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Monitoring of hydrochemical parameters of lignite mining lakes in Central Germany using airborne hyperspectral casi-scanner data

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**Abstrakty:**

EN Active and abandoned coal mines have a huge impact on the environment. The most challenging problem is caused by acid mine drainage (AMD). Using traditional methods such as single point measurements to determine and analyze mining lakes over the period of a few years is difficult due to the lakes' high dynamic and inner differentiation. To overcome this difficulty, a new method has been successfully tested to additionally monitor residual lakes. Using a manifold data set (like images from the hyperspectral airborne scanner casi, ground truth data, spectral field and laboratory measurements), the optical properties (reflection, absorption and scattering) of acid mining lakes were defined for the first time ever. Furthermore, hydrochemical parameters in quality and quantity were ascertained in a two-stage process. First, optical properties of the mining lakes were analyzed and defined for each of the limnological stages of development. Second, based on the lakes' optical properties, algorithms for classification of the hydrochemical parameters evolved and were reliably utilized. The new algorithms enable the monitoring of mining lakes from acidic to alkaline as well as the quantification of the hydrochemical properties inside the lake water.

Słowa kluczowe:

EN Hyperspectral remote sensing Lignite mining Water quality monitoring Environmental impacts Geochemistry

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Bibliografia:

1. Azcue, J.M., "Environmental impacts of mining activities", 1999
2. Boine, J.& Gläßer, C., "Optical properties of open cast lignite mining lakes in Central Germany", 19th International Society of Photogrammetry and Remote Sensing Congress, Amsterdam, Netherlands, July 16th–22nd, 2000, Proc, 2000, p.533-540
3. Crowley, J.K.& Williams, D.E.& Hammarstrom, J.M.& Piatak, N.& Chou, I.M.& Mars, J.C., "Spectral reflectance properties (0.4–2.5µm) of secondary Feoxide, Fe-hydroxide, and Fe-sulphate-hydrate minerals associated with sulphide-bearing mine wastes", *Geochemistry: Exploration, Environment, Analysis*, vol. 3, 2003, p.219-228
4. Dekker, A.G., 1993. Detection of optical water quality parameters for eutrophic waters by high resolution remote sensing. Vrije University Amsterdam, PhD Thesis, Den Haag, 240 pp.
5. DIN, "Physikalische und physikalisch-chemische Kenngrößen (Gruppe C)", Gesellschaft, Wasserchemische (Eds.), Deutsche Einheitsverfahren (DEV) zur Wasser-, Abwasser- und Schlammmuntersuchung, Weinheim, Document DIN 38.404, C, 1979
6. DIN, "Summarische Wirkungs- und Stoffkenngößen (Gruppe H), Bestimmung der Säure- und Basekapazität (H7)", Gesellschaft, Wasserchemische (Eds.), Deutsche Einheitsverfahren (DEV) zur Wasser-, Abwasser- und Schlammmuntersuchung, Weinheim, Document DIN 38.409, H7, 1979
7. DIN, "Kationen (Gruppe E), Bestimmung der 33 Elemente AG, Al, As, B, Ba, Be, Bi, Ca, Cd, Co, Cr, Cu, Fe, K, Li, Mg, Mn, Mo, Na, Ni, P, Pb, S, Sb, Se, Si, Sn, Ti, V, W, Zn und Zr durch Atomemissionsspektrometrie mit induktiv gekoppeltem Plasma (ISP-OES) (E22)", Gesellschaft, Wasserchemische (Eds.), Deutsche Einheitsverfahren (DEV) zur Wasser-, Abwasser- und Schlammmuntersuchung, Weinheim, Document DIN 38.406, E22, 1987
8. DIN, "Summarische Wirkungs- und Stoffkenngößen (Gruppe H), Bestimmung der abfiltrierbaren Stoffe und des Glührückstandes (H2)", Gesellschaft, Wasserchemische (Eds.), Deutsche Einheitsverfahren (DEV) zur Wasser-, Abwasser- und Schlammmuntersuchung, Weinheim, Document DIN 38.409, H2, 1987
9. DIN, "Summarische Wirkungs- und Stoffkenngößen (Gruppe H), Anleitung zur Bestimmung des gesamten organischen Kohlenstoffs (TOC) und des gelösten organischen Kohlenstoffs (DOC) (H3)", Gesellschaft, Wasserchemische (Eds.), Deutsche Einheitsverfahren (DEV) zur Wasser-, Abwasser- und Schlammmuntersuchung, Weinheim, Document DIN 38.409, H3, 1987
10. DIN, "Anionen (Gruppe D), Bestimmung der Anionen Fluorid, Chlorid, Nitrit,Phosphat (ortho-), Bromid, Nitrat und Sulfat in wenig belasteten Wässern mit der Ionenchromatographie (D19)", Gesellschaft, Wasserchemische (Eds.), Deutsche Einheitsverfahren (DEV) zur Wasser-, Abwasser- und Schlammmuntersuchung, Weinheim, Document DIN 38.405, D19, 1988
11. Duffek, A.& Schultze, M., "Chemische Veränderungen eines sauren Tagebaurestsees während der Flutung mit Flusswasser", Jahrestagung der Deutschen Gesellschaft für Limnologie, Kiel, Germany, September 17th–21st, 2001, 2002, p.406-410
12. Eismann, L., "Quaternary geology of eastern Germany (Saxony, Saxon-Anhalt, South Brandenburg, Thuringia), type area of the elsterian and saalian stages in Europe", *Quaternary Science Reviews*, vol. 21, 2002, p.1275-1346
13. Frauendorf, J., 2002. Entwicklung und Anwendung von Fernerkundungsmethoden zur Ableitung von Wasserqualitätsparametern verschiedener Restseen des Braunkohlentagebaus in Mitteldeutschland. Martin Luther University Halle Wittenberg, Faculty of Natural Sciences III, PhD Thesis, Halle,

181pp.

14. Gege, P., "Improved method for measuring Gelbstoff absorption spectra", Ocean Optics XVII Conference, Fremantle, Australia, October 25th-29th, 2004. Proc, 2004
15. Geller, W.& Schultze, M., "Acidification", Likens, G. (Eds.), Encyclopedia of Inland Waters, 2009, p.1-12
16. Geller, W.& Klapper, H.& Schulze, M., "Typologie von sauren Restseen", Deutsche Gesellschaft für Limnologie, Tagungsbericht 1996, Schwedt, 1997, p.577-581
17. Geller, W.& Klapper, H.& Salomons, W., "Acid Mining Lakes", 1998
18. Geller, W.& Koschorreck, M.& Schultze, M.& Wendt-Potthoff, K., "Restoration of acid drainage", Likens, G. (Eds.), Encyclopedia of Inland Waters, 2009, p.342-358
19. Gläßer, C.& Thürkow, D.& Dette, Ch.& Scheuer, S., "Development of an integrated technical-methodical approach to visualise hydrological processes in an exemplary post-mining area in Central Germany", International Society of Photogrammetry and Remote Sensing Journal of Photogrammetry and Remote Sensing, vol. 65, 2010, p.275-281
20. Heege, T.& Fischer, J., "Mapping of water constituents in Lake Constance using multispectral airborne scanner data and a physically based processing scheme", Canadian Journal of Remote Sensing, vol. 30, 2004, p.77-86
21. Heege, T.& Kisselev, V.& Miksa, S.& Pinnel, N.& Häse, C., "Mapping aquatic systems with a physically based process chain", Ocean Optics XVII Conference, Fremantle, Australia, October 25th-29th, 2004. Proc, 2005
22. Hellier, W., "Treatment of coal mine drainage with constructed wetlands", Azcue, J.M. (Eds.), Environmental Impacts of Mining Activities—Emphasis on Mitigation and Remedial Measures, 1999, p.103-121
23. Kaufmann, H.& Segl, K.L.& Guanter, L.& Chabrilat, S.& Hofer, S.& Bach, H.& Hostert, P.& Mueller, A.& Chlebek, C., "Review of EnMAP scientific potential and preparation phase", 6th EARSeL Imaging Spectroscopy SIG Workshop, Tel Aviv, Israel, March 16th-18th, 2009. Proc, 2009
24. Kemper, T.& Sommer, S., "Estimate of heavy metal contamination in soils after a mining accident using reflectance spectroscopy", Environmental Science & Technology, vol. 36, 2002, p.2742-2747
25. Klapper, H.& Geller, W., "Water quality management of mining lakes—a new field of applied hydrobiology", Acta hydrochimica et hydrobiologica, vol. 29, 2001, p.363-374
26. Klapper, H.& Schultze, M., "Geogenically acidified mining lakes—living conditions and possibilities of restoration", Internationale Revue der gesamten Hydrobiologie, vol. 80, 1995, p.639-653
27. Knöller, K.& Strauch, G.& Trettin, R.& Mayer, B., "Application of stable isotope tracers to evaluate the sulfur cycle in mining landscapes of eastern Germany", IV South American Symposium on Isotope Geology, Salvador, Brazil, August 24th-27th, 2003. Short Papers, 2003
28. Olbert, C., "Atmospheric correction for casi data using an atmospheric radiative transfer model", Canadian Journal of Remote Sensing, vol. 24, 1998, p.114-127
29. Olbert, C.& Fischer, J.& Frauendorf, J.& Gläßer, C., "Quantitative estimation of water constituents in lignite open cast residual lakes with inverse modeling", 5th International Airborn Remote Sensing Conference, San Francisco, USA, September 17th-20th, 2001. Proc, 2001
30. Ong, C.& Swayze & Clard, R., "An investigation of the use of the tetracorder expert system for multi-temporal mapping of acid drainage-related minerals using airborne hyperspectral data", 3rd EARSeL Workshop on Imaging Spectroscopy, Herrsching, Germany, Mai 13th-16th, 2003, Proc, 2003, p.357-362
31. Paktunc, A.D., "Characterization of mine wastes for prediction of acid mine drainage", Azcue, J.M. (Eds.), Environmental Impacts of Mining Activities, 1999, p.19-40
32. Pietsch, W., "Vegetationsentwicklung und Gewässergenese in den Tagebauseen des Lausitzer Braunkohlen-Reviere", Archiv für Naturschutz und Landschaftsforschung, vol. 13, 1973, p.187-217
33. Regenspurg, S., 2003. Characterisation of schwertmannite—geochemical interactions with arsenate and chromate and significance in sediments of lignite opencast lakes. University Bayreuth, PhD Thesis, Bayreuth, 124 pp.
34. Rianza, A.& Müller, A., "Hyperspectral remote sensing monitoring of pyrite mine wastes: a record of climate variability (Pyrite Belt, Spain)", Environmental Earth Sciences, vol. 61, 2009, p.575-594
35. Schmidt, H.& Glaesser, C., "Multitemporal analysis of satellite data and their use in the monitoring of the environmental impacts of open cast lignite mining areas in Eastern Germany", International Journal of Remote Sensing, vol. 19, 1998, p.2245-2260
36. Schreck, P.& Gläßer, W., "Regional geology of the lignite mining districts in Eastern Germany", Geller, W.& Klapper, H.& Salomons, W. (Eds.), Acidic Mining Lakes—Acid Mine Drainage, Limnology and Reclamation, 1998, p.15-21
37. Schroeter, L.& Gläßer, C., "Analyses and monitoring of lignite mining lakes in Eastern Germany with spectral signatures of Landsat TM satellite data", International Journal of Coal Geology, vol. 86, 2011, p.27-39
38. Schultze, M.& Klapper, H., "Prognose und Steuerung der Gewässergüte der mitteldeutschen Restseen", Dresdner Grundwasserforschungszentrum e.V. (DGFZ), 1995, p.181-201
39. Schultze, M.& Boehrer, B.& Kuehn, B.& Büttner, O., "Neutralisation of acidic mining lakes with river water", Verhandlungen des Internationalen Verein Limnologie, vol. 28, 2002, p.936-939
40. Schultze, M.& Duffek, A.& Boehrer, B.& Kuehn, B.& Herzsprung, P.& V. Tümpling, W.& Büttner, O.& Geller, W., "Changes of water quality in acidic mining lake Goitzsche (Germany) during its flooding with river water", 3rd International Conference On Water Resources and Environment Research (ICWRER), Dresden, Germany, July 22nd-25th, 2002 Proc, 2002
41. Schultze, M.& Geller, M.& Wendt-Potthoff, K.& Benthaus, F.-C., "Management of water quality in German pit lakes", Securing the Future/8th ICARD Conference, Skelleftea, Sweden, June 23rd-16th, 2009, Proc, 2009, p.1-15
42. Schultze, M.& Pokrandt, K.-H.& Hille, W., "Pit lakes of the Central German lignite mining district: creation, morphometry and water quality aspects", Limnologica, vol. 40, 2010, p.148-155
43. Stuffer, T.& Kaufmann, C.& Hofer, S.& Forster, K.P.& Schreier, G.& Mueller, A.& Eckardt, A.& Bach, H.& Penne, B.& Benz, U.& Haydn, R., "The EnMAP hyperspectral imager—an advanced optical payload for future applications in Earth observation programmes", Acta Astronautica, vol. 61, 2007, p.115-120
44. Swayze, G.A.& Smith, K.S.& Clark, R.N.& Sutley, S.J.& Pearson, R.M.& Vance, J.S.& Hageman, P.L.& Briggs, P.H.& Meier, A.L.& Singleton, M.J.& Roth, S., "Using imaging spectroscopy to map acidic mine waste", Environmental Science and Technology, vol. 34, 2000, p.47-54
45. Thiemann, S.& Kaufmann, H., "Determination of chlorophyll content and trophic state of lakes using field spectrometer and IRS-1C satellite data in the Mecklenburg Lake District", Remote Sensing of Environment, vol. 73, 2002, p.227-235
46. Thürkow, D.& Gläßer, C.& Scheuer, S.& Schiele, S., "Visualization of hydrological processes with GEOVLEX: introduction of an integrated methodical technical online learning approach", König, G. & Lehmann, H. & Köhring, B. (Eds.) Tools and Techniques for E-Learning, International

47. Trettin, R. & Gläser, H.R. & Schultze, M. & Strauch, G., "Sulfur isotope studies to quantify sulfate components in water of flooded lignite open pits—
Lake Goitzsche, Germany", Applied Geochemistry, vol. 22, 2007, p.69-89

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