Algorithm Updates and Validation Reports for Snow water equivalent and Soil moisture

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The University of Tokyo

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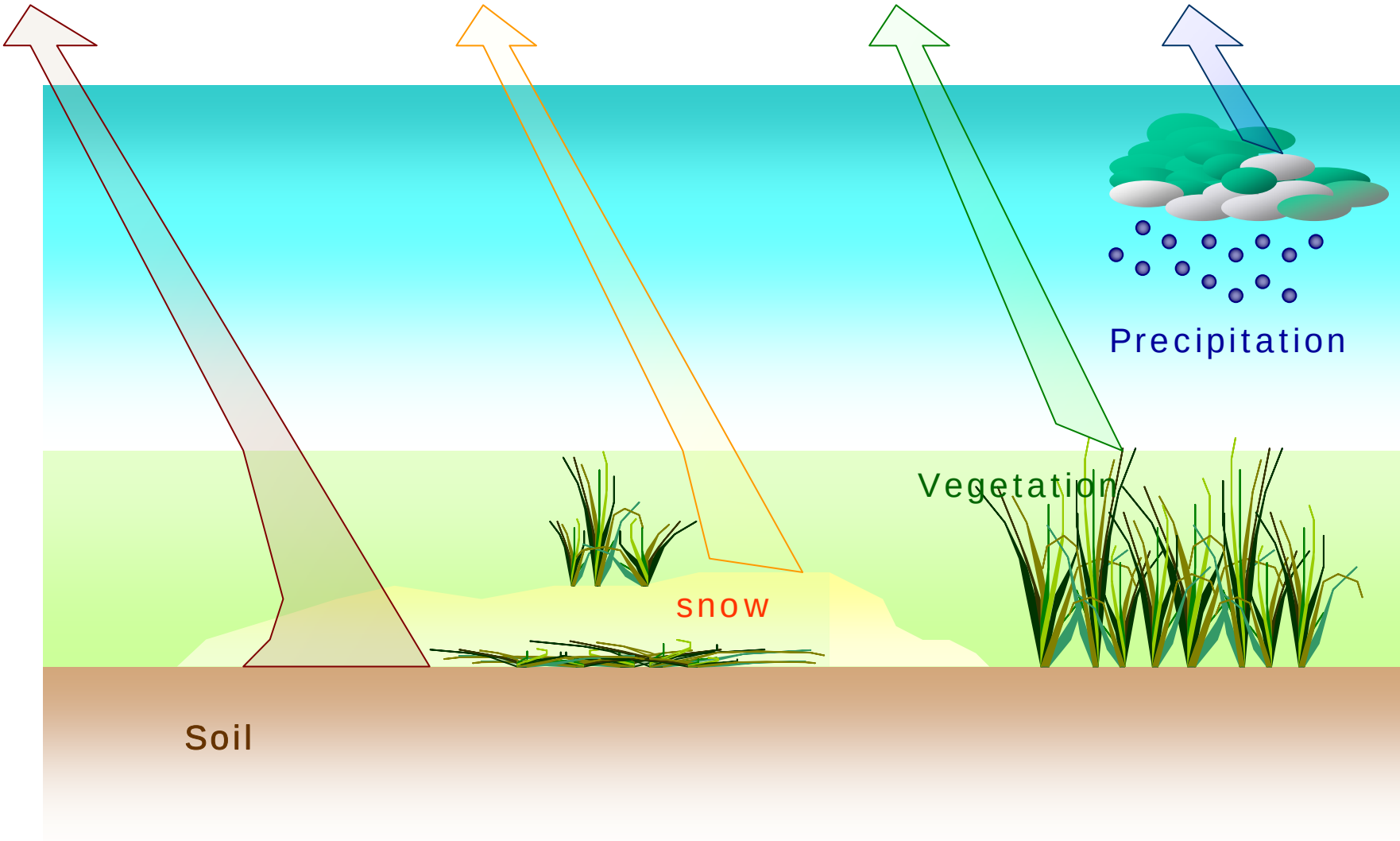
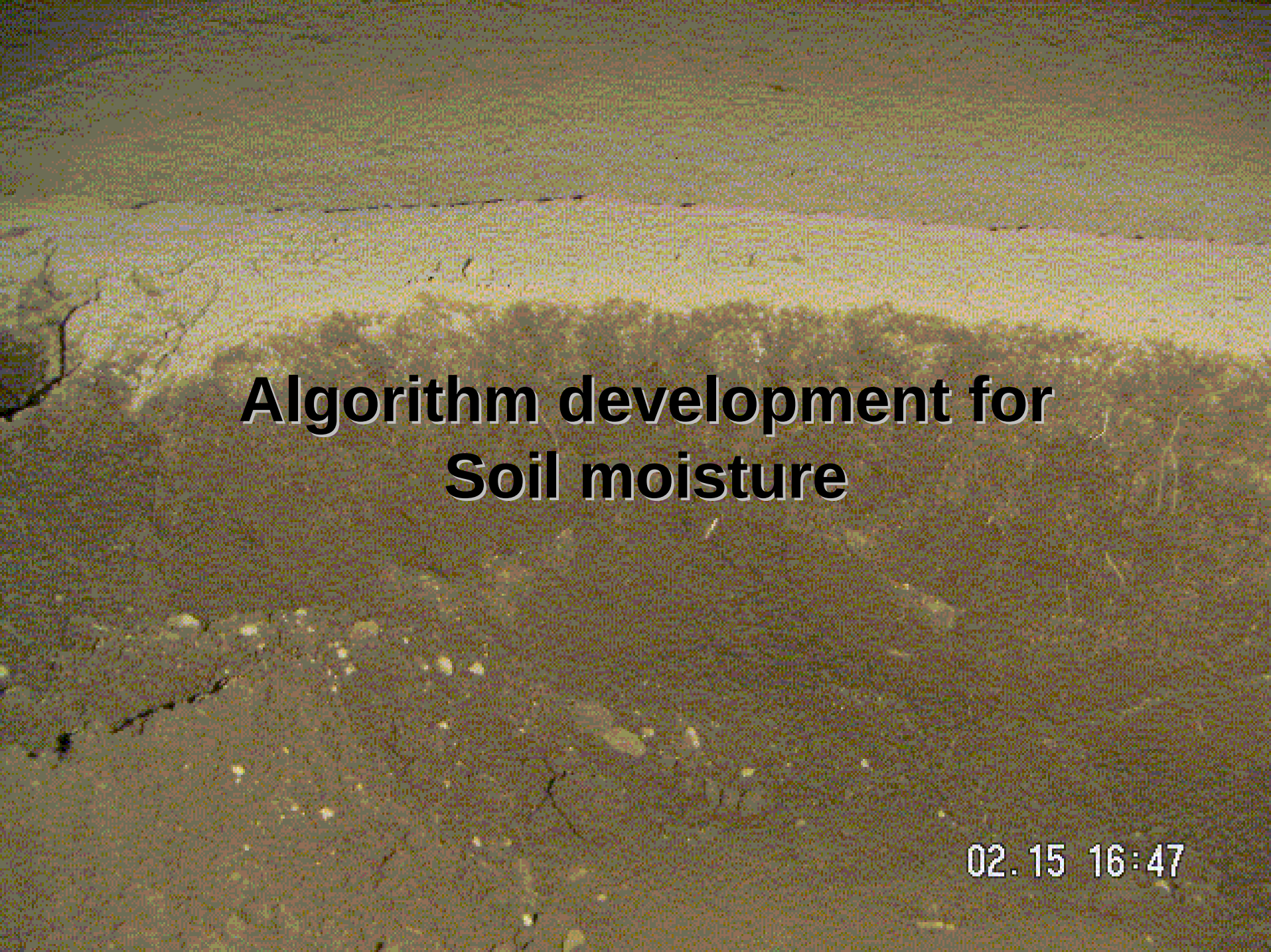
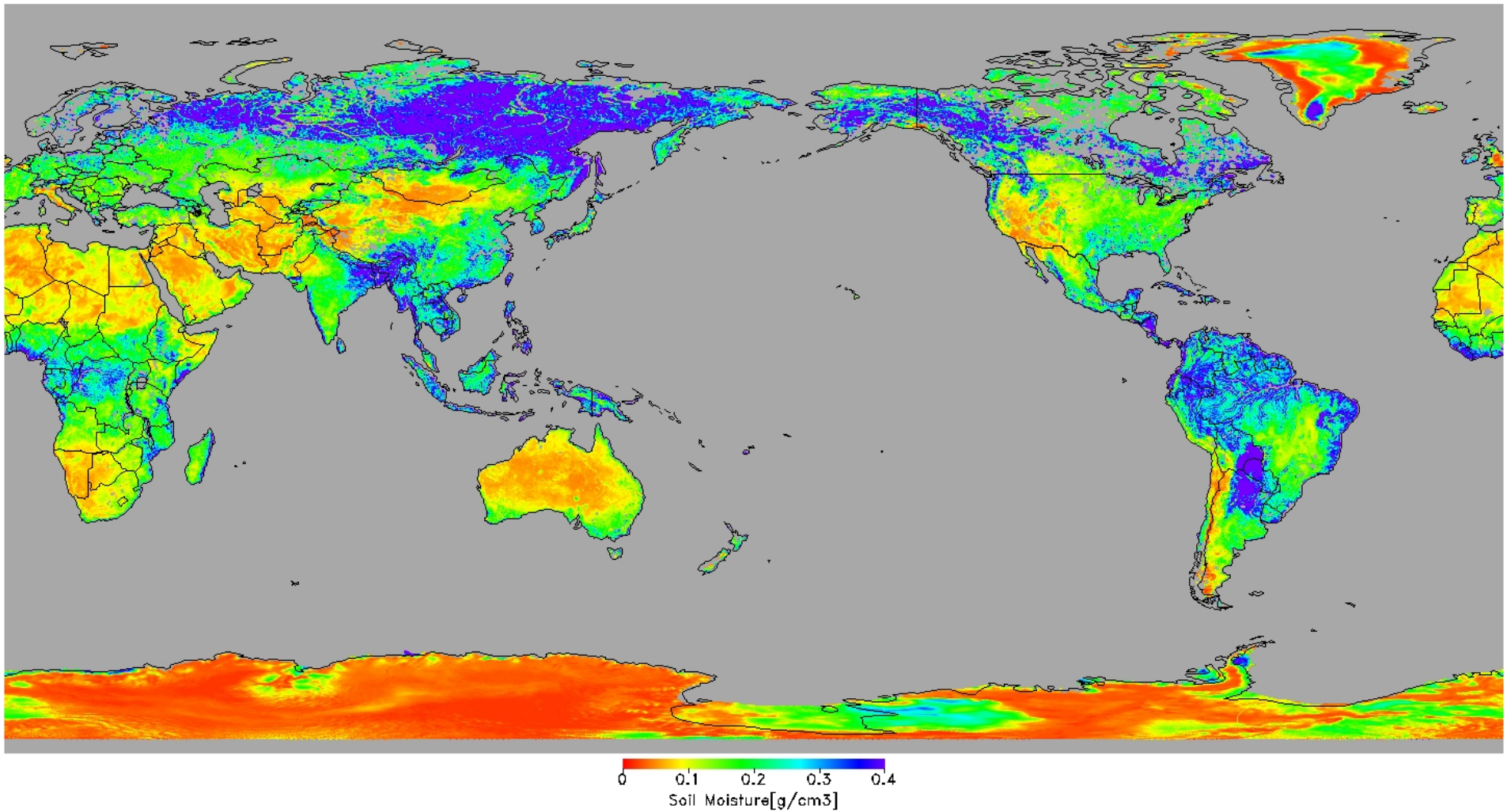
$$T_b = \underline{T_{b(soil)} e^{-\tau_{snow}} e^{-\tau_{vege}}} e^{-\tau_{precip}} + \underline{T_{b(snow)} e^{-\tau_{vege}}} e^{-\tau_{precip}} + \underline{T_{b(vege)}} e^{-\tau_{precip}} + T_{b(precip)}$$



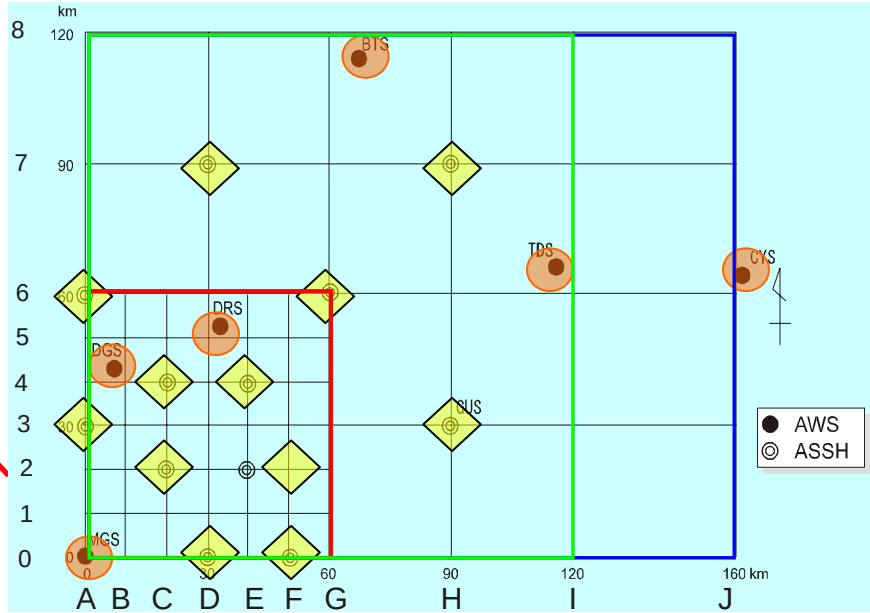
Algorithm development for Soil moisture

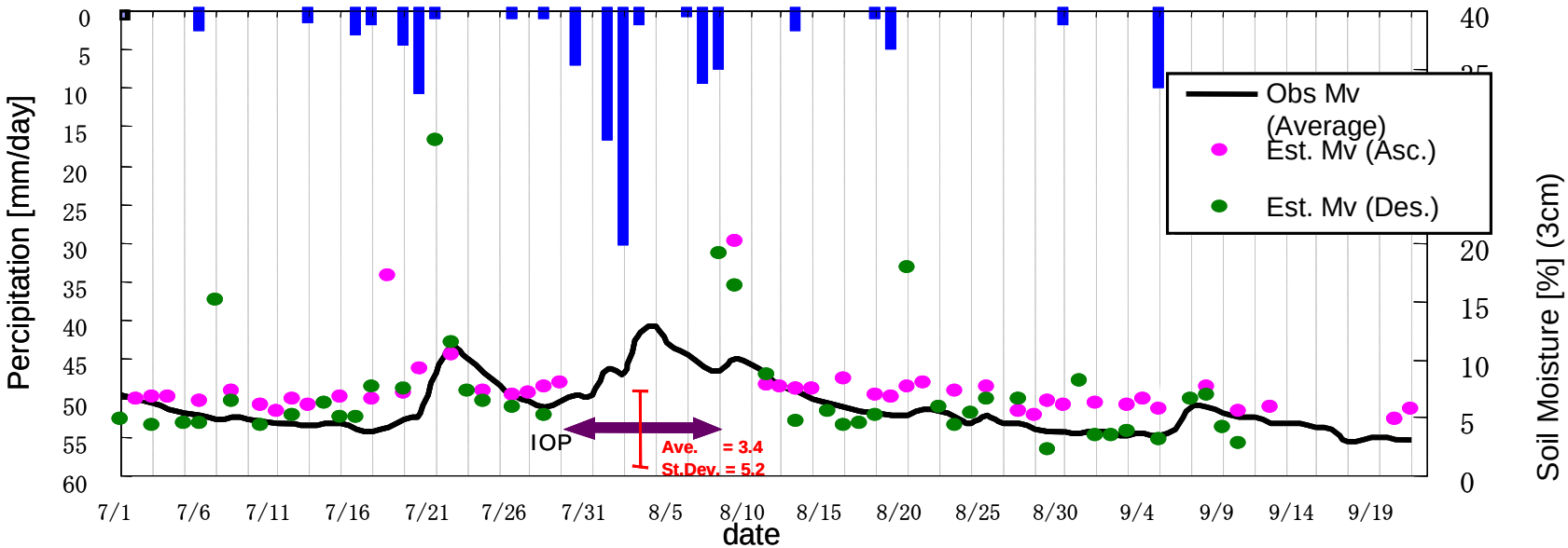


AMSR−E/SM0 5days Mean [Koike 2002/7/1−5 Dec]

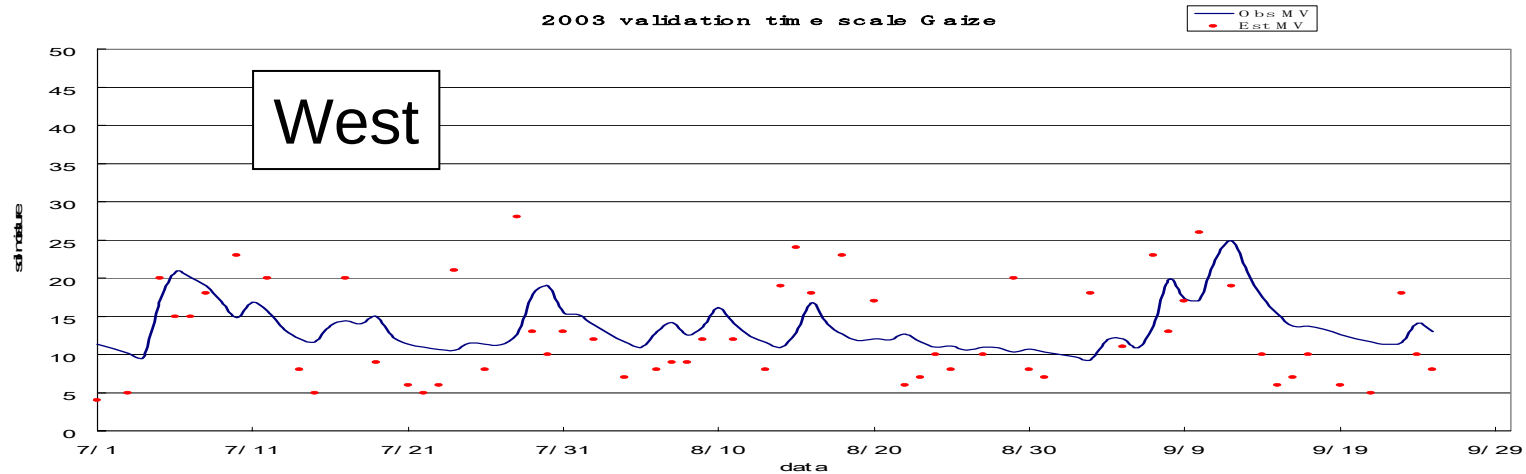


AMSR-E Soil Moisture Validation
t the Reference Site in Mongolia

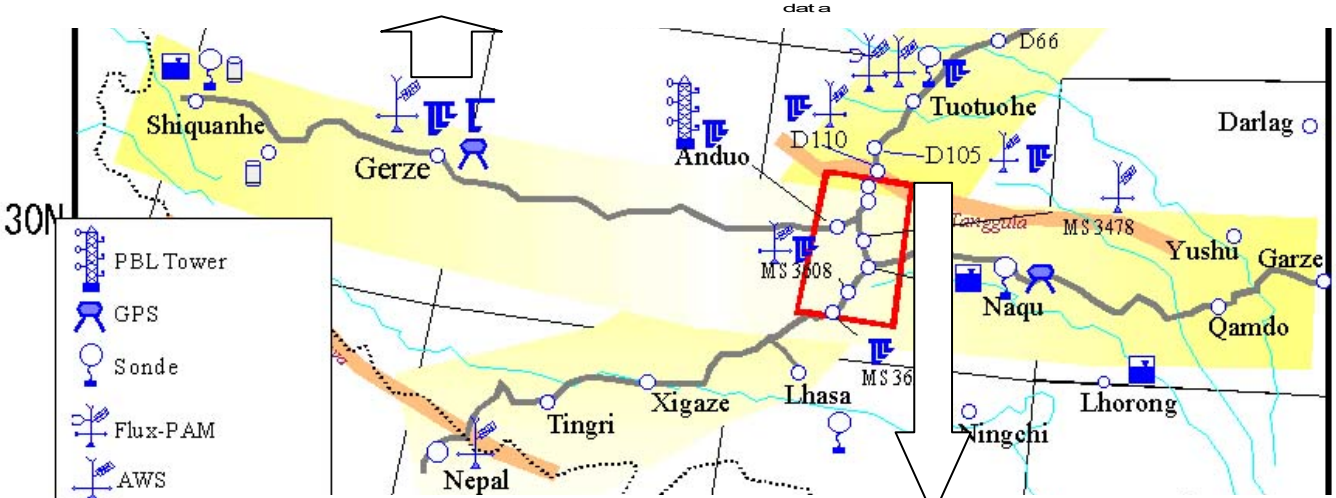




(Koike et al., 2003)

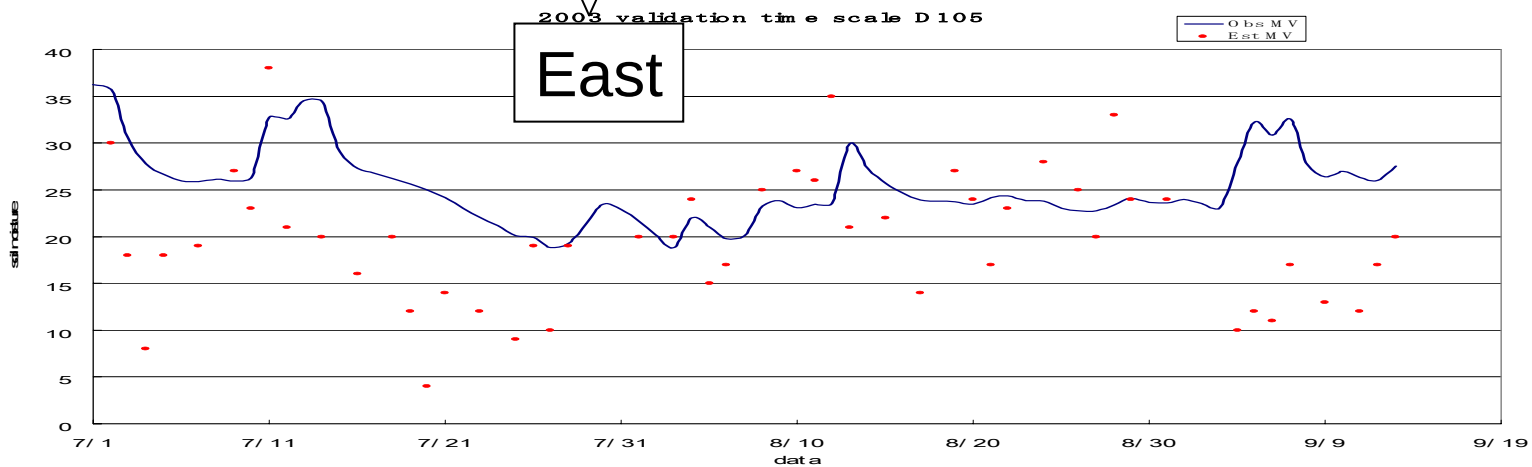


5.7%



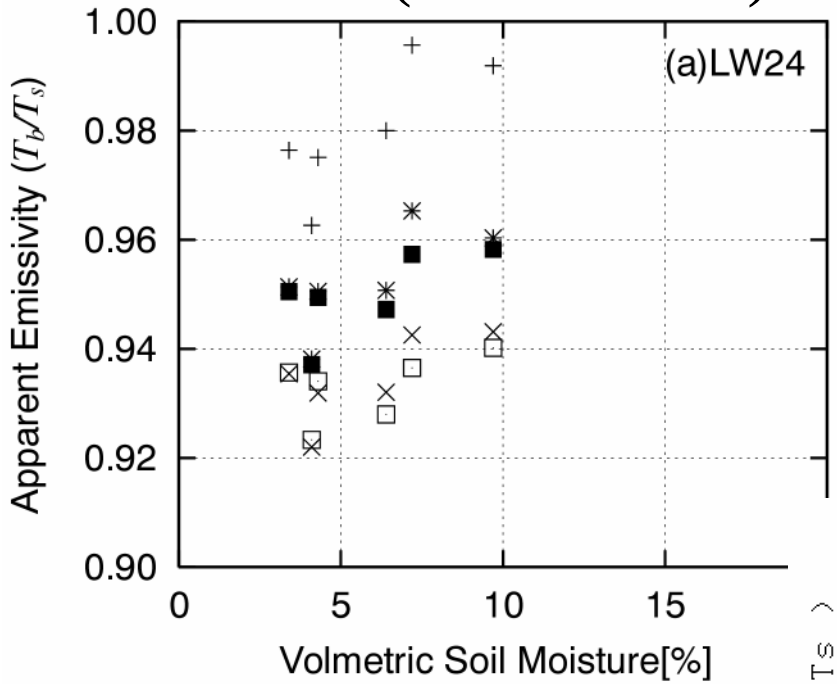
average of the absolute errors

8.1%

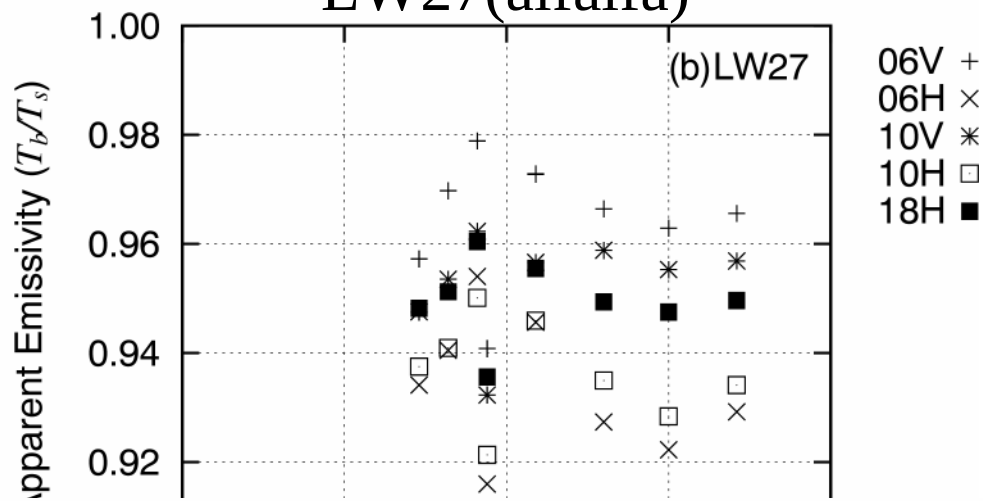


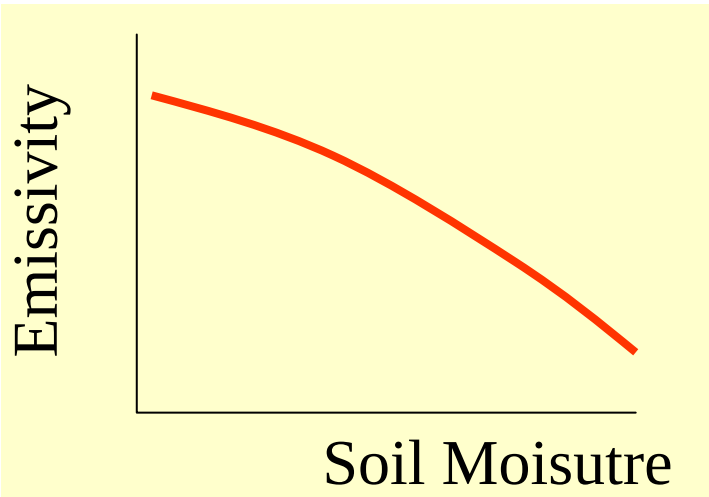
Apparent Emissivity

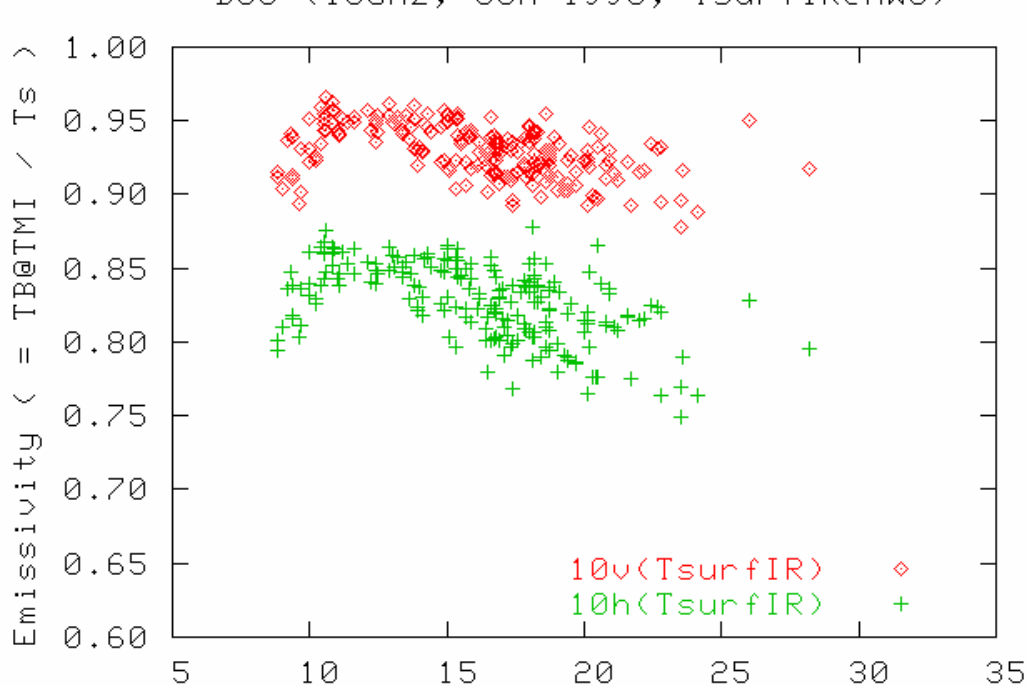
LW24(follow wheat)

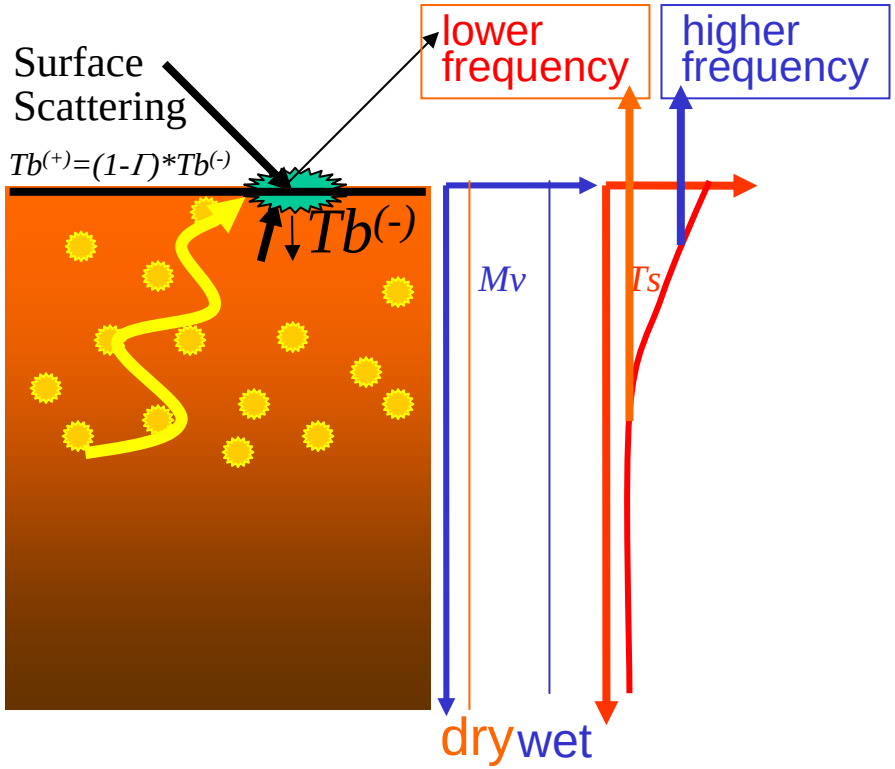


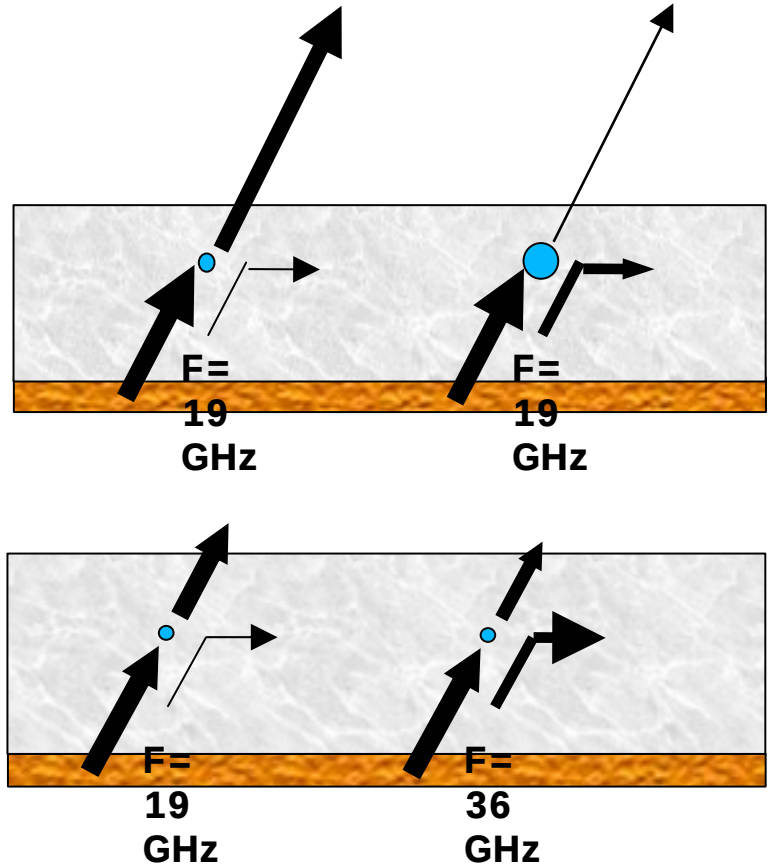
LW27(alfalfa)

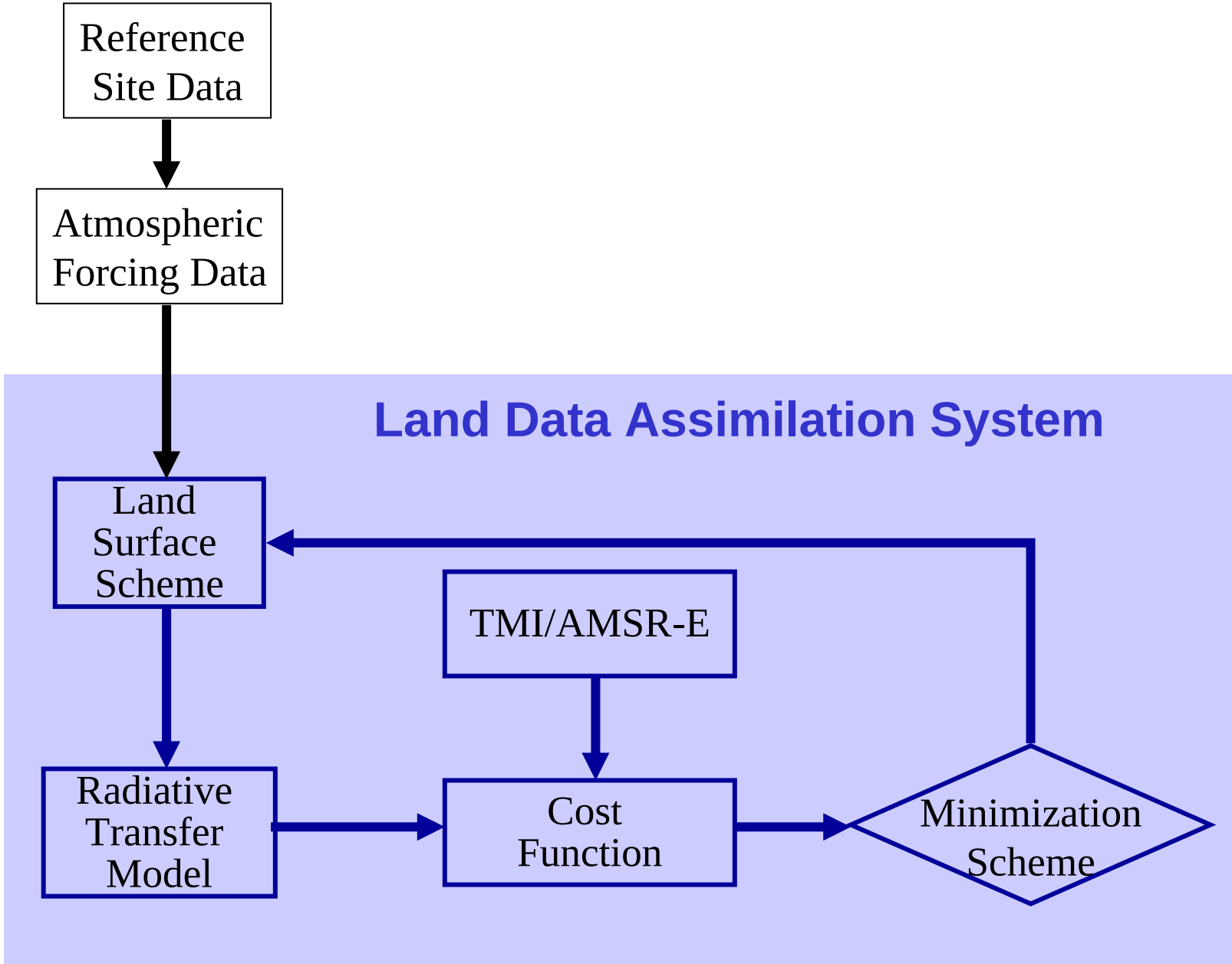






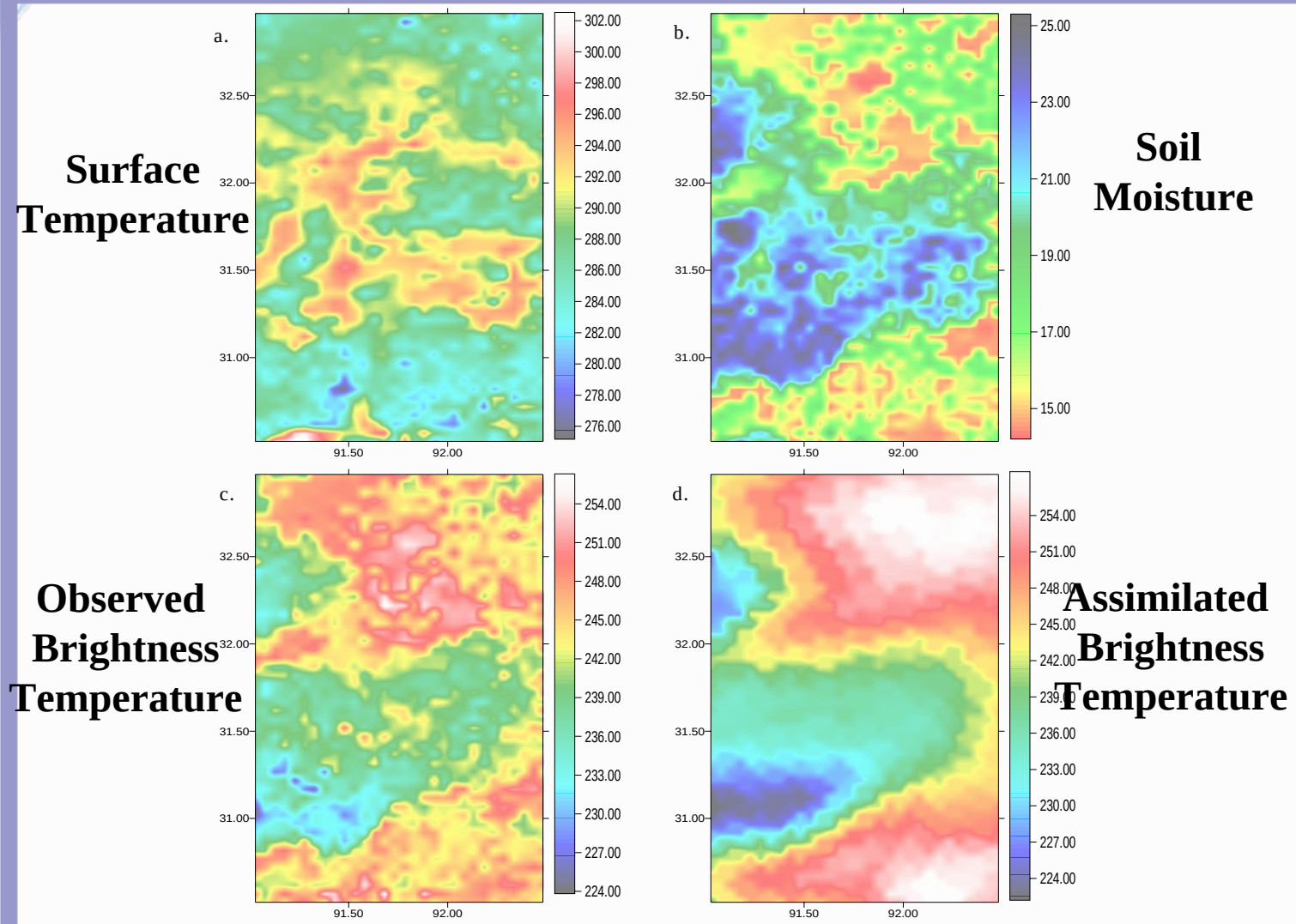

Surface
Scattering
$Tb^{(+)}=(1-\Gamma)*Tb^{(-)}$
$Tb^{(-)}$
lower
frequency
higher
frequency
Mv
Ts
dry
wet


F=
19
GHz
F=
19
GHz
F=
19
GHz
F=
36
GHz


Reference Site Data
Atmospheric Forcing Data
Land Data Assimilation System
Land Surface Scheme
TMI/AMSR-E
Radiative Transfer Model
Cost Function
Minimization Scheme

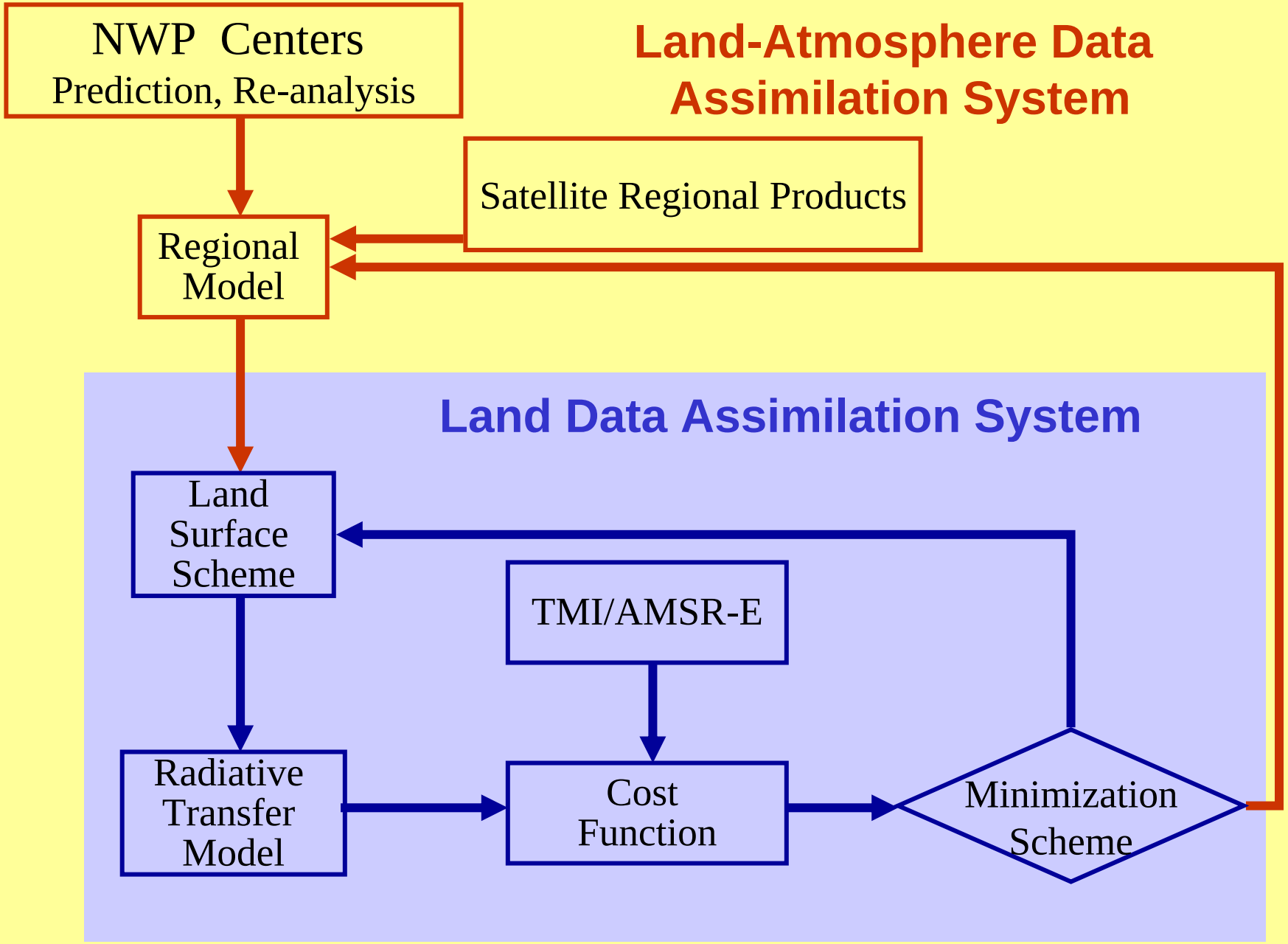
Model Application

Pathmathevan & Koike, 2001



(a.) Estimated Surface Temperature (*K*) (b.) Estimated Soil Moisture (*v/V*) and Brightness Temperature (K) {

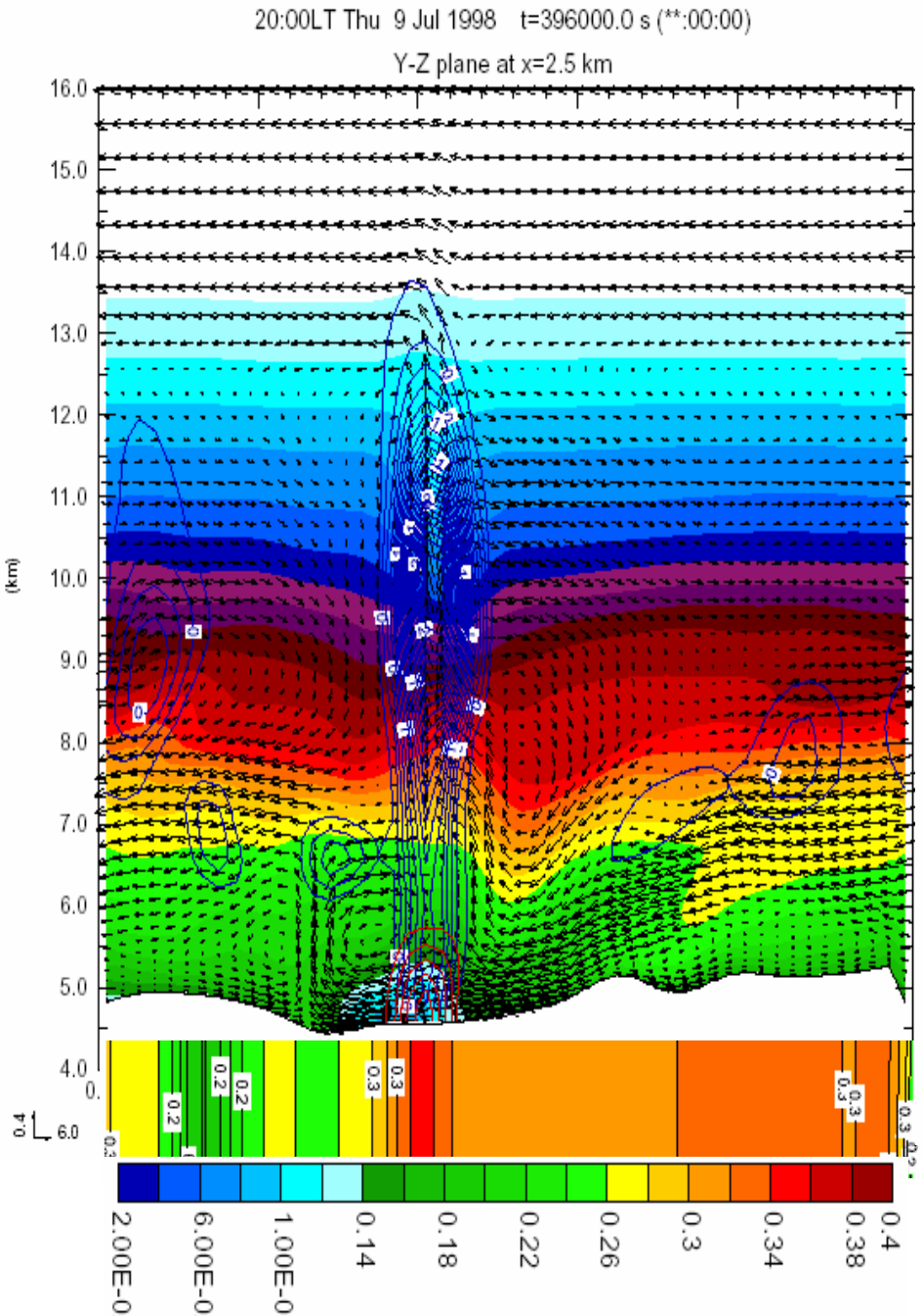
(c.) Estimated 10.65GHz-H (d.) Observed 10.65GHz-H } at 1.00pm on 5th of July 1998.

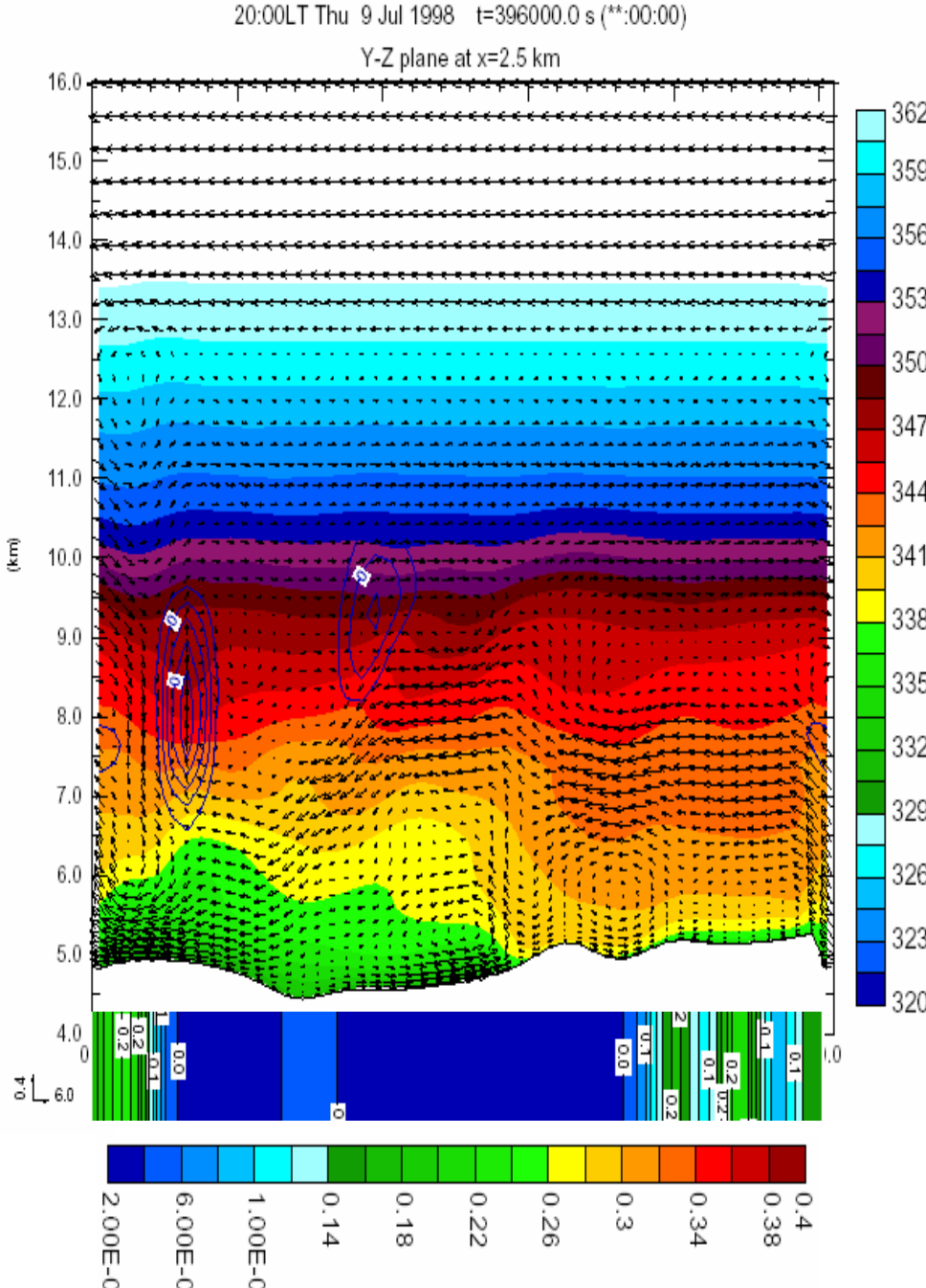

Land-Atmosphere Data Assimilation System
NWP Centers
Prediction, Re-analysis
Satellite Regional Products
Regional Model
Land Data Assimilation System
Land Surface Scheme
TMI/AMSR-E
Radiative Transfer Model
Cost Function
Minimization Scheme

L-A DAS

Boussetta & Koike, 2005

Only Regional Model





Algorithm development for Snow water equivalent

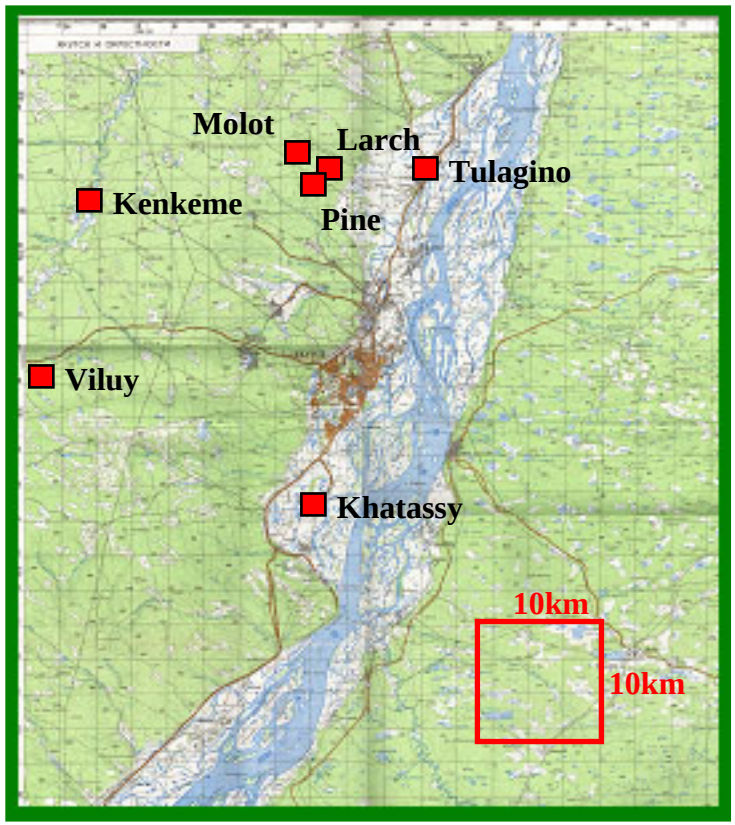
Problems

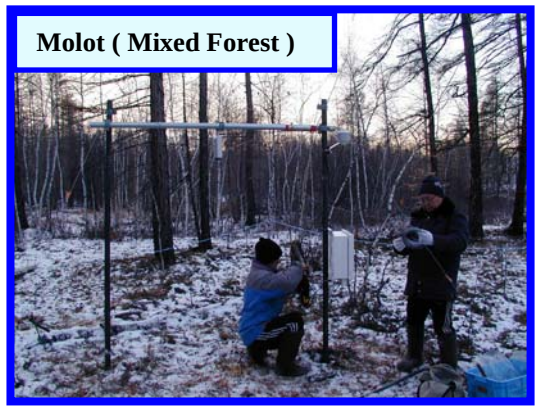
1. Limitation of the Availability of the RTM for Wide Range Combinations of Frequency and Grain Size
2. Too Much Extinction Effects in Snow Layers
3. Identification of Snow Grain Size
4. Identification of Effects of Soil under Snow

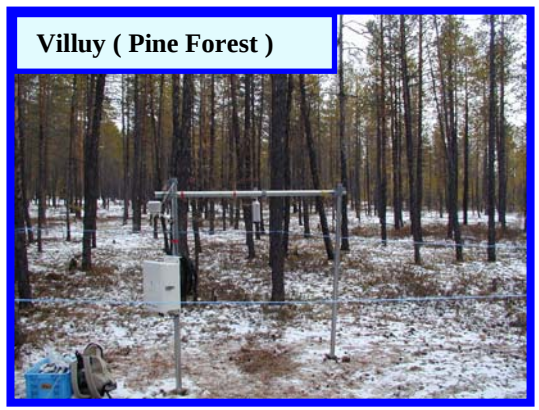
Improvements

1. 4-Stream Fast RTM 〔Liu(1998)〕
2. Dense Media RTM 〔Tsang(1992)〕
3. Estimation of Snow Grain Size in an Algorithm
4. Classification of Soil Effects by 6.9-H Channel

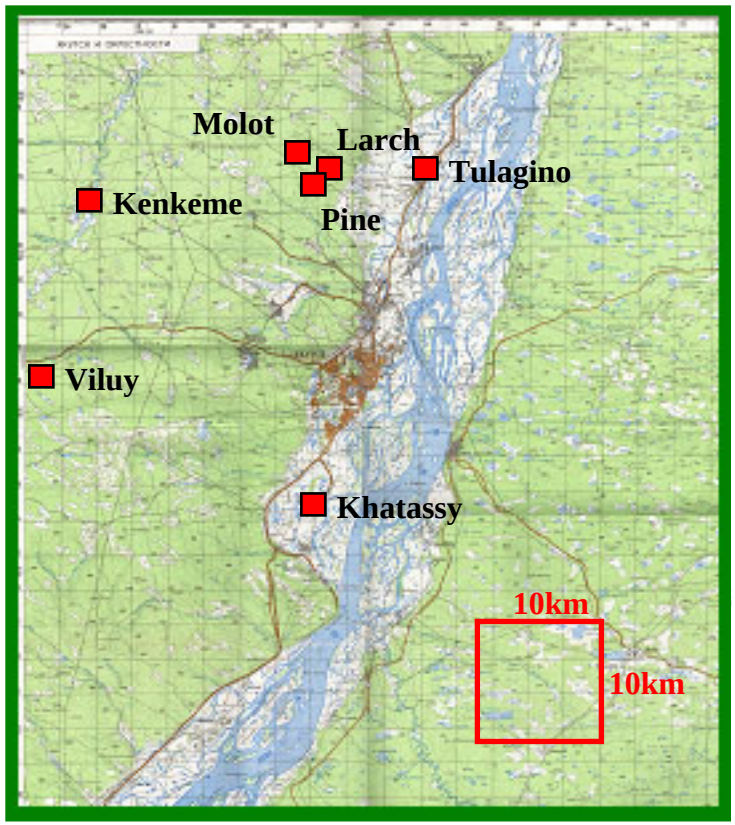
Observation Site

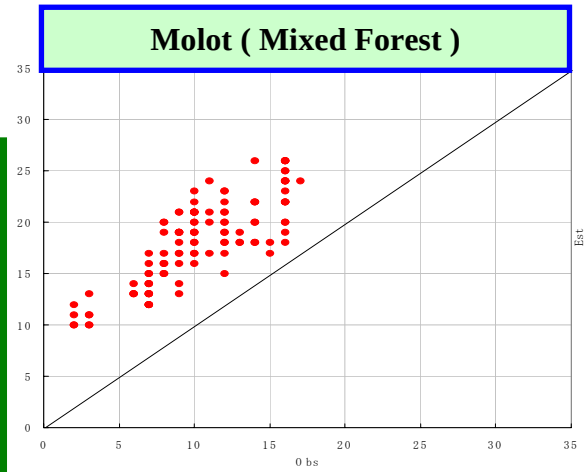


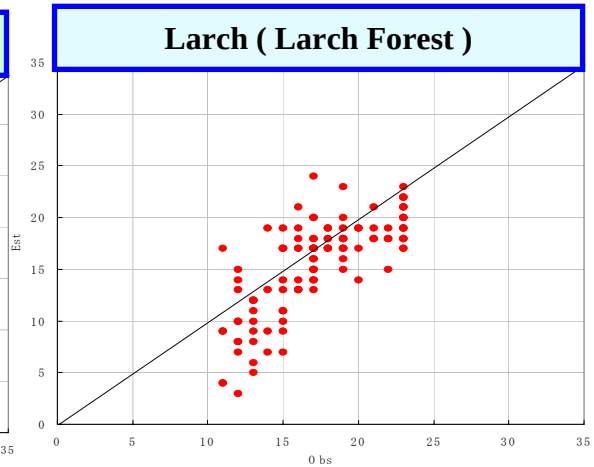


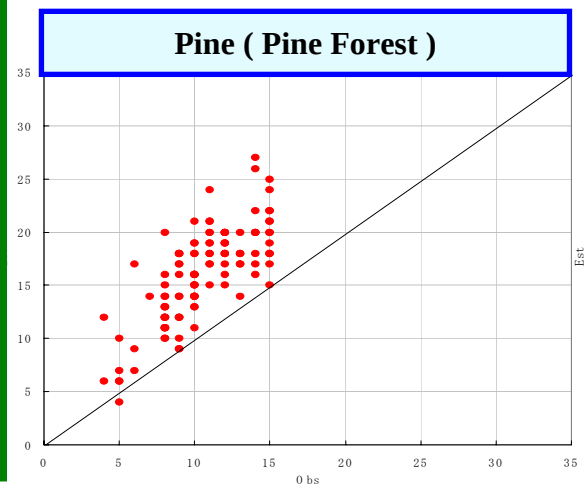


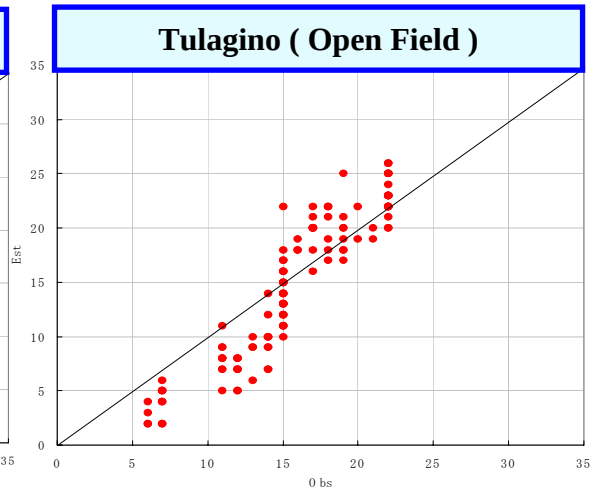
Point-Grid Validation

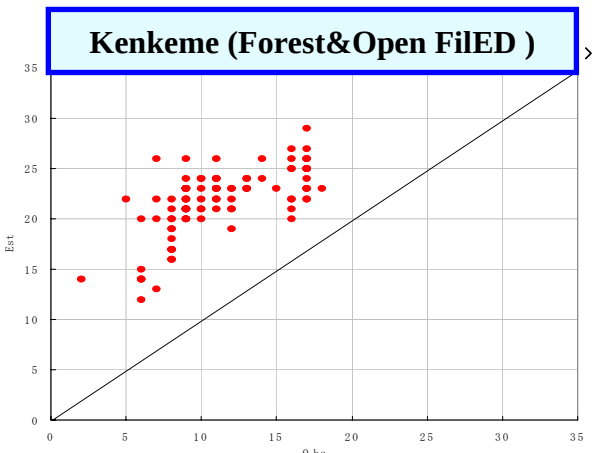


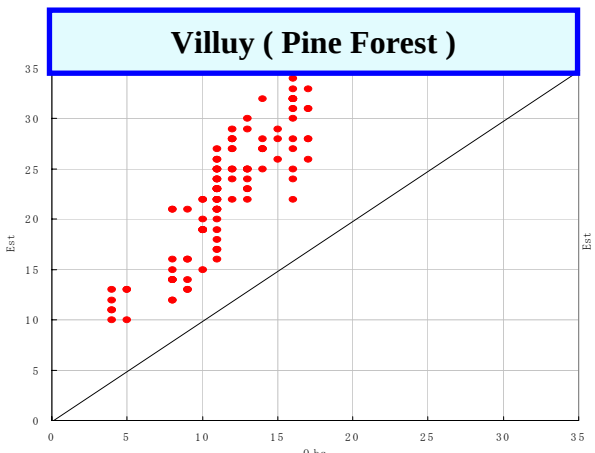


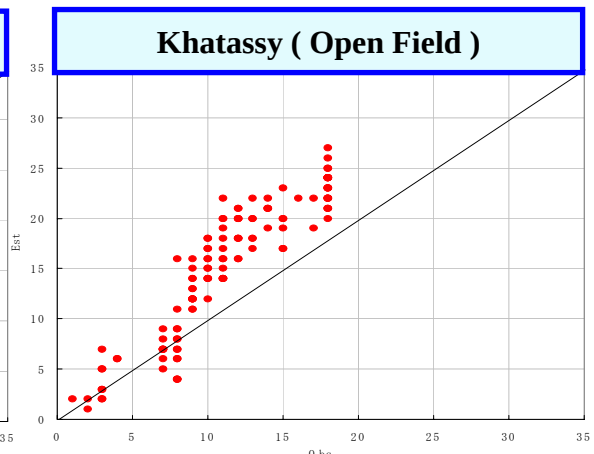




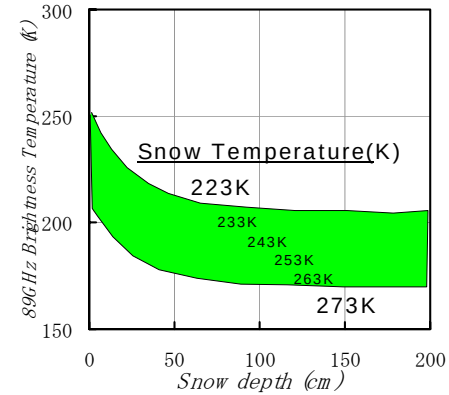






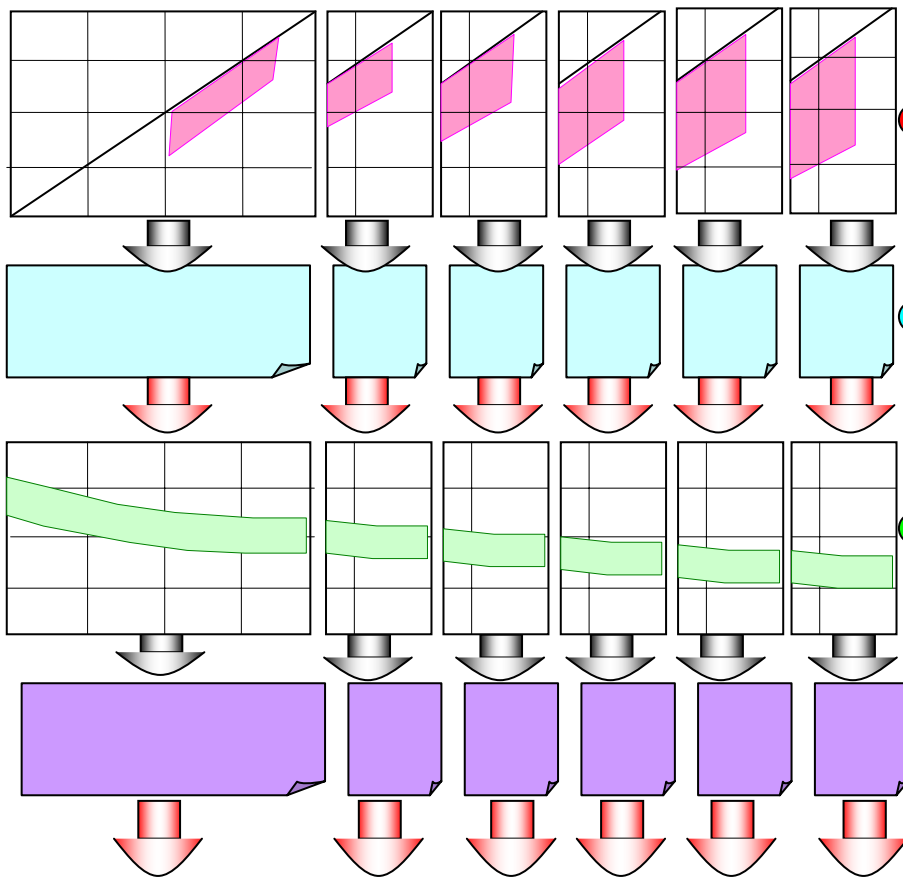


Satellite brightness temperature
19GHz・37GHz



Snow grain size

0.2 0.3 0.4 0.5 0.6 0.7mm



Tb at 18.7H, 36.5H
- Snow Depth & Temp.

Estimated
Snow Depth and Temp.

Snow Depth & Temp.
- Tb at 89H

Calculates 89GHz
brightness
temperature TB_{89cal}

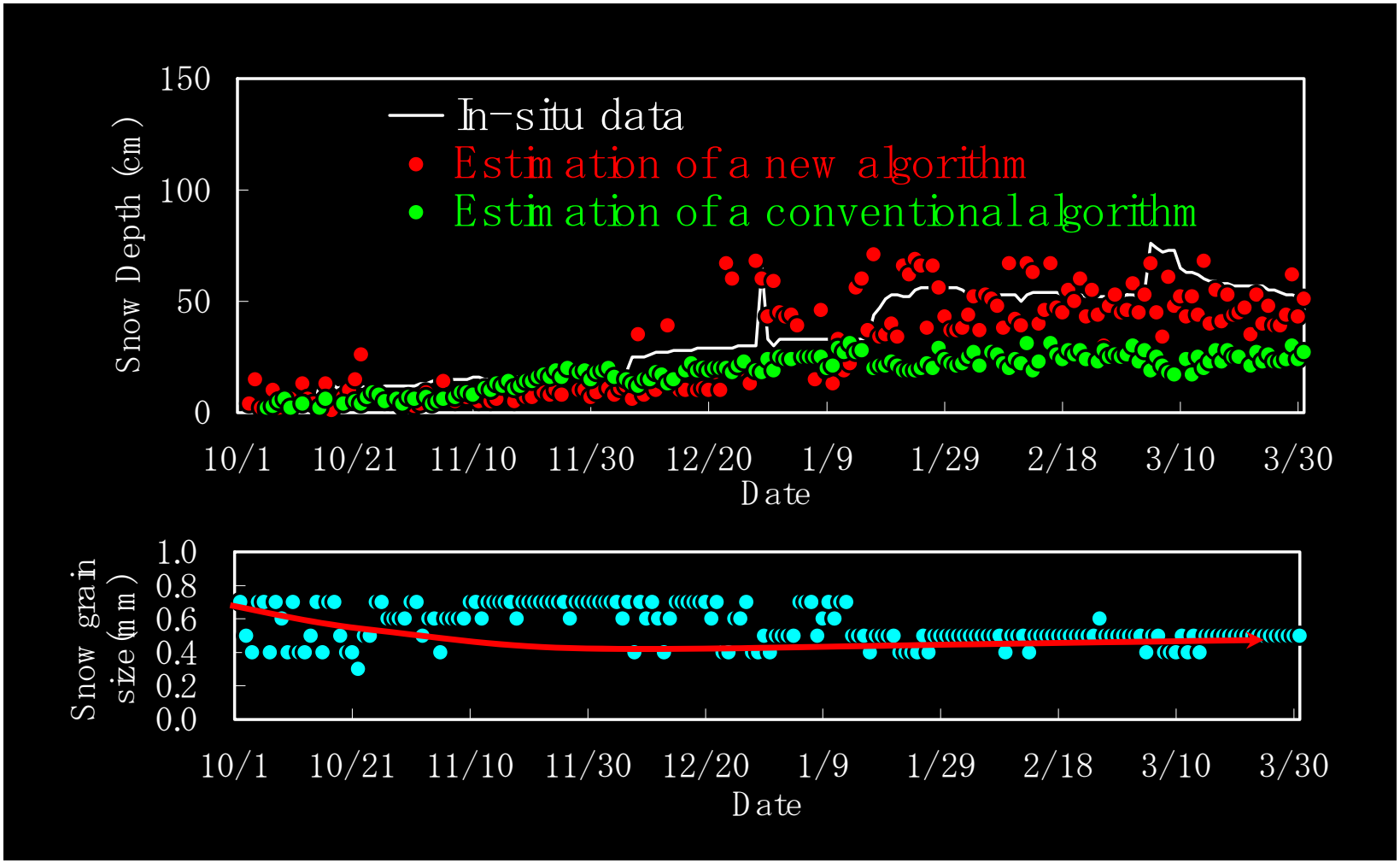
Calculates the modulus of difference of TB_{89cal} and TB_{89}

Satellite brightness temperature 89GHz (TB_{89})

$$\Delta TB89h = |TB_{89h} - TB_{89hcal}|$$

Tsutsui & Koike (2005)

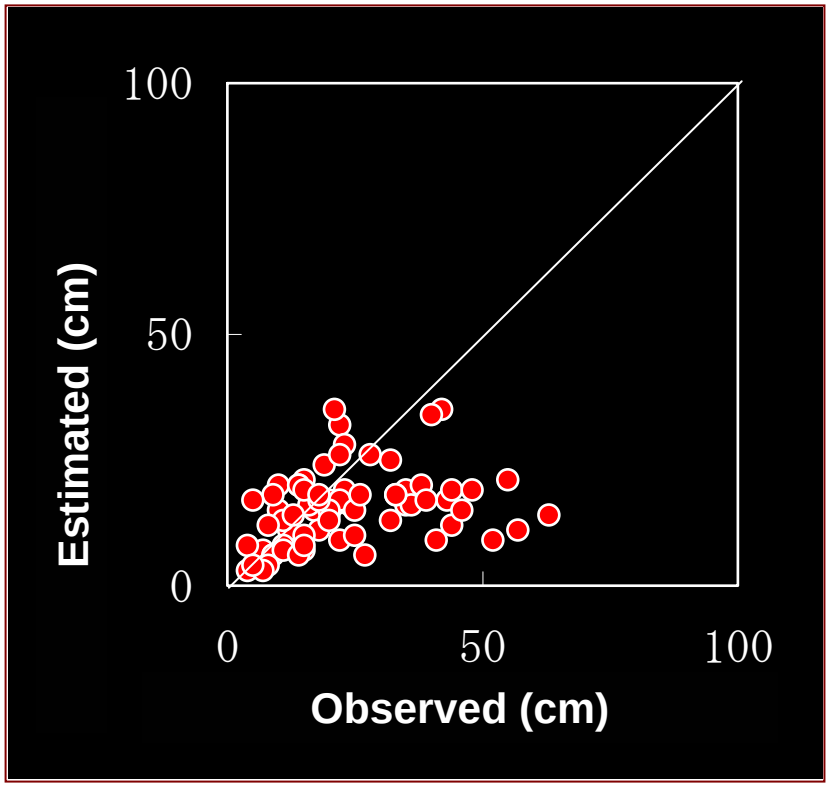
IMPROVED!



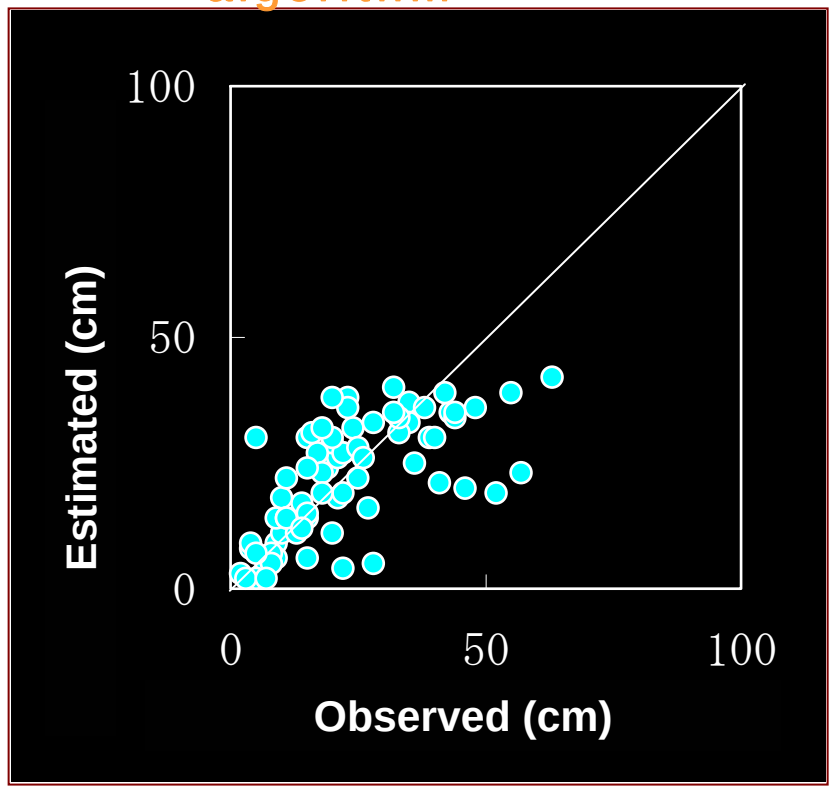
Tsutsui & Koike (2005)

IMPROVED!

Conventional algorithm



New algorithm

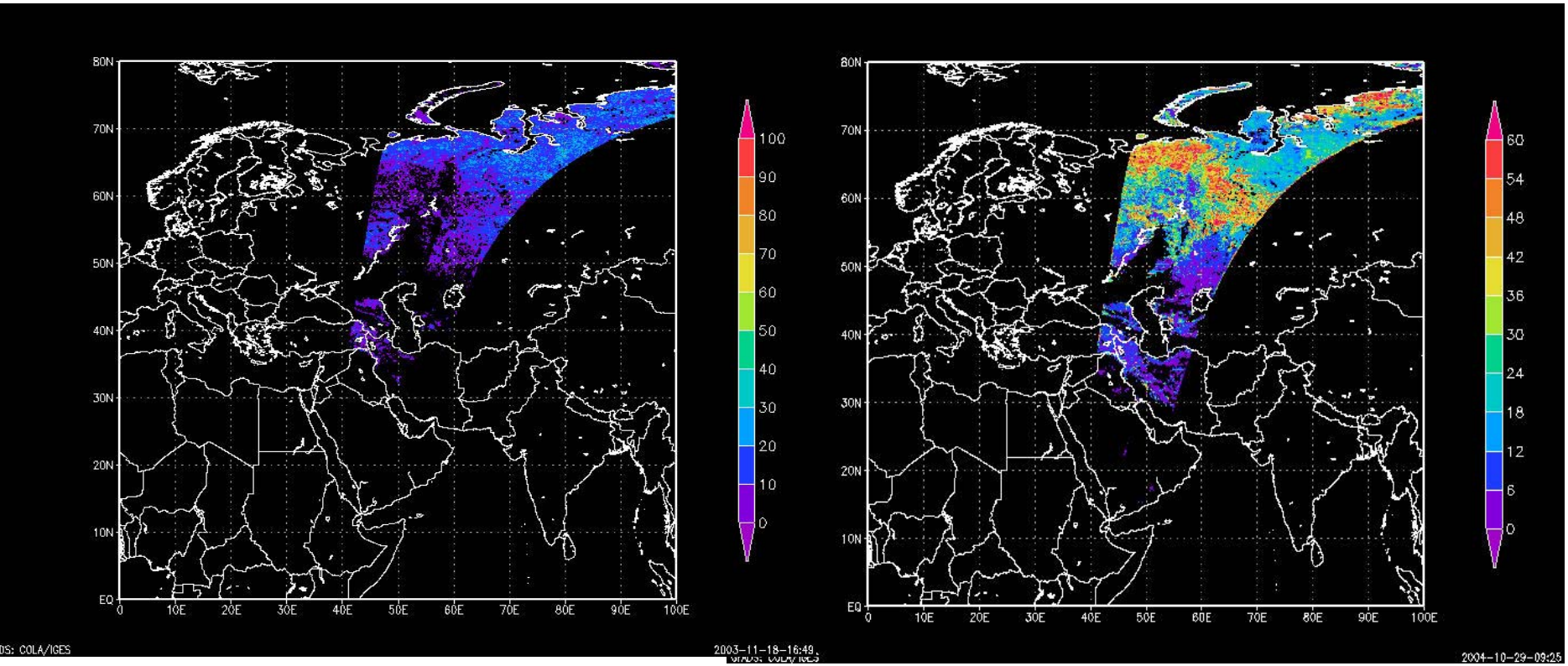


Tsutsui & Koike (2005)

IMPROVED!

Conventional algorithm

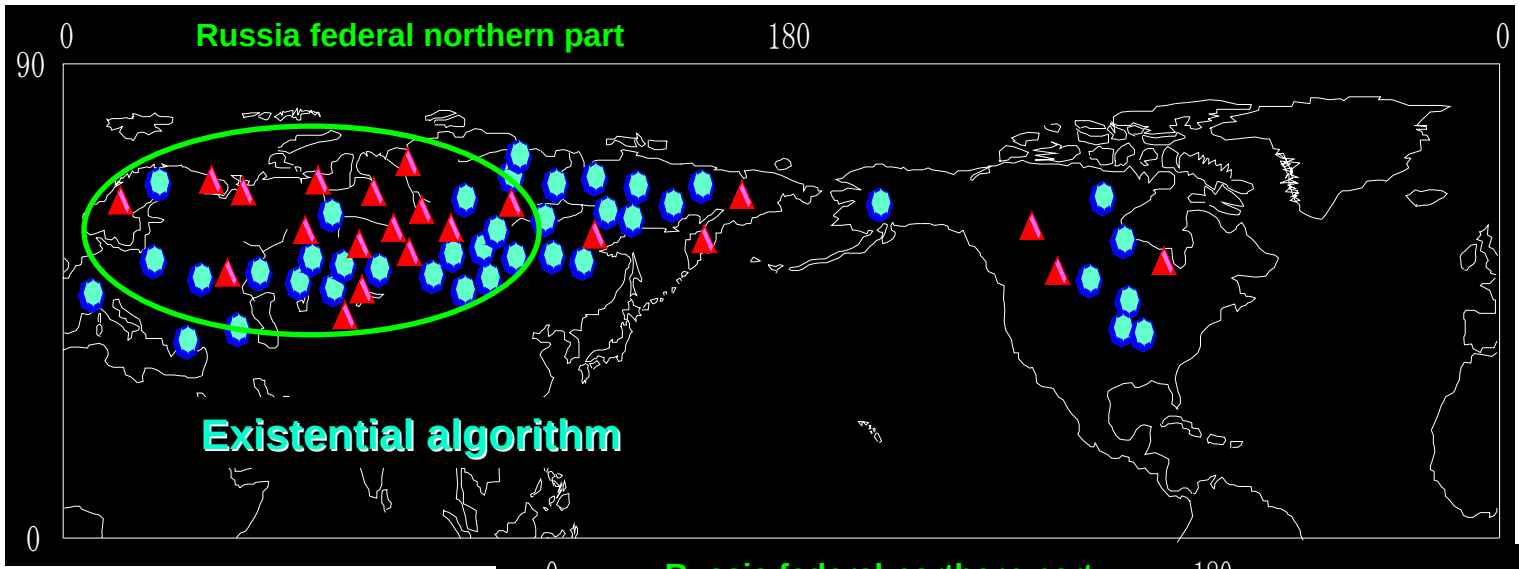
New algorithm

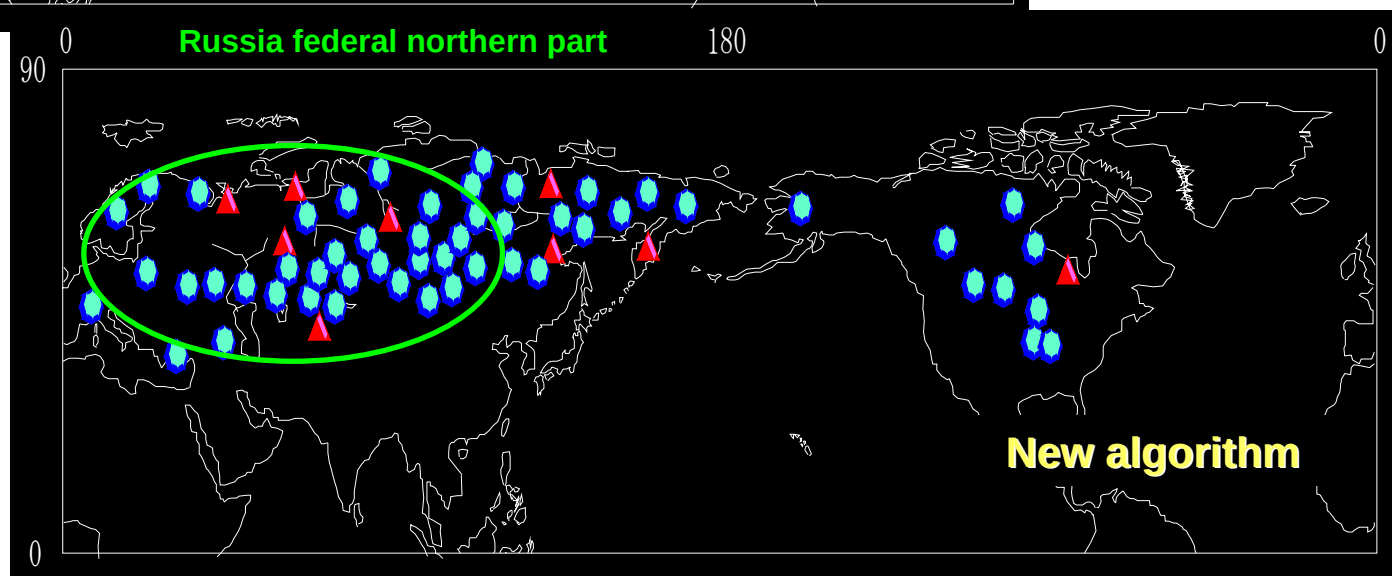


Tsutsui & Koike (2005)

IMPROVED!

⊿SD : Average of Absolute Errors
⊿SD < 20cm : ▲
⊿SD > 20cm : ●
Out of Algorithm Applicability: ■





Tsutsui & Koike (2005)