How large do atmospheric rivers get to be in Northern California?

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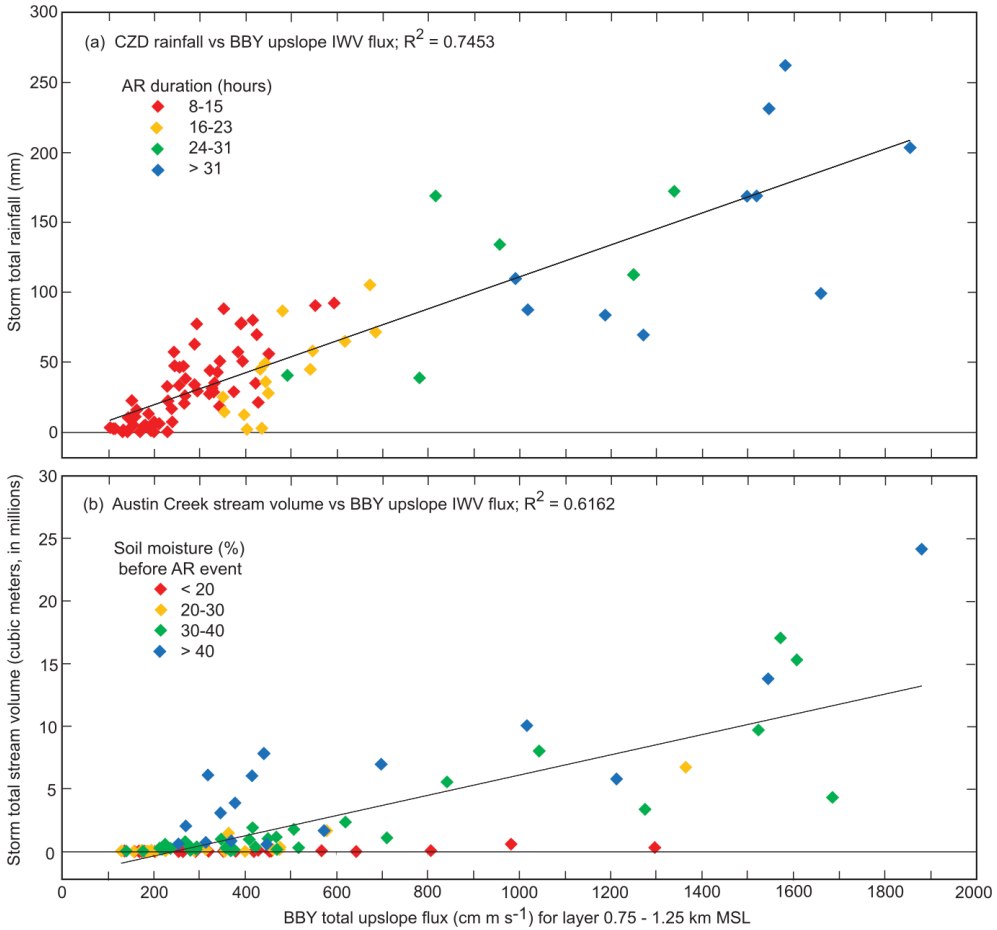
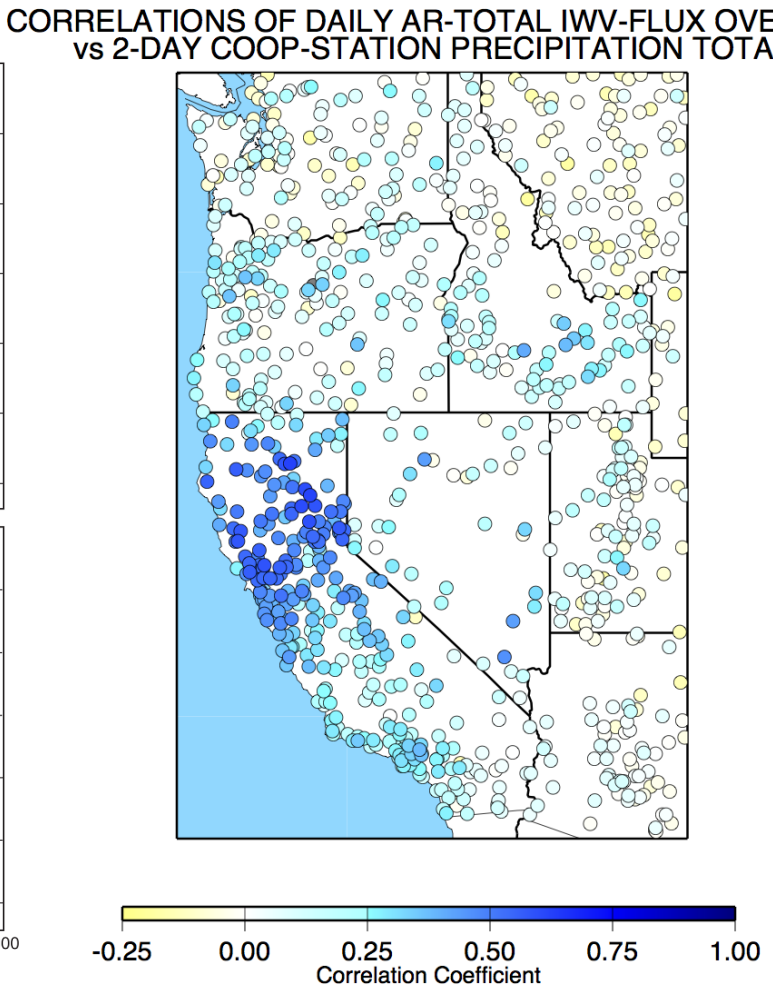
SCRIPPS INSTITUTION OF OCEANOGRAPHY AT UC SAN DIEGO

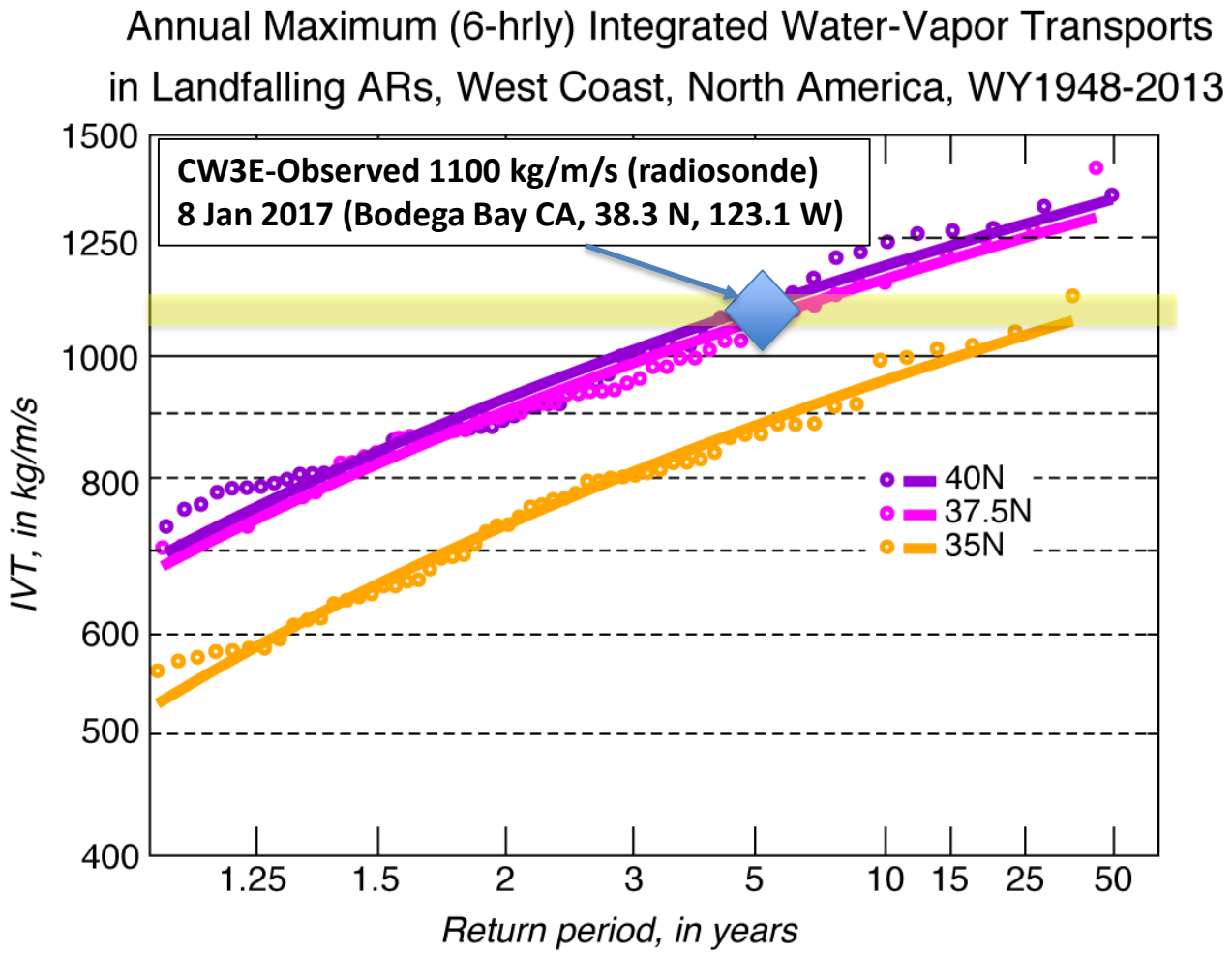
Heads up on extreme IVT → situational awareness re: extreme precip…





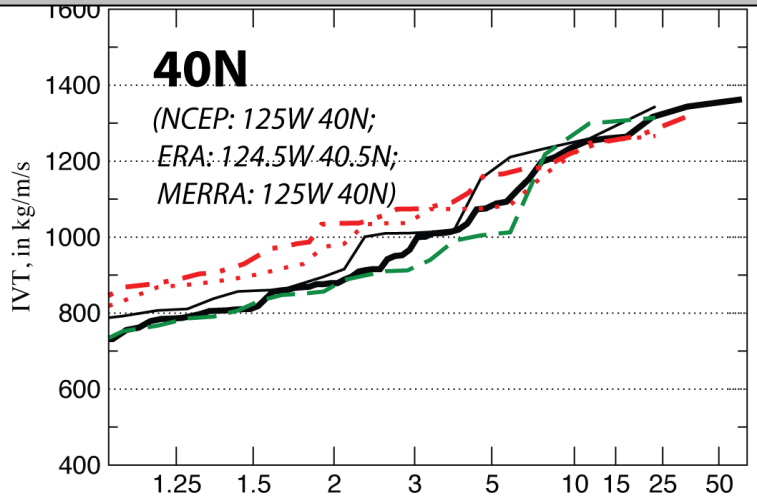
Ralph et al., JHM, 2013; Lavers et a., GRL, 2016

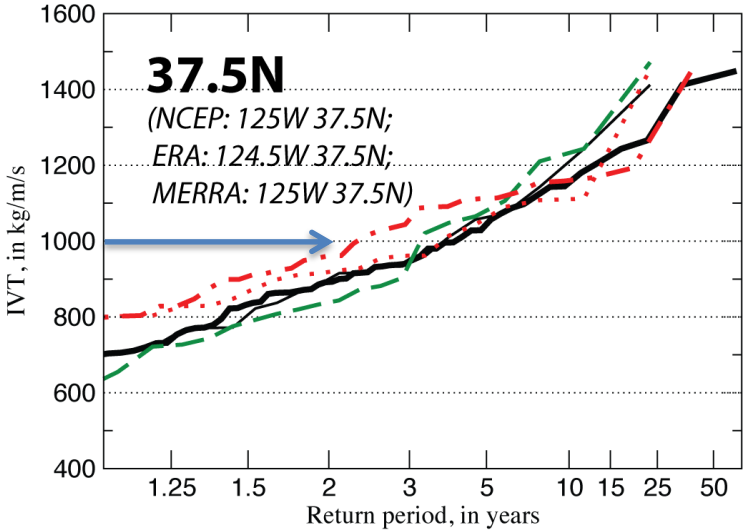
Return Period of Maximum IVT in the Landfalling Atmospheric River of 8 January 2017: ~ **5 years**

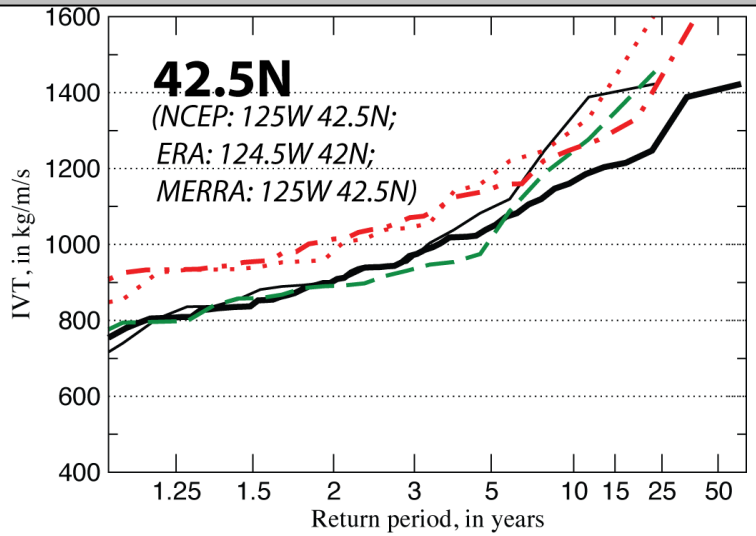


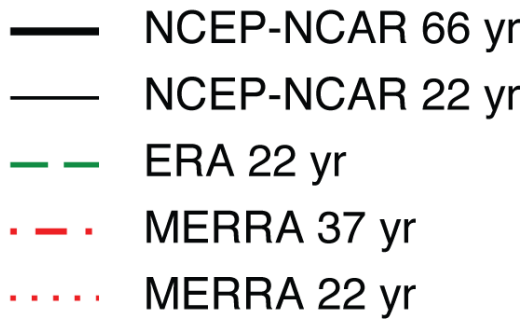
Mike Dettinger (USGS and CW3E), Marty Ralph (Scripps/CW3E)

Choice of Reanalyses to focus on…MERRA most conservative





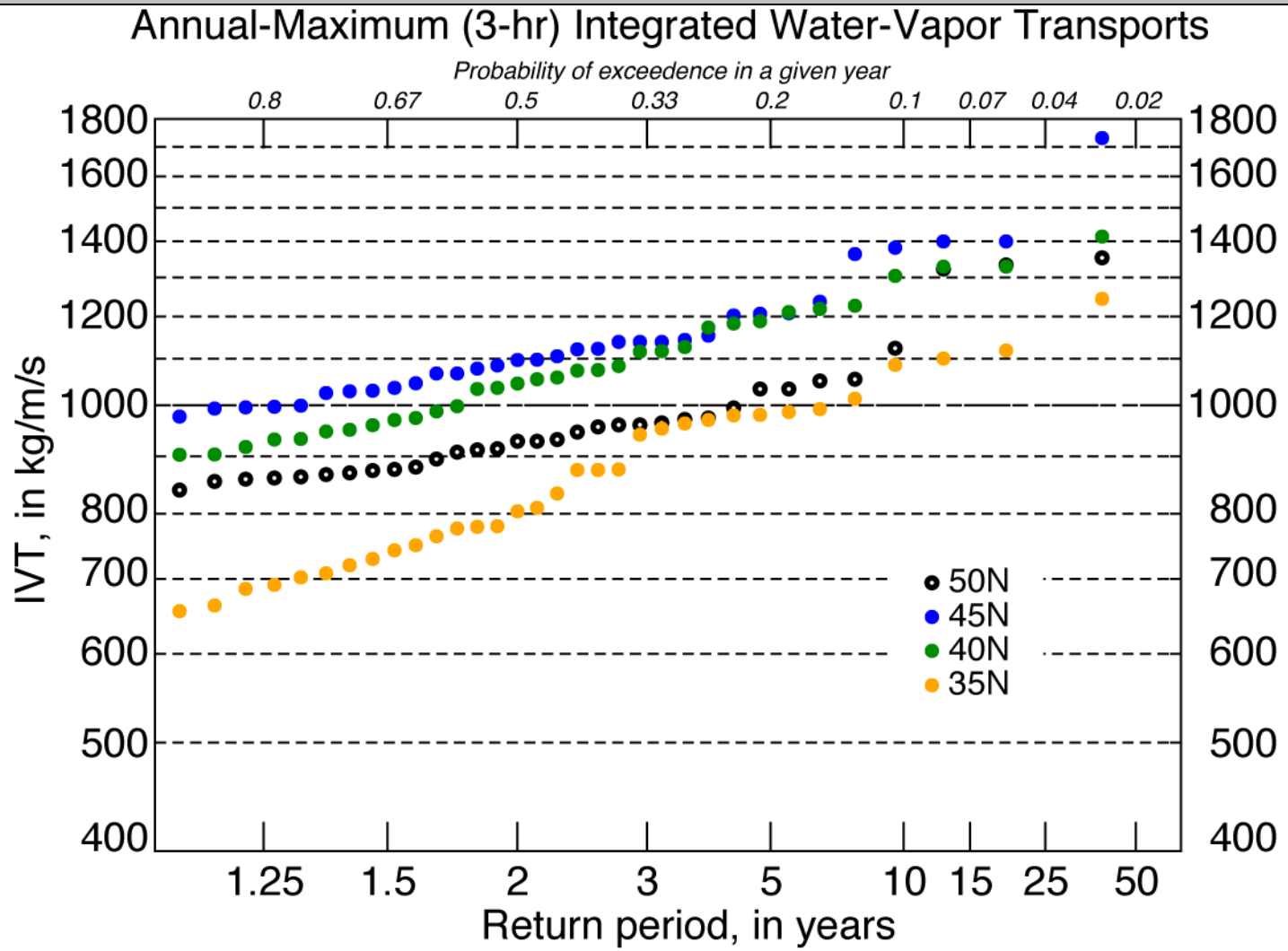




Based on Rutz et al., 2014, AR-detection methodology

Dettinger et al., JGRA, in review

MERRA 3-hrly IVT Return Periods, 1980-2016



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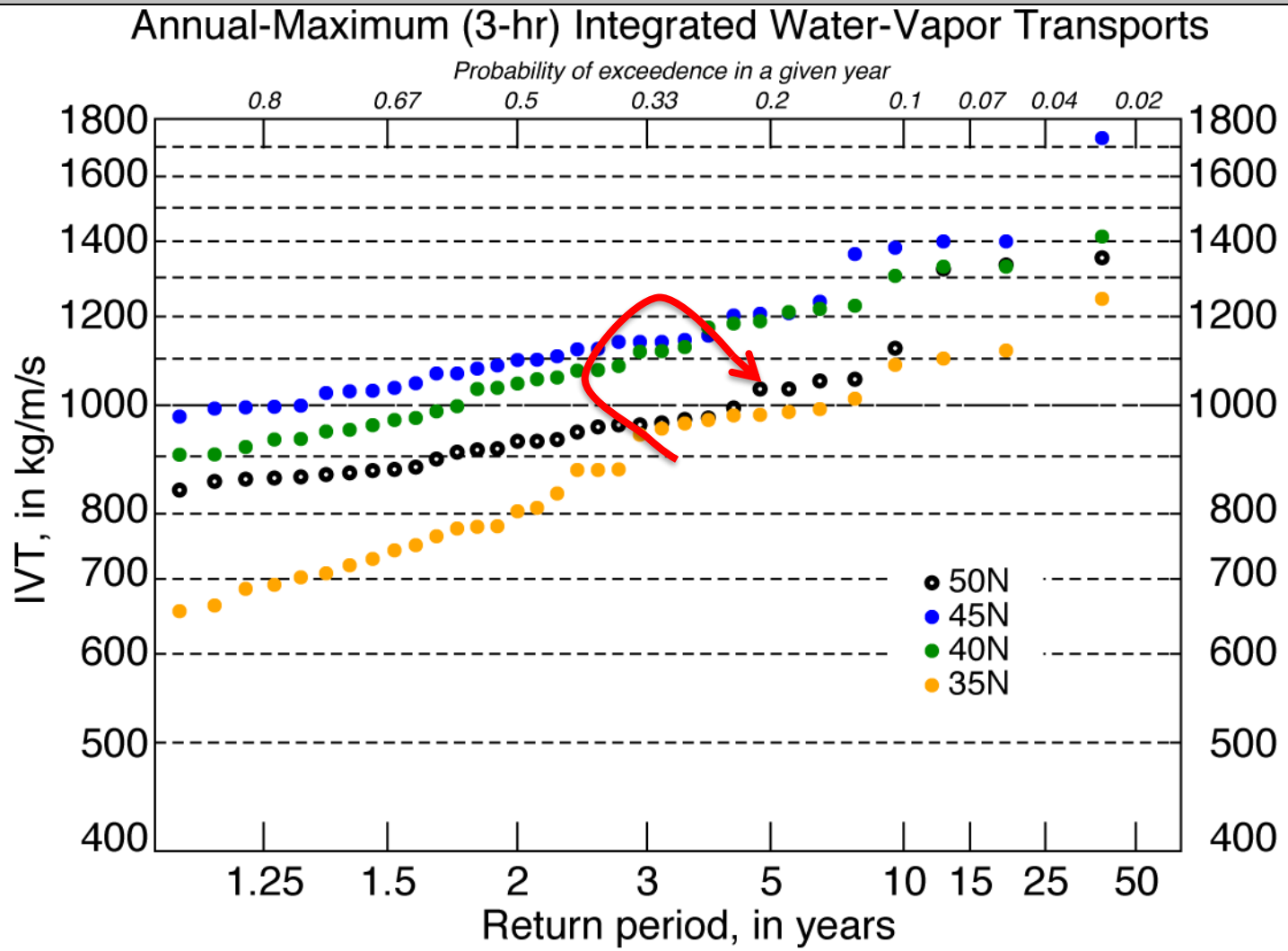
MERRA 3-hrly IVT Return Periods, 1980-2016



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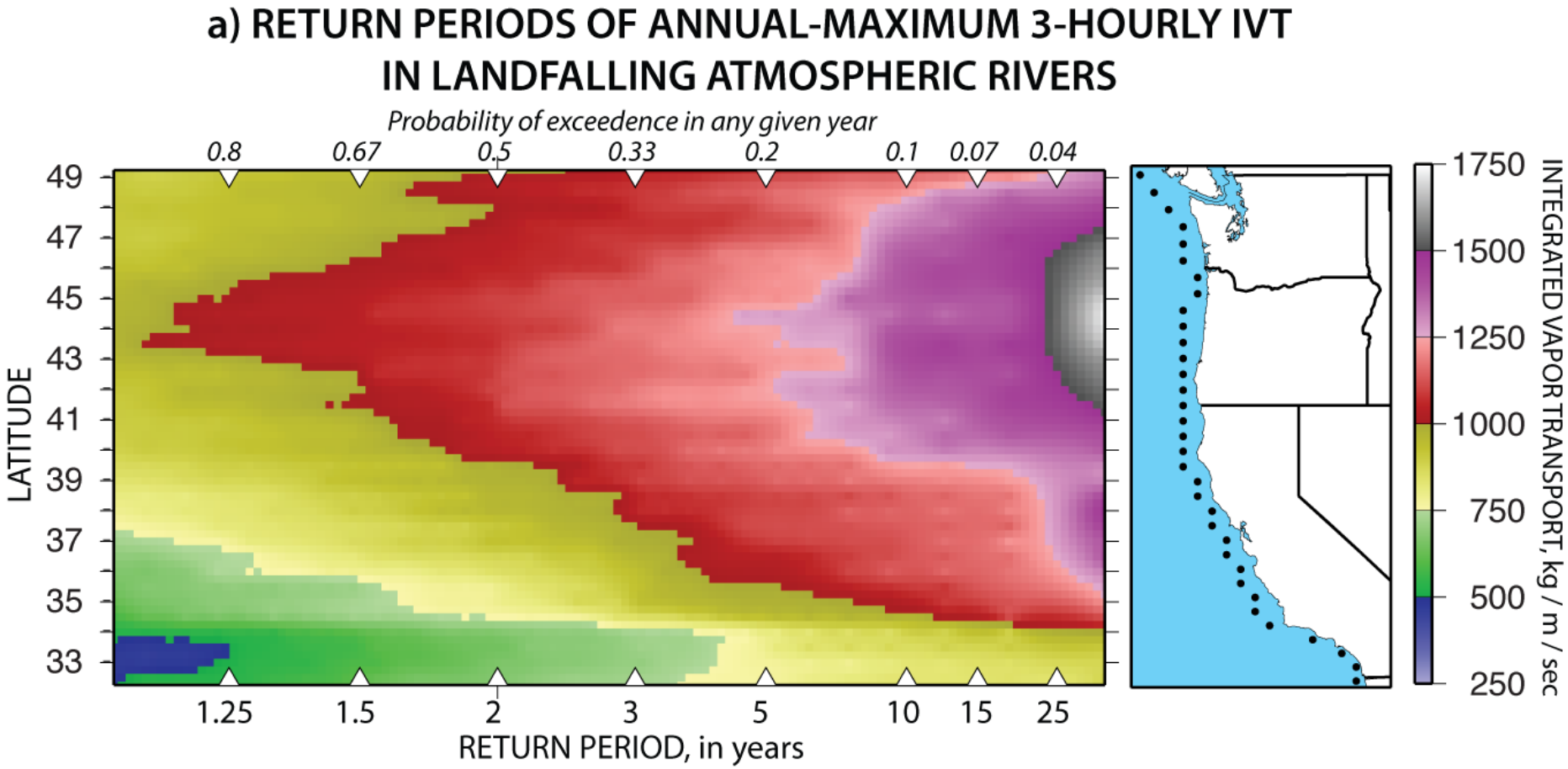
Geography of AR-IVT return periods



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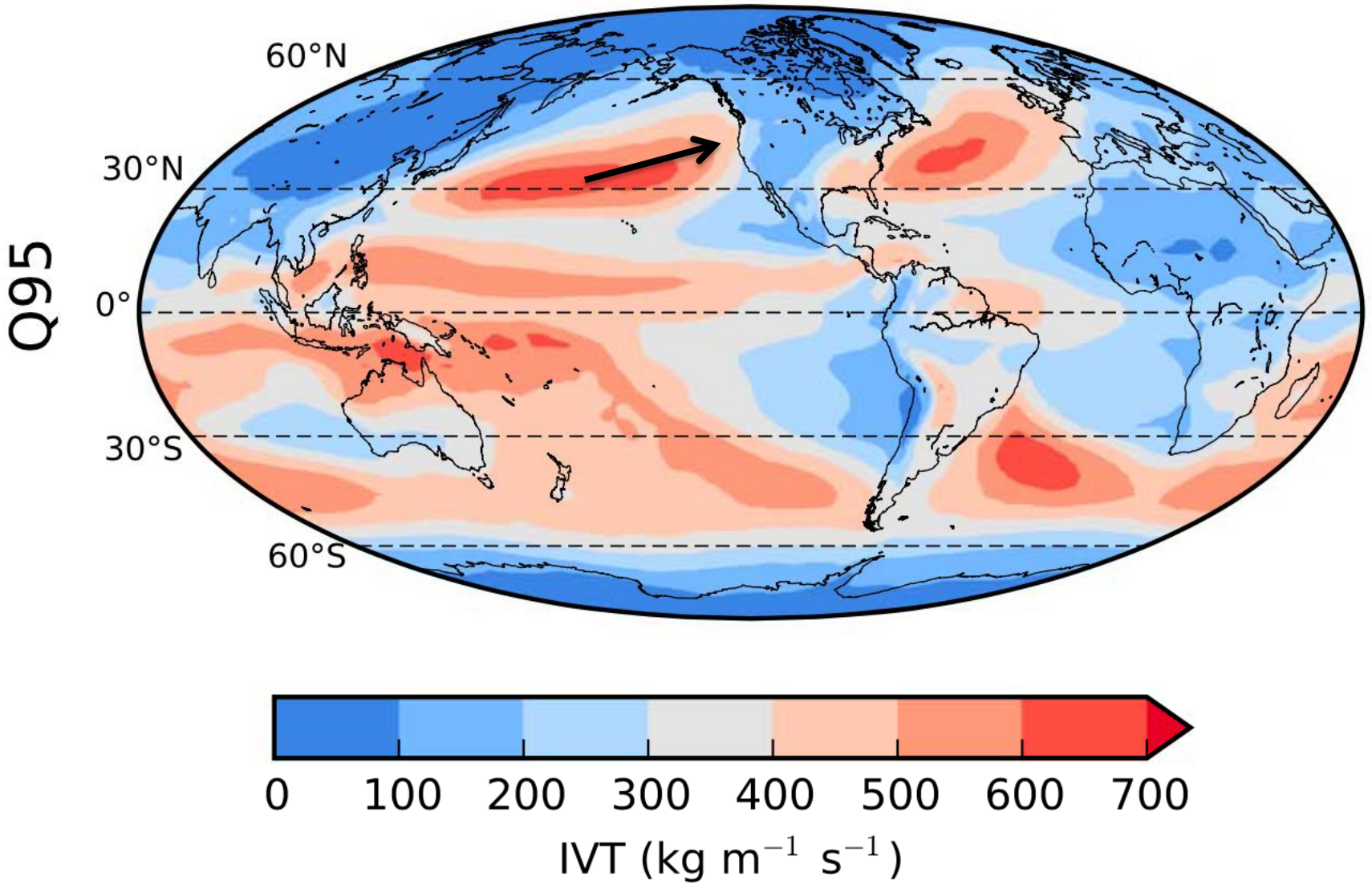
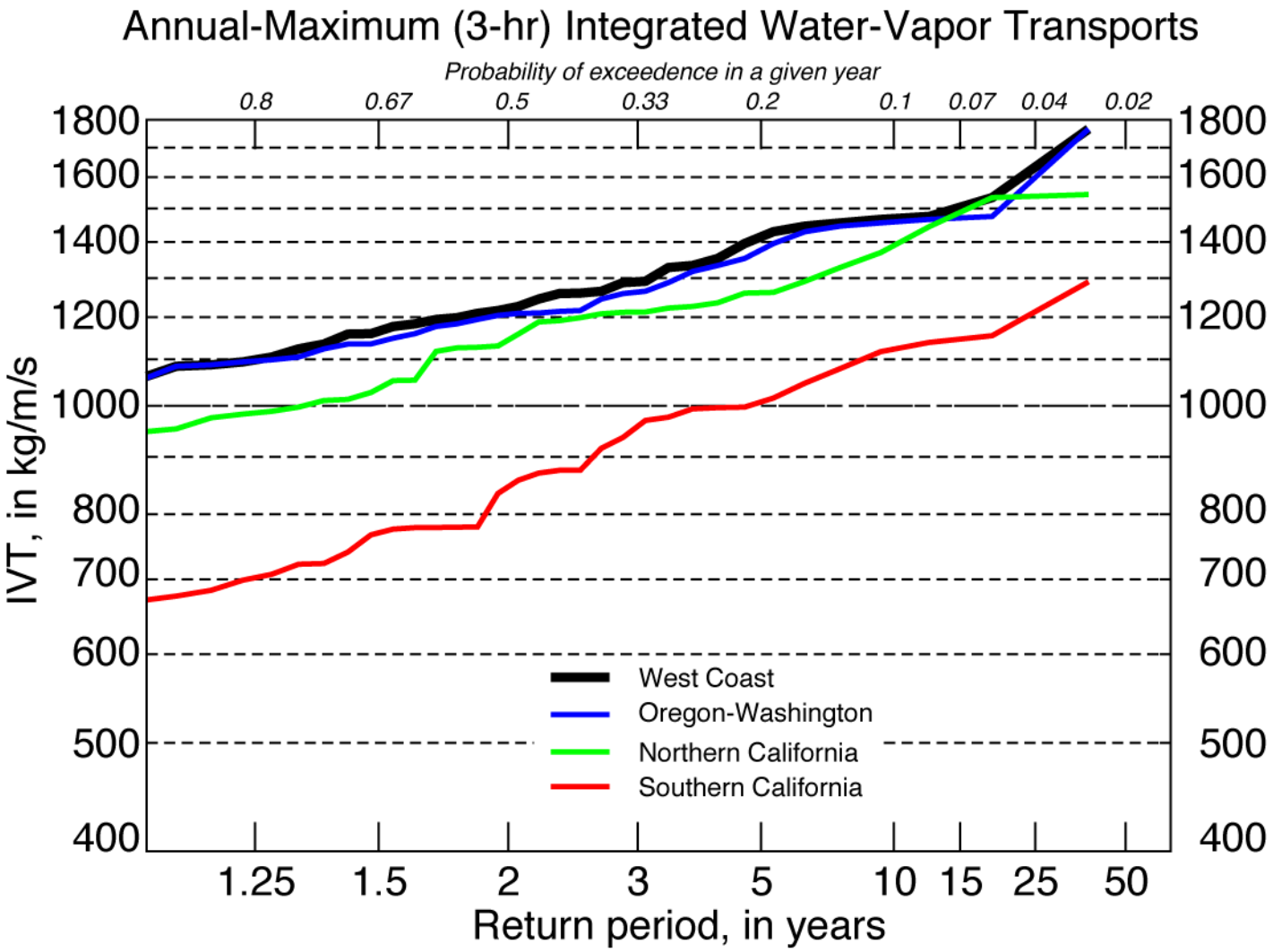
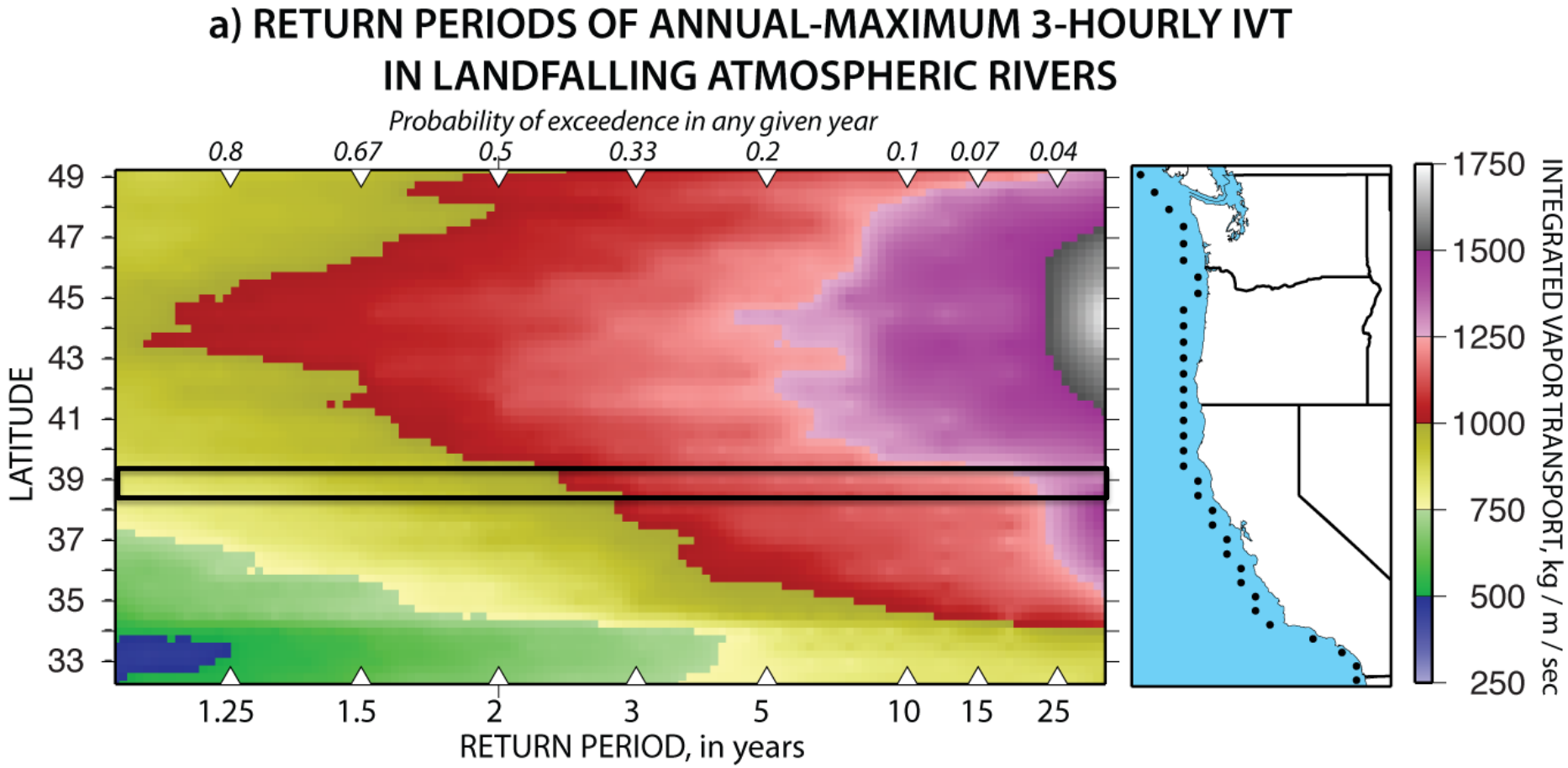
ERAI 95%-ile IVTs, 1979-2005



Lavers et al., GRL, 2015

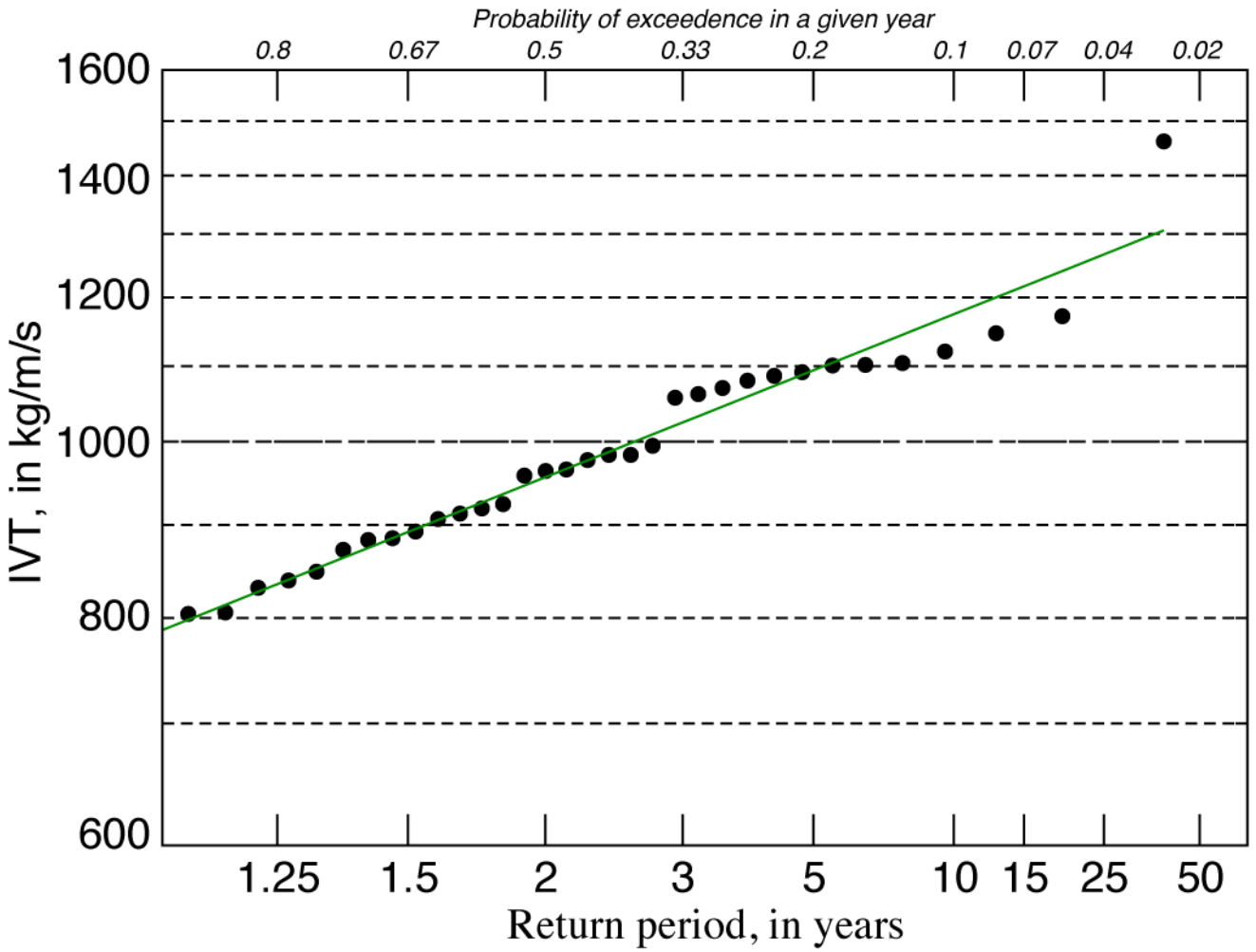

Annual-Maximum (3-hr) Integrated Water-Vapor Transports
Probability of exceedence in a given year
0.8
0.67
0.5
0.33
0.2
0.1
0.07
0.04
0.02
1800
1600
1400
1200
1000
800
700
600
500
400
IVT, in kg/m/s
West Coast
Oregon-Washington
Northern California
Southern California
1.25
1.5
2
3
5
10
15
25
50
Return period, in years

Geography of AR-IVT return periods



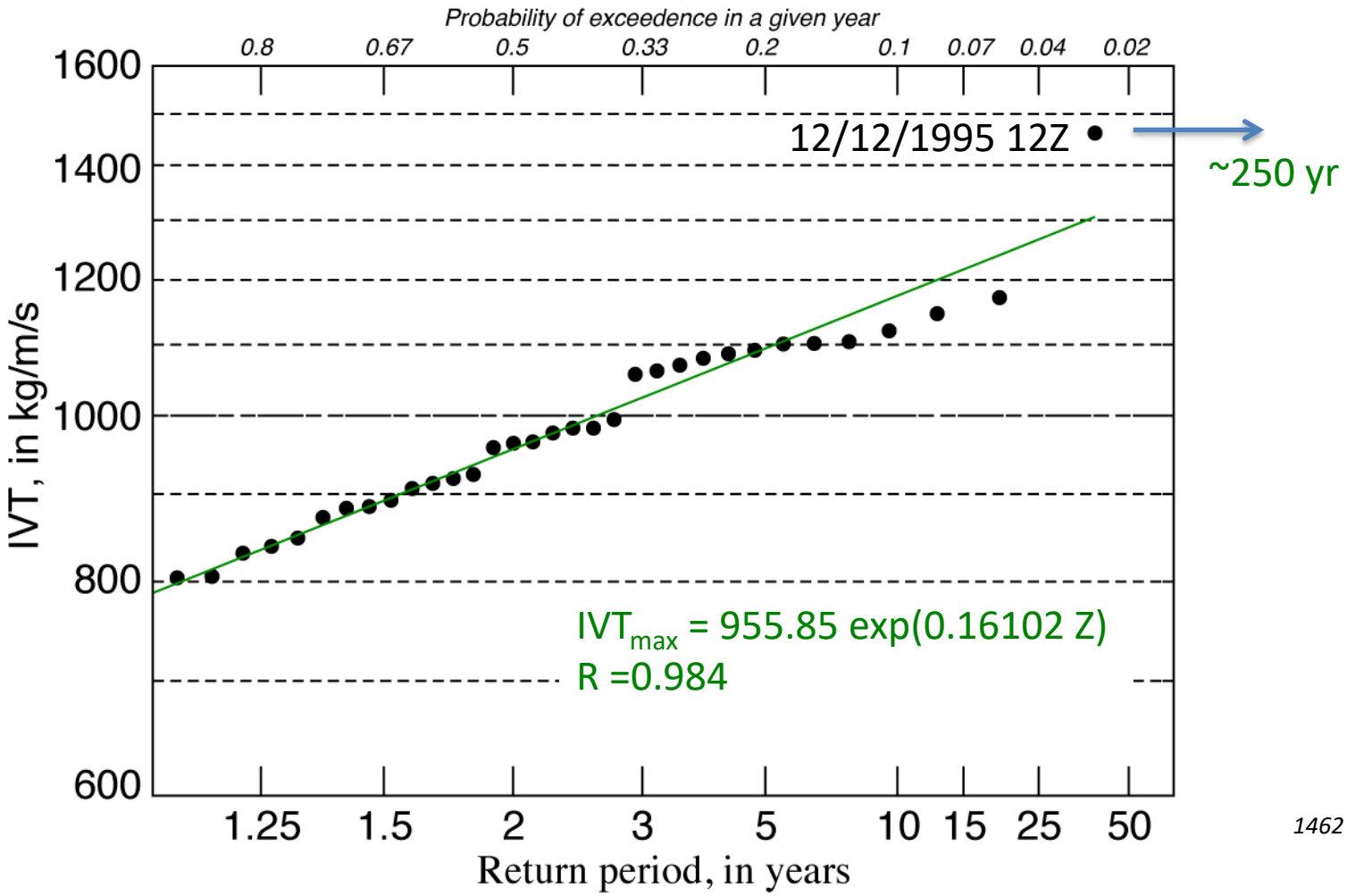
Dettinger et al., JGRA, in review

Russian River AR-IVT return periods

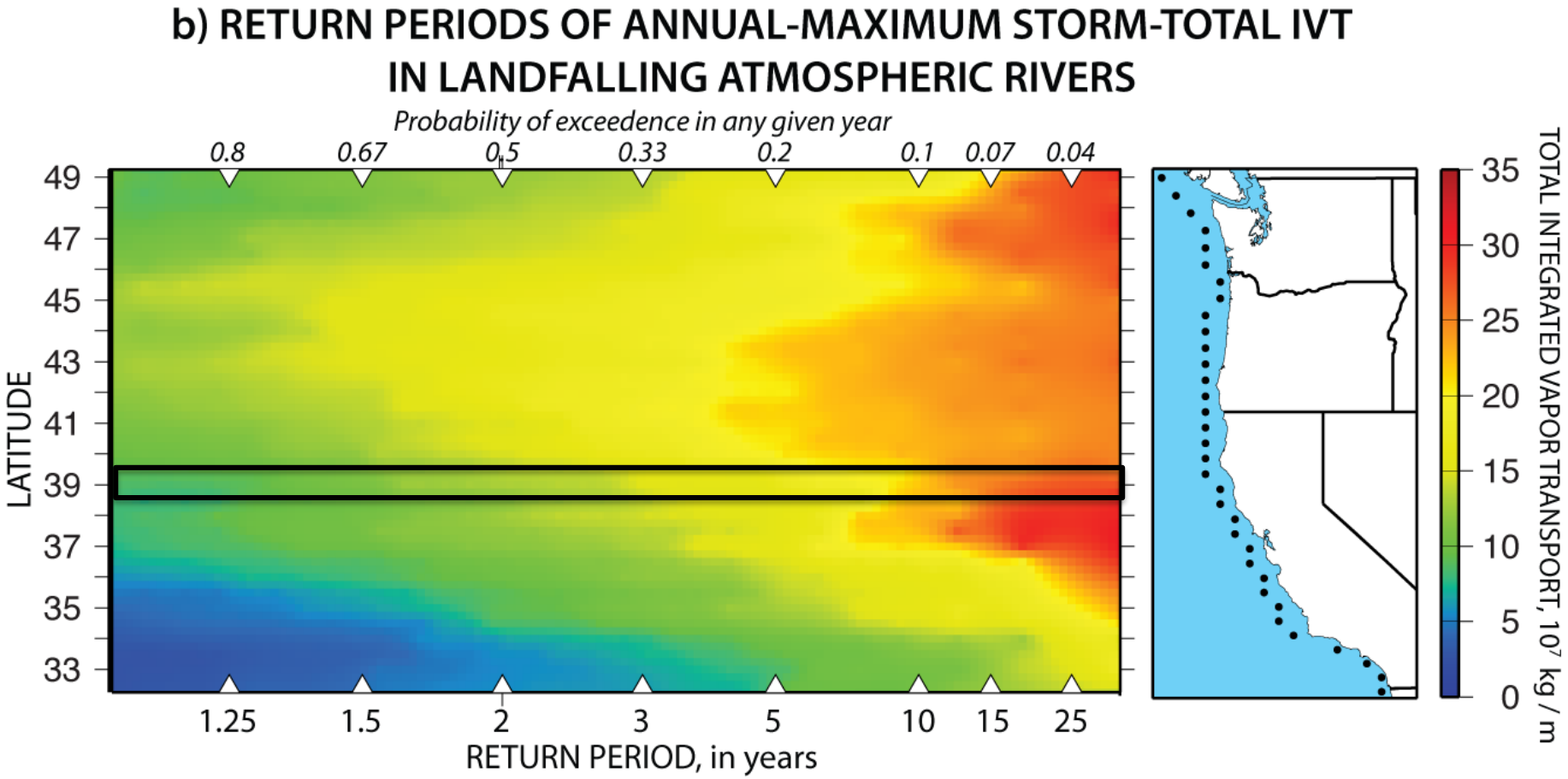


Dettinger et al., JGRA, in review

Russian River AR-IVT return periods

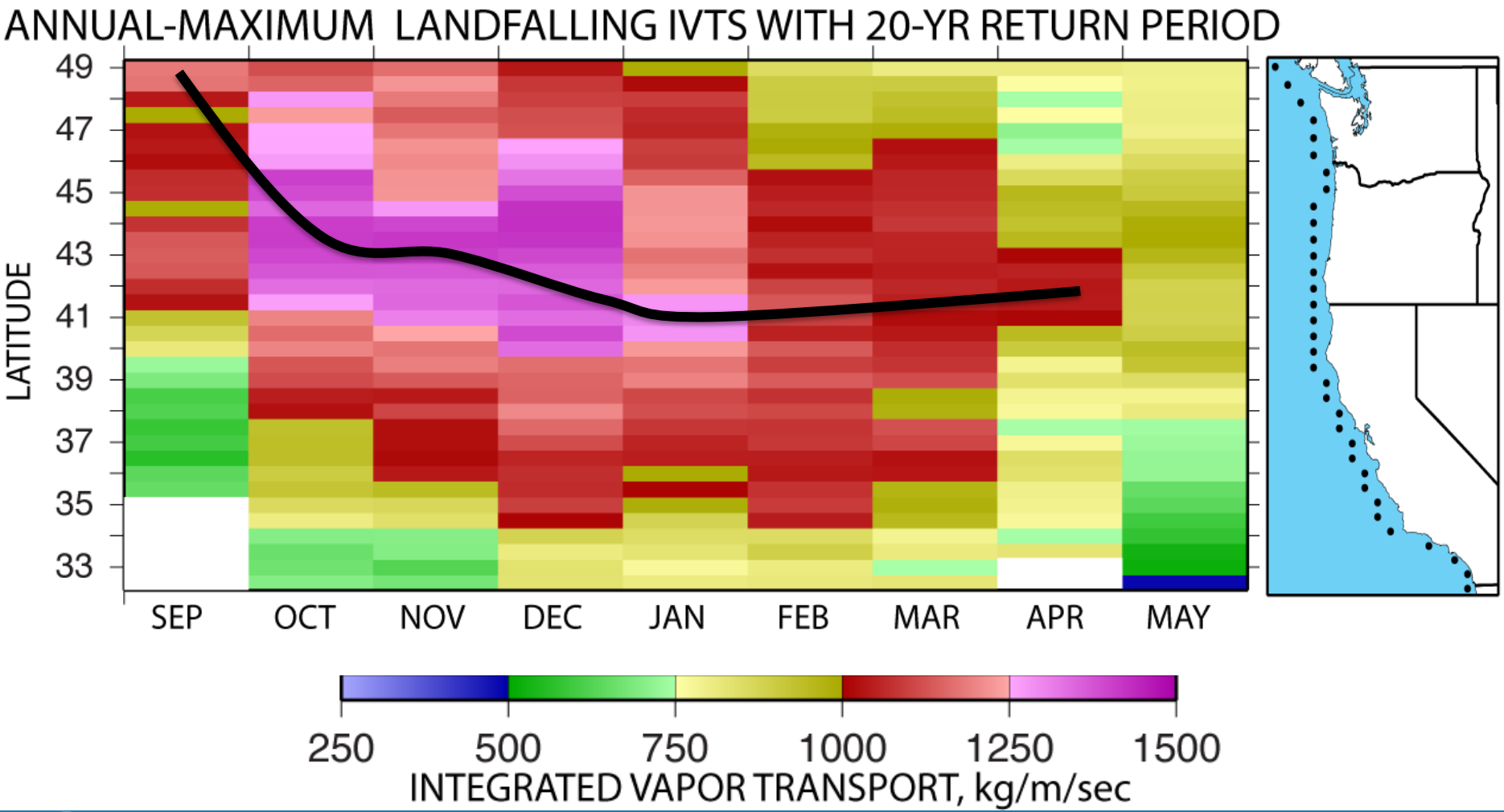


Geography of storm-total return periods



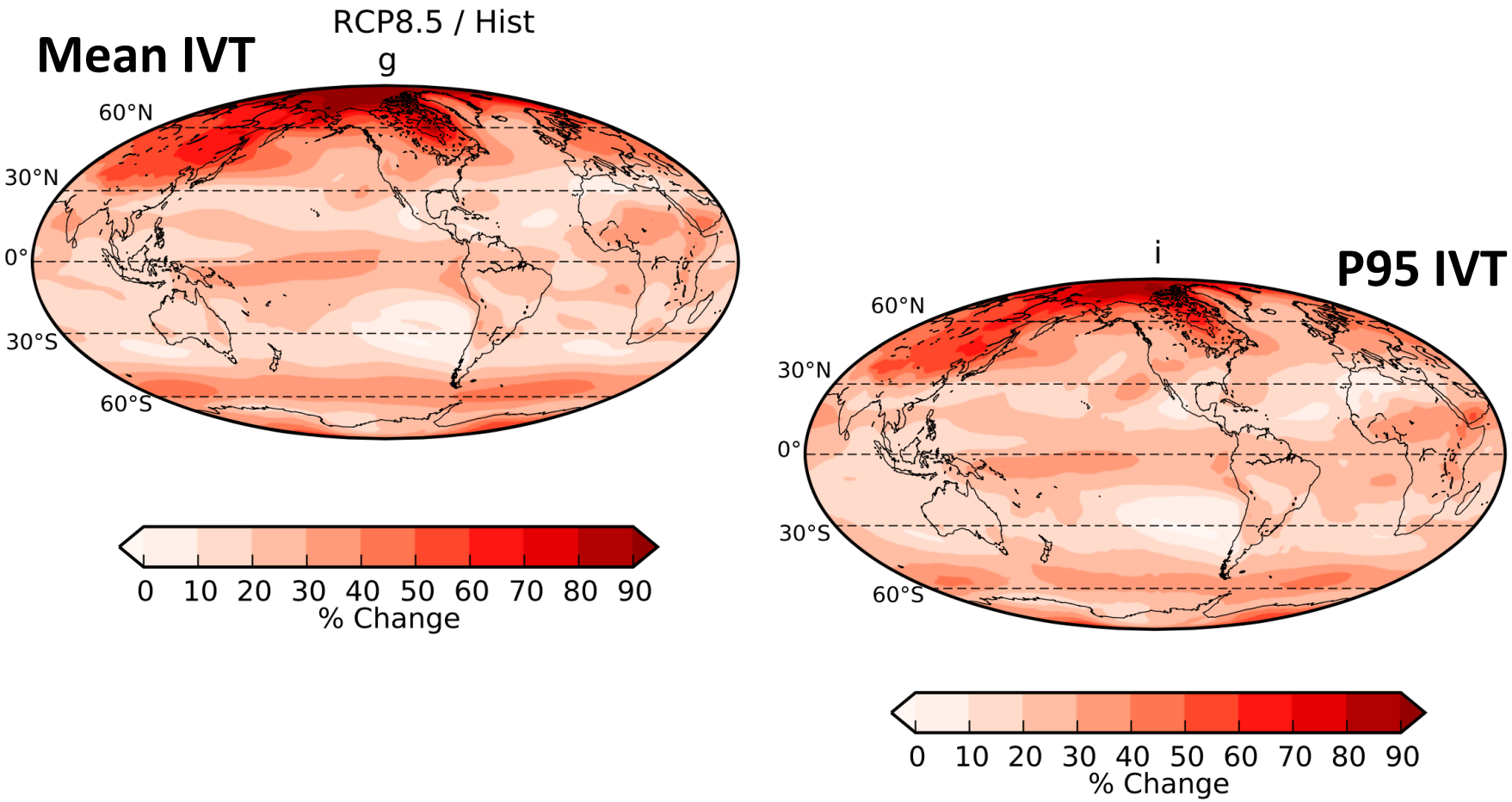
Dettinger et al., JGRA, in review

Seasonality of AR-IVT return periods



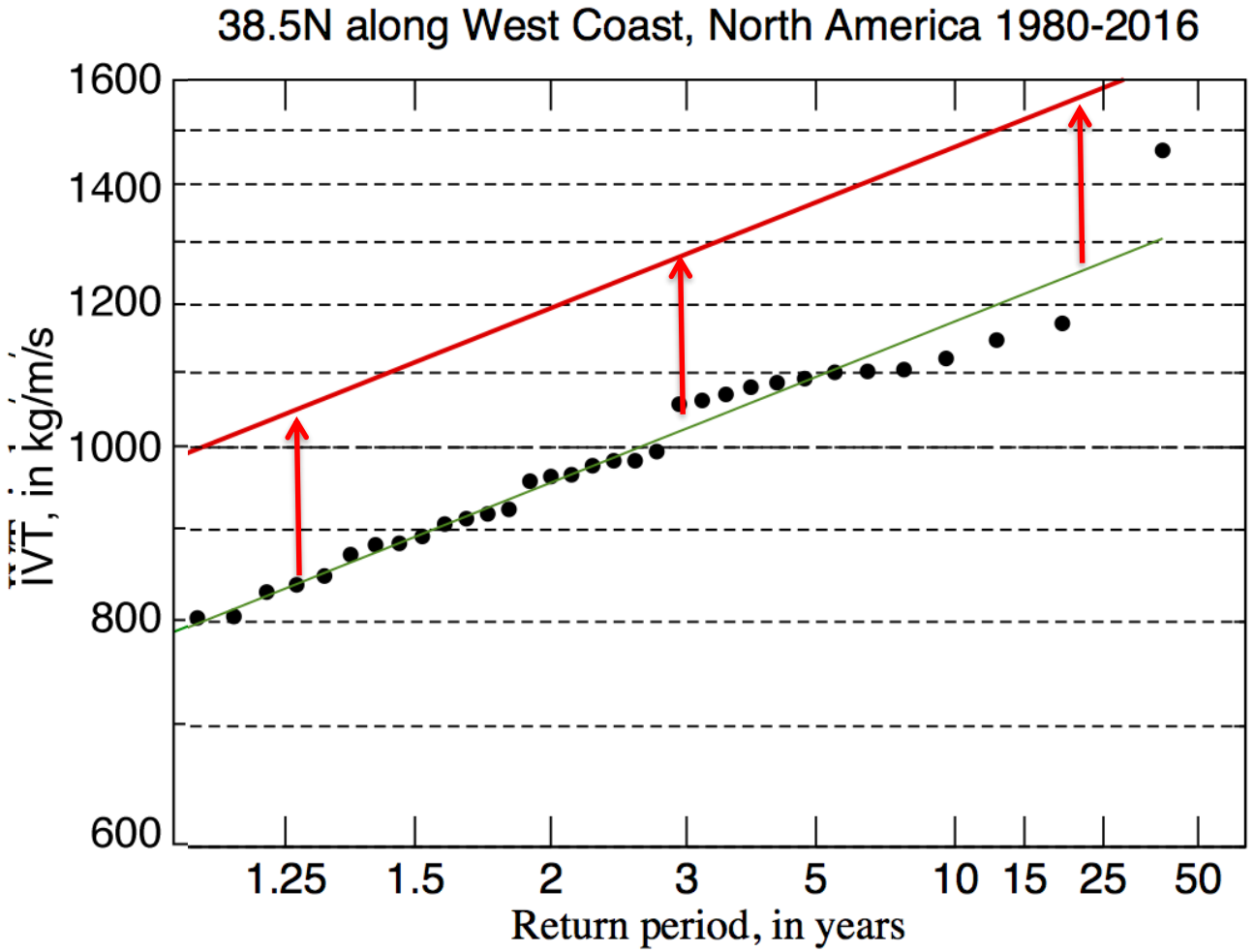
Dettinger et al., JGRA, in review

IVTs: RCP8.5 (2073-99) / Historical



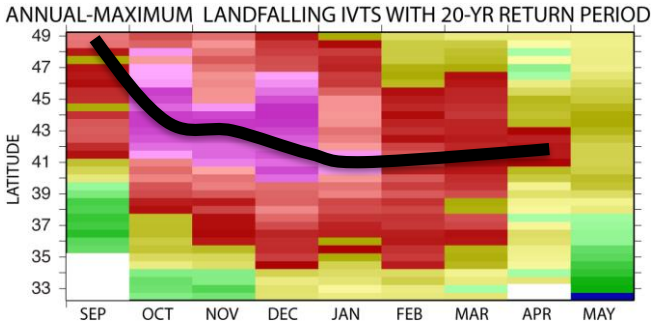
Lavers et al., GRL, 2015

Russian R AR return periods w/ clim chg?



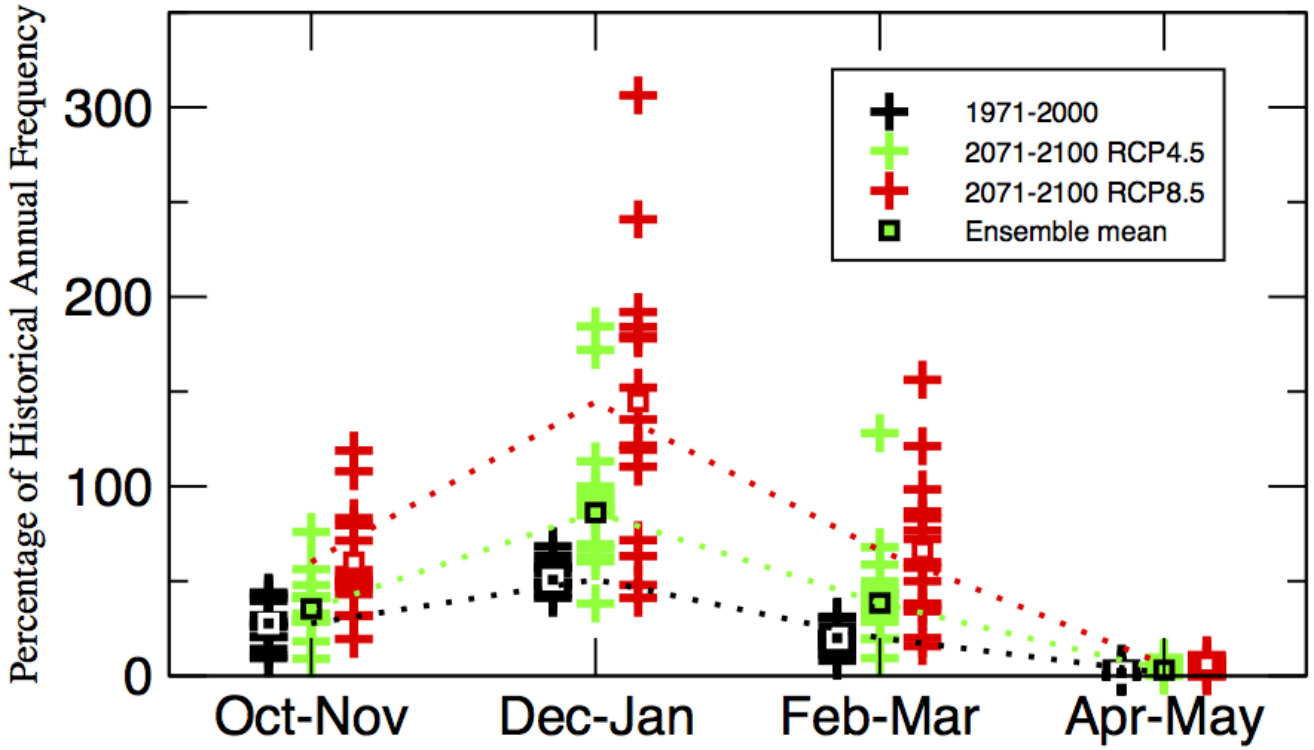
Dettinger et al., JGRA, in review

How is the seasonality of the largest AR IVT landfalls projected to change this century?



Frequency of Exceedences of Historical 95%-ile AR IVTs

[15 CMIP5 GCMs; West Coast, 39N]



CONCLUSIONS

- Historically strongest ARs have made landfalls around 43º-45ºN on the West Coast
- At least one AR with IVT=1000 kg/m/s makes landfall on West Coast each year
- Broader zone of high storm-total IVT maxima, with Russian near the tip-top
- North to south sznal progression of largest IVTs
- Climate change may scale IVTs by ca. 125%

For weak-to-moderate ARs, a percentile scale…

Atmospheric River We

AR Category	AR Strength	Max IVT* (kg/m/s)
	Not an AR	< 250
AR CAT 1	Minimal	250-500
AR CAT 2	Moderate	500-750
AR CAT 3	Strong	750-1000
AR CAT 4	Extreme	1000-1250
AR CAT 5	Exceptional	>1250
	*Defined as the instantaneou **Duration of at least minim the duration differs from this ***Range represents affects ****Within 200 km of the co	

Landfalling Latitude	IVT Thresholds					
	250 kg/m/s	500 kg/m/s	750 kg/m/s	1000 kg/m/s	1250 kg/m/s	Max recorded
50N	0%	77%	97.8%	99.4%	>99.9%	1536 kg/m/s
47.5N	0%	74%	94.4%	99.7%	>99.9%	1298 kg/m/s
45N	0%	70%	94.4%	99.8%	99.9%	1552 kg/m/s
42.5N	0%	71%	94.7%	99.4%	99.9%	1423 kg/m/s
40N	0%	73%	94.9%	99.2%	99.8%	1363 kg/m/s
37.5N	0%	77%	95%	99.3%	99.9%	1448 kg/m/s
35N	0%	84%	97.2%	99.8%	--	1136 kg/m/s
32.5N	0%	86%	98.9%	--	--	974 kg/m/s

Historical percentiles of instantaneous IVT maxima in 3-day windows that include an AR (Rutz-categorized) landfall on West Coast in NCEP-NCAR Reanalysis fields, 1948-2013.

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