



Fig. 6.19. Smoothed series of varve thickness (upper edge of the band) in comparison with the strictly periodic signal (lower edge). The time span of given sequences is respectively: 6727–3212, 6127–5587, and 5937–5832 yr cal BP.

Another presentation of periodicities is shown in Fig. 6.19. Many periods are indicated in literature as observed in nature. 200-yr period is present in $\Delta^{14}\text{C}$ signal (Sonett & Finney 1990), and periods of 11 yr and 22 yr are imprints of solar activity onto the atmosphere and, as some authors believe (Mitchell 1979, Schove 1983), on the biosphere. Fig. 6.19 enables easy visual inspection whether the data are periodic or not. Strict periodicity is suggested below the smoothed data sequences for comparison. The magnetic solar activity (22 yr) is precisely correlated with the sunspots (11 yr). May be this fact is visible on the last plot, where 11 yr periodicity seems to be superimposed on the 22 yr period.

REFERENCES

- Anderson R. Y. 1992. Possible connection between surface winds, solar activity and the Earth's magnetic field. *Nature* 358: 51–53.
- Anderson R. Y. 1993. The varve chronometer in Elk Lake: Record of climatic variability and evidence for solar-geomagnetic- ^{14}C -climate connection. In: J. P. Bradbury & W. E. Dean (eds), *Elk Lake, Minnesota: Evidence for Rapid Climate Change in the North-Central United States: Boulder Colorado. Geological Survey of America, Special Paper 276*: 45–67.
- Andree M., Oeschger H., Siegenthaler U., Riesen T., Moell M., Ammann B. & Tobolski K. 1986. ^{14}C dating of plant macrofossils in lake sediment. *Radiocarbon* 28: 411–416.
- Baillie M. G. L. & Pilcher J. R. 1973. A simple cross-dating program for tree-ring research. *Tree-ring Bulletin* 33: 7–14.
- Barnett V. & Lewis T. 1978. *Outliers in statistical data*. J. Wiley, Chichester.
- Becker B. 1981. Fällungsdaten römischer Bauhölzer anhand einer 2350-jährigen süddeutschen Eichen-Jahrringchronologie. *Fundberichte aus Baden Württemberg* 6: 369–386.
- Becker B. 1982. Dendrochronologie und Paläoökologie subfossiler Baumstämme aus Flussablagerungen. *Mitteilungen der Kommission für Quartärforschung der Österreichischen Akademie der Wissenschaften* 5: 1–120.
- Becker B. & Schmidt B. 1993. Extension of the European Oak Chronology to the Past 9224 Years. *PACT* 29: 37–50.
- de Geer G. 1912. A geochronology of the last 12,000 years. 11th International Geological Congress (1910), Stockholm 1: 241–253.
- Godłowski K. & Kozłowski J. K. 1979. *Historia starożytna ziem polskich*. Państwowe Wydawnictwo Naukowe, Warszawa.
- Goslar T. 1987. Dendrochronological studies in the Gliwice Radiocarbon Laboratory, equipment, first results. *Annales Academiae Scientiarum Fennicae, Ser AIII* 145: 97–104.
- Goslar T. & Walanus A. 1987. A Monte-Carlo study of the probability distribution of “t” value used in dendrochronological dating. *Zeszyty Naukowe Politechniki Śląskiej, Geochronometria* 4: 9–18.
- Goslar T., Kuc T., Ralska-Jasiewiczowa M., Róžański K., Arnold M., Bard E., van Geel B., Pazdur M. F., Szeroczyńska K., Wicik B., Więckowski K. & Walanus A. 1993. High-resolution lacustrine record of the Late Glacial/Holocene transition in central Europe. *Quaternary Science Reviews* 12: 287–294.
- Hajdas I., Ivy S. D., Beer J., Bonani G., Imboden D., Lotter A. F., Sturm M. & Suter M. 1993. AMS radiocarbon dating and varve chronology of Lake Soppensee: 6000 to 12,000 years BP. *Climate Dynamics* 9: 107–116.
- Hajdas I., Bonani G. & Goslar T. 1995. Radiocarbon dating of Holocene part of the Gościąg floating varve chronology. *Radiocarbon* 37: 71–74.
- Hirons R. K. & Edwards K. J. 1986. Events at and around the first and second Ulmus declines: palaeoecological investigations in Co. Tyrone, Northern Ireland. *New Phytologist* 104: 131–153.
- Johnsen S., Clausen H. B., Dansgaard W., Fuhrer K., Gundestrup N., Hammer C. U., Iversen P., Jouzel J., Stauffer B. & Steffensen J. P. 1992. Irregular glacial interstadials recorded in a new Greenland ice core. *Nature* 359: 311–313.
- Kelts K., Hsü K. J. 1978. Freshwater carbonate sedimentation. In: A. Lerman (ed.), *Lakes: Geology, Chemistry, Physics*, pp. 295–323. Springer Verlag, New York.
- Kempe S. & Degens E. G. 1979. Varves in the Black Sea and Lake Van (Turkey). In: C. Schlüchter (ed.), *Moraines and Varves*, pp. 309–318. Balkema, Rotterdam.
- Kromer B. & Becker B. 1993. German oak and pine calibration, 7200 BC to 9400 BC. *Radiocarbon* 35: 125–136.
- Kruse H. H., Linick T. W., Suess H. E. & Becker B. 1980. Computer-matched radiocarbon dates of floating tree-ring series. *Radiocarbon* 22: 260–266.
- Latalowa M. 1992. Man and vegetation in the pollen diagrams from Wolin Island (NW Poland). *Acta Palaeobotanica* 32: 123–249.
- Mangerud J., Andersen S. T., Berglund B. E. & Donner J. J. 1974. Quaternary stratigraphy of Norden, a proposal for terminology and classification. *Boreas* 3: 109–128.
- Mitchell J. M., Jr. 1979. Evidence of a 22-year rhythm in western United States related to the Hale solar cycle since the 17th century. In: B. M. McCormac & T. A. Seliga (eds), *Solar terrestrial influences on weather and climate*, pp. 125–143. D. Reidel Pub. Co., Dordrecht, Holland.
- O'Sullivan P. E. 1983. Annually-laminated lake sediments and the study of Quaternary environmental changes – a review. *Quaternary Science Reviews* 1: 245–313.
- Pazdur A., Pazdur M. F., Wicik B. & Więckowski K. 1987a. Radiocarbon chronology of annually laminated sediments from the Gościąg Lake. *Bulletin of Polish Academy of Sciences, Earth Science* 35: 139–145.
- Pazdur A., Fontugne M. R., Goslar T. & Pazdur M. F. 1995. Late glacial and Holocene water-level changes of the Gościąg Lake, central Poland, derived from carbon isotope studies of laminated sediment. *Quaternary Science Reviews* 14: 125–135.
- Pazdur M. F., Awiuk R., Goslar T., Pazdur A., Walanus A., Wicik B. & Więckowski K. 1987b. Chronologia radiowęglowa rocznie laminowanych osadów z Jeziora Gościąg w świetle kalibracji radiowęglowej skali czasu. *Zeszyty Naukowe Politechniki Śląskiej, Geochronometria* 4: 69–84.

- Pearson G. W. 1986. Precise calendrical dating of known growth-period samples using a "curve-fitting" technique. *Radiocarbon* 28: 292–299.
- Pearson G. W., Becker B. & Qua F. 1993. High-Precision ^{14}C Measurements for German and Irish Oaks to show the Natural ^{14}C Variations from 7890 to 5000 BC. *Radiocarbon* 35: 93–104.
- Pearson F. J. Jr. & Coplen T. B., 1978. Stable isotope studies of lakes, In: A. Lerman (ed), *Lakes: Geology, Chemistry, Physics*. Springer Verlag, New York.
- Pilcher J. R., Hillam J., Baillie M. G. L. & Pearson G. W. 1977. A long sub-fossil oak tree-ring chronology from the North of Ireland. *New Phytologist* 79: 713–729.
- Pilcher J. R., Baillie M. G. L., Schmidt B. & Becker B. 1984. A 7,272-year tree-ring chronology for western Europe. *Nature* 312: 150–152.
- Ralska-Jasiewiczowa M. & van Geel B. 1992. Early human disturbance of the natural environment recorded in annually laminated sediments of Lake Gościąg, central Poland. *Vegetation History and Archaeobotany* 1: 33–42.
- Ralska-Jasiewiczowa M., van Geel B., Goslar T. & Kuc T. 1992. The record of the Late Glacial/Holocene transition from the varved sediments of Lake Gościąg (central Poland). In: A. M. Robertsson, B. Rindberg, U. Miller & L. Brunnberg (eds), *Quaternary Stratigraphy, Glacial Morphology and Environmental Changes*. *Sveriges Geologiska Undersökning* 81: 257–268.
- Renberg I. 1981. Formation, structure and visual appearance of iron-rich, varved lake sediments. *Verhandlungen Internationalen Vereinigung für Limnologie* 21: 94–101.
- Saarnisto M., Huttunen P. & Tolonen K. 1977. Annual lamination of sediments in Lake Lovojärvi, southern Finland, during the past 600 years. *Annales Botanici Fennici* 14: 35–45.
- Sandgren P. 1993. Palaeomagnetic and mineral magnetic investigations of the laminated sediments in Lake Gościąg and the soils in its catchment, central Poland. *Polish Botanical Studies, Guidebook Series* 8: 127–144.
- Schmidt B. 1973. Dendrochronologische Untersuchungen an Eichen aus der Kölner Bucht und den Werra-Weser-Gebiet. *Archäologisches Korrespondenzblatt* 1: 155–158.
- Schmidt B. 1987. Dendrochronologie und Ur- und Frühgeschichte, Köln.
- Schove D. J. (ed.) 1983. Sunspot cycles. Hutchinson Ross Pub. Com., Stroudsburg, Pennsylvania.
- Seibold E. 1958. Jahreslagen in sedimenten der mittleren Adria. *Geologisches Rundschau* 47: 100–117.
- Sonett C. P. & Finney S. A. 1990. The spectrum of radiocarbon, In: J.-C. Pecker & S. K. Runcorn (eds), *The Earth's climate and variability of the Sun over recent millenia – geophysical, astronomical and archaeological aspects*. *Philosophical Transactions of the Royal Society of London*, A 330: 591–600.
- Starkel L. 1977. Paleogeografia holocenu. Państwowe Wydawnictwo Naukowe, Warszawa.
- Starkel L. 1991. Podział stratygraficzny holocenu. In: L. Starkel (ed.), *Geografia Polski, Środowisko przyrodnicze*. Państwowe Wydawnictwo Naukowe, Warszawa.
- Stuiver M. & Becker B., 1993. High-Precision Decadal Calibration of the Radiocarbon Time Scale, 1950–6000 BC. *Radiocarbon* 35: 35–66.
- Taylor K. C., Lamorey G. W., Doyle G. A., Alley R. B., Grootes P. M., Mayewski P. A., White J. W. C. & Barlow L. K. 1993. The 'flickering switch' of late Pleistocene climatic change. *Nature* 361: 432–436.
- Troels-Smith J. 1960. Ivy, mistletoe and elm: climatic indicators – fodder plants. *Danmarks Geologiske Undersogelse* 4: 1–32.
- Walanus A. & Goslar T. 1993. Computerized measurements of laminae thicknesses. *Polish Botanical Studies, Guidebook Series* 8: 121–125 (in Polish with English summary).
- Ważny T. 1990. Aufbau und Anwendung der Dendrochronologie für Eichenholz in Polen. Dissertation, Universität Hamburg, Hamburg.
- Wicik B. 1993. Some chemical properties of waters and sediments of the "Na Jazach" lake complex in the Płock Basin. *Polish Botanical Studies, Guidebook Series* 8: 93–104 (in Polish with English summary).
- Wohlfarth B., Björck S., Possnert G., Lemdahl G., Brunnberg L., Ising J., Olsson S. & Svensson N.-O. 1993. AMS dating Swedish varved clays of the last glacial/interglacial transition and the potential/difficulties of calibrating Late Weichselian 'absolute' chronologies. *Boreas* 22: 113–128.