

### **3. Observations: Surface and Atmospheric Climate Change**

Executive Summary

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References

Appendix: Techniques, Error Estimation, and Measurement Systems

First guess at section sizes, totalling 60 (including refs and diagrams/captions)

3.1 2pp

3.2 14pp

3.3 9pp

3.4 2pp

3.5 5pp

3.6 5pp

3.7 3pp

3.8 8pp

3.9 4pp

Refs 7pp

Appendix 2pp

Total of 61pp

Diagrams to be discussed at Trieste. The first draft should include as many of the ones we want to use as possible, even if only as placeholders. Eventually, some will need to be updated to include as much of 2006 data as possible. Remainder will come from published papers, modified/updated where necessary (through contacts with authors).

Boxes to be stand alone of a set size (normally a half but possibly a whole page with a double page for recent extreme events on all continents), but part of the page count for the section. Please see the recent 2003 climate assessment BAMS article (July04), which will be useful here.

## Executive Summary

### 3.1 Introduction

*(Describe organization of chapter: consider interdecadal variability and trends in the large scale atmospheric system, then describe observed regional changes, their seasonality, and their links to interdecadal variability; present variables in terms of variability and pdfs).*

[Jones, Trenberth]

### 3.2 Changes in Surface Climate

*(Temperature (including SST), pressure, humidity, and precipitation (amount, frequency, intensity, extremes, pdfs, percentiles, extent, type (rain, hail, snow etc)), urban heat island effects. Also evaluate availability of information on other variables including e.g., wind, waves, soil moisture, and include where possible).*

#### 3.2.1 Background

#### 3.2.2 Temperature in the Instrumental Record for Land and Oceans

**Box: Adjustments to land observations (Dave Easterling)**

##### 3.2.2.1 Land-surface air temperature

Maximum and minimum temperature, DTR, globe, NH, SH

3.2.2.2 Urban temperatures and the Urban Heat Island - include generic aspects as well (land-use changes), and not just large towns/ cities.

##### 3.2.2.3 Sea surface temperature and marine air temperature

**Box: Adjustments to Marine Observations (David Parker)**

3.2.2.4 Land and sea combined: globe, NH, SH, zonal means.

Need for IPCC series?

3.2.2.5 Consistency between land and ocean surface temperature changes.

3.2.2.6 Variability on different time scales (which time scales?)

[Parker, Klein Tank, Rusticucci, Rahimzadeh, Zhai, Easterling, Jones]

3.2.3 Consistency with the retreat of Glaciers, Sea Ice, and Snow Cover (liaise with Chapter 4 – section may not be needed)

#### 3.2.4 Precipitation and Atmospheric Moisture

##### 3.2.4.1 Background

3.2.4.2 Changes in Precipitation and Related Variables, including amount, frequency, intensity, extremes, pdfs, percentiles, extent, type (rain, hail, snow etc)

**Box: Precipitation homogeneity/adjustment issues and also solid/liquid**

##### 3.2.4.2.1 Land

Mid and high latitudes; Tropics and subtropics

Urban areas: Urban Heat Island (runoff, the concrete jungle, pollution)

##### 3.2.4.2.3 Ocean

3.2.4.3 Water Vapour [Seidel?]

##### 3.2.4.4 Evaporation

##### 3.2.4.4.1 Land

##### 3.2.4.4.2 Ocean

3.2.4.5 Soil moisture, runoff and river discharge [Dai?]

**Box: Actual vs pan evapotranspiration** (opposite trends many places)  
[Easterling, Ambenje, Zhai, Rusticucci, Rahimzadeh, Klein-Tank, Trenberth]

### 3.3 Changes in the free atmosphere

3.3.1 Temperature of the Upper Air: troposphere and stratosphere {Parker}

3.3.1.1 Weather balloons/sondes

3.3.1.2 Satellites; MSU

3.3.1.3 Rocketsondes and lidar

3.3.1.4 Reanalyses

3.3.1.5 The tropopause / tropopause heights

3.3.1.6 Synthesis and comparison with the surface temperatures  
(important – maybe a box?)

3.3.2 Humidity [Soden]

3.3.2.1 Lower-tropospheric water vapour

3.3.2.2 Radiosonde observations

3.3.2.3 Upper-tropospheric and lower-stratospheric water vapour

3.3.3 Clouds [Soden]

**Box: Clouds from the surface vs space (Steve Warren?)**

3.3.3.1 Land

3.3.3.2 Ocean

3.3.3.3 Global

3.3.4 Radiation (TOA, surface) [Soden]

3.3.4.1 Sunshine at surface

3.3.4.2 Relation with clouds

3.3.5 Uncertainties in discerning changes

[Soden, Parker, Trenberth]

### 3.4 Changes in Atmospheric Circulation

*(Means and variances; introduce idea of EOFs and modes as lead-in to next section).*

3.4.1 Surface or sea level pressure

EOFs, “modes”, intro to 3.5

3.4.2 Geopotential height

3.4.3 Winds

3.4.4 Waves, surface fluxes [Gulev?]

3.4.5 The stratosphere [Shepherd, Hartmann, Baldwin?]

[Bojariu, Renwick, Trenberth]

### 3.5 Patterns of Circulation Variability

*(ENSO, NAO, PDO, SAM, NAM, etc.; note need for care in definitions, interactions between modes; changes and teleconnections; seasonality of changes; consider winds, wind stress, interactions with air/sea fluxes). Need to identify patterns of T and precipitation associated with each and trends. Note links to SSTs or other possible causal agents.)*

#### **Box: defining all the indices**

- 3.5.1 Teleconnections
- 3.5.2 El Niño-Southern Oscillation and Tropical/Extra-tropical Interactions
- 3.5.3 Decadal to Inter-decadal Pacific Oscillation, and the North Pacific Oscillation (PNA. PSA)
- 3.5.4 The Northern Hemisphere, excluding the North Pacific Ocean (NAM, NAO, etc) [Bojariu]
- 3.5.5 The Southern Hemisphere (SAM)
- 3.5.6 Other (more local) indices or just stick to major ones?
- 3.5.7 Summary

[Renwick, Bojariu, Trenberth]

### 3.6 Changes in the Tropics and Sub-Tropics

*(Include both "up and down" for monsoons, viz. India, SE Asia, Australia, West Africa, S & N America + arid regions (Middle East etc). Note some extra-tropical regions are monsoonal; evaluate trends related to ITCZ, consider as available other features of tropical climate)*

- 3.6.1 Monsoons
  - 3.6.1.1 Asia
  - 3.6.1.2 Australia
  - 3.6.1.3 The Americas
  - 3.6.1.4 Africa
- 3.6.2 The Hadley and Walker circulations
- 3.6.3 The ITCZ and SPCZ
- 3.6.4 Subtropical highs and drought

[Zhai, Ambenje, Renwick, Trenberth]

### 3.7 Extra-Tropical Changes

*(Consider e.g., storm tracks, "blocking", extra-tropical monsoons, other changes outside the tropics).*

- 3.7.1 Storm tracks
- 3.7.2 Blocking
- 3.7.3 Teleconnections (?)

[Renwick, Soden, Trenberth]

### 3.8 Changes in Extreme Events

(Assess available data on the range of extremes: cyclones, hurricanes, storms, heat waves, cold snaps, extreme precipitation, floods, droughts, etc.; also carefully consider what may be said regarding any particular climate events, such as recent floods in Europe)

#### Box: On extreme indices measures?

##### 3.8.1 Background

##### 3.8.2 Is there evidence for changes in variability or extremes?

###### 3.8.2.1 Temperature

###### 3.8.2.2 Precipitation

##### 3.8.3 Is there evidence for changes in extreme weather or climate events?

Utilize regional workshop results

**Boxes: Specific events: Floods in Europe summer 2002; Heat wave in Europe summer 2003; Drought in Australia, 2002-2003 EN; Drought in SW USA, other? (All, attempt to discuss major climate events in all continents over the 2001-2005 period; note these should *not* be simply weather events, but rather a series of events as part of a pattern)**

###### 3.8.3.1 Tropical cyclones [Landsea]

###### 3.8.3.2 Extra-tropical cyclones

###### 3.8.3.3 Droughts and wet spells

###### 3.8.3.4 Tornadoes, hail and other severe local weather

##### 3.8.4 Summary

[Klein-Tank, Easterling, Zhai, Ambenje, Rahimzadeh, Rusticucci, Jones]

### 3.9 Synthesis: Consistency Across Observations

*(Draw together a consistent physically-based interpretation of the observations insofar as possible. Consider linkages between different regions (such as monsoon and extra-tropics, surface and mid-troposphere, etc.) and between patterns of variability (e.g., ENSO, PDO, NAO), and trends therein. Identify gaps, key advances since the TAR, key remaining uncertainties.)*

##### 3.9.1 Consistency of Observed Trends

##### 3.9.2 Summary

##### 3.9.3 Gaps and uncertainties

[Jones, Trenberth]

#### References

Appendix: Techniques, Error Estimation, and Measurement Systems

[Easterling, Parker, Jones, Trenberth]

Section leaders in **bold**.

**Timetable:**

*At Trieste/early October*

Selection of CAs (Trieste) – late September

Recruiting of CAs first week of October (WGI to be informed of all CAs that provide material)

Tasks assigned in detail

*Mid-October onwards*

Deadline for contributions from CAs first week of November.

First draft of subsections to section leaders by 15 November

First draft of all sections to Jones and Trenberth by 1 December

Iterations

**First draft of chapter due TSU mid January to WGI for review (February-April)**

Provide WGI with list of friendly reviewers

**LAs to note:**

You will see that all subsections do not come out at the same length or with similar numbers of sub-subsections, so the possibility exists for reordering material and renumbering.

Before Trieste, please review this possible outline. Look first for topics **not** there that should be. Feel free to make suggestions. From Trieste we will need names alongside all of the subsections at all levels, along with a clear understanding of who will recruit those who are not LAs (one of us) and thus who become contributing authors (CAs), who the material will come in to, and thus who is responsible for putting the subsections together. Thus for each subsection where a CA is used, an LA must also be assigned. LAs can and should contribute to all areas where they have direct expertise.

If you feel that you should be assigned on topics where you are currently not listed, please volunteer. If you feel that you are not capable of handling the task assigned please speak up now, or sooner rather than later, as someone must step in. It is NOT an option to not do the task.