Multi-sensor Soil Moisture Retrieval using SMOS

Mahdi Allahmoradi
PhD Candidate

Supervisors: Andrew Western, Jeffrey Walker, Dongryeol Ryu and Edward Kim

Contributor:
Chris Rüdiger

Objective

The main objective of this research is to test the hypothesis that more accurate soil moisture information can be derived from SMOS if vegetation attenuation and land surface temperature information are derived from other coincident remote sensing observations (MODIS, WindSat, MTSAT-1R, etc.).

Introduction

Radiometer measurements are sensitive to:

- Soil moisture content
- Vegetation Water Content
- Surface roughness
- Soil Properties
- Land Surface Temperature
- …

Introduction

SMOS Assumptions (relevant to this research)

Assumption 1: Soil surface temperature and soil deep temperature will be extracted from ECMWF (European Centre for Medium-Range Weather Forecasts) products.

Assumption 2: Using LAI for computing optical depth. LAI will be obtained from ECOCLIMAP which is a global database for land surface parameters.

Research Questions

This thesis will address four key research questions as outlined below:

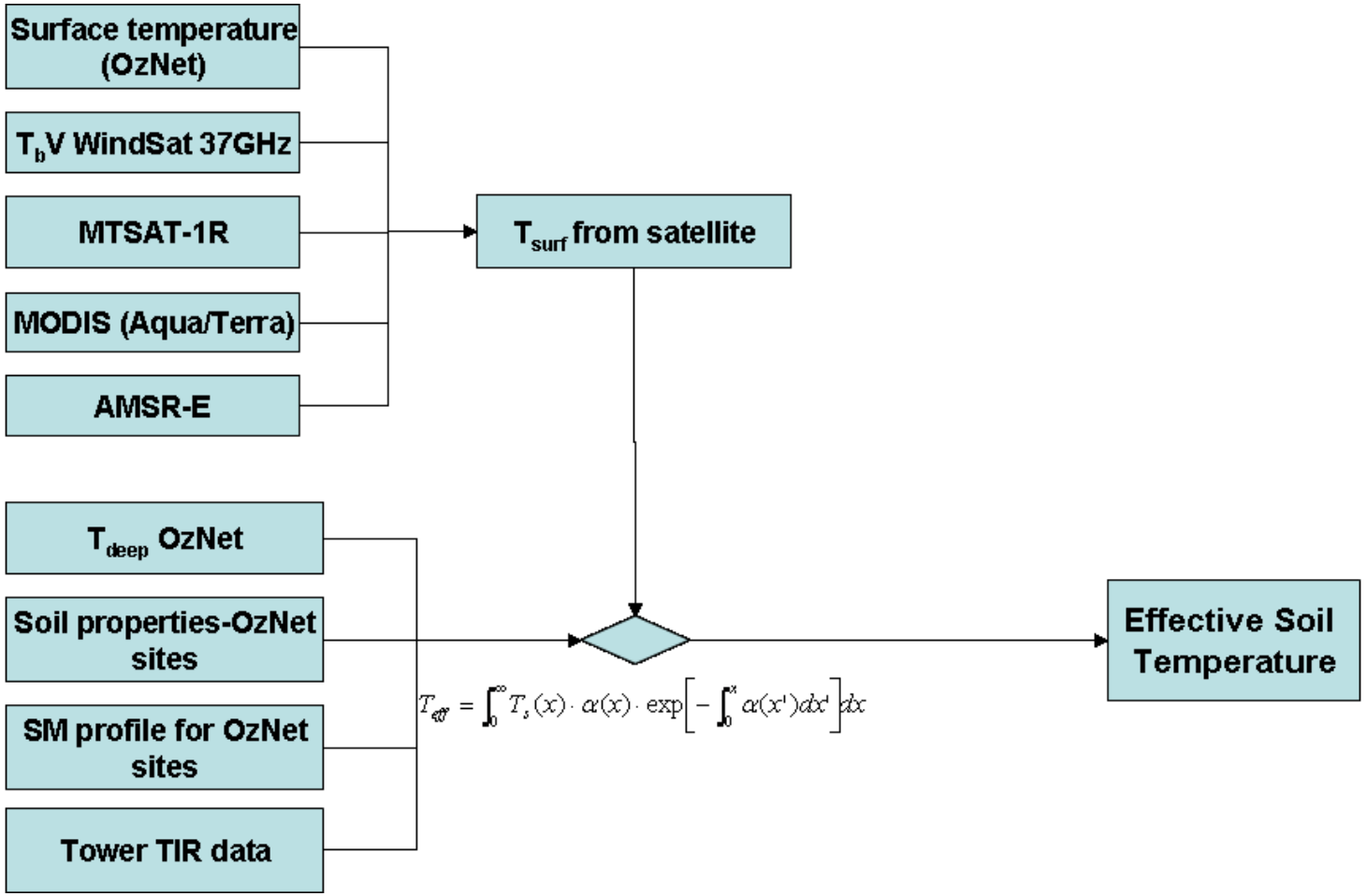
- Can effective temperature be estimated from MODIS and WindSat satellites to a satisfactory accuracy?
- How estimated VWC from MODIS, WindSat and MTSAT-1R derived Vegetation Indexes can improve retrieved soil moisture?
- Can a multi-sensor approach demonstrate a suitable soil moisture retrieval accuracy using data from NAFE'06 and AACES?
- How a multi-sensor approach can improve the SMOS soil moisture product?

Datasets

- NAFE'06 (National Airborne Field Experiment)
- AACES (Australian Airborne Cal/Val Experiment for SMOS)
- SMOS (L1c, L2)
- MODIS
- WindSat
- MTSAT-1R
- OzNet monitoring stations
- BoM Forcing Data

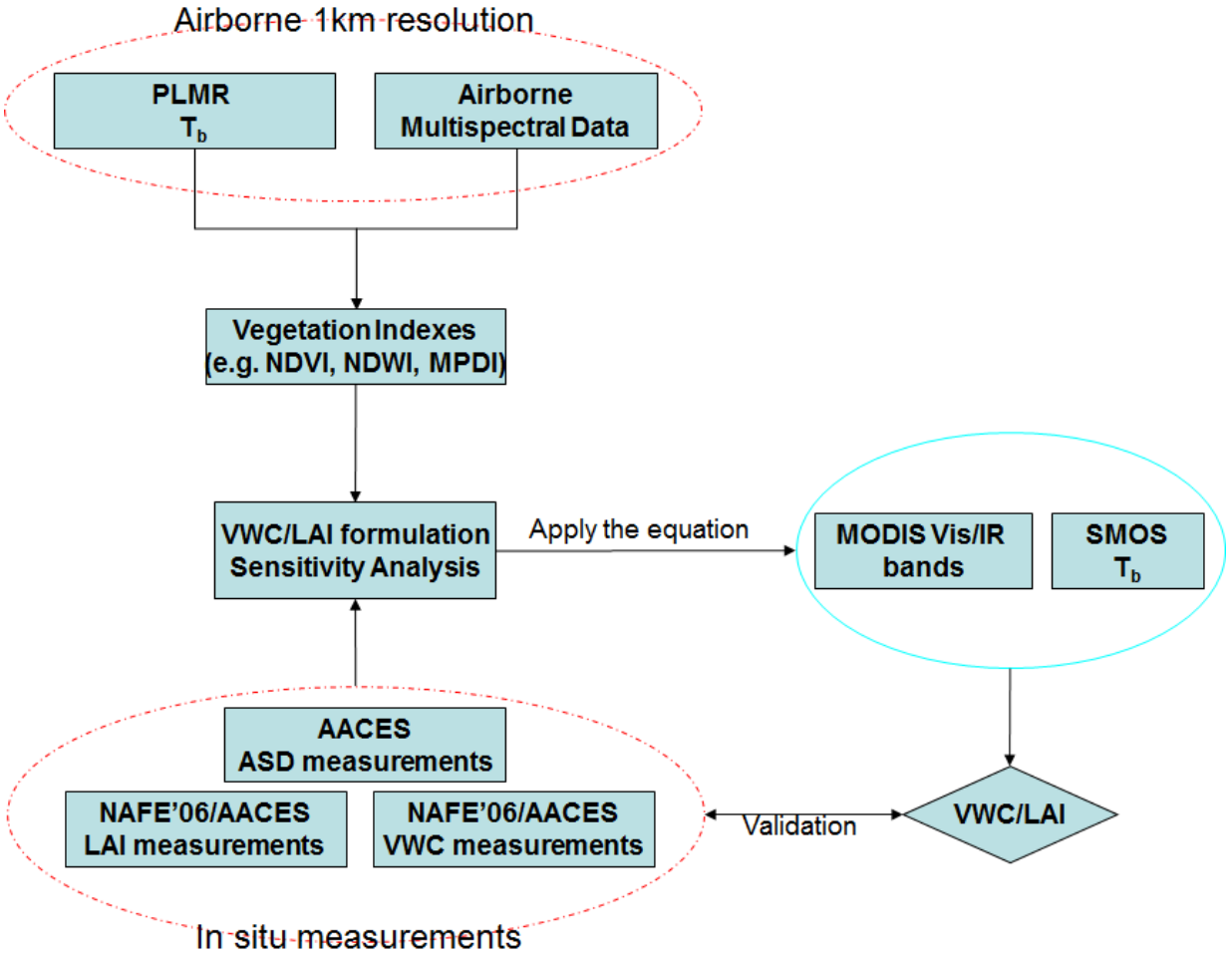
Approach

Q1: Effective Soil Temperature



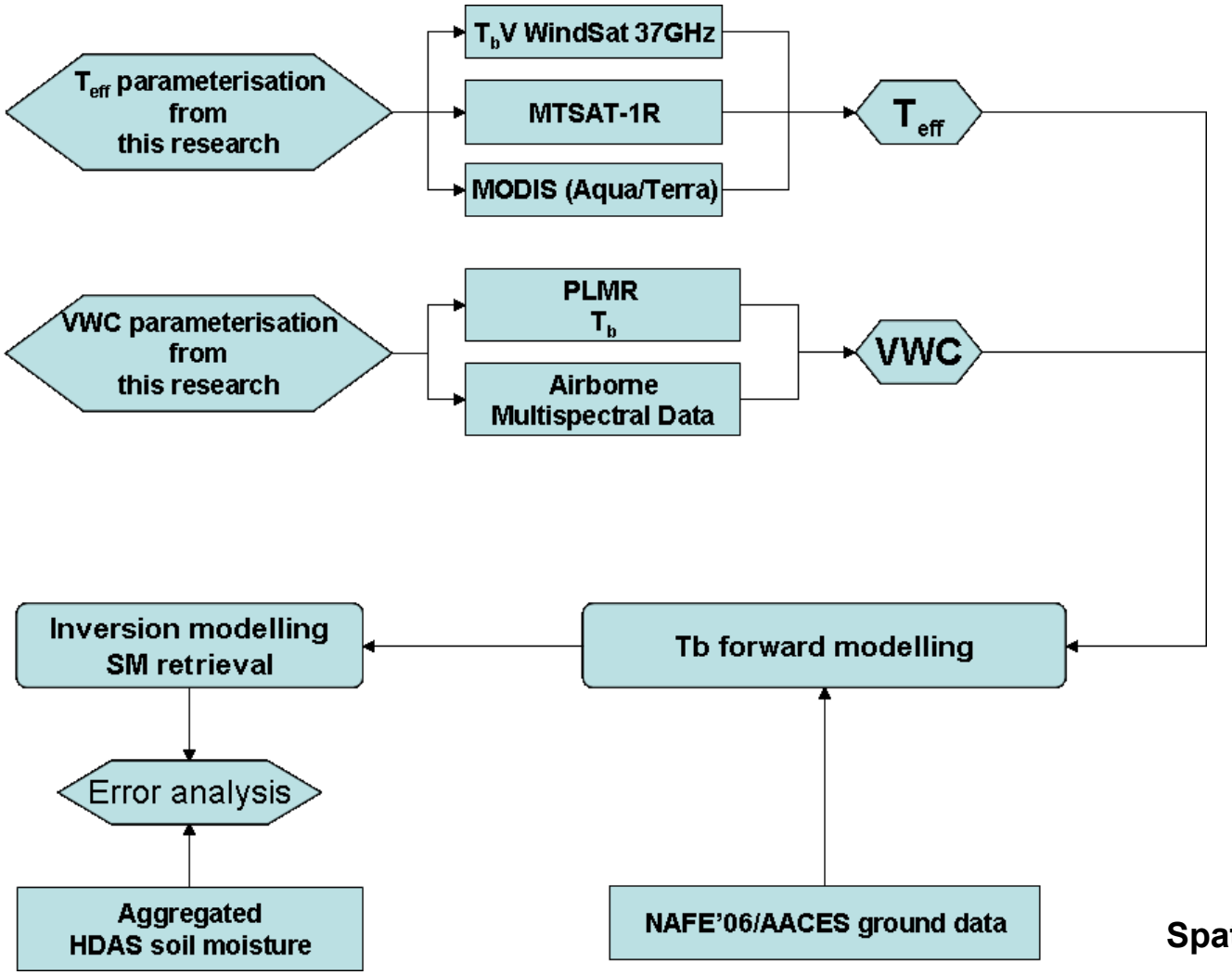
Approach

Q2: Vegetation Water Content



Approach

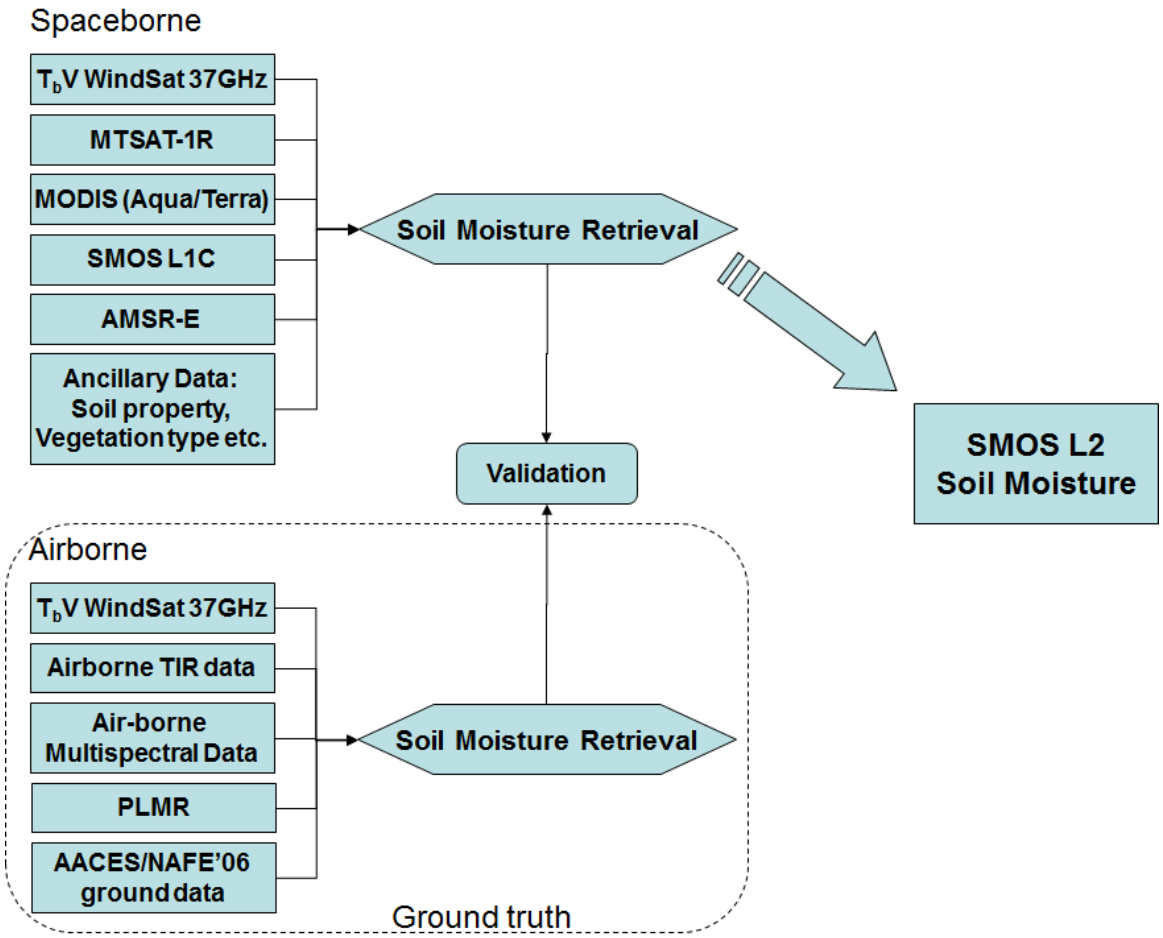
Q3: Airborne Multi Sensor Retrieval



Spatial Resolution: 1km

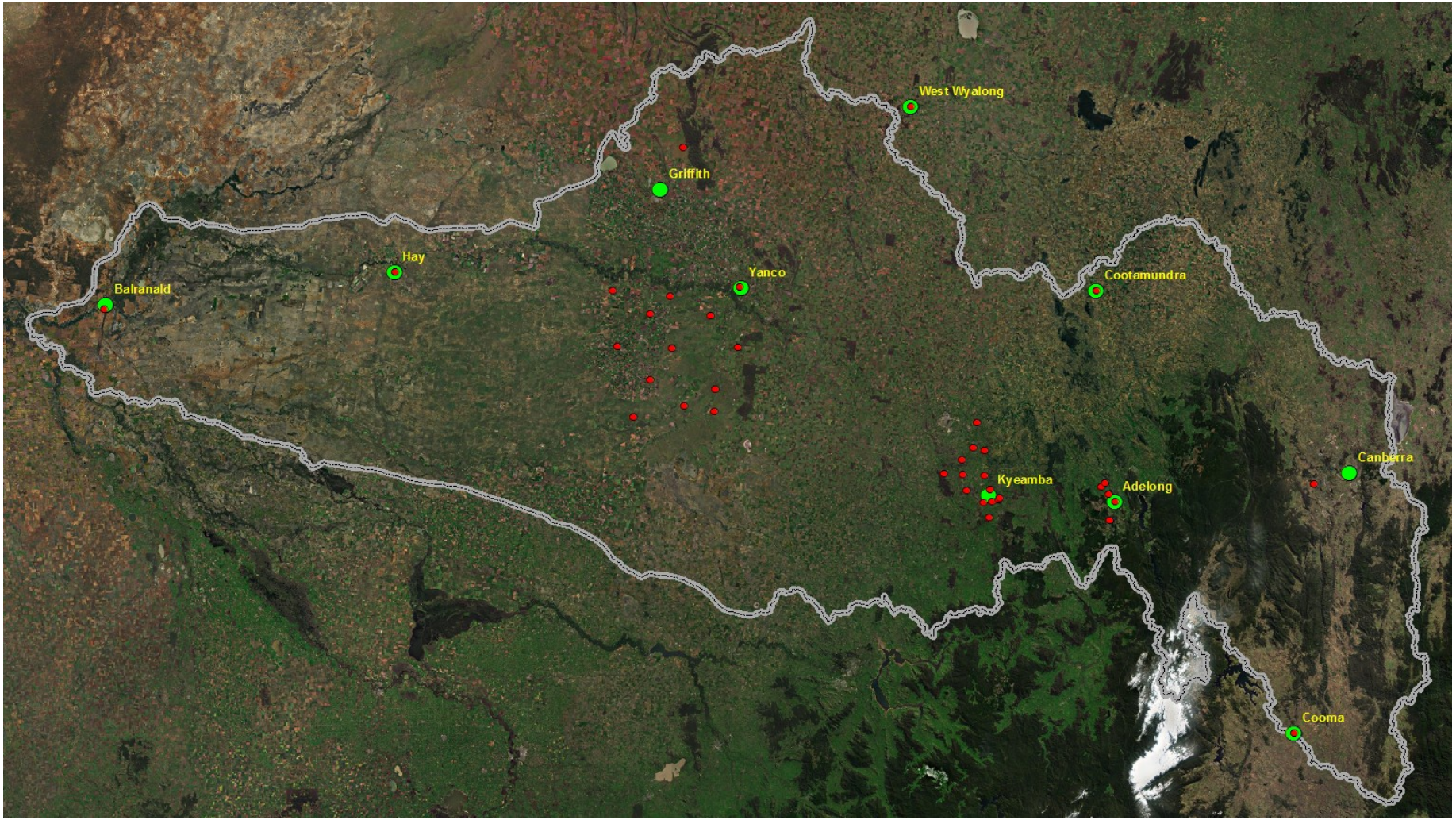
Approach

Q4: Spaceborne Multi-Sensor Retrieval

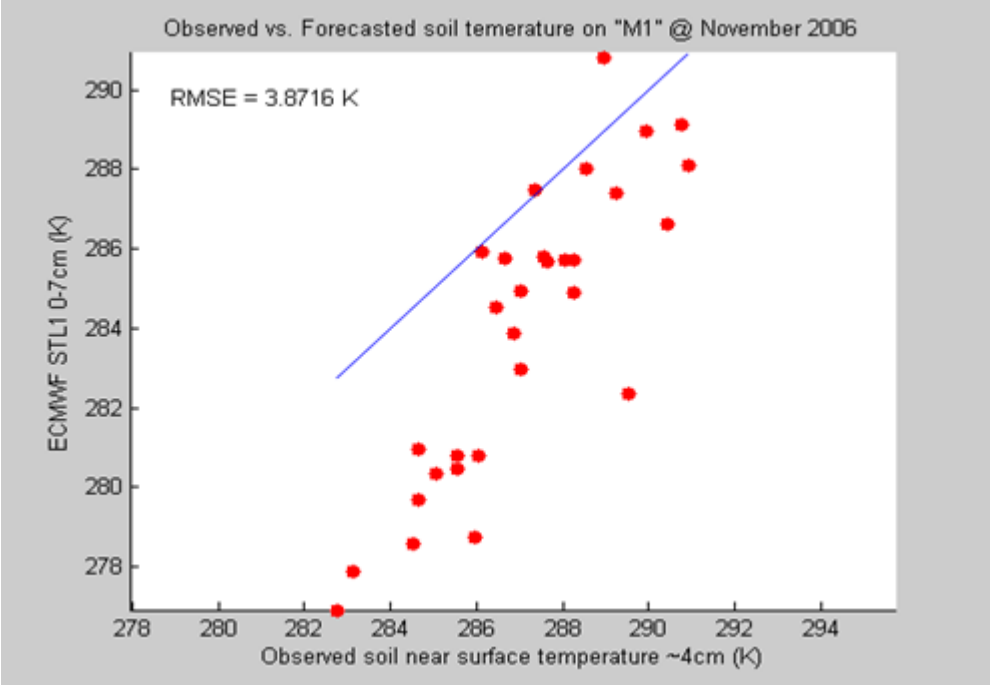


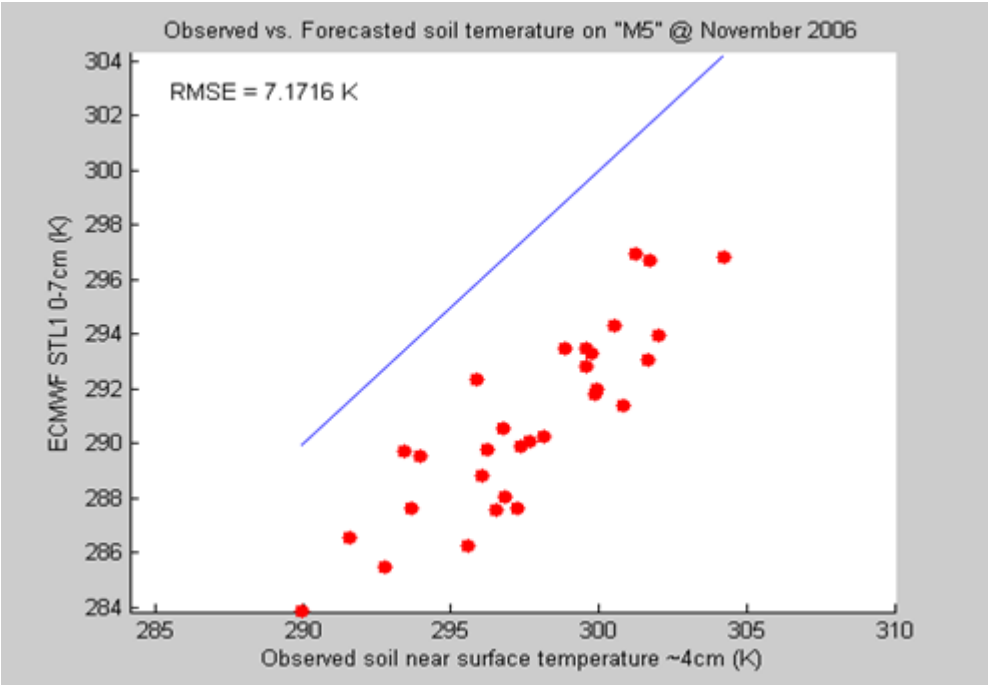
Spatial Resolution: ~50km

Study Area

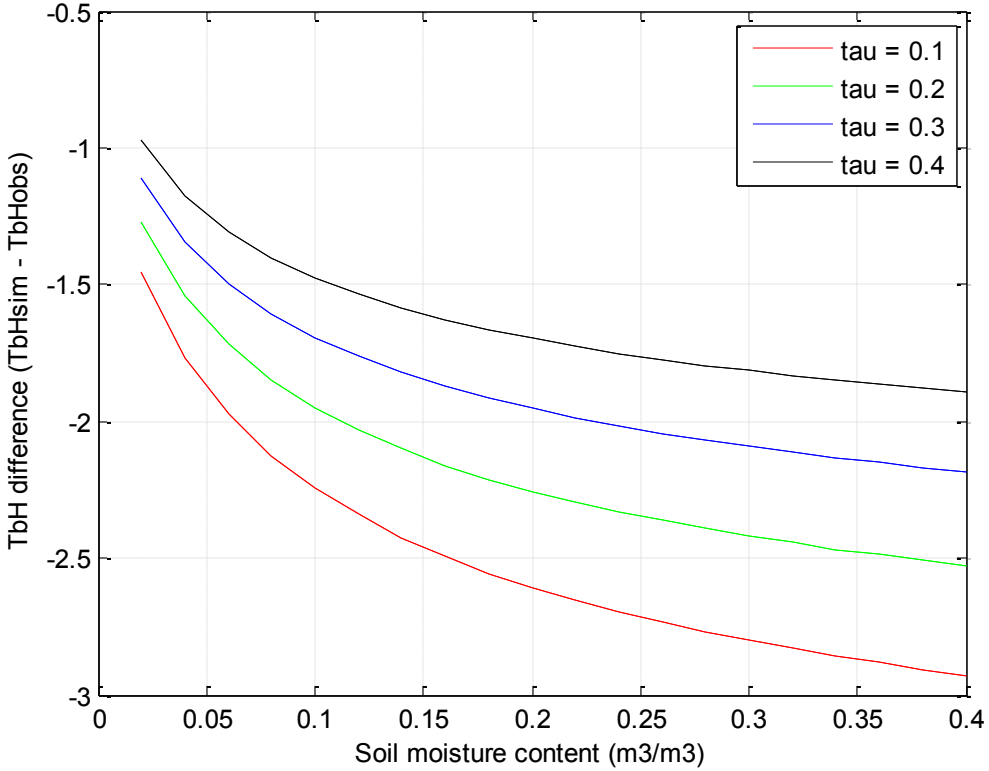

West Wyalong
Griffith
Hay
Balranald
Yanco
Cootamundra
Canberra
Kyeamba
Adelong
Cooma

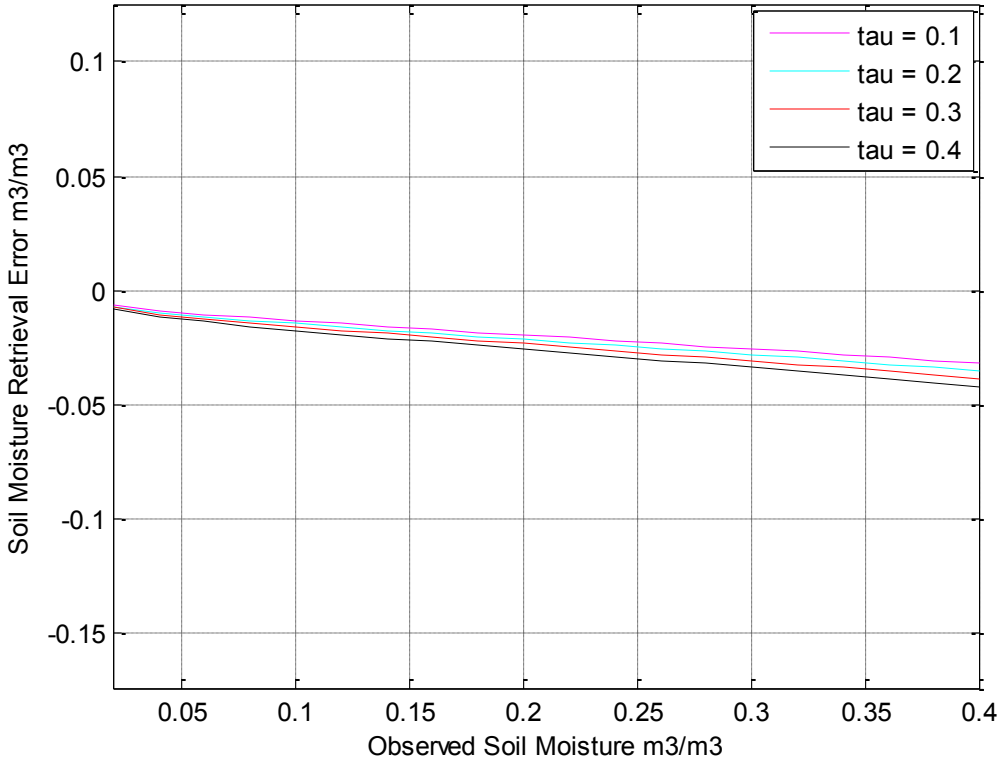
Observed vs. forecasted soil temperature





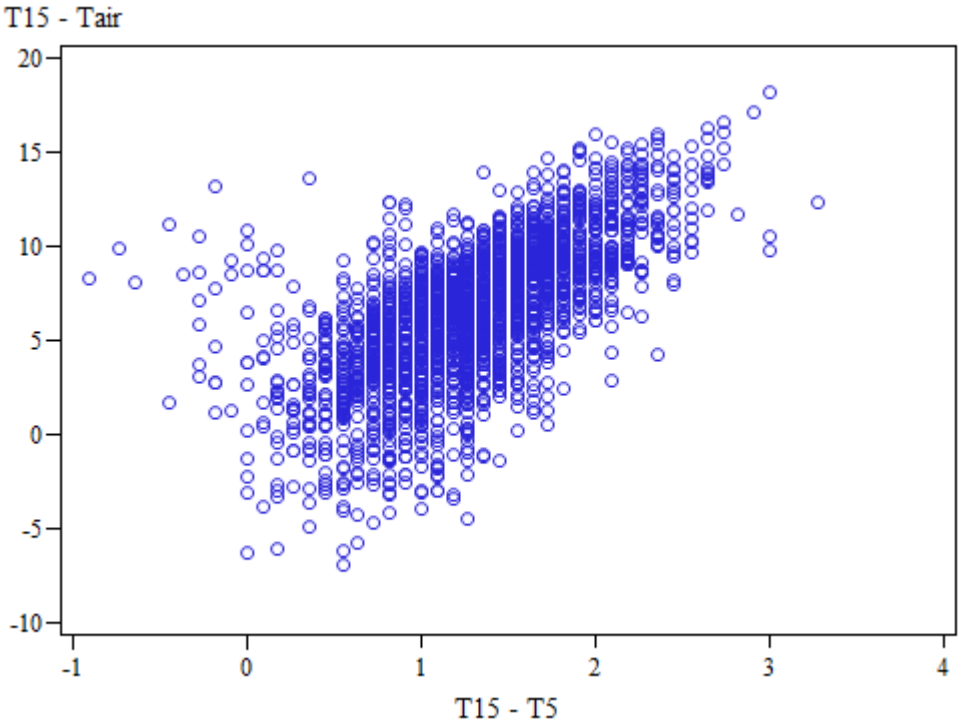
Tb Perturbation (-4 K for STL1)



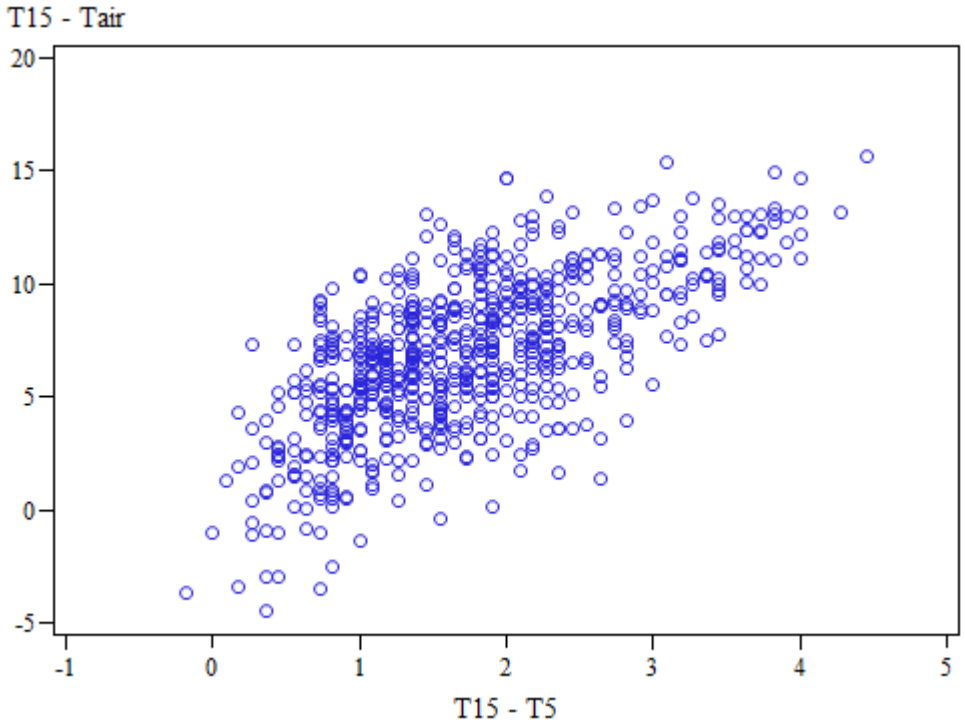


*Assuming vegetation temperature and deep soil temperature are correct sand 0.6, clay 0.2 using default values for L-MEB

Temperature variations @ 6AM

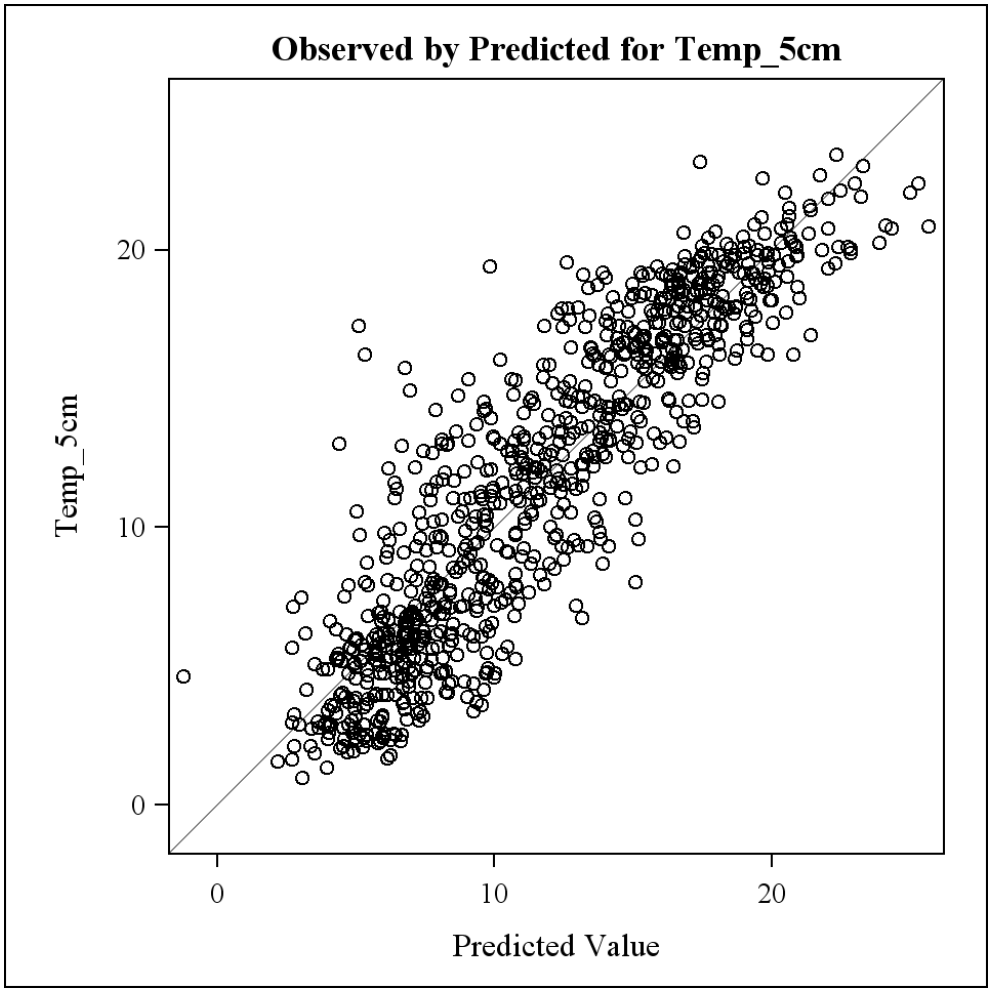


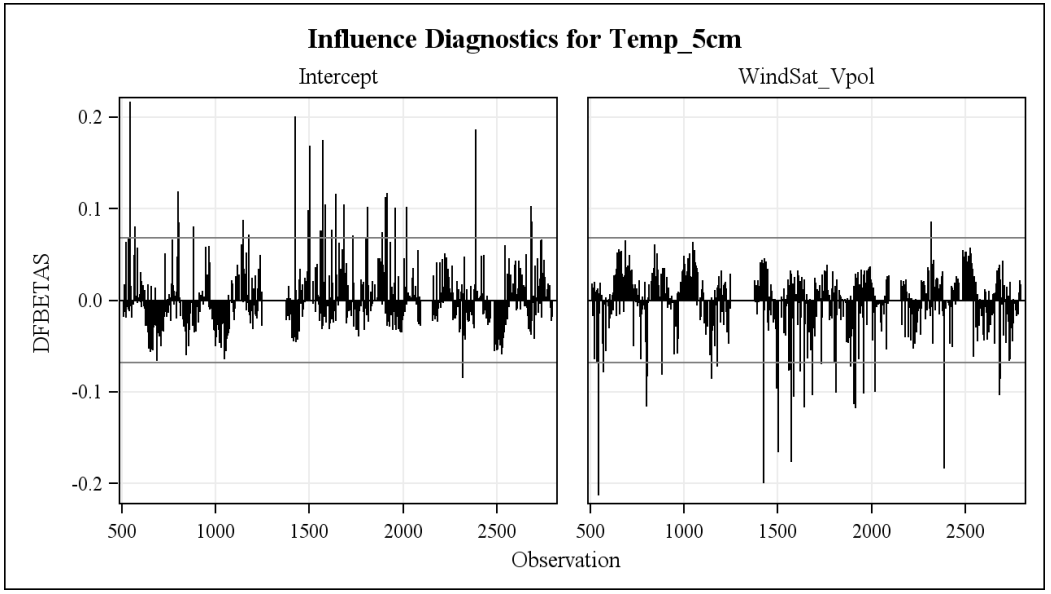
M1



M5

Linear Regression (M1)





Root MSE	2.54137
R-Square	0.8037

Multi-Linear Regression (M1)

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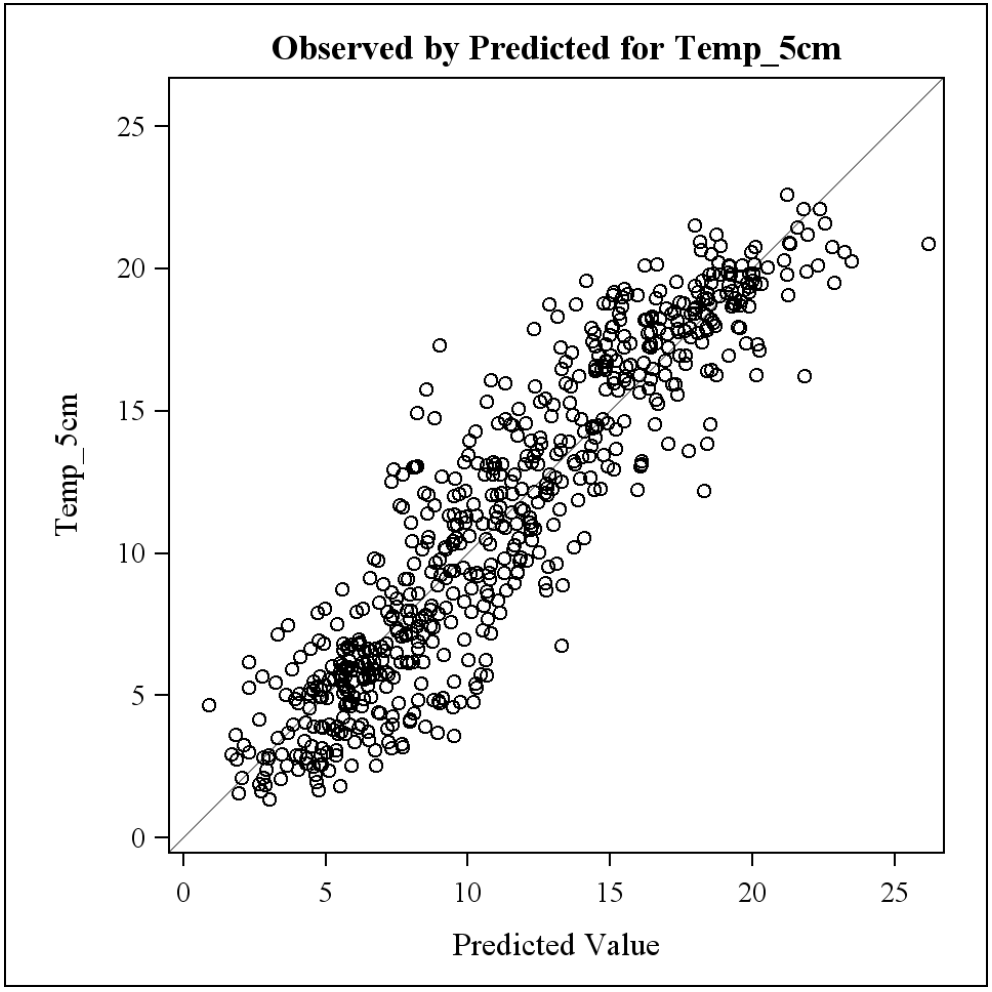
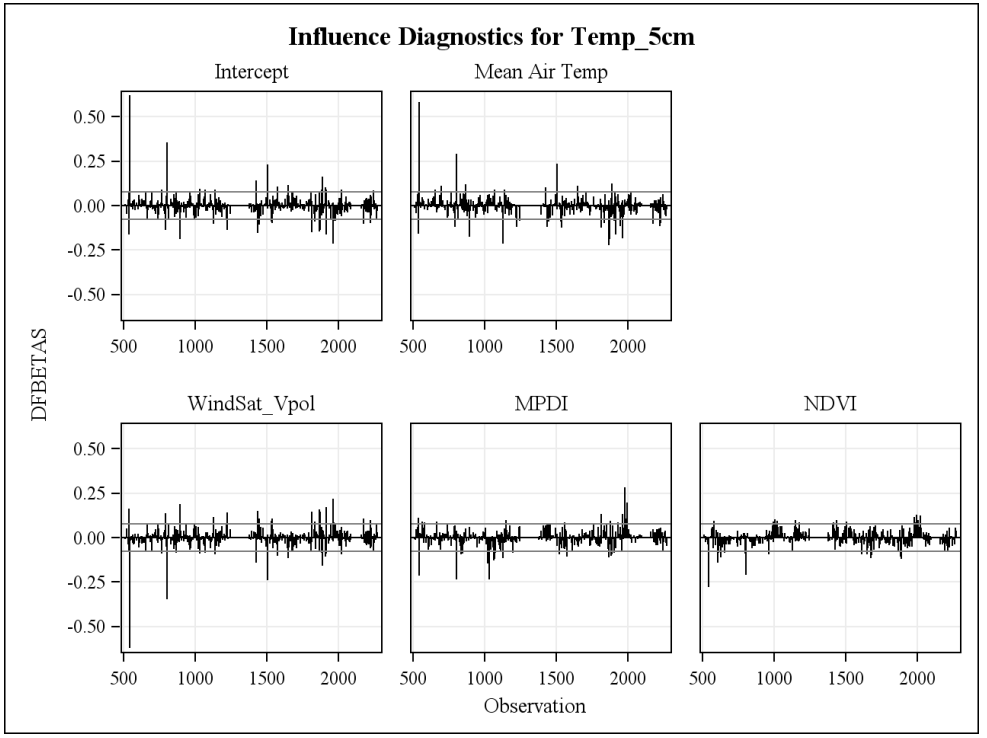
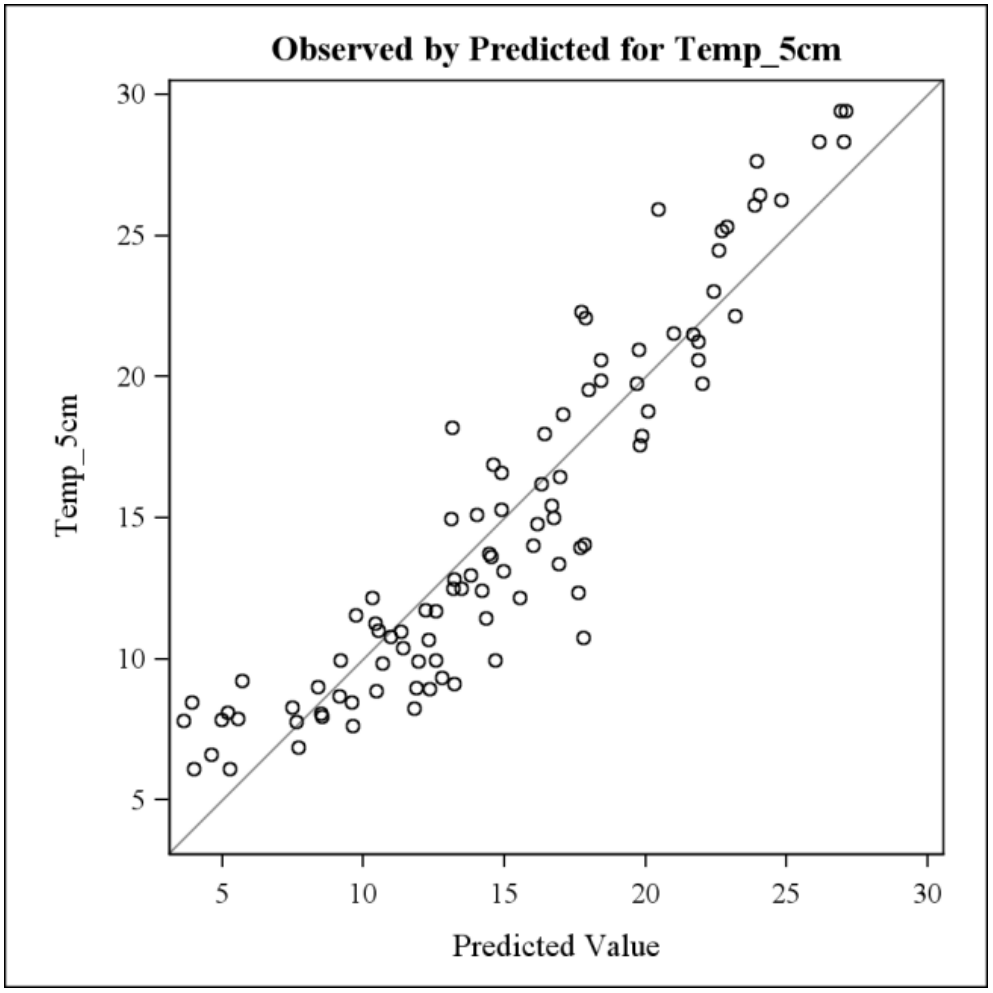
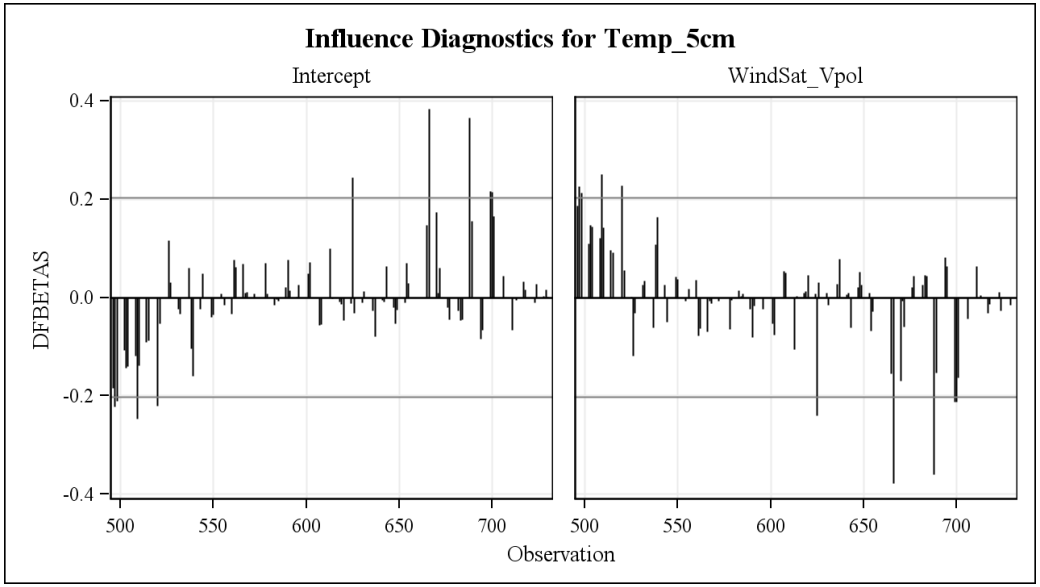




Root MSE	2.23786
R-Square	0.8449

Linear Regression (M5)





Root MSE	2.43343
R-Square	0.8542

Multi-Linear Regression (M5)

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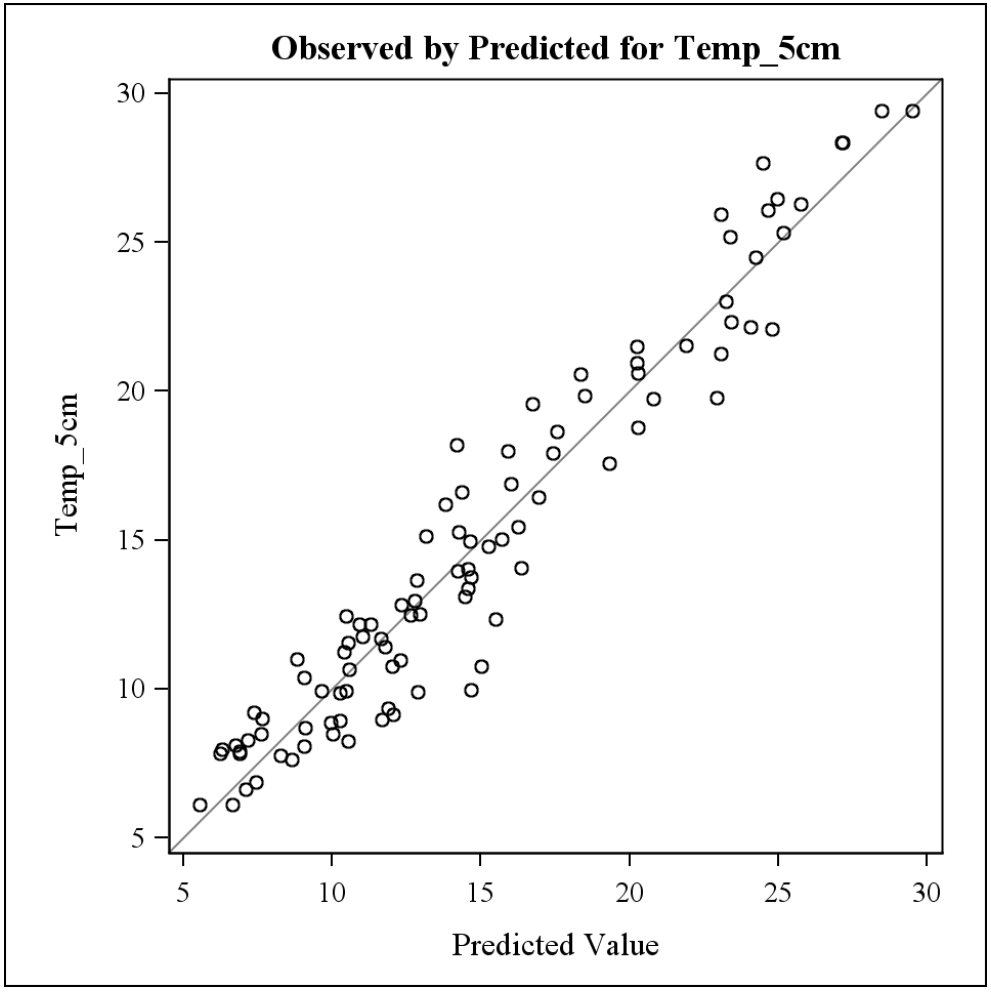

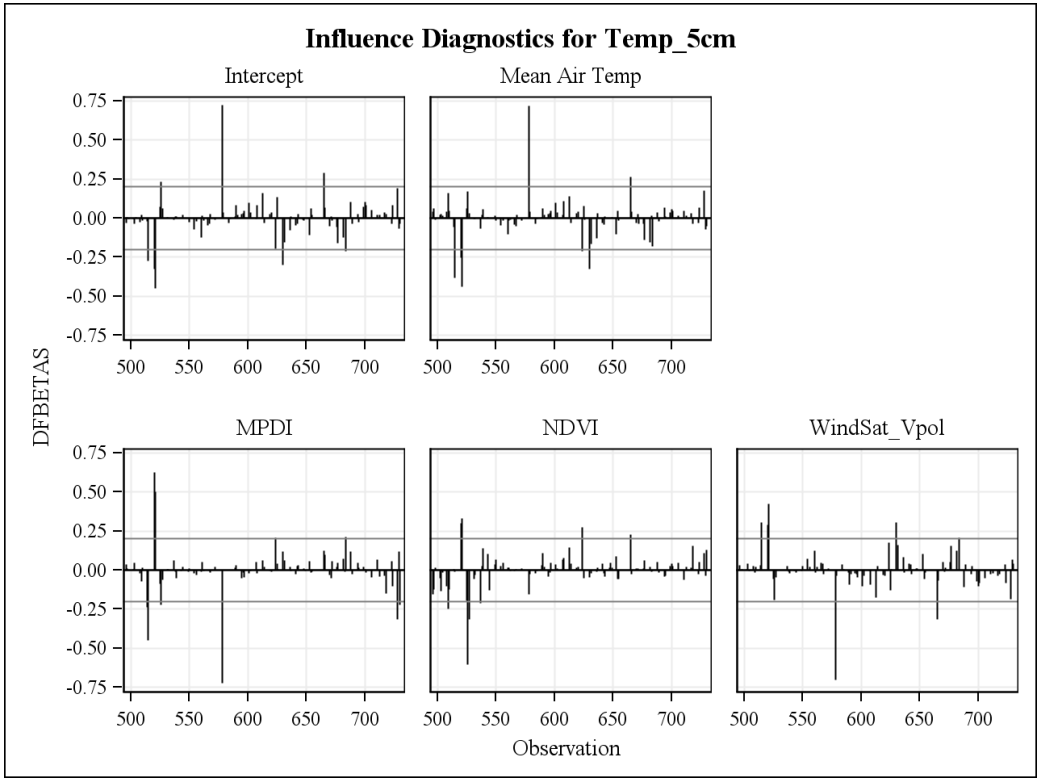

Root MSE	1.68391
R-Square	0.9324

ECOCLIMAPS LAI for Yanco (November)

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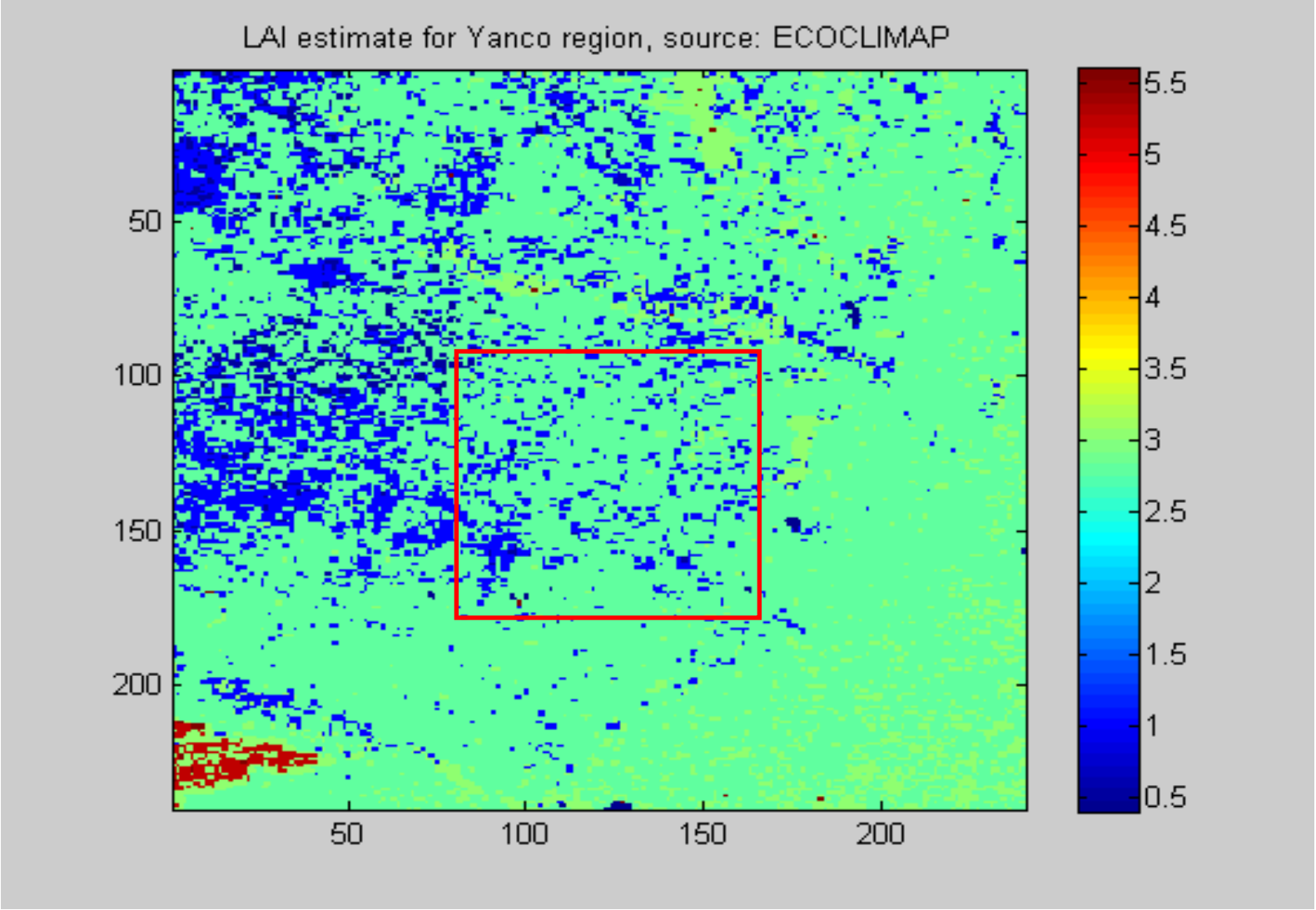

Measured vs. estimated LAI (ECOCLIMAP) November 2006

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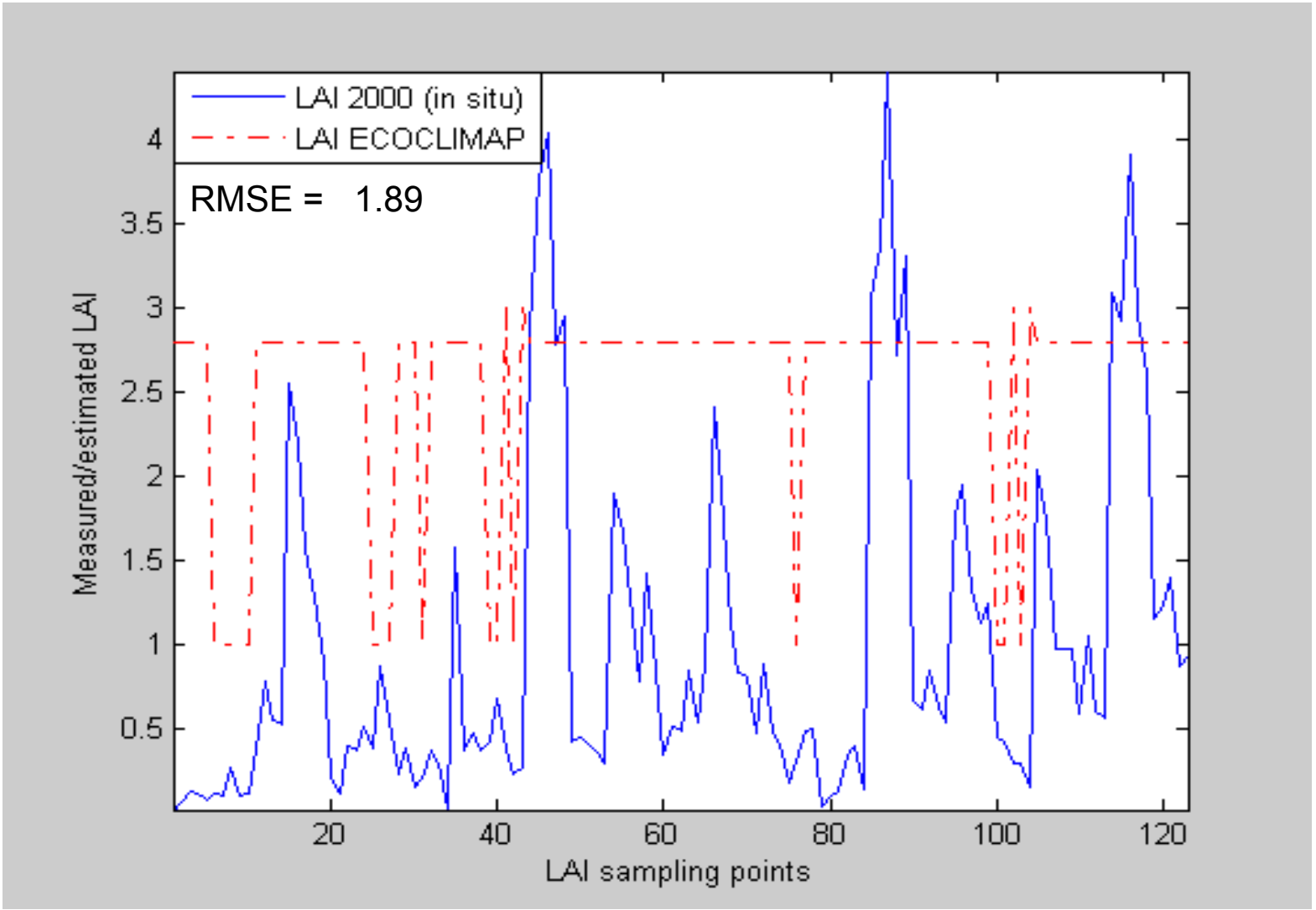

Thank you!