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Global spatial distribution of wetlands

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Summary

We reviewed currently available data bases of wetlands including peatlands, their spatial resolution, and the time period when the data was assembled. We found six global datasets that use information from various data sources. The database with the greatest spatial detail (0.5 arcminutes, ca 1 km at the equator) and finest classification is the Global Land and Wetland Database (Lehner & Döll 2004). It reflects the situation before 1992 and is also the most recent map.

Introduction

The soils of wetlands and peatlands store an enormous amount of carbon because decomposition is restricted by the availability of oxygen. Draining of wetlands often greatly increases the decomposition of dead plant material and release of carbon dioxide into the atmosphere. This process can significantly affect the global carbon budget when it happens at a large extent. The global distribution of wetlands, however, is not well characterized because there is no specialized global remote sensing product. This prevents also the timely detection of changes in the extent of wetlands and peatlands.

We reviewed currently available data bases of wetlands and peatlands, their spatial resolution, and the time period when the data was assembled.

Review

Global maps

Existing maps of wetlands have been reviewed earlier by Sanderson (2001). The review compared five maps using the wetlands databases of Matthews & Fung (Fig. 1, 1987, 1° × 1° resolution) and Aselmann & Crutzen (Aselmann and Crutzen 1989, 2.5 × 5.0°). The M&F map is derived from the Soil map of the world (FAO 1971-1981) combined with a vegetation classification data base (Matthews 1983) and Operational Navigation Charts. The A&C map cites (Gore 1983) and 'various maps' as sources. Sanderson recommends using the map by Stillwell-Soller et al. (1995, 1° × 1°) interpolated from Aselmann & Crutzen (Aselmann and Crutzen 1989) and additional data in the global circulation model STOCHEM because the map was derived from more direct information about wetlands.

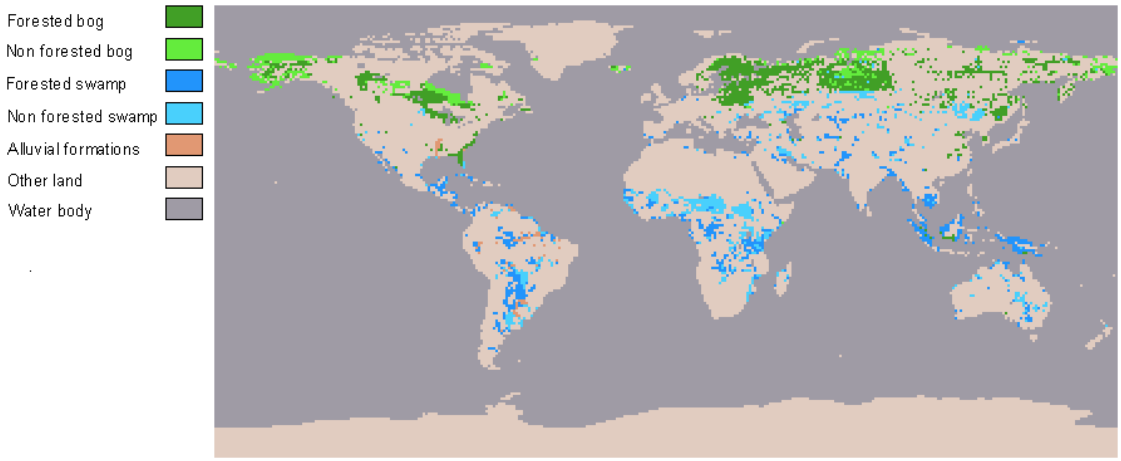

Fig. 1. Database of (1987) as shown in (Mitra et al. 2005).

Another wetlands map (Fig. 2, Reich 1997, 2' × 2') has been compiled by the United States of America Department of Agriculture (USDA) from a reclassified FAO-UNESCO Soil map of the world (FAO 1971) combined with a USDA Soil climate map.

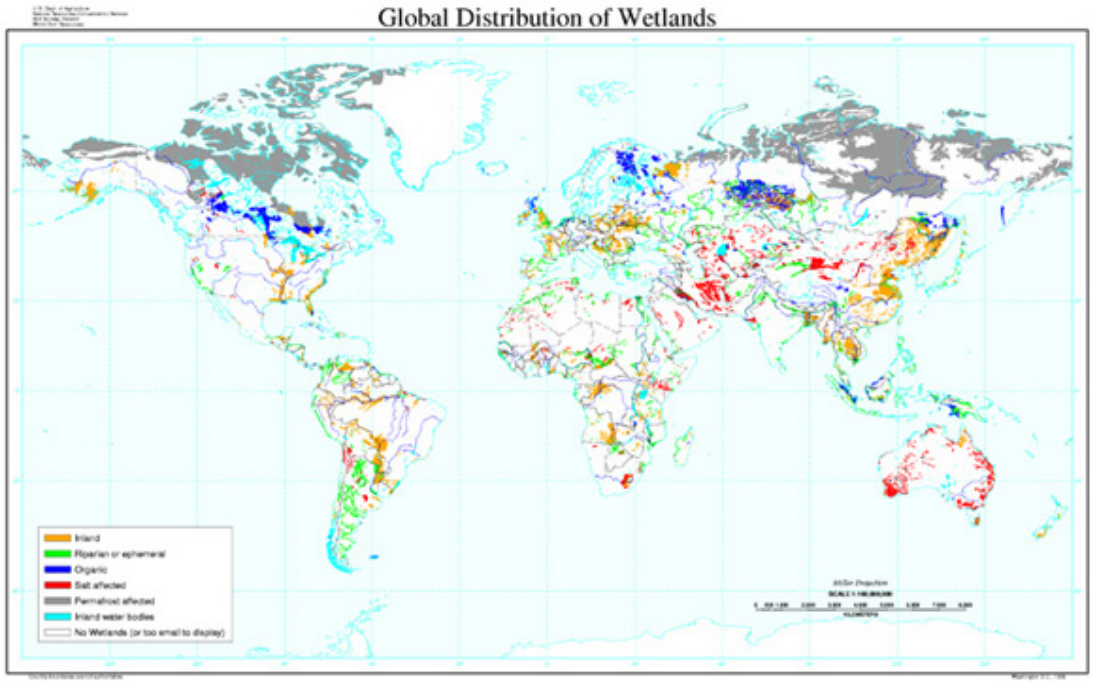

Fig. 2. Wetlands map compiled by the USDA (Reich 1997).

Mitra et al. (2003, Mitra et al. 2005) compared the Matthews & Fung map with land cover maps from the International Satellite Land Surface Climatology Project (ISLSCP, http://badc.nerc.ac.uk/data/islscp/) and the International Geosphere–Biosphere Programme/Data Information System (DISCover). The ISLSCP map is based on hydrological maps (Darras et al. 1999 in Mitra et al. 2003). The map, however, seems to be no longer accessible. The DISCover map is based on remote

sensing with AVHRR (Loveland and Belward 1997). The M&F and ISLSCP maps matched only 57% although their global estimates of wetland area was very similar. The match among M&F and ISLSCP with DISCover, however, was even lower. The original remote sensing data of the DISCover map is now provided in much finer resolution as the Global Land Cover Characteristics Data Base based on AVHRR remote sensing (Fig. 3, Loveland et al. 2000).

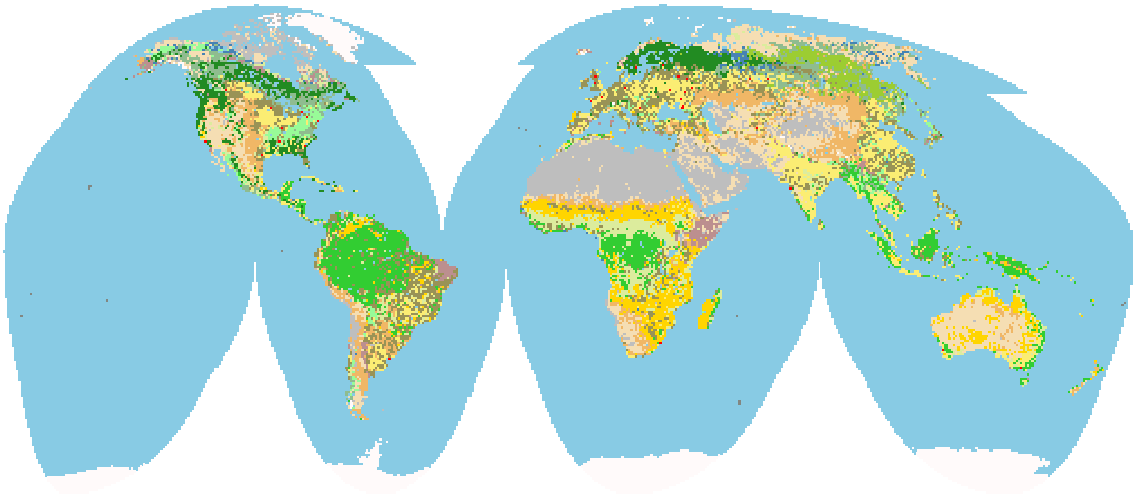

Fig. 3. Global ecosystems extracted from the Global Land Cover Characteristics Data Base 2.0 (Loveland et al. 2000), http://edc2.usgs.gov/glcc/globe_int.php.

The most recent conventional map (Fig. 4) provided by the Global Lakes and Wetlands Database (GLWD) uses mostly information from the Digital Wetlands Data set (World Conservation Monitoring Centre 1993, Lehner and Döll 2004). It is available online (http://www.worldwildlife.org/science/data/item1877.html). The most detailed map layer distinguishes nine types of wetlands and has a resolution of 30 arcseconds. Lehner & Döll (Lehner and Döll 2004) also provide a contemporary overview of existing global and regional data sets of lakes, reservoirs, and wetlands.

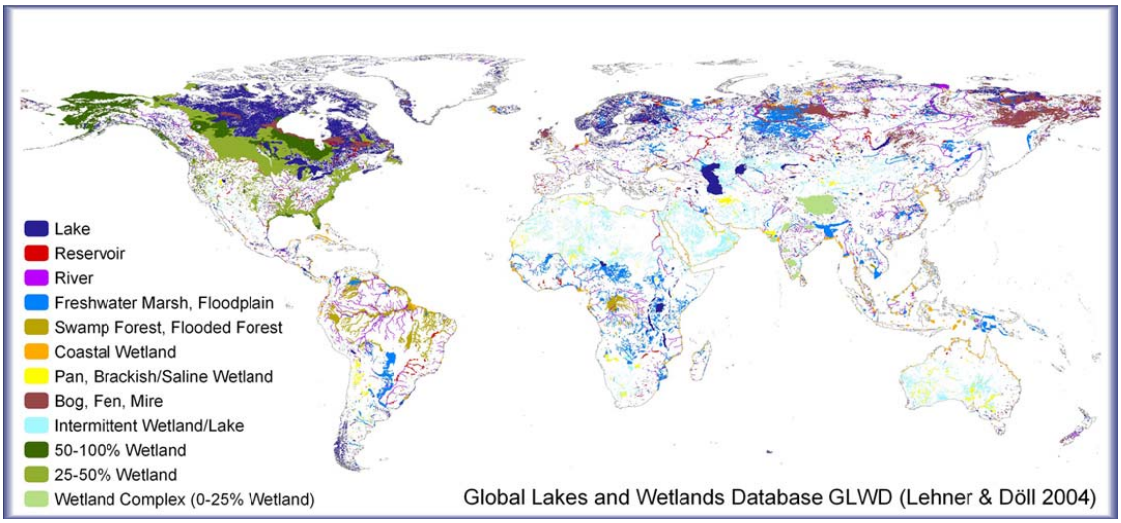

Fig. 4. Global lakes and wetlands database (Lehner and Döll 2004).

Global inventories

The International Union for Conservation of Nature carried out inventories of wetlands between 1985 and 1995. The reports have recently been made accessible via the WWW (http://www.iwmi.cgiar.org/wetlands/WetlandDir.asp). Information on each site can be accessed through a map server (http://webmap.iwmi.org/). It is provided by the Global Wetland Initiative of the International Water Management Institute.

Another global inventory of wetlands was commissioned by the Bureau of the RAMSAR Wetlands Convention (Finlayson and Spiers 1999). It was based on literature research, government documents, polling of organizations, and personal communication in 1998. The final report pointed out the large inconsistency in information among countries due to access to data and differences in definitions. This was reiterated in a review of global and continental figures by Mitra et al. (2003)

Reference or Title	wetland categories	spatial resolution	reflected time
Matthews & Fung 1987	5 (forested bog, nonforested bog, forested swamp, nonforested swamp, alluvial formation), percentage of cell area covered by wetlands	1° × 1°	1970s
Aselmann & Crutzen 1989	6 (bog, fen, swamp, marsh, floodplain, shallow lake)	2.5 × 5.0°	<1983
ISLSCP	6 (bogs, fens, swamps, marshes, floodplains, shallow lakes)	1° × 1°	<1988
DISCover	1, percentage of cell area covered by wetlands	1° × 1°	1992/1993
Global Land Cover Characteristics Data Base 2.0	1–4	1 km × 1 km or 30” × 30”	1992/1993
GLWD, Lehner & Döll 2004	9	30” × 30”	<1993

Peatlands

Peatlands are an important class of wetlands because of their high carbon content. The importance of peatlands for biodiversity and climate change have been recently reviewed (Parish et al. 2008). The review contains a map of mires (Fig. 5) as percent of land area after Lappalainen (1996) and a map of percentage of peatland area per country after van Engelen & Huting (2002). H. Joosten maintains the comprehensive Global Peatland Database (www.imcg.net/gpd/gpd.htm) of the International Mire Conservation Group. The GPD is an ongoing critical evaluation of the literature. The data is being summarized for Wetlands International (Joosten 2009).

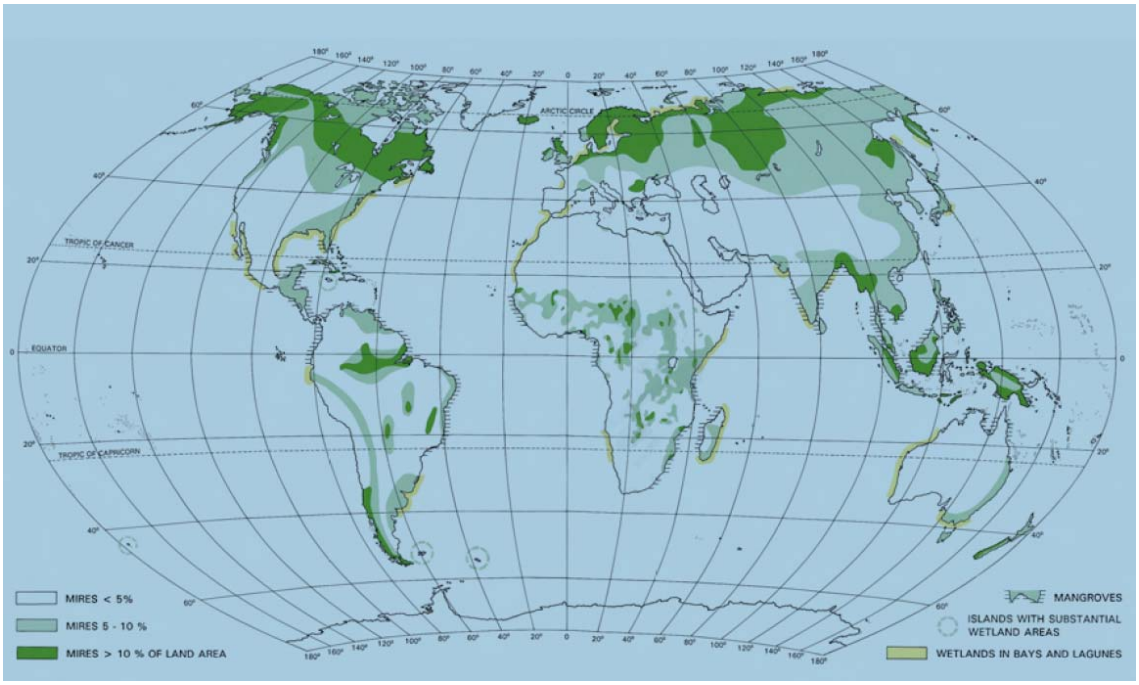

Fig. 5. Global peatlands according to Lappalainen (1996) as shown in Parish et al. (2008).

Conclusions

Our review shows the limited data base for monitoring wetlands, especially peatlands. Wetlands are usually charted by a combination of soil types, vegetation classes and possibly inundation. The success of remote sensing products is still not much better than conventional methods (Mitra et al. 2005) but is important for continued monitoring. Remote sensing methods are developed further on regional scales, e.g. the GlobWetland project (http://www.globwetland.org, see also the special issue in Journal of Environmental Management 90(7)) or the Wetland Map of China (http://www.slrss.cn) (Niu et al. 2009).

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