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Characterising sub-seasonal drought and the southern Australian context

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with thanks to David Hoffmann and Hanh Nguyen

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Outline

Characterisations of sub-seasonal drought

Coincidence of acute and flash drought

Southern Australian context and (Potential) Project – ‘Predicting Flash Drought in Australia’

**Work in progress – these are my preliminary musings*

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Characterisations of sub-seasonal drought

How does occurrence differ depending on definition?

ACUTE DROUGHT

Short-lived, but acute drought, characterised by large rainfall, soil moisture etc. deficits.

Not necessarily rapid onset.

FLASH DROUGHT

Rapid-onset and acute drought, characterised by significant soil moisture and/or evapotranspiration deficits.

Playing with data…

ACUTE DROUGHT

1 month Standardized Precipitation Index (SPI1)

Data*

Global Precipitation Climatology Project (GPCC) precipitation data

- Monthly data from 1901 to 2013

FLASH DROUGHT

Soil moisture at depth *d* (SM_d)* 10 cm and 40 cm

*Soil moisture converted to de-seasonalized percentiles

$\triangle SM_d = SM_{d,t-1} - SM_{d,t}$

$\triangle SM_d > -0.2$

and (e.g. Ford and Labosier (2017))

$SM_{d,t} < 0.2$

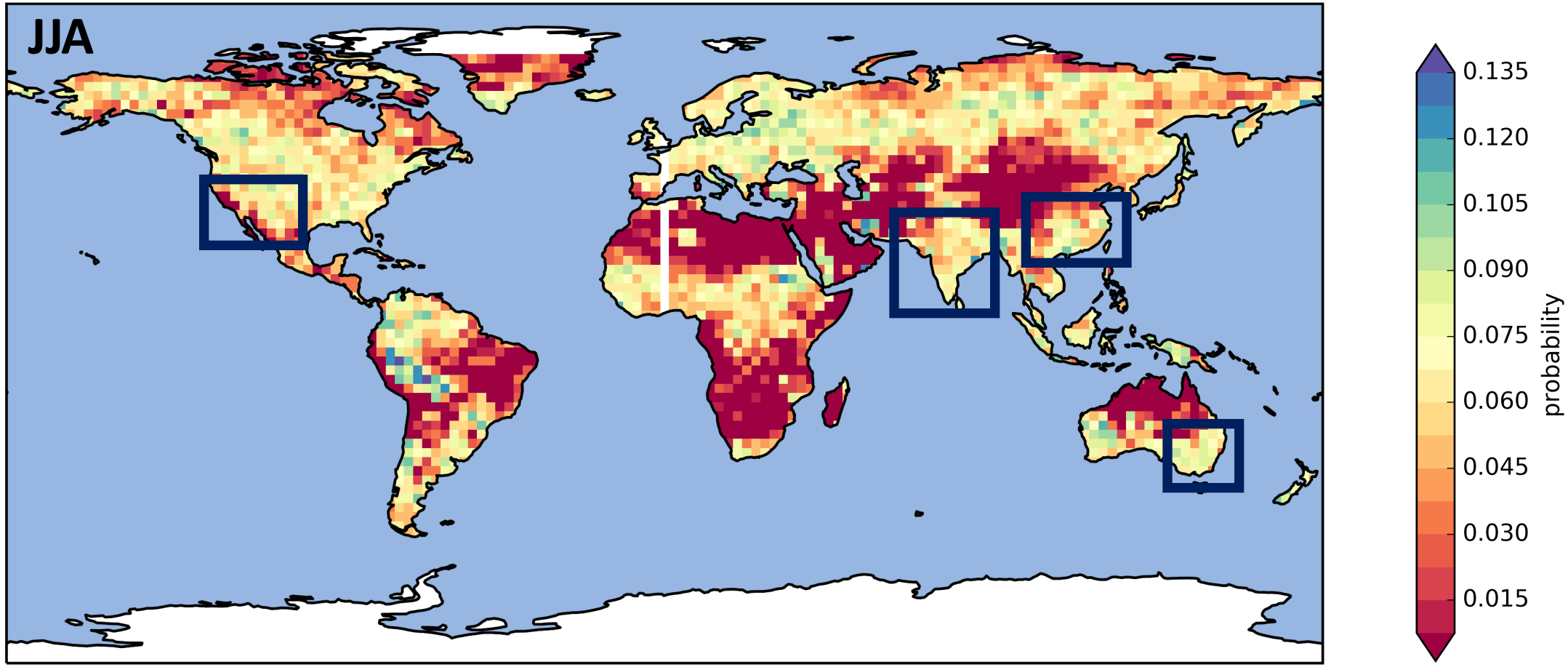
Data*

Global Land Data Assimilation Scheme (GLDAS) soil moisture estimates

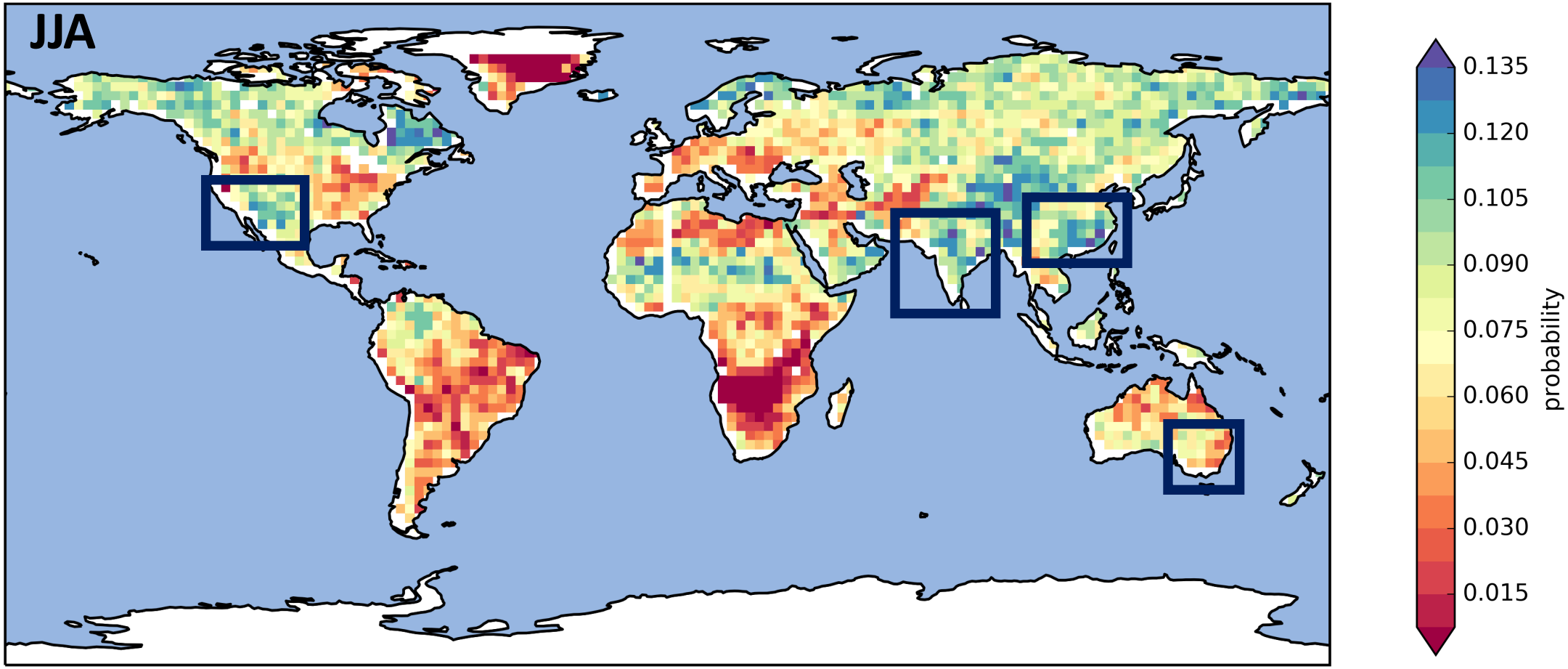
- NOAH land surface scheme
- Monthly data from 1948 to 2016

***Focus on JJA**

Acute Drought Climatology (SPI < -1.5)



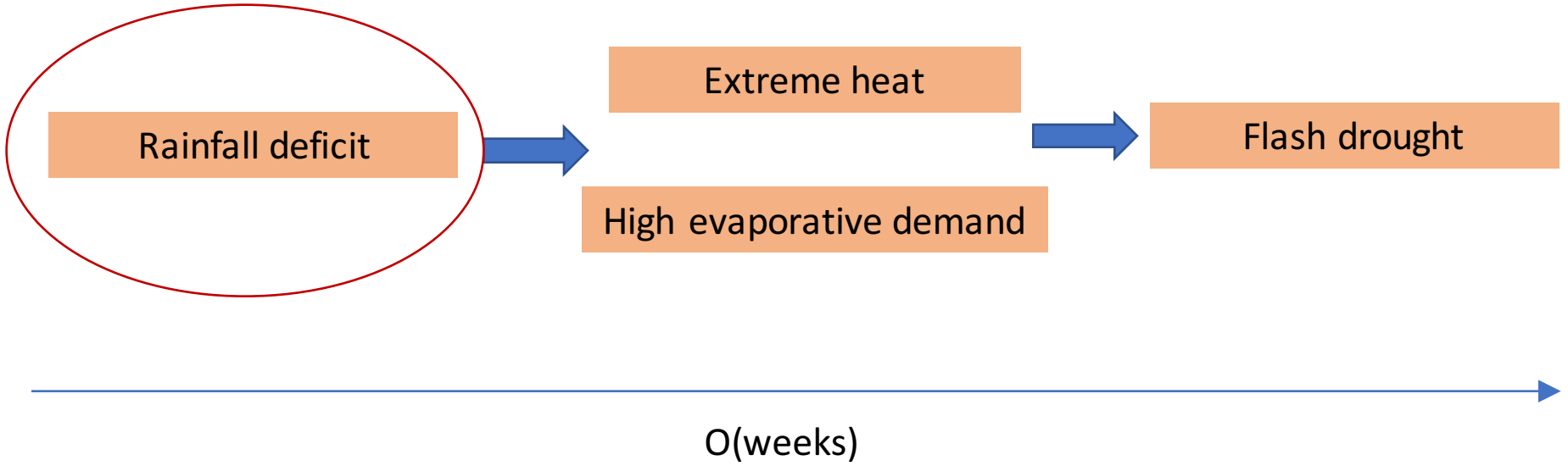
Flash Drought Climatology ($\triangle SM_{10cm} > -0.2$ & $SM_{10cm} < 0.2$)*



*Ford and Labosier (2017)

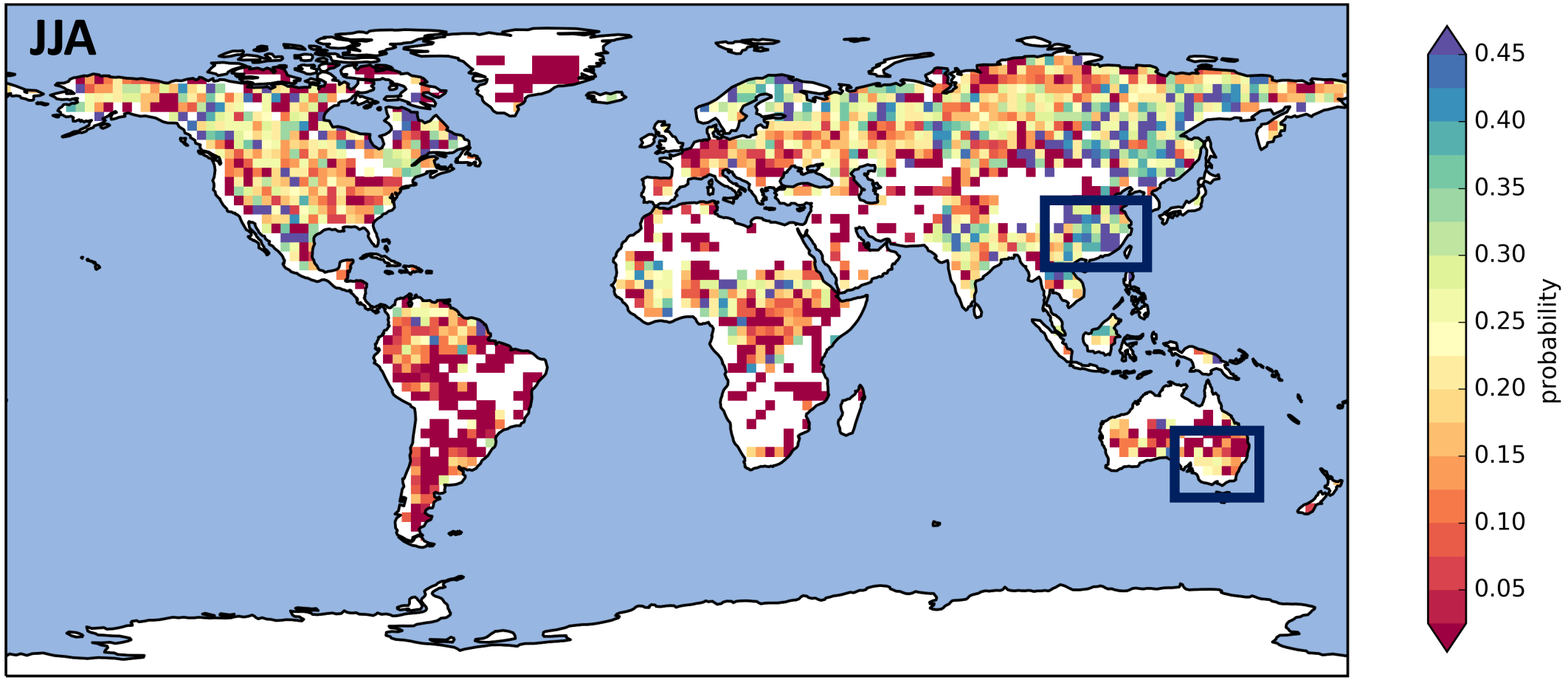
Precipitation deficits and flash drought

Are acute rainfall deficits a necessary condition for flash drought?



Are acute and flash droughts coincident?

Coincidence of flash drought (F) and acute drought (A) i.e. $P(F|A) = (P\ F \cap A)/P(A)$



Summary & questions raised

- Geographic differences in the spatial distribution of drought probability is highly dependent on definition
- Likelihood of acute/flash drought is seasonally dependent (not shown here)
- Preliminary evidence that the ”requirement” of a preceding rainfall deficit may not be a significant factor for occurrence of flash drought in some regions.
- Questions:
    - What is important? Heat and/or blocking/ridging aspects?
    - Where is the precipitation factor important and where is the evaporative demand important?
    - Can we even develop a “one-size-fits-all” definition of flash drought?

*Major caveats to what I’ve shown here:

- Will depend on definitions used
- Will be sensitivity to data set (as shown by Hoffmann)

Is there scope for predicting flash drought events in southern Australia?

(Potential) project and moving forward

- Potential evidence of recent “flash drought”-like events
- Are these “flash droughts” or ”acute drought” coincident with heatwaves?
- Is there any element of predictability (e.g. via ENSO)?

Surveying the damage of an October summer on Wimmera grain belt: poor, poorer and plain horrific

Share on Facebook | Share on Twitter

ABC Rural By Danielle Grindlay

Updated 18 October 2015 at 5:14 pm

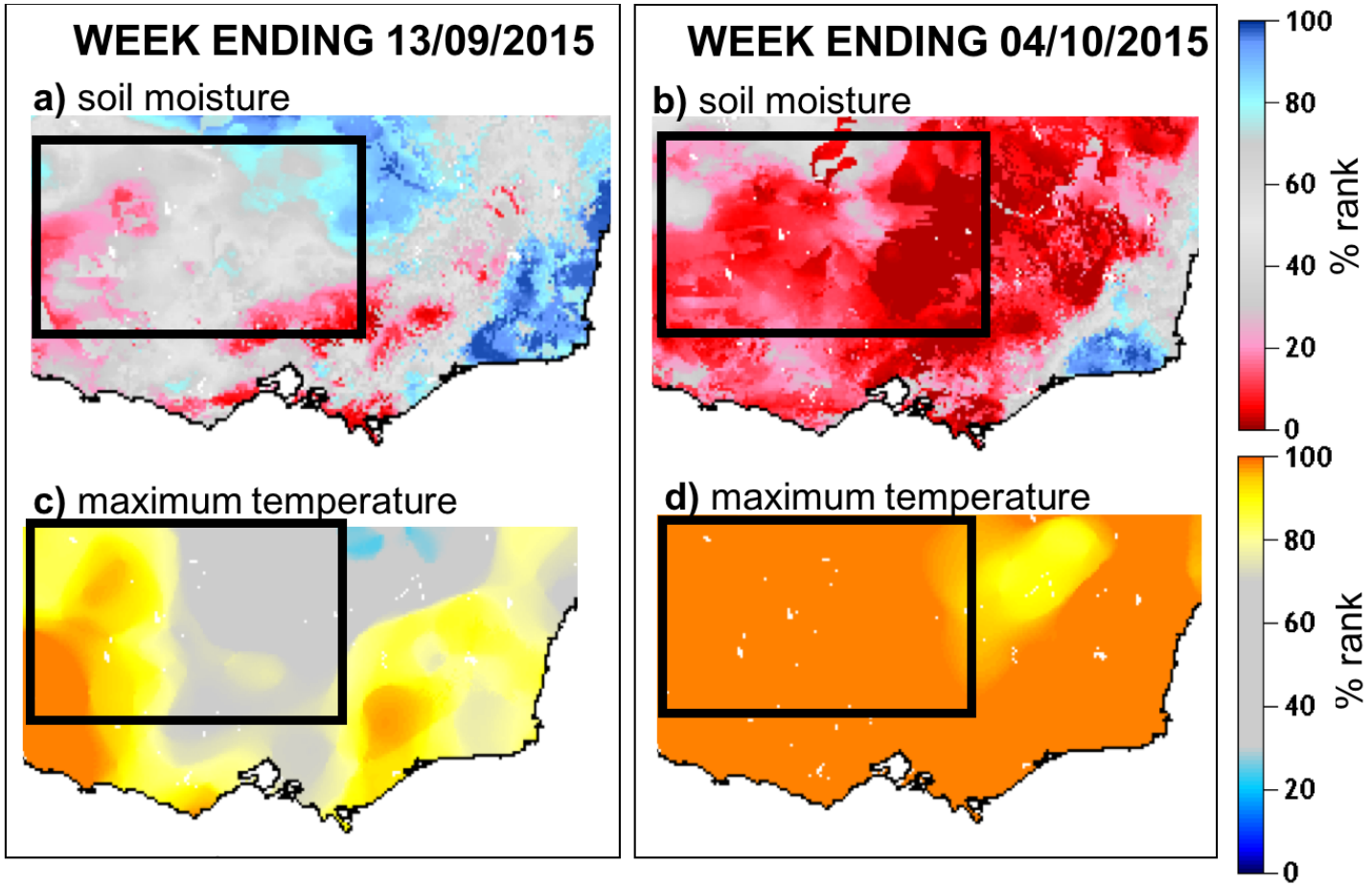
First posted 16 October 2015 at 1:40 am

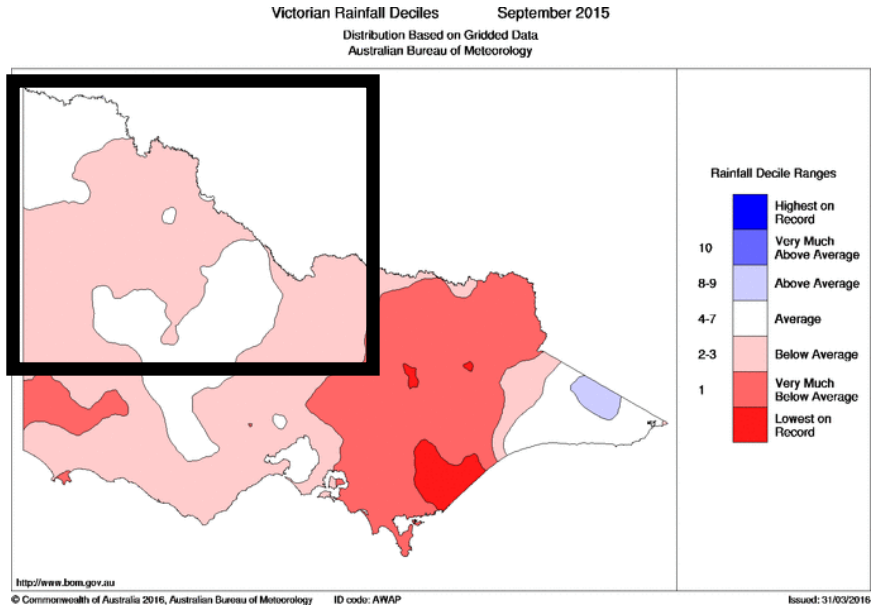
A dried out bean crop in the Wimmera. Four days of high temperatures hit growers hard at the start of October. (Danielle Grindlay)

"As long as it doesn't get too hot, we should actually be okay."

October 2015

“Flash drought” in western Victoria in 2015





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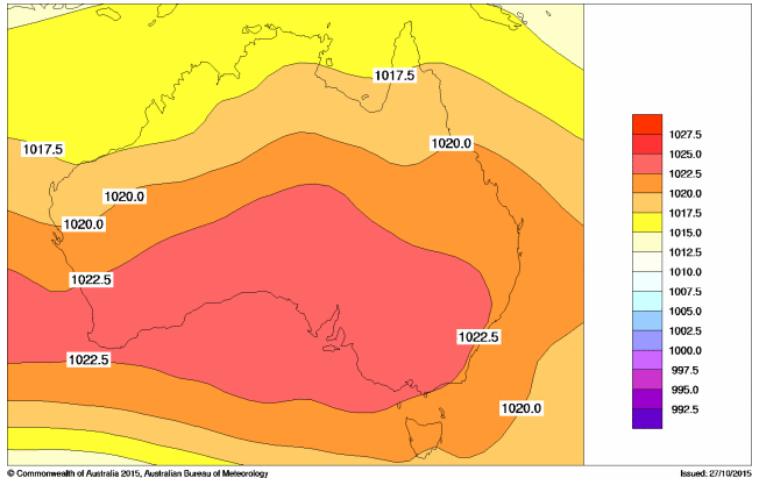
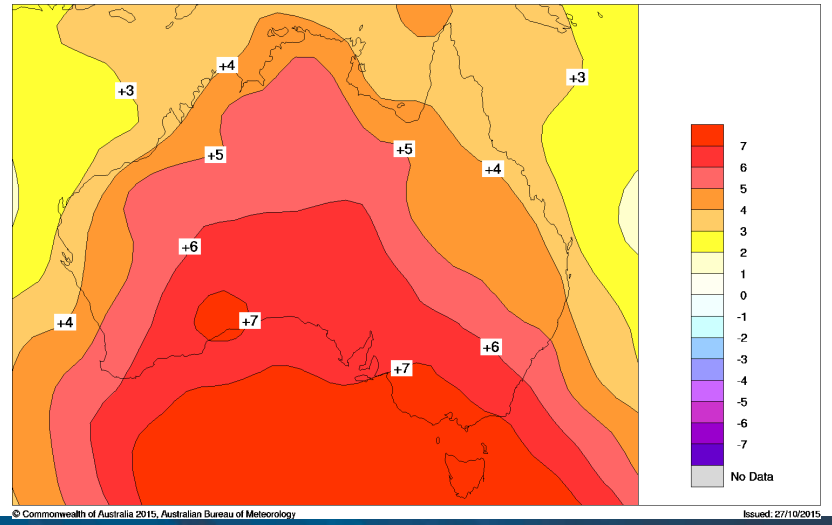
What caused the event and is there predictability?

- Precipitation lower than average but not highly abnormal (i.e. not “meteorological drought” conditions)
- Prolonged clear skies associated with persistent ridge over the area – warmer than average temperatures
- Predictability of heat and rainfall associated with ENSO





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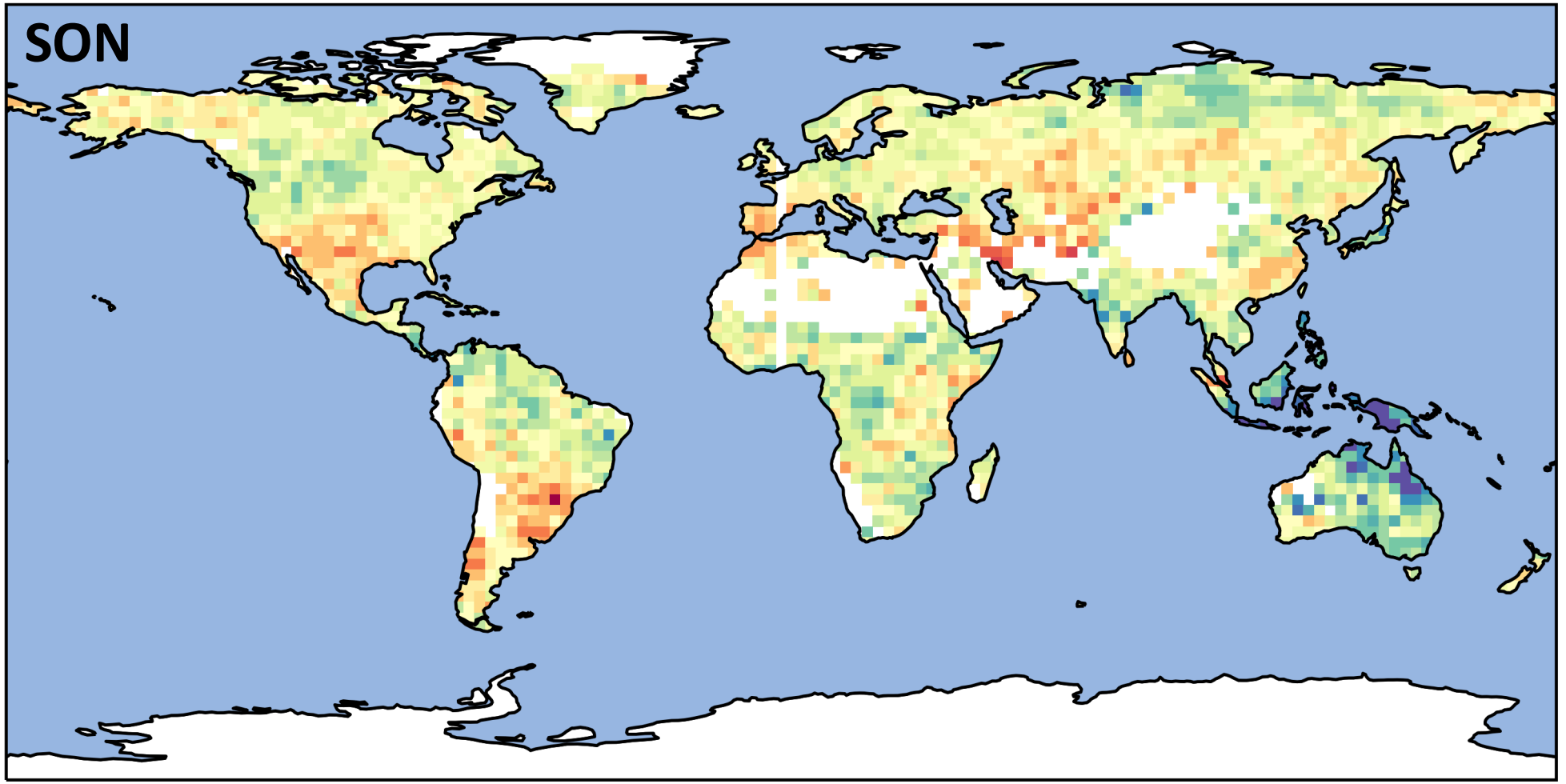
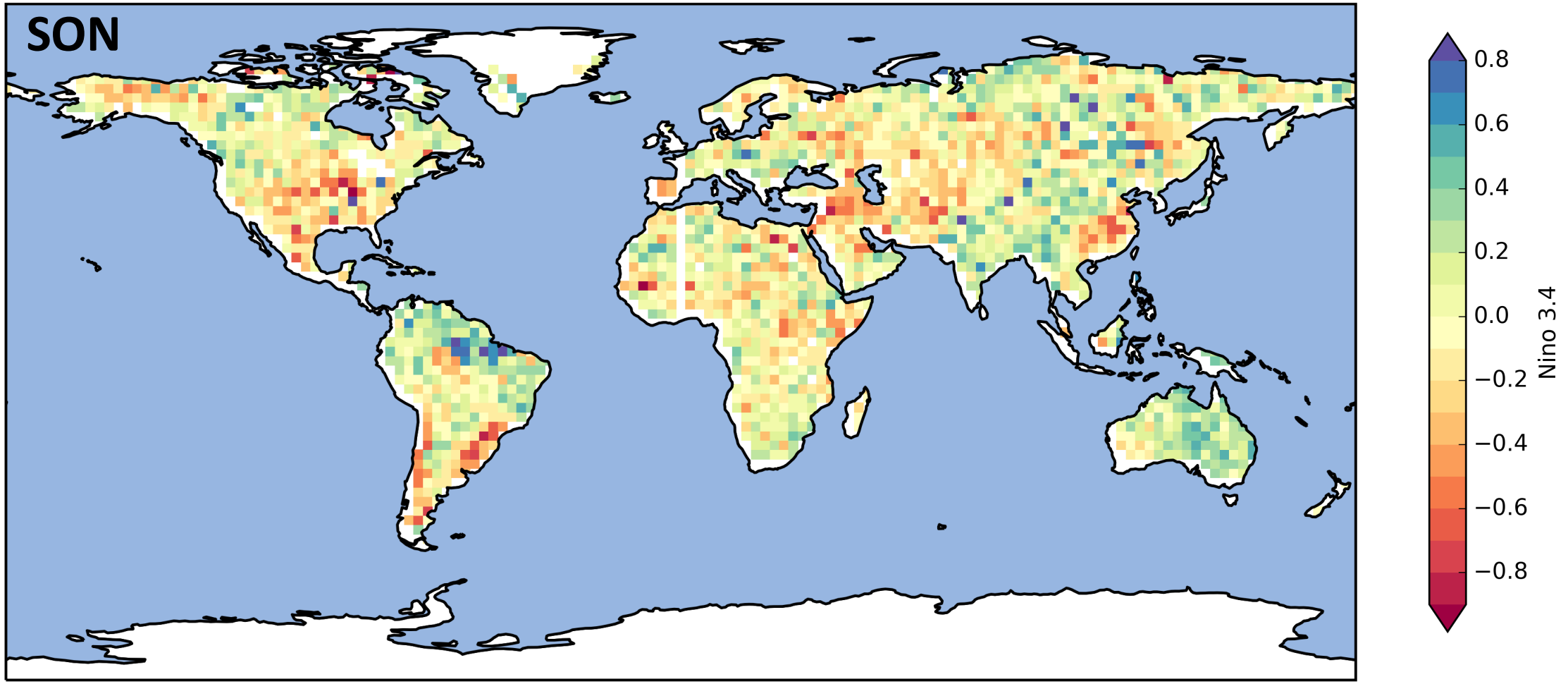
Acute drought (SPI1 < -1.5) and Niño 3.4 index



Flash drought ($\triangle SM_{10cm} > -0.2$ & $SM_{10cm} < 0.2$) and Niño 3.4 index



Understanding flash drought in southern Australia

- What is the risk of occurrence?

- What are the physical mechanisms behind flash drought in this region?
  - Precipitation driven or evaporative demand driven? (relationships to heatwaves)
  - Precursors and importance (or not) of antecedent conditions
  - Atmospheric mechanisms (e.g. persistent ridging etc.)

- Are any of the above predictable on S2S time scales?
  - Examination in the S2S models

Thank you

Questions and feedback are welcome!

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