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Antecedent Index

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It is the responsibility of HSA Hydrologists and Forecasters to maintain a 24 hour watch of stream levels in their warning areas. It is also their responsibility to issue Flood Warnings and Flood Forecasts whenever stream levels are expected to exceed flood stage. However, quite often, flood events begin during hours when the RFCs are closed and the HSA Hydrologist is off duty. Consquently, many of the initial warnings and flood forecasts are prepared by evening and midnight shift forecasters, who are caught up in other weather problems during these times.

A hydrologic term of importance to each person responsible for preparing a stage forecast is "Antecedent Index". This paper will briefly explain the concept of Antecedent Index (AI) and show you how varying it a few tenths may produce vastly different results.

The AI is a by-product of the Antecedent Precipitation Index (API). The API is used to calculate runoff by estimating the amount of available water in soils after a rain event. In other words precipitation minus loss. Loss is the amount of water it takes to replenish what has been depleted from a river basin. What is left after this process is runoff, which includes both surface and interflow runoff. Mathematically the API process looks like this:

$$I_t = I_o K^t$$

Where I_o is the initial value of API, I_t is the value t days later and K is a recession factor and is a function of potential evapotranspiration, usually between .85 and .98. If we set t to unity this equation becomes $I_1 = KI_o$.

Here is an example of how the API is calculated for five-day period. We set $API_{yda} = 1.00$ and $K = 0.90$.

Date	1	2	3	4	5
.90 X API_{yda}	1.00	1.13	1.47	2.22	2.00
24hr precip	.25	.50	1.00	0	0
API_{tda}	1.25	1.63	2.47	2.22	2.00

The actual AI used today incorporates features of the API but introduces corrections for physical processes such as temperatures, latitude, solar radiation, etc.

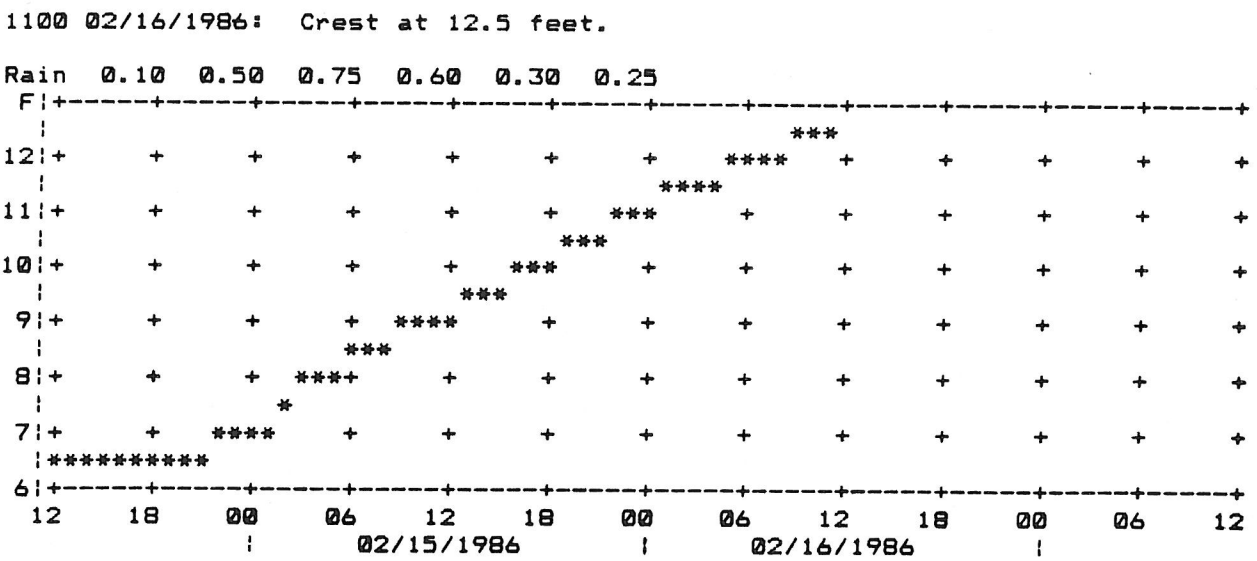
Notice in the above example that there was no precipitaiton recorded on day 4 and 5. What if precipitation had occurred but was not reported for some reason. What effect would this have on any stage forecasts made using this AI value? Maybe none at all, but then maybe the difference might be significant. In the example below we will show how varying the AI will produce a substantial increase in a stage forecast.

The following conditions are for Cambridge,OH:

initial AI = 2.5

6 hour precipitation starting at 18z on February 14 (18z, 0.10; 00z, 0.50; 06z, 0.75; 12z, 0.60; 18z, 0.30; 00z, 0.25)

River stage before onset of rain 6.5 feet.
River stage reported at 12z the next day 10.3 feet.



Repeating the same forecast except lowering the AI to 2.2 gives the following results.

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0500 02/16/1986:  Above Flood Stage.
0500 02/16/1986:  13.0 feet--Water starts out of banks.
1100 02/16/1986:  Crest at 13.9 feet.

Rain  0.10  0.50  0.75  0.60  0.30  0.25
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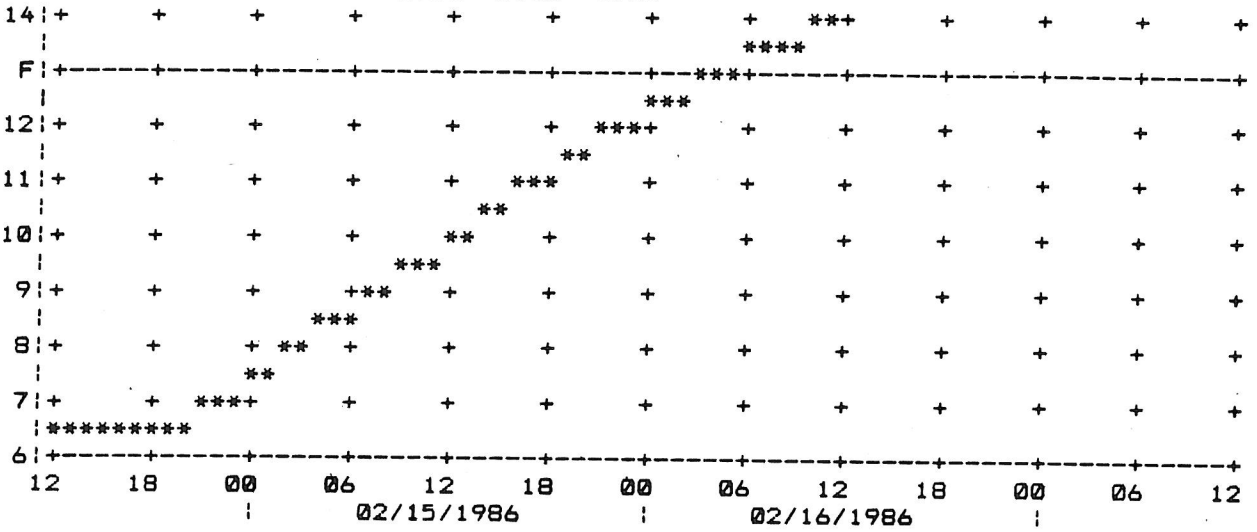

The second hydrograph forecast is more in line with the stage that was reported at that time. This shows the advantage of using a hydrograph forecast over advisory table forecast. While the advisory table forecasts can only give you the crest stage, the hydrograph forecasts give you a clear picture of what is actually occurring. Thus, by keeping track of the rate of rise, it is possible for forecasters to recognize situations where AI values may or may not be handling the existing flood situation.

If we assume the rainfall pattern is known, the rate of rise will be a function of the AI value. The intent of this attachment is to make forecasters more aware of the role AI plays in flood forecasting. In the first hydrograph forecast, the crest was below flood stage. However, in the second hydrograph forecast, a decrease of three tenths in the AI value produced a crest stage above flood stage and nearly two feet above the first forecast.

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