

Multi-Sector Dynamics Workshop

JP-JGCRI Collaboration: Comparison of Coupled Human-Earth System Models

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Snowmass, CO
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Team

MIT Joint Program

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UC Davis? MIT?

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JGCRI

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Project Goals

- Model comparison of coupled human-earth system models at MIT JP (IGSM) and JGCRI (GCAM)
 - Earth system components: MESM and Hector
 - Human system components: EPPA and GCAM
- Run set of standardized scenarios: Reference, Flat and 2°C
- Compare results and draw out insights
 - Emissions, concentrations, forcing, temperature
 - Energy, electricity, GDP, population, carbon price
 - Examine impact of choice of key climate parameters vs. choice of model

Project Design

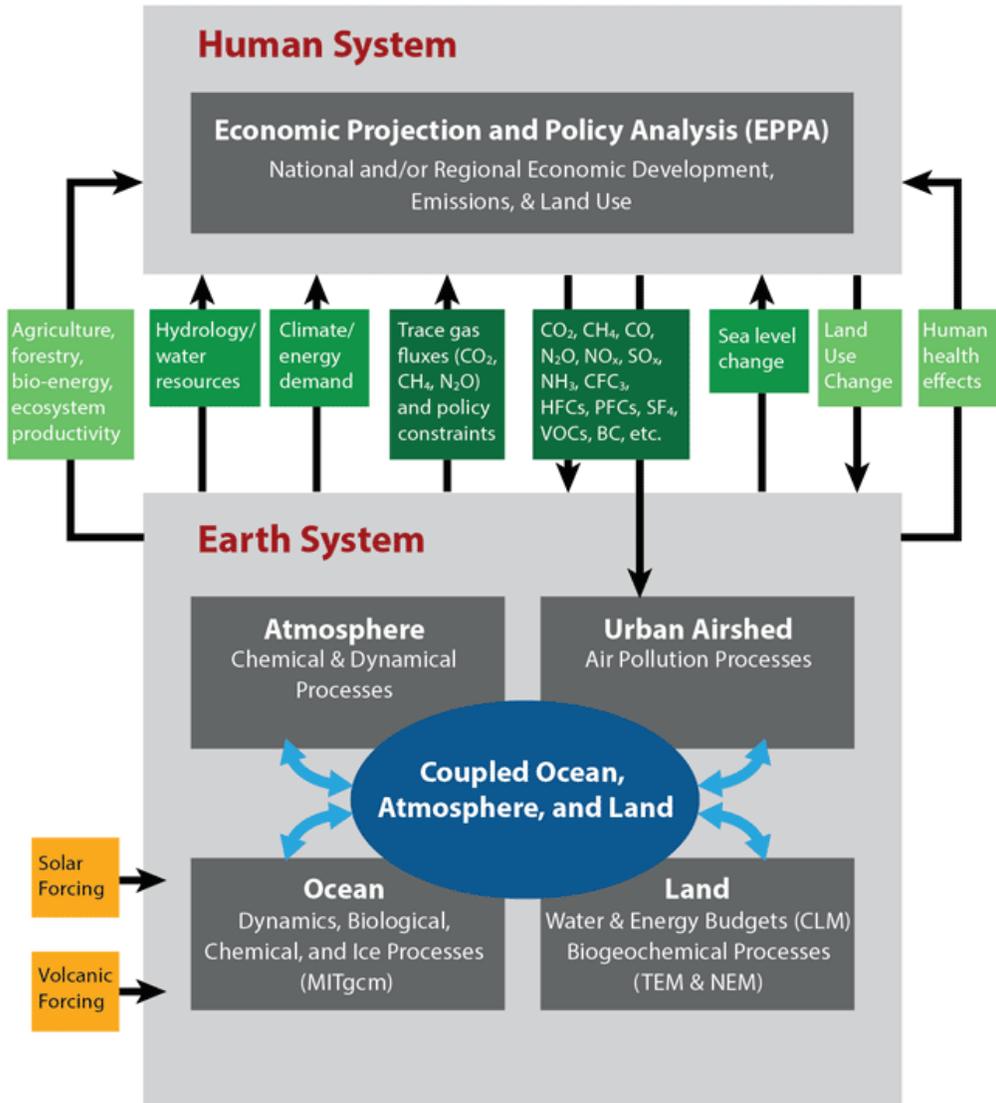
Each team:

- Runs scenarios through their human system model and passes emissions to other team
- Translates other team's emissions results into format needed for their earth system model
- Runs own and other team's emissions scenarios through their earth system model

	EPPA	GCAM
MESM	EPPA-MESM	GCAM-MESM
HECTOR	EPPA-HECTOR	GCAM-HECTOR

Models

MIT IGSM



GCAM

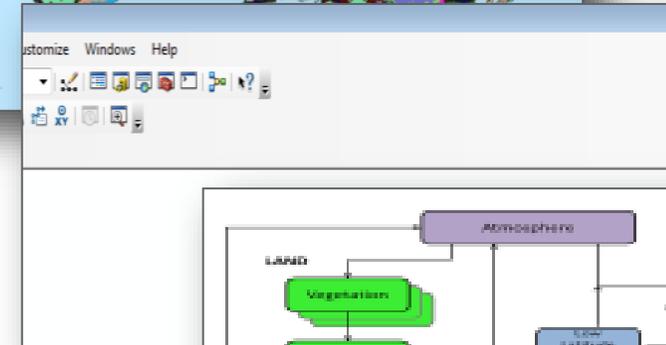
32 Energy & Economy Regions



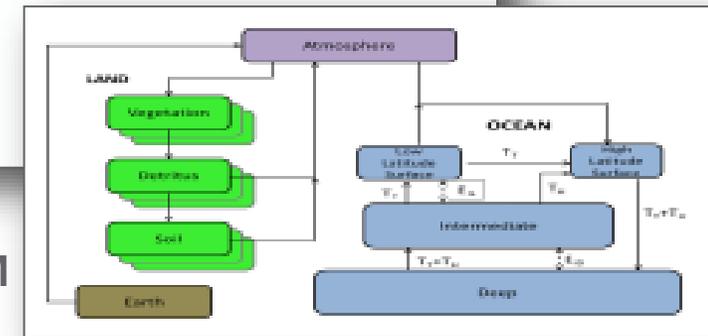
283 Land Regions



233 Water Basins



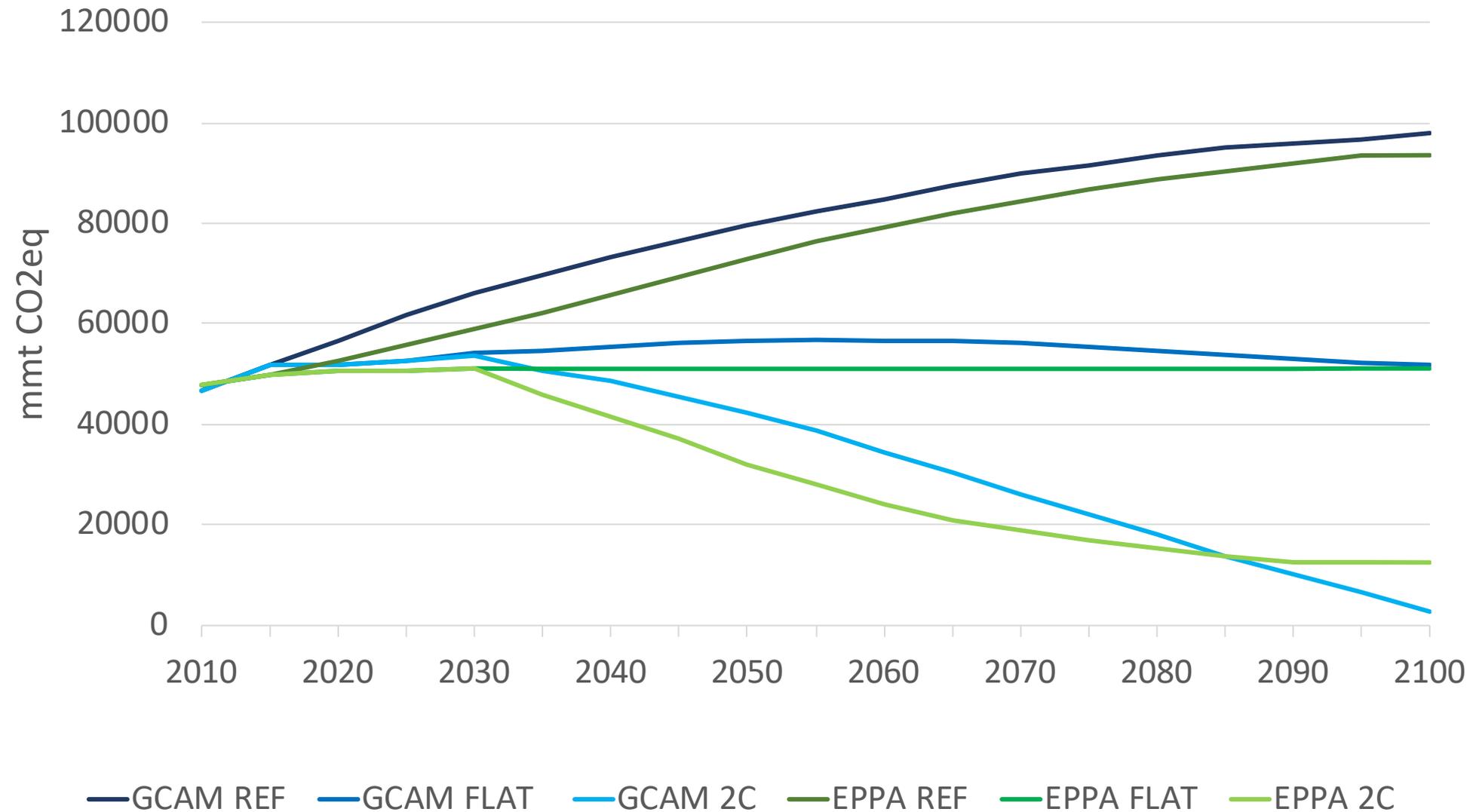
Reduced-Form ESM (Hector)



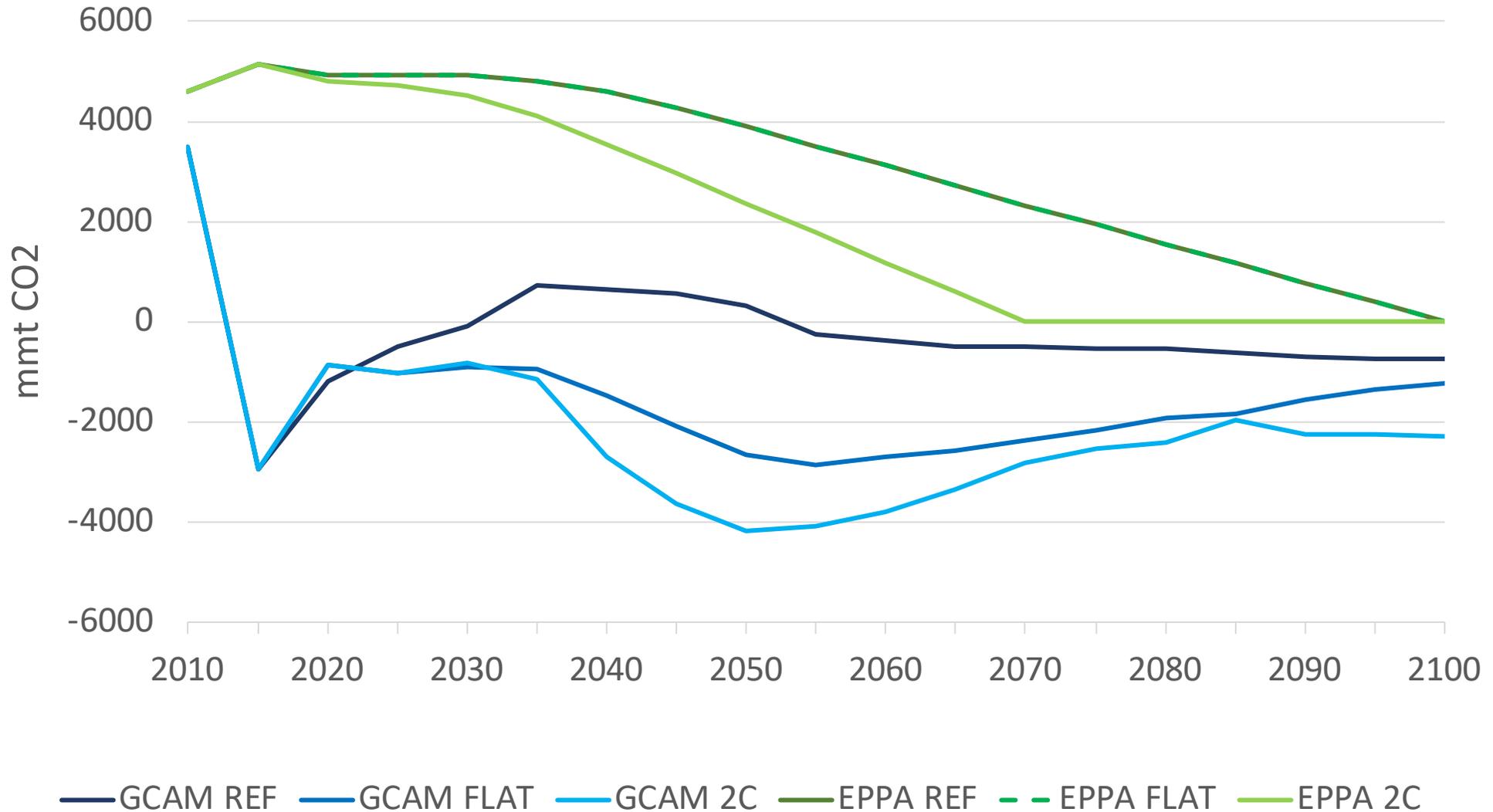
Main Findings So Far

- Land use change emissions are very different in human system models... but differences are compensating to make total CO₂eq emissions quite similar

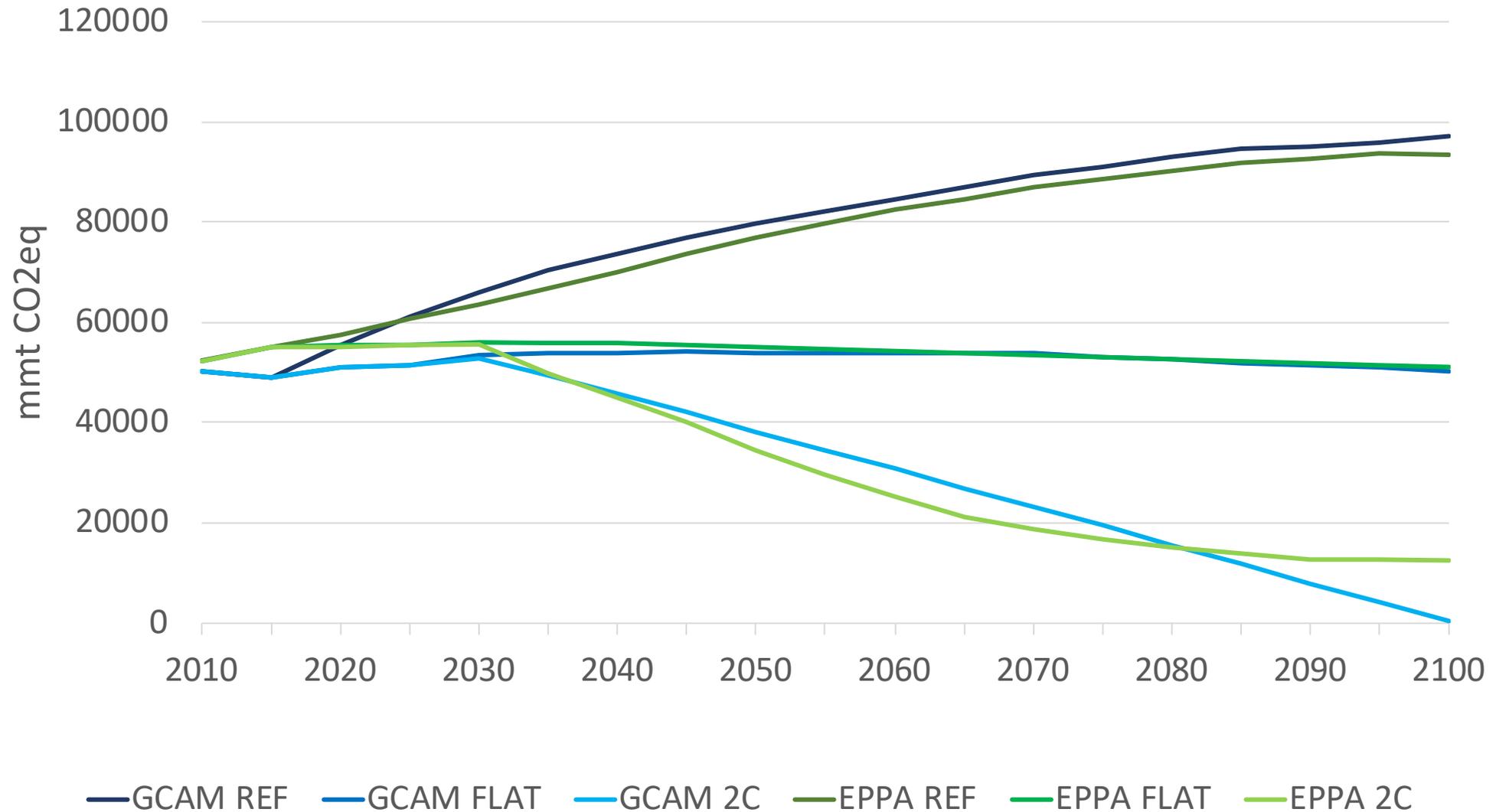
Results: Emissions, Global CO₂eq w/out LUC



Results: Emissions, LUC emissions



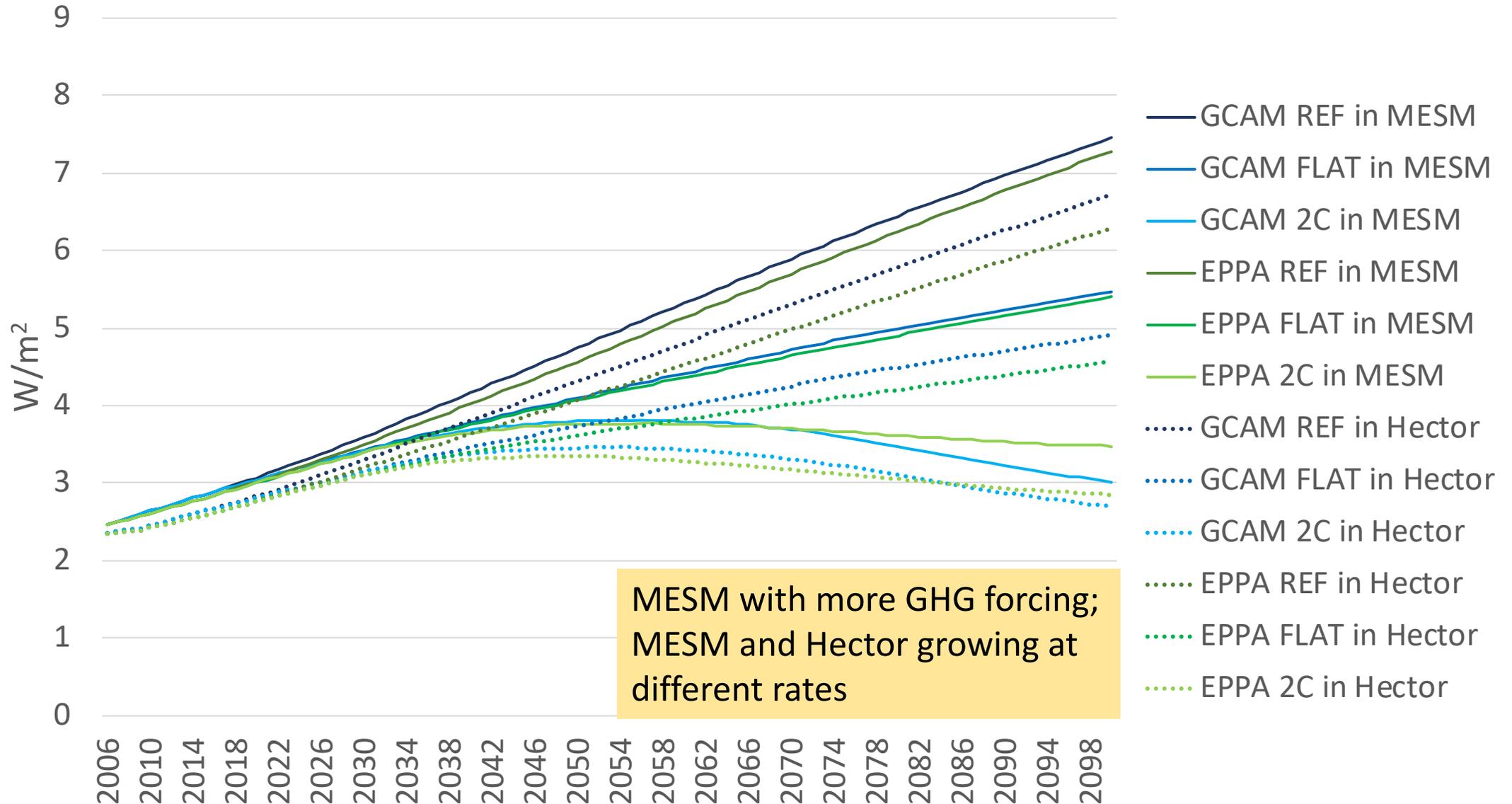
Results: Emissions, Global CO2eq



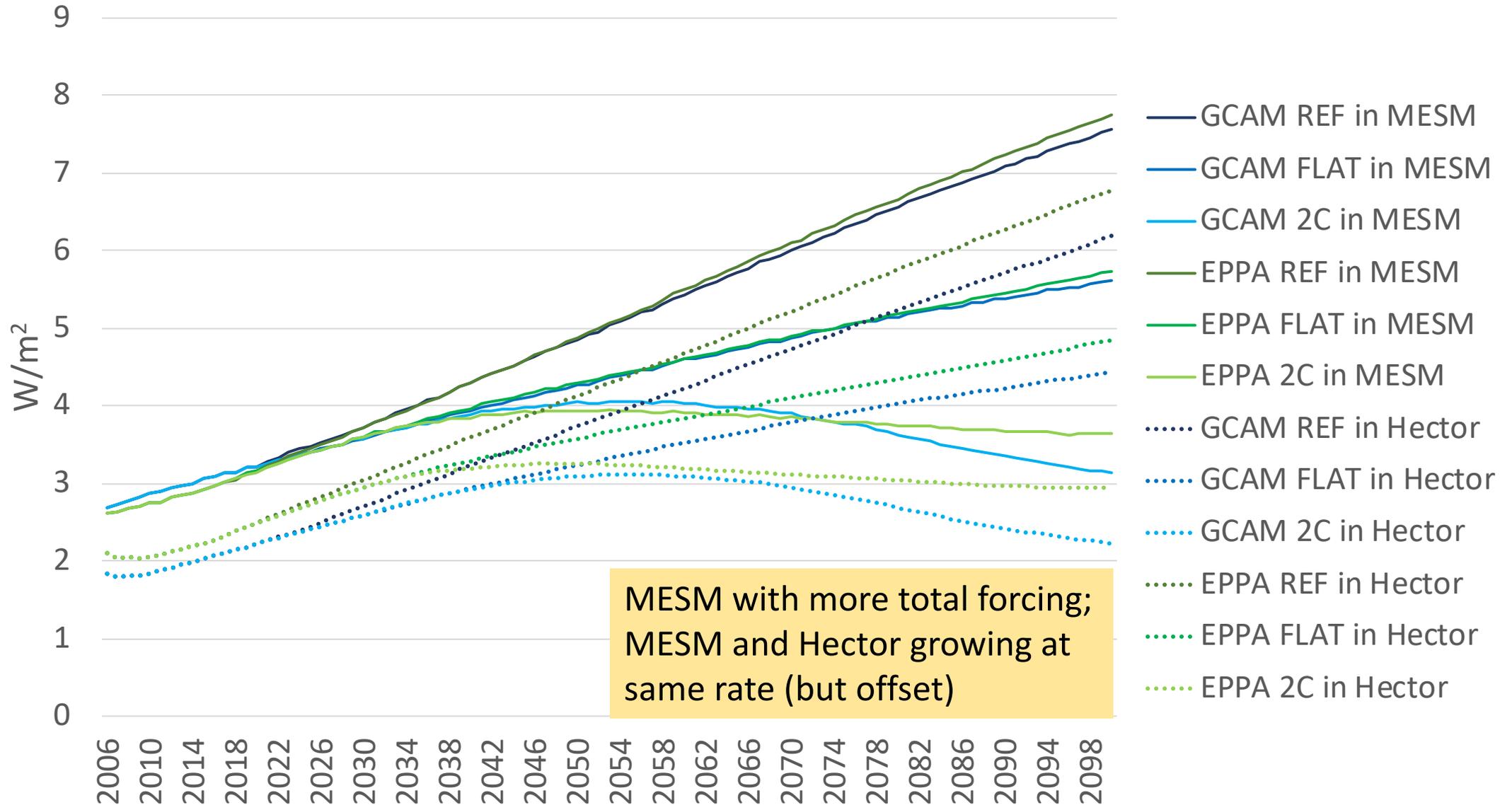
Main Findings So Far

- Land use change emissions are very different in human system models... but differences are compensating to make total CO₂eq emissions quite similar
- Earth system models get similar temperatures, but different total forcing
 - Role of aerosols
 - Role of climate sensitivity and ocean heat uptake
 - Similar TCR even though no coordination on climate parameters

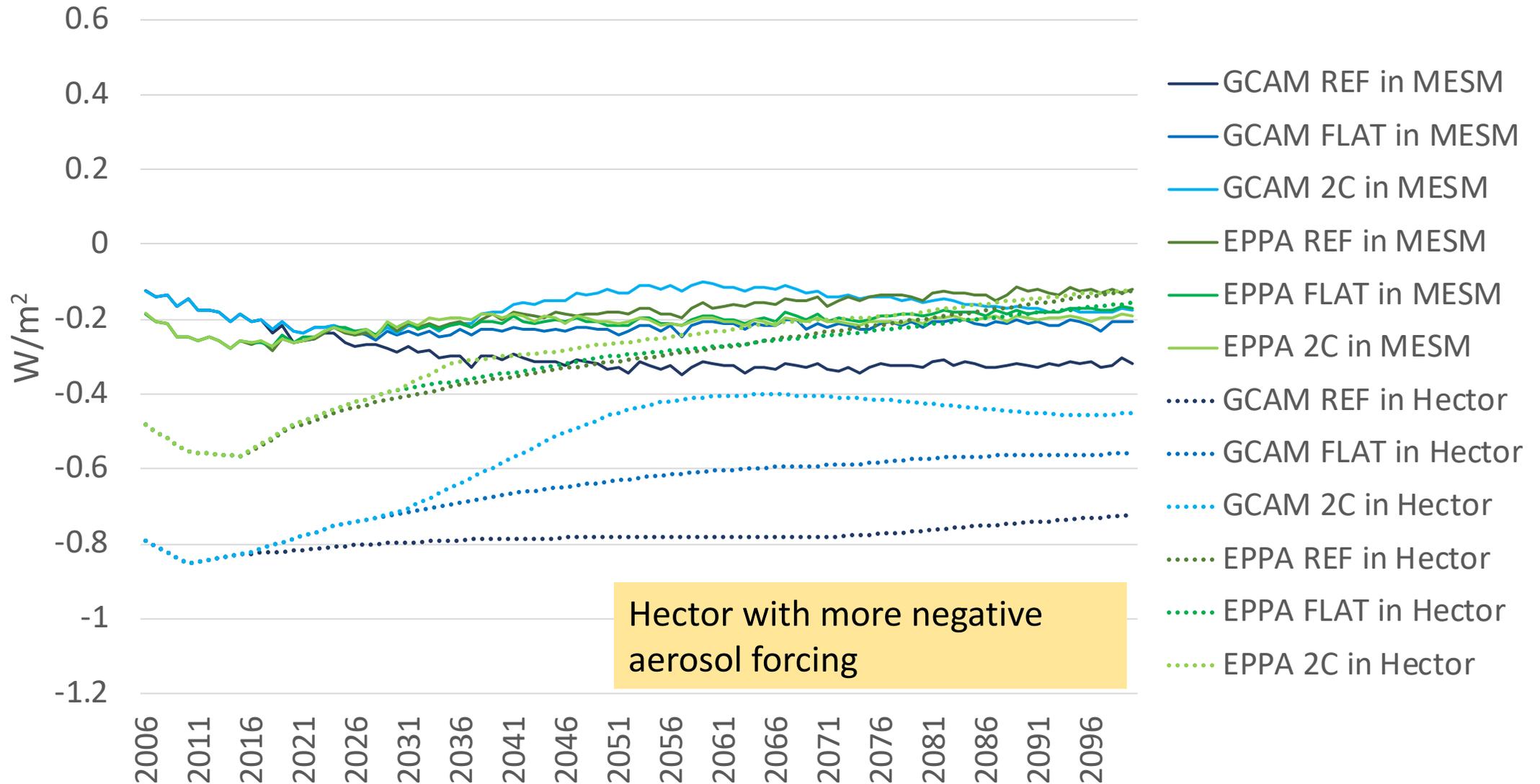
Results: GHG Forcing



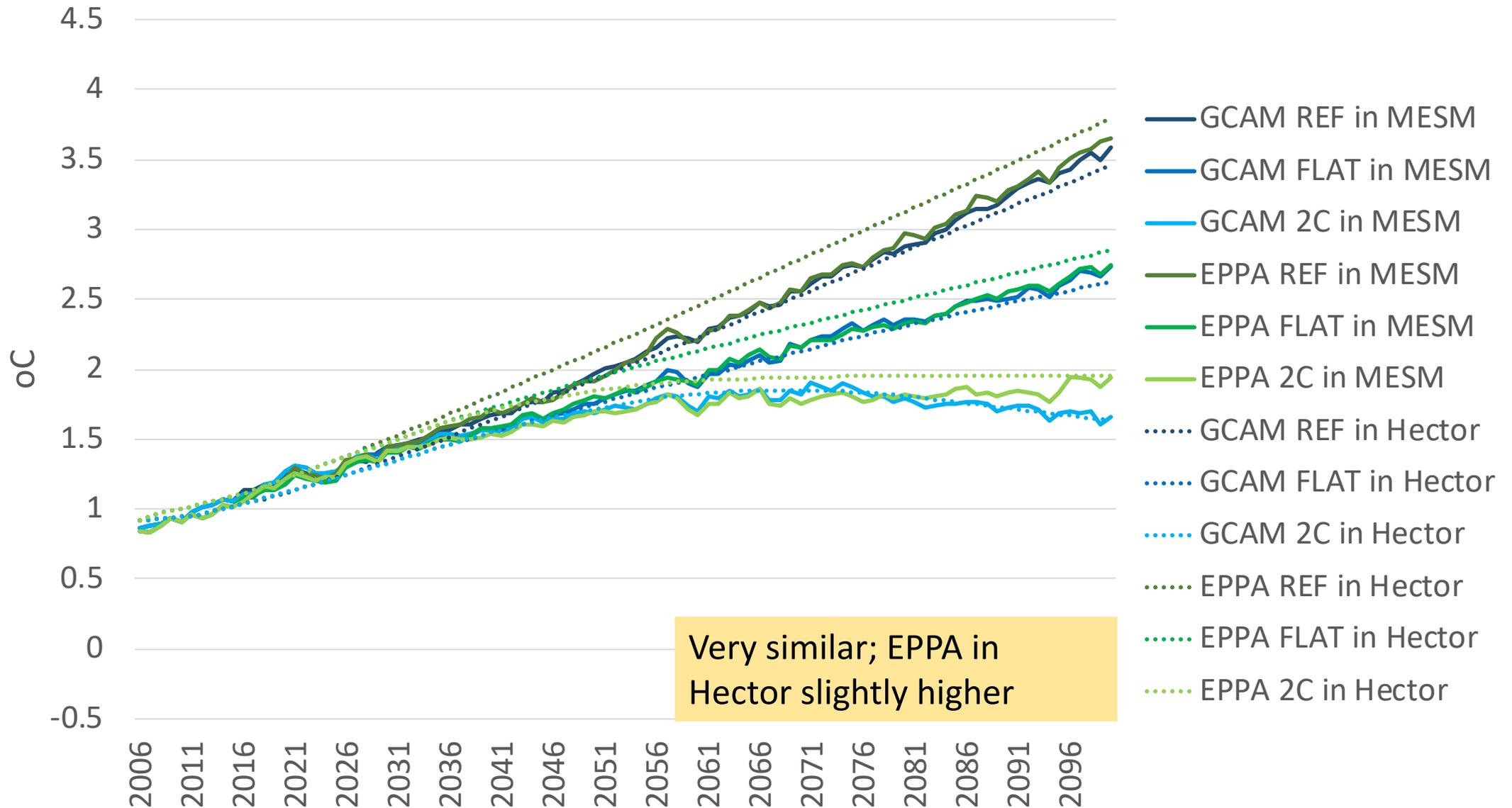
Results: Total Forcing



Results: Aerosol Forcing



Results: Temperature



Very similar; EPPA in Hector slightly higher

Next Steps

- Further investigate results
- Compare energy, economic results
- Complete paper

How did this collaboration start?

- Discussion between Erwan and Leon at the GCAM workshop
- People from JP and JGCRI were asked to participate in initial phone call about potential collaboration... moved ahead from there
- Purely curiosity-driven (no funding or solicitation)

Successes

- Established soft coupling capabilities between our models (MESM can take in GCAM emissions, Hector can take in EPPA emissions)
- Established diagnostics of various components
- Benchmarked the models
- Reconciled historical observations with historical emissions/concentrations/forcing and simulated temperature
 - MESM uses concentrations
 - Hector uses emissions (or forcing)
- Motivated to learn more about each other's models
- Communication (email, teleconferences monthly to quarterly when momentum)
- Sharing data in google drive in excel form (may not be sufficient for more complex analysis)

Challenges

- Main challenge is keeping project moving forward at a reasonable pace
 - As an unfunded side project without a specific timeline or deliverables, this gets placed on everyone's back burners at different times, making progress pretty slow
 - Gave ourselves deadline... missed that deadline, slowing momentum (also Erwan left MIT and Corrine has split duties)
- Lack of knowledge as to whether this project is valuable... no one is pushing it besides us
 - No clear formal way to advertise it or make it a formal project... so it stays a side project

What would you do differently?

- Reach out to broader DOE-MSD community to get feedback as to whether project interesting/worthwhile (and choice of scenarios to explore)
- Reach out to other research groups with coupled human-earth system models (IIASA, PBL...) to expand and formalize project, help with momentum
- Start with comparing historic baselines

What support do you wish you had received?

- Confirmation that project is a valuable undertaking within DOE MSD
 - Avenue for doing that?
 - e.g. receive feedback from MSD community
 - e.g. propose small projects outside of renewal times (i.e. updating deliverables of original agreement, or additional seed funding)

Other Insight

- Gatherings are useful for pushing work forward (i.e. GCAM workshop, DOE PI meeting, AGU...)
 - Potential for virtual gatherings to play that role as well
- Helpful to have deadline for deliverables (e.g. special issue, conference...)

Thank you!