Regional Climate Change Effects and Stormwater Facility Resilience

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Rainfall Patterns

Cascade Mountains Have Influence

Example:
• Mean Annual = 33 – 173 inches per year
Downscaling Global to Local

CCSM4

0 1000 2000 3000m
Atmospheric Rivers
(aka “Pineapple Express”)
2019 Oregon 4th Climate Assessment

Projections for Temperature & Precipitation

www.occri.net/ocar4
MODEL RANKING

• This had already been done with the latest round of global model projections (Rupp et al. 2013, http://onlinelibrary.wiley.com/doi/10.1002/jgrd.50843/full)

• New approach: compare precipitation drivers, not precipitation itself
  • Sea level pressure: patterns and variability in the North Pacific
  • Jet stream: peak speed and location
  • Atmospheric water vapor: patterns and variability in the North Pacific
  • Geopotential height: spatial pattern and mean bias in North Pacific
COMBINED ERROR SCORE

Normalized Error Score

Best

Worst

PC_ALL
PC1-5
PC1-3
PC1-2

Models:
- CESM1-WACCM
- CESM1-CAM5
- MPI-ESM-WR
- MPI-ESM-LR
- NorESM1-M
- NorESM1-G
- GFDL-ESM2M
- GFDL-ESM2G
- MRI-ESM1
- ACCESS1-0
- IPSL-CM5A-LR
- EC-Earth
- HadGEM2-ES
- CNRM-CM5
- PCM
- FASM
- CSIRO-Mk3-6-0
- CESM1-BCC
- CESM1-FASMI
- BNU-ESM
- CCCM4
- HadGEM2-AO
- MRI-CCM3
- HadGCM3
- GISS-E2-H
- GISS-E2-R
- FGOALS-g2

Different models are represented by different symbols: triangles for PC2_ALL, red circles for PC1-5, green squares for PC2-3, and blue dots for PC1-2.
RCP 8.5
• 2050s Very short less intense
• 2080s more intense!
RCP 8.5
• 2050s less than 10% increase
• 2080s similar to 2050s for longer duration storms
Stormwater is the most significant source of pollutants to our receiving waterbodies!
TYPES OF STORMWATER FACILITIES EVALUATED:

- DETENTION PONDS
- INFILTRATION PONDS
- WATER QUALITY WETPONDS
- SAND FILTERS
- BIOSWALES
- BIORETENTION
DOWNSCALED LOCATIONS

- 24 WRF Locations
- 65 King County
- 20 Seattle
- Sea-Tac Used
Sizing BMP facilities
### Number of BMPs Designed

- **Using 1 Location**
- **2 Land Cover Scenarios**
- **7 BMPs**
- **2 Soil Types**

= 140 BMPs Designed & Evaluated

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<thead>
<tr>
<th>Land Cover</th>
<th>BMP</th>
<th>Soil Type</th>
<th>Sea-Tac RCP 45</th>
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RELATIVE % CHANGE TO 1990S (LOW PERMEABILITY)

RCP 8.5 - 2080 vs 1990s

-20% 0% 20% 40% 60% 80% 100%
Basic Sand Filter (sq ft) Bioretention Cell (cu. Ft) Detention (acre*feet) Wet biofiltration swale (sq ft) Wet biofiltration swale (up) (sq. ft) Wetpond (acre*feet)

Commercial Residential
RELATIVE % CHANGE TO 1990S (HIGH PERMEABILITY)

17

RCP 8.5 - 2080s vs 1990s

- Basic Sand Filter (sq ft)
- Bioretention Cell (cu. ft)
- Detention (acre*feet)
- Wet biofiltration swale (sq ft)
- Wet biofiltration swale (up) (sq. ft)
- Wetpond (acre*feet)

Commercial
Residential

300+%
SUMMARY OF KING COUNTY STUDY

- Extreme rainfall intensities increase overall
- Till soils – BMPS generally increase 20-40%
- Outwash soils – BMPS generally increase 50-200%
- A more disturbed landscape has less effect on BMP designs
- RCP 8.5 resulted in a larger range of BMP sizes from little difference to very large
- Substantial model bias sizing BMPS when comparing modeled 1990’s to historical 1990’s
Recommendations in Discussion

Guidance for Stormwater Design Manual Updates (KCSWDM)

- Require using available climate time series (bigger BMPs)
- Fee in Lieu (hold line)
- Lower redevelopment thresholds (accelerate recovery)
- Require Climate Risk Analysis (larger / riskier)
- Reserve land for future expansion of BMPs
Need to Know More

- Evaluate using more climate scenarios (4+ more coming!)
- Evaluate at more locations
- Evaluate different Time Periods
- Evaluate more strategies
  - Design Adapt BMPs
  - Reduced TIA
  - Tree Planting / Forest Retention
MODELING EFFORTS IN OREGON

• Via ACWA Stormwater Committee, engaged with UW CIG for WRF model simulations for Oregon
• Plan is for it to be initially funded in FY 19-20 by:
  • After modeling complete, bias-corrected precipitation projections for any sites within the model domain (all of OR)
  • Ask me about joining in! 😊
QUESTIONS?