

CONTEXT

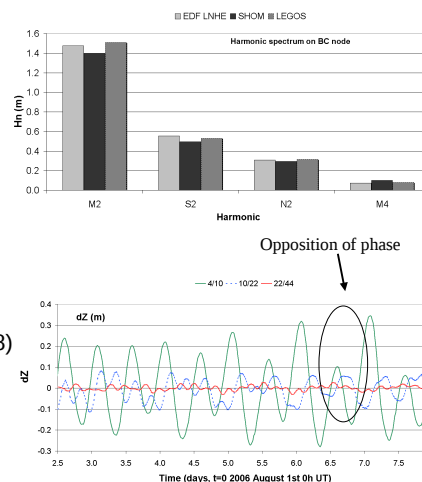
- o Biggest estuary in western Europe: many human, biologic and economic activities.
- o Accurate hydrodynamics is required for transport of sediment, algae or pollutant and also for flood control purpose.
- o Objective: tend to a fully predictive model.
 - ✓ Measured water level as boundary => tide prediction.
 - ✓ Calibration of the friction coefficient => roughness prediction.

SENSITIVITY TO TIDE PREDICTION

- o Tide predicted by:

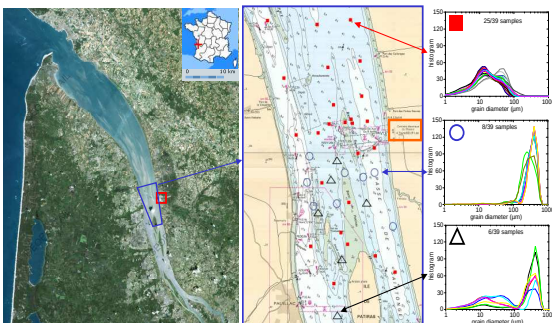
$$h_{tide} = h_0 + \sum_n H_n f_n \cos [\sigma_n t - g_n + V_n + u_n]$$

- o h_0 averaged level, s_n harmonic angular speed.
- o Harmonic constants (H_n , g_n) given by tide models:
 - ✓ EDF LNHE: 4 harmonics M2, N2, S2, M4.
 - ✓ SHOM: 21 harmonics.
 - ✓ LEGOS: 44 harmonics.
- o Nodal factors f_n , u_n and initial phase V_n (Schureman 1958)
 - => model comparison with 4 harmonics.
 - => influence of harmonic number with LEGOS model (4, 10, 20 and 44 waves).

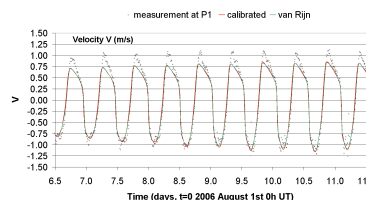
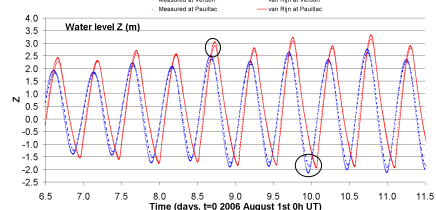
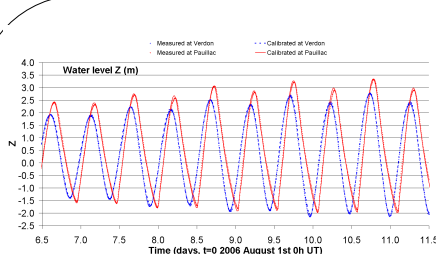
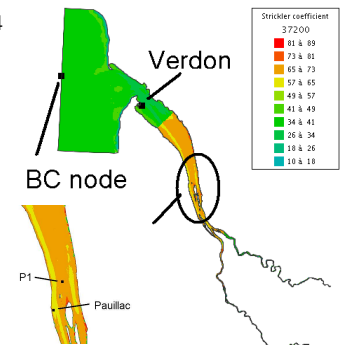


- o Unstructured grid of 22720 nodes.
- o Hydrodynamic solved by Telemac 2d (Hervouet 2007).
- o Bathymetry: central part measured in 2005, elsewhere in 1995.
- o Flow rates from tributaries.
- o Harmonic constants from tide models on the boundary nodes (EDF LNHE, SHOM and LEGOS).
- o Available measurements: bed material, water levels and velocities.
- o Comparison between harmonic spectra given by tide models.
 - => Difference of water level at Verdon ranging from 10 to 25 cm.
 - => Influence on the calibration of the friction coefficient.
- o Influence of harmonic numbers:
 - => from 4 to 10 waves: 25 cm.
 - => from 10 to 20 waves: 10 cm.
 - => from 20 to 44 waves: 2-3 cm.
- o Tide model from LEGOS is selected.

FRICITION COEFFICIENT



- o Calibrated: values of the Strickler coefficient in 4 zones, $K=37.5 \text{ m}^{1/3}/\text{s}$ in the mouth, 60 in the central part, $75 \text{ m}^{1/3}/\text{s}$ from rivers junction to Bordeaux, $60 \text{ m}^{1/3}/\text{s}$ in the tributaries.
- o Predicted by van Rijn (2007): decomposition of the roughness (grains, ripples and dunes). Friction coefficient depending on the flow velocity, water depth and median diameter of the bed material (d_{50}).
- o Mouth $d_{50} = 0.31 \text{ mm}$ (GPMB), central part $d_{50} = 0.03 \text{ mm}$ (measurement campaign 2009).



- o Calibrated in regard of water level measurements in 2006 (spring and neap): $dZ < 10-15 \text{ cm}$.
- o Water level calibration checked on measurements from 1999 and 2009.
- o Comparisons with flow velocity measurements in 2006 and 2009.
- o Velocity under-estimated: friction coefficient probably compensates inaccuracies (numerical, tide models ..).
- o Feasibility of using van Rijn formula ($dZ \sim 20 \text{ cm}$).
- o Friction coefficient predicted by van Rijn close to calibrated values.

CONCLUSIONS AND FUTURE WORK

- o Robust calibration and tide description.
- o Better description of the bathymetry.
- o Finer description of the bed material distribution.
- o Results quality strongly linked to accuracy of tide prediction.
- o Needing a robust tide model near the estuary mouth (= new tide model).
- o Coupling with sediment transport module (Sisyphe).

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