TUFLOW – An Introduction

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Overview

TUFLOW Background & Recent Milestones

TUFLOW Model Types and Applications





TUFLOW

- Stands for <u>Two-Dimensional Unsteady Flow</u>
- Also, solves full one-dimensional equations
- Solves the "Shallow" Water Equations (SWE) for modelling "long waves", ie.
 - Tides , Storm Surges, Tsunamis
 - Floods (Rivers and Urban)





TUFLOW Solves ALL SWE Physical Processes







Inertia

- Very important where velocity
 - Speeds up or slows down
 - Changes direction
- Essential at structures and bends









Viscosity Sub-Grid Scale Turbulence

- Important where bed resistance term not dominant and/or rapid changes in velocity gradient
 - Low Manning's n values and/or deep water
 - Flow constrictions
- Smagorinsky formula preferred (varies coefficient based on velocity gradient)
- Many 2D schemes omit this term
- Never have to artificially increase viscosity for stability









Milestones

- 1989/1990 TUFLOW Developed and first applied
- 1991–2000 Applied to high profile 2D flood studies
- 2001 TUFLOW made commercially available
- 2004 Selected for London SS Inundation Study
- 2006 SMS and XP-2D interfaces released
- 2009 Most used 2D flood modeling software in UK
- Today used in over 15 countries and more than 400 organizations







2D Data Input Types Background Imagery

- Needed as a background for developing the 2D model
 - Aerial Photos
 - Topo Maps

 Need to be geo-referenced









2D Data Input Types DTM

- Ground or bathymetric elevations from DTM
- TUFLOW allows inputs from any number of DTMs









2D Data Input Types 2D Domain Extent

SMS 10.0 Beta - [dp_2d_only_demo_ppt.sms] 🛐 File Edit Display Data Triangles Scatter Window Help 2D Domain 🎽 🔚 🍜 🏦 🖻 🧕 🍃 ter Module elevatio 🗠 🗌 🔜 Mesh Data **Outer Extent** Q± 119.0 🗄 🗍 🏡 Q100 2D Only * 116.0 Z elevation 113.0 🕩 Vel Q100 2D Only (Rotated Rectangle) \mathbf{A} 110 6 123 Vel Q100 2D Only_mag ÷.• 107.0 123 Head Q100 2D Only 104.0 🐨 📺 Cartesian Grid Data 101.0 . ⊡--**⊡** ∎∎ 6m Used to create 98 D Z Depth 95 N 🖻 🔽 🗰 CGrid 10 Z Depth 2D cells 🗹 📷 Scatter Data 🖃 🔽 🚺 Topography & Bathym 123 elevation 🚽 科 Map Data -Area Property - d_ bc_2d_only 🗹 🔓 grid_001 🗆 🔓 Fill Evees 🔲 କ Bridge Deck Active Area 🗹 💽 Images 12 Time steps: 0 09:30:00 ~ 0 09:45:00 0 10:00:00 0 010:15:00 010:30:00 Т 0.10:45:00 0 11:00:00 哥 0 11:15:00 0 11:30:00 0 11:45:00 (304588.0, 4386167.0) 🚷 🕲 🎛 🛄 🖬 🧩 🌖 🏸 📖 外







2D Data Input Types Active/Inactive Areas

- Can use polygons to activate or deactivate areas
- Reduces output file sizes
- Reduces run-time









2D Data Input Types Land-use (Materials)

- Polygons of Land-use Categories (Materials)
- Each material
 - Manning's n (Fixed or Depth Varying)
 - Rainfall infiltration losses









2D Data Input Types Boundaries

- Flow vs Time
 - Side Inflow
 - Area Inflow
- Water Level
 - vs Time
 - vs Discharge
- Direct Rainfall
 - Flow vs h
 - Z vs Time









2D Data Input Types Geometry Modifications

- Embankments (Levees, Roads, Railways)
- Landfill
- Excavations
- Land-use









2D Data Input Types Flow Constrictions

- Modify 2D cells
 - Soffit/Obvert
 - Adjust cell-side flow widths
 - Additional energy losses (eg. from piers)
 - Side wall friction (box culverts)
 - Bridges

Box Culverts

Floating Decks







2D Data Output Types

- Water Levels (h)
- Velocities (V)
- Depths (d)
- Unit Flow (q)
- Several Hazard Categories (Zx)
- Energy (E)
- Froude No. (F)
- Flow Regime (R)
 Mass Error (MB1)
 and more.























Urban Areas – Buildings and Fences







Modelling Fences!

- Able to raise element sides
- Element sides wet and dry
- Layered parameters
 - eg. vary blockage and losses with height
- Collapse element sides
- Switch between u/s and d/s controlled weir flow









Collapsible Fences Animation







Modelling Blockages!?







2D Layered Adjustments















Detailed Urban Models







Detailed Urban Models

1,600 pipes / culverts 900 pits (drains) 600 manholes 1.8 million wet cells at peak







Flood Impact Assessments









TUFLOW FV







TUFLOW AD Module









TUFLOW MOR Module







GIS Based

Creating Models: GIS / Text Editor / Excel Results: GIS / SMS / WaterRIDE / Excel





















TUFLOW Manual

- 550 pages
- Hyperlinked
 - Easy to navigate
- Very detailed
- Messages and Tutorial Wikis

TUFLOW User Manual

GIS Based 2D/1D Hydrodynamic Modelling

2010 (Build 2010-10-AB)

www.TUFLOW.com www.TUFLOW.com/forum support@tuflow.com

New Features/Changes

How to Use This Manual Chapters Table of Contents List of Figures List of Tables Appendices

> .tcc File Commands .tcc File Commands .tbc File Commands .tef File Commands .ecf File Commands

Command Hyperlinks

Glossary & Notation











TUFLOW Forum

- Post and reply to topics
- Receive emails of TUFLOW updates and announcements
- ~700 members
- www.tuflow.com\forum









TUFLOW In Summary

- Successfully applied to:
 - Estuaries / Coastal Waters / Storm Surges
 - Major Rivers
 - Broad-scale models (River/Streams 1D; Floodplain 2D)
 - Urban Flooding (Overland 2D; Pipe Network 1D)
- GIS Based / SMS Interface
- Pre-dominant 2D Flood Modelling Software in Australia and the UK



