ICTP update

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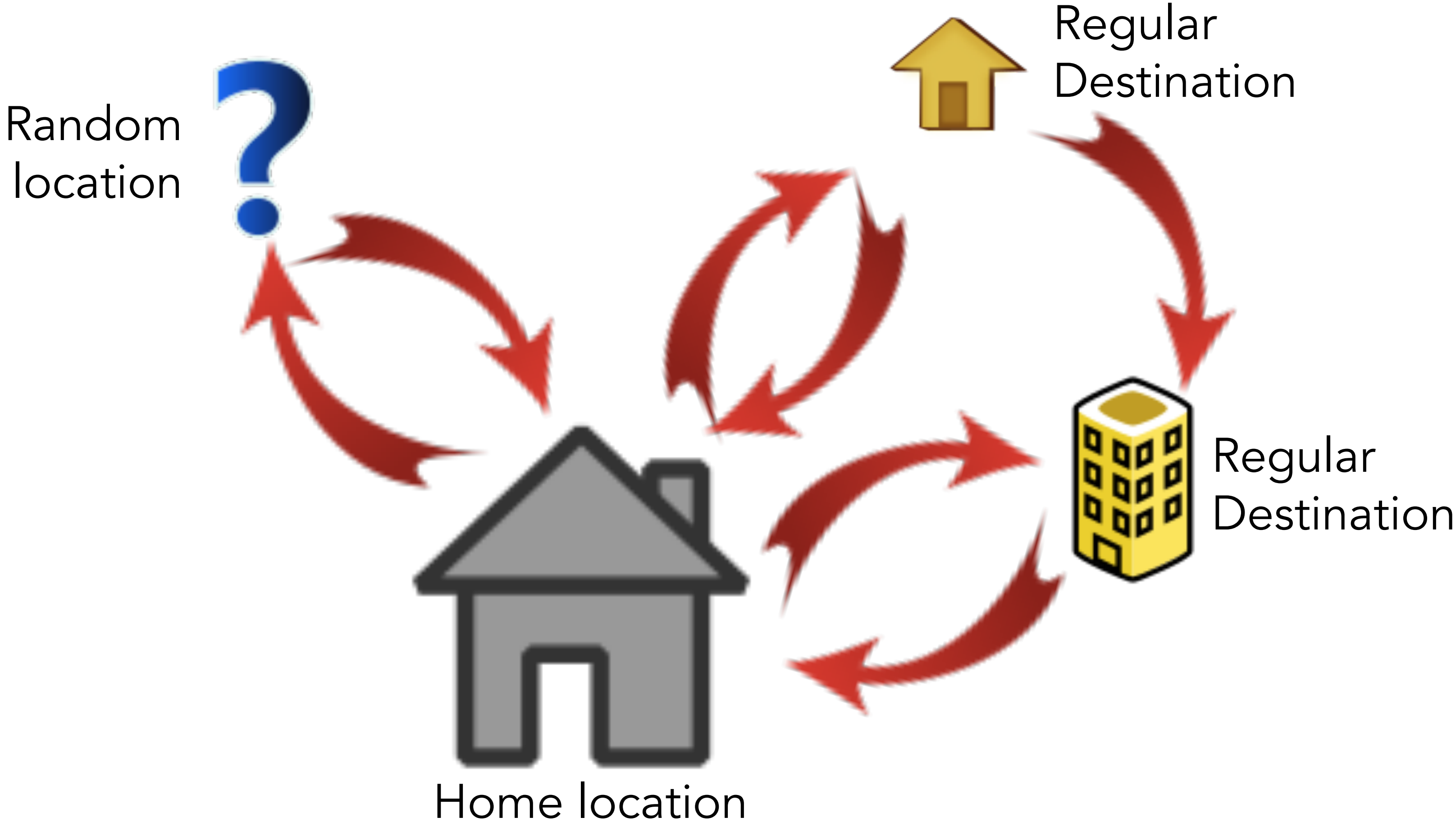
HEALTHY FUTURES

- Finished at the end of 2014
- Special Issue released in Geospatial health in 2016
- Papers:
  - Historical malaria in Uganda
  - Migration in Uganda using 150000 phone records
  - Land use impact on malaria in Eastern Africa
  - New systems for forecast dissemination

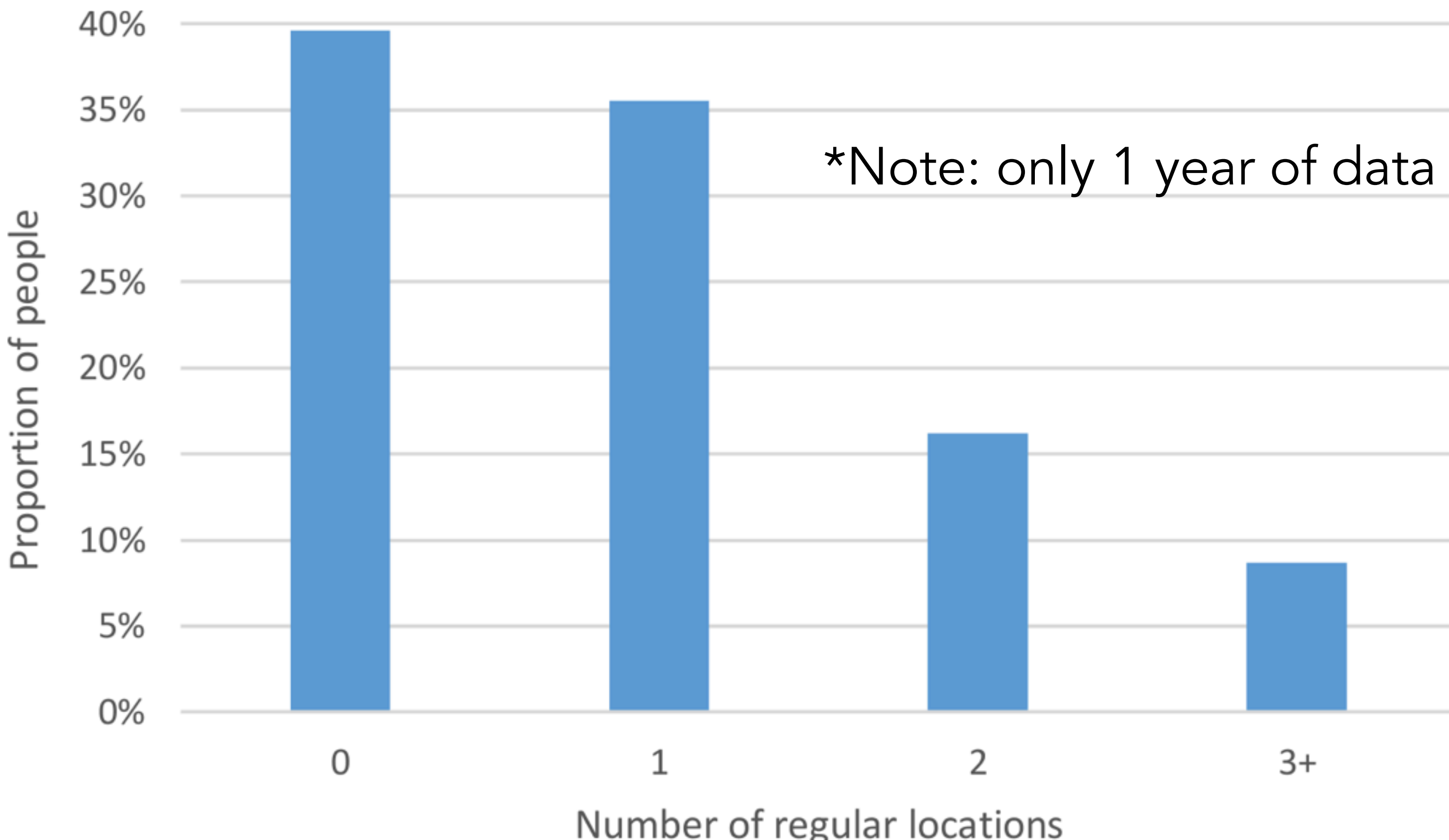
Migration analysis basis



Identify home location, regular destinations and probabilities of a journey

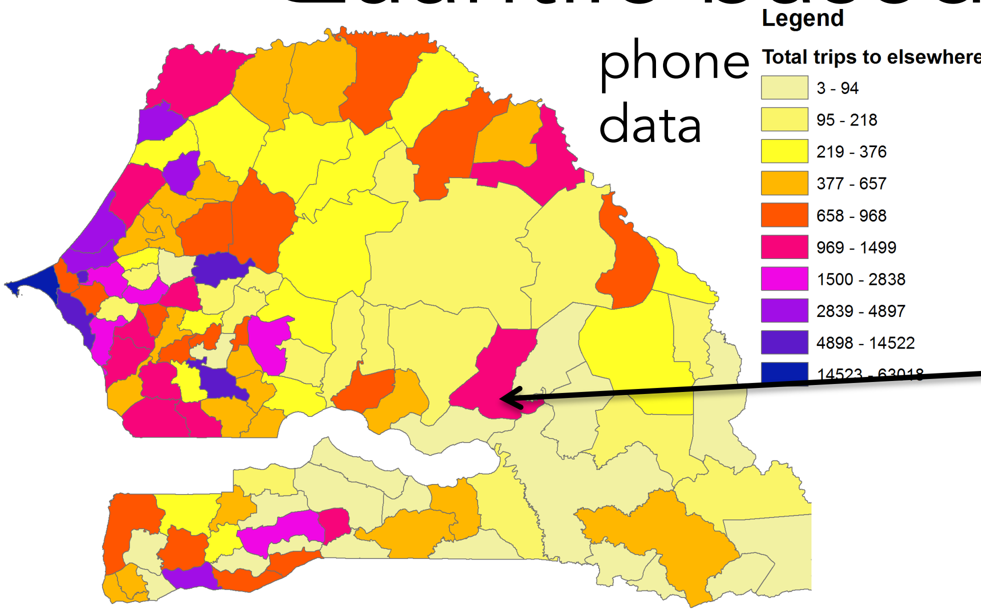
Number of regular destinations

- 60% of people regularly move to 1 or more regular destinations
- <10% have 3 or more regular destinations*



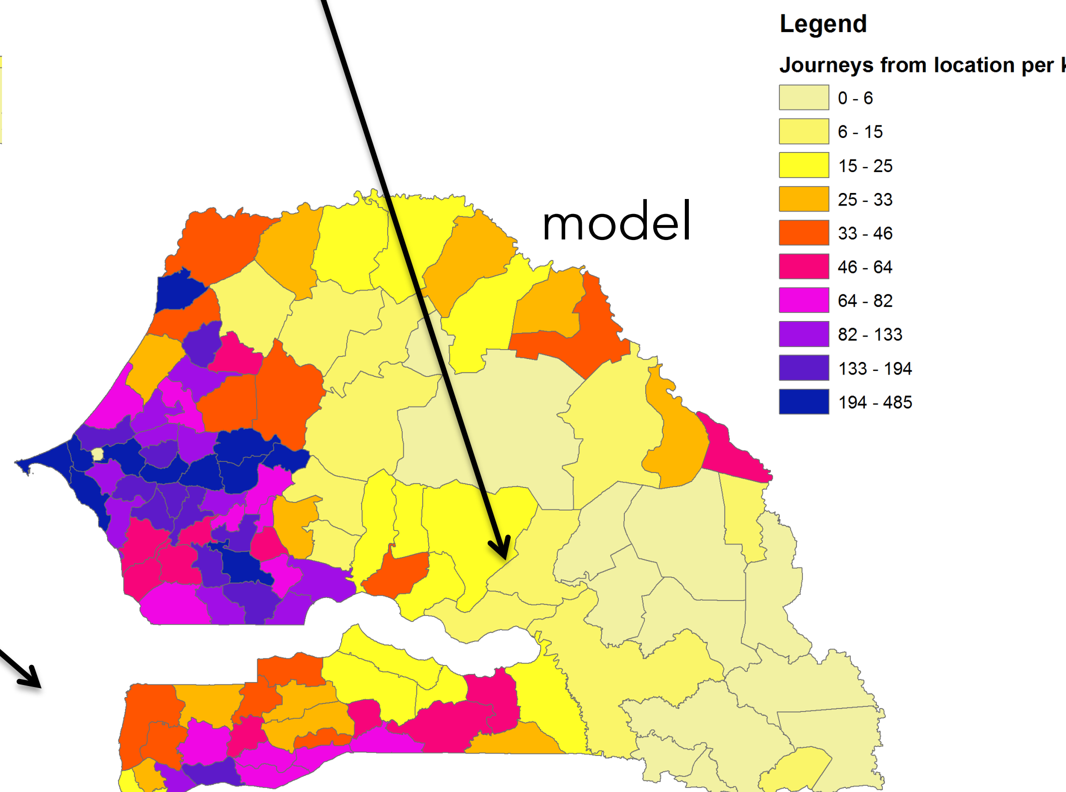
Quantile based comparison

phone data



Tambacounda
Need to sub-sample distance probabilities as a function of population density

model



Movement to/from Casamance overestimated – need for resistance maps to account for journey difficulty

Contributions to the WMO-WHO joint publication in 2016

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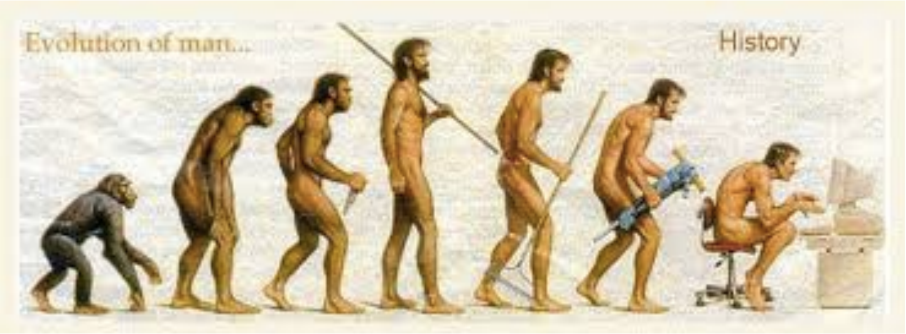
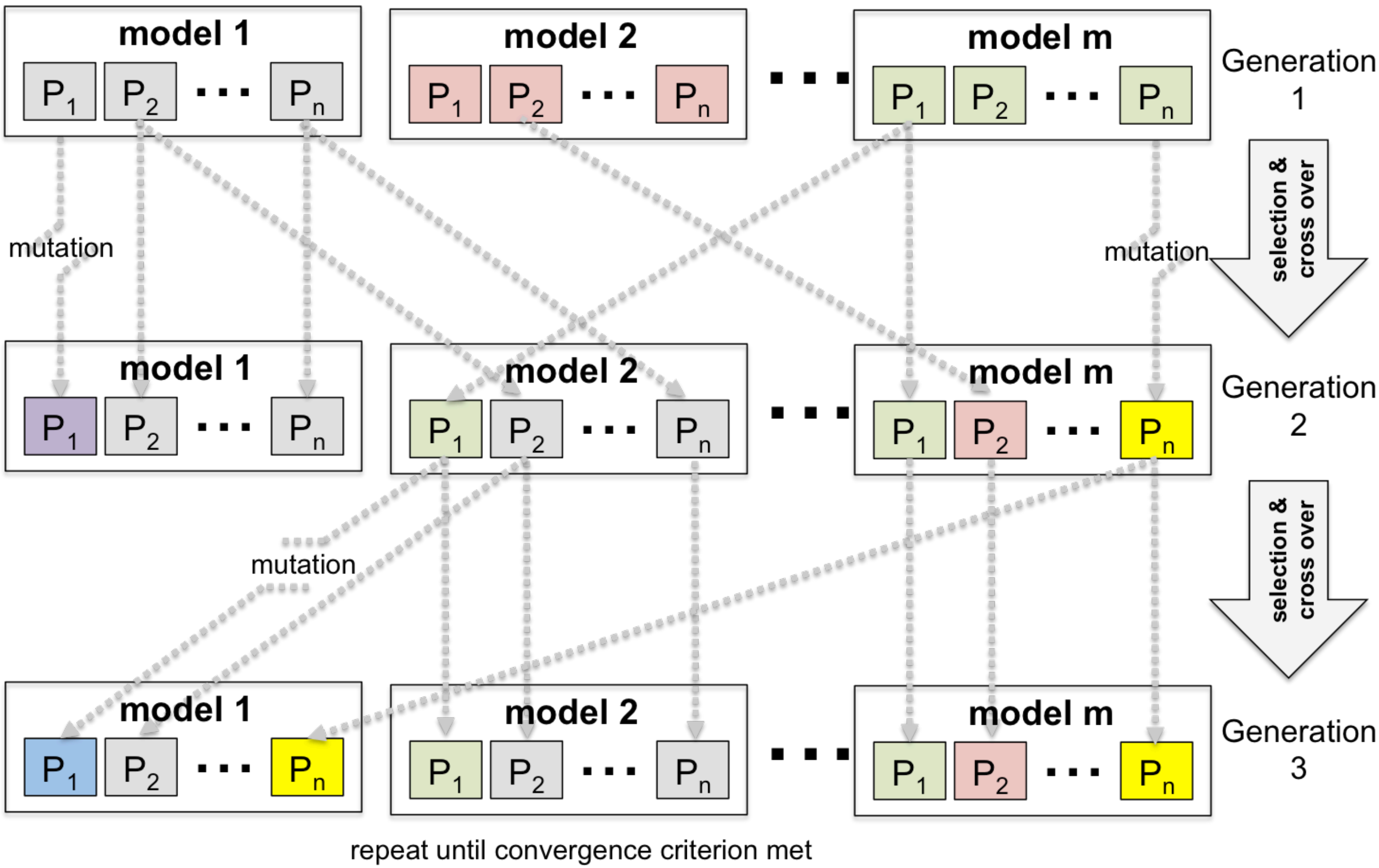
(Soft) Constraint Genetic Algorithm for Ensemble Prediction Model Parameter Setting



- ❑ Genetic algorithms used for a large variety of problems
- ❑ Can be used for model parameter calibration - "tuning"
- ❑ Advantages:
  - Simple, no adjoint required
  - Framework suited to existing ensemble approaches
  - Can handle highly nonlinear, discontinuous problems



- Method based on evolution:
  - Ensemble of models with different parameter settings
  - Metric for their fitness determines their ability to pass parameters to child generation
  - mutation of parameters to search parameter space

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Basic GA approach applied to Lorenz System

- 51 ensemble members
- Tested with the Lorenz system
- Perfect initial conditions
- Mutation rate and probability decays in time for efficient search at outset

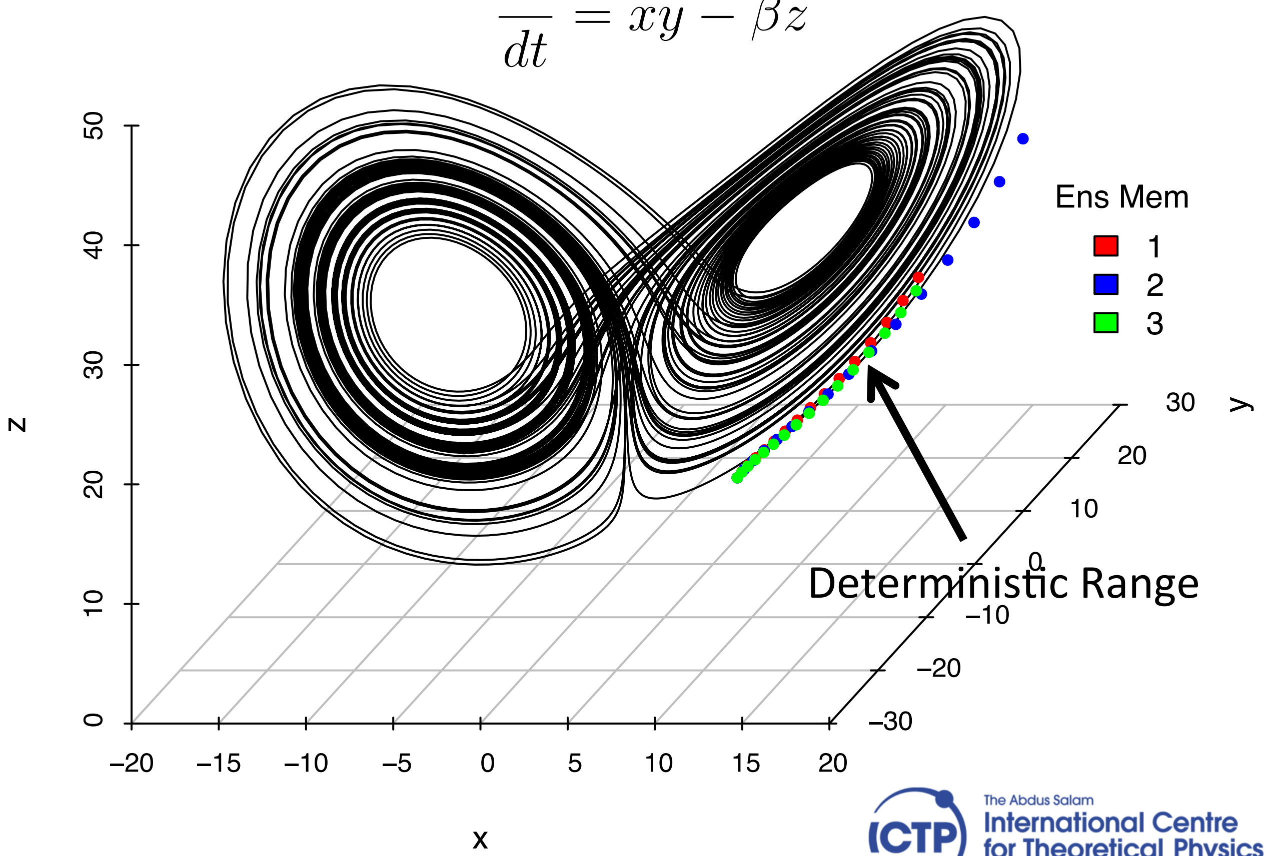
$$\mathcal{L} = \eta F(RMSE)$$

normalization factor

$$\frac{dx}{dt} = \alpha(y - x)$$

$$\frac{dy}{dt} = x(c - z) - y$$

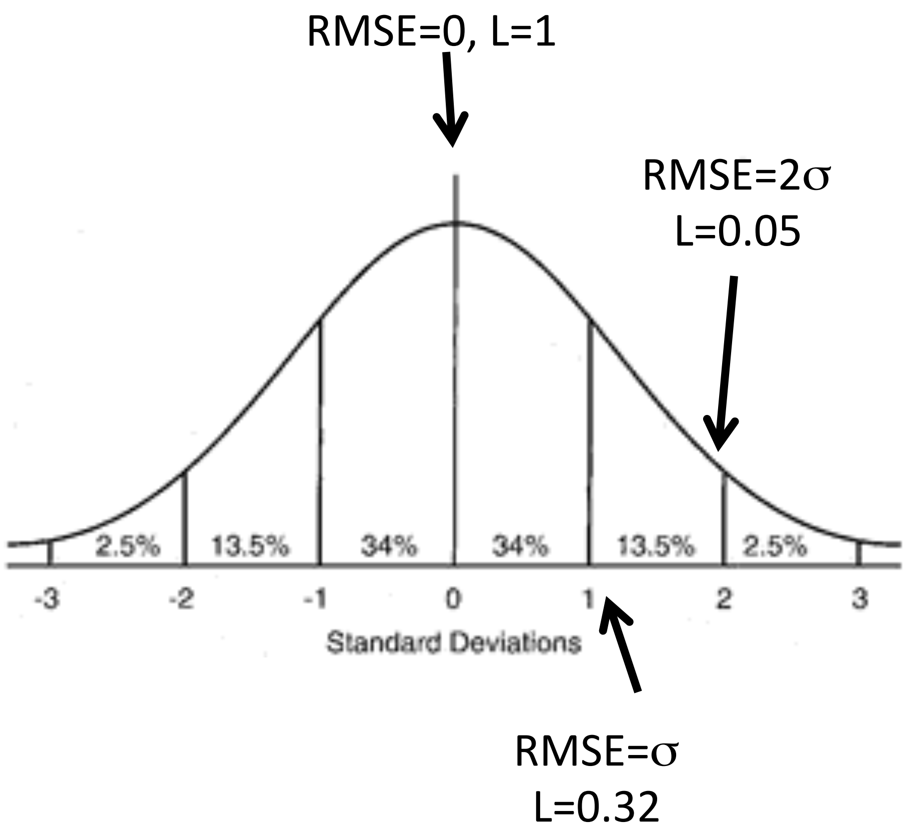
$$\frac{dz}{dt} = xy - \beta z$$



Likelihood functional form

(defines the probability of a model becoming a parent)

- Could be based on r^2 or RMSE
- To minimize RMSE (equivalent to minimizing log-likelihood for a Gaussian variable) a sharp function such as L~1/RMSE produces a precise solution.
- But… preferable to account for observational uncertainty
- Assume observational errors are Gaussian in nature (usually possible to perform a variable transformation)
- Allows multiple metrics to be easily combined
- Produces "flat" penalty function once RMSE is within observational error.



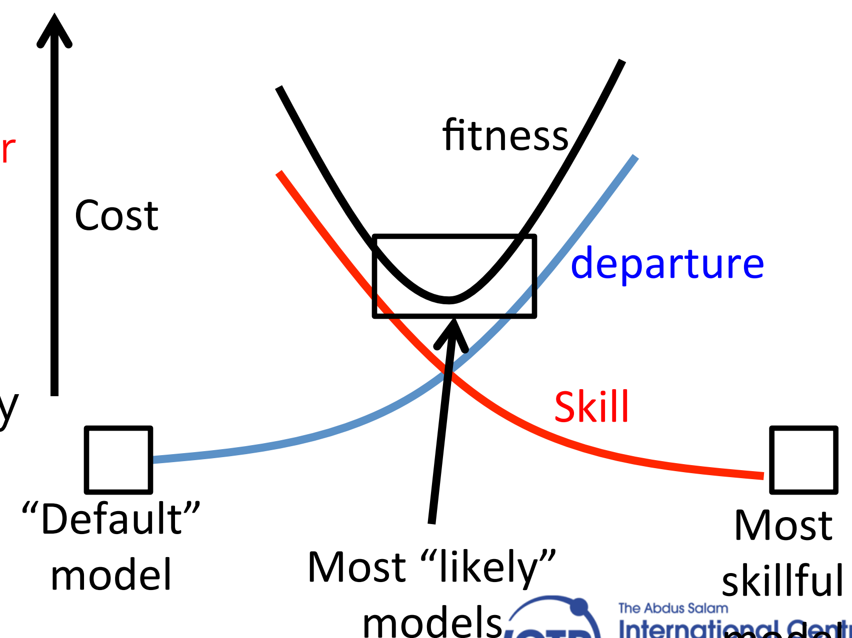
Application to NWP: A soft constraint

- GA has been applied to a wide range of problems
- in theory perfectly suited to a NWP EPS framework
- However, the dimensionality of the problem is very high in NWP
- Introduce concept of soft constraint, penalty for departures of parameters around their default values (cf. 4DVAR)
- Advantages:
  - Reduction of dimensionality (search essential in a N-sphere)
  - Allow the uncertainty of each parameter to be accounted for, preventing unreasonable parameter settings
- Not the optimum system in terms of skill but best compromise solution within the realm of assessed uncertainty (flat cost minimum).

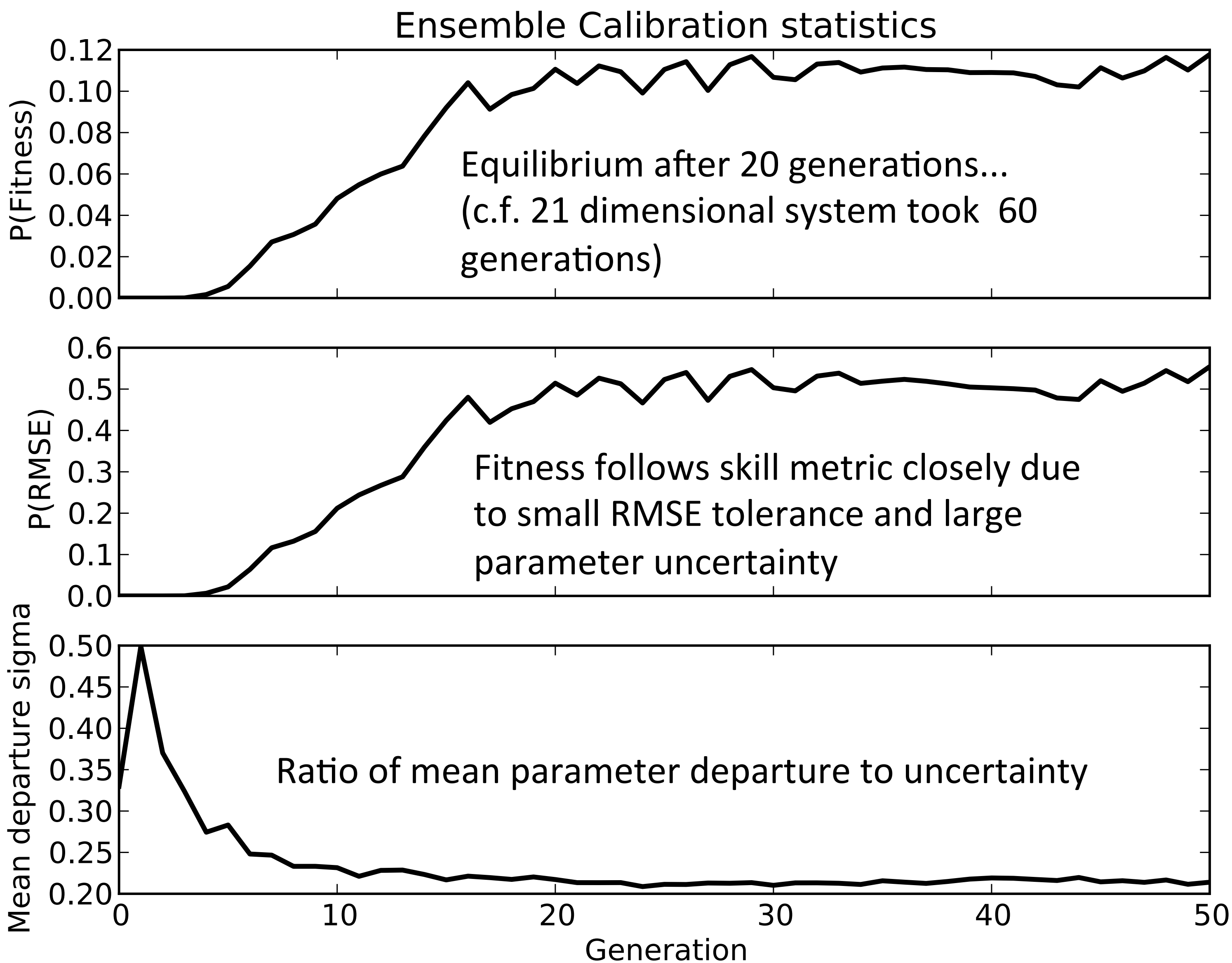
$$\mathcal{L} = \eta \underbrace{P(C_s)}_{skill} \underbrace{\prod_{i=1}^{n} P(K_i)}_{constraint}$$

Assume parameters are Gaussian

$$K_i \sim \mathcal{N}(K_{i0}, K_{i,\sigma}^2)$$



Fitness function – with strict skill



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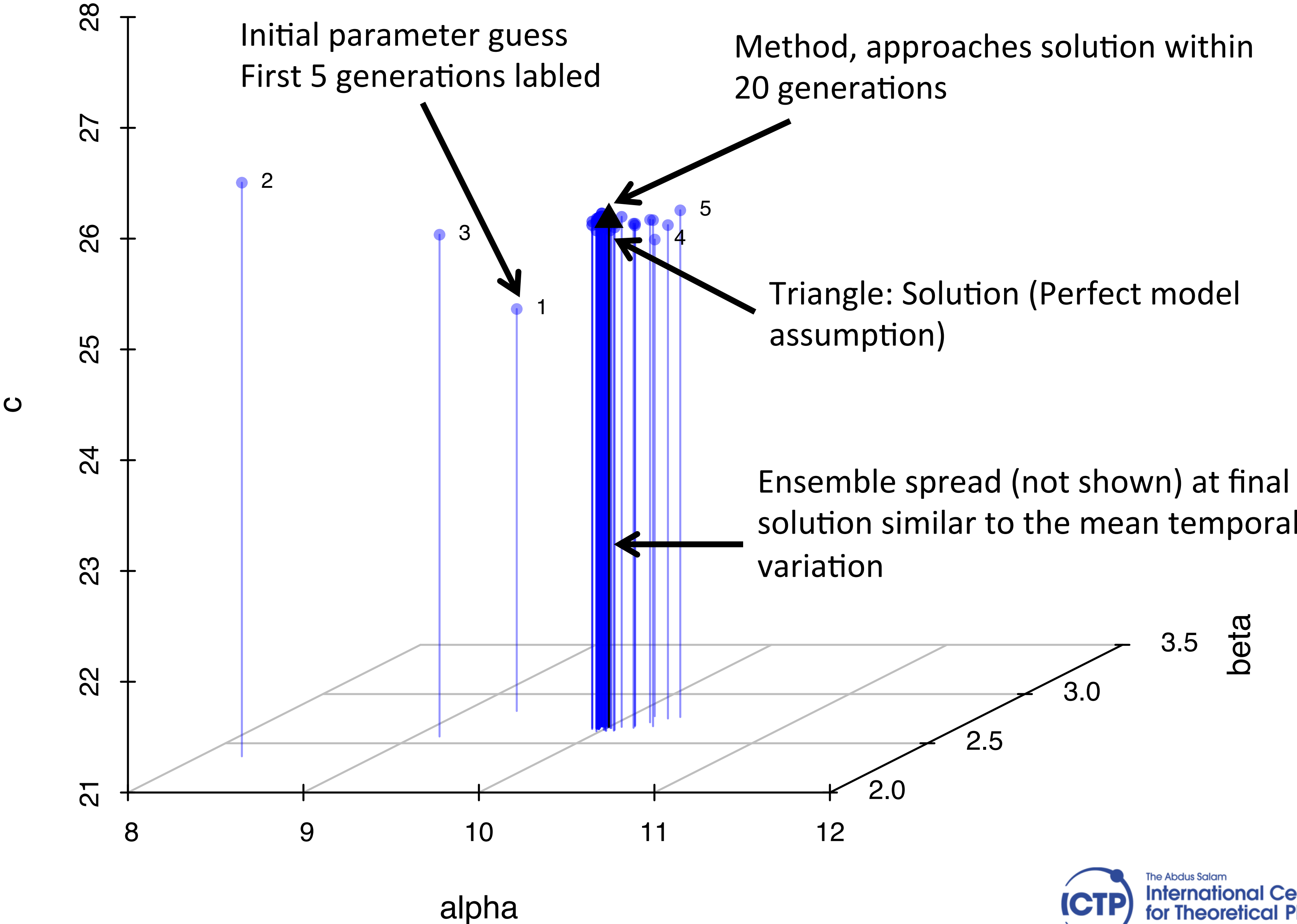
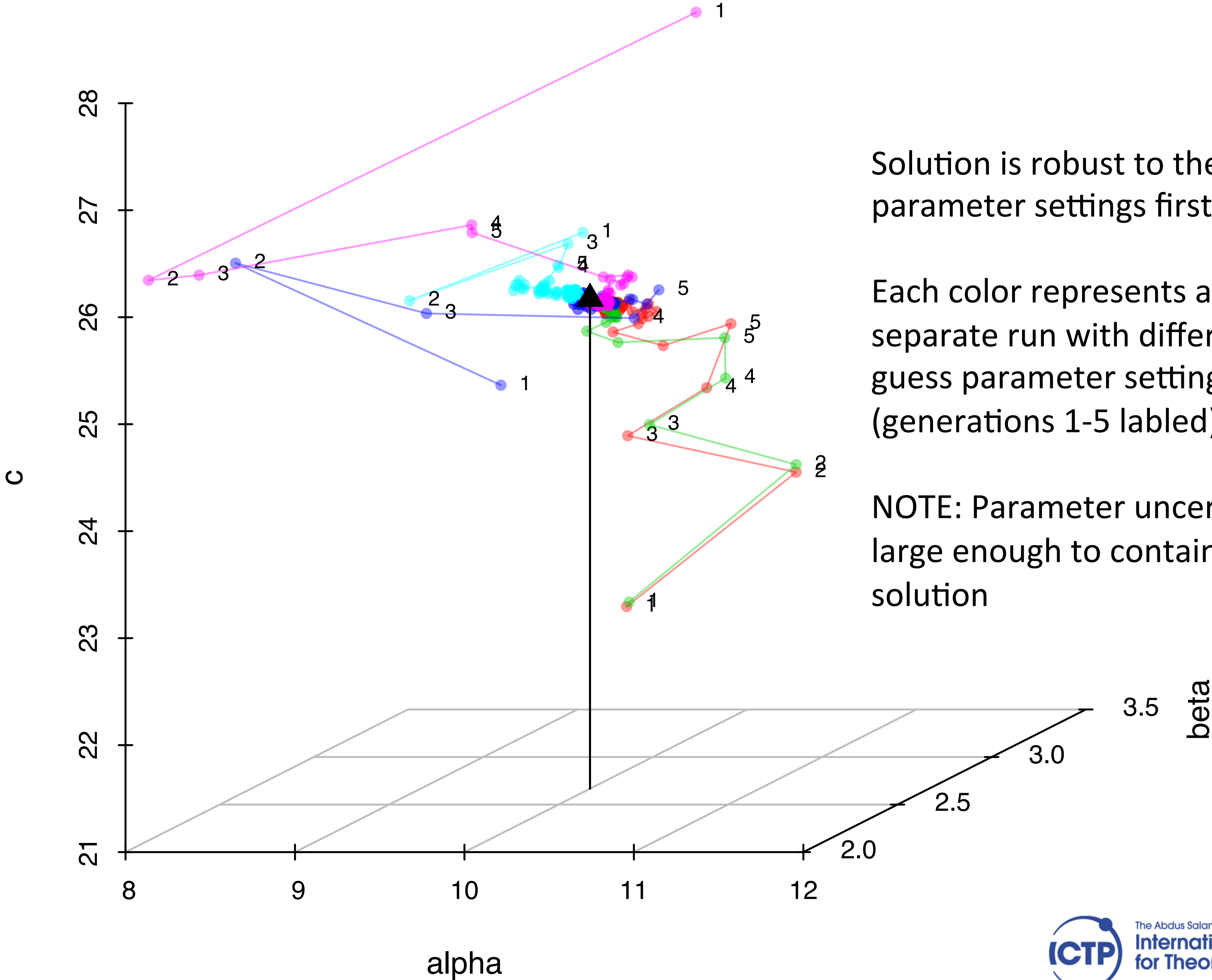
Ensemble mean parameter settings as a function of generation (for large tolerance setting)



Ensemble mean parameters – sensitivity to first guess

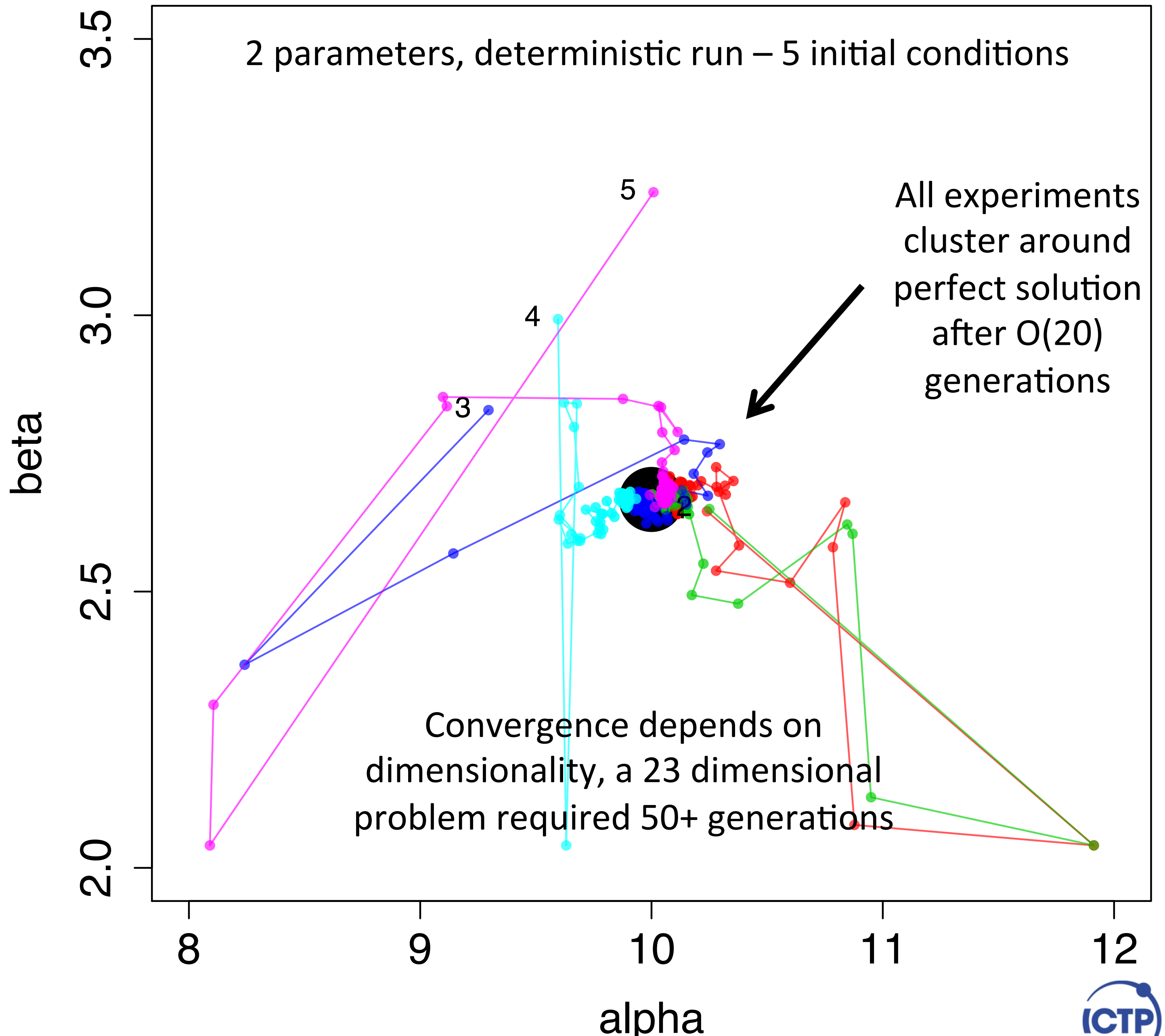


Solution is robust to the parameter settings first guess

Each color represents a separate run with different first guess parameter settings (generations 1-5 labled)

NOTE: Parameter uncertainty is large enough to contain solution

Ensemble mean parameters – sensitivity to first guess



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CHFP article

- First draft now ready for circulation
- Based on OVERLEAF
- Link to be circulated today

Key schools and training activities since last WGSIP

- Workshop on Climate Applications for Food Security | (smr 2621) Niger AGRHYMET (with A. Robertson)
- Advanced School and Workshop on Subseasonal to Seasonal (S2S) Prediction and Application to Drought Prediction | (smr 2714)
- ICTP-IITM-COLA Targeted Training Activity (TTA): Towards improved monsoon simulations | (smr 2896)
- Summer School on Aerosol-Cloud Interactions and International CFMIP Conference on Clouds, Circulation and Climate Sensitivity | (smr 2832)
- ICTP Workshop on Teleconnections in the Present and Future Climate | (smr 2834)
- School on Climate System Prediction and Regional Climate Information | (smr 2720)
- Workshop on Climate Impacts on Health in Asia | (smr 2838)

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