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I, "***Jyoti Sharma***," certify that the work embodied in this thesis is my own bonafide work and carried out by me under the supervision of "***Prof. Rajendra Prasad***" from "***July 2017***" to "***July 2022***" at the "***Department of Physics***," Indian Institute of Technology (BHU), Varanasi. The matter embodied in this thesis has not been submitted for the award of any other degree/diploma. I declare that I have faithfully acknowledged and given credits to the research workers whenever and wherever their works have been cited in my work in this thesis. I further declare that I have not wilfully copied any other's work, paragraphs, text, data, results, etc., reported in journals, books, magazines, reports, dissertations, theses, etc., or available on websites and have not included them in this thesis and have not cited as my own work.

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LIST OF ABBREVIATIONS

AMSR-E	Advanced Microwave Scanning Radiometer on the Earth Observing System
ANFIS	Adaptive Neuro Fuzzy Inference System
ANN	Artificial Neural Network
ASCAT	Advanced Scatterometer
ATI	Approximation of Thermal Inertia
ATBD	Algorithm Theoretical Basis Document
AVHRR	Advanced Very High-Resolution Radiometer
BHU	Banaras Hindu University
CCR	Cross- and Co-polarized Ratio
CCR_RF	Cross- and Co-polarized Ratio with Random Forest
CCR_SVR	Cross- and Co-polarized Ratio with Support Vector regression
CCR_ANFIS	Cross- and Co-polarized Ratio with Adaptive Neuro Fuzzy Inference System
CPF	Cumulative Probability Function
DCA	Dual Channel Algorithm
DEM	Digital Elevation Model
DISPATCH	Disaggregation based on Physical and Theoretical scale Change
DPRVI	Dual Polarimetric Radar Vegetation Index
DPRVI_RF	Dual Polarimetric Radar Vegetation Index with Random Forest
DPRVI_SVR	Dual Polarimetric Radar Vegetation Index with Support Vector Regression
DPRVI_ANFIS	Dual Polarimetric Radar Vegetation Index with Adaptive Neuro Fuzzy Inference System
E_SCA	Enhanced Single Channel Algorithm
ESA	European Space Agency
EOS	Earth Observing System

ESD	Earth Science Division
ESM	Earth Systematic Mission
EVI	Enhanced Vegetation Index
EW	Extra Wide
EWT	Equivalent Water Thickness
estSM	Estimated Soil Moisture
FAO	Food and Agriculture Organization
FM-CW	Frequency Modulated-Continuous Wave
FOV	Field of View
FY	Financial Year
GPR	Ground Penetrating Radar
GPS	Global Positioning System
GRACE	Gravity Recovery and Climate Experiment
GRD	Ground Range Detected
GSFC	Goddard Space Flight Center
GWC	Ground Water Content
IEEE	Institute of Electrical and Electronics Engineers
ISMN	International Soil Moisture Network
ISRO	Indian Space Research Organisation
ISS	International Space Station
IW	Interferometric Wide
JPL	Jet Propulsion Laboratory
LAI	Leaf Area Index
LM	Levenberg-Marquardt
LPDAAC	Land Processes Distributed Active Archive Center
LPRM	Land Parameter Retrieval Model
LST	Land Surface Temperature

LULC	Land Use Land Cover
LUT	Look-Up Table
MRT	MODIS Reprojection Tool
MODIS	Moderate Resolution Imaging Spectroradiometer
MTDCA	Multi-Temporal Dual Channel Algorithm
NAFE06	National Airborne Field Experiment 2006
NASA	National Aeronautics and Space Administration
NIR	Near Infrared
NDVI	Normalized Difference Vegetation Index
NDWI	Normalized Difference Water Index
ODSM	Optimized Downscaled Soil Moisture
OOB	Out of Bag
PALS	Passive/Active L/S-band
RADAR	Radio Detection and Ranging
RCS	Radar Cross-section
RF	Random Forest
RGB	Red Green Blue
RMSD	Root Mean Square Difference
RMSE	Root Mean Square Error
RTM	Radiative Transfer Model
RVI	Radar Vegetation Index
RVI_RF	Radar Vegetation Index with Random Forest
RVI_SVR	Radar Vegetation Index with Support Vector Regression
RVI_ANFIS	Radar Vegetation Index with Adaptive Neuro Fuzzy Inference System
SAR	Synthetic Aperture Radar
SCA	Single Channel Algorithm
SEE	Soil Evaporative Efficiency

SHF	Super High Frequency
SLC	Single Look Complex
SM	Strip Map
SMAP	Soil Moisture Active Passive
SMAPEX	Soil Moisture Active Passive Validation Experiment
SMD	Science Mission Directorate
SMMR	Scanning Multichannel Microwave Radiometer
SMOS	Soil Moisture Ocean Salinity
SNAP	Sentinel Application Platform
SRTM	Shuttle Radar Topography Mission
SSM/I	Special Satellite Microwave/Imager
ST	Surface Temperature
SVM	Support Vector Machine
SVR	Support Vector Regression
SWIR	Short Wavelength Infrared
TDR	Time Domain Reflectometry
TOPSAR	Terrain Observation with Progressive Scans SAR
TV	Televisions
TWC	Total Water Content
TWRS	Terrestrial Water Resources Satellite
ubRMSE	Unbiased Root Mean Square Error
UHF	Ultra-High Frequency
UTM	Universal Transverse Mercator
UXO	Unexploded Ordnance
VMSMI	Vegetation Modulated Soil Moisture Index
VOD	Vegetation Optical Depth
VTCI	Vegetation Temperature Condition Index

VSAT	Very Small Aperture Terminal
VWC	Vegetation Water Content
WV	Wave

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LIST OF SYMBOLS

e	Emissivity
T_B	Brightness temperature
T	Surface temperature
e_s	Soil surface emissivity
$\boldsymbol{\gamma}$	Vegetation attenuation coefficient
ω	Single scattering albedo
τ	Vegetation optical depth
θ	Incident angle of satellite
b	Proportionality constant for VOD and VWC
s	Stem factor
e_o	Smooth surface emissivity
h	Surface roughness parameter
σ	Standard deviation of surface height
λ	wavelength
e_{oH}	Smooth surface emissivity in horizontal polarization
e_{oV}	Smooth surface emissivity in vertical polarization
ε	Dielectric constant
ε_s'	Real part of dielectric constant
ε_s''	Imaginary part of dielectric constant
n_s	Refractive index for moist soil
n_d	Refractive index for dry soil
n_u	Refractive index for free water
n_b	Refractive index for bound soil water

k_s	Normalized attenuation coefficient for moist soil
k_d	Normalized attenuation coefficient for dry soil
k_u	Normalized attenuation coefficient for free water
k_b	Normalized attenuation coefficient for bound soil water
M_v	Soil moisture
M_{vt}	Maximum bound water fraction in the soil layer
C	Clay percentage in soil
T_s	Soil skin temperature
T_v	Vegetation temperature
f_v, F_v	Vegetation parameter
I	Thermal inertia
k	Bulk thermal conductivity
ρ	Density
c	Specific heat capacity
ΔT	Temperature difference between the maximum and minimum Temperature
kg	Kilogram
m	Meter
cm	Centimeter
mm	Milimeter
K	Kelvin
^oC	Celsius
km	Kilometer
σ^o	Backscattering coefficient
G	Giga

Hz	Hertz
*T**	Normalized LST
R	Correlation coefficient
C_2	Covariance matrix
m	Degree of polarization
β	Span of the Covariance matrix
λ_1, λ_2	Eigen values of Covariance matrix
S	Scattering matrix

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