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A novel thermophysical model of the production rate of C/1995 O1 (Hale-Bopp)

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A new approach to thermophysical modeling of comets is presented and applied to interpret the production rate measurements of water and CO ice of comet C/1995 O1 (HaleBopp). A long-term observation campaign of this exceptional comet indicates that the production rate of a volatile species like CO is coupled to the solar irradiation of the surface. An explanation could be the location of CO ice close to the surface. Our novel thermophysical model aims to investigate this hypothesis. The model shows that by consequently treating the heat conduction problem of comets as a Stefan problem of a multi-layered nucleus the obtained production rate curves compare well with measurements. We elucidate under which choice of parameters, i.e. thermal conductivity, this is achieved. After having successfully tested our model against observations of comet Hale-Bopp we discuss possible implications on the target comet of ESA's Rosetta mission 67P/Churyumov-Gerasimenko.