California Energy Commission Workshop on Future Climate Scenarios for California

Day 1 (00.06.12)

INTRODUCTION

Opening remarks: Commissioner Robert Laurie

Remarks also by Commissioner Rosenfell - Global Warming is most imptortant issue facing us for rest of our careers

Self-introductions

GUIDO FRANCO
What are goals, needs? Scenarios should be
- physically plausible
- distinguish natural oscillations and greenhouse warming
- adequate time/space resolution
- use robust results as much as possible
- broad range to bracket future
- link potential changes with changes observed so far

CA objectives
- support regional modeling efforts (several models)
- RCMs should be a unifying factor
- CEC Global Climate Chagnge RD&D plan
  : focus on hydroclimate modeling
  : economic impacts from irrigation

TOM WILSON:
For econ. futures planning, year: 2020 is distant to economists.
Issues:
1. Want scenarios for impacts
2. Where should R&D funds go?

JOEL SMITH
Baseline scenarios are needed for changes outside climate change in pop., GNP, technology, institutions

Cl. change
↓
bio impacts
↓
Social/econ. impacts
↓
adaptation
↓

vulnerability purposeful adaptations

Scenarios need to communicate uncertainties
- define plausible range of change for key variables (must identify these)
- want workshop to ID ~ _ doz. scenarios of change
- give vulnerability of system

time frames: 2020, 2060, 2100
sources: GCMs
RCMs
Incremental Scenarios (specified-delta changes)
Soc/econ scenarios will use low and high assumptions
Eg. Pop. growth = present rate, or
= stabilizes @ 2030

WHAT ARE NEEDS FOR IMPACTS?

<u>JOHN DRACUP</u> – hydrology

Hydrology needed for health (see Lund model of management)
Hydrology subject to human (impaired, controled) streams
- need to work with unimpaired streams (~ 40 used in CA research)

1. Modify streamflow w/clim. change
Options (a) take stochastic model and change means/variances based on scenarios
(b) rainfall/runoff model to simulate
- what sp/temp. resolutions needed?

<u>Data needs</u>
1. Need *30 km* to get climate changes with orography
2. Data: USGS – mean *daily* obs. most easily avail.
Thus, Daily @ 30 km for stream flow (output target)

2. Groundwater
- not much in literature
- how will its temperature change? May not be impt.

Q: Chuck – rain vs. snow changes? A: Expect snow period. ↓

Irrigation: ~ 80% of CA water drawn is for ag.
Lund: Ground Water is impt. (~ 30- - 40% CA water use is from GW, more during drought)
Cayan: critical aspect is floods. Tied to rain vs snow & heavy floods appear greater in recent decades.
Dracup: how does CCh. on hydrology compare with historical high, low, normal periods?
Gleick: system operation also important.

Dracup: historical hydrology record is short - < 100 yr.

JAY LUND:
water management model: CALVIN
- econ-engineering optimization model
- maximize state econ. benefit looking @ urban, ag, etc. needs.

1. Entire CA water system
2. Sf & groundwater systems
3. Econ optimization
4. prescribes monthly operations

Not in yet: flood control, hydropower scenario

For future scenario take base run and modify
Do not run anew on its own
Input: Monthly t.s. of runoff and groundwater

Future changes in condition: new/old dams, other control structures

RICHARD HOWITT:
Also on CALVIN
Ag gets 80% of current water
Model works on "trade-off" contour to help determine econ. optimization
Ag (plant) water requirements can change w/climate
Urban demands included

Input Needs: Prec, T, CO_2, O_3 (or some measure of air quality) monthly, for 25 regions in CA

RON NEILSON:
Primary tool is -
MAPS – Century version 1 (MC1)
Resolution 4-50 km (but run for independent, nin-interacting points)
Δt = daily – monthly
part of VEMAP models group

Input Needs:
MAPS: monthly long-term ave..
but MC1 needs time series (monthly, daily)
$T_{min,max}$

Prec	Soil depth
Mean humidity	density
Mean wind speed	texture
Mean radiation	elevation
	Latitude

VEMAP
1885 – 1993 obs. climatology @ 0.5 deg. From obs.

10-km clim. For US, used to downscale monthly 0.5 deg. to 10 km grid

MC1 and one other VEMAP model (LPJ) include dynamic fire and dynamic vegetation model

(Should ask RN – VEMAP height adjust for P?
- how handle data voids? For Tmin/max?)

MAPSS run w/various scenarios all show increased veg. density in CA
MC1 also showing increase in fire across west (higher fuel loads)
Tendency for veg.stress area increase as T↑
Hadley & CCC model both give increase in Palmer Drought SI in both CA & corn belt (w/no concurrence elsewhere).

MARLYN SHELTON
Current CA climate
1. What determines it?
2. Data sources?
3. Trends?

Determinants
1. Driver: radiation balance
CA covers ~ 10^o latitude → 15% change in radiant energy across state
2. Subtropical high southwest of CA also influences
3. Adjacent to Pacific Ocean
4. Westerly flow
5. Orography w/mtns. perpendicular to prevail. winds.

Sources: USHCN – 54 coop stations (20W/precip)
West. Reg. Clim. Center – 184 stations, daily
CA Data Exchange Center
– 500 stations
- monthly snow depth & water content
NCEP/NCAR Rean.

Redding, CA 1875 – 1994: downward T trend (north end of central valley) but other examples showing upward trend
Tendency for T_{min} to increase more than T_{max}
Precip. does not show much of a trend

Regarding SLP jump on 1976-77 (Trenberth work): See that SWE amounts lower after jump.
Important questions how will storm tacks change?
Do GCMs reproduce observed variability?

DAN CAYAN

natural variability

Cycles: PDO (20-40 yr) → has ENSO-like spatial structure
ENSO (2-7 yr.)

PDO – no strong consensus on a PDO proxy to apply to paleoclimate.

Review of ENSO circulation storm track changes

precip. correlations – high @ ±30%/at and opposite in tropics.

scenarios must have credence in a global system, not be isolated points

e.g.: El Nino → Pacific storms progress into CA
LA Nina - Pacific storms do not
Short term extremes: more extremes of precip.and stream flow in southwest during El Nino; more extremes in NW during LaNina

Issues examined:

- fraction of Apr – June runoff vs entire year
- wind speed & dir. distributions in El Nino vs. climo.
- seasonal T trends 1950-1997 in GHCN 25° set
- spring onset: - Lilac bloom
  - snowmelt runoff pulse both show correspondence w/T changes
- relation of mold & mosquitoes to wet periods

measure of climate change beyond winter changes are important

TOM WIGLEY

How good are GCMs? Looking at

- mag. & pattern of means
- mag. & pattern of variability
- relationships among variables:
  - are mechanism done correctly?
  - correct mechanisms for observed behavior?

TW has over 20 GCM's datasets on hrs PC (mainly monthly data)

1. Pattern correlation for monthly P over globe, each month of year, then averaged
   correlations range from 0.55 – 0.76
   not much trend in correl. as models get newer but Had CM does get better w/time.

2. Global Δ Precip. Vs 1°C of warming
   ~ 3% per 1°C in early models tied perhaps to cloud params.
   ~ 1% per. 1°C more recent models
   Cayon: done for separate regions? (not yet-TW)

3, Performance of 21 GCMs over west Coast (CA & OR) and western US
ΔP as % change per 1°C mean global warming (CA, Dec-Jan-Feb.)
range of –10..7% to + 55.9% (CCC model the highest)
(average = +7.6%, sdev = 13.4%)
Had CM: + 25.40%
The two models in US assessment give bigger changes than all the others

4. Pattern of change for western US (30-50 N 100-125W)
Highest model – model correlations are HadCM & CCC (*Thus, US Nat. Assess. did not sample full range of behavior*.)

5. Correl. each model w/overall models' average UK, CCC, CSIRO correl. well w/overall average.

6. Prob. of increased P (sampling among all models) in CA ~ 70%

7. S.CA vs N.CA DJF precip., 1900-1998
High interannual variability (~5-10:1 for wet vs. dry extremes)
High interdecadal variability (~ 2:1 for wet vs. dry)

WIGLEY on work by WILBY & DETTINGER
Statistical downscaling in Sierra Nevada w/projections to future
Issue: How does one choose predictor variables?
Predicting daily runoff for 3 basins in CA
1. SDS to get daily P, T_{min}, T_{max}
2. PRMS for hydro simulation

Predictors (a) 500 hpa
(b) wind speed
(c) ?? (humidity variable)

Both CCC & UKMO have large ΔPrecip in future scenario for CA in ΔJF
Basins: American
Carson
Merceed
Different regression param. for each month
Compare: obs. streamflow, PRMS driven by obs., and PRMS w/SDS using reanalysis
Flow in PRMS w/obs: correlation, r = 0.94 vs obs. flow
Flow in PRMS w/SDS: r = 0.82 vs obs. flow

SDS of HadCM: large winter Prec. increase
T_{max} & T_{min} increase, T_{min} more so
Snowpack changes (increase) in Carson & Merced
No change in American
Discharge increase in Dec – Feb w/large Apr. increase also in Merced

R Neilson - need to couple in veg. Changes when looking @ hydrological changes

CHUCK HAKKARINEN:

IPCC Ch. 13 - Methods for Developing Scenarios (but no scenarios)

Criteria for scenario suitability
- consistent w/global proj.
- phys. plausible & realism
- "appropriate" for impact assessment
- representative potential range of future cl. Ch.
- easily accessible

NORM MILLER

A. Clim. Change & Am./Russian Rivers

8 yr. Sim @ 36 km for western US
obs. precip. – in basins: where are gages located?
SDS to understand range of uncertainty in predictability

Issue: How good is monsoon signal in HadCM & RCMs?

What makes a useful scenario?

What is optimal sp/temp. resolution?

& length of sim
of models

Variables: guided by VEMAP

T_{min}	mean wind
T_{max}	mean radiation
Precip.	(total, PAR, etc)
Mean humidity	CO_2

CA goal = 2030, 2060----

T.W. - Cannot use full transient run want to make snapshots out of specific points.

R.N. – using CCC transients important for veg. changes

R.D. - transient simulation poses problems in that you don't have stat. steady state.
Opens up possibility for wider range of variations in scenario.

T.W. - CA poses big issue of signal/note because interannual variability is so large

LISA SLOAN

recent past & paleoclimate changes

RCM CA clim/hydro regimes in response to Global Warming
Res. currently: 50 km
Goal; 15 km
Using Reg CM2
West Coast domain
W/climo SSTs & CCM output

Somehow doing 1968 (La Nina) & 1988 (El Nino) - 1 year sim.

In the context of the BC supplied

Issues: what domain to use?

How small can you get info out (single grd scale?)
Comparison of 68-88 differences

Plan: present, Holocene & future
Calibrate w/respect to current & past climate
Will derive offline local studies also running global paleo models

DAN CAYAN
Wx & climate forecasts for CA by California Applications Program (CAP)
Developing forecasts for interested users in CA region
(web: search for Calif. App. Program)
Why agencies don't use forecasts
- don't trust
- not user specific
- don't know how to interpret (Dettinger & Pulwarthy BAMS 1997)

NORM MILLER
LBL group working with Scripps & group in Tucson
Work with Queensland, Australia
RCMs: MAS + Sacramento hydrol. Model
Landslide prediction
Isotopes in model for sources/sinks of water
Tucson: NSF STC

Discussion
1. Accessibility of scenarios
R.N. – fairly elaborate process to feed in model output directly
- alternative: take Δ between control of scenario now very elaborate process

2. Δ's vs direct input
3. Time scales of variability changes that one can expect to get indication on.

Output desired

Immediate use

Sector:	Veg	Ag	Hydrol	Energy
T_{min}	x	x	x	x
T_{max}	x	x	x	x
P	x	x	x	x
Humidity	x			
Wind	x			
Radiation	x		x	
CO_2	x	x		

Would like to work toward these or use as diagnostics:
Cloudiness Fog info
Lightning info PET
Soil moisture

	Veg.	Ag	Hydrol	Energy
Spatial Res.	10 km (desired)	26 regions	30 km (desired)	county level
Temporal Res.	daily (hourly use-ful but not essential	daily	daily (6 hrly used by river fest. center)	monthly
Length	will take what can get			

RN: For length, 3 classes: 1 monthly climatology'
2. full time series – eco/veg need 100 years
3. Use temporally dynamic model for shorter pd. To get behavior (e.g., hydro model)

TOM WILSON

Some discussion on incremental (specified Δ) changes, mainly on humidity: use RH const.

Q(a) reasonably wide range of scenarios?
- use T.W's set of GCMs to bracket?

R.N. – VEMAP wanted more models for scenarios (e.g., CCM, GFDL, …). CEC get them to do it?

Discussion of using GCMs to guide incremental change scenarios
- use to help ID thresholds in impacts system
- uses TW's Δ/1^{o}C, 2^{o}C, etc.
- want dynamic model results from those? Perhaps by feeding in ΔT (time)

Plan:
2 GCMs - Hadley & GFDL (as a "dry" representative)
increments: 3 variants out: + 1.5^{o}C, + 2.5, +5
2 variants on precip. 0%, 5% increase per ^{o}C