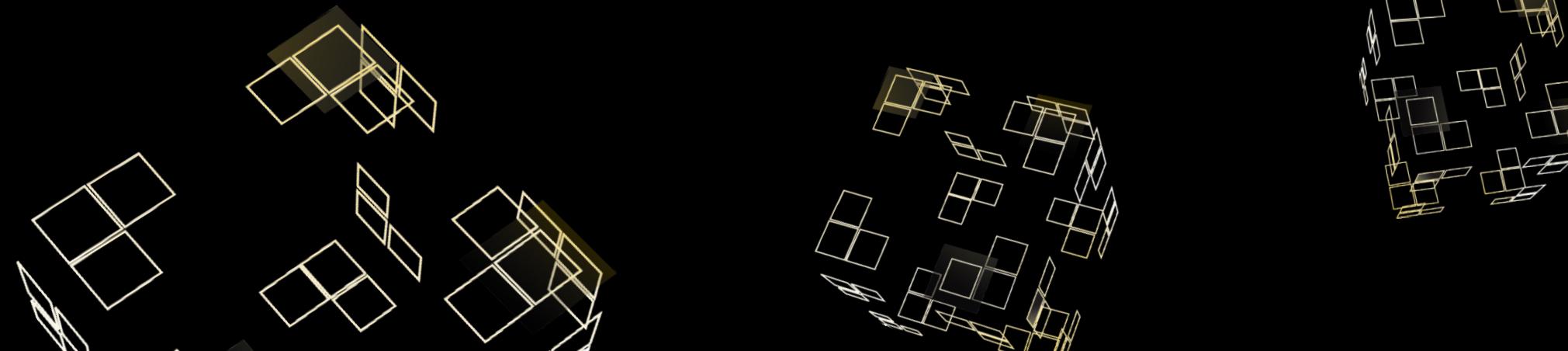


School of AI  
12<sup>th</sup> Meetup and Lectures

# MACHINE LEARNING INITIATIVE FOR LUNAR SCIENCE

*Shashwat Shukla*

*UT – ITC MSc Graduate*



# OUTLINE

OVERVIEW

LUNAR LAVA  
TUBE  
SENSING

LUNAR RADAR  
BACKSCATTER  
MODELLING

EMPLACEMENT  
OF LUNAR  
HELIUM-3

TSIOLKOVOSKIY  
CENTRAL PEAK

CONCLUSION

# MACHINE LEARNING FOR LUNAR EXPLORATION

*Artificial Intelligence for Moon*

*Remote Sensing*

*Transforming RS Data into Science*



# LUNAR LAVA TUBE SENSING

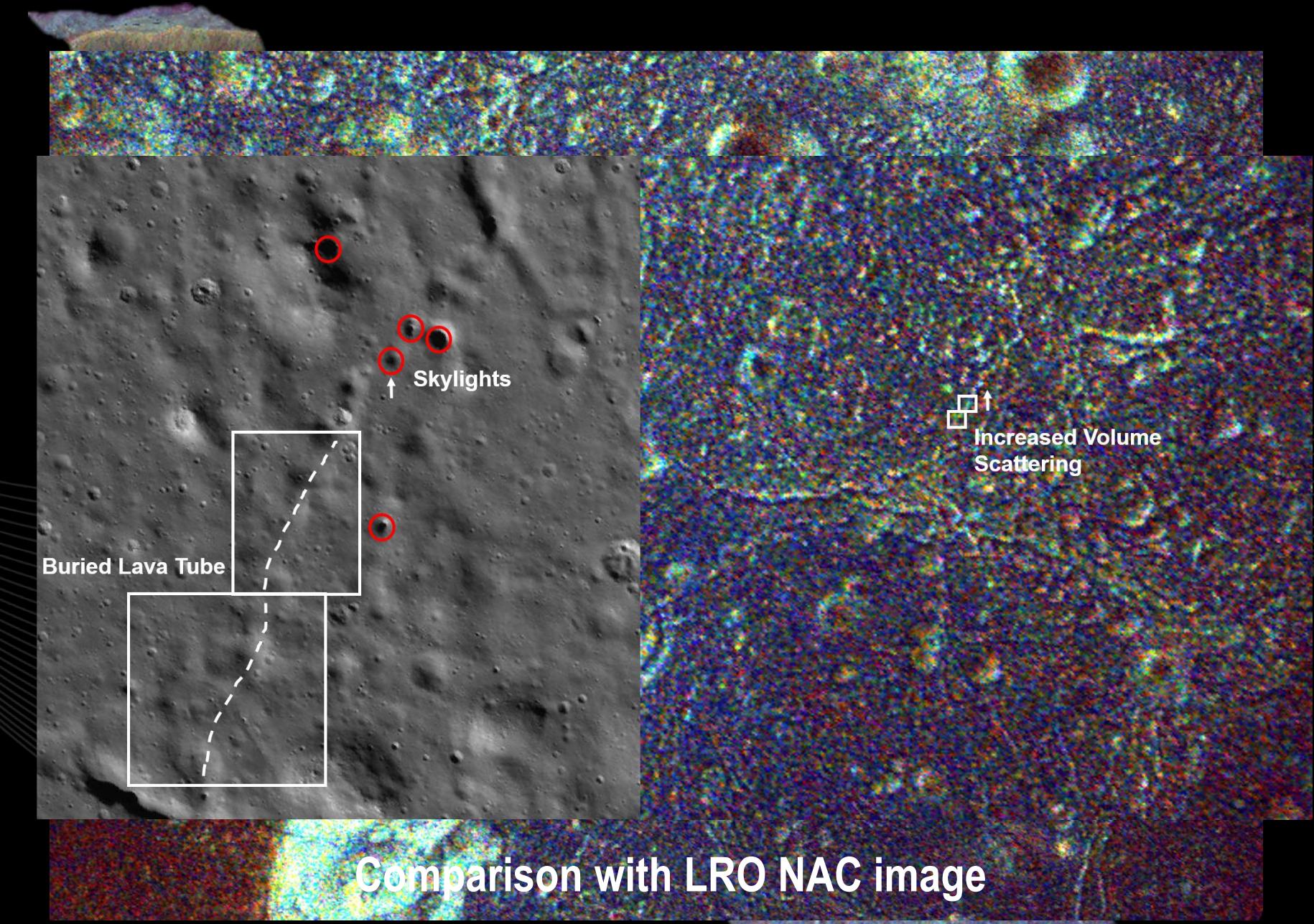
## EVIDENCE OF WATER ICE NEAR PHILOLAUS SKYLIGHT CANDIDATES

*New radar perspective*

*Enhanced volumetric scattering mechanisms near lava pits*

*Association of higher CPR values*

*Modelling buried water ice deposits using Multilayer Perceptron Regressor*



# LUNAR RADAR BACKSCATTER MODELLING

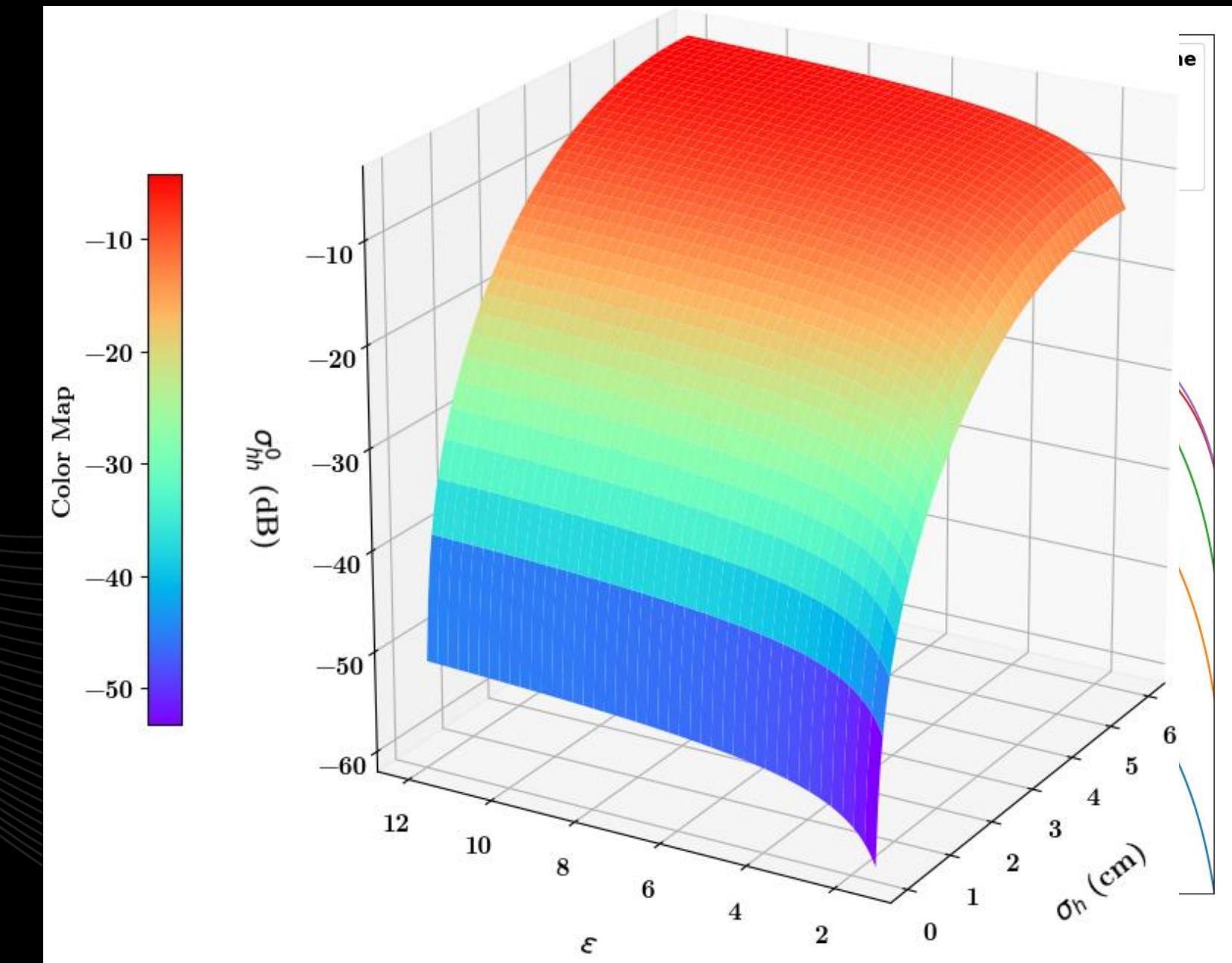
## MULTILAYER LUNAR REGOLITH MODEL

Radar backscatter as a function of dielectric constant and surface roughness using parameterized IEM

Simulated backscatter is validated at the Apollo landing sites

Error in backscatter is < 0.5 dB

IEM simulation useful for Inversion Modelling



Simulated Radar Backscatter as a function of incidence angle constant and surface roughness (Incidence: 57.5°)

# LUNAR RADAR BACKSCATTER MODELLING (I)

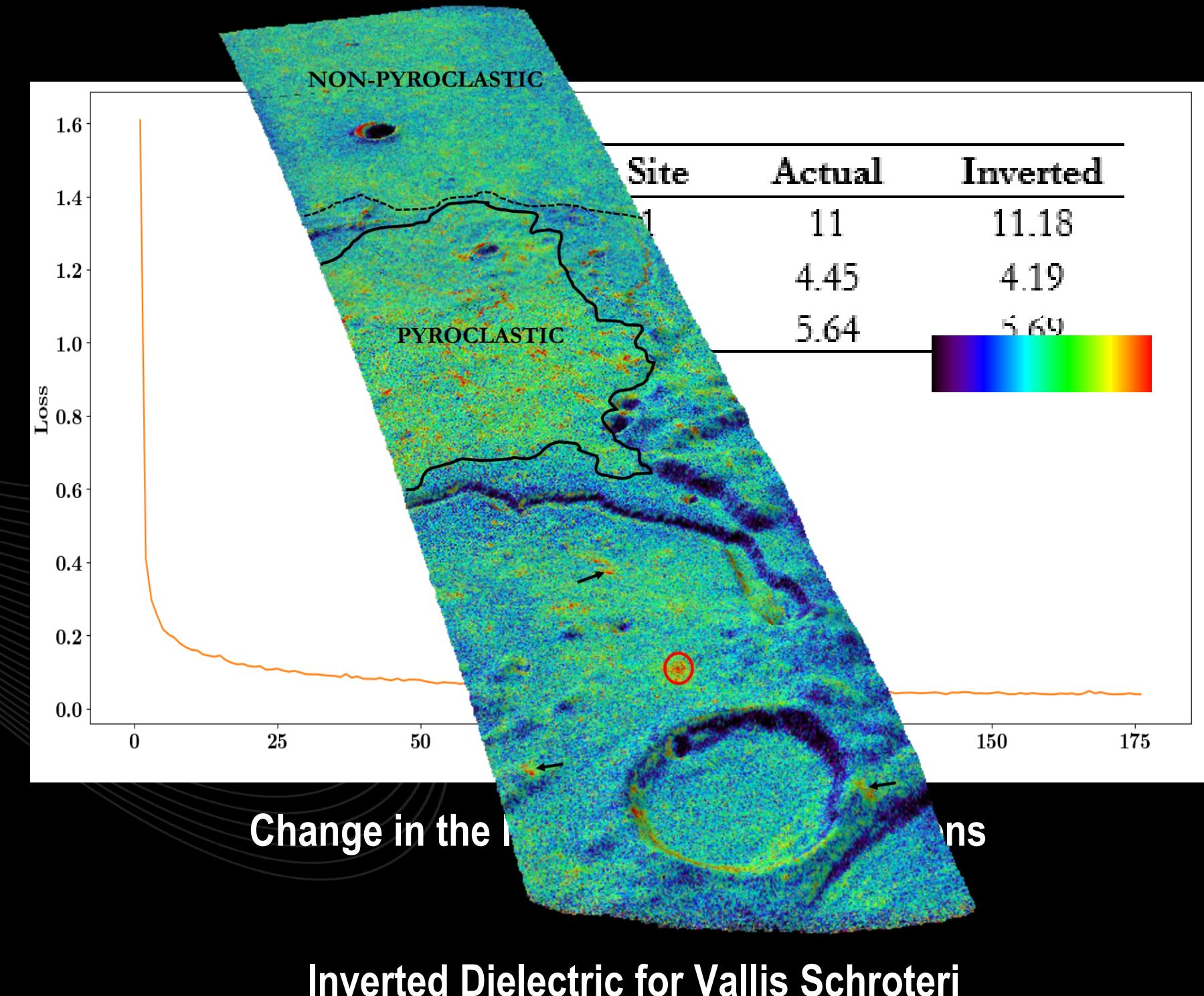
## MLP NEURAL NETWORK REGRESSOR BASED DIELECTRIC INVERSION

IEM sensitivity as training data

K-fold shuffling: data overfitting is avoided

Model validation for Apollo landing sites,  
RMSE: 0.26, MAE: 0.13,  $d$ : 0.996

Testing is performed on bistatic data of Vallis  
Schroteri and monostatic data of Apollo  
landing sites



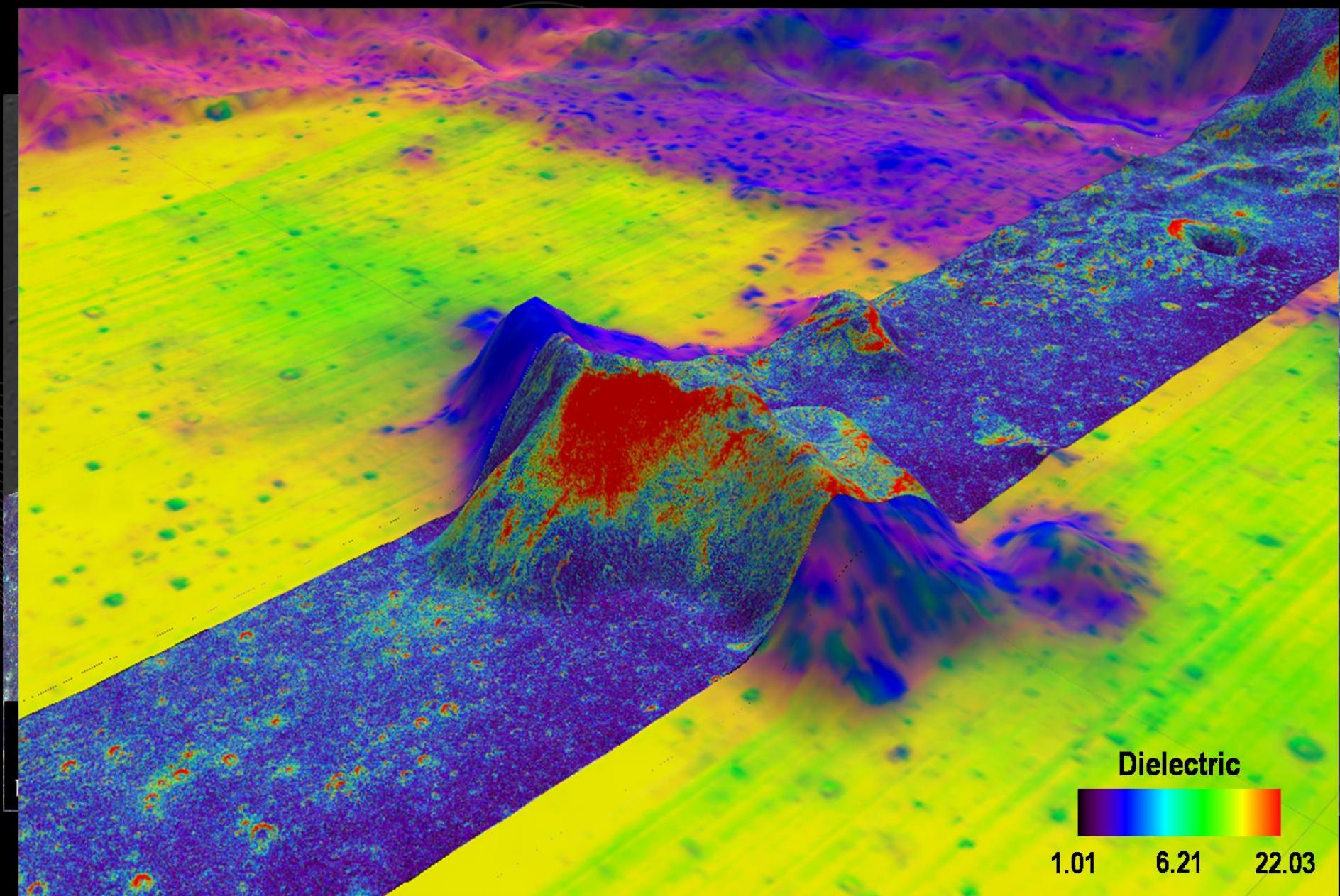
# TSIOLKOVOSKIY CENTRAL PEAK

## DEEP LEARNING FOR INVERSION MODELLING

*Training data include surface, volume, subsurface, subsurface-volume scattering terms*

*10 hidden layers with tanh activation function and lower RMSE of 0.13*

*Those pixels with high dielectric content exhibit plagioclase feldspar deposition and pronounced hydration*



# CONCLUSION

**Machine Learning** essential for unravelling lunar science

**Deep Learning** for Lunar Volatile and Mineral Prospecting

**Support Vector Machines** for 3D Geological Modelling



THANK YOU