An Evaluation of a Convolutional Neural Network for Classifying Images from In-situ Cloud Probes

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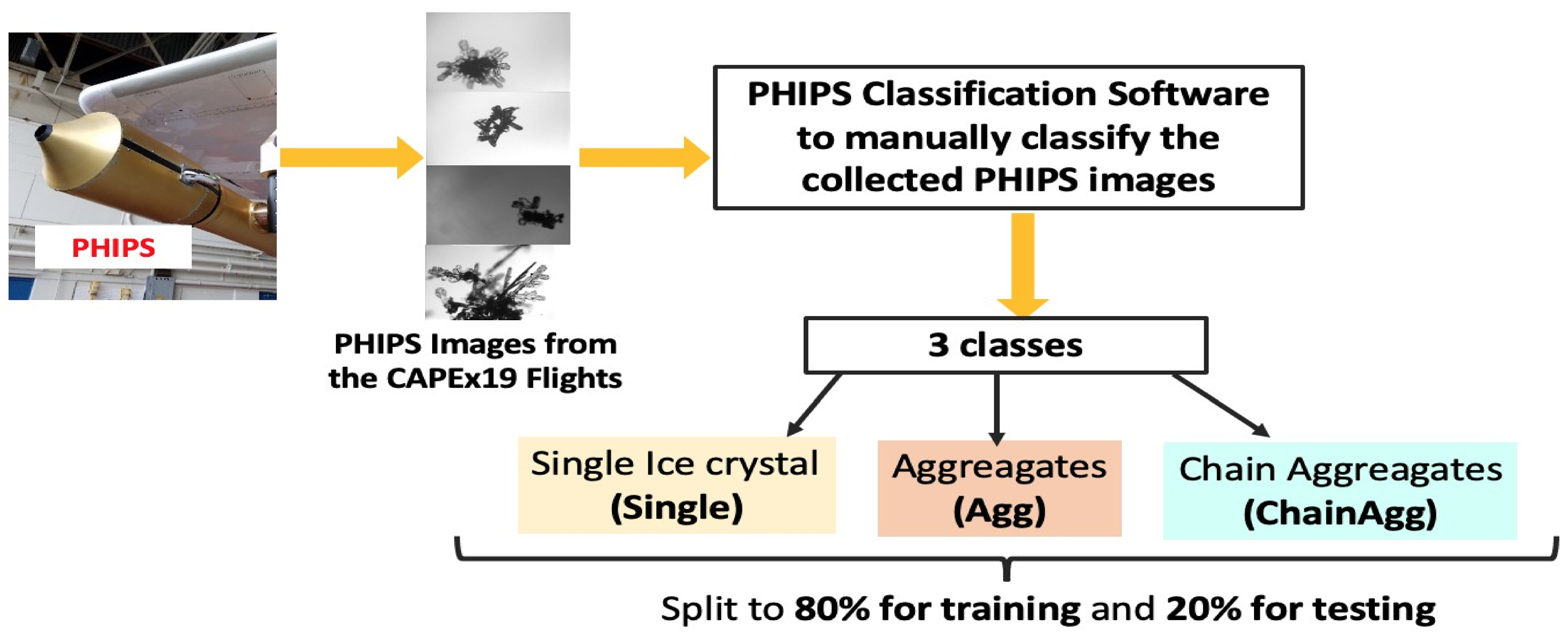
Motivation and Objective

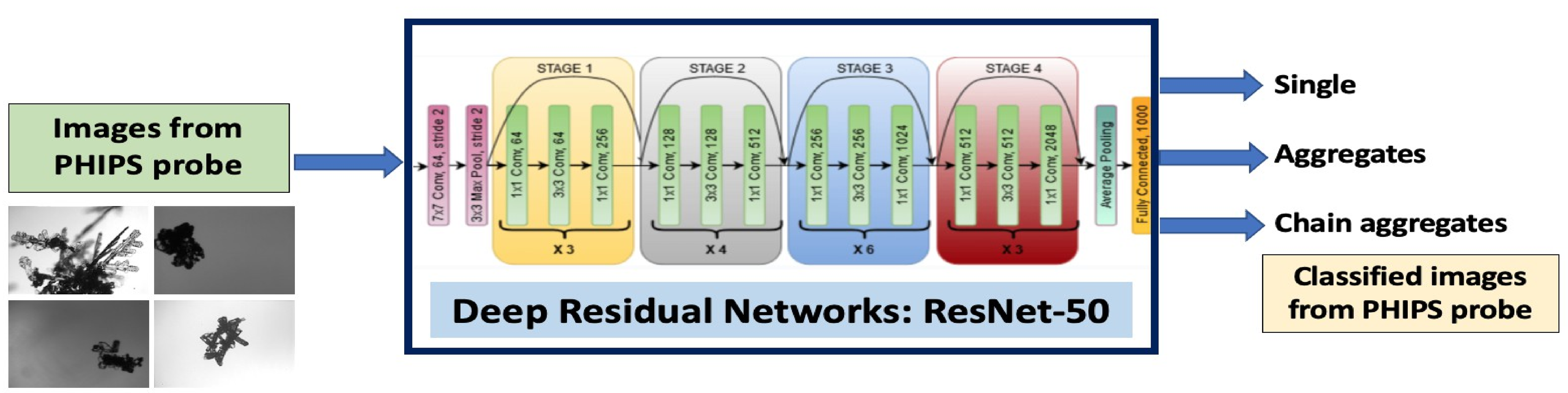
- Identifying ice crystals' properties leads to a better understanding of the microphysical processes.
- Classifying ice crystals by habit provides information about their origins.
- Traditional classification methods require large amount of scientist's time.
- Given the sizable dataset collected from the Particle Habit Imaginary and Polar Scattering (PHIPS) during recent field projects such as CAPEx19 and IMPACTS 2022, there is a need for an automated classification approach.

Objective: Develop a Convolutional Neural Network model to classify the PHIPS images gathered during the CAPEx19 and IMPACTS 2022 field projects with an attributed confidence and evaluate its performance.

Dataset

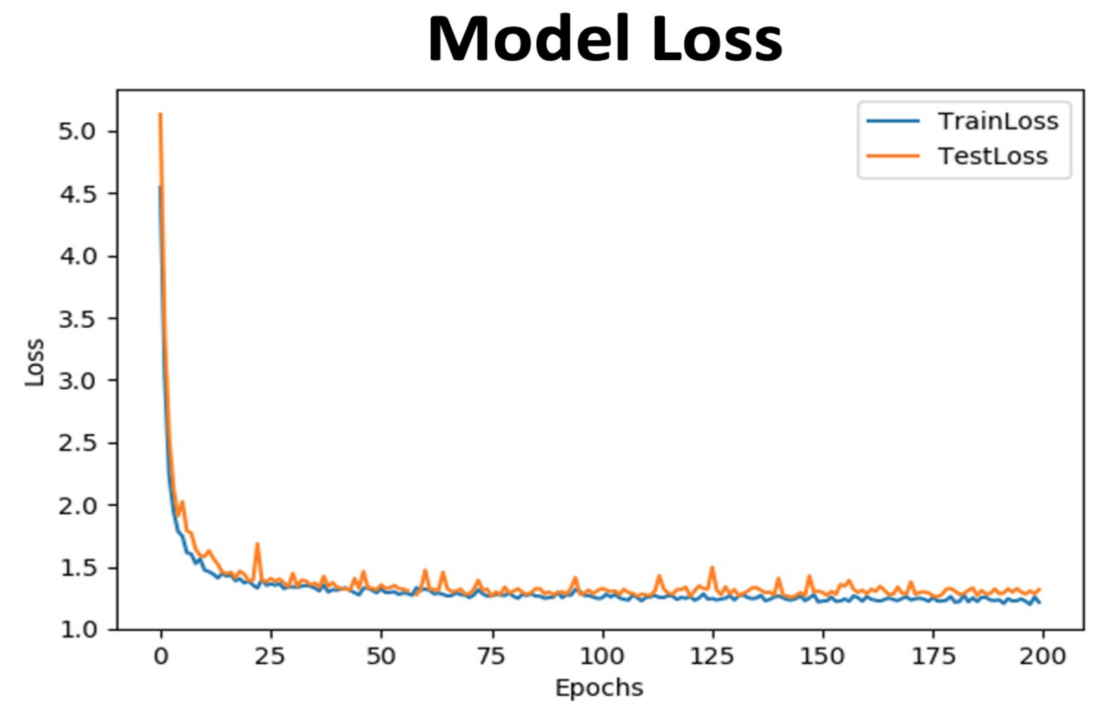


Method

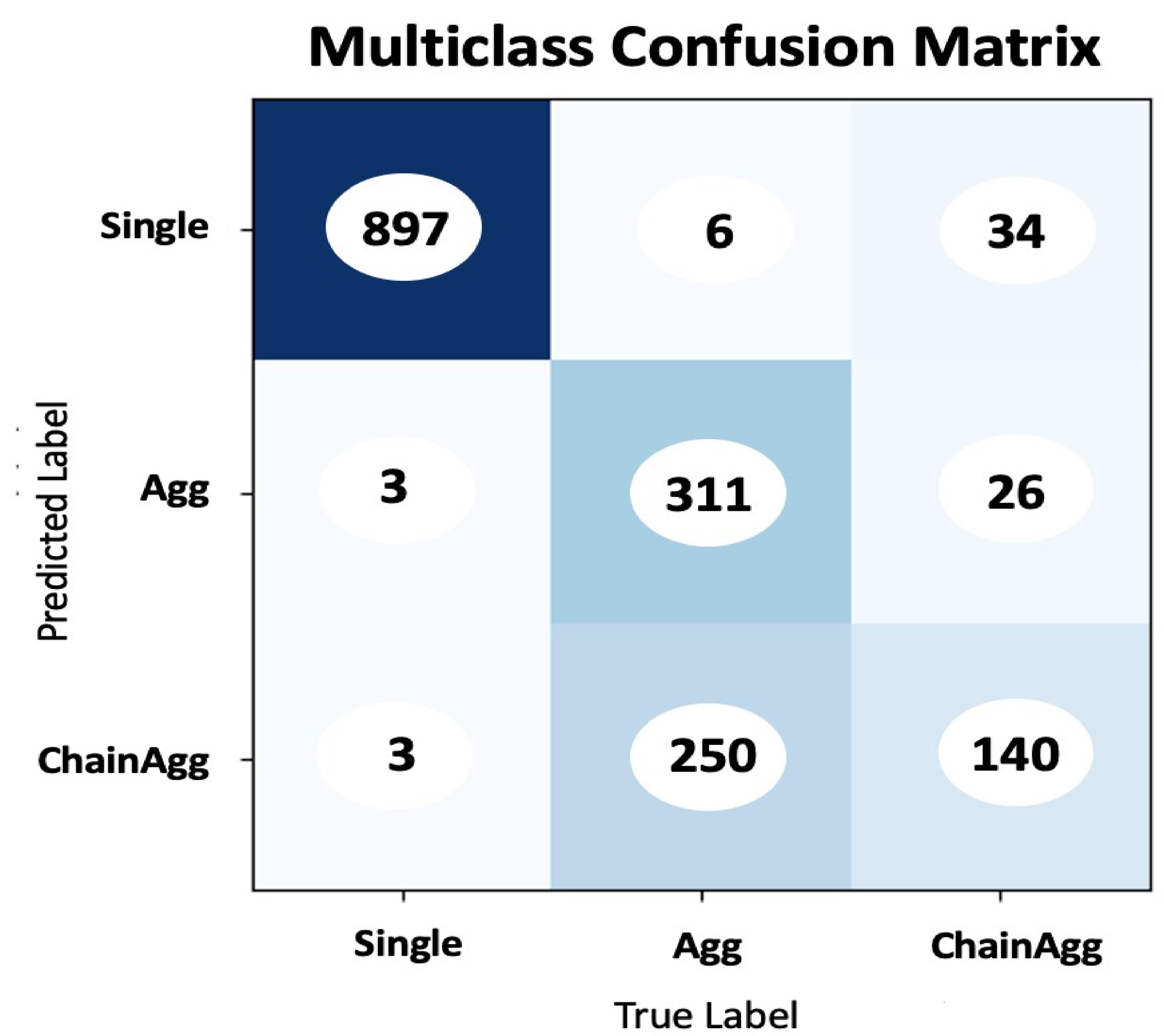


Results

Model Metrics: Loss function



Model Evaluation per Class: Confusion Matrix and Statistical measures



Class	True Positive	True Negative	False Positive	False Negative	Sensitivity (%)	Specificity (%)	Accuracy (%)
Single	897	727	40	8	99.1	94.7	97.1
Chain Agg	140	1217	255	60	70	82.6	85.1
Agg	311	1076	29	256	54.8	97.3	82.9

Conclusion

- A good fit: training and test loss decrease to a point of stability with a minimal gap between two final loss values.
- Global good agreement between true label and predicted label for all classes.
- The model shows a good performance for single ice crystal followed by chain aggregates and aggregates.
- Model's sensitivity and accuracy for aggregates are still low comparing to the other classes.

Future Work

- Train the developed model with more PHIPS images collected during the IMPACTS field project flights with more aggregates and chain aggregates images.
- Refine the dataset considered to train the model to include several other classes.
- Generalize the model to classify ice crystal images from different type of probes.

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