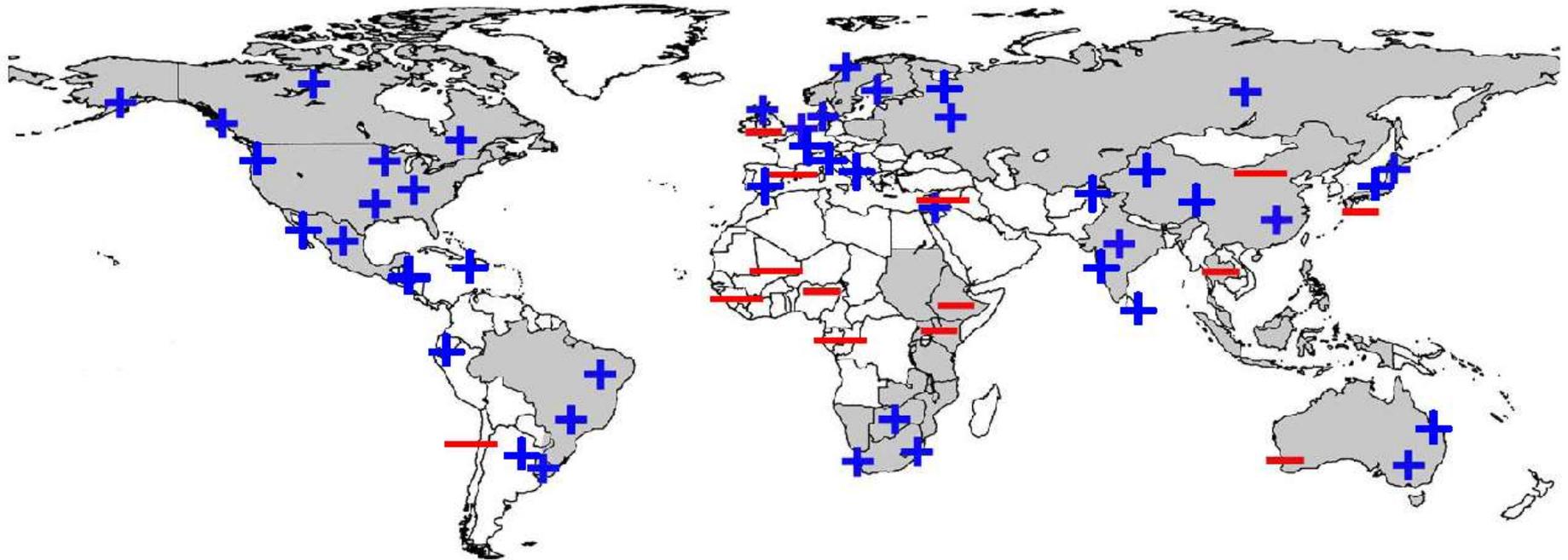


Very heavy rains and prolonged no-rain periods in the Pacific Sector of the Northern Extratropics

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Regions with disproportionate changes in intense precipitation during the past decades compared to the change in the annual and/or seasonal precipitation

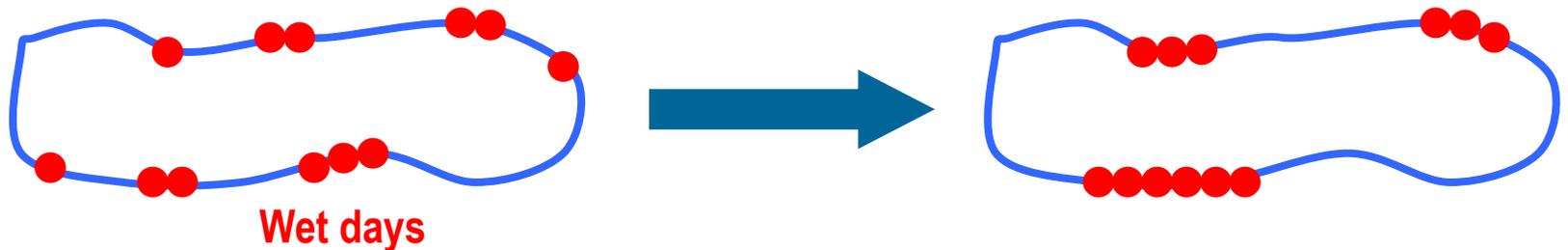


Easterling et al. 2000, substantially updated from Groisman et al. 2005, Zhai et al. 2005, Roy and Balling 2004, Aguilar et al. 2005, Brunetti et al. 2004, Cavazos 2008, Zolina et al. 2010; and finalized in Groisman and Knight 2012. Thresholds used to define “heavy” and “very heavy” precipitation vary by season and region.

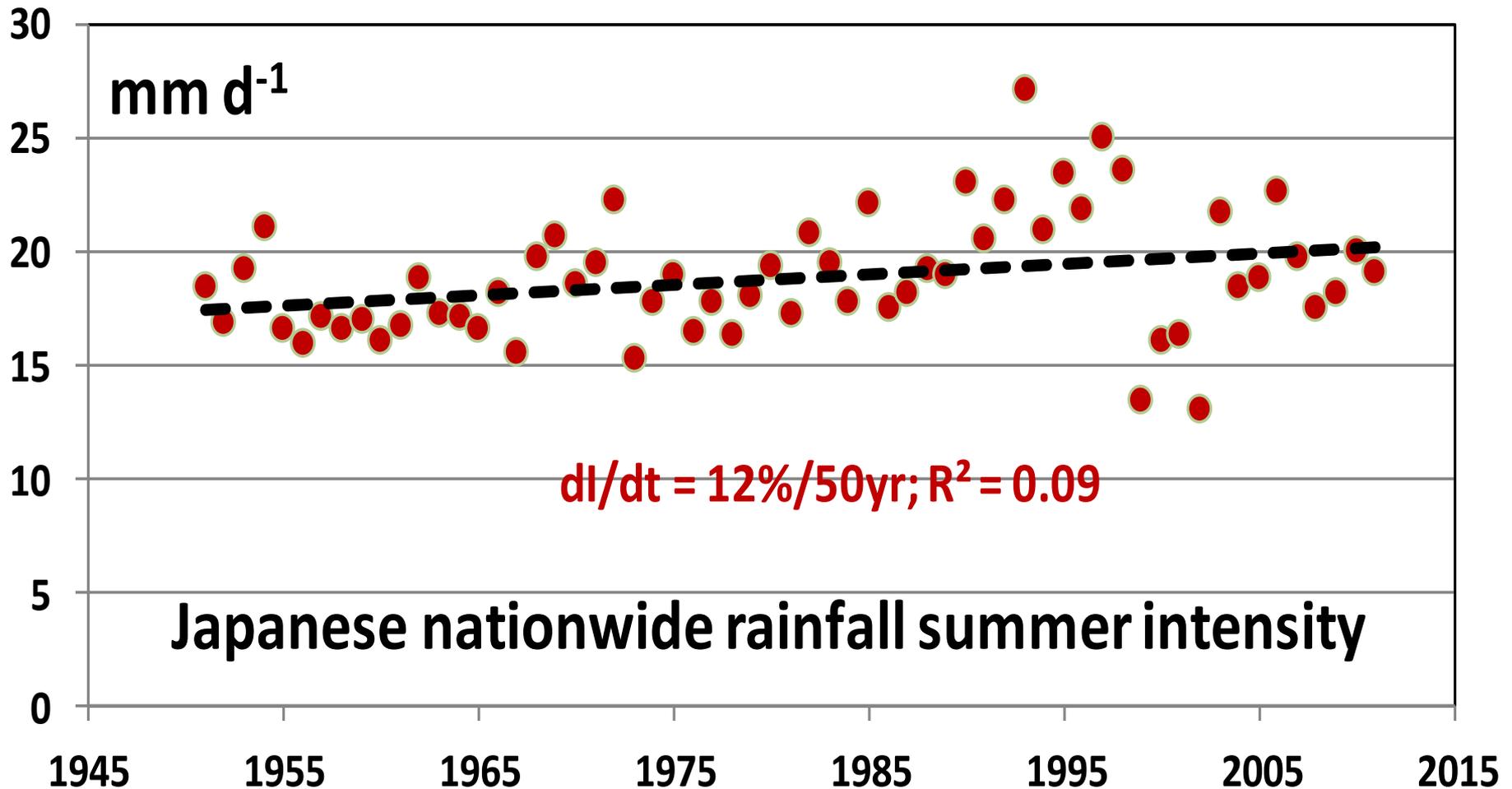
Definitions, observations

- When wet or dry events are extraordinary and are associated with flooding, water shortages, severe vegetation stress, crop failures, property losses, and harm to human health, we name them **extremes**.
- **Numerous observational studies show that in the past several decades precipitation has become more intense over most of the extra-tropics.**
- **At the same time, (and often in the same regions) precipitation events may occur more or less frequently or come in sequences of prolonged no-rain and wet periods.**

Beads with a fixed number of stones illustrate how we can have in the same region simultaneously increases in prolonged Wet Day and Dry Day Periods even with unchanged precipitation totals (design by O.G. Zolina).



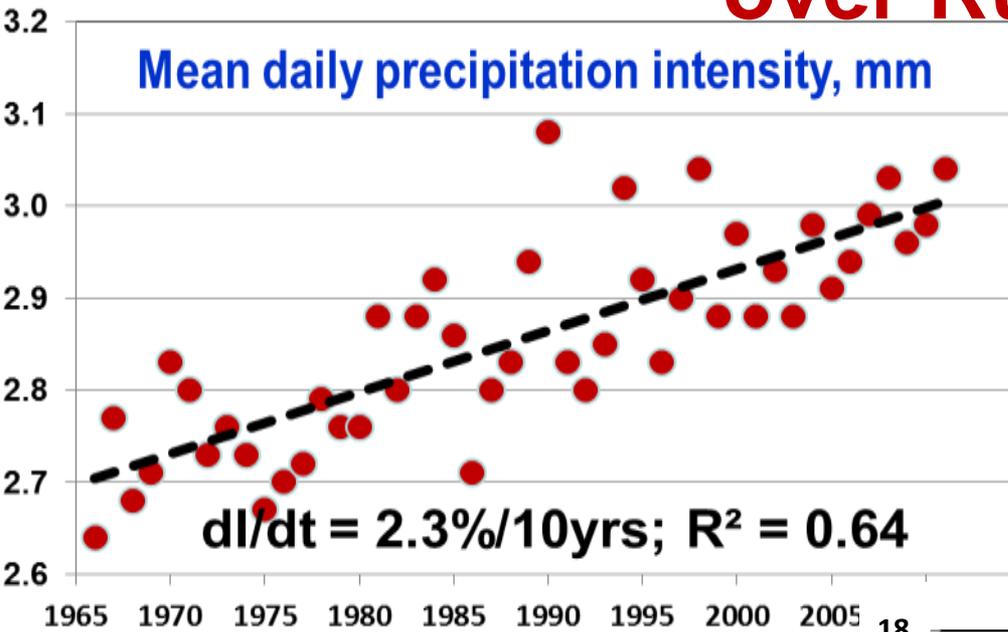
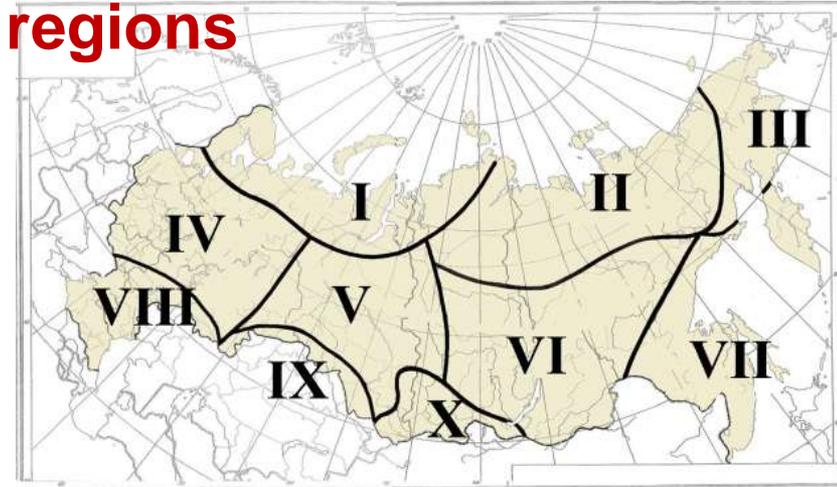
Mean summer (JJA) rainfall intensity, mm d⁻¹ over Japan



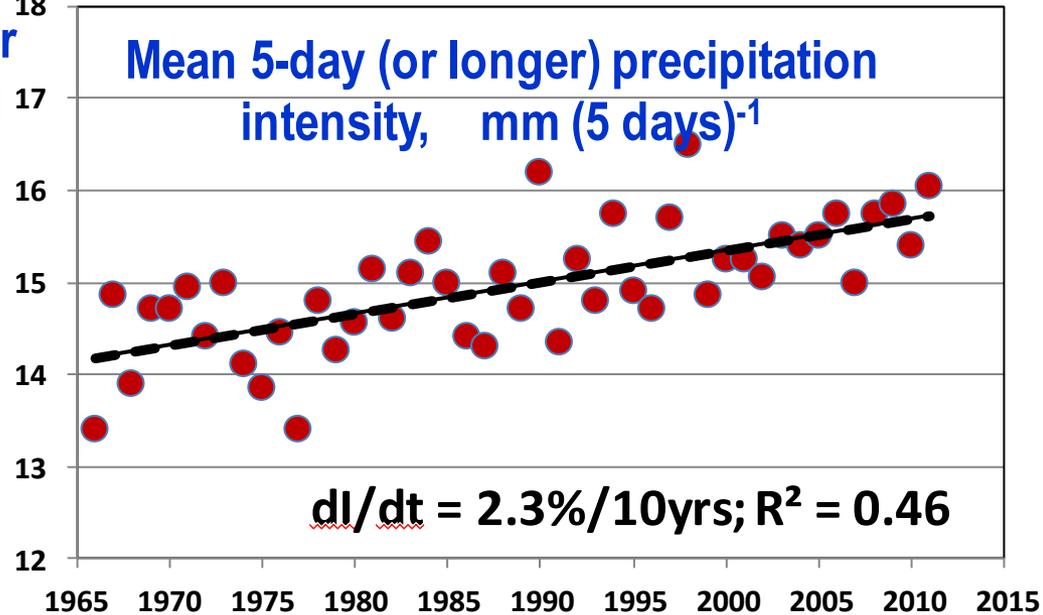
First in the world work on this topic was made by Iwashima, T., and R. Yamamoto, 1993: *J. Meteor. Soc. Japan*, 71, 637–640.

Nationwide precipitation intensity, I , changes over Russia

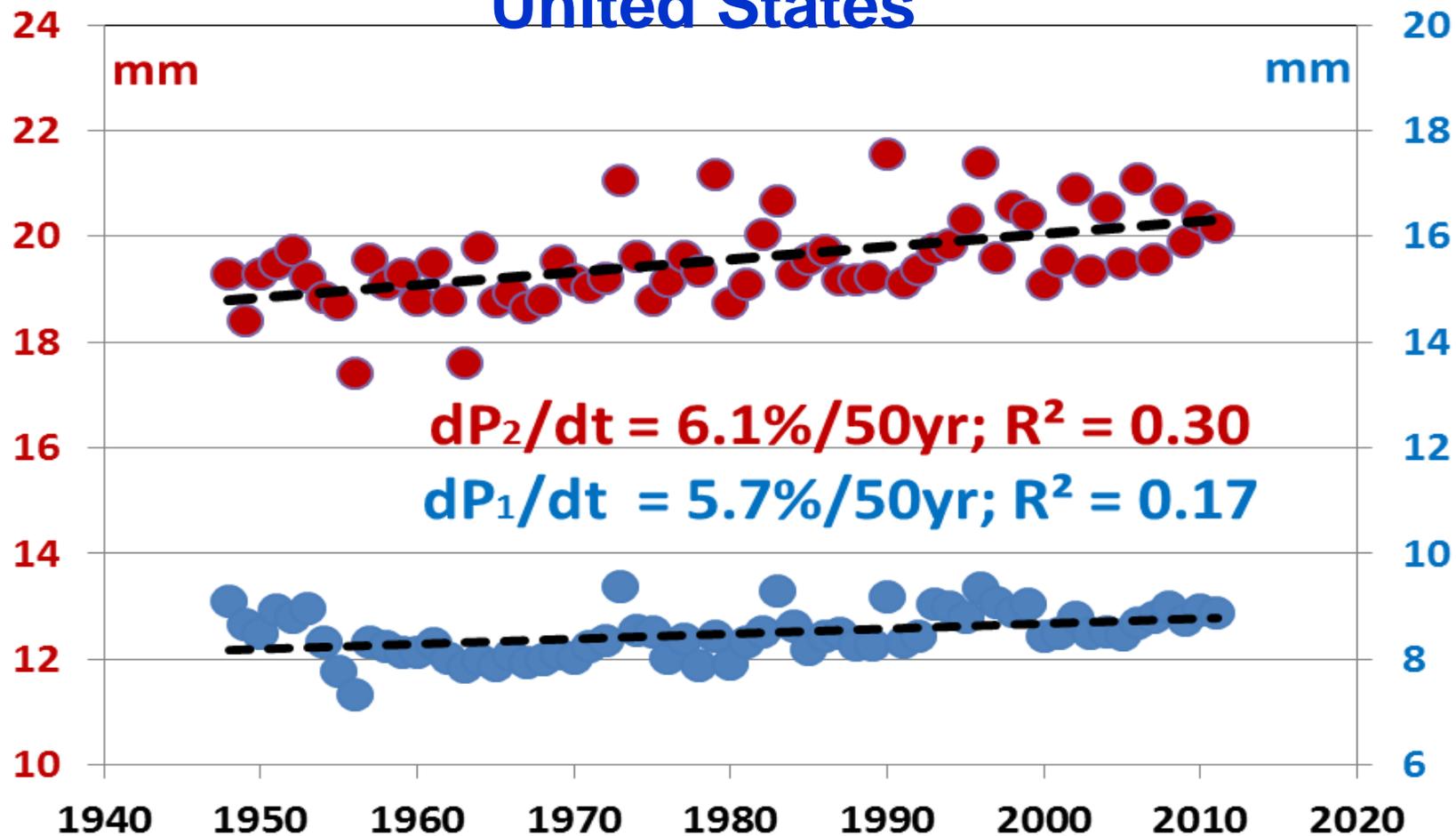
Russian climatological regions



To receive the nationwide time series, for each year and each station mean annual precipitation intensity was calculated as (totals/number of events). Thereafter, point estimates were area-averaged arithmetically within climatological regions shown in the map and, finally, these regional mean values were averaged again with the weights proportional to the areas of the regions.



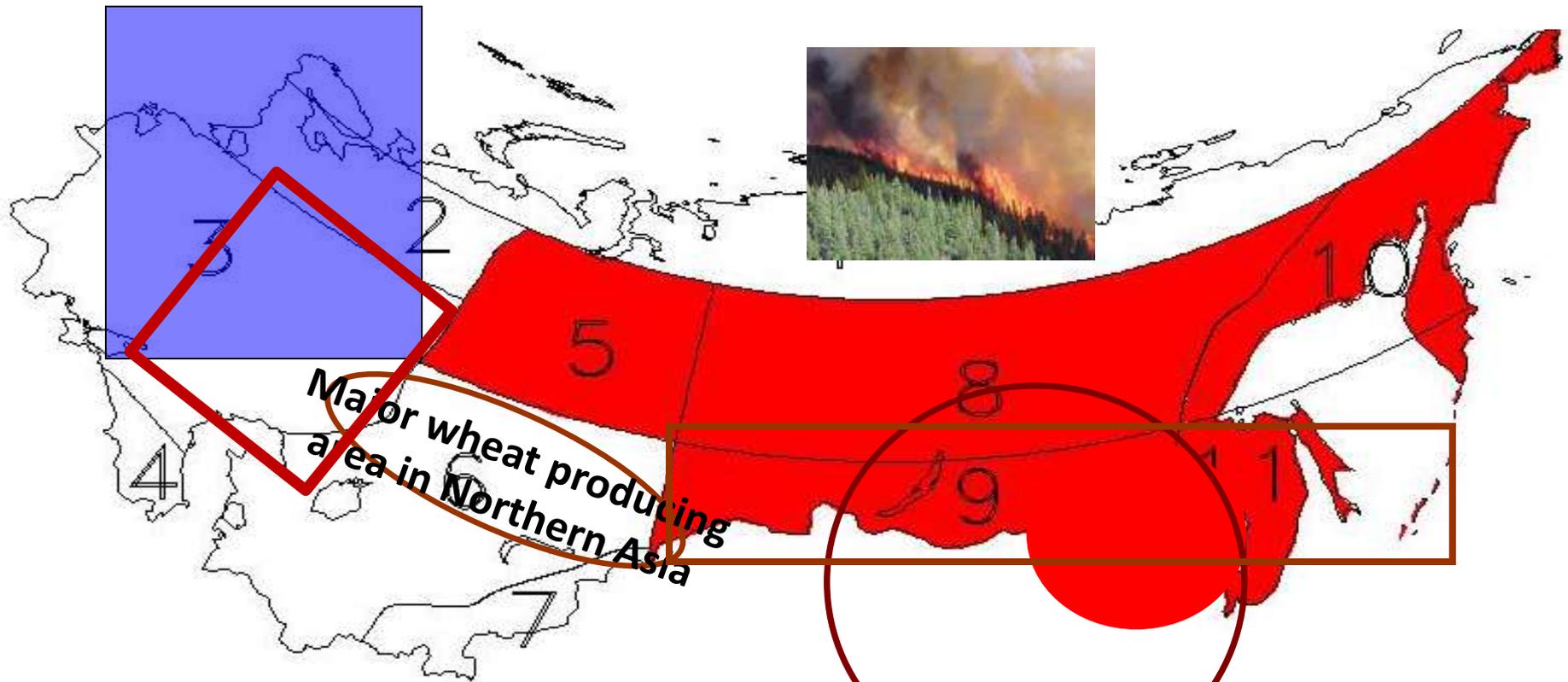
Mean precipitation per event that comes with 1-day- and 2-day-long events over the contiguous United States



The estimates of precipitation intensity in 1-day-long (P_1 , mm day⁻¹) and two-day-long (P_2 , mm (2 days)⁻¹) are based upon all precipitation events above 0.5 mm at ~6,000 long-term U.S. cooperative stations during the 1948-2011 period (Updated archive of Groisman et al. 2012).

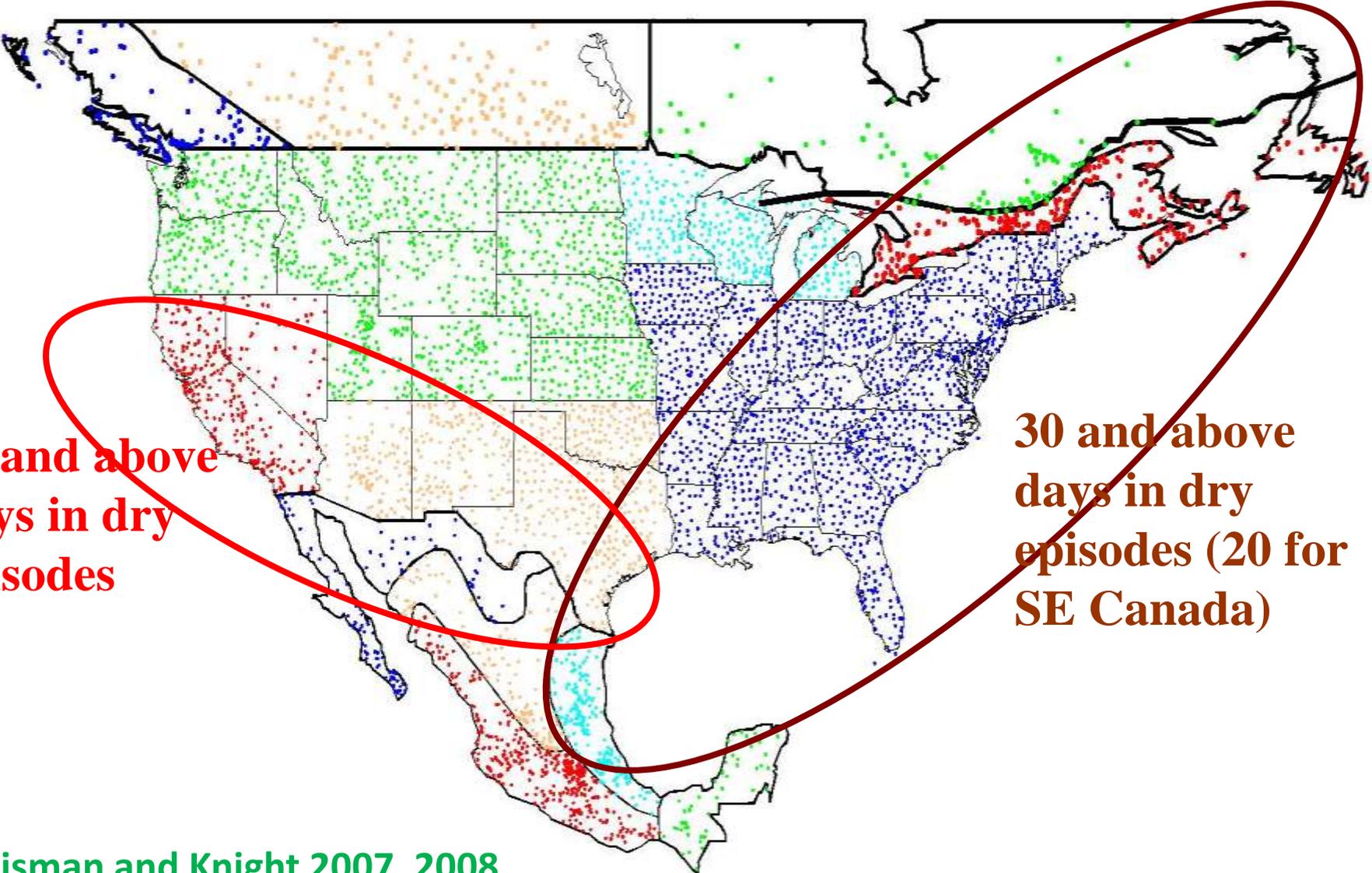
Changes in the surface water cycle over Northern Eurasia that have been statistically significant in the 20th century

More humid conditions (blue),
more dry conditions (red),
more agricultural droughts (circled),
more prolonged dry episodes (rectangled).



Groisman et al 2009 (Bull. Amer. Meteorol. Soc.)

Regions where dry episode frequency was increasing during the past 40 years in the warm season



**60 and above
days in dry
episodes**

**30 and above
days in dry
episodes (20 for
SE Canada)**