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NATURAL ENVIRONMENT RESEARCH COUNCIL

Assimilating earth observation data into JULES

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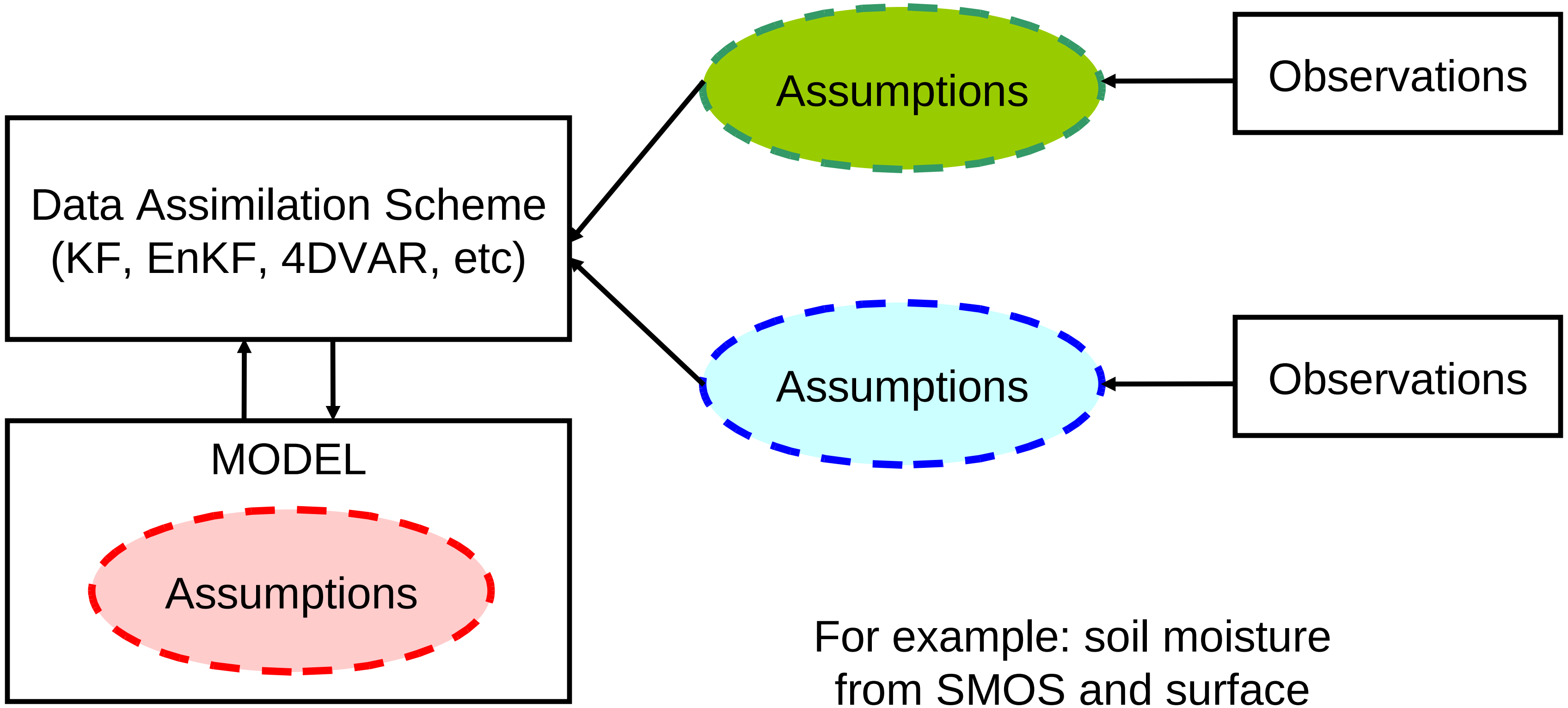
UCL

THE UNIVERSITY *of York*

Assimilating products



For example: soil moisture from SMOS and surface temperature from MODIS

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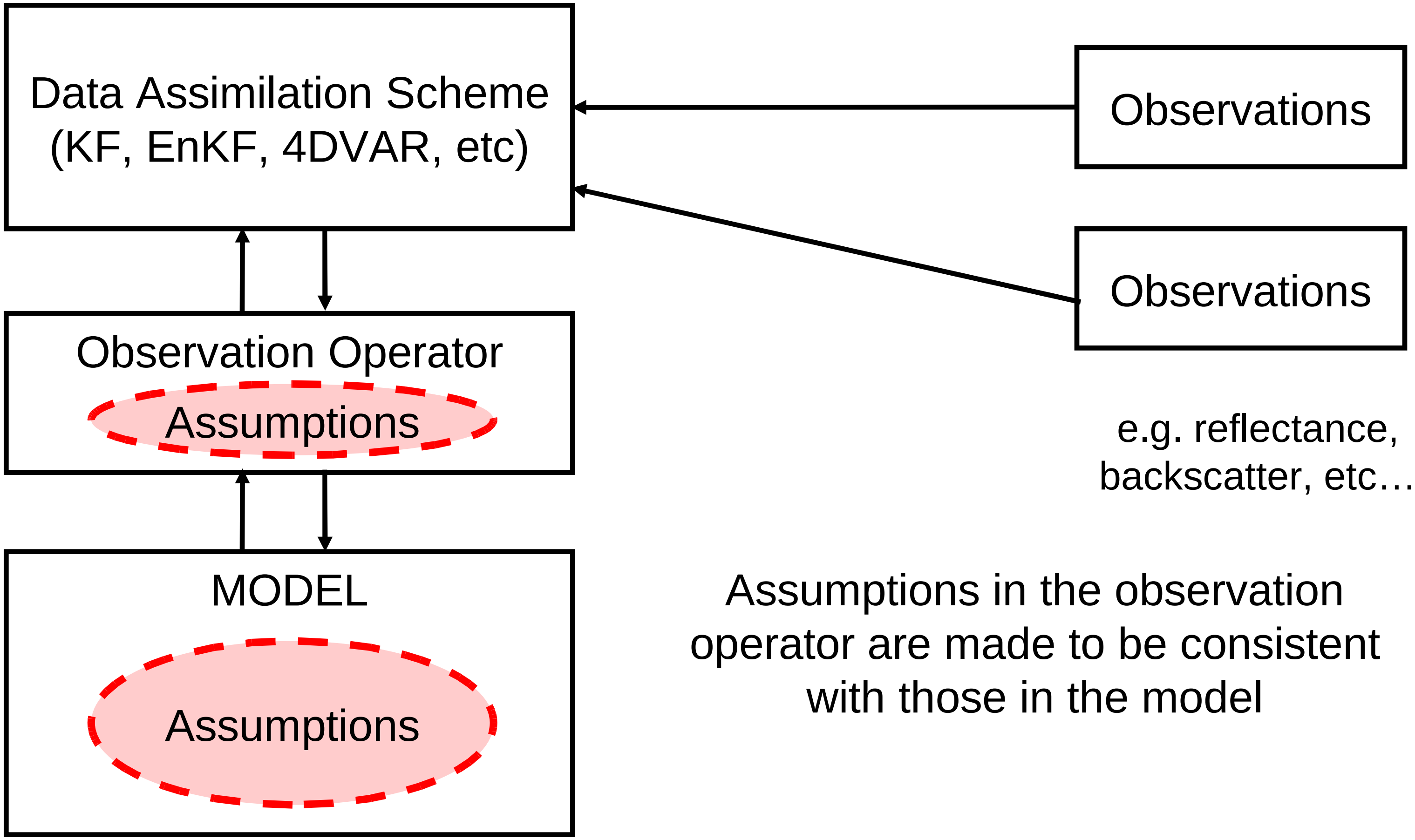
Assimilating observations



Assumptions in the observation operator are made to be consistent with those in the model

T. Quaife, P. Lewis, M. DE Kauwe, M. Williams, B. Law, M. Disney, P. Bowyer (2008), Assimilating Canopy Reflectance data into an Ecosystem Model with an Ensemble Kalman Filter, Remote Sensing of Environment, 112(4),1347-1364.

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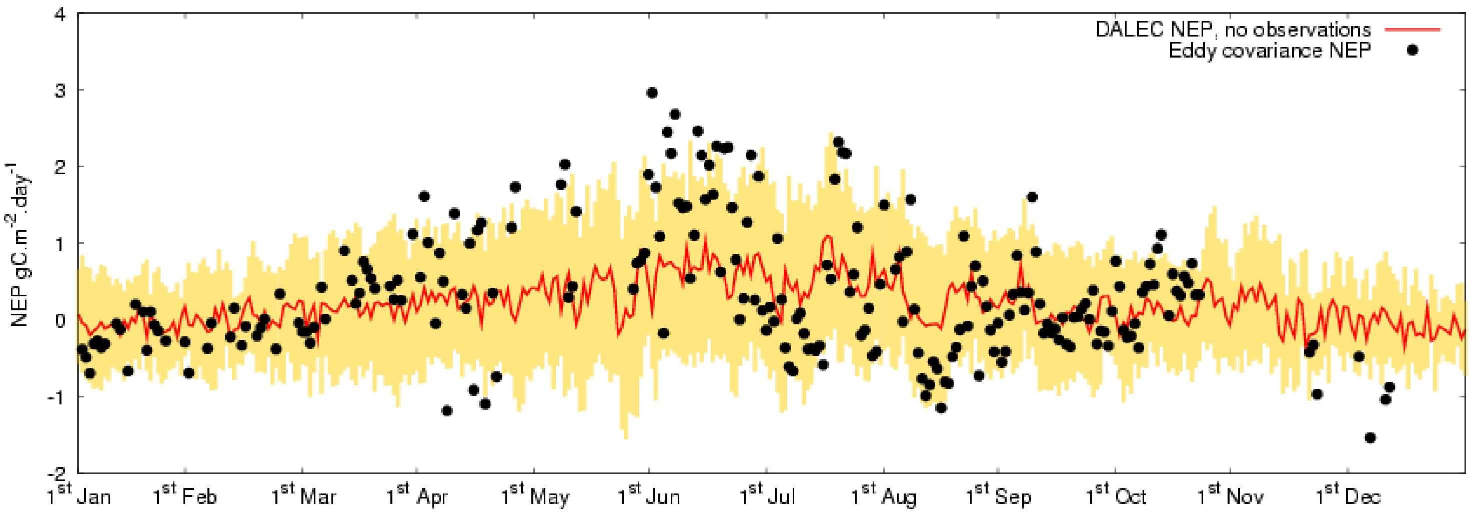
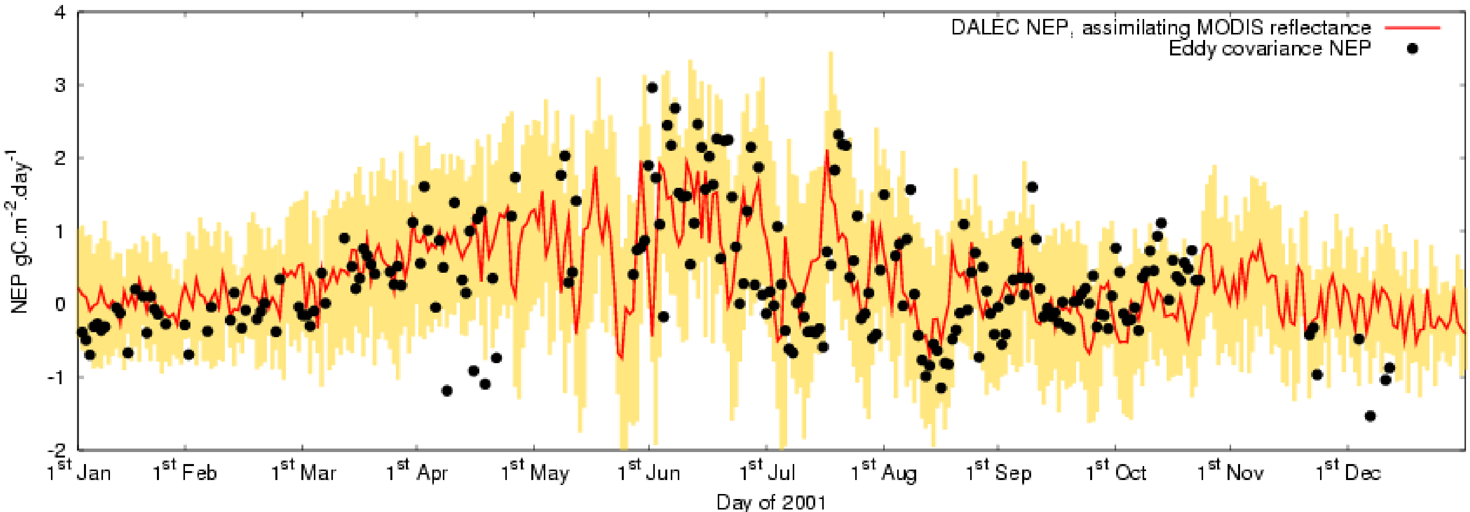
DALEC results: NEP

No assimilation



Assimilating MODIS

(bands 1 and 2)



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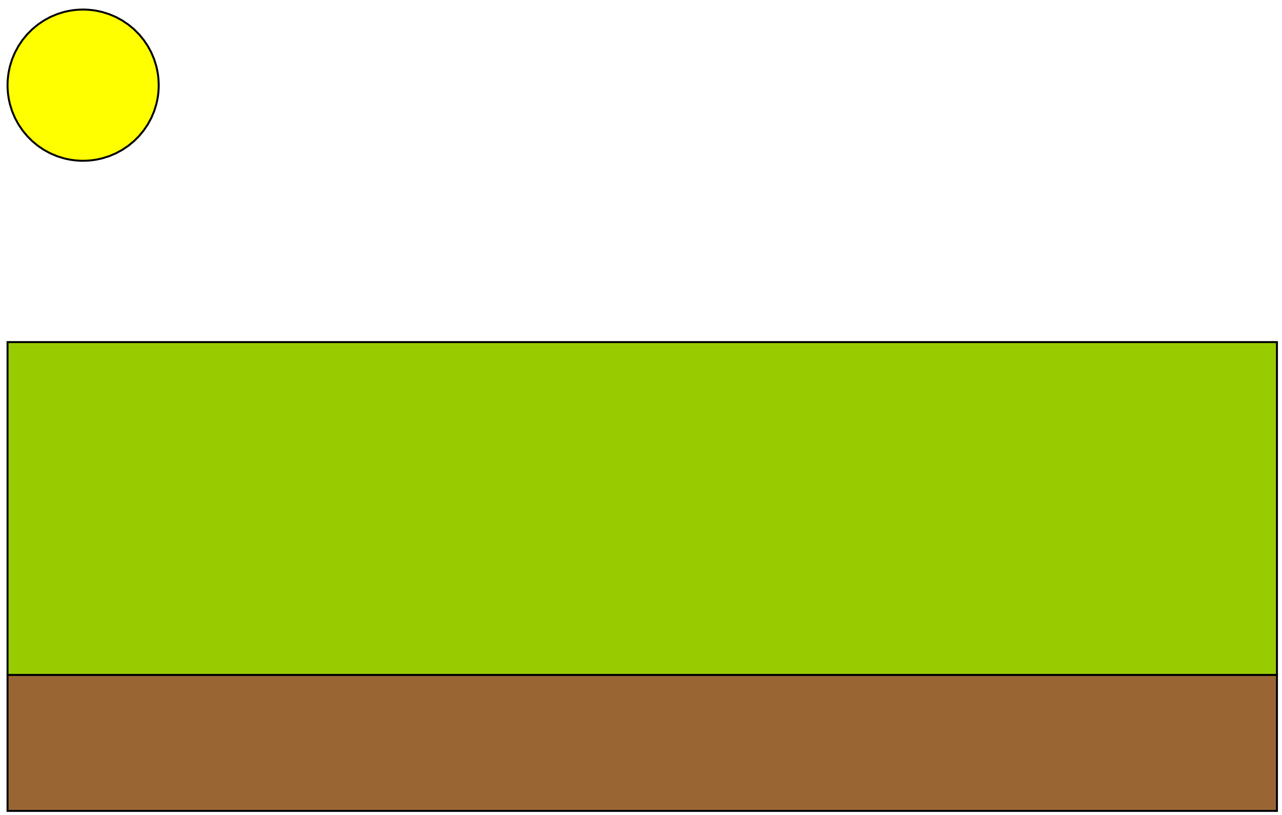
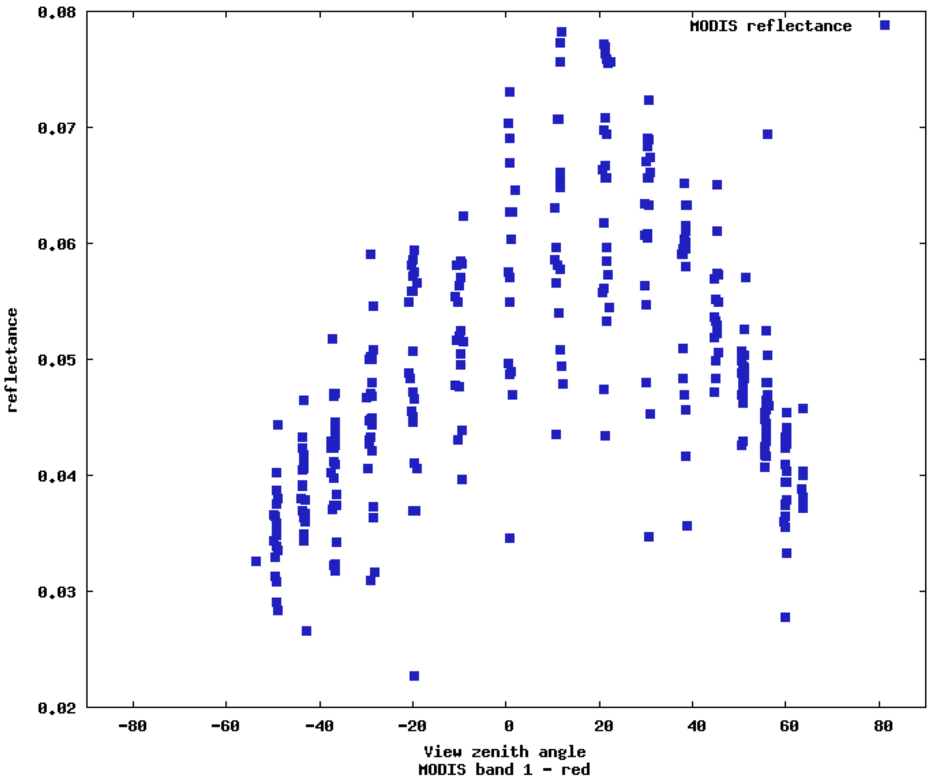
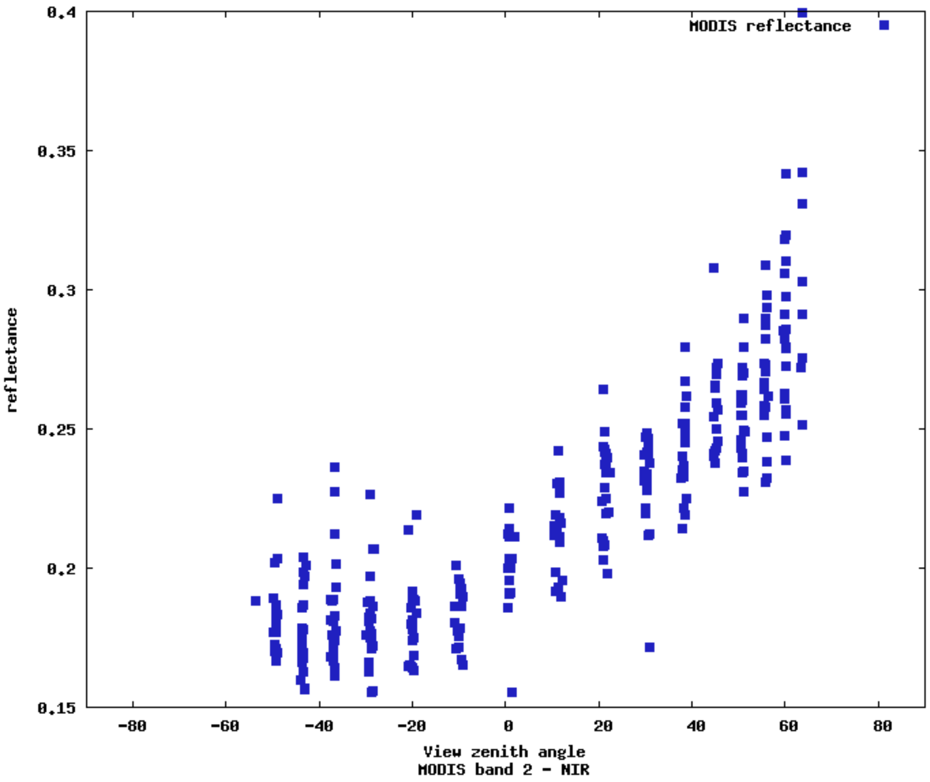
JULES: 1D Radiative Transfer (using a 2-stream model)



Observed reflectance





Band 1
(red)

Band 2
(NIR)

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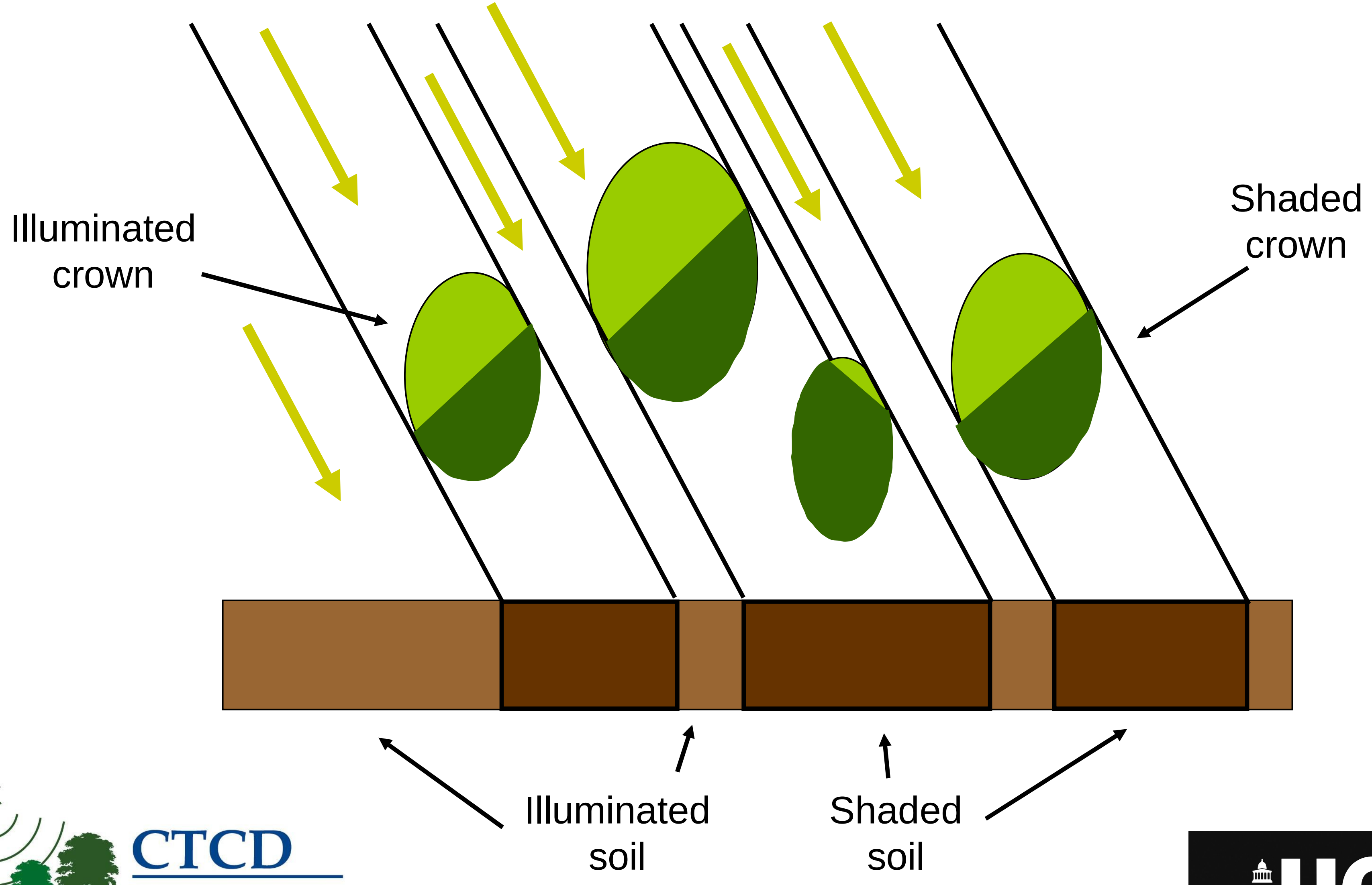
Geometric Optic Radiative Transfer



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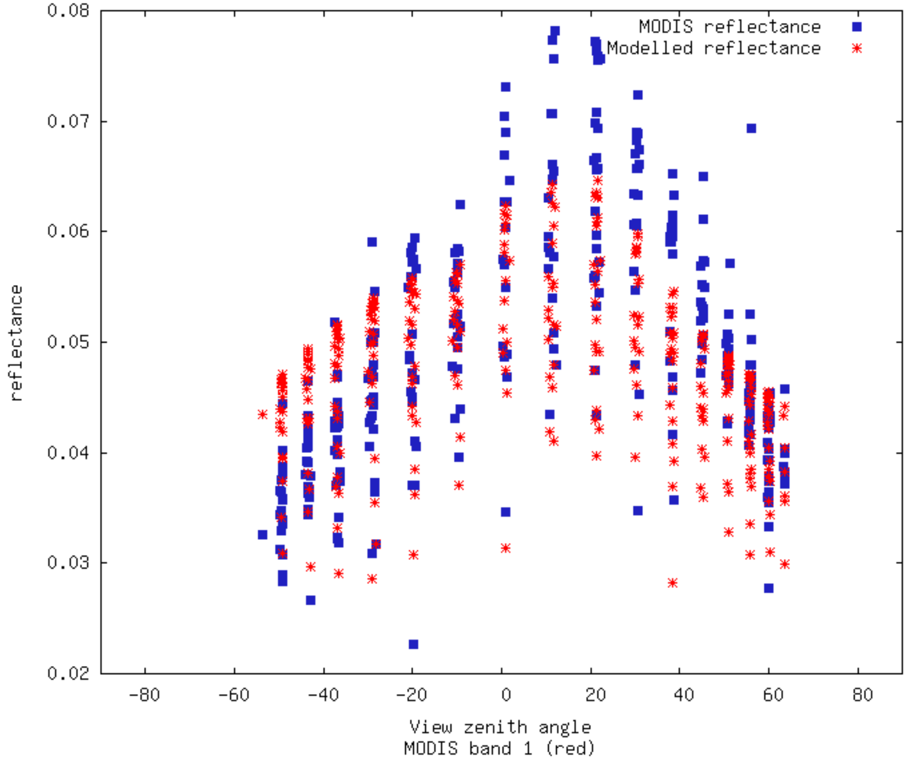
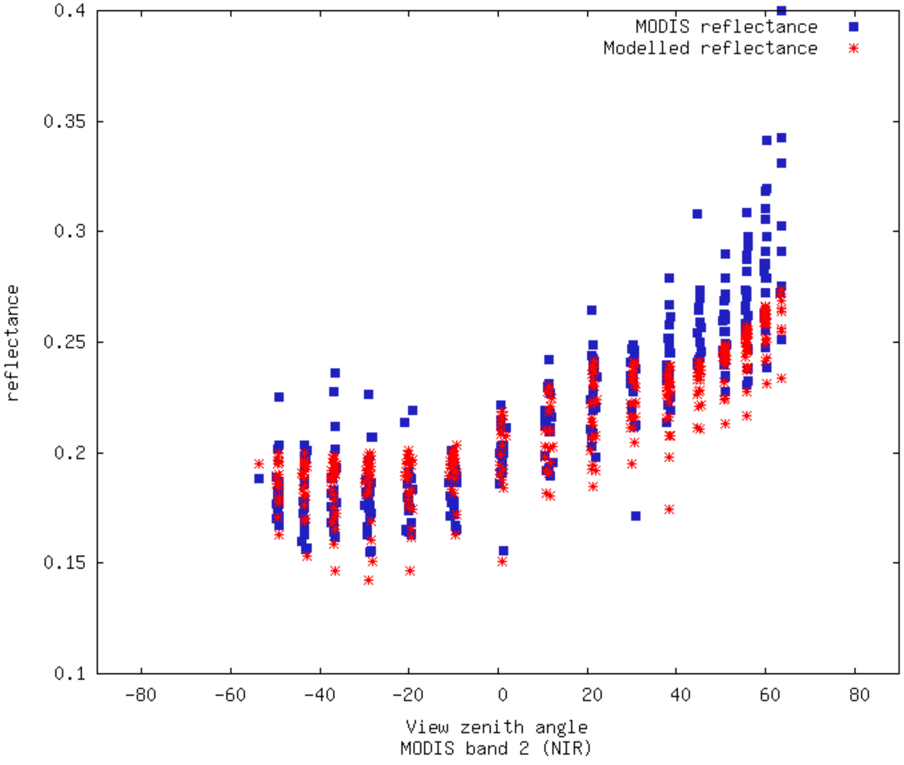
Modelled vs. observed reflectance





Band 1
(red)

Band 2
(NIR)

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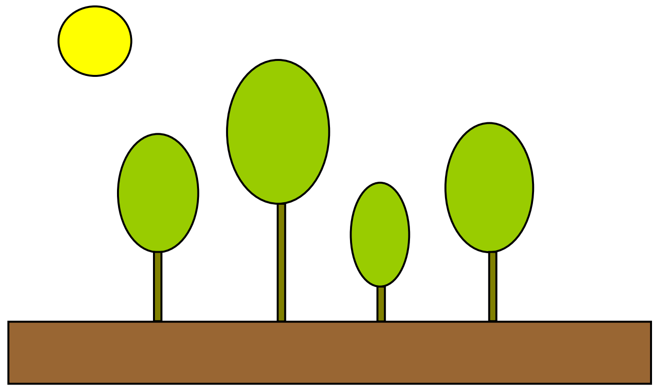
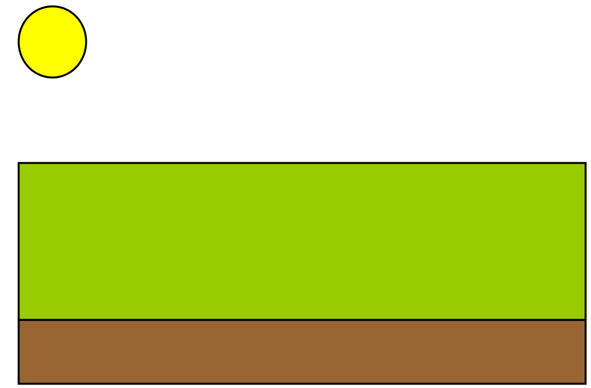
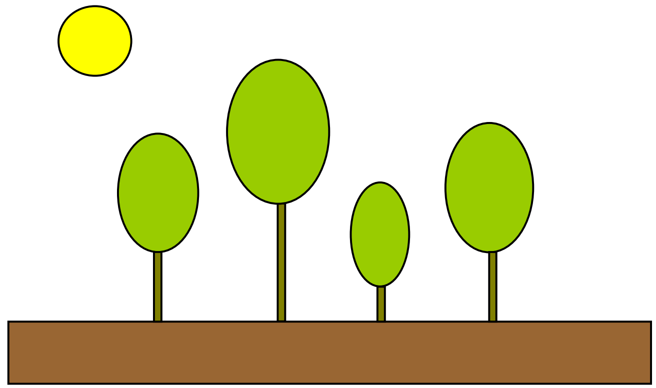
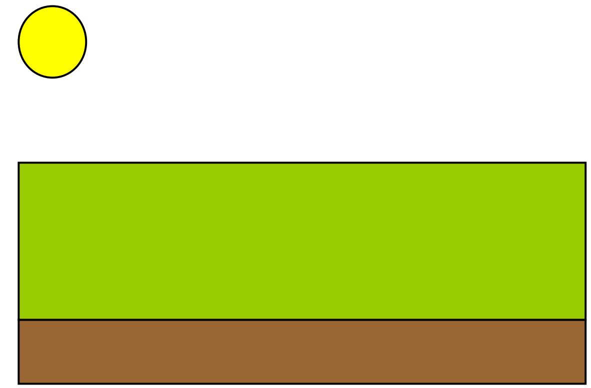
RT scheme equivalence

If,

LAI  = 

then,

fAPAR  < 

Problem with 1D approach

- It is problematic to correctly:
  - a) calculate fAPAR, and
  - b) model the observed EO signal.
- In fact, for most cases, given the correct LAI JULES* will not calculate fAPAR correctly.

* and most other GCMs and DVMs!

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Two options

- Add more detailed RT into JULES

  - e.g. GORT, FLIGHT etc.

- Accept that 1D variables are "effective"

  - requires restatement of the 2-stream model.

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More detailed RT

- ✓ Will provide the most control over the light interception and EO prediction by the model

- ✗ Development time
- ✗ Computational overheads
- ✗ Requirement for significant additional information and/or modelling

Effective variables

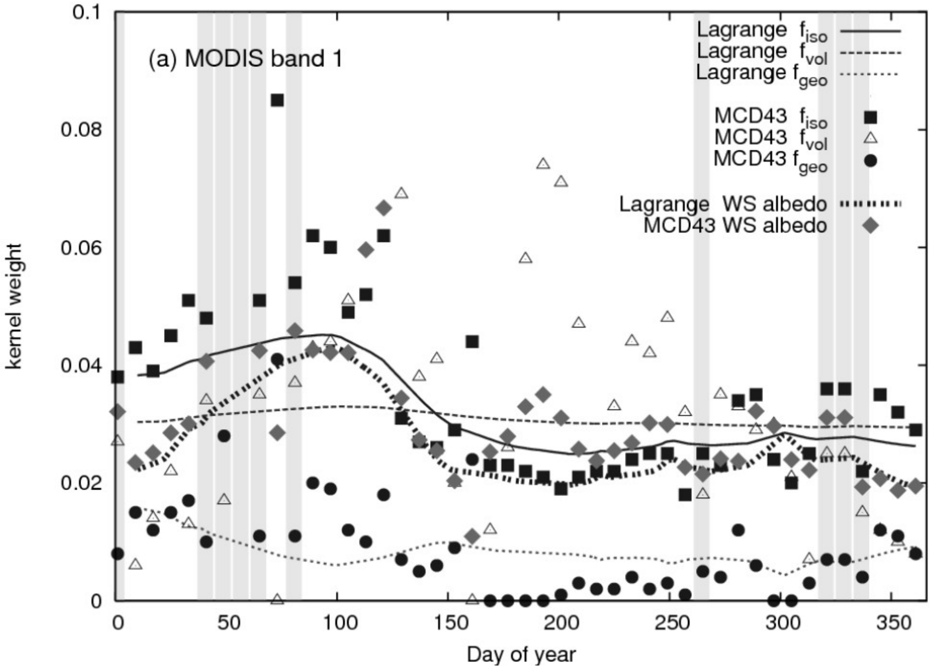
- ✓ Easily implement in JULES 2-stream
- ✓ Little additional information required
- ✓ Allows calculation of true fAPAR from true LAI

- ✗ Only deals with integrated fluxes

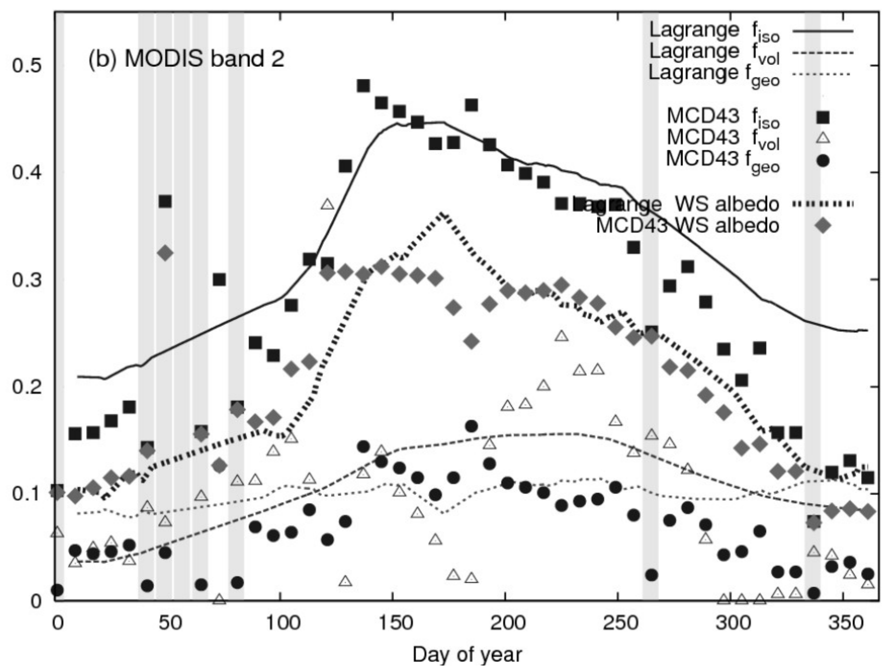
A potential way forward

- Pinty et al. (2004, 2006) propose a correction scheme to the two stream model.
- Uses a simple model to move between real LAI and effective LAI.
  - function of the solar zenith
  - Adds only 2 parameters to JULES
- Will permit direct comparison against MODIS broadband albedo (MOD43).

MODIS albedo



Band 1 (red)



Band 2 (NIR)

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A third way...

- Recollision probability:

  After a photon has undergone a scattering event within a canopy the most significant variable controlling its fate is the probability of it interacting with the canopy again.