Assessing High Resolution Tasked BlackSky Optical Imagery for Surface Water Detection

Social [Pixel] Lab

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Tasked acquisition of BlackSky Image to monitor the Yellowstone flooding on June 22 2022.

Using satellites to improve flood risk estimates

Millions at risk of flooding Tellman et al, 2021

Mitigation requires to detect floods from space

High resolution necessary in built up areas

NASA CSDA Program: Assess if BlackSky Images should be purchased for flood monitoring research

Assess BlackSky Data for Surface Water Detection

Why BLACKSKY ?

Can be Tasked (active flood monitoring)

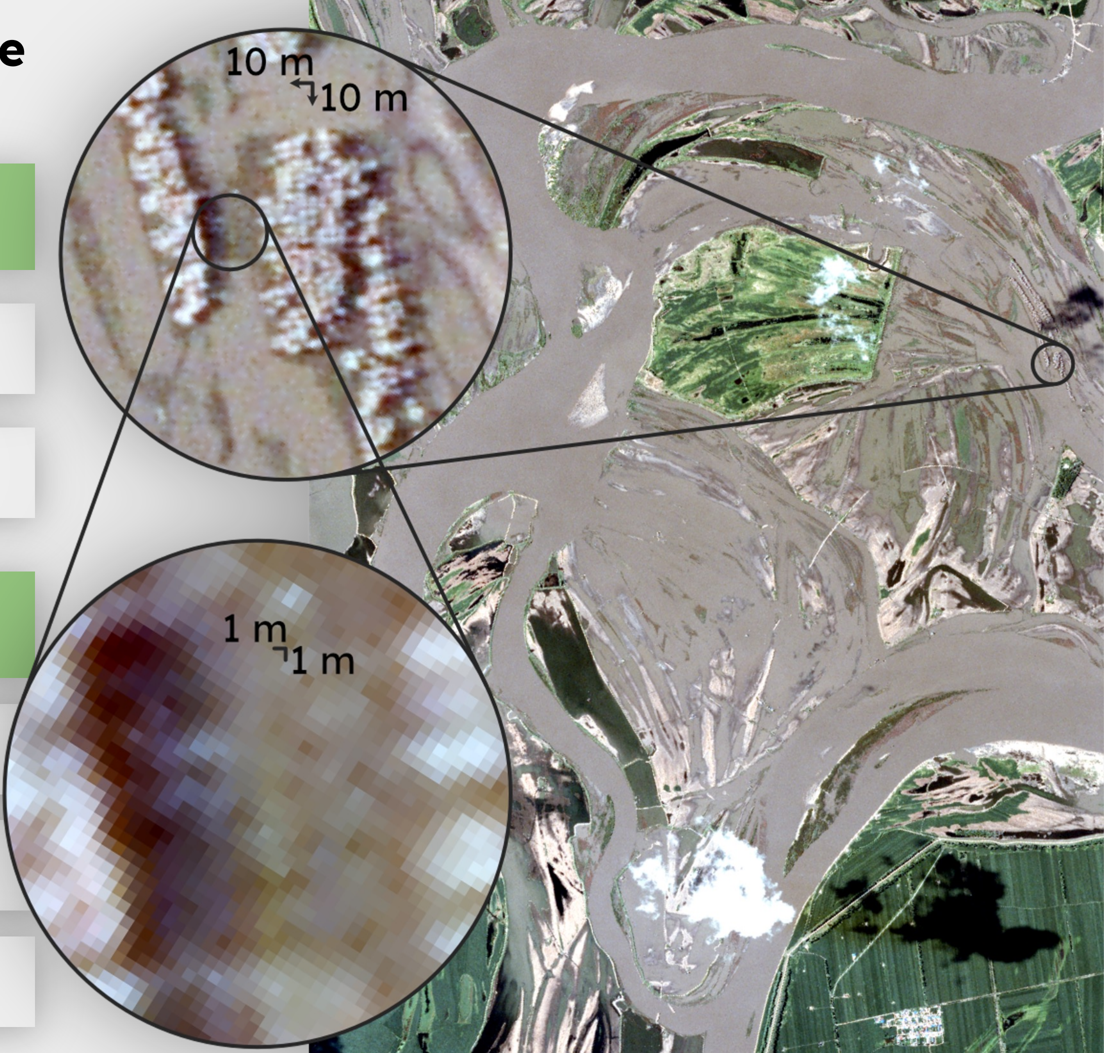
1 meter resolution

Characteristics

~ twenty Satellites

Optical Imagery

3 Bands: Red, Green, Blue



South Mulan, China, Aug. 23, 2022

Data acquired to observe permanent water and monitor "active" flood areas

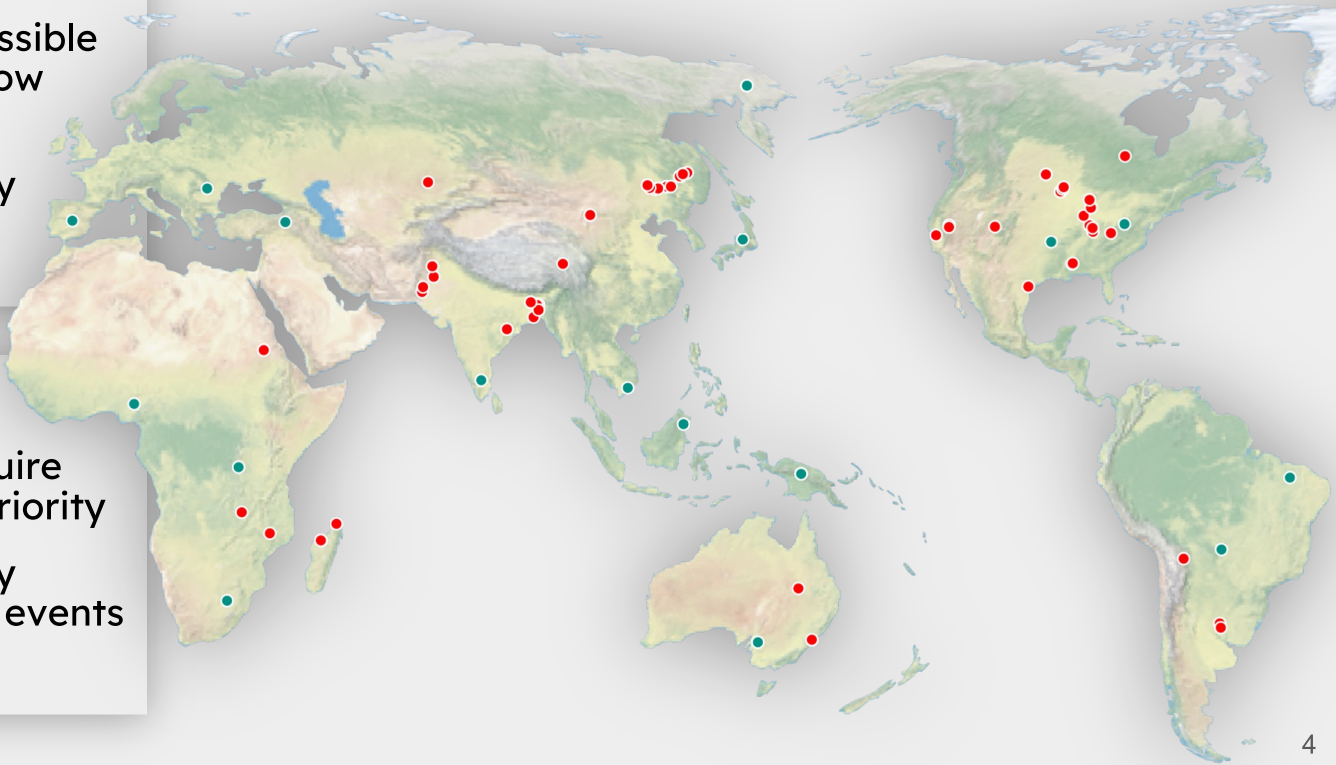
2 Priorities: 1) Low; 2) High

Low (green dots):

- Capture image whenever possible within a given time Frame, low priority
- Assess capability of BlackSky to observe **permanent** water areas

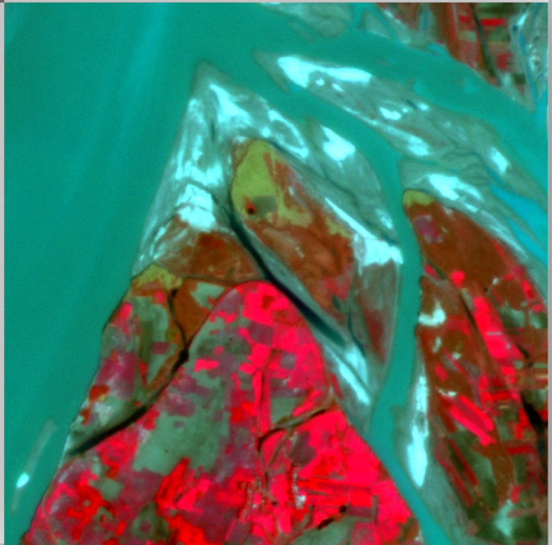
High (red dots):

- Actively task satellite to acquire image, move camera, high priority
- Assess capability of BlackSky to observe **unforeseen** flood events for **active** monitoring



← **BlackSky**
True Color Composite
Red, Green, Blue
1 [m] resolution

PlanetScope Image →
False Color Composite
NIR, Green, Blue
3 [m] resolution



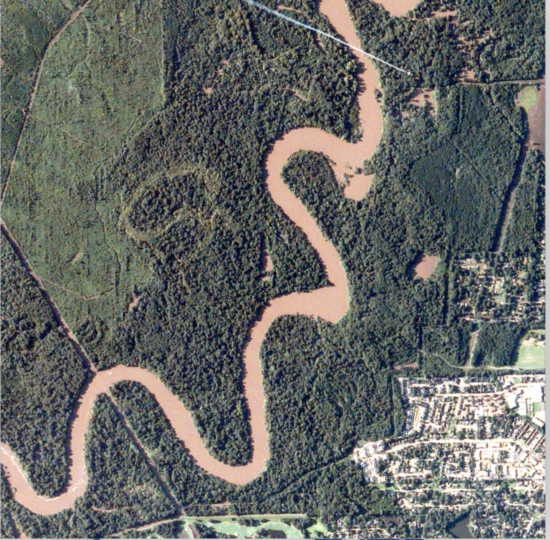
East Chilmari, Bangladesh, Nov. 4, 2022

Compare to Planetscope based model

BlackSky is lacking a Near Infrared Red (NIR) band

NIR is one of the most useful bands to detect water

Can better resolution compensate for the lack of NIR band?



← BlackSky Images →

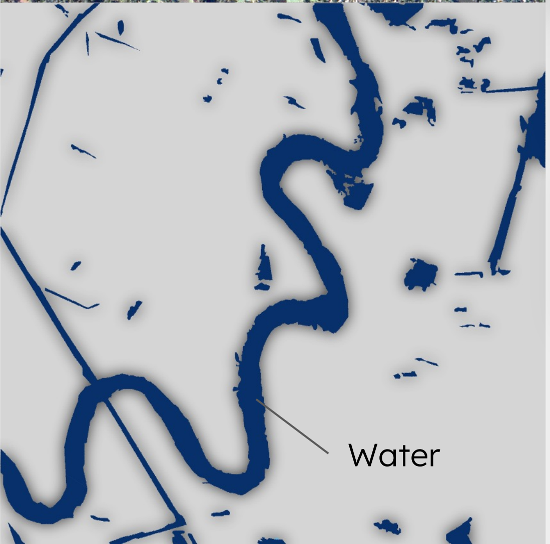
Hand Annotate BlackSky Images for Training

Labeled 77 3072x3072 Chips

Insufficient Chips to train model from scratch

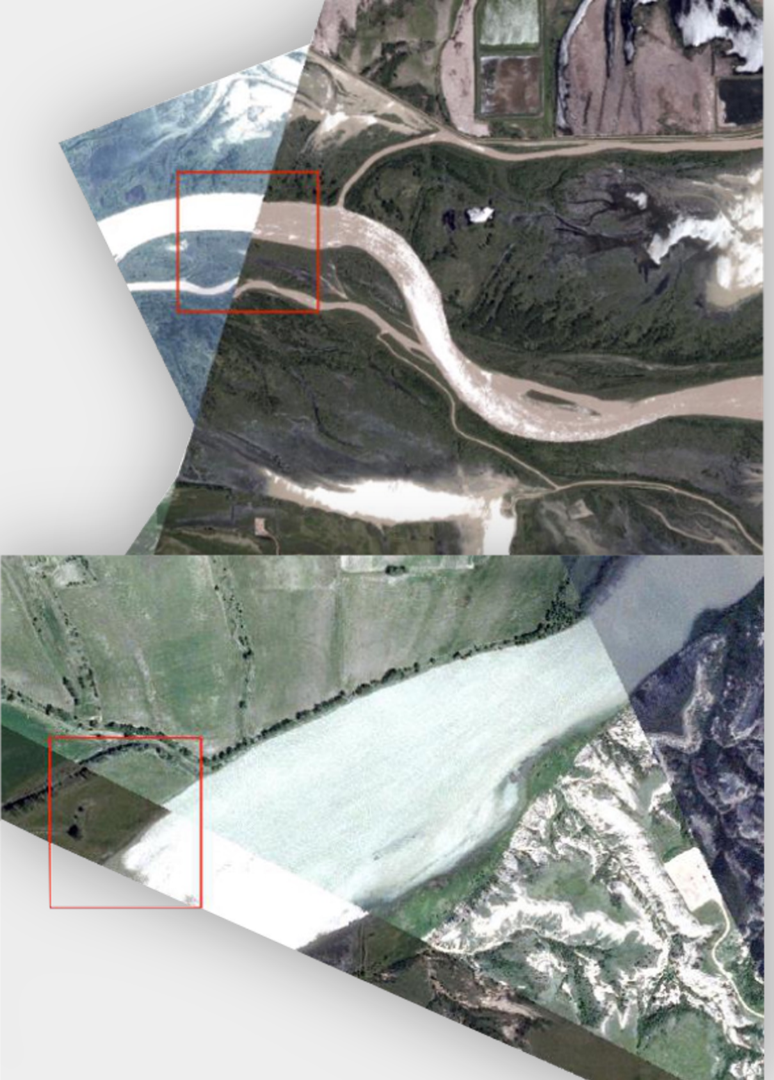
Model pre-trained on Planet, transfer learned to BlackSky Images

← Hand Labeled Chips →



Jackson, USA

Shorkot, Pakistan



Model

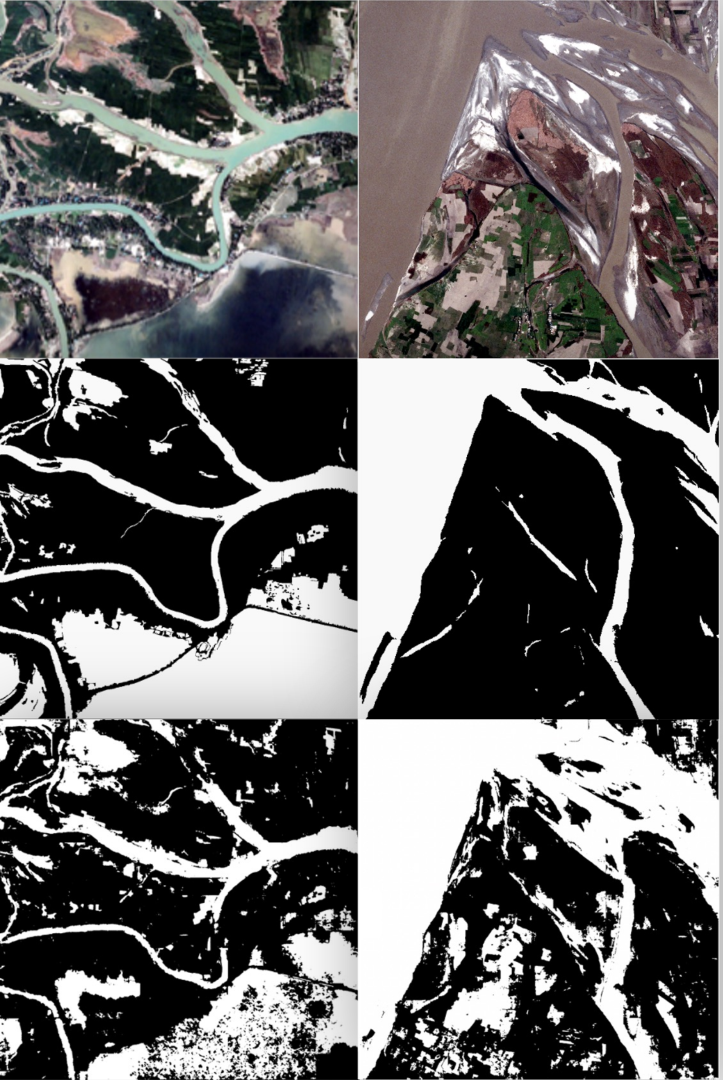
Base model: U-Net trained on Planet Images

Because of co-registration issues: Model outputs can’t be compared directly

Planet Model	F1	IoU
Trained on 4 bands (RGBNIR) PS	**0.963**	**0.938**
Trained on 3 bands (RGB) PS	0.876	0.822

Loss in performance from 4 bands to 3 bands

For BlackSky: model transfer learned from 3 Band Planet Model



← BlackSky Image

← Hand Labeled

← Transfer Learned

Results

BlackSky models:
1) Run directly on Planet model
2) Transfer learn Planet model on BS labels
3) Transfer learn on pretrained ResNet18

Experiment	F1	IoU
Directly feed to pre-trained PS model	0.613	0.531
Transfer learn on pre-trained PS model	**0.876**	**0.813**
Transfer learn on pre-trained ResNet18 model	0.561	0.501

Transfer learning from Planet base model significantly improves model performance

Conclusions

High resolution improves delineation of inundation area

Initial assessment would suggest higher resolution does not compensate for no NIR band

Further work needed to directly compare BlackSky output with Planet output

Jackson, USA

CSDAP Assessment

Tasking powerful tool to monitor inundation events

Image acquisition still highly dependent on cloud cover

Portal allows to specify cloud threshold, but cloud estimates not very accurate

Poor image geolocation/coregistration, difficult to monitor same area over time

Sensors cover very small area

High priority tasking more expensive, but higher probability of image acquisition

Arroyo Feliciano River, Argentina

Thank you for your attention!

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Ice River in Canada