Kombination spektraler & räumlicher Information

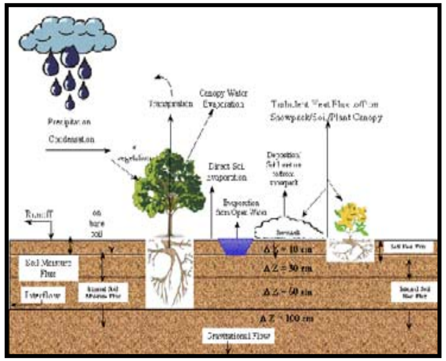
zur fernerkundlichen Erfassung von Vegetationsparametern

Clement Atzberger (BOKU – Wien)

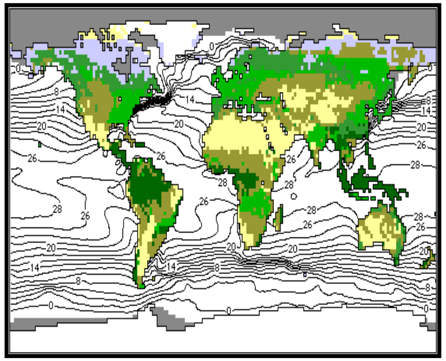
OVG, Velden 08 05 2012

Biophysikalische Größen: LAI ...

Hydrology

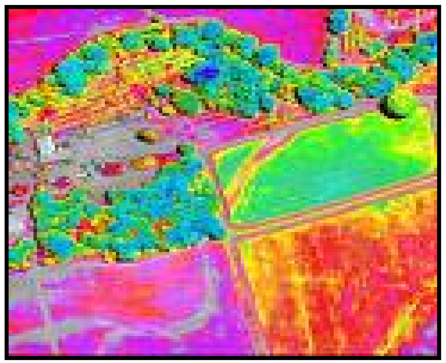


Climatology

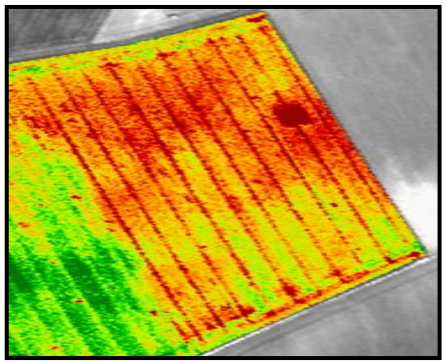


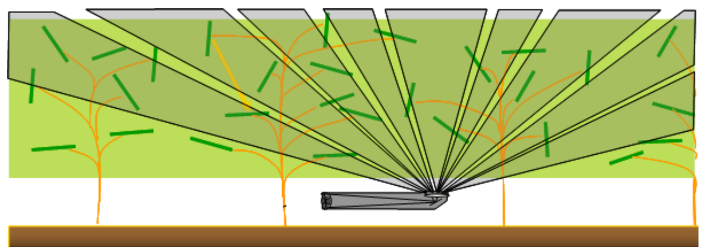
Anwendungsbeispiele Blattflächenindex (LAI)

Ecology



Precision Agriculture





Hintergrund

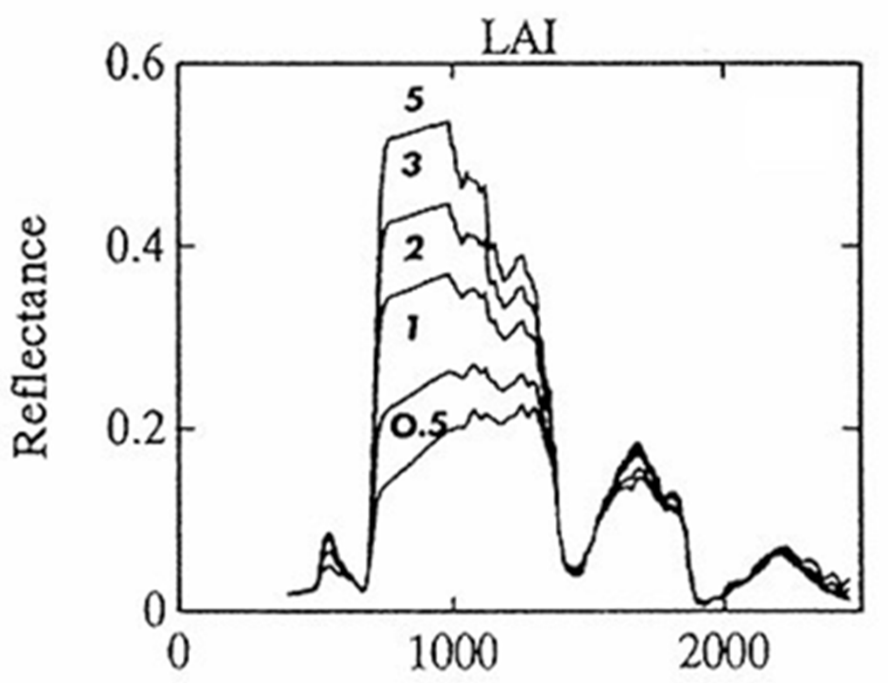
Vernachlässigung von Nachbarschaftsbeziehungen

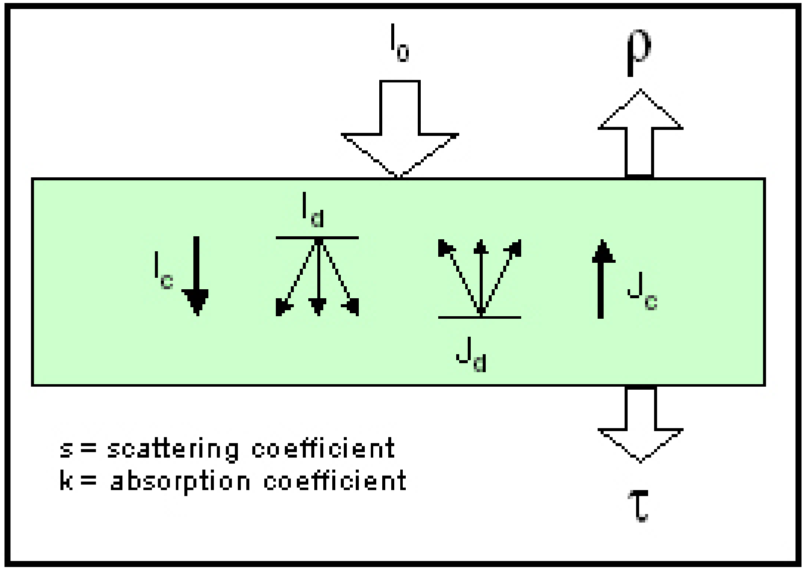
Fernerkundung
RTM inversion: LAI-Schätzung

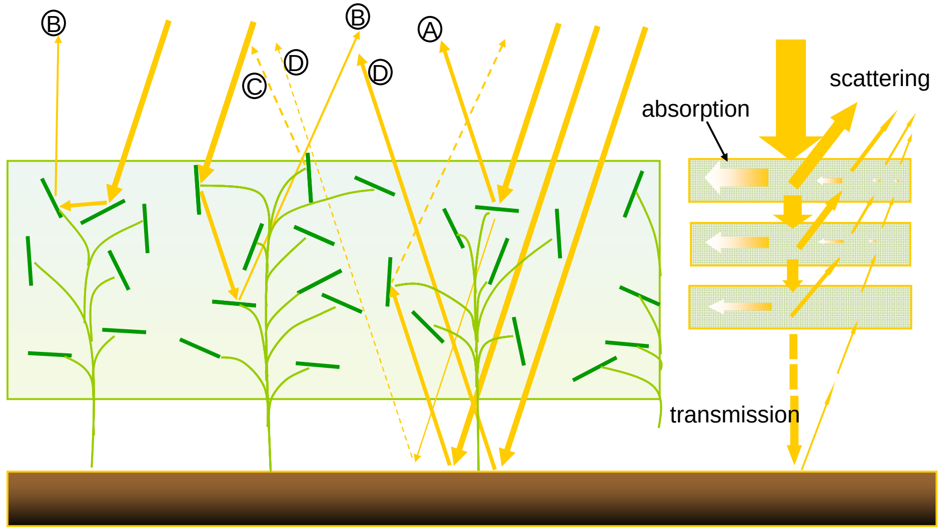
Fernerkundung
Texturberechnung: Klassifikation

Photogrammetrie
Stereo-Matching: Oberflächenmodell

Entstehung der spektralen Signatur



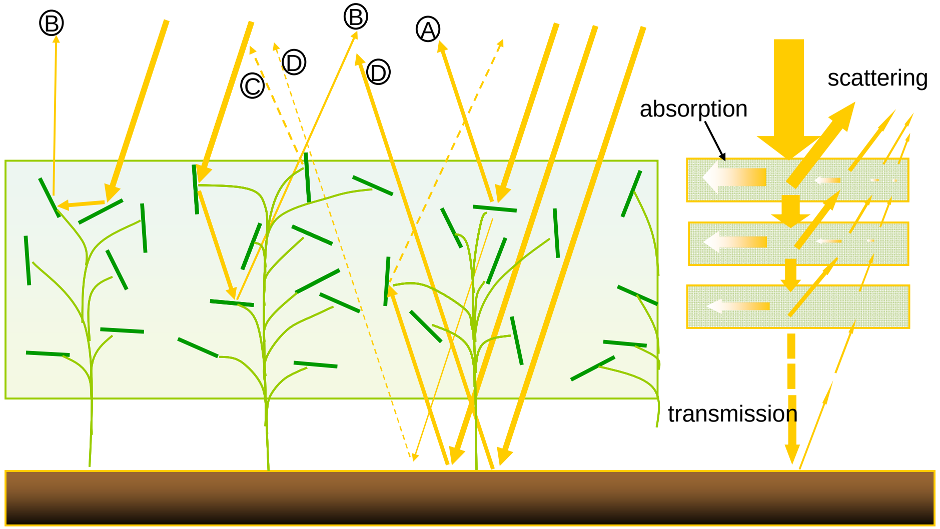


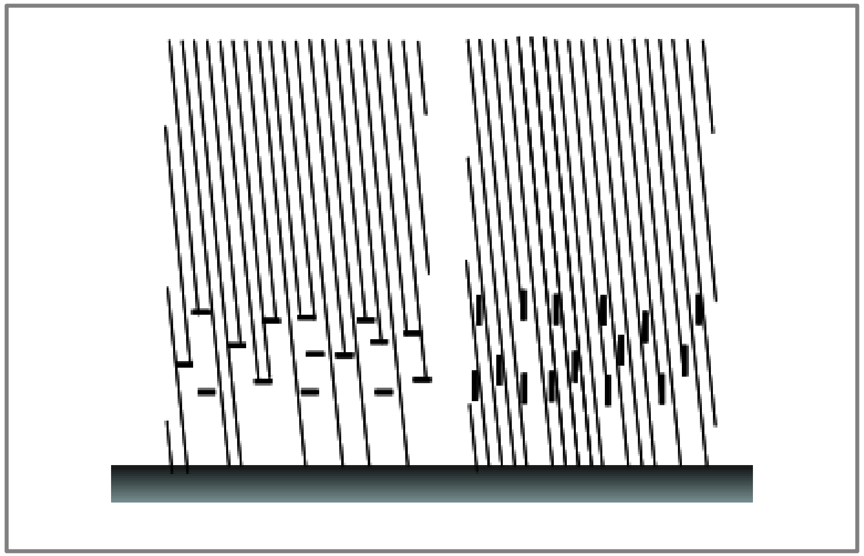


Interaktionsprozesse im Bestand & resultierende Bestandsreflexionen

Hintergrund

Entstehung der spektralen Signatur

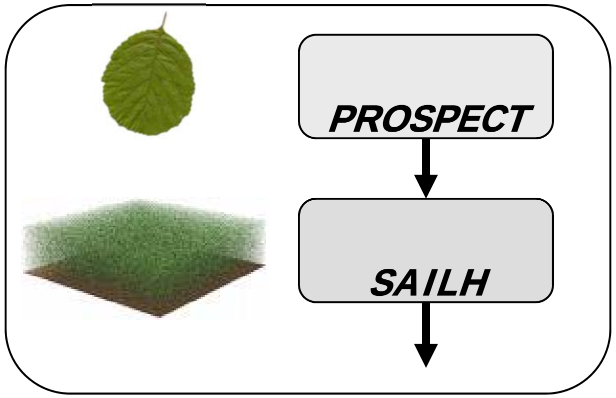


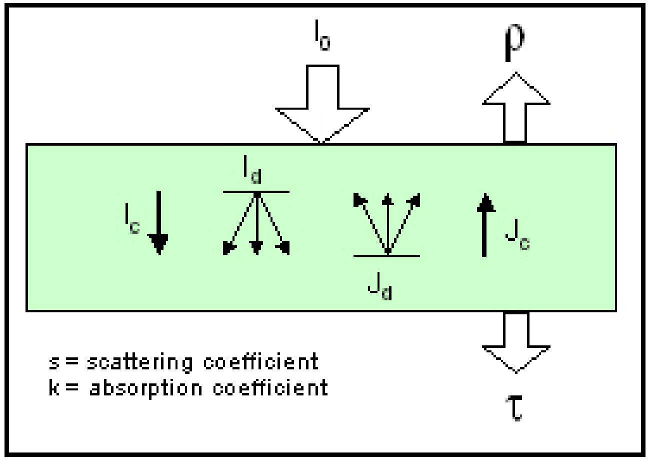


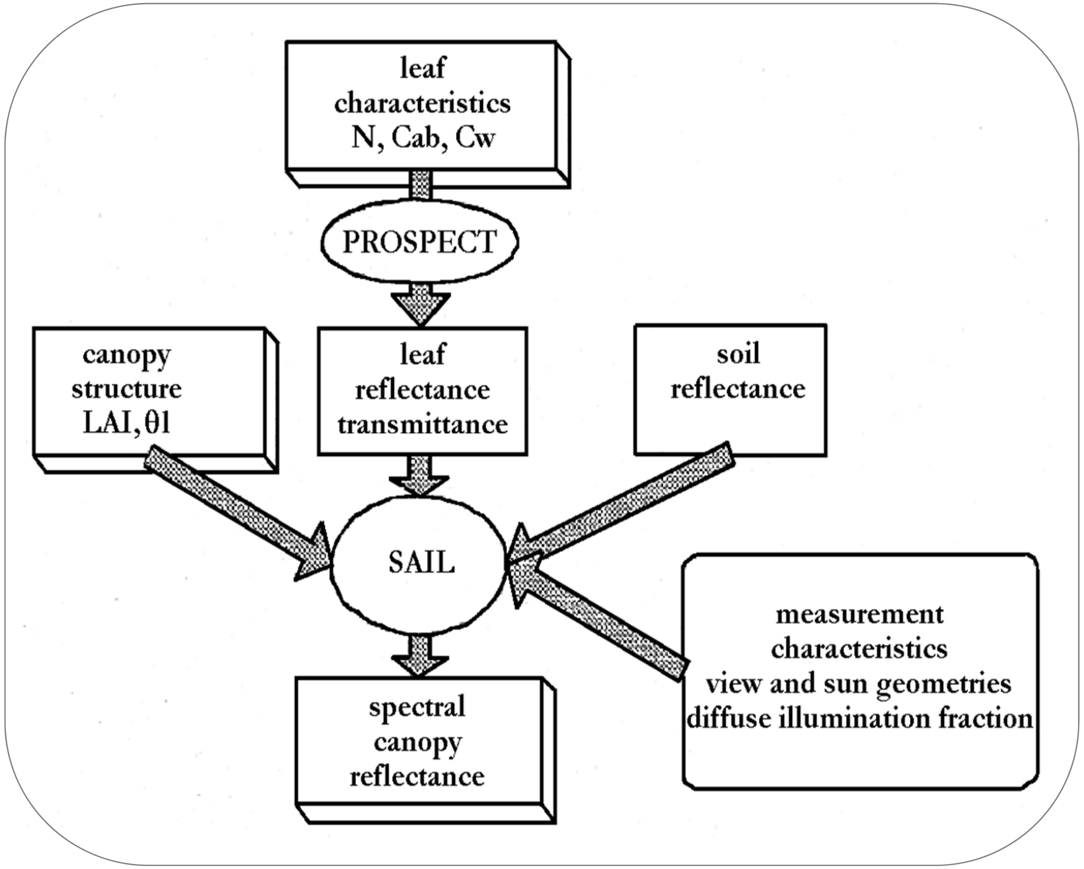
Blatthaltungswinkel (ALA)

Hintergrund

Modellierung des Strahlungstransfers

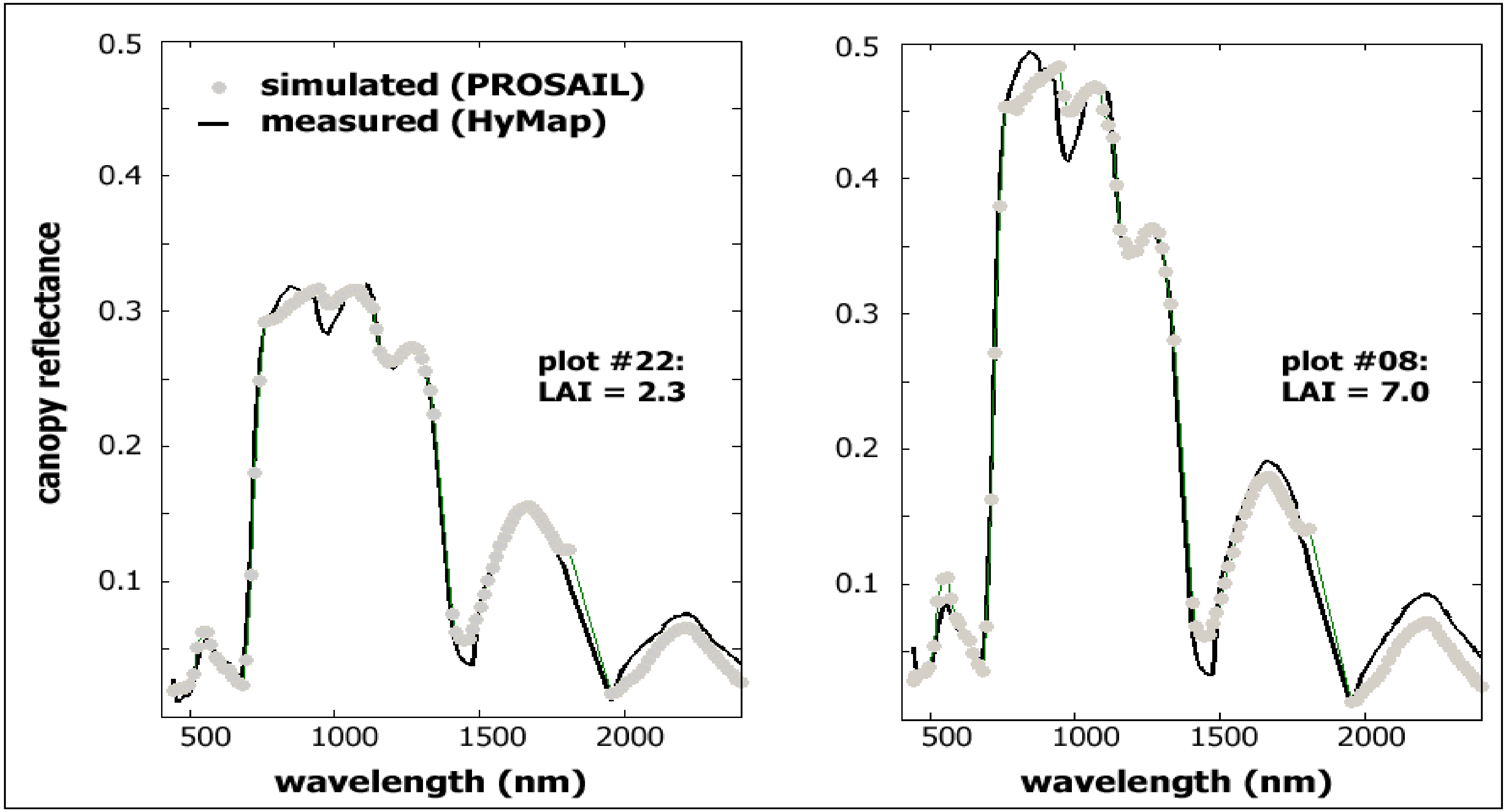






PROSAIL Strahlungstransfermodell

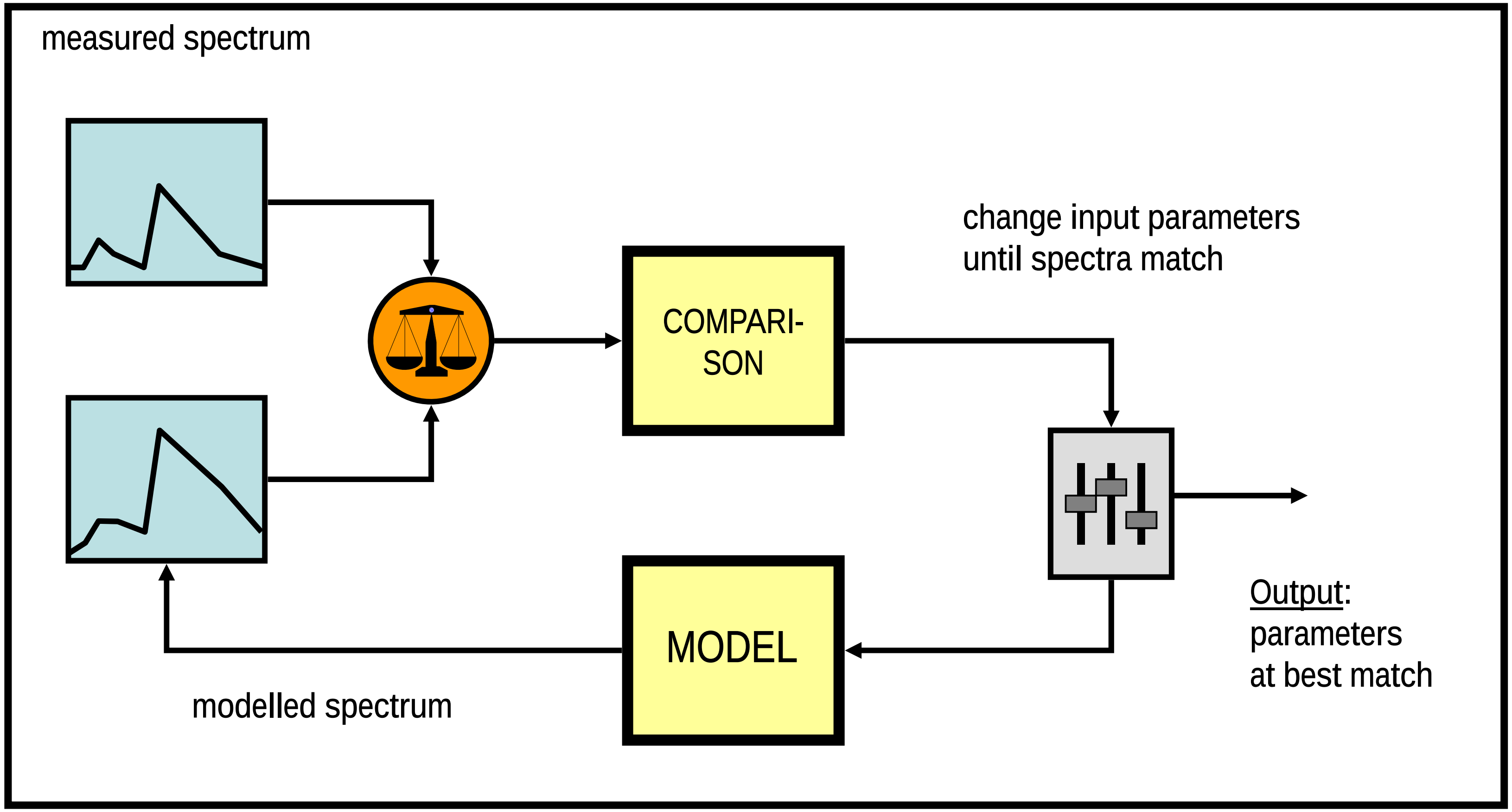
Modellierung des Strahlungstransfers



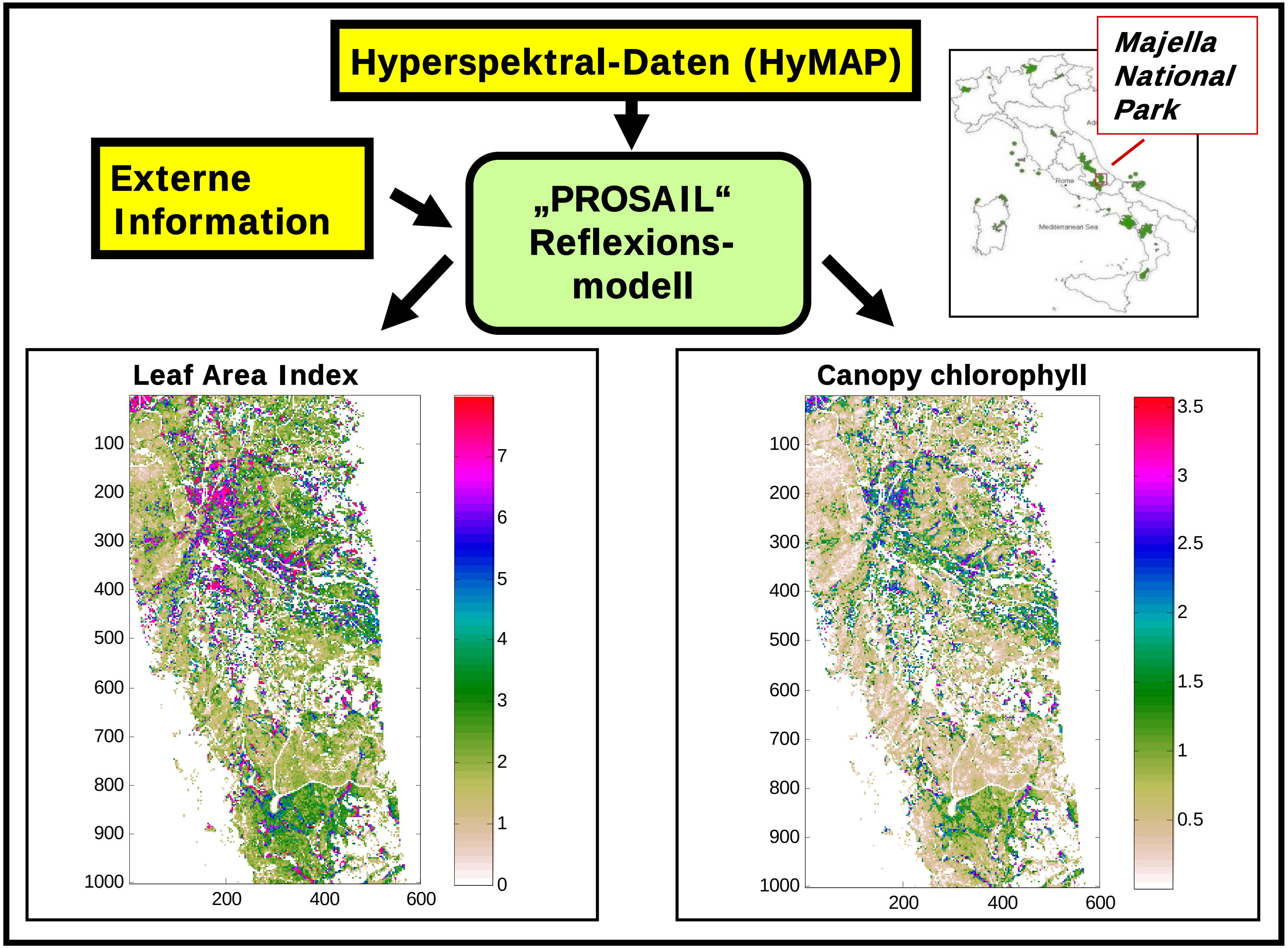
Vowärtssimulation: PROSAIL über Grassland (Majella National Park)

Hintergrund

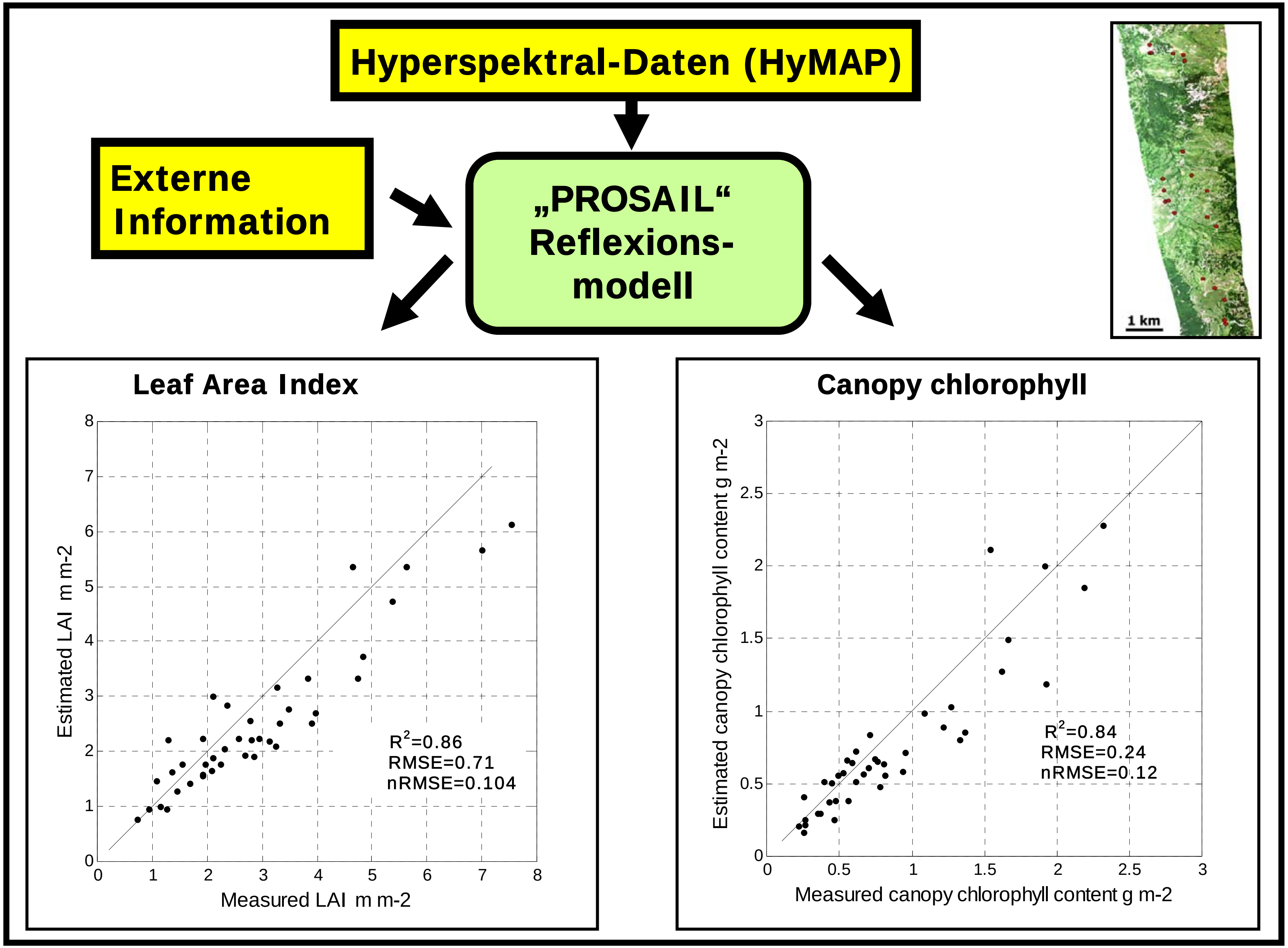
Inversion eines Strahlungstransfersmodells



Inversion physikalisch basierter Reflexions-modelle (nach Verhoef, 2005)



Modellierte Grassland-Parameter: LAI (links) und Bestands-Chlorophyllgehalt (rechts)



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Das « ill-posed » inverse Problem

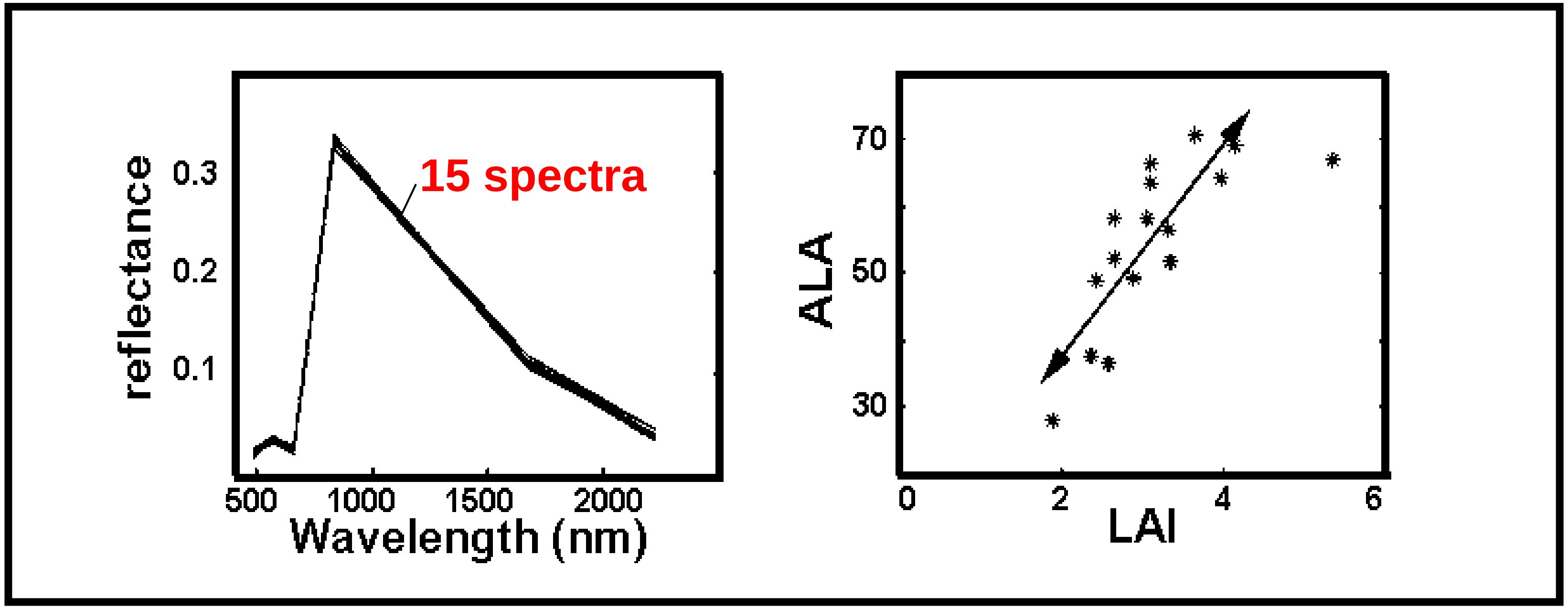
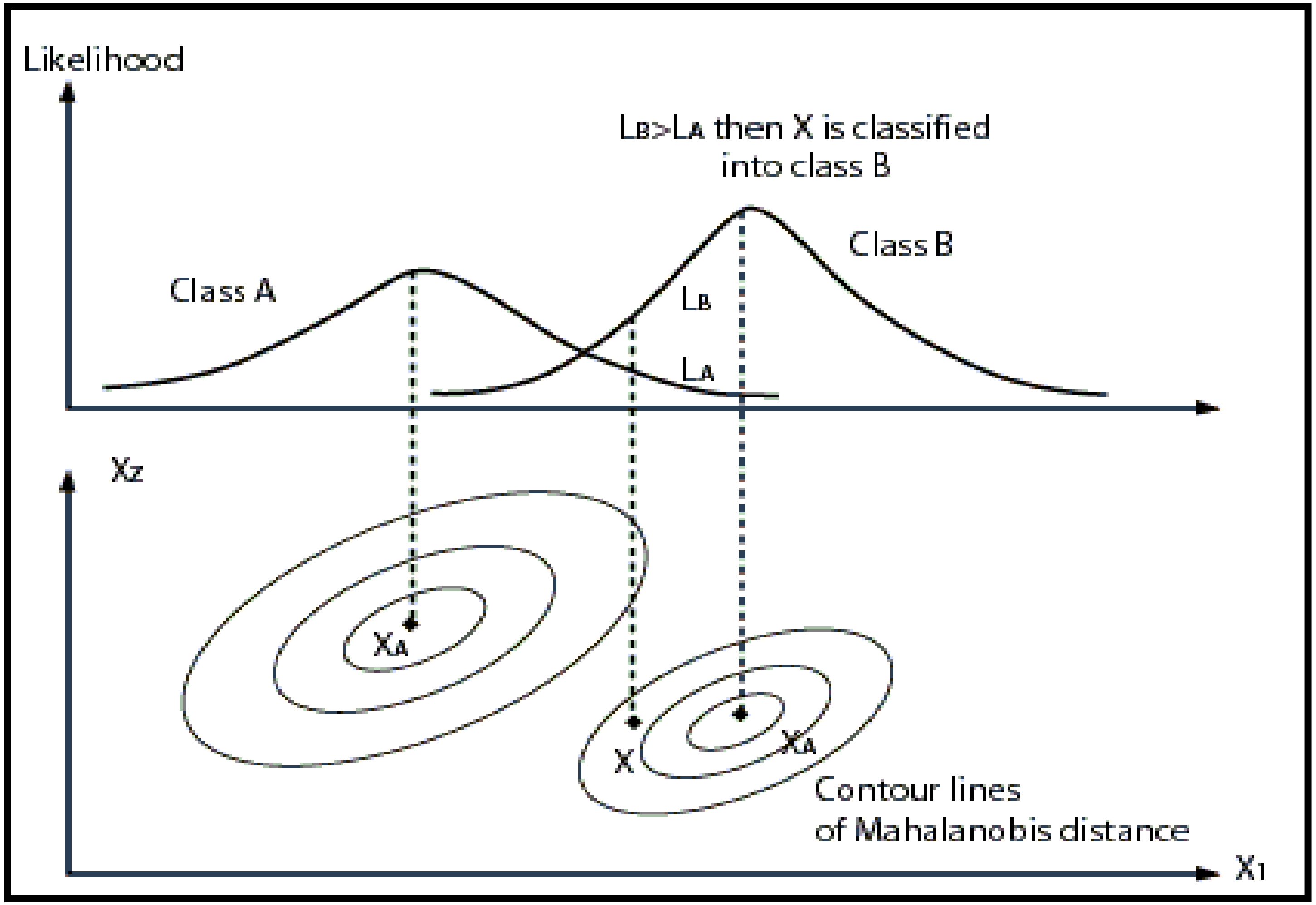


Illustration des Problems bei der Inversion von Strahlungstransfermodellen für 6-kanalige Landsat TM Bilder (PROSAIL Simulationen). Blatthaltungswinkel (ALA) und Blattflächenindex (LAI) gleichen sich gegenseitig aus

Das « ill-posed » inverse Problem



Ill-posedness im Klassifikationsprozess: Spektrale Überlappung am Beispiel MLC

Problemstellung

« Ill-posedness » - graphisch

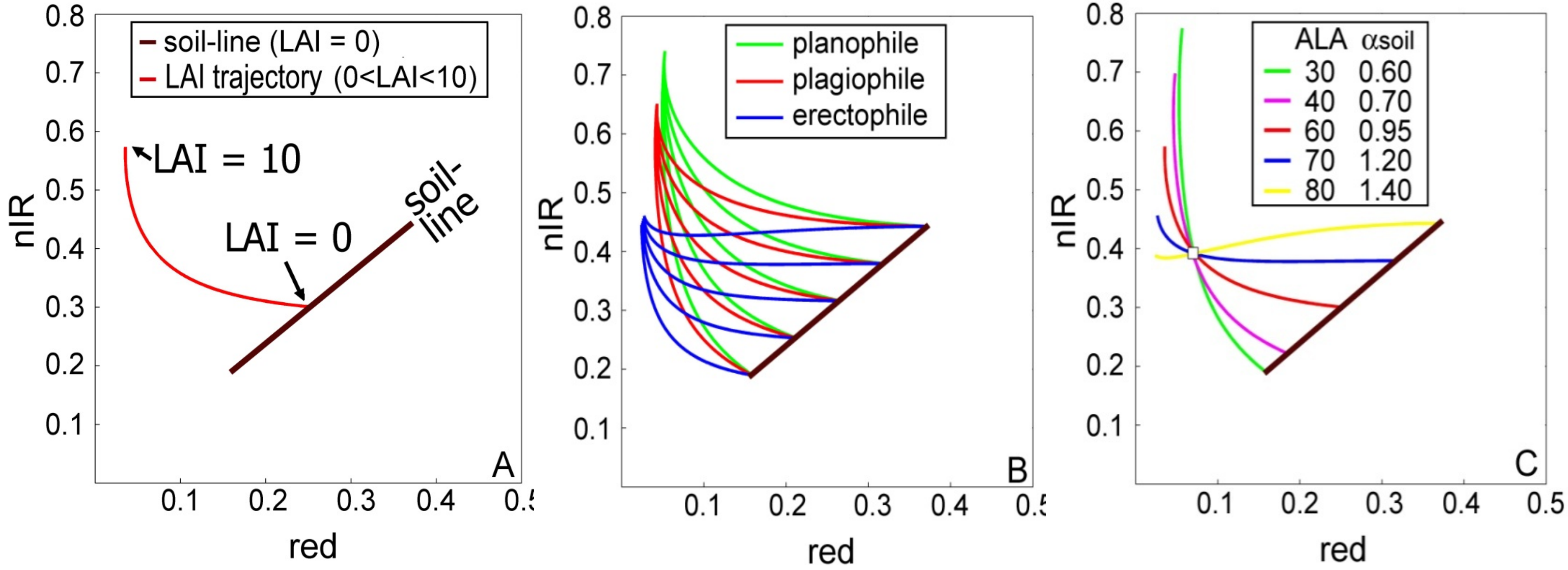
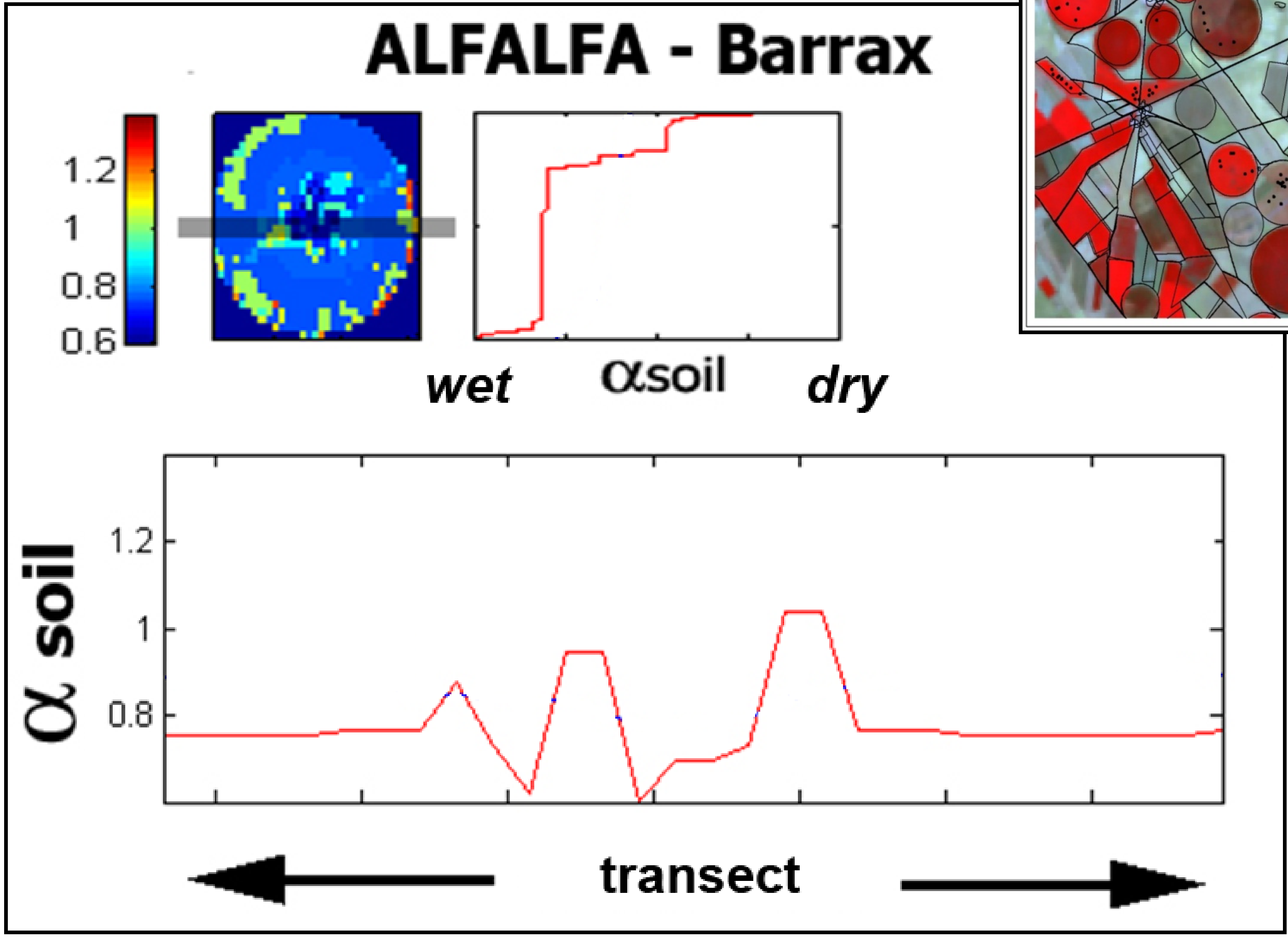
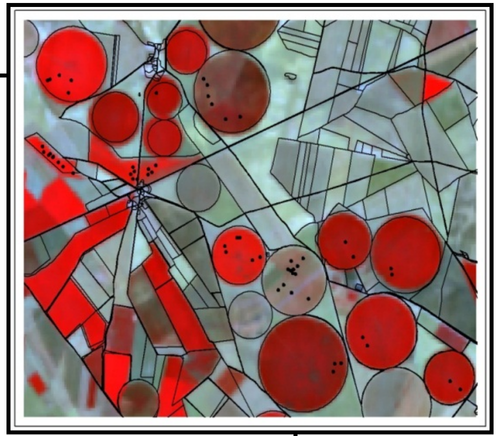


Illustration der ill-posedness im 2-dimensionalen Merkmalsraum

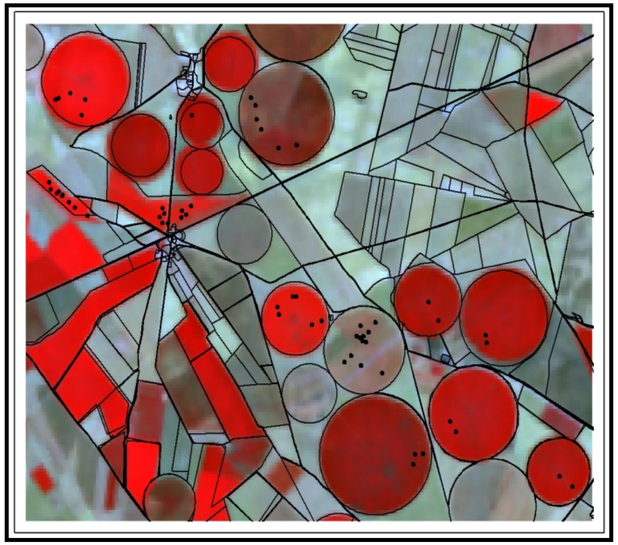
« Ill-posedness » - experimentell



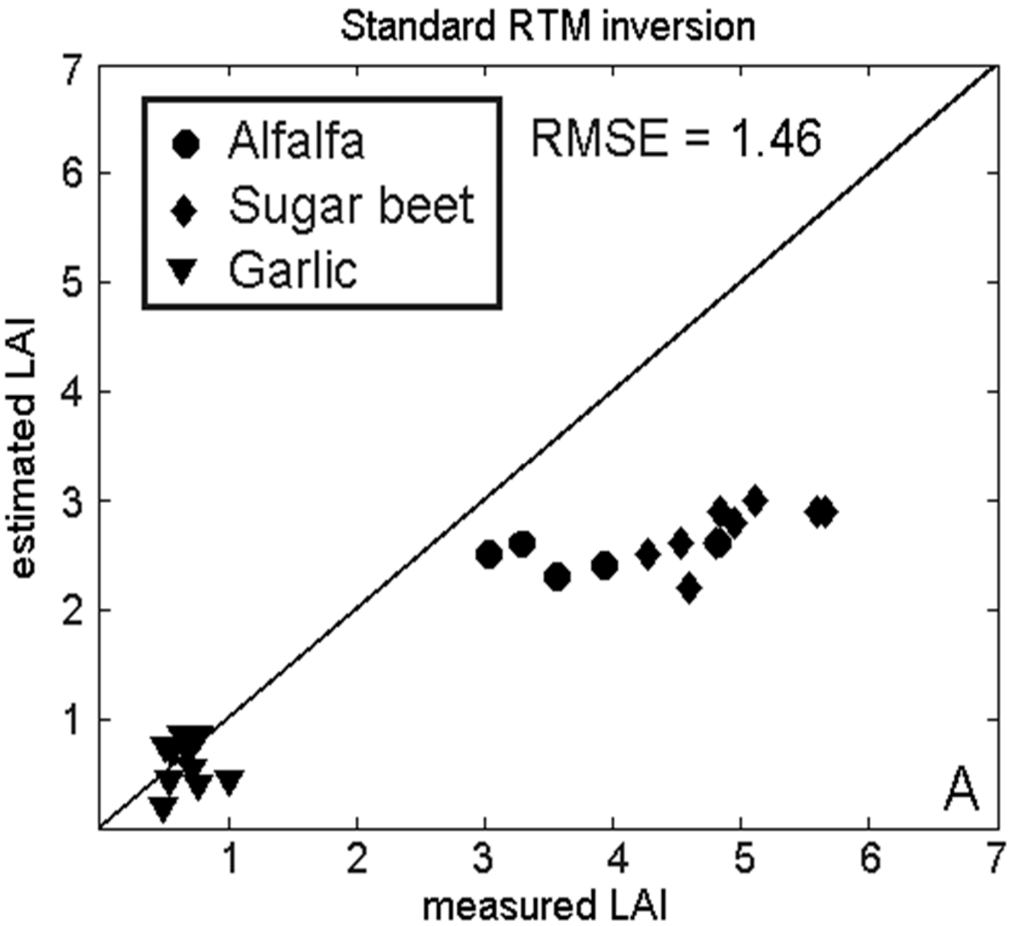


Modellierte Variation in der Bodenhelligkeit entlang einer horizontalen Linie durch ein Luzerne-Feld. Die Inversion des Strahlungstransfermodells (PROSAIL) wurde pixel-basiert (Standardverfahren) und objekt-basiert durchgefuehrt

« Ill-posedness » - experimentell



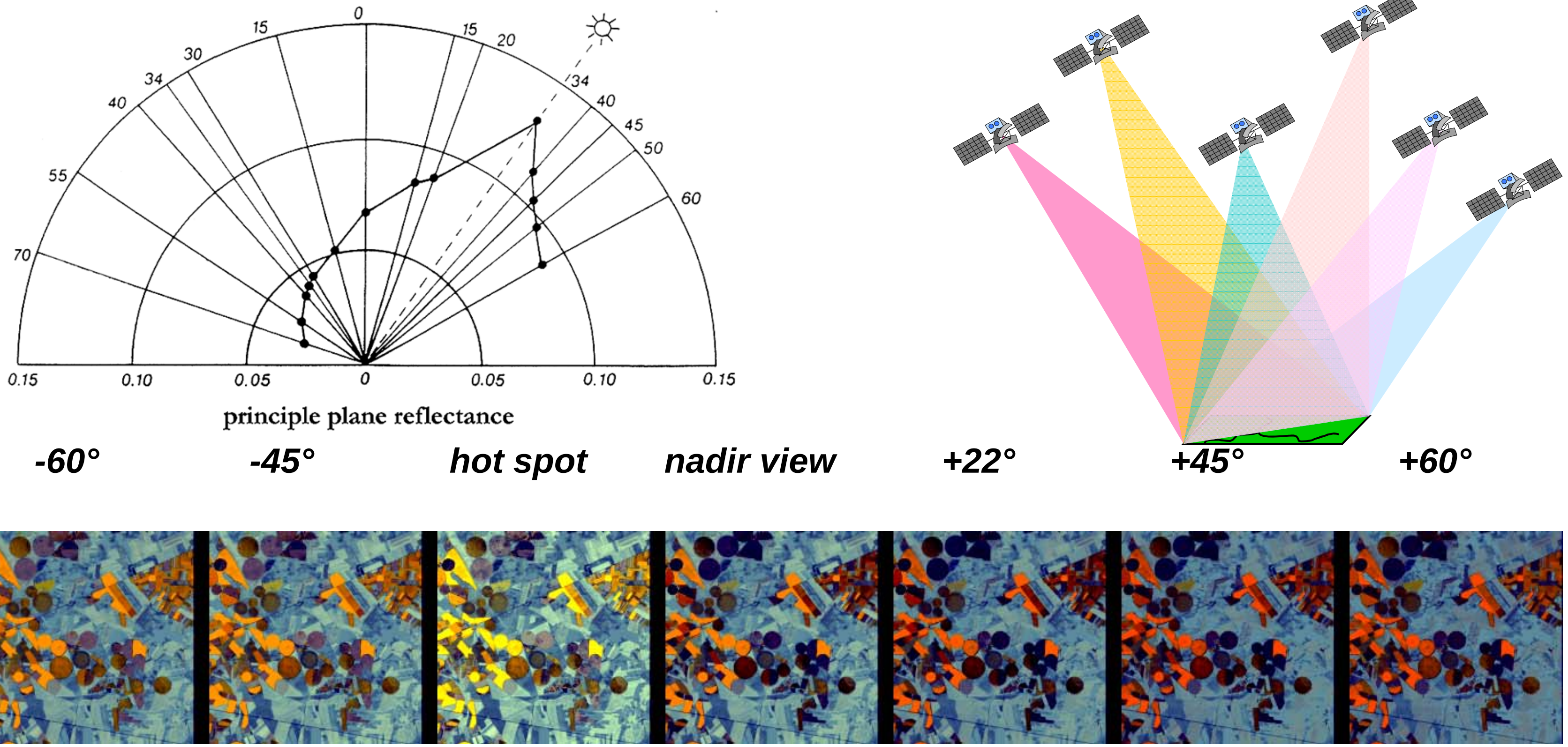
Barrax test site for testing the proposed model regularization



Systematische LAI Unterschätzung durch unterschätzten ALA

Methodik

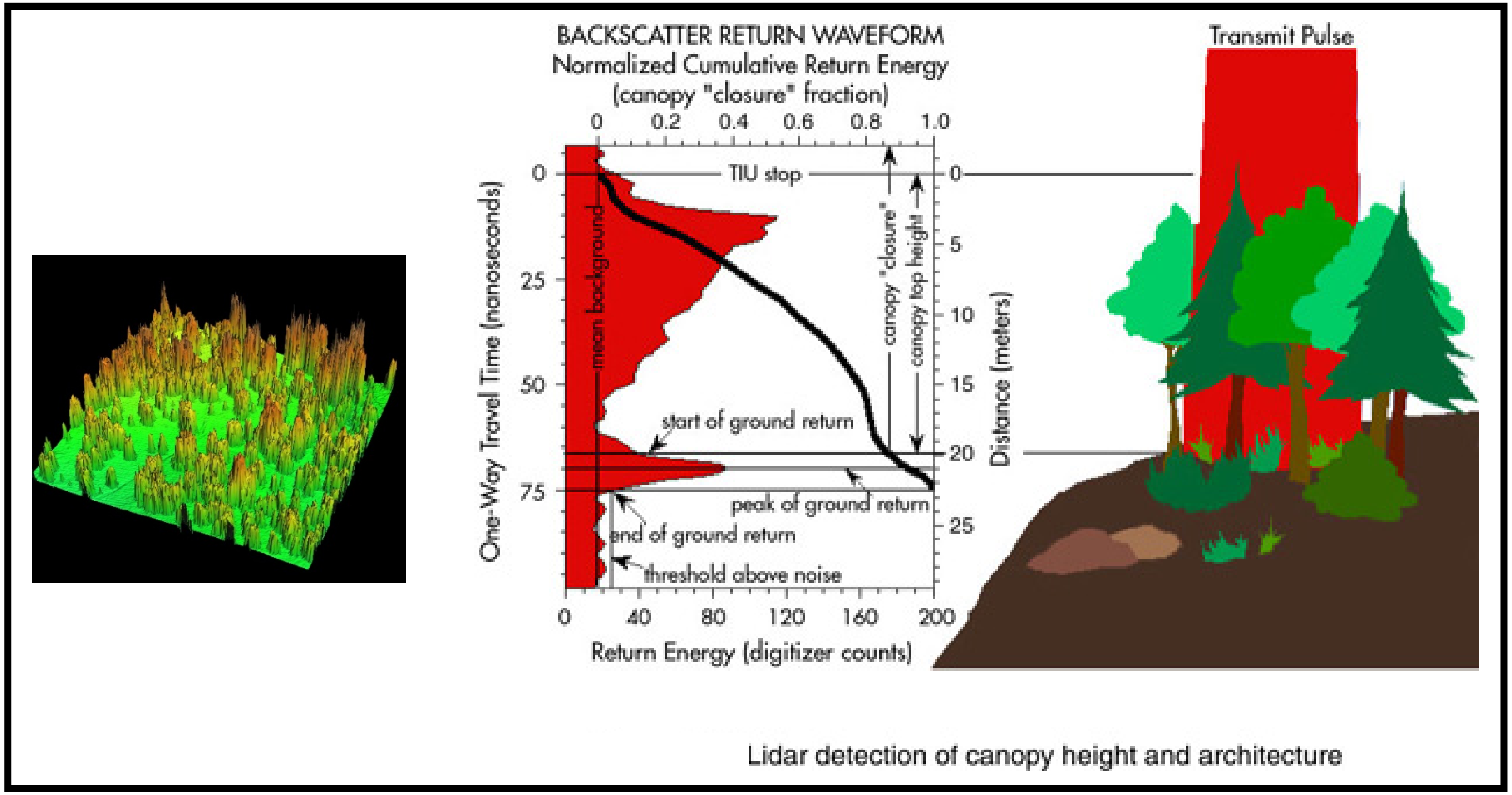
Regularisation: a priori information



660 nm, 730 nm, 840 nm

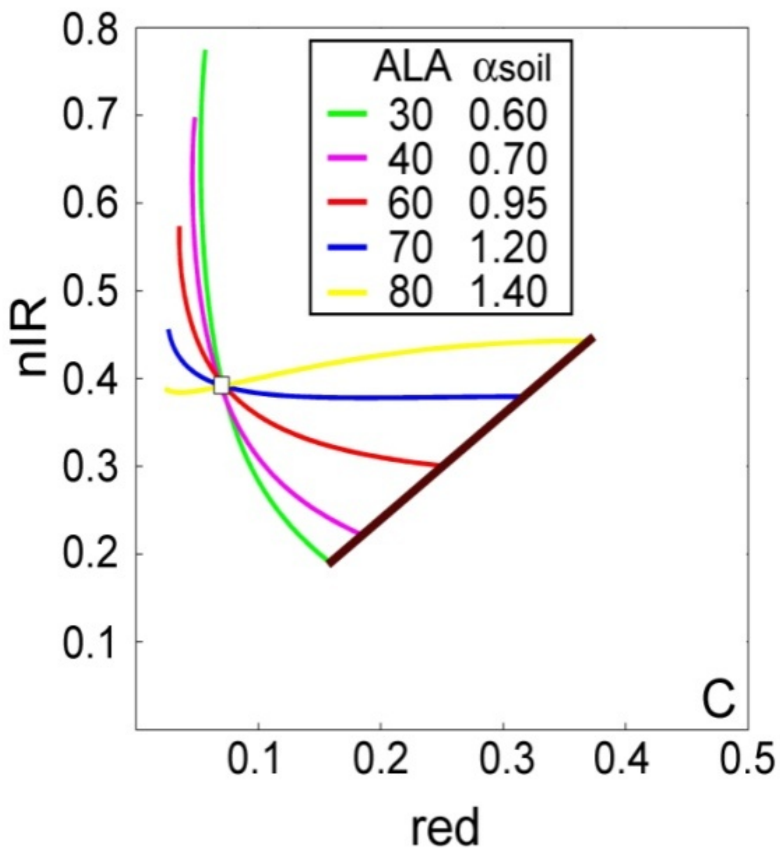
The ill-posed problem can be considerably reduced by increasing the dimensionality of the data set – here: combining spectral and directional data (source: web)

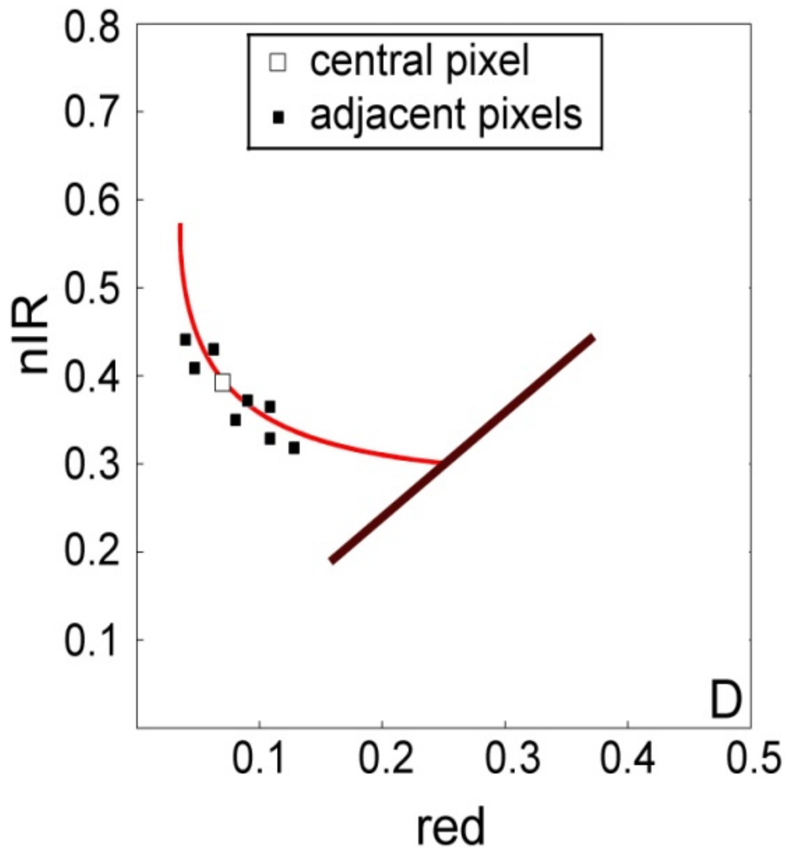
Regularisation: a priori information



The number of variables to be retrieved can be reduced if some variables can be mapped from other EO data (e.g. canopy height and architecture from LIDAR measurements) (source: web)

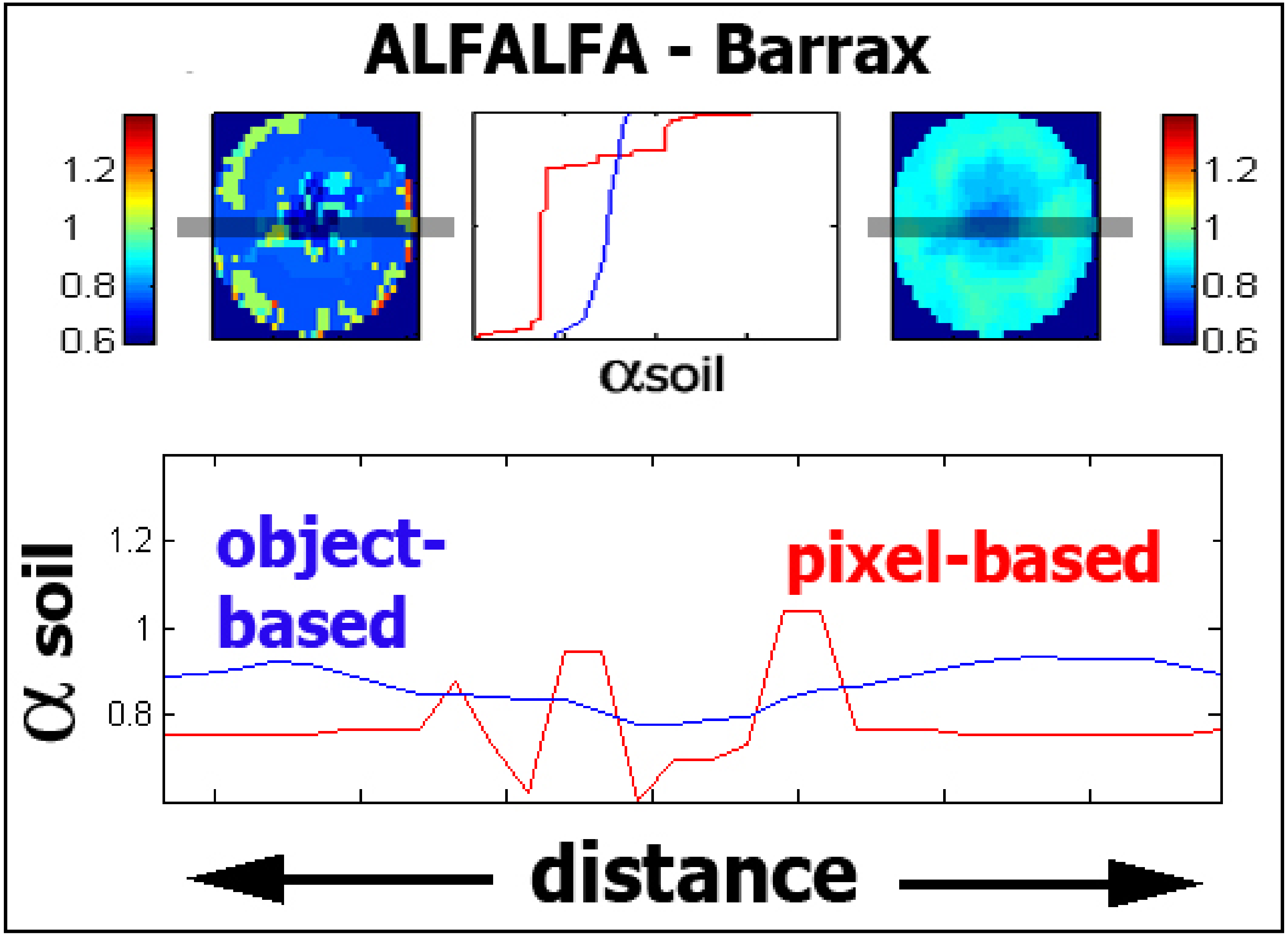
Nutzung räumlicher Information





Optimization of „LAI trajectories“ for pixels within 3 x 3 gliding windows, assuming that only LAI shows a remarkable variation within ± 1 pixel

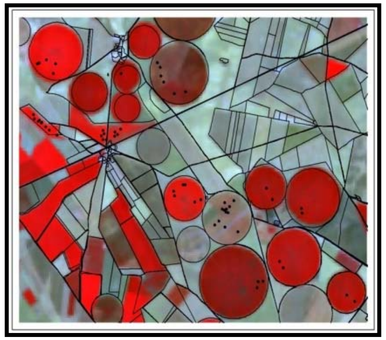
Methodik

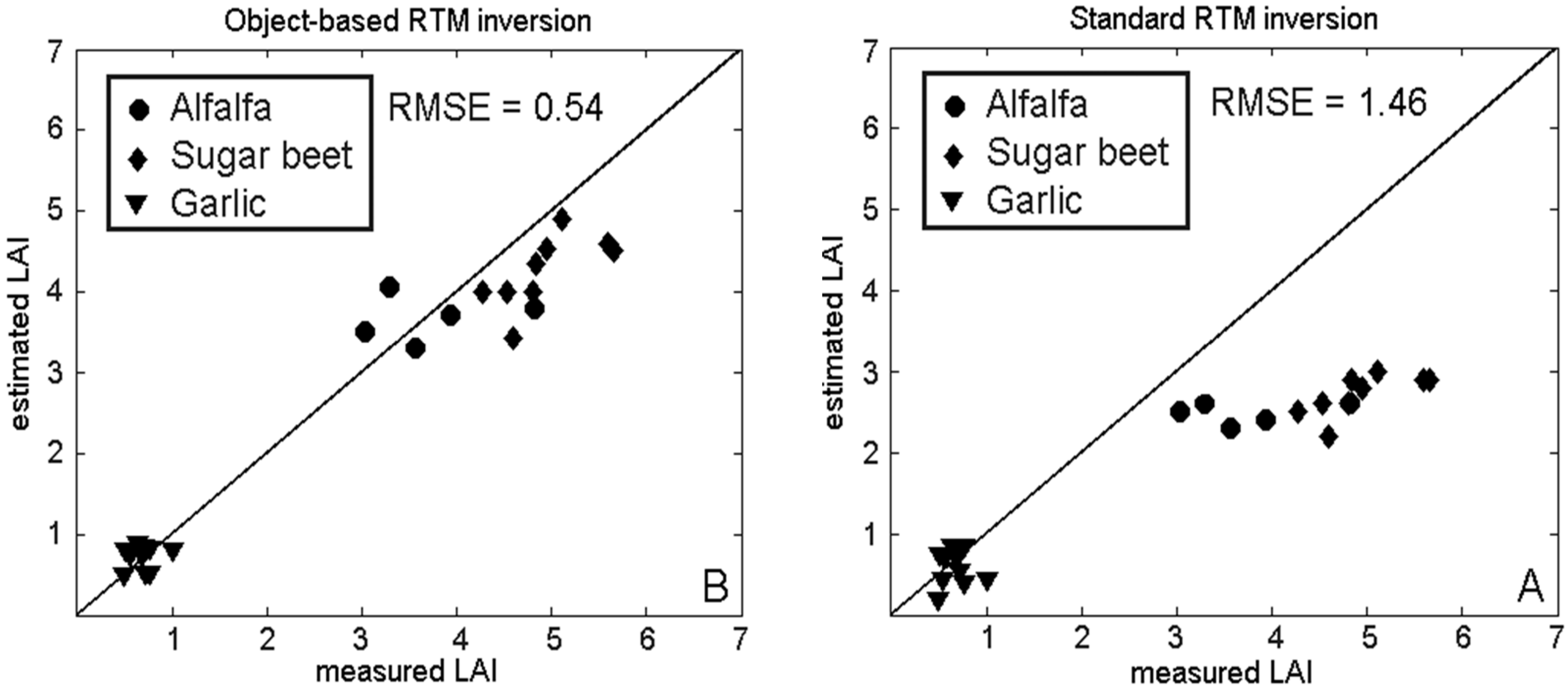


Modellierte Variation in der Bodenhelligkeit entlang eines horizontalen Transects durch ein Luzerne-Feld. Die Inversion des Strahlungstransfermodells (PROSAIL) wurde pixel-basiert (Standardverfahren) und objekt-basiert durchgefuehrt

Ergebnisse

Nutzung räumlicher Information



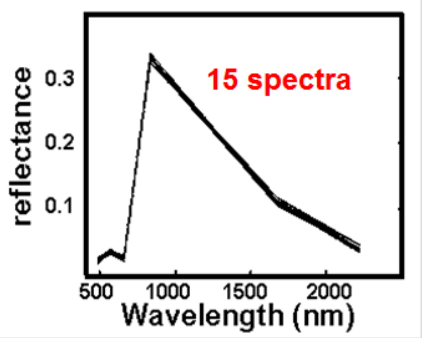


Inversionsergebnisse Barrax test site ohne Nutzung von a priori Information

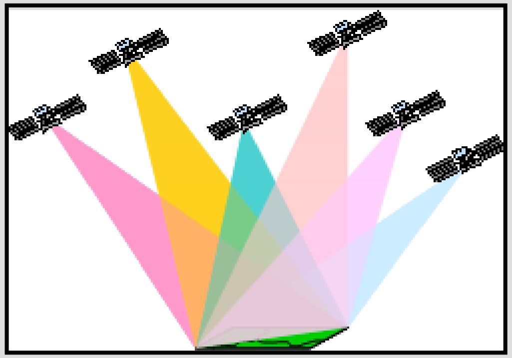
Ergebnisse

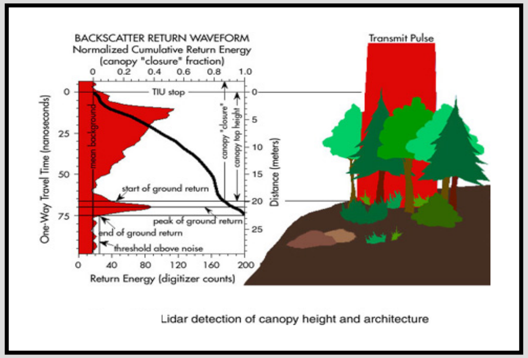
Conclusions

1. Counterbalancing variables lead an ill-posed inverse problem



2. Regularization attempts not always possible





3. Spatial neighbourhood yields additional information to regul-arize the inverse problem