This manuscript investigates a worthwhile topic in the mis-use of the chloride mass balance (CMB) method of estimating recharge. This is a very well used technique that could be used inappropriately if the inherent assumptions are not adhered to.

The central idea in this manuscript is that output-input ratios of chloride can be used as a method of determining if a catchment has reached equilibrium after a land-use change. If it has not reached equilibrium the authors assert that the CMB cannot be used. There are many problems with this idea. The most obvious being that no justification is given to why O/I ratios are useful, if part of the source of chloride is geochemical rather than entirely cyclic then equilibrium will never occur. Not being able to use the CMB when the catchment is not in equilibrium is wrong. Methods have been developed over the decades that account for non-equilibrium and are used routinely – there is no mention within the manuscript of these techniques (Allison and Hughes, 1978; Walker et al., 1991).

Being able to predict the time taken to reach equilibrium after a land use change is something that would be useful to know. There is a history of literature on this subject due to research into dryland salinity that has been ignored by this manuscript (Dawes et al., 2004; Gilfedder et al., 2003). If this literature had been read, then the authors could have tested if the hydrogeological properties of catchments, which theory tells us are relevant to the time required for equilibrium, rather than the hydrological properties tested that were not relevant for the time required to reach equilibrium.

As the manuscript is presented I cannot recommend it for publication.

P7027, L19 The most important assumption in the CMB and the O/I ratios used here is that chloride is cyclic and sourced from precipitation. No mention has been made of this assumption or any justification for using O/I ratios in the case study. Rock weathering or other geochemical sources can be a source of chloride (Acworth and Jankowski, 2001).

P7027, L20 I am not sure that the CMB requires that recharge be constant. Recharge is dependant upon rainfall (amongst other things) so cannot be considered constant. Especially in semi-arid/arid areas where recharge is likely to be episodic. The CMB provides an average rate of recharge usually over the residence time of the water in the aquifer.

P7027, L25 Significant land use changes are not limited to coastal Australia, the inland areas have also been cleared for agriculture.

P7028, L3 I don’t think *large amount* of water resources is the appropriate term here considering the water restrictions that have been imposed over the past few years due to a lack of water resources.

P7028, L6 No support is given to the assertion that the CMB is the first recharge method to be considered.

L7028, L25 There may not be a conceptual model specifically of chloride equilibrium, but many conceptual models have been developed for dryland salinity that could easily be applied to a CMB. No reference or discussion is given here to the Groundwater Flow Systems concept (Coram, 1998; Coram et al., 2000; Walker et al., 2003) or the models that have previously been developed to predict how long it takes a catchment to return to hydrological equilibrium after a land use change (Dawes et al., 2004; Gilfedder et al., 2003; Smitt et al., 2003).

P7029, L4 There should be 2 more classes in this classification. A catchment with a water transfer does not have to be in equilibrium with respect to chloride.

P7030, L3 The CMB applied in the saturated zone does not estimate the amount of water that crosses the water table as is defined by R. It estimates the recharge (R) minus any evapotranspiration direct from the saturated zone (ET_{GW}) as phreatophytes will continue to concentrate the chloride after it has recharged the saturated zone. This quantity has been referred to as net recharge when using the CMB in Gnangara and Tomago. The use of net recharge in this manuscript is confusing considering the previous use of net recharge in studies using the CMB.

P7030, L5 Water resources should not be allocated on the basis of your net recharge. Any GW extraction from within the catchment will reduce baseflow, your net recharge changes with extraction. Some have even argued that recharge is irrelevant in water management and that it is discharge that should be focused upon (Bredehoeft, 2002).

P7030, L10 How is $q_e.c_e$ to be determined? Event flow is complex mixture of overland flow, interflow and baseflow that is anything but simple to resolve (Hughes et al., 2008; Hughes et al., 2007).

P7030, L14 Groundwater can discharge to the surface without becoming baseflow. This is the cause of dryland salinity and occurs in many catchments that have been cleared for agriculture.

P7030, L19 How do you determine that there is no change in the storage (S) of chloride in the unsaturated zone?

P7030, L20 How can you be sure that all groundwater recharged within the catchment is discharged within the catchment? (Mitchell et al., 2006) describes a series of field studies that found local groundwater flow systems are far more complex than anticipated. At Boorowa most of the salt passed under the gauge (Crosbie et al., 2007) and at Brays Flat the groundwater flow direction was perpendicular to the stream network (Crosbie et al., 2008).

P7031, L20 The CMB is estimating recharge not discharge. The O/I ratios are affected by water transfers, recharge is not. The CMB can be applied in a catchment with water transfers, it is the classification scheme proposed here that is not applicable in a catchment with water transfers. If the salt load is known that is exported/imported by water transfers then it can be accounted for in calculating the O/I ratios and then the system collapses back to a type I/II catchment.

P7032, L4 The CMB can still be used in a catchment that has not reached equilibrium using modified forms. This has been done for decades. A steady state

CMB can be performed in the unsaturated zone (Allison and Hughes, 1978) or if the unsaturated zone has not yet reached equilibrium then a transient CMB can be applied (Radford et al., 2009; Walker et al., 1991).

P7033, L10 How do you know the catchment O/I ratios were in equilibrium prior to clearing?

P7033, L25 Was one relationship between EC and Cl used irrespective of geology? Sandsone and Limestone will have quite differing relationships due to the presence of ions other than chloride.

P7034, L14 It should be noted here that the outputs calculated are surface water outputs and not groundwater outputs.

P7034, L14 The annual average streamflow and chloride load are based on very short time series during a drought. The most recent decade has not been representative of the time since land clearing and so should not be used in this manner (CSIRO, 2008).

P7035, L6 No reference is given to how much of the native vegetation in the catchments have been cleared. I would expect different results if 20% has been cleared compared to 80% cleared.

P7037, L19 Why not test any hydrogeological parameters? This paper is concerned with the groundwater coming into equilibrium. Previous approaches have shown that it is transmissivity, specific yield, recharge, length and head that determines how long it takes a catchment to reach equilibrium after a land use change (Gilfedder et al., 2003; Smitt et al., 2003).

P7037, L21 Is precipitation significant because it is a surrogate for recharge?

P7039, L7 You have gone to great length to explain that this particular catchment is at equilibrium and can be used to estimate recharge using the CMB, and then said that only the low end of the distribution of chloride in groundwater can be used because the high chloride is due to non-equilibrium conditions. This is not consistent, either the CMB can be used or it can’t be used.

P7040, L10 The use of this range of values is very subjective and perhaps even arbitrary. (Eriksson, 1985) showed that the distribution of chloride in groundwater should be log-normally distributed and then argued that a harmonic mean should be used. Why is not appropriate to use a harmonic mean (or geometric mean) rather than select some number from the low end of the distribution?

P7040, L10 How is $q_e.c_e$ determined? Event flow is complex mixture of overland flow, interflow and baseflow that is anything but simple to resolve (Hughes et al., 2008; Hughes et al., 2007).

P7039, L14 No account of the uncertainty is given for this recharge estimate? There is considerable uncertainty in the chloride deposition and chloride concentration of the groundwater, this uncertainty can be incorporated into the recharge estimate (Crosbie et al., 2009).

P7039, L17 This statement is wrong and should be deleted. Any extraction in the catchment reduces baseflow and therefore changes your net recharge number. But does not change your recharge number.

P7046, fig 1 What about catchments that are gaining in one season and losing in another?

P7047, fig 2 The greyscale DEM cannot be seen behind the colour Cl deposition map. 2 figs perhaps?

P7053, fig 8 Are these 52 samples from the one bore? Or one sample from 52 bores? Or somewhere in between?

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