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Ammonium photo-production in aquatic systems: synthesis and ecological significance

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Photo-chemical ammonium production in aquatic systems has received considerable interest over the last decade. Chromophoric Dissolved Organic Matter (CDOM), the main UV chromophore in natural waters, is involved in this process. However, it is not clear whether CDOM acts as a direct substrate or photo-sensitiser whilst there is evidence that both CDOM quantity and quality (spectral shape, diagenetic history) play a role. In addition, inorganic Fe, pH and hydroxyl radical have been shown to affect photo-chemical rates. Our limited understanding from mechanistic studies suggests that multiple ammonium formation pathways exist. Furthermore, photo-chemical ammonium consumption has been observed raising uncertainty over the regional ecological significance of this process as a nutrient source for aquatic micro-organisms. Nevertheless, a number of studies have scaled-up experimental ammonium photoproduction rates to regional nitrogen (N) budgets and shown that this process may constitute a substantial N source for plankton. Here, we provide a synthesis of published work, including our own ammonium photoproduction rate data from freshwater, estuarine and open ocean environments. Our synthesis will discuss similarities and discrepancies between existing datasets in the light of regional variability, and will attempt an assessment of the likely roles of ammonium photoproduction in regional N cycles.