Supplementary Files of

Global perspectives and future research directions for the phytoremediation of heavy metal-contaminated soil: A knowledge mapping analysis from 2001 to 2020

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Table legends

Table S1The 25 highest frequency 25 keywords of keyword cluster in field of PHMCS from 2001-2020.

Table S2 The most recent keyword bursts in field of PHMCS from 2001-2020

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Table S1The top 25 keywords of keyword cluster in field of PHMCS from 2001-2020.

Cluster IDs	Size	Year	Top 25 keywords of each cluster
#0 Bioremediation	203	2008	Bioremediation; Biodegradation; Rhizosphere; Degradation; PAHS; Pyrene; Rhizoremediation; Polycyclic aromatic hydrocarbons; PAH; Bioaugmentation; Phenanthrene; Petroleum hydrocarbons; Endophytic Bacteria; Polycyclic aromatic hydrocarbon; Polycyclic aromatic hydrocarbons; Rhizobacteria; Plant growth promotion; Cadmium; Microbial community; Hydrocarbons; Diversity; PGPR; Bacterial community; EDTA; Hyperaccumulation
#1 Arsenic	194	2007	Arsenic; *Pteris vittata;* Bioaccumulation; Speciation; Arsenate; Translocation; Phosphate; Biosorption; Uptake; Water; Reduction; Rice; Pteris vittata l.; Wetland; Chinese brake fern; Plant uptake; EDTA; Arsenic speciatio; Iron plaque; Arsenite; Sediment; Bioconcentration; Wastewater; Phosphorus; Constructed wetland
#2 Biochar	190	2011	Biochar; Phytostabilization; Compost; Bioavailability; Immobilization; Mine tailings; Trace elements; Aided phytostabilization; Amendments; Revegetation; Sewage sludge; Remediation; Metal; Cadmium; Soil remediation; Technosol; Mobility; Reclamation; Ecological restoration; Pyrolysis; Microbial biomass; Phytoavailability; Mine soil; Phytostabilisation; hyperaccumulation
#3 Oxidative stress	165	2012	Oxidative stress; Antioxidant enzymes; Photosynthesis; Antioxidants; Chromium; Reactive oxygen species; Peroxidase; Glutathione; Chlorophyll; Rhizosphere; Phytotoxicity; Proline; Catalase; Salinity; Halophyte; Gas exchange; Antioxidative enzymes; Chlorophyll fluorescence; Stress; Superoxide dismutase; Heavy metal stress; Gene expression; Halophytes; ROS; Plant stress
#4 Hyperaccumulation	141	2006	Hyperaccumulation; Nickel; Serpentine; Hyperaccumulator; Metal Hyperaccumulation; *Thlaspi caerulescens*; Tolerance; Alyssum murale; Brassicaceae; Agromining; Phytomining; Arabidopsis halleri; Serpentine soil; Alyssum; Serpentine soils; Transporter; Ultramafic soils; Ultramafic; Zinc; Noccaea caerulescens; *Thlaspi caerulescen*; Metal tolerance; Ultramafic soil; Cobalt; Metallophyte
#5 EDTA	114	2007	EDTA; Phytoextraction; Lead; EDD; Cadmium; Pb; Heavy metals; Citric acid; Arsenic; Cd; Chelating agents; Zinc; Chelate; Indian mustard; Copper; NTA; Contaminated soil; Zn; Enhanced phytoextraction; Bioremediation; Heavy metal; Oxidative stress; *Zea mays*; Chelators; Chelating agent
#6 Orbuscular mycorrhizal fungi	82	2009	Arbuscular mycorrhizal fungi; Arbuscular mycorrhiza; Willow; Salix; Poplar; *Populus; Glomus Intraradices*; Phytomanagement; Symbiosis; Soil contamination; Nitrogen; Salix viminalis; Glomus mosseae; Glomus; Trees; Phosphorus; Willows; Short rotation coppice; Glomus caledonium; Medicago truncatula; Saprobe fungi; Metallothionein; Heavy metals; Biomass production; Ectomycorrhizal fungi
#7 Environmental pollution	22	2015	Environmental pollution; Toxicology; Environmental science; Environmental toxicology; Environmental chemistry; Metal pollution; Chemistry; Radioisotopes; Environmental hazard; Microbiology; Soil science; Microbes; Soil microbiology; Environmental contamination; Co-planting; Heavy metals; Potentially toxic metals; Phytoextraction; S. bicolor; Environmental engineering; Chenopodium album l.; Triticum aestivum l.; Crop rotation; Simple uptake model; Canna indica

Table S2 The most recent keyword bursts in field of PHMCS from 2001-2020.

Keywords	Strength	Begin	End	2001-2020
Mining area	5.43	2015	2020	
Sequential extraction procedure	5.34	2015	2020	
Wetland	4.7	2015	2020	
Proline	3.51	2015	2020	
Health risk	11.55	2016	2020	
Physiological response	9.52	2016	2020	
Organic amendment	8.65	2016	2020	
Cadmium toxicity	6.77	2016	2020	
Phytomanagement	6.15	2016	2020	
Agromining	5.62	2016	2020	
Cesium	4.35	2016	2020	
GRA	4.33	2016	2020	
Seed germination	3.18	2016	2020	
Risk assessment	10.12	2017	2020	
Potentially toxic element	9.88	2017	2020	
Assisted phytoremediation	9.01	2017	2020	
Aided phytostabilization	8.48	2017	2020	
Cadmium stress	8.29	2017	2020	
Giant reed	6.95	2017	2020	
Electrokinetic remediation	6.13	2017	2020	
Drought	6.1	2017	2020	
Enhanced phytoremediation	6.09	2017	2020	
Paddy soil	6.05	2017	2020	
Salt stress	5.94	2017	2020	
Natural attenuation	5.23	2017	2020	
Lettuce	4.87	2017	2020	
Pyrolysis	4.44	2017	2020	
Ectomycorrhizal fungi	4.09	2017	2020	
Hg	3.68	2017	2020	
Reactive oxygen specy	3.68	2017	2020	
Polychlorinated biphenyls pcb	3.48	2017	2020	
Acid mine drainage	3.45	2017	2020	
Anaerobic digestion	3.27	2017	2020	
Co-contaminated soil	3.27	2017	2020	
Biochar	27.43	2018	2020	
Subcellular distribution	10.05	2018	2020	
Risk	8.16	2018	2020	
Lipid peroxidation	8.02	2018	2020	
Excess copper	7.42	2018	2020	

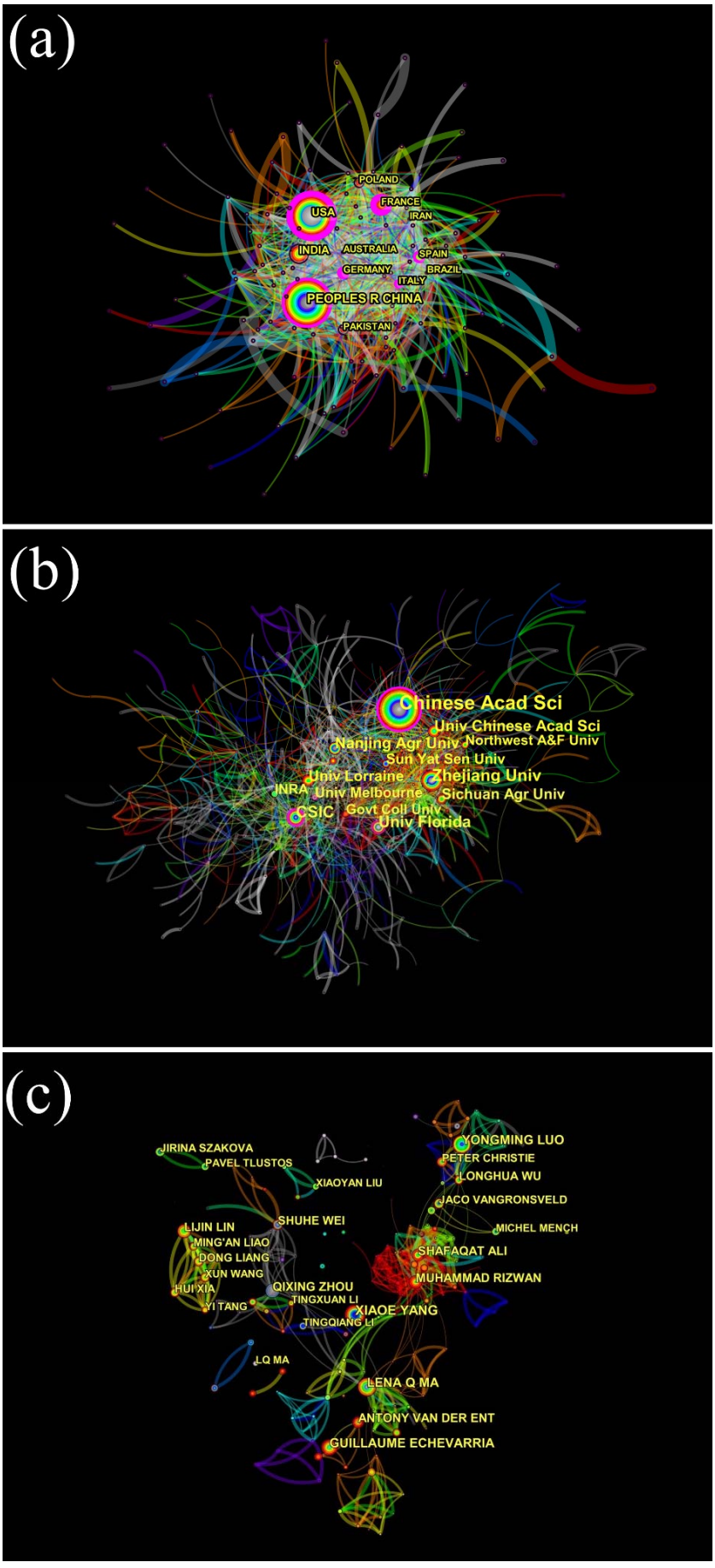
Spatial distribution	7.05	2018	2020	▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬
Sp nov.	7.05	2018	2020	▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬
Heavy metal pollution	6.68	2018	2020	▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬
Health risk assessment	6.67	2018	2020	▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬
Metal pollution	6.3	2018	2020	▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬
Nanoparticle	6.13	2018	2020	▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬
Intercropping	6.13	2018	2020	▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬
Metal(loid)	5.76	2018	2020	▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬
Heavy metal stress	5.76	2018	2020	▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬
Brassica napus	5.63	2018	2020	▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬
Festuca arundinacea	5.56	2018	2020	▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬
Petroleum	5.46	2018	2020	▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬
Salicylic acid	5.34	2018	2020	▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬
Antioxidative enzyme	5.19	2018	2020	▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬
Cd uptake	4.97	2018	2020	▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬
Temperature	4.84	2018	2020	▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬
Residue	4.59	2018	2020	▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬
Land use	4.4	2018	2020	▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬
In situ	4.4	2018	2020	▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬
Agricultural soil	4.35	2018	2020	▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬
Lead accumulation	4.28	2018	2020	▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬
Food chain	4.08	2018	2020	▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬
Sedum plumbizincicola	4.08	2018	2020	▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬
Photosystem II	4.08	2018	2020	▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬
Organic carbon	4.08	2018	2020	▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬
Environmental risk	3.91	2018	2020	▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬
Salt	3.91	2018	2020	▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬
Selection	3.63	2018	2020	▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬
Endophyte	3.43	2018	2020	▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬
Plant stress	3.34	2018	2020	▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬
Pattern	3.34	2018	2020	▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬
Diesel	3.21	2018	2020	▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬
Bioaccessibility	3.11	2018	2020	▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬

Figure captions

Fig. S1 The scientific collaboration between countries/regions (a), institutions (b) and authors (c) in field of PHMCS from 2001-2020.

Fig. S2 Co-occurrence network of keywords in field of PHMCS from 2001-2020.

Fig. S3 Co-citation network in field of PHMCS from 2001-2020.



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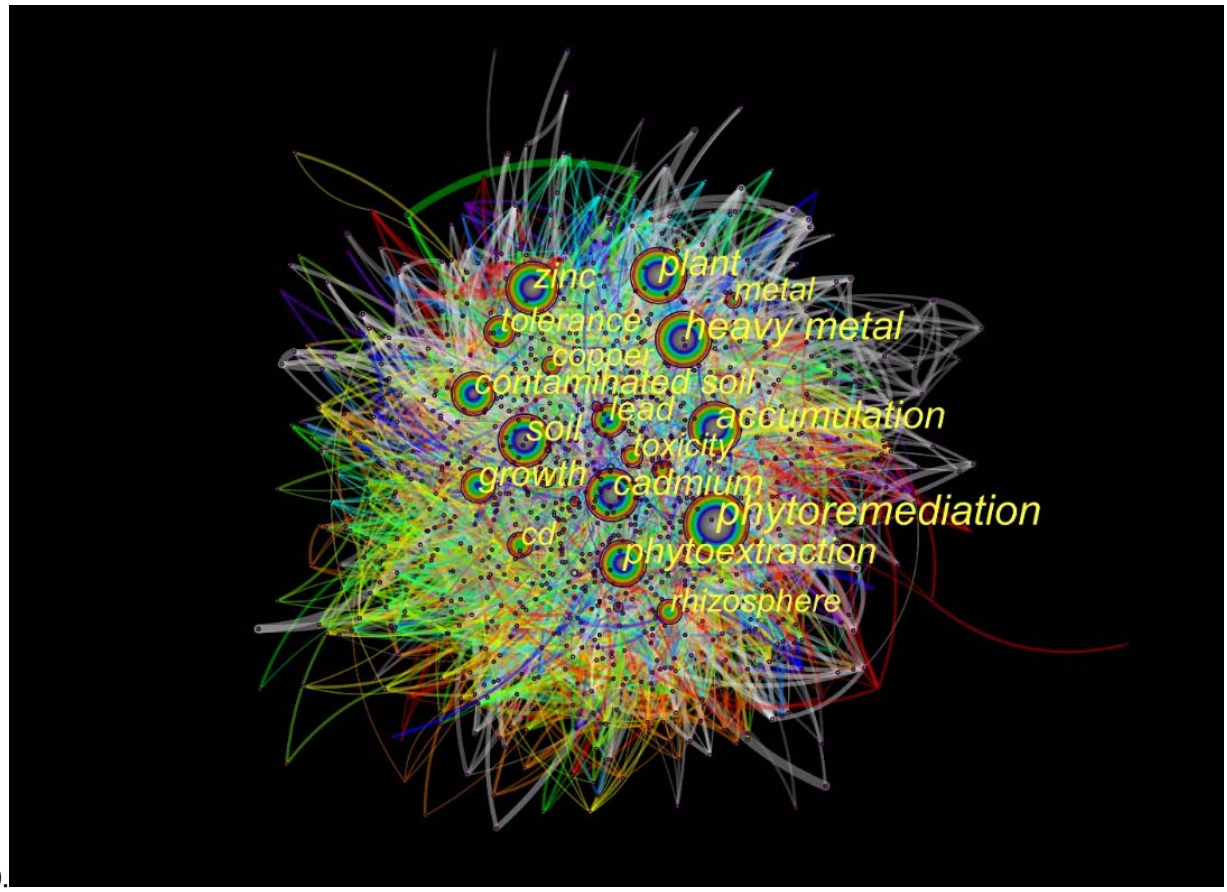

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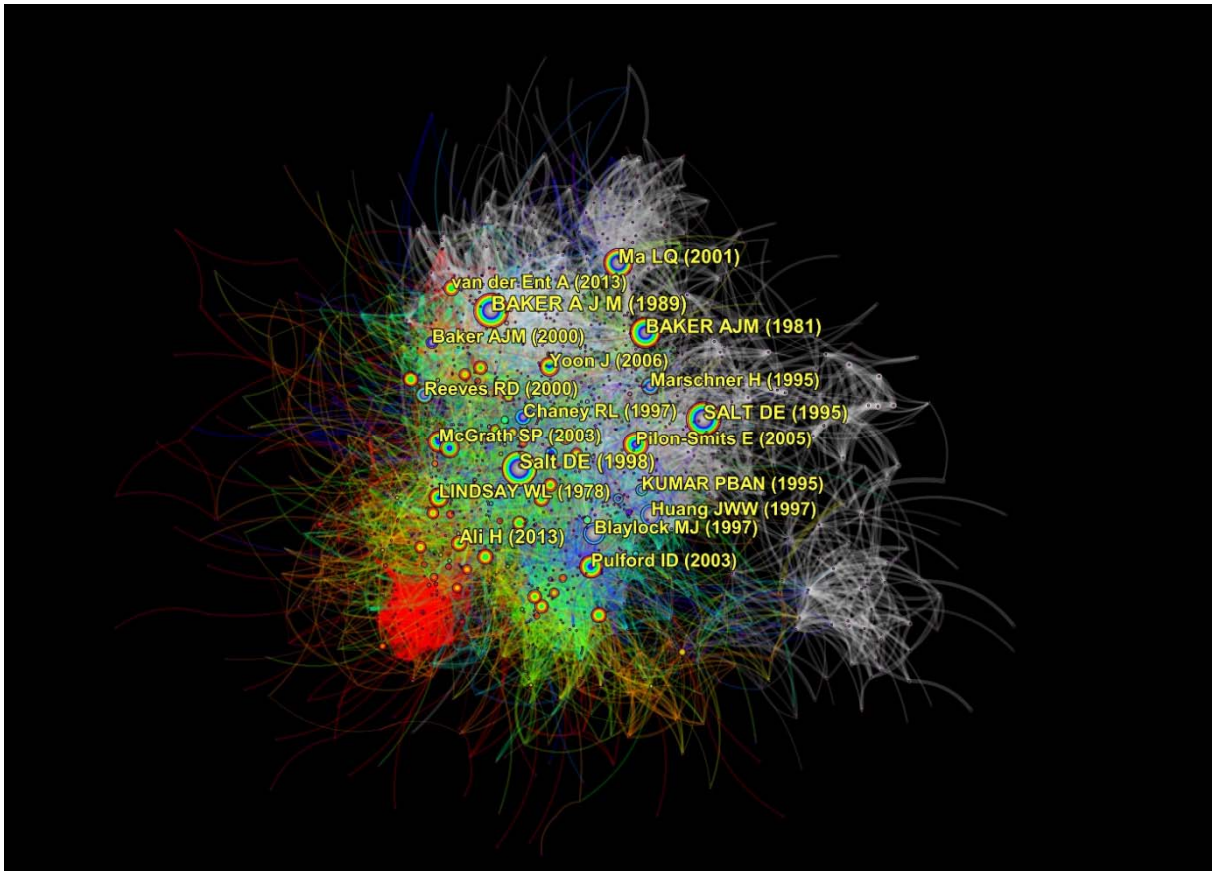

Fig. S3 Co-citation network in field of PHMCS from 2001-2020.