Bridging the gap between satellite datasets and climate models

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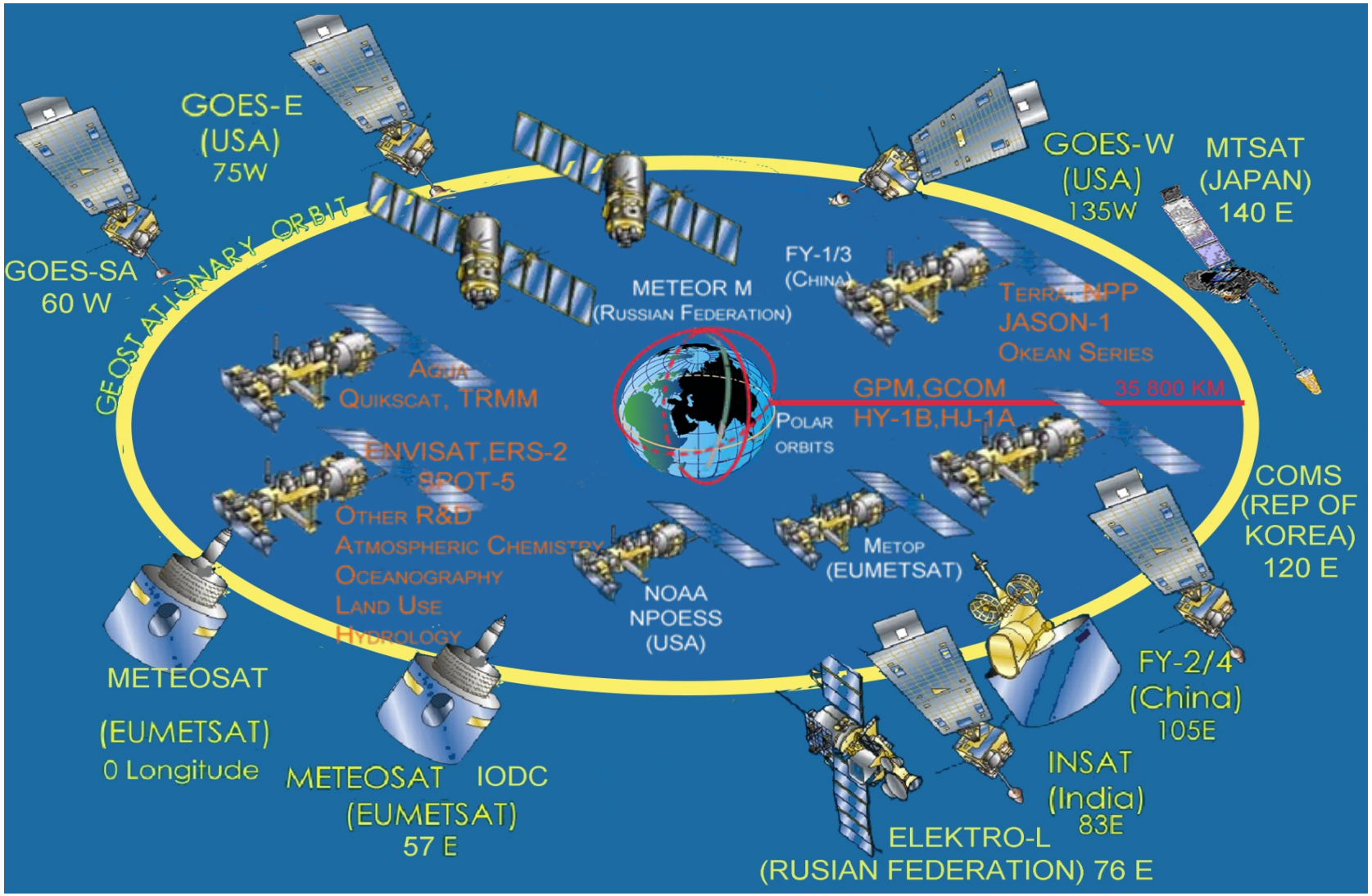
Lots of satellite data!



Uses of satellite data for climate

- To measure decadal and longer term changes in the climate
- Detection & attribution of observed variations to natural and anthropogenic forcings
- Evaluate the physical processes most relevant to reducing uncertainty in climate prediction
- To develop, constrain and validate climate models thus gaining confidence in projections of future change
- Input to reanalyses (e.g. ERA-CLIM, JRA-25,..)
- Seasonal and decadal model initialisation (ocean, land surface, stratosphere)
- To identify biases in current and past *in situ* measurements (e.g. radiosondes, buoys)

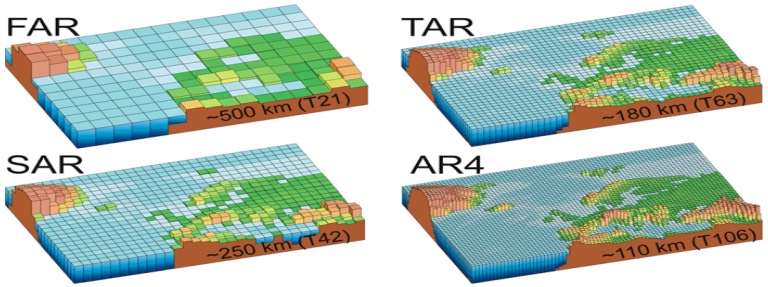
Why don’t we use more satellite data?

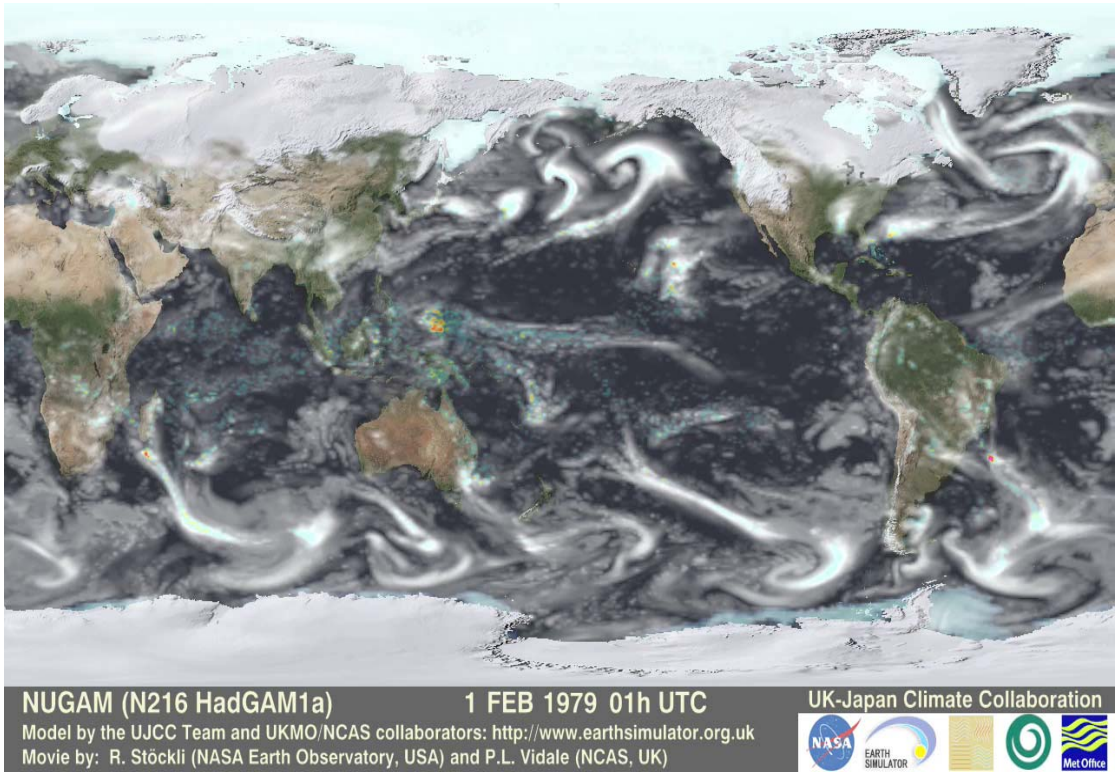
- **Until recently the satellite data time series were <15 years which is not long enough for meaningful trend estimates.**
- **Real time data is subject to biases which must be corrected. For climate we want to reduce biases to a minimum - this takes time to do well**
- **We need to reprocess datasets (maybe several times) to remove biases and add uncertainty estimates.**
- **The models don’t always represent the same parameters as the satellite measurements so observation simulators are also required in some cases.**

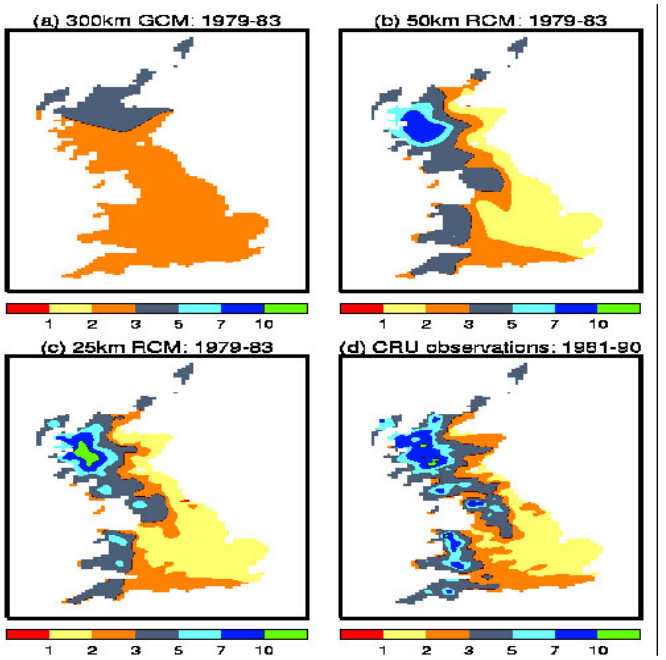
New challenges for climate research

- **Higher resolution (horiz, vertical, time)**
- **Regional climate prediction (e.g. UKCP)**
- **More physical processes**
- **Seasonal to decadal prediction**
- **Use of reanalyses for climate**
- **Seamless prediction - weather prediction to climate change using same model**
- **Metrics developed to evaluate models – CCI datasets can help here**
- **The way we use observational data is evolving**

Model resolutions are increasing







E.g. the new Met Office model, HadGEM3, will have a horizontal resolution of ~ 60 km and 85 vertical levels

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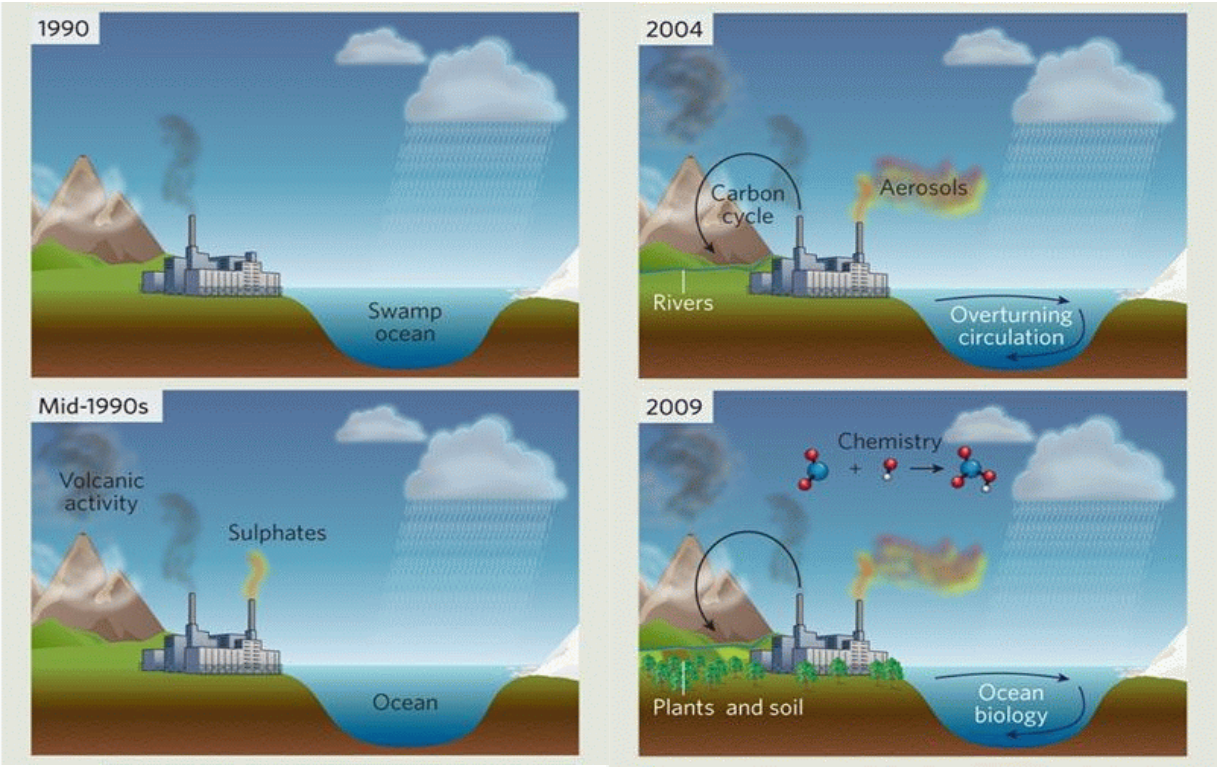
Climate models are becoming increasingly complex…



W. Collins et al., 2008

A fully coupled Earth System Model includes:

- **Atmosphere, ocean, sea-ice, land surface**
- **Land ecosystems: vegetation, soils**
- **Ocean ecosystems: plankton**
- **Aerosols: sulphate, black carbon, organic carbon, dust, sea salt**
- **Tropospheric chemistry: ozone, methane, oxidants**

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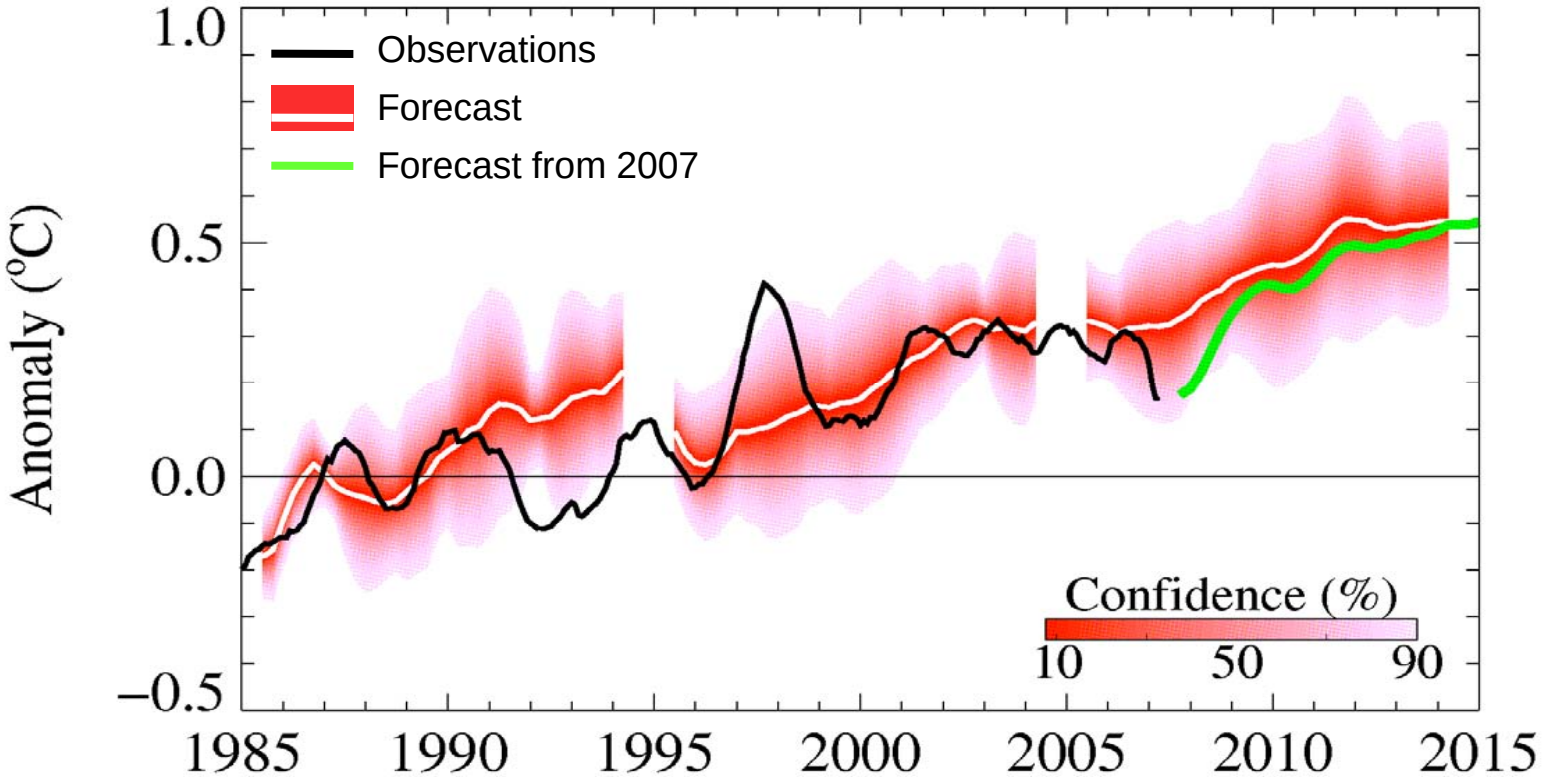
Decadal prediction:Global mean surface temperature anomaly



D. Smith et al., Science 2007

Requires data for both initialisation and verification of forecasts.

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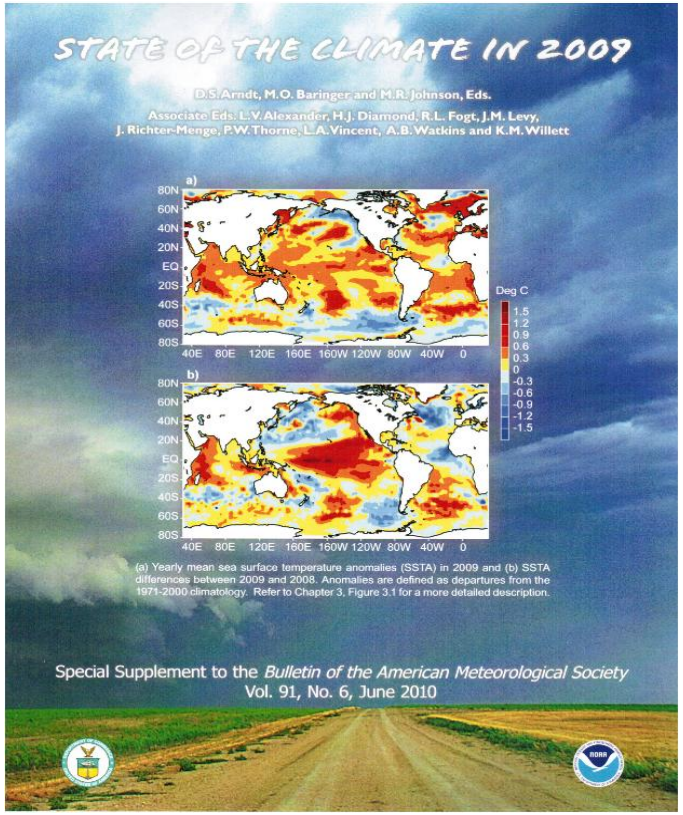
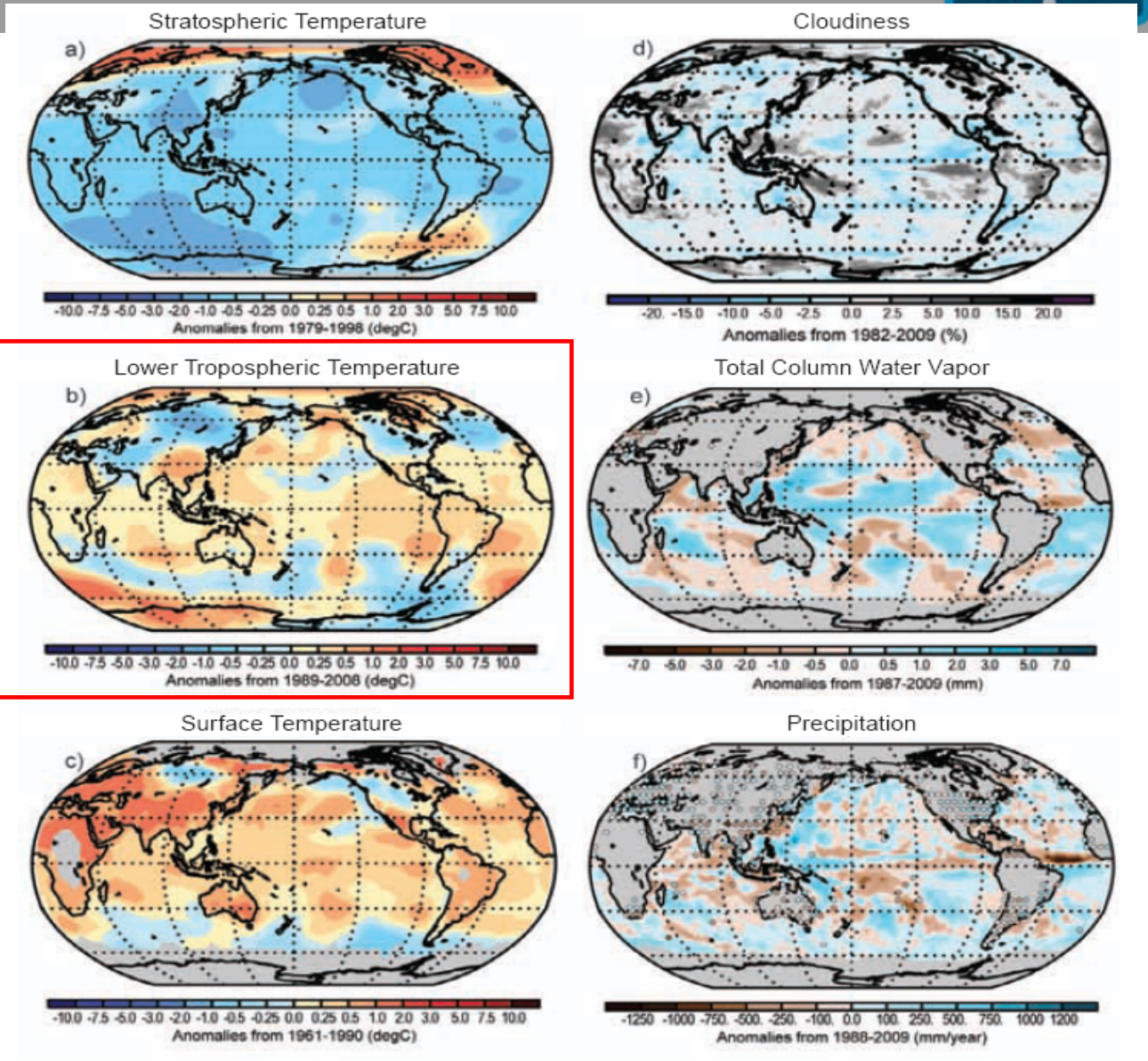
Use of reanalyses for climate change

Growing acceptance of the use of reanalysis data for climate change monitoring:





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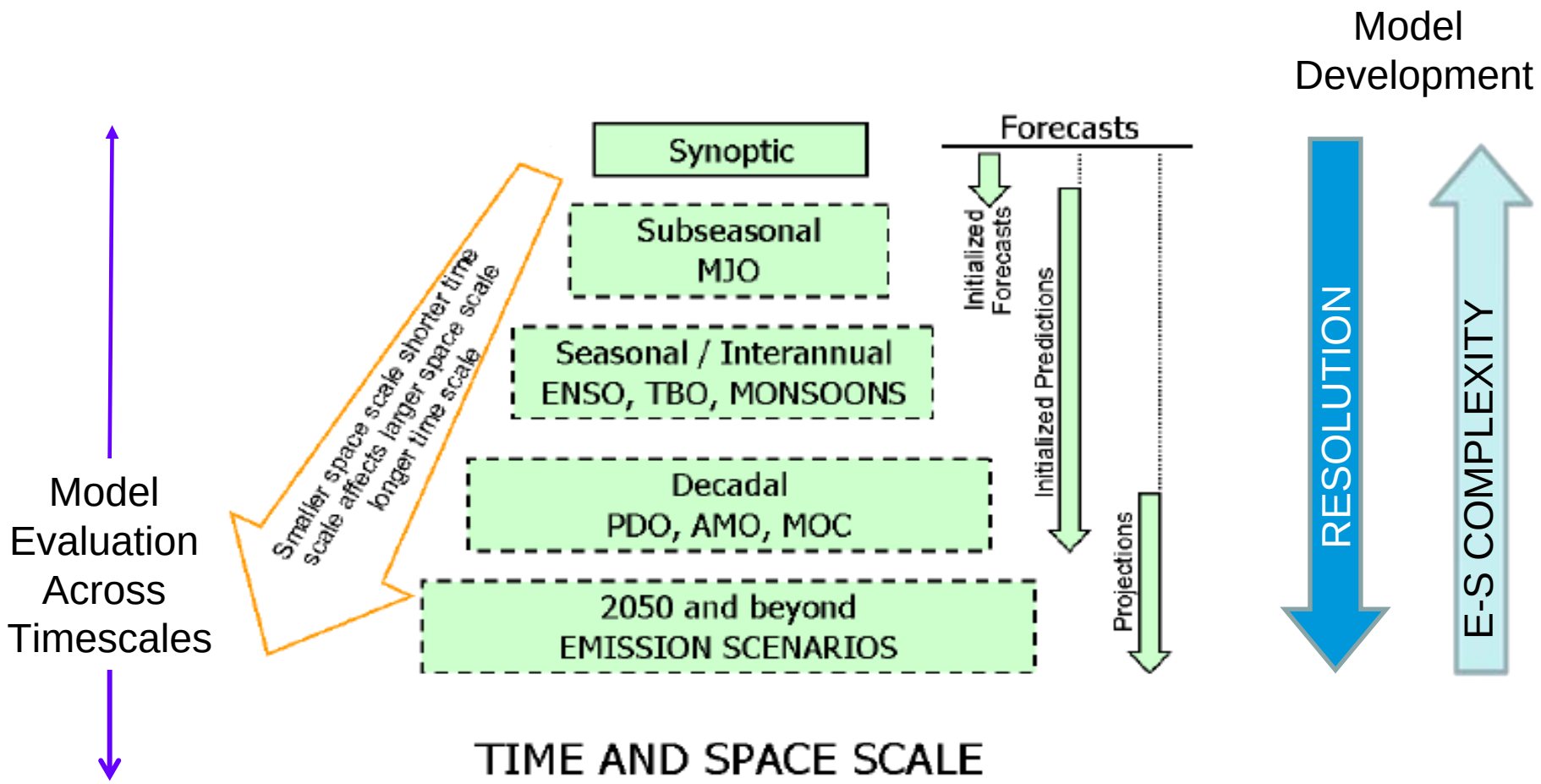
Seamless Prediction



Hurrell et. al. (2009), BAMS