Modélisation sur Enxoé

Lisbonne, 9-11 mars 2011
Enxoé watershed

• Description
  – Area: 60km²
  – River Length: 9km
  – Altitude Range: 160 – 350m
  – Annual Precipitation: 500mm
  – Pressures: 50%
    No Irrig Agriculture/Pasture; 35% Olive Trees; High animal presence (cattle, sheeps) low urban presence

Future steps

Enxoé Modelling

SWAT

MOHID Land

Enxoé dynamics

Future steps
Land Uses

Montado

December

May

October
Land Uses

Irrigation

Olive

Small Farms
Data

- Data for model implementation

- DTM – NASA 90m
- Land Use Corine 2000
- Soil Texture – EU soil
- Precipitation
Data

• Data for validation
  – Collected during the project
  – Neighbour watersheds (flow)
  – Reservoir volumes and discharges
Watershed

- 65 basins
- 161 hru
- Auto fertilization (maximum 200kgN/ha.year)
SWAT - Calibration

- Ground water behaviour
  - Impact on daily hydrogram

- Soil depth
  - Impact on monthly flow

Diagram:
- Porous Media
- Shallow Aquifer
- Gw_delay
- Alpha_BF
- River

Graphs showing default and calibrated hydrograms over time.
Comparison with long term historic flow data outside Enxoe

• Lack of historic in enxoé river basin
• 1 month data Aguaflash December 2009 and from October 2010.
• For checking long term trends and temporarility
• Run SWAT to neighbour watersheds and cal/validate to long term data

– Monte da Ponte with 455 km²; 100-300m alt.; 45km river
– Limas with 97 Km²; 100-250m al 25km river
– Enxoé is 60 Km²; 180-300m alt.; 9km river
Comparison with long term historic flow data outside Enxoe

- Monthly Flow

1958-1990
R2: 0.80
Nash: 0.68

1984-1989
R2: 0.77
Nash: 0.74
Comparison with long term historic flow data outside Enxœ

- Flow Frequency

![Graph showing exceedance frequency and monthly flow for Rio Cobres - Monte da Ponte Station]
Comparison with indirect data inside Enxoe

- Enxoe Reservoir balance 13 years data
  - Discharges
  - Water abstraction
  - Volume change

- Meteorology
  - Evaporation
  - Precipitation

- Compare to SWAT model Inflow and Mohid Model inflow
Comparison with indirect data inside Enxoe

Reservoir Input

hm³/month

month

From Reservoir Balance

SWAT
Water Quality Simulation - SWAT

Low concentrations when compared to intensive agriculture areas
Water Quality Simulation - SWAT

- SST (mg/L)
• Validation in long term hydrodynamics and qualitatively water quality

• Balances
Water Balance 1980-2009

20% goes in river
Water Balance 1980 - 2009

Precipitation – 500 mm

Hydrol Year

Balance 1980 - 2009

Runoff
Percolation
Evapotranspiration
Nitrate Balance 1980 - 2009

NO3 patheways in agriculture land

->2 kg/ha.year
->10 kg/ha.year
Nitrates vs. Water yield et Précipitations

\[ y = 0.0102x - 2.7202 \]
\[ R^2 = 0.5623 \]

\[ y = 0.022x + 0.6047 \]
\[ R^2 = 0.7025 \]

Precipitation that does not get to river and not transport nitrate
Soil Loss

- \( > 2 \) ton/ha.year
- \( > 5 \) ton/ha.year
MES vs. Water yield and Précipitations

\[ y = 2.5122x - 834.8 \]
\[ R^2 = 0.8068 \]

\[ y = 5.2505x - 5.6177 \]
\[ R^2 = 0.9539 \]
Flow decomposition
Mohid Land

- 60x40 cells 200mx200m 12 layers soil 0.5-
- Development
  - Vegetation
  - Property transport
  - Erosion/deposition
  - Pesticide application
- Data for implementation
- Data for validation
Comparison

Reservoir Input

Jan-Feb 2009
SWAT ET 15-20% Precip
MOHID LAND ET 30%-50% Precip
SST

• first results
December 2009 events
December 2009 events

• Water Depth
December 2009 events

• Where did the water went to?
  – Peaks inside soil – surface layer
December 2009 events

- Water Depth

![Graph showing Water Depth with MOHID Land and Enxoé dynamics models, and Reality infiltrated less and no runoff to river. The graph also shows Soil Saturation with Probe and MOHID lines.]
December 2009 events
Runoff Processes

Permeable soils

Precipitation Rate

Conductivity Rate

Less permeable soils

Precipitation Rate

Conductivity Rate

Processes occur also for same soil depending on precipitation rates.
Sensitivity analysis

• Mohid Land a physic tool to understand dynamics
• Sensibility Tests
  – Lowering conductivity (promoting infiltration excess)
  – Reducing soil depth (promoting saturation excess)
  – Reducing surface rugosity (promoting flow)

Bibliography

  – Impermeabilization, soil surface sealing?
Soil sealing Processes

Then dries out and forms a crust with low permeability


December 2009 events

• Impermeability Results

Hint: Watershed is not impermeable but behaving has impermeable
• Enxoé behaviour in December peaks
  – Related to impermeability or resistance to infiltration (as impermeable)
  – It could be punctual behaviour – related to high precipitation event in October (65mm in 2h)
  – Next action:
    • See if this behaviour appears in other level measures 2010–2011 records. Punctual or dominant behaviour

• Models are giving same long-term trends of the system and with Mohid Land we may study event dynamics

Enxoé Modelling

SWAT

MOHID Land

Enxoé dynamics

Future steps
What data says

Salinity Enxoé

October 2010

Fev 2011

Salinity Enxoé
What data says

Salinity Enxoé

December 2009

Salinity Enxoé
Conclusions

• Concept model
  – Long term functioning
    • Precipitation 500mm
    • Runoff 10%
    • Percolation 10%
    • Evapotranspiration 80%
    • Nitrate loss is low consistent with extensive agriculture and data in river
    • Soil loss is not high consistent with gentle slopes, natural vegetation and data in river. *And arrives in few events.* But high percentage of annual load arrives in 2-4 days.

  – Floods
    • Floods rise in 1h – 6h and fall in 1h-1d
    • In flood arrives water with lower salinity (mainly runoff) but couple of days recovers initial salinity (groundwater replaces water).
    • Soil sealing may be important for decreasing permeability.

• Models
  – SWAT good results in long term dynamics and qualitatively in WQ
  – Did not managed to show Dec09 peaks (CN, hydrologic group, lower drained soil...). SWAT will not solve Enxoé peaks (hours).
  – Mohid Land good results in long term dynamics
  – Developing tool to understand watershed dynamics physically and in events
Next Actions

• Continue Sampling
  – Automatic Sampler protection against floods and mices (pictures)

• Continue modelling
  – Pesticide in SWAT (but it is not a issue)
  – Sediment and pesticide in Mohid Land
  – Impermeability continues?