

CrIS Cloud clearing using VIIRS and application to Hurricane forecast

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Cloudy radiances contain useful information for NWP forecast. With the difficulties in both forward radiative transfer and Jacobian calculations, direct assimilation of cloudy radiances is still challenging. An alternative way is to assimilate cloud cleared radiances (CCRs), which is the equivalent clear sky radiances if cloud impact is removed from the observations. Due to the differences between VIIRS and MODIS, the cloud clearing technique using AIRS/MODIS developed by Li et al. (2005) can not be applied to CrIS/VIIRS directly. The major difference is that VIIRS has no absorption bands in both CO₂ and H₂O bands while MODIS has 9 IR bands (4 CO₂ and 2 H₂O bands). This difference poses great ineffectiveness for the quality control using VIIRS, which ensures the cloud cleared radiances (CCRs) are close enough to clear VIIRS radiances, but only in the three window bands. An evaluation technique, by examining the horizontal gradients between neighbor FOVs, reveals low quality of the CCRs in absorption bands in CO₂ and H₂O. Instead of improving the CCRs, two additional quality control procedures are added to remove bad CrIS/VIIRS CCRs. 1) The CCRs have larger noises than original radiance observations because of the nature of the problem. The closer the N^* is to 1, the more noises the CCRs have. So the first quality control removes any CCRs with N^* close to 1. And 2) cloud clearing technique requires the pair of FOVs under consideration to be homogeneous in both clear and cloudy portions. That means the FOV with larger cloud coverage should have colder radiances than the other one. Pairs of FOVs do not follow this violates the assumption of the homogeneousness. After these two quality controls, the CCRs exhibit much more reasonable horizontal gradients than without them, which is close to clear sky. Experiments are carried out to study the impact of CrIS CCRs on Hurricane Joaquin forecast in both regional and global NWP. Substantial positive impact is observed in the regional NWP in terms of track forecast, as well as slight positive impact in intensity forecast. Results from global NWP will be shown as well.