Atmospheric correction and aquatic applications of Landsat and Sentinel-2 satellite imagery

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We present a simple atmospheric correction method for aquatic applications of high resolution (10-60 m) satellite sensors, in particular the Landsat series (5, 7 and 8, launched in 1984, 1999 and 2013), and the Sentinel-2 series (A and B, launched in 2015 and 2017). The method assumes no water-leaving radiance in two shortwave infrared (SWIR) channels in the atmospheric windows around 1.6 and 2.2 micron, and that the observed signal in those channels can be fully attributed to the atmosphere. Top-of-atmosphere reflectances are derived from the images, either by using the coefficients provided by the space agencies (L8, S2A and S2B by default, and newer processing versions for L5 and L7) or by normalizing TOA radiances to the extraterrestrial irradiance (older processing versions of L5 and L7, optional for L8). A gas and Rayleigh correction is first performed, using a lookup table generated using 6SV. After Rayleigh correction, a non water masking is applied, using a 2.15% threshold on the 1.6 micron channel. The remaining signal in the 1.6 and 2.2 micron bands is used to estimate the multiple scattering aerosol reflectance, fitting a simple exponential model to the visible and near-infrared channels. Due to the low signal and low signal to noise ratio in the SWIR bands, a spatial smoothing is recommended before processing. By using SWIR bands for the atmospheric correction, the method is well-adapted for processing data over turbid and extremely turbid waters without imposing known water reflectance characteristics (i.e. particle type) during processing. Applications of high resolution imagery are also presented, including those related to human activities, such as the monitoring of the impacts of offshore construction and dredging and disposal activities. Potential for characterization of validation sites (e.g. AERONET-OC) and water quality monitoring in the first nautical mile (European Water Framework Directive) are explored. The potential for multi-mission time-series is illustrated. Validation results using the two Belgian AERONET-OC stations are presented.