Mean Temperature in a Closed Basin by Remote Sensing (*) (**) 

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Summary. — In this paper a procedure to determine the mean vertical temperature in a closed shallow basin will be presented. The procedure is based on the remotely observed surface temperature implemented by a calibration point at which usual meteorological measurements are performed. By the energy conservation equation applied at the calibration point the behaviour of the mean vertical temperature is obtained. Field measurement have been performed (June 1987) in a basin called Comacchio Valley (Italia). Experimental results are shown.

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1. – Introduction.

Nowadays the water surface temperature by data collected in the thermal infrared (TIR) from spacecraft platform have a good quality. This, of course, when the target is large, homogeneous and with known emissivity like water surface. In our study we use a quite large basin situated in the North of Italy called Comacchio Valley which has the required characteristics.

The TIROS-N/NOAA satellite series has one or two detectors in the TIR.

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They are the channel 4 ((10.3 ÷ 11.3) μm) and the channel 5 ((11.5 ÷ 12.5) μm) of the advanced very high resolution radiometer (AVHRR). The geometric resolution at nadir is about 1 km, the radimetric resolution at 300 K is about 0.1 K and a point on the earth can be seen at least two times a day. These features together with the continuity in service of this series of satellites provide a valid and cheap mean to measure water surface temperature on a closed basin as Comacchio Valley.

To determine the surface temperature accurate atmospheric correction will be used. This is performed by LOWTRAN 5 modified version (1). A calibration point with in situ measurements will be also used.

The energy conservation equation has to be used because the water surface temperature remotely sensed is surface temperature. Surface and bulk temperature may be quite different (even some degrees). The difference between the skin and the surface temperature is neglected (2).

Comacchio Valley is a big fish-pond particularly used to grow eel. It is very shallow (about one meter), with a bottom quite flat and constant water content.

Temperature in the basin is a driving condition in aquaculture. The procedure presented appears suitable for this basin.

2. – Radiative processes.

The radiative processes involved are both short and long-wave radiation.

The incident solar (short-wave) radiation (direct and diffuse) will be, in part, reflected by the water surface and, in part, transmitted inside the water. The transmitted part will be then absorbed by the water. The resulting effect is equivalent to a heat source in the interior of the water. In our study we assume that the whole transmitted solar radiation is absorbed before it reaches the bottom (sediment). This assumption appears reasonable due to the water turbidity even if the depth of the water is rather small. Finally the solar irradiance has been assumed constant on the whole basin surface, i.e. space variability of clouds in the basin is neglected.

For the long-wave radiation (i.e. thermal radiation) only the water-air surface has to be taken into account. The basin has been considered a gray body and the flux outgoing from its surface is

\[ \Phi = \varepsilon \sigma T_s^4, \]

(1)

(1) D. C. ROBERTSON, L. S. BERNSTEIN and R. HAIMES: Additional of a 5 cm⁻¹ spectral resolution band model option to Lowtran 5 (Aerodyne Research Inc., Badford, MA 01730, 1980).