Using RapidEye imagery and the RandomForest algorithm for spatial modeling of Leaf Area Index values – Methodological Considerations and a Case Study from tropical China

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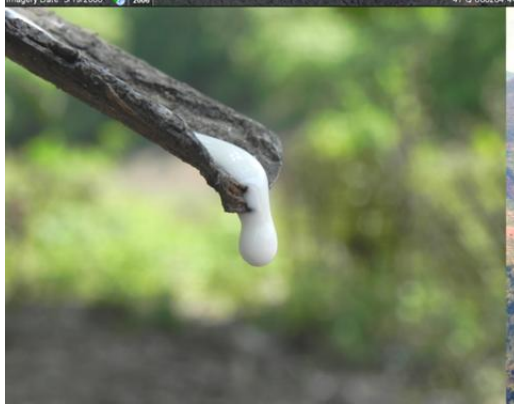
TRANSFORMING LIVES AND LANDSCAPES

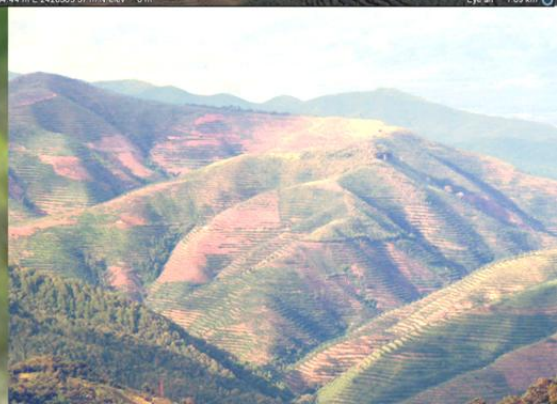
The Upper Mekong Region

Rubber (*Hevea brasiliensis*)

- Rubber covers more than 1.000.000 ha in mainland South East Asia
- Rubber plantation area is predicted to quadruple by 2050
- **Rubber replaces**
  - **lowland tropical rainforests and**
  - **secondary vegetation following swidden cultivation**

(Fox et al. 2012)





Why Leaf Area Index (LAI)?

LAI indicates

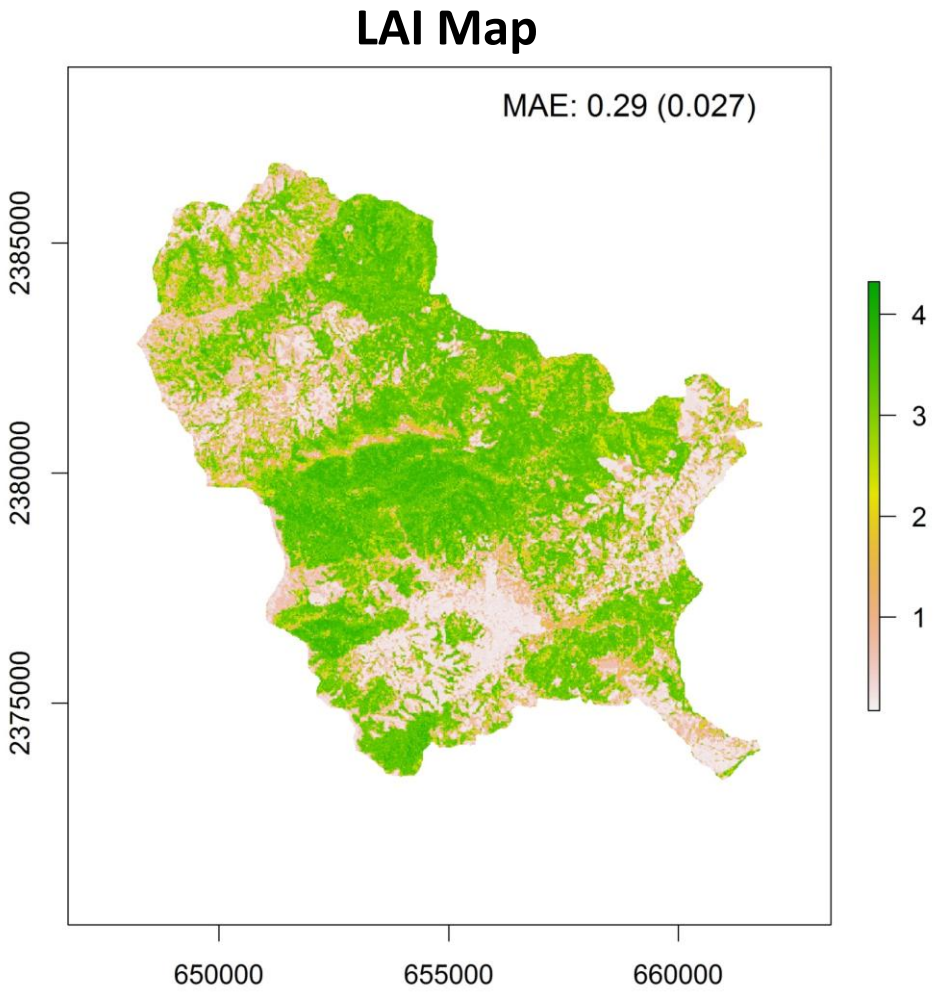
- vegetation productivity
- evapotranspiration
- surface energy balance

(Tang et al. 2012)

LAI is required by process models describing energy exchange in the biosphere/ atmosphere system.

(Baret and Buis 2008)

LAI maps can reveal ecosystem disturbance.



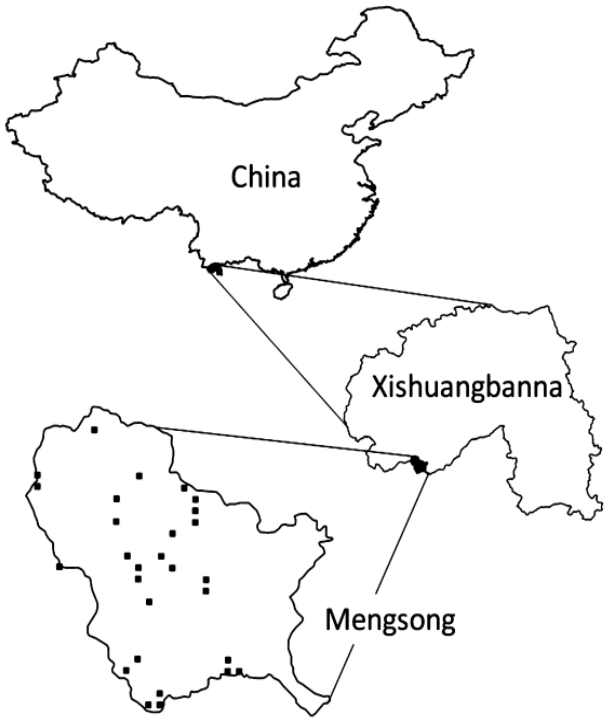
Research Questions

- Is RapidEye imagery suitable for LAI mapping in forested areas?
- Does image texture increase accuracy of LAI maps?
- How are the uncertainties associated to such a map best described and quantified?

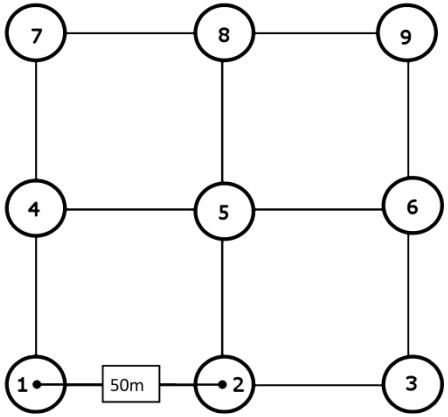
Field Data

28 sample plots each consisting of 9 subplots (total: 252 subplots)

LAI assessed on each subplot with hemispherical photography

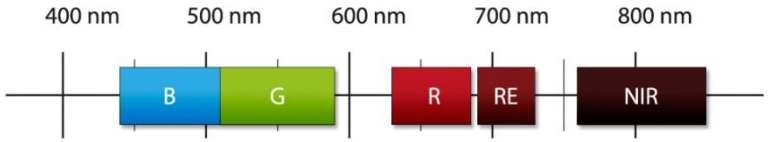


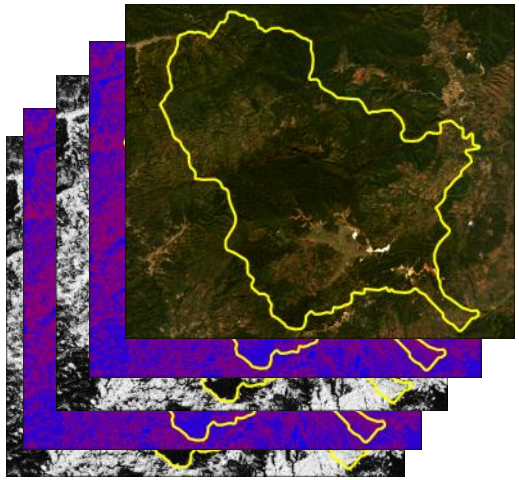
Hemispherical photograph



Plot design

Remote Sensing Data



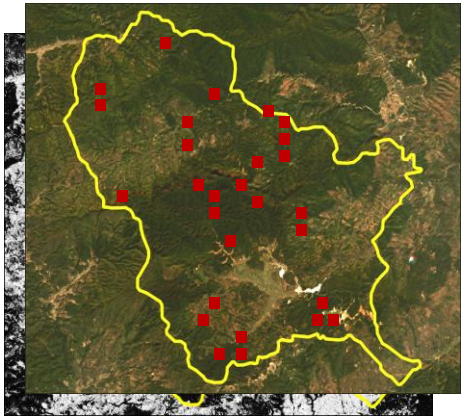


- RapidEye
  - 5 spectral bands / 5 m pixel size
- 6 Vegetation indices (VI)
- 16 Texture indices (TX)
  - Calculated for NIR band
  - Occurrence (3), Co-occurrence (9), surface roughness (2)
  - Calculated for moving windows of 15, 25 and 35 m side length

➢ **59 image bands → 59 predictor variables**

RapidEye
Delivering the World

LAI Mapping



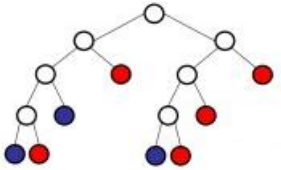
RapidEye image
+ vegetation indices
+ texture features

Hemispherical photos

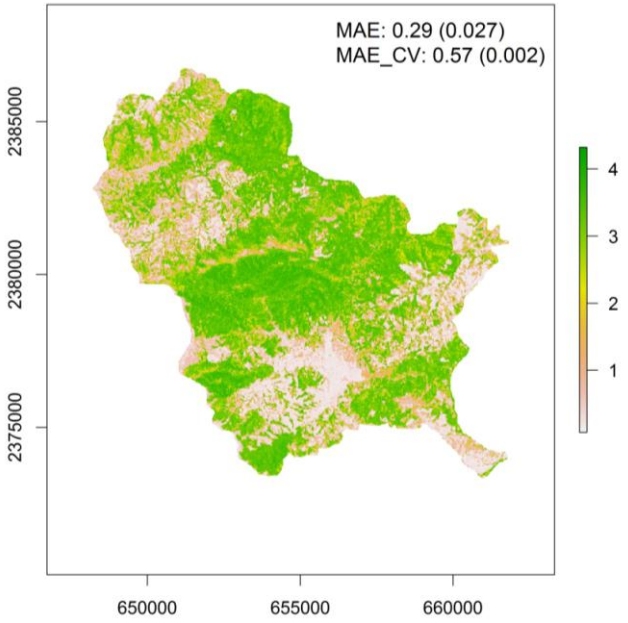
Pixel values

LAI

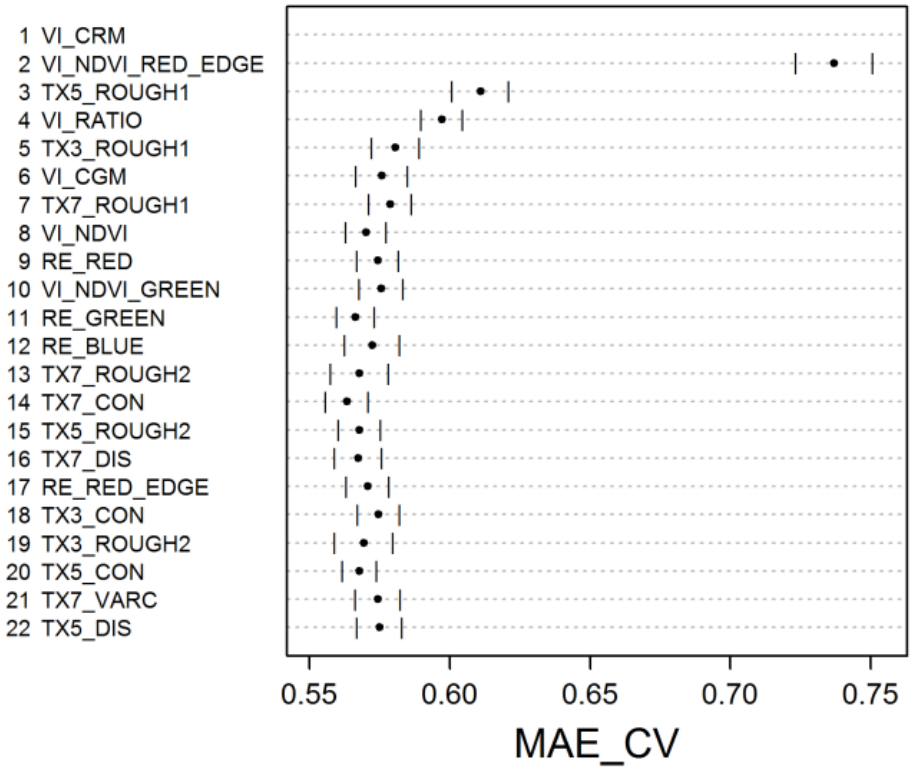
Random Forest

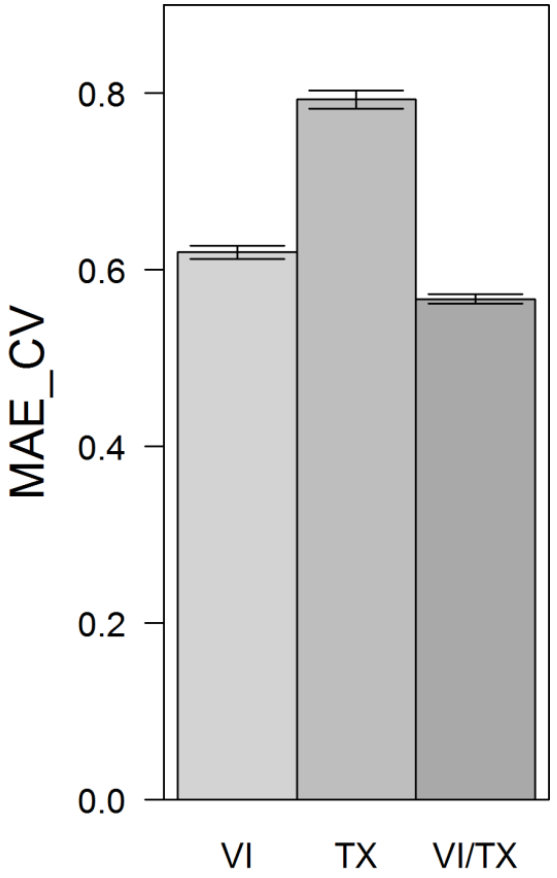


LAI Map



Feature Selection



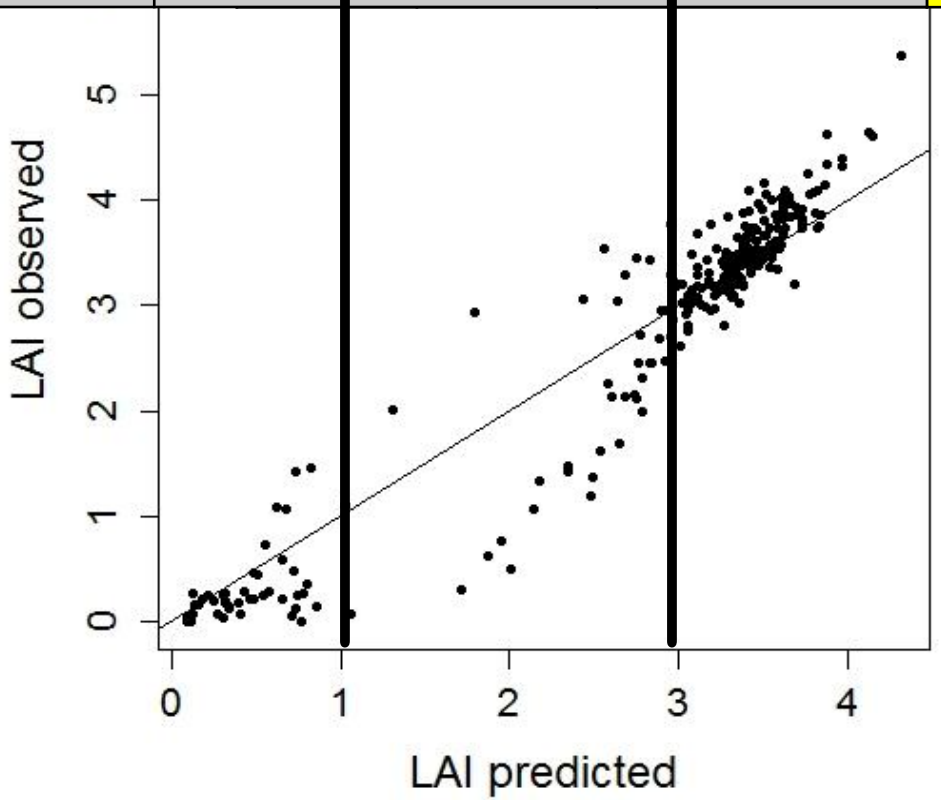


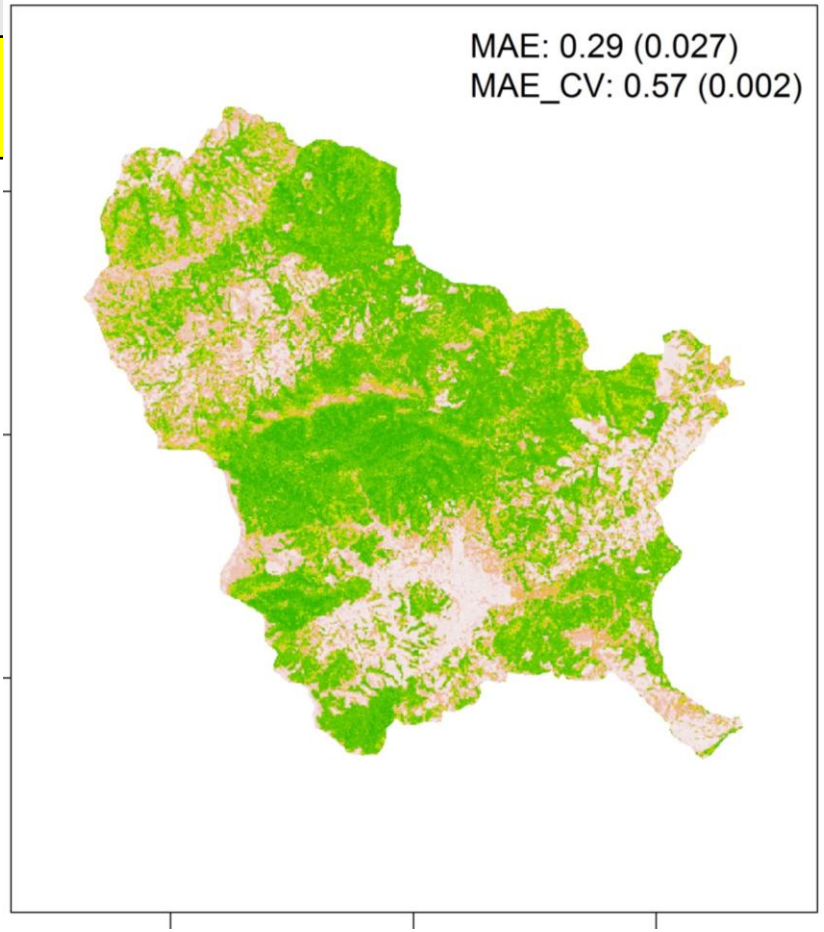
22 out of 59 image bands were relevant for LAI mapping

- Vegetation indices
- RapidEye bands
- Texture features (roughness and co-occurrence)

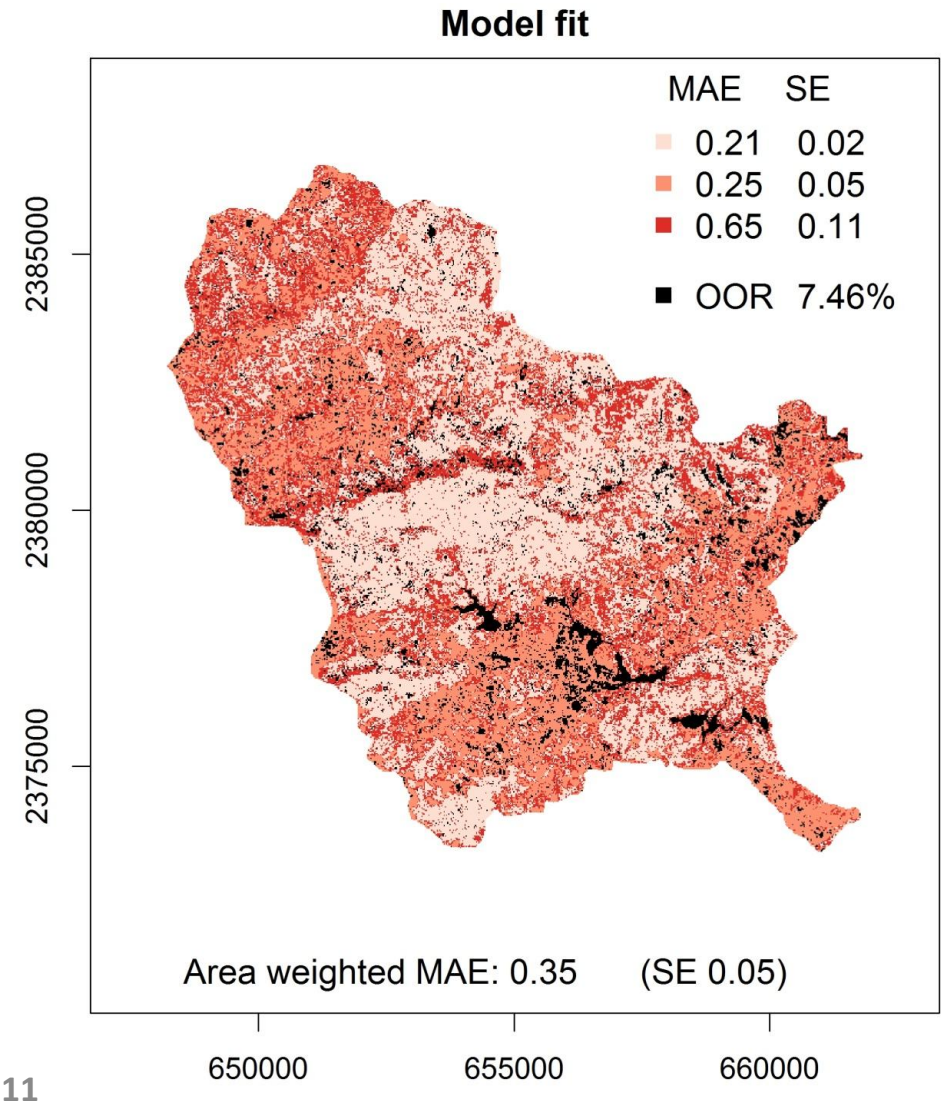
Map Uncertainty

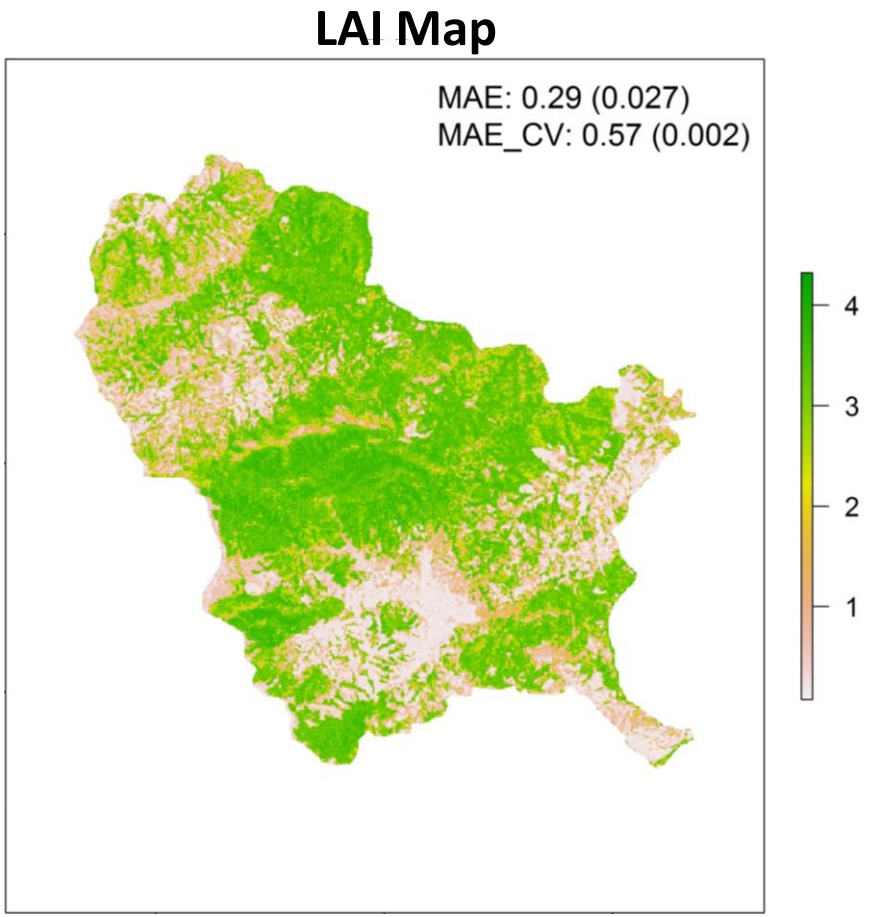
	LAI < 1	LAI 1 – 2	LAI > 3	Sum
MAE	0.25	0.65	0.21	-
Weight	0.27	0.29	0.44	1
MAE* Weight	0.07	0.19	0.09	





Uncertainty Map





→ **Model fit as a proxy for map uncertainty**

Thank you for your attention!

References

Baret F, Buis S. 2008. Estimating canopy characteristics from remote sensing observations: review of methods and associated problems. In: “Advances in Land Remote Sensing: System, Modelling, Inversion and Application” (Liang S ed). Springer, New York, USA, pp. 173-201.

Tang H, Dubayah R, Swatantran A, Hofton M, Sheldon S, Clark DB, Blair B. 2012. Retrieval of vertical LAI profiles over tropical rain forests using waveform LIDAR at La Selva, Costa Rica. Remote Sensing of Environment 124, 242–250.

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