I. GCASE: Methodology
Climate change impact assessment on water resources

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Project Goals and Approach

1. Develop water resources decision support modeling framework that addresses future climate uncertainties
   - Climate scenarios and surface water flows
   - Linkages to groundwater recharge
   - Linkages to water management decisions

2. Increase stakeholders’ capacity to adapt water planning and management to future climate uncertainties

3. Establish transferability of the modeling approach and stakeholder engagement
Santa Cruz River - Alluvial Aquifer
Seasonal Precipitation & Streamflow

Nogales Gauge

**RAINFALL**

**STREAMFLOW**

Rainfall (mm/season)

Streamflow (1000 m³/season)
Precipitation Categorization

- **SUMMER (Jul-Sep)**
  - WET
  - MEDIUM
  - DRY

- **WINTER (Nov-Mar)**
  - WET
  - MEDIUM
  - DRY
Rainfall Generator

Future Likely Rainfall Scenarios

Inter-arrival time of clusters

Duration of clusters

Chance for hour rainfall

Hourly rainfall magnitude

Future Likely Rainfall Scenarios
Hydrologic Modeling Framework

1. Basin: Hourly rainfall generator of likely scenarios
2. Nogales USGS stream gauge: streamflow model
3. Santa Cruz River: flow routing in the river channel
4. Microbasins: groundwater recharge and storage changes
5. Long term assessment for various management schemes

Climate Scenarios
Climate and Hydrologic Models

Global Circulation Models
- General climatology patterns ocean-land
- Pacific sea surface temperature and relations to SW climatology
- Trade wind, atmospheric rivers etc.
- General climatology of temperature and precip.

Regional Mesoscale Models
- Spatial distribution of climatological variables due to terrain and microclimate
- Special regional features
- Summer rainfall, snow
- Regional prevalent synoptic conditions

Watershed Hydrologic Models
- Developed using local high resolution data
- Further refinement of microclimate features
- Interaction – surface – Groundwater
- Feedback with management decision
Issues with widely used climate impact assessment procedures

Statistical Downscaled CMIP 3 &5
Climate and Hydrology Projections
http://gdo-dcp.ucllnl.org/downscaled_cmip_projections/
Precipitation from 8 IPCC-AR3, A2 emission scenario, dynamically downscaled regional climate models

<table>
<thead>
<tr>
<th>No.</th>
<th>Regional Model</th>
<th>Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Max Planck Institute (MPI)</td>
<td>35 km², 6 h, 1950-2100</td>
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<tr>
<td>2</td>
<td>Hadley center (HADCAM3)</td>
<td>1950-2100</td>
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<tr>
<td>3-8</td>
<td>North American Regional Climate Change Assessment Program [NARCCAP]</td>
<td>50km², 3 h, 1970-2000, 2040-2070</td>
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</tbody>
</table>
Projected Wetness by 8 models

**SUMMER**
- 7 models projected MORE DRY summers
- Only 2 models projected MORE WET summers

**WINTER**
- 8 models projected MORE DRY winters
- 6 models projected MORE WET winters
Regional Climate Model

Clear reduction in Summer

Higher variability in Winter

MPI Summer [July-September]

MPI Winter [November-March]
Summary

• We developed a modeling framework that is capable to generate ensembles of likely realizations that represent the climate variability of rainfall, streamflow and ground water recharge

• Climate projections indicate:
  – higher frequency of dry summers
  – lower frequency of wet summers
  – higher frequency of dry and wet winters