Climate change impact assessment on maize production in Jilin, China

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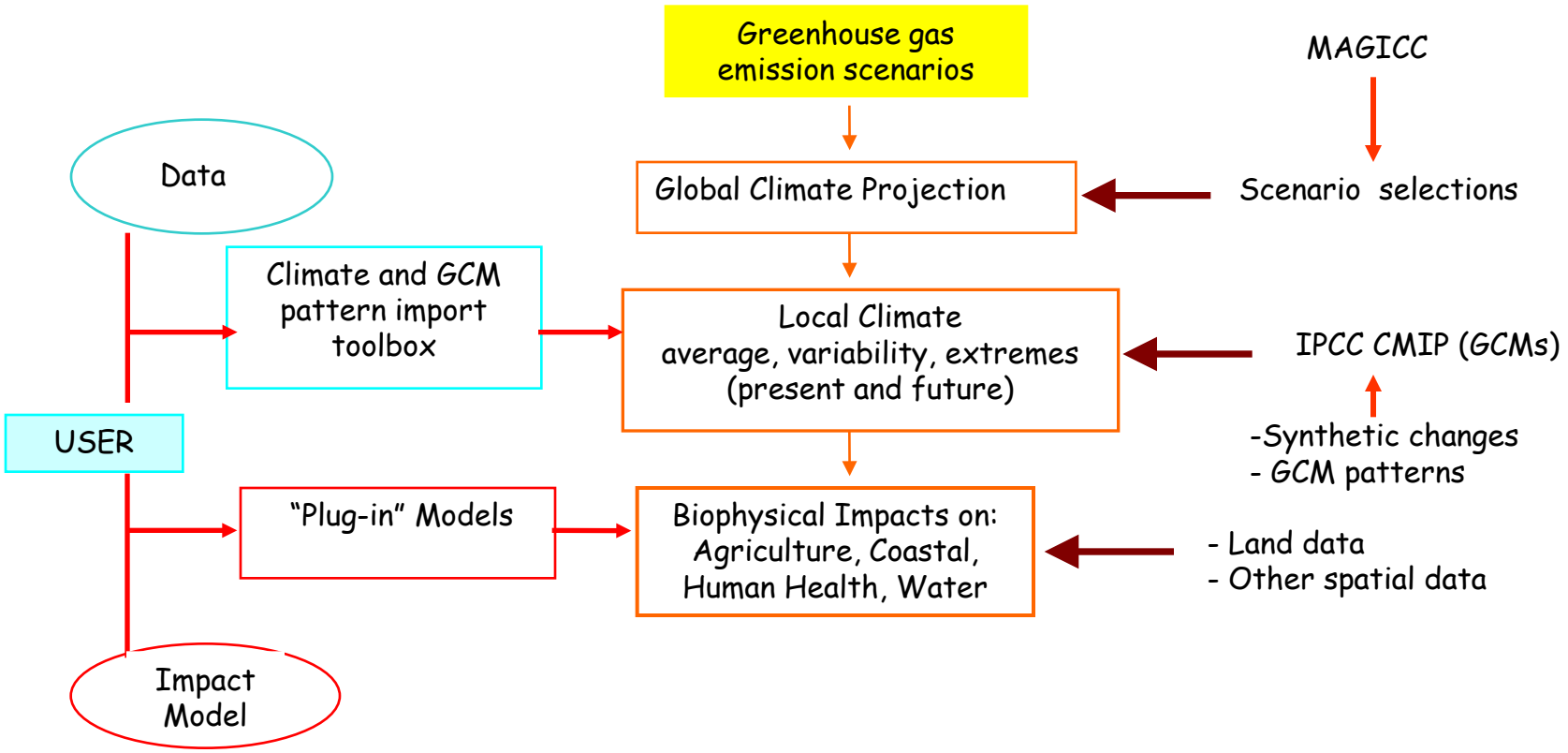
Backgrounds

- APN CAPaBLE project with focus on integrated system development for food security assessment
- Bio-physical & Economic
- Uncertainties: e.g. GCMs, CO_2 emission scenarios
- Adaptation measures (cross multi-scales)

SimCLIM model



Case Study: Jilin Province

Climate Scenario

- Baseline Climate

  CRU global climatology dataset, 1961-1990 (New, 2000)

- Climate change scenarios
  - Pattern scaling (Santer, 1990; Mitchell, 2003)
  - 20 GCMs change patterns (Covey et al., 2003)
  - 6 SRES emission scenarios (IPCC, 2000)

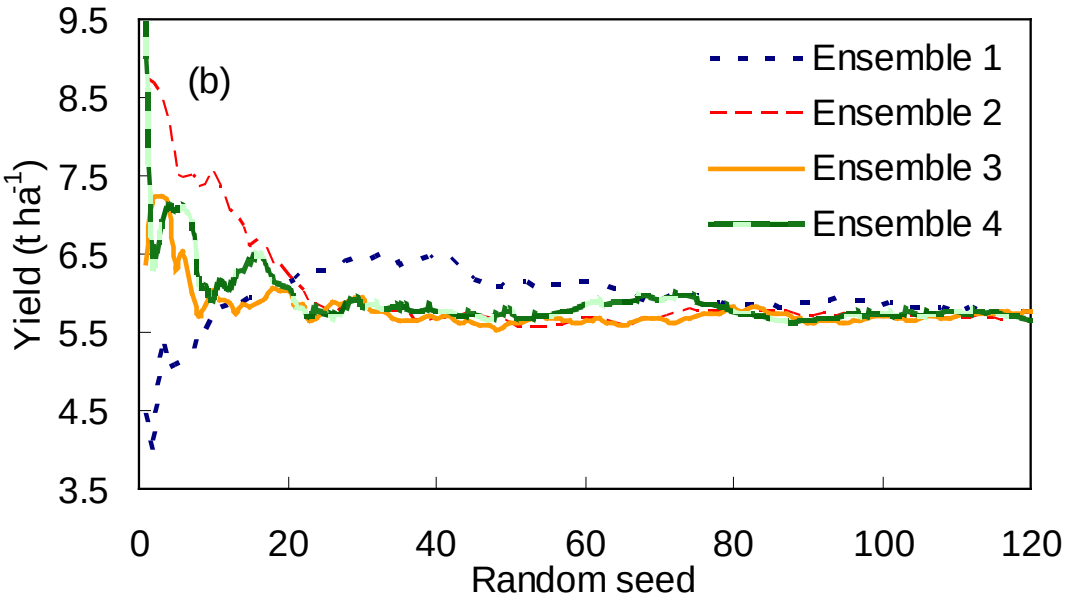
DSSAT model – to simulate maize growth

- CERES-Maize model (Jones, 1986)

- Site-based, daily time step
- Input – weather, soil, cultivating strategies, cultivar parameters
- Output – yield, phenological parameters (e.g. growing season, growing phase date), etc.

DSSAT – weather generator

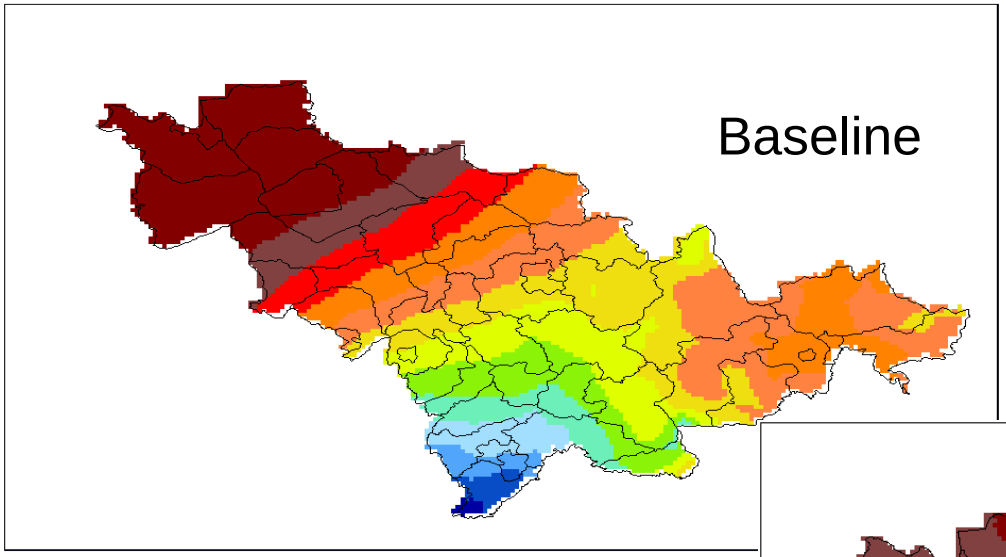
- SIMMETEO (Geng & Auburn, 1986)
- Input – monthly T_{max}, T_{min}, R_s, Prec.
- Random seed sensitive

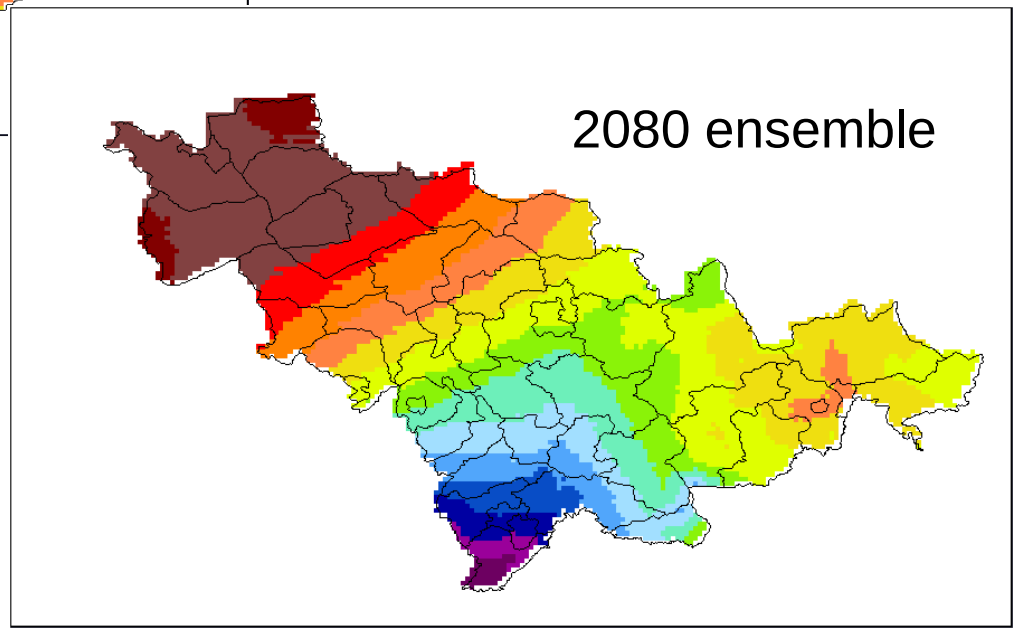


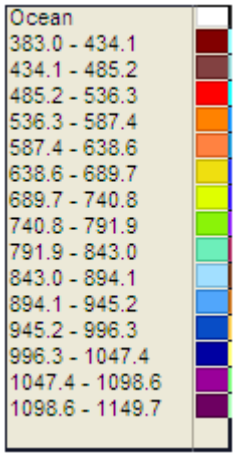
So, the average result of 100-seed simulations

Climate change projections

Precipitation (mm)

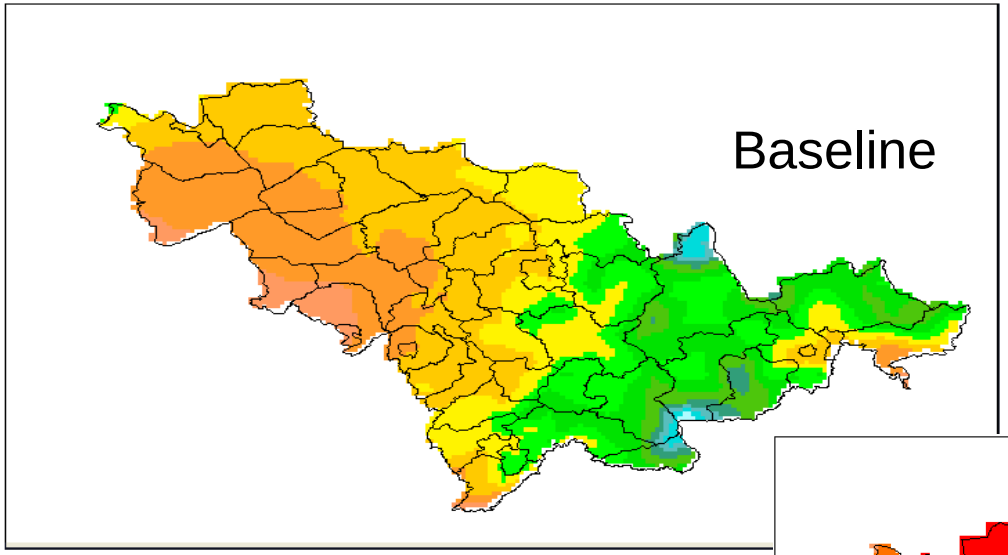


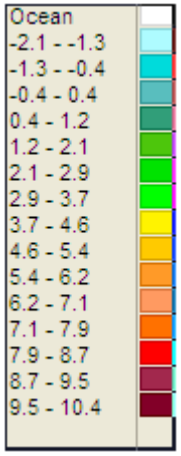


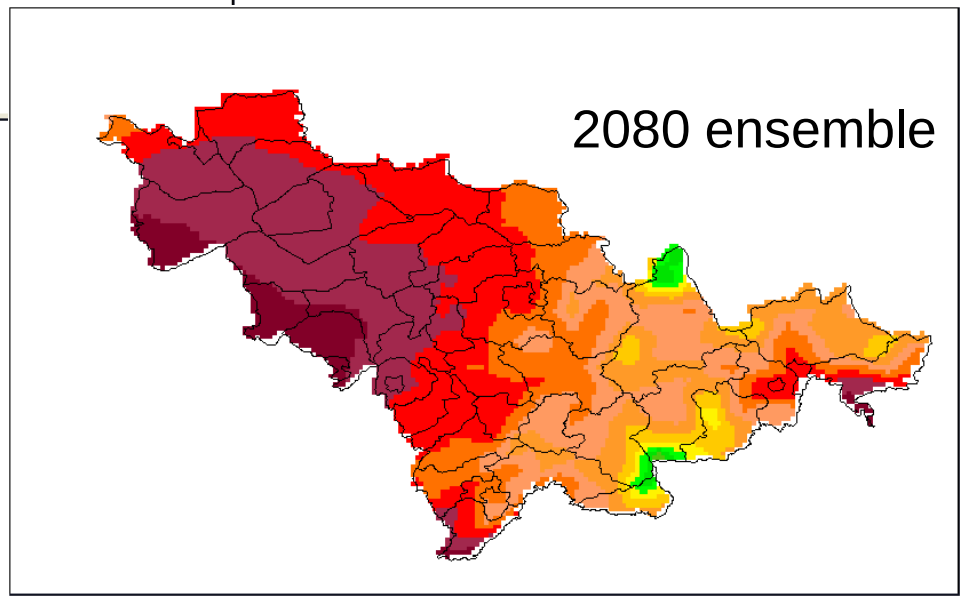


Climate change projections

Mean temperature (degC)

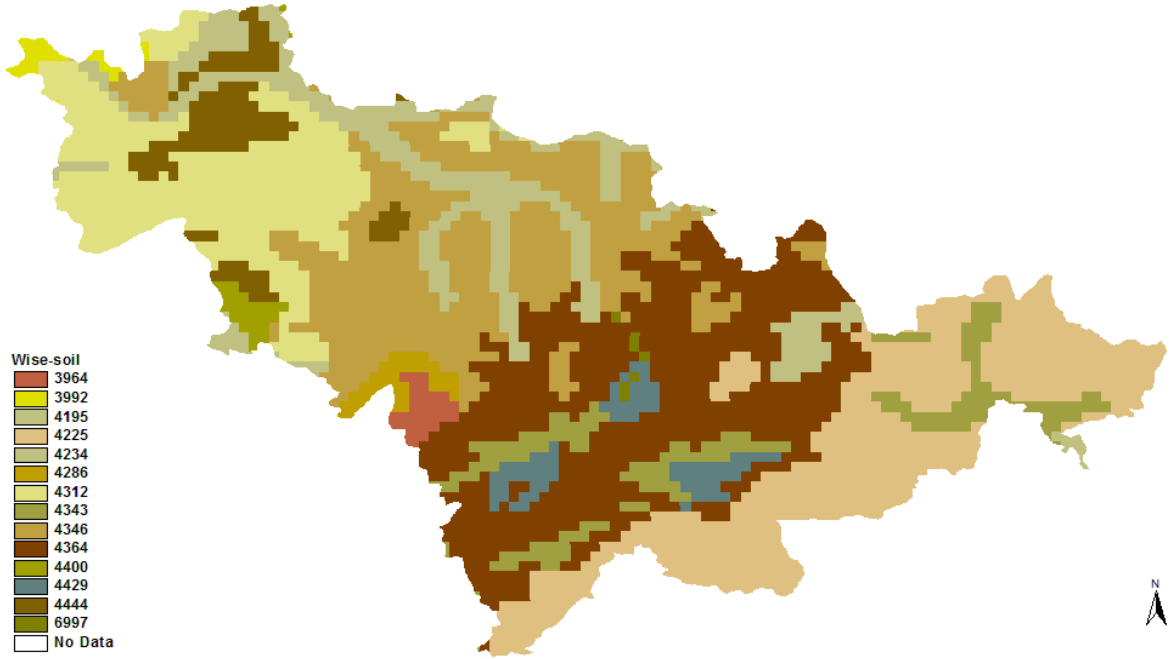






DSSAT – Soil

- ISRIC-WISE soil dataset (Batjes, 2006)
- 5 × 5 minutes
- 14 FAO soil categories



DSSAT – cultivating strategies

	Scheme
Planting manner	density: 6 plants m^{-2}
	date: controlled by soil temperature
Fertilization	nitrogen fertilizer (kg ha^{-1}) applied by county
Irrigation	controlled by the total irrigation quota (350mm) and frequency

Calibration – cultivar parameters

- Cultivar parameters

  P1, P2, P5

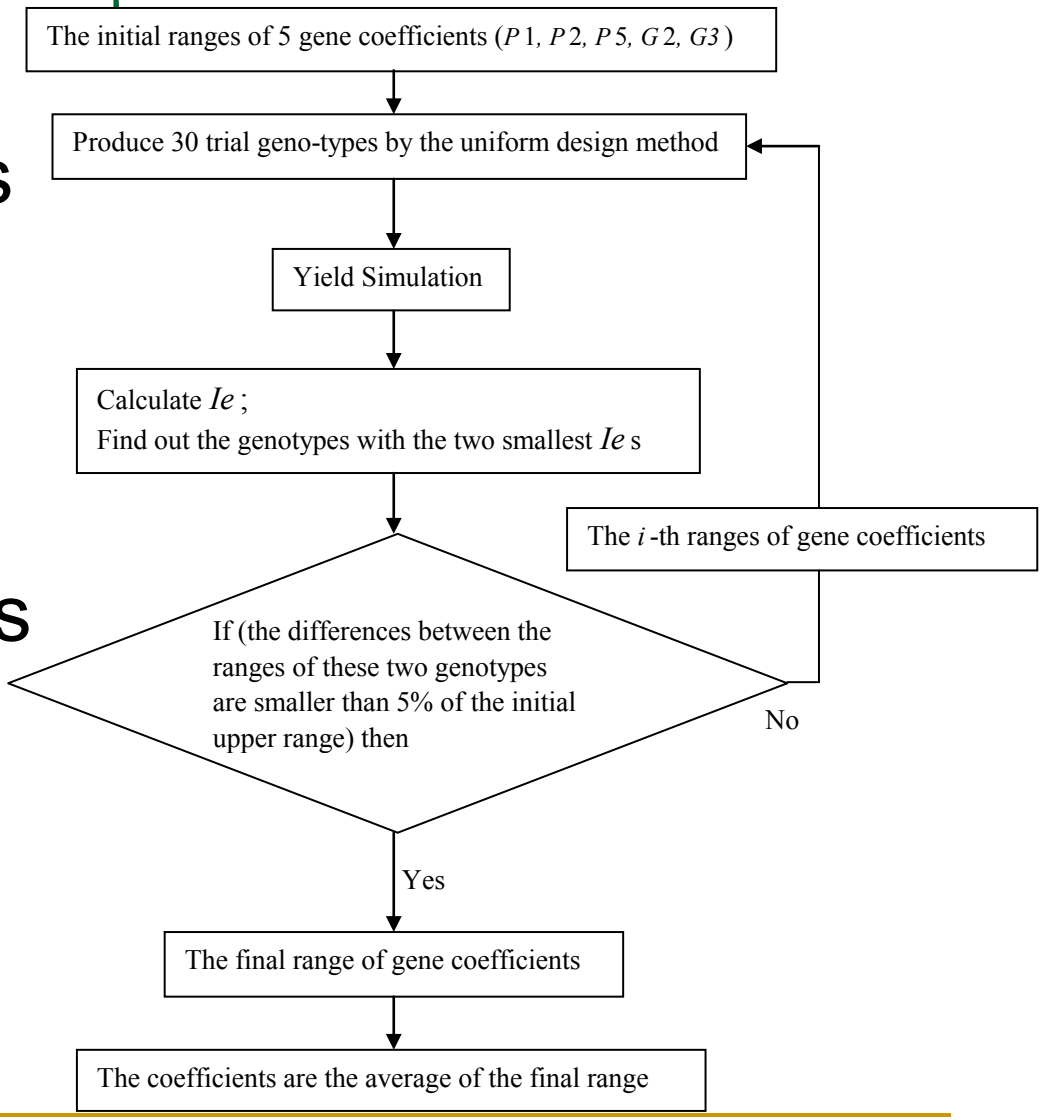
  G2, G3

- 11-site observations

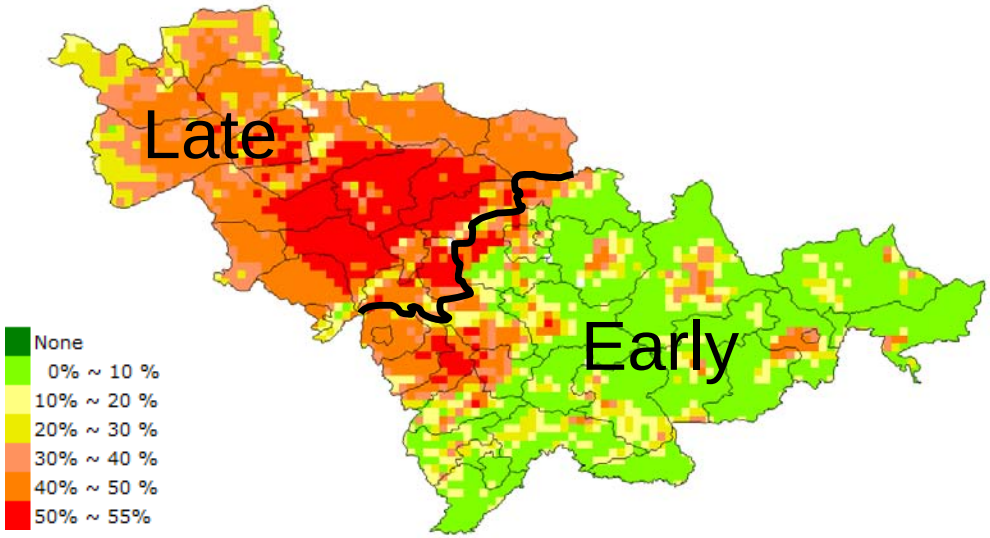
  yield,

  sowing date,

  harvest date



Calibration – cultivar selection



	Late	Early
P1	280	270
P2	0.3	0.3
P5	790	700
G2	720	720
G3	8.5	8.5

Calibration – 11 sites (1996- 2000)

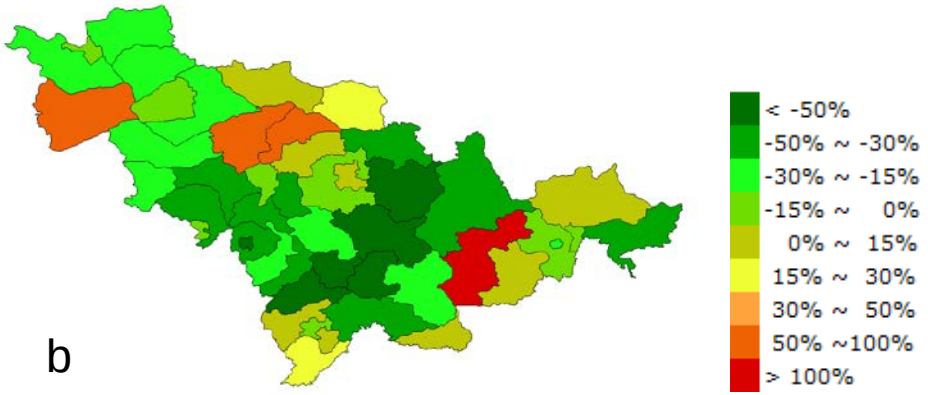
Site	Cultivar	Y_{sim}/Y_{obs}	M_{sim}/M_{obs}
Changling	Late	0.55	0.94
Nong'an	Late	0.92	1.03
Yushu	Late	0.87	1.06
Lishu	Late	1.05	1.05
Ji'an	Late	0.94	0.96
Shulan	Early	0.87	1.06
Yongji	Early	0.99	0.95
Dunhua	Early	1.23	1.13
Liaoyuan	Early	1.05	1.01
Meihekou	Early	0.94	0.94
Huadian	Early	0.90	1.00

Validation –

Compare with the county census yield (1990-2002)

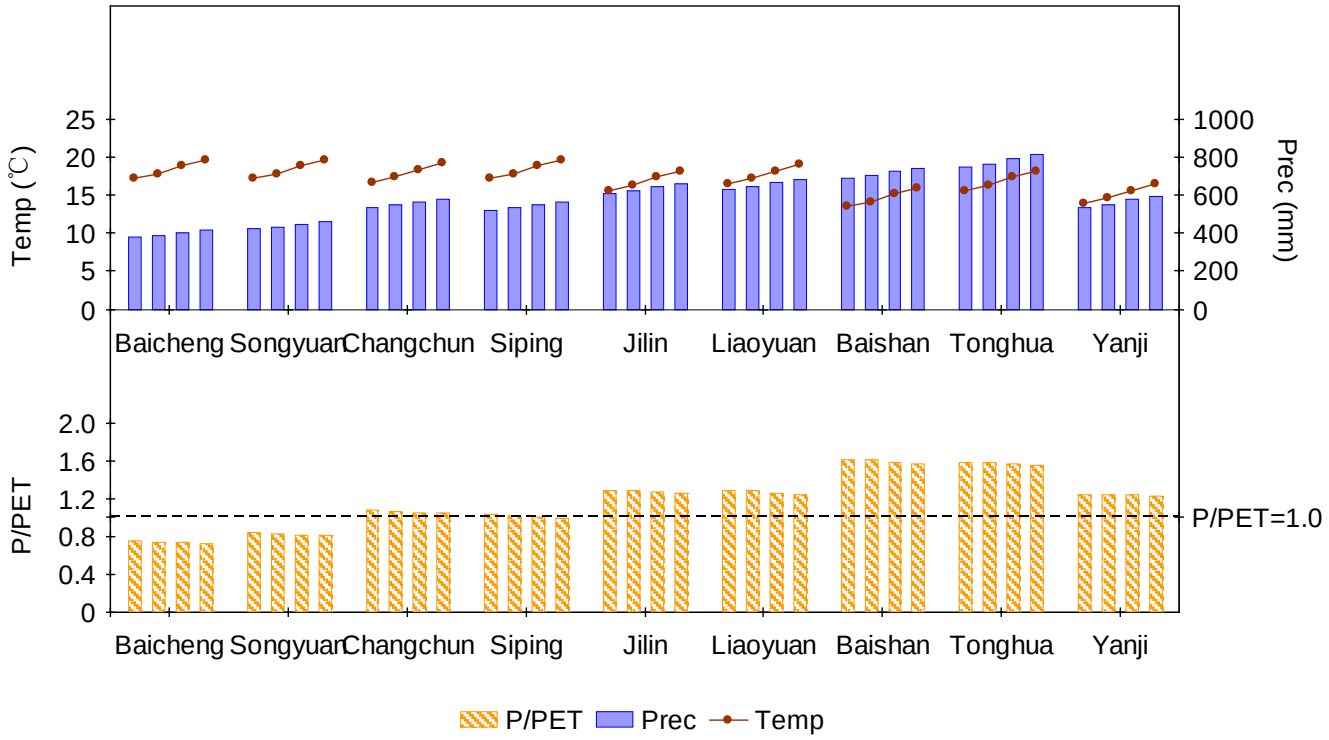
- Average

- Standard deviation

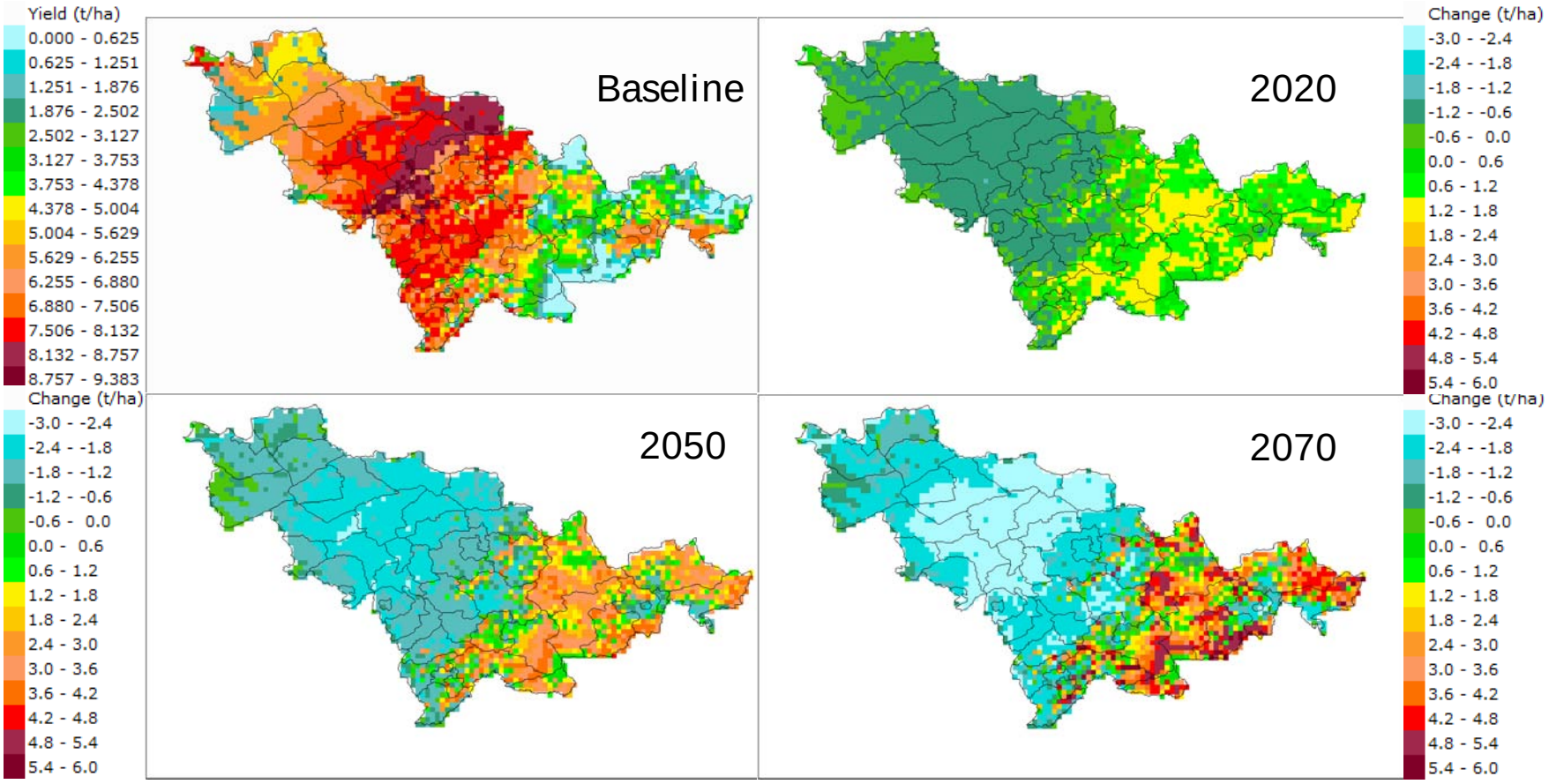


Climate scenarios

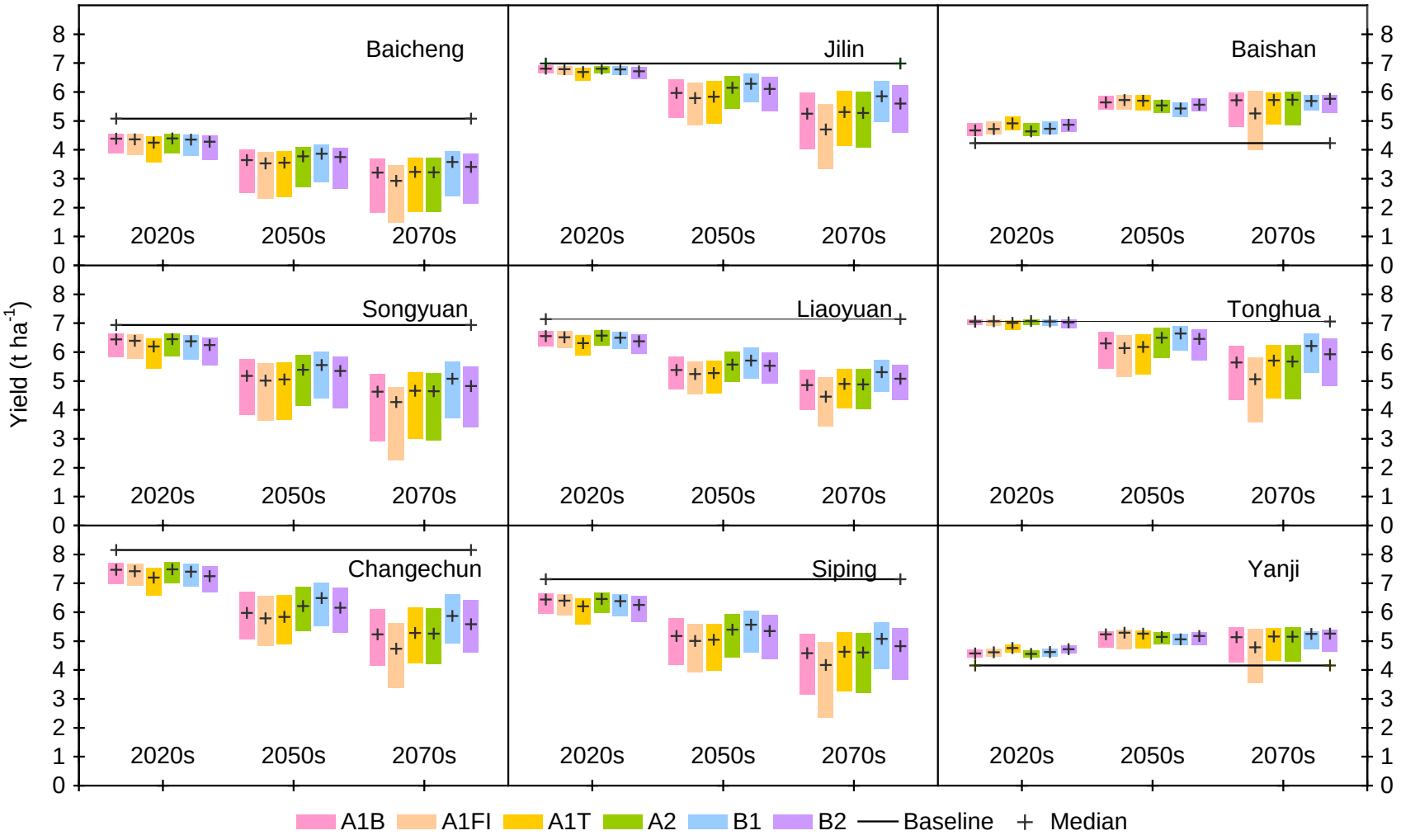
- Climate change in Jilin Province
- Growing season (Apr.-Sept.)
- Temp.
- Prec.
- Prec/PET



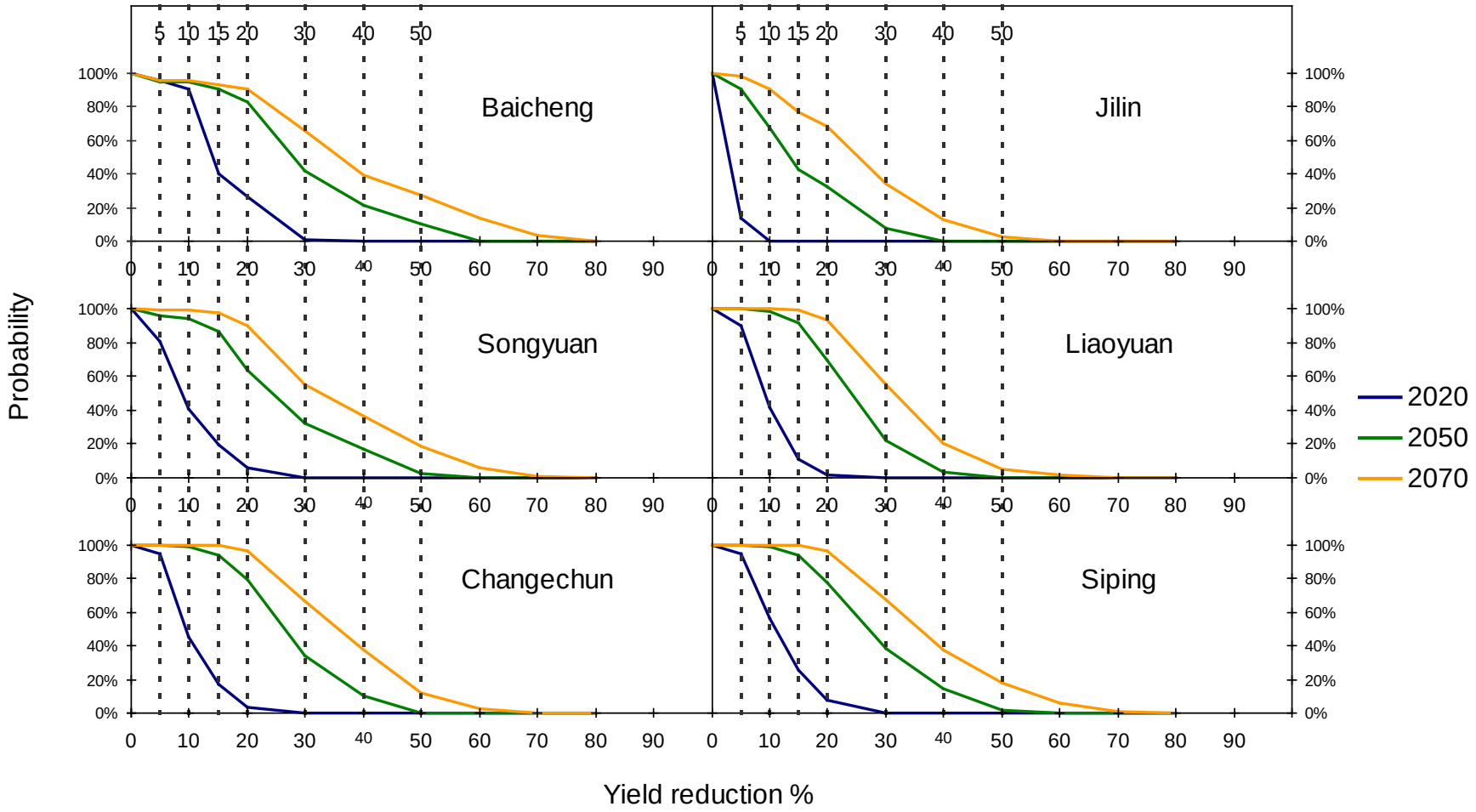
Results – spatial pattern of yield change



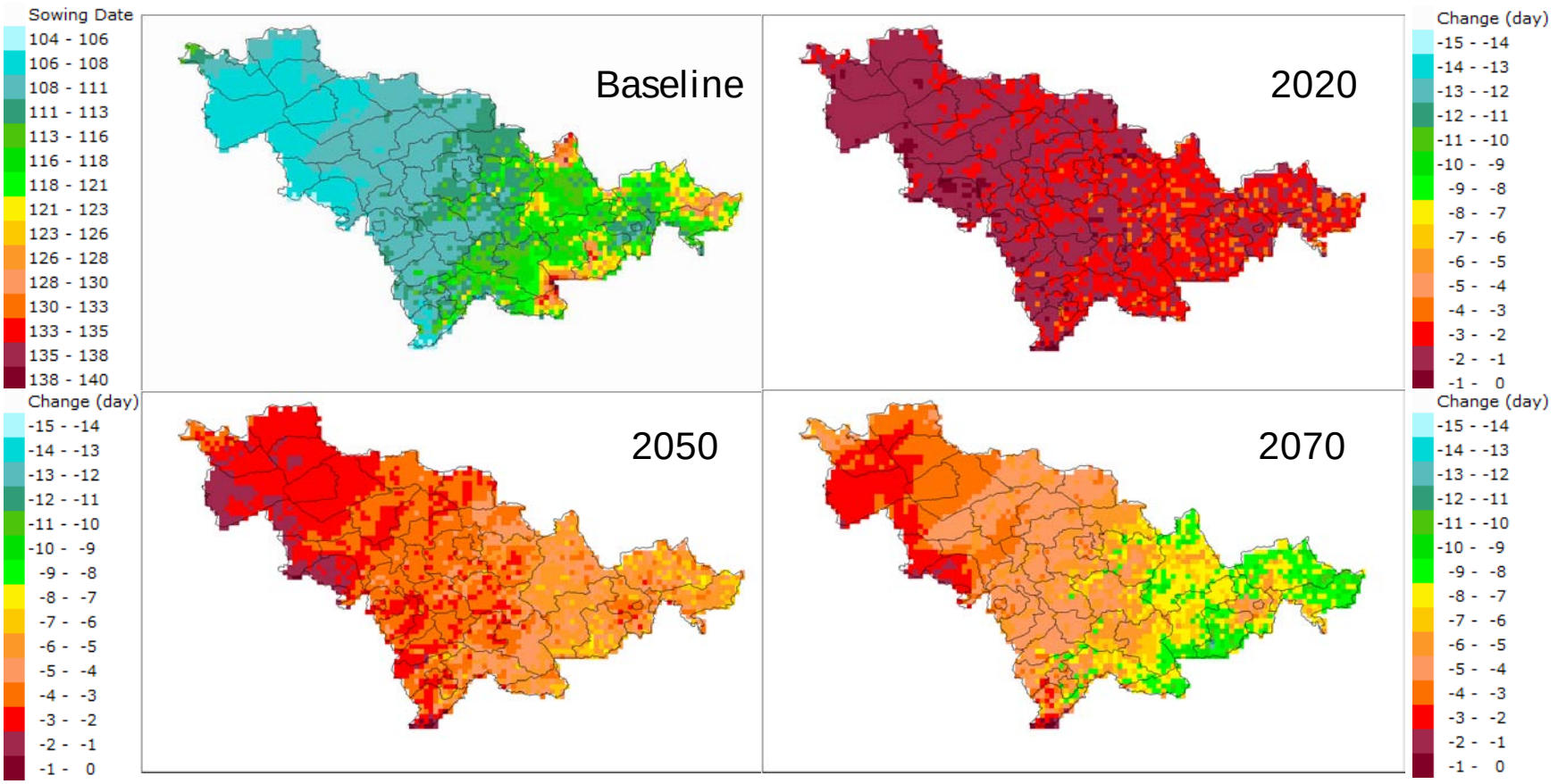
Results – uncertainties among scenarios



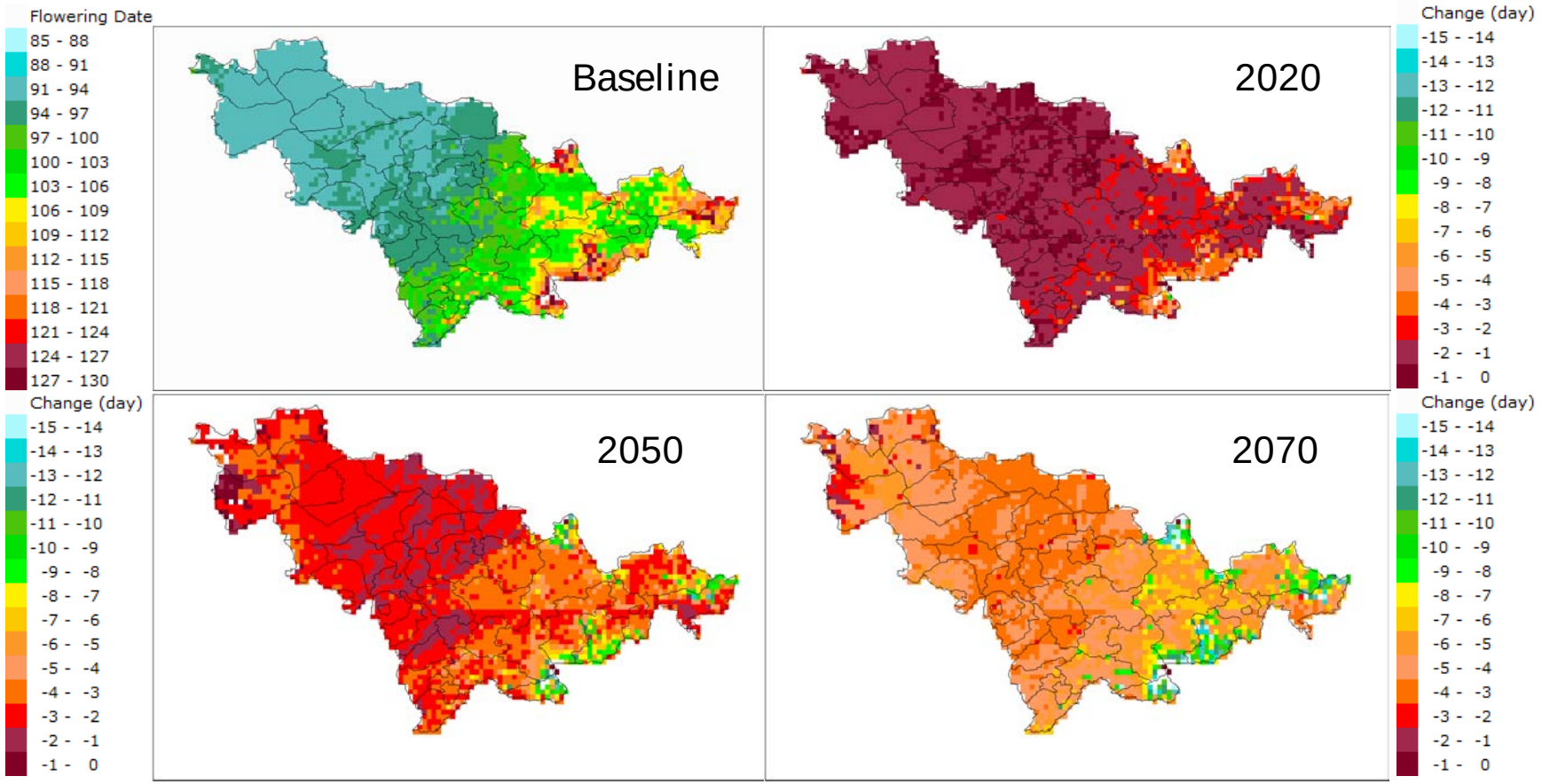
Results – the probability of yield reduction



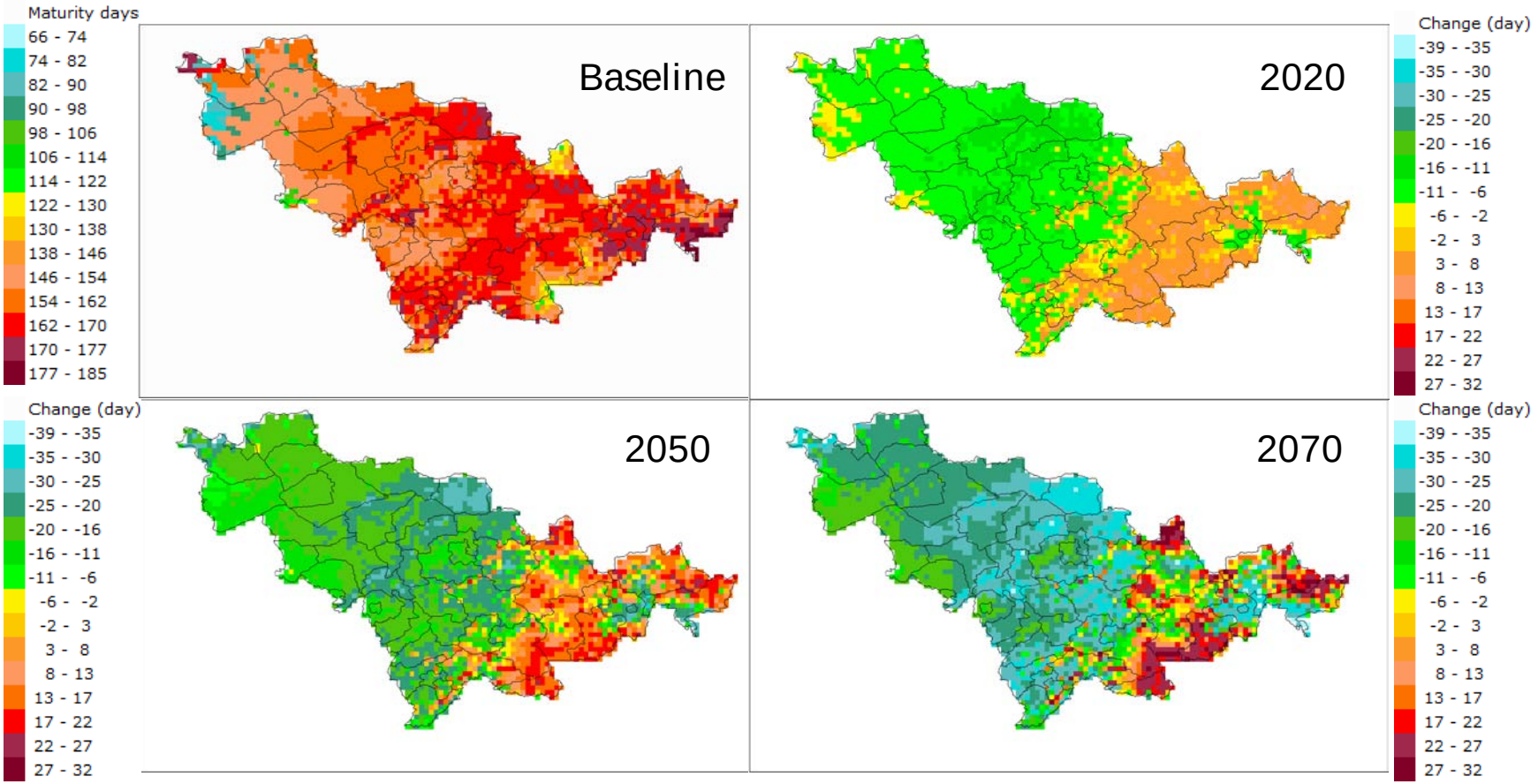
Results – changes in sowing date



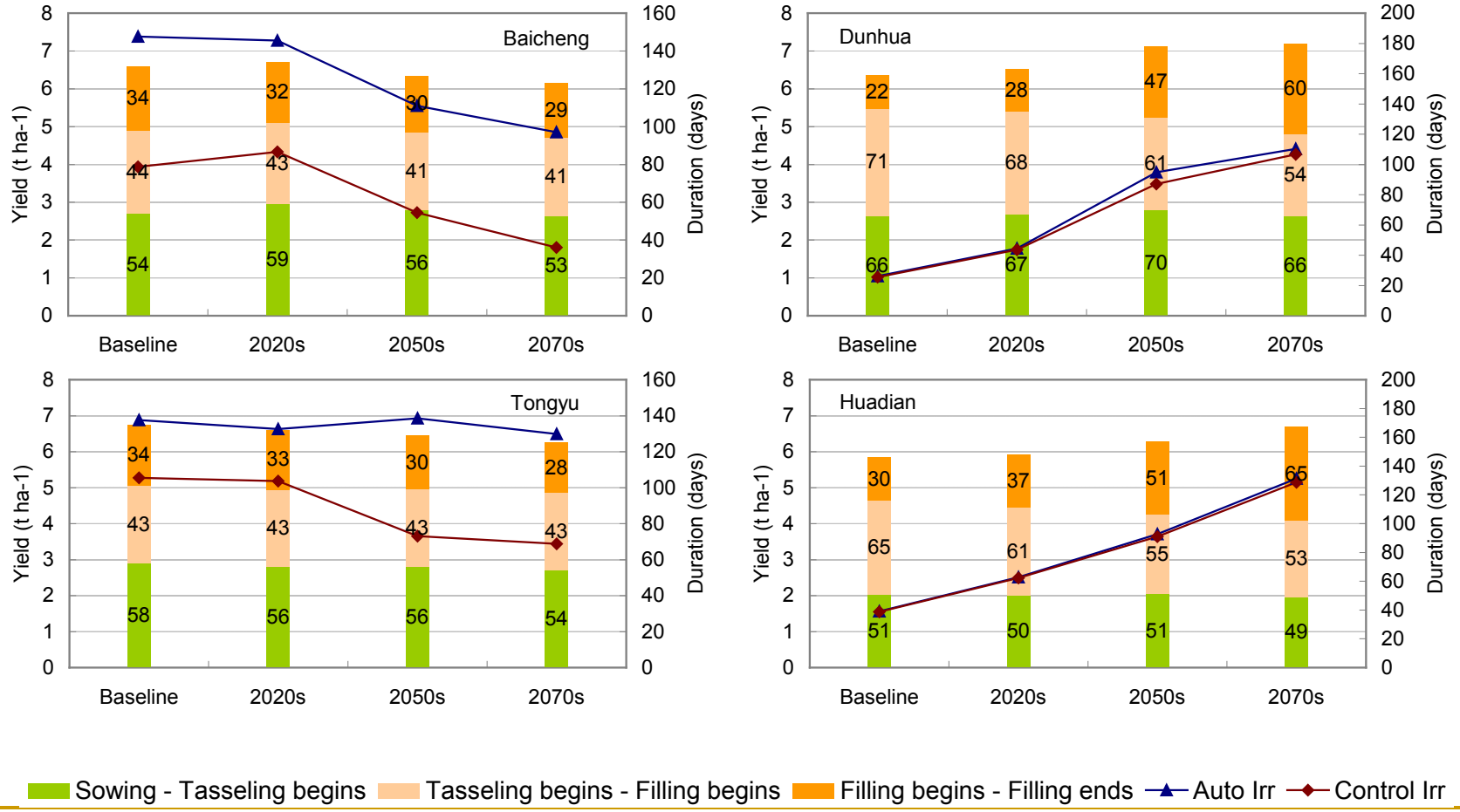
Results – changes in flowering date



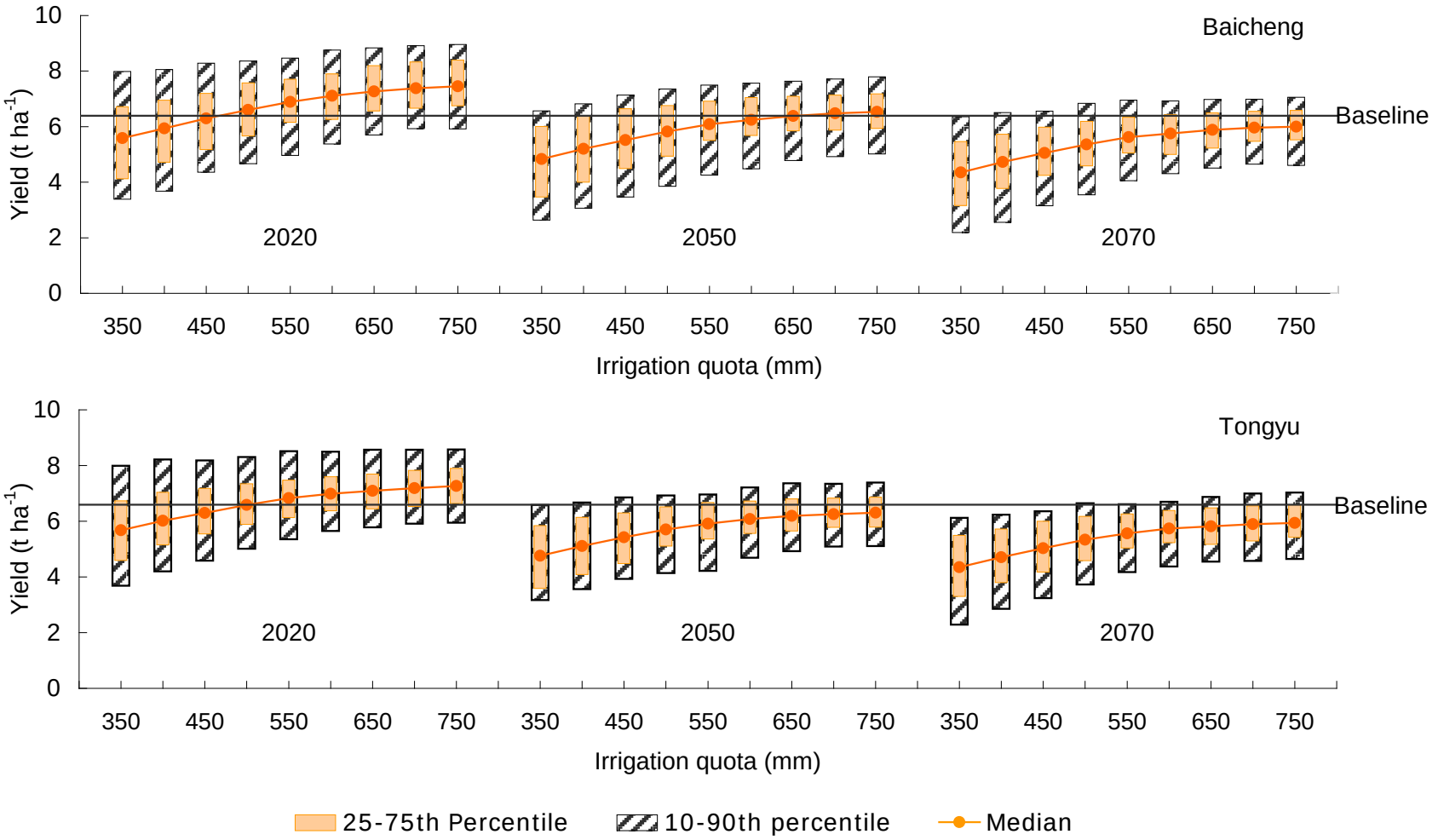
Results – changes in growing season



Results – yield and growing phase



Results – adaptation analysis: irrigation



Conclusion

- Impacts on maize yield

  west & central areas

  eastern mountain areas

- Impacts on phenology

  shortened growing season in the west and central (especially the reduced grain filling phase)

- Adaptation measures

  Increase in total irrigation (20- 50 years)

  New cultivar with longer growing season (>50 years)

Thank You