1. Motivation & Purpose

This study aims at modeling the evolution of meanders by coupling the Bank Erosion and Retreat Model (BERM) by Chen and Duan, 2006) with a nonlinear flow model (by Blanckaert and de Vriend, 2010).

1.1 Linear flow method

Assume: $\frac{d b}{d s} = 0$; $r \gg b$

The results of linear & nonlinear flow models are similar in mildly curved channels with a nonlinear flow model and experimental result (Friedkin, 1945) of the cross-channel flow.

2. Theory – physical process which redistribute flow in curved channels

By Blanckaert & de Vriend (2010)

Extra terms compared to linear model by Johannesson and Parker (1989)

Transverse water surface and bed slope

Changes in curvature

Streamwise momentum redistribution by secondary flow

Cross-flow due to changes in transverse water surface and bed slope

3. Verification of linear & nonlinear flow models

Fig. Comparison of the analytical solution of linear model and experimental result (Friedkin, 1945)

Fig. Schematization of flow structure in a bend; definition of reference system and notations used in the non-linear flow model (adapted from Blanckaert & de Vriend 2010)

4. Flowchart for meander evolution model

Start

Set flow parameters

Set original curvature channel

Set time counter to zero, t=0

$t \rightarrow t+1$

Compute $C_s$ from Eq.

Compute $C_B$ from Eq.

Compute $C_H$ from Eq.

Compute $C_R$ from Eq.

Compute $C_F$ from Eq.

Compute $C_{RR}$ from Eq.

Compute $C_{BF}$ from Eq.

Compute $C_{HR}$ from Eq.

Compute $C_{FR}$ from Eq.

Compute new curvature

If $C_F > 0$

No

Go

End

Fig. Flowchart of the calculation process

5. Conclusions

- The results of linear & nonlinear flow models are similar in mildly curved channels with a flat bed.
- Linear models overestimate streamwise momentum redistribution by secondary flow in strongly curved channels.
- The nonlinear flow model gives a better result in high-sinuous channels with transverse bed slope.
- A better meander evolution model is expected and being built by coupling the Bank Erosion and Retreat Model (BERM, by Chen and Duan, 2006) with a nonlinear flow model (by Blanckaert and de Vriend, 2010).

6. References