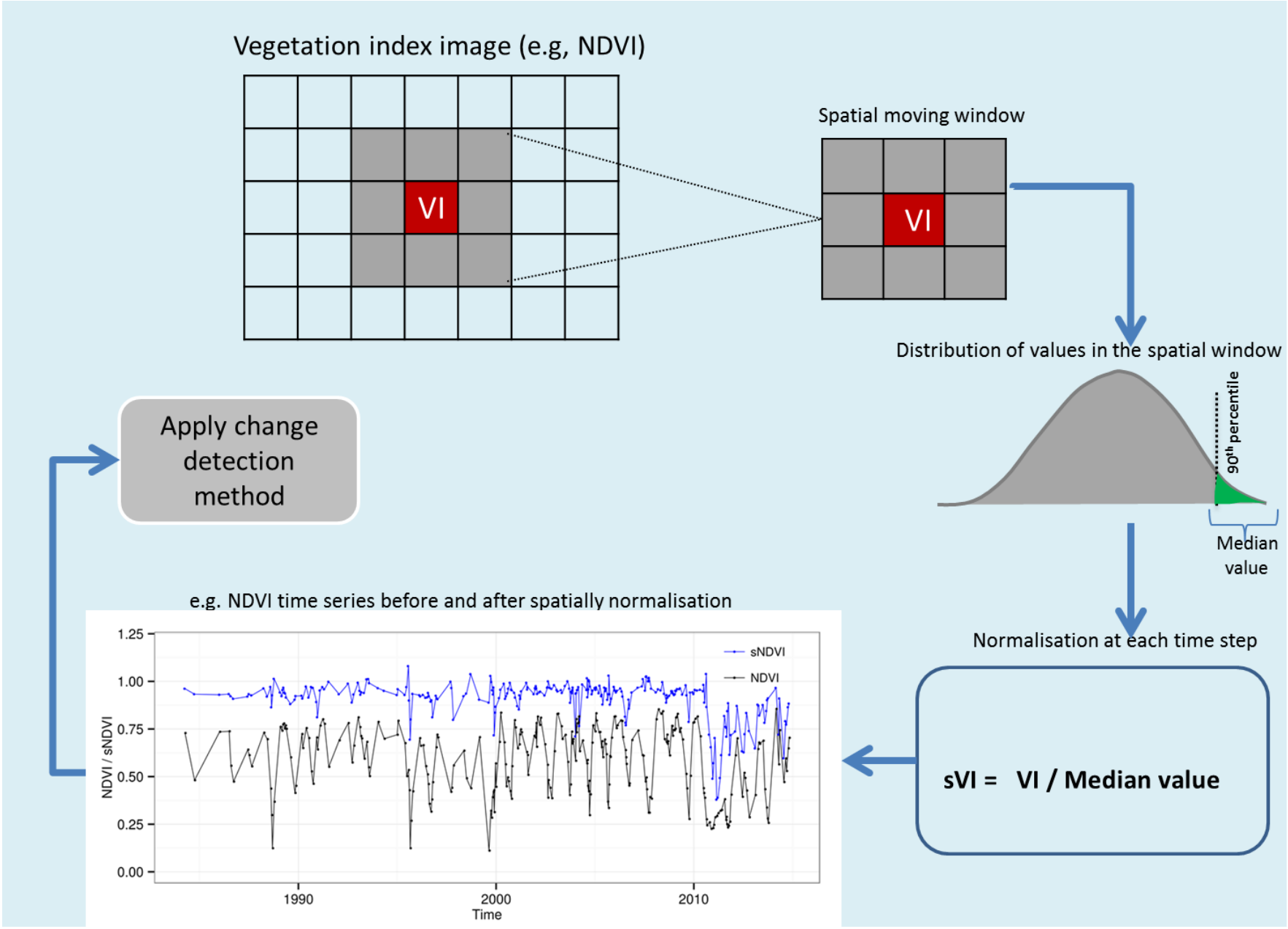
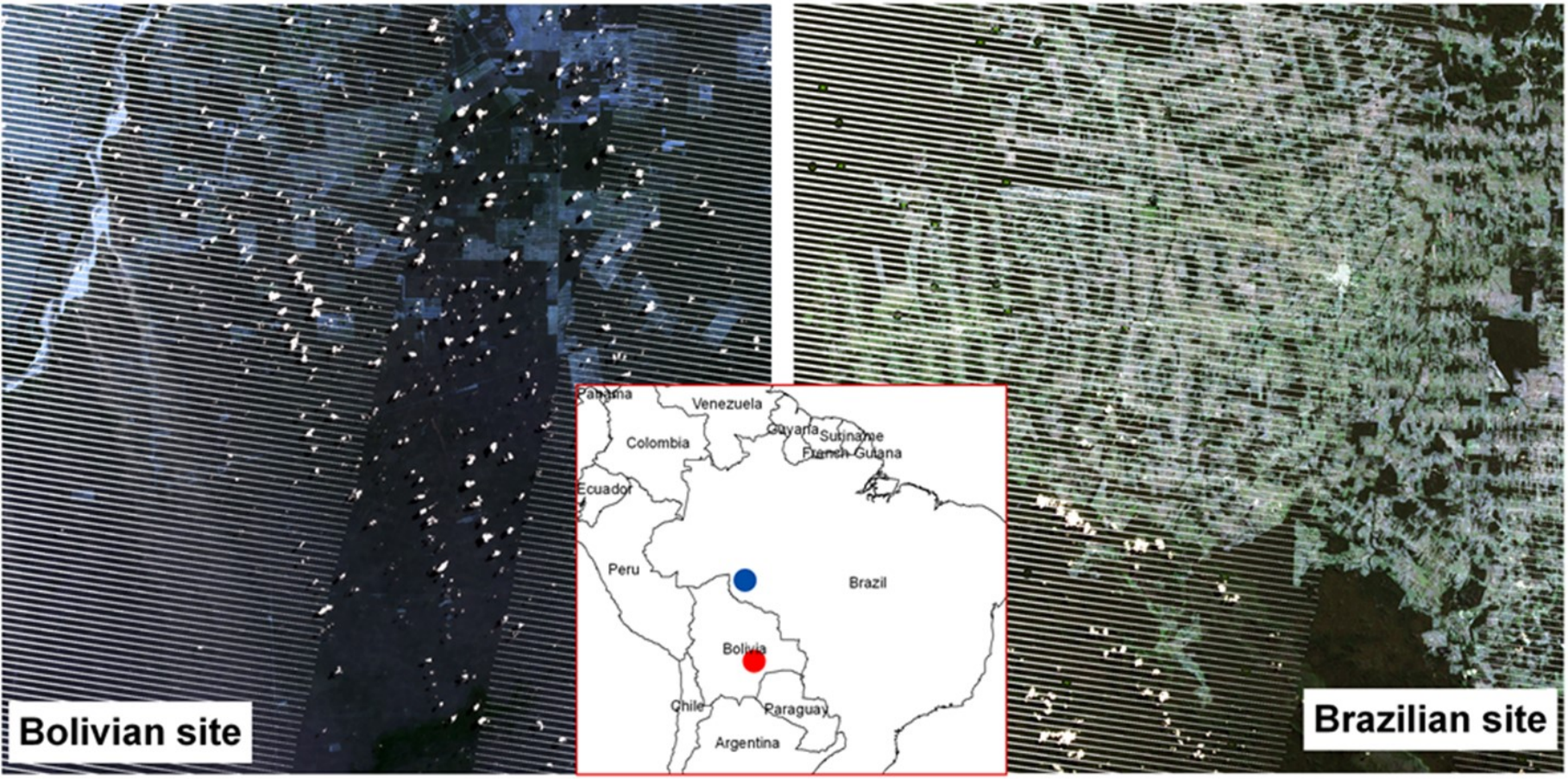
Tackling seasonality problem using spatial context



Spatial context - a case study

Dry forest

Humid forest



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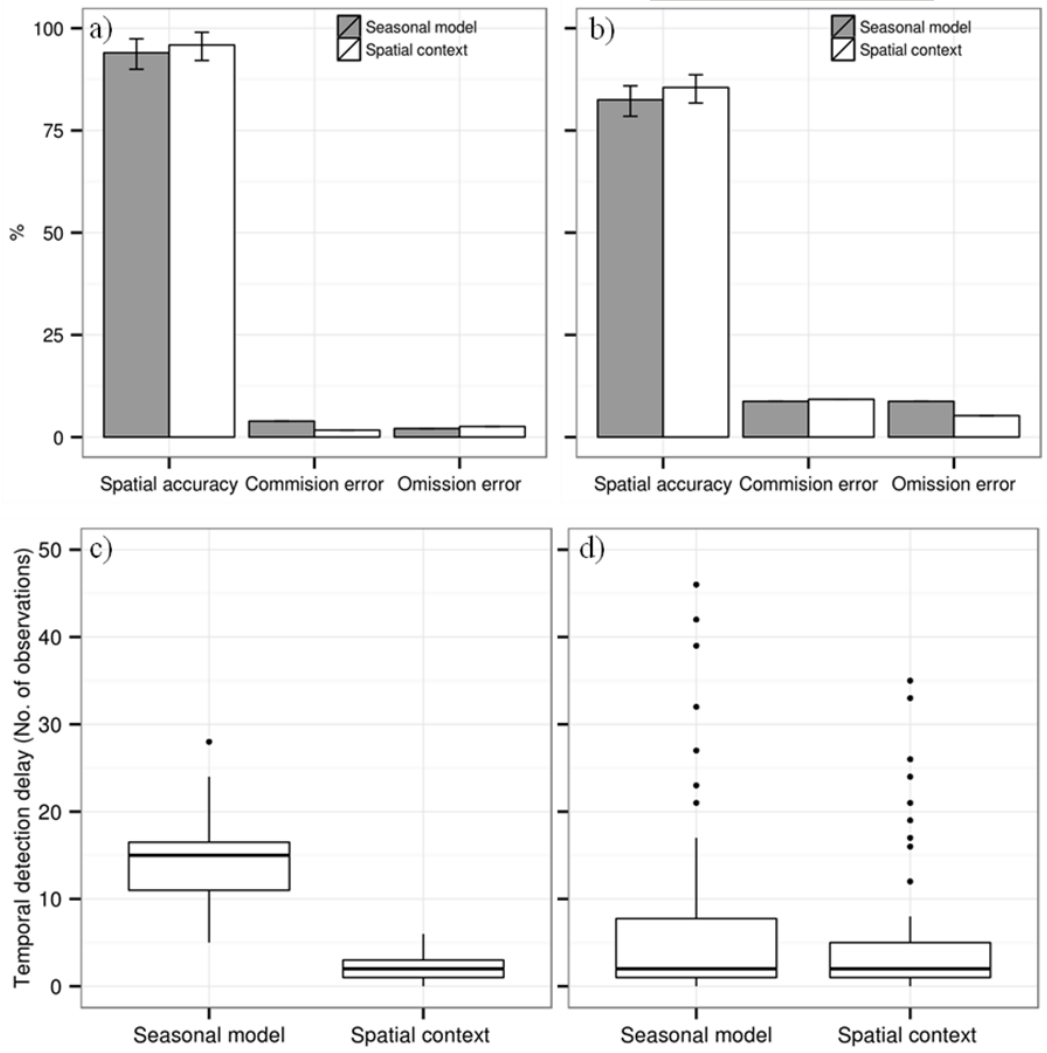
Method: BFAST (Verbesselt et al.2012)

Spatial context: spatial and temporal accuracy

Dry forest

Humid forest



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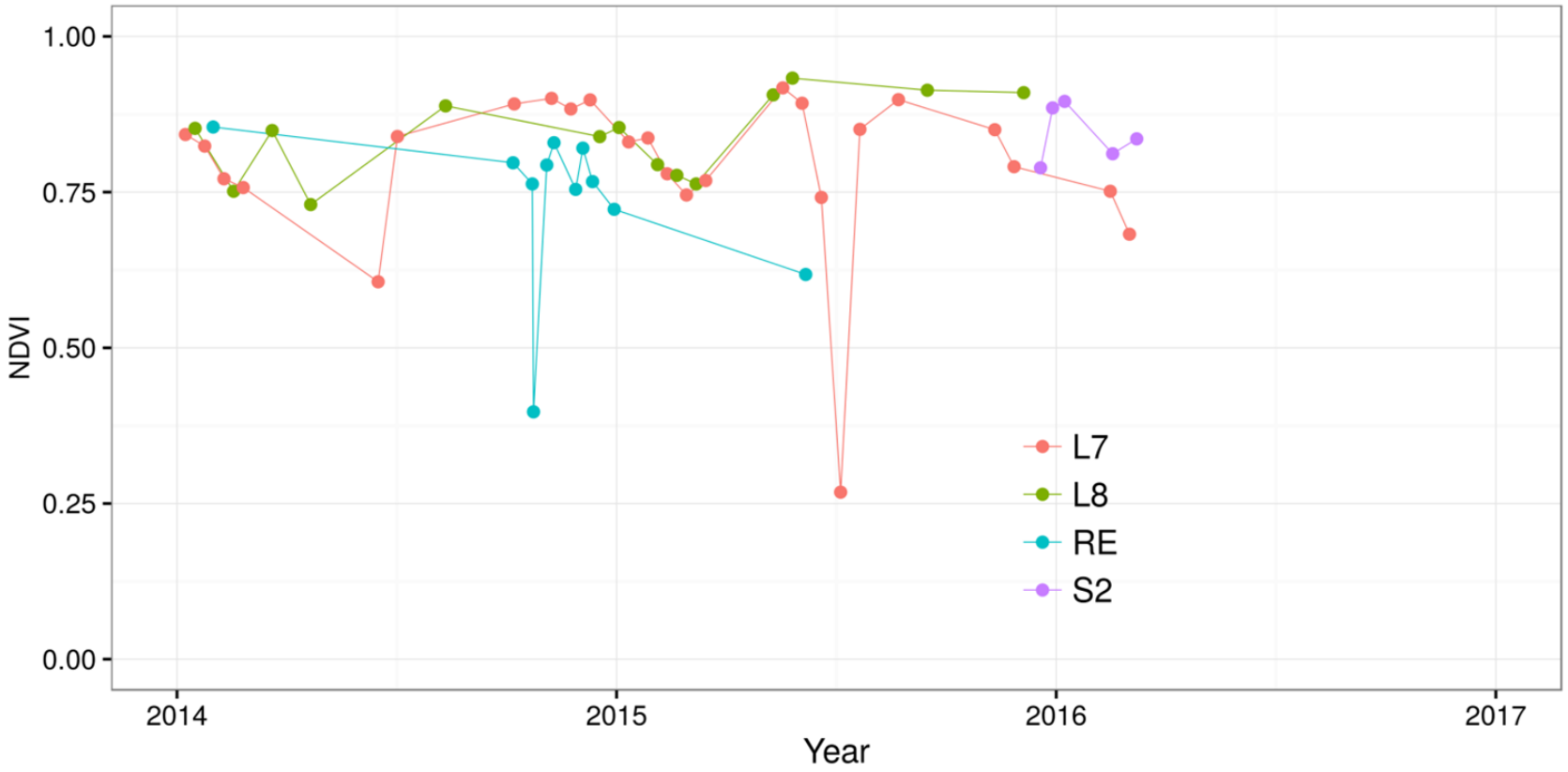
Hamunyela, E., et al. (2016), Remote Sensing of Environment

Dealing with inter-sensor differences



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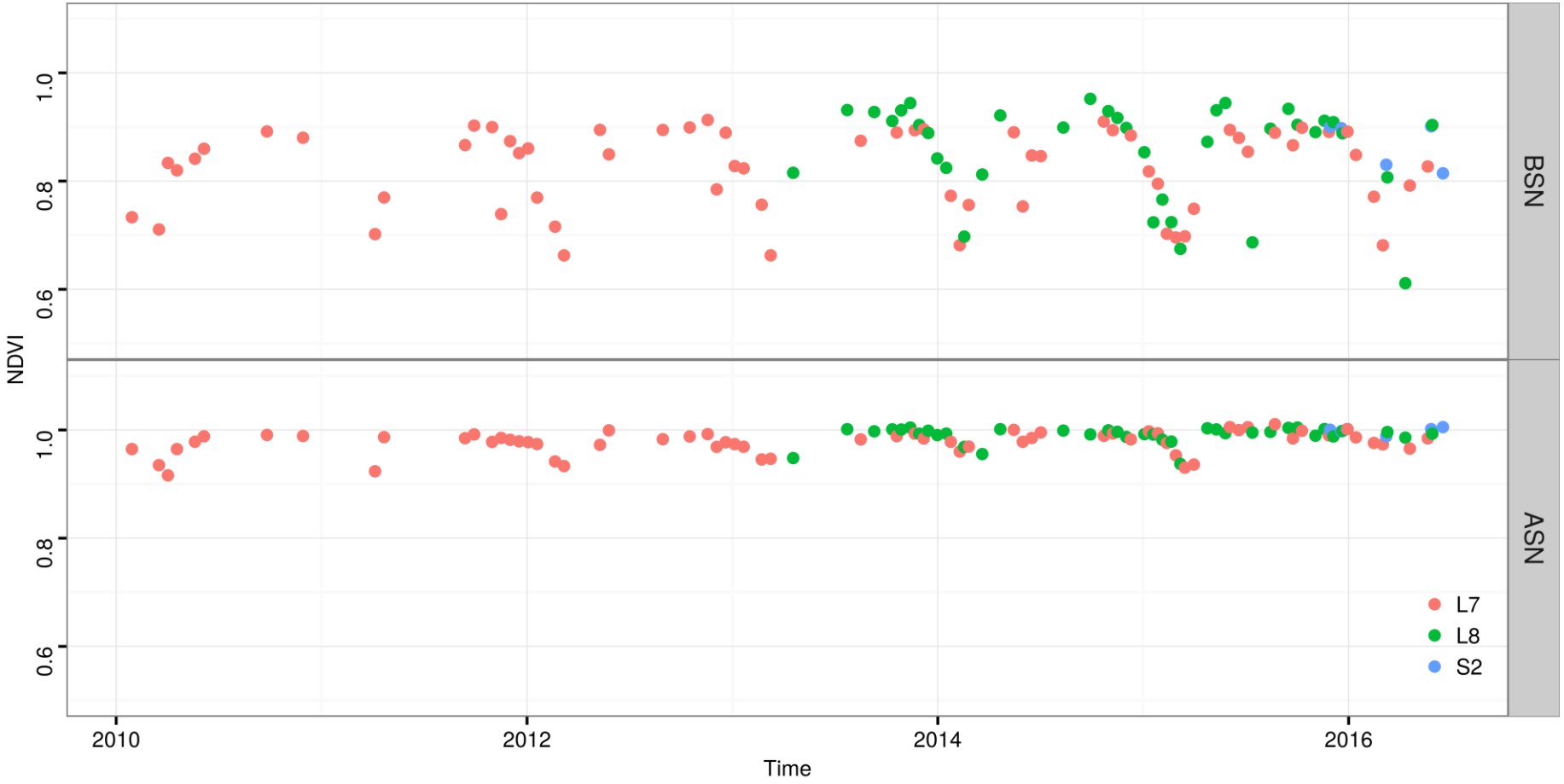
Inter-sensor differences: spatial normalization



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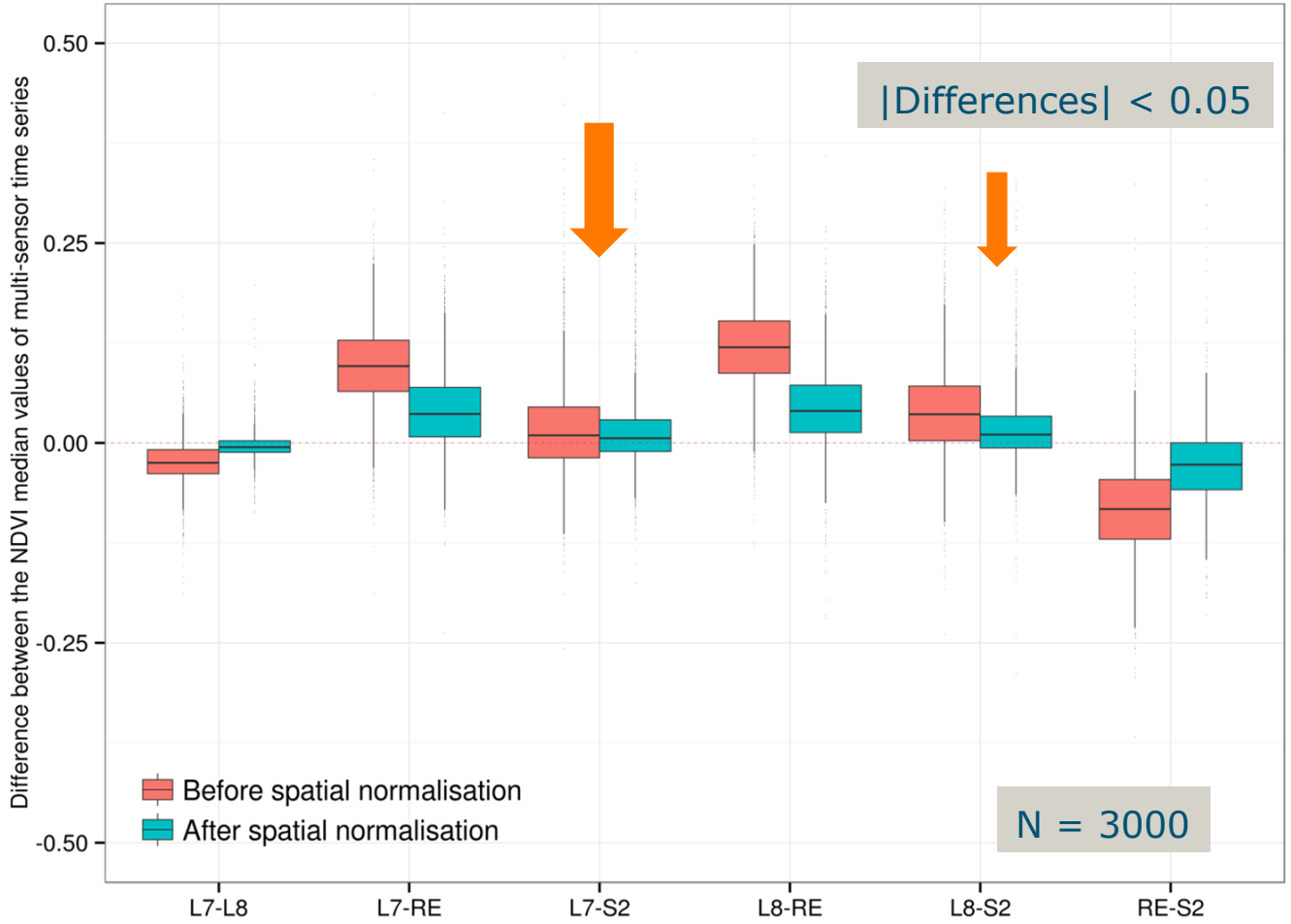
Spatial normalization for S2, Landsat, RE



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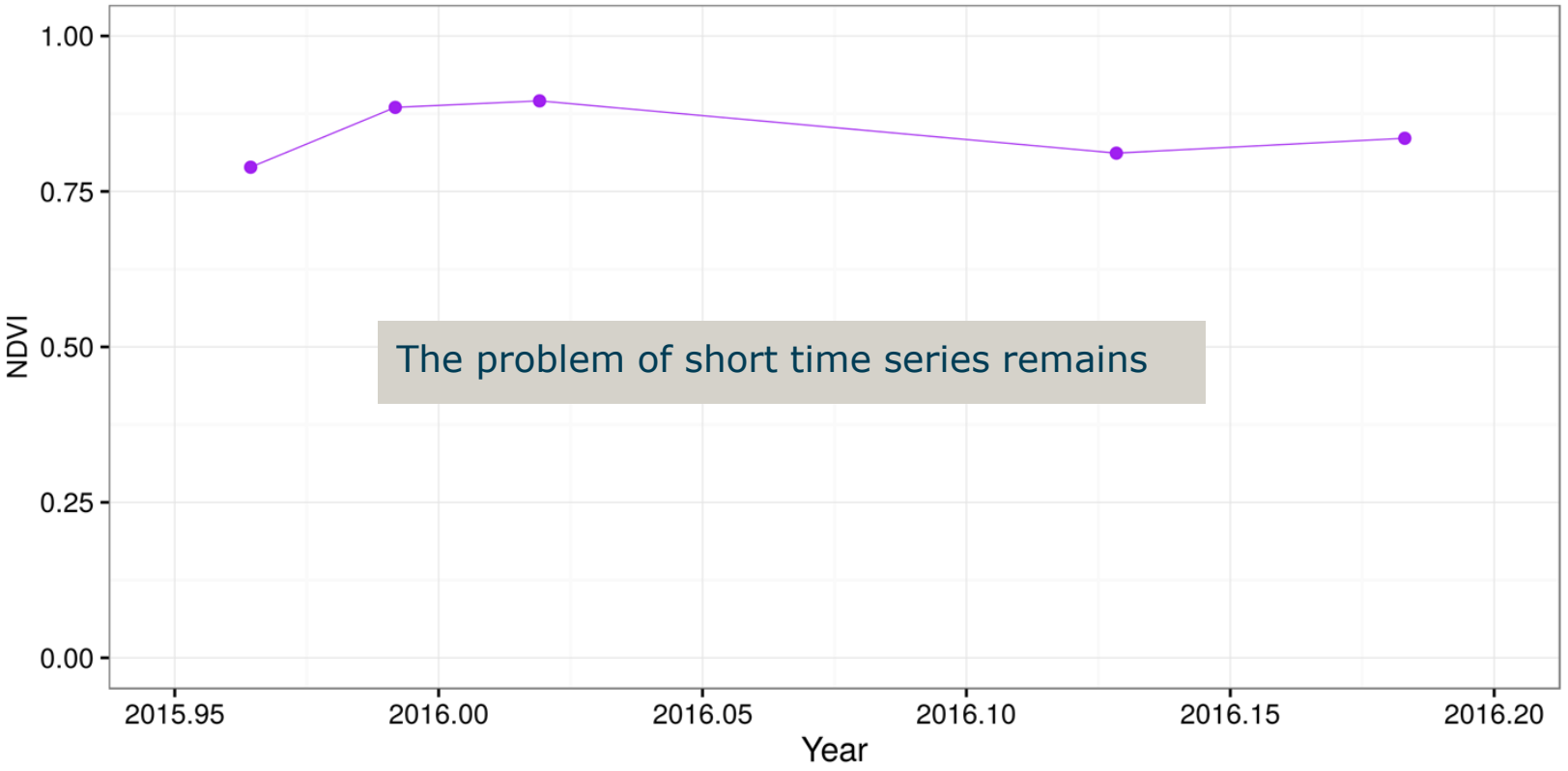
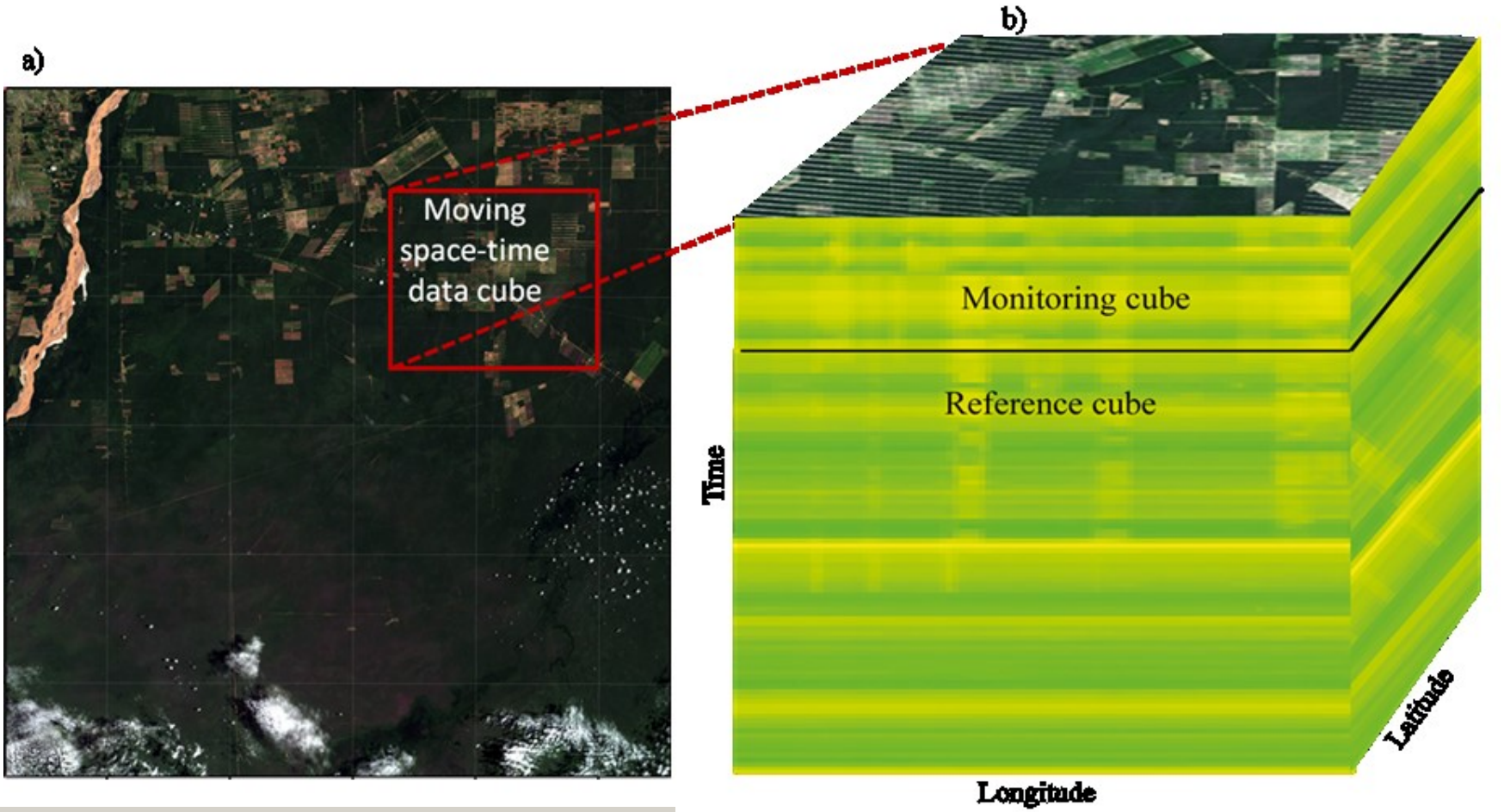
But...



The problem of short time series remains

Single pixel-time series analysis → Space-time change analysis

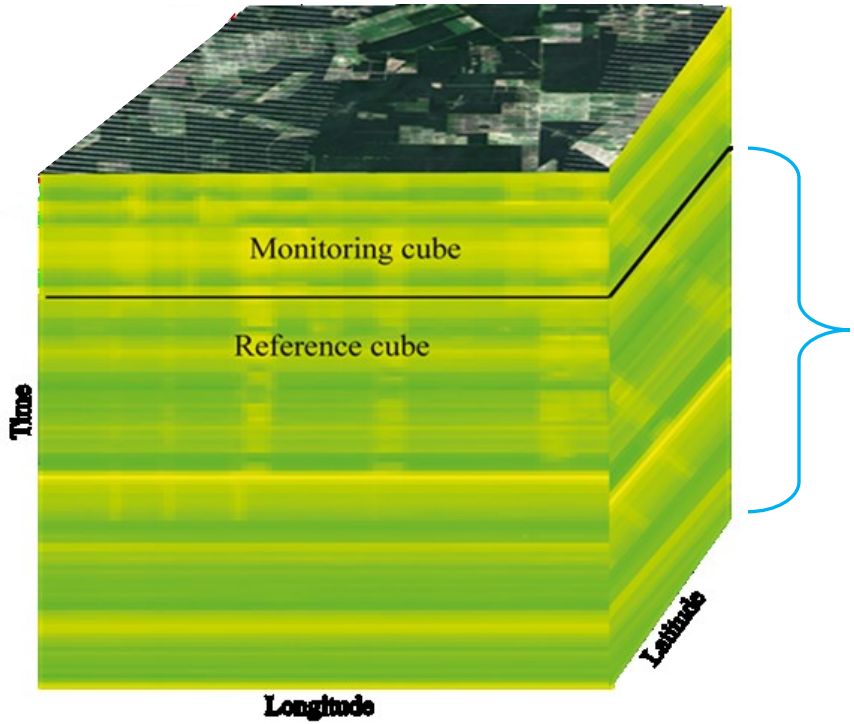
Space-time data cube –the concept



Hamunyela, E. et al. (2016), Remote Sensing

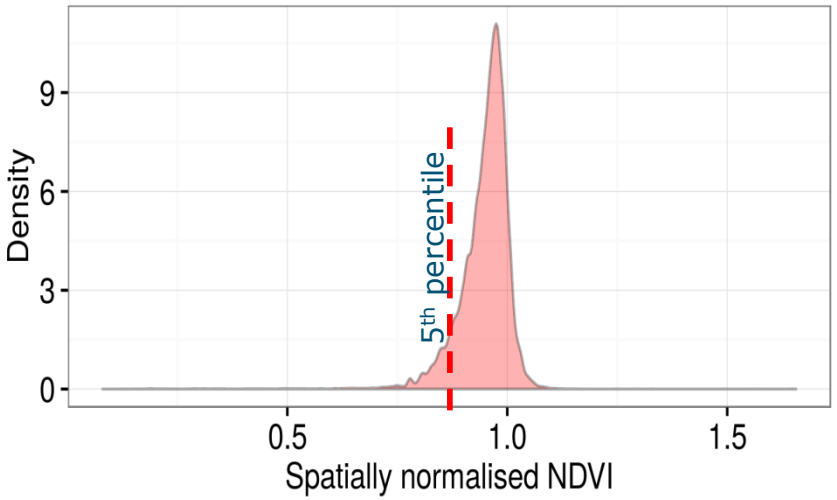
Threshold for forest change

Spatially moving data cube



Extreme value approach

Seneviratne et al. (2012)



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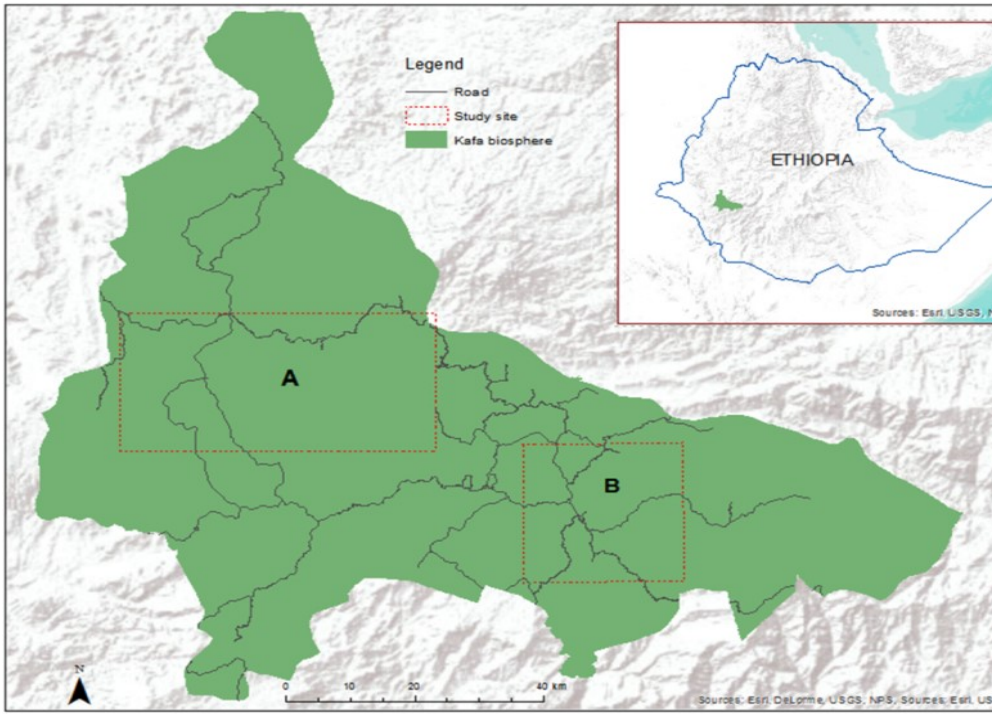
Using space-time data cube

Kafa biosphere, Ethiopia



- Tracking disturbance s that occurred between 2011 - 2016
- Reference period : 2008 – 2010
- 3 scenarios:
  - Landsat (L7+L8) only [**30 m**]
  - L7, L8, RE, S2 [**30m]**
  - L7, L8, RE in reference period, S2 in monitoring period [**10m**]

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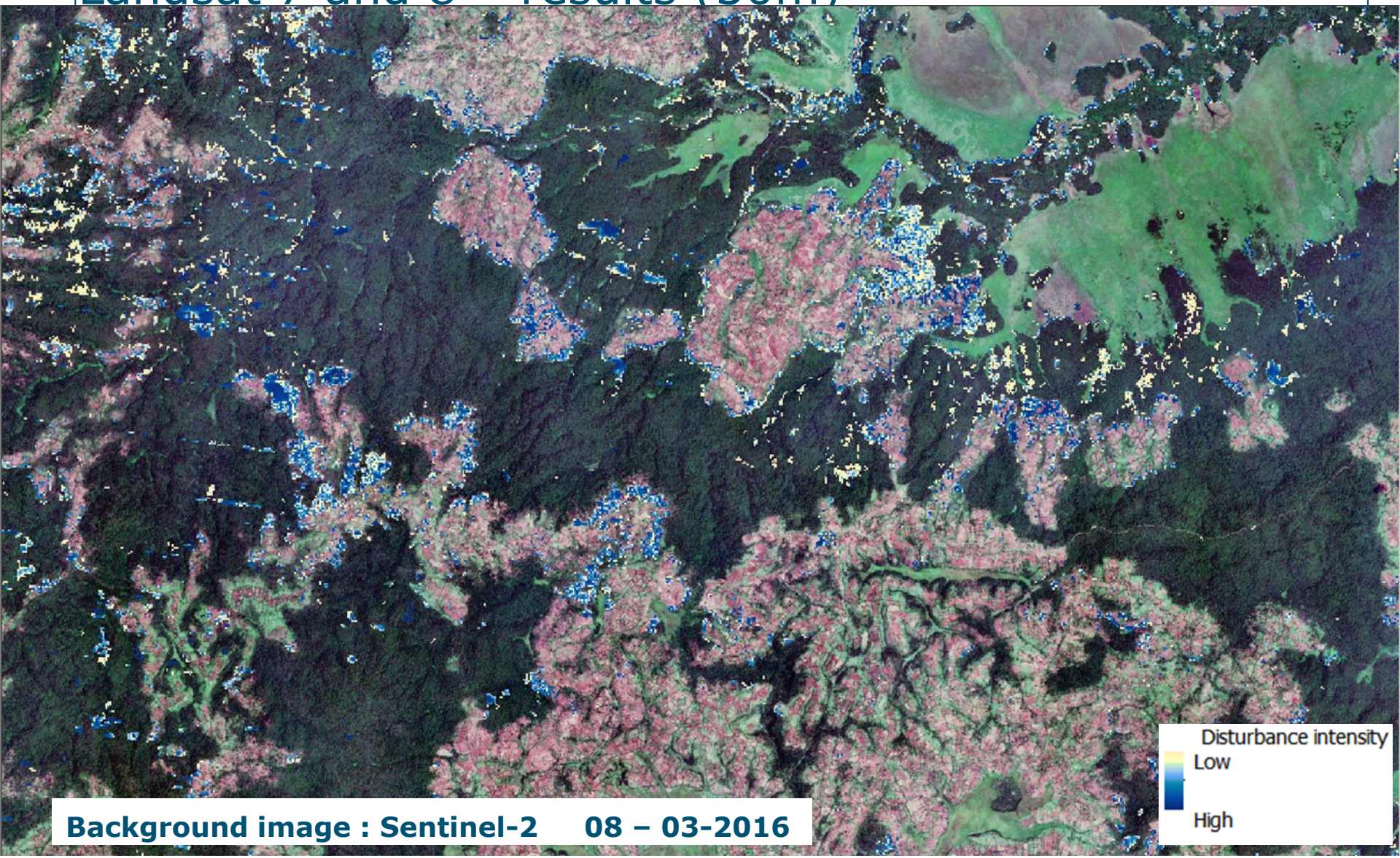
Landsat 7 and 8 – results (30m)



Background image : Sentinel-2 08 – 03-2016

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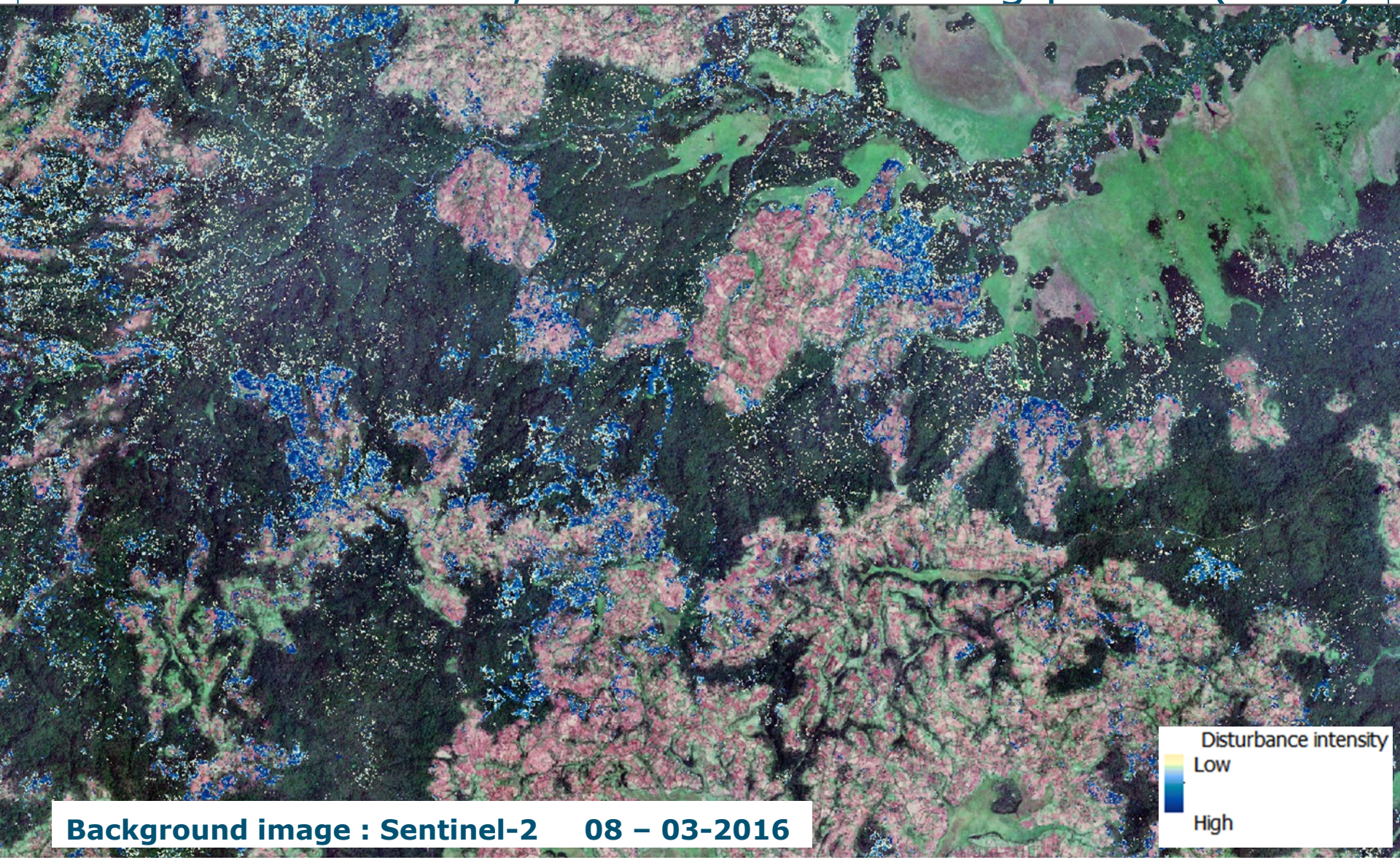
Landsat as reference, S2 in the monitoring period (10m)



Background image : Sentinel-2 08 – 03-2016

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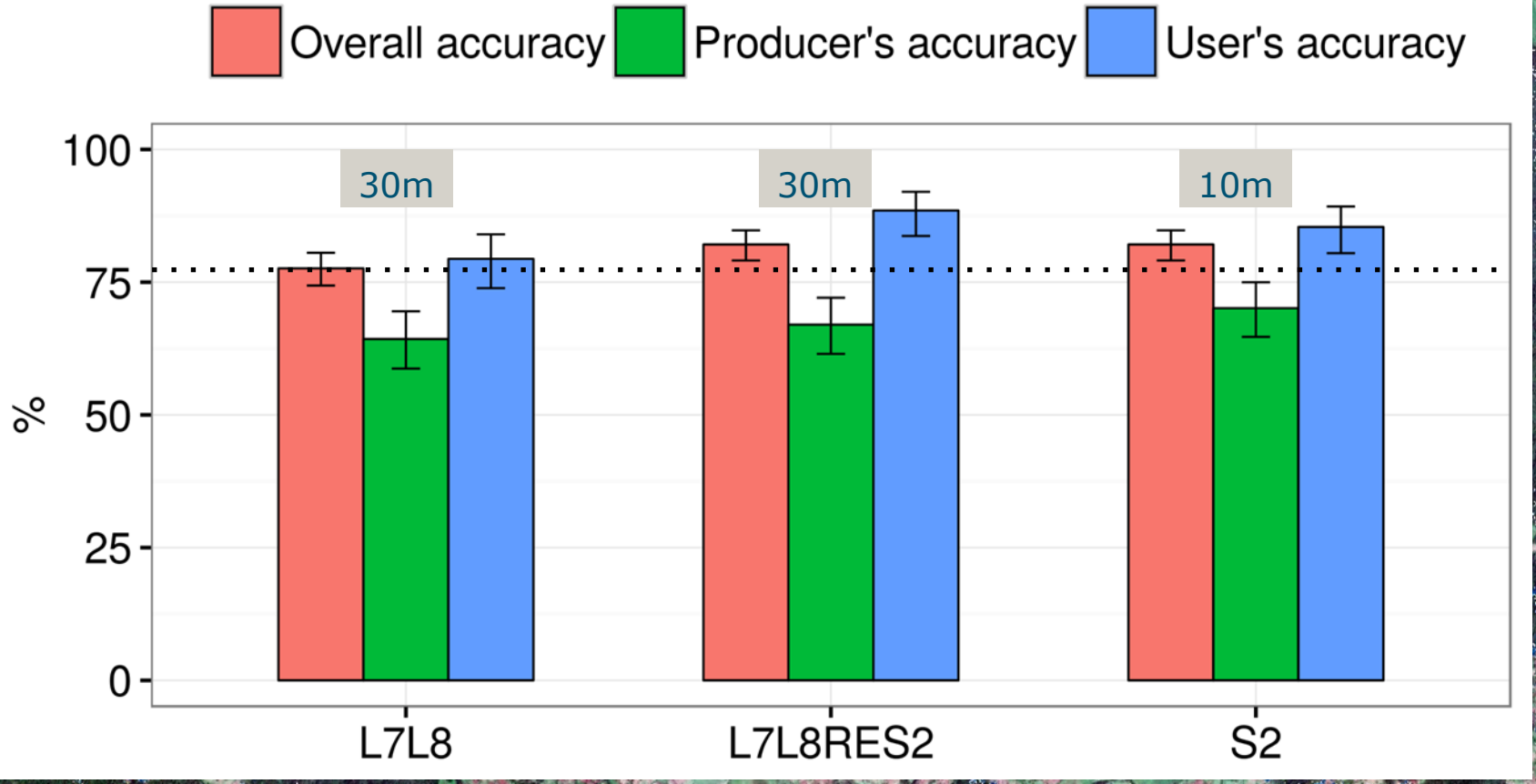
Spatial Accuracy



Take home

- Sentinel data
  - Near real-time forest cover change monitoring
- Multi-sensor & space time time algorithms are needed
  - Spatial normalisation
  - Fusion approaches (Reiche et al. 2016)

Acknowledgements

- FORMOSA, http://www.formosa.global/
- Contact details
  - Eliakim.hamunyela@wur.nl
  - Jan.Verbesselt@wur.nl

Open-source R packages and tutorials:

- **Bfast: http://bfast.r-forge.r-project.org/**
- **bfastSpatial: http://github.com/dutri001/bfastSpatial**
- **timeSyncR: https://github.com/bendv/timeSyncR** (Cohen et al., 2010, RSE).
- **MulTiFuse: https://github.com/jreiche/multifuse** (Reiche et al. 2015)
- **S2utils:** https://github.com/bbrede/S2utils