Monitoring Of Infrastructure Corridors Using Deep Leaning

Case Study:

Encroachment Detection In Oil And Gas Pipeline Buffer Zone

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Background

- GAIL India Ltd. Maintains 15000 Km Pipe line infrastructure for Gas Transportation.
- Regular Surveillance of entire Pipeline is mandatory for checking any physical disturbances over pipeline Right of Usage (ROU) at 30m.
- Till now manual marking of exception was done

Existing Surveillance Method

- Visual inspection by Helicopters-Monthly: *Very time consuming, costly and not very effective as it requires, human-eye based navigation.*
- Inspection by Walkers -Six months :*involves risk of life in case of any natural disasters like landslides or floods.*

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Need for study

- Automatic detection of urban features like building plays an important role not only in infrastructural monitoring but also in urban planning
- The recent research in deep leaning in branch of computer science has given the way to develop the algorithms which can help in automatic detection of building in satellite data.

Objective

- Develop deep-learning methodology to detect building within a given area without much manual efforts.
- Create output image in tiff format having rectangular window over the for detecting features, which are converted to a shape file to be used in GIS environment

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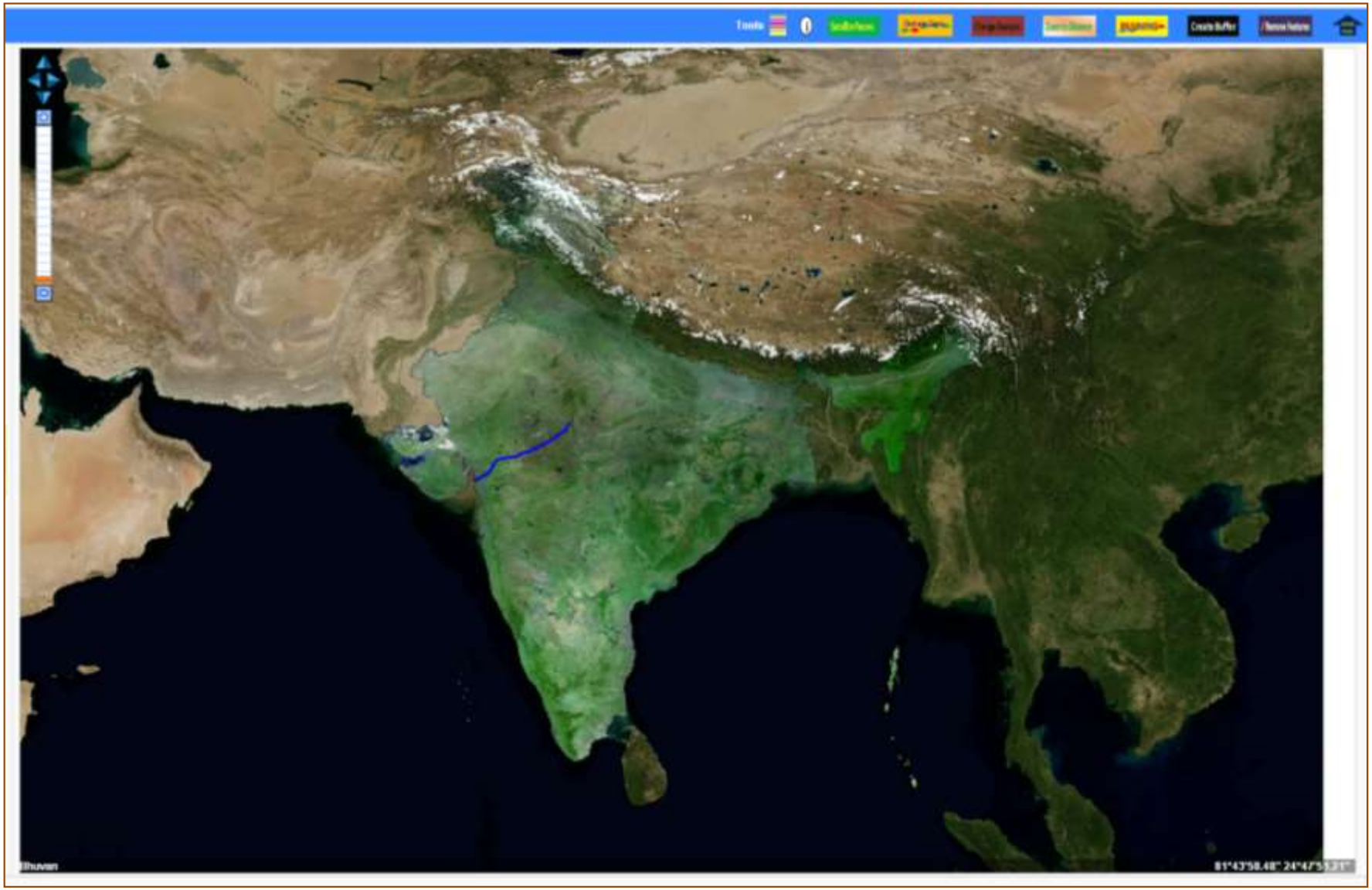
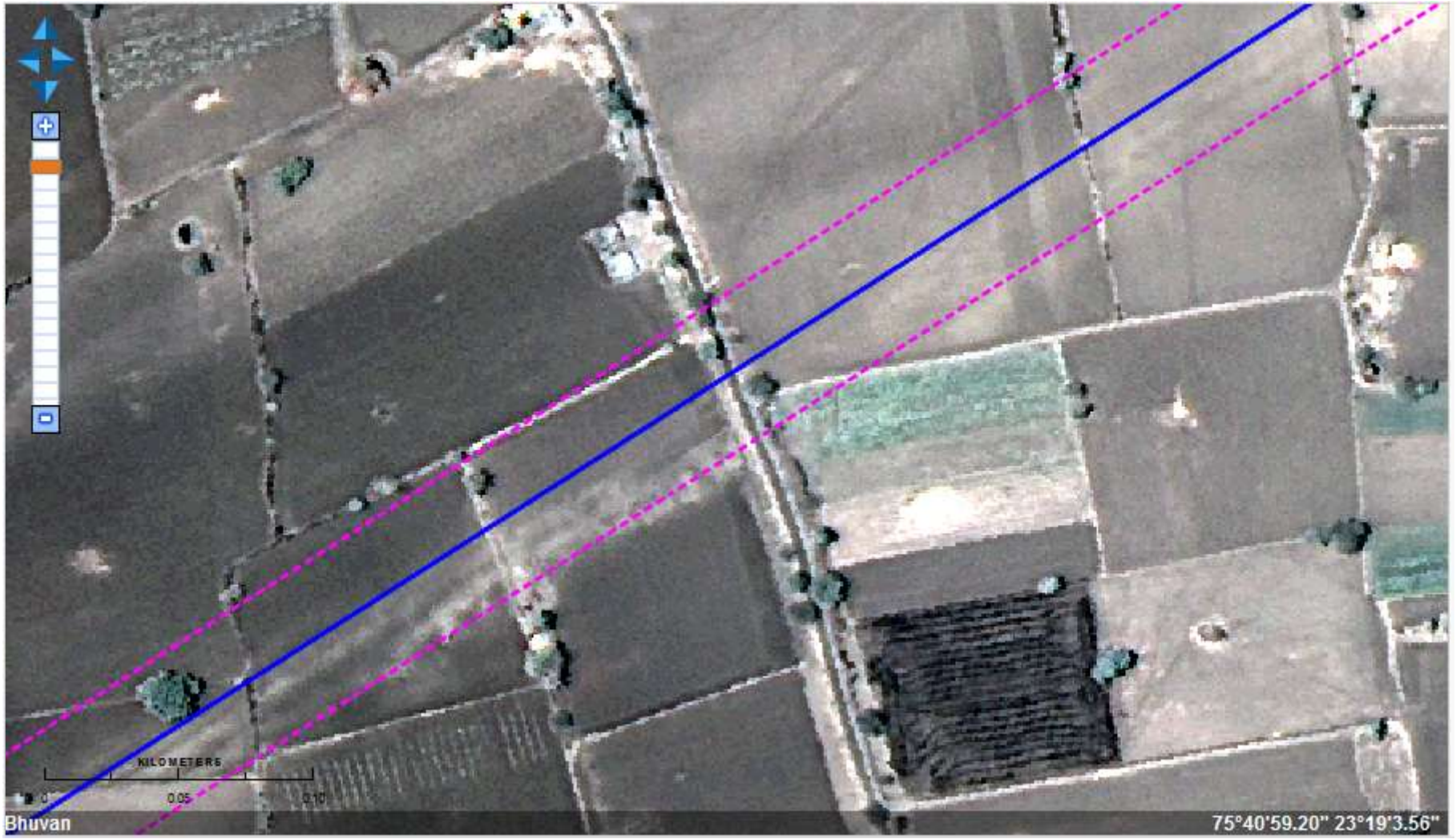
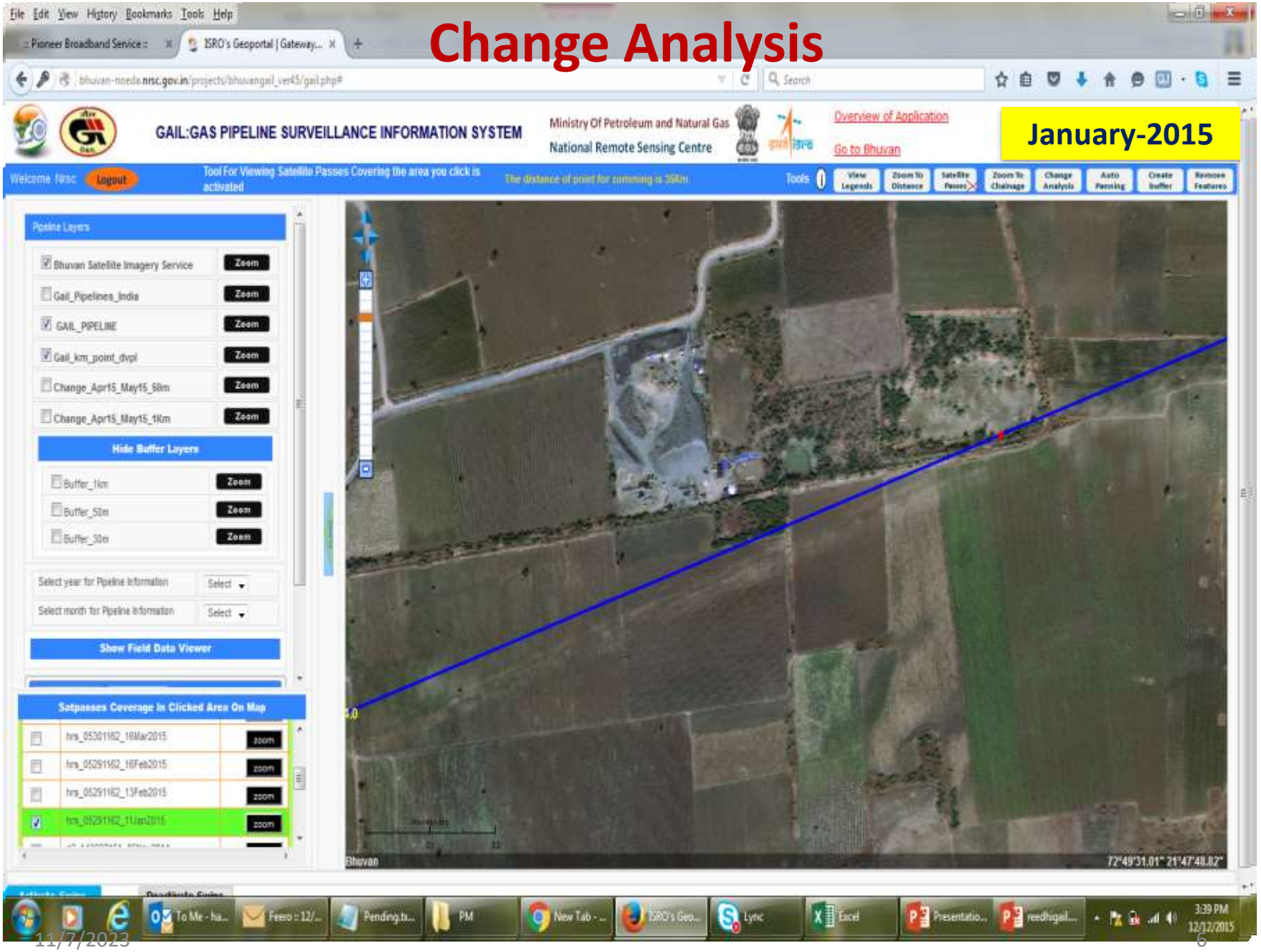
PipeLine Visualization



ROU Visualization



Change Analysis



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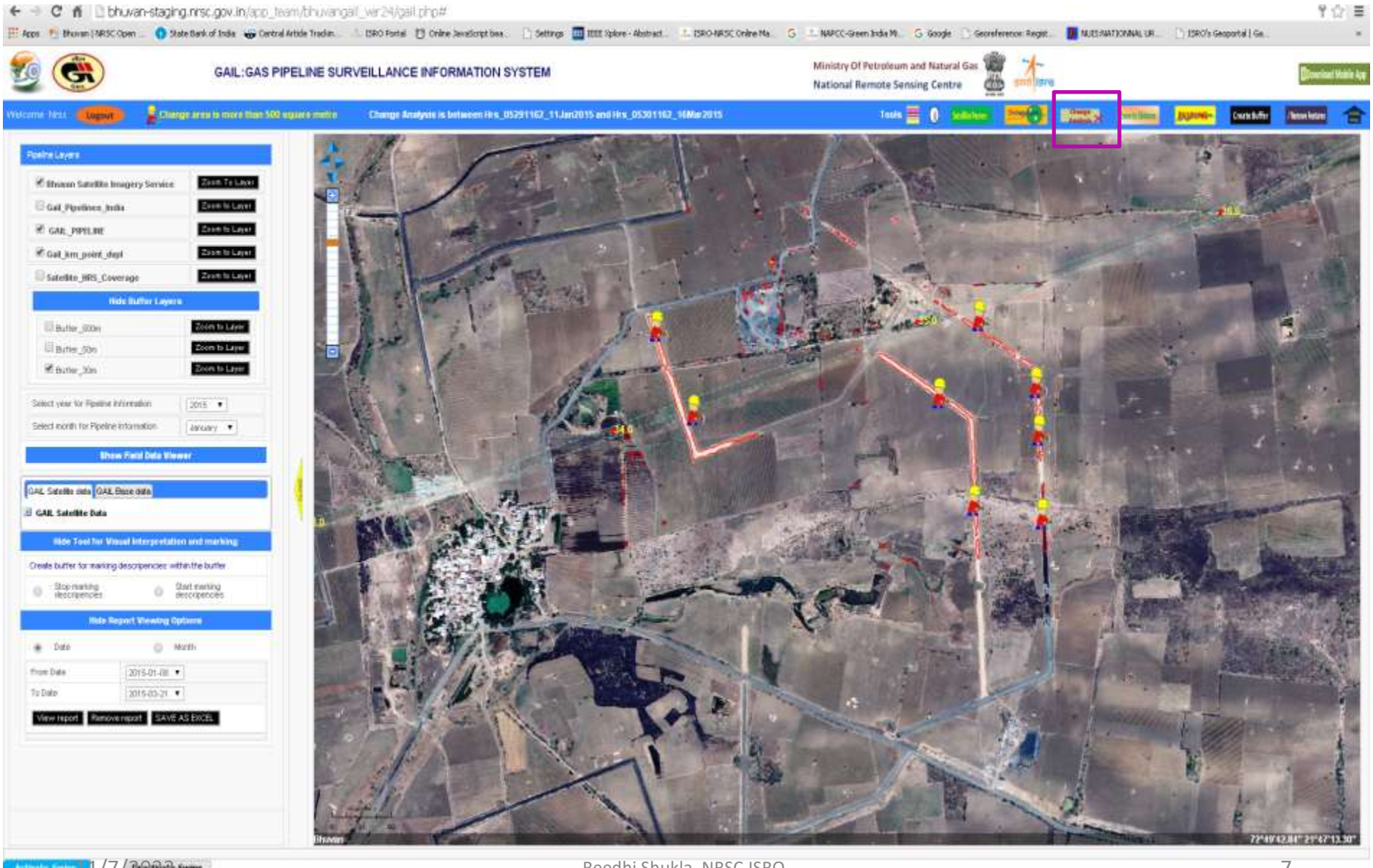
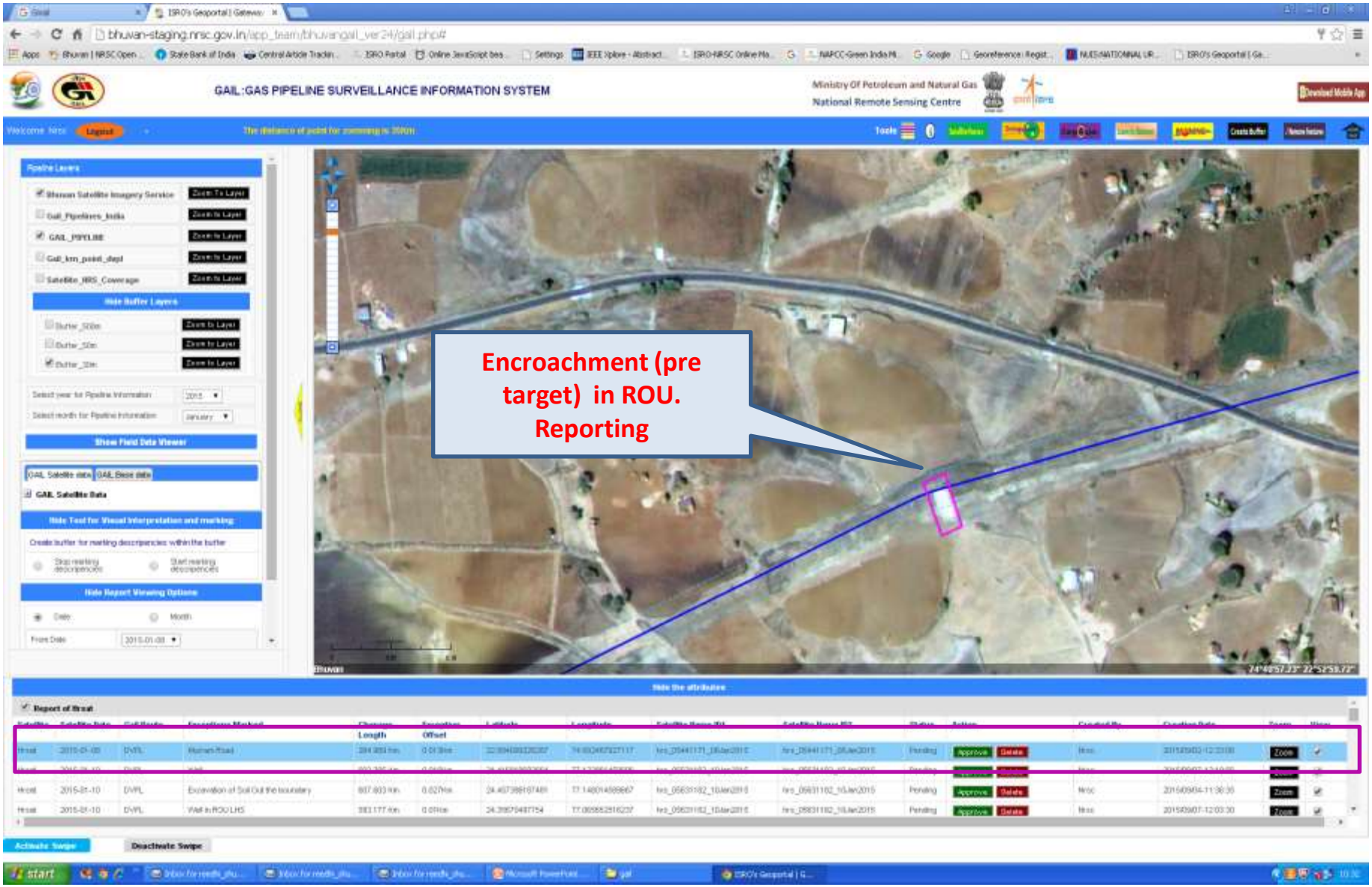


Report Visualization(pre target identified on the application)



Deep Learning based Solution for Encroachment monitoring

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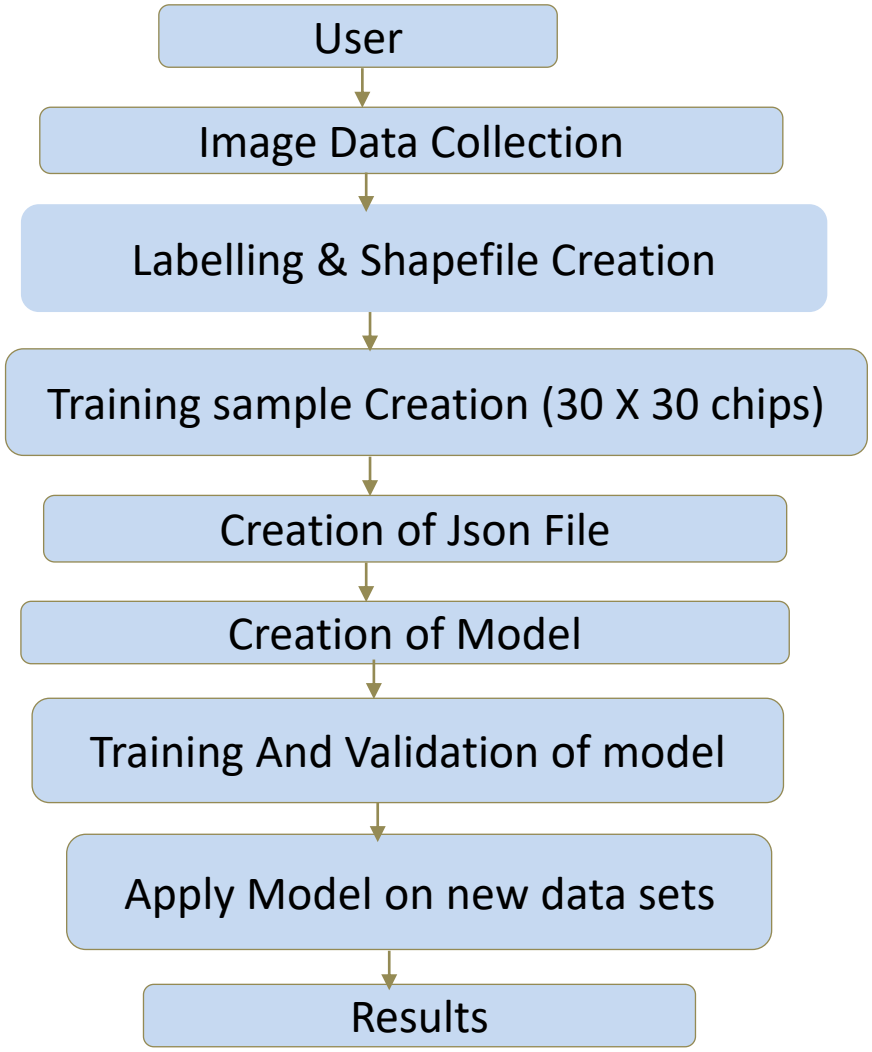
Deep Learning based Solution for Encroachment monitoring



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Training Sample preparation

- The satellite data is visualized in Quantum gis and features are marked
- If feature is building the attribute value is 1 and if feature is non building the status is 0 as shown.
- The shape file is taken as input for the preparation sample chips of 30x30
- The chips are used as input for the preparation of JSON file.
- JSON file is prepared having values corresponding to data, labels, locations and scene id.

1__4_1_2_2__74.380310079_22.7899426013

0__4_1_2_2__74.398448368_22.7926289727

- The total of 224 sample :47 are positive and 177 are negative samples

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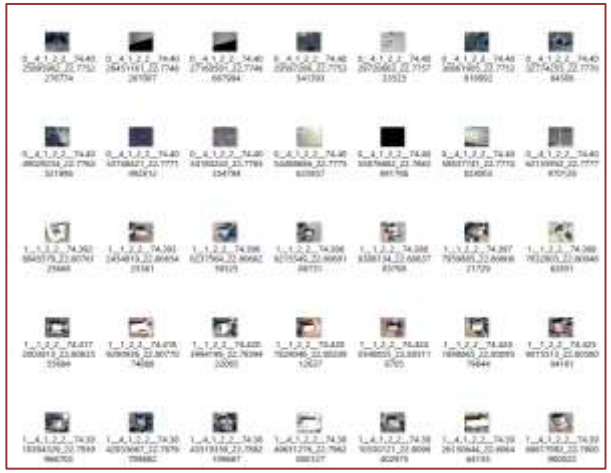
Data Preprocessing

- The JSON file prepared is taken as input for the training of the model.
- The tensor flow libraries for the reading of JSON file and training of neural networks and building detection in very high resolution satellite data.
- The pre-processing of data is required in order to train the neural network.
- To improve the performance of the neural network the new training data set is artificially calculated using existing training data sets using random flip right and left and random rotation.



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Model Training and Validation On Data

- The model parameters :
- Epoch: 70
- Loss: 0.01767
- Acc: 0.95
- Iter: 160/160

Technologies Used: Open source

- Anaconda
- Python
- Tensor flow with Keras frame work

- The methodology is being used on satellite imagery having 1 m of spatial resolution. The accuracy of the 75% is achieved using the above methodology.

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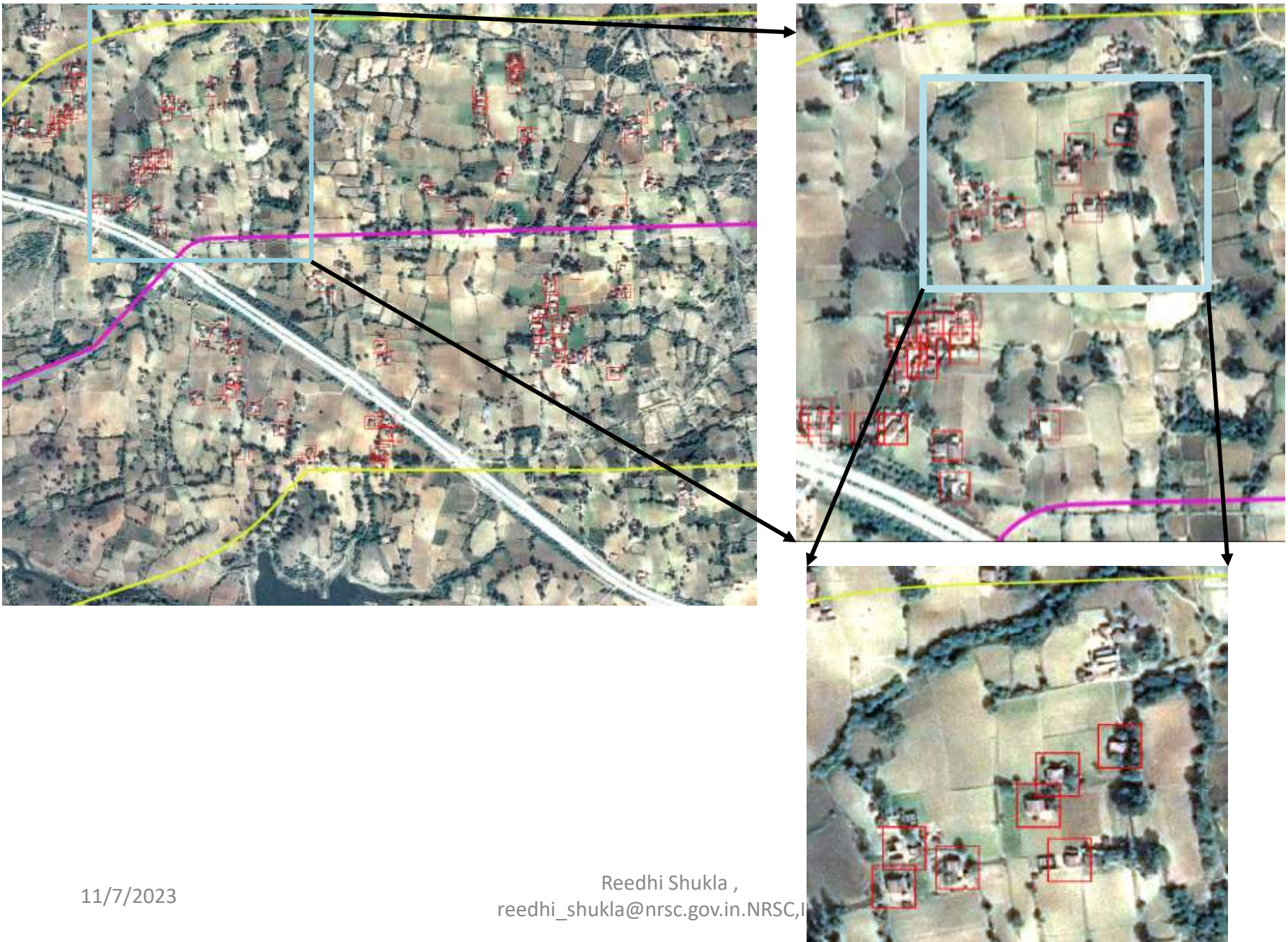
Results



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Advantages and Limitations

- The model is applied only on 4 band multispectral satellite data and samples are also collected from the same data.
- The same model, may not work for the panchromatic high resolution imagery.
- The advantage of the above methodology is that same can be applied on different satellite data only by changing the samples used for the training of the models.

Results: 85% of accuracy has been achieved

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Conclusion

- Improvement in algorithms by increasing the number of training samples to enhance the accuracy of the building detection
- The model can be used for urban for planning by finding out the new building in a given area
- Model can also be used for infrastructural monitoring like finding exception with pipeline ROU
- The scope of the model is not limited to the detection of buildings only the model can be trained for detection of different objects like trees etc for

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Advancement in work (Building footprint detection and Extraction)

- The work is further extended for detection and extraction of building footprints in VHRS .
- Unet with Resnet encoder is used for the same
- Model is trained for 60 epochs with batch size 16
- For preliminary study 10k samples are used
- The model is tested over parts of Hyderabad, Meriyalguda,Indore ,Kanchipuram(drone)

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VHRS 0.5m Spatial Resolution Building Footprint Extraction In Dense Urban Area

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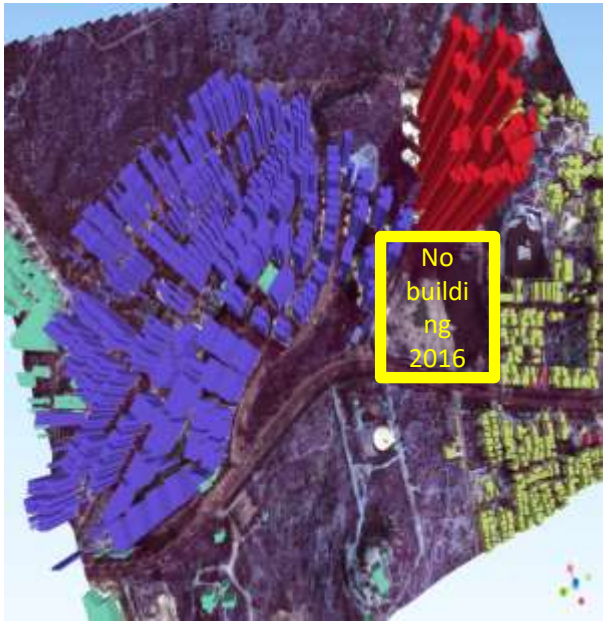
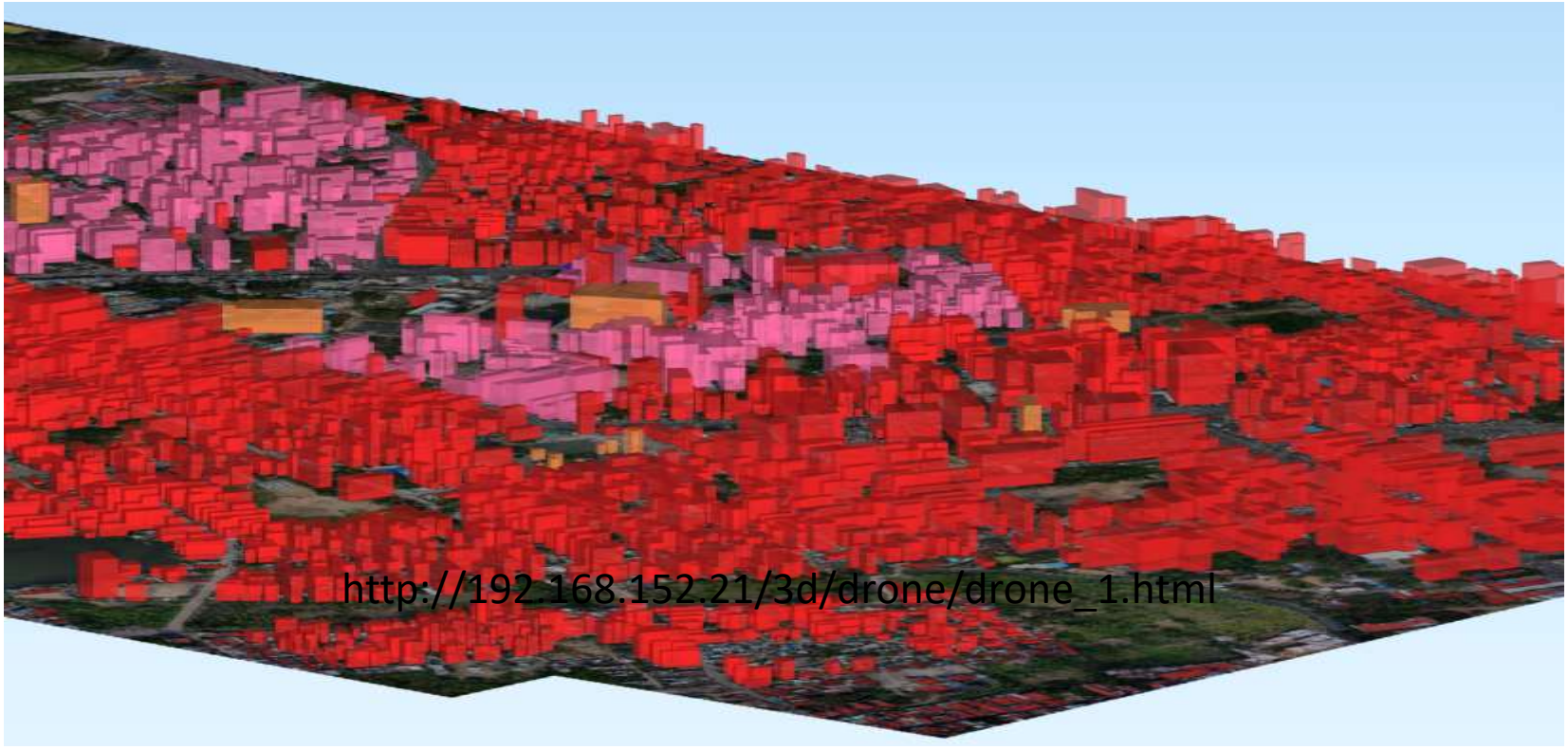
Vertical Change identification



Building Footprint extraction In Drone Data



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Input

Detected Tree with Yellow Borders

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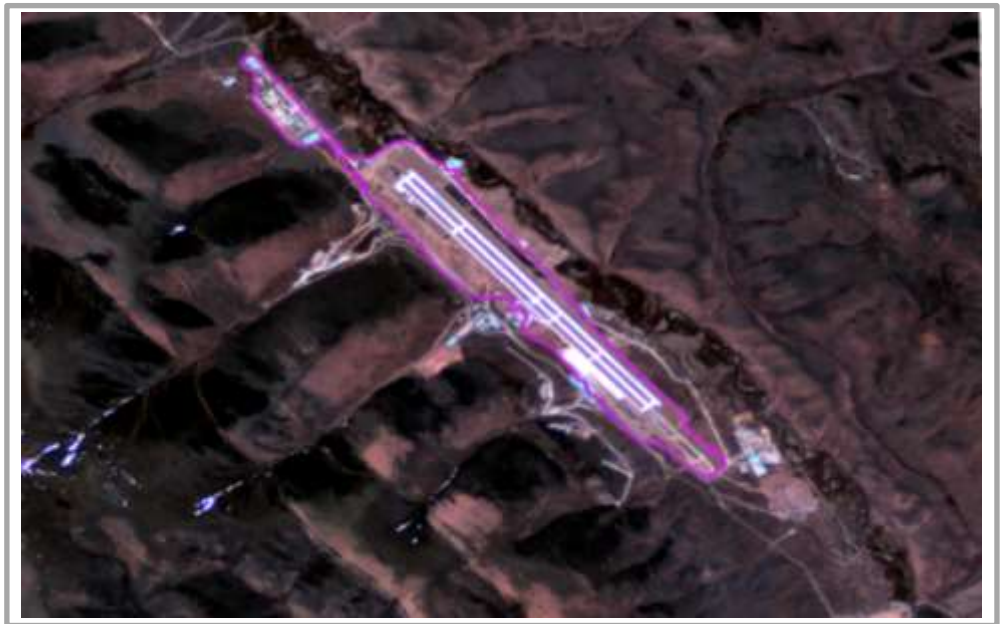
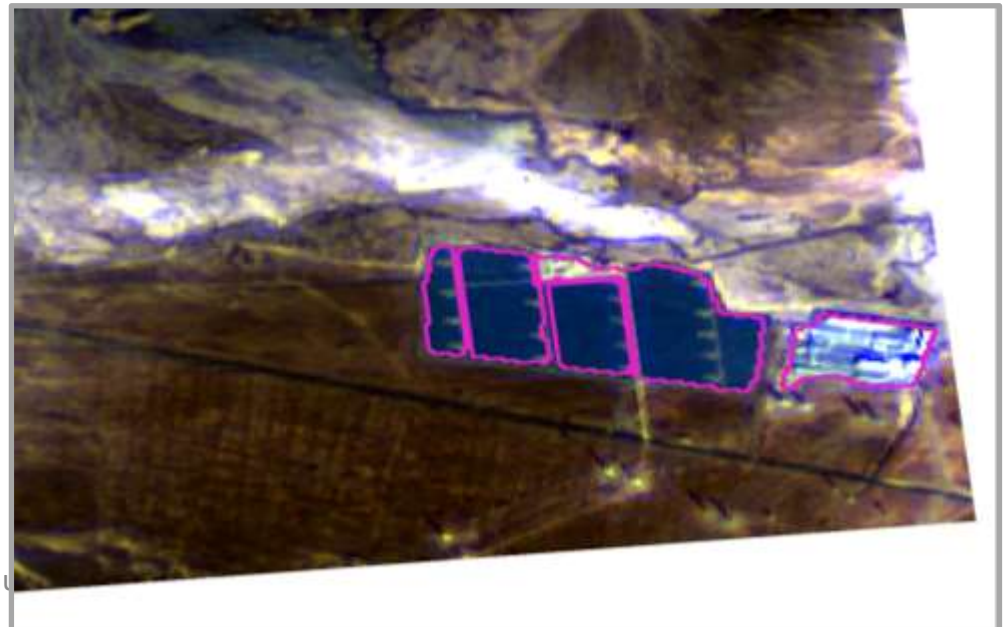
Air Stripe Detection



Solar Farm Detection



Thank you

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