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science for global insight

Future exposure and vulnerability to multi-sector hotspots

Edward Byers, Matthew Gidden, Peter Burek, David LeClere, Amanda Palazzo, Joeri Rogelj, Yusuke Satoh, Yoshi Wada, Petr Havlik, Volker Krey, Simon Langan, Barbara Willaarts, Keywan Riahi

International Institute for Applied Systems Analysis, Laxenburg, Austria
edward.byers@iiasa.ac.at

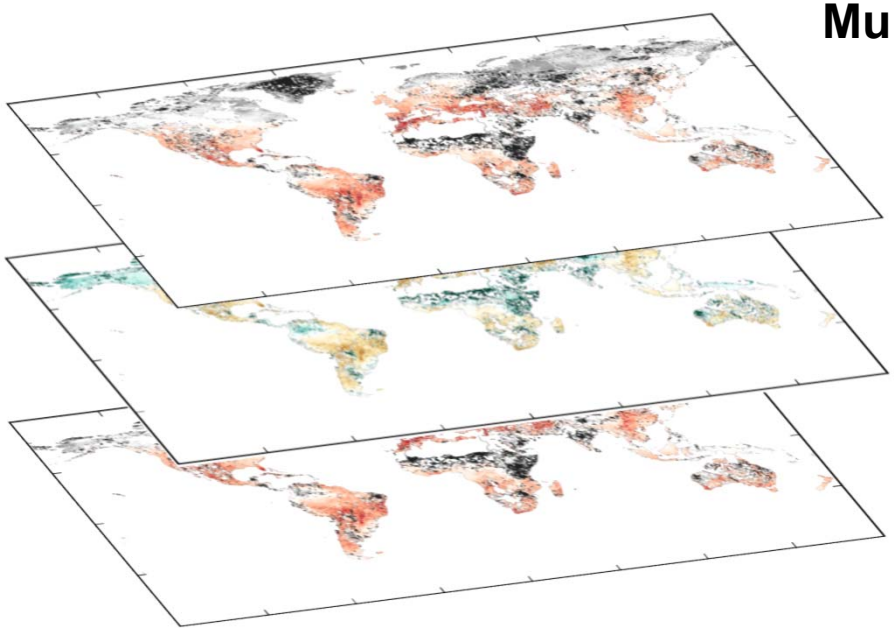
Impacts World 2017

C8: Socio-economic consequences of climate extremes and compound impacts

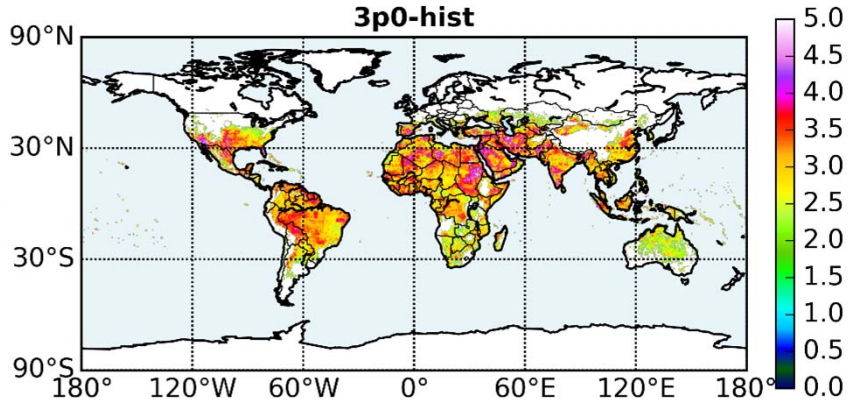
11th October 2017

Global mapping of multi-sector climate and vulnerability hotspots

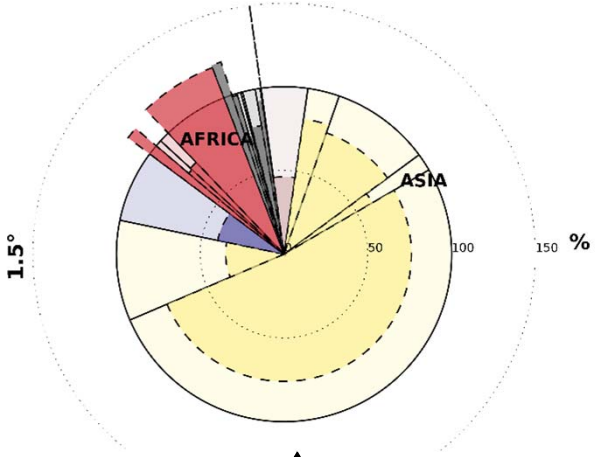
Multiple Indicators (~12) across 3 sectors



combined indicators



Regions with multi-sector climate hotspots and vulnerable populations



Downscaling future scenarios of socioeconomic change

- **Shared Socioeconomic Pathways (SSPs)**

O'Neill et al. (2014)

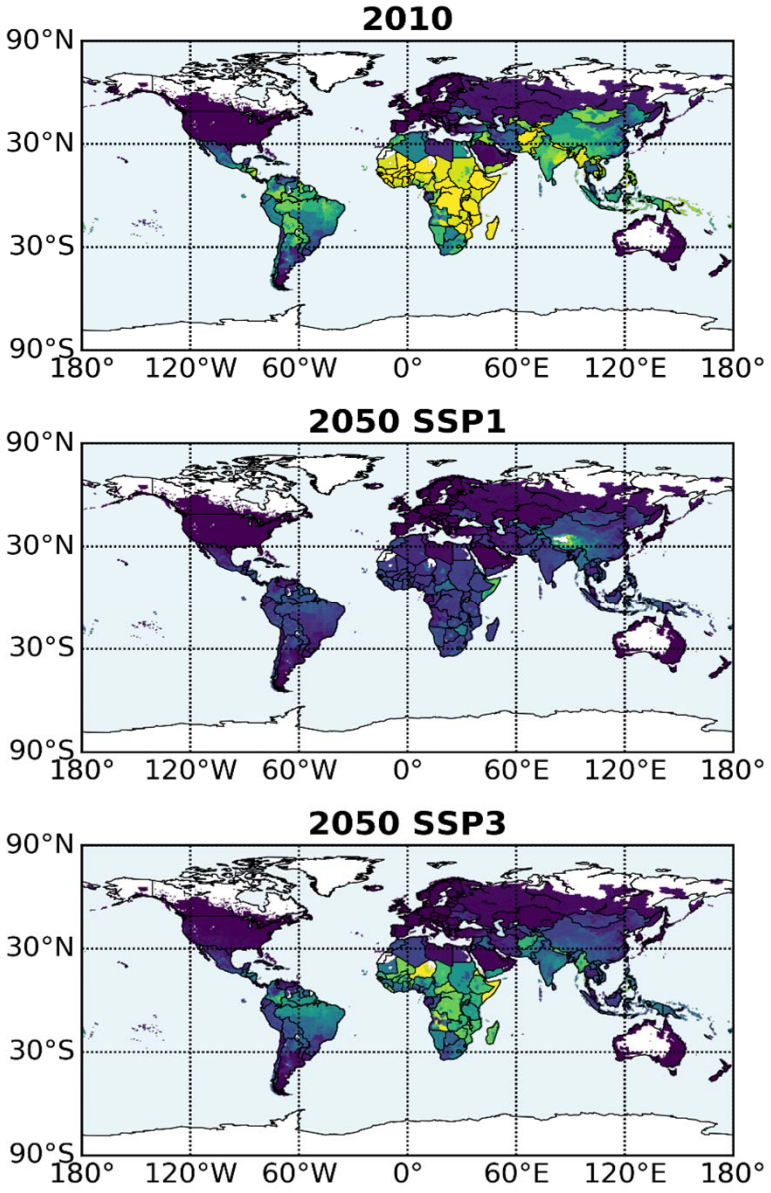
- **Population**
- **Urbanization**
- **GDP**
- **GINI (inequality)**
- **Income**

Jones & O'Neill (2016)
Jiang & O'Neill (2017)
Dellink et al. (2017)

Gridded to 0.125° (1/8th °)

Gidden et al. (…, *forthcoming*)

Who is vulnerable to poverty (<$10/day)?



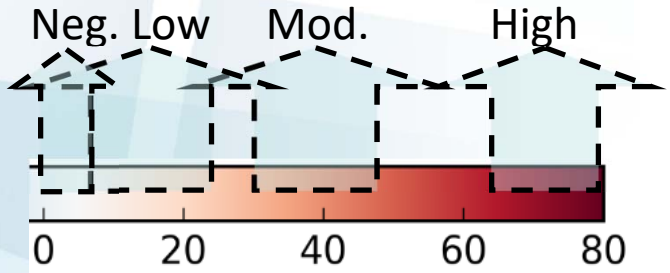
Indicators

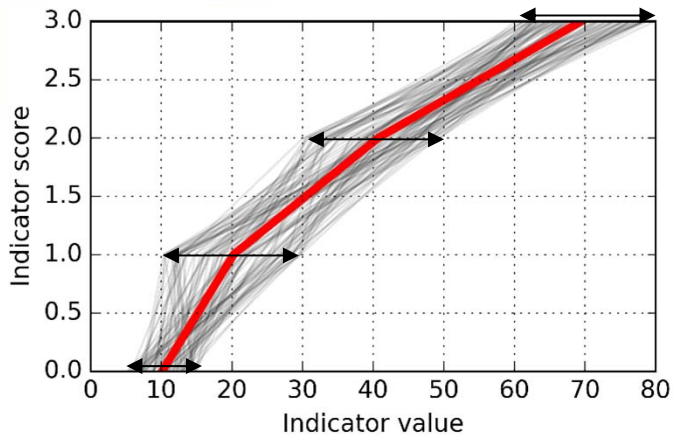
Indicator	Description	Models
Water		
Water stress index	Water stress index: as a proportion of human demands divided by renewable surface water resources	5 GCMs, 3 GHMs
Non-renewable GW abstraction index	Fraction of groundwater abstraction that is non-renewable	HadGEM2-ES + PCR-GLOBWB
Drought intensity	% change in drought intensity (deficit / duration)	5 GCMs, 4 GHMs
Peak flows risk	High fraction of ensemble agreement where substantial change in flood risk (doubling) is expected	5 GCMs, 4 GHMs
Seasonality	% change for the index of mean seasonality	5 GCMs, 4 GHMs
Inter-annual variability	% change for the index of mean inter-annual variability	5 GCMs, 4 GHMs
Energy		
Access to clean cooking	*Fraction of population with access to clean cooking*	MESSAGE + SSPs
Heatwave event exposure	Total days experienced as 5-day events above hist. p99 for locations where Tmean p99>26°C.	5 GCMs
Cooling demand growth	Measure absolute change in CDD>26°C.	5 GCMs
Hydroclimate risk to power production	Combined thermal and hydropower capacity impacted by changes in low flows, peak flows and variability	5 GCMs, 4 GHMs
Land		
Crop yield	Mean change in crop yield as basket of staple crops	GLOBIOM
Water exploitation index	Identify major changes of agriculturally driven water exploitation	GLOBIOM + LPJmL
Habitat degradation	Change from non-ag to agricultural land use	GLOBIOM
Nitrogen leaching	*Measurement of excess nitrogen leaching due to intensive agriculture*	GLOBIOM

Climate change index scoring under uncertainty

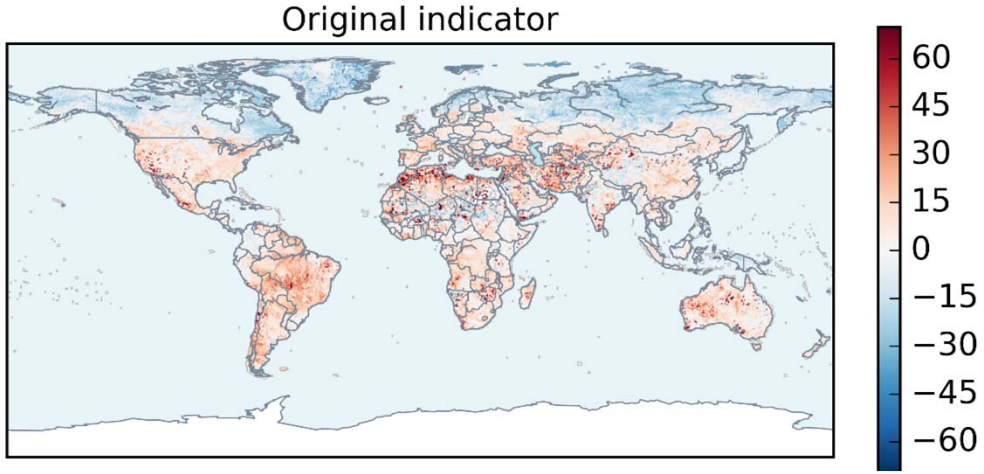
Continuous scale (0 to 3) with intermediate ranges determined

0. Negligible risk
1. Low risk
2. Moderate risk
3. High risk





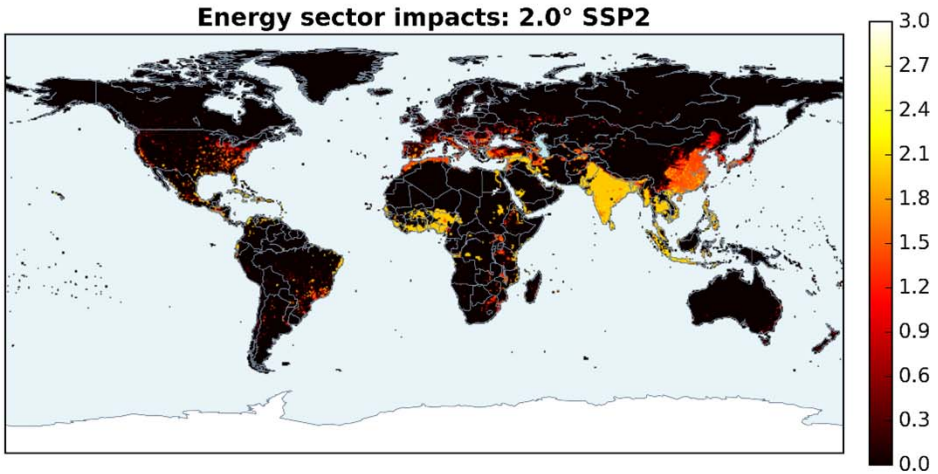
2.0°C climate example: Drought intensity change

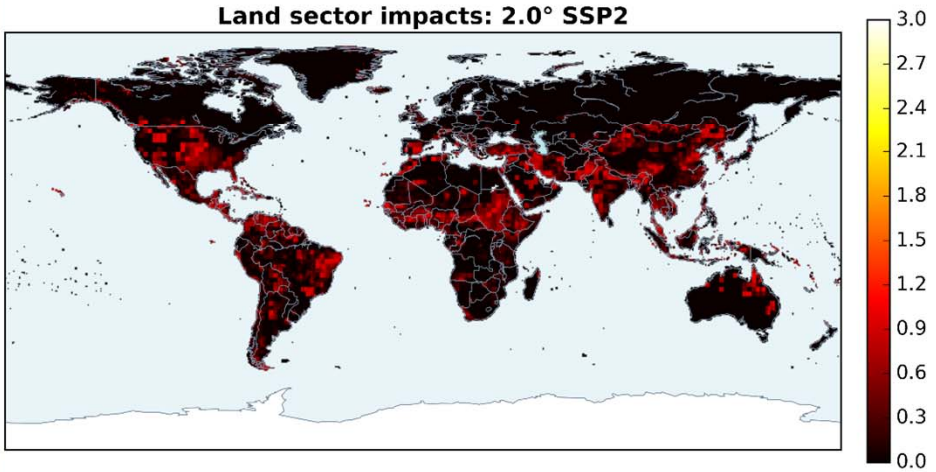


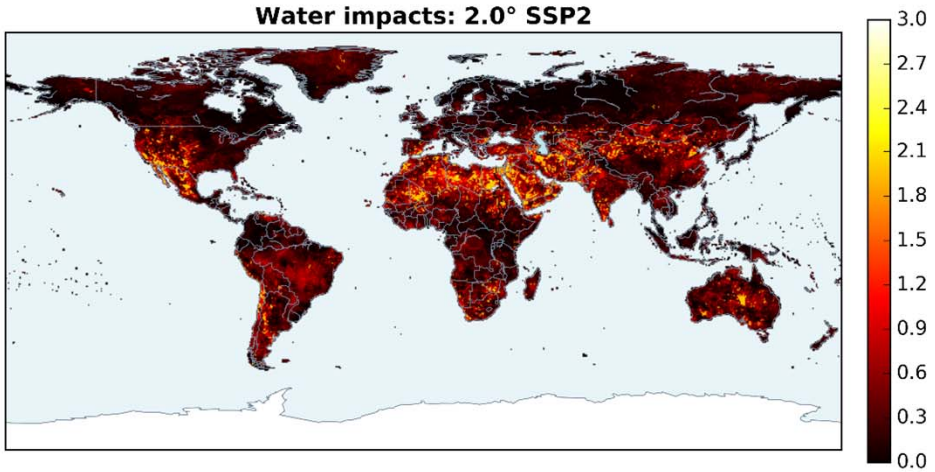
Sectoral aggregation

Combine average scores with 'hotspot points'

- Scores are averaged within sectors and indicators can be weighted
- Hotspots:
  - Min. score 2 if 2 sectors > 2.5
  - Min. score 2 in 1 sector == 3.0

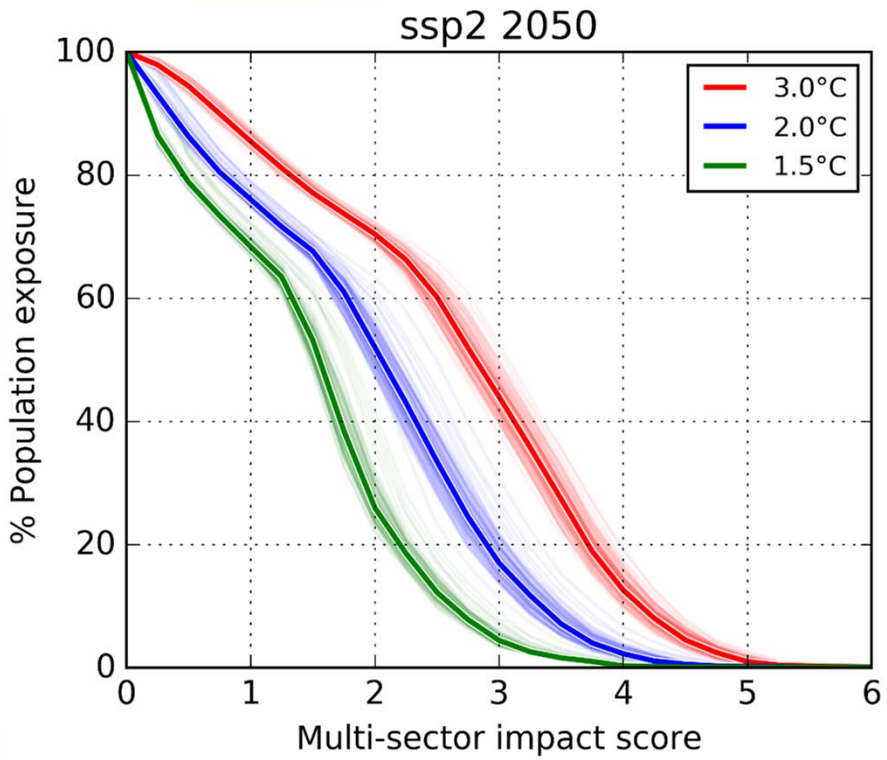


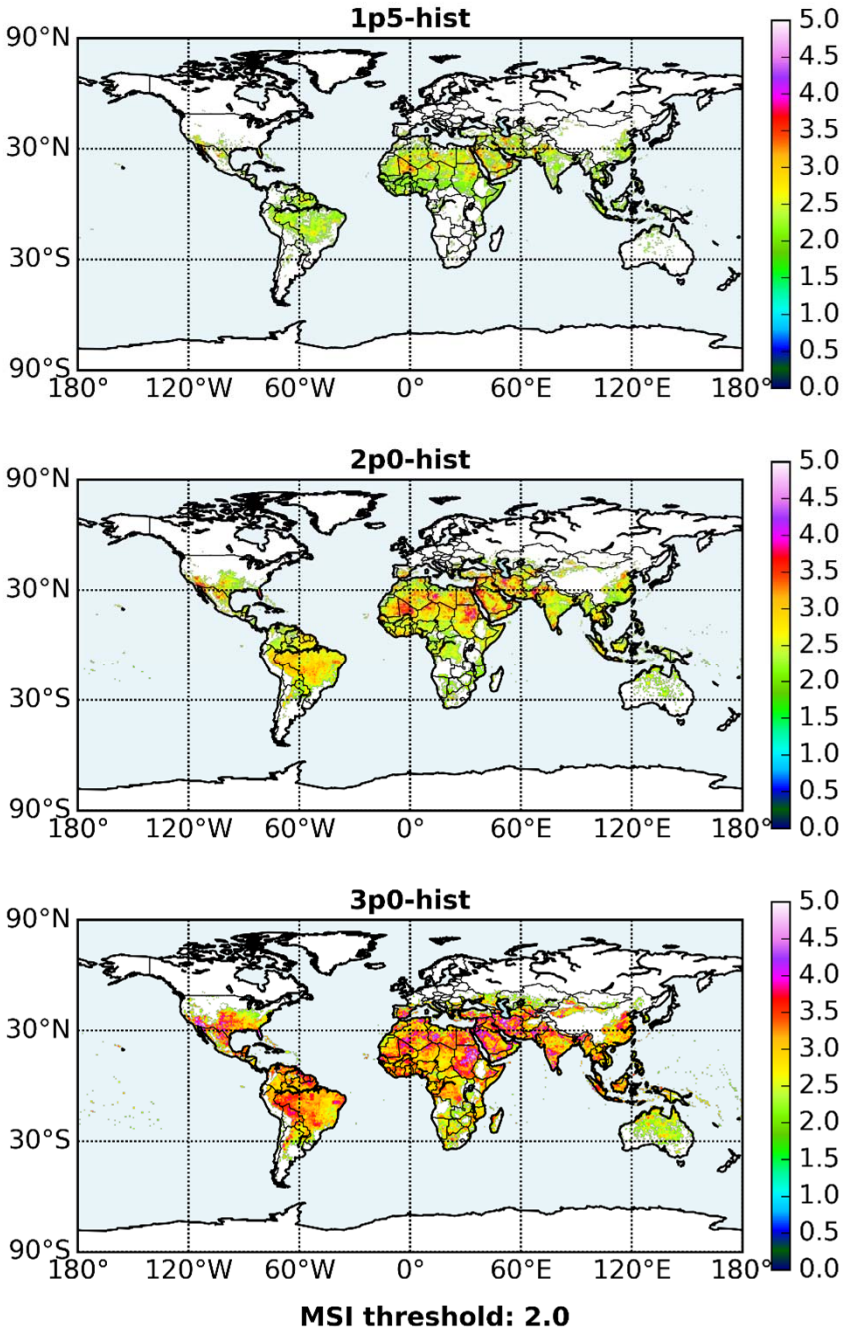




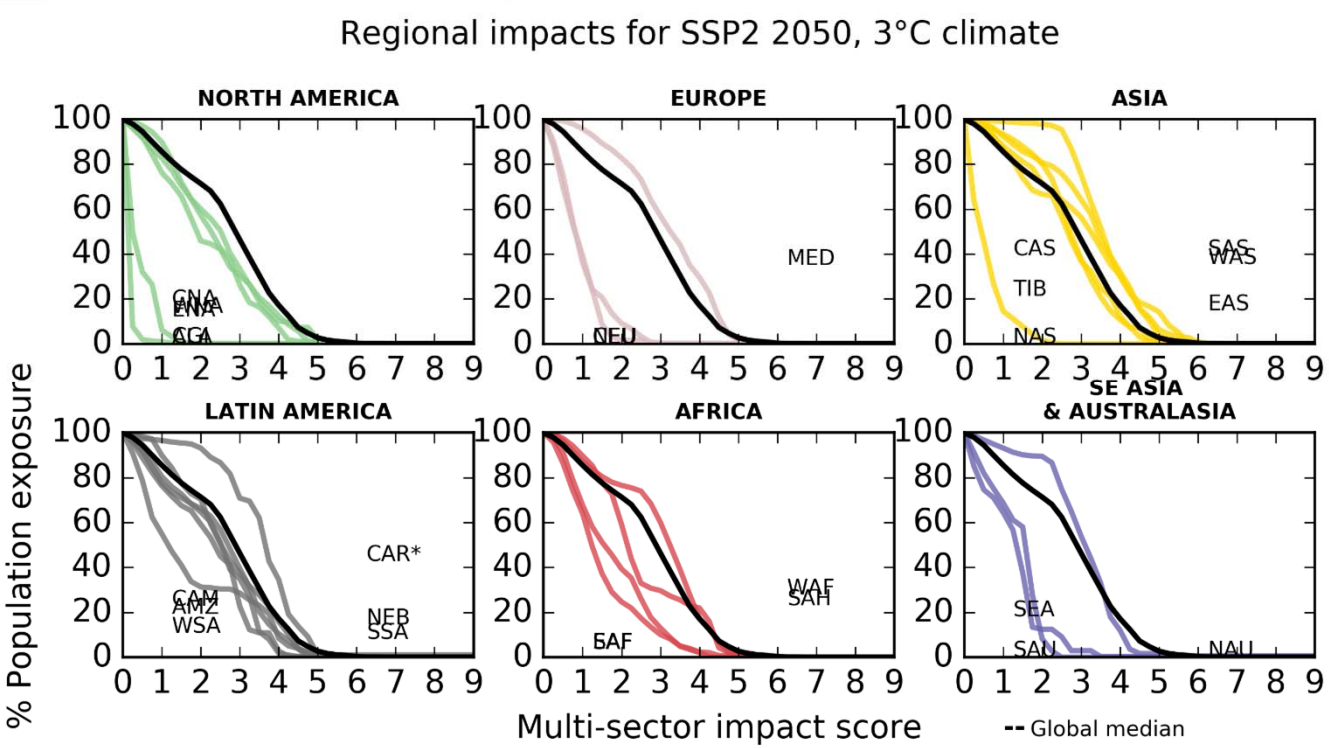
Hotspot areas

- **Growing in area**
- **Growing in intensity**



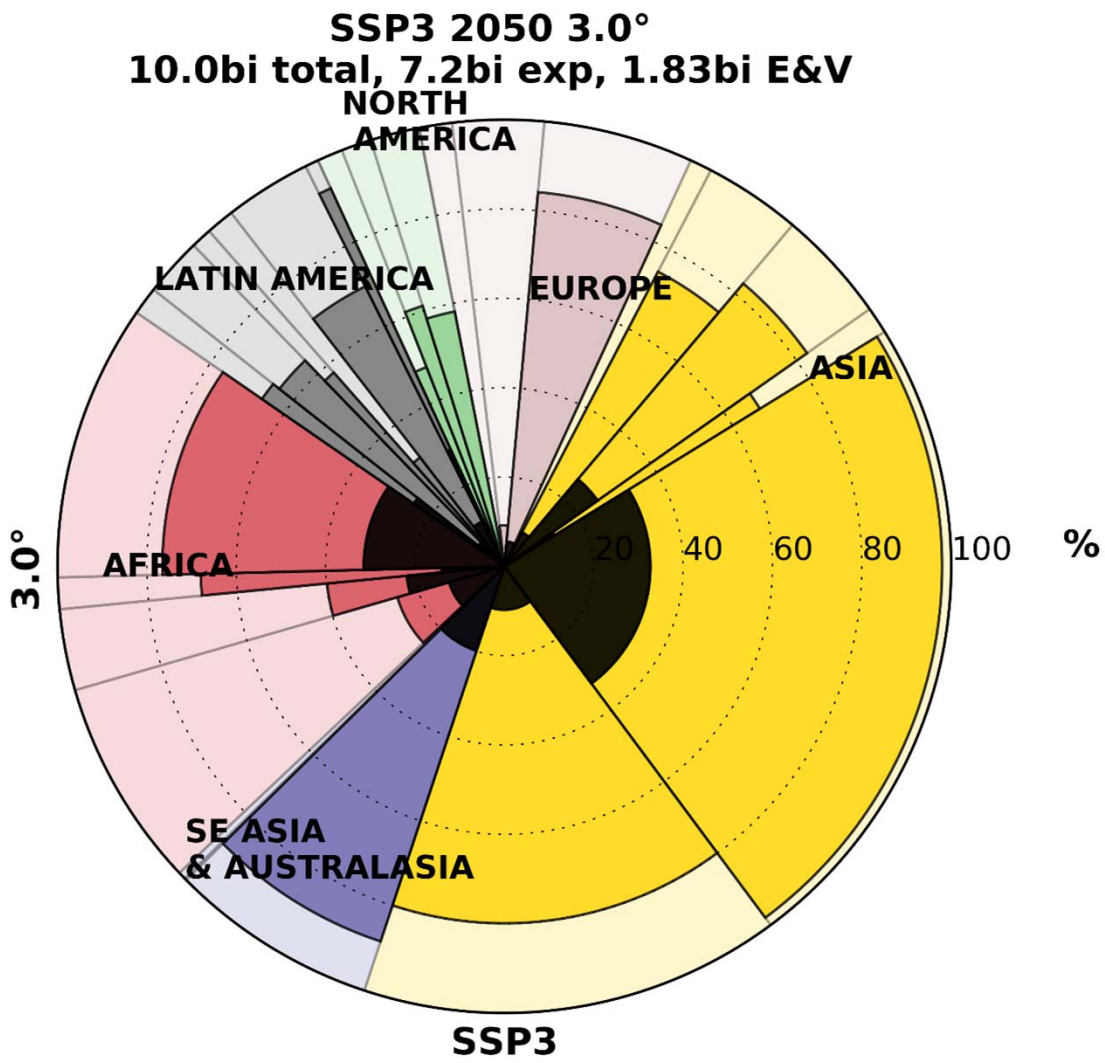


Regionalised impacts



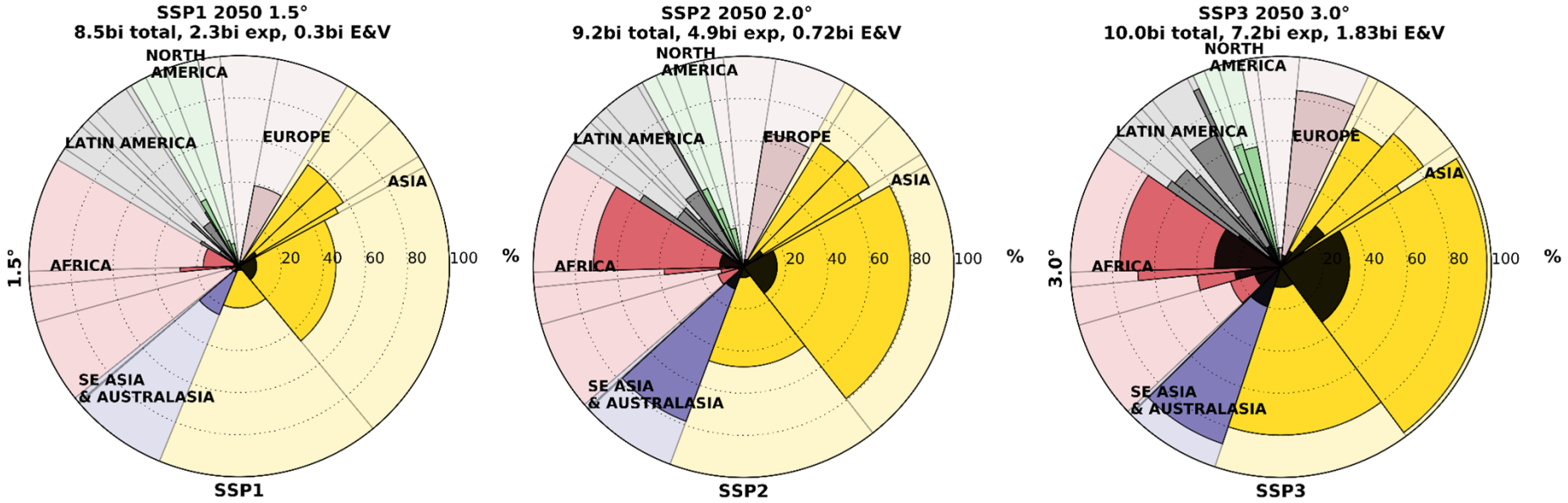
- Northern hemisphere regions have better than average impacts
- Most Asian and southern regions are on/worse than average

Exposure & vulnerability



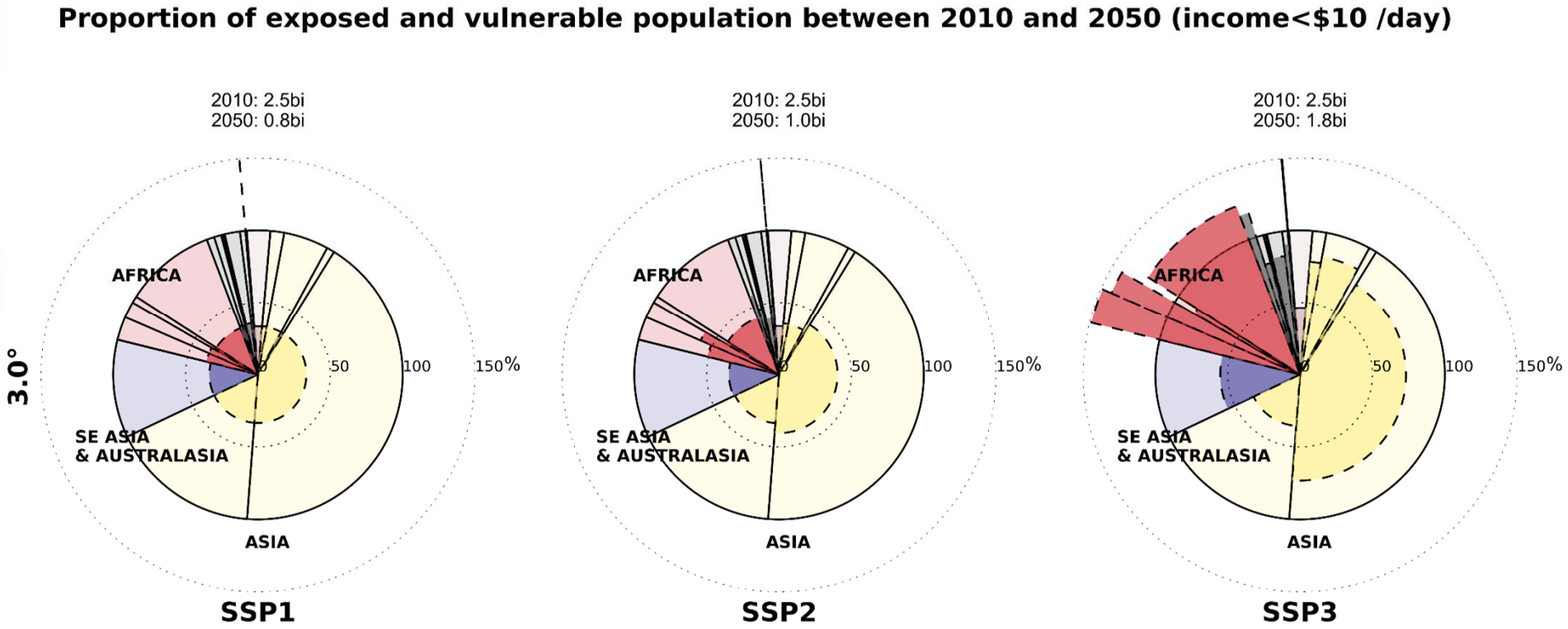
Exposure & vulnerability

2050	1.5°C / SSP1		2.0°C / SSP2		3.0°C / SSP3
T	8.5 bi		9.2 bi		10.0 bi
E	2.3 bi	x2	4.9 bi	x1.5	7.2 bi
V	1.1 bi		1.3 bi		2.7 bi
E&V	0.3 bi	x2	0.7 bi	x2.5	1.8 bi



Importance of reducing inequality

- Difference: SSP1/2 to SSP3 is factor of **~2**
- Holds true for range of thresholds and across GMTs



Conclusions

Water and hydroclimate

- Water stress indices are spatially concentrated and driven by socioeconomic drivers
- Large areas of land impacted by increases in drought intensity and variability

Overall

- Overall multi-sector exposure depends most on GMT
- Reducing inequality and poverty is key to reducing the Exposed & Vulnerable population, regardless of GMT