

Downscaling of SMOS soil moisture using MODIS data over an agricultural site

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Introduction:

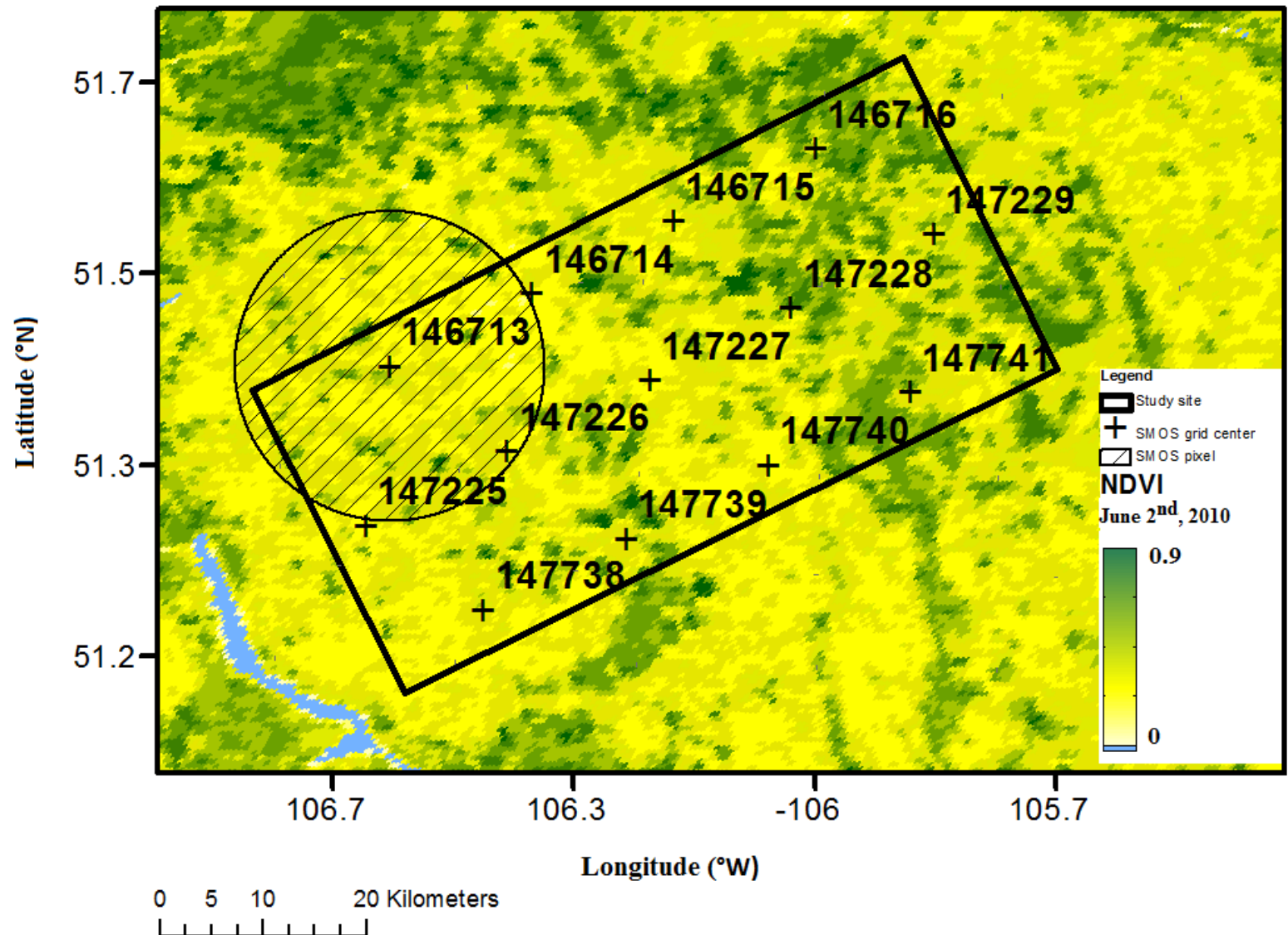
SMOS/ soil moisture product

- ✓ 2D interferometric radiometer
- ✓ L band (21 cm, 1.4 GHz)
- ✓ Soil moisture at 5 cm of depth
- ✓ An accuracy of 4% on volumetric soil moisture
- ✓ Less than 3 days of revisit period
- ✓ Spatial resolution ~ 40 km

Objectif

- ✓ Estimate the soil moisture at 1 km scale by a combination of SMOS soil moisture product with MODIS Aqua/Terra data

Study site



Data

June 13th (JD 164) and 14th (JD 165), 2010

✓ MODIS Terra/Aqua

- Overpass times (local time):

10:30 (Terra) and 12:30 (Aqua)

✓ SMOS SM product (SMUDP2 - v5.01)

- Overpass times (local time):

6:00 (Ascending) and 18:00 (Descending)

Methodology:

Downscaling relationship

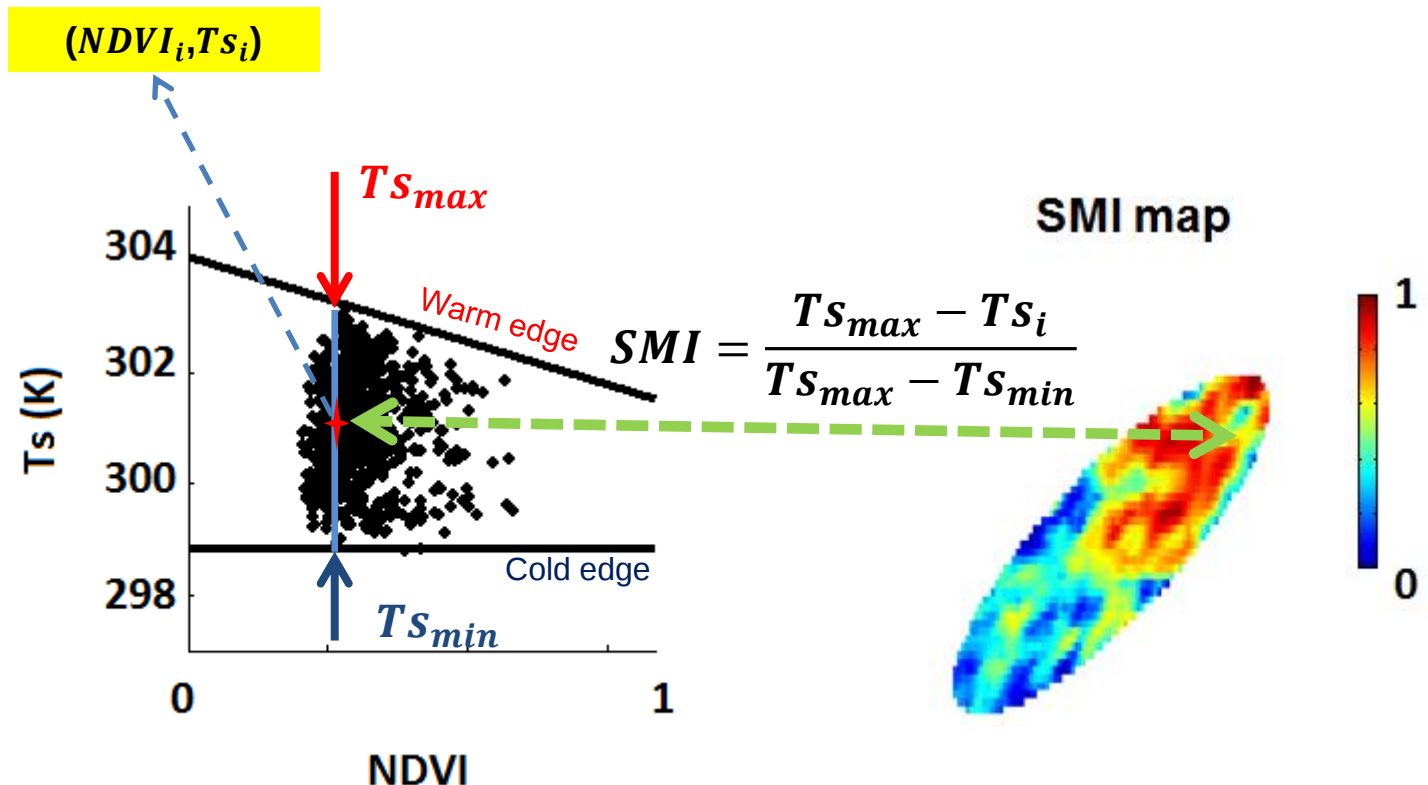
$$SM_{1km} = \langle \mathbf{SM} \rangle + \frac{\partial SM}{\partial SMI} \cdot (SMI_{1km} - \langle \mathbf{SMI} \rangle)$$

(Merlin et al., 2013)

- ✓ SM : Soil Moisture
- ✓ SMI: Soil Moisture Index
- ✓ $\langle \rangle$: defined at SMOS scale (40 km)

Methodology: Soil Moisture Index (SMI)

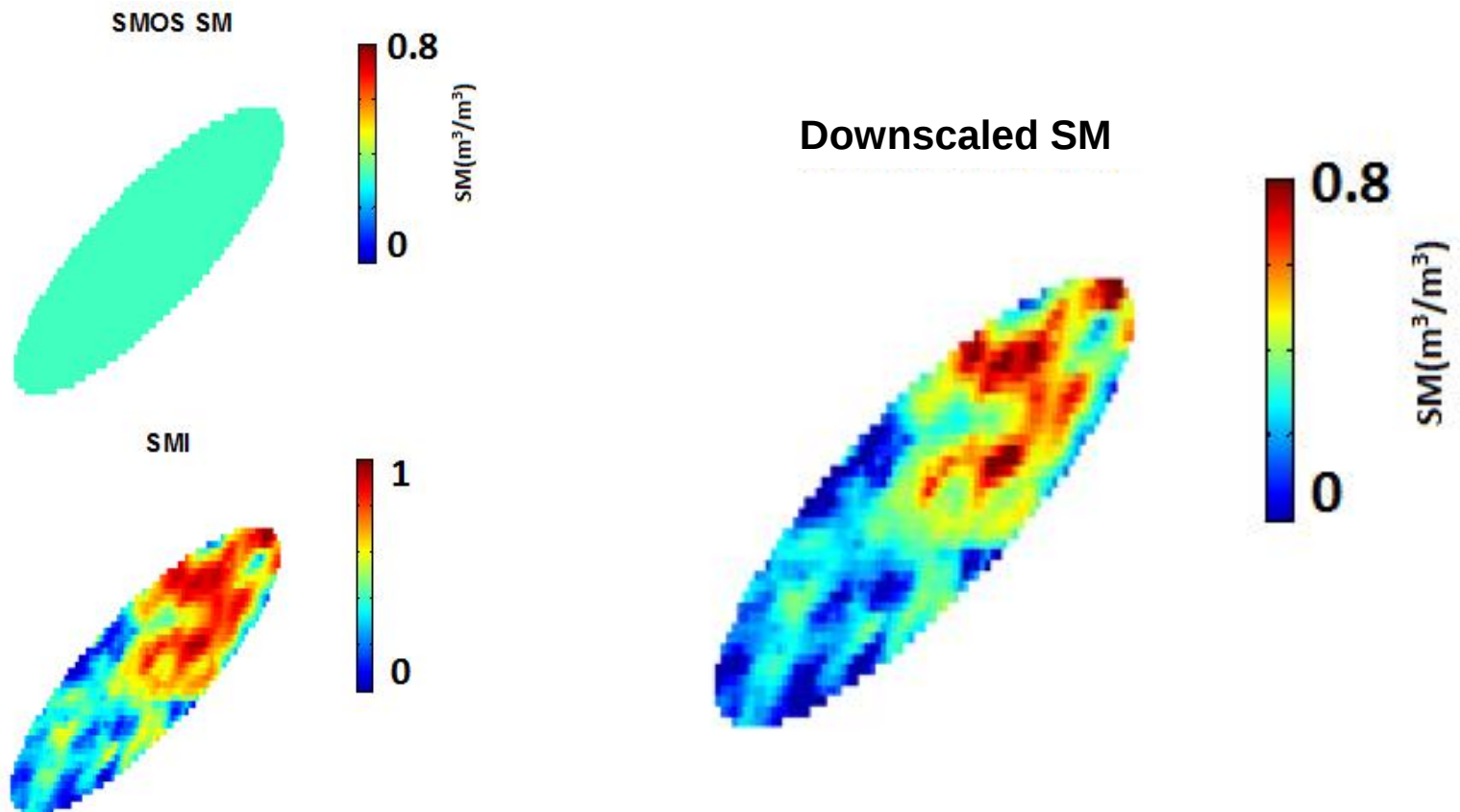
SMI = Soil Evaporative Efficiency (SEE)



Methodology:

$$SM_{1km} = \langle SM \rangle + \frac{\partial SM}{\partial SMI} \cdot (SMI_{1km} - \langle SMI \rangle)$$

✓ Linear model: $SM = SMI \cdot SM_p$ / SM_p : Soil parameter = $\frac{\langle SM \rangle}{\langle SMI \rangle}$

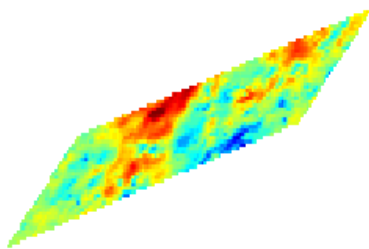


Results:

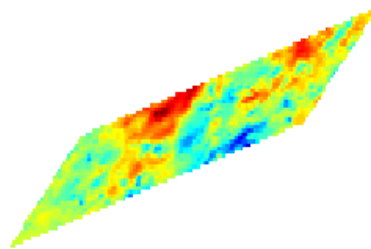
Soil moisture maps at 1 km resolution

SMOS / MODIS-Aqua

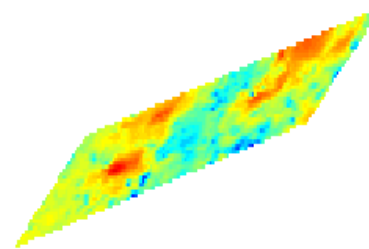
JD 164 - 6 a.m



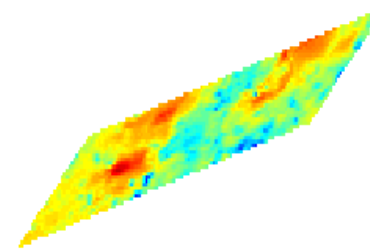
JD 164 - 6 p.m



JD 165 - 6 a.m

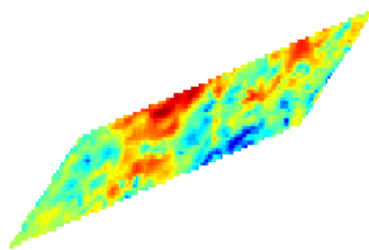


JD 165 - 6 p.m

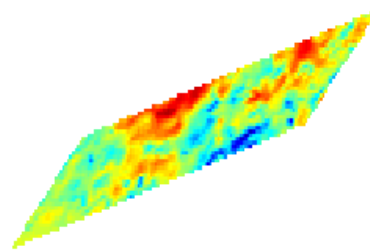


SMOS / MODIS-Terra

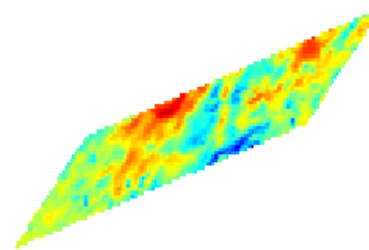
JD 164 - 6 a.m



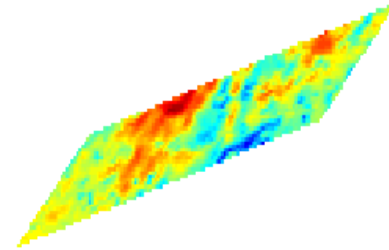
JD 164 - 6 p.m



JD 165 - 6 a.m



JD 165 - 6 p.m



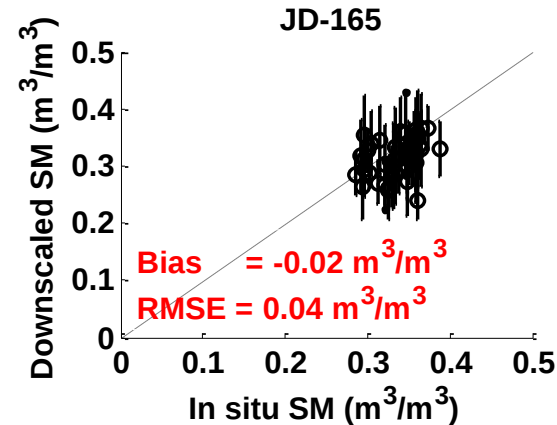
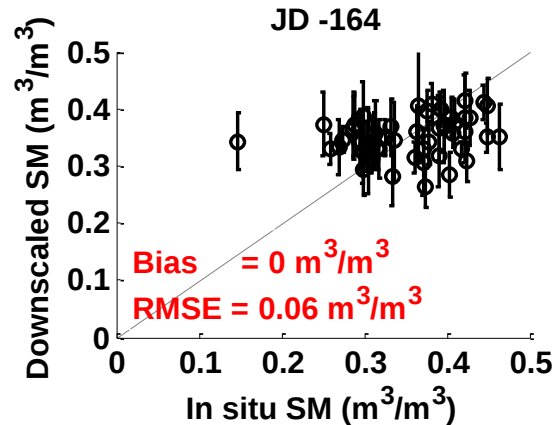
SM (m^3/m^3)



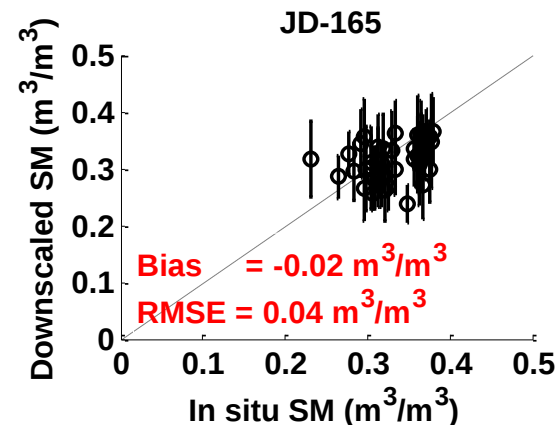
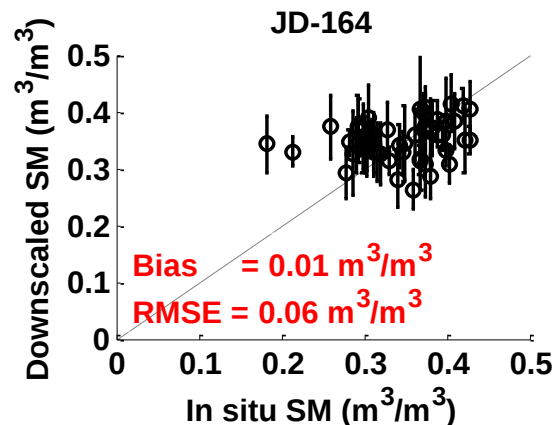
Results:

Downscaled SM vs in situ SM at 6 a.m.

SMOS / MODIS-Aqua



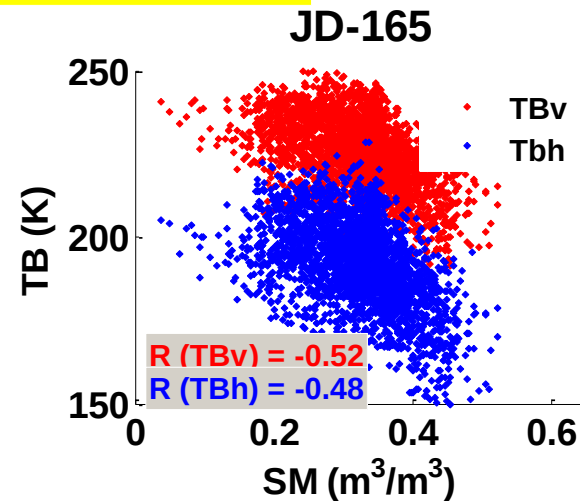
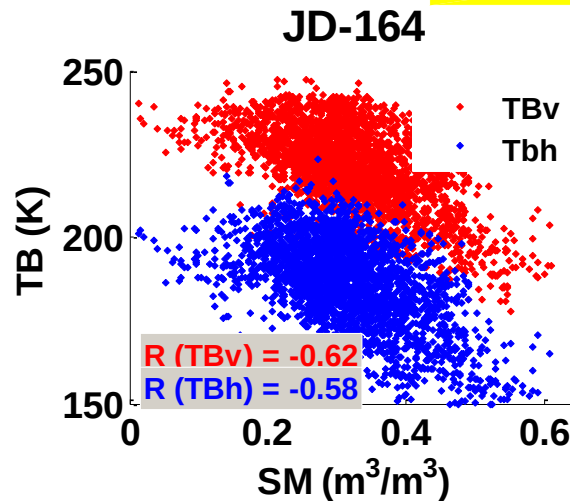
SMOS / MODIS-Terra



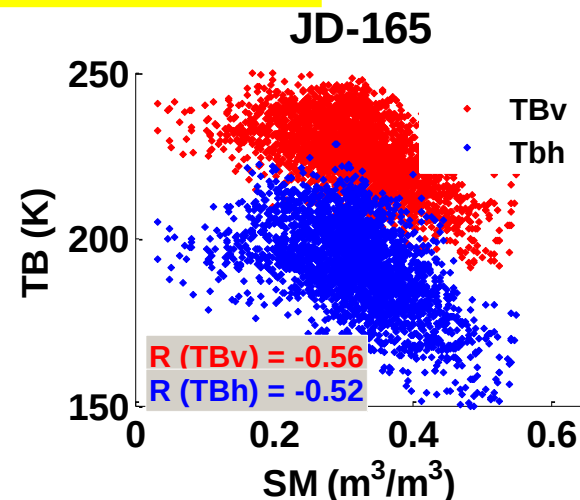
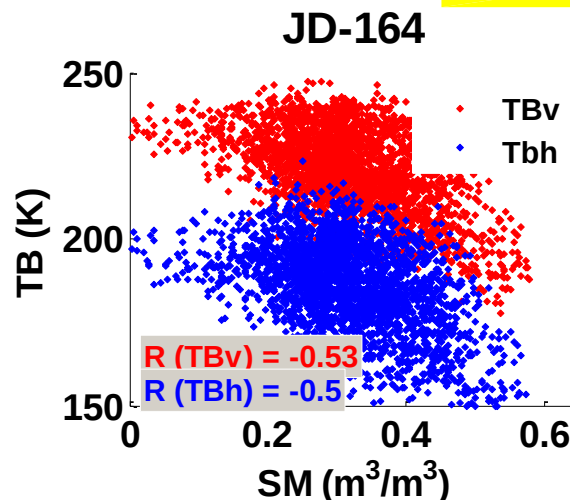
Results:

Downscaled SM vs TB (L band) at 6 a.m.

SMOS / MODIS-Aqua

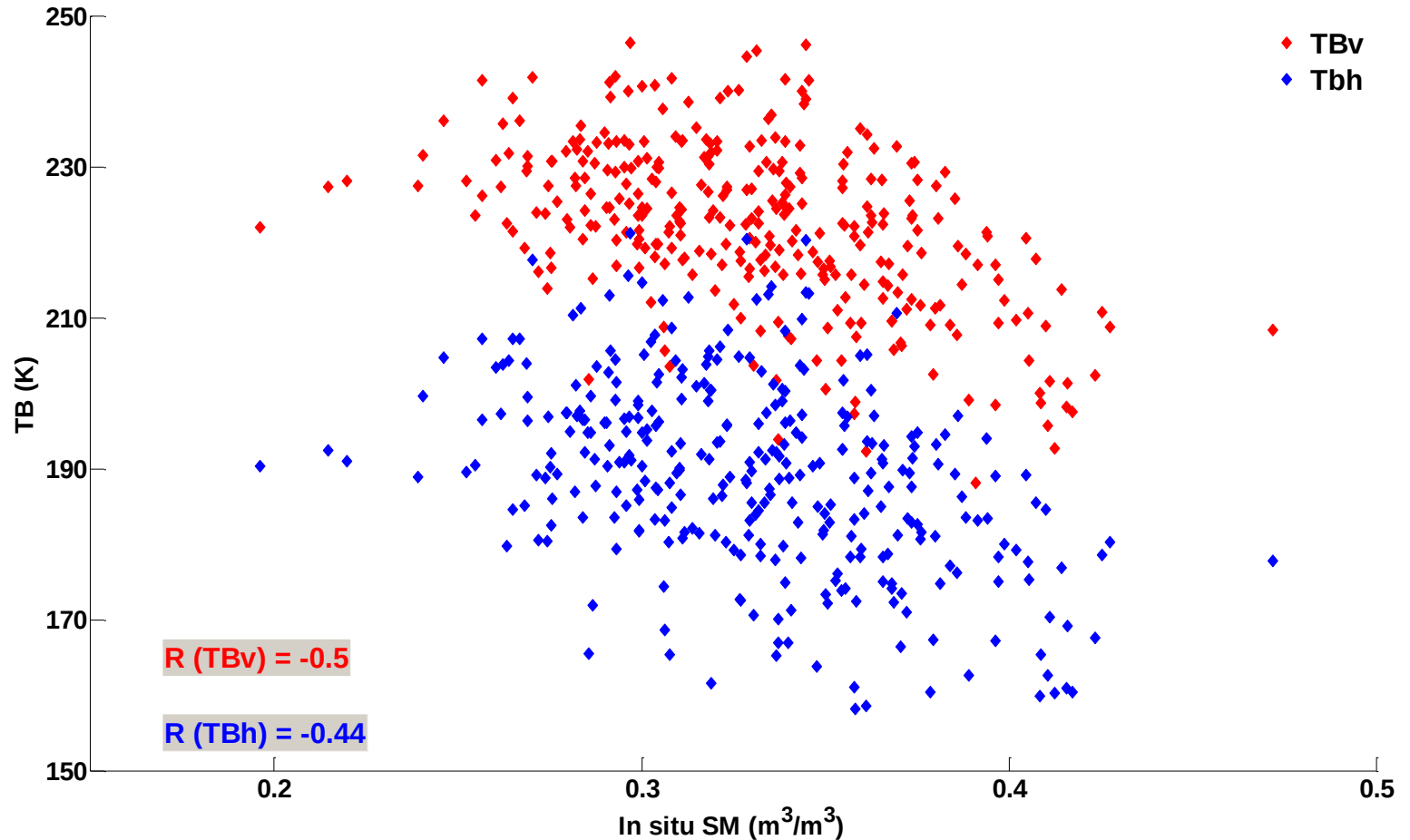


SMOS / MODIS-Terra



Results:

In situ SM vs TB (L band) at 6.am



Future work

- ✓ Using SMAPVEX data
- ✓ What can we do for cloudy days?
 - This method is not useful for a cloudy day because of MODIS data (Ts and NDVI) availability
 - For Canex-SM10 days , just 2 of 15 are no cloudy days.

References

- ✓ Merlin, O., Escorihuela, M.J., Miquel Aran Mayoral M.A., Hagolle, O., Al Bitar, Kerr, Y., 2013. Self-calibrated evaporation-based disaggregation of SMOS soil moisture: An evaluation study at 3 km and 100 m resolution in Catalunya, Spain. Remote Sensing of Environment 130, 25–38.
- ✓ <http://pages.usherbrooke.ca/canexsm10/>

Acknowledgments

✓ The authors would like to thank:

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- the **CanEx-SM10** and **SMAPVEX12** funding agencies.
- the **European Space Agency** (ESA) for providing the SMOS data.



Thank you for your attention