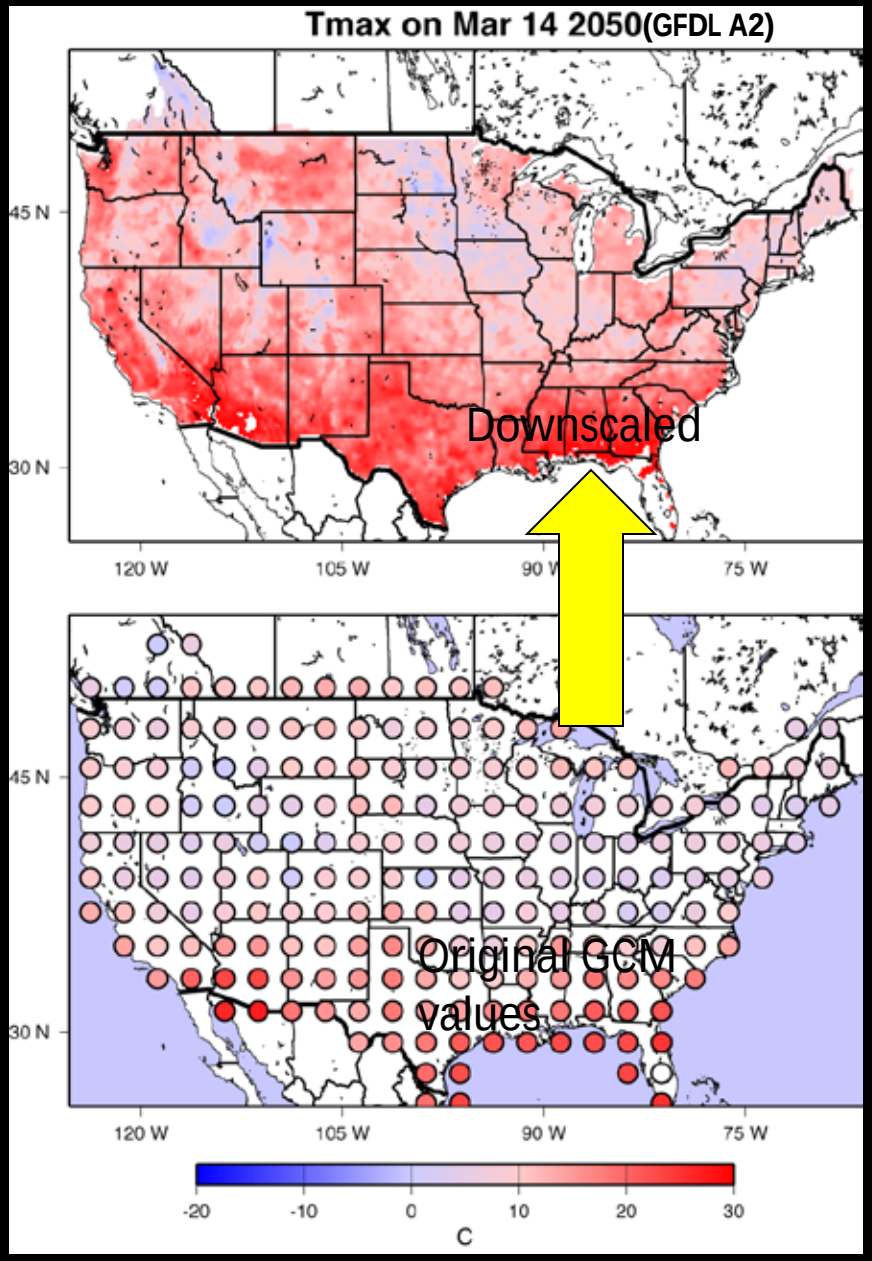
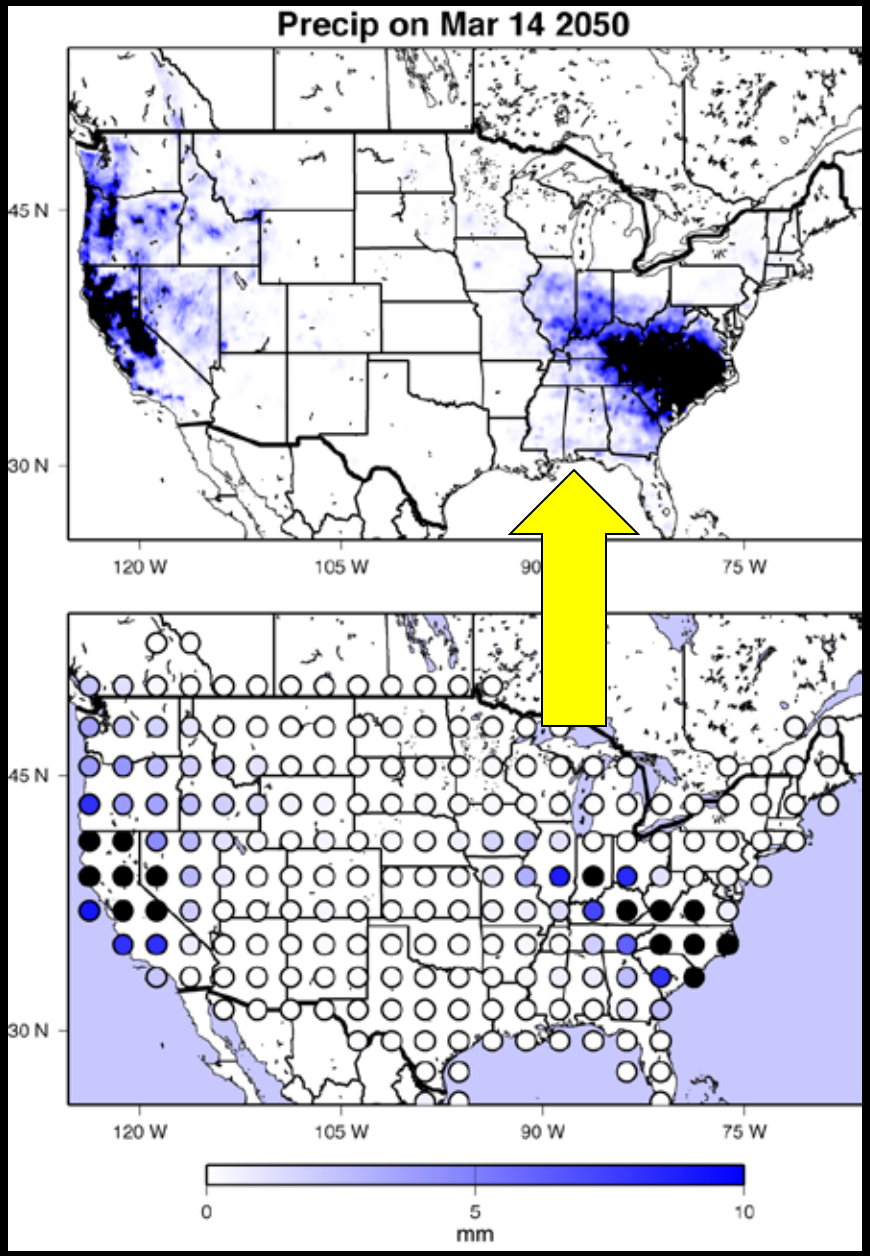
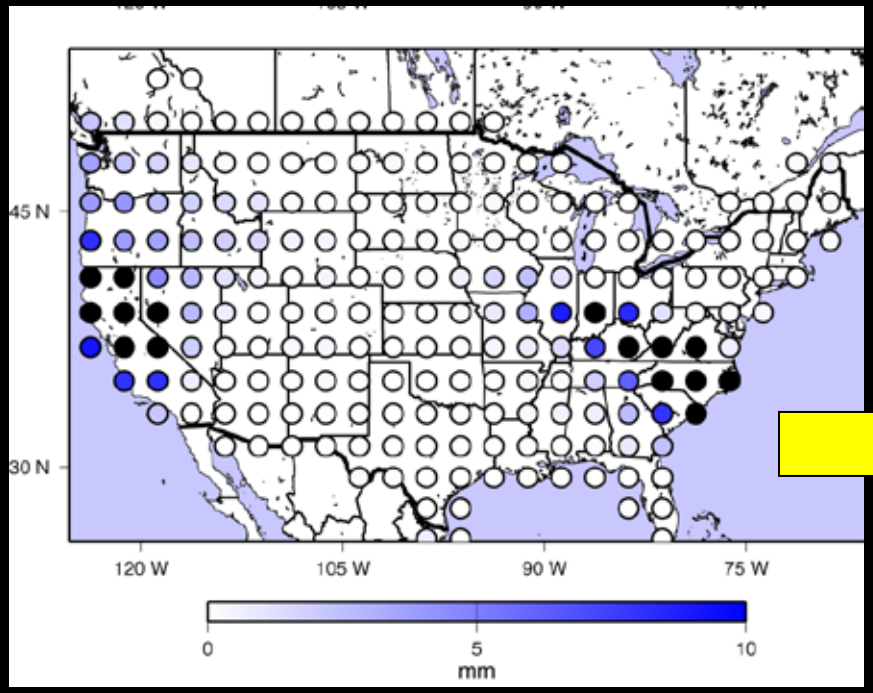
Urban Drainage:
Ideas for Paths Forward

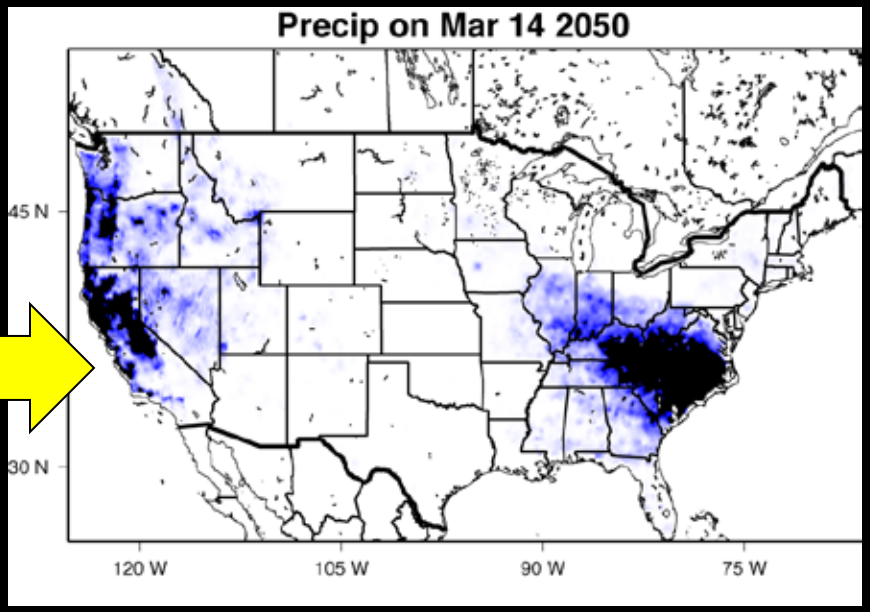
THE DOWNSCALING PROBLEM: One day in the 21st Century...







One day in the 21st Century...



Urban drainage adaptations call for better downscaling *or* understanding of extreme precipitation events.

Special requirements:

- Extremes, not means!
- Long enough realizations to support frequency analysis of rare events
- Adequate representations of extreme-event meteorological processes & results

Urban runoff models want:

High temporal resolution High spatial resolution High precip resolution

1. History-based Vulnerability Analyses

- **Using existing data & stormwater models, map critical vulnerabilities of a city's stormwater management systems**

- **The question to climate analysts becomes "How likely are these breaking points to be reached in available climate-change projections & by common sense?"**

- *Uses most-realistic, highest-res data*
- *"Simply" expands beyond standard design-storm methods*
- *Infinite range of possibilities to be explored?*
- *Minimal connections to specific clim-chg projections*

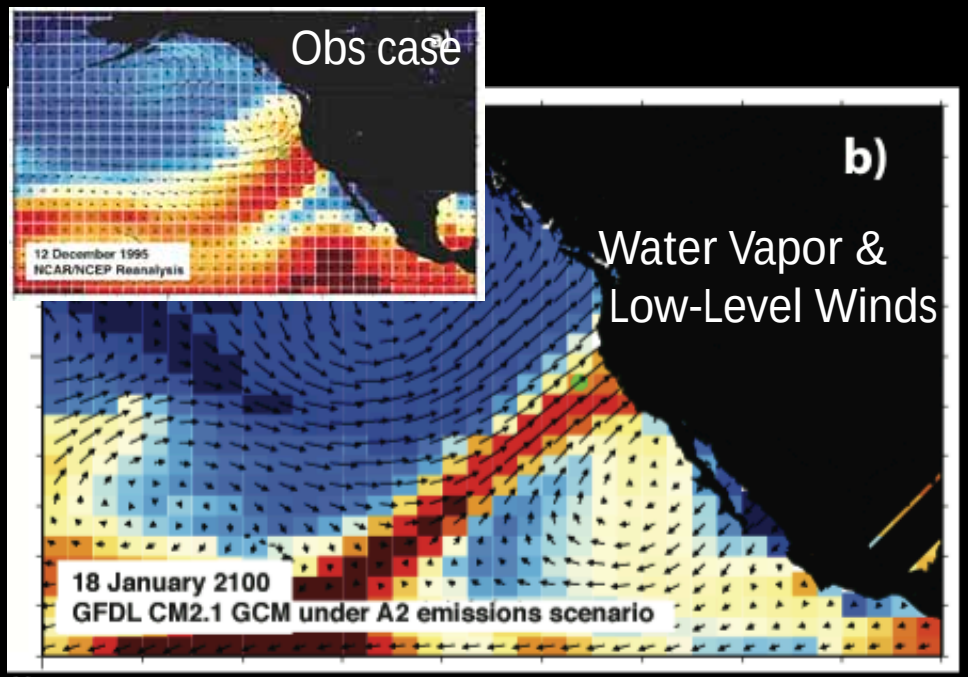
2. Severe-Storm Condition Evaluations

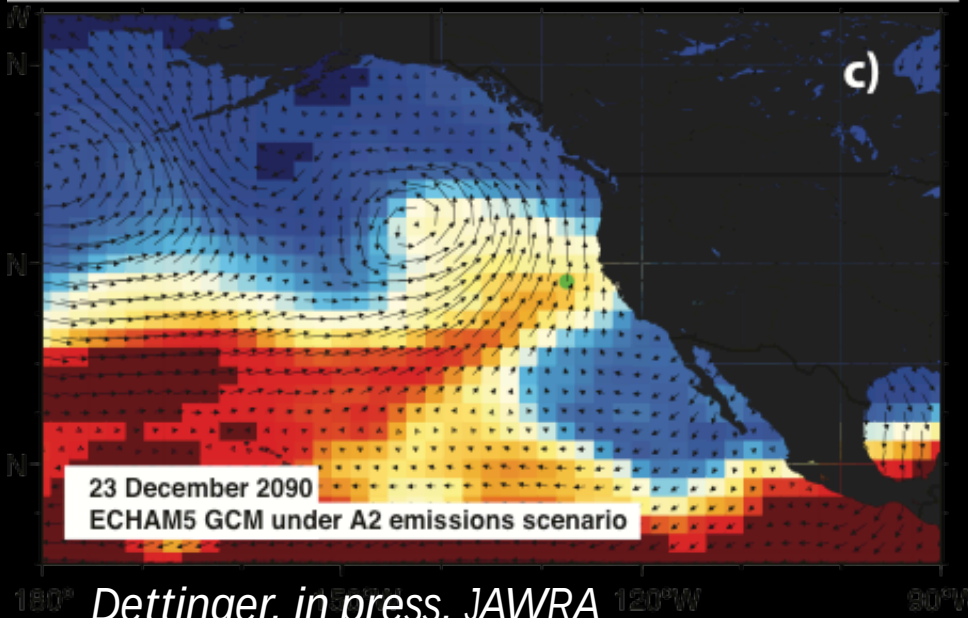
- **Focus on the specific storm types that challenge the stormwater systems most *(describing them in large-scale meteorological terms rather than "just" by intense precip)***

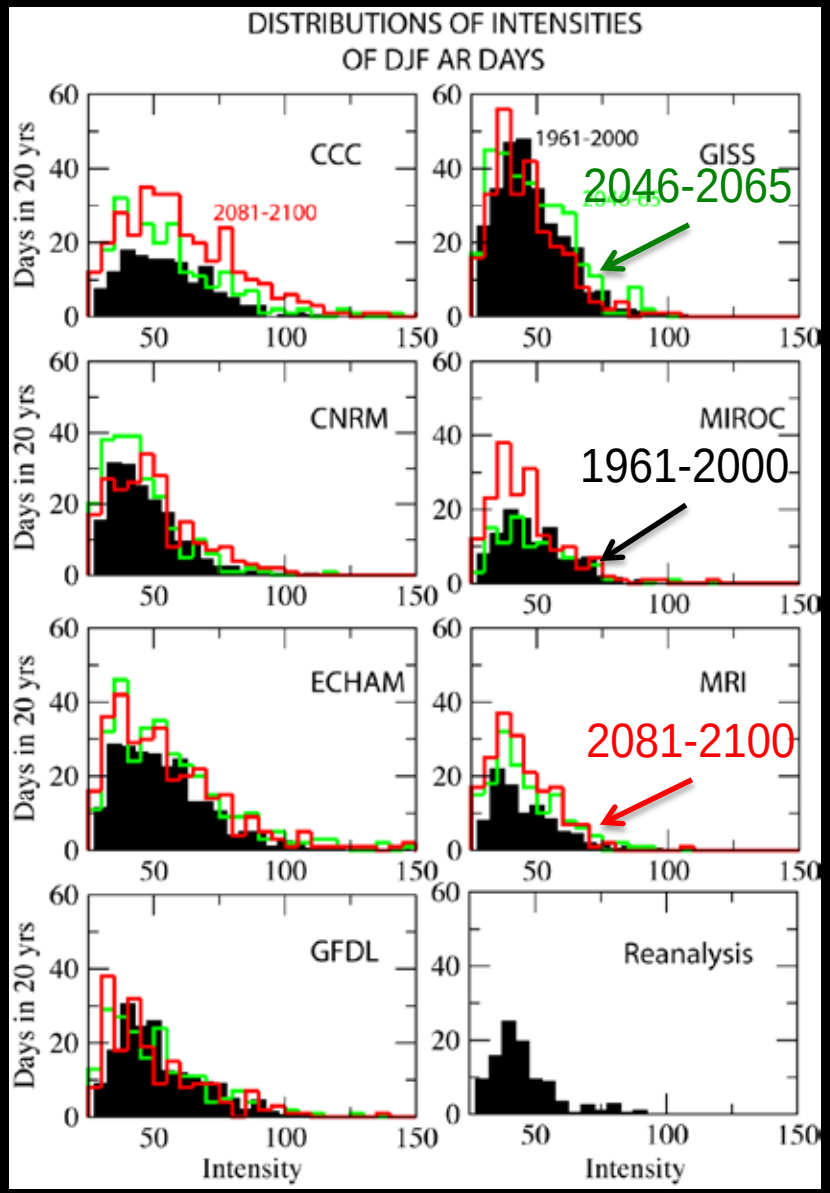
- **The question to climate analysts becomes "What sort of changes are projected in frequency & intensity of these storm types?"**

- *Focuses on best aspects of GCMs (general circulation models)*
- *Natural extension of historical vulnerability analyses*
- *Reduces range of possibilities to be explored*
- *Direct connections to specific clim-chg projections, without undue belief in uncertain details*

"Semi-quantitative characterization" of a particular category of West Coast extreme storm events: Atmospheric Rivers in IPCC AR4 projections







Dettinger, in press, JAWRA

3. High-resolution Simulations and Downscaling

- **Continue along the developing path of "dynamical downscaling," using advances in that field as they emerge**

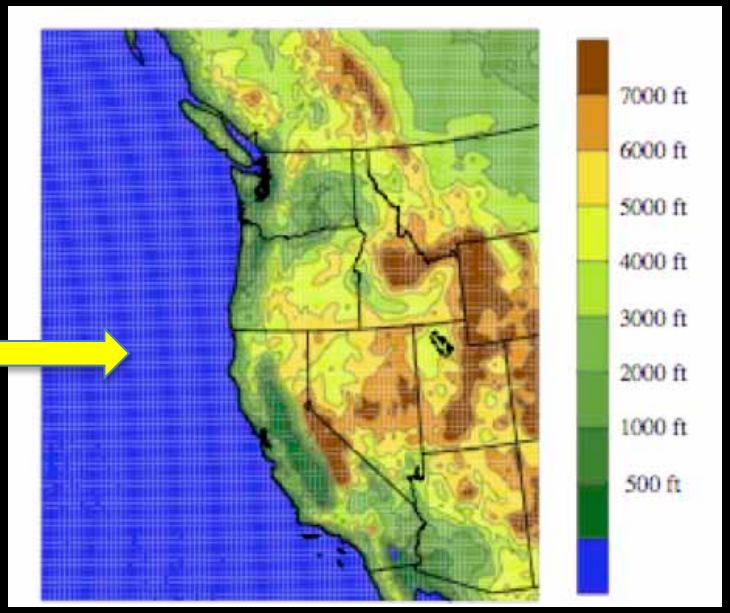
- **The question to climate analysts becomes "What precipitation extremes are projected at finest scales obtainable?"**

- *Provides detailed examples of extremes that might be faced*
- *Support may be necessary to ensure focus on stormwater-info needs (most focus remains on average changes)*
- *Direct connections to specific clim-chg projections*
- *Technology is still developing & expensive*
- *Short simulations provide little basis for freq-analysis of rare extremes*

Other research needs/options:

Massive-ensemble regional downscaling (RegCPDN)

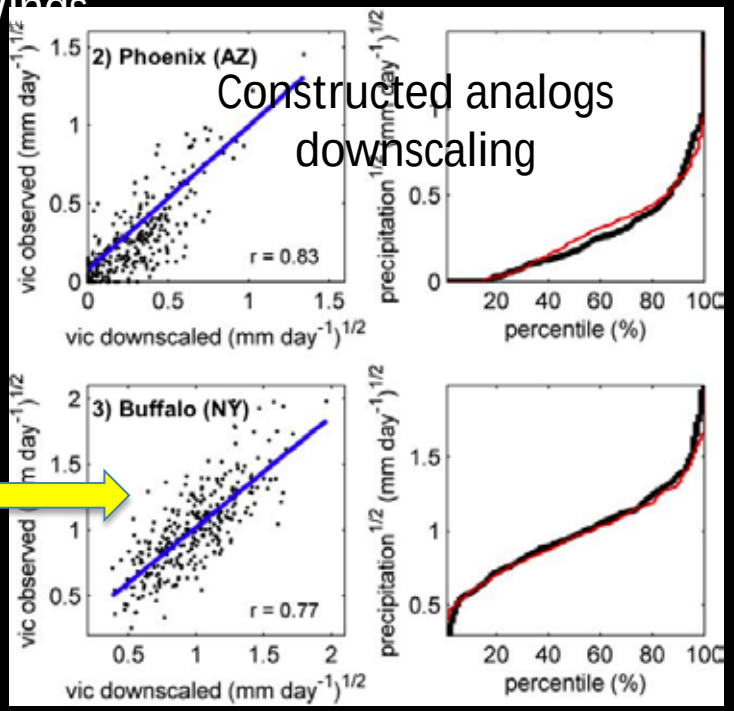
- *Tens of thousands of years of simulations on 25-km grids, outputting (among other things):*
  - à *Maximum daily P each year*
  - à *10-year maximum P within 3 consecutive days*
  - à *Number of days with P > 3 thresholds over 10yr windows*



Water Vapor & Low-Level Winds

Statistical downscaling

- *Many advantages (speed, bias correction, ...)*
- *Revisit/revalidate/redesign(?) statistical dscaling with extreme, rare events as focus*



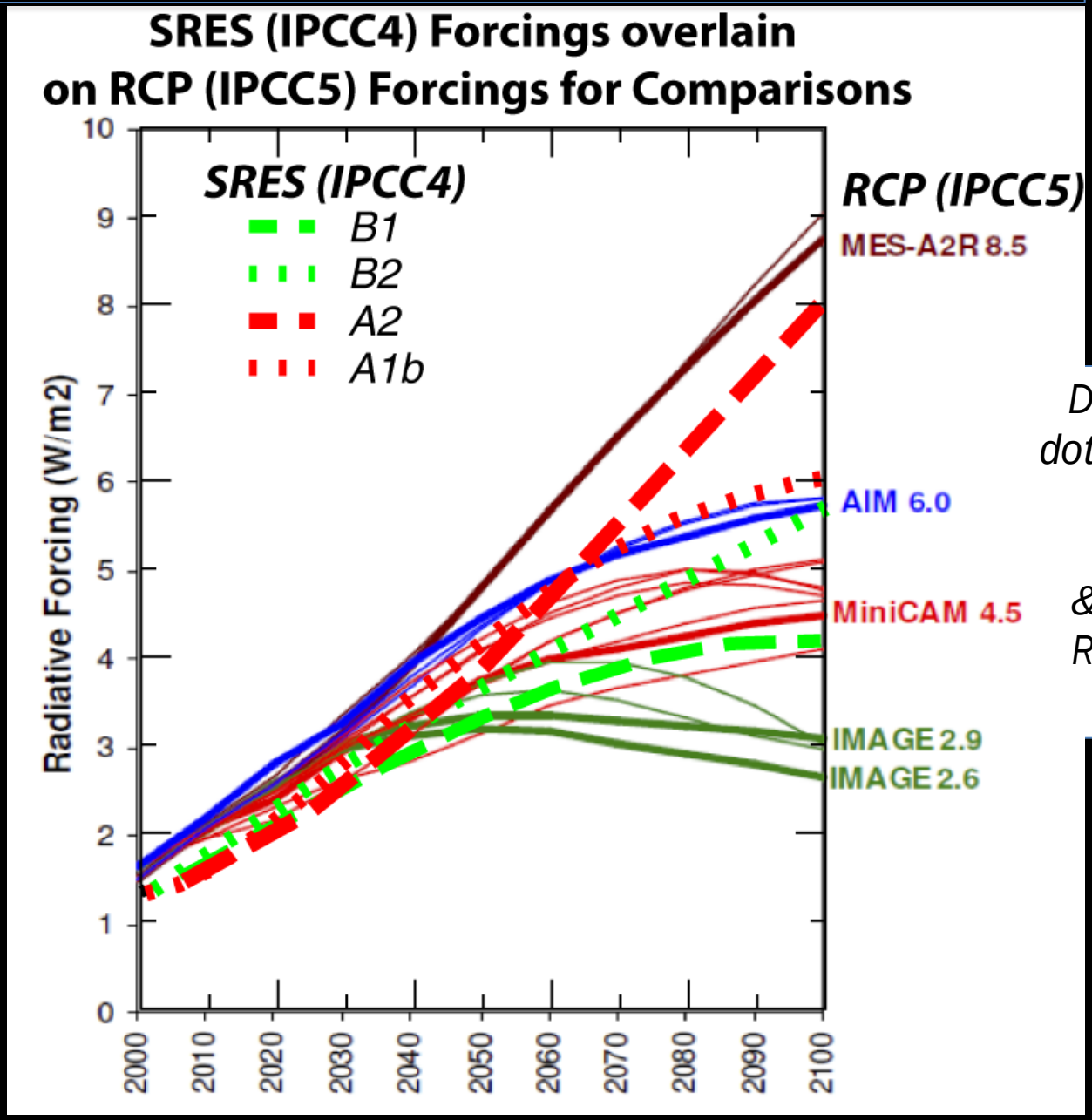
Constructed analogs downscaling

IPCC4 SRES scenarios vs. IPCC AR5 Representative Concentration Pathway (RCP) exemplars

Notice that RCP8.5 is more extreme than A2 and by end of century more like A1Fi (see slide #1)

A1b "approximates" RCP6.0

B1 "approximates" RCP4.5 at this global-aggregated scale.



Dashed and dotted curves are SRES (IPCC4) & solids are RCP (IPCC5) scenarios