Rock Creek Floodplain Analysis

By Jon Franczyk

Project Outline

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- Results, pt.1
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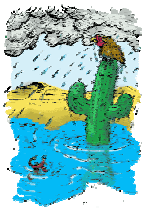
- Conclusion

Project Goals

- Determine Rock Creek population that resides within the 100yr floodplain
- Evaluate the impact projected climate change will have on potential flooding

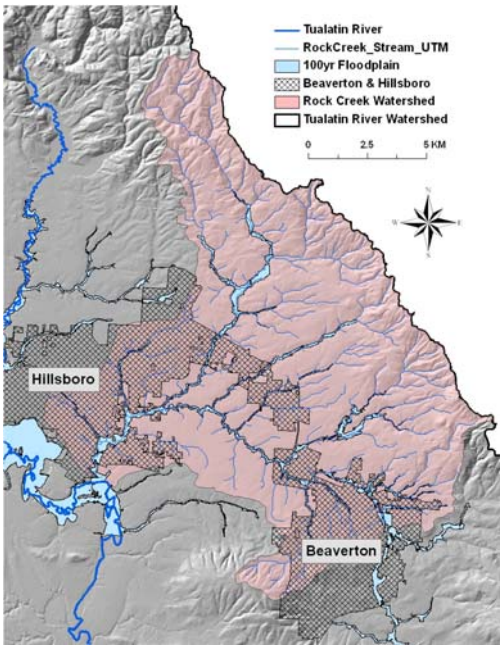
Introduction

- Flood of 1996
  - Unusually wet winter
  - Cold/snow followed by warm, tropical air & heavy rain
- Climate Change in PNW
  - Palmer et al. (2004) climate study, UW
  - Temperature (6 GCMs)
    - 2040, 2ºF increase (~1ºC)
    - 2080, 4ºF increase (~2ºC)
- Hydrologic cycle intensifying (Huntington 2004)

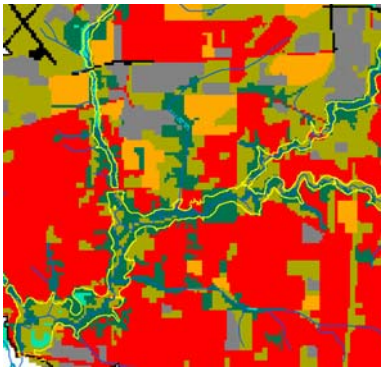


Study Area

- Tributary of Tualatin River
- Watershed = 192km^2
- Headwaters in Tualatin Mtns.
- Includes portions of Hillsboro & Beaverton
- Modified marine climate



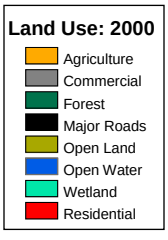
Background

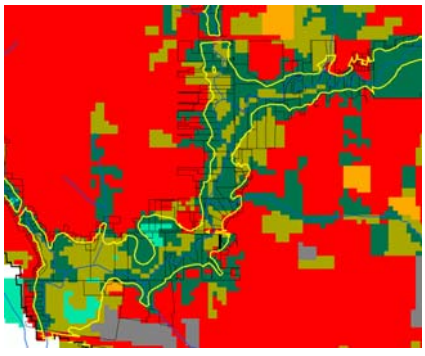


Total Property Value

$1,980,935,784

Land Use Type W/in Floodplain	
Land Use Type	**Area (km2)**
Agricultural	0.04
Commercial	0.06
Forest	0.24
Open Land	0.23
Wetlands	0.13
Residential	0.10





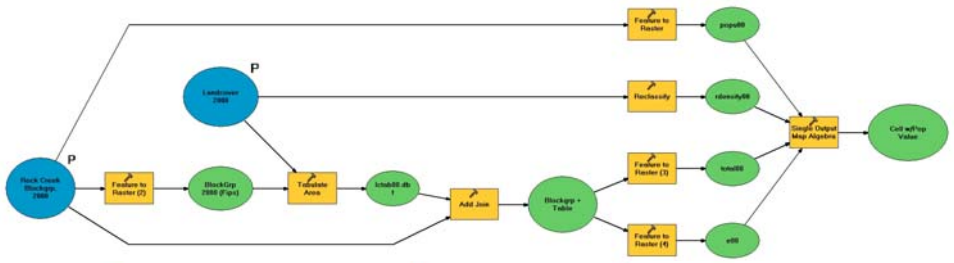
Data Sources, pt1

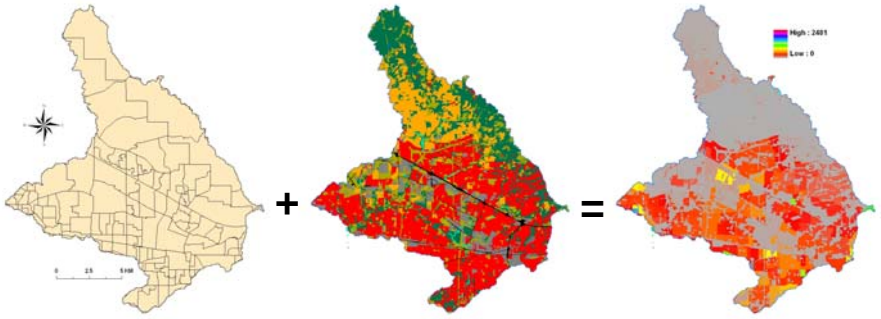
Data Type	Data Source	Purpose
Rock Creek Watershed Boundary	RLIS	Define study area
Rock Creek Land Use, 2000	Mike Boeder, Thesis	Disaggregate population based on land use type
100yr Floodplain for Tualatin Basin	Clean Water Services	Floodplain analysis
Rock Creek River Layer	Clean Water Services	Location of Rock Creek
Washington County, Year 2000 Block Groups	RLIS	Provide initial population distribution

Methods : Floodplain Population

1. Cut all layers to Rock Creek watershed boundary
2. Calculate population for land cover cells
3. Convert 100yr floodplain vector to raster
4. Determine land use types within 100yr floodplain

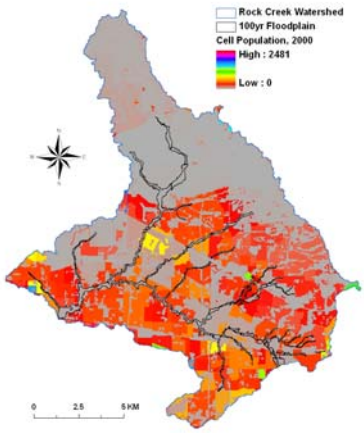
Model

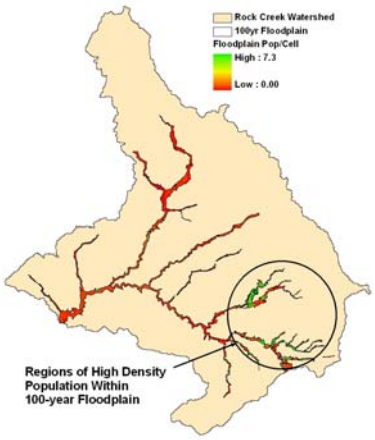




Population Results

Area (km^2)	Min	Max	Mean	Total
0.81	0.00	7.27	0.43	3885.29



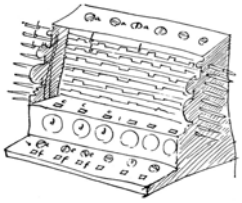


Data Sources, pt2

Data Type	Data Source	Purpose
Mean Monthly Precipitation Data (1971-2000)	Oregon Climate Service: PRISM	Climate Data
Mean Monthly Min/Max Temperature Data (1971-2000)	Oregon Climate Service: PRISM	Climate Data
Digital Elevation Model (10m)	USGS, Seamless datasets	Derive hillshade, flow direction, flow accumulation
Tualatin River Layer	NHDPlus Hydrology Dataset	Derive flow direction, flow accumulation, map creation
West Linn Gage Station Mean Monthly Stream flow Data (1975-2000)	USGS, Tualatin River Streamflow Page	Baseline runoff model validation

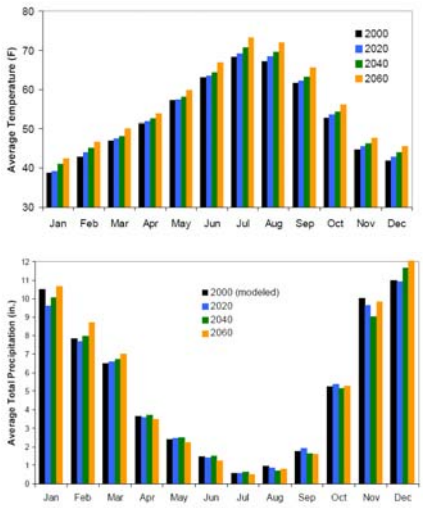
Methods: Climate Change

1. Prepare PRISM datasets for analysis
2. Create base layer stream flow accumulation record using water balance equation
3. Develop climate change scenarios
4. Compare stream flow results



Climate Change: Tualatin Basin

- Palmer et al. (2004) climate study, UW
- Temperature (6 GCMs)
  - 2040, 2ºF increase (~1ºC)
  - 2080, 4ºF increase (~2ºC)
- By 2040, annual stream flow < historical
- Increase in average annual precipitation
- Drier summers = lower late-spring & summer flow



Hydrologic Cycle & Water Balance

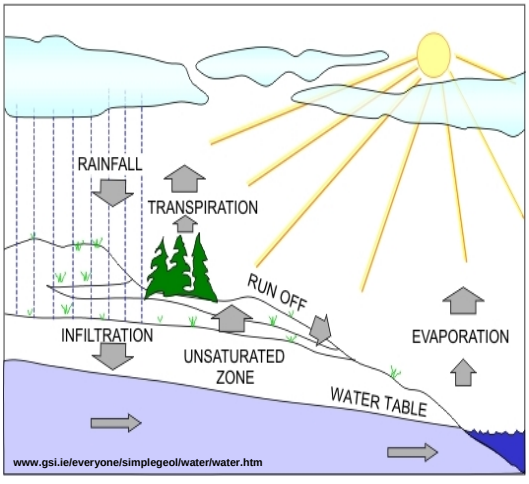
OCS
OREGON CLIMATE SERVICE

$Q = P - E_t$

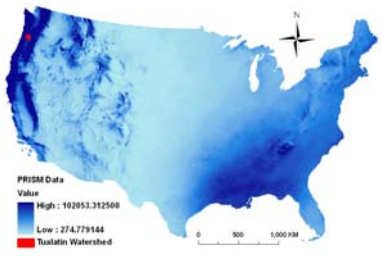
Q = Runoff
P = Precipitation
E_t = Evapotranspiration

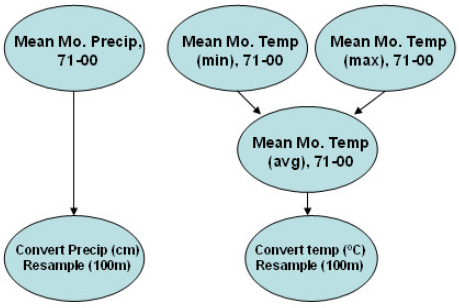
$E_t = 1.6[10T_a / I]^a$

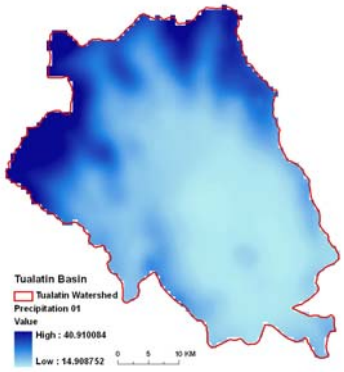
Ta = Mean Mo. Temp
I = Annual Heat Index
a = coefficient



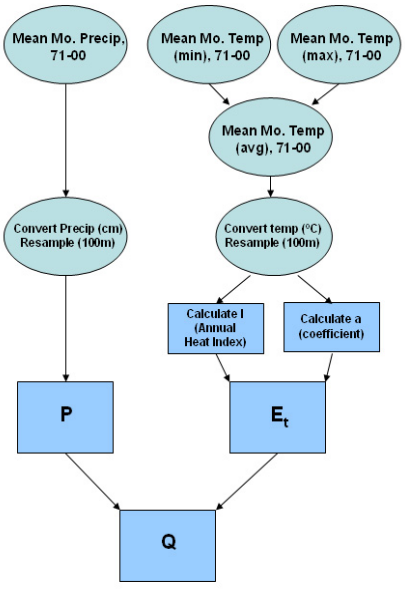
Prepare PRISM Datasets

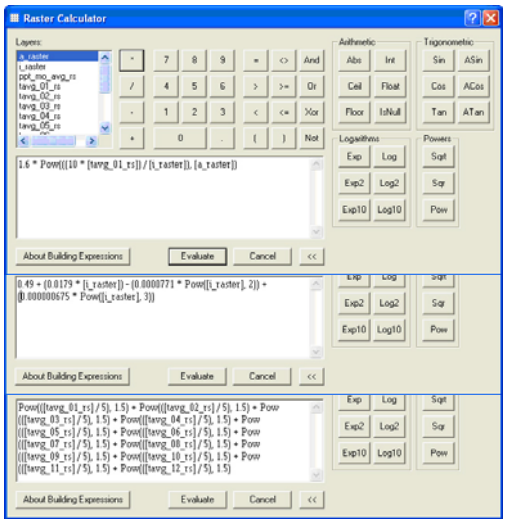






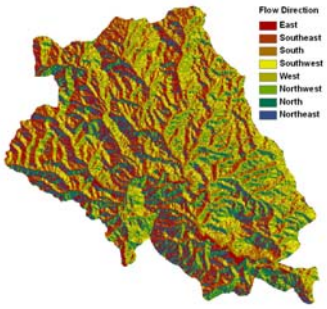
$$E_t = 1.6[10T_a / I]^a$$

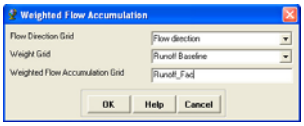


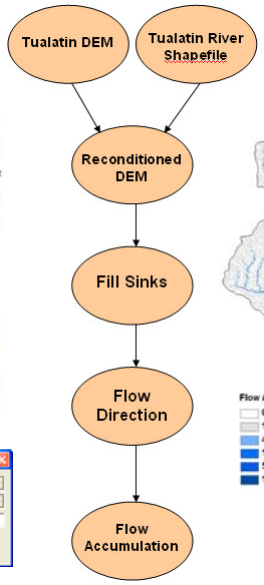


Runoff Accumulation Raster

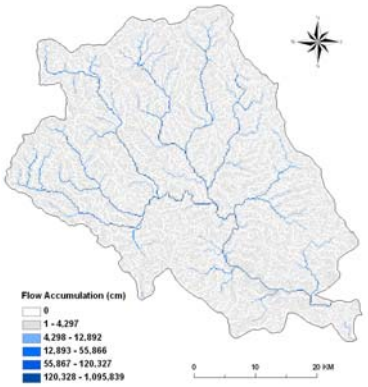
8-Direction Pour Point Method





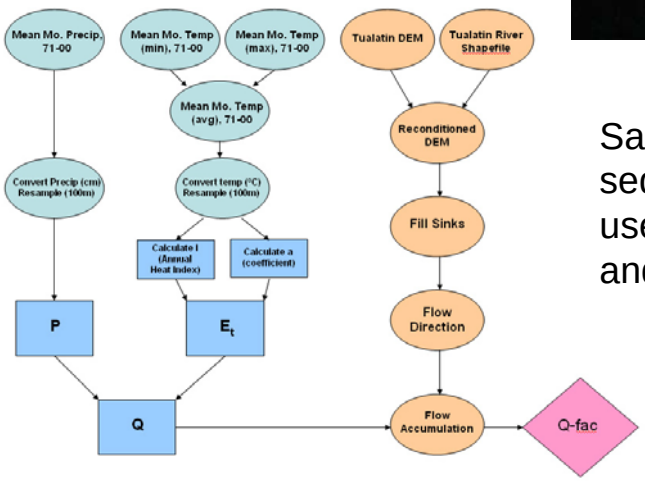


Drainage Threshold = 10 cells



All maps created in ESRI ArcMap

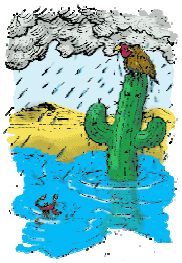
Model Overview

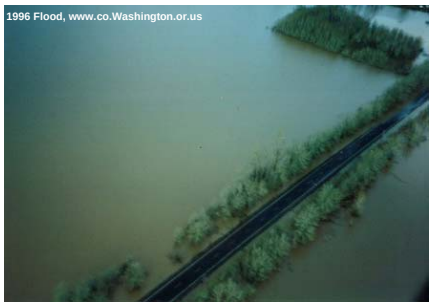


Same model sequence was used for base line and scenarios

Climate Change Scenarios

- Scenarios projected climate changes for Tualatin region (Palmer et al. 2004)
- Four climate scenarios
  - Sc1 = T +1oC, P +10%
  - Sc2 = T +1oC, P -10%
  - Sc3 = T +2oC, P +10%
  - Sc4 = T +2oC, P -10%
- Created new precip/temp rasters reflecting projections, then recalculated runoff

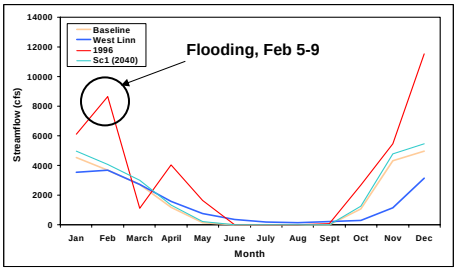


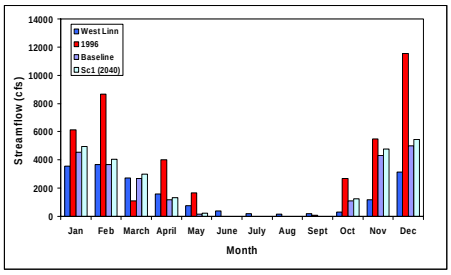


Results

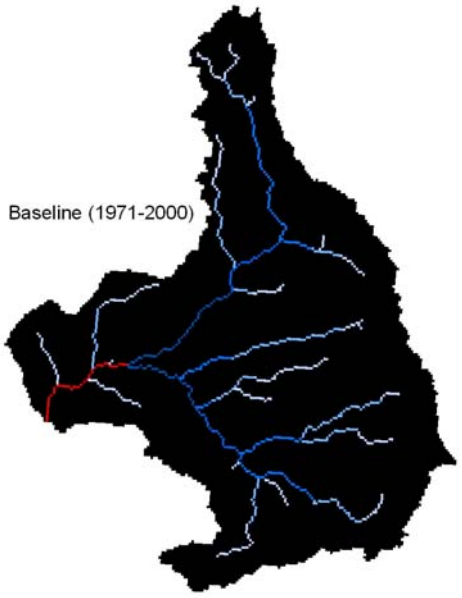
Scenario	Avg Mo. Runoff (cfs)	Change (%Bsln)
West Linn Gage	1481	n/a
Baseline	1887	n/a
2040, Sc1	2093	+10.9
2040, Sc2	1624	-13.9
2080, Sc3	2064	+9.4
2080, Sc4	1597	-15.4
1996	3445	+83.0

Sc1 showed the greatest increase in stream flow; Sc4 showed the greatest decrease in stream flow





Stream Flow



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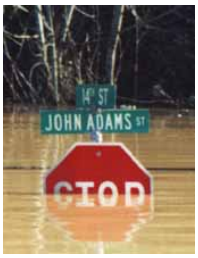
Discussion



- Minimal population within floodplain = 1.5%
- Baseline (1971-2000) overestimated stream flow
- Water balance does not include influence of
  - Soil types
  - Land cover
- 1996 mean monthly stream flow significantly higher than baseline

Conclusion

- Flood risk damage more significant to property than people
- Climate change models do not necessarily show increased potential flood risk
- Potential for floods may increase for climate scenarios that show rise in stream flow (inconclusive)

Resources

Boeder, M. 2005. Thesis

Dunne, T. and L. Leopold. 1978. *Water in Environmental Planning*. W.H. Freeman and Company, New York, USA.

Holloway, S., J. Schumacher, & R. Redmond. 1997. People & Place: Dasymetric Mapping Using Arc/Info. In *Cartographic Design Using ArcView and Arc/Info*. High Mountain Press, NM.

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