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Title: Remote sensing of river ice and ice jams using an automated algorithm with local cloud mask for MODIS and VIIRS: Application over the Lower Susquehanna River (2001-2016)

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Ice jams are accumulations of smaller ice fragments and frazil which may partially obstruct the natural flow of the river when present. Ice jams are natural occurrences during the winter seasons, in particular during the freeze-up and break-up periods during which ice tends to be mobile and have a higher likelihood of forming ice dams. In severe cases, ice dams may cause the river stage to rapidly increase over a short period of time. Hence, ice jams are difficult to model and predict and potentially severe and unexpected floods may occur over a short period of time.

Satellite observations may be used to observe the river surface for indicators of ice jams. Daily river ice maps are being generated based on the CRIOS (MODIS-Terra) and VIIRS river ice algorithms that were developed at NOAA-CREST. Both algorithms rely on their respective cloud products to inform on where river ice may be observed. However due to the global nature of the cloud products errors may occur locally such as false cloud detections or detection of semitransparent clouds. In these cases it may still be possible to correctly ascertain whether ice is present or not, potentially resulting in better revisit times. For this purpose a third river ice detection algorithm, incorporating more liberal internal cloud screening, was developed. The algorithm, consisting of a threshold-based decision tree method, was applied to both MODIS platforms and VIIRS in order to map river ice and investigate/detect ice jams for a time period spanning 2001 to 2016.

Preliminary results indicate that this scheme is most effective when applied to MODIS-Aqua data, because its cloud mask appears to have a significant bias toward cloud detection when snow and ice is present. Additionally, by retrieving more grid cells when applied, the developed algorithm fulfills its purpose of providing a comparatively more liberal cloud mask. It also provides consistent ice cover results between the platforms (correlations in excess of 90% on same day observations). Reflectance difference maps are able to generally inform on ice jam locations and extent.

Remote sensing of river ice with local cloud mask (2001-2016)
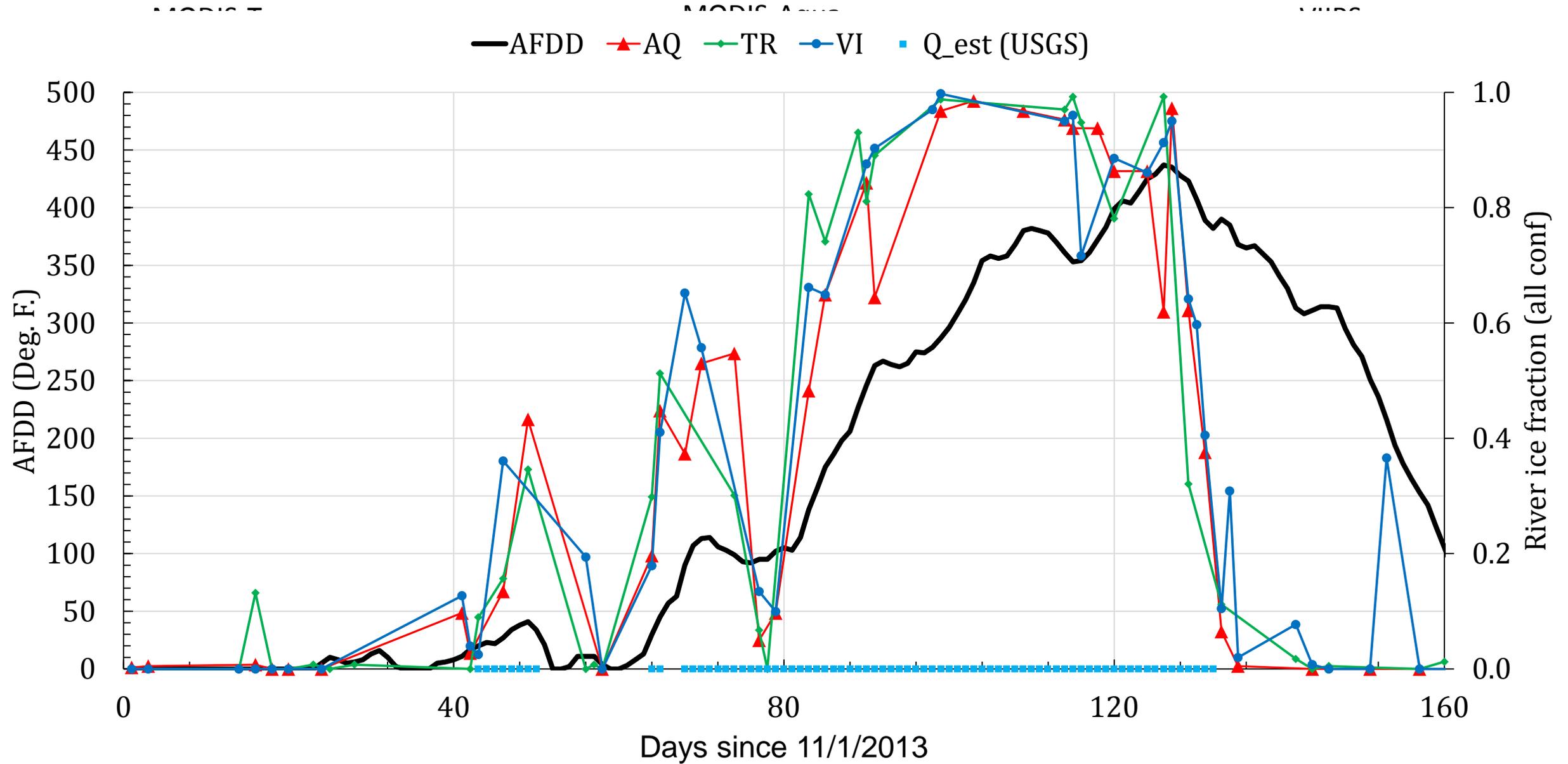
Remote sensing of river ice and ice jams using an automated algorithm Application over the Lower Susquehanna River (2001-2016)

- Classification algorithm is a threshold-based decision tree type, developed from physical basis and statistical analysis (IDL)
  - Uses a land/water mask generated by multispectral max. likelihood method (ENVI/IDL)
  - Incorporates cloud masking (which is in-between that of MODIS/VIIRS overall), better than either
  - Uses 1 VIS (0.55 or 0.64 micron) + 1 SWIR (1.6 or 2.1 micron) band to discriminate
    - ice in three confidence bands
    - open water
    - snow
    - (opt. thick) cloud
  - Adaptive thresholding in case of snow cover adjacent to river
  - Viewing geometry based thresholding at VZA of 20° and 40° (MODIS only).
  - Validated by in-situ gauge, traffic camera obs. of river