The potential role of forecasting for integrating solar generation into the National Electricity Market

Ben Elliston and Iain MacGill

School of Electrical Engineering & Telecommunications
Centre for Energy and Environmental Markets
UNSW

b.elliston@student.unsw.edu.au

Outline

- Solar forecasting needs of the NEM
  - AEMO
  - solar generators
  - non-solar generators
- Solar forecasting
  - Numerical Weather Prediction (NWP)
  - Satellite image processing
  - Local sensors
- Lots of further work

Solar forecasting needs of the NEM

- Many issues already faced by wind

- Three generator classes

  - Non-scheduled (< 30MW)

  - Semi-scheduled (intermittent and > 30MW)

  - Scheduled (all others)

- Solar Flagships projects

  - PV: 150—195MW

  - Solar thermal: 150—250MW

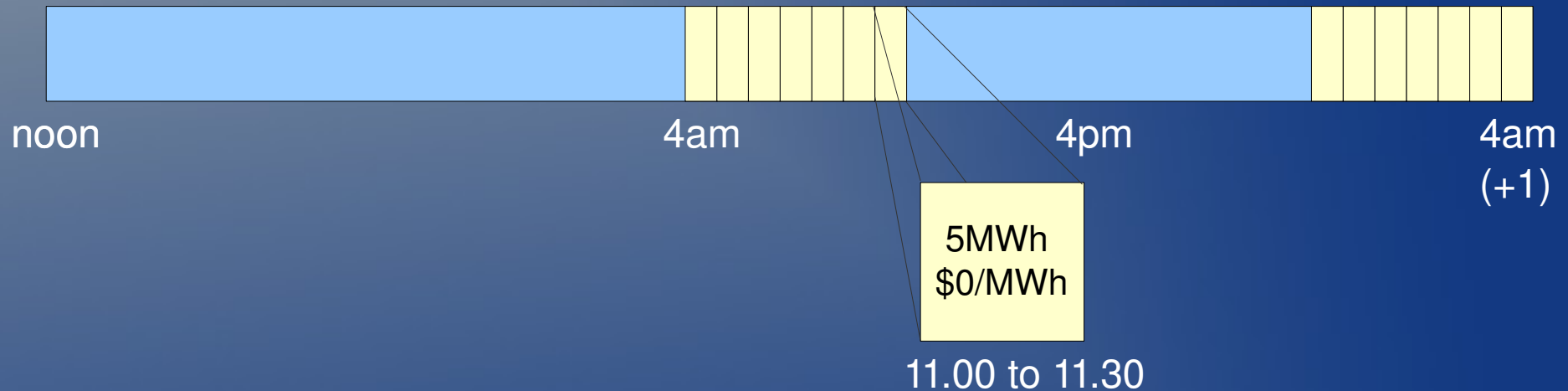# AEMO forecasting requirements

- Australian Wind Energy Forecasting System

- Emphasis on power system security

- Forecast horizons: 5 min → 2 years

- Short term

    – management of ancillary services

- Medium term (hours to 1 day)

    – unit commitment

- Long term (days to weeks+)

    – reserves, generator maintenance

Solar Generator Requirements

- Forecasts to improve plant operation and profitability

- Two technologies of interest
    - photovoltaics (flat plate, concentrating PV)
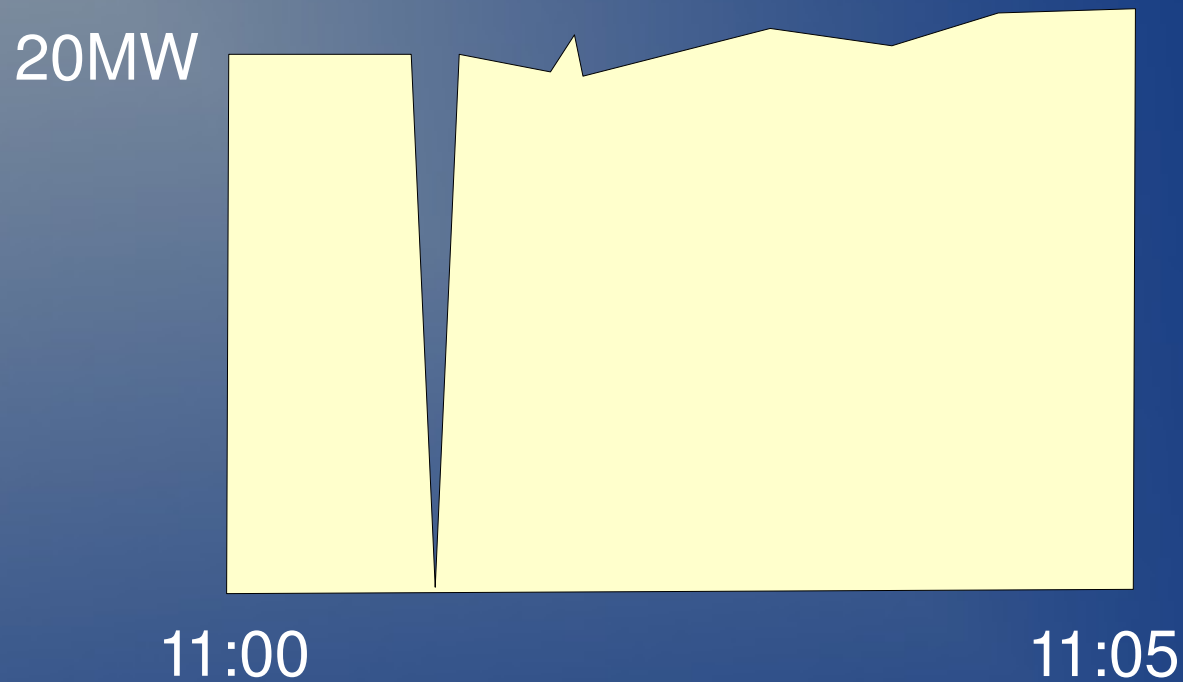   - concentrating solar thermal (CSP)

Spot market operation

- Semi-scheduled and scheduled: 48 half-hour dispatch offers (40 hour horizon)

noon   4am   4pm   4am (+1)

5MWh $0/MWh

11.00 to 11.30

- AEMO market rules allow for re-bidding
- "Causer pays" principle applies

Solar generator requirements

- Can still deliver 95+% of offered energy
- .. but will pay for ancillary services

Non-solar generator requirements

- Forecasts help other generators (wind, fossil fuel, other) with dispatch & unit commitment

- Forecast horizon dictated by:
    - start-up times
    - ramp rates

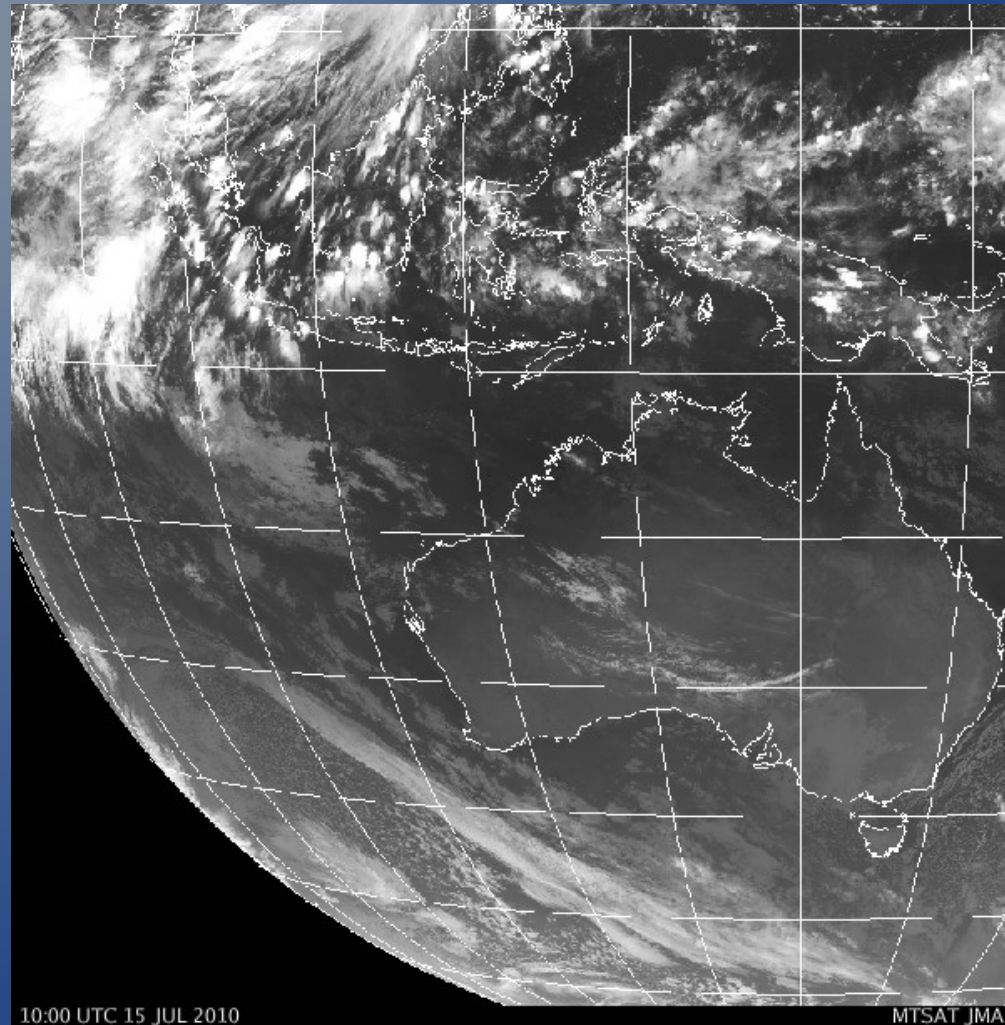# Solar forecasting

- Techniques:
    - Climate modelling
        - Decades ahead
    - Numerical Weather Prediction (NWP)
        - Hours to days ahead
    - Satellite image processing
        - Up to six hours
    - Statistical techniques
        - Minutes

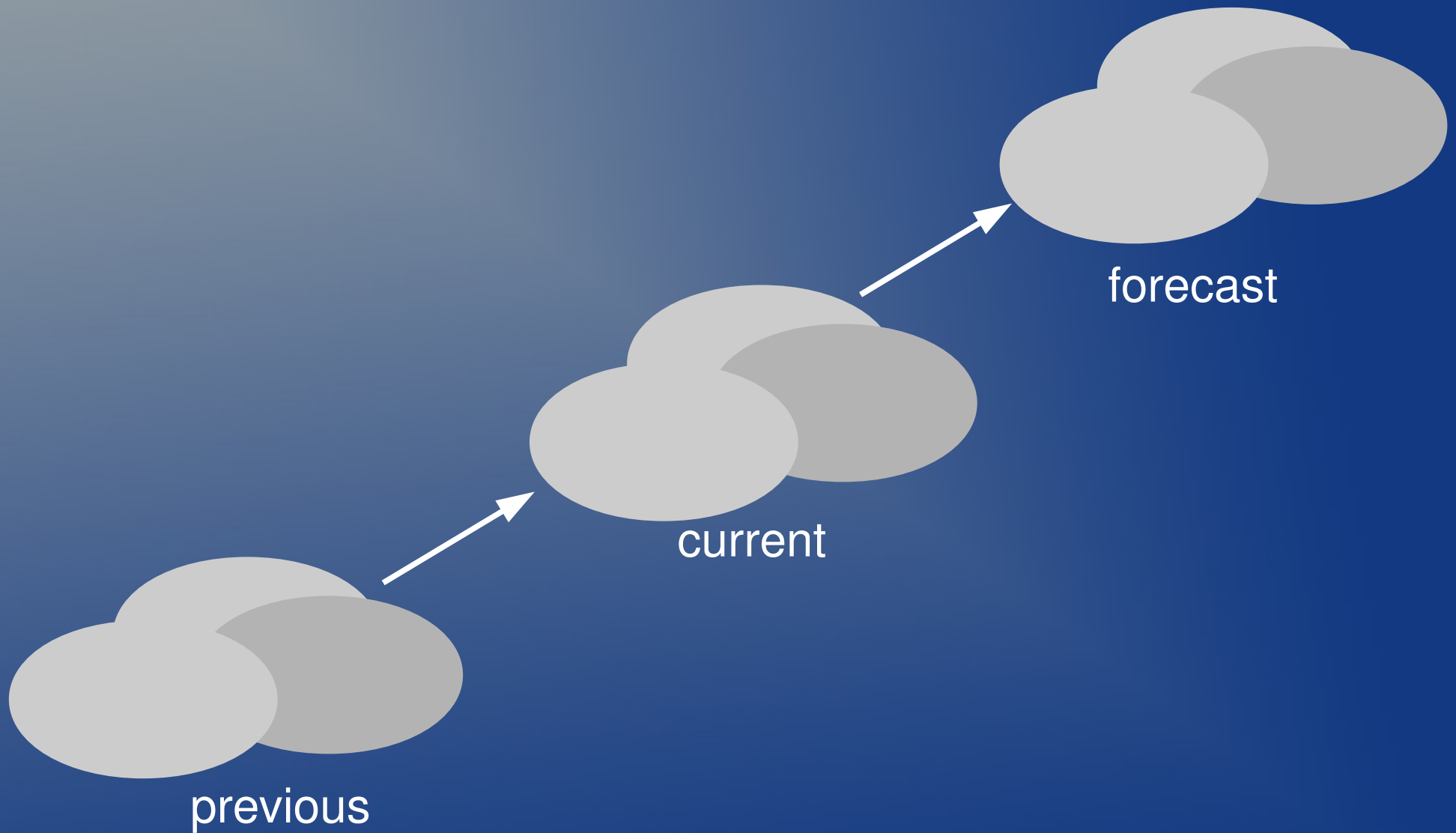# Numerical Weather Prediction

- Global NWP models have coarse spatial and temporal resolution

- Improved by feeding NWP output into:

    - regional NWP model; or

    - apply Model Output Statistics (MOS)
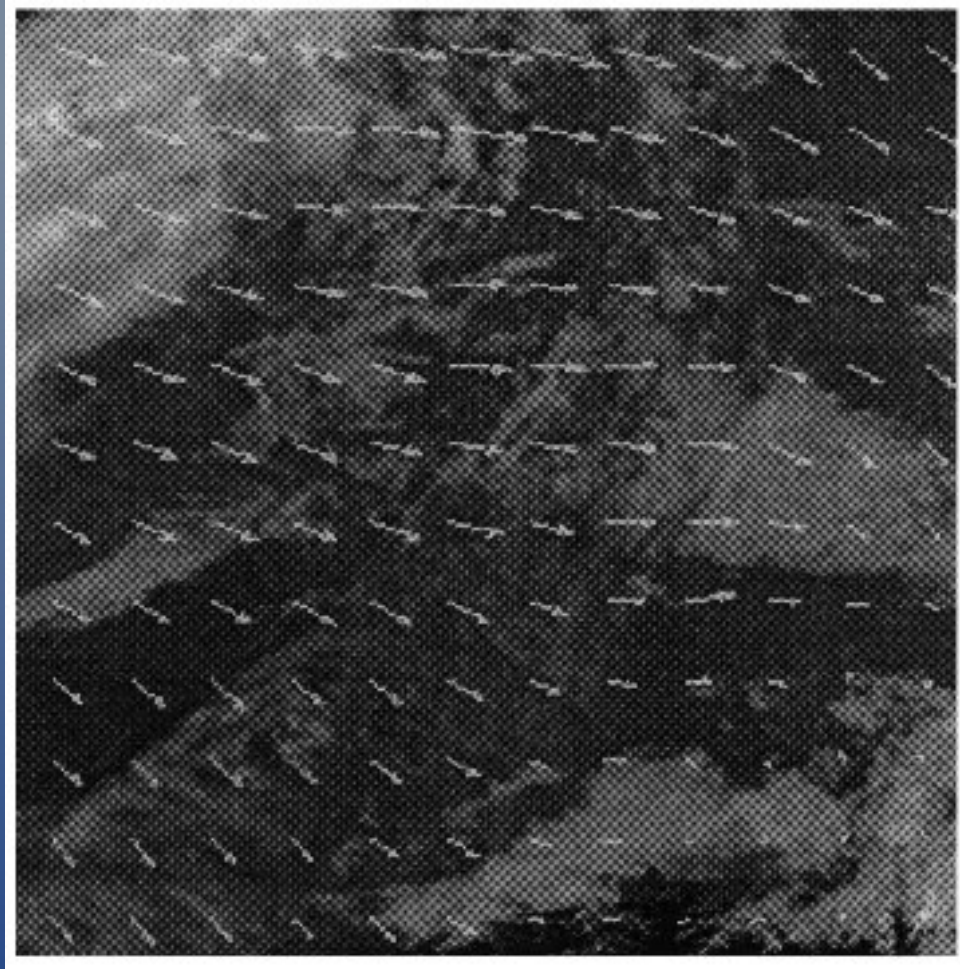
Satellite image processing

MTSAT-2 image (Japanese Meteorological Agency)

Satellite image processing

previous
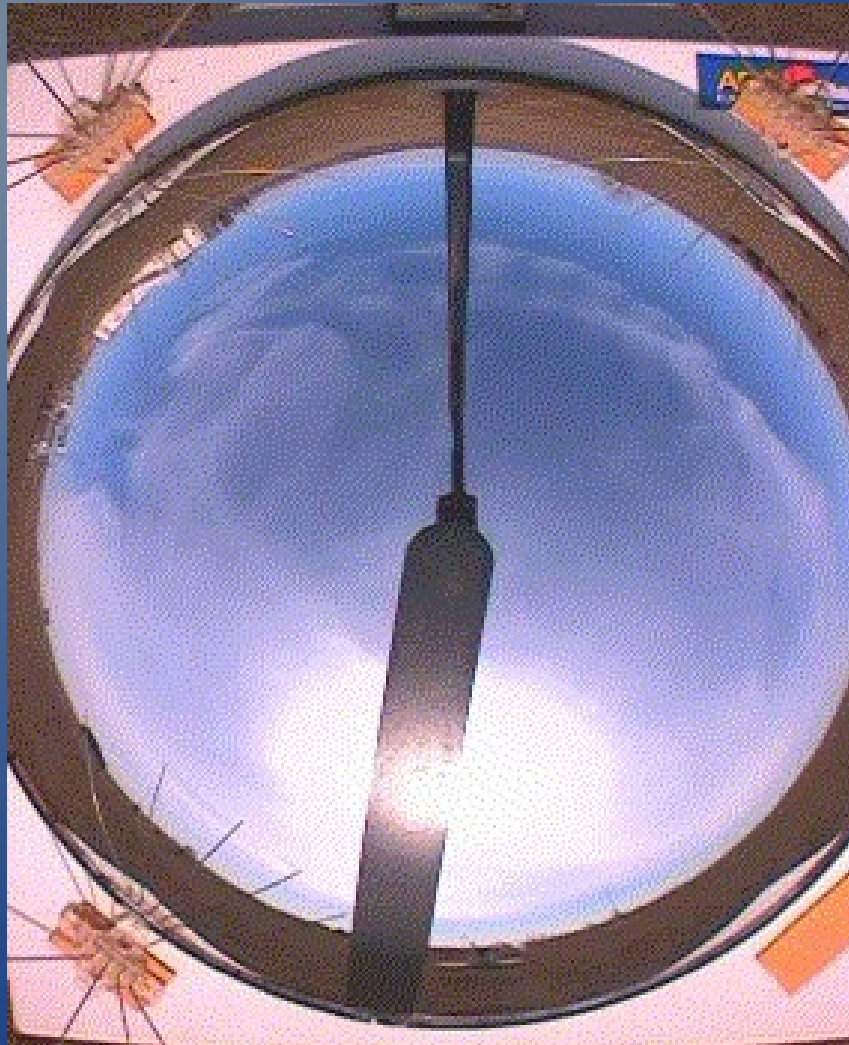
current

forecast

Satellite image processing

Motion vector field (Hammer et al., 1999)

Local sensors

Total Sky Imager (Modica et al, 2010)

Australia's forecasting capability

- AWEFS

- Australian Community Climate and Earth-System Simulator (ACCESS)

- Forecasts from regional NWP
  - direct and diffuse components
  - 48 hour horizon
  - forecast quality unevaluated

- Satellite images produced every 30 minutes
  - may require higher spatial & temporal resolution
  - next generation (2015): every 10 minutes

Conclusions

- Current NEM structure allows for immediate expansion of solar generation

- Value of forecasts: efficient market operation

- Further work:
    - accuracy of BoM's new NWP forecasts;
    - performance of satellite image-based algorithms in Australia;
    - forecast accuracy on different time horizons and implications for existing generation;
    - the cost effectiveness of improving forecasts to reduce "causer pays" costs.

Questions?

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