Another work using deep CNN [21] is been presented in a tool called Deep-gaofill. The tool is a image gap filling model using deep convolutional neural network which is trained for filling the pixels in radar images. This work is just a demo since it is not trained with huge dataset.

CloudFCN [22] is a CNN based detection machine learning model for any raster images. The model is aimed to identify thing and thick cluster of cloud and its shadow over the area. The model is trained with Landsat and sentinel images for training purpose. The work uses RGB band images for training purpose. The work is compared with SVM , PCA and single-pixel neural networks (NNs) [39,40,41]

Similar work for cloud detection using fully convolutional network [23,25] is proposed and used in tool named Cloud-Net and Ukiscsmask for cloud detection. Ukiscsmask is trained using Landsat OLI dataset over U-Net CNN model for cloud detection the work is an extension of existing work where this model extends the cloud classification to five classes (“shadow”, “cloud”, “water”, “land” and “snow/ice”). Where prior to this only 3 classes exists (Cloud, land , no cloud).

On the other hand Cloud-Net[25] is trained machine learning model using CNN for cloud detection in Landsat 8 data. The model is very specific in nature due to its training data restrictions. The work is compared with existing FMask model to compare the accuracy of cloud detection. The proposed cloud-Net model proved provide better accuracy in term of detection of cloud in landsat 8 data.

Some of the similar proposed ML based toolkit for cloud and cloud shadow detection are Cdnet and GLNET [27,28,29]. These are some simple CNN based model for cloud detection and classification into thick and thin cloud. For cloud shadow detection using deep learning is shown in AISD [31] where deep Deeply Supervised convolutional neural network for Shadow Detection (DSSDNet) is used to improve the cloud shadow detection raster Landsat data. In [32] a Distortion Coding Network method is proposed for cloud detection. In [33] another cloud detection algorithm is proposed using GAN which is an unsupervised model with higher accuracy than any other model but need huge data for training. Similar work using machine learning are proposed in [34,35] for cloud detection for various satellite datasets. Since the accuracy in GIS models depends on the quantity of dataset trained and the variety of datasets, so new developments are taking place to make the model more accurate.

After cloud detection and removal the empty pixels need to be filled/generated for this some of the work using mathematical modles[16,21] are proposed. In some of new research Machine learning models and deep learning models are used to improve the accuracy and quality of the pixels. In [26] author has proposed a Generative adversarial network to use deep neural network to generate similar pixel for replacing cloud pixels.